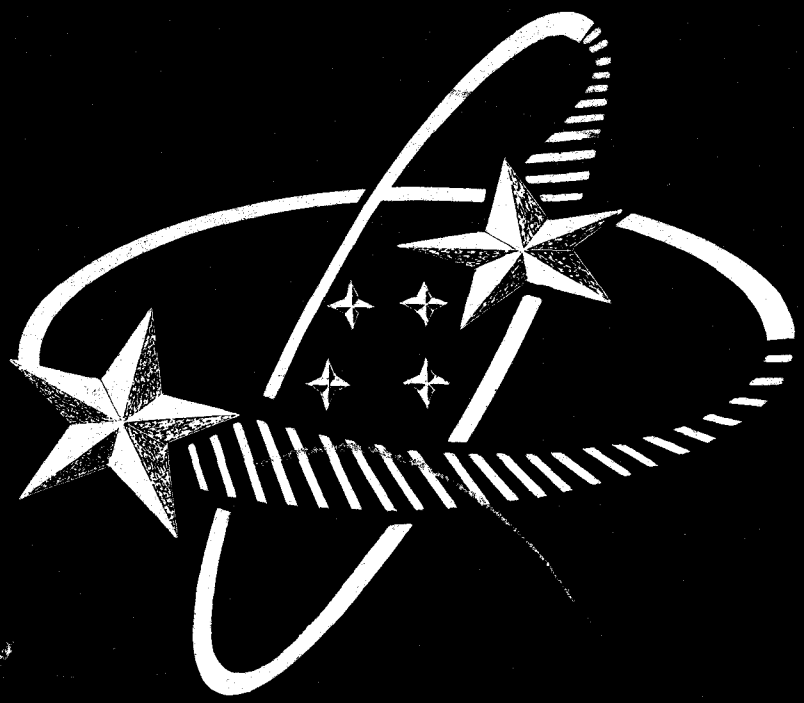

ELECTRONICS TECHNICIAN 3 & 2 VOL. 1

(COMMUNICATIONS)

NAVAL TRAINING COMMAND

RATE TRAINING MANUAL NAVTRA 10195-A

Date Due -

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PREFACE

The primary purpose of all Navy training is to produce a victorious, combat Navy which can guarantee victory at sea. This victory is dependent upon the readiness of the personnel aboard. Each man is assigned tasks to perform according to the needs of the ship. This rate training manual, consisting of two volumes, is based upon the technical tasks required of Electronics Technicians Third and Second Class. Special efforts have been made to make the manual useful for the Fleet, the Naval Schools, and the Naval Reserve. Conscientious use of this manual and its associated enlisted correspondence course/functional individual training system (ECC/FITS) will contribute greatly to the Navy's "training for victory at sea."

As one of the Navy's rate training manuals for a specific rating, this Manual was prepared by the Naval Training Publications Detachment, Washington, D.C., for the Naval Training Command. Special credit is given to the following Commands for their reviews during the preparation of the manual: The Naval Schools Command, Treasure Island, San Francisco, Calif.; The Naval Examining Center, Great Lakes, Ill.; The Training Command, U.S. Atlantic Fleet, Norfolk, Va.; The Training Command, U.S. Pacific Fleet, San Diego, Calif.; The Naval Ship Systems Command, Washington, D.C.; and The Naval Electronic Systems Command, Washington, D.C.

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

CHAPTER 1

PREPARING FOR ADVANCEMENT

This rate training manual (consisting of two volumes) has been prepared for men of the U.S. Navy, and Naval Reserve. Consientious study of this manual will contribute greatly to the Electronics Technician's ability to maintain the electronic equipment aboard ship at maximum efficiency so that victory at sea will be guaranteed. The ET qualifications used as a guide in the preparation of the manual are those listed in the Manual of Qualifications for Advancement, NAVPERS 18068-C for Electronics Technicians Third and Second Class.

Chapters 2, 3, and 4 of this volume cover general maintenance procedures, microelectronics, and general purpose test equipment. The remaining eight chapters deal with communication systems. An electronic system is defined according to MIL-STD-280, and the system concept is then used in discussing the various communication systems.

Simplified block diagrams are used to show the relationship between the various sets, groups, and units that make up the systems. Block diagrams are also used, for the most part, in describing the functional operation of the units, assemblies, and subassemblies. The joint electronics type designation system, and the metric system, are shown in appendixes I and II.

Volume 2 of this manual discusses radar systems and electronic navigation systems.

The remainder of this chapter gives information on the enlisted rating structure, the ET rating, requirements and procedures for advancement, and references that will help you, both in working for advancement and in performing your duties as an ET. This includes information on how to make the best use of rate training manuals. It is strongly recommended that you study this chapter carefully before beginning study of the remainder of this manual.

THE ENLISTED RATING STRUCTURE

The two main types of ratings in the present enlisted rating structure are general ratings and service ratings.

GENERAL RATINGS identify broad occupational fields of related duties and functions. Some general ratings include service ratings; others do not. Both Regular Navy and Naval Reserve personnel may hold general ratings.

SERVICE RATINGS identify subdivisions or specialties within a general rating. Although service ratings can exist at any petty officer level, they are most common at the P03 and P02 levels. Both Regular Navy and Naval Reserve personnel may hold service ratings.

THE ELECTRONICS TECHNICIAN RATING

When you decided to become an ET, you selected one of the most interesting and challenging fields available to men in the Navy. Electronics Technicians maintain electronic equipment used for communications, detection, tracking, recognition and identification, and navigation. Advances in electronics continue to bring about improvements in these equipments, and new equipment is continually being developed. Thus, the ET is a keyman in our modern Navy.

Electronics Technician rates are included in the personnel allowance for practically all Navy ships including repair ships and tenders. Billets for ET3s and ET2s are also included at Naval communication stations, Naval air stations, Naval training stations, Fleet weather centers, and shore-based repair facilities.

The ET rating was established in 1948, and includes service ratings ETR (radar) and ETN (communications) at the E-4 and E-5 levels. For advancement to ET1, you must be qualified in both service ratings. Navy Enlisted Classification (NEC) codes for the rating are listed in the

Manual of Navy Enlisted Classifications NAVTRA 15105 (revised). The classification codes identify those men with special training and/or qualifications on equipments such as special radar and communications sets, secure communications equipment, inertial and satellite navigation equipment, ground controlled approach equipment, tactical data systems equipment, electronic standards equipment, and equipment related to special projects.

The ET should have a good background in mathematics. If you are lacking in this area, the mathematics training manuals Mathematics, Vol. 1, NAVPERS 10069-C, Mathematics Vol. 2, NAVPERS 10071-B, and Mathematics, Vol. 3, NAVPERS 10073-A are recommended. Skill in the use of tools and test equipment will be acquired through performance of your daily duties. Gaining the necessary technical knowledge and keeping abreast of the changes in your field will require reading and studying in your spare time.

Upon advancement to ET3, you will be evaluated on your leadership and supervisory ability as well as your ability to perform your technical duties. Study the leadership principles and techniques discussed in Military Requirements for Petty Officer 3 and 2, NAVPERS 10056 (revised).

As you study material concerning leadership traits, keep in mind that probably none of our most successful leaders possess all of these traits to a maximum degree, but a weakness in some traits are more than compensated for by strength in others. Critical self-evaluation will enable you to realize the traits in which you are strong, and the traits which you must strive to improve. Leadership principles can be taught, but a good leader acquires that quality only through hard work and practice.

SAFETY

Before starting his first job, the ET must be aware of the hazards involved, and the precautions to be observed when working with electrical and electronic circuits and equipment. These precautions include the following:

1. Precautions for the prevention of electric shock, such as securing power and tagging switches; use of shorting stick, rubber mats and gloves; proper grounding of equipment; and special precautions when working on energized circuits, and with high voltages.
2. Precautions to be observed when working aloft. These include the use of proper safety equipment, and guarding against electric shock, stack gases, and electromagnetic radiation.
3. Precautions to be observed when using solvents and handling radioactive and cathode-ray tubes.

In addition to the material in this training manual, safety procedures of importance to the ET are contained in the following publications:

1. Basic Electronics, Vol. 1, NAVPERS 10087-C chapter 2
2. Basic Electricity, NAVPERS 10086-B, chapter 1
3. Electronics Installation and Maintenance Book (EIMB), NAVSHIPS 0967-000-0100, section 3
4. NAVSHIPS Technical Manual, NAVSHIPS 0901-000-0000, chapter 9600 section 2, and chapter 9670 section 5.

SECURITY

The security of the United States in general, and of Naval operations in particular, depends to a large extent upon the success attained in safeguarding classified materials. Electronics Technicians maintain and repair various types of classified electronics equipment, and therefore, have access to restricted areas and classified information. Each ET must be diligent in complying with all regulations pertaining to the security of electronics equipment, spaces, and printed matter.

Security Classifications

Official information that requires protection in the interest of national defense is limited to three categories of classification. In descending order of importance, these categories carry the designation of Top Secret, Secret, or Confidential.

TOP SECRET.—Top Secret material or information is that of which the defense aspect is paramount, and the unauthorized disclosure of which would result in EXCEPTIONALLY GRAVE DAMAGE to the Nation. Such grave damage might consist of, but is not limited to—

1. Leading to a definite break in diplomatic relations affecting the defense of the United States, an armed attack against the United States or her allies, or a war

2. The compromise of military or defense plans, or intelligence operations, or scientific or technological developments vital to the national defense

SECRET.—The classification Secret is limited to defense information or material, the unauthorized disclosure of which could result in SERIOUS DAMAGE to the Nation, such as jeopardizing the international relations of the U.S., endangering the effectiveness of a program or policy of vital importance to national defense, compromising important military or defense plans or technological developments, or revealing important intelligence operations.

CONFIDENTIAL.—The use of the classification Confidential is limited to defense information or material, the unauthorized disclosure of which could be PREJUDICIAL TO THE DEFENSE INTERESTS of the Nation, such as:

1. Operational and battle reports that contain information of value to the enemy
2. Intelligence reports
3. Military radiofrequency and call sign allocations that are especially important, or are changed frequently for security reasons
4. Devices and material relating to communications security
5. Information that reveals strength of land, air, or naval forces in the United States and overseas areas, identity and composition of units, or detailed information relating to their equipment
6. Documents and manuals containing technical information used for training, maintenance, and inspection of classified munitions of war
7. Operational and tactical doctrine
8. Research, development, production, and procurement of munitions of war
9. Mobilization plans
10. Personnel security investigations and other investigations, such as courts of inquiry, which require protection against unauthorized disclosure
11. Matters and documents of a personal or disciplinary nature, which, if disclosed, could be prejudicial to the discipline and morale of the armed forces
12. Documents used in connection with procurement, selection, or promotion of military personnel, the disclosure of which could violate the integrity of the competitive system

NOTE: Official information of the type described in items 10, 11, and 12 is classified Confidential only if its unauthorized disclosure could in fact be prejudicial to the defense interests of the Nation.

Security Areas

The shipboard and shore station spaces that contain classified matter are known as security areas. These security areas (sometimes called sensitive areas) have varying degrees of security interest, depending upon their purpose and the nature of the work and information or materials concerned. Consequently, the restrictions controls, and protective measures required vary according to the degree of security importance. To meet different levels of security sensitivity, three types of security areas have been established: EXCLUSION, LIMITED, and CONTROLLED areas.

EXCLUSION AREA.—The cryptocenter, registered publications issuing office (RPIO) vault, classified conference room, and other spaces requiring the highest degree of control of access are designated exclusion areas. They contain classified matter of such nature that admittance to the area permits, for all practical purposes, access to such matter.

Exclusion areas are fully enclosed by walls or bulkheads of solid construction. All entrances and exits are guarded, and only persons whose duties require access and who possess appropriate security clearances are authorized to enter, after being positively identified. Normally, a list of personnel authorized entry, signed by the CO, is posted in the area.

LIMITED AREA.—Radio central, message center, relay station, transmitter rooms, and other communication spaces usually are designated limited areas.

Operating and maintenance personnel whose duties require freedom of movement within limited areas must have proper security clearances. The commanding officer may, however, authorize entrance of persons who do not have clearances. In such instances, escorts or attendants and other security precautions must be used to prevent access to classified information located within the area.

Entrances and exits of limited areas are either guarded or controlled by attendants to check personnel identification, or they may be protected by automatic alarm systems.

CONTROLLED AREA.—Passageways or spaces surrounding or adjacent to limited or

exclusion areas are often designated controlled areas. Although a controlled area does not contain classified information, it serves as a buffer zone of security restriction. Moreover, it provides greater control, safety, and protection for limited and exclusion areas.

Controlled areas require personnel identification and control systems adequate to limit admittance to those having bona fide need for acess to the area.

Security Investigations And Clearances

Before a person can have access to classified material, his character and his past must be checked to the extent appropriate to the sensitivity of the material he will be handling. Following are the two basic qualifications.

1. He must be of unquestionable integrity, trustworthiness, and loyalty to the United States.
2. He must be of excellent character and of such habits and associations as to cast no doubt upon his discretion and good judgment in handling classified information.

TYPES OF INVESTIGATIONS.—To determine whether an individual meets the criteria for a security clearance, two types of personnel security investigations are made. They are the national agency check (NAC) and the background investigation (BI).

A national agency check consists of the review of the records and files of several Government agencies to determine if any derogatory information exists on the individual or on an organization to which he may have belonged.

The background investigation is much more extensive than a national agency check. It is designed to develop information on whether the access to classified information by the person being investigated is clearly consistent with the interests of national security. It inquires into the loyalty, integrity, and reputation of the individual.

TYPES OF CLEARANCES.—A personnel security clearance is an administrative determination that an individual is eligible, from a security standpoint, for access to classified information of the same or lower category as the clearance being granted.

Of the two types of clearances (INTERIM and FINAL), an interim clearance is granted as the result of a lesser investigative process, and is a method for establishing temporary eligibility for access to certain levels of classified information.

An interim clearance is granted only when the delay in waiting for completion of the necessary steps for final clearance would be harmful to the national interest. Procedures to effect a final clearance are initiated simultaneously with initiation of the procedures for an interim clearance. The only type of clearance not granted to military personnel is the interim CONFIDENTIAL.

A final clearance is granted when it is determined that an individual is eligible, from a security standpoint, for access to classified information of specific levels.

Each clearance, final and interim, is evidenced by a certificate of clearance. Certificates of clearance are made a matter of record and become a permanent part of an individual's service record.

Security Violations And Compromises

No one in the Navy is authorized to handle any classified material except that required in the performance of duty. All other persons are unauthorized, regardless of grade, duties, or clearance.

If it is known—or even suspected—that classified material is lost, or is passed into the hands of some unauthorized person, the material is said to be compromised. The seriousness of the compromise depends on the nature of the material and the extent to which the unauthorized person may divulge or make use of what he learns.

Individuals found responsible for the loss, unauthorized disclosure, or possible subjection to compromise of classified information, and individuals who violate security regulations, are promptly disciplined regardless of rank or position. Disciplinary action for military personnel may include trial by court-martial.

Accounting for and Control of Dissemination of Classified Material

The control of classified material is necessary for several purposes. It must be controlled to limit dissemination and to prevent excessive production or reproduction; it must be controlled so that, when regraded or declassified, the holders or recipients can be ascertained

and notified; it must be controlled so that the office or person normally responsible for its security can be ascertained; and Top Secret material must be controlled so that its location can be determined promptly and so that those who have access to its contents can be ascertained. These requirements can generally be fulfilled by effective supervision, conscientious and informed execution of personal responsibilities, and efficient administration. In addition, the importance of Top Secret material requires a formal record for hand to hand transfer of custody from one accountable office or command to another. Secret material also requires a record of transfer of custody from one accountable command to another; and for Top Secret material, there is a special system for recording those who have access to Top Secret material.

The Accounting system for an activity must provide readily available information on: what classified material it has received, what classified material it has produced, who has custody of a particular Top Secret document, and what disposition has been made of Top Secret and Secret material.

When military or civilian personnel resign or are to be separated from the Naval Establishment or released from active duty, all classified material held by them shall be turned in to the source from which received, to their commanding officer, or to the nearest naval command, as appropriate, prior to delivery of final orders or separation papers. In addition, any person in the Naval Establishment about to be relieved must deliver to his successor all classified material in his custody. Appropriate receipts must be completed covering as a minimum all Top Secret material.

Persons in command are responsible for controlling the dissemination of classified information emanating from or distributed within their commands. They are also responsible for the promulgation of additional directives that may be required to prevent unauthorized dissemination of information under their control. Classified material must not be removed from a command without the specific permission of the commanding officer or his authorized representative.

The dissemination of classified material is limited to those persons whose official duties require them to have knowledge or possession of such material. Responsibility for determining whether a person's official military or other governmental duties require that he possess or have access to any classified information and whether he is authorized to receive it rests upon each individual who has possession, knowledge, or command control of the information involved, and not upon the prospective recipient. These principles are equally applicable whether the prospective recipient is an individual, a U.S. military command, a defense contractor or another federal agency. In the case of a foreign government there is the additional requirement for written authorization from the Chief of Naval Operations.

Classified information must not be disclosed over telephones because of the insecurity due to executive cut-in, phantom voice interception, microwave transmission intercept, and wiretapping. Telephones located in sensitive areas must be provided with a means of complete disconnection such as a plug or jack arrangement if they are to be considered safe. Intercom systems located in sensitive areas must be confined to the sensitive area.

From a security viewpoint, the printing, duplicating or reproduction of classified material poses many problems; it contributes to the increasing volume of classified material; it permits quick and easy production of uncontrolled material containing classified information; the equipment or processes require care or special procedures to prevent or eliminate latent impressions or offset versions of the classified information; and a quantity of excess and waste material is produced which can also contribute to compromise of the classified information.

Classified material may be produced or reproduced, however, when authorized by appropriate authority. Classified material produced or reproduced by any means must be recorded, and samples, waste or overruns resulting from the reproduction process must be safeguarded as specified in the Department of the Navy Security Manual for Classified Information, OPNAV Instruction 5510.1 series.

Transmission of Classified Material

Classified material must be safeguarded during transmission from one place to another as well as when held within a command. Due to the very nature of the problem, compromise or loss is more probable during transmission than at any other time. For this reason, specific rules ensure maximum security consistent with the need for rapid communication of the information.

Top Secret material may not be sent through any postal system, United States or foreign. It may be transmitted only by one of the following means:

1. Direct personal contact of military personnel (E-7 or above) and U.S. civilian employees (GS-7 or above) who have been cleared for access to Top Secret information. Military personnel (E-5 and E-6) and U.S. civilian employees (GS-5 and GS-6) who have been cleared for access to Top Secret information may transmit between Department of Defense elements located in relative close proximity to one another, provided the transmission is accomplished (begun and completed) during normal daytime duty hours on the same day.
2. Armed Forces Courier Service
3. Electric means in encrypted form

Secret and Confidential material may be sent by any of the methods authorized for transmitting Top Secret material, or by U.S. registered mail.

The foregoing rules apply only within the continental United States. When the national borders must be crossed, the rules are modified slightly. Secret and Confidential matter can be transmitted by U.S. registered mail provided it stays within U.S. military postal channels. Within the continental U.S., Canada, and Alaska, Secret and Confindential may be sent by registered mail with registered mail receipt.

Commanding officers are authorized to establish systems for transmitting classified material within the confines of their commands. Such systems must ensure that:

1. Top Secret material always is controlled by Top Secret control officers.
2. Personnel transmitting the classified material have security clearances for the highest category they are allowed to handle.
3. Personnel whose primary duties entail transmission of classified material are authorized in writing for such duties.
4. All personnel entrusted with transmitting classified material are instructed properly concerning their duties.

Transmission of classified material to Department of Defense contractors must meet the following conditions:

1. The contractor must have an appropriate clearance.
2. The releasing activity having cognizance over the contract or program under which the classified material is being released must determine that the contractor has a "need to know".
3. The recipient of the classified material must have the ability to physically safeguard the material.

Stowage of Classified Material

All classified matter not in actual use must be stowed in a manner that will guarantee its protection. The degree of protection necessary depends on the classification, quantity, and scope of the material.

A numerical evaluation system has been developed for determining the relationship between the security interest and the level of protection required. The more secure the stowage facilities, the higher the numerical values assigned. Table 1-1 shows the numerical values required for quantity and type of documents of each classification. Table 1-2 is a guide for evaluating stowage facilities. Both of the tables must be used together.

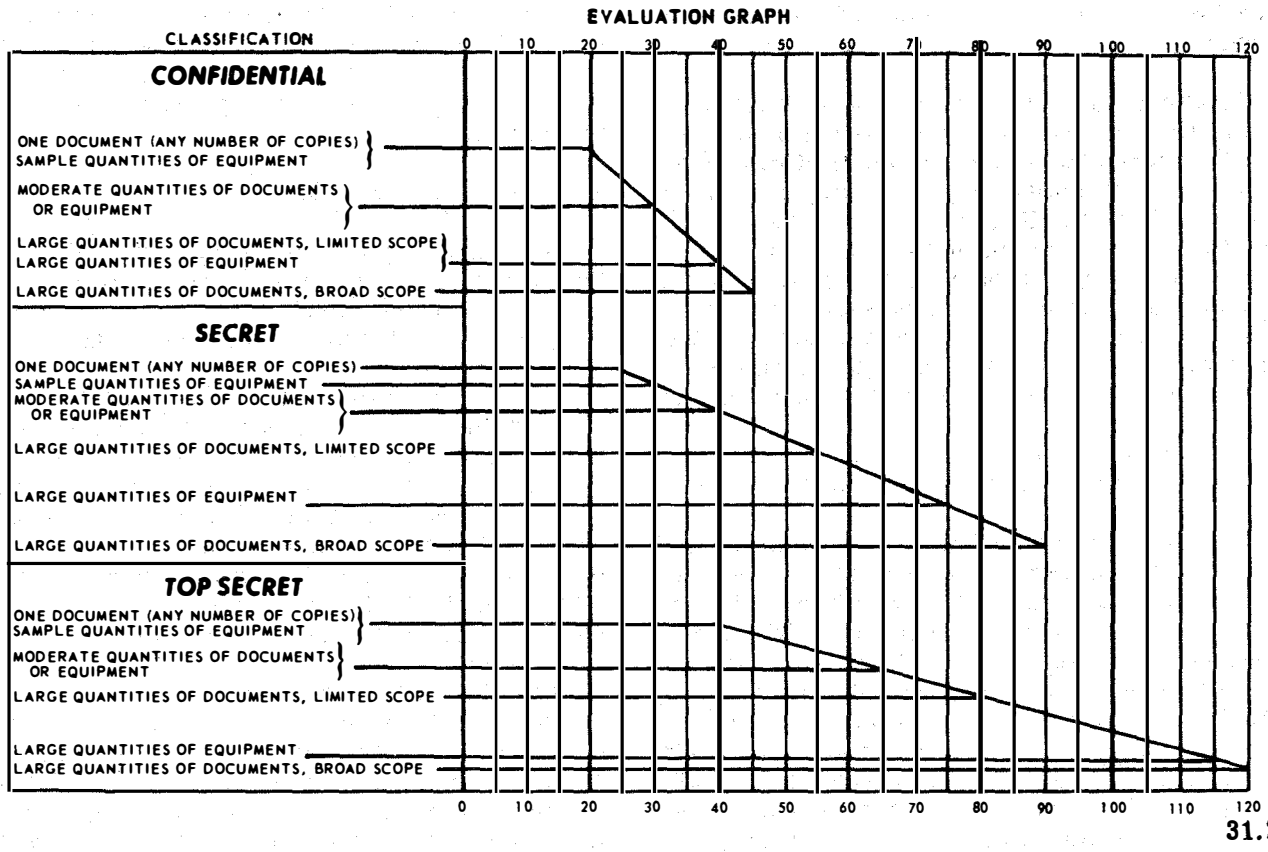
Assume that a ship stows plain language translations to encrypted messages in a metal container with attached keylock in the cryptocenter. Visitors are not allowed in any of the communication spaces. Only cryptographers may enter the cryptocenter itself or remove anything from its safe. The cryptographer on watch acts as a guard in attendance at the container. From table 1-2 a numerical value may be assigned to these facilities as follows:

	Value
Sheltered aboard a commissioned ship	25
Stowed in metal container with attached high security key padlock	5
Military guard in attendance at container	60
Total	90

From the graph in table 1-1 it can be seen that stowage facilities with a numerical value of 90 are secure enough for everything but large quantities of Top Secret equipment and large quantities of Top Secret documents covering a broad scope.

Keys or combinations to safes and lockers containing classified material are made available only to persons whose duties require access to them. At least every 12 months keys or combinations must be changed. They also must be

Table 1-1.—Numerical values required for classified material



changed whenever any person having knowledge of them is transferred from the organization, and at any time the keys or combinations are suspected of being compromised. A key padlock should also be changed whenever a key is lost.

Any time discovery is made of an unlocked and unattended safe or cabinet that contains classified material, report the condition immediately to the senior duty officer. Do not touch the container or contents, but guard them until the duty officer arrives. The duty officer then assumes responsibility for such further actions as locking the safe, recalling the responsible persons, and reporting the security violation to the commanding officer. The custodian must hold an immediate inventory of the contents of the safe and report any loss to the commanding officer.

Destruction of Classified Material

Classified material that is not required must not be allowed to accumulate. It must either be sent to stowage at a naval records management center, or it must be destroyed. Classified documents are destroyed by burning, pulping, pulverizing, or shredding. Burning is the method used most commonly in the fleet. When destruction is accomplished by means other than burning, the residue must be inspected to ensure complete mutilation.

When classified papers are burned, the destruction must be witnessed by two commissioned officers. If sufficient officers are unavailable, warrant officers, enlisted men (E-7 or above), or U.S. civilian employees in grade GS-7 or above may witness the burning, provided they are cleared for at least the highest classification of material being destroyed. If none of these personnel categories are available, a mature and reliable enlisted man in pay grade E-5 or E-6, or a U.S. civilian employee in grade GS-5 or GS-6, may be designated as a witnessing official.

Destruction of classified matter falls into two categories, routine and emergency. Destruction, when authorized or ordered, must be complete.

Destruction of superseded and obsolete classified materials that have served their purpose is termed routine destruction. Emergency destruction of classified material is authorized when there is danger of the material falling into enemy hands.

The most efficient method of destroying combustible material is by burning. It is likely that as an ET 3 or 2 you may be called upon to assist in burning classified material. Every member of the burn detail should know exactly what is to be burned and should doublecheck each item before it is burned. To facilitate complete destruction of bound publications, tear them apart, crumple the pages, and feed the pages to the fire a few at a time. If burn material is carried in a bag that is not to be burned, turn the bag inside out to make certain every piece of paper is removed and burned. All material must be watched until it is completely consumed. The ashes must be broken up and scattered so that no scraps escape destruction.

When no incinerator is available, which often is true aboard ship, classified material may be burned in a perforated metal drum or container with a cover of wire netting. Care must be taken to prevent the classified material from being carried away by the wind. As destruction is accomplished, a list is made of the material that has been destroyed. Informing higher authority of exactly what material has been destroyed is second in importance only to the actual destruction.

Emergency destruction of classified material is authorized any time it is necessary to prevent its capture by an enemy. On board ship, classified material is not subjected to the same risks as on land. If a ship is in danger of sinking or is severely disabled, however, action is taken in accordance with the ship's emergency destruction bill, the execution of which is an all-hands evolution.

This bill details the method and the order of destruction of classified matter.

Cryptographic (crypto) material has the highest priority for emergency destruction. Insofar as humanly possible, it must not be permitted to fall into enemy hands. After crypto-material is destroyed, noncrypto communications material by order of classification beginning with the highest classification is destroyed, then other classified material in the following order:

1. Classified material pertaining to future plans and operations.
2. Classified material pertaining to standing, operating, or tactical procedures.
3. Equipment of a classified nature, together with pertinent technical, descriptive, and operating instructions
4. Remaining classified material. The order of destruction to follow classification; the highest classified material being destroyed first.

When it is necessary to dispose of equipment that must remain classified, destruction shall be accomplished by any means that will prevent recognition and reconstruction or by jettisoning in random water areas of at least 1000 fathoms depth. This does not apply to crypto equipment. Special instructions are issued for this equipment.

Command Security Programs

Security is a means—not an end. Regulations that govern the security of classified material are comparable to electronic safety regulations. They do not guarantee protection, and they do not attempt to meet every conceivable situation. If strictly adhered to, however, they will provide a satisfactory degree of security.

To ensure that the required security measures are implemented, each command formulates written security procedures to reflect the command's particular requirements. These security procedures specify what is to be done, how it is to be done, who is to do it, and who is to supervise it.

In order that classified information may be controlled with maximum efficiency, the commanding officer or officer in charge of each command designates an officer to act as the CLASSIFIED MATERIAL CONTROL OFFICER. In commands that initiate, receive, or process top Secret documents, he appoints a TOP SECRET CONTROL OFFICER. When an activity possesses crypto material, the CO names a CRYPTOSECURITY OFFICER. In addition, certain commands may designate a SPECIAL SECURITY OFFICER.

