NAVSHIPS 94500 (A) *(Non-Registered)*

PREPARATION GUIDE

for

ELECTRONIC EQUIPMENT TECHNICAL MANUALS

DEPARTMENT OF THE NAVY

BUREAU OF SHIPS

FOREWORD

This document is a guide for use in the preparation of Type II, Type IIa, and Type III technical manuals for electronic equipments, as required by MIL-M-15071E. It has been arranged to closely approximate the final form of a Type II technical manual, indicating the type of information to be supplied. Type IIa technical manuals are to follow the general guides noted herein, except that they should be written to the level of an engineer, and do not require as extensive coverage with respect to trouble-shooting and maintenance information. Likewise, Type III manuals are to follow these guides, except that the information is to be system-oriented. To aid the contractor in assuring that a given technical manual fulfills all requirements for the type of coverage, a series of quality-control check lists has been provided in appendix II.

The requirements set forth herein should provide military technicians with sufficient operational and maintenance data. It is not intended to preclude the use of other arrangements of data to provide a more rapid solution to specialized operational or maintenance problems, provided that advance approval is obtained from the bureau or agency concerned.

NAVSHIPS 94500 (A) *(Non-Registered)*

PREPARATION GUIDE

for

ELECTRONIC EQUIPMENT TECHNICAL MANUALS

DEPARTMENT OF THE NAVY

BUREAU OF SHIPS

Approved: (Date)

5 MAY 1962

In unclassified manuals, the security classification is omitted from both the top and bottom of all pages. In such cases, the NAVSHIPS number should be in line with other page heads.

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	4-1 to 4-14	Original
ii to v	Original	5-1 to 5-14	Original
1-0 to 1-4	Original	6-1 to 6-3	Original
2-1 to 2-3	Original	i-0 to i-2	Original
3-0 to 3-2	Original		

* (NAME OF CONTRACTOR) (CONTRACTOR'S ADDRESS) Contract: (number)

Errors found in this publication (other than obvious typographical errors), which have not been corrected by means of Temporary Corrections or Permanent Changes should be reported. Such report should include the complete title of the publication and the publication number (short title); identify the page and line or figure and location of the error; and be forwarded to the Electronics Publications Section of the Bureau of Ships.

All Navy requests for NAVSHIPS electronics publications listed in the current issue of NAVSANDA Publication 2002 "Requisitioning Guide and Index of Forms and Publications", Cognizance Symbol I, or in a subsequent issue of the Electronics Information Bulletin should be directed to the appropriate Forms and Publications Supply Point.

* List contract data for all contracts involved with equipments covered by the manual.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

LIST OF ILLUSTRATIONS

LIST OF TABLES

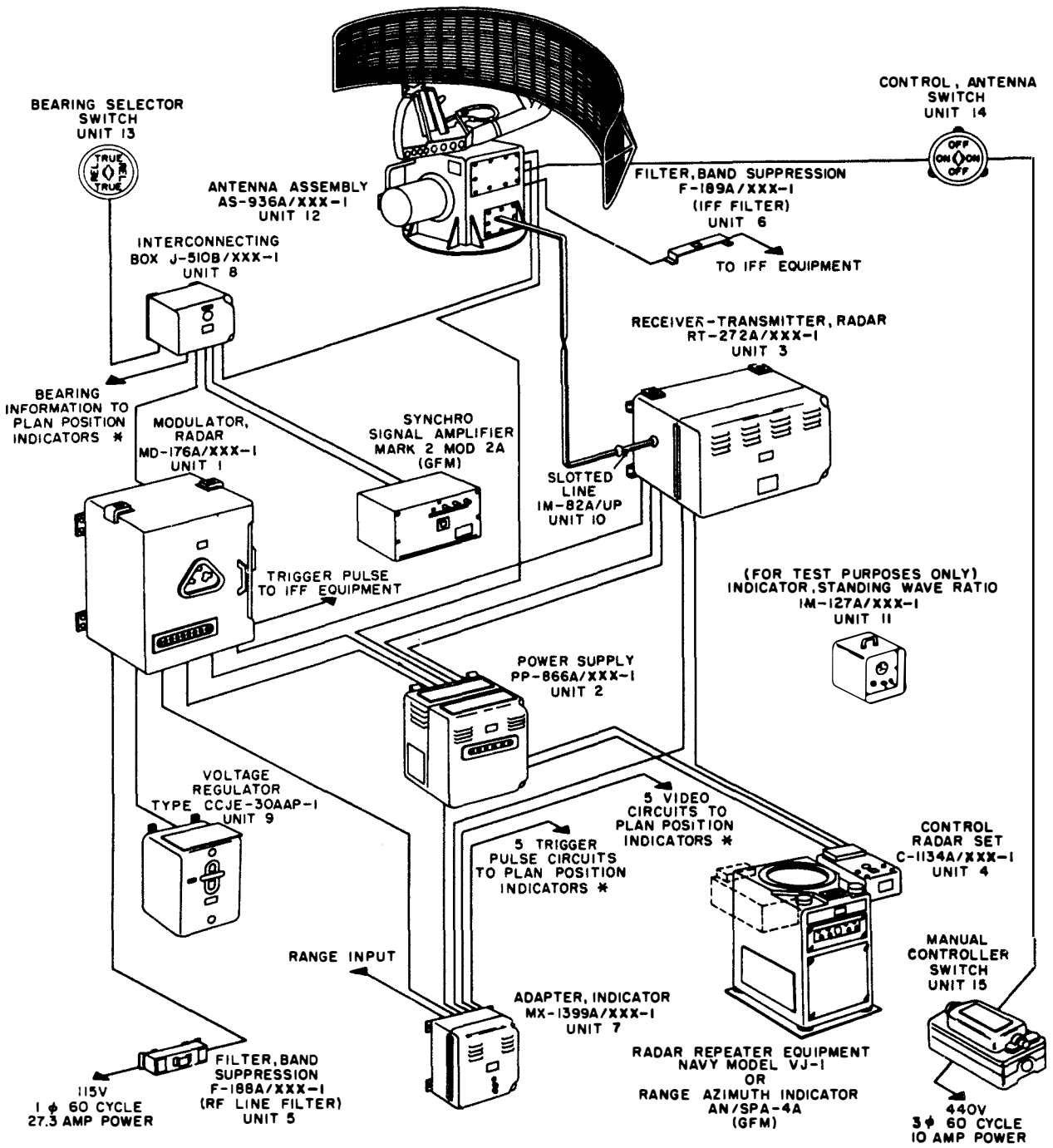


Figure 1-1. Radar Set AN/XXX-1, Relationship of Units

SECTION 1

GENERAL INFORMATION

The purpose of this section is to provide a functional description of the equipment for use by command personnel and others requiring a general summary of the equipment or system. The functional description should be nontechnical in nature and explain the intended use (why, where, when, and with what), capabilities, limitations, and relationship of the units.

1-1. SCOPE.

A statement similar to the following should be included as the first paragraph:

This Technical Manual is in effect upon receipt and supersedes NAVSHIPS 9XXXX. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL DESCRIPTION.

The general description is to be a brief, nontechnical explanation of the intended use of the equipment or system, its capabilities, and limitations. What does it do? What is it used with? Where is it used? What does it consist of? If the manual covers more than one equipment, a statement pointing out the differences should be included. A full-page photograph or line drawing of the complete equipment is to be included as the first illustration (see page 1-0). For a very large equipment, this illustration may be on a fold-in page. Show the relative sizes of the units and how the units fit together functionally, with each unit identified by nomenclature (using leaders when necessary). Accessory equipment required for normal operation should also be shown and marked "Not Supplied" or "GFM", as applicable (see figure 1-1).

1-3. DESCRIPTION OF UNITS.

When the equipment or system consists of more than one unit, a separate paragraph should be used for the description of each unit, giving the official nomenclature with a brief statement of the function and the physical and electrical characteristics of the unit. Any special design features should be indicated.

1-4. REFERENCE DATA.

Reference data similar to that listed below is to be included for each set covered by the manual. Items may be modified or omitted, as necessary, for the particular equipment.

a. Frequency or frequency range.
   (1) Tuning bands and range of each band.
   (2) Number of preset frequencies.

b. Type of frequency control.

c. Types of emission or reception, and modulation characteristics.

d. Nominal carrier output for each type of emission at output terminals, using a properly designed dummy load of indicated characteristics. Typical output curves are desirable if power varies with frequency.

e. Peak power, duration, and pulse repetition rate.

f. Receiver intermediate frequencies, receiver selectivity, frequency range of receiver local oscillator, antenna gain, antenna stability, transmitter bandwidth (e.g., at 3 db, 20 db, 30 db), and pulse width.

g. Receiver output (watts or milliwatts) into specified resistive loads. It is preferable to state whether output is through headphones, speaker, or other type of equipment. Input and output impedances should also be noted.

h. For frequency control crystals:
   (1) Government designation.
   (2) Type of cut.
   (3) Frequency range of crystal circuit.
   (4) Oscillation frequency.
   (5) Equipment output frequency.
   (6) Crystal temperature coefficient.
   (7) Crystal calibration and operating temperature.
   (8) Frequency accuracy over the operating range.

i. Frequency stability and accuracy data.

j. Electrical and mechanical input and output data for each unit, including source of input and destination of output. For example: Trigger input: 25 volts peak, across 75 ohms, positive polarity, 15 to 20 μsec, at 1000 pps, from J2 in modulator; video output: positive video pulses, limited to 2 ± 0.5 volts across 75 ohms, to J5 in indicator adapter.

k. Electrical and mechanical characteristics of recommended antennas:
   (1) Rotation vs mechanical load.
   (2) Beam width.
   (3) Resolution.
   (4) Speed and direction of rotation.

l. Ambient temperature limitations for set or units.

m. Operating characteristics of power supply.
   (1) Government type designation.
   (2) Voltages (if ac, the number of phases and frequency should be given; if dc, it should be stated).
   (3) Current and power factor required at each specified supply voltage for:
      (a) Starting.
      (b) Various operating conditions of the particular equipment, such as locked key, radiate, standby, and intermittent output (including duty cycles).

n. Adequate information concerning equipment compatibility with other equipments.

o. Heat dissipation information (in watts) for each unit.

TABLE 1-1. EQUIPMENT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		UNIT NO.	*OVER-ALL DIMENSIONS (IN.)			*VOLUME (CU FT)	*WEIGHT (LB)
	NAME	DESIGNATION		HEIGHT	WIDTH	DEPTH		
1	Antenna Assembly	AS-615/XXX-1	12	76	126 swing circle		—	420
1	Indicator Adapter	MX-1399/XXX-1	7	20.19	17.06	10.88	2.16	50
1	Modulator	MD-176/XXX-1	1	42.75	30.06	19.06	14.15	320
1	Power Supply	PP-866/XXX-1	2	27.94	19.06	14.06	4.33	135
1	Radar Set Control	C-1134/XXX-1	4	13.69	8.94	13.63	9.64	18
1	Receiver-Transmitter	RT-272/XXX-1	3	25.19	32.81	20.19	9.65	255
1	Slotted Line	IM-82/XX	10	3.63	3.63	14.5	0.11	5
1	VSWR Indicator	IM-127/XXX-1	11	10.31	8	7	0.334	7
	Radar Equipment	AN/XXX-1	—	—	—	—	40.37	1210
1	Maintenance Standards Book for Radar Set AN/XXX-1	NAVSHIPS 9XXXX.42		11.5	9.5	0.5	—	—
1	Operating Instruction Chart for Radar Set AN/XXX-1	NAVSHIPS 9XXXX.21	—	11	8.5	—	—	—
1	Performance Standards Sheet for Radar Set AN/XXX-1	NAVSHIPS 9XXXX.32	—	11	8.5	—	—	—
2	Technical Manual for Radar Set AN/XXX-1	NAVSHIPS 9XXXX	—	11.5	9.5	2	—	—

* Includes mounting materials.

p. Radiation hazard information for applicable units.

1-5. EQUIPMENT SUPPLIED.

Include a list of all equipment supplied on the contract or order. The list should include all accessories, special tools, special test equipment, technical manuals, and miscellaneous parts. The preferred arrangement of such information is shown in table 1-1. It is not necessary to list maintenance parts boxes, unless they are a permanent part of the equipment; however, all Government-furnished items which form a part of the equipment should be covered. The weight and over-all dimensions of each unit should include plugs, separable mounting bases, electron tubes, crystals, and other removable parts, but not bulk cable. The weights of separable mounting bases and other removable units of the complete equipment should be given when significant. Otherwise, a note stating that weight of unit includes weight of separable items will be sufficient. Also, the volume and weight of the complete equipment is to be included.

1-6. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED.

A list of all equipments and publications required but not supplied is to be included in the form shown in table 1-2, giving sufficient characteristics to permit selection of suitable equivalents.

1-7. FACTORY OR FIELD CHANGES.

If factory or field changes have been made, include a table to list the following information: field change number; descriptive title; purpose of change; serial numbers of equipment affected (see table 1-3); and a brief statement which includes sufficient data (clues) to permit an observer to quickly determine whether the change has been accomplished. Conversely, if no changes have been made, this should be noted. In manuals procured for the Department of the Navy, include a reference to NAVSHIPS 900,000, Electronics Installation and Maintenance Book (EIMB), for the complete field change identification guide index.

1-8. EQUIPMENT SIMILARITIES.

A brief description or table giving the basic similarities and differences between various sets of the same equipment series or family is to be given, together with an indication of the extent to which the manual describes the installation, operation, and maintenance of other equipments.

1-9. PREPARATION FOR RESHIPMENT.

This paragraph is to contain any extraordinary precautions that should be followed (because of the special nature of the equipment) in preparing the equipment for reshipment. It must take into account such factors as removal of large electron tubes, disassembly of equipment, critical bending radius of coaxial cables, etc.

TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	RADAR SET AN/XXX-1, EQUIPMENT CHARACTERISTICS
	NAME	DESIGNATION		
1	Electronic Voltmeter	ME-30A/U	Trouble-shooting and maintenance procedures	Voltages: .02 to 275 vac Impedance: 9.5 mego Frequency: 60 to 100,000 cps
1	IFF Equipment	AN/UPX-XX	Provide IFF capabilities	IFF trigger: 25-50 volts, peak IFF video input level: 1-2.5 volts, peak
1	Oscilloscope (cont)	AN/USM-38	Trouble-shooting and maintenance procedures	Max horizontal sweep: 75,000 μsec/in Repetition rate: 4.5K/sec Max amplitude signal: 450 volts, peak Min circuit loading impedance: 1 mego

TABLE 1-2. (Continued)

QTY PER EQUIP	NOMENCLATURE		REQUIRED USE	RADAR SET AN/XXX-1, EQUIPMENT CHARACTERISTICS
	NAME	DESIGNATION		
	Oscilloscope (cont)			Min rise time: 0.08 μsec Response: 60 cps to 4.5 mc
1	Range Azimuth Indicator	AN/SPA-XA	PPI display of radar information	Video input: 25-50 volts, peak Trigger requirement: 75-100 volts, peak Min range display: 1 mile Max range display: 100 miles Target resolution: 10 yds at 1 mile 100 yds at 10 miles
1	Instruction Book for Electronic Voltmeter ME-30A/U	NAVSHIPS 9XXXX		
1	Instruction Book for IFF Equipment AN/UPX-XX	NAVSHIPS 9XXXX		
1	Instruction Book for Range Azimuth Indicator AN/SPA-XA	NAVSHIPS 9XXXX		

TABLE 1-3. FIELD CHANGES

FIELD CHANGE NUMBER	FIELD CHANGE TITLE AND PURPOSE	SERIAL NO. AFFECTED	INDICATION OF ACCOMPLISHMENT
1-AN/XXX-1	Standing Wave Ratio Indicator Kit. Provide VSWR indication	All	VSWR label is installed on STC and AFC chassis cover.
2-AN/XXX-1	Reliable Radar True and Relative Bearing Indication. Provide true-relative bearing information	All	A true-relative bearing switch is mounted adjacent to radar set control.
3-AN/XXX-1	High Voltage Reset Kit. Addition of high voltage reset switch.	All	H.V. overload reset button is added on radar set control.

SECTION 2

INSTALLATION

This section is to include the following kinds of information, as applicable: primary power data, initial adjustment and inspection procedures, unpacking and handling data, site selection information, installation requirements, and cabling and interference reduction data. When installation plans (per MIL-D-23140 or equivalent) have been supplied or are part of the contract, the material to be included in this section can summarize the data contained on such drawings.

2-1. UNPACKING AND HANDLING.

Only when special precautions are required should instructions for unpacking or handling the equipment be given. For complicated procedures, illustrations to supplement such instructions are usually necessary.

2-2. POWER REQUIREMENTS.

Power requirements are to be given, together with a reference to the power distribution diagram in Section 5, when external power is required.

2-3. SITE SELECTION.

Include considerations for the selection of a suitable site, as may be applicable to the particular equipment. Instructions needed for the erection of auxiliary shelters and supporting structures should also be given if such procedures are not already provided in other publications of the bureau or agency concerned.

2-4. INSTALLATION REQUIREMENTS.

a. Factors to be considered when determining the proper location of units of the equipment are to be included here, when applicable. Reference should be made to the main equipment illustration (figure 1-1) when discussing installation requirements. However, when necessary for clarity, additional photographs or drawings should be used to augment the text. Some (but not necessarily all) factors to be considered in determining the proper location of units are:

(1) Provide best operating conditions.

(2) Facilitate maintenance and adjustment of equipment, and replacement and repair of defective parts or complete units.

(3) Prevent interaction between units and other electronic equipment in the vicinity.

(4) Conform to critical and minimum cable length requirements.

(5) Provide adequate heat dissipation.

b. The following points on installation are to be discussed when applicable: use of short ground leads, effective bonding and shielding, preferred positions, length and method of support of transmission line and antenna leads, drainage or pressurization of waveguide, minimum bending radius of coaxial cable and waveguide, etc. Include any special instructions for removal of packing, chocks, or other items used to protect the equipment from damage during shipment, together with procedures for installation of separately-packed parts or assemblies within their respective units. Also, when applicable, include a note cautioning installation personnel against over-stressing mounting bolts, to preclude the possibility of damage to equipment or injury to personnel due to shearing when subjected to shock.

c. Outline drawings (see figure 2-1) when included, are to contain all dimensions required for installation, such as mounting dimensions and clearances. When a unit consists of more than one frame or section, the method of separation (rack mounts, etc) should be noted, in addition to any instructions for reassembly of the equipment, if shipped disassembled.

Note

When installation plans are supplied as part of the contract, they should be referenced, and the information normally given in paragraphs 2-3 and 2-4a through c can then be summarized in a shortened (possibly tabular) form.

