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Technical Document 296

EXISTING AND PROPOSED ANTENNA SYSTEM DESIGNS FOR U. S. MARINE CORPS LANDING VEHICLE, TRACKED, COMMUNICATIONS (LVTC7)

Evaluates the existing eight-antenna configuration, and proposes an arrangement that consolidates five vhf dipoles into one broadband trimonopole.

L. M. Peters

11 December 1973

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ADMINISTRATIVE INFORMATION

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OVERVIEW OF THE STUDY

This document represents the test results, analyses, and conclusions of a study of the U. S. Marine Corps Landing Vehicle, Tracked, Communications (LVTC7) antenna system. The specific antenna system recommendations contained in this document are the result of measurements obtained with 1/12- and 1/24-scale brass models of the LVTC7 vehicle. A different antenna system approach is presented which incorporates a new broadband vhf antenna design. Possible design approaches for a vhf multicoupler for the broadband antenna are discussed.

OBJECTIVE

The primary objective of this effort was to recommend a new antenna-system design approach (including rf distribution) for the LVTC7 vehicle. The proposed system should be the best compromise for overcoming the problems with the existing configuration within the constraints imposed by vehicle structure design and equipment selected by the Marine Corps.

This objective was to be met by using modeling techniques. Two brass scale models of the LVTC7 vehicle (1/12 and 1/24 scale) were built. These models were also to be used to compile a comprehensive set of radiation patterns for both the present and the proposed antenna systems.

SCOPE

The scope of this study includes the following:

1. Model measurements at 1/12 and 1/24 scale to analyze the present antenna system performance.

2. Model measurements to simulate land- and sea-deployment conditions.

3. Comparison of previously measured full-scale data to establish a relationship between the actual vehicle and the two models.

4. Model measurements for antenna radiation patterns in the azimuthal and vertical planes.

5. Model measurements to verify individual antenna designs and the feasibility of the antenna arrangement, including antenna impedance and radiation patterns.

6. An analysis using applicable antenna and electromagnetic theory to estimate expected system range performance.

7. Design approaches and feasibility determination for a new vhf multicoupler and broadband antenna.

8. Recommendations for modifications to the present antenna system and arrangement.

LIMITATIONS

This study does not consider any major chassis design alternatives which affect antenna placement, nor does it cover the below-deck layout requirements for the equipment to be served by the antenna system. In addition, measurements were not made for the single uhf antenna on the LVTC7.

BACKGROUND: PROBLEMS WITH THE LVTC7 ANTENNA ARRANGEMENT

The LVTC7 is a full-tracked, armored landing vehicle for communications built for the Marine Corps by the FMC Corporation. The primary mission of this vehicle is to be a communications command post during amphibious operations. It was designed to provide unit commanders with the tactical advantage of a mobile field communications center.

The vehicle is capable of encrypted voice communication in the high-frequency (hf), very-high-frequency (vhf), and ultra-high-frequency (uhf) bands. Its antenna system consists of eight antennas – one hf, six vhf, and one uhf. A very limited amount of space is available on the vehicle for mounting these antennas. Consequently, the present eight-antenna configuration has resulted in two problems: a closely coupled antenna system and the "porcupine effect."

A closely coupled system is usually defined as one in which the antennas are separated by about 1/2 wavelength or less at the frequency of interest. Three consequences of close coupling which result in an overall system performance degradation are: (1) antenna radiation pattern distortion, (2) antenna detuning, and (3) receiver front-end overloading.

The "porcupine effect" means that the identity of the command vehicle is compromised because of its large complement of antennas. The antennas stick out like so many quills, making the vehicle easy to identify.

As mentioned above, this present configuration was investigated using scale models. The results served as a basis for comparing antenna system design changes. The three basic criteria for any design change are: (1) to increase the overall communication efficiency, (2) to reduce the number of antennas without reducing the communications circuit requirements, and (3) to improve the electromagnetic compatibility of the systems. One design approach to meet these criteria is to replace five of the vhf antennas with a multicoupler and broadband antenna combination. This is the proposed system analyzed in this report.

DESCRIPTION OF PRESENT ANTENNA SYSTEM

The present antenna system arrangement of the LVTC7 is shown in figure 1.

The hf antenna is a 15-foot monopole or whip fed by the AN/PRC-47 transceiver, which has a power output capability of 100 watts PEP. The frequency range of the PRC-47 is 2 to 12 MHz. The base of the antenna is connected to the transceiver by about 3 feet of RG-8/U coaxial cable. The tuning and matching of the antenna is accomplished within the PRC-47 equipment.

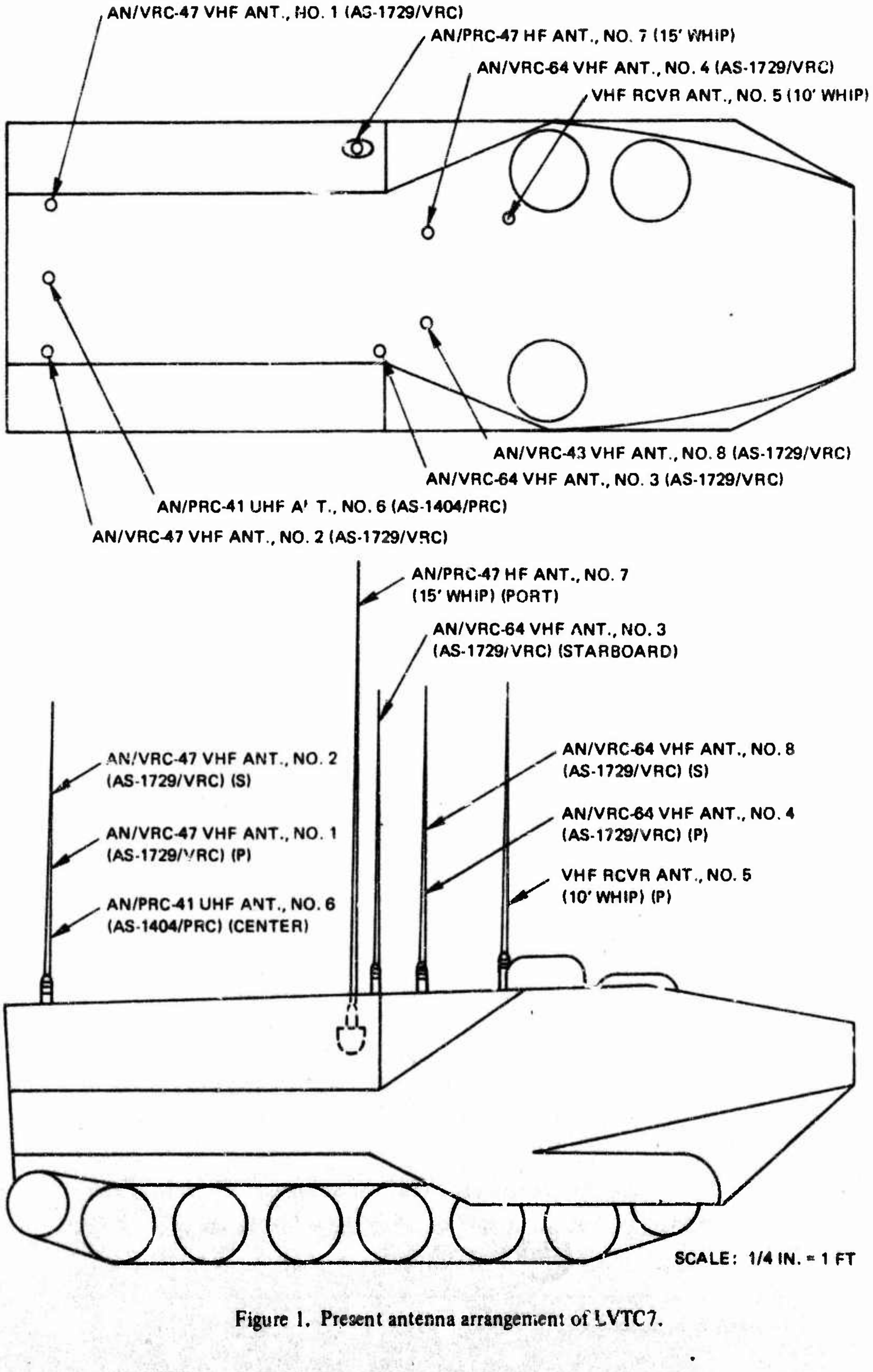

Figure 1. Present antenna arrangement of LVTC7.

The vhf antenna group consists of five AS-1729/VRC antennas and one 10-foot monopole or whip. The AS-1729/VRC antennas are used with two AN/VRC-47s, two AN/VRC-64s, and one AN/VRC-43. All of these operate in the range of 30 to 76 MHz, with power outputs of about 50 watts for the VRC-43 and VRC-47 and 2 watts for the VRC-64. The 10-foot monopole is untuned and used to feed four receivers in parallel. The first receiver is connected to the antenna with 20 feet of RG-58/U coaxial cable.

The AS-1404/PRC is a uhf broadband antenna designed to be used with the AN/PRC-41 manpack transceiver. The antenna is used on the vehicle with a PRC-41 that has a power output of 3 watts in the range of 225 to 400 MHz.

DESIGN GUIDELINES

These significant design guidelines are important to follow for a landing vehicle antenna system:

1. The LVTC7 antenna environment is unique. Several antennas must be arranged in a very small area. Clearance requirements and operational envelopes of all vehicular systems must be observed. A broadband antenna capable of handling several rf circuits simultaneously through a multicoupler may be proposed to reduce the overall number of antennas.

2. Mutual coupling between antennas is a potential source of system degradation. Undesirable effects of mutual coupling include distortion of radiation patterns, alteration of antenna feedpoint impedance, and the transfer of rf energy from one antenna to another. To alleviate these problems, the number of antennas should be reduced while maintaining the required electrical isolation.

3. Environmental factors that might degrade the performance of an antenna should be avoided where possible. Some factors in this category are stack gases and saltwater spray.

4. Communications circuits must be established independent of direction, using vertical polarization unless otherwise specified.

1/12-SCALE-MODEL TESTING APPROACH

Antenna performance can be measured with either a full-size or scale-model vehicle. Each has its advantages. Measurements of radiation patterns in the azimuthal plane, isolation, and impedance had already been made on the full-sized amphibious vehicle.[1] The LVTC7 was then modeled for the following reasons:

1. A full-scale vehicle will not always be available for future testing.

2. Modeling costs are usually less than those for the use of a full-sized vehicle.

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[1]See references in Appendix C.

3. Models are easily updated when chassis changes are made in the full-sized vehicle.

4. Radiation patterns in the vertical plane, which are difficult and very expensive to measure full scale, are easily obtained.

5. Antenna system design changes are easily tested.

Measurements were first made on the existing antenna arrangement for the vhf antennas. These measurements can be used for comparison with measurements made on future antenna system designs. The vehicle was modeled at 1 inch equals 1 foot for a 1/12-scale model. This scale brings the vhf frequency band (30–76 MHz) into the range covered by the model-range measuring system. Next, tests were run on the proposed antenna arrangement, which employs a broadband antenna. The reasons for this alternate arrangement are given in the Proposed Broadband Antenna section.

1/12-SCALE MODEL OF AS-1729/VRC ANTENNA

Tests at vhf also required modeling the AS-1729/VRC antenna at 1/12 scale. This antenna is a 10-foot, base-tuned, center-fed, vertically polarized dipole having an omnidirectional azimuthal radiation pattern. It is not a broadband antenna, but covers the 30-to-76-MHz frequency band in 10 pretuned segments. Its gain is nominally equivalent to a 1/4-wavelength monopole at 0° elevation over an extended groundplane. Figure 2 is a picture of the 1/12-scale model of the AS-1729/VRC antenna. The teflon base is used to mount the model antenna on the vehicle. The model design was based on the full-scale antenna. A unique feature of this antenna is that the shielding for the inner conductor is grounded to the top of an outer shield. This ground point is located approximately in the middle of the antenna model.

The base-tuned impedance matching network was not modeled because of its complex circuitry and large number of components, each of which would also have to be modeled at 1/12th scale. Thus, the impedance of the model could not be measured, but its voltage standing wave ratio (VSWR) was measured using the setup shown later in figure 7. From the VSWR measurements, the mismatch loss was calculated.

The 1/12-scale antenna was verifieid as being a model of the full-sized antenna, as each provided the same radiation patterns when measured over an extended groundplane.

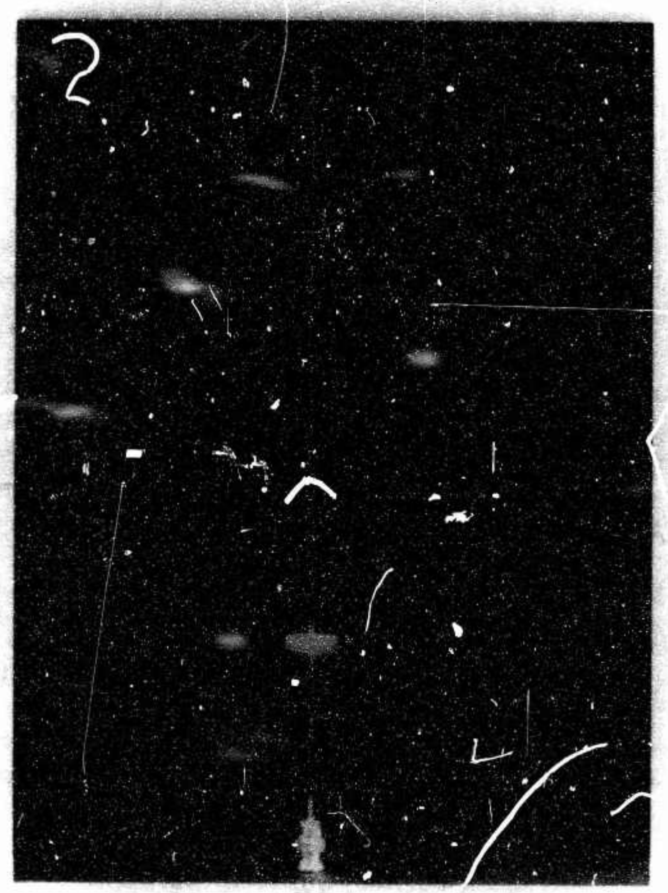


Figure 2. 1/12-scale model of AS-1729/VRC antenna.

ANTENNA RADIATION PATTERN MEASUREMENTS

The basic test setup for antenna radiation pattern measurements is shown schematically in figure 3. The measurements were made by transmitting a known signal from the arch antenna of the NELC model range to the antenna under test mounted on the vehicle. The signal received by the vehicle's antenna is plotted on a polar recorder. The vehicle is mounted in the center of a specially designed turntable, which is an integral part of the groundplane and is rotated through 360° to obtain azimuthal patterns. The arch antenna can be raised or lowered to measure vertical patterns. Reference 2 discusses in greater detail the use of the model range for measuring antenna radiation patterns at vhf and uhf.

Figures 4 and 5 show the model submerged in the groundplane up to the waterline. The model range facility, including the base of the arch tower and the illuminating antenna can be seen in the background of figure 4. Figure 6 is a close-up of the model with all five AS-1729 antennas replaced by the proposed antenna system – a broadband trimonopole antenna.

Energy levels are calibrated on the model range by the A-B comparison method, the reference levels having previously been determined by measuring the levels of a 1/4-wavelength monopole mounted in the center of the groundplane's turntable. This procedure establishes the system levels relative to a

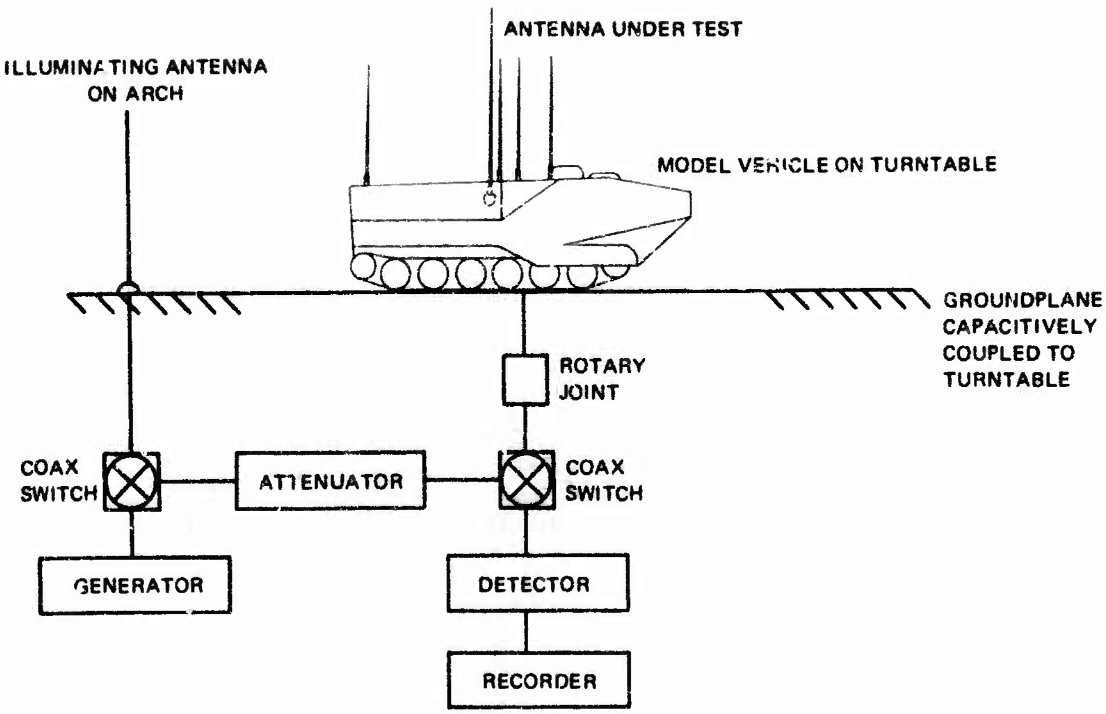


Figure 3. Test setup for antenna radiation pattern measurements.

Figure 4. 1/12-scale model of LVTC7 submerged in groundplane to waterline, with model range in background.

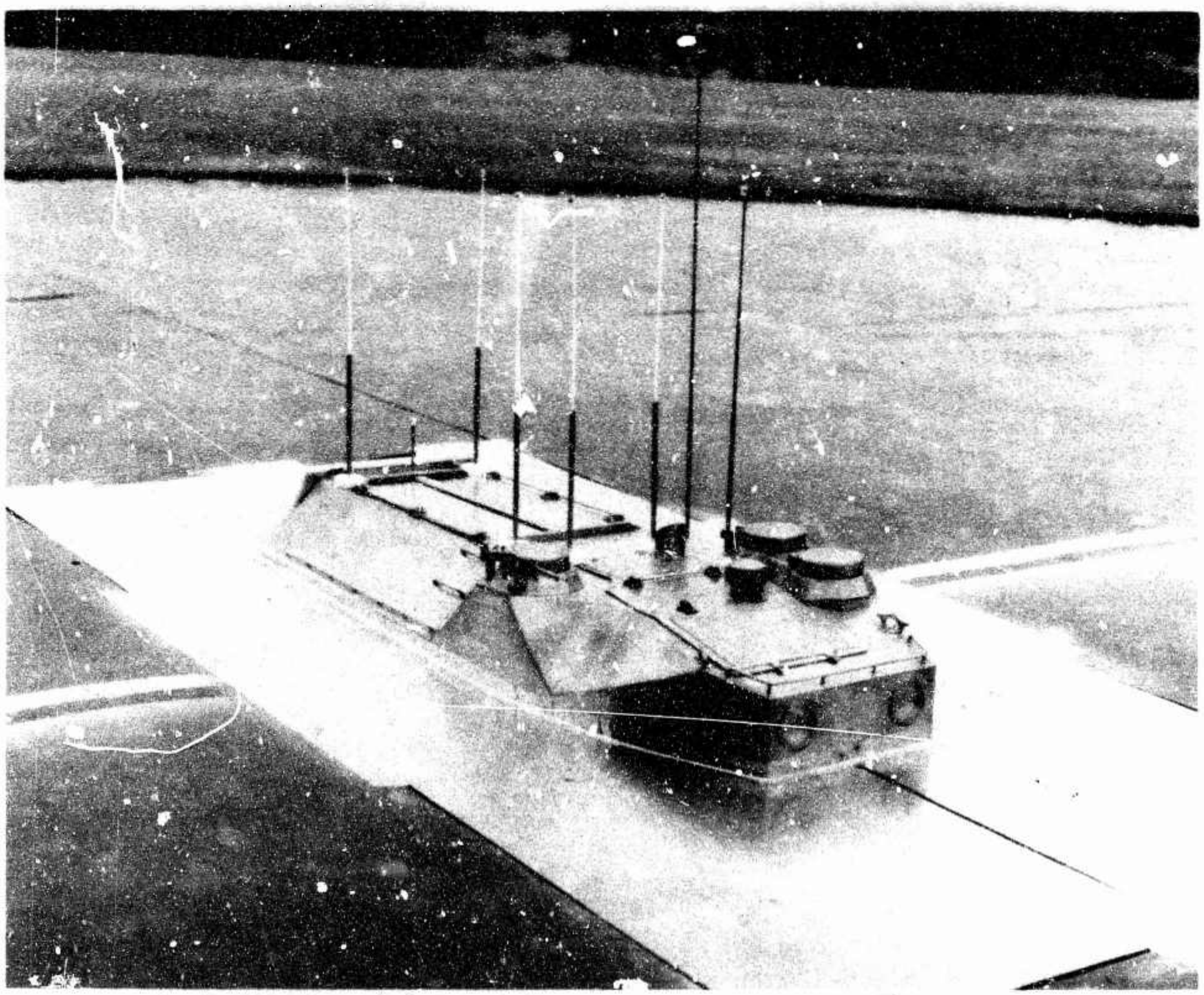


Figure 5. 1/12-scale model of LVTC7 submerged in groundplane to waterline; close-up showing present antenna arrangement.

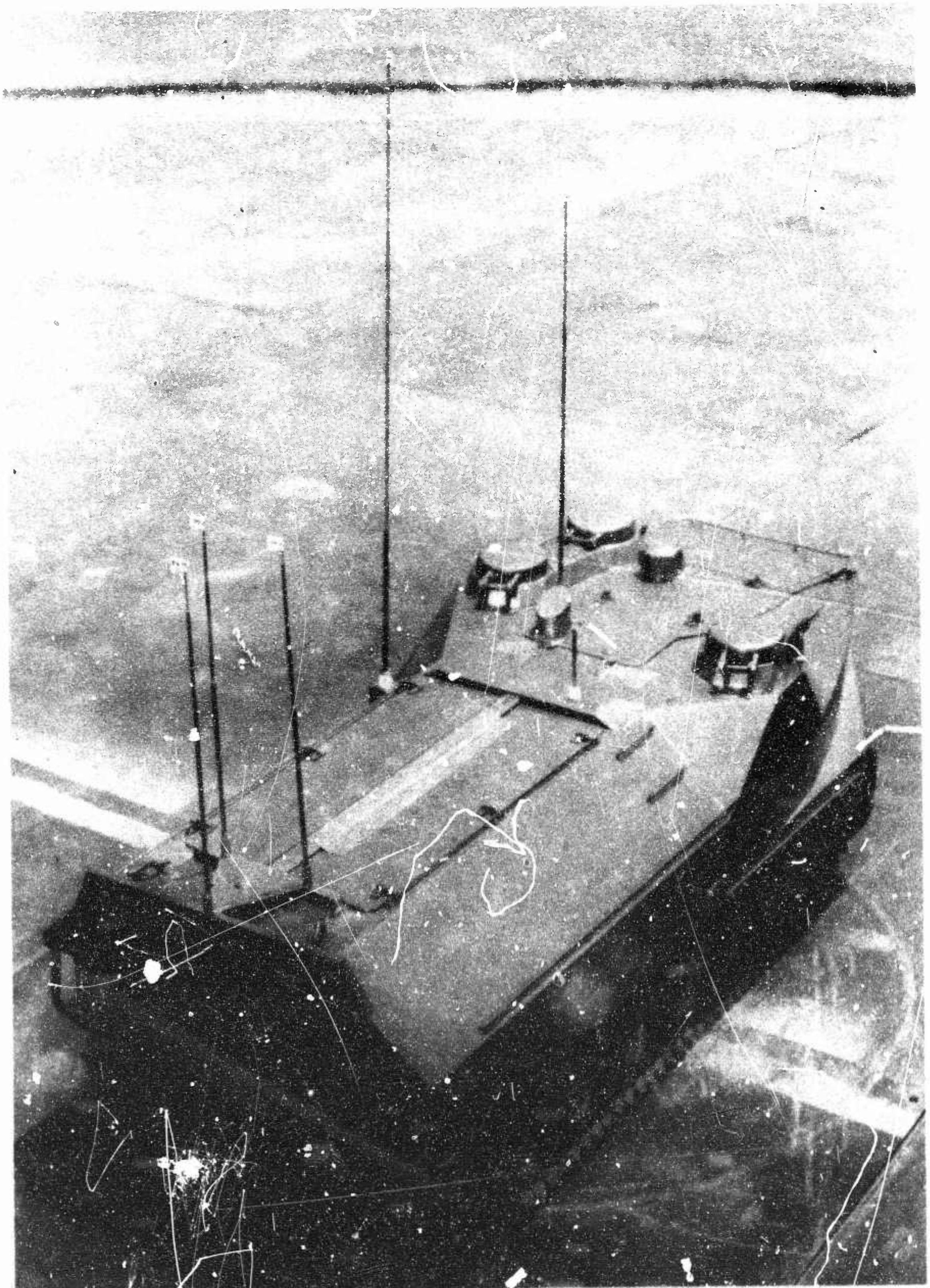


Figure 6 1/12-scale model of LVTC7 on top of groundplane; close-up showing all five AS-1729 antennas replaced by broadband trimonopole antenna.

1/4-wavelength monopole for each frequency. The vehicle antenna gain, which contains a loss due to its impedance mismatch, is thus established relative to a 1/4-wavelength monopole. The impedance mismatch for the model antenna was added to the 1/4-wavelength-monopole reference value in each figure in Appendix A. This was done to make the pattern gain for the antenna on the model independent of the mismatch loss. Thus, the value given for 0 dB on each figure includes this loss.

Azimuthal patterns were taken at 5° elevation at four frequencies across the band: 392.4, 542.4, 685.2, and 876 MHz, which are 1/12-scale equivalents of 32.7, 45.2, 57.1, and 73 MHz. Maximum agreement between the azimuthal patterns of the full-scale AS-1729 antenna at these frequencies and its 1/12-scale model was sought to establish the model as truly representative of the full-size vehicle in the vhf frequency band. The full-scale patterns deviate substantially from being omnidirectional, as they contain many nulls – some very deep. The patterns obtained from the model, however, did provide an accurate reproduction of these full-size patterns. Agreement between the two patterns was achieved within 3 dB over 90% of the pattern circumference. Vertical plane patterns from 5° to 60° in elevation were then taken at 0°, 90°, 180°, and 270° relative to the vehicle's heading at the same four frequencies.

ANTENNA IMPEDANCE MEASUREMENTS

Figure 7 is a schematic of the test setup used to measure the impedance of the broadband trimonopole antenna. The impedance was measured for both the land- and sea-deployment cases for two conditions: (1) other antennas open-circuited at their feedpoints; and (2) other antennas grounded at their feedpoints. These measurements were made to obtain three kinds of information:

1. For a transmitting antenna, the tuning characteristics, including sensitivity to change in termination of other antennas, are estimated.

2. Compatibility of the antenna with the multicoupler can be estimated.

3. Antenna system efficiency can be calculated when the coupling device characteristics are known.

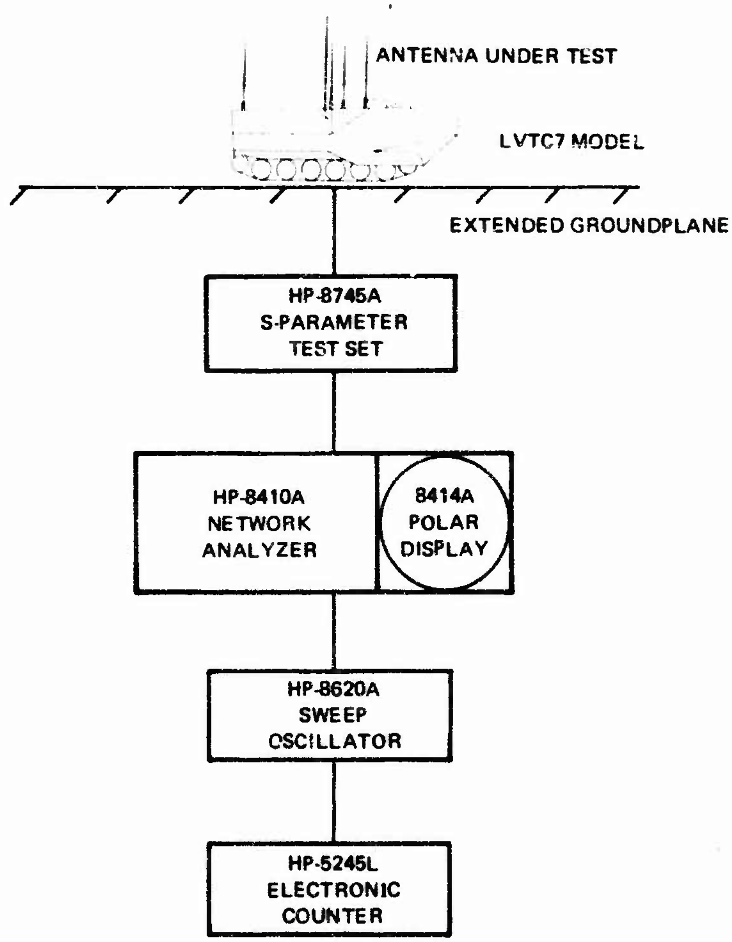


Figure 7. Test setup for antenna impedance and VSWR measurements.

ANTENNA VSWR MEASUREMENTS

Figure 7 is also a schematic of the test setup used to measure the VSWR of the five AS-1729 center-fed, dipole antennas. From the VSWR measurements, the antenna mismatch loss can be calculated. This loss is used to connect the model antenna pattern gains to that expected from the full-scale AS-1729. These connected patterns are used in the calculations for predicted range performance.

The VSWR was measured for each AS-1729 antenna for both land- and sea-deployment cases for the condition of all other antennas shorted at their feedpoints. This was done to maximize the coupling effect of the antenna for worst-case analysis. The VSWR was measured at four scale frequencies: 392.4, 542.4, 685.2, and 876 MHz.

1/24-SCALE-MODEL TESTING APPROACH

Figures 8 to 10 are photographs of the 1/24-scale brass model LVTC7. They show the model mounted either on top of (figs. 8 and 9) or submerged into (fig. 10) the groundplane. The arch towers for both NE[illegible] antenna

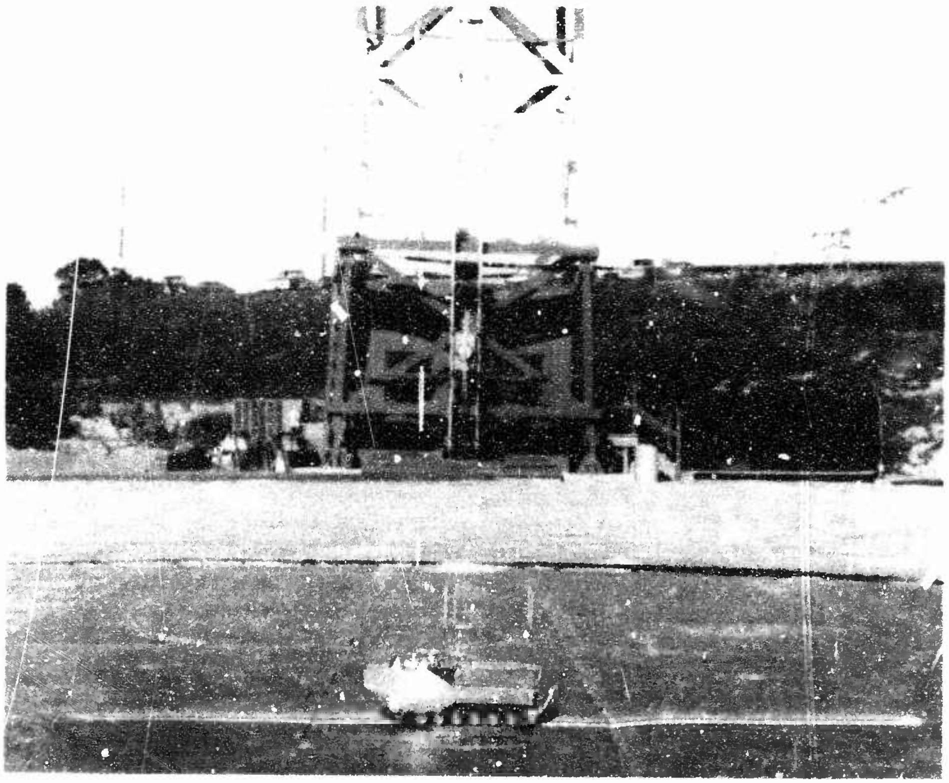


Figure 8. 1/24-scale model of LVTC7 on top of groundplane, with model range in background.

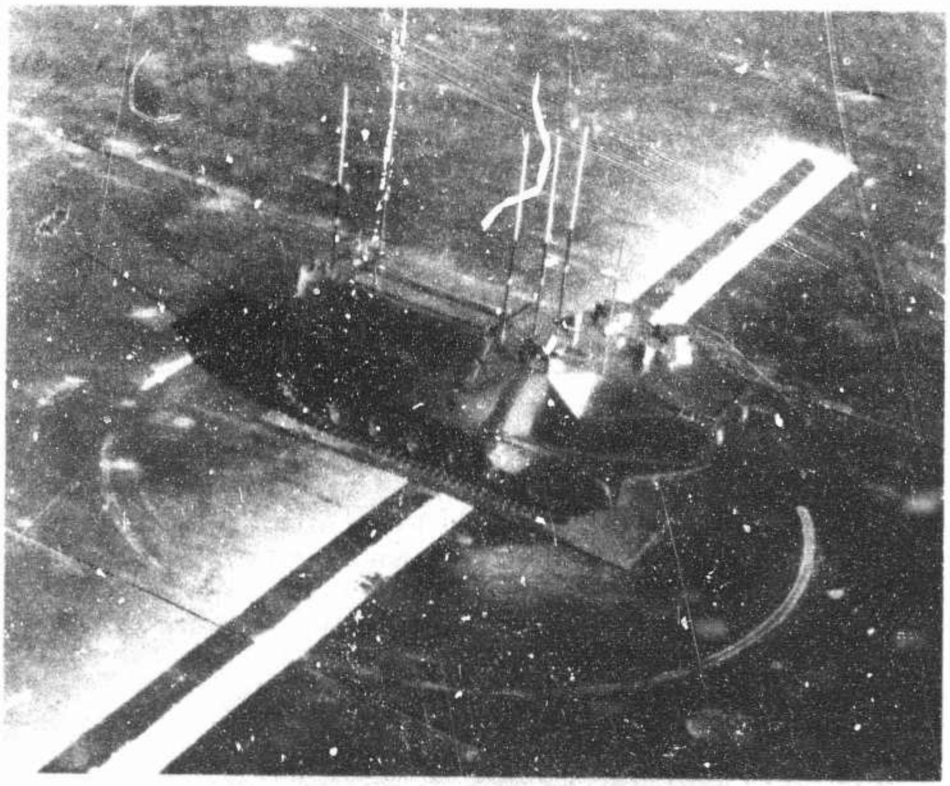


Figure 9. 1/24-scale model of LVTC7 on top of groundplane, close-up.

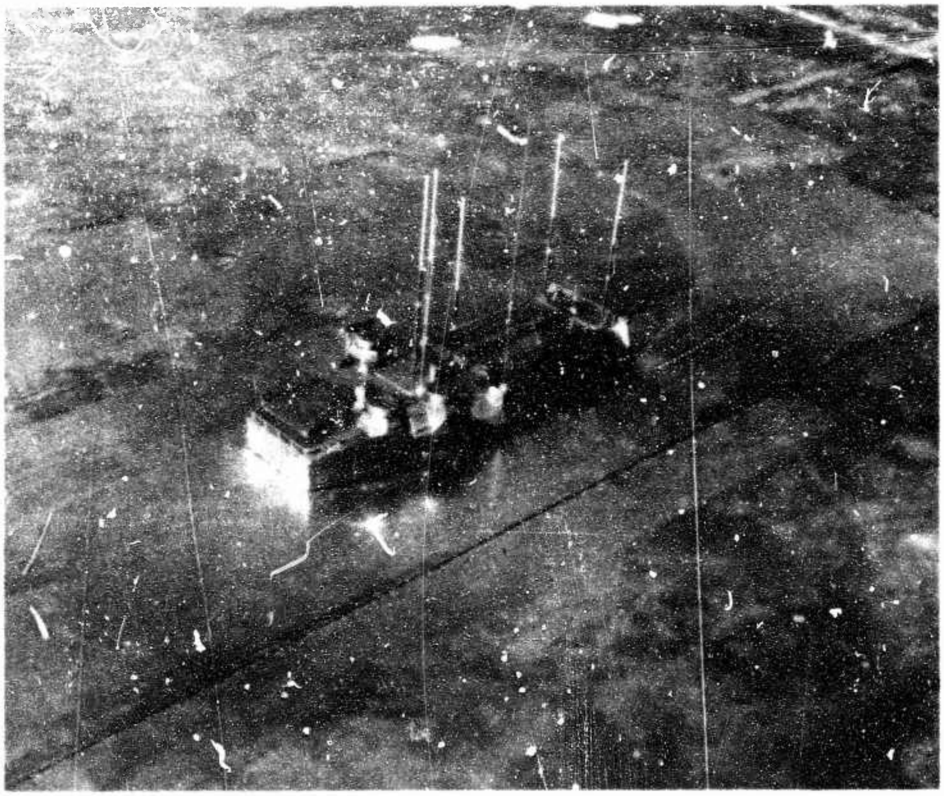


Figure 10. 1/24-scale model of LVTC7 submerged in groundplane to waterline; close-up.

model ranges can be seen in the background of figure 8. The vehicle is shown configured with the present antenna arrangement in all three figures.

This smaller model was built for the same reasons itemized in the 1/12-Scale-Model Testing Approach section, only for use at hf instead of vhf. Tests were made on the 15-foot hf antenna using the present antenna arrangement. Thus, pattern agreement with the full-scale hf antenna could be observed. To bring the hf frequency band (2–12 MHz) within the range of the measuring equipment, the vehicle was modeled at 1/2 inch equals 1 foot for a 1/24-scale model.

ANTENNA RADIATION PATTERN MEASUREMENTS

The same basic setup shown in figure 3 for vhf was used to measure the radiation patterns of the 15-foot hf antenna. Azimuthal patterns were taken at 5° elevation at 237.04 MHz (1/24-scale equivalent of 9.96 MHz). Vertical plane patterns were then taken from 5° to 60° in elevation at 0°, 90°, 180°, 270° relative to the vehicle's heading. Patterns were taken for both land- and sea-state conditions.

ANTENNA IMPEDANCE AND VSWR MEASUREMENTS

No impedance or VSWR measurements were made on the hf antenna.

PROPOSED BROADBAND ANTENNA

As discussed earlier, the present configuration of eight antennas on the relatively small LVTC7 has resulted in overall communication performance degradation. This is the result of excessive antenna VSWR and deep radiation pattern nulls (see reference 1). The presence of this many antennas can also compromise the identity of the command vehicle to the enemy. Therefore, any redesign of the existing antenna system should emphasize reducing the total number of antennas, but without reducing the communication circuit requirements or performance.

The approach investigated here is to replace the five AS-1729 dipoles with a broadband vhf antenna and multicoupler combination. The same number of circuits could be maintained, but fewer antennas would be used. The following section contains a discussion about preliminary work in progress at NELC to seek a feasible vhf multicoupler design for this application. This multicoupler should be designed for use with any suitable vhf broadband antenna.

An extensive search was conducted to find a broadband vhf antenna that could meet the unique requirements demanded by the LVTC7 vehicle. The type of antenna sought had to be simple in design and construction, yet able to withstand considerable physical and environmental abuse. The antenna that most closely met these requirements was the trimonopole. This is a broadband antenna, designed at NELC (patent pending), which can be used at vhf. This simple yet rugged antenna basically consists of three vertical whips that are equally spaced from each other in the form of a triangle. They are simultaneously fed at their bases.

Figure 6 shows a 1/12-scale model of this antenna which was built for this evaluation. It is shown mounted aft on the vehicle's centerline. Figure 11 is a diagram of a proposed design approach for the full-scale version. The dimensions of the scale model, also shown in figure 11, differ slightly from being exactly 1/12 scale of the full-scale version. This is because the dimensions of the full-scale trimonopole were changed slightly to improve its impedance across the band.

Radiation-pattern and impedance measurements were made with this antenna mounted in two different locations on the vehicle. Figure 12 is a diagram of the vehicle showing the two locations tested for the trimonopole. These are referred to as the stern and midvehicle locations. Results of these tests are presented in the Test Results section.

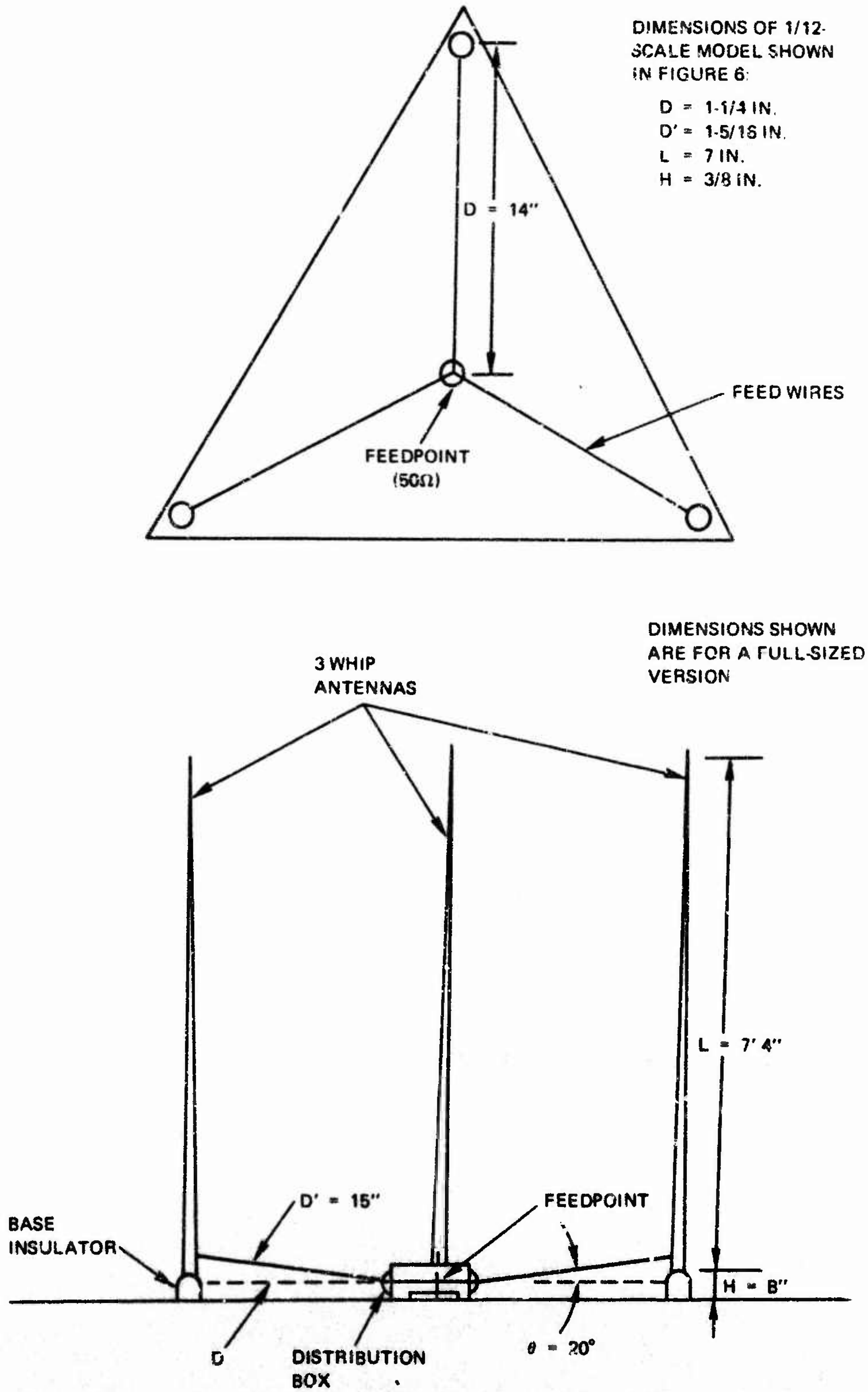


Figure 11. Design approach for full-scale trimonopole antenna.

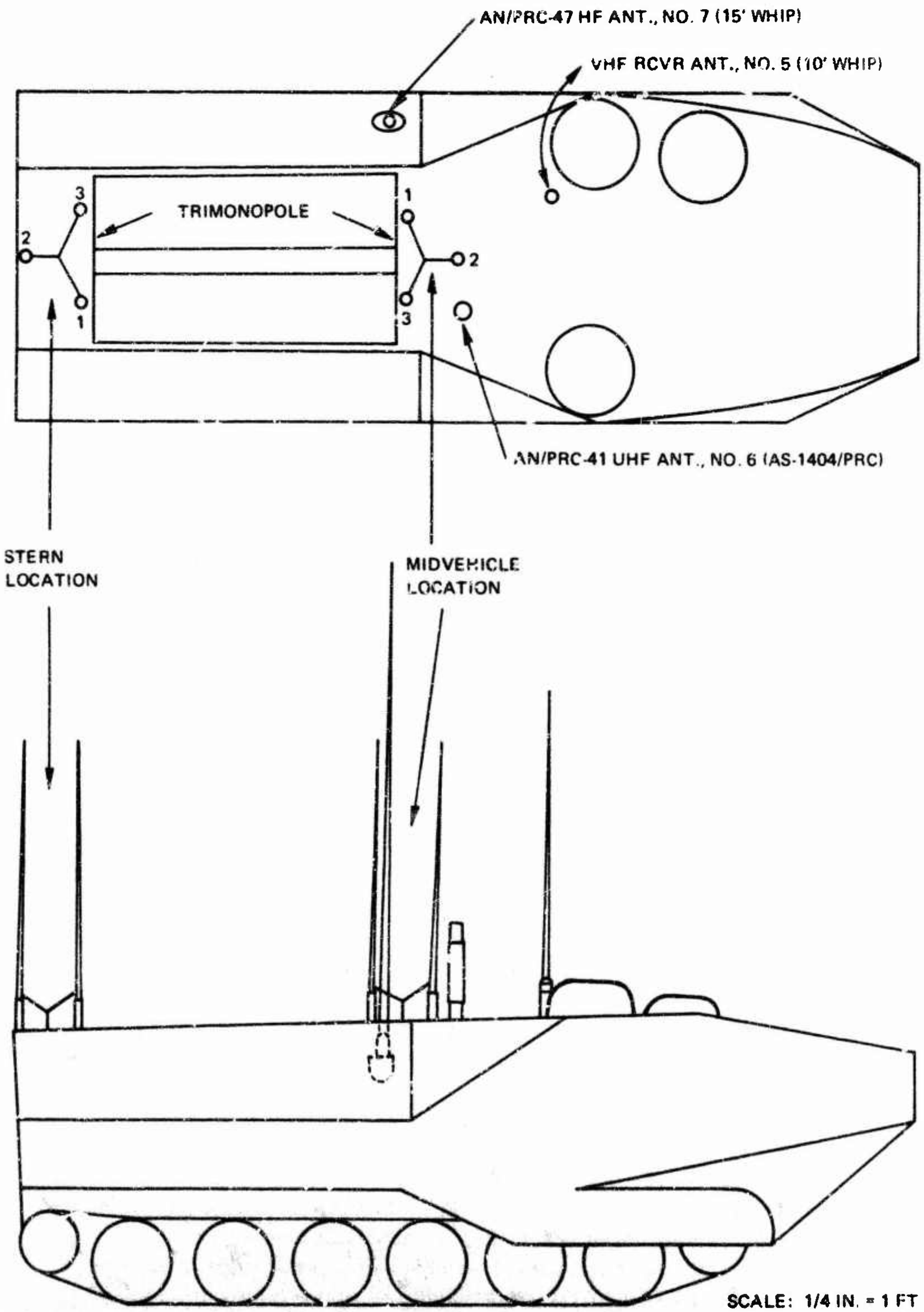


Figure 12. Two proposed locations for trimonopole antenna on LVTC7.

MULTICOUPLER STUDY

The use of close-coupled multiple antennas on the small LVTC7 platform causes antenna radiation pattern disturbances, antenna detuning resulting in equipment VSWR changes, and receiver front-end overload, as described previously. A method of minimizing these problems is the use of a single vhf transmitting antenna with a multicoupler for all RT-246/VRC and RT-524/VRC transceiver units. It is the purpose of this section to identify probable multicoupler techniques and to select a recommended technique.

MULTICOUPLER REQUIREMENTS

The most desired multicoupler characteristics are low insertion loss, minimal channel separation requirements, adequate isolation from channel to channel, freedom from generation of spurious signals, and minimal encumbrance of the operator in terms of additional or critical adjustments. For the LVTC7 vehicle, there are additional physical constraints of size and form factor which are set by the space available in and around the operator positions. These constraints and operational requirements are to be investigated in the follow-on work in FY 74. For the purposes of this report, it is sufficient to know approximate sizes and general limitations. Measurements indicate that space available at the operator positions, assuming no relocation of the existing equipment, is restricted to 3 inches in height, 6 to 10 inches in depth, and 10 to 12 inches in width.

There are additional requirements set by the receivers, as typified by the R-442/VRC outlined in the ECAC reports.[3,4] Additional data on the R/T units will be requested from ECAC for work during FY 74. Based on the preliminary data and results of tests at NELC, it appears that additional rf selectivity will be required in the receivers.

Assuming no changes are made to the vhf communications equipment, a total of five transmitters and nine receivers will be required to operate from the proposed broadband transmit antenna and the present vhf receive antenna.

REPRESENTATIVE MULTICOUPLER TECHNIQUES

Four basic categories encompass most multicoupler techniques. These categories are antennas, amplifiers, tuned passive devices, and untuned passive devices. There are also combinations of these four. Table 1 indicates representative techniques from each group which come closest to meeting the LVTC7 requirements.

Examination of this table indicates that only techniques 4, 9, and 10 satisfy the requirements for the LVTC7. Technique 10 is clearly preferable, while 4 and 9 are about equal when all factors are considered.

A low-loss transmitter combining with a tuned filter at the receiver input, technique 10, offers the possibility of adding only a single knob, the receiver filter, to the operator controls. This technique requires development of a wideband-transmitter combining scheme with losses less than 3 dB, which may not be possible.

TABLE 1. REPRESENTATIVE MULTICOUPLER TECHNIQUES.

Technique	Operation Complexity	Channel-to-Channel Isolation	Insertion Gain	Additional Prime Power Required	Other Advantages/ Disadvantages
1. Cross-polarized antennas	None	20 dB	Few dB	None	Only two channels, physical constraints
2. Multiport antennas	None	20 to 30 dB	Few dB	None	Only three channels, may not be realizable at vhf
3. Power amplifier, wideband	None	Adequate	Selected	9X	Second harmonic problem for octave bandwidths, peak power limitations, intermodulation distortion
4. Tuned filters	Moderate to high	Adequate	-2 to -3 dB	None	Complex tune-up procedure, maintenance problems, rcvr and xmtr use same antenna
5. Isolators	None	20 dB	-1 to -2 dB	None	Generation of spurious noise due to ferrites
6. Hybrids	None	20 to 30 dB	-3.5 dB/ hybrid	None	Combining 6 channels results in 10-dB loss
7. Traveling wave directional couplers	Low to moderate	Adequate	-1 to -2 dB	None	Difficult to design for tuning to different channels by operator, physical constraints at vhf
8. HI-Q loop excites a broadband structure	?	?	?	None	?
9. Hybrid combining with narrowband amplification and tunable filters at rcvr input	None	Adequate	None	7X	Considerable heat must be dissipated due to combining technique, maintenance problems
10. Low-loss transmitter combining with tuned filter at rcvr input	Low	Adequate	-2 to -3 dB	None	Minimal operator complexity, provides receiver filter suitable for other VRC applications, wideband-transmitter combining may not be realizable over full band

Hybrid combining with narrowband amplification and tunable filters at receiver input, technique 9, also offers the possibility of adding only a single knob to the operator controls; but, in this case, the usual 3.5-dB-per-hybrid loss requires about 2 kW of additional prime power to compensate for the loss in hybrids. An additional disadvantage of this technique is that it requires dissipation of an additional 6100 BTU due to heat losses. While the heat load could be dissipated externally, it would provide an additional IR source on the vehicle, and would have to be evaulated for intensity compared to other vehicle sources prior to implementation.

The conventional tuned filter approach for multicoupling, technique 4, has the disadvantage of requiring a longer tune-up procedure, involving several additional operator controls. While this method has been used on shipboard, it appears desirable to avoid it, if possible, in the LVTC7 application. Losses associated with this conventional technique are in the 2- to 3-dB range, and are being used as a maximum loss criterion for the selected technique.

RECOMMENDED MULTICOUPLER TECHNIQUES

Assuming that additional data to be received from ECAC do not alter the requirements imposed on the multicoupler, techniques 10, 4, and 9, in that order, are the preferred implementations.

TEST RESULTS, ANALYSES, AND CALCULATIONS

In this section, the results of the tests described earlier are presented, and predicted range performance parameters are discussed. Sample calculations for predicted range are presented as a method for system performance analyses and comparisons.

ANTENNA RADIATION PATTERNS

1/12-SCALE MODEL OF AS-1729 ANTENNA

Figures A-1 to A-6 and A-7 to A-12 in Appendix A show the radiation patterns for the full-scale and 1/12-scale-model AS-1729 dipole antennas, respectively. These patterns were taken in the vertical plane at selected frequencies. The model's patterns were measured at frequencies scaled up by a factor of 12 from the full-scale frequencies. As suggested earlier, excellent agreement exists between the two sets of patterns. This is evident in the lobing structure of the two antennas. The nulls between the lobes for a given frequency occur at the same elevation angle in both cases. A simple inductive matching network consisting of a shunting wire to ground was used on the model to obtain the proper lobing structure above 60 MHz. Thus, the model antenna is truly representative of the AS-1729 dipole at 1/12 scale.

1/12-SCALE VHF ANTENNAS ON VEHICLE

Figures A13 to A36, A37 to A60, A61 to A84, A85 to A108, A109 to A132, and A133 to A153 are the radiation patterns taken for the five AS-1729 antennas (1, 2, 3, 4, and 8) and the 10-foot vhf whip (antenna 5), respectively. These patterns were taken using the present antenna arrangement while simulating both the land and sea states. All antenna numbers are specified according to figure 1.

The azimuthal plane patterns of the model antenna are a close reproduction of the full-scale patterns at each frequency. The model patterns closely match the many nulls in the full-scale patterns, with a maximum difference of 3 dB between them over 90% of the pattern. This verifies that the model antenna system closely approximates the full-scale system. Thus, patterns obtained from future system redesigns will be closely representative of what would be obtained at full scale. The vertical plane patterns presented are therefore considered equally representative of the full-scale vertical radiation structure.

1/24-SCALE HF ANTENNA

Figures A154 to A159 are the radiation patterns taken for the 15-foot hf whip antenna. These patterns were taken using the 1/24-scale model. The present arrangement was also used while simulating both land- and sea-deployment conditions.

Agreement between the model and full-scale patterns in the azimuthal plane were also verified to be within 3 dB for more than 90% of the pattern. The vertical plane patterns are again considered equally representative. All patterns were taken at 237.04 MHz, the 1/24-scale equivalent of 9.960 MHz.

1/12-SCALE BROADBAND ANTENNA

The proposed vhf broadband trimonopole antenna was tested for two different locations on the LVTC7 vehicle. The location of the stern and mid-vehicle positions is shown in figure 12. The stern position requires that the uhf antenna (AS-1404/PRC) be relocated. It can be moved to a position forward of the double hatch doors, about 2 feet to starboard of centerline. The midvehicle position does not require any antenna relocation. The trimonopole, of course, replaces the five AS-1729 dipoles. Use of the broadband trimonopole reduces the total antenna complement to four: one hf, one vhf, one uhf, and one broadband vhf antenna.

Figures A160 to A183 and A184 to A207 are the radiation patterns for the stern and midvehicle locations, respectively. Both land- and sea-deployment conditions were simulated. Patterns were taken at the same four frequencies utilized for the AS-1729 dipoles. Antennas 5, 6, and 7 (see figure 1) were all grounded for these measurements.

The patterns indicate that a high degree of omnidirectionality is possible with this antenna in either location. The stern position provides the greatest omnidirectionality for both land and sea deployment. The most obvious example of this can be seen in figures A178 and A202, which are for the same conditions except for different mounting locations. Figure A202 has a deep null at 300°, whereas figure A178 is fairly omnidirectional.

Figure 13 shows the impedance of the vhf trimonopole (the dimensions of which appear in figure 11) when measured over an extended groundplane. The impedance is within a 3:1 VSWR circle for the 30-to-76-MHz band.

The photographs in figure 14 display the impedance variations for the trimonopole antenna in two different mounting locations. These impedances were measured using the setup of figure 7. Figures 14A, B, C, and D and figures 14E, F, G, and H are for the stern and midvehicle locations, respectively. The trace in each photo represents 30 to 75 MHz.

The photographs clearly demonstrate that the least impedance variation occurs for the stern location for both land and sea conditions. The impedance changes very little in the stern when the other antennas are open circuited or grounded. Furthermore, the impedance is always within a VSWR of 3:1 for the stern location, but extends beyond this circle when mounted amidships.

The AS-1729 dipole has an approximately +3-dB gain across the 30-to-76-MHz frequency band relative to a 1/4-wavelength monopole. Its base tuning mechanism, however, has a nearly 50% efficiency. Thus, this dipole has nearly the same gain as a 1/4-wavelength monopole.

The gain of the broadband trimonopole is also approximately that of a 1/4-wavelength monopole. Therefore, this antenna has nearly the same gain as the AS-1729 dipole.

