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22 June 1977

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SONAR TEST AND TEST INSTRUMENTATION SUPPORT
Quarterly Progress Report No. 4 under Contract N00140-76-C-6487
1 March - 31 May 1977

Dudley D. Baker et al.

NAVAL UNDERWATER SYSTEMS CENTER
Contract N00140-76-C-6487

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I. INTRODUCTION

Applied Research Laboratories, The University of Texas at Austin (ARL:UT), was awarded Contract N00140-76-C-0487, sponsored by the Naval Underwater Systems Center, New London Laboratory (NUSC/NL), effective 1 June 1976. Some of the work under this contract represents a follow-on effort to previous work sponsored by NUSC/NL under Contract N00140-74-C-651b.

The work under Contract N00140-76-C-0487 is divided into six task areas that focus on technical support in areas of sonar technology:

- I. AN/FQM-10(V) Sonar Test Set Field Support
- II. Transducer Repair Facility Test Site Field Support
- III. AN/WQM-5 Sonar Test Set Field Support
- IV. Special Purpose Passive Sonar Systems Support
- V. Sonar Instrumentation Test and Evaluation
- VI. Study of Towed Line Array Acoustical Testing at Transducer Repair Facilities

This report is quarterly Progress Report No. 4 under Contract N00140-76-C-0487. Section headings in this report correspond to the six task areas. Additional sections are included on documentation support, procurement of AN/WQM-5 components and field change kits, and AN/BqW-5 power supply development.

II. TRF, AN/FQM-10(V), AND AN/WQM-5 FIELD SUPPORT

All funds under this contract designated to the technical and material support of Transducer Repair Facility (TRF) test sites, AN/FQM-10(V) Sonar Test Sets, and AN/WQM-5 Sonar Test Sets were expended before 1 March 1977. Follow-on support is now being provided under Contracts NO0140-76-A-A022 and N00024-77-C-6039.

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III. SPECIAL PURPOSE PASSIVE SONAR SYSTEMS SUPPORT

ARL:UT has continued a modest effort of technical support to interface the AN/BQR-20A to the submarine sonar systems. Throughout most of this report period, the effort was limited to a signal and noise analysis of frequency domain equalizers. The results of this work will be documented in an ARL:UT technical memorandum (ARL-TM-77-12) to be distributed during the next report period.

IV. SONAR INSTRUMENTATION TEST AND EVALUATION

A. Introduction

Progress on the design of a replacement for the outdated AN/SQM-5 Sonar Noise Recorder is described in the following sections.

B. Sea Tests

On 22 March 1977, an ARL:UT representative went to sea aboard USS WAINWRIGHT (CG 28) to test the capabilities of the engineering model of the AN/SQM-() in an on-board environment. The AN/SQM-() was successfully interfaced to the ship's AN/SQS-26BX sonar system; noise measurements were made concurrently with both the AN/SQM-() and the AN/SQM-5. The AN/SQM-() performed successfully, although the spurious noise spoke that was being investigated could not be detected by either device. This was perhaps caused by the very high ambient noise level of a sea state 3 or more.

Future sea tests are planned by NAVSECNORDIV for improved evaluation of the performance of the new system.

C. Testing of Engineering Model

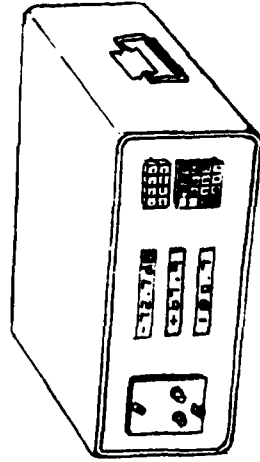
The successful testing of the AN/SQM-() engineering model has shown that the solid state calculator controlled approach is a workable solution to the AN/SQM-5 replacement problem. ARL:UT is in the process of reevaluating the design approach to determine how the final package should be configured.