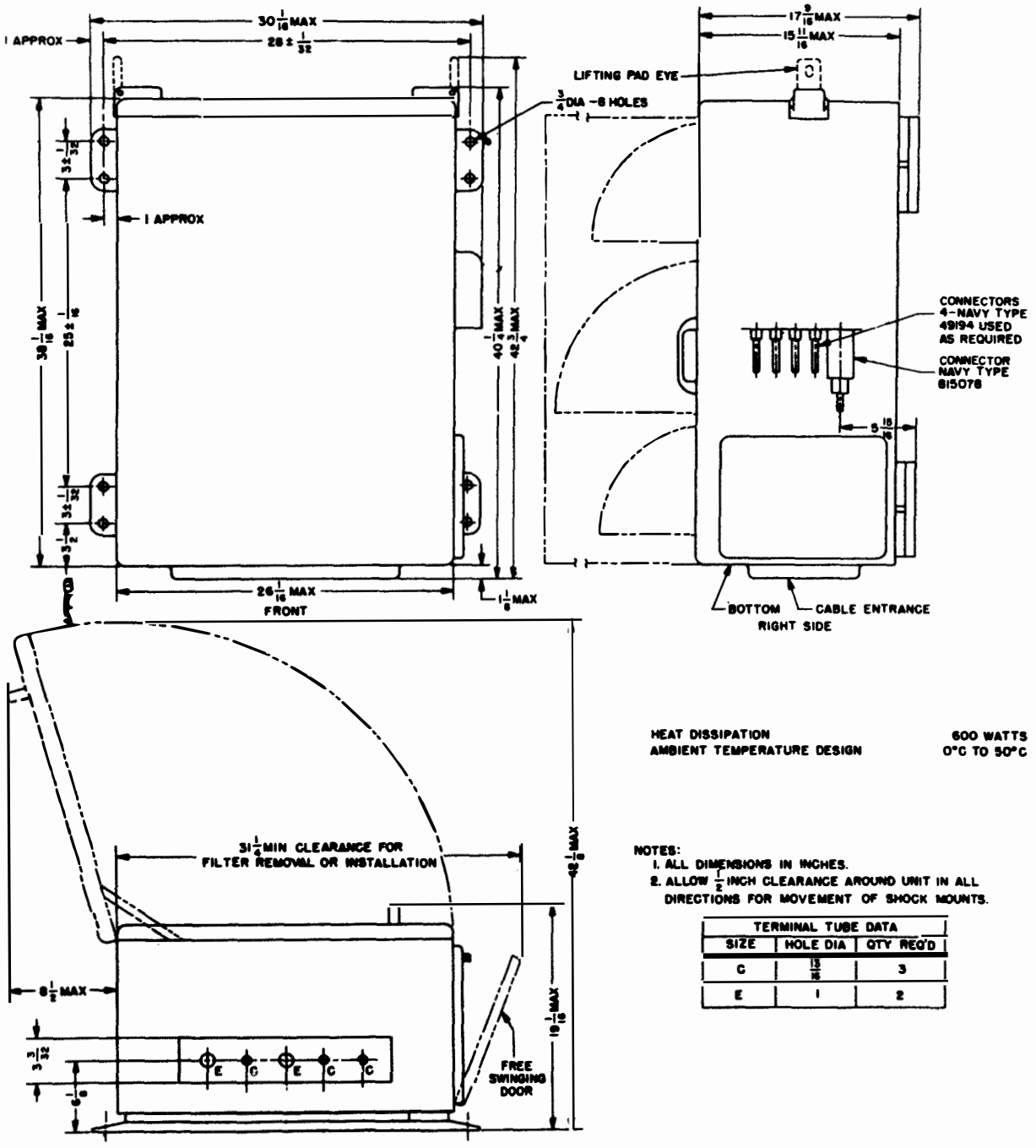
d. For interconnecting wiring details, the appropriate diagrams in Section 5 should be referenced.

2-5. CABLE ASSEMBLIES.

A table of all cables needed for installation of the equipment, including such information as the number of active and spare conductors, is necessary. For power cables, indicate the load each power cable will be required to handle. For multi-conductor cables, the color code legend should be given, as applicable. Where new or special types of cables are to be prepared from bulk parts, appropriate instructions are to be supplied if such instructions are not already included in an existing publication of the bureau or agency concerned (such as NAVSHIPS 900,000, Electronics Installation and Maintenance Book). To increase clarity in the preparation instructions, each part of the cable and any associated parts should be identified by part and drawing number. If special tools are required for the preparation of such cables, they should be listed.

2-6. INSPECTION AND ADJUSTMENT.

This portion is to cover all inspections and adjustments that must be made to insure optimum operation. Illustrations (photographs and drawings) are important supplements to the descriptive matter



NOTES:
1. ALL DIMENSIONS IN INCHES.
2. ALLOW 1/2 INCH CLEARANCE AROUND UNIT IN ALL DIRECTIONS FOR MOVEMENT OF SHOCK MOUNTS.

TERMINAL TUBE DATA		
SIZE	HOLE DIA	QTY REQ'D
C	13/16	3
E	1	2

Figure 2-1. Modulator MD-140/XXX-1, Outline Drawing

at this point. It is not necessary to cover in detail adjustments, settings, and tests, which require periodic rechecking. Such procedures are included in other sections and may be referenced. Typical information to be covered under this heading is as follows:

a. Procedure for energizing the equipment for the first time.

b. Instructions for making all adjustments required after installation, and prior to releasing the equipment to the operating personnel. These instructions are to include any precautions to be followed during the adjustment procedure to prevent faulty operation, damage to the equipment, or injury to installation personnel.

c. Instructions for checking the performance of the equipment to insure correct installation. This should include actual operation and positioning of the controls, listing each step in proper sequence or a reference to the information if it is covered in the operation instructions.

2-7. INTERFERENCE REDUCTION.

If the r-f interference characteristics of the equipment are affected by the manner of installation, step-by-step procedures to reduce these characteristics to an absolute minimum must be covered. This includes both interference with other equipments and susceptibility to interference from other equipments.

SECTION 3

OPERATION

This section is to include the following kinds of information: routine and emergency operating instructions, safety precautions, operating limits, transfer between automatic and manual operating conditions (when applicable), complete starting and stopping instructions, and any instructions required by the operator to prepare the equipment for use. Where operating procedures are to be performed in specific sequence, step-by-step procedures should be given. Tables and charts can be used for the presentation of operating instructions where varying operating conditions may be encountered. Instructions should also be included for using built-in test equipment for performing maintenance that is normally accomplished by operator personnel. All discussion should be limited to controls normally used by operating personnel; adjustments which must be made by technical personnel should be discussed only when the equipment is primarily designed solely for operation by technical personnel.

3-1. FUNCTIONAL OPERATION.

This is to consist of a clear, concise, non-technical discussion of the functional operation of the equipment. Equipment operation, its intended use, its capabilities, and its limitations, should be explained together with the basic principles behind the operation of the set.

3-2. PREPARATION FOR USE.

Procedures required to quickly set up and dismantle portable and mobile equipment are to be given when this work is normally performed by the operator; otherwise this information can be located in Section 2.

3-3. OPERATING PROCEDURES.

These are to cover the procedures required to perform each function for which the equipment was designed, in addition to any unique operational features. Call attention to any precautions that should be observed during operation, as well as any limiting operating conditions, warnings as to operating safety, and precautions to prevent faulty equipment use. Any situation in which the operator is likely to misinterpret a reading should be noted. A caution against the use of any control, readily available to the operator, which only technical personnel should use is to be added. When the manual covers test equipment, an explanation of all test applications for the equipment should be included, to the extent that such applications are not included in NAVSHIPS 91828, Handbook of Test Methods and Practices.

a. DESCRIPTION OF CONTROLS. — This is to consist of a description of all controls used during operation. Controls should be referred to exactly as they are marked on the equipment (spelling, abbreviations, capitalization, etc). When the number of controls justify, tabulate the information.

b. SEQUENCE OF OPERATION. — The normal sequence of operation is to be presented by means of text and illustrations. The procedure should be clear, with steps conforming generally to the following sequence (modification of this sequence may be made when necessary to serve the requirements of specific equipment):

(1) Before use.
(2) During use.
(3) Standby (when applicable).
(4) After use.
(5) Secure. A special notice stating how the equipment is to be turned off in an emergency must be included.

When illustrating control panels (see figure 3-1), each control used to operate the equipment should be identified by using call-outs and lines drawn to the controls, or by other means that will clearly identify the controls. It is not necessary to indicate controls which are not used in normal operation, except in connection with cautions or warnings.

c. INDICATOR PRESENTATIONS. — When applicable, indicator presentations and typical instrument readings (with acceptable upper and lower limits) are necessary to indicate to the operator what recognizable results may be expected. When

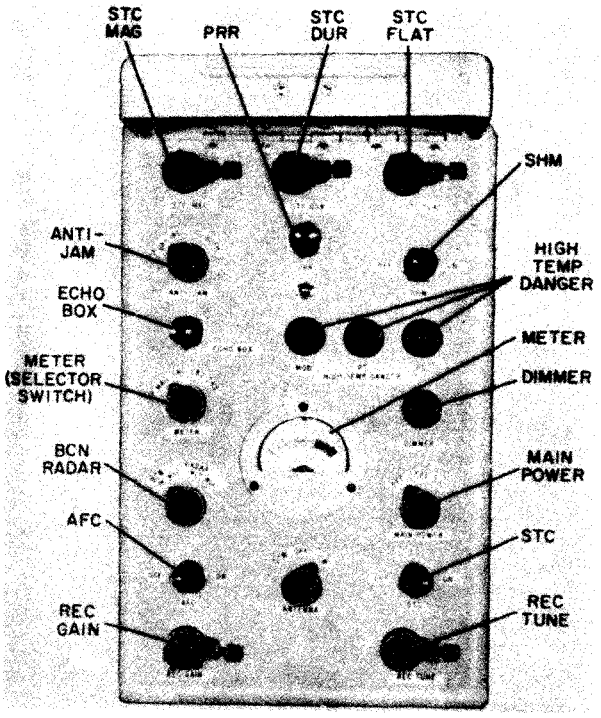


Figure 3-1. Radar Set Control C-113/XXX-1, Operating Control Locations

illustrating indicator presentations or waveforms (other than instrument readings), try to portray actual results as far as possible, rather than an artist's conception of the ideal or the theoretical presentation encountered under optimum conditions (see figure 3-2). The number of illustrations and the treatment thereof should be consistent with proper coverage. In general, the following illustration coverage is typical:

(1) Series of views (or instrument readings) showing indications that should be obtained during the adjustment and tuning of the equipment.

(2) Typical instrument readings and indicator presentations for various uses of the equipment.

(3) Scope and instrument views illustrating proper and improper indications.

(4) Proper notations and brief explanation of the distinguishing characteristics of scope presentations, when the presentations of several objects are similar.

d. TUNING ADJUSTMENTS. —All tuning adjustments that are to be made by the operator should be described and illustrated in proper sequence using call-outs to associated instructions (or references to adjacent text).

3-4. SUMMARY OF OPERATING PROCEDURES.

A straightforward, step-by-step procedure (in tabular form) for operating the equipment is to be included. The procedure should enable an operator, inexperienced with the equipment, to operate it without reference to other data.

a. SCOPE. —Complete operating instructions, presented in logical sequence, should be given so that the following can be accomplished:

(1) Start the equipment.

(2) Tune or adjust the equipment.

(3) Select all available types of transmission or reception.

(4) Increase or decrease power.

(5) Change frequencies.

(6) Perform all special functions incorporated in the equipment.

(7) Operate the equipment from all available control stations.

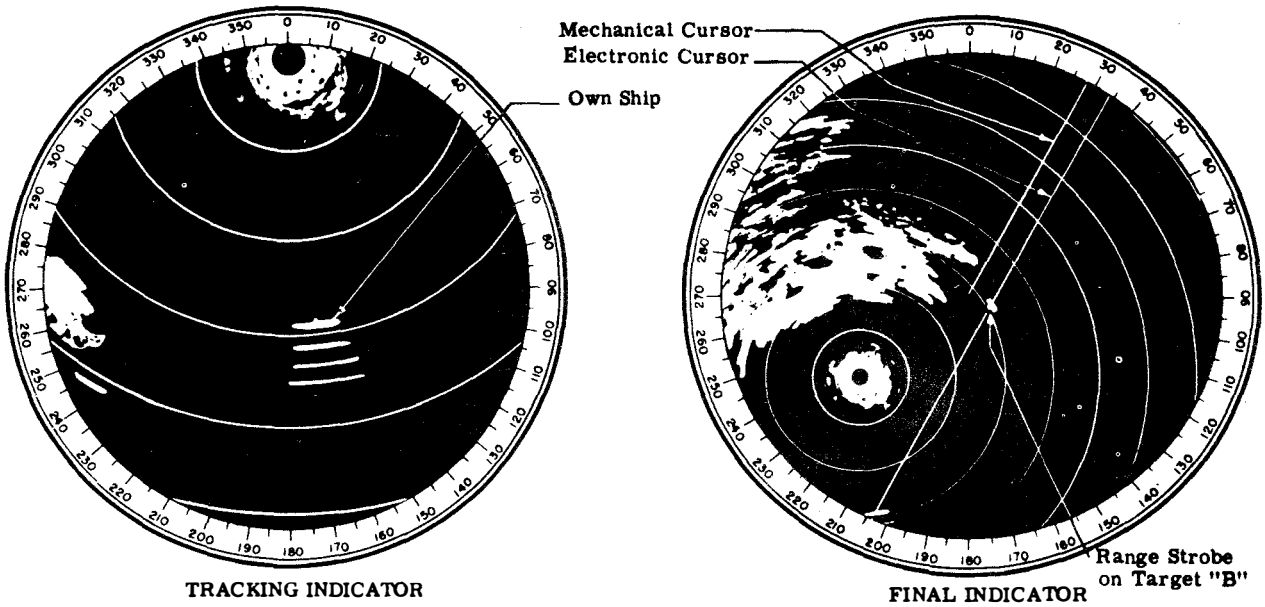
(8) Turn off the equipment.

(9) Secure the equipment.

Note

A reproduction of the Operating Instruction Charts (in accordance with MIL-C-17581, Charts, Operating Instructions, for Ship or Shore Electronic Equipment) may be substituted in lieu of the above.

b. AUXILIARY CONTROLS AND SWITCHES. — The locations of important auxiliary switches and



TRACKING INDICATOR

FINAL INDICATOR

The tracking indicator display has been expanded so that the tracking may be effected more accurately. The final indicator display is manually off-centered so that target "B" appears near the center of the display. Since the origin of the electronic cursor is the location of the tracking strobe, the electronic cursor and mechanical cursor are no longer coincident.

Figure 3-2. Expansion of Indicator Display

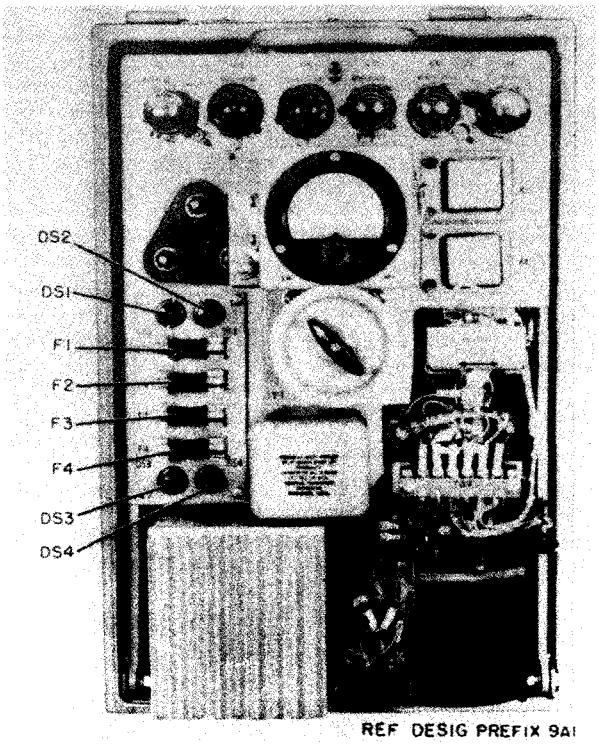


Figure 3-3. Voltage Regulator CN-167/XXX-1, Fuse and Fuse Indicator Locations

controls (such as the main power and antenna switches) not mounted on the equipment itself should be specified.

c. CAUTION AND WARNING NOTICES. —Include adequate caution and warning notices.

3-5. EMERGENCY OPERATION.

Where applicable, include instructions for substitute methods of operation, similar to the following:

a. OTHER THAN NORMAL. —These are instructions to be included for changing to an alternate method of operation (such as "Battle Short" operation, local operation, etc) when the normal method is not possible due to emergencies or unusual conditions.

b. JAMMING. —These are to consist of instructions for the operation of the equipment in the presence of jamming signals.

3-6. OPERATOR'S MAINTENANCE.

a. OPERATING CHECKS AND ADJUSTMENTS. —Include operating checks and adjustments which must be made by the operator prior to or during operation. Coverage should be similar to the operating procedures in paragraph 3-3, including procedures for the use of all built-in test features. The text can be brief and arranged in steps, with reference made to all appropriate controls. Any necessary precautions are to be included.

b. PREVENTIVE MAINTENANCE. —This is to include information covering the preventive maintenance to be performed by the operator. If Maintenance Standards Books have been provided, they should be referred to for the necessary information; if separate books are not provided, Section 5 should be referenced for the required preventive maintenance information.

c. EMERGENCY MAINTENANCE. —This covers information to be included for such emergency maintenance as operating personnel are expected to perform. Provide instructions and precautions for the replacement of fuses and assemblies within the capabilities of the operator, in order to permit emergency repair during battle conditions when the technician is not available. Tables and illustrations which indicate symptoms of probable fuse failures, fuse and fuse indicator locations, etc (see figure 3-3) should be included.

3-7. COLOR CODE CHART (TEST EQUIPMENT MANUALS ONLY).

For technical manuals covering resistance or capacitance measuring equipment, provide a color code chart at the end of Section 3. The chart should cover only those items which the equipment is intended to measure; e.g., resistor color codes should be supplied if the equipment is an ohmmeter resistance bridge, and capacitor color codes if it is a capacitance bridge.

SECTION 4

TROUBLE SHOOTING

This section is to contain all the information required by the electronics technician to quickly and efficiently locate the cause of an equipment malfunction or performance deterioration. When historical data is inadequate, information should be based on the six logical steps (paragraph 4-1a through 4-1f). Materials to be included are as follows: equipment over-all functional description and functional block diagram; over-all functional description of each functional section, together with its functional block diagram, servicing block diagram, and pertinent test data; detailed functional description, simplified schematic diagram, servicing block diagram information, and applicable test data for individual portions of functional sections.

The functional descriptions should be presented in a clear, logical manner and at such a level as to be clearly understood by a graduate of an Electronics Technicians Class "A" school. The use of mathematics should be held to a minimum. Clear and logical explanations should also be given for complex electromechanical, mechanical, and hydraulic devices. Functional block, servicing block, and simplified schematic diagrams may be provided to support the functional descriptions.

Such items as test equipment list, performance data, performance indicating devices (front panel indicators), critical adjustment checks, test-point information, parts location information, and other pertinent information or data will prove valuable as aids to the trouble shooting. It is not necessary to include information on lengthy procedures that are described in NAVSHIPS 91828, Handbook of Test Methods and Practices; reference may be made to NAVSHIPS 91828 for this information.

Even though adequate historical data is available, or approval has been granted to use a different trouble-shooting approach, whereby trouble-shooting charts are to be provided, the functional descriptions noted above should be included.

4-1. LOGICAL TROUBLE SHOOTING.