In performing his duties, the classified material control officer—

1. Serves as the commanding officer's adviser and direct representative in cases pertaining to security of classified material
2. Assures that all persons who are to handle classified information are properly cleared and instructed. The clearance status should be recorded and be accessible for verification

Table 1-2.—Table of numerical equivalents

Element of Security	Value
1. Stowage Areas:	
a. Security Fences:	
(1) Classified area surrounded by a security fence with all gates secured or controlled	5
b. Protective Lighting:	
(1) Security areas lighted by protective lighting	5
c. Building or Ship:*	
(1) Conventional frame or good quality temporary structure	5
(a) Controlled areas within	15
(b) Limited areas within	25
(c) Exclusion areas within	35
(2) Masonry or steel structure with substantial partitions, floors and ceilings (including magazines)	10
(a) Controlled areas within	20
(b) Limited areas within	30
(c) Exclusion areas within	40
(3) Aboard a Commissioned Ship	25
(a) Controlled area	35
(b) Limited area	40
(c) Exclusion area	50
(4) "In Service" or MSC chartered vessel	10
(a) Controlled areas within	20
(b) Limited areas within	30
(c) Exclusion areas within	40
2. Stowage Containers:**	
a. Metal, keylock (built-in)	0
b. Metal, key padlock (attached)	0
c. Metal, high security key padlock (attached)	5
d. Metal, combination padlock (attached)	5
e. Metal, high security combination padlock (attached)	10
f. Metal, combination lock (built-in)	15
g. Strongroom or weapons magazine	15
h. Class C Vault	50
i. Class B Vault	60
j. Class A Vault	70
k. Class 2, approved GSA security container	60
l. Class 3, approved GSA security container	50
m. Class 4, approved GSA security container	60
n. Class 5, approved GSA security container	70
o. Class 6, approved GSA security container	55
p. Class 5 map and plan, approved GSA security container	70
2. Stowage Containers—Continued	
q. Class 6 map and plan, approved GSA security container	55
3. Guarding:	
a. Supporting Guard Force:	
(1) Civilian Supporting Guard Force	10
(2) Military Supporting Guard Force	15
b. Guards:	
(1) Civilian Guards:	
(a) Civilian guard in general area	10
(b) Civilian guard check of container each hour	15
(c) Civilian guard check of container each ½ hour	20
(d) Civilian guard in attendance at container	30
(2) Military Guards:	
(a) Military guard in general area	15
(b) Military guard check of container each hour	20
(c) Military guard check of container each ½ hour	25
(d) Military guard in attendance at container	60
c. Sentry dog accompanying military or civilian guard	10
4. Protective Alarm Systems:	
a. Area Alarm System:	
(1) Make or break (electro-mechanical) alarm to detect entry into immediate area	5
(2) Other alarm system to detect entry into immediate area	10
(3) Alarm system to detect entry or attempted entry into immediate area	15
(4) Alarm system to detect entry or attempted entry and approach to immediate area	25
b. Container Alarm Systems:	
(1) Make or break (electro-mechanical) alarm to detect opening of container	10
(2) Other alarm system to detect opening of container	15
(3) Alarm system to detect opening or tampering with container	20
(4) Alarm system to detect opening or tampering with and approach to container	25

* Buildings must be under U.S. Government control or if not under U.S. Government control the space occupied within the building must be at least a controlled area.

** Evaluate as indicated provided other elements in the security program are available to minimize the possibility of unauthorized access to the container.

31.3

3. Formulates and coordinates security control measures within the command
4. Maintains a program of declassification and downgrading of information
5. Prepares classification guides to aid in the proper classification of material originated within the command. Preparation of such guides usually is limited to shore activities
6. Exercises security control over visits to and from the command
7. Reviews proposed press releases, and indicates classified information that must be deleted therefrom
8. Performs the duties of Top Secret control officer if another officer is not so designated

The Top Secret control officer, subordinate to the classified material control officer, is responsible within the command for the receipt, custody, accountability, and distribution of Top Secret information and for its transmission outside the command. In performing his duties, the TOPSEC control officer is governed by certain basic rules. He must, for instance—

1. Avoid unnecessary dissemination of Top Secret information
2. Release to a subordinate echelon only the absolute minimum of Top Secret information necessary for proper planning or action
3. Transmit Top Secret information within the command by direct personal contact
4. Maintain a continuous chain of receipts for Top Secret material
5. Maintain a current roster of persons within the command who are cleared for access to Top Secret information

Certain commands within the Naval Establishment are designated to maintain a Special Security Officer (SSO). The Special Security Officer and all persons detailed to assist him are granted a special clearance by the designator.

Material intended for the Special Security Officer is wrapped in a double sealed opaque envelope. The outer container bears, the command address. The inner container bears the command address, the classification of the material, and the notation "To be Opened Only by the Special Security Officer." Packages so marked are immediately delivered, with the inner container unopened, to the Special Security Officer. If the receiving command does not have a Special Security Officer, the inner container is not opened and will be marked "No Special Security Officer at this Command." The inner envelope is placed in an outer opaque envelope and returned to the sender via Armed Forces Courier Service.

Additional information concerning security is included in the Department of the Navy Security Manual For Classified Information, OPNAV Instruction 5510.1 series.

ADVANCEMENT

Some of the rewards of advancement are easy to see. You get more pay. Your job assignments become more interesting and more challenging. You are regarded with greater respect by officers and enlisted personnel. You enjoy the satisfaction of getting ahead in your chosen Navy career.

But the advantages of advancement are not yours alone. The Navy also profits. Highly trained personnel are essential to the functioning of the Navy. By each advancement, you increase your value to the Navy in two ways. First, you become more valuable as a specialist in your own rating, and second, you become more valuable as a person who can train others and thus make far-reaching contributions to the entire Navy.

HOW TO QUALIFY FOR ADVANCEMENT

What must you do to qualify for advancement? The requirements may change from time to time, but usually you must:

1. Have a certain amount of time in your present grade.
2. Complete the required military and rating manuals, and correspondence courses.
3. Demonstrate your ability to perform all the PRACTICAL requirements for advancement by completing the Record of Practical Factors, NAVPERS 1414/1.
4. Be recommended by your commanding officer, after the petty officers and officers supervising your work have indicated that they consider you capable of performing the duties of the next higher rate.
5. Demonstrate your KNOWLEDGE by passing written examinations on the occupational and military qualification standards for advancement.

Some of these general requirements may be modified in certain ways. Figure 1-1 gives a more detailed view of the requirements for advancement of active duty personnel; figure 1-2 gives this information for inactive duty personnel.

Remember that the qualifications for advancement can change. Check with your division officer or training officer to be sure that you know the most recent qualifications.

Advancement is not automatic. Even though you have met all the requirements, including passing the written examinations, you may not be able to "sew on the crow" or "add a stripe." The number of men in each rate and rating is controlled on a Navywide basis. Therefore, the number of men who may be advanced is limited by the number of vacancies that exist. When the number of men passing the examination exceeds the number of vacancies, some system must be used to determine which men may be advanced and which may not. The system used is the "final multiple" and is a combination of three types of advancement systems.

Merit rating system
Personnel testing system
Longevity, or seniority, system

The Navy's system provides credit for performance, knowledge, and seniority, and, while it cannot guarantee that any one person will be advanced, it does guarantee that all men within a particular rating will have equal advancement opportunity.

The following factors are considered in computing the final multiple:

POINTS	FACTOR	WEIGHT
80 (MAX)	Examination Score	40%
50 (MAX)	Performance (Average of marks received)	25%
20 (MAX)	Total Active Service (1 per yr)	10%
20 (MAX)	Time in Present Grade (2 per yr)	10%
15 (MAX)	Awards (pts per award)	7.5%
15 (MAX)	PNA (Maximum 3 per exam cycle)	7.5%
200 (MAX POSSIBLE)		100.%

PNA (passed, not advanced) points are awarded as follows: A maximum of three points can be accrued each examination. Over five examination cycles, a maximum of 15 points can be obtained. The Naval Examining Center maintains historical tapes on candidate PNA point awards. These are awarded to passing candidates not advanced as follows:

EXAMINATION FACTOR STANDING SCORE		PERFORMANCE EVALUATION FACTOR	
RELATIVE STANDING	POINTS	RELATIVE STANDING	POINTS
Exceeding above average (Score in 70s)	1.5	Upper 25% by peer group standing	1.5
Above average (Score in 60s)	1.0	Peer group standing of 26% - 50%	1.0
Average (remainder of passing candidates)	0.5	Peer group standing of 51% - 75%	0.5
		Lower 25% by peer group standing	0.0

NOTE: Maximum of 3 multiple points per cycle.

All of the preceding information (except the examination score and PNA points) is submitted to the Naval Examining Center with your examination answer sheet. After grading, the examination scores and PNA points for those passing are added to the other factors to arrive at the final multiple. A precedence list, which is based on final multiples, is then prepared for each pay grade within each rating. Advancement authorizations are then issued, beginning at the top of the list, for the number of men needed to fill the existing vacancies.

HOW TO PREPARE FOR ADVANCEMENT

What must you do to prepare for advancement? You must study the qualifications for advancement, work on the practical factors, study the required rate training manuals, and study other material that is required for advancement in your rating. To prepare for advancement, you

REQUIREMENTS*	E1 to E2	E2 to E3	#† E3 to E4	#E4 to E5	† E5 to E6	† E6 to E7	† E7 to E8	† E8 to E9
SERVICE	4 mos. service—or completion of	8 mos. as E-2.	6 mos. as E-3	12 mos. as E-4	24 mos. as E-5.	36 mos. as E-6. 8 years total enlisted service.	36 mos. as E-7. 8 of 11 years total service must be enlisted.	24 mos. as E-8. 10 of 13 years total service must be enlisted.
SCHOOL	Recruit Training. (C.O. may advance up to 10% of graduating class.)		Class A for PR3, DT3, PT3, AME 3, HM 3, PN 3, FTB 3, MT 3,			Class B for AGC MUC, MNC. ††		
PRACTICAL FACTORS	Locally prepared check-offs.	Record of Practical Factors, NavPers 1414/1, must be completed for E-3 and all PO advancements.						
PERFORMANCE TEST			Specified ratings must complete applicable performance tests before taking examinations.					
ENLISTED PERFORMANCE EVALUATION	As used by CO when approving advancement.		Counts toward performance factor credit in advancement multiple.					
EXAMINATIONS**	Locally prepared tests.	See below.	Navy-wide examinations required for all PO advancements.				Navy-wide, selection board.	
RATE TRAINING MANUAL (INCLUDING MILITARY REQUIREMENTS)		Required for E-3 and all PO advancements unless waived because of school completion, but need not be repeated if identical course has already been completed. See NavPers 10052 (current edition).					Correspondence courses and recommended reading. See NavPers 10052 (current edition).	
AUTHORIZATION	Commanding Officer	Naval Examining Center						

* All advancements require commanding officer's recommendation.
† 1 year obligated service required for E-5, and E-6: 2 years for E-7, E-8, and E-9.
# Military leadership exam required for E-4 and E-5.
** For E-2 to E-3, NAVEXAMCEN exams or locally prepared tests may be used.
†† Waived for qualified EOD personnel.

5.1

Figure 1-1.—Active duty advancement requirements.

REQUIREMENTS *	E1 to E2	E2 to E3	E3 to E4	E4 to E5	E5 to E6	E6 to E7	E8	E9
TOTAL TIME IN GRADE	4 mos.	8 mos.	6 mos.	12 mos.	24 mos.	36 mos. with total 8 yrs service	36 mos. with total 11 yrs service	24 mos. with total 13 yrs service
TOTAL TRAINING DUTY IN GRADE †	14 days	14 days	14 days	14 days	28 days	42 days	42 days	28 days
PERFORMANCE TESTS		Specified ratings must complete applicable performance tests before taking examination.						
DRILL PARTICIPATION	Satisfactory participation as a member of a drill unit in accordance with BUPERSINST 5400.42 series.							
PRACTICAL FACTORS (INCLUDING MILITARY REQUIREMENTS)	Record of Practical Factors, NavPers 1414/1, must be completed for all advancements.							
RATE TRAINING MANUAL (INCLUDING MILITARY REQUIRE MENTS)	Completion of applicable course or courses must be entered in service record.							
EXAMINATION	Standard Exam		Standard Exam required for all PO advancements. Also pass Military Leadership Exam for E-4 and E-5.				Standard Exam, Selection Board.	
AUTHORIZATION	Commanding Officer		Naval Examining Center					

*Recommendation by commanding officer required for all advancements.
†Active duty periods may be substituted for training duty.

5.2

Figure 1-2.—Inactive duty advancement requirements.

will need to be familiar with (1) the Quals Manual. (2) the Record of Practical Factors, (3) BIBLIOGRAPHY FOR ADVANCEMENT STUDY, NAVTRA 10052, and (4) applicable rate training manuals. The following sections describe them and give you some practical suggestions on how to use them in preparing for advancement.

Quals Manual

THE MANUAL OF QUALIFICATIONS FOR ADVANCEMENT. NAVPERS 18068C, gives the minimum occupational and military qualification standards for advancement to each pay grade within each rating. This manual is usually called the "Quals Manual," and the qualifications themselves are often called "quals." The qualification standards are of two general types: (1) military qualification standards and (2) occupational qualification standards.

MILITARY STANDARDS are requirements that apply to all ratings rather than to any one particular rating. Military requirements for advancement to third class and second class petty officer rates deal with military conduct, naval organization, military justice, security, watch standing, and other subjects which are required of petty officers in all ratings.

OCCUPATIONAL STANDARDS are requirements that are directly related to the work of each rating.

Both the military requirements and the occupational qualification standards are divided into subject matter groups. Within each subject matter group, they are further divided into PRACTICAL FACTORS and KNOWLEDGE FACTORS. Practical factors are things you must be able to DO. Knowledge factors are things you must KNOW in order to perform the duties of your rating.

In most subject matter areas, you will find both practical factor and knowledge factor qualifications. In some subject matter areas, you may find only one or the other. It is important to remember that there are some knowledge aspects to all practical factors, and some practical aspects to most knowledge factors. Therefore, even if the Quals Manual indicates that there are no knowledge factors for a given subject matter area, you may still expect to find examination questions dealing with the knowledge aspects of the practical factors listed in that subject matter area.

You are required to pass a Navywide military/leadership examination for E-4 or E-5, as appropriate, before you take the occupational examinations. The military/leadership examinations are administered on a schedule determined by your commanding officer. Candidates are required to pass the applicable military/leadership examination only once. Each of these examinations consists of 100 questions based on information contained in MILITARY REQUIREMENTS FOR PETTY OFFICERS 3 & 2, NAVPERS 10056 and other publications listed in BIBLIOGRAPHY for advancement study. NAVTRA 10052.

The Navywide occupational examinations for pay grades E-4 and E-5 will contain 150 questions related to occupational areas of your rating.

If you are working for advancement to second class, remember that you may be examined on third class qualifications as well as on second class qualifications.

The QUALS MANUAL is kept current by means of changes. The occupational qualifications for your rating which are covered in this training manual were current at the time the manual was printed. By the time you are studying this manual, however, the quals for your rating may have been changed. Before using any set of quals always check them against an UP-TO-DATE copy of the QUALS MANUAL.

Record of Practical Factors

Before you can take the servicewide examinations for advancement, there must be an entry in your service record to show that you have qualified in the practical factors of both the military qualifications and the occupational qualifications. The RECORD OF PRACTICAL FACTORS, mentioned earlier, is used to keep a record of your practical factor qualifications. This form is available for each rating. The form lists all practical factors, both military and occupational. As you demonstrate your ability to perform each practical factor, appropriate entries are made in the DATE and INITIALS columns.

Changes are made periodically to the MANUAL OF QUALIFICATIONS FOR ADVANCEMENT, and revised forms of NAVPERS 1414/1 are provided when necessary. Extra space is allowed on the Record of Practical Factors for entering additional practical factors as they are published in changes to the QUALS MANUAL. The Record of Practical Factors also provides

space for recording demonstrated proficiency in skills which are within the general scope of the rating but which are not identified as minimum qualifications for advancement.

Until completed, the NAVPERS 1414/1 is usually held by your division officer; after completion, it is forwarded to the personnel office for insertion in your service record. If you are transferred before qualifying in all practical factors, the incomplete form should be forwarded with your service record to your next duty station. You can save yourself a lot of trouble by making sure that this form actually is inserted in your service record before you are transferred. If the form is not in your service record, you may be required to start all over again and requalify in the practical factors which have already been checked off.

NAVTRA 10052

The BIBLIOGRAPHY FOR ADVANCEMENT STUDY, NAVTRA 10052 (revised), is a very important publication for any enlisted person preparing for advancement. This bibliography lists required and recommended rate training manuals and other reference material to be used by personnel working for advancement.

NAVTRA 10052 is revised and issued once each year by the Naval Training Command. Each revised edition is identified by a letter following the NAVTRA number. When using this publication, be SURE that you have the most recent edition.

If extensive changes in qualifications occur in any rating between the annual revisions of NAVTRA 10052, a supplementary list of study material may be issued. When you are preparing for advancement, check to see whether changes have been made in the qualifications for your rating. If changes have been made, see if a Notice has been issued to supplement NAVTRA 10052 for your rating.

The required and recommended references are listed by pay grade in NAVTRA 10052. If you are working for advancement to third class, study the material that is listed for third class. If you are working for advancement to second class, study the material that is listed for second class; but remember that you are also responsible for the references listed at the third class level.

In using NAVTRA 10052 you will notice that some rate training manuals are marked with an asterisk (*). Any manual marked in this way is MANDATORY—that is, it must be completed at the indicated rate level before you can be eligible to take the servicewide examination for advancement. Each mandatory manual may be completed by (1) passing the appropriate enlisted correspondence course that is based on the mandatory training manual; (2) passing locally prepared tests based on the information given in the training manual; or (3) in some cases, successfully completing an appropriate Navy school.

Do not overlook the section of NAVTRA 10052 which lists the required and recommended references relating to the military qualification standards for advancement. Personnel of ALL ratings must complete the mandatory military requirements training manual for the appropriate rate level before they can be eligible to advance.

The references in NAVTRA 10052 which are recommended but not mandatory should also be studied carefully. ALL references listed in NAVTRA 10052 may be used as source material for the written examinations, at the appropriate rate levels.

Rate Training Manuals

As a result of the establishment of the Naval Training Support Command under the Chief of Naval Training, new editions of rate training manuals, correspondence courses, curricula, and other training publications formerly designated with the abbreviation NAVPERS are being designated with NAVTRA. This training manual, for example, is NAVTRA 10195-A, which means that it is a publication of the Naval Training Support Command which succeeds a manual designated NAVPERS 10195.

In this chapter, and elsewhere in this manual, training publications which already carry the new abbreviation are so listed; those not yet changed are listed as NAVPERS numbers.

There are two general types of rate training manuals. RATING manuals (such as this one) are prepared for most enlisted ratings. A rating manual gives information that is directly related to the occupational qualifications of ONE rating. SUBJECT MATTER manuals or BASIC manuals give information that applies to more than one rating.

Rate training manuals are revised from time to time to keep them up to date technically. The revision of a rate training manual is identified by a letter following the NAVTRA number. You can tell whether any particular copy of a training manual is the latest edition by checking the

NAVTRA number and the letter following this number in the most recent edition of LIST OF TRAINING MANUALS AND CORRESPONDENCE COURSES, NAVTRA 10061. (NAVTRA 10061 is actually a catalog that lists all current training manuals and correspondence courses; you will find this catalog useful in planning your study program.)

Each time a rate training manual is revised, it is brought into conformance with the official publications and directives on which it is based; but during the life of any edition, discrepancies between the manual and the official sources are almost certain to arise because of changes to the latter which are issued in the interim. In the performance of your duties, you should always refer to the appropriate official publication or directive. If the official source is listed in NAVTRA 10052, the Naval Examining Center uses it as a source of questions in preparing the Fleet-wide examinations for advancement. In case of discrepancy between any publications listed in NAVTRA 10052 for a given rate, the Examining Center will use the most recent material.

Rate training manuals are designed to help you prepare for advancement. The following suggestions may help you to make the best use of this manual and other Navy training publications when you are preparing for advancement.

1. Study the military qualifications and the occupational qualifications for your rating before you study the training manual, and refer to the quals frequently as you study. Remember, you are studying the manual primarily in order to meet these quals.

2. Set up a regular study plan. It will probably be easier for you to stick to a schedule if you can plan to study at the same time each day. If possible, schedule your studying for a time of day when you will not have too many interruptions or distractions.

3. Before you begin to study any part of the manual intensively, become familiar with the entire book. Read the preface and the table of contents. Check through the index. Look at the appendixes. Thumb through the book without any particular plan, looking at the illustrations and reading bits here and there as you see things that interest you.

4. Look at the training manual in more detail, to see how it is organized. Look at the table of contents again. Then, chapter by chapter, read the introduction, the headings, and the subheadings. This will give you a pretty clear picture of the scope and content of the book. As you look through the book in this way, ask yourself some questions:

- What do I need to learn about this?
- What do I already know about this?
- How is this information related to information given in other chapters?
- How is this information related to the qualifications for advancement?

5. When you have a general idea of what is in the training manual and how it is organized, fill in the details by intensive study. In each study period, try to cover a complete unit—it may be a chapter, a section of a chapter, or a subsection. The amount of material that you can cover at one time will vary. If you know the subject well, or if the material is easy, you can cover quite a lot at one time. Difficult or unfamiliar material will require more study time.

6. In studying any one unit—chapter, section, or subsection— write down the questions that occur to you. Many people find it helpful to make a written outline of the unit as they study, or at least to write down the most important ideas.

7. As you study, relate the information in the training manual to the knowledge you already have. When you read about a process, a skill, or a situation, try to see how this information ties in with your own past experience.

8. When you have finished studying a unit, take time out to see what you have learned. Look back over your notes and questions. Maybe some of your questions have been answered, but perhaps you still have some that are not answered. Without looking at the training manual, write down the main ideas that you have gotten from studying this unit. Don't just quote the book. If you can't give these ideas in your own words, the chances are that you have not really mastered the material.

9. Use enlisted correspondence courses whenever you can. The correspondence courses are based on rate training manuals or on other appropriate texts. As mentioned before, completion of a mandatory rate training manual can be accomplished by passing an enlisted correspondence course based on the rate training manual. You will probably find it helpful to take other correspondence courses as well as those based on mandatory manuals. Taking a correspondence course helps you to master the information given in the training manual, and also helps you see how much you have learned.

10. Think of your future as you study rate training manuals. You are working for advancement to third class or second class right now, but some day you will be working toward higher rates. Anything extra that you can learn will help you, both now and later.

SOURCES OF INFORMATION

Besides training manuals, NAVTRA 10052 lists other publications on which you may be examined. You should not only study the sections required, but should become as familiar as possible with all publications you use.

One of the most useful things you can learn about a subject is how to find out more about it. No single publication can give you all the information you need to perform the duties of your rating. You should learn where to look for accurate, authoritative, up-to-date information on all subjects related to the military requirements for advancement and the occupational qualifications of your rating.

PUBLICATIONS YOU SHOULD KNOW

Electronic technical publications include various handbooks, bulletins, and manuals published and distributed by the Ship Systems Command, and manufacturers' technical manuals The Navy Stock List of Publications and Forms, NAVSUP 2002, furnishes a complete list of NavShips technical publications along with instruction for ordering copies.

One bulletin of great importance to the ET is Electronics Information Bulletin (EIB), NavShips 0967-001-0000 published biweekly for naval electronics activities. A complete file of these bulletins should be maintained.

This bulletin lists field changes and corrections that must be made in instruction books and other publications that are used in the maintenance of electronic equipment. It also lists electronics publications that become available, and gives valuable suggestions, from case histories, for servicing electronic equipment.

The Electronics Installation and Maintenance Book (EIMB) furnished data applying to all types of electronics equipment including the theory of operation of basic electronic circuits. The EIMB is organized and issued as 12 separate handbooks, each with its own NavShips number. A complete listing of all handbooks, stock numbers, and most recent changes can be found in current issues of the EIB.

Another NavShips publication of importance to the ET is the Naval Ships Technical Manual, NAVSHIPS 0901-000-0000. This manual is the basic doctrine publication of the Naval Ship Systems Command. Chapter 9670 is of particular importance to the ET and should be a part of the ET library.

The Naval Ship Systems Command Technical News is a monthly publication which contains interesting and useful articles on all aspects of shipboard engineering. This magazine is particularly useful because it presents information which supplements and clarifies information contained in the Naval Ships Technical Manual and because it presents information on new developments.

The manufacturers' technical manuals that are furnished with most electronic equipment are valuable sources of information on operation, maintenance and repair. The manufacturers' technical manuals that deal with Naval Ship Systems Command equipment are usually given NAVSHIPS numbers. These manuals are described in chapter 2 of this training manual.

Some publications are subject to change or revision from time to time—some at regular intervals, others as the need arises. When using any publication that is subject to change or revision, be sure that you have the latest edition. When using any publication that is kept current by means of changes, be sure you have a copy in which all official changes have been made. Studying canceled or obsolete information will not help you to do your work or to advance in rating; it is likely to be a waste of time and may even be seriously misleading.

TRAINING FILMS

Training films available to naval personnal are a valuable source of supplementary information on many technical subjects. Training films are listed in the UNITED STATES NAVY FILM CATALOG, NAVAIR 10-1-777 (formerly NAVWEPS 10-1-777), published in 1971. Copies may be ordered in accordance with the NAVY STOCK LIST OF PUBLICATIONS AND FORMS, NAVSUP 2002. Monthly supplements to the Film Catalog are distributed to catalog holders.

When selecting a film, note its date of issue listed in the Film Catalog. As you know, procedures sometimes change rapidly. Thus, some films become obsolete rapidly. If a film is obsolete only in part, it may sometimes be shown effectively if before or during its showing you carefully point out to trainees the procedures that have changed.

CHAPTER 2

MAINTENANCE

Maintenance may be defined as the function of retaining equipment in, or restoring it to, an operational condition. This includes many operations such as servicing, repair, modification, modernization, overhaul, rebuilding, testing, inspecting, and providing spare parts. Maintenance of electronics equipment is divided into two main categories—preventive maintenance and corrective maintenance.

Preventive maintenance consists of the accomplishment of those maintenance actions deemed necessary to maintain uninterrupted operation within design specifications, and to reduce or eliminate failures, thus prolonging the useful life of the equipment. If these actions are performed on a regular periodic basis, the maintenance is referred to as planned/preventive maintenance.

Corrective maintenance (or repair) is the correction of damage to equipment so as to restore it to an operational condition. This includes the isolation of trouble (troubleshooting), replacement of defective parts, and the readjustment and/or realignment of equipment to bring it up to a satisfactory operating level. Corrective maintenance may also be classified as class A, B, or C maintenance.

Class A maintenance (rebuilding or restoring) is the act of overhauling, repairing, modifying (field changing) and/or restoring a specific electronic set, group, unit, assembly, or subassembly so that it meets its most recent equipment design and technical specifications, and is essentially as good as new equipment.

Class B maintenance (overhaul) is the act of repairing and/or modifying a specific electronic set, group, unit, assembly or subassembly so as to restore its operating characteristics to the extent required to meet its most recent design and technical specifications.

Class C maintenance is the act of repairing on board ship a specific electronic set, group, unit, assembly, or subassembly to correct those deficiencies specified by a particular job order or work request.

Maintenance may also be referred to as operational, technical, and tender/yard maintenance.

Operational maintenance consists of inspection, cleaning, lubrication, and servicing, and may also consist of adjustments and minor parts replacement not requiring high technical skill or internal alignment.

Technical maintenance consists of replacement of parts, subassemblies, or assemblies, and the alignment, testing, and adjustment of equipment. This type of maintenance requires skill and detailed knowledge of the equipment.

Tender/yard maintenance is maintenance which requires a major overhaul or complete rebuilding of assemblies, subassemblies, or parts.

In Department of Defense maintenance publications, the terms organizational, field, and depot maintenance are substituted for operational, technical, and tender/yard maintenance.

SAFETY PRECAUTIONS

Safety precautions relating to maintenance of electronics equipment are dicussed in chapter 2 of Basic Electronics, Vol. 1, NAVPERS 10087-C, and chapter 9670, section 5 of the NAVSHIPS Technical Manual. The following paragraphs review and build upon the material contained in these publications by discussing precautions when handling fluorescent tubes and when working aloft. Also presented are some of the important "DOs" and "DON'Ts" concerning safety for Electronics Technicians.

PRECAUTIONS WHEN HANDLING FLUORESCENT TUBES

Precautions to be observed when handling radioactive and cathode-ray tubes are discussed

in Basic Electronics, Vol. 1, NAVPERS 10087-C. Fluorescent tubes manufactured before 1949 contained a poisonous chemical and therefore special precautions were necessary when handling and disposing of these tubes. These special precautions are no longer necessary for the fluorescent tubes in use today. However, the general precautions relating to any breakable glass objects should be observed.

PRECAUTIONS WHEN WORKING ALOFT

Hazards while working aloft include death or injury from falling, asphyxiation from stack gasses, electric shock (either from the equipment being worked on or from induced voltages in guy wires and other ungrounded conductive materials due to radiation from radio and radar antennas). Also included are overexposure to radiation from high powered radar antennas, contact with rotating or oscillating antennas or other moving machinery, and overexposure to inclement weather conditions.

In addition to the danger from electric shock due to energized equipment and induced voltages, there may also be a shock hazard due to static charges. Static charges are caused by electrically charged particles that exist naturally in the air. Under certain conditions these charged particles will collect on metallic objects such as wire antennas and produce a shock hazard. Grounding the objects concerned will eliminate the hazard. Shocks from static charges will not cause direct harm to the individual, but any unexpected shock while aloft may cause a person to fall.

Before going aloft, permission must be obtained from the officer of the deck, and all transmitters and machinery in the vicinity of the work area must be secured and tagged. Permission must also be obtained from the engineer officer to ensure that boiler tubes will not be blown or boiler safeties set during the time the work is being done aloft. If in port or at anchor, permission must also be obtained from the OOD of any ships alongside. Notify these ships when work is completed.

An approved parachute-type safety harness (fig. 2-1) must be worn at all times when working aloft. (The lineman's type safety belt is no longer authorized for Navy use.) Safety harnesses must be checked periodically in accordance with the Planned Maintenance Subsystem. Tools to be used on the job should be placed in a canvas bag and hauled up with a line to the job

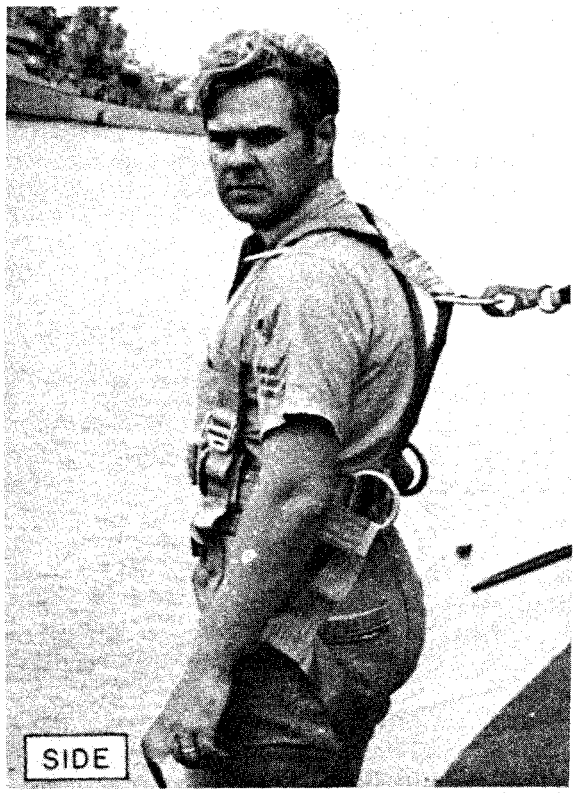


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Figure 2-1.—Parachute-type safety harness.

location. To guard against dropping tools and seriously injuring someone, it is recommended that the tool being used be tied to the safety harness with a piece of line.

POINTS TO REMEMBER

Some important points to remember relating to safety are listed in the following paragraphs.

Remember to secure power from ALL sources, tag supply switches, and discharge all capacitors and other devices that may contain a stored electrical charge before working on electrical or electronics equipment.

Do not work on energized equipment unless in an emergency, and then only after obtaining permission from appropriate authority and taking special precautions. Voltages as low as 30 volts can be dangerous under certain conditions. Approximately 100 milliamperes through the heart area for 1 second can be fatal.

Do not use your fingers to test a "hot" circuit; use an approved meter. Do not hold test probes when measuring voltages over 300 volts. Do not work alone when working on energized circuits and equipments.

Use an approved fuse puller to remove and replace cartridge fuses. Do not short out, block open, or otherwise disable any interlock switch.

Observe all "high voltage," "RF radiation," and other types of safety warning signs. Ensure that the metal cases of portable test equipment and power tools are properly grounded. Do not use a power tool that has a frayed cord or damaged plug.

Take time to be safe—hurrying invites accidents.

PREVENTIVE MAINTENANCE

Preventive maintenance actions enable the technician to prevent troubles from occurring in equipment, and to correct any other troubles before they result in actual breakdown of the equipment. These actions (which normally consist of cleaning, lubrication, periodic tests and inspections, and recording of performance data) are carried out as specified by the Planned Maintenance Subsystem (PMS) for the individual equipment or system concerned.

The PMS is a subsystem of the 3-M System, and is discussed in Military Requirements for PO3&2, NAVPERS 10056-C. As an ET3 or ET2 you will be concerned mainly with the Weekly PMS Schedule (OPNAV 4790/15), the Maintenance Requirement Cards (OPNAV 4700-1), the Feedback Report (OPNAV 4790/7A), and that portion of the Work Center PMS Manual (OPNAV 43P1) that applies to your equipment.

THE WEEKLY PMS SCHEDULE

A Weekly PMS Schedule (fig. 2-2) is posted in each Work Center, and is used by the Work Center Supervisor to assign and monitor the accomplishment of the required PMS actions by the work center personnel.

The Weekly PMS Schedule contains the following:

a. A particular Work Center, date, and approval signature

b. A list of the systems, subsystems, and components assigned to the maintenance group, and related Maintenance Index Pages (MIP) in the Work Center PMS Manual (OPNAV 43P1)

c. Names of the maintenance personnel assigned to individual maintenance actions

d. The maintenance requirements to be performed during one week.

e. A column for scheduling outstanding repairs and PM checks due in next 4 weeks. This enables the Work Center Supervisor to list forthcoming PM checks and corrective maintenance actions as being beyond the capability of the ship's personnel, lack of spare parts, or lack of proper tools. These repairs may be phased into the workload and accomplished with currently scheduled maintenance.

The Weekly PMS Schedule is used as follows:

a. The weekly and daily maintenance requirements are entered on the Weekly PMS Schedule, using the Maintenance Index Page (MIP) as a guide. Weekly requirements may be entered on Monday to provide ease of rescheduling. Daily requirements must appear each day. These may be preprinted on the Weekly PMS Schedule.

b. The Work Center Supervisor transposes all PMS requirements for the current week from the Quarterly Maintenance Schedule to the Weekly PMS Schedule. He is responsible for updating the Quarterly Maintenance Schedule when the weekly PMS requirement has been completed. He must achieve a balanced work load and give appropriate consideration to the week's operating schedule. He must ensure that related maintenance actions are scheduled together.

WEEKLY PMS SCHEDULE (CONVENTIONAL)
OPNAV FORM 4790/15 (3-71)
S/N 0107-770-3260

WORK CENTER: COMMUNICATIONS | PMS SCHEDULE FOR WEEK OF: 2-8 AUGUST 1971 | APPROVAL SIGNATURE

MIP	COMPONENT	MAINTENANCE RESPONSIBILITY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT.-SUN.	OUTSTANDING REPAIRS AND P.M. CHECKS DUE IN NEXT 4 WEEKS
C1	AN/URR-35	ABLE			M2				
C2	AN/URR-27	BAKER		~~M1, M2, Q1~~					
C3	AM-1365/URT	CHARLES		(M1) → M1					
C5	AN/WRT-2	DOW	~~M1~~						
C7	AN/URC-32A	GREEN	~~W1~~				W1		
C8	AN/SRR-19A	HAPP	W1 -	→ -	→ -	W1			
C10	AN/WRT-1A	INGLE	W1 -	→ -	W1				
C13	CV-691/U	JUSTICE							
C14	AN/URA-17	KIDD	~~W1~~						
C16	AN/SRA-33	LOWE							
C17	AN/SRA-38	MAY							

UPDATE THIS SCHEDULE DAILY

98.175

Figure 2-2.—Weekly PMS schedule.

MIPs/MRCs must be reviewed to determine related maintenance requirements.

c. Maintenance personnel obtain PMS assignments from the Weekly PMS Schedule, obtain MRC cards, tools, and material, and perform the maintenance action. The completed maintenance action is then reported to the Work Center Supervisor.

THE MAINTENANCE REQUIREMENT CARD

The Maintenance Requirement Card (MRC) provides maintenance personnel with detailed guidance for the performance of each planned/preventive maintenance action. MRCs are grouped as follows:

MRC Set—Consists of the complete index of MRCs describing the minimum maintenance requirement for a specific system, subsystem, or component. The MRCs in a set are listed under the same MIP number.

MRC Group—Consists of MRCs covering all planned maintenance requirements listed on the MIPs assigned to one specific work center.

MRC Deck—Consists of all MRC groups and Equipment Guide Lists (EGLs) for the centers within a department. An example is the master MRC deck for the Operations Department.

Maintenance requirement cards for specific electronics equipment are shown inchapter 11 of this manual.

CORRECTIVE MAINTENANCE

To perform effective corrective maintenance the ET must have a good working knowledge of the basic principles of electricity and electronics. The only way to acquire this knowledge is by diligent study. The ET must also be thoroughly familiar with the theory of operation of the equipments that he must service.

Skill in the use of test equipment (and hand-tools) is also necessary for effective corrective maintenance. Skill comes with practice and with careful study of the technical manual that comes with each piece of test equipment. The ET should take advantage of every opportunity to learn more about every type of electronic test equipment used aboard ship.

Maintenance personnel must try to find the source of the trouble causing the equipment failure, particularly when the trouble is a recurrent one. The recurrence of a fault usually indicates that the EFFECT, not the CAUSE, has been remedied.

There are numerous ways to isolate a fault to a component (part) of a system, depending on the type of equipment. The technician must, first of all, know what each component does before he can know that it is not functioning properly.

The best way (the most economical in time and effort) to isolate a fault is by using a logical troubleshooting method. This method (called the six-step troubleshooting method) is discussed in chapter 12 of this manual.

MAINTENANCE DATA COLLECTION SUBSYSTEM

The maintenance data collection subsystem (MDCS) is the subsystem of the 3-M System which provides a means for recording and reporting information (such as manhours and material expenditures) associated with the various categories of maintenance actions.

The subsystem uses coded data elements to record much of this information in order to standardize the data collected and to facilitate its processing and use. The failure and corrective action information recorded on maintenance action documents, and the material usage information recorded on associated supply documents are retrievable, through this system, for engineering analysis and maintenance history. In addition, the system makes it possible to report the need to delay the accomplishment of required maintenance or to indicate the principal reason for this delay. The MDCS forms that you will be mainly concerned with as an ET3 or ET2 are the Maintenance Data Form OPNAV Form 4790-2K and supply requisition form NAVSUP Form 1250.

Maintenance Data Form (OPNAV Form 4790-2K)

Routine maintenance action reporting is accomplished on a multipurpose Maintenance Data Form which, occasionally, is augmented by Supplemental Report Form. The Maintenance Data Form is used to report the completion or deferral of a maintenance action, or to request needed assistance. The standard data elements which must be completed to report any categories of maintenance information have been grouped together in separate, clearly labeled sections of the form to simplify data recording and to facilitate automatic data processing (ADP).

In addition to the standard data elements, the form provides special shaded sections to record data elements for maintenance actions associated with specially identified systems or equipments, or reports completed under certain unique circumstances. In this manner, provision has been made for reporting special or additional maintenance related information. The form is a single sheet, multipurpose form printed on NCR (no carbon required) paper.

To provide a complete record of a maintenance action, it may be necessary to use two or more reporting forms. Information on a maintenance action may be recorded on a deferral, subsequent changes to that deferral, a work request, associated supply documents, and any number of special supplemental reports. To ensure against the loss of essential data on these forms, they must be unmistakably linked to each other, and to the proper maintenance action, until all the data have been properly processed. This is accomplished by assigning to each maintenance action a unique identification number, and by ensuring that this number appears on each associated data collection form.

In the MDCS this identification is a 13 character number known as the Job Control Number (JCN). It is composed of a five character Unit Identification Code, a four character Work Center Code, and a four character sequential serial number called the Job Sequence Number (JSN). The JSNs are normally numerical and are assigned, in sequence from 0001 through 9999 by the Work Center Supervisor. The numbers are then recycled to 0001. The time lapse before recycle occurs is usually sufficient to preclude any confusion in identifying maintenance action documents. Provisions have been made for extending the range of JSNs by using a

letter in lieu of the first numeral (A001, B205, etc.)

COMPLETED MAINTENANCE ACTION (OPNAV Form 4790-2K).—The Completed Maintenance Action form (fig. 2-3) is prepared for the following:

a. All reportable corrective maintenance
b. Authorized alterations which are completed without having first been deferred
c. PMS actions for which the MRC specifies the use of repair parts or material
d. PMS actions which require that meter readings be reported as part of the MRC procedure
e. PMS actions during which clearances, tolerances, or readings are obtained which must be reported in accordance with Type Commander (TYCOM) instructions
f. Preventive maintenance actions other than PMS. Routine PMS actions are not reported

To fill out the Maintenance Data Form for a completed maintenance action (fig. 2-3), enter your ship's name and hull number in the upper left corner, check the maintenance action completed box in the upper right corner, and complete the rest of the form as described below. (Appendices referred to are those in the 3-M Manual, OPNAV 43P2.)

Block 1: The Unit Identification Code (UIC) is the code for your activity. If this code consists of only four digits, enter a zero as the first digit.

Block 2: Work Center codes are in Appendix 3. The first two characters identify the department and division; the last two digits identify the work center. (0E01 is the electronic maintenance group of the operations department.)

Block 3: The job sequence number (JSN) is a four digit work serial number assigned sequentially by the Work Center Supervisor. The UIC, Work Center Code, and JSN make up the job control number as stated previously.

Block 4: Enter the equipment identification code (EIC) for the equipment on which maintenance was performed. This code is found in the EIC Master Index Manual. To determine the proper EIC, refer to the system level EIC sequence section of the Master Index and find the name of the system that includes your equipment. Opposite the system name is a number or letter followed by six zeros. The number or letter identifies the section of the manual in which the EIC codes for the equipment associated with the system are listed.

For example, (as in the case of fig. 2-3), you find in the system level EIC sequence section that the EIC code for radar and IFF systems is POOOOOO. You then refer to the P section of the system, subsystem, equipment EIC sequence and find the EIC code for the SPS-10 radar set to be P113000.

In addition to the EIC sequence section, the Master Index also includes a nomenclature sequence section. This section lists the noun names of systems, subsystems, and equipments (along with their EIC codes) in alphabetical order.

Block 5: Enter the code that best describes the first indication of trouble. These codes are contained in Appendix 4. The 9 listed in block 5 is the code for "fails to radiate."

Block 6: Enter the code from Appendix 5 which describes the circumstances under which the need for corrective maintenance was discovered.

Block 7: Enter the Julian date. A Julian calendar is shown in Appendix 2. The last numeral of the year is entered first, followed by 3 digits for the consecutive day of the year. The 1140 listed in block 7 is 20 May 1971. (The 20th of May is the 140th day of the year.)

Block 8: Enter the code from Appendix 6 which best describes the status of the equipment at the time the need for maintenance was discovered. The 2 in block 8 of figure 2-3 means nonoperational.

Block 9: Enter the serial number of the equipment as identified by the first four characters of the EIC in block 4. This would be the serial number of the AN/SPS-10 radar set in the example shown in figure 2-3.

Block 10: Enter the allowance parts list number assigned to the part being repaired or replaced. This number is found in the Coordinated Shipboard Allowance List (COSAL), and the List of Effective Pages (LOEP) in the Departmental Master 3-M Manual, OPNAV 43P1. If the number is not listed in the COSAL or LOEP, enter "not listed."

Block 11: This block is completed when a field change or alteration is performed.

Block 12: Enter the code from Appendix 7 which best describes the action taken to complete the maintenance.

Block 13: Enter the total manhours to the nearest tenth expended on the maintenance. Enter

zeros in the spaces to the left which are not used. For example, if two men worked 1.5 hours, the entry would be 0030.

Block 14: Enter the rate of the senior man performing the maintenance.

Block 15: Enter the Julian date of the day the maintenance is completed.

Block 16: Enter the code from Appendix 6 which best describes the status of the equipment after the maintenance is completed. (1 indicates operational.)

Block 17: Enter the code from Appendix 8 which best describes the cause of the failure. (9 indicates normal stress or deterioration.)

Block 18-21: Completed when the equipment contains a time meter. Not filled in when field changes or alterations (block 11) are involved. Enter in block 18 the time to the nearest tenth of an hour that was actually spent on the maintenance. Include troubleshooting time, repairing time, and time spent checking equipment after the repair. This time is actual clock time, not manhours. For example, if one man (or any number of men) worked for 2.5 hours, the time entered would be 0025.

Block 19: Enter a single numeral (1-9) to indicate the percentage to the nearest 10% of active maintenance time (block 18) that was spent on troubleshooting. If no troubleshooting was involved, enter zero.

Block 20: Enter the equipment meter or counter reading to the nearest hour, at the time the first indication of trouble was recognized. If more than one meter is installed, use the one that monitors operating hours for the equipment being worked on.

Block 21: Record the meter designation that applies to block 20. When no designator has been assigned, leave blank.

Block 22-42: Discussed later under deferred maintenance.

Block 43: Enter the noun name of the equipment identified in block 4, using abbreviations as necessary. Use AN nomenclature when available. Briefly describe what was wrong with the equipment and what was done to correct the fault. Print one letter to a space.

Block 44-47: Leave blank.

Block A: Signature of the senior man performing the maintenance.

Block B: Signature of the Work Center Supervisor.

Blocks 48-54: To be filled in only if the equipment being worked on is included in the selected equipment list appearing in Appendix 18. Enter in block 48 the EIC code for the equipment being worked on, as in block number 4.

Block 49: Enter the manufacturer's part number or the Federal Stock Number (FSN). The FSN number should be used only if there is no manufacturer's part number. Check the appropriate box for the number used.

Block 50: If the manufacturer of the part is known, enter his code number here. Manufacturer's codes are obtained from the Supply Department.

Block 51: Enter the serial number of the part. If the number is large, use only the last ten characters.

Block 52: Enter the code from Appendix 12 which best describes the condition of the failed part. (Code 2 indicates an open coil winding.)

Block 53: Enter the reference designation for the part from the appropriate schematic diagram.

Block 54: Enter from Appendix 13 the code which best describes what was done with the faulty part. If there are several faulty parts, complete the rest of section 5 but document only the most significant parts. (Code D indicates discarded.)

Blocks S-Z are for use as directed by Type Commanders. Section 6 is for the use of repair activities in planning, scheduling, and controlling work.

DEFERRED MAINTENANCE ACTION (OPNAV Form 4790-2K).—The Deferred Maintenance Action form (fig. 2-4) is prepared for maintenance actions which cannot be completed within the time normally required. The initial documentation is completed in duplicate. A copy of the form is submitted as soon as the need to defer maintenance is recognized. The original of the deferral is retained on board for documentation of additional data, and is submitted only after the deferred maintenance is completed, or the deferral is cancelled. Deferred action reports are submitted for reportable maintenance which falls in the following categories:

a. Cannot be accomplished because of the ship's operations. (In this respect, the ship's operations are considered to include both in port and at sea activities that preclude the accomplishment of required maintenance.)

b. Cannot be accomplished because of a lack of parts or material.

c. Cannot be accomplished because of a need for technical skills or equipment not available on board. (Outside assistance is required.)

OPNAV FORM 4790/2K(1-70)
S/N-0107-3052

REPORT SYMBOL OPNAV 4790-1

MAINTENANCE DATA FORM

MAINTENANCE ACTION
CHECK ONE: COMPL [X] DEFER [ ] WORK REQ [ ]

USS H.P. JONES DD-999
SHIP NAME / HULL NUMBER

JOB CONTROL NUMBER

1. UNIT I.D. CODE	2. WORK CENTER	3. JOB SEQ. NO.	4. EQUIP I.D. CODE	5. FIT	6. WD	7. WD DATE	8. STAT
07952	0E01	0001	P113000	009	1	1 DAY 20	2

9. IDENTIFICATION NUMBER	10. APL / AEL	11. ALTERATION (SHIP ALT. ORD ALT FLD CHG. ETC.)
00063551	57036110	

SECTION I — AS DISCOVERED INFORMATION

SECTION II — COMPLETED ACTION

12. A/T	13. MAN HOURS 1/10	14. RATING/RATE	15. COMPLETION DATE YR DAY	16. STAT	17. CAUSE	TIME METER	18. ACT. MAINT. TIME 1/10	19. TBL ISL	20. EQUIP. METER READING	21. MTR
01	0030	ETR3	11 DAY 20	0	19		0025	5	27607	

SECTION III — DEFERRAL ACTION PLANNING

AND

22. A/T	23. MAN HOURS 1/10	24. RATING/RATE	25. DEFERRED DATE YR DAY	26. STAT	27. PRI.	28. PRI.	29. PPR	COUNTER EQUIPMENT	30. ACT. MAINT. TIME 1/10	31. TBL ISL	32. EQUIP. METER READING	33. MTR

34. INIT. A/T	35. REPAIR W.C.	36. EST. MAN HOURS	37. ASS'T REPAIR W.C.	38. ASS'T EST. M/H	39. AVL	40. SCHED. START DATE YR DAY	41. SCHED. COMPL. DATE YR DAY	42. REPAIR ACTIVITY U.I.C.

SECTION IV — REMARKS/DESCRIPTION

INSURV BOARD USE

43. NOUN NAME	44. TIME	45. CLASSIFICATION NO.	46. LI/S	47. M
MD-1176A/AN/SPS10				

RADAR FAILED TO RADIATE REPLACED TIME DELAY RELAY IN MODULATOR

COMPARTMENT	DECK	FRAME	SIDE	INTERGRATED PRI	SHEET NO.
					CONT SHEET

1ST CONTACT / MAINT MAN	2ND CONTACT / SUPERVISOR NAME	CO SIGNATURE
A C. J. Jones	B P.W. Thurburg	C

SECTION V — FAILED PARTS/COMPONENT

48. EIC TO LDA	49. MFG. PART NO. / FSN	50. MFG. CODE	51. SERIAL NUMBER	52. F PT COND.	53. REF. SYMBOL	54. DIS
P113000	5995-723430-5	11068		02	K-105	D

55.	56. MFG. PART NO. / FSN / FSS	57.	58.	59.	60.	61.

62.	63. MFG. PART NO / FSN	64.	65.	66.	67.	68.

SECTION VI — SUPPLEMENTARY INFORMATION

69. BLUEPRINTS, TECH MANUALS, PLANS, ETC.	AVAILABLE ON BOARD YES	NO	70. PREARRIVAL AND/OR ARRIVAL CONFERENCE ACTION — REMARKS	71. SCREENING ACTION
				SHIP
				SOD
				TYCOM

SHOP						LEAD P&E CODE	PLANNER I.D	DATE OF ESTIMATE — ARRIVAL ± DAYS
EST. M/H						TOTAL MANDAYS	M/D DOLLARS $	MATERIAL $ / TOTAL COST $
DOC. M/H						JOB ORDER NUMBER		

SOD SIG. D	TYCOM SIG / REPAIR OFFICER E	COMPLETED BY F	ACCEPTED BY G

GPO 890-100

17.81K

Figure 2-3.—Maintenance data form (completed maintenance action).

OPNAV FORM 4790/2K (1-70)
S/N-0107-3052

REPORT SYMBOL OPNAV 4790-1

MAINTENANCE DATA FORM

MAINTENANCE ACTION — CHECK ONE: COMPL. | DEFER X | WORK REQ

USS H.P. JONES DD-999
SHIP NAME/HULL NUMBER

SECTION I

JOB CONTROL NUMBER

1. UNIT I.D. CODE	2. WORK CENTER	3. JOB SEQ NO.	4. EQUIP I.D CODE
07952	0E01	0001	P113000

AS DISCOVERED INFORMATION

5. F/T	6. WD	7. WD DATE (YR / DAY)	8. STAT
009	1	11 / 042	2

9. IDENTIFICATION NUMBER	10. APL/AEL	11. ALTERATION (SHIP ALT ORD ALT F.L.O CHG ETC.)
0008635	57036 11 00	

SECTION II – COMPLETED ACTION

12. A/T	13. MAN HOURS 1/10	14. RATING/RATE	15. COMPLETION DATE (YR / DAY)	16. STAT	17. CAUSE	TIME METER	18. ACT. MAINT TIME 1/10	19. TBL ISL	20. EQUIP. METER READING	21. MTR

AND

SECTION III – DEFERRAL ACTION PLANNING

22. A/T	23. MAN HOURS 1/10	24. RATING/RATE	25. DEFERED DATE (YR / DAY)	26. STAT	27. AVL	28. PRI.	29. FPR	COUNTER EQUIPMENT	30. ACT MAINT TIME 1/10	31. TBL ISL	32. EQUIP METER READING	33. MTR
07	004	ETR2	11 / 040	2	5	3	X					

34. MAT. A/T	35. REPAIR W.C.	36. EST MAN HOURS	37. ASS'T REPAIR W.C.	38. ASS'T EST. M/H	39. AVL	40. SCHED. START DATE (YR / DAY)	41. SCHED. COMPL. DATE (YR / DAY)	42. REPAIR ACTIVITY U.I.C.
		0002						

SECTION IV – REMARKS/DESCRIPTION

INSURV BOARD USE

43. NOUN NAME	44. TIME	45. CLASSIFICATION NO.	46. U/S	47. M
MD-176A/ANSPS-10				

K/0S TIME DELAY RELAY FAILED TO CLOSE DUE TO OPEN COIL XXX ORDERED K/0S WILL REPLACE WHEN RECEIVED ON BOARD

S T V W X Y Z CONT SHEET

COMPARTMENT	DECK	FRAME	SIDE	INTERGRATED PRI	SHEET NO

1ST CONTACT/MAINT MAN	A	2ND CONTACT/SUPERVISOR NAME	B	CO SIGNATURE	C
C.J. Jones		D.W. Shubing			

SECTION V – FAILED PARTS/COMPONENT

48. EIC TO LDA	49. MFG. PART NO. FSN	50. MFG. CODE	51. SERIAL NUMBER	52. F PT BOND.	53. REF. SYMBOL	54. DIS
56.	56. MFG. PART NO. FSN	57.	58.	59.	60.	61.
62.	63. MFG. PART NO. FSN	64.	65.	66.	67.	68.

SECTION VI – SUPPLEMENTARY INFORMATION

69. BLUEPRINTS, TECH MANUALS, PLANS, ETC.	AVAILABLE ON BOARD YES	NO	70. PREARRIVAL AND/OR ARRIVAL CONFERENCE ACTION – REMARKS	71. SCREENING ACTION
				SHIP
				SOD
				TYCOM

SHOP						LEAD P&E CODE	PLANNER I.D	DATE OF ESTIMATE – ARRIVAL & DATE
EST. M/H						TOTAL MANDAYS	M/D DOLLARS $	MATERIAL $	TOTAL COST $
DOC M/H						JOB ORDER NUMBER		

SOD SIG D.	TYCOM SIG./REPAIR OFFICER E.	COMPLETED BY F	ACCEPTED BY G

GP 0 890-100

17.81K

Figure 2-4.—Maintenance data form (deferred maintenance action).

d. All PMS actions (monthly and less frequent) that must be deferred for outside assistance will be reported as a deferred maintenance action.

To fill out the Maintenance Data Form for a deferred maintenance action, proceed as follows:

Section 1 is completed in the same manner as described for the completed action form.

Section 2 is filled in upon completion of the deferred action.

Block 22: Enter the code from Appendix 9 that best describes why the maintenance cannot be accomplished. (Code 7 indicates that the required part is not on board.)

Block 23: Enter the total manhours to the nearest tenth expended up to the time of the deferral.

Block 24: Enter the rate of the senior man engaged in the maintenance.

Block 25: Enter the Julian date of the day the maintenance is deferred.

Block 26: Enter the code from Appendix 6 that best describes the status of the equipment at the time of deferral.

Block 27: Enter the code from Appendix 10 that best describes the type of availability need to complete the deferral. (Code 5 indicates ship's force.)

Block 28: Enter the code from Appendix 11 that best describes the urgency for completing the deferral. (Code 3 indicates routine repair.)

Block 29: Enter an **X** when failed part information is required. The activity completing the maintenance will furnish the necessary data.

Blocks 30-33: Completed when equipment contains a time meter or counter. Refer to blocks 18-21 of the completed maintenance action form.

Blocks 34 and 35 are completed when an internal work request is submitted.

Block 36: Enter the estimated manhours to the nearest whole hour required to complete the action. This entry is for the Work Center shown in block 2 when the deferral is to be completed by the ship's force. For other types of availabilities, the entry is for the total ship's force manhours in connection with the deferral.

Block 37: When the type of availability is ship's force and assistance is required, enter the Work Center that will provide the assistance.

Block 38: The Work Center listed in block 37 will enter its estimate of total manhours required to complete its portion of the maintenance. When the type of availability is other than ship's force, the type commander's representative will fill in block 38.

Blocks 39-42 are completed when an internal work request is submitted.

Block 43: Enter the name or AN designator of the equipment identified in block 4. All deferrals must include the following information:

1. The trouble, followed by three **X**s
2. What needs to be done
3. Parts needed to complete the work

After a deferral has been submitted, the reason for the deferral could change. Any change in the deferred action taken, or to the type of availability requires submission of a new deferral form. Such changes will usually cause other data to be incorrect; therefore, the new form must be carefully checked.

When the deferred maintenance is completed, check the completed maintenance block, complete the blocks in section 2, and describe in block 43 what was done.

WORK REQUEST. (OPNAV Form 4790/2K)—Appropriate blocks on four sheets of the maintenance data form are filled in to record the need for outside assistance. Variations, however, from the standard number of copies may be required by certain repair activities. These procedures are intended to accommodate those activities desiring to use the internal work request concept for planning and controlling maintenance assistance between Work Centers within the activity. Basic information for initiating the Work Request normally will come from the ship's copy of an associated deferred action form.

The Work Request is also used to request assistance from another Work Center within the ship or activity. It is filled in from the information contained on the filed copy of the deferred action. The Work Request contains the same JCN as the associated deferred action.

For those activities that do not desire to control internal Work Requests, or where the situation precludes the planning and control of requested work, the initiation and accomplishment of the work may be documented by using the single sheet Work Request procedures outlined in OPNAV 43P2 and 42P5.

For the Work Request, blocks 1 through 11, 28 and 29 of the Maintenance Data Form are completed, using the information contained on the deferral form. In block 43 enter the name

or AN designator of the equipment and tell what needs to be done.

In blocks A and B print the names of two contact men. If the equipment is to remain on board, fill in the location blocks.

In block 69 list all applicable blueprints, technical manuals, schematics and other documents. When the work has been accomplished, complete the deferral copy retained on board and forward it to the department head.

SUPPLY REQUISITION FORMS.—Documenting material usage and cost data on maintenance transactions requires the joint effort of the ship's supply and maintenance personnel. NAVSUP Form 1250 and DD Form 1348 (discussed in Military Requirements for PO3&2, NAVPERS 10056-C) are the source documents used to record material usage and cost data in support of maintenance actions. Supply personnel are expected to assist maintenance personnel whenever difficult or unusual documentation problems arise. Issues of materials which do not directly involve a maintenance action or minor consumables will not be reported in the MDCS.

