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NAVAL TECHNICAL MANUAL SYSTEM DESIGN ANALYSIS STUDY.
AN/BQQ-5 TECHNICAL DATA PRODUCT ANALYSIS

Thomas W. Carrington, Jr.

IBM Federal Systems Division

Prepared for:

Naval Ship Research and Development Center

15 January 1976

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Navy Technical Manual System Design Analysis Study

AN/BQQ-5 Technical Data Product Analysis

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TECHNICAL MEMORANDUM

NAVY TECHNICAL MANUAL SYSTEM

DESIGN ANALYSIS STUDY

AN/BQQ-5 TECHNICAL DATA PRODUCT ANALYSIS

15 January 1976

Prepared for

NAVAL SHIP RESEARCH and DEVELOPMENT CENTER
Bethesda, Maryland 20034
Contract N00024-74-C-1259

Federal Systems Division
INTERNATIONAL BUSINESS MACHINES CORPORATION
Gaithersburg, Maryland 20760

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Section 1. INTRODUCTION

The Navy Technical Manual System (NTMS) is a system of procedures and equipments being conceived within the Navy to support and improve the management, production, distribution, storage, utility, and effectiveness of operator and maintenance technical data in the 1980 time period. One key facet of this system is expected to be computer-based information handling capabilities.

The NTMS program associated with the development of this overall system is currently in a concept formulation phase which will provide a framework within which subsequent system design can be accomplished. Within the context of this concept formulation process, various requirements, objectives, characteristics of, and plans for NTMS have been developed and presented in previous reports.^{1,2} It is helpful, however, to characterize and discuss the technical data products and processes associated with the development of a particular Navy weapons system, in order to assess what implications might arise from such a system with respect to the NTMS information system.

Accordingly, this report examines the functional characteristics of technical manuals and data management within a current Navy system development effort, specifically that associated with the AN/BQQ-5 Sonar System. The purpose of the examination is to provide a basis for discussion and further conceptualization relative to how various facets of NTMS might evolve.

The AN/BQQ-5 System was chosen for this examination because it is representative of existing types of hardware systems which are incorporating new maintenance philosophies and approaches. Further, due to the existence of different AN/BQQ-5 configurations and unique technical manual maintenance documentation requirements, an environment appears to exist where the benefits of information system technology could be applied. No implications should be drawn, however, which imply that any specific NTMS concepts and facilities will be characterized by or in any way limited by the BQQ-5 environment. Similarly, no conclusions should be drawn as to specific devices, equipments, or procedural approaches which might evolve.

¹Sulit, R. A., et al., "Navy Technical Manual System (NTMS) Program Development Plan," Report No. 4483, Naval Ship Research and Development Center, Bethesda, Maryland, November 1974.

²Touchton, C. F., et. al. "Navy Technical Manual System, Publishing Subsystem, Functional Objectives Definition," Report No. FSD 75-0118, IBM Corporation, Federal Systems Division, Gaithersburg, Maryland, 6 June 1975.

Section 2. AN/BQQ-5 SONAR DOCUMENTATION

2.1 SYSTEM OVERVIEW

The AN/BQQ-5 Sonar Set is an analog/digital sonar system designed for installation aboard several different classes of U.S. Navy submarines. The development program associated with this system encompasses all the facets of a large, complex system development effort such as the engineering required to support prototype and production hardware units, as well as the development of software to support both tactical and nontactical (maintenance) functions.

Within the AN/BQQ-5 development program, various units of documentation will be delivered to the Navy as required by contract and as defined in the Contract Data Requirement List (CDRL). Part of the documentation being delivered consists of technical documentation; another part consists of those items required for the monitoring of system development and contract performance. These latter items are outside the definition of technical manuals and, as such, will be beyond the scope of NTMS and detailed examination in this report.

The remainder of this section contains an overview of selected elements of the AN/BQQ-5 Sonar System environment, for the purpose of providing a context within which the products and processes associated with this environment can be examined.

2.1.1 Configuration Considerations

In general, the functional capability of the Sonar Set will not vary among the different submarines. Due to different physical installation requirements, however, various "repackagings" of system components will be performed. To denote such changes, the Sonar Set which has a P/N (Part Number), dash number, construction, i.e., 6930000-10, will have the dash number of the part number changed to indicate a "dash level" specifying the exact Sonar set installed aboard.

For each dash level installation of the Sonar Set there will be a unique software package and a corresponding unique set of hardware maintenance documentation.

2.1.2 Maintenance Documentation Concept

The AN/BQQ-5 Sonar Set documentation concept is based directly on the system maintenance concept. This latter concept is based on the Performance Monitoring/Fault Localization (PM/FL) capability which is built into the equipment hardware/software complex itself.

The PM software continuously monitors the hardware performance to determine if a fault condition has been detected. Upon detection of a fault, an FL diagnostic program will be initiated to determine which hardware assemblies are capable of causing the error and will direct the Sonar technician to examine, on the average, 15 different assemblies. The technician, utilizing the appropriate maintenance procedure, will replace hardware assemblies one at a time, and rerun the FL software until the failing unit is located. It should be pointed out that some of the FL testing is performed with the Sonar Set in an "off-line" testing mode. The AN/BQQ-5 documentation, in conjunction with the PM/FL software, provides the maintenance and diagnosis technical data required to keep the Sonar Set operating within specification limits.

2.2 DOCUMENTATION CONCEPT

The AN/BQQ-5 documentation consists of the following major units:

- a. **Technical Manuals**
 - 1. **System Manual**
 - 2. **Operators Manual**
 - 3. **Maintenance Manual**
- b. **Training Material**
 - 1. **Learner's Guide**
 - 2. **Instructor's Guide**
 - 3. **Graphic Training Aids**
- c. **Software Documentation**
 - 1. **Program Specification**
 - 2. **Program Design Plan**
 - 3. **Program Listing**
 - 4. **Program Operating Procedure**
 - 5. **Program Certification Plan**
 - 6. **Program Certification Procedure**

d. **Project Monitoring Documentation**

1. **Progress Reports**
2. **Development Plans**
3. **Maintenance Plans**
4. **Various other required reports.**

The technical manuals are characterized in Table 2-1, and discussed in relationship to the total AN/BQQ-5 documentation in the following subsections.

2.2.1 Technical Manuals

The technical manuals to be delivered with the AN/BQQ-5 Sonar Set comprise the largest unit of documentation. For each sonar configuration, it is estimated that more than 30,000 page units of documentation are required. Due to their complexity, size, and wide distribution, these technical manuals are discussed in the following subsections.

2.2.1.1 System Manual

The AN/BQQ-5 System Manual is a one-volume, hard-copy document which is designed to present an overview of the system's capabilities and equipment to senior Naval and civilian personnel. The document currently consists of 102 pages which contain, in addition to text, 9 pages of front matter, 3 pages of Table of Contents, 19 illustrations, and 19 tables.

The text of this manual is presented in a two columns per page format, with single spacing between lines and double spacing between paragraphs and item listings. This manual is prepared for hard copy only and will not be microfilmed for shipboard use.