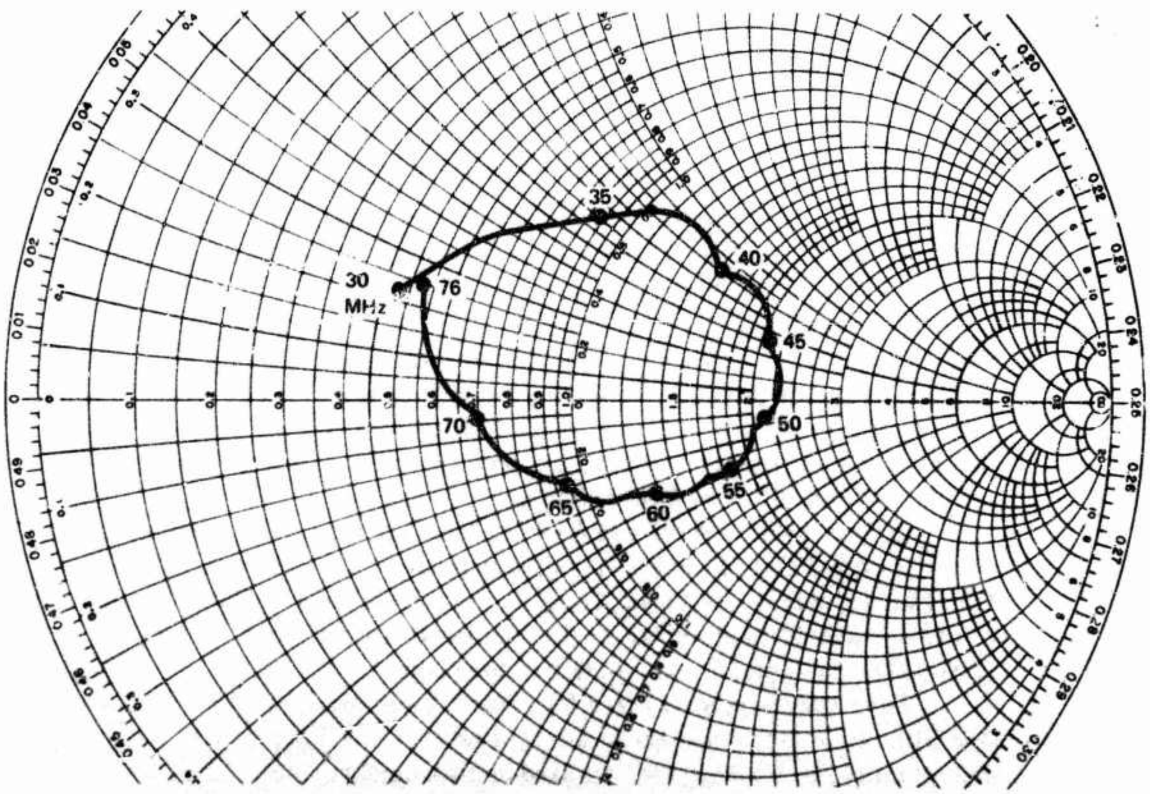
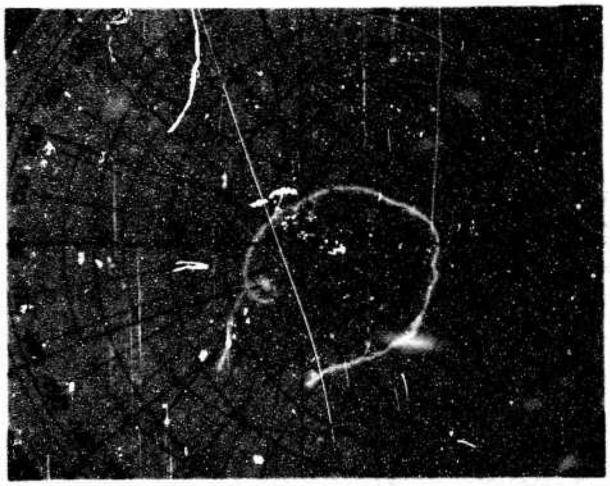
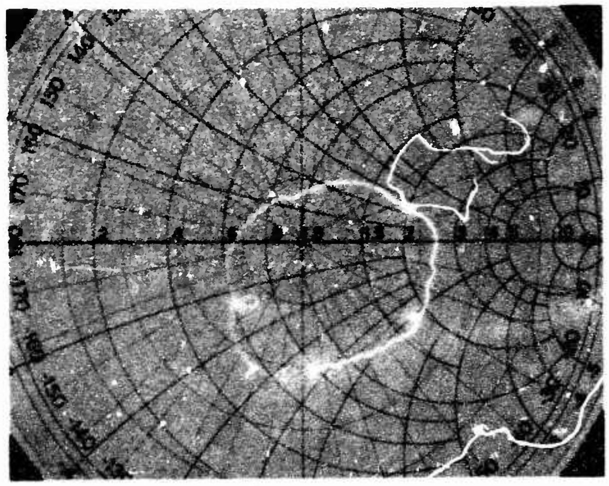


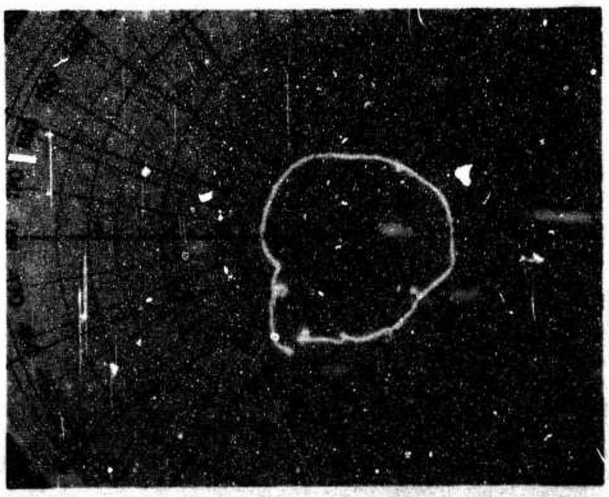
Figure 13. Impedance of broadband trimonopole antenna.



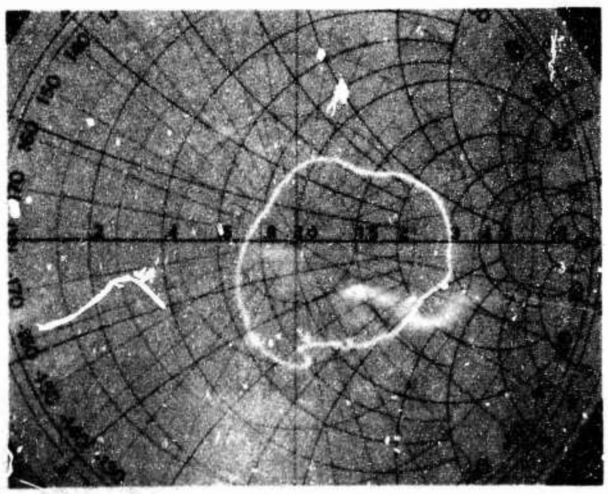
A. LAND STATE, STERN LOCATION, OTHER ANTENNAS GROUNDED.



B. LAND STATE, STERN LOCATION, OTHER ANTENNAS OPEN.

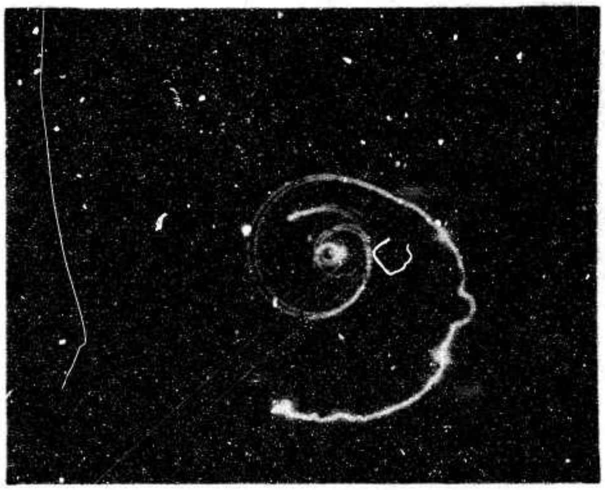


C. SEA STATE, STERN LOCATION, OTHER ANTENNAS GROUNDED.

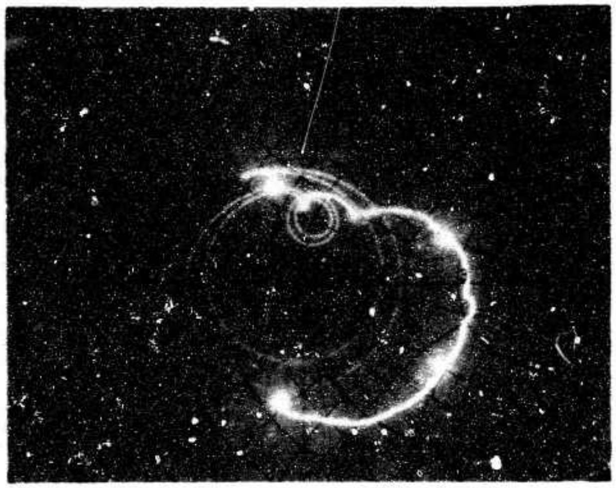


D. SEA STATE, STERN LOCATION, OTHER ANTENNAS OPEN.

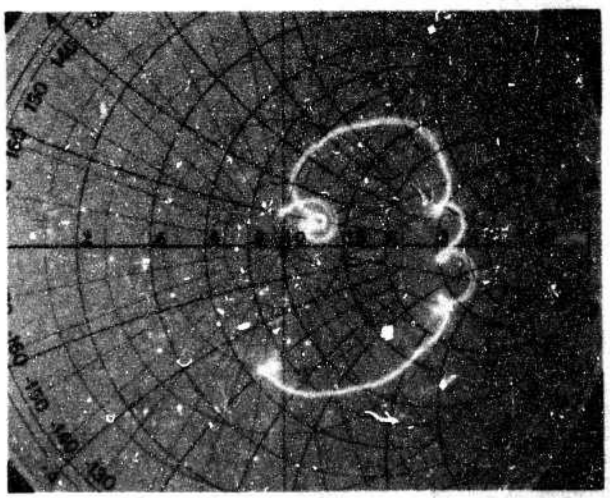
Figure 14. Impedance variations for broadband trimonopole antenna.



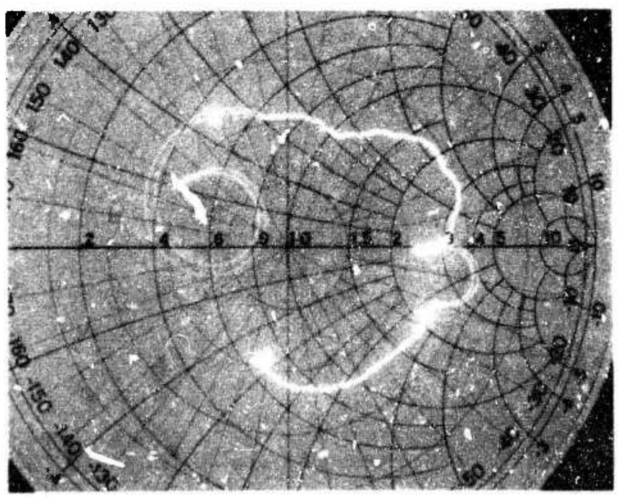
E. LAND STATE, MIDVEHICLE LOCATION, OTHER ANTENNAS GROUNDED.



F. LAND STATE, MIDVEHICLE LOCATION, OTHER ANTENNAS OPEN.



G. SEA STATE, MIDVEHICLE LOCATION, OTHER ANTENNAS GROUNDED.



H. SEA STATE, MIDVEHICLE LOCATION, OTHER ANTENNAS OPEN.

Figure 14. (Continued).

SYSTEM COMPARISONS

The present AS-1729 vhf antennas and the proposed trimonopole can be compared by looking at their azimuthal patterns. Both types of antennas have inherently omnidirectional radiation patterns when mounted on extended groundplanes. Radiation pattern distortion can be caused by reradiation from closely coupled antennas or hull currents. Examination of these patterns reveals a greater degree of distortion for the dipoles. The deviation from circularity occurs more frequently and to a greater extent than for the trimonopole. This is valid for both land and sea states. The trimonopole was at least equal to, but no worse than, the dipoles. Although both antenna system arrangements are closely coupled, the adverse effect on the trimonopole system is less.

A comparison of the stern and midvehicle locations for the trimonopole reveals a higher degree of omnidirectionality at all frequencies for the stern position. This is true for both land- and sea-state conditions. Figures A166 and A190 illustrate this for the stern and midvehicle locations for the LVTC7 on land. Figures A178 and A202 illustrate this for the sea state.

A change in the patterns occurs when going from land to seawater. This is caused by the change in groundplane level and conductivity, thereby changing the effect of the hull currents.

MISMATCH LOSSES AT 1/12 SCALE

The VSWRs of the AS-1729 dipoles and the trimonopole were measured using the test setup of figure 7; the mismatch losses for these antennas were calculated from the measured VSWR values. These impedance losses in dB were added to the 1/4-wavelength-monopole reference value of the corresponding radiation pattern. This was done to make the pattern gain for the antenna on the model independent of the mismatch loss, as discussed earlier. The full-scale AS-1729 antenna is pretuned; therefore, its mismatch loss is always assumed to be less than 1.

One possible consequence of using the trimonopole design is that one of its elements could be either broken or shot off. Table 2 shows the mismatch losses for the trimonopole with and without an element missing. (Refer to figures 6 and 12 for the element numbers.) The table shows that although this loss does increase in most cases when an element is missing, it does not increase enough (3-dB maximum increase) to adversely affect communications efficiency. Because of the symmetry involved, little distortion would be anticipated in the antenna patterns with an element missing. Thus, the trimonopole could perform efficiently using only two elements, if necessary.

TABLE 2. IMPEDANCE MISMATCH LOSSES (dB) FOR BROADBAND TRIMONOPOLE ANTENNA.
(All other antennas are grounded; element numbers refer to figures 6 and 12.)

SEA STATE

Location	Condition	Frequency			
		392.4 MHz	542.4 MHz	685.2 MHz	876 MHz
Stern	No elements missing	0.2	0.6	0.7	0.5
	No. 2 element missing	0	0	0	0
	No. 3 element missing	0	0	0	0
Midvehicle	No elements missing	0.1	1.4	1.6	0.8
	No. 1 elements missing	0.02	1.9	2.4	0.9
	No. 2 elements missing	0.13	2.1	2.4	1.1
	No. 3 elements missing	0.02	1.9	3.1	1.2

LAND STATE

Location	Condition	Frequency			
		392.4 MHz	542.4 MHz	685.2 MHz	876 MHz
Stern	No elements missing	0.1	0.7	0.8	0.8
	No. 1 element missing	0.2	1.6	1.9	1.6
	No. 2 element missing	0.4	1.5	1.9	1.1
	No. 3 element missing	0.12	1.6	1.9	1.6
Midvehicle	No elements missing	0.1	1.2	1.4	0.7
	No. 1 element missing	0.4	1.9	2.2	0.7
	No. 2 element missing	0.4	2.1	2.2	0.8
	No. 3 element missing	0.1	2.2	2.7	1.1

PREDICTED RANGE PERFORMANCE

Both the present vhf antenna system and the proposed system using the broadband trimonopole are evaluated to predict the maximum range that can be expected from each system. This range prediction is based on two-way communication under worst-case conditions.

The curve in figure B1 (in Appendix B) displays field strength in dB/μV/m (ground wave) as a function of distance in statute miles over seawater for several frequencies, assuming 1-kW radiated power from a lossless short monopole on the earth's surface. This curve can be used to determine the maximum range for a communications link. To use the curve, some assumptions are needed.

The assumptions made for both systems are:

1. The received FM signal for a maximum range is -91.5 dBm (20 dB quieting) for single-channel voice in a 50-ohm system (ref 3, p. II-18).

2. The available power output of the RT-524 transceiver is 40 watts (+46 dBm).

3. No external noise (i.e., receiver noise) limits sensitivity.

4. The land/water interface effect on field strength is negligible, since the link is with beach units at the edge of the seawater.

5. The receive antenna is omnidirectional with 0-dB gain.

The range analysis equation used for converting the given information to that necessary for using the range prediction curve is:

$$E\ (\mathrm{dB}/\mu\mathrm{V/m}) = V_{rec}\ (\mathrm{dB}/\mu\mathrm{V}) + 18.8 - 20 \log (\lambda/2\pi) + RG_{rec} + \alpha_r + \beta_r + RG_{xmt} + \alpha_t + \beta_t \qquad (1)$$

where

E = electric field strength in dB/μV/m

V_{rec} = receiver sensitivity in dB/μV

λ = wavelength in meters

RG_{rec} = receive antenna's relative gain in dB/1/4λ monopole

RG_{xmt} = transmit antenna's relative gain in dB/1/4λ monopole

α_r = cable attenuation of receive system in dB

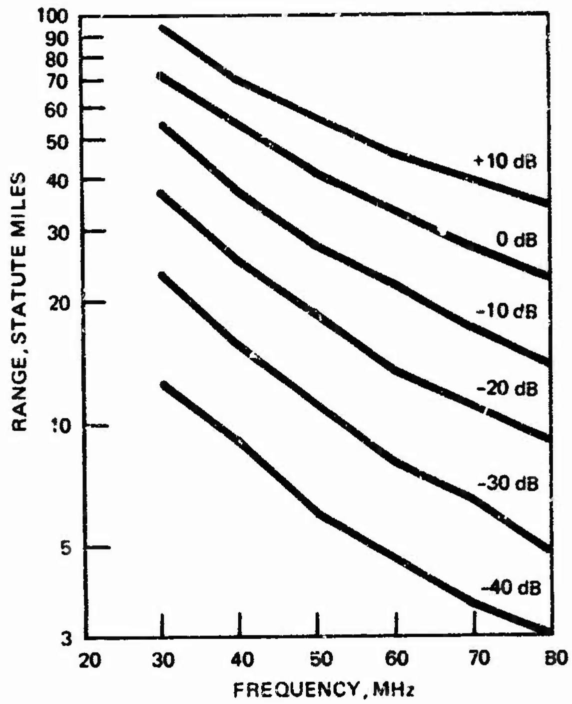
α_t = cable attenuation of transmit system in dB

β_r = multicoupler insertion loss of receive system in dB

β_t = multicoupler insertion loss of transmit system in dB

Equation (1) above is derived in Appendix B. With the assumptions above and equation (1), the curve of figure B1 can be used to determine the predicted maximum range for each system. Sample calculations are included in Appendix B.

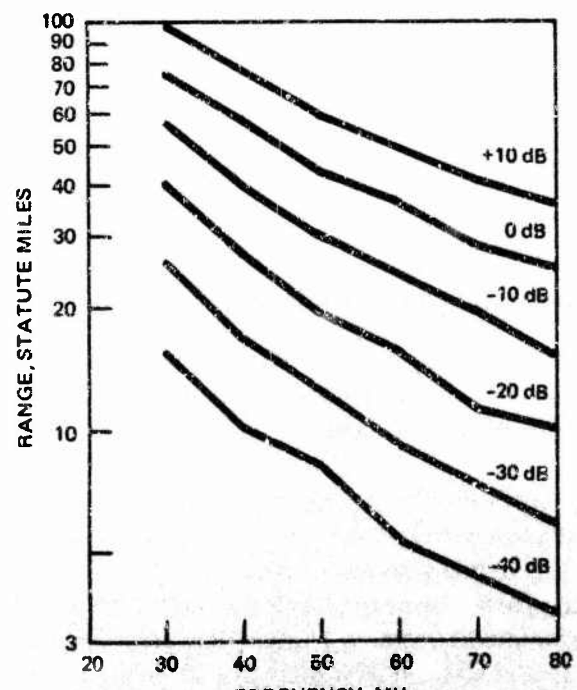
Figures 15 and 16 are plots of predicted range over seawater as a function of frequency using radiation pattern null depth in dB as a parameter for the present and proposed vhf antenna systems, respectively. Thus, the predicted range performance at a particular bearing, using an azimuthal pattern can be determined. For example, from the azimuthal pattern in figure A37 for an AS-1729, antenna 2, land state, at 32.7 MHz, the antenna gain at 90° is 3.5 dB below a 1/4-wavelength monopole. From figure 15, this corresponds to an expected groundwave range of 63 miles. However, at 295°, a



CONDITIONS FOR A 0-dB SYSTEM

1. Groundwave over seawater.
2. AS-1729/VRC antenna
3. 46-dBm radiated power
4. -91.5-dBm (20 dB quieting) receive sensitivity

Figure 15. Predicted range performance as a function of frequency when using present antenna system for vhf.



CONDITIONS FOR A 0-dB SYSTEM

1. Groundwave over seawater
2. Trimonopole antenna
3. 46-dBm radiated power
4. -915-dBm (20 dB quieting) receive sensitivity

Figure 16. Predicted range performance as a function of frequency when using broadband trimonopole antenna for vhf.

deep pattern null occurs. The gain at 295° is 29 dB below a 1/4-wavelength monopole, which corresponds to a range of 23 miles. Thus, a range decrease of more than 40 miles could occur when the vehicle makes a nearly 180° turn. The trimonopole antenna radiation patterns can similarly be interpreted by use of figure 16.

Comparison of figures 15 and 16 reveals that the range expectancy is from 1 to 4 miles less when using the trimonopole antenna system for a given frequency. This is because the broadband trimonopole requires a multicoupler that was assumed to have 2-dB insertion loss. This loss is responsible for the slight range decrease. However, as discussed above, the trimonopole antenna distributes its radiated energy in a more nearly omnidirectional pattern in most cases than do any of the vhf antennas in the present arrangement. Thus, the range performance can be expected to be more uniform over all directions, resulting in more reliable communications.

Under field conditions, the actual range performance can be expected to deviate from that predicted in figures 15 and 16. This occurs as operating conditions differ from the conditions assumed in the calculations. However, these curves provide a good basis of analysis of the two systems and a rule-of-thumb prediction for actual range expectancies.

There does not appear to be any way of changing the present antenna system arrangement which could result in an improved pattern performance. The limited space available precludes making any significant arrangement changes. Therefore, development of a full-scale broadband vhf antenna, whether a trimonopole or other design, is the best practical solution. Development of the new antenna's multicoupler should also proceed concurrently. It would significantly improve the pattern performances in both the azimuthal and vertical planes, while reducing the adverse effects associated with a closely coupled system. It would also improve isolation between hf transmitters and vhf receivers and between vhf transmitters and hf receivers; the multicoupler's filtering techniques significantly increase the isolation, thereby improving the electromagnetic compatibility of the LVTC7 antenna system. The net result would be a simpler, more efficient system for the LVTC7 vehicle at vhf.

SUMMARY AND CONCLUSIONS

The LVTC7 Marine Corps landing vehicle has a large communications responsibility. The present antenna system consists of eight antennas mounted on a small, unique platform, which has resulted in a closely coupled system. This close coupling has limited the overall communications effectiveness.

This report has presented measurements obtained from the existing antenna system by using 1/12- and 1/24-scale brass models. A new antenna system design, consisting of a vhf broadband antenna and multicoupler combination to replace five vhf antennas, has been proposed. This approach was also studied using the 1/12-scale brass model. Calculations were included for the predicted range performance for each system.

The following conclusions are based on the results of these brass-scale-model tests.

PRESENT ANTENNA SYSTEM

1. The radiation patterns are not omnidirectional (within 6 dB) in all cases. This is because the present antenna configuration has resulted in a closely coupled system.

2. Null depths as deep as 20 dB relative to the maximum of the pattern are common. In some cases, the azimuthal patterns have more than one large null.

3. Both azimuthal and vertical patterns change in going from land to seawater. This is caused by the change in groundplane level and conductivity, which changes the effect of the hull currents.

4. The 1/12- and 1/24-scale brass models were successfully verified as being representative of the full-scale vehicle.

5. Two deep nulls are common in the vertical plane at 73 MHz while the vehicle is on land. The number and depth of the nulls is not as common at this frequency while the vehicle is in seawater.

6. The LVTC7 communications vehicle will have difficulty in providing optimum communications performance, particularly at vhf.

PROPOSED ANTENNA SYSTEM

1. The vhf broadband trimonopole appears to offer a high potential as a replacement for the five AS-1729/VRC dipoles.

2. The trimonopole, when mounted in the stern position, has an impedance across the 30-to-76-MHz band of 3:1 or less under both land- and sea-deployment conditions.

3. The stern position is preferred over the midvehicle position for the trimonopole, particularly while in seawater. The impedance variation is less, and the patterns have fewer nulls.

4. The trimonopole antenna can perform well even when an element is missing.

5. The possibility of using low-loss transmitter combiners with tuned filters at the receiver inputs appears to be the most feasible multicoupler approach at this time.

6. Range performance when using the trimonopole at vhf should be more reliable.

7. A greater degree of omnidirectionality is achievable with the stern-mounted trimonopole than with the present antenna arrangement at vhf.

RECOMMENDATIONS

The following recommendations are a result of the model studies performed on the present and the proposed antenna systems.

1. Replace the five AS-1729/VRC dipole antennas with a single broadband antenna and develop a multicoupler.

2. Mount a vhf broadband antenna on the vehicle's centerline just aft of the double hatch doors. Relocate the uhf antenna forward of the hatch doors, approximately 2 feet to the starboard of the centerline.

3. Build a full-scale vhf broadband trimonopole antenna to test as a feasible replacement for the five vhf dipoles.

4. Relocate antenna 4 to avoid the deterioration caused by the engine's exhaust gases, or reroute these gases to avoid this for any other antenna.

NELC PHOTOGRAPHS

Illustrations in this document include the following NELC photographs.

Illustration No.	NELC Photograph No.
2	LSF 978-5-73
4	LSF 841-4-73
5	LSF 840-4-73
6	LSF 1476-7-73
8	LSF 726-4-73
9	LSF 725-4-73
10	LSF 572-3-73

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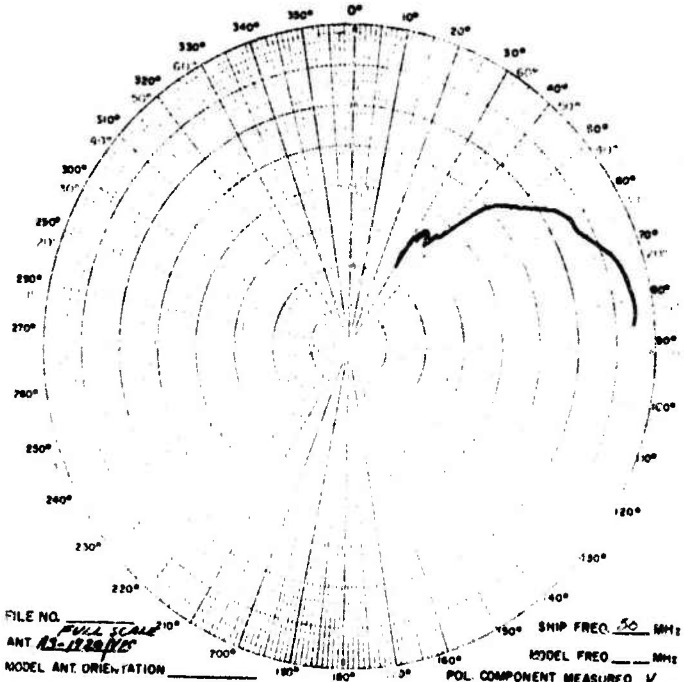
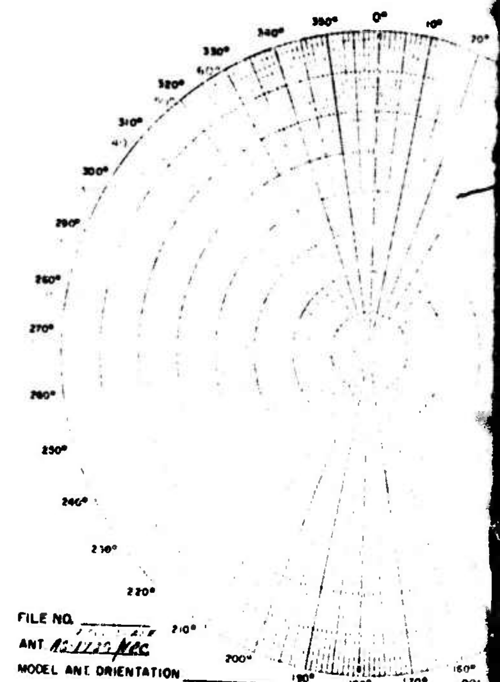
APPENDIX A: ANTENNA RADIATION PATTERNS



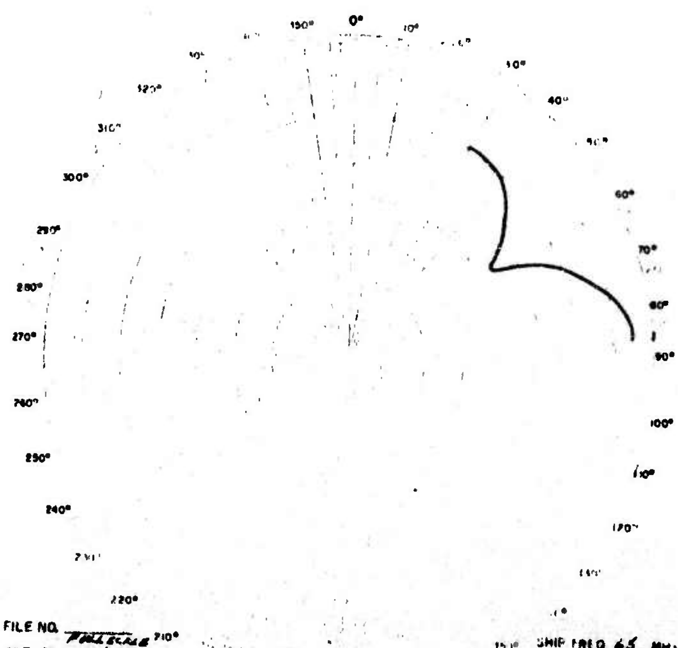
FILE NO. ____ FULL SCALE
ANT AS-1729/VRC
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ. 50 MHz
MODEL FREQ ____ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +3 dB REL
REMARKS ____
ENGR ____ DATE MAY 1973

FIGURE A7



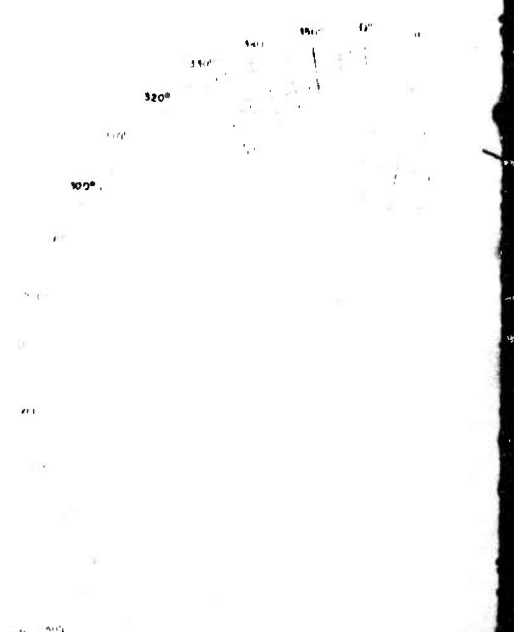
FILE NO. ____
ANT AS-1729/VRC
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0 DEGREES RELATIVE TO SHIP HEADING
REMARKS ____
ENGR ____ DATE MAY 19



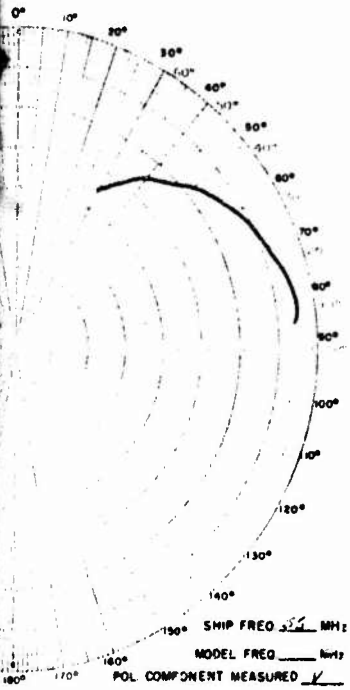
FILE NO. ____ FULL SCALE
ANT AS-1729/VRC
MODEL ANT ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 65 MHz
MODEL FREQ ____ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART +3 dB REL
REMARKS ____
ENGR ____ DATE MAY 1973

FIGURE A4



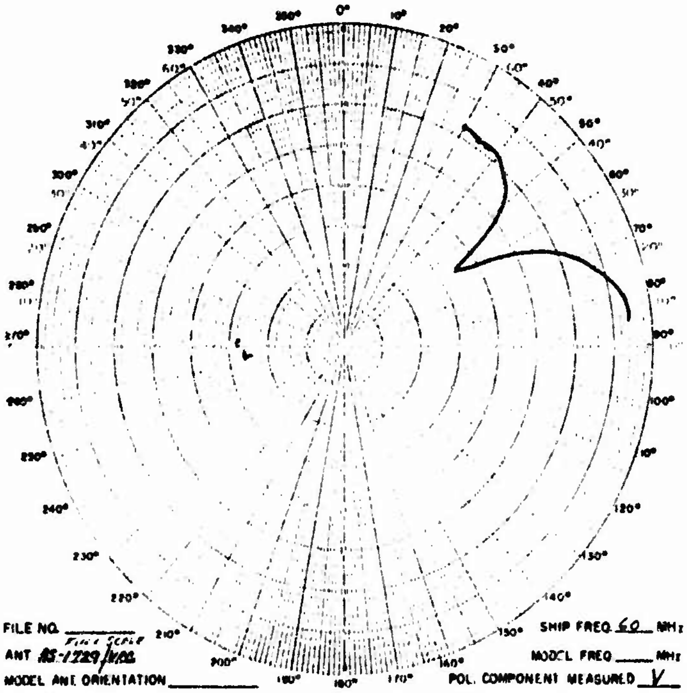
MODEL ANT ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0 DEGREES RELATIVE TO SHIP HEADING
REMARKS ____
ENGR ____ DATE MAY 19



SHIP FREQ 55 MHz
MODEL FREQ ____ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +3 dB REL.

REMARKS____________________

DATE MAY 1973 FIGURE A-2

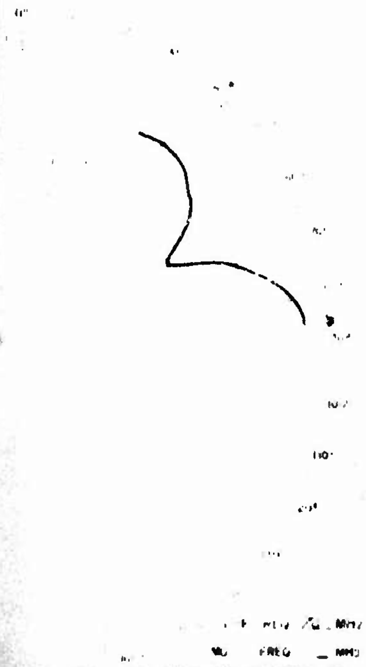


FILE NO. ________
ANT AS-1729/VRC
MODEL ANT ORIENTATION__________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 60 MHz
MODEL FREQ ____ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +3 dB REL.

REMARKS____________________

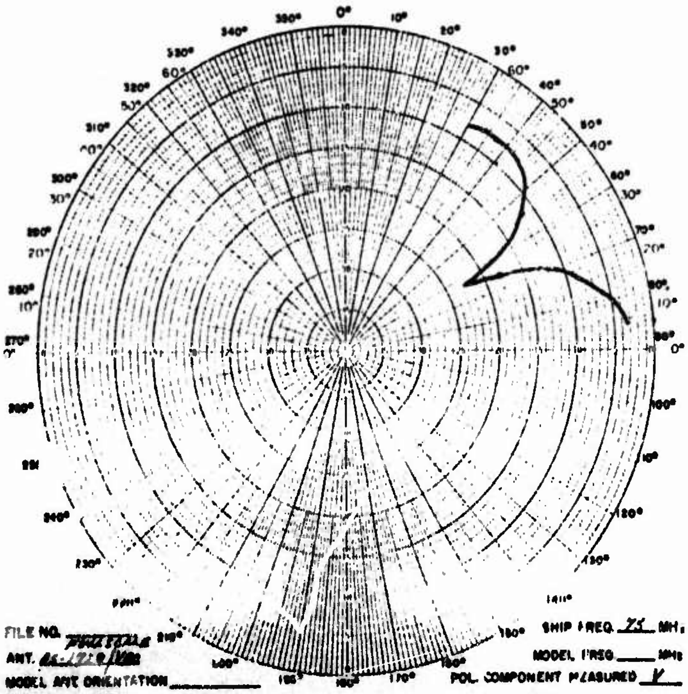
ENGR________ DATE MAY 1973 FIGURE A-3



SHIP FREQ 70 MHz
MODEL FREQ ____ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART +3 dB REL.

REMARKS____________________

DATE MAY 1973 FIGURE A-5



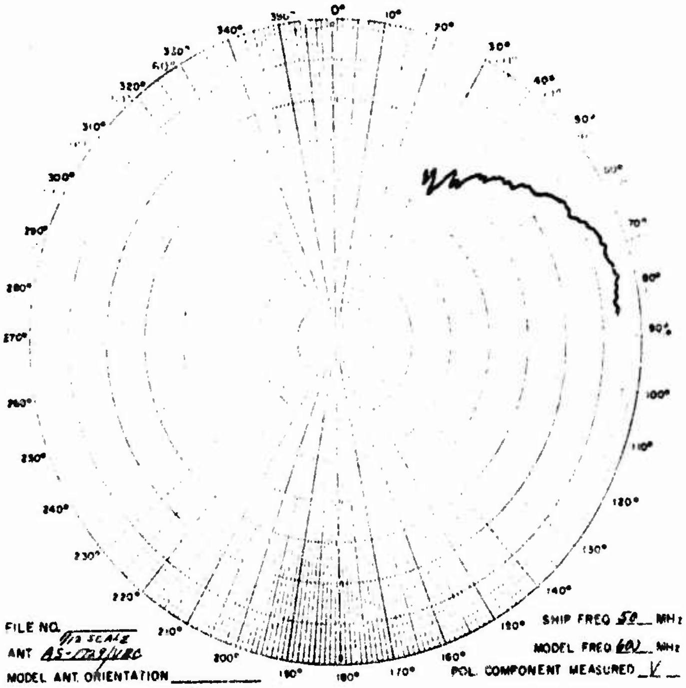
FILE NO.
ANT. AS-1729/VRC
MODEL ANT ORIENTATION__________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 75 MHz
MODEL FREQ ____ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +3 dB REL.

REMARKS____________________

ENGR________ DATE MAY 1973 FIGURE A-6

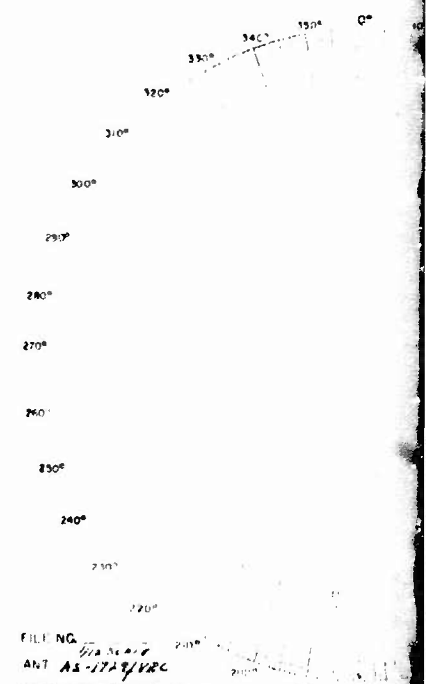
2



FILE NO. 1/12 SCALE
ANT AS-1729/VRC
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING

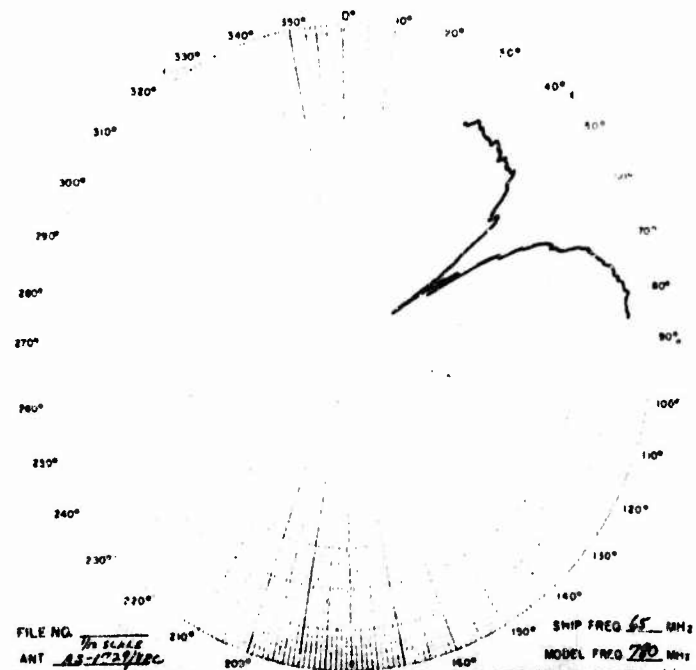
SHIP FREQ 50 MHz
MODEL FREQ 600 MHz
POL. COMPONENT MEASURED V
REMARKS ____

ENGR ____ DATE MAY 1973 FIGURE A-7



FILE NO. 1/12 SCALE
ANT AS-1729/VRC
MODEL ANT ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING

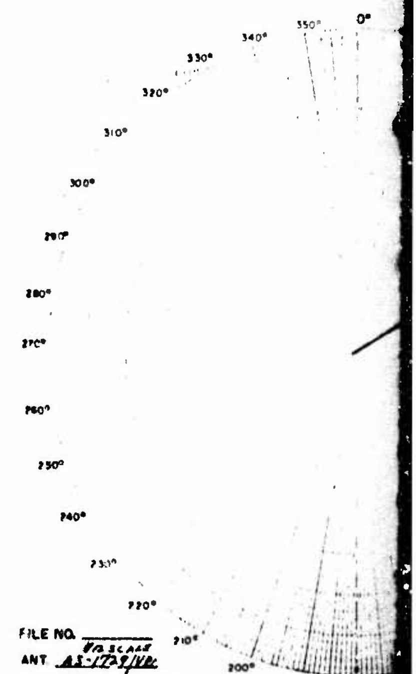
ENGR ____



FILE NO. 1/12 SCALE
ANT AS-1729/VRC
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 65 MHz
MODEL FREQ 780 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = — dB REL. TO λ/4 MONOPOLE
INDUCTIVE MATCHING
REMARKS NETWORK USED

ENGR ____ DATE MAY 1973 FIGURE A-10



FILE NO. 1/12 SCALE
ANT AS-1729/VRC
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING

ENGR ____

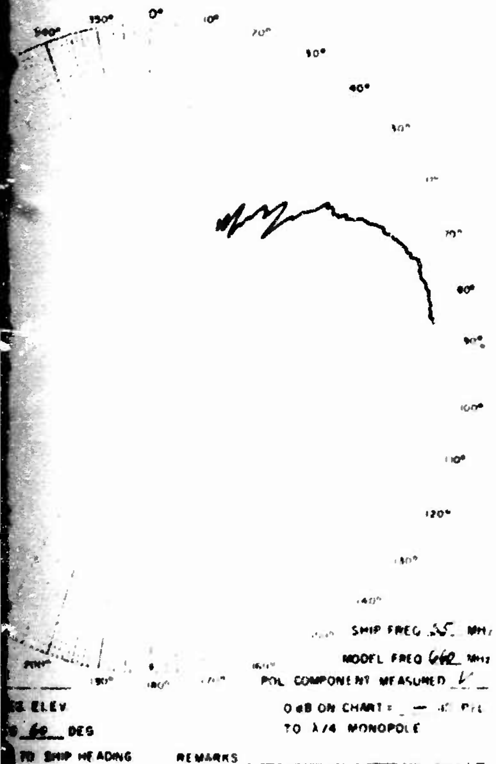


FIGURE A

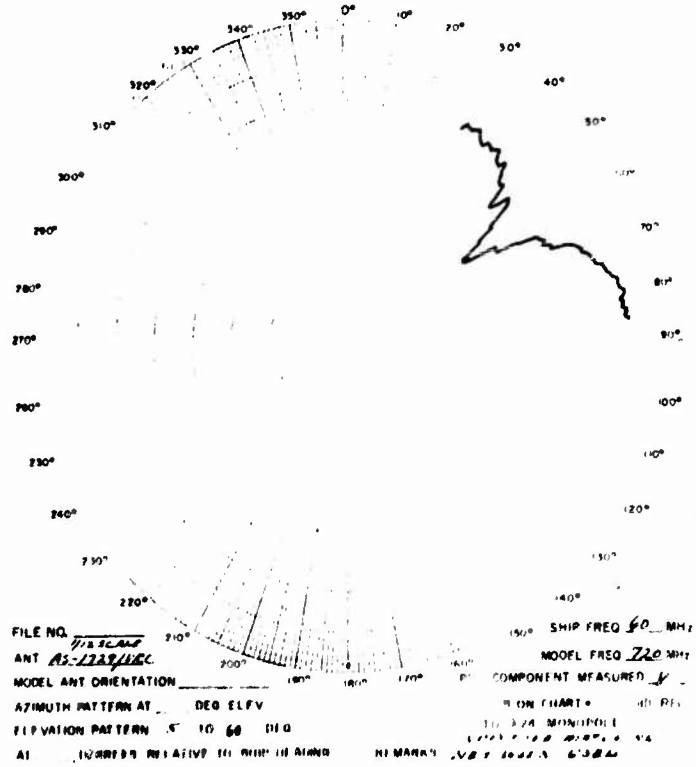


FIGURE A-9

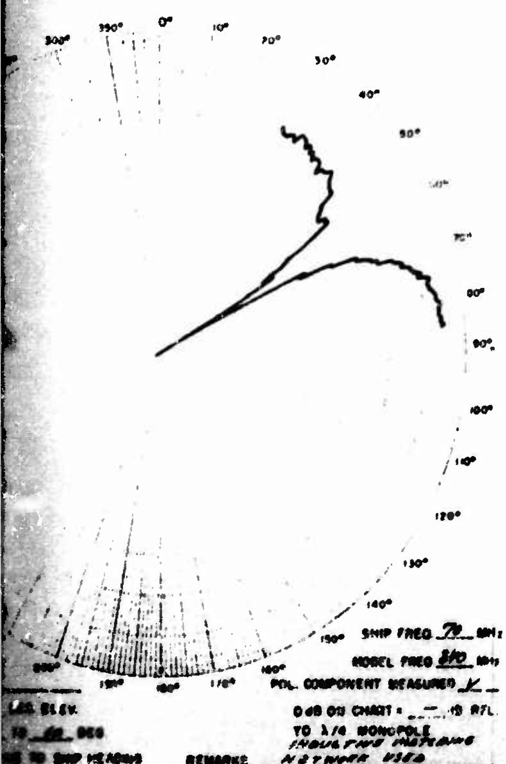


FIGURE A-11

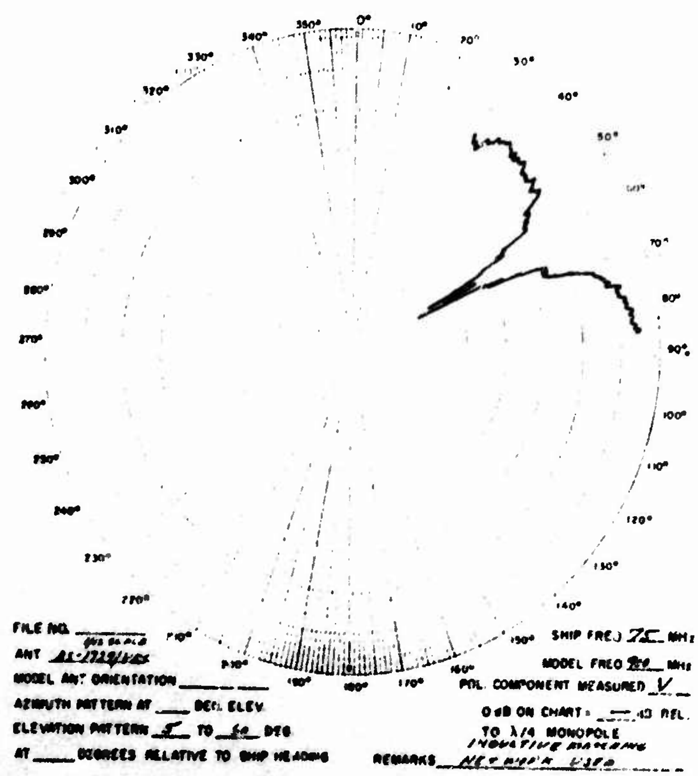
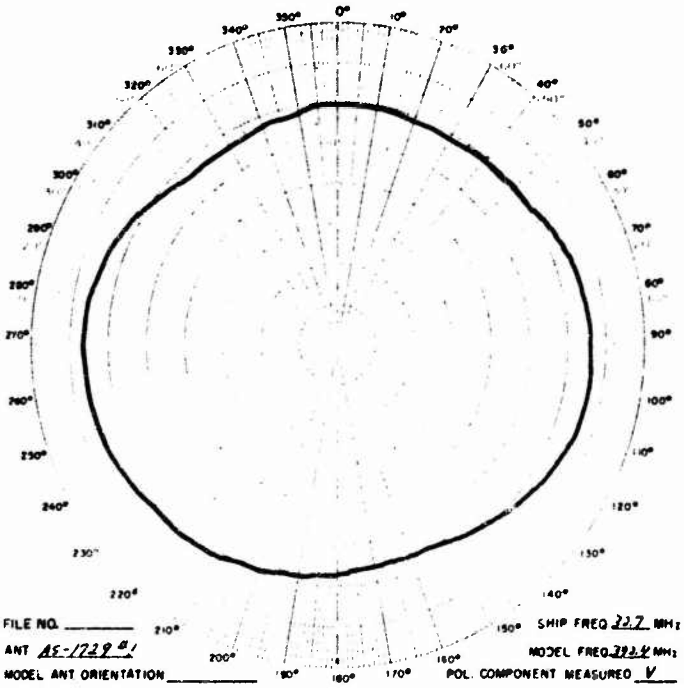


FIGURE A-12



FILE NO. ______ SHIP FREQ 33.7 MHz

ANT AS-1729 #1 MODEL FREQ 393.4 MHz

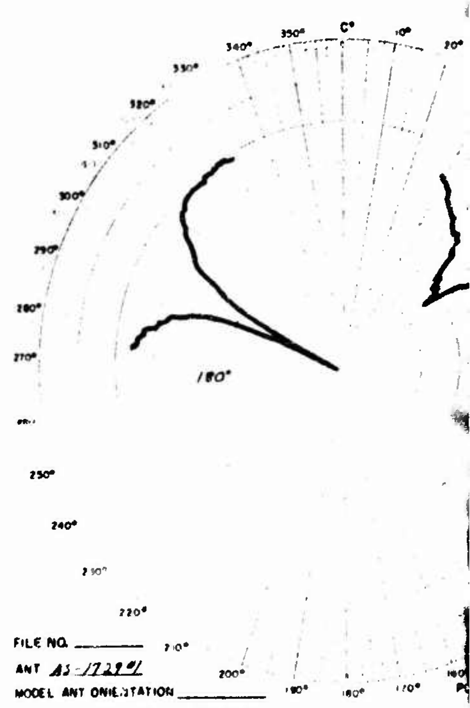
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = 14.4 dB REL. TO λ/4 MONOPOLE

ELEVATION PATTENN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE

ENGR ______ DATE MAY 1973 FIGURE A-13



FILE NO. ______

ANT AS-1729 #1

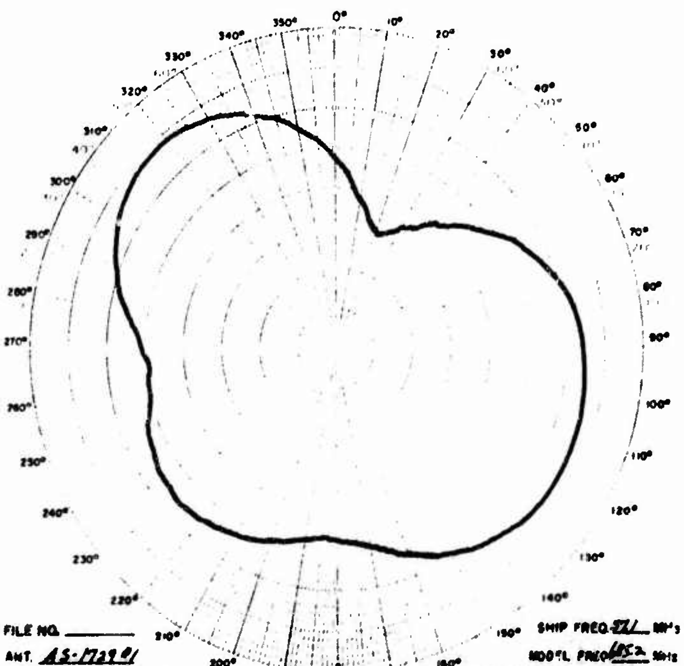
MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTENN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LA

ENGR ______ DATE MAY 1



FILE NO. ______ SHIP FREQ 33.1 MHz

ANT. AS-1729 #1 MODEL FREQ 385.2 MHz

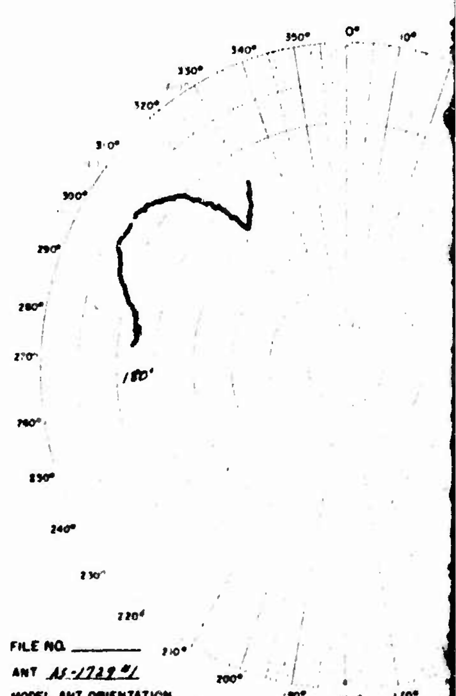
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = 14.5 dB REL. TO λ/4 MONOPOLE

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE

ENGR ______ DATE MAY 1973 FIGURE A-19



FILE NO. ______

ANT AS-1729 #1

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV

ELEVATION PATTERN 5 TO 60 DEG

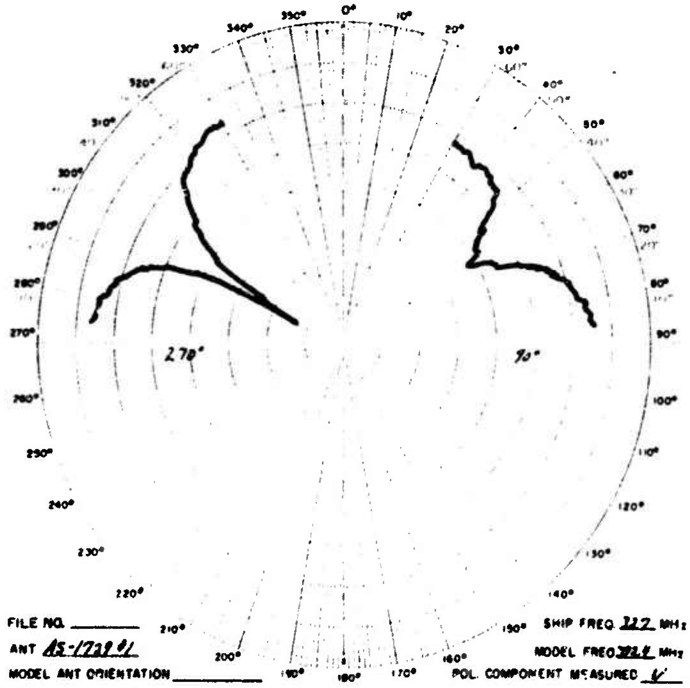
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS

ENGR ______ DATE MA

SHIP FREQ 31.7 MHz
MODEL FREQ 371.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +9.4 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE

DATE MAY 1973 FIGURE A-14



FILE NO. ________
ANT AS-1729 01
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ___ DEG ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +9.9 dB REL. TO λ/4 MONOPOLE

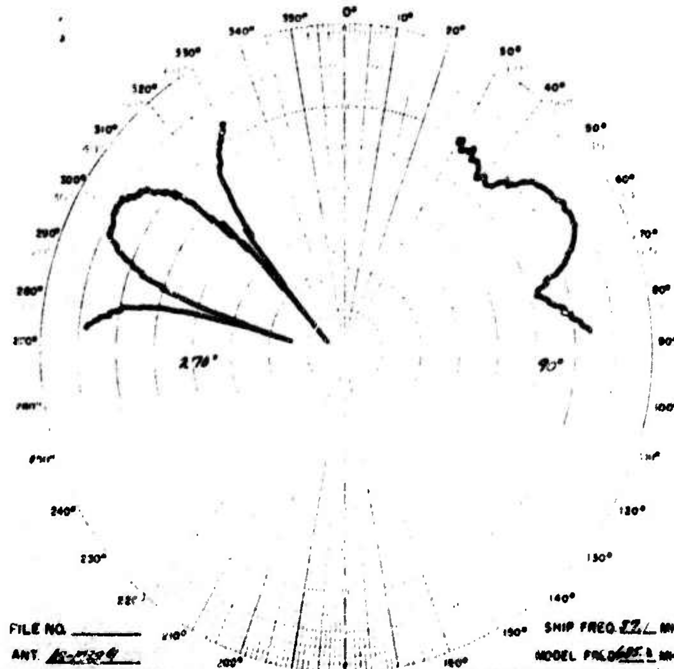
REMARKS LAND STATE

ENGR ________ DATE MAY 1973 FIGURE A-15

SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10.8 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE

DATE MAY 1973 FIGURE A-20

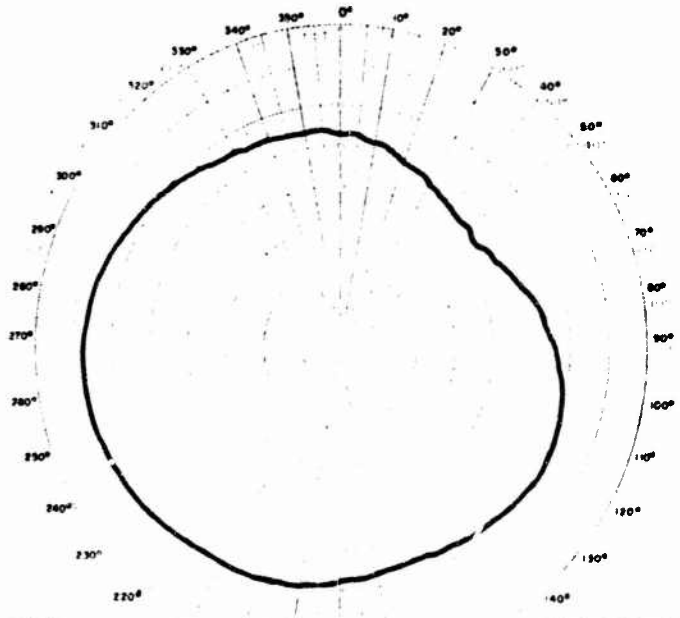


FILE NO. ________
ANT. AS-2239
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ___ DEG ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10.8 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE

ENGR ________ DATE MAY 1973 FIGURE A-21



FILE NO. ________

ANT AS-1729#1

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT 5 DEG ELEV

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.2 MHz

MODEL FREQ 584 MHz

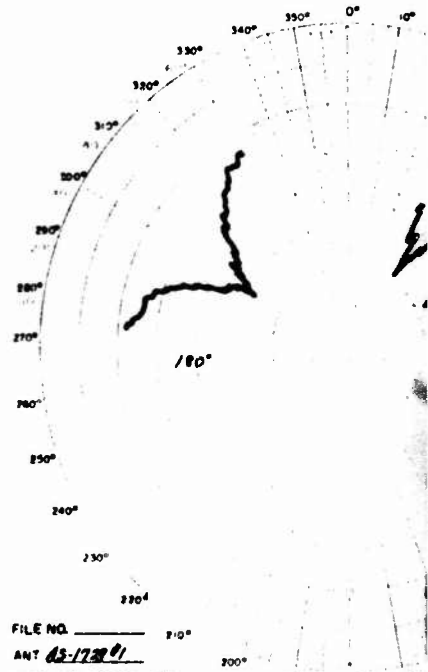
POL COMPONENT MEASURED V

0 dB ON CHART = 14.8 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE

ENGR ________ DATE MAY 1973

FIGURE A-16



FILE NO. ________

ANT AS-1729#1

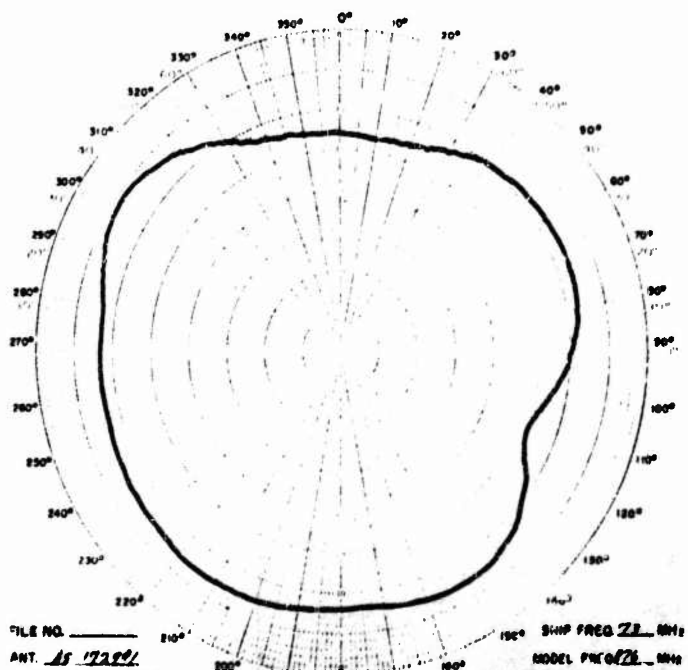
MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARK



FILE NO. ________

ANT. AS 1729#1

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT 5 DEG ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 73 MHz

MODEL FREQ 876 MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = 4/3 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, MOUNTING ANTENNA NETWORK USED

ENGR ________ DATE MAY 1973

FIGURE A-22

FILE NO. ________

ANT AS-1729#1

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG. ELEV.