When adequate historical data is not available, trouble-shooting procedures should be based on the following six logical steps. Information describing the technique of trouble shooting, equivalent to the following, is to be included as part of the first paragraph of the trouble-shooting section:

Note

When other techniques of trouble shooting have been approved, the opening paragraph is to present the concept of trouble shooting used.

a. SYMPTOM RECOGNITION. —This is the first step in the trouble-shooting procedure and is based on a complete knowledge and understanding of equipment operating characteristics. All equipment troubles are not the direct result of component failure. Therefore, a trouble in an equipment is not always easy to recognize since all conditions of less than peak performance are not always apparent. This type of equipment trouble is usually discovered while accomplishing preventive maintenance procedures, such as the PQMSEE checks. It is important that the "not so apparent" troubles, as well as the apparent troubles, be recognized.

b. SYMPTOM ELABORATION. —After an equipment trouble has been "recognized", all the available aids designed into the equipment should be used to further elaborate on the original trouble symptom. Use of front panel controls and other built-in indicating or testing aids should provide better identification of the original trouble symptom. Also, checking or otherwise manipulating the operating controls may eliminate the trouble.

c. LISTING PROBABLE FAULTY FUNCTION. —The next step in logical trouble shooting is to formulate a number of "logical choices" as to the cause and likely location (functional section) of the trouble. The "logical choices" are mental decisions which are based on knowledge of the equipment operation, a full identification of the trouble symptom, and information contained in this manual. The over-all functional description and its associated block diagram should be referred to when selecting possible faulty functional sections.

d. LOCALIZING THE FAULTY FUNCTION. — For the greatest efficiency in localizing trouble, the functional sections which have been selected by the "logical choice" method should be tested in an order that will require the least time. This requires a mental selection to determine which section to test first. The selection should be based on the validity of the "logical choice" and the difficulties in making the necessary tests. If the tests do not prove that functional section to be at fault, the next selection should be tested, and so on until the faulty functional section is located. As aids in this process the manual contains a functional description and a servicing block diagram for each functional section. Waveforms (or other pertinent indications) are included at significant check points on servicing block diagrams to aid in isolating the faulty section. Also, test data (such as information on control settings, critical adjustments, and required test equipment) are supplied to augment the functional description and servicing block diagram for each functional section.

e. LOCALIZING TROUBLE TO THE CIRCUIT. —After the faulty functional section has been isolated, it is often necessary to make additional "logical choices" as to which group of circuits or circuit (within the functional section) is at fault. Servicing block diagrams for each functional section and individual functional circuit groups (when required) provide the signal flow and test location information needed to bracket and then isolate the faulty circuit. Functional descriptions, simplified schematics, and pertinent test data for individual

circuits or groups of circuits comprising the functional section are all placed together in one area of the manual. Insofar as is practicable, this information is contained on facing pages. Information which is too lengthy in nature to be included in this arrangement is readily referenced from the test data portion of the trouble-shooting information.

f. FAILURE ANALYSIS. —After the trouble (faulty component, misalignment, etc) has been located (but prior to performing corrective action), the procedures followed up to this point should be reviewed to determine exactly why the fault affected the equipment in the manner it did. This review is usually necessary to make certain that the fault discovered is actually the cause of the malfunction, and not just the result of the malfunction.

4-2. OVER-ALL FUNCTIONAL DESCRIPTION.

Include a functional explanation of the operation of the complete equipment, using an over-all functional block diagram (see figure 4-1) to illustrate the functional relationship of the sections (one block per functional section). The functional sections of a typical radar might include the following: modulator circuits, transmitter circuits, receiver circuits, servo system mechanisms, indicator circuits, built-in testing circuits, and antenna system. A list of typical functional sections of other types of equipment will be provided by the bureau or agency concerned upon request. In explaining the relationship of various functional sections to each other and to auxiliary equipment, some points that are to be clarified are as follows:

a. Signal or control sequence and general appearance of input and cutput signals or waveforms, for all functional sections within the signal path. Insofar as practicable, data flow on illustrations is to proceed from left to right and from top to bottom.

b. Name and general function of all auxiliary circuits and mechanisms, such as power supplies, external triggering devices, control information, etc.

c. Reference to over-all equipment performance characteristics, such as expected pick-up ranges of radar or sonar sets, expected reception or transmission ranges of communications equipment, etc. For specific data pertinent to the actual equipment being serviced, the technician should be told to refer to his Performance Standard Sheet.

4-3. FUNCTIONAL SECTION DESCRIPTION.

a. OVER-ALL FUNCTIONAL SECTION DESCRIPTION. —Provide a functional description of the operation of each functional section in terms of its functional circuit group(s). The breakdown of the section into circuit groups will depend on the section complexity (see figure 4-4 for sample breakdown of a radar receiver). The discussion is to be kept on the circuit group level and should identify each of the functional circuit groups comprising the

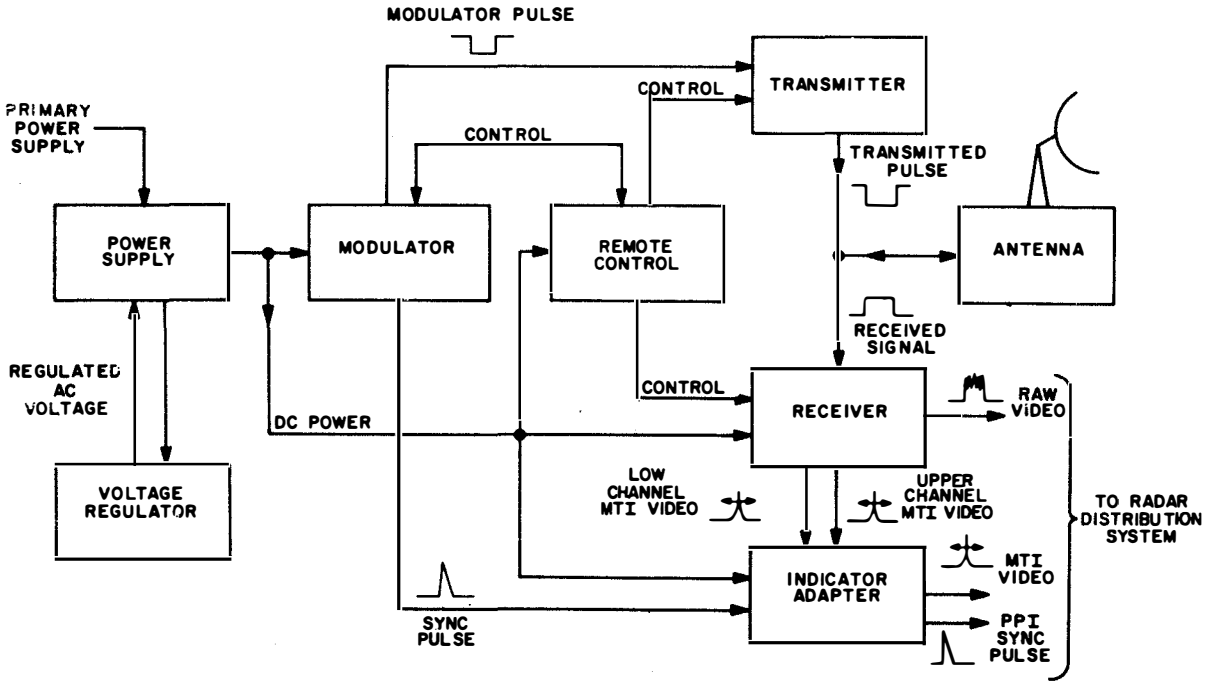


Figure 4-1. Radar Set AN/XXX-1, Over-all Functional Block Diagram

section, explaining the relationship of the group function with respect to the over-all section function. The functional operation of each circuit group, with respect to major signal changes within the group, should then be discussed, stressing such items as input or output information and the effects of auxiliary signals (or control) on the group. All discussions must follow a logical sequence of events pertaining to the main signal flow through the section. If the section is large or complex in nature, include a functional block diagram of the section (see figure 4-4); otherwise, a reference to the functional section servicing block diagrams will suffice (refer to paragraph 4-4). Functional diagrams for digital devices (such as the computer portion of an early warning radar set) are to incorporate the logic symbol requirements of Standard MIL-STD-806, Graphical Symbols for Logic Diagrams.

b. OVER-ALL FUNCTIONAL SECTION TEST DATA. —Include the following:

(1) Information which will aid in determining the over-all performance of the individual functional section, such as transmitter power, receiver sensitivity, power supply outputs, etc.

(2) Information on tests which, when performed, will either pinpoint or eliminate the functional section under consideration. Reference should be made to the functional section servicing block diagram for circuit location of test points.

(3) A list of test equipment and special tools needed to perform testing on the functional-section level (refer to paragraph 4-10).

(4) A list of all indicating devices (listing normal indications) and pertinent controls that will aid in determining the operating performance of the functional section (refer to paragraph 4-8).

(5) A list of all critical adjustments or alignment procedures which affect the operation of the functional section (refer to paragraph 4-9).

(6) All information required to perform available programmed or automatic testing procedures that aid in determining which functional section is at fault (refer to paragraph 4-11).

(7) A complete and comprehensive servicing block diagram of the functional section (refer to paragraph 4-5).

(8) Illustrations (or references to the illustrations in Section 5) for locating, physically, such items as test points, indicators, controls, and parts, and references to the over-all or unit schematics applicable to the functional section.

(9) Any other pertinent information which will serve as an aid in locating faulty functional sections.

(10) Any notes, cautions, or warnings necessary for explanations or for preventing damage to equipment or injury to personnel.

c. CIRCUIT (STAGE) DESCRIPTIONS. —As a further aid in the explanation of the functional section, each circuit making up the functional section is to be discussed in a logical manner, tracing the main signal flow through the functional section. Circuit descriptions should follow sequentially the applicable functional section information. To the extent possible, plan the arrangement of the circuit discussion (or portions thereof) so that the circuit functional description, simplified schematic diagram, and applicable test information will appear on the same or facing pages (see figure 4-2 for suggested page layout). The number of circuits covered on any one such layout will depend on the complexity and the amount of space required to provide the description of the functional operation, the simplified schematic diagram, and the test data.

(1) FUNCTIONAL DESCRIPTION. —Provide essential information on the functional operation of the circuit. The discussion should proceed logically from one circuit to the next and should be limited to the functional operation of each circuit. An "electron chase" is not necessary unless the circuit is sufficiently complex or unique to warrant this treatment. The functional description of a sample circuit might be as follows: a description of the input signal (voltage, waveform type and polarity, etc) and any auxiliary inputs (or outputs); how the output of the circuit is developed (explaining the function of the more important circuit components and their effect on the signal); then a description of the circuit output(s) and its relationship to other circuits. It is not necessary to describe in detail conventional circuits which are covered in basic electronics courses or those described in the Handbook of Electronic Circuits NAVSHIPS 900,000. 102 (see Appendix I for an outline of the circuits covered; a reference to NAVSHIPS 900,000. 102 for such descriptions is sufficient. Discussion of such circuits can be limited to the unique features or parts arrangements (if any) that vary from those described in the Handbook of Electronic Circuits, and the input and output signals and their relationship to associated circuitry. The functioning of those electromechanical or hydraulic devices whose complexity so warrant should also be described. Such items as construction details may be subordinated, but emphasis should be placed on the over-all purpose and relationship of electronic functions.

(2) SIMPLIFIED SCHEMATIC DIAGRAM.— Provide a simplified schematic diagram (see figure 4-3) for the circuit (or portions thereof) under discussion in the functional description. The diagram is to identify circuit elements (parts) by graphical symbols and reference designations complying with the requirements of Section 5. Main signal paths are to be distinguishable from auxiliary signal paths. Show waveforms of voltages at significant points. Data flow should proceed from left to right and from top to bottom, wherever possible. Also, wherever possible, locate the simplified schematic diagram on the same page as its applicable functional text discussion, or on the facing page.

(3) TEST DATA. —Cover pertinent test data for the circuit (or portions thereof) under discussion in the functional description. Listed below are some of the items (but not necessarily all) that are to be covered:

(a) Reference to the applicable servicing block and unit schematic diagrams.

(b) A list of all critical adjustments or alignments which might affect circuit operation. References to Section 5 for actual procedures should be included.

(c) Procedures for performing any

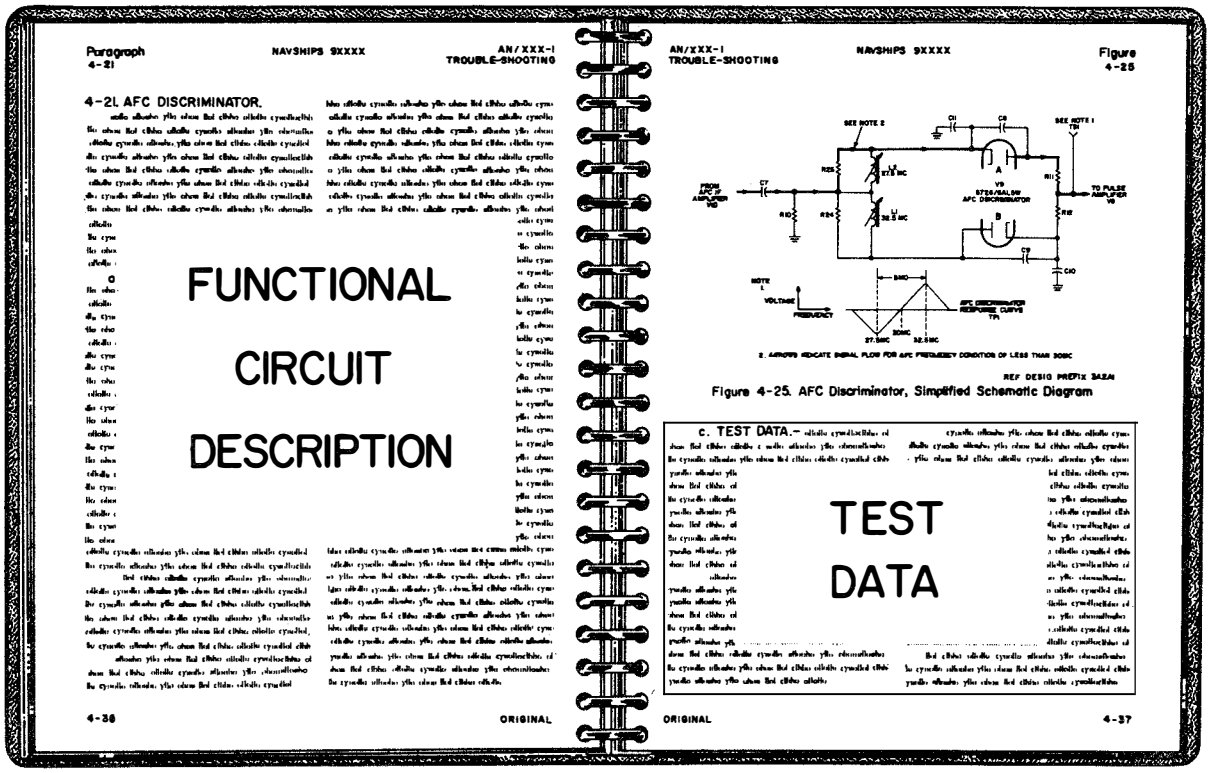


Figure 4-2. Sample Page Layout for Functional Circuit or Stage Descriptions

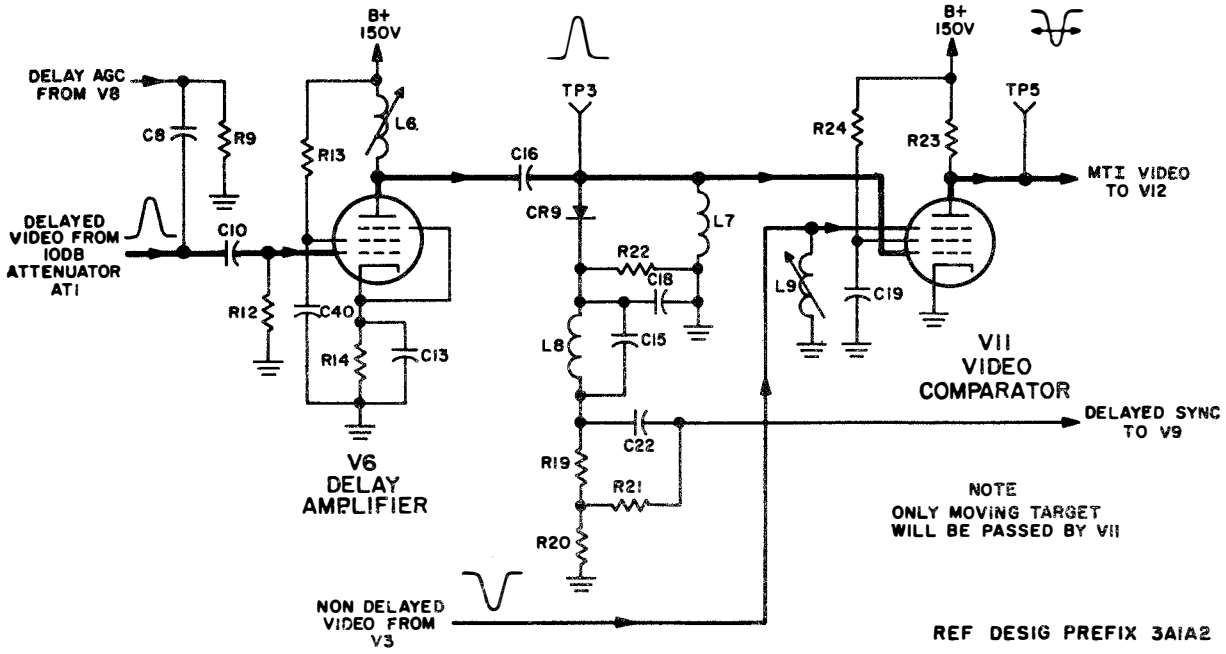


Figure 4-3. MTI Comparator, Simplified Schematic Diagram

available programmed or automatic testing procedures (if available) which can be used to isolate faulty circuits.

(d) A list of test equipment and special tools used in isolating faulty circuits and parts.

(e) Reference to schematic diagram (in Section 5) for resistance chart and tube pin socket voltage values associated with circuit test data.

(f) References to illustrations (in Section 5) which call out the physical locations of test points associated with the circuit under test.

(g) Any other pertinent information which will serve as an aid in locating faulty circuits and parts.

(h) Any notes, cautions, or warnings necessary for explanations, or for preventing damage to equipment or injury to personnel.

4-4. FUNCTIONAL SECTION BLOCK DIAGRAMS.

Provide a functional block diagram (see figure 4-4) of each functional section, showing the following: functional assemblies and mechanisms (servos, etc); their relationship to each other and to external or auxiliary circuits; input and output signals (by name) for both the functional section and each of its internal functional assemblies; and theoretical waveforms, if applicable. These diagrams should: represent each functional group of circuits (examples: modulator trigger circuits, receiver AFC circuits, receiver STC circuit) by a block, showing functional mechanisms (examples: indicator servo system, antenna positioning gear system, transmitter tuning motor drive) isometrically or perspectively; represent important electrical interconnections by single lines; represent data flow direction of current (or control) by arrows between the units; indicate source or destination of all input signals to and output signals from the functional section. Insofar as practicable, all data flow is to proceed from left to right and from top to bottom.

Note

If the functional section consists of a relatively small number of circuits or is not of a complex nature, and the functional section servicing block diagram adequately fulfills the block diagram requirements, then reference can be made to this illustration instead of preparing a separate block diagram.

4-5. SERVICING BLOCK DIAGRAMS.

These are to provide the maintenance technician with a pictorial guide for use in trouble shooting. A servicing block diagram is to be provided for each functional section of the equipment (see figure 4-5). If the equipment is small and relatively simple in design, the servicing block diagram for the entire equipment may be included in a single illustration (see figure 4-7). If size or complexity requires, each functional group of circuits within a functional section should also be represented by a servicing block diagram (see figure 4-6). These diagrams are to be presented on fold-in sheets located at the end of the section, each sheet having page size apron so that the diagram can be viewed while the manual is open at another point. The planning of servicing block diagrams is to be based on the following:

a. Servicing block diagrams must include all circuits of the equipment, functional section, or functional group of circuits, as applicable. Each functional section or functional group of circuits is to be enclosed by phantom lines, using a heavier weight phantom line for enclosing a functional section than those enclosing a functional group of circuits (see figures 4-5 and 4-7). The descriptive name of each functional section or group of circuits should be placed at the bottom of the enclosed area.

b. Main signal or data flow paths are to be represented by heavy lines. Lighter weight lines can then be used for auxiliary or secondary signal or data paths. Signal or data flow is to progress from left to right and from top to bottom, whenever possible, with inputs entering from the left or top and outputs leaving at the right.

c. Tubes (or semiconductors) must be shown as separate blocks, except tubes of identical circuits (such as the circuits in an i-f strip); such circuits may be represented by an elongated block, which is of sufficient length to accommodate the lettering (see figure 4-7, subassembly 1A2A2, stages V3 to V7). Multivibrators and other circuits having dual sections which perform the same function (such as a parallel power amplifier) can be drawn as a double block (see figure 4-7, subassembly 1A2A3, tubes V1A and V1B). The name of the circuit or tube and its designation is to be included within the tube block. For uniformity, individual circuit blocks should have a ratio of height to width of two to three (except when greater width is necessary to accommodate lettering). When more than one circuit or tube is represented by a block, the block width can be increased to accommodate the additional lettering required. The circuit blocks are to be drawn using heavy weight lines. Tube or semiconductor elements involved in the signal flow path, plus other elements which have special significance, are to be labeled outside the circuit block, to the left or above the flow path, using the following abbreviations:

TUBES	TRANSISTORS
P - Plate	E - Emitter
G - Grids	C - Collector
K - Cathode	B - Base

The element (pin) number must also be indicated below or to the right of the flow path.