It should be noted that many of the illustrations in the current release of this document consist of multipage foldouts which will be reformatted and reduced in size in subsequent releases of the manual. These illustrations consist primarily of hand drawn line art ranging from simple block diagrams to ship installation drawings. The manual is prepared in accordance with MIL-M-15071 for content and MIL-M-38784 for format.

Table 2-1. AN/BQQ-5 Technical Manual Product Description

Characteristic	System Manual	Operators Manual	Maintenance Manual
Audience	Commanding and Executive Offices Civilian Naval Personnel	Sonar Offices Sonar Operators Civilian Naval Personnel	Sonar Technicians Civilian Naval Personnel
Presentation Media	Hard Copy	Hard Copy	Hard Copy and Microfilm
Classification	Confidential	Confidential	Confidential
Size	8½ x 11 inch, vertical format two columns per page one volume	8½ x 11 inch, vertical format columns per page one volume	Hardcopy — 11 x 17 inch, turn page format, two 8½ x 11 page units of text on 11 x 17 page Microfilm — approximately 23 cartridges, 16 mm
Page Count	102 pages, 19 illustrations, 19 tables	418 pages, 175 illustrations, 23 tables	approximately 3300 page units
Text Preparation	Manually typed	Manually typed	Manually typed
Illustrations Preparation	Hand drawn line art, typed and Leroy lettered	Hand drawn line art, typed and Leroy lettered	Hand drawn line art, typed and Leroy lettered 600 typewritten 1000 Leroyed 7400 computer generated
Type of Illustrations	Block Diagrams, Graphs, Ships Drawings, Annotated Illustrations	Block Diagrams, Graphs, Ships Drawings, Annotated Illustrations, Equipment Illustrations with Legends	Graphs, Ships Drawings, Annotated Illustrations, Wiring Diagrams, Function Block Diagrams, Function Circuit Diagrams, Logic Diagrams, Parts
Presentation Mode	Passive	Passive	Passive
Indexing/ Reference Scheme	Conventional	Conventional	See Subsection 3.1.2
Effectivity List	Document manually updated to reflect equipment configurations and modifications	Document manually updated to reflect equipment configurations and modifications	Document manually updated to reflect equipment configurations and modifications
Applicable Specification	MIL-M-15071 Content MIL-M-38784 Format	MIL-M-15071 Content MIL-M-38784 Format	MIL-M-15071 Content MIL-M-38784 Format

2.2.1.2 Operators Manual

The AN/BQQ-5 Operators Manual is a one-volume hard copy document prepared for use by Sonar Officers and Sonar Operators. This volume presents much of the same type of material as is presented in the System Manual but at a greater level of detail. The manual is designed to present a functional view of the system components, controls, display descriptions, and operating procedures. It should be noted that the material does not present tactical training information such as "when" to operate the equipment. This manual currently consists of approximately 418 pages which contain, in addition to text, 175 illustrations and 23 tables.

All of the illustrations are hand drawn line art with lettering performed either with a Leroy lettering set or by typewriter. Many of the illustrations in the current release of the manual are presented on multipage foldouts which will be reformatted to either single or double page illustrations in future releases. The primary consideration for the elimination of multipage foldout is the cost factor associated with the preparation and revision of the line art as contained on such pages. Several of the figures in the manual present equipment panel drawings which require numerous subsequent pages of legend description. This presentation technique illustrates a requirement of a capability for integrated text and graphics.

2.2.1.3 Maintenance Manual

The AN/BQQ-5 Maintenance Manual presents a comprehensive introduction and detailed theory of operation for each of the functions of the AN/BQQ-5 Sonar Set, in addition to maintenance, repair, and troubleshooting procedures. Table 2-2 describes the general contents of each of the volumes of the maintenance manual. The manual currently consists of a total, of 23 volumes of information to aid the Sonar technicians in maintaining the Sonar Set. The manuals provide Naval personnel with the following data:

- a. General and detailed theory of operation of the Sonar Set
- b. Troubleshooting techniques
- c. Removal and replacement procedures
- d. Repair procedures
- e. Alignment and adjustment procedures
- f. Sonar Set parts data.

This manual, when fully developed, will consist of over 30K pages of documentation. For a single Sonar Set configuration containing 23 volumes, several of the volumes will be unique to that configuration. The manual will be prepared in both hard copy and microfilm with the format of

Table 2-2. AN/BQQ-5 Sonar Set Maintenance Manual Organization

Vol. No.	Contents (or System Function Title)	Sonar Set Units Contained in Vol.
1	Introduction to manual	—
2	Introduction to System	—
3	Array and T/R Switching	1, 2, 3, 4, 7/180, 21
4	Amplifier Scanning	7A1, 7A2
5	Transmission	6, 11 through 17, part of 114, 125, 181, 182
6	Passive Filtering/Equalizing/Clipping (F/E/C)	111
7	Passive Beamforming	113
8	Passive Processing	115
9	Low Frequency Beamforming	119, 185, 186
10	Beamformer Interface Unit (BIU)/Spectrum Analysis	117
11	Active Filtering/Clipping (F/C)	112
12	Active Beamforming	part of 114
13	Active Processing	116
14	Data Conversion	24, 33, 34, 118, 179
15	Classification Processing	176
16	Post Processing	178
17	Central Computing and Audio Communications	26A1, 26A2, 26A3, 26A4, 128
18	Control and Display	120, 121, 122, 123, 168, 169, 177
19	Performance Monitoring/Fault Localization (PM/FL) Control	124, 134, 170, 183
20	Power and Cooling	5, 38, 39, 40, 51, 52, 55, 184
21	System Troubleshooting, Cabling Diagram and AIL	All
22	Parts List and Parts Location Illustrations	All
23	Fault Group Index and Alphabetical Index	All
24	Low Frequency Beamforming	119, 129, 185, 186
25	Multifunction Interface Unit/Digital Spectrum Analyzer (MIU/DSA)	130

hard copy document directed towards microfilm. The microfilm retrieval technique is based upon the U. S. Navy's Maintenance Information Automated Retrieval System (MIARS).

The volumes are prepared in an 11x17 inch page format with two 8-1/2 x11 page units of text presented on a single page. When viewed from microfilm, only one half of the 11x17 inch page will be presented on the viewer. All illustrations, wiring diagrams and other figures are constructed on either an 8-1/2 x11 or 11x17 inch page unit. Each page unit contains a frame number to aid in microfilm text retrieval.

The manuals are organized with all text presented in the front of a given volume, followed by figures, tables, and other groups of material. This arrangement was accepted by the Navy to reduce document preparation, page duplication, and publication cost. (Normally, in most hard copy manuals, tables and figures follow directly after the text call out). When a Sonar technician utilizes a volume of the maintenance manual in microfilm which has a reference to a figure, he obtains a display of the referenced figure by entering its frame number into the microfilm reader/printer. If a copy of the reference or text is required, a hard copy is available by a push-button request.

Table 2-3 contains a summary of the types of material found in the maintenance manuals. For each of the materials listed in Table 2-1, a YES/NO notation is presented to denote the use of a computer to aid the preparation. The appendix to this report contains an example of each of the categories of data presented in Table 2-2. Further characterization and quantization of the types of illustration were not attempted since much of the material is currently in various stages of preparation.

Table 2-3

SUMMARY OF AN/BQQ-5 MAINTENANCE MATERIAL

Material Type	Number of Pages	Computer Assisted Preparation
1 page or less illustration	628	No
2 page illustration	1041	No
Page Unit of Text	2070	No
Page Unit of Tables	160	No
Wiring List/Parts List	2700	Yes
Fault Group Index	2000	Yes
Automated Interface Listings	2600	Yes
Automated Logic Diagrams	7400	Yes
Table of Contents, List of Illustrations, etc.	1300	Yes
Index	250	Yes
Blank Frame Pages for Microfilm	3000	No

2.2.2 Training Material

The AN/BQQ-5 Sonar Set will be delivered in both tactical and training configurations. The training material being developed consists of a two-volume "Learner's Guide" and a companion two-volume "Instructor's Guide" to be used in conjunction with the maintenance manuals. This material consists of approximately 2250 pages of text and associated graphics. In addition to the training manuals, various graphic aids are being supplied such as view graph material, wall charts, and operating material.

2.2.3 Software Documentation

The software documentation to be delivered with the AN/BQQ-5 Sonar Set will consist of program specifications, a program design plan, program listings, and program descriptions. The requirement for this documentation is contained in the CDRL items F001AA, F001AB, Preliminary, and Final Tactical/Test Software. The format and content of the documentation is defined in NAVSHIPS specification 0967-011-0011 titled "Specification For Digital Program Documentation," 1 October 1968. At the time of this report, this documentation is in various stages of generation by the programmers who are developing the AN/BQQ-5 system software. For the Software Program Specifications and Design Plans, it has been estimated that 10,000 pages of documentation will be produced for both the tactical and nontactical software. A corresponding program listing of the software will require approximately 14,000 pages. The certification plan and procedures have been estimated at approximately 1000 pages.

2.2.4 Project Monitoring Documentation

The last category of documentation identified in this section is that material required for monitoring of contractual performance by the U. S. Navy. Since this material (progress report, development plans), etc.) will have limited distribution and will not be used to convey technical information, it is considered to be beyond the scope of NTMS and this report.

Section 3. AN/BQQ-5 MAINTENANCE DOCUMENTATION ENVIRONMENT

3.1 PROCESS DESCRIPTION

3.1.1 Process Development Organization

AN/BQQ-5 maintenance documentation is prepared within the Technical Manual Department of the IBM/FSD facility at Manassas, Va. This department is part of the Ship System Integrated Logistic Support organization. Members of this department are technical writers whose responsibility is to interface with system designers, engineers, and programmers to prepare the necessary hardware maintenance documentation. The Technical Manual Department receives all required publication support from various vendors engaged in full time technical document production and publication.

3.1.2 Text Preparation

Two distinct processes are involved in the preparation of text for the AN/BQQ-5 Sonar Set. The first process consists of the usual development of text and associated material (e.g., illustrations, table diagrams) for the initial publication of a document. The second process involved in the AN/BQQ-5 documentation is the preparation of subsequent documentation for other dash level Sonar Sets. This preparation consists of adding an update package to the previous dash level documentation. This updated procedure is discussed in subsection 3.2, Revision Process.

Text for the AN/BQQ-5 manuals is prepared in a handwritten manuscript and is either draft typed by the Secretarial Support Center, or submitted directly to an outside vendor. Typically, the vendor will take manuscripts, markedup drafts, sketched artwork and will generate a clean draft for proofing. The camera copy for the manuals is prepared on standard 8-1/2x11 inch mats for text and 8-1/2x11 or 11x17 inch mats for all illustrations, charts, and diagrams. When a clean draft (camera copy) is available, the technical writers will review the draft at either the vendor's facility or in the development facility.

Prior to the return of the camera copy, the vendor prepares various program coding sheets which note the titles of sections, paragraphs, illustrations, and references. The data from the coding sheets is used as input to a computer program which generates the Table of Contents, List of Illustrations, List of Tables, and special reference call outs. The special reference call outs are printed by the computer and pasted down on each sheet of camera copy to aid in the use of the document when in microform (see subsection 3.1.4). In addition, each page of the maintenance manual is numbered with a microfilm frame count.

When the camera copy of a manual is returned from a vendor, the Technical Manual Department will assemble the various components (e.g., Table of Contents, List of Illustrations) into a final package for the printer.

3.1.3 Printing

Initially, 150 copies of a volume of the AN/BQQ-5 documentation are printed. Subsequent document revisions or dash level releases are accomplished by the printing of an update package. The documents are printed in either a standard 8-1/2x11 vertical format for the System or Operators Manual, or an 11x17 inch horizontal turn page format for the Maintenance Manuals. In either format, the pages are usually printed with backup (both sides).

To aid in the production of the microfilming of the maintenance manuals, two additional copies of the manuals are printed with no backup (one side only). This procedure is described in subsection 3.1.4.

3.1.4. Microfilm

Due to the space required to store the 30K pages of the Maintenance Manual, a requirement was established to publish the manual in microfilm. The Maintenance Manual requires approximately 26 cartridges of microfilm. Each volume requires at least one cartridge, while a large volume, such as Volume 22, requires three cartridges. Each cartridge has a maximum capacity of approximately 2600 frames of 8-1/2x11 inch format or a maximum of 1200 frames of 11x17 inch format. No attempt has been made to minimize the amount of film required by having multiple volumes on a single cartridge.

The microfilm copy of the Maintenance Manuals does not always use the camera copy, but rather a special one-side-only print of the manual. Prior to microfilming, a number of blank pages, each with a frame number, are inserted into the manual to allow for future revisions. This procedure reduces the impact of the updating process on the indexing and retrieval scheme. When an update of a segment is required, the entire publication cycle is re-entered, e.g., the original camera copy is modified, updates generated to the hard copy, a one-sided print made, and a microfilm update generated. The new master is then duplicated, and new microfilm cartridges are generated for distribution.

The microfilm system for the AN/BQQ-5 Sonar System utilizes the U.S. Navy's Maintenance Information Automated Retrieval System (MIARS). This system utilizes 16mm roll microfilm cartridges with the AR150A Automatic Microfilm Reader/Printer. Each microfilm installation will have two microfilm displays, a reader/printer, and a reader only unit. The latter unit is provided as a backup to the AR150A and does not have the automatic search capability. The microfilm utilizes a standard reduction ratio (24:1) of the original copy, with the 11x17 inch page

appearing as one frame on the film. However, only one half of the frame is displayed at a time; that is, an 8-1/2x11 page is presented. For a display of an 11x17 illustration, the film must be advanced to view the other half of the frame. While greater reductions of the image area are possible, the 24:1 reduction provides good viewing and reproduction characteristics for the microfilm.

The microfilm viewer has an automatic search feature which allows the user to retrieve any frame on the cartridge by entering the frame number via the keyboard. The special reference call outs on the bottom of each page are utilized by the user to aid in the retrieval of nonsequential frames.

3.2 REVISION PROCESS

The Technical Manual Department follows two paths in preparing revision to the manuals. The first path constitutes "normal" revision to a document, while the second path consists of additional releases of the manual to address subsequent equipment installation.