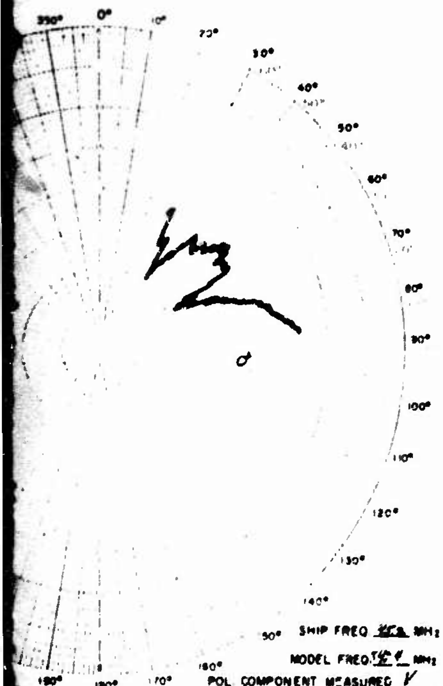
ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

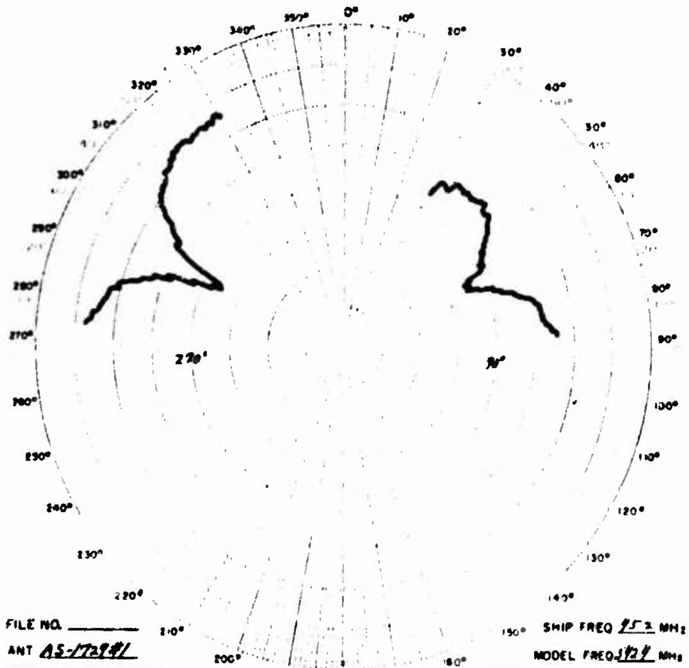
REMARKS

ENGR ________ DATE

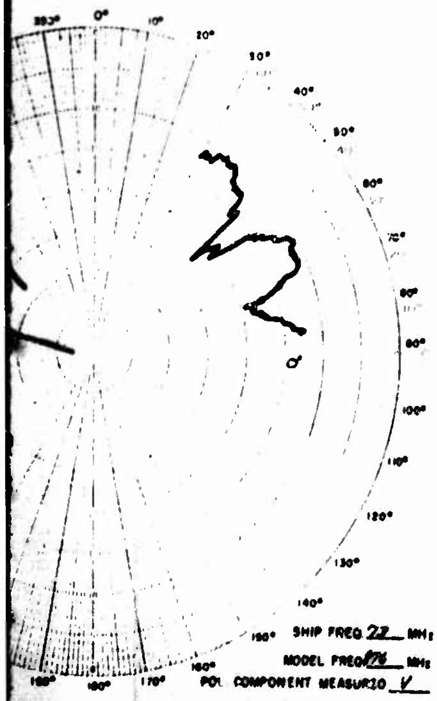
3



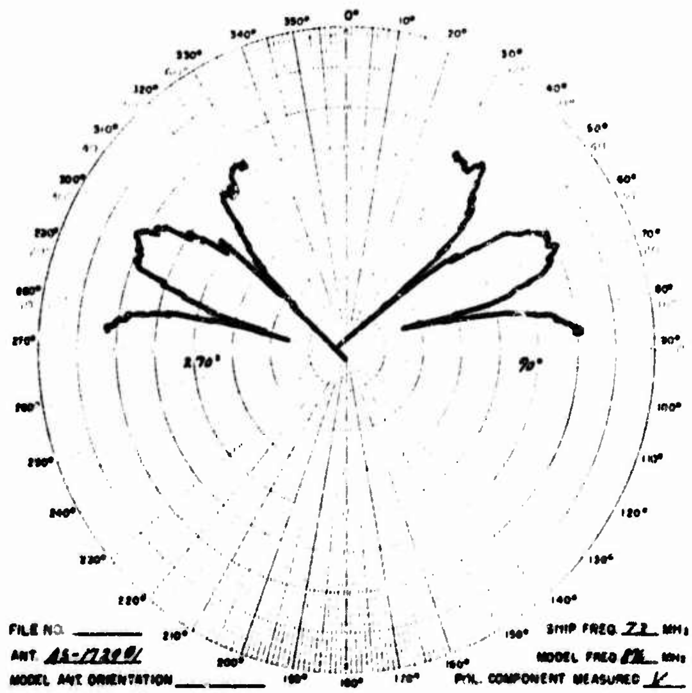
SHIP FREQ 452 MHz
MODEL FREQ 1424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 14.8 dB REL.
TO λ/4 MONOPOLE
DEG.
HEADING
REMARKS LAND STATE Figure A17



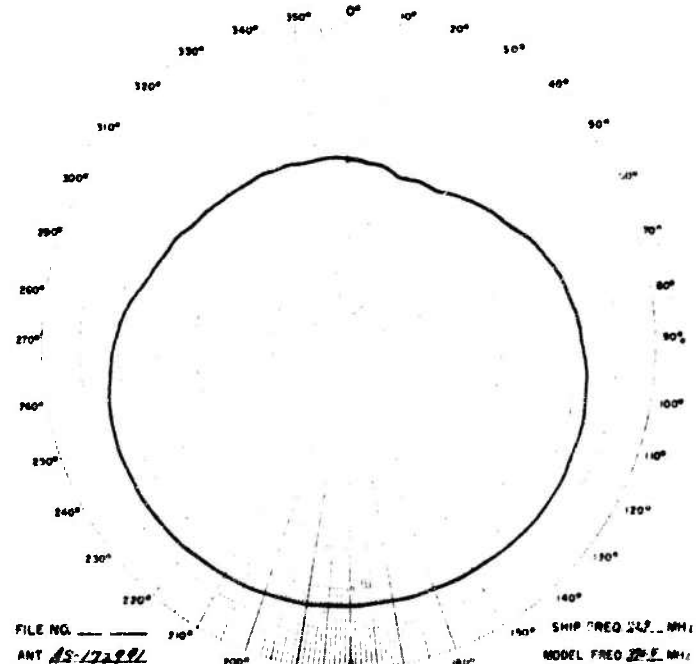
FILE NO. ______
ANT. AS-1729/1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 452 MHz
MODEL FREQ 1424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 14.8 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1973
FIGURE A-18



SHIP FREQ 72 MHz
MODEL FREQ 176 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 10 dB REL.
TO λ/4 MONOPOLE
DEG.
HEADING
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973
FIGURE A-23



FILE NO. ______
ANT. AS-1729/1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 72 MHz
MODEL FREQ 176 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973
FIGURE A-24



FILE NO. ___ ___

ANT AS-1729?/

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ [illegible] MHz

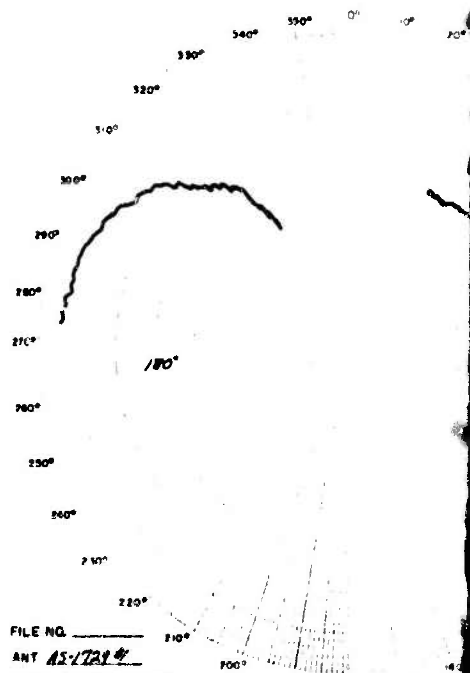
MODEL FREQ [illegible] MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = [illegible] dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-25



FILE NO. ______

ANT AS-1729/

MODEL ANT ORIENTATION ______

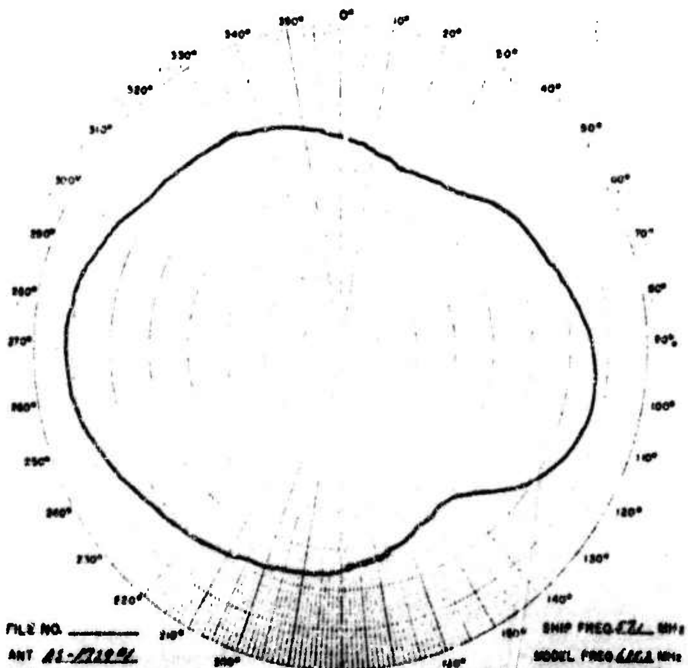
AZIMUTH PATTERN AT ___ DEG ELEV.

ELEVATION PATTERN 5 TO 60 DEG

AT [illegible] DEGREES RELATIVE TO SHIP HEADING

REMARKS SE[illegible]

ENGR ______ DATE MAY 1[illegible]



FILE NO. ______

ANT AS-1729/

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ [illegible] MHz

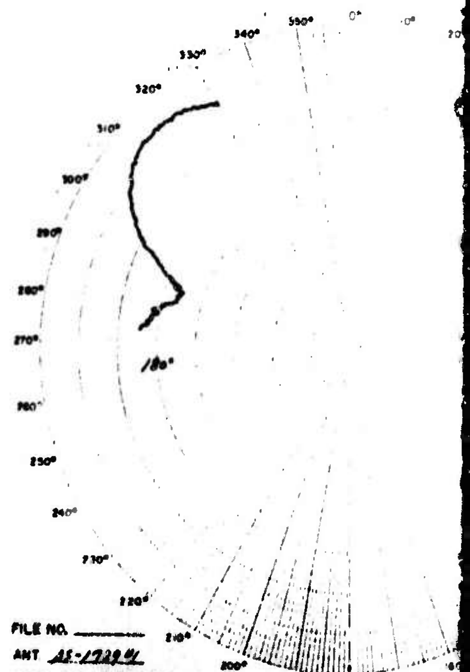
MODEL FREQ [illegible] MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = [illegible] dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-31



FILE NO. ______

ANT AS-1729/

MODEL ANT ORIENTATION ______

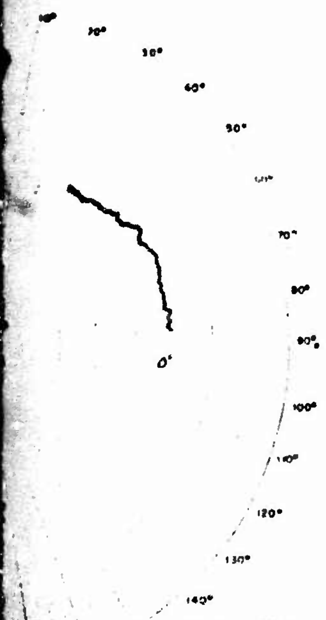
AZIMUTH PATTERN AT ___ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

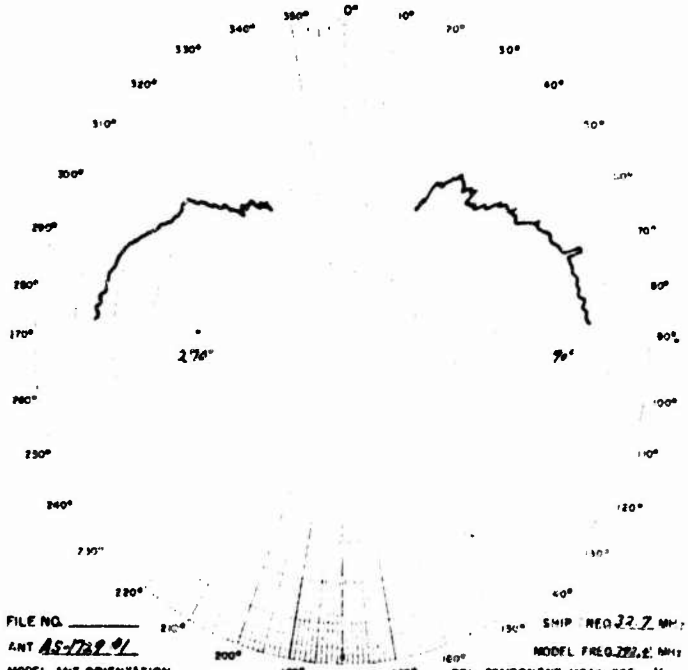
AT [illegible] DEGREES RELATIVE TO SHIP HEADING

REMARKS S[illegible]

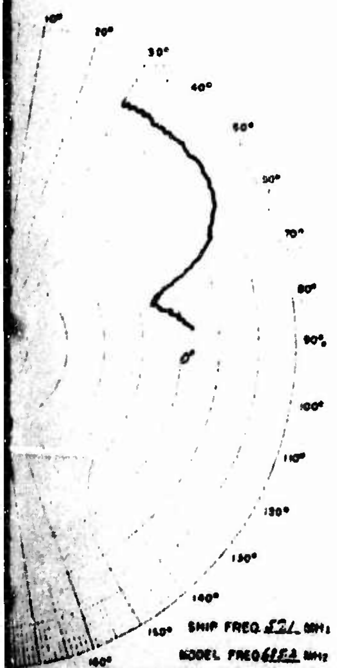
ENGR ______ DATE MA[illegible]



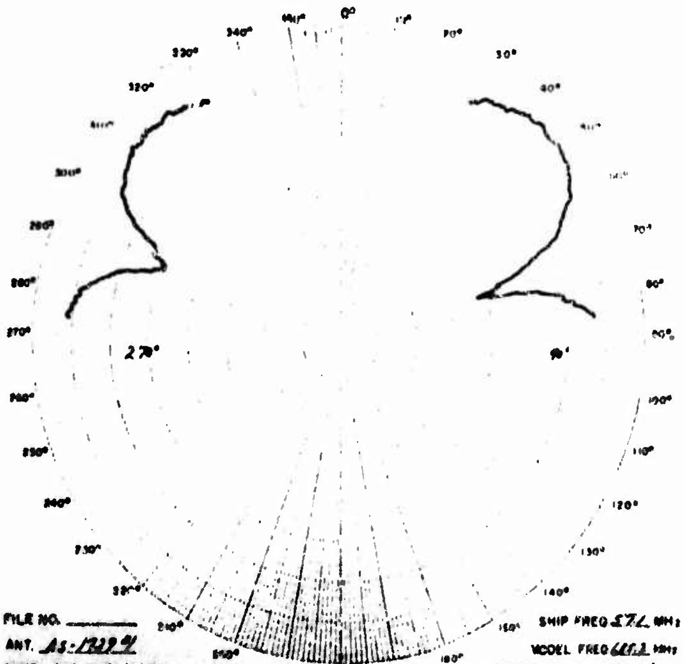
SHIP FREQ 32.7 MHz
MODEL FREQ 292.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 144 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1973 FIGURE A-26



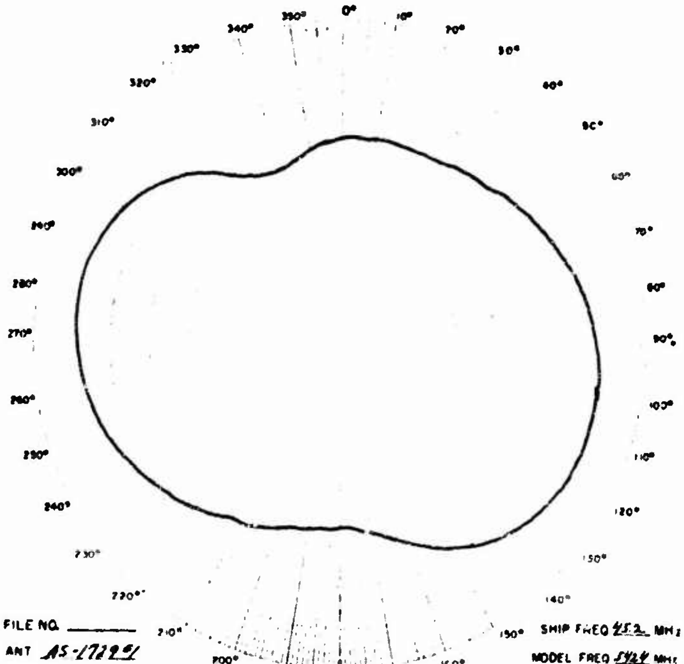
FILE NO. ______
ANT AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 32.7 MHz
MODEL FREQ 292.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 144 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ______ DATE MAY 1973 FIGURE A-27



SHIP FREQ 52.1 MHz
MODEL FREQ 465.3 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 4/13.9 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1973 FIGURE A-32



FILE NO. ______
ANT. AS-1729 #
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 52.1 MHz
MODEL FREQ 465.3 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 4/13.9 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ______ DATE MAY 1973 FIGURE A-33



FILE NO. ________

ANT AS-1729/1

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT 5 DEG ELEV

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 452 MHz

MODEL FREQ 5424 MHz

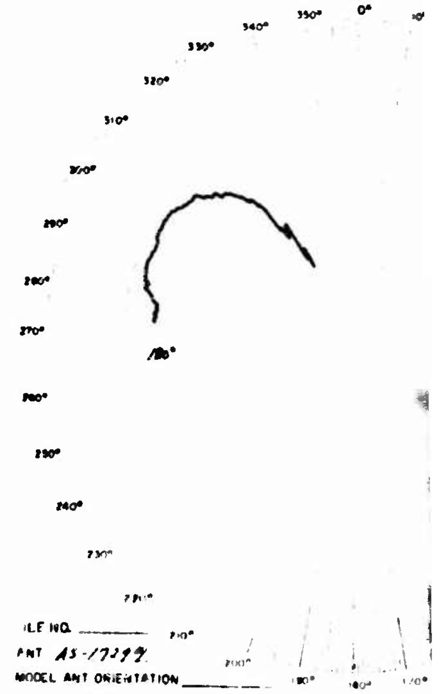
POL. COMPONENT MEASURED V

0 dB ON CHART = +4.8 dB REL TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR ________ DATE MAY 1973

FIGURE A 21



FILE NO. ________

ANT AS-1729/1

MODEL ANT ORIENTATION ________

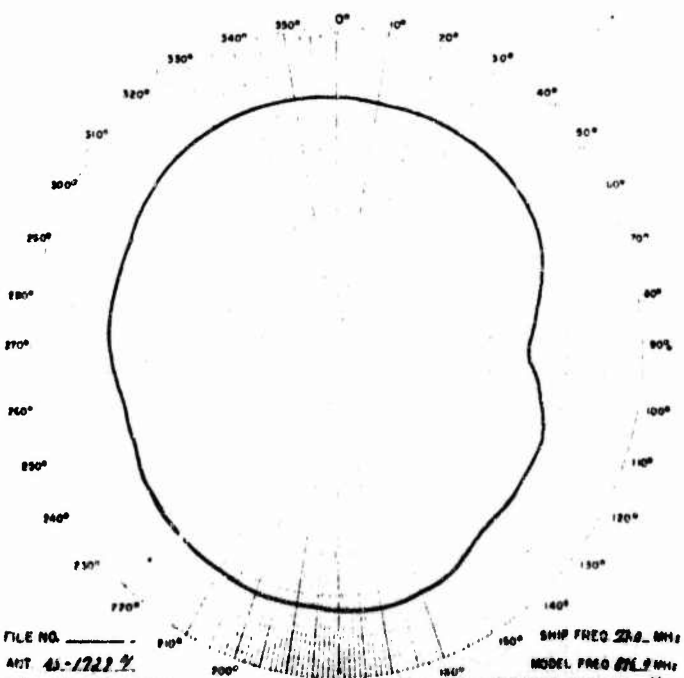
AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ________ DATE



FILE NO. ________

ANT AS-1729/1

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 2?0 MHz

MODEL FREQ ???.? MHz

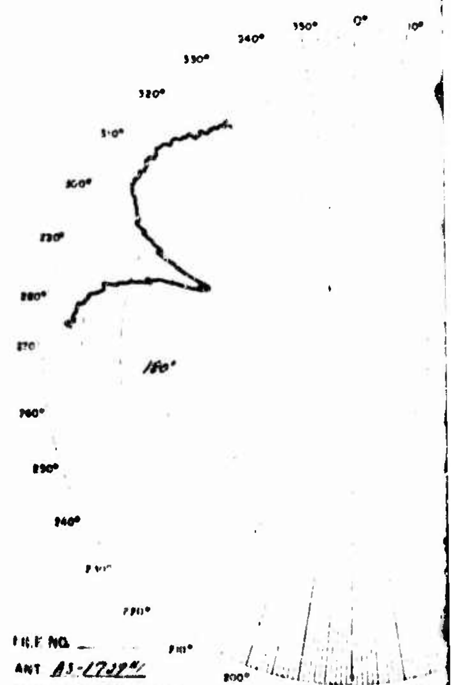
POL. COMPONENT MEASURED V

0 dB ON CHART = +11 dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR ________ DATE MAY 1973

FIGURE A 24



FILE NO. ________

ANT AS-1729/1

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG. ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ________ DATE

3

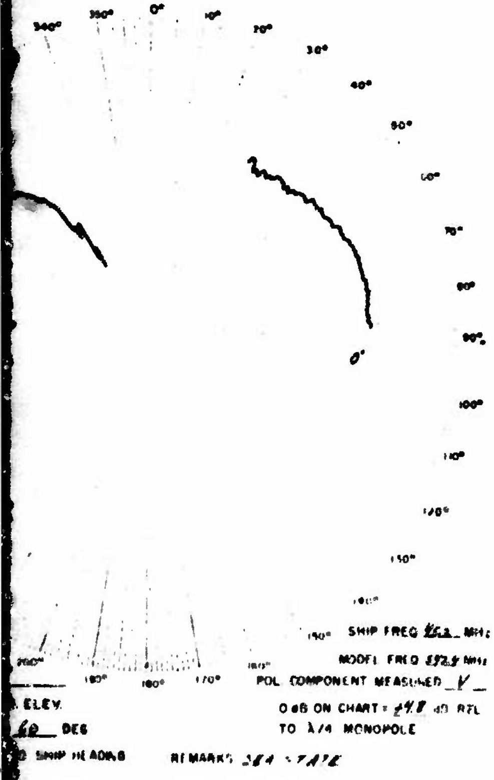


FIGURE A-29

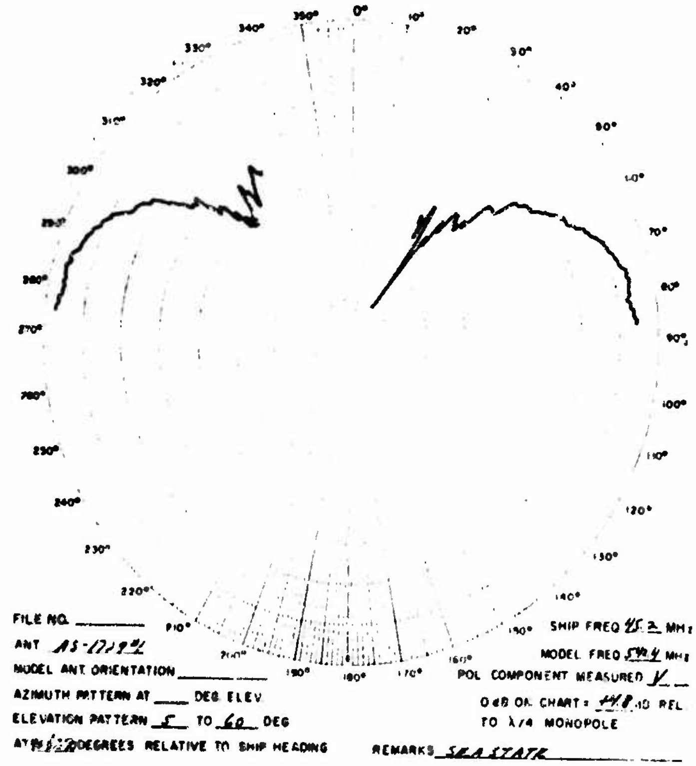


FIGURE A-30

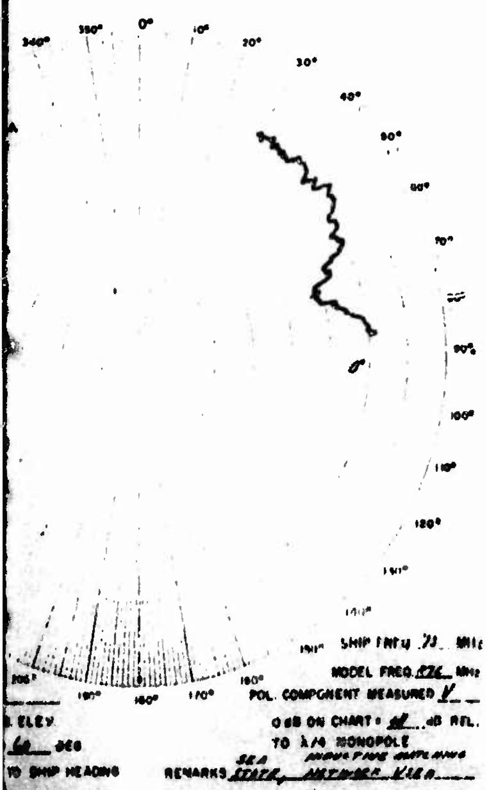


FIGURE A-35

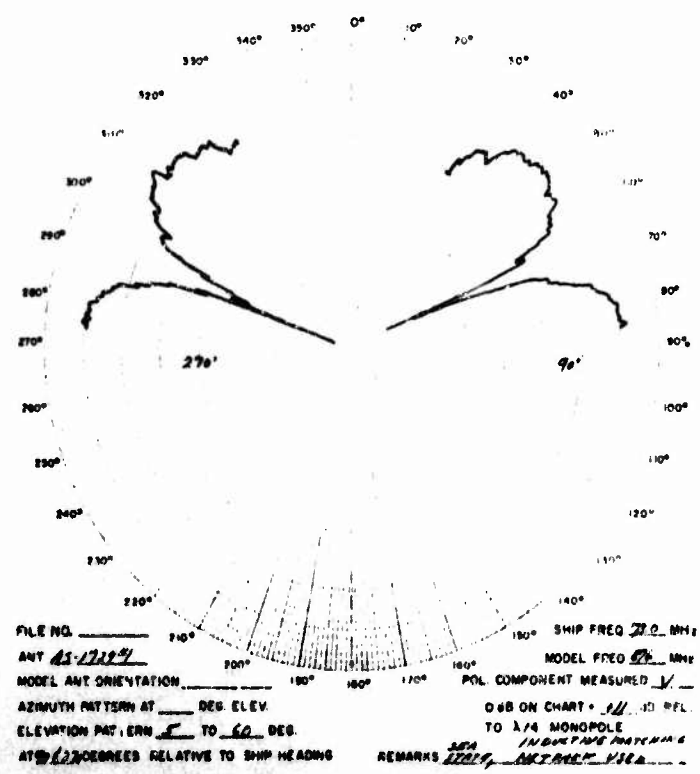
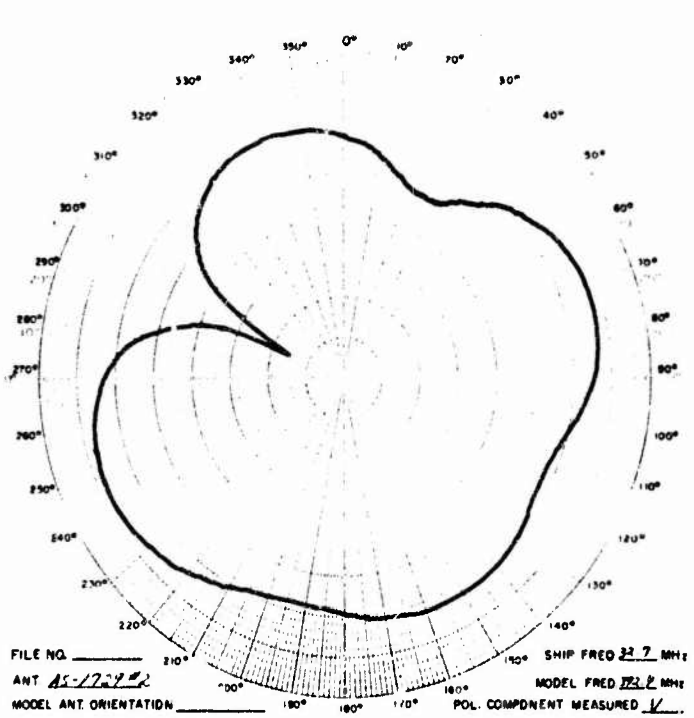


FIGURE A-36



FILE NO. ______ SHIP FREQ 32.7 MHz

ANT AS-1729#2 MODEL FREQ 392.4 MHz

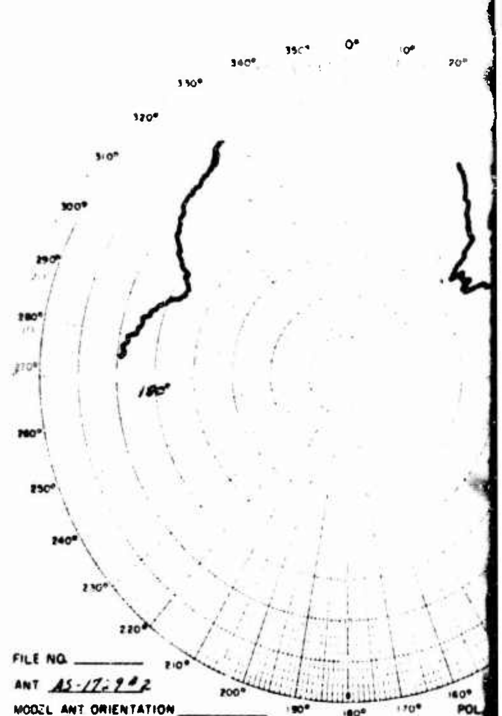
MODEL ANT. ORIENTATION ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +4 dB REL.

ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND SL. E

ENGR ______ DATE MAY 1973 FIGURE A-7



FILE NO. ______

ANT AS-1729#2

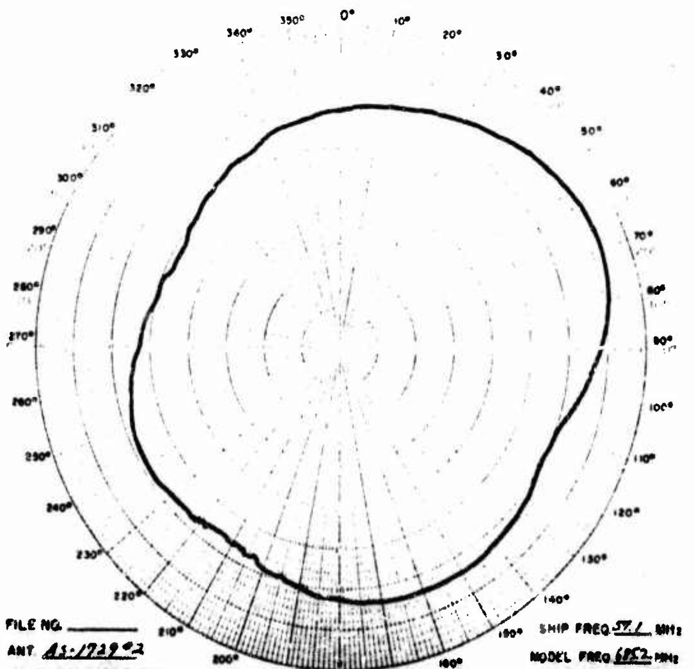
MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAN

ENGR ______ DATE MAY 197



FILE NO. ______ SHIP FREQ 57.1 MHz

ANT AS-1729#2 MODEL FREQ 685.2 MHz

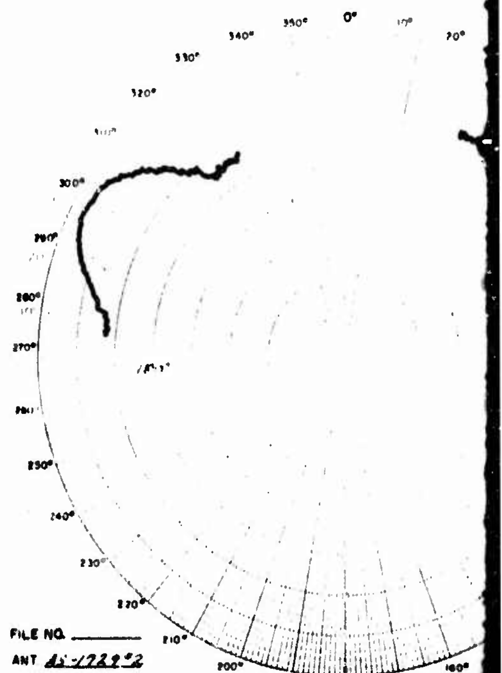
MODEL ANT. ORIENTATION ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +12 dB REL.

ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE

ENGR ______ DATE MAY 1973 FIGURE A-43



FILE NO. ______

ANT AS-1729#2

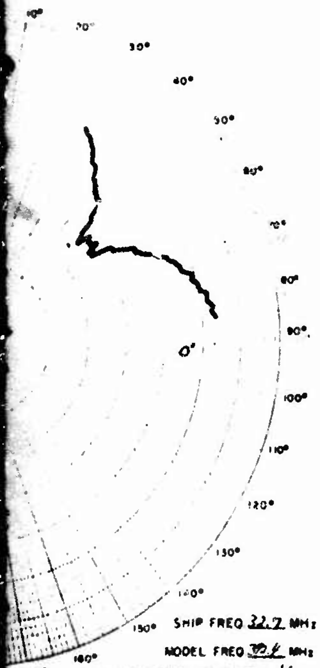
MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAN

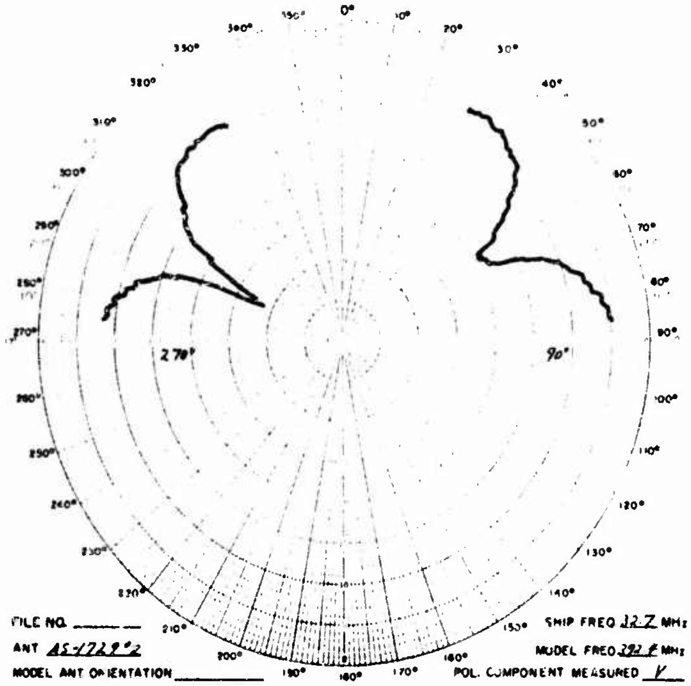
ENGR ______ DATE MAY 197



SHIP FREQ 32.7 MHz
MODEL FREQ 39.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4 dB REL.
TO λ/4 MONOPOLE

...MARKS ½ LAND STATE

...E MAY 1973 FIGURE A-38

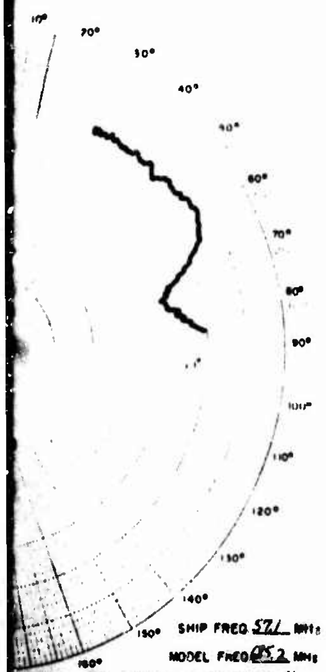


FILE NO. ______
ANT AS-1729 #2
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT @ 127 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4 dB REL.
TO λ/4 MONOPOLE

REMARKS LAND STATE

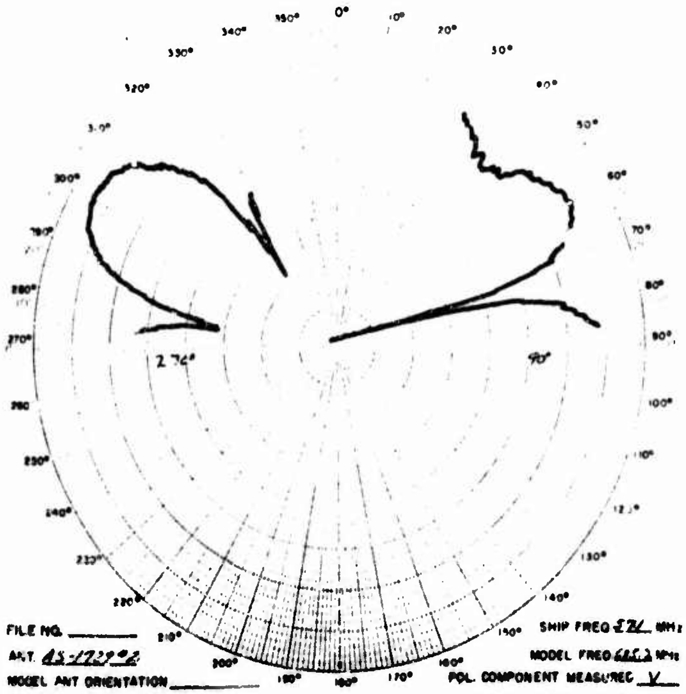
ENGR ______ DATE MAY 1973 FIGURE A-37



SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12.9 dB REL.
TO λ/4 MONOPOLE

...MARKS LAND STATE

...ATE MAY 1973 FIGURE A-44

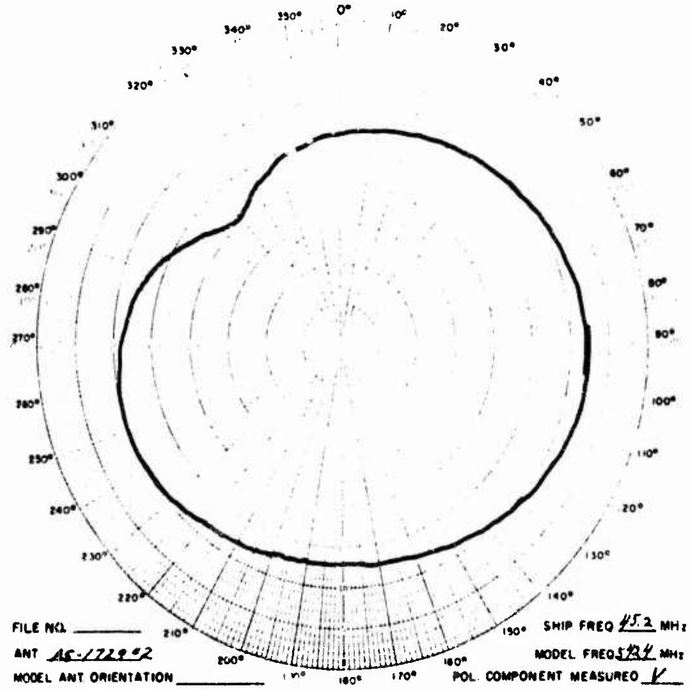


FILE NO. ______
ANT AS-1729 #2
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT @ 127 DEGREES RELATIVE TO SHIP HEADING

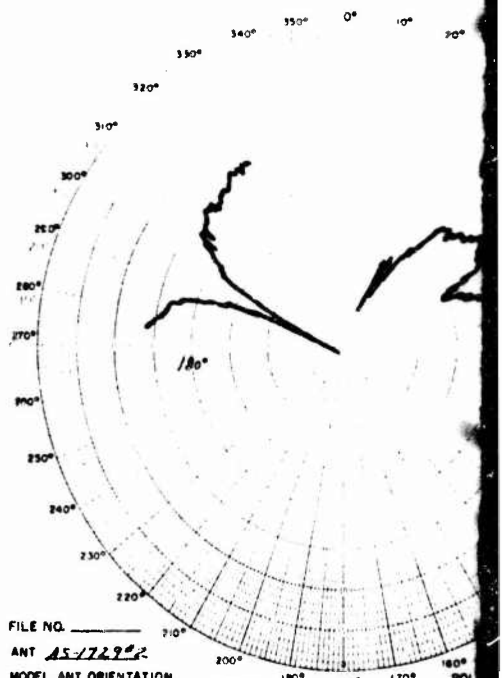
SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12.9 dB REL.
TO λ/4 MONOPOLE

REMARKS LAND STATE

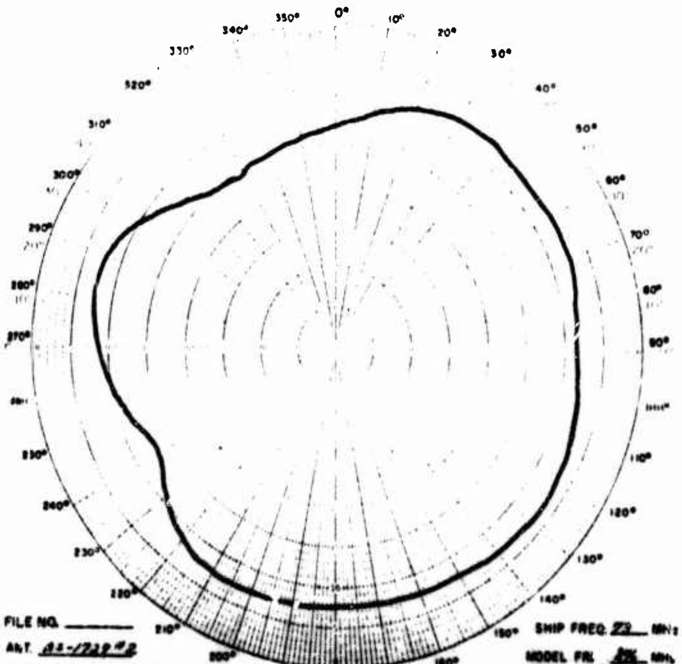
ENGR ______ DATE MAY 1973 FIGURE A-45



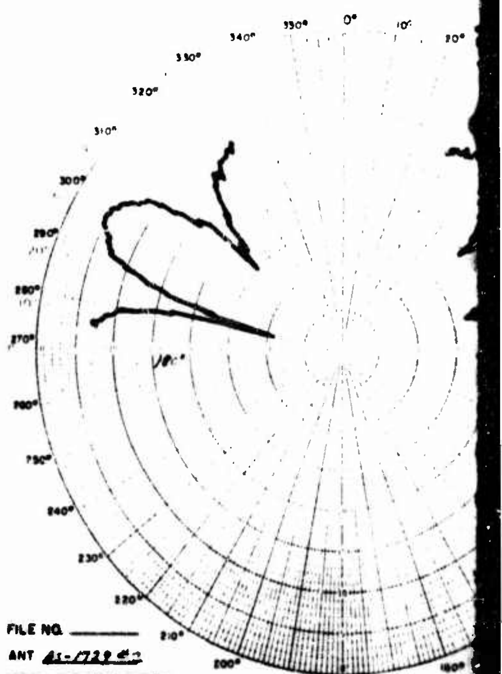
FILE NO. ______ SHIP FREQ 45.2 MHz
ANT AS-1729#2 MODEL FREQ 5424 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +12.2 dB REL.
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-40



FILE NO. ______
ANT AS-1729#2
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAN
ENGR ______ DATE MAY 19

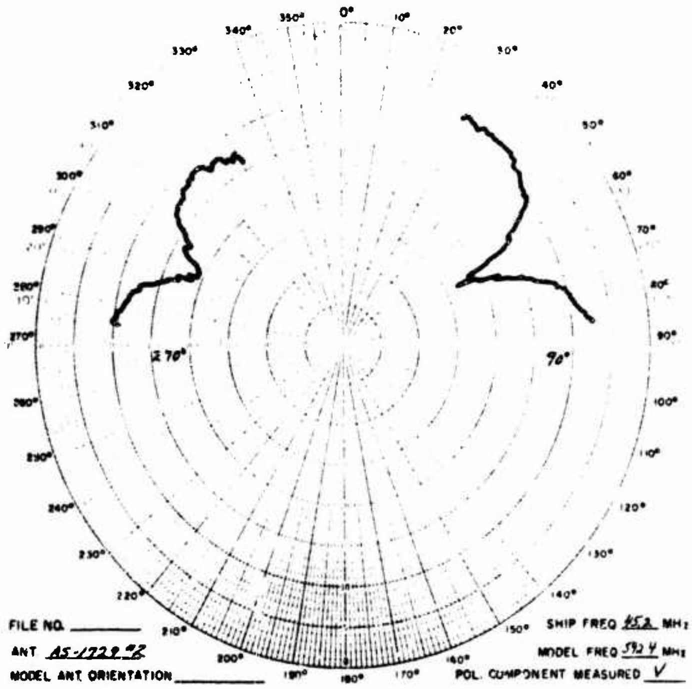


FILE NO. ______ SHIP FREQ 73 MHz
ANT AS-1729#2 MODEL FRQ [illegible] MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +12 dB REL.
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE, [illegible]
ENGR ______ DATE MAY 1973 FIGURE A-46

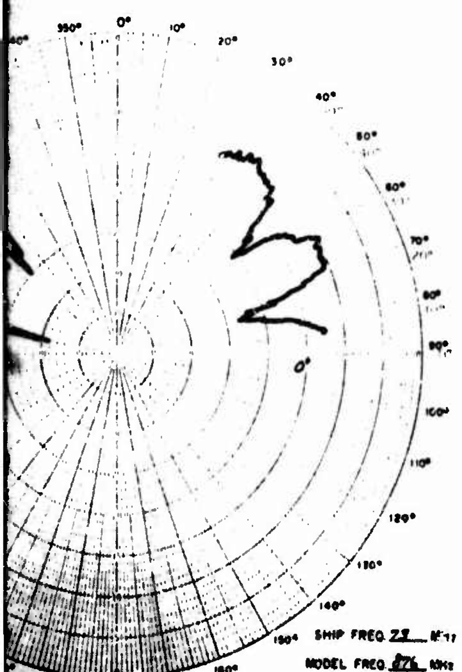


FILE NO. ______
ANT AS-1729#2
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAN STA
ENGR ______ DATE MAY 19

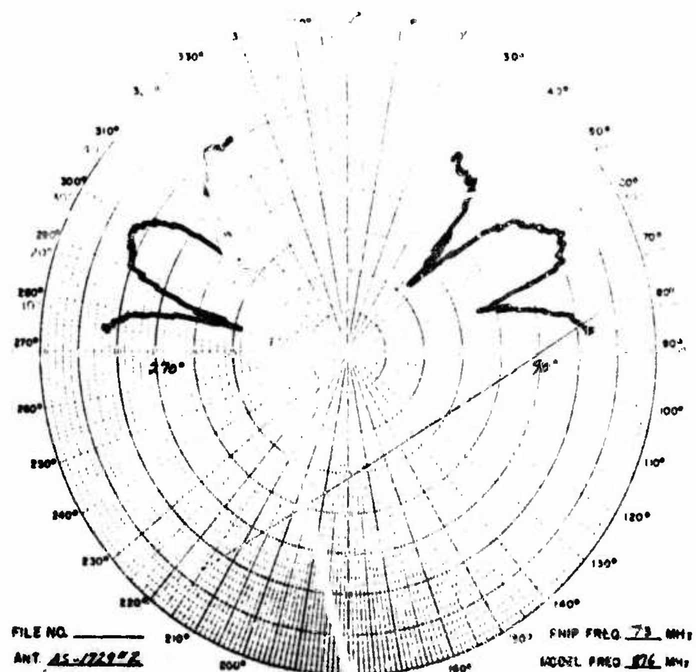
SHIP FREQ 452 MHz
MODEL FREQ 5424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12.2 dB REL. TO λ/4 MONOPOLE
...EV.
... DEG.
...HIP HEADING
REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-41



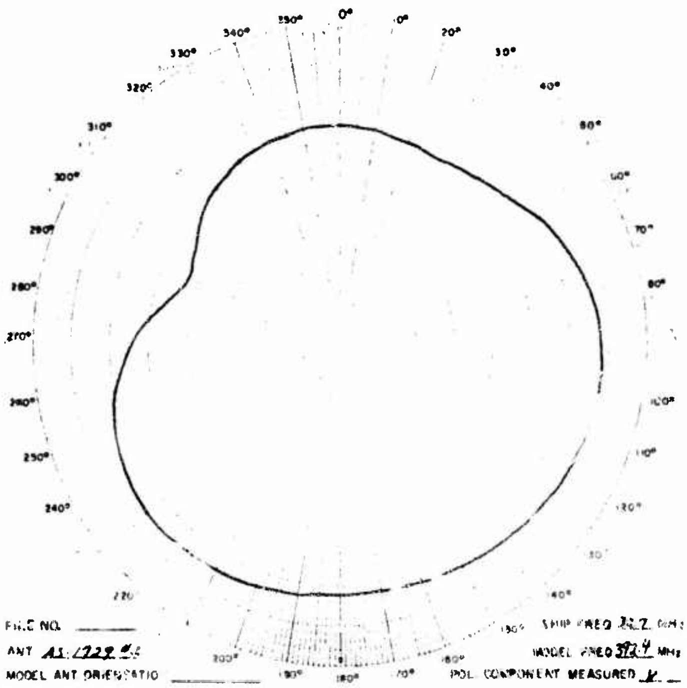
FILE NO. ______
ANT AS-1729 #2
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 452 MHz
MODEL FREQ 5424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12.2 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-42



SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12 dB REL. TO λ/4 MONOPOLE
...EV.
... DEG.
...HIP HEADING
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-47



FILE NO. ______
ANT. AS-1729 #2
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-48



FILE NO. ______ SHIP FREQ 26.2 MHz

ANT AS-1729 #2 MODEL FREQ 392.4 MHz

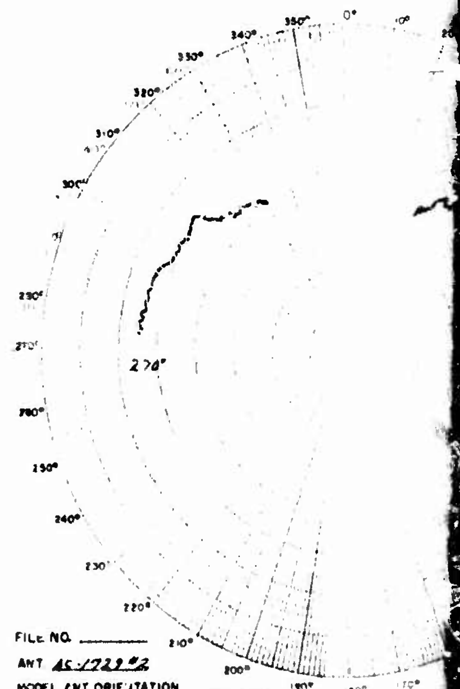
MODEL ANT ORIENTATIO ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = 14.6 dB REL.

ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE

ENGR ______ DATE MAY 1972 FIGURE A-49



FILE NO. ______

ANT AS-1729 #2

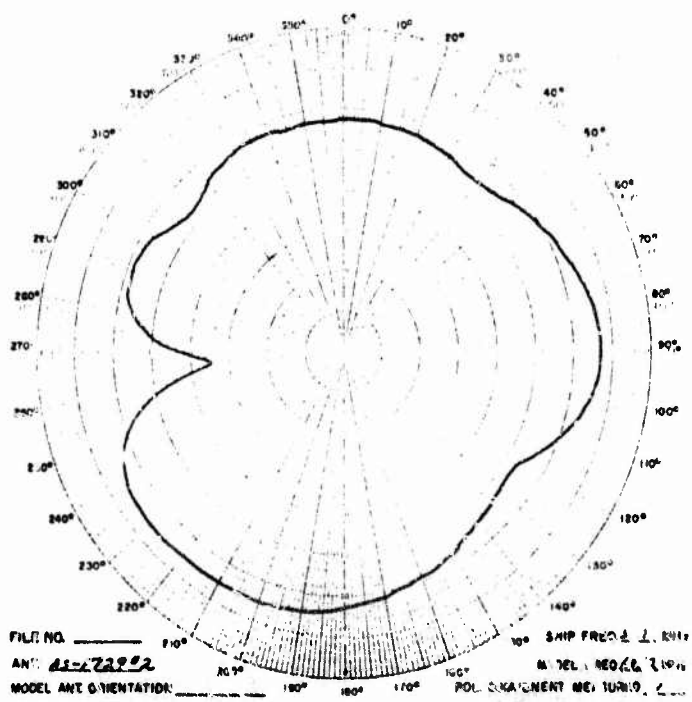
MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG

AT 270 DEGREES RELATIVE TO SHIP HEADING REMARKS

ENGR ______ DATE



FILE NO. ______ SHIP FREQ

ANT AS-1729 #2 MODEL FREQ

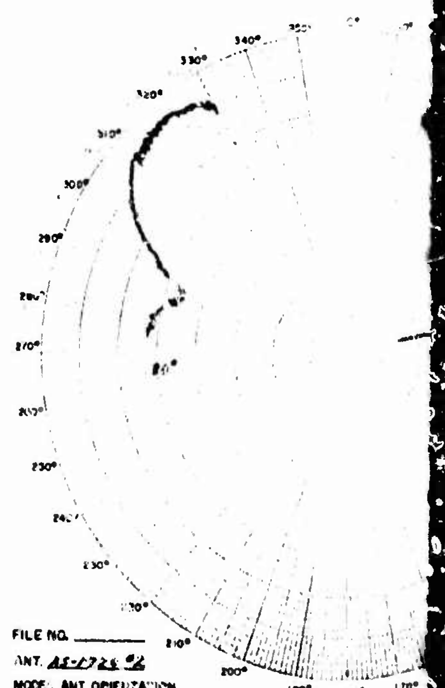
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE

ENGR ______ DATE 1972 FIGURE A-55



FILE NO. ______

ANT. AS-1729 #2

MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 270 DEGREES RELATIVE TO SHIP HEADING REMARKS

ENGR ______ DATE

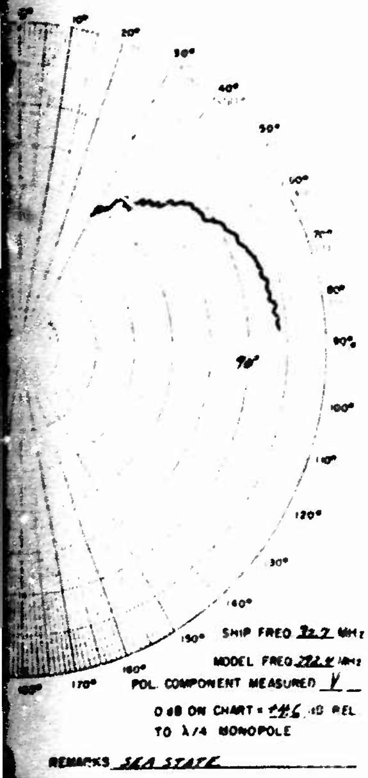


FIGURE A-50

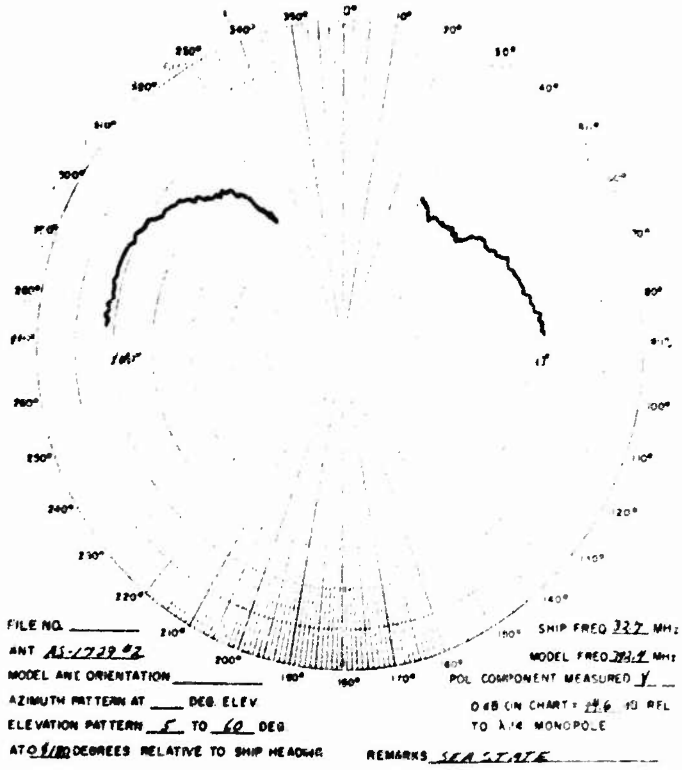


FIGURE A-51

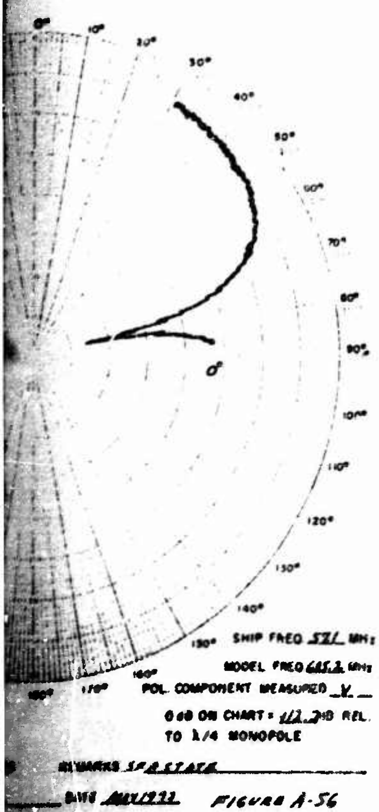


FIGURE A-56

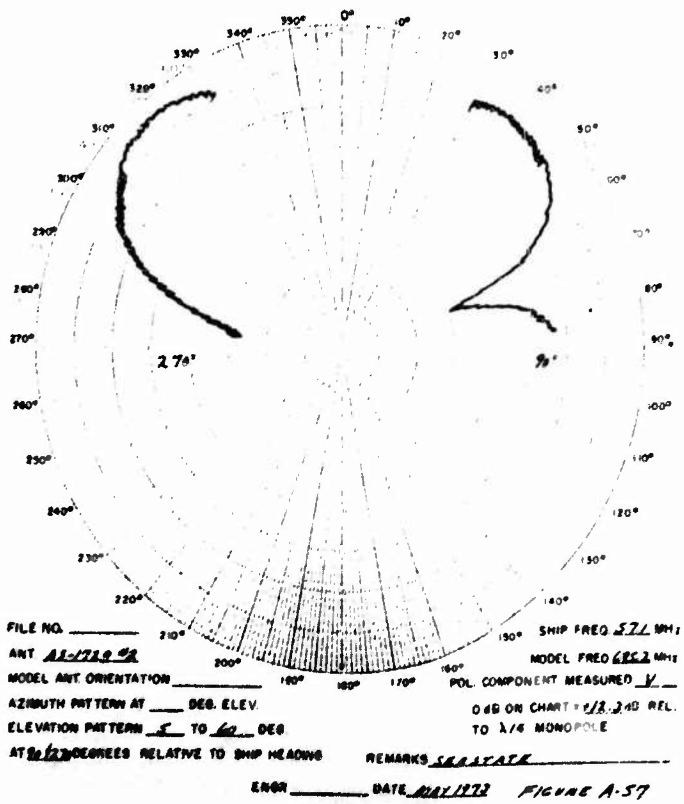
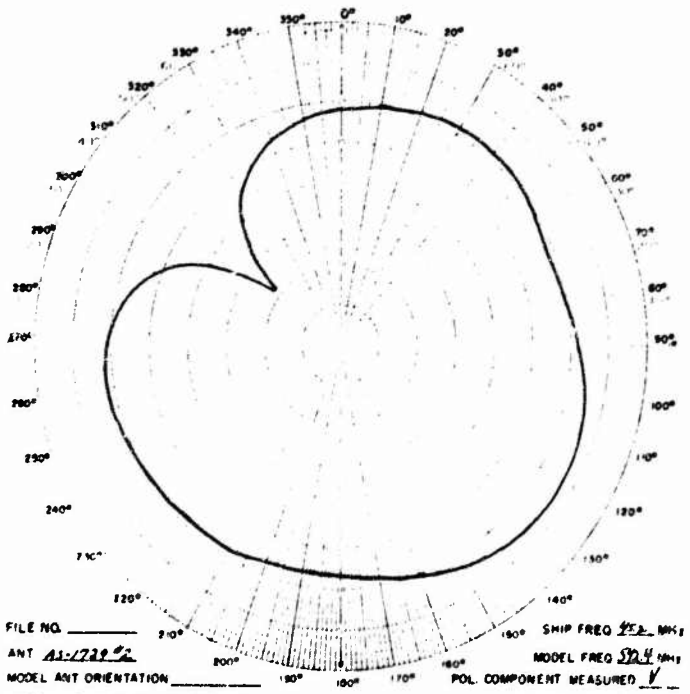
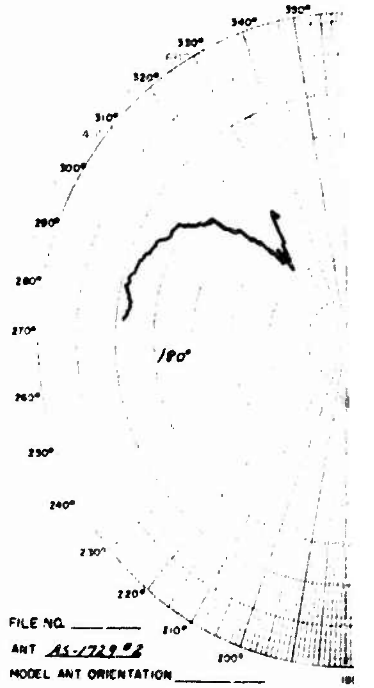


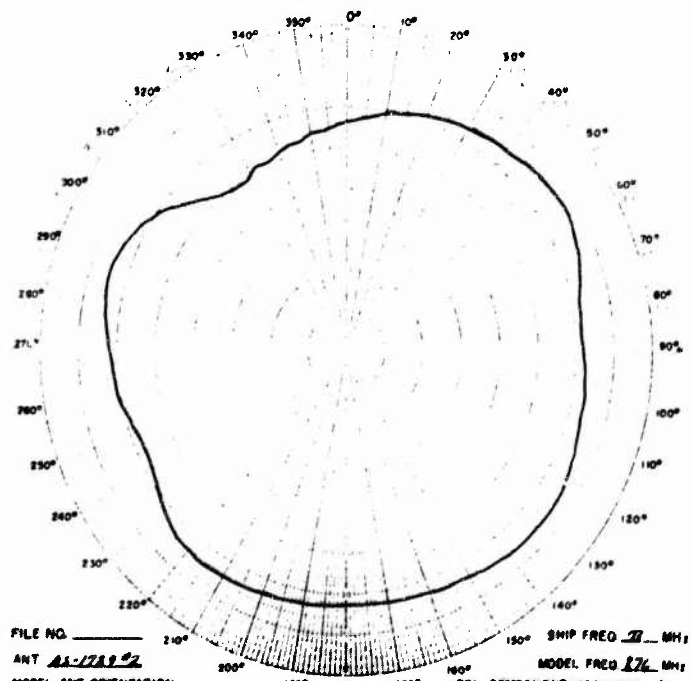
FIGURE A-57



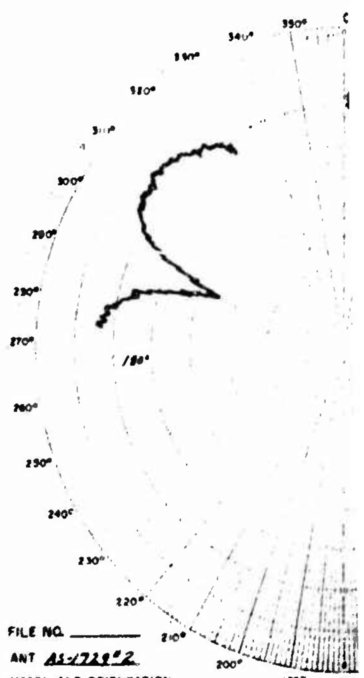
FILE NO. ________ SHIP FREQ 452 MHz
ANT AS-1729 #2 MODEL FREQ 592.4 MHz
MODEL ANT ORIENTATION ________ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART: 10.6 dB REL
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE
ENGR ________ DATE MAY 1973 FIGURE A-52



FILE NO. ________
ANT AS-1729 #2
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
ENGR ________

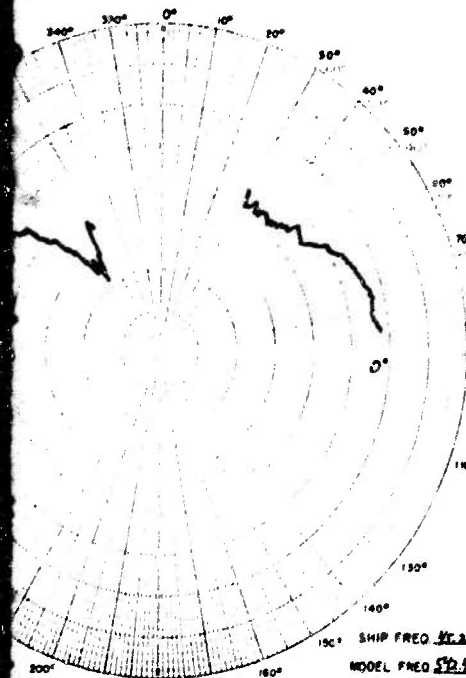


FILE NO. ________ SHIP FREQ 73 MHz
ANT AS-1729 #2 MODEL FREQ 876 MHz
MODEL ANT ORIENTATION ________ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = 9.1 dB REL.
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR. ________ DATE MAY 1973 FIGURE A-53

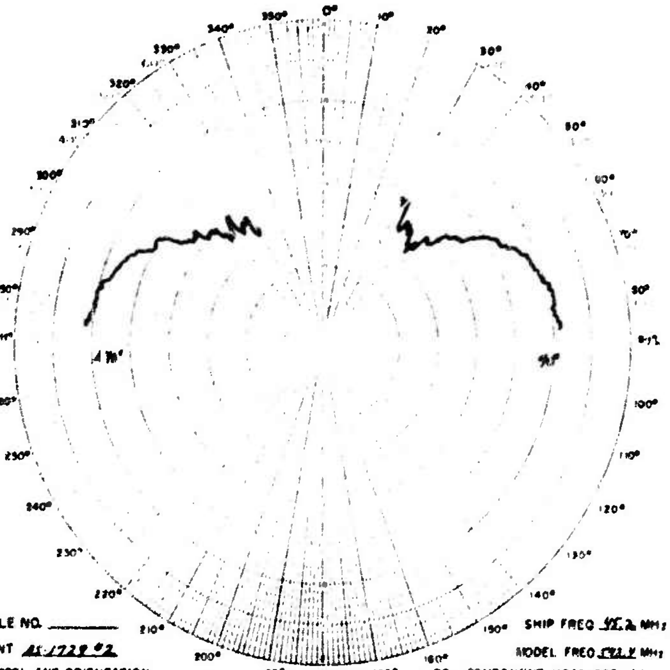


FILE NO. ________
ANT AS-1729 #2
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
ENGR ________

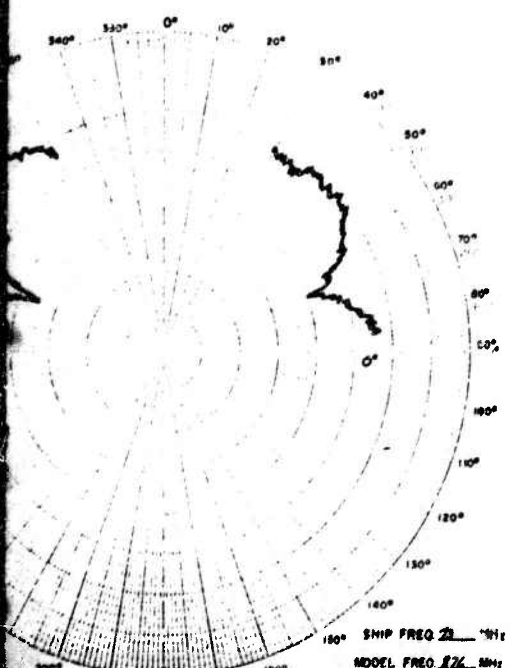
2



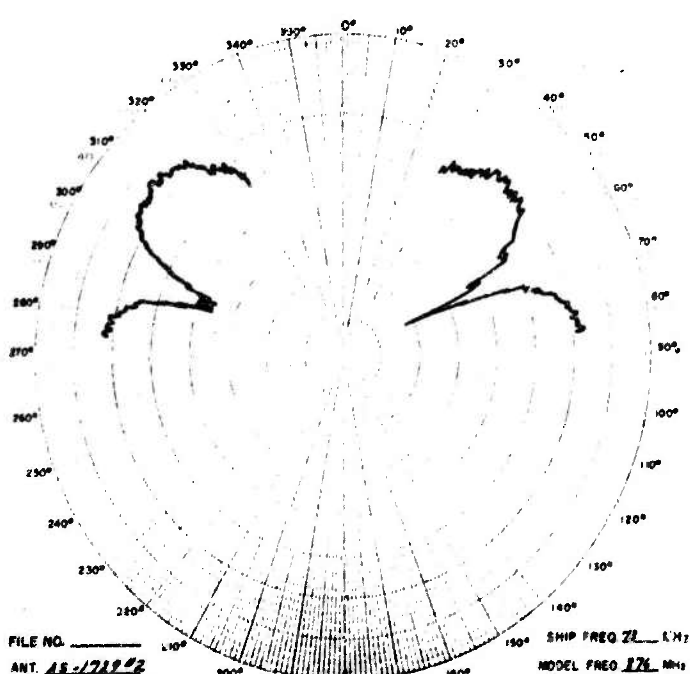
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
DEG. ELEV.
0 dB ON CHART = +10.6 dB REL.
... 60 DEG
TO λ/4 MONOPOLE
... TO SHIP HEADING REMARKS SEA STATE
ENGR ______ DATE MAY 1973 FIGURE A-53



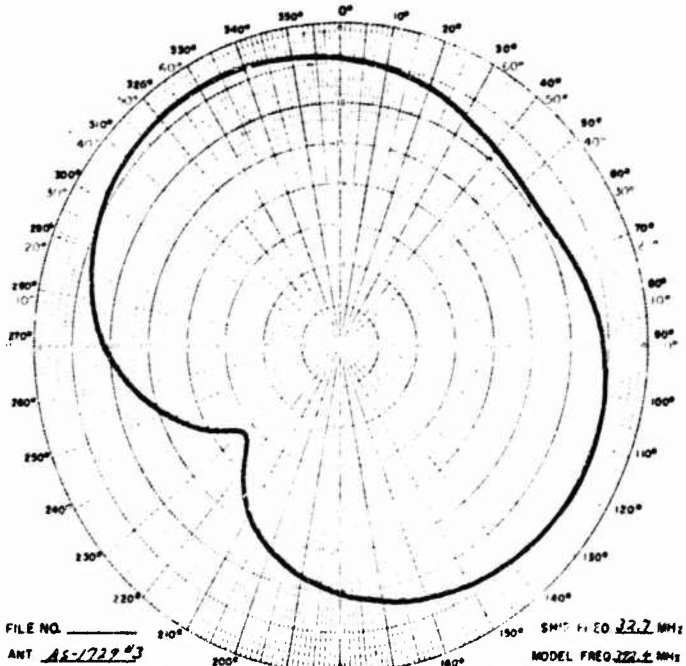
FILE NO. ______
SHIP FREQ 45.2 MHz
ANT AS-1729 #2
MODEL FREQ 542.4 MHz
MODEL ANT ORIENTATION ______
POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV.
0 dB ON CHART = +10.6 dB REL.
ELEVATION PATTERN 5 TO 60 DEG
TO λ/4 MONOPOLE
AT 0/123 DEGREES RELATIVE TO SHIP HEADING
REMARKS SEA STATE
ENGR ______ DATE MAY 1973 FIGURE A-54



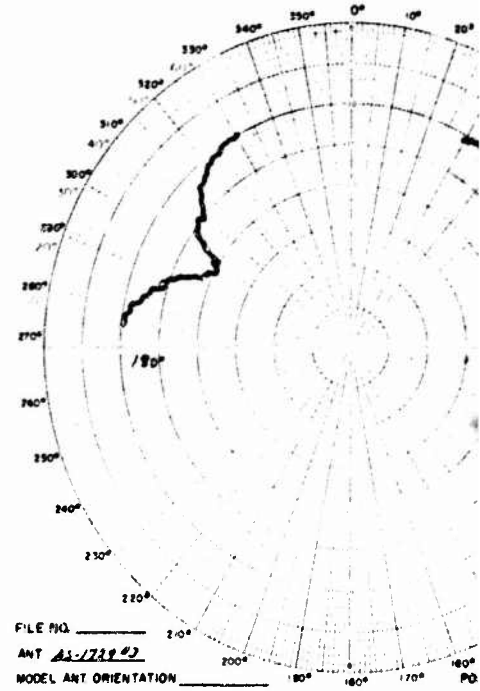
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
DEG. ELEV.
0 dB ON CHART = +11 dB REL.
TO 60 DEG.
TO λ/4 MONOPOLE
... TO SHIP HEADING REMARKS SEA STATE INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-59



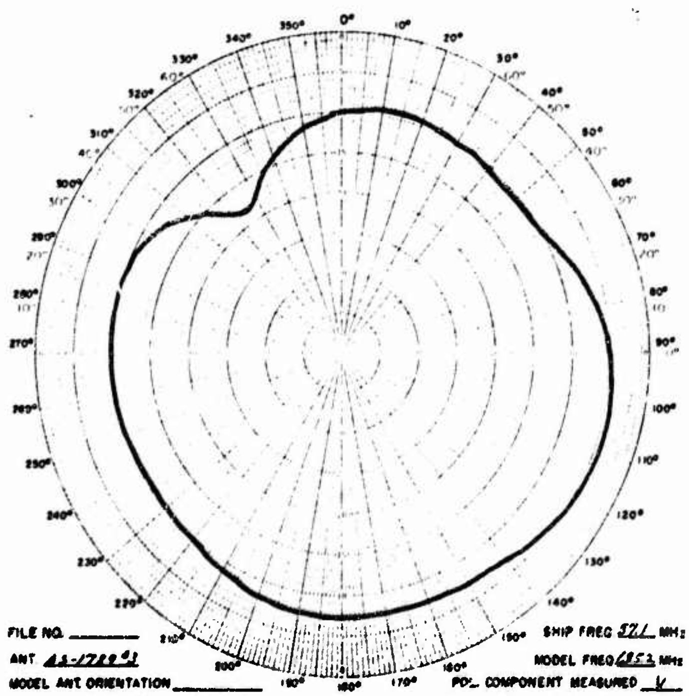
FILE NO. ______
SHIP FREQ 73 MHz
ANT. AS-1729 #2
MODEL FREQ 876 MHz
MODEL ANT ORIENTATION ______
POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV.
0 dB ON CHART = +11 dB REL.
ELEVATION PATTERN 5 TO 60 DEG.
TO λ/4 MONOPOLE
AT 0/123 DEGREES RELATIVE TO SHIP HEADING
REMARKS SEA STATE INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-60



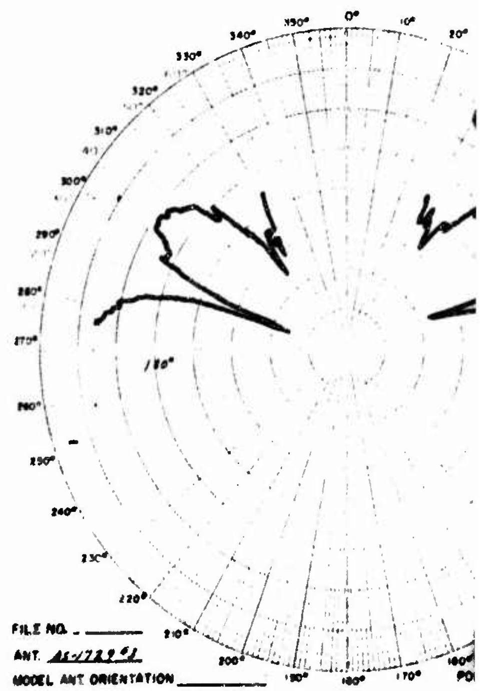
FILE NO. ____ SHIP FREQ 33.7 MHz
ANT AS-1729 #3 MODEL FREQ 272.4 MHz
MODEL ANT ORIENTATION ____ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = +5.2 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ____ DATE MAY 1973 FIGURE A-61



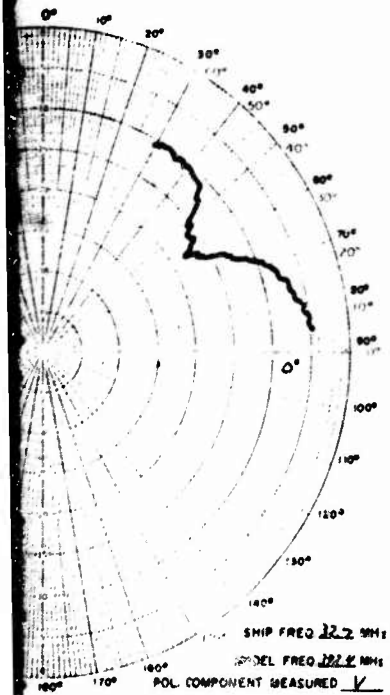
FILE NO. ____
ANT AS-1729 #3
MODEL ANT ORIENTATION ____ PO
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS SEA
ENGR ____ DATE MAY 1



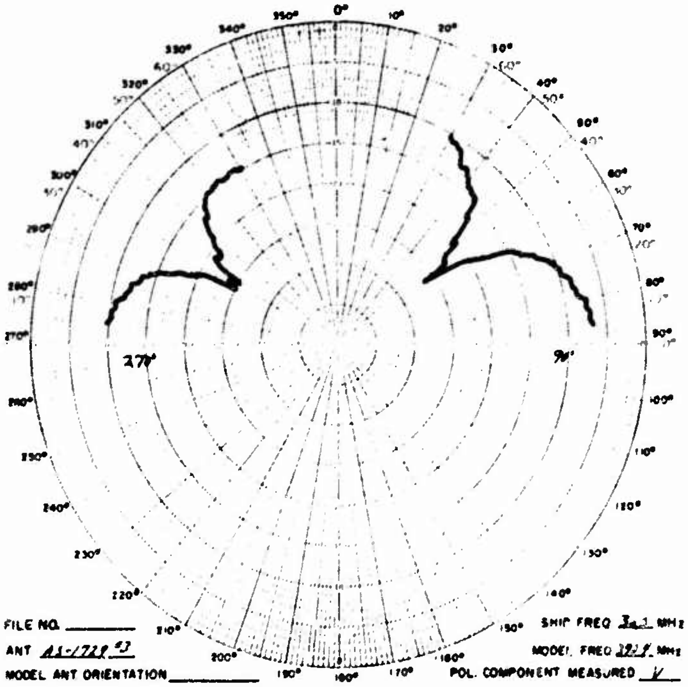
FILE NO. ____ SHIP FREQ 57.1 MHz
ANT AS-1729 #3 MODEL FREQ 685.2 MHz
MODEL ANT ORIENTATION ____ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = +8.8 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ____ DATE MAY 1973 FIGURE A-67



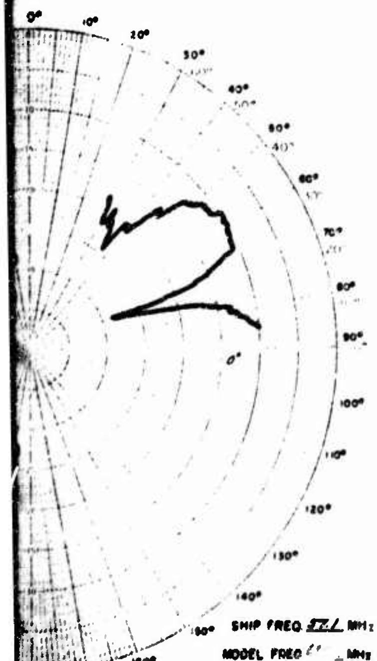
FILE NO. ____
ANT. AS-1729 #3
MODEL ANT ORIENTATION ____ PO
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LA
ENGR ____ DATE MAY 1



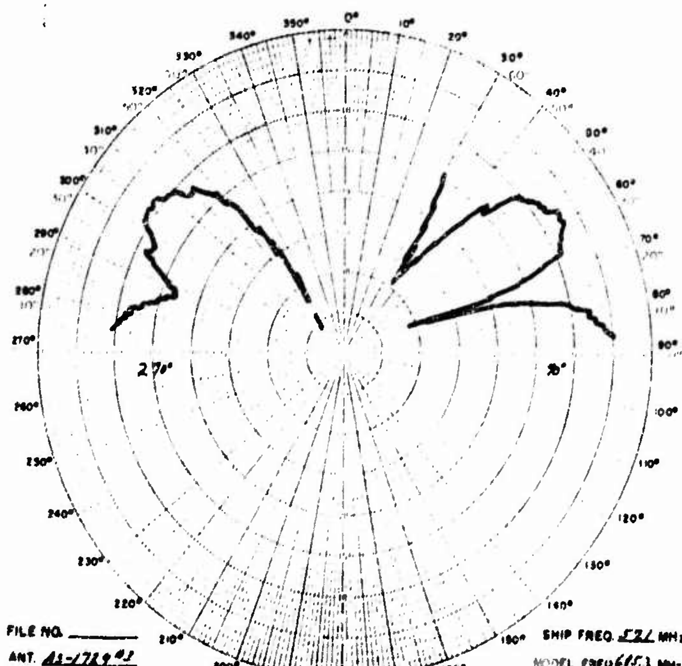
SHIP FREQ 32.2 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.2 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1972 FIGURE A-62



FILE NO. ______
ANT AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 32.2 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.2 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1972 FIGURE A-63

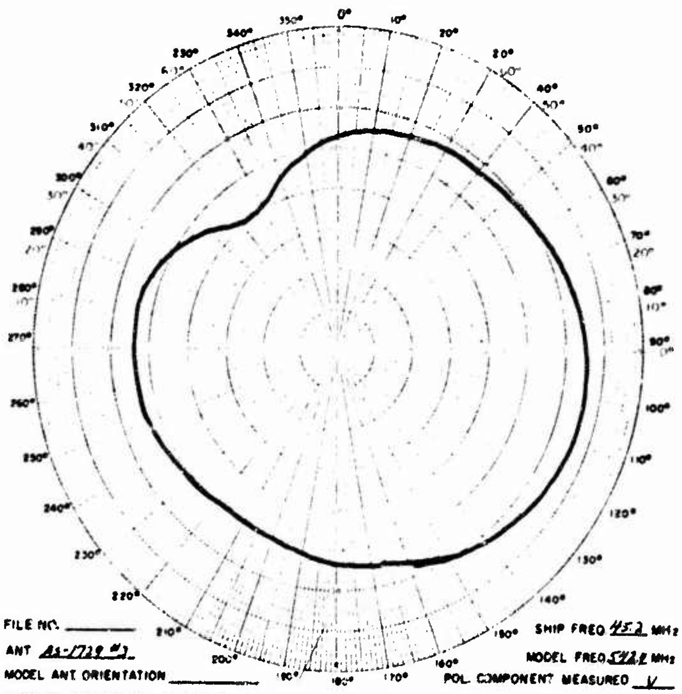


SHIP FREQ 57.1 MHz
MODEL FREQ 6__ MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +8.8 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE
DATE MAY 1972 FIGURE A-68

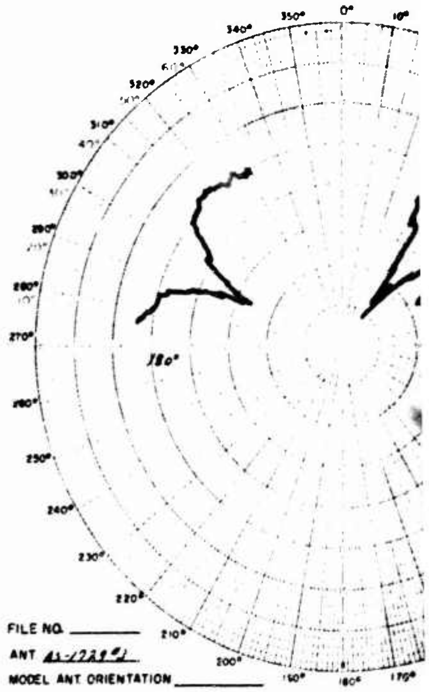


FILE NO. ______
ANT. AS-1729 #3
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ. 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +8.8 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1972 FIGURE A-69

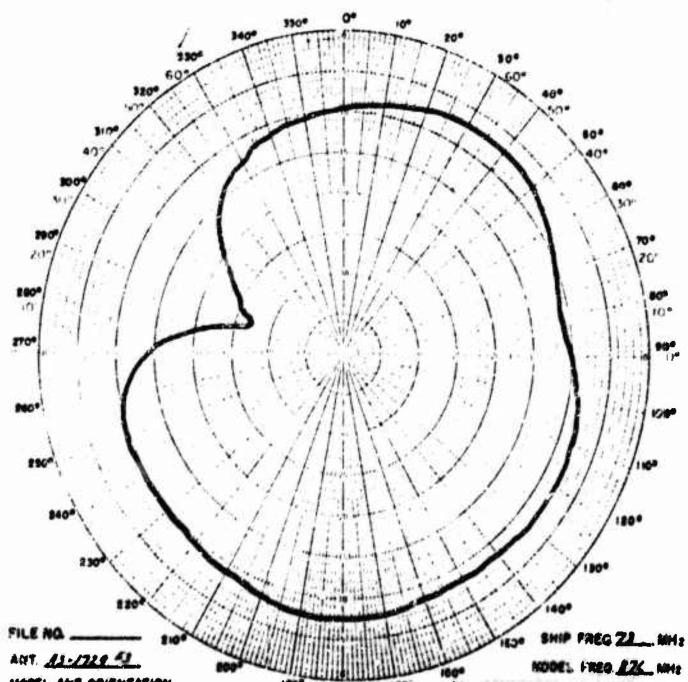
12



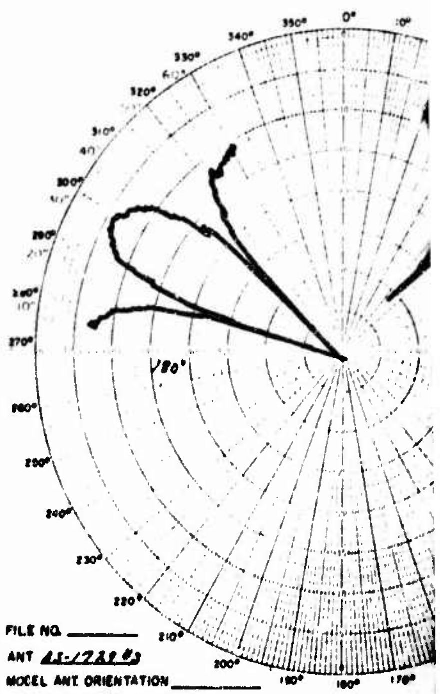
FILE NO. ______ SHIP FREQ 45.2 MHz
ANT AS-1729 #3 MODEL FREQ 542.2 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG ELEV 0 dB ON CHART = +12.2 dB REL.
ELEVATION PATTERN ___ TO ___ DEG TO λ/4 MONOPOLE
AT ___ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-64



FILE NO. ______
ANT AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV
ELEVATION PATTERN ___ TO ___ DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS
ENGR ______ DATE

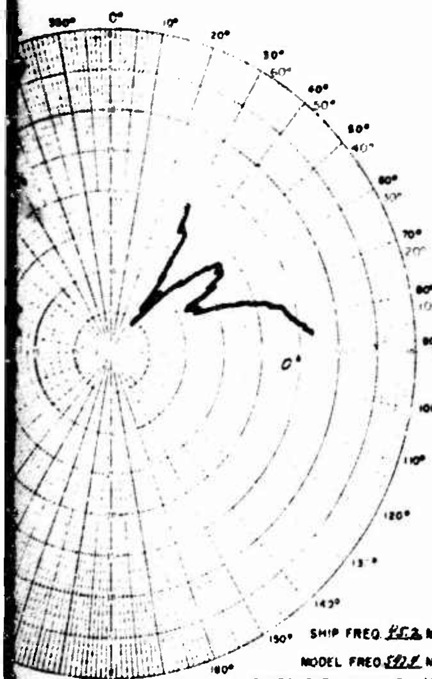


FILE NO. ______ SHIP FREQ 22 MHz
ANT. AS-1729 #3 MODEL FREQ 176 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED ___
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +14 dB REL.
ELEVATION PATTERN ___ TO ___ DEG. TO λ/4 MONOPOLE
AT ___ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-70

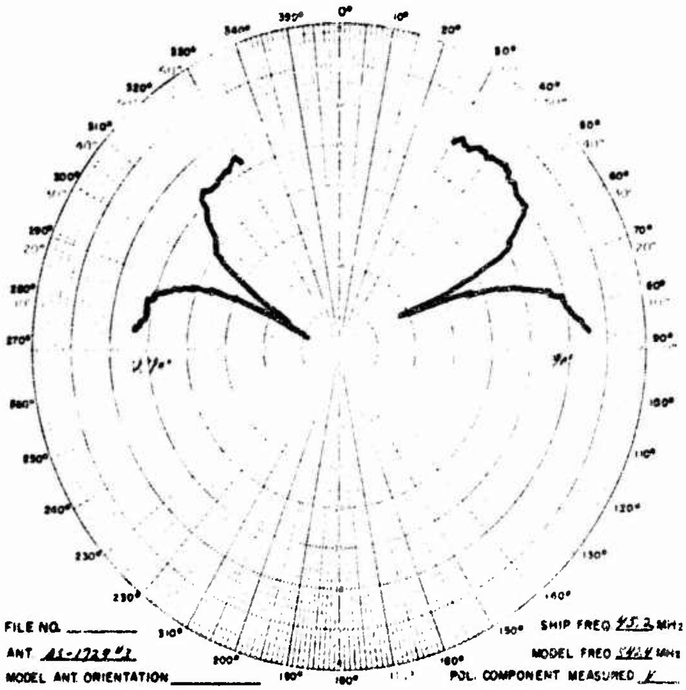


FILE NO. ______
ANT AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS
ENGR ______ DATE

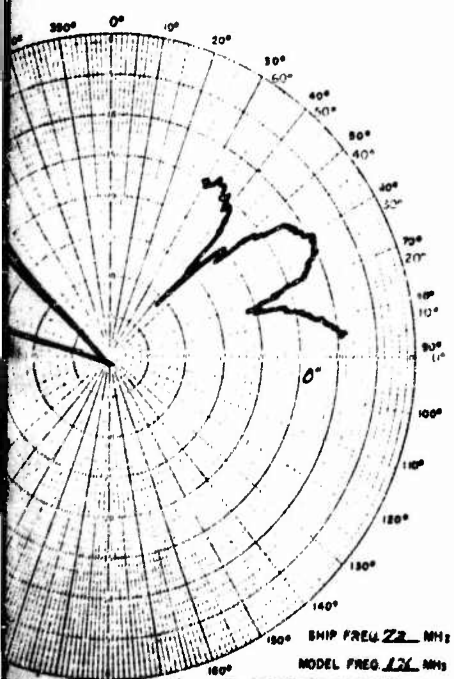
3



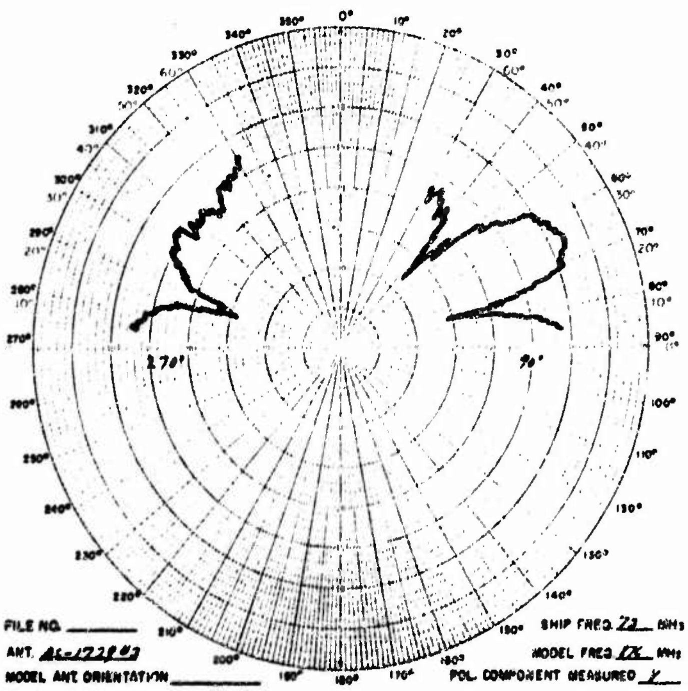
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12.2 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-65



FILE NO. ______
ANT. AS-1729 #2
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +12.2 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-66

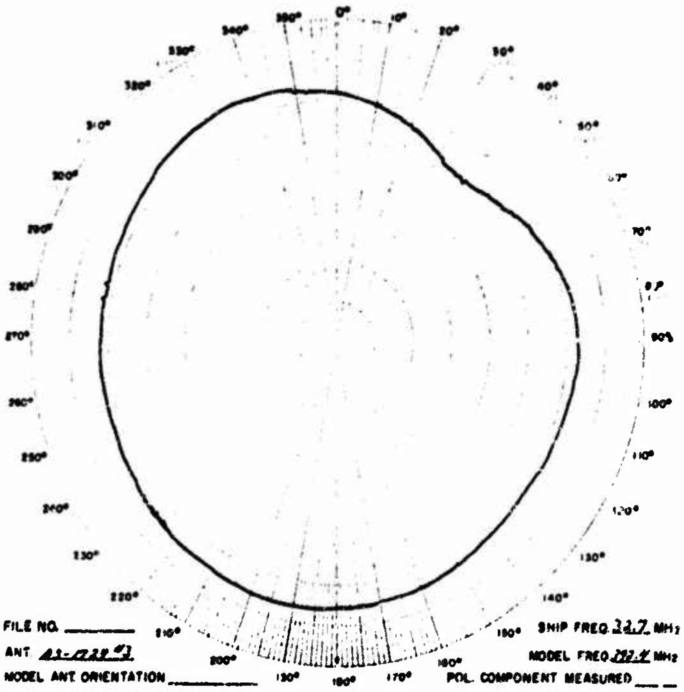


SHIP FREQ 72 MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +14 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-71

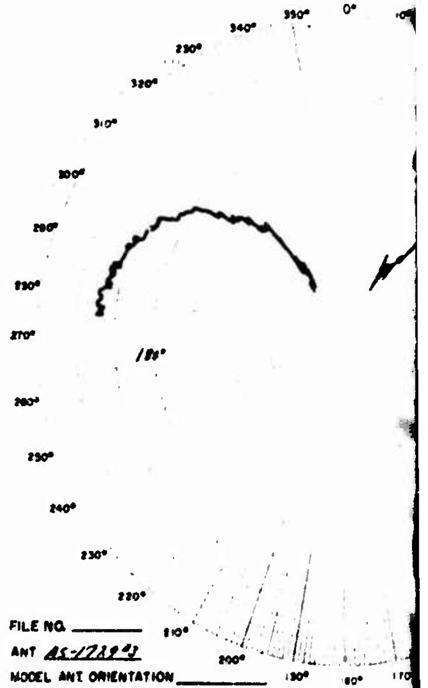


FILE NO. ______
ANT. AS-1729 #2
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 72 MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +14 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-72

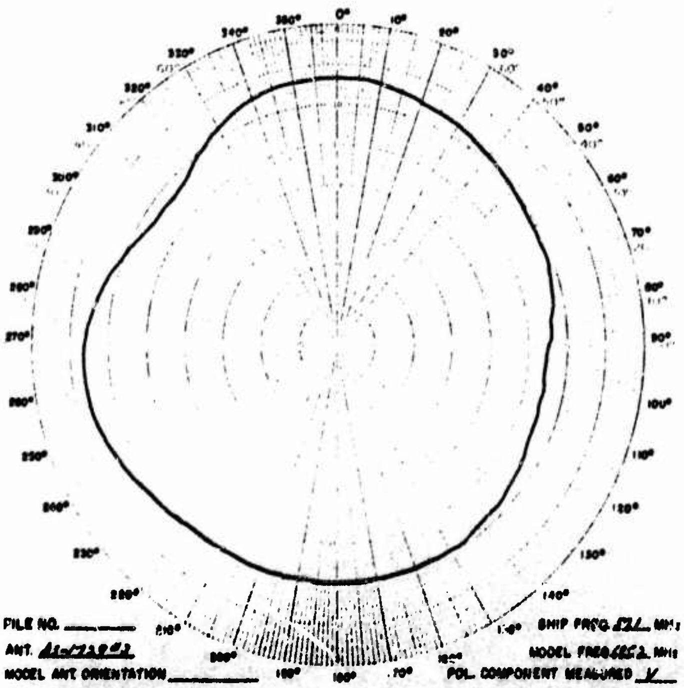
4



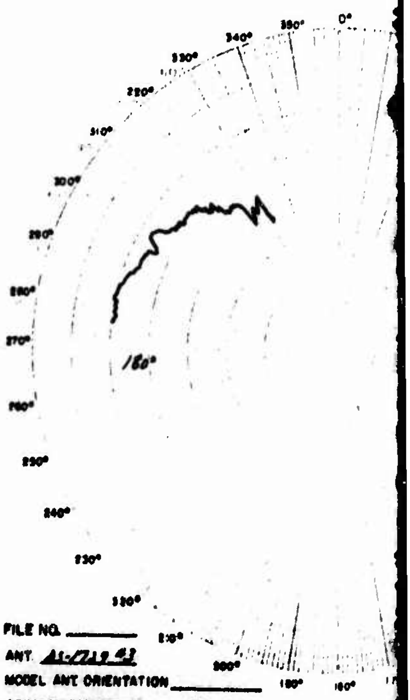
FILE NO. ______ SHIP FREQ. 32.7 MHz
ANT AS-1729 #3 MODEL FREQ. 792.4 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED ____
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +10 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE ______
ENGR ______ DATE MAY 1972 FIGURE A-73



FILE NO. ______
ANT AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMAR
ENGR ______ DATE



FILE NO. ______ SHIP FREQ. 32L MHz
ANT. AS-1729 #3 MODEL FREQ. 692.2 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG ELEV. 0 dB ON CHART = 40 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE ______
ENGR ______ DATE MAY 1972 FIGURE A-79



FILE NO. ______
ANT. AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMA
ENGR ______ DAT

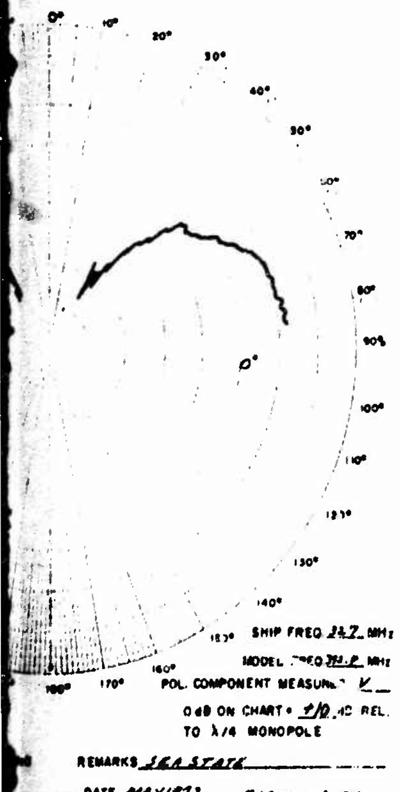


FIGURE A-74

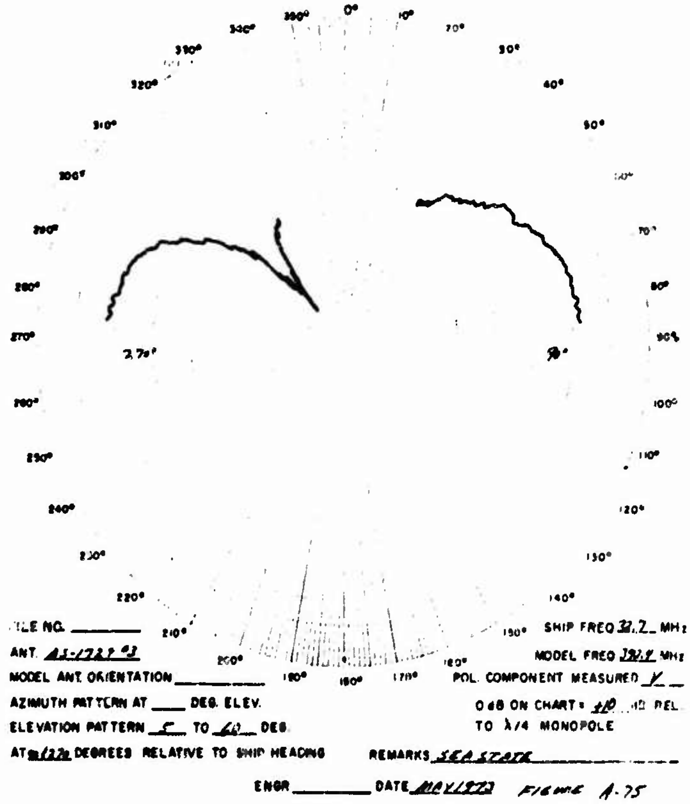


FIGURE A-75

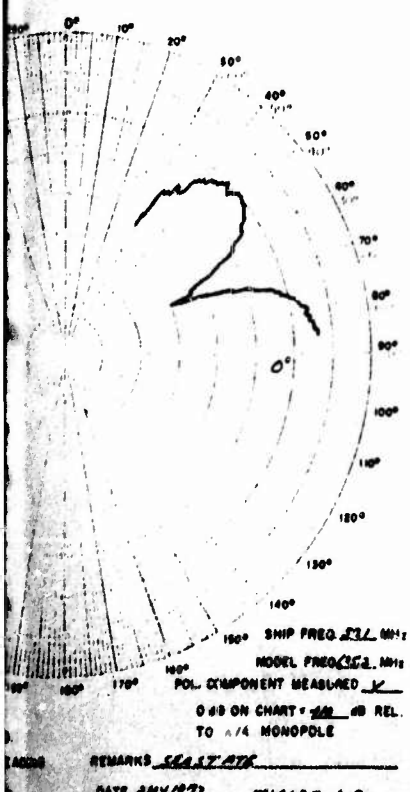


FIGURE A-80

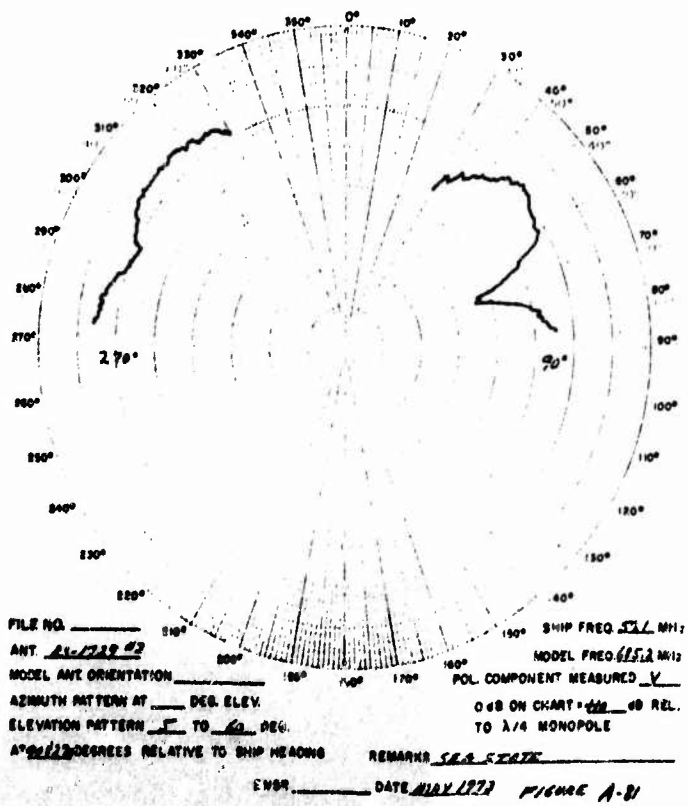
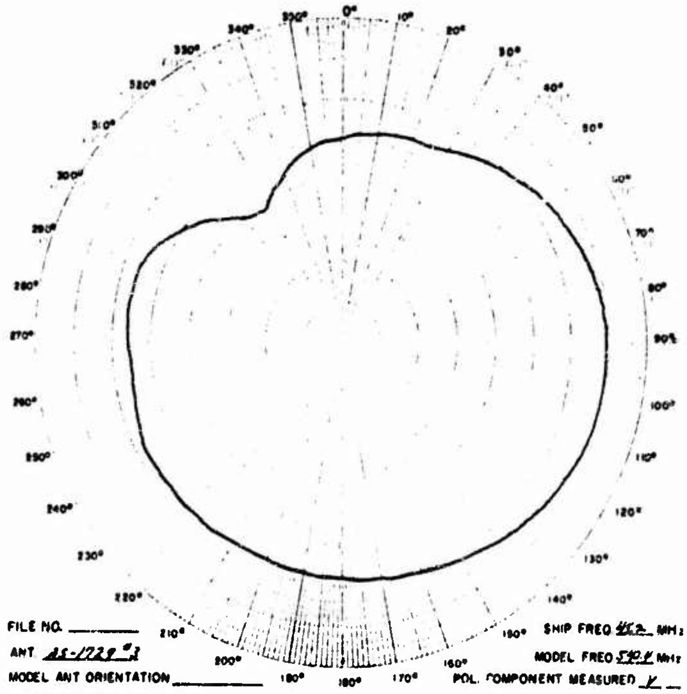


FIGURE A-81

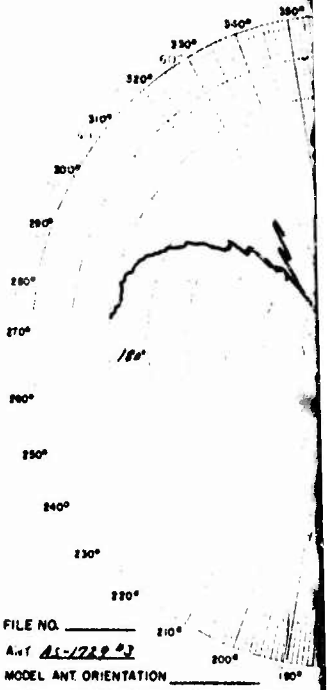
12



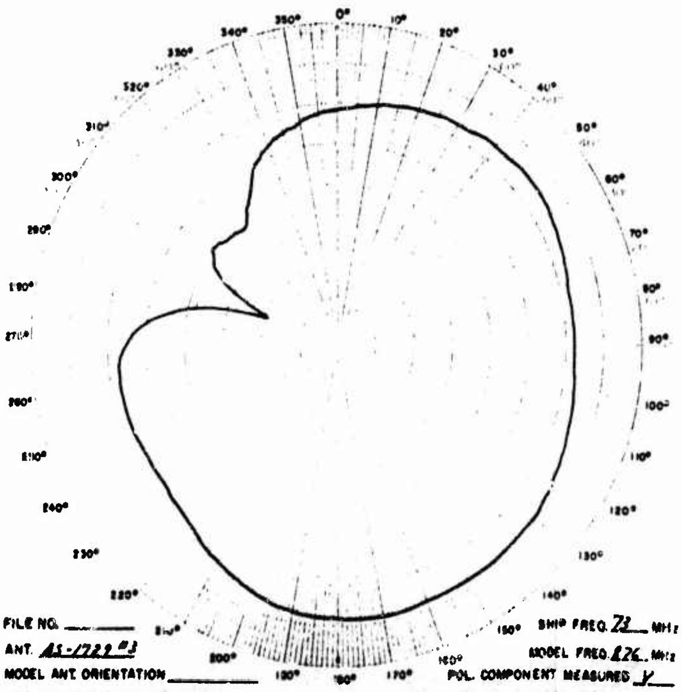
FILE NO. ______
ANT. AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ [illegible] MHz
MODEL FREQ 540.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-76



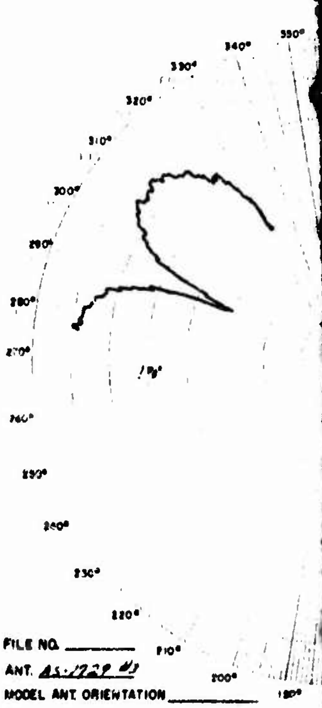
FILE NO. ______
ANT. AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
ENGR ______



FILE NO. ______
ANT. AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

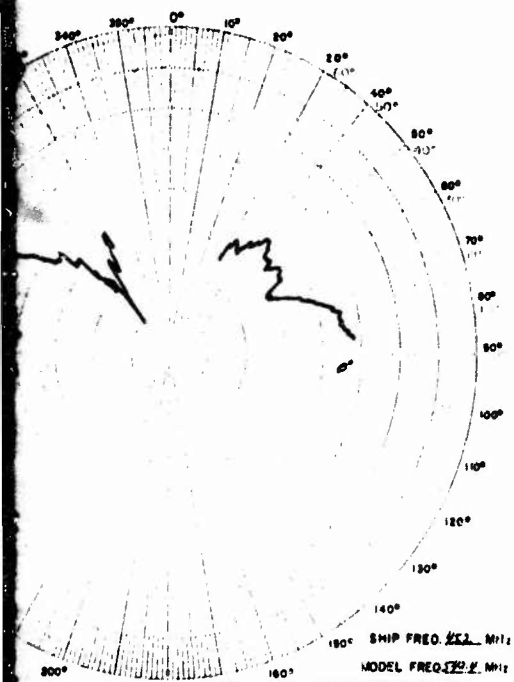
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 1/6 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED

ENGR ______ DATE MAY 1973 FIGURE A-92



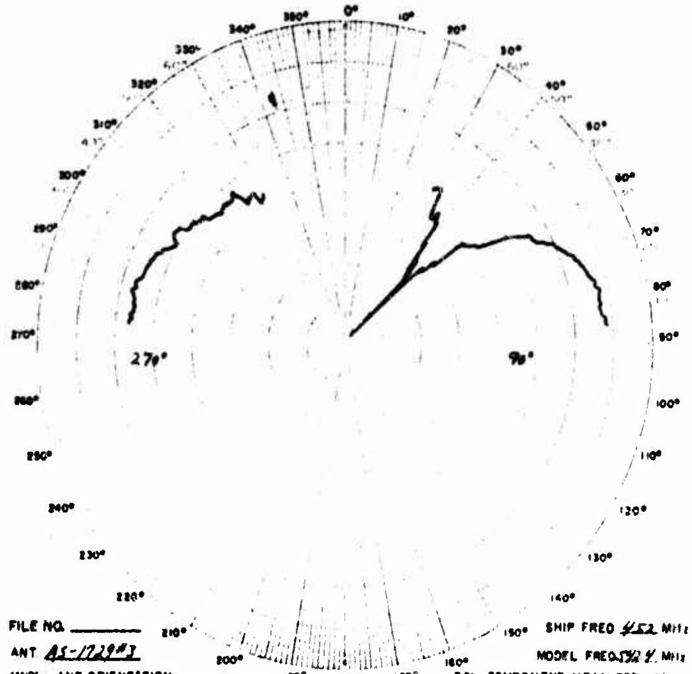
FILE NO. ______
ANT. AS-1729 #3
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
ENGR ______

3



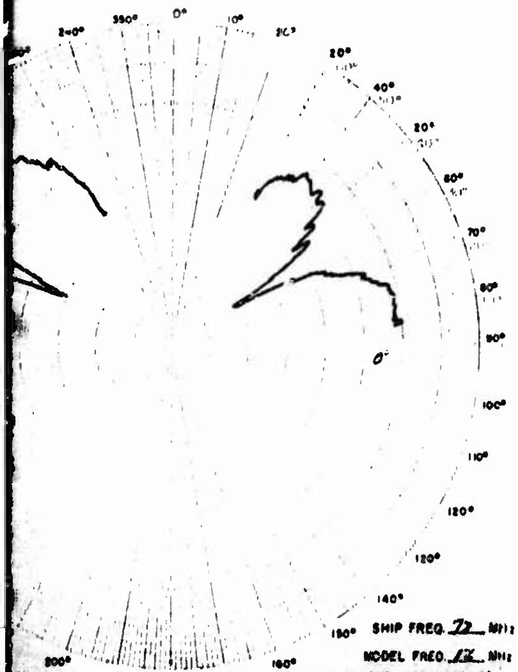
SHIP FREQ. 452 MHz
MODEL FREQ. 542.4 MHz
POL. COMPONENT MEASURED V
DEG. ELEV.
TO 60 DEG.
0 dB ON CHART = +10 dB REL.
TO λ/4 MONOPOLE
TO SHIP HEADING
REMARKS SEA STATE
ENGR ______ DATE MAY 1973

FIGURE A-77



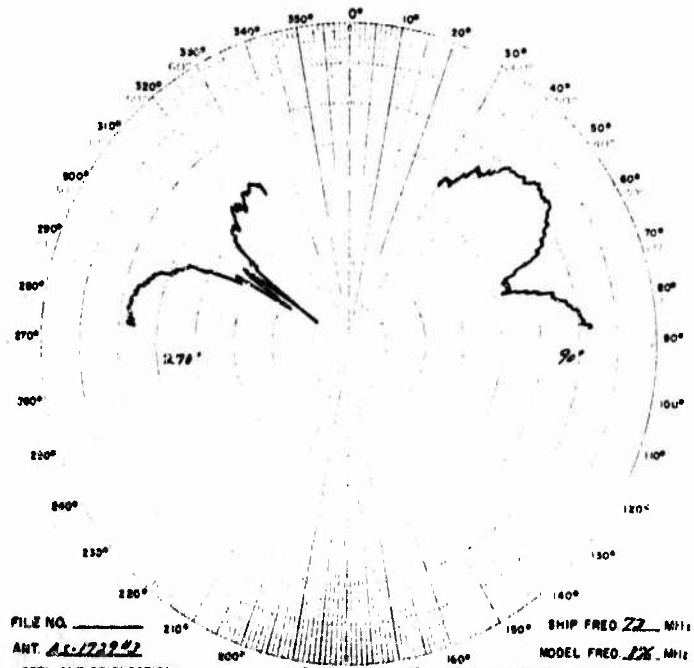
FILE NO. ______
ANT. AS-1729#3
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 452 MHz
MODEL FREQ. 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ______ DATE MAY 1973

FIGURE A-78



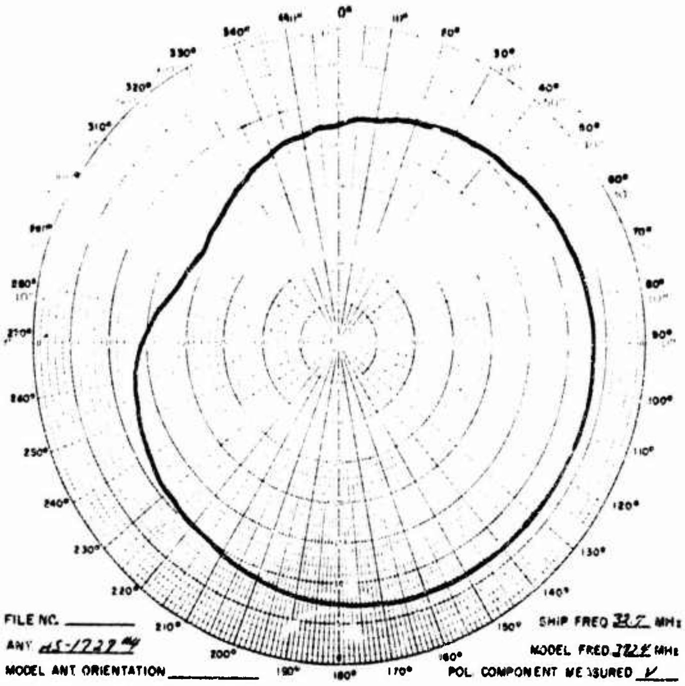
SHIP FREQ. 72 MHz
MODEL FREQ. 86 MHz
POL. COMPONENT MEASURED V
DEG. ELEV.
TO 60 DEG.
0 dB ON CHART = +16 dB REL.
TO λ/4 MONOPOLE
VE TO SHIP HEADING
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973

FIGURE A-83



FILE NO. ______
ANT. AS-1729#3
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 72 MHz
MODEL FREQ. 86 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +16 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973

FIGURE A-84



FILE NO. ________ SHIP FREQ 32.5 MHz

ANT AS-1729 ⁴/U MODEL FREQ 322.4 MHz

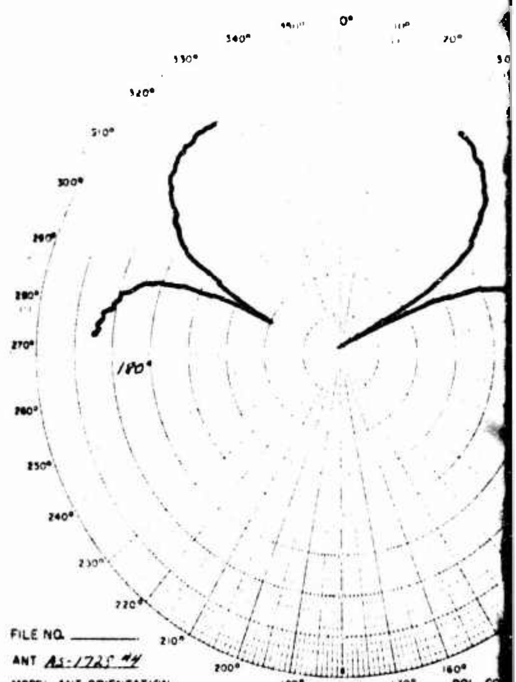
MODEL ANT ORIENTATION ________ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +5.1 dB REL.

ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE

ENGR ______ DATE MAY 1972 FIGURE A-85



FILE NO. ________

ANT AS-1729 ⁴/U

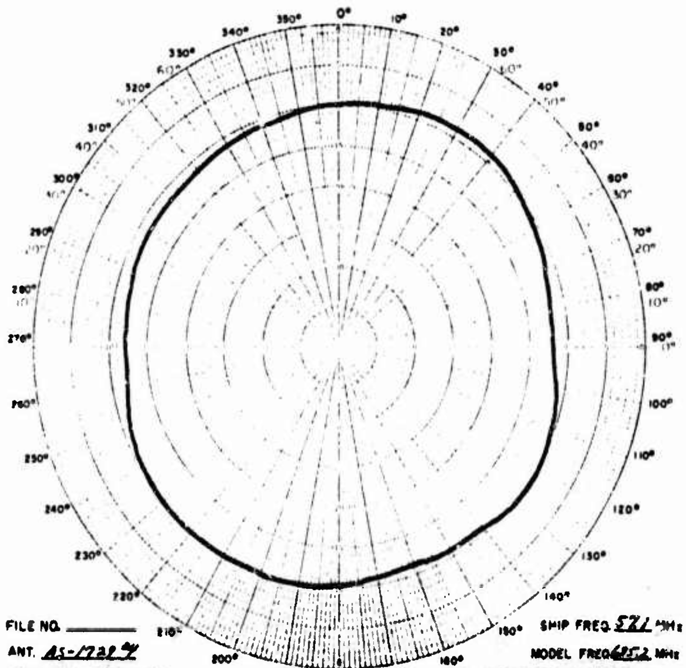
MODEL ANT ORIENTATION ________ POL. CO

AZIMUTH PATTERN AT ____ DEG. ELEV 0 dB

ELEVATION PATTERN 5 TO 60 DEG TO

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND S

ENGR ______ DATE MAY 1972



FILE NO. ________ SHIP FREQ 57.1 MHz

ANT. AS-1729 ⁴/U MODEL FREQ 625.2 MHz

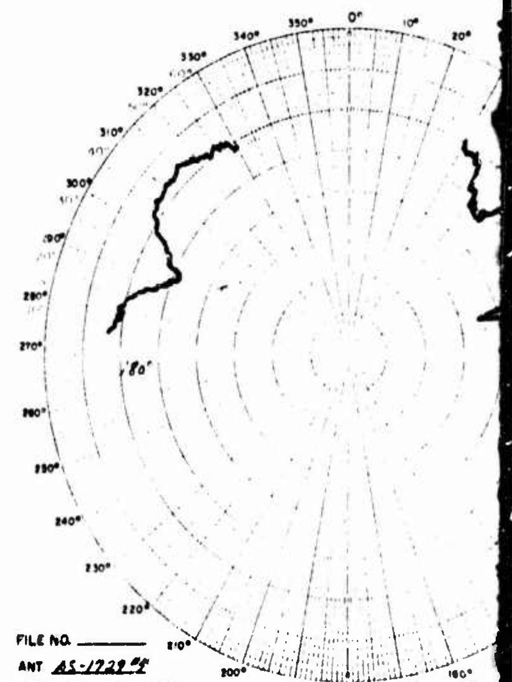
MODEL ANT. ORIENTATION ________ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +8.2 dB REL.

ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE

ENGR ______ DATE MAY 1972 FIGURE A-91



FILE NO. ________

ANT AS-1729 ⁴/U

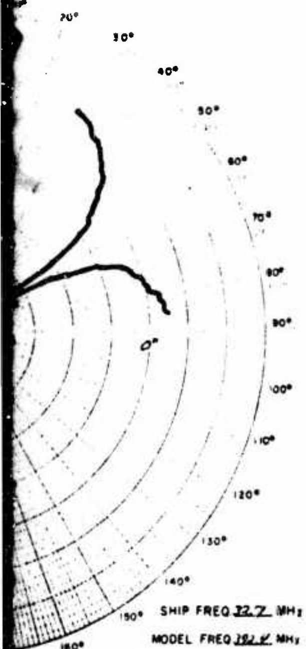
MODEL ANT ORIENTATION ________ POL. C

AZIMUTH PATTERN AT ____ DEG. ELEV. 0

ELEVATION PATTERN 5 TO 60 DEG. TO

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND

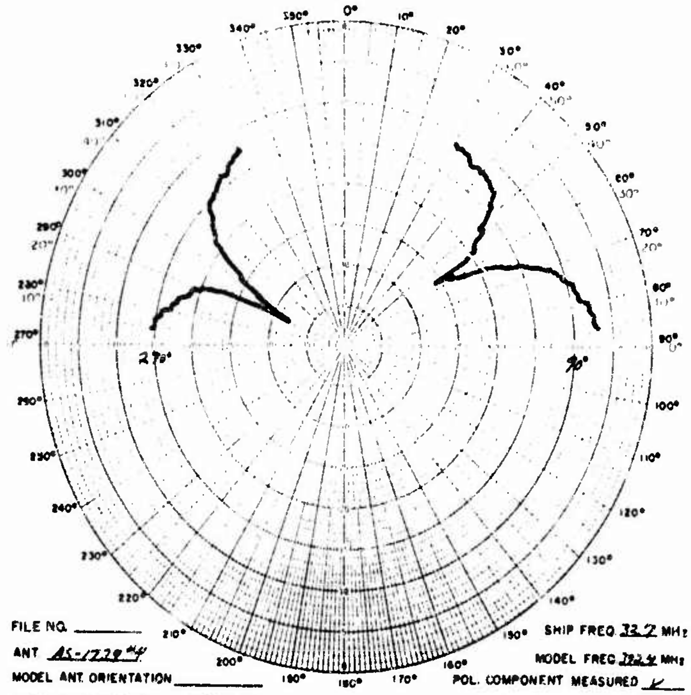
ENGR ______ DATE MAY 1972



SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL. TO λ/4 MONOPOLE

...RKS LAND STATE
...E MAY 1973

FIGURE A-86



FILE NO. ______
ANT AS-1729 #4
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL. TO λ/4 MONOPOLE

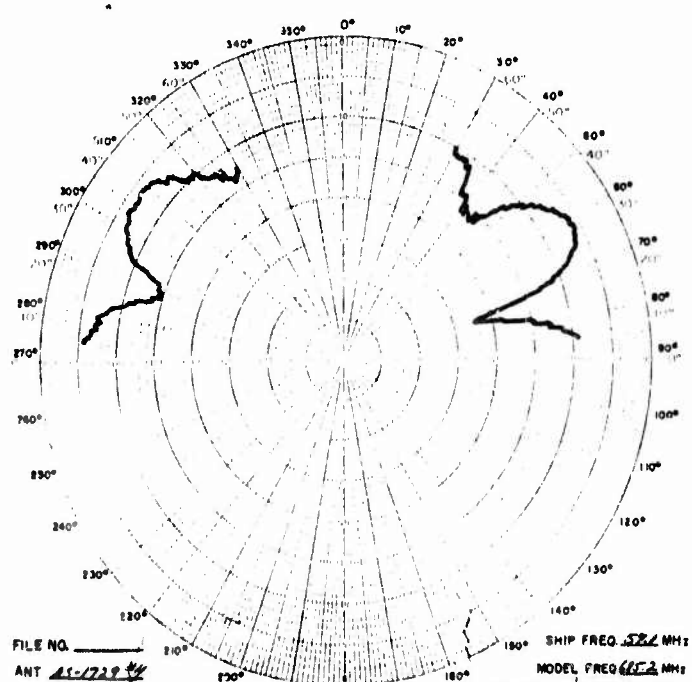
REMARKS LAND STATE
ENGR ______ DATE MAY 1973

FIGURE A-87

SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10.2 dB REL. TO λ/4 MONOPOLE

...MARKS LAND STATE
...TE MAY 1973

FIGURE A-92

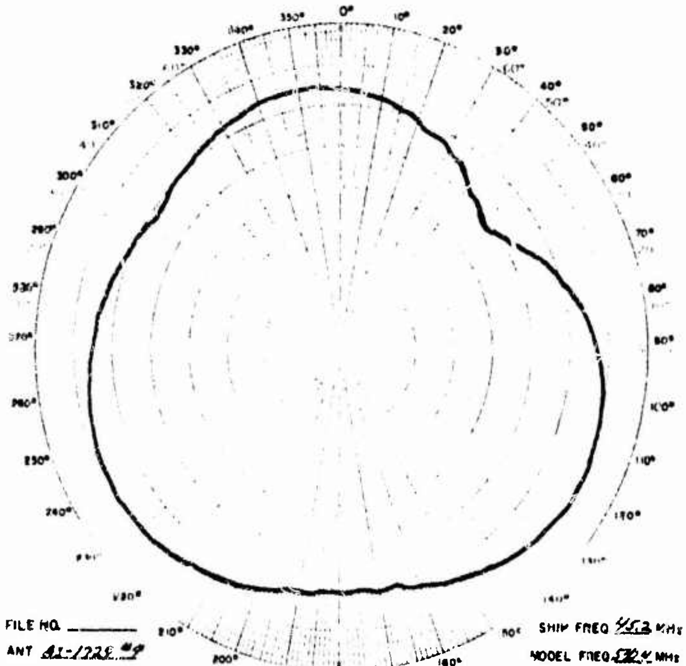


FILE NO. ______
ANT AS-1729 #4
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

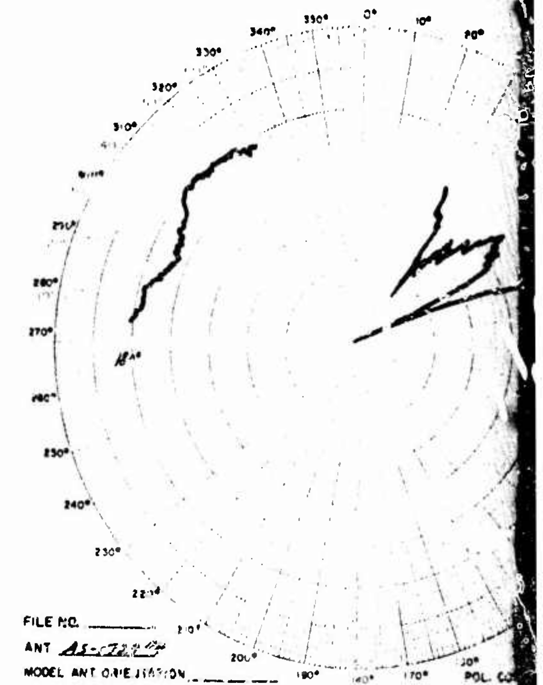
SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10.2 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE
ENGR ______ DATE MAY 1973

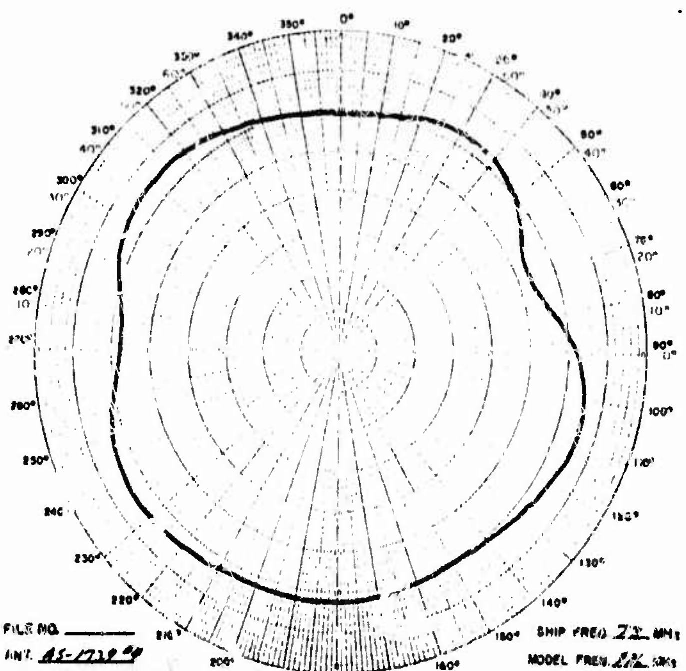
FIGURE A-93



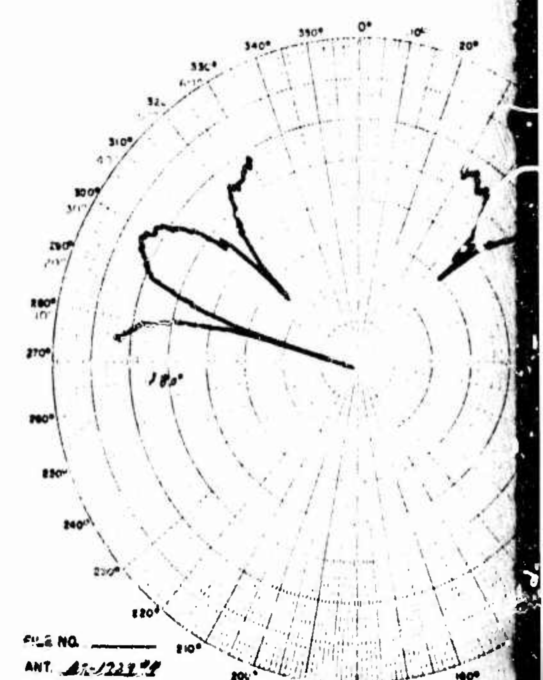
FILE NO. ______ SHIP FREQ 453 MHz
ANT AS-1729 #9 MODEL FREQ 520.4 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG ELEV. 0 dB ON CHART = 22 dB REL.
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-18



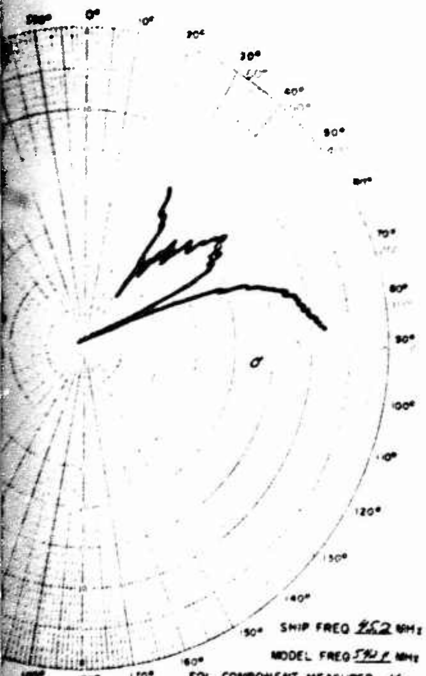
FILE NO. ______
ANT AS-1729 #9
MODEL ANT ORIENTATION ______ POL. CO...
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND...
ENGR ______ DATE MAY 1973



FILE NO. ______ SHIP FREQ 72 MHz
ANT. AS-1729 #9 MODEL FREQ 82 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = 47 dB REL.
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973 FIGURE A-21

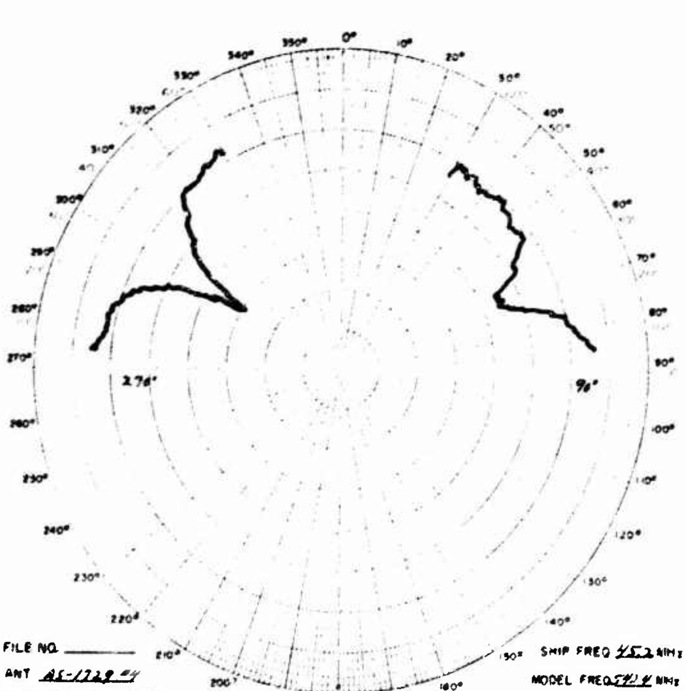


FILE NO. ______
ANT. AS-1729 #9
MODEL ANT ORIENTATION ______ POL. CO...
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE...
ENGR ______ DATE MAY 1973



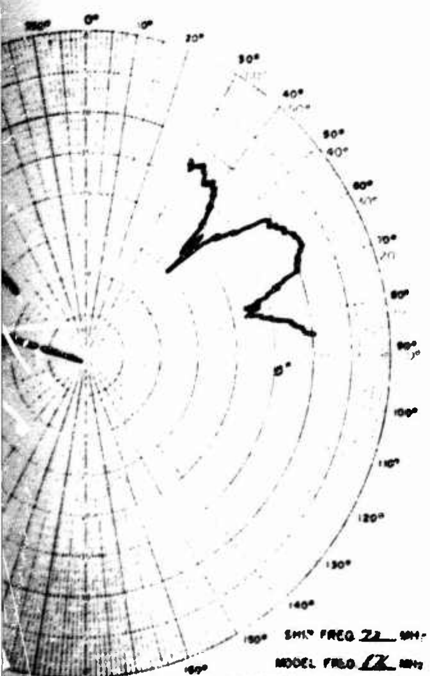
SHIP FREQ 452 MHz
MODEL FREQ 5424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +92 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE
DATE MAY 1973

FIGURE A-89



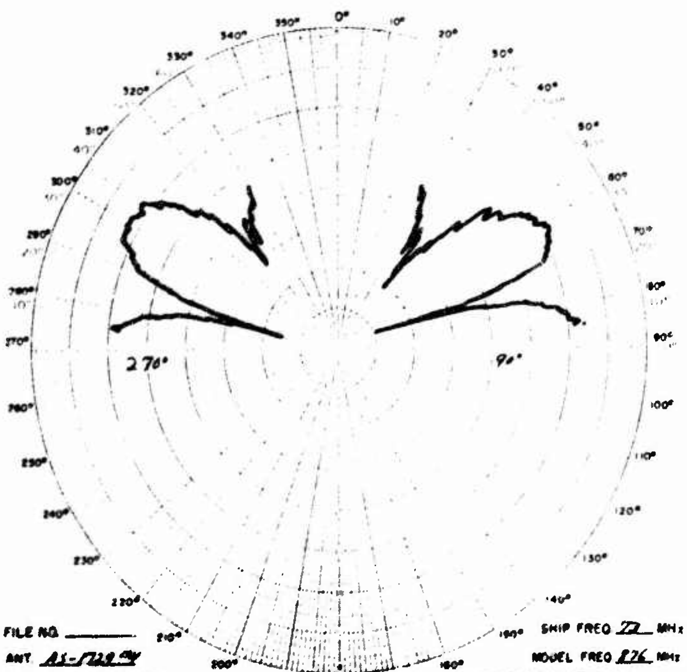
FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT [illegible] DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 452 MHz
MODEL FREQ 5424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +92 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1973

FIGURE A-90



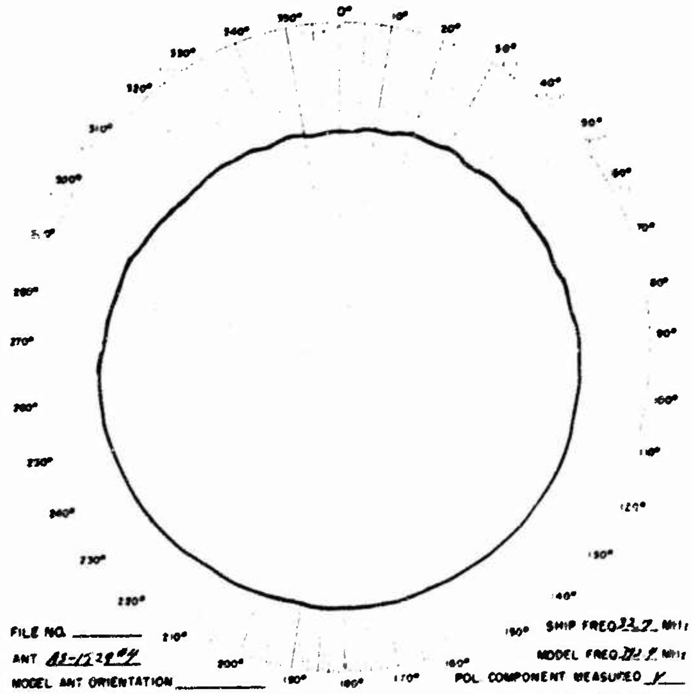
SHIP FREQ 72 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +13 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
DATE MAY 1973

FIGURE A-95



FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT [illegible] DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 72 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +13 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1973

FIGURE A-96



FILE NO. ______ SHIP FREQ 33.7 MHz

ANT AS-1729 #4 MODEL FREQ 303.9 MHz

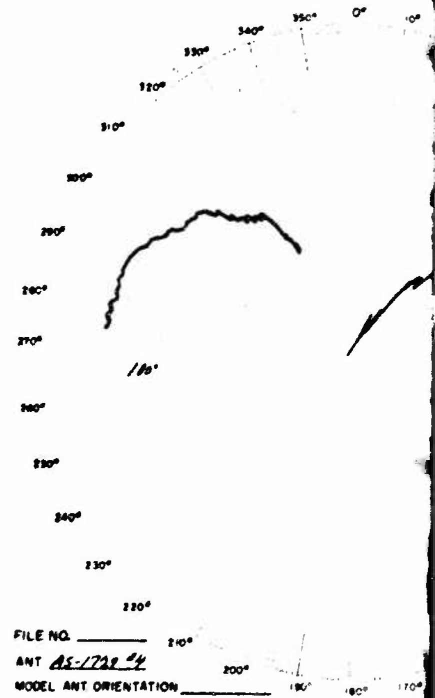
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = 8.1 dB REL.

ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-97



FILE NO. ______

ANT AS-1729 #4

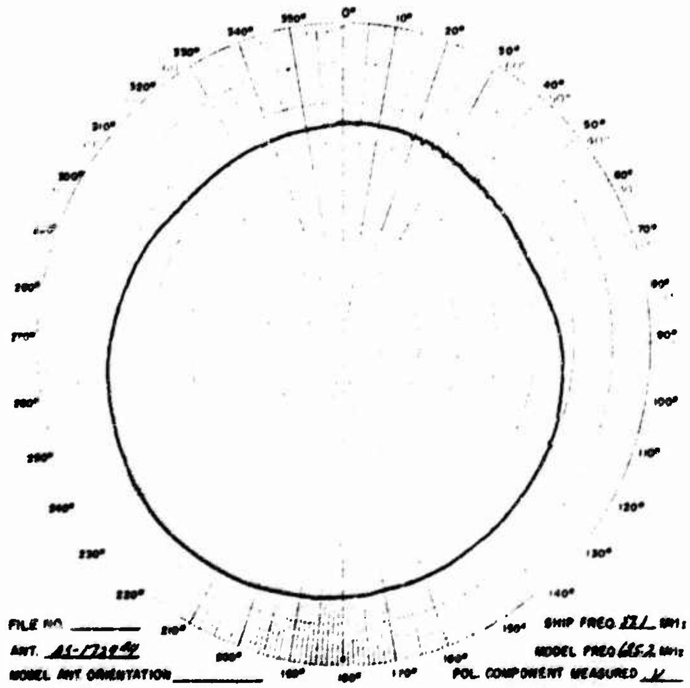
MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARK

ENGR ______ DATE



FILE NO. ______ SHIP FREQ 17.1 MHz

ANT. AS-1729 #4 MODEL FREQ 685.2 MHz

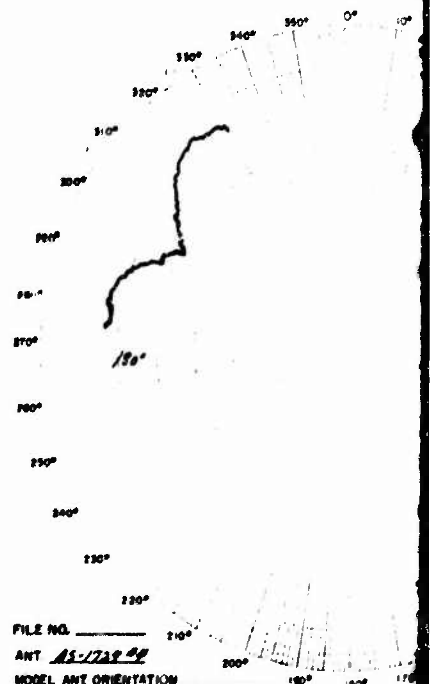
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = 47.6 dB REL.

ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE

AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-103



FILE NO. ______

ANT AS-1729 #4

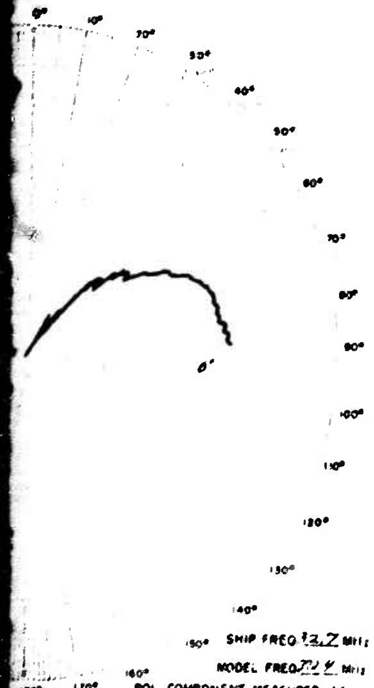
MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMAR

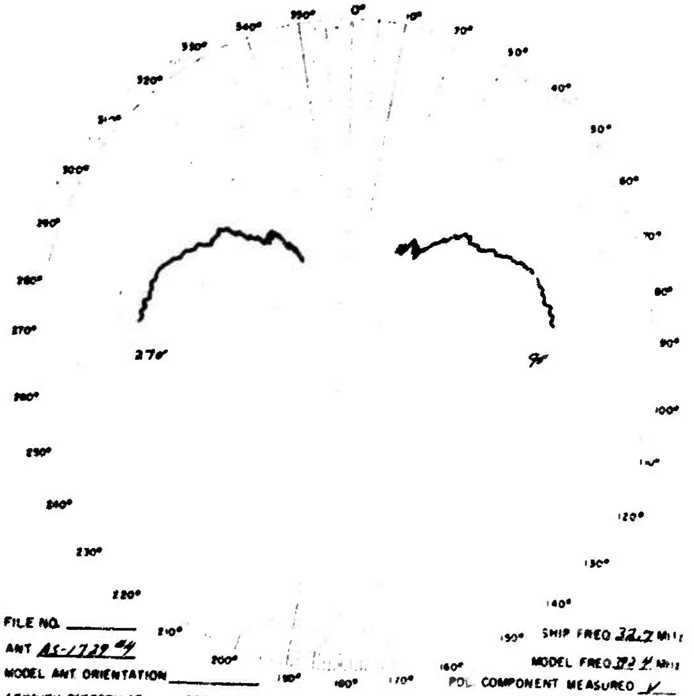
ENGR ______ DATE



SHIP FREQ 32.7 MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +3.1 dB REL TO λ/4 MONOPOLE

REMARKS LAND STATE

DATE MAY 1973 FIGURE A-98

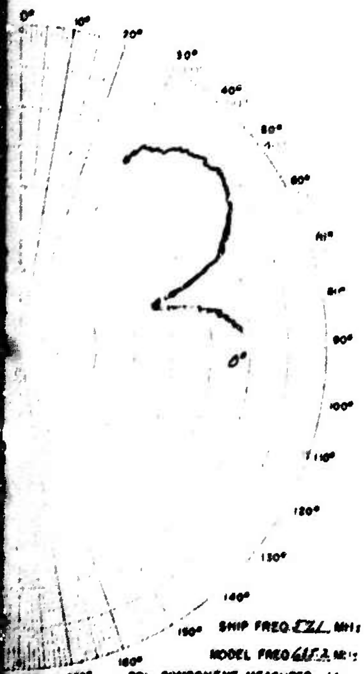


FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT [illegible] DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +3.1 dB REL TO λ/4 MONOPOLE

REMARKS SEA STATE

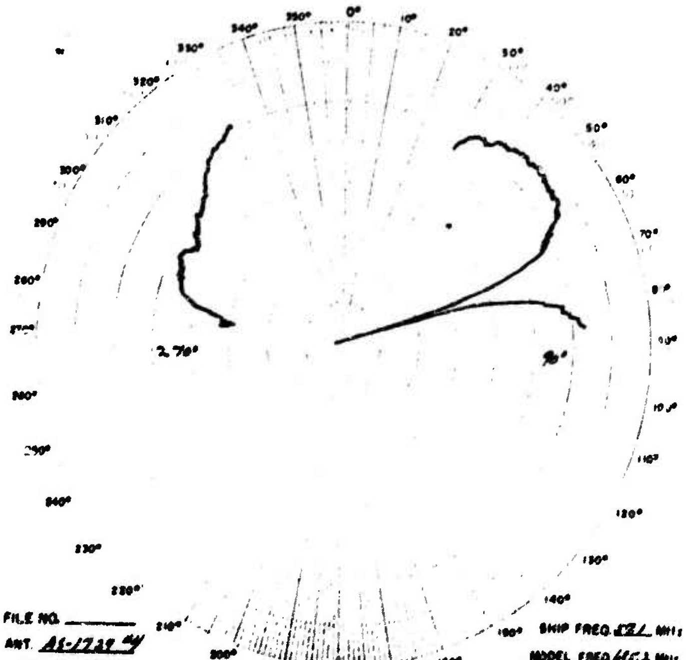
ENGR ______ DATE MAY 1973 FIGURE A-99



SHIP FREQ [illegible] MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = [illegible] dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE

DATE MAY 1973 FIGURE A-104

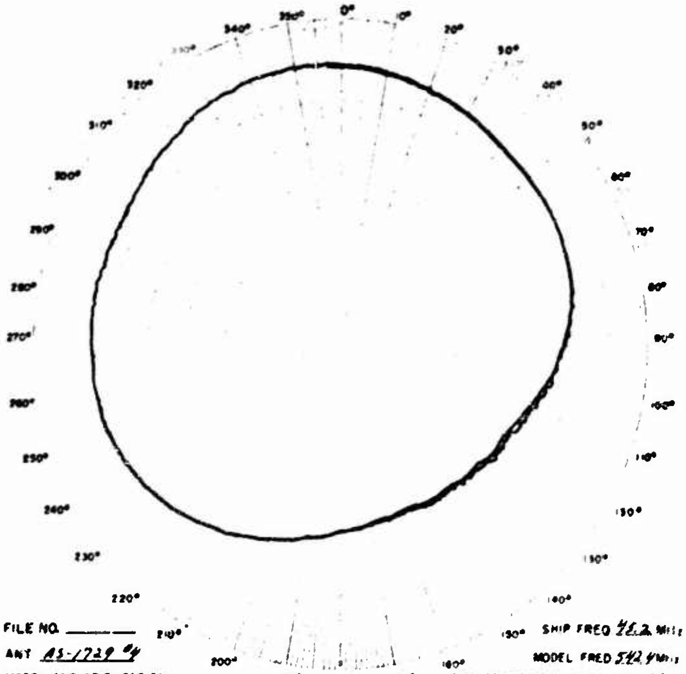


FILE NO. ______
ANT. AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT [illegible] DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ [illegible] MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = [illegible] dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE

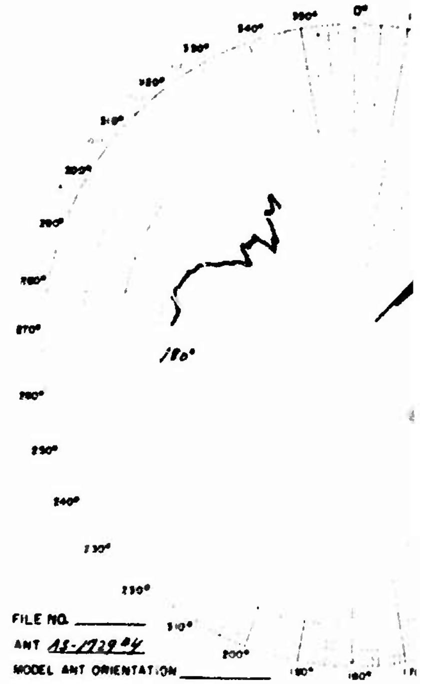
ENGR ______ DATE MAY 1973 FIGURE A-105



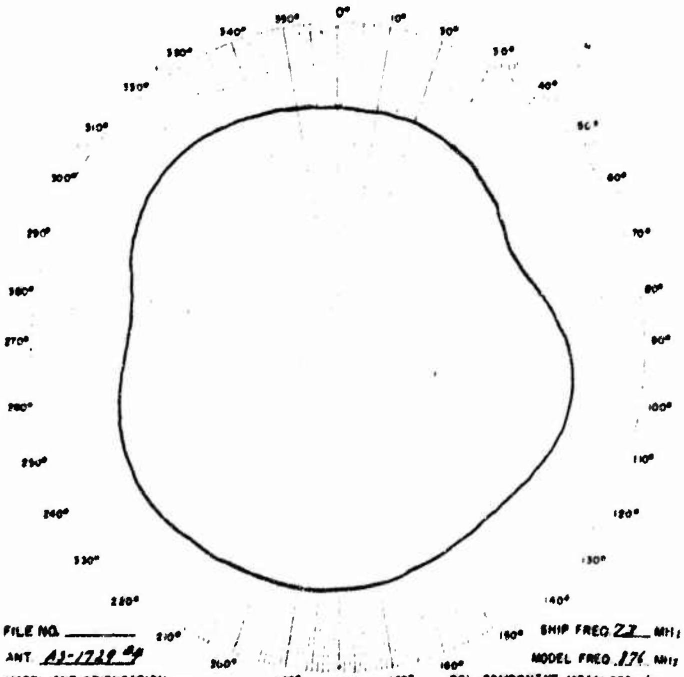
FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG ELEV
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART: +6.2 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE

ENGR ______ DATE MAY 1972 FIGURE A-130



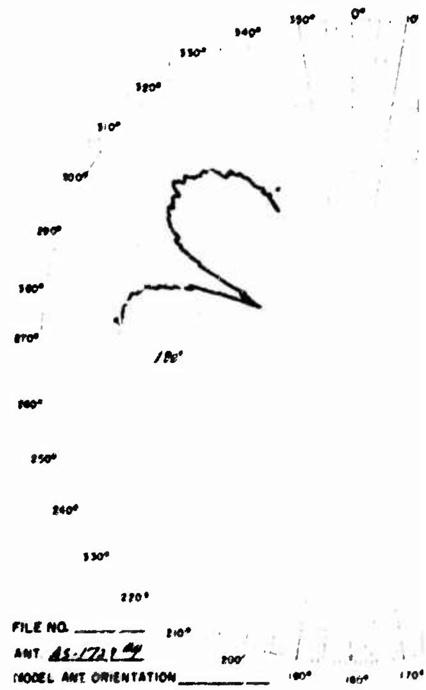
FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
REMA…
ENGR ______ DATE



FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

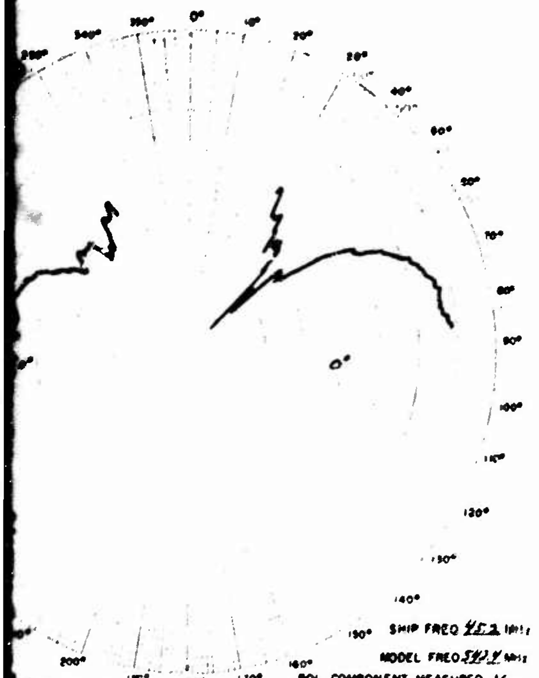
SHIP FREQ 22 MHz
MODEL FREQ 176 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART: 1/2 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED

ENGR ______ DATE MAY 1972 FIGURE A-106



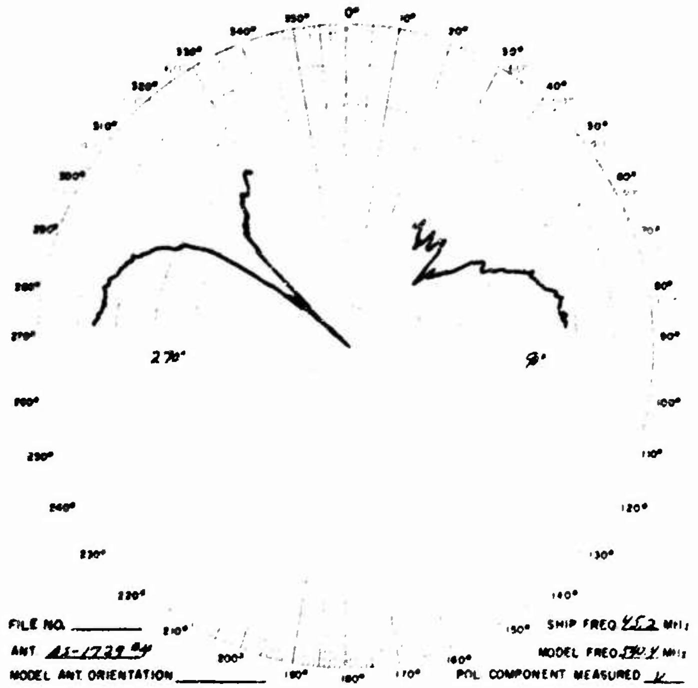
FILE NO. ______
ANT AS-1729 #4
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
REMARK…
ENGR ______ DATE…

3



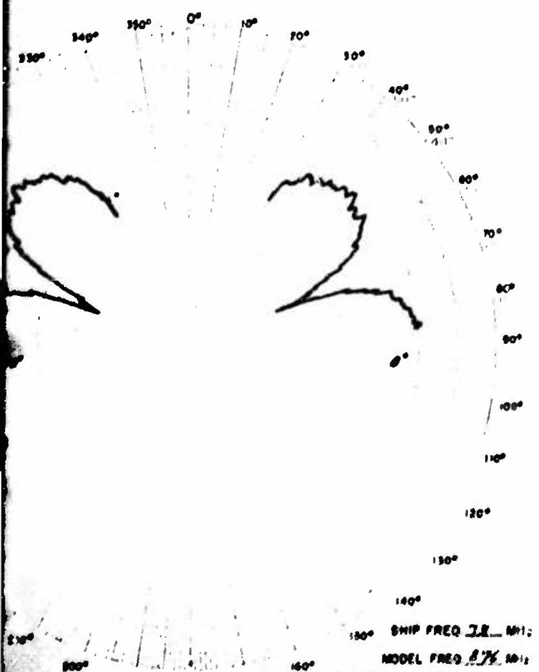
SHIP FREQ 452 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
___ DEG. ELEV
___ TO 60 DEG
...TIVE TO SHIP HEADING
0 dB ON CHART = +6.2 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ________ DATE MAY 1973

FIGURE A-101



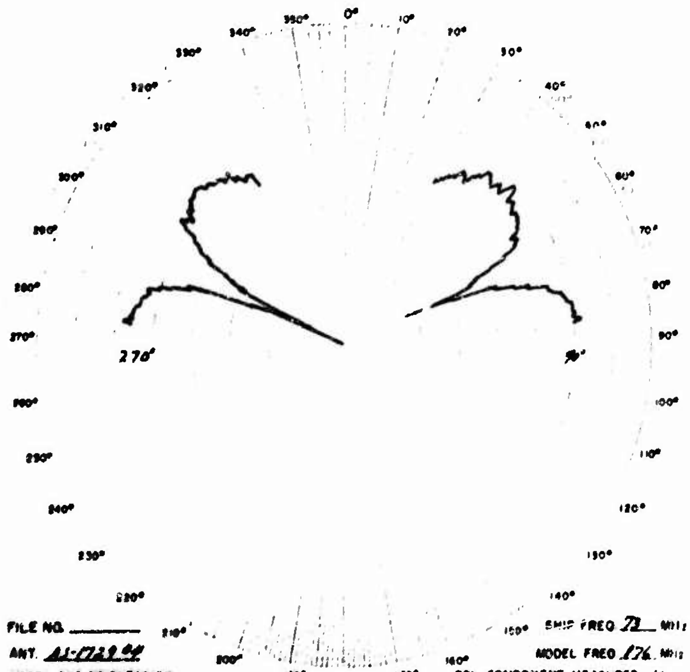
FILE NO. ________
ANT. AS-1729 A/U
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT ___ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 452 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +6.2 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ________ DATE MAY 1973

FIGURE A-102



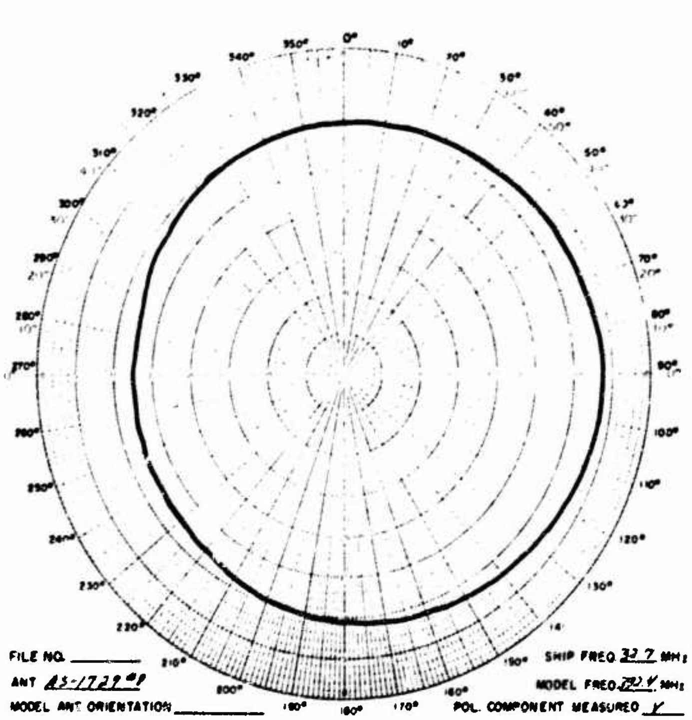
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
___ DEG. ELEV.
5 TO 60 DEG
...LATIVE TO SHIP HEADING
0 dB ON CHART = +18 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ________ DATE MAY 1973

FIGURE A-103

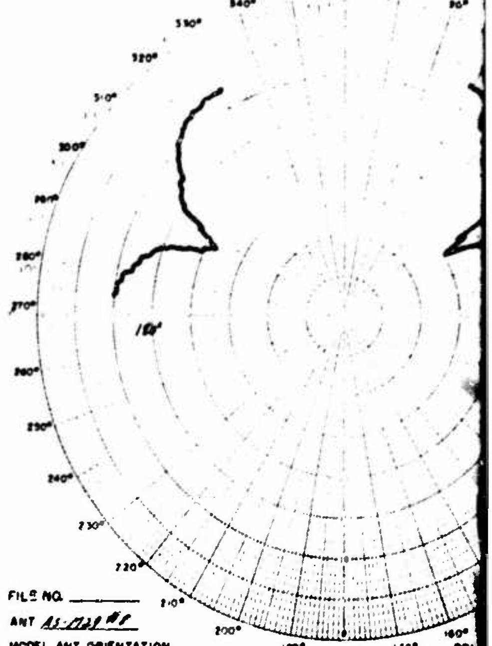


FILE NO. ________
ANT. AS-1729 A/U
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT ___ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +18 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ________ DATE MAY 1973

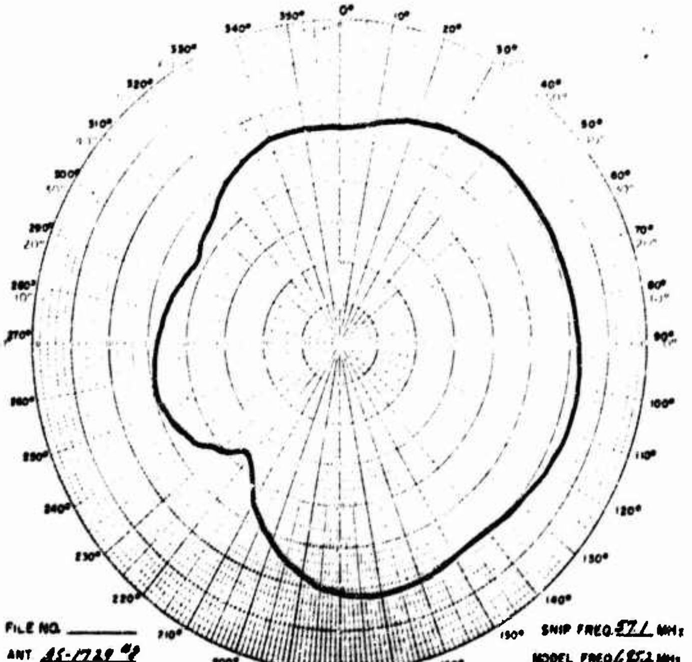
FIGURE A-104



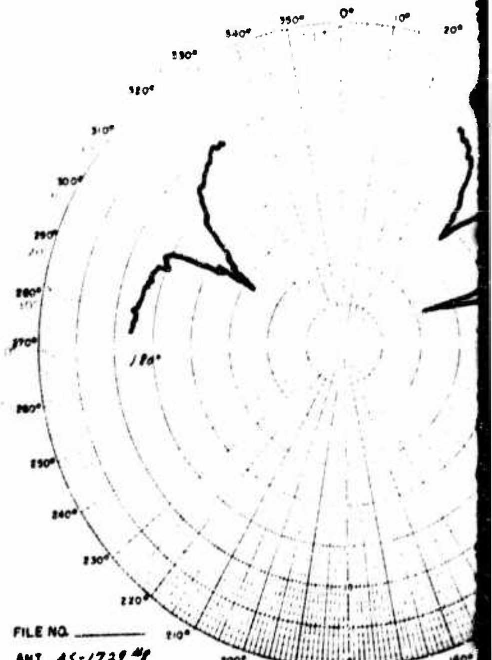
FILE NO. ______ SHIP FREQ 32.7 MHz
ANT AS-1729 #1 MODEL FREQ 292.4 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +8.3 dB REL.
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1972 FIGURE A-114



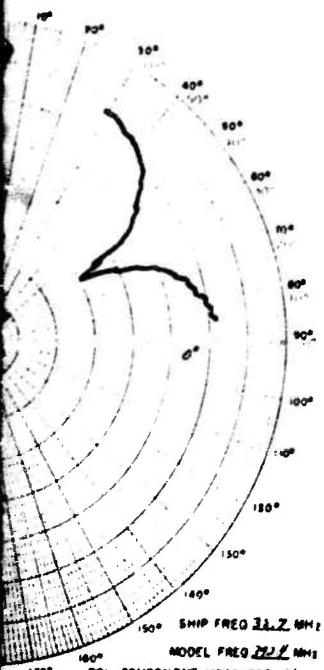
FILE NO. ______
ANT AS-1729 #1
MODEL ANT ORIENTATION ______ POL
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAN
ENGR ______ DATE MAY 197



FILE NO. ______ SHIP FREQ 77.1 MHz
ANT AS-1729 #2 MODEL FREQ 693.2 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = +15.3 dB REL.
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1972 FIGURE A-115



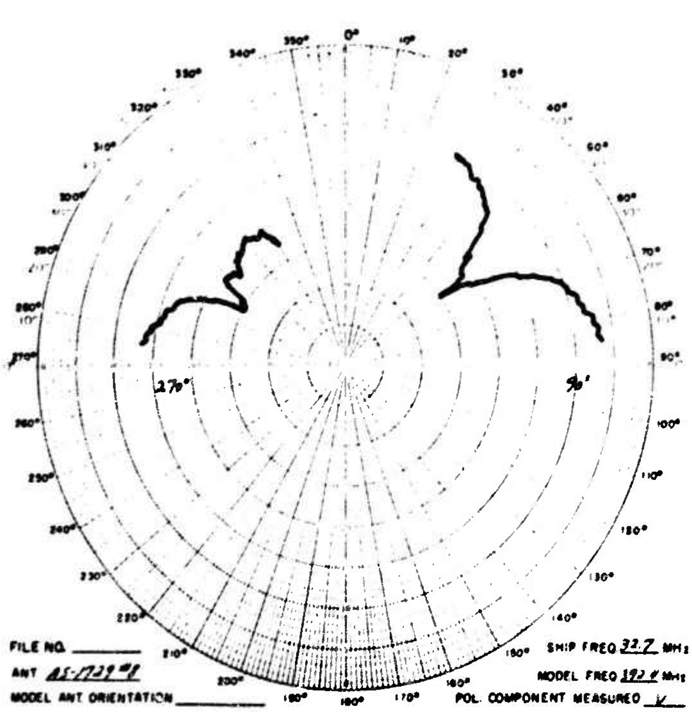
FILE NO. ______
ANT AS-1729 #2
MODEL ANT ORIENTATION ______ PO
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LA
ENGR ______ DATE MAY



SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +8.3 dB REL.
TO λ/4 MONOPOLE

REMARKS LAND STATE

DATE MAY 1973 FIGURE A-110



FILE NO. ______
ANT AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +8.3 dB REL
TO λ/4 MONOPOLE

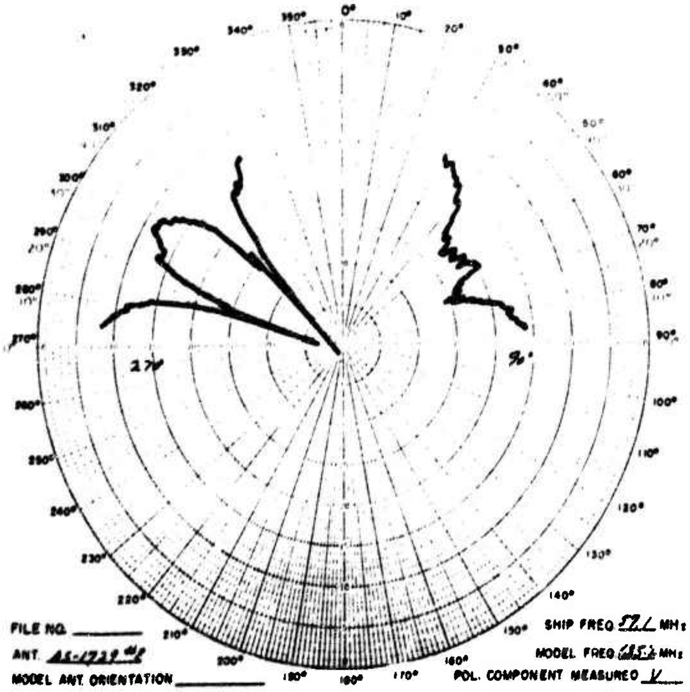
REMARKS LAND STATE

ENGR ______ DATE MAY 1973 FIGURE A-111

SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +15.3 dB REL.
TO λ/4 MONOPOLE

REMARKS LAND STATE

DATE MAY 1973 FIGURE A-116

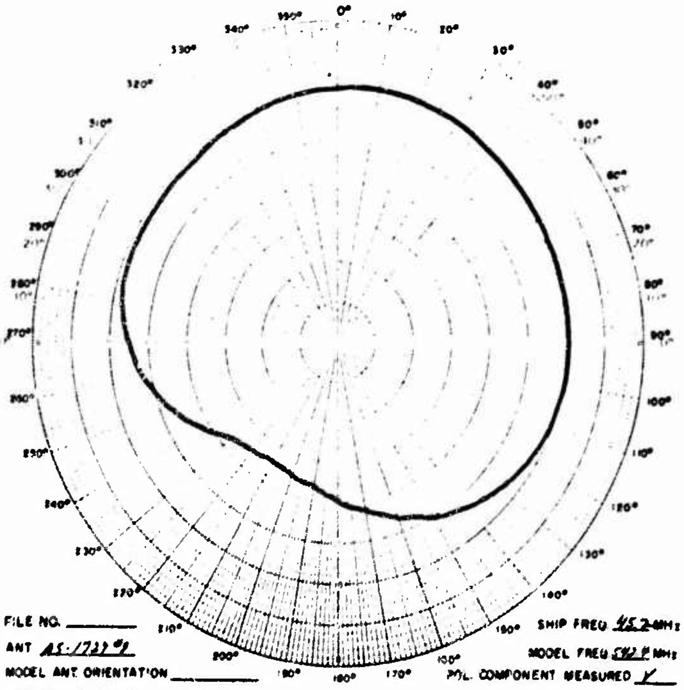


FILE NO. ______
ANT AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

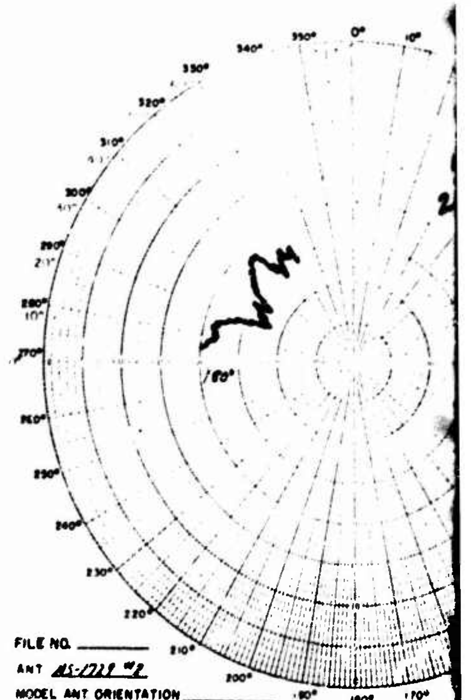
SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +15.3 dB REL.
TO λ/4 MONOPOLE

REMARKS LAND STATE

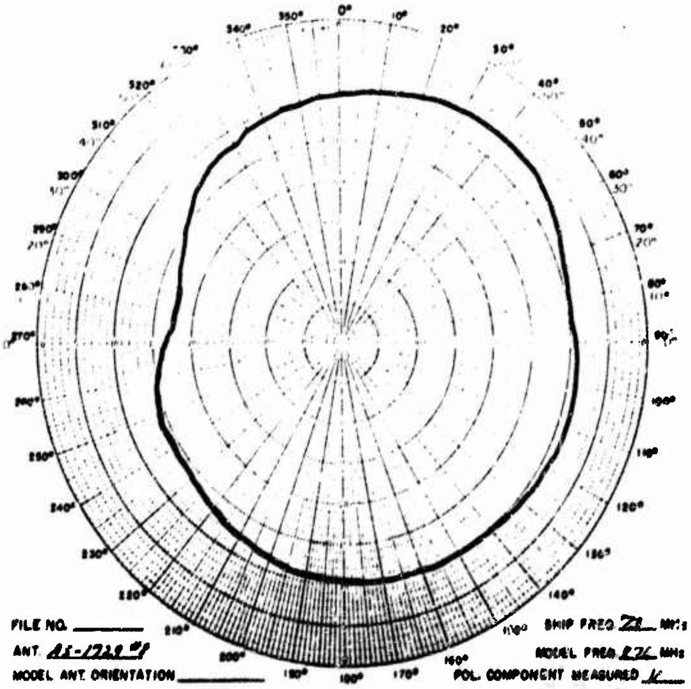
ENGR ______ DATE MAY 1973 FIGURE A-117



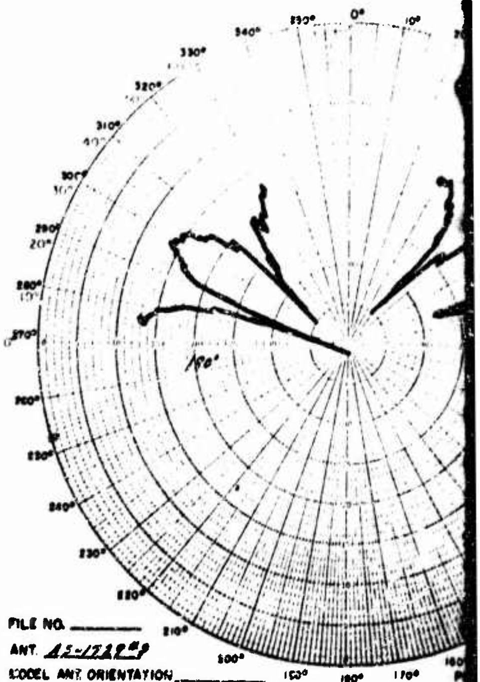
FILE NO. ______ SHIP FREQ 45.2 MHz
ANT AS-1729 #1 MODEL FREQ 542.? MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = +98 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1971 FIGURE A-112



FILE NO. ______
ANT AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS
ENGR ______ DATE

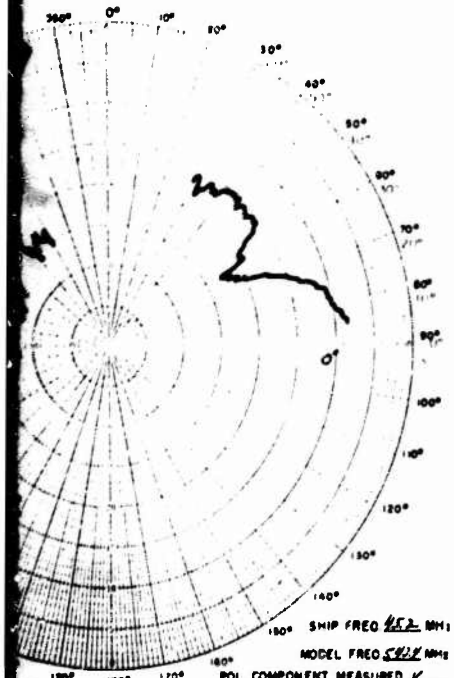


FILE NO. ______ SHIP FREQ 23 MHz
ANT AS-1729 #1 MODEL FREQ 276 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +13 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE, [illegible]
ENGR ______ DATE MAY 1971 FIGURE A-118



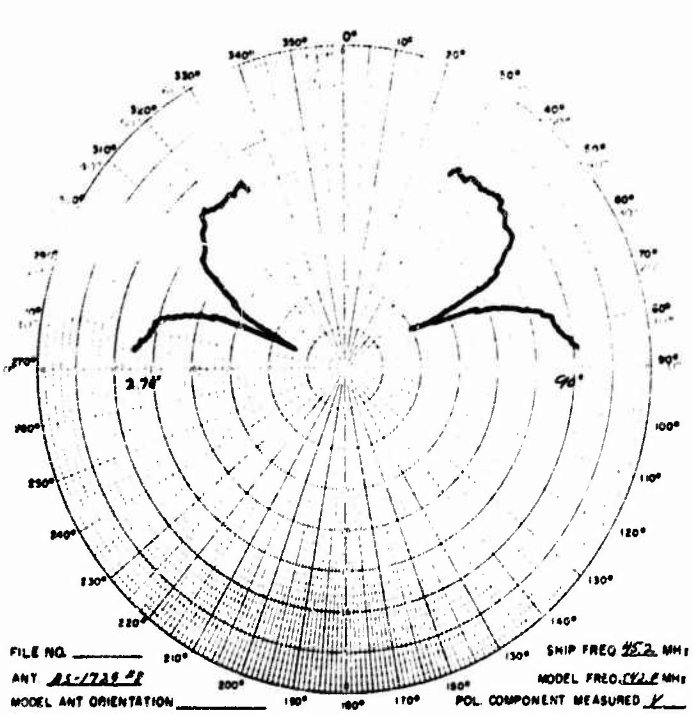
FILE NO. ______
ANT AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS
ENGR ______ DATE

3



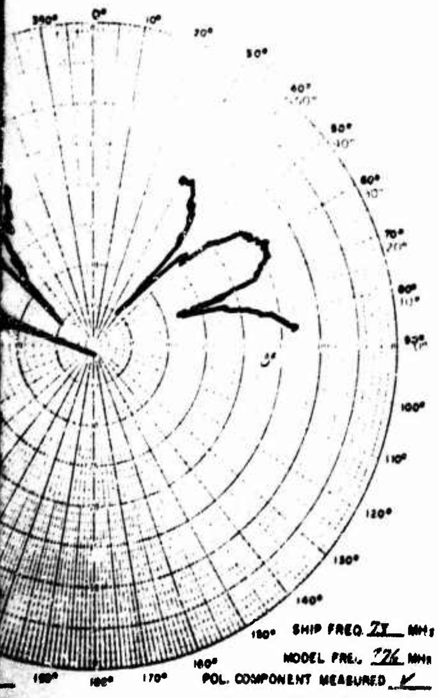
SHIP FREQ 452 MHz
MODEL FREQ 5424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +9.8 dB REL. TO λ/4 MONOPOLE
DEG.
...P HEADING
REMARKS LAND STATE
ENGR ______ DATE MAY 1972

FIGURE A-113



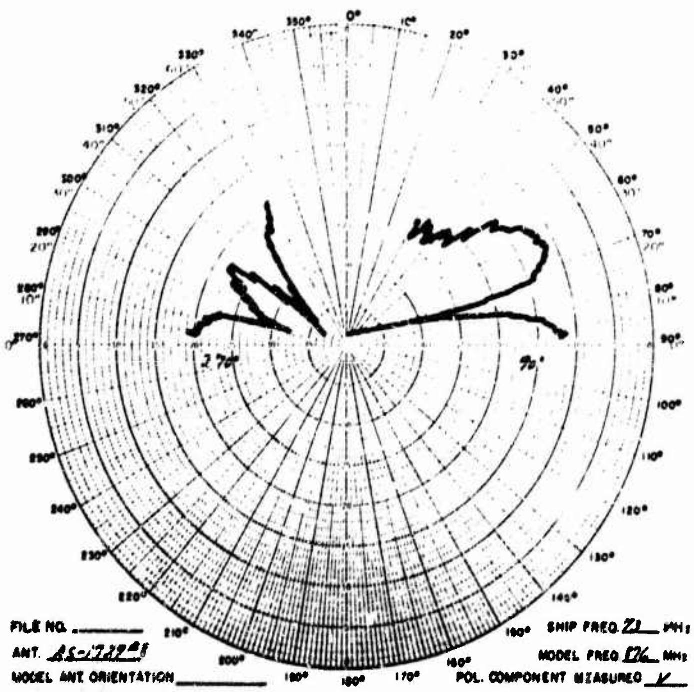
FILE NO. ______
ANT AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 452 MHz
MODEL FREQ 5424 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +9.8 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE MAY 1972

