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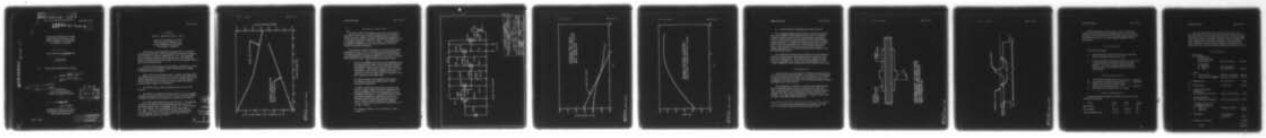

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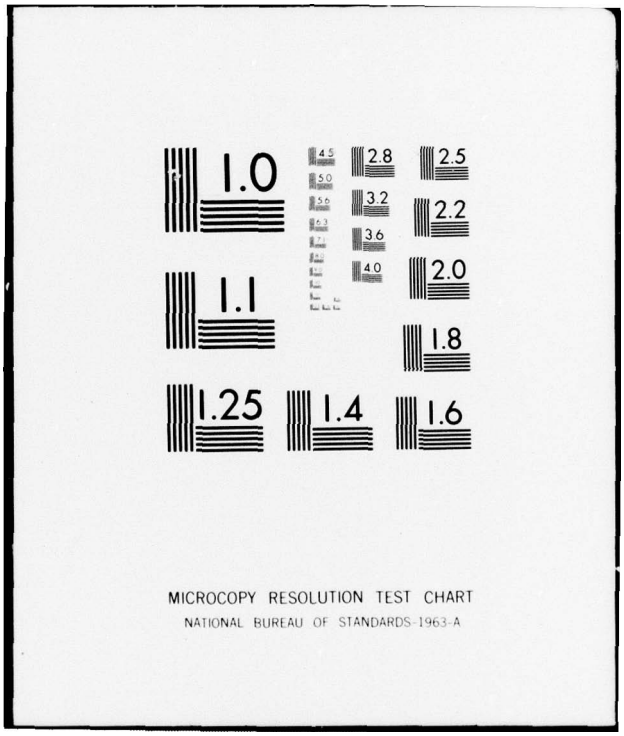
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Scripps Institution of Oceanography
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(9) MPL Technical Memorandum 133

(6) FLIP DIMUS.

(10) Daniel K. Gibson and Gerald L. Denny

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FLIP DIMUS

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The following recommendations are being made as a result of a preliminary design study, which investigated the feasibility of adapting BQR-2 DIMUS for permanent installation on FLIP. Such installation with modifications proposed herein would provide FLIP a submarine detection capability with automatic alarm for protection against collisions when in the vertical position.

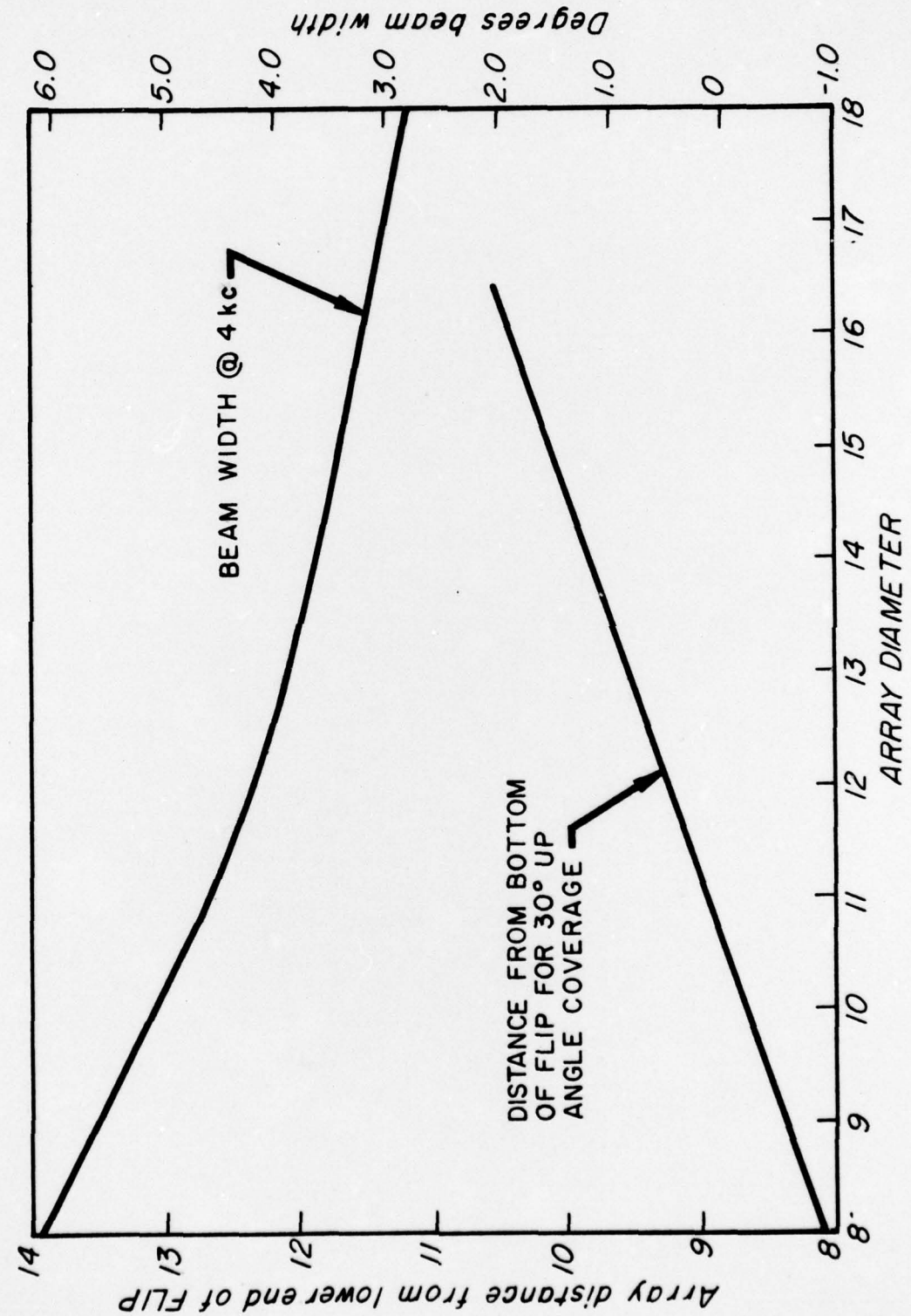
The BQR-2 DIMUS requires 48 hydrophones arranged in a circular configuration with the hydrophones spaced equidistant at 7.5 degree increments around the periphery.

When FLIP is in the vertical position, its lower extremity will be some 300 feet below the water line. It is assumed that the DIMUS array will be suspended from the lower end of FLIP at a suitable distance so that the array will not be shadowed for target energy arriving from positive elevation angles up to 30 degrees.

It is further assumed that an operating band of 1 to 4 kc will be used.

The results of computations of beamwidth at 4 kc and of required separation between the array and FLIP for desired 30 degree up-angle coverage as functions of array diameter are illustrated in Figure 1.

The BQR-2 DIMUS beamformer forms 96 beams. Assuming that shoulder-to-shoulder beams are desired at the upper limit of the operating frequency band, a beamwidth of 360° / 96 = 3.75° is called for. From Figure 1 the array diameter for this beamwidth is 13.5 feet. In order to provide a 30° up-angle coverage using a 13.5 foot diameter array, the array must be suspended 9 feet 8 inches below the lower end of FLIP.



GIBSON: FIG 1
MPL - M- 668 (U) / RAPP 1/25/63

Hydrophone and Array

The BQR-2 DIMUS was designed to be used as a backfit to the Navy BQR-2B sonar system with the 48 signal inputs of the DIMUS bridged across the outputs of the BQR-2B hydrophone preamplifiers. The overall sound pressure sensitivity of the BQR-2B hydrophones and preamplifiers combined is -20 db re 1 v/dyne. A hydrophone and preamplifier combination for use with the DIMUS on FLIP must provide an equivalent sensitivity.

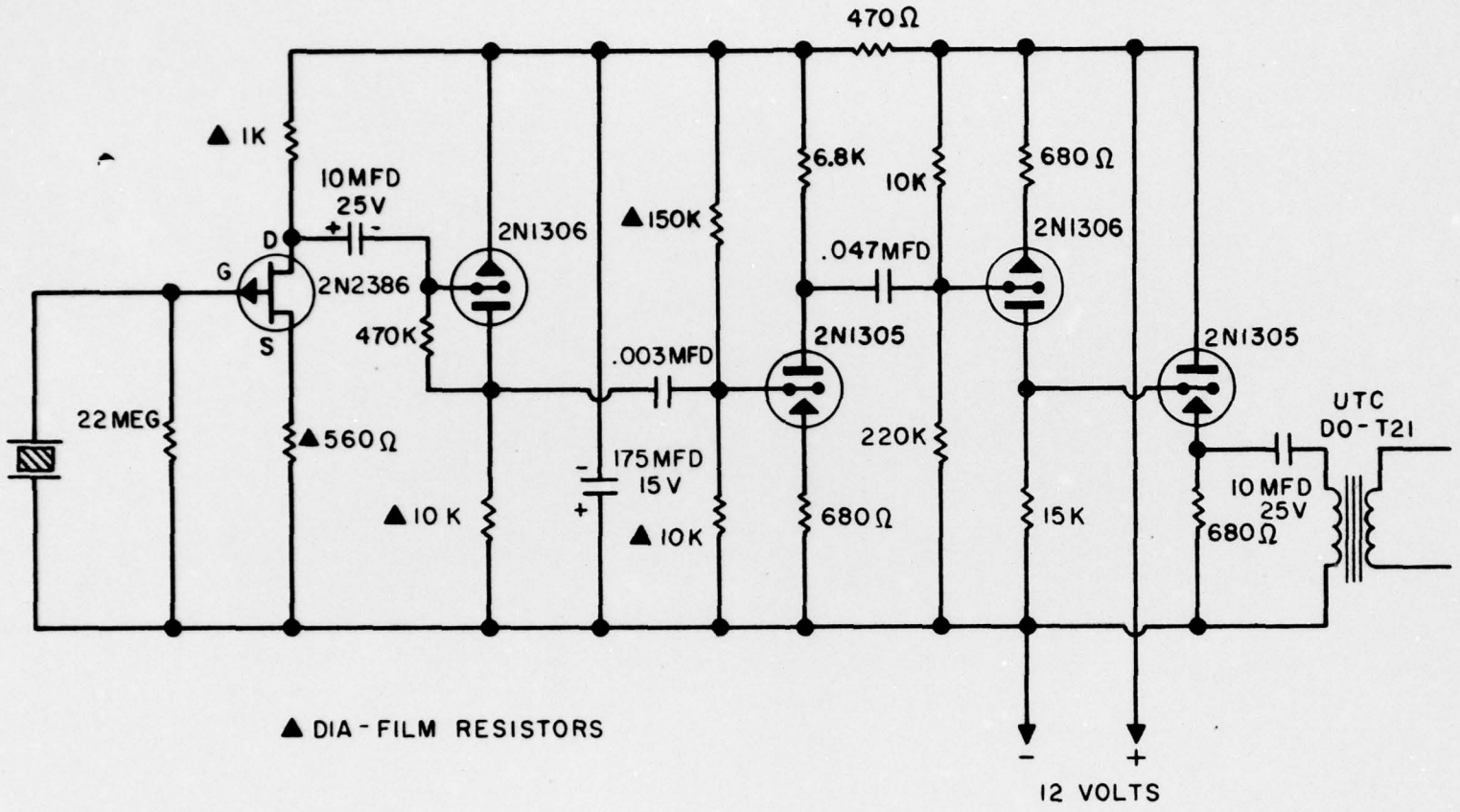
For the most economical approach to the problem of providing hydrophones for use on FLIP, it is proposed that 48 hydrophones be assembled by salvage and reuse of components that will be available from cannabilization of hydrophones which were used in the ALBACORE DIMUS (DIMUS V) array. The following steps should be taken:

1. Remove the existing 10 db vacuum tube preamplifiers from each hydrophone and replace with a field effect transistor preamplifier having lower self-noise and approximately 70 db of gain. The frequency response in the 1-4 kc band should have a 6 db per octave rising characteristic to compensate for the sea-noise spectrum and provide a flat-power spectrum at the DIMUS input.

   The new preamplifiers will substitute for the BQR-2 preamplifiers used in the shipboard BQR-2 DIMUS experimental installation.

   A suitable transistorized preamplifier shown schematically in Figure 2 using a field effect transistor at its input and having the desired characteristics, has been breadboarded and tested. The equivalent input or circuit noise of this amplifier and hydrophone expressed in equivalent input pressure noise spectrum level (db re 1 dyne^2/cycle) is compared graphically in Figure 3 with the ambient sea-noise spectrum expected with a zero sea state condition.

   The frequency response of the preamplifier is shown in Figure 4.



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MARINE PHYSICAL LABORATORY SAN DIEGO 52, CALIFORNIA			CONTRACT NO. Nonr. 2216 (10)
FLIP-DIMUS HYDROPHONE PRE-AMPLIFIER USING FIELD EFFECT INPUT TRANSISTOR			
PROJECT	FLIP-DIMIS	DATE	MPL DRAWING NO.
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Gibson and Denny

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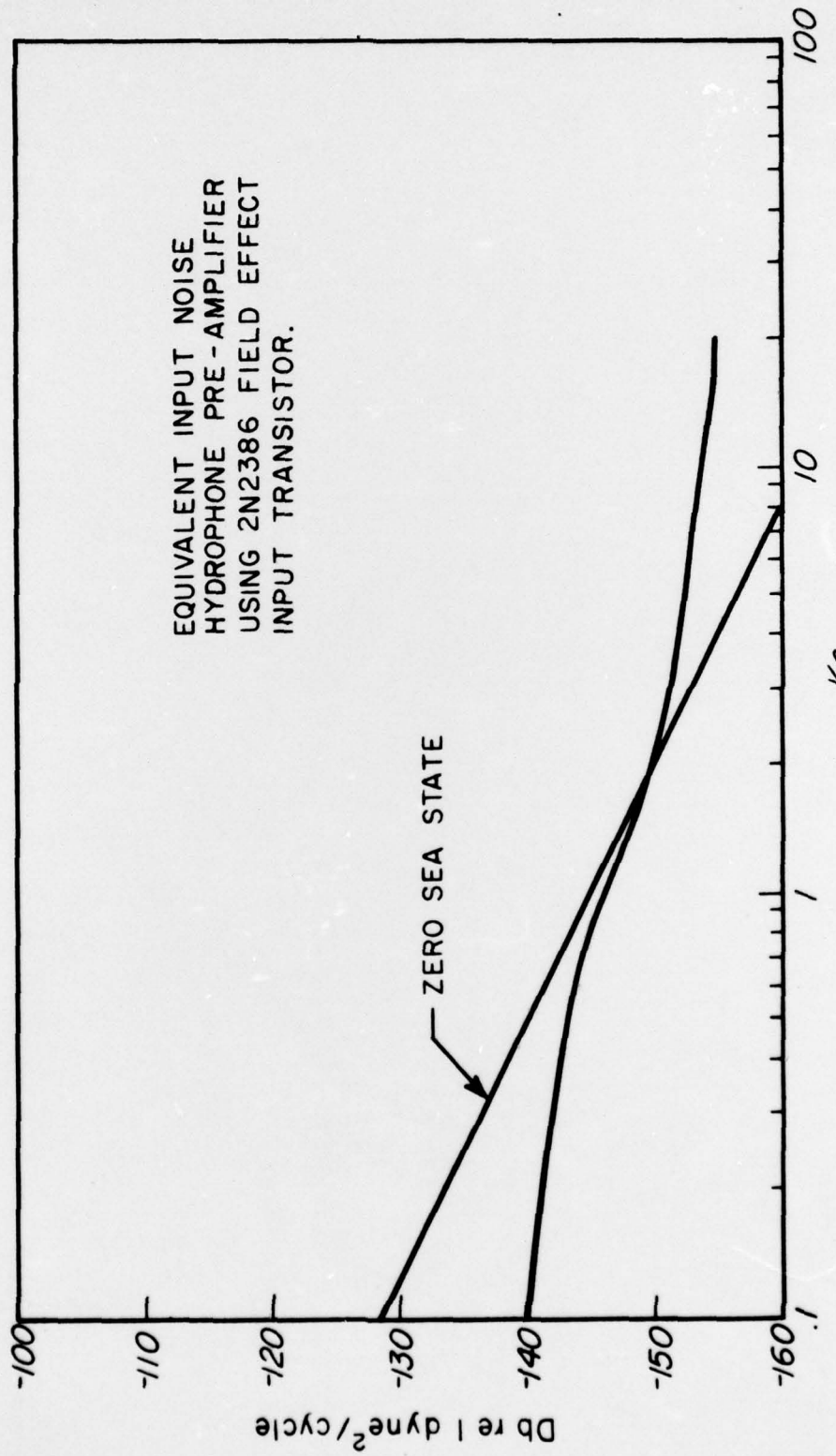
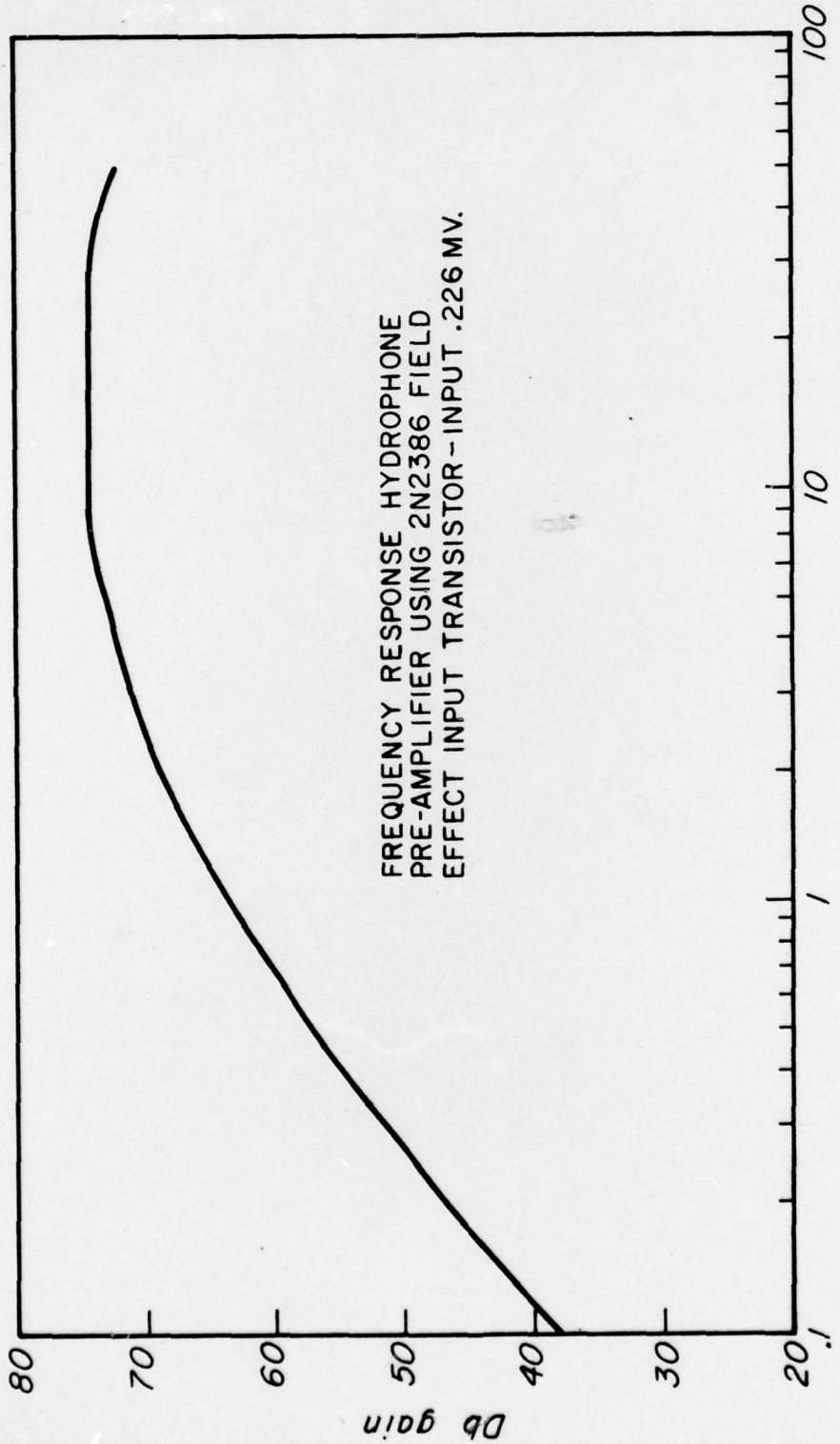


GIBSON: FIG. 3
MPL-M-675 (U) / RAPP 2/6/63



GIBSON: FIG. 4
MPL-M-676 (U)/ RAPP 2/6/63

2. Remove boots and encapsulate the active element.[1/]

The existing hydrophone cables should be removed and replaced with a four-conductor, filled submarine cable of the same diameter. A cable of smaller diameter may be used providing a polyurethene sleeve is molded onto the cable at the point where it enters the phone, as shown in Figure 5. Considerable savings in cable may be realized if these cables are terminated in one or two junction boxes near the array. From the junction boxes two multi-conductor cables (24 shielded-pair conductors, each cable) would be run the length of FLIP up to the laboratory area.

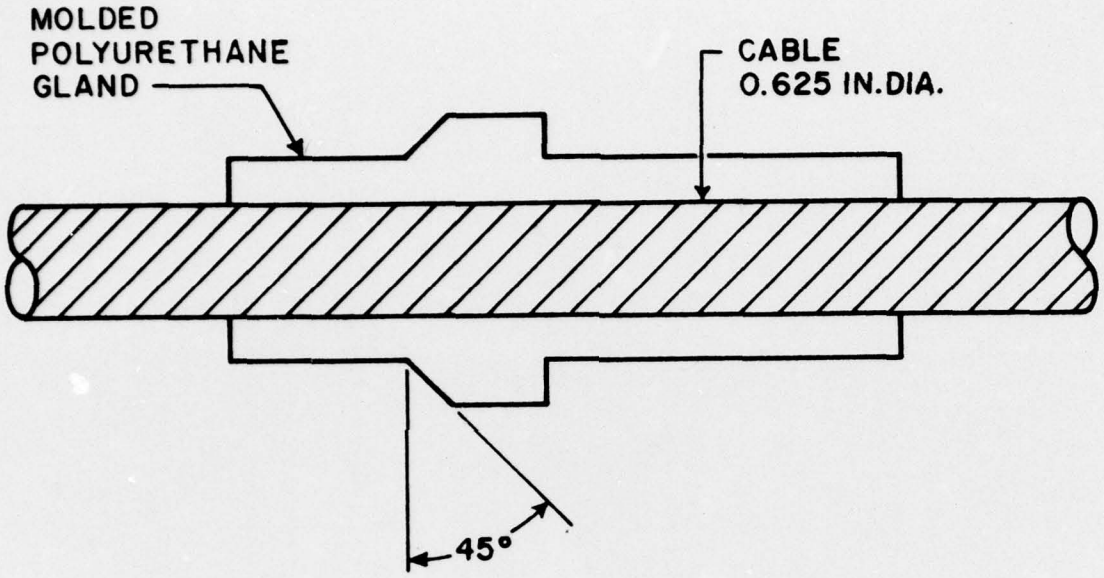
As a result of the increased array diameter, the clock frequency will have to be decreased to approximately 10.6 kc in order to make use of the existing matrix. This will provide for slightly more than 5 bits per wavelength at the center of the operating frequency band. A minor modification of the existing main clock oscillator is necessary.

Alarm System

An alarm system may be installed on DIMUS to provide protection for FLIP when in the vertical position. It is possible to use the existing record scan output shown in Figure 6 and a threshold detector circuit to trigger an acoustical noise source on FLIP thereby alerting an approaching submarine of FLIP's presence.

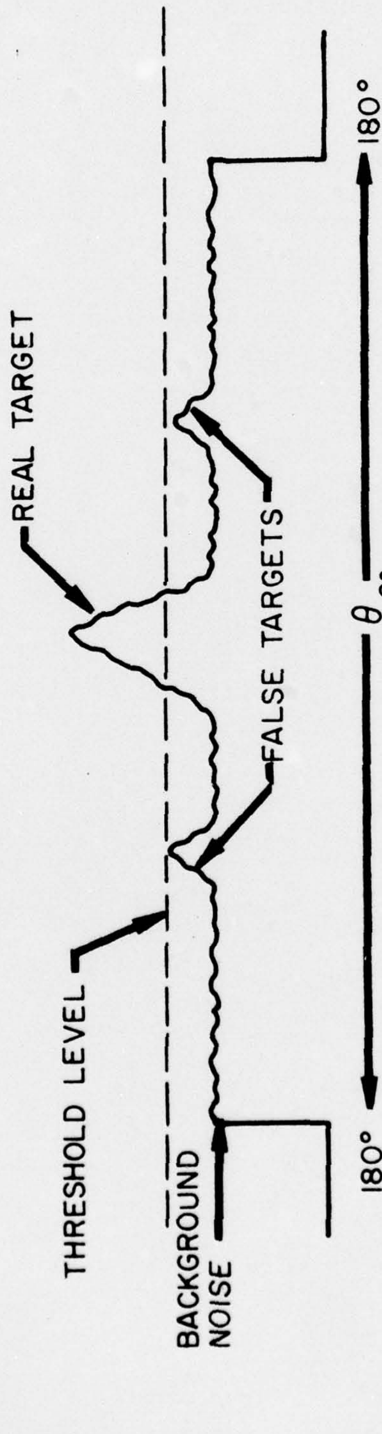
The threshold level would be set just above the background noise level or somewhat higher in order to reduce the false alarm rate. When a target appears the keying circuit would be energized and transmission of the noise source would begin and continue until shut off manually. The alarm system should operate on signal-to-noise ratios of -20 to -25 db with low false alarm rate.

[1/] U. S. Navy Underwater Sound Reference Laboratory, Code 202, Attn: Dr. Anderson, letter to MPL dated 18 October 1962.



DIMENSIONS, EXCEPT THE CABLE (0.625), ARE APPROXIMATE AND CAN BE SCALED. EXACT DIMENSIONS TO BE SPECIFIED PRIOR TO PRODUCTION.

GIBSON: FIG. 5
MPL-662 (U)/RAPP 1/17/63



GIBSON: FIG. 6
MPL-M-669 (U)/RAPP 1/28/63

If battery operation is desired in the event of a main power failure or for quiet listening, the DIMUS system may be powered in total from a dc to ac inverter or the main shift register clock may be powered direct from an 18 v battery thereby reducing the load to the inverter.

New Circuitry

New circuitry required:

1. Threshold detector with some adjustment of threshold level for adjustment of false alarm rate.

2. A power amplifier and transducer driven by a noise source or oscillator which can be keyed from the threshold detector. This same accessory equipment makes it possible to operate the DIMUS in an active mode for echo-ranging.

Power Requirements

1. Total DIMUS including time bearing recorder --- 550 watts.
2. Total DIMUS less time bearing recorder -------- 400 watts.
3. DIMUS ac power less main shift register clock and time bearing recorder---------- 250 watts.
4. Shift register clock dc power 18 v at 5 amps.

Space Requirements

Spaces needed for installation of DIMUS and spares are of the following requirements:

Item	Depth	Width	Height
Main Cabinet	11"	21"	63"
Power Cabinet	15-1/2"	18-3/4"	20"
Time Bearing Recorder	15-1/2"	19-1/2"	27"

The Time Bearing Recorder may or may not be used. The dimensions given are of the cabinets only, another 6" should be added to the depth to allow for connectors and cables, also some extra height should be allowed for, depending on the type of shock mounting that is used. Additional space should be provided for a transient display scope, which also could be used for servicing the equipment. Space required for spares is small and they could be stored anywhere on FLIP.

Cost Estimates

A.	Hydrophones		
	1. Encapsulation (3 man-hours/phone at $5.00/hour)	50 at $15.00 each	$ 750.00
	2. Preamplifiers		
	a. Materials	50 at $35.00 each	
	b. Labor	50 at $15.00 each	2500.00
B.	Cable		
	1. Four-conductor	1000 feet at $.30/foot	300.00
	2. Twenty-four shielded pair	600 feet at $.683/foot	410.00
C.	Stuffing Tubes	50 at $1.50 each	75.00
D.	Junction Boxes	2 at $200.00	400.00
E.	Main Clock Oscillator Modification (Sr. Electronics Technician)	5 hours at $6.00/hour	30.00
F.	Threshold Detector (Sr. Electronics Technician)	20 hours at $6.00/hour	120.00
G.	Hydrophone Mounts and Array Support Structure		
	1. Shop Time	100 hours at $6.00	600.00
	2. Materials		100.00
H.	Installation	12 man-days at $50.00/day	600.00
I.	Inverter, if necessary		200.00
	TOTAL		$ 6085.00