The "normal" path of revision consists of the traditional concept of updating, e.g., the pages which are affected are modified, change control pages are generated, and the revised package enters the publication cycle.

The second path in the revision process provides for the production of this "dash level" documentation. A dash series of equipment indicates usually that either a repackaging or reconfiguration of hardware units has been accomplished which may incorporate a new or advanced technology for an existing system function. It is planned that in some of the future system releases, several of the volumes will become obsolete and new volumes will be published.

A "dash level" of documentation is achieved by combining the basic document containing all previous applicable revisions with a unique revision for the dash level. This point is illustrated in Figure 3-1, Documentation Configuration Matrix. On a "dash level" 1 and 3 system, Volume 5 could consist of only the basic document. For a "dash level" 10 system, Volume 5 consists of the basic document plus revision 1. All revisions to the system documentation are numbered serially. The Documentation Configuration Matrix, is updated, to assist the user in determining whether or not a given revision is applicable to a given dash level and volume.

One other major feature of the revision process to be covered in this report is an examination of "how" the revision package is assembled. At the present time, each volume of the Maintenance Manual series is the responsibility of a technical writer who reviews all engineering changes to specific units of the Sonar Set. The technical writer, upon determining that an engineering change will affect the text or diagrams of a section of the Maintenance Manual, initiates the documentation changes. Upon generation of the appropriate changes, a validation/verification procedure is employed.

VOL	SYSTEM APPLICATION															
	-1				-3				10							
1	-8040				-8040				-8040							
	APPL CHNG				APPL CHNG				APPL CHNG				APPL CHNG			
	B 1 2 3 4				B 1 2 3 4				B 1 2 3 4				B 1 2 3 4			
	5 6 7 8 9				5 6 7 8 9				5 6 7 8 9				5 6 7 8 9			
	10 11 12 13 14				10 11 12 13 14				10 11 12 13 14				10 11 12 13 14			
2	-8050				-8050				-8050							
	APPL CHNG				APPL CHNG				APPL CHNG				APPL CHNG			
	B 1 2 3 4				B 1 2 3 4				B 1 2 3 4				B 1 2 3 4			
	5 6 7 8 9				5 6 7 8 9				5 6 7 8 9				5 6 7 8 9			
	10 11 12 13 14				10 11 12 13 14				10 11 12 13 14				10 11 12 13 14			
3	-8060				8060				-8060							
	APPL CHNG				APPL CHNG				APPL CHNG				APPL CHNG			
	B 1 2 3 4				B 1 2 3 4				B 1 2 3 4				B 1 2 3 4			
	5 6 7 8 9				5 6 7 8 9				5 6 7 8 9				5 6 7 8 9			
	10 11 12 13 14				10 11 12 13 14				10 11 12 13 14				10 11 12 13 14			
4	-8070				-8070				-8070							
	APPL CHNG				APPL CHNG				APPL CHNG				APPL CHNG			
	B 1 2 3 4				B 1 2 3 4				B 1 2 3 4				B 1 2 3 4			
	5 6 7 8 9				5 6 7 8 9				5 6 7 8 9				5 6 7 8 9			
	10 11 12 13 14				10 11 12 13 14				10 11 12 13 14				10 11 12 13 14			
5	-8080				-8080				-8080							
	APPL CHNG				APPL CHNG				APPL CHNG				APPL CHNG			
	B 1 2 3 4				B 1 2 3 4				B 1 2 3 4				B 1 2 3 4			
	5 6 7 8 9				5 6 7 8 9				5 6 7 8 9				5 6 7 8 9			
	10 11 12 13 14				10 11 12 13 14				10 11 12 13 14				10 11 12 13 14			
6	-8090				-8090				-8090							
	APPL CHNG				APPL CHNG				APPL CHNG				APPL CHNG			
	B 1 2 3 4				B 1 2 3 4				B 1 2 3 4				B 1 2 3 4			
	5 6 7 8 9				5 6 7 8 9				5 6 7 8 9				5 6 7 8 9			
	10 11 12 13 14				10 11 12 13 14				10 11 12 13 14				10 11 12 13 14			

HOW TO USE THIS MATRIX:

1. The system configuration is shown by the dash number under the heading "System Application". The dash number is a part of the system part number located on the Sonar Set Control, Unit 122. For example, if the system part number is 6930000-1, the system configuration is -1 and appears in the matrix under "System Application."
2. The columns in the matrix headed -1, -3, etc., list the volumes of this maintenance manual that apply to the system configuration. The four digit number contained in each box in the matrix indicates the last four digits of the NAVSEA number 097-574-XXXX which corresponds to a particular volume of the manual. The smaller boxes in the matrix indicate the basic issue ("B" in the small box) or the particular change number ("1" through "14") of the volume by a gray shading of the applicable letter or number.

*Previously published as Table 1-2. (U) System Application Versus Applicable Manual Volume Matrix (U), NAVSEA 0967-574-8180, Volume I.

Figure 3-1. Documentation Configuration Matrix*

3.3 DISTRIBUTION PROCESS

The distribution process is based on lists of maintenance manual users in hardcopy and microfilm, identified to the BQQ-5 development facility by the Navy. For the users of the hardcopy, the basic document for all dash levels has been distributed. Hardcopy revisions will be shipped to these document users as they are generated. Microfilm will be distributed to specified users as each "dash level" of the system is completed. Normal security procedures are utilized to safeguard classified material.

3.4 STORAGE PROCESS

Two separate storage facilities are required for the AN/BQQ-5 documentation. At the present time, the classified sections of the manuals have been separated from the nonclassified and are placed in a designated classified storage facility. The unclassified portions of the documents are kept in a warehouse facility. It is estimated that 65 percent of the material associated with the AN/BQQ-5 equipment is classified. A history copy of every distinct AN/BQQ-5 document is maintained and the master of each document is retained for updating in the documentation library.

2. Objective of the documentation
3. Usage of the documentation
4. Level of detail expected
5. The audience (level of training, education, and experience)
6. A style guide to be followed
7. Requirement for a validation/verification program
8. Requirement for a configuration management program
9. Quality assurance procedures.

4.2 DOCUMENTATION DEVELOPMENT YARDSTICKS

Within various development activities, the cost of documentation should be evaluated by NTMS management to ensure that cost effective technologies are being utilized to produce required documentation. As part of this evaluation, development cost should be grouped into two broad categories: (a) contractor's estimates for a professional staff (technical writers, engineers, programmers, etc.) to perform the tasks of data gathering of materials for manuscript and graphics; and (b) contractor's estimates of production cost, from manuscript typing to the production of camera ready copy.

The latter category of production cost should be evaluated to determine if the publication technologies employed will effectively support review, updating, and revisions of subsequent documentation. For NTMS, techniques to raise the visibility of cost should be developed which will aid in this evaluation.

4.3 DOCUMENTATION SYSTEM MANAGEMENT

Computer assisted text preparation and revision techniques can be used to reduce the quantity of labor hours expended to control the production of technical manuals. In addition, a computer-based system could aid in the rapid identification of units of documentation, i.e., paragraph, page, volume, etc., required to support a given piece of equipment or configuration. The quick identification of a change, a retrofit, or an emergency change, could greatly reduce the time lag, documentation inaccuracy, and distribution problems now being experienced by many users of Navy technical manuals. It should be pointed out that a configuration management software package to provide the capabilities for a documentation system as described above does not exist today. This

capability for a documentation system could be developed, however, by utilizing the advanced technologies being employed in large data base/data communication systems.

4.4 SECURITY VERSUS COST EFFECTIVENESS OF DOCUMENTATION SYSTEMS

A major problem which should be examined further in the NTMS Context is the question of security versus cost effectiveness of computer-based documentation systems. It is generally recognized that much documentation can be cost effectively prepared with the aid of a computer system. When producing classified documentation, however, the additional cost factors of a secure computer system environment may cause the cost advantages of a computer assisted documentation facility to quickly disappear.

Two implications exist for future NTMS systems. First, the quantity of classified work to be performed on the traditionally large computer systems used for text processing must justify the associated cost. The second implication establishes a requirement for the development of small, low cost, standalone computer systems which can be physically secured to provide the cost effectiveness required for the production of classified documentation.

4.5 TECHNICAL MANUAL DISTRIBUTION MANAGEMENT

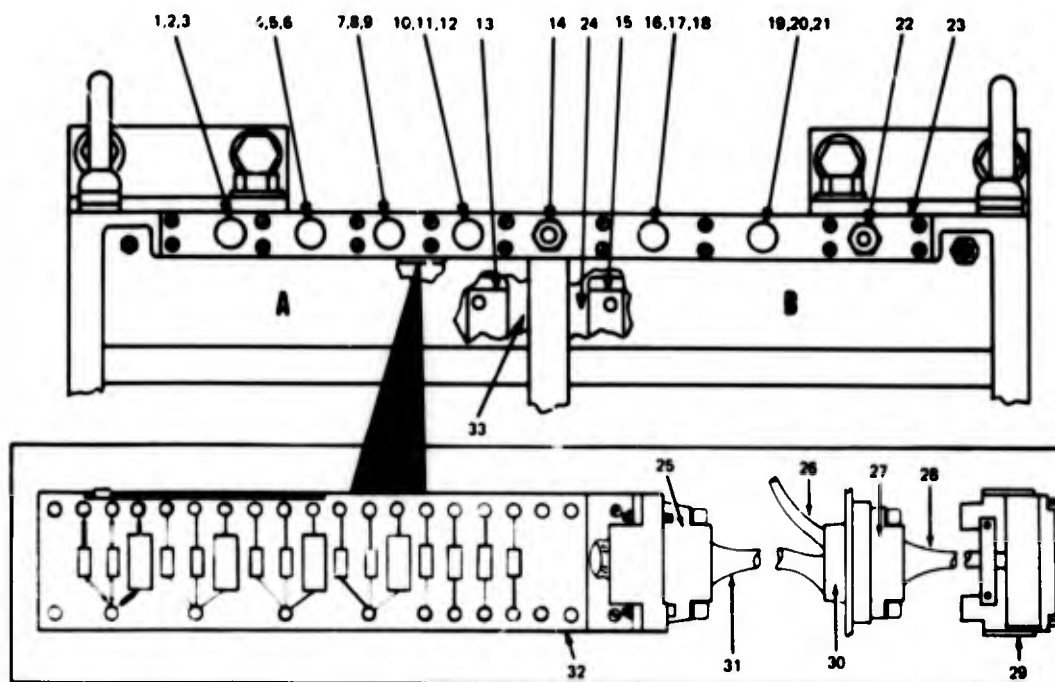
The timely distribution of technical manual material is another problem which NTMS should address. During the analysis of the AN/BQQ-5 documentation environment, it was noted that no procedures or processes exist by which either urgent or interim maintenance documentation could be distributed rapidly to users in the fleet. The documentation considered for this distribution would probably be related safety items, repair of critical malfunction, or data required more quickly than normal distribution processes provide.

The usage of microfilm cartridges such as those used for AN/BQQ-5 documentation provides the Navy with an opportunity to ensure that the correct level of documentation is being utilized in the fleet. It is normally assumed that when a user receives new microfilm cartridges, the old cartridge will be removed and destroyed. An audit procedure could be established such that a certification card would be distributed with the microfilm to be completed by the user, certifying that the old microfilm has been removed and destroyed. This certification card would be returned to the distribution facility for use as an input for a configuration management/documentation control program.

APPENDIX

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NAVSEA 067-574-8270
VOLUME 22



Index No.	Part Name	Index No.	Part Name
1	Lamp DS1	18	Lampholder XDS5
2	Lens MP8	19	Lamp DS6
3	Lampholder XDS1	20	Lens MP13
4	Lamp DS2	21	Lampholder XDS6
5	Lens MP9	22	Switch S2
6	Lampholder XDS2	23	Lamp assy gasket MP5
7	Lamp DS3	24	Gasket MP6
8	Lens MP10	25	Connector W7P1
9	Lampholder XDS3	26	Harness assy W6
10	Lamp DS4	27	Connector WBP100
11	Lens MP11	28	Cable assy WB
12	Lampholder XDS4	29	SHP connector WBP1
13	Switch S3	30	Connector J100
14	Switch S1	31	Harness assy W7
15	Switch S4	32	Resistor-grid board assy Z1
16	Lamp DS5	33	Gasket MP7
17	Lens MP12		

0810

Figure 23-130-2. (U) 130 - PNB classification processor (partial view) (U)

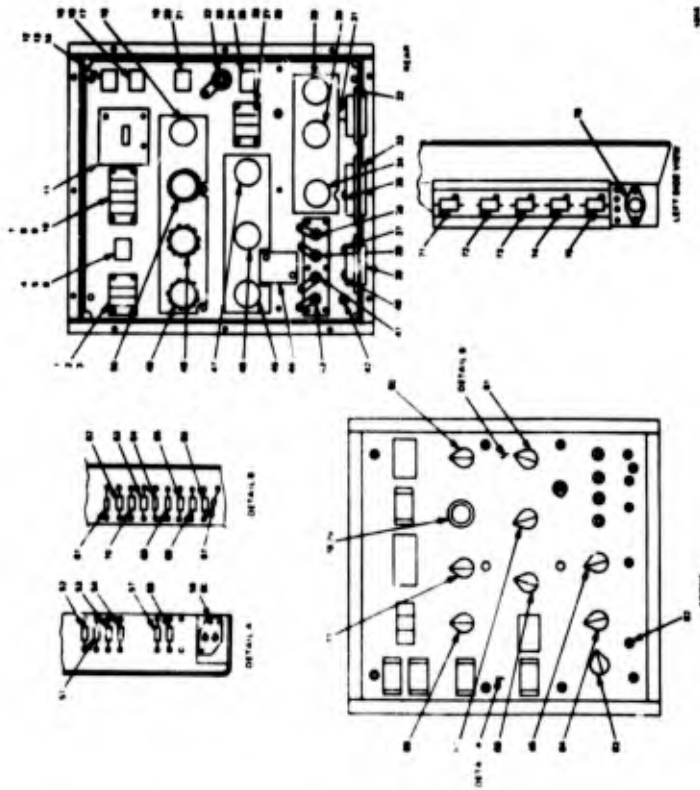
UNCLASSIFIED

3549

EXHIBIT 1. AN/BQQ-5 Single Page Illustration

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REVISIONS AND CHANGES
VOLUME 2



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	
...

Figure 23-129-5. (UP) 129-5 maintenance control panel component location diagram (UP)

35-62

EXHIBIT 2. AN/BQQ-5 Double Page Illustration

UNCLASSIFIED

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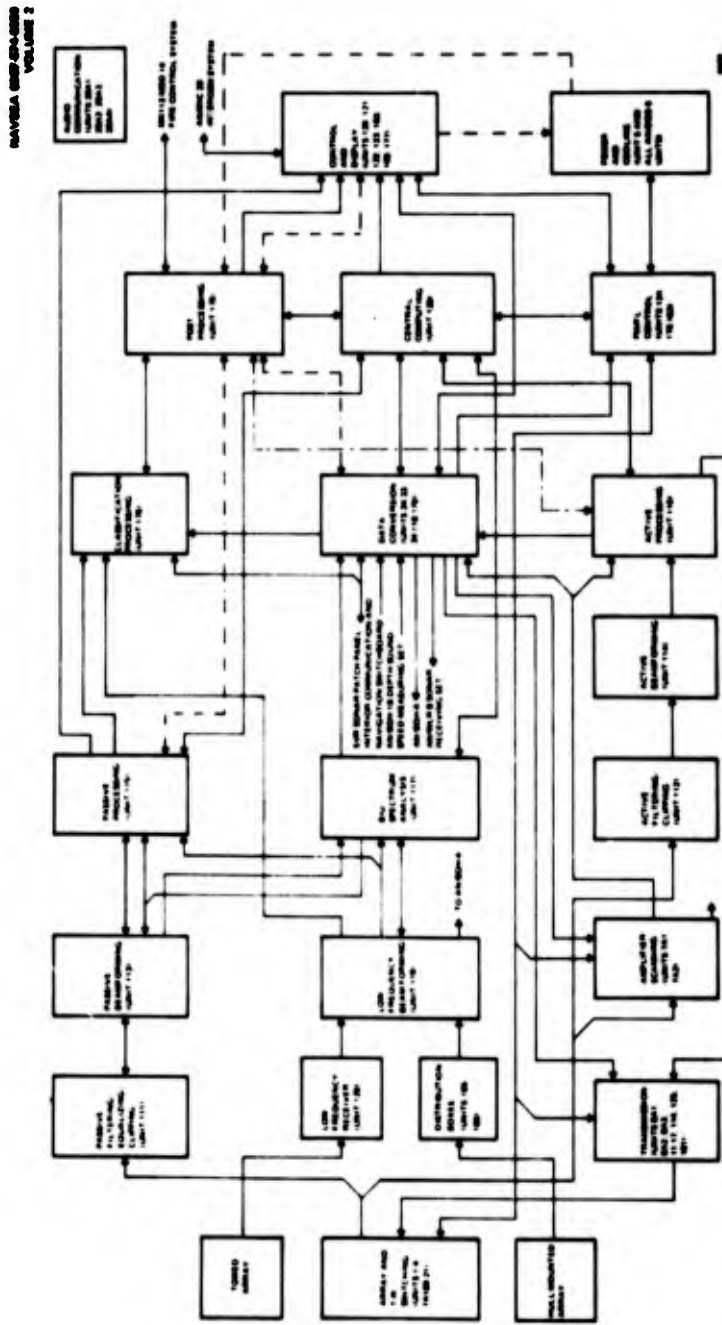


Figure 2.2. (U) Simplified AN/BQQ-5 Function Diagram (U)

0224

EXHIBIT 4. AN/BQQ-5 Block Diagram

UNCLASSIFIED

SECTION 14

THEORY OF OPERATION FOR DATA CONVERSION FUNCTION (U)

14.1. (U) INTRODUCTION.

14.1.1. (U) Section 14 provides the general theory of operation and detailed theory of operation for the data conversion function to enable maintenance at the organizational level.

14.1.2. (U) The general theory of operation (paragraph 14.2) describes the operation of the data conversion function by discussing the signal flow, interfacing and function of the hardware functional areas. The general theory is keyed to the functional block diagram (FBD) 6934012.

14.1.3. (U) The detailed theory of operation (paragraph 14.3) presents a detailed description of each of the hardware functional areas. This discussion is keyed to both the FBDs and the automated logic diagrams (ALDs). The ALDs are referenced within the FBD functional blocks.

NOTE

All data conversion function power circuits are described in Volume 20.

The data conversion function is designed so that it can interface with the AN/BQH-4/5 Recording System; however, this system is not installed at the present time.

14.2. (U) GENERAL THEORY.

14.2.1. (U) INTRODUCTION. The data conversion function (FBD 012-1) performs:

1. Audio processing of selected beams.
2. Synchro-to-digital (S/D) conversion of 17 synchro orders (representing synchro angular positions) for further processing.

3. Digital-to-synchro (D/S) conversion of synchro orders that provide control for the transmission function and the amplifier scanning function.

4. Conversion of analog automatic target following (ATF) information and signal-to-noise ratio (SNR) information to digital form for further processing.

5. Conversion of digital bearing deviation indication (BDI) information to an analog signal to drive the RLI-UDI meter on the Control-Display Console (CDC) and generation of controls for the amplifier scanning function.

6. Analog-to-digital (A/D) conversion and formatting of SNR signals for display on the Precision Data Recorder.

7. Summing and equalization of compensator left half and right half beams for further processing.

8. Audio communications interface between the AN/WQC-2 and the Sonar Set AN/BQQ-5.

The data conversion function is controlled by the central computing function while operating the Sonar Set AN/BQQ-5 in Normal Configuration, or the post processing function while operating in Bypass Configuration. Hereinafter, computing function refers to the function that is providing control.

14.2.1.1. (U) With the exception of summing and equalizing compensator outputs, all of the operations performed by the data conversion function are initiated by the computing function or via the computing function initiated by the Control-Display Console (CDC) operator. Summing and equalizing compensator outputs are independent

F012-1 0148 F012 0148

Table 14-5. (U) Strobe Audio Discretes A (U)

CONTROL WORD BIT	DESCRIPTION
2 1 0 5 4 3 8 7 6	Selects audio signal for CDC 3 Selects audio signal for CDC 2 Selects audio signal for CDC 1
0 0 0 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1	No selection Select Audio Gate PBB D/A 1 signal (FBD 012-6) Select Audio Gate PBB D/A 2 signal (FBD 012-6) Select Audio Gate Active D/A 1 signal (FBD 012-6) Select Audio Gate Active D/A 2 signal (FBD 012-6) Select Audio Gate Comp 1 signal (FBD 012-6) Select Audio Gate Comp 2 signal (FBD 012-6) Select Audio Gate BIU signal (FBD 012-6)
10 9	PBB audio processor logic selection for PBB 2 D/A Mux bus (FBD 012-4)
0 X 1 0 1 1	Select DIMUS Fullbeam Audio beam no. 2 Select DIMUS Tracker Audio beam no. 1 Select DIMUS Tracker Audio beam no. 2
12 11	PBB audio processor logic selection for PBB 1 D/A Mux bus (FBD 012-4)
0 X 1 0 1 1	Select DIMUS Fullbeam Audio beam no. 1 Select DIMUS Fullbeam Audio beam no. 2 Select DIMUS Tracker Audio beam no. 1
14 13	PBB audio processor logic selection for PBB 3 D/A Mux bus (FBD 012-4)
0 X 1 0 1 1	No selection Select DIMUS Fullbeam Audio beam no. 1 Select DIMUS Fullbeam Audio beam no. 2

Notes: Control Word bits 0-2 are decoded for control of Control-Display Console (CDC) -3, bits 3-5 for CDC -2, and bits 6-8 for CDC -1.
X = Don't care.

Table 14-6. (U) Strobe Audio Discretes B (U)

CONTROL WORD BIT	DESCRIPTION
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	Passive 1 D/A Converter and Filters (FBD 012-5) Passive 2 D/A Converter and Filters (FBD 012-5) Sum-Diff Audio Filter Comp 1 (FBD 012-5) Sum-Diff Audio Filter Comp 2 (FBD 012-5) DIFAR-Like Audio Filter (FBD 012-5)
0 0 0 0 0 1 0 1 0 0 1 1 1 0 0 1 0 1 1 1 0 1 1 1	Select filter 1 Select filter 2 Select filter 3 Select filter 4 Select filter 5 (No selection for BIU/SAU) No selection No selection No selection

Notes: Bits 0-2, 3-5, 6-8, 9-11, and 12-14 are decoded to control the hardware functions listed.

F012-4 0151 F012-5 0152 F012-6 0153

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VOLUME 20

TABLE 22-208. (U) HARNESS ASSEMBLY-184W1 WIPE LIST(U)

DESCRIPTION SZ CCLOR TYPE	BDL	GRP	CP	W/ LCC	FRM CONN	PIN	LCC	TC CCNN	PIN	REV	SIGNAL NAME
18 BRN 3 SH CD	1	4		J2E	*X			J41	A		UNIT 119 115VAC 60HZ PH A
18 GRY 3 SH CD	1	4		J28	*N			J41	B		UNIT 119 115VAC 60HZ PH B
18 TAN 3 SH CD	1	4		J28	*Y			J41	C		UNIT 119 115VAC 60HZ PH C
22 BK/W SF GND	1	4		J28	GRP 1				E15		SMLC(CAB/CHAS GND)
18 BRN 3 SH CD	2	4		J28	AJ			J43	A		UNIT 120 115VAC 60HZ PH A
18 GRY 3 SH CD	2	4		J28	AH			J43	B		UNIT 120 115VAC 60HZ PH B
18 TAN 3 SH CD	2	4		J28	*k			J43	C		UNIT 120 115VAC 60HZ PH C
22 BK/W SH GND	2	4		GRF	2			J43	D		SHIELD JUMPER
18 BRN 3 SH CD	3	4		J28	*M			J44	A		UNIT 121 115VAC 60HZ PH A
18 GRY 3 SH CD	3	4		J28	*B			J44	B		UNIT 121 115VAC 60HZ PH B
18 TAN 3 SH CD	3	4		J28	*C			J44	C		UNIT 121 115VAC 60HZ PH C
22 BK/W SF GND	3	4		J28	GRP 3				E15		SMLC(CAB/CHAS GND)
18 BRN 3 SH CD	4	4		J28	*F			J46	A		UNIT 122 115VAC 60HZ PH A
18 GRY 3 SH CD	4	4		J28	*Z			J46	B		UNIT 122 115VAC 60HZ PH B
18 TAN 3 SH CD	4	4		J28	AK			J46	C		UNIT 122 115VAC 60HZ PH C
22 BK/W SH GND	4	4		J28	GRF 4				E15		184 CAB/CFAS GND
18 BRN 3 SH CD	5	4		J28	AV			J52	A		UNIT 177 115VAC 60HZ PH A

* CENCIES LOWER CASE LETTER

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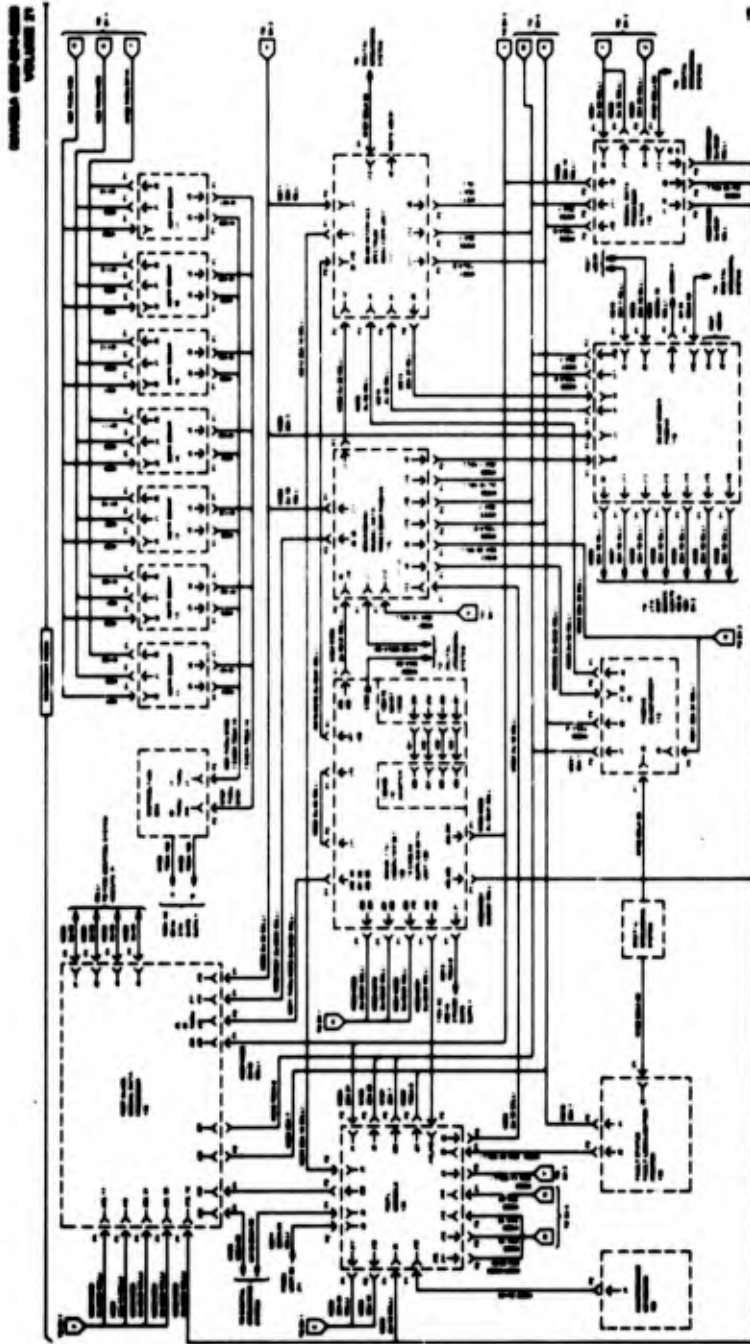