FIGURE A-114



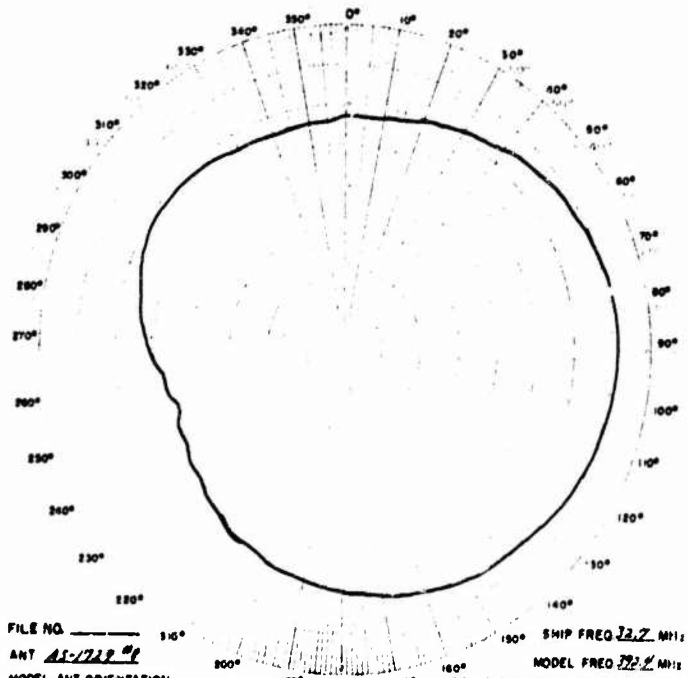
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +13 dB REL. TO λ/4 MONOPOLE
DEG.
...P HEADING
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1972

FIGURE A-119



FILE NO. ______
ANT. AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ___ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +13 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ______ DATE MAY 1972

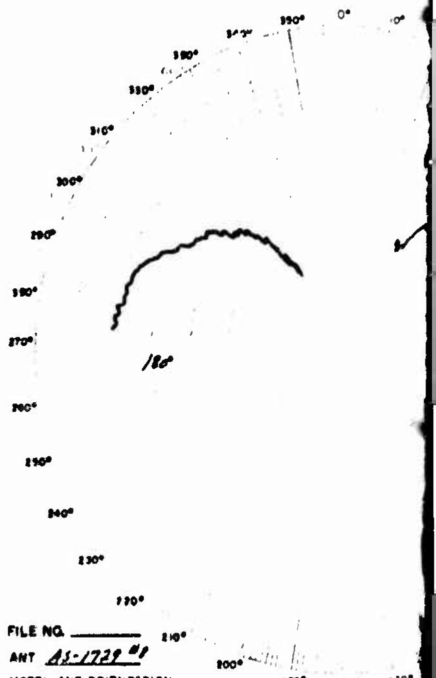
FIGURE A-120



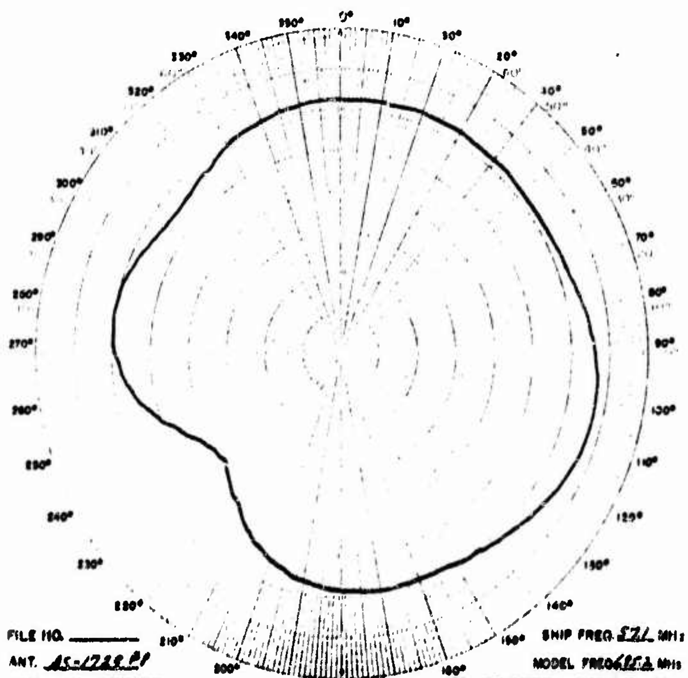
FILE NO. ______
ANT AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4.3 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-121



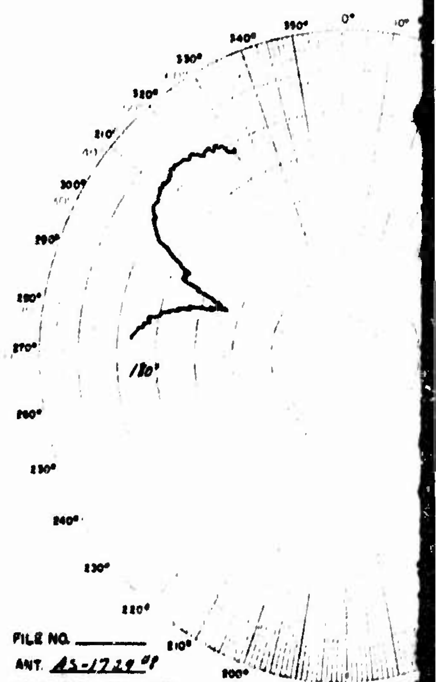
FILE NO. ______
ANT AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
REMARKS
ENGR ______ DATE



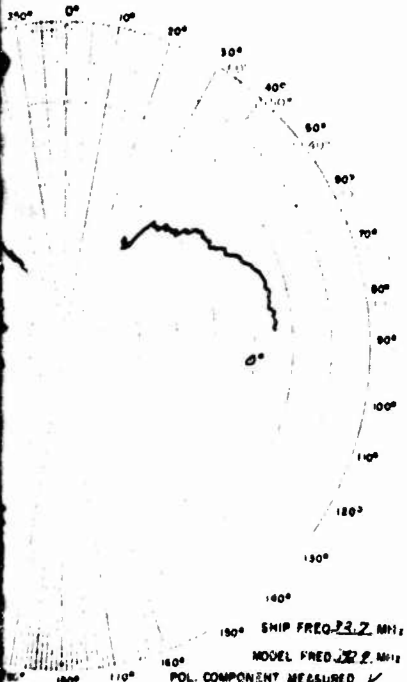
FILE NO. ______
ANT. AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +10.4 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE

ENGR ______ DATE MAY 1973 FIGURE A-07

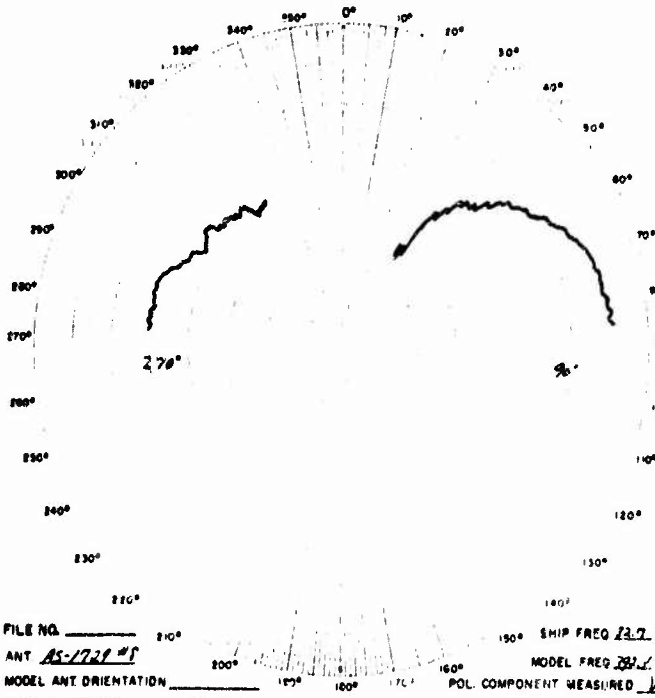


FILE NO. ______
ANT. AS-1729 #1
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING
REMARKS
ENGR ______ DATE



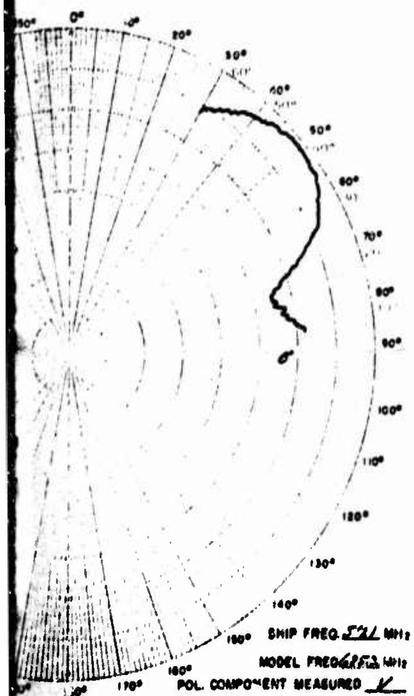
SHIP FREQ 23.7 MHz
MODEL FREQ 237.1 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4.3 dB REL
TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1973

FIGURE A-122



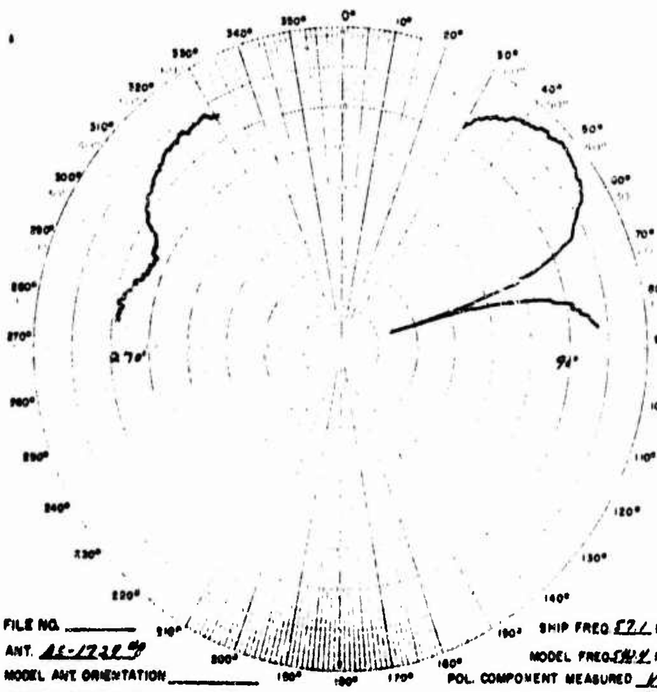
FILE NO. ________
ANT AS-1729 #5
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 23.7 MHz
MODEL FREQ 237.1 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4.3 dB REL
TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ________ DATE MAY 1973

FIGURE A-123



SHIP FREQ 57.1 MHz
MODEL FREQ 571.3 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4.4 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1973

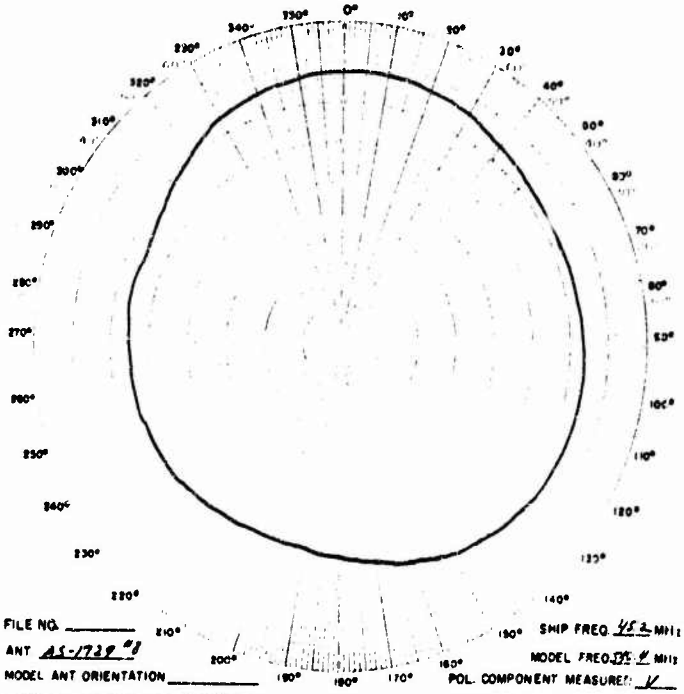
FIGURE A-128



FILE NO. ________
ANT. AS-1729 #9
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 10 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 57.1 MHz
MODEL FREQ 571.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +4.4 dB REL.
TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ________ DATE MAY 1973

FIGURE A-129

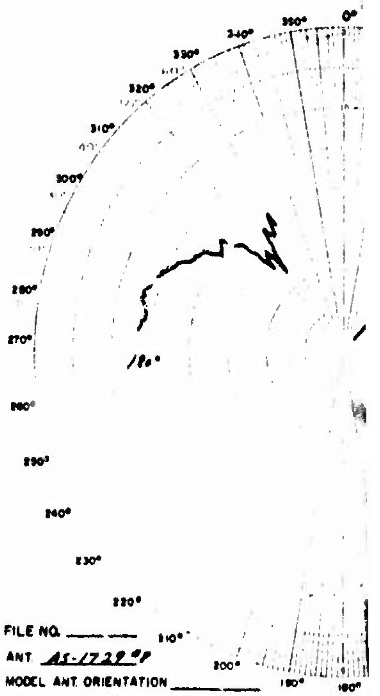
2



FILE NO. ______
ANT AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

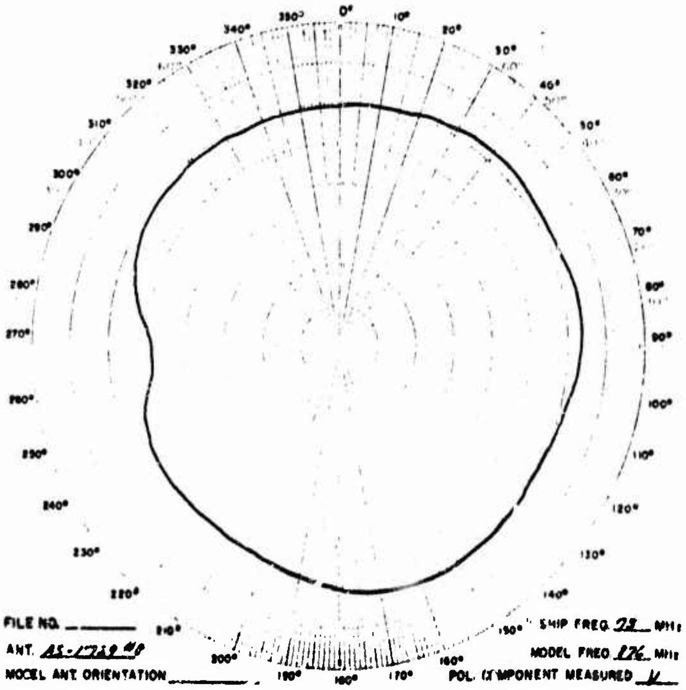
SHIP FREQ. 45.2 MHz
MODEL FREQ. 339.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +11 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE

ENGR ______ DATE MAY1973 FIGURE A-124



FILE NO. ______
ANT AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG.
AT 0 & 180 DEGREES RELATIVE TO SHIP HEADING

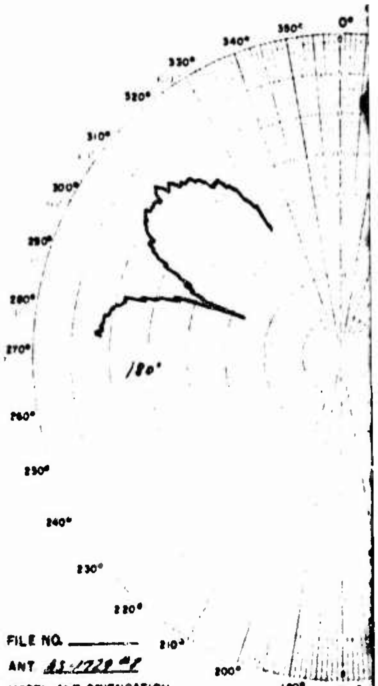
ENGR ______



FILE NO. ______
ANT. AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ. 23 MHz
MODEL FREQ. 176 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +18 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE, INDUCTIVE MATCHING METHOD USED

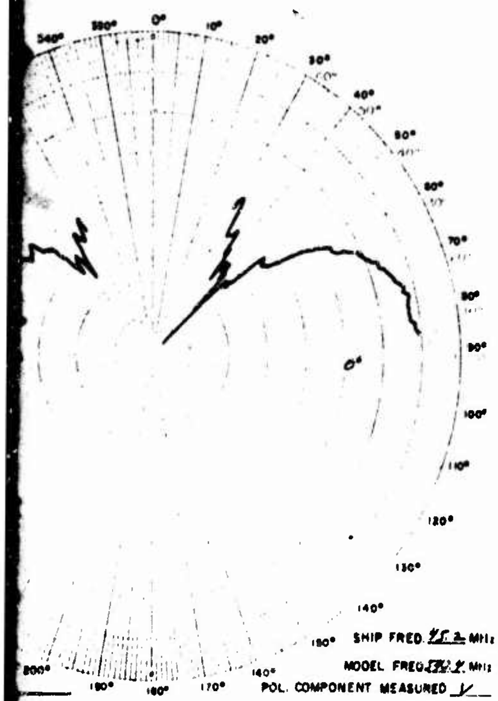
ENGR ______ DATE MAY1973 FIGURE A-130



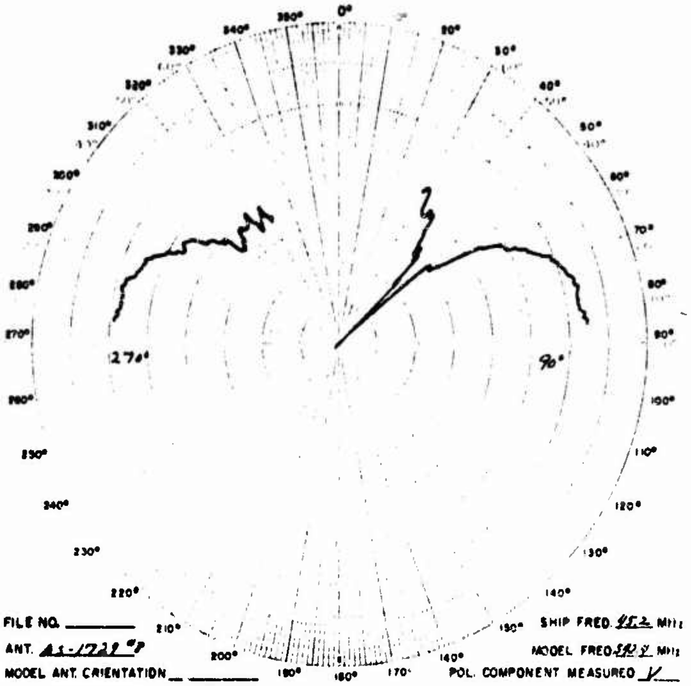
FILE NO. ______
ANT AS-1729 #8
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG.
AT 0 & 180 DEGREES RELATIVE TO SHIP HEADING

ENGR ______

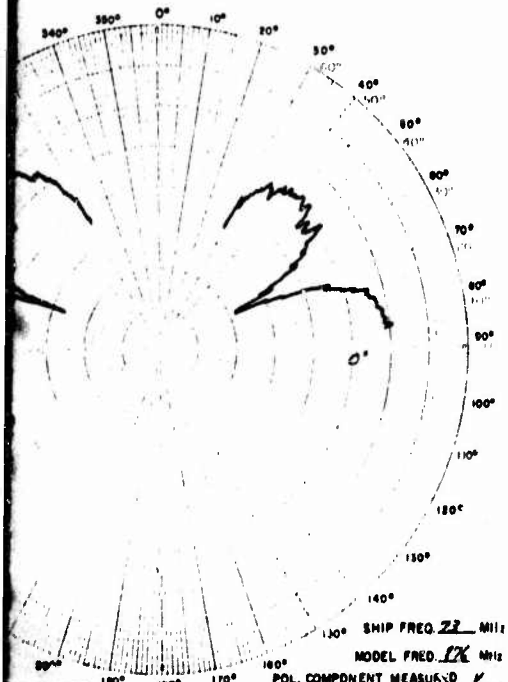
3



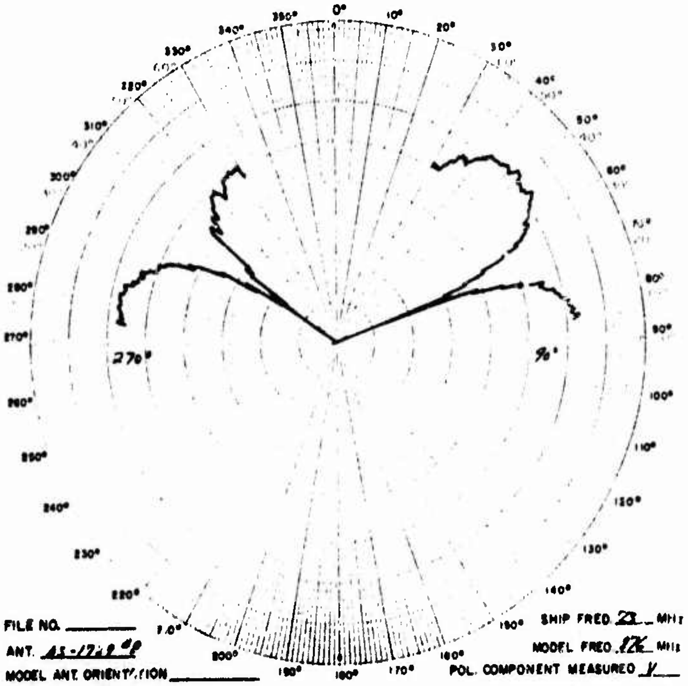
SHIP FREQ. 45.2 MHz
MODEL FREQ. [illegible] MHz
POL. COMPONENT MEASURED V
ELEV
0 dB ON CHART = +11 dB REL
60 DEG
TO λ/4 MONOPOLE
SHIP HEADING
REMARKS SEA STATE
ENGR ________ DATE MAY 1973 FIGURE A-125



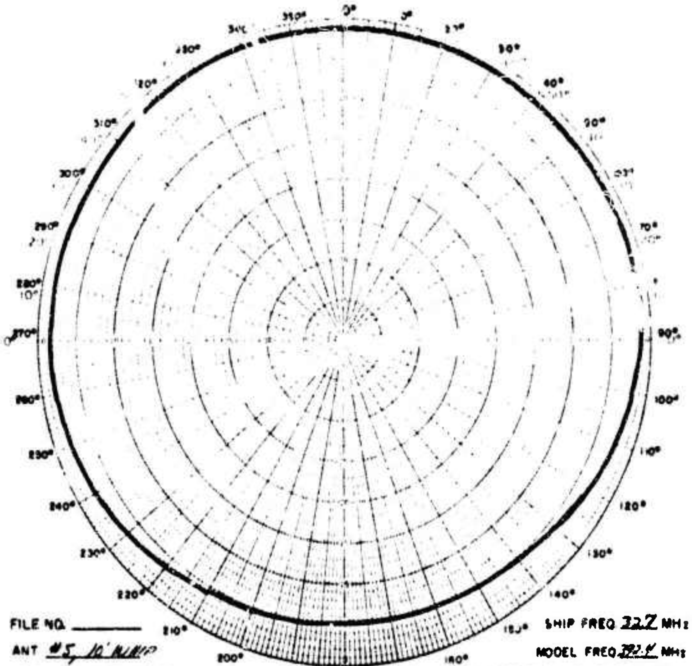
FILE NO. ________
SHIP FREQ. 45.2 MHz
ANT. AS-1729 #P
MODEL FREQ. [illegible] MHz
MODEL ANT. ORIENTATION ________
POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV.
0 dB ON CHART = +11 dB REL
ELEVATION PATTERN 5 TO 60 DEG.
TO λ/4 MONOPOLE
AT [illegible] DEGREES RELATIVE TO SHIP HEADING
REMARKS SEA STATE
ENGR ________ DATE MAY 1973 FIGURE A-126



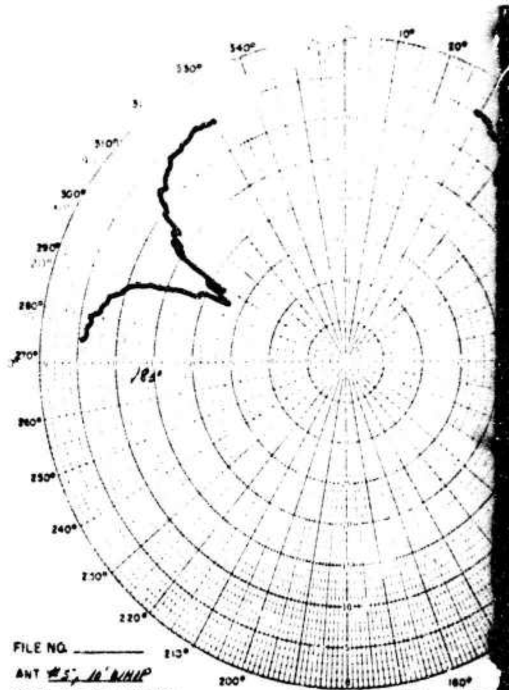
SHIP FREQ. 23 MHz
MODEL FREQ. 176 MHz
POL. COMPONENT MEASURED V
DEG. ELEV.
0 dB ON CHART = +18 dB REL.
TO 60 DEG
TO λ/4 MONOPOLE
TO SHIP HEADING
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ________ DATE MAY 1973 FIGURE A-131



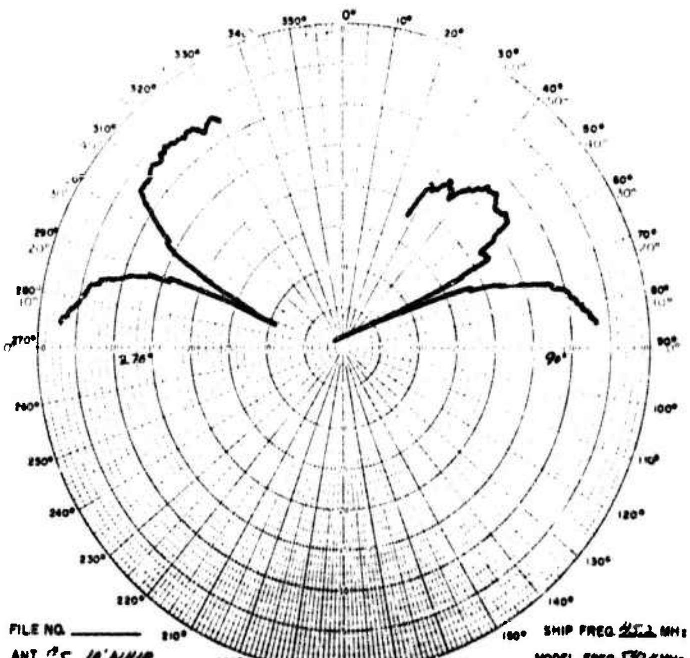
FILE NO. ________
SHIP FREQ. 23 MHz
ANT. AS-1729 #P
MODEL FREQ. 176 MHz
MODEL ANT. ORIENTATION ________
POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV.
0 dB ON CHART = +18 dB REL.
ELEVATION PATTERN 5 TO 60 DEG.
TO λ/4 MONOPOLE
AT [illegible] DEGREES RELATIVE TO SHIP HEADING
REMARKS SEA STATE, INDUCTIVE MATCHING NETWORK USED
ENGR ________ DATE MAY 1973 FIGURE A-132



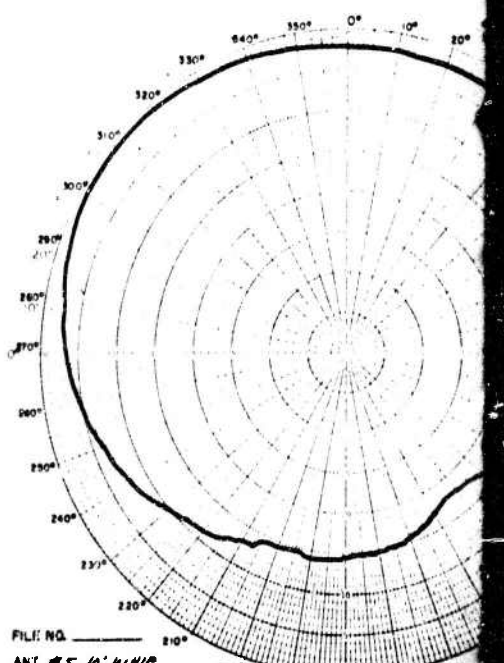
FILE NO. ____ SHIP FREQ 327 MHz
ANT #5, 10' WHIP MODEL FREQ 392.4 MHz
MODEL ANT ORIENTATION ____ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +2 dB REL.
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ____ DATE MAY 1973 FIGURE A-133



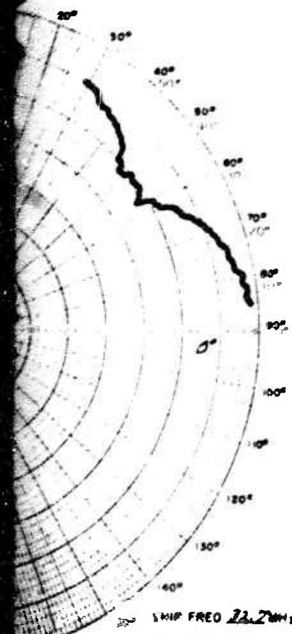
FILE NO. ____
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ____ POL.
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND
ENGR ____ DATE MAY 197



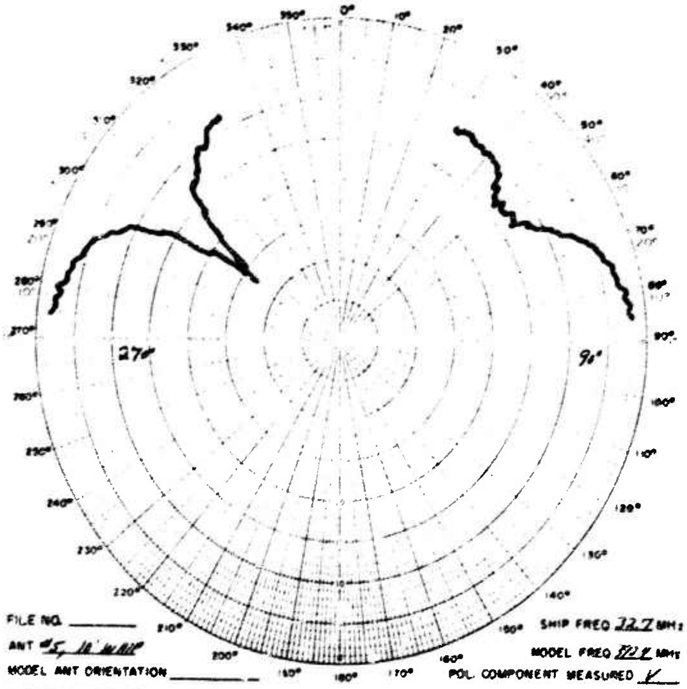
FILE NO. ____ SHIP FREQ 452 MHz
ANT. #5, 10' WHIP MODEL FREQ 542 MHz
MODEL ANT. ORIENTATION ____ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV. 0 dB ON CHART = +5 dB REL.
ELEVATION PATTERN 5 TO 60 DEG. TO λ/4 MONOPOLE
AT 90/270 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ____ DATE MAY 1973 FIGURE A-139



FILE NO. ____
ANT. #5, 10' WHIP
MODEL ANT. ORIENTATION ____ POL
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAN
ENGR ____ DATE MAY 197



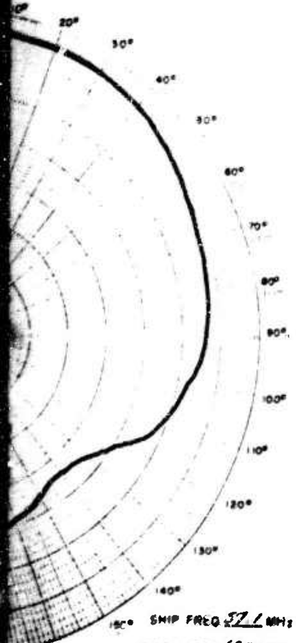
SHIP FREQ 32.2 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +2 dB REL. TO λ/4 MONOPOLE
...KS LAND STATE
...MAY 1973 FIGURE A-134



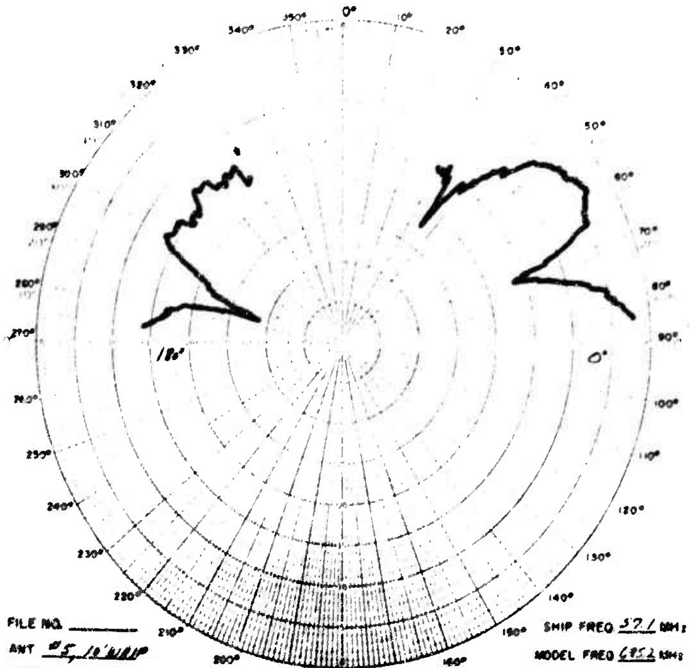
FILE NO. ______
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.2 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +2 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE
ENGR ______ DATE MAY 1973
FIGURE A-135



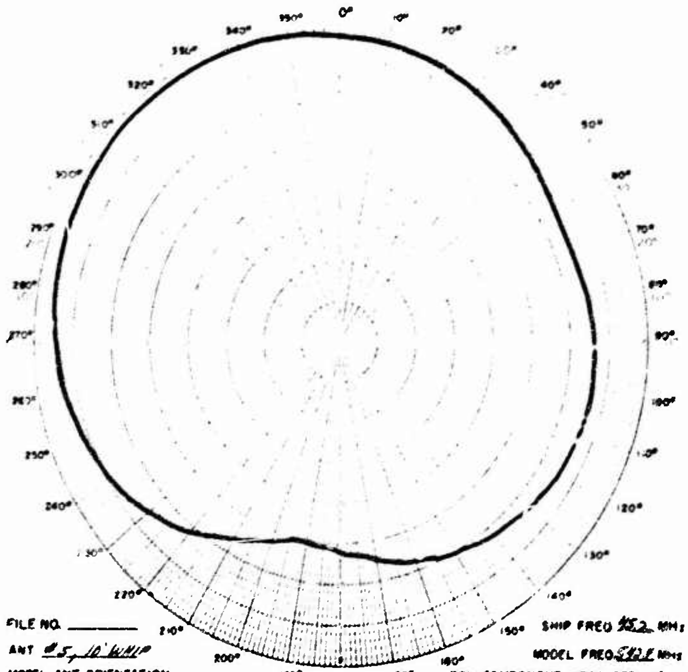
SHIP FREQ 57.1 MHz
MODEL FREQ 695.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +6 dB REL. TO λ/4 MONOPOLE
...KS LAND STATE
...MAY 1973 FIGURE A-139



FILE NO. ______
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 57.1 MHz
MODEL FREQ 695.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +6 dB REL. TO λ/4 MONOPOLE

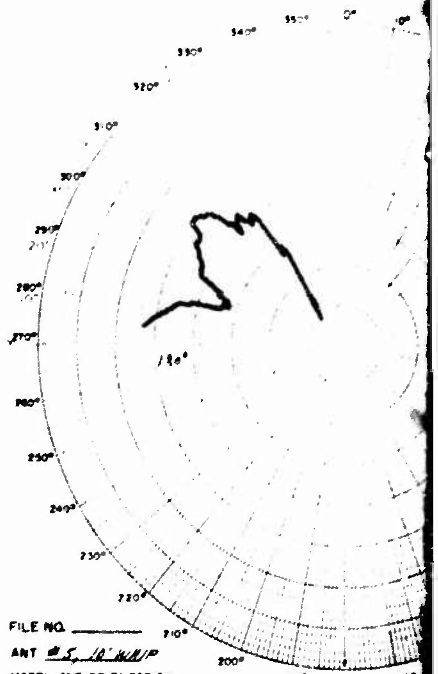
REMARKS LAND STATE
ENGR ______ DATE MAY 1973
FIGURE A-140



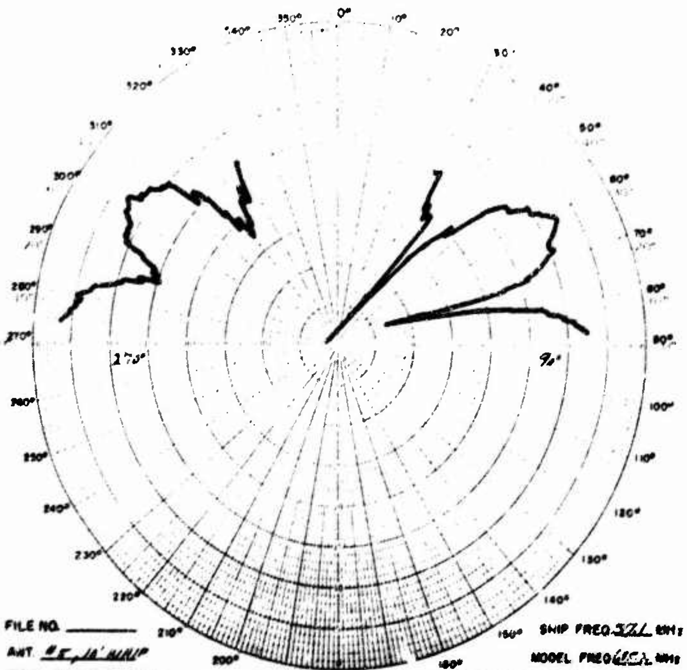
FILE NO. ________
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT 5 DEG ELEV
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE

ENGR ________ DATE 11 MAY 1973 FIGURE A-136



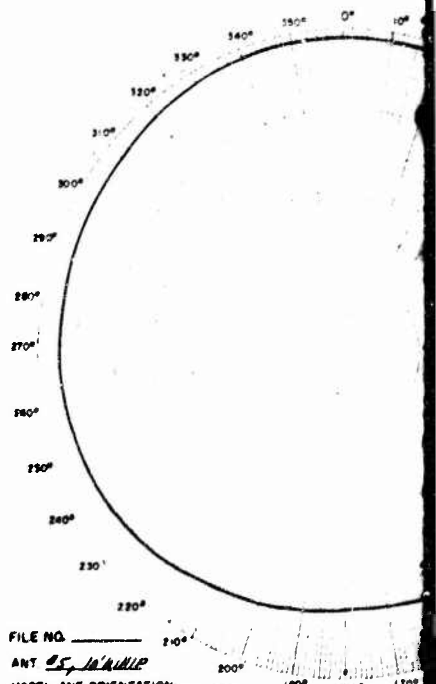
FILE NO. ________
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 90/180 DEGREES RELATIVE TO SHIP HEADING
REMARKS
ENGR ________ DATE



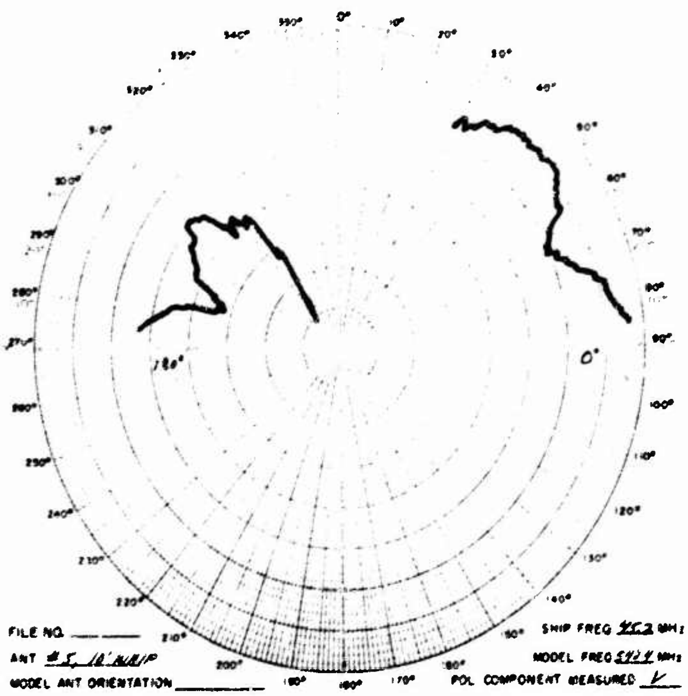
FILE NO. ________
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 52.1 MHz
MODEL FREQ 625.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +6 dB REL. TO λ/4 MONOPOLE
REMARKS LAND STATE

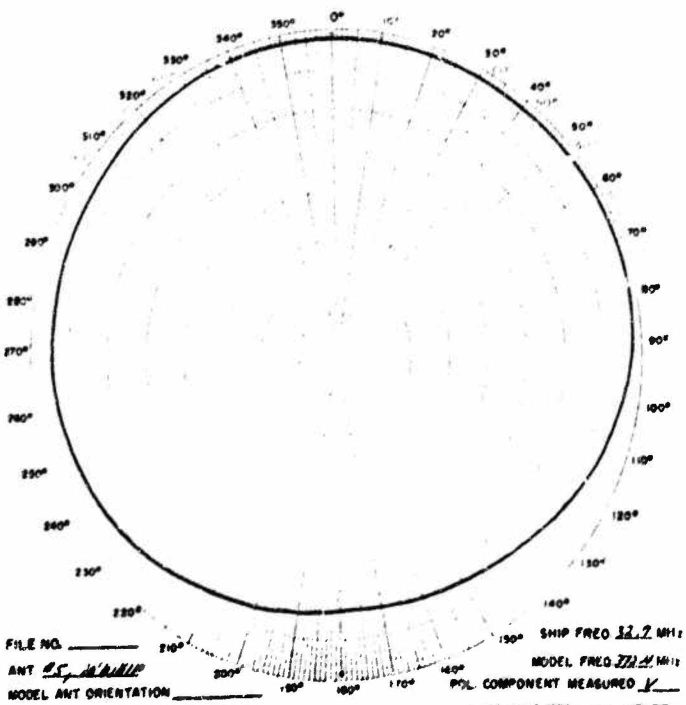
ENGR ________ DATE 11 MAY 1973 FIGURE A-141



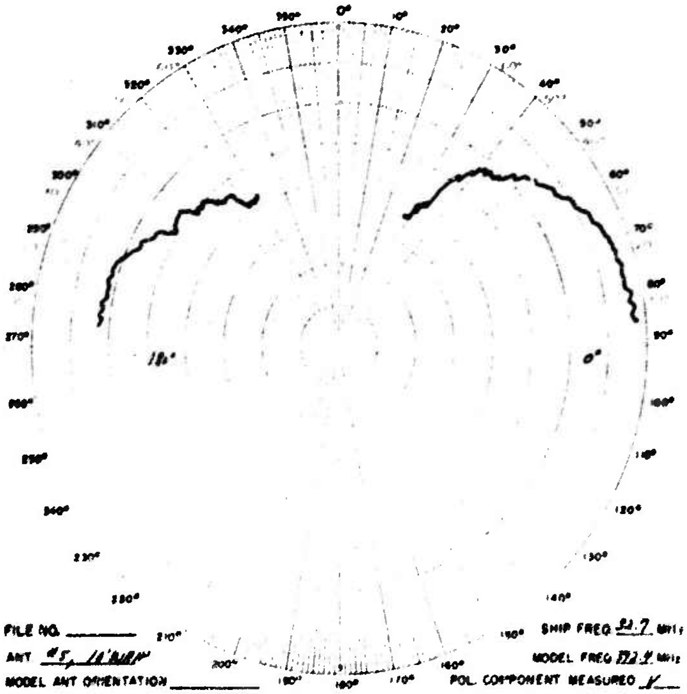
FILE NO. ________
ANT #5, 10' WHIP
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT 5 DEG ELEV
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING
REMARKS
ENGR ________ DATE



FILE NO. ______ SHIP FREQ 45.2 MHz
ANT #5, 10' WHIP MODEL FREQ 542.4 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG ELEV 0 dB ON CHART = +5 dB REL
ELEVATION PATTERN 5 TO 60 DEG TO λ/4 MONOPOLE
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAND STATE
ENGR ______ DATE MAY 1973 FIGURE A-137



FILE NO. ______ SHIP FREQ 32.7 MHz
ANT #5, 10' WHIP MODEL FREQ 392.4 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +2 dB REL.
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE
ENGR ______ DATE MAY 1973 FIGURE A-142



FILE NO. ________

ANT #5, 16' WHIP

MODEL ANT ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 31.7 MHz

MODEL FREQ 373.4 MHz

POL. COMPONENT MEASURED V

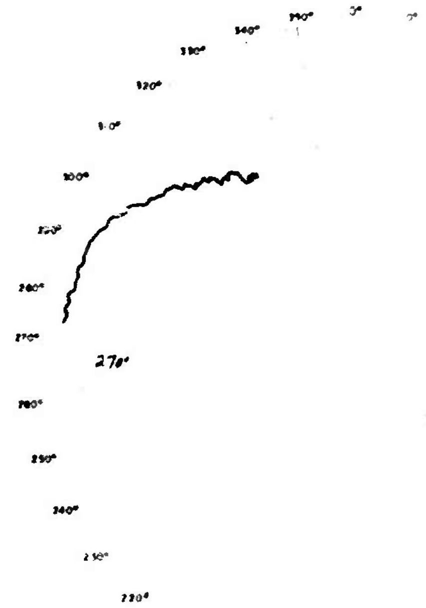
0 dB ON CHART = 12 dB REL TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR

DATE

Figure A 143



FILE NO. ________

ANT #5, 16' WHIP

MODEL ANT ORIENTATION ________

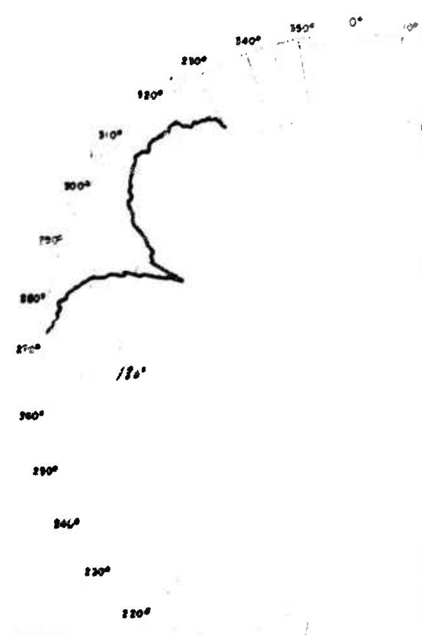
AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN ____ TO ____ DEG

AT 90/270 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ________ DATE



FILE NO. ________

ANT. #5, 16' WHIP

MODEL ANT. ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG

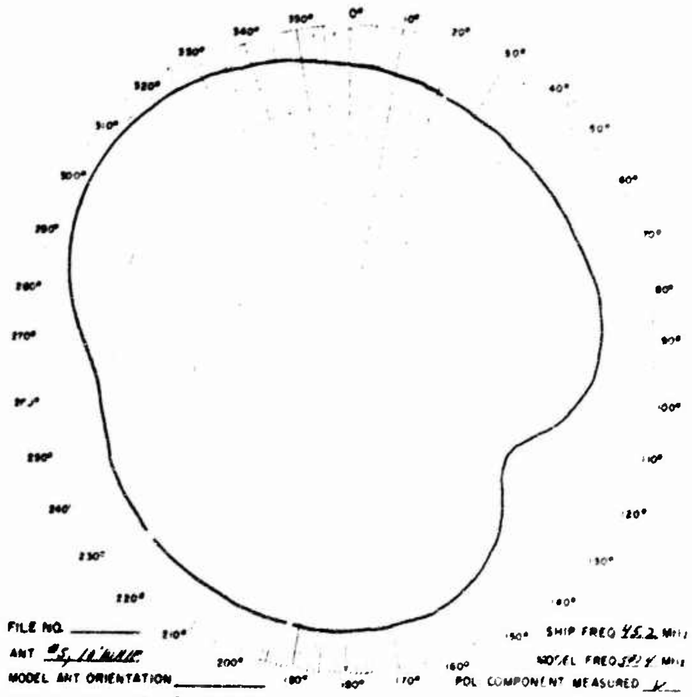
AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ________ DATE

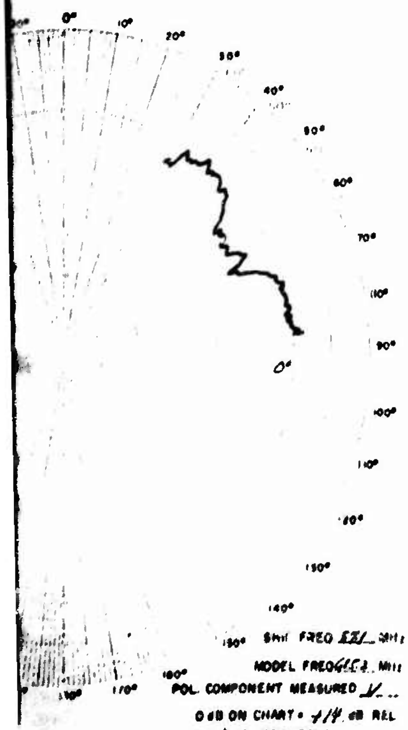
SHIP FREQ 32.7 MHz
MODEL FREQ 392.8 MHz
POL COMPONENT MEASURED V
0 dB ON CHART: +3 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1973

FIGURE A-144



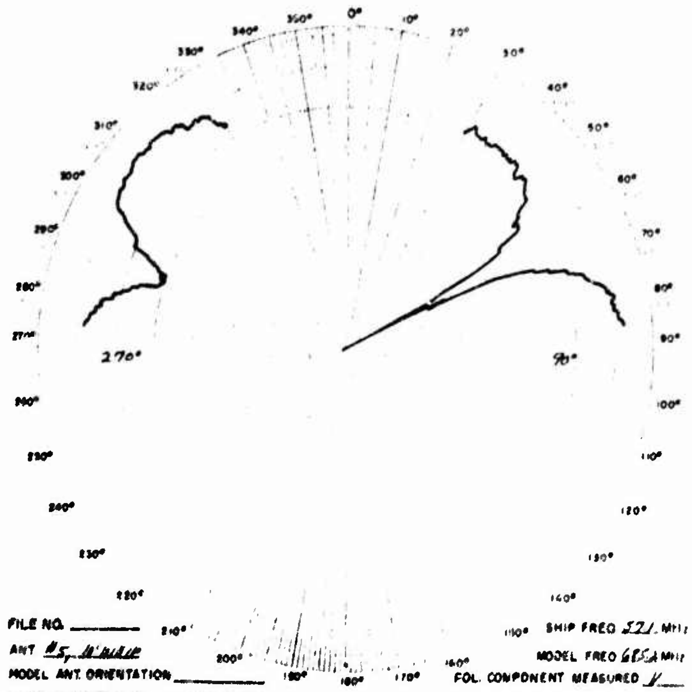
FILE NO. ______
ANT #5, 16' WHIP
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT 5 DEG ELEV
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL COMPONENT MEASURED V
0 dB ON CHART: +6 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ______ DATE MAY 1973

FIGURE A-145



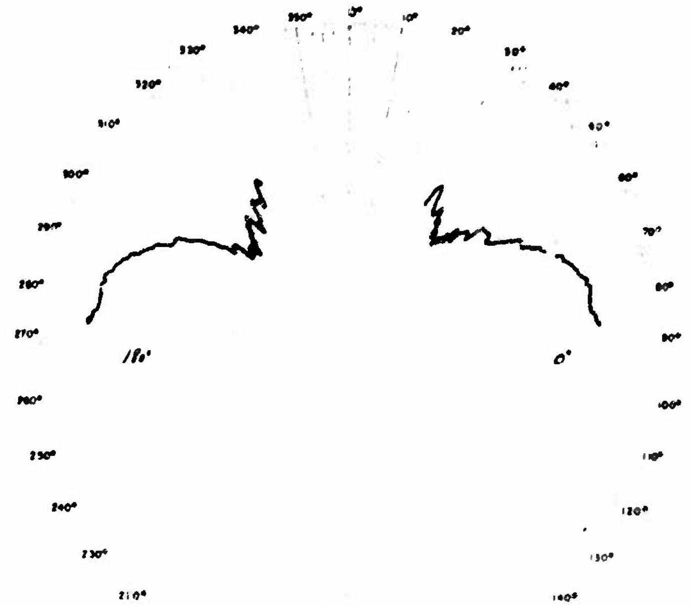
SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART: +14 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE MAY 1973

FIGURE A-149



FILE NO. ______
ANT #5, 16' WHIP
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART: +14 dB REL TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ______ DATE MAY 1973

FIGURE A-150



FILE NO. ______

ANT #5, 10' WHIP

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.3 MHz

MODEL FREQ 5?24 MHz

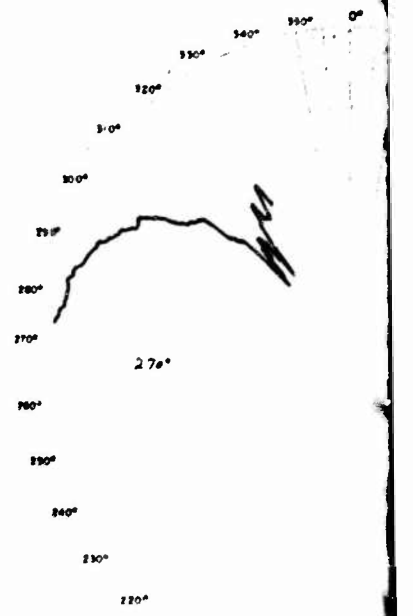
POL COMPONENT MEASURED V

0 dB ON CHART = 46 dB REL TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR ______ DATE MAY 1973

FIGURE A-146



FILE NO. ______

ANT #5, 10' WHIP

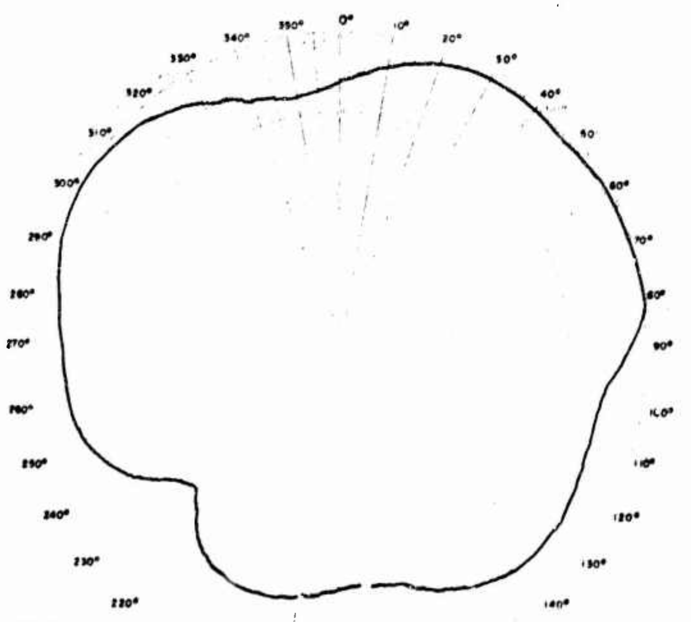
MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 90/270 DEGREES RELATIVE TO SHIP HEADING

ENGR ______



FILE NO. ______

ANT #5, 10' WHIP

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT 5° DEG. ELEV

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 72 MHz

MODEL FREQ 776 MHz

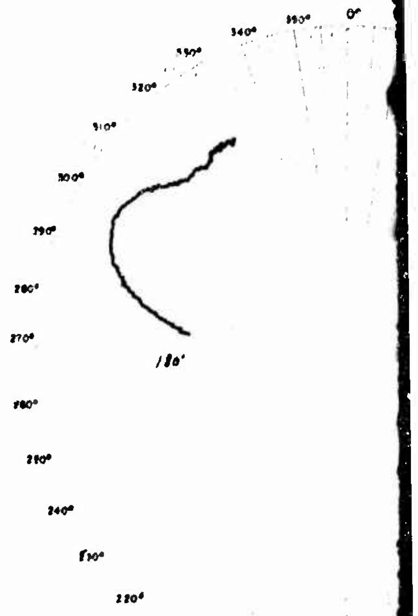
POL. COMPONENT MEASURED V

0 dB ON CHART = 13 dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE

ENGR ______ DATE MAY 1973

FIGURE A-151



FILE NO. ______

ANT #5, 10'

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG ELEV

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

ENGR ______

3

FIGURE A-147

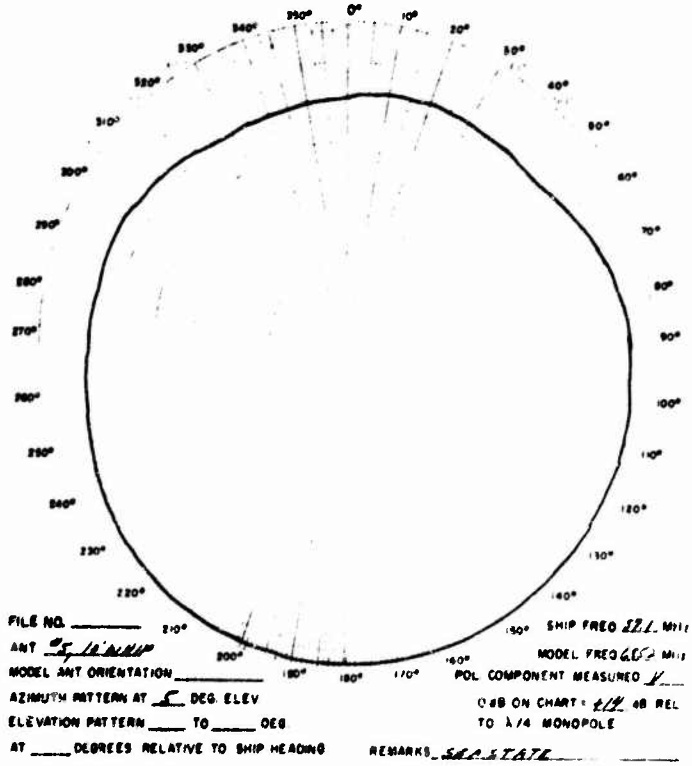


FIGURE A-148

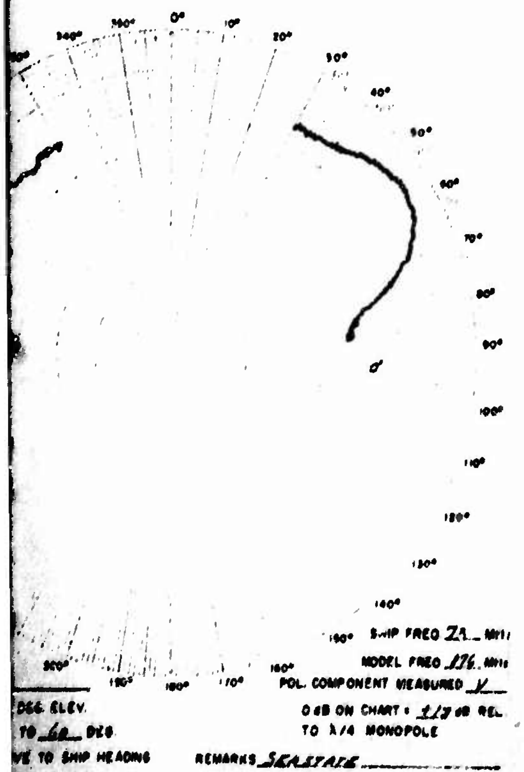


FIGURE A-152

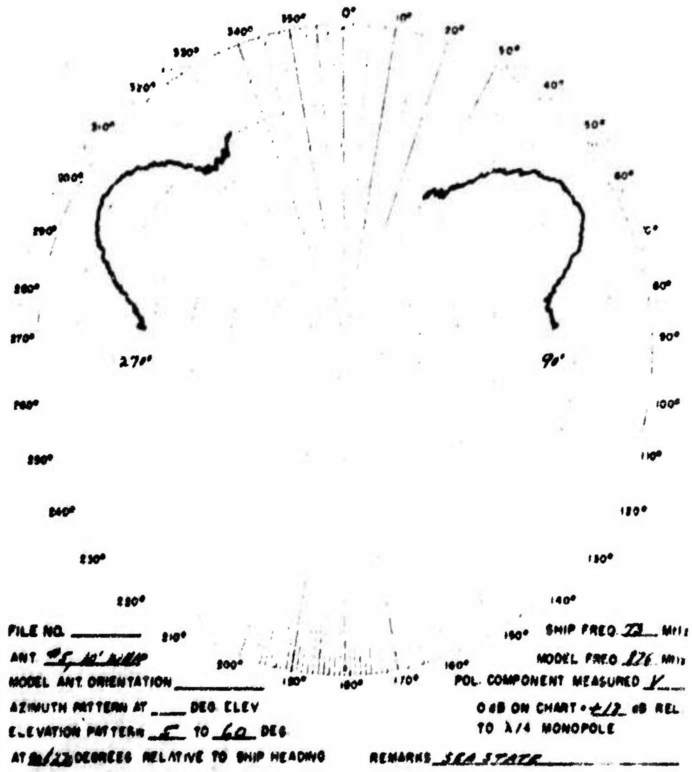
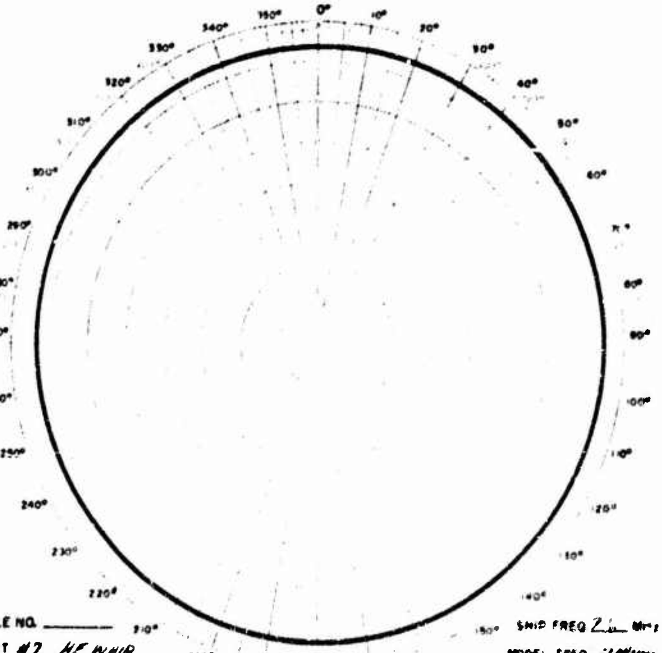
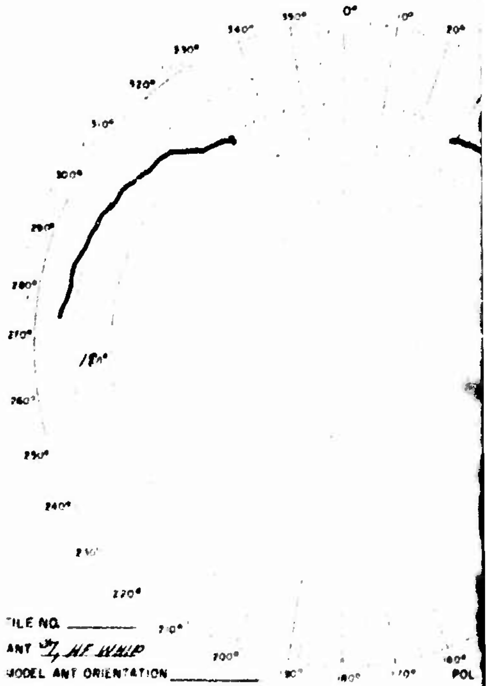