For clarity, the height-to-width ratio of transformers should be two to one, and that of delay lines, inductors, etc, one to one. The above ratios can be increased to accommodate lettering whenever the need arises.

d. To indicate the direction of flow, arrowheads should be superimposed on, or placed adjacent to, signal or data flow paths.

e. The actual physical and electrical layout of items of an electromechanical nature (such as waveguides, duplexers, transducers, tuned cavities, synchros, and electrically or mechanically driven gear trains) are to be represented as closely as possible without unduly complicating the block diagram.

f. When required for clarity, such items as switch contacts, relay contacts, potentiometers, tuning capacitors, terminal strips, jacks and plugs, test points, coaxial connectors can be drawn schematically, using the appropriate symbols as required by Standard MIL-STD-15-1, -2, -3. When individual connections to a terminal board are illustrated, the terminal board number and the terminal numbers are to be indicated.

g. Waveforms for inputs, outputs, and applicable test points must be illustrated on the diagram (refer to paragraph 4-7).

h. Operating or adjustment controls which require illustration are to be indicated by a dotted line extending from the circuit to a small circle. If the control is a screwdriver adjustment, two parallel lines should be drawn through the circle to indicate a slot. The control reference designation and the name or function must also be indicated. If the control is a front panel operating control, its name is to be enclosed within a rectangular box. Example:

RCVR GAIN

i. All external signals that affect elements in the diagram are to be labeled to indicate their source and function.

j. Include notes to explain such items as the following: the method of indicating controls, switches, relays, etc; tube element designation and numbering; type of oscilloscope used to obtain waveforms; symbols placed by waveforms; equipment control settings; also, any other explanations which are too lengthy to include in the diagram.

4-6. WAVEFORMS.

Idealized (rather than actual or theoretical) waveforms are to be included on servicing block diagrams for all significant test points (i.e., not limited to only those points provided as "front panel" test jacks). Idealized waveforms are those that represent the waveform in such a manner that no other information or explanation will be required to distinguish between a correct presentation and an incorrect one. Information pertaining to amplitude, time, duration, and phase relationships for significant portions[1] of the waveform should be included in the waveform illustration. It is important that the waveforms represented be those viewed using an approved Navy oscilloscope. The type of oscilloscope used is to be indicated, along with any required control setting data (for the equipment as well as the oscilloscope), in notes that accompany the illustration on which the waveform is shown. Waveforms must not be shown with a black background. If the number of waveforms to be illustrated is large or if the illustration layout would be affected adversely, waveforms may be grouped on the illustration apron (if space is available) or on a facing page. If this arrangement is used, each waveform is to be identified on the diagram and in the grouping by a test-point symbol.

[1]Significant portions of a waveform are those portions on which the operation of the circuit itself or succeeding circuits is based.

4-7. TEST POINTS.

Significant test points throughout the equipment (not necessarily limited to those provided as "front panel" test jacks) are to be identified on servicing block diagrams (see figures 4-5, 4-6, and 4-7) and on parts location illustrations (see figures 5-1 and 5-2) by the use of test-point symbols. Assign star test-point symbols to those test points which are used to isolate functional sections or circuit groups in trouble shooting. Circle test points are to be assigned to those points which are helpful in isolating faulty circuits. Information available at the indicated test points, such as waveforms and critical voltages, should be shown on the illustration (not required on parts location illustrations).

4-8. PERFORMANCE INDICATORS.

As a portion of the applicable test data information, include a list of all indicating devices which can be used to determine the operating condition of the functional section, or circuit (as applicable). All normal indications should be given for such devices; also any control settings which affect or govern the operation or indication of these devices. This information is to be presented in a concise form (preferably tabular) for convenient access by the technician. Reference should also be made to the tables and illustrations in Section 3 which indicate the symptoms of probable fuse failures and the locations of fuses.

4-9. ADJUSTMENTS AND ALIGNMENTS.

As a portion of the applicable test data information, include a list of all critical adjustments or alignments which, if maladjusted, would cause faulty operation. Reference can be made to the adjustment procedures in Section 5 for the actual procedure. The list is to indicate the circuit and/or function affected and the name of the adjustment, in addition to referencing the adjustment procedure.

4-10. TEST EQUIPMENT AND SPECIAL TOOLS.

Include as a portion of the applicable test data information a list of all test equipment and special tools required (and equivalents, if available). The test equipment, used for the testing of equipment under the cognizance of the Bureau of Ships, should be selected from NAVSHIPS 91727, Electronic Test Equipment Application Guide, or that selected with guidance from the bureau or agency concerned.

4-11. PROGRAMMED TESTING.

Where automatic or programmed testing is incorporated in an equipment, include complete instructions for the performance of such testing. If further testing is required to isolate faulty circuits or parts, a statement at the end of the procedure is to be added to indicate the additional tests that should be made.

NOTE

Figure 4-4 is a typical functional block diagram for one functional section of an equipment. If the equipment is relatively simple in design, figure 4-4 can be omitted and reference made to the applicable servicing block diagram (see figures 4-5 and 4-7).

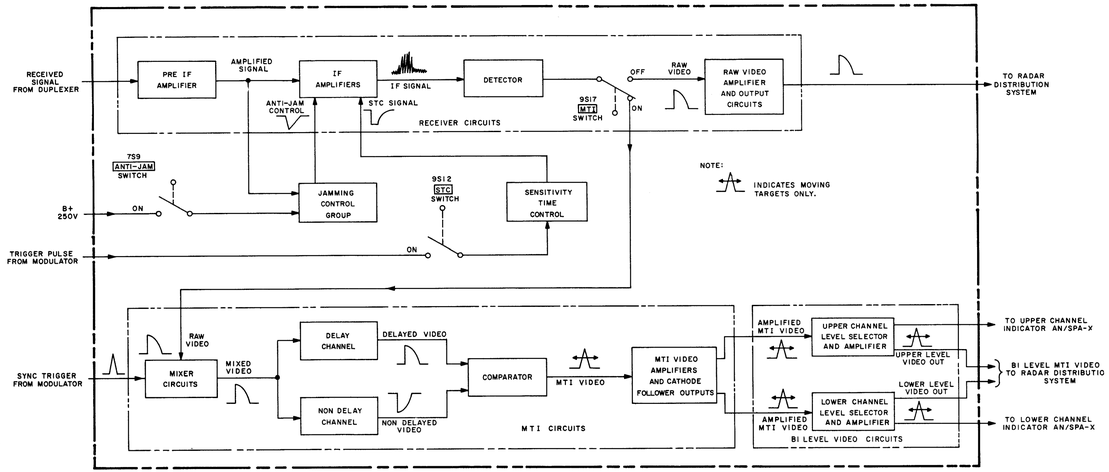


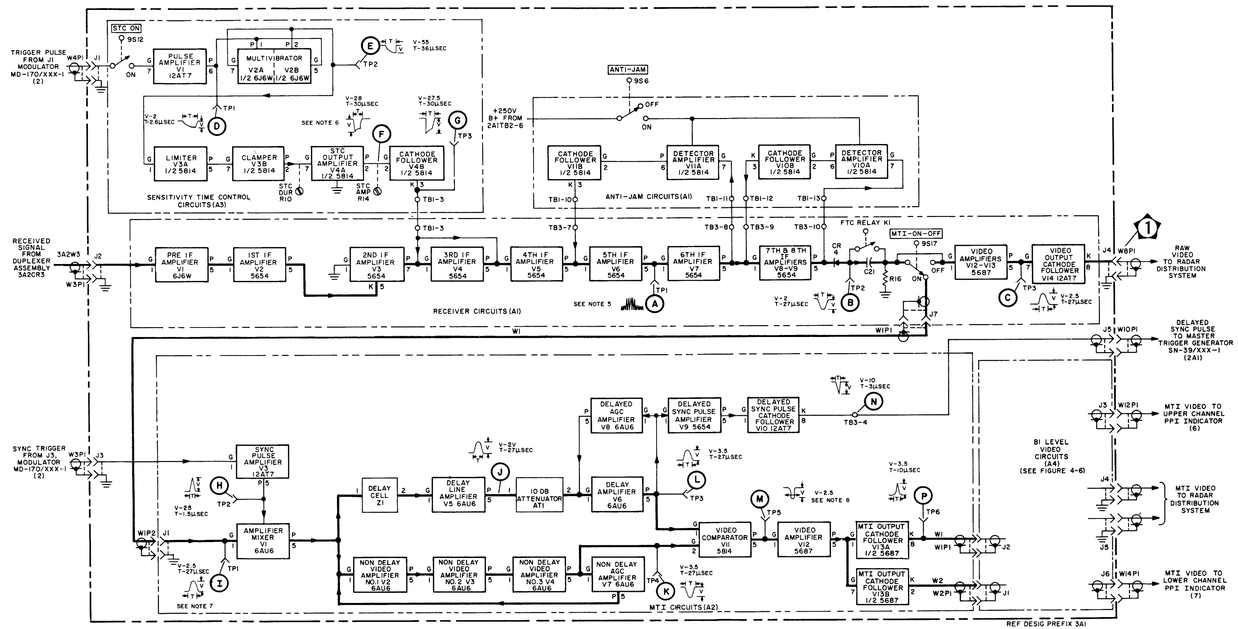
Figure 4-4. Receiver R-104/XXX-1, Functional Block Diagram

4-12. SUBASSEMBLY TESTERS.

The Bureau of Ships recognizes that there will be instances when specially-designed test devices will be used for the trouble shooting and repair of certain plug-in subassemblies (small subchassis, circuit boards, etc). In such cases the equipment technical manual should treat the subassemblies as individual parts. The trouble shooting and repair of the plug-in subassemblies must then be included in a separate section or manual for the special tester.

NOTE

Figure 4-5 is a typical servicing block diagram for one functional section of an equipment. If the section is complex, each circuit group within the section can be represented by a separate servicing block diagram (see figure 4-6). If all sections of the equipment are relatively simple, they can be covered in a single over-all equipment servicing block diagram (see figure 4-7).



NOTES:

1 – HEAVY LINES INDICATE MAIN SIGNAL PATH; LIGHTS LINES INDICATE AUXILIARY OR SECONDARY SIGNAL PATHS.

2 – LETTERS AND NUMBERS OUTSIDE TUBE BLOCKS INDICATE ELEMENT AND PIN (SOCKET) NUMBER. NUMBERS ON COILS, TRANSFORMERS, ETC INDICATE TERMINAL NUMBER.

3 – WAVEFORMS RECORDED USING OSCILLOSCOPE AN/USM-24. OSCILLOSCOPE CONTROL SETTINGS:
V MULTIPLIER–10, V GAIN–1/2
SYNC–SIGNAL (INT), H GAIN–1/2

4 – EXPLANATION OF SYMBOLS PLACED AT WAVEFORMS:
T–DURATION OF THE PORTION OF THE WAVEFORMS INDICATED.
V–PEAK VOLTAGE.

5 – TIME AND AMPLITUDE DEPENDENT ON TYPE OF CLOSE-IN CLUTTER RECEIVED.
OPERATING CONTROL SETTINGS:
ANTI-JAM SWITCH (95I6)–OFF
STC SWITCH (95I2)–OFF

6 – OPERATING CONTROL SETTINGS:
STC DUR (3A1A4R10)–MAX CW
STC AMP (3A1A4R14)–MAX CW

7 – OPERATING CONTROL SETTINGS:
MTI SWITCH (95I7)–ON
STC SWITCH (95I2)–OFF
ANTI-JAM SWITCH (95I6)–OFF

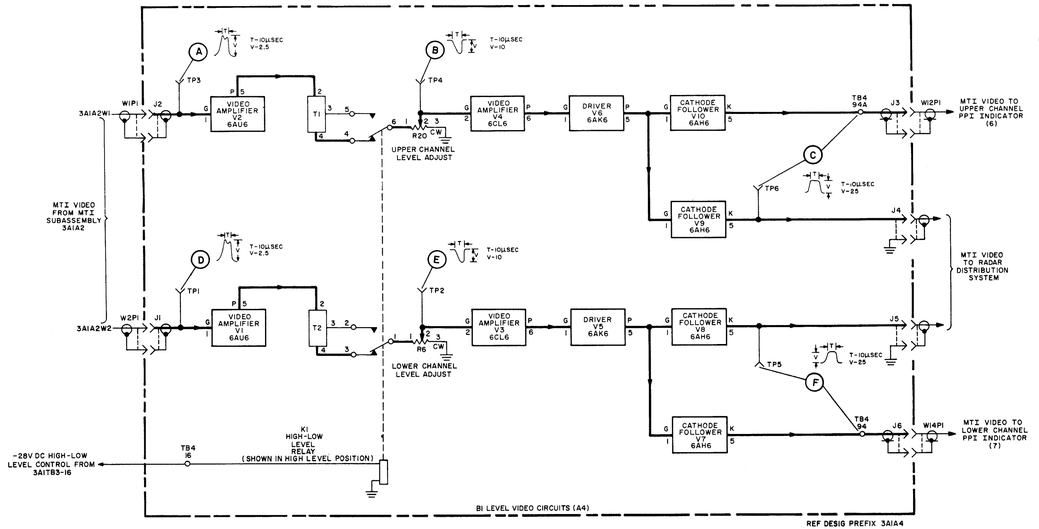
8 – ONLY THOSE TARGETS WHICH ARE MOVING TOWARD OR AWAY FROM THE RADAR WILL BE PASSED BY THE VIDEO COMPARATOR (3A1A2VII)

Figure 4-5. Receiver R-104/XXX-1, Servicing Block Diagram

NOTE

Figure 4-6 is a typical circuit group servicing block diagram, used for the more complex equipments.

SECURITY CLASSIFICATION
NAVSHIPS 94500(A)
SECURITY CLASSIFICATION
NAVSHIPS 94500(A)
SECURITY CLASSIFICATION
NAVSHIPS 94500(A)



NOTES:

1 – HEAVY LINES INDICATE MAIN SIGNAL PATHS; LIGHT LINES INDICATE AUXILIARY OR SECONDARY SIGNAL PATHS.

2 – LETTERS AND NUMBERS OUTSIDE TUBE BLOCKS INDICATE ELEMENT AND PIN (SOCKET) NUMBER. NUMBERS ON COILS, TRANSFOMERS, AND OTHER PARTS INDICATE TERMINAL NUMBERS.

3 – WAVEFORMS RECORDED ON OSCILLOSCOPE AN/USM-24.
OSCILLOSCOPE CONTROL SETTINGS:
V MULTIPLIER –10, V GAIN –1/2
SYNC–SIGNAL (INT), H GAIN –1/2

4 – EXPLANATION OF SYMBOLS PLACED AT WAVEFORMS:
T–TIME DURATION OF PORTION OF WAVEFORM INDICATED
V–PEAK VOLTAGE OF WAVEFORM.

5 – OPERATING CONTROL SETTINGS:
MTI SWITCH (9S17)–ON
STC SWITCH (9S12)–OFF
ANTI–JAM SWITCH (9S6)–OFF
VIDEO LEVEL SWITCH (9S16)–HIGH

Figure 4-6. Bi-Level Video Amplifier AM-101/XXX-1, Servicing Block Diagram

NOTE

Figure 4-7 is a typical over-all equipment servicing block diagram, used for a simple equipment.

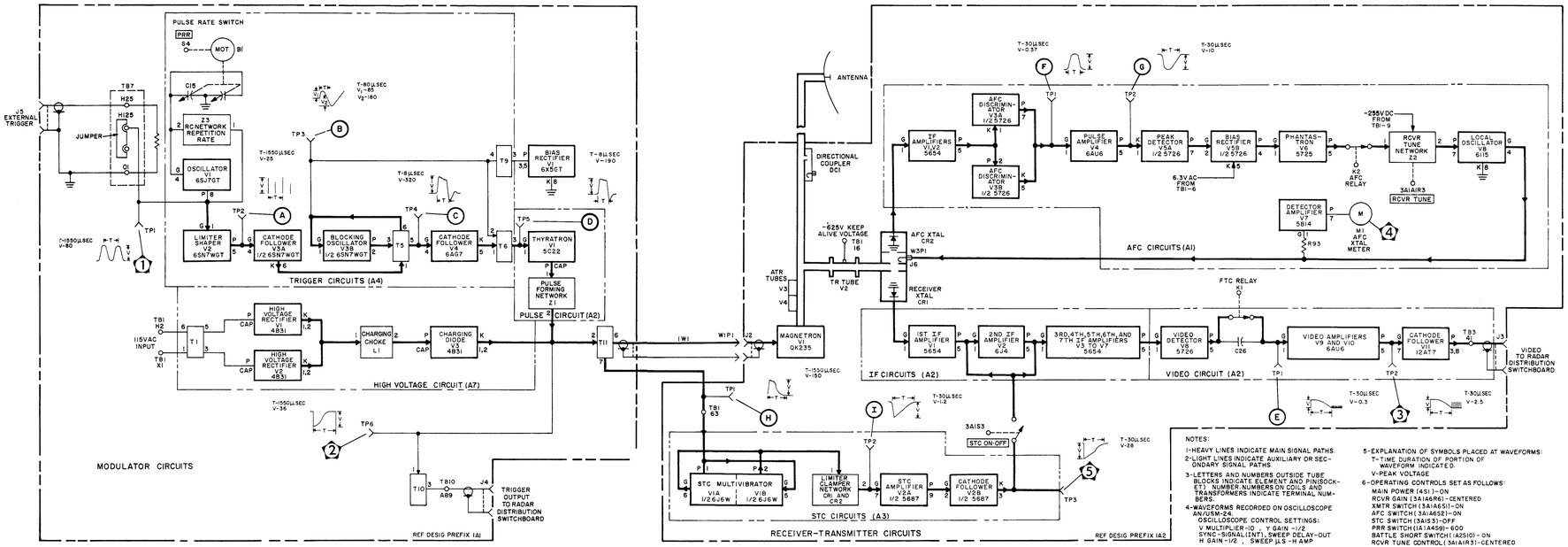


Figure 4-7. Radar Set AN/XXX-1, Servicing Block Diagram

SECTION 5

MAINTENANCE

This section is to provide all the information and instructions required for preventive maintenane and repair. It is important that the maintenance data contain adequate information for the performance of all preventive maintenance required to maintain the equipment, while the repair data is to provide adequate information for removal, repair, replacement, and adjustment required as a result of a repair. The maintenance and repair data is best presented on a unit-by-unit basis. Where procedures required for maintenance or repair are the same for more than one unit, assembly, subassembly, etc, the procedures should be given for only one unit and references made to these procedures for the other unit.

All preventive maintenance procedures and test inspections are to be included in this section if they are not required to be supplied in a separate Maintenance Standards Book. When maintenance standards information is incorporated, it is necessary that the maintenance portion of this section provide performance checks and routine maintenance procedures. Typical checks and tests should include (but are not limited to) the following: electrical and mechanical items, cleaning and inspection, and lubrication. Each of the procedures for the preceding items must be properly illustrated. Acceptable limits of performance for the applicable procedures must also be established and included within the procedure chart. In general, the procedure is to indicate what is to be done, when to do it, how to do it, and the expected results. Lubrication instructions are to include the manufacturer's recommendations on lubrication, the type of lubricant to use, and the time intervals for lubrication. Lubricants should be identified by military specification numbers or commercial designations, as applicable.

The repair instructions are to provide for the removal, repair, adjustment, and replacement of all items which are within the ability of the electronics technician to perform.

5-1. FAILURE, AND PERFORMANCE AND OPERATIONAL REPORTS.