Figure 25-12. AN/BQQ-5 Cabling Diagram (Sheet 2 of 3)

0125

EXHIBIT 8. AN/BQQ-5 Cabling Diagram

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NAVSEA 0967-574-8270
VOLUME 22

TABLE 23-2. (U) MAINTENANCE PARTS LIST (CONTD) (U)

REFERENCE DESIGNATION	NOTE	PART NAME AND DESCRIPTION	FRAME NUMBER
114W3	A	WIRING HARNESS, BRANCHED -AC-GATE A 6931475-1	1262 03640
114W3	BC	WIRING HARNESS, BRANCHED -AC-GATE A 6931475-2	1262 03640
114W4		WIRING HARNESS, BRANCHED -AC-GATE B 6931476-1	1264 03640
114W5		HARNESS ASSEMBLY, K1/TB2 6931681-1	1250 03640
114W6		HARNESS ASSEMBLY, Z1/TB2 6931164-1	1258 03640
114W7		HARNESS ASSEMBLY, LIGHT/SWITCH 6931680-1	1258 03640
114W7P1		CONNECTOR, PLUG, ELECTRICAL 26 CONTACT, CRIMP TYPE SOCKETS. SREC26SJT	1258 81312
114W8		CABLE ASSEMBLY, THERMAL WARNING 6931425-1	1258 03640
114W8P1		S/A 114A/P1	PN WS6117P8B 1258
114W8P2 THRU 114W8P99		NOT USED	
114W8P100		CONNECTOR, PLUG, ELECTRICAL 20 SIZE 20 CRIMP PIN TYPE CONTACTS WITH POLARIZED JACKSCREWS SREC20PJT937	1258 81312

S/A DENOTES 'SAME AS'

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EXHIBIT 9. AN/BQQ-5 Parts List

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NAVEA CRIP-PRO-0000
VOLUME 20

TABLE 2-1. (U) FAULT GROUP INDEX (CONT'D)(U)

FAULT GROUP	REFERENCE DESIGNATION	AL/P/D	IMAGE NUMBER	FBI NUMBER	IMAGE NUMBER	PARAGRAPH	THEORY NUMBER	IMAGE NUMBER	SPECIAL INSTRUCTIONS	IMAGE NUMBER
40001	178A1D07	LOC1RA15AGM		101A-2	0224V16	16.3.1		0046V16	23-178 CMC-15	0081V16
	178A2A01			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178A2A02			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-08	0081V16
	178A2A03			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-08	0081V16
	178A2A05			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-08	0081V16
	178B4P02	LOC1RH08ACE								
	178B4P18	BOL1RH0768R		105A3V16	101A-4	0226V16	16.3.3.31	0076V16	23-178 CMC-15	0081V16
	178B4P28	JDR1RH0808E								
	178A1A06	LOC1RA1128G								
	178A1D06	LOC1RA150AJAR		10231V16	101A-3	0225V16	16.3.2.11	0053V16	23-178 CMC-15	0081V16
	178A1D37	LOC1RA15AGC								
	178A2A01			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178A2A02			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178A2A03			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
178A2A05			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16	
178B4P02	LOC1RH08ACE									
178B4P18	BOL1RH0768G		105A3V16	101A-4	0226V16	16.3.3.31	0076V16	23-178 CMC-15	0081V16	
178B4P28	JDR1RH0808F									
40006	178A1A06	LOC1RA1128E								
	178A1D06	LOC1RA150AGAM		10231V16	101A-3	0225V16	16.3.2.11	0053V16	23-178 CMC-15	0081V16
	178A1D37	LOC1RA15AGF								
	178A2A01			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178A2A02			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178A2A03			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178A2A05			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
	178B4P02	LOC1RH08ACE								
	178B4P18	BOL1RH0768D		105A3V16	101A-4	0226V16	16.3.3.31	0076V16	23-178 CMC-15	0081V16
	178B4P28	JDR1RH0808G								
	178A1A06	LOC1RA1128A								
	178A1D06	LOC1RA150AEAF		10231V16	101A-3	0225V16	16.3.2.11	0053V16	23-178 CMC-15	0081V16
	178A1D37	LOC1RA15AGF								
	178A2A01			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16
178A2A02			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16	
178A2A03			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16	
178A2A05			101A-2	0224V16	16.3.1		0046V16	23-178 CMC-00	0081V16	
178B4P02	LOC1RH08ACE									
178B4P18	BOL1RH0768A		105A3V16	101A-4	0226V16	16.3.3.1	0076V16	23-178 CMC-15	0081V16	
178B4P28	JDR1RH0808H									

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EXHIBIT 10. AN/BQQ-5 Fault Group Index

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NAVSEA 0967-574-8260
VOLUME 21

TABLE 23-215 (JJ) SYSTEM CABLE NO. #1 WIRE LIST (CONT) (U) 08-15-75

LINE	WIRE	NO.	FROM	TO	WIRE	NO.	FROM	TO	WIRE	NO.	FROM	TO	SIGNAL	FUNCTION	SIGNAL	CHARACTERISTICS	COMMENTS
13	*M	039-02	3	---	*M	SMLD											REV 04-15-72 IGRD-UNIT 1
14	*M	039-02	4	---	---	SMLD											REV 07-18-71 IGRD-UNIT 1
15	*K	039-03	4	WHT		*KIT7-7											REV 07-18-71
16	*X	039-03	4	BLK		*KIT7-8											REV 07-18-71
17	*M	039-03	5	WHT		*MIT7-7											REV 07-18-71
18	*N	039-03	5	BLK		*MIT7-11											REV 07-18-71
19	*Y	040-02	5	---	*Y	SMLD											REV 04-15-72 IGRD-UNIT 1
20	*Y	040-02	6	---	---	SMLD											REV 07-18-71 IGRD-JNIT 1
21	AK	039-03	6	WHT		AKIT7-11											REV 07-18-71
22	AL	039-03	6	BLK		ALIT7-12											REV 07-18-71
23	AX	039-04	7	WHT		AXIT7-13											REV 07-18-71
24	AJ	039-04	7	BLK		3JIT7-14											REV 07-18-71

CONN. DWG. NO. 603026
* DENOTES LOWER CASE LETTER

CODE IDENT 52088
DWG # AN/BQQ-5-MIA
REV: A SHEET 2

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0132

EXHIBIT 11. AN/BQQ-5 Automated Interface Listing

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NAVSEA 0967-574-8180

**PRELIMINARY
TECHNICAL MANUAL
MAINTENANCE**

SONAR SET AN/BQQ-5 (U)

**Volume 14
Data Conversion (U)**

INTERNATIONAL BUSINESS MACHINES CORPORATION
CONTRACT N00024 70 C 1300

Each transmittal of this document outside of the Department of Defense must have approval of the issuing Service

Published by direction of Commander, Naval Sea Systems Command

1 JANUARY 1975

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0001

EXHIBIT 13. AN/BQQ-5 Maintenance Manual Front Cover

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NAVSEA 0967-574-8180
VOLUME 14

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