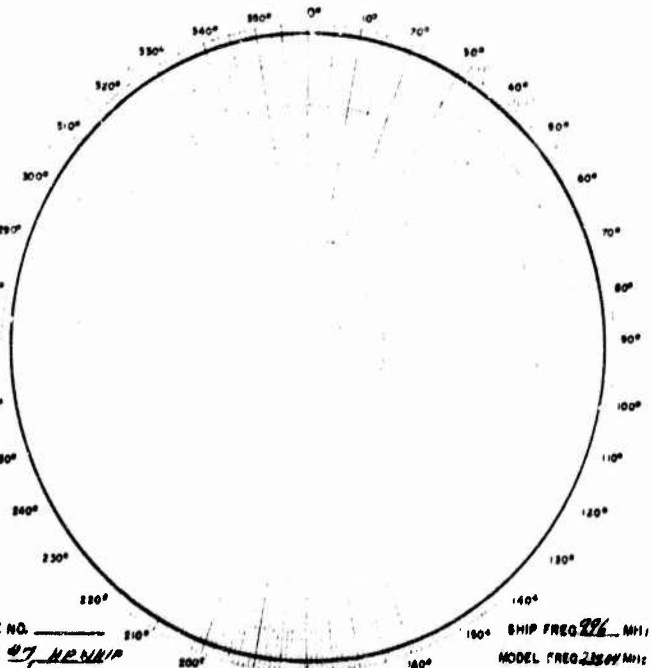
FIGURE A-153



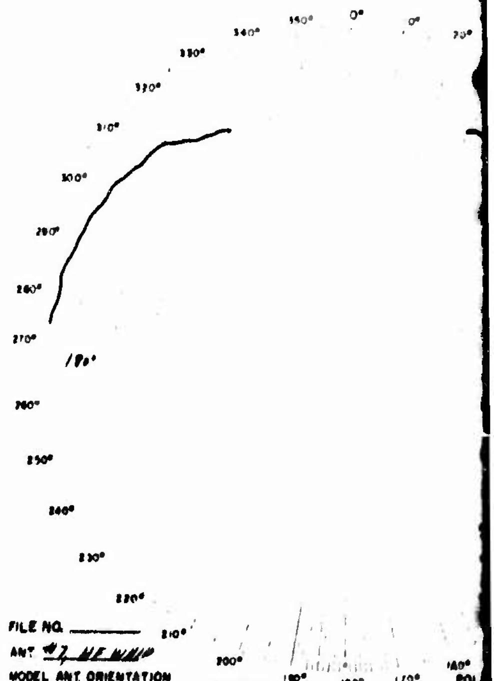
FILE NO. ________ SHIP FREQ 2.6 MHz
ANT #7, HF WHIP MODEL FREQ 1184 MHz
MODEL ANT ORIENTATION ________ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG ELEV 0 dB ON CHART = 0 dB REL
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS LAKE STATE
ENGR ________ DATE MAY 1973 FIGURE A-154



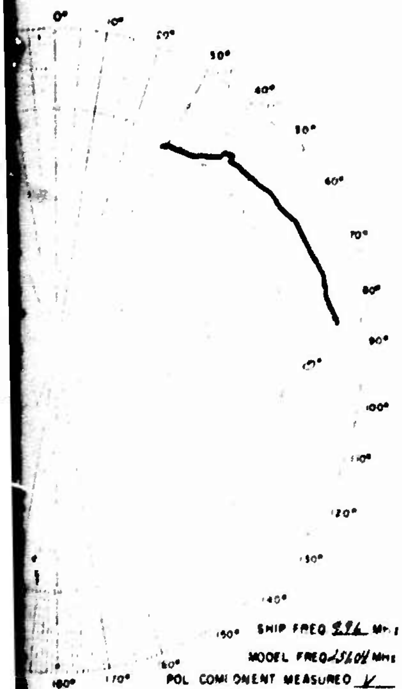
FILE NO. ________
ANT #7, HF WHIP
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS LAN
ENGR ________ DATE MAY 19



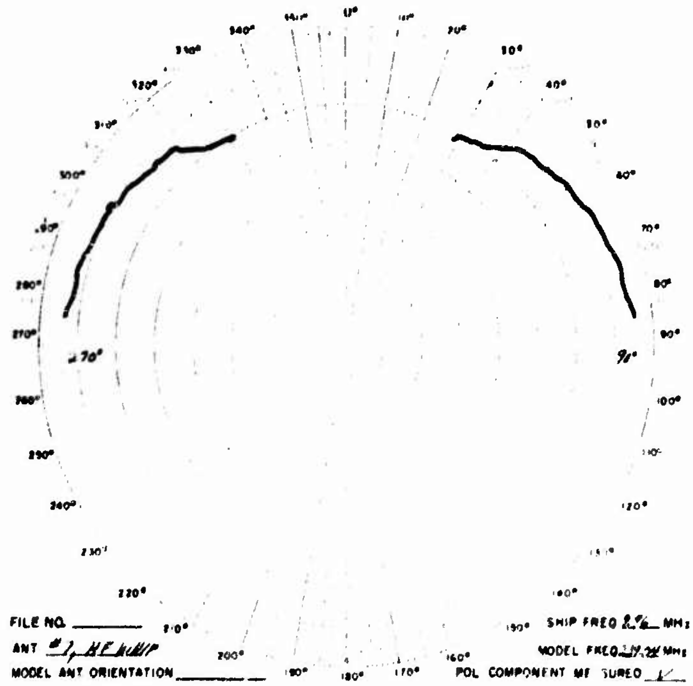
FILE NO. ________ SHIP FREQ 2.6 MHz
ANT #7, HF WHIP MODEL FREQ 1184 MHz
MODEL ANT ORIENTATION ________ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = 0 dB REL
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE
ENGR ________ DATE MAY 1973 FIGURE A-157



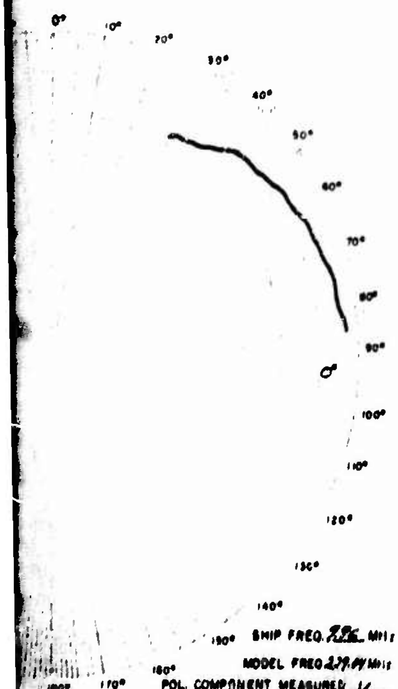
FILE NO. ________
ANT #7, HF WHIP
MODEL ANT ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN ____ TO ____ DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS SE
ENGR ________ DATE MAY 197



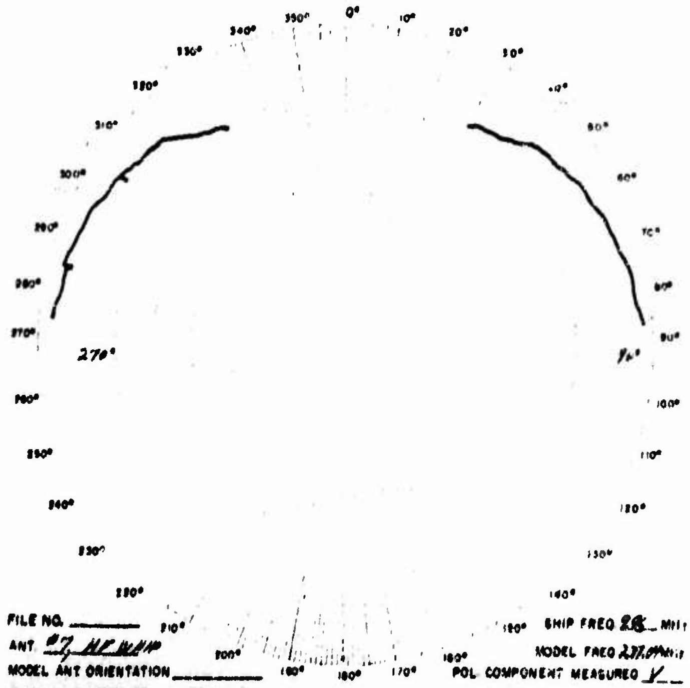
SHIP FREQ 2.96 MHz
MODEL FREQ 251.04 MHz
POL COMPONENT MEASURED V
0 dB ON CHART = 0 dB REL TO λ/4 MONOPOLE
REMARKS LAND STATE
DATE 11 MAY 1973 FIGURE A-155



FILE NO. ______
ANT #7, HF WHIP
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 2.96 MHz
MODEL FREQ 251.04 MHz
POL COMPONENT MEASURED V
0 dB ON CHART = 0 dB REL TO λ/4 MONOPOLE
REMARKS LAND STATE
ENGR ______ DATE 11 MAY 1973 FIGURE A-156



SHIP FREQ 2.96 MHz
MODEL FREQ 251.04 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = 0 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE
DATE 11 MAY 1973 FIGURE A-158



FILE NO. ______
ANT #7 HF WHIP
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG ELEV
ELEVATION PATTERN ____ TO ____ DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 2.96 MHz
MODEL FREQ 251.04 MHz
POL COMPONENT MEASURED V
0 dB ON CHART = 0 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE
ENGR ______ DATE 11 MAY 1973 FIGURE A-159

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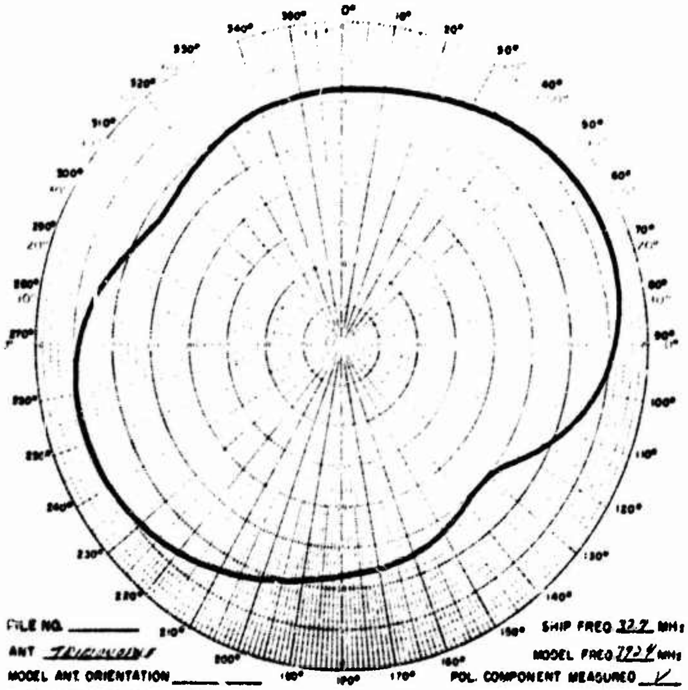
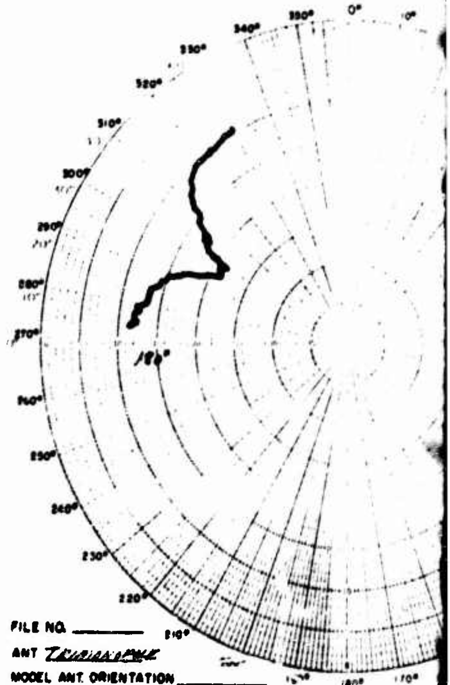


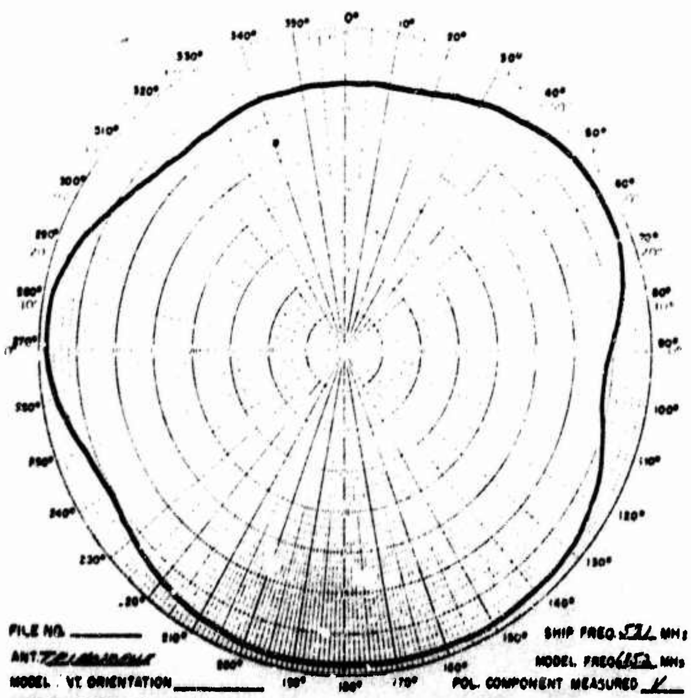
FILE NO. ________
ANT [illegible]
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.2 MHz
MODEL FREQ [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL. TO λ/4 MONOPOLE
REMARKS [illegible]

ENGR ________ DATE JUNE 1973 FIGURE A [illegible]



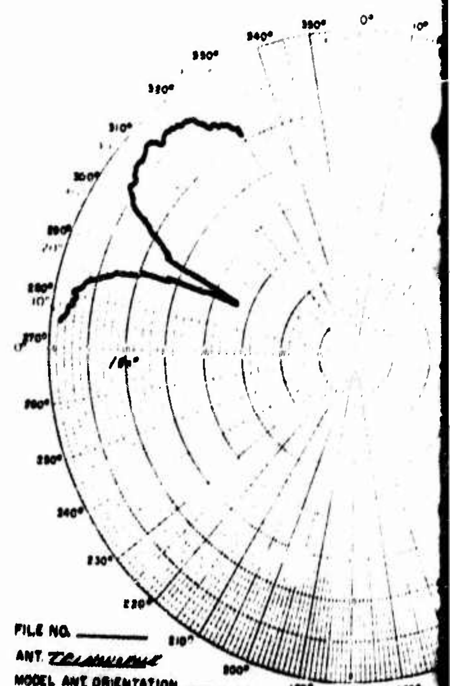
FILE NO. ________
ANT [illegible]
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT [illegible] DEGREES RELATIVE TO SHIP HEADING
REMARKS
ENGR ________ DATE [illegible]



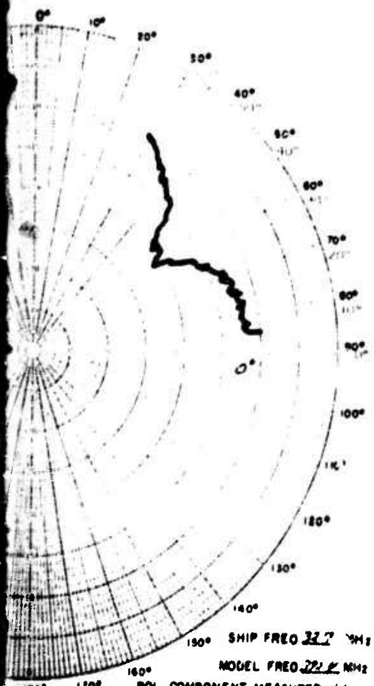
FILE NO. ________
ANT. [illegible]
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT 5 DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ. [illegible] MHz
MODEL FREQ. [illegible] MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = [illegible] dB REL. TO λ/4 MONOPOLE
REMARKS [illegible]

ENGR ________ DATE [illegible] FIGURE A-166

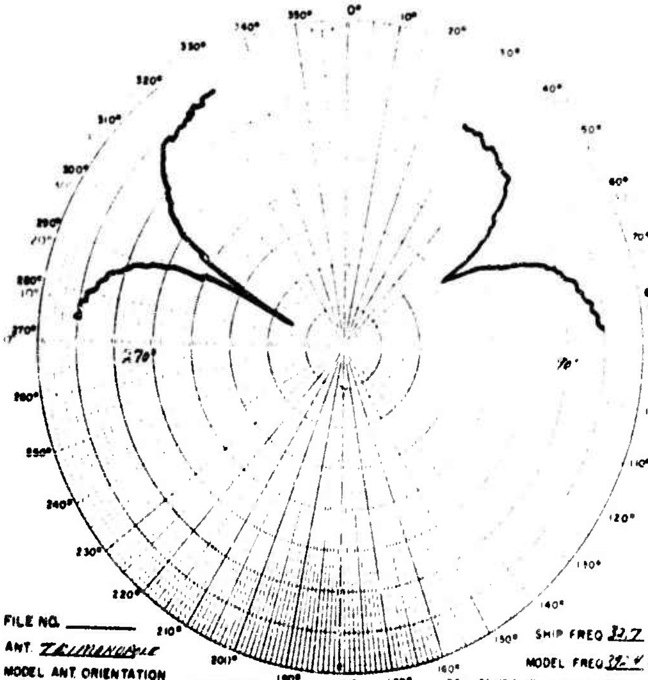


FILE NO. ________
ANT. [illegible]
MODEL ANT. ORIENTATION ________
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT [illegible] DEGREES RELATIVE TO SHIP HEADING
REMARKS
ENGR ________ DATE [illegible]



SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL. TO λ/4 MONOPOLE

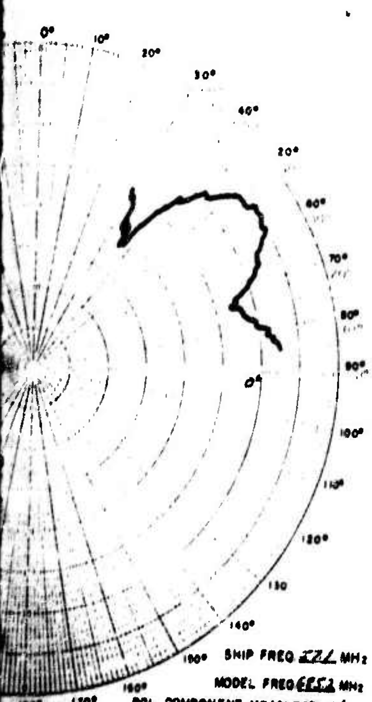
REMARKS LAND STATE, STERN
DATE June 1973 FIGURE A-161



FILE NO. ______
ANT. TRIMMONOPOLE
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

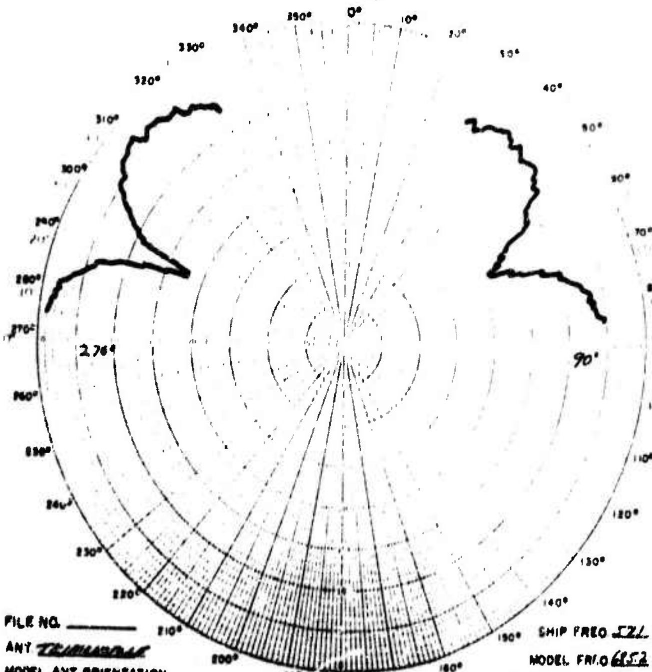
SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, STERN
ENGR ______ DATE June 1973 FIGURE A-162



SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +11.8 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, STERN
DATE June 1973 FIGURE A-167

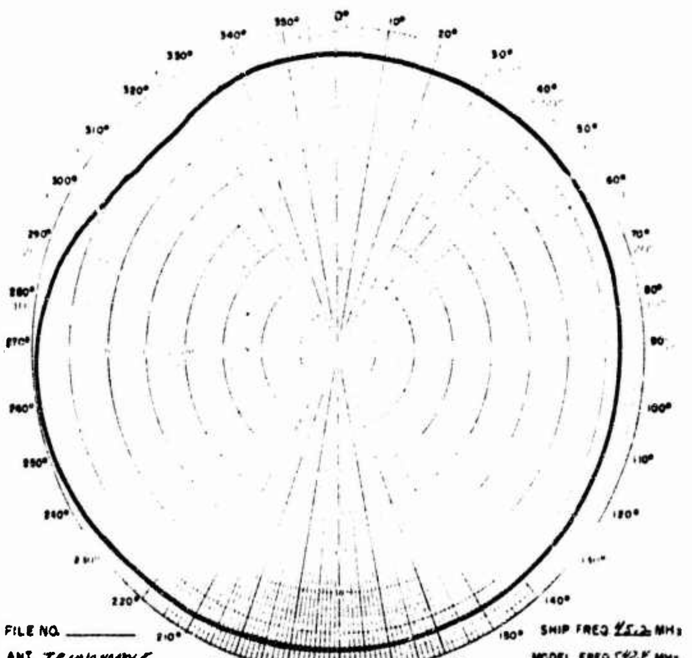


FILE NO. ______
ANT. TRIMMONOPOLE
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 57.1 MHz
MODEL FREQ 685.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +11.8 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, STERN
ENGR ______ DATE June 1973 FIGURE A-168

2



FILE NO. ______ ANT *TRIMONOPOLE* MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT *5* DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING

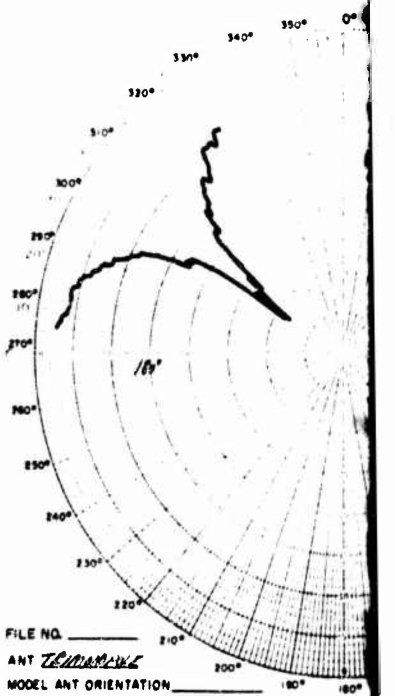
SHIP FREQ *45.2* MHz MODEL FREQ *542.4* MHz

POL. COMPONENT MEASURED *V*

0 dB ON CHART = *+5.7* dB REL. TO λ/4 MONOPOLE

REMARKS *LAND STATE, STERN*

ENGR ______ DATE *JUNE 1977* *FIGURE A-161*



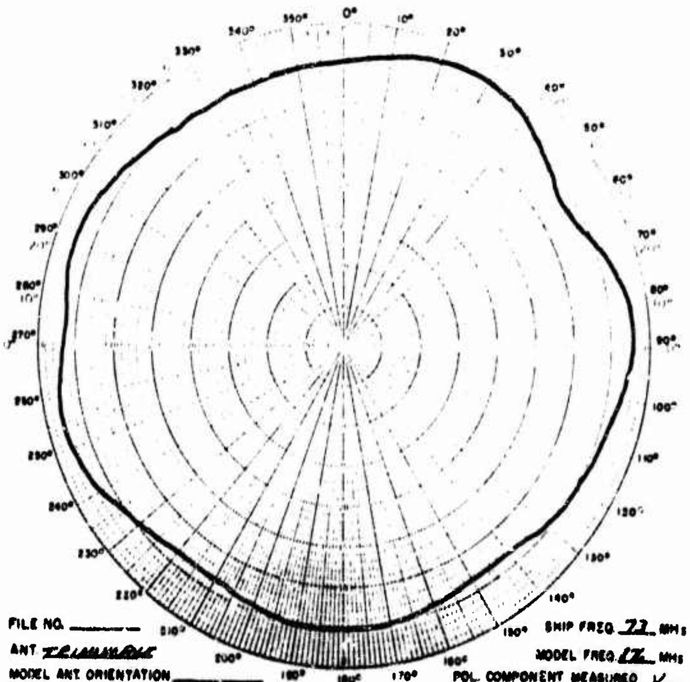
FILE NO. ______ ANT *TRIMONOPOLE* MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN *5* TO *60* DEG

AT *0/180* DEGREES RELATIVE TO SHIP HEADING

ENGR ______



FILE NO. ______ ANT *TRIMONOPOLE* MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT *5* DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

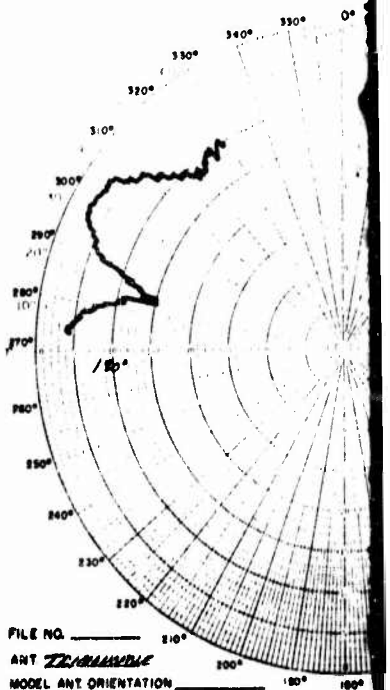
SHIP FREQ *73* MHz MODEL FREQ *876* MHz

POL. COMPONENT MEASURED *V*

0 dB ON CHART = *0.8* dB REL. TO λ/4 MONOPOLE

REMARKS *LAND STATE, STERN*

ENGR ______ DATE *JUNE 1977* *FIGURE A-169*



FILE NO. ______ ANT *TRIMONOPOLE* MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN *5* TO *60* DEG

AT *0/180* DEGREES RELATIVE TO SHIP HEADING

ENGR ______

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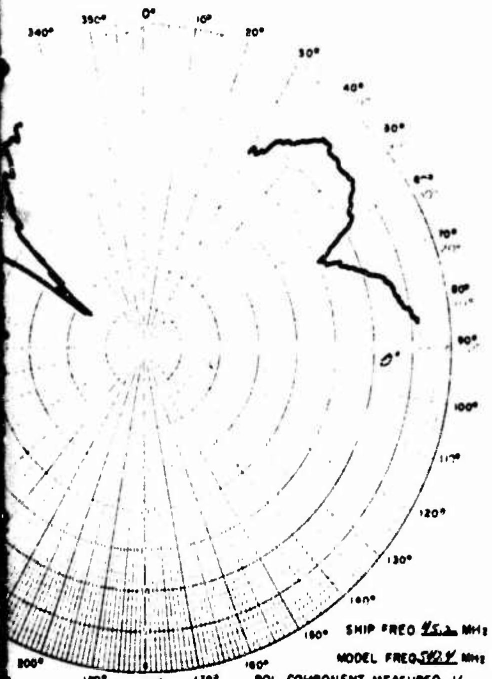
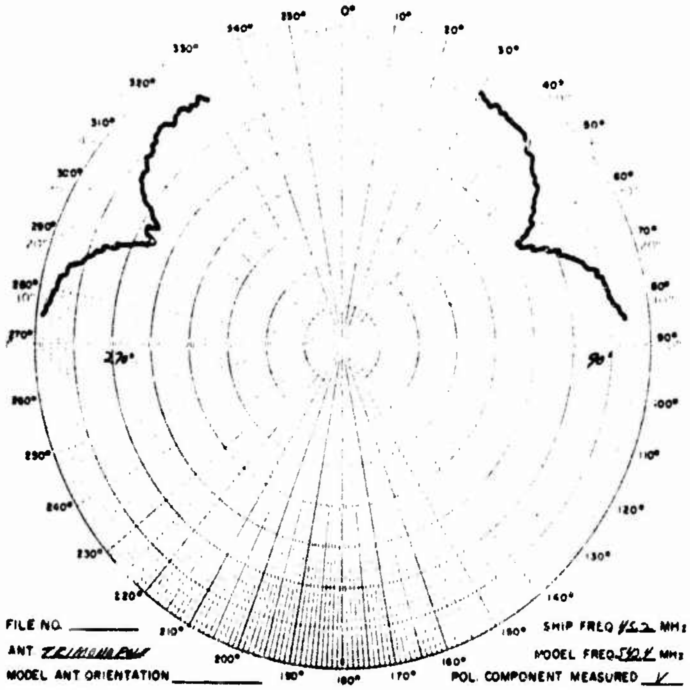
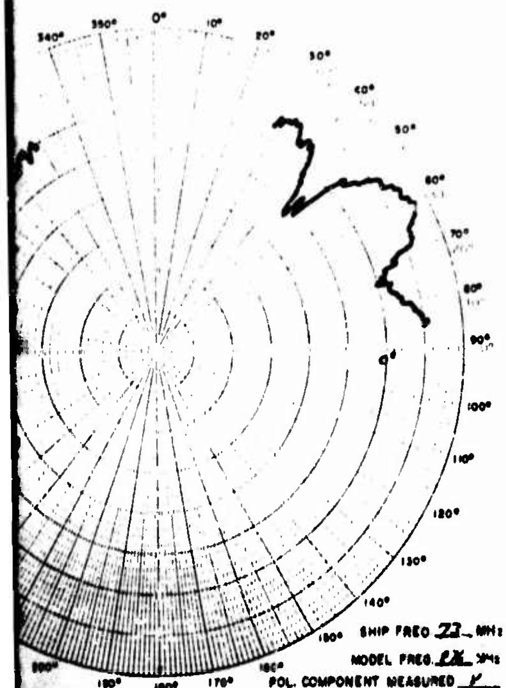


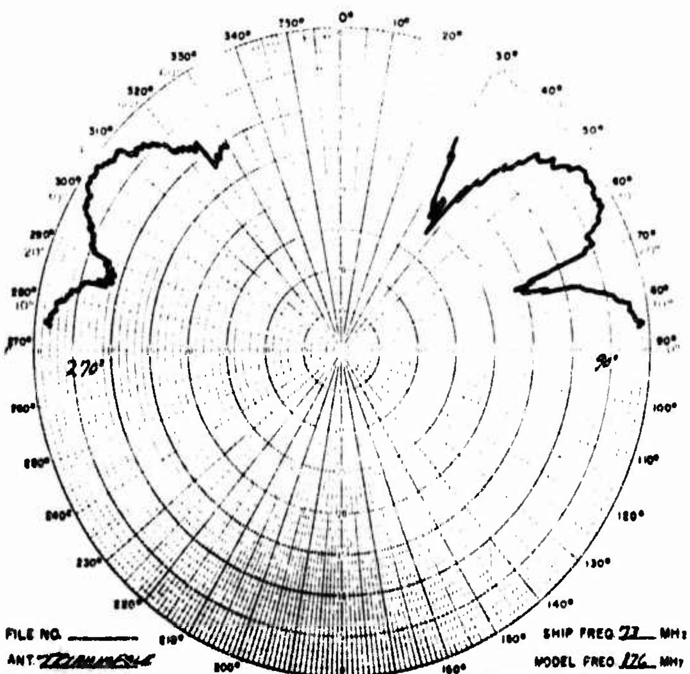
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
. ELEV.
0 dB ON CHART = +5.7 dB REL. TO λ/4 MONOPOLE
60 DEG
TO SHIP HEADING
REMARKS LAND STATE, STERN
ENGR ________ DATE June 1973 FIGURE A-164



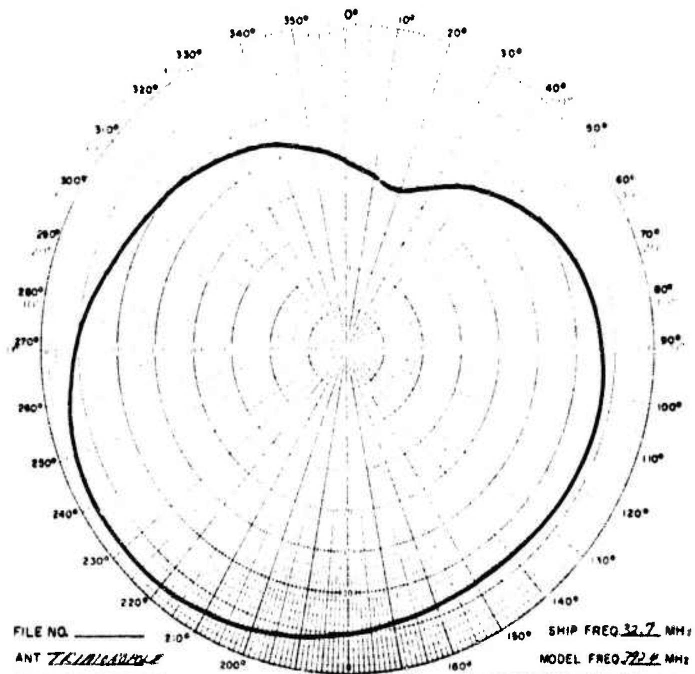
FILE NO. ________
SHIP FREQ 45.2 MHz
ANT TRIMONOPOLE
MODEL FREQ 542.4 MHz
MODEL ANT ORIENTATION ________
POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV.
0 dB ON CHART = +5.7 dB REL.
ELEVATION PATTERN 5 TO 60 DEG
TO λ/4 MONOPOLE
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
REMARKS LAND STATE, STERN
ENGR ________ DATE June 1973 FIGURE A-165



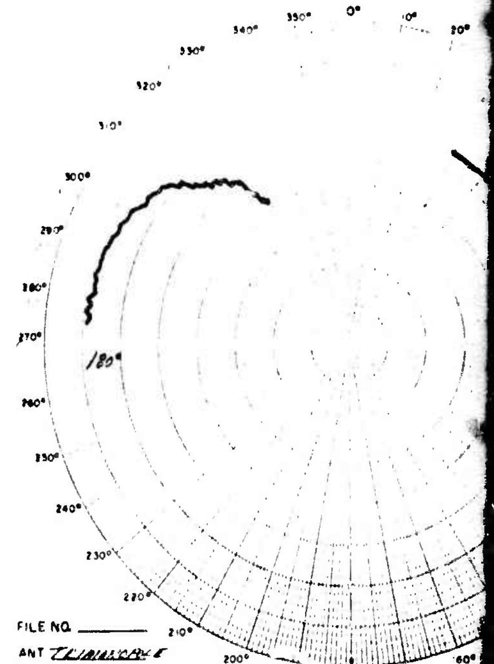
SHIP FREQ 23 MHz
MODEL FREQ 276 MHz
POL. COMPONENT MEASURED V
S. ELEV.
0 dB ON CHART = 0.8 dB REL. TO λ/4 MONOPOLE
60 DEG.
TO SHIP HEADING
REMARKS LAND STATE, STERN
ENGR ________ DATE June 1973 FIGURE A-170



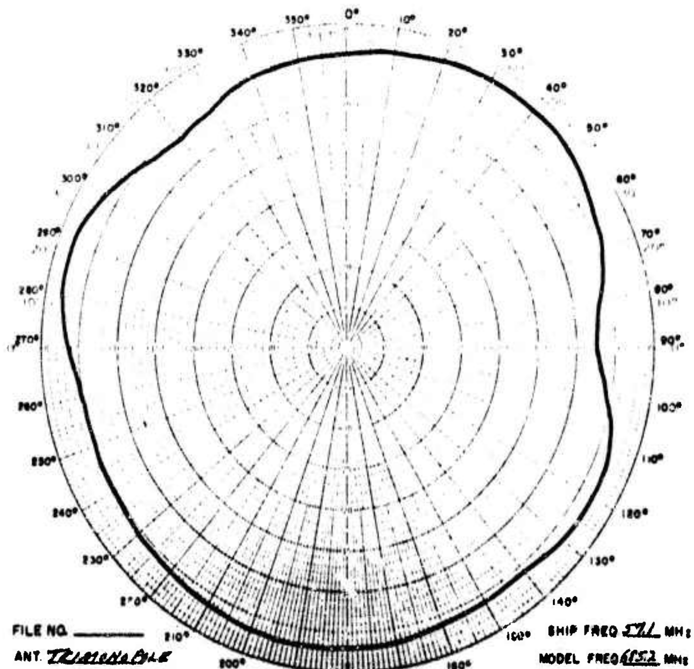
FILE NO. ________
SHIP FREQ 23 MHz
ANT TRIMONOPOLE
MODEL FREQ 276 MHz
MODEL ANT ORIENTATION ________
POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT ____ DEG. ELEV.
0 dB ON CHART = 0.8 dB REL.
ELEVATION PATTERN 5 TO 60 DEG.
TO λ/4 MONOPOLE
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
REMARKS LAND STATE, STERN
ENGR ________ DATE June 1973 FIGURE A-171



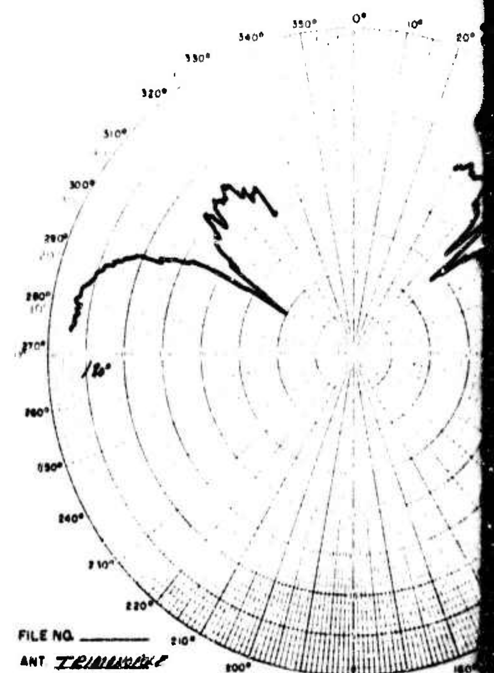
FILE NO. ______ SHIP FREQ 32.7 MHz
ANT TRIMONOPOLE MODEL FREQ 792.4 MHz
MODEL ANT. ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV 0 dB ON CHART = +5.2 dB REL TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE, STERN
ENGR ______ DATE JUNE 1973 FIGURE A-172



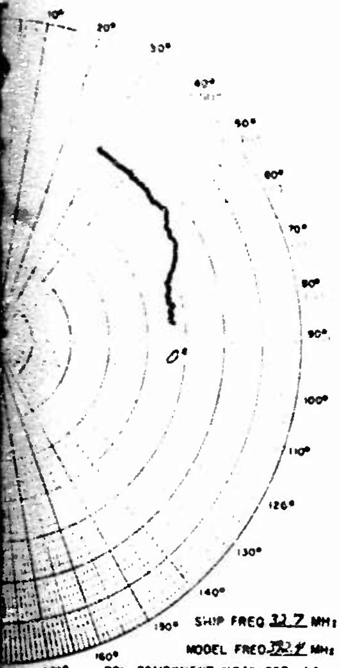
FILE NO. ______
ANT TRIMONOPOLE
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS SEA
ENGR ______ DATE JUNE



FILE NO. ______ SHIP FREQ 57.1 MHz
ANT. TRIMONOPOLE MODEL FREQ 685.2 MHz
MODEL ANT. ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG. ELEV. 0 dB ON CHART = +5.7 dB REL. TO λ/4 MONOPOLE
ELEVATION PATTERN ____ TO ____ DEG.
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE, STERN
ENGR ______ DATE JUNE 1973 FIGURE A-171



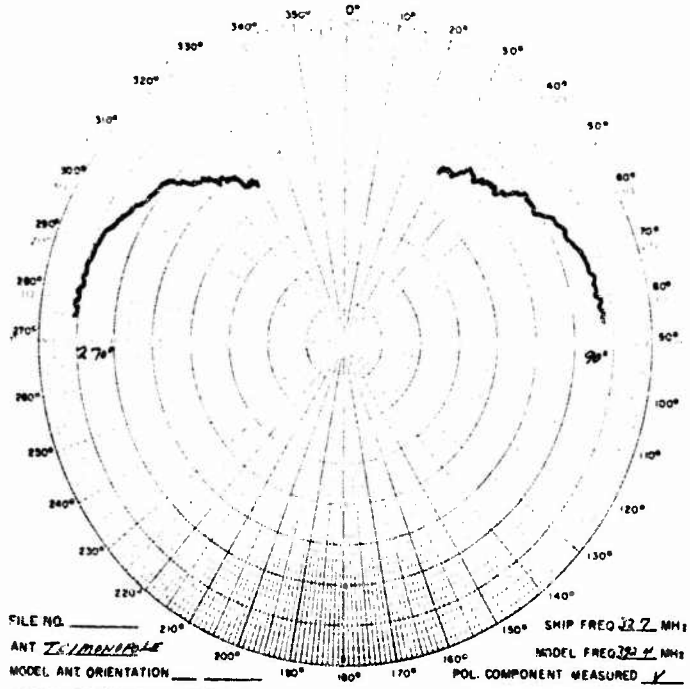
FILE NO. ______
ANT TRIMONOPOLE
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN ____ TO ____ DEG.
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS SE
ENGR ______ DATE JUNE



SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.2 dB REL.
TO λ/4 MONOPOLE

REMARKS SEA STATE, STERN

DATE JUNE 1973 FIGURE A-173

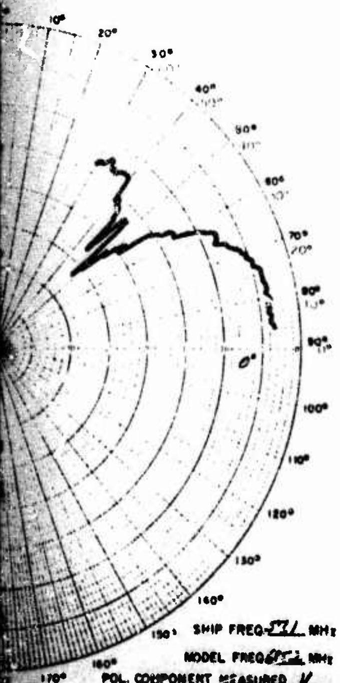


FILE NO. ______
ANT TRI MONOPOLE
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 392.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.2 dB REL.
TO λ/4 MONOPOLE

REMARKS SEA STATE, STERN

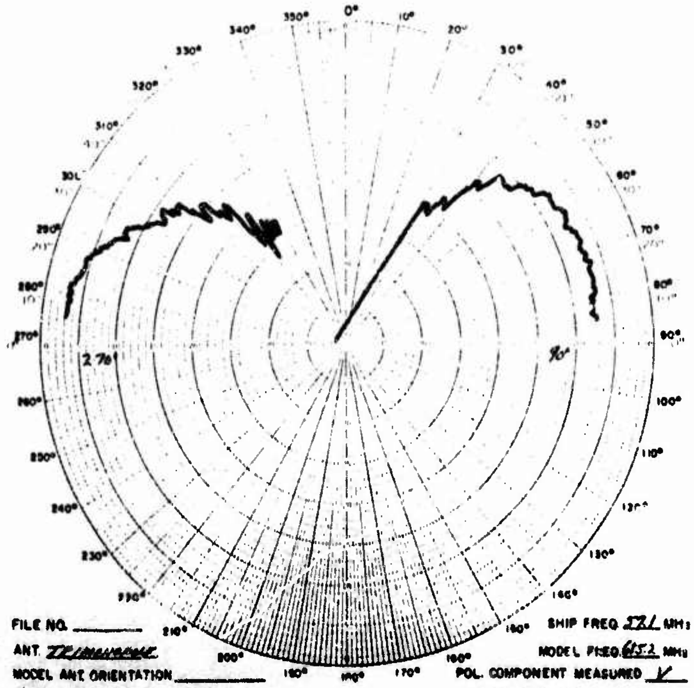
ENGR ______ DATE JUNE 1973 FIGURE A-174



SHIP FREQ 51.1 MHz
MODEL FREQ 613.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.7 dB REL.
TO λ/4 MONOPOLE

REMARKS SEA STATE, STERN

DATE JUNE 1973 FIGURE A-179



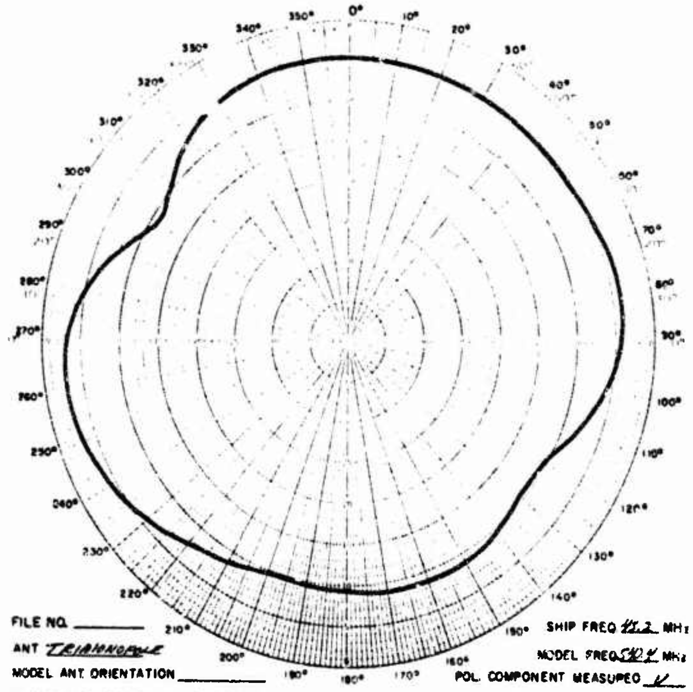
FILE NO. ______
ANT TRI MONOPOLE
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 51.1 MHz
MODEL FREQ 613.2 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.7 dB REL.
TO λ/4 MONOPOLE

REMARKS SEA STATE, STERN

ENGR ______ DATE JUNE 1973 FIGURE A-180

12



FILE NO. ______

ANT TRIMONOPOLE

MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.2 MHz

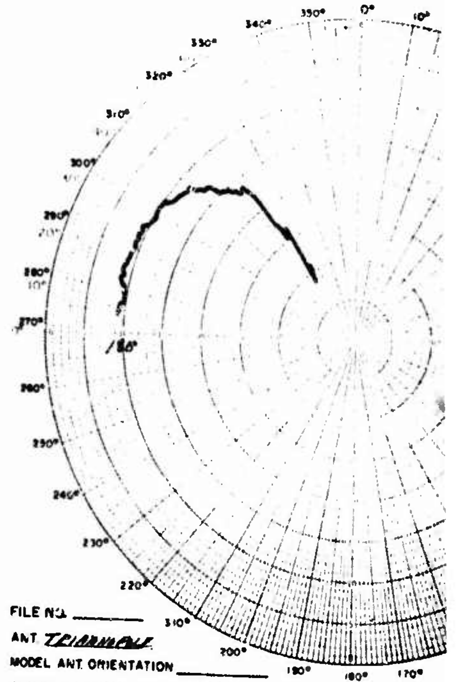
MODEL FREQ 540.4 MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = +5.6 dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE, STERN

ENGR ______ DATE JUNE 1973 FIGURE A-175



FILE NO. ______

ANT TRIMONOPOLE

MODEL ANT. ORIENTATION ______

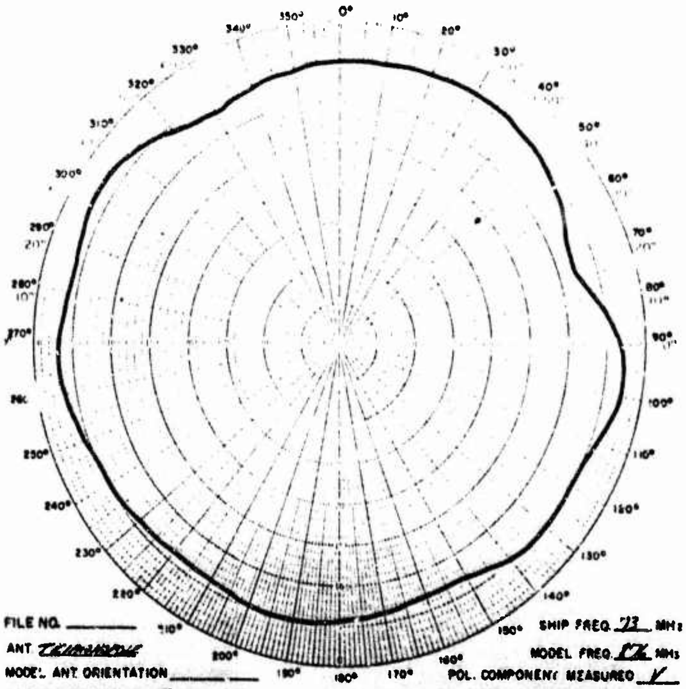
AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ______ DATE



FILE NO. ______

ANT TRIMONOPOLE

MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ. 73 MHz

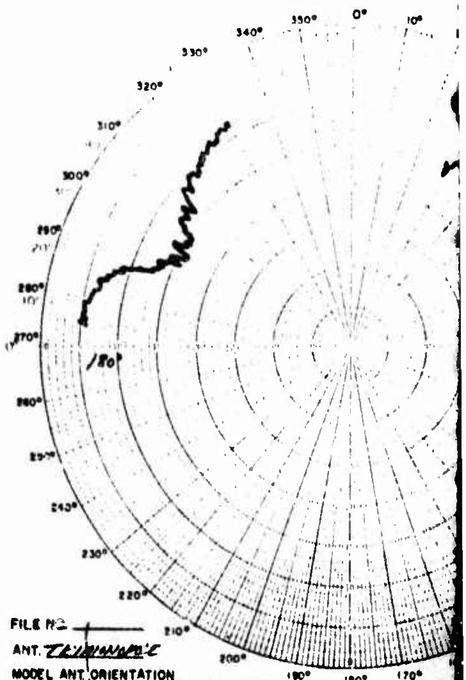
MODEL FREQ. 876 MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = +5.5 dB REL. TO λ/4 MONOPOLE

REMARKS SEA STATE, STERN

ENGR ______ DATE JUNE 1973 FIGURE A-181



FILE NO. ______

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

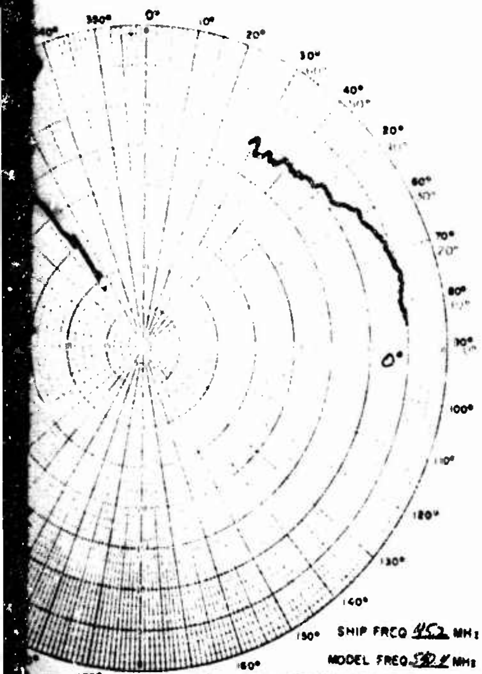
ELEVATION PATTERN ____ TO ____ DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ______ DATE

3



SHIP FREQ 452 MHz

MODEL FREQ 540.4 MHz

POL. COMPONENT MEASURED V

...ELEV.

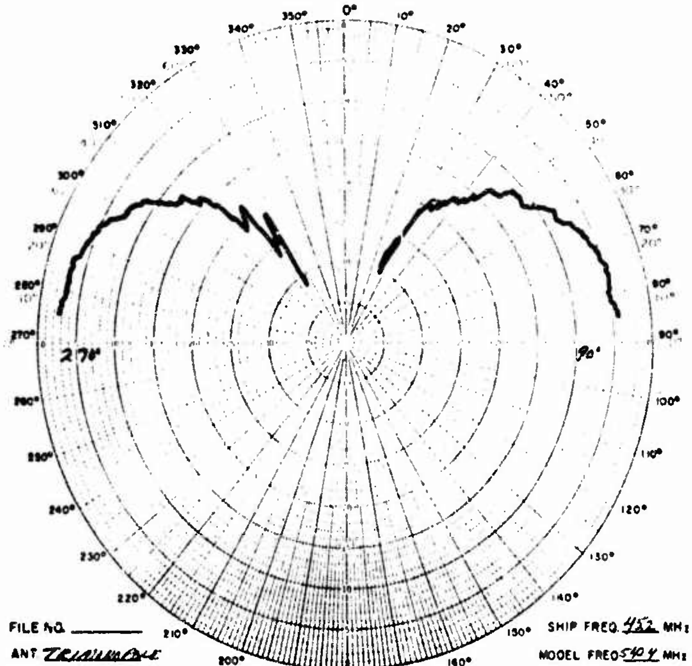
0 dB ON CHART = +5.6 dB REL. TO λ/4 MONOPOLE

...DEG.

...IP HEADING

REMARKS SEA STATE, STERN

ENGR ______ DATE June 1972 FIGURE A-176



FILE NO. ______

SHIP FREQ 452 MHz

ANT TRIMONOPOLE

MODEL FREQ 540.4 MHz

MODEL ANT ORIENTATION ______

POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT ____ DEG. ELEV.

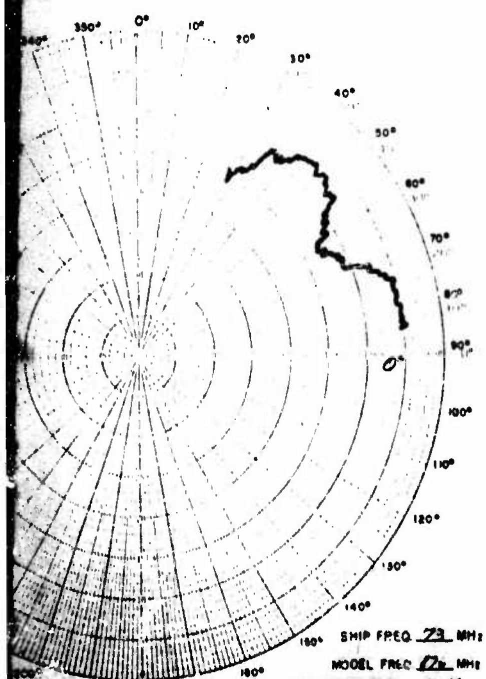
0 dB ON CHART = +5.6 dB REL. TO λ/4 MONOPOLE

ELEVATION PATTERN 5 TO 60 DEG.

AT 90/270 DEGREES RELATIVE TO SHIP HEADING

REMARKS SEA STATE, STERN

ENGR ______ DATE June 1972 FIGURE A-177



SHIP FREQ 73 MHz

MODEL FREQ 876 MHz

POL. COMPONENT MEASURED V

...ELEV.

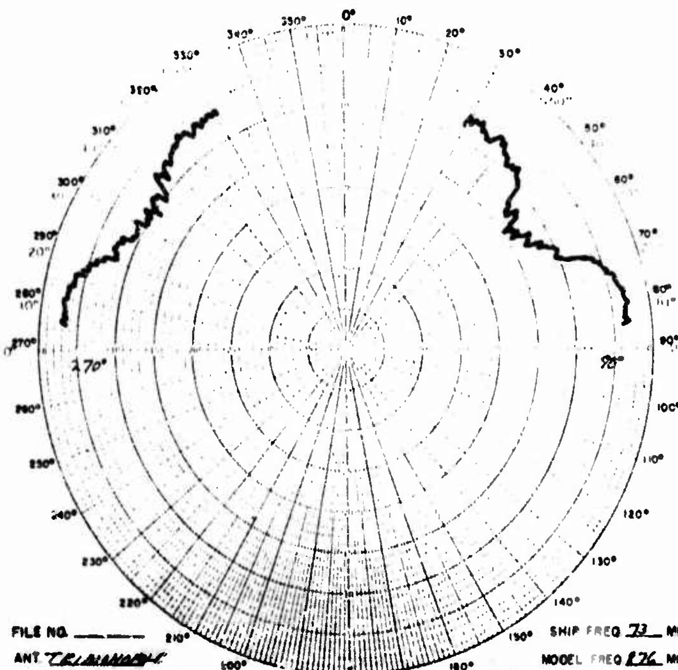
0 dB ON CHART = +5.5 dB REL. TO λ/4 MONOPOLE

____ DEG.

...C SHIP HEADING

REMARKS SEA STATE, STERN

ENGR ______ DATE June 1972 FIGURE A-182



FILE NO. ______

SHIP FREQ 73 MHz

ANT TRIMONOPOLE

MODEL FREQ 876 MHz

MODEL ANT ORIENTATION ______

POL. COMPONENT MEASURED V

AZIMUTH PATTERN AT ____ DEG. ELEV.