A note similar to the following is to be included as the first paragraph in Section 5:

Note

The Bureau of Ships no longer requires the submission of failure reports for all equipments. Failure Reports and Performance and Operational Reports are to be accomplished for designated equipments (refer to Electronics Installation and Maintenance Book, NAVSHIPS 900,000) only to the extent required by existing directives. All failures shall be reported for those equipments requiring the use of Failure Reports.

5-2. PREVENTIVE MAINTENANCE.

This section of the manual and the Maintenance Standards Book together are to provide complete and comprehensive preventive maintenance information so that proper equipment operation can be maintained. When Maintenance Standards Books are required as an item of the contract, the information called for by paragraph 5-2a is not necessary.

a. MAINTENANCE STANDARDS. —When Maintenance Standards Books are not required in the contract or order, the preventive maintenance portion of this section is to contain all the instructions necessary for performing preventive mechanical and electrical maintenance. Coverage is to be as follows:

(1) TEST EQUIPMENT AND SPECIAL TOOLS. —This is to consist of a list of the test equipment and special tools required to perform the preventive maintenance procedures.

(2) SPECIAL PROCEDURES. —These are to include detailed procedures that are prerequisite to performing the preventive maintenance procedures, such as preliminary control settings, calibration and adjustment information, and instructions for making special jigs or adapters.

(3) REFERENCE STANDARDS PROCEDURES. —A "Reference Standards Procedures" chart, equivalent to that shown in table 5-1, is to be provided. The tabulation should subdivide the test procedures by functional sections corresponding to the functional sections of the set or system (see Section 4), and reference should be made in the table to the period and step that contain the instructions required for performing each procedure. A note similar to the following is to precede the table:

Note

The procedures listed below consist of the minimum number of reference standards which will indicate, when completed, the relative performance of the set or system. Each group of tests represents a functional section of the set or system. The procedures are listed in the suggested sequence of performance; however, deviation from the listed order will in no way affect the unity or result of the reference standards, unless otherwise noted.

(4) PREVENTIVE MAINTENANCE PROCEDURES. —The instructions for performing the preventive maintenance procedures are to be given in a series of procedure tables and illustrations in accordance with Specification MIL-M-21741, except that provisions for recording the actual standards or actions taken need not be included and procedures need only be identified by a number (stars or circles not required). The procedures are to be arranged numerically within each maintenance period. Non-scheduled reference standards tests (those reference

TABLE 5-1. REFERENCE STANDARDS PROCEDURES

SECTION	ACTION REQUIRED	REFERENCE
TRANSMITTER	Record peak power output.	W1
RECEIVER	Record minimum discernible signal power.	W2
ANTENNA	Record VSWR meter M7 indication.	W3

standards tests that are not deemed necessary to be performed on a periodic basis) should be located at the end of the arrangement.

(5) PERIODIC SCHEDULE CHARTS. —Instructions (and possibly sample schedule charts) are to be provided for the preparation of periodic schedule charts to record or check the results obtained from the maintenance procedures listed in the reference standards procedures chart (see table 5-1).

b. TUNING AND ADJUSTMENT. —Include instructions for all tuning, alignment, and other adjustment procedures required to insure optimum equipment performance. Each procedure should include adequate notes, cautions, and warnings. The following data is to be listed, as applicable:

(1) TEST EQUIPMENT AND SPECIAL TOOLS. —List the test equipment and special tools required to perform the specific procedures.

(2) SPECIAL JIGS. — Provide instructions for making necessary special jigs, adapters, and test assemblies.

(3) CONTROL SETTINGS. —Include the preliminary control settings that should be made before starting the tuning or adjustment procedures. Indicate each control designation as it appears on the panel, followed by the reference designation in parentheses. When the number of control settings justify, tabulate the information.

(4) TEST SETUP. —This is to consist of a description of the test setup required to perform the procedure. For clarity, include a photograph (or line drawing) which provides call-outs of all adjustment controls, and illustrates the desired positions, settings, and connections of all test equipment.

(5) INSTRUCTIONS. — Provide step-by-step instructions for performing the required procedure. It may be necessary to supply calibration curves, waveforms, and other reference standards required to insure that optimum performance has been obtained. Reference may be made to standards included in this section, or (when more detailed information is required) to separate Maintenance Standards Books if they are supplied with the equipment.

5-3. REPAIR.

a. REMOVAL, REPAIR, AND REPLACEMENT OF PARTS, SUBASSEMBLIES, AND UNITS. —When the method or procedure is not obvious, include information concerning removal, repair, and replacement (or reassembly) of subassemblies, gears, bearings, electron tubes, thermometers, thermostats, crystals, relays, or other parts that are either subject to wear or are expected to require replacement during the service life of the equipment. To augment the information given, supply sufficient information to enable the technician to locate all parts and test points. In most cases, part location illustrations (paragraph 5-4a) will be sufficient if the FIG. NO. column of the Maintenance Parts List (table 6-2) includes references to the appropriate identifying illustration for such locations. (A statement pointing this out should be given.) In instances when parts location data is not available for inclusion in the maintenance parts list in Section 6, a cross-reference table containing information to aid in the location of each part is to be included with the applicable unit repair data, convenient to the appropriate parts location illustrations. Finally, there may be cases when an equipment contains printed circuit boards or other assemblies on which coordinates are permanently engraved. In these instances, tabular listings of parts locations can be supplied in lieu of illustration call-outs, provided the board or assembly is called out on an illustration. Throughout all repair procedures, it is recommended that adequate cautions and warnings be provided.

(1) REMOVAL. —This is the initial step in the repair procedure and is to consist of step-by-step procedures for removal of an item, and, if warranted by the complexity of the operation, procedures for disassembly of that item. Include instructions for the use of special jigs or fixtures used in the removal procedures.

(2) REPAIR.

(a) TEST EQUIPMENT. —This is to consist of a list of the test equipment and special tools required to perform the repair and any adjustment needed as a result of the repair.

(b) INSTRUCTIONS. — Provide instructions for making the necessary repairs (including cleaning and inspection, if required) and adjustments. It is necessary to provide special instructions covering the use and handling of radioactive and fluorescent devices, delicate instruments, etc, if improper use or handling could result in bodily injury or damage to the equipment. Any test methods calling for the use of oscilloscopes, signal generators, wavemeters, frequency meters, and other test devices are to be included. If the equipment being repaired employs voltages in excess of 300 volts, it is necessary to include a high-voltage warning together with a reference to NAVSHIPS 900,000, Electronics Installation and Maintenance Book, for high-voltage

measurement precautions. Standards must be included to help in determining when electron tubes (especially magnetrons), batteries, and other expendable items should be discarded. Reference may be made to standards included in separate Maintenance Standards Books, if they are supplied with the equipment. Include calibration curves for such items as selectivity, sensitivity, audio frequency response, crystal filter characteristics, and automatic volume control action if their inclusion is considered necessary for proper operating conditions. Provide information on tolerances, permissible wear limits, clearances, etc, as may be necessary for critical mechanical items.

(3) REPLACEMENT. —Provide all the necessary reassembly and/or reinstallation instructions, as may be warranted by the complexity of the operation. These instructions should cover pretesting, break-in procedures, adjustments, and lubrication, as necessary. Where applicable, include instructions for repackaging of defective items for return to a repair facility.

b. EMERGENCY MAINTENANCE FOR ELECTRONIC ASSEMBLIES. —When an equipment is made up of plug-in assemblies, instructions are to be given for interchanging multi-purpose assemblies that will perform the required function without requiring rewiring or replacement of component parts.

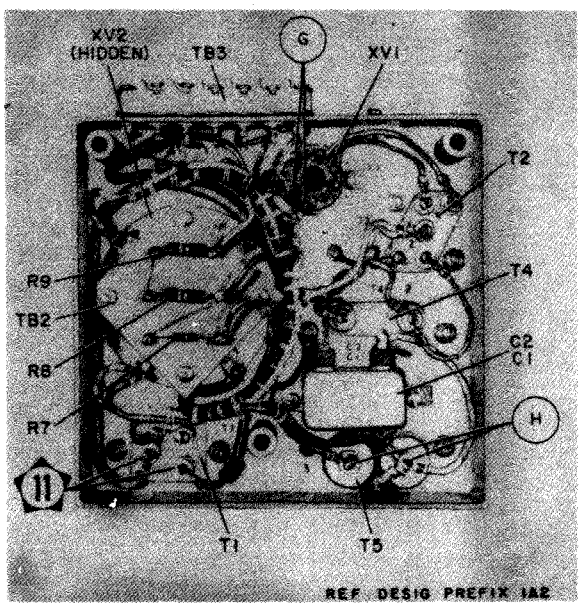


Figure 5-1. Power Supply PP-416/XXX-1, Under-Chassis Component and Test-Point Locations

5-4. ILLUSTRATIONS.

Although this section of the technical manual is concerned with maintenance, it is also intended to include information which can be considered as useful or common to other sections of the manual. For this reason certain illustrations are recommended with the repair data since it is the most convenient location. Illustrations to be included in the maintenance section are: parts locations, interconnection and intraconnection diagrams, power schematics, equipment schematics, exploded views, preventive maintenance test setups, and any others having repair significance. The connection diagrams and schematics are to be presented on fold-in sheets located at the end of the section, each sheet having a page-size apron so that the diagram can be viewed while the manual is open at another point. When it is necessary to divide a single diagram to form a multiple-sheet illustration, print the illustration on both sides of the sheets (except for the last sheet) to facilitate circuit or lead tracing between portions of the drawing.

a. PART LOCATION ILLUSTRATIONS. — These are important supplements to the repair instructions noted in paragraph 5-3. They are to identify, by means of call-outs, the relative locations of all circuit elements and test points which might require replacement during the service life of the equipment. (Certain exceptions are noted in paragraph 5-3a.) Types of illustrations that can be used for parts locations are given below.

(1) PHOTOGRAPHS. —Photographs will prove the most helpful in parts location since they illustrate the parts as they would be seen by the technician. An example of a photograph used in parts location is shown in figure 5-1.

(2) LINE DRAWINGS.

(a) CHASSIS ARRANGEMENT. —This consists of a line illustration, containing the kind of information portrayed in figure 5-1. This type of line illustration may be used as a substitute for a photograph.

(b) PRINTED-CIRCUIT BOARD. — Printed-circuit boards are relatively new and unique in construction. Consequently, a special treatment is necessary in order to provide adequate illustration coverage (see figure 5-2). Printed-circuit boards must be illustrated foil side up. When printed wiring appears on both sides of the board, both sides are to be illustrated. All parts mounted on the board must be outlined in black (even though mounted on the reverse side of the board) and their connections to the printed wiring clearly illustrated. Illustrate internal elements of such items as electron tubes, coils, transformers, and transistors schematically within the part outline and label each part with the applicable reference designation. To facilitate parts location, a locating grid and corresponding guide chart are to be provided when more than 30 items are mounted on a board. Test point graphic symbols should be located outside the board area, when not printed upon the board by the manufacturer, with call-out leaders drawn from these symbols to the test-point locations. In like manner (when equivalent information is not printed on the board) label the input and output terminals with the functions (signals and voltages) carried, and their point of origin or destination.

(c) EXPLODED VIEW. —An exploded view is a means of denoting the method of assembly (or disassembly) of a complex device (usually a mechanical item) together with relative locations of

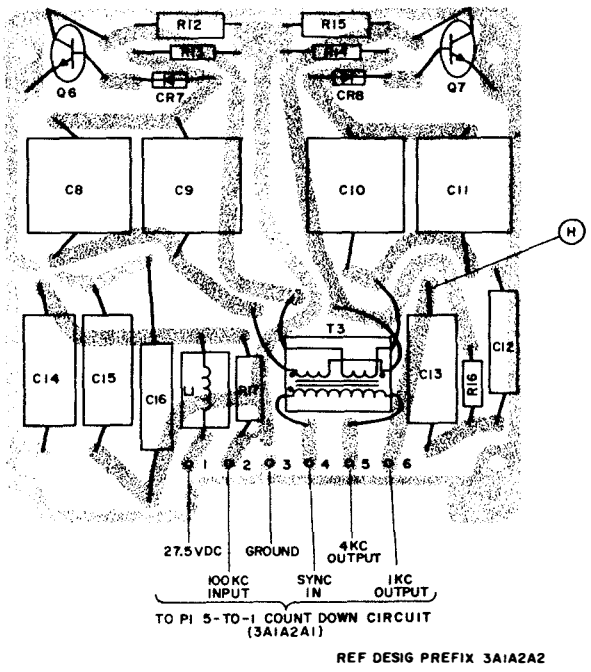


Figure 5-2. Count-Down Frequency Divider, 4-to-1, Component and Test-Point Locations

the parts within the item and is to be included when necessary. This type of illustration receives greatest application on assemblies containing a number of hidden parts which affect the disassembly procedure or for which the disassembly procedure is not considered obvious. A sample exploded view is given in figure 5-3.

b. CONNECTION DIAGRAMS. — Provide appropriate information to cover intraconnection (intrarack wiring) of rack-mounted, plug-in subassemblies, and interconnection of units of an equipment, as applicable. Such information can be provided in the form of wire-running lists (tabular presentation) or as diagrams. Include data that describes the method of presentation so that the user can readily determine circuit paths. Provide examples as necessary. When provided in diagram form, the guides noted below should be followed.

(1) INTRARACK WIRING DIAGRAMS. — These should be prepared as highway-type diagrams and are to include data such as wire types and sizes, routing of leads, lead length, and appropriate identification to permit tracing of leads between assemblies.

(2) UNIT INTERCONNECTION DIAGRAMS. — These diagrams are to contain all the information necessary to make the electrical connections between units of the equipment, and to the primary power source (see figure 5-5). Sufficient data is to be contained on the diagrams to enable circuits to be traced between units. Indicate which cables (if any) are contractor furnished. In addition, show connections to related equipment (such as an associated indicator equipment). A note similar to the following is to be included on the interconnection diagram.

Note

The interconnecting cable types and the conductor grouping may vary among installations. Refer to the applicable ship or station plans to determine the actual cabling for any specific installation.

c. POWER SCHEMATIC DIAGRAMS. — These diagrams are to consist of schematic presentations of the primary power distribution section, showing all circuits connected to the primary power source. The diagram used is to be an across-the-line type (such as figure 5-4) in which the various circuit segments that are connected across the primary supply source are drawn as rungs of a ladder. All switches, interlocks, fuses, terminal board identifications, and terminal numbers must be shown, together with the primary power requirements.

d. EQUIPMENT SCHEMATIC. — An over-all equipment schematic diagram is preferred. However, when an equipment is large or complicated and over-all schematics are impracticable, separate schematic diagrams of the individual units may be substituted for the over-all equipment schematic diagram. Figures 5-6 and 5-7 are included to serve as guides when preparing schematic diagrams. Figure 5-7 has been marked up to show some of the more frequent faults found on schematic diagrams. Important guides to follow in preparation of schematics are given below:

(1) The schematic diagram for each unit is to be drawn so that, together with the interconnecting diagram, all parts are included and all circuits can easily be traced from unit to unit.

(2) Drafting standards and graphical symbols used on schematics are to conform to Standard MIL-STD-1, ASA Y14.15, and Standard MIL-STD-15-1, -2, and -3.

(3) Reference designations used must be in accordance with Standard MIL-STD-16. The only exception is when designations marked on the equipment deviate from those in MIL-STD-16. Then the equipment markings should be used.

(4) Provide road map coordinates (grid system) on each schematic which includes more than 100 symbols for parts (see figure 5-6), using numbers for the coordinates at the top and bottom, and letters for the coordinates at each end. The coordinates should not be separated by more than 1 inch. When a diagram is divided into sections because of size, the top and bottom coordinates can be continued in numerical order from section to section. A table is to be included on the diagram apron to indicate the location of all circuit elements by the road map coordinates given. If a part, such as a relay or twin tube, is drawn in sections at different locations on the schematic, list as many sets of coordinates as necessary to locate all sections of the part. This table is to be repeated when the diagram