The present AN/SQM-() Data Acquisition and Synchro Control (DASC) unit is designed primarily as an input/output device controlled by a Hewlett-Packard 9825A calculator and therefore it has no stand-alone capability. A more viable approach to the design of the device is to incorporate into the unit a microcomputer that would provide limited stand-alone capability. The basic AN/SQM-5 measurement capabilities could then be duplicated by using only the data acquisition and control unit and the plotter. For measurement applications requiring data storage, printouts, complex computations, or nonstandard plots, the programmable calculator would be required.

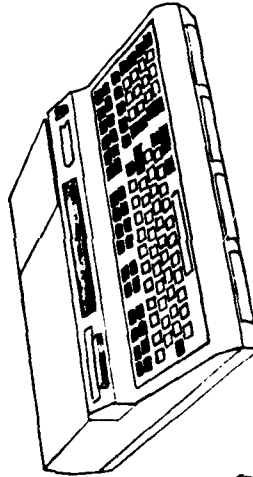
Other considerations being evaluated are the size, weight, maintainability, and cost of the DASC. The use of SEM modules, while providing some advantages with respect to maintainability and reliability, would make the unit unreasonably expensive and impose severe constraints on the design of the unit. By use of the microcomputer concept, the size, weight, and cost of the unit can be substantially reduced without seriously degrading the reliability of the unit.

Figure 1 shows an engineering sketch of the three system units that would comprise a prototype production AN/SQM-()V Sonar Noise Recording System. The DASC unit contains the microcomputer controlled S/D, D/S, and true rms detection elements. Control of this unit would be either by a front panel keyboard in the local modes or by the calculator's General Purpose Interface Bus (GPIB)* in the remote mode of operation. The plotter (Tektronix 4662 or equivalent), also compatible with the GPIB, would be controlled by the calculator in the full system configuration or by the DASC unit in the minimum configuration. The calculator would provide for data storage, data printouts, complex computations, and expanded plotting capability. It is referred to as AN/SQM-()V because it is envisioned to be a variable configuration, depending on the job at hand.

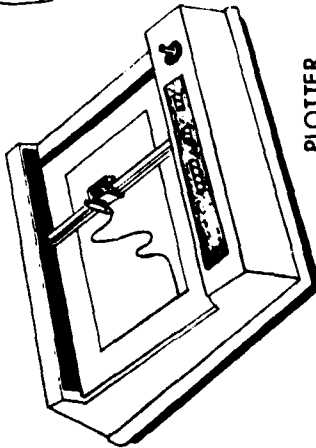
* Conforms to IEEE-488, 1975, standard.



DATA ACQUISITION AND
SYNCHRO CONTROL UNIT



CALCULATOR



PLOTTER

FIGURE 1
AN/SQM-() V SONAR NOISE RECORDING SYSTEM

The block diagram shown in Fig. 2 shows the interrelationships of the various building blocks making up the DASC unit. Many of these components are being mass produced commercially, resulting in readily available, low cost, state-of-the-art devices that can be incorporated in the unit.