When a repair part is needed before a specific maintenance action can be completed, the maintenance man aboard a non-mechanized ship uses NAVSUP Form 1250 to request the issue of the part from the ship's supply department. Supply personnel issue the part, if it is in stock aboard ship. If it is not in stock, the information on the form is used by supply to order the part from off-ship sources.

When a repair part is required to complete a specific maintenance action aboard a mechanized ship, the maintenance man uses DD Form 1348.

After appropriate action has been taken by the supply personnel, the requesting maintenance man receives a copy of the supply request along with the material. In cases where the material is not available on board, the supply document is marked NIS (not in stock) or NC (not carried), as appropriate, and the supply personnel take appropriate action to obtain the requested material.

Field Changes

Field Changes are the means by which approved and authorized alterations and modifications are made to electronic equipments for the purpose of improving the equipment performance, operational characteristics, or maintenance features. Recommendations for Field Changes may originate from various sources such as the Fleet, naval shipyards, contractors, project managers, and equipment engineers.

Field Changes are mandatory and are to be accomplished on the equipment affected in accordance with the instructions contained in the Field Change bulletin at the earliest opportunity. Field Changes are issued in kits and are classified as type 1, 2, 3 or 4 as follows:

A type 1 Field Change kit includes all parts, materials, special tools, and instructions required to accomplish the change to the affected equipment and to revise existing equipment nameplates, publications, and charts.

A type 2 Field Change kit contains the instructions to accomplish the Field Change and to correct the related publications. The required parts are not included.

A type 3 Field Change kit includes the instructions to accomplish the change, and some of the parts, materials, and special tools required to accomplish the change and to revise the existing nameplates, publications, and charts.

A type 4 Field Change includes the instructions for accomplishing the change and for correcting the related publications. No parts or special tools are required.

Field Changes are further classified as class A, B, or C as follows:

A class A Field Change is a change approved for accomplishment by forces afloat or station personnel. No installation funding is required.

A class B Field Change is a change approved for accomplishment by Naval Shipyards, tenders, and repair facilities, without reference to the cognizant Systems Command, upon allocation of funds by the Type Commander.

A class C Field Change is a change normally requiring shipyard or other industrial assistance for accomplishment, and the cognizant Systems Command is obligated for funding.

When a Field Change is accomplished, record its completion on the Field Change Accomplishment plate of the equipment affected, and on the appropriate MDCS Maintenance Data Form in accordance with OPNAV 43P2.

ENVIRONMENTAL EFFECTS ON ELECTRONIC EQUIPMENT

It is beyond the scope of the chapter to present all the problems encountered from environmental conditions, because individual methods of installation and stowage of electronic equipments

differ from ship to ship and from one naval shore station to another. However, some of the preventive and corrective measures that should be taken under adverse environmental conditions, and the effects on the equipment subjected to these conditions, are given in the following paragraphs.

TEMPERATURE

Extremely low temperature may cause brittleness in certain types of metals, and loss of flexibility to rubber, insulation, and similar material. Extremely high temperatures may cause deformation, and deterioration of terminal boards, seals, insulation and heat-sensitive devices. Rapid changes of temperature may be especially damaging to certain types of electronic components.

The cooling or heating of air spaces surrounding the components of electronic equipment is generally accomplished and controlled by blowers, fans, hot oil and water coolers, etc., either to dissipate the heat generated by the equipment components, or to heat or cool the surrounding ambient air. Regardless of the method employed for the cooling or heating of spaces, if personnel neglect to keep the screens, filters, fans, ducts, surface area of coolers, and equipment free from foreign matter, the heating or cooling will be greatly affected, which may result in equipment damage or malfunction caused by improper temperature control.

HUMIDITY

High humidity, (prevalent in tropical climates) is the "arch enemy" of electronic equipment. Its resultant damage to equipment parts is caused by condensation and fungus growth, under conditions of both high salt-laden moist air and high temperature. In this case, adequate ventilation of the equipment is of the utmost importance to protect the equipment components from entrapped moisture and extremely high operating temperatures. To overcome any adverse effects on electronic equipments, maximum and minimum temperature gradients should be controlled by one of the cooling or heating mediums provided.

In many cases, critical electronic components are encapsulated, potted, or sealed, to protect them from the detrimental effects of moisture and temperature variations. However, sealing the component does not completely eliminate the problem of high-humidity conditions, because the seals sometimes must be broken for maintenance or repair work. There is also the possibility that the electronics technician will not always have on hand the suitable sealing compounds to repair or replace sealed components. Where this condition exists, except in cases of emergency, the repair or replacement of sealed components should not be performed in the field.

Equipment that is to remain idle and deenergized for a considerable length of time should have their space heaters (if provided) turned ON to keep the insulation and equipment dry. If space heaters are not provided for the equipment, electric lamp bulbs or a portable electric heater as a temporary measure can be placed within or near the equipment. This is especially important in humid or cold climates.

CORROSIVE ATMOSPHERE

The effect of a corrosive atmosphere on metal parts, and insulation can cause serious damage to unprotected electronic equipment. For this reason, the technician should be cognizant of the harmful effects of all corrosive elements. He must be especially aware of the effects produced by salt spray or salt-impregnated air. To prevent corrosive effects, a regular periodic cleaning schedule for most equipments has been established by PMS. This schedule normally includes dusting and cleaning, lubrication of the moving parts, and the application of approved solvents or wetting agents to remove any accumulation of foreign matter, such as soil, dust, dirt, oil film, and salt-impregnation. Failure to adhere to this regular periodic cleaning schedule can lead to degradation and early equipment failure. In addition, all access doors and panels should be securely fastened and in place when maintenance work is not being performed on the equipment.

In the event that a piece of electronic equipment becomes soaked with salt water, oil or acquires a thick coat of oily dirt, the following procedure may be used to clean the equipment:

1. Deenergize the equipment.
2. Disconnect and remove the drawers or units which are to be cleaned.
3. Remove all tubes, subassemblies, assemblies, cover plates, plug-in cables, and any parts which could be affected by water.

4. Move all of the items to a place near a source of fresh water, such as a shower stall.
5. Liberally wash down the items with fresh water; for oil and greasy dirt, use an approved dry cleaning solvent or a nonionic detergent.
6. Rinse thoroughly with fresh water and allow the excess water to drain off.
7. Use clean, low pressure air to blow out as much of the water as possible.
8. Completely dry the parts using heat lamps, electrical heaters, hot air blowers, or the galley ovens. Be careful not to overheat the parts.
9. Clean out all connectors with solvent and pipe cleaners.
10. After the parts are dry, make visual inspections and resistance tests to locate damaged parts. Replace parts as necessary.
11. Reassemble and reinstall all parts of the equipment, and make all required tests and alignments as indicated in the technical manual.

RECORDS AND REPORTS

In addition to the 3-M System forms discussed earlier, there are various other types of record and report forms that concern the ET. Some of the common ones are described briefly below.

REFERENCE STANDARDS BOOK

The Reference Standards Book includes: (1) Reference Standards Tests, (2) Reference Standards Summary Sheets, and (3) Performance Standards Sheets. When these three items are contained in a single publication, they constitute a Reference Standards Book for a particular equipment or system.

Reference Standards Tests consist of a series of measurements made initially when the equipment is operating at peak performance. These measurements, containing upper and lower limits, provide maintenance personnel with standards against which subsequent measurements may be compared in order to ascertain equipment readiness at any given time. The Reference Standards Tests are accompanied by blank spaces (fig. 2-5) which are used by maintenance personnel to record the results of subsequent measurements. This allows maintenance personnel to develop a performance history of an equipment. The Reference Standards Tests are scheduled on a routine basis such as daily, weekly, and monthly. These tests are superseded and canceled when the PMS is implemented. Reference Standards Books are to be retained on board ships, however, even after PMS has been installed, in order that technical data on installed equipments will be available for ready reference.

Two identical Reference Standards Summary Sheets precede the front matter of a newly issued Reference Standards Book. The Reference Standards Summary Sheets provide blank spaces for maintenance personnel to record the results of all Reference Standards Tests. After the sheets are filled in, one is retained in the book and the second is submitted to NAVSHIPS for evaluation.

A Performance Standards Sheet (fig. 2-6) lists the capability of a particular equipment or system. The sheet also lists the measurements that can be performed to determine if the equipment is operating at its designed capability. A Performance Standards Sheet is used by maintenance personnel to determine the overall operation of an equipment by test results from the Reference Standards Book with the data given on the Performance Standards Sheet. This sheet is usually the first page in a newly issued Reference Standards Book.

ELECTRONIC PERFORMANCE & OPERATIONAL REPORT

The Naval Ships System Command must keep tab on new (and converted) equipments to evaluate their usefulness. This is accomplished with the Electronic Performance and Operational Report, NAVSHIPS 3878, shown in figure 2-7.

It is not desired that reports be submitted on all equipments. Detailed instructions for the preparation and submission, and a listing of equipment requiring a report are contained in NAVSHIPS Instruction 9670-20E. When applicable, NAVSHIPS 3878 is submitted quarterly to the Naval Ships Systems Command.

The NAVSHIPS 3878 reports are essential to keeping the Naval Ships System Command informed on equipment performance and operation. Because they provide firsthand information on equipment under actual operating conditions and report the maximum ranges obtained, they are extremely valuable in evaluating the electronics maintenance program, enforcing manufacturers'

QUARTERLY STEPS Q1 thru Q8

NAVSHIPS 94715.42

AN/WRR-2, -2A
AN/FRR-59, -59A

OPERATING CONDITIONS AND CONTROL SETTINGS:

Equipment in full operation and conditioned for A1 reception.
O.L. THRES: OFF

STEP NO.	ACTION REQUIRED	READ INDICATION ON	REFERENCE STANDARD
Q1	Record over-all sensitivity of Mode A1 at low end of 2-4 mc band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	*PROCEDURE: Connect signal generator to the ANT IN jack (J957). Adjust generator for a 2-mc unmodulated signal and set output at 5 μv. Set BAND selector to 2-4. Tune receiver to 2 mc and adjust the ANT COMP and HF ADJ controls for maximum indication on the RESONANCE meter. Reduce generator output to zero and adjust RF GAIN for a -2 db indication on the LINE A OUTPUT meter. Set generator output to 5 μv and adjust generator frequency for a maximum indication on the RESONANCE meter. Readjust generator output for a +18 db indication on the LINE A OUTPUT meter. Record the generator output in microvolts.		
Q2	Repeat for high end of band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Tune receiver to 4 mc and repeat step Q1.		
Q3	Record over-all sensitivity of Mode A1 at low end of 4-8 mc band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Set BAND selector to 4-8. Tune receiver to 4 mc and repeat step Q1.		
Q4	Repeat for high end of band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Tune receiver to 8 mc and repeat step Q1.		
Q5	Record over-all sensitivity of Mode A1 at low end of 8-16 mc band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Set BAND selector to 8-16. Tune receiver to 8 mc and repeat step Q1.		
Q6	Repeat for high end of band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Tune receiver to 16 mc and repeat step Q1.		
Q7	Record over-all sensitivity of Mode A1 at low end of 16-32 mc band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Set BAND selector to 16-32. Tune receiver to 16 mc and repeat step Q1.		
Q8	Repeat for high end of band.	Signal Generator AN/URM-25	_____ μv (1.5 max.)
	PROCEDURE: Tune receiver to 32 mc and repeat step Q1.		

36.100

Figure 2-5.—Sample page from Reference Standards Book (reference Standards tests).

6 April 1972 NAVSHIPS 94715.32 AN/WRR-2, -2A AN/FRR-59, -59A

PERFORMANCE STANDARD SHEET

for

RADIO RECEIVING SETS AN/WRR-2, -2A, AN/FRR-59, -59A

TABLE I - OPERATIONAL PERFORMANCE
The many variables involved, such as radio propagation conditions at the time of the test, power output of the transmitter being received and the type of antenna installation, preclude definitive predictions of operation ranges. To achieve optimum reliable ranges, frequency selection should be made in accordance with DNC-14, as corrected by half-hourly radio propagation predictions given over WWV and WWVH.

NOTE: KC = KHz

TABLE II - STANDARDS FOR EQUIPMENT MEASUREMENT		
MEASUREMENT	STEP	STANDARD
Bandwidth (IF, 1.0 KHz)	Q19 and Q20	0.8 KHz min. (at 6 db) 2.4 KHz min. (at 60 db)
Receiver Sensitivity (Sr)	Q1 thru Q8	1.5 μv max.
Performance Figure (PF)*	Calculate	1.5 max.

* PF = Sr (μv)

Total time required to perform Table II measurements - 1 hour.

All steps refer to tests in the Reference Standards Book, NAVSHIPS 94715.42

This Performance Standards Sheet supersedes NAVSHIPS 93550.32

36.100

Figure 2-6.—Performance standards sheet.

guarantees, evaluating installation adequacy, improving equipment operation and safety, and improving equipment design.

The NAVSHIPS 3878 report contains a place for general remarks on the back of the form (not shown). Indicated here is any pertinent information not included elsewhere on the form such as detailed information on any unusual difficulty encountered in operation; exceptional maintenance required; and suggestions for improvement in design, tests, and new applications.

ELECTRONIC PERFORMANCE & OPERATIONAL REPORT
NAVSHIPS 3878 (Rev. 6-60) *Submit original only to Bureau - No forwarding letter required*

REPORT CLASSIFICATION: UNCLASSIFIED | DATE: 31 MARCH 1971

FROM: USS RANGER (CVA-61) *(Ship name, type and hull no.)* ☐ LANT ☐ FLEET ☒ PAC

TO:

REPORTING PERIOD: FROM 1 JAN 1971 TO 31 MARCH 1971

TYPE AND MODEL OF EQUIPMENT: AM-1365/URT Amplifier | SERIAL NUMBER: 383

FIELD CHANGES TO DATE	ACCOMPLISHED	NOT ACCOMPLISHED	HOURS DURING PERIOD OF THIS REPORT OPERATED	NOT IN OPERATING CONDITION
	None	None	180	56

PERFORMANCE FIGURE (PF) & TECHNICAL EVALUATION: ☒ OUTSTANDING ☐ GOOD ☐ SATISFACTORY ☐ UNSATISFACTORY

OPERATIONAL EVALUATION: ☒ OUTSTANDING ☐ GOOD ☐ SATISFACTORY ☐ UNSATISFACTORY

RADAR

PEAK POWER OUTPUT (PT) dbm		AVER. VSWR IN TRANSMISSION LINE		AVER. ECHO BOX RING TIME YDS		MIN. DISCERNIBLE SIGNAL (PMDS) dbm	
MAX. RANGE TARGETS DETECTED	MI	MI	MI	MAX. ALTITUDE AT RANGE DETECTED	MI	MI	MI
MAX. ALTITUDE TARGETS DETECTED	FT	FT	FT	RANGE AT MAX. ALTITUDE DETECTED	FT	FT	FT
TARGET CLASS. TYPE - DETAIL (SEE REVERSE)	1			TARGET CLASS. TYPE - DETAIL (SEE REVERSE)			
MAXIMUM RELIABLE RADAR RANGE MI				MINIMUM RELIABLE RADAR RANGE YDS			

SONAR

SOURCE LEVEL (LS) db//uBAR	RECEIVING SENSITIVITY db//VOLT/uBAR		SEA STATE	PROCEDURE USED		
NOISE LEVEL db//VOLT	5 KNOTS	10 KNOTS	15 KNOTS	20 KNOTS	25 KNOTS	30 KNOTS
MAXIMUM RANGE SONAR TARGETS DETECTED AND TRACKED	RANGING YDS		LISTENING YDS		SOUNDING FATHOMS	
TARGET CLASSIFICATION TYPE AND DETAIL						
ST PATTERN						
OWN SHIP'S SPEED.	KTS		KTS		KTS	

COMMUNICATIONS

PERCENT OF TIME OUT OF CONTACT WHILE WITHIN RANGE (IF ANY)	ANTENNA SYSTEMS	INTERFERENCE (Frequencies, intensity, and sources)
0 %	No problems	No problems

POWER OUTPUT	AVERAGE VSWR	REL RANGE	RECEIVER SENSITIVITY
Voice 100 WATTS	1.5:1	40 miles	NA MICROVOLTS

ELECTRONIC WARFARE

MAXIMUM RANGE AND ALTITUDE TARGETS DETECTED	MI	FT	MI	FT	MI	FT
TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)						
MAXIMUM RELIABLE RANGE AND ALTITUDE	MI	FT	MI	FT	MI	FT
TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)						
MAX. RANGE SONAR TARGETS DETECTED YDS	ST PATTERN		MAX. RELIABLE SONAR RANGE YDS		ST PATTERN	

35.83

Figure 2-7.—Electronic Performance and Operational Report.

SHIP ELECTRONICS INSTALLATION RECORD

The ship Electronics Installation Record (NAVSHIPS 4110) furnishes an up-to-date inventory of the electronic equipment aboard each ship to interested Fleet and shore activities. To be effective, the NAVSHIPS 4110 must be extremely accurate and kept current. Detailed instructions for preparing, revising, and submitting NAVSHIPS 4110 are found in Reporting Electronic Equipment Installation, NAVSHIPS 0967-088-5010 (formerly NAVSHIPS 900, 135D).

Format

The ship's data portion of the NAVSHIPS 4110 (fig. 2-8) is filled in by NAVSHIPS. The ship makes no entries in this part of the form except to fill in the date on which preparation or revision of the form is completed by the ship.

The SSC column on the form is filled in by NAVSHIPS with a numerical code equivalent to equipment nomenclature to facilitate automatic data processing.

The equipment data portion of the form is filled in by the ship under the column headings of CATEGORY, LOCATION, EQUIPMENT MODEL, SERIAL NUMBER, and EQUIPMENT VOLTAGE. The equipment is listed on the form (1) in category order, (2) within each category by location, and (3) within each location by numerical and alphabetical sequence. The equipment is divided into eight major categories as follows:

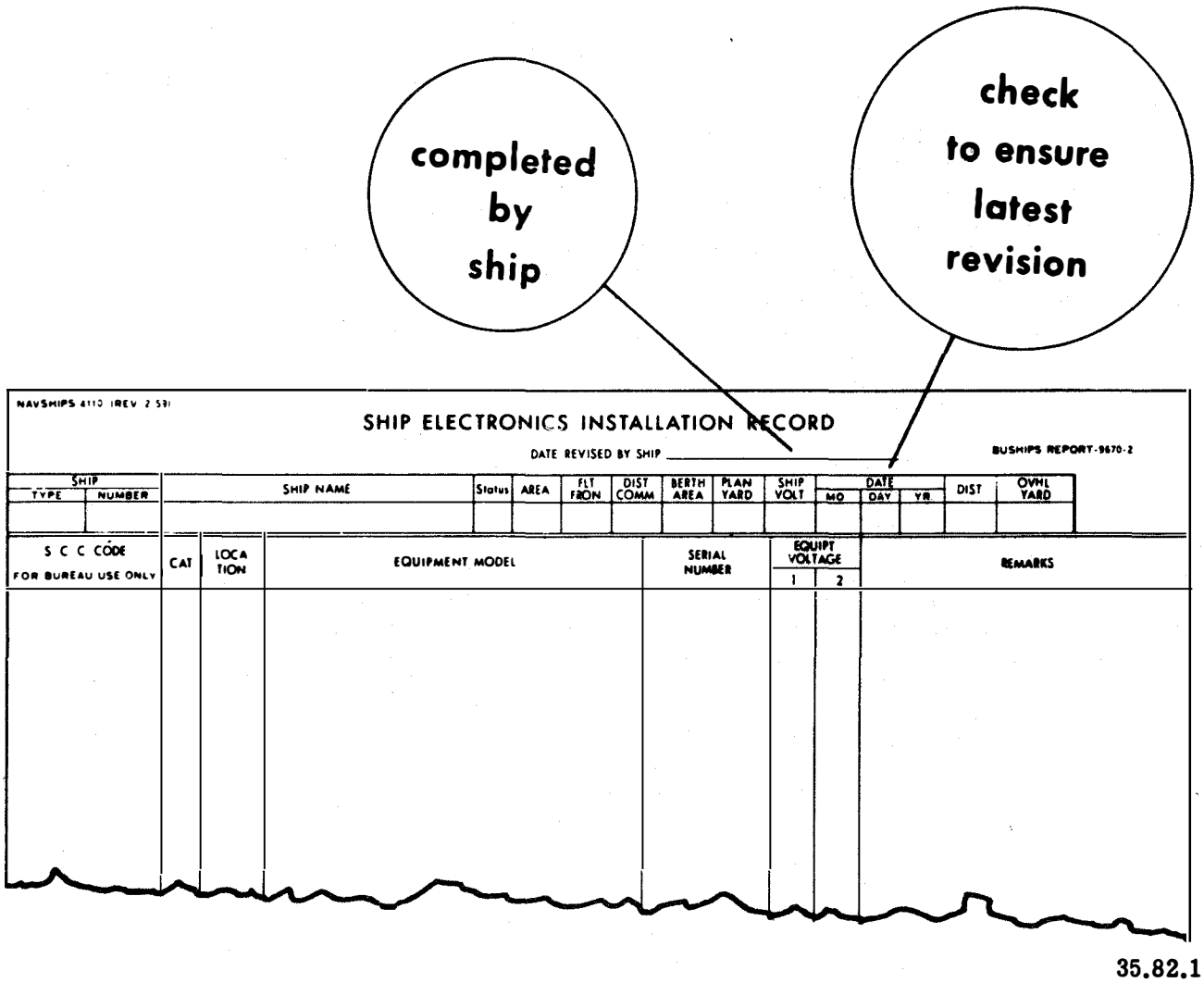

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Figure 2-8.—Ship Electronics Installation Record (NAVSHIPS 4110).

EQUIPMENT	CATEGORY
Communications	1
Radar and Radar Identification	2
Sonar and Sonar Identification	3
General Purpose Test	4
Infrared, Radiac, Radio Navigation, and Countermeasures	6
Intercommunications	7
Power Supply	8
Misc. Commercial, Shore and Certain Test Equipment	9

Category 5, formerly Fire Control Equipment, is now deleted. Category 7, IC equipment, is reported to the Electronics Supply Office (ESO) in accordance with NAVSHIPS Instruction 9670.85. Code numbers (listed in NAVSHIPS 0967-088-5010) are used in the LOCATION and EQUIPMENT VOLTAGE columns of the form to indicate the equipment location and input voltage(s).

The REMARKS column provides space for any remarks deemed necessary by the ship. The Naval Ship Engineering Center (NAVSEC) includes a 4-digit code in this column. The first digit is the category code, and the remaining three digits are the subcategory code. The complete 4-digit code, however, is normally referred to as the subcategory or SCAT code. This SCAT code can be cross referenced to the equipment in the NAVSHIPS 0900-001-2000 series publications. A general guide to SCAT codes for electronic equipments follows:

EQUIPMENT	SCAT CODE
Communications	0001 through 1999
Radar	2000 " 2999
Sonar	3000 " 3999
Test	4000 " 4999
Infrared	6000 " 6099
Radiac	6200 " 6399
Navigation	6500 " 6699
ECM	6700 " 6999
Power	8000 " 8999
Commercial & Shore	9000 " 9999

Revising and Submitting

Corrected NAVSHIPS 4110s are submitted as follows: (1) for ships being overhauled—one week prior to completion of the overhaul, and (2) for all ships not undergoing construction, conversion, or overhaul—when a major change is made in the ship's installation record. When changes to the installation record are extremely minor, the update may be reported by the use of the Electronics Equipment Interim Report (NAVSEC 9670/3 fig. 2-9). One post card is required for each minor change. When the post card is received by NAVSEC, the NAVSHIPS 4110 is updated, but no new outputs are generated for distribution. Therefore, the use of these cards should be limited to extremely minor changes.

When updating the NAVSHIPS 4110, two copies are prepared; one for submission to NAVSEC and one for the ship's file. Ensure that the latest copy of the form is used for updating. If a revision is submitted on any copy other than the latest, it will be returned to the ship for resubmission.

To correct the data for an equipment, cross out the incorrect data and write in the correct data. Ensure that the corrections are kept in the proper column or immediately adjacent to the deleted data as shown in figure 2-10.

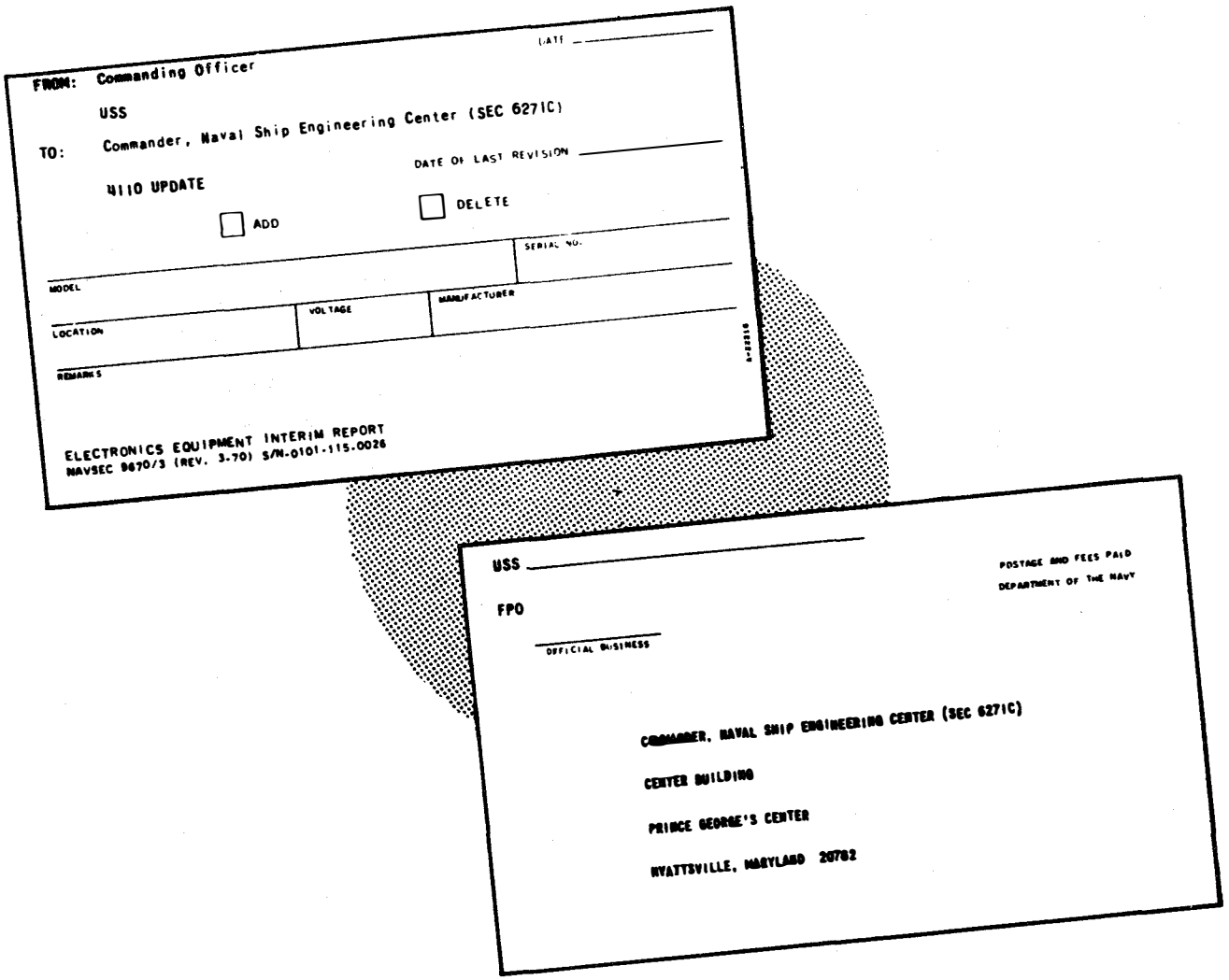
When an equipment is deleted, a colored line (preferably red or green) should be drawn through the data for the affected equipment (fig. 2-11). Do not obliterate the old data as ADP personnel must be able to read the deleted information.

When a new equipment is added to the list, it may be inserted in any space available, but preferably on a separate sheet. It is not necessary to insert new items by category or location. This will be done automatically by machine processing. When an equipment on the list is replaced by a new equipment, delete the equipment being replaced, and add the new equipment to the list as shown in figure 2-12.

NOTE: The Ships Equipment Configuration Accounting System (SECAS), when implemented, will replace the NAVSHIPS 4110.

EQUIPMENT TECHNICAL MANUALS

Equipment technical manuals include information essential to the proper installation, operation, and maintenance of the equipments to which they apply. There are various types of technical manuals (all of which contain



35.82.2

Figure 2-9.—Interim report post cards.

essentially the same types of information) in different formats and arrangements. Electronics equipment technical manuals that you will be using (fig. 2-13) include the conventional manuals which are divided into sections or chapters, each containing specific related information, and the Symbolic Integrated Maintenance Manual (SIMM) which incorporates new concepts in presenting technical data. (See page 40)

Other types of technical manuals which you may encounter include interim and temporary manuals which precede the approved military manuals, and the manufacturer's technical manuals which may be issued in place of the standard military manuals.

CONVENTIONAL MANUALS

The most common conventional equipment technical manuals are the 6-and 8-part manuals. Their organization and a description of the material contained in these manuals are presented in the following paragraphs.

The 6-Part Technical Manual

Front Matter

1. General Information
2. Installation
3. Operation

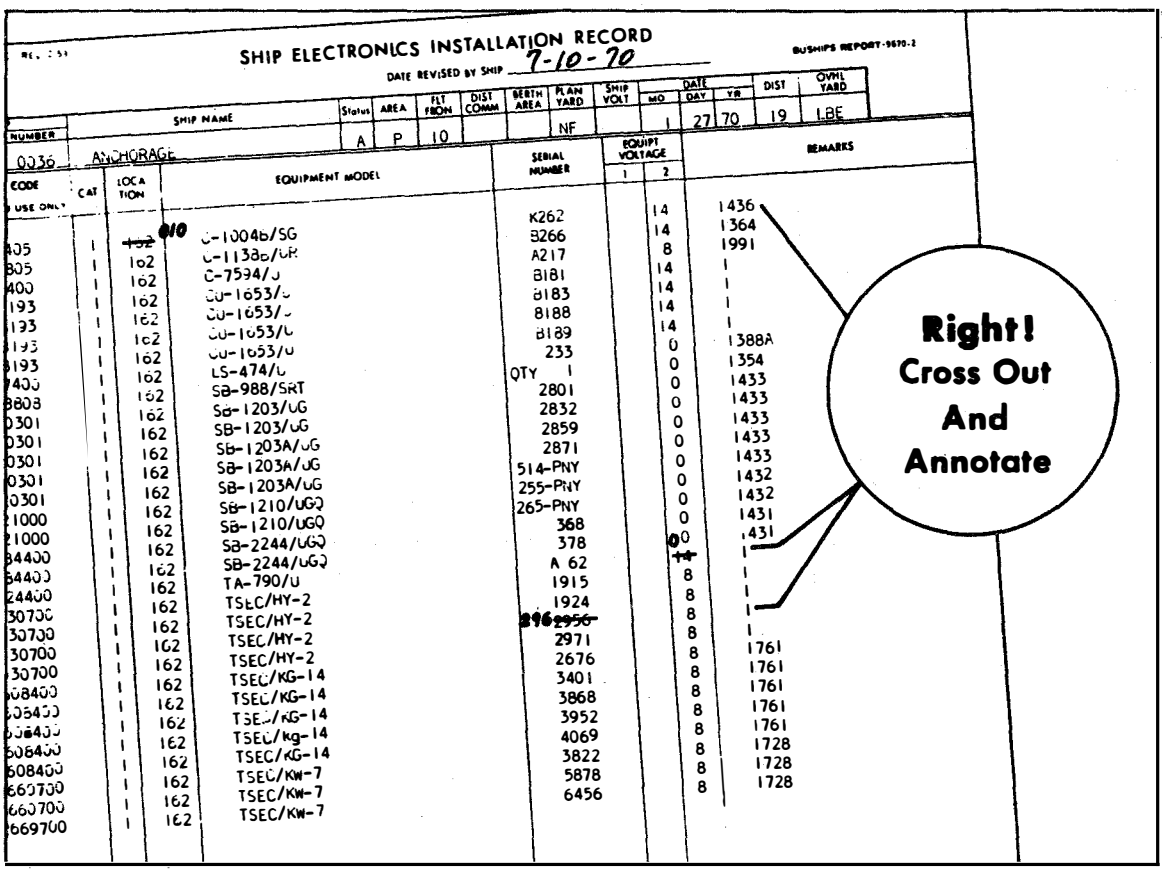


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Figure 2-10.—Proper corrections.

4. Troubleshooting combines functional description and troubleshooting chapters
5. Maintenance combines corrective maintenance, preventive maintenance, and alignment chapters
6. Parts List

The 8-Part Technical Manual

Front Matter

1. General Information
2. Operation
3. Functional Description
4. Scheduled Maintenance
5. Troubleshooting
6. Corrective Maintenance includes alignment
7. Parts List
8. Installation

Front Matter

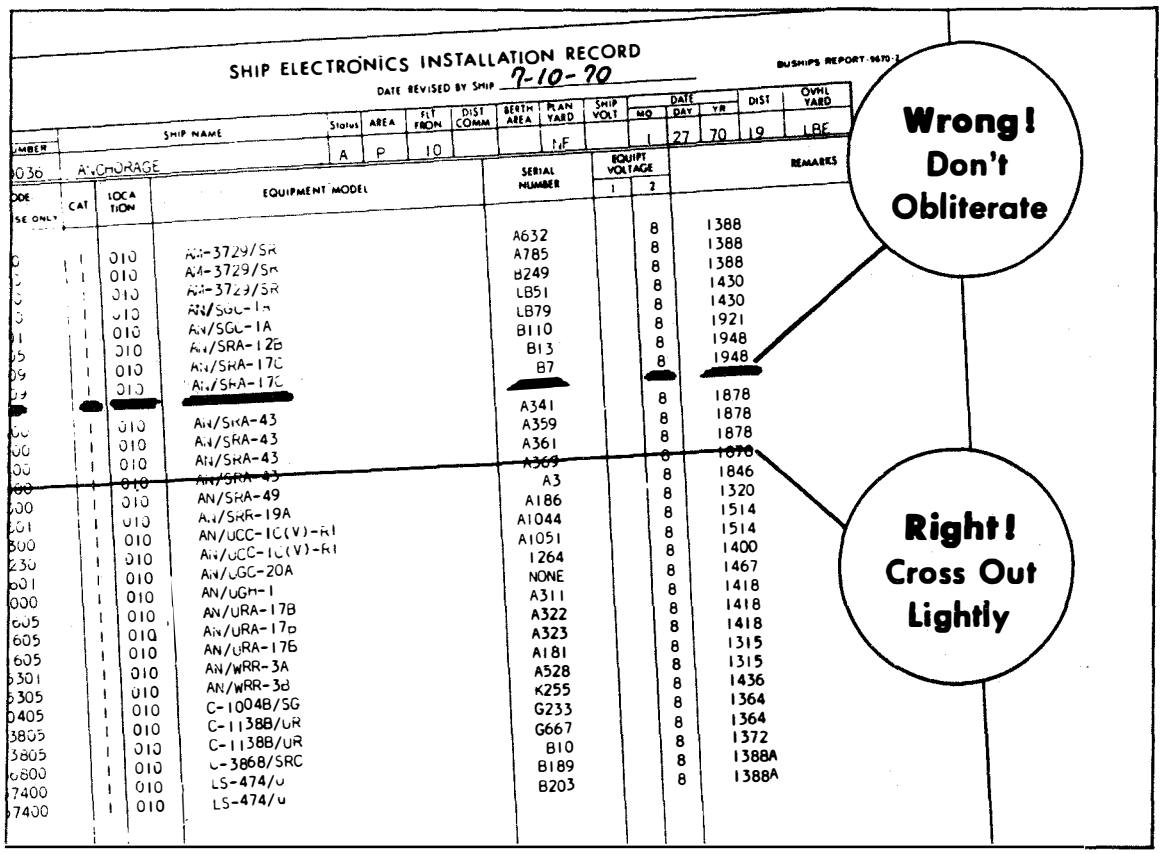
This chapter will be found in each volume of a multivolume technical manual and contains the following information:

A COVER and a TITLE PAGE which lists the equipment or system nomenclature, the security classification, publication, number, volume number (if required), and the command in charge of the equipment. In addition, the TITLE PAGE includes an approval date and, if needed, a change number and date.

A FORWARD which explains the content, usage, and intent of the manual.

A LIST OF EFFECTIVE PAGES (table 2-1) which lists all pages of the manual and indicates the change status of each page. (See page 40)

A CHANGE RECORD which is to be filled in with information concerning the changes entered in the manual, such as the change number, the person making the change, and the date.



35.82.1

Figure 2-11.—Proper method of deletion.

An INDEX containing: a Table of Contents, listing the number and title of the chapters, sections, and main paragraphs; a List of Illustrations, listing the number, title and page number of each figure; a List of Tables, listing the number, title, and page number of each table.

In multivolume manuals, Volume I contains a complete index covering all volumes. The other volumes contain only their own indexes.

A DESCRIPTION OF CODES AND SYMBOLS which are particular to that technical manual, including how to interpret the symbols used.

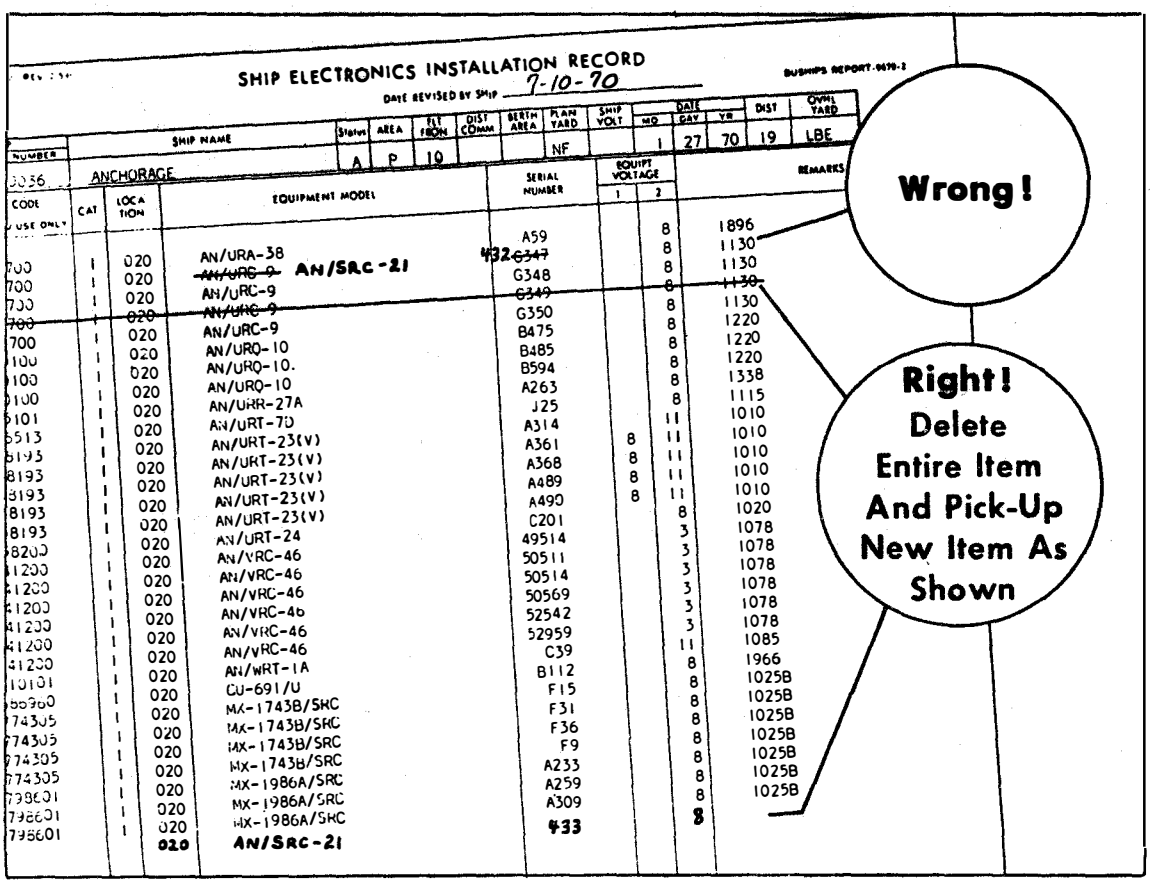
General Information

This chapter provides a functional description of the equipment or system to allow command personnel and other users to easily and rapidly determine the intended use, capabilities, limitations, and relationships of the units and contains the following:

An INTRODUCTION which provides an explanation of the purpose, scope, supersedure data, and applicability of the manual, including the models, serial numbers, and configurations of the equipment covered.

A GENERAL or EQUIPMENT DESCRIPTION which briefly and nontechnically describes the intended use, capabilities, and limitations. The RELATIONSHIP OF UNITS is a pictorial illustration (figure 2-14) of all the units of a set or system showing the basic interconnections between the units and other equipment.(See page 41)

The REFERENCE DATA, which includes Nameplate Data, Functional Characteristics, Capabilities and Limitations, Rated Outputs, and Environmental Characteristics. EQUIPMENT, ACCESSORIES AND DOCUMENTS SUPPLIED which lists all equipment, test equipment, publications, and accessories required but not



35.82.1

Figure 2-12.—Proper method of deletions and additions.

supplied. A table of FIELD CHANGES AND FACTORY CHANGES, which lists the changes that apply to that equipment, and whether they were accomplished.

Operation

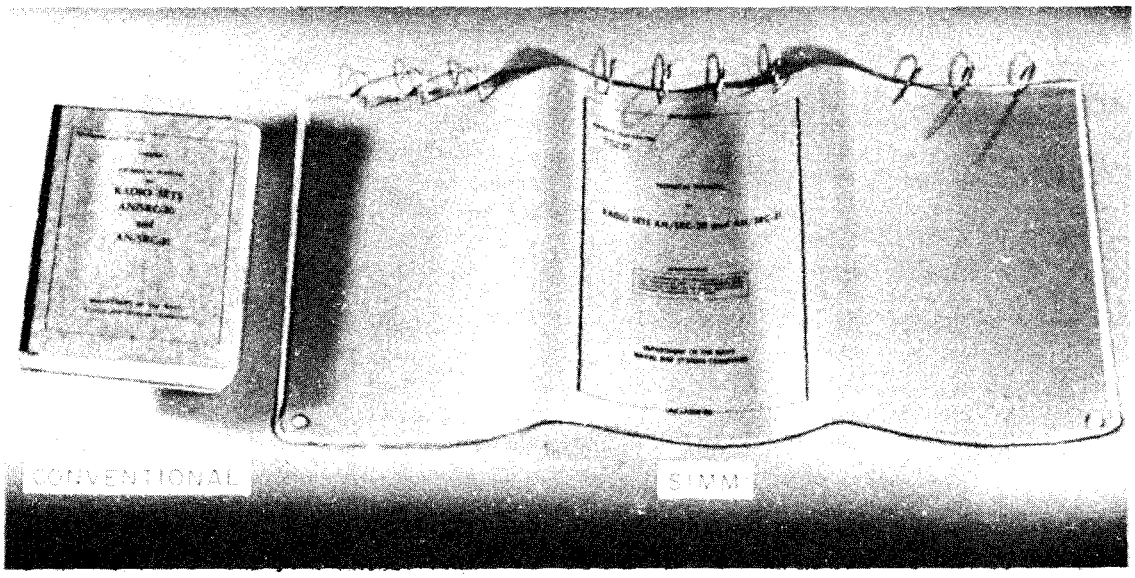
This chapter contains routine and emergency operating instructions, safety precautions, operating limits, complete starting and stopping instructions, and any instructions required by the operator to prepare the equipment for use. An INTRODUCTION describes the operator's relationship to the equipment and identifies the units having controls and indicators which he uses. A DESCRIPTION OF CONTROLS AND INDICATORS includes names, positions, and operating functions of each control (figure 2-15) and the normal operating condition of each indicator. (See page 42)

The OPERATING PROCEDURES include Operator Turn-on, Modes of Operation, Operation Under Interfering Conditions, Operator Turn-off, Emergency Operation, and Emergency Turn-off.

The OPERATOR'S MAINTENANCE contains Operating Checks and Adjustments, Preventive Maintenance, and Emergency Maintenance. In some technical manuals this chapter is in a separate volume to allow it to be kept near the equipment for easy reference.

Installation

This chapter contains all the information required for the installation of the equipment, such as site selection, unpacking and handling, clearances, and recommendations for reduction of electromagnetic interference. In addition, this chapter contains tests and test procedures



162.136

Figure 2-13.—Equipment technical manuals.

required to demonstrate that the equipment is capable of satisfying operational requirements. It also contains an INSTALLATION STANDARDS SUMMARY SHEET (figure 2-16), which is used to record the results of the installation verification tests. (See page 43)

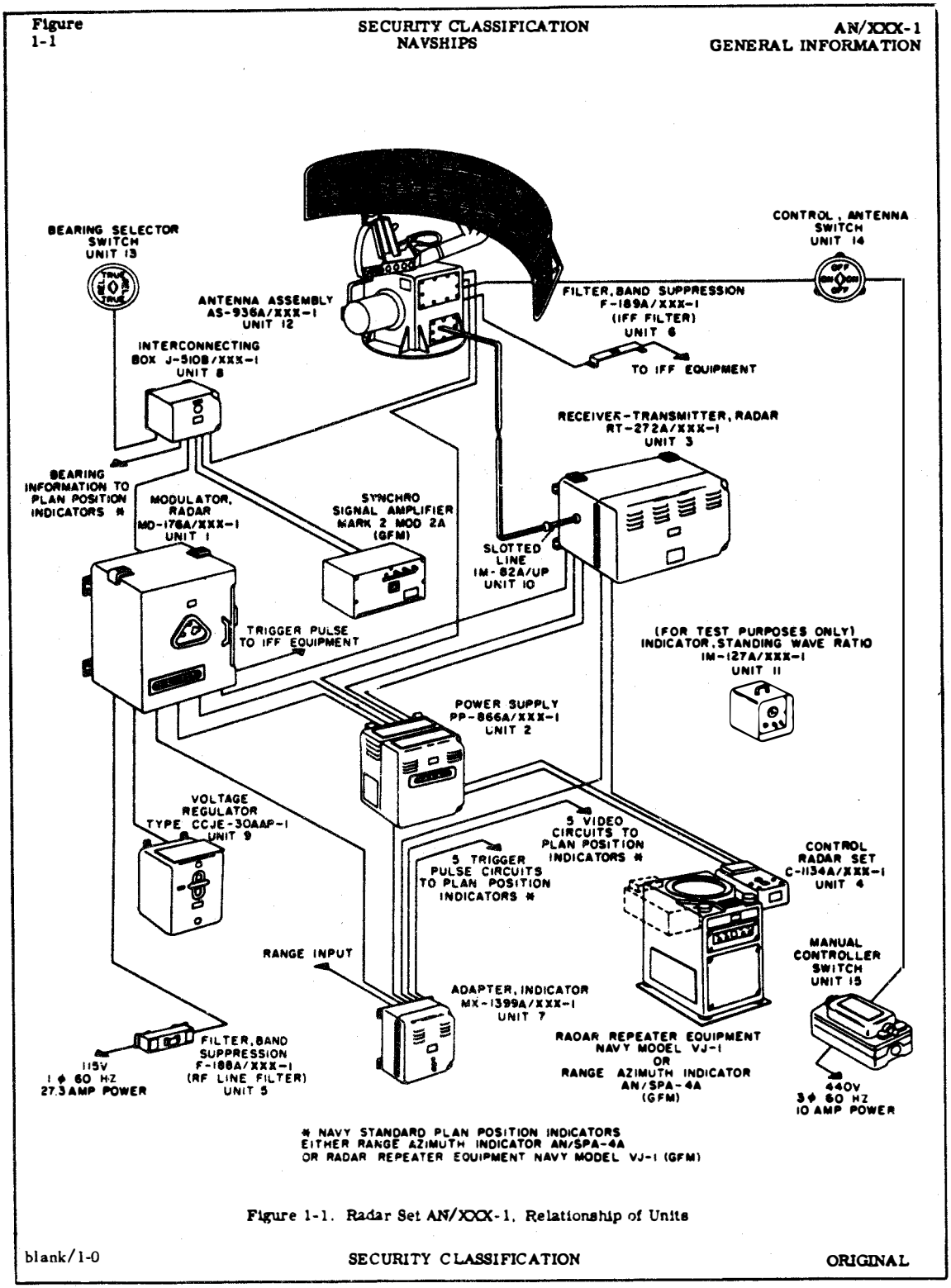
Functional Description

This chapter provides a detailed analysis of the principles of operation of the overall equipment and its major functions, including supporting functions such as power, cooling and control. OVERALL FUNCTIONAL BLOCK DIAGRAMS (figure 2-17) show all the major functions of the equipment by means of blocks which represent individual units or assemblies. Each block is identified by name, nomenclature, and number. Connecting lines and arrowheads show the direction of signal flow. Inputs and outputs are titled and waveforms may be included. Each of the major functions of the equipment is described on a separate FUNCTIONAL BLOCK DIAGRAM (figure 2-18), which depicts the development of each function from input to output in detail. The electrical connections and functions of a specific circuit arrangement are shown by the SIMPLIFIED SCHEMATIC DIAGRAM (figure 2-19).

Table 2-1.—List of effective pages showing changes

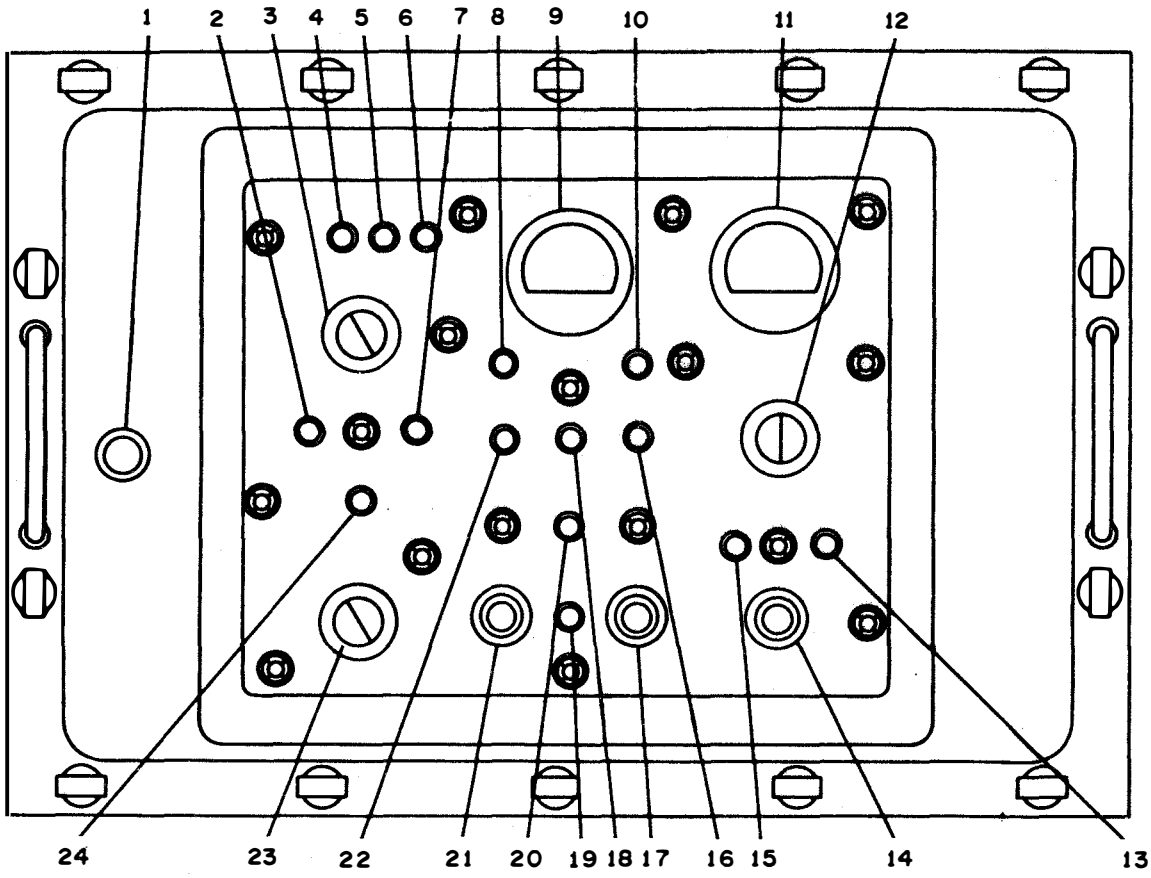
PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	2	3-6B	1
A	2	3-7 & 3-8	Orig
B & C	Orig	4-1 thru 4-4	Orig
i	2	4-4A	2
ii thru vii	Orig	5-1 thru 5-18	Orig
1-0 thru 1-5	Orig	5-18A	1
2-0 thru 2-17	Orig	6-0 thru 6-20	Orig
3-0 thru 3-6	Orig	7-1 thru 7-4	1
3-6A	2	i-1 thru i-3	2

74.258(162A)



32.172(162A)

Figure 2-14.—Equipment illustration showing relationship of all units.



1. PHONE BUZZ buzzer
2. POWER INTERLOCKS lamp
3. POWER switch
4. STDBY lamp
5. READY lamp
6. TEST lamp
7. CW ILLUMINATOR INTERLOCKS lamp
8. RF POWER DRIVE lamp
9. RF POWER meter
10. RF POWER RADIATED lamp
11. DEVIATION meter
12. DEVIATION switch
13. FM NOISE ALARM lamp
14. NME RESET button
15. AM NOISE ALARM lamp
16. ILLUMINATOR STATUS NO GO lamp
17. RADIATE OFF button
18. ILLUMINATOR STATUS MARGINAL lamp
19. RADIATE lamp
20. HT MODE lamp
21. RADIATE ON button
22. ILLUMINATOR STATUS FAULT lamp
23. DIRECTOR LOUVERS switch
24. DIRECTOR LOUVERS OPEN lamp

162.137

Figure 2-15.—Equipment controls and indicators.

The reference designation prefix 3A1A2, shown on figure 2-19, identifies the unit, assembly, and subassembly associated with the parts shown on the schematic. Reference designations are discussed in chapter 5 of this manual.

Other diagrams include PIPING DIAGRAMS, that show the interconnections of components by piping, tubing or hoses, and MECHNICAL DIAGRAMS, that show the operational sequence and arrangement of mechnical devices.

RADIO RECEIVER R-XXX/URR
NAVSHIPS

INSTALLATION STANDARDS SUMMARY

Input Voltage_____Vac
Input Frequency_____Hz
(When reference standard tests are made)

Date_____
Serial Number_____
of Model_____
Installed in (ship or station)
_____
Length of transmission line
_____

Record on this summary sheet the test indications which have been obtained during the installation verification test.

Paragraph No.	Ref. Std.	Paragraph No.	Ref. Std.
8-10	a._____ Check	8-46	a._____ μV
			b._____ μV
8-21	a._____ Vdc		c._____ Check
	b._____ Vdc		d._____ μV
	c._____ Vdc		e._____ μV
	d._____ Vdc		f._____ μV
		8-51	a._____ Sec
8-33	a._____ Check		b._____ Check
	b._____ Check		c._____ Check
	c._____ Check		d._____ Hz
	d._____ Check		e._____ Hz
			f._____ Check
			g._____ Check

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Figure 2-16.—Installation standards summary sheet.

Troubleshooting

This chapter contains all information and instructions necessary to locate troubles and conduct tests on each component, assembly, or subassembly of the equipment. Included are the following:

An INTRODUCTION explaining the approach and logic of the troubleshooting principles and data and their relationship to each other.

A TROUBLESHOOTING INDEX (table 2-2) which lists all equipment and functions with references to the appropriate procedures and diagrams that can be used to troubleshoot a specific function. (See page 46)

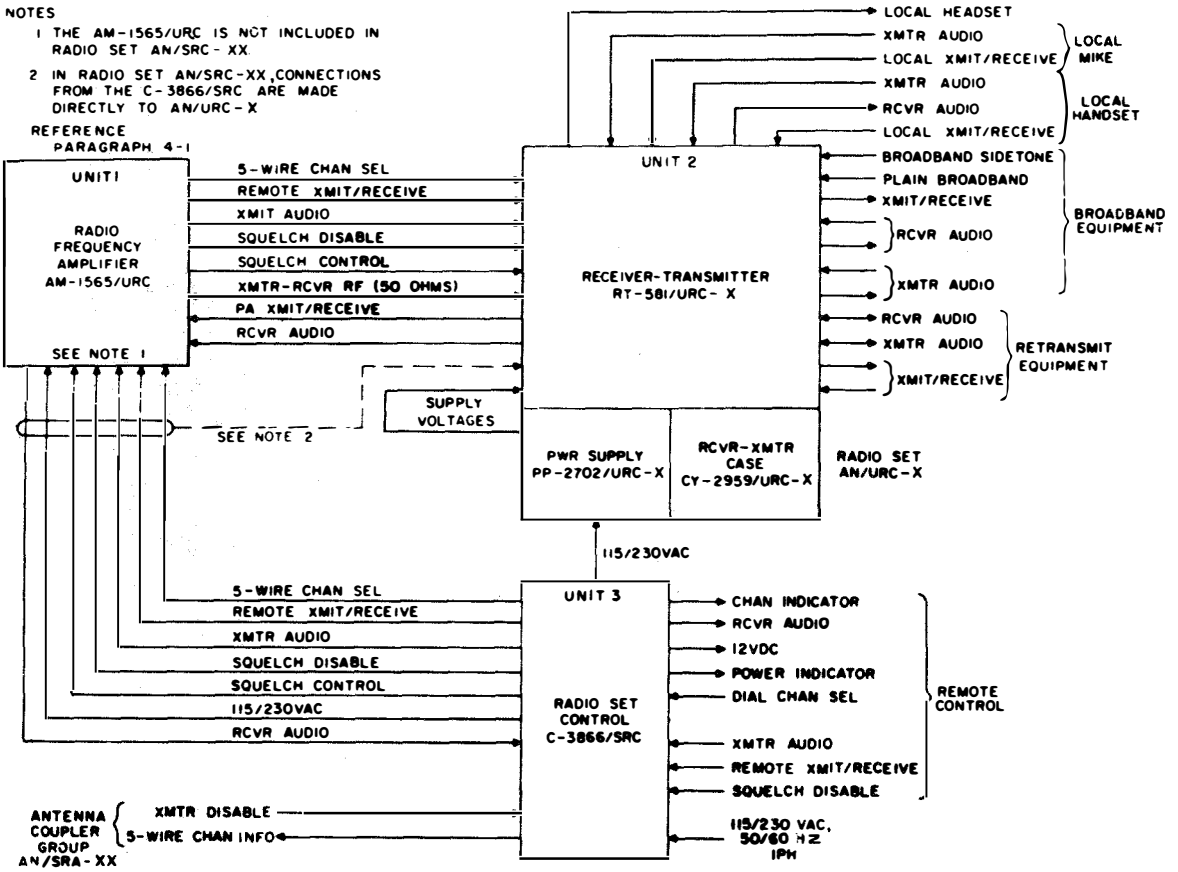
RELAY, LAMP, and PROTECTIVE DEVICE INDEXES (table 2-3) which list all relay coils, indicator lamps and protective devices with the item reference designation, function name, voltages, ratings, and a reference to the troubleshooting diagram. (See page 49)

The MAINTENANCE TURN-ON PROCEDURE (table 2-4) lists the step-by-by-step procedure to energize the equipment with the correct indication for each step and the troubleshooting or corrective action for out-of-tolerance observations. (See page 50)

SIGNAL FLOW DIAGRAMS (Figure 2-20 foldin end of Chapter) are detailed block diagrams which illustrate the functional development of each equipment output from its origin to its measurable output. These diagrams also include test points, test parameters, schematic diagram references, that data for test equipment setup, adjustments, controls, switches, and mechanical couplings.

CONTROL DIAGRAMS (figure 2-21) are used to indicate all control circuits and group them according to their common characteristics.

POWER DISTRIBUTION DIAGRAMS (figure 2-22 foldin end of chapter) depict the distribution of power from the equipment input to the various modules and subassemblies of the equipment. PIPING DIAGRAMS are included for fluid cooling, air, gas, and hydraulic systems as needed.



162.21

Figure 2-17.—Overall functional block diagram.

MAINTENANCE SCHEMATIC DIAGRAMS (figure 2-23 foldin end of chapter) completely cover the equipment. These include unit-to-unit interconnection diagrams, intra-unit interconnection diagrams, and unit, assembly, and subassembly schematic diagrams.

Scheduled Maintenance

This chapter contains preventative maintenance procedures and performance test instructions to be accomplished on a scheduled basis. NOTE: The scheduled maintenance instructions in this chapter are canceled when PMS is implemented for the appropriate equipment aboard your ship or station.

The sections in this chapter include:

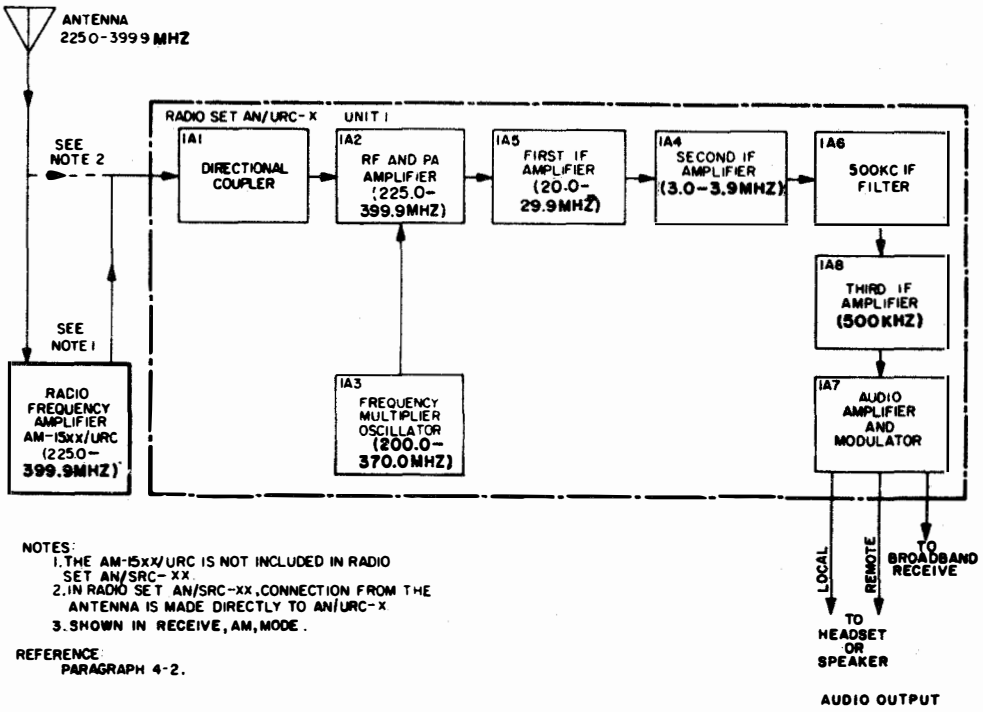
The INTRODUCTION, which explains the purpose, scope, and arrangement of the scheduled performance tests and preventive maintenance procedures. PREVENTIVE MAINTENANCE PROCEDURES include the information required to inspect, clean, and lubricate the equipment. The SCHEDULED PERFORMANCE TESTS which contain step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation.

Corrective Maintenance

This chapter contains the instructions required to remove, repair, adjust, and reinstall the circuit elements and mechanical items. Exploded and sectional views and parts placement diagrams are provided as necessary. Information on the use of special tools and test equipment are also included.

Alignment

This chapter provides information for the complete alignment of the system or equipment. It includes all inputs, point of input injection,



162.140

Figure 2-18.—Functional block diagram.

results expected, point of measurement and test equipment required.

Parts List

This chapter lists and identifies all repair parts including the attaching hardware.

The INTRODUCTION explains the scope and arrangement of the parts list, and includes the models and serial numbers of the equipments covered.

The LIST OF MAJOR UNITS lists the units comprising the equipment. The units are listed by unit numbers in numerical order.

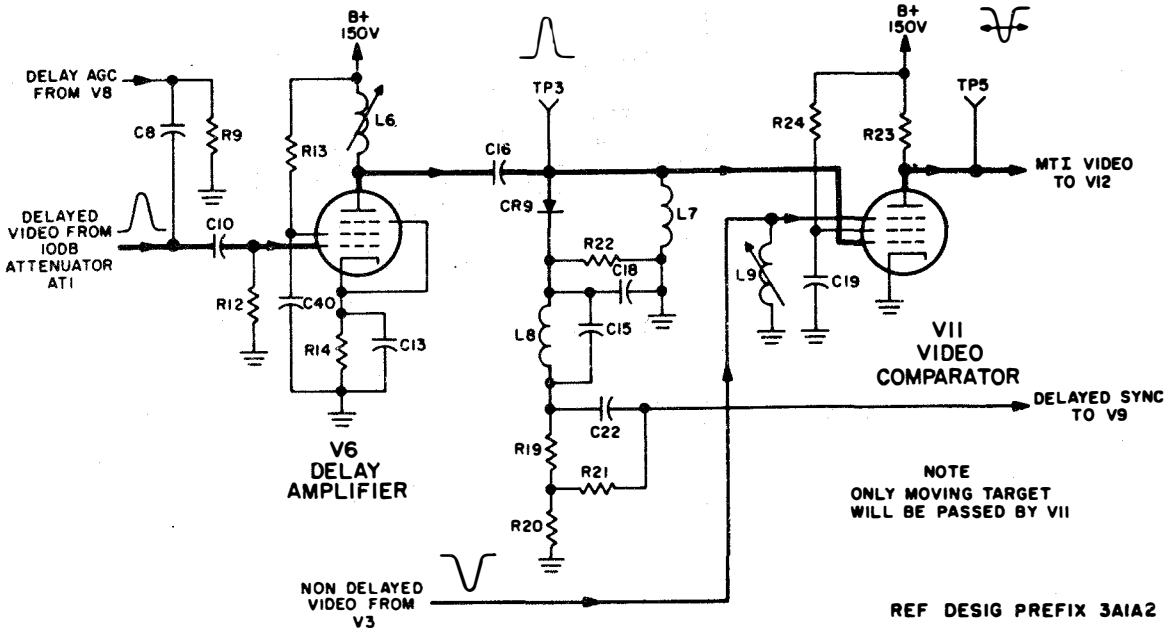
The PARTS LISTS is divided and arranged by major units in numerical sequence. Maintenance parts for each unit are listed alphabetically-numerically following the unit designation, for example:

Unit	1
(Cabinet parts)	1AT1
	1B1
	1C1
	1CR1
	1R1
	etc.
Assembly	1A1
(Assembly parts)	1A1AT1
	1A1B1
	1A1C1
	1A1CR1
	1A1R1
	etc.
Subassembly	1A1A1
(Subassembly parts)	1A1A1AT1
	1A1A1B1
	1A1A1C1
	1A1A1CR1
	1A1A1R1
	etc.
Unit	2
	etc.

The LIST OF MANUFACTURERS contains the names, addresses, and code symbols of all manufacturers supplying items for the equipment.

Security Classification

The security classification of the technical manual is printed at the top and bottom of the front and back covers and the title page. If the



162.141

Figure 2-19.—MTI comparator, simplified schematic diagram.

manual is classified (confidential, secret, etc.) the classification is also printed at the top and bottom of every page in the manual. The classification may also be determined from the color of the front and back covers. The covers for manuals prepared according to Military Specification MIL-M-15071G (NAVY) of 1 August 1969 are: blue-unclassified, green-confidential, yellow-secret, and pink-top secret.

The regulations for the custody, control, and accounting of classified material were presented in chapter 1 of this volume.

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Table 2-2.—Troubleshooting index.

FUNCTIONAL AREA	TROUBLE SHOOTING PARAGRAPH	TROUBLE SHOOTING DIAGRAM	FUNCTIONAL DESCRIPTION PARAGRAPH	ALIGNMENT/ ADJUST PARAGRAPH
AC Power	5-3	5-8	3-9a	6-105, 6-106
DC Power	5-4	5-19	3-9b	6-107 through 6-110, 6-127
Keying	5-5	5-24	3-13	6-22
Receive RF	5-8	5-1	3-4	6-112 through 6-115
System Channel and Frequency Selection	5-9	5-16	3-10, 3-12	6-121

WARNING

DANGEROUS VOLTAGES ARE PRESENT EVEN THOUGH CONDITIONS OF NOTES A AND B ARE MET.

GENERAL NOTES

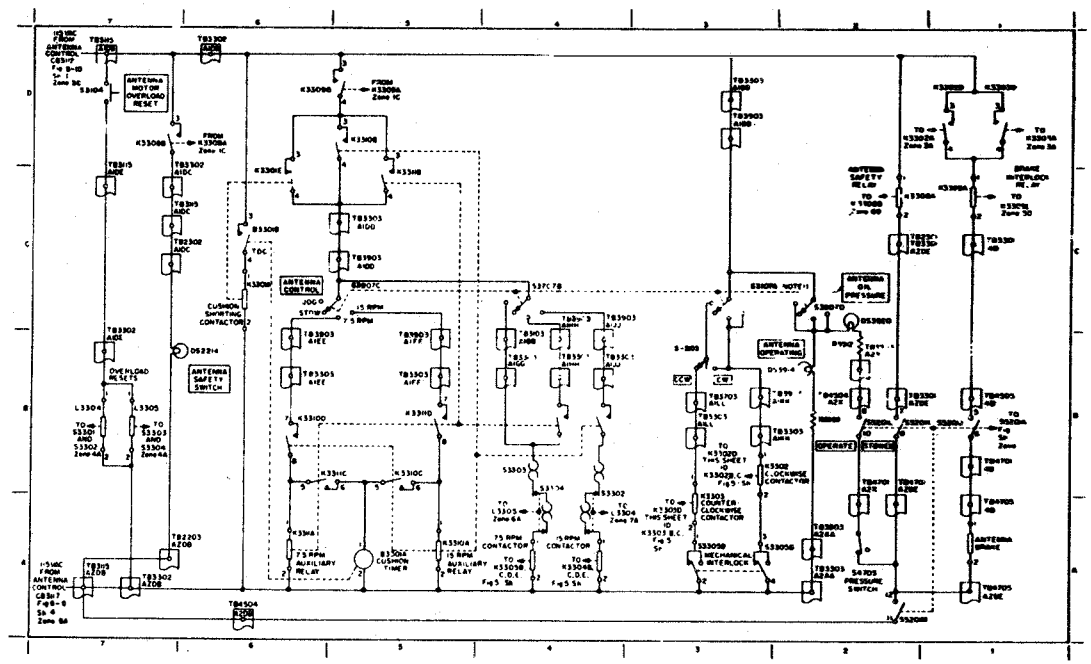
A. SWITCHES AND RELAY CONTACTS SHOWN IN STOW MODE OF OPERATION.

B. SWITCHES S3907 AND S5201 ARE SHOWN IN A STOW CONDITION.

C. S3907 IS LOCATED AGAINST THE FRONT PANEL.

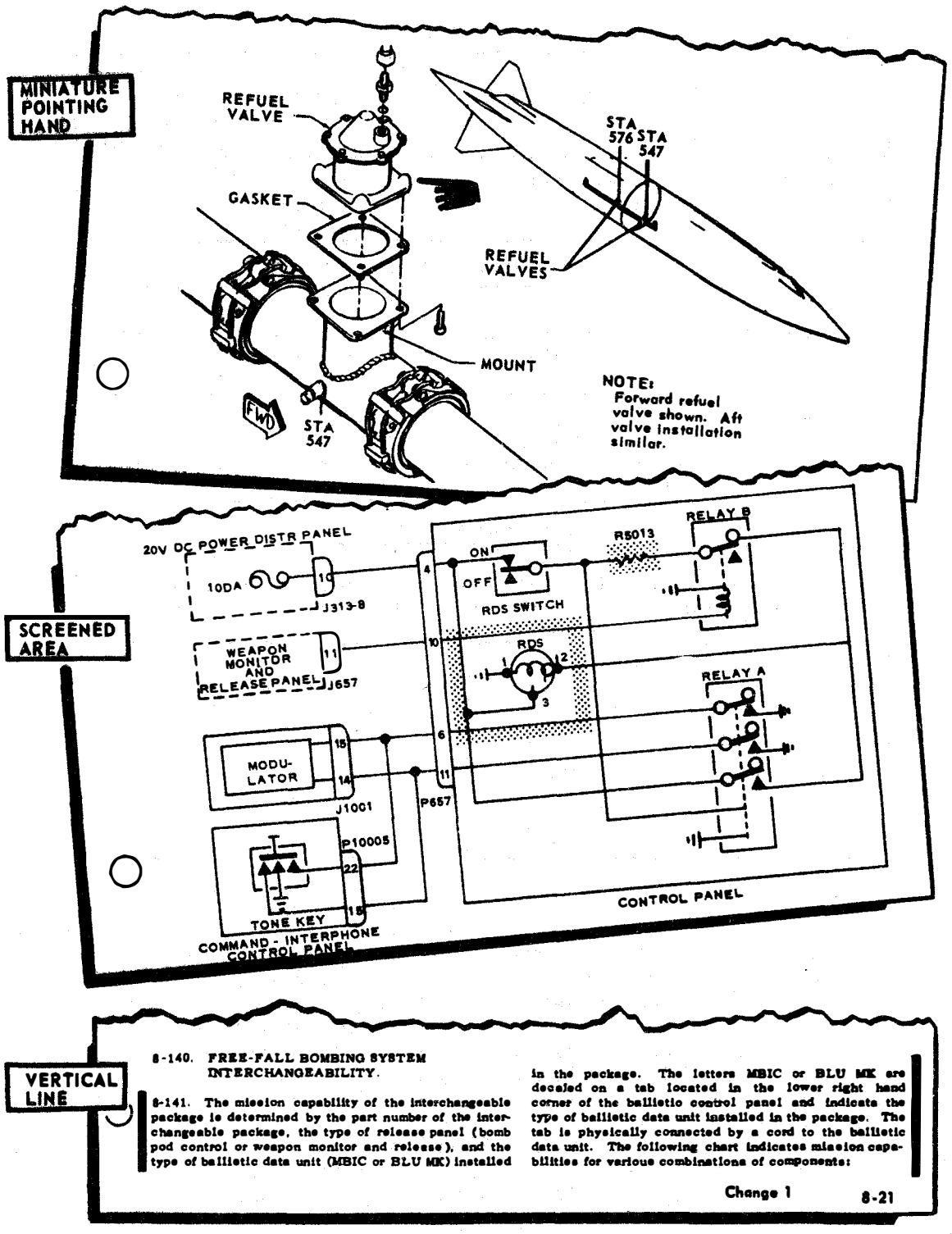
PART LOCATION INDEX

Ref Des	Zone	Ref Des	Zone	Ref Des	Zone
B3301A	5A	K3311D	5B	TB2302-A1DC	6C
B3301B	6C	K3311E	4B	TB2303-A2DB	6A
DS2214	9B	L3304	7A	TB3115-A1DB	7D
DS3914	2B	L3305	6A	TB3115-A1DC	6C
DS3920	2B	L4701	1A	TB3115-A1DE	7C
K3301A	6C	R3806	2A	TB3115-A2DB	7A
K3301E	5D	R3812	2B	TB3301-A2DE	1C
K3302	3A	S3104	7D	TB3601-4B	1C
K3302D	1D	S3301	4A	TB3302-A1DB	6D
K3303	3A	S3302	6A	TB3302-A1DC	6C
K3303D	1D	S3303	4A	TB3302-A1DE	7B
K3304A	4A	S3304	4A	TB3302-A2DB	6A
K3305A	4A	S3305A	3A	TB3303-A1BB	3D
K3305B	1C	S3305B	3B	TB3303-A1DD	5C
K3306B	6D	S3907A	3C	TB3303-A1EE	5B
K3309A	1C	S3907B	6C	TB3303-A1FF	5B
K3309B	5D	S3907C	5C	TB3303-A1GG	4B
K3310A	5A	S3907D	2C	TB3303-A1HH	4B
K3310B	5D	S3908	3B	TB3303-A1JJ	4B
K3310C	5B	S4703	2A	TB3303-A1KK	3B
K3310D	5B	S5201J	1B	TB3303-A1LL	3B
K3310E	4B	S5201K	1B	TB3303-A2AA	2A
K3311A	5A	S5201L	2B	TB3903-A1BB	3D
K3311B	5D	S5201M	1A	TB3903-A1DD	5C
K3311C	5B	TB2301-A2DE	1C	TB3903-A1EE	5B



162.146

Figure 2-21.—Control diagram.



162.149

Figure 2-24.—Sample of change symbols.

Table 2-3.—Relay, lamp, and protective device indexes

RELAY INDEX

REFERENCE DESIGNATION	FUNCTIONAL NAME	ENERGIZING VOLTAGE	TROUBLE-SHOOTING DIAGRAM (FIG. NO.)
6A4K9	HV Door Interlock	115 Vac	5-21
6A4K10	Cabinet Interlock	28 Vdc	5-22
6A4K11	Buzzer Relay	28 Vdc	5-22

INDICATOR LAMP INDEX

REFERENCE DESIGNATION	FUNCTIONAL NAME	ENERGIZING VOLTAGE	TROUBLE-SHOOTING DIAGRAM (FIG. NO.)
9A8DS15	HV INTERLOCK CONFIDENCE-VSWR TRIP-OUT	28 Vdc	5-22
9A8DS16	HV INTERLOCK CONFIDENCE-HVPS	28 Vdc	5-22

CIRCUIT BREAKER AND FUSE INDEX

REFERENCE DESIGNATION	FRONT PANEL MARKING	RATING		CIRCUIT PROTECTED	TROUBLE-SHOOTING DIAGRAM (FIG. NO.)
		VOLTS	AMPS		
9A8F1	KLYSTRON FILAMENT FUSE ALARM 5 AMP	250	5	Klystron filament control circuit and filament transformer 9A1T106.	5-32
14A2F1	CONTROL	125	3	Voltage sensor bridge power supply consisting diodes 13A2CR1 through CR4.	5-2

CHANGES

Changes in equipment design, alignment procedures, and maintenance procedures will require that the technical manual be changed to keep pace.

There are two types of changes: temporary changes which are often listed in the EIB and major changes which are issued by the command in charge of the equipment or by the manufacturer. These changes consist of various types: pen and ink, where the technician writes in the change, paste in, where a new item is placed over the old item; and complete pages, where the old page is removed from the book and the new pages are inserted.

New pages will frequently have the changed section marked by a symbol. Refer to figure 2-24 for an example of these symbols.

The miniature pointing hand denotes the changed part on a pictorial diagram. The screened area encloses a changed circuit or part on a schematic diagram. Vertical lines enclose changes in the text.

All corrections and changes must be made in the manuals. If corrections are not made, much time may be lost in attempting to repair an equipment by use of an obsolete schematic diagram. Upon completion of the change, the Change Record in the Front Matter must be filled in to indicate that the manual has been updated. The CHANGE INSTRUCTION (figure

Table 2-4.—Maintenance turn-on procedure

STEP	OBSERVE	REFERENCE
1. Preliminary Procedure.		
a. Position the following switches on rear deck assembly 1A210A1 as indicated. Switch — Position POWER — OFF BATTLE SHORT — OFF STOW — BRAKES APPLY		
b. Position POWER switch on console, 1A220A20 (see figure 5-2) to OFF.		
c. Check to ensure that all chassis or subassemblies in the four compartments of electronic rack assembly, 1A70 are in the retracted position and all covers are secured.	Covers Secured	
d. Remove all obstructions from the rotational paths of the director main antenna assembly.	Director Clear	
2. Power Off.		
a. At power control panel perform the following.		
(1) Check convenience lamp indicators.	Lighted	Schematic, figure 5-233
e. At track meter panel, 1A340-02, check COOLANT FAILURES lamp.	Extinguished (Depress RESET button if lamp is lighted)	Relay diagram, figure 5-77, SH 4(4B)

2-25) explains the purpose of the change, the coverage of the change, specific instructions for the insertion of the change and the effective date of the change. After the changes have been made to the manual, the change instruction is inserted in the manual immediately behind the front cover, before all previous changes.

SIMM MANUALS

Although the SIMM manual (fig. 2-13) is prepared to fulfill the same purpose as conventional manuals, it is constructed differently and uses different methods of organizing and presenting the information. The SIMM manual is organized on a functional basis in three major groupings: the hardware group, the major functions group, and the overall equipment function group. The hardware group (the lowest group) includes all major hardware assemblies. Each of these hardware assemblies is further subdivided into subassemblies. Separate diagrams, text, part location and identification information with related maintenance and troubleshooting data are included for each assembly and subassembly.

UNCLASSIFIED

Interim Change T-1 NAVSHIPS 0967-173-6011

INSTRUCTION SHEET

Interim Change T-1 to Technical Manual for Teletypewriter Set AN/UGC-16 NAVSHIPS 0967-173-6011 (formerly NAVSHIPS 94104)

General Instructions:

This interim change revises the manual to reflect the equipment changes made by Field Change 5-AN/UGC-16. When this change is included in the manual, the manual shall cover the equipment as though Field Change 5, NAVSHIPS 0967-173-6050, has been accomplished on the equipment. This change does not supersede any other changes or corrections.

Maintenance support activities shall make this change in the technical manual immediately but shall keep the superseded data intact for support of equipments that have not been modified.

Holders of equipment accompanied by technical manuals shall not make this change in the manual until accomplishment of the field change referenced above.

Insert this interim change in the manual immediately after the front cover preceding the title page, prior changes, or interim corrections in effect.

Specific Instructions:

1. Remove the following pages and insert the corrected T-1 pages:

REMOVE	INSERT
8-16	8-16 T-1
8-18	8-18 T-1

2. Add the following page:

Insert 6-2A between pages 6-2 and 6-3.

DATED: 1 July 1969

UNCLASSIFIED

162.150

Figure 2-25.—Sample of instruction sheet of temporary and permanent changes.

The major functions group arranges the assemblies and subassemblies according to major functions such as transmitting, receiving, displaying data, etc.

The highest group ties the major functions together to represent the overall equipment function.

For example, in the case of radio set AN/SRC-20, 21, the hardware group would consist of the RF Amplifier (AM-1565/URC), radio set (AN/URC-9), and the Radio Set Control (C-3866/SRC). The major functions group would include the transmitting function, the channel and frequency select function, and the power distribution function. The overall equipment function is a UHF transceiver capable of sending and receiving amplitude modulated voice and CW signals.

The SIMM manual presents the necessary data for the installation, operation, and maintenance of electronics equipment by the use of various diagrams and charts. These are the blocked schematic, blocked text, precise access block diagram, overall functional block diagram, maintenance dependency chart, and parts data chart.

The Blocked Schematic Diagram

The BLOCKED SCHEMATIC DIAGRAM (fig. 2-26) identifies each circuit element (switch, resistor, capacitor) or functional entity (amplifier, oscillator) according to its functional level. This diagram distinguishes between the functions and hardware by using shaded areas of blue and gray. Blue shaded areas indicate functional groupings of components or circuits. Darker shades of blue indicate circuits within the functional circuits. Each area of blue includes all circuit elements that are involved in accomplishing the circuit function. These areas are called functional entities. Gray shaded areas indicate physical packaging of equipment. Darker shades of gray indicate subpackaging within the lighter shades of gray. These shades of blue and gray are not shown in the illustrations used in this manual.

Note in figure 2-26 that the parts that work together to perform a basic function (such as amplifying, generating, gating, etc.) are blocked together. These blocks are shaded and coded with a mnemonic code which ties them to the identical blocks on other diagrams. This allows the technician to readily determine precisely what parts work together to perform a particular function. This is a marked improvement over the schematics in conventionally prepared manuals in which the parts that work together are, in many cases, not readily apparent. The technician, in this case, has to rely on his training, experience, and knowledge of the equipment to find the parts that work together.

The Blocked Text Diagram

The BLOCKED TEXT diagram (fig. 2-27) is blocked off and shaded identically to the respective blocked schematic diagram. In lieu of parts in the blocks, however, the blocked text describes what action takes place within the particular block.

Precise Access Block Diagram

The PRECISE ACCESS BLOCK diagram (PABD, fig. 2-28) shows all the circuits and hardware assemblies that make up a major function. It identifies the assemblies and depicts the nature and direction of signal flow through the assemblies. Shading is done in the same manner as on the blocked schematic. The PABD also serves as an interconnection diagram, as the signal paths are shown as they pass in and out of each assembly, drawer, and cabinet.

In order to present the various functional entities that make up a major function on a single page, the PABD uses three basic symbols: the triangle, trapezoid, and square.

The triangle represents a circuit that changes the voltage or power level of an incoming signal such as voltage or power amplifiers, cathode followers, etc. These circuits always contain active elements.

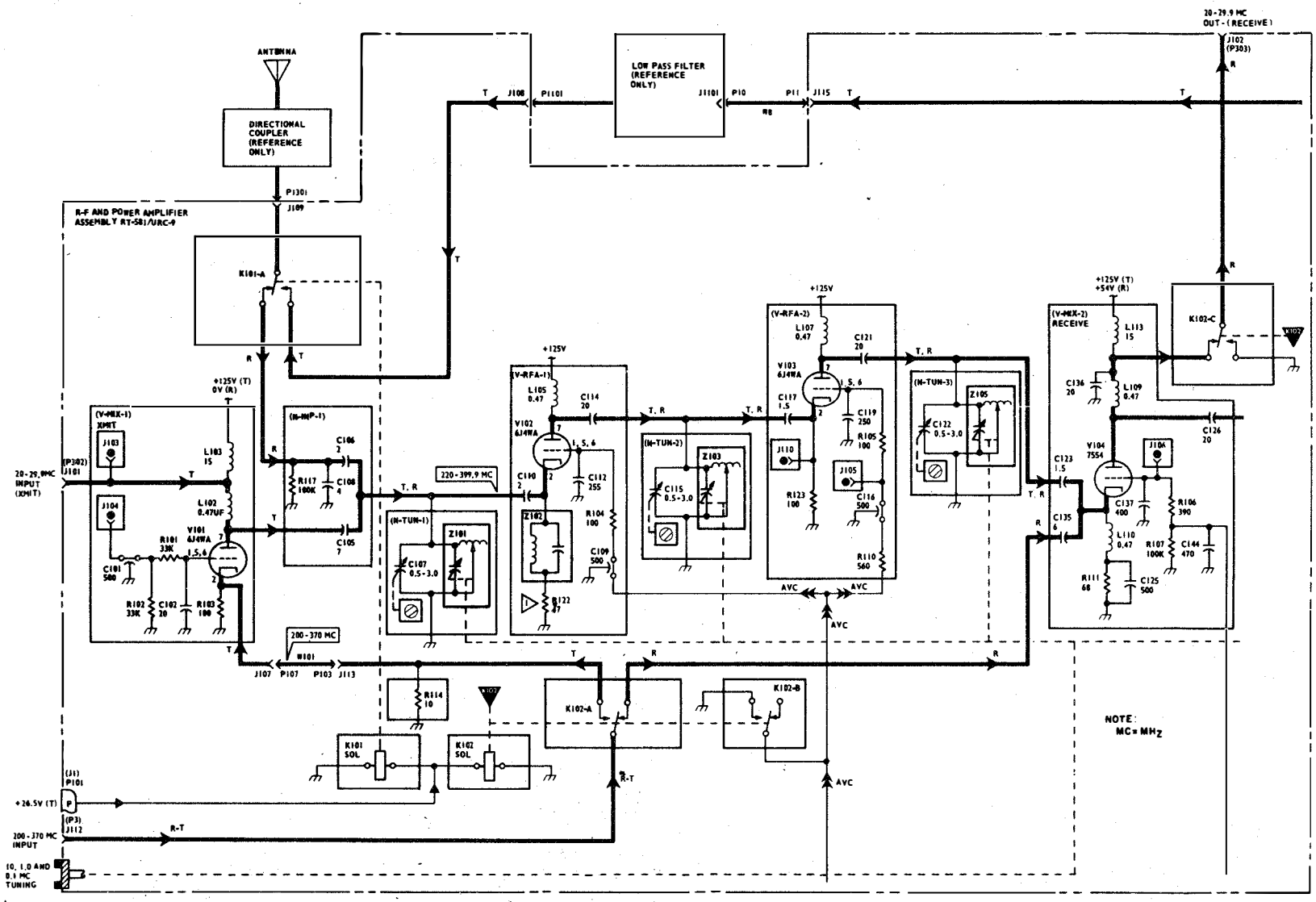
The trapezoid depicts a circuit which generates a signal or processes an incoming signal in some manner other than a changing voltage or power level. Examples are oscillators, multivibrators, and mixers. These circuits always contain one or more elements which may be active (electron tube or transistor) or passive (semiconductor diode).

The rectangle represents a circuit that is made up of purely passive elements, such as resistors, capacitors, and inductors.

Like the blocked schematic, the PABD is augmented by an identically blocked and shaded facing page of blocked text (fig. 2-29).

Overall Block Diagram

The OVERALL BLOCK diagram (fig. 2-30) shows and describes the relationships between



162.151

Figure 2-26.—Blocked schematic.

the major functions, thus presenting the overall equipment function. The SIMM overall block diagram differs from those in the conventional manuals in that the SIMM diagram shows cable connections, intraconnections, and graphic representations of certain controls and electronic parts. The function relating to each block is included in the block and shaded gray. Again, the relationship of the gray functional blocks to the hardware is shown by the blue of the hardware area.

Maintenance Dependency Chart

The SIMM manual uses a new approach to the task of troubleshooting. By analogy, if a lamp is to light (Event), its switch must work, and it must be connected to a 115V a.c. receptacle. In the simplest form of SIMM language, this analogy and its equivalent equipment statement, "if a specified source of energy is available, and a particular functional part is working, an event will occur," can be shown by the SIMM expression of a rectangle, dependency triangle, dot and rectangle connected in series as shown in figure 2-31. (See page 59)

The dependency triangle, the dot, and the rectangle are the basic symbols used in the SIMM approach to troubleshooting. They represent dependency upon the functional part or circuit, and event, respectively. Every piece of equipment in its normal operation has many events. Many of these events are determined by the particular mode of operation or switch position the equipment operator selects. Each event depends upon a source of energy or the normal occurrence of another event in addition to the normal operation of a part, a circuit, or a series of parts or circuits. Often, one part or circuit might be involved in the occurrence of more than one event. In practice, the technician is taught to troubleshoot by looking for the fault between the last good event and the first bad event. The entire relationship between an equipment's operation, its event, its functioning parts and circuits, and the dependencies which make the events occur are presented on a Maintenance Dependency Chart.

The MAINTENANCE DEPENDENCY CHART (fig. 2-32) is a symbolic representation of signal flow through the equipment. The chart presents events, as they occur, in a scheme that points out the interdependent relationship between the functional entities in the equipment, with the dependency relationship clearly outlined. The format used combines turn-on and checkout procedures with fault isolation. Through the use of the chart, fault isolation may be obtained at any level down to the circuit stage. The chart then provides direct access to a schematic for a detailed diagnosis or to a component replacement procedure. The chart is composed of four parts: the procedure column (on the left), the heading (across the top), the body, and the notes and specifications (on the right).

The procedures column specifies the operator actions required to turn on and check out the equipment. The turn-on procedure must be performed in the order given, top to bottom, since each step is dependent upon the proper execution of the preceding step. The checkout steps, indicated by the lettered steps within the numbered step (as shown by letter A in step 1 of figure 2-32) provide a means of checking portions of the equipment that are not checked out under normal operating conditions.

Checkout steps need not be performed, and it is not necessary to perform them in any sequence. However, if they are performed, they must be performed with the equipment set up for the proper turn-on steps, i.e., if checkout step A is performed, it is necessary to complete turn-on steps 1 through 3. Checkout steps may also provide a means of exercising certain self-test features of the equipment.

The heading (figure 2-32) uses alphanumeric or symbol designators to identify the action indicators, available test points, circuit elements, functional entities, and functional devices, i.e., P1307-A/B, K10-A, T1. The physical location of the indicators or entities is identified at the top of the column heading, including a reference to the schematics. Indicators that are recognizable from outside the equipment (front panel indicators, front panel test points) are shown in solid black background with white lettering. The signal specification numbers, located in the box at the base of the column heading are keyed to the notes and specifications located to the right of the chart. The signal specification number references the specification or description of an event that should be present at the check point.

The body of the chart contains symbols that are divided into three general categories: Events, Dependencies, and Function Symbols.

An event is either an action that can be detected by sight or sound (a motor running, lamp

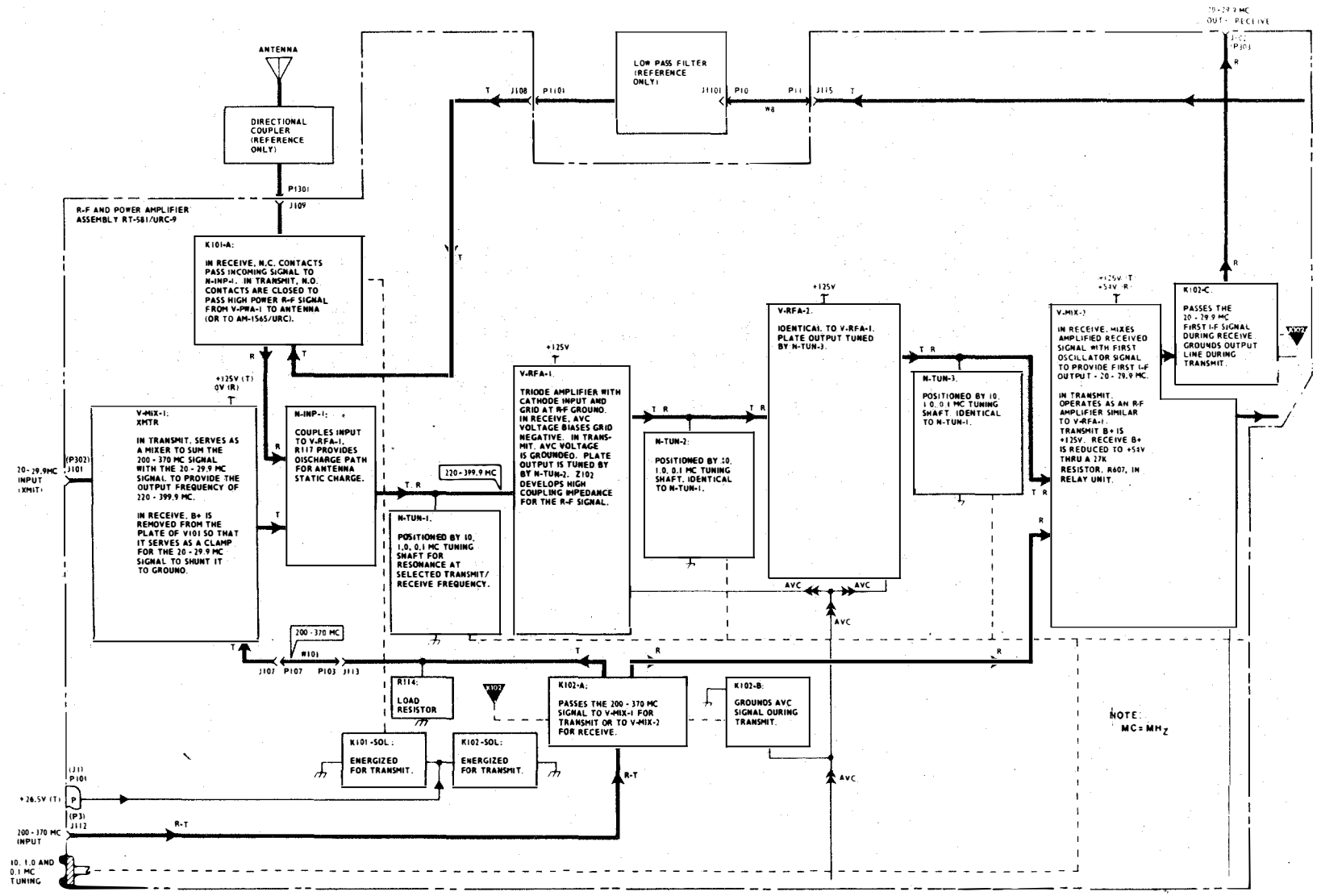


Figure 2-27.—Blocked text.

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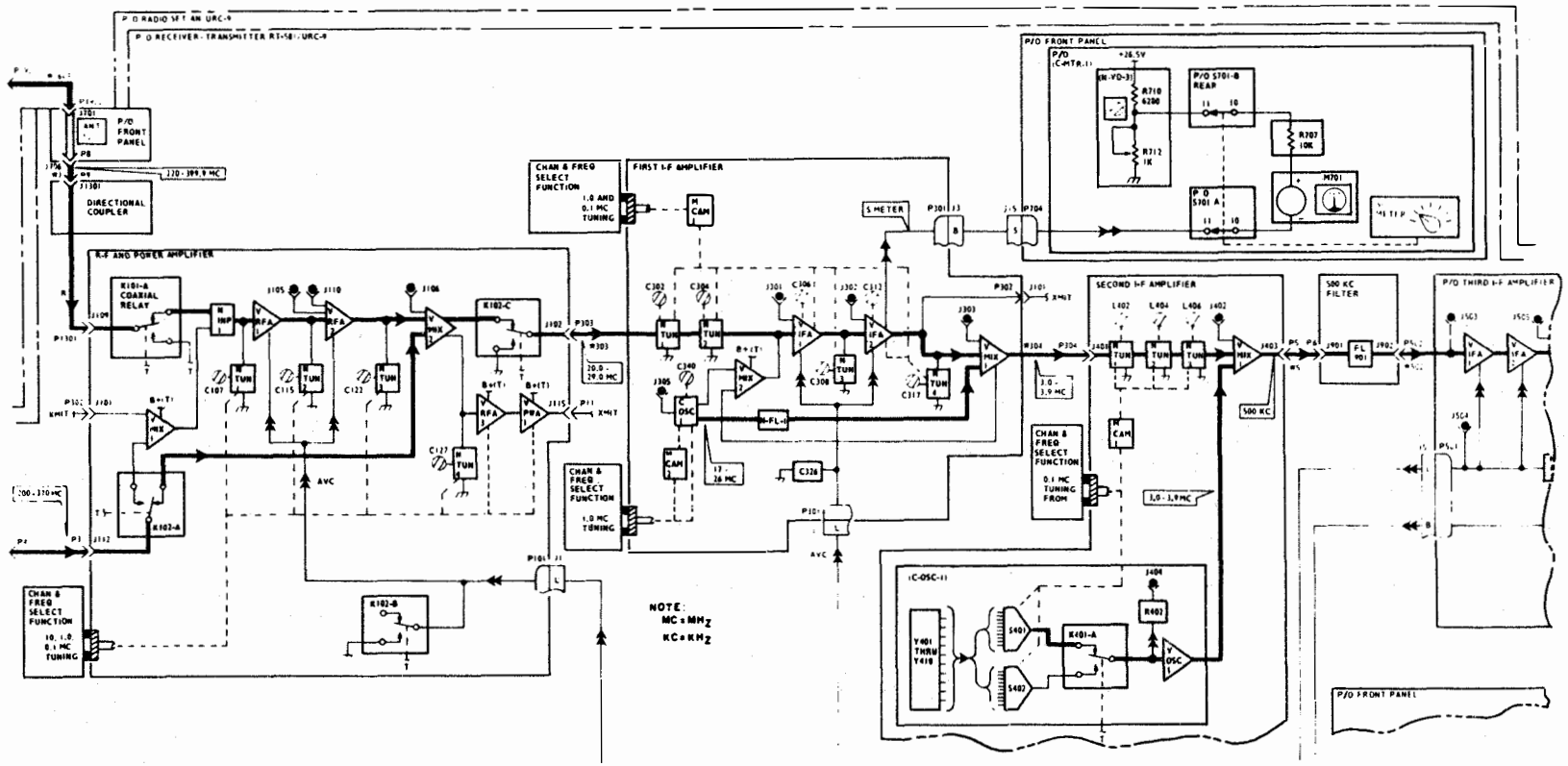

Figure 2-28.—Precise access block diagram (PABD).

162.153

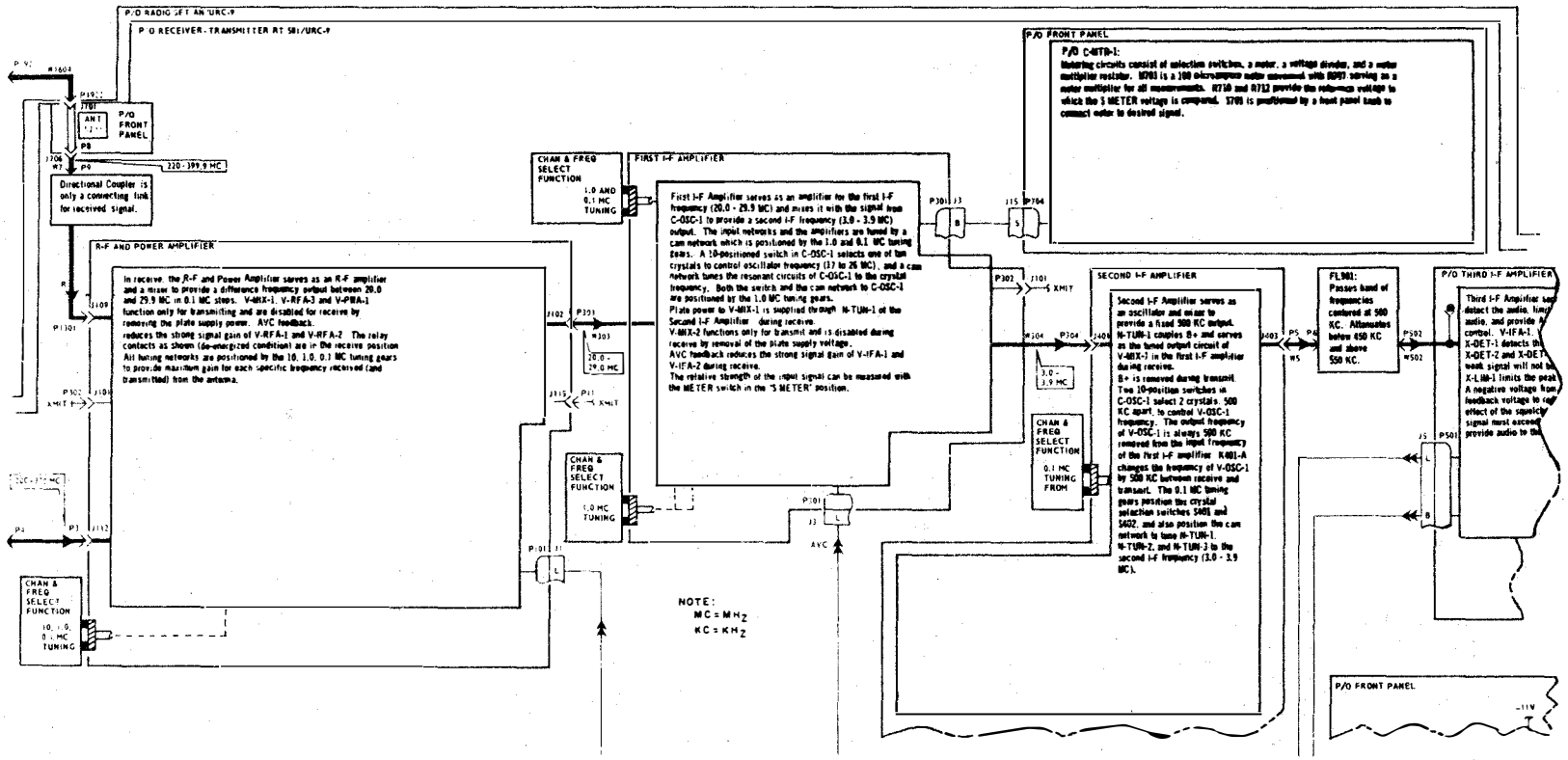

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Figure 2-29.—Precise access block diagram text.

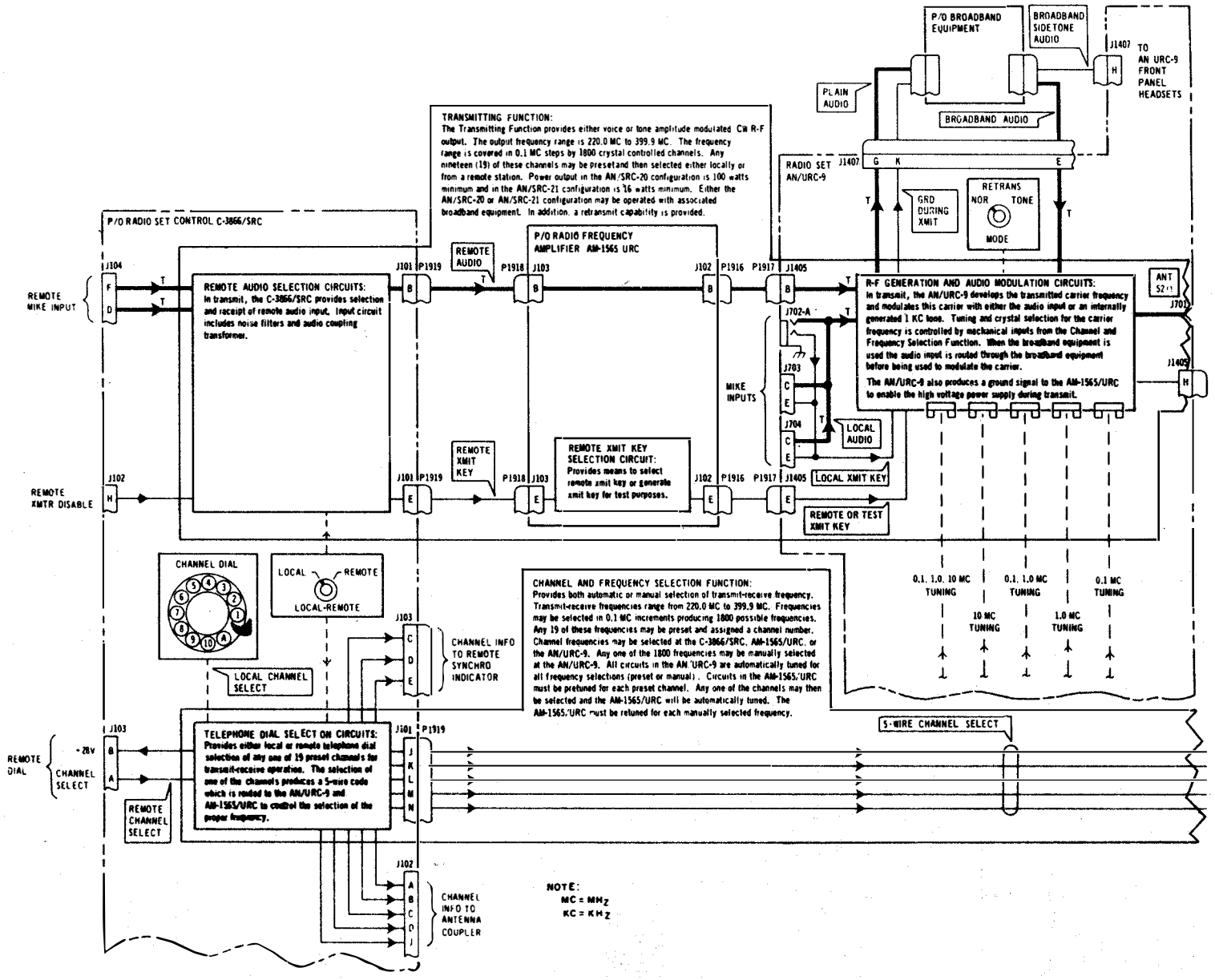

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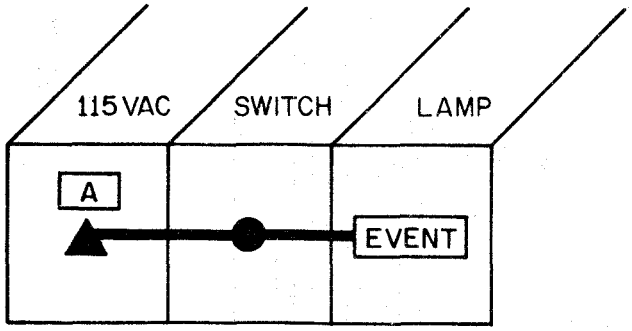
Figure 2-30.—Overall block diagram.



162.156

Figure 2-31.—Simplified maintenance dependency chart.

lighting, meter indicating) or is an availability of a signal that can be determined by a measurement. As shown in figure 2-31, the Action Event Symbol is a rectangular area which encloses an indication of the action. There are three types of Action Event symbols used to represent the degree to which the event is accessible: (1) External, (2) Internal, and (3) Indirect.

LIT	A front panel indicator or an event recognizable from outside the cabinet. (black background)
LIT	Internal test points that are readily accessible. (gray background)
EN	A circuit point at which a measurement might at some time be made. This point is not necessarily readily accessible. (white background)

Abbreviations used to indicate Action Events are listed below:

EN — Energized (Relay and Contactors)
LIT — Lighted (Lights, Filaments, VR Tubes)
RUN— Run (A motor operating.)
TD — Time Delay (Time-delay sequence is initiated.)
IND — Indication (A meter is energized and is displaying a voltage or current.)
OUT— Lamp is not Lit.
NA — Not Available (Specified voltage, current, or signal is not available.)
DE — De-energized (Relay is de-energized.)

The Availability Event symbol is a rectangular area with the letter A inside as shown below. The "A" denotes Availability and indicates that a voltage, signal or other data is present at a specified value. The Availability symbol represents a special type of event that requires an externally applied multimeter, or oscilloscope or other test equipment to determine if the proper voltage or signal is available.

A

Availability Event Symbol

This symbol is used to show the technician where in the circuit he can expect a voltage, current, or waveform to exist to prove that an event has happened elsewhere or that events should be happening which are dependent upon a signal at the particular point of availability. The background shading of this symbol also indicates the accessibility of the point in the equipment.

The Dependency Symbol is a black triangle as shown below.

Dependency Symbol

The black triangle means that the Event on the same horizontal line is dependent upon occurrence of the Action or Signal Availability Event directly above the triangle in the same vertical column.

The Dependency Symbol is used to show dependency on the Maintenance Dependency Chart. It is not an EVENT symbol but shows the dependency relationships between series or parallel circuit branches. The Dependency Symbol is the only symbol that shows connection or relationship in the vertical direction. Figure 2-33 shows the action event, availability event, and dependency symbols on a maintenance dependency chart.

Function Symbols represent a circuit or a circuit element and are identified at the top of the vertical column. These Symbols are used to show relationship and connecting links between other symbols along a horizontal circuit path. The Symbols take several forms to describe different conditions but the circuit elements they represent must be operating properly or be "good" before any action on the line can occur. Such Symbols represent fuses, relay contacts, power supplies, switches and circuit breakers, oscillator stages, amplifier stages, etc. The

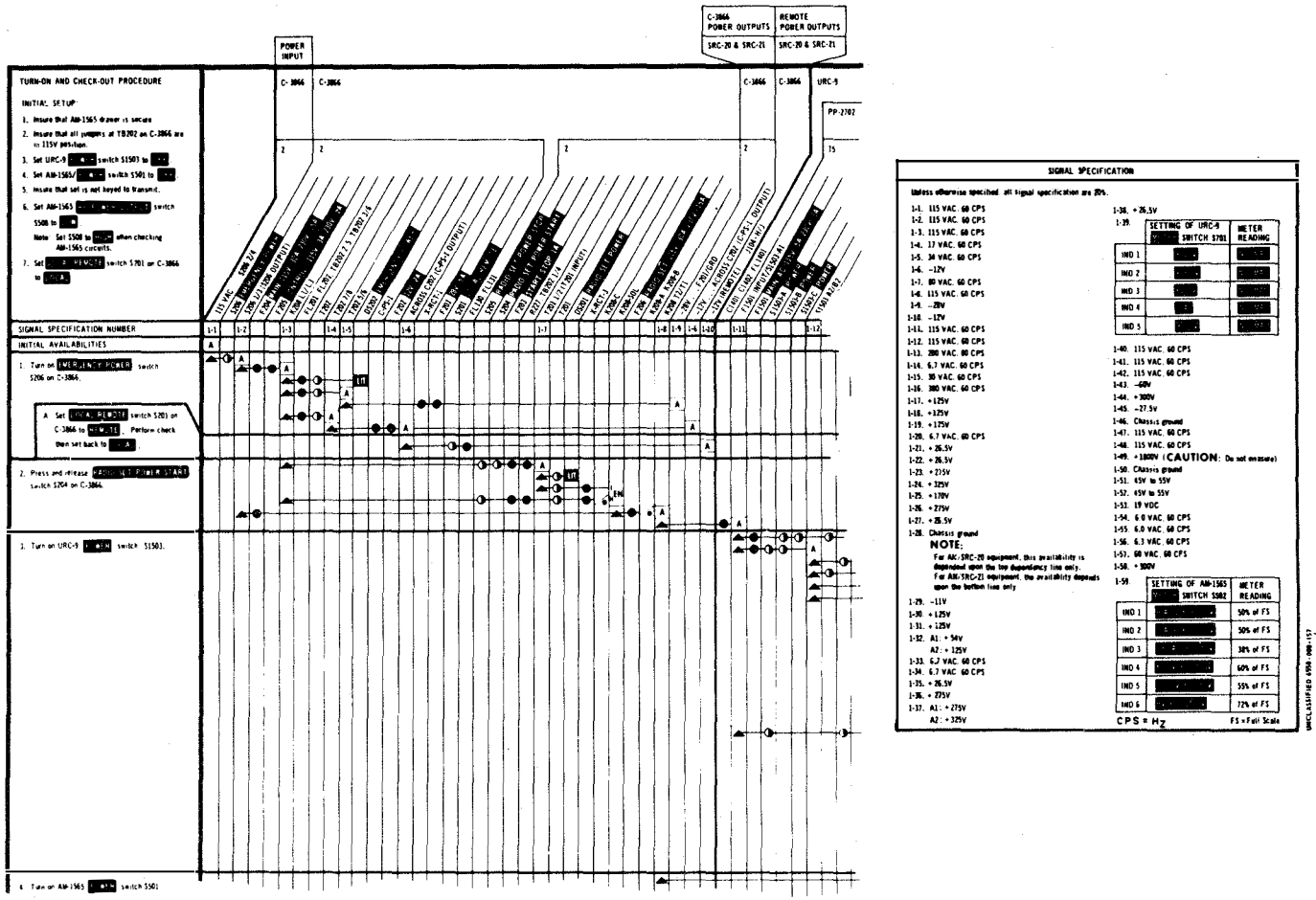
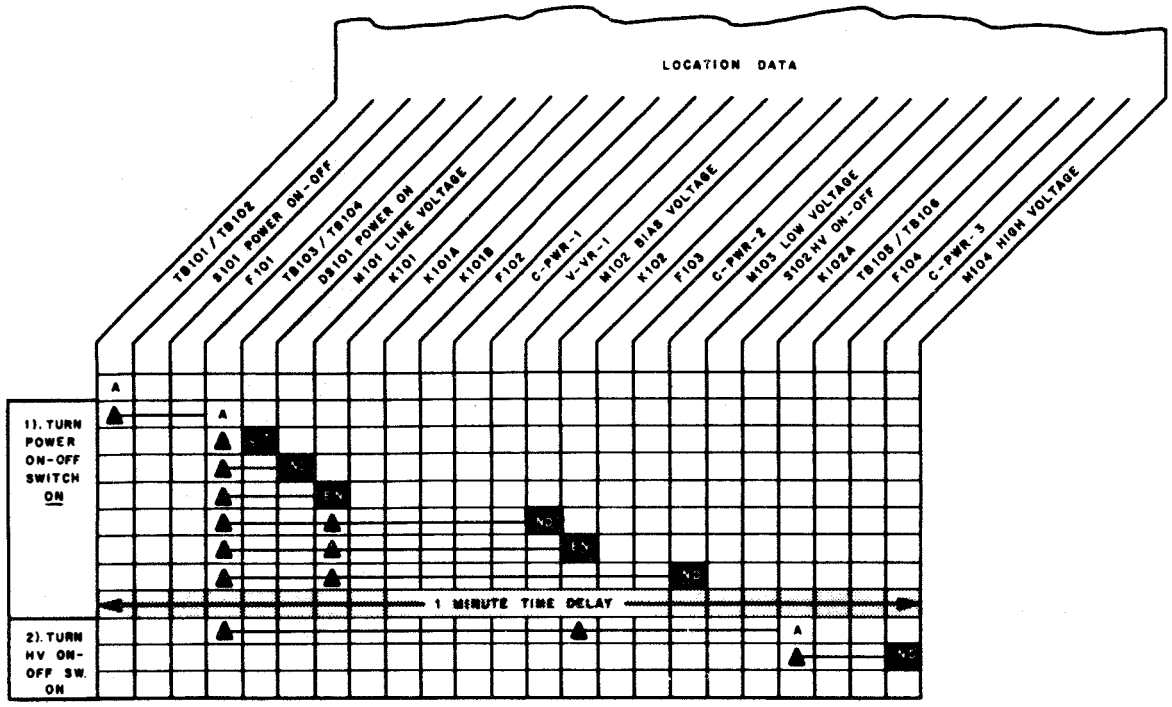


Figure 2-32.—Maintenance dependency chart (MDC).



162.158

Figure 2-33.—Action event, availability event, and dependency symbols on the MDC.

function Symbols used in Maintenance Dependency Charts are shown below:

- ● The functional entity or circuit element shown in the column heading above the symbol must be "good" for an Action or an Availability Event shown on the same horizontal line to occur.
- /● The relay contacts provide continuity only when the relay coil is energized.
- ●/ The relay contacts provide continuity only when the relay coil is not energized.
- ◑ One aspect of the circuit or circuit element is proven good by the occurrence of an Action or Availability Event in the same line (This symbol does not prove a functional entity or a circuit element wholly good.)

Figure 2-34 shows the use of some Function symbols on the maintenance dependency chart.

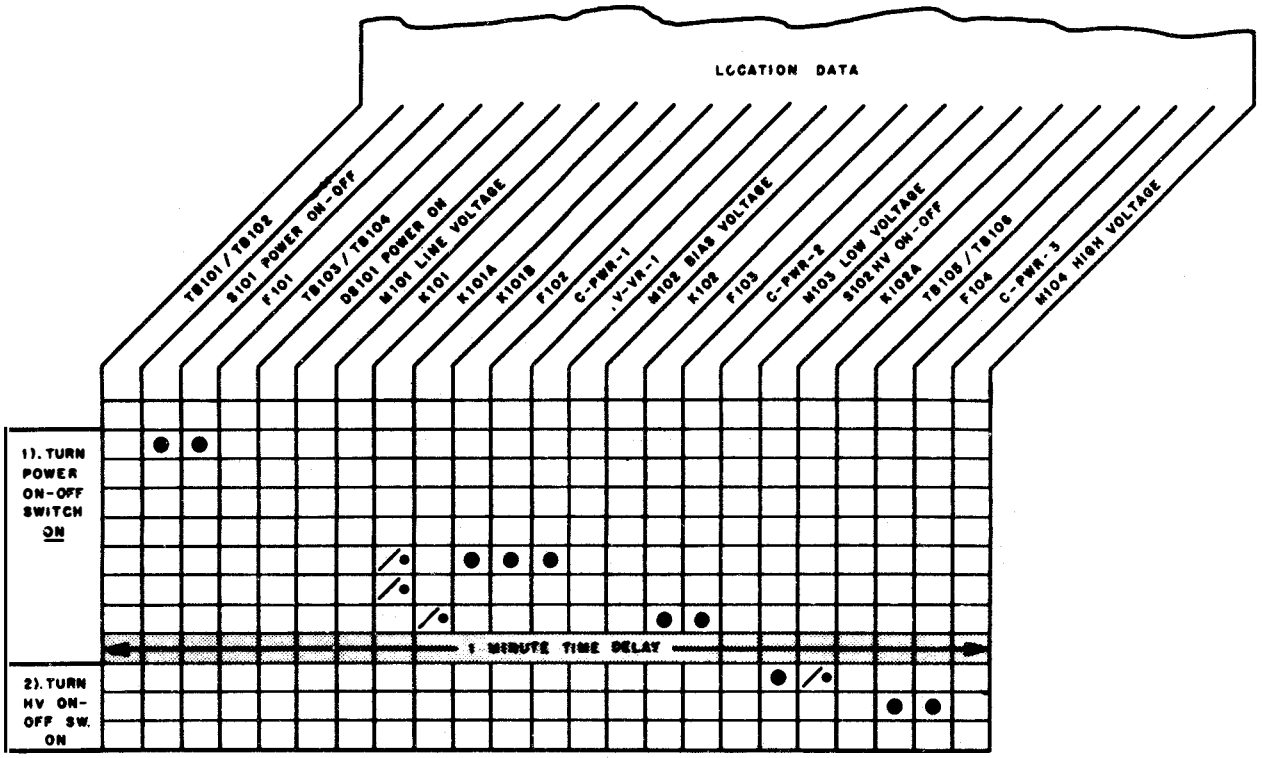
To use the Maintenance Dependency Chart for troubleshooting, assume that in figure 2-35 black dots (●) represent the basic circuits (oscillator stages, amplifier stages, etc.) or circuit elements (relay contacts, relay coils, switches, etc.) employed to provide an action [LIT] at the end of the event line. The black triangle (▲) is a dependency marker.

The action [LIT] is dependent upon an availability of a power source at the [A] block and on the proper operation of each of the circuit or circuit elements (●) represented along the event line. If the lamp which indicates the action fails to light, any item along the event line, as well as the source [A], is suspected.

In the case of multiple event lines, many entities listed in the heading are common to more than one event line while others are unique to a single line.

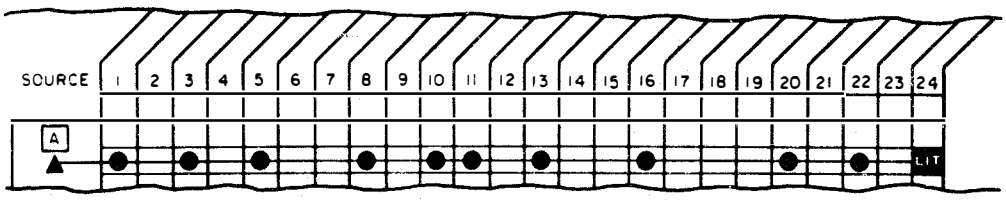
In figure 2-36 assume that the lamp does not light on line 4 but does light on lines 1, 2, 3, and 5. It becomes readily apparent that the circuit and circuit element represented by the black dots in columns 4 and 18 are the only ones that can be suspect as faulty since they are unique to line 4. All items represented by dots in the other columns are common to lines 1, 2, 3, or 5, and are proven good because the indicators at the end of the event line light.

Examination of the Partial Maintenance Dependency Chart, in figure 2-37 will show that



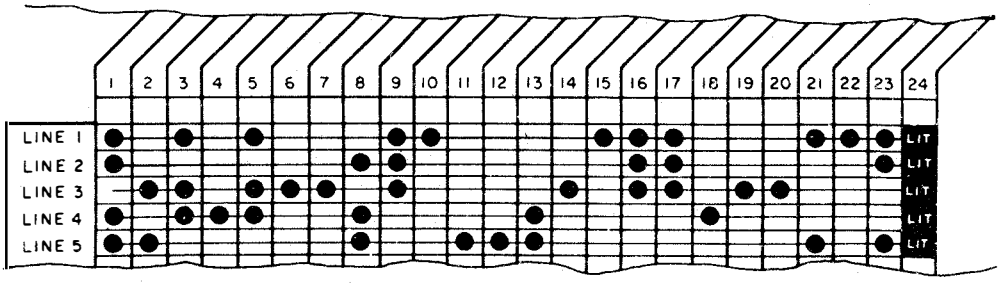
162.159

Figure 2-34.—Function symbols on the MDC.



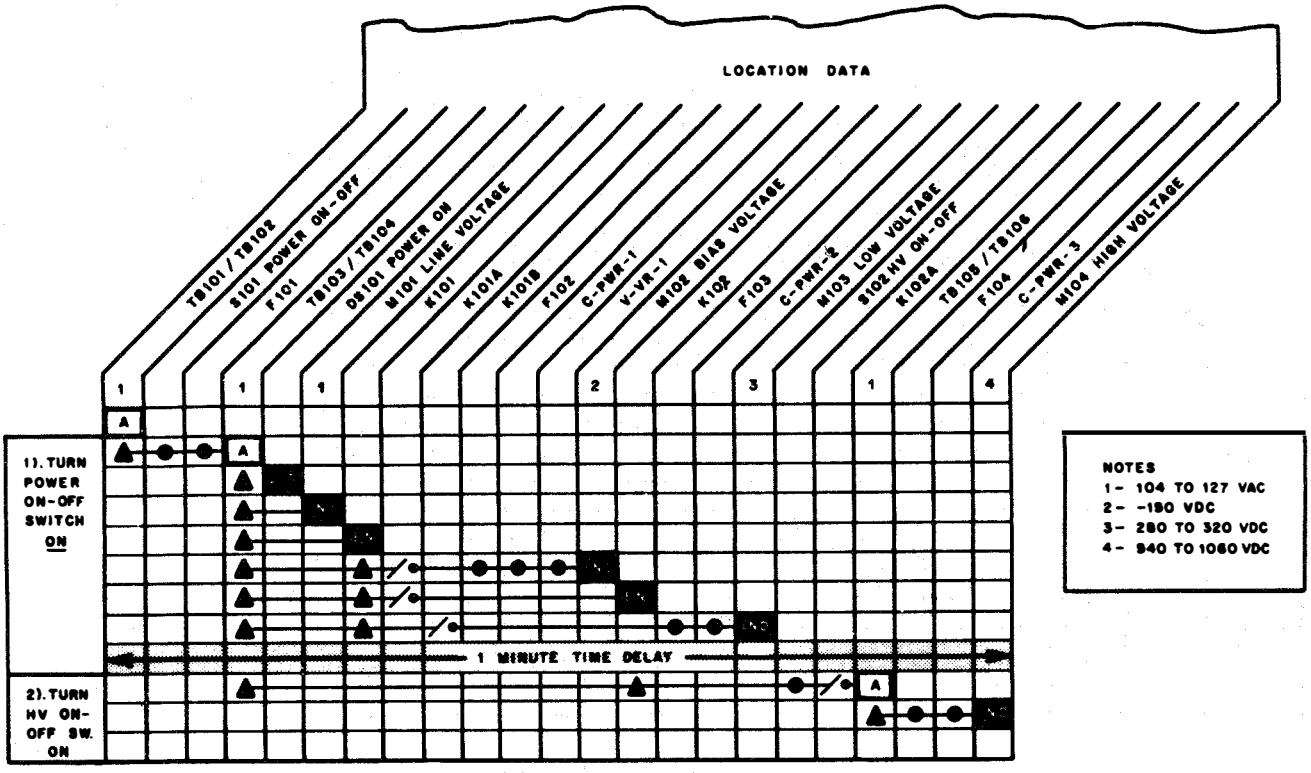
162.160

Figure 2-35.—Single event line.



162.161

Figure 2-36.—Multiple event lines.



162.162

Figure 2-37.—Partial MDC.

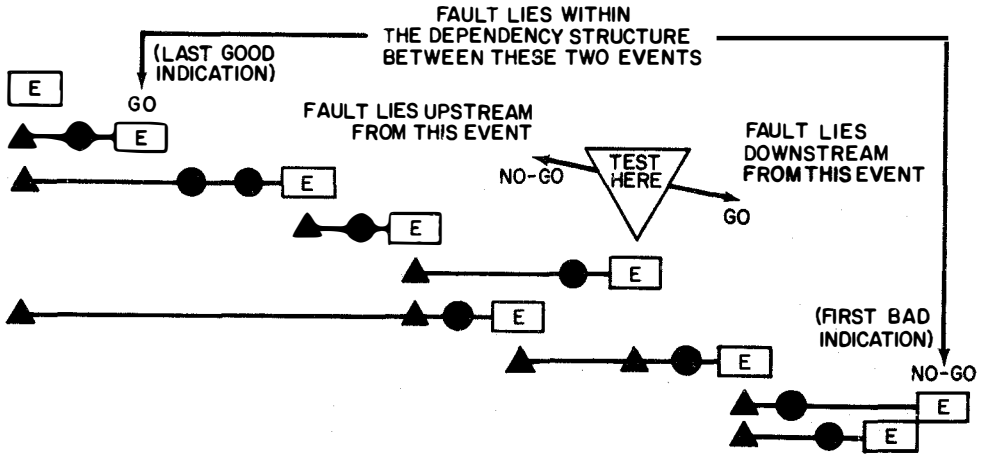
there are 10 Events, which occur as indicated by the white and black rectangles. You will note that there is only one Event on each horizontal line. The Availability [A] at TB101/TB102 is termed the Input Event, and the other Events are dependent Events, i.e., dependent upon the Input Event. You will also note that Availabilities are usually specified at important junction points.

To show how this chart reads, the fact that M102 indicates—150 VDC proves:

1. V-VR-1 is good.
2. C-PWR-1 is good.
3. F-102 is good.
4. Contacts K101A are providing continuity.
5. K-101 is energized.
6. The correct voltage is available at TB103/104.
7. F101 is good.
8. S101 is good.
9. The input voltage is available.

The chart in figure 2-38 illustrates the fault isolation process on a Maintenance Dependency Chart. The technician simply makes note of the equipment's front panel indicators which have "out-of-spec" indications. The events are then marked for reference, and the first bad indication and the last good indication of the dependency structure are established. The dependency structure between these two events contains the faulty element. To further narrow the area of concern, split-half diagnostics are used. The next event to be tested in located midway within the dependency structure defined by the last good and first bad indications. This event should be chosen for its ease of access as indicated by the event symbol's background. If the event is GO, the fault lies within the dependency structure downstream from the event. If the event is NO-GO, the fault lies upstream from the event. This procedure is repeated until a single dependency line is isolated whose input event is good and whose output event is bad. The fault lies on this line, and the functional entity identified by the dot contains the fault.

An important rule in using the Maintenance Dependency Charts—if an Event is proven good for one Dependent Event, it is proven good for all Dependent Events. In a like manner, if a



162.163

Figure 2-38.—Fault isolation.

functional entity or circuit element has been proven good in connection with an Event; then, it is good in connection with all other Events with which it is associated.

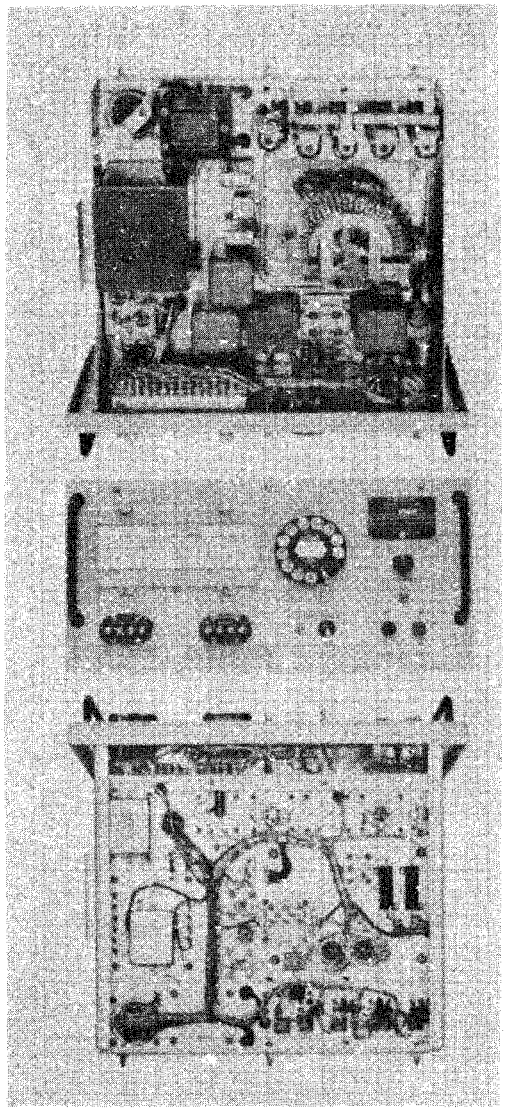
Isolation of a faulty functional entity or circuit element alone is important; also, knowledge of the physical location of the suspected circuit is important. Accordingly, along the top of the Maintenance Dependency Chart the assembly and the cabinetry in which the suspect circuit or circuit element is located is also indicated. Information and details on the suspect circuit or element can be readily ascertained by using the Functional Index to locate the data package for the assembly containing the suspect item. The suspect item's location can be determined (insofar as the assembly and cabinet are concerned) from the Maintenance Dependency Chart. Knowing the piece of hardware in which the assembly and its suspect item is contained, one can find all pertinent data in the assembly data packages listed in the index.

Parts List and Functional Index

Another one of the principal features of SIMM is its method of indexing. Each hardware assembly (unit, major assembly, and subassembly, as required) is fully treated in a four-part data package. All data packages are arranged so that the same type of information is located in the same sequence in every package. Each package includes a parts list and parts location illustrations (2-39); blocked text; blocked schematic; and related technical maintenance data. All information at the hardware assembly level is provided in four pages or less. Hence, the index for assemblies lists only four page numbers for each assembly. Indexing the higher level PABD's and text, and the system block diagram, the functional coverage page, the instructional page (how to use the manual), the maintenance dependency charts, installation and operation information, by page number is the only other requirement. This eliminates the need for long lists of contents, illustrations and tables. The indexing of a SIMM manual (fig. 2-40) permits the finding of pertinent information in seconds.

Improvements

As this training manual goes to press, various improvements are being made to the SIMM technical manual. Current SIMM manuals will use a keyed-text technique instead of the blocked text. In the keyed-text, the text material is arranged in tabular format and keyed to the diagram by circled numbers as shown by figure 2-41. This method of presentation permits significantly more text material to be presented than the blocked text method. In addition to the schematic diagrams, the keyed-text will also be used with the precise access block diagrams (called functional block diagrams), and the overall block diagram (called the functional description diagram.



SLIDE MOUNTED ASSEMBLY

REF DESIG	LOCATING COORD	NAME AND DESCRIPTION
C201	C.2/5.3	CAPACITOR, SPRAGUE ELECTRONIC CO. PART NO. 10VP106-47 1S
C202	D.3/4.4	CAPACITOR, MIL TYPE CL53C1-130UP3
C203	D.3/3.3	CAPACITOR, MIL TYPE CL53C1-130UP1
CR201	F.3/6.1	DIODE, MIL TYPE 1N538
CR202	F.3/6.2	DIODE, MIL TYPE 1N538
CR203	E.5/6.1	DIODE, MIL TYPE 1N538
CR204	E.5/6.2	DIODE, MIL TYPE 1N538
CR205	B.2/6.1	DIODE, MIL TYPE IN 2498
CR206	B.2/5.4	DIODE, MIL TYPE IN2498
CR207	B.4/5.4	DIODE, MIL TYPE IN2498
CR208	B.4/6.1 (H)	DIODE, MIL TYPE IN2498
CR209	F.1/6.2 (H)	DIODE, MIL TYPE 1N538
CR210	F.2/5.5 (H)	DIODE, MIL TYPE 1N538
CR211	E.4/6.2 (H)	DIODE, MIL TYPE 1N538
CR212	E.4/5.5 (H)	DIODE, MIL TYPE 1N538
CR213	E.5/16.5	DIODE, MIL TYPE 1W547
DS201	E.3/6.5	LAMP, MIL TYPE MS25237-328
DS202	G.2/7.3 (H)	LAMP, MIL TYPE MS25237-328
F301	B.4/13.5	FUSE, MIL TYPE F07A250V5AS
F202	A.4/13.5	FUSE, MIL TYPE F08A250V2AS
F203	D.2/13.5	FUSE, MIL TYPE F03A250V8AS
F204	D.2/13.5	FUSE, MIL TYPE F08AI25V30AS
F205	D.2/13.5	FUSE, MIL TYPE F03A250V3AS
F206	D.2/13.5	FUSE, MIL TYPE F03AI25V30AS
FL201	D.2/13.5	FILTER, RADIO INTERFERENCE, SPRAGUE ELECTRIC CO. PART NO. JNI4-B06A
FL202	B.5/17.1	FILTER, RADIO INTERFERENCE, SPRAGUE ELECTRIC CO. PART NO. JNI4-B06A
J201	B.3/2.1	CONNECTOR, MIL TYPE MS3102A36-7P
K201	G.5/2.5	RELAY, CLARE, C.P. AND CO. PART NO. A106786
K202	G.1/2.5	RELAY, CLARE, C.P. AND CO. PART NO. B106786
K203	F.3/2.5	RELAY, CLARE, C.P. AND CO. PART NO. C106786
K204	E.4/2.5	RELAY, CLARE, C.P. AND CO. PART NO. D106786
K205	E.1/2.5	RELAY, CLARE, C.P. AND CO. PART NO. E106786
K206	G.2/3.3	SWITCH, TELEPHONE, ROTARY, CLARE, C.P. AND CO. PART NO. RP12360G2
K207	D.3/4.1	RELAY, SIGMA INSTRUMENTS INC. PART NO. 91597
K208	C.4/2.1	RELAY, LEACH CORP. PART NO. 9071
K209	E.3/17.4	RELAY, GENERAL ELECTRIC CO. PART NO. 3SAF1242
L201	D.2/5.2	REACTOR, COLLINS RADIO CO. PART NO. 94-0367-00
L202	D.1/6.2	REACTOR, COLLINS RADIO CO. PART NO. 94-0367-00
R101	C.2/15.5	RESISTOR, MIL TYPE RC32GF101K
R102	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R103	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R104	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R105	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R106	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R107	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R108	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R109	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R110	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R211	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R112	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R213	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R214	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R215	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R216	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R217	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R218	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R219	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R220	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R121	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R222	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R223	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R224	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R225	G.1/3.5	RESISTOR, IRC INC. PART NO. GBT1-222M5
R226	G.2/7.2	RESISTOR, RESISTORS, INC. PART NO. T40-6058-00
R227	G.1/16.2	RESISTOR, DALE ELECTRONICS INC. PART NO. RN50-2500DG
R228	G.3/16.2	RESISTOR, DALEELECTRONICS INC. PART NO. RN50-10000G
R229	B.4/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA501B
R230	B.5/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA501B
R231	C.1/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA501B
R232	C.4/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R233	C.5/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R234	D.1/7.2	RESISTOR, VARIABLE, MIL TYPE RT6LAYSA502B
R235	B.3/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R236	B.5/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R237	C.1/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R238	C.3/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R239	C.4/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R140	D.1/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R241	D.2/7.2	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R242	B.3/7.3 (H)	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R243	B.5/7.3 (H)	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R244	C.2/7.3 (H)	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R245	C.4/7.3 (H)	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R246	C.5/7.3 (H)	RESISTOR, VARIABLE, MIL TYPERV6LAYYSA502B
R247	D.2/7.3 (H)	RESISTOR, VARIABLE, MIL TYPE RV6LAYSA502B
R248	G.4/17.1	RESISTOR, MIL TYPE RW29V101
R249	G.4/5.4	RESISTOR, P O K206
RV101	G.4/18.3	RESISTOR, VOLTAGE SENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
RV102	F.1/5.3	RESISTOR, VOLTAGE SENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
RV103	G.1/18.3	RESISTOR, VOLTAGE SENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
RV104	F.3/18.3	RESISTOR, VOLTAGE SENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
RV105	E.5/18.3	RESISTOR, VOLTAGE SENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
RV106	E.3/18.2	RESISTOR, VOLTAGE SENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
RV107	E.1/18.4 (H)	RESISTOR, VOLTAGESENSITIVE, AUTOMATIC ELECTRIC CO. PART NO. RY56
S201	G.2/6.5	SWITCH, OAK MFG. CO. PART NO. 2525DF3
S202	E.4/7.3	SHAL, TELEPHONE, AUTOMATIC ELECTRICCO. PART NO. Z36277-1
S203	———	NOT USED
S204	F.5/6.5	SWITCH, ARROW-HART AND HEGEMAN ELECTRIC CO. PART NO. B-2BLACK
S205	G.3/6.4	SWITCH, AARROW-HART AND HEGEMAN ELECTRIC CO. PART NO. B-1RED
S206	E.5/7.1	SWITCH, MIL TYPE MS3506/6-2
T201	D.5/6.1	TRANSFORMER, COLLINS RADIO CO. PART NO. 94-0708-672
T202	B.1/6.3	TRANSFORMER, COLLINSRADIO CO. PART NO. 672-0117-00
T203	G.4/8.1	TRANSFORMER, STANCOR ELECTRONICS INC. PART NO. 29061
T204	G.2/6.2	TRANSFORMER, AUDIO FREQUENCY. ADC PRODUCTS INC. PART NO. A13241
TB201	F.4/16.2	TERMINAL BOARD, COLLINS RADIO CO. PART NO. 597-0043-092
TB202	E.3/17.2	TERMINAL BOARD, COLLINS RADIO CO. PART NO. 593-0040-002
TB203	F.2/5.4	TERMINAL BOARD, COLLINS RADIO CO. PART NO. 593-0055-002
TB204	F.3/5.5	TERMINALBOARD, COLLINS RADIO CO. PART NO. 593-0054-002

(H) DENOTES HIDDEN

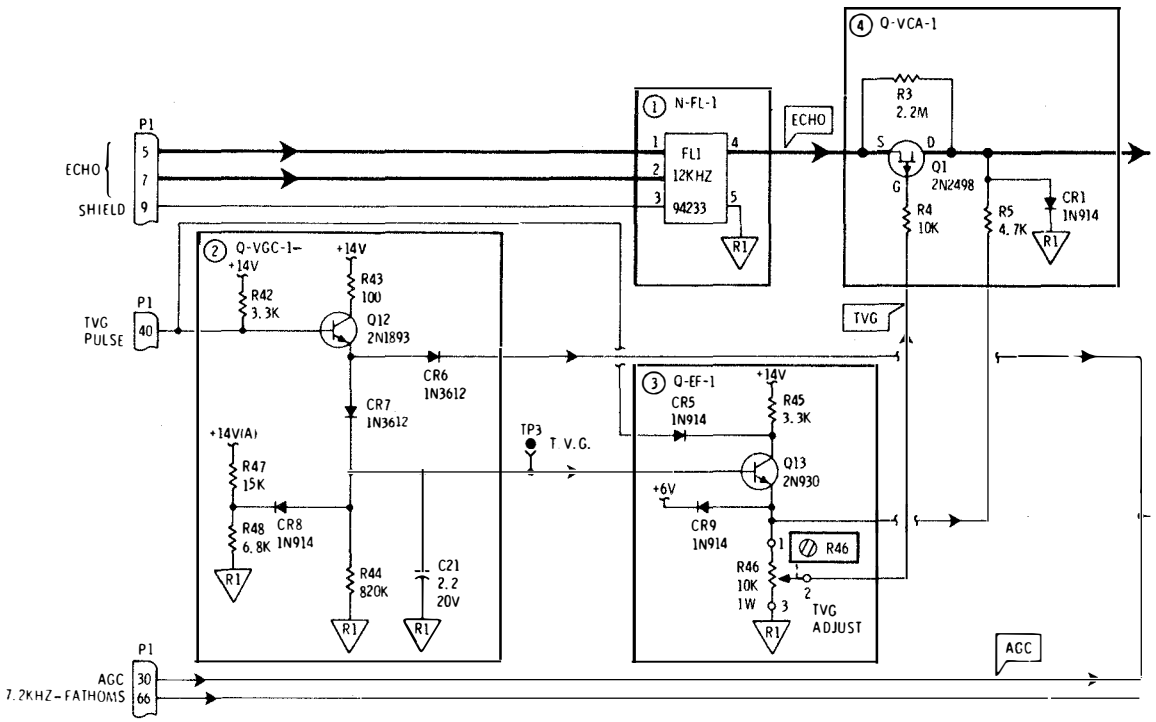
Figure 2-39.—Parts data.

FUNCTIONAL INDEX

*Includes power schematic for AM-1565/URC

162.165

Figure 2-40.—Functional index.

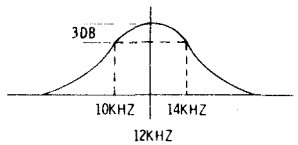


1A4A1 RECEIVER ASSEMBLY

AMPLIFIES THE LOW LEVEL RECEIVED ECHO. CONVERTS THE TVG PULSE (TIME VARIABLE GAIN) INTO A DECREASING EXPONENTIAL VOLTAGE TO BLANK THE RECEIVER AT TRANSMIT TIME AND ALLOW IT TO RECOVER SLOWLY. AGC IS ALSO PROVIDED TO REDUCE THE GAIN OF THE RECEIVER WHEN THE NOISE LEVEL HAS INCREASED (NOISE CAUSED BY RECEIVED ACOUSTIC ENERGY OTHER THAN THE ECHO).

(1) N-FL-1 FILTER

PROVIDES IMPEDANCE MATCHING BETWEEN THE FILTER IN THE TRANSMIT-RECEIVE NETWORK AND THE INPUT AMPLIFIER. HAS A CENTER FREQUENCY OF 12KHZ WITH A BANDPASS 2KHZ EITHER SIDE OF CENTER (3DB POINTS).



FILTER INPUT IMPEDANCE IS 120 OHMS, OUTPUT IMPEDANCE IS 240 OHMS.

(2) Q-VGC-1 VOLTAGE GAIN CONTROL

EMITTER FOLLOWER CONFIGURATION. NORMALLY BIASED OFF, CONDUCTS UPON RECEIPT OF TVG PULSE. DIVIDER R47 AND R48 ALONG WITH DIODE CR8 LIMIT THE TVG VOLTAGE AT TP3 TO APPROXIMATELY +3.8V. THE TVG PULSE HAS THE SAME PULSE WIDTH AS THE TRANSMIT PULSE AND IS APPLIED TO C11 THRU CR6.

(3) Q-EF-1 EMITTER FOLLOWER

COUPLES TVG PULSE TO Q-VCA-1. AMPLITUDE CONTROLLED BY R46 IN EMITTER CIRCUIT.

(4) Q-VCA-1 VOLTAGE CONTROLLED ATTENUATOR

ACTS AS VARIABLE RESISTOR BETWEEN OUTPUT OF N-FL-1 AND INPUT TO Q-AMP-1. PINCHED OFF BY THE POSITIVE TVG VOLTAGE APPLIED TO GATE DURING TRANSMIT TIME.

Figure 2-41.—Blocked schematic with keyed text.

162.179

Another area of the manual to be improved is the maintenance dependency chart. Instead of only one MDC for each major function, future manuals will have additional MDCs for the functional block and schematic diagrams. MDCs will also be provided with an acetate or Mylar overlay so that the technician can use a grease pencil to mark his progress when troubleshooting. Also, the manual will be smaller than the 15"x35" shown in figure 2-13. New SIMM manuals will be 11"x27". This gives them a folded dimension of 9"x11", which is the same size as conventional manuals.