0 dB ON CHART = +5.5 dB REL. TO λ/4 MONOPOLE

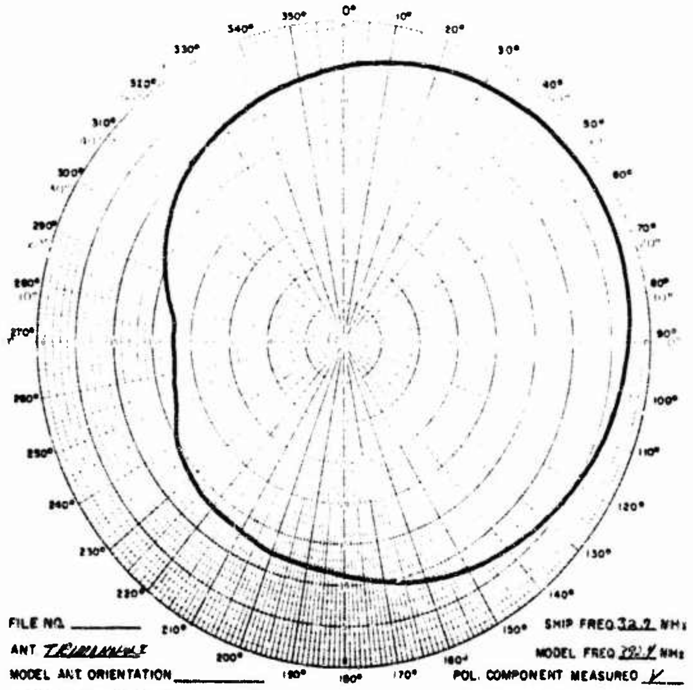
ELEVATION PATTERN 5 TO 60 DEG.

AT 90/270 DEGREES RELATIVE TO SHIP HEADING

REMARKS SEA STATE, STERN

ENGR ______ DATE June 1972 FIGURE A-183

4



FILE NO. ________

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION __________

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.2 MHz

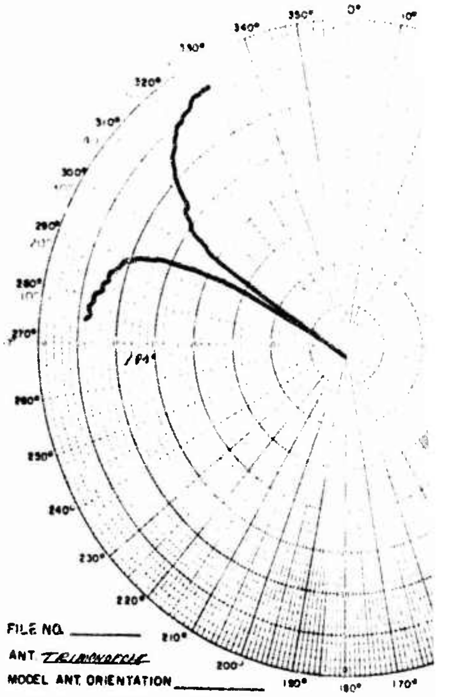
MODEL FREQ 29?.4 MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = +5.1 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, AIRVEHICLE

ENGR. ________ DATE JUNE 1973 FIGURE A-184



FILE NO. ________

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION __________

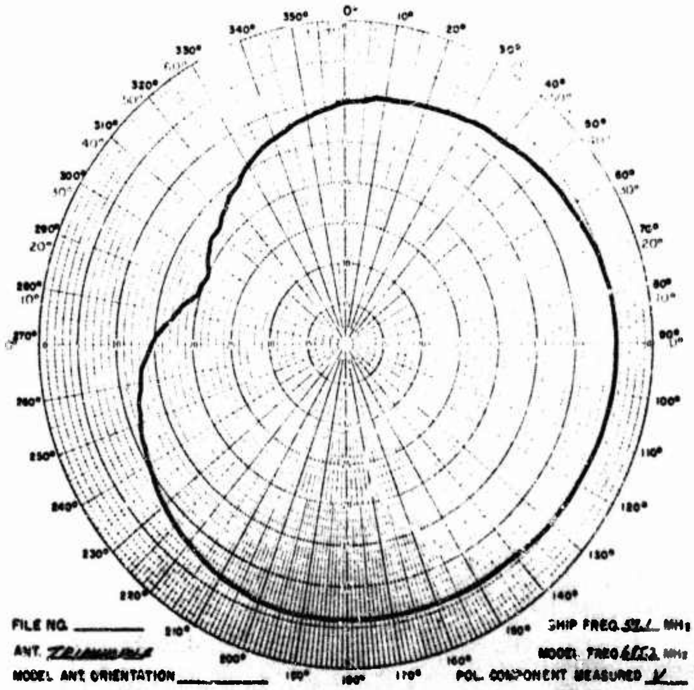
AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ________ DATE



FILE NO. ________

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION __________

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 57.1 MHz

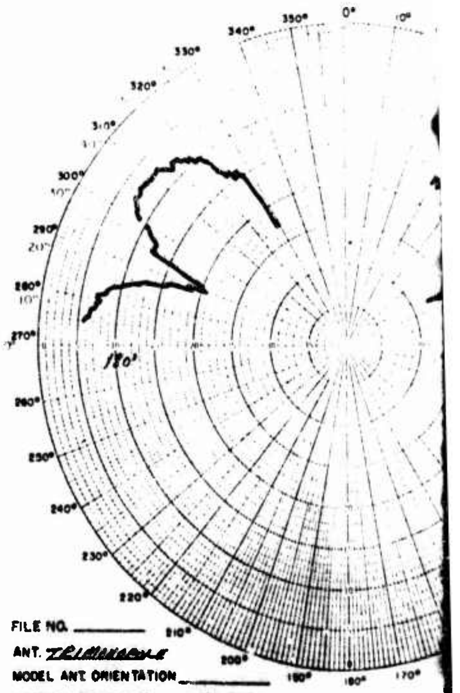
MODEL FREQ 6??.? MHz

POL. COMPONENT MEASURED V

0 dB ON CHART = +6.4 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, AIRVEHICLE

ENGR ________ DATE JUNE 1973 FIGURE A-190



FILE NO. ________

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION __________

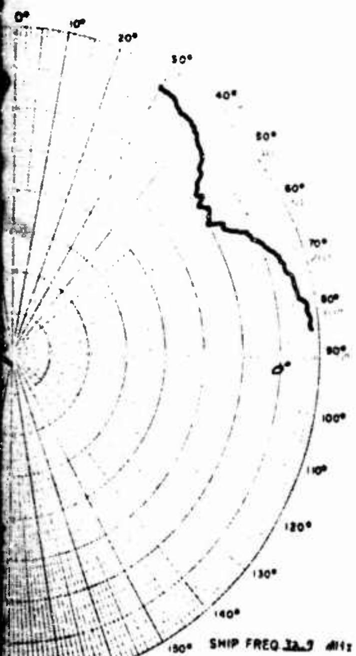
AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMARKS

ENGR ________ DATE



SHIP FREQ 32.9 MHz

MODEL FREQ [illegible] MHz

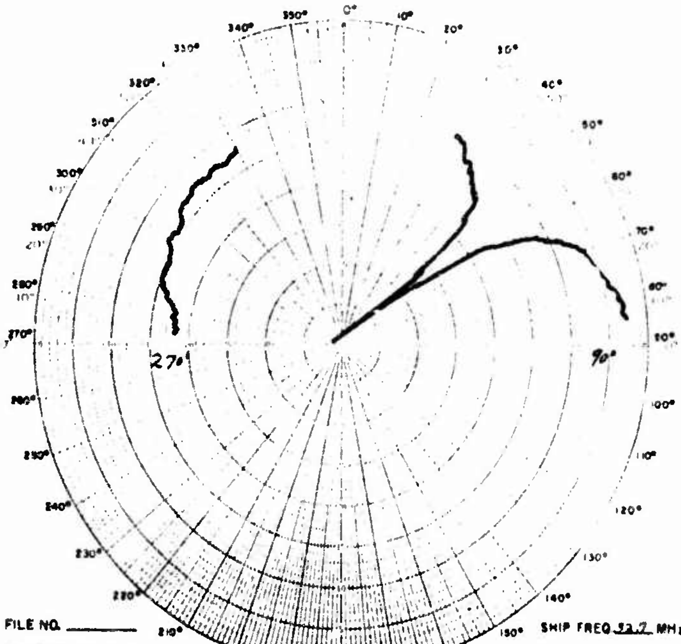
POL. COMPONENT MEASURED V

0 dB ON CHART = 10.1 dB REL.

TO λ/4 MONOPOLE

REMARKS LAND STATES, MIDVEHICLE

DATE JUNE, 1973 FIGURE A-185



FILE NO. ________

ANT TRIMONOPOLE

MODEL ANT. ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz

MODEL FREQ 192.4 MHz

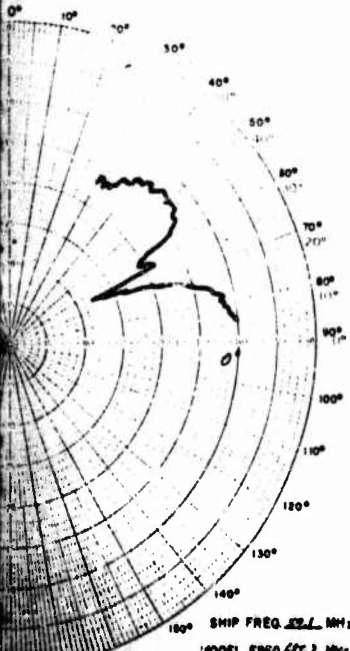
POL. COMPONENT MEASURED V

0 dB ON CHART = +5.1 dB REL.

TO λ/4 MONOPOLE

REMARKS LAND STATE, MIDVEHICLE

ENGR ________ DATE JUNE 1973 FIGURE A-186



SHIP FREQ 57.1 MHz

MODEL FREQ 685.3 MHz

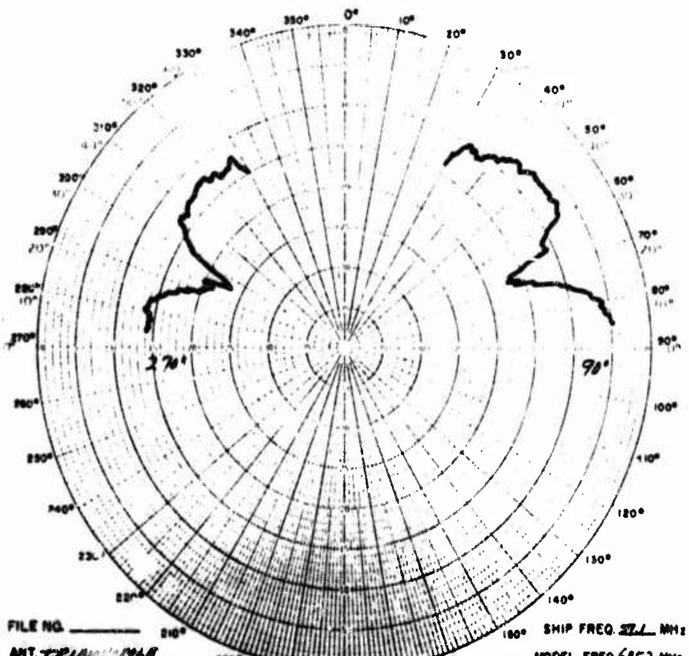
POL. COMPONENT MEASURED V

0 dB ON CHART = +6.4 dB REL.

TO λ/4 MONOPOLE

REMARKS LAND STATE, MIDVEHICLE

DATE JUNE 1973 FIGURE A-191



FILE NO. ________

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION ________

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 90/270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 57.1 MHz

MODEL FREQ 685.3 MHz

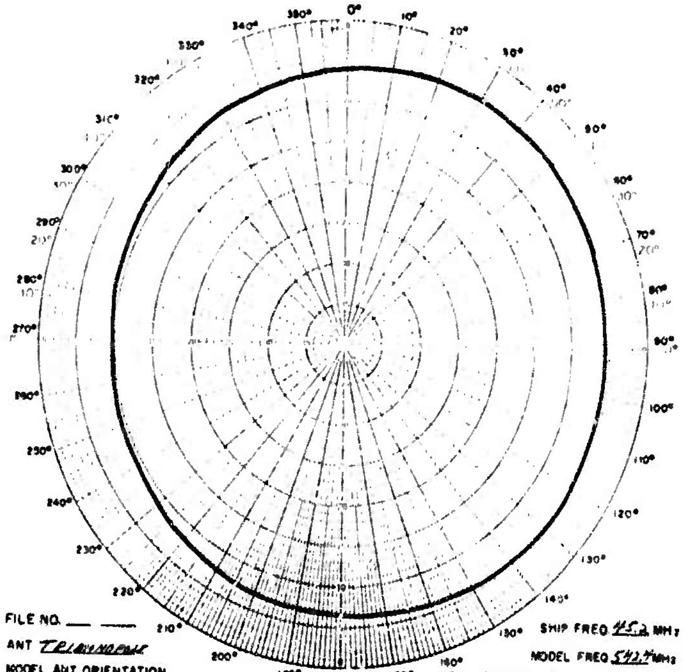
POL. COMPONENT MEASURED V

0 dB ON CHART = +6.4 dB REL.

TO λ/4 MONOPOLE

REMARKS LAND STATE, MIDVEHICLE

ENGR ________ DATE JUNE 1973 FIGURE A-192



FILE NO. ___ ___

ANT TRIANGLEPOLE

MODEL ANT ORIENTATION ___

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ___ TO ___ DEG.

AT ___ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.2 MHz

MODEL FREQ 542.4 MHz

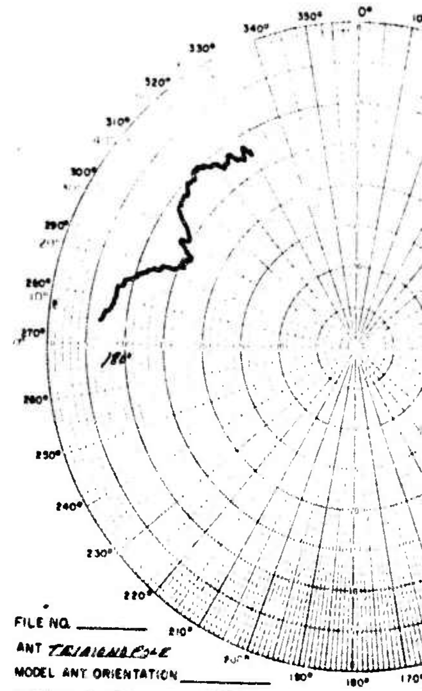
POL. COMPONENT MEASURED V

0 dB ON CHART = +2 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, MIDVEHICLE

ENGR ___ DATE JUNE 1973

FIGURE A-187



FILE NO. ___

ANT TRIANGLEPOLE

MODEL ANT ORIENTATION ___

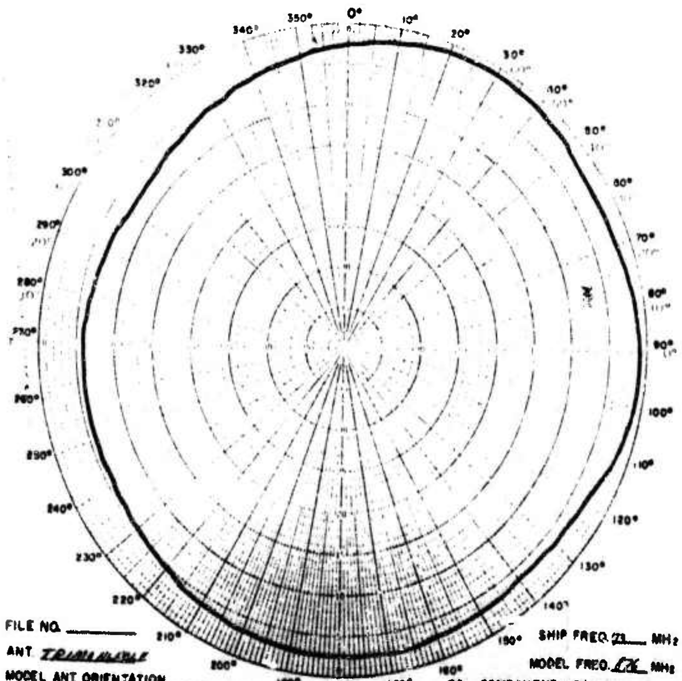
AZIMUTH PATTERN AT ___ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

REMAR

ENGR ___ DATE



FILE NO. ___

ANT TRIANGLEPOLE

MODEL ANT ORIENTATION ___

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ___ TO ___ DEG.

AT ___ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 73 MHz

MODEL FREQ 876 MHz

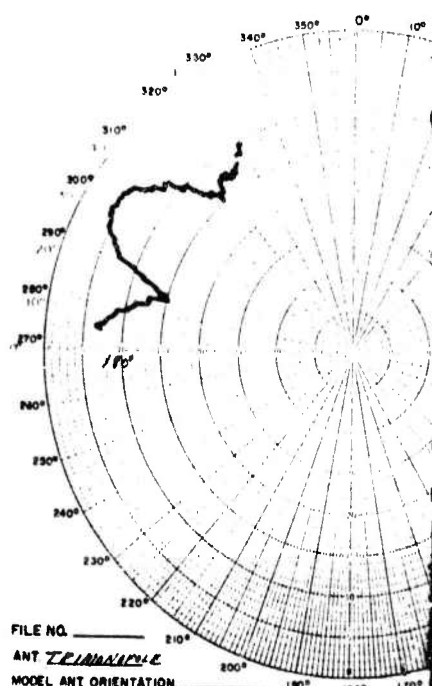
POL. COMPONENT MEASURED V

0 dB ON CHART +8.7 dB REL. TO λ/4 MONOPOLE

REMARKS LAND STATE, MIDVEHICLE

ENGR ___ DATE JUNE 1973

FIGURE A-193



FILE NO. ___

ANT TRIANGLEPOLE

MODEL ANT ORIENTATION ___

AZIMUTH PATTERN AT ___ DEG. ELEV.

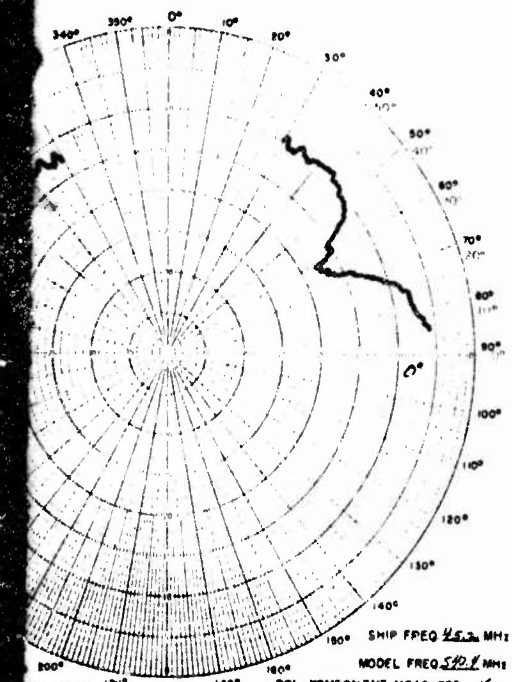
ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

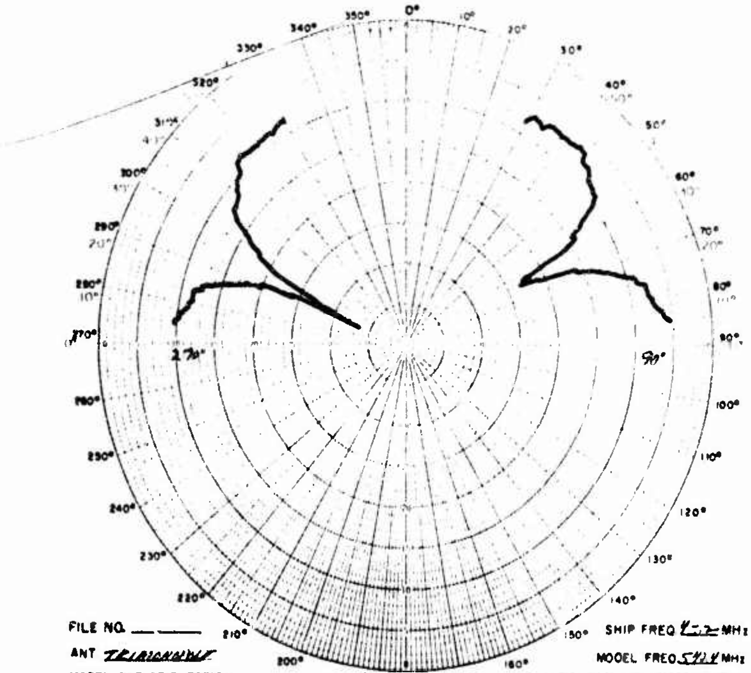
REMARK

ENGR ___ DATE

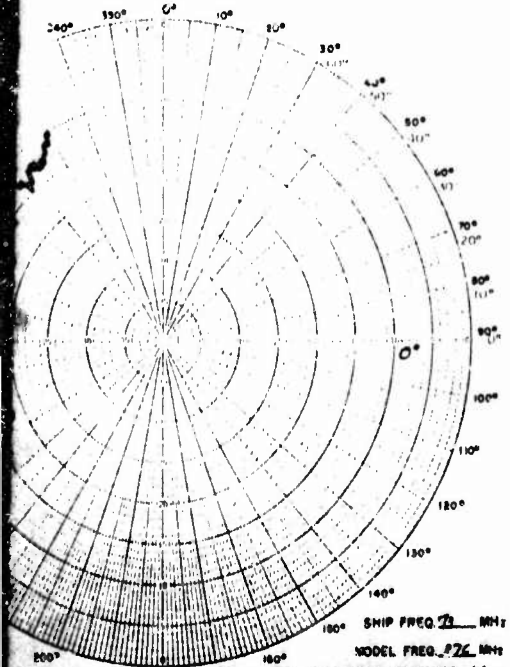
3



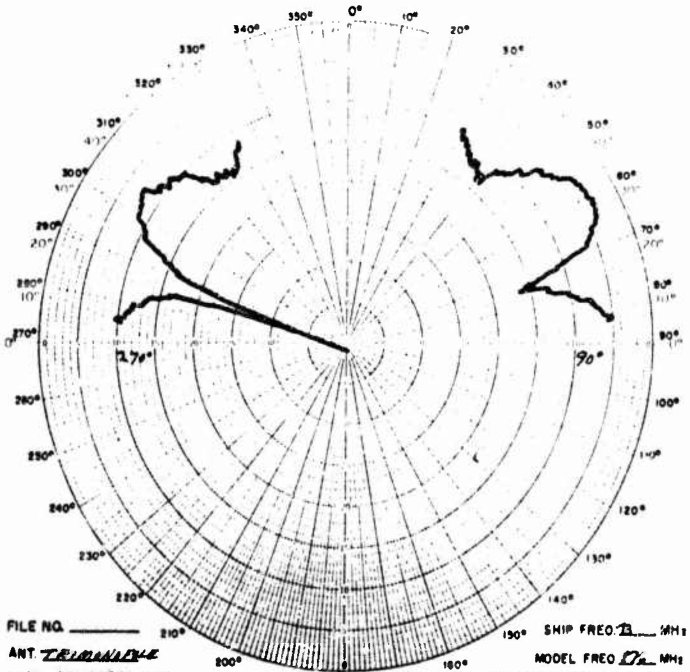
SHIP FREQ 45.2 MHz
MODEL FREQ 540.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +1.2 dB REL.
TO λ/4 MONOPOLE
...G. ELEV.
...60 DEG
...TO SHIP HEADING
REMARKS LAND STATE, MIDVEHICLE
ENGR ______ DATE JUNE 1973
FIGURE A-188



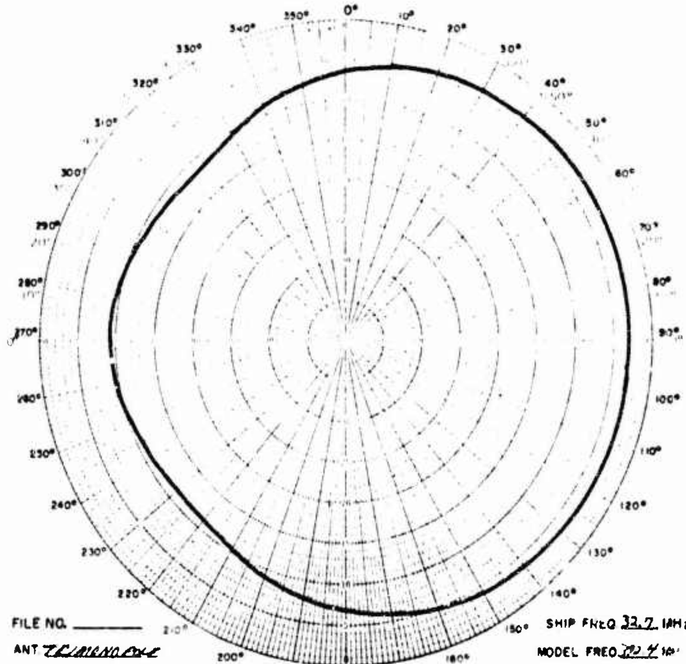
FILE NO. ______
ANT TRIMONOPOLE
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV
ELEVATION PATTERN 5 TO 60 DEG
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 45.2 MHz
MODEL FREQ 540.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +1.2 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE, MIDVEHICLE
ENGR ______ DATE JUNE 1973
FIGURE A-189



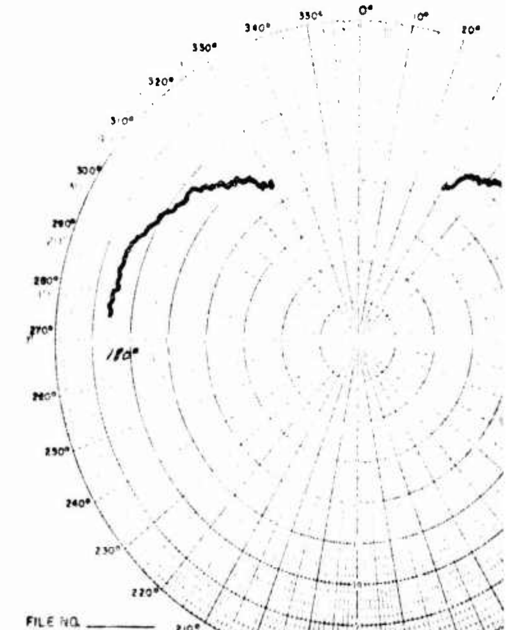
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.7 dB REL.
TO λ/4 MONOPOLE
...DEG. ELEV.
...TO 60 DEG.
...VE TO SHIP HEADING
REMARKS LAND STATE, MIDVEHICLE
ENGR ______ DATE JUNE 1973
FIGURE A-194



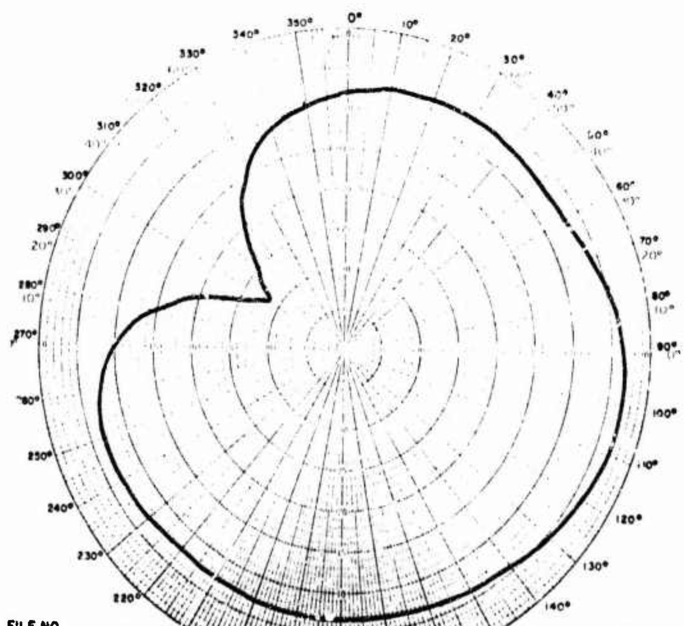
FILE NO. ______
ANT. TRIMONOPOLE
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.7 dB REL.
TO λ/4 MONOPOLE
REMARKS LAND STATE, MIDVEHICLE
ENGR ______ DATE JUNE 1973
FIGURE A-195



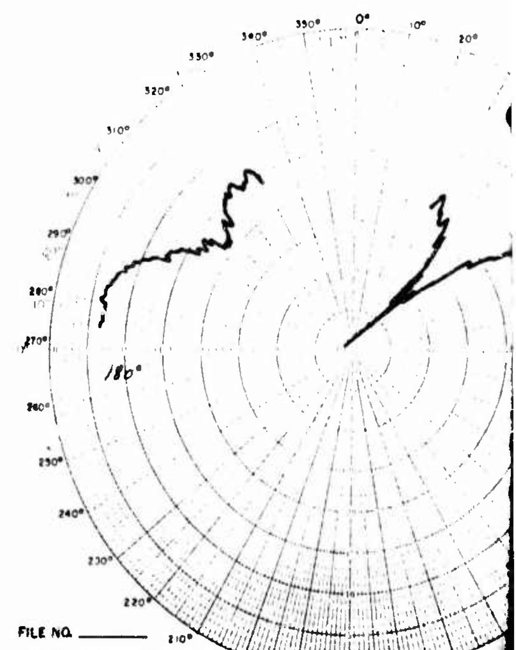
FILE NO. ______ SHIP FREQ 32.7 MHz
ANT TRIMONOPOLE MODEL FREQ 392.4 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG ELEV 0 dB ON CHART = +5.1 dB REL.
ELEVATION PATTERN ____ TO ____ DEG TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE, MIDVEHICLE
ENGR ______ DATE JUNE 1973 FIGURE A-196



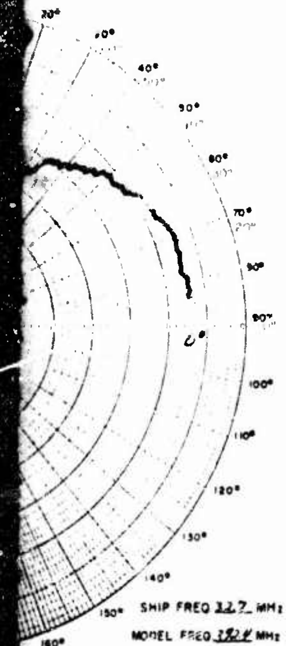
FILE NO. ______
ANT TRIMONOPOLE
MODEL ANT ORIENTATION ______ POL. C
AZIMUTH PATTERN AT ____ DEG ELEV 0
ELEVATION PATTERN 5 TO 60 DEG TO
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS SEA S
ENGR ______ DATE JUNE 197



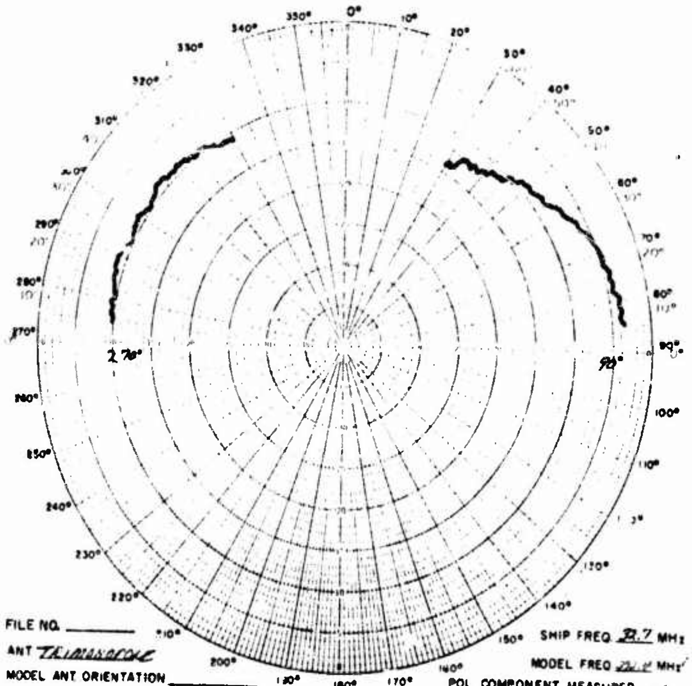
FILE NO. ______ SHIP FREQ 52.1 MHz
ANT TRIMONOPOLE MODEL FREQ 625.2 MHz
MODEL ANT ORIENTATION ______ POL. COMPONENT MEASURED V
AZIMUTH PATTERN AT 5 DEG ELEV. 0 dB ON CHART = +11.6 dB REL.
ELEVATION PATTERN ____ TO ____ DEG. TO λ/4 MONOPOLE
AT ____ DEGREES RELATIVE TO SHIP HEADING REMARKS SEA STATE, MIDVEHICLE
ENGR ______ DATE JUNE 1973 FIGURE A-202



FILE NO. ______
ANT TRIMONOPOLE
MODEL ANT ORIENTATION ______ POL. C
AZIMUTH PATTERN AT ____ DEG. ELEV. 0
ELEVATION PATTERN 5 TO 60 DEG. TO
AT 0/180 DEGREES RELATIVE TO SHIP HEADING REMARKS SEA S
ENGR ______ DATE JUNE 197



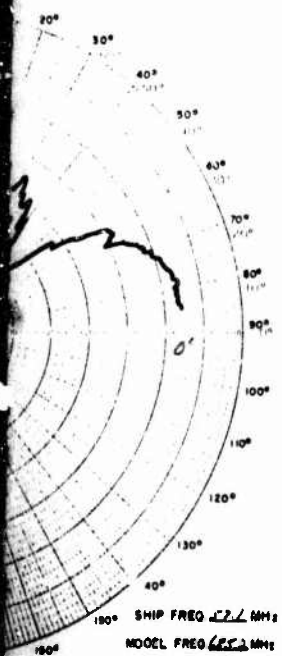
SHIP FREQ 32.7 MHz
MODEL FREQ 3924 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL.
TO λ/4 MONOPOLE
...SEA STATE, MIDVEKKLE
...JUNE 1973 FIGURE A-197



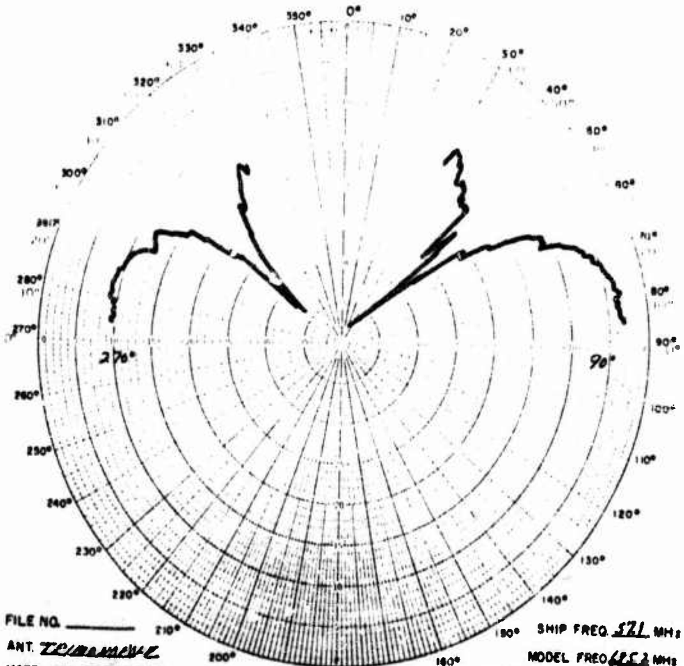
FILE NO. ______
ANT TRIMONOPOLE
MODEL ANT ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
90&270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 32.7 MHz
MODEL FREQ 3924 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.1 dB REL.
TO λ/4 MONOPOLE

REMARKS SEA STATE, MIDVEKKLE
ENGR ______ DATE JUNE 1973 FIGURE A-198



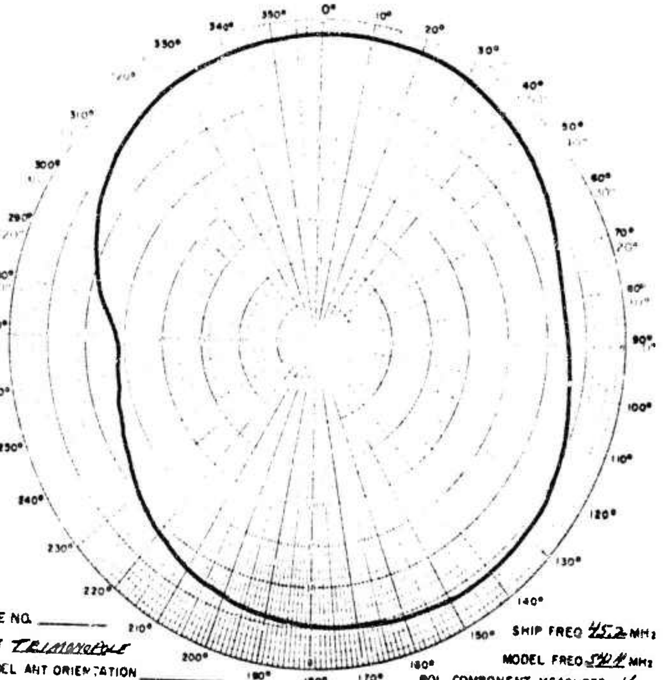
SHIP FREQ 52.1 MHz
MODEL FREQ 6252 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +11.6 dB REL.
TO λ/4 MONOPOLE
...KS SEA STATE, MIDVEKKLE
...JUNE 1973 FIGURE A-203



FILE NO. ______
ANT. TRIMONOPOLE
MODEL ANT. ORIENTATION ______
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90&270 DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 52.1 MHz
MODEL FREQ 6252 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +11.6 dB REL.
TO λ/4 MONOPOLE

REMARKS SEA STATE, MIDVEKKLE
ENGR ______ DATE JUNE 1973 FIGURE A-204



FILE NO. ______

ANT TRIMONOPOLE

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ 45.2 MHz

MODEL FREQ 542.4 MHz

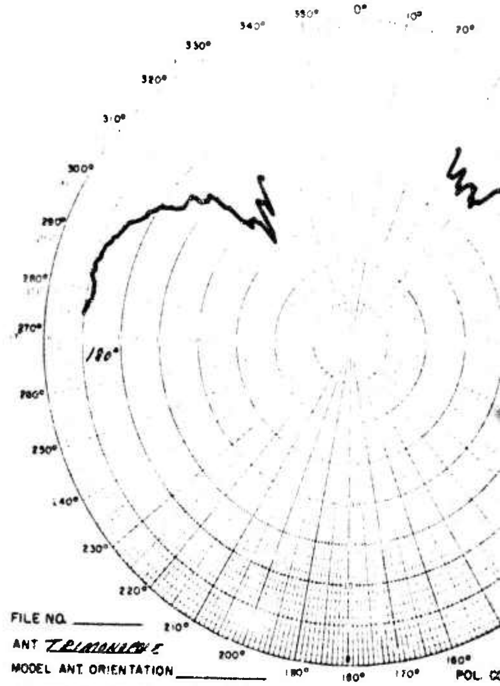
POL. COMPONENT MEASURED V

0 dB ON CHART = 26.4 dB REL. TO λ/4 MONOPOLE

REMARKS SEASTATE, MIDVERKLE

ENGR ______ DATE JUNE 1973

FIGURE A-194



FILE NO. ______

ANT TRIMONOPOLE

MODEL ANT ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

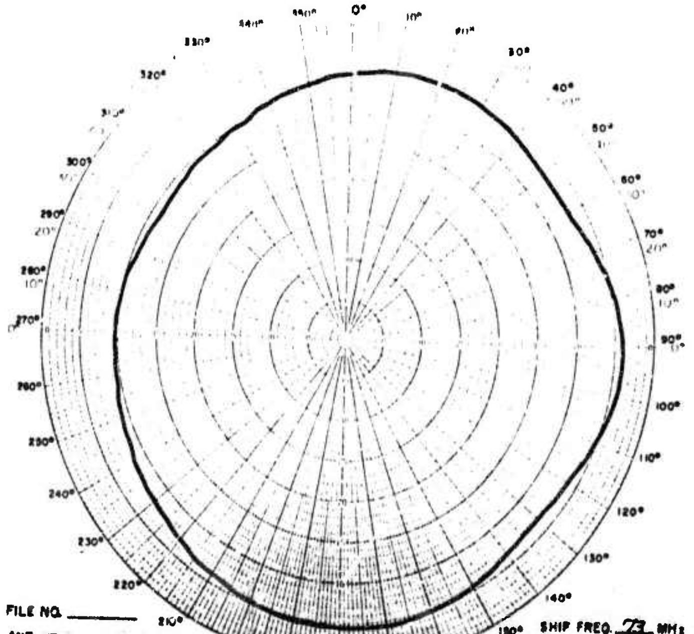
POL. CO

0 d

TO

REMARKS SEA S

ENGR ______ DATE JUNE 197



FILE NO. ______

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT 5 DEG. ELEV.

ELEVATION PATTERN ____ TO ____ DEG.

AT ____ DEGREES RELATIVE TO SHIP HEADING

SHIP FREQ. 73 MHz

MODEL FREQ. 876 MHz

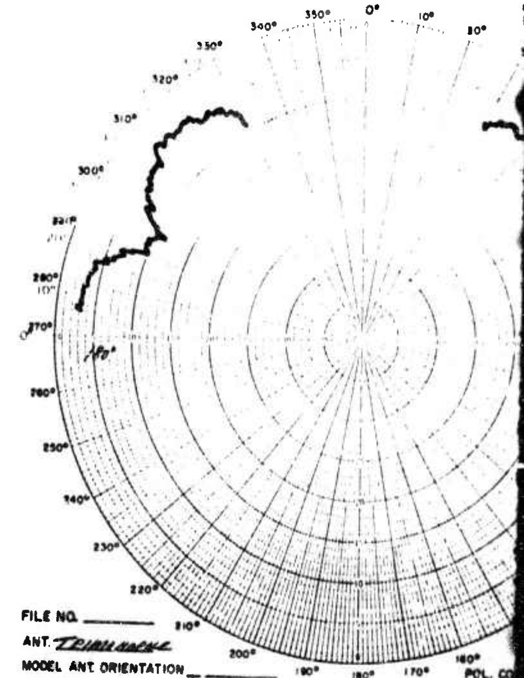
POL. COMPONENT MEASURED V

0 dB ON CHART = 15.8 dB REL. TO λ/4 MONOPOLE

REMARKS SEASTATE, MIDVERKLE

ENGR ______ DATE JUNE 1973

FIGURE A-205



FILE NO. ______

ANT. TRIMONOPOLE

MODEL ANT. ORIENTATION ______

AZIMUTH PATTERN AT ____ DEG. ELEV.

ELEVATION PATTERN 5 TO 60 DEG.

AT 0/180 DEGREES RELATIVE TO SHIP HEADING

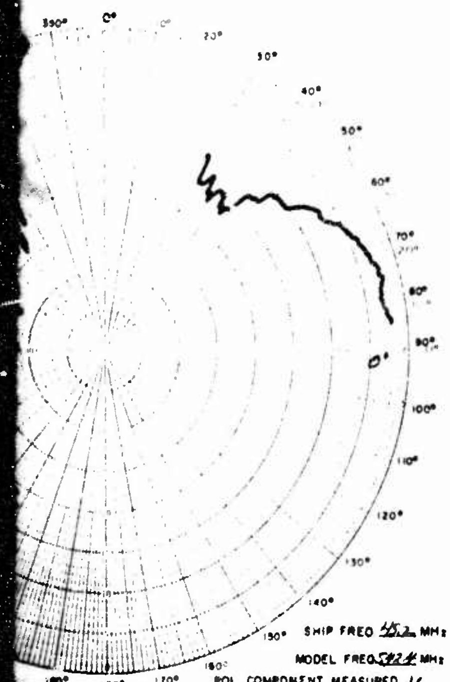
POL. CO

0 d

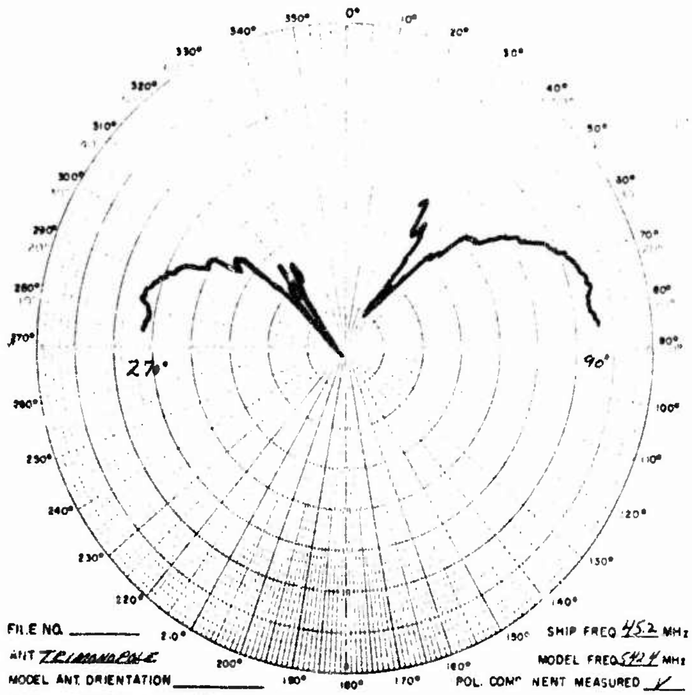
TO

REMARKS SEA S

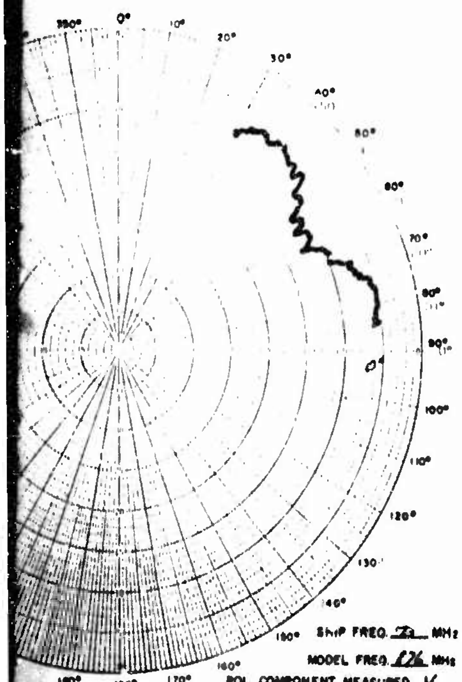
ENGR ______ DATE JUNE 197



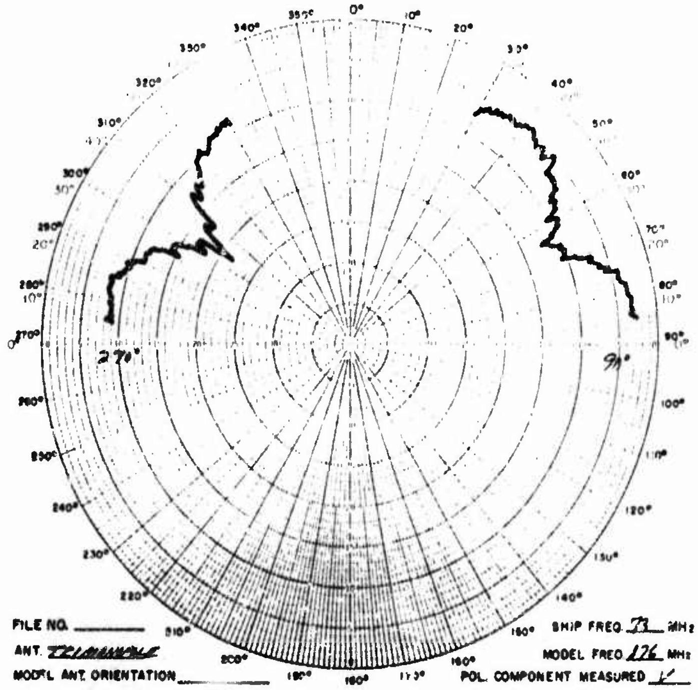
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL COMPONENT MEASURED V
0 dB ON CHART = +6.4 dB REL. TO λ/4 MONOPOLE
DEG.
HEADING
REMARKS SEA STATE, MIDVERKLE
ENGR ____ DATE JUNE 1973 FIGURE A-200



FILE NO. ____
ANT TRIMONOPOLE
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG
AT 90&270 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 45.2 MHz
MODEL FREQ 542.4 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +6.1 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE, MIDVERKLE
ENGR ____ DATE JUNE 1973 FIGURE A-201



SHIP FREQ. 73 MHz
MODEL FREQ. 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.8 dB REL. TO λ/4 MONOPOLE
EV.
2 DEG.
HIP HEADING
REMARKS SEA STATE, MIDVERKLE
ENGR ____ DATE JUNE 1973 FIGURE A-206



FILE NO. ____
ANT. TRIMONOPOLE
MODEL ANT. ORIENTATION ____
AZIMUTH PATTERN AT ____ DEG. ELEV.
ELEVATION PATTERN 5 TO 60 DEG.
AT 90/2 DEGREES RELATIVE TO SHIP HEADING
SHIP FREQ 73 MHz
MODEL FREQ 876 MHz
POL. COMPONENT MEASURED V
0 dB ON CHART = +5.8 dB REL. TO λ/4 MONOPOLE
REMARKS SEA STATE, MIDVERKLE
ENGR ____ DATE JUNE 1973 FIGURE A-207

APPENDIX B: DERIVATION OF RANGE PREDICTION EQUATION AND A SAMPLE CALCULATION OF MAXIMUM RANGE FOR VHF-FM (30-76 MHz) ANTENNA AND RF DISTRIBUTION SYSTEM

The predicted range attainable by a communications link can be determined from the curves in figure B1. This figure displays field strength in dB/μV/m (ground wave) as a function distance in statute miles over seawater for several frequencies, assuming 1-kW radiated power from a lossless short monopole on the earth's surface. To use the curve, some assumptions are needed. The assumptions made for all systems are:

1. The received FM signal necessary for a maximum range is -91.5 dBm (20 dB quieting) for single-channel voice in a 50-ohm system (ref 3, p. II-18).

2. The available power output of the RT-524 transceiver is 40 watts (+46 dBm).

3. No external noise (i.e., receiver noise) limits sensitivity.

4. The land/water interface effect on field strength is negligible, since the link is with beach units at the edge of the seawater.

5. The receive antenna is omnidirectional with 0-dB gain.

The equation for converting the given information to that necessary for using the curve is derived here.

For the receiving system

For a $\lambda/4$ monopole antenna over a groundplane.

$$V_{oc} = Eh_e$$

$$V_{oc} = E\,\lambda/2\pi$$

where:

V_{oc} = open-circuit voltage (volts)

E = electric field strength (volts/m)

h_e = $\lambda/2\pi$ = antenna effective height (meters)

λ = wavelength (meters)

For the transmitting system

Figure B1 is for 1-kW, +60-dBm radiated power; however, the RT-524 transceiver power is only +46 dBm, and there are other losses associated with the transmitting system which require additional corrections. It is assumed that a reduction of X dBm transmitter power can be compensated for by requiring X dB more field strength at the receiving antenna. If a multicoupler is used in the system, an additional term must be added to account for the insertion loss. Therefore, the correction factor for the transmitting system becomes

$$X\,(\mathrm{dB}) = 60 - 46 + RG_{xmt} + \alpha_t + \beta_t = 14 + RG_{xmt} + \alpha_t + \beta_t$$

where RG_{xmt} is the transmitting antenna's relative-gain correction factor for an antenna other than a short lossless monopole; α_t is the cable attenuation on the transmit side; and β_t is the multicoupler insertion loss on the transmit side.

The total expression for using the curve then becomes:

$$E\,(\mathrm{dB}/\mu\mathrm{V/m}) = V_{rec}\,(\mathrm{dB}/\mu\mathrm{V}) + 18.8 - 20 \log (\lambda/2\pi) + RG_{rec} + \alpha_r + \beta_r + RG_{xmt} + \alpha_t + \beta_t$$

which is the range analysis equation (1) given in the text, where:

E = electric field strength in dB/µV/m

V_{rec} = receiver sensitivity in dB/µV

λ = wavelength in meters

RG_{rec} = receive antenna's relative gain in dB/1/4λ monopole

RG_{xmt} = transmit antenna's relative gain in dB/1/4λ monopole

α_r = cable attenuation of receive system in dB

α_t = cable attenuation of transmit system in dB

β_r = multicoupler insertion loss of receive system in dB

β_t = multicoupler insertion loss of transmit system in dB

The predicted maximum range is calculated for the trimonopole multicoupler rf distribution combination as the transmit side and an AS-1729 antenna system as the receive side. The calculations for the present system using AS-1729 antennas are identical except that term β_t is omitted.

The calculations begin with:

Receive System

λ at 30 MHz = 10 meters

λ at 40 MHz = 7.5 meters

λ at 50 MHz = 6.0 meters

λ at 60 MHz = 5.0 meters

λ at 70 MHz = 4.28 meters

λ at 80 MHz = 3.75 meters

and

$$20 \log (10/2\pi) = 4.02$$

$$20 \log (7.5/2\pi) = 1.5$$

$$20 \log (6.0/2\pi) = 0.4$$

$$20 \log (5.0/2\pi) = -2.0$$

$$20 \log (4.28/2\pi) = -3.32$$

$$20 \log (3.75/2\pi) = -4.48$$

The receiver sensitivity is -91.5 dBm (20 dB quieting), or

$$V_{rec} = 15.6 \text{ dB}/\mu\text{V}$$

Cable loss, α_r, was assumed to be 0.5 dB across the band, which is a very close approximation.

Converting to dB above a microvolt (dB/μV),

$$V_{oc} (\text{dB}/\mu\text{V}) = E (\text{dB}/\mu\text{V/m}) + 20 \log (\lambda/2\pi)$$

and converting from receiver voltage to antenna open-circuit voltage in dB,

$$V_{oc} (\text{dB}/\mu\text{V}) = V_{rec} (\text{dB}/\mu\text{V}) + 20 \log \frac{Z_{ant} + Z_{rec}}{Z_{rec}} + \alpha_r$$

where

Z_{ant} = 37 ohms, for a $\lambda/4$ monopole

Z_{rec} = 50 ohms

α_r = cable attenuation on receive side

Therefore,

$$V_{oc} (\text{dB}/\mu\text{V}) = V_{rec} (\text{dB}/\mu\text{V}) + 4.8 + \alpha_r$$

After combining and rearranging terms,

$$E (\text{dB}/\mu\text{V/m}) = V_{rec} (\text{dB}/\mu\text{V}) + 4.8 - 20 \log (\lambda/2\pi) + \alpha_r$$

For any antenna other than a $\lambda/4$ monopole, an additional correction factor, RG_{rec}, is necessary. This correction factor is the relative gain, RG, that another antenna has with respect to a $\lambda/4$ monopole. If the system uses a multicoupler, a term for its insertion loss, β_r, must be included. So, for the receiving system,

$$E (\text{dB}/\mu\text{V/m}) = V_{rec} (\text{dB}/\mu\text{V}) + 4.8 - 20 \log (\lambda/2\pi) + \alpha_r + RG_{rec} + \beta_r$$

where:

α_r for 15 feet (RG – 58/U) = 0.5 dB

So,

$\alpha_r = \alpha_t = 0.5$ dB

Multicoupler insertion loss is zero on the receive side because no multicoupler is assumed, and 2 dB on the transmit side. So,

$\beta_r = 0, \beta_t = 2$ dB

The antenna gains for both the trimonopole and the AS-1729 with respect to a 1/4-wavelength monopole are the same. Therefore,

$RG_{rec} = RG_{xmt} \cong 0$ dB

All factors in the range prediction equation have now been given numerical values, and E (dB/μV/m) can be calculated.

For 30 MHz

E (dB/μV/m) = 15.6 dB/μV + 4.8 – 4.02 (at 30 MHz) + 0.5 dB

+ 0 dB + 14 dB + 0 dB + 0.5 dB + 2 dB

E (dB/μV/m) = 33.4 (for a 0-dB radiation pattern null depth)

+ 33.4 dB/μV/m from figure B1 = 72 statute miles

E = 23.4 for 10-dB pattern gain for 95 statute miles

E = 43.4 for 10-dB null depth for 55 statute miles

53.4 for 20-dB null depth for 37 statute miles

63.4 for 30-dB null depth for 23 statute miles

73.4 for 40-dB null depth for 14 statute miles

For 40 MHz

E (dB/μV/m) = 15.6 dB/μV + 4.8 – 1.5 (at 40 MHz) + 0.5 dB

+ 0 dB + 14 dB + 0 dB + 0.5 dB + 2 dB

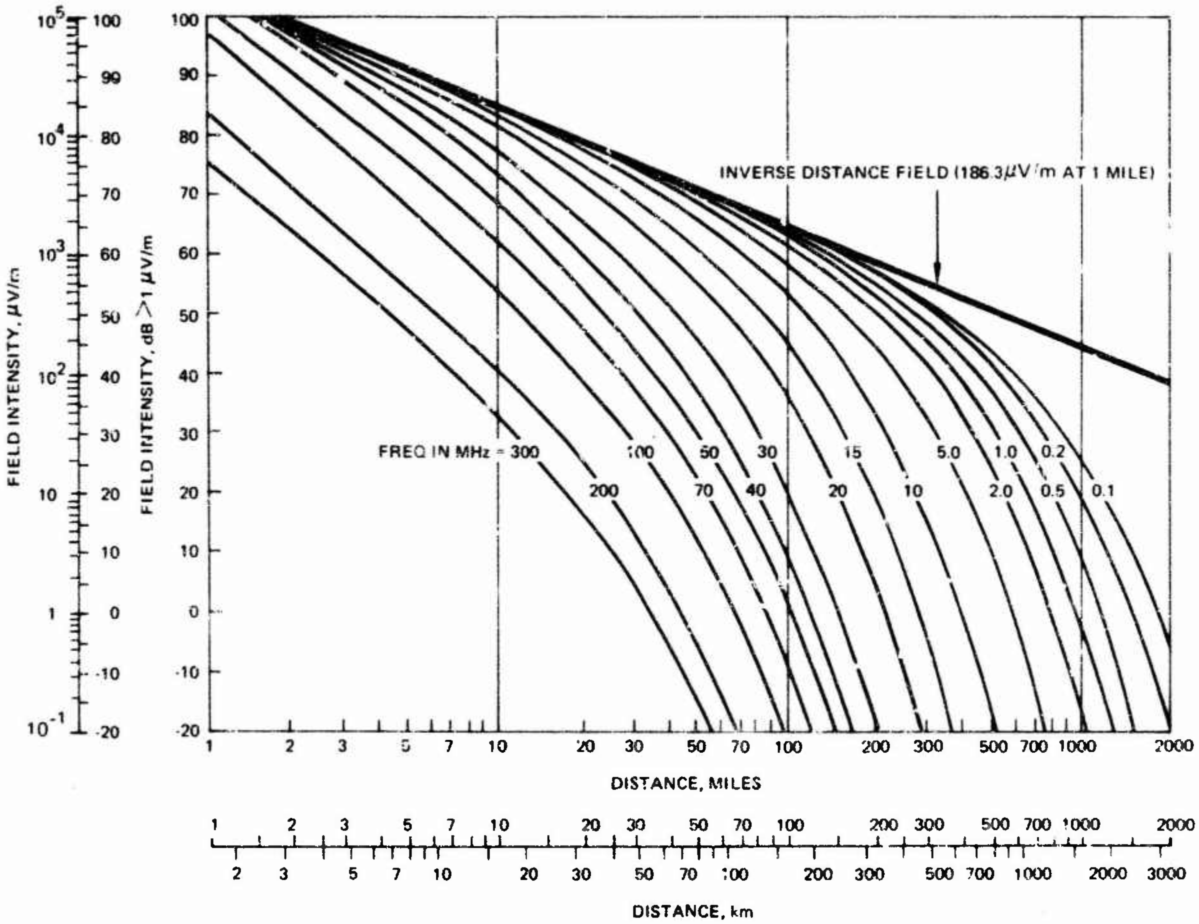


Figure B1. Field intensity at various distances as a function of frequency, with antennas at the earth's surface. Inverse distance field intensity of transmitting antenna is 186.3 μV/m at 1 mile over seawater, with parameters of $\epsilon = 80$, $\sigma = 5$ mhos/m.

E (dB/μV/m) = 35.9 (for a 0-dB radiation pattern null depth)
+ 35.9 dB/μV/m from figure B1 = 54 statute miles

E = 25.9 for 10-dB pattern gain for 70 statute miles

E = 45.9 for 10-dB null depth for 37 statute miles

55.9 for 20-dB null depth for 25 statute miles

65.9 for 30-dB null depth for 15.5 statute miles

75.9 for 40-dB null depth for 9 statute miles

The calculations continue similarly for 50, 60, 70, and 80 MHz.

APPENDIX C
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Using 1/12- and 1/24-scale brass models, measurements of radiation patterns, isolation, and impedance are made on the existing antenna system of the U. S. Marine Corps Landing Vehicle, Tracked, Communications (LVTC7). (The present arrangement – eight antennas on a small platform – had resulted in a closely coupled system that degraded communications performance.) A new antenna system design, consisting of a vhf broadband antenna and multicoupler combination to replace five vhf antennas, is proposed. This approach is studied using the 1/12-scale brass model. Calculations for the predicted range performance of each system are included.

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CHANGE 1

1. On page 1, change "O&MN NAVSEC (NELC B169)" to "XF21.222.033, Task E332 (NELC B607)"
2. Following page 62, on page 1 of the DD form 1473, block 8, make the same change described in item 1.
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4. On cover of document, add "Changed 22 February 1974"