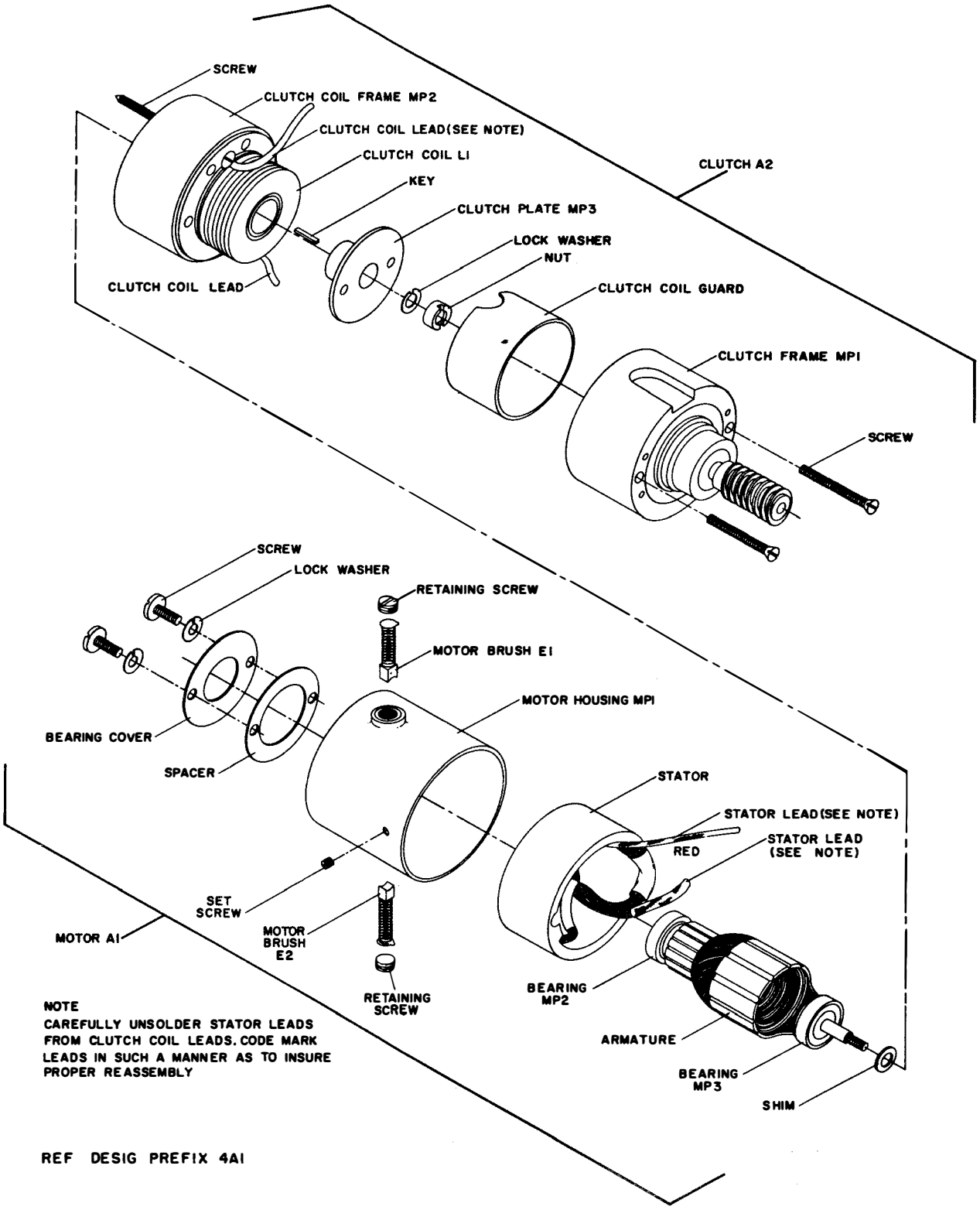


Figure 5-3. Drive Assembly, Exploded View

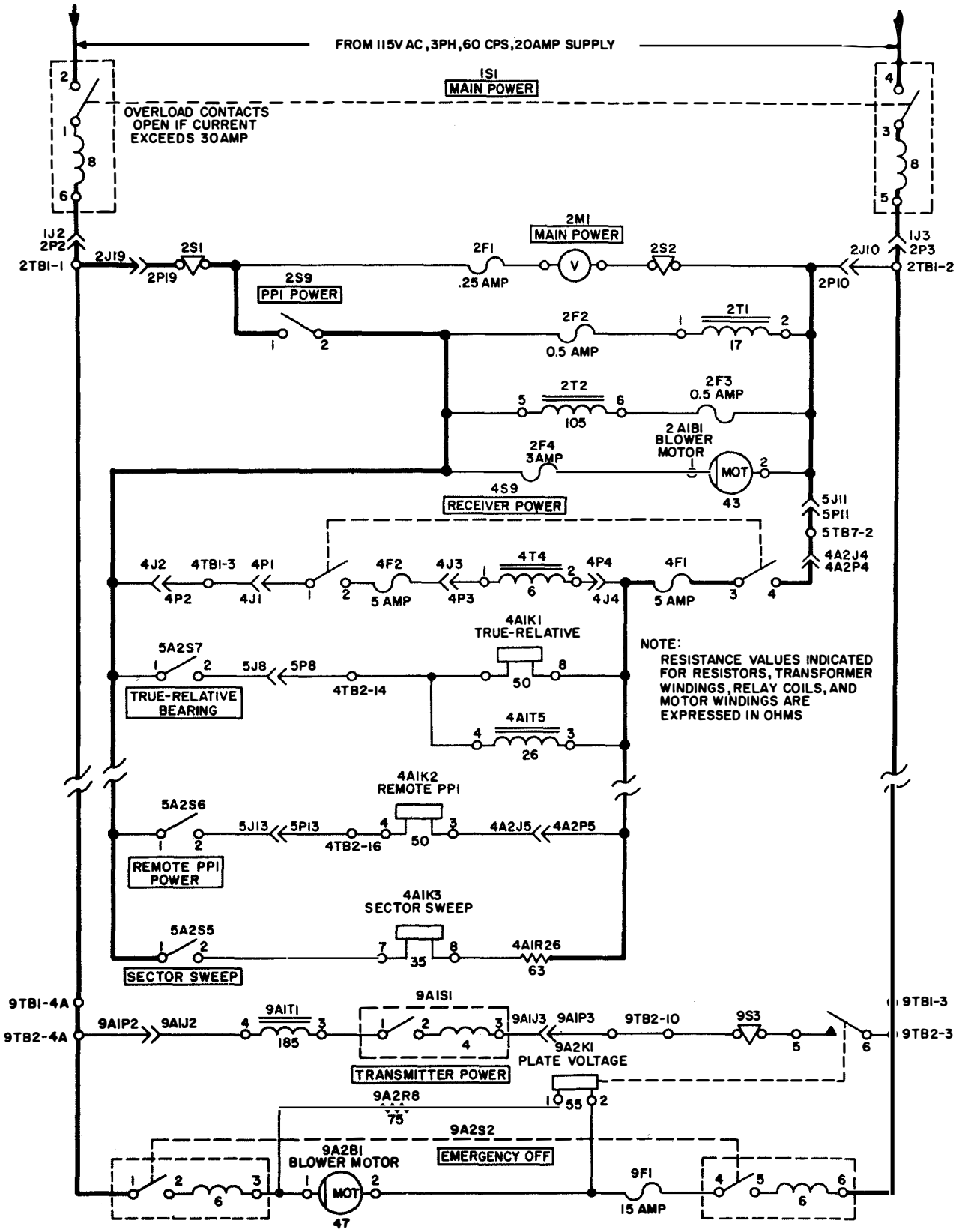


Figure 5-4. Radar Set AN/XXX-1, Primary Power Distribution, Schematic Diagram

is drawn in sections and appears on separate pages. For each set of coordinates, the numerical coordinate must be listed first to avoid possible confusion with reference designations; for example, 3E instead of E3.

(5) Similar circuits are to be drawn in a similar manner.

(6) Relay contacts can be separated from their associated operating coils when this will increase clarity.

(7) Separate halves of twin tubes when such an arrangement will improve the functional circuit layout. Each half can then be located at the appropriate place in the circuit. When so separated, each half should be drawn as an incomplete envelope (see figure 5-6).

(8) Represent major and minor signal paths by different line weights. The heavier line weight should be for the major signal path. In all illustrations, whenever practicable, signal flow is to be from left to right and from top to bottom. Arrows denoting the direction of signal flow may be placed adjacent to or on the signal-flow lines, whichever placement will yield the better presentation for the particular illustration.

(9) The use of ground, B+, and filament busses should be kept to a minimum, except in the power supply proper. As a substitute, individual grounds can be used, and appropriate notes may be included to indicate sources of low dc voltage. For example: "Reg B+", "+260v", etc.

(10) Voltages given are to be actual readings based on the use of an electronic voltmeter. Indicate whether the voltage is ac or dc.

(11) If space permits, the data listed below is to be given adjacent to the applicable point on the diagram; otherwise it may be placed as near as possible, and call-outs used to indicate the point in question.

(a) Reference designations for all circuit elements (including terminal boards). Wherever possible, the numbering sequence for circuit elements is to progress in a logical manner from left to right and from top to bottom.

(b) Test points.

(12) The functional names of all operational and adjustment controls must be conspicuously marked on the schematic; for example: VERT CENT, TRIM CAP, etc. In addition, any operating control markings that are stencilled or engraved on the equipment are to be set off in a rectangular box; for example: RF GAIN The functions or names of all stages (tubes, transistors, etc) should also be included.

(13) Indicate the function, source, or destination of all input, output, and incomplete circuits; for example: B+ FROM POWER SUPPLY, MAG FIL, SYNC, VIDEO OUT TO TB1-3 INDICATOR ADAPTER (7), etc. Such incomplete circuits should extend to edge of diagram.

(14) MIL type designations (or commercial type designations if no MIL type number is available) are to be used for crystal rectifiers, transistors, and electron tubes. It is permissible to omit the letters MIL or USN.

(15) Electrical values of capacitors, inductors, and resistors are to be expressed in picofarads (pf), microhenries (μh), and ohms, respectively, unless otherwise indicated. Resistance values should be noted for all wirewound devices, such as motors, relay coils, and transformers. The electrical values need not be followed by units of measurement provided an appropriate note (stating units used) is made a part of the drawing. The direction of rotation is to be indicated for potentiometers, variable resistors, rheostats, etc, together with a note to explain the significance of the indicator. Notes equivalent to the following are to be used to explain the above requirements:

Note

1. Unless otherwise indicated, electrical values are expressed in microhenries, ohms, and picofarads.
2. The letters (CW or CCW) placed adjacent to the appropriate terminal of a potentiometer or rheostat indicates the direction of rotation, when viewed from the shaft end.

(16) Current and voltage values under normal operating conditions are to be included for relay coils and primary and secondary windings of power transformers.

(17) It is necessary to include the terminal numbers, color of leads, or other means of identifying leads for terminal boards, reactors, relays sockets, transformers, etc. When terminal boards are not physically marked to indicate terminal numbers, assign terminal numbers in accordance with NAVSHIPS 900,186, Dictionary of Standard Terminal Designations for Electronic Equipment. Terminal boards may be divided into portions (broken) and located in separate areas of the schematic if this treatment will enhance the functional presentation or layout. If the terminal board is divided, it must be shown with a broken edge to indicate incompleteness.

(18) Measurements are to denote normal voltages to ground, from points of particular significance, such as test points (jacks), tube socket pins (except filament pins), and terminal boards, with the equipment connected and in operative condition. A skull and crossbones is to be used to indicate live terminations of circuits operating at more than 300 volts.

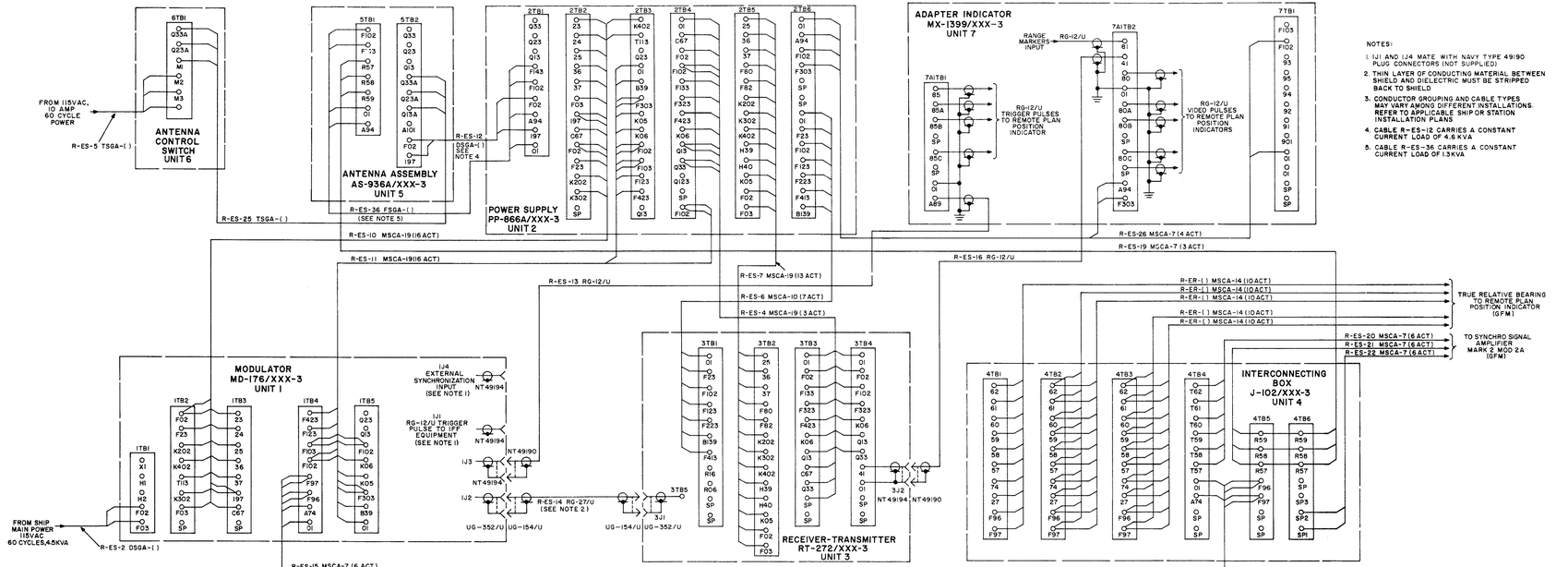
(19) Include a note to indicate the common test points and characteristics of the instruments used to obtain the various values.

(20) Include a resistance chart (for electron tube circuits only) equivalent to the one below, giving the necessary information for each circuit shown on the unit (or functional section) schematic diagram. Where space is limited, the chart may be located on the illustration apron. If this is not possible, the chart should be included at the end of the text concerning the particular unit. This chart should give the normal resistance to ground (or other points of

significance) for each tube socket pin of the circuits covered. In addition, list all conditions which will affect the resistance values given, such as control settings, equipment connections, tubes removed from sockets, etc. If semiconductors (transistors, diodes, etc) are employed in circuits, adequate caution notices must be included to prevent damage to these devices when making resistance measurements in the circuit. No resistance measurements are required to be made on transistors themselves.

RESISTANCE CHART

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
V1	30K	150	0	0	1.9K	13K	110	-	-
V2	0	100	0	0	9K	100	4.5K	-	-
V3	10K	1.7K	0	0	250	1.6K	1.6K	-	-
V10	150K	1MEGO	2.6K	10	10	.1.9K	2.4K	-	-



NOTES:

1. 1J1 AND 1J4 MATE WITH NAVY TYPE 49190 PLUG CONNECTORS (NOT SUPPLIED)
2. THIN LAYER OF CONDUCTING MATERIAL BETWEEN SHIELD AND DIELECTRIC MUST BE STRIPPED BACK TO SHIELD
3. CONDUCTOR GROUPING AND CABLE TYPES MAY VARY AMONG DIFFERENT INSTALLATIONS. REFER TO APPLICABLE SHIP OR STATION INSTALLATION PLANS
4. CABLE R-ES-12 CARRIES A CONSTANT CURRENT LOAD OF 4.6 KVA
5. CABLE R-ES-36 CARRIES A CONSTANT CURRENT LOAD OF 1.3 KVA

Figure 5-5. Radar Set AN/XXX-1, Interconnection Diagram

PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	2C	CR5	9F	R29	8I	R65	23F
C2	5D	CR6	9F	R30	6H	R66	23G
C3	5B	CR7	11F	R31	9H	R67	21H
C4	6C	CR8	12F	R32	9G	R68	21I
C5	8B	CR9	16F	R33	10H	R69	23H
C6	12C	CR10	16G	R34	12I	R70	24G
C7	14B	J1	19B	R35	11H	R71	24D
C8	17B	J2	19C	R36	11G	R72	24E
C9	14C	R1	3A	R37	10E	R73	24D
C10	5D	R2	3B	R38	10E	S1	24G, H
C11	5G	R3	4B	R39	12E	T1	15, 16B
C12	7F	R4	2D	R40	12E	T2	21F
C13	6H	R5	3E	R41	13E	TB1	3F, G, H
C14	8G	R6	5E	R42	12E	TP1	3C
C15	9G	R7	6C	R43	13H	TP2	15B
C16	12G	R8	7C	R44	14H	TP3	10B
C17	13G	R9	7B	R45	15H	TP4	18B
C18	13G	R10	9B	R46	14E	TP5	11G
C19	15F	R11	9C	R47	14E	TP6	20F
C20	15G	R12	9C	R48	15E	TP7	25E
C21	15G	R13	10C	R49	17E	TP8	21D
C22	17G	R14	11C	R50	18F	TP9	21H
C23	17G	R15	12C	R51	17F	V1A	3C
C24	17F	R16	12C	R52	17G	V1B	4C
C25	17F	R17	13C	R53	17H	V2A	7B
C26	18F	R18	12B	R54	18H	V2B	11B
C27	20G	R19	14B	R55	18G	V3A	13B
C28	20H	R20	17A	R56	18E	V3B	15B
C29	21H	R21	15D	R57	18F	V4	6, 7G
C30	19F	R22	18C	R58	19F	V5	10G
C31	21E	R23	6E	R59	20G	V6	14G
C32	24E	R24	7E	R60	20H	V7	18, 19G
CR1	7C	R25	5G	R61	20H	V8A	21F
CR2	9C	R26	5H	R62	20E	V8B	24F
CR3	5F	R27	8G	R63	21E	V9A	22E
CR4	6F	R28	8H	R64	21E	V9B	22H

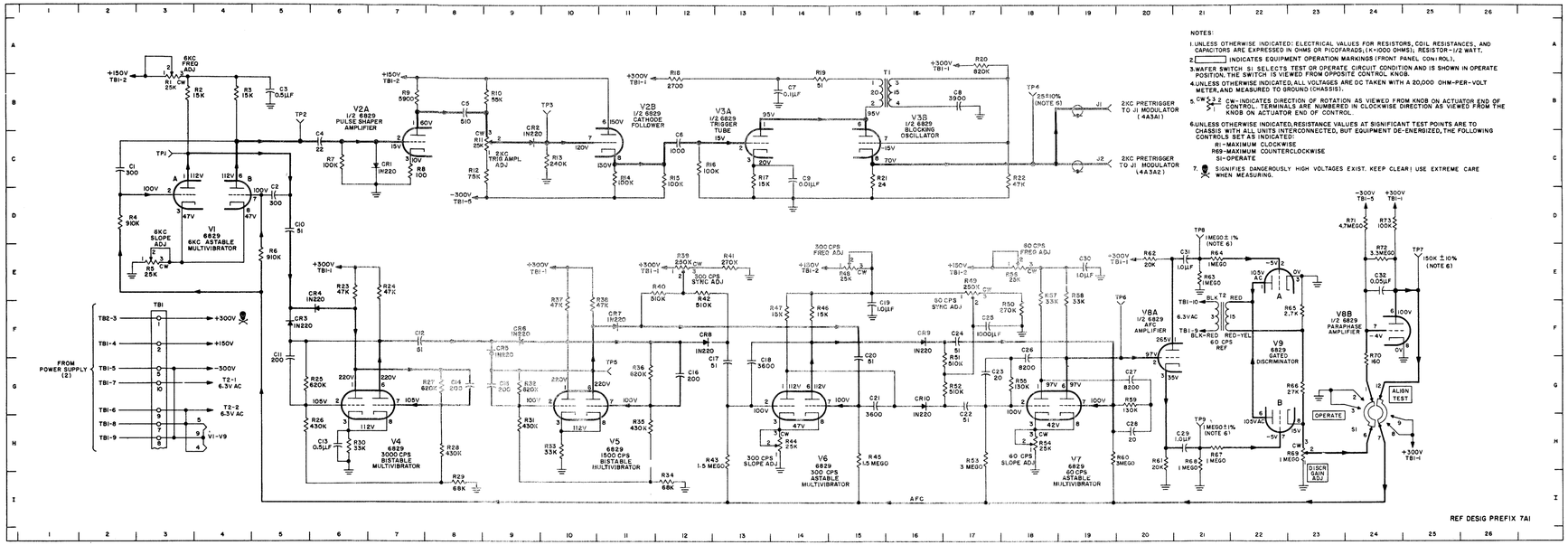


Figure 5-6. Gate Trigger Generator SN-125/XXX-1 Schematic Diagram

NOTE

The comments shown on figure 5-7 represent review comments pointing out actual deficiencies. The main cause for rejection of figure 5-7 is that the circuit is not presented in a functional manner as required by paragraph 5-4. Figure 5-6 is the same circuit with the noted deficiencies corrected and laid out functionally.

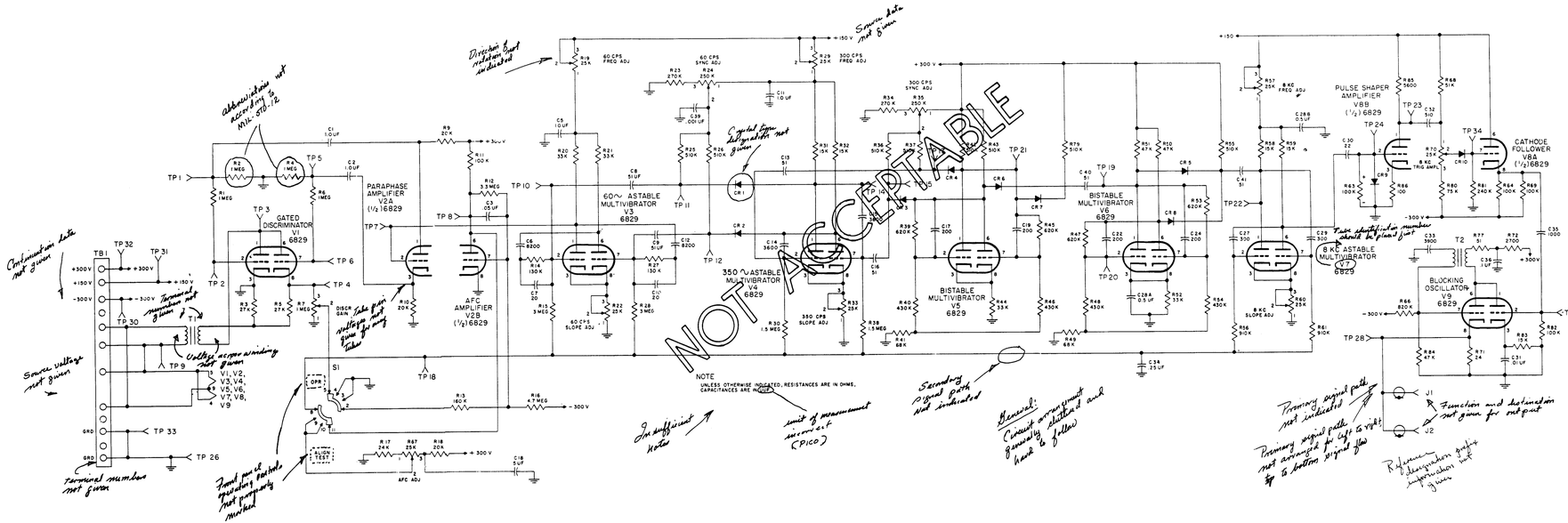


Figure 5-7. Typical Schematic Diagram Faults

SECTION 6

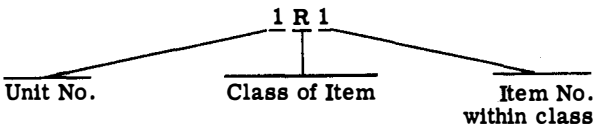
PARTS LIST

This section is to contain a brief introduction, a series of tables, and an explanation of the use of each table, equivalent to the content examples given below. There may be instances when parts location information (FIG. NO.) is not readily available for inclusion in the maintenance parts list (see paragraph 6-3). In such cases, a cross-reference table, containing information to aid in the location of each part, is to be included with the applicable repair data in Section 5, convenient to the parts location illustrations.