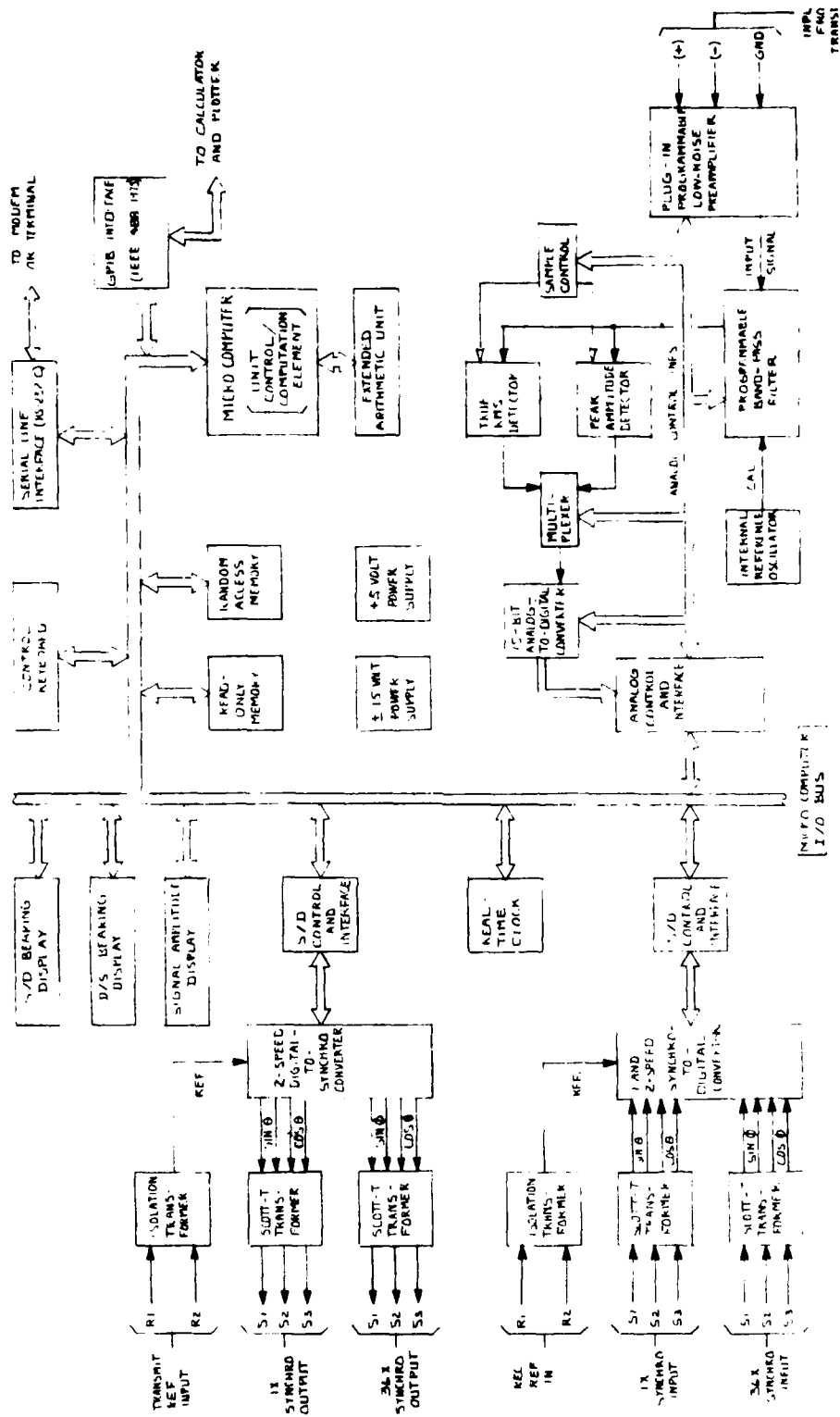


FIGURE 2
BLOCK DIAGRAM DATA ACQUISITION AND SYNCHRO CONTROL UNIT, AN/SQM-C(V)

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V. ASSISTANCE WITH EXPANSION OF TRF CAPABILITIES
TO INCLUDE NEW TRANSDUCERS

A. Introduction

ARL:UT originally worked under Contract N00024-75-C-6070 to technically assist NAVSEA with expanding the capabilities of the Navy's three TRFs to encompass several new kinds of transducers, most of which are towed line hydrophone arrays. NAVSEA's plan is to equip the TRFs by FY 79 for repairing and testing the towed line arrays used with the following sonar systems: AN/BQQ-5, AN/BQQ-6, AN/SQR-18 (IETAS), AN/SQR-19 (ETAS), and AN/BQR-25 (STASS). In addition to these towed arrays, the plan includes equipping the TRFs to repair the transducers associated with the AN/WQM-6 Standard Acoustic Target Source (SATS) and the AN/WQM-7 equipment.