6-1. INTRODUCTION.

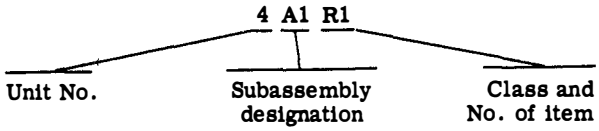
a. REFERENCE DESIGNATIONS.—The unit numbering method of assigning reference designations has been used to identify units, assemblies, subassemblies, and parts. This method has been expanded as much as necessary to adequately cover the various degrees of subdivision of the equipment. Examples of this unit numbering method and typical expansions of the same are illustrated by the following:

Example 1:



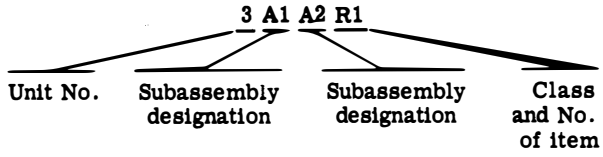
Read as: First (1) resistor (R) of first unit (1).

Example 2:



Read as: First (1) resistor (R) of first (1) subassembly (A) of fourth (4) unit.

Example 3:



Read as: First (1) resistor (R) of second (2) subassembly (A) of first (1) subassembly (A) of third (3) unit.

b. REF DESIG PREFIX.—Partial reference designations are used on the equipment and illustrations. The partial reference designations consist of the class letter(s) and the identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Prefixes are provided on illustrations following the notation "REF DESIG PREFIX".

6-2. LIST OF UNITS.

Table 6-1 is a listing of the units comprising the equipment. The units are listed by unit numbers in numerical order. Thus when the complete reference designation of a part is known, this table will furnish the identification of the unit in which the part is located, since the first number of a complete reference designation identifies the unit. Table 6-1 also provides the following information for each unit listed: (1) quantity per equipment, (2) official name, (3) designation, (4) colloquial name, and (5) location of the first page of its parts listing in table 6-2.

6-3. MAINTENANCE PARTS LIST.

Table 6-2 lists all units and their maintenance parts. The units are listed in numerical sequence. Maintenance parts for each unit are listed alphabetically-numerically by class of part following the unit designation. Thus the parts for each unit are grouped together. Table 6-2 provides the following information: (1) the complete reference designation of each unit, assembly, subassembly, or part, (2) reference to explanatory notes in paragraph 6-6, (3) noun name and brief description, and (4) identification of the illustration which pictorially locates the part.

Printed circuit boards, assembly boards, modules, etc., are listed first as individual items in the maintenance parts list. In addition, at the completion of a parts listing for each unit, the individual circuit board, assembly board, module, etc., is then broken down by components into separate parts listings. When there is a redundancy of such electronic assemblies in subsequent units, reference is made to the parts breakdown previously listed.

Note

Classified parts are designated by the following classification symbols placed in the NOTES column (in addition to any numerically identified notes) of the Maintenance Parts List: "C" Confidential, "CMH" Confidential—Modified Handling, "S" Secret, "TS" Top Secret. A brief description is given for all key parts (parts differing from any parts previously listed in this table) and sub-key parts (parts identical to a key part but appearing for the first time for a unit). The names and descriptions

are omitted for other parts, but reference is made to the key or sub-key part for the data. Unless otherwise indicated, all drawing numbers apply to equipment manufacturer and all type numbers apply to part manufacturer.

6-4. LIST OF MANUFACTURERS.

Table 6-3 lists the manufacturers of parts used in the equipment. The table includes the manufacturer's code used in table 6-2 to identify the manufacturers.

6-5. STOCK NUMBER IDENTIFICATION.

Allowance Parts List (APL) issued by the Electronics Supply Office (ESO) include Federal Stock Numbers and Source Maintenance and Recoverability Codes. Therefore, reference should be made to the APL prepared for the equipment for stock numbering information.

6-6. NOTES.

The following notes provide information as referenced in table 6-2.

TABLE 6-1. LIST OF UNITS

UNIT NO.	QTY	NAME OF UNIT	DESIGNATION	COLLOQUIAL NAME	PAGE
1	1	Radar Modulator	MD-176/XXX-1	Modulator	7-3
2	1	Power Supply	PP-866/XXX-1		7-15
3	1	Radar Receiver-Transmitter	RT-272/XXX-1	Receiver-Transmitter	7-25
4	1	Radar Set Control	C-1134/XXX-1	Set Control	7-70
5	1	Band Pass Filter	F-188/XXX-1	RF Filter	7-90
6	1	Band Pass Filter	F-189/XXX-1	IFF Filter	7-107
7	1	Indicator Adapter	MX-1399/XXX-1	Adapter	7-125

TABLE 6-2. MAINTENANCE PARTS LIST

COMPUTER-TRACKING, GROUP OA-3218/XXX-1

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
1		COMPUTER-TRACKING, GROUP: Consists of 1 tracking computer, 1 marker generator, and 2 power supplies; provides 4-channel interceptor and 4 regulated dc voltages for AN/XXX-1; mfr ABC, dwg 573D399G01.	5-18

COMPUTER, TRACKING CP-321/XXX-1

1A1		COMPUTER, TRACKING: Mfr ABC, dwg 573D3377G01.	
1A1A1		RESOLVER, DRIVER AMPLIFIER, ASSEMBLY: Printed circuit board w/all components assembled for operation; mfr PDC, dwg 573D1366G01.	5-19
1A1A1C1		CAPACITOR, FIXED, PLASTIC DIELECTRIC: 1 μf ±10%, 300 vdcw, hermetically sealed; mfr AC, type 1007.	5-20
1A1A1C2		CAPACITOR: MIL type CP53B1EF205K.	5-20
		Note: It is suggested that a blank space of approximately 1/2 inch be left at the bottom of each page of the Maintenance Parts List for insertion of corrections, comments, changes, etc.	

1. Listed for reference only. Non-replaceable in this application.
2. Used only in AN/XXX-1 equipments, serial numbers 1 thru 300.
3. A reliable-type tube cannot be used in this application. When requesting replacements, specify "no substitute acceptable".

TABLE 6-3. LIST OF MANUFACTURERS

MFR CODE	NAME	ADDRESS
A C	Aerovox Corp.	New Bedford, Mass.
A B C	Allen-Bradley Co.	Milwaukee, Wis.
A L C	American Lava Corp.	Chattanooga, Tenn.
O M C	Ohmite Mfg. Co.	Chicago, Ill.
P D C*	Pic Design Corp.	Lynbrook, L.I., N.Y.

* Any method of assigning manufacturer's code is acceptable as long as the system is consistent throughout the parts tabulation.

General Rules for Parts Listing

1. List of Units. The list of units (table 6-1) should be prepared only for those equipments consisting of more than two units.

2. Maintenance Parts List. The maintenance parts list (table 6-2) is to include: (1) all circuit elements, including those in repairable printed circuit boards, assembly boards, modules, etc; (2) all mechanical items having maintenance significance; and (3) standard hardware, structural parts, and mechanical parts having no maintenance significance, but which are referred to in text or illustrations (assembly or disassembly procedures). In general, the maintenance parts list, which provides a separate listing for each unit, is to be arranged so that the unit itself is listed as the first item in the list of parts. Additional line spaces must not be inserted between item listings. If a unit listing begins on a page on which the listing for another unit ends, the nomenclature of that unit should be separated from the items above and below it by means of horizontal rules (or equivalent lines). All accessories and their parts (except those that are themselves units) should be treated as if they were single items (grouped at the end of the list). The maintenance parts table columns (shown in table 6-2) should contain the information noted below.

(a) The REF DESIG column is to contain the reference designations of all parts listed, in alphabetical-numerical order. When reference designations have been cancelled for more than two consecutive items, only the first and last of the designations are to be listed, separated by the word "to". For example: 1A1C5 to 1A1C8, Not Used.

(b) In the NOTES column, numbers or other code designations are to be used to refer to explanatory information provided in the notes paragraph (see paragraph 6-6).

(c) The NAME AND DESCRIPTION column is to contain the noun name and military type designation. For parts not covered by a military type designation, include sufficient descriptive data to aid in identification of the part within the equipment and in determining the suitability of an intended substitute. Such information should consist of the name of the item, physical characteristics (material and pertinent dimensions), performance characteristics (electrical and mechanical information), and manufacturer's data (manufacturer's name, part number, and drawing number). Complete information must be given for all key parts (those differing from any part previously listed) and sub-key parts (those identical to a key part, but appearing for the first time in a particular unit listing). The name and description should be omitted for parts not covered by military type designations that are identical to key or sub-key parts and reference made for the data. For proprietary mechanical items identified on illustrations, the information may be limited to the item name and manufacturer's designation. If a mechanical item has no maintenance significance, the information should be limited to the item name and "Listed for reference only," or reference made to a note from the NOTE column (see paragraph 6-6). Printed circuit boards, assembly boards, modules, or other plug-in assemblies (both repairable and non-repairable) are to be listed as individual items. At the completion of the parts listing for each unit, all repairable circuit boards, assembly boards, modules, etc, should be broken down into separate parts listings. Non-repairable assembly boards should not be broken down. When identical plug-in assemblies are contained in other units, they should be listed once (as individual items) and then referenced, as with key and sub-key parts.

(d) The FIG. NO. column is to include the figure number of the pictorial illustration which identifies the physical location of the part. This can be omitted if the information is given in section 5 or if all parts are identified on a single illustration.

3. List of Manufacturers. All manufacturers are to be listed in alphabetical-numerical order by the abbreviation or code used for their identification in the parts list, together with their names and addresses (see table 6-3).

INDEX

INDEX (Cont)

INDEX (Cont)

NOTE

The last page of the technical manual is to contain the user activity comment sheet, as required by Specification MIL-M-15071E.

APPENDIX I

GENERAL OUTLINE
FOR
HANDBOOK OF ELECTRONIC CIRCUITS
NAVSHIPS 900, 000. 102

This outline indicates the types of circuits and the extent of coverage provided in the Handbook of Electronic Circuits. It has been included to aid the contractor in the preparation of the circuit descriptions required in the trouble-shooting section of a technical manual. This handbook is expected to be available during the latter part of 1962. See par. 4-3c(l) on page 4-3 for use of this outline.

ELECTRONICS INSTALLATION AND MAINTENANCE BOOK (EIMB)

Outline

for

HANDBOOK OF ELECTRONIC CIRCUITS NAVSHIPS 900,000.102

Section 1 INTRODUCTION.

- Purpose
- Use
- Scope

Section 2 GENERAL INFORMATION ON ELECTRON TUBE CIRCUITS.

- Definitions of Letter Symbols Used
  - Construction of Symbols
  - List of Symbols
- Biasing Methods
  - Cathode Bias
  - Grid-Leak Bias
  - Fixed Bias
- Classes of Amplifier Operation
  - Class A Operation
  - Class B Operation
  - Class AB Operation
  - Class C Operation
- Coupling Methods
  - R-C Coupling
  - Impedance Coupling
  - Transformer Coupling
  - Direct Coupling
- Time Constants
  - R-C Circuits
  - R-L Circuits

Section 3 GENERAL INFORMATION ON SEMICONDUCTOR CIRCUITS.

- Definitions of Letter Symbols Used
- Diode Circuits
- Triode Common-Base Circuits
- Triode Common-Emitter Circuits
- Triode Common-Collector Circuits
- Tetrode, Power, and Special Purpose Circuits
- Classes of Amplifier Operation
  - Class A Operation
  - Class B Operation
  - Class AB Operation
  - Class C Operation
- Coupling Methods
  - R-C Coupling
  - Impedance Coupling
  - Transformer Coupling
- Time Constants

Section 4 POWER SUPPLY CIRCUITS.

Part A. Electron-Tube Circuits

- Single-Phase, Half-Wave Rectifier
- Single-Phase, Full-Wave Rectifier
- Single-Phase, Full-Wave Bridge Rectifier
- Three-Phase, Half-Wave (3-Phase Star) Rectifier
- Three-Phase, Full-Wave, Single "Y" Secondary
- Three-Phase, Full-Wave, Delta Secondary
- Three-Phase, Parallel (Double) "Y" Secondary with Interphase Reactor
- Three-Phase, Half-Wave (6-Phase Star) "Y" Secondary with Center Tap
- Half-Wave Voltage Doubler
- Full-Wave Voltage Doubler
- Voltage Tripler
- Voltage Quadrupler
- High-Voltage Supply Circuit, Audio Oscillator Type
- High-Voltage Supply Circuit, R-F Oscillator Type

Part B. Semiconductor Circuits

- Single-Phase, Half-Wave Rectifier
- Single-Phase, Full-Wave Rectifier
- Single-Phase, Full-Wave Bridge Rectifier
- Three-Phase, Half-Wave (3-Phase Star) Rectifier
- Three-Phase, Full-Wave, Single "Y" Secondary
- Three-Phase, Full-Wave, Delta Secondary
- Three-Phase, Half-Wave (6-Phase Star) "Y" Secondary with Center Tap
- Half-Wave Voltage Doubler
- Full-Wave Voltage Doubler
- Voltage Tripler
- Voltage Quadrupler
- High-Voltage Supply Circuit, DC-to-DC Converter

Part C. Electromechanical Circuits

- Dynamotor
- Nonsynchronous Vibrator Supply
- Synchronous Vibrator Supply

Part D. Filter Circuits

- Shunt-Capacitor
- L-C Capacitor-Input
- L-C Choke-Input
- R-C Capacitor-Input
- Resonant Filter

Section 5 VOLTAGE-REGULATOR CIRCUITS.

Part A. Electron-Tube Circuits

- Gas-Tube Regulator
- Electronic Regulator
  - D-C Regulator with Series Tube, Pentode Amplifier, and Gas-Tube Reference
  - D-C Regulator with Series Tube, Twin-Triode Amplifier, and Gas-Tube Reference
  - D-C Regulator with Series Tube, Cascade Twin-Triode Amplifier, and Gas-Tube Reference

Part B. Semiconductor Circuits

Regulator

Part C. Electromechanical Circuits

Regulator

Section 6 AMPLIFIER CIRCUITS.

Part A. Electron-Tube Circuits

Audio Amplifier
Voltage Amplifier, R-C Coupled Triode
Voltage Amplifier, R-C Coupled Pentode
Voltage Amplifier, Impedance-Coupled Triode
Voltage Amplifier, Transformer-Coupled Triode
Power Amplifier, Single-Ended, R-C Coupled Triode
Power Amplifier, Single-Ended, R-C Coupled Pentode
Power Amplifier, Push-Pull (Class A, AB, and B)
Phase Inverter Amplifier
Transformer Type
Single-Tube Paraphase
Two-Tube Paraphase
Paraphase, Cathode-Coupled
Differential Paraphase
Cathode Follower
Basic
Low-Level Video
Pulse
Video Amplifier
Triode
Pentode
Driver, Triode
Driver, Beam Power
Chain (Mixer, Amplifier, and Driver)
Cathode-Coupled (In-Phase)
Squelch Amplifier
Audio, AGC Controlled
R-F Amplifier
Voltage, Pentode
Grounded-Grid, Triode
Cascade
Cascode
Travelling-Wave
Tuned Interstage (I-F)
Buffer, Triode
Buffer, Pentode
Frequency Multiplier
Push-Push Frequency Multiplier
Power, Single-Ended (Class B or C)
Power, Push-Pull (Class B or C)
Direct-Coupled (D-C) Amplifier
Basic
Push-Pull
Deflection Amplifier
Voltage, for Electrostatic CRT
Current, for Electromagnetic CRT
Feedback Amplifier
Positive (Direct, Regenerative)
Negative (Inverse, Degenerative)

Part B. Semiconductor Circuits

Audio Amplifier
Direct-Coupled
R-C Coupled
Impedance-Coupled
Transformer-Coupled
Power (Class A, AB, and B), Push-Pull, Transformer-Coupled
Power, Push-Pull, Single-Ended Complementary Circuit
Power, Push-Pull, Single-Ended Series-Connected Circuit
Power, Push-Pull, Capacitance-Diode Coupling
Power, Compound-Connected
Power, Bridge-Connected
Phase Inverter Amplifier
One-Stage
Two-Stage
Video Amplifier
Wide-Band
R-F Amplifier
Tuned Interstage (I-F)
Tuned, Common-Base
Tuned, Common-Emitter

Section 7 OSCILLATOR CIRCUITS.

Part A. Electron-Tube Circuits

L-C Oscillator
Tickler-Coil (Armstrong)
Hartley
Colpitts
Clapp
Tuned-Plate-Tuned-Grid
Electron-Coupled
Ultraudion
R-C Oscillator
Phase-Shift
Wien-Bridge
Electromechanical Oscillator
Basic Crystal
Colpitts Crystal
Electron-Coupled Colpitts Crystal
Pierce Crystal
Magnetostriction
Negative-Resistance Oscillator
Dynatron
Transitron
Kallitron
Tuned-Line Oscillator
Lighthouse-Tube
Lecher Line
Magnetron Oscillator
Reflex Klystron Oscillator

Part B. Semiconductor Circuits

L-C Oscillator
Tickler-Coil (Armstrong)
Hartley
Colpitts
Clapp

R-C Oscillator
Phase-Shift
Wien-Bridge
Electromechanical Oscillator
Tickler-Coil Feedback Crystal
Colpitts Crystal
Overtone Crystal

Section 8 MULTIVIBRATOR CIRCUITS.

Part A. Electron-Tube Circuits

Astable Multivibrator
Plate-to-Grid Coupled, Triode
Electron-Coupled, Pentode
Cathode-Coupled, Triode
Bistable Multivibrator
Eccles-Jordan (Flip-Flop), Triode
Eccles-Jordan (Flip-Flop), Pentode
Monostable Multivibrator
Plate-to-Grid Coupled, Triode
Common-Cathode-Resistor, Triode
Phantastron

Part B. Semiconductor Circuits

Astable Multivibrator
Basic Free-Running
Bistable Multivibrator
Basic Flip-Flop
Direct-Coupled (or Binary)
Squaring Circuit
Saturating
Nonsaturating
Relay Control
Monostable Multivibrator
Basic One-Shot

Section 9 BLOCKING AND SHOCK-EXCITED OSCILLATOR CIRCUITS.

Part A. Electron-Tube Circuits

Free-Running PRF Generator
Triggered Blocking Oscillator
Parallel
Series
Fast-Recovery
Pulse-Frequency Divider
Distance-Mark Divider
Shock-Excited Ringing Oscillator
Shock-Excited Peaking Oscillator

Part B. Semiconductor Circuits

Free-Running PRF Generator
Triggered Blocking Oscillator
Basic
Nonsaturating, Diode-Clamped

Section 10 SWEEP-GENERATOR CIRCUITS.