B. Visits to NAVSHIPYDS MARE and PEARL

During this report period, visits were made to NAVSHIPYDS PEARL and MARE to discuss space requirements for towed line array repairs. Details of each visit are included in EAG Trip Reports TR-EA-10 of 2 May 1977 and TR-EA-12 of 13 May 1977. During the visit at MARE, the restoration and repair manual for the TB-16/BQ was reviewed; representatives from NAVSEA 660F, Hydrotronics, Inc., NAVSHIPYD MARE, NAVSEA 04312, and ARL:UT attended this review.

C. Current Progress

Efforts have continued to monitor the design of the new TRF building at NAVSHIPYD PTSMH by consulting with Mr. M. Phillips of Ganteaume and McMullen, Inc., an architectural firm. A 28 ft x 240 ft area in the building is planned for the repair of towed arrays.

ARL:UT has completed a study of the test equipment requirements for the STASS and TB-16/BQ towed line arrays. ARL:UT is investigating the feasibility of replacing the manufacturer's test sets for both the STASS and TB-16/BQ arrays with a Hewlett-Packard instrumentation package based on the 9825A programmable calculator. This system can be programmed to perform the present time consuming steps that an operator uses to measure the various parameters of the towed arrays. With proper interfacing, all of the Navy's towed line arrays can probably be tested at the TRFs with one general purpose test set, rather than having special purpose sets for each array.

D. Future Plans

During the next report period, ARL:UT will begin investigating the feasibility of using a standard work bench for the complete repair of towed line arrays by using semiautomated handling equipment for individual modules. The repair procedures will be streamlined for a cost effective fast turnaround at the TRF.

VI. DOCUMENTATION SUPPORT

A. Introduction

ARL:UT participated in two tasks in the area of documentation support, which focused on preparing the Sonar Dome Handbook.

B. Revision of the "Sonar Dome Handbook, Volume V, Submarine Sonar Domes," NAVSEA 0967-LP-412-3050

During April, 400 copies of the January 1977 revision of the "Sonar Dome Handbook, Volume V, Submarine Sonar Domes," NAVSEA 0967-LP-412-3050, were assembled and mailed in accordance with the distribution list provided by NAVSEA. 50 additional copies were retained as reserve stock at ARL:UT, at the direction of NAVSEA. This document had been duplicated during the last reporting period, but the plastic covers supplied by the vendor were defective and had to be replaced. This delayed completion of the project by about six weeks.

C. Revision of the "Sonar Dome Handbook, Volume II, AN/SQS-26 Steel and Rubber Sonar Domes," NAVSEA 0967-LP-412-3020

Starting in April and continuing through May, a reediting of the "Sonar Dome Handbook, Volume II, AN/SQS-26 Steel and Rubber Sonar Domes," NAVSEA 0967-LP-412-3020, was carried out. This reedited version was submitted to NAVSECNORDIV on 20 May 1977 for review, approval, and the resolution of two minor technical discrepancies.

VII. AN/WQM-5 PROCUREMENT AND FIELD CHANGE PROGRAM

A. AN/WQM-5 Series Field Change Kits

By 31 May 1977 work on the field change units being manufactured by C-Tech, Inc., Massena, New York, was well under way. Virtually all material for the components being fabricated has been acquired. Construction of printed circuit cards is in progress and wiring of the first unit has begun. Initial testing of the first units is expected to occur in late July or August.

To date, nine of the calculators and two of the plotters to be incorporated in the AN/WQM-5 have been delivered to ARL:UT. The remaining units will be ordered in the near future to ensure that delivery coincides with the delivery of the units built by C-Tech, Inc.

By 31 May, work was well under way on the technical manual changes that will be part of the field change kit. Test material is being drafted and schematic diagrams are being finalized. These diagrams will be reduced to fit in the technical manual format.

B. Procurement of the AN/WQM-5A Sonar Test Set for Spain

The original AN/WQM-5 components manufactured by Dranetz Engineering Laboratories, required for the Spanish Navy's AN/WQM-5A, were delivered to ARL:UT on 11 May 1977. The Hewlett-Packard calculator and required interface units are currently being checked out and will be combined with the units currently on order from C-Tech, Inc., to make up the AN/WQM-5A to be delivered to Spain.

VIII. AN/BQQ-5 SWITCHING POWER SUPPLY

A. Introduction

ARL:UT was tasked under Contract N00024-74-C-1069 by NAVSEA Code 660F to perform a study of the current switching power supply (built by IBM) which is used in the AN/BQQ-5 sonar system. This basic study has progressed to a new design proposed by ARL:UT that should make the reliability requirement of 100,000 h MTBF a reality.

The work under Contract N00140-76-C-6487, a follow-on task to the original study, requires ARL:UT to fabricate and demonstrate a model of the proposed new supply.

B. Current Progress

The ARL:UT Modular Power Supply Type 4B (MPS) was described in the previous progress report. During this report period, the design was refined, the engineering model was demonstrated to NAVSEA personnel and consultants, conferences were attended, a manufacturer was consulted for pricing of the supply, and meetings with interested parties were held in Washington, DC, and Boston, Massachusetts.

The design changes were made primarily on the series dissipative regulators (SDRs). Two series regulators are required for the MPS to bring the output noise and ripple within specifications; these regulators were discovered to be reliable and very efficient. Several configurations based on monolithic voltage regulators were tried, but these either latched up or were inefficient. A hookup using a

quadrature operational amplifier, two Darlington transistors, and about 50 other parts finally evolved. Except for some minor problems involving stability and noise, this regulator met specifications. Current efforts are being directed toward eliminating these shortcomings and making the design more compatible with hybrid construction techniques.

The method of mechanically and thermally mounting the modules was adequate, but improving the layout and procuring parts which are easy to install will make the modules easier to construct and test.

C. Demonstration

Messrs. D. L. Baird of NAVSEA 660FB and B. Daney of NAVSEA OCHP-11 attended a demonstration at ARL:UT 5-6 April 1977, along with Messrs. M. L. Williams of EG&G and M. Fry of Instruments, Inc., as consultants. Mr. B. Vasilow, manager of the production at IBM Federal Systems, Oswego, New York, also attended and offered suggestions as to where problem areas can occur relating to the history of production of the IBM supply.

Mr. M. L. Williams questioned the reliability of the IBM supply because of the way redundancy was achieved on both a modular and individual part basis.

D. Conferences Attended

On 12-14 May 1977, Messrs. D. Monteith, K. Butler, J. Stockton, and B. Shaw from ARL:UT attended a conference on Powercon 4 in Boston at which papers on a variety of switchmode applications were presented and new techniques were discussed. Parts were obtained from both vendors and conference attendees.

On 12-13 May, Messrs. L. Dittell and E. Shaw attended the Electronic Components Conference held in Washington, D. C., and gained further insight into types of parts, reliability of manufacturers, and effects of aging and temperature on reliability.

E. Liaison with Power Supply Manufacturer

Messrs. K. Butler and E. Shaw went to WCC Electronics Division in Huntsville, Alabama, to determine manufacturing costs for the ARL:UT MPS both in small and large quantities. Given a completed design and drawings, the power supply, in lots of 1000, would cost \$4000.

F. Liaison with NAVSEA and NAVFLEX

A display of the ARL:UT MPS at NAVSEA and NAVFLEX on 18 May 1977, in Washington, DC, and on 11 May at Draper Laboratories in Boston generated considerable interest.

At present, the MIL-217-B reliability study of both the ARL:UT and IBM MPSS is partially complete and will be reported in the next quarterly progress report.

22 June 1977

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