Part A. Electron-Tube Circuits

Sawtooth-Wave Sweep Generator, Gas-Tube
Neon
Thyratron
Sawtooth-Wave Sweep Generator, Triode
Basic
Bootstrap
Trapezoidal-Wave Sweep Generator, Triode

Part B. Semiconductor Circuits

Sawtooth-Wave Sweep Generator
Unijunction (Double-Base Diode)
Four-Layer Diode

Section 11 DETECTOR (DEMODULATOR) CIRCUITS.

Part A. Electron-Tube Circuits

AM Detector
Diode
Diode (with AVC)
Diode (with Noise Limiter)
Grid-Leak
Plate
Infinite-Impedance
Regenerative
Superregenerative
FM (or PM) Detector
Foster-Seeley Discriminator
Travis Discriminator
Ratio
Gated-Beam
Video Detector
Basic

Part B. Semiconductor Circuits

AM Detector
Diode, Voltage Output
Diode, Current Output
Common-Emitter
Common-Base
FM Detector
Foster-Seeley Discriminator
Ratio
Video Detector
Basic

Section 12 MIXER CIRCUITS.

Part A. Electron-Tube Circuits

Audio Mixer
Common Plate-Load
Separate Plate-Load
Video Mixer
Common-Cathode Type
Common-Plate Type

Part B. Semiconductor Circuits

Section 13 FREQUENCY (HETERODYNE) CONVERTER CIRCUITS.

Part A. Electron-Tube Circuits

Mixer
Diode

Triode
Pentode
Pentagrid
Balanced
Pentagrid Converter

Part B. Semiconductor Circuits

Mixer
Diode
Triode
Microwave Diode
Autodyne Converter

Section 14 MODULATOR CIRCUITS.

Part A. Electron-Tube Circuits

AM Modulator
Choke
Transformer-Coupled, Plate
Transformer-Coupled, Control-Grid
Transformer-Coupled, Suppressor-Grid
Transformer-Coupled, Screen-Grid
Transformer-Coupled, Plate and Screen
Transformer-Coupled, Cathode
Series
SSB Modulator
Balanced, Push-Pull Carrier Input
Balanced, Parallel Carrier Input
Balanced Bridge
PM Modulator
Basic Phase
Phasitron
FM Modulator
Basic Reactance-Tube
Balanced Reactance-Tube
Pulse Modulator
Gas-Tube Spark-Gap
Thyratron (Gas-Filled)
Hard-Tube

Part B. Semiconductor Circuits

AM Modulator
Base-Injection
Emitter-Injection
Collector-Injection
SSB Modulator
Basic Balanced
FM Modulator
Basic Reactance

Section 15 LIMITER (CLIPPER) CIRCUITS.

Part A. Electron-Tube Circuits

Diode Limiter
Series, Positive-Lobe
Series, Negative-Lobe
Parallel, Positive-Lobe
Parallel, Negative-Lobe
Two-Diode, Positive- and Negative-Lobe
Triode Limiter
Grid
Saturation
Cut-Off
Overdriven Amplifier
Pentode Limiter
Video
R-F

Part B. Semiconductor Circuits

Diode Limiter
Series, Positive-Lobe
Series, Negative-Lobe
Parallel, Positive-Lobe
Parallel, Negative-Lobe
Two-Diode, Positive- and Negative-Lobe
Triode Limiter, Basic Common-Base

Section 16 CLAMPER (D-C RESTORER) CIRCUITS.

Part A. Electron-Tube Circuits

Diode Clamper
Negative
Positive
Biased-Negative
Biased-Positive
Triode Clamper
Basic Single-Tube
Synchronized

Part B. Semiconductor Circuits

Diode Clamper
Negative
Positive
Biased-Negative
Biased-Positive
Triode Clamper, Basic Common-Base

Section 17 WAVE-SHAPING CIRCUITS.

R-C Differentiator
R-L Differentiator
R-C Integrator
R-L Integrator
Saturable-Core Reactor Peaking
Semiconductor Pulse Shaper

Section 18 COUNTER CIRCUITS.

Part A. Electron-Tube Circuits

Positive Counter, Diode
Negative Counter, Diode
Step-by-Step (Step) Counter

Part B. Semiconductor Circuits

Positive Counter, Diode
Negative Counter, Diode
Step-by-Step (Step) Counter

Section 19 LOGIC CIRCUITS.

Part A. Electron-Tube Circuits

Part B. Semiconductor Circuits

- Logic Polarity
  - Positive
  - Negative
- Diode Logic
  - OR
  - AND
  - Matrices, Rectangular
  - Matrices, Encoding
  - Matrices, Decoding
  - Matrices, Pyramid
  - Matrices, Xmas-Tree Relay
  - Half-Adder
- Transistor Logic
  - OR
  - AND
  - NOT
  - NOR
  - NAND
  - Flip-Flop
  - Emitter Follower
  - Lamp Drivers and Relay Pullers

Part C. Mechanical Circuits

- Switch Logic
  - OR
  - AND
  - Flip-Flop
  - Two-way and Three-way Circuits
  - Simplification

Section 20 TIME-DELAY CIRCUITS.

Part A. Electron-Tube Circuits

- Phantastron
  - Basic
  - Fast-Recovery

Part B. Semiconductor Circuits

Part C. Artificial Delay Lines

- Electromagnetic
- Electromechanical (Acoustic)

Section 21 CONTROL CIRCUITS.

Part A. Electron-Tube Circuits

- AGC (or AVC)
  - Basic
- AFC
  - Phantastron
  - Thyratron
  - Reactance Tube
  - D-C Amplifier
- Servomechanism
  - Synchro System
  - Servo Motor Controller
  - Resolver Driver
  - Phase-Sensitive Null Detector

Part B. Semiconductor Circuits

- AGC (or AVC)
  - Emitter-Current Control
  - Auxiliary-Diode
  - Auxiliary-Diode, Collector

Section 22 CATHODE-RAY TUBE CIRCUITS.

- Electrostatic
  - Grid Signal
  - Cathode Signal
- Electromagnetic
  - Grid Signal
  - Cathode Signal
- Deflection System
  - Electrostatic
  - Electromagnetic

Section 23 FILTER CIRCUITS.

- High-Pass
- Low-Pass
- Band-Pass
- Band-Rejection

Section 24 TRANSMISSION LINES.

- Resonant
- Nonresonant
- Waveguide
- Duplexer

APPENDIX II

CONTRACTOR QUALITY-CONTROL CHECK LISTS

The check lists that follow serve a dual purpose: they aid the contractor in determining whether a technical manual satisfies all requirements for a given type of coverage, and they assist the procuring agency in expediting its review. For this reason, a completed copy of the appropriate check list is to accompany all manuscripts submitted for review and approval.

TYPE II
CHECK LIST FOR MANUSCRIPTS OF TECHNICAL MANUALS

CONTRACTOR _____ CONTRACT NUMBER(S) _____

TITLE OF MANUAL _____

SECURITY CLASSIFICATION _____

	YES	NO	NOT APPL
a. The manuscript consists of the following subdivisions in the order indicated:	( )	( )	
Cover			
Front Matter			
Section 1 General Information			( )
Section 2 Installation			( )
Section 3 Operation			( )
Section 4 Trouble Shooting			( )
Section 5 Maintenance			( )
Section 6 Parts List			( )
Index			( )
b. Front Matter			
Content and format conform	( )	( )	( )
Cover and Title Page	( )	( )	
List of Effective Pages (loose-leaf books)	( )	( )	( )
Table of Contents	( )	( )	( )
Appropriate portion of Table of Contents appears at front of each volume (multi-volume books)	( )	( )	( )
List of Illustrations	( )	( )	( )
Appropriate portion of List of Illustrations appears at front of each volume (multi-volume books)	( )	( )	( )
List of Tables	( )	( )	( )
Appropriate portion of List of Tables appears at front of each volume (multi-volume books)	( )	( )	( )
c. Section 1—General Information			
Full page illustration on page 1-0	( )	( )	
Supercession data & applicability of manual	( )	( )	( )
Statement of model(s) covered	( )	( )	
Functional description of set & of each unit	( )	( )	
Information concerning field changes	( )	( )	( )
Reference data	( )	( )	
Reshipment data	( )	( )	( )
Tables:			
Equipment supplied	( )	( )	
Equipment and publications required but not supplied	( )	( )	( )
Field changes	( )	( )	( )
Equipment similarities	( )	( )	( )
d. Section 2—Installation			
Instructions for unpacking & handling	( )	( )	( )
Considerations for site selection	( )	( )	( )
Power requirements (if external power is required)	( )	( )	( )
Installation requirements:			
Installation pointers for set & for each unit	( )	( )	( )
Outline drawings for each unit	( )	( )	( )
Inspection & adjustments	( )	( )	( )
Procedure for energizing set for first time	( )	( )	( )
Procedures for making all required adjustments to insure proper installation	( )	( )	( )
Instructions for checking installation	( )	( )	( )
Procedures to reduce radio interference	( )	( )	( )

	YES	NO	NOT APPL
e. Section 3—Operation			
Non-technical discussion of functional operation of set	( )	( )	
Operating procedures:			
Description of controls	( )	( )	( )
Sequence of operations to accomplish each function	( )	( )	
Indicator presentations	( )	( )	( )
Tuning adjustments (to be accomplished by operator)	( )	( )	( )
Adequate Caution and Warning notices	( )	( )	( )
Illustrations of each control panel (identifying all controls used by operator)	( )	( )	( )
Summary of operating procedures	( )	( )	( )
Procedures for emergency operation	( )	( )	( )
Test procedures (test equipment only)	( )	( )	( )
Operator's maintenance:			
Operating checks and adjustments	( )	( )	( )
Emergency maintenance procedures	( )	( )	( )
Color code charts (test equipment only)	( )	( )	( )
f. Section 4—Trouble Shooting			
Discussion level no higher than that of an Electronics Technician "A" school graduate	( )	( )	
Logical trouble shooting explanation included	( )	( )	
Over-all equipment functional description includes:			
Over-all equipment functional block diagram	( )	( )	
Over-all equipment functional description	( )	( )	
Functional section descriptions include:			
Over-all functional section description	( )	( )	
Over-all functional section test data	( )	( )	( )
Functional section block diagrams included	( )	( )	( )
If used, functional section block diagrams include:			
All inputs and outputs properly labeled	( )	( )	
Main circuit path identified by heavy weight line and arrows indicate direction of flow	( )	( )	
Insofar as practical data flow is from left to right, top to bottom	( )	( )	
Circuit (stage) description includes:			
Functional description for all circuits	( )	( )	
Reference made to NAVSHIPS 900,000.102 for circuit descriptions covered therein	( )	( )	( )
Simplified schematic diagram of each circuit	( )	( )	( )
Test data for each circuit	( )	( )	( )
Reference to servicing block diagram	( )	( )	
Servicing block diagrams included for each functional section	( )	( )	
Servicing block diagrams include:			
All circuits within the functional section	( )	( )	
Phantom lines used to designate functional limits	( )	( )	
Main signal or data paths designated by heavy line	( )	( )	
Insofar as practical signal flow is from left to right, top to bottom	( )	( )	
Inputs enter from left or top and outputs leave at the right	( )	( )	
Individual blocks used for tubes or semiconductors	( )	( )	( )
Identical circuits or dual purpose tubes shown as elongated blocks	( )	( )	( )
Tube or semiconductor elements involved with signal path properly designated	( )	( )	
Arrow heads used to indicate direction of signal flow	( )	( )	
Electromechanical items represented physically as well as electrically	( )	( )	( )
Electrical and electronics symbols conforming to MIL-STDS	( )	( )	
Waveforms included and properly identified	( )	( )	( )
Operating (front panel) controls properly designated	( )	( )	( )
All inputs and outputs properly labeled	( )	( )	
Notes included to explain the following;			
Type of oscilloscope used	( )	( )	( )
Oscilloscope control setup	( )	( )	( )
Equipment control setup	( )	( )	( )

	YES	NO	NOT APPL
Explanation of symbols used on waveforms	( )	( )	( )
Use of heavy and light weight signal paths	( )	( )	( )
Tube or semiconductor element identification	( )	( )	( )
All test equipment properly identified in applicable test data areas	( )	( )	( )
Instructions given for use of automatic or programmed testing	( )	( )	( )
g. Section 5—Maintenance			
If Maintenance Standards Books are not required under the same contract, the section is subdivided to cover Preventive Maintenance and Repair	( )	( )	( )
Discussion level no higher than Electronics Technician class "A" school graduate	( )	( )	( )
Failure report note included	( )	( )	
Instructions for making all tuning and adjustments	( )	( )	( )
List of test equipment and special tools required	( )	( )	( )
Information for making any required special jigs	( )	( )	( )
List of preliminary control settings	( )	( )	( )
Description of test set-up	( )	( )	( )
Cross reference list which identifies figure number of illustration which calls-out each circuit element	( )	( )	( )
Illustrations with call-outs, identifying all circuits elements, mechanical repair parts, and test points	( )	( )	
Calibration curves and other reference standards	( )	( )	
Data on removal, adjustment, repair, & reassembly of parts and sub-assemblies	( )	( )	( )
Exploded & cut-away views (when needed for maintenance)	( )	( )	( )
Step-by-step removal instructions	( )	( )	( )
Adjustment & repair data:			
List of test equipment & special tools required	( )	( )	( )
Procedure for making necessary adjustment or repair	( )	( )	
Minimum acceptable standards	( )	( )	( )
Procedures for reassembly	( )	( )	( )
Connection diagrams or wire-running lists:			
For inter-unit connections	( )	( )	( )
For intrarack connections	( )	( )	( )
Power schematic diagram of primary power distribution, showing all items connected across primary supply	( )	( )	
Over-all schematic diagram of set (or individual functional section schematic diagrams) which includes:			
True functional layout	( )	( )	
Road-map coordinates with cross-reference list on apron (not required if less than 100 parts included)	( )	( )	( )
Reference designations conforming to MIL-STDS (unless equipment marked differently)	( )	( )	
Drafting standards conforming to MIL-STDS	( )	( )	
Arrows indicating direction of flow	( )	( )	
Bold lines indicating main data flow paths	( )	( )	
Multiple parallel lines in groups of two or three	( )	( )	
Test point identification	( )	( )	( )
Electrical values of circuit elements	( )	( )	
Voltage values to ground	( )	( )	
Resistance values to ground in chart form	( )	( )	( )
h. Section 6—Parts List			
Introduction	( )	( )	
List of Units (not required if less than 2 units)	( )	( )	( )
Maintenance Parts List	( )	( )	( )
List of Manufacturers	( )	( )	( )
i. General Requirements			
Information accurately covers all variations of equipment identified by same nomenclature	( )	( )	( )
Correct grammar, spelling, and punctuation	( )	( )	

TYPE II (Cont)

	YES	NO	NOT APPL
Consistent use of terminology through book	( )	( )	
Sufficient notes, cautions, & warnings	( )	( )	
Security classification of sections conform	( )	( )	( )

I certify that the manuscript conforms to the statements as checked above, and meets the requirements of the specification.

_____
Head of Publications Department

_____
Head of Technical Engineering Group

TYPE IIa
CHECK LIST FOR MANUSCRIPTS OF TECHNICAL MANUALS

CONTRACTOR _____ CONTRACT NUMBER(S) _____

TITLE OF MANUAL _____

SECURITY CLASSIFICATION _____

	YES	NO	NOT APPL
a. The manuscript consists of the following subdivisions in the order indicated:	( )	( )	
Cover			
Front Matter			
Section 1 General Information			( )
Section 2 Installation			( )
Section 3 Operation			( )
Section 4 Trouble-Shooting			( )
Section 5 Maintenance			( )
Section 6 Parts List			( )
b. Front Matter			
Content and layout conform	( )	( )	( )
Cover and Title Page	( )	( )	
List of Effective Pages (loose-leaf books)	( )	( )	( )
Table of Contents	( )	( )	( )
Appropriate portion of Table of Contents appears at front of each volume (multi-volume books)	( )	( )	( )
List of Illustrations	( )	( )	( )
Appropriate portion of List of Illustrations appears at front of each volume (multi-volume books)	( )	( )	( )
List of Tables	( )	( )	( )
Appropriate portion of List of Tables appears at front of each volume (multi-volume books)	( )	( )	( )
c. Section 1—General Information			
Full page illustration on page 1-0	( )	( )	
Supercession data & applicability of manual	( )	( )	( )
Statement of model(s) covered	( )	( )	
Functional description of set & of each unit	( )	( )	
Information concerning field changes	( )	( )	( )
Reference data	( )	( )	
Tables:			
Equipment supplied	( )	( )	
Equipment and publications required but not supplied	( )	( )	( )
Field changes	( )	( )	( )
Equipment similarities	( )	( )	( )
d. Section 2—Installation			
Instructions for unpacking & handling	( )	( )	( )
Consideration for site selection	( )	( )	( )
Power requirements (if external power is required)	( )	( )	( )
Installation requirements:			
Installation pointers for set & for each unit	( )	( )	( )
Outline drawings for each unit	( )	( )	( )
Inspection & adjustment:			
Procedure for energizing set for first time	( )	( )	( )
Procedure for making all required adjustments	( )	( )	( )
Instructions for checking installation	( )	( )	( )
Procedures to reduce radio interference	( )	( )	( )
e. Section 3—Operation			
Operating procedures:			
Sequence of operating procedures to accomplish each function including description of controls, indicator			

TYPE IIa (Cont)

	YES	NO	NOT APPL
presentations, required tuning adjustments, and adequate warning and caution notices	( )	( )	( )
f. Section 4—Trouble Shooting			
Discussion level of Electronics Engineer	( )	( )	
Overall functional block diagram, supplemented by a brief explanation	( )	( )	
Functional block diagram of each "Functional Section," supplemented by an explanation	( )	( )	
Clear explanations, with sketches of all new or unusual circuit arrangements, tubes, or test procedures	( )	( )	
Simplified schematics (with wave shapes at indicated points when needed for understanding)	( )	( )	
Test data	( )	( )	
g. Section 5—Maintenance			
Discussion level of Electronics Engineer	( )	( )	( )
Calibration curves and other reference standards	( )	( )	( )
Data on removal, adjustment, repair, & reassembly of parts and sub-assemblies	( )	( )	( )
Exploded & cut-away views (when needed for maintenance)	( )	( )	( )
Illustrations with call-outs, identifying all circuit elements	( )	( )	( )
Adjustment & repair data:			
List of test equipment & special tools required	( )	( )	( )
Procedure for making necessary adjustment or repair	( )	( )	
Minimum acceptable standards	( )	( )	( )
Procedures for reassembly	( )	( )	( )
Connection diagrams or wire-running lists:			
For inter-unit connections	( )	( )	( )
For intrarack connections	( )	( )	( )
Power schematic diagram of primary power distribution, showing all items connected across primary supply	( )	( )	
Overall schematic diagram of set (or individual functional section schematic diagrams) which includes:			
True functional layout	( )	( )	
Reference designations conforming with MIL-STDS (unless equipment marked differently)	( )	( )	
Electrical values of circuit elements	( )	( )	
h. Section 6—Parts List			
Introduction	( )	( )	
List of Units (not required if less than 2 units)	( )	( )	( )
Maintenance Parts List	( )	( )	( )
List of Manufacturers	( )	( )	( )
i. General Requirements			
Technical level of Electronics Engineer	( )	( )	
Correct grammar, spelling, and punctuation	( )	( )	
Consistent use of terminology through book	( )	( )	
Sufficient notes, cautions, & warnings	( )	( )	
Security classification of sections conform	( )	( )	( )

I certify that the manuscript conforms to the statements as checked above and meets the requirements of the specification.

Head of Publications Department

Head of Technical Engineering Group

TYPE III
CHECK LIST FOR MANUSCRIPTS OF TECHNICAL MANUALS

This check list is to contain appropriate detail checks similar to those given in the Type II and Type IIa check lists, and is to be prepared in accordance with the technical manual requirements set forth in the applicable contract, order, or ship specification.

NOTES: