TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR RADAR SET AN/SPS-64(V)5 (NSN 5840-01-034-3946) (RELATIVE MOTION)

HEADQUARTERS, DEPARTMENT OF THE ARMY

19 JANUARY 1982

WARNINGS
RADIOACTIVE MATERIAL

Microwave receiver protector tube V3 in the receiver-transmitter contains radioactive material, Tritium (H-3).
As long as the tube is unbroken it does not emit any harmful radiation and is safe to handle.
If the tube is broken, avoid skin contact and notify the local Radiological Protection Officer (RPO) for assistance.
If skin contact is made with any area suspected of being contaminated with Tritium, immediately clean the skin with lukewarm water and a nonabrasive soap and call the local RPO for further decontamination procedures.
Disposal of radioactive microwave receiver protector tubes not in equipment, damaged or broken shall be handled as radioactive waste in accordance with AR 755-15.
The statements below are brief summaries of the safety warnings. Full warning precautions appear throughout the text before any procedure which involves dangerous voltages.

WARNING
RADIATION HAZARD

Be careful to avoid possible harmful effects (particularly to the eyes) of radiation from radar transmissions.
To avoid harmful radiation, turn the indicator POWER switch to the ST BY or OFF position when working on the antenna.
NEVER look directly into the antenna from a distance of less than 6 feet when the radar is operational.

WARNING
EXTREMELY DANGEROUS VOLTAGES EXIST
IN THE FOLLOWING UNITS

BEFORE TOUCHING ANY PARTS, DISCHARGE ANY STORED HIGH VOLTAGE USING A WELL-INSULATED GROUNDING LEAD.

RECEIVER TRANSMITTER .... 9,000 and 12,000 volts
INDICATOR .... 17,000 volts

Many power supplies use a floating common bus which operate at voltages between -75 and -175 v with respect to chassis. Be extremely careful.

WARRANTY
RADAR SYSTEM SPS-64(V)

Raytheon warrants each new radar to be free of defects in material and workmanship and will exchange any parts proven to be defective, at no charge, for a period of one year from the date of original installation, except for specialized electron power tubes, provided the radar has been properly installed and operated. The warranty is contingent upon receipt of an installation report and warranty certificate completed by the installing firm.

Specialized electron power tubes (Magnetron, Modulator, CRT, and T/R Limiter) will be replaced, if proven to be defective, at no charge for a period of six months or 1000 hours of use, whichever comes first, after the date of original installation.

If, upon inspection of Raytheon or one of its authorized representatives, the radar proves to be defective and has not been damaged by accident, abuse or misuse, it will be repaired during normal working hours by an authorized Raytheon Service Station at no charge for a period of six months after the date of original installation. Travel cost of Raytheon's authorized radar service station representative up to a total of 50 highway miles will be borne by Raytheon.

Raytheon equipment, or parts thereof, which have been repaired or altered outside of its plant except by authorized Raytheon Service Stations, are not warranted in any respect. * Raytheon shall not be liable for special or consequential damages of any nature with respect to any merchandise or services sold, rendered or delivered. This certificate is the only warranty expressed or implied by Raytheon, except as to title. Raytheon reserves the right to make changes or improvements on previously sold equipments.

This warranty is effective only with respect to the original purchaser from Raytheon Marine Company or an authorized Raytheon Commercial Dealer.

*EXCEPTION

U.S. Government personnel who have successfully completed a Raytheon Marine Company approved training course are authorized to perform the following operations without voiding the warranty.

1. Certify installations of equipment on which factory training was received.
2. Replace any component furnished as shipboard spares, and make necessary adjustments on such equipment.

The material in this manual was furnished by Raytheon Marine Company.

TM 11-5840-360-14-1-1

TECHNICAL MANUAL HEADQUARTERS
DEPARTMENT OF THE ARMY
No. 11-5840-360-14-1-1 WASHINGTON, DC, *19 January 1982*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR RADAR SET AN/SPS-64(V)5 (NSN 5840-01-034-3946) (RELATIVE MOTION)

This volume contains Chapters 0 through 5 and Appendixes A through F. Chapter 6 is contained in TM 11-5840-360-14-1-2.

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to Commander, US Army Communications-Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703.

In either case, a reply will be furnished to you.

CHAPTER 0 GENERAL

CHAPTER 1 GENERAL INFORMATION

CHAPTER 2 INSTALLATION

A complete set of technical manuals for the AN/SPS-64(V)5 consists of TM 11-5840-360-14-1-1, Volume 1, Relative Motion, Chapters 0 through 5; TM 11-5840-360-14-1-2, Volume 1, Relative Motion, Chapter 6; and TM 11-5840-360-14-2, Volume 2, True Motion/Anti-Collision.

CHAPTER 3 OPERATION

CHAPTER 4 FUNCTIONAL DESCRIPTION

CHAPTER 5 MAINTENANCE

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 0. GENERAL

0-1. Scope

a. This chapter explains what Radar Set AN/SPS-64(V)5 is and how to use the manual for operation, maintenance, and repairs.

b. Radar Set AN/SPS-64(V)5 is a marine navigational radar with true motion capabilities. It uses units of the (V)1 system with the addition of the factory-installed True Motion/Anti-Collision (TM/AC) option.

c. The basic components of the AN/SPS-64(V)5 are:

(1) Indicator Azimuth Range IP-1302/SPS-64(V) (4, App D), which consists of:

(a) Indicator Azimuth Range IP-12831SPS64(V), similar to the IP-1282/SPS-64(V) with a 16inch indicator. The Variable Range Marker is wired to provide a three-digit readout in nautical miles.

(b) The TM/AC headset added above the indicator contains the controls for normal operation. Addition of TM/AC option includes the North Stabilization Kit (NSK) and Electronic Bearing Line (EBL).

(2) Receiver-Transmitter RT-1246/SPS-64(V) (1, App D) is similar to RT-1240/SPS-64(V), except it uses a tunable magnetron.

(3) Antenna AS-3194/SPS-64(V) (2, App D).

(4) Antenna Pedestal AB-12471SPS-64(V) (3, App D).

d. Technical Manuals 11-5840-360-14-1-1 and -1-2 (relative motion) provide the operation, maintenance, and repair coverage for the basic radar set, (V)1, with VRM, and NSK features. Other models mentioned in text do not apply to the (V)5. In some case, portions have been removed from the manuals.

e. Technical Manual 11-5840-360-14-2 (True Motion/Anti-Collision) provides the operation, maintenance and repair coverage for the radar operating as a true motion radar. It also provides instructions for emergency operation of the radar if the TM/AC unit fails.

f. Before starting troubleshooting or maintenance, the task must first be identified to determine if it is a basic (V)1 or a TM/AC function and then the appropriate manual consulted for procedures or tests. Basic alignments are covered in TM 11-5840-364-14-1-1 and -1-2. Alignments that are part of, or interact with, the TM/AC are covered in TM 11-5860360-14-2.

g. A laminated card with simplified operating instructions, TM 11-5860-360-14-LD, is available for mounting near the radar set.

h. All the material (text, illustrations, and tables) of chapter 6, Sections 6.5 through 6.13, pertain to the (V)2, (V)3, or (V)4 configuration and have not been included in the Department of the Army manuals.

0-2. Indexes of Publications

DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, modification work orders (MWO's) or additional publications pertaining to the equipment.

0-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73/AFR 400-54/MCO 4430.3E.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

0-4. Administrative Storage

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-1.

0-5. Destruction of Army Electronics Materiel

Destruction of Army Electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

0-6. Reporting Equipment Improvement Recommendations (EIR)

If your AN/SPS-64(V)5 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

CHAPTER 1. GENERAL INFORMATION

SECTION I: INTRODUCTION

1.1 SCOPE OF MANUAL

This manual provides shipboard operating and maintenance instructions for Radar Sets AN/SPS-64 (V) 1, AN/SPS-64(V)2, AN/SPS-64(V)3, and AN/SPS64(V) 4.

The manual is divided into chapters and, where necessary, subdivided into sections. This chapter contains an introduction (Section I), system descriptions (Section II) and equipment descriptions (Section III).
Installation instructions, operating instructions, a functional theory of operation, maintenance instructions, and drawings including detailed theory of operation and parts lists are contained in Chapters 2 through 6, respectively.

1.2 APPLICABILITY CODES

Unless noted by specific nomenclature, or as coded below, the information set forth in this manual is applicable to all systems/equipments. The systems and codes used in this manual are as follows:

System	Code
Radar Set AN/SPS-64(V) 1	(V1)
Radar Set AN/SPS-64 (V) 2	(V2)
Radar Set AN/SPS-64(V)3	(V3)
Radar Set AN/SPS-64(V)4	(V4)

The codes, indicating limited applicability of information, are given as a parenthetical suffix to the titles of appropriate paragraphs, figures and tables.

1.3 FUNCTIONS AND CAPABILITIES OF SYSTEMS

This radar system is specifically designed for navigational marine use. Advanced design techniques have minimized its size, weight, and power consumption and maximized reliability and performance. The equipment is designed to withstand long periods of vibration and shock and the extremes of weather encountered in marine service. This radar features high output power, high pulse-repetition rate, narrow antenna beam width, sensitive receiver, and computer enhanced display to provide an accurate, clearly-defined, and bright radar screen presentation on all ranges, even on a fast-moving vessel.

The radar is available in both S-band (10 cm) and X-band (3-cm) frequency models. The 50-kW S-band radar provides excellent target visibility in most adverse weather conditions due to the inherent penetrating characteristics of the high-powered S-band transmitted energy. The 20-kW X-band radar, with its narrow horizontal beam width, features high target definition and superior bearing resolution.

In the normal mode of operation, the radar displays ships, buoys, and land around the ship's position, which is shown at the center of the display. In the offset mode of operation, the entire display is offset by 70 percent of the CRT radius (astern only). This permits an expanded view of the area ahead of the ship without giving up the advantages of being on the shortest range possible. No offset is available on the 48 or 64 mile ranges.

The indicator has selectable display ranges, subdivided by range rings, to enable the operator to quickly estimate the range of echoes. The indicator also has a variable range marker (VRM) function that permits direct digital readout of echo range. An electronic bearing line (EBL) feature is also available to aid in determining the exact relative bearing of any echo displayed. With this information, the ship's position can be fixed rapidly and reliably to provide for safe operation, day or night, regardless of atmospheric visibility.

Radar Set AN/SPS-64(V) is furnished in four (4) system configurations. They are called the Single configuration (V1), the Dual Partial configuration (V2), the Dual configuration (V3) and the Dual Special configuration (V4).

(V1) The Single system navigational radar operates on X-band at 20 kW with a single 12-inch indicator. Rapid antenna rotation permits a new target update every two (2) seconds. Improved reliability is achieved with solid state components which reduce noise and spikes to a minimum while providing for maximum isolation between the transmitter and balanced receiver mixer.

(V2) The Dual Partial system includes all the features of the Single system (V1), plus the advantage of increased reliability through redundancy.
This is achieved through the introduction of a second receiver transmitter (RT-1240), a second azimuth range indicator (IP-1283) and a switching unit (SA-2156) that enables the radar system to function in any one of six (6) operating modes. The mode chosen determines which indicator shall be master (i.e., in control) and whether one or two receiver transmitter(s) will be operating.

(V3) In the Dual system configuration two (2) antennas (AS-3194) and three (3) or four (4) indicators (IP-1282/1283) are interconnected to provide up to sixteen (16) operating modes using two (2) switching units (SA-2139). This allows either receiver transmitter to drive all the indicators (3 or 4) or both receiver transmitters to operate simultaneously with divided control of the indicators. Amplification and isolation to drive the multiple indicators from one or both receiver transmitter(s) (RT-1240) is provided by the pair of video amplifiers (AM-6932).
This dual arrangement reduces the possibility of total system failure by providing alternate switching paths.

(V4) This configuration, called the Dual Special system, offers the maximum in options and reliability.
It is a combination of the single X-band system and a 50-kW S-band all-weather radar permitting reliable navigation in all weather conditions. Two switching units interconnect the two receiver transmitters and three indicators. Under this option provision is made for interface with two additional indicators (AN/SPA-25) and (AN/SPA-66) via the signal data converter (CV-3442).

Either receiver transmitter can drive all the indicators or each receiver transmitter can operate independently, driving three indicators.

1.4 SAFETY PRECAUTIONS

1.4.1 High Voltage Warning

1.4.2 Instructions for Artificial Respiration[1]

a. Take a deep breath, open your mouth wide, and make an airtight seal around the casualty's mouth. Seal the casuality's nose by using one of the techniques shown in Figure 1-1. Be sure to always keep the casualty's head tilted back to enable a maximum airway.

b. With your eyes focused on the casualty's chest, blow forcefully into his mouth. Rising of the casualty's chest indicates that the air is reaching his lungs. In this case the procedure is continued. If the chest does not rise, corrective action must be taken. First, hold the jaw up more forcefully and blow harder, making sure that the air is not leaking from the nose. If the chest still does not rise, recheck the mouth for foreign matter and, if necessary, turn the casualty on his side and strike him between the shoulders with considerable force, repeatedly if necessary, to dislodge obstruction in the airway; then inflate his lungs.

c. Remove your mouth from the casualty's mouth and listen for the return of air from his lungs. If the casualty's exhalation is noisy, elevate his jaw more.

d. After each exhalation of air from the casualty's lungs, blow another deep breath into his mouth. Make the first five to ten breaths deep and give them at a rapid rate in order to provide fast reoxygenation. Thereafter, give the breaths at a rate of 12 to 20 per minute until the casualty is able to breathe satisfactorily for himself. A smooth rhythm is desired but split second timing is not essential. As the casualty attempts to breathe, adjust the timing of your efforts to assist him.

WARNING

HIGH VOLTAGE IS USED IN THE OPERATION OF THIS EQUIPMENT

DEATH ON CONTACT MAY RESULT IF PERSONNEL FAIL TO OBSERVE SAFETY PRECAUTIONS I

NEVER WORK ON ELECTRONIC EQUIPMENT UNLESS THERE IS ANOTHER PERSON NEARBY WHO IS FAMILIAR WITH THE OPERATION HAZARDS OF THE EQUIPMENT AND WHO IS COMPETENT IN ADMINISTERING FIRST AID . WHEN THE TECHNICIAN IS AIDED BY OPERATORS, HE MUST WARN THEM ABOUT DANGEROUS AREAS.

WHENEVER POSSIBLE, THE POWER SUPPLY TO THE EQUIPMENT MUST BE SHUT OFF BEFORE BEGINNING WORK ON THE EQUIPMENT. TAKE PARTICULAR CARE TO GROUND EVERY CAPACITOR I LIKELY TO HOLD A DANGEROUS POTENTIAL. WHEN WORKING INSIDE THE EQUIPMENT, AFTER THE POWER HAS BEEN TURNED OFF, ALWAYS GROUND EVERY PART BEFORE TOUCHING IT.

BE CAREFUL NOT TO CONTACT HIGH-VOLTAGE CONNECTIONS OR 115, 280, 220 OR 440-VOLT AC INPUT CONNECTIONS WHEN INSTALLING OR OPERATING THIS EQUIPMENT.

WHENEVER THE NATURE OF THE OPERATION PERMITS, KEEP ONE HAND AWAY FROM THE EQUIPMENT TO REDUCE THE HAZARD OF CURRENT FLOWING THROUGH VITAL ORGANS OF THE BODY.

EXTREMELY DANGEROUS POTENTIALS
GREATER THAN 200 VOLTS EXIST IN SOME OF THE UNITS COVERED IN THIS MANUAL

POTENTIALS LESS THAN 200 VOLTS MAY CAUSE DEATH UNDER CERTAIN CONDITIONS. REASONABLE PRECAUTIONS SHOULD BE TAKEN AT ALL TIMES.

[1]Modified from FM 21-11, First Aid for Soldiers

a. Nose sealed with thumb and finger.

b. Nose sealed with cheek.

Figure 1-1 Artificial Respiration Techniques

1.4.3 Resuscitation Warning

WARNINGS

1. ***AFTER A PERIOD OF RESUSCITATION THE CASUALTY'S ABDOMEN MAY BULGE. THIS INDICATES THAT SOME OF THE AIR IS GOING INTO THE STOMACH. SINCE INFLATION OF THE STOMACH MAKES IT MORE DIFFICULT TO INFLATE THE LUNGS, APPLY GENTLE PRESSURE TO THE ABDOMEN WITH YOUR HAND BETWEEN INFLATIONS.***
2. ***IF YOUR BREATHING AT THE START HAS BEEN VERY DEEP AND RAPID, YOU MAY BECOME FAINT, TINGLE, OR EVEN LOSE CONSCIOUSNESS IF YOU PERSIST. AFTER ADMINISTERING THE FIRST FIVE TO TEN DEEP, RAPID BREATHS, YOU SHOULD ADJUST YOUR BREATHING TO A RATE OF 12 TO 20 TIMES A MINUTE WITH ONLY MODERATE INCREASE IN NORMAL VOLUME SO THAT YOU WILL BE ABLE TO CONTINUE TO GIVE ARTIFICIAL RESPIRATION FOR A LONG PERIOD WITHOUT TEMPORARY ILL EFFECTS.***

SECTION II: SYSTEMS DESCRIPTION

1.5 GENERAL

The AN/SPS-64 Navigational Radar is ideal for Coast Guard applications. Furnished in four (4) different system configurations, it is adaptable for use on a wide range of Coast Guard cutter classes.

The (V1) Single System may be used on ships of the WPB-82, WPB-95 and WLM-133 classes.

The (V2) Dual Partial System may be used on ships of the WAGO-180 and WLB-180 classes.

The (V3) Dual System may be used on ships of the WMEC-210 and WAGO-213 classes.

The (V4) Dual Special System may be used on ships of the WHEC-327 and WHEC-378 classes.

1.6 RADAR SET AN/SPS-64(V)1

The radar is shown in Figure 1-2 and is made up of antenna AS-3194 {(X-band); antenna pedestal AB-1247 (X-band); receiver transmitter RT-1240 (X-band); and azimuth range indicator IP-1282 (12"). Two cables and waveguide connect the receiver transmitter to the antenna and pedestal. Ship's power input is applied to the receiver transmitter unit and indicator.

The 6-foot antenna contains the drive motor and gearing to rotate the antenna, and also contains a resolver which translates antenna position information into electrical signals. These signals cause the plan position indicator (PPI) trace on the azimuth range indicator to rotate in synchronism with the antenna.

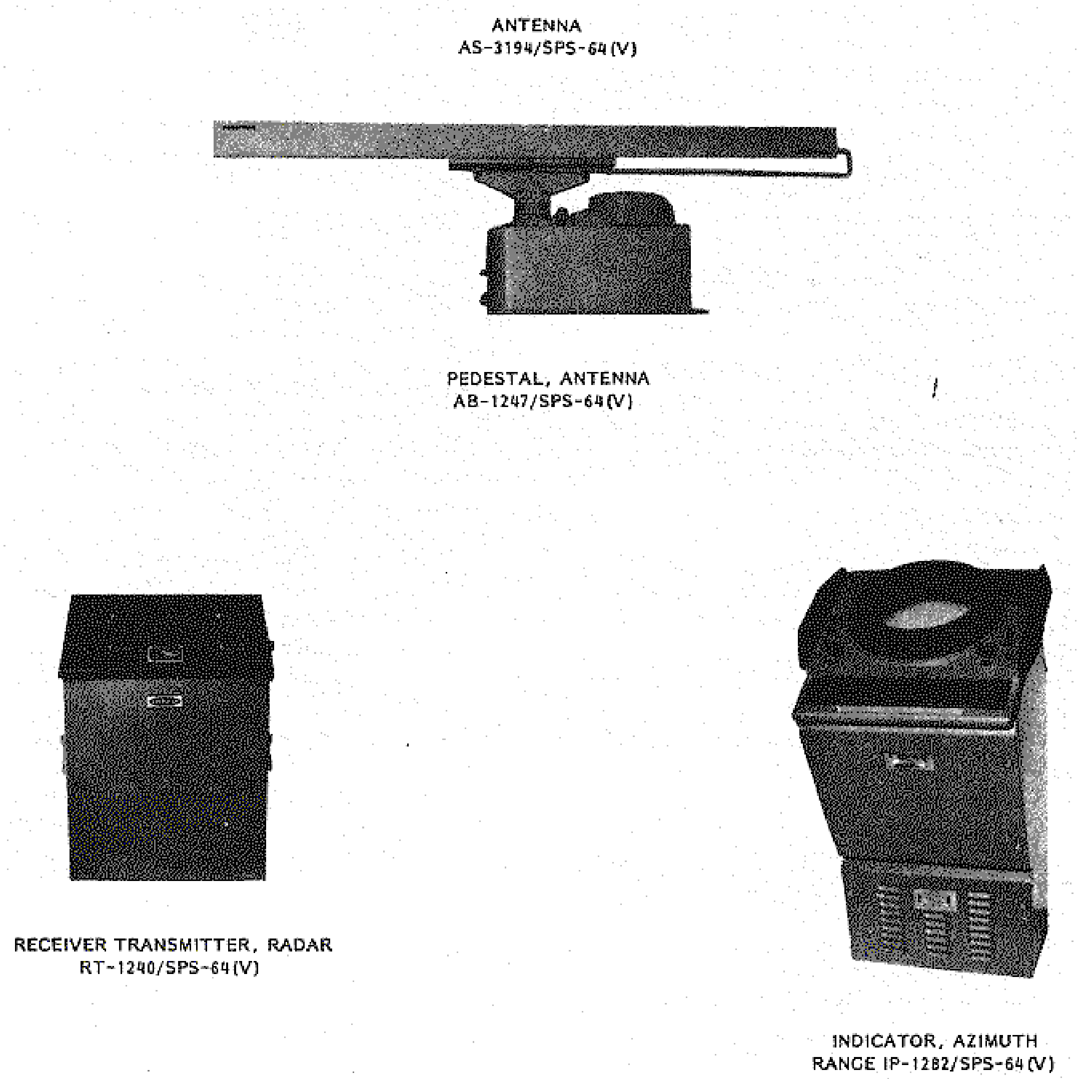


Figure 1-2 Radar Set AN/SPS-64 (V) 1 Major Units

The 12-inch azimuth range indicator IP-1282 contains the cathode ray tube (CRT) and all digital and analog circuits necessary for the CRT presentation and control of the radar. All operating controls are located on the front panel and positioned to facilitate adjustment during day or night use.

The Receiver Transmitter RT-1240, which is designed for bulkhead mounting, contains the modulator, transmitter and receiver circuits, mounted in a single case.

1.6.1 Equipment Supplied (V1)

Table 1-1 lists the equipment supplied with Radar Set AN/SPS-64(V) 1.

1.6.2 Equipment Required But Not Supplied (V1)

Table 1-2 lists the equipment required but not supplied for Radar Set AN/SPS-64(V) 1.

1.6.3 Block Diagram Description (V1)

Figure 1-3 is a pictorial diagram that illustrates the basic functions of the radar. The transmit pulse is generated by the transmitter section of the receiver-transmitter and radiated outward from the ship in a narrow beam by the antenna. As the antenna rotates, the beam scans the surrounding surface in all directions. Any object scanned by the antenna reflects a portion of the radiated signal back to the antenna.

A duplexer circuit couples the transmitter section or the receiver section to the antenna to permit a single antenna to be used for transmission and reception. The signal reflected from an object is received by the antenna and processed through the duplexer to the mixer and IF amplifier. Detected echoes are displayed on the CRT screen of the indicator.

A faint line of light, or trace, rotates around the center of the display continuously, in step with the antenna rotation. As the trace rotates, processed and synchronized video appears on the trace to display a complete radar picture of the surrounding area with every rotation of the trace. The processed video technique utilized in the radar provides a brighter picture on the shorter ranges than that available with a conventional display.

Table 1-2 Radar Set AN/SPS-64 (V) 1 Equipment Required But Not Supplied

Cable	Waveguide	Type
X		TSGA-3
X		TSGA-4
X		MSCA-7
X		Belden 8286 or Belden 9253
X		Belden 9775
X		FSGA-9
	X	RG-67/U
	X	RG-68/U

The echoes displayed on the screen depend on the size, shape, material, and position of the objects. Practice in good visibility is helpful in interpretation of the radar display. The performance of all marine radars is affected by unwanted echoes (clutter) such as those produced by rain and waves, which obscure signals from valid echoes. Operating controls are included to minimize the effect of clutter.

The power modules in the indicator and receiver transmitter convert the ship's input power to the supply voltages and frequencies required. Power for the antenna rotation motor is routed through the receiver transmitter.

1.6.4 Performance Characteristics (V1)

Performance characteristics for the receiver transmitter, RT-1240, are specified in paragraph 1.11.2 while the same data for the antenna and azimuth range indicators are found under paragraphs 1.12.2 and 1.13.2 respectively.

1.6.5 Required Test Equipment and Tools (V1)

Required test equipment and tools are specified in Table 1-3.

1.6.6 Shipboard Spares

Shipboard spares are specified in Table 1-4. This same information applies for the V2 and V3 systems.

Table 1-1 Radar Set AN/SPS-64(V) 1 Equipment Supplied

Qty.	Model	Description	Product Code
1	RT-1240/SPS-64 (V)	Receiver Transmitter,	M27550
1	AS-3194/SPS-64(V)	Antenna	M27409
1	AB-1247/SPS-64(V)	Antenna Pedestal	M27575
1	IP-1282/SPS-64(V)	Azimuth Range Indicator	M27501

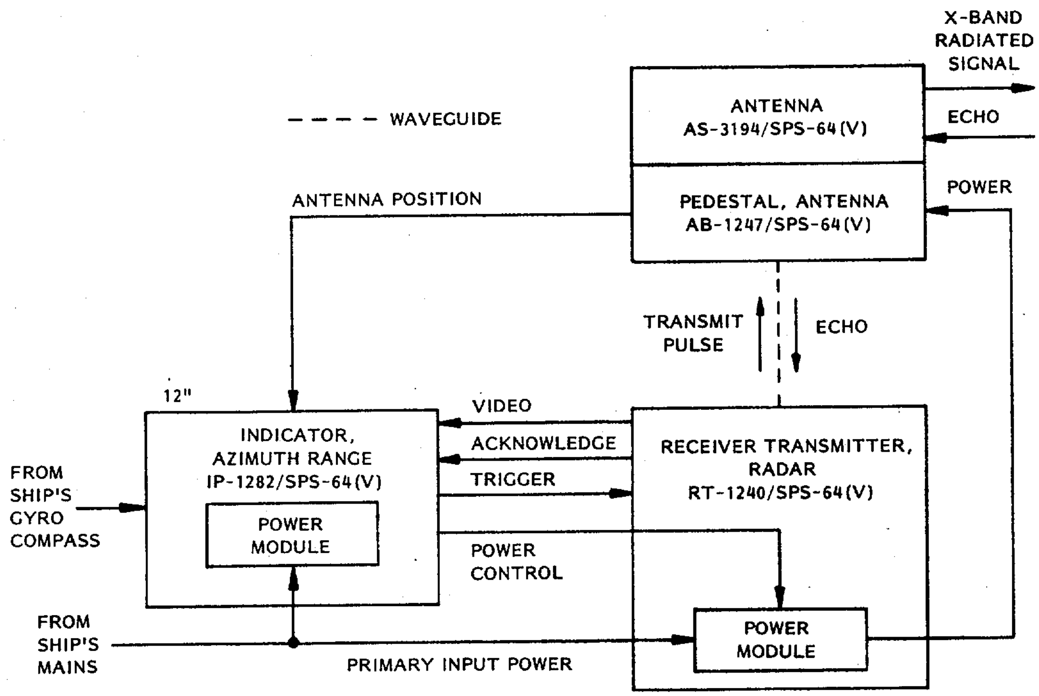


Figure 1-3 Radar Set AN/SPS-64(V)1 Block Diagram

Table 1-3 Radar Set AN/SPS-64(V) 1, (V)2 and (V)3 Recommended Test Equipment, Tools and Materials

Item Description	Qty.	Manufacturer or Supplier	Model/Part Number
TOOLS			
Trimpot Adjustment Tool	2	Bornes	
Puller, Printed Circuit Board	1	Calmark	112
Oil Injection Syringe	1	Any	---
TEST EQUIPMENT			
Multimeter	2	Simpson	260
Oscilloscope	1	Tektronix	335
Power Meter	1	Hewlett Packard	432A
Thermistor Mount, Power Meter	1	Hewlett Packard	478A
Probe, oscilloscope, 10OX	2	Tektronix	P6105
Probe, oscilloscope, High Voltage	1	Tektronix	P6015
Signal Generator	1	Hewlett Packard	620B
Gauge, Tension	1	Chatillon	719-10
Clip, Integrated Circuit	2	Pomona Electronics	3916
Resistor, 220 Ohm, 200 Watt	1	Any	---
Resistor, 470 Ohm, 1/2 Watt	1	Any	---
Resistor, 680 Ohm, 1/2 Watt	1	Any	
Diode, Zener, 5.1 Volt	1	Any	---
Connector, BNC Tee	1	Any	---
Variac, 115Vac, 10A	1	Any	
Frequency Meter	1	Hewlett Packard	X532B
Attenuator, Fixed, Microwave, 20dB or Atten Set	1	Weinschel Engineering	530A-20
Adapter, Power cord, ground insulating	2	Any	---
Adapter, Type N Connector to UG-135 Waveguide Flange	2	Hewlett Packard	X281A
MATERIALS			
Gear Box Lubricant, MIL-L-6086, Grade M		Raytheon	*980131-1
Oil, Lubricating, Light Machine		Raytheon	230-7176P1
Grease MIL G23827		Raytheon	230-1158P8
Gasket Compound		Permatex	Aviation Form-A-Gasket
Anti-Seize Compound		Kiekhaefer Mercury	Quicksilver Anti -corro-sion Grease
Heat Sink Compound		Raytheon	95-981

* For operation below -150F (-24°C) use MIL-L-6086B, Grade L (Part Number 980131-2)

Table 1-4 Radar Set AN/SPS-64(V)1, (V)2, (V)3 Recommended Spares

Azimuth Range Indicator	Part Number	Qty.
Indicator		
Sweep Drive PCB	589436-1	1
Position Transmission PCB	589412-1	1
Sweep Generator PCB	589415-1	1
Timing Control PCB	589418-1	1
Data Storage PCB	589421-1	1
Counter PCB	589424-1	1
Video Amplifier PCB	589430-1	1
Control PCB	166133-1	1
VRM PCB	167520-1	1
CKT Card Extender PCB	589556-1	1
Lamps	277-1011P2	1
HV Regulator PCB	166165-1	1
Fuse, 5A	226-7176P57	2
Fuse, 4A	226-7177P14	2
Fuse, 6A	226-7176P58	2
PRF Generator PCB	589427-1	1
NSK		
Resolver Drive PCB	167688-1	1
Exciter PCB	167211-1	1
Stepper Motor	315-7243P1	1
Receiver Transmitter		
Modulator Tube, Type 4PR6SOC	589752-1	1
Magnetron, Type M5149	167542-1	1
T/R Limiter	166083-1	1
Relay	589648-2	1
Relay	165584-1	1
Relay	165043-1	1
X-Band Gunn Oscillator	589364-1	1
Control PCB	166489-1	1
Pulse Drive PCB	166380-1	1
Delco 2N3902	18-212	1
RCA 65115	588150-2	1
Diode 1N415D	167579-11	4
Fuse, 3A	226-7176P68	2
Fuse, 5A	226-7177P15	2
Fuse, 1.5A	226-7177P26	2
Fuse, 10A	226-7181P2	1
Antenna		
Drive Belt	167591-1	2
O-Ring	167636-1	1
Magnet	320-7180P3	1
Reed Relay	271-7247PI	1
Resolver	315-7243P2	1
Antenna Drive Motor	167666-1	1

1.7 RADAR SET AN/SPS-64(V)2

The Dual (Partial) System uses one 12-inch indicator, one 16-inch indicator, one antenna pedestal, and two receiver transmitters, essentially the same as the primary radar components described in paragraph 1.6. One six-position switching unit SA-2156 is used to select the various operating modes of the system. The Dual (Partial) System allows the use of two indicators with a single antenna by the addition of three interface equipments; the interface unit J-3463, the video amplifier A/i-6932 and the waveguide switch SA-2140. Refer to Figure 1-4 for illustrations of the units that comprise the system.

1.7.1 Equipment Supplied (V2)

Table 1-5 lists the equipment supplied with the Radar Set AN/SPS-64 (V) 2.

1.7.2 Equipment Required But Not Supplied (V2)

Table 1-6 lists the cable and waveguide required but not supplied for Radar Set AN/SPS64 (V) 2.

1.7.3 Block Diagram Description (V2)

Figure 1-5 is a block diagram showing the major components of Radar Set AN/SPS-64(V)2. These components are functionally identical to those described in paragraph 1.6.3. The primary advantages of this system are the presence of an additional indicator and the redundancy of the receiver transmitter and video amplifier. This redundancy enhances system reliability and availability. Depending on the mode of operation, as selected at the interface unit one indicator acts as the master, the other as a slave unit. Only one receiver transmitter and video amplifier will be active at any given time to drive either or both of the indicators. The Dual (Partial) system is remotely controlled by the switching unit; the control circuits are positive command, latch-up, with limit switches that indicate when waveguide switching is completed.

1.7.4 Performance Characteristics (V2)

Performance characteristics for specific equipment are found in the reference paragraph listed below:

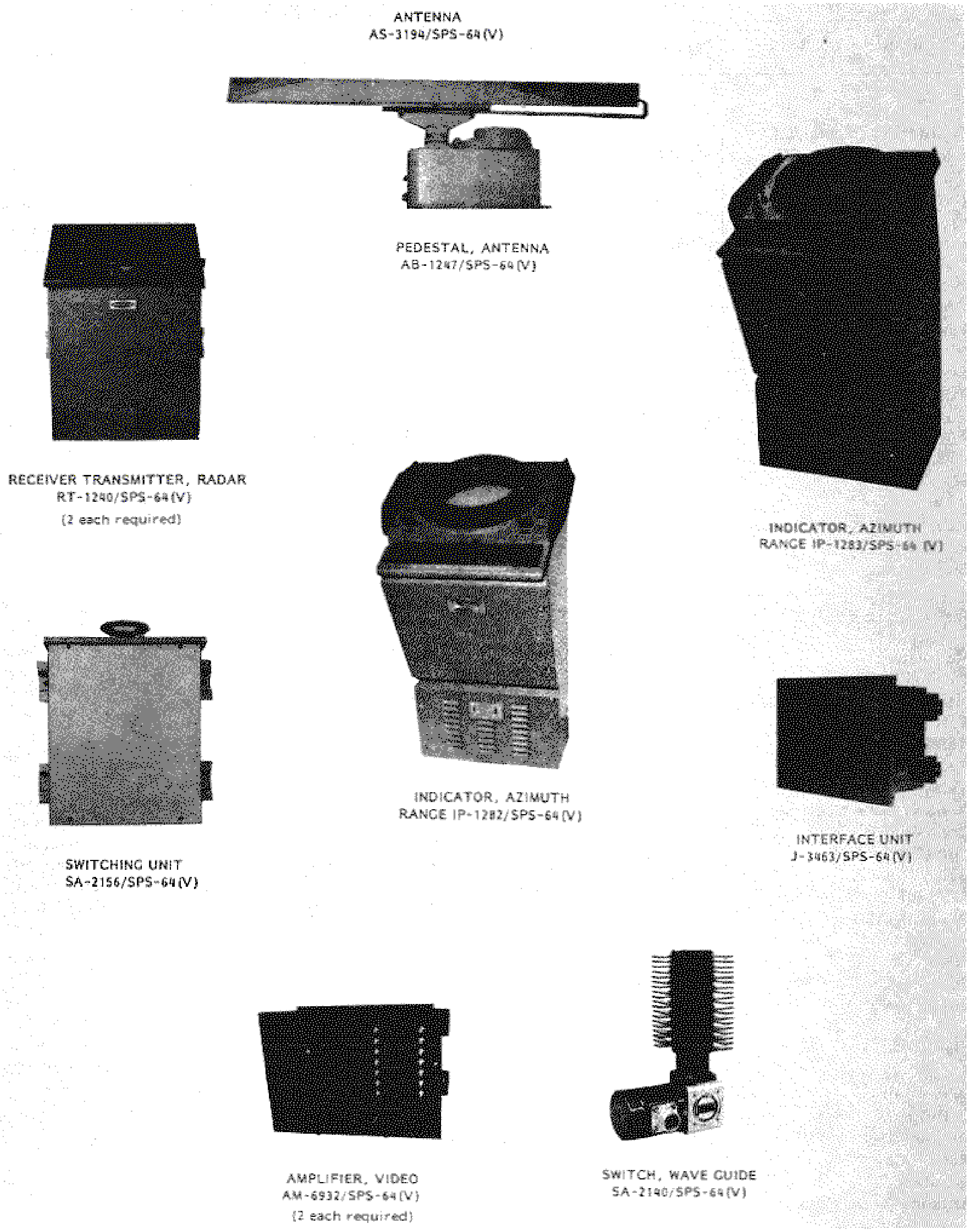


Figure 1-4 Radar Set AN/SPS-64(V)2 Major Units

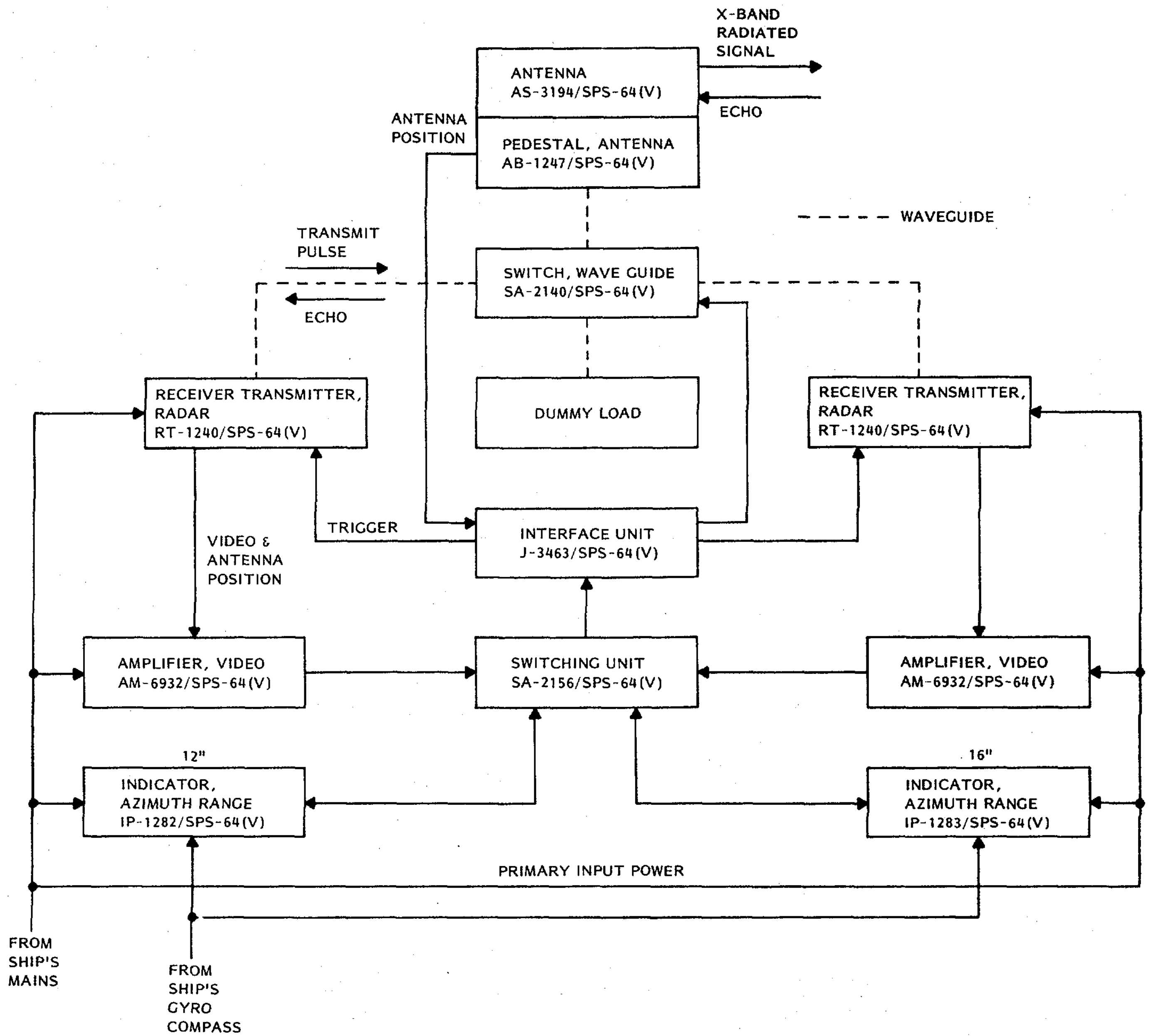


Figure 1-5 Radar Set AN/SPS-64 (V)2 Block Diagram

Table 1-5 Radar Set AN/SPS-64(V)2 Equipment Supplied

Qty.	Model	Description	Product Code
2	RT-1240/SPS-64(V)	Receiver Transmitter,	M27550
1	AS-3194/SPS-64(V)	Antenna Pedestal	M27409
1	AB-1247/SPS-64(V)	Pedestal, Antenna	M27575
1	SA-2156/SPS-64(V)	Switching Unit	M27459
I	J-3463/SPS- 64.(51V	Interface Unit	M27601
1	IP-1283/SPS-64(V)	Azimuth Range Indicator	M27502
1	IP-1282/SPS-64(V)	Azimuth Range Indicator	M27501
2	AM-6932/SPS-64 (V)	Video Amplifier	M27456
1	SA-2140/SPS-64 (V)	Wave Guide Switch	M27601

Equipment		Paragraph
Receiver Transmitter	RT-1240	1.11
Antenna	AS-3194	1.12
Indicators	IP-1282 & 1283	1.13
Switching Unit	SA-2156	1.14
Video Amplifier	AM-6932	1.15
Interface Unit	J-3463	1.16
Wave Guide Switch	SA-2140,	1.17

1.7.5 Required Test Equipment and Tools

Required test equipment and tools are listed in Table 1-3.

Table 1-6 Radar Set AN/SPS-64(V)2 Equipment Required But Not Supplied

Cable	Waveguide	Type
X		Belden 8777
X		Belden 9253
X		Belden 9773
X		Belden 9775
	X	RG-67/U
X		MSCA-7
X		FSGA-9
X		TSGA-3
X		TSGA-4

1.7.6 Recommended Spares

Spares are listed in Table 1-4.

1.8 RADAR SET AN/SPS-64(V)3

The Dual System uses two 12-inch indicators, one 16-inch indicator, two antennas, two antenna pedestals and two receiver transmitters, all primary radar components. Two six-position switching units are used, each capable of switching two indicators to either receiver transmitter. This dual arrangement reduces the possibility of total system failure by providing alternative switching paths and devices. It is more reliable than a single twelve-position switch because available switches are more rugged, with fewer critical shaft angle locations. Furthermore, standard configurations are used, with easy circuit traceability for installation and maintenance. Figure 1-6 illustrates the units that comprise the system.

1.8.1 Equipment Supplied (V3)

Table 1-7 lists the equipment supplied with Radar Set AN/SPS-64 (V)3.

Table 1-7 Radar Set AN/SPS-64 (V)3 Equipment Supplied

Qty.	Model	Description	Product Code
2	RT-1240/SPS-64(V)	Receiver Transmitter,	M27550
2	AS-3194/SPS-64 (V)	Antenna	M27409
2	AB-1247/SPS-64(V)	Antenna Pedestal	M27575
1	IP-1283/SPS-64(V)	Azimuth Range Indicator	M27502
2	IP-1282/SPS-64(V)	Azimuth Range Indicator	M27501
2	AM-6932/SPS-64(V)	Video Amplifier	M27456
2	SA-2139/SPS-64(V)	Switching Unit	M27455

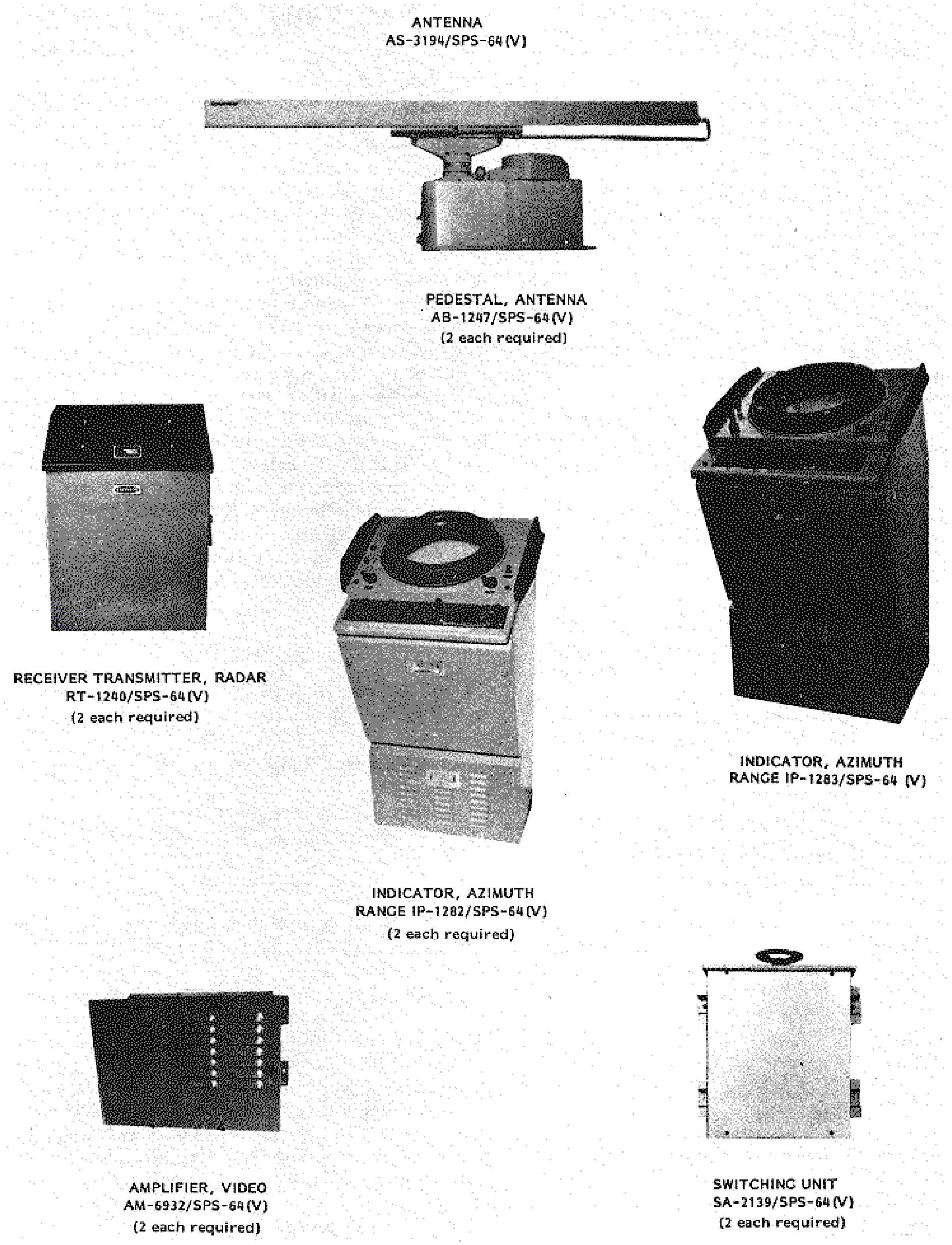


Figure 1-6 Radar Set AN/SPS-64(V)3 Major Units

1.8.2 Equipment Required But Not Supplied (V3)

Table 1-8 lists the cable and waveguide required but not supplied for Radar Set AN/SPS-64 (V)3.

Table 1-8 Radar Set AN/SPS-64(V)3 Equipment Required But Not Supplied

Cable	Waveguide	Type
X		Belden 8777
X		Belden 9253
X		Belden 9775
X		RG-59A/U
	X	RG-67/U
X		FSGA-9
X		MSCA-7
X		TSGA-3
X		TSGA-4

1.8.3 Block Diagram Description (V3)

Figure 1-7 is a block diagram showing the major components of Radar Set AN/SPS-64(V)3. This radar set uses two 12-inch indicators, one 16-inch indicator, two antennas, two antenna pedestals and two receiver transmitters, all primary radar components (described in paragraph 1.6.3). Two six-position switching units are used, each capable of switching two indicators to either receiver transmitter. This dual arrangement reduces the possibility of total system failure by providing alternative switching paths and devices. It is more reliable than a single twelve-position switch because available switches are more rugged, with fewer critical shaft angle locations. Furthermore, standard configurations are used, with easy circuit traceability for installation and maintenance.

1.8.4 Performance Characteristics (V3)

Performance characteristics for specific equipment is foundthe reference paragraphs listed below:

Equipment		Paragraph
Receiver Transmitter	RT-1240	1.11
Antenna	AS-3194	1.12
Indicators	IP-1282 & 1283	1.13
Switching Unit	SA-2139	1.14
Video Amplifier	AM-6932	1.15

1.8.5 Required Test Equipment and Tools (V3)

Required test equipment and tools are listed in Table 1-3.

1.8.6 Shipboard Spares (V3)

Shipboard spares are listed in Table 1-4.

1.9 RADAR SET AN/SPS-64(V)4

The Dual (Special) System uses one 12-Inch Indicator, two 16-Inch Indicators, one X-band antenna and antenna pedestal, one S-band antenna and antenna pedestal and one each X-band and S-band Receiver Transmitter. The system adds the Dual Interface components to drive the AN/SPA-66 and AN/SPA-25 Indicators. The technique adopted to configure the existing AN/SPA Indicators of the SLA/10 system into the Raytheon system is to provide an interface which accepts signals (AN/SPA-type synchro) from the selected radar antenna, and all other required signals with the same characteristics used by Raytheon indicators. The AN/SPA interface consists of a control indicator at the AN/SPA-66 and the AN/SPA-25, a signal data converter and an amplifier generator. These units convert all signals and lines to have correct interfaces for the AN/SPA indicators. The signal data converter includes all power supplies required for the conversion and amplifier circuits. It also interfaces with additional controls required to operate the AN/SPA indicators. The AN/SPA interface presents a single interface to the switching unit. To retain the SPA bearing features, synchros are added to both antennas to provide appropriate bearing signals for the SPA-25 and SPA-66 indicators. The switching units select the required antenna synchro signals appropriate to the selected configuration mode. Refer to Figure 1-8 for unit illustrations.

1.9.1 Equipment Supplied (V4)

Table 1-9 lists the equipment supplied with Radar Set AN/SPS-64(V)4.

1.9.2 Equipment Required But Not Supplied (V4)

Table 1-10 lists cable and waveguide required but not supplied for Radar Set AN/SPS-64(V)4.

1.9.3 Block Diagram Description (V4)

Figure 1-9 is a block diagram showing the major components of Radar Set AN/SPS-64(V)4. This radar set operates at X-band, 9420+7 MHz (tunable from 9405 to 9435 MHz) with a peak pulse power output of 20 kW and pulse widths of 0.06, 0.5, and 1 microsecond. The AN/SPS-64(V) 4 also operates at S-band (fixed frequency 3050 + 25 MHz) with a peak pulse power output of 50 kW (+10 kW) and pulse widths of 0.06, 0. 5, and 1 microsecond. Target echoes, fixed marks and the ship's heading flash are displayed on three daylight view azimuth range indicators (plan position display).

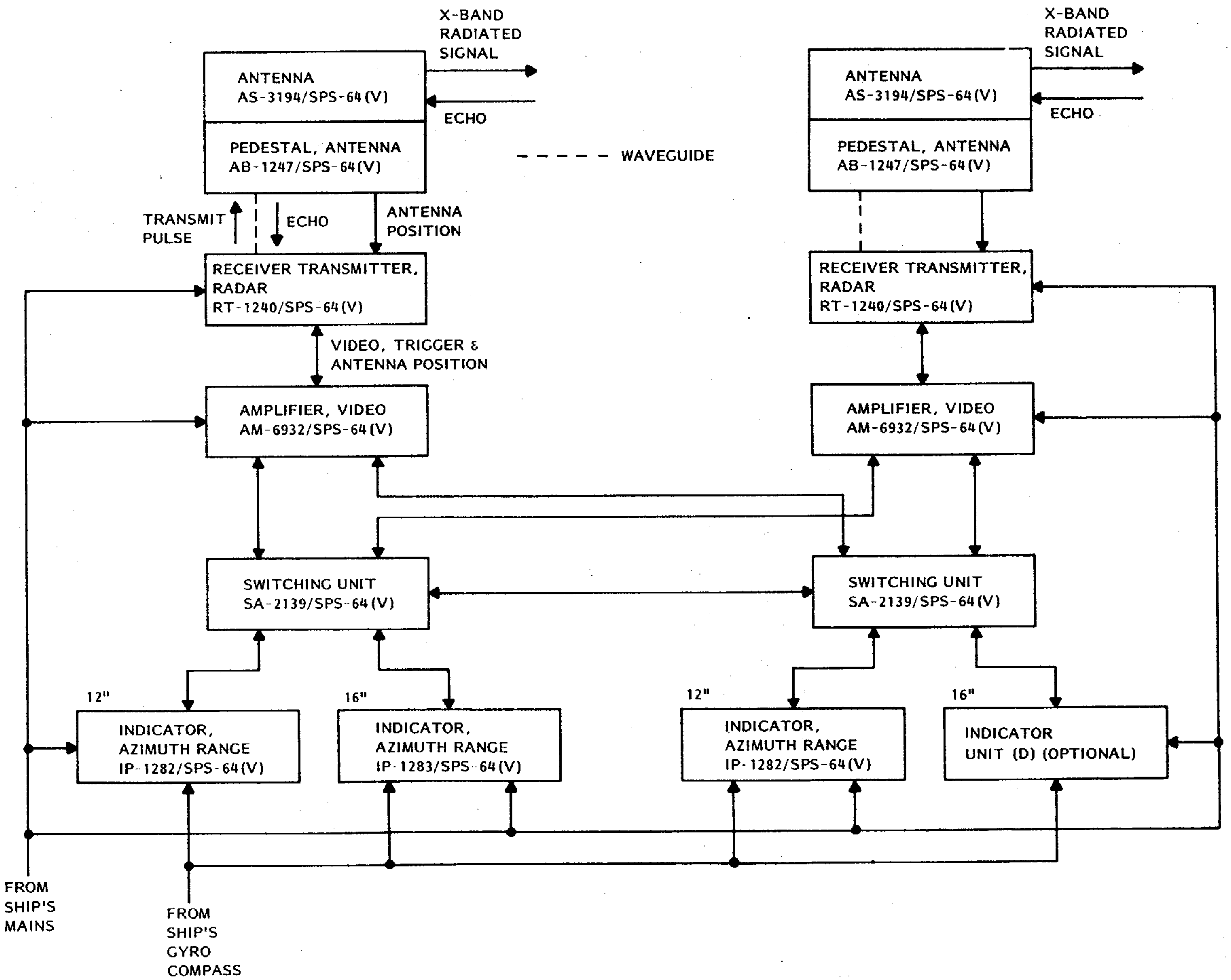


Figure 1-7 Radar Set AN/SPS-64 (V)3 Block Diagram

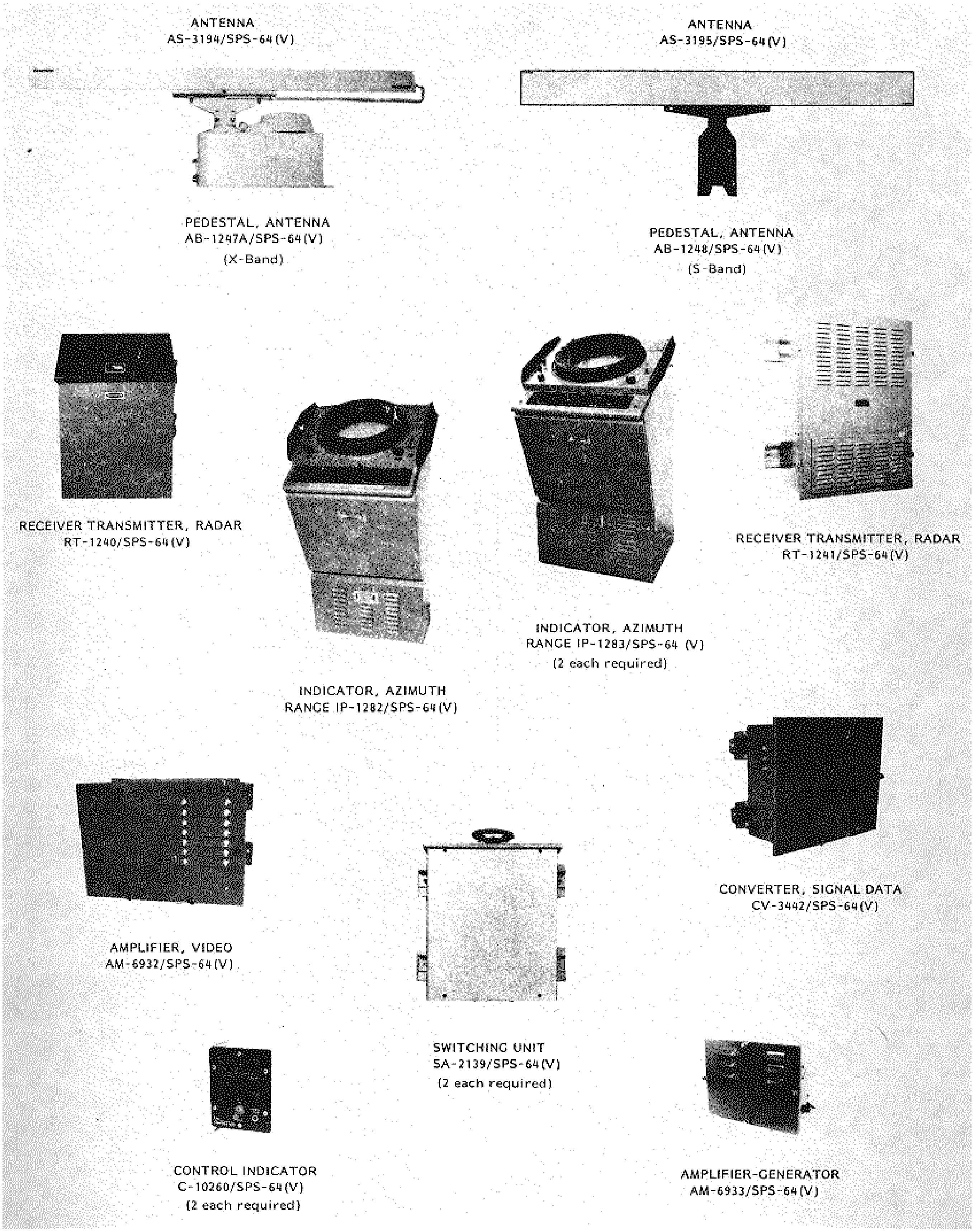


Figure 1-8 Radar Set AN/SPS-64 (V) 4 Major Units

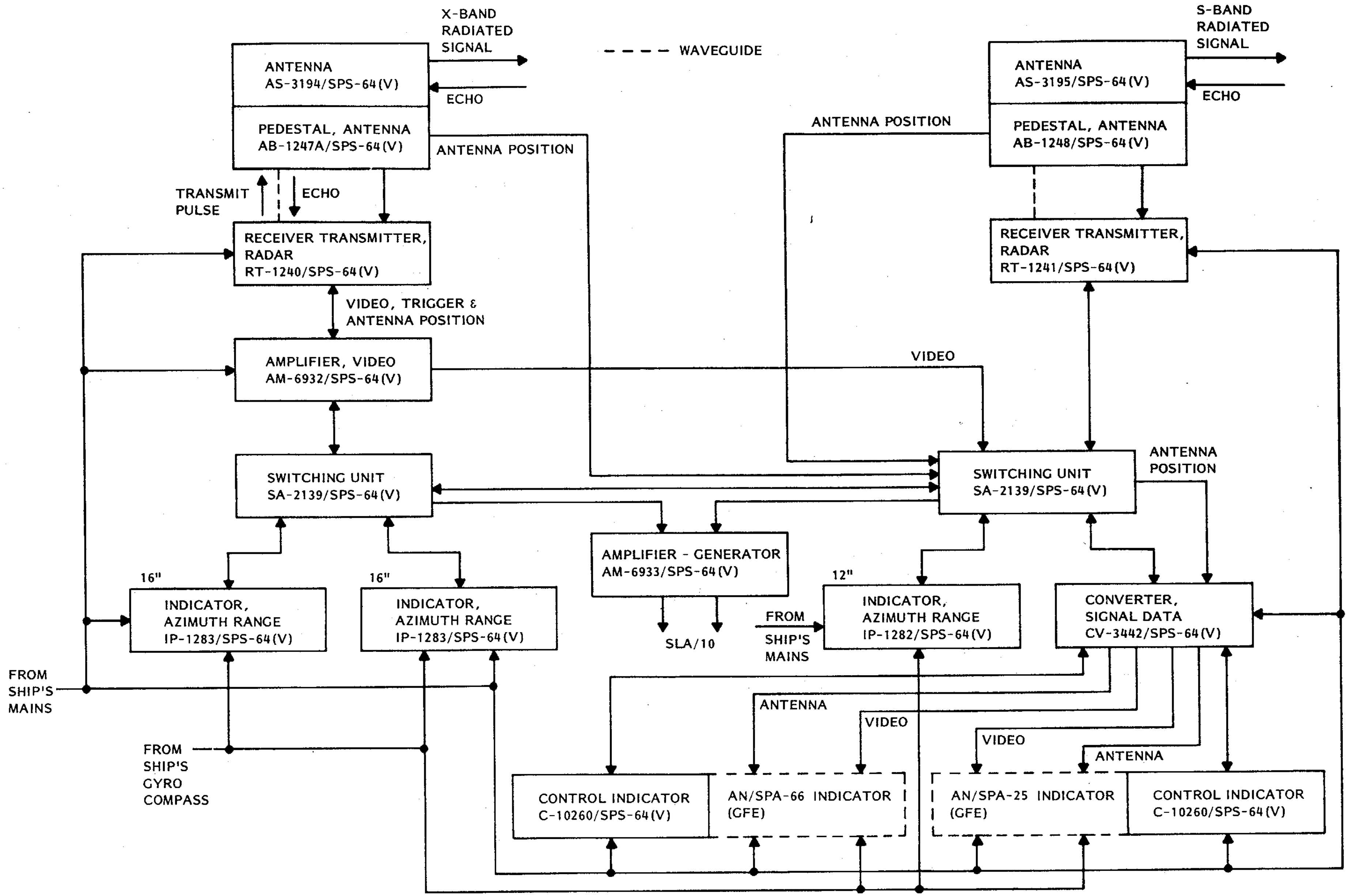


Figure 1-9 Radar Set AN/SPS-64(V) 4 Block Diagram

Table 1-9 Radar Set AN/SPS-64 (V) 4 Equipment Supplied

Qty.	Model	Description	Product Code
1	RT-1240/SPS-64(V)	Receiver Transmitter, Radar	M27550
1	RT-1241/SPS-64(V)	Receiver Transmitter, Radar	M27551
1	AS-3194/SPS-64 (V)	Antenna	M27409
1	AB-1247A/SPS-64(V)	Pedestal, Antenna	M27576
1	AS-3195/SPS-64 (V)	Antenna	M27475
1	AB-1248/SPS-64(V)	Pedestal, Antenna	M27578
2	C-10260/SPS-64(V)	Control Indicator	M27603
1	AM-6933/SPS-64(V)	Amplifier-Generator	M27600
2	IP-1283/SPS-64(V)	Indicator, Azimuth Range	M27502
1	IP-1282/SPS-64(V)	Indicator, Azimuth Range	M27501
2	SA-2139/SPS-64(V)	Switching Unit	M27455
1	AM-6932/SPS-64(V)	Amplifier, Video	M27456
1	CV-3442/SPS-64(V)	Converter, Signal Data	M27602

Table 1-10 Radar Set AN/SpS64(V)4 Equipment Required But Not Supplied

Cable	Waveguide	Type
X		Belden 8777
X		Belden 8769
X		Belden 9253
X		Belden 9773
X		Belden 9775
X		RG-59A/U
	X	RG-67/U
X		FSGA-9
X		MSCA-7
X		TSGA-3
X		TSGA-4
X		TTRSA-4
X		7/8 in EIA

The AN/SPS-64(V)4 radar system uses one 12inch and two 16-inch azimuth range indicators, two antennas and antenna pedestals (X-band and S-band), and two receiver transmitters (X-band and S- band). The system also includes the signal data converter, two control indicators, an amplifier-generator, and two switching units. The switching units select the required antenna synchro signals appropriate to the selected configuration mode.

The existing AN/SPA indicators and the AN/ SLA-10 ESM Blanking system are configured into the AN/SPS-64(V)4 system via the signal data converter which accepts video, trigger, and synchro signals from the selected antenna, and all other required signals with the same characteristics used by the AN/SPS-64(V)4 indicators. The sight data converter unit converts all signals and lines to the correct interfaces for the AN/SPA indicators. The signal data converter includes all power supplies required for the conversion and amplification circuits and presents a single interface to the switching unit. The control indicators interface with additional controls required to operate the AN/SPA indicators. To retain the AN/SPA bearing features, synchros are added to both antenna pedestals to provide appropriate bearing signals to the selected configuration mode.

1.9.4 Performance Characteristics (V4)

Performance characteristics for specific equipment of Radar Set AN/SPS-64(V)4 are found in the reference paragraphs listed below:

Equipment		Paragraph
Receiver Transmitter	RT-1240	1.11
Antenna AS-3194 & Pedestal AB-1247		1.12
Indicators	IP 1282 & 1283	1.13
Switching Unit	SA-2139	1.14
Video Amplifier	AM-6932	1.15
Receiver Transmitter	RT-1241	1.18
Antenna AS-3195 & Pedestal AB-1248		1.19
Signal Data Converter	CV-3442	1.20
Control Indicator	C-10260	1.21
Amplifier - Generator	AM-6933	1.22

1.9.5 Required Test Equipment and Tools

Required test equipment and tools are listed in Table 1-11.

1.9.6 Recommended Spares

Spares are listed in Table 1-12.

Table 1-11 Radar Set AN/SPS-64(V)4 Test Equipment, Tools and Materials

Item Description	Qty.	Manufacturer or Supplier	Model/Part Number
TOOLS			
Trimpot Adjustment Tool	2	Bornes	
Puller, Printed Circuit Board	1	Calmark	112
Oil Injection Syringe	1	Any	- - - - -
Grooving Tool, Cable	1	Andrew Corporation	36577-2
Wrench, Glandnut	1	Raytheon	169140-1
Center Probe Insertion Tool	1	Raytheon	169141-1
Gear Reducer Support	1	Raytheon	169139-1
TEST EQUIPMENT			
Multi meter	2	Simpson	260
Oscilloscope	1	Tektronix	335
Power Meter	1	Hewlett Packard	432A
Thermistor Mount, Power Meter	1	Hewlett Packard	478A
Probe, Oscilloscope, 10X	2	Tektronix	P6105
Probe, Oscilloscope, High Voltage	1	Hewlett Packard	P6015
Signal Generator	1	Hewlett Packard	620B
Gauge, Tension	1	Chatillon	719-10
Signal Generator	1	Hewlett Packard	8616A
Clip, Integrated Circuit	2	Pomona Electronics	3916
Resistor, 220 ohm, 200 Watt	1	Any	- - - - -
Resistor, 470 ohm, 1/2 Watt	1	Any	- - - - -
Resistor, 680 ohm, 1/2 Watt	1	Any	- - - - -
Diode, Zener, 5.1 Volt	1	Any	- - - - -
Connector, BNC Tee	1	Any	UG-274/U
Variac, 115Vac, 10A	1	Any	- - - - -
Frequency Meter	1	Hewlett Packard	X532B
Attenuator, Fixed Microwave, 20dB	1	Weinschel Engineering	530A-20
Adapter, Power Cord Ground Insulating	2	Any	- - - - -
Adapter, Type N, Connector to UG-135 Waveguide Flange	2	Hewlett Packard	X281A
MATERIALS			
Gear Box Lubricant, MIL-L-6086,Grade M		Raytheon	*980131-1
Oil, Lubricating, Light Machine	-	Raytheon	230-7176P1
Grease MIL G23827	-	Raytheon	230-1158P8
Gasket Compound	-	Permatex	Aviation Form-A-Gasket
Anti-Seize Compound	-	Kiekhaefer Mercury	Quicksilver Anti-corrosion Grease
Heat Sink Compound	-	Raytheon	95-981

* For operation below -150F (-240C) use MIL-L-6086B, Grade L (Part Number 980131-2)

Table 1-12 Radar Set AN/SPS-64(V)4 Shipboard Spares

Description	Part Number	Qty.
Amplifier-Generator		
Interface PCB	167193-1	1
Fuse	226-7177P42	2
Signal Data Converter		
Interface PCB	167200-1	1
Lamp	277-7184P1	1
Fuse	226-7176P36	2
Diff. Generator	167532-1	1
Control Indicator		
Lamp	277-7184P1 1	
Video Amplifier		
Resolver Drive PCB	167137-1 1	
S-Band Antenna		
V-Belts	167591-4	1
Synchro	167620-1	1
Heading Line Switch	585158-1	1
Antenna Motor	167667-1	1
S-Band Receiver Transmitter		
Magnetron	166254-1	1
Modulator Tube	589752-1	1
TR Limiter Diode	168577-1	1
TR Cell	168576-1	1
Relay	167032-1	1
Relay	167068-1	1
Relay	167307-1	1
Contactor	167575-1	1
Capacitor, HV	167028-1	2
Diode, Microwave	167579-11	4
Pulse Logic PCB	166946-1	1
Magnetron Heater	166991-1	1
Sched PCB		
Preregulator PCB	167878-1	1
Chopper Drive PCB	167880-1	1
(LV) Base Driver PCB	167882-1	1
L.V. Output PCB	167129-1	1
(HV) Base driver PCB	167882-2	1
H.V. Output PCB	167126-1	1
2N6545	167372-4	4
Pulse Dr. PCB	167074-1	1
LM 320	167729-1	1
LM 340	166371-2	1

Table 1-12 Radar Set AN/SPS-64(V)4 Shipboard Spares (cont'd)

Description	Part Number	Qty.
Indicator		
Position Transmission PCB	589412-1	1
Sweep Generator PCB	589415-1	1
Timing Control PCB	589418-1	1
Data Storage PCB	589421-1	1
Counter PCB	589424-1	1
Video Amplifier PCB	589430-1	1
Control PCB	166133-1	1
VRM PCB	167520-1	1
CKT Card Extender PCB	589556-1	1
Lamps	277-1011P2	1
HV Regulator PCB	166165-1	1
Fuse 5A	226-7176P57	2
Fuse 4A	226-7177P14	2
Fuse 6A	226-7176P58	2
PRF Generator PCB	589427-1	1
NSK		
Resolver Driver PCB	167688-1	1
Exciter PCB	167211-1	1
Stepper Motor	315-7243P1	1
X-Band Receiver Transmitter		
Modulator Tube	589752-1	1
Magnetron	167542-1	1
T/R Limiter	166083-1	1
Relay	589648-2	1
Relay	165584-1	1
Relay	165043-1	1
X-Band Gunn Oscillator	589364-1	1
Control PCB	166489-1	1
Pulse Driver PCB	166380-1	1
Delco 2N3902	18-212	1
RCA 65115	588150-2	1
Diode 1N415G	167579-11	4
Fuse 3A	226-7176P68	2
Fuse 5A	226-7177P15	2
Fuse 1.5A	226-7177P26	2
Fuse 10A	226-7181P2	2
LM 309K	588291-1	1
X-Band Antenna		
Drive Belt	167591-1	2
O-Ring	167636-1	1
Magnet	320-7180P3	1
Reed Relay	271-7247P1	1
Resolver	315-7234P2	1
Antenna Drive Motor	167666-1	1

SECTION III: EQUIPMENT DESCRIPTIONS

1.10 GENERAL

This section of the Instruction Manual describes the physical and functional characteristics of the equipment comprising the AN/SPS-64(V) Radar.

A System Equipment Applicability Matrix, Table 1-13 lists the equipment configuration for the four (4) versions of this radar. Across reference between the official nomenclature assigned by the Coast Guard and the common name used by the contractor is also included in the table.

1.11 RECEIVER TRANSMITTER RT-1240

1.11.1 Function of Equipment

The receiver transmitter (X-band) generates the radio frequency burst for radiation by the antenna in accordance with timing and control signals from the indicators. The echoes reflected from the target are amplified and detected to provide video target data to the indicators.

1.11.2 Performance Characteristics

Performance characteristics of the receiver transmitter are specified in Table 1-14.

1.11.3 Physical Description

A physical description of the receiver transmitter is given in Table 1-25.

1.11.4 Power Requirements

The power requirements for receiver transmitter RT-1240 are 115 Vac, 60 Hz, 10, 225W.

1.12 ANTENNA AS-3194 AND PEDESTAL AB-1247

1.12.1 Function of Equipment

RF energy from the transmitter section of the receiver transmitter is coupled into waveguide and directed to the slotted waveguide array. Energy is radiated from the array in a narrow unidirectional beam, so that the bearing of an object reflecting energy can be determined to within approximately 10. Vertically, the beam is relatively wide (approximately 220), so that the roll and pitch of the vessel will not normally impair the antenna direct line of sight to the horizon. The antenna radiates the pulse of high frequency energy, and receives the reflected pulse of energy when the transmitter is off.

Table 1-13. Systems/Equipments Applicability Matrix

EQUIPMENT MODEL NUMBER	EQUIPMENT NAMEPLATE	COMMON NAME	Radar Set AN/SPS-64			
			(V)1	(V)2	(V)3	(V)4
AS-3194/SPS-64(V)	Antenna	X-Band Array	1	1	2	1
AB-1247/SPS-64(V)	Pedestal, Antenna	X-Band Antenna Pedestal	1	1	2	-
AB-1247A/SPS-64(V)	Pedestal, Antenna	X-Band Antenna Pedestal (with synchro)	-	-	-	1
RT-1240/SPS-64(V)	Receiver Transmitter, Radar	20 KW X-Band MTR	1	2	2	1
IP-1282/SPS-64(V)	Indicator, Azimuth Range	12 Inch Indicator	1	2	2	1
IP-1283/SPS-64(V)	Indicator, Azimuth Range	16 Inch Indicator	-	1	1	2
SA-2139/SPS-64(V)	Switching Unit	Interswitch (USCG)	-	-	2	2
SA-2156/SPS-64(V)	Switching Unit	Interswitch (USCG)	-	1	-	-
J-3463/SPS-64(V)	Interface Unit	Junction Box	-	1	-	-
SA-2140/SPS-64(V)	Switch, Wave Guide	Waveguide Switch	-	1	-	-
AM-6932/SPS-64(V)	Amplifier, Video	VARD	-	2	2	1
AS-3195/SPS-64(V)	Antenna	S-Band Array	-	-	-	1
AB-1248/SPS-64(V)	Pedestal, Antenna	S-Band Antenna Pedestal	-	-	-	1
RT-1241/SPS-64(V)	Receiver, Transmitter Radar	50 KW S-Band MTR	-	-	-	1
AM-6933/SPS-64(V)	Amplifier-Generator	ESM Interface Unit	-	-	-	1
CV-3442/SPS-64(V)	Converter, Signal Data	SPA Interface Unit	-	-	-	1
C-10260/SPS-64(V)	Control Indicator	FTC Control Box	-	-	-	2

Table 1-14. Receiver Transmitter RT-1240 Performance Characteristics

Parameter	Description
Transmitter	
Frequency	9420 ± 7 MHz
Peak Pulse Power Output	20 kW minimum
Pulse Width	0.06 usec (0.25 to 3 NM); 0.5 usec (6,12 NM); 1 usec (24, 48, 64 NM); 0.5 usec (12 RT)
PRF	3600, 1800, and 900 PPS
Receiver	
Intermediate Frequency	45 MHz
IF Amplifier Bandwidth	24 MHz (0.06 usec PW); 4 MHz (0.5 and 1 usec PW)
Video Amplifier Bandwidth	20 MHz equivalent (sampled data system)
Noise Figure	10 dB maximum
Minimum Discernible Signal	-98 dBm
System Environment	
Ambient Temperature Range	0° to +55° C
Relative Humidity (at 550 C)	95%
Shock (all planes)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

The slotted waveguide array is continuously rotated by the drive system which reduces the antenna motor shaft speed to the desired antenna rotation speed. The resolver is an electro-mechanical device which converts the rotation and instantaneous direction of the antenna into electrical signals that cause the PPI trace to rotate in synchronism with the antenna. The heading line is generated by means of a reed switch that momentarily closes once every revolution.

1.12.2 Performance Characteristics

Performance characteristics of the antenna and pedestal are specified in Table 1-15.

1.12.3 Physical Description

A physical description of the antenna and pedestal is found in Table 1-25.

1.12.4 Power Requirements

The power requirements for the antenna are 115 Vac, 10, 60 Hz, 350W.

1.13 INDICATORS IP-1282 (12-INCH) AND IP-1283 (16-INCH)

1.13.1 Function of Equipment

These indicators provide PPI display for a full 3600 coverage. There are ten display ranges extending from 0.25 to 64 miles. An added feature includes an Electronic Bearing Line (EBL) for accurate measurement of target bearing and range information. Heading flash and both fixed and variable range markers are displayed on the CRT along with targets.

1.13.2 Performance Characteristics

Performance characteristics of the indicators are specified in Table 1-16.

1.13.3 Physical Description

Physical descriptions of the IP-1282 and IP-1283 are given in Table 1-25.

1.13.4 Power Requirements

The power requirements for the indicators are 115 Vac, 10, 50-60 Hz, 160 W.

Table 1-15 Antenna AS-3194 and Antenna Pedestal AB-1247 Performance Characteristics

Parameter	Description
Type	End-fed slotted array
Polarization	Horizontal
Horizontal Beam Width (at -3 dB)	1.20
Vertical Beam Width (at -3 dB)	20.70
Gain	28.5 dB
Horizontal Side Lobes	-29dB
Rotation Speed	33 RPM
Ambient Temperature Range	-250 to +550 C
Relative Humidity (at 550 C)	95%
Shock (all planes)	20G
Vibration	1G at 5-50 Hz
Waterproofing	24 hrs at 1 inch/hour or 1 hour at 5 inches/hour
Rated Wind Load	
Operating	100 knots
Survival	150 knots

Table 1-16 Indicators IP-1282 and IP-1283 Performance Characteristics

Parameter	Description		
CRT Phosphor	P19		
Range Ring Accuracy	10 yards or ± 0.25 percent (whichever is greater)		
Range Resolution	0.25, 0.5, 0.75 NM 20 yards	1.5 NM 25 yards	3.0 NM 43 yards
Bearing Resolution	1.25° at 1/3 radius		
Bearing Accuracy	±1.0 degree		
VRM Accuracy	10 yards or 1.0 percent (whichever is greater)		
VRM Resolution	5.062 yards or ± 0.25 percent (whichever is greater)		
Ambient Temperature Range	0° to +55° C		

Table 1-16 Indicators IP-1282 and IP-1283 Performance Characteristics (Cont'd)

Parameter	Description											
Relative Humidity (at 550C)	95%											
Shock (all planes)	15G											
Vibration	1G at 5-50 Hz											
Water-proofing	Drip-proof											
Range Scale (miles)	0.25	0.5	0.75	1.5	3	3 PWR BOOST	6	12	24	48	64	12RT
Normal Display Sweep (usec)	111	111	111	111	111	166.5	166.5	166.5	222	222	222	166.5
Offset Display Sweep (usec)	189	189	189	189	189	285	295	295	378	N/A	N/A	285
RANGE SELECT Switch Position	1	2	3	4	5	5 plus PWR BOOST	6	7	8	9	10	11
Range Ring Interval (miles)	0.125	0.25	0.25	0.25	0.5	0.5	1	2	4	8	16	2
Number of Range Rings	2	2	3	6	6	6	6	6	6	5	3	6
Receiver Transmitter Pulse Width (nsec)	60	60	60	60	60	500	500	500	1000	1000	1000	500
Sample Period (nsec)	30.9	30.9	30.9	30.9	30.9	124	248	248	495	495	495	N/A
Display Rep Rate (kHz)	3.6	3.6	3.6	3.6	3.6	1.8	1.8	1.8	0.9	0.9	0.9	1.8

1.14 SWITCHING UNITS SA-2139 (V3, V4) AND SA-2156 (V2)

1.14.1 Function of Equipment

Each unit is a six (6) position manually operated switch which provides the on-line receiver transmitter and master indicator selection. In version V2 of the system one (1) SA-2156 is used while versions V3 and V4 require the use of two (2) SA-2139s.

1.14.2 Performance Characteristics

Performance characteristics of the units are specified in Table 1-17.

1.14.3 Physical Description

A physical description of the units is found in Table 1-25.

1.14.4 Power Requirements

The switching units are passive devices requiring no power for operation.

1.15 VIDEO AMPLIFIER AM-6932

1.15.1 Function of Equipment

The video amplifier provides the necessary amplification to drive the multiple indicators from a single receiver transmitter and antenna pedestal. Video and resolver signals are amplified and split for use in the indicators. Terminal boards provide the interconnection for various signal paths.

1.15.2 Performance Characteristics

Performance characteristics of the video amplifier are specified in Table 1-18.

1.15.3 Physical Description

A physical description of the video amplifier is found in Table 1-25.

1.15.4 Power Requirements

The power requirements of the video amplifier are 115 Vac, 60 Hz, 22 W.

1.16 INTERFACE UNIT J-3463(V2)

1.16.1 Function of Equipment

The primary function of the interface unit is to couple control signals between the active receiver transmitter and the antenna pedestal. Contained within is a 28 Vdc power supply which provides the energy to activate wave guide switch, SA2140.

1.16.2 Performance Characteristics

Performance characteristics of the interface unit are specified in Table 1-19.

1.16.3 Physical Description

A physical description of the interface unit is found in Table 1-25.

Table 1-17. Switching Units SA-2139 (V3, V4) and SA-2156 (V2) Performance Characteristics

Parameter*	Description
Voltage and Current Rating	10A @ 125 Vac
Overload	50 operations @ 30 amperes, 125 Vac resistive
Dielectric Strength	120 VRMS (minimum)
Insulation Resistance	100 megohms (minimum)
Contact Resistance	100 milliohms (maximum)
Ambient Temperature Range	0° to +55° C
Relative Humidity (at 550 C)	95%
Shock (all planes)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

* Specifications at 250C.

Table 1-18 VARD AM-6932 Performance Characteristics (V2, V3, V4)

Parameter	Description
Video Amplifier Input	Impedance, 75 ohms, Input Signal, 0 to 2.5V nominal (3.5V max); Minimum Pulse Width, 50 nsec
Video Amplifier Output	Impedance, 75 ohms, Output Signal, 0 to 5V nominal (7V max)
Buffer Amplifier Input	Impedance, 10K, Input Signal, 0 to 6V peak (nominal); Frequency, 900 Hz
Buffer Amplifier Output	Load, 600 ohms to 50K (one to four Azimuth Range Indicators via Switching Unit); Impedance, less than 1 ohm; Amplitude, 0 to 6V peak (adjustable from 4.2 to 7.2V peak with nominal input)
Resolver Driver Input	Impedance, greater than 2K; Amplitude, 6V peak AC (nominal); Frequency 900 Hz Bandwidth 0 to 3.4 kHz
Ambient Temperature Range	0° to +550 C
Relative Humidity (at 550 C)	95%
Shock (all planes)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

Table 1-19 Interface Unit J-3463 Performance Characteristics

Parameter	Description
Input Line	115 Vac, 50-60 Hz
Power Supply Output	28V, 2A
Ambient Temperature Range	0° to +550 C
Relative Humidity (at 550 C)	95%
Shock (all planes)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

1.16.4 Power Requirements

The power requirements of the interface unit are 115 Vac, 10, 50-63 Hz, 25 W.

1.17 WAVE GUIDE SWITCH SA-2140 (V2)

1.17.1 Function of Switch

The waveguide switch couples RF energy from the on-line receiver transmitter to the common antenna while terminating the off-line receiver transmitter into the dummy load. The waveguide switch position is controlled by the mode selected at switching unit SA-2156.

1.17.2 Performance Characteristics

Performance characteristics of the wave guide switch are specified in Table 1-20.

1.17.3 Physical Description

A physical description of the wave guide switch is found in Table 1-25.

1.17.4 Power Requirements

The power requirement of the wave guide switch is 28 Vdc. The attached dummy load has a rated average power dissipation of 500 W and a test peak power of 290 kW.

1.18 RECEIVER TRANSMITTER RT-1241 (V4)

1.18.1 Function of Receiver Transmitter

The receiver transmitter provides 50 kW peak power at S-band for radiation by the antenna. Target echoes are received by the antenna and then amplified to provide video data to the indicators.

Table 1-20 Wave Guide Switch SA-2140 Performance Characteristics (V2)

Parameter	Description
Wave Guide Switch	
Frequency Range	8.2 to 12.4 GHz
Flange	Choke, UG-135/U
No. and Angle of Positions	Transfer 900 (4-port)
Dummy Load (P/O Wave Guide Switch)	
Frequency Range	8.2 to 12.4 GHz
Maximum VSWR	1.10 to 1

1.18.2 Performance Characteristics
Performance characteristics of the receiver transmitter are specified in Table 1-21.

1.18.3 Physical Description
A physical description of this receiver transmitter is given in Table 1-25.

1.18.4 Power Requirements
The power requirements of the receiver transmitter are 208/220/440 Vac, 60 Hz, 30, 1500 W.

1.19 ANTENNA AS-3195 AND PEDESTAL AB-1248

1.19.1 Function of Equipment
The pedestal supports and rotates the antenna at 33 RPM. The antenna both radiates the narrow horizontal beam generated by the receiver transmitter, and receives the target echoes for transmission to the indicators.

1.19.2 Performance Characteristics
Performance characteristics of the antenna and pedestal are specified in Table 1-22.

Table 1-21. Receiver Transmitter RT-1241 Performance Characteristics (V4)

Parameter	Description
Transmitter	
Frequency Range	3050 ± 25 MHz
Peak Pulse Power Output	50 ± 10 KW
Pulse Width	0.06 usec (0.25 to 3 NM); 0.5 usec (6,12 NM); 1 usec (24, 48, 64 NM); 0.5 usec (12RT)
PRF	3600, 1800, 900 PPS
Receiver	
Intermediate Frequency	45 MHz
IF Amplifier Bandwidth	24 MHz (0.06 usec PW); 4 MHz (0.5 and 1 usec PW)
Video Amplifier Bandwidth	20 MHz equivalent (sample data system)
Noise Figure	10 dB maximum
MDS	-98dB minimum
System Environment	
Ambient Temperature Range	0° to +55° C
Relative Humidity (at 550 C)	95%
Shock (all planes-)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

Table 1-22. Antenna AS-3195 and Antenna Pedestal AB-1248 Performance Characteristics (V4)

Parameter	Description
Type	End-fed slotted array
Polarization	Horizontal
Horizontal Beam Width (at -3 dB)	2°
Vertical Beam Width (at -3 dB)	23°
Gain	27.5 dB
Horizontal Side Lobes	-29 dB
Rotation Speed	33 RPM
Ambient Temperature Range	-25° to +55° C
Relative Humidity (at 550 C)	95%
Shock (all planes)	20G
Vibration	1G at 5-50 Hz
Waterproofing	24 hrs. at 1 inch/hour or 1 hour at 5 inches/hour
Rated Wind Load	
Operating	100 knots
Survival	150 knots

1.19.3 Physical Description

A physical description of the antenna and pedestal is found in Table 1-25.

1.19.4 Power Requirements

The power requirements for the pedestal are 440 Vac, 30, 800 W per phase.

1.20 SIGNAL DATA CONVERTER CV-3442 (V4)

1.20.1 Function of Equipment

The signal data converter provides the amplification and impedance matching to drive the AN/ SPA-25 and AN/SPA-66 indicators. The video and heading flash signals are amplified and split before their input to the remote indicators. Azimuth synchro data is passed directly to the remote indicators for Relative Bearing display or is combined with the ship's course data for North Stabilized Display.

Selection of relative or true bearing display at the remote indicators is controlled at the signal data converter. Video time constant selection is provided by Control Indicator C-10260 Units mounted on the remote indicators.

1.20.2 Performance Characteristics

Performance characteristics of the signal data converter are specified in Table 1-23.

1.20.3 Physical Description

A physical description of this unit is found in Table 1-25.

1.20.4 Power Requirements

The power requirements of this device are: 115Vac, 11, 60Hz, 300W.

1.21 CONTROL INDICATOR C-10260 (V4)

1.21.1 Function of Equipment

The control indicator provides for the antenna bearing mode signals displayed on the AN/SPA-25 and AN/SPA-66 Indicators. This unit also controls the time constant and heading line blanking.

1.21.2 Physical Description

A physical description of this unit is given in Table 1-25.

1.22 AMPLIFIER-GENERATOR AM-6933 (V4)

1.22.1 Function of Equipment

When either receiver transmitter is radiating, the amplifier-generator receives a trigger pulse; if both are radiating, their two triggers are received. This unit contains two identical trigger reshaping circuits which provide the output drive pulses to the AN/SLA-10 blanking video mixer.

1.22.2 Performance Characteristics

Performance characteristics of this item are specified in Table 1-24.

1.22.3 Physical Description

A physical description of this unit is found in Table 1-25

1.22.4 Power Requirements

The power requirements of this item are: 115Vac, 10, 60 Hz, 200 W.

Table 1-23. Signal Data Converter CV-3442 Performance Characteristics (V4)

Parameter	Description
Video Input	+3.5V (maximum) into 75 ohms
Acknowledge Pulse Input	+3.5V (maximum) into 75 ohms
Gyro Compass Input	70 Vdc/step-by-step, 10-minute steps
FTC Control Line Input	Negative level lines select FTC time constant
Antenna Azimuth (AZ REF) Input	115V, 10, 60 Hz
Antenna Azimuth (AZ SYNCHRO) Input	90V (line-line), 30
SPA-66/SPA-25 Trigger Outputs	5 used (minimum) pulse; Output Level (high) +10 ± 1 Vdc into 75 ohms; Output Level (low) 0 Vdc (passive pull down); Short circuit protected
SPA-66/SPA-25 Video Outputs	Positive going signal; Output Level (high) 2.5 ±.5 Vdc into 75 ohms; Output Level (low) 0 ± 2 V into 75 ohms
Video Output	Composite of video and heading flash signals
Synchro Output	90V (line-line)
Relative Bearing Synchro Output	90V (line-line) 30 synchro from antenna and AZ REF passed to SPA units
North-Stabilized Synchro Output	90V (line-line) 30 difference data signal between antenna relative bearing and ships gyro compass; and AZ REF passive to SPA units
Azimuth Reference (AZ REF)	115V, 10, 60 Hz
Ambient Temperature Range	0° to +55° C
Relative Humidity (at 550 C)	95%.
Shock (all planes)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

Table 1-24 Amplifier - Generator AM-6933 Performance Characteristics (V4)

Parameter	Description
3-CM and 10-CM Trigger Input	Input Level (high) +0.7 ± 0.1 Vdc; Input Level (low) 0.1 ± 0.1 Vdc
3-CM and 10-CM SLA-10 Outputs	Output Level (high) +10 ± 1.0 Vdc (into 75 ohms); Output Level (low) 0 to 0.2 Vdc
Ambient Temperature Range	0° to +55° C
Relative Humidity (at 55° C)	95%
Shock (all planes)	15G
Vibration	1G at 5-50 Hz
Waterproofing	Drip-proof

Table 1-25 Equipment Physical Data

Unit	Height (inches)	Width (inches)	Depth (inches)	Weight (pounds)
Radar Receiver Transmitter (X-Band)	23-1/4	21-3/4	12	50
Radar Receiver Transmitter (S-Band)	32-3/16	23-5/16	14	110
Azimuth Range Indicator (12-Inch)	44	25	25	120
Azimuth Range Indicator (16-Inch)	44	29	28	165
Antenna and Antenna Pedestal (X-Band)	23-27/32	80 (Swing Circle)		140
Antenna and Antenna Pedestal (S-Band)	48-5/16	148 (Swing Circle)		332
Video Amplifier	12-15/32	17-1/2	8-7/16	20
Signal Data Converter	14	17	6	25
Control Indicator	5	4	3	1
Amplifier-Generator	9	12	5	12
Switching Units	21-7/8	20-11/16	10	75
Interface Unit	16	12	7	15
Wave Guide Switch	3	3	10	4-1/2

Table 1-26. REFERENCE DESIGNATION INDEX

UNIT			NAME
1.			Antenna AS-3194 (X-band)
2.	(see Note 1)		Antenna Pedestal AB-1247 (X-band)
3.		(A1000)*	Receiver Transmitter RT-1240 (20 KW X-band)
	A1	(A1100)*	Pulse and Driver PCB
	A2	(A1200)*	Power Module
	A2A1	(A1300)*	Control PCB
	A2A2	(A1200)*	Passive PCB
	A3		Not used
	A4	(A1400)*	High Voltage PCB
	A5		Not used
	A6	(A1 600)*	IF Amplifier Assy
4.			Azimuth Range Indicator IP-1282 (12")
	A1		Power Module
	A1A1		Control PCB
	A1A2		Passive PCB
	A1A3		HV Regulator
	A1A4		Potentiometer Component Board
	A2		Card Basket
	A2A1		Video Amplifier PCB
	A2A2		Counter PCB
	A2A3		Data Storage PCB
	A2A4		Timing Control PCB
	A2A5		Interference Reject PCB
	A2A6		PRF Generator PCB
	A2A7		VRM PCB
	A2A8		Position Transmission PCB
	A2A9		EBL Switching PCB
	A2A10		Sweep Generator PCB
	A3		Sweep Output Assy
	A3A1		Sweep Drive Assy (X)
	A3A2		Sweep Drive Assy (Y)
	A4		LED Assy (B)
	A5		LED Assy (A)
	A6		VRM LED Readout
	A7		Plotter
	A8		Yoke
	A9		NSK Assy
	A9A1		Resolver Drive PCB
	A9A2		Exciter PCB
	A10		Joystick
	A11		Control Panel
	A12		Deflection Yoke
	A13		VRM Encoder
5.			Azimuth Range Indicator IP-1283 (16")
			See Unit 4 for breakdown
6.			Video Amplifier AM-6932
	A1		Resolver Drive PCB
	A2		Video Amplifier PCB
	A3		Power Supply
7.			Interface Unit J-3463
8.			Wave Guide Switch SA-2140
9.			Switching Unit SA-2156 (Commercial)

* UNITS and subassemblies are marked with the applicable A1000 reference symbols.

Table 1-26. REFERENCE DESIGNATION INDEX (Continued)

UNIT	NAME		
10.		Switching Unit SA-2139 (USCG)	
	A1		Resistor Assy Panel
11.		Antenna AS-3195	
12.		Antenna Pedestal AB-1248 (S-band)	
13.		Receiver Transmitter RT-1241 50 KW (S-band)	
	A1		Power Control
	A2		High Voltage Power Supply
	A2A1	Preregulator PCB	
	A2A2	Chopper Control PCB	
	A2A3	Base Driver PCB	
	A2A4	Mother Board	
	A2A5	Output PCB	
	A3		Low Voltage Power Supply - See 13A2 for breakdown
	A4		High Voltage Assy
	A5		Magnetron Heater Scheduling
	A6		Pulse Logic
	A7		Pulse Driver
	A8		Microwave Assy (S-band)
	A9		IF Amplifier
	A10		Resolver Drive
		All Video Amplifier Assy	
	A12		Performance Monitor Power/Control
14.		Amplifier-Generator AM-6933	
	A1		Power Supply
	A2		ESM PCB (+12V, -12V, +5V)
15.		Signal Data Converter CV-3442	
	A1		SPA PCB Assy
	A2		Distribution Panel Assy
	A3		Stepper Motor Assy
	A4		+12V, -12V Power Supply Assy
16.		Control Indicator C-10260	

Note

1. AB-1247A- Same as AB-1247 except used only in dual special configuration. Contains an additional synchro for dual special configura tion AN/SPS-64(V)4.

Table 1-27. EQUIPMENT CONFIGURATION

RADAR SYSTEM	Unit 1 Antenna AS-3194 (X-band)	Unit 2 Antenna Pedestal AB-1247 (X-band)	Unit 3 Receiver Transmitter RT-1240 (X-band)	Unit 4 Azimuth Range Indicator IP-1282 (12")	Unit 5 Azimuth Range Indicator IP-1283 (16")	Unit 6 Video Amplifier AM-6932	Unit 7 Interface Unit J-3463	Unit 8 Wave Guide Switch SA-2140	Unit 9 Switching Unit SA-2156	Unit 10 Switching Unit SA-2139 (USCG)	Unit 11 Antenna AS-3195 (S-band)	Unit 12 Antenna Pedestal AB-1248 (S-band)	Unit 13 Receiver Transmitter RT-1241 (S-band)	Unit 14 Amplifier - Generator AM-6933	Unit 15 Signal Data Converter CV-3442	Unit 16 Control Indicator C-10260
SINGLE CONFIGURATION AN/SPS-64 (V) 1 SER. NO. 1-108	1 – 108	1 – 108	1 – 108	1 – 108												
DUAL PARTIAL AN/SPS-64 (V) 2 SER. NO. 1-45	109 – 153	109 – 153	109 – 198	109 – 153	1 – 45	1 – 90	1 – 45	1 – 45	1 – 45							
DUAL CONFIGURATION AN/SPS-64 (V) 3 SER. NO. 1-32	154 – 217	154 – 217	199 – 262	154 – 217	46 – 77	91 – 154				1 – 64						
DUAL SPECIAL AN/SPS-64 (V) 4 SER. NO. 1-18	218 – 235	1* – 18	263 – 280	218 – 235	78 – 113	155 – 172				65 – 100	1 – 18	1 – 18	1 – 18	1 – 18	1 – 18	1 – 36

*Note I. AB-1247A same as AB-1247 except used only in dual special configuration. Contains an additional synchro for dual special configuration AN/SPS-64(V)4.

CHAPTER 2. INSTALLATION

NOTE

The installations outlined herein are for guidance only. Refer to current Coast Guard directives for applicable information.

SECTION I: GENERAL

2.1 INSPECTION UPON RECEIPT

2.1.1 Unpacking Instructions

NOTE

Retain the shipping container, packing material, and hardware for storage or reshipment.

2.1.1.1 Major Units

Each of the major units (including cables and optional units) comprising Radar Set AN/SPS-64 (V) is packed in a separate cardboard shipping carton or wooden shipping crate. The cardboard shipping cartons contain fitted packing covers and/or loose filler pellets to provide cushioning and protection for the unit. Each of the units can be removed by cutting the shipping tape and carefully removing the unit along with its protective cover from its shipping container.

NOTE

Exercise caution while cutting the shipping tape to avoid damage to the contents. If damage to any units is noticed, contact the nearest Raytheon Service Center listed on the inside front cover of this manual.

The receiver transmitter is packed in a cardboard carton which is sealed with shipping tape. This container is enclosed by two cushioned packing covers and placed into a second cardboard carton. The receiver transmitter may be removed by first opening the outer carton, removing the inner carton with its packing covers, removing the covers, and then opening the inner carton.

The antenna pedestal is shipped in a wooden shipping crate. Unpack the pedestal as follows:

NOTE

Exercise caution while cutting the metal shipping bands which secure the shipping crate. If any damage is noticed, contact the nearest Raytheon Service Center listed on the inside front cover of this manual.

1. Cut and remove the shipping bands from the packing crate.
2. Carefully remove the nails that secure the cover, and remove the cover from the crate.
3. Remove the hardware securing the pedestal to the bottom of the shipping crate.
4. Carefully lift and remove the pedestal from the packing crate.

CAUTION

USE EXTREME CAUTION WHEN UNPACKING AND REMOVING THE ANTENNA TO AVOID SCRATCHING OR DAMIAGING THE PROTECTIVE COVER. IF DAMAGE IS NOTICED, CONTACT THE NEAREST RAYTHEON SERVICE CENTER LISTED ON THE INSIDE FRONT COVER OF THIS MANUAL.

The antenna is shipped in a wooden/fiberboard container. Three-layer fiberboard sides are form wrapped on wooden ends and secured with two metal bands. To unpack the antenna, carefully cut the metal shipping bands, fold back the fiberglass cover and carefully lift the antenna from the container. Retain the end-cushioning material for repacking if storage is anticipated.

The indicator is shipped in a wooden crate. When packed for shipping, the indicator is bolted and banded to a pallet which serves as the bottom of the shipping crate. The procedure below should be followed when unpacking the indicator.

NOTE

Exercise caution while unpacking the indicator. If any damage is noticed, contact the nearest Raytheon Service Center listed on the inside front cover of this manual.

1. Cut and remove the shipping bands from the packing crate.
2. Carefully remove the nails that secure the packing crate cover, and remove the cover from the crate.
3. Carefully remove the four sides of the packing crate.
4. Cut and remove the shipping bands that secure the indicator to the shipping pallet.
5. Remove the bolts that secure the indicator to the shipping pallet.
6. Carefully lift and remove the indicator from the shipping pallet.

2.1.1.2 Miscellaneous Units

The video amplifier, switching units signal data converter, waveguide switch, interface unit, control indicator and amplifier-generator are shipped in separate cardboard shipping cartons or wooden shipping crates. Unpack the equipment following the procedures given above.

2.1.2 Equipment Inspection

Complete and detailed packing lists are shipped with the equipment. After all shipping containers have been unpacked, their contents should be inspected for damage and should be checked against the packing lists to ascertain that all items are accounted fdr.

NOTE

It is strongly recommended that a Raytheon representative be called in when the equipment is unpacked, especially in case of apparent transport damage or if an item is thought to be missing. This representative is qualified to assist in ascertaining the amount of damage and the replacement parts needed.

2.1.3 Repacking and Storage

After all of the radar components have been unpacked and inspected, they should be repacked in their shipping cartons or crates and stored in a dry place until ready for installation. The units should not be removed from the cartons or crates again until the actual installation procedure is underway.

NOTE

During installation, the radar components should be temporarily covered with a water/dust-proof cover to protect them from water spray, paint spray, dust, etc.

2.2 SYSTEMS INSTALLATION PLANNING

2.2.1 General Installation Practices

Maximum flexibility is provided for the installation of the radar. Several factors contribute to a successful plan:

1. The type, service, and size of the vessel.
2. The availability of mounting space, and its location.
3. Space required for operation and servicing of the units.
4. The availability of ship's power.
5. Freedom from electrical and mechanical interference.

In general, the antenna should be installed on a mast as high as practical, or mounted in line with the ship's centerline atop the wheelhouse or bridge. The indicator is mounted in the wheelhouse at a convenient viewing location. The receiver transmitter installation should be close to the antenna, preferably directly below it.

When planning the antenna installation, particular attention should be given to the waveguide and cable run, especially the waveguide. It is important to ensure that:

1. Cable runs are not seriously obstructed by the type of mounting employed.
2. Cable runs are properly supported and do not provide impromptu foot-holds or hand-holds.
3. All waveguide joints are choke-to-cover with the choke at the bottom and have waterproofing O-ring seals.
4. The electrical installation conditions outlined in Section II, paragraphs 2.3 through 2.15 are met.

2.2.2 Equipment Location Considerations The exact position, attitude, and location of the units cannot be predetermined because each system is in effect custom-installed. In addition to the factors set forth in paragraph 2.2.1, the following considerations should be observed:

1. The length of cable run between the receiver transmitter and the antenna should be as short as possible consistent with shipboard practices.
2. The length of cable run between the receiver transmitter and the indicator should not exceed 220 feet.
3. The length of the waveguide run from the antenna pedestal rotating joint to the receiver transmitter cover flange must not exceed 50 feet (WR90 waveguide) or 100 feet (WR112 waveguide).

NOTE

Contact Raytheon for recommendations concerning installations requiring longer cable and/or waveguide runs than specified above.

2.2.2.1 Antennas and Pedestals - Generally, the best results are obtained by installing the antenna and pedestal on a mast near the bridge structure. The principal planning features to be considered are:

1. The location must not be near the top of the stack or at some lower adjacent point. The stack is a large obstruction to the radiated beam that would adversely affect the beam pattern, and may also subject the antenna to excessive heat and operation in a corrosive environment.
2. The radiated antenna beam must not be obstructed by large masses close to its source. The view in the forward direction must be unobstructed.

3. Sufficient clearance should be allowed for access to the radar units for inspection and servicing. For the slotted waveguide array, allow a minimum turning circle diameter of 7 feet for the 6-foot array, 10 feet for the 9-foot array, and 13 feet for the 12-foot array.

4. The pedestal must be mounted so that the array rotates in a plane parallel to the ship's water line. The pedestal should face forward (±5°) .

5. The waveguide run shield ' be kept as short as possible, in an almost straight, line to the receiver transmitter unit.

6. If the antenna is supported on a stub mast, the mast must be located where it can be properly braced or guyed to minimize vibration.

7. If the antenna is mounted at an unsafe working height, a service platform and guard rail must be included in the installation.

2.2.2.2 Receiver Transmitters. - The main consideration in planning the location of the receiver transmitter is its position relative to that of the antenna. The receiver transmitter shall be installed according to the following guidelines:

1. The receiver transmitter shall be installed at least 3 feet away from the indicator. The units may be mounted closer than 3 feet if they are separated by a steel bulkhead.

2. The receiver transmitter shall be installed at least 6 feet away from the magnetic compass.

3. The receiver transmitter is drip-proof only, and must not be exposed to the weather.

4. Sufficient clearance shall be provided to allow for servicing and ventilation.

5. The waveguide run to the antenna shall be kept as direct as possible, with a minimum of elbows and bends.

6. A rust-free cover should be installed around the waveguide where necessary for protection against physical damage. A minimum clearance of one inch shall be provided between waveguide and cover.

2.2.3 Video Amplifiers (V2, V3, V4). The video amplifier units should be located near the receiver transmitter to provide convenient access for maintenance. Sufficient clearance must be provided for maintenance and ventilation.

2.2.2.4 Indicators. - The indicator shall be installed in the wheelhouse such that the display is viewed looking forward. The following guidelines shall be observed whenever possible:

1. The indicator shall be installed at least 3 feet away from the receiver transmitter. The units may be mounted closer than 3 feet if they are separated by a steel bulkhead.

2. The indicator shall be installed at least 3 feet away from the magnetic compass to avoid mutually adverse magnetic interaction.

3. The indicator is drip-proof only, and must not be exposed to the weather.

4. To maximize simplicity of operation, the indicator shall be mounted with the heading line., pointing to the bow.

5. Sufficient clearance shall be provided to allow for servicing and ventilation.

2.2.2.5 Switching Units (V2, V3, V4). - The location of the switching unit(s) will depend on the system configuration (dual-partial, dual, or dual-special) and the location of the equipment to which the unit will be connected. The unit should be located in the area of the prime indicator to facilitate system mode selection.

2.2.2.6 Wave Guide Switch (V2). - The wave guide switch is installed in the waveguide between the two receiver transmitters with a single waveguide run to the antenna pedestal. The wave guide switch should not be more than 15 feet from either receiver transmitter.

2.2.3 Equipments To Be Installed Per System

The equipments to be installed for each system are listed in Table 2-1. The table also references the applicable paragraph for each installation procedure.

2.2.4 System Power Requirements

The individual equipment power requirements for each system are given in Table 2-2.

2.2.5 System Interconnections

Table 2-3 lists the system interconnecting cables required for each equipment and system.

2.2.5.1 AN/SPS-64(V) 1 Interconnections. - The interconnections required between Radar Set AN/SPS64 (V) 1 equipment and related ship's equipment are shown in Figure 2-1.

2.2.5.2 AN/SPS-64 (V)2 Interconnections. - The interconnections required between Radar Set AN/SPS64(V) 2 equipment and related ship's equipment are shown in Figure 2-2.

2.2.5.3 AN/SPS-64 (V)3 Interconnections. The interconnections required between Radar Set AN/SPS64(V)3 equipment and related ship's equipment are shown in Figure 2-3.

Table 2-1. Equipment Installations Per System

Equipment	Paragraph Reference	Radar Set AN/SPS			
		(V)1	(V)2	(V)3	(V)4
Antenna Pedestal AB-1247	2.3	X	X	X	X
Antenna Pedestal AB-1247A	2.3	-	-	-	X
Antenna AS-3194	2.4	X	X	X	X
Receiver-Transmitter RT-1240	2.5	X	X	X	X
Azimuth Range Indicator IP-1282	2.6	X	X	X	X
Azimuth Range Indicator IP-1283	2.6	-	X	X	X
Switching Unit SA-2139 (V3, V4)	2.7	-	-	X	-
Switching Unit SA-2156 (V2)	2.7	-	X	-	-
Interface Unit J3463 (V2)	2.8	-	X	-	-
Wave Guide Switch.SA-2140 (V2)	2.9	-	X	-	X
Video Amplifier AM-6932 (V2, V3, V4)	2.10	-	X	X	X
Antenna Pedestal AB-1248 (V4)	2.11	-	-	-	X
Antenna AS-3195 (V4)	2.11-	-	-	-	X
Receiver-Transmitter RT-1241 (V4)	2.12	-	-	-	X
Signal Data Converter CV-3442 (V4)	2.13	-	-	-	X
Control Indicator C-10260 (V4)	2.14	-	-	-	x
Amplifier-Generator AM- 6933 (V4)	2.15	-	-	-	X

Table 2-2. Power Requirements Per System

Equipment	**115 Vac, 60Hz**				**440 Vac, 60Hz, 30**
	(V1)	**(V2)**	**(V3)**	**(V4)**	**(V4)**
Receiver Transmitter RT-1240	3A	6A	6A	3A	--
Indicator IP-1282	2.1A	2.1A	4.2A	2.1A--	--
Indicator IP-12832.1A	--	2.1A	2.1A	4.2A--	--
Antenna Pedestal AB-1247	9A	9A	18A	--	--
Antenna Pedestal AB-1247	--		--	9A	--
Receiver Transmitter RT-1241	--	--	--	5A	--
Antenna Pedestal AB-1248--	--	--	--	--	1.8A/0
Switching Unit SA-2139		--			--
Switching Unit SA-2156	--		--		--
Amplifier - Generator AM-6993-5A	--	--	--	.5A	--
Signal Data Converter CV-3442	--	--	--	2.6A	--
Interface Unit J-3463		1A			
Video Amplifier AM-6932		.5A	.5A	.5a	
Totals per system	14A	20.7A	30.8A	26.9A	1.8A/0

2.2.5.4 AN/SPS-64 (V) 4 Interconnections. - The interconnections required between Radar Set AN/SPS64(V)4 equipment and related ship's equipment are shown in Figure 2-4.

2.2.5.5 Cable Data. - Table 2-4 lists the cable type, manufacturer, and characteristics for all Radar Set AN/SPS-64 (V) interconnecting cables.

NOTE

All wiring must conform to AIEE recommendations and the American Bureau of Shipping Coast Guard Specifications.

Cable shields shall be bonded to the chassis to reduce interference between the radar units and other shipboard electronic equipment, especially the ship's communications equipment. All surfaces must be cleaned to ensure good electrical connections.

2.2.6 Special Installation Equipment Required

Special equipment required for installation of Radar Set AN/SPS-64(V) is listed below.

Table 2-3. System Interconnecting Cables

Equipment	AN/SPS-64 System			
	(V1)	(V2)	(V3)	(V4)
Antenna Pedestal AB-1247	WSS-5 WSS-6	WDP-14 WDP-15	WDD-10/31 WDD-11/32	WDS-13 WDS-14 WDS-19
Receiver Transmitter RT-1240	WSS-3 WSS-4* WSS-5 WSS-6	WDP-7*/18* WDP-8/19 WDP-7/12 WDD-12/33	WDD-9*/34* WDD-10/31 WDD-11/32 WDS-14	WDS-11 WDS-12 WDS-13
Azimuth Range Indicator IP-1282	WSS-1* WSS-2* WSS-3 WDP-4	WDP-I* WDP-2* WDP-3 WDD-5/25	WDD-1*/23* WDD-2*/26* WDD-4/24 WDS-31	WDS-4* WDS-10* WDS-30
Azimuth Range Indicator IP-1283	N/A	WDP-21 WDP-22 WDP-23* WDP-24*	WDD-3*/30* WDD-6/27 WDD-7/28 WDD-8*/29*	WDS-1*/9* WDS-2*/3* WDS-5/7 WDS-6/8
Switching Unit SA-2139	N/A	N/A	WDD-17 WDD-18 WDD-19 WDD-14/20 WDD-15/21 WDD-16/22	WDS-5/30 WDS-6/31 WDS-7 WDS-8 WDS-15/16 WDS-17 WDS-19/33 WDS-20 WDS-21 WDS-22 WDS-23 WDS-24 WDS-25 WDS-29 WDS-32 WDS-39
Switching Unit SA-2156	N/A	WDP-3 WDP-4 WDP-5 WDP-6 WDP-20 WDP-21 WDP-22	N/A	N/A
Interface Unit J-3463	N/A	WDP-11* WDP-6 WDP-9 WDP-12 WDP-13 WDP-14 WDP-15	N/A	N/A
Wave Guide Switch SA-2140	N/A	WDP-13	N/A	N/A

Table 2-3. System Interconnecting Cables (Cont'd)

Equipment	AN/SPS-64 System			
	(V1)	(V2)	(V3)	(V4)
Video Amplifier AM-6932	N/A	WDP-8/19 WDP-5/20	WDD-14/20 WDD-15/21 WDD-16/22	WDS-12 WDS-15 WDS-16 WDS-17
Antenna Pedestal AB-1248	N/A	N/A	N/A	WDS-33 WDS-35 WDS-36
Receiver Transmitter RT-1241	N/A	N/A	N/A	WDS-24 WDS-32 WDS-35 WDS-36 WDS-37 WDS-38
Signal Data Converter CV-3442	N/A	N/A	N/A	WDS-39 WDS-40 WDS-41 WDS-42 WDS-43 WDS-44 WDS-45 WDS-46 WDS-47 WDS-48 WDS-49
Control Indicator C-10260	N/A	N/A	N/A	WDS-40/43
Amplifier Generator AM-6993	N/A	N/A	N/A	WDS-25 WDS-26* WDS-26* WDS-28 WDS-29

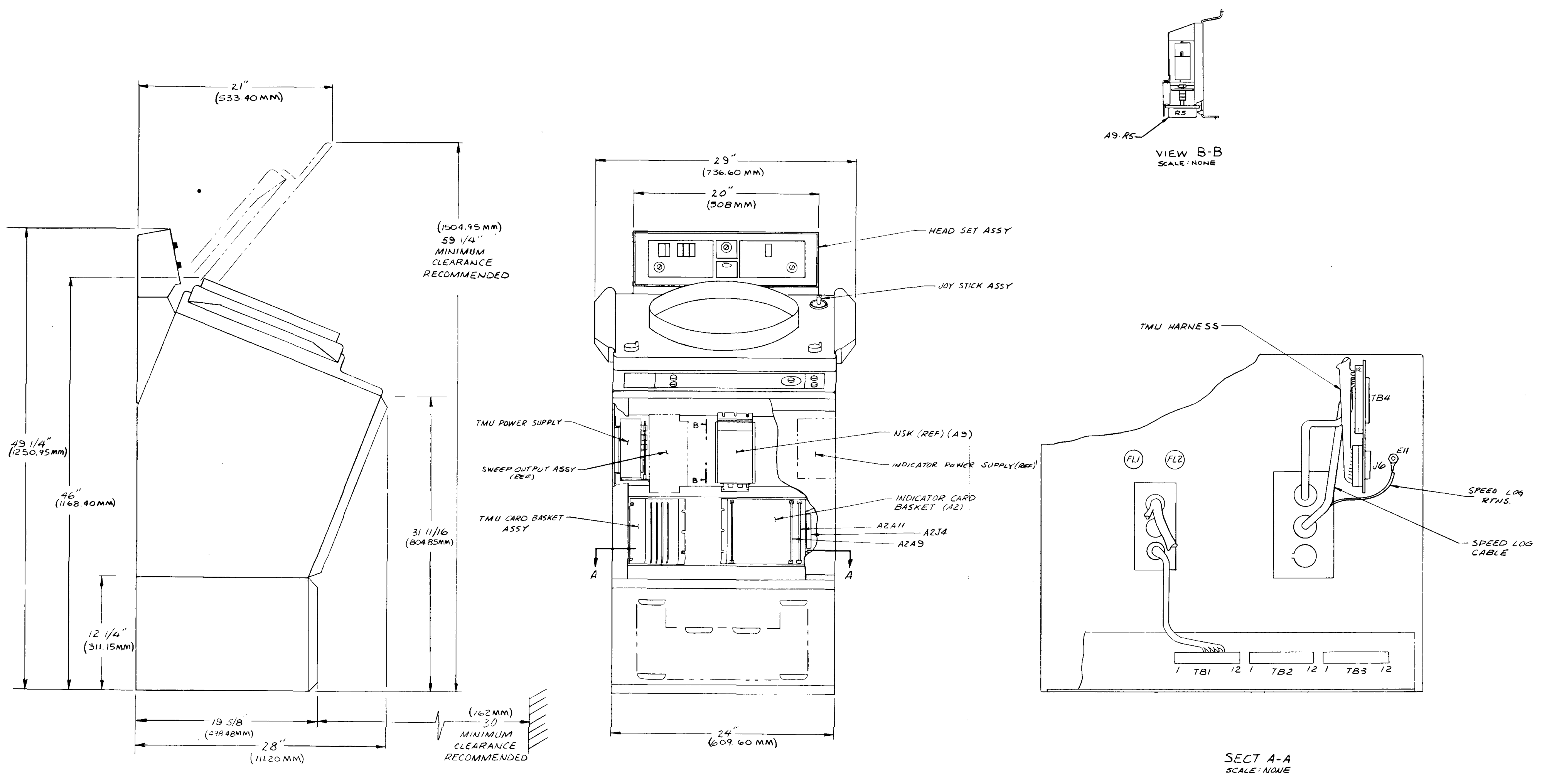
* These cables terminate at ship's power and gyro sources.

SECTION II: EQUIPMENT INSTALLATION

2.3 ANTENNA PEDESTAL AB-1247

The antenna pedestal shall be bolted to a flat horizontal mounting plate which is welded to a 6inch diameter mast or bracket assembly (see Figures 2-5 and 2-6) of sufficient strength to support 140 pounds. The recommended mounting plate (not supplied) is shown in Figure 2-7, Detail A.

The preferred method of antenna installation is to mount the antenna pedestal on an existing masthead (see Figure 2-5). This type of installation generally provides an unrestricted antenna radiation pattern.



INSTALLATION INSTRUCTIONS

I. The Indicator that T M is to be installed n must have the following options installed and operating
- A NSK
- B EBL
- C VRM

Also, the indicator must be aligned properly, in particular the sweep generator PCB A2A10

II.. The TMU consists of the following major assemblies
- A Head Set Assy
- B. Power Supply Assy
- C. Card Basket Assy
- D. Joy Stick Assy
- E. Sine-Cosine Pot (A9-R 5)

III. Mechanical Assembly
- A. Remove Indicator Power Supply
- B. Remove the 2 Cover Pirates On The Top Rear of Indicator
- C. Remove Indicator Card Basket
  1. Check that there is a wire from A2J4 60 to A2A11 28. A2J4 59 to A2A11 F
  2. Check A2J4-6 to J6-V A2J4-9 to J6-W
- D Swing down Sweep output assembly and NSK if already installed In Indictor
- E. Drop TMU harness through the left side headset mounting ho e and bolt headset assy in place
- F. Mount TMU power supply on left side of indicator in the space provided.
- G. Connect TMU harness to:
  1. Power Supply
  2. J-6
  3 A2J4
  4 TM U Ac input to TB4 10, 11 & 12
- H Connect Speed Log Cables to TB4
- * I. Install and wire A9R-5
- * J Install and wire joystick assy

  *See NSK/joystick jumper kit. 165835
- K.. Plug T M U harness to TMU card basket assy, and install card basket indicator
- L.. Reinstall the indicator power supply the indicator card basket. the NSK assy and the sweep output assy
- M. Remove EBL card (A2A9) and link as necessary for TMU option

  BRD91 PIN 589468-2 REV C
  1. Link E2 to E4
  2 Link EB to El
  3 Link E14 to E15
  4. Link E18 to E19

  Reinstall EBL card (A2AB)

  BRD PIN 5894682 REV D&E
  1. Link E2 to E4
  2. Link E8 to E10
  3 . Link E14 to E15
  4. Link E18 to E19
  5 Link E16 to E17
- N Remove Offset Switch and Offset Switch Lamp Cover ends of wires with Shrink Sleeving
- O Install Offset Switch Cover P ate

IV REFER TO MANUAL FOR FURTHER INSTALLATION NSTRUCTIONS

Figure 2-1. Radar Set AN/SPS-64(V)1 Cabling Diagram.

Cable No.	Type	No. of Wires	No. of Spares
WDP-1	MSCA-7	7-#18	2-#18
	<20' TSGA-3	3-#16	
WDP-2	>20' TSGA-4	3-#14	NONE
WDP-3	BELDEN 8777	6-#22	1-#22
		3 COAX	
WDP-4	BELDEN 9253	4-#18,21-#22	3-#18
		3 COAX	
WDP-5	BELDEN 9253	4-#18,21-#22	3-#18
WDP-6	BELDEN 9773	6-#18	2-#18
	<20' TSGA-3	3-#1 6	
WDP-7	>20' TSGA-4	3-#14	NONE
		3 COAX	
WDP-8	BELDEN 9253	4,#18,21-#22	1-#18,1-#22
WDP-9	BELDEN 9775	18-#18	2-#18
		1.00 x .50 in.	
WDP-10	RG-67/U	WAVEGUIDE	
	<10' TSGA-4	3-#14	#
WDP-11	>10' TSGA-9	3-#11	NONE
WDP-12	BELDEN 9775	18-#18	2-#18
WDP-13	BELDEN 9773	6-#18	NONE
WDP-14	BELDEN 9775	18-#18	NONE
WDP-15	FSGA-9	4-#11	1-#11
		1.00 x .50 in.	
WDP-16	RG-67/U	WAVEGUIDE	#
		1.8"x .50 in.	
WDP-17	RG-67/U	WAVEGUIDE	#
	<20' TSGA-3	3-#16	
WDP-18	>20' TSGA-4	3-#14	NONE
		3 COAX	
WDP-19	BELDEN 9253	4-#18,21-#22	1-#18,1-#22
		3 COAX	
WDP-20	BELDEN 9253	4-#18,21-#22	3-#18
WDP-21	BELDEN 8777	6-#22	1-#22
		3 COAX	
WDP-22	BELDEN 9253	4-#18,21-#22	3-#18
	<20' TSGA-3	3-#16	

NOTES

1. THIS CABLE (BELDEN 9773) INCLUDES THE ANTENNA SWITCH POSITION INDICATOR AND SWITCH POWER.
2. THIS UNIT (ANTENNA JUNCTION BOX) CONTAINS CONTACTORS WHICH CONTROL ANTENNA ROTATION.
3. THIS CABLE IS FOR ANTENNA SWITCH POWER.
4. TTRSA-10 MAY BE SUBSTITUTED FOR THIS CABLE.

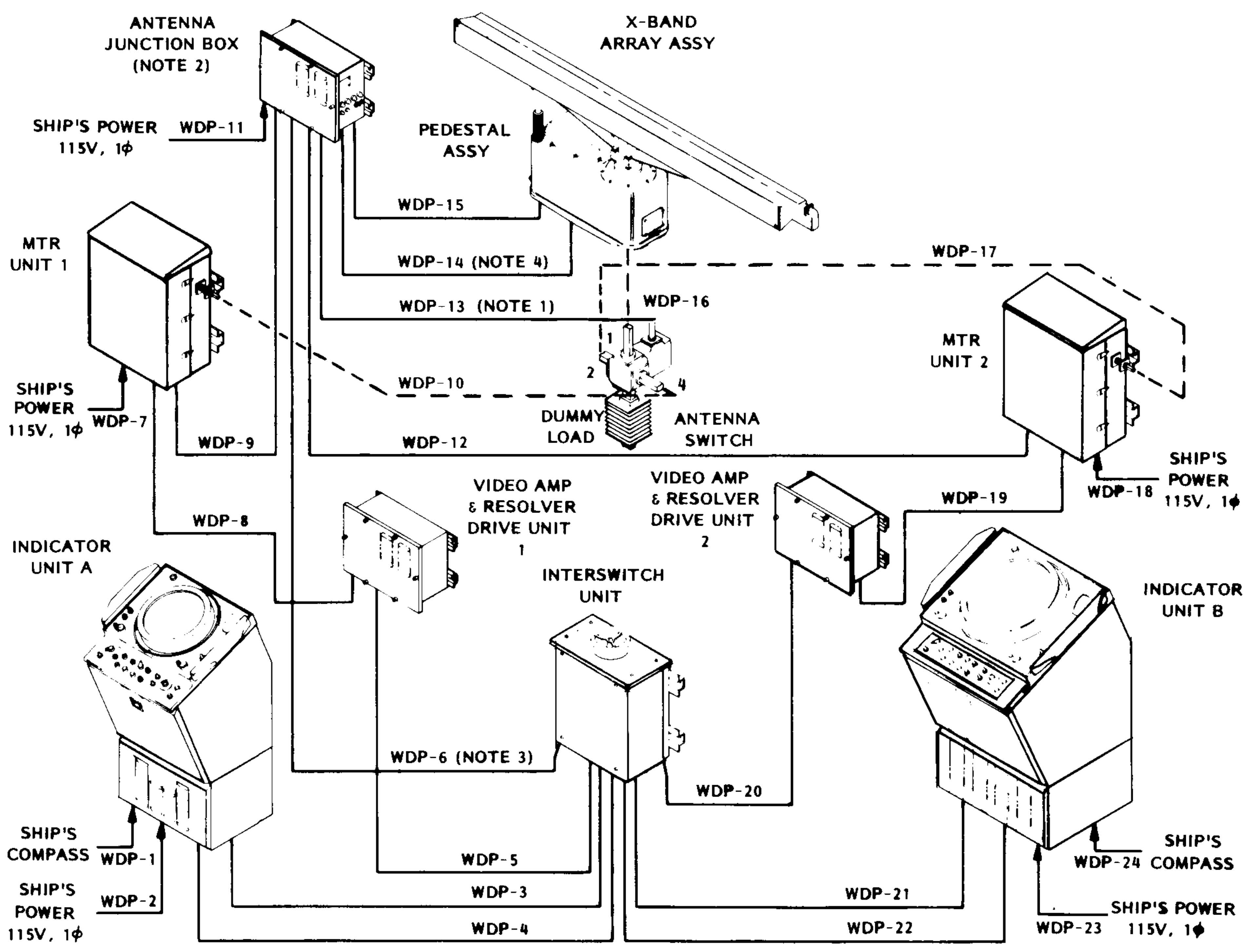


Figure 2-2. Radar Set AN/SPS-64(V)2 Cabling Diagram

Cable No.	Type	No. of Wires	No. of Spares
WDD-1	MSCA-7	7-#18	2-#18
	<20' TSGA-3	3-#16	
WDD-2	>20' TSGA-4	3-114	NONE
	<20' TSGA-3	3-#16	
WDD-3	>20' TSGA-4	3-#14	NONE
		3 COAX	
WDD-4	BELDEN 9253	4-#18,21-#22	3-#18
WDD-5	BELDEN 8777	6-#22	1-#22
WDD-6	BELDEN 8777	6-#22	NONE
		3 COAX	
WDD-7	BELDEN 9253	4-#18,21-#22	3-#18
WDD-8	MSCA-7	7-#18	2-#18
	<10' TSGA-4	3-#14	
WDD-9	>10' TSGA-9	3-#11	NONE
WDD-10	FSGA-9	4-#11	1-#
WDD-l1	BELDEN 9775	18-#16	NONE
		3 COAX	
WDD-12	BELDEN 9253	4-#18,21-#22	1-#18,1-#22
			1.00x .50in.
WDD-13	RG-67/U	WAVEGUIDE	#
		3 COAX	
WDD-14	BELDEN 9253	4-#18,21-#22	3-#18
WDD-15	RG-59A/U	1 COAX	#
WDD-16	RG-59A/U	1 COAX	#-
		3 COAX	2 COAX
WDD-17	BELDEN 9253	4-#18,21-#22	3-#18
		3 COAX	COAX
WDD-18	BELDEN 9253	4-#18,21-#22	3-#18
WDD-19	BELDEN 8777	6-#22	2-#22
		3 COAX	
WDD-20	BELDEN 9253	4-#18,21-#22	3-#11
WDD-21	RG-59A/U	1 COAX	#
WDD-22	RG-59A/U	1 COAX	#
WDD-23	MSCA-7	7-#18	2-#18
WDD-24	BELDEN 8777	6-#22	NONE
		3 COAX	
WDD-25	BELDEN 9253	4-#18,21-#22	3-#18
	<20' TSGA-3	3-#16	
WDD-26	>20' TSGA-4	3-#14	NONE
WDD-27	BELDEN 8777	6-#22	1-#22
		3 COAX	
WDD-28	BELDEN 9253	4-#18,21-#22	3-#18
Cable No.	**Type**	**No. Of Wires**	**No. of Spares**
WDD-29	MSCA-7	7-#18	2-#18
	<20' TSGA-3	3-#16	
WDD-30	>20' TSGA-4	3-114	NONE
WDD-31	FSGA-9	4-#11	1-#11
WDD-32	BELDEN 9775	18-#16	NONE
		3 COAX	
WDD-33	BELDEN 9253	4-#18,21-#22	1-118,1-#22
	<10' TSGA-4	3-#14	
WDD-34	>10' TSGA-9	3-#11	NONE
	1.00x .50 in.		
WDD-35	RG-67/U	WAVEGUIDE	#
		C167872 Rev 1	

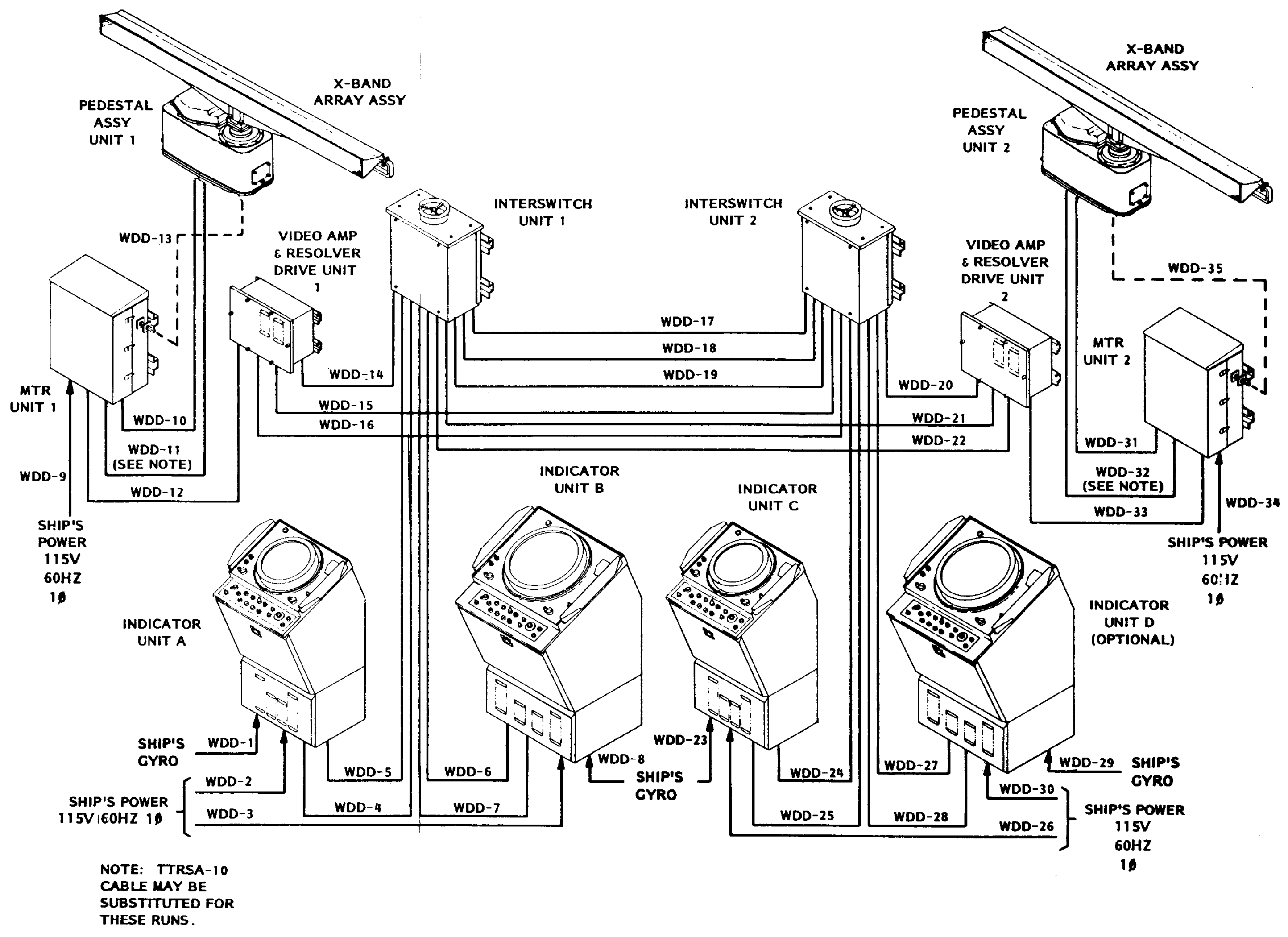


Figure 2-3. Radar Set AN/SPS-64(V)3 Cabling Diagram

Cable No.	Type	No. of Wires	No. of Spares
WDS-1	MSCA-7	7-#18	2-#18
	<20' TSGA-3	3-#16	
WDS-2	>20' TSGA-4	3-#14	NONE
	<20' TSGA-3	3-#16	
WDS-3	>20' TSGA-4	3-#14	NONE
	<20' TSCA-3	3-#16	
WDS-4	>20' TSGA-4	3-#14	NONE
WDS-5	BELDEN 8777	6-#22	1-#22
		3 COAX	
WDS-6	BELDEN 9253	4-#18,21-#22	3-#18
WDS-7	BELDEN 8777	6-#22	NONE
		3 COAX	
WDS-8	BELDEN 9253	4-#18,21-#22	3-118
WDS-9	MSCA-7	7-#18	2-#18
WDS-10	MSCA-7	7-#18	2-#18
	<10' TSGA-4	3-#14	
WDS-11	>10' TSGA-9	3-#11	NONE
	3 COAX		
WDS.-12	BELDEN 9253	4-#18,21-#22	1-#18,1-#22
WDS-13	FSGA-9	4-#11	1-#11
WSD-14	BELDEN 9775	1i-#18	NONE
	3 COAX		
WDS-15	BELDEN 9253	4-#18,21-#22	3-#18
WDS-16	RG-59A/U	1 COAX	#
WDS-17	RG-59A/U	1 COAX	#
		1.00 x .50 IN	
WDS-18	RG-67/U	WAVEGUIDE	#
WDS-19	TTRSA-4	8-#20	2-#120
WDS-20	RG-59A/U	1 COAX	
WDS-21	BELDEN 8777	6-#22	2-#22
		3 COAX	2 COAX
WDS-22	BELDEN 9253	4-#18,21-#22	3-#18
		3 COAX	2 COAX
WDS-23	BELDEN 9253	4-#18,21-#22	3-#18
WDS-24	RG-59A/U	1 COAX	#
WDS-25	RG-59A/U	1 COAX	#
	<20' TSGA-3	3-#16	
WDS-26	>20' TSGA-4	3-#14	NONE
WDS-27	RG-59A/U	1 COAX	#
WDS-28	RG-59A/U	1 COAX	#
WDS-29	RG-59A/U	1 COAX	#
WDS-30	BELDEN 8777	6-#22	1-#22
		3 COAX	
WDS-31	BELDEN 9253	4-#18,21-#22	3-#18
		3 COAX	
WDS-32	BELDEN 9253	4-#18,21-#22	3-#18
WDS-33	TTRSA-4	8-#20	2-#20
WDS-34	7/8 in. EIA	1 COAX	#
WDS-35	FSGA-9	4-#11	NONE
WDS-36	BELDEN 8769	38-#22	#22
WDS-37	FSGA-9	4-#11	NONE
	<10' TSGA-4	3-#14	
WDS-38	>10' TSGA-9	3-#11	NONE
		3 COAX	1 COAX
WDS-39	BELDEN 9253	4-#18,21-#22	16-#22
WDS-40	BELDEN 9773	6-#18	NONE
WDS-41	MSCA-7	7-#18	3-#18
	<20' TSGA-3	3-#16	
WDS-42	>20' TSGA-4	3-#14	NONE
WDS-43	BELDEN 9773	6-#18	NONE
WDS-44	BELDEN 9773	6-#18	1-#18
WDS-45	RG-59A/U	1 COAX	#
WDS-46	RG-59A/U	1 COAX	#
WDS-47	BELDEN 9773	6-#18	1-#18
WDS-48	RG-59A/U	1 COAX	#
WDS-49	RG-59A/U	1 COAX'	#

NOTE

1. **THESE CABLES (TTRSA-4) CARRY SYNCHRO SIGNALS FOR SPA BEARING INPUTS**
2. **THE SPA INTERFACE UNIT PROVIDES, VIDEO, TRIGGER AND DATA COMPATABILITY WITH THE SPA SUBSYSTEM**
3. **TTRSA-10 MAY BE SUBSTITUTED FOR THIS CABLE.**

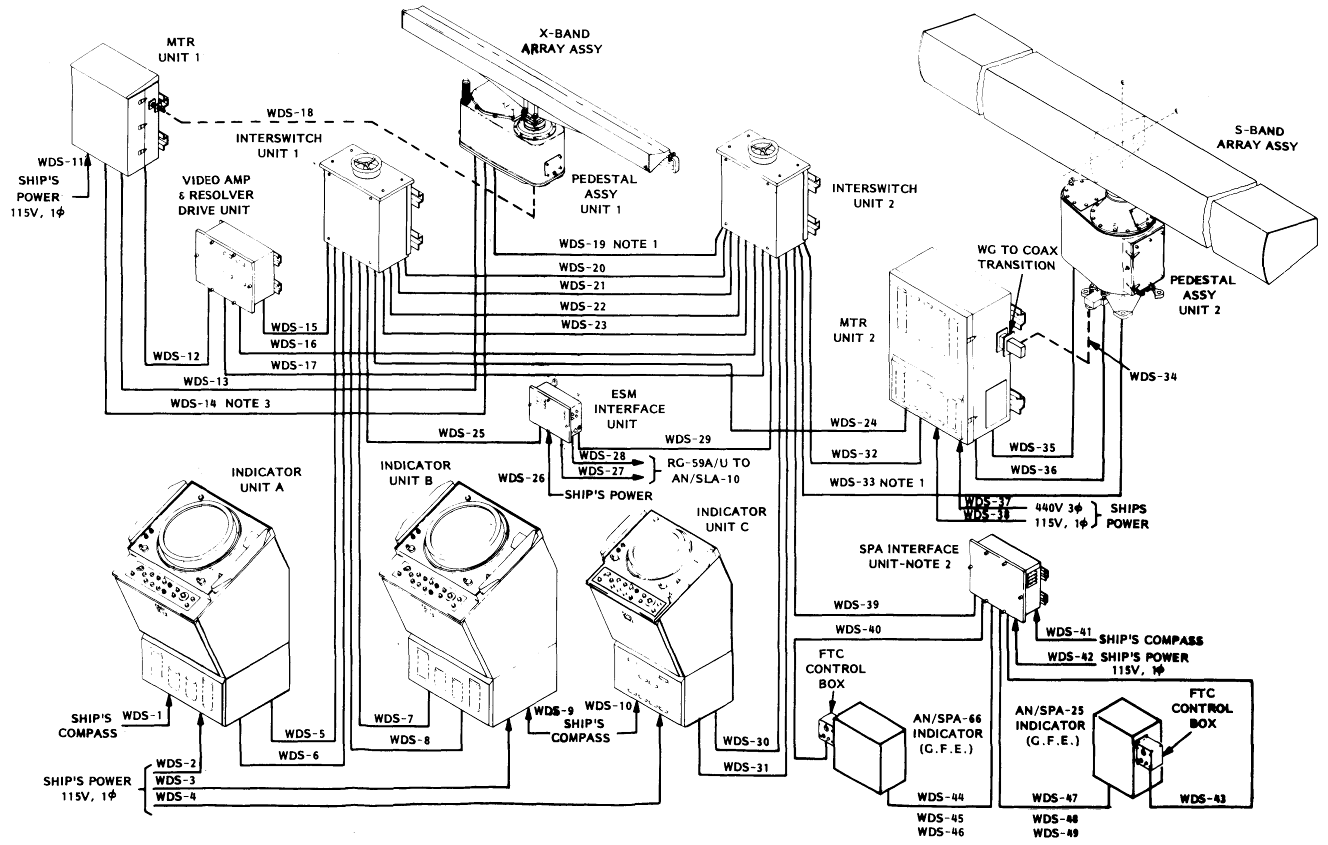


Figure 2-4 Radar Set AN/SPS-64(V)4 Cabling Diagram

Table 2-4. Interconnecting Cable Data

Cable Type	Manufacturer	Characteristics
8286	Belden Corp.	3 coaxial conductors, 4 No. 18 conductors, 21 No. 22 conductors; hypalon jacket; marked with manufacturer's name and part no.
8769	Belden Corp.	38 no.22 conductors, cabled in shielded pairs; breakdown voltage 1500V between adjacent shields; outer jacket marked with manufacturer's name and cable identification no.
8777	Belden Corp.	6 no.22 conductors, cabled in shielded pairs; breakdown voltage 1500V between adjacent shields; outer jacket marked with manufacturer's name and cable identification no.
9253	Belden Corp.	Same as 8286 except with armored outer jacket.
9773	Belden Corp.	6 no.18 conductors.
9775	Belden Corp.	18 No. 16 conductors, cabled in shielded pairs; breakdown voltage 1500V between adjacent shields; PVC jacket; marked with manufacturer's name and part no.
FSGA-9		4 No. 11 conductors
MSCA-7		7 No. 18 conductors
TSGA-3		3 No. 16 conductors
TSGA-4		3 No. 14 conductors
TSGA-9		3 No. 11 conductors
TTRSA-4		8 No. 20 conductors
7/8" EIA	Cablewave Systems or Andrew Corp.	single coaxial cable, 7/8" EIA, foam dielectric; VSWR less than 1: 15:1 at 3.05 GHz; 50 ohms impedance

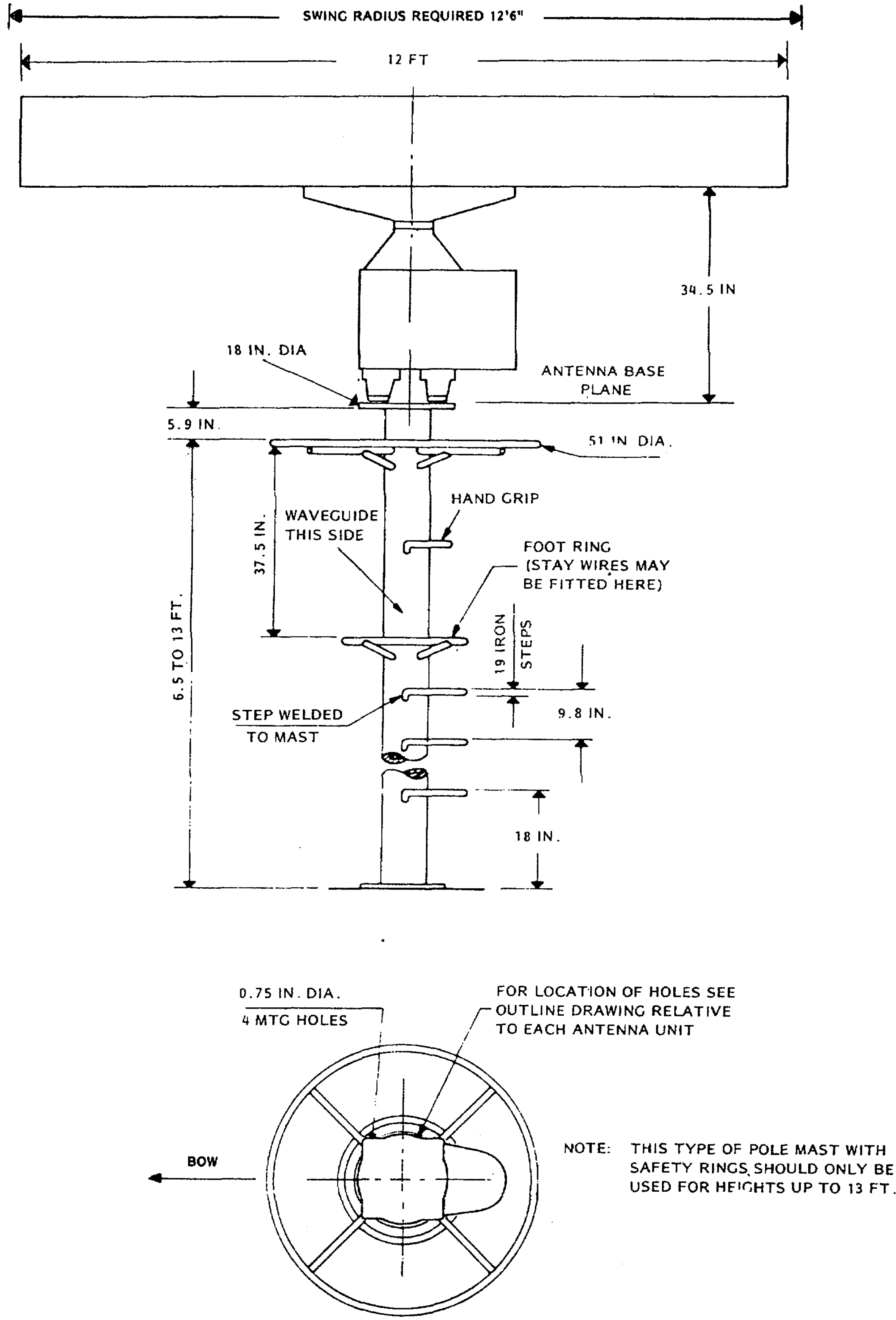


Figure 2-5. Antenna Pedestal Typical Masthead Mounting and Service Platform

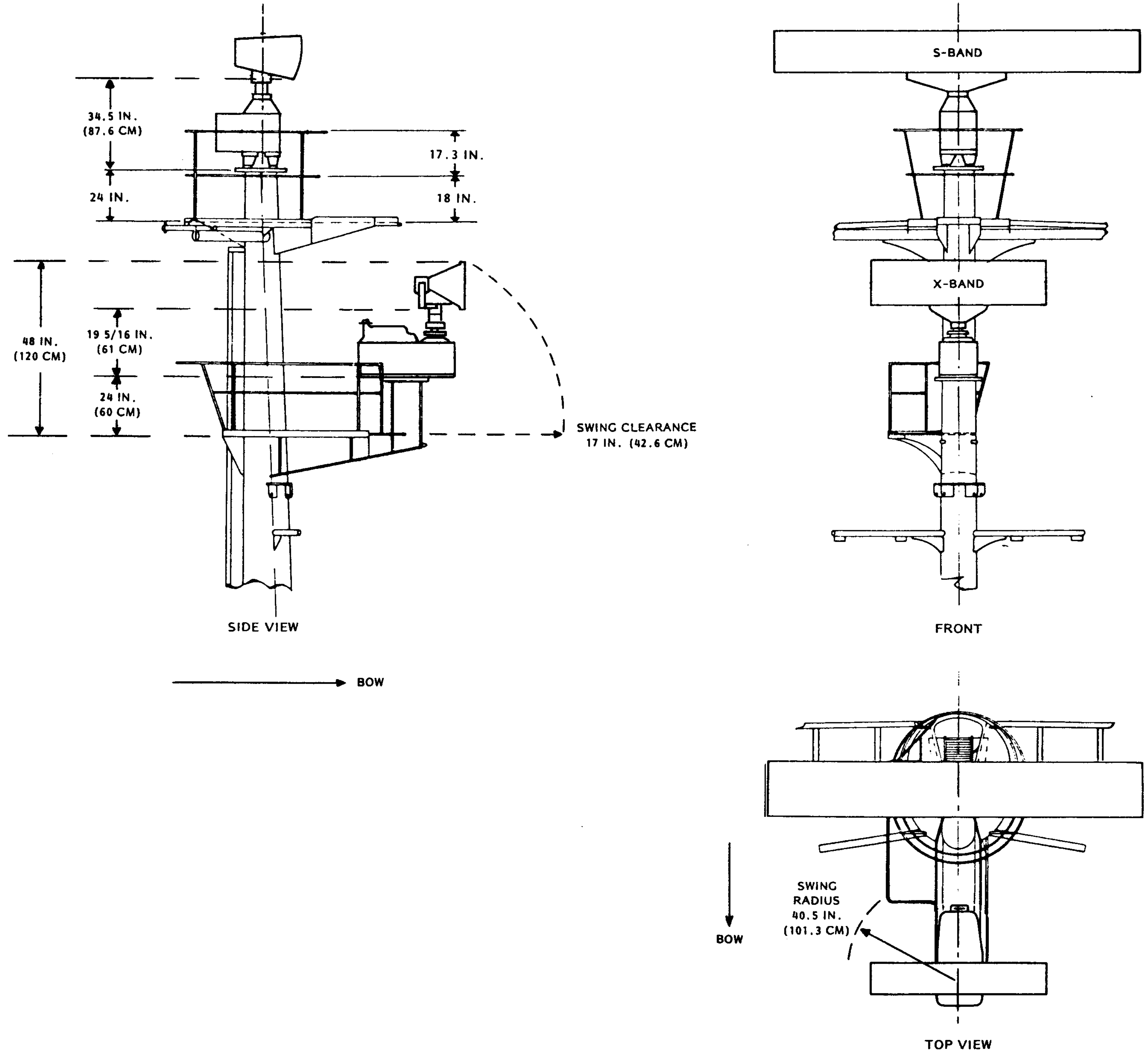


Figure 2-6. Antenna Pedestal Typical Offset Mounting and Service Platform

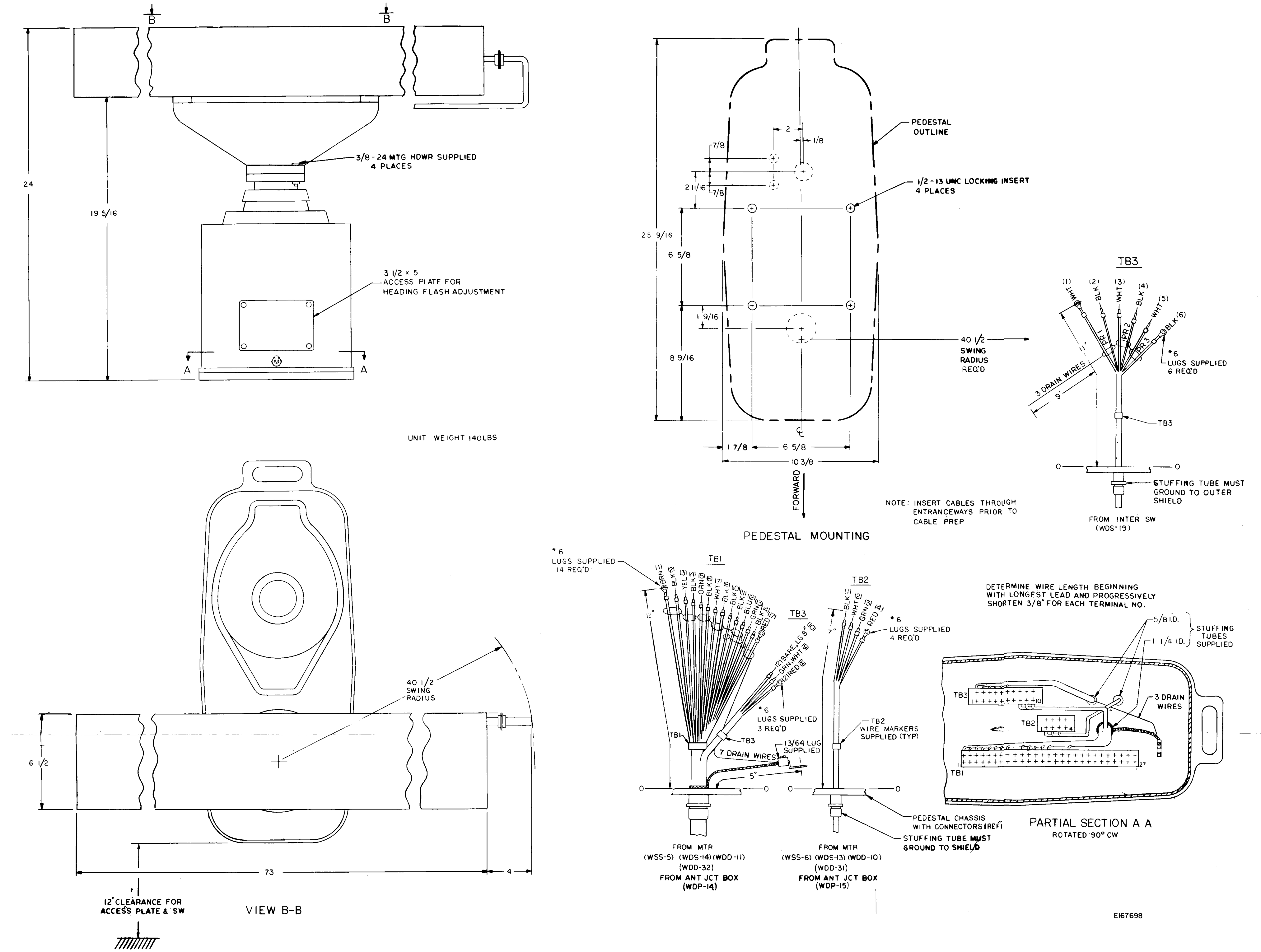


Figure 2-7(1). Antenna Pedestal AB-1247 and Antenna AS-3194 Installation Diagram.

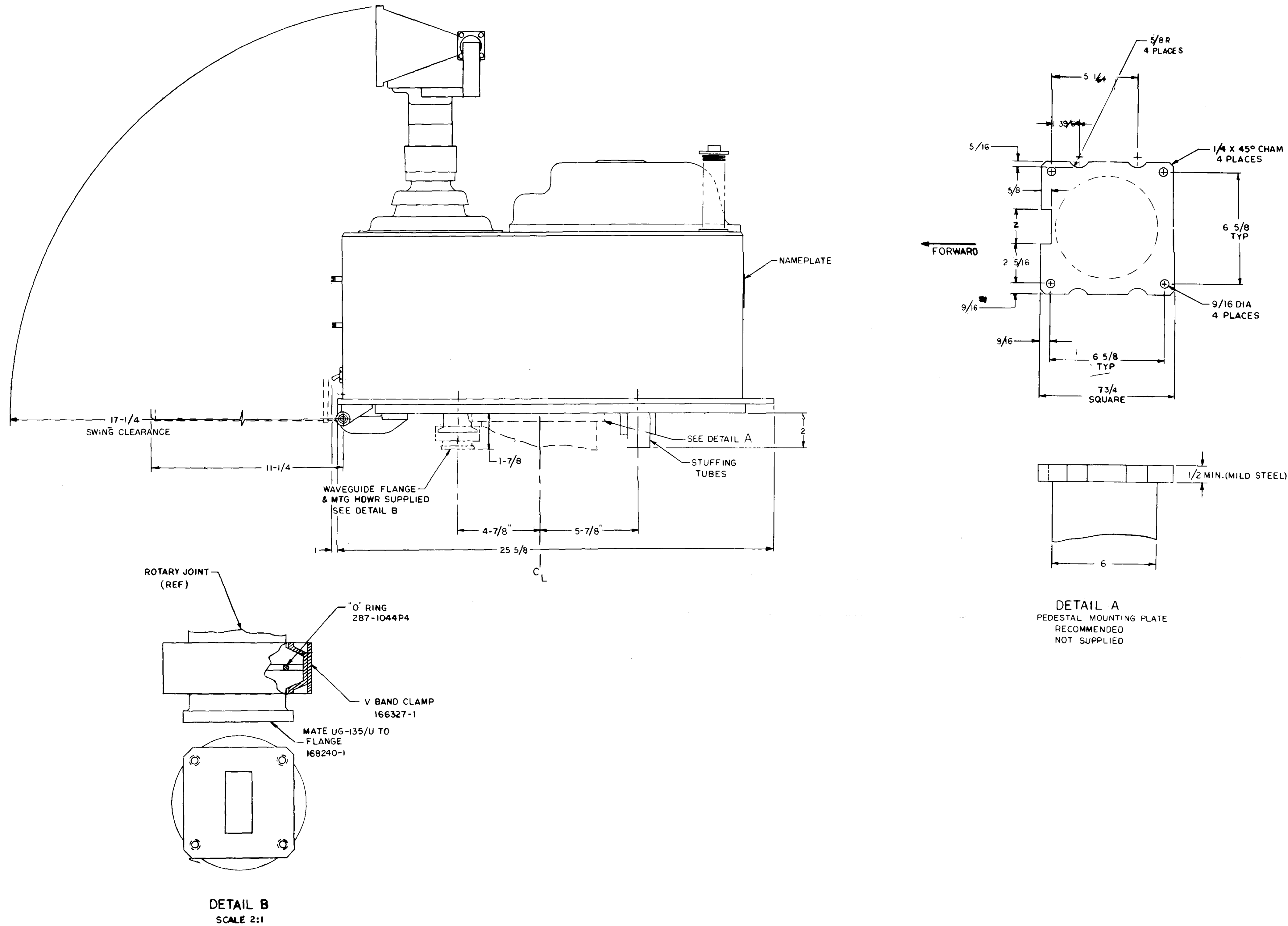


Figure 2-7(2). Antenna Pedestal AB-1247 and Antenna AS-3194 Installation Diagram.

Figure 2-6 illustrates an alternate method for utilizing existing masts or for constructing masts, platforms, or other assemblies to accommodate the antenna pedestal assembly.

The mounting assembly (mast or bracket) may be positioned off center from the fore and aft center line if necessary.

The antenna and pedestal assembly outlines and mounting dimensions are shown in Figure 2-7.

2.3.1 Service Platform

A service platform is required where the antenna is mounted at greater than stand-up working height from the deck or mounting surface. Figures 2-5 and 2-6 include (for reference only) details of the servicing platform. The guard rail and support gussets are necessary components of the servicing platform.

2.3.2 Mounting Hardware

When installing the antenna, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.

2. Mating surfaces of the steel mounting plate and the aluminum antenna casting should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent dissimilar metal action.

3. Where guy wires are required, they must be interrupted by strain type insulators to minimize their effect on communications equipment.

4. All applicable IAW codes must be followed.

2.3.3 Mounting Instructions

When installing an antenna pedestal with a 9foot or 12-foot antenna, it is recommended that the antenna and pedestal be assembled on deck, per paragraph 2.4, then hoisted into position and mounted on the mast as a unit. The antenna pedestal is provided with two eye-bolts to facilitate hoisting.
Nylon web straps (1-1/2-inch wide) with spring closed hooks may be used to attach and lift the unit(s) .

CAUTION

EXERCISE EXTREME CARE TO PREVENT DAMAGE TO THE ANTENNA ARRAY, PARTICULARLY THE ARRAY FACE PROTECTIVE COVER, WHEN LIFTING.

Hoist the antenna pedestal (and the antenna array, if installed) as follows:

1. Rotate the antenna array so that it is positioned lengthwise between the pedestal eye bolts; maintain the antenna in this position while hoisting.

2. Attach two lifting straps to the eye bolts and apply sufficient lift to tense the straps; insure straps are clear of antenna face.

CAUTION

WITH THE ANTENNA ARRAY MOUNTED ON THE PEDESTAL, THE CENTER OF GRAVITY OF THE UNIT IS SHIFTED AWAY FROM THE EYE BOLT LOCATION (TOWARD THE ANTENNA SHAFT). A LINE MUST BE ATTACHED TO THE PEDESTAL COVER HANDLE TO STABILIZE THE UNIT DURING HOISTING.

3. Keeping the unit stabilized, carefully hoist it into position above the pre-installed mounting plate.

4. Align the mounting holes in the pedestal base with those in the plate and carefully lower the unit.

5. Before the lifting straps are removed, secure the antenna pedestal to the mounting plate using four 1/2-13 stainless steel bolts and flatwashers (the pedestal base contains matched-thread locking inserts).

2.3.4 Interconnections

Interconnections to the X-band antenna pedestal are shown in Figures 2-1 (V1), 2-2 (V2), 2-3 (V3) and 2-4 (V4). Additional information is provided in paragraphs 2.3.4.1 and 2.3.4.2, below.

2.3.4.1 Cable Connections. - To gain access to the terminal boards in the X-band antenna pedestal, loosen the captive screws underneath that secure the hinged top to the bottom of the pedestal. Loosen and remove the waveguide clamp which secures the waveguide adapter to the pedestal. Grasp the top hinged cover by its handle and swing the entire top and antenna array to its service position.

Two cables provide the electrical interconnections for the X-band antenna pedestal. One cable carries control signals to and from the pedestal; the other, an armored cable (FSGA-9), carries power for the antenna drive motor. The cables enter through the bottom of the pedestal via stuffing tubes which are supplied in the installation kits; Figure 2-7 shows the locations at which the stuffing tubes are to be installed. The stuffing tube bodies thread directly into the base of the pedestals. Cable connections to the terminal boards inside the pedestal are illustrated in Figure 2-7.

2.3.4.2 Waveguide Connections. - A waveguide run is required from the X-band antenna pedestal waveguide rotating joint to the waveguide output flange in the X-band receiver transmitter.

Waveguide (in standard 12-foot lengths) and choke and cover flanges are available from Raytheon (see Table 2-5). An "O"-ring gasket shall always be used when assembling waveguide runs in a choke-to-cover coupling. The choke flange must be positioned to face away from the antenna and toward the receiver transmitter along the line of the run.

Coupling flanges must be silver-soldered to the waveguide ends. The following guidelines should be observed.

1. The waveguide ends and flange walls must be chemically cleaned to ensure an efficient bond.
2. The finished joint must be smooth and clean
3. The internal walls must be smoothed and polished to ensure a continuous contact.

The end of the X-band waveguide run from the receiver transmitter is terminated with a square flange-to-round-flange adapter (supplied by Raytheon). This adapter is secured to the pedestal by a circular V-clamp and threaded bolt assembly. Access to the inside of the pedestal is achieved by removing the circular clamp and then unscrewing the captive bottom plate securing screws. The entire top of the pedestal including the antenna array can then be tilted forward by grasping the handle at the rear of the pedestal top case.

Rectangular plastic brackets (see Table 1-5) shall be used to secure the waveguide run to the mast and to the wheelhouse structure.

2.3.5. Lubrication

Check and, if necessary, lubricate the antenna pedestal per paragraph 5.7.1.1. Install the breather plug (supplied in the installation kit) at the filler port.

Table 2-5 X-Band Waveguide Components

Description	Part Number for Large X-Band Waveguide RG-51/U (WR112)	Part Number for Small X-Band Waveguide RG-52/U (WR90)
Waveguide, rigid, copper, without flanges, 12-foot length	341-1006P2	341-1006P1
Flange, cover, brass, with clearance holes	341-1004P1	341-101P1
Flange, cover, aluminum, with clearance holes	341-1004P2	341-1011P3
Flange, choke, brass, with 8-32 threaded holes	341-1008P1	341-7174P1
Flange, choke, aluminum with 8-32 threaded holes	341-1008P3	341-7174P3
Waveguide, flexible, with flanges, 24-inch length	341-1009P1	341-7190P1
Elbow, E-bend, 900, brass, with flanges	341-0282G2	341-7191P1
Elbow, H-bend, 900, brass, with flanges	341-0281G1	341-7191P2
Twist, 900, brass, with flanges, 6-inch length	341-0295P5	341-7192P1
Waveguide, elliptical, semi-rigid, aluminum	Not Available	166606-1
Flange, cover, elliptical, aluminum	Not Available	167051-1
Flange, choke, elliptical, aluminum	Not Available	167052-2
Gasket, O-ring	287-1044P1	287-1044P4
Screw, 8-32, 5/8-inch, SST	207-7197P38	207-7197P38
Lockwasher, Number 8	236-1150P4	236-1150P4
Mounting bracket, E-plane, plastic	31T-019G801	Not Available
Mounting bracket, H-plane, plastic	31T-019G802	Not Available
Deck gland	39X-003G801	Not Available
Transition, waveguide, WR90 to WR112	168356-1	168356-1

NOTE - VJR112 parts are available worldwide; TBS - Part No. to be supplied.

2.3.6 Initial Alignment

Perform the initial inspections, checks and alignments (if necessary) per paragraphs 5.7.1.2 through 5.7. 1.4.

2.4 ANTENNA AS-3194 MOUNTING INSTRUCTIONS

2.4.1 Array Mounting

The antenna array and the pedestal are shipped in separate packages and must be assembled at or near the installation site. It is recommended that a 9- or 12-foot antenna array be assembled to the pedestal on deck, then hoisted into position and mounted as a unit. The 6-foot array can be assembled on a premounted pedestal with relative ease. Refer to Figure 6.3-2 when performing the following procedure:

CAUTION

DO NOT SCRATCH OR OTHERWISE DAMAGE THE PROTECTIVE COVER ON THE FRONT OF THE ANTENNA ARRAY.

NOTE

The parenthetical entries in the following steps refer to Find Number on Figure 6.3-2, which should be used to identify and locate parts called out in the procedure.

1. Apply a coat of waterproofing compound between mating surfaces of the hub (4) and T-bar.
2. Locate sealing gasket and O-ring gasket supplied with the antenna installation kit.
3. Install the O-ring into the mating groove of the hub (4).
4. Install the sealing gasket over the waveguide opening in the top of the rotary joint.
5. Position the antenna array and T-bar assembly over the hub (4) such that the front of the array is facing the same direction as the "FRONT" marking (keyway side) of the hub (4).
6. Align the two guide pins on the T-bar with the mating holes in the rotary joint (16).
7. Verify that the alignment pins match up with the mating holes, then secure the T-bar to the hub (4) using four 3/8" bolts, flat washers, and lock nuts.
8. Torque the bolts and lock nuts to 271 inchpounds.

2.4.2 T-Bar Vibration Damper Adjustment

NOTE

This adjustment is made at the factory. Readjustment at installation is not necessary unless the original adjustment has been disturbed.

The antenna array is secured to the T-bar using four shouldered mounting studs and associated hardware which also provide vibration damping. During system installation, correct adjustment of the vibration damping hardware can be checked as follows:

1. Verify that the distance between the bottom of the shoulder on the shouldered stud and the top of the flat washer is 0.950 ± 0.010 inch.
2. Turn the lower locknut if adjustment is necessary.

2.5 RECEIVER TRANSMITTER RT-1240

2.5.1 Mounting Hardware

When installing the receiver transmitter, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.
2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive metal action.

2.5.2 Mounting Instructions

The receiver transmitter chassis assembly is fitted with two horizontal channel members to facilitate bulkhead mounting. Installation dimensions and clearances for the receiver transmitter are given in Figure 2-8. Extra clearance is required on the right side to allow for waveguide or cable entry (see Figures 2-1 through 2-4), and beneath the unit for cable entry. Allow 36 inches in front of the receiver transmitter for servicing and ventilation.

2.5.3 Interconnections

Interconnections to the receiver transmitter are shown in Figures 2-1 (V1), 2-2 (V2), 2-3 (V3) and 2-4 (V4). Additional information is provided in paragraphs 2.5.3.1 and 2.5.3.2, below.

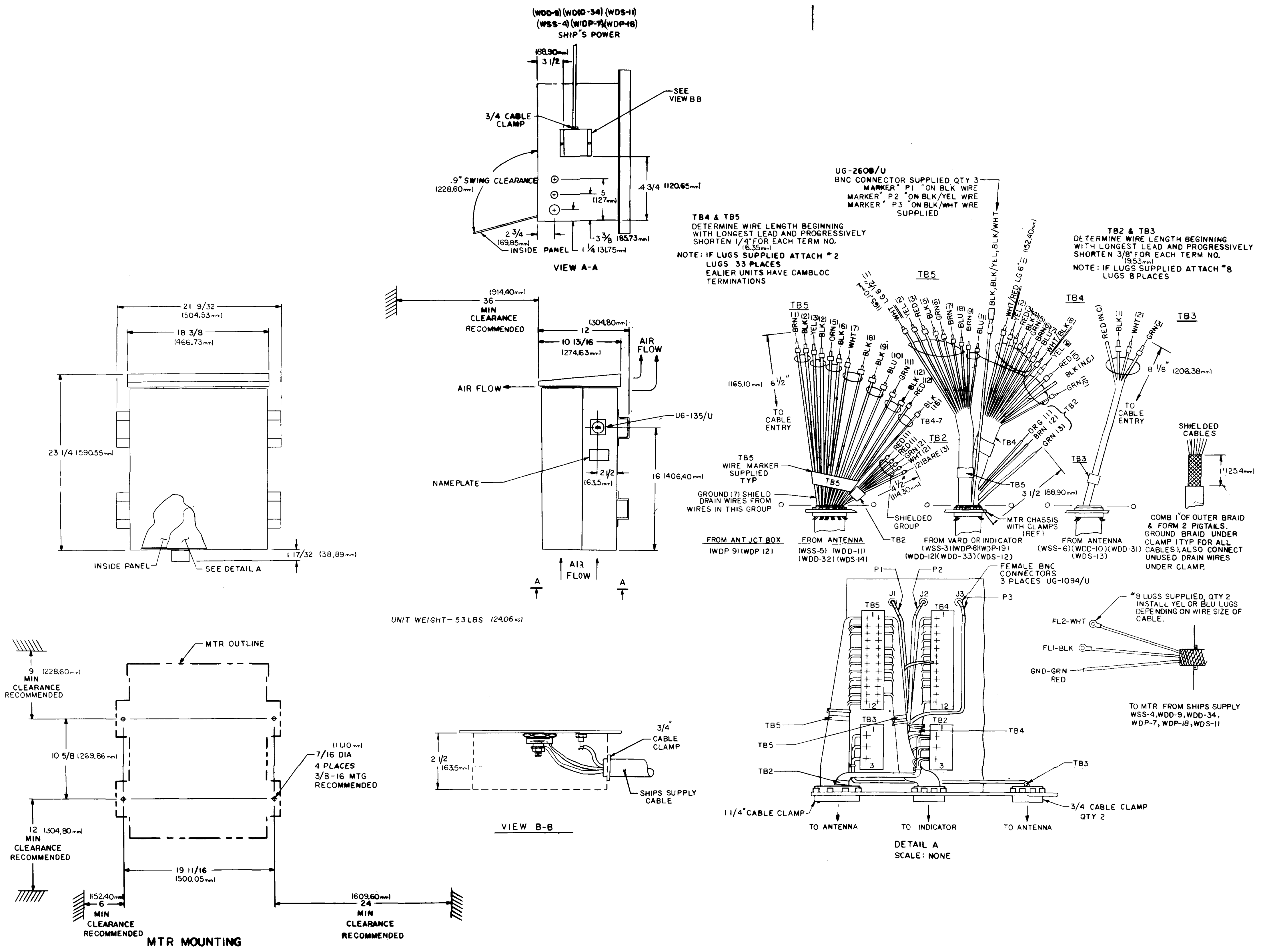


Figure 2-8. Receiver Transmitter RT-1240 Installation Diagram.

2.5.3.1 Cable Connections. - Access to terminal boards within the receiver transmitter is provided by removing the wrap-around cover which is secured to the receiver transmitter chassis assembly by six clamping catches. All receiver transmitter interconnecting cables enter the receiver transmitter through the bottom of the cabinet (see Figures 2-1 through 2-4). To gain access to the terminal boards and connectors which interface these cables, remove the receiver transmitter front cover by releasing the four clamping catches.

Ship's mains shall be connected to the receiver transmitter through a 15-ampere fuse or circuit breaker box (with power disconnect switch) .

2.5.3.2 Waveguide Installation. - Information required for waveguide installation is given in paragraph 2.3.4.2. See Figure 2-9 for recommended X-band waveguide interconnections.

2.6 AZIMUTH RANGE INDICATORS IP-1282 AND IP-1283

2.6.1 Mounting Hardware

When installing the indicator, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.

2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive action.

2.6.2 Mounting Instructions

Figures 2-10 and 2-11 provide the dimensions and data required for mounting the 12-inch and 16inch indicator units. These figures also include outline drawings showing the overall dimensions of the indicator with base assembly attached.

The recommended method of installing the indicator is to secure the base assembly directly to the deck. The base assembly is secured by removing the lower access cover, tightening the mounting bolts, and replacing the cover.

NOTE

If the indicator is bulkhead mounted, use plate (Part Number 589541- or 169511-1) and associated hardware (see Figure 6.4-55 or Figure 6.4-57, item 4) to secure all interconnecting cables to the bottom of the indicator cabinet.

To install the indicator, it is necessary to remove the access covers. Since the indicator circuits are exposed when the indicator is being installed, the following precautions shall be observed: (1) Use the correct tools; (2) Do not touch any of the screwdriver controls; (3) Apply leverage externally.

WARNING

THE CRT IS EXPOSED WITH THE INDICATOR UPPER ACCESS COVER REMOVED OR WITH THE HINGED CONTROL PANEL IN THE RAISED POSITION. TAKE EXTREMIE LCARE TO PREVENT BREAKAGE.

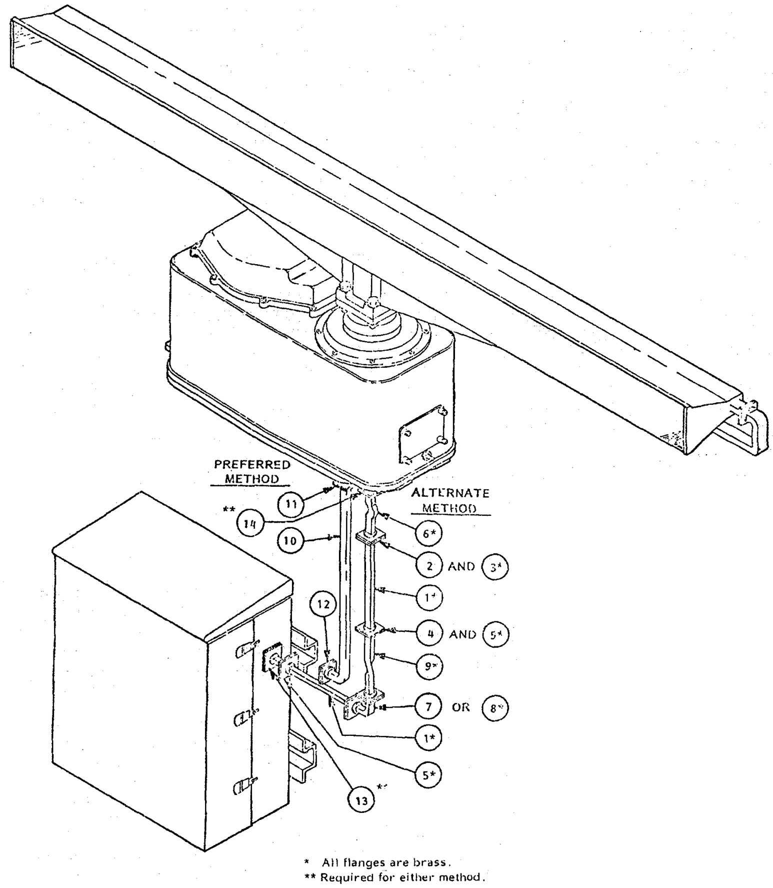
2.6.3 Cable Connections

Interconnections to the indicator(s) are shown in Figures 2-1 (V1), 2-2 (V2), 2-3 (V3) and 2-4 (V4) .

Terminal boards within the indicator are exposed by removing the wrap-around cover which is secured to the indicator chassis assembly by four snap-fasteners.

Indicator cables are connected up through the base assembly and to the terminal boards and connectors inside the cabinet (see Figures 2-10 and 2-11). These terminal boards and connectors are accessible by removing the upper front cover from the indicator cabinet and swinging down the NSK assembly (if installed).

Ship's mains shall be connected to the indicator through a 10-ampere fuse or circuit breaker box (with power disconnect switch).



Key No.	Description	Part Number
1	waveguide, RG 52 U	341 1006P1
2	Flange, cover, with clearance holes	341 1011P1
3	Flange, cover, with 8-32 threaded holes	341 1011P2
4	Flange, choke, with 8-32 threaded holes	341 7174P1
5	Flange, choke, with clearance holes	341 7174P2
6	Waveguide flexible, with flanges (24 inch length)	341 7190P1
7	Waveguide elbow 90°, with flanges (E bend)	341 7191P1
8	Waveguide elbow 90°, with flanges (H bend)	341 7151P2
9	Waveguide twist 90°, with flanges (6 inch length)	341 7192P1
10	Waveguide, elliptical, flexible	166066-1
11	Waveguide, connector, cover	167051-1
12	Waveguide, connector, choke	167051-2
13	Vented waveguide section	585511-1
14	Adapter, Waveguide	167861-1
	Screw, 8-32, 5/8" SST	207-7197P38
	Lockwasher	236-11550P4
	O-Ring Gasket	287-1044P4

Figure 2-9 Recommended X-Band Waveguide Interconnection Diagram

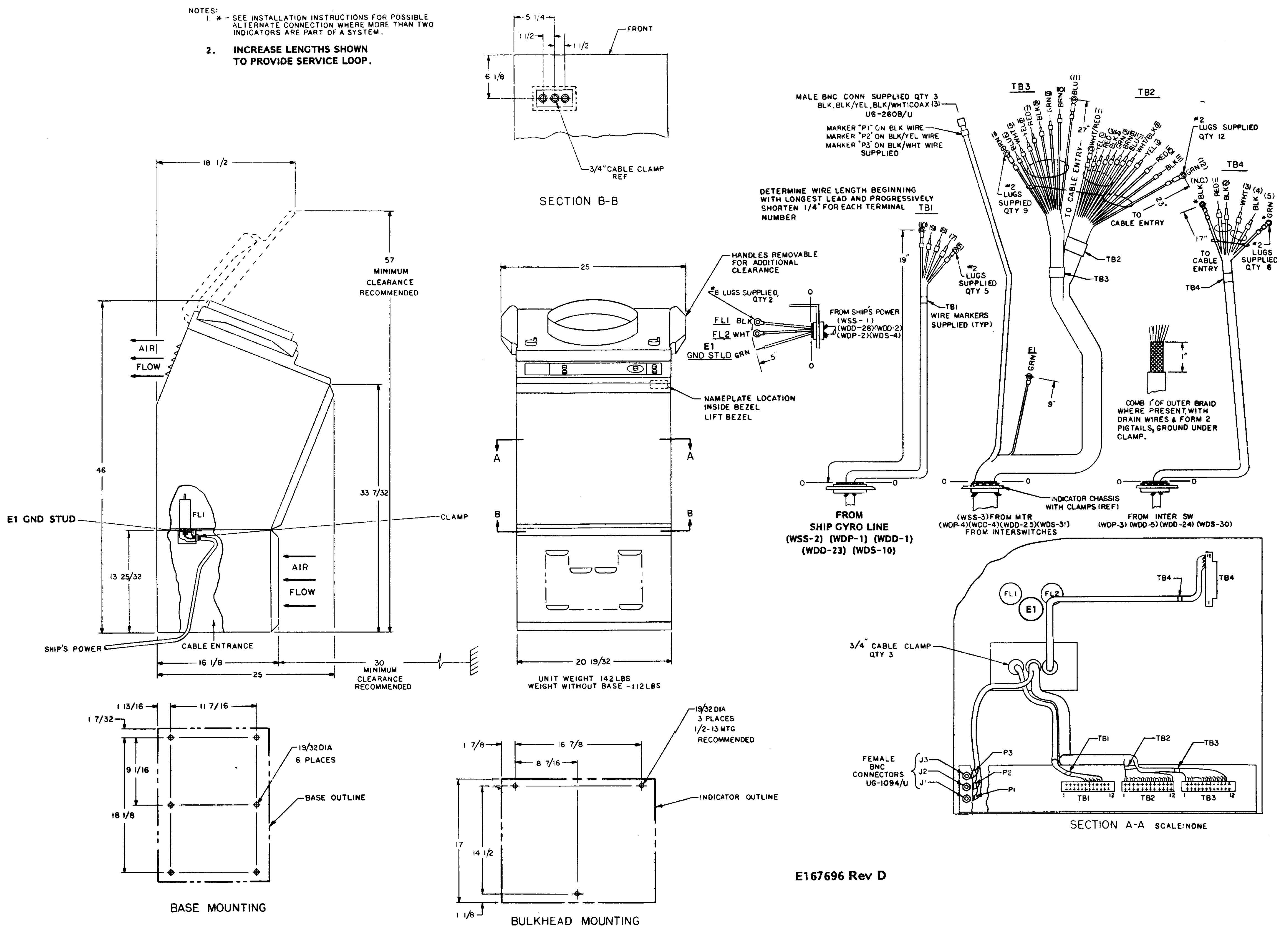


Figure 2-10. Azimuth Range Indicator IP-1282 Installation Diagram.

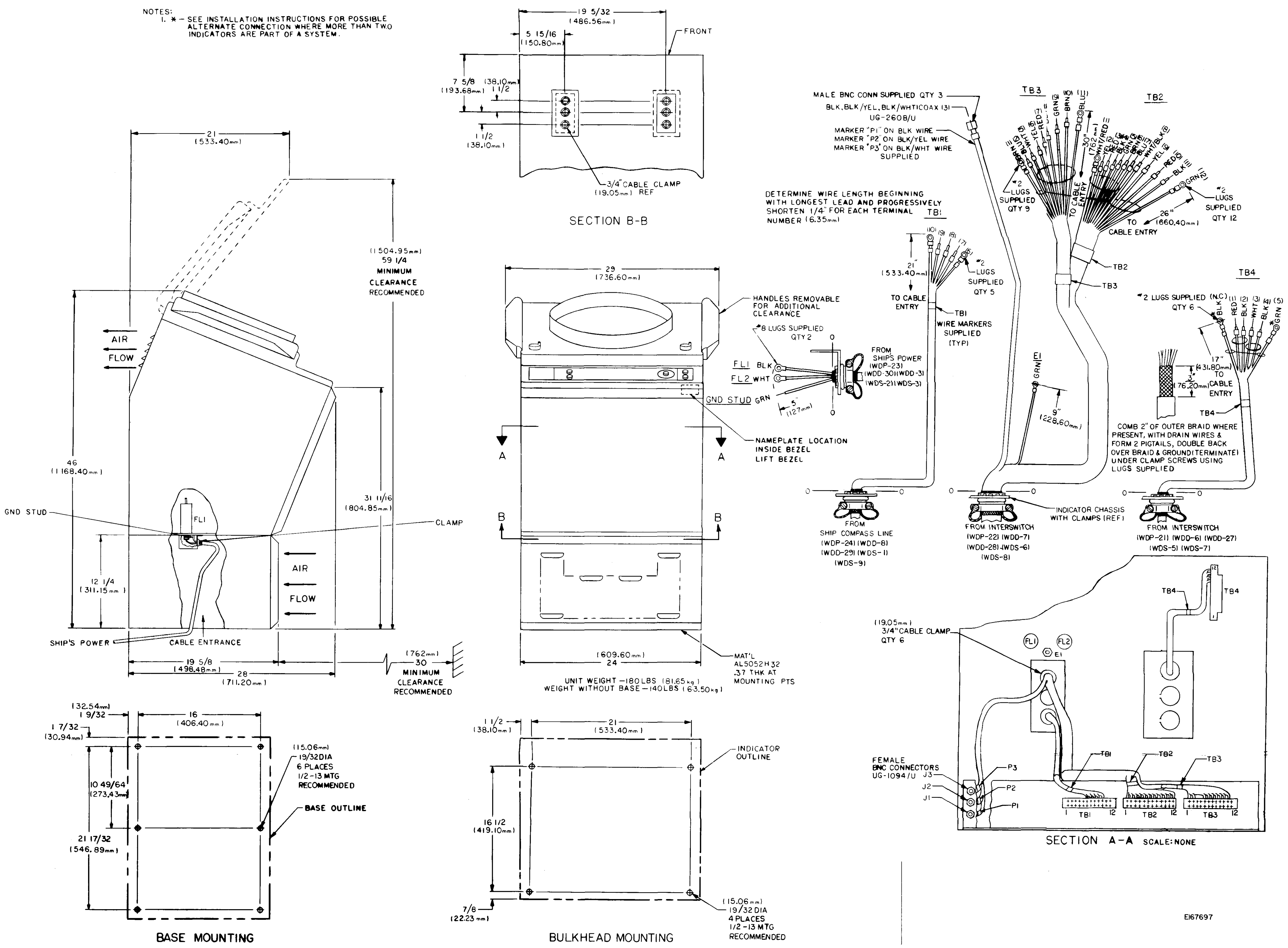


Figure 2-11. Azimuth Range Indicator IP-1283 Installation Diagram (V2, V3, V4).

2.6.4 Installation Modifications

NOTE

Position transmission PCB's have U7 installed and link E1& E2 removed for all configurations even though the IC is not necessary for single systems. Thus all PCB's are the same.

2.6.4.1 Position Transmission PCB 4/5 A2A8.

The modifications required on Position Transmission PCB 4/5 A2A8 depend upon system configuration. Modify the 4/5 A2A8 PCB for the system installed as follows:

1. For a single system:
   a. Do not link terminals E1 and E2 on 4/5 A2A8 PCB (removed link if installed) .
   b. Install integrated circuit DM8820 (166018-1) at U7 of 4/5 A2A8 PCB.

2. For a system with dual indicators (A and B and an interswitch:
   a. Do not link terminals E1 and E2 on 4/5 A2A8 PCB (remove link if installed) .
   b. Install integrated circuit DM8820 (166018-1) at U7 of 4/5 A2A8 PCB.

3. For a system with three or four indicators (A, B, C, D) and an interswitch:
   a. Do not link terminals E1 and E2 on 4/5 A2A8 PCB (remove link if installed) .
   b. Install integrated circuit DM8820 (166018-1) at U7 of 4/5 A2A8 PCB.
   c. Remove R62 and R63 from 4/5 A2A8 PCB of middle indicators, i.e.:
      (1) Three-indicator (A, B, C) system: remove R62 and R63 from indicator B only.
      (2) Four-indicator (A, B, C, D) system : remove R62 and R63 from indicators B and C.

2.6.4.2 PRF Generator PCB 4/5 A2A6. - Check the links on PRF Generator PCB 4/5 A2A6 as follows:

1. Insure that no links are connected at terminals E1 through E16 or E28 through E31 (coarse delay). Link terminal E17 to E54 (U23 pin 9)].

2. Trigger Delay Links
   a. For single systems (one receiver transmitter and one indicator, no interswitch), install links on 4/5 A2A6 PCB as follows:
      (1) Link terminal E32 to E34.
      (2) Determine waveguide run length. Starting at E17, each terminal E17 through E26 represents 15 feet of waveguide run. Install link from E34 to the terminal between E17 and E26 which most nearly matches waveguide run length. (This is a fine setting.) Coarse adjustment is to be performed per the Trigger Delay Adjustment procedure given in Section 5 of this manual.)
   b. For dual system (two receiver transmitters and two indicators with interswitch), install links on 4/5A2A6 PCB as follows:
      (1) Install links per step 2a above.
      (2) Link terminal E33 to E35.
      (3) Determine waveguide run length from receiver transmitter 1 to its associated antenna pedestal. Starting at E17, each terminal E17 through E26 represents 15 feet of waveguide run. Install link from E35 to the terminal between E17 and E26 which most nearly matches receiver transmitter II waveguide run length. (This is a fine setting; coarse adjustment is to be performed per the Trigger Delay Adjustment procedure given in Section 5 of this manual.)

3. Acknowledge Pulse Links. - .Install links on 4/5 A2A6 PCB as follows:
   a. Link E42 to E43 for all indicators.
   b. For single system, link terminal E40 to E38 (14V acknowledge pulse).
   c. For any system having an interswitch or a (Video Amplifier.) (but not both), link terminal E40 to E37 (7V acknowledge pulse) at all indicators.
   d. For any system having both an interswitch and Video Amplifier, link terminal E40 to E36 (3.5V acknowledge pulse) at all indicators.

4. For systems having two X-band or two S-band receiver transmitters and two indicators, remove link between terminals E50 and F51 on 4/5 A2A6 PCB in one indicator only.

5. For nautical mile radars, install links between the following terminals on the 4/5A2A6 PCB:

E48 to E49
E44 to E46

For statute mile radars, install the links on 4/5 A2A6 PCB as follows:

E44 to E45
E47 to E48

If the radar is changed from nautical to statute miles or vice-versa, refer to parts list for 4/5 A2A6 PCB for values and part numbers of crystal Y1 and inductor L1.

6. For interswitch/master slave operation, add jumper (if necessary) as applicable per Table 2-6 to PRF generator PCB 4/5 A2A6.

Table 2-6 PRF Generator PCB Data Selector Wiring

Mode	A	B	Delay Jumpers Coarse (120 ft. per Tap)	Delay Jumpers Fine (15 ft. per Tap)
Master, Receiver Transmitter I	1	0	E28 to a Tap	E35 to a Tap E18 thru E26
Slave, Receiver Transmitter I	0	0	E1 thru E16 E1 thru E16	E33 to a Tap E18 thru E26
Master, Receiver Transmitter II or single Receiver Transmitter/ Indicator system	1	1	E29 to a Tap E1 thru E16	E34 to a Tap E18 thru E26
Slave, Receiver Transmitter II	0	1	E31 to a Tap El thru E16	E32 to a Tap E18 thru E26

2.6.5 Initial Alignment

Before proceeding with initial alignment, perform the following checks to insure that the printed circuit board (PCB) links (jumpers) in the indicator are properly installed for the options included.

CAUTION

INSURE INDICATOR POWER SWITCH IS OFF BEFORE REMOVING ANY PCB.

2.6.5.1 Video Amplifier PCB 4/5 A2A1. - Check the links on Video Amplifier PCB 4/5 A2A1 as follows:

1. If the Electronic Bearing Line (EBL) PCB 4/5 A2A9 is not installed, link terminals El to E2 on 4/5 A2A1 PCB. If EBL is installed, do not link.
2. If the Variable Range Marker (VRM) PCB 4/5 A2A7 is not installed, link terminals E3 to E4 on 4/5 A2A1 PCB. If VRM is installed, do not link.

2.6.5.2 Data Storage PCB 4/5 A2A3. - If Interference Reject (IR) PCB 4/5 A2A5 is not installed, place links between the following terminals on the Data Storage PCB 4/5A2A3; if IR PCB 4/5 A2A5 is installed, do not link.

1. Link terminal El to E2.
2. Link terminal E3 to E4.

2.6.5.3 Variable Range Marker PCB 4/5 A2A7.VRM PCB 4/5 A2A7 can drive either three-digit (nautical or statute miles or kilometers) or six-digit (yards) LED displays. The VRM LED readout PCB 4/5A6 installed on the bezel assembly determines which readouts are available for the installed indicator. If a three-digit LED PCB (167985-1) is installed, nautical mile, statute mile or kilometer readouts are available; the following listing gives links and jumpers required for these three-digit readouts.

Readout	4/5 A2A7 PCB Link	4/5 XA2A7 PCB Socket Jumpers	Note: (see below)
Nautical Miles	E1 to E2	A to 1 B to 2 C to 3	1
Statute Miles	E1 to E2	A to 1 B to 2 C to 3	2
Kilometers	E1 to E2	A to 2 B to 3 C to 4	1

NOTE 1

PRF Generator PCB 4/5 A2A6 must be linked for nautical miles (see paragraph 2.6.4.2, item 5 above) .

NOTE 2

PRF Generator PCB 4/5 A2A6 must be linked for statute miles (per paragraph 2.6.4.2, item 5 above).

If a six-digit LED PCB (167516-1) is installed in the indicator, only the yards readout is available. The following links and jumpers must be installed to obtain the proper readout.

1. 4/5 A2A7 PCB Link: E1 to E3.
2. 4/5 XA2A7 PCB Socket Jumpers:
   A to 3
   B to 2
   C to 4

3. PRF Generator PCB 4/5A2A6: Linked for nautical miles (see paragraph 2.6.4.2, item 5 above).

2.6.5.4 EBL Switching PCB 4/5 A2A9. - Install links between the following terminals on EBL PCB 4/5 A2A9:

E2 to E4
E8 to E10
E13 to E15
E16 to E17
E19 to E20

NOTE

If True Motion (TMU) or Anti-Collision (ACU) options are installed, these links will be modified.

2.6.5.5 NSK Exciter PCB 4/5 A9A2. - Install a link between terminals El and E2 on the 4/5 A9A2 PCB. This link will be removed if ACU is installed.

NOTE 1

Before the radar is put into service it shall be tested and adjusted in accordance with the instructions furnished in Section 5.5.

NOTE 2

Product warranty is contingent upon receipt by Raytheon Marine Company of an installation report executed by a qualified service engineer.

Check and, if necessary, perform the indicator alignment procedures per paragraph 5.12.3.

2.7 SWITCHING UNITS SA-2139 (V3, V4) AND SA-2156 (V2)

2.7.1 Cable Connections (V2,V3,V4)

Cable connection data for the switching units is provided in Tables 2-7 through 2-11. The tables list the cable numbers, the source (including the bundle identifier, wire color, wire number and connection) and the destination (unit, connection, and applicable figure number).

CAUTION

USE A 40-WATT IRON AND 60/40 SOLDER WHEN CONNECTING POWER LEADS TO RF INTERFERENCE LINE FILTERS FL2 AND FL3 IN THE RECEIVER TRANSMITTER. THESE FILTERS (PART NUMBER 363-7184P1) CONTAIN AN OIL-FILLED CAVITY WHICH IS SEALED WITH SOLDER THAT MELTS AT 315°0C. EXCESSIVE HEAT COULD DAMAGE THE SEAL AND CAUSE OIL LEAKAGE WHICH MIGHT DAMAGE THE FILTER.

2.7.2 Installation Modifications (V2,V3,V4)

The switching units are commonly wired and jumpered for the system in which they are to be installed. Table 2-12 lists the internal jumpers required in each unit for the four configurations (V1, V2, V3, and V4). During installation, verify that the units are properly wired and jumpered as specified in the table.

2.7.3 Mounting Hardware (V2,V3,V4)

When installing the switching units, the following general rules must be observed, as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.

2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC-4 (Part Number 230-1014P3) to prevent corrosive action.

2.7.4 Mounting Instructions (V2,V3,V4)

The switching units are self-contained, designed for bulkhead mounting, and each weighs approximately 75 pounds. Refer to Figure 2-12 for mounting and installation dimensions.

2.8 INTERFACE UNIT J-3463 (V2)

2.8.1 Mounting Hardware (V2)

When installing the interface unit, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.

2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive action.

2.8.2 Mounting Instructions (V2)

The interface unit should be bulkhead mounted at a location between the receiver transmitters and the antenna. See Figure 2-13 for mounting and installation dimensions.

2.8.3 Cable Connections (V2)

Cable interconnection data for the interface unit is provided in Figures 2-2 and 2-13.

Table 2-7 AN/SPS-64(V)2 Switching Unit SA-2156 Cable Connections

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDP-5 9253	WHT/RED	WHT/RED	1	S1-A 1F	Video Amplifier No. 1 AM-6932	TB1-1	2-15
		YEL	1	S1-A 3F		TB1-2	
		RED	1	S1-A 5F		TB1-3	
		BLK	1	S1-A 7F		TB1-4	
		GRN	1	S1-A 9F		TB1-5	
		BRN	1	S1-A 11F		TB1-6	
	WHT/RED	BLU	1	S1-A 13F		TB1-7	
	WHT/BLK	WHT/BLK	1A	S1-A 15F		TB1-8	
		YEL	1A	S1-A 17F		TB1-9	
		RED	1A	S1-A 19F		TB1-10	
		BLK	1A	S1-A 21F		TB1-11	
		GRN	1A	S1-A 23F		TB1-12	
		BRN	1A	S1-A 25F		TB1-13	
	WHT/BLK	BLU	1A	S1-A 27F		TB1-14	
	WHT	WHT	1B	S1-B 1F		TB3-1	
		YEL	1B	S1-B 3F		TB3-2	
		RED	1B	S1-B 5F		TB3-3	
		BLK	1B	S1-B 7F		TB3-4	
		GRN	1B	S1-B 9F		TB3-5	
		BRN	1B	S1-B 11F		TB3-6	
	WHT	BLU	1B	S1-B 13F		TB3-7	
	4-WIRE (NO.18)	GRN	1	TB2-2		TB4-3	
	COAX	BLK	1	S1-B 17F		P4	
		SHIELD		A1E3		P4 SHELL	
	COAX	BLK/WHT	1	A1E12		P1	
		SHIELD		A1E8	Video Amplifier	P1 SHELL	
WPD-5	COAX	BLK/YEL	1	A1E24	No. 1	A2P3	
9253		SHIELD		A1E20	AM-6932	A2P3 SHELL	
WDP-20 9253	WHT/RED	WHT/RED	2	S1-A 1B	Video Amplifier No. 2 AM-6932	TB1-1	
		YEL	2	S1-A 3B		TB1-2	
		RED	2	S1-A 5B		TB1-3	
		BLK	2	S1-A 7B		TB1-4	
		GRN	2	S1-A 9B		TB1-5	
		BRN	2	S1-A 11B		TB1-6	
	WHT/RED	BLU	2	S1-A 13B		TB1-7	
	WHT/BLK	WHT/BLK	2A	S1-A 15B		TB1-8	
		YEL	2A	S1-A 17B		TB1-9	
		RED	2A	S1-A 19B		TB1-10	
		BLK	2A	S1-A 21B		TB1-11	
		CRN	2A	S1-A 23B	Video Amplifier	TB1-12	
WDP-20		BRN	2A	S1-A 25B	No. 2	TB1-13	
9253	WHT/BLK	BLU	2A	S1-A 27B	AM-6932	TB1-14	2-15

NOTES:

1. Ground all spare wires at both ends including coax and power spares.
2. Bond all equipment chassis to ground.
3. Wire colors apply only to specified cable types.

Table 2-7 AN/SPS-64(V)2 Switching Unit SA-2156 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDP-20 9253	WHT	WHT	2B	S1-B 1B	Video Amplifier No. 2 AM-6932	TB3-1	2-15
		YEL	2B	S1-B 3B		TB3-2	
		RED	2B	S1-B 5B		TB3-3	
		BLK	2B	S1-B 7B		TB3-4	
		GRN	2B	S1-B 9B		TB3-5	
		BRN	2B	S1-B 11B		TB3-6	
	WHT	BLU	2B	S1-B 13B		TB3-7	
	4-WIRE (NO.18)	GRN	2	TB2-2		TB4-3	
	COAX	BLK	2	S1-B 17B		P4	
		SHIELD		A1E3		P4 SHELL	
	COAX	BLK/WHT	2	A1E15		P1	
		SHIELD		A1E9	Video Amplifier	P1 SHELL	
WDP-20	COAX	BLK/YEL	2	A1E27	No. 2	A2P3	
9253		SHIELD		A1E21	AM-6932	A2P3 SHELL	2-15
WDP-4 9253	WHT/RED	WHT/RED	3	S1-A 1H	Indicator A IP-1282/IP-1283	TB2-1	2-10
		YEL	3	S1-A 3H		TB2-2	
		RED	3	S1-A 5H		TB2-3	
		BLK	3	S1-A 7H		TB2-4	
		GRN	3	S1-A 9H		TB2-5	
		BRN	3	S1-A 11H		TB2-6	
	WHT/RED	BLU	3	S1-A 13H		TB2-7	
	WHT/BLK	WHT/BLK	3A	S1-A 15H		TB2-8	
		YEL	3A	S1-A 17H		TB2-9	
		RED	3A	S1-A 19H		TB2-10	
		BLK	3A	S1-A 21H		TB2-11	
		GRN	3A	S1-A 23H		TB2-12	
		BRN	3A	S1-A 25H		TB3-1	
	WHT/BLK	BLU	3A	S1-A 27H		TB3-2	
	WHT	WHT	3B	S1-B 1H		TB3-5	
		YEL	3B	S1-B 3H		TB3-6	
		RED	3B	S1-B 5H		TB3-7	
		BLK	3B	S1-B 7H		TB3-8	
		GRN	3B	S1-B 9H		TB3-9	
		BRN	3B	S1-B 11H		TB3-10	
	WHT	BLU	3B	S1-B 13H		TB3-11	
	4-WIRE (NO.18)	GRN	3	TB2-1		E1	
	COAX	BLK	3	S1-B 17H		P1	
		SHIELD		A1E2		P1 SHELL	
	COAX	BLK/WHT	3	S1-B 19H		P3	
		SHIELD		A1E6		P3 SHELL	
WDP-4	COAX	BLK/YEL	3	S1-B 23H	Indicator A	P2	
9253		SHIELD		A1E18	IP/1282/IP-1283	P2 SHELL	2-10

Table 2-7 AN/SPS-64(V)2 Switching Unit SA-2156 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDP-22 9253	WHT/RED	WHT/RED	4	S1-A 2H	Indicator B IP-1282/IP-1283	TB2-1	2-10
		YEL	4	S1-A 4H		TB2-2	
		RED	4	S1-A 6H		TB2-3	
		BLK	4	S1-A 8H		TB2-4	
		GRN	4	S1-A 10H		TB2-5	
		BRN	4	S1-A 12H		TB2-6	
	WHT/RED	BLU	4	S1-A 14H		TB2-7	
	WHT/BLK	WHT/BLK	4A	S1-A 16H		TB2-8	
		YEL	4A	S1-A 18H		TB2-9	
		RED	4A	S1-A 20H		TB2-10	
		BLK	4A	S1-A 22H		TB2-11	
		GRN	4A	S1-A 24H		TB2-12	
		BRN	4A	S1-A 26H		TB3-1	
	WHT/BLK	BLU	4A	S1-A 28H		TB3-2	
	WHT	WHT	4B	S1-B 2H		TB3-5	
		YEL	4B	S1-B 4H		TB3-6	
		RED	4B	S1-B 6H		TB3-7	
		BLK	4B	S1-B 8H		TB3-8	
		GRN	4B	S1-B 10H		TB3-9	
		BRN	4B	S1-B 12H		TB3-10	
	WHT	BLU	4B	S1-B 14H		TB3-11	
	4-WIRE (NO.18)	GRN	4	TB2-1		E1	
	COAX	BLK	4	S1-B 18H		P1	
		SHIELD		A1E2		P1 SHELL	
	COAX	BLK/WHT	4	S1-B 21H		P3	
		SHIELD		A1E7		P3 SHELL	
WDP-22	COAX	BLK/YEL	4	S1-B 25H	Indicator B	P2	
9253		SHIELD		A1E19	IP-1282/IP-1283	P2 SHELL	
WDP-3		RED	6A	S1-C 7A	Indicator A	TB4-1	
8777		BLK	6A	S1-C 2A	IP-1282/IP-1283	TB4-2	
		GRN	6B	TB1-1		TB4-5	
WDP-3		WHT	6	S1-C 3H	Indicator A	TB4-3	
8777		BLK	6	S1-C 4H	IP-1282/IP-1283	TB4-4	
WDP-21		RED	7A	S1-C 7A	Indicator B	TB4-1	
8777		BLK	7A	S1-C 2A	IP-1282/IP-1283	TB4-2	
		GRN	7B	TB1-2		TB4-5	
WDP-21		WHT	7	S1-C 5H	Indicator B	TB4-3	
8777		BLK	7	S1-C 6H	IP-1282/IP-1283	TB4-4	2-10
WDP-6		RED	8A	S1-C 10H	Interface Unit	TB5-8	2-13
9773		BLK	8A	S1-C 10B	J-3463	TB5-6	
WDP-6		WHT	8	S1-C 10H	Interface Unit	TB5-8	
9773		BLK	8	S1-C 10B	J-3463	TB5-6	2-13

Table 2-8 AN/SPS-64(V)3 Switching Unit SA-2139 No. 1 Cable Connections

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDD-14 9253	WHT/RED	WHT/RED	1	S1-A 1H	Video Amplifier AM-6932 (VARD No. 1)	TB1-1	2-15
		YEL	1	S1-A 3H		TB1-2	
		RED	1	S1-A 5H		TB1-3	
		BLK	1	S1-A 7F		TB1-4	
		GRN	1	S1-A 8H		TB1-5	
		BRN	1	S1-A 10H		TB1-6	
	WHT/RED	BLU	1	S1-A 12F		TB1-7	
	WHT/BLK	WHT/BLK	1A	S1-A 13H		TB1-8	
		YEL	1A	S1-A 15H		TB1-9	
		RED	1A	S1-A 17H		TB1-10	
		BLK	1A	S1-A 19H		TB1-11	
		GRN	1A	S1-A 21H		TB1-12	
		BRN	1A	S1-A 23H		TB1-13	
	WHT/BLK	BLU	1A	S1-A 25F		TB1-14	
	WHT	WHT	1B	S1-B 11H		TB3-1	
		YEL	1B	S1-B 13H		TB3-2	
		RED	1B	S1-B 15H		TB3-3	
		BLK	1B	S1-B 17F		TB3-4	
		GRN	1B	S1-B 18F		TB3-5	
		BRN	1B	S1-B 19F		TB3-6	
	WHT	BLU	1B	S1-B 20F		TB3-7	
	4-WIRE (No. 18)	GRN	1	TB2-3		TB4-3	
	COAX	BLK	1	S1-B 24B		P5	
		SHIELD		A1E14A		P5 SHELL	
	COAX	BLK/WHT	1	S1-B 25F		P3	
		SHIELD		A1E5A	Video Amplifier	P3 SHELL	
WDD-14	COAX	BLK/YEL	1	S1-B 27F	AM-6932	A2P3	
9253		SHIELD		A1E10A	(VARD No. 1)	A2P3 SHELL	2-15
WDD-4 9253	WHT/RED	WHT/RED	2	S1-A 1F	Indicator A IP-1282/IP-1283	TB2-1	2-10
		YEL	2	S1-A 3F		TB2-2	
		RED	2	S1-A 5F		TB2-3	
		BLK	2	S1-A 7H		TB2-4	
		GRN	2	S1-A 8F		TB2-5	
		BRN	2	S1-A 10F		TB2-6	
	WHT/RED	BLU	2	S1-A 12H		TB2-7	
	WHT/BLK	WHT/BLK	2A	S1-A 13F		TB2-8	
		YEL	2A	S1-A 15F		TB2-9	
		RED	2A	S1-A 17F		TB2-10	
		BLK	2A	S1-A 19F		TB2-11	
		GRN	2A	S1-A 21F		TB2-12	
WDD-4		BRN	2A	S1-A 23F	Indicator A	TB3-1	
9253	WHT/BLK	BLU	2A	S1-A 25H	IP-1282/IP-1283	TB3-2	2-10

Table 2-8 AN/SPS-64(V)3 Switching Unit SA-2139 No. 1 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDD-4 9253	WHT	WHT	2B	S1-B 11F	Indicator A IP-1282/IP-1283	TB3-5	2-10
		YEL	2B	S1-B 13F		TB3-6	
		RED	2B	S1-B 15F		TB3-7	
		BLK	2B	S1-B 17H		TB3-8	
		GRN	2B	S1-B 18H		TB3-9	
		BRN	2B	S1-B 19H		TB3-10	
	WHT	BLU	2B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	2	TB2-2		E1	
	COAX	BLK	2	S1-B 22H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	2	A1E1		P3	
		SHIELD		A1E5B		P3 SHELL	
WDD-4 9253	COAX	BLK/YEL	2	A1E6	Indicator A IP-1282/IP-1283	P2	
		SHIELD		A1E10B		P2 SHELL	
WDD-7 9253	WHT/RED	WHT/RED	3	S1-A 2B	Indicator B IP-1282/IP-1283	TB2-1	
		YEL	3	S1-A 4B		TB2-2	
		RED	3	S1-A 6B		TB2-3	
		BLK	3	S1-A 7H		TB2-4	
		GRN	3	S1-A 9B		TB2-5	
		BRN	3	S1-A 11B		TB2-6	
	WHT/RED	BLU	3	S1-A 12H		TB2-7	
	WHT/BLK	WHT/BLK	3A	S1-A 14B		TB2-8	
		YEL	3A	S1-A 16B		TB2-9	
		RED	3A	S1-A 18B		TB2-10	
		BLK	3A	S1-A 20B		TB2-11	
		GRN	3A	S1-A 22B		TB2-12	
		BRN	3A	S1-A 24B		TB3-1	
	WHT/BLK	BLU	3A	S1-A 25H		TB3-2	
	WHT	WHT	3B	S1-B 12B		TB3-5	
		YEL	3B	S1-B 14B		TB3-6	
		RED	3B	S1-B 16B		TB3-7	
		BLK	3B	S1-B 17H		TB3-8	
		GRN	3B	S1-B 18H		TB3-9	
		BRN	3B	S1-B 19H		TB3-10	
	WHT	BLU	3B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	3	TB2-2		E1	
	COAX	BLK	3	S1-B 23H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	3	A1E2		P3	
		SHIELD		A1E5B		P3 SHELL	
WDD-7 9253	COAX	BLK/YEL	3	A1E7	Indicator B IP-1282/IP-1283	P2	
		SHIELD		A1E10B		P2 SHELL	2-10

Table 2-8 AN/SPS-64(V)3 Switching Unit SA-2139 No. 1 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDD-18 9253	WHT/RED	WHT/RED	4	S1-A 1D	Switching Unit SA-2139 No. 2	S1-A 2H	2-12
		YEL	4	S1-A 3D		S1-A 4H	
		RED	4	S1-A 5D		S1-A 6H	
		BLK	4	S1-A 7C		S1-A 7D	
		GRN	4	S1-A 8D		S1-A 9H	
		BRN	4	S1-A 10D		S1-A 11H	
	WHT/RED	BLU	4	S1-A 12C		S1-A 12D	
	WHT/BLK	WHT/BLK	4A	S1-A 13D		S1-A 14H	
		YEL	4A	S1-A 15D		S1-A 16H	
		RED	4A	S1-A 17D		S1-A 18H	
		BLK	4A	S1-A 19D		S1-A 20H	
		GRN	4A	S1-A 21D		S1-A 22H	
		BRN	4A	S1-A 23D		S1-A 24H	
	WHT/BLK	BLU	4A	S1-A 25C		S1-A 25D	
	WHT	WHT	4B	S1-B 11D		S1-B 12H	
		YEL	4B	S1-B 13D		S1-B 14H	
		RED	4B	S1-B 15D		S1-B 16H	
		BLK	4B	S1-B 17C		S1-B 17D	
		GRN	4B	S1-B 18C		S1-B 18D	
		BRN	4B	S1-B 19C		S1-B 19D	
	WHT	BLU	4B	S1-B 20C		S1-B 20D	
	4-WIRE (NO. 18)	GRN	4	TB2-4		TB2-4	
WDD-18 9253	COAX	BLK	4	S1-B 24H		S1-B 23B	
		SHIELD		A1E14A		A1E14A	
WDD-17 9253	WHT/RED	WHT/RED	5	S1-A 2H		S1-A 1D	
		YEL	5	S1-A 4H		S1-A 3D	
		RED	5	S1-A 6H		S1-A 5D	
		BLK	5	S1-A 7D		S1-A 7C	
		GRN	5	S1-A 9H		S1-A 8D	
		BRN	5	S1-A 11H		S1-A 10D	
	WHT/RED	BLU	5	S1-A 12D		S1-A 12C	
	WHT/BLK	WHT/BLK	5A	S1-A 14H		S1-A 13D	
		YEL	5A	S1-A 16H		S1-A 15D	
		RED	5A	S1-A 18H		S1-A 17D	
		BLK	5A	S1-A 20H		S1-A 19D	
		GRN	5A	S1-A 22H		S1-A 21D	
		BRN	5A	S1-A 24H		S1-A 23D	
	WHT/BLK	BLU	5A	S1-A 25D		S1-A 25C	
	WHT	WHT	5B	S1-B 12H		S1-B 11D	
		YEL	5B	S1-B 14H		S1-B 13D	
		RED	5B	S1-B 16H		S1-B 15D	
		BLK	5B	S1-B 17D		S1-B 17C	
		GRN	5B	S1-B 18D		S1-B 18C	
WDD-17		BRN	5B	S1-B 19D	Switching Unit	S1-B 19C	2-12
9253	WHT	BLU	5B	S1-B 20D	SA-2139 No. 2	S1-B 20C	

Table 2-8 AN/SPS-64(V)3 Switching Unit SA-2139 No. 1 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDD-17 9253	4-WIRE (NO. 18)	GRN	5	TB2-4	Switching Unit SA-2139 No. 2	TB2-4	2-12
WDD-17 9253	COAX	BLK SHIELD	5	S1-B 23B A2E14A	Switching Unit SA-2139 No. 2	S1-B 24H A1E14A	2-12
WDD-5 8777		RED	6A	TB1-3	Indicator A IP-1282/IP-1283	TB4-1	2-10
		BLK	6A	TB1-4		TB4-2	
		GRN	6B	TB1-1		TB4-5	
		WHT	6	S1-B 4H		TB4-3	
WDD-5 8777		BLK	6	S1-B 5H	Indicator A IP-1282/IP-1283	TB4-4	
WDD-6 8777		RED	7A	TB1-3	Indicator B IP-1282/IP-1283	TB4-1	
		BLK	7A	TB1-4		TB4-2	
		BLK	7B	S1-B 3H		TB4-2	
		GRN	7B	S1-B 1H		TB4-1	
		WHT	7	S1-B 6H		TB4-3	
WDD-6 8777		BLK	7	S1-B 7H	Indicator B IP-1282/IP-1283	TB4-4	2-10
WDD-19 8777		RED	8A	S1-B 1A	Switching Unit SA-2139 No. 2	S1-B 1B	2-12
		BLK	8A	S1-B 3A		S1-B 3B	
WDD-19 8777		BLK	8B	S1-B 3B	Switching Unit SA-2139 No. 2	S1-B 3A	
		GRN	8B	S1-B 1B		S1-B 1A	2-12

Table 2-9 AN/SPS-64(V)3 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDD-20 9253	WHT/RED	WHT/RED	1	S1-A 1H	Video Amplifier No. 2 AM-6932	TB1-1	2-15
		YEL	1	S1-A 3H		TB1-2	
		RED	1	S1-A 5H		TB1-3	
		BLK	1	S1-A 7F		TB1-4	
		GRN	1	S1-A 8H		TB1-5	
		BRN	1	S1-A 10H		TB1-6	
	WHT/RED	BLU	1	S1-A 12F		TB1-7	
	WHT/BLK	WHT/BLK	1A	S1-A 13H		TB1-8	
		YEL	1A	S1-A 15H		TB1-9	
		RED	1A	S1-A 17H		TB1-10	
		BLK	1A	S1-A 19H		TB1-11	
		GRN	1A	S1-A 21H		TB1-12	
		BRN	1A	S1-A 23H		TB1-13	
	WHT/BLK	BLU	1A	S1-A 25F		TB1-14	
	WHT	WHT	1B	S1-B 11H		TB3-1	
		YEL	1B	S1-B 13H		TB3-2	
		RED	1B	S1-B 15H		TB3-3	
		BLK	1B	S1-B 17F		TB3-4	
		GRN	1B	S1-B 18F	Video Amplifier No. 2 AM-6932	TB3-5	
WDD-20 9253		BRN	1B	S1-B 19F		TB3-6	
	WHT	BLU	1B	S1-B 20F		TB3-7	2-15

Table 2-9 AN/SPS-64(V)3 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDD-20 9253	4-WIRE (NO. 18)	GRN	1	TB2-3	Video Amplifier No. 2 AM-6932	TB4-3	2-15
	COAX	BLK	1	S1-B 24B		P5	
		SHIELD		A1E14A		P5 SHELL	
	COAX	BLK/WHT	1	S1-B 25F		P3	
		SHIELD		A1E5A	Video Amplifier	P3 SHELL	
WDD-20	COAX	BLK/YEL	1	S1-B 27F	No. 2	A2P3	
9253		SHIELD		A1E10A	AM-6932	A2P3 SHELL	2-15
WDD-25 9253	WHT/RED	WHT/RED	2	S1-A 1F	Indicator C IP-1282/IP-1283	TB2-1	2-10
		YEL	2	S1-A 3F		TB2-2	
		RED	2	S1-A 5F		TB2-3	
		BLK	2	S1-A 7H		TB2-4	
		GRN	2	S1-A 8F		TB2-5	
		BRN	2	S1-A 10F		TB2-6	
	WHT/RED	BLU	2	S1-A 12H		TB2-7	
	WHT/BLK	WHT/BLK	2A	S1-A 13F		TB2-8	
		YEL	2A	S1-A 15F		TB2-9	
		RED	2A	S1-A 17F		TB2-10	
		BLK	2A	S1-A 19F		TB2-11	
		GRN	2A	S1-A 21F		TB2-12	
		BRN	2A	S1-A 23F		TB3-1	
	WHT/BLK	BLU	2A	S1-A 25H		TB3-2	
	WHT	WHT	2B	S1-B 11F		TB3-5	
		YEL	2B	S1-B 13F		TB3-6	
		RED	2B	S1-B 15F		TB3-7	
		BLK	2B	S1-B 17H		TB3-8	
		GRN	2B	S1-B 18H		TB3-9	
		BRN	2B	S1-B 19H		TB3-10	
	WHT	BLU	2B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	2	TB2-2		E1	
	COAX	BLK	2	S1-B 22H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	2	A1E2		P3	
		SHIELD		A1E5B		P3 SHELL	
WDD-25	COAX	BLK/YEL	2	A1E7	Indicator C	P2	
9253		SHIELD		A1E10B	IP-1282/IP-1283	P2 SHELL	
WDD-28 9253	WHT/RED	WHT/RED	3	S1-A 2B	Indicator D IP-1282/IP-1283	TB2-1	
		YEL	3	S1-A 4B		TB2-2	
		RED	3	S1-A 6B		TB2-3	
		BLK	3	S1-A 7H		TB2-4	
		GRN	3	S1-A 9B		TB2-5	
WDD-28		BRN	3	S1-A 11B	Indicator D	TB2-6	
9253	WHT/RED	BLU	3	S1-A 12H	IP-1282/IP-1283	TB2-7	2-10

Table 2-9 AN/SPS-64(V)3 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDD-28 9253	WHT/BLK	WHT/BLK	3A	S1-A 14B	Indicator D IP-1282/IP-1283	TB2-8	2-10
		YEL	3A	S1-A 16B		TB2-9	
		RED	3A	S1-A 18B		TB2-10	
		BLK	3A	S1-A 20B		TB2-11	
		GRN	3A	S1-A 22B		TB2-12	
		BRN	3A	S1-A 24B		TB3-1	
	WHT/BLK	BLU	3A	S1-A 25H		TB3-2	
	WHT	WHT	3B	S1-B 12B		TB3-5	
		YEL	3B	S1-B 14B		TB3-6	
		RED	3B	S1-B 16B		TB3-7	
		BLK	3B	S1-B 17H		TB3-8	
		GRN	3B	S1-B 18H		TB3-9	
		BRN	3B	S1-B 19H		TB3-10	
	WHT	BLU	3B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	3	TB2-2		E1	
	COAX	BLK	3	S1-B 23H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	3	A1E1		P3	
		SHIELD		A1E5B		P3 SHELL	
WDD-28 9253	COAX	BLK/YEL	3	A1E6	Indicator D IP-1282/IP-1283	P2	
		SHIELD		A1E10B		P2 SHELL	2-10
WDD-17 9253	WHT/RED	WHT/RED	4	S1-A 1D	Switching Unit No. 1 SA-2139	S1-A 2H	2-12
		YEL	4	S1-A 3D		S1-A 4H	
		RED	4	S1-A 5D		S1-A 6H	
		BLK	4	S1-A 7C		S1-A 7D	
		GRN	4	S1-A 8D		S1-A 9H	
		BRN	4	S1-A 10D		S1-A 11H	
	WHT/RED	BLU	4	S1-A 12C		S1-A 12D	
	WHT/BLK	WHT/BLK	4A	S1-A 13D		S1-A 14H	
		YEL	4A	S1-A 15D		S1-A 16H	
		RED	4A	S1-A 17D		S1-A 18H	
		BLK	4A	S1-A 19D		S1-A 20H	
		GRN	4A	S1-A 21D		S1-A 22H	
		BRN	4A	S1-A 23D		S1-A 24H	
	WHT/BLK	BLU	4A	S1-A 25C		S1-A 25D	
	WHT	WHT	4B	S1-B 11D		S1-B 12H	
		YEL	4B	S1-B 13D		S1-B 14H	
		RED	4B	S1-B 15D		S1-B 16H	
		BLK	4B	S1-B 17C		S1-B 17D	
		GRN	4B	S1-B 18C		S1-B 18D	
		BRN	4B	S1-B 19C		S1-B 19D	
	WHT	BLU	4B	S1-B 20C		S1-B 20D	
WDD-17 9253	4-WIRE (NO. 18)	GRN	4	TB2-4	Switching Unit No. 1 SA-2139	TB2-4	2-12

Table 2-9 AN/SPS-64(V)3 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDD-17 9253	COAX	BLK SHIELD	4	S1-B 24H A1E14A	Switching Unit No. 1 SA-2139	S1-B 23B A1E14A	2-12
WDD-18 9253	WHT/RED	WHT/RED	5	S1-A 2H		S1-A 1D	
		YEL	5	S1-A 4H		S1-A 3D	
		RED	5	S1-A 6H		S1-A 5D	
		BLK	5	S1-A 7D		S1-A 7C	
		GRN	5	S1-A 9H		S1-A 8D	
		BRN	5	S1-A 11H		S1-A 10D	
	WHT/RED	BLU	5	S1-A 12D		S1-A 12C	
	WHT/BLK	WHT/BLK	5A	S1-A 14H		S1-A 13D	
		YEL	5A	S1-A 16H		S1-A 15D	
		RED	5A	S1-A 18H		S1-A 17D	
		BLK	5A	S1-A 20H		S1-A 19D	
		GRN	5A	S1-A 22H		S1-A 21D	
		BRN	5A	S1-A 24H		S1-A 23D	
	WHT/BLK	BLU	5A	S1-A 25D		S1-A 25C	
	WHT	WHT	5B	S1-B 12H		S1-B 11D	
		YEL	5B	S1-B 14H		S1-B 13D	
		RED	5B	S1-B 16H		S1-B 15D	
		BLK	5B	S1-B 17D		S1-B 17C	
		GRN	5B	S1-B 18D		S1-B 18C	
		BRN	5B	S1-B 19D		S1-B 19C	
	WHT	BLU	5B	S1-B 20D		S1-B 20C	
	4-WIRE (NO. 18)	GRN	5	TB2-4		TB2-4	
WDD-18 9253	COAX	BLK SHIELD	5	S1-B 23B A1E14A	Switching Unit No. 1 SA-2139	S1-B 24H A1E14A	2-12
WDD-24 8777		RED	6A	TB1-3	Indicator C IP-1282/IP-1283	TB4-1	2-10
		BLK	6A	TB1-4		TB4-2	
		BLK	6B	S1-B 3H		TB4-2	
		GRN	6B	S1-B 1H		TB4-1	
WDD-24 8777		WHT	6	S1-B 4H	Indicator C	TB4-3	
		BLK	6	S1-B 5H	IP-1282/IP-1283	TB4-4	
WDD-27 8777		RED	7A	TB1-3	Indicator D IP-1282/IP-1283	TB4-1	
		BLK	7A	TB1-4		TB4-2	
		GRN	7B	TB1-1		TB4-5	
WDD-27 8777		WHT	7	S1-B 6H	Indicator D	TB4-3	
		BLK	7	S1-B 7H	IP-1282/IP-1283	TB4-4	2-10
WDD-19 8777		RED	8A	S1-B 1B	Switching Unit No. 1 SA-2139	S1-B 1A	2-12
		BLK	8A	S1-B 3A		S1-B 3A	
WDD-19 8777		BLK	8B	S1-B 3B	Switching Unit No. 1 SA-2139	S1-B 3B	
		GRN	8B	S1-B 1A		S1-B 1B	2-12

Table 2-10 AN/SPS-64(V)4 Switching Unit SA-2139 No. 1 Cable Connections

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDS-15 9253	WHT/RED	WHT/RED	1	S1-A 1H	Video Amplifier AM-6932	TB1-1	2-15
		YEL	1	S1-A 3H		TB1-2	
		RED	1	S1-A 5H		TB1-3	
		BLK	1	S1-A 7F		TB1-4	
		GRN	1	S1-A 8H		TB1-5	
		BRN	1	S1-A 10H		TB1-6	
	WHT/RED	BLU	1	S1-A 12F		TB1-7	
	WHT/BLK	WHT/BLK	1A	S1-A 13H		TB1-8	
		YEL	1A	S1-A 15H		TB1-9	
		RED	1A	S1-A 17H		TB1-10	
		BLK	1A	S1-A 19H		TB1-11	
		GRN	1A	S1-A 21H		TB1-12	
		BRN	1A	S1-A 23H		TB1-13	
	WHT/BLK	BLU	1A	S1-A 25F		TB1-14	
	WHT	WHT	1B	S1-B 11H		TB3-1	
		YEL	1B	S1-B 13H		TB3-2	
		RED	1B	S1-B 15H		TB3-3	
		BLK	1B	S1-B 17F		TB3-4	
		GRN	1B	S1-B 18F		TB3-5	
		BRN	1B	S1-B 19F		TB3-6	
	WHT	BLU	1B	S1-B 20F		TB3-7	
	4-WIRE (NO. 18)	GRN	1	TB2-3		TB4-3	
	COAX	BLK	1	S1-B 24B		P5	
		SHIELD		A1E14A		P5 SHELL	
	COAX	BLK/WHT	1	S1-B 25F		P3	
		SHIELD		A1E5A		P3 SHELL	
WDS-15	COAX	BLK/YEL	1	S1-B 27F	Video Amplifier	A2P3	
9253		SHIELD		A1E10A	AM-6932	A2P3 SHELL	2-15
WDS-6 9253	WHT/RED	WHT/RED	2	S1-A 1F	Indicator A IP-1282/IP-1283	TB2-1	2-10
		YEL	2	S1-A 3F		TB2-2	
		RED	2	S1-A 5F		TB2-3	
		BLK	2	S1-A 7H		TB2-4	
		GRN	2	S1-A 8F		TB2-5	
		BRN	2	S1-A 10F		TB2-6	
	WHT/RED	BLU	2	S1-A 12H		TB2-7	
	WHT/BLK	WHT/BLK	2A	S1-A 13F		TB2-8	
		YEL	2A	S1-A 15F		TB2-9	
		RED	2A	S1-A 17F		TB2-10	
		BLK	2A	S1-A 19F		TB2-11	
		GRN	2A	S1-A 21F		TB2-12	
WDS-6		BRN	2A	S1-A 23F	Indicator A	TB3-1	
9253	WHT/BLK	BLU	2A	S1-A 25H	IP-1282/IP-1283	TB3-2	2-10

Table 2-10 AN/SPS-64(V)4 Switching Unit SA-2139 No. 1 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDS-6 9253	WHT	WHT	2B	S1-B 11F	Indicator A IP-1282/IP-1283	TB3-5	2-10
		YEL	2B	S1-B 13F		TB3-6	
		RED	2B	S1-B 15F		TB3-7	
		BLK	2B	S1-B 17H		TB3-8	
		GRN	2B	S1-B 18H		TB3-9	
		BRN	2B	S1-B 19H		TB3-10	
	WHT	BLU	2B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	2	TB2-2		E1	
	COAX	BLK	2	S1-B 22H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	2	A1E1		P3	
		SHIELD		A1E5B		P3 SHELL	
WDS-6 9253	COAX	BLK/YEL	2	A1E6	Indicator A IP-1282/IP-1283	P2	
		SHIELD		A1E10B		P2 SHELL	
WDS-8 9253	WHT/RED	WHT/RED	3	S1-A 2B	Indicator B IP-1282/IP-1283	TB2-1	
		YEL	3	S1-A 4B		TB2-2	
		RED	3	S1-A 6B		TB2-3	
		BLK	3	S1-A 7H		TB2-4	
		GRN	3	S1-A 9B		TB2-5	
		BRN	3	S1-A 11B		TB2-6	
	WHT/RED	BLU	3	S1-A 12H		TB2-7	
	WHT/BLK	WHT/BLK	3A	S1-A 14B		TB2-8	
		YEL	3A	S1-A 16B		TB2-9	
		RED	3A	S1-A 18B		TB2-10	
		BLK	3A	S1-B 20B		TB2-11	
		GRN	3A	S1-B 22B		TB2-12	
		BRN	3A	S1-B 24B		TB3-1	
	WHT/BLK	BLU	3A	S1-B 25H		TB3-2	
	WHT	WHT	3B	S1-B 12B		TB3-5	
		YEL	3B	S1-B 14B		TB3-6	
		RED	3B	S1-B 16B		TB3-7	
		BLK	3B	S1-B 17H		TB3-8	
		GRN	3B	S1-B 18H		TB3-9	
		BRN	3B	S1-B 19H		TB3-10	
	WHT	BLU	3B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	3	TB2-2		E1	
	COAX	BLK	3	S1-B 23H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	3	A1E2		P3	
		SHIELD		A1E5B		P3 SHELL	
WDS-8 9253	COAX	BLK/YEL	3	A1E7	Indicator B IP-1282/IP-1283	P2	
		SHIELD		A1E10B		P2 SHELL	2-10

Table 2-10 AN/SPS-64(V)4 Switching Unit SA-2139 No. 1 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	SOURCE Wire Color	SOURCE Wire No.	SOURCE Connection	DESTINATION Unit	DESTINATION Connection	DESTINATION Fig. No.
WDS-22 9253	WHT/RED	WHT/RED	4	S1-A 1D	Switching Unit No. 2 SA-2139	S1-A 2H	2-12
		YEL	4	S1-A 3D		S1-A 4H	
		RED	4	S1-A 5D		S1-A 6H	
		BLK	4	S1-A 7C		S1-A 7D	
		GRN	4	S1-A 8D		S1-A 9H	
		BRN	4	S1-A 10D		S1-A 11H	
	WHT/RED	BLU	4	S1-A 12C		S1-A 12D	
	WHT/BLK	WHT/BLK	4A	S1-A 13D		S1-A 14H	
		YEL	4A	S1-A 15D		S1-A 16H	
		RED	4A	S1-A 17D		S1-A 18H	
		BLK	4A	S1-A 19D		S1-A 20H	
		GRN	4A	S1-A 21D		S1-A 22H	
		BRN	4A	S1-A 23D		S1-A 24H	
	WHT/BLK	BLU	4A	S1-A 25C		S1-A 25D	
	WHT	WHT	4B	S1-B 11D		S1-B 12H	
		YEL	4B	S1-B 13D		S1-B 14H	
		RED	4B	S1-B 15D		S1-B 16H	
		BLK	4B	S1-B 17C		S1-B 17D	
		GRN	4B	S1-B 18C		S1-B 18D	
		BRN	4B	S1-B 19C		S1-B 19D	
	WHT	BLU	4B	S1-B 20C		S1-B 20D	
	4-WIRE (NO. 18)	GRN	4	TB2-4		TB2-4	
WDS-22 9253	COAX	BLK	4	S1-B 24H		S1-B 23B	
		SHIELD		A1E14A		A1E14A	
WDS-23 9253	WHT/RED	WHT/RED	5	S1-A 2H		S1-A 1D	
		YEL	5	S1-A 4H		S1-A 3D	
		RED	5	S1-A 6H		S1-A 5D	
		BLK	5	S1-A 7D		S1-A 7C	
		GRN	5	S1-A 9H		S1-A 8D	
		BRN	5	S1-A 11H		S1-A 10D	
	WHT/RED	BLU	5	S1-A 12D		S1-A 12C	
	WHT/BLK	WHT/BLK	5A	S1-A 14H		S1-A 13D	
		YEL	5A	S1-A 16H		S1-A 15D	
		RED	5A	S1-A 18H		S1-A 17D	
		BLK	5A	S1-A 20H		S1-A 19D	
		GRN	5A	S1-A 22H		S1-A 21D	
WDS-23		BRN	5A	S1-A 24H	Switching Unit	S1-A 23D	
9253	WHT/BLK	BLU	5A	S1-A 25D	No. 2 SA-2139	S1-A 25C	2-12

Table 2-10 AN/SPS-64(V)4 Switching Unit SA-2139 No. 1 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	SOURCE Wire Color	SOURCE Wire No.	SOURCE Connection	DESTINATION Unit	DESTINATION Connection	Fig. No.
WDS-23 9253	WHT	WHT	5B	S1-B 12H	Switching Unit No. 2 SA-2139	S1-B 11D	2-12
		YEL	5B	S1-B 14H		S1-B 13D	
		RED	5B	S1-B 16H		S1-B 15D	
		BLK	5B	S1-B 17D		S1-B 17C	
		GRN	5B	S1-B 18D		S1-B 18C	
		BRN	5B	S1-B 19D		S1-B 19C	
	WHT	BLU	5B	S1-B 20D		S1-B 20C	
	4-WIRE (NO. 18)	GRN	5	TB2-4		TB2-4	
WDS-23 9253	COAX	BLK	5	S1-B 23B	Switching Unit No. 2 SA-2139	S1-B 24H	
		SHIELD		A1E14		A1E14A	2-12
WDS-5 8777		RED	6A	TB1-3	Indicator A IP-1282/IP-1283	TB4-1	2-10
		BLK	6A	TB1-4		TB4-2	
		GRN	6B	TB1-1		TB4-5	
WDS-5		WHT	6	S1-B 4H	Indicator A	TB4-3	
8777		BLK	6	S1-B 5H	IP-1282/IP-1283	TB4-4	
WDS-7 8777		RED	7A	TB1-3	Indicator B IP-1282/IP-1283	TB4-1	
		BLK	7A	TB1-4		TB4-2	
		BLK	7B	S1-B 3H		TB4-2	
		GRN	7B	S1-B 1H		TB4-1	
WDS-7		WHT	7	S1-B 6H	Indicator B	TB4-3	
8777		BLK	7	S1-B 7H	IP-1282/IP-1283	TB4-4	2-10
WDS-21		RED	8A	S1-B 1A	Switching Unit	S1-B 1B	2-12
8777		BLK	8A	S1-B 3A	No. 2 SA-2139	S1-B 3B	
WDS-21		BLK	8B	S1-B 3B	Switching Unit	S1-B 3A	
8777		GRN	8B	S1-B 1B	No. 2 SA-2139	S1-B 1A	2-12

Table 2-11 AN/SPS-64[(V)4 Switching Unit SA-2139 No. 2 Cable Connections

Cable No.	SOURCE Bundle Identifier	SOURCE Wire Color	SOURCE Wire No.	SOURCE Connection	DESTINATION Unit	DESTINATION Connection	Fig. No.
WDS-32 9253	WHT/RED	WHT/RED	1	S1-A 1H	Receiver Transmitter RT-1241	TB1-1	2-17
		YEL	1	S1-A 3H		TB1-2	
		RED	1	S1-A 5H		TB1-3	
		BLK	1	S1-A 7F		TB1-4	
		GRN	1	S1-A 8H		TB1-5	
		BRN	1	S1-A 10H		TB1-6	
	WHT/RED	BLU	1	S1-A 12F		TB1-7	
	WHT/BLK	WHT/BLK	1A	S1-A 13H		TB1-8	
		YEL	1A	S1-A 15H		TB1-9	
		RED	1A	S1-A 17H		TB1-10	
		BLK	1A	S1-A 19H		TB1-11	
		GRN	1A	S1-A 21H	Receiver	TB1-12	
WDS-32		BRN	1A	S1-A 23H	Transmitter	TB2-9	
9253	WHT/BLK	BLU	1A	S1-A 25F	RT-1241	TB2-11	2-17

Table 2-11 AN/SPS-64(V)4 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDS-32 9253	WHT	WHT	1B	S1-B 11H	Receiver Transmitter RT-1241	TB2-1	2-17
		YEL	1B	S1-B 13H		TB2-2	
		RED	1B	S1-B 15H		TB2-3	
		BLK	1B	S1-B 17F		TB2-5	
		GRN	1	S1-B 18F		TB2-6	
		BRN	1	S1-B 19F		TB2-7	
	WHT	BLU	1	S1-B 20F		TB2-8	
	4-WIRE (NO. 18)	GRN	1	TB2-3		TB2-10	
		BLU	1	NC		TB2-13	
	COAX	BLK	1	S1-B 24B		P1	
		SHIELD		A1E14A		P1 SHELL	
	COAX	BLK/WHT	1	A1E16		P2	
		SHIELD		A1E18	Receiver	P2 SHELL	
WDS-32	COAX	BLK/YEL	1	S1-B 27F	Transmitter	P3	
9253		SHIELD	1	A2E10A	RT-1241	P3 SHELL	2-17
WDS-31 9253	WHT/RED	WHT/RED	2	S1-A 1F	Indicator C IP-1282/IP-1283	TB2-1	2-10
		YEL	2	S1-A 3F		TB2-2	
		RED	2	S1-A 5F		TB2-3	
		BLK	2	S1-A 7H		TB2-4	
		GRN	2	S1-A 8F		TB2-5	
		BRN	2	S1-A 10F		TB2-6	
	WHT/RED	BLU	2	S1-A 12H		TB2-7	
	WHT/BLK	WHT/BLK	2A	S1-A 13F		TB2-8	
		YEL	2A	S1-A 15F		TB2-9	
		RED	2A	S1-A 17F		TB2-10	
		BLK	2A	S1-A 19F		TB2-11	
		GRN	2A	S1-A 21F		TB2-12	
		BRN	2A	S1-A 23F		TB3-1	
	WHT/BLK	BLU	2A	S1-A 25H		TB3-2	
	WHT	WHT	2B	S1-B 11F		TB3-5	
		YEL	2B	S1-B 13F		TB3-6	
		RED	2B	S1-B 15F		TB3-7	
		BLK	2B	S1-B 17H		TB3-8	
		GRN	2B	S1-B 18H		TB3-9	
		BRN	2B	S1-B 19H		TB3-10	
	WHT	BLU	2B	S1-B 20H		TB3-11	
	4-WIRE (NO. 18)	GRN	2	TB2-2		E1	
	COAX	BLK	2	S1-B 22H		P1	
		SHIELD		A1E14B		P1 SHELL	
	COAX	BLK/WHT	2	A1E1		P3	
		SHIELD		A1E5B		P3 SHELL	
WDS-31	COAX	BLK/YEL	2	A1E6	Indicator C	P2	
9253		SHIELD		A1E10B	IP-1282/IP-1283	P2 SHELL	2-10

Table 2-11 AN/SPS-64(V)4 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE				DESTINATION		
	Bundle Identifier	Wire Color	Wire No.	Connection	Unit	Connection	Fig. No.
WDS-39	WHT/BLK	BLK	3A	NC	Signal Data	A1TB3-2	2-18
9253	WHT/BLK	BLU	3A	S1-A 25H	Converter	A2TB3-1	
					CV-3442		
	WHT	WHT	3B	S1-A 28H		A3TB1-4	
		YEL	3B	S1-A 29H		A3TB1-5	
	WHT	RED	3B	S1-A 30H		A3TB1-6	
	4-WIRE	BRN	3	TB3-2		A3TB1-1	
	(NO. 18)	ORN	3	TB3-1		A3TB1-3	
	4-WIRE	BRN	3	TB2-2		A3TB1-3	
	(NO. 18)	BLU	3	TB3-4		A3TB1-2	
	COAX	BLK/WHT	3	A1E2		A2P1	
		SHIELD		A1E5B	Signal Data	A2P1 SHELL	
WDS-39	COAX	BLK/YEL	3	A1E7	Converter	A2P3	
9253		SHIELD		A1E10B	CV-3442	A2P3 SHELL	2-18
WDS-23	WHT/RED	WHT/RED	4	S1-A 1D	Switching Unit	S1-A 2H	2-12
9253		YEL	4	S1-A 3D	No. 1 SA-2139	S1-A 4H	
		RED	4	S1-A 5D		S1-A 6H	
		BLK	4	S1-A 7C		S1-A 7D	
		GRN	4	S1-A 8D		S1-A 9H	
		BRN	4	S1-A 10D		S1-A 11H	
	WHT/RED	BLU	4	S1-A 12C		S1-A 12D	
	WHT/BLK	WHT/BLK	4A	S1-A 13D		S1-A 14H	
		YEL	4A	S1-A 15D		S1-A 16H	
		RED	4A	S1-A 17D		S1-A 18H	
		BLK	4A	S1-A 19D		S1-A 20H	
		GRN	4A	S1-A 21D		S1-A 22H	
		BRN	4A	S1-A 23D		S1-A 24H	
	WHT/BLK	BLU	4A	S1-A 25C		S1-A 25D	
	WHT	WHT	4B	S1-B 11D		S1-B 12H	
		YEL	4B	S1-B 13D		S1-B 14H	
		RED	4B	S1-B 15D		S1-B 16H	
		BLK	4B	S1-B 17C		S1-B 17D	
		GRN	4B	S1-B 18C		S1-B 18D	
		BRN	4B	S1-B 19C		S1-B 19D	
	WHT	BLU	4B	S1-B 20C		S1-B 20D	
	4-WIRE (NO. 18)	GRN	4	TB2-4		TB2-4	
WDS-23	COAX	BLK	4	S1-B 24H	Switching Unit	S1-B 23B	
9253		SHIELD		A1E14A	No. 1 SA-2139	A1E14A	2-12

Table 2-11 AN/SPS-64(V)4 Switching Unit SA-2139 No. 2 Cable Connections (Cont'd)

Cable No.	SOURCE Bundle Identifier	Wire Color	Wire No.	Connection	DESTINATION Unit	Connection	Fig. No.
WDS-22 9253	WHT/RED	WHT/RED	5	S1-A 2H	Switching Unit No. 1 SA-2139	S1-A 1D	2-12
|	|	YEL	5	S1-A 4H	|	S1-A 3D	|
		RED	5	S1-A 6H		S1-A 5D	
		BLK	5	S1-A 7D		S1-A 7C	
		GRN	5	S1-A 9H		S1-A 8D	
		BRN	5	S1-A 11H		S1-A 10D	
	WHT/RED	BLU	5	S1-A 12D		S1-A 12C	
	WHT/BLK	WHT/BLK	5A	S1-A 14H		S1-A 13D	
	|	YEL	5A	S1-A 16H		S1-A 15D	
		RED	5A	S1-A 18H		S1-A 17D	
		BLK	5A	S1-A 20H		S1-A 19D	
		GRN	5A	S1-A 22H		S1-A 21D	
		BRN	5A	S1-A 24H		S1-A 23D	
	WHT/BLK	BLU	5A	S1-A 25D		S1-A 25C	
	WHT	WHT	5B	S1-B 12H		S1-B 11D	
	|	YEL	5B	S1-B 14H		S1-B 13D	
		RED	5B	S1-B 16H		S1-B 15D	
		BLK	5B	S1-B 17D		S1-B 17C	
		GRN	5B	S1-B 18D		S1-B 18C	
		BRN	5B	S1-B 19D		S1-B 19C	
	WHT	BLU	5B	S1-B 20D		S1-B 20C	
|	4-WIRE (NO. 18)	GRN	5	TB2-4	|	TB2-4	|
WDS-22 9253	COAX	BLK	5	S1-B 23B	Switching Unit	S1-B 24H	
		SHIELD		A1E14A	No. 1 SA-2139	A1E14A	2-12
WDS-30 8777		RED	6A	S1-B 1H	Indicator C IP-1282/IP-1283	TB4-1	2-10
|		BLK	6A	S1-B 3H	|	TB4-2	|
		GRN	6B	TB1-1		TB4-5	
WDS-30 8777		WHT	6	S1-B 4H	Indicator C	TB4-3	
		BLK	6	S1-B 5H	IP-1282/IP-1283	TB4-4	2-10
WDS-21 8777		RED	7A	S1-B 1B	Switching Unit	S1-B 1A	2-12
		BLK	7A	S1-B 3B	No. 1 SA-2139	S1-B 3A	|
WDS-21 8777		BLK	7B	S1-B 3A	Switching Unit	S1-B 3B	
		GRN	7B	S1-B 1A	No. 1 SA-2139	S1-B 1B	2-12
WDS-19 TTRSA-4		WHT	9	TB3-2	Antenna Pedestal AB-1247A	TB3-1	2-7
|		BLK	9	TB3-4	|	TB3-2	|
		WHT	9A	S1-A 28C		TB3-3	
		BLK	9A	S1-A 29C		TB3-4	
WDS-19		WHT	9B	S1-A 30C	Antenna Pedestal	TB3-5	
TTRSA-4		BLK	9B	TB3-1	AB-1247A	TB3-6	2-7
WDS-33 TTRSA-4		WHT	10	TB3-2	Antenna Pedestal AB-1248	TB3-1	2-16
|		BLK	10	TB3-4	|	TB3-2	|
		WHT	10A	S1-A 28D		TB3-3	
		BLK	10A	S1-A 29D		TB3-4	
WDS-33		WHT	10B	S1-A 30D	Antenna Pedestal	TB3-5	
TTRSA-4		BLK	10B	TB3-1	AB-1248	TB3-6	2-16

Table 2-12 Switching Units Internal Jumpers

Single Radar (V1) Jumper List for One Indicator

I Indicator A (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E34 to a position E17 through E26 (will be changed during alignment)
2. Link E40 to E38
3. Link E54 to E17 (may change during alignment)
4. Link E44 to E46
5. Link E48 to E49

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

II. Receiver Transmitter I (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1100

1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

Dual Partial (V2) Jumper List for Two Indicators

I. Indicator A (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link El to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E44 to E46
6. Link E48 to E49

D. VRM A2A7

1. Link E1 to E3
2. Install U7

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBLA2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

II. Indicator B (4/5)

A. Video Amplifier A2A1

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Partial (V2) Jumper List for Two Indicators (Cont'd)

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. a. Bend pin 4 on U13 (IC socket) (pin 4 disconnected)
   b. Without IC socket, remove link between E50 and E51
5. Link E54 to E17 (may change during alignment)
6. Link E44 to E46
7. Link E48 to E49

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

III. Switching Unit (9)

A. Link TB2-1 to 2 to 3

Dual Partial (V2) Jumper List for Two Indicators (Cont'd)

IV. <u>Video Amplifier No. 1</u> (6)

A. 75 Ω dummy load in J2

V. <u>Video Amplifier No. 2</u> (6)

A. 7592 dummy load in J2

VI. <u>Receiver Transmitter I (20 KW Receiver Transmitter</u>) (3)

A. Pulse and Driver PCBA1

1. Link Al to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link El to F1

VII <u>Receiver Transmitter II (20 KW Receiver Transmitter</u>

A. Pulse and Driver PCB A1

1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

Dual Radar (V3) Jumper List for Two Indicators

I. <u>Indicator B</u> (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will change during alignment)
2. Link E32 to E34 to a position E17 through E26 (will change during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E44 to E46
6. Link E48 to E49

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V3) Jumper List for Two Indicators (Cont'd)

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

II. Indicator C (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. a. Bend pin 4 on U13 (IC socket) (pin 4 disconnected)
   b. Without IC socket remove link E50 to E51
5. Link E54 to E17 (may change during alignment)
6. Link E44 to E46
7. Link E48 to E49

Dual Radar (V3) Jumper List for Two Indicators (Cont'd)

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E29 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

III. Switching Unit No. 1 (9)

A. Link TB1-1 to TB1-2 to El (ground)

B. Link TB2-2 to TB2-3 to TB2-4

C. Connect 75-ohm coax between J1 (center conductor) and S1B-27A; connect shield to A1E10A

D. Connect 75-ohm coax between J2 (center conductor) and 51B-25A; connect shield to A1E5A

E. Connect 75-ohm, 1-watt resistor between A1E1 and A1E5B

F. Connect 75-ohm, 1-watt resistor between A1E6 and A1E10B

IV. Switching Unit No. 2 (10)

A. Link TB1-1 to TB1-2 to E1 (ground)

B. Connect 75-ohm, watt resistor between A1E1 and A3E5B

C. Connect 75-ohm, 1-watt resistor between A1E6 and A1E10B

D. Link TB2-2 to TB2-3 to TB2-4

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V3) Jumper List for Two Indicators (Cont'd)

E. Connect 75-ohm coax between J1 (center conductor) and S1B-27A; connect shield to A1E10A.
F. Connect 75-ohm coax between J2 (center conductor) and S1B-25A; connect shield to A1E5A.

V. Receiver Transmitter I (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1

1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

VI. Receiver Transmitter II (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1
1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

Dual Radar (V3) Jumper List for Three Indicators

I. Indicator A (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E48 to E49
6. Link E44 to E46

Dual Radar (V3) Jumper List for Three Indicators (Cont'd)

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2 Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev. C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

II. Indicator B (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will change during alignment)
2. Link E32 to E34 to a position E17 through E26 (will change during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E48 to E49
6. Link E44 to E46

D. VRM A2A7

1. Link E1 to E3

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V3) Jumper List for Three Indicators (Cont'd)

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7
3. Remove R62 and R63

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

III Indicator C (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. a. Bend pin 4 on U13 (IC socket) (pin 4 disconnected)
   b. Without IC socket, remove link between E50 and E51
5. Link E54 to E17 (may change during alignment)
6. Link E44 to E46
7. Link E48 to E49

D. VRM A2A7

1. Link E1 to E3

Dual Radar (V3) Jumper List for Three Indicators (Cont'd)

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev. C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

IV. Switching Unit No. 1 (9)

A. Link TB1-2 to E1

B. Link TB2-2 to TB2-3 to TB2-4

C. Connect 75-ohm coax between J1 (center conductor) and S1B-27A; connect shield to A1E10A

D. Connect 75-ohm coax between J2 (center conductor) and S1B-25A; connect shield to A1E10A.

V. Switching Unit No. 2 (10)

A. Link TB1-1 to TB1-2 to E1 (ground)

B. Connect 75-ohm, 1-watt resistor between A1E1 and A3E5B

C. Connect 75-ohm, 1-watt resistor between A1E6 and A1E10B

D. Link TB2-2 to TB2-3 to TB2-4

E. Connect 75-ohm coax between J1 (center conductor) and S1B-27A; connect shield to A1E10A.

F. Connect 75-ohm coax between J2 (center conductor) and S1B-25A; connect shield to A1E5A.

VI. Receiver Transmitter I (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V3) Jumper List for Three Indicators (Cont'd)

1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to Fl

VII. Receiver Transmitter II (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1
1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

Dual Radar (V3) Jumper List for Four Indicators

I. Indicator A (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6
1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E48 to E49
6. Link E44 to E46

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

Dual Radar (V3) Jumper List for Four Indicators (Cont'd)

F. EBLA2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev. C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

II. Indicator B (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6
1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E48 to E49
6. Link E44 to E46

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7
3. Remove R62 and R63

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V3) Jumper List for Four Indicators (Cont'd)

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

III. Indicator C (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link El to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. a. Bend pin 4 on U13 (IC socket) (pin 4 disconnected)
   b. Without IC socket remove link E50 E51
5. Link E54 to E17 (may change during alignment)
6. Link E44 to E46
7. Link E48 to E49

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7
3. Remove R62 and R63 only if four indicators are used

Dual Radar (V3) Jumper List for Four Indicators (Cont'd)

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev. C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

IV. Indicator D (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. a. Bend pin 4 on U13 (IC socket) (pin 4 disconnected)
   b. Without IC socket remove link E50 to E51
5. Link E54 to E17 (may change during alignment)
6. Link E44 to E46
7. Link E48 to E49

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V3) Jumper List for Four Indicators (Cont'd)

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

V. Switching Unit No. 1 (9)

A. Link TB2-2 to TB2-3 to TB2-4

B. Connect 75-ohm coax between J1 (center conductor) and S1B-27A; connect shield to A1E10A

C. Connect 75-ohm coax between J2 (center conductor) and S1B-25A; connect shield to A1E5A.

VI. Switching Unit No. 2 (10)

A. Link TB2-2 to TB2-3 to TB2-4

B. Connect 75-ohm coax between J1 (center conductor) and S1B-27A; connect shield to A1E1A.

C. Connect 75-ohm coax between J2 (center conductor) and S1B-25A; connect shield to A1E5A.

VII. Receiver Transmitter I (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB Al

1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

VIII. Receiver Transmitter II (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1

1. Link A1 to D1
2. Link A2 to D2
3. Link A3 to D3
4. Link E1 to F1

Dual Radar (V4) Jumper List for Three Indicators

I. Indicator A (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
1. b. Without EBL Link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E48 to E49
6. Link E44 to E46

D. VRM A2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev. C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V4) Jumper List for Three Indicators (Cont'd)

II. Indicator B (4/5)

A. Video Amplifier A2A1

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
   2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will change during alignment)
2. Link E32 to E34 to a position E17 through E26 (will change during alignment)
3. Link E40 to E36
4. Link E54 to E17 (may change during alignment)
5. Link E48 to E49
6. Link E44 to E46

D. VRMA2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7
3. Remove R62 and R63

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E16
4. Link E16 to E17 (Rev C and up only)
5. Link E19 to E20

G. NSK Exciter A9A2

1. Link E1 to E2

III. Indicator C (4/5)

A. Video Amplifier A2A1

Dual Radar (V4) Jumper List for Three Indicators (Cont'd)

1. a. With EBL remove link E1 to E2
   b. Without EBL link E1 to E2
2. Remove link E3 to E4

B. Data Storage A2A3

1. Remove link E1 to E2
2. Remove link E3 to E4
3. With IR remove link E6 to E7
   Without IR link E6 to E7

C. PRF Generator A2A6

1. Link E33 to E35 to a position E17 through E26 (will be changed during alignment)
2. Link E32 to E34 to a position E17 through E26 (will be changed during alignment)
3. Link E40 to E36
4. a. With IC socket bend pin 4 on U13 (IC socket) (pin 4 disconnected)
   b. Without IC socket remove link E50 to E51
5. Link E54 to E17 (may change during alignment)
6. Link E48 to E49
7. Link E44 to E46

D. VRMA2A7

1. Link E1 to E3

E. Position Transmission A2A8

1. Remove link E1 to E2
2. Install U7

F. EBL A2A9

1. Link E2 to E4
2. Link E8 to E10
3. Link E13 to E15
4. Link E16 to E17 (Rev. C and up only)
5. Link E19 to E20

G. NSK Exciter A2A9

1. Link E1 to E2

Table 2-12 Switching Units Internal Jumpers (Cont'd)

Dual Radar (V4) Jumper List for Three Indicators (Cont'd)

IV. Switching Unit No. 2 (10)

A. Connect 75-ohm coax between J1 (center conductor) and S1B27-A; connect shield to A1E10A.
B. Connect 75-ohm coax between J2 (center conductor) and S1B25-A; connect shield to A1E5A.
C. Link A1E18 to A1E5A

D. Link TB2-2 to TB2-3 to TB2-4

E. Link S1B25-F to A1E17

F. Link S1B22-F to A1E19

V. Switching Unit No. 1 (9)

Dual Radar (V4) Jumper List for Three Indicators (Cont'd)

A. Connect 75-ohm coax between J1 (center conductor) and S1B27-A; connect shield to A1E10A.
B. Connect 75-ohm coax between J2 (center conductor) and S1B25-A; connect shield to A1E5A.
C. Link TB2-2 to TB2-3 to TB2-4

D. Link TB1-2 to El

VI. Receiver Transmitter I (20 KW Receiver Transmitter) (3)

A. Pulse and Driver PCB A1100
   1. Link A1 to D1
   2. Link A2 to D2
   3. Link A3 to D3
   4. Link E1 to F1

2.9 WAVE GUIDE SWITCH SA-2140 (V2)

2.9.1 Waveguide Terminations, Locations and Support (V2)

The waveguide switch has three choke type waveguide flanges (see Figure 2-14) to mate with X-band waveguide type UG-39/U or UG-135/U. The waveguide switch is installed in and supported by the waveguide between the receiver transmitters and the antenna.

2.9.2 Mounting Instructions (V2)

The waveguide switch is installed in the waveguide between the receiver transmitters and the antenna. The switch should not be more than 15 feet from either receiver transmitter. Installation data is provided in Figure 2-14.

2.9.3 Cable Connection (V2)

The only cable connection required for the waveguide switch is the power cable from the interface unit (see Figures 2-2 and 2-14).

2.10 VIDEO AMPLIFIER AM-6932 (V2, V3, V4)

2.10.1 Mounting Hardware (V2, V3, V4)

When installing the video amplifier, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.

2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4, (Part Number 230-1014P3) to prevent corrosive action.

2.10.2 Mounting Instructions (V2, V3, V4)

The video amplifier units should be bulkhead mounted near the receiver transmitter units to provide convenient access. Sufficient clearance must be provided for ventilation and maintenance (see Figure 2-15).

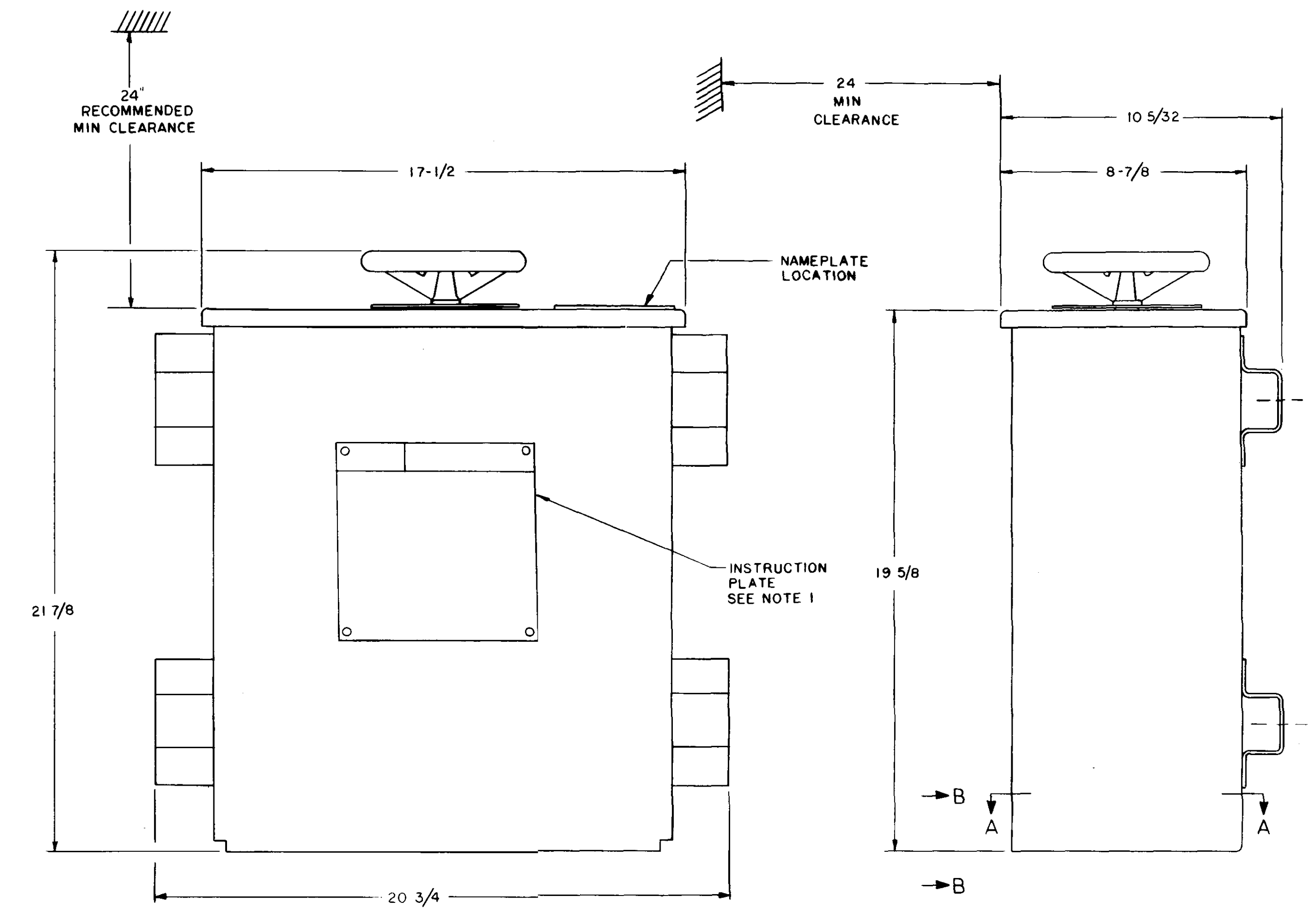
2.10.3 Cable Connections (V2, V3, V4)

Cable connection data required for the video amplifiers is provided in Figures 2-2 (V2), 2-3 (V3), 2-4 (V4) and 2-15.

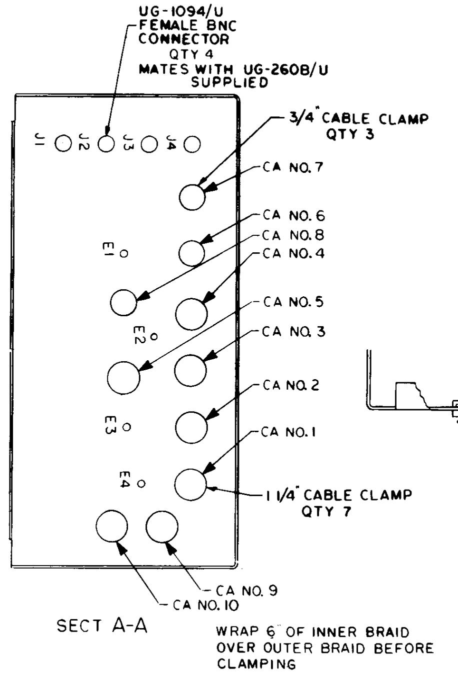
2.11 ANTENNA PEDESTAL AB-1248 AND ANTENNA AS-3195 (V4)

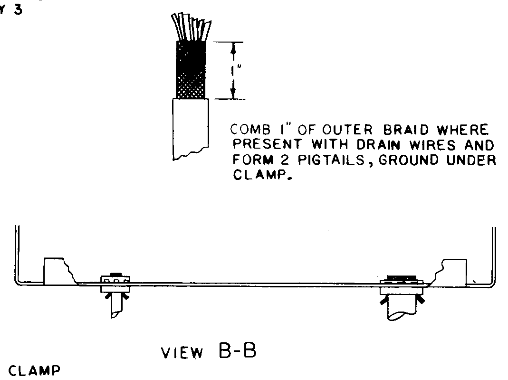
The antenna pedestal shall be bolted to a flat horizontal mounting plate which is welded to a 6-inch diameter mast or bracket assembly (see Figures 2-5 and 2-6) of sufficient strength to support 350 pounds. The location and size of the pedestal mounting holes are shown in Figure 2-16.

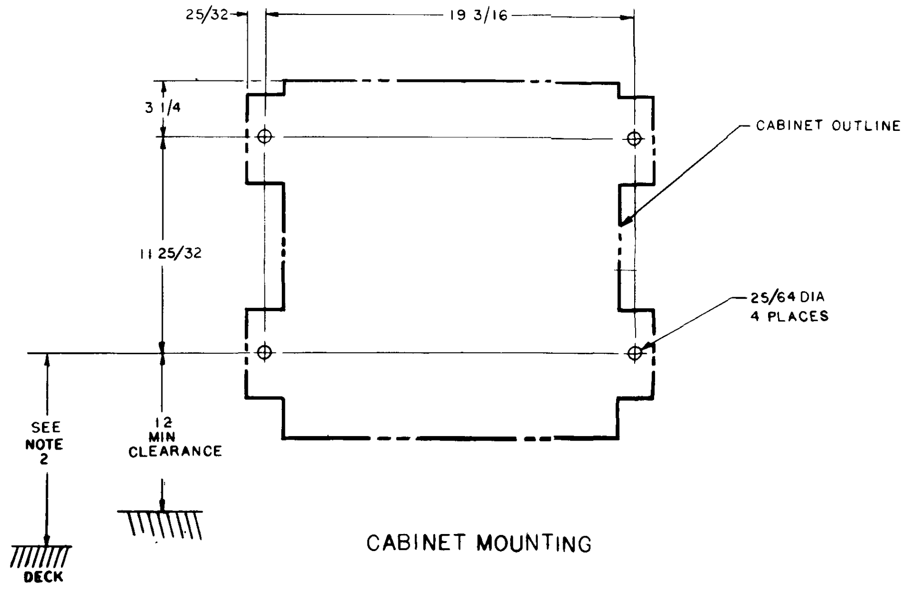
The preferred method of antenna installation is to mount the antenna pedestal on an existing masthead (see Figure 2-5). This type of installation generally provides an unrestricted antenna radiation pattern.



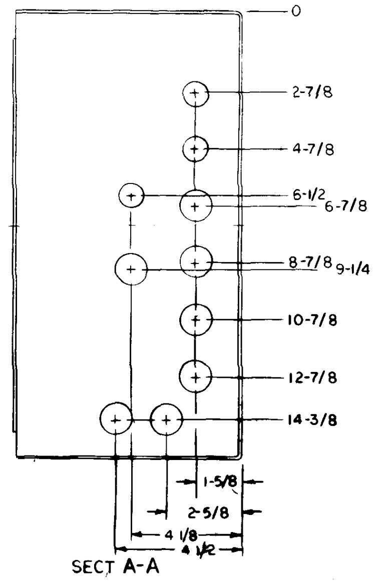
SYSTEM	COAX CA RG59/U AND DESTINATION				INTERSW NO.
	J1	J2	J3	J4	
DUAL PARTIAL	—	—	—	—	
DUAL DUAL	VIDAMP AND RESOLVER DRIVE NO 2 WDD-21	VIDAMP AND RESOLVER DRIVE NO 2 WDD-22	—	—	1
	VIDAMP AND RESOLVER DRIVE NO 1 WDD-15	VIDAMP AND RESOLVER DRIVE NO 1 WDD-16	—	—	2
DUAL SPECIAL	S BAND MTR WDS-24	J3 INTERSW NO 2 WDS-20	—	ESM INTFC J2 WDS-25	1
	VIDAMP AND RES DRIVE WDS-16	VIDAMP AND RES DRIVE WDS-17	J2 INTERSW NO 1 WDS-25	ESM INTFC J1 WDS-29	2







CABINET MOUNTING



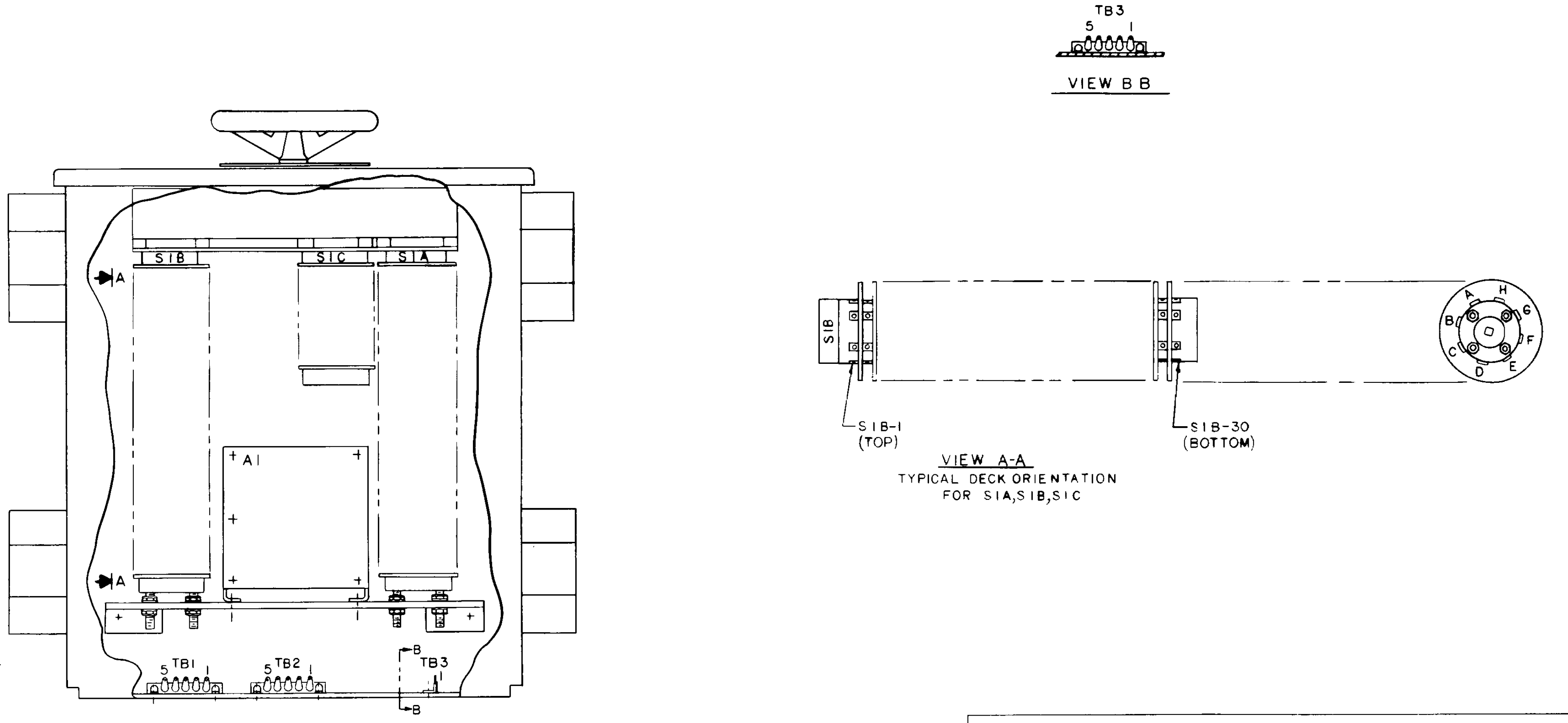
SECT A-A

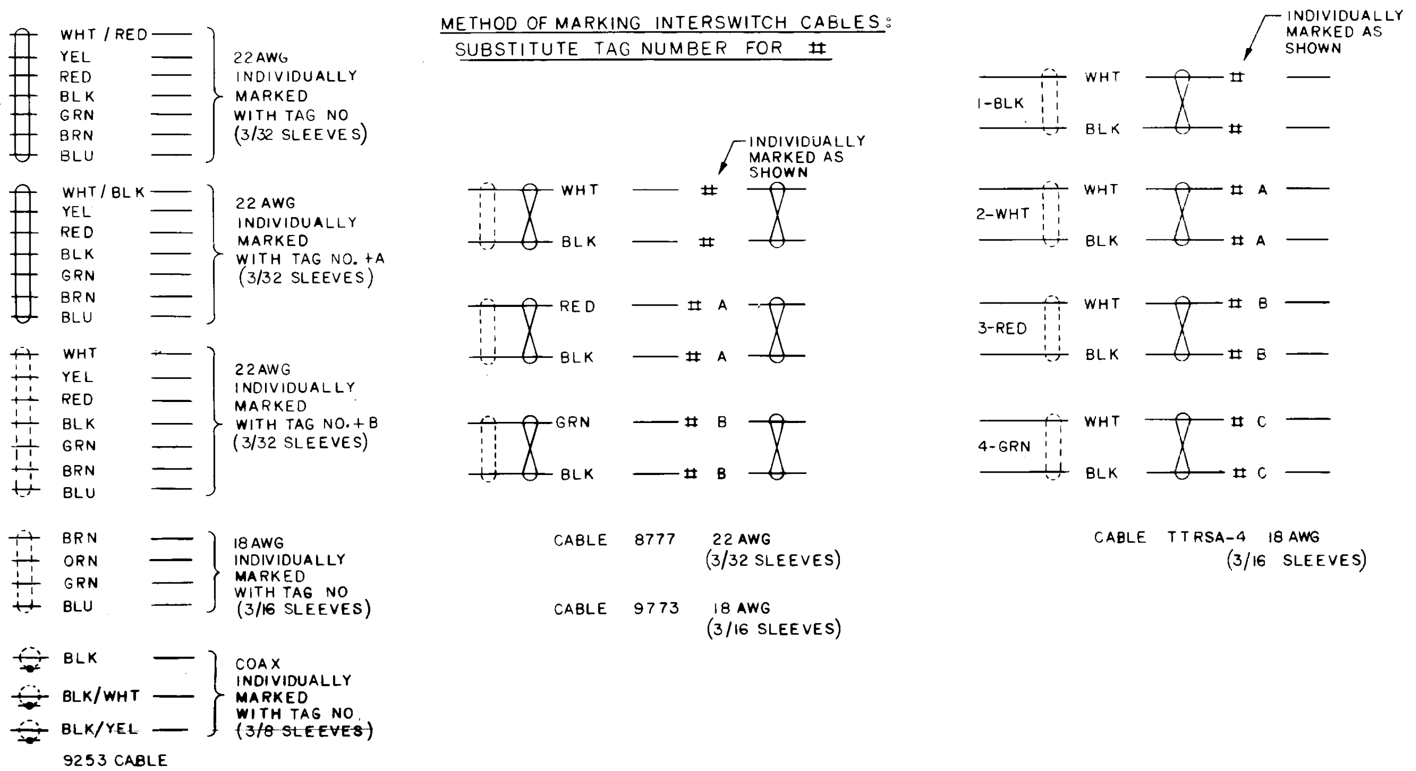
NOTES
1. ADD PROPER INSTRUCTION PLATE AT INSTALLATION.
2. RECOMMENDED DIMENSION IS 24" FOR EASE OF OPERATION.

UNIT WEIGHT—50 LBS

EI67702

Figure 2-12 (1) Switching Units SA-2139 (V3, V4) and SA-2156 (V2) Installation Diagram (Part 1 of 2)





INTERSWITCH CABLE MARKING / WIRE NUMBER CONVERSION

NOTE: CABLE ENTRY NUMBER IS SAME AS TAG NO.

DUAL PARTIAL

TAG NO	WIRE NO	DEST	CABLE TYPE
1	(WDP-5)	VARD 1	(9253)
2	(WDP-20)	VARD 2	(9253)
3	(WDP-4)	IND A	(9253)
4	(WDP-22)	IND B	(9253)
5	—	—	—
6	(WDP-3)	IND A	(8777)
7	(WDP-21)	IND B	(8777)
8	(WDP-6)	ANT JUNCT BOX	(9773)

DUAL INTERSWITCH I

TAG NO	WIRE NO	DEST	CABLE TYPE
1	(WDD-14)	VARD 1	(9253)
2	(WDD-4)	IND A	(9253)
3	(WDD-7)	IND B	(9253)
4	(WDD-18)	II	(9253)
5	(WDD-17)	II	(9253)
6	(WDD-5)	IND A	(8777)
7	(WDD-6)	IND B	(8777)
8	(WDD-19)	II	(8777)

DUAL SPECIAL INTERSWITCH I

TAG NO	WIRE NO	DEST	CABLE TYPE
1	(WDS-15)	VARD	(9253)
2	(WDS-6)	IND A	(9253)
3	(WDS-8)	IND B	(9253)
4	(WDS-22)	II	(9253)
5	(WDS-23)	II	(9253)
6	(WDS-5)	IND A	(8777)
7	(WDS-7)	IND B	(8777)
8	(WDS-21)	II	(8777)

DUAL INTERSWITCH II

TAG NO	WIRE NO	DEST	CABLE TYPE
1	(WDD-20)	VARD 2	(9253)
2	(WDD-25)	IND C	(9253)
3	(WDD-28)	IND D	(9253)
4	(WDD-17)	I	(9253)
5	(WDD-18)	I	(9253)
6	(WDD-24)	INC C	(8777)
7	(WDD-27)	INC D	(8777)
8	(WDD-19)	I	(8777)

DUAL SPECIAL INTERSWITCH II

TAG NO	WIRE NO	DEST	CABLE TYPE
1	(WDS-32)	S MTR	(9253)
2	(WDS-31)	IND C	(9253)
3	(WDS-39)	SPA INT	(9253)
4	(WDS-23)	I	(9253)
5	(WDS-22)	I	(9253)
6	(WDS-30)	IND C	(8777)
7	(WDS-21)	I	(8777)
9	(WDS-19)	X PED	(TTRSA-4)
10	(WDS-23)	S PED	(TTRSA-4)

EI67702A

Figure 2-12 (2) Switching Units SA-2139 (V3, V4) and SA-2156 (V2) Installation Diagram (Part 2 of 2)

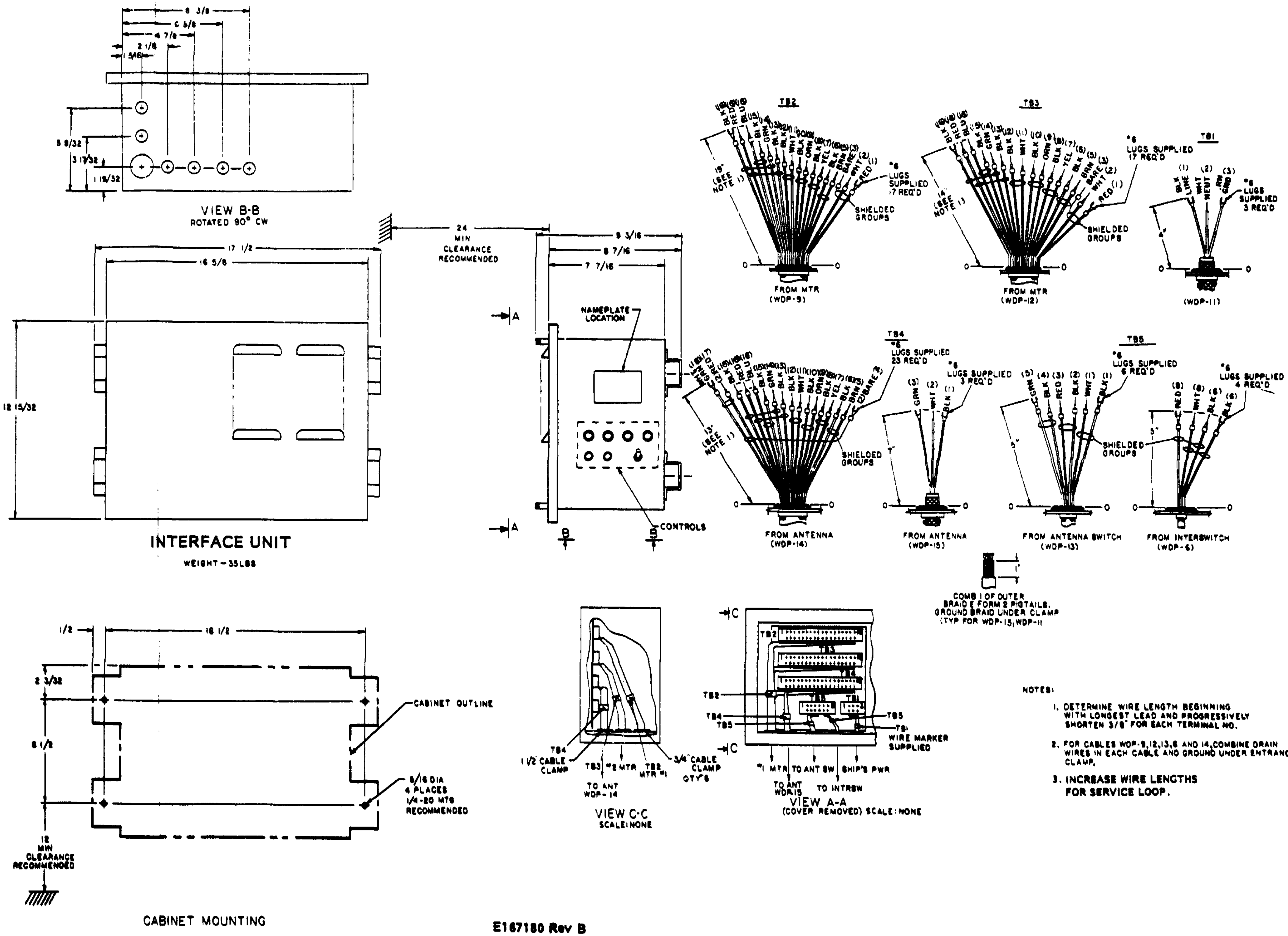


Figure 2-13. Interface Unit J-3463 Installation Diagram (V2).

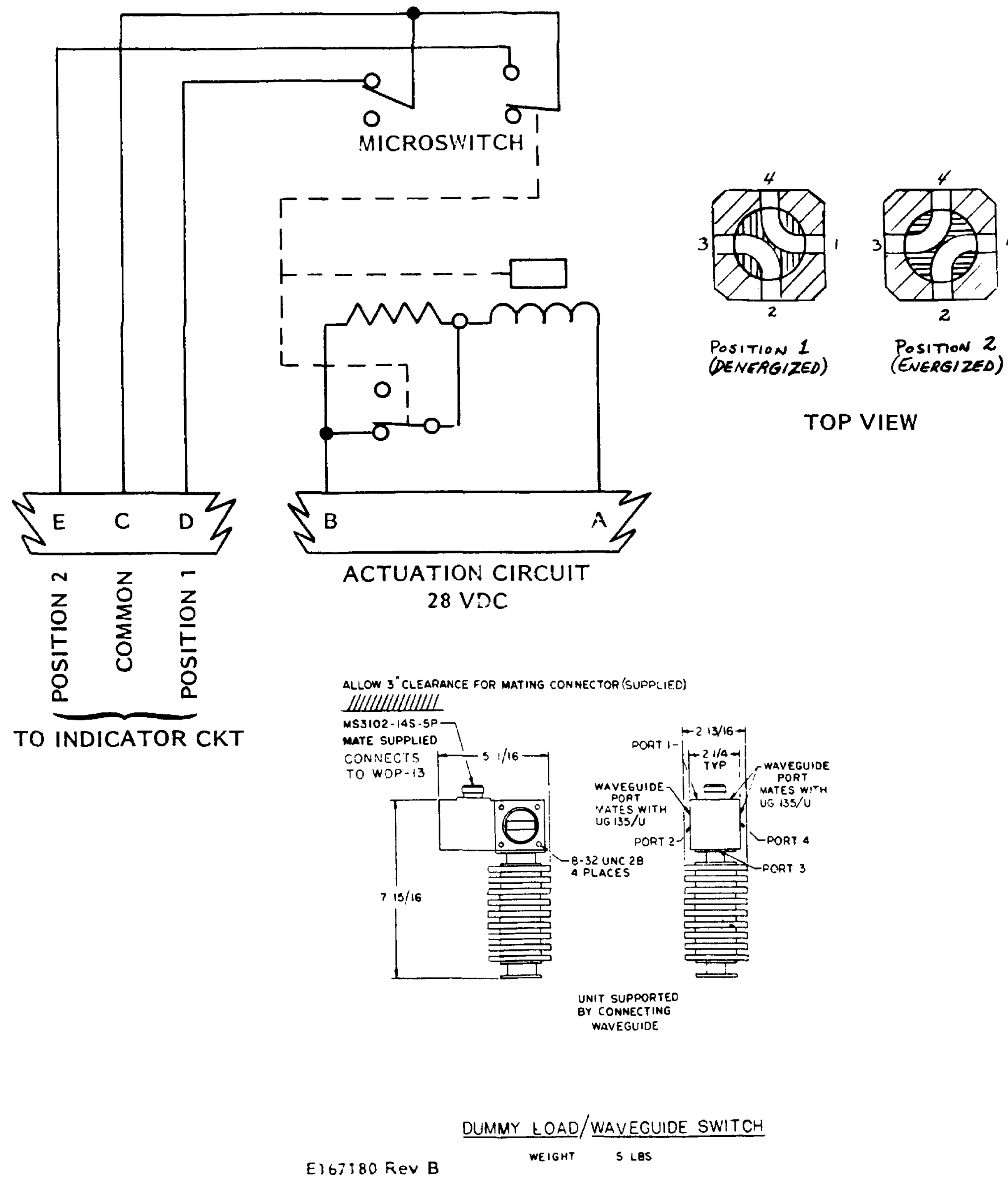


Figure 2-14. Wave Guide Switch SA-2140 Installation Diagram (V2).

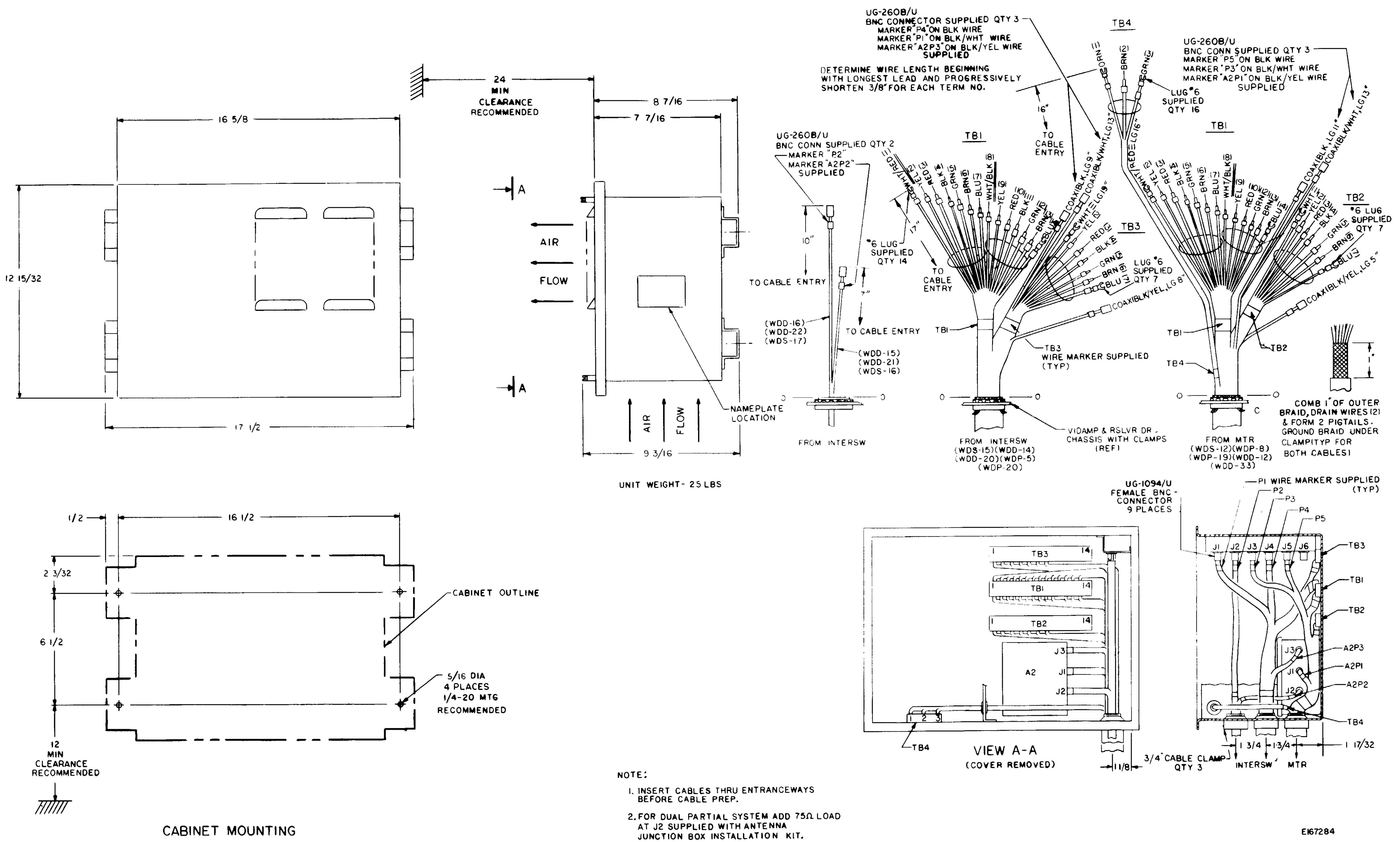
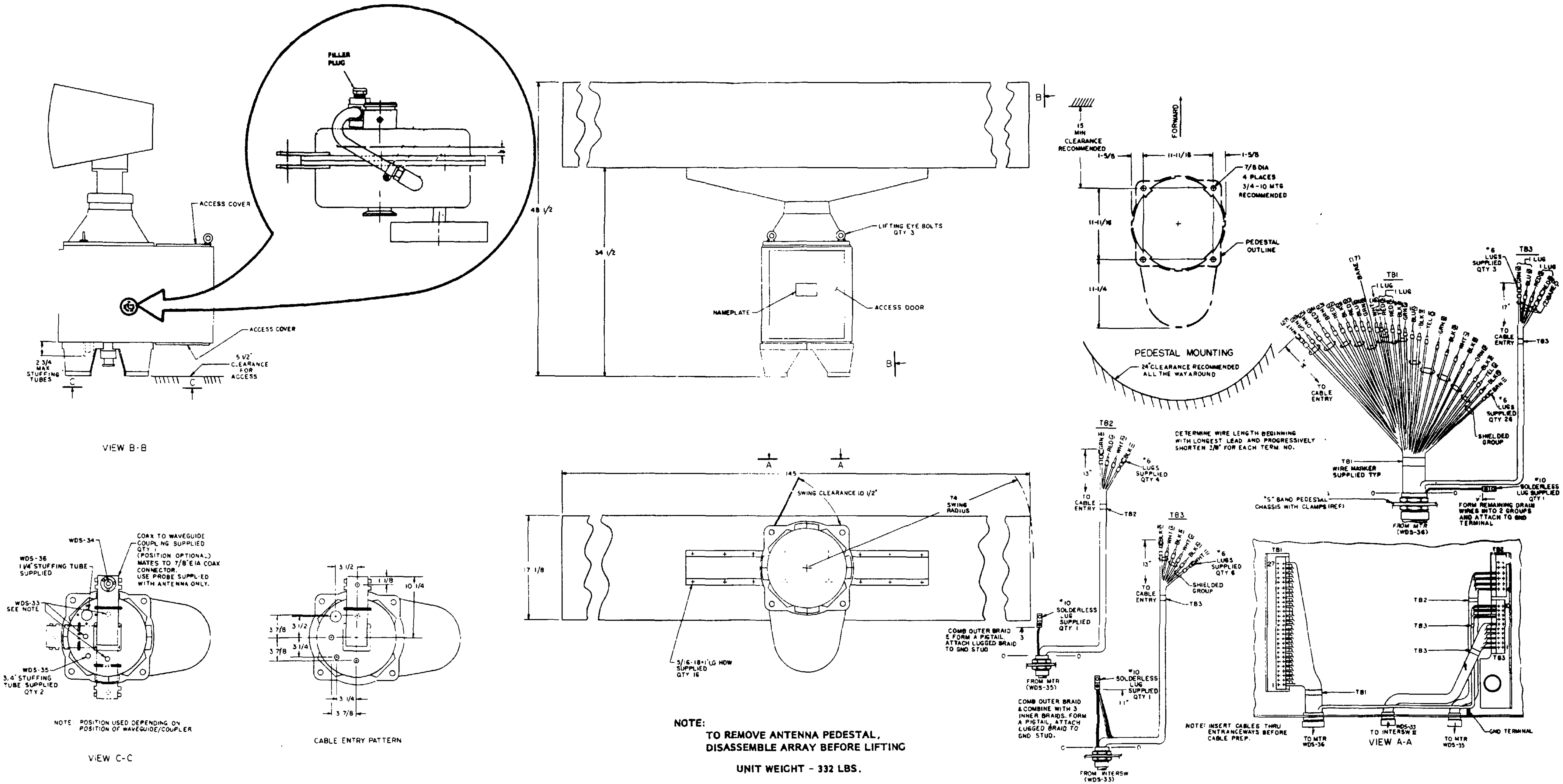


Figure 2-15. Video Amplifier AM-6932 Installation Diagram (V2, V3, V4).



E167699 Rev B

Figure 2-16. Antenna Pedestal AB-1248 and Antenna AS-3195 Installation Diagram (V4).

Figure 2-6 illustrates an alternate method of utilizing existing masts or for constructing masts, platforms, or other assemblies to accommodate the antenna pedestal assembly.

The mounting assembly (mast or bracket) may be positioned off center from the fore and aft center line if necessary. Figure 2-16 shows the minimum clearances necessary for mounting the antenna. The antenna and pedestal assembly outlines and mounting dimensions are shown in Figure 2-16.

2.11.1 Assembly Instructions (V4)

2.11.1.1 Array and Pedestal Assembly (V4). - Antenna Pedestal AB-1248 and Antenna AS-3195 are shipped in separate packages and must be assembled at the installation site. For initial installation it is recommended that the antenna array and pedestal be mounted as a unit. Use the following procedure for assembly of the antenna array and pedestal.

CAUTION

TAKE CARE TO PREVENT DAMAGE TO THE TIPS OF THE RF CABLE: DO NOT ALLOW THE CABLE TO BECOME KINKED.

1. Place the antenna pedestal on the deck in an area where the 12-foot antenna array can be positioned cross-wise on the pedestal. Support the rear of the pedestal to prevent tipping.

2. Cut the plastic tie-wraps which secure the cable section to the antenna support T-bar and carefully remove the cable section.

NOTE

The bends in the cable section are performed at factory, do not alter these bends except as instructed later in this procedure.

3. Insure RF cable is properly seated in the cut-always in the top of the antenna support T-bar and that it is secured in the feed-through fitting at the end of the T-bar.

4. Remove the plastic bag containing mounting hardware from the void in the top of the T-bar; this hardware is for use in installation of the cable section.

5. Apply a continuous 1/8-inch bead of waterproofing compound (such as Dow Corning RTV) around the antenna mating surface of the T-bar. At the RF cable feed-through fitting, fill the space between the top of the fitting and top of the T-bar with RTV.

CAUTION

TAKE CARE NOT TO SCRATCH OR OTHERWISE DAMAGE THE PROTECTIVE COVER ON THE FRONT OF THE ANTENNA ARRAY.

NOTE

Check mounting holes in bottom of array for short paint plug bolts; if bolts are present, remove them.

6. Lift the antenna array into position above the T-bar with array facing in direction of "FRONT" marking on pedestal and carefully align the mounting holes, then lower the array onto the T-bar.

7. Secure the antenna array to the pedestal using 16 stainless steel 5/16-18 bolts, lockwashers and flatwashers (supplied in pedestal installation kit; array contains matched-thread inserts).

8. Insure that the both ends of RF cable section contain a center conductor bullet; if either bullet is missing or damaged, replace it with the spare from the mounting hardware bag.

9. Obtain an O-ring and three bolts, lockwashers and nuts from bag of mounting hardware. Apply anti-seize compound to bolt threads.

10. Position the cable section between the end of the T-bar cable and the array cable connector; align the guide pins/holes in the cable connector.

11. Insert the bullet tip into the array connector and carefully push the cable connector straight in until the bullet seats; secure the connectors using three bolts, lockwashers and nuts.

12. Attach the other end of the RF cable section to the end of the T-bar cable in the same manner.

CAUTION

DO NOT ALTER THE VERTICAL BEND AT THE ARRAY CONNECTOR END OF THE CABLE SECTION: IF THE CABLE IS TOO LONG AS BENT, MAKE A GRADUAL HORIZONTAL BEND BETWEEN THE CABLE CLAMPS.

CAUTION

A MINIMUM CABLE BEND RADIUS OF 10 INCHES MUST BE OBSERVED.

13. Secure the cable section in the cable clamps provided on the bottom of the array.

Check and, if necessary, lubricate the antenna pedestal per paragraph 5.7.2.1.

Install the breather plug (supplied in the installation kit) at the filler port.

2.11.1.2 Rotary Joint Waveguide Positioning. - The waveguide section on the S-band antenna pedestal rotary joint which mates with the RF coaxial cable or waveguide run from the receiver transmitter can be installed in three different positions (see Figure 2-16). The position should be selected to facilitate the most direct transmission line run between the receiver transmitter and pedestal. The pedestal is shipped with the waveguide section installed; if it is necessary to change the position of the waveguide section, the following procedure should be used.

NOTE

The following procedure should be performed before the antenna pedestal is mounted on the mast.

CAUTION

EXERCISE EXTREME CARE TO PREVENT DAMAGE TO THE ROTARY JOINT ASSEMBLY THROUGHOUT PERFORMANCE OF THE FOLLOWING PROCEDURE

1. Remove all stuffing tubes from the bottom of the pedestal.
2. Remove the coax-to-waveguide transition from the rotary joint.
3. Turn the rotary joint to one of its three mounting positions (see Figure 2-16) which will facilitate the most direct transmission line run from the pedestal to the receiver transmitter.
4. Reconnect the coax-to-waveguide transition to the rotary joint.
5. Install stuffing tubes removed in step 1.

2.11.2 Service Platform

A service platform is required where the antenna is mounted at greater than stand-up working height from the deck or mounting surface. Figures 2-5 and 2-6 include (for reference only) details of the servicing platform. The guard rail and support gussets are necessary components of the servicing platform.

2.11.3 Mounting Hardware

When installing the antenna, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.
2. Mating surfaces of the steel mounting plate and the aluminum antenna casting should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent dissimilar metal action.
3. Where guy wires are required, they must be interrupted by strain type insulators to minimize their effect on communications equipment.

2.11.4 Mounting Instructions

When installing the antenna pedestal and antenna, the antenna and pedestal should be assembled on deck, per paragraph 2.11.1.1, then hoisted into position and mounted on the mast as a unit. The antenna pedestal is provided with three eye-bolts to facilitate hoisting. Nylon web straps (1-1/2-inch wide) with spring closed hooks should be used to attach and lift the unit.

When hoisting the pedestal and array, a spreader bar must be used to prevent the lifting straps from rubbing against the array face.

CAUTION

EXERCISE EXTREME CARE TO PREVENT DAMAGE TO THE ANTENNA ARRAY, PARTICULARLY THE ARRAY FACE PROTECTIVE COVER, WHEN LIFTING.

Hoist the antenna pedestal (and the antenna array) as follows:

NOTE

The position of the rotary joint waveguide section should be checked before the antenna pedestal is mounted on the mast; refer to paragraph 2.11.1.2 if it is necessary to change the position.

1. Remove two 6-32 screws from drain holes in bottom of array.
2. Rotate the antenna so that the array faces aft (toward the single eye-bolt); maintain the antenna in this position while hoisting.
3. Attach three lifting straps to the pedestal eye bolts and to the shackles on the bottom of the spreader bar.
4. Attach hoisting line to spreader bar and apply sufficient lift to tense straps; insure aft strap is well clear of antenna face.
5. Carefully hoist unit into position above preinstalled mounting plate; align mounting holes in pedestal with those on mounting plate and carefully lower unit.
6. Shim pedestal supports to assure sound mechanical interface between mounting plate and pedestal.
7. Secure pedestal to mounting plate using stainless steel 3/4-inch bolts, lockwashers, flatwashers and nuts (four each) before lifting straps are removed.

2.11.5 Cable Connections (V4)

Access to the terminal boards in the S-band antenna pedestal is provided via the hinged access cover on the front of the pedestal assembly. The cover is secured by six captive fasteners. Terminal board TB1 is on the left inside the hatch, TB2 and TB3 on the right.

Two cables provide the electrical interconnections for the S-band antenna pedestal. One cable carries control signals to and from the pedestal; the other, an armored cable (FSGA-9), carries power for the antenna drive motor. The cables enter through the bottom of the pedestals via stuffing tubes which are supplied in the installation kits; Figure 2-16 shows the locations at which the stuffing tubes are to be installed. The stuffing tube bodies thread directly into the base of the pedestals. Cable connections to the terminal boards inside the pedestals are illustrated in Figure 2-16. For S-band radars, a four-conductor cable (FSGA-9 or equivalent) must always be used to carry the antenna drive motor power from the receiver transmitter to the pedestal, even when a single-phase drive motor is used (one conductor is required for connection of starting capacitor C2 in the receiver transmitter when a single-phase motor is used).

The RF interface between the S-band antenna pedestal and the S-band receiver transmitter can be provided via coaxial cable or waveguide. For runs of 65 feet or less, 7/8-inch EIA foam dielectric coaxial cable is recommended; Raytheon part numbers for ordering the cable and accessories are:

Cable: 168856-1 or -2
Connectors (two required): 168857-1 or -2
Elbow, 90°, Coaxial (optional): 168857-3
Hardware kit: (Part No. to be supplied)

NOTE

The dash numbers for the cable and connectors (-1 or -2) must agree, e.i. -1 connectors must be used on -1 cable.

For runs exceeding 100 feet, S-band waveguide is recommended.

In installations using RF coaxial cable transmission line, two waveguide-to-cable transitions (Raytheon part number 167175-1) are required to interface the cable with waveguide fittings at both the antenna pedestal and receiver transmitter. Also, a center probe (part number 166313-1) must be installed on both ends of the RF cable center conductor after the conductors are assembled. Cable preparation and connector assembly instructions are provided in the installation kit.

The center probe is designed to fit snugly over the center conductor; a pressure sealing adhesive (such as LOCTITE®) should be used to secure the probe,

CAUTION

THE DISTANCE THAT THE PROBE EXTENDS INTO THE WAVEGUIDE-TO-CABLE TRANSITION IS CRITICAL: THE PROBE MUST BE TAPPED ONTO THE CENTER CONDUCTOR UNTIL THE DISTANCE FROM THE PROBE TIP TO THE END OF THE TEFLON BUSHING AROUND THE CENTER CONDUCTOR IS 1.332 ± 0.005 INCHES AS MEASURED WITH A CALIPER (FOR EARLIER MODELS). LATER MODELS HAVE A LONGER PROBE WHICH MAY BE PUSHED IN ALL THE WAY TO ACHIEVE THE SAME DIMENSIONS.

Installation of the waveguide-to-coaxial cable transition at the antenna pedestal must be accomplished using the following procedure.

CAUTION

IMPROPER INSTALLATION OF THE WAVEGUIDE-TO-COAXIAL CABLE TRANSITION CAN CAUSE DAMAGE TO THE ROTARY JOINT; FOLLOW THE PROCEDURE CAREFULLY.

1. Locate two mounting holes in tabs extending from pedestal housing which are in-line with rotary joint waveguide section; insert cap screw (167976-1, contained in pedestal installation kit) in each mounting hole and start two 1/4-20 nuts (20-1167P1, in pedestal installation kit) on each screw (do not tighten).

2. Position waveguide-to-coaxial cable transition (167175-1) in-line with rotary joint waveguide section and insert cap screws through mounting holes on transition. Start one 1/4-20 nut on bottom of each cap screw.

3. Adjust two lower nuts on each screw to coarsely align flange on transition with that on rotary joint waveguide section; leave loose enough to allow insertion of gasket and alignment of flanges.

CAUTION

WHEN SECURING TRANSITION, DO NOT APPLY FORCE TO ROTARY JOINT OR ALLOW WEIGHT OF TRANSITION TO STRESS ROTARY JOINT.

4. Insert gasket (167668-1) between transition and rotary joint flanges and align flanges and gasket; secure flanges using ten 1/4-inch stainless steel cap screws (207-1161P10) and lock nuts (2031155P56).

5. Tighten top nuts on each transition support cap screw to secure screws to pedestal housing.

6. Using not more than one-half turn increments, alternately adjust two lower nuts on each cap screw to level the transition and rotary joint waveguide section and secure the transition.

In installations using waveguide RF transmission line, the waveguide may be connected directly to the receiver transmitter flange, but not to the pedestal flange. It is recommended that waveguide-to-cable-to-waveguide transitions be made at both the pedestal and receiver transmitter ends of the waveguide run to minimize the effect of vibration differentials along the run. The S-band waveguide flanges at both the receiver transmitter and the antenna pedestal rotary joint are CPR-284 rectangular type flanges. To accomplish the waveguide-to-cable-to-waveguide interface (required at the pedestal, recommended at the receiver transmitter), the waveguide run should be brought to within approximately three feet of the pedestal or receiver transmitter flange; two waveguide-to-cable transitions (167175-1) and a short sections of 7/8-inch EIA foam dielectric RF coaxial cable (168856-1 or -2, with corresponding connectors 168857-1 or -2) are used to complete the interface. The RF cable center probe dimensions specified above (for RF cable installations) must be observed at each waveguide-to-cable transition.

Rectangular nylon brackets (see Table 2-5) shall be used to secure the waveguide run to the mast and to the wheelhouse structure.

CAUTION

WHEN A SINGLE-PHASE ANTENNA DRIVE MOTOR IS USED IN THE S-BAND ANTENNA PEDESTAL, A CAPACITOR MUST BE INSTALLED IN THE RECEIVER TRANSMITTER TO PROVIDE STARTING TORQUE. REFER TO PARAGRAPH 2.12.3 FOR STARTING CAPACITOR INSTALLATION INSTRUCTIONS.

2.11.6 Lubrication (V4)

Check and, if necessary, lubricate the pedestal per paragraph 5.7.2.1. Install breather plug 167615-1 (supplied in installation kit) at filler port.

2.11.7 Initial Alignment (V4)

Perform the initial inspections, checks and alignments (if necessary) per paragraphs 5.7.2.2 through 5.7.2.5.

2.12 RECEIVER TRANSMITTER RT-1241 (V4)

2.12.1 Mounting Hardware (V4)

When installing the receiver transmitter, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) mounting hardware should be used.

2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive action.

2.12.2 Mounting Instructions (V4)

The receiver transmitter assembly is fitted with two horizontal channel members to facilitate bulkhead mounting. Installation dimensions and clearances for the receiver transmitter are given in Figure 2-17. Extra clearance is required on the right side to allow for waveguide or cable entry (see Figure 2-9), and beneath the unit for cable entry. Allow 36 inches in front of the receiver transmitter for servicing and ventilation.

CAUTION

STARTING CAPACITOR C2 MUST BE INSTALLED IN THE S-BAND RECEIVER TRANSMITTER IF A SINGLE-PHASE DRIVE MOTOR IS USED IN THE S-BAND PEDESTAL.

2.12.3 Cable Connections (V4)

Cable and waveguide connection data is provided in Table 2-3 and Figures 2-4 and 2-17.

Access to terminal boards within the receiver transmitter is provided by removing the wrap-around cover which is secured to the receiver transmitter chassis assembly by four clamping catches. All receiver transmitter interconnecting cables enter the receiver transmitter through the bottom of the cabinet (see Figure 2-17). To gain access to the terminal boards and connectors which interface these cables, remove the receiver transmitter front cover by releasing the four clamping catches. For access to the antenna drive motor power cable connections at contactor K1, remove the contactor cover plate on the exterior right-hand side of the receiver transmitter.

Ship's mains shall be connected to the receiver transmitter through a 15-ampere fuse or circuit breaker box (with power disconnect switch).

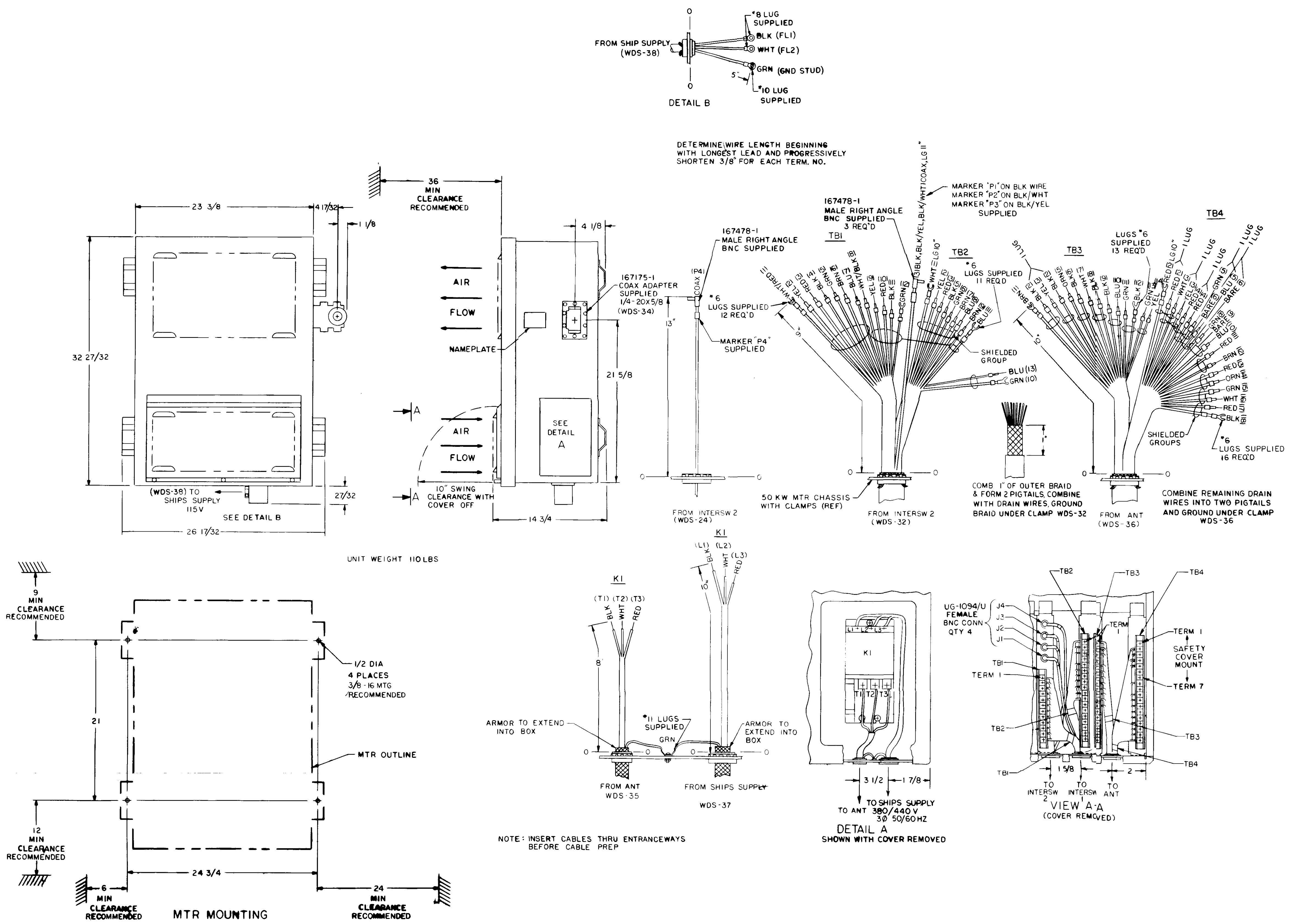


Figure 2-17. Receiver Transmitter RT-1241 Installation Diagram (V4).

When installing the FSGA-9 antenna drive motor power cable for an S-band radar which uses a single-phase antenna drive motor (part number 167726-3), install the starting capacitor C2 part number 167574-3, provided in Motor Starting Capacitor Installation Kit, (167176-1) at the receiver transmitter as follows:

1. Remove contactor cover plate.
2. Install tie anchors (214-7193P3) at the two threaded holes below the contactor using 10-32 by 1/2-inch screws (107-7195P491).
3. Mount capacitor (167574-3) using tie wraps (214-7192P4).
4. Connect red wire of the FSGA-9 antenna drive motor power cable to one terminal of the capacitor.
5. Connect a jumper wire between terminal T2 of contactor K1 (where cable white wire is connected) and the other capacitor terminal.

2.13 SIGNAL DATA CONVERTER CV-3442 (V4)

2.13.1 Mounting Hardware (V4)

When installing the signal data converter, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) hardware should be used.
2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive action.

2.13.2 Mounting Instructions (V4)

The signal data converter is drip-proof only and must not be exposed to the weather. The unit is designed for bulkhead mounting and should be located not more than 100 feet from the SPA indicators nor more than 30 feet from the associated switching unit. Mounting data is provided in Figure 2-18.

2.13.3 Cable Connections (V4)

Cable connection data is provided in Figures 2-4 and 2-18.

2.14 CONTROL INDICATORS C-10260 (V4)

2.14.1 Mounting Locations and Hardware (V4)

The control indicators are to be mounted close to SPA indicators so that the controls and indicators are readily visible to the operator.

When installing the control indicator, the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) hardware should be used.
2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive action.

2.14.2 Mounting Instructions (V4)

The control indicators can be mounted on the left-hand or right-hand side of the SPA indicators. Mounting data is provided in Figure 2-19.

2.14.3 Cable Connections (V4)

Cable connection data is provided in Figures 2-4 and 2-19.

2.15 AMPLIFIER-GENERATOR AM-6933 (V4)

2.15.1 Mounting Hardware (V4)

When installing the amplifier-generator the following general rules must be observed as applicable:

1. Corrosion-resistant (i.e. stainless steel) hardware should be used.
2. Mating surfaces of dissimilar metals should be coated with a silicone compound such as Dow Corning DC4 (Part Number 230-1014P3) to prevent corrosive action.

2.15.2 Mounting Instructions (V4)

The amplifier-generator is drip-proof only and must not be exposed to the weather. It is designed for bulkhead mounting and should be within 30 feet of the switching units. Mounting data is provided in Figure 2-20.

2.15.3 Cable Connections (V4)

Cable connection data is provided in Figures 2-4 and 2-20.

SECTION III: INITIAL TURN-ON

2.16 POWER CHECKS

Perform a check of the primary power inputs to the radar set. Table 2-13 lists the primary power input test points.

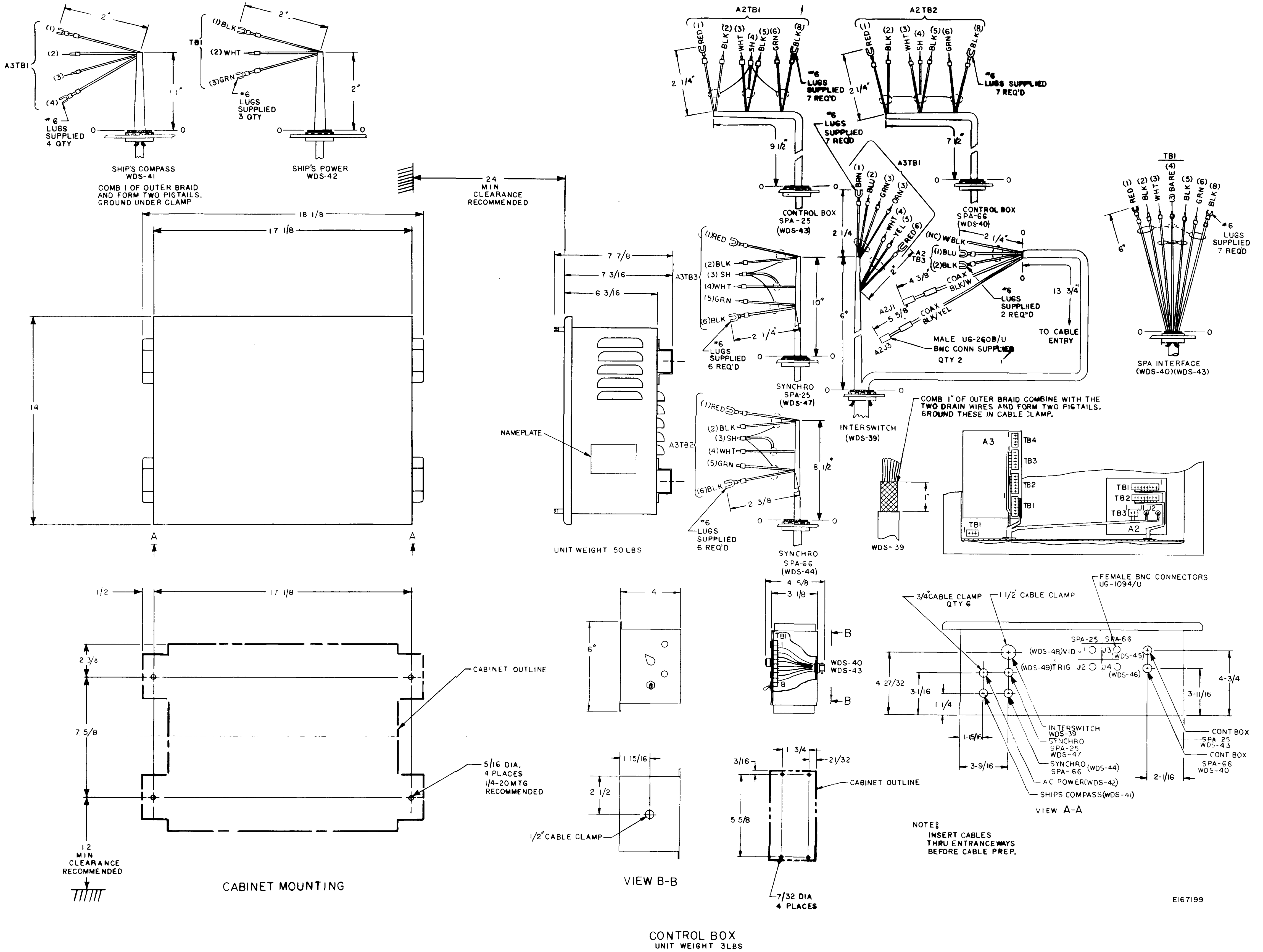


Figure 2-18. Signal Data Converter CV-3442 installation Diagram (V4).

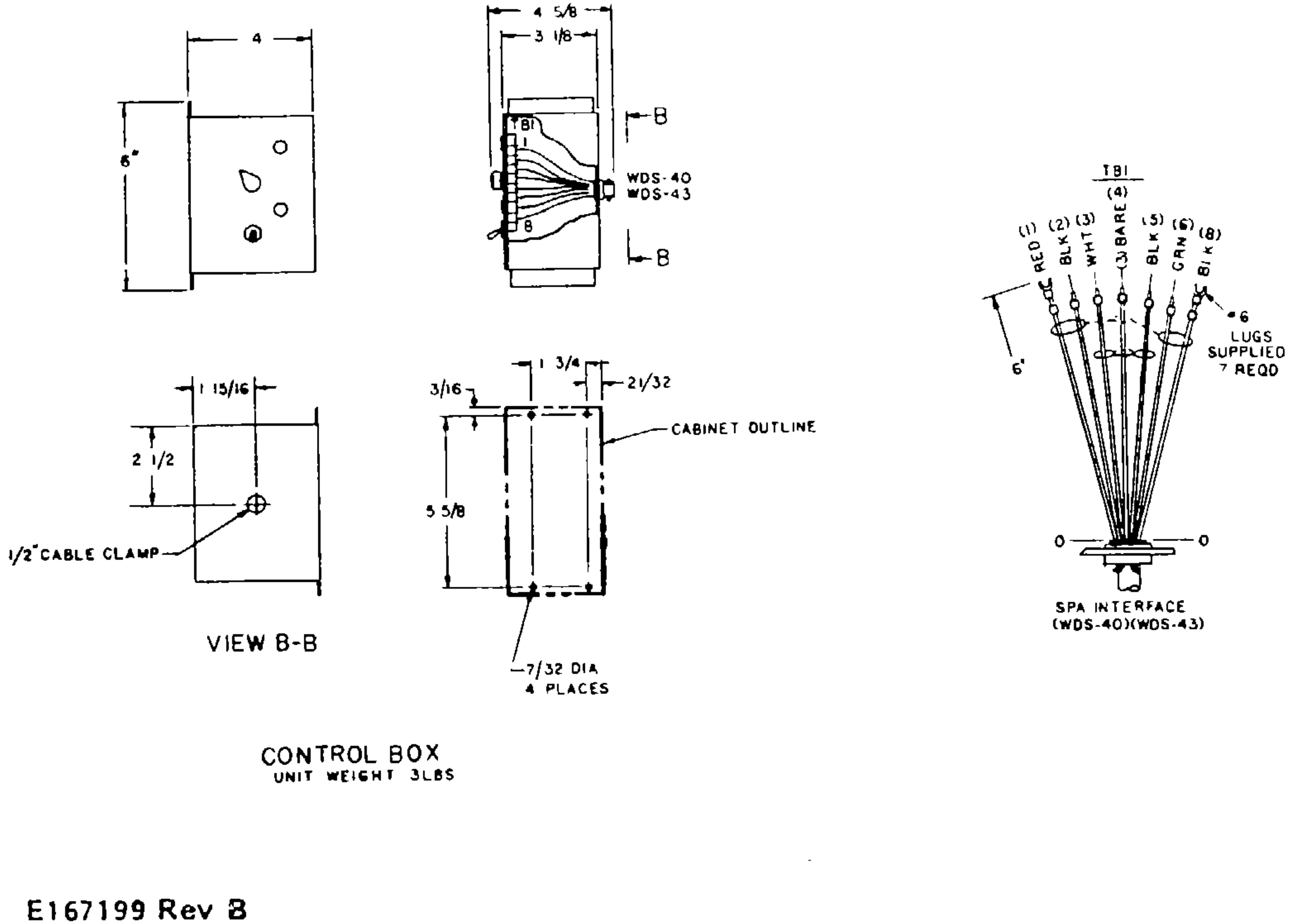
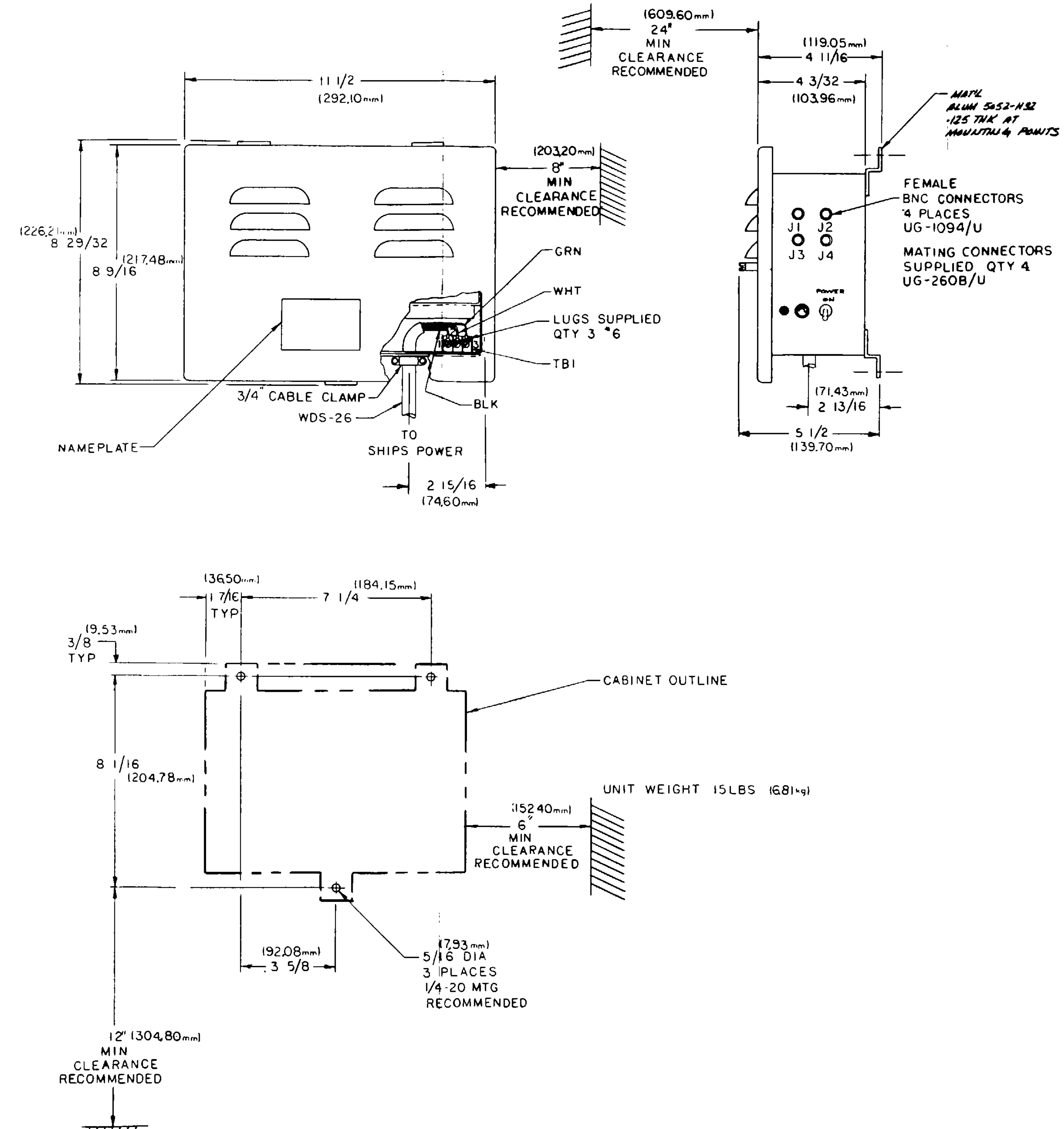


Figure 2-19. Control Indicators C-10260 Installation Diagram (V4).



COAX CABLES		
CABLE NO.	FROM	TO
WDS-29	J1	INTERSW 2 J4
WDS-25	J2	INTERSW 1 J4
WDS-28	J3	SLA-10 S BAND
WDS-27	J4	SLA-10 X BAND

CABINET MOUNTING

D167190

Figure 2-20. Amplifier-Generator AM-6393-Installation Diagram (V4).

Table 2-13. Primary Power Input Test Points

Equipment	Input Voltage	Test Points
Receiver Transmitter RT-1240	115V, 60Hz, 1∅	FL2(+) and FL3(-)
Indicator IP-1282/IP-1283	115V, 60Hz, 1∅	FL1-1 and FL2-1
Interface Unit J-3463	115V, 60Hz, 1∅	TB1-1 and TB1-2
Amplifier-Generator AM-6933	115V, 60Hz, 1∅	TB1-1 and TB1-2
Signal Data Converter CV-3442	115V, 60Hz, 1∅	TB1-1 and TB1-2
Receiver Transmitter RT-1241	115V, 60Hz, 1∅	FL1 (Line) and FL2(Line)
	440V, 60Hz, 3∅	K1L1, L2 and L3

2.17 TURN-ON PROCEDURES

2.17.1 AN/SPS-64(V) 1

The initial turn-on procedure for Radar Set AN/SPS-64(V) 1 is given in Chapter 3, paragraphs 3.2.1 and 3.2.2.

2.17.2 AN/SPS-64(V) 2

The initial turn-on procedure for Radar Set AN/SPS-64(V)2 is given in Chapter 3, paragraphs 3.3.1 through 3.3.3.

2.17.3 AN/SPS-64(V)3

The initial turn-on procedure for Radar Set AN/SPS-64(V)3 is given in Chapter 3, paragraphs 3.4.1 through 3.4.3.

2.17.4 AN/SPS-64(V) 4

The initial turn-on procedure for Radar Set AN/SPS-64(V) 4 is given in Chapter 3, paragraphs 3.5.1 through 3.5.3.

2.18 INITIAL ADJUSTMENTS

2.18.1 General

Initial adjustment procedures for Radar Set AN/SP6-64(V) are given in Chapter 5 of this manual. Table 2-14 lists the adjustments applicable to each radar set, the paragraph containing each procedure and the sequence in which each procedure is to be performed.

2.18.2 V2 System Maintenance Modes

When performing initial adjustments on Receiver Transmitter RT-1240 for the V2 system, select the DP-5 or DP-6 maintenance mode (see Table 3-1).

2.18.3 Range Zero Calibration Modes

When performing the range zero calibration on Indicator IP-1282 or IP-1283 for the V2, V3 or V4 systems, at each indicator repeat the calibration for all possible configurations (as master indicator; as slave indicator; controlling X-band receiver transmitter; controlling S-band receiver transmitter) .

Table 2-14. Initial Adjustment Procedures and Sequence.

Procedure	Paragraph	Sequence for AN/SPS-64 V1	V2	V3	V4
RT-1240					
Power Module Adjustments	5.10.3.1 and 5.10.3.2	1	1, 4[1]	1, 4	1
Transmitter Frequency Adjustment	5.10.3.6	2	2, 5[1]	2, 5	2
Local Oscillator Adjustment	5.10.3.7	3	3, 6[1]	3, 6	3
IP-1282/IP-1283					
Power Supply Adjustments	5.12.3.1 and 5.12.3.2	4	7, 8	7, 8, 9	6, 7, 8
Sweep Circuits Alignment	5.12.3.4	7	13, 14	16, 17, 18	15, 16, 17
Range Zero Alignment	5.12.3.3	9	16 thru 19[2]	21 thru 26[2]	24 thru 29[2]
AB-1247					
Belt Tension Adjustment	5.8.1.3	5	9	10, 12	9
Resolver Alignment	5.11.3.1	6	10	11, 13	10
Bearing and Heading Line Adjustment	5.11.3.1	8	15	19, 20	18
Synchro Transmitter Alignment	5.11.3.2	N/A	N/A	N/A	19
AM-6932					
Sweep Drive Normalization	5.16.3.1	N/A	11, 12[1]	14, 15	13
RT-1241					
Power Supply Adjustments	5.17.3.1 and 5.17.3.2	N/A	N/A	N/A	4
Local Oscillator Adjustment	5.17.3.4	N/A	N/A	N/A	5
Sweep Drive Normalization	5.16.3.1	N/A	N/A	N/A	14
AB-1248					
Belt Tension Adjustment	5.8.2.3	N/A	N/A	N/A	11
Resolver Alignment	5.11.3.1	N/A	N/A	N/A	12
Bearing and Heading Line Adjustment	5.11.3.1	N/A	N/A	N/A	21
Synchro Transmitter Alignment	5.11.3.2	N/A	N/A	N/A	22
CV-3442					
Synchro Differential Generator Alignment	5.19.3.1	N/A	N/A	N/A	20
North Stabilization Alignment	5.19.3.2	N/A	N/A	N/A	23

([1]) Refer to paragraph 2.18.2
([2]) Refer to paragraph 2.18.3

CHAPTER 3. OPERATION

SECTION I: SYSTEMS OPERATION

3.1 GENERAL

This chapter is divided into two sections: the first, Section I describes the systems operation; and Section II describes the indicator operation.

Systems operation includes the turn-on procedure, operating modes and shut-down procedures. Indicator operation covers the control adjustments, display interpretation, range/bearing measurements and radar navigation.

All slave indicators should be set to the same range as the associated master indicator.

CAUTION

TURN ALL INDICATORS TO STBY BEFORE CHANGING THE SETTING OF THE SWITCHING UNITS SA-2139 OR SA-2156.

The Mode Selection Nameplates are shown in Figure 3-1.

3.2 RADAR SET AN/SPS-64(V) 1 OPERATION

3.2.1 Pre-Operating Conditions (V1)

Verify the following control or switch settings:

Equipment	Control/Switch	Position
RT-1240	LOCAL GAIN CONTROL	Fully CCW
	LOCAL MTR TEST	OFF
	ANTENNA	ON
AB-1247	ON/OFF Safety Switch	ON

3.2.2 Turn-on Procedure (V1)

1. At the indicator turn the POWER switch to OFF.
2. Turn the following controls fully counterclockwise.

	VRM (inner knob)
GAIN	READOUT (outer knob)
CONTRAST	ANTI-CLUTTER RAIN
PNL LIGHTS	ANTI-CLUTTER SEA
BRG SCALE	EBL DIM
RANGE RINGS	BRILLIANCE

3. Set the HD UP/GYRO STAB/HDG SET switch to HD UP.
4. Set the OFFSET switch up (away from operator).
5. Turn the POWER switch to ST BY. Observe that the lamp located near the POWER switch flashes after approximately 10 seconds (a similar lamp within the MTR also flashes).
6. Turn the POWER switch to TX ON. Observe the following: (1) The lamp near the POWER switch glows steadily if the 3.5-minute time delay (measured from the time the POWER switch was turned from OFF to ST BY) has expired. (2) The parallel-connected lamp within the receiver transmitter, will also glow steadily. (3) The antenna rotates.

NOTE:

If the lamps resume flashing at any time during operation, a system fault is indicated.

3.2.3 Shut-down Procedure (V1)

Set all indicator POWER switches to OFF

WARNING

VOLTAGE IS PRESENT WITHIN THE VARIOUS UNITS WITH THE POWER SWITCH IN ANY POSITION. DO NOT ATTEMPT ANY MAINTENANCE WITHIN THE UNITS UNLESS THE SHIP'S POWER DISCONNECT SWITCH TO THE RADAR IS OPENED.

3.2.4 Indicator Operation (V1)

Detailed procedures for operating the indicator are specified in paragraphs 3.8 thru 3.11.

3.3 RADAR SET AN/SPS-64(V)2 OPERATION

3.3.1 Operating Modes (V2)

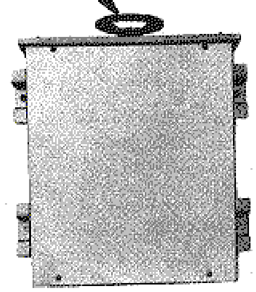
CAUTION

THE POWER SWITCHES AT ALL INDICATORS MUST BE SET TO THE STBY POSITION BEFORE CHANGING THE SETTING OF THE SWITCHING UNIT SA-2156.

The operating modes for V2 are selected using the Switching Unit SA-2156.

Table 3-1 shows four (4) operational, and two (2) maintenance modes for options in system function. Modes DP-1 thru DP-4 are operational modes; DP-5 and DP-6 provide one indicator as master for the operating receiver transmitter (MTR) while the other MTR and indicator are in a maintenance mode.

MODE SELECTOR SWITCH



SWITCHING UNIT SA-2139/SPS-64(V)

INTERSWITCH UNIT [1]

INSTRUCTIONS: PLACE INDICATORS IN STAND-BY OR OFF POSITIONS BEFORE CHANGING MODES. UNLISTED SWITCH POSITIONS WILL NOT DAMAGE EQUIPMENT.
M - MASTER (1) MTR 1 (2) MTR 2
S - SLAVE

MODE	SWITCH POSITION ISU 1	SWITCH POSITION ISU 2	INDICATOR A	INDICATOR B	INDICATOR C	INDICATOR D
DD-1	1	6	M(1)	S(1)	S(1)	S(1)
DD-2	2	6	S(1)	M(1)	S(1)	S(1)
DD-3	3	4	S(1)	S(1)	M(1)	S(1)
DD-4	3	5	S(1)	S(1)	S(1)	M(1)
DD-5	4	3	M(2)	S(2)	S(2)	S(2)
DD-6	5	3	S(2)	M(2)	S(2)	S(2)
DD-7	6	1	S(2)	S(2)	M(2)	S(2)
DD-8	6	2	S(2)	S(2)	S(2)	M(2)
DD-9	1	1	M(1)	S(1)	M(2)	S(2)
DD-10	2	2	S(1)	M(1)	S(2)	M(2)
DD-11	4	4	M(2)	S(2)	M(1)	S(1)
DD-12	5	5	S(2)	M(2)	S(1)	M(1)

(V3) DUAL SYSTEM

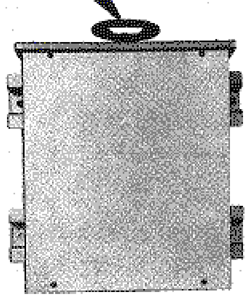
INTERSWITCH UNIT [1]

INSTRUCTIONS: PLACE INDICATORS IN STAND-BY OR OFF POSITIONS BEFORE CHANGING MODES. UNLISTED SWITCH POSITIONS WILL NOT DAMAGE EQUIPMENT.
M - MASTER (1) MTR 1 (2) MTR 2
S - SLAVE

MODE	SWITCH POSITION ISU 1	SWITCH POSITION ISU 2	INDICATOR A	INDICATOR B	INDICATOR C	AN/SPA-25G INDICATORS
DS-1	1	6	M(1)	S(1)	S(1)	S(1)
DS-2	2	6	S(1)	M(1)	S(1)	S(1)
DS-3	3	4	S(1)	S(1)	M(1)	S(1)
DS-4	4	3	M(2)	S(2)	S(2)	S(2)
DS-5	5	3	S(2)	M(2)	S(2)	S(2)
DS-6	6	1	S(2)	S(2)	M(2)	S(2)
DS-7	1	1	M(1)	S(1)	M(2)	S(2)
DS-8	2	1	S(1)	M(1)	M(2)	S(2)
DS-9	4	4	M(2)	S(2)	M(1)	S(1)
DS-10	5	-	S(2)	M(2)	M(1)	S(1)

(V4) DUAL SPECIAL

MODE SELECTOR SWITCH



SWITCHING UNIT SA-2156/SPS-64(V)

INTERSWITCH UNIT [1]

INSTRUCTIONS: PLACE INDICATORS IN STAND-BY OR OFF POSITIONS BEFORE CHANGING MODES. UNLISTED SWITCH POSITIONS WILL NOT DAMAGE EQUIPMENT.
M - MASTER (1) MTR 1 (2) MTR 2
S - SLAVE

MODE	SWITCH POSITION ISU 1		INDICATOR A	INDICATOR B	ANTENNA ON XCVR	
DP-1	1		M(1)	S(1)	1	
DP-2	6		S(1)	M(1)	1	
DP-3	4		M(2)	S(2)	2	
DP-4	3		S(2)	M(2)	2	
DP-5	2		M(1)	M(2)	1	
DP-6	5		M(2)	M(1)	2	

(V2) DUAL PARTIAL

Figure 3-1. Switching Units SA-2139 (V3, V4) and SA-2156 (V2) Operating Controls and Mode Selection Nameplates.

Table 3-1. Radar Set AN/SPS-64(V)2 Mode Selection.

Mode	Operating Indicators A	B	Operating Receiver Transmitter	Antenna Control (Ind/MTR)	Maintenance (Ind/MTR)
DP-1	M	S	I	A/I	--
DP-2	S	M	I	B/I	--
DP-3	M	S	II	A/II	--
DP-4	S	M	II	B/II	--
DP-5	M	--	I	A/I	B/II
DP-6	--	M	II	B/11	A/I

The maintenance mode receiver transmitter RF output is terminated in a dummy load via Wave Guide Switch SA-2140.

3.3.2 Pre-Operating Conditions (V2)

Verify the following control or switch settings:

Equipment	Control/Switch	Position
Receiver Transmitter RT-1240*	LOCAL GAIN CONTROL	Fully CCW
	LOCAL MTR TEST	OFF
	ANTENNA	ON
Antenna Pedestal AB-1247	ON/OFF Safety Switch	ON
Video Amplifier AM-6932*	Internal POWER Switch	ON
Interface Unit J-3463	POWER	ON

* Settings apply to both receiver transmitters &. and video amplifiers.

3.3.3 Turn-on Procedure (V2)

1. Insure that POWER switches on both indicators are OFF.
2. Select desired mode at switching unit SA-2156.
3. Insure that pre-operating conditions of paragraph 3.3.2 are in effect.
4. Set slave indicator POWER switch to ST BY.
5. Turn the following controls fully counterclockwise on both indicators.

	VRM (inner knob)
GAIN	READOUT (outer knob)
CONTRAST	ANTI-CLUTTER RAIN
PNL LIGHTS	ANTI-CLUTTER SEA
BRG SCALE	EBL DIM
RANGE RINGS	BRILLIANCE

6. Set the HD UP/GYRO STAB/HDG SET switch to HD UP.
7. Set the OFFSET switch up (away from operator).
8. Turn the master indicator POWER switch to ST BY. Observe that the lamp located near the POWER switch flashes after approximately 10 seconds (a similar lamp within the receiver transmitter also flashes).
9. Turn the POWER switch to TX ON. Observe the following: (1) The lamp near the POWER switch glows steadily if the 3.5-minute time delay (measured from the time the POWER switch was turned from OFF to ST BY) has expired. (2) The parallel-connected lamp within the receiver transmitter will also glow steadily. (3) The antenna rotates.

NOTE:

If the lamps resume flashing at any time during operation, a system fault is indicated.

3.3.4 Shut-down Procedure (V2)

1. Set POWER switch to OFF on both indicators.
2. Turn-off Interface Unit J-3463.

3.3.5 Indicator Operation (V2)

3.3.5.1 Master Indicator (V2, V3, V4). - Procedures for the master indicator operation applicable to (V2, V3, and V4) are specified in paragraphs 3.8 thru 3.11.

3.3.5.2 Slave Indicator (V2, V3, and V4). -

Control Effectivity

At the slave indicator the following controls are disabled:

TX ON (POWER switch)
TUNE control
GAIN control
FTE ON position (FTE ON/FLASH OFF switch)
ANTI-CLUTTER SEA control
PWR BOOST
INTRF REJECT switch

NOTE:
The above functions are controlled at the master indicator.

There are three (3) sweep rates used in each indicator. All slave indicators must be set to a range scale within the same group as the master indicator. The groups are defined below.

Group	RANGE SELECT Switch
1. Short	.25, .5, .75, 1.5 and 3 (w/o Power Boost) MILES
2. Medium	3 (w/ Power Boost), 6 and 12 MILES
3. Long	24, 48 and 64 MILES

When the master indicator is set to 12RT MILE range scale, the slave indicator should be set to the same range.

NOTE:
Failure to set a slave indicator range scale in accord with the master indicator will result in erroneous display at the slave indicator.

Slave indicator POWER switch should be set to ST BY for normal operation.

3.4 RADAR SET AN/SPS-64(V)3 OPERATION

3.4.1 Operating Modes (V3)

Sixteen (16) operating modes are available for the AN/SPS-64(V)3 Radar Set if four (4) indicators are installed. These modes are selected using two (2) Switching Units SA-2139. With only three (3) indicators, however, only ten (10) operating nodes are available.

Table 3-2 specifies the switch settings required to establish the desired modes and the system configuration for each mode.

CAUTION
THE POWER SWITCHES AT ALL INDICATORS MUST BE SET TO THE STBY POSITION BEFORE CHANGING THE SETTING OF THE SWITCHING UNIT SA-2139.

3.4.2 Pre-Operating Conditions (V3)

Verify the following control or switch settings:

Equipment	Control/Switch	Position
RT-1240*	LOCAL GAIN CONTROL	Fully CCW
	LOCAL MTR TEST	OFF
	ANTENNA	ON
AB-1247	ON/OFF Safety switch	ON
AM-6932*	Internal POWER switch	ON

* Settings apply to both receiver transmitters and both video amplifiers.

Table 3-2. Radar Set AN/SPS-64(V)3 Mode Selection.

MODE	INDICATORS				INTERSWITCH POSITION		MTR/VARD/ ANTENNA
	A	B	C	*D (Optional)	#1	#2	
DD-1	Master	Slave	Slave	Slave	1	6	1
DD-2	Slave	Master	Slave	Slave	2	6	1
DD-3	Slave	Slave	Master	Slave	3	4	1
DD-4*	Slave	Slave	Slave	Master	3	5	1
DD-5	Master	Slave	Slave	Slave	4	3	2
DD-6	Slave	Master	Slave	Slave	5	3	2
DD-7	Slave	Slave	Master	Slave	6	1	2
DD-8*	Slave	Slave	Slave	Master	6	2	2
DD-9	Master	Slave			1	1	1
			Master	Slave			2
DD-10*	Slave	Master			2	2	1
			Slave	Master			2
DD-11	Master	Slave			4	4	2
			Master	Slave			1
DD-12*	Slave	Master			5	5	2
			Slave	Master			1
DD-13*	Master	Slave			1	2	1
			Slave	Master			2
DD-14	Slave	Master			2	1	1
			Master	Slave			2
DD-15*	Master	Slave			4	5	2
			Slave	Master			1
DD-16	Slave	Master			5	4	2
			Master	Slave			1

* Optional - If not installed, modes are eliminated.

3.4.3 Turn-on Procedure (V3)

1. Insure that all POWER switches on the IP-1282 and IP-1283 indicators are OFF.

2. Select the desired mode at both SA-2139 Switching Units.

3. Insure that the pre-operating conditions of paragraph 3.4.2 are in effect.

4. Set all slave indicator POWER switches to ST BY.

5. Turn the following controls fully counter-clockwise.

GAIN	READOUT (outer knob)
CONTRAST	ANTI-CLUTTER RAIN
PNL LIGHTS	ANTI-CLUTTER SEA
BRG SCALE	EBL DIM
RANGE RINGS	BRILLIANCE
VRM (inner knob)	

7. Set the HD UP/GYRO STAB/HDG SET switch to HD UP.

8. Set the OFFSET switch up (away from operator).

9. Turn the POWER switch to ST BY. Observe that the lamp located near the POWER switch flashes after approximately 10 seconds (a similar lamp within the receiver transmitter also flashes).

10. Turn the POWER switch to TX ON. Observe the following: (1) The lamp near the POWER switch glows steadily if the 3.5 minute time delay (measured from the time the POWER switch was turned from OFF to ST BY) has expired. (2) The parallel-connected lamp within the receiver transmitter will also glow steadily. (3) The antenna rotates.

NOTE:

If the lamps resume flashing at any time during operation, a system fault is indicated.

3.4.4 Shut-down Procedure (V3)

1. Set all indicator POWER switches to OFF.

2. Set POWER switches to OFF on both Video Amplifiers AM-6932.

3.4.5 Indicator Operation (V3)

3.4.5.1 Master Indicator (V2, V3, V4). - The procedure for the master indicator operation is specified in paragraphs 3.8 thru 3.11.

3.4.5.2 Slave Indicators (V2, V3, V4). - The procedure for the slave indicator operation is specified in paragraph 3.3.5.2.

3.5 RADAR SET AN/SPS-64(V)4 OPERATION

3.5.1 Operating Modes (V4)

Ten (10) operating modes are available for Radar Set AN/SPS-64(V)4. Mode selection is made using two (2) Switching Units, SA-2139.

Table 3-3 specifies the switch settings required to establish the desired modes and the system configuration for each mode.

Only the IP-1282 and IP-1283 indicators (A, B, and C), can function as master indicators. Operating modes DS-7 through DS-10 provide for Dual master indicator operation. In any one of these modes, one master indicator controls the X-band receiver transmitter and antenna while the other master indicator controls the S-band receiver transmitter and antenna.

This version of the .Radar Set, AN/SPS-64(V)4 includes an S-band receiver transmitter (RT-1241) with a peak power of 50 kW, enabling improved all weather performance. During inclement weather, the use of S-band equipment is recommended.

3.5.2 Pre-Operating Conditions (V4)

Verify the following control or switch settings:

Equipment	Control/Switch	Position
RT-1240	LOCAL GAIN CONTROL	Fully CCW
	LOCAL MTR TEST	OFF
	ANTENNA	ON
AB-1247A	ON/OFF Safety Switch	ON
AM-6932	Internal POWER Switch	ON

Table 3-3 Radar Set AN/SPS-64(V) 4 Mode Selection

Mode	INDICATORS A	B	C	AN/SPA-25	AN/SPA-66	INTERSWITCH POSITION #1	#2	RECEIVER TRANSMITTER ANTENNA
DS-1	Master	Slave	Slave	Slave	Slave	1	2	1
DS-2	Slave	Master	Slave	Slave	Slave	2	3	1
DS-3	Slave	Slave	Master	Slave	Slave	3	1	1
DS-4	Master	Slave	Slave	Slave	Slave	4	6	2
DS-5	Slave	Master	Slave	Slave	Slave	5	6	2
DS-6	Slave	Slave	Master	Slave	Slave	6	4	2
DS-7	Master	Slave	 Master	 Slave	 Slave	1	4	1 2
DS-8	Slave	Master	 Master	 Slave	 Slave	2	5	1 2
DS-9	Master	Slave	 Master	 Slave	 Slave	4	1	2 1
DS-10	Slave	Master	 Master	 Slave	 Slave	5	1	2 1

Equipment	Control/Switch	Position
RT-1241	LOCAL TEST	REMOTE ENABLE
	LOCAL PRF SELECTOR	REMOTE
	MONITOR SELECT	MAG I
	LOCAL GAIN CONTROL	OFF
	ANT ROTATION	ON
AB-1248	ON/OFF Safety Switch	ON
AM-6933	POWER	ON
CV-3442	POWER	ON
SPA-25 Indicator	POWER	ON
SPA-66 Indicator	POWER	ON

3.5.3 Turn-on Procedure (V4)

1. Insure that all indicator (IP-1282 and IP-1283) POWER switches are OFF.

2. Select the desired operating mode at both Switching Units SA-2139. (No. 1 and No. 2)

3. Insure that the pre-operating conditions of paragraph 3.5.2 are in effect.

4. Set all slave indicator POWER switches to ST BY.

5. Turn the following controls fully counter-clockwise:

GAIN	READOUT (outer knob)
CONTRAST	ANTI-CLUTTER RAIN
PNL LIGHTS	ANTI-CLUTTER SEA
BRG SCALE	EBL DIM
RANGE RINGS	BRILLIANCE
VRM (inner knob)	

6. Set the HD UP/GYRO STAB/HDG SET switch to HD UP.

7. Set the OFFSET switch up (away from operator).

9. Turn the master indicator(s) POWER switch to ST BY. Observe that the lamp located near the POWER switch flashes slowly after approximately 10 seconds (a similar lamp within the receiver transmitter also flashes)

10. Turn the POWER switch to TX ON. After a 3.5-minute delay verify. (1) The antenna rotates. (2) The lamp near the POWER switch glows steadily. (3) The parallel-connected lamp within the receiver transmitter also glows steadily.

NOTE:

If the lamps resume flashing rapidly at any time during operation, a system fault is indicated.

3.5.4 Shut-down Procedure (V4)

1. Set all the indicator POWER switches to OFF.

2. If it is anticipated that the equipment will remain off for an extended period, then set the POWER switches of the following units to OFF:

Amplifier Generator AM-6933
Signal Data Converter CV-3442

3.5.5 Indicator Operation (V4)

3.5.5.1 Master Indicator (V2, V3 and V4). The procedure for the operation of the master indicator is specified in paragraphs 3.8 through 3.11.

3.5.5.2 Slave Indicators (V2, V3, and V4). The procedure for the operation of the slave indicators is specified in paragraph 3.3.3.2.

SECTION II: INDICATOR OPERATION

3.6 GENERAL

Turn-on and turn-off procedures are given at the system level as referenced in paragraphs 3.2 for (V1), 3.3 for (V2), 3.4 for (V3), and 3.5 for (V4).

In multiple indicator systems, the receiver transmitters are controlled from the master indicator while the controls at the slave indicators affect only their display parameters (intensity, contrast, etc.) for that indicator, refer to paragraph 3.3.5 for definition of effectivity of the slave Indicator operating controls.

Master/slave status of the indicators in a multiple indicator system is determined by the settings of the switching units; see Tables 3-1 for (V2), 3-2 for (V3), or 3-3 for (V4).

NOTE:

The North Stabilization Circuits contained in the SPS-64 Indicators lose synchronism with the ship's gyro compass whenever the individual indicator POWER switches are set to OFF. When an indicator is turned on, the NSK circuits must be aligned per paragraph 3.8.2, Steps 25 through 30.

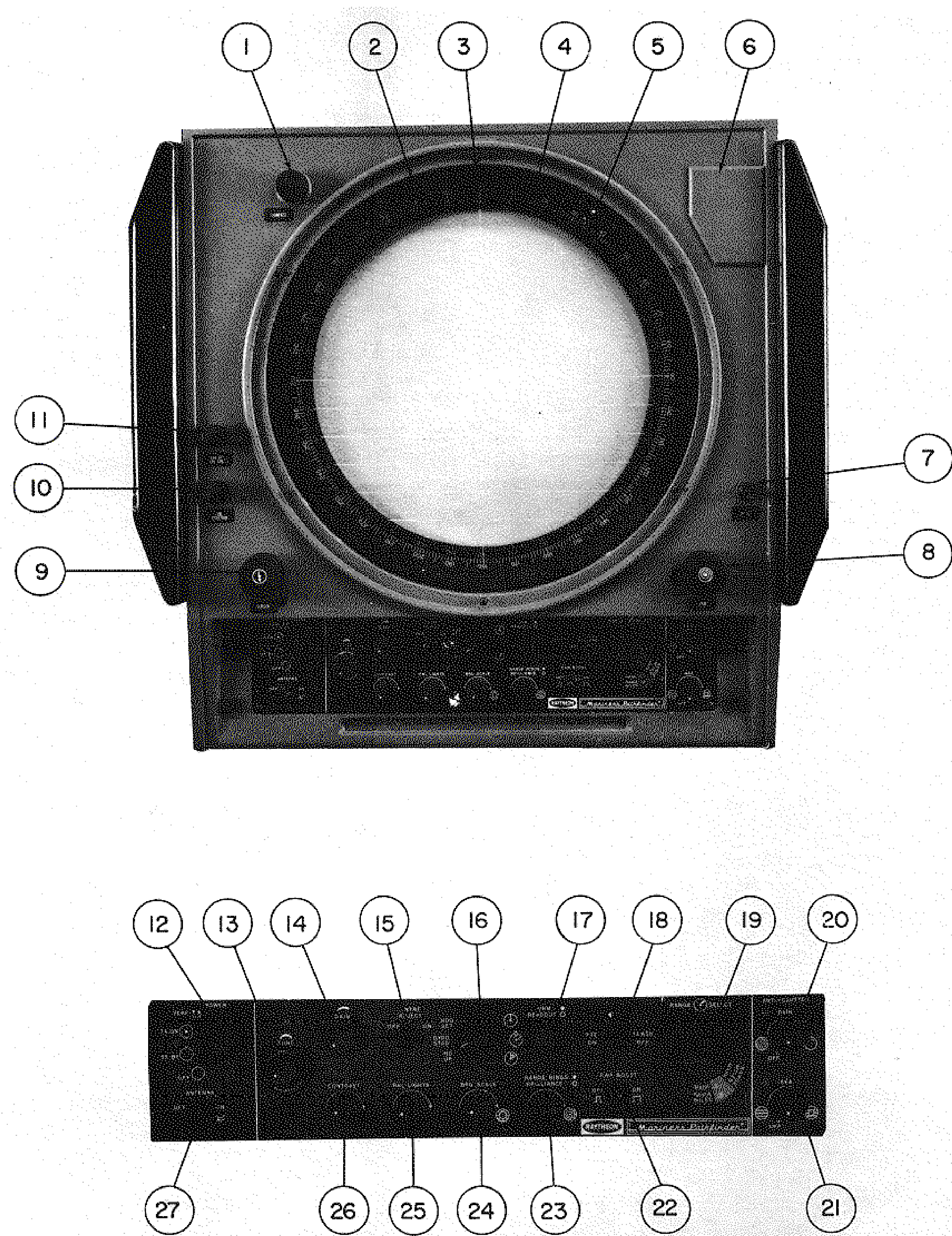
3.7 OPERATING CONTROLS

Figure 3-2 depicts the indicator controls and briefly describes their function.

Detailed functions of the controls are specified in paragraphs 3.7.1 through 3.7.23.

3.7.1 POWER Switch

This is the main power control switch. In the OFF position, the radar is shut down. In the ST BY (standby) position, the transmit indicator blinks and the radar system is ready for operation after a warm-up period of approximately 3.5 minutes. In the TX ON position, the radar is fully operational. The PERF position activates the performance monitor.



1 COMPASS Control - Rotates true bearing ring (4) when TBK is not in use.

2 Range Scale and Markers Indicators - Each of these 11 lamps lights to indicate the range scale and corresponding markers selected by the RANGE SELECT switch (20).

3 VRM Digital Readout - Provides range reading corresponding to size of VRM ring on PPI screen and range scale in use.

4 True Bearing Scale - Indicates true bearing of ship when TBK is in operation.

5 Relative Bearing Scale - Provides indication of relative bearing.

6 EBL ORIGIN Joystick and TGT MARK Pushbutton - Joystick positions EBL origin on selected echo return. Pushbutton places target mark on desired echo return. Use with true motion.

7 OFFSET Switch - Provides expanded view of area ahead of ship by offsetting ship's position by 70 percent of CRT radius (astern direction). No offset is available on 48 or 64 mile ranges.

8 VRM Control - Adjusts size of VRM ring displayed on CRT.

9 CURSOR Control - Provides 3600 rotation of cursor cross-hair graticule.

10 EBL Control - Controls azimuth position of the EBL.

11 EBL DIM Control and EBL READ Switch - EBL DIM (inner knob) adjusts the brightness of the EBL. In the offset mode of operation, the EBL READ switch (outer knob) is turned CW to return EBL origin to center of CRT display to provide correct bearing readings.

12 POWER Switch and Transmit Indicator -

OFF - Turns the radar off.

ST BY - Radar is operational after approximately 3.5 minutes. Transmit indicator flashes as long as the switch is in this position.

TX ON - Radar is fully operational when indicator glows steadily.

PERF - Enables performance monitor.

13 TUNE Control and Indicator - TUNE control is adjusted for maximum average brightness on the indicator and maximum echo return displayed on the PPI.

14 GAIN Control - Sets signal level. Normally adjusted to provide slight background "speckle".

15 INTRF REJECT Switch - Cancels the display of interference from other radar equipped vessels operating within reception range.

16 NSK Function Switch - HD UP - Orients PPI map so that radar returns from directly ahead of ship appear at 00 on the relative bearing scale (5). The heading line flash also appears at 00.

GYRO STAB - Orients PPI map so that radar returns from true north appear at 0° on the relative bearing scale, heading line flash indicates ship's true heading.

HDG SET - Momentary (spring-loaded to GYRO STAB); used to set heading flash to ship's true heading.

17 VRM and READOUT Controls - Adjust intensity of VRM ring and intensity of VRM digital readout (3).

18 FTE ON/FLASH OFF Switch - Cancels heading line flash in the FLASH OFF position. Enables false target detection circuit in the FTE ON position.

19 RANGE SELECT Switch - Selects any of 11 available ranges.

20 ANTI-CLUTTER RAIN Control and Switch - Reduces unwanted fill-in of larger echoes such as areas of heavy precipitation of land masses. Function is switched off when control is fully CCW.

21 ANTI-CLUTTER SEA Control - Suppresses PPI display of reflections from nearby wavetops and heavy spray.

22 PWR BOOST Switch - When held in the ON position, changes system operation from short to medium pulse on 3-mile range to enhance display of small nearby objects.

23 RANGE RINGS and BRILLIANCE Controls - Control intensity of range marker rings and brightness of displayed video.

24 BRG SCALE Control - Adjusts intensity of true bearing scale (4) and relative bearing scale (5).

25 PNL LIGHTS Control - Adjusts intensity of panel illumination lamps and plotter intensity.

26 CONTRAST Control - Selects video threshold to determine brightness level at which each signal return echo will be displayed on the PPI.

27 ANTENNA Switch - Spring-loaded normally ON switch applies rotational power to the antenna motor. Stops antenna rotation when held in the OFF position.

Figure 3-2 Indicators IP-1282/IP-1283 Operating Controls

WARNING

PRIMARY POWER IS PRESENT AT THE INDICATOR, RECEIVER TRANSMITTER, AND ANTENNA, EVEN WITH THE INDICATOR POWER SWITCH SET TO OFF. DO NOT PERFORM ANY ADJUSTMENTS OR MAINTENANCE UNLESS THE SHIP'S POWER DISCONNECT SWITCH TO THE RECEIVER TRANSMITTER (AND TO THE INDICATOR IF SEPARATE SWITCHES ARE USED) IS OFF.

3.7.2 Transmit Indicator

The transmit indicator (connected in parallel with one on the receiver transmitter) is off when primary power is removed from the radar. It glows steadily when the transmitter is on, and flashes when the transmitter is in standby. The transmit indicator flashes when the POWER switch is in TX ON and the timer has not run down, or when the system contains a fault.

3.7.3 CONTRAST Control

The CONTRAST control is a video gain control which adjusts the brightness of the digital video only and has no effect on the brightness of the range rings or the VRM ring. The correct setting of this control produces a PPI display on which all targets are visible with an optimum two-level brightness differential between strong and weak returns. As the control is turned counterclockwise, the video gain is decreased causing all target returns to become dimmer. As a result, weak target returns become so dim that they are barely visible, and in some cases, disappear completely from the PPI. If rotation is continued in the counterclockwise direction, all video returns eventually disappear from the screen. When the CONTRAST control is turned clockwise, the brightness of all digital video is increased. Strong target returns become much brighter and weak returns which were not displayed before are now visible. If the control is turned fully clockwise, all target returns (weak and strong) are displayed with a high degree of brightness and may appear slightly out of focus.

3.7.4 VRM and READOUT Controls

The inner control (VRM) adjusts the intensity of the variable range ring displayed on the PPI. The outer control (READOUT) adjust the brightness of the VRM digital readout corresponding to the size of the variable range ring.

3.7.5 VRM Control

This control adjusts the diameter of the variable range ring on the PPI to read any range from approximately 5 to approximately 130,000 yards.

3.7.6 CURSOR Control

This control rotates the cross-hair bearing cursor through 3600 to provide an accurate indication of echo bearing.

3.7.7 PNL LIGHTS, BRG SCALE, RANGE RINGS Controls

These controls vary the brightness of: (1) the control panel lamps and plotter lamps; (2) the bearing scale and cursor lamps; and (3) the range markers.

3.7.8 BRILLIANCE Control

Adjusts the brilliance of the PPI display.

3.7.9 RANGE SELECT Switch

Selects any of the 11 ranges. The shortest range that covers the desired area should be used. Range is increased by clockwise rotation and decreased by counterclockwise rotation of the switch. The selected range is illuminated on the RANGE MILES scale of the selector knob; the value of the corresponding range rings is displayed on the MARK scale. Range and mark information is also displayed by indicators located above the PPI screen.

3.7.10 PWR BOOST Switch

When held in the ON position, system operation is changed from short pulse to medium pulse on the 3-mile range to improve reception of small or weak echoes near the limit of that range. The switch returns to the OFF position when released.

NOTE:

Because of the operating parameters of the power supply protection features, the transmitter may occasionally shut down when the system is switched from 3 to 6 miles, or when PWR BOOST is selected. This will result in blanking of echoes for the first 2 to 3 sweep rotations. This is entirely normal; echoes will reappear automatically at the end of 6 seconds.

3.7.11 ANTI-CLUTTER SEA Control

The ANTI-CLUTTER SEA (ACS) control, also known as the sensitivity time control, is an auxiliary gain control. While the GAIN control affects echo strength uniformly throughout all ranges, the effect of ACS is greatest on short-range echoes, becoming progressively less as range increases.

The range of ACS control is variable from 0 to more than 3 miles to allow an optimum picture to be obtained under adverse weather conditions. Maximum reduction in the strength of nearby echoes occurs when the ACS knob is turned fully clockwise; when turned fully counterclockwise, there is no reduction in echo strength. Specifically, ACS reduces the strength of the mass of random echoes received from nearby waves. ACS should be used to reduce the strength of the echoes such that clutter appears only as small dots, and small objects can be distinguished (see Figure 3-3).

NOTE:

At short ranges, the setting of the ACS knob should never be advanced so far as to completely obliterate all clutter, since this setting could result in the loss of echoes. At long ranges (8 miles and up) turning the knob fully clockwise will reduce bloom at the CRT center without any loss of useful information. This will help to extend the life of the CRT.

Clutter appears on the display as a very large number of small echoes. The positions of these echoes vary from scan to scan, usually covering a considerable area. Sea clutter is usually limited to a range of approximately 3 to 4 miles from the vessel when the sea is rough. The area of sea clutter is approximately oval in shape, not centered about the vessel, and with the largest part lying to windward.

When the ACS knob is adjusted from the optimum setting, a crescent of clutter will probably remain in the windward direction. Excessive application of ACS will create a zone of darkness around and beyond the maximum range to which the clutter extends. This may eliminate many desired echoes, particularly if the GAIN control is set so that the speckled background is not clearly visible at longer ranges. In any event, small readjustments of the GAIN control may be necessary after adjusting the ACS knob.

3.7.12 ANTI-CLUTTER RAIN Control

The function of the ANTI-CLUTTER RAIN (ACR) control is to reduce the displayed size of the large echoes which, because of their size, may overlap and obscure smaller echoes in their immediate vicinity. This is particularly true of large echo areas depicting rainfall and large land masses. The control causes only the leading edges of large echoes to be displayed, but affects small echoes only slightly (see Figure 3-4).

ACR can be used to great advantage on short range settings to distinguish between two very close echoes on the same bearing which would otherwise be merged into one echo. The control is a combined switch and potentiometer. When fully counterclockwise (OFF) the fast-time constant circuit is switched off. As the control is turned clockwise, the effectiveness of ACR progressively increases.

3.7.13 FTE ON/FLASH OFF Switch

This is a spring-loaded 3-position (center off) toggle switch. When held in the FTE ON position, the FTE (False Target Elimination) circuit is turned on to aid in recognition of false targets. If a target is suspected as being false, its location should be noted on the PPI and verified for two or three sweeps. On the next sweep, just before the sweep line approaches the location of the false target, the FTE ON/FLASH OFF switch should be set and held in the FTE ON position. If the target is true, its location will remain stationary on the PPI as the previous sweeps. If the target is false, its position will shift out toward the edge of the PPI display, and in some cases, disappear completely.

When the switch is held in the FLASH OFF position, the normally displayed ship's heading line is switched off when its display would obscure an echo.

3.7.14 GAIN Control

Rotation of the GAIN control varies receiver gain, and thus the strength of the echoes (and noise signals) on the display. The normal setting for this control produces a light background speckle on the display. The radar is most sensitive when this background speckle is just visible; objects will then be detected at the greatest possible range (see Figure 3-5).

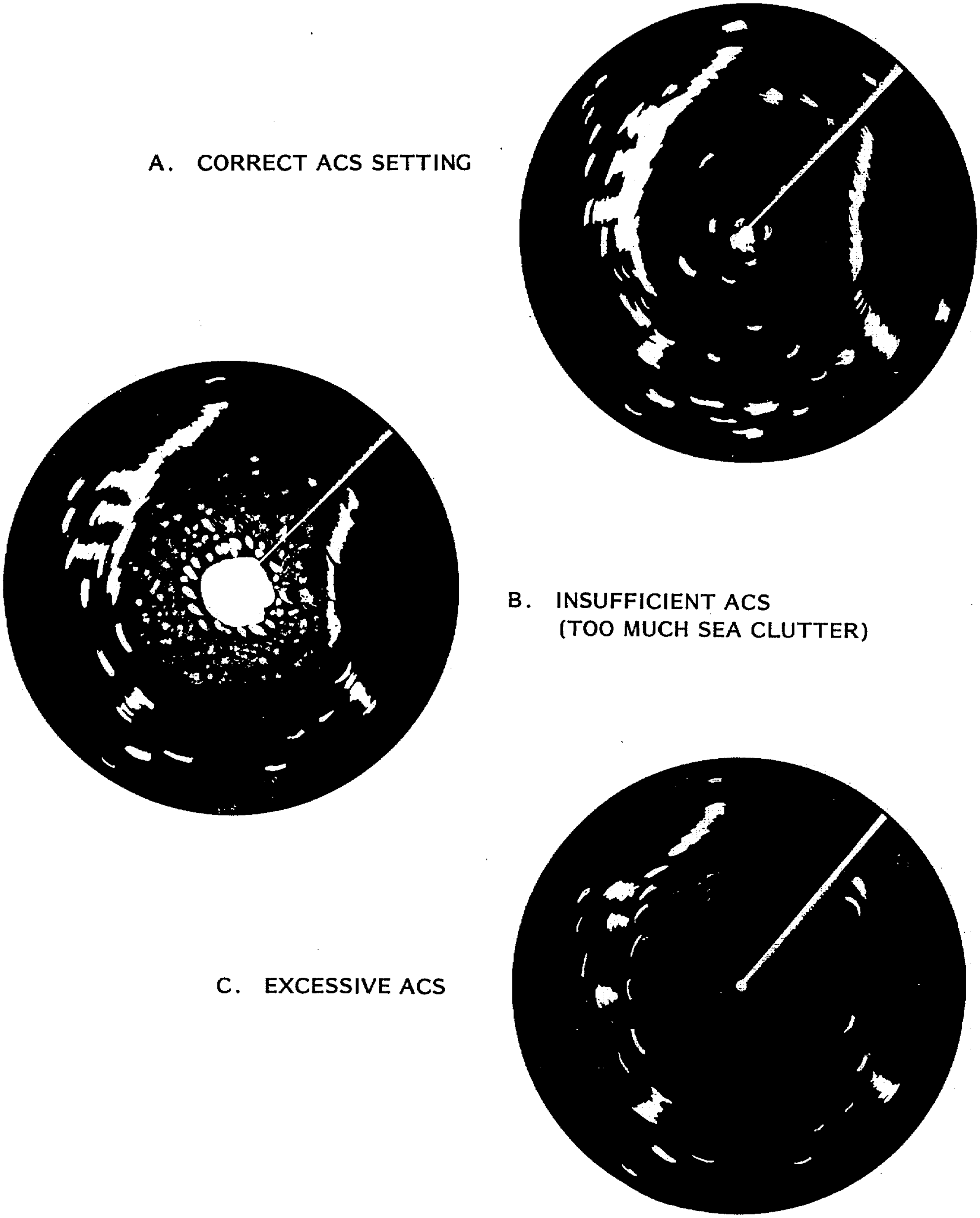


Figure 3-3 Effect of ACS Control on Display

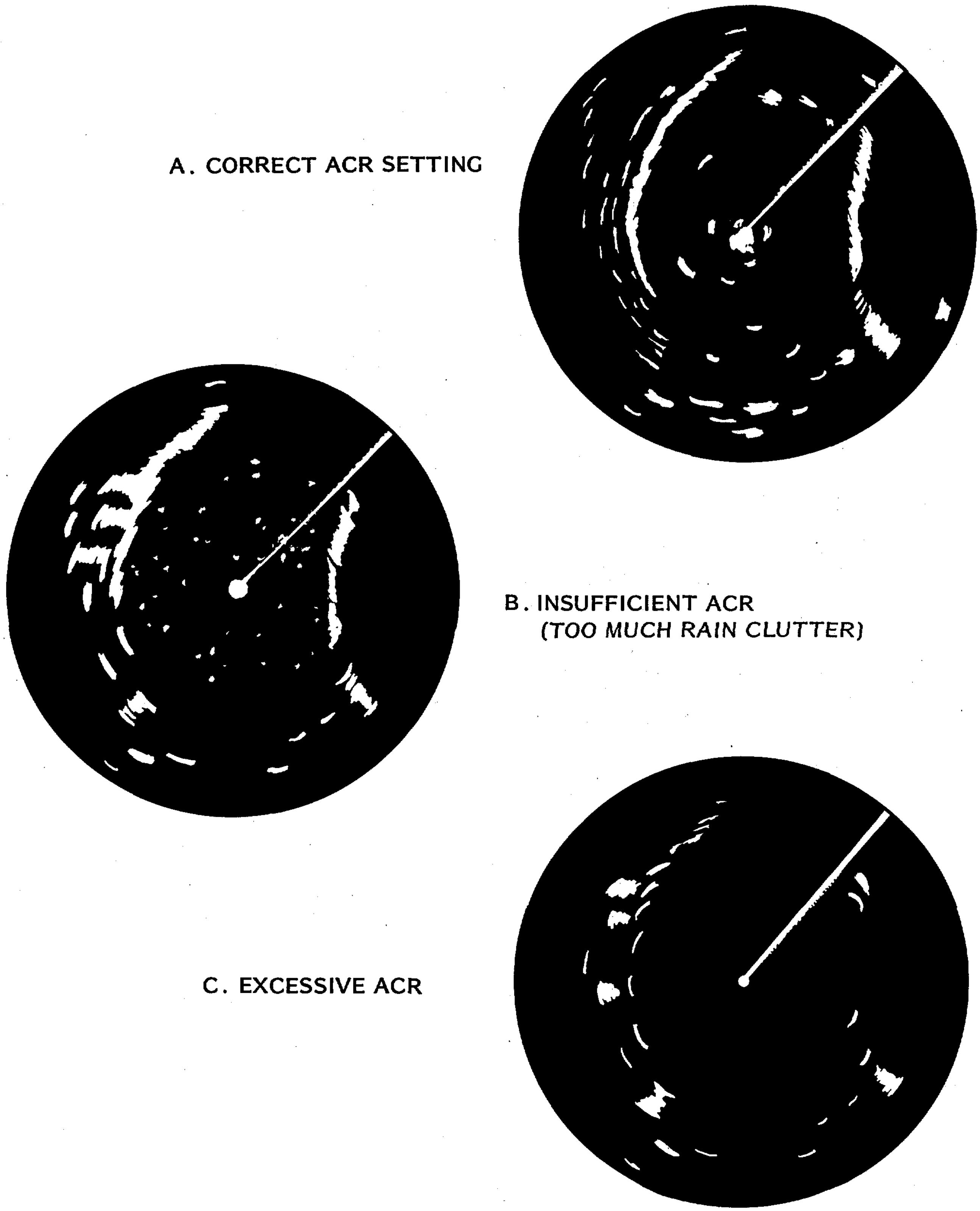


Figure 3-4 Effect of ACR Control on Display

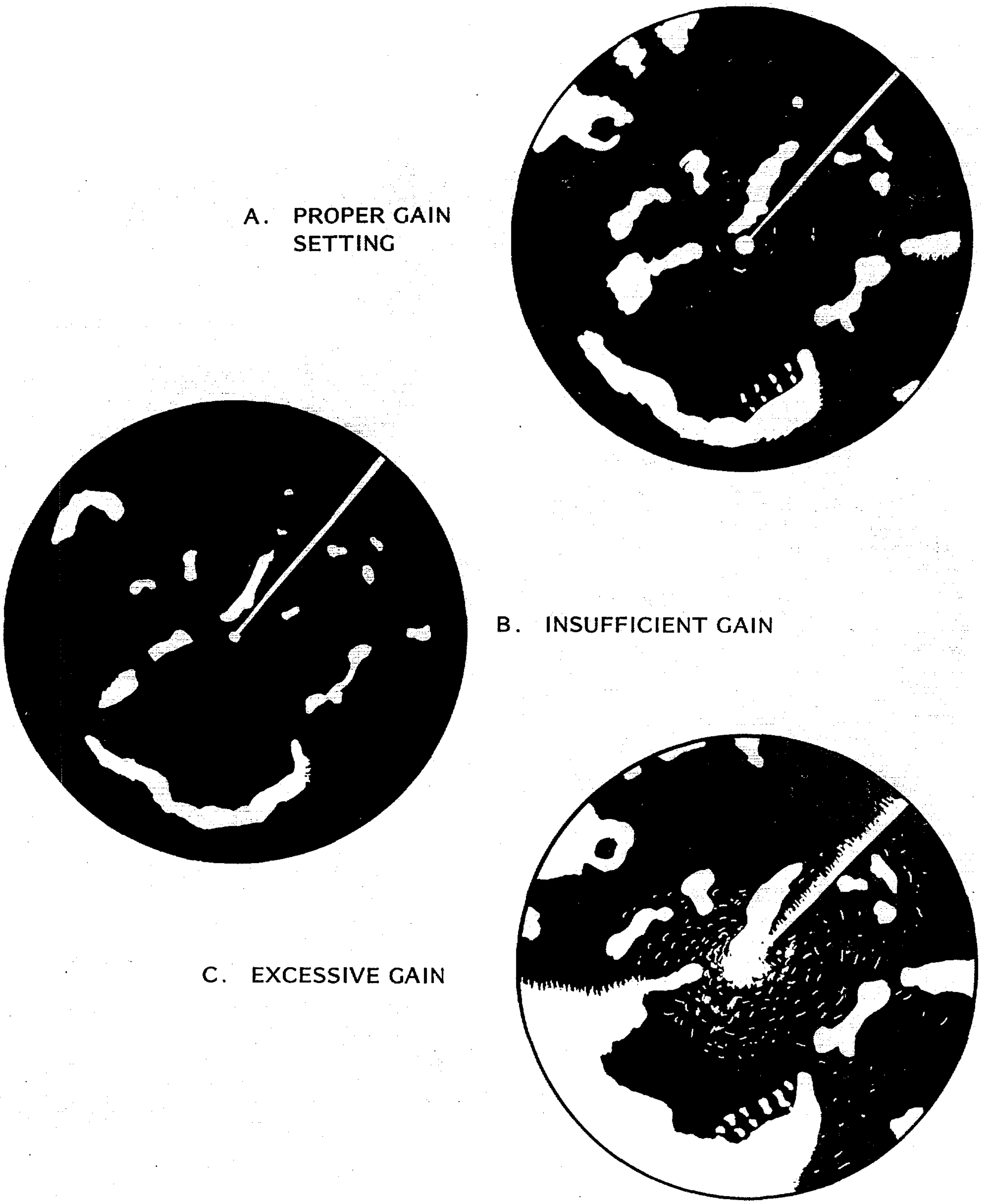


Figure 3-5 Effect of GAIN Control on Display

With too little gain, some weak echoes are missed, and there is a decrease in the range at which objects can be detected. With excessive gain, additional echoes are not seen, but the contrast between echoes and the background noise signals is reduced, making observation more difficult.

A temporary setting at lower or higher than normal gain may be useful in detecting significant echoes. For example, with the GAIN control at its normal setting, "clutter" from rain or snow may obscure the echo from a nearby ship (or other object) within a squall or storm. Reducing the gain temporarily will usually permit the stronger and more distinct ship echo to override the "clutter". However, detection of objects beyond the squall or storm may require a higher GAIN control setting than normal. At the longer range, "clutter" may attenuate, but not completely obscure, echoes from distant objects.

3.7.15 TUNE Control and Indicator

The TUNE control and indicator operate from signals integrated over the first mile of range only. For correct operation, the RANGE SELECT switch should be set to either the 6 or 12 mile range and the ANTI-CLUTTER SEA control adjusted counterclockwise until a presentation is observed on the screen. The TUNE control is now adjusted near the center of its range until the TUNING indicator glows at maximum average brightness. The indicator will brighten and dim as the tuning comes on and off peak. Tuning may also be accomplished by observing a weak. isolated echo and rotating the TUNE control until the echo is maximized.

3.7.16 ANTENNA Switch

This spring loaded switch is normally in the ON position and is used to apply rotation power to the antenna. When held in the OFF position, power is removed from the antenna motor, and the antenna stops rotating. The brightness of the PPI display also decreases since the automatic dimming feature of the radar is activated.

3.7.17 INTRF REJECT Switch

This switch energizes the Interference Rejection circuit (optional) which functions to cancel the display of interference from other radar equipped vessels operating within reception range.

3.7.18 HD UP/GYRO STAB/HDG SET Switch

This switch is supplied as part of the North Stabilized Presentation option. In the HD UP position, the heading line flashes at 0° relative at every revolution of the sweep trace on the PPI. In the GYRO STAB position, North always appears at the 0° position, and the heading line flashes to indicate ship's true heading. The HDG SET position is selected to automatically synchronize the sweep orientation with the ship's gyro.

3.7.19 COMPASS Control (16-Inch Indicator Only)

Provides manual rotation of the true bearing ring when the TBK (optional) is not installed.

3.7.20 EBL DIM/EBL READ Switch

EBL DIM controls the brightness of the EBL. EBL READ returns the EBL origin to the center of the display when the radar is in the offset mode.

3.7.21 EBL Control

Controls the azimuth position of the electronic bearing line.

3.7.22 TGT MARK Pushbutton/EBL ORIGIN Joystick

This combination control is supplied with the TM/CPA option and the Collision Avoidance System option. The joystick portion of the control is used to position a reference spot over a target of interest on the PPI screen. The TGT MARK button is now pushed to identify that target for future reference in course plotting.

3.7.23 OFFSET Switch

Allows ship's position to be offset by 70% of CRT radius (astern only). This permits an expanded view of the area ahead of the ship without giving up the advantages of being on the shortest range possible. No offset is available on the 48 or 64 mile ranges.

NOTE:

No other controls, including those adjusted by screwdriver, may be moved or adjusted by unauthorized personnel.

3.8 OPERATING PROCEDURES

3.8.1 Energizing Procedures

The energizing procedures for Radar Sets AN/SPS-64(V)1, (V)2, (V)3 and (V)4 are given at the systems level and specified in paragraph 3.2 (V1), 3.3 (V2), 3.4 (V3) and 3.5 (V4).

3.8.2 Control Adjustments

1. Turn the PNL LIGHTS control clockwise until control panel illumination is visible (if ambient lighting is at a low level).

2. Turn the BRG SCALE control clockwise to illuminate the compass ring (s) at the edge of the PPI.

3. Turn the RANGE RINGS control clockwise to illuminate the range rings on the PPI.

4. Turn the RANGE SELECT switch to the 24 MILE position.

5. Turn the VRM handwheel one turn clockwise.

6. Adjust the VRM intensity control (inner knob) until the variable range ring is visible. Adjust the VRM READOUT control (outer knob) so that the digital range indication display is visible in the window above the 0° mark of the indicator.

7. Check that rotation of the VRM handwheel expands or reduces the size of the variable range ring and changes the digital range readout. Check the alignment between inner and outer markers and the reading displayed on the MARK scale of the RANGE SELECT knob.

8. Check the EBL function by turning the EBL DIM control (inner knob) clockwise until the EBL is visible. Turn the EBL control to check that the position of the EBL display on the PPI changes.

9. Set the OFFSET switch down (toward operator). The PPI presentation will be offset toward the lower edge of the PPI screen by 70% of the CRT radius.

10. Turn the EBL READ switch (outer knob) clockwise and observe that the EBL origin moves up to the center of the PPI screen. Release the EBL READ switch and observe that the EBL moves back down.

11. Set the OFFSET switch up and observe that the entire PPI presentation (rotating heading line flashing at 0°, and EBL) moves back up to the center of the PPI screen.

12. Turn the GAIN control fully clockwise. Turn the CONTRAST control clockwise until noise and echo returns are visible on the PPI screen. Turn the GAIN control counterclockwise until the gain is at the threshold where grass just starts to appear.

13. Rotate the TUNE control about its center to produce maximum grass on the PPI screen and maximum brilliance on the TUNE indicator.

14. Observe the PPI screen for echoes. Identify a weak echo at mid-range (halfway between the center and the outer edge). Stop the antenna to point at a weak target by holding the ANTENNA switch in the OFF position to aid in fine-tuning.

15. Fine adjust the TUNE control until the echo is strongest. Release the ANTENNA switch to resume rotation.

NOTE:

With no antenna rotation, the dimming feature will cause the sweep to dim, thus preventing CRT burn.

16. Readjust the TUNE, CONTRAST, and/or GAIN controls for optimum target presentation on the PPI. With the CONTRAST control properly adjusted, the two-level video enhancement feature of the radar will easily distinguish between weak echoes (low level of brightness) and strong echoes (high level of brightness).

17. Turn the RANGE SELECT switch to the 6-MILE position.

18. Turn the ANTI-CLUTTER SEA control slowly clockwise until the sea return is reduced to a degree that presents a good picture without loss of small echoes. It may also be necessary to adjust overall gain slightly by turning the GAIN control. Short range picture quality can be further enhanced by adjusting the ANTI-CLUTTER RAIN control and the CONTRAST control.

19. Turn the RANGE SELECT switch to 1.5 MILE position.

20. Turn the ANTI-CLUTTER SEA control slowly clockwise. Sea return clutter will gradually decrease. Continue turning the control until close in echoes can be distinguished. The ideal setting of the control depends largely on weather and sea conditions.

21. Adjust the RANGE RINGS control so that the brightness of the rings is approximately the same as that of weaker echoes.

22. Turn the RANGE SELECT switch to each of the remaining ranges and note that the range rings appear with each selection. Observe that the corresponding range lamp is illuminated at the top of the PPI display. Also check for presence of the ship's heading flash on all ranges. Hold the FTE ON/ FLASH OFF switch in the FLASH OFF position and check that the heading flash does not appear on subsequent rotations. Release the switch.

23. Turn the RANGE SELECT switch to the 3 MILE position.

24. Set and hold the PWR BOOST switch in the ON position. Notice that the strength of all echoes increases. Weak echoes which were barely visible before are now definable on the PPI screen.

NOTE:

Whenever the indicator is completely deenergized (i.e., POWER switch set to OFF), the following NSK synchronization procedure must be performed when returning the indicator to the standby (ST BY) or transmit (TX ON) mode.

25. Set the HD UP/GYRO STAB/HDG SET switch (Figure 3-1, callout 17) to the GYRO STAB position.

26. Obtain ship's heading from gyro compass reading.

27. Observe CRT heading flash bearing on relative bearing scale.

28. Set and hold the switch to the spring-loaded HDG SET position and observe direction in which heading flash rotates on successive sweeps.

NOTE:

To reverse the direction of the heading flash rotation, momentarily release the switch and then return it to HDG SET position.

29. Hold the switch in the HDG SET position until the heading flash bearing on the relative bearing scale agrees with the gyro compass reading.

NOTE:

When the switch is held in the HDG SET position, the heading flash will rotate slowly for approximately four seconds (two sweeps) . The rate of rotation will then increase.

30. Alternately release and set the switch to the HDG SET position until the CRT heading flash agrees with the gyro compass reading.

NOTE:

When steps 25 through 30 above have been performed, the heading flash will remain in synchronism with the gyro compass in the standby and transmit modes, but will lose synchronism when the indicator is turned off.

3.8.3 Operational Techniques

The RANGE RINGS, BRG SCALE, and PNL LIGHTS controls should not normally require readjustment during active operation. The GAIN, TUNE, BRILLIANCE and CONTRAST controls may need slight adjustment over a prolonged active operating period to ensure optimum performance.

The ANTI-CLUTTER controls must be adjusted as conditions dictate, particularly in bad weather, so that no small echoes are lost. The picture may be optimized by careful use of the ANTI-CLUTTER RAIN control.

When not in use, the radar should be placed in the standby condition if use is anticipated within the hour. In standby, the radar is ready for immediate use when required. To place the radar in standby, set the POWER switch from TX ON to ST BY without adjusting any other controls.

Radar Set AN/SPS-64(V)4 includes S-band Receiver Transmitter RT-1241 with a peak power of 50 kW enabling improved all-weather performance. During inclement weather the use of S-band equipment is recommended (see Figure 3-6).

3.8.4 Shut-down Procedure

Procedures for deenergizing Radar Set AN/SPS-64(V)1 through (V)4 are specified in the Systems Operational level. Refer to paragraph 3.2.3 for (V1), 3.3.4 for (V2), 3.4.4 for (V3) and 3.5.4 for (V4) as applicable.

X-BAND DISPLAY

S-BAND DISPLAY

Figure 3-6 X-Band vs. S-Band Display Comparison (V4)

3.9 DISPLAY INTERPRETATION

3.9.1 The Radar Map

The radar display is a maplike representation of the area in which the radar is operating (see Figure 3-7). The ship's position is at the center of the display or -70% in the offset mode. The ship's dead ahead bearing is indicated by the heading line flashing at the 0° bearing with every revolution of the sweep trace.

Coastline contours are depicted as solid echo areas. Other surface vessels, and channel buoys, are displayed as small single echoes. Prominent landmarks (such as bridges, lighthouses, and dockside installations) which are readily seen from the ship, are also large enough for the radar to detect and display. Greater detail is shown when using a short range scale, but the best technique is to start with a long range scale and switch to shorter ranges as the ship approaches the coastline, harbor, or other vessels in the area.

Until the operator is thoroughly familiar with interpreting the radar display, every opportunity should be taken to compare charted coastal areas and prominent landmarks with their corresponding display patterns. Harbor and coastal navigation should be practiced during daylight with clear weather conditions.

3.9.2 PPI Map Orientation

The heading line is always displayed on the indicator at 0° relative, and is coincident with the antenna beam passing the ship's bow. Thus the top of the indicator picture represents the direction in which the ship is heading. With a north-stabilized display (optional), the top of the indicator picture represents north, with the heading line moving around the screen to represent the ship's heading (bow).

3.9.3 Effect of Ship's Movement

The appearance of the radar display changes according to ship's speed and course. With no movement of the ship, a steady display of fixed radar echoes is shown. If the ship is moving ahead on a constant course, echoes appearing at the top of the display move downward across the display.

If the ship alters course to the right, the displayed echoes will be displaced by an equal amount in bearing in a counterclockwise direction, and vice versa. These changes in display patterns with ship movement are extremely important when plotting the ship's course and the courses of nearby vessels.

When the north stabilized display (GYRO STAB) is used, the point of land masses on the PPI display are not affected by the own ship's course changes. The heading line readout on the relative (fixed) bearing scale indicates the own ship's true heading.

3.9.4 Navigational Echoes

Echoes displayed on the PPI screen are large or small, bright or faint, depending on the size and range of the object. The radar indication is similar to an observer's visual indication; a nearby small object may appear to be the same size as a distant large object. With experience, however, the approximate size of different objects can be determined by the relative size and brightness of their radar echoes.

Buoys and small boats are easily identified. Since they bob and toss about in the waves, they do not present a consistent reflecting surface. Consequently, their echoes have a tendency to fade and brighten and at times to disappear momentarily.

High coastlines and mountainous coastal regions can be observed at the longest range of the radar. However, the first sight of landfall on the radar display may be a mountain several miles inland from the coastline. The actual coastline may not appear until the range is reduced to line-of-sight distance.

3.9.5 Sea Return

Radar echoes may be received from irregularities on the surface of the water, particularly at close. range by breaking wavecreasts in heavy seas. These echoes appear on the PPI screen as dense background noise and clutter in the shape of an almost solid disc, as far as one mile in all directions from the display center.

3.9.6 Storm and Rain Squall Returns

Returns from storm areas and rain squalls consist of countless small echoes, continuously changing in size, intensity, and position. These returns appear as a large hazy area on the display and may be very helpful for bad weather warnings. If the returns from storm areas and rain squalls are not desired, the ANTI-CLUTTER RAIN control can be adjusted to minimize them.

3.9.7 Ghost Images

There are several types of ghost images. They sometimes have the appearance of true echoes, but in general they are intermittent and poorly defined. A ghost image retains a fixed relationship with respect to the true image and has a more arc-like appearance with a tendency to smear.

HARBOR VIEW
1.5 MILE RANGE

Figure 3-7 Display Interpretation

When the interference reject feature is selected ghost images caused by other radars operating in the vicinity are eliminated.

3.9.8 Radar Interference

Whenever two or more radar equipped vessels are operating within reception range of each other, mutual interference is likely. This will usually appear on the screen as a series of small dots, which move to and from the PPI center, sometimes in a straight line, but more often in a long, sweeping curve. This should not, as a rule, impair the effectiveness of the radar as a navigation aid. Radar interference can be completely eliminated by setting the INTRF REJECT switch to ON.

3.9.9 Side Lobes

A very small part of the RF energy from each transmitted pulse is radiated outside the single narrow beam, producing side lobe patterns. Side lobes have no effect on distant or small surface objects, but the echo from a large object at short range may produce an arc on the PPI similar to a range ring, or appear as a series of echoes forming a broken arc. Side-lobe echoes normally occurs at range below 3 miles and can be reduced by adjustment of the ANTI-CLUTTER SEA control.

3.9.10 Blind Sectors

Funnels, masts, and samson posts (when located near the antenna array) may cause shadows. In the shadow area beyond the obstruction there will be a reduction of the beam intensity, although not necessarily a complete cut-off. However, if the subtended angle is more than a few degrees there will be a blind sector.

In some shadow sectors the beam intensity may not be sufficient to obtain an echo from a very small object even at close range, despite the fact that a large vessel can be detected at a much greater range. For this reason the angular width and relative bearing of any shadow sector must be determined at installation. This information should be posted near the indicator, and operators must be alert for objects in blind sectors.

3.9.11 Navigation and Surface Surveillance

The radar system is designed for navigation and surface surveillance. Harbor and coastal navigation should be practiced in daylight under clear weather conditions so that observations can be taken to compare the PPI presentation with visible surroundings. Navigational information shown on the chart of a particular operating area will be easily recognizable on the PPI, within the limits of the range in use at that time and the shielding effect of land masses.

3.10 RANGE AND BEARING MEASUREMENTS

3.10.1 Plotter

Each indicator (IP-1282 and IP-1283) is supplied with a plotter assembly to aid in recording target range and azimuth information. Target position is periodically marked using a grease pencil, resulting in a temporary record of the targets position relative to that of own ship. This record is used to determine the target course and speed.

The brightness of the grease pencil reflections on the plotter is determined by the setting of the PNL LIGHTS control on the front panel.

3.10.2 Range and Bearing Measurements

3.10.2.1 VRM Discontinuities. - Range and bearing measurements at Indicators IP-1282 and IP-1283 are performed using the Electronic Bearing Line (EBL) and Variable Range Marker (VRM) features.

NOTE:

When the indicator is turned on, the VRM will not be displayed. The VRM handwheel must be turned slightly clockwise to display the VRM spot on the CRT. When the VRM readout is zero, the VRM spot is not displayed on the CRT.

The VRM nautical mile is equal to 2025 yards. At distances greater than 10,000 yards when using range scales less than 24 miles, the VRM readout increments in 100-yard steps. In the 24-, 48-, and 64-mile ranges the VRM updates internally by the standard increment and the display will be rounded accordingly. On the 24-mile range, where the standard increment is 160 yards, the display will increment by either 100 or 200 yards. The standard increments for each of the ranges is given below.

Range (miles)	Standard Increment (yards)
0.25, 0.5, 0.75	5
1.5	10
3	20
6	40
12	80
24	160
48	320
64	320
12 RT	80

To improve VRM readout accuracy, the VRM readout change step is intentionally caused to deviate from normal incrementing at specific ranges. The listing given below indicates where the VRM deviates from its normal increment; this deviation is always 10 yards.

650	3890	7130
1300	4540	7780
1950	5830	8430
3240	6480	9720

In order to compute the readout just prior to the VRM readout listed, take the standard increment for the selected range, add 10 yards and then subtract from the applicable number in the listing.

Example: Range is 6 miles
Standard increment is 40
Number from listing is 5830
5830 - (40 + 10) = 5780

Therefore, the readout sequence will be 5780, 5830 and the display will increment or decrement by 40 on either side of these numbers.

3.10.2.2 Range/Bearing Measurement Procedure. -

1. Adjust RANGE RINGS control for desired intensity of range rings.
2. Turn the VRM handwheel 1/4-turn clockwise, then adjust VRM intensity control for desired intensity of VRM spot on CRT.
3. Identify target of interest on CRT and adjust EBL control to make displayed EBL pass through target.
4. Read target bearing from intersection of displayed EBL and fixed heading scale.

NOTE:

When HD UP operation is in effect, the target bearing thus obtained is relative bearing; when GYRO STAB is selected, target true bearing is indicated.

5. Adjust the VRM handwheel to superimpose the VRM spot on the EBL over the target of interest; read the target range directly from the VRM digital readout at the top of the CRT.

3.11 RADAR NAVIGATION

3.11.1 Obtaining a Position Fix

Figure 3-8 shows examples of alternative methods of using radar echoes from prominent points which can be identified on a chart. A position fix based on two or more points will furnish a more accurate fix, especially when the points are nearly 90° apart from the ship's position.

A highly accurate position fix should be plotted by noting the ranges to three identifiable points and plotting them on the chart as shown in Figure 3-8A. Radar rangefinding is more accurate than visual, rangefinding. The distances (ranges) are plotted by using dividers to measure the distance on the chart scale and transferring it to the chart. One end of the divider is placed on the point and the other end traces the range arc.

Figure 3-8B illustrates the method used when only one point is available. The range is plotted as described above. The bearing is plotted from the point back to intersect the range arc. The relative bearing must be converted to a true bearing before plotting.

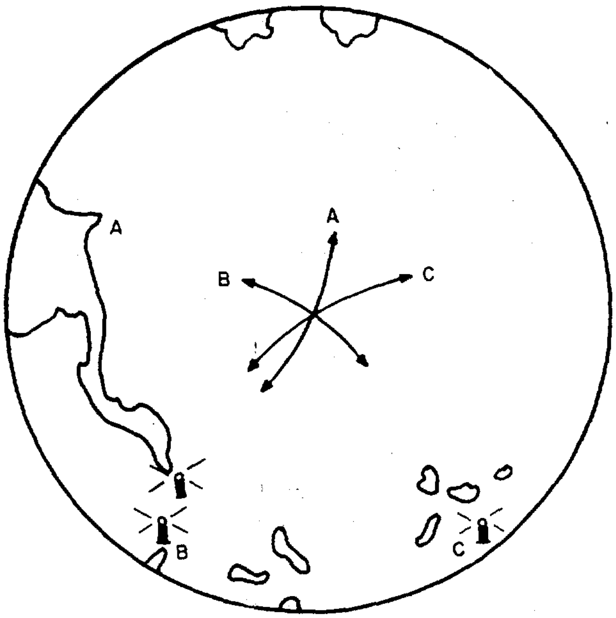
Figure 3-8C illustrates how to find the ship's position at the intersection of two plotted bearings. The two points selected should be as near 90° apart as possible. Greater accuracy is obtained if three bearing to objects nearly 60° apart are plotted. These bearings should be converted to true bearings before plotting. This method may be less accurate than plotting range arcs since radar bearings, due to the beamwidth of the radar, are less exact than radar range.

3.11.2 Avoiding Collision

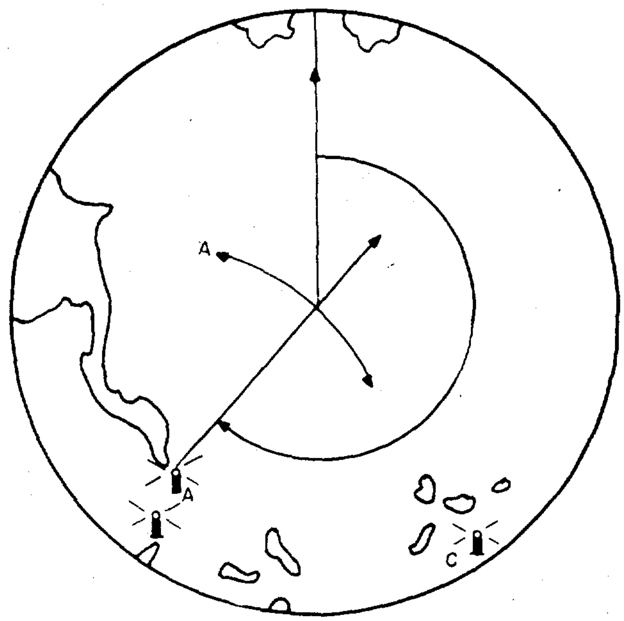
As soon as an echo appears on the display, its range and relative bearing should be noted on a plotting sheet or chart. As in visual observation, "constant bearing with decreasing range indicates a collision course." As soon as a series of plots indicates a closing range and no significant change in relative bearing, positive action should be considered mandatory. The "Regulation for Preventing Collision at Sea" should always be observed.

3.11.3 Determining Radar Line-of-Sight Range

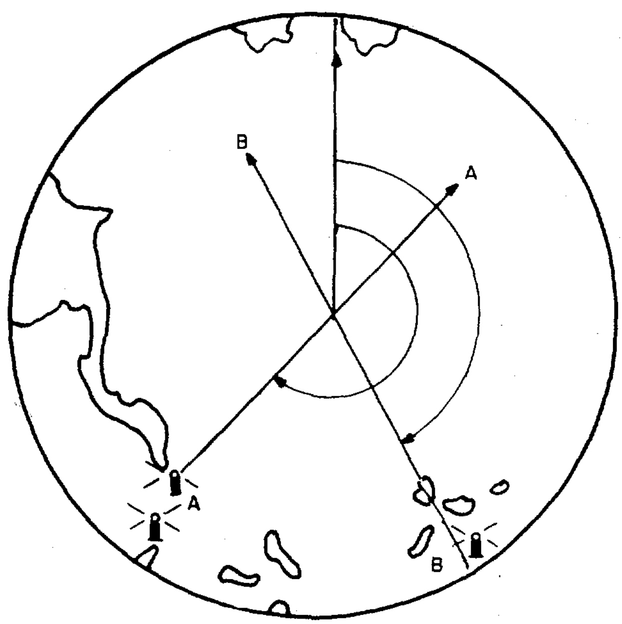
When searching for distant echoes, the radar line-of-sight range to the echo can be a limiting factor. Radar waves behave like light waves but are refracted slightly more, increasing the distance to the radar horizon to slightly beyond the optical horizon (displayed range is correct, however). As Figure 3-9 shows, the radar line-of-sight range is a combination for the radar horizon of the ship's radar antenna and the radar horizon of the echoes. The nomograph shown in Figure 3-9 provides a convenient method for determining any one of the three factors involved when the other two factors are known.



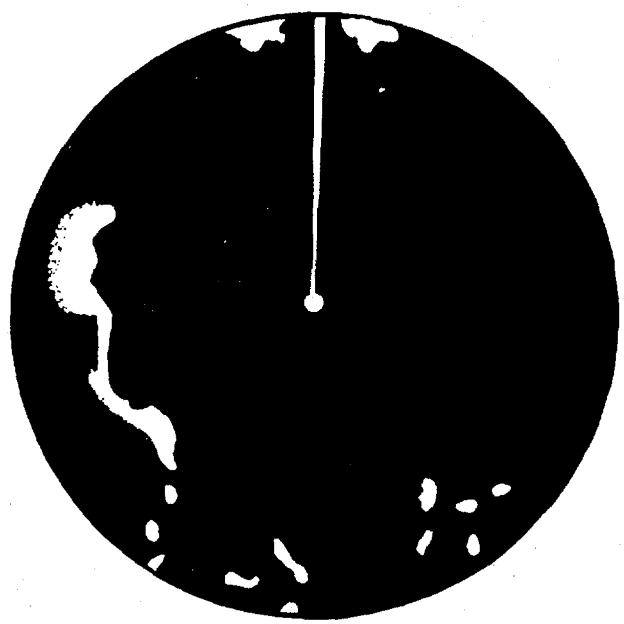
A. THREE RANGE ARCS PLOTTED ON CHART



B. ONE RANGE ARC AND ONE BEARING PLOTTED ON CHART

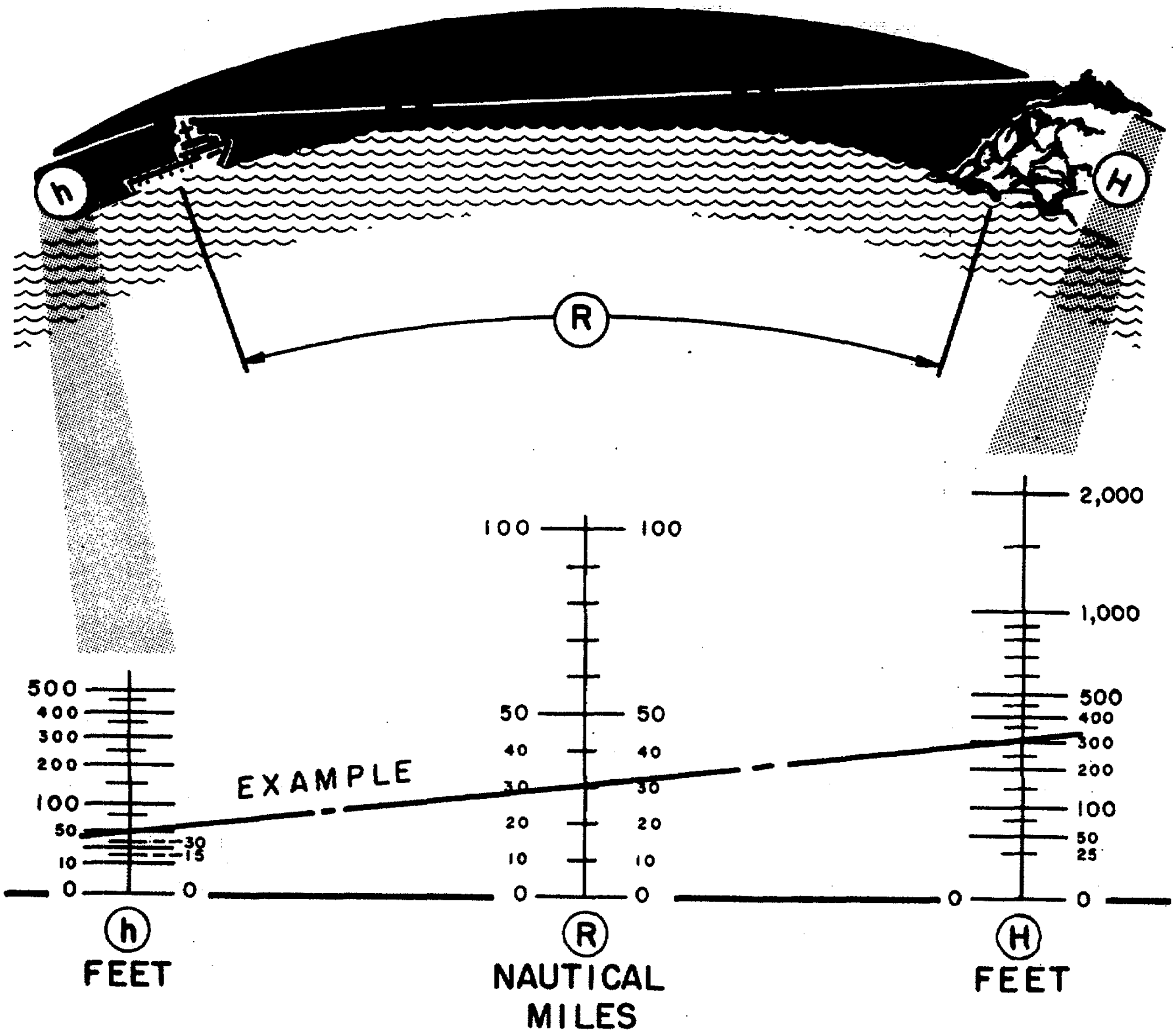


C. TWO BEARINGS PLOTTED ON CHART



D. RADAR DISPLAY

Figure 3-8 Methods of Position Plotting



Example: Assume that the antenna is 50 feet above water, and the highest point of land that the vessel is approaching is 300 feet. In this case, land can normally be observed on the radar display at a range of approximately 30 nautical miles. A straightedge is set at point h at 50 and point H at 300, and the expected range R reads 30.

Figure 3-9 Radar Line-of-Sight Range Nomograph

CHAPTER 4. FUNCTIONAL DESCRIPTION

4.1 GENERAL

The theory of operation for Radar Set AN/SPS64(V) is presented in three forms: system block diagram descriptions; functional block diagram descriptions; and detailed circuit descriptions.

System block diagram descriptions are given in Chapter 1, Section II of this manual, paragraphs 1.6.3 (AN/SPS-64(V)1), 1.7.3 (AN/SPS-64(V)2), 1.8.3 (AN/SPS-64(V)3) and 1.9.3 (AN/SPS-64(V) 4).

This chapter contains functional block diagram descriptions for the major components of the radar sets. The applicable paragraphs and the components covered are listed below:

Paragraph	Component
4.2	Receiver Transmitter RT-1240
4.3	Antenna AS-3194 and Antenna Pedestal AB-1247/AB-1247A
4.4	Azimuth Range Indicators IP-1282/IP-1283
4.5	Switching Units SA-2139 (V3, V4) and SA-2156 (V2)
4.6	Interface Unit J-3463 (V2)
4.7	Wave Guide Switch SA-2140 (V2)
4.8	Video Amplifier AM-6932 (V2, V3,V4)
4.9	Receiver Transmitter RT-1241 (V4)
4.10	Antenna AS-3195 and Antenna Pedestal AB-1248 (V4)
4.11	Signal Data Converter CV-3442 (V4)
4.12	Control Indicator C-10260 (V4)
4.13	Amplifier-Generator AM-6933 (V4)

Detailed circuit descriptions of each electronic subassembly are presented in Chapter 6 of this manual with accompanying schematic diagrams.

4.2 RECEIVER TRANSMITTER RT-1240

The modulator, transmitter, and receiver sections of Radar Set AN/SPS-64(V) are contained in the receiver transmitter. Solid-state electronics are utilized throughout except for the magnetron and the hard-tube modulator. The primary functions of the receiver transmitter are to generate and transmit a train of short pulses and to amplify the echoes received by the antenna.

The receiver transmitter inputs are: the trigger and control signals from the indicator; the microwave signal returns from the antenna; and ship's power. The receiver transmitter outputs are: the transmitter pulse to the antenna; the video output and the acknowledge pulse to the indicator; and the ship's power (fused) to the antenna motor.

A functional block diagram of the receiver transmitter is shown in Figure 4-1. A description of the receiver transmitter subassemblies, subdivided functionally and keyed to Figure 4-1, is given below:

4.2.1 Pulse Generation and Receiver Control Circuits

The pulse generation and receiver control circuits establish the pulse width for the transmitter and select either narrow or wide bandwidth for the receiver. The circuits also determine sensitivity threshold control recovery start timing to control receiver short range gain.

The trigger for the transmitter is received from the indicator at the proper PRF for the selected range. The medium pulse enable and long pulse enable signals control the pulse width decoder to determine which of the pulse generators (one-shot multivibrators) is enabled. The trigger pulse is routed through the trigger delay generator to allow enough time for the STC generator circuit to begin developing the STC waveform. The resulting delayed trigger is applied to the short pulse generator. Its output is applied to the long and medium pulse generators. The longest pulse present at the pulse width gate input is gated through. Table 4-1 summarizes the various combinations.

The output of the pulse width gate is routed to the amplifier driver which amplifies the pulse to drive the modulator.

Each of the pulse widths is independently adjustable: short pulse (R28); medium pulse (R23); and long pulse (R25).

During short pulse operation the pulse width decoder switches the receiver IF bandwidth to 24 MHz, via the bandwidth gate, switch and relay K3.

During medium and long pulse operation the IF bandwidth is 4 MHz. Bandwidth relay K3, in addition to switching the IF bandwidth, reduces the magnetron filament voltage during medium and long pulse operation.

The non-delayed indicator trigger is applied through the STC delay generator to the STC integrator-amplifier. The output of the integrator-amplifier, the delayed STC waveform is applied to the IF amplifier to control short range gain of the receiver. The slope of the STC waveform trailing edge is set by STC Law control R57 and the indicator ANTI-CLUTTER SEA control. The STC waveform can be adjusted to approximately a 4 mile range to control short range gain.

Table 4-1. Transmitter Drive Pulse Selection

Command Medium	Command Long	Pulse Generator Medium	Pulse Generator Long	Drive Pulse
High	High	Disabled	Disabled	Short
High	Low	Disabled	Enabled	Long
Low	High	Enabled	Disabled	Medium

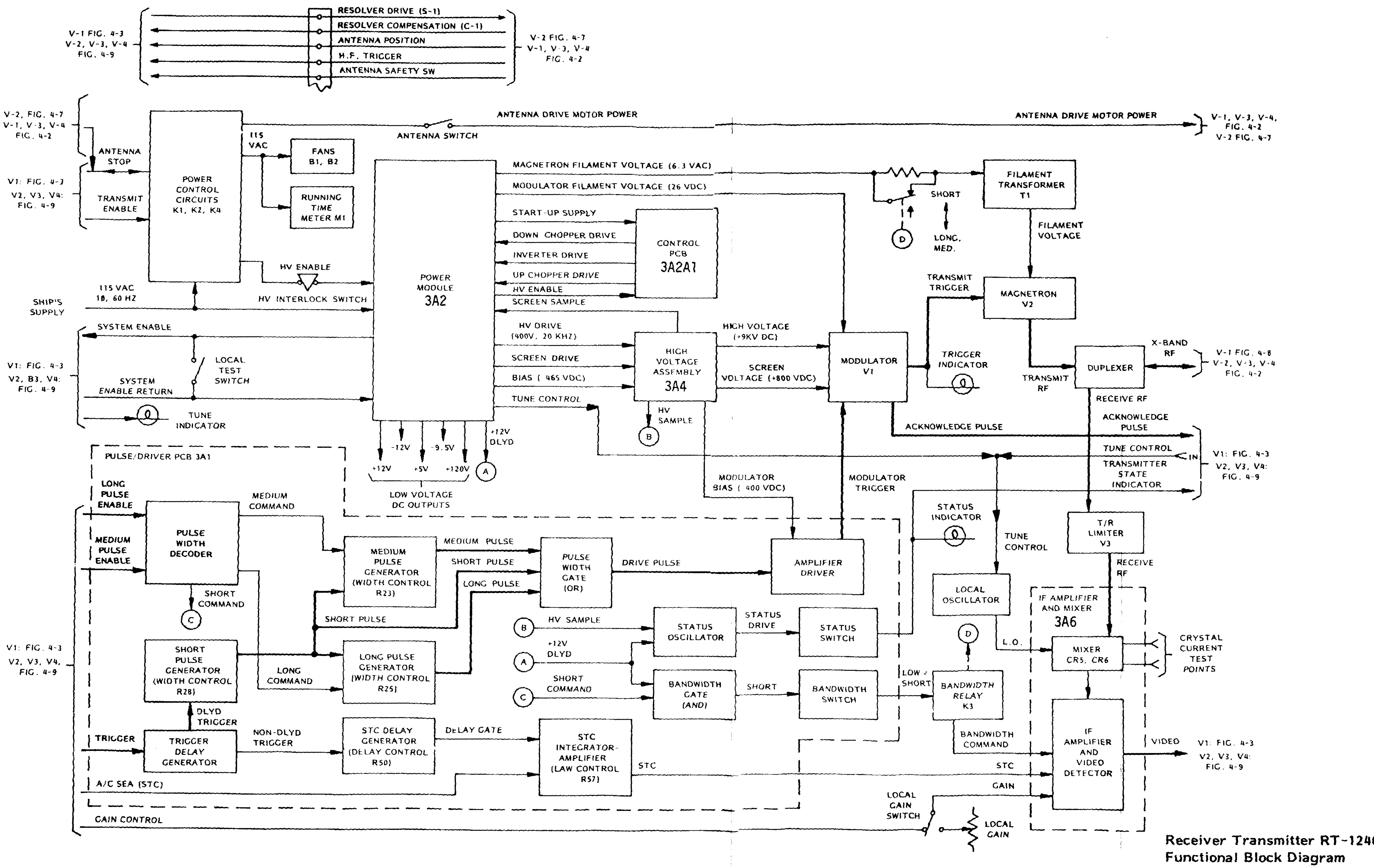


Figure 4-1. Receiver Transmitter RT-1240 Functional Block Diagram

4.2.2 Modulator-Transmitter Circuits

The primary function of modulator V1 is to provide a means of pulsing the magnetron transmitter. The output of a pulsewidth generator is amplified to drive the modulator which allows the magnetron to be brought rapidly into and out of oscillation. The modulator is a hard-tube type whose pulse width (.065,0.5, and 1 microsecond) is selected and triggered by the indicator. When the magnetron fires, the modulator generates the acknowledge pulse which is sent to the indicator to trigger and synchronize the display with the transmitted pulse.

The transmitter utilizes magnetron V2 to produce a minimum peak output of 20 kilowatts for the X-band radar. The magnetron output is coupled through an RF duplexer to the external waveguide, which routes the high frequency burst of energy to the antenna via a rotary joint located in the antenna pedestal.

During medium and long pulse operation, when the magnetron duty cycle (PRF/pulse width) is relatively high, the magnetron filament voltage is lowered by means of bandwidth relay K3.

4.2.3 Duplexer and Receiver RF Circuits

The duplexer couples the transmitted RF energy from the transmitter to the antenna pedestal rotary joint. Reflected RF energy received by the antenna is coupled through the duplexer to the receiver. The receiver RF circuits process the received RF signals for use by the IF and video amplifier circuits.

Since the transmitter and receiver use a common waveguide feed and antenna, a protective device (T/R limiter V3) is used to prevent high powered transmitter pulses from feeding into the sensitive receiver circuits. Without this protection, the mixer crystals would be physically destroyed, and the local oscillator damaged. This passive limiter also provides protection for the crystals against pulses from other transmitters when the radar is switched off.

The mixer crystals, CR5 and CR6, combine the received RF signals (at the transmitter frequency) with the signal from the local oscillator (45 MHz above the transmitter frequency) to produce the 45-MHz echo signals for the receiver.

4.2.4 Receiver Circuits

The receiver circuits process the 45-MHz received RF signals to provide video data for the indicator. The receiver circuits include an IF amplifier, a video detector and a video amplifier.

The IF signal is amplified by a 45 MHz solid-state three-stage IF amplifier. The bandwidth of the IF strip is switched from 4 to 24 MHz, depending on transmitter pulse width.

The input amplifier gain is controlled by the STC signal. The STC signal also controls the IF amplifier gain at close ranges. The overall gain of the IF amplifier is controlled by the indicator GAIN control.

The full-wave video detector detects the IF signal envelope and provides positive video signals to the regenerative video amplifier which supplies positive video signals to the indicator.

4.2.5 Power Control and Power Supplies

Primary input power to the receiver transmitter (115 Vac, single phase, 60 Hz) is controlled by the system enable lines which are closed when the indicator POWER switch is set to the ST BY or TX ON position. The receiver transmitter LOCAL TEST switch is connected in parallel with the indicator POWER switch to provide independent turn-on capability to standby at the receiver transmitter for maintenance.

Ac power outputs from the receiver transmitter (115 Vac, single phase, 60 Hz) provide: antenna drive motor power (switch-controlled by the receiver transmitter ANT ON/OFF switch); indicator power in single-indicator systems (V1); and video amplifier power in multiple-indicator systems (V2, V3, V4).

The low voltage power supply provides the following operating voltages for the receiver transmitter circuits:

+5 and +12 Vdc (logic circuits)
+26 Vdc (modulator filament)
+120 Vdc (pulse driver)
6.3 Vac (magnetron filament)
-12 Vdc
-465Vdc

The high voltage power supply provides the following operating voltages for the modulator:

+9 KVdc (anode)
+800 Vdc (screen grid)
-400 Vdc (control grid)

4.3 ANTENNA AS-3194 AND ANTENNA PEDESTAL AB -1247/AB-1247A

The antenna is an X-band slotted waveguide array mounted on the antenna pedestal. The antenna pedestal contains the antenna drive motor, drive system, sine-cosine resolver, heading line switch and (Antenna Pedestal AB-1247A only) synchro transmitter.

RF energy from the transmitter is coupled into waveguide and directed to the slotted waveguide array. Energy is radiated from the array in a narrow undirectional beam, so that the bearing of an object reflecting energy can be determined to within approximately 1°. Vertically, the beam is relatively wide so that the roll and pitch of the vessel will not normally impair the antenna direct line of sight to the horizon. The antenna radiates the pulse of high frequency energy, and receives the reflected pulse of energy when the transmitter is off.

The slotted waveguide array is continuously rotated by the drive system which reduces the antenna motor shaft speed to the desired antenna rotation speed. The resolver is an electro-mechanical device which converts the rotation and instantaneous direction of the antenna into electrical signals that cause the PPI trace to rotate in synchronism with the antenna. The heading line is generated by means of a reed switch that momentarily closes once every revolution. Figure 4-2 is a functional block diagram of the antenna and pedestal.

4.3.1 Antenna Drive Mechanism

The antenna drive mechanism consists of a 1/4horsepower drive motor and a gear reducer assembly. Operating power for the motor is supplied from the receiver transmitter through safety switch S1, the interlock switch and the normally closed thermostat switch. The motor drives the gear reducer assembly by means of a belt to provide antenna rotation at a speed of approximately 33 rpm.

4.3.2 Radiating Characteristics

The antenna array is horizontally polarized to produce a horizontal beam width of approximately 1.3 degrees and a vertical beam width of approximately 23 degrees. The array also produces horizontal sidelobes within 10 degrees (up to 29 dB down) of the main lobe, or more than 10 degrees (greater than 30 dB down). When the system is in operation, the peak power transmitted by the antenna is approximately 20 KW (18 W average) .

WARNING

WITH THE SYSTEM OPERATING AND THE ANTENNA STOPPED, A RADIATION HAZARD IS PRESENT WITHIN 6 FEET OF THE ANTENNA.

4.3.3 Antenna Position Circuits

The antenna position circuits provide data to the indicators to synchronize the indicator sweep with the antenna. The position circuits include sweep resolver B2, reed switch S2 and (in Antenna Pedestal AB-1247A only) synchro transmitter B3.

The stator winding of resolver B2 receives the resolver drive input (a 900-Hz square wave) from the indicator via the receiver transmitter. A compensation winding on B2 provides a feedback signal back to the indicator to regulate a constant drive input to the stator winding. The rotor of B2 is mechanically coupled to the antenna drive mechanism. Sine-modulated and cosine-modulated square wave outputs from rotor windings of B2 are sent to the indicator to rotate the PPI sweep in synchronism with the antenna.

Reed switch 52 can be mechanically adjusted for a momentary closure when the antenna is positioned forward at zero degrees. Closure of S2 provides a heading flash (HF) trigger to the indicators.
Synchro transmitter B3 (supplied with Antenna Pedestal AB-1247A only) provides antenna position data to the AN/SPA-25 and AN/SPA-66 indicators. Excitation voltage, 115 Vac, 60 Hz, is applied to the rotor winding of B3. The rotor is driven by antenna shaft gearing. The outputs, used to position the AN/SPA-25 and AN/SPA-66 indicator sweeps, are taken from stator windings of B3.

4.4 AZIMUTH RANGE INDICATORS IP-1282/IP-1283

The indicator displays the video output of the receiver at the proper bearing and range. The IP1282 (12-inch) and IP-1283 (16-inch) indicators use common electronic circuits and have identical control panels. The location of the bezel-mounted controls differs slightly due to the difference in cabinet size. Figure 4-3 is a functional block diagram of the indicators. The following description applies to both indicators.

4.4.1 Sweep Generation

4.4.1.1 North Stabilization Circuits. - The north stabilization circuits combine antenna position data and ship's compass data to enable the indicator display to be oriented with north appearing at the top (zero degrees) of the CRT. The north stabilized display is presented when the NSK function switch on the indicator control panel is in the GYRO STAB or HDG SET position. When the NSK function switch is in the HD UP position, north stabilization is disabled and the indicator display is oriented to present the ship's heading at the top of the CRT. The NSK resolver is automatically rotated to align the display with the ship's gyro compass when the NSK function switch is held in the HDG SET position.
When a north-stabilized display is presented, indicator lamps at the top of the indicator are illuminated to inform the operator of the condition.

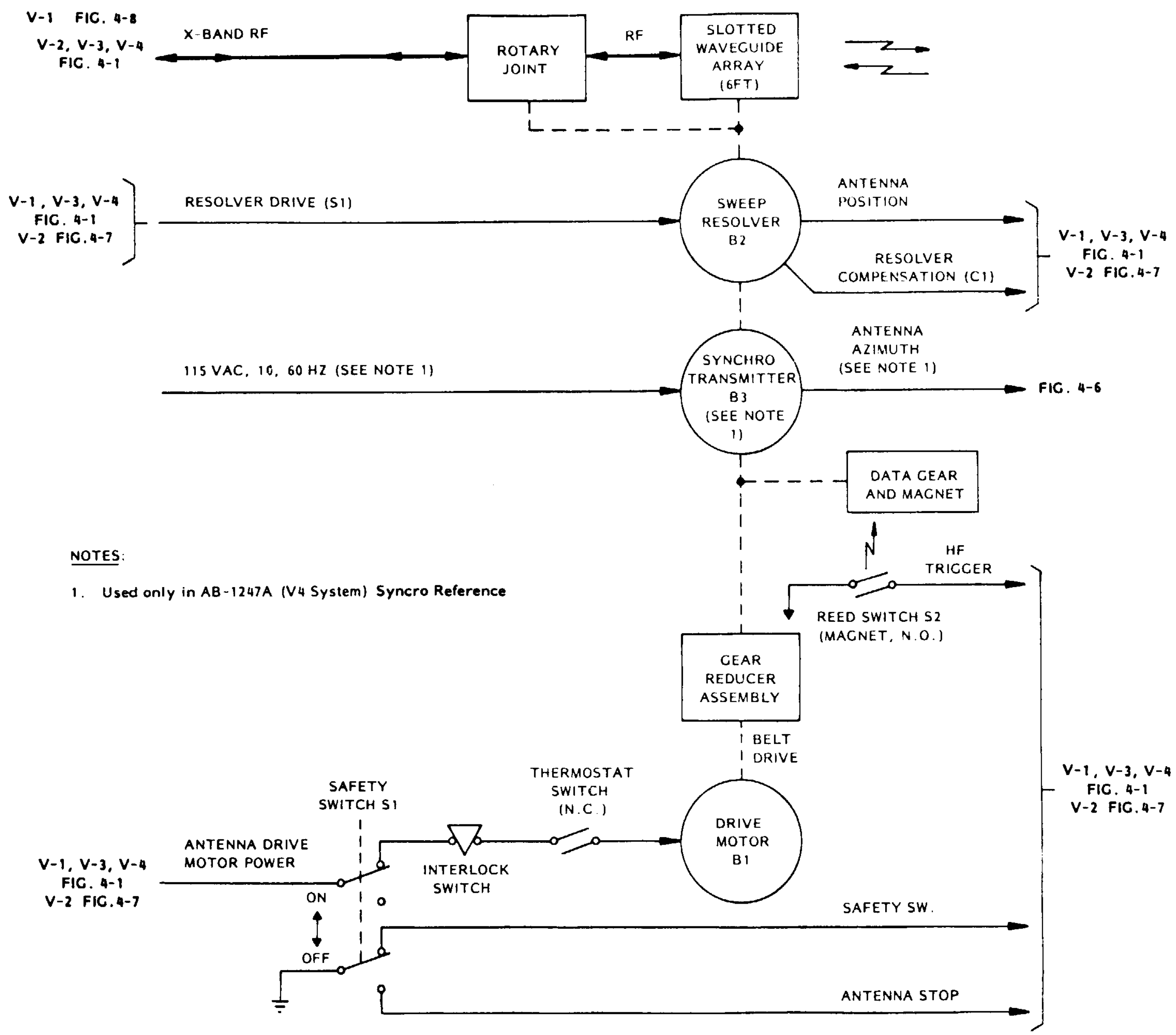


Figure 4-2. Antenna AS-3194/Antenna Pedestal AB-1247 Functional Block Diagram

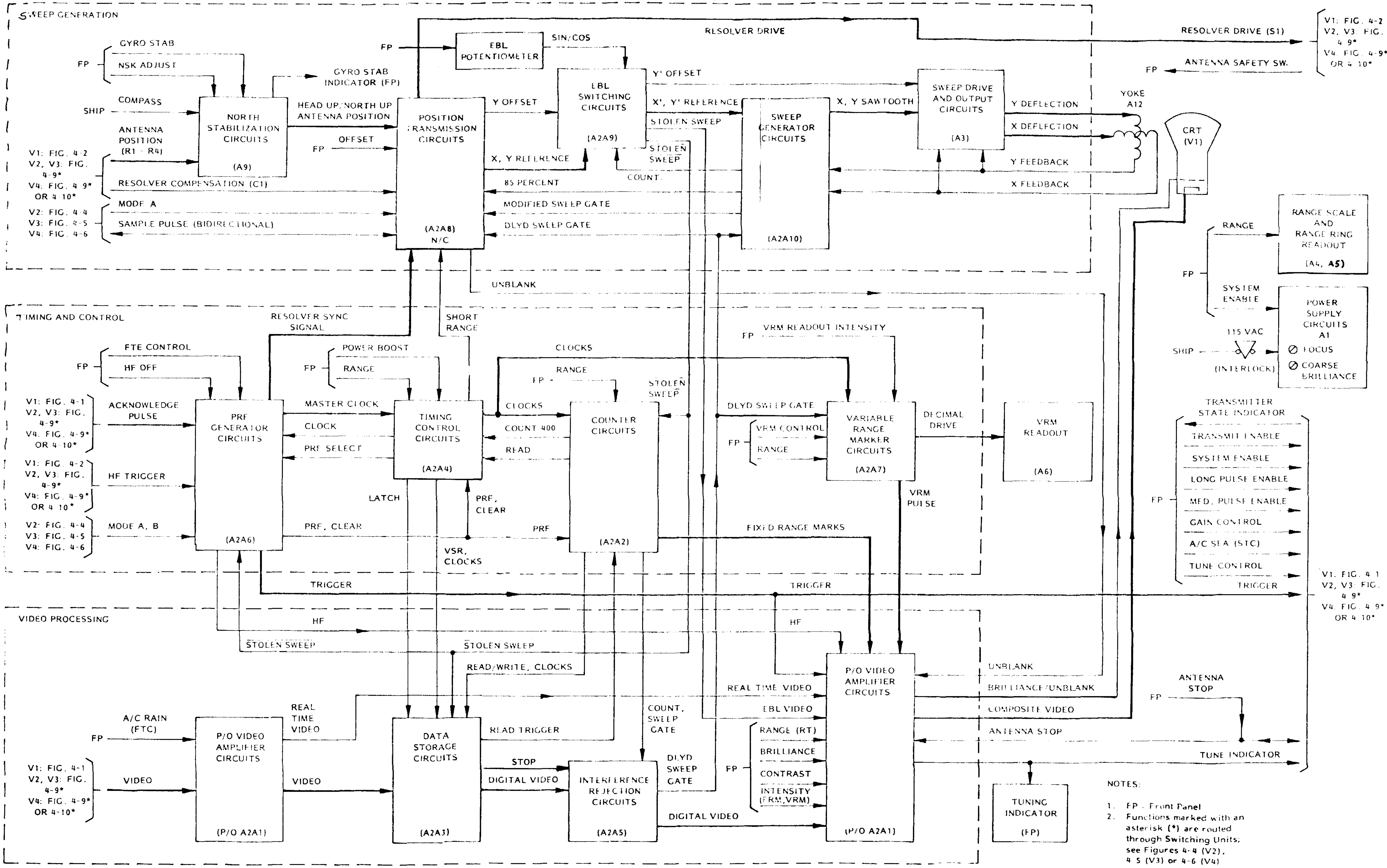


Figure 4-3. Azimuth Range Indicator's IP-1282/IP-1283 Functional Block Diagram

4.4.1.2 Position Transmission Circuits. - The position transmission circuits provide the following outputs:

a. Resolver drive signal
b. Sample pulses
c. X/Y reference signals
d. Display offset
e. Unblanking signal

When an indicator is designated master indicator by a command from the interswitch, the position transmission circuits produce the resolver drive signal for the antenna resolver and sample pulses for the slave indicators. The resolver drive signal is modulated by the antenna position and returned, via the NSK circuits to the position transmission circuits in the master and slave indicators. The sample pulses from the master indicator are sent to the slave indicators position transmission circuits to control sampling of antenna position data.

The resolver drive circuit of the slave indicator(s) is disabled by the absence of the master command signal from the digital processor.

The X/Y reference signals, derived by combining antenna position data and sampled/stored data, are applied to the sweep generator circuits via the EBL switching circuits.

The display offset signal, enabled by the OFFSET switch on the indicator bezel, is coupled through the EBL switching circuit to the Y-axis deflection amplifier in the sweep drive and output circuits.

The unblanking signal applied to the video amplifier is used to unblank the CRT for video display. The unblanking signal is derived from the modified sweep gate and the 85 percent signal from the sweep generator circuits. Burn protection is provided for the CRT by inhibiting CRT unblanking for subsequent sweeps when the sweep does not reach 85 percent of the CRT radius. When the INTRF REJECT switch is set to the ON position, the delayed sweep gate from the interference rejection circuits delays the unblanking signal by one range cell.

4.4.1.3 Sweep Generation Circuits. - The X and Y reference signals from the position transmission circuits are applied as sweep charging voltages to separate sawtooth generators. The charging rate (fast, medium or slow) is determined by the setting of the RANGE SELECT switch. Sweep charging is initiated by the delayed sweep gate from the interference rejection circuits. The X and Y sawtooth outputs are applied to the sweep drive and output circuits.

4.4.1.4 Sweep Drive and Output Circuits. - The X and Y sweep outputs are amplified in deflection amplifiers and applied to the CRT deflection yoke. The currents through the deflection yoke generate a net magnetic field which deflects the CRT sweep in synchronism with the antenna position. The CRT sweep is terminated at the end of the sweep gate, or if the sweep is deflected 10% beyond the CRT radius (whichever occurs earlier).

4.4.2 Video Processing

4.4.2.1 Data Storage Circuits. - Video signals from the receiver are converted to digital form and stored. High and low level signals are processed separately to provide two-level video display. The stored digital video is applied to the interference rejection circuits coincident with the beginning of the CRT sweep, at a rate determined by the range-scale selected sweep rate. High and low level video data is applied separately to the interference rejection circuits.

4.4.2.2 Interference Rejection Circuits. - The operation of the interference rejection (IR) circuits is selected by the INTRF REJECT switch on the indicator control panel. In the OFF position, video data is forwarded to the video amplifier for CRT display. In the ON position, the video data is forwarded to the video amplifier and also stored in IR memory. At the beginning of the next CRT sweep, the incoming video is compared with the stored video from the previous sweep. If the incoming and stored video are coincident (indicating true targets), the video is forwarded for display. If the incoming and stored video are not coincident (indicating random interference), the video signal is inhibited.

4.4.2.3 Video Amplifier Circuits. - The video amplifier circuits provide video amplification, signal mixing, CRT unblanking and processing of front panel control signals. Video amplification and signal mixing are provided for the following:

a. Digital video (high and low level)
b. Real time video
c. Fixed range marks
d. EBL (electronic bearing line) video
e. VRM (variable range mark)
f. Heading flash

The CRT is unblanked in response to the unblank command from the position transmission circuits.

Signals from the following front panel controls are processed:

a. CONTRAST - controls digital video contrast
b. RANGE RINGS - controls intensity of range marker rings
c. BRILLIANCE - controls brightness of sweep
d. VRM - controls intensity of VRM ring
e. EBL DIM - controls brightness of EBL
f. ANTI-CLUTTER RAIN - provides video differentiation (FTC)
g. RANGE SELECT (12RT position) - selects real time video display

The composite video is forwarded to the CRT cathode for intensity modulation display.

Tuning indicator drive signals are sent to the indicator and receiver transmitter TUNE indicators. The trigger from the PRF generator circuits controls the timing of the tune indicator signal.

4.4.3 Timing and Control

The timing and control circuits provide timing signals for the indicator and control system configuration selection.

4.4.3.1 PRF Generation Circuits. - The PRF generation circuit contains the 32.32 MHz system master timing oscillator and generates the PRF and clear signals for resetting all digital processor timing circuits. The circuit also generates clock signals for the variable range marker circuit, the resolver sync signals for the position transmission circuit, and the trigger for the video amplifier circuit.

4.4.3.2 Timing Control Circuits. - This circuit contains count-down circuits which process the master clock signal to generate timing and clock signals to control processing of digital video in the data storage circuits.

4.4.3.3 Counter Circuits. - The counter circuit contains the read/write control, sweep gate generator and range ring generator. The circuit generates the display clocks and sweep gate for the interference rejection circuits and the read/write control signals for the data storage circuits.

4.4.3.4 Variable Range Marker Circuits. - The VRM circuits generate a VRM pulse to display a variable range ring on the CRT and provide a digital readout of the VRM range in yards. The range of the VRM ring is controlled by the front panel VRM handwheel and is used to obtain precise target range.

4.4.4 Power Control and Power Supply Circuits

Primary 115 Vac input power from the ship's supply is applied through an interlock and energizes the power supply circuits when the front panel POWER switch is in the ST BY or TX ON position.

The power supply produces the following indicator operating voltages:

+5 Vdc	-60 Vdc
+6.3 Vdc	-465 Vdc
-12 Vdc	+4.5 KVdc
+12 Vdc	+17 KVdc
+60 Vdc	

4.4.5 CRT and Front Panel Circuits

The indicator uses a 12-inch (IP-1282) or 16inch (IP-1283) cathode ray tube (CRT) to display target and related video data. Yoke A12 provides a changing electromagnetic deflection field for CRT sweep rotation. The following inputs are applied to CRT V1:

Final anode	+17 KV
Focus anode	+4.5 KV
Grid No. 2	+475 V (Brilliance)
Grid No. 1	Positive unblank command
Cathode	Negative video, fixed and variable range marks, EBL

The indicator front panel controls/circuits provide control signals to the following circuits:

a. Master Indicator - PRF and pulse width (function of range scale), anti-clutter (sea) commands. Power on/off standby/transmit, receiver gain, three mile power boost, tune control and false target eliminator (FTE). These circuits are controlled by the master indicator only.

b. Master/Slave Indicator - North Stabilization, antenna stop, video contrast, brilliance range rings, panel lights, bearing scale lights VRM, VRM Readout, Flash off, anti-clutter (rain), offset and EBL. These circuits are controlled by the master and slave indicators.

4.5 SWITCHING UNITS SA-2139(V3,V4) AND SA-2156 (V2)

The switching units are rotary, multiple-deck switches which enable indicators in a multiple-indicator system to function as master or slave indicators. The switching units also provide signal switching and signal splitting for the various modes in each system

In the (V2) system, using one switching unit, interface is provided between the indicators and the video amplifiers. There are six modes available in the (V2) system.

In the (V3) system, using two switching units, interface is provided between the indicators and the video amplifiers. In the standard system (three indicators) twelve modes are available. If the optional fourth indicator is installed, sixteen modes are available. The combination of the switching unit settings determines the system mode.

In the (V4) system, using two switching units, interface is provided between the S-band receiver transmitter and the indicators/signal data converters, with ten modes available.

4.5.1 Signal Switching Circuits (V2, V3, V4)

Functional signal routing charts are provided in Figures 4-4 (V2), 4-5 (V3), and 4-6 (V4). The charts list the signals, the source, the switching unit switch and wafer, and the destination.

4.5.2 Signal Splitting Circuits (V2, V3, V4)

The signal splitting circuits of the switching units are completely passive and do not alter signals or voltages in any way. Video and acknowledge pulse signals are split to generate two half-amplitude signals.

4.6 INTERFACE UNIT J-3463 (V2)

The interface unit, remotely controlled by the switching unit, provides routing and switching of control and status signals between the receiver transmitters, indicators, waveguide switch and the antenna pedestal. Figure 4-7 is a functional block diagram of the interface unit.

4.6.1 Waveguide Switch Control Circuits (V2)

The spring-loaded waveguide switch normally connects the output of receiver transmitter I to the antenna pedestal rotary joint and the output of receiver transmitter II into a dummy load (position 1).

When mode DP-3 or DP-4 is selected, a switched 28V (position 2 command) signal from the switching unit is routed through the interface unit to the waveguide switch. This command signal causes the waveguide switch to connect the output of receiver transmitter II to the antenna pedestal rotary joint and the output of receiver transmitter I into a dummy load (position 2). Status signals from the waveguide switch to the interface unit provide a visual indication of the position (1 or 2) of the switch.

4.6.2 Signal Switching Circuit (V2)

The signal switching circuit routes resolver drive and compensation signals between the active receiver transmitter and the antenna pedestal.

Resolver drive relay K3, when deenergized (modes DP-1 and DP-2) routes the resolver drive/compensation signals between receiver transmitter I and the pedestal. When modes DP-3 or DP-4 are selected, relay K3 is energized and routes the resolver drive/ compensation signals between receiver transmitter II and the pedestal.

4.6.3 Signal Feedthrough Circuit (V2)

The following signals to both receiver transmitters are applied through the interface unit from the antenna pedestal:

a. Resolver outputs R1 through R4
b. Heading flash trigger
c. Antenna safety switch
d. Antenna Stop

4.6.4 Power Supply (V2)

The output of power supply PS-1, +28 Vdc is applied to the switching unit and to the waveguide switch.

4.7 WAVE GUIDE SWITCH SA-2140 (V2)

The waveguide switch is a two-position four-port, X-band RF switch which enables selection of one of two receiver transmitters (MTR's) to use a single antenna. Figure 4-8 is a functional block diagram of the waveguide switch.

4.7.1 RF Switch Circuit (V2)

Two of the four ports of the waveguide switch are connected to the two X-band receiver transmitters, one port is connected to the antenna pedestal and the other port is connected to the dummy load. In modes DP-1 and DP-2, the switch solenoid is deenergized and receiver transmitter I is connected to the antenna and receiver transmitter II is connected to the dummy load (position 1). In modes DP-3 and DP-4, the switch solenoid is energized and receiver transmitter II is connected to the antenna and receiver transmitter I is connected to the dummy load (position 2).

Source			Switching Units		Destination	
Signal	Equipment	Fig.	Switch	Wafers	Equipment	Fig.
System Enable	Video Amplifier	4-9	S1-A	1,2	Master Indicator	4-3
Transmit Enable	Master Indicator	4-3	S1-A	3,4	Video Amplifier	4-9
Tuning Indicator	Master Indicator	4-3	S1-A	5,6	Video Amplifier	4-9
MTR State	Video Amplifier	4-9	S1-A	7,8	All Indicators	4-3
Long Pulse Enable	Master Indicator	4-3	S1-A	9,10	Video Amplifier	4-9
Medium Pulse Enable	Master Indicator	4-3	S1-A	11,12	Video Amplifier	4-9
Antenna Stop	Any Indicator	4-3	S1-A	13,14	Video Amplifier	4-9
System Enable Ret.	Master Indicator	4-3	S1-A	15,16	Video Amplifier	4 9
A/C Sea Control	Master Indicator	4-3	S1-A	17,18	Video Amplifier	4-9
Gain Control	Master Indicator	4-3	S1-A	19,20	Video Amplifier	4-9
Spare	---	--	S1-A	21,22		
Tune Control	Master Indicator	4-3	S1-A	23,24	Video Amplifier	4-9
Antenna Safety Switch	Video Amplifier	4-9	S1-A	25.26	All Indicators	4-3
HF Trigger	Video Amplifier	4-9	S1-A	27,28	All Indicators	4-3
Spares	---	--	S1-A	29,30	---	--
Resolver S1 Indicator	Master	4-3	S1-B	1,2	Video Amplifier	4-9
Resolver S3/C3 Indicator	Master	4-3	S1-B	3,4	Video Amplifier	4-9
Resolver C1 Amplifier	Video	4-9	S1-B	5,6	Master Indicator	4-3
Resolver R1 Amplifier	Video	4-9	S1-B	7,8	Master Indicator	4-3

Source			Switching Units		Destination	
Signal	Equipment	Fig.	Switch	Wafers	Equipment	Fig.
Resolver R3 Amplifier	Video	4-9	S1-B	9,10	Master Indicator	4-3
Resolver R2 Amplifier	Video	4-9	S1-B	11,12	Master Indicator	4-3
Resolver R4 Amplifier	Video	4-9	S1-B	13,14	Master Indicator	4-3
Spares	---	--	S1-B	15,16	---	--
Trigger Indicator	Master	4-3	S1-B	17,18	Video Amplifier	4-9
Acknowledge Pulse	Video Amplifier	4-9	S1-B	19,20,21,22	All Indicators	4-3
Video Amplifier	Video	4-9	S1-B	23,24.25,26	All Indicators	4-3
Spares			S1-B	27,28,29,30		
Sample Pulse	Switching Unit		S1-C	2,7	Each Indicator	4-3
Mode A	Switching Unit		S1-C	3,5	Each Indicator	4-3
Mode B	Switching Unit		S1-C	4,6	Each Indicator	4-3
Spares	---	--	S-C	1,8,9	---	--
28 VDC (W/G Switch	Waveguide Switch	4-8	S1-C	10	Waveguide Switch	4-8

Figure 4-4. Switching Unit SA-2156
Functional Signal Routing Chart (V) 2

Source			Switching Units		Destination	
Signal	Equipment	Fig.	Switch	Wafers	Equipment	Fig.
System Enable	Video Amplifier	4-9	S1-A	1,2	Master Indicator	4-3
Transmit Enable	Master Indicator	4-3	S1-A	3,4	Video Amplifier	4-9
Tune Indicator	Master Indicator	4-3	S1-A	S.6	Video Amplifier	4-9
MTR State	Video Amplifier	t-9	S1-A	7	All Indicators	4- 3
Long Pulse Enable	Master Indicator	4-3	S1-A	8,9	Video Amplifier	4-9
Medium Pulse Enable	Master Indicator	4-3	S1-A	10,11	Video Amplifier	4-9
Antenna Stop	Any Indicator	4-3	S1-A	12	Video Amplifier	4-9
System Enable Return	Master Indicator	4-3	S1-A	13,14	Video Amplifier	4-9
AVC Sea Control	Master Indicator	4-3	S1-A	15, 16	Video Amplifier	4-9
Gain Control	Master Indicator	4-3	S1-A	17,19	Video Amplifier	4-9
Spares	---	---	S1-A	19,20	---	---
Tune Control	Master Indicator	4-3	S1-A	21,22	Video Amplifier	4-9
Antenna Safety Switch	Video Amplifier	4-9	S1-A	23,24	Master Indicator	4-3
HF Trigger	Video Amplifier	4-9	SI-A	25	All Indicators	4-3
Spares	---	---	S1-A	26, 27	---	---
Spares	---	---	S1-A	28, 29,30	---	---
Sample Pulse	Master Indicator	4-3	S1-B	1,2,3	Slave Indicators	4-3
Mode A	Switching Unit		S1-B	4.6	Each Indicator	4-3
Mode B Unit	Switching Indicator	---	S1-B	5,7	Each	4-3
Spares	---	---	S1-B	8, 9, 10	---	---

Source			Switching Units		Destination	
Signal	Equipment	Fig.	Switch	Wafers	Equipment	Fig.
Resolver S1	Master Indicator	4-3	S1-B	11,12	Video Amplifier	4-9
Resolver S3/C3	Master Indicator	4-3	S1-B	13,14	Video Amplifier	4-9
Resolver C1	Video Amplifier	4-9	S1-B	15,16	Master Indicator	4-3
Resolver R1	Video Amplifier	4-9	S1-B	17	All Indicators	4-3
Resolver R2	Video Amplifier	4-9	S1-B	18	All Indicators	4-3
Resolver R3	Video Amplifier	4-9	S1-B	19	All Indicators	4-3
Resolver R4	Video Amplifier	4-9	S1-B	20	All Indicators	4-3
Spare-	---	---	S1-B	21	---	---
Trigger	Master Indicator	4-3	S1-B	22,23,24	Video Amplifier	4-9
Acknowledge Pulse	Video Amplifier	4-9	S1-B	25,26	All Indicators	4-3
Video	Video Amplifier	4-9	S1-B	27,28	All Indicators	4-3
Spares	---	---	S1-B	29,30	---	---

Figure 4-5. Switching Units SA-2139 Functional Signal Routing Chart (V) 3

Source			Switching Units		Destination	
Signal	Equipment	Fig.	Switch	Wafers	Equipment	Fig.
System Enable	Video Amplifier	4-9 (X) or 4-10 (S)	S1-A	1,2	Master Indicator	4-3
Transmit Enable	Master Indicator	4-3	S1-A	3,4	Video Amplifier	4-9 (X) or 4-10 (S)
Tune Indicator	Master Indicator	4-3	S1-A	5,6	Video Amplifier	4-9 (X) or 4-10 (S)
MTR State	Video Amplifier	4-9 (X) or 4-10 (S)	S1-A	7	All Indicators	4-3
Long Pulse Enable	Master Indicator	4-3	S1-A	8,9	Video Amplifier	4-9 (X) or 4-10 (S)
Medium Pulse Enable	Master Indicator	4-3	S1-A	10,11	Video Amplifier	4-9 (X) or 4-10 (S)
Antenna Stop	Any Indicator	4-3	S1-A	12	Video Amplifier	4-9 (X) or 4-10 (S)
System Enable Return	Master Indicator	4-3	S1-A	13,14	Video Amplifier	4-9 (X) or 4-10 (S)
A/C Sea Control	Master Indicator	4-3	S1-A	15,16	Video Amplifier	4-9 (X) or 4-10 (S)
Gain Control	Master Indicator	4-3	S1-A	17,18	Video Amplifier	4-9 (X) or 4-10 (S)
Spare	---	---	S1-A	19,20	---	---
Tune Control	Master Indicator	4-3	S1-A	21,22	Video Amplifier	4-9 (X) or 4-10 (S)
Antenna Safety Switch	Video Amplifier	4-9 (X) or 4-11 (S)	S1-A	23,24	All Indicators	4 3
HF Trigger	Video Amplifier	4-9 (X) or 4-11 (S)	SI-A	25	All Indicators	4-3
Spares	---	---	S1-A	26,27	---	---
Antenna Azimuth Synchro	Antenna Pedestals	4-2 (X) or 4-11 (S)	S1-A	28,29,30	Signal Data Converter	4-12
Sample Pulse	Master Indicator	4-3	S1-B	1,2,3	Slave Indicators	4-3
Mode A	Switching Unit	---	S1-B	4,6	Each Indicator	4-3
Mode B	Switching Unit	---	S1-B	5,7	Each Indicator	4-3

Source			Switching Units		Destination	
Signal	Equipment	Fig.	Switch	Wafers	Equipment	Fig.
Spares-	---	---	S-B	8,9, 10	---	---
Resolver SI	Master Indicator	4-3	S1-B	11,12	Video Amplifier	4-9 (X) or 4-10 (5)
Resolver S3/C3	Master Indicator	4-3	S1-B	13,14	Video Amplifier	4-9 (X) or 4-10 (S)
Resolver C1	Video Amplifier	4-9 (X) or 4-10 (S)	S1-B	15, 16	Master Indicator	4-3
Resolver R1	Video Amplifier	4-9 (X) or 4-10 (5)	S1-B	17	All Indicators	4-3
Resolver R3	Video Amplifier	4-9 (X) or 4-10 (S)	S1-B	18	All Indicators	4-3
Resolver R2	Video Amplifier	4-9 (X) or 4-10 (S)	S1-B	19	All Indicators	4-3
Resolver R4	Video Amplifier	4-9 (X) or 4-10 (S)	S1-B	20	All Indicators	4-3
Spare-	---	---	S1-B	21-		
Trigger	Master Indicator	4-3	S1-B	22,23,24	Video Amplifier	4-9 (X) or 4-10 (S)
Acknowledge Pulse	Video Amplifier	4-9 (X) or 4-10 (5)	S1-B	25,26	All Indicators	4-3
Video	Video Amplifier	4-9 (X) or 4-10 (5)	S1-B	27,28	All Indicators	4-3
Spares-	---	---	S1-B	29,30	---	---

Figure 4-6. Switching Units SA-2139 Functional Signal Routing Chart (V) 4

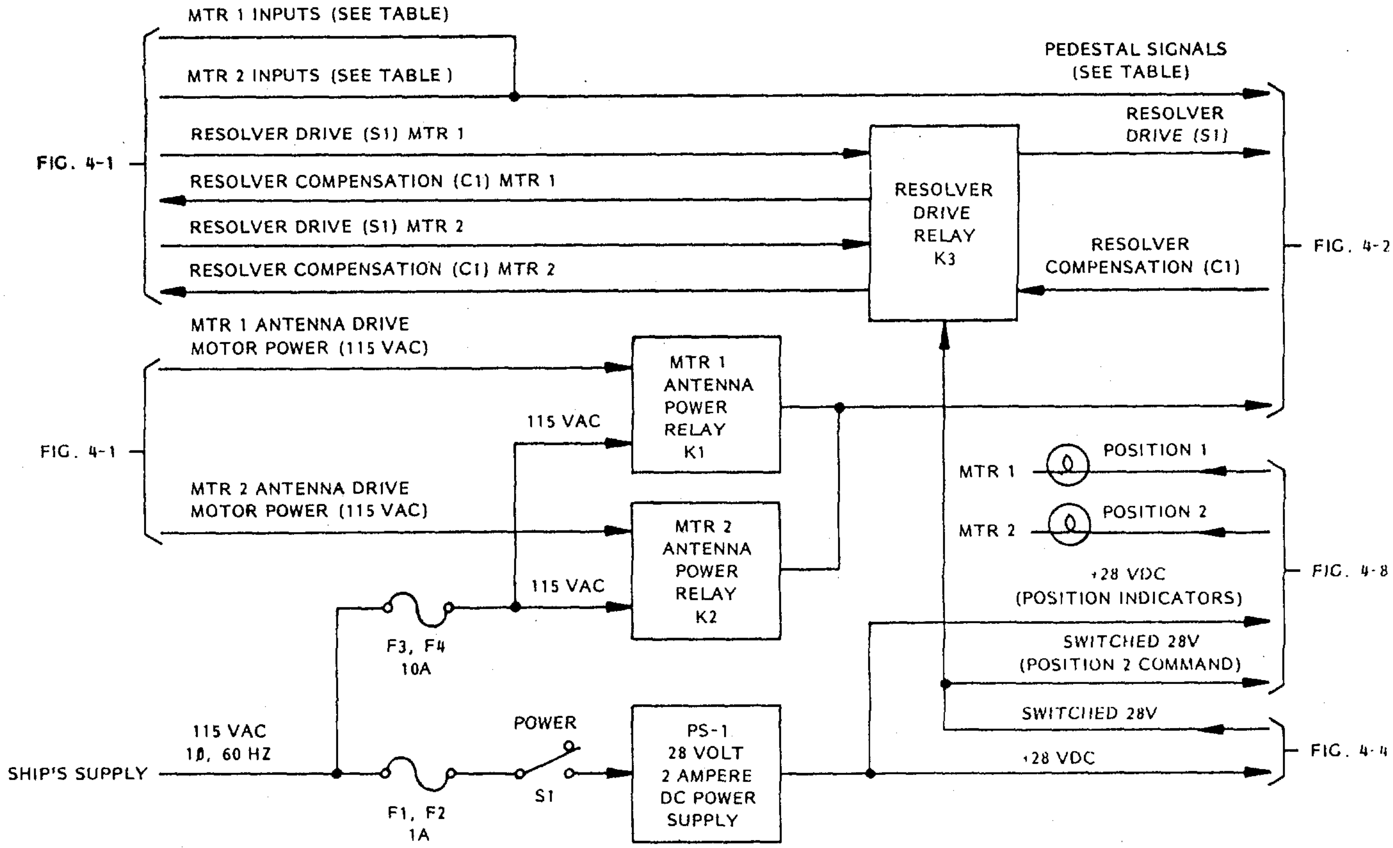


TABLE
MTR TO PEDESTAL SIGNALS

1. Resolver Outputs R1 through R4
2. Safety Switch Dimmer
3. HF Trigger
4. Antenna Safety Switch

Figure 4-7. Interface Unit J-3463 Functional Block Diagram (V2)

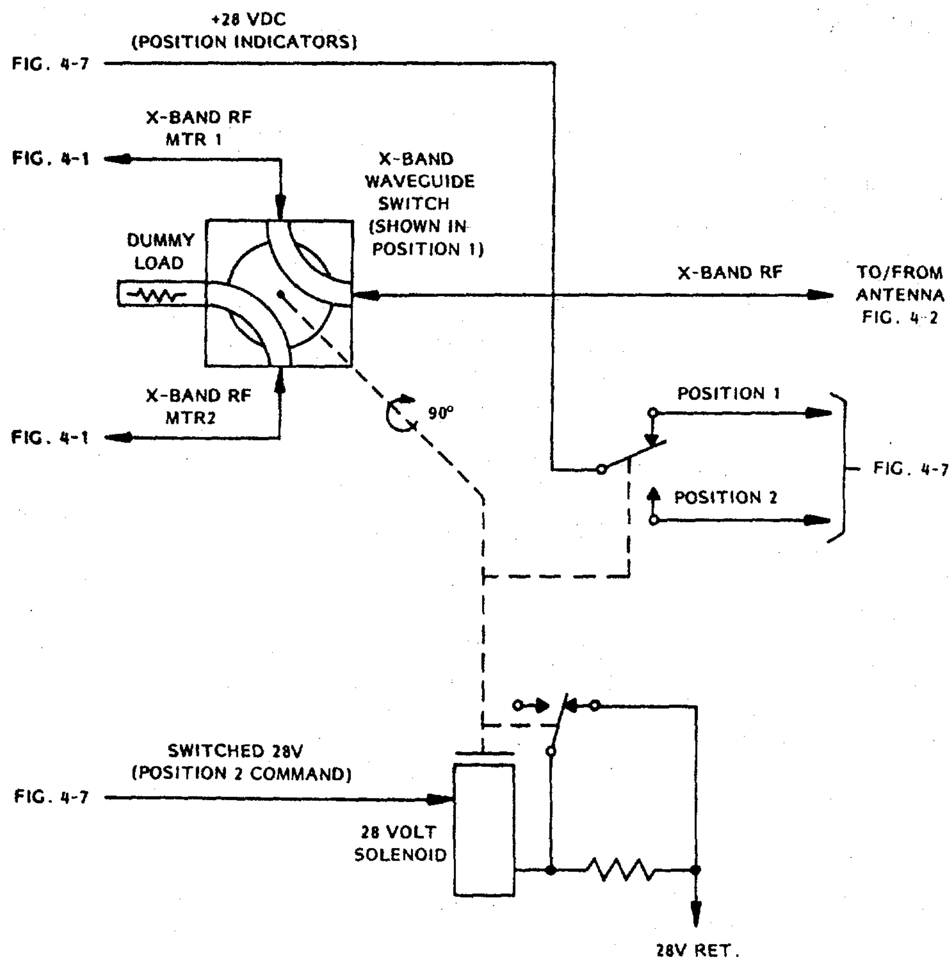


Figure 4-8. Wave Guide Switch SA-2140 Functional Block Diagram (V2)

4.7.2 RF Switch Control and Position Sensing Circuit (V2)

The spring-loaded waveguide switch will be in position 1 (modes DP-1 or DP-2) until the switch solenoid is energized by selection of modes DP-3 or DP-4. When DP-3 or DP-4 is selected, a +24V position 2 command signal is applied to the switch solenoid from the switching unit via the interface unit. When the solenoid is energized, the switch is moved to position 2 (receiver transmitter II state), a position 2 status signal is applied to the interface unit, and a resistor is added in the solenoid line to reduce the solenoid current from a high switching level to a lower holding level

4.7.3 Dummy Load V2

During the normal operating modes, DP-1 through DP-4, the off-line receiver transmitter is connected to the dummy load but no power is applied to the dummy load as the off-line receiver transmitter is turned off. During the two maintenance modes, DP-5 and DP-6, it is possible to have both receiver transmitters turned on and the off-line receiver transmitter RF output will be applied to the dummy load. The dummy load has a frequency range of 8200 to 12400 MHz, a rated average power rating of 500 watts, a test peak power of 290 kW and a VSWR of 1.10 (max.) .

4.8 VIDEO AMPLIFIER AM-6932 (V2, V3, V4)

The video amplifier provides resolver signal, video signal, acknowledge pulse, and control signal interface coupling between the receiver transmitters receiver transmitters and switching units. Figure 4-9 is a functional block diagram of the video amplifier.

4.8.1 Video Amplifier Circuits (V2, V3, V4)

The video amplifier circuits comprise three 6 dB video amplifiers and a passive 70-ohm splitter. The video signal from the receiver transmitter is amplified by one of the video amplifiers and applied to the passive splitter. The two outputs from the passive splitter are amplified by the other two video amplifiers and applied to switching units.

4.8.2 Resolver Drive Circuits (V2, V3, V4)

The resolver drive circuits provide the gain necessary to drive the antenna resolver from the master indicator via the switching unit, receiver, transmitter, and interconnecting cables. The circuits also provide the gain and isolation necessary to drive multiple indicators from the antenna resolver.

The resolver drive circuits compare a feedback signal from the resolver compensating winding and a 900-Hz square-wave reference signal from the interswitch units to produce a highly stabilized resolver drive output signal which is added to the resolver stator via the receiver transmitter.

Position information (antenna resolver output signals) are applied to two buffer amplifiers to provide low-impedance outputs to the switching units.

4.8.3 Acknowledge Pulse Circuit (V2, V3, V4)

The acknowledge pulse circuit employs a passive splitter with an input and output impedance of 75 ohms. The acknowledge signal from the receiver transmitter is split into two half--amplitude acknowledge signals and applied to the switching units.

4.8.4 Signal Feedthrough Circuits (V2, V3, V4)

The junction terminals serve as tie points for the various control signals required to interface the receiver transmitter with the switching units.

4.8.5 Power Supply Circuits (V2, V3, V4)

A regulated power supply in the video amplifier assembly provides ±12 Vdc as operating voltages for the modules in the assembly.

4.9 RECEIVER TRANSMITTER RT-1241 (V4)

The modulator, transmitter, and receiver sections for the S-band are contained in RT-1241. Solid-state electronics are utilized throughout except for the magnetron and the hard-tube modulator. The primary functions of the receiver transmitter are to generate and transmit short pulses and to amplify the echoes received by the antenna.

The receiver transmitter inputs are: the trigger and control signals from the indicator; the microwave signal returns from the antenna; and ship's power. The receiver transmitter outputs are: the transmitter pulse to the antenna; the video output and the acknowledge pulse to the indicator; and the ship's power (fused) to the antenna motor.

A functional block diagram of the receiver transmitter is shown in Figure 4-10. A description of the receiver transmitter subassemblies, subdivided functionally and keyed to Figure 4-10, is given below:

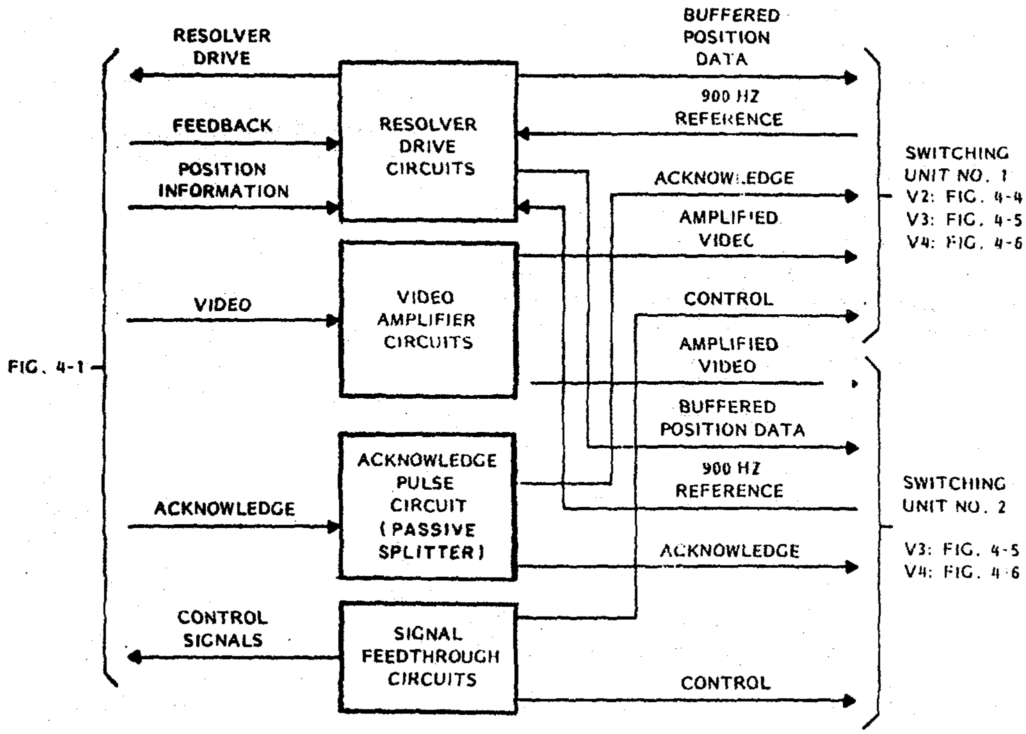


Figure 4-9. Video AmplifierAM-6932 Functional Block Diagram (V2, V3, V4)

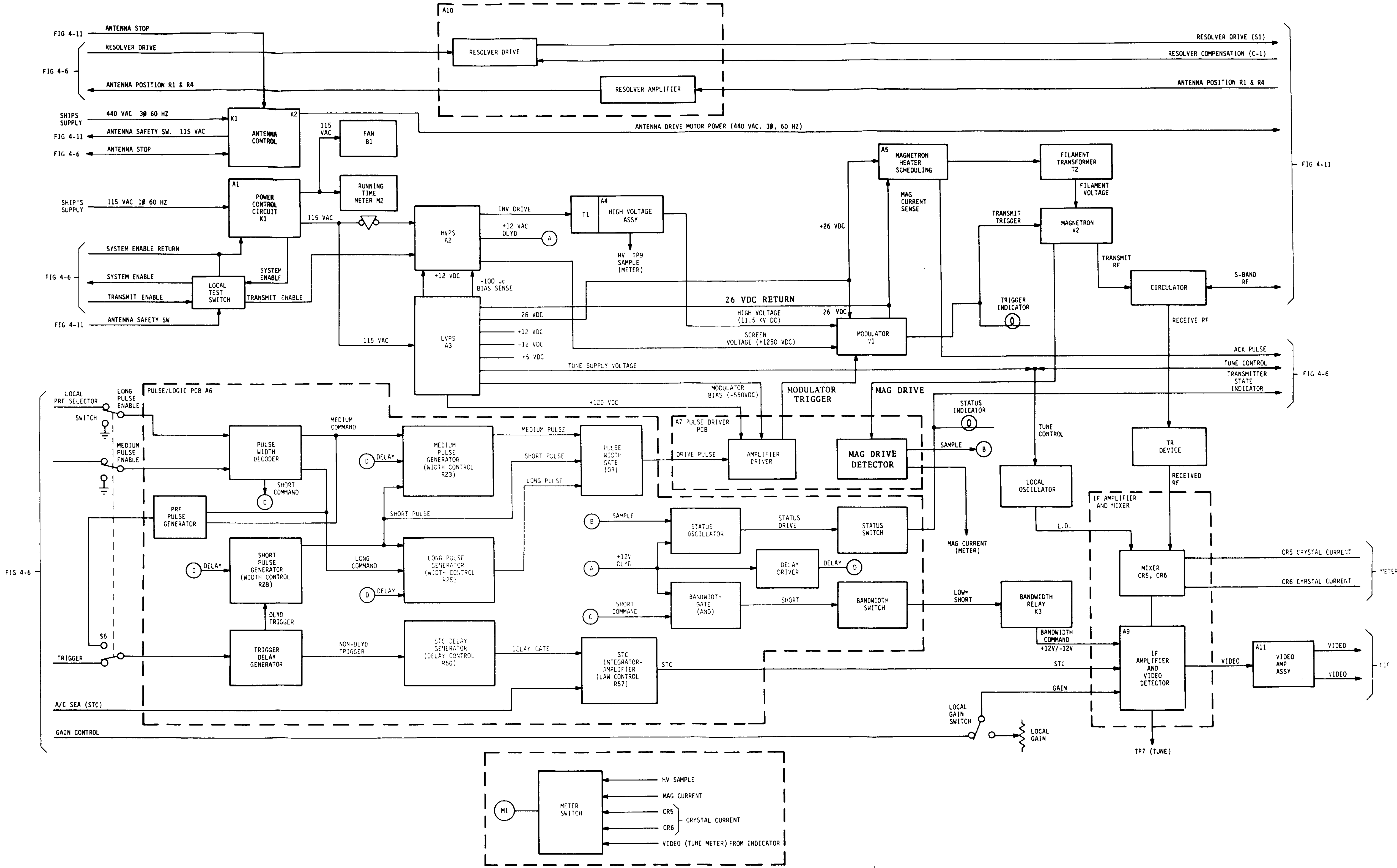


Figure 4-10. Receiver Transmitter RT-1241 Functional Block Diagram (V4) (S-Band)

4.9.1. Pulse Generation and Receiver Control Circuits RT-1241

The pulse generation and receiver control circuits establish the pulse width for the transmitter and select either narrow or wide bandwidth for the receiver. The circuits also determine STC recovery start timing to control receiver short range gain.

Input triggers for the transmitter are normally received from the master indicator at the proper PRF for the selected range. For test purposes, an on-board local oscillator provides the proper repetition rate. This allows for complete testing of a receiver transmitter without the use of a working display. The PRF selector lines control the local test oscillator and the 2-input, 3-output pulse width decoder to determine which of the pulse generators (one-shot multivibrators) is triggered. The MTR trigger pulse is routed through the trigger delay generator circuit to begin developing the STC waveform. After the delay period, the one-shot multivibrators are all triggered; however, the 2-input, 3-output pulse width decoder determines which ones are enabled to produce an output pulse.

The output of the pulse width gate is routed to the amplifier driver which amplifies the pulse to drive the modulator. Each of the pulse widths is independently adjustable: short pulse (R28); medium pulse (R23); and long pulse (R25).

During short pulse operation the pulse width decoder switches the receiver IF bandwidth to 30 MHz, via the bandwidth gate, switch and relay K3. During medium and long pulse operation the IF bandwidth is 3 MHz.

The non-delayed indicator trigger is applied through the STC delay generator to the STC integrator-amplifier. The output of the integrator-amplifier, the delayed STC waveform, is applied to the IF amplifier to control short range gain of the receiver. The slope of the STC waveform trailing edge is set by STC Law control R57 and the ANTI-CLUTTER SEA control. The STC waveform can be adjusted to approximately an eight-mile range to control short range gain.

Maintenance test switches provide local control of the receiver transmitter status (off, standby, on) and selection of the PRF and pulse width.

4.9.2. Transmission Circuits (RT-1241)

4.9.2.1. Modulator-Transmitter Circuits (V4). -The primary function of modulator V1 is to provide a means of pulsing the magnetron transmitter. The modulator is the same type used in the X-band radar but is driven harder for the higher power S-band magnetron. The output of a pulse width generator is amplified to drive the modulator which allows the magnetron to be brought rapidly into and out of oscillation. The modulator is a hard-tube type whose pulse width is selected and triggered by the indicator. When the magnetron fires, the modulator generates the acknowledge pulse which is sent to the indicator to trigger and synchronize the display with the transmitted pulse.

The transmitter utilizes magnetron V2 to produce a minimum peak output of 50 kilowatts for the S-band radar. The magnetron output is coupled through an RF circulator to the external waveguide, which routes the high frequency burst of energy to the antenna via a rotary joint located in the antenna pedestal.

4.9.2.2. Magnetron Heater Scheduling and Acknowledge Pulse Detector Circuits- - Proportional heater control for the magnetron is provided by the magnetron heater scheduling circuit. The duty cycle is sensed in the cathode of the modulator by this circuit which adjusts the filament voltage to the magnetron. The acknowledge pulse detector circuit, also triggered by a pulse derived from the modulator cathode, provides the acknowledge pulse to the indicator for display synchronization.

4.9.3. Circulator and Receiver RF Circuits (RT-1241)

The 3-port circulator couples the transmitted RF energy from the transmitter to the antenna pedestal rotary joint. Reflected RF energy received by the antenna is coupled through the circulator to the receiver. The receiver RF circuits process the received RF signals for use by the IF and video amplifier circuits.

Since the transmitter and receiver use a common waveguide feed and antenna, a TR device is used to prevent high powered transmitter pulses from feeding into the sensitive receiver circuits. Without this protection, the mixer crystals would be physically destroyed, and the local oscillator damaged. The passive limiter provides protection for the crystals against pulses from other transmitters when the radar is switched off.

The mixer crystals, CR5 and CR6, combine the received RF signal (at the transmitter frequency) with the signal from the local oscillator (45 MHz above the transmitter frequency) to produce the 45-MHz echo signals for the receiver. The local oscillator is mechanically adjustable and, electrically tunable from the indicator TUNE control.

4.9.4 Receiver Circuits (V4)

The receiver circuits are identical to the receiver circuits in the X-band receiver transmitter and are described in paragraph 4.2.4.

4.9.5 Video Amplifier Circuits (V4)

The video amplifier circuits are identical to the circuits in Video Amplifier AM-6932 and are described in paragraph 4.8.1.

4.9.6 Resolver Drive Circuits (V4)

The resolver drive circuits are identical to the circuits in Video Amplifier AM-6932 and are described in paragraph 4.8.2.

4.9.7 Built-in Test Circuits (V4)

The built-in test circuits provide a means of monitoring and controlling the receiver transmitter during maintenance. Meter Ml, in conjunction with the MONITOR SELECT switch, provides an indication of crystal currents, high voltage, magnetron current, and is also used for tuning. The LOCAL TEST switch permits local control of the receiver transmitter (off, standby, on). The LOCAL PRF SELECTOR selects either remote (indicator controlled) or local (short, medium, long) pulse repetition rates for test purposes.

4.9.8 Power Control and Power Supplies (V4)

Primary input power to the receiver transmitter (115 Vac, single phase, 60 Hz and 440 Vac, three phase, 60 Hz) is controlled by the transmit enable lines which are closed when the indicator POWER switch is set to the ST BY or TX ON position. The receiver transmitter LOCAL TEST switch is connected in parallel with the indicator POWER switch to provide independent turn-on capability to standby at the receiver transmitter for maintenance.

The 440 Vac, switched by a power contactor to provide antenna drive motor power, is also switch controlled by the receiver transmitter ANT ROTATION switch. The low voltage power supply provides the following operating voltages for the receiver transmitter circuits:

+5 and +12 Vdc (logic circuits)
+26 Vdc (modulator filament)
+120 Vdc (pulse drive)
-12 Vdc
-550 Vdc

The high voltage power supply provides the following operating voltages for the modulator:

+11.5 KVdc (anode)
+1250 Vdc (screen grid)
-550 Vdc (control grid)

4.10 ANTENNA AS-3195 AND ANTENNA PEDESTAL AB-1248 (V4)

The antenna is an S-band end-fed slotted waveguide array mounted on the antenna pedestal. The antenna pedestal contains the antenna drive motor, drive system, sine-cosine resolver, syncho transmitter and heading line switch.

RF energy from the transmitter is coupled and directed to the slotted waveguide array. Energy is radiated from the array in a narrow un-directional beam, so that the bearing of an object reflecting energy can be determined to within approximately 1°. Vertically, the beam is relatively wide so that the roll and pitch of the vessel will not normally impair the antenna direct line of sight to the horizon. The antenna radiates the pulse of high frequency energy, and receives the reflected pulse of energy when the transmitter is off.

The slotted waveguide array in continuously rotated by the drive system which reduces the antenna motor shaft speed to the desired antenna rotation speed. The resolver is an electro-mechanical device which converts the rotation and instantaneous direction of the antenna into electrical signals that cause the PPI trace to rotate in synchronism with the antenna. The heading line is generated by means of a reed switch that momentarily closes once every revolution. Figure 4-11 is a functional block diagram of the antenna and pedestal.

4.10.1 Antenna Drive Mechanism (V4)

The antenna drive mechanism consists of a 1horsepower drive motor and a gear reducer assembly. Operating power for the motor is supplied from the receiver transmitter through safety switch SI, the interlock switch and the normally closed thermostat switch. The motor drives the gear reducer assembly by means of a belt to provide antenna rotation at a speed of approximately 33 rpm.

4.10.2 Radiating Characteristics (V4)

The antenna array is horizontally polarized to produce a horizontal beam width of approximately 2 degrees and a vertical beam width of approximately 23 degrees. The array also produces horizontal sidelobes within 10 degrees (up to 29 dB down) of the main lobe, or more than 10 degrees (greater than 30 dB down). When the system is in operation, the peak power transmitted by the antenna is approximately 50 kW.

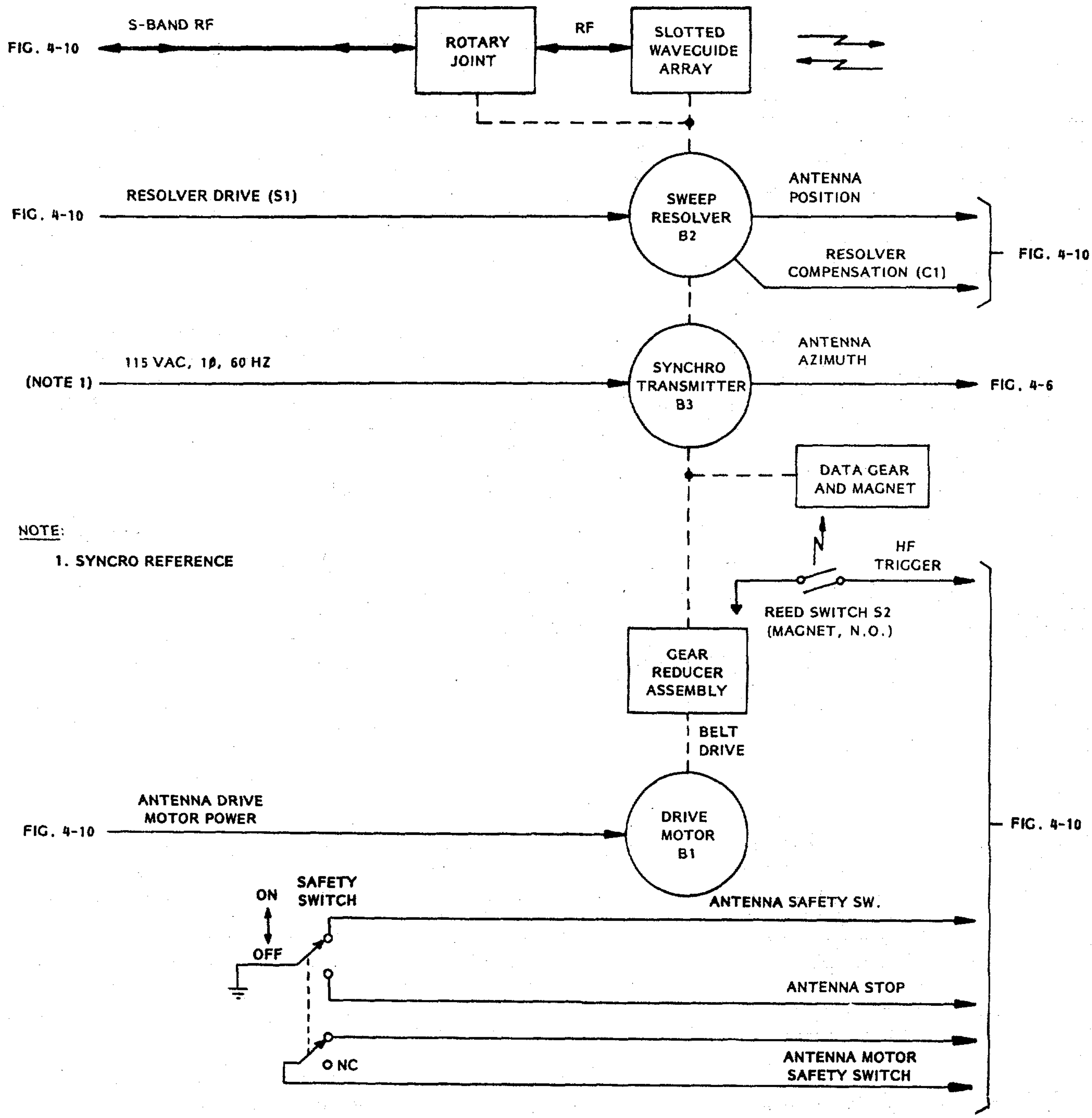


Figure 4-11. Antenna AS-3195 and Antenna Pedestal AB-1248 Functional Block Diagram (V4)

WARNING
WITH THE SYSTEM OPERATING AND THE ANTENNA STOPPED, A RADIATION HAZARD IS PRESENT WITH 35 FEET OF THE ANTENNA

4.10.3 Antenna Position Circuits (V4)

The antenna position circuits provide data to the indicators to synchronize the indicator sweep with the antenna. The position circuits include sweep resolver B2, synchro transmitter B3 and reed switch S2.

The stator winding of resolver B2 receives the resolver drive input (a 900-Hz square wave) from the indicator via the receiver transmitter. A compensation winding on B2 provides a feedback signal back to the indicator to regulate a constant drive input to the stator winding. The rotor of B2 is mechanically coupled to the antenna drive mechanism. Sire-modulated and cosine-modulated square-wave outputs from rotor windings of B2 are sent to the indicator to rotate the PPI sweep in synchronism with the antenna.

Synchro transmitter B3 provides antenna position data to the AN/SPA-25 and AN/SPA-66 indicators. Excitation voltage, 115 Vac, 60 Hz, is applied to the rotor winding of B3. The rotor is driven by antenna shaft gearing. The outputs, used to position the AN/SPA-25 and AN/SPS-66 indicator sweeps, are taken from stator windings of B3.

Reed switch S2 can be mechanically adjusted for a momentary closure when the antenna is positioned forward at zero degrees. Closure of S2 provides a heading flash (HF) trigger to the indicators.

4.11 SIGNAL DATA CONVERTER CV-3442 (V4)

The signal data converter provides compatible operating signals to the AN/SPA-25 and AN/SPA-66 from Radar Set AN/SPS-64(V)4. Figure 4-12 is a functional block diagram of the signal data converter.

4.11.1 Video Amplifier and FTC Circuits (V4)

Video data from the receiver transmitter, via the switching unit, is buffered, differentiated, split and applied to the AN/SPA-25 and AN/SPA-66 indicators. Video differentiation, to provide time constants matched to the transmitter pulse widths, is selected at the control indicators which are mounted on the AN/SPA-25 and AN/SPA-66 indicators.

4.11.2 Heading Flash Circuit (V4).

The heading flash signal from the antenna. via the switching unit, is applied to the input protection circuit which limits positive- and negative going transients. The Schmitt trigger produces a positive-going transition which is applied to the brighten sweep flip/flop shift register. The output of the register is applied through the gain controls and mixed into the video output lines. When selected at the control indicators mounted on the ANI SPA-25 and AN/SPA-66 indicators, the heading flash information can be removed from the video output lines.

4.11.3 Acknowledge Pulse/Trigger Circuit (VII)

The acknowledge pulse from the receiver transmitter, via the switching unit, is applied to the in-put protection circuit which limits positive- and negative-going transients. The Schmitt trigger generates a noise-free negative-going transition to fire the single shot multivibrator. The multivibrator output is inverted and applied through the overload protection drivers to provide independent triggers for the AN/SPA-25 and AN/SPA-66 indicators. The multivibrator also provides a clock signal for the heading flash circuit.

4.11.4 Azimuth Synchro and North Stabilization Circuits (V4)

Antenna position signals from the antenna synchro transmitter are connected directly through the signal data converter to the AN/SPA---25 and AN/ SPS-66 indicators when the RB/NS switch is in the RB position. In the NS position the antenna position signals are applied through the differential generator to the indicators. The differential generator shaft position is controlled by the stepper mot(or' through a 45: 1 gear reduction train. Ship's heading data from the gyro compass causes the stepper motor to drive the differential generator in response to ship's heading changes. The differential generator combines the antenna position signals with the ships heading data to provide north stabilized synchro data to the AN/SPA-25 and AN/ SPA-66 indicators. When the RB/NS switch is in the NS position signals are forwarded to the control indicators mounted on the AN/SPA-25 and AN!/ SPA-66 indicators for visual display of the NS condition,

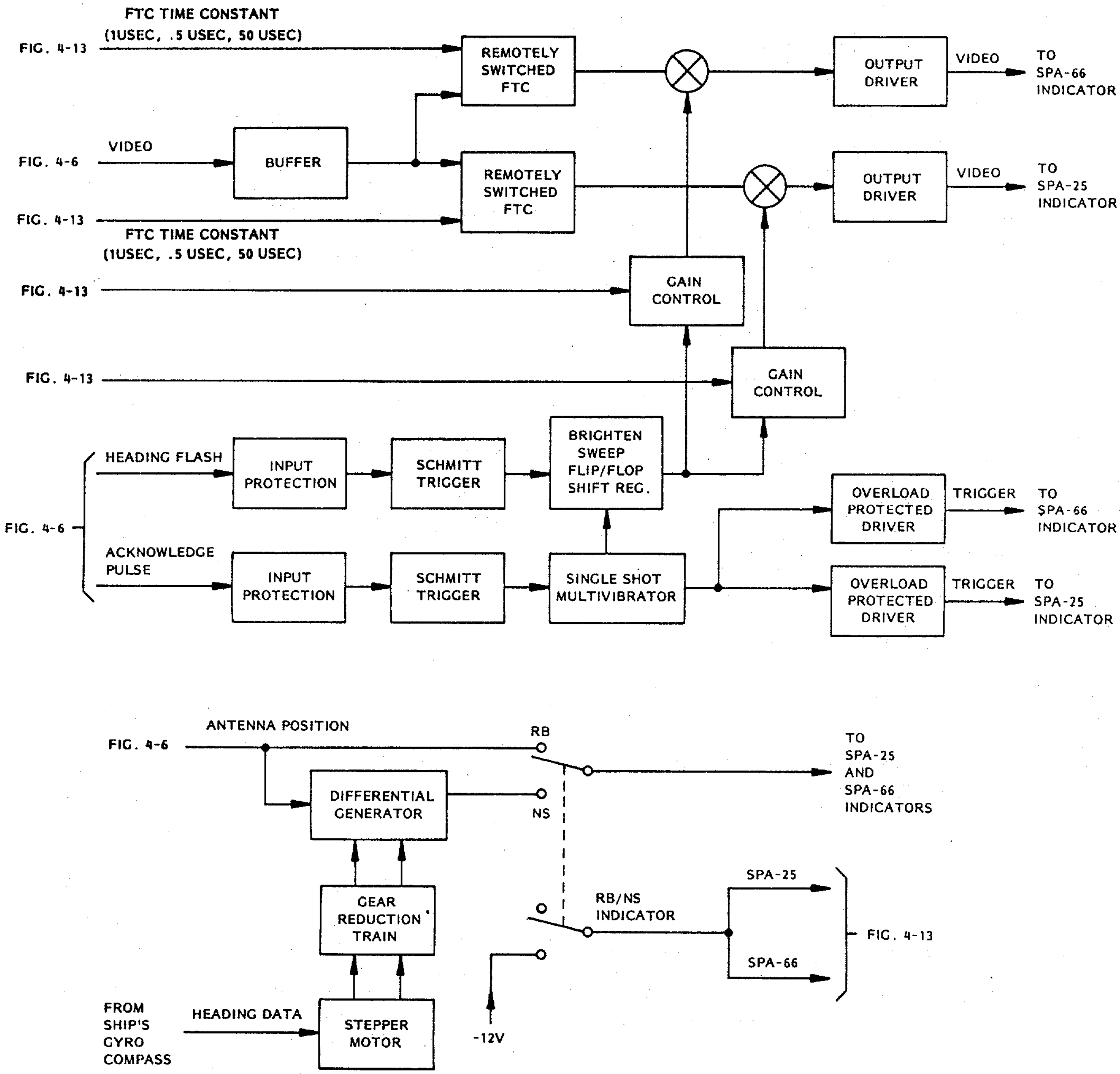


Figure 4-12. Signal Data Converter CV-3442 Functional Block Diagram (V4)

4.11.5. Power Supply Circuits (V4)

A regulated power supply provides +12 and -12 Vdc operating voltages for the modules in the signal data converter from a 115-Vac, single-phase, 60-Hz source.

4.12. CONTROL INDICATOR C10260 (V4)

The control indicators, one mounted on the AN/ SPA-25 indicator and the other mounted on the AN/ SPA-66 indicator, provide time constant control, heading flash blanking, and display antenna bearing mode and the signal data converter status. Figure 4-13 is a functional block diagram of the control indicator

Fast time constant switch S1, a four-position rotary switch (OFF, 1 µsec, 0.5 µsec and 50 µsec) selects the appropriate video differentiation time constant by providing a ground return for the applicable line connected to the signal data converter. In the OFF position normal video data is displayed on the AN/ SPA indicators. In the other three positions the video is FTC controlled, breaking up large target masses permitting small targets within masses to be identified.

Heading flash switch S2, when set to OFF, provides a ground return to the signal data converter to disable the heading flash appearing on the AN/ SPA indicators.

When the north stabilized (NS) mode is selected, an NS indicating signal from the signal data converter illuminates NS indicator DS1. When the signal data converter is operating, an FTC illumination signal is applied to indicators DS2 and DS3.

4.13. AMPLIFIER-GENERATOR AM-6933 (V4)

The amplifier-generator provides amplified, pulse width controlled pre-trigger pulses to Blanker-Video Mixer AN/SLA-10. Figure 4-14 is a functional block diagram of the amplifier-generator.

4.13.1. Trigger Amplifier-Generator Circuits (V4)

Identical circuits are used to process the X-band (3 cm) and S-band (10 cm) transmit triggers. The triggers are amplified by the differential amplifier and applied to the single-shot multivibrator. The output of the multivibrator, a negative-going pulse with an adjustable pulse width (approximately 0.3 to 10 µsec), is applied to the overload protection driver. The pulse is inverted to provide a positive-going, pulse width adjustable pulse to the AN/SLA-10. Overload protection is provided by bypassing the pulse around the output current amplifier.

4.13.2. Power Supply Circuits (V4)

The power supply circuits provide +12, -12 and regulated +5 Vdc operating voltages for the amplifier-generator.

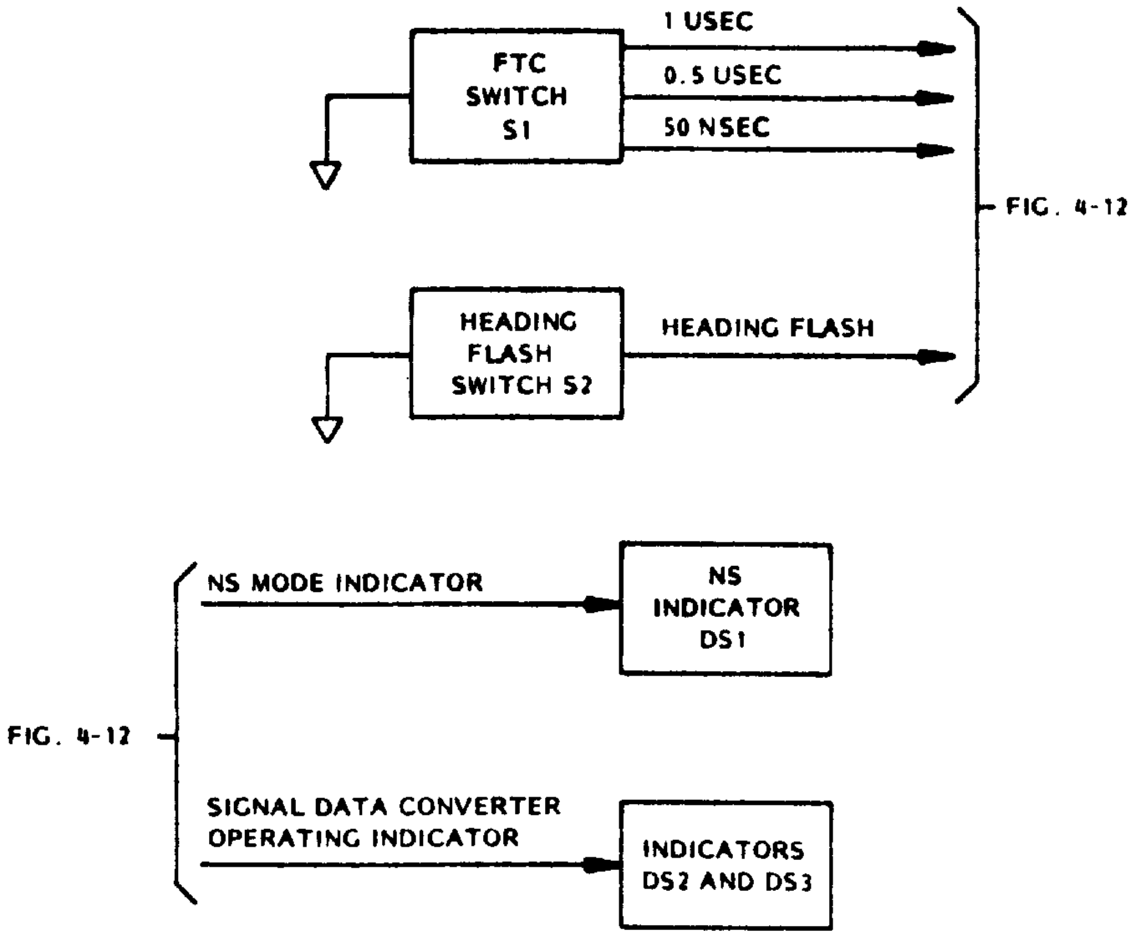


Figure 4-13 Control Indicator C-10260 Functional Block Diagram (V4)

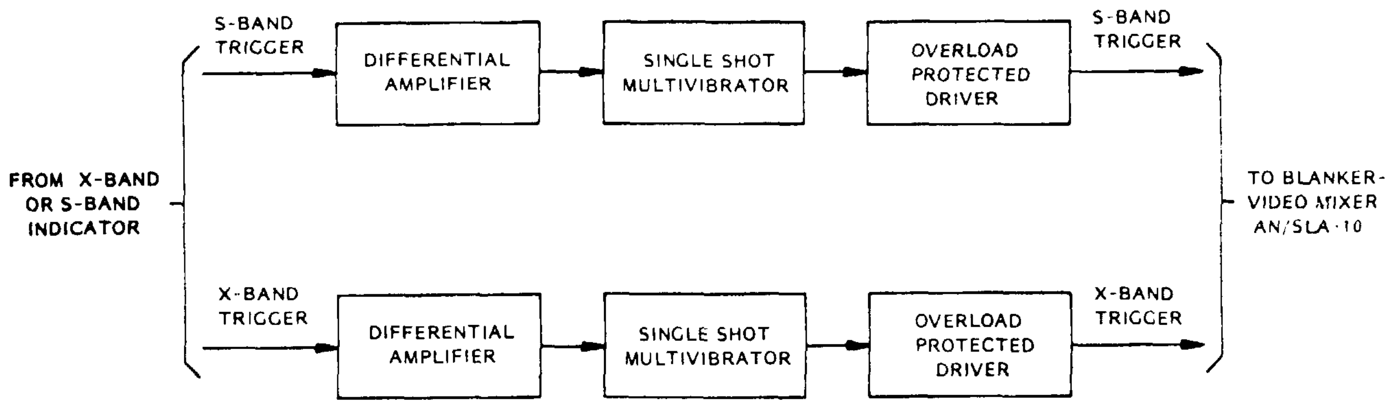


Figure 4-14. Amplifier-Generator AM-6933 Functional Block Diagram (V4)

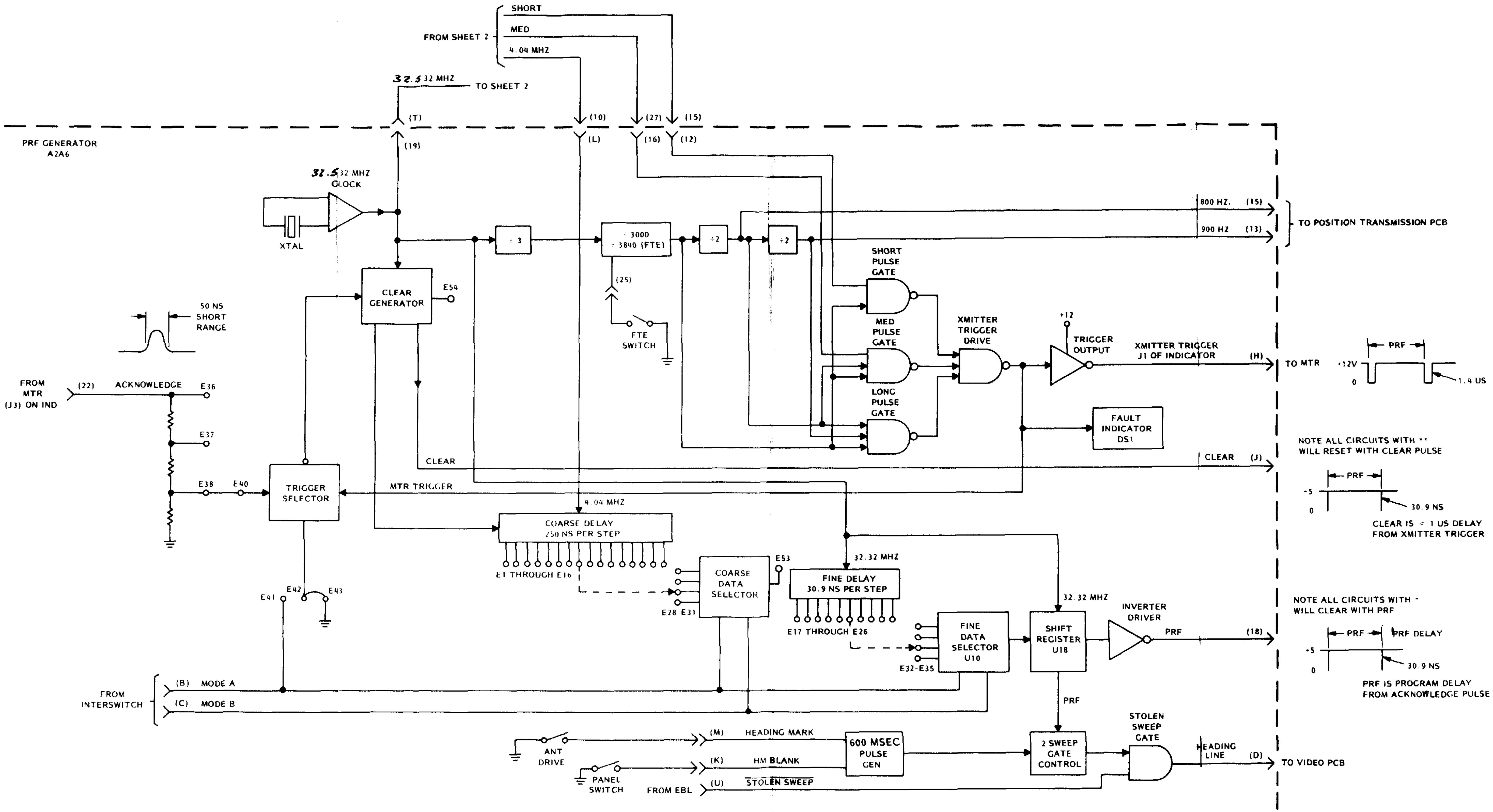


Figure 4-15. Indicator Timing Functional Block Diagram (Sheet 1)

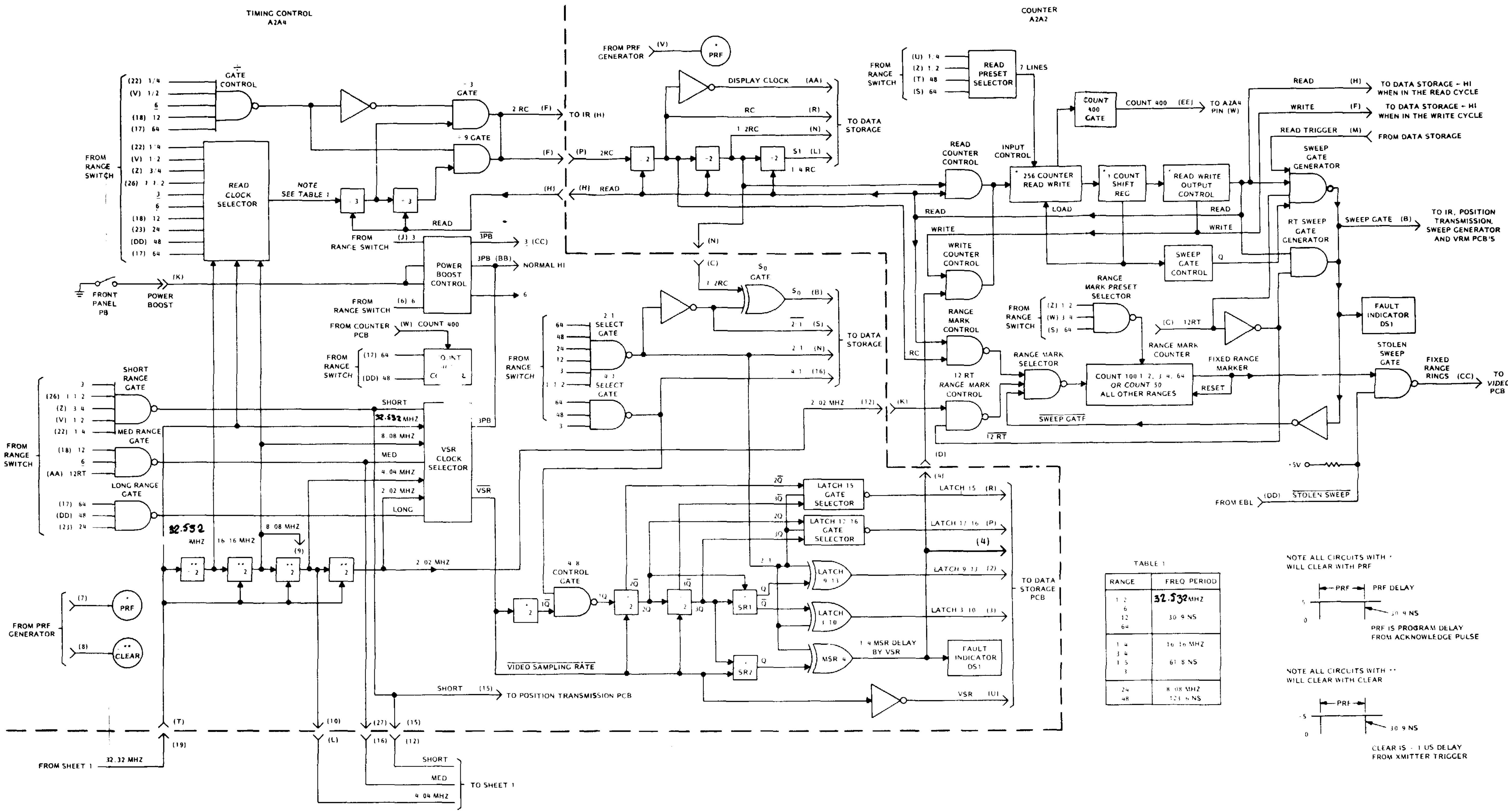


Figure 4-15. Indicator Timing Functional Block Diagram (Sheet 2)

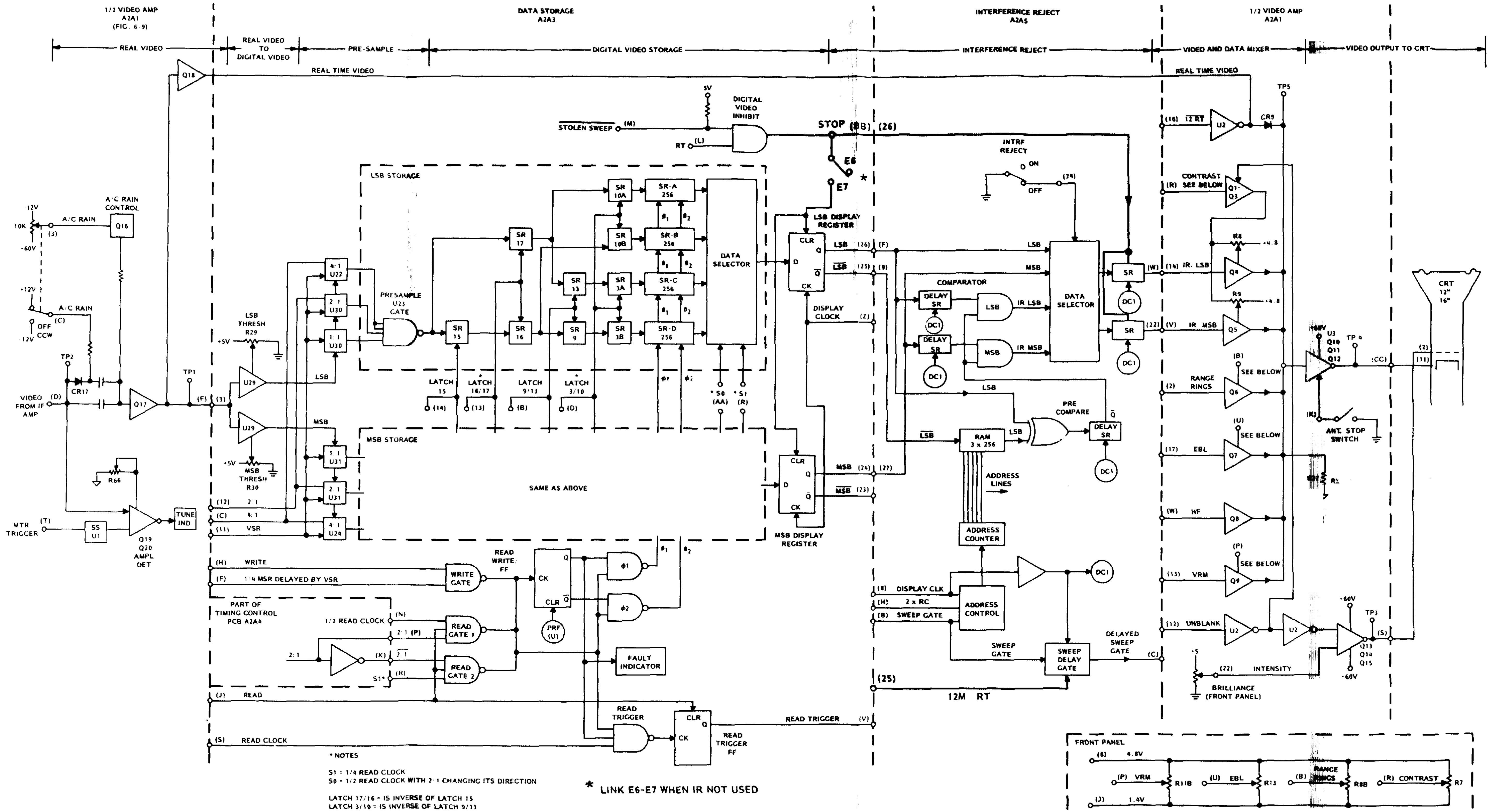


Figure 4-16. Video Functional Block Diagram

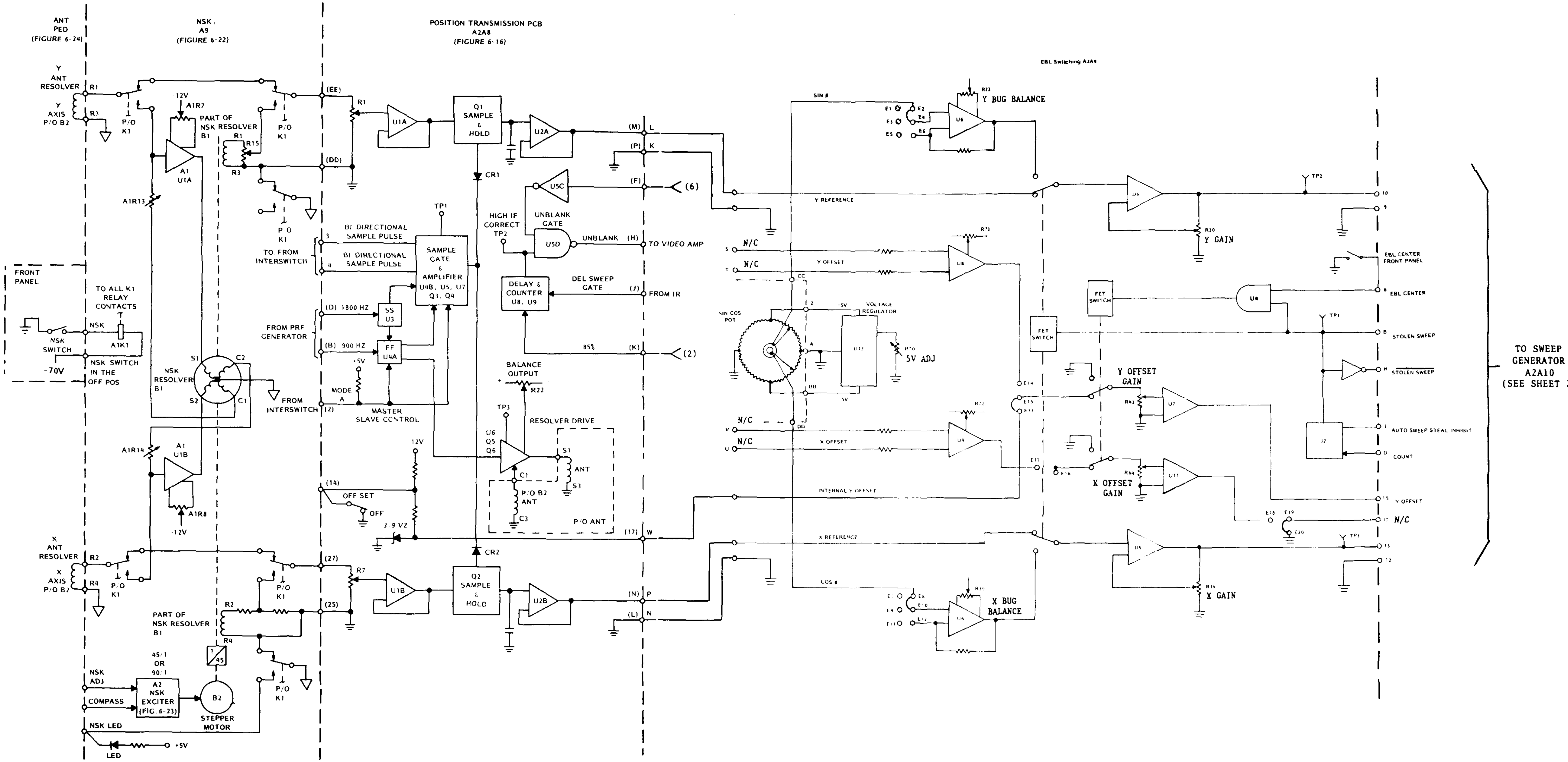


Figure 4-17. Sweep Functional Block Diagram (Sheet 1 of 2)

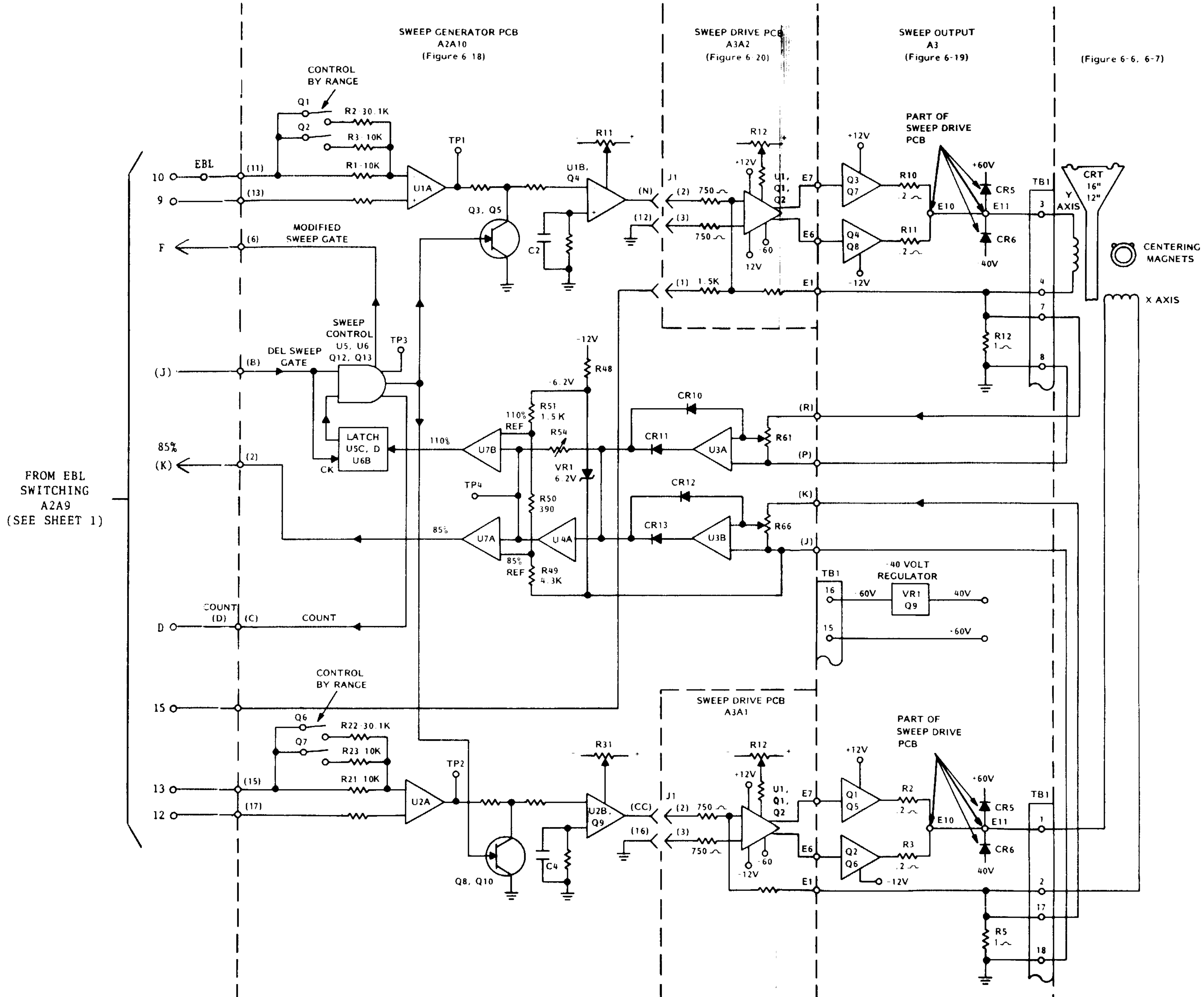


Figure 4-17. Sweep Functional Block Diagram (Sheet 2 of 2)

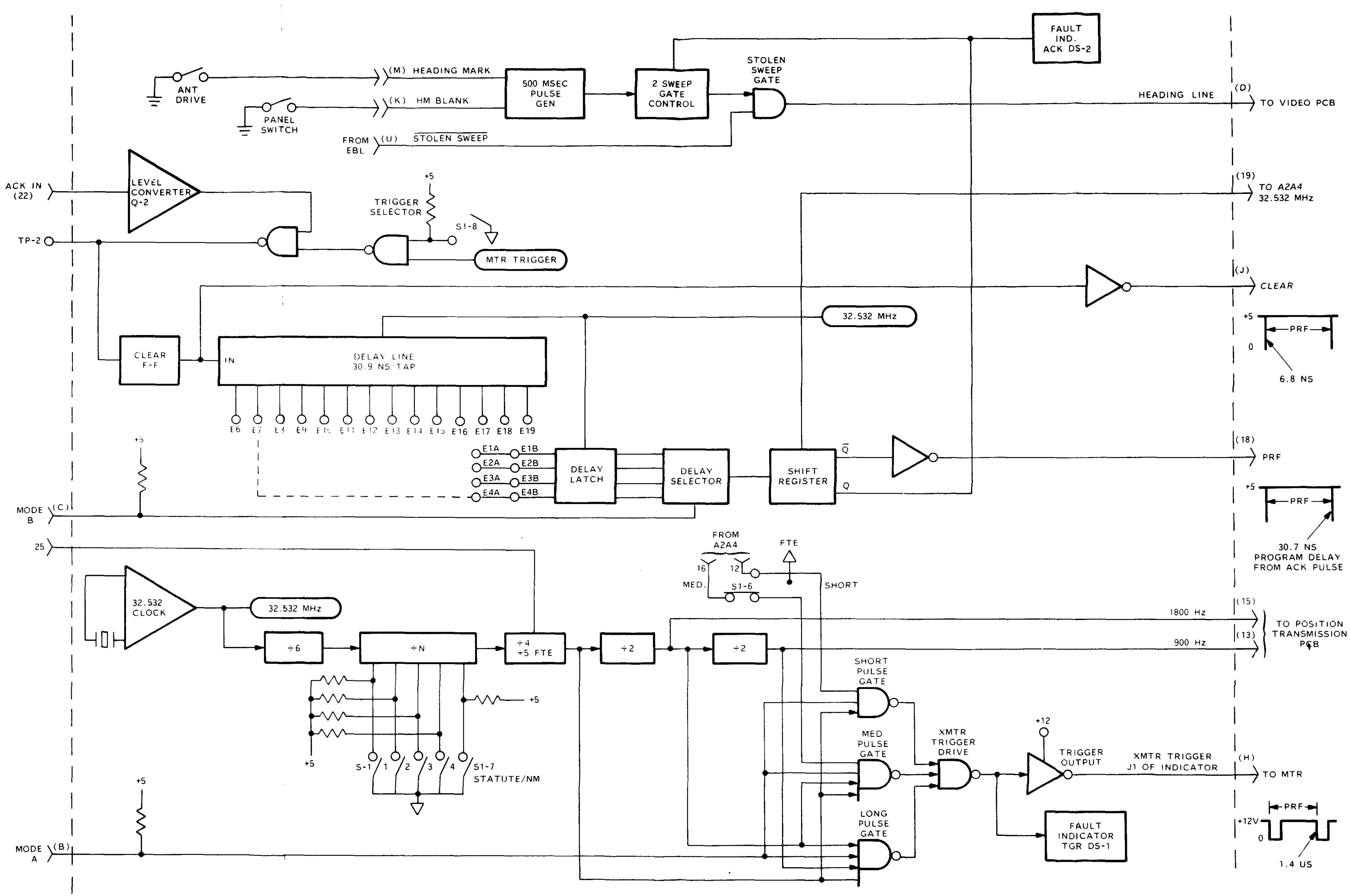


Figure 4-18. PRF Generator PCB P/N 169128-1 Functional Block Diagram

CHAPTER 5. MAINTENANCE

NOTE

All voltage measurements taken in this chapter are using a VOM having an input impedance of 20 K ohms per volt. Use of other meters may cause variations in voltage readings.

SECTION I: INTRODUCTION

5.1 GENERAL

This chapter provides information and instructions covering preventive and corrective maintenance for the AN/SPS-64(V) Radar Sets, versions 1 through 4. Section I includes safety information, tool and test equipment requirements, and explanation of parts documentation. Section II contains preventive maintenance schedules and procedures. Section III provides a performance verification procedure for each radar set. These procedures provide system level fault isolation sorting via references to the individual equipment troubleshooting charts in Section IV; the troubleshooting references are keyed to performance indications. Section IV provides troubleshooting, removal/replacement, and alignment procedures, as applicable, for each equipment used in the AN/SPS-64(V) Radar Sets. Section V contains procedures for making RF power, receiver sensitivity (MDS) and antenna VSWR measurements.

5.2 SAFETY

All equipments used in the AN/SPS-64(V) Radar Sets contain voltages hazardous to life when operating. Hazardous ac voltage is present in most equipments even though the equipment is deenergized, unless the ship's power circuit breakers associated with the equipments have been turned off. The indicator and receiver-transmitter equipments contain potentially lethal dc voltages when operating, and can retain dangerous dc charge potentials after being deenergized. Maintenance personnel are cautioned to exercise extreme care and use common sense when servicing equipments. The following safety precautions must always be observed.

1. Deenergize equipment and turn off associated ship's power circuit breakers before servicing whenever possible.
2. Never service an operating equipment alone.
3. When it is necessary to make measurements on operating equipment, deenergize the equipment first, make all necessary measurement connections, then energize equipment.
4. When it is necessary to make adjustments on operating equipment, do so using one hand, keeping the other hand clear of equipment chassis.
5. When removing components for servicing, always ground the component, its terminals and nearby terminals before touching.
6. Always deenergize equipment before removing plug-in printed circuit boards and assemblies.
7. Become familiar with the artificial repiration techniques explained in paragraph 1.4.

WARNING

THE POIVER SUPPLIES CONTAINED IN THE INDICATORS AND RECEIVER TRANSMITTERS UTILIZE FLOATING COMMON TRANSMIT WHICH OPERATE AT DC VOLTAGE LEVELS UP TO 300 VOLTS.

5.3 TOOLS, TEST EQUIPMENT AND MATERIALS

Table 5-1 lists the tools, test equipment, and materials recommended for servicing the radar. Equivalent items may be substituted where necessary. Items shown are in addition to the common items normally carried aboard.

5.4 PARTS LOCATION AND PARTS LISTS

The locations of major components and assemblies within each AN SPS-64(V) equipment are illustrated in this chapter and are referenced by figure number- in the paragraph devoted to the particular equipment in Section IV. Detailed assembly and component part location drawings along with their associated parts lists tabulations are provided as part of the drawing set for each equipment in Chapter 6.

SECTION II: EQUIPMENT PREVENTIVE MAINTENANCE

5.5 GENERAL

The following paragraphs provide information regarding general preventive maintenance practices applicable to the AN/SPS-64 V) Radar Sets.

Table 5-1. Tools, Test Equipment and Materials

Item Description	Qty.	Manufacturer or Supplier	Model/Part Number
TOOLS			
Trimpot Adjustment Tool	2	Bornes	
Puller, Printed Circuit Board	1	Calmark	112
Oil Injection Syringe	1	Any	----
Grooving Tool, Cable*	1	Andrew Corporation	36577-2
Wrench, Glandnut*	1	Raytheon	169140-1
Center Probe insertion Tool*	1	Raytheon	169141-1
Gear Reducer Support*	1	Raytheon	169139-1
TEST EQUIPMENT			
Multimeter	2	Simpson	260
Oscilloscope	1	Tektronix	335
Power Meter	1	Hewlett Packard	432A
Thermistor Mount, Power Meter	1	Hewlett Packard	478A
Probe, Oscilloscope, 10X	2	Tektronix	P6015
Probe, Oscilloscope, High Voltage	1	Tektronix	P6015
Signal Generator	1	Hewlett Packard	620B
Gauge, Tension	1	Chatillon	719-10
Signal Generator*	1	Hewlett Packard	8616A
Clip, Integrated Circuit	2	Pomona Electronics	3916
Resistor, 200 Ohm, 200 Watt	1	Any	----
Resistor, 470 Ohm, 1/2 Watt	1	Any	----
Resistor, 680 Ohm, 1/2 Watt	1	Any	----
Diode, Zener, 5.1 Volt	1	Any	----
Connector, BNC Tee	1	Any	UG-274/U
Variac, 115VAC, 10A	1	Any	----
Frequency Meter	1	Hewlett Packard	X532B
Attenuator, Fixed, Microwave, 20 dB	1	Weinschel Engineering	530A-20
Adapter, Power Cord, Ground Isolating	2	Any	----
Adapter, Type N Connector to UG-135 Waveguide Flange	2	Hewlett Packard	X281A
MATERIALS			
Gear Box Lubricant, MIL-L-6086, Grade M		Raytheon	**980131-1
Oil, Lubricating, Light Machine	-	Raytheon	230-7176P1
Grease MIL G23827	-	Raytheon	230-1158P5
Gasket Compound	-	Permatex	Aviation Form-A-Gasket
Anti-Seize Compound	-	Kiekhaefer Mercury	Quicksilver Anti -Corrosion Grease
Heat Sink Compound	-	Raytheon	95-981

* Required for AN/SPS-64(V)4 installations only.
** For operation below -150F (-24°C), use MIL-L-60B6B, Grade L (Part No. 980131-2)

5.5.1 High Voltage Arc Prevention

High voltage components within the receiver transmitters and the indicators must be kept clean and dust-free to prevent the possibility of HV arcing. Diesel soot and dirt should be removed with a mild detergent and water, and all surfaces dried thoroughly.

5.5.2 Condensation Prevention

If the equipment is to be inoperative for periods longer than 24 hours, it should be fully energized for at least one hour each day. This procedure ensures that any condensation, particularly in tropical climates, is dried out and vented.

5.5.3 Inspection (Monthly Intervals)

Inspect the exterior of all units for dust and finish deterioration. Clean or repair as necessary.

NOTE

The flare of the antenna unit is covered by a fiberglass window, which must not be painted. Metal-based paint will considerably distort the radiation pattern, and will absorb part of the radiated energy. The remaining external surfaces of the equipment have been epoxy-paint sprayed, and should require only cleaning in normal use.

5.5.4 Cleaning (Monthly Intervals)

Wash the exterior of the antenna and pedestal assembly with fresh water. Clean the display face of the indicator unit with a clean soft cloth slightly dampened with fresh water.

5.6 PREVENTIVE MAINTENANCE SCHEDULE

The preventive maintenance activities listed in Table 5-2 are recommended to preclude unnecessary mechanical failures and to forewarn the technician of impending faults due to performance degradation.
The table references the paragraph in which the procedural instructions are given and defines the recommended frequency for performance of the procedures. Activities 1 through 8, 15 and 16 of Table 5-2 apply to all AN/SPS-64(V) Radar Sets; activities 9 through 14 are applicable to AN/SPS-64(V) 4 only.

5.7 PREVENTIVE MAINTENANCE PROCEDURES

WARNING

WHEN PERFORMING MAINTENANCE AT THE ANTENNA, SET THE ANTENNA SAFETY SWITCH TO OFF.

5.7.1 Antenna Pedestals AB-1247 and AB-1247A

5.7.1.1 Lubrication. - Perform the following steps:

1. Remove the access cover from the top of the antenna pedestal assembly.
2. Unscrew the oil cap and dipstick. Wipe the dipstick clean.
3. Insert the dipstick into the filler hole and remove.
4. lubricant level is below the line, pour a small amount of gear box lubricant (MIL-L-6086, Grade M) into the filler hole. Total capacity is 1.11 quarts (1.05 liters).

NOTE:

For operation below -150F (-24°C) use MIL-L-6086B, Grade L.

5. Re-check the level. If necessary, add an additional amount of lubricant, and re-check again.
5. .1.2 Drive System Inspection. - Perform the following steps:
1. Disconnect waveguide located underneath the pedestal.
2. Remove the screws that secure the hinged pedestal top to the fixed bottom plate.
3. Swing the hinged pedestal top into its service position.

CAUTION

BE AWARE OF THE ANTENNA ARRAY POSITION AT ALL TIMES WHILE PERFORMING THE FOLLOWING STEPS.

4. While manually rotating the drive sheave and belt (see Figure 5-3), check the belt for any signs of stretching, deterioration, fraying, breaks, cracks, or loss of flexibility.
5. Verify that the belt and the sheave surfaces that come in contact with the belt are clean and free from oil.
6. Check for smoothness of rotation (no binding or roughness); inspect gear box for signs of oil leaks, and drive motor for evidence of excessive heating.

Table 5-2 Preventive Maintenance Schedule

Preventive Maintenance Activity	Procedure Paragraph	Frequency*			
		W	M	S-A	A
1. Performance Check	5.8.2	X	X	X	X
2. Inspect all equipments	5.5.3		X	X	X
3. Clean all equipments	5.5.4		X	X	X
4. Lubricate Pedestal AB-1247/1247A	5.7.1.1		X	X	X
5. Check Belt Tension AB-1247/1247A	5.7.1.3		X	X	X
6. Check Sheave Alignment AB-1247/1247A	5.7.1.4			X	X
7. Inspect Drive System AB-1247/1247A	5.7.1.2				X
8. Inspect Cover Gasket AB-12L47/1247A	5.7.1.5				X
9. Lubricate Pedestal AB-1248 (V4)	5.7.2.1		X	X	X
10. Check Belt Tension AB-1248 (V4)	5.7.2.3		X	X	X
11. Clean Air Filters RT-1241 (V4)	5.7.3		X	X	X
12. Check Sheave Alignment AB-1248 (V4)	5.7.2.4			X	X
13. Inspect Drive System AB-1248 (V4)	5.7.2.2				X
14. Inspect Access Hatch Gasket AB-1248 (V4)	5.7.2.5				X
15. High Voltage Arc Prevention	5.5.1	As Required			
16. Condensation Prevention	5.5.2	As Required			

* Frequency: W - Weekly, M - Monthly, S-A - Semiannually, A - Annually

5.7.1.3 Belt Tension Check and Alignment. - Gain access per steps 1, 2 and 3 of paragraph 5.7.1.2, Using a tension gauge, check for belt deflection of 1/8" when 4 to 5 pounds of tension are applied to the belt midway between the sheaves (see Figure 5-4). If tension is incorrect, adjust as follows:

1. Loosen the four motor mounting bolts. Insert screwdriver through tension adjustment slot and engage teeth on motor mounting plate.

2. To increase belt tension, move the motor away from the driven sheave. To decrease belt tension, move the motor toward the driven sheave.

3. Temporarily snug the four motor mounting bolts. Rotate the drive sheave a few times to check for ease of operation, and then check belt tension again. If the tension is correct, tighten the four motor mounting bolts. If the tension is incorrect, repeat this procedure.

5.7.1.4 Sheave Alignment Check. - Check sheave alignment as follows:

1. Set Antenna Safety Switch OFF.

2. Gain access per steps 1,2 and 3 of paragraph 5.7.1.2. Set Indicator (master) POWER switch to OFF.

3. While turning the drive sheave (see Figure 5-4), check that the grooves in the drive sheave are aligned with the grooves on the driven sheave. If they are not, adjust as follows.

4. Remove three hex screws from bottom of drive sheave hub; place these screws in the three threaded holes in the hub and tighten in a uniform pattern (this loosens the hub and sheave from the motor shaft).

5. Adjust the vertical position of the drive sheave on the motor shaft to correct alignment.

6. Remove the three hex screws from the bottom of the drive sheave hub and place them in the three unthreaded holes in the hub; tighten into the sheave in a uniform pattern.

7. Repeat step 2; if alignment is incorrect, repeat steps 4 through 7 until alignment is achieved .

5.7.1.5 Cover Gasket Inspection. - Perform the following steps:

1. Remove the waveguide clamp located underneath the pedestal.

2. Remove the screws that secure the hinged pedestal top to the fixed bottom plate.

3. Swing the hinged pedestal top into its service position.

4. Inspect the sponge rubber gasket around the bottom of the hinged pedestal housing for deterioration or breaks.

5. Check for evidence of water seepage on surface of fixed base plate where gasket mates.

6. Swing pedestal down, tighten securing screws and attach waveguide clamp.

7. Remove access hatch cover from front of pedestal and drive motor cover from top of pedestal.

8. Inspect cover gaskets for deterioration or breaks; check gasket mating surfaces for signs of seepage.

5.7.2 Antenna Pedestal AB-1248 (V4)

WARNING

WHEN PERFORMING MAINTENANCE AT THE ANTENNA, SET ANTENNA SAFETY SWITCH TO OFF.

5.7.2.1 Lubrication (V4). - Check gear box lubricant level as follows.

1. Loosen captive screws and open access door on front of pedestal.

2. Observe oil level in filler hose; level should be 9/16 inch above upper edge of gear box lip. If low, perform steps 3 and 4.

3. Hold upper end of filler hose and loosen clamp screw at upper end of hose; keep end of hose above oil level as hose is disconnected from fitting.

4. Extend loose end of hose and add lubricant MIL-L-6086B Grade M through hose end until oil level is correct. Total capacity is 2.32 quarts (2.2 liters) .

NOTE:

For operation below -15F (-24C) use MIL-L-6086B, Grade L.

5.7.2.2 Drive System Inspection (V4). - Inspect the antenna system as follows.

1. Loosen the captive screws and open the access door on front of pedestal. Remove top and bottom access covers at rear of pedestal.

CAUTION

BE AWARE OF THE ANTENNA ARRAY POSITION AT ALL TIMES WHILE PERFORMING THE FOLLOWING STEPS.

2. While manually rotating the antenna, check the belts for any signs of stretching, deterioration, fraying, breaks, cracks, or loss of flexibility.

3. Verify that the belts and the sheave surfaces that come in contact with the belt are clean and free from oil.

4. Check for smoothness of rotation (no binding or roughness); inspect gear box for signs of oil leaks, and drive motor for evidence of excessive heating.

5. Verify that V-clamp at top of rotary joint and fan assembly at top of drive motor shaft are secure.

5.7.2.3 Belt Tension Check and Alignment (V4). Perform the following steps.

1. Remove bottom access cover at rear of pedestal.

2. Using a tension gauge, check for belt deflection of 1/8" when 4 to 5 pounds of tension are applied to each belt at a point adjacent to the belt feedthrough port in the housing. If tension is incorrect, adjust as follows.

3. Open access door on front and remove top access cover at rear of pedestal.

4. Loosen lock nuts on turnbuckle and slightly loosen turnbuckle anchor bolts.

5. Adjust turnbuckle to increase or decrease belt tension as necessary; temporarily snug turnbuckle lock nuts.

6. Repeat step 2. If tension is correct, tighten turnbuckle lock nut and anchor bolts; if incorrect, loosen lock nuts and repeat steps 5 and 6 until correct tension is achieved.

NOTE:

If tension between the belts is non-uniform or if sufficient tension cannot be achieved by adjustment, replace one or both belts as necessary per paragraph 5.18.2.1.

5.7.2.4 Sheave Alignment Check (V4). - Check sheave alignment as follows.

CAUTION

BE AWARE OF THE ANTENNA ARRAY POSITION AT ALL TIMES WHILE PERFORMING THE FOLLOWING STEPS.

1. At Receiver Transmitter RT-1241, disable high voltage by opening interlock switch S6.
2. Set Indicator (master) POWER switch to TX ON; set Antenna Safety switch to ON.
3. Open access door at front of pedestal.
4. Observe sheaves and drive belts as antenna rotates; verify sheaves are aligned vertically and line of travel of belts is straight. If incorrect, note position of drive sheave (too low or too high), and adjust as follows.
5. Set Antenna Safety switch to OFF. Remove bottom access cover at rear of pedestal.
6. Remove three hex screws from bottom of drive sheave hub; place these screws in the three threaded holes in the hub and tighten in a uniform pattern (this loosens the hub and sheave from the motor shaft).
7. Adjust the vertical position of the drive sheave on the motor shaft as noted in step 4 to correct alignment.
8. Remove the three hex screws from the bottom of the drive sheave hub and place in the three unthreaded holes in the hub; tighten into the sheave in a uniform pattern.
9. Set Antenna Safety switch to ON and repeat step 4. If alignment is incorrect, repeat steps 5 through 9 until alignment is achieved.

5.7.2.5 Access Hatch Gasket Inspection (V4). - Inspect access cover gaskets as follows:

1. Open access door at front of pedestal. Remove top and bottom access covers at rear of pedestal.
2. Inspect door and cover gaskets for breaks or deterioration.
3. Check door and cover gasket mating surfaces for evidence of seepage.

5.7.3 Receiver Transmitter RT-1241 Air Filter Cleaning (V4)

Loosen captive screws and remove both air filter covers from cabinet front cover. Remove air filters and wash in warm fresh water with detergent. Rinse thoroughly in fresh water and allow to dry before reinstalling.

SECTION III: SYSTEM MAINTENANCE AND PERFORMANCE CHECKS

5.8 SYSTEM TROUBLESHOOTING

5.8.1 General

System level troubleshooting is based on system performance checks. A performance check procedure is provided in paragraph 5.8.2 for each version (V)1, (V)2, (V)3and (V)4 of the AN/SPS64(V) Radar Set. These procedures check the major operating parameters of the radar sets and provide initial fault isolation sorting at the system level. Associated with each procedural step is a reference to the appropriate equipment troubleshooting procedure in Section IV. When faulty indications are observed during the system performance check, record the step numbers at which the faulty indications are noted, and proceed with the performance check. Upon completion of the performance check, analyze the faulty indications to determine if a logical pattern (indicating a common fault) exists. If so, refer to the performance check step most closely related to the suspected common fault and proceed to the equipment troubleshooting chart referenced in that step. If no pattern is recognized, refer to the step at which the first faulty indication was noted and proceed to the referenced troubleshooting chart.

5.8.2 Performance Verification Procedures

Paragraphs 5.8.2.1 through 5.8.2.4 following provide performance verification procedures for each version of the AN/SPS-64(V) Radar Sets. Perform the steps of the paragraph applicable to the radar set installed. The data enclosed in slashes / / following each step defines the figure number and applicable entry point of the associated troubleshooting chart, e.g., /5-2(19)/ refers to instruction box log number (19) on Figure 5-2.

5.8.2.1 AN/SPS-6L4(V)1 System Performance Check. - Perform the following steps in the sequence indicated:

1. Set Indicator POWER switch to ST BY; verify the following:
   a. Lamps on control panel, bearing scales and plotter illuminate. /5-9(1)/
   b. Status indicator (LED adjacent to POWER switch) flashes slowly (approximately once per second). /5-2 (1)/
2. Set Indicator POWER switch to TX ON; after 3.5 minute time delay, verify the following:
   a. Antenna rotates. /5-5(1)/
   b. Status indicator glows steadily. /5-2(22)/
3. Set Indicator RANGE SELECT switch to each of its eleven positions in turn; verify the following at each position
   a. Sweep present. /5-8(4)/
   b. Video targets displayed. /5-8(4)/
   c. Range rings, electronic bearing line (EBL) and heading line displayed. /5-8(4)/

d. Correct range and range ring interval readout (LED's above CRT). /5-8(65)/

4. Turn Indicator VRM handwheel two turns clockwise; verify variable range marker (VRM) is displayed. /5-8(4)/ 5. Adjust each of the following Indicator controls and verify proper response (per paragraph 3.7) to each:

a. ANTENNA ON/OFF switch /5-8(184)/
b. TUNE control /5-8(146)/
c. GAIN control /5-8(136)/
d. CONTRAST control /5-8(55)/
e. INTRF REJECT switch /5-8(136)/
f. PNL LIGHTS control /5-9(1)/
g. BRG SCALE control /5-9(1)/
h. VRM intensity control /5-8(56)/
i. READOUT control (VRM LED) /5-8 (87)/
j. RANGE RINGS intensity control /5-8(36)/
k. BRILLIANCE control /5-8(18)/
l. FTE ON switch /5-8(188)/
m. FLASH OFF switch /5-8(188)/
n. PWR BOOST switch /5-8(146)/
o. ANTI-CLUTTER RAIN control /5-8(43)/
p. ANTI-CLUTTER SEA control /5-8(146)/
q. EBL DIM/EBL READ control /5-8(105)/
r. EBL control /5-8(114)/
s. OFFSET control /5-8(136)/

6. Set Indicator HDG SET/GYRO STAB/HD UP switch to GYRO STAB and observe heading line bearing. Adjust heading line to agree with ship's compass using HDG SET feature. Verify GYRO STAB indicator (LED above CRT) is lit and heading line follows ship's heading changes. /5-8(136)/

7. Set Indicator RANGE SELECT switch to 24 MILES. At Receiver Transmitter RT-1240, measure voltage indicative of magnetron current between TP7(+) and TP10O(-); correct voltage depends upon type of magnetron installed as follows: /5-2(51)/

MAGNETRON	VOLTAGE
Raytheon	3.0 to 3.5 VDC
Toshiba	3.0 to 3.5 VDC
English Electric	3.5 to 4.0 VDC

8. At Receiver Transmitter RT-1240, measure crystal current of 23 + 5uA between TP10 (ground) and both TP1 and TP2 on A1600 assembly. /5-2(53)/

5.8.2.2 AN/SPS-64(V)2 System Performance Check. - Perform the following steps in the sequence indicated:

1. Set POWER switch to OFF at both indicators.

2. At Switching Unit, select mode DP-1 per Table 3-1.

3. Set POWER switches to ON at the following units:

a. Video Amplifiers AM-6932 No. 1 and No. 2.
b. Interface Unit J-3463.

NOTE:
For DP-1 mode (steps 4 through 11 below), the following definitions apply:

a. Master indicator: Indicator A
b. Slave indicator: Indicator B
c. Receiver Transmitter: MTR I

4. Set master and slave Indicator POWER switches to ST BY; verify the following at both indicators:

a. Lamps on control panel, bearing scales and plotter illuminate. /5-9(1) for faulty indicator/
b. Status indicator (LED adjacent to POWER switch) flashes slowly (approximately once per second). /5-2(1)/

5. Set master Indicator POWER switch to TX ON; after 3.5-minute time delay, verify the following:

a. Antenna rotates. /5-12(1)/
b. Status indicator glows steadily at both master and slave indicators. /5-2(22)/

6. Keeping the switches in step, set both master and slave Indicator RANGE SELECT switches to each of their eleven positions in turn; verify the following at both indicators for each position:

a. Sweep present. /5-12(1)/
b. Video targets displayed. /5-12(1)/
c. Range rings, electronic bearing line (EBL) and heading line displayed. /5-8(4) for faulty Indicator/
d. Correct range and range ring interval readout (LEDs above CRT). /5-8 (65) for faulty Indicator/

7. Rotate master Indicator VRM handwheel two turns clockwise; verify variable range marker (VRM) is displayed. /5--8(4)/ 8. At master Indicator, adjust each of the following controls and verify proper response (per paragraph 3.7) to each:

a. ANTENNA ON/OFF switch /5-8(184))/
b. TUNE control /5-8(146)/
c. GAIN control /5-8(136)/
d. CONTRAST control /5-8(55)1
e. INTRF REJECT switch /5-8(136)/
f. PNL LIGHTS control /5-9(1)/
g. BRG SCALE control /5-9(1)/
h. VRM intensity control /5-8(56)/
i. READOUT control (VRM LED) /5-8(87)/
j. RANGE RINGS intensity control /5-8(36)/
k. BRILLIANCE control /5-8(18)/
l. FTE ON switch /5-8(188)/
m. FLASH OFF switch /5-8(188)/

n. PWR BOOST switch /5-8(146) / (3 mi only)
o. ANTI-CLUTTER RAIN control /5-8(43)/
p. ANTI-CLUTTER SEA control /5-8(146)/
q. EBL DIM/EBL READ control /5-8(105)/
r. EBL control /5-8(114)/
s. OFFSET control /5-8(136)/

9. Set master Indicator HDG SET/GYRO STAB/ HD UP switch to GYRO STAB and observe heading line bearing. Adjust heading line to agree with ship's compass using HDG SET feature. Verify GYRO STAB indicator (LED above CRT)-is lit and heading line follows ship's heading changes.
/5-8(136)/

10. Set master Indicator RANGE SELECT switch to 24 MILES. At Receiver Transmitter RT-1240, measure voltage indicative of magnetron current between TP7(+) and TPI0(-); correct voltage depends upon type of magnetron installed as follows: /5-2(51)/

MAGNETRON	VOLTAGE
Raytheon	3.0 to 3.5 VDC
Toshiba	3.0 to 3.5 VDC
English Electric	3.5 to 4.0VDC

11. At Receiver Transmitter RT-1240, measure crystal current of 23 + 5uA between TP10 (ground) and both TP1 and TB2 on A1600 assembly. /5-2(53)/

12. Set POWER switches to OFF at both indicators.

13. At Switching Unit, select DP-4 mode per Table 3-1.

14. Repeat steps 4 through 11 above per the following definitions:
a. Master indicator: Indicator B
b. Slave indicator: Indicator A
c. Receiver Transmitter: MTR II

15. Refer to Table 3-1; perform a through d following for each mode: /Para. 5-13/
a. Set POWER switch to OFF at both Indicators.
b. Select mode at Switching Unit per Table 3-1.
c. Set Indicator POWER switches as follows:
(1) Master: TX ON (2) Slave: ST BY d. After 3-5-minute time delay, verify the following per Table 3-1:
(1) Proper Receiver Transmitter selection.
(2) Proper Indicator master/slave selection.

5.8.2.3 AN/SPS-64 (V)3 System Performance Check. - Perform the following steps in the sequence indicated:

1. Set POWER switch to OFF at all indicators.

2. At Switching Units, select DD-1 mode per Table 3-2.

NOTE:

For DD-1 mode (steps 4 through 11 below), the following definitions apply:

a. Master indicator: Indicator A
b. Slave indicators: Indicators B, C (and D, if installed)
c. Receiver Transmitter: MTR I

3. Set POWER switches to ON at Video Amplifier AM-6932 units No. 1 and No. 2.

4. Set all Indicator POWER switches to ST BY; verify the following at each Indicator:
a. Lamps on control panel, bearing scales and plotter illuminate. /5-9(1) for faulty Indicator/
b. Status indicator (LED adjacent to POWER switch) flashes slowly (approximately once per second). /5-2 (1) /

5. Set master Indicator POWER switch to TX ON; after 3.5-minute time delay, verify the following:
a. Antenna rotates. /5-5(1)/
b. Status indicator glows steadily at each Indicator. /5-2 (22)./

6. Keeping the switches in step, set RANGE SELECT switches of all Indicators to each of their eleven positions in turn; verify the following at each Indicator for each position:
a. Sweep present. /5-15(2)/
b. Video targets displayed. /5-15(2)/
c. Range rings, electronic bearing line (EBL) and heading line displayed. /5-8(4) for faulty Indicator/
d. Correct range and range ring interval readout (LEDs above CRT). /5-8(65) for faulty Indicator/

7. At master Indicator, rotate VRM handwheel two turns clockwise; verify variable range marker displayed. /5-8(4)/

8. At master Indicator, adjust each of the following controls and verify proper response (per paragraph 3.7) to each:
a. ANTENNA ON/OFF switch /5-8(184)/
b. TUNE control /5-8 (146)/
c. GAIN control /5-8(136)/
d. CONTRAST control /5-8 (55)/
e. INTRF REJECT switch /5-8(136)/
f. PNL LIGHTS control /5-9(1)/
g. BRG SCALE control /5-9(1)/
h. VRM intensity control /5-8(56)/
i. READOUT control (VRM LED) /5-8(87)/

j. RANGE RINGS intensity control /5-8(36)/
k. BRILLIANCE control /5-8(18)/
l. FTE ON switch /5-8(188)/
m. FLASH OFF switch /5-8(188)/
n. PWR BOOST switch /5-8(146) / (3 mi only)
o. ANTI-CLUTTER RAIN control /5-8(43)/
p. ANTI-CLUTTER SEA control /5-8(146)/
q. EBL DIM/EBL READ control /5-8(105)/
r. EBL control /5-8(114)/
s. OFFSET control /5-8(136)/

9. Set master Indicator HGD SET/GYRO STAB/ HD UP switch to GYRO STAB and observe heading line bearing. Adjust heading line to agree with ship's compass using HDG SET feature. Verify GYRO STAB indicator (LED above CRT) is lit and heading line follows ship's heading changes.
/5-8(136)/

10. Set master Indicator RANGE SELECT switch to 24 MILES. At Receiver Transmitter RT-1240, measure voltage indicative of magnetron current between TP7(+) and TP10 (-); correct voltage depends upon type of magnetron installed as follows: /5-2(51)/

MAGNETRON	VOLTAGE
Raytheon	3.0 to 3.5 VDC
Toshiba	3.0 to 3.5 VDC
English Electric	3.5 to 4.0 VDC

11. At Receiver Transmitter RT-1240, measure crystal current of 23 + 5uA between TP10 (ground) and both TP1 and TP2 on A1600 assembly. /5-2(53)/

12. Set POWER switches to OFF at all Indictors.

13. At Switching Units, select mode DD-6 per Table 3-2.

14. Repeat steps 4 through 11 above per the following definitions:
a. Master indicator: Indicator B
b. Slave indicators: Indicators A, C (and D if installed)
c. Receiver Transmitter: MTR II

15. Set POWER switches to OFF at all Indicators.

16. At Switching Units, select mode DD-7 per Table 3-2.

17. Repeat steps 4 through 11 above per the following definitions:
a. Master indicator: Indicator C
b. Slave indicators: Indicators A, B (and D if installed)
c. Receiver Transmitter: MTR II

NOTE:
Steps 18, 19 and 20 are to be performed only if optional Indicator D is installed; if not installed, proceed to step 21.

18. Set POWER switches to OFF at all Indicators.

19. At Switching Units, select mode DD-4 per Table 3-2.

20. Repeat steps 3 through 10 above per the following definitions:
a. Master indicator: Indicator D
b. Slave indicators: Indicators A, B, C
c. Receiver Transmitter: MTR I

21. Refer to Table 3-2; perform a through d following for each mode: /Para. 5-13/
a. Set POWER switches to OFF at all Indicators.
b. Select mode at Switching Units per Table 3-2.
c. Set Indicator POWER switches as follows:
(1) Master Indicator(s): TX ON
(2) Slave Indicators: ST BY
d. After 3.5-minute time delay, verify the following per Table 3-2:
(1) Proper Receiver Transmitter versus master Indicator selection.
(2) Proper master/slave Indicators selection.

5.8.2.4 AN/SPS-64(V) 4 System Performance Check. - Perform the following steps in the sequence indicated:

1. Set POWER switches to OFF at all AN/SPS64 (V) Indicators.

2. At Switching Units, select DS-1 mode per Table 3-3.

3. Set POWER switches to ON at the following units:
a. Video Amplifier AM-6932
b. Amplifier-Generator AM-6933
c. Signal Data Converter CV-3442
d. AN/SPA-25 and AN/SPA-66 indicators

NOTE:
For DS-1 mode (steps 4 through 9 below), the following definitions apply:
a. Master indicator: Indicator A
b. Slave indicators: Indicators B, C, AN/SPA-25, AN/SPA-66
c. Receiver Transmitter: MTR I (X-band)

4. Set all AN/SPS-64(V) Indicator POWER switches to ST BY; verify the following at each AN/SPS-64(V) Indicator:
a. Lamps on control panel, bearing scales and plotter illuminate. /5-9(1) for faulty Indicator/
b. Status indicator (LED adjacent to POWER switch) flashes slowly (approximately once per second). /5-2 (1)/

5. Set master Indicator POWER switch to TX ON; after 3.5 minute time delay, verify the following:

a. Antenna rotates. /5-5(1)/

b. Status indicator glows steadily at each AN/SPS-64(V) Indicator. /5-2(22)/

6. Keeping the switches in step, set RANGE SELECT switches of all AN/SPS-64(V) Indicators to each of their eleven positions in turn; verify the following at each AN/SPS-64(V) Indicator for each position:

a. Sweep present. /5-8(4)/

b. Video targets displayed. /5-8(4)/

c. Range rings, electronic bearing line (EBL) and heading line displayed. /5-8 (4) for faulty Indicator/

d. Correct range and range ring interval readout (LED's above CRT). /5-8(65) for faulty Indicator/

7. At master Indicator, rotate VRM handwheel two turns clockwise; verify variable range marker displayed. /5-8(4)/

8. At master Indicator, adjust each of the following controls and verify proper response (per paragraph 3.7) to each:

a. ANTENNA ON/OFF switch /5-8(184)/

b. TUNE control /5-8(146)/

c. GAIN control /5-8(136)/

d. CONTRAST control /5-8(55)/

e. INTRF REJECT switch /5-8(136)/

f. PNL LIGHTS control /5-9(1)/

g. BRG SCALE control /5-9(1)/

h. VRM intensity control /5-8(56)/

i. READOUT control (VRM LED) /5-8(87)/

j. RANGE RINGS intensity control /5-8(36) /

k. BRILLIANCE control /5-8(18)/

l. FTE ON switch /5-8(188)/

m. FLASH OFF switch /5-8(188)/

n. PWR BOOST switch /5-8(146)/(3 mi only)

o. ANTI-CLUTTER RAIN control /5-8(43)/

p. ANTI-CLUTTER SEA control /5-8(146)/

q. EBL DIM/EBL READ control /5-8(105)/

r. EBL control /5-8(114)/

s. OFFSET control /5-8(136)/

9. Set master Indicator HGD SET/GYRO STAB/ HD UP switch to GYRO STAB and observe heading line bearing. Adjust heading line to agree with ship's compass using HDG SET feature. Verify GYRO STAB indicator (LED above CRT) is lit and heading line follows ship's heading changes.
/5-8(136)/

10. At master Indicator set RANGE SELECT switch to 24 miles. At AN/SPA-25 and AN/SPA-66 indicators, select display from AN/SPS-64(V) radar. At Control Units C-10260 (mounted on AN/SPA indicators) select HEADING LINE ON and 1 USEC FTC. At Signal Data Converter CV-3442 select Relative Bearing (RB) display.

11. At both AN/SPA-25 and AN/SPA-66 indicators, verify the following:

a. Normal sweeps present. /5-24(1)/

b. Video targets displayed. /5-24(1)/

c. Heading line displayed at 0° relative bearing. /5-24(1)/

12. At both Control Units C-10260 set FTC switch to 0.5 USEC, then 50 NSEC; verify size (depth) of video targets displayed on both AN/SPA25 and AN/SPA-66 indicators is reduced progressively. /5-24(25)/

13. At Signal Data Converter CV-3442 select North Stabilization (NS) display; verify heading line on AN/SPA-25 and AN/SPA-66 indicators is displayed at ships heading per gyro compass and follows changes in ships heading. /5-24(16)/

14. At Amplifier-Generator AM-6933, verify presence of a 10OV, 5 + 1 µsec pulse at the following PCB terminal (for the mode selected) using an oscilloscope. /5-27(1)/

MODE	PCB TERMINAL
DS-1 (X-band)	EL
DS-6 (S-band)	E3

15. Set master Indicator RANGE SELECT switch to 24 MILES. At Receiver Transmitter RT-1240, measure voltage indicative of magnetron current between TP7(+) and TP10(-); correct voltage depends upon type of magnetron installed as follows: /5-2(51)/

MAGNETRON	VOLTAGE
Raytheon	3.0 to 3.5 VDC
Toshiba	3.0 to 3.5 VDC
English Electric	3.5 to 4.0 VDC

16. At Receiver Transmitter RT-1240, measure crystal current of 23 + 5uA between TP10 (ground) and both TP1 and TP2 on A1600 assembly. /5-2(53)/

17. Set POWER switches to OFF at all AN/SPS-64(V) Indicators.

18. At Switching Units, select mode DS-2 per Table 3-3.

19. Repeat steps 4 through 9 above for DS-2 mode per the following definitions:

a. Master indicator: Indicator B

b. Slave indicators: Indicators A, C, AN/SPA-25, AN/SPA-66

c. Receiver Transmitter: MTR I (X-band)

NOTE:

When step 9 is completed for DS-2 mode, proceed to step 20 below.

20. Set POWER switches to OFF at all AN/SPS64(V) indicators.

21. At Switching Units, select DS-6 mode per Table 3-3.

22. Repeat steps 4 through 14 above and perform steps 23 and 24 below for DS-6 mode per the following definitions:

a. Master indicator: Indicator C

b. Slave indicators: Indicator A, B, AN/SPA-25, AN/SPA-66

c. Receiver Transmitter: MTR II (S-band)

23. At Receiver Transmitter RT-1241, set MONITOR SELECT switch to MAG I; verify meter reading is at high edge (but within) green zone. /5-17(55)/

24. At Receiver Transmitter RT-1241, set MONITOR SELECT switch to XTAL 1, then XTAL 2; verify meter reading is in green zone for both positions and differential between readings is not greater than one-half the green zone. /5-17(56)/

25. Refer to Table 3-3; perform a through d below for each mode: /Para. 5-13/

a. Set POWER switch to OFF at all AN/SPS64(V) Indicators.

b. Select mode at Switching Units per Table 3-3.

c. Set Indicator POWER switches as follows:

(1) Master Indicator(s): TX ON

(2) Slave Indicator: ST BY

d. After 3.5-minute time delay; verify the following:

(1) Proper Receiver Transmitter versus master Indicator selection.

(2) Proper master/slave Indicator selection.

SECTION IV: EQUIPMENT CORRECTIVE MAINTENANCE

5.9 GENERAL

This section contains corrective maintenance information for each equipment used in the AN/SPS64(V) Radar Sets. The information is presented by equipment unit and comprises, as applicable, troubleshooting instructions, removal/replacement procedures and alignment procedures for each equipment. Because of the equipment locations and functional interactions, two technicians are generally required for performance of the troubleshooting and alignment procedures. Prior to initiating any removal/replacement procedure, all power must be removed from the unit under test by turning off all ships circuit breakers associated with the unit under test. Following removal/replacement activity, alignment of the equipment unit(s) involved must be verified per the applicable alignment procedures.

5.9.1 Troubleshooting Charts

Fault isolation within each of the equipment units used in the AN/SPS-64(V) Radar Sets is supported by troubleshooting flow charts. In general, a troubleshooting chart is provided for each equipment unit; exceptions to this are:

a. Troubleshooting data for the Wave Guide Switch SA-2140 used in the AN/SPS-64(V) 2 Radar Set is included in the troubleshooting chart for the Interface Unit J-3463, Figure 5-12.

b. Troubleshooting data for the Control Indicator C-10260 used in the AN/SPS-64(V)4 Radar Set is included in the troubleshooting chart for the Signal Data Converter CV-3442, Figure 5-24.

Initiation of troubleshooting per the flow chart for a particular equipment may be indicated in several ways, the most common being: 1) reference from the applicable System Maintenance Performance Verification Procedure (see paragraph 5.8); 2) reference from the troubleshooting flow chart for an interfacing equipment; and 3) obvious equipment oriented faulty indications (e.g., no antenna rotation, panel lamps not lit, lack of response t: , operating controls or built-in test controls, etc.). The troubleshooting charts provide instructions for making observations or measurements and require the technician to make a "go/no-go" type of decision for each observation or measurement. Based on the decision, the technician is directed to proceed to another instruction; this process continues until the fault is isolated to a particular replaceable assembly or component.

When a troubleshooting instruction calls for measurement of a waveform amplitude or voltage level and the required amplitude or level is given without tolerances, the "go/no go" decision should be based on the following guidelines.

1. When the required voltage level is given in whole numbers, use a tolerance of ±10%.

2. When the required voltage level is given with decimals indicated (e.g., 13.6V or 7.0V), use a tolerance of ±0.5 or ±10%, whichever is less.

3. For waveforms, use the voltage criteria given above for signal amplitude if the observed waveshape is as shown in the chart.

When a fault appears to be isolated to a replaceable printed circuit board (PCB) assembly, the troubleshooting charts instruct the technician to replace the PCB; the dc voltages required for operation of the PCB should always be checked per the appropriate schematic diagram in Chapter 6 prior to PCB replacement.

When applicable, the troubleshooting charts use a "check interconnections" instruction; this instruction serves two purposes. First, it indicates that the cause of the trouble being traced apparently lies outside the equipment unit in which the technician is troubleshooting (i.e., a required input to that equipment is missing or incorrect). Second, in cases where the equipment unit being checked interfaces with different equipments depending on system configuration, the technician is steered to appropriate interfacing equipment via the interconnection diagrams to continue troubleshooting.

The troubleshooting charts contain log numbers at the upper right-hand corner of each instruction box; these log numbers serve two purposes. First, they provide a means by which the troubleshooting sequence used in tracing a trouble can be recorded. As each instruction is performed, the technician should note the log number; this allows him to retrace his steps if necessary. Second, the log numbers provide a means by which the technician can be referred directly to the instruction box related to a particular function within a complex troubleshooting chart. The reference may be contained on another troubleshooting chart or in the Performance Verification Procedures of paragraph 5.8. In using this type of referencing, the technician proceeds directly to the appropriate functional checks for the suspect equipment, without having to perform the entire troubleshooting sequence for that equipment.

5.9.2 Printed Circuit Board Removal/Replacement

The printed circuit board (PCB) assemblies used in the AN/SPS-64(V) radar equipments fall into the three following general categories:

a. Plug-in PCBs
b. Connector-wired PCBs
c. Direct-wired PCBs

Paragraphs 5.9.2.1 through 5.9.2.3 following provide general removal/replacement instructions for each PCB category.

CAUTION

INSURE THAT PCB'S ARE STRAPPED PROPERLY BEFORE USING AS A REPLACEMENT.

5.9.2.1 Plug-in PCB Removal/Replacement. Plug-in PCBs are used in Azimuth Range Indicators IP-1282 and IP-1283. The PCBs (Al through A10) are located in card rack A2 which contains a slotted guide and fixed connector for each PCB.

Use the following procedure to remove and replace the plug-in PCBs.

1. Set POWER switch to OFF at Indicator containing PCB to be removed.

2. Remove upper front access cover and stress bar from the Indicator.

CAUTION

THE PCBS SHOULD NOT BE REMOVED WITH INDICATOR POWER ON. IN PARTICULAR, REMOVING THE AI VIDEO AMPLIFIER PCB WITH INDICATOR POWER ON MAY CAUSE BURNING OF THE CRT FACE.

3. Grasp the PCB to be removed at upper and lower corners and gently move it up and down while pulling outward to free it from its connector.

4. Pull the PCB straight out of its slot.

5. Orient the replacement PCB such that its components are located on the right-hand side and carefully align it with the slots in the card rack.

6. Slide the PCB straight into the card slot until resistance of the connector is felt; place thumbs at upper and lower corners of the PCB and carefully apply even pressure until the PCB seats in the connector.

7. Replace stress bar and access cover.

5.9.2.2 Connector-Wired PCB Removal/Replacement. - All electrical connections for this type of PCB are accomplished via removable connectors. Connector-wired PCBs are used in the following AN/SPS-64(V) equipments:

a. Azimuth Range Indicators IP-1282 and IP-1283
b. Video Amplifier AM-6932 (V2, V3, V4)
c. Receiver Transmitter RT-1241 (V4)
d. Signal Data Converter CV-3442 (V4)
e. Amplifier-Generator AM-6933 (V4)

Use the following general procedure for removing and replacing connector-wired PCBs.

1. Set POWER switch to OFF at equipment unit containing PCB to be removed.
2. Open equipment to gain access to the PCB (access details are given in the first paragraph of the section devoted to each equipment, e.g., paragraphs 5.10, 5.11, etc.).
3. Verify that each connector plug on the PCB is marked with the mating jack number; attach a tag to each unmarked plug.
4. Disconnect all connector plugs from the PCB.
5. Note the PCB mounting position. Remove the mounting hardware and withdraw the PCB.
6. Locate the replacement PCB in the same position and install mounting hardware.
7. Observing the mating jack numbers, connect all plugs removed in step 4 at the replacement PCB.
8. Replace access covers.

5.9.2.3 Direct-Wired PCB Removal/Replacement. All electrical connections to this type of PCB are made by solder connections at the point on the PCB where the external wires attach. Direct-wired PCBs are used in the following AN/SPS-64(V) equipments:

a. Azimuth Range Indicators IP-1282 and IP-1283
b. Receiver Transmitters RT-1240 and RT-1241
c. Switching Units SA-2139 and SA-2156 d. Video Amplifier AM-6932

Use the following general procedure for removing and replacing direct-wired PCBs.

1. Set POWER switch to OFF at equipment unit containing PCB to be removed.
2. Open equipment to gain access to the PCB (access details are given in the first paragraph of the section devoted to each equipment, e.g., paragraphs 5.10, 5.11, etc.).
3. At each PCB wire connection (in turn):
    a. Tag the wire with sufficient information to identify the connection point on the PCB.
    b. Unsolder and disconnect the wire, taking care to avoid applying excessive heat to components and the PCB surfaces.
4. Note the PCB mounting position. Remove the mounting hardware and withdraw the PCB.
5. Locate the replacement PCB in the same position and install mounting hardware.
6. Observing the connection points tagged on the external wires, connect each wire in turn to the replacement PCB and solder, taking care to avoid applying excessive heat to components and PCB surfaces.
7. Replace access covers.

5.10 RECEIVER TRANSMITTER RT-1240

Paragraphs 5.10.1 through 5.10.3 and their related subparagraphs provide corrective maintenance information for Receiver Transmitter RT-1240 (20 KW X-band MTR). The information includes troubleshooting instructions (5.10.1), removal and replacement procedures (5.10.2) and alignment procedures (5.10.3) . The locations of assemblies and major components within Receiver Transmitter RT-1240 are shown in Figure 5-1. Schematic diagrams, parts list tables and assembly drawings applicable to Receiver Transmitter RT-1240 are contained in Section 6.2 of Chapter 6.

Access to the assemblies and components within Receiver Transmitter RT-1240 is provided by releasing the six clamping catches on the front cover and removing the cover. When the cover is removed, a safety interlock switch is activated which disables the high voltage power supply; the interlock switch may be pulled outward to permit high voltage operation if required for troubleshooting or alignment. Access to the modulator, magnetron and microwave circuits is achieved by loosening the two captive screws on the control panel and swinging the panel outward until it locks in its service position.

WARNING

APPROXIMATELY +9 KV DC (REGULATED) IS PRESENT IN THE VICINITY OF THE MODULATOR TUBE, HIGH VOLTAGE PCB AND MAGNETRON WHEN THE HIGH VOLTAGE POWER SUPPLY IS OPERATING.

5.10.1 Troubleshooting Procedure

Fault isolation within Receiver Transmitter RT1240 is facilitated by use of Troubleshooting Chart, Figure 5-2. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

WARNING

THE POWER SUPPLY CONTAINED IN RECEIVER TRANSMITTER RT-1240 UTILIZES A FLOATING COMMON BUSS WHICH OPERATES AT APPROXIMATELY -150 VDC WITH RESPECT TO CHASSIS GROUND. EXERCISE EXTREME CARE TO AVOID CONTACT. DO NOT GROUND THE FLOATING COMMON BUSS EXCEPT WHEN, AFTER ALL POWER HAS BEEN REMOVED FROM THE EQUIPMENT, RESIDUAL DC VOLTAGE MUST BE DISCHARGED FOR TEST EQUIPMENT CONNECTION OR COMPONENT REMOVAL.

LEGEND

A Magnetron Filament Transformer, T1

B High Voltage Assembly, A1400

C Magnetron Oscillator, V2

D IF Amplifier and Mixer Assembly, A1600

E Mixer Diodes, CR5 and CR6

F Transmit/Receive (T/R) Limiter, V3 (hidden)

G High Voltage Power Supply Assembly (Power Module), A1200

H Control PCB Assembly, A1300

J Local Oscillator Assembly, X2 (see Figure 5-3)

K Crystal Current Test Points, A1600 TP1 and TP2

L Line Filters, FL2 and FL3

M Relays K2, K3, K4

N Input Fuses, F1 and F2

O Relay, K1 (hidden)

P Terminal Board, TB2

Q Terminal Board, TB4

R Terminal Board, TB3

S Terminal Board, TB5

T Pulse Driver PCB Assembly, A1100

U Coaxial Cable Connectors (BNC) - J1, J2, J3

V Modulator, V1

W Trigger Indicator, DS1

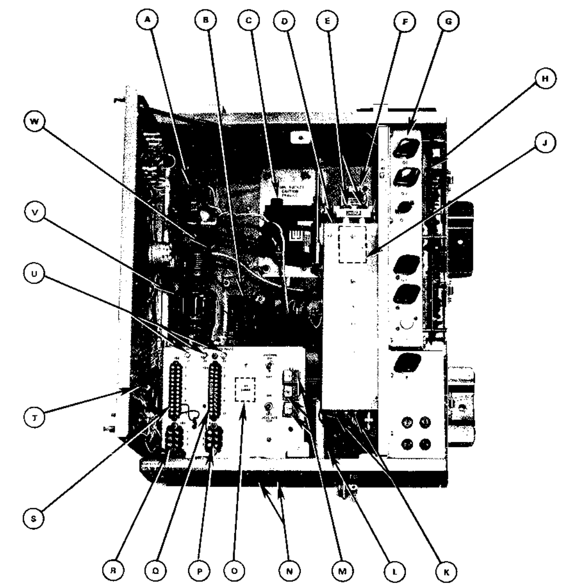


Figure 5-1 Receiver Transmitter RT-1240
Parts Location

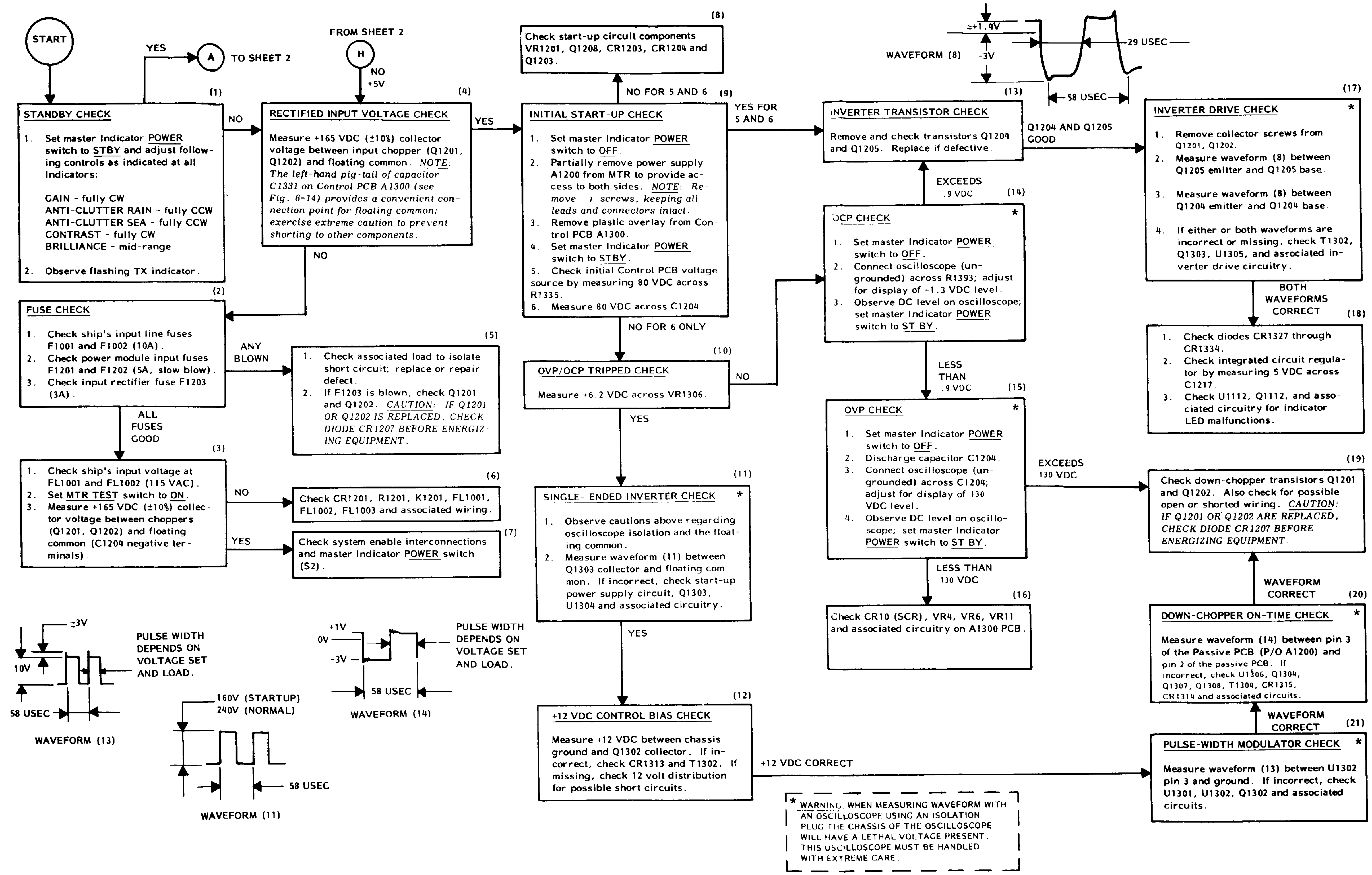


Figure 5-2 Receiver Transmitter RT-1240 Troubleshooting Chart (Sheet 1 of 4)

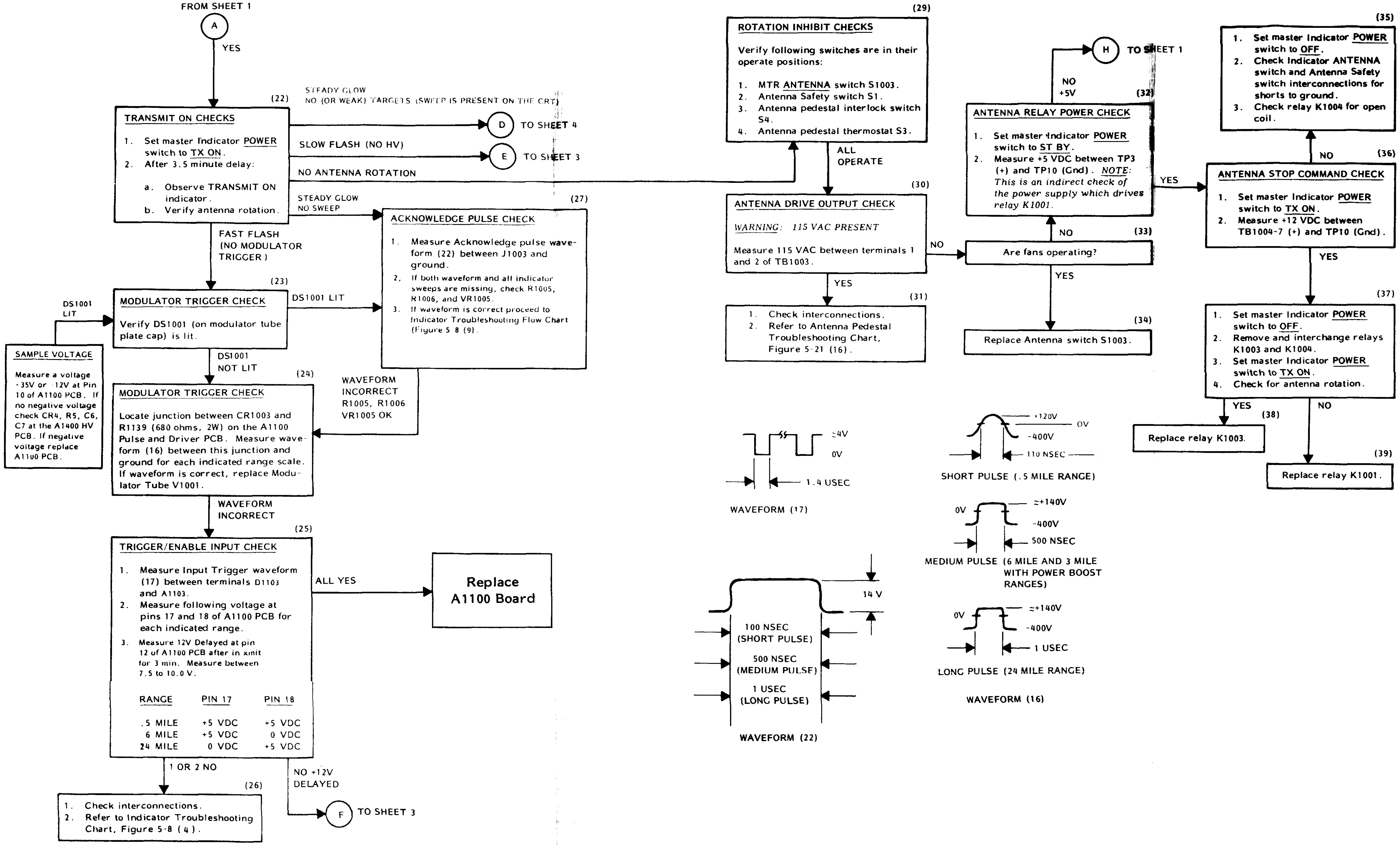


Figure 5-2 Receiver Transmitter RT-1240 Troubleshooting Chart (Sheet 2 of 4)

FROM SHEET 2

E

SLOW FLASH (NO HV)

(40)

HV UP-CHOPPER CHECK

Measure waveform (19) at Q1206 collector and chassis. If missing, check HV fuse F1204, interlock S1004, K1002 and transmit enable interconnections.

WAVEFORM INCORRECT → (44)

WAVEFORM CORRECT → (41)

WAVEFORM MISSING → G

FROM SHEET 2

F

NO +12V DELAYED → (41)

(41)

+12V (DELAYED) CHECK

Measure following voltages between TP9 (+12V DLY) and TP10 (ground):

Short Pulse: 7.38 VDC to 9.02 VDC
Medium Pulse: 8.1 VDC to 9.9 VDC
Long Pulse: 8.1 VDC to 9.9 VDC

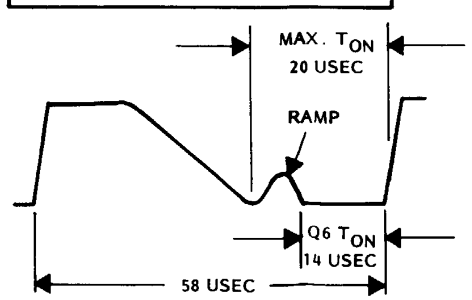
If incorrect, check CR1220, CR1221, and associated circuitry (located on Passive PCB).

YES → (42)

(42)

+12V (DELAYED) CIRCUIT CHECK

1. Measure 0 VDC at pin 8 of U1107-2. If incorrect, check U1107-2 and associated circuitry on the A1100 PCB.
2. Measure voltage across C1135. Correct indication is -12 VDC (short pulse) and -35 VDC (long pulse). If correct, check U1112 and associated circuitry. If incorrect, check CR1404 and associated circuitry.



WAVEFORM (19)

(43)

Replace magnetron V1002.

AUDIBLE ARCING OR ALL CONDITIONS CORRECT → (43)

(44)

MAGNETRON ARCING CHECK

1. Listen for arcing in magnetron.
2. Set master Indicator POWER switch to OFF.
3. Remove filament connector from magnetron V1002.
4. Set master Indicator POWER switch to TX ON.
5. After 3.5 minutes, measure +7.4 to +10.0 VDC (+12V DLYD) between TP9 (+) and TP10 (-). (HV not tripping).
6. Measure waveform (19) between A1206 collector and chassis; verify T_{ON} is 14 to 17 (maximum) usec.
7. Set master Indicator POWER switch to OFF.
8. Connect filament at V1002.
9. Set master Indicator POWER switch to TX ON.
10. Measure waveform (19) between Q1206 collector and chassis; verify T_{ON} is 7 to 8 usec.

ANY CONDITION INCORRECT → (45)

(45)

MODULATOR ARCING CHECK

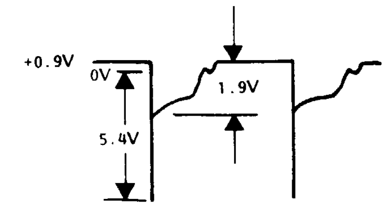
1. Set master Indicator POWER switch to OFF.
2. Remove modulator tube V1001.
3. Set master Indicator POWER switch to ON.
4. Measure waveform (19) between Q1206 collector and chassis; note T_{ON}.

T_{ON} >8 USEC → (46)

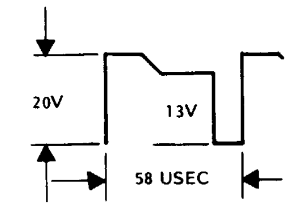
$T_{ON} \leq$ 8 USEC → (48)

(48)

Replace modulator V1001.



WAVEFORM (35)



WAVEFORM (37)

G → (46)

(46)

HV UP-CHOPPER/MULTIPLIER CHECK

WARNING: HIGH VOLTAGE IS PRESENT IN THE AREA OF THE MODULATOR AND MAGNETRON.

1. Set master Indicator POWER switch to OFF.
2. Remove F1204 and set master Indicator POWER switch to TX ON. *NOTE: To speed up the 3-1/2 minute delay, connect a 4.7K resistor across R1361.*
3. Measure waveform (35) between Q1311 emitter and chassis.
4. If waveform is present, check Q1206 and all components on the A1400 HV assembly for shorts or opens.

WAVEFORM INCORRECT → (49)

(49)

3.5 MINUTE DELAY CHECK

Measure 12 VDC from Q1310 collector to chassis ground. If incorrect, check U1307, Q1305, Q1310, and associated circuitry. *NOTE: Pins 1 through 8 of U1307 should be high after the 3.5 minute delay.*

12 VDC CORRECT → (50)

(50)

HV UP-CHOPPER DRIVE CHECK

Measure waveform (37) between Q1306 collector and chassis. If present, check Q1311 and associated circuitry. If not, check pulse-width modulator U1308, Q1306, and associated circuitry.

Figure 5-2 Receiver Transmitter RT-1240 Troubleshooting Chart (Sheet 3 of 4)

FROM SHEET 2

D

STEADY GLOW, NO (OR WEAK) TARGETS

(51)
MAGNETRON CURRENT CHECK

1. Select 24 mile range.
2. Check magnetron current by measuring the following voltage between MAG CURRENT (TP7) and GND (TP10) test points:

MAGNETRON TYPE
RAYTHEON: 3.0 TO 3.5 VDC
English Electric: 3.5 to 4.0 VDC
Toshiba: 3.0 to 3.5 VDC

NOTE: Do not allow the magnetron voltage to exceed the values specified above. If it does, adjust HV control R1357 on the A1300 Control PCB to bring within tolerance.

MAGNETRON CURRENT INCORRECT

(52)
WARNING: TURN MASTER INDICATOR POWER SWITCH TO OFF BEFORE PERFORMING STEP 1 OR STEP 2.

1. Check for proper contact between V1002 magnetron pins and tube socket pins.
2. Replace V1002 magnetron. *NOTE: When replacing the magnetron, record the following information for new magnetron in the maintenance log:*
   a. Manufacturer
   b. Magnetron Current Setting
   c. Reading on system elapsed time meter.

MAGNETRON CURRENT CORRECT

(53)
CRYSTAL CURRENT CHECK

Measure 23 ± 5 microamperes crystal current between both TP1 and TP2 and chassis on the A1600 IF Amplifier and Mixer Assembly.

CRYSTAL CURRENT INCORRECT

(54)
1. Low or unbalanced current: Check mixer diodes CR1005 and CR1006.
2. No current or both low: Check local oscillator (Gunn diode):
   a. Align per Para. 5.10.3.5.
   b. Input voltages (if incorrect check Q1301 and associated circuit):

      Supply: 10.5 VDC
      Tune: -1 to -10 VDC (depending on tune control setting).
3. Repeated crystal failures: Replace T/R Limiter V1003.

DIODES AND SUPPLY VOLTAGES GOOD, CAN'T ALIGN

(55)
1. Replace local oscillator assembly X1002.
2. If unbalanced crystal current problem persists, replace IF Amplifier Assembly A1600.

CRYSTAL CURRENT WITHIN TOLERANCE

(56)
IF AMPLIFIER ASSEMBLY CHECK

Measure waveform (X) at A1600 J1.

VIDEO NORMAL

(62)
1. Check interconnections.
2. Refer to applicable troubleshooting Chart:

   V1: Indicator, Fig. 5-8 (4).
   V2, V3, V4: Video Amplifier, Fig. 5-15 (6).

NO OR WEAK VIDEO

MDS

(57)
IF AMPLIFIER CONTROL CHECK

1. Measure waveform (U) at A1600 STC terminal; slope should vary continuously as ANTI-CLUTTER SEA control is rotated through its entire range.
2. Measure smooth change from -12 VDC to 0V at A1600 GAIN terminal as GAIN control is varied from fully CW to fully CCW (return to CW).
3. Measure following voltages at A1600 B/W terminal for the indicated range scales:

   0.5 MILES: +12 VDC
   6 MILES: 12 VDC
   48 MILES: 12 VDC

GAIN CONTROL INCORRECT

(60)

(63)
1. Check interconnections.
2. Refer to Indicator Troubleshooting Chart, Fig. 5-8.

STC WAVEFORM INCORRECT

Measure smooth change from 0V to +12 VDC at junction of CR9 and R57 on A1100 PCB as ANTI-CLUTTER SEA is rotated through its entire range (return to CCW).

NO

YES

(64)
Replace PCB A1100.

BANDWIDTH INCORRECT

(61)
Measure following voltage on pins 17 and 18 of A1100 PCB for each indicated range scale:

RANGE	PIN 18	PIN 17
.5 MILES	+5 VDC	+5 VDC
6 MILES	0 VDC	+5 VDC
24 MILES	+5 VDC	0 VDC

YES

(65)
1. Select 0.5 mile range.
2. Measure +12 VDC at pin 9 of A1100 PCB.

NO

YES

(66)
Replace relay K3.

NO

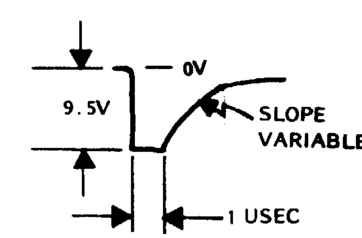
ALL CORRECT

(58)
1. Check +12V and -12V inputs at A1600 terminals.
2. Check for accumulation of water at low point of waveguide.
3. Check rotary joint for damage.

ALL OK

(59)
Replace IF Amplifier Assembly A1600.

WAVEFORM (X)
(SHAPE TYPICAL)



WAVEFORM (U)

Figure 5-2 Receiver Transmitter RT-1240 Troubleshooting Chart (Sheet 4 of 4)

5.10.2 Removal/Replacement Procedures

Before initiating any removal or replacement activity at Receiver Transmitter RT-1240, insure that all power is removed from the equipment by performing the following steps:

1. Insure that POWER switch is set to OFF at associated (master) Indicator.

2. Set LOCAL TEST switch to OFF.

3. Turn off ships circuit breakers which supply power to Receiver Transmitter RT-1240 under test.

NOTE 1:

When the Receiver Transmitter cover is removed, the high voltage interlock switch automatically springs to a power disable position. Power may be restored to the unit with the cover removed by pulling the interlock switch outward.

CAUTION

ONLY NON-FERROUS TOOLS SHOULD BE USED WHEN WORK IS BEING PERFORMED INSIDE THE RECEIVER TRANSMITTER UNIT. EXAMPLES OF NONFERROUS MATERIALS ARE STAINLESS STEEL, ALUMINUM OR BERRYLIUM COPPER.

5.10.2.1 Modulator Tube V1. - See Figure 5-1; refer to assembly drawings in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

WARNING

RESIDUAL HIGH VOLTAGE CHARGES MAY BE PRESENT. DISCHARGE ALL MODULATOR TUBE TERMINALS AND ALL COMPONENTS IN THE VICINITY OF THE MODULATOR TUBE BEFORE TOUCHING.

3. Remove the screw and washer, located on the left-hand outer side of the cabinet, that retains the nylon rod, supporting spring and tube cap.

4. Loosen the tube cap set screw and remove the tube cap from the tube.

5. Loosen retaining clamp at the base of tube.

6. Pull the tube from the tube base assembly.

7. Reinstall using the reverse of the above.

5.10.2.2 Magnetron Oscillator V2. - See Figure 5-1: refer to assembly drawings in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

WARNING

RESIDUAL HIGH VOLTAGE CHARGES MAY BE PRESENT. DISCIIARGE ALL MAGNETRON TUBE TERMINALS AND ALL COMPONENTS IN THE VICINITY OF THE MAGNETRON TUBE BEFORE TOUCHING.

3. Disconnect filament plug (potted wire terminals).

4. Loosen the alien screws on the tuning rod and disconnect the rod.

5. Remove the six screws, washers and lockwashers and lift the magnetron oscillator out.

6. Reinstall using the reverse of above.

5.10.2.3 T/R Limiter V3. - See Figure 5-1; refer to assembly drawings in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

WARNING

RESIDUAL HIGH VOLTAGE CHARGES MAY BE PRESENT. DISCHARGE ALL COMPONENTS IN THE VICINITY OF THE T/R LIMITER BEFORE TOUCHING.

3. Remove the IF Amplifier Assembly per paragraph 5.10.2.7. Steps 1,2,3,6.

4. Remove the four screws, washers and lockwashers that attach the T/R limiter to the duplexer assembly. Note orientation of the T/R limiter.

5. Remove the four screws, nuts and washers that attach the T/R limiter to the waveguide flange and remove the T/R limiter.

6. Reinstall new T R Limiter with correct orientation using the reverse of the above.

5.10.2.4 Local Oscillator Assembly X2. - See Figure 5-1; refer to assembly drawings in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

3. Remove the IF Amplifier Assembly per paragraph 5.10.2.7 using steps 1,2,3,6 and 7.

4. Disconnect all wires from the local oscillator assembly, noting and tagging the connection locations.

5. Remove the four nuts attaching the oscillator to the IF Amplifier Assembly and remove the oscillator assembly.

6. Reinstall using the reverse of the above.

5.10.2.5 Mixer Diodes CR5/CR6. - See Figure 5-1; refer to assembly drawings in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Unscrew one of the mixer diodes caps and note the polarity of the diode installed.

CAUTION

A. DO NOT EXPOSE MIXER DIODES TO EXCESSIVE RF RADIATION.

B. IF MIXER DIODE FORWARD/ REVERSE RATIO IS TO BE CHECKED, DO NOT USE THE RX 10,000 FUNCTION OF THE MULTIMETER.

3. If replacement is necessary, install the new diode in the cap in the same polarity as the original diode, and screw cap into mixer assembly.

4. Repeat steps 2 and 3 for second mixer diode.

5.10.2.6 Relay Kl1. - See Figure 5-1; refer to assembly drawing in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

3. Remove the hardware that secures the terminal board bracket; relay K1 is located on the back side of the bracket.

4. Pull the bracket forward just enough to gain access to the two screws holding the relay.

5. Disconnect all wires from the relay terminals, tagging each for connection point.

6. Remove the two screws which hold the relay and withdraw the relay.

7. Replace relay K1 using the reverse of the above.

5.10.2.7 IF Amplifier and Mixer Assembly A1600. See Figure 5-1; refer to assembly drawings in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

3. Remove Power Module Assembly A1200 per paragraph 5.10.2.8.

4. Disconnect all wires from the A1600 assembly, tagging each for connection point.

5. Disconnect BNC plug at A1600 J1.

6. Remove screw, lockwasher and flat washer which secure right-hand side of A1600 assembly to chassis mounting bracket.

7. Remove the four nuts and lockwashers which secure the 900 E-bend waveguide flange to the waveguide tee on the A1600 assembly; withdraw the A1600 assembly from the unit.

8. Replace IF Amplifier and Mixer Assembly A1600 using the reverse of the above.

5.10.2.8 Power Module Assembly A1200. - See Figure 5-1; refer to assembly drawing in Chapter 6, Section 6.2 as necessary.

1. Insure removal of power from the unit per paragraph 5.10.2.

2. Remove front cover; loosen control panel captive screws and swing control panel into its service position.

3. Remove the seven screws and lockwashers that attach the Power Module to the center bracket of the Receiver Transmitter chassis.

4. Lift the Power Module up and out far enough to access the harness connector.

5. Disconnect the harness connector and remove the Power Module from the unit.

6. Replace the Power Module Assembly A1200 using the reverse of the above.

5.10.3 Alignment Procedures

When performed in the sequence indicated, the instructions given in paragraphs 5.10.3.1 through 5.10.3.8 following constitute an overall alignment procedure for Receiver Transmitter RT-1240. The functions covered in each of the procedures should be checked and adjusted as necessary following all repair or replacement activities.

NOTE:

For V2, V3 or V4 systems, observe Switching Unit setting and refer to Tables 3-1, 3-2 or 3-3 respectively to determine which Indicator is serving as the master for the Receiver Transmitter under test.

5.10.3.1 Power Module Frequency Adjustment. - Perform the following steps to check operating frequency of power module:

1. Set master Indicator POWER switch to ST BY.

2. Connect oscilloscope at collector of Q9 on A1300 Control PCB.

3. Verify period between leading edges of negative-going trigger pulses is 58 ± 1 used (16.95 to 17.55 kHz).

4. If incorrect adjust R40 on A1300 PCB to obtain correct period.

5.10.3.2 Power Module Output Voltage Adjustment. - Check and align power module output voltages as follows:

1. Set master Indicator POWER switch to ST BY.

2. Connect multimeter, set for 1000 Vdc measurement, as follows:

   a. Positive lead: TP10 (ground)

   b. Negative lead: TP1 (-470)

3. Adjust R6 on A1300 Control PCB to obtain -465 Vdc reading on multimeter.

4. Connect multimeter as indicated in Table 5-3 and verify correct dc voltage at each test point (TP10 is ground).

Table 5-3 Receiver Transmitter RT-1240 Power Supply Test Points

POSITIVE LEAD	NEGATIVE LEAD	DC VOLTAGE
TP10O	TP1	-465 ± 5
TP10O	TP2	-12.5 ± 0.5
TP3	TP10	+5 ± 0.25
TP4	TP10	+12.5 ± 0.5
TP5	TP10	+120 ± 10

5.10.3.3 Pulse Width Adjustments. - Set the three transmitter pulse widths per the following steps:

1. At master Indicator:

   a. Set POWER switch to TX ON.

   b. Set RANGE SELECT switch to 1.5 MILES.

   c. Allow 3.5-minute warm-up time delay.

2. Connect oscilloscope probe at junction of R39 and CR3 on A1100 Pulse/Driver PCB.

3. Adjust oscilloscope to display leading and trailing edges of the modulator drive pulse at the point where they pass through zero Vdc.

4. Adjust R28 on A 100 PCB to obtain 110 nsec between leading and trailing edges at zero Vdc.

5. Set master Indicator RANGE SELECT switch to 6 MILES and repeat step 3.

6. Adjust R23 on Al100 PCB to obtain 500 nsec between leading and trailing edges at zero Vdc.

7. Set master Indicator RANGE SELECT switch to 24 MILES and repeat step 3.

8. Adjust R25 on A1100 PCB to obtain 1000 nsec between leading and trailing edges at zero Vdc.

5.10.3.4 High Voltage Adjustment. - Set the output from the high voltage regulator as follows:

1. At master Indicator:

   a. Set POWER switch to TX ON.

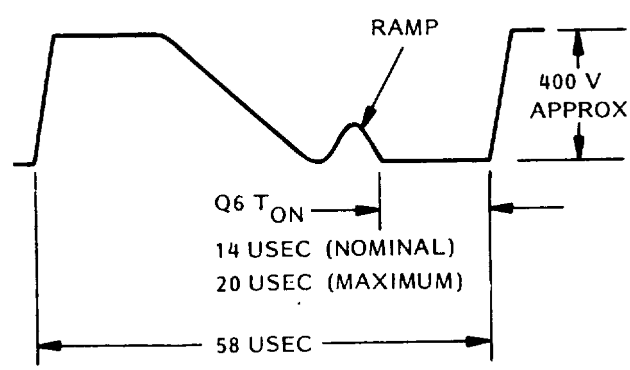
   b. Set RANGE SELECT switch to 24 MILES.

   c. Allow 3.5-minute turn-on time delay.

2. Connect multimeter, set to 10 Vdc scale, between TP7 (+) and TP10 (-).

WARNING
REGULATED 400 VDC PRESENT

3. Connect oscilloscope between ground and collector of Q6 on A1200 power module assembly; adjust for display of waveform similar to that shown below.



CAUTION
DURING THE FOLLOWING STEP, DO NOT ALLOW THE ON TIME OF Q6 (Q6 T_{ON}) TO EXCEED 20 USEC.

4. While monitoring the oscilloscope waveform, adjust R57 on A1300 Control PCB to obtain the multimeter reading given below in accordance with the type of magnetron installed:

   a. Raytheon magnetron: 3.0 to 3.5 Vdc

   b. Toshiba magnetron: 3.0 to 3.5 Vdc

   c. EEV magnetron: 3.5 to 4.0 Vdc

5.10.3.5 Power Module Duty Cycle Limit Adjustment.

NOTE:

This adjustment is set at the factory, and should not require alignment unless U1 on the A1300 Control PCB has been replaced, or a low-voltage power supply regulation problem has occurred. Follow the procedure below if adjustment is necessary.

1. Set master Indicator POWER switch to OFF.
2. Turn off ship's circuit breaker which controls 115 VAC to Receiver Transmitter RT-1240 under test.
3. Connect variac rated at 115 Vac, 10A between ships input power cable and inputs to FL2 and FL3 at Receiver Transmitter RT-1240; ground variac to equipment.
4. Set ships circuit breaker to ON and master Indicator POWER switch to ST BY.
5. Connect multimeter, set at 250 Vac scale, between FL1 and FL2 inputs and adjust variac for 115 Vac.
6. Connect oscilloscope probe at U2 pin 3 on A1300 Control PCB using an IC slip; adjust for display of 5V pulse train.
7. Set master Indicator POWER switch to TX ON.
8. Adjust variac to reduce input line voltage; verify width of positive excursions of pulse train increases.
9. Adjust variac to reduce input line voltage through 95 Vac; verify positive excursion width stops increasing as input voltage passes through 95 VAC and positive excursion pulse width does not exceed 40 µsec.
10. If necessary, adjust R22 on A1300 Control PCB and repeat step 9 until correct result is obtained.

5.10.3.6 Transmitter Frequency Adjustment. Perform the following steps to change the operating frequency of the tunable magnetron.

1. At master Indicator:
    a. Set POWER switch to ST BY.
    b. Set RANGE SELECT switch to 24 MILES.
2. Attach 20dB attenuator at FORWARD port of directional coupler mounted near RF output flange. Connect frequency meter to attenuator using type N-to-waveguide adapter and RG-214/U coaxial cable.
3. Connect power meter thermistor mount to frequency meter using type N-to-waveguide adapter
4. Set master Indicator POWER switch to TX ON; allow 3.5-minute time delay to elapse.
5. Adjust frequency meter for a dip on power meter and note magnetron initial operating frequency.
6. Adjust the magnetron tuning shaft extending through the side of cabinet a small amount and retune the frequency meter to determine direction of shaft rotation versus frequency change.
7. Set frequency meter to desired operating frequency. (9420 MHz) 8. Adjust magnetron tuning shaft for optimum dip on power meter.
9. Perform local oscillator adjustment procedure given in the following paragraph.

5.10.3.7 Local Oscillator Adjustments. - Perform the following steps to align the local oscillator to the transmitter operating frequency.

1. At master Indicator:
    a. Set POWER switch to TX ON.
    b. Set TUNE control to center of its range.
    c. Set RANGE SELECT switch to 6 MILES.
2. Connect multimeter, set to +10 VDC scale, between TUNE (+) and GND (-) test points at Receiver Transmitter RT-1240.
3. Disconnect output cable at J1 of A1600 IF Amplifier Assembly; install BNC Tee connector on cable-and connect Tee at A1600 J1.
4. Connect oscilloscope to Tee connector at A1600 J1.

CAUTION

DO NOT FORCE THIS CONTROL.
IT IS EXTREMELY DELICATE.

5. Turn local oscillator cavity tuning adjustment (see Figure 5-3) fully CW.
6. While observing multimeter, carefully turn local oscillator cavity tuning adjustment control CCW until multimeter deflection indicates presence of signal.

NOTE:

Depending upon the magnetron operating frequency, a false signal node may be encountered when adjusting the local oscillator cavity. This false node will be indicated by presence of high level noise and no video targets on the oscillator and CRT displays. If this false node is encountered, continue turning the cavity adjustment control CCW until the multimeter indicates signal presence at another control setting and video targets are displayed on the oscilloscope.

7. Observe oscilloscope display and identify a non-saturating video target which is displayed during each rotation of the antenna. If necessary, adjust master Indicator GAIN control to optimize target amplitude.
8. Observe identified target on oscilloscope and carefully adjust local oscillator cavity adjustment control to obtain maximum target signal amplitude.
9. Connect multimeter, set for 50uA measurement, between TPI (+) on A1600 assembly and chassis (-).
10. Turn local oscillator injection power adjustment control (see Figure 5-3) to obtain 23uA reading on multimeter.
11. Connect multimeter between TP2 on A1600 assembly and chassis; verify 23 ± 5uA reading on multimeter.

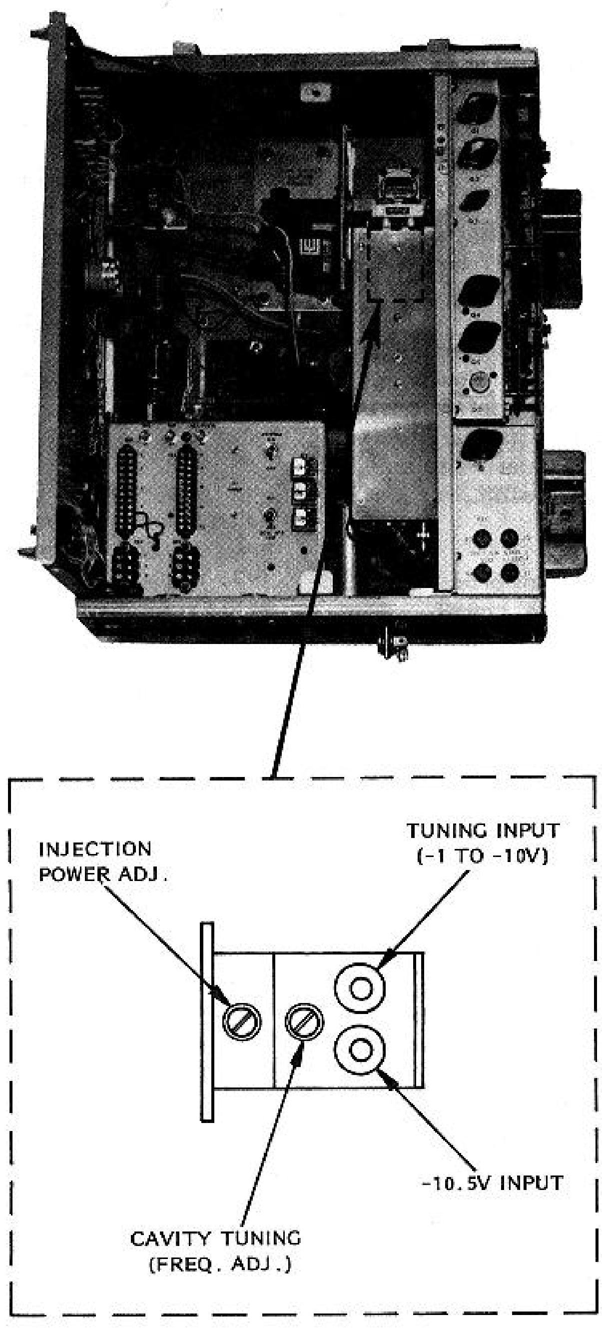


Figure 5-3 Local Oscillator Adjustment Locations

NOTE:

If the difference between step 10 and 11 current measurements exceeds 5 microamperes, a new pair of matched crystals (CR5 and CR6) should be installed in the mixer assembly.

12. At master Indicator, adjust TUNE, GAIN and CONTRAST controls to optimize CRT target display.

5.10.3.8 Anti-Clutter Sea (STC) Adjustment. - The STC circuit has been factory adjusted. However, re-adjustment may be necessary for a particular installation or following repairs. If, after careful evaluation of performance, if it is determined that readjustment is necessary, the following procedure shall be used.

NOTE:

The range zero alignment procedure given in paragraph 5.12.3.3 must have been accomplished prior to performance of the procedure.

1. At master Indicator:
   a. Set POWER switch to TX ON.
   b. Set RANGE SELECT switch to 6 MILES.
   c. Set GAIN control fully CCW.
   d. Set ANTI-CLUTTER SEA control fully CCW.
   e. Allow 3.5-minute time delay to elapse.
2. Adjust master Indicator BRILLIANCE control so that CRT trace is barely visible, then adjust GAIN control to display a background noise speckle.
3. Set master Indicator ANTI-CLUTTER SEA control fully CW; verify background noise speckle is diminished to a range of at least 3 miles. If incorrect, adjust R57 (STC Law control) on Receiver Transmitter RT-1240 A 1100 PCB.
4. At master Indicator:
   a. Set RANGE SELECT switch to .5 MILES.
   b. Adjust ANTI-CLUTTER SEA control CCW until well defined short range targets are displayed.
5. Turn STC Delay control R50 on Receiver Transmitter RT-1240 CW to display a dark circle at the center of the CRT, then turn R50 CCW until diameter of the dark circle is reduced to between 1/8 and 1/16 inch.

NOTE:

Under adjustment of the STC Delay control R50 will result in degraded minimum range performance; over adjustment may cause burning of the CRT face.

6. At master Indicator set RANGE SELECT switch to 1.5 MILES. If attenuation of returns from significant short range targets is noted, re-adjust STC Law control R57 on Receiver Transmitter RT-1240 to optimize target display.

NOTE:

This re-adjustment may alter the 3-mile noise cutoff established in step 3 and degrade STC performance; perform the re-adjustment with care.

5.11 ANTENNA PEDESTALS AB-1247 AND AB-1247A

Paragraphs 5.11.1 through 5.11.3 and their related subparagraphs provide corrective maintenance information for Antenna Pedestals AB-1247 (V1, V2, V3 X-band) and AB-1247A (V4 X-band, with synchro transmitter). The information includes troubleshooting instructions (5.11.1), removal and replacement procedures (5.11.2) and alignment procedures (5.11.3). The locations of assemblies and major components within the antenna pedestals are shown in Figure 5-4. Schematic diagrams, parts list tables and assembly drawings applicable to the AB-1247 and AB-1247A pedestals are contained in Section 6.3 of Chapter 6.

Primary access to the assemblies and components within the AB-1247 and AB-1247A antenna pedestals is provided by disconnecting the waveguide fitting from the rotary joint, disconnecting the pedestal housing from the fixed base plate, and raising the housing until it locks into its service position.

Detailed instructions for raising the pedestal in this manner are given in the appropriate procedures.

WARNING

WHEN WORKING AT TIIE ANTENNA PEDESTAL, ALWAYS SET THE ON/OFF SAFETY SWITCH (LOCATED ON TIIE FRONT EX| TERIOR OF TIIE PEDESTAL) TO OFF.

SYMBOL	LEGEND
A	Interlock Switch S4
B	Starting Capacitor C1
C	Drive Motor B1
D	Belt Tension Adjustment Slot
E	Drive Motor Mounting Bolts (4 ea.)
F	Gear Reducer Assembly
G	Rotary Joint Assembly
H	Synchro Transmitter B3 (AB-1247A ONLY)
J	Terminal Board TB3
K	Terminal Board TB2
L	Terminal Board TB1
M	Resolver B2
N	Data Unit Assembly (See Figure 5-6)
P	Driven Sheave
Q	Anti-Rotation Plate
R	Drive Belt
S	Drive Sheave
T	Drain Hose

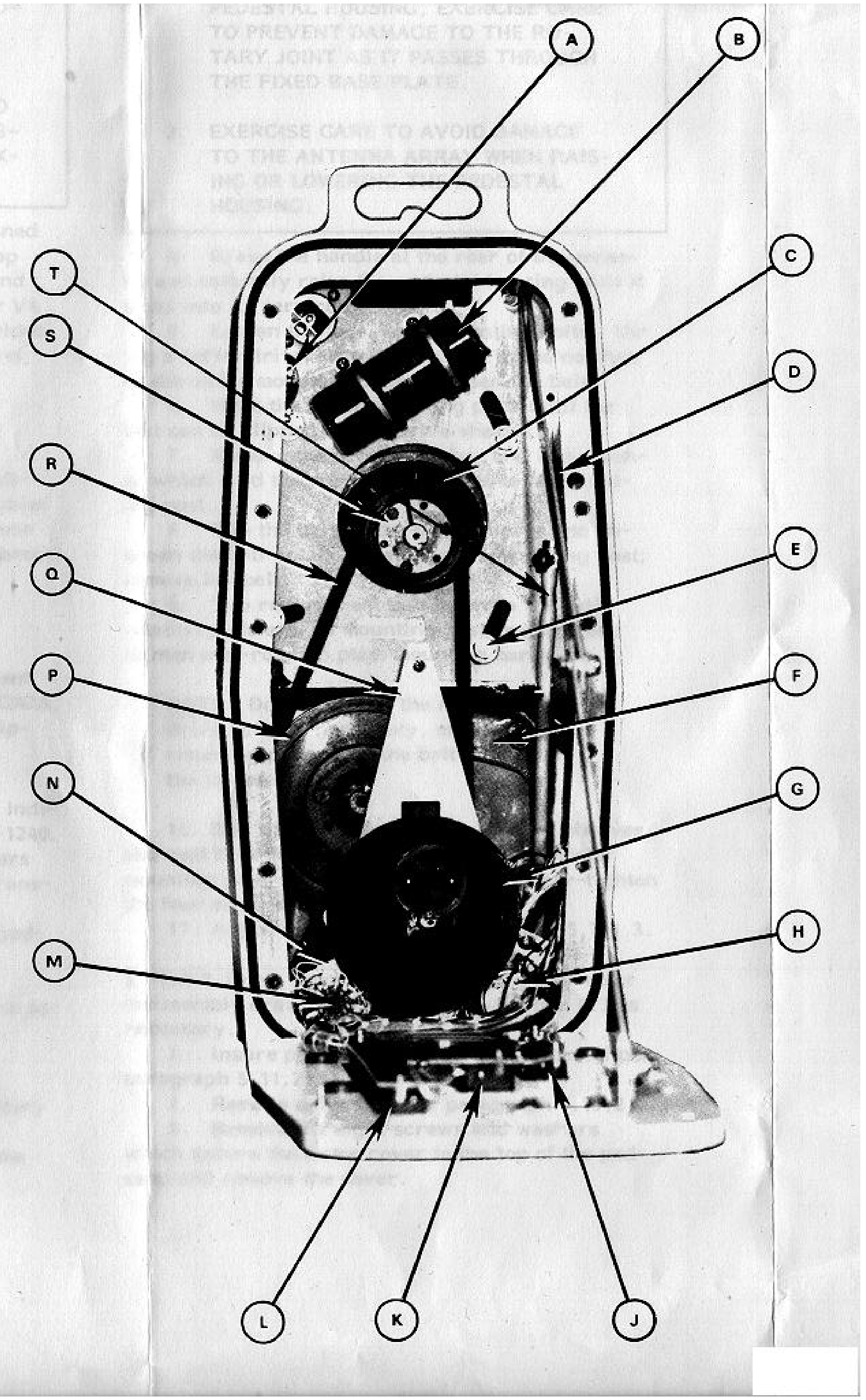


Figure 5-4 Antenna Pedestal AB-1247 Parts Location

CAUTION

1. USE CARE TO AVOID DAMAGE TO THE ANTENNA ARRAY WHEN LIFTING THE PED ESTAL INTO ITS SERVICE POSITION.

2. WHEN RAISING OR LOWERING THE PEDESTAL, EXERCISE EXTREME CARE TO AVOID DAMAGING THE ROTARY JOINT AS SEMBLY AS IT PASSES THROUGH THE FIX ED BASE PLATE.

Access to the antenna drive motor is obtained by removing the domed cover located on the top rear of the pedestal. Access to the resolver and heading line switch adjustment arms (and, for V4 systems, the synchro adjustment arm) is provided by removing the small cover plate at the front of the pedestal housing.

5.11.1 Troubleshooting Procedure

Fault isolation within Antenna Pedestals AB1247 and AB-1247A is facilitated by use of Troubleshooting Chart, Figure 5-5. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

5.11.2 Removal/Replacement Procedures

Before initiating any removal or replacement activity at Antenna Pedestals AB-1247 or AB-1247A, insure that all power is removed from the equipment by performing the following steps:

1. Set POWER switch to OFF at (master) Indicator for associated Receiver Transmitter RT-1240.
2. Turn off and tag ship's circuit breakers which supply power to associated Receiver Transmitter RT-1240.
3. Set ON/OFF Safety switch at front of pedestal to OFF.

5.11.2.1 Drive Belt. - See Figure 5-4; refer to assembly drawings in Chapter 6, Section 6.3 as necessary .

1. Remove power per paragraph 5.11,2.
2. Disconnect the waveguide from the rotary joint.
3. Loosen the twelve captive screws in the bottom of the pedestal fixed base plate.

CAUTION

1. WHEN RAISING OR LOWERING THE PEDESTAL HOUSING, EXERCISE CARE TO PREVENT DAMAGE TO THE ROTARY JOINT AS IT PASSES THROUGH THE FIXED BASE PLATE.

2. EXERCISE CARE TO AVOID DAMAGE TO THE ANTENNA ARRAY WHEN RAISING OR LOWERING THE PEDESTAL HOUSING .

4. Grasp the handle at the rear of the pedestal and carefully raise the pedestal housing until it locks into its service position.
5. Loosen the four motor mounting bolts. Using a screw driver, apply pressure to the notches on the motor mounting plate to loosen the belt.
6. Move the motor mounting plate until the belt can be slipped off the drive sheave.
7. Remove the screw, washer and lock washer which hold the anti-rotation plate to its mounting post.
8. Slip the belt off the drive sheave and between the anti-rotation plate and its mounting post; remove the belt.
9. Slip replacement belt between the anti-rotation plate and its mounting post; replace and tighten anti-rotation plate mounting hardware.

NOTE:

Do not stretch the replacement drive belt. If necessary, move the motor mounting plate until the belt slips over the sheaves easily.

10. Slip the replacement belt over the sheaves and seat it in the outer grooves; move the motor mounting plate to tense the belt, then finger-tighten the four motor mounting bolts.
11. Adjust be lt tension per paragraph 5.7.1.3.

5.11.2.2 Drive Motor B1. - See Figure 5-4; refer to assembly drawings in Chapter 6, Section 6.3 as necessary.

1. Insure power is removed from pedestal per paragraph 5.11.2.
2. Remove drive belt per paragraph 5.11.2.1.
3. Remove the eight screws and washers which secure the motor cover to the top of the pedestal and remove the cover.

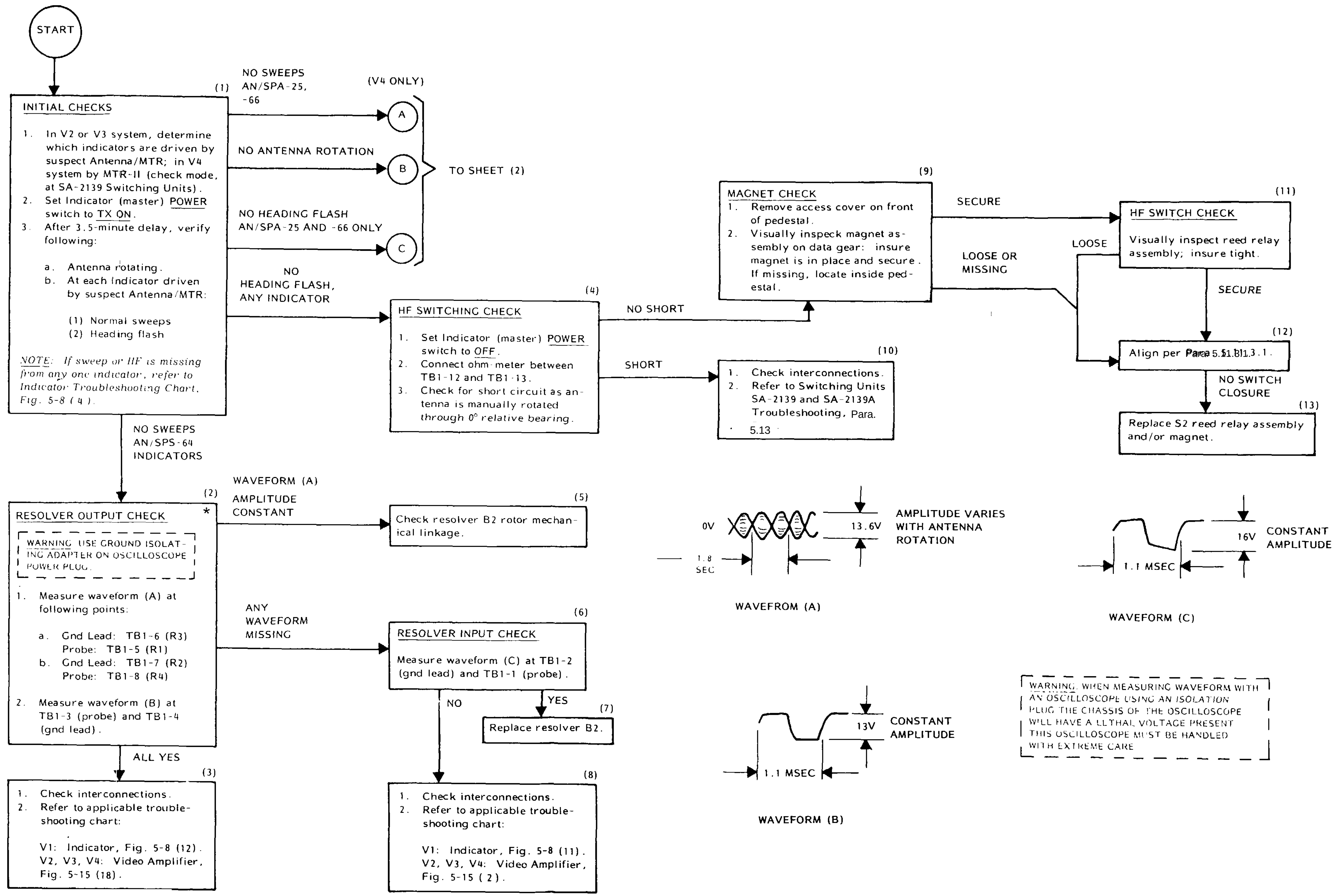


Figure 5-5 Antenna Pedestal AB-1247 Troubleshooting Chart (Sheet 1 of 2)

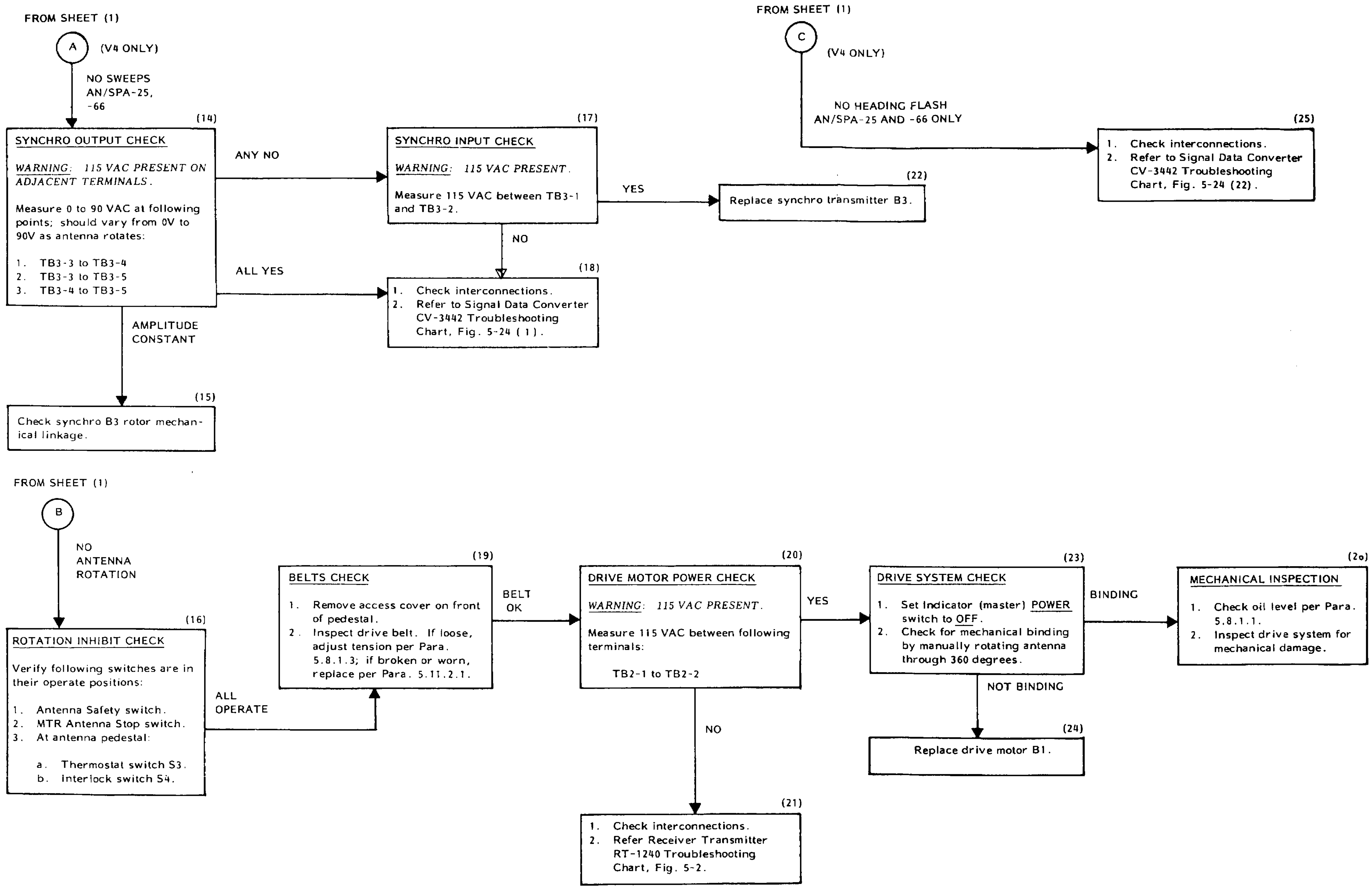


Figure 5-5 Antenna Pedestal AB-1247 Troubleshooting Chart (Sheet 2 of 2)

4. Loosen the alien-head set screw in the hub of the blower wheel; carefully pull the blower wheel from the motor shaft.

5. Disconnect the two wires from thermostat switch S3 (mounted on baffle), noting and tagging connection locations.

6. Remove the four screws, washers and lock washers from the bottom of the four stand-offs which support the sheet metal baffle; remove baffle with stand-offs attached.

7. Disconnect motor wires from terminal strip and starting capacitor, noting and tagging connection points.

8. Press blower wheel onto motor shaft and tighten set screw in blower wheel hub.

9. While supporting the drive motor, remove the four motor mounting bolts from the bottom side of the pedestal casting, the lower the pedestal housing to its operating position (do not secure).

10. Remove the lock nut and washer which hold the motor mounting plate to the top side of pedestal casting.

11. Grasp the blower wheel and lift the drive motor out, tilting the motor as necessary to allow the mounting plate to clear the pedestal casting.

12. Loosen the set screw in the blower wheel hub and carefully pull the blower wheel from the motor shaft.

13. Remove the four machine screws which hold the mounting plate to the motor; remove the plate .

14. Note the position of the sheave on the bottom shaft of the motor. Remove three hex screws from bottom of the sheave hub; place these screws in the three threaded holes in the hub and tighten in a uniform pattern to loosen the hub and sheave from the motor shaft; remove the hub and sheave from the shaft.

15. Place the sheave and hub on the bottom shaft of the replacement motor, positioning sheave as noted in the preceding step.

16. Remove the three hex screws from the bottom of the sheave hub and place them in the three unthreaded holes in the hub; tighten into the sheave in a uniform pattern to secure the sheave and hub to the motor shaft.

17. Lay the replacement motor on its side and position it such that, when viewed from the bottom of the motor, the exit port for the two starting capacitor wires is on the right-hand side (at approximately So degrees); position the motor mounting plate on the bottom of the motor such that the notch es are located up and to the left. Secure the mount ing plate to the motor using the four machine screw s .

18. Insuring that set screw in blower wheel hub is aligned with flat on top motor shaft, carefully press blower wheel onto motor shaft and tighten set screw.

19. Note the location of the threaded stud on the top side of the pedestal casting in the motor compartment; note also the location of the hole in the motor mounting plate (on side of plate opposite the notches) through which the threaded stud secures the plate to the pedestal casting.

20. Grasp the blower wheel and lower the motor into the motor compartment, aligning the mounting plate hole with the threaded stud; taking care to prevent damaging the threads, lower the mounting plate onto the threaded stud and secure with lock nut and washer.

21. While supporting motor, raise pedestal until it locks into its service position and install the four motor mounting bolts.

22. Loosen set screw in blower wheel hub and carefully pull wheel from motor shaft.

23. Connect motor wires to terminal strip and starting capacitor as noted in step 7.

24. Install the sheet metal baffle by securing each of the four stand-offs to the casting with a screw, washer and lock washer.

25. Connect wires to thermostat S3 as noted in step 5.

26. Insuring that set screw in blower wheel hub is aligned with flat on motor shaft, carefully press blower wheel onto shaft and tighten set screw .

27. Install motor cover on top of pedestal, applying anti-seize compound to each of the eight securing screws washers.

28. Replace drive belt per paragraph 5.11.2.1.

29. Align drive sheave per paragraph 5.7.1.4.

30. Adjust belt tension per paragraph 5.7.1.3.

5.11.2.3 Resolver B2. - See Figure 5-4; refer to assembly drawings in Chapter 6, Section 6.3 as necessary.

1. Insure power is removed from pedestal per paragraph 5.11.2

2. Remove Rotary Joint assembly per paragraph 5.11.2.5.

3. Remove Data Unit assembly per paragraph 5.11.2.4.

4. Disconnect eight harness wires and two jumpers from resolver B2, tagging each for terminal connection.

5. Loosen the two set screws in the resolver shaft coupling.

6. Loosen the three clips at the base of the resolver and remove the resolver.

7. Replace resolver B2 by reversing the preceding steps.

8. Align per paragraph 5.11.3.1.

5.11.2.4 Data Unit Assembly. - See Figures 5-4 and 5-6; refer to assembly drawings in Chapter 6, Section 6.3 as necessary .

1. Insure power is removed from pedestal per paragraph 5.11.2.

2. Gain access per steps 2, 3 and 4 of paragraph 5.11.2.1.

3. Remove Rotary Joint assembly per paragraph 5.11.2.5.

4. Using a common pencil, scribe the point of mesh between the data gear on the Data Unit assembly and the drive gear.

5. Remove the two hex bolts which hold the Data Unit assembly; withdraw the assembly as far as possible without stressing the harness wires.

NOTE:

Disconnect the wires listed in steps 6 and 7 only if it is necessary to re move the Data Unit assembly completely; if the task being performed can be accomplished by moving the assembly within the range of the harness do not disconnect the wires.

6. Disconnect the eight harness wires from resolver B2, tagging each for connection terminal.

7. Disconnect two harness wires from bottom of reed switch standoff terminals, noting connection points.

8. Replace Data Unit assembly by reversing the preceding steps, insuring that scribe marks on data and drive gears are aligned when the assembly mounting bolts are installed.

9. Align per paragraph 5.11.3.1.

5.11.2.5 Rotary Joint Assembly. - See Figure 5-4; refer to assembly drawings in Chapter 6, Section 6.3 as necessary .

1. Insure power is removed from the pedestal per paragraph 5.11.2.

2. Gain access per steps 2, 3 and 4 of paragraph 5.11.2.1.

3. Remove the screw, washer and lock washer which secure the anti-rotation plate to its mounting post.

4. Disconnect wire from brush assembly (mounted on anti-rotation plate).

CAUTION

DO NOT ALTER SETTINGS OF SPRING TENSION ADJUSTMENT SCREWS ON ROTARY JOINT MOUNTING PLATE. THESE SCREWS ARE FACTORY SET AND SHOULD NOT BE ADJUSTED IN THE FIELD.

5. Remove two lock nuts which attach rotary joint assembly to rotary joint mounting plate and carefully withdraw rotary joint.

6. Replace rotary joint assembly by reversing the preceding steps.

CAUTION

THE TOP OF THE ROTARY JOINT ASSEMBLY CONTAINS TWO GUIDE PINS HOLE5. HEN REPLACING THE ASSEMBLY, INSURE THAT THESE HOLES ARE MATED WITH THE PINS ON THE BOTTOM OF THE ARRAY BE FORE TIGHTENING THE LOCK NUT5.

5.11.2.6 Reed Switch Assembly. - See Figures 5-4 and 5-6; refer to assembly drawings in Chapter 6, Section 6.3 a s necessary .

1. Insure power is removed from pedestal per paragraph 5.11.2 .

2. Gain access per steps 2, 3 and 4 of paragraph 5.11.2.1.

3. Remove rotary joint assembly per paragraph 5.11.2.5.

4. Remove data unit assembly per paragraph 5.11.2.4.

5. Using a grease pencil, scribe radial alignment marks on the data gear and the shaft end which extends through the data gear.

6. Loosen the screw in the hub clamp and slide the clamp and data gear from the shaft.

7. Carefully note the position of the reed switch glass envelope with respect to the mounting posts; note particularly the method by which the switch leads are attached to the posts and dressed. When installing the new reed switch, locate it in as nearly the same position as possible.

8. Disconnect switch leads from mounting posts and remove switch.

9. Rotate the glass envelope of the new reed switch to orient the reeds as shown in the detail of Figure 5-6. Maintaining proper reed orientation, position the switch as noted in step 7.

10. Leaving sufficient lead length free to permit slight positional adjustment of the switch, attach and solder switch leads to mounting posts.

11. Slide the data gear and hub clamp onto the shaft until the gear contacts the retaining ring. Hold the shaft coupling and turn the gear to align the scribe marks on the gear and shaft end, then tighten the hub clamp screw.

12. Connect a multimeter, set for R x 1 resistance measurement, between terminals 10 and 13 of T B 1.

13. Rotate data gear to pass magnet slowly back and forth across reed switch. If switch closure is indicated on multimeter, proceed to step 15; if not perform step 14.

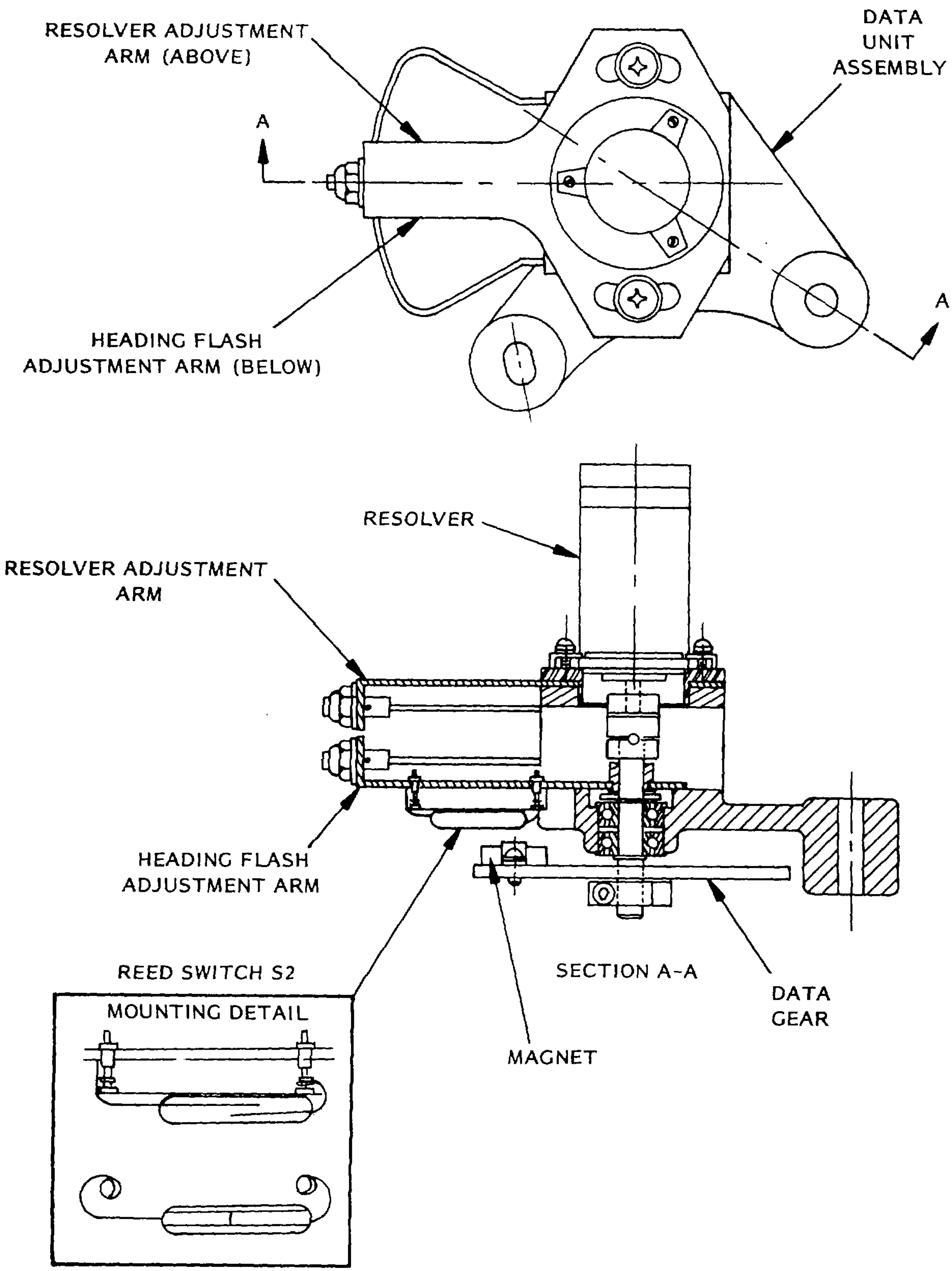


Figure 5-6 Reed Switch and Magnet Assemblies Location

14. While slowly passing magnet back and forth across reed switch, carefully adjust the position of the switch until multimeter indicates a short as magnet passes across switch.

15. Replace data unit assembly per paragraph 5.11.2.4, insuring that scribe marks on data gear and drive gear are aligned.

16. Replace rotary joint assembly per paragraph 5.11.2.5.

17. Align per paragraph 5.11.3.1.

5.11.2.7 Synchro Transmitter B3 (V4). - This procedure is applicable to only the AB-1247A antenna pedestal used in AN/SPS-64(V)4 installations. See Figure 5-4; refer to assembly drawings in Chapter 6, Section 6.3 as necessary.

1. Insure power is removed from pedestal per paragraph 5.11.2.

2. Gain access per steps 2, 3 and 4 of paragraph 5.11.2.1.

3. Remove rotary joint assembly per paragraph 5.11.2.5.

4. Disconnect five harness wires from synchro transmitter B3, tagging each for connection terminal.

5. Loosen the three clamps screws which secure synchro body; turn the clamps and withdraw the synchro.

6. Replace synchro transmitter B3 by reversing the preceding steps.

7. Align synchro transmitter B3 per paragraph 5.11.3.2.

5.11.2.8 Antenna Array AS-3194. - Refer to assembly drawings in Chapter 6, Section 6.3 as necessary .

1. Insure power is removed from pedestal per paragraph 5.11.2.

2: Remove the four bolts, washers, lock washers and nuts which secure the array to the pedestal.

3. Carefully lift the array from the pedestal, insuring that O-ring and sponge rubber gasket are retained.

4. Before replacing or installing new array, apply anti-seize compound to top of rotary joint assembly.

CAUTION

DO NOT SET COMPOUND IN THE ROTARY JOINT.

5. Install sponge rubber gasket in base of antenna support and O-ring in array mounting plate on pedestal. Make sure that the O-ring is lubricated with silicon grease.

6. Lift array into position above pedestal with array facing in the direction marked "FRONT" on mounting plate. Align guide pins on bottom of array support with holes in top of rotary joint and carefully lower array onto pedestal.

7. Secure array to pedestal using hardware removed in step 2.

5.11.3 Alignment Procedures

The procedures given in paragraphs 5.11.3.1 throng h 5.11.3.4 following cover the normally required shipboard alignments applicable to Antenna Pedestals AB-1247 and AB-1247A. Refer to Figure 5-4 for location of assemblies and major components.

5.11.3.1 Bearing and Heading Line Adjustment. -The Sweep Circuits Alignment procedure given in paragraph 5.12.3.5 must be checked (and accomplished if necessary) prior to performance of this procedure.

NOTES:

1. For V2 systems, determine which Receiver Transmitter is controlling the Antenna Pedestal by observing the indicator lamps at Interface Unit J-3463. Also determine which Indicator is serving as master for the controlling Receiver Transmitter by observing the setting of Switch ing Unit SA-2156 and referring to Table 3-1.

2. For V3 or V4 systems, refer to Table 3-2 or 3-3 respectively and observe settings of Switching Units SA-2139 to determine which Indicator is serving as master for the antenna pedestal under test and its associated receiver transmitter.

3. The term Indicator, as used in the following steps, refers to the master Indicator associated with the antenna pedestal under test and its associated receiver transmitter .

1. Set Indicator HD UP/GYRO STAB/HDG SET switch to HO UP position. Identify a target both visually and on the indicator CRT display.

2. Using the ship's port and starboard pelorus. measure the visual bearing to the target. Convert the pelorus readings to relative bearing and compute the mean of the two readings. Use the computed mean bearing in the following steps.

3. Using the Indicator CURSOR control, position the cursor graticule line directly over the target.

4. Observe the Indicator relative bearing scale and note the reading intersected by the cursor graticule line. This reading should correspond so that indicated by the ship's pelorus (±1°).

NOTE:

If the bearing error observed in step 4 is ±12° or less, perform steps S through 14 only. If the error is greater than ±12°, perform steps 13 through 26 first, then steps 1 through 14.

5. Carefully measure the magnitude and direction of bearing error. For example, if the pelorus reading is 45° and the bearing scale reading is 50°, the bearing error is +5°. If the bearing scale reading is 41°, the bearing error is -4°.

6. Using the CURSOR control, set the graticule line to the exact number of degrees on the plus or minus side of 0° corresponding to the error reading determined in the previous step. In the example given, the graticule should intersect +5° (005°) or -4° (356°).

WARNING

EXERCISE EXTREME CARE WHEN WORKING I NEAR A ROTATING ANTENNA.

7. Remove the cover plate from the front of the antenna pedestal and loosen the locking nut on the heading line adjustment arm (see Figure 5-4).

8. Slide the heading line adjustment arm along the guide wire until the heading line is displayed directly under the cursor graticule line on the CRT display. Tighten the heading line adjustment locking nut.

9. Loosen the resolver adjustment locking nut and move the resolver adjustment arm until the heading line flashes at 0° relative on the CRT display. (See Note below.) Tighten the resolver adjustment locking nut and secure the antenna pedestal adjustment cover plate.

NOTE:

If the resolver arm adjustment range is insufficient, perform steps 10 through 1 4 to I low i rig .

10. Set the resolver adjustment arm at the middle of the guide wire and snug the locking nut. Loosen the three screws in the top of resolver B2.

11. Turn the antenna safety switch to off. Loosen the captive screws which secure the pedestal housing and disconnect the waveguide from the rotary joint. Raise the pedestal.

12. Loosen the three screws that secure the resolver B2. Rotate the body of the resolver in the direction of the heading line. Example if the heading is -30°(330°) rotate the resolver CCW 30° if the heading is +40°(0409 rotate the resolver CW.

13. Secure the three screws on the resolver B2. Lower the antenna pedestal to its operating position. Tighten the captive screws which secure the pedestal housing to the base and connect the waveguide to the rotary joint. Turn antenna safety switch to ON.

14. Repeat Step 9.

15. At the antenna pedestal, set the ON/OFF switch to OFF.

16. Remove the cover plate from the front of the antenna pedestal and loosen the heading line adjustment locking nut (see Figure 5-4). Position the heading line adjustment arm at the middle of the guide wire and snug the locking nut.

17. Loosen the captive screws which secure the pedestal housing and disconnect the waveguide from the rotary joint. Do not raise pedestal.

NOTE:

During the following steps, the antenna must always be turned clockwise (as viewed from above), even if it means making a full rotation. Moving the antenna back and forth causes the normal backlash in the gears to introduce bearing errors.

18. Manually rotate the antenna clockwise until the squint holes are aligned with the bow; maintain the antenna in this position through step 19 following.

19. Using a grease pencil, mark the rotating hub and fixed quill cover with vertical lines to indicate alignment position. Taking care to insure that the antenna does not rotate, raise the pedestal into its service position.

20. Connect a multimeter between TB1-10 and TB1-13 to measure continuity when the heading line switch closes.

21. Loosen (do not remove) the two bolts which secure the Data Unit Assembly. Pivot the Data Unit Assembly slightly clockwise around the top bolt to disengage the data gear.

22. Verify pencil marks on hub and quill cover are aligned. Turn gear on Data Unit Assembly until multimeter indicates a short.

23. Pivot the Data Unit Assembly counterclockwise and obtain the nearest mesh between the data gear and drive gear; tighten the bolts which secure the Data Unit Assembly, insuring that a small amount of backlash exists between the gears.

24. Disconnect the multimeter and lower the antenna pedestal to its operating position. Tighten the captive screws which secure pedestal housing to the base and connect the waveguide to the rotary joint.

25. Set pedestal ON/OFF switch to ON. Set Indicator POWER switch to TX ON. After a 3.5-minute delay, verify that heading line is displayed on CRT during each antenna rotation. Return to step 1.

5.11.3.2 Synchro Transmitter Alignment (V4). -The synchro transmitter in the AB-1247A Antenna Pedestal provides antenna azimuth data for use at the AN/SPA-25 and SPA-66 remote indicators. The following procedure applies to AN/SPS-64(V)4 installations only

NOTE:

The Bearing and Heading Line Adjustment given in the preceding paragraph must be in effect prior to performance of this procedure.

1. Set all AN/SPS-64(V) Indicator POWER switches to OFF. Set Signal Data Converter CV-3442 POWER switch to OFF.

2. Refer to Table 3-3 and set Switching Units SA 2139 for DS-9 mode.

NOTE:

Selection of DS-9 mode permits system operation to continue using MTR-2 (S-band) and Indicators A and B while the following procedure is performed.

3. At Antenna Pedestal AB-1247A (X-band):
   a. Set Safety switch to OFF.
   b. Disconnect and tag external leads at TB3 terminals 3, 4 and 5.

NOTE:

During the following steps, the antenna must always be turned clockwise (as viewed from above), even if it means making a full rotation. Moving the antenna back and forth causes the normal backlash in the gears to bearing introduce errors .

4. Remove the cover plate from the front of the antenna pedestal and loosen the locking nut on the syncro adjustment arm. Position the arm at the middle of the guide wire and snug the locking nut.

5. Manually rotate the X-band antenna clockwise until the face is pointing slightly to the left of the bow (approximately 340° relative); maintain this position through step 6 following.

6. Disconnect the waveguide from the rotary joint and loosen the captive screws which secure the pedestal housing to the base plate. Tilt the housing up into its service position.

7. Remove external leads a t TB1 terminals 10, 13 and TB3 terminals 3, 4, and 5. Connect a multimeter, set for resistance measurement between TB1-10 and TB1-13.

8. Connect multimeter, set for resistance measurement, between TB1-10 and TB1-13.

9. Slowly rotate the antenna clockwise, stopping when the multimeter indicates a short circuit (heading flash switch closure).

NOTE:

Maintain the multimeter connections at TB1-10 and TB1-13; check the multimeter reading prior to each of the following steps to insure that switch closure is maintained.

10. Install a jumper between TB3-2 (R2) and TB3-S (53).

11. Connect a second multimeter, set to 250 Vac scale, between TB3-1 (R1) and TB3-4 (52).

12. Set Signal Data Converter CV-3442 POWER switch to ON.

WARNING

115 VAC IS PRESENT AT TB 3 AND SYNCHRO TRANSMITTER B3.

13. Loosen the three screws which secure synchro transmitter B3; turn the body of the synchro to obtain minimum voltage reading (null) on the multimeter. Tighten the three screws which secure synchro B3.

14. Set Signal Data Converter CV-3442 POWER switch to OFF.

15. At Antenna Pedestal
    a. Remove jumper between TB3-2 and TB3-5.
    b. Connect external leads at TB3 terminals 3, 4 and 5.

16. Set the second multimeter to the 250 Vac scale and connect it between TB3-3 USA) and TB3-S (53); reduce the voltage settling progressively to 2.5 VAC as alignment is achieved in step 17 following .

17. Set Signal Data Converter CV-3442 POWER switch to ON.

NOTE:

First verify multimeter indicates a short circuit before proceeding .

18. Loosen the locking nut on the synchro adjustment arm and carefully adjust the arm position to obtain zero Vac reading on the multimeter; tighten the locking nut, insuring that the zero Vac reading is maintained.

19. Set Signal Data Converter CV-3442 POWER switch to OFF.

20. At Antenna Pedestal:
    a. Disconnect multimeter and reconnect external leads at TBI terminal 10,13.
    b. Carefully lower the pedestal housing and tighten the captive screws in the base plate.
    c. Connect the waveguide to the rotary joint.
    d. Set Safety switch to ON.

21. Set Indicator C (master for MTR-I, X-band) POWER switch to TX ON.

22. Set POWER switches to ON at the following units:
    a. Video Amplifier AM-6932
    b. Signal Data Converter CV-3442
    c. AN/SPA-25 and AN/SPA-66 indicators

23. At Signal Data Converter CV-3422, select relative bearing (RB) display for AN/SPA-25 and AN/SPA-66 indicators.

24. At AN/SPA-25 indicator, select display from AN/SPS-64(V) radar; verify heading line is displayed at 0° relative (see notes following next step) .

25. Repeat step 23 for AN/SPA-66 indicators.

NOTES:

1. The synchro control transformers at the AN/SPA-25 and AN/SPA-66 indicators are zeroed for operation with other ships radars; do not adjust these synchros.

2. If the heading flashes on the AN/SPA-25 and AN/SPA-66 indicators occur within ±10° of 0° relative, loosen the adjustment locking nut at the pedestal and move the adjustment arm to place the heading flashes at 0° relative.

5.11.3.3 Belt Tension Adjustment. - The belt tension adjustment procedure is contained in Preventive Maintenance, Section II; refer to paragraph 5.7.1.3.

5.11.3.4 Sheave Alignment. - The sheave alignment procedure is contained in Preventive Maintenance, Section II; refer to paragraph 5.7.1.4.

5.12 AZIMUTH RANGE INDICATORS 1P-1282 AND 1P-1283

Paragraphs 5.12.1 through 5.12.3 and their related subparagraphs provide corrective maintenance for the 16-inch Azimuth Range Indicator 1P-1282 and the 12-inch indicator 1P-1283. The information includes troubleshooting instructions (5.12.1), removal and replacement procedures (5.12.2) and alignment procedures (5.12.3). The locations of assemblies and major components within the Indicators are shown in Figure 5-7. Schematic diagrams, parts list tables and assembly drawings applicable to the 1P-1282 and 1P-1283 Indicators are contained in Section 6.4 of Chapter 6.

Access to the electronic assemblies within the Indicators is provided by loosening the one-quarter turn captive fasteners and removing the upper front access cover. When the cover is removed, an interlock switch is activated which disables the Indicator power supply; the interlock switch may be pulled outward to permit Indicator operation for troubleshooting or alignment. Access to the electrical connections of the front panel controls and indicators, the panel lamps, and the cursor and compass mechanisms is obtained by loosening the two captive screws in the bezel (sloping front panel) assembly and raising the bezel until it locks into position (two locking positions are provided).

WARNING

APPROXIMATELY +17 KV DC (REGULATED) IS PRESENT ON ONE OF THE RED LEADS FROM THE POIVER SUPPLY TO THE CATHODE RAY TUBE WHEN THE INDICATOR IS OPERATING

5.12.1 Troubleshooting Procedure

Fault isolation within the 1P-1282 and IP 1283 Indicators is facilitated by use of Troubleshooting Charts; Figure 5-8 provides information for overall Indicator troubleshooting; Figure 5-9 provides information for troubleshooting the Indicator power supply assembly. Instructions for use of the troubleshooting charts are given in paragraph 5.9.1. The Indicators contain several digital processing printed circuit boards (PCBs) for which flow-chart type troubleshooting data is impractical. Troubleshooting data for these PCBs is presented in tabular form on sheets 11 through 14 of Figure 5-8. Where applicable, the flow-chart portion of the Indicator troubleshooting chart (sheets 1 through 10 of Figure 5-8) contains references to this tabular data; when such references are encountered, use the following general procedure to troubleshoot the PCB to which the reference table applies:

1. Set the Indicator POWER switch to OFF and mount the PCB in the extender card. Insert the extender card into the card slot and set Indicator POWER switch to TX ON.
2. Using the OUTPUT DATA section of the referenced table, check each output pin for the correct signal.
3. When the erroneous output is located, refer to the REQUIRED INPUTS column to identify the input signals associated with the erroneous output.

SYMBOL	LEGEND
A	Cathode Ray Tube (CRT) V1
B	Compass Drive Mechanism
C	EBL Potentiometer R14
D	Cursor Drive Mechanism
E	Bezel Assembly
F	Control Panel All (hidden)
G	VRM Encoder A13
H	Plotter Assembly A7
J	LED PCB Assembly A5
K	VRM PCB Assembly A6
L	LED PCB Assembly A4
M	Sweep Drive PCB A3A2
N	Sweep Drive PCB A3A1
P	Terminal Board TB1 (hidden)
Q	North Stabilization Assembly A9
R	Fuses F1, F2
S	Interlock Switch S11
T	High Voltage Power Supply Assembly A1
U	Terminal Board TB2 (hidden)
V	Terminal Board TB3 (hidden)
W	Card Basket Assembly A2
X	Sweep Generator PCB A2A10
Y	Video Amplifier PCB A2A1
Z	CRT Socket XVI
AA	Line Filters FL1, FL2
AB	Yoke Assembly A12
AC	Connectors (BNC) J1, J2, J3 (hidden)
AD	Sweep Output Assembly A3

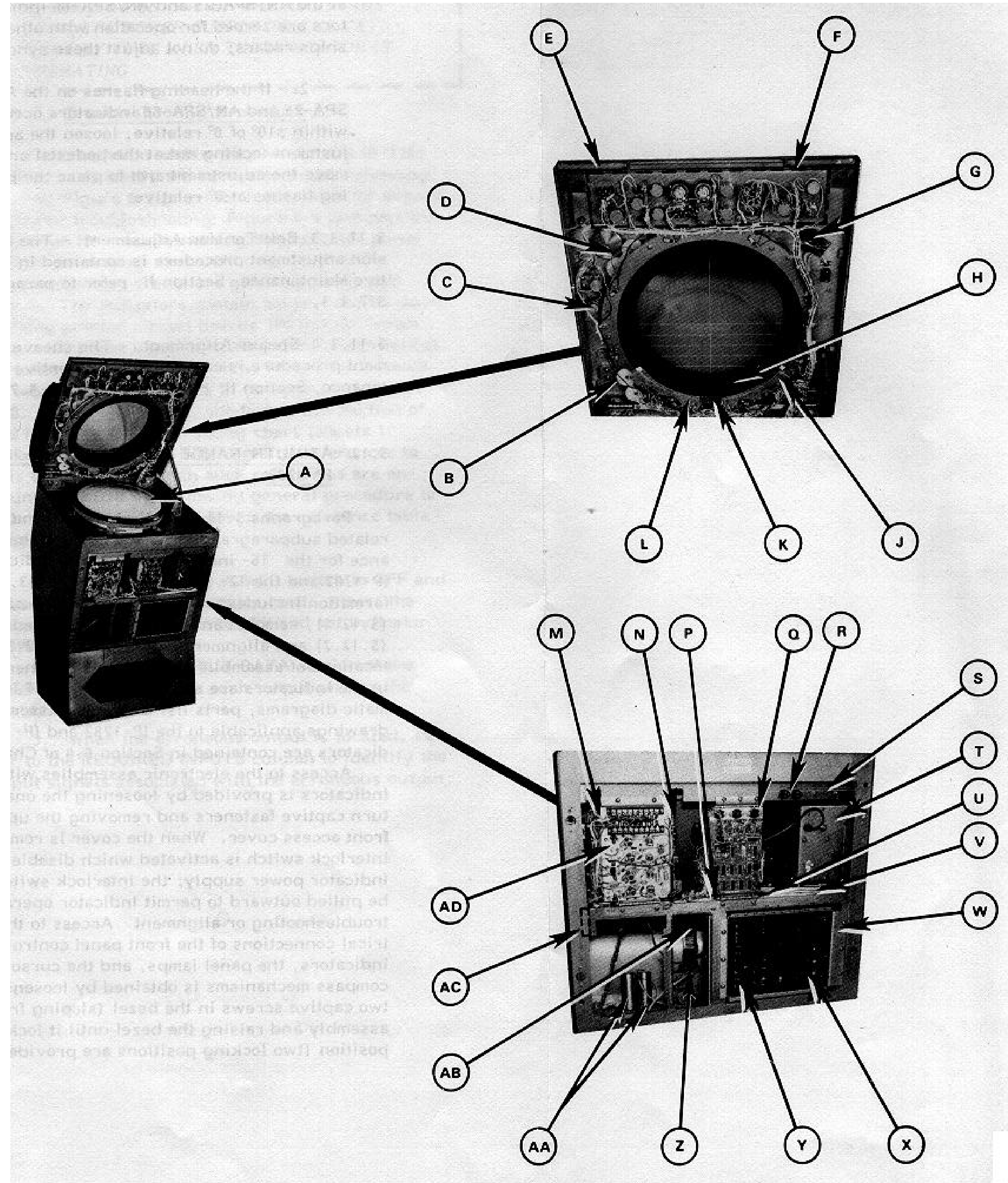


Figure 5-7 Azimuth Range Indicators IP-1282/IP-1283 Parts Location

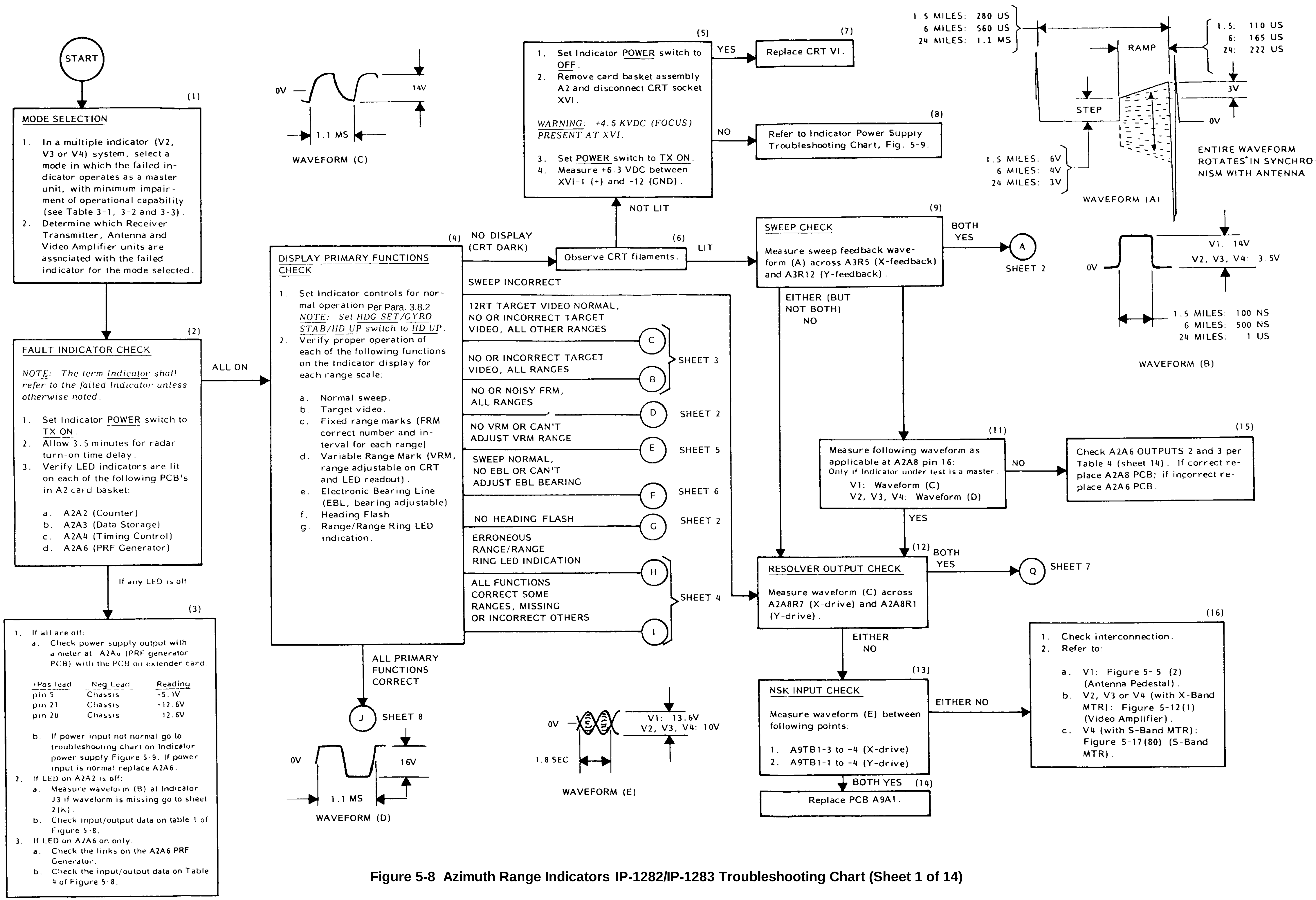


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 1 of 14)

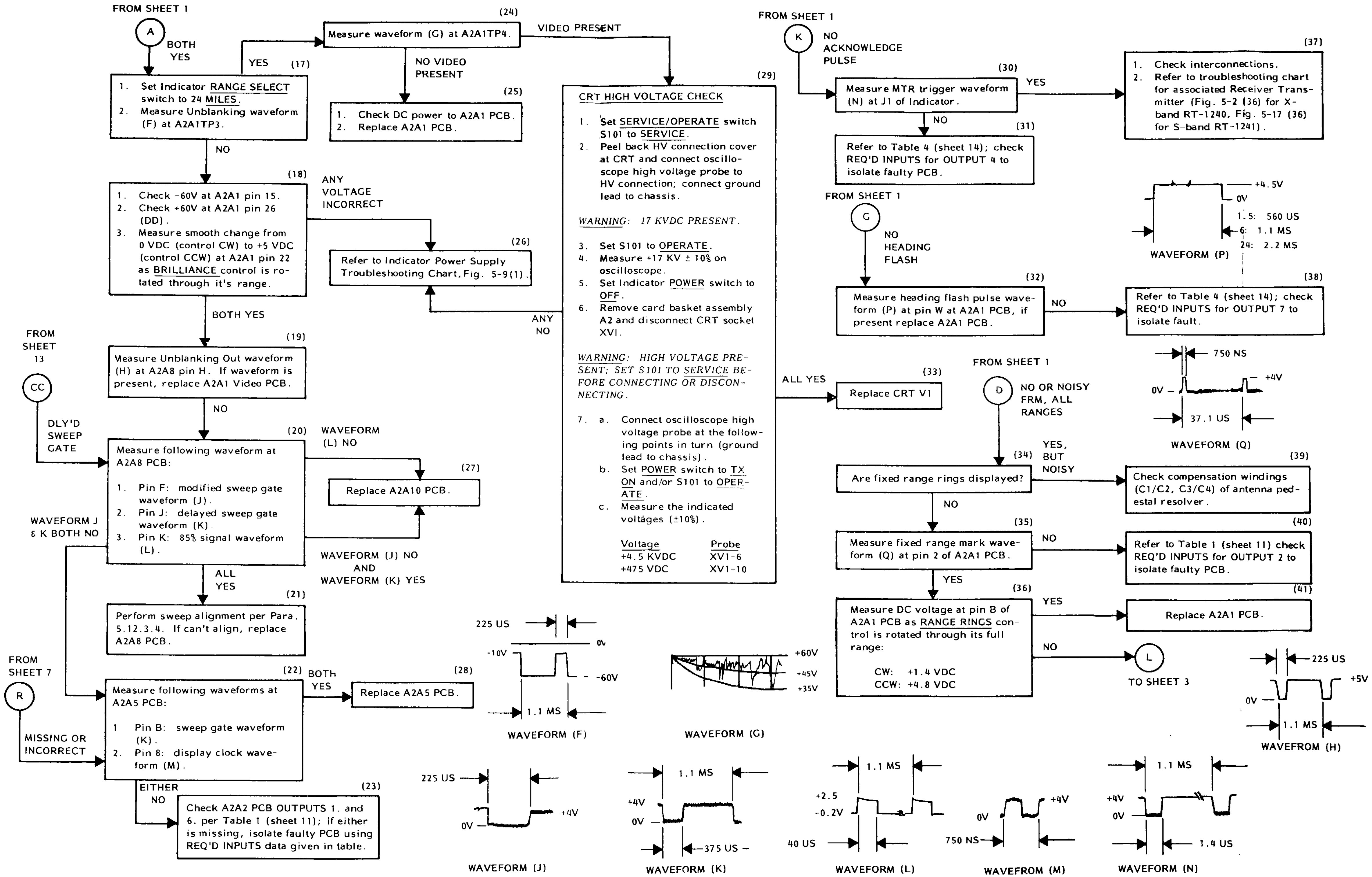


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 2 of 14)

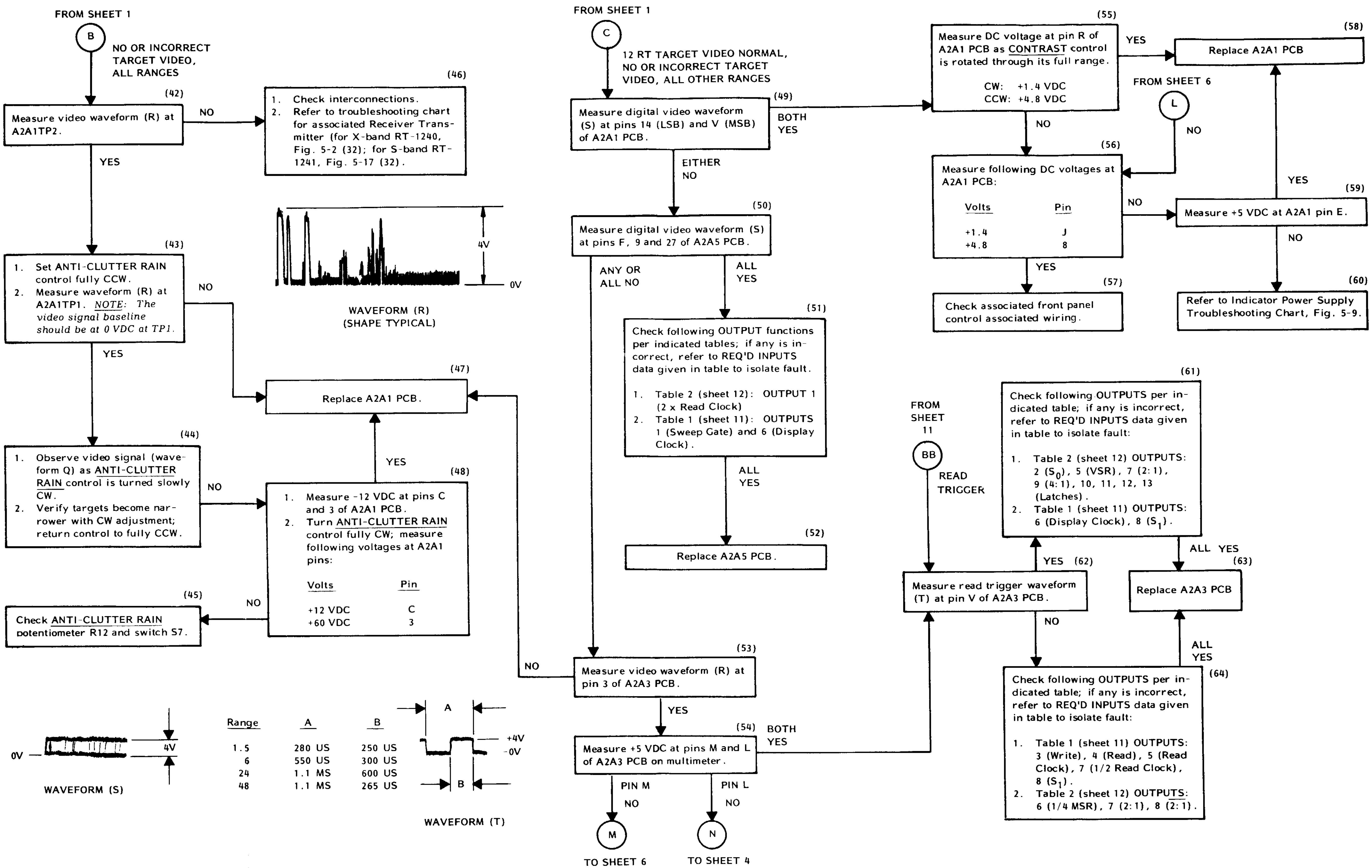


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 3 of 14)

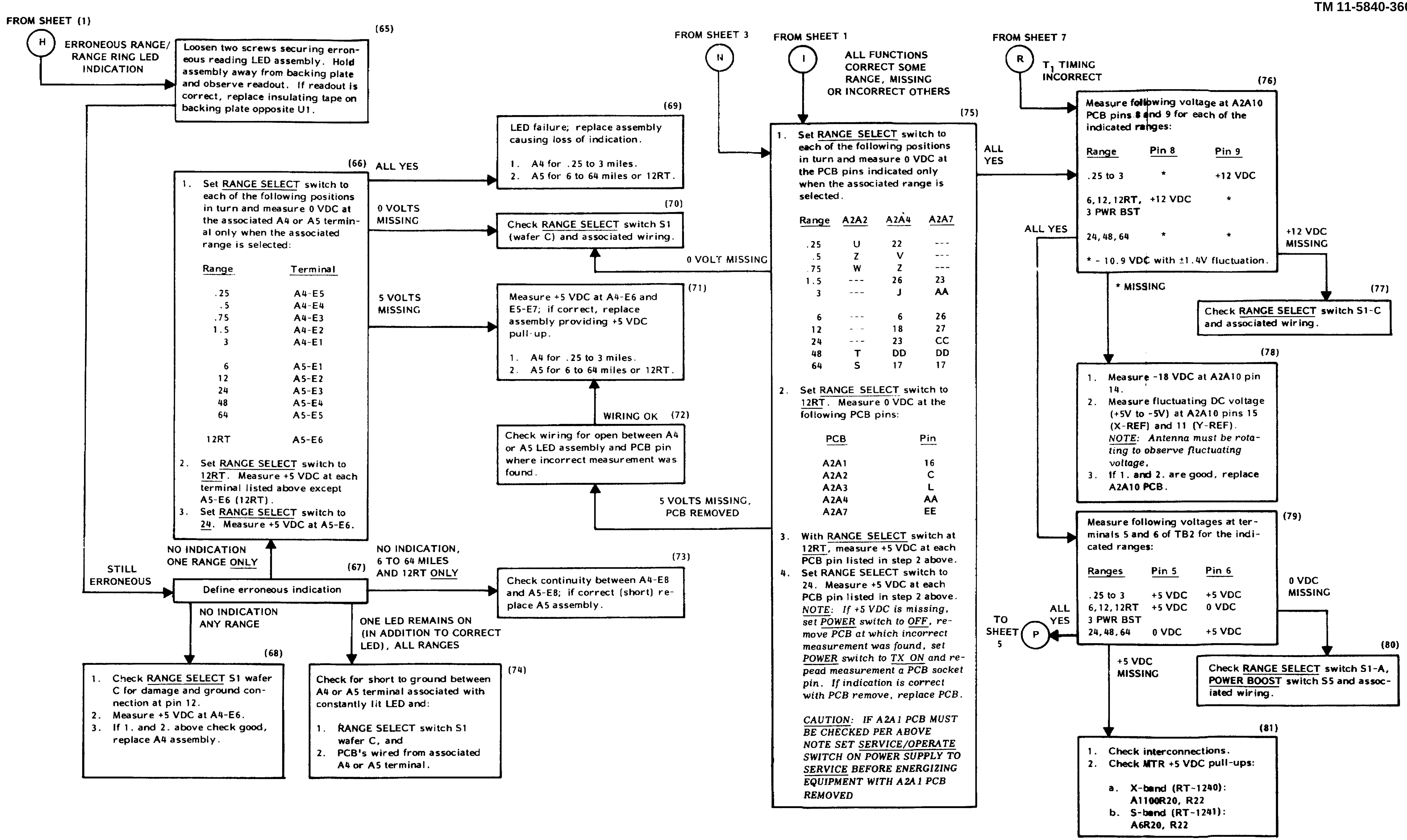


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 4 of 14)

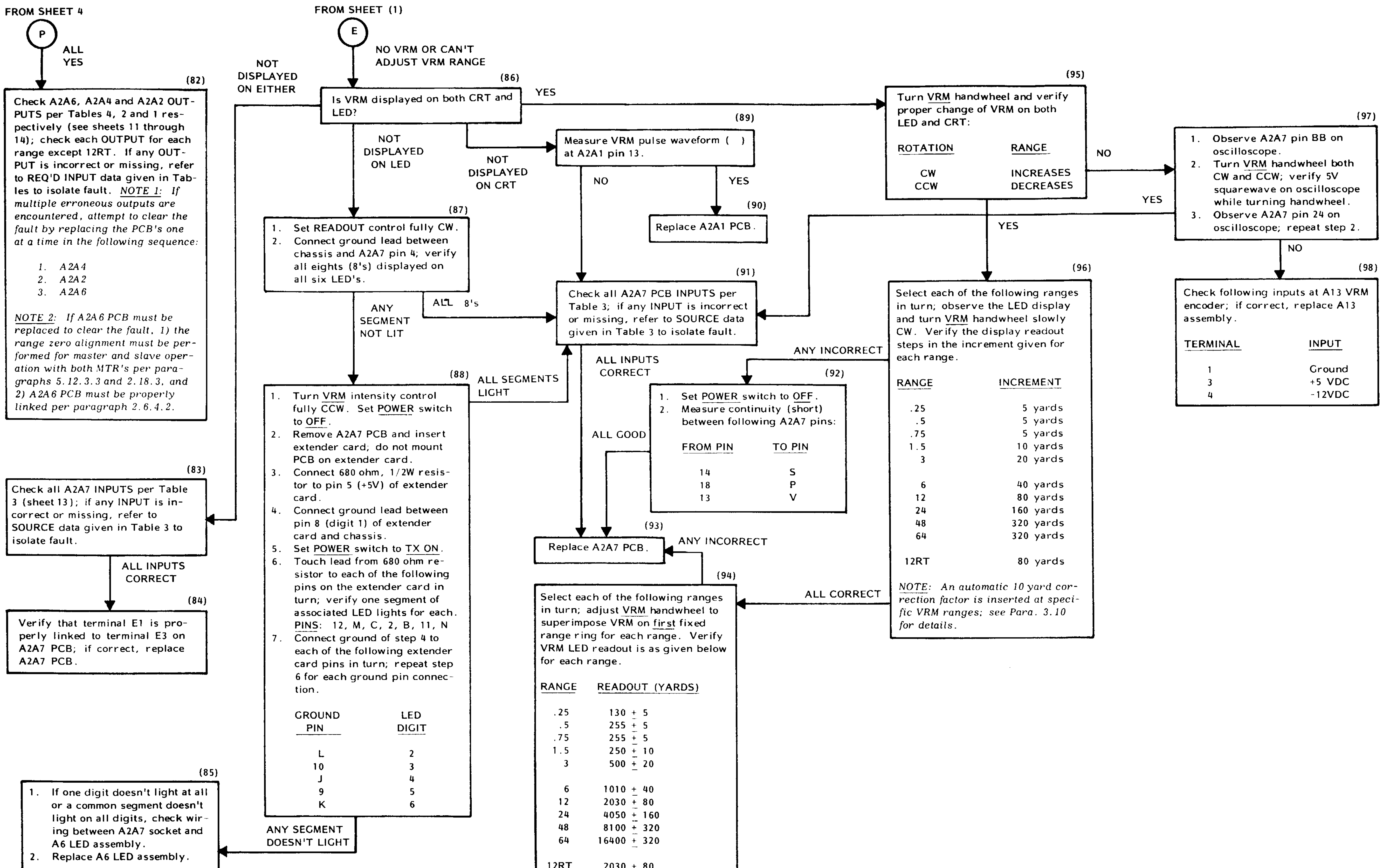


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 5 of 14)

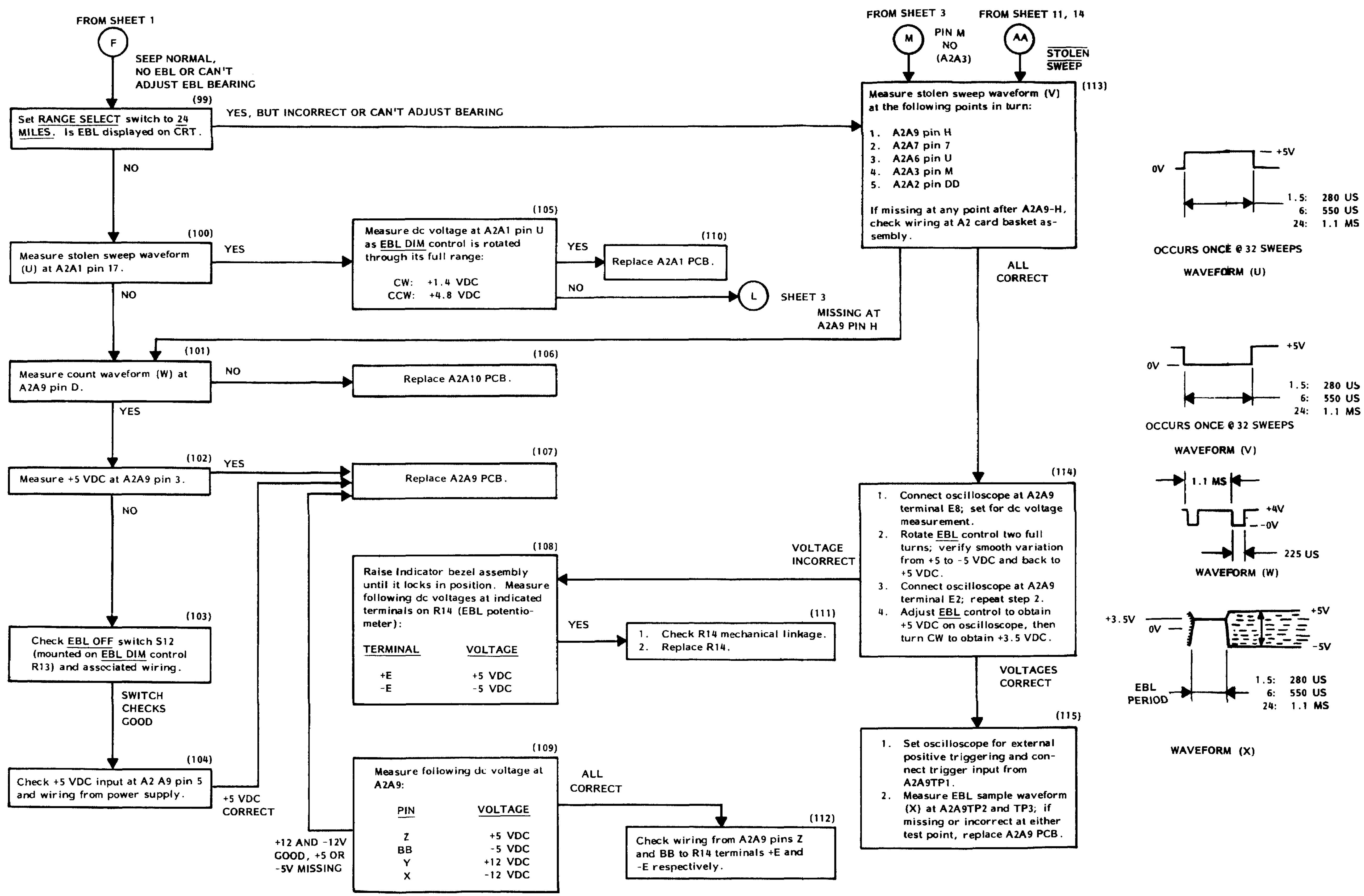


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 6 of 14)

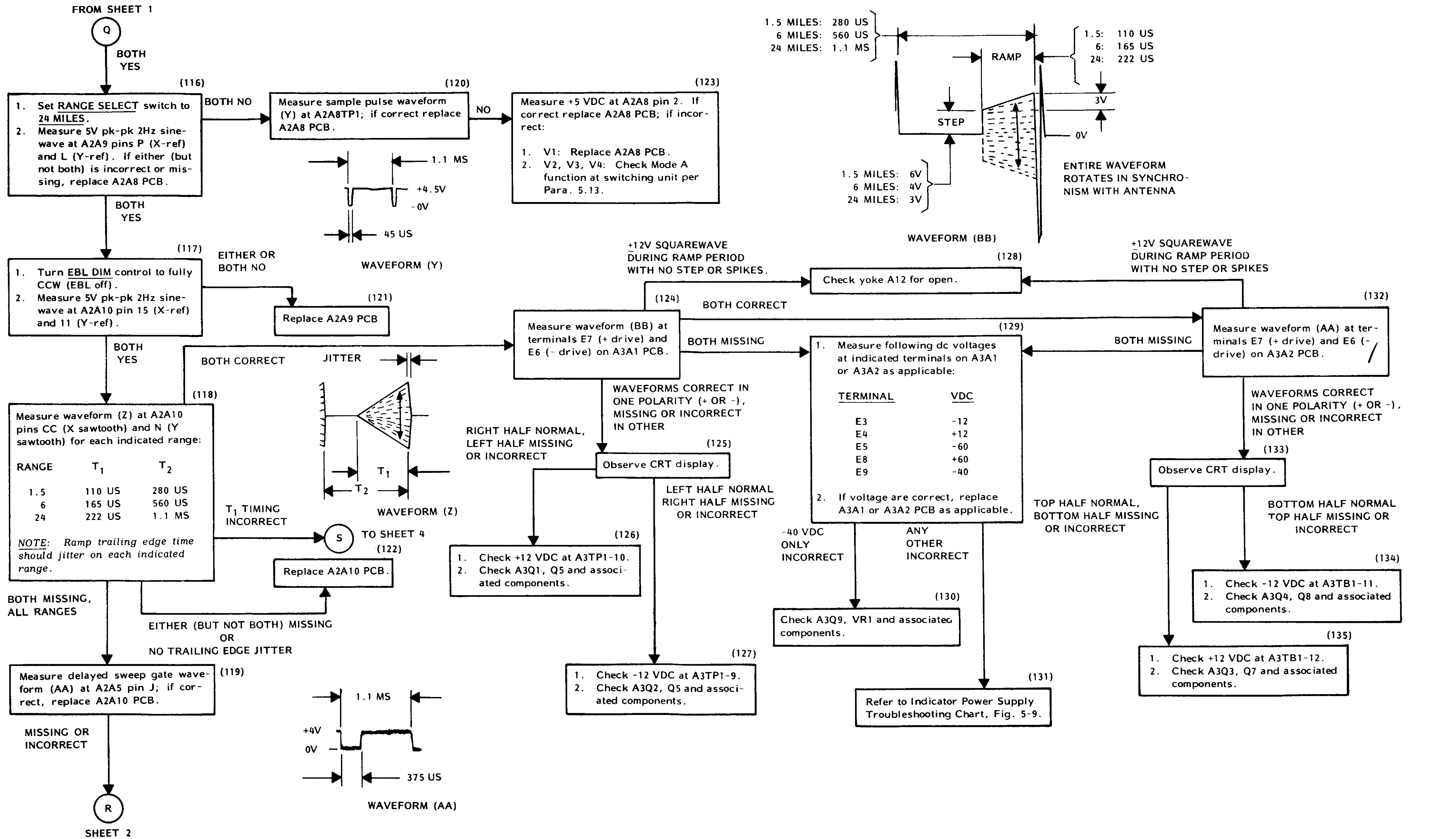


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 7 of 14)

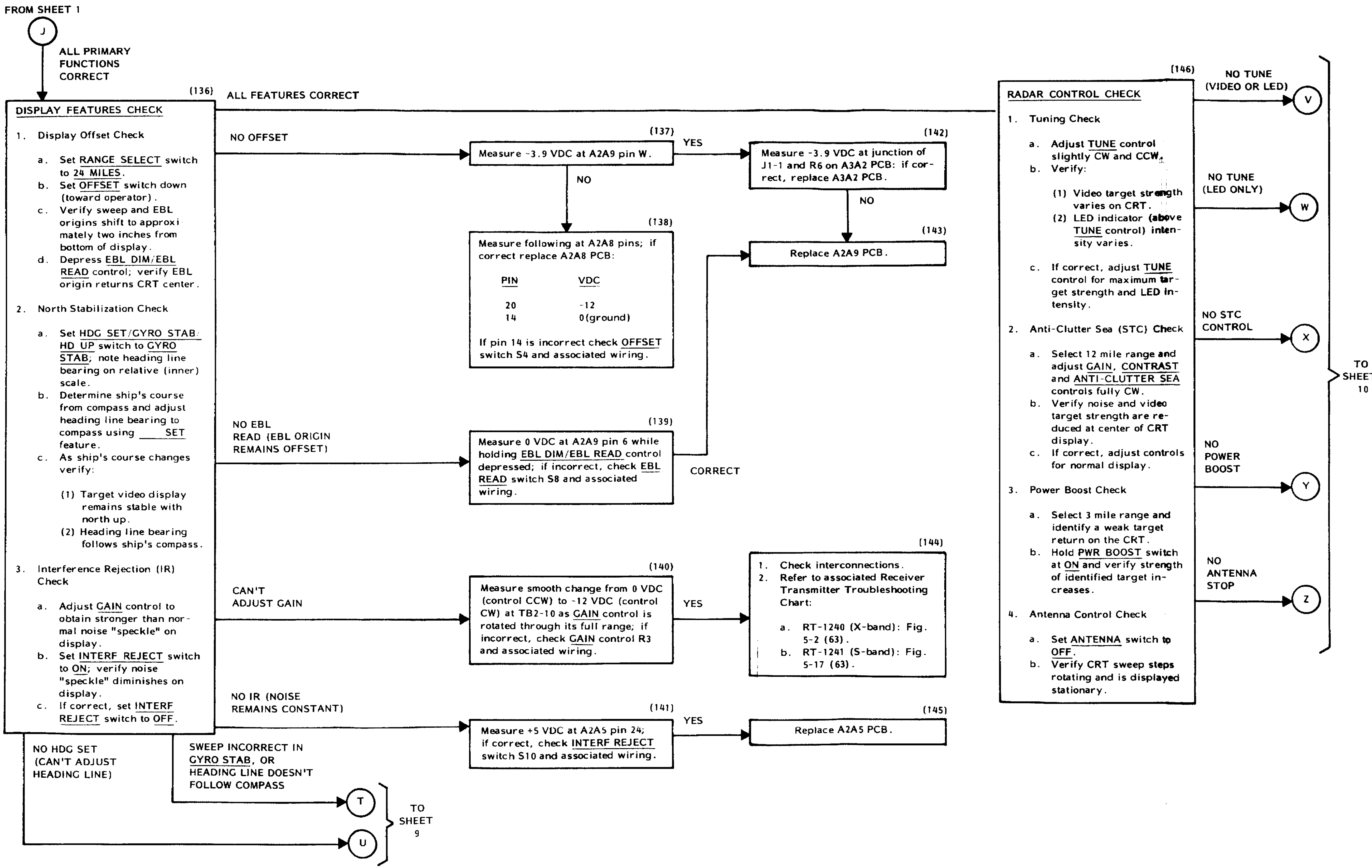


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart(Sheet 8 of 14)

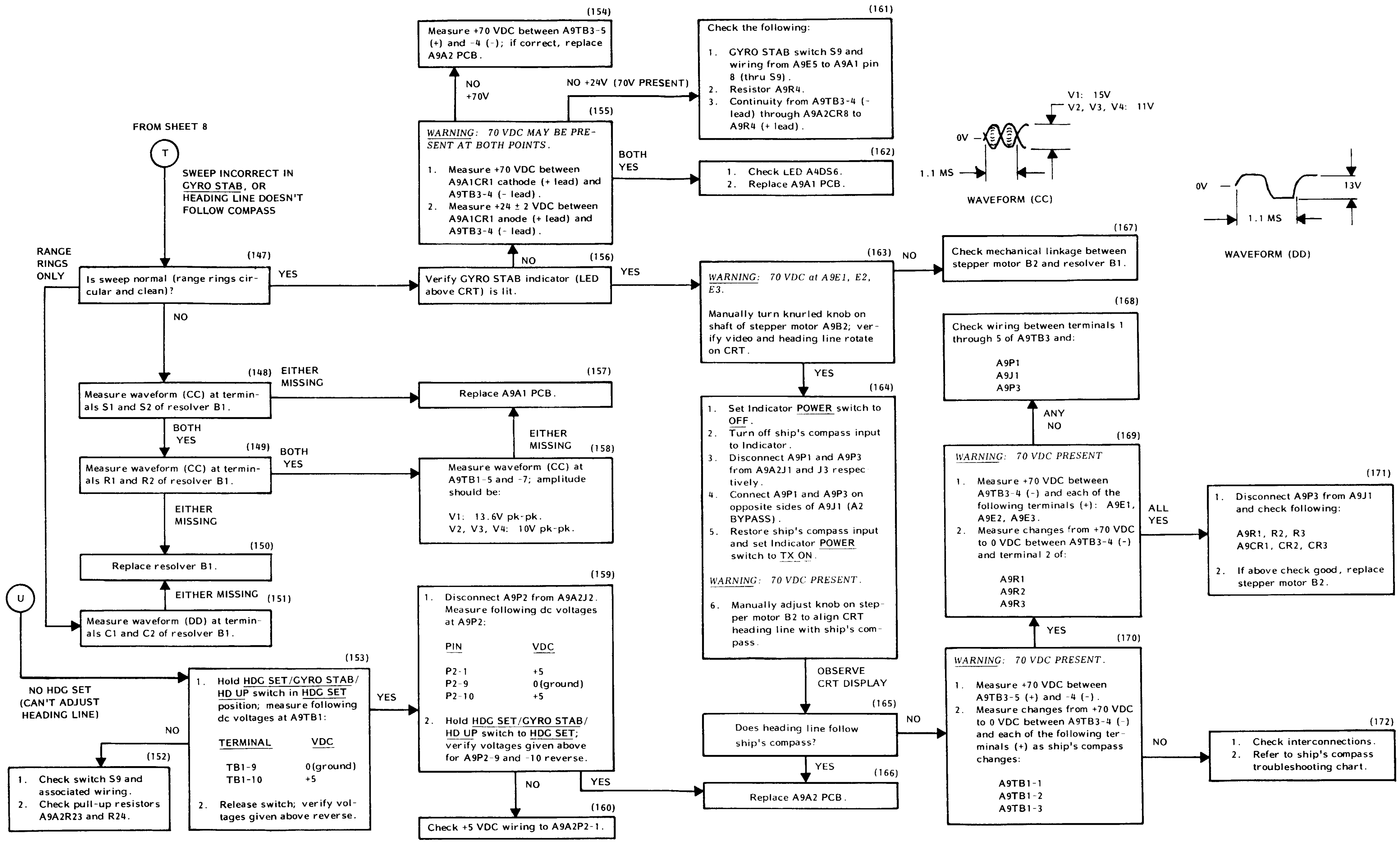


Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 9 of 14)

FROM SHEET 8

(V) NO TUNE (VIDEO OR LED)

(173)

1. Disconnect external lead at TB2-12.
2. Measure resistance from TB2-12 to ground as TUNE control is rotated through its full range:

TUNE CONTROL	OHMS (± 10%)
CW	52.7K
CCW	2.7K

YES → (177)

1. Connect external lead at TB2-12.
2. Check interconnections.
3. Refer to associated Receiver Transmitter Troubleshooting Chart:
   a. RT-1240 (X-band): Fig. 5-2 (56).
   b. RT-1241 (S-band): Fig. 5-17 (56).

NO → (178)

Check R1, R2 and associated wiring.

FROM SHEET 8

(W) NO TUNE (LED ONLY)

(174)

Measure pre-PRF waveform (EE) at A2A1 pin T. If incorrect, replace A2A6 PCB.

WAVEFORM CORRECT → (179)

1. Set Indicator POWER switch to OFF.
2. Set SERVICE/OPERATE switch S101 (located on Power Supply A1) to SERVICE.
3. Remove A2A1 PCB and set POWER switch to TX ON.
4. Measure +5 VDC at pins 7 and H of A2A1 PCB socket.

EITHER NO → (175)

Replace associated LED.

BOTH YES → (180)

Replace A2A1 PCB.

FROM SHEET 8

(X) NO STC CONTROL

(176)

Measure smooth change from 0 VDC (control CW) to +12 VDC (control CCW) at TB2-9 as ANTI-CLUTTER SEA is rotated through its full range. If incorrect, check R4 and associated wiring.

YES → (181)

1. Check interconnections.
2. Refer to associated Receiver Transmitter Troubleshooting Chart:
   a. RT-1240 (X-band): Fig. 5-2 (63).
   b. RT-1241 (S-band): Fig. 5-17 (63).

FROM SHEET 8

(Y) NO POWER BOOST

(182)

1. Set RANGE SELECT switch to 3 MILES.
2. Measure following dc voltages at A2A4 pins 27 and 15:

PWR BOOST	PIN 27	PIN 15
ON	+5 VDC	+5 VDC
OFF	0 VDC	+5 VDC

NO → (183)

Measure following dc voltage at A2A4 pin K:

PWR BOOST	PIN K
ON	0 VDC
OFF	+5 VDC

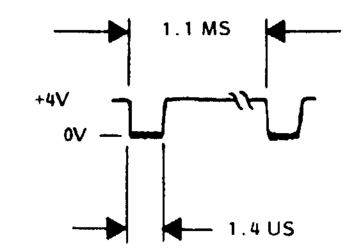
If correct, replace A2A4 PCB; if incorrect, check switch S5-2 and associated wiring.

FROM SHEET 8

(Z) NO ANTENNA STOP

(184)

1. Set ANTENNA switch to OFF; verify CRT display dims.
2. Measure 0 VDC (ground) at TB2-7; if incorrect (+12 VDC present), check switch S6 and associated wiring. *NOTE: If antenna does not rotate when ANTENNA switch is ON and POWER switch is at TX ON (after 3.5 minute delay), check:*
   a. Antenna Safety switch setting.
   b. Antenna Stop and Safety switch interconnections for short to ground.



WAVEFORM (EE)

Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 10 of 14)

Table 1. COUNTER PCB A22
INPUT/OUTPUT DATA

(185)

OUTPUT DATA

Out-Put	Function	Pin	Signal	Conditions/Notes	Req'd Inputs (see INPUT DATA)
1.	Sweep Gate	B	Negative (5V to 0V) pulse at PRF	Width changes with selected range.	A, B, E, F, G, H
2.	Fixed Range Marks	CC	Positive 5V pulses.	Interval changes with selected range	Same as output 1 plus C, H and (for 12RT only)D
3.	Write	F	Positive 5V gate at PRF	Width changes with selected range.	A, B, H
4.	Read	H	Positive 5V gate at PRF	Complement of output 3.	A, B, G, H
5.	Read Clock	R	5V squarewave	Selected Range / Freq. (kHz) / Period (nsec): 0.25 — 897.7 — 1113.8 0.5, 6, 12, 64, 3PB — 1795.5 — 556.8 0.75, 1.5, 3 — 2693.3 — 371.2 24,48 — 1346.6 — 742.4	A, B, G
6.	Display Clock	AA	5V squarewave	Complement of output 5.	A, B, G, H
7.	1/2 Read Clock	N	5V squarewave	One-half freq. (twice period) of output 5.	A, B, G, H
8.	S1	L	5V squarewave	One-fourth freq. (4 x period of output 5.	A, B, G, H
9.	Count 400	EE	Positive 5V gate at PRF.	Used only in 48 and 64 mile ranges.	A, B, G, H

INPUT DATA

In-Put	Function	Pin(s)	Signal	Conditions/Notes	Source
A	PRF	V	Negative (5V to 0V) 30.9 ns pulse at PRF.	Interval changes with selected range	A2A6-18 (sheet 14)
B	1/4 MSR DLYD BY VSR	D	5V squarewave	Selected Range / Freq. (mHz) / Period (nsec): .25,.5, .75,1.5 — 8.08 — 123.6 3 — 4.04 — 247.2 6,12 — 1.01 — 988.8 24 — 5.05 — 197.8 48, 64 — (1)2.53 — 395.2; (2)8.08 — 123.6 3 PWR BST — 2.02 — 494.4 (1) 0 to 200 count (2) 201 to 256 count	A2A4-4 (sheet 12)
C	Stolen Sweep	DD	Negative (5V to 0V) gate.	Occurs every 32nd sweep; width = 1/PRF.	A2A9-H (sheet 6 AA)
D	2.02 mHz	K	5V squarewave	Used only in 12RT.	A2A4-12 (sheet 12)
E	Real Time Command	C	0V VDC or 5 VDC	0V in 12RT; 5V all other ranges.	0V: S1C-11 5V: A5-E6
F	Read Trigger	M	Positive 5V gate at PRF.	Width changes with selected range; not used in 12RT.	A2A3-V (sheet 3 BB)
G	2 x Read Clock	P	5V Squarewave	Selected Range / Freq. (kHz) / Period (nsec): .25 — 1795.5 — 556.9 .5,6,12,64, 3 PWR BST — 3591.1 — 278.4 .75,1.5,3 — 5386.6 — 185.6 24,48 — 2693.3 — 371.2	A2A4-F (sheet 12)
H	Range Select	U(.25) Z(.5) W(.75) T(48) S(64)	0 VDC or 5 VDC	0V when associated range is selected; 5V when any other range selected.	0V: S1-C 5V: A4 or A5 (LED) PCB's

Figure 5-8 Azimuth Range Indicator. IP-1282/IP-1283 Troubleshooting Chart (Sheet 11 of 14)

TABLE 2. TIMING CONTROL PCB A2A4
INPUT/OUTPUT DATA

(186)

OUTPUT DATA

Output	Function	Pin	Signal	Conditons/Notes	Req'd Inputs (see INPUT DATA)
1.	2 x Read Clock	F	5V squarewave	Selected Range / Freq. (kHz) / Period (nsec) .25 / 1795.5 / 556.9 .5,6,12,64, 3 PWR BST / 3591.1 / 287.4 .75,1.5,3 / 5386.6 / 185.6 24,48 / 2693.3 / 371.2	A,B,E,F
2.	S_0	B	5V squarewave	One-fourth freq. (4 x period) of output 1.	A,B,C,E,F
3.	4.04 MHz	10	5V squarewave	247.2 nsec	A,E
4.	2.02 MHz	12	5V squarewave	494.4 nsec	A,E
5.	Video Sample Rate (VSR)	U	5V squarewave	Selected Range / Freq. (MHz) / Period (nsec) .25,.5,.75, 1.5,3 / 32.32 / 30.9 3 PWR BST / 8.08 / 123.6 6,12,12RT / 4.04 / 247.2 24,48,64 / 2.02 / 494.4	A,E,F (and 3 POWER BOOST only)G
6.	1/4 MSR DLYD BY VSR	4	5V squarewave	Selected Range / Freq. (MHz) / Period (nsec) .25,.5, .75,1.5 / 8.08 / 123.6 3 / 4.04 / 247.2 6,12 / 1.01 / 988.8 24 / 5.05 / 197.8 48,64 / (1) 2.53 / 395.5 48,64 / (2) 8.08 / 123.6 3 PWR BST / 2.02 / 494.4 (1) 0 to 200 count (2) 201 to 256 count	A,E,F (and 3 POWER BOOST only)G
7.	2:1	S	0 VDC or 5 VDC	0 VDC in .25,.5,.75,6,3PB 5 VDC in 1.5,3,12,24,48,64	F(and 3 POWER BOOST only)G
8.	$\overline{2:1}$	N	5 VDC or 0 VDC	Opposite of output 7.	F(and 3 POWER BOOST only)G
9.	4:1	16	0 VDC or 5 VDC	5 VDC in 3,48,64; 0 VDC in all other ranges.	F
10.	Latch 15	R	5V squarewave	Selected Range / Freq. (MHz) / Period (nsec) .25,.5,.75 / 16.16 / 61.9 1.5 / 8.08 / 123.6 3,3PWR BST / 4.04 / 247.2 6 / 2.02 / 494.2 12 / 1.01 / 988.8 24 / .505 / 1980.0 48,64 / .252 / 3960.0	A,E,F (and 3 POWER BOOST only)G
11.	Latch 16/17	P	5V squarewave	Complement of output 10.	A,E,F
12.	Latch 9	2	5V squarewave	Selected Range / Freq. (MHz) / Period (nsec) .25,.5 .75,1.5 / 8.08 / 123.8 3 / 4.04 / 247.2 3 PWR BST / 2.02 / 494.4 6,12 / 1.01 / 988.8 24 / .505 / 1980.0 48,64 / .252 / 3960.0	A,E,F (and 3 POWER BOOST only)G
13	Latch 3/10	3	5V squarewave	Complement of output 12.	A,E,F (and 3 POWER BOOST only)G
14.	Medium Command	27	0 VDC or 5 VDC	5 VDC in 3 POWER BOOST, 6,12 12RT; 0 VDC all other ranges.	F (and 3 POWER BOOST only)G
15.	Short Command	15	0 VDC or 5 VDC	5 VDC in .25,.5,.75,1.5,3; 0 VDC in all other ranges.	F

CONTINUED - SEE FOLLOWING PAGE FOR INPUT DATA

Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 12 of 14)

TABLE 2. TIMING CONTROL PCB A2A4
INPUT/OUTPUT DATA (CONTINUED)

INPUT DATA

Input	Function	Pin	Signal	Conditions/Notes	Source
A	32.32 MHz	T	5V squarewave	Oscilloscope response may degrade rise/fall times.	A2A6-19 (sheet 14)
B	Read	H	Positive 5V gate at PRF.	With changes with selected selected range.	A2A2-H (sheet 11)
C	1/2 Read Clock	C	5V squarewave	Selected Range / Freq. (kHz) / Period (nsec) .25 / 449 / 2227 .5, 6, 12, 64, 3 PWR BST / 898 / 1114 .75, 1.5, 3 / 1346 / 742 24, 48 / 673 / 1486	A2A2-N (sheet 11)
D	PRF	7	Negative (5V to 0V) 30.9 nsec pulse at PRF	Interval changes with selected range.	A2A6-18 (sheet 14)
E	Clear	8	Negative (5V to 0V 30.9 nsec pulse at PRF	Interval changes with selected range; preceeds input D by waveguide run delay.	A2A6-J (sheet 14)
F	Range Select	*	0 VDC or 5 VDC	0 VDC when associated range is selected; 5 VDC all other ranges *Range/Pin — Range/Pin .25/22 — 12/18 .5/V — 24/23 .75/Z — 48/DD 1.5/26 — 64/17 3/J — 12RT/AA 6/6	0VDC: S1C 5VDC: A4 or A5 (LED) PCB's
G	POWER BOOST Command	K	0 VDC or 5 VDC	POWER BOOST off: 5 VDC POWER BOOST on: 0 VDC	0 VDC: S5 5 VDC: Internal pull-up, (A2A4R10)

TABLE 3. VRM PCB A2A7
INPUT DATA

(187)

Function	Pin	Signal	Conditions/Notes	Source
Delayed Sweep Gate	16	Negative (5V to 0V) gate at PRF.	Width changes with selected range.	A2A5-C (sheet 2 CC)
2.02 MHz	U	5V squarewave	Used only 12RT	A2A4-12 (sheet 12)
Read Clock	T	5V squarewave	Selected Range / Freq. (kHz) / Period (nsec) .25 / 897.7 / 1113.8 .5, 6, 12, 64, 3 PWR BST / 1795.5 / 556.8 .75, 1.5, 3 / 2693.3 / 371.2 24, 48 / 1346.6 / 742.4	A2A2-R (sheet 11)
Range Select	*	0 VDC or 5 VDC	0V when associated range is selected; 5V when any other is selected. *Range — Input Pin 1.5 — 23 3 — AA 6 — 26 12 — 27 24 — CC 48 — DD 64 — 17 12RT — EE	0V: S1-C 5V: A4 or A5(LED)PCB

Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283
Troubleshooting Chart (Sheet 13 of 14)

TABLE 4. PRF GENERATOR PCB A2A6 INPUT/OUTPUT DATA

OUTPUT DATA

Output	Function	Pin	Signal	Conditions/Notes	Req'd Inputs (see INPUT DATA)
1.	32.32 MHz	19	5V squarewave	Oscilloscope response may degrade rise and fall times.	Power only
2.	1800 Hz	15	5V squarewave	1400 Hz FTE on	Power only
3	900 Hz	13	5V squarewave	700 Hz FTE on	Power only
4.	MTR Trigger	H	Negative (4V to 0V) 1.4 usec pulse at PRF	Interval (defines PRF): Selected Range — Interval (usec) FTE ON/OFF .25 to 3 — 278/217 6,12,12RT — 556/435 24,48,64 — 1112/870 3 PWR BST — 556/435	C,D(and FTE ON only)G
5.	PRF	18	Negative (5V to 0V) 30.9 nsec pulse at PRF	Follows output 4. by ≈ 1 usec	A,B,E,F
6.	Clear	J	Negative (5V to 0V) 30.9 nsec pulse at PRF.	Preceeds output 5. by waveguide run delay.	A
7.	Heading Flash Pulse	D	Positive 5V gate	Occurs once per anetnna rotation: width ≈ 2 x output 4. interval.	A,B,E,F H,I,J

INPUT DATA

Input	Function	Pin	Signal	Conditions/Notes	Source
A	Acknowledge Pulse	22	Positive pulse at PRF	Amplitude: V1: 14V V2,V3,V4: 3.5V Width (baseline): 1. .25 to 3 mile ranges: 100 nsec 2. 6,12 and 3 mile with POWER BOOST ranges: 500 nsec 3. 24,48,64 mile ranges: 1 usec	1. X band: RT-1240J3 2. S-band: RT-1241J3

INPUT DATA (CONTINUED)

Input	Function	Pin	Signal	Conditions/Notes	Source
B	4.04 MHz	L	5V squarewave	494.4 nsec	A2A4-10(sheet 12)
C	Medium Command	16	0 VDC or 5 VDC	5V: 6,12,12RT or 3 with POWER BOOST ranges. 0V: All other ranges.	A2A4-17(sheet 12)
D	Long Command	12	0 VDC or 5 VDC	5V: 24,48,64 mile ranges. 0V: All other ranges.	A2A4-15(sheet 12)
E	Mode A	B	0 VDC or 5 VDC	5V: Master Indicator 0V: Slave Indicator	0V: Interswitch 5V: Internal pull-up (A1A6R25)
F	Mode B	C	0 VDC or 5 VDC	5V: MTR 2 0V: MTR 1	0V: Interswitch 5V: Internal pull-up (A2A6R26)
G	FTE ON	25	0 VDC or 5 VDC	0V: FTE ON (held) 5V: FTE off (normal)	0V: FTE ON switch S3 5V: Internal pull-up (A2A6R5)
H	HF Trigger	M	Negative (5V to 0V) pulse	Occurs once each antenna rotation.	0V: Pedestal Reed switch S2 5V: Internal pull-up (A2A6R2)
I	HF OFF	K	0 VDC or 5 VDC	0V: FLASH OFF (held) 5V: Flash on (normal)	0V: FLASH OFF switch S3 5V: Internal pull-up (A2A6R4)
J	Stolen Sweep	U	Negative (5V to 0V) pulse	Occurs every 32nd sweep; width = 1/PRF	A2A9-H (sheet 6 AA)

Figure 5-8 Azimuth Range Indicators IP-1282/IP-1283 Troubleshooting Chart (Sheet 14 of 14)

NOTE - When measuring waveforms, use isolation plug to isolate oscilloscope from chassis ground to prevent power supply damage.

NOTE - Always set POWER switch to OFF before removing or installing PCBs.

CAUTION - High voltage is present at power supply A1.

START

(1)

1. Set POWER switch to OFF.
2. Check fuse F101, F102, and F103 on power supply.
3. Remove CRT connector plug.
4. Note location and remove all PCBs from card basket.
5. Remove sweep output assembly as a load from the power supply. Carefully note and disconnect leads from TB1-9 through TB1-16.
6. Turn PNL LIGHTS control CW.
7. Set POWER switch to STBY and observe indicator panel lamps.

PANEL LAMPS LIT → (2)

(2)

1. Set POWER switch to OFF.
2. Re-insert PCBs one at a time and set POWER switch to ST BY to determine if a PCB is drawing excessive current.
3. Re-connect sweep output assembly and set POWER switch to ST BY to determine if this assembly is at fault.
4. Repair or replace defective PCB or sweep output assembly.
5. Re-insert all remaining PCBs.

PANEL LAMPS OFF → (3)

(3)

1. Set POWER switch to OFF.
2. Set switch A1S101 to SERVICE.
3. Set POWER switch to ST BY.
4. Observe panel lamps. If panel lamps are on, check high voltage sections of power supply A1. Also check for shorted CRT.

PANEL LAMPS OFF → (4)

(4)

1. Note types of transistors Q101, Q102, Q103, and Q104.
2. Remove all four transistors.
3. Using an ohmmeter, determine shorted transistor.
4. Replace defective transistor.
5. Re-install remaining transistors.
6. Set POWER to ST BY and observe panel lamps.

PANEL LAMPS OFF → (5)

(5)

1. Perform visual inspection of power supply to determine malfunction. Repair defect causing malfunction.
2. Set POWER switch to ST BY.

PANEL LAMPS OFF → A

TO SHEET 2

Figure 5-9 Azimuth Range Indicators IP-1282/IP-1283 Power Supply Troubleshooting Chart (Sheet 1 of 3)

FROM SHEET 1

A

PANEL LAMPS OFF

(6)

1. Set A1S101 to SERVICE to remove HV from anode.

2. Remove entire power supply from indicator. Remove power supply cover. Power supply may be repaired on the bench.

3. Remove screws from Q102.

4. Insert Q102 into its socket. Do not install the screws that secure the transistor.

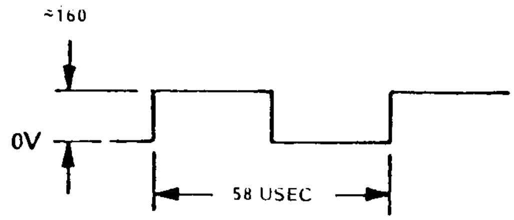
5. Connect a 5-volt zener diode to P3-17 (anode) and P3-1 (cathode).

6. Connect a 470 ohm, 0.5W resistor between P3-17 and junction of CR9 and C11 to place a 5.1V reference on P3-17. *NOTE - Remove diode and resistor after malfunction is cleared.*

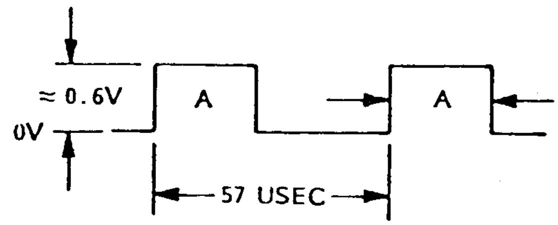
7. Connect a jumper between Pins J101-E and J101-F to simulate turn on.

8. Carefully apply 115V, 60 Hz primary power to Pins J101-A and J101-B.

9. Measure 81-vdc across A1A1C39. If the measurement is low, check VR101, Q8, and associated circuitry. If the measurement is high, check VR101 and R103.



WAVEFORM (7)



WAVEFORM (9)

WARNING: WHEN MEASURING WAVEFORM WITH AN OSCILLOSCOPE USING AN ISOLATION PLUG THE CHASSIS OF THE OSCILLOSCOPE WILL HAVE A LETHAL VOLTAGE PRESENT. THIS OSCILLOSCOPE MUST BE HANDLED WITH EXTREME CARE.

81 VDC CORRECT

(7)

Check Clock waveform (7) by connecting oscilloscope to collector of Q8. Frequency adjusted by R47. *

CLOCK FREQUENCY CORRECT

(9)

1. Check chopper voltages. *NOTE - Make certain that screws are removed from Q102.* *

2. Measure waveform (9) across R8.

3. Adjust R28 and observe that pulse width A varies. If pulse A is missing, check U1 and associated circuitry. If R28 produces no variation in pulse width A, check U2, U3, and associated circuitry.

CLOCK FREQUENCY INCORRECT, OR CLOCK MISSING

(8)

Measure 12-vdc across VR4. If correct, check U5 and associated circuitry. If incorrect, check Q7 and associated circuitry.

R28 VARIES PULSE WIDTH A

B

TO SHEET 3

Figure 5-9 Azimuth Range Indicators IP-1282/IP-1283 Power Supply Troubleshooting Chart (Sheet 2 of 3)

FROM SHEET 2

B

R28 VARIES PULSE WIDTH

A

(10)

NOTE - *Insert Q103 and Q104 into their sockets. Do not install the screws that secure these transistors.* *

Measure waveform (10) across R11.

WAVEFORM INCORRECT

(12)

1. Check Q3, Q4, and associated circuitry.
2. Check U4 and associated circuitry.

WAVEFORM CORRECT

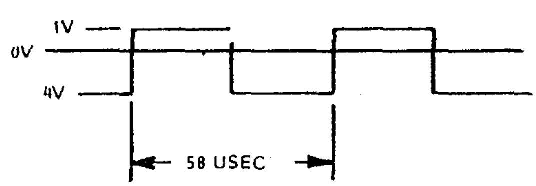
(11)

1. Check diodes CR103, CR104, CR105, CR14 through CR18 and associated circuitry.
2. Check for shorted connections on J101 or between J101 and the card basket.

(13)

1. Set POWER switch to OFF
2. Remove 115V power from power supply.
3. Remove jumper from power supply.
4. Remove 5V test diode and 470 ohm resistor.
5. Re-install screws in Q102, Q103, and Q104.
6. Re-connect sweep output assembly.
7. Adjust power supply per Sections 5.5.2 and 5.5.3.

WARNING: WHEN MEASURING WAVEFORM WITH AN OSCILLOSCOPE USING AN ISOLATION PLUG THE CHASSIS OF THE OSCILLOSCOPE WILL HAVE A LETHAL VOLTAGE PRESENT. THIS OSCILLOSCOPE MUST BE HANDLED WITH EXTREME CARE.



WAVEFORM (10)

Figure 5-9 Azimuth Range Indicators IP-1282/IP-1283 Power Supply Troubleshooting Chart (Sheet 3 of 3)

4. Refer to the INPUT DATA section of the table and check each input associated with the erroneous output. If all associated inputs are correct, replace the PCB.

5. If one or more of the associated inputs is incorrect, refer to the SOURCE column and continue troubleshooting per the reference given.

WARNING

THE POWER SUPPLY CONTAINED IN THE IP-1282 AND IP-1283 INDICATORS UTILIZES A FLOATING COMMON BUSS WHICH OPERATES AT APPROXIMATELY -75 VDC WITH RESPECT TO CHASSIS. EXERCISE EXTREME CARE TO AVOID CONTACT. DO NOT GROUND THE FLOATING COMMON BUSS EXCEPT WHEN, AFTER ALL POWER HAS BEEN REMOVED FROM THE EQUIPMENT, RESIDUAL DC VOLTAGE MUST BE DISCHARGED FOR TEST EQUIPMENT CONNECTION OR COMPONENT REMOVAL.

5.12.2 Removal/Replacement Procedures

CAUTION

REMOVE ALL POWER FROM THE INDICATOR PRIOR TO PERFORMING ANY FUNCTION INSIDE THE UNIT AS GIVEN BELOW.

The following steps outline the procedure for removing power from Indicator IP-1282 or IP-1283:

1. When the indicator front cover is removed, the safety interlock switch automatically removes power to the unit. To restore power to the unit with the front cover removed, the switch can be twisted and pulled to bypass the interlock feature.

2. At the Receiver Transmitter, set the LOCAL TEST switch to the OFF position.

3. Set the ship's circuit breakers/switches supplying power to the AN/SPS-64(V) to OFF.

4. Remove fuses F1 and F2 from the indicator. The fuses are located under the front cover on the indicator control panel.

5.12.2.1 Power Module Assembly A1. -

1. Remove power per paragraph 5.12.2.

2. Remove the indicator front cover by first loosening the captive screws.

3. Remove the vibration bar by first removing the 2 screws, one in the upper right hand corner the other screw in the lower left hand corner of the indicator.

4. Release and remove the NSK assembly, per paragraph 5.12.2.3. Steps 3.

5. Disconnect the anode connector located above the yoke assembly.

WARNING

BEFORE TOUCHING ANY PARTS, DISCHARGE ANY STORED HIGH VOLTAGE USING A WELL-INSULATED GROUNDING LEAD

6. Disconnect the harness connector located on the side of the Power Module and the focus lead from the front of the Power Module assembly A1.

7. Remove 3 cross-recessed screws, washers and lockwashers, located front right, to free the power module assembly from the cabinet side.

8. Pull the entire assembly straight forward and out of the indicator. The rear of the assembly fits onto a large supporting pin.

9. Reinstall using the reverse of above.

5.12.2.2 Sweep Output Assembly A3. -

1. Remove power per paragraph 5.12.2.

2. Remove the indicator front cover by first loosening the captive screws.

3. Remove the vibration bar by first removing the 2 screws, one in the upper right hand corner the other screw in the lower left hand corner of the indicator.

4. Remove the 2 cross-recessed screws, washers and lockwashers located at the top of assembly A3. The assembly will swing out and down.

5. To completely remove assembly A3 from the indicator, disconnect all wires from A3 noting the hook-up locations, and remove the assembly hinge from the indicator.

6. Reinstall using the reverse of above.

5.12.2.3 North Stabilization Kit (NSK) Assembly A9. -

1. Remove power per paragraph 5.12.2.

2. Remove the indicator front cover by first

3. Remove the vibration bar by first removing the 2 screws, one in the upper right hand corner the other screw in the lower left hand corner of the indicator.

4. Remove the 3 cross-recessed screws, washers and lockwashers located at the top of assembly A9 and swing the assembly out and down.

5. To completely remove assembly A9 from the indicator, disconnect all wires from A9, noting the hook-up locations, and remove the assembly hinge from the indicator.

6. Reinstall using the reverse of above.

5.12.2.4 Cathode Ray Tube (CRT) V1. -

1. Remove power per paragraph 5.12.2.

2. Open up the indicator bezel by loosening the 2 captive screws at the front edge of the bezel, and lifting the bezel up to it's maximum stay-slide position. There are two stay-slide settings for degree of opening the bezel.

3. Remove the front cover and swing the NSK assembly A9 out per paragraph 5.12.2.3. Using steps 3, 4.

4. Pull the CRT connector loose from the bottom of the CRT socket.

5. Disconnect the anode connector located above the yoke assembly.

WARNING

BEFORE TOUCHING ANY PARTS, DISCHARGE ANY STORED HIGH VOLTAGE USING A WELL-INSULATED GROUNDING LEAD

6. Remove the nuts that attach the CRT tabs to the top of the cabinet, and lift the CRT up and out of the indicator.

7. Reinstall using the reverse of above.

5.12.2.5 Deflection Yoke Assembly A12. -

1. Remove power per paragraph 5.12.2.

2. Remove the indicator front cover by first loosening the captive screws.

3. Remove the vibration bar and NSK per paragraph 5.12.2.3 steps 3 and 4.

4. Pull the CRT connector loose from the bottom of the CRT socket.

5. Disconnect the yoke wires from the sweep output assembly as follows: Blue from TB1 terminal 1; Red from TB1 terminal 2; Yellow from TB1 terminal 3; and Green from TB1 terminal 4.

6. Loosen the screw on the clamp that secures the yoke and drop the yoke away from the CRT neck.

7. Reinstall using the reverse of above.

5.12.2.6 VRM Encoder Assembly A13. -

1. Remove power per paragraph 5.12.2.

2. Open the indicator control bezel and lift up to maximum stay-slide position.

3. Remove the VRM control knob.

4. Disconnect the encoder assembly wires, noting hook-up locations.

5. Remove the hex head retainer located on front of the control panel and remove the encoder assembly.

6. Reinstall using the reverse of above.

5.12.2.7 Range Readout LED Assemblies A4 and A5. -

1. Remove power per paragraph 5.12.2.

2. Open the indicator control bezel and lift up to maximum stay-slide position.

3. Disconnect assembly hook-up wires, noting hook-up locations.

4. Remove the 2 cross-recessed screws, washers and lockwashers in each assembly, and remove the PCB.

5. Reinstall using the reverse of above.

5.12.2.8 VRM Readout LED Assembly A6. -

1. Remove power per paragraph 5.12.2.

2. Open the indicator control bezel and lift to maximum stay-slide position.

3. Disconnect assembly hook-up wires, noting hook-up locations.

4. Remove 2 cross-recessed screws, washers and lockwashers to release the PCB assembly.

5. Reinstall using the reverse of above.

5.12.2.9 Cursor Drive Assembly. -

1. Remove power per paragraph 5.12.2.

2. Open the indicator control bezel and lift up to maximum stay-slide position.

3. The cursor drive assembly is held in position between the plate shaft and the cursor by a spring pressure fit. Remove by gently separating the two pulleys and lifting the assembly out.

4. Reinstall using the reverse of above.

5.12.2.10 Compass Scale Drive Assembly.-

NOTE

The compass scale drive assembly is supplied only in Indicator IP-1283.

1. Remove power per paragraph 5.12.2.

2. Open the indicator control bezel and lift to maximum stay-slide position.

3. The compass drive is a manual operation consisting of two gears that may be removed. One gear is held in place by a spring pin through the hub of the gear and the shaft. The other gear is held by a shoulder screw installed on the outer side of the gear and into a mounting plate. This screw has been installed with LOCTITE on the threads and may be very tight upon removal.

4. Reinstall using the reverse of above. LOCTITE should be freshly applied to the threads of the shoulder screw.

5.12.2.11 Plotter Assembly A7 (IF Installed). -

1. Remove power per paragraph 5.12.2.

2. Loosen the slotted-head screws that secure the plotter assembly to the indicator bezel. Twist the plotter assembly and prepare to remove it.

3. Slowly lift the plotter assembly A7 and disconnect the connector at J5 in the upper left hand corner.

3. Disconnect the wiring connector and re- move the plotter assembly.

4. Reinstall using the reverse of above.

5.12.2.12 Control Panel Assembly. -

1. Remove power per paragraph 5.12.2.

2. Remove the knobs and switches located on the front of the control panel.

3. Remove the 4 slotted-head screws and washers attaching the panel to the bezel and lift the panel off.

4. Reinstall using the reverse of above.

5.12.2.13 Lamps

1. Remove power per paragraph 5.12.2.
2. Remove all lamps by turning the retaining spring to the side.
3. Remove all lamps by pulling them out of their socket holders.
4. Reinstall using the reverse of above.

5.12.3 Alignment Procedures

Paragraphs 5.12.3.1 through 5.12.3.8 following provide instructions for alignment of all shipboard adjustable maintenance controls contained in Azimuth Range Indicators IP-1282 and IP-1283. When performed in the sequence indicated, these instructions constitute an overall Indicator alignment procedure. The alignments should be checked and adjusted as necessary following all Indicator repair and replacement activities. Refer to Figure 5-7 for location of assemblies and major components.

5.12.3.1 Power Supply Adjustments, - This procedure provides instructions for adjustments of power supply operating frequency, output voltage level, CRT coarse brilliance and CRT focus. Adjustment of the power supply overvoltage/overcurrent (OVP/OCP) protection circuit is covered in paragraph 5.12.3.2 following. Perform the following steps in the sequence given.

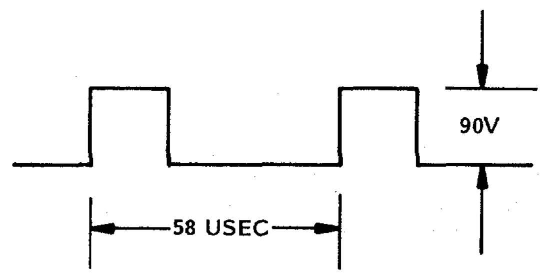
NOTE:
Power Supply A1 contains two controls which are factory set and should not be adjusted in the field; these are:

a. High voltage control A1A3R205.
b. PULSE WIDTH ADJ control A1A1R33.

1. Set the Indicator POWER switch to OFF.
2. Remove the access cover from the front of the Indicator.
3. Carefully disengage the A1 High Voltage Power Supply from the Indicator cabinet by removing three screws per 5.12.2.1.

WARNING
SET THE SERVICE/OPERATE SWITCH A2S101 TO SERVICE TO DISABLE THE HIGH VOLTAGE OUTPUT OF THE POWER SUPPLY.

4. Position the power supply for easy access to the screwdriver adjustment potentiometers on the back and to transistors A12Q101 through Q104 on the side.
5. Reconnect the harness connector P101 to the power supply assembly 4/5A1.
6. Reconnect the Anode lead to the CRT and the Focus lead to the power supply assembly 4/5A1.
7. Mechanically isolate the power supply chassis from the Indicator cabinet by placing a clean folded-up cloth between them.
8. Electrically ground the power supply chassis to the indicator cabinet with a clip lead.
9. Verify that all PCBs (including the extender card) are inserted in their proper locations in the A2 Card Basket.
10. Set the Indicator POWER switch to TX ON.
11. Connect an oscilloscope to the collector of A1A2Q103.
12. Adjust the FREQ-SET control A1A1R47 to obtain the waveform shown below:



13. Connect a multimeter, set at 10 Vdc scale, between pin 5 (positive lead) of the extender card and chassis.
14. Adjust OUTP ADJ control A1A1R28 for a reading of +5.1 Vdc on multimeter.
15. Disconnect multimeter. Set SERVICE/OPERATE switch A1A2S101 to OPERATE.

WARNING
HIGH VOLTAGE IS PRESENT.

16. Turn front panel BRILLIANCE control fully clockwise. Adjust BRILLIANCE PRESET control (A1A2R112) until sweep is barely visible on CRT display. Adjust front panel BRILLIANCE control for desired sweep intensity. Adjust GAIN and CONTRAST fully CCW.
17. Adjust front panel RANGE RINGS control for desired range ring brightness. Adjust FOCUS control (R111 on Potentiometer PCB A1A4) to obtain the sharpest possible definition of the range rings on the CRT display.
18. Set Indicator POWER switch to OFF.
19. Remove the grounding clip lead and the protective cloth, and carefully Install the A1 High Voltage Power Supply into the Indicator cabinet.

20. Reinstall the power supply using the reverse paragraph 5.12.2.1.

5.12.3.2 Power Supply OVP Adjustment. - The Indicator Power Supply Adjustments given in paragraph 5.12.3.1 must be in effect prior to performance of this procedure.

1. Perform steps 1 through 3 of paragraph 5.12.3.1, except leave the SERVICE/OPERATE X switch A1A2S101 in the OPERATE position.

WARNING
HIGH VOLTAGE IS PRESENT AT THE RED OUTPUT LEADS OF THE POWER SUPPLY. DO NOT TOUCH THESE LEADS.

CAUTION
WHEN MEASURING VOLTAGE ACROSS CAPACITORS, BE SURE METER LEAD POLARITY IS MATCHED TO THAT OF CAPACITOR (+ LEAD TO + TERMINAL).

2. Remove the power supply cover.
3. Mechanically isolate the power supply chassis from the indicator cabinet by placing a clear folded- up cloth between them.
4. Electrically ground the power supply chassis to the indicator cabinet with a chip lead.
5. Reconnect the harness connector P101 to the power supply.
6. Reconnect the Anode lead to the CRT and the focus lead to the power supply assembly 4/5A1.
7. Connect a multimeter across 4/5 A2A2C105 with the meter setting on 2.5Vdc.
8. Measure +.20Vdc across 4/5 A1A2R108B.

NOTE:
+0.20 Vdc indicates that the power supply is not in an overcurrent condition. The power supply should trip if the voltage across C105 is within the range of 0.95 to 1.35 volts. If this voltage is measured across C105 and the power supply has not tripped, proceed to the Indicator Power Supply Troubleshooting Chart, Figure 5-9 (8).

9. Turn OVP control A1A1R39 fully clockwise.
10. Connect multimeter, set to 250 Vdc scale, across A1A2C103; multimeter should read +90 V.
11. Adjust OUTPUT ADJ control A1A1R28 to obtain +100 Vdc (10 percent overvoltage) .

CAUTION
MISADJUSTMENT CAN DAMAGE PCB IN INDICATORS.

12. Turn OVP control A1A1R39 counterclockwise until the power supply trips out and the meter indicates 0 volts across C103.
13. Turn OUTPUT ADJ control A1A1R28 1/4- turn counterclockwise.
14. Turn the Indicator POWER switch to OFF and then to TX ON.
15. Connect multimeter positive lead at pin 5 of extender card and negative lead to Card Basket A2 chassis; set multimeter to 10 Vdc scale.
16. Adjust OUTPUT ADJ control A1A1R28 to obtain +5.1 Vdc reading on multimeter. .
17. Set Indicator POWER switch to OFF.
18. Remove the ground clip lead and protective cloth and reinstall the power supply cover.
19. Carefully install the 4/SA1 High Voltage Power Supply into the Indicator cabinet.
20. Install the vibration bar and the access cover to the front of the indicator.

5.12.3.3 Master Clock Oscillator Adjustment. - The master clock oscillator circuit is adjusted at the factory and should be field adjusted only when necessitated by replacement of the oscillator crystal Y1 or other oscillator circuit component on the PRF Generator PCB A2A6. If adjustment is required, the following steps must be followed exactly.

1. At Indicator requiring adjustment:
   a. Set POWER switch to OFF.
   b. Remove the indicator front cover by first loosening the captive screws. Pull out the indicator safety switch.
   c. Remove the vibration bar by first removing the 2 screws. One in the upper right hand corner the other screw is in the lower left hand corner of the indicator.
   d. Remove PRF Generator PCB A6 and extender card from A2 card basket.
   e. Mount A6 PCB on extender card and insert into A2A6 card slot.
   f. Set POWER switch to ST BY.
   g. Set RANGE SELECT switch to 24 MILES.
2. Connect oscilloscope, set for 2 volts and .2 MS per division, at trigger output connector J1; adjust for display of two trigger pulses.
3. Adjust capacitor C16 on A2A6 PCB clockwise until time interval between trigger pulses starts to increase; note adjustment positions of C16.
4. Adjust capacitor C16 on A2A6 PCB counter-clockwise until time interval between trigger pulses again starts to increase; note adjustment position of C16.

NOTE:
Verify that C16 must be turned approximately 45 degrees between the adjustment positions noted in steps 3 and 4 before trigger movement is observed. If the adjustment does not exhibit this "dead range", replace crystal Y1 on A2A6 PCB.

5. Adjust capacitor C16 on A2A6 PCB to a position midway between the adjustment positions noted in steps 3 and 4 above.

6. Disconnect oscilloscope and connect a time interval counter at trigger output connector J1.

7. Set the RANGE SELECT switch to each of the positions listed below and verify the trigger pulse time interval indicated for each range:

RANGE SELECT	TIME INTERVAL
24 MILES	1113.8 usec
6 MILES	556.9 usec
.25 MILES	278.45 usec

8. Set POWER switch to OFF for ten seconds, then return it to ST BY and repeat step 7.

9. Set POWER switch to OFF and remove extender card. Insert A6 PCB and extender card into their respective slots in the A2 card basket.

5.12.3.4 Range Zero Alignment. - Two range zero alignment procedures are given below, one for AN/SPS-64(V)1 (single indicator) systems and one for AN/SPS-64(V)2, (V)3 and (V)4 (multiple indicator) systems. Perform the steps given in paragraph 5.12.3.4.1 for AN/SPS-64(V)1 installations; perform those given in paragraph 5.12.3.4.2 for AN/SPS-64(V)2, (V)3 or (V)4 installations.

5.12.3.4.1 The following steps are applicable to AN/SPS-64(V)1 installations only.

1. Set Indicator POWER switch to OFF.

2. Remove the upper access cover from the front of the Indicator.

3. Remove the vibration bar by first removing the 2 screws, one in the upper right hand corner. The other screw is in the lower left hand corner.

4. Remove the PRF Generator PCB A6 from the A2 Card Basket.

5. Verify that E17 is jumpered to E54 (U23 pin 9) on A2A6 PCB (install if necessary) .

6. Solder a jumper between E33 and E35. Connect one end of a 6-inch jumper to E35. Tack-solder the other end of this jumper to E26.

7. Insert PCB extender card into slot A2A6 of the card basket.

8. Insert the PRF Generator PCB A6 into the extender card.

9. Set Indicator POWER switch to TX ON and adjust the radar for a normal display of the .25 MILE range.

10. Locate and determine the distance between the antenna under test and the bow of the ship.

11. Identify the bow on the CRT using the 1/4 mile range. Rotate the VRM out to the bow on the CRT and note the range on the VRM display. Proceed as follows:

   a. If the VRM display is greater than the distance in step 10 then proceed with steps 12 through 23.

   b. If the VRM display is less than the distance in step 10 then proceed with steps 15 through 23 following.

12. Set Indicator POWER switch to OFF. Re- move PCB A6 from the extender card.

13. On A6 PCB, remove the jumper between E17 and E54; install a jumper between E17 and E53 (between U2 and U3).

14. Solder a jumper between E29 and E31. Solder one end of a 6-inch jumper to E31. Tack-solder the other end of this jumper to E1.

15. Insert PCB A6 into extender card (in A2A6 slot of the Card Basket).

16. Set Indicator POWER switch to TX ON; observe the target identified in step 9.

NOTE:

The VRM display should now be less or equal to the distance to the bow. If the VRM display is greater than the distance to the bow then move the jumper on 4/5A6 PCB from E1 to E2, E2 to E3, etc., until the VRM display is less than or equal to the distance to the bow.

17. On 4/5A6 PCB move the jumper from E26 to E25 and observe the bow on the CRT. If the VRM is less than the bow of the ship, move the jumper from E25 to E24, E23 etc. until the VRM display readout is the same as the distance to the bow.

NOTE:

Do not move the jumper beyond E17 in the sequence established in step 16.

18. Set Indicator POWER switch to OFF.

19. Remove A2A6 PCB and PCB extender card.

20. Shorten the length of the jumper moved in step 16 and permanently solder it to the selected terminal.

21. Insert A2A6 PCB into its slot within the Card Basket.

22. Install the vibration bar on the front of the Indicator.

23. Install the Indicator access cover.

5.12.3.4.2 The following steps are applicable to AN/SPS-64(V)2, (V)3 and (V)4 installations only. The procedure must be performed for each Indicator installed.

NOTE:

System mode switching is required during this procedure. When a procedural step calls for mode selection, refer to the table referenced below for the applicable system installed.

AN/SPS-64(V)2:	Table 3-1
AN/SPS-64(V)3:	Table 3-2
AN/SPS-64(V)4:	Table 3-3

1. Set all Indicator POWER switches to OFF.
2. At Indicator A:
   a. Remove the upper access cover from the front of the indicator.
   b. Remove the vibration bar by first removing the 2 screws one in the upper right hand corner. The other screw is in the lower left hand corner.
   c. Remove the PRF Generator PCB A6 from the A2 Card Basket.
3. Verify that E17 is jumpered to E54 (U23 pin 9) on A2A6 PCB (install if necessary) .

NOTE:
Steps 4 through 25 following will be performed with Indicator A defined as the Indicator under test.

4. At Switching Unit(s), establish a mode in which Indicator under test and associated receiver transmitter are selected per Condition 1 of Table 5-4.

Table 5-4. Multiple Indicator System Range Zero Alignment Data

MODE			
Con-dition	Indicator Under Test	Associated Rcvr Xmiter	Delay Select
1	MASTER	MTR-I	E35
2	SLAVE	MTR-I	E33
3	MASTER	MTR-II	E34
4	SLAVE	MTR-II	E32

5. On A6 PCB solder one end of a six-inch jumper at Delay Select terminal listed for Condition 1 in Table 5-4; tack-solder other end of this jumper at terminal E26.
6. Insert PCB extender card into slot A2A6 of the Card Basket.
7. Insert the PRF Generator PCB A6 into the extender card.
8. Set Indicator POWER switches as follows:
   a. Master Indicator(s): TX ON
   b. Slave Indicator(s): ST BY
9. Set all Indicator RANGE SELECT switches to .25 MILE and adjust for normal display.
10. Visually identify a long straight target such as a pier at a distance between 100 yards and 1/8 mile.
11. Locate target identified in step 10 on CRT display of Indicator under test and proceed as follows:
    a. If the straight edge of the target is "pulling" (bowed toward the center of the display), proceed to step 18.

b. If the straight edge of target is "pushing" (bowed away from the center of the display), perform steps 12 through 18 following.

12. Set all Indicator POWER switches to OFF. Remove PCB A6 from the extender card at the indicator under test.

13. On A6 PCB, remove the jumper between E17 and E54; install a jumper between E17 and E53 (located between U2 and U3).

14. On A6 PCB, solder jumpers as follows:

a. E28 to E29

b. E29 to E30

c. E30 to E31

15. On A6 PCB, solder one end of a 1.5-inch jumper at E31; tack-solder other end of this jumper at E1.

16. Insert A6 PCB into extender card in A2A6 slot at Indicator under test.

17. Set all Indicator POWER switches to TX ON, observe the target identified in step 10 on the CRT display of the Indicator under test.

NOTE:

The straight edge of the target should now be "pulling" (bowed toward the center of the display) or straight; if "pulling", proceed to step 18. If the target is still "pushing" move the jumper from E1 to E2, E2 to E3, etc. on A6 PCB until the "pulling" effect is obtained, then proceed to step 18.

18. Move the jumper from E26 to E25 on A6 PCB and observe the target identified in step 10. If the straight edge of the target is still "pulling" on the CRT display of the Indicator under test, move the jumper from E25 to E24, E24 to E23, etc. until the target edge appears perfectly straight.

NOTE:

Do not move the jumper beyond E17 in the sequence established in step 18.

19. Set all Indicator POWER switches to OFF.

20. Repeat steps 4 and 5 above, substituting Condition 2 for Condition 1.

21. Repeat steps 18 and 19 above.

22. Repeat steps 4 and 5 above, substituting Condition 3 for Condition 4.

23. Repeat steps 18 and 19 above.

24. Repeat steps 4 and 5 above, substituting Condition 4 for Condition 1.

25. Repeat steps 18 and 19 above.

NOTE:

Steps 26 through 42 following will be performed with Indicator B defined as the indicator under test.

26. At Indicator under test:

a. Remove the upper access cover from the front of the Indicator.

b. Remove the A6 PRF Generator PCB A6 from the A2 Card Basket.

27. At Indicator A, remove A2A6 PCB from the A2 Card Basket.

NOTE:

Keep track of which A6 PCB belongs in Indicator A.

28. On A6 PCB taken from Indicator under test, connect jumpers from the following terminals in the same manner as on the A6 PCB taken from Indicator A:

a. E17

b. E32

c. E33

d. E34

e. E35

f. E28

g. E29

h. E30

i. E31

29. Install A6 PCB taken from Indicator A in the A2A6 slot at Indicator A.

30. At Indicator under test, insert A6 PCB into extender card and insert extender card into A2A6 card slot.

31. Repeat step 4 above.

32. Set Indicator POWER switches as follows:

a. Master Indicator(s): TX ON

b. Slave Indicator(s): ST BY

33. At A2A6 PCB of the Indicator under test, locate the jumper connected to the Delay Select terminal listed for Condition 1 in Table 5-4.

34. Locate the target identified in step 10 above on the CRT display of the Indicator under test and proceed as follows:

a. If the straight edge of the target is "pulling" (bowed toward the center of the display);, move the jumper located in step 33 to the next <u>lower</u> numbered terminal (E26 through E18) and observe the display. Repeat as necessary until target edge appears perfectly straight.

b. If the straight edge of the target is "pushing" (bowed away from the center of the display), move the jumper located in step 33 to the next <u>higher</u> number terminal (E18 through E26) and observe the display. Repeat as necessary until target edge appears perfectly straight.

35. Set all Indicator POWER switches to OFF.

36. Repeat step 4 above, substituting Condition 2 for Condition 1.

37. Repeat steps 32 through 35 above, substituting Condition 2 for Condition 1 in step 33.

38. Repeat step 4 above, substituting Condition 3 for Condition 1.

39. Repeat steps 32 through 35 above, substituting Condition 3 for Condition 1 in step 33.

40. Repeat step 4 above, substituting Condition 4 for Condition 1.

41. Repeat steps 32 through 35 above, substituting Condition 4 for Condition 1 in step 33.

42. At Indicator under test:

  a. Set POWER switch to OFF.

  b. Remove A2A6 PCB and extender card.

  c. Insert A6 PCB into A2A6 card slot.

  d. Install front access cover.

NOTE:

Step 43 following is applicable to AN/SPS-64(V)3 and V(4) installations only.

43. Repeat steps 26 through 42 above with Indicator C defined as the Indicator under test.

NOTE:

Step 44 following is applicable to only AN/SPS-64(V)3 systems in which optional Indicator D is installed.

44. Repeat steps 26 through 42 above with Indicator D defined as the Indicator under test.

45. Install front access cover at Indicator A.

5.12.3.5 Sweep Circuits Alignment. - The following steps provide an overall Indicator sweep circuits alignment procedure. All steps must be performed in the sequence given. The procedure is applicable to both IP-1282 (12-inch) and IP-1283 (16-inch) indicators.

NOTE 1:

For V2, V3 or V4 systems installations, the Indicator under test must be a master Indicator. Refer to Table 3-1, 3-2 or 3-3 as applicable and set Switching Unit(s) for an appropriate system mode.

NOTE 2:

For V2 or V3 system installations the Resolver Drive PCB in the Video Amplifier AM-6932 associated with the Receiver Transmitter in use must have been aligned per paragraph 5.16.3 prior to performing this procedure. For V4 systems, the Resolver Drive PCB is located in Video Amplifier AM-6932 (with MTR I in use) or Receiver Transmitter RT-1241 (MTR II in use, see paragraph 5.17.3.7).

1. Set Indicator POWER switch to OFF.

2. Turn off ships circuit breaker supplying power to Indicator under test.

3. At Indicator:

  a. Set RANGE SELECT switch to 24 MILES.

  b. Turn EBL DIM/EBL READ control fully counterclockwise (EBL off).

  c. Set OFFSET switch to off (away from operator).

  d. Set HDG SET/GYRO STAB/HD UP switch to HD UP.

  e. Remove upper front access cover and stabilizer bar.

4. Loosen the CRT yoke clamp and push the yoke up the neck of the CRT as far as it will go.

Tighten yoke clamp.

5. Remove EBL PCB A9 from the A2 card basket.

6. Turn on ships circuit breakers which provide power to Indicator under test.

7. Set Indicator POWER switch to ST BY.

8. Connect multimeter, set to 2.5 Vdc scale, as follows:

  a. Positive lead to junction of R2 and R3 on Sweep Output assembly A3.

  b. Negative lead to chassis.

9. Adjust BAL control R12 on A3A1 PCB for 0.0 Vdc reading on multimeter.

10. Move multimeter positive lead to junction of R10 and R22 on Sweep Output assembly A3.

11. Adjust BAL control R12 on A3A2 PCB for 0.0 Vdc reading on multimeter.

12. Set Indicator POWER switch to OFF.

13. Mount A9 EBL PCB on extender card and insert extender card into A9 slot of card basket A2.

14. Turn following Indicator front panel controls fully counterclockwise:

  a. CONTRAST

  b. VRM

  c. RANGE RINGS

15. Set Indicator POWER switch to TX ON.

16. Connect oscilloscope at TB3-5 and adjust for display of the 900 Hz resolver drive signal.

17. Adjust drive offset control R22 on Position Transmission PCB A2A8 to make the resolver drive signal displayed on oscilloscope symmetrical about zero Vdc.

18. Adjust R54, R61 and R66 controls on Sweep Generator PCB A2A10 twenty turns counterclockwise.

19. Adjust RANGE RINGS control until range rings are visible.

20. Observe that the sweep is <u>octagonal</u> and fills approximately half of the PPI screen.

21. Connect oscilloscope, set for 5 volts/division, at pin L of EBL PCB A2A9/extender card. Adjust oscilloscope for display of 2 Hz sinewave.

22. Adjust Y-reference gain control R1 on Position Transmission PCB A2A8 to obtain exactly 10 volt peak-to-peak signal.

23. Connect oscilloscope at pin P of EBL PCB A2A9/extender card.

24. Adjust X-reference gain control R7 on A2A8 PCB to obtain exactly 10 volt peak-to-peak signal.

25. Observe the range rings, which should now be nearly circular but not necessarily centered.

26. At A2A10 PCB, adjust R61 and R66 controls seven turns clockwise.

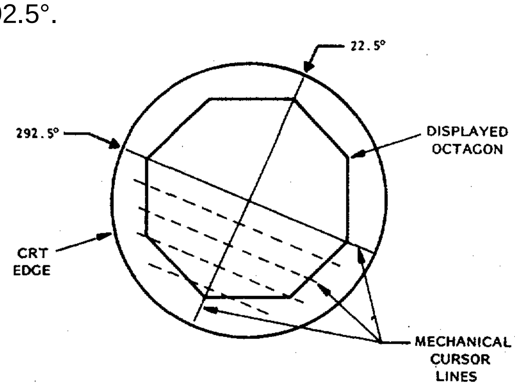
27. Observe that the octagonal sweep display has increased in size; verify that at least five range rings are visible.

28. Adjust CURSOR control to position CRT mechanical cursor line at exactly 22.5° on relative bearing scale.

WARNING

115 VAC IS PRESENT AT TERMINALS OF FL1 AND FL2 IN VICINITY OF CRT TUBE SOCKET. EXERCISE EXTREME CARE TO AVOID CONTACT.

29. Locate the CRT centering magnet adjustment tabs in the base of the yoke assembly. Carefully adjust the tabs to position the displayed octagon with respect to the mechanical cursor lines as shown below; insure that cursor lines intersect octagon internal angles at 22.5° and 292.5°.



30. Adjust CURSOR control to position CRT mechanical cursor line at exactly 0° on the relative bearing scale. Adjust BRILLIANCE control to define point of sweep origin at center of CRT.

31. Adjust A1R12 and A2R12 on Sweep Output assembly A3 to position the CRT sweep origin directly under the center of the mechanical cursor.

32. While setting OFFSET switch alternately on and off, verify sweep origin moves vertically on CRT display, remaining under the mechanical cursor line for both positions of the OFFSET switch.

NOTE:

When the requirement of step 32 is met, proceed to step 35. If that condition is not met, perform steps 33 and 34.

33. Loosen CRT yoke clamp and carefully rotate the yoke until sweep origin moves vertically between OFFSET switch settings. Tighten the yoke clamp, insuring that the yoke does not slip down.

34. Repeat steps 28 through 32 above until requirements of steps 29, 31 and 32 are met simultaneously.

35. Set OFFSET switch off. Set Indicator POWER switch to OFF.

36. Remove EBL PCB A9 and extender card. Insert A9 PCB (without extender) into A9 slot of card basket A2.

37. Remove Sweep Generator PCB A10 from card basket A2. Mount A10 PCB on extender card and insert extender card into A10 slot of card basket.

38. Set Indicator POWER switch to ON.

39. Adjust R54 on the A2A10 PCB clockwise until the sweep just covers the face of the CRT, i.e., just until the straight sides of the octagon are not visible.

40. Adjust R11 on the A2A10 PCB until the range rings are approximately centered on the vertical axis of the display.

41. Adjust R31 on the side of A2A10 PCB until the range rings are approximately centered on the horizontal axis of the display.

42. Loosen captive screws and raise Indicator bezel assembly until it locks in position.

43. Connect multimeter, set to 5 Vdc scale, between chassis (negative lead) and +E terminal of EBL potentiometer R14 (on under side of bezel).

44. Adjust R70 on EBL PCB A2A9 to obtain exactly +5.0 Vdc reading on multimeter.

45. Connect multimeter between chassis (positive lead) and -E terminal of R14; verify multimeter reads -5.0° ± 0.1 Vdc.

46. Set Indicator POWER switch to OFF.

47. Remove A2A10 PCB and extender card. Insert A10 PCB (without extender) into A10 slot of card basket A2.

48. Mount EBL PCB A9 on extender card; insert extender card into A9 slot of card basket A2.

49. Set Indicator POWER switch to ON.

50. With RANGE SELECT switch at 24 MILES, adjust VRM handwheel to obtain 46600 yards (23 miles) readout on VRM LED indicator at top of CRT. Adjust VRM intensity control until VRM range ring is visible.

51. Turn EBL front panel knob to position displayed EBL at 0° on relative bearing scale.

52. Adjust R1 on Position Transmission PCB A2A8 to superimpose the EBL VRM dot on the VRM range ring.

53. Turn EBL front panel knob to position displayed EBL at 180° on relative bearing scale.

54. Note error (if any) between EBL VRM dot and VRM range ring; adjust R23 on EBL PCB A2A9 to remove one-half the error.

55. Repeat steps 51 through 54 until no vertical error is detectable between EBL VRM dot and VRM range ring.

56. Turn EBL front panel knob to position displayed EBL at 090° on relative bearing scale.

57. Adjust R7 on A2A8 PCB to superimpose the EBL VRM dot on the VRM range ring.

58. Turn EBL front panel knob to position displayed EBL at 270° on the relative bearing scale.

59. Note error (if any) between EBL VRM dot and VRM range ring; adjust R39 on EBL PCB A2A9 to remove one-half the error.

60. Repeat steps 56 through 59 until no horizontal error is detectable between EBL VRM dot and VRM range ring.

61. Turn EBL front panel knob to slowly rotate displayed EBL through 360°; verify EBL VRM dot remains within ± 2 range cells of VRM range ring.

62. Adjust R30 on EBL PCB A2A9 to position sixth range ring 1/8 inch from edge of the cursor at 0° and 180°.

63. Adjust R34 on EBL PCB A2A9 to position sixth range ring 1/8 inch from edge of the cursor at 090° and 270°.

64. While alternately setting OFFSET switch on and off, adjust R43 on EBL PCB A2A9 to obtain the applicable downward vertical offset as follows:

a. 12 inch (IP-1282) Indicator: 3.0 inch offset.

b. 16 inch (IP-1283) Indicator: 4.0 inch offset.

65. Set RANGE SELECT switch to 48, then 64 MILE positions. Verify display is normal for both ranges.

NOTE:

If, on 48 and/or 64 mile ranges, portions of the sweep are blanked, adjust R54 on Sweep Generator PCB A2A10 slightly counterclockwise until normal display is observed, then select 24 mile range. Verify, on 24 mile range, that sweep covers entire CRT face with no flat (octagon) edges visible. If octagon edges are visible, repeat steps 39 through 65 above.

66. Set Indicator POWER switch to OFF. Remove A2A9 EBL PCB and extender card. Insert EBL PCB into A9 slot of card basket A2.

67. Lower and secure bezel assembly. Replace stabilizer bar and upper front access cover.

5.12.3.6 North Stabilization Circuits Alignment. The sweep circuits alignment given in paragraph 5.12.3.5 must be in effect prior to performance of this procedure.

1. At Indicator under test:

a. Remove upper front access cover and swing A9 assembly down into its service position.

b. Set POWER switch(es) as follows:

(1) If Indicator under test is a master Indicator, set its POWER switch to TX ON.

(2) If Indicator under test is a slave Indicator, set its POWER switch to ST BY and that of associated master Indicator to TX ON.

c. Set RANGE SELECT switch to 24 MILES.

d. Turn CONTRAST control fully counter-clockwise.

e. Set HDG SET/GYRO STAB/HD UP switch to GYRO STAB.

f. Adjust BRILLIANCE control counter-clockwise until range rings are barely visible.

g. Set all remaining controls for normal operation.

2. Verify ship's gyro compass system is operating.

3. Disconnect following leads at Indicator terminal boards:

a. TB3-5 (resolver S1)

b. TB3-7 (resolver C1)

4. Connect oscilloscope, set for dc voltage measurement, at 4/5A9A1J3-2.

5. Adjust R8 on A9A1 PCB for 0.0 Vdc on oscilloscope.

6. Connect oscilloscope set for dc. voltage measurement at 4/5A9A1J3-4.

7. Adjust R7 on A9A1 PCB for 0.0 Vdc on oscilloscope.

8. Reconnect leads disconnected in step 4.

9. Disconnect lead from terminal 8 (R1 signal) of Indicator terminal board TB3.

CAUTION

THE CRT DISPLAY SHOULD NOW SHOW A HORIZONTAL TRACE. TURN BRILLIANCE CONTROL COUNTERCLOCKWISE AS NECES-SARY TO PREVENT BURNING OF THE CRT FACE.

10. Carefully rotate the knob of A9B2 until the CRT trace is sweeping between 090° and 270°.

11. Reconnect the lead removed from TB3-8.

12. Adjust R14 on A9A1 PCB to position sixth range ring 1/8 inch from edge of the cursor display at 270°.

13. Disconnect lead at TB3-8 (see CAUTION above).

14. Carefully rotate the knob of 4/5A9B2 until the CRT trace is sweeping between 0° and 180°.

15. Reconnect the lead removed from TB3-8.

16. Adjust R13 on A9A1 PCB to position sixth range ring 1/8 inch from edge of the cursor display at 270°.

17. Adjust R15 on A9A1 PCB to position sixth range ring 1/8 inch from edge of the cursor display at 0°.

18. Carefully rotate the knob on 4/5A9B2 so that the sweep rotates slowly through 3600 , verify that the sixth range ring remains circular on the display.

19. If the range ring remains circular proceed with step 20. If the range ring is not circular repeat steps 9 through 18.

20. Set POWER switch to OFF. Tighten 4/5A9B1 securing screws. Swing A9 assembly up into its operate position and secure. Replace Indicator upper front access cover.

5.12.3.7 Video Circuits Alignment. - The following steps provide instructions for adjustment of the variable controls on the A2A1 Video Amplifier and A2A3 Data Storage PCBs.

1. At Indicator under test:
   a. Set POWER switch to OFF.
   b. Remove upper front access cover.
   c. Remove A2A3 Data Storage PCB and extender card from A2 card basket.
   d. Mount A3 PCB on extender card and insert into A3 slot of card basket.

2. Set POWER switch(es) as follows:
   a. If Indicator under test is a master Indicator, set its POWER switch to TX ON.
   b. If Indicator under test is a slave Indicator, set its POWER switch to ST BY and that of associated master Indicator to TX ON.

3. Install Integrated Circuit (IC) clip on U29 of A2A3 PCB.

4. Connect multimeter, set for 10 VDC measurement, between pin 2 of A2A3U29 (positive lead) and chassis.

5. Adjust R29 (LSB) on A2A3 PCB to obtain 1.0 VDC reading on multimeter.

6. Move multimeter positive lead to pin 11 of A2A3U29.

7. Adjust R30 (MSB) on A2A3 PCB to obtain 3.0 VDC reading on multimeter.

8. Set POWER switch to OFF at Indicator under test.

9. Remove extender card, disengage A3 PCB and remove IC clip; insert A3 PCB into its slot in card basket A2.

10. Remove A1 PCB from card basket and mount it on the extender card; insert extender card into Al slot of card basket.

11. At Indicator under test, set POWER switch per step 2 above.

12. At master Indicator, turn GAIN control fully counterclockwise. At Indicator under test, turn CONTRAST control fully clockwise.

13. Connect oscilloscope, set for ac input and 5 volts per division, to TP4 of A2A1 PCB at Indicator under test.

NOTE:

The video signals displayed in the following steps are negative-going pulses from a baseline of approximately +60 Vdc.

14. At master Indicator, adjust GAIN control clockwise just until negative-going LSB video signals are observed on oscilloscope.

15. At Indicator under test, adjust R8 on A2A1 PCB until LSB video signal amplitude is 25 volts (baseline to peak) on oscilloscope.

16. At Indicator under test, turn CONTRAST control counterclockwise until LSB video signal amplitude is 15 volts (baseline to peak) on oscilloscope.

17. At master Indicator, adjust GAIN control slowly clockwise just until two-level (LSB and MSB) video signals are displayed on the oscilloscope.

18. At Indicator under test, adjust R9 on A2A1 PCB until MSB video signal amplitude is 35 volts (baseline to peak) on oscilloscope.

19. At Indicator under test, observe LED indicator above TUNE control and adjust R66 on A2A1 PCB for desired indicator brightness.

20. At indicator under test observe heading line on CRT and adjust R20 on A2A1 PCB for desired heading line brightness.

21. At Indicator under test:
   a. Set POWER switch to OFF.
   b. Remove extender card from A2A1 card slot and disengage A2A1 PCB.
   c. Insert A2A1 PCB and extender card into their respective slots in A2 card basket.
   d. Replace upper access cover.

5.12.3.8 Reflection Plotter Alignment. - Perform the following steps to insure proper alignment of the reflection plotter. The Indicator at which the alignment is to be performed is referred to as the Indicator under test.

1. Set Indicator POWER switches as follows:
   a. If the Indicator under test is a master Indicator, set its POWER switch to TX ON.
   b. If the Indicator under test is a slave Indicator, set its POWER switch to ST BY and that of the associated master Indicator to TX ON.

2. Adjust controls of the Indicator under test for normal operation.

3. Locate the three alignment screws in the facial surface of the plotter assembly housing. Using a grease pencil, place a dot on the glass surface of the plotter adjacent to each alignment screw; the dots should be placed approximately one inch from the edge of the glass surface and on the radial lines between the center of the CRT and each alignment screw.

4. Adjust the PNL LIGHTS control for desired brightness of the dot reflections on the face of the CRT.

5. View one of the dot reflections from an oblique angle and adjust the adjacent alignment screw to cause the reflection to appear in the plane of the sweep trace on the face of CRT.

NOTE:

Clockwise adjustment will cause the reflection to appear below the trace; counterclockwise adjustment will cause it to appear to rise above the trace.

6. Repeat step 5 for each of the remaining alignment screws.

7. Place a grease pencil dot on the plotter surface at the center of the display. View the resulting reflection from several angles and verify that it lies in the plane of the sweep trace.

5.13 SWITCHING UNITS SA-2139 (V3, V4) AND SA-2156 (V2)

Switching Units SA-2139 and SA-2156 (Interswitches) are passive multi-position switching assemblies which provide system mode selection control. Radar Set AN/SPS-64(V)2 uses one Switching Unit SA-2156. Radar Sets AN/SPS-64(V)3 and (V) 4 each use two Switching Units SA-2139. Switching Units SA-2156 and SA-2139, although electrically quite different, are physically similar; the locations of major components and assemblies within the units are shown on Figure 5-10. Schematic diagrams, parts list tables and assembly drawings for both Switching Units are contained in Section 6.5 of Chapter 6. Access to the components within either Switching Unit is obtained by removing the four screws on the front of the unit and removing the outer shell

5.13.1 Troubleshooting Procedure (V2, V3, V4)

Troubleshooting of the SA-2139 or SA-2156 Switching Units should be addressed using the following general technique:

1. Determine the faulty function by troubleshooting the equipments which interface with the Switching Unit(s) .

2. Using the interconnection diagram applicable to the system configuration (Figures 6.1-1 through 6.1-4), determine which switch assembly (S1A, S1B or SC). and which wafer(s) within the Switching Unit(s) control the faulty function; identify the input and output terminals of the wafer (s) for the function.

3. Verify that the signal or control level is correct at the input terminal (s). If incorrect, determine the source equipment using the interconnection diagrams and refer to the troubleshooting chart for that equipment.

4. Refer to the schematic diagram for SA-2139 or SA-2156 in Section 6.5 of Chapter 6 and perform continuity measurements at the switch wafer (s) which control the function to isolate the fault.

5.13.2 Removal/Replacement Procedures (V2, V3, V4)

In the event a damaged wafer or wafer terminal is found to be the cause of the malfunction, a spare wafer may be substituted in lieu of replacing the switch assembly. To substitute a spare wafer for a damaged one, proceed as follows:

1. At the switch assembly (S1A, S1B or S1C) containing the damaged wafer, select the spare wafer which is physically nearest to the damaged one. Spare wafers for the SA-2139 and SA-2156 Switching Units are:

a. SA-2139: S1A Wafers 26 and 27
S1B Wafers 29 and 30
S1C Wafers 1 through 10

b. SA-2156: S1A Wafers 29 and 30
S1B Wafers 15, 16, 29 and 30
S1C Wafers 7, 8 and 9

2. Inspect the damaged wafer for presence of metal straps which jumper adjacent terminals on the wafer; note the terminals jumpered. Move the straps to the selected spare wafer and install so as to jumper the same terminals.

3. Inspect the damaged wafer for presence of metal straps which jumper terminals of the damaged wafer to the same terminals of adjacent wafers; note the terminals and wafers jumpered. Connect jumper wires (in lieu of the metal straps) from the terminals of the adjacent wafers to the same terminals of the selected spare wafer.

4. Inspect the damaged wafer for presence of jumper wires between terminals; note the terminals jumpered. Move the jumper wires (one at a time) to the selected spare wafer and connect between the noted terminals.

5. Inspect the damaged wafer for presence of jumper wires to terminals of adjacent wafers; note the wafers and terminals jumpered. Install new jumper wires between the noted terminals of the adjacent wafers and the selected spare wafer. Discard the original jumper wires.

6. Inspect the damaged wafer for presence of wires to component board A1; note the wafer terminals and component board connection points. Connect new wires between the component board connection points and the noted terminals on the selected spare wafer. Discard the original wires.

7. Inspect the damaged wafer for presence of connections from external cables. Disconnect the external cables wires from the damaged wafer terminals (one at a time) and reconnect at the same terminals on the selected spare wafer.

NOTE:

All wire connections and all straps (except those to adjacent wafers) should now have been removed from the damaged wafer. Change the schematic to correspond to the new change.

5.14 INTERFACE UNIT J-3463 (V2)

Paragraphs 5.14.1 through 5.14.3 and their related subparagraphs provide corrective maintenance information for the Interface Unit J-3463 (Antenna Junction Box). The information includes troubleshooting instructions (5.14.1), removal and replacement procedures (5.14.2) and alignment procedures (5.14.3). The locations of assemblies and major components within Interface Unit J-3463 are shown in Figure 5-11. Schematic diagrams, parts list tables and assembly drawings applicable to the Interface Unit are contained in Section 6.6 of Chapter 6.

Access to the assemblies and components within the Interface Unit J-3463 is provided by loosening the captive screws on the front cover and removing the cover.

5.14.1 Troubleshooting Procedure (V2)

Fault isolation within the Interface Unit J-3463 is facilitated by use of Troubleshooting Chart, Figure 5-12. Troubleshooting information for Wave Guide Switch SA-2140 is included in Figure 5-12. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

5.14.2 Removal/Replacement Procedures

5.14.2.1 Power Supply PS1. -

1. Remove unit cover by loosening the 6 captive screws.

2. Disconnect the wires from PS1, noting hook-up locations.

3. Remove the seven screws attaching the power supply to the cabinet and lift the power supply out of the cabinet.

4. Reinstall using the reverse of above.

5.14.2.2 Relays K1, K2 and K3.

1. Remove unit cover by loosening the 6, captive screws.

2. Push the spring retainer to the side and remove the relay from the socket.

3. Reinstall in reverse of above.

5.14.2.3 Diode CR1.

1. Remove unit cover by loosening the 6 captive screws.

2. Remove the screws attaching the chassis/TB board assembly to the case and lift the assembly up.

3. Diode CR1 is located on the under side of the chassis/TB assembly and attached to the terminals of the relay socket of K3. Note polarity upon removal.

4. Reinstall in the reverse of above.

5.14.2.4 Lamps. -

1. Remove unit cover by loosening the 6 captive screws as removal of DS1 lamp necessitates the removal of the control cover for access to the soldered lamp.

2. Lamps DS2 and DS3 are accessible by unscrewing the lamp domes on the outer case control area.

3. Reinstall using the reverse of above.

5.14.3 Power Supply Adjustment (V2)

NOTE:

Current Limit control R2 is factory set and should not be adjusted in the field.

1. Set POWER switch to OFF.

2. Remove front access cover.

3. Connect multimeter, set to 50 Vdc scale, between TB5-2 (positive lead) and TB5-4.

4. Set POWER switch to ON.

5. Adjust R13 on power supply assembly PS1 to obtain +28.0 ± 0.5 Vdc reading on multimeter.

6. Set POWER switch to OFF. Disconnect multimeter leads and replace front access cover.

SYMBOL	LEGEND
A	Switch Section, S1B
B	Switch Section, S1C
C	Switch Section, S1A
D	Resistor Panel Assembly, A1
E	Terminal Strip, TB3
F	Terminal Strip, TB2
G	Terminal Strip, TB1

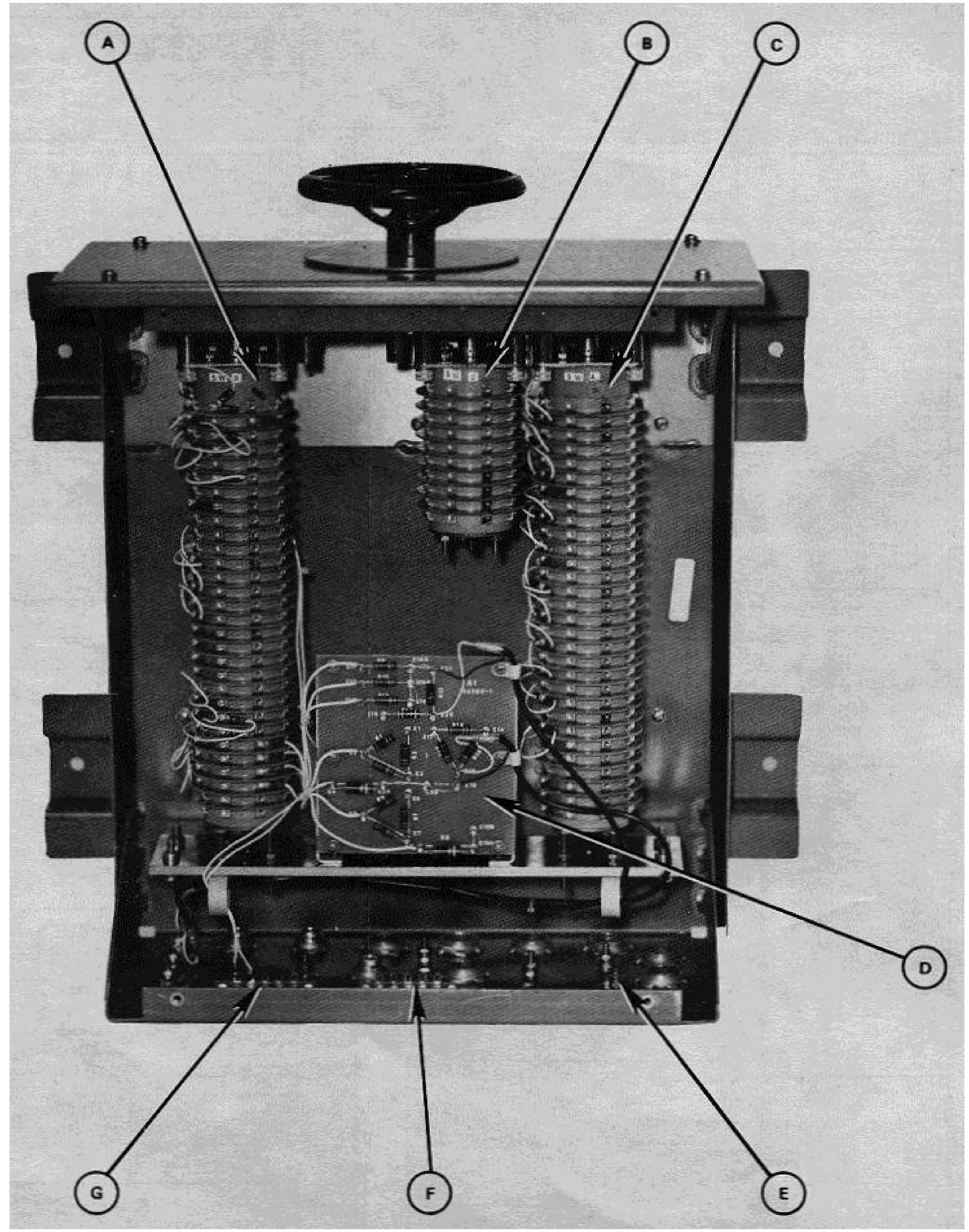


Figure 5-10 Switching Units SA-2139 (V3, V4) and SA-2156 (V2) Parts Location

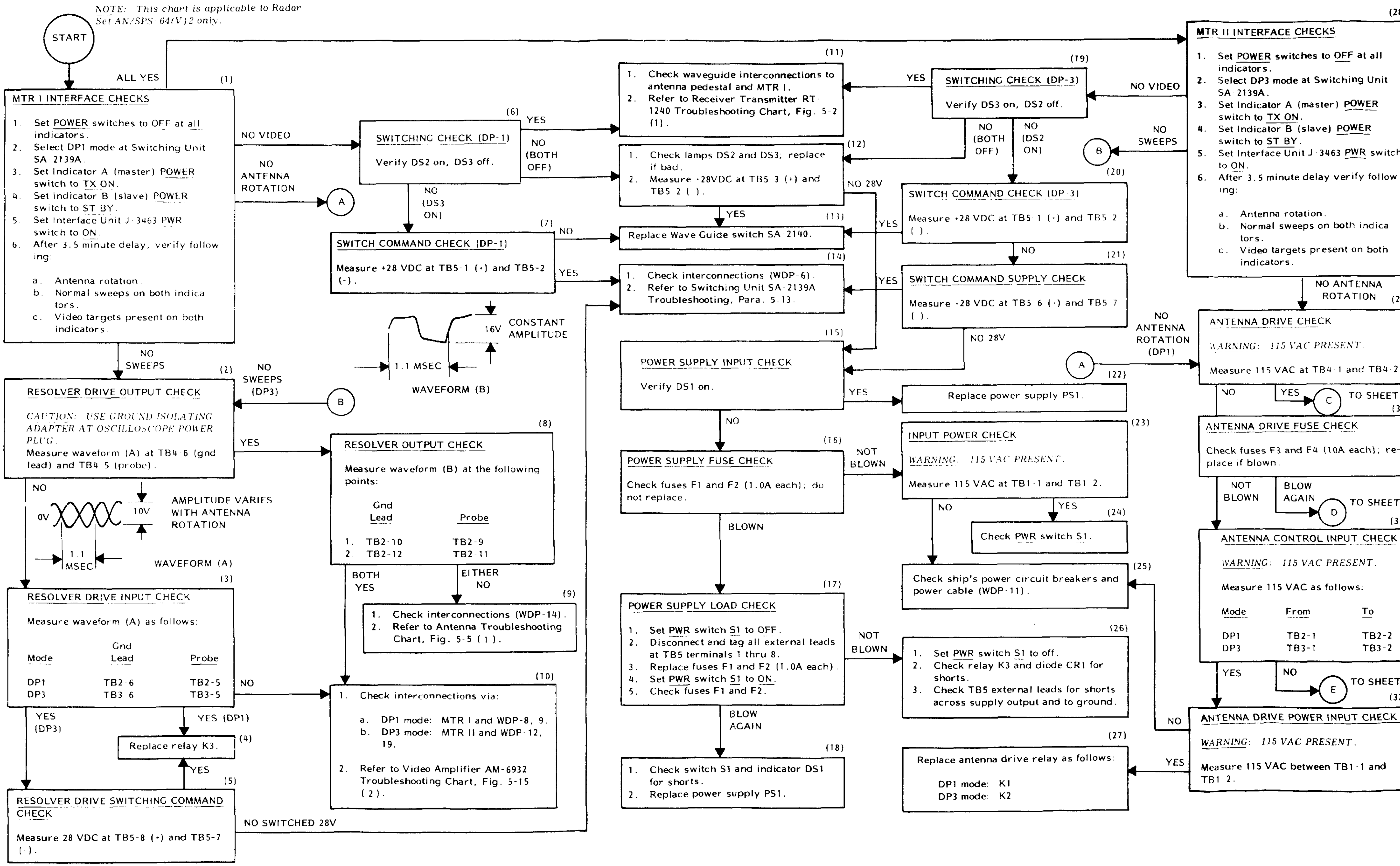


Figure 5-12 Interface Unit J-3463 and Wave Guide Switch SA-2140 Troubleshooting Chart (V2) (Sheet 1 of 2)

SYMBOL	LEGEND
A	Terminal Board, TB4
B	Terminal Board, TB3
C	Terminal Board, TB2
D	Power Supply, PS1
E	Relay, K3
F	Fuses, F1 through F4
G	PWR Switch, S1
H	Switch Position Indicators, D52 and D53
J	Relay, K1
K	Relay, K2
L	Terminal Board, TB1
M	Terminal Board, TB5
N	D52

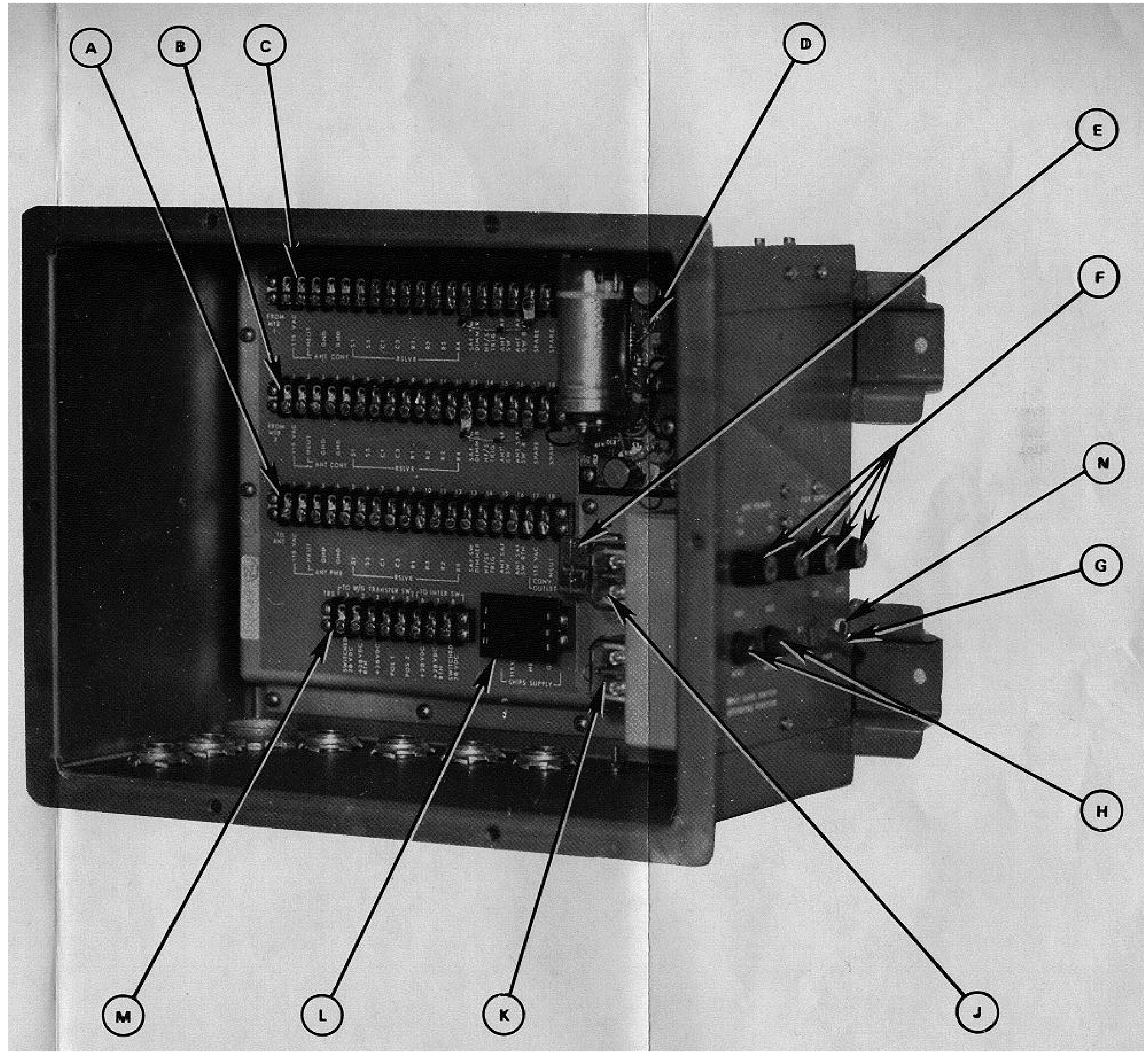


Figure 5-11 Interface Unit J-3463 Parts Location (V2)

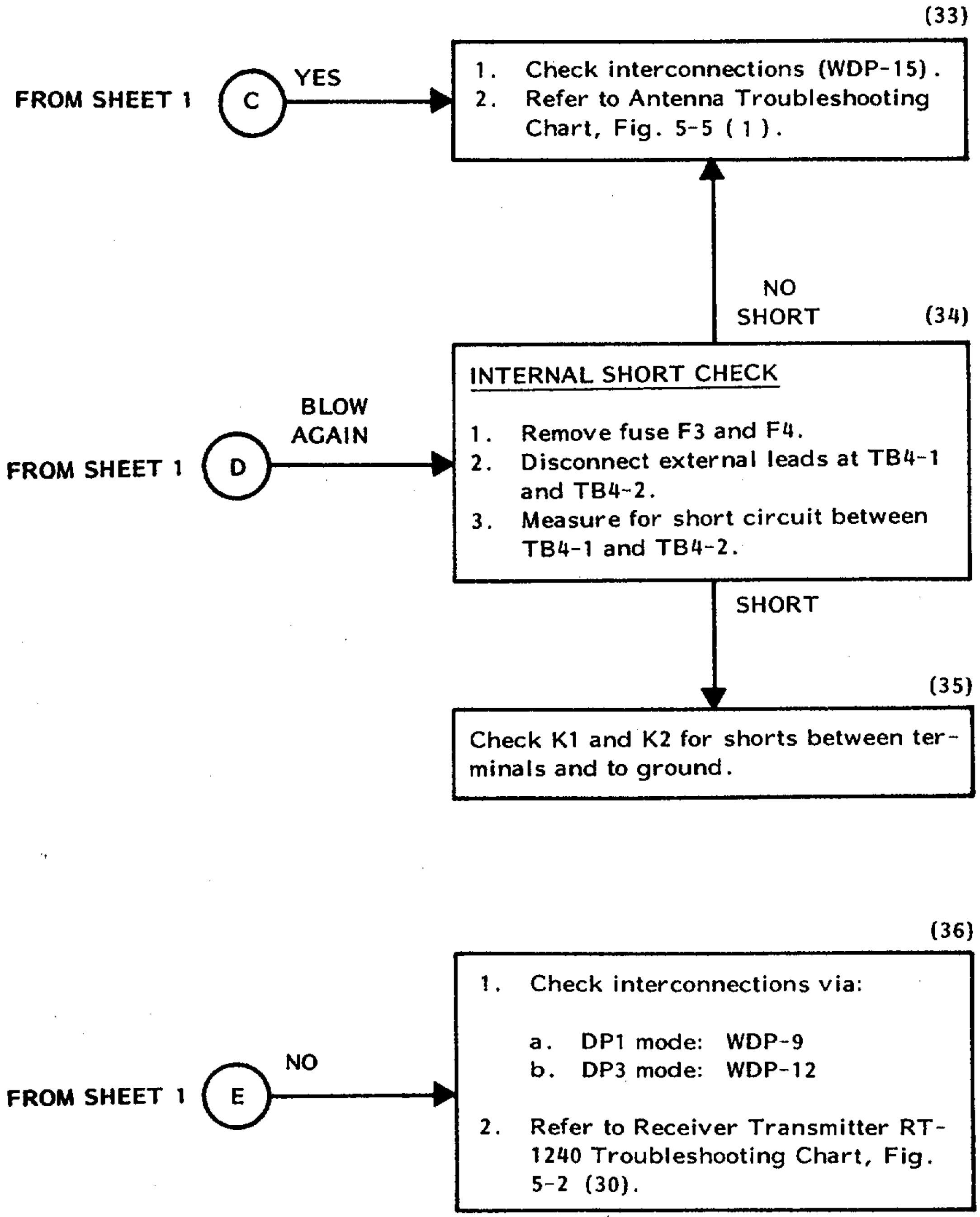


Figure 5-12 Interface Unit J-3463 and Wave Guide Switch SA-2140 Troubleshooting Chart (V2) (Sheet 2 of 2)

5.15 WAVE GUIDE SWITCH SA-2140 (V2)

Paragraphs 5.15.1 and 5.15.2 and their related subparagraphs provide corrective maintenance information for the Wave Guide Switch SA-2140. The information includes troubleshooting instructions (5.15.1) and removal and replacement procedures (5.15.2). No alignment procedures are required. The locations of major components comprising the Wave Guide Switch are shown in Figure 5-13. The schematic diagram, parts list table and assembly drawings applicable to Wave Guide Switch SA-2140 are contained in Section 6.7 of Chapter 6.

5.15.1 Troubleshooting Procedure (V2)

Fault isolation for the Wave Guide Switch SA-2140 is facilitated by use of Troubleshooting Chart, Figure 5-12, which also contains troubleshooting information for Interface Unit J-3463. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

5.15.2 Removal/Replacement Procedures (V2)

Before initiating any removal or replacement activity at Wave Guide Switch SA-2140, insure that all power is removed from the equipment by performing the following steps:

1. Set ON/OFF Safety switch at front of pedestal to OFF.
2. Set POWER switch to OFF at (master) Indicator.
3. Turn off and tag ship's circuit breakers which supply power to the equipment.

5.15.2.1 Wave Guide Switch Assembly. -

1. Remove power per paragraph 5.15.2.
2. Remove power plug from wave guide switch.
3. Remove the attaching hardware which secures the waveguide switch assembly to the waveguide mounting.
4. Reinstall using the reverse of above.

5.15.2.2 Dummy Load. -

1. Remove power per paragraph 5.15.2.
2. Perform paragraph 5.15.2.1.
3. Remove the 4 cap screws which secure the dummy load to the switch assembly. Retain the O-ring for reassembly.
4. Reinstall the dummy load using the reverse of the above, using caution to install the O-ring between the dummy load and the switch assembly.

5.16 VIDEO AMPLIFIER AM-6932 (V2, V3, V4)

Paragraphs 5.16.1 through 5.16.3 and their related subparagraphs provide corrective maintenance information for the Video Amplifier AM-6932. The information includes troubleshooting instructions (5.16.1), removal and replacement procedures (5.16.2) and alignment procedures (5.16.3). The locations of assemblies and major components within Video Amplifier AM-6932 are shown in Figure 5-14. Schematic diagrams, parts list tables and assembly drawings applicable to Video Amplifier AM-6932 are contained in Section 6.8 of Chapter 6. Access to the assemblies and components within the Video Amplifier AM-6932 is provided by loosening the six captive screws in the front cover and removing the cover.

5.16.1 Troubleshooting Procedure (V2, V3, V4)

Fault isolation within the Video Amplifier AM-6932 is facilitated by use of Troubleshooting Chart, Figure 5-15. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

5.16.2 Removal/Replacement Procedures (V2, V3, V4)

Before initiating any removal or replacement activity at Video Amplifier AM-6932, insure that all power is removed from the equipment by performing the following steps:

1. Set ON/OFF Safety switch at front of pedestal to OFF.
2. Set POWER switch to OFF at (master) Indicator.
3. Turn off and tag ship's circuit breakers which supply power to the equipment.

5.16.2.1 Resolver Drive PCB Assembly A1. -

1. Remove power per paragraph 5.16.2.
2. Remove cover by loosening 6 captive screws.
3. Disconnect harness at connectors.
4. Remove 4 screws, washers and lockwashers to release the PCB assembly.
5. Reinstall using the reverse of above.

5.16.2.2 Video Amplifier PCB Assemblies A2A1, A2A2 and A2A3. -

1. Remove power per paragraph 5.16.2.

SYMBOL	LEGEND
A	Dummy Load
B	Electrical Connector
C	Waveguide Ports (3)
D	Waveguide Switch Assembly

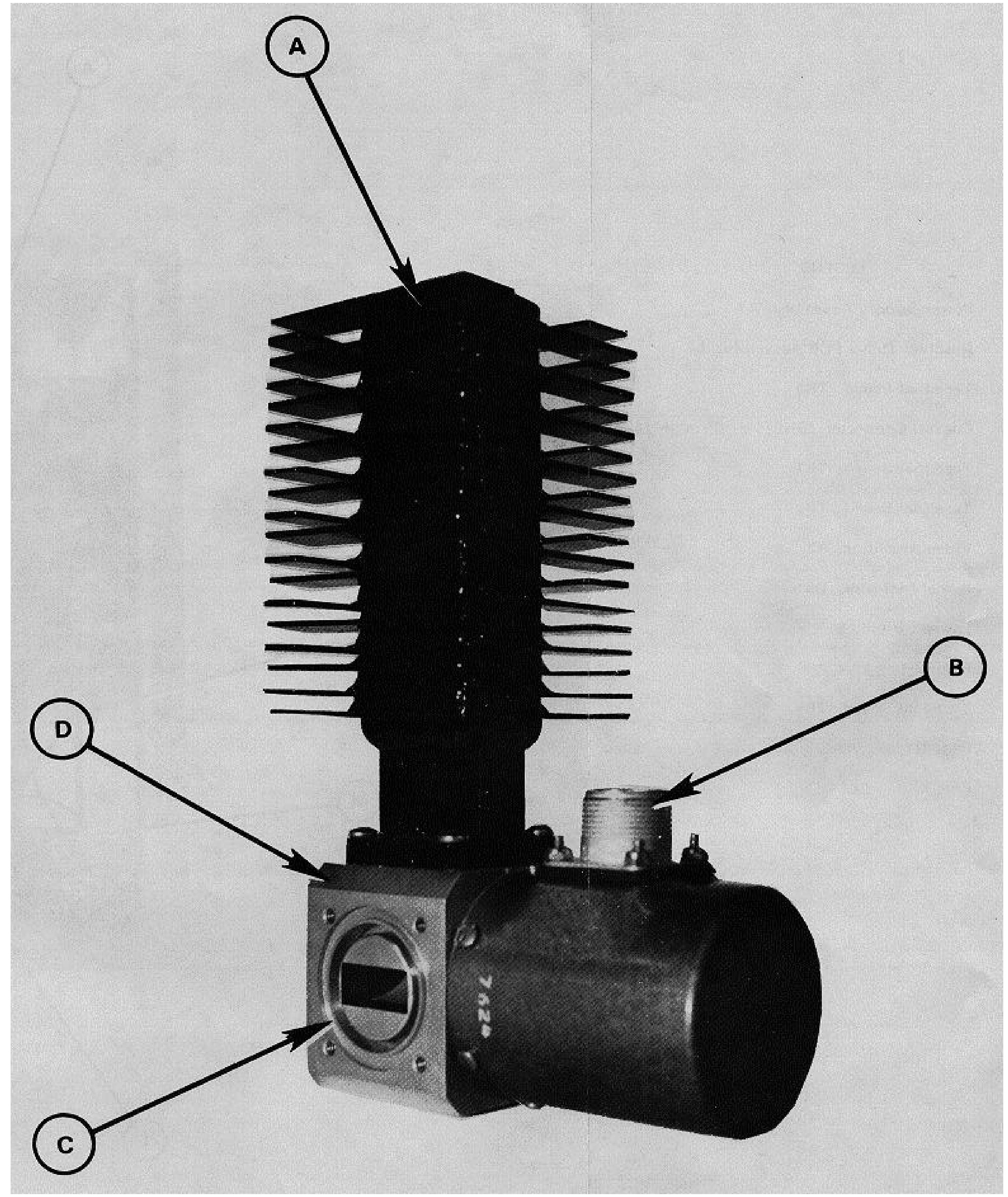


Figure 5-13 Wave Guide Switch SA-2140 Parts Location (V2)

SYMBOL	LEGEND
A	Power Supply Assembly, A3
B	Resolver Drive PCB Assembly, A1
C	Terminal Board, TB3
D	Coaxial Connector (BNC), J1 through J6
E	Terminal Board, TB1
F	Terminal Board, TB2
G	Video Amplifier, A2
H	Power Indicator, DS1
J	Power Switch, S1
K	Fuse, F1
L	Terminal Board, TB4
M	Fan, B1
N	Line Filter, FL1

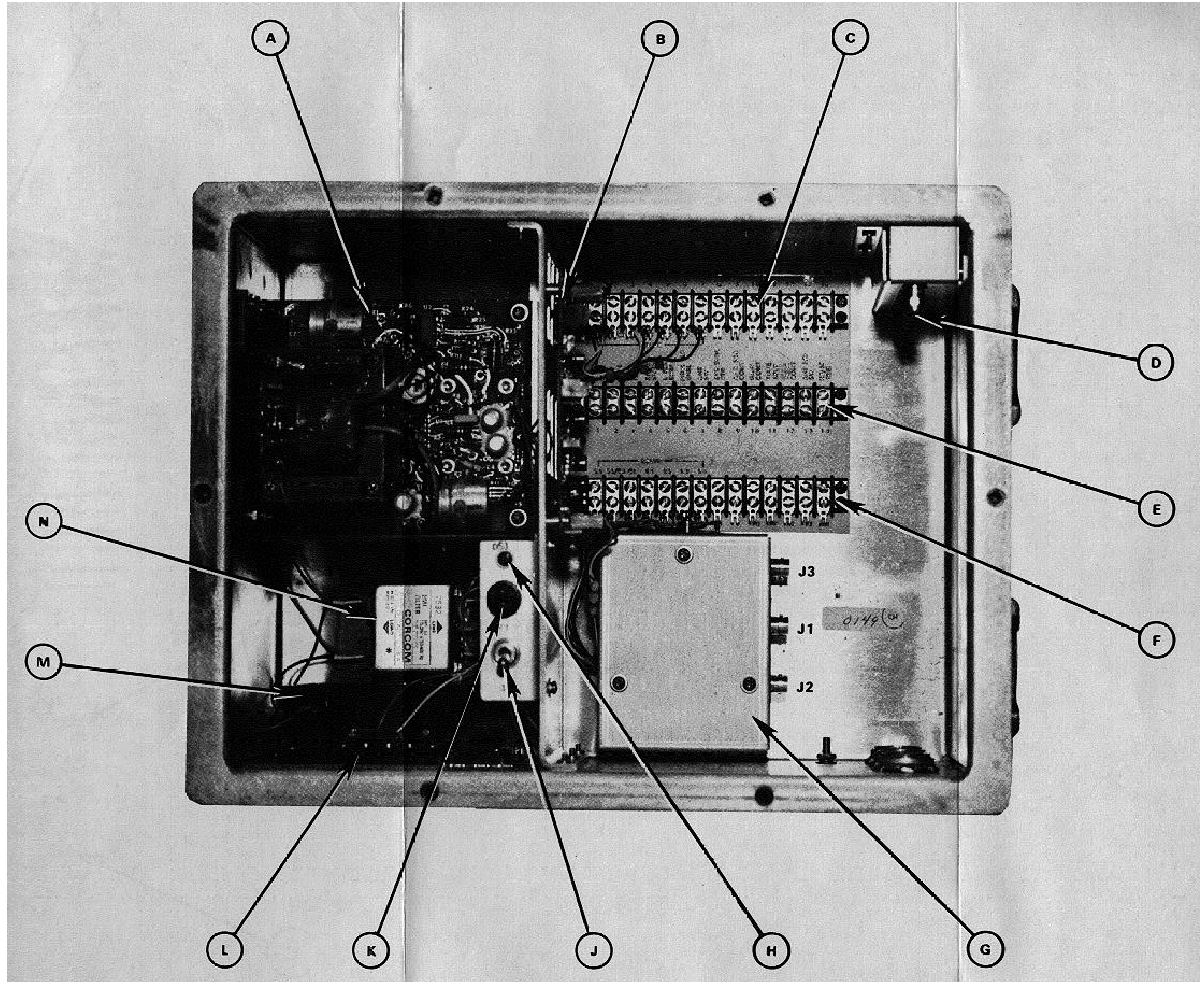


Figure 5-14 Video Amplifier AM-6932 Parts Location (V2, V3, V4)

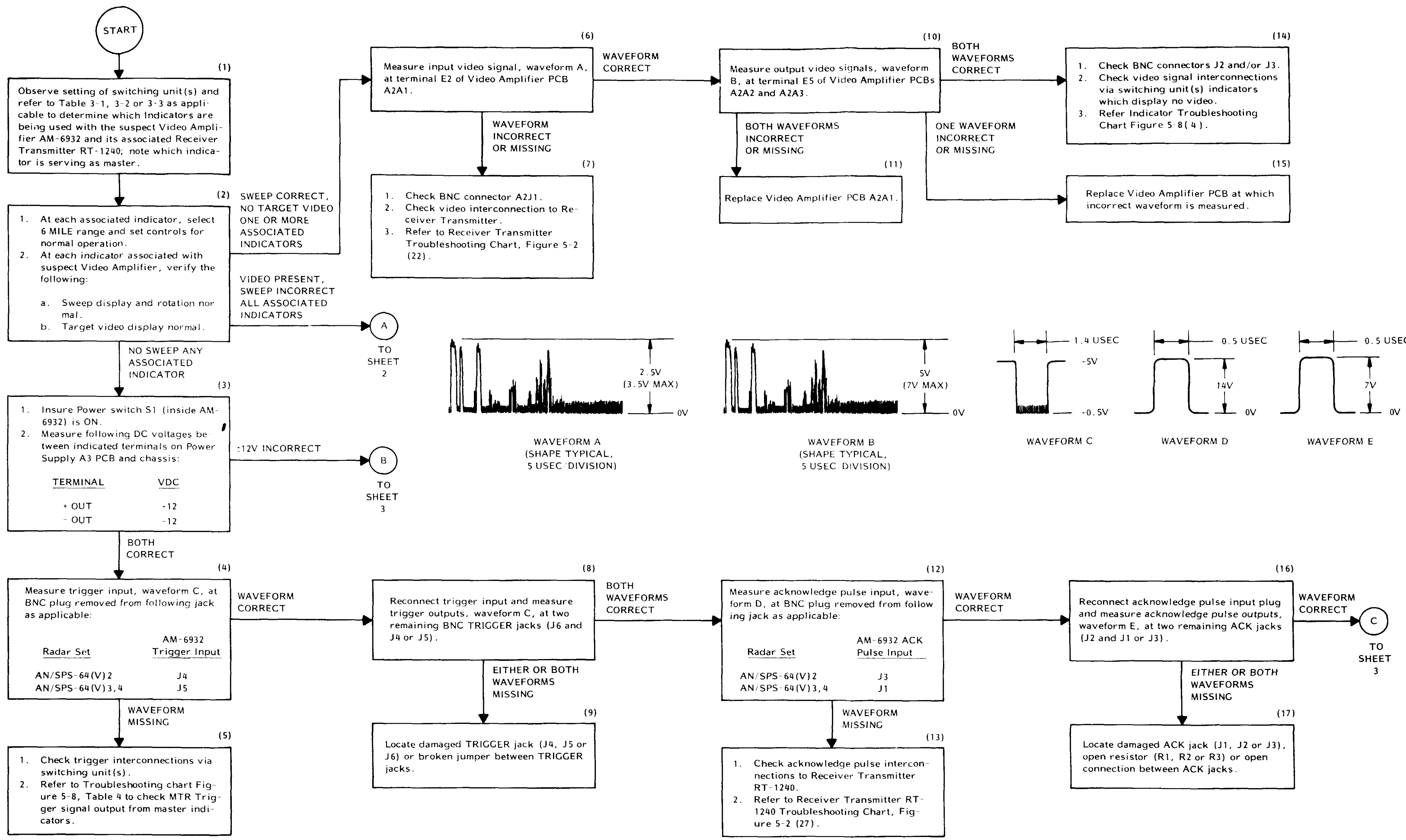


Figure 5-15 Video Amplifier AM-6932 Troubleshooting chart (V2, V3, V4) (Sheet 1 0f 3)

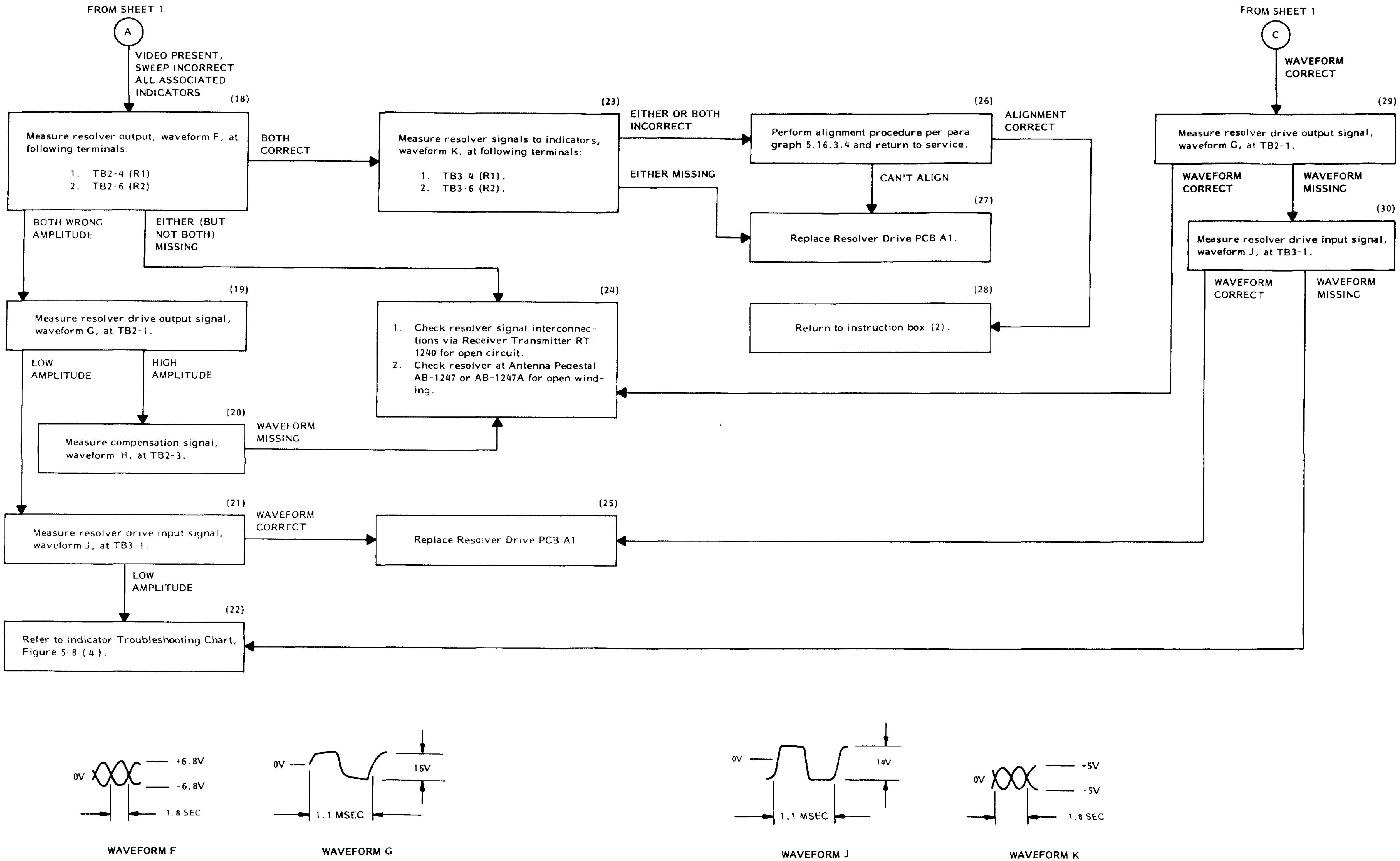


Figure 5-15 Video Amplifier AM-6932 Troubleshooting chart (V2, V3, V4) (Sheet 2 0f 3)

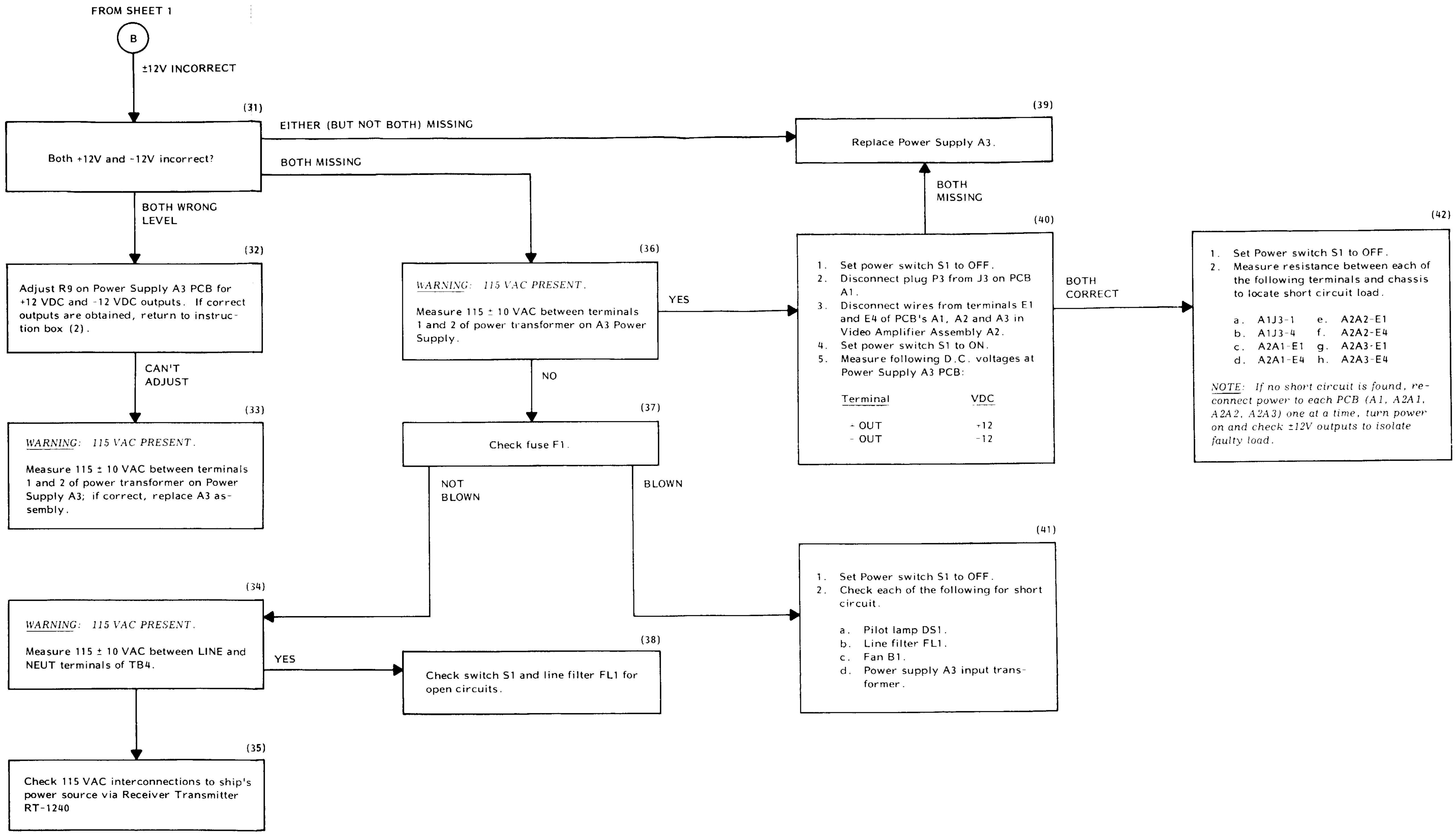


Figure 5-15 Video Amplifier AM-6932 Troubleshooting chart (V2, V3, V4) (Sheet 3 0f 3)

2. Remove cover by loosening the 6 captive scr 2ws.

3. Remove the three screws, washers and lockwashers located on the top of the amplifier cover and remove the cover.

4. Slide the PCB assembly from the card guide and disconnect the wires as necessary, noting the hook-up locations.

NOTE:

The three PCB assemblies are identical.

5. Reinstall using the reverse of above.

5. 16.2.3 Power Supply A3.

1. Remove power per paragraph 5. 16.2.

2. Remove unit cover by loosening the 6 captive screws.

3. Disconnect wires noting hook-up locations.

4. Remove mounting nuts, screws, washers and lockwashers to release the power supply as-sembly and lift out of the cabinet.

5. Reinstall using the reverse of above.

5.16.2.4 Fan B1.

1. Remove power per paragraph 5.16.2.

2. Remove unit cover by loosening the 6 captive screws.

3. Disconnect wires noting hook-up locations.

4. Remove the 4 screws, nuts, washers and lockwashers to release the fan assembly.

5. Reinstall using the reverse of above.

5.16.3 <u>Alignment Procedures (V2, V3, V4</u>)
Adjustment procedures for Resolver Drive PCB and Power Supply assemblies of Video Amplifier AM-6932 are covered in the following paragraphs. Refer to Figure 5-14 for location of assemblies and major components.

5.16.3.1 Resolver Drive PCB Adjustment (V2, V3, V4). - The following procedure is applicable to the Resolver Drive PCBs used in both the Video Amplifier AM-6932 (Al) and Receiver Transmitter RT-1241 (A10) . Power for the Resolver Drive PCBs is con-trolled as follows:

a. AM-6932 A1 PCB: AM-6932 POWER switch and associated master Indicator POWER switch.

b. RT-1241 AI0 PCB: Associated master Indicator POWER switch.

1. Set appropriate POWER switch to OFF.

2. Disconnect plug connected at jack J 1 of Resolver Drive PCB.

3. Install integrated circuit (IC) clip at U2 of Resolver Drive PCB.

4. Connect oscilloscope, set for dc input coupling and minimum volts/division, at U2 pin 12 on Resolver Drive PCB. Set oscilloscope input switch to ground and adjust for zero - Vdc reference on display, then return input switch to dc.

5. Set appropriate POWER switch to ON.

6. Adjust R37 on Resolver Drive PCB to obtain 0.0 Vdc on oscilloscope.

7. Connect oscilloscope at U2 pin 10 on Resolver Drive PCB.

8. Adjust R36 on Resolver Drive PCB to obtain 0.0 Vdc on oscilloscope.

9. Connect plug removed from J1 of Resolver Drive PCB.

10. Set radar controls for normal operation and verify antenna rotation.

11. With oscilloscope connected at U2 pin 10, set time base controls for 500 used/division and adjust for display of the 900 Hz signal component.

NOTE:

The amplitude of the 900 Hz signal varies with antenna rotation (approximately 2 Hz rate) . In the following steps adjust for the maximum amplitude condition.

12. Adjust R32 on the Resolver Drive PCB to obtain a 10-volt peak-to-peak signal on the oscilloscope; verify signal is symmetrical about zero volt (swings from +5V to -5V).

13. Connect oscilloscope at U2 pin 12 on Re-solver Drive PCB.

14. Adjust R33 on the Resolver Drive PCB to obtain a 10-volt peak-to-peak signal on the oscilloscope; verify symmetry.

15. Disconnect oscilloscope and remove.- IC clip.

5.16.3.2 Power Supply Adjustment (V2, V3, V4). The ±12V power supply contained in Video Amplifier AM-6932 is identical to that used in Signal Data Converter CV-3442. Refer to paragraph 5.19.3.1 for adjustment instructions.

5.17 <u>RECEIVER TRANSMITTER RT--1241 (V4)</u>

Paragraphs 5. 17.1 through 5.17.3 and their related subparagraphs provide corrective maintenance information for the Receiver Transmitter RT 1241 (50 KW S-band MTR) The information includes troubleshooting instructions (5. 17.1), removal and replacement procedures (5.17.2) and alignment procedures (5.17.3). The locations of assemblies and major components within Receiver Transmitter RT-1241 are shown in Figure 5-16.
Schematic diagrams, parts list tables and assembly drawings applicable to the Receiver Transmitter RT-1241 are contained in Section 6.9 of Chapter 6.

SYMBOL	LEGEND
A	Magnetron Oscillator V2
B	Filament transformer T2
C	Microwave assembly A8
D	If Amplifier and Mixer assembly A9
E	Magnetron Heater Scheduling PCB Assembly A5
F	Resolve Drive PCB Assembly A10
G	Antenna Power Contactor K1 (behind panel)
H	Output connectors (BNC)
I	Terminal Board TB4
J	Terminal board TB3
K	Terminal board TB2
L	Line Filter FL1, FL2 (behind panel)
M	Terminal board TB1
N	Power control Assembly A1
P	Fuses F3, F4
Q	Video Amplifier Assembly
R	Low voltage Power supply Assembly A3
S	High Voltage Power supply Assembly A2
T	Fuses F1, F2
U	Video amplifier Assembly A11
V	Pulse Logic PCB Assembly
W	Relays K2, K3
X	High Voltage Transformer T1
Y	Blower B1
Z	Spark Gap E1
AA	Pulse Driver PCB Assembly A7
AB	Modulator V1
AC	High Voltage Assembly A4

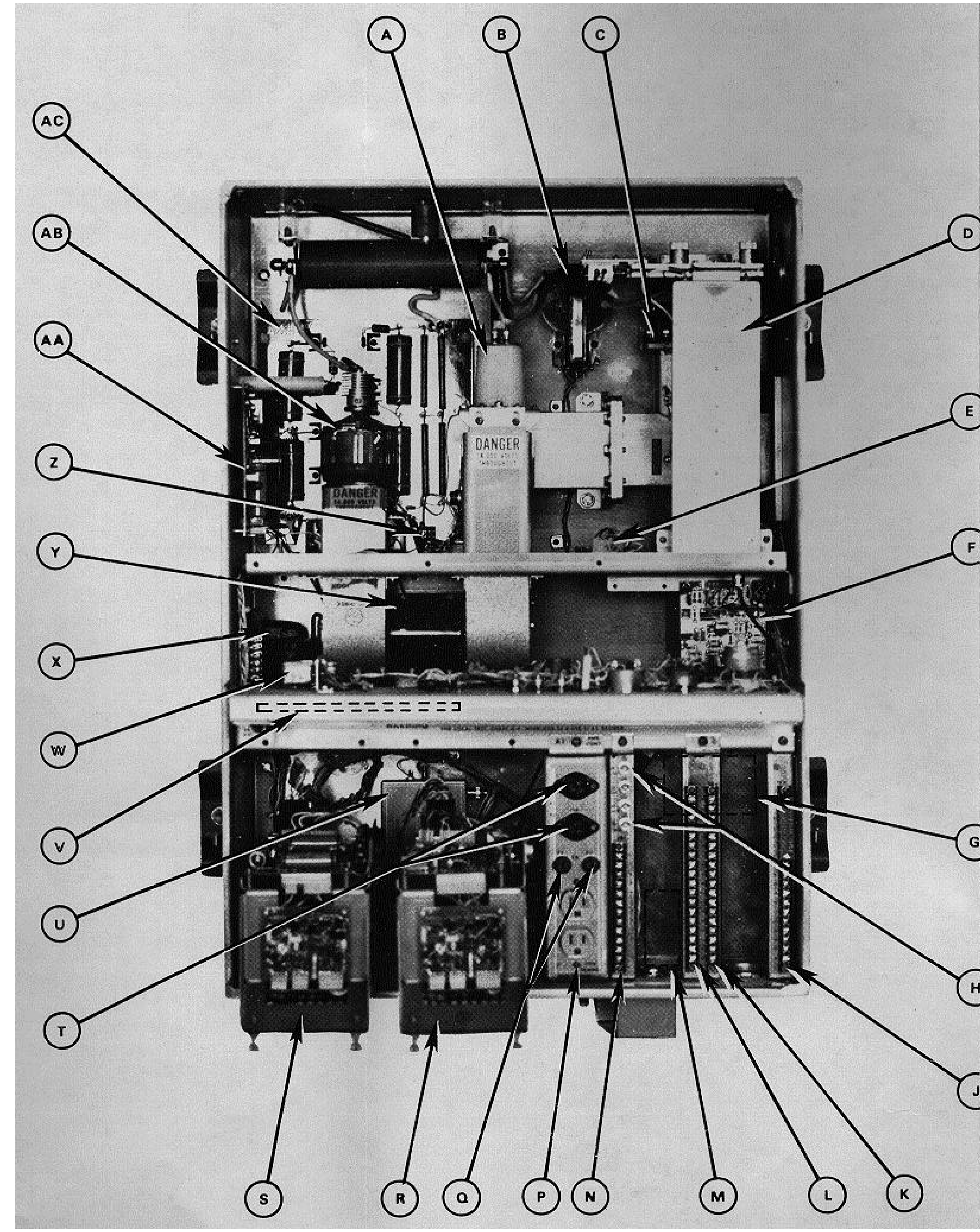


Figure 5-16 Receiver transmitter RT-1241 Parts Location (V4)

Access to the assemblies and components within Receiver Transmitter RT-1241 is provided by releasing the four clamping catches on the front cover and removing the cover. When the cover is removed, a safety interlock switch is activated which disables the high voltage power supply; the interlock switch may be pulled outward to permit high voltage operation if required for troubleshooting or alignment. Access to the low and high voltage power supply components is obtained by loosening the captive screws at the top of their respective assemblies and lowering the assemblies into their service positions.

WARNING

APPROXIMATELY +12KV DC (REGULATED) IS PRESENT IN THE VICINITY OF THE MODULATOR, HIGH VOLTAGE MULTIPLIER COMPONENT BOARD AND MAGNETRON WHEN THE HIGH VOLTAGE POWER SUPPLY IS OPERATING.

5.17.1 Troubleshooting Procedure (V4)

Fault isolation within the Receiver Transmitter RT-1241 is facilitated by use of Troubleshooting Charts. Figure 5-17 provides information for overall troubleshooting; Figure 5-18 provides information for troubleshooting the high and low voltage power supplies. Instructions for use of the troubleshooting charts are given in paragraphs 5.9. 1.

WARNING

THE HIGH AND LOW VOLTAGE POWER SUPPLIES CONTAINED IN RECEIVER TRANSMITTER RT-1241 UTILIZE FLOATING COMMON BUSSES WHICH OPERATE AT APPROXIMATELY - 150 TO -175 VDC WITH RESPECT TO CHASSIS. EXERCISE EXTREME CARE TO AVOID CONTACT. DO NOT GROUND THE FLOATING COMMON BUSSES EXCEPT WHEN, AFTER ALL POWER HAS BEEN REMOVED FORM THE EQUIPMENT, RESIDUAL DC VOLTAGE MUST BE DISCHARGED FOR TEST EQUIPMENT CONNECTION OR COMPONENT REMOVAL.

CAUTION

WHEN IT IS NECESSARY TO CONNECT TEST EQUIPMENT 'WHICH OPERATES FROM SHIPS POWER AT RECEIVER TRANSMITTER RT 1241, ALWAYS USE A GROUND ISOLATING ADAPTER ON THE TEST EQUIPMENT POWER CORD. EXERCISE CARE TO AVOID GROUNDING THE FLOATING COMMON VIA THE TEST EQUIPMENT CONNECTIONS.

5.17.2 Removal/Replacement Procedures (V4)

WARNING

INSURE ALL POWER IS REMOVED FROM THE RECEIVER TRANSMITTER BEFORE REMOVING COMPONENTS OR ASSEMBLIES.

The following steps outline the procedure for unit access and removal of power.

1. Remove the receiver transmitter front cover; the high voltage interlock switch (S6) will automatically spring into a power disable position.

   Power may be restored to the unit with the cover removed by pulling the interlock switch out.

2. Turn the REMOTE ENABLE/OFF/STD BY/ ON switch to the OFF position. The switch is located on the internal control panel.

3. Remove the fuses located on the control panel.

4. Remove the four screws and remove the safety barrier.

CAUTION

NON-FERROUS TOOLS SHOULD BE USED WHEN WORK IS BEING PERFORMED INSIDE THE RECEIVER TRANSMITTER. EXAMPLES OF NON-FERROUS MATERIALS ARE STAINLESS STEEL, ALUMINUM OR BERYLLIUM COPPER.

5.17.2.1 Modulator Tube V1.

WARNING

BEFORE TOUCHING ANY PARTS, DISCHARGE ANY STORED HIGH VOLTAGE USING A WELL-INSULATED GROUNDING LEAD.

1. Remove power per paragraph 5.17.2.
2. Remove the screw and washer located on the left-hand exterior of the cabinet support spring.
3. Loosen the tube cap set screw and remove the tube cap from the tube.
4. Twist the support clamp at the base of the tube.
5. Pull the tube from the tube assembly.
6. Reinstall using the reverse of the above.

5.17.2.2 Magnetron Tube V2.

WARNING

BEFORE TOUCHING ANY PARTS, DIS CHARGE ANY STORED HIGH VOLTAGE USING A WELL-INSULATED GROUNDING LEAD.

1. Remove power per paragraph 5.17.2.
2. Remove the two pins attached to the top of the tube.

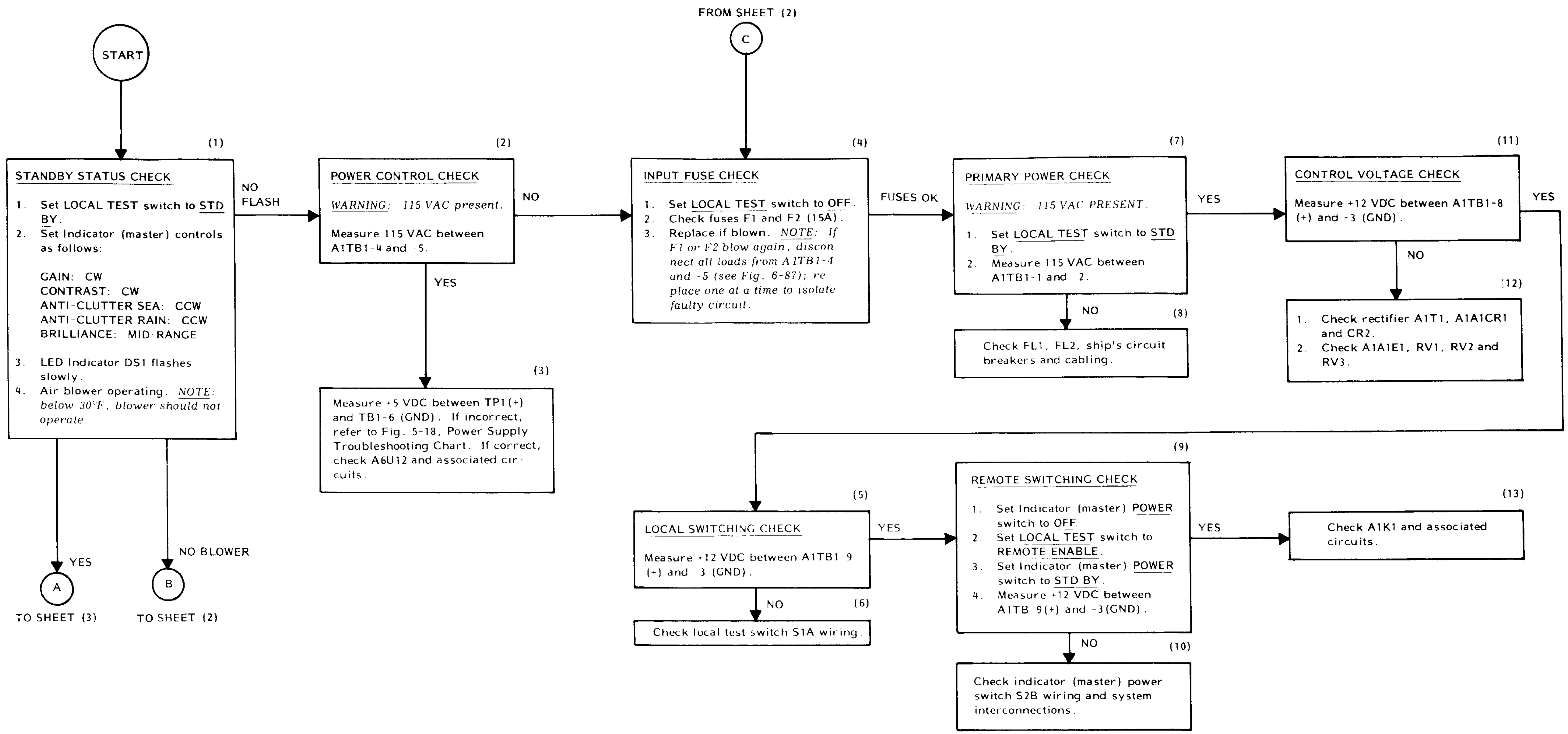


Figure 5-17 Receiver transmitter RT-1241 Troubleshooting chart (V4) (Sheet 1 of 6)

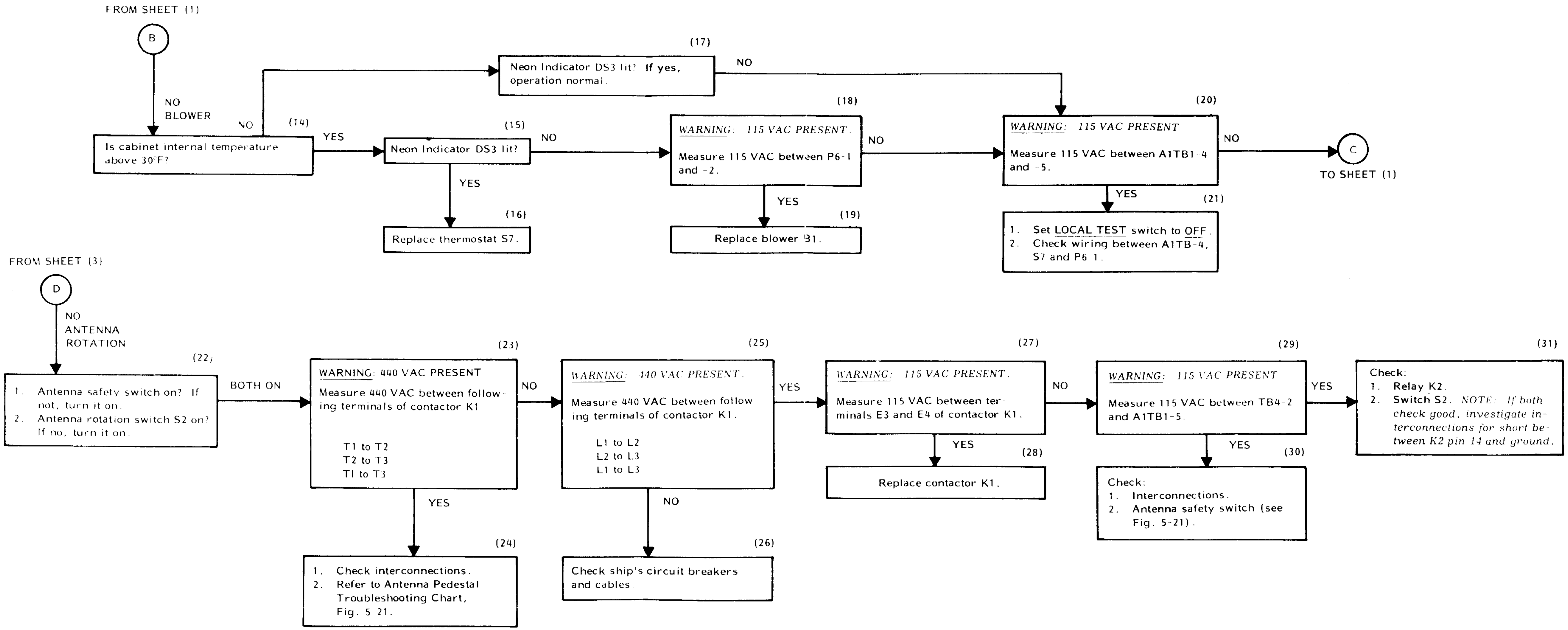


Figure 5-17 Receiver transmitter RT-1241 Troubleshooting chart (V4) (Sheet 2 0f 6)

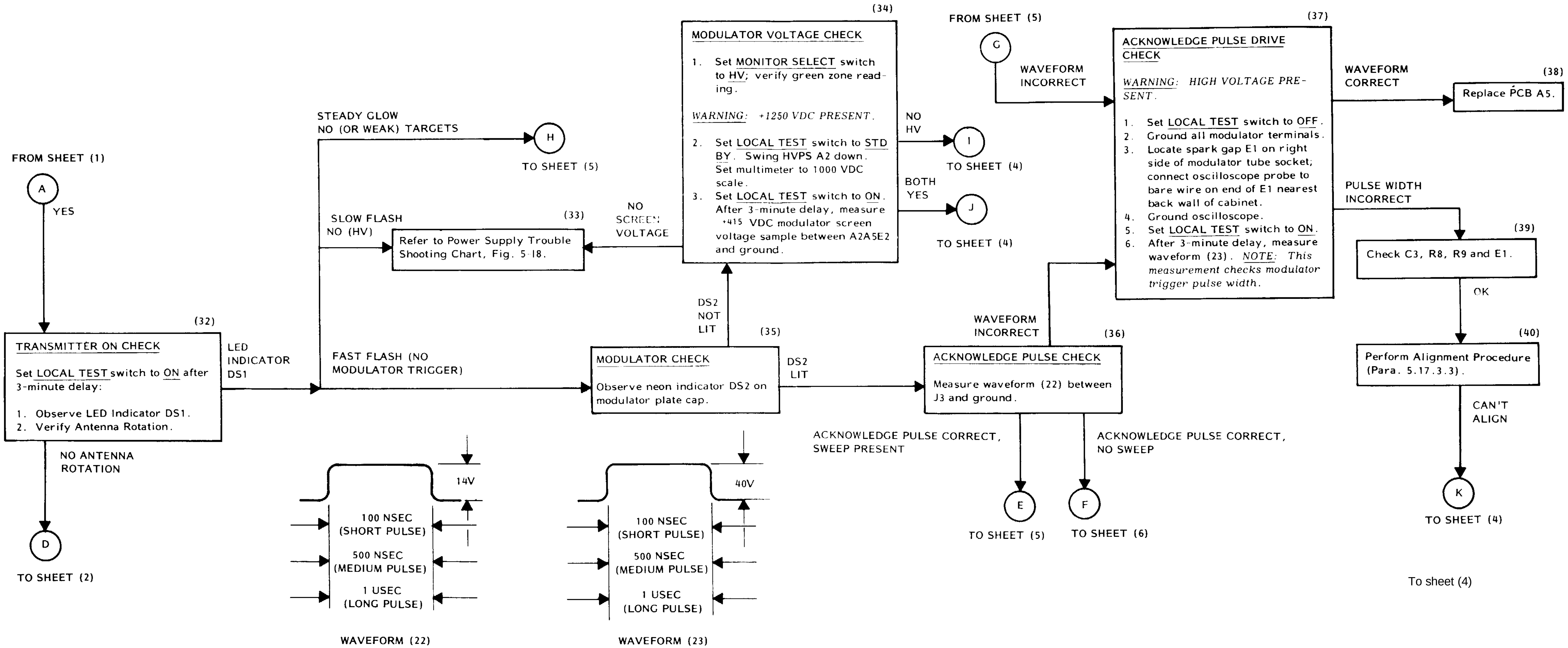


Figure 5-17 Receiver Transmitter RT-1241 Troubleshooting Chart (V4) (Sheet 3 of 6)

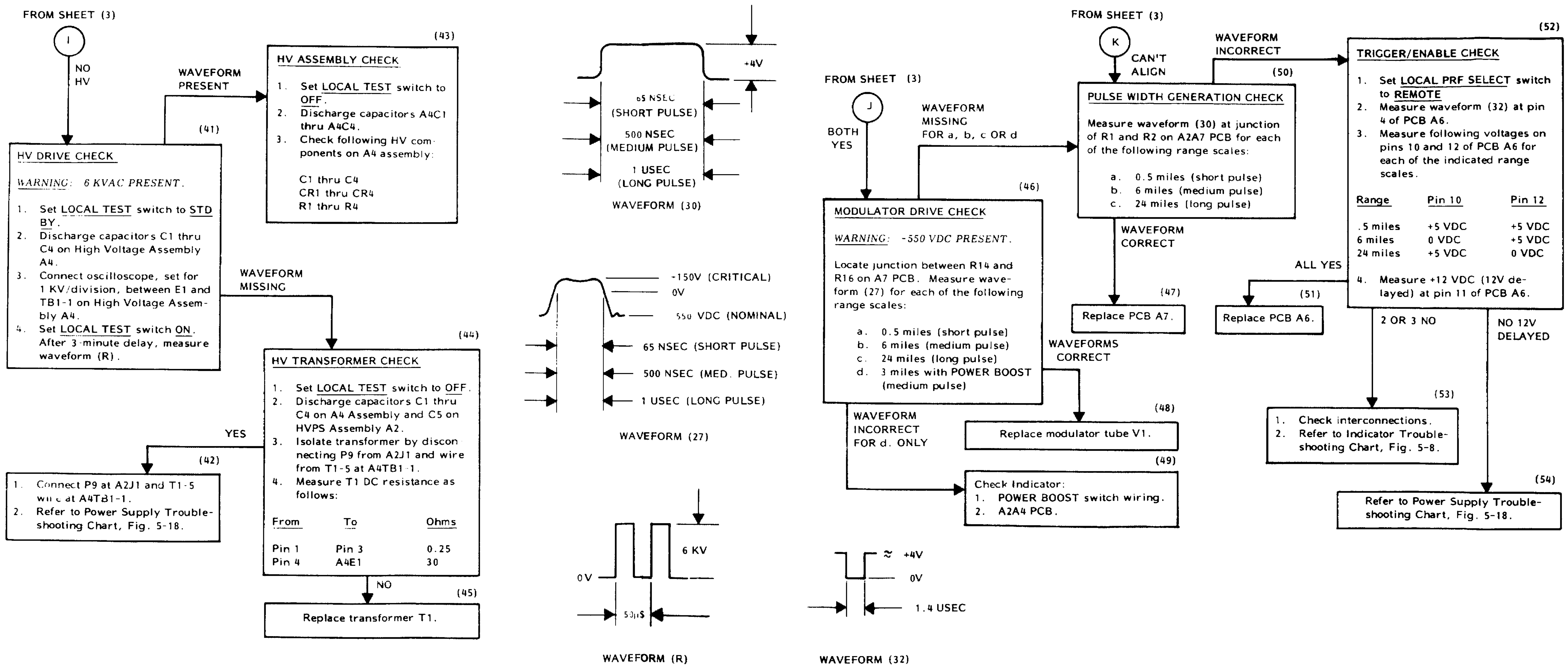


Figure 5-17 Receiver Transmitter RT-1241 Troubleshooting Chart (V4) (Sheet 4 of 6)

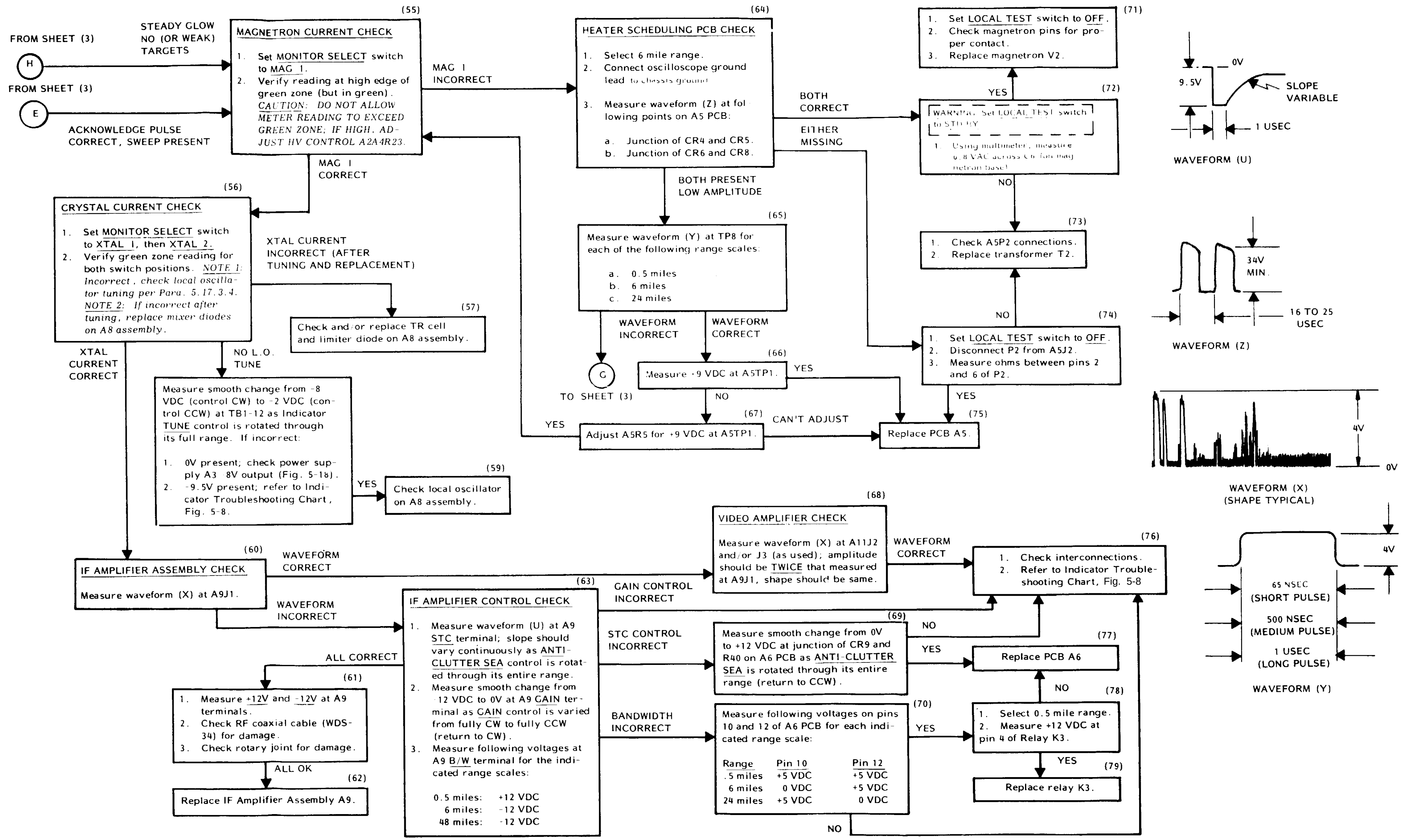
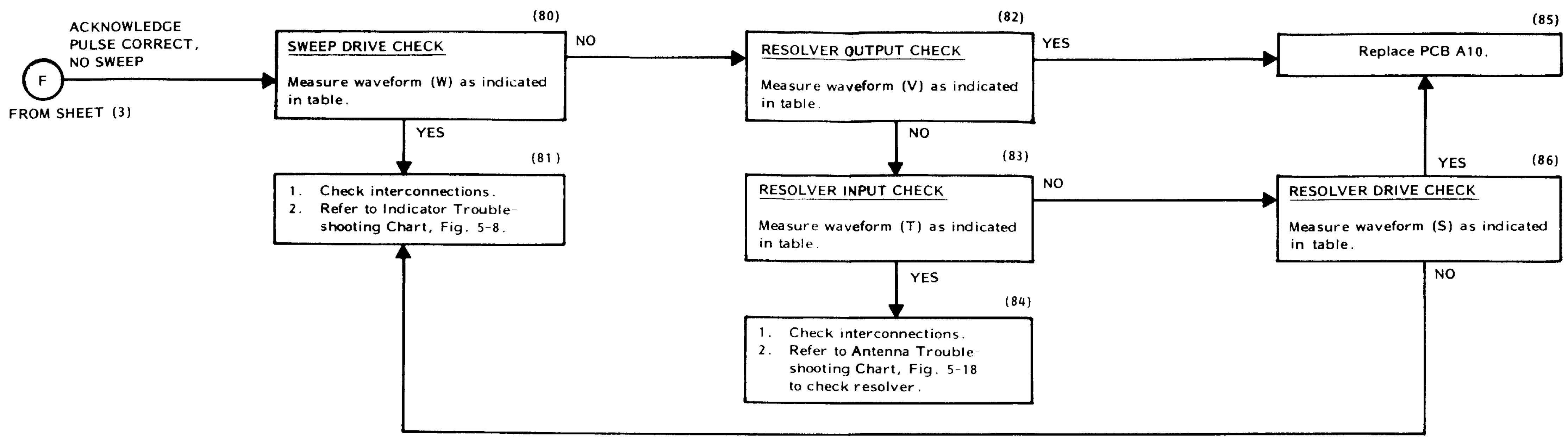


Figure 5-17 Receiver Transmitter RT-1241 Troubleshooting Chart (V4) (Sheet 5 of 6)



TABLE

WFRM	TEST POINTS (ON A10 PCB)	ANTENNA STATIONARY	ANTENNA ROTATING	NOTES
W	PROBE: U2-10, U2-12; GND LEAD: Chassis, Chassis	0V, +5V, -5V, 1.1 MSEC	0V, +5V, -5V, 1.8 SEC	Amplitude varies with antenna position.
V	PROBE: R32-1, R33-1; GND LEAD: Chassis, Chassis	0V, 6.8V, 6.8V, 1.1 MSEC	0V, 6.8V, 6.8V, 1.8 SEC	Amplitude varies with antenna position.
T	PROBE: Junction C2/R21; GND LEAD: Chassis Gnd	0V, 16V, 1.1 MSEC	N/A	Constant amplitude same for rotating and stationary antenna.
S	PROBE: Junction CR3/R1; GND LEAD: Chassis Gnd	5V, 1.1 MSEC	N/A	Constant amplitude same for rotating and stationary antenna.

Figure 5-17 Receiver Transmitter RT-1241 Troubleshooting Chart (V4) (Sheet 6 of 6)

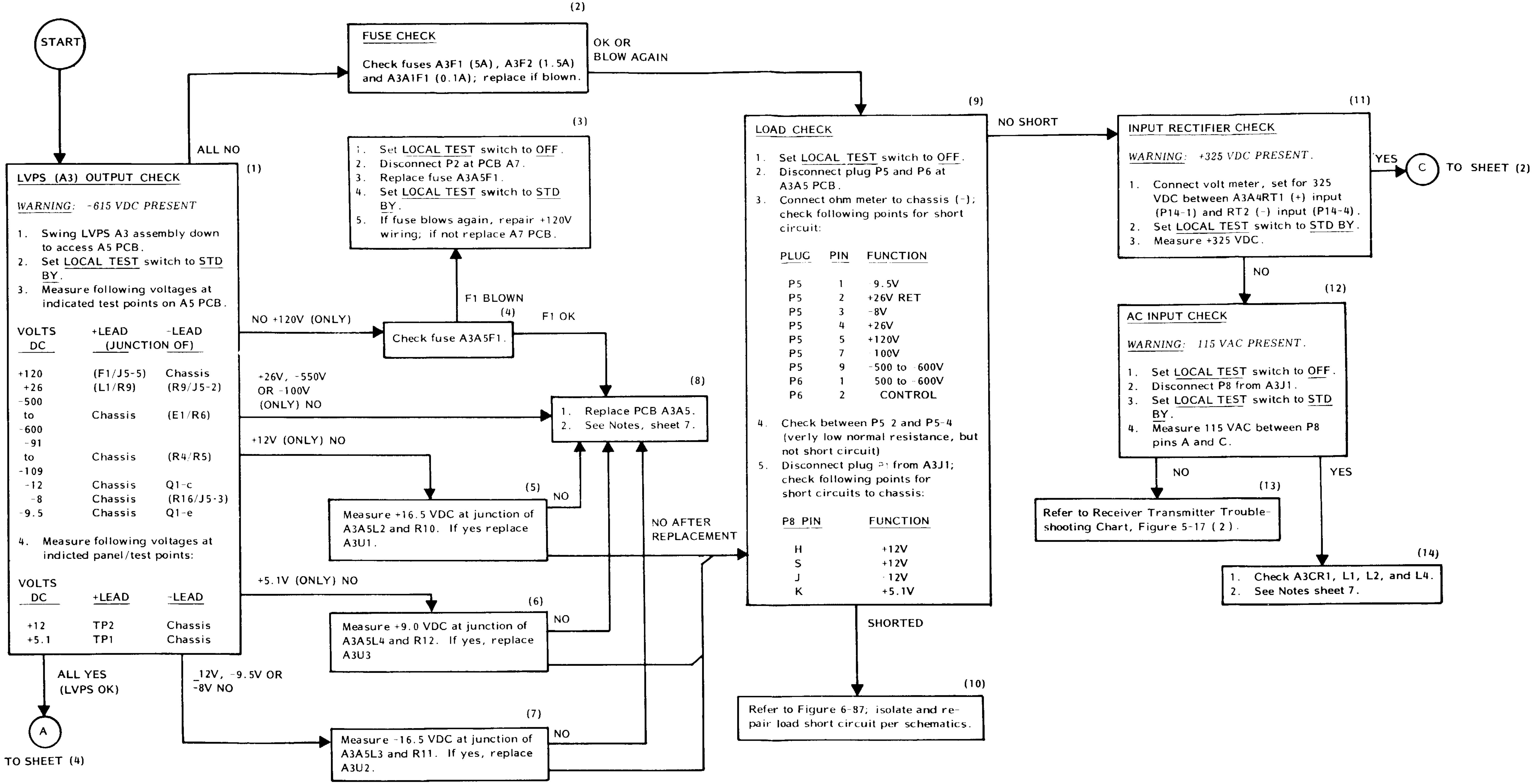


Figure 5-18 Receiver Transmitter RT-1241 Power Supplies Troubleshooting Chart (V4) (Sheet 1 of 7)

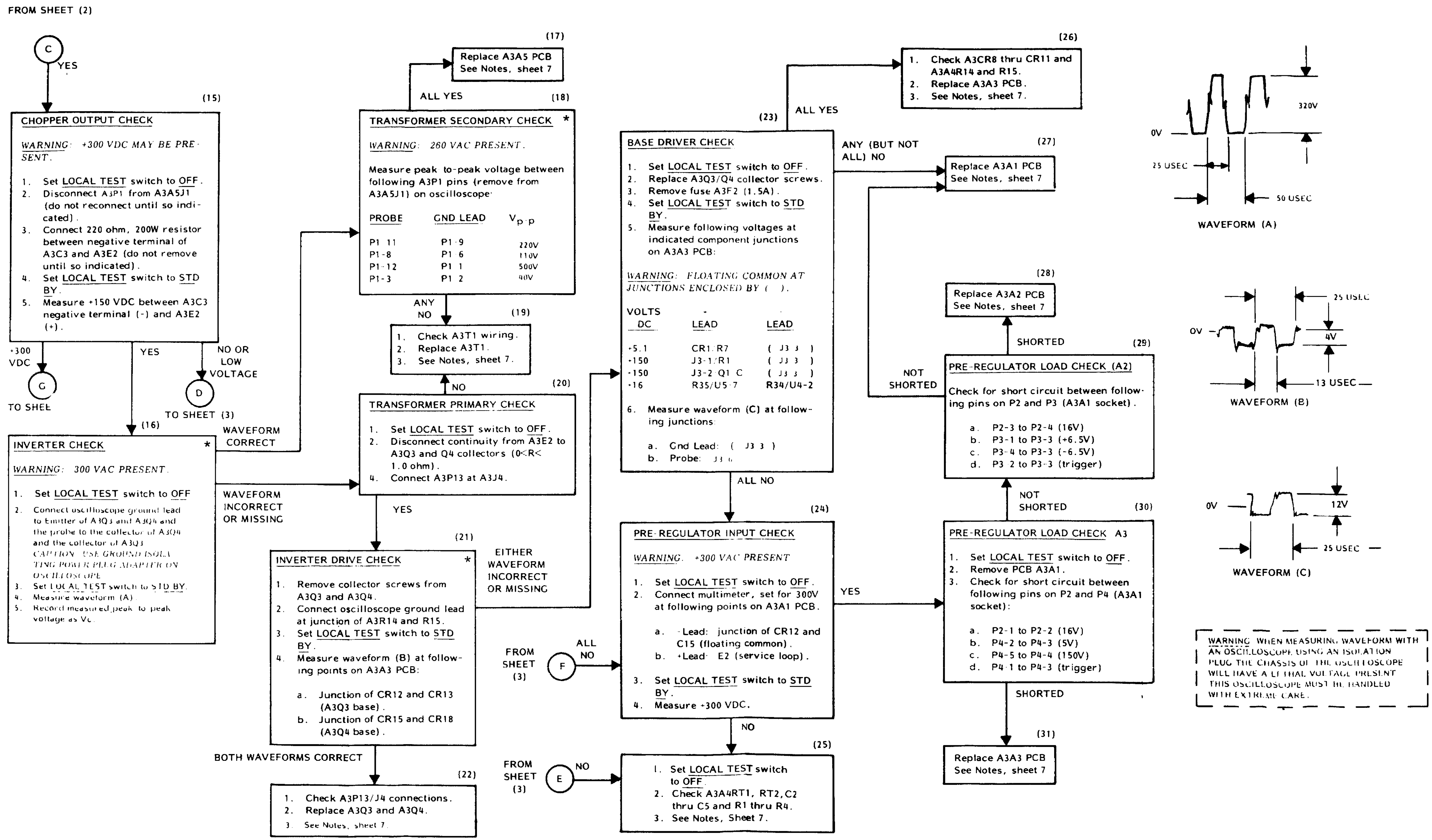


Figure 5-18 Receiver Transmitter RT-1241 Power Supplies Troubleshooting Chart (V4) (Sheet 2 of 7)

FROM SHEET (2)

D

NO OR LOW VOLTAGE

(32)

OVP CIRCUIT CHECK

1. Set LOCAL TEST switch to OFF.
2. Turn CURRENT LIMIT ADJ control A3A2R10 fully CCW.
3. Connect multimeter, set for 300V as follows:
   a. Lead: A3C3 negative terminal.
   b. -Lead: A3E2
4. Set LOCAL TEST switch to STD BY.
5. While observing multimeter slowly turn CURRENT LIMIT ADJ control A3A2R10 CW until meter reads +150 VDC.

+150V ACHIEVED →

(34)

NOTE: Suspect transient triggering of OVP circuit: if symptom repeats at turn on or periodically during operation, replace PCB A3A3, then A3 assembly.

1. Set LOCAL TEST switch to OFF.
2. Remove 220 ohm test resistor and connect A3P8 at A3A5J1.
3. Refer to Para. 5.17.3.1 for current limit adjustment procedure.

VOLTAGE RISES, RETURNS TO 0V BEFORE REACHING +150V →

(35)

1. Replace PCB A3A3.
2. See Notes sheet 7.

NO VOLTAGE ↓

(33)

CHOPPER DC INPUT CHECK

WARNING: +300 VDC PRESENT.

1. Set LOCAL TEST switch to OFF.
2. Move multimeter -lead to junction of A3A4CR2, CR3, CR4.
3. Set LOCAL TEST switch to STD BY.
4. Measure +300 VDC

NO → E TO SHEET (2)

YES →

(36)

CHOPPER CONTROL INPUT CHECK *

1. Remove fuse A3F2 (1.5A).
2. Measure following voltages at indicated component junctions on A3A2 PCB:

VOLTS DC	LEAD	LEAD
+16	C17 R45	C16 R43
+6.5	C1 R1	R5 R11
6.5	R5 R11	C2 R2

3. Measure waveform (D) at following points on A3A2 PCB:
   a. Gnd Lead: junction of R5 and R11.
   b. Probe: R33 input (J2 2).
4. Move probe to following junctions; measure 4.5 to 5.0V pk-pk, 20kHz waveform at both:
   a. R37/R38
   b. R39/R40

+16, +6.5V OR -6.5V (BUT NO ALL) NO ↓

(37)

1. Replace PCB A3A1.
2. See Notes sheet 7.

ALL NO → F TO SHEET (2)

4.5 TO 5.0V ONLY NO →

(40)

1. Replace PCB A3A3.
2. See Notes sheet 7.

ALL YES →

(38)

CHOPPER DRIVE CHECK *

1. Connect oscilloscope ground lead at junction of A3A4R7, R8 and R9.
2. Measure waveform (E) at following junctions on A3A4 PCB:
   a. R7 P1 4 (Q1 base).
   b. R8 P1 5 (Q2 base).

NO →

(41)

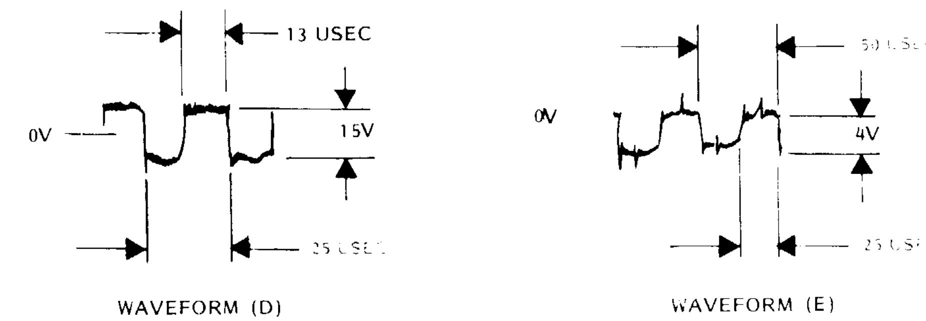
1. Replace PCB A3A2.
2. See Notes sheet 7.

YES ↓

(39)

1. Check A3P1 J3 connections.
2. Replace A3Q1 and A3Q2.
   CAUTION: CHECK A3A4CR5 BEFORE ENERGIZING POWER SUPPLY.
3. See Notes sheet 7.

FROM SHEET (2) G +300 VDC →



* WARNING: WHEN MEAS[illegible] ... PLUG THE CHASSIS OF THE OSC[illegible] WILL HAVE A LETHAL VOLTAGE PRESENT. THIS OSCILLOSCOPE MUST BE HANDLED WITH EXTREME CARE.

Figure 5-18 Receiver Transmitter RT 1241 Power Supplies Troubleshooting Chart (V4) (Sheet 3 of 7)

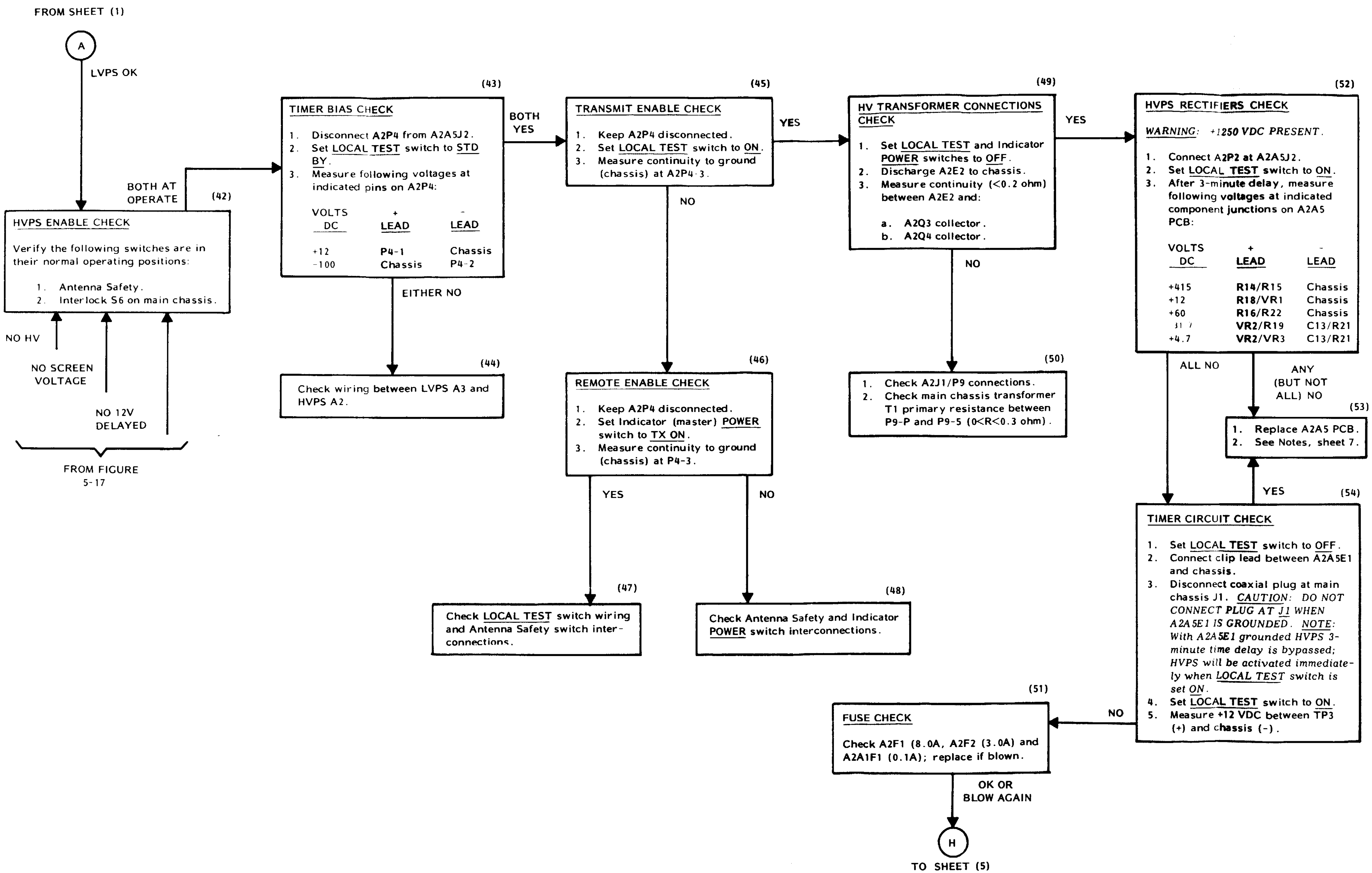


Figure 5-18 Receiver Transmitter RT-1241 Power Supplies Troubleshooting Chart (V4) (Sheet 4 of 7)

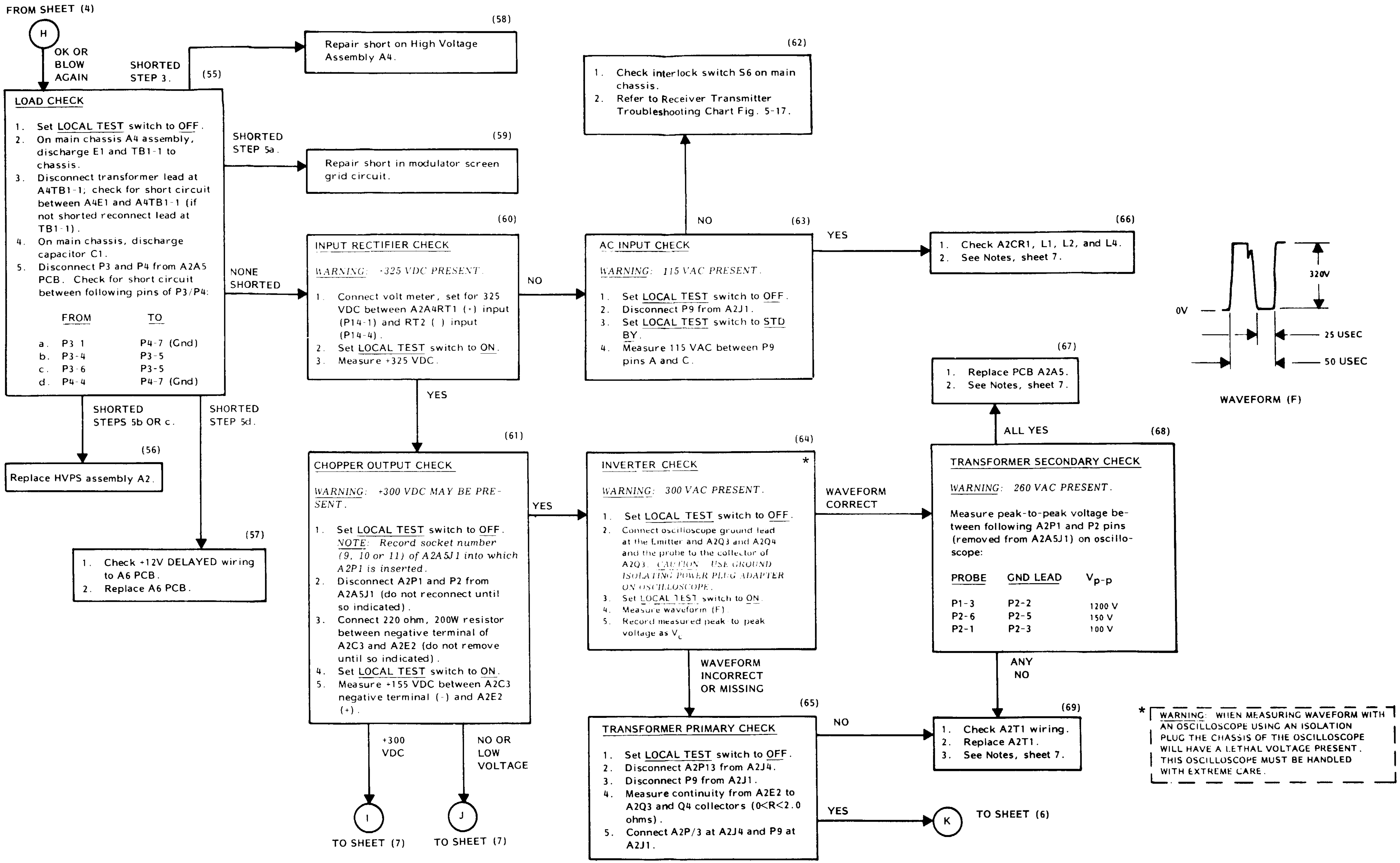


Figure 5-18 Receiver Transmitter RT-1241 Power Supplies Troubleshooting Chart (V4) (Sheet 5 of 7)

FROM SHEET (5)

K

YES

(70)

INVERTER DRIVE CHECK *

1. Remove collector screws from A2Q3 and A2Q4.
2. Connect oscilloscope ground lead at junction of A2R14 and R15.
3. Set LOCAL TEST switch to ON.
4. Measure waveform (G) at following points on A2A3 PCB:
   a. Junction of CR12 and CR13 (A2Q3 base).
   b. Junction of CR15 and CR18 (A2Q4 base).

EITHER WAVEFORM INCORRECT OR MISSING

BOTH WAVEFORMS CORRECT

(71)

1. Check A3P13/J4 connections.
2. Replace A3Q3 and A2Q4.

(72)

BASE DRIVER CHECK *

1. Set LOCAL TEST switch to OFF.
2. Replace A2Q3/Q4 collector screws.
3. Remove fuse A2F2 (3.0A).
4. Set LOCAL TEST switch to ON.

WARNING: FLOATING COMMON AT JUNCTIONS ENCLOSED BY ( )

VOLTS DC	+ LEAD	- LEAD
+5.1	CR1/R7	(C1/CR3)
+150	J3-1/R1	(C1/CR3)
+150	J3-2/Q1-C	(C1/CR3)
+16	R35/U5-7	R34/U4-2

6. Measure waveform (H) at following junctions.
   a. Gnd Lead: (C1/CR3)
   b. Probe: CR10/J3-6

ALL YES

(75)

1. Check A2CR8 thru CR11 and A2A4R14 and R15.
2. Replace A2A3 PCB.

ANY (BUT NOT ALL) NO

(76)

1. Replace A2A1 PCB.
2. See Notes, sheet 7.

(77)

1. Replace A2A2 PCB.
2. See Notes, sheet 7.

SHORTED

(78)

PRE-REGULATOR LOAD CHECK (A2)

Check for short circuit between following pins on P2 and P3 (A2A1 socket).

a. P2-3 to P2-4 (16V)
b. P3-1 to P3-3 (+6.5V)
c. P3-4 to P3-3 (-6.5V)
d. P3-2 to P3-3 (trigger)

NOT SHORTED

ALL NO

(73)

PRE-REGULATOR INPUT CHECK

WARNING: +300 VDC PRESENT.

1. Set LOCAL TEST switch to OFF.
2. Connect multimeter, set for 300V at following points on A2A1 PCB:
   a. -Lead: junction of CR12 and C15 (floating common).
   b. +Lead: E2 (service loop).
3. Set LOCAL TEST switch to ON.
4. Measure +300 VDC.

ALL NO

FROM SHEET (7) L

YES

NOT SHORTED

(79)

PRE-REGULATOR LOAD CHECK (A3)

1. Set LOCAL TEST switch to OFF.
2. Remove PCB A2A1.
3. Check for short circuit between following pins on P2 and P4 (A2A1 socket).
   a. P2-1 to P2-2 (16V)
   b. P4-2 to P4-3 (5V)
   c. P4-5 to P4-4 (150V)
   d. P4-1 to P4-3 (trigger)

NO

(74)

NO

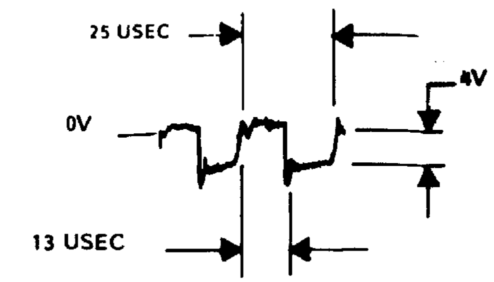
FROM SHEET (7) M

1. Set LOCAL TEST switch to OFF.
2. Check A2A4RT1, RT2, C2 thru C5 and R1 thru R4.
3. See Notes, sheet 7.

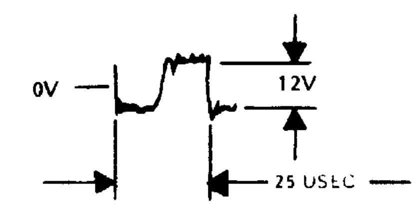
SHORTED

(80)

1. Replace A2A3 PCB.
2. See Notes, sheet 7.



WAVEFORM (G)



WAVEFORM (H)

Figure 5-18 Receiver Transmitter RT-1241 Power Supplies Troubleshooting Chart (V4) (Sheet 6 of 7)

FROM SHEET (5)

J

NO OR LOW VOLTAGE

(81)

OVP CIRCUIT CHECK

1. Set LOCAL TEST switch to OFF.
2. Turn CURRENT LIMIT ADJ control A2A2R10 fully CCW.
3. Connect multimeter, set for 300V as follows:

   a. -Lead: A2C3 negative terminal
   b. +Lead: A2E2

4. Set LOCAL TEST switch to ON.
5. While observing multimeter, slowly turn CURRENT LIMIT ADJ control A2A2R10 slowly CW until meter reads +150 VDC

+150V ACHIEVED

(83)

NOTE: Suspect transient triggering of OVP circuit, if symptom repeats at turn-on or periodically during operation, replace PCB A2A3, then A2 assembly.

1. Set LOCAL TEST switch to OFF.
2. Remove 220 ohm test resistor and connect A2P1 and P2 at A2A5J1; insure that A2P1 is inserted into the correct socket of A2A5J1 (previously recorded).
3. Refer to Para. 5.17.3.2 for current limit adjustment procedure.

VOLTAGE RISES; RETURNS TO 0V BEFORE REACHING +150 V

(84)

1. Replace PCB A2A3.
2. See Notes.

NO VOLTAGE

(82)

CHOPPER DC INPUT CHECK

WARNING: +300 VDC PRESENT.

1. Set LOCAL TEST switch to OFF.
2. Move multimeter +lead to junction of A2A4CR2, CR3, CR4.
3. Set LOCAL TEST switch to ON.
4. Measure +300 VDC.

NO

M

TO SHEET (6)

YES

(85)

CHOPPER CONTROL INPUT CHECK *

1. Remove fuse A2F2 (1.5A).
2. Measure following voltages at indicated component junctions on A2A2 PCB:

VOLTS DC	+ LEAD	- LEAD
+16	C1/R45	C16/R43
+6.5	C1/R1	R5/R11
-6.5	R5/R11	C2/R2

3. Measure waveform (I) at following points on A2A2 PCB:

   a. Gnd Lead: junction of R5 and R11.
   b. Probe: R33 input (J2-2).

4. Move probe to following junctions; measure 4.5 to 5.0V pk-pk, 20 kHz waveform at both:

ALL NO

L

TO SHEET (6)

+16V, +6.5V OR -6.5V (BUT NOT ALL) NO

(86)

1. Replace PCB A2A1.
2. See Notes.

4.5 TO 5.0V ONLY NO

(90)

1. Replace PCB A2A3.
2. See Notes.

ALL YES

(88)

CHOPPER DRIVE CHECK *

1. Connect oscilloscope ground lead at junction of A2A4R7, R8 and R9.
2. Measure waveform (J) at following junctions on A2A4 PCB:

   a. R7/P1-4 (Q1 base).
   b. R8/P1-5 (Q2 base).

NO

(87)

1. Replace PCB A2A2.
2. See Notes.

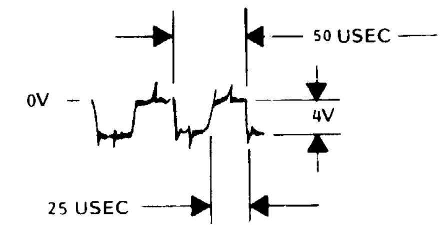
YES

FROM SHEET (5)

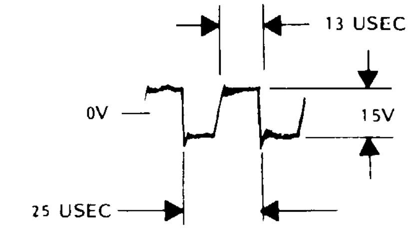
I

(89)

1. Check A2P1/J3 connections.
2. Replace A2Q1 and A2Q2. *CAUTION: CHECK A2A4CR5 BEFORE ENERGIZING POWER SUPPLY.*
3. See notes.



WAVEFORM (J)



WAVEFORM (I)

* WARNING WHEN MEASURING WAVEFORM WITH AN OSCILLOSCOPE USING AN ISOLATION PLUG THE CHASSIS OF THE OSCILLOSCOPE WILL HAVE A LETHAL VOLTAGE PRESENT. THIS OSCILLOSCOPE MUST BE HANDLED WITH EXTREME CARE.

NOTES:

1. *If replacement corrects previous faulty indication, remove test components and replace fuses. Restore normal connections, insuring that A2P1 is inserted into the correct socket of A2A5J1 as noted in instruction log number 61. Return equipment to service.*
2. *If problem persists, replace HVPS assembly A2 or LVPS assembly A3 as applicable. (Available from depot spares.)*

Figure 5-18 Receiver Transmitter RT-1241 Power Supplies Troubleshooting Chart (V4) (Sheet 7 of 7)

3. Remove the four screws, washers and lockwashers located on the base of the magnetron shroud.

4. Remove the six screws, washer and lockwashers attaching the magnetron tube to the magnetron bracket.

5. Lay the shroud/bracket assembly forward.

6. Turn the large hex nut counterclockwise to release the magnetron tube from the microwave assembly.

CAUTION

PULL THE MAGNETRON FORWARD CAREFULLY TO PREVENT DAMAGE TO THE GLASS PROBE THAT EXTENDS INTO THE HEX NUT OPENING.

7. Reassemble using the reverse of the above procedure.

5.17.2.3 T/R Cell.

1. Remove power per paragraph 5.17.2.

2. Perform the procedure given in paragraph 5.17.2.8 to remove the Microwave Assembly A8 and provide access needed for the replacement of the T/R Cell.

3. Remove the ten hex head screws, washers, lockwashers and nuts that attach the T/R Cell to the Microwave Assembly.

4. Remove the ten hex head screws, washers, and lockwashers that attach the T/R Cell to the circulator and remove the T/R Cell.

5. Reassemble using the reverse of the above, insuring that the T/R Cell OUTPUT is in the "up" position.

5.17.2.4 Limiter Diode.

1. Remove power per paragraph 5.17.2.

2. Remove the limiter diode located on the lower side of the Mixer assembly by screwing in a counterclockwise direction.

3. Reinstall diode using caution not to over tighten, as the diode must seat firmly, but will break if tightened too far into the assembly.

5.17.2.5 Mixer Diodes.

1. Remove power per paragraph 5.17.2.

2. The mixer diodes are located on the upper side of the Mixer assembly. They may be removed by unscrewing the slotted caps of the enclosures.

3. Reinstall the matched pair of diodes (part numbers 167579-7 and -8) with careful attention to the correct polarity as noted on the case.

5.17.2.6 Mixer Assembly.

1. Remove power per paragraph 5.17.2.

2. Remove Microwave Assembly A8 per paragraph 5.17.2.8.

3. Remove the two screws and connecting nut holding the local oscillator to the Mixer assembly. This will free the harness and the local oscillator from the Mixer assembly.

4. Remove the nine slotted head screws, washers, and lockwashers that hold the IF Amplifier assembly cover. Remove the cover.

5. Disconnect the two wires, noting connection locations, between the feed-through capacitors of the Mixer assembly and the IF Amplifier PCB assembly.

6. Remove the hex nuts on the inside of the IF Amplifier assembly to separate the Mixer Assembly from the IF assembly.

7. Remove the ten hex head screws, washers, lockwashers, and nuts that hold the Mixer assembly to the T/R Cell, and remove the T/R Cell.

8. Reassemble using the reverse of the above, insuring that the T/R Cell OUTPUT is in the "up" position.

5.17.2.7 Local Oscillator Assembly.

1. Remove power per paragraph 5.17.2.

2. Tag the three grey covered red and black twisted pair wires, noting the termination points (TUNE, +12, and -12), then disconnect the wires from the local oscillator.

3. Remove the four slotted head screws, washers, lockwashers and nuts to free the local oscillator from the Mixer assembly.

4. Reassemble using the reverse of the above, insuring the correct wire hook-up locations.

5.17.2.8 Microwave Assembly A8.

1. Remove power per paragraph 5.17.2.

2. Disconnect the magnetron shroud assembly and lay forward per paragraph 5.17.2.2.

3. Disconnect the IF Amplifier assembly per paragraph 5.17.2.9.

4. Remove the exterior waveguide connection on the right-hand side of the cabinet.

5. Remove the ten hex head screws and lockwashers located on the cabinet exterior which hold the microwave assembly.

6. Remove the hex head screws and lockwashers located at the inside rear of the cabinet which attach the Microwave Assembly and lift the Microwave Assembly out.

7. Reassemble using the reverse of the above.

5.17.2.9 IF Amplifier Assembly.

1. Remove power per paragraph 5.17.2.

2. Open and lower the control panel; disconnect the BNC connector below the IF assembly.

3. Disconnect the harness connector just to the right of the IF assembly on the center subchassis.

4. Disconnect all wires, noting and tagging hook-up locations.

5. Remove the two screws and lockwashers located at the base of the IF assembly and support bracket.

6. Remove nine screws and washers that detach the assembly PCB cover.

7. Disconnect the two feed-through wires from the microwave assembly at the PCB.

8. Remove the two hex nuts holding the feed through capacitors to the microwave assembly, and lift the IF assembly out.

9. Reassemble using the reverse of above.

5.17.2.10 Power Supply Assemblies A2 and A3. The following procedure applies to both power supply assemblies.

1. Remove power per paragraph 5.17.2.
2. Loosen the two captive screws located at upper bracket, and swing the supply downward.
3. Disconnect harness from spring connector located at rear of the assembly.
4. Shift assembly to the right to free the assembly from the hinges and lift the power supply out.

5.17.2.11 High Voltage PCB Assembly A4.

WARNING

BEFORE TOUCHING ANY PARTS, DISCHARGE ANY STORED HIGH VOLTAGE USING A WELL-INSULATED GROUND LEAD.

1. Remove power per paragraph 5.17.2.
2. Disconnect hook-up wires to the PCB assembly, noting and tagging connection locations.
3. Remove the five nylon screws holding the PCB assembly to the rear wall of the cabinet, and remove the PCB assembly.
4. Reassemble using the reverse of above.

5.17.2.12 Antenna Contactor K1. - Contactor K1 is located on the right-hand exterior recess of the cabinet.

1. Remove power per paragraph 5.17.2.
2. Disconnect hook-up wires, noting and tagging hook-up location, by loosening terminal screws on the contactor.
3. Remove one screw at top and two screws at the bottom of the contactor and lift out.
4. Reassemble using the reverse of above.

5.17.2.13 Blower B1.

1. Remove power per paragraph 5.17.2.
2. Disconnect harness connector.
3. Remove eight screws and lockwashers located on floor of the center sub chassis and lift blower assembly oust.
4. Reassemble using revel-se (if above.

5.17.2.4 Thermostat S7. The thermostat is located on the left hand side of the magnetron shroud.

1. Remove power per paragraph 5.17.2.
2. Disconnect wires, noting and tagging hook up location.
3. Remove two screws attaching the thermostat to the shroud and remove the thermostat.
4. Reassemble using the traverse of above.

5.17.2.15 Meter M1. The meter is located on front of the control panel.

1. Remove power per paragraph 5.17.2.
2. Loosen four captive screws at top of the control panel and lower panel down and out.
3. Remove connecting wires, noting and tagging hook-up location.
4. Remove four hex nuts and washers to free the meter.
5. Reassemble using reverse of above.

5.17.3 Alignment Procedures (V4)

The following procedures are applicable to AN/ SPS-64(V)4 system installations only. Paragraphs 5.17.3.1 through 5.17.3.7 following provide instructions for adjustment of all field adjustable maintenance controls contained in Receiver Transmitter RT-1241. When performed in the sequence given, these instructions constitute an overall alignment procedure for the receiver transmitter.

NOTE

When the cover of Receiver Transmitter RT 1241 is removed, HV interlock switch S6 must be pulled outward to re store transmitter operating power.

5.17.3.1 Low Voltage Power Supply Adjustments (V4) . - The following steps establish the proper operating frequency and output voltage levels for the Low Voltage Power Supply (LVPS) A3. All test points and controls called out are located in Receiver Transmitter RT 1241.

WARNING

THE LVPS OPERATOES AS A FLOATING SUPPLY; THE FOLLOWING COMMON IS NORMALLY AT -150 TO -175 VDC WITH RESPECT TO CHASSIS. EXERCISE EXTREME CARE TO AVOID CONTACT WHEN MAKING ADJUSTMENTS. ALWAYS TURN POWER OFF BEFORE CONNECTING OR DISCONNECTING TEST EQUIPMENT.

1. Set LOCAL TEST switch to OFF.
2. Lower LVPS assembly 13A3 into its service position.
3. Place oscilloscope probe near service loop on 13A3A4A1 (Preregulator) PCB.
4. Connect multimeter, set for 10 Vdc scale, as follows:
    a. Positive lead: terminal post 13A3A4E5.
    b. Negative Lead: floating common at A3A4C3 negative terminal.
5. Set LOCAL TEST switch to ON.
6. Adjust FREQ control A3A1R9 to obtain exactly 25 usec squarewave period on oscilloscope.
7. Adjust PRE-REG volt control A3A1R15 to obtain +5. 1 Vdc reading on multimeter.
8. Set LOCAL TEST switch to OFF. Disconnect oscilloscope and multimeter.
9. Connect multimeter, set to 10 Vdc scale, between test points E1 (+) and E2 (-) on A3A2 PCB.
10. Set LOCAL TEST switch to ON.
11. Adjust PHOTO DIODE CURR control A3A2R44 to obtain +7.0 Vdc reading on multimeter.
12. Set LOCAL TEST switch to OFF.
13. Connect multimeter, set to 50 Vdc scale, across A3A5C4 (positive lead to positive terminal) and set LOCAL TEST switch to ON.
14. Adjust OUTPUT V control A3A4R23 to obtain +26.0 Vdc reading on multimeter.
15. Set LOCAL TEST switch to OFF.
16. Connect multimeter, set for 1000 Vdc scale, between control panel TP6 -550V test point (negative lead) and TP10 GND test point.
17. Set LOCAL TEST switch to ON.

NOTE

The following step establishes a preliminary setting for -550V ADJ control A3R1; the final adjustment procedure is given in paragraph 5.17.3.3.

18. Adjust -550 Vdc control R1 on LVPS assembly A3 to obtain a -550 Vdc reading on multimeter.
19. Set LOCAL TEST switch to OFF. Disconnect multimeter. Raise LVPS assembly into its operate position and secure.

NOTE

The adjustments given in paragraphs 5.17.3.2 and 5.17.3.3 must be checked and performed as necessary upon completion of step 19.

5.17.3.2 High Voltage Power Supply (V4). The following steps establish the proper operating frequency and output voltage levels for the High Voltage Power Supply (HVPS) A3. All test points and controls called out are located in Receiver Transmitter RT-1241.

WARNING

THE LVPS OPERATOES AS A FLOATING SUPPLY; THE FOLLOWING COMMON IS NORMALLY AT -150 TO -175 VDC WITH RESPECT TO CHASSIS. EXERCISE EXTREME CARE TO AVOID CONTACT WHEN MAKING ADJUSTMENTS. ALWAYS TURN POWER OFF BEFORE CONNECTING OR DISCONNECTING TEST EQUIPMENT.

CAUTION

DO NOT GROUND THE FLOATING COMMON LINE. PARTICULAR CARE MUST BE TAKEN WHEN CONNECTING TEST EQUIPMENT TO INSURE THAT THE FLOATING COMMON IS NOT GROUNDED.

NOTE

CURR LIM control A2A2R10 is factory set and should not be adjusted in the field.

1. Set LOCAL TEST switch to OFF.
2. Lower HVPS assembly A2 into its service position.
3. Place oscilloscope probe near service loop on 13A3A4A1 (Preregulator) PCB.
4. Connect multimeter, set for 10 Vdc scale, as follows:
    a. Positive lead: terminal post 13A3A4E5.
    b. Negative Lead: floating common at A2A4C3 negative terminal.
5. Set LOCAL TEST switch to ON.
6. Adjust FREQ control A2A1R9 to obtain exactly 25 usec squarewave period on oscilloscope.
7. Adjust PRE-REG VOLT control A2A1R15 to obtain +5.1 Vdc reading on multimeter.
8. Set LOCAL TEST switch to OFF. Disconnect oscilloscope and multimeter.
9. Connect multimeter, set to 10 Vdc scale, to E1 (+) and E2 (-) on A2A2 PCB.
10. Set LOCAL TEST switch to ON.
11. Adjust PHOTO DIODE CURR control A2A2R44 to obtain +7.0 Vdc reading on multimeter. Disconnect multimeter.
12. Set MONITOR SELECT switch to MAG 1. Set LOCAL PRF SELECTOR switch to MED.
13. Adjust OUTPUT V control A2A4R23 to obtain an M1 test meter reading at the high edge of the green zone.

14. Set MONITOR SEL ECT switch to HV and verify green zone reading on test meter M1. Leave MONITOR SELECT switch al HV through step 17 following .

15. Connect oscilloscope, Set for approximately -10 Vdc measurement, at control panel HV SAMPLE TP9.

16. Set LOCAL PRF SELECTOR switch alternately between SHORT and MED, noting the dc voltage level displayed on the oscilloscope for each position.

17 Adjust LOAD COMP control A2A4R29 until the voltage difference observed between SHORT and MED is 0.1 Vdc or less.

18. Repeat steps 12 and 13 above.

19. Set LOCAL. TEST switch to OFF.

20. Turn off all ships circuit breakers which supply power to Receiver Transmitter RT- 1241.

21. Connect variac between ships 115Vac input cable and FL1 and FL2. Ground variac to equipment chassis.

22. Connect multimeter, set to 250 Vac scale, between FL1 and FL2 inputs; maintain connection through step 32 following.

23. Set ships circuit breakers which supply power to Receiver Transmitter RT-1241 to ON.

24. Adjust variac for 120 Vac reading on multimeter .

25. Connect second multimeter, set for 10 Vdc scale, between A2A5E3 (+} and chassis (-) .

26. Set LOCAL TEST switch to ON. After 3minute time delay, verify second multimeter reads +5.0 + 0.5Vdc.

27. Turn BIAS VOLT control A2A5R7 fully counterclockwise.

28. Adjust variac to reduce reading to first multimeter to 114 Vac.

29. Carefully adjust BIAS VOLT control A2A5R7 clockwise just until reading on second multimeter drops to zero Vdc.

30. Adjust variac to reduce reading on first multimeter to 80 Vac. Second multimeter reading should remain at zero Vdc.

31. Carefully adjust BIAS VOLT control A2A5R7 counterclockwise just until reading on first multimeter jumps to + 5.0 ± 0.5 VDC.

32. Set LOCAL. TEST switch to OFF.

33. Turn off all ships circuit breakers which supply power to Receiver Transmitter RT 1241.

34. Disconnect variac and restore normal cable connections at FL1 and FL2 inputs.

35. Set ships circuit breakers supplying power to Receiver Transmitter RT- 1241 to ON.

36. Set LOCAL TEST switch to ON and allow for 3 minute time delay.

37. Connect multimeter as indicated in Table 5-5 and verify correct dc voltage at each test point.

given in paragraph 5.17.3.3 must be checked and performed as required upon completion of step 37.

Table 5-5. Receiver Transmitter RT-1241 Power Supply Test Points

POSITIVE LEAD	NEGATIVE LEAD	DC VOLTAGE
TP1	TP10	+5.1 ± 0.25
TP2	TP10	+12.0 ± 0.5
TP3	TP10	+12.0 ± 0.5
TP10	TP4	-12.0 ± 0.5
TP5	TP10	+120 ± 10
TP10	TP6	- 550 ± 50
TP9	TP10	+11.8 ± 0.5

5.17.3.3 Transmitter Circuits Adjustment (V4) . The following procedure provides instructions for adjustment of the frequency of the built-in test PRF generator, the pulse widths of the modulator drive pulse generators and final adjustment of the modulator bias and high voltage levels.

NOTE

Observe the settings of Switching Units SA-2139 and refer to Table 3-3 to determine which Indicator is serving as master for Receiver Transmitter RT-1241 (MTR 11).

1. At Receiver Transmitter RT-1241:
   a. Set LOCAL TEST switch to REMOTE ENABLE .
   b. Set LOCAL PRF SELECTOR to REMOTE.
2. At master Indicator:
   a. Set POWER switch to TX ON.
   b. Set RANGE SELECT switch to 1.5 MILES

3. At Receiver Transmitter RT-1241, connect oscilloscope, set for 2 volts and 50 usec per division, at J5 TRIGGER jack; adjust oscilloscope for display of two negative-going trigger pulses.

4. Carefully note the time between positive [trailing) edges of the trigger pulses.

5. At Receiver Transmitter RT-1241:
   a. Set LOCAL TEST switch to ON.
   b. Set LOCAL PRF SELECTOR switch to SHORT .

6. Observe positive edges of squarewave signal displayed on oscilloscope; adjust frequency control R9 on Receiver Transmitter RT-1241 A6 Pulse Logic PCB to obtain the time noted in step 4 above between positive edges of the squarewave signal.

NOTE

All test points and controls called out in the remainder of this procedure are located at Receiver Transmitter RT-1241.

7. Set LOCAL TEST switch to OFF.
8. Set LOCAL PRF SELECTOR switch to MED.
9. Using a 10X probe, connect oscilloscope at test point TP2 of Pulse Driver PCB A7; set oscilloscope for dc input coupling and 50V/division display.
10. Set LOCAL TEST switch to ON; after 3.5minute delay, adjust oscilloscope to display positive portion of modulator drive pulse.
11. Adjust 550 ADJ control RI on Low Voltage Power Supply A3 to obtain pulse peak amplitude of +150 volts.
12. Adjust medium pulse adjust control R23 on Pulse Logic PCB 13A6 to obtain a pulse width of 500 nsec from the peak of the leading edge to the base of the trailing edge.
13. Set LOCAL PRF SELECTOR switch to SHORT. Verify pulse peak amplitude is +150 + 5 volts on oscilloscope.
14. Adjust short pulse adjust control R28 on Pulse Logic PCB 13A6 to obtain a pulse width of 65 nsec from the peak of the leading edge to the base of the trailing edge.
15. Set LOCAL PRF selector switch to LONG. Verify pulse peak amplitude is +150 + 5 volts on oscilloscope.
16. Adjust long pulse, adjust control R25 on Pulse Logic PCB 13A6 to obtain a pulse width of 1000 nsec at the peak of the leading edge to the base of the trailing edge.
17. Set MONITOR SELECT switch to MAG I.
18. Adjust high voltage OUTPUT V control A4R23 on High Voltage Power Supply A2 to obtain an M1 test meter reading in the middle of the green zone.
19. Set master Indicator POWER switch to OFF. Set LOCAL TEST switch to REMOTE ENABLE. Disconnect oscilloscope. Set LOCAL PRF SELECTOR switch to REMOTE.

5.17.3.4 Magnetron Heater Scheduling PCB Adjustment (V4) - The radar duty cycle varies with the range scale selected. The following steps align the Magnetron Heater Scheduling PCB circuit to insure that the proper voltage level is applied to the magnetron filament for the duty cycle in use. All test points and controls called out in the following steps are located at Receiver Transmitter RT-1241.

1. Set switches as follows:
   a. LOCAL TEST: ON
   b. LOCAL PRF SELECTOR: MED
   c. MONITOR SELECT: MAG I
2. Connect multimeter, set to 50 Vdc scale, between TP1 (+) on the Magnetron Heater Scheduling PCB A5 and chassis.
3. Verify test meter Ml reading is in the middle of the green zone.
4. Adjust output control A5R5 to obtain the following Vdc reading on multimeter:

   +9.0 Vdc for EEV Magnetron

   +12 Vdc for Ratheon Magnetron

5.17.3.5 Local Oscillator Adjustment (V4). The following steps align the local oscillator to the transmitter operating frequency.

NOTE

Observe settings of Switching Units SA-2139 and refer to Table 3-3 to determine which Indicator is serving as master for Receiver Transmitter RT 1241.

1. At master Indicator:
   a. Set POWER switch to TX ON.
   b. Set TUNE control to center of its range.
   c. Set RANGE SELECT switch to 6 MILES.
2. Connect multimeter, set to +10 Vdc scale, between TP7 TUNE (+) and TP10 GND (-) test points at Receiver Transmitter RT 1241.
3. Disconnect output cable at J1 of A9 IF Amplifier Assembly; install BNC Tee connector on cable and connect Tee at A9J 1.
4. Connect oscilloscope to Tee connector at A9J 1.
5. Turn local oscillator frequency adjustment (see Figure 5-19) fully clockwise.
6. While observing multimeter, carefully turn local oscillator frequency adjustment control counterclockwise until multimeter deflection indicates presence of signal.

NOTE

A false signal node may be encountered when adjusting the local oscillator cavity. This false node will be indicated by presence of high level noise and no video targets on the oscilloscope and CRT displays. If this false node is encountered, continue turning the frequency adjustment control counterclockwise until the multimeter indicates signal presence at another control setting and video targets are displayed on the oscilloscope.

7. Observe oscilloscope display and identify a non-saturating video target which is displayed during each rotation of the antenna. If necessary, adjust receiver transmitter GAIN control to optimize target amplitude.

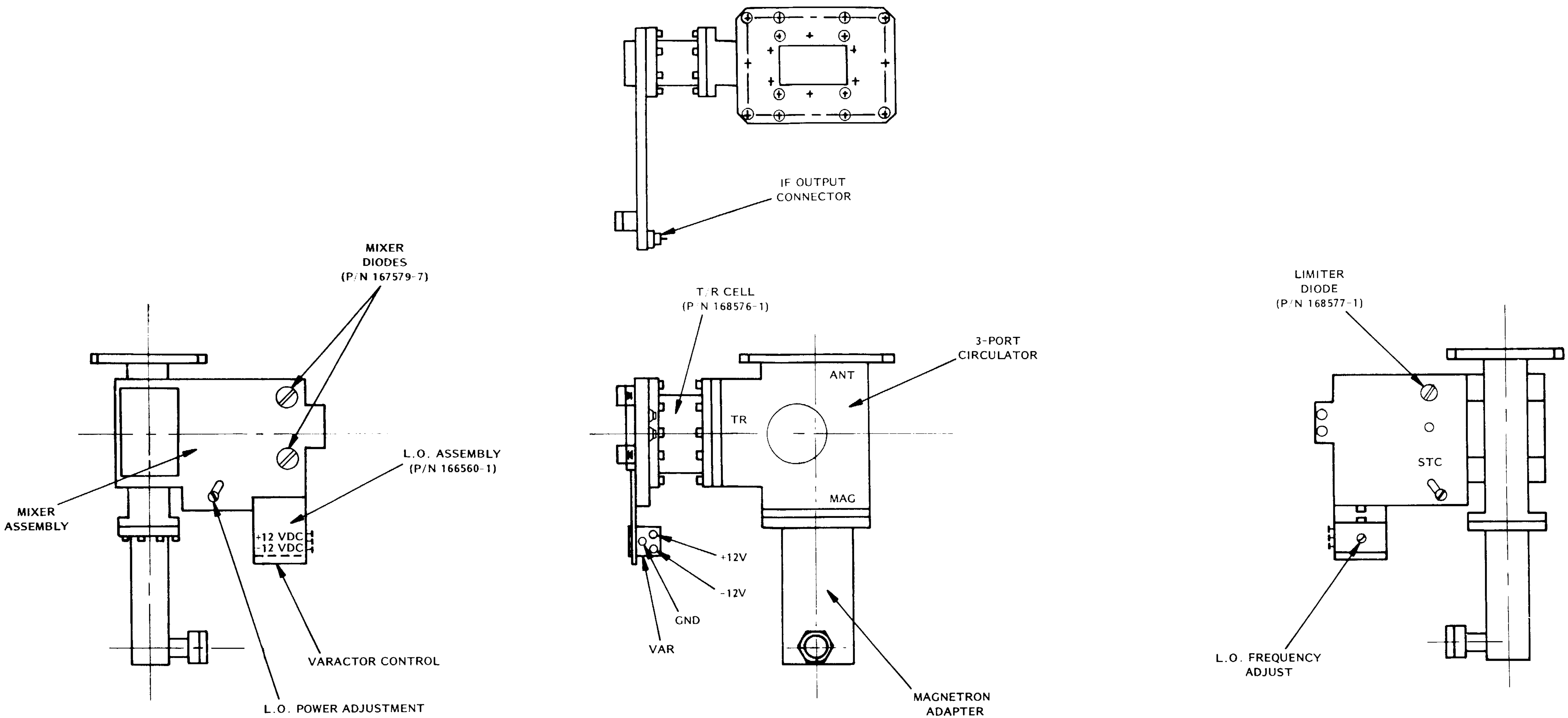


Figure 5-19. Microwave Assembly A8 Parts Locations (V4) (RT-1241)

8. Observe identified target on oscilloscope and carefully adjust local oscillator frequency adjustment control to obtain maximum target signal amplitude.

9. Set MONITOR SELECT switch to XTAL 1.

10. Turn local oscillator power adjustment control (see Figure 5-19) to obtain a reading at the center of the green zone on test meter M1.

11. Set MONITOR SELECT switch to XTAL 2.

12. Verify green zone reading on test meter M1.

NOTE:

If a green zone reading is not obtained in step 12, the mixer diodes should be replaced.

13. At master Indicator, adjust TUNE, GAIN and CONTRAST controls to optimize CRT target display.

5.17.3.6 Anti-Clutter Sea (STC) Adjustment (RT-1241) The STC circuit has been factory adjusted. However, re-adjustment may be necessary for a particular installation or following repairs. If, after careful evaluation of performance, it is determined that re-adjustment is necessary, the following procedure shall be used.

NOTE:

Observe settings of Switching Units SA-2139 and refer to Table 3-3 to determine which Indicator is serving as master for Receiver Transmitter RT-1241 (MTR II).

1. At master Indicator:
   a. Set POWER switch to TX ON.
   b. Set RANGE SELECT switch to .25 MILES.
   c. Turn ANTI-CLUTTER SEA control fully counterclockwise.
   d. Adjust GAIN control for normal noise speckle on CRT display.

2. At Receiver Transmitter RT-1241, disconnect cable at J1 of IF Amplifier Assembly A9; install BNC Tee connector on cable and connect Tee at A9J 1.

3. Connect oscilloscope input to Tee connector at A9J1; synchronize oscilloscope from J5 TRIGGER jack on control panel.

4. Turn STC delay control R50 on Pulse Logic PCB A6 counterclockwise until trailing edge of transmit pulse is visible on oscilloscope, then turn R50 clockwise just until trailing edge of transmit pulse is blanked.

5. At master Indicator:
   a. Set RANGE SELECT switch to 24 MILES.
   b. Turn ANTI-CLUTTER SEA and GAIN control fully clockwise.

6. Set oscilloscope for 20 usec/division display.

7. Adjust STC control R57 on Pulse Logic PCB A6 to eliminate noise signal out to 40 usec point on the oscilloscope display.

8. Observe noise signal level at right-hand edge of oscilloscope display; adjust STC control R48 on Pulse Logic PCB A6 to obtain noise level at 100 usec point of the display which is equal to one-half that at the right-hand edge of the display.

5.17.3.7 Resolver Drive PCB Adjustment (V4). - The Resolver Drive PCB A10 in Receiver Transmitter RT-1241 is identical to that used in Video Amplifier AM-6932. See paragraph 5.16.3 for alignment procedure.

5.18 ANTENNA PEDESTAL AB-1248 (V4)

Paragraphs 5.18.1 through 5.18.3 and their related subparagraphs provide corrective maintenance data for Antenna Pedestal AB-1248 (S-band). The information includes troubleshooting instructions (5.18.1), removal and replacement procedures (5.18.2) and alignment procedures (5.18.3). The locations of assemblies and major components within Antenna Pedestal AB-1248 are shown in Figure 5-20. Schematic diagrams, parts list tables and assembly drawings applicable to Antenna Pedestal AB-1248 are contained in Section 6.10 of Chapter 6.

Access to the assemblies and components within the Antenna Pedestal AB-1248 is provided as follows:

1. Access to the rotary joint, data gear box assembly, gear reducer oil filler port and terminal boards is obtained via the main access door at the front of the pedestal which is secured by six captive screws.

2. Alignment access for synchro transmitter B3 (part of data gear box assembly) is provided through a small access hatch at the front of the pedestal, above the main access door.

3. Access to the drive belts and drive sheave is afforded by a removable access cover at the bottom rear of the pedestal.

4. Access to the antenna drive motor is obtained by removing the cover at the top rear of the pedestal.

5.18.1 Troubleshooting Procedure (V4)

Fault isolation within the Antenna Pedestal AB-1248 is facilitated by use of Troubleshooting Chart, Figure 5-21. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

SYMBOL	LEGEND
A	Antenna Support (T-Bar)
B	RF Cable Feed-through Fitting
C	Drive Assembly
D	Synchro Transmitter B3
E	ON/OFF Safety Switch
F	Oil Fill/Level-Check Hose
G	Terminal Board TB3
H	Oil Fill Port/Breather Plug
J	Data Gear Box Assembly (See Figure 5-22)
K	Resolver B2
L	Terminal Board TB1
M	Gear Reducer Assembly
N	Rotary Joint Assembly
P	Terminal Board TB2
Q	Turnbuckle
R	Motor Mounting Bolts (4 each)
S	Drive Belts (2 each)
T	Drive Sheave
U	Drive Motor B1
V	Waveguide-to-Coaxial Cable Transition Assembly

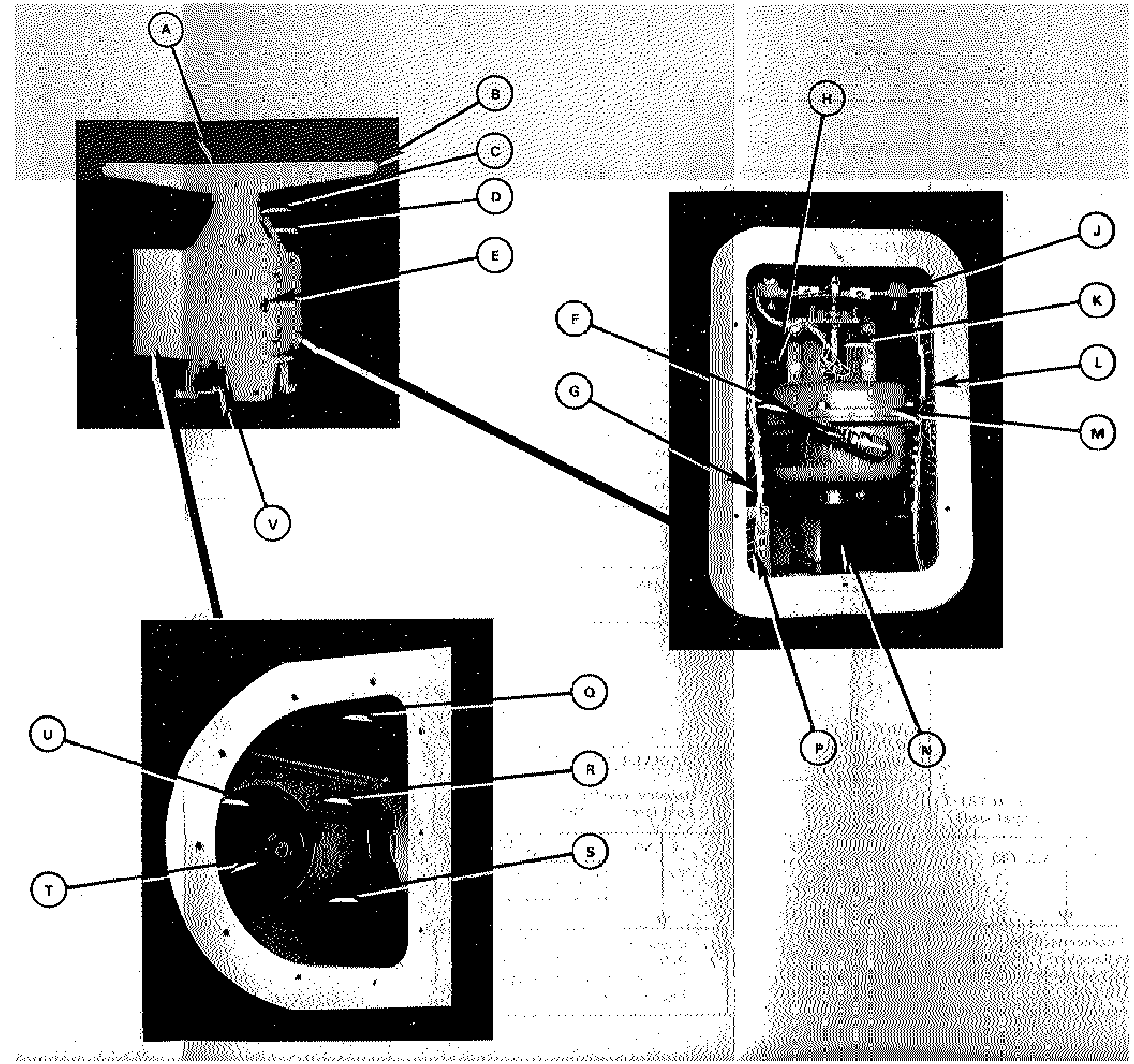


Figure 5-20. Antenna Pedestal AB-1248 Parts Location (V4).

START

(1) INITIAL CHECKS

1. In V2 or V3 system, determine which indicators are driven by MTR-II (check mode at SA-2139 Switching Units).
2. Set Indicator (master) POWER switch to TX ON.
3. After three-minute delay, verify following:
   a. Antenna rotating.
   b. At each Indicator driven by MTR-II:
      (1) Normal sweeps
      (2) Heading Flash

- NO SWEEPS AN/SPA-25 -66 → A
- NO ANTENNA ROTATION → B
- NO HEADING FLASH AN/SPA-25 AND -66 ONLY → C

(A, B, C) TO SHEET (2)

- NO HEADING FLASH, ANY INDICATOR → (4)
- NO SWEEPS AN/SPS-64 INDICATORS → (2)

(4) HF SWITCHING CHECK

1. Set Indicator (master) POWER switch to OFF.
2. Connect ohm-meter between TB1-12 and TB1-13.
3. Check for short circuit as antenna is manually rotated through 0° relative bearing.

- NO SHORT → (9)
- SHORT → (10)

(9) MAGNET CHECK

1. Remove access cover on front of pedestal.
2. Visually inspect magnet assembly on data gear: insure magnet is in place and secure. If missing, locate inside pedestal.

- SECURE → (11)
- LOOSE OR MISSING → (12)

(10)

1. Check interconnections.
2. Refer to Switching Units SA-2139 and SA-2156 Troubleshooting, Para. 5.13.

(11) HF SWITCH CHECK

Visually inspect switch assembly; insure secure in clamp.

- SECURE → (12)
- LOOSE → (12)

(12) Align per Para. 5.18.3.1.

- NO SWITCH CLOSURE → (13)

(13) Replace S2 switch assembly and/or magnet.

(2) RESOLVER OUTPUT CHECK

CAUTION: USE GROUND-ISOLATING ADAPTER ON OSCILLOSCOPE POWER PLUG.

1. Measure waveform (A) at following points:
   a. Gnd Lead: TB1-6 (R3) Probe: TB1-5 (R1)
   b. Gnd Lead: TB1-7 (R2) Probe: TB1-8 (R4)
2. Measure waveform (B) at TB1-3 (probe) and TB1-4 (gnd lead).

- WAVEFORM (A) AMPLITUDE CONSTANT → (5)
- ANY WAVEFORM MISSING → (6)
- ALL YES → (3)

(5) Check resolver B2 rotor mechanical linkage.

(6) RESOLVER INPUT CHECK

Measure waveform (C) at TB1-2 (gnd lead) and TB1-1 (probe).

- YES → (7)
- NO → (8)

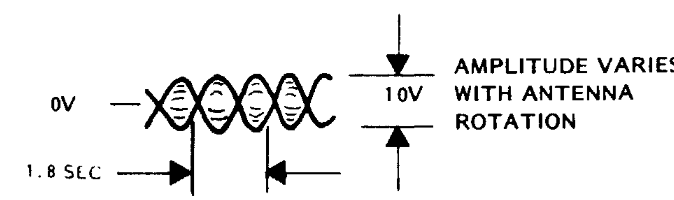
(7) Replace resolver B2.

(3)

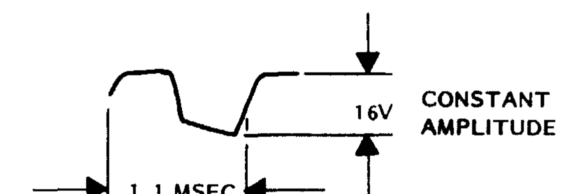
1. Check interconnections.
2. Refer to Receiver Transmitter RT-1241 Troubleshooting Chart, Fig. 5-17 (32).

(8)

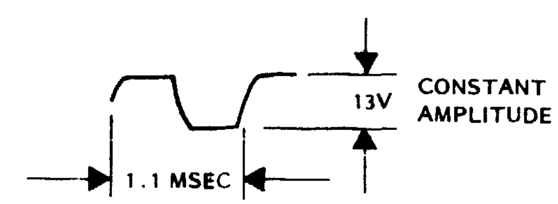
1. Check interconnections.
2. Refer to Receiver Transmitter RT-1241 Troubleshooting Chart, Fig. 5-17 (83).



WAVEFORM (A)



WAVEFORM (C)



WAVEFORM (B)

Figure 5-21. Antenna Pedestal AB-1248 Troubleshooting Chart (V4) (Sheet 1 of 2).

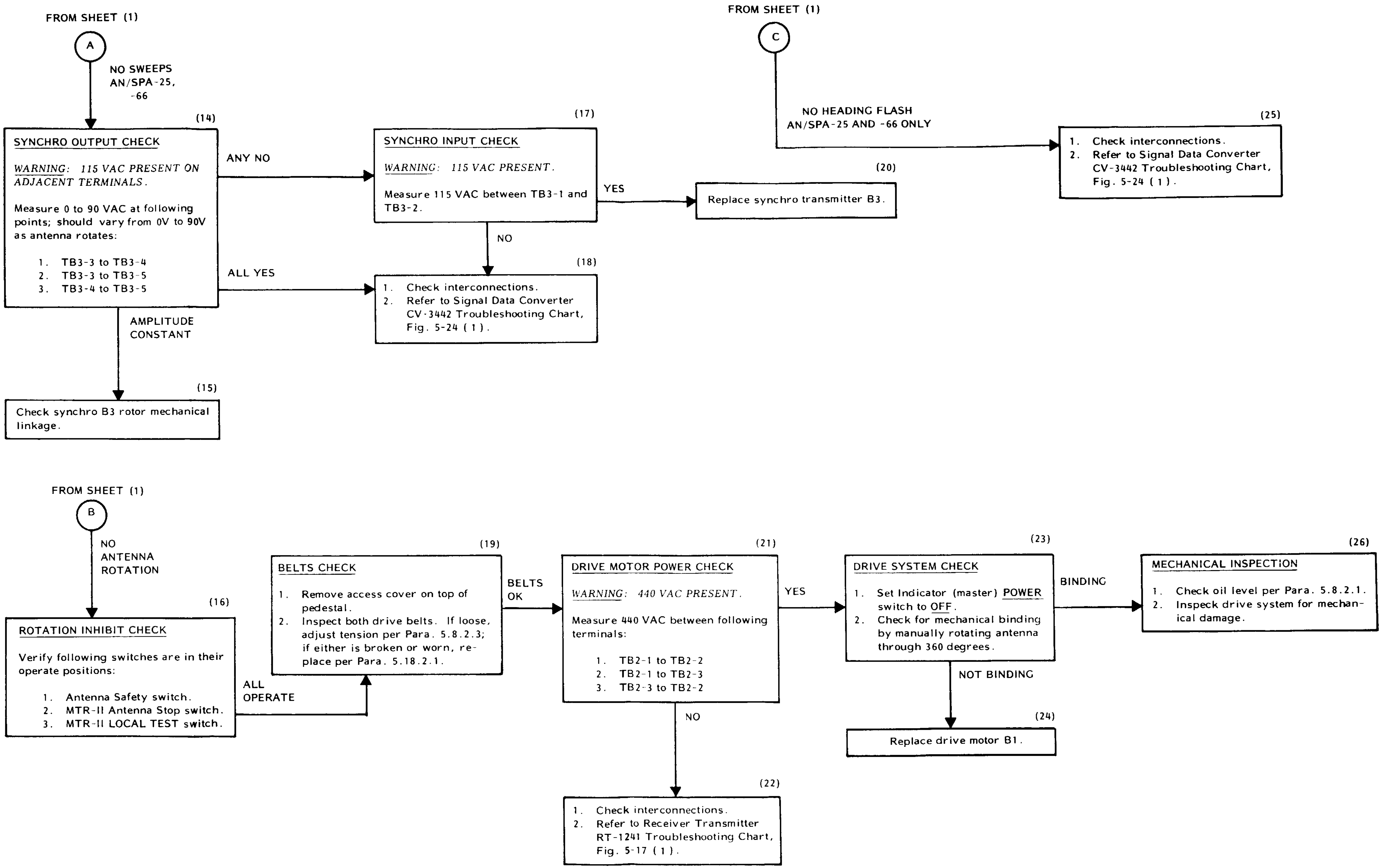


Figure 5-21. Antenna Pedestal AB-1248 Troubleshooting Chart (V4) (Sheet 2 of 2).

5.18.2 Removal/Replacement Procedures AB-1248

Before initiating any removal and replacement activity at Antenna Pedestal AB-1248 insure that all power is removed from the equipment by performing the following steps:

1. Set ON/OFF Safety switch at front of pedestal to OFF.
2. Set POWER switch to OFF at (master) Indicator for associated Receiver Transmitter RT-1241.
3. Turn off and tag ship's circuit breakers which supply power to associated Receiver Transmitter RT-1241.

There are three access ports to be used for disassembly or service functions: a large front access hatch with captive fasteners only to be released; and two aft openings, upper and lower. Use only tools of a non-ferrous material.

5.18.2.1 Drive Belt (Matched Pair). -

1. Remove power per paragraph 5.18.2.
2. Access for belt removal is through the forward access hatch and the lower aft covered opening.
3. Do not force belts over sheaves. Back off on the turnbuckle accessible through the forward access hatch. Turn the lock nut clockwise when facing aft, and the turnbuckle counterclockwise to loosen sheaves.
4. Slip belts from sheaves in both forward and aft locations.
5. Reassemble in the reverse of above. Apply tension until belt at mid-span has 1/8-inch deflection when 4 to 5 pounds is applied. After tensioning, tighten the turnbuckle anchor bolt and locknuts on the turnbuckle.

5.18.2.2 Drive Motor B1. -

1. Remove power per paragraph 5.18.2.
2. Remove drive belts per paragraph 5.18.2.1.
3. Remove aft top cover (9 bolts and 1 eye bolt) .
4. Turn the blower wheel until the flat of the motor shaft faces the accessible area needed to place a tool into the 5/16-24 set screw holding the blower wheel firm to the shaft.
5. Pull the blower wheel up off the shaft.

NOTE:

The forced fit of the blower wheel onto the shaft necessitates a special tool to aid in the removal of the blower wheel and caution must be used to avoid damage to the blower wheel.

6. Remove the 2 self--thread screws and 2 motor cover screws to release the baffle plate.
7. Disconnect the motor hook up wires, noting the locations.
8. Remove the 4 hex head bolts at the base of the motor using the aft lower access, and lift the motor up and out.
9. Reassemble using the reverse of above.

5.18.2.3 Resolver B2 (Data Gear Assembly). -

1. Remove power per paragraph 5.18.2.
2. Open the forward access hatch.
3. Disconnect the harness at the data gear assembly connector location with a grease pencil, near the data gear location.
4. Remove the 2 alien screws holding the gear assembly, and lower the gear assembly down and out of the pedestal.
5. Disconnect the resolver wires, noting hookup locations.
6. Remove the 3 screws that attach the resolver to the gear assembly, and pull the resolver out.
7. Reassemble in the reverse of above.

5.18.2.4 Synchro Transmitter B3 (Data Gear Assembly) .

1. Remove power per paragraph 5.18.2.
2. Remove the data gear assembly per paragraph 5.18.2.3.
3. Remove the 4 screws at the base of the synchro, and loosen the lock nut assembly that attaches the shaft on the synchro to the gear assembly shaft, and remove the synchro.
4. Reassemble in the reverse of above using loctite on the gear assembly shaft.

5.18.2.5 Gear Reducer Assembly (Pedestal Drive Assembly) . -

1. Remove power per paragraph 5.18.2.
2. Remove the drive belts per paragraph 5.18.2.1.
3. Unhook the turnbuckle per paragraph 5.18.2.1.
4. Remove the 16 bolts that attach the pedestal drive assembly to the pedestal assembly.
5. Remove the pedestal drive assembly up and out. A crane is necessary for this procedure.
6. Remove the four adapter coupling bolts attaching the reducer assembly to the pedestal drive assembly, and slide the reducer assembly away.
7. Reinstall using the reverse of the above.

5.18.2.6 Rotary Joint Assembly. -

1. Remove power per paragraph 5.18. 2.
2. Access for this procedure uses the forward access hatch.
3. Remove the ten 1/4 inch stainless steel screws that secure the transition from the rotary joint and remove the transition.
4. Remove the four 7/16 inch stainless steel cap screws from the wave guide portion of the rotary joint.
5. Carefully remove the wave guide portion from the rotary joint making sure not to damage the probe.
6. Loosen the 7/16-inch nut on the V-band clamp and carefully lower the assembly down under the pedestal assembly. The fit is tight due to an O-ring between the pedestal housing and the rotary joint housing, therefore the rotary joint assembly must be PULLED down and out.

CAUTION

THERE IS A TUBE/PROBE LOCATED AT THE UPPER PORTION OF THE ROTARY JOINT ASSEMBLY THAT EXTENDS INTO A SMALL TUBE WITHIN A TUBE IN THE CABLE ASSEMBLY. CARE MUST BE EXERCISED TO AVOID DAMAGE TO THE PROBE.

7. The tube/probe should accompany the rotary joint assembly when it is removed. There is also an O-ring (seal) located at the upper joining surface that must not be lost.

8. Reassembly consists of leading the probe back into the mating tube of the cable assembly. Correct mating is essential, and when this is assured, tighten the V-band clamp. To complete re-installation reverse the above procedure.

5.18.2.7 Reed Switch Assembly S2 (Data Gear Assembly). -

1. Remove power per paragraph 5.18.2.
2. Remove the reed switch assembly by snapping it out of the fuse clip, noting polarity.
3. Replace using the reverse of above. Adjust for proper dwell angle per Figure 5-22.

5.18.2.8 Magnet Assembly - Qty. of 2 (Data Gear Assembly). -

1. Remove the power per paragraph 5.18.2.
2. Use the forward access hatch for this procedure.
3. Locate the magnet on the data gear, and turn the gear until maximum access to the magnet is achieved.
4. The magnet is seated in a silicon compound and may be pushed out of the holding bracket.
5. Reassemble using fresh silicon compound when installing the magnet into the bracket.

5.18.2.9 Antenna Array. - The antenna is mounted onto the antenna support of the pedestal drive assembly. A 1/4-inch bead of RTV compound was installed around the antenna support, just inside the mounting holes. The procedure for removing the antenna array is given below.

1. Remove power per paragraph 5.18.2.
2. Remove the three connector screws using caution to retain the O-ring and the insulator.
3. Remove the connector cable from the antenna and attach the cable in such a way that no sharp bends are permitted as this will damage the interior of the cable tubing.
4. Remove the 12 bolts that attach the antenna array to the antenna support.
5. Reinstall the antenna array using a 1/4-inch bead of fresh RTV compound all around the support to seal the antenna array to the antenna support.

5.18.2.10 RF Cable Assembly. -

1. Remove power per paragraph 5.18.2.
2. Remove the antenna array per paragraph 5.18.2.9.
3. Remove the data unit assembly per paragraph 5.11.2.4.
4. Using the gear reducer tool, prop the gear reducer assembly, supporting it into a stable position.
5. Remove the four nuts attaching the coupling adapter together. Use caution to retain the plates and key.
6. Using the special wrench, unscrew the waveguide nut holding the cable assembly to the gear reducer assembly.
7. Remove the cable flange located on the end of the antenna support, and carefully pull the cable assembly up and out, using caution to protect the probe located within the rotary joint assembly.
8. Reinstall using the reverse of above. Use the special tool as an aid to the reinsertion of the probe into the rotary joint assembly.

5.18.3 <u>Alignment Procedures (V4)</u>

The procedures given in paragraph 5.18.3.1 through 5.18.3.4 following cover the normally required shipboard alignments applicable to Antenna Pedestal AB-1248. Refer to Figure 5-20 for location of assemblies and major components.

5.18.3.1 Bearing and Heading Line Adjustment (V4). - The Sweep Circuits Alignment procedure given in paragraph 5.12.3.5 must be checked (and accomplished if necessary) at the master Indicator prior to performance of this procedure.

NOTE 1:

Refer to Table 3--3 and observe settings of Switching Units SA-2139 to determine which Indicator is serving as master for Receiver Transmitter RT-1241 (MTR II) and Antenna Pedestal AB-1248.

NOTE 2:

The term Indicator, as used in the following steps, refers to the master Indicator.

NOTE 3:

The following procedure should be performed with the ship tied-up in port.

1. Set Indicator HD UP/GYRO STAB/HDG SET switch to HD UP position. Identify a fixed target within +10° of 0° relative both visually and on the Indicator CRT display.
2. Using the ship's port and starboard pelorus, measure the visual bearing to the target. Convert the pelorus reading to relative bearing and compute the mean of the two readings. Use the computed mean bearing in the following steps.

3. Using the Indicator CURSOR control, position the cursor graticule line directly over the target.

4. Observe the Indicator relative bearing scale and note the reading intersected by the cursor graticule line. This reading should correspond to that indicated by the ship's pelorus (±1°).

NOTE:

If the bearing error observed in step 4 is less than ±1.5°, perform steps 5 through 11 only. If the error is 1.5° or greater, perform steps 12 through 23 first, then steps 1 through 11.

5. Carefully measure the magnitude and direction of bearing error. For example, if the pelorus reading is 45° and the bearing scale reading is 50°, the bearing error is +5°. If the bearing scale reading is 41°, the bearing error is -4°.

6. Using the CURSOR control, set the graticule line to the exact number of degrees on the plus or minus side of 0° corresponding to the error reading determined in the previous step. In the example given, the graticule should intersect +5° (005°) or 4° (356°) .

WARNING

EXERCISE EXTREME CARE WHEN WORKING NEAR A ROTATING ANTENNA.

7. Open the front access door at the antenna pedestal.

WARNING

440 VAC AND 115 VAC ARE PRESENT AT TERMINAL BOARDS INSIDE THE ACCESS DOOR.

8. Loosen (do not remove) the two screws which secure the reed switch bracket to the data gear box assembly (see Figure 5-20).

9. Slide the reed switch bracket horizontally until the heading line is displayed directly under the cursor graticule line on the CRT display (sliding the bracket to the left rotates the heading line counterclockwise on the display) . Tighten the bracket securing screws, insuring that heading line alignment is maintained.

10. Loosen (do not remove) the three screws which secure resolver B1.

11. Carefully rotate the body of resolver B1 until the heading line is displayed at exactly 0° relative on the CRT display. Tighten the resolver securing screws, insulating that alignment is maintained.

NOTE:

Upon completion of step 11, alignment of synchro transmitter B3 must be checked (and performed if necessary) per paragraph 5.18.3.2 following.

12. Set Indicator POWER switch to OFF.

13. At the antenna pedestal, set the ON/OFF switch to OFF and open the front access door.

NOTE:

During the following steps, the antenna must always be turned clockwise (as viewed from above), even if it means making a full rotation. Moving the antenna back and forth causes the normal backlash in the gears to introduce bearing errors.

14. Manually rotate the antenna clockwise until the holes in the squint plate are aligned precisely with the bow; maintain the antenna in this position through step 21 following.

15. Loosen (do not remove) the two screws which hold the reed switch bracket. Slide the bracket left and right to find the limits of movement, then center the bracket between the limits and tighten the screws.

16. Connect a multimeter, set for resistance measurement, between TB1-12 and TB1-13. Maintain this connection through step 21 following.

17. Locate the two hex screws which hold the data gear box assembly. Keeping the data gear and drive gear meshed, slightly loosen the right-hand screw and remove the left-hand screw.

18. Pivot the data gear box assembly around the right-hand screw to disengage the data gear from the drive gear.

19. Rotate the data gear to the position at which the reed switch closes (multimeter indicates short).

20. Viewing the data gear from below, carefully rotate the data gear counterclockwise until the reed switch opens (multimeter indicates open circuit), then rotate it very carefully clockwise just until multimeter indicates a short.

NOTE:

In performing the following step, insure that the data gear does not move more than one-half of a gear-tooth interval to obtain the nearest mesh.

21. Pivot the data gear box into its normal position, obtaining the nearest mesh between the data gear and the drive gear. Replace and tighten the data gear box hex screws.

22. Disconnect the multimeter. Set the antenna pedestal ON/OFF switch to ON.

23. Set the Indicator POWER switch to TX ON. After a three-minute time delay, verify heading line is displayed at 0° on CRT with less than 1.5° error.

NOTE:

If heading line error is less than 1.5°, return to step 1. If the error is 1.5° or greater, note the direction in which the CRT heading must be rotated to move it to 0° relative and perform steps 24 through 27 following.

24. Repeat steps 12 through 17 above.

25. Identify the point of mesh between the data gear and drive gear.

NOTE:

Each mesh point (gear tooth interval) between the data and drive gears represents 2.8° of rotation of the heading line on the CRT. Rotating the data gear clockwise (as viewed from below) rotates the CRT heading line counterclockwise.

26. Keeping the existing mesh point identified, pivot the data gear box assembly just far enough to disengage the data gear. Using the degrees per tooth and rotational direction information noted above, carefully rotate the data gear by the number of teeth and in the direction necessary to move the CRT heading line to 0° relative.

27. Repeat steps 21 through 23 above, observing the notes preceding step 21 and following step 23.

5.18.3.2 Synchro Transmitter Alignment (V4). - The following steps provide instructions for aligning the synchro transmitter in Antenna Pedestal AB-1248 which provides antenna azimuth data for the AN/SPA-25 and AN/SPA-66 indicators. The Bearing and Heading Line Alignment given in paragraph 5.18.3.1 must be correct prior to performance of this procedure.

1. Set all AN/SPS-64(V) Indicator POWER switches to OFF. Set Signal Data Converter CV-3442 POWER switch to OFF.

2. Refer to Table 3-3 and set Switching Units SA-2139 for DS-7 mode.

NOTE:

Selection of DS-7 mode permits system operation to continue using MTR I (X-band) and Indicators A and B while the following procedure is performed.

3. At Antenna Pedestal AB-1248 (S-band):
   a. Set ON/OFF switch to OFF.
   b. TB3 terminals 3, 4 and 5 and TB1 terminal 13.

NOTE:

During the following steps, the antenna must always be turned clockwise (as viewed from above), even if it means making a full rotation. Moving the antenna back and forth causes the normal backlash in gears to introduce bearing errors.

4. Manually rotate the S-band antenna clockwise until the face is pointing slightly to the left of the bow (approximately 340° relative); maintain this position through step 6 following.

5. Open the access door at the front of the antenna pedestal and remove the access cover above the door.

6. Connect multimeter, set for resistance measurement, between TB1-12 and TB1-13 (see Figure 5-20) .

7. Slowly rotate the antenna clockwise, stopping just when the multimeter indicates a short circuit (heading line switch closure).

NOTE:

Maintain the multimeter connections at TB1-12 and TB1-13; check the multimeter reading prior to each of the following steps to insure that switch closure is maintained.

8. Install a jumper between TB3-2 (R2) and TB3-5 (S3).

9. Connect a second multimeter, set to 250 Vac scale, between TB3-1 (R1) and TB3-4 (S2).

10. Set Signal Data Converter CV-3442 POWER switch to ON.

WARNING

115 VAC IS PRESENT AT TB3 AND SYNCHRO TRANSMITTER B3.

11. Loosen (do not remove) the three screws which secure synchro transmitter B3 (see Figure 5-20 and 5-22); turn the body of the synchro to obtain minimum voltage reading (null) on the multimeter. Snug the screws which secure synchro B3.

12. Set Signal Data Converter CV-3442 POWER switch to OFF.

13. At Antenna Pedestal:
    a. Remove jumper between TB3 2 and TB3-5.
    b. Connect external leads at TB3 terminals 3, 4 and 5.

14. Set the second multimeter to the 250 Vac scale and connect it between TB3 3 (S1) and TB3-5 (S3); reduce the voltage setting progressively to 2.5 Vac as alignment is achieved in step 16 following.

15. Set Signal Data Converter CV-3442 POWER switch to ON.

NOTE:

Verify first multimeter indicates a short circuit before proceeding.

WARNING

115 VAC IS PRESENT AT THE TERMINALS OF SYNCHRO TRANSMITTER B3; EXERCISE CARE TO AVOID CONTACT.

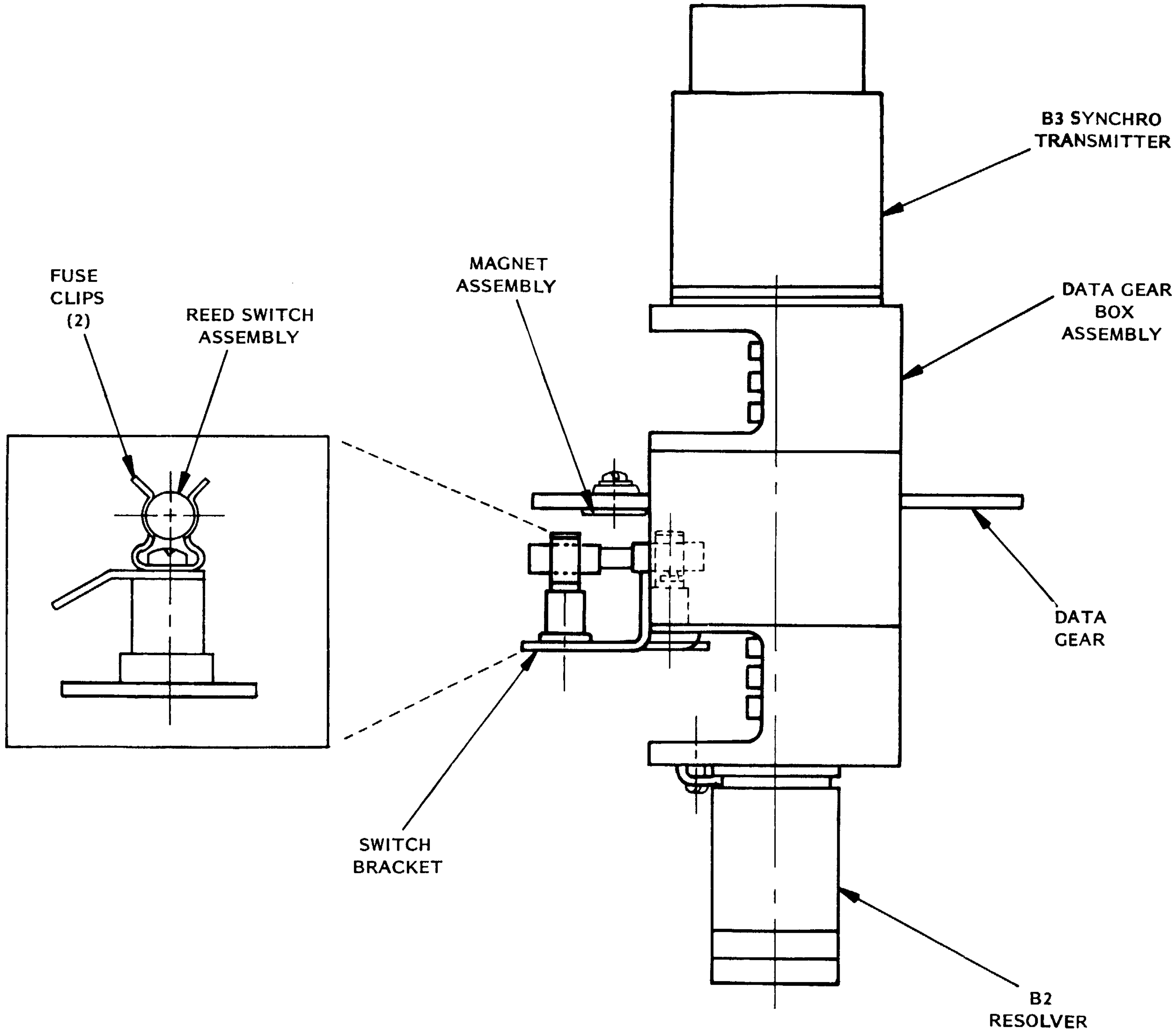


Figure 5-22. Data Gear Box Assembly Parts Location AB-1248

16. Loosen (do not remove) the screws which secure synchro transmitter B3. Carefully turn the body of the synchro to obtain zero Vac (null) reading on the multimeter, tighten the securing screws, insuring that zero Vac reading is maintained.

17. Set Signal Data Converter CV-3442 POWER switch to OFF.

18. At Antenna Pedestal:

a. Disconnect multimeters.

b. Reconnect wire to TB1-13.

c. Close and secure front access

d. Set ON/OFF switch to ON.

19. Set Indicator C (master for MTR II, S-band) POWER switch to TX ON.

20. Set POWER switches to ON at the following units:

a. Video Amplifier AM-6932

b. Signal Data Converter CV-3442

c. AN/SPA-25 and AN/SPA-66 indicators.

21. At Signal Data Converter CV-3422, select relative bearing (RB) display for AN/SPA-25 and AN/SPA-66 indicators.

22. At AN/SPA-25 indicator, select display from AN,/SPS-64(V) radar; verify heading line is displayed at 0° relative (see notes following next step) .

23. Repeat step 23 for AN/SPA-66 indicators.

NOTE 1:

The synchro control transformers at the AN/SPA-25 and AN/SPA-66 indicators are zeroed for operation with other ships radars; do not adjust these synchros.

NOTE 2:

If the heading lines on the AN/SPA-25 and AN/SPA-66 indicators occurs at the same bearing (but not 00 relative), loosen the antenna pedestal synchro transmitter, turn its body to position the heading lines at 0° relative on the AN/SPA-25 and tighten the synchro.

5.18.3.3 Belt Tension Adjustment (V4). - The belt tension adjustment procedure for Antenna Pedestal AB-1248 (S-band) is contained in Preventive Maintenance, Section II, refer to paragraph 5.7.2.3.

5.18.3.4 Sheave Alignment (V4). - The sheave alignment procedure for Antenna Pedestal AB-1248 is contained in Preventive Maintenance, Section II; refer to paragraph 5.7.2.4.

5.19 SIGNAL DATA CONVERTER CV-3442 (V4)

Paragraphs 5.19.1 through 5.19.3 and their related subparagraphs provide corrective maintenance for Signal Data Converter CV-3442 (SPA Interface Unit). The information includes troubleshooting instructions (5.19.1), removal and replacement procedures (5.19.2) and alignment procedures (5.19.3). The locations of assemblies and major components within Signal Data Converter CV-3442 are shown in Figure 5-23. Schematic diagrams, part list tables and assembly drawings applicable to Signal Data Converter CV-3442 are contained in Section 6.11 of Chapter 6.

Access to the assemblies and components within the Signal Data Converter CV-3442 is provided by loosening the six captive screws in the corner and removing the cover.

5.19.1 Troubleshooting Procedure (CV-3442)

Fault isolation within the Signal Data Converter CV-3442 is facilitated by use of Troubleshooting Chart, Figure 5-24. Instructions for use of the troubleshooting chart are given in paragraph 5.9.1.

5.19.2 Removal/Replacement Procedures (CV-3442)

Before initiating any removal or replacement activity at Signal Data Converter CV 3442, insure that all power is removed from the equipment by performing the following steps:

1. Set ON/ OFF Safety switch at front of antenna pedestal to OFF.

2. Set POWER switch to OFF at (master) Indicator for associated Receiver Transmitter RT-1241.

3. Turn off and tag ship's circuit breakers which supply power to associated Receiver Transmitter RT-1241.

4. Set Signal Data Converter CV-3442 ON/OFF switch to OFF.

5. Remove fuses located on the outer case of the Signal Data Converter.

6. Remove the cover of the Signal Data Converter by loosening the six captive screws.

5.19.2.1 Power Supply PS1. -

1. Remove power per paragraph 5.19.2.

2. Disconnect the wires from the power supply, noting hook-up locations.

SYMBOL	LEGEND
A	Stepper Motor Assembly A3
B	PCB Assembly
C	Power Supply Assembly PS1
D	Distribution Panel Assembly A2
E	Terminal Boards A2TB1, A2 TB2
F	Heading Line Intensity Controls A2R1, A2R2
G	Input Connectors (BNC) A2J1, A2J2
H	Terminal Board A2TB3
J	Output Connectors (BNC) J1 through J4
K	Fan B1
L	Terminal Boards A3TB1, A3TB2
M	Terminal Board TB1
N	NS/RB Switch A3S1
P	Power Switch S1
Q	Fuses F1, F2
R	Synchro Differential Generator A3B2
S	Line Filter FL1 (behind A3 Assembly)
T	Stepper Motor A3B1
U	North Stabilization Adjustment Knob
V	GYRO STEPPER Switch A3S2
W	Terminal Board TB2 (behind A3 Assembly)
X	Terminal Boards A3TB3, A3TB4

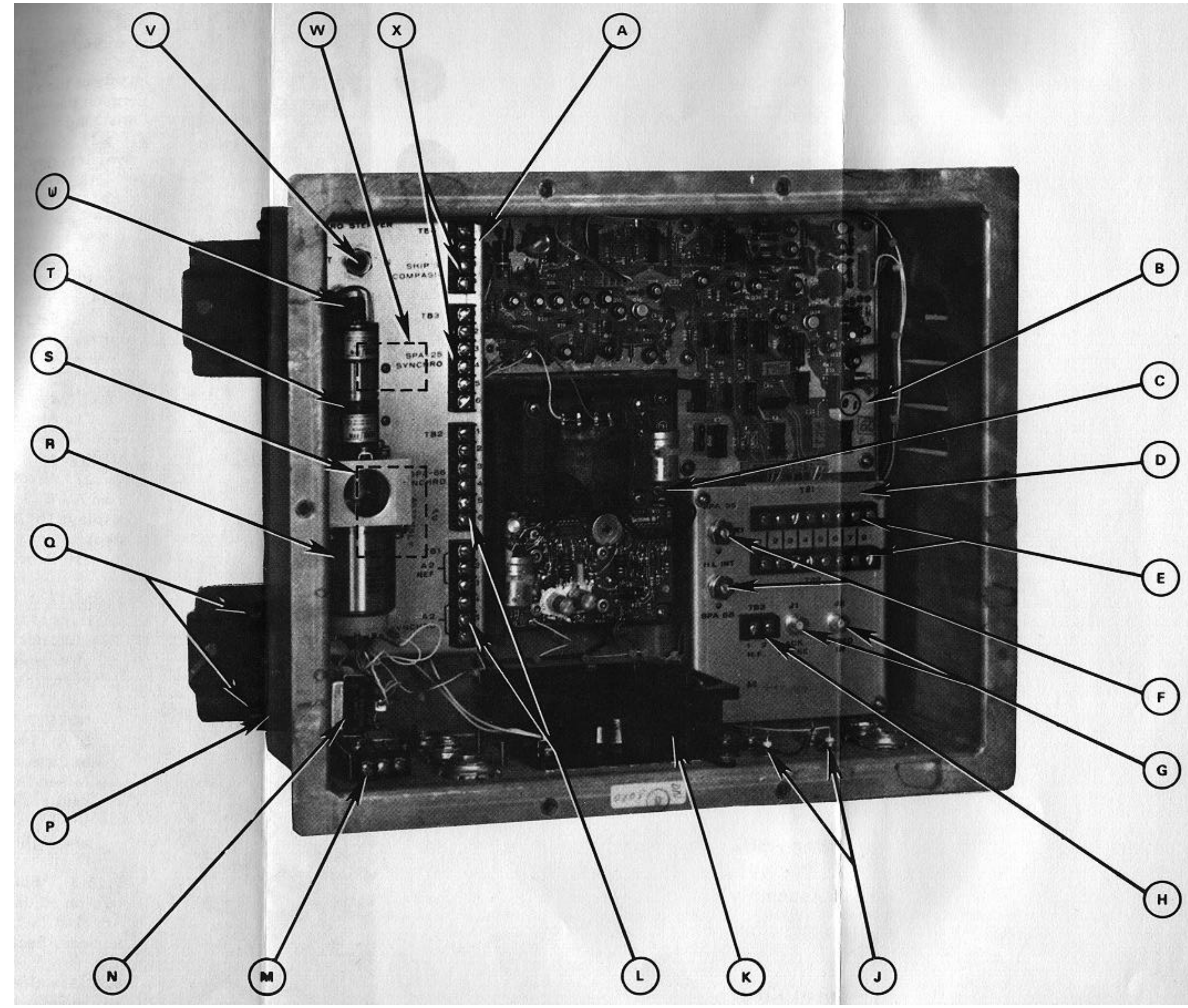


Figure 5-23. Signal Data Converter CV-3442 Parts Location (V4).

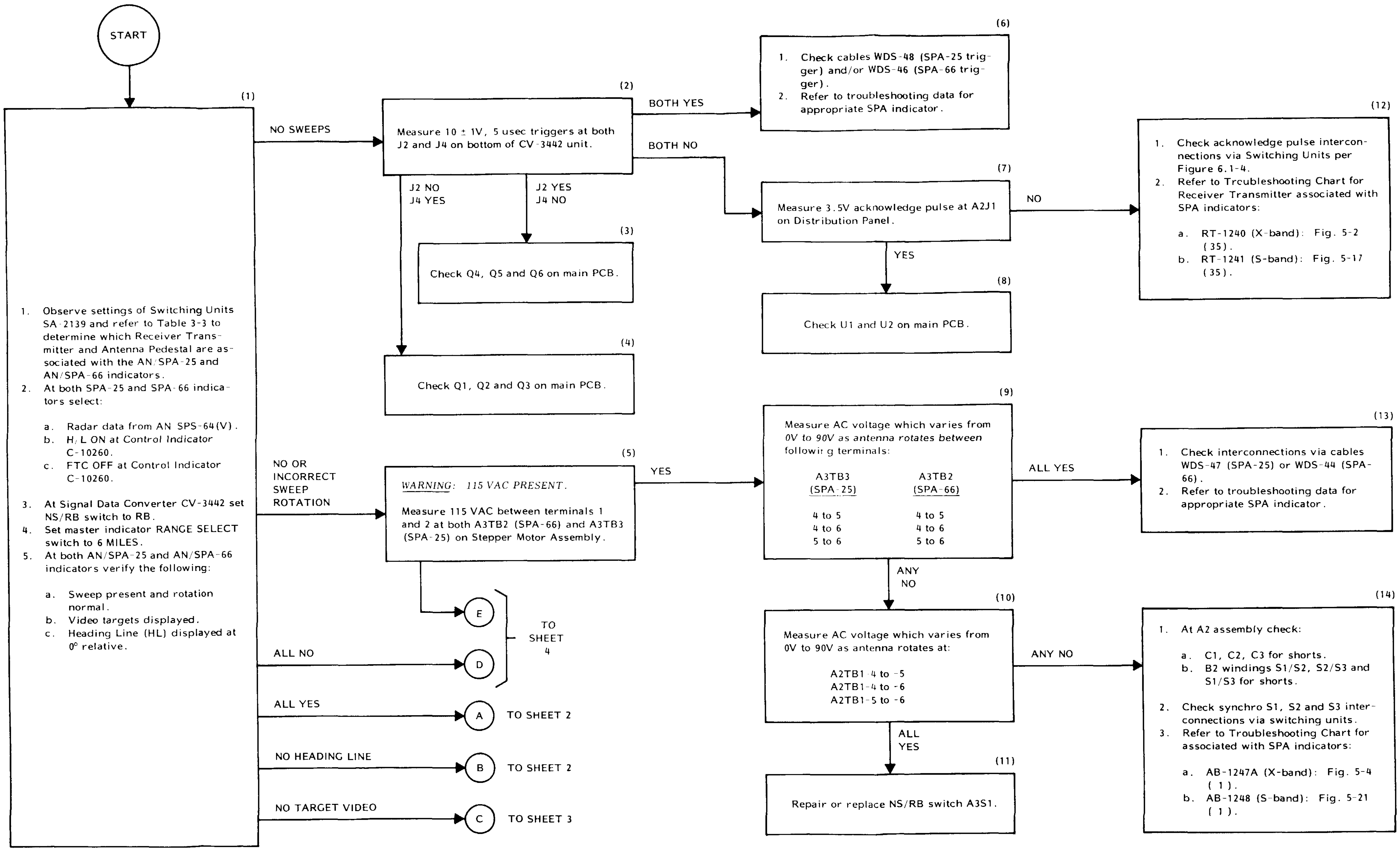


Figure 5-24 Signal Data Converter CV-3442 Troubleshooting Chart (V4) (Sheet 1 of 4)

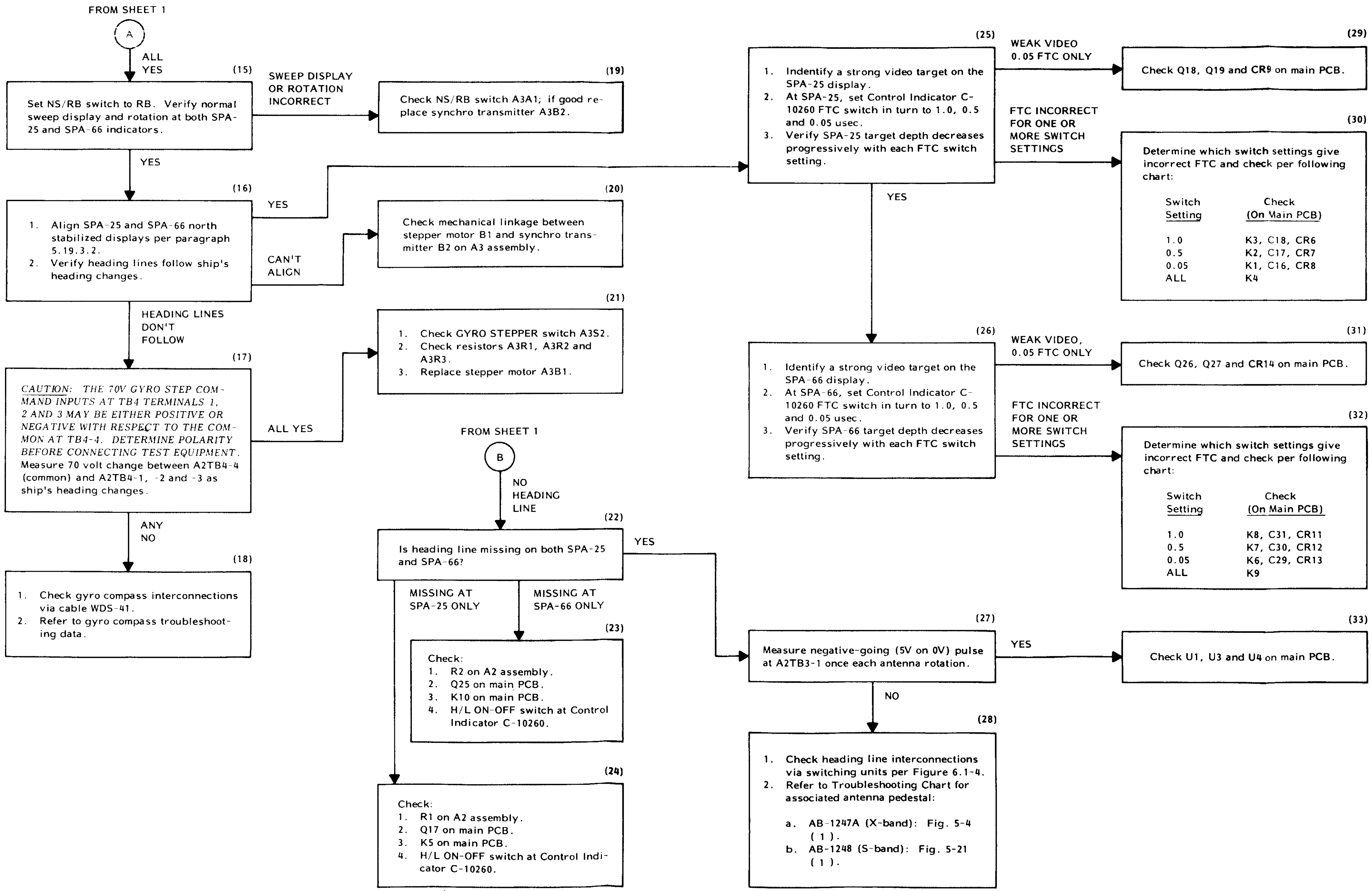


Figure 5-24 Signal Data Converter CV-3442 Troubleshooting Chart (V4) (Sheet 2 of 4)

FROM SHEET 1

(C)

NO TARGET VIDEO

(34) Is video missing from both SPA-25 and SPA-66?

- NO VIDEO, SPA-66 ONLY → (43)
- NO VIDEO SPA-25 ONLY → (38)
- YES → (35)

(35) Measure waveform A at J2 on A2 assembly.

- WAVEFORM CORRECT → (36)
- WAVEFORM INCORRECT OR MISSING → (37)

(36) Check Q7 through Q11 and associated circuits on main PCB.

(37)
1. Check video interconnections via switching units.
2. Refer to Troubleshooting Chart for associated Receiver Transmitter:
   a. RT-1240 (X-band): Fig. 5-2 (32).
   b. RT-1241 (S-band): Fig. 5-17 (32).

(38) At SPA-25 Control Indicator C-10260 set FTC switch to 1.0 usec; is target video displayed on SPA-25?

- YES → (41)
- NO → (39)

(41) Check K4 and C19 on main PCB.

(39) Measure waveform B at J1 on bottom of CV-3442 unit.

- WAVEFORM CORRECT → (42)
- WAVEFORM INCORRECT OR MISSING → (40)

(42)
1. Check interconnections via cable WDS-49.
2. Refer to troubleshooting data for AN/SPA-25 Indicator.

(40) Check the following circuits on main PCB.
1. Q12 and Q13.
2. Q14 through Q16.
3. CR10, R25.
4. Short in cable WDS-49.

(43) At SPA-66 Control Indicator C-10260 set FTC switch to 1.0 usec; is target video displayed on SPA-66?

- YES → (46)
- NO → (44)

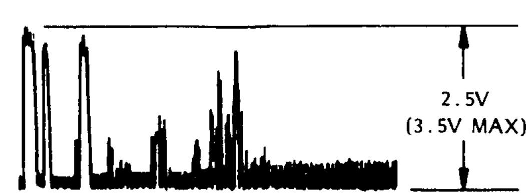
(46) Check K9 and C32 on main PCB.

(44) Measure waveform B at J3 on bottom of CV-3442 unit.

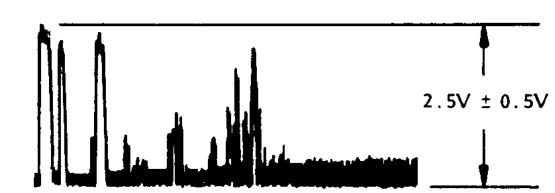
- WAVEFORM CORRECT → (47)
- WAVEFORM INCORRECT OR MISSING → (45)

(47)
1. Check interconnections via cable WDS-45.
2. Refer to troubleshooting data for AN/SPA-66 Indicator.

(45) Check the following circuits on main PCB.
1. Q20 and Q21.
2. Q22 through Q24.
3. CR17, R44.
4. Short in cable WDS-45.



WAVEFORM A
(SHAPE TYPICAL,
5 USEC/DIVISION)



WAVEFORM B
(SHAPE TYPICAL,
5 USEC/DIVISION)

Figure 5-24 Signal Data Converter CV-3442 Troubleshooting Chart (V4) (Sheet 3 of 4)

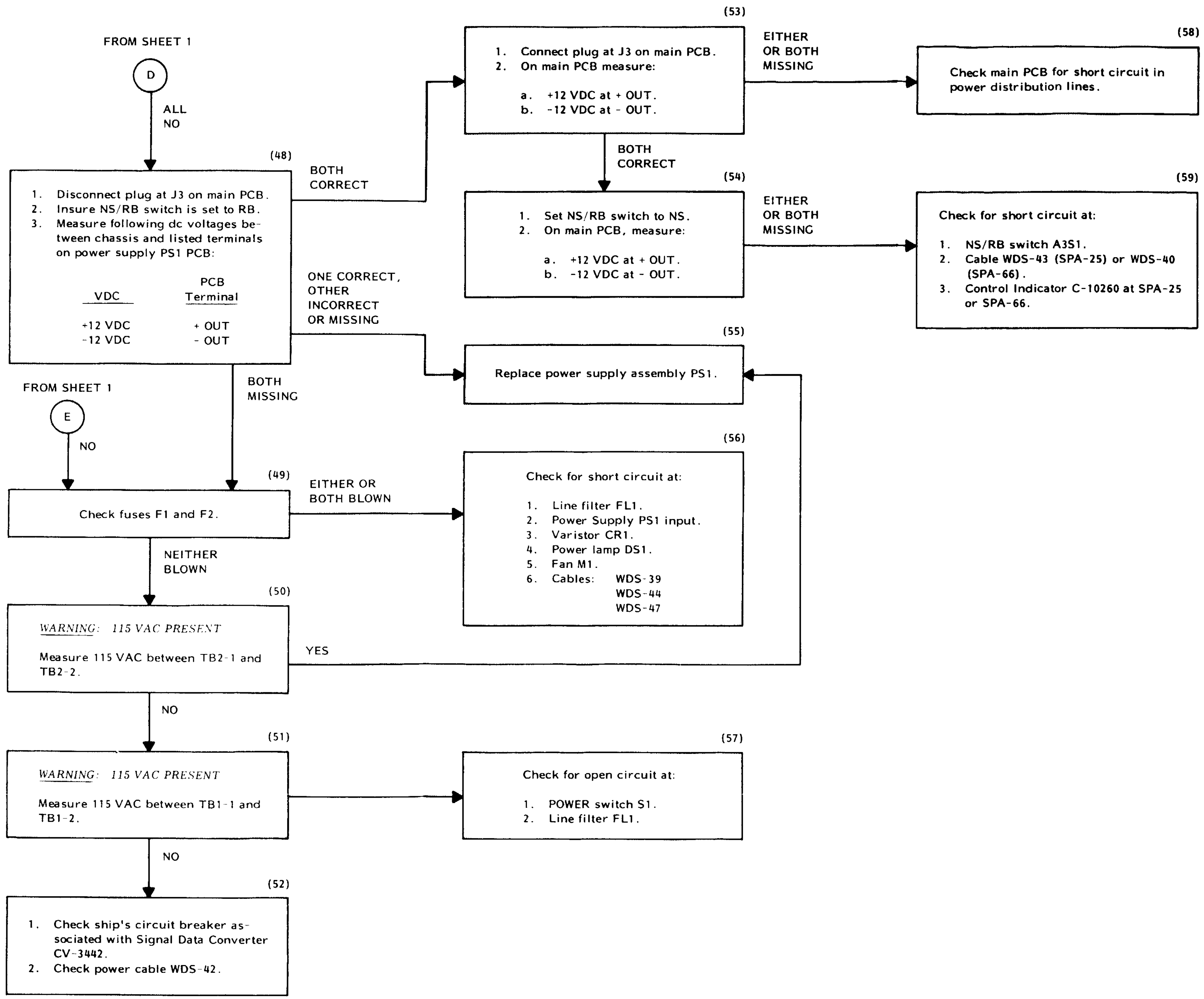


Figure 5-24 Signal Data Converter CV-3442 Troubleshooting Chart (V4) (Sheet 4 of 4)

3. Remove the 4 cross- recessed screws, washers and lockwashers to release the power supply assembly from the data case.

4. Reinstall using the reverse of above.

5.19.2.2 Fan B1.

1. Remove power per paragraph 5.19.2.

2. Disconnect the wires from B1 noting hook up locations.

3. Remove the 4 screws, nuts, washers and lockwashers attaching the fan to the case and lift the fan out.

4. Reinstall using the reverse of above.

5.19.2.3 Stepper Motor B1.

1. Remove power per paragraph 5.19.2.

2. Stepper motor removal will necessitate the removal of the stepper motor assembly.

3. Disconnect wires attached to the terminal boards noting hook-up locations.

4. Remove the heading line switch hardware located on the case exterior.

5. Remove the 6 screws and washers on the case exterior that attach the motor assembly to the case.

6. Lift motor assembly up and out of the cabinet as far as possible without straining the still connected wires.

7. Disconnect the wires between the stepper motor and the terminal board located on the floor of the cabinet. Note hook-up locations.

8. Remove the knob attached to the stepper motor shaft.

9. Loosen the 2 set screws located in the coupler on the inside of the synchro support block.

10. Remove the 3 motor clamps and remove the stepper motor.

11. Reinstall using the reverse of the above.

5.19.2.4 Synchro Differential Generator B2.

1. Remove power per paragraph 5.19.2.

2. Loosen the 2 set screws located in the coupler on the inside of the synchro support block.

3. Loosen the 3 motor clamps enough to free the synchro.

4. Disconnect the wires noting the hook-up locations as marked on the synchro terminals and remove the synchro from the stepper motor assembly.

5. Reinstall using the reverse of above.

5.19.3 <u>Alignment Procedures (CV-3442)</u>

The following paragraphs provide instructions for aligning the field adjustable maintenance controls contained in Signal Data Converter CV-3442. Refer to Figure 5-23 for location of major components and assemblies.

5.19.3.1 Power Supply Adjustment (V4). The following procedure is applicable to the ±12 Vdc power supplies contained in Signal Data Con verter CV-3442, Video Amplifier AM-6932 and Amplifier-Generator AM-6933.

1. Remove unit access cover.

2. Connect multimeter, set to 50 Vdc scale, between COM (negative lead) and +OUT terminals at power supply assembly.

3. Set POWER switch S1 to ON.

4. Adjust VOLTAGE ADJUST control R9 to obtain +12 ± 0.1 Vdc reading on multimeter.

4. Connect multimeter between COM (positive lead) and -OUT terminals at power supply assembly.

5. Verify -12 ± 0.5 VDC reading on multimeter.

6. Set POWER switch S1 to OFF. Disconnect multimeter and replace access cover.

5.19.3.2 North Stabilization Alignment (CV 3442 Perform the following steps to align the stepper motor assembly for proper north stabilized display on the AN/SPA-25 and AN/SPA-66 indicators.

> **<u>NOTE</u>: Refer to Table 3-3 and observe settings of Switching Units SA-2139 to determine which AN/SPS-64(V) Indicator is serving as master for the AN/SPA 25 and AN/SPA 66 Indicators and which receiver transmitter (MTR I or MTR II) is associated with the master Indicator.**

1. Remove access cover from Signal Data Converter CV 3442.

2. Set POWER switches as follows:

   a. Master Indicator: TX ON

   b. Video Amplifier AM-6932 (if MTR I is in use): ON

   c. Signal Data Converter CV 3442: ON

   d. AN/SPA 25 and AN/SPA-66 indicators: ON

3. At Signal Data Converter CV-3442, select north stabilized (NS) display for AN/SPA 25 and AN/ISPA-66 indicators.

4. At both AN/SPA-25 and AN/SPA 66 indicators, select data from AN/'SPS-64(V) radar.

5. At Control Indicators C-10260 (mounted on AN/SPA 25 and AN,/SPA 66 indicators), set HEAD ING LINE switches to ON.

6. Obtain ships heading from gyro compass.

7. Depress and hold (through step 8) toggle switch S2 on Stepper Motor assembly in Signal Data Converter CV-3442.

8. Turn knob (adjacent to Stepper Motor assembly toggle switch S2) to position heading lines displayed on AN/SPA 25 and AN/SPA-66 indicators at the heading obtained from the gyro compass.

9. Release Stepper Motor assembly toggle switch and verify that heading lines displayed on AN/SPA-25 and AN/SPA-66 indicators follow ships heading changes and remain in agreement with gyro compass.

10. Set POWER switches listed in step 2 to OFF. Replace access cover at Signal Data Converter CV3442.

5.19.3.3 Heading Line Intensity Adjustments (V4).The intensity of the heading lines displayed on the AN/SPA-25 and AN/SPA-66 indicators is controlled by potentiometers located in Signal Data Converter CV-3442. Separate potentiometers provide independent heading line intensity control for each of the remote indicators.

1. Perform steps 1 through 5 of paragraph 5.19.3.2, observing the note preceding step 1.

2. Adjust AN/SPA-25 and AN/SPA-66 indicator controls for normal intensity of displayed targets.

3. At Signal Data Converter CV-3442, adjust R1 on Distribution Panel assembly to obtain desired brightness of the heading line displayed on the AN/ SPA-25 indicator.

4. At Signal Data Converter CV-3442, adjust R2 to obtain desired brightness of the heading line displayed on the AN/SPA-66 indicator.

5. Set POWER switches to OFF. Replace access cover.

5.19.3.4 Video DC Offset Adjustments (V4). - The video output circuits in Signal Data Converter CV3442 combine the target video and heading line video signals for display on the AN/SPA-25 and AN/SPA-66 indicators. The following steps are performed to balance the dc components of the two signals.

NOTE: Refer to Table 3-3 and observe settings of Switching Units SA-2139 to determine which AN/SPS-64(V) Indicator is serving as master for the AN/SPA-25 and AN/SPA-66 indicators and which receiver transmitter (MTR I or MTR II) is associated with the master Indicator.

1. Remove access covet- from Signal Data Converter CV-3442.

2. Set POWER switches as follows:

a. Master Indicator: ST BY

b. Video Amplifier AM-6932 (if MTR I is in use): ON

c. Signal Data Converter CV-3442: ON

3. At Control Indicators C-10260 (mounted on AN/SPA-25 and AN/SPA-66 indicators), set HEADING LINE switches to ON.

4. Disconnect plug at J 1 of Signal Data Converter CV-3442.

5. Using a coaxial cable (RG-59 A/U) terminated in BNC connectors, connect oscilloscope at J1 of Signal Data Converter CV-3442.

6. Adjust oscilloscope for dc voltage measurement at 50 mV per division.

7. Adjust offset adjust control R31 on Signal Data Converter CV-3442 PCB assembly for +50 mV dc level on oscilloscope.

8. Disconnect oscilloscope and restore normal connection at J 1.

9. Disconnect plug at J3 of Signal Data Converter CV-3442; connect oscilloscope at J3.

10. Adjust offset adjust control R51 on PCB assembly for +50 mV dc level on oscilloscope.

11. Disconnect oscilloscope and restore normal connection at J3.

12. Set POWER switches to OFF. Replace access cover.

5.20 <u>CONTROL INDICATOR C 10260 (V4)</u>

Control Indicator C-10260 (SPA Control Box) is a passive remote unit (mounted on the AN/SPA25 and AN/SPA-66 indicators) which provides FTC (fast time constant) selection and heading line on/ off control to Signal Data Converter CV-3442. Component locations are shown in Figure 5-25. Troubleshooting information for Control Indicator C-10260 is included on Figure 5-24 with that for the signal Data Converter. The schematic diagram, parts list table and assembly drawing for Control Indicator C-10260 are contained in Section 6.12 of Chapter 6. Access to terminal board TB1 and components within Control Indicator C10260 is obtained by removing the plate on the rear of the unit. Fault isolation within the Control Indicator C-10260 can be accomplished as follows:

1. To check the FTC selector switch S1 and heading line (HL) ON/OFF switch S2, turn off power at the Signal Data Converter and make continuity measurements at terminal board TB1 for each setting of the switches pet the schematic dia gram.

2. To check the NORTH STAB indicator, set POWER switch to ON and HEADING LINE MODE switch to NS at Signal Data Converter and measure --12 Vdc at Control indicator TB1 6. If present, replace NORTH STAB LED DS1; in not present, refer to Figure 5-24 (48).

3. To check panel lamp power, set POWER switch to ON at the Signal Data Converter and measure -12 Vdc at Control Indicator TB1-8. If present, replace panel lamps DS2 and/or DS3; if not present, refer to Figure 5-24 (48).

SYMBOL	LEGEND
A	TB1
B	S2
C	DS1
D	DS2
E	S1
F	DS3

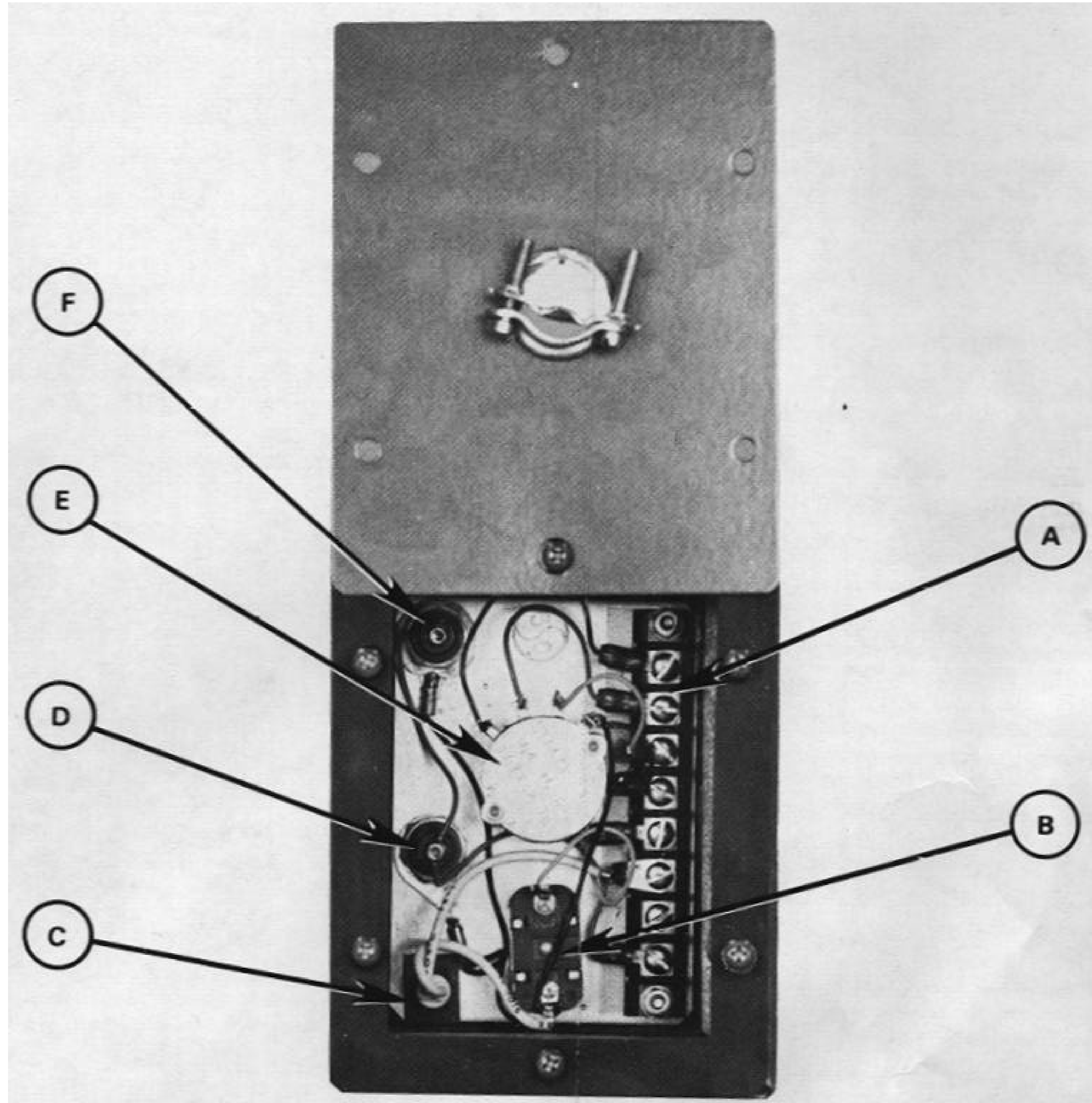


Figure 5-25 Control Indicator C-10260 Parts Location (V4)

5.21 AMPLIFIER-GENERATOR AM-6933 (V4)

Paragraphs 5.21.1 through 5.21.3 and their related subparagraphs provide corrective maintenance information for the Amplifier-Generator AM6933 (ESM Interface Unit). The information includes troubleshooting instructions (5.21.1), removal and replacement procedures (5.21.2) and alignment procedures (5.21.3). The locations of assemblies and major components within Amplifier-Generator AM-6933 are shown in Figure 5-26. Schematic diagrams, parts list tables and assembly drawings applicable to Amplifier-Generator AM6933 are contained in Section 6.13 of Chapter 6. Access to the assemblies and components within the Amplifier-Generator AM-6933 is provided by loosening the captive screws in the cover and removing the cover.

5.21.1 Troubleshooting Procedure (AM-6933)

Fault isolation within the Amplifier-Generator AM-6933 is facilitated by use of Troubleshooting Chart, Figure 5-27. Instructions for use of the troubleshooting chart given in paragraph 5.9.1.

5.21.2 Removal/Replacement Procedures (AM-6933)

Before initiating any removal or replacement activity at Amplifier-Generator AM-6933, insure all power is removed from the equipment by performing the following steps:

1. Set ON/OFF Safety switch at front of pedestal to OFF.
2. Set POWER switch to OFF at (master) Indicator for associated Receiver Transmitter RT-1241.
3. Turn off and tag ship's circuit breakers which supply power to associated Receiver Transmitter RT-1241.

5.21.2.1 Power Supply Assembly. -

1. Remove power per paragraph 5.21.2.
2. Loosen the 4 captive screws in the cover and remove the cover.
3. Disconnect the wires from the power supply assembly noting hook-up locations.
4. Remove the LI screws, lockwashers and nuts that attach the power supply to the case and remove the power supply.
5. Reinstall using the reverse of above.

5.21.3 Alignment Procedure (AM-6933)

The following paragraphs provide instructions for adjustment of the power supply and pulse generator circuits contained in Amplifier-Generator AM-6933. Refer to Figure 5-26 for location of assemblies and major components.

5.21.3.2 Power Supply Adjustment (V4). - The ±12V power supply contained in Amplifier-Generator AM-6933 is identical to that used in Signal Data Converter CV-3442. Refer to paragraph 5.19.3.1 for adjustment instructions.

5.21.3.2 Output Pulse Width Adjustments (V4). Performance of the following steps insures that the pulses sent from the AN/SPS-64(V)4 radar to the AN/SLA-10 Blanker-Video Mixer are of the correct width.

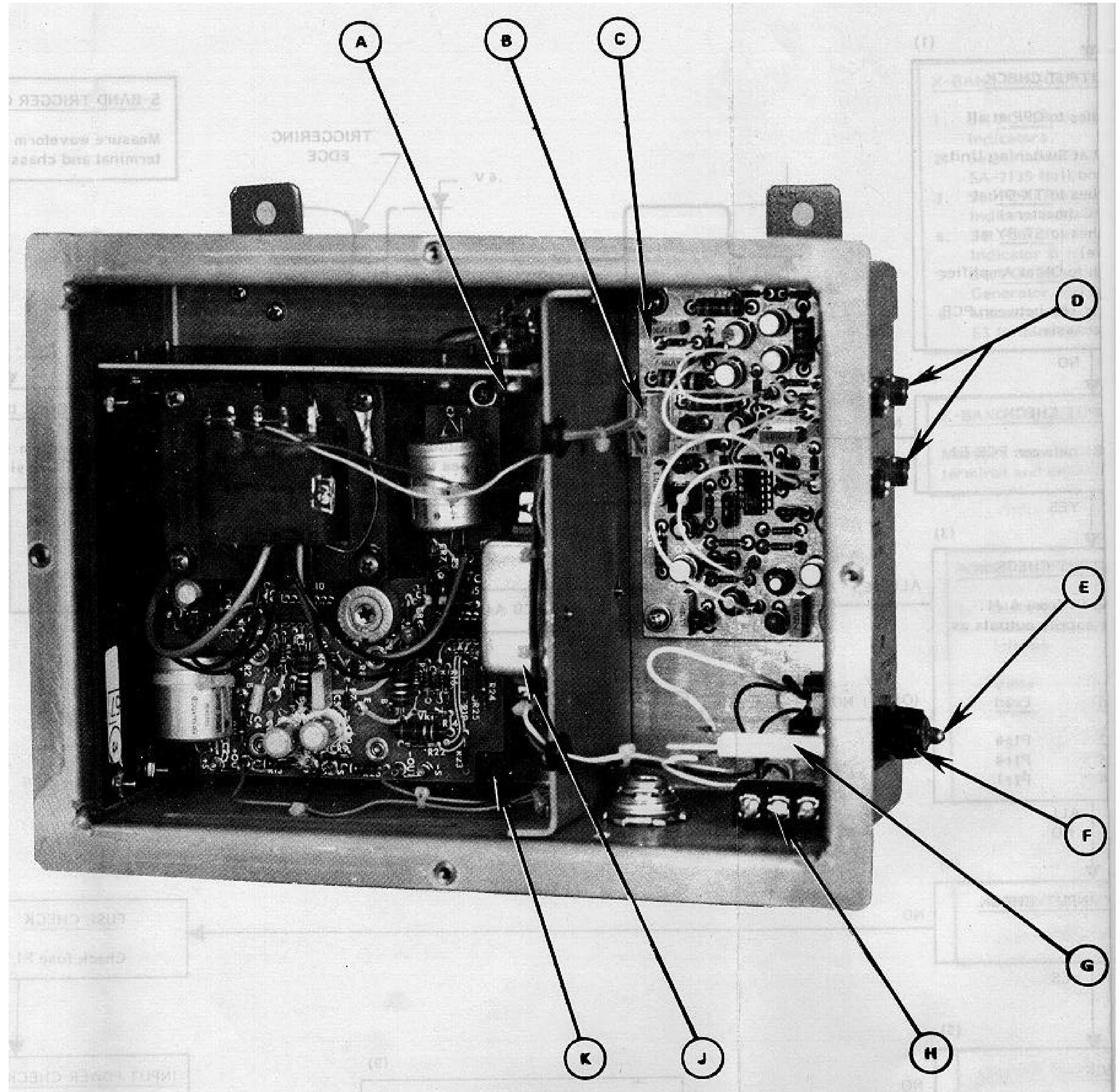
1. Refer to Table 3-3. Set Switching Units SA-2139 for DS-7 mode (this activates both receiver transmitters, providing input triggers to both channels of the Amplifier-Generator AM-6933).
2. Set AN/SPS-64(V) Indicator POWER switches as follows:
   a. Indicator A (master): TX ON
   b. Indicator B (slave): ST BY
   c. Indicator C (master): TX ON
3. Remove access covers and set internal power switches S1 to ON at:
   a. Video Amplifier AM-6932.
   b. Amplifier-Generator AM-6933.

NOTE: The following steps refer to Amplifier-Generator AM-6933.

4. Connect oscilloscope, set for 5 volts and 1 usec per division display, at terminal E3 on the PCB assembly.
5. Adjust pulse width control R9 on PCB assembly for an output pulse width of 5 usec.
6. Connect oscilloscope at terminal E4 of PCB assembly.' 7. Adjust pulse width control R22 on PCB assembly for an output pulse width of 5 usec.
8. Disconnect oscilloscope. Set all AN/SPS64(V) Indicator POWER switches to OFF.

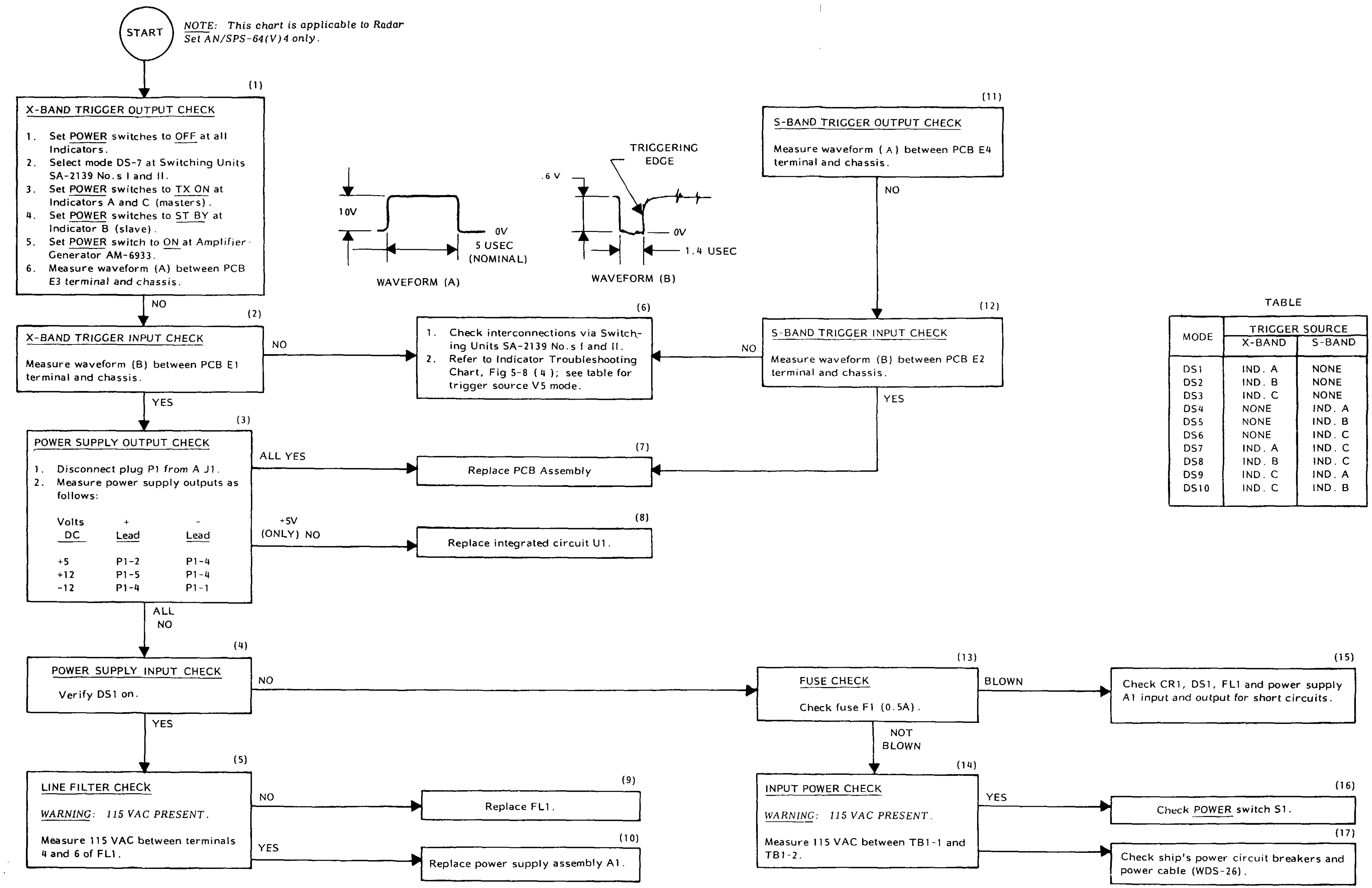
NOTE: Internal POWER switches S1 at Video Amplifier AM-6932 and Amplifier-Generator AM-6933 should remain on.

9. Replace access covers.



SYMBOL	LEGEND
A	Regulator U1
B	Plug P1/Jack J1
C	PCB Assembly
D	Connectors (BNC) J1 through J4
E	Power Switch S1
F	Fuse F1
G	Pilot Lamp DS1
H	Terminal Board TB1
J	Line Filter FL1
K	Power Supply Assembly

Figure 5-26 Amplifier-Generator AM-6933 Parts Location (V4)



TABLE

MODE	TRIGGER SOURCE	
	X-BAND	S-BAND
DS1	IND. A	NONE
DS2	IND. B	NONE
DS3	IND. C	NONE
DS4	NONE	IND. A
DS5	NONE	IND. B
DS6	NONE	IND. C
DS7	IND. A	IND. C
DS8	IND. B	IND. C
DS9	IND. C	IND. A
DS10	IND. C	IND. B

Figure 5-27 Amplifier-Generator AM-6933 Troubleshooting Chart (V4)

SECTION V: RF TEST PROCEDURES

5.22 GENERAL

This section contains procedures for making RF measurements which require use of test equipment which is permanently installed external to the AN/ SPS-64(V) Radar Sets. The procedures are divided into X-band test procedures (paragraph 5.23) which are applicable to all AN/ SPS-64(V) Radar Sets and S band test procedures (paragraph 5.24) which are applicable to AN-SPS-64(V)4 installations only. Procedures for power output, receiver sensivity (MDS) and antenna VSWR measurements are provided for both X band and S-band equipments, measurement of transmitter frequency is covered-e for X band equipment only.

5.23 X BAND RF TEST PROCEDURES

5.23.1 Peak Power Output Measurement

1. Attach 20 dB attenuator (Weinschel Engineering model 530A 20 or equivalent) at FOR WARD port of 20 dB Directional Coupler (located in the waveguide run near the output flange of Receiver Transmitter RT-1240).

2. Connect thermistor mount (HP 478A or equivalent) of power meter (HP 432A or equivalent) at output port of 20 dB attenuator.

3. At (master) Indicator associated with Receiver Transmitter RT-1240 under test, set POWER switch to TX ON and RANGE SELECT switch to 24 MILES.

NOTE: The values given in parentheses in the following steps indicate the nominal values that should be obtained.

4. After 3.5 minute delay, observe power meter reading (1.8 mW or greater); multiply read ing by 10^4 (attenuation factor) and record result as average power (18 W).

5. At Receiver Transmitter RT 1240 connect oscilloscope to U4 pin 6 on A1100 Pulse and Driver PCB.

6. Measure pulse width (PW) and pulse repetition time (PRT) from oscilloscope display; record both in terms of seconds (PW = 1 x 10 x 10^{-6} sec, PRT -1.11 x 10^{-3} sec).

7. Calculate radar duty cycle (0.0009) as follows:

$$\text{Duty Cycle} = \frac{PW}{PRT}$$

8. Calculate transmitter peak power (20 kW minimum) as follows:

$$\text{Peak Power} = \frac{\text{Average Power Recorded In Step 4}}{\text{Duty Cycle Calculated in Step 7}}$$

5.23.2 Receiver Sensitivity (Minimum Discernible Signal- MDS) Measurement

1. Set (master) Indicator POWER switch to ST BY.

2. Calibrate signal generator (HP 620E or equivalent) output power level at 9420 MHz per its instruction manual.

3. Set signal generator controls as follows:

   a. Frequency: 9420 MHz
   b. Modulation: Internal pulse, 0.5 us-c width, 1800 Hz PRF
   c. Output Level: -67 dBrm

4. Connect signal generator RF output to FORWARD port of directional coupler using six foot RG 214/U coaxial cable (supplied with HP 620E) .

NOTE: The loss of six feet of RG 214, J coaxial cable is approximately 2.4 dB at X-band frequencies. The actual loss of the test cable should be measured at 9420 MHz.

5. Connect oscilloscope at receiver output connector A1600J1 in Receiver Transmitter RT 1240; trigger oscilloscope from signal generator.

6. Adjust signal generator attenuation and(l frequency controls to identify test video signal on oscilloscope; set attenuation control for non-saturating test signal and carefully adjust frequency vernier to maximize test signal amplitude.

7. Increase signal generator output attenuation setting until test signal is just visually discernible in the displayed noise.

NOTE: Adjustment of the signal generator delay control will aid in identifying the test signal at the threshold of discernibility.

8. Verify MDS, calculated as follows, is less than or equal to 98 dBm. MDS (Signal Generator Attenuation) - (Directional Coupler Attenuation) (Test Cable Attenuation)

NOTE: For 20 dB directional coupler loss and 2.4 dB cable loss, the signal generator must be set to -75.6 dBm or less for an MDS of -98 dBm.

5.23.3 Antenna/Waveguide VSWR Measurement

1. Set (master) Indicator POWER switch to ST BY.

2. Attach 20 dB attenuator (Weinschel Engineering model 530A-20 or equivalent) at FORWARD port of 20 dB Directional Coupler (located in the waveguide run near the output flange of Receiver Transmitter RT 1240).

3. Connect thermistor mount (HP 478 A or equivalent of power meter (HP 432A or equivalent) ,at output port of 20 dB attenuator.

4. At (master) Indicator associated with Receiver Transmitter RT-1240 under test, set POWER switch to TX ON and RANGE SELECT switch to 24 MILES.

5. Measure forward power decibels (dBm); add 20.0 dB power meter reading and record sum as forward power.

6. Set (master) Indicator POWER switch to ST BY.

7. Disconnect thermistor mount from attenuator and reconnect at directional coupler REFLECTED port.

8. Set (master) Indicator POWER switch to TX ON.

9. Record power meter reading in dBm as reflected power.

10. Calculate return loss by subtracting reflected power (recorded in step 9) from forward power (recorded in step 5).

11. Convert return loss to VSWR using the following chart, verify VSWR is 1.5 or less.

VSWR	RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)
17.391	1	1.196	21
8.724	2	1.173	22
5.848	3	1.152	23
4.419	4	1.135	24
3.570	5	1.119	25
3.010	6	1.106	26
2.615	7	1.094	27
2.323	8	1.083	28
2.100	9	1.074	29
1.925	10	1.065	30
1.785	11	1.058	31
1.671	12	1.052	32
1.577	13	1.046	33
1 499	14	1.041	34
1 433	15	1.036	35
1.377	16	1.032	36
1.329	17	1.029	37
1.288	18	1.026	38
1.253	19	1.023	39
1.222	20	1.020	40

NOTE: The VSWR requirement of 1.5: 1 or less given in step 11 is based on a 1.25:1 VSWR for the rotary joint and antenna and a waveguide VSWR of 1.2:1 or less.

5.23.4 Transmitter Frequency Measurement

1. Set (master) Indicator switches as follows:
   a. RANGE SELECT: 24 MILES
   b. POWER: ST BY

2. Attach 20 dB attenuator (Weinschel Engineering model 530A 20 or equivalent) at FOR WARD port of directional coupler.

3. Connect frequency meter (HP X532 B or equivalent) to attenuator output using RG-214/U coaxial cable and type N-to waveguide adapter (HP X281A or equivalent).

4. Connect power meter (HP 532A or equivalent) thermistor mount (HP 478A or equivalent) to frequency meter using N to--waveguide adapter.

5. Set power meter for mid-scale reading. Preset frequency meter to 9420 MHz.

6. Adjust frequency meter for maximum dip (not less than 1.0 dB); read transmitter frequency from meter.

5.24 S-BAND RF TEST PROCEDURES

5.24.1 Peak Power Output Measurement

1. Attach 20 dB attenuator (Weinschel Engineering model 530A 20 or equivalent) at FORWVARD port of 20 dB Directional Coupler (located in the waveguide run near the output flange of Receiver Transmitter RT 1241).

2. Connect thermistor mount (HP 478A or equivalent) of power meter (HP 432A or equivalent) at output port of 20 dB attenuator.

3. At (master) Indicator associated with Receiver Transmitter RT 1241 under test, set POWER switch to TX ON and RANGE SELECT switch to 24 MILES.

NOTE: The values given in parentheses in the following steps indicate the nominal values that should be obtained.

4. After three minute delay, observe power meter reading (4.5 mW or greater); multiply reading by 104 (attenuation factor) and record result as average power (45 W) .

5. At Receiver Transmitter RT-1241, connect oscilloscope to U4 pin 8 on A6 Pulse Logic PCB.

6. Measure pulse width (PW) and pulse repetition time (PRT) from oscilloscope display; record both in terms of seconds (PW = 1 x 10-6 sec, PRT = 1.11 x 10-3 sec).

7. Calculate radar duty cycle (0.0009) as follows:

$$\text{Duty Cycle} = \frac{PW}{PRT}$$

8. Calculate transmitter peak power (50 kW minimum) as follows:

$$\text{Peak Power} = \frac{\text{Average Power Recorded in Step 4}}{\text{Duty Cycle Calculated in Step 7}}$$

5.24.2 Receiver Sensitivity (Minimum Discernible Signal - MDS) Measurement

1. Set (master) Indicator POWER switch to ST BY.

2. Calibrate signal generator (HP 8616A or equivalent) output power level at 3050 MHz per its instruction manual.

3. Set signal generator controls as follows:

a. Frequency: 3050 MHz
b. Output Level: -67 dBm
c. Modulation: External pulse

4. Adjust pulse generator (or equivalent) for an output pulse having the following characteristics:

a. Voltage: 25 ± 5V peak
b. Frequency: 1800 Hz
c. Width: 10 usec
d. Rise/Fall Time: 2 usec maximum

5. Connect pulse generator output at signal generator external pulse modulation input.

6. Connect signal generator RF output to FORWARD port of directional coupler using six foot RG214/U coaxial cable.

NOTE: The loss of six feet of RG 214/U coaxial cable is approximately 1.1 dB at S-band frequencies. The actual loss of the test cable should be measured at 3050 MHz.

7. Connect oscilloscope at receiver output connector A9J1 in Receiver Transmitter RT-1241; trigger oscilloscope from pulse generator.

8. Adjust signal generator attenuation and frequency controls to identify test video signal on oscilloscope; set attenuation control for non-saturating test signals and carefully adjust frequency vernier to maximize test signal amplitude.

9. Increase signal generator output attenuation setting until test signal is just visually discernible in the displayed noise.

NOTE: Adjustment of the pulse generator delay control will aid in identifying the test signal at the threshold of discernibility.

10. Verify MDS, calculated as follows, is less that or equal to -98 dBm. MDS = (Signal Generator Attenuation) - (Directional Coupler Attenuation) (Test Cable Attenuation)

NOTE: For 20 dB directional coupler loss and 1.1 dB cable loss, the signal generator must be set to -76.9 dBm or less for an MDS of -98 dBm.

5.24.3 Antenna/RF Cable VSWR Measurement

1. Perform steps 1 through 11 of paragraph 5.23.3.

2. Convert return loss to VSWR using the chart given in paragraph 5.23.3; verify VSWR is less than 1.67.

NOTE: The VSWR requirement is 1.65:1; this requirement is based on a 1.5:1 VSWR for the rotary joint and antenna and a 1.1:1 VSWR for the RF interconnecting cable.

5.25 Power Measurement Using AN/USM-177 Test Set

NOTE: Do not turn radar transmitter on until the test set has been nulled and zeroed.

1. Select a fixed attenuator of the proper size and frequency range to ensure that the thermistor dissipates no more than 10 mW (10 DBM). Use the largest attenuator if in doubt. Use 20 dB pad in incident jack.

2. Turn radar to standby and perform any adjustments which affect transmitter power, i.e., PRF, magnetron filament voltage, etc.

3. Connect the fixed attenuator (if necessary) to the "incident power" jack on the bidirectional coupler.

4. Connect the thermistor mount to the fixed annetuator, if used, otherwise directly to the "incident power" jack on the bidirectional coupler.

5. Using the supplied cable connec the thermistor mount to the meter.

6. Select the proper "mount res". This information is on the thermistor mount.

7. Plug in the test set and turn to "line on".

8. Select the proper "calib factor". This information is found on the graph on the thermistor mount.

9. Turn the range selector switch to the "0.1 mW" position.

10. Adjust the "zero" and "vernier" controls until the meter reads 1/3 to 2/3 full scale deflection.

11. Turn the range switch to "null".

12. Using a screwdriver, turn the null adjustment until the meter nulls.

13. Select: the proper setting on the range switch for the power being measured. If in doubt start with the highest scale (10 DBM) and work down.

14. Zero the meter using the "zero" and "vernier" controls.

15. Turn the radar to transmit.

16. Adjust the range switch on the test set so that the meter indication is 1/3 to 2/3 full scale deflection. Turn the radar to standby when switching meter ranges.

17. Add the following losses:

    a. Bidirectional coupler ________________________________ +DBM
    b. Range switch ________________________________ +DBM 5-122

c. Meter indication	______________________	-DBM
d. Total = Average power	______________________	+DBM
e. Duty cycle gain (from graph)	______________________	+DBM
f. Total (d + e) = Peak power	______________________	+DBM

18. Convert average and peak power (in DBM) to watts, if necessary.

19. Turn radar to off or standby before disconnecting thermistor mount.

5.26 Power and Frequency Measurement With the TS-147/Up Radar Test Set

1. Turn radar to standby and turn on test set. Allow each to warm up.

2. Make any necessary adjustments which affect transmitter power i.e., PRF, magnetron filament voltage, etc.

3. Connect cable between "RF" jack on test set and "incident power" jack on bidirectional coupler.

4. Set the "frequency" knob well off the transmitter frequency. Note: Do not mistake the "freq" knob for the power adjustment.

5. Set the "DBM" dial fully CCW, which is maximum attenuation.

6. Turn the "test" knob to TRAN.

7. Note: The settings of the other controls make no difference.

8. Adjust the test set meter to SET ZERO using the coarse and fine "zero adjust" controls.

9. Turn the radar to transmit.

10. Adjust the "DBM" dial until the test set meter reads SET POWER (0 DBM).

11. Note the "DBM" dial indication. Use the top set of numbers.

12. Total the following losses:

a. "DBM" Dial Reading	______________________	+DBM
b. Cable attenuation	______________________	+DBM
c. Bidirectional Coupler Attenuation	______________________	+DBM
d. Total = Average Power	______________________	+DBM
e. Duty Cycle Gain (From Graph)	______________________	+DBM
f. Total (d + e) = Peak Power	______________________	+DBM

13. Convert average and peak power (in DBM) to watts, if necessary.

14. With the meter still reading SET POWER adjust the "frequency" knob until the test set meter dips. Note: Increased meter sensitivity may be attained by actuating the "high sens" switch during this procedure.

15. Note the "frequency" dial reading at the point of maximum dip. This is the transmitter frequency in MHz/10.

5.27 MDS Test Using the TS-147 Test Set

1. Turn on the radar and allow to warm up.

2. Turn on the test set and allow to warm up.

3. Tune radar L.O. for maximum video presentation. Set receiver gain at maximum.

4. Connect cable between "incident power" jack on bi-directional coupler and "RF" jack on test set.

5. Set the test set controls as follows:
   A. Test knob to "TEST".
   B. DBM knob fully counter-clockwise.
   C. Signal width to "MIN".
   D. Phase near mid-position.
   E. Ext Mod/Int FM to "INT FM".
   F. Power set knob fully clockwise.

6. Turn radar to XMIT and observe output from video drivers on O-scope.

7. Adjust the signal freq knob for maximum signal on O-scope.

8. Adjust the DBM knob to keep radar RCVR from saturating. Re-adjust the signal freq knob for maximum presentation.

9. Turn the test knob to "TRAN".

10. Return the DBM knob to fully CCW.

11. Adjust the coarse and fine set zero controls until meter reads "set zero".

12. Turn the test knob to "RECV".

13. Adjust the DBM knob until signal again appears.

14. Adjust the signal width control to "CW" while simultaneously adjusting the phase control to maintain the presentation on the scope. NOTE: The presentation will disappear as the "CW" position is approached. This is normal.

15. Adjust the set power knob until the meter reads "SET POWER".

16. Return the signal width and phase knobs fully CCW to "MIN".

17. Adjust the DBM knob until signals are just visible above the noise. The phase knob may be used to maintain the best presentation.

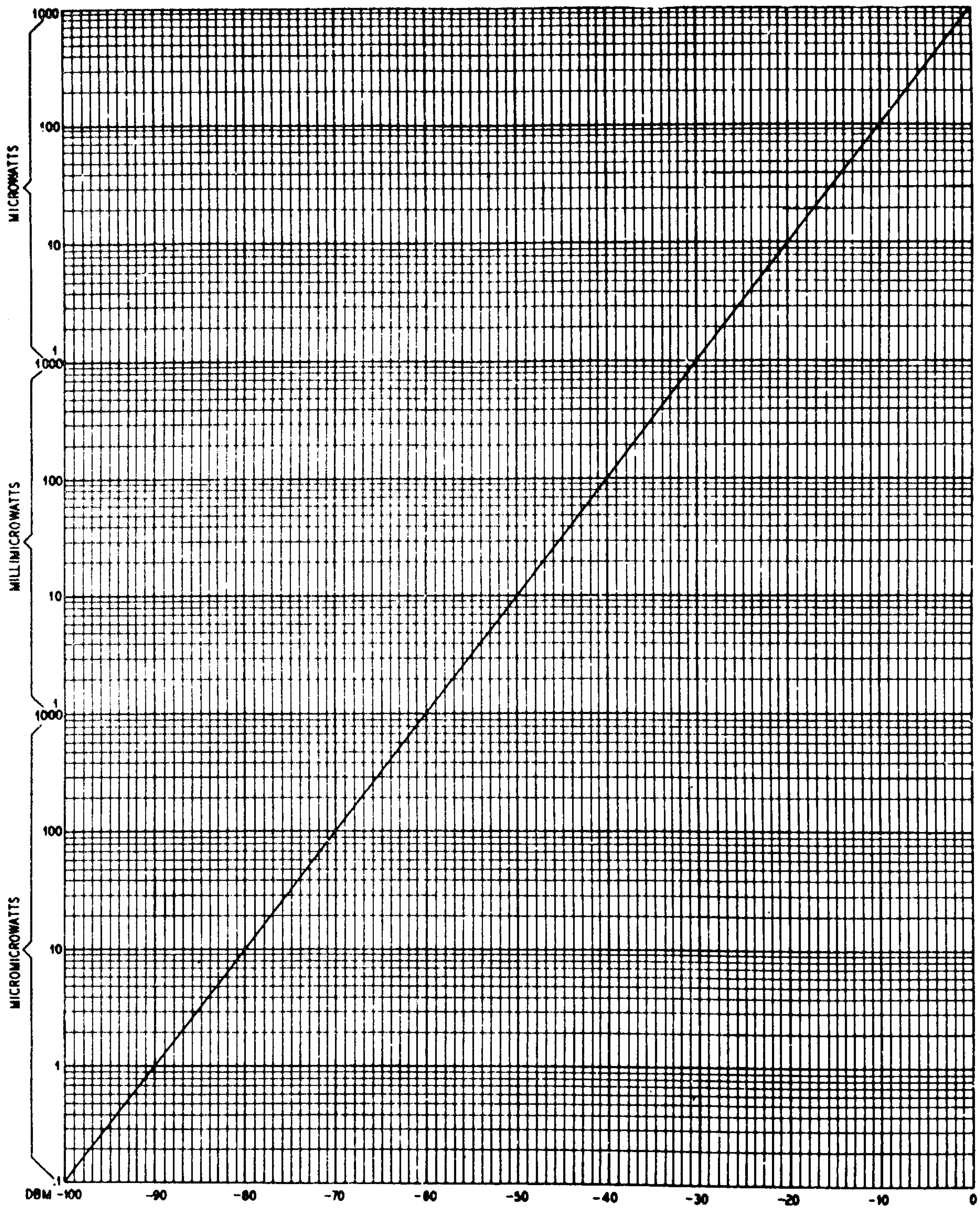
18. Record the losses:

Bidirectional Coupler	- ____________ . ____________	DBM
Cable Attenuation	- ____________ . ____________	DBM
DBM Dial Reading	- ____________ . ____________	DBM
TOTAL	- ____________ . ____________	DBM

19. This total represents the MDS in -DBM. Convert to watts.

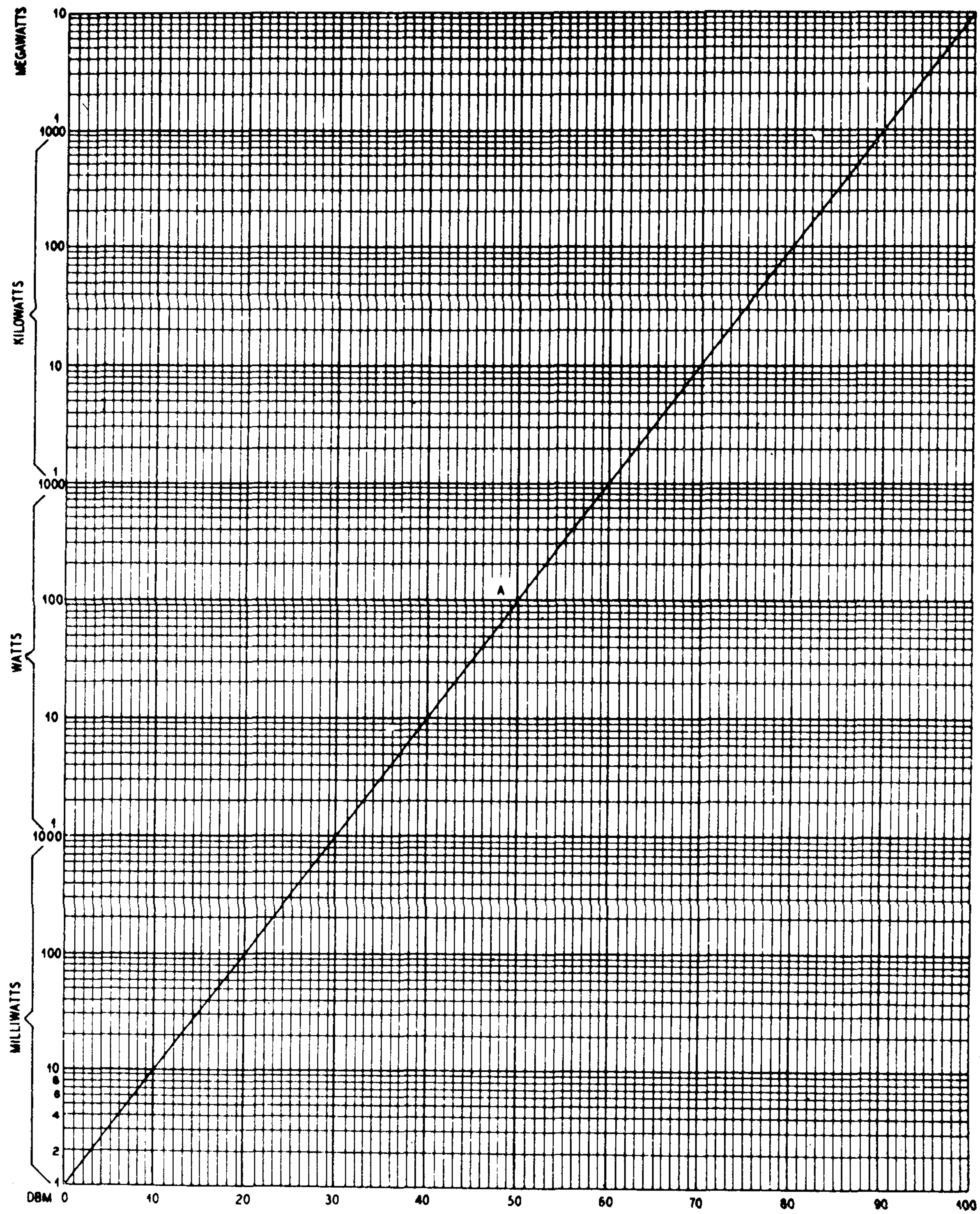
D. B. M. TO WATTS CONVERSION CHART

.1 MICRO-MICROWATTS TO 1ØØØ MICROWATTS



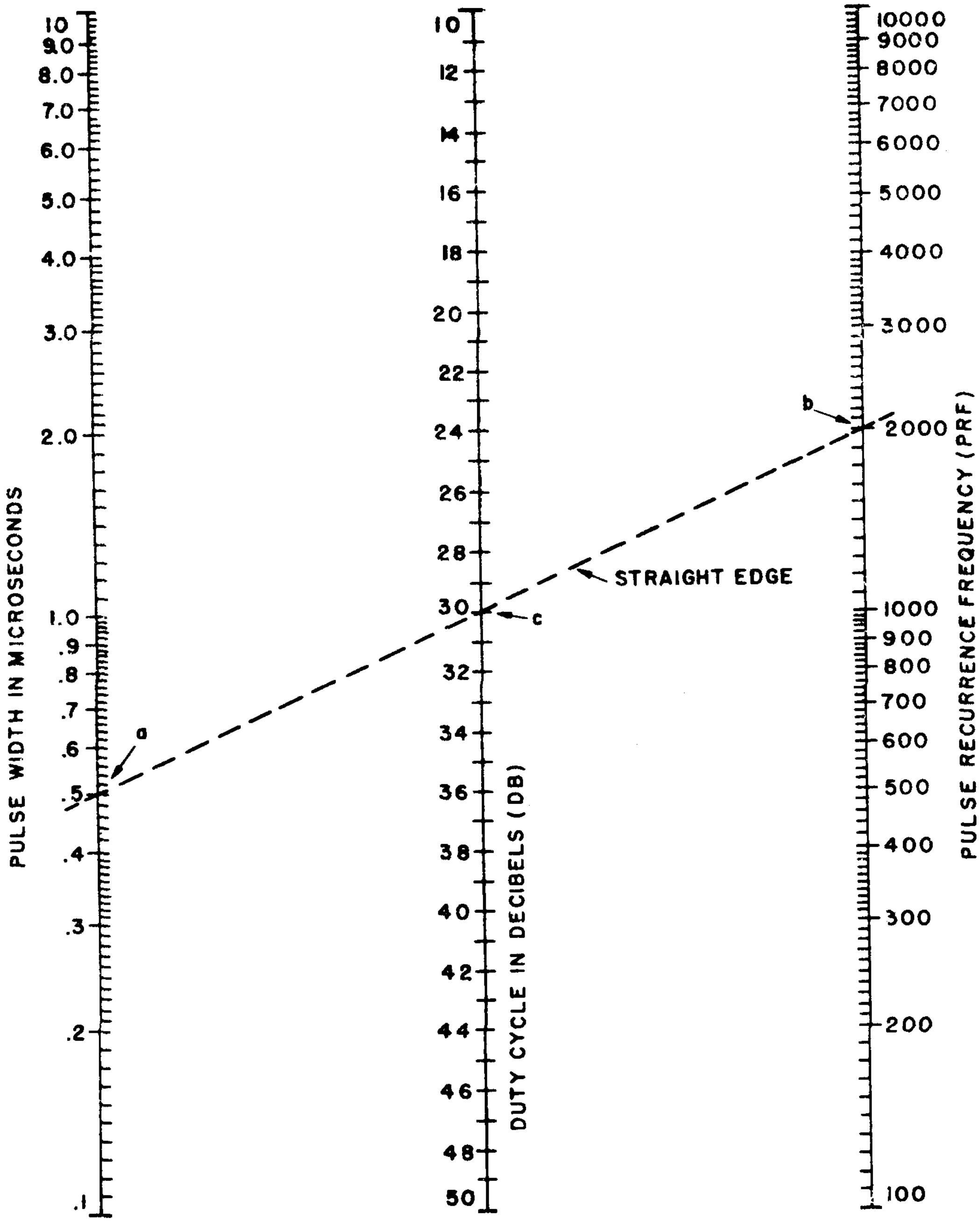
D. B. M. TO WATTS CONVERSION CHART

1 MILLIWATT TO 1Ø MEGAWATTS



Average to Peak Power In db. Conversion Chart

(Duty Cycle Gain)



INSTRUCTIONS

1. LAY A STRAIGHT EDGE THROUGH THE RADAR PULSE WIDTH IN MICROSECONDS IN THE LEFT COLUMN AND THE RADAR'S PULSE REPITITION FREQUENCY IN PULSES PER SECOND IN RIGHT COLUMN.
2. READ THE DUTY CYCLE GAIN (DIFFERENCE BETWEEN AVERAGE AND PEAK POWER) IN DB. IN THE CENTER COLUMN.
3. ADD THE AVERAGE POWER IN DB. TO THE D)UTY CYCLE GAIN IN DB. TO FIND THE PEAK POWER IN DB.

Appendix A

12 & 16 Inch Compass Adapter

1. GENERAL

The Compass Adapter, a synchro to stepper converter (P/N 169153-1 thru 169153-7) is designed to convert 360:1, 180:1, or 36:1 ship's gyro output in the form of synchro data transmission for use with the stepper input required by the indicator when the True Bearing Kit (TBK) and/or North Stabilization Kit (NSK) options are installed. General information regarding operation, installation, and maintenance may be found in the instruction manual furnished with the radar system. Conversion instructions relating to the NSK option are presented in Attachment A to this document. Instructions relative to converting to the TBK system are given in Attachment B. Tables 1 and 2 should be referred to when ordering replacements.

2. OPERATION

There are no operating procedures; once the unit is installed, there is no further adjustment necessary. The control panel contains the ON/OFF power switch, a pilot light indicating power, and two fuses for ship's power. Fuses for the output lines are located on the internal printed circuit board.

3. NSTALLATION

Prior to installing the converter, verify that both Indicator and Antenna power is turned off at the source.

The adapter should be installed in the cable run between the indicator, or indicators, and the gyro. The second indicator is wired in parallel with the first indicator. Refer to Figures 1, 2 and 3 for proper hook-up and mounting details. Figure 4 is the schematic diagram for the compass adapter.

4. ALIGNMENT

After hook-up, turn the system on and manually line up the true bearing ring to correspond to the gyro repeater setting. Use "HDG SET" control to align the NSK to the gyro compass setting. Manually process the ship's gyro to verify that the TB and NSK ring are following the gyro.

NOTE

Indicator circuitry must be modified per Attachments A and B to be compatible with the 28 volt compass adapter output.

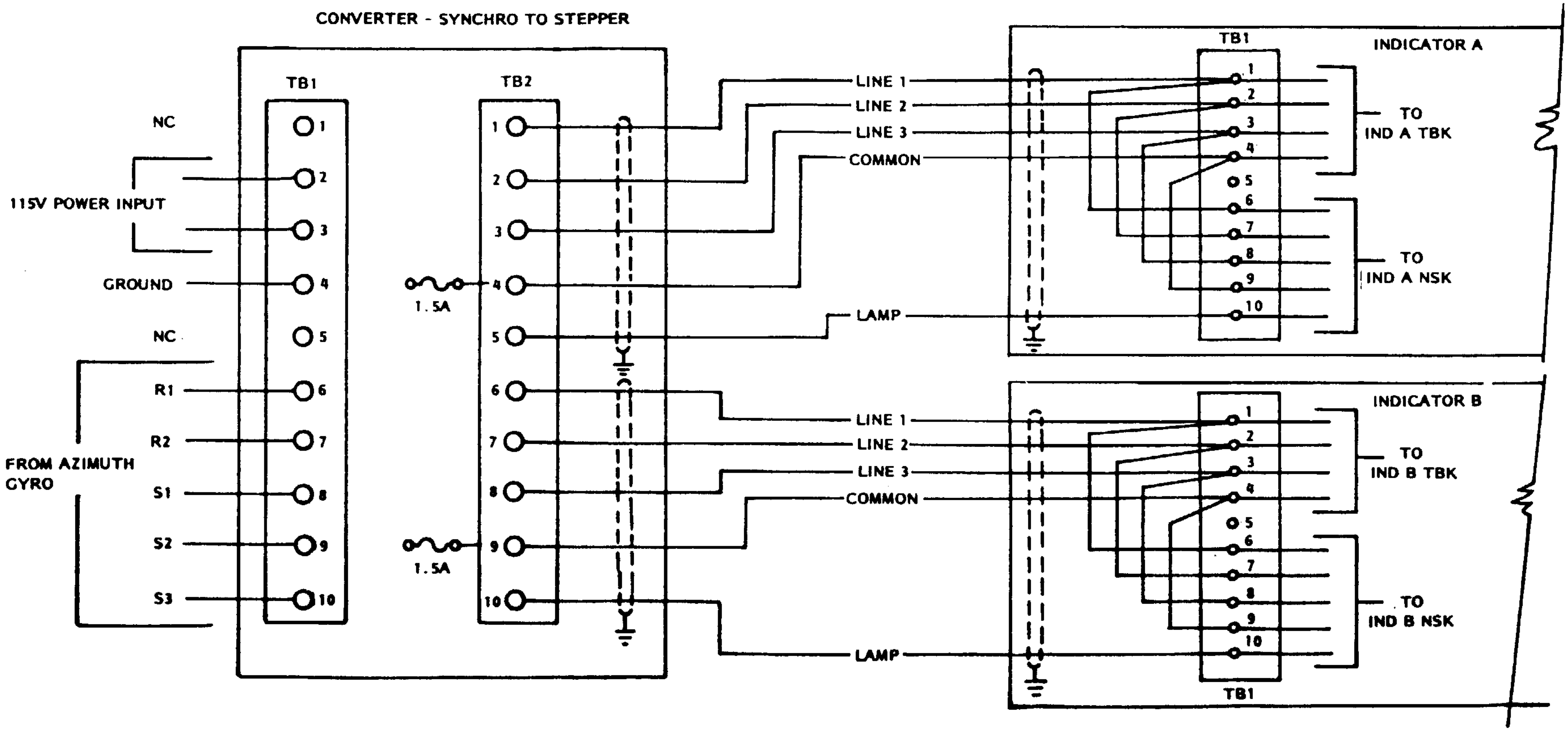
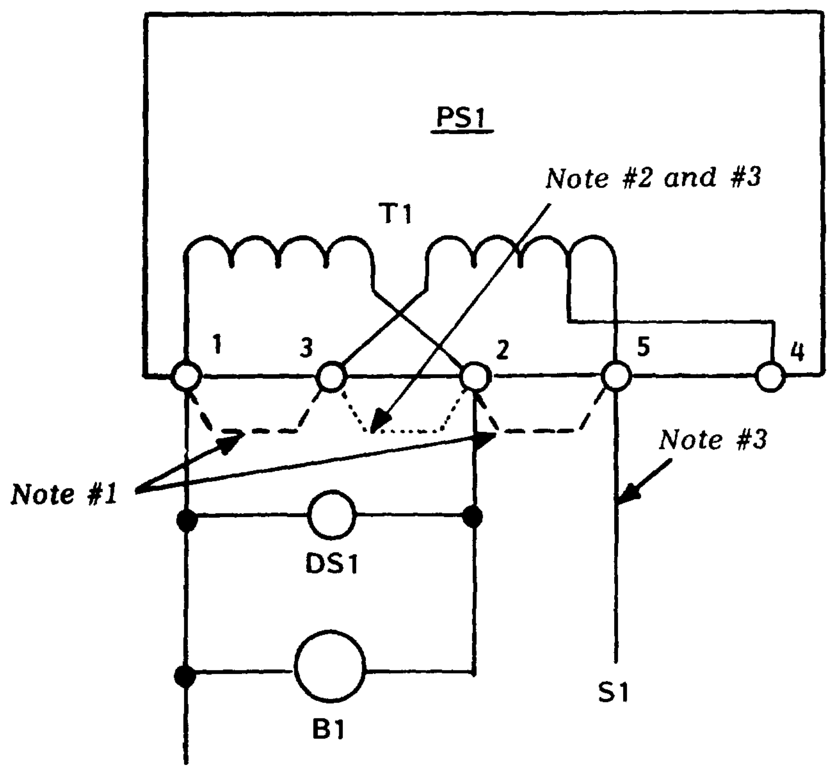


Figure 1 Interconnection Diagram



NOTE

1. For 115 V INPUT, jumper terminal 1 to terminal 3 and terminal 2 to terminal 5.
2. For 230 V INPUT, jumper terminal 2 to terminal 3.
3. For 208 V INPUT, move S1 connection at terminal 5 to terminal 4, and jumper terminal 2 to terminal 3.

Figure 2 Compass Adapter Jumper Diagram

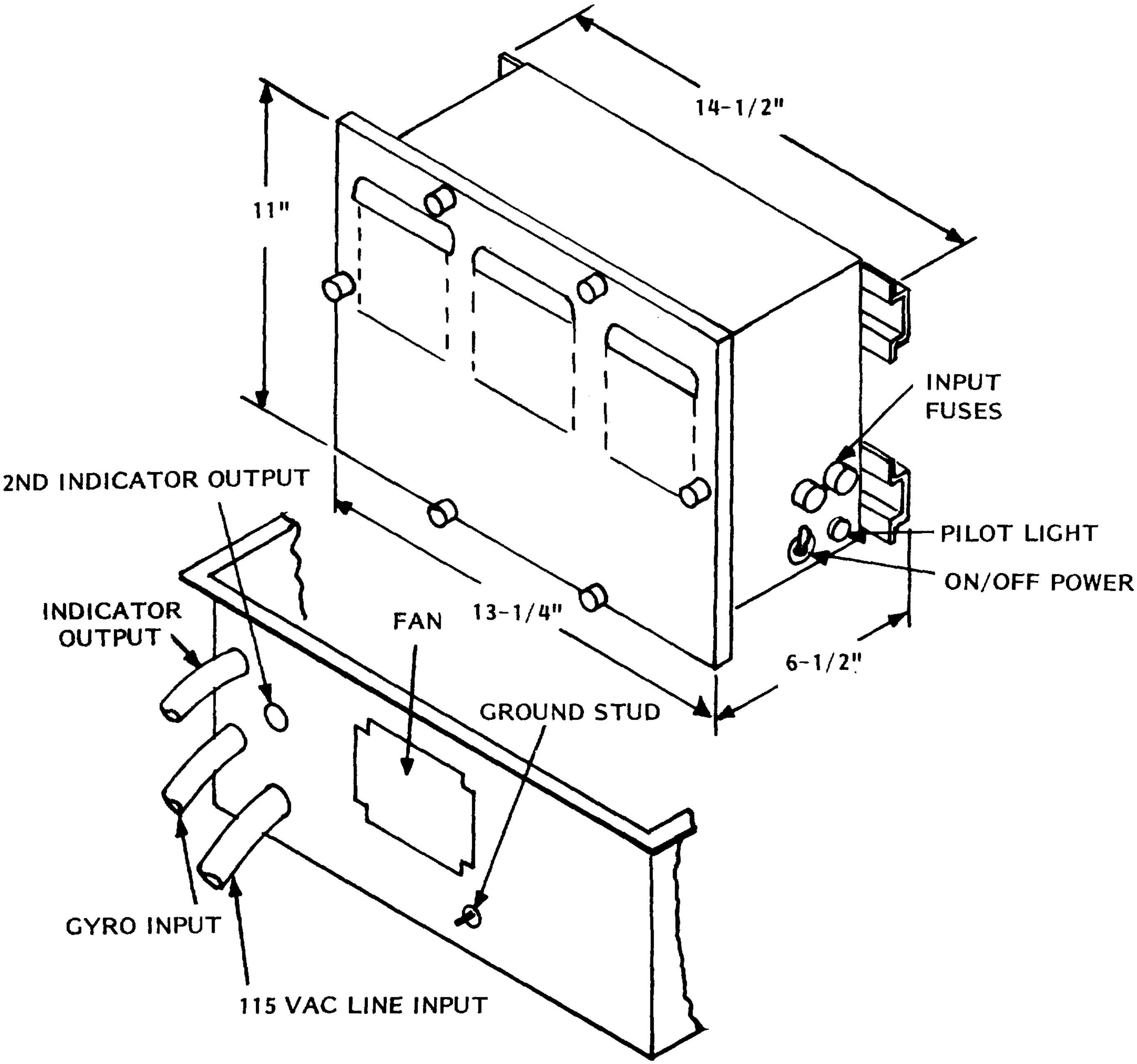


Figure 3 Compass Adapter Outline

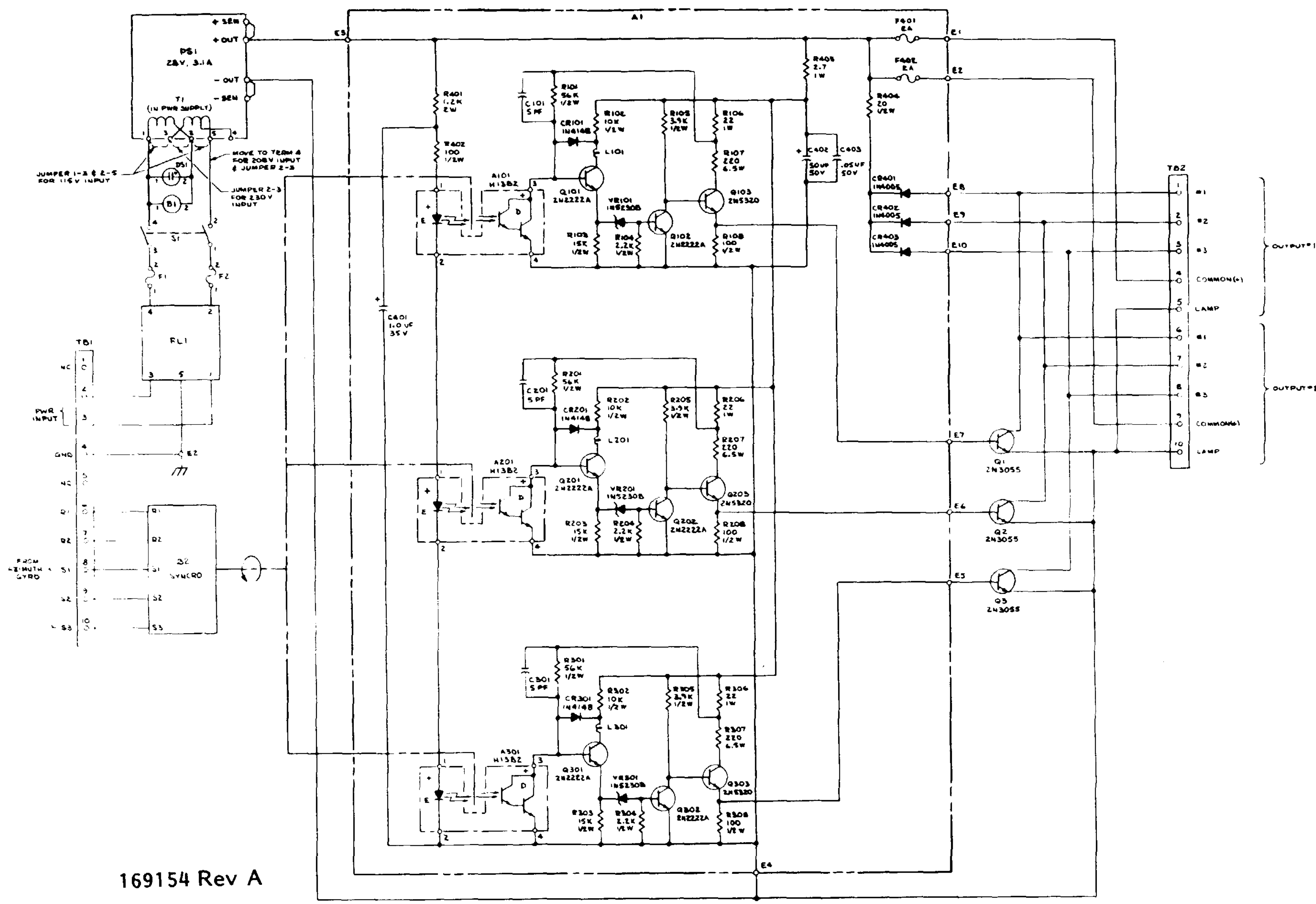


Figure 4 Compass Adapter Schematic Diagram

Table 1 Compass Adapters Reference Application Table

For Use With Compass System	Synchro Motor	V Ref	V Sig	Speed	Encoder Apertures	Product Code
Anschutz	Anschutz NB23-91	50/60V 50/60 Hz	20/24	360	1	M27595
Plath	Anschutz NB23-94	50/60V 50/60 Hz	68/82	360	1	M27592
Arma Brown Microtechnica Serius (series 60 Hz) Hokushin	23TR6A	115V 60 Hz	90	360	1	M27593
USN/USCG 60 Hz	23TR6A	115V 60 Hz	90	36	10	M27594
Brown A.O.I.P.	23TR6A	115V 60 Hz	90	180	2	M27596
Microtechnica Serius (Series 400 Hz)	23TR4	115V 400 Hz	90	360	1	M27597
USN 400 Hz	23TR4	115V 400 Hz	90	36	10	M27598

Table 2 Compass Adapter Part Number Cross Reference Listing

Product Code	Compass Adapter	Synchro	Encoder
M27595	169153-1	169305-1	169127-1
M27592	169153-2	169305-2	169127-1
M27593	169153-3	315-7215P1	169127-1
M27594	169153-4	315-7215P1	169127-3
M27596	169153-5	315-7215P1	169127-2
M27597	169153-6	315-7215P2	169127-1
M27598	169153-7	315-7215P2	169127-3

TABLE 3
COMPASS ADAPTER PARTS LIST

FIND NO	QTY	PART OR IDENT. NO.	CIRCUIT SYMBOL	DESCRIPTION
1	1	169115-2		CASE ASSY
2	1	169116-2		COVER
3	4	93-482-2		CLAMP CABLE
4	1	91-1000-2	B 1	MUFFIN GRILLED FAN
5	1	73-1421		GRILL
6	1	169119-1		ANGLE BKT PCB MTG
7	2	226-7177P28	F 1	FUSE
		226-7177P28	F 2	FUSE
8	2	343-1010P3	XF 1	FUSE HOLDER
		343-101OP3	XF 2	FUSE HOLDER
9	1	228-7273P2	S 1	SWITCH DPST
10	1	588007-4		NUT, PACKING
11	1	43-353	DS 1	PILOT LAMP
12	1	169118-1		BRKT SYNCHRO MTG
13	1	169924-1		ID NAMEPLATE
14	1	169121-1		BRKT XSTR MTG
15	3	386-7187P2	Q 1	TRANSISTOR 2N3055
		386-7187P2	Q 2	TRANSISTOR 2N3055
		386-7187P2	Q 3	TRANSISTOR 2N3055
16	1	359-7206P1		GROMMET RUBBER
17	1	169120-1		BRACKET TERM BD
18	3	586065-2	XQ 1	SOCKET XSTR
		586065-2	XQ 2	SOCKET XSTR
		586065-2	XQ 3	SOCKET XSTR
19	2	167822-3	TB 1	TERMINAL BD

TABLE 3 (cont'd)

FIND NO	QTY	PART OR IDENT. NO.	CIRCUIT SYMBOL	DESCRIPTION
19		167822-3	TB 2	TERMINAL BD
20	1	589655-1	FL 1	RF FILTER
21	1	See Tables 1 and 2		SYNCHRO
22	1	169122-1		HUB SYNCHRO
23	1	See Tables 1 and 2		ENCODER WHEEL
24	1	169125-1		LIGHT COVER OPT SN
25	1	169126-1		COVER, TERM BOARD
26	1	169156-1	A 1	PCB,CONV,SYN/STPR
27		169154		SCH, CONV, SYN/STPR
28	1	981330-1	PSI	P/S SOC C MOD
29		95-981		JOINT COMPOUND
30	1	2-687		SPEED NUT
31	1	203-1005P21		NUT, HEXAGON
32	3	203-1166P2		NUT, HX,4-40, CRES
33	8	203-1166P3		NUT, HX, 6-32, CRES
34	4	203-1166P4		NUT, HX, 8-32, CRES
35	1	207-7186P8		SET SCREW
36	2	207-7195P161		PHMS 4-40X3/16
37	18	207-7195P327		PHMS 6-32X3/8
38	14	207-7195P333		PHMS 6-32X5/8
39	4	207-7195P411		PHMS 8-32X1/2N
40	4	207-7195P323		PHMS 6-32X1/4
41	1	207-7195P423		PHMS 8-32X1 1/4
42	4	207-7195P491		PHMS 10-32X1/2
43	4	210-7194P15		STANDOFF,HEX M/F
44	2	210-7194P16		STANDOFF,HEX M/F
45	6	236-1149P8		WASHER FLAT 6

TABLE 3 (cont'd)

FIND NO	QTY	PART OR IDENT. NO.	CIRCUIT SYMBOL	DESCRIPTION
46	5	236-1150P2		WSHR,LOCK
47	33	236-1150P3		LOCKWASHER 6
48	5	236-1150P4		WSHR, LOCK
49	5	236-1150P5		WSHR, LOCK
50	8	236-1152P25		WASHER, LOCK
51	4	216-7184P5		POP RIVET,AL
52	3	3-462		WSHR,INSUL
53	1	30-054-147		SPACER
54	1	4-114		LUG 6
55	3	6-2020-7		SCR 4-40X5/8
56	3	6-4000-13		FW 4 SS/P
57	1	169308-1		WRNG HARN
58	1	169309-1		JUMPER KIT
59	6	165420-2		SCREW,CAPTIVE
60	1	169165-1		GASKET
61		230-7223P1		SEALANT
62		169325		CONV GEN BREAKDOWN
63	1	169323-1		PACKAGING ASSY
64		230-7178G1		RESIN BOND

TABLE 4
COMPASS ADAPTER PCB PARTS LIST

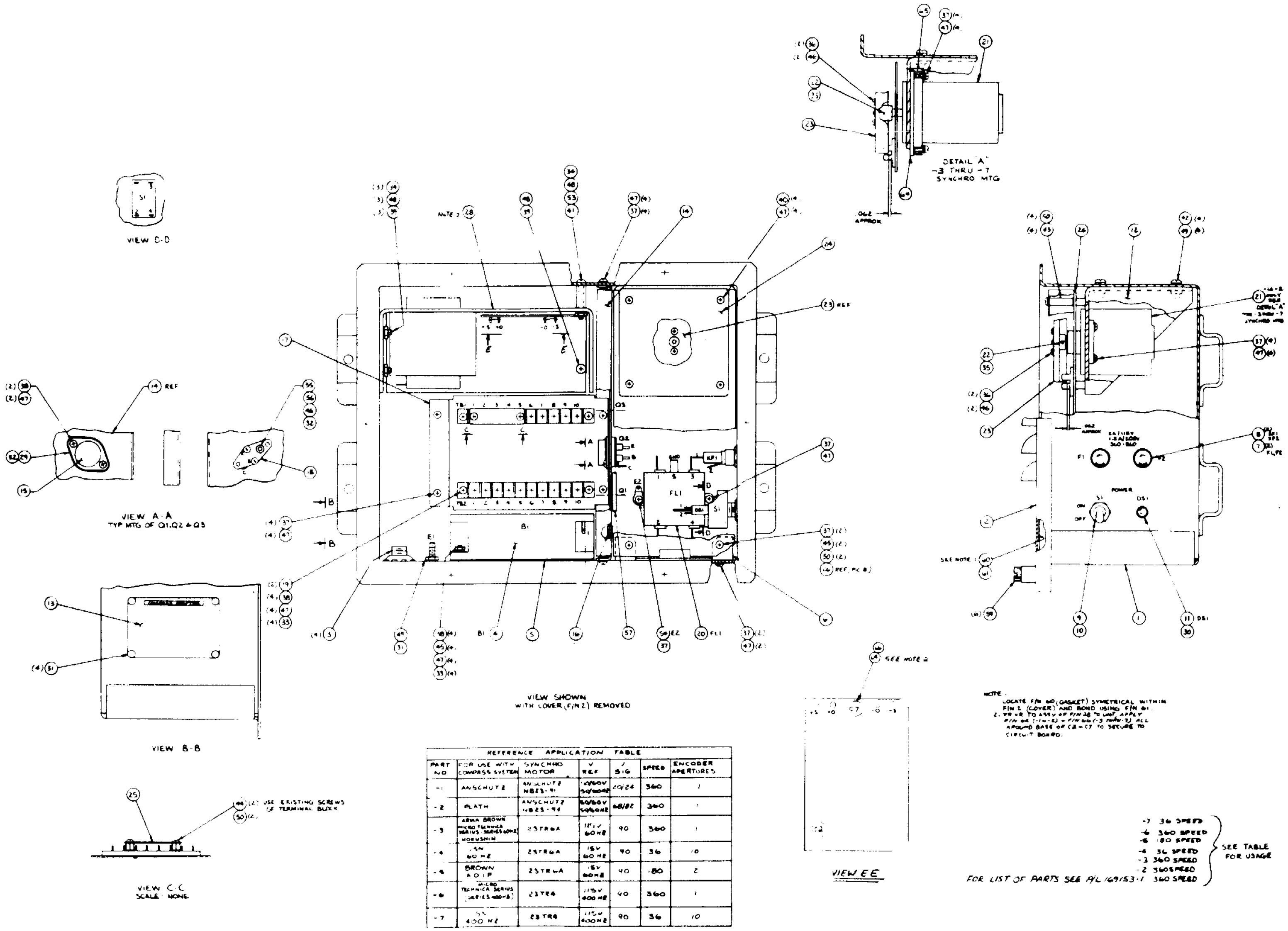
FIND NO	QTY	PART OR IDENT. NO.	CIRCUIT SYMBOL	DESCRIPTION
	3	165188-1	Q103	XSTR. 2N5320
		165188-1	Q203	XSTR. 2N5320
		165188-1	Q303	XSTR. 2N5320
	2	226-7176P43	F401	FUSE,F,AGC2,250V
		226-7176P43	F402	FUSE,F,AGC2,250V
	3	235-7053P1	C101	CAP, 5PF, 300V, M,5
		235-7053P1	C201	CAP, 5PF, 300V, M, 5
		235-7053P1	C301	CAP, 5PF, 300V, M, 5
	1	235-7207P37	C403	CAP, D,. 050UF, 50V
	1	235-7353P130	C402	CAP, 50UF,50V
	1	235-7395P76	C401	CAP, 1. OUF, 35V,T
	3	280-1145P109	R102	RES,10k,.5W
		280-1145P109	R202	RES,10K,.5W
		280-1145P109	R302	RES,10K,.5W
	3	280-1145P115	R103	RES,15K,.5W
		280-1145P115	R203	RES,15K,.5W
		280-1145P115	R303	RES,15K,.5W
	1	280-1145P12	R404	RES,20 OHM,.5W
	3	280-1145P136	R101	RES,56K,.5W
		280-1145P136	R201	RES,56K,.5W
		280-1145P136	R301	RES,56K,.5W
	4	280-1145P37	R108	RES,100 OHM, 5W
		280-1145P37	R208	RES,100 OHM,.5W
		280-1145P37	R308	RES, 100 OHM,.5W
		280-1145P37	R402	RES,100 OHM,.5W

TABLE 4 (cont'd)

FIND NO	QTY	PART OR IDENT. NO.	CIRCUIT SYMBOL	DESCRIPTION
	3	280-1145P85	R104	RES,2.2K, .5W
		280-1145P85	R204	RES,2.2K, .5W
		280-1145P85	R304	RES,2.2K, 5W
	3	280-1145P94	R105	RES,3.9K, .5W
		280-1145P94	R205	RES,3.9K, .5W
		280-1145P94	R305	RES, 3.9K,.5W
	1	280-1147P76	R401	RES, 1.2K OHM,2W
	3	280-1180P13	R106	RES,22 OHM,1W
		280-1180P13	R206	RES,22 OHM,1W
		280-1180P13	R306	RES,22 OHM,1W
	1	280-7178P3	R403	RES,2.7 OHM,1W
	3	297-7204P2	L101	FERRITE BEAD
		297-7204P2	L201	FERRITE BEAD
		297-7204P2	L301	FERRITE BEAD
	3	322-7220P1	CR101	DIODE, IN4148, S
		322-7220P1	CR201	DIODE, 1N4148, S
		322-7220P1	CR301	DIODE, 1N4148, S
	6	386-7249P57	Q101	XSTR,2N2222A
		386-7249P57	Q 102	XSTR,2N2222A
		386-7249P57	Q201	XSTR,2N2222A
	3	585096-10	VR101	DIODE ZENER 1N5230
		386-7249P57	Q202	XSTR,2N2222A
		386-7249P57	Q301	XSTR,2N2222A
		386-7249P57	Q302	XSTR,2N2222A
	3	585096-10	VR101	DIODE ZENER 1N5230
		585096-10	VR201	DIODE ZENE-R 1N5230

TABLE 4 (cont'd)

FIND NO	QTY	PART OR IDENT. NO.	CIRCUIT SYMBOL	DESCRIPTION
		585096-10	VR301	DIODE ZENER 1N5230
		3586054-41	R107	RESISTOR
		586054-41	R207	RESISTOR
		586054-41	R307	RESISTOR
		3587565-4	CR401	DIODE,S16,S
		587565-4	CR402	DIODE, S16, S
		587565-4	CR403	DIODE,S16,S
		3588076-1	A101	SEMICONDUCTOR DEV
		588076-1	A201	SEMICONDUCTOR DEV
		588076-1	A301	SEMICONDUCTOR DEV
1	1	169155-1		PCB, CONV, SYN/STPR
2	4	585804-1		FUSE CLIP
3	6	207-7195P165		PHMS 4-40X5/16
4	6	2-703		HEX NUT
5	6	586795-1		PAD
6		273-7190P1		WIRE TND COPR 22AW
7		267-7178P15		SLEEVING 22 CLEAR
8	3	308-7203P1		HT SK,XSTR
9	6	6-4000-13		FW 4 SS/P
10	6	236-1150P2		WSHR,LOCK
11		980154-1		SILICONE VARNISH
12		980156-1		FLUORESCENT DYE



REFERENCE APPLICATION TABLE						
PART NO	FOR USE WITH COMPASS SYSTEM	SYNCHRO MOTOR	V REF	V SIG	SPEED	ENCODER APERTURES
-1	ANSCHUTZ	ANSCHUTZ NB23-91	110/60V 50/60HZ	20/24	360	1
-2	PLATH	ANSCHUTZ NB23-94	80/60V 50/60HZ	68/82	360	1
-3	ARMA BROWN MICRO TECHNICA SERIUS SERIES 60HZ HOKUSHIN	23TR6A	115V 60HZ	90	360	1
-4	SN 60 HZ	23TR6A	15V 60 HZ	90	36	10
-5	BROWN A O I P	23TR6A	15V 60HZ	40	180	2
-6	MICRO TECHNICA SERIUS (SERIES 400HZ)	23TR6	115V 400 HZ	40	360	1
-7	SN 400 HZ	23TR6	115V 400HZ	90	36	10

Figure 5 Assembly Drawing

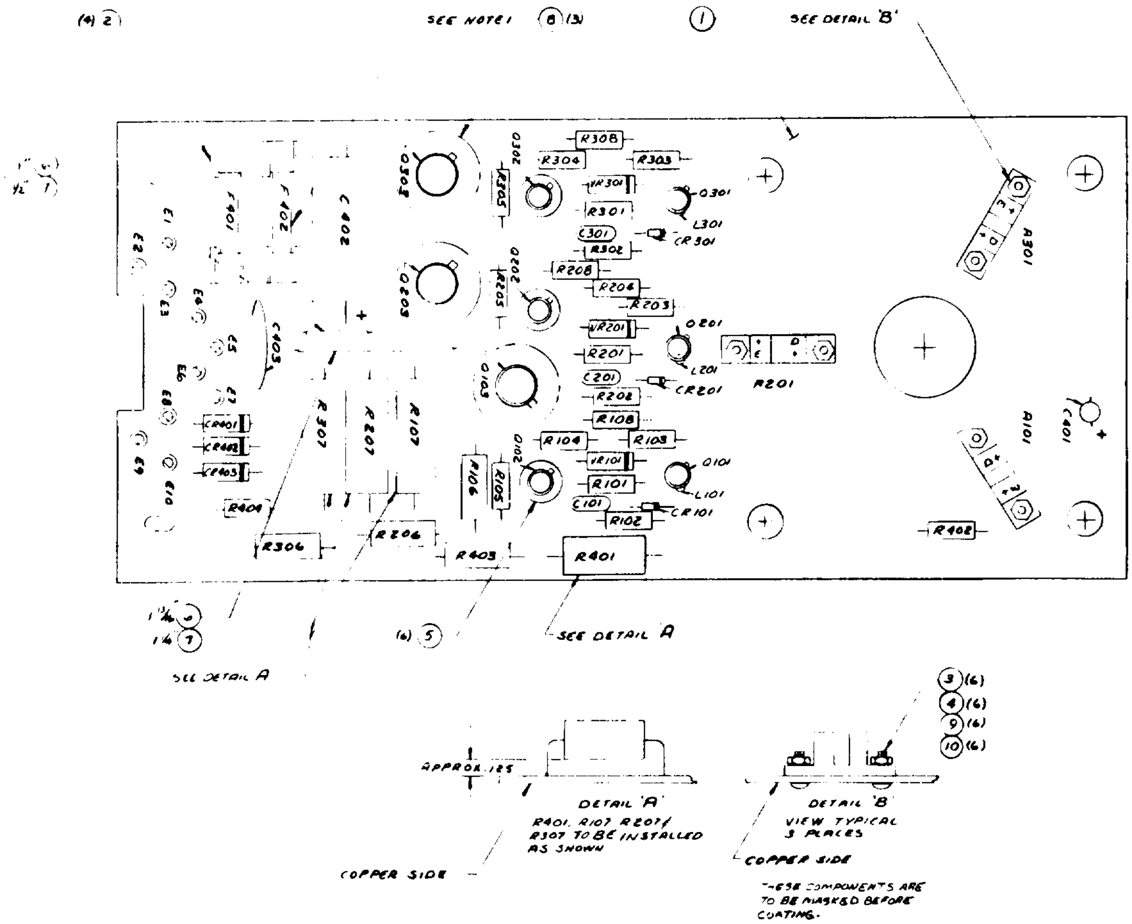
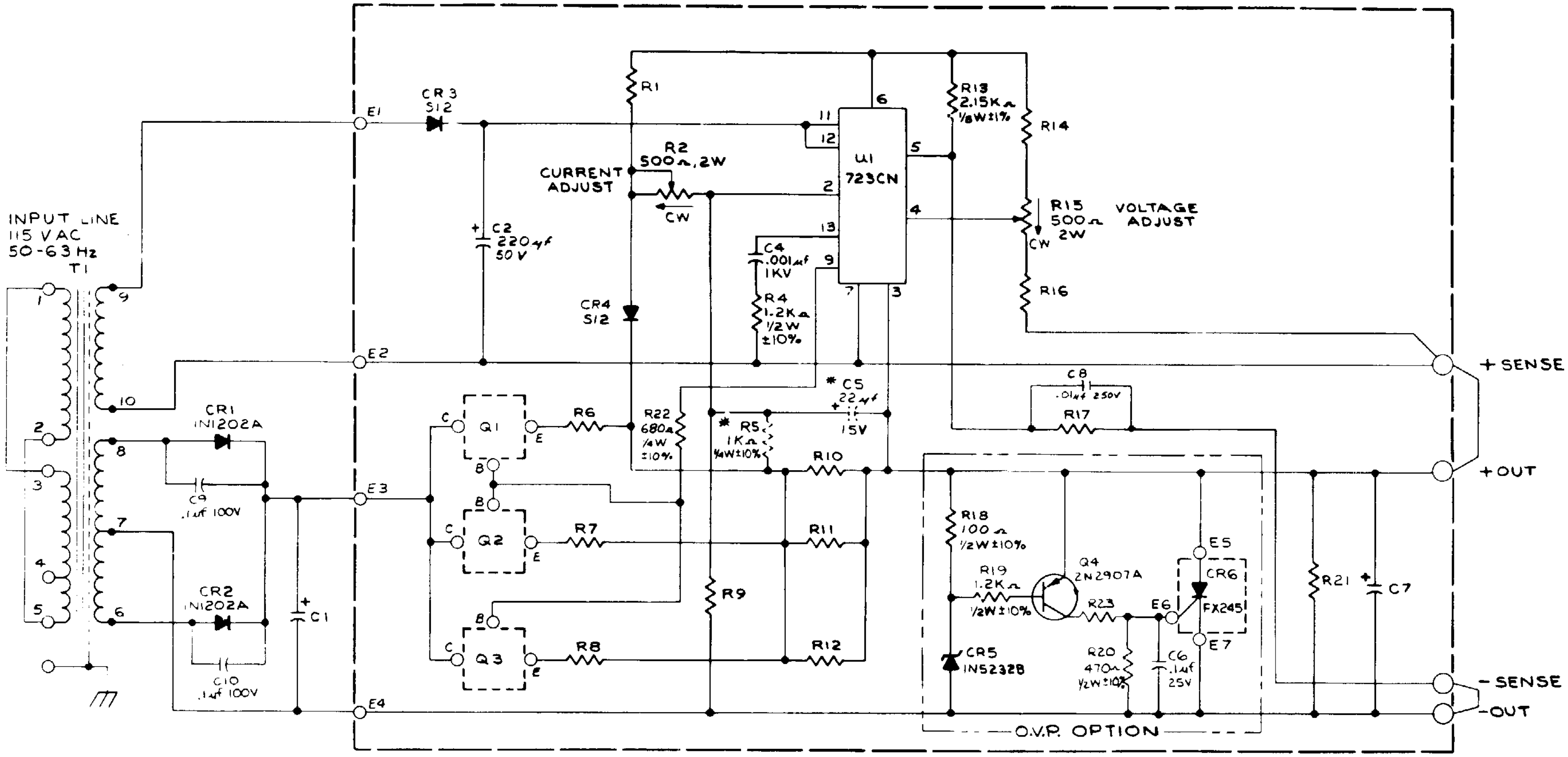


Figure 6 PCB Parts Location Diagram

Table 5 Power Supply Model 28-3.1 Parts List

Symbol	Description	Part Number
T1	Xfmr Assy 28 Volt	166535-6
	PCB Assy 28 Volt	166537-6
Q1	Xstr, Silicon, Power	166242-2
Q2	Xstr, Silicon, Power	166242-2
Q3	Xstr, Silicon, Power	166242-2
CR1	Diode, 1N1202A	587393-2
CR2	Diode, 1N1202A	587393-2
C1	Cap, Fxd, AL Electrolytic	24-2595-9
C9	Cap,D,.1 uF,100V	235-7207P40
C10	Cap,D,.1 uF,100V	235-7207P40
C2	Cap, Elect, Alum	165857-30
C7	Cap, Elect, Alum	166857-30
R2	Res, Vari, WW	166240-1
R15	Res, Vari, WW	166240-1
R10	Res,WW,O.1 ohm,2W	166605-1
R6	Res,WW,0.33 ohm,2W	166605-6
R7	Res,WW,0.33 ohm,2W	166605-6
R8	Res,WW,0.33 ohm,2W	166605-6
U1	I. C.	167301-1
C4	Cap, Disc, Cer	235-7421P14
C8	Cap, Fxd, Met Polyester	24-2015-1
R4	Res,1.2K ohm,.5W	280-1145P77
R1	Res,4.7K,.5W	280-1145P98
R21	Res,820 ohm,2W	280-1147P71
R22	Res,680 ohm,1/4W	280-1171P68
R9	Res, Fxd,24K,1/2W	585326-182
R17	Res 1/2W	586250-135
R13	Res 1/2W	586250-90
R14	Res 1/2W	586250-90
R16	Res 1/2W	586250-90
CR3	Diode, S12, S	587565-2
CR4	Diode, S12, S	587565-2

D166526 Rev A



UNIT	C1	C7	Q1, Q2, Q3	R6, R7, R8	R9	R10	R11	R12	R14, R16	R17	R21	R1	R23
2-10	30,000µf 15V	470µf 25V	2N6383	.1Ω 2W±10%	1.8KΩ 1/2W±5%	.1Ω 2W±10%	.1Ω 2W±10%	.1Ω 2W±10%	5.11KΩ 1/8W±1%	3.32KΩ 1/8W±1%	10Ω 2W±10%	2.2KΩ 1/2W±10%	NOT USED
5-10	30,000µf 15V	470µf 25V	2N6383	.1Ω 2W±10%	4.7KΩ 1/2W±5%	.1Ω 2W±10%	.1Ω 2W±10%	.1Ω 2W±10%	5.11KΩ 1/8W±1%	5.11KΩ 1/8W±1%	33Ω 2W±10%	2.2KΩ 1/2W±10%	10Ω 1/2W±10%
12-6.0	15,000µf 30V	470µf 25V	2N6383	.15Ω 2W±10%	11KΩ 1/2W±5%	.1Ω 2W±10%	.1Ω 2W±10%	NOT USED	3.01KΩ 1/8W±1%	9.53KΩ 1/8W±1%	150Ω 2W±10%	2.7KΩ 1/2W±10%	330Ω 1/2W±10%
15-5.0	15,000µf 30V	470µf 25V	2N6383	.22Ω 2W±10%	13KΩ 1/2W±5%	.1Ω 2W±10%	.1Ω 2W±10%	NOT USED	3.01KΩ 1/8W±1%	11KΩ 1/8W±1%	220Ω 2W±10%	2.7KΩ 1/2W±10%	560Ω 1/2W±10%
24-3.5	7,500µf 50V	220µf 50V	2N6384	.22Ω 2W±10%	22KΩ 1/2W±5%	.15Ω 2W±10%	.15Ω 2W±10%	NOT USED	2.15KΩ 1/8W±1%	16.9KΩ 1/8W±1%	560Ω 2W±10%	2.7KΩ 1/2W±10%	1KΩ 1/2W±10%
28-3.1	7,500µf 50V	220µf 50V	2N6384	.33Ω 2W±10%	24KΩ 1/2W±5%	.1Ω 2W±10%	NOT USED	NOT USED	2.15KΩ 1/8W±1%	18.7KΩ 1/8W±1%	820Ω 2W±10%	4.7KΩ 1/2W±10%	1.2KΩ 1/2W±10%

* USED ON M10 OPTION ONLY

Figure 7 Power Supply, PSI, Schematic Diagram

ATTACHMENT A
NSK CONVERSION INSTRUCTIONS

The following procedure should be used to convert the North Stabilization Kit installed in any 12 inch or 16 inch indicator for operation with any one of four different input voltages. The conversion requires replacement of components on the NSK Assembly (A9) proper and on both of the attached PCB assemblies, A9A1 and A9A2.

BEFORE STARTING MODIFICATION

1. Referring to Table A-2, determine the value and part number of the components required for NSK operation at the desired input voltage.

2. Obtain the required number of components (for the total number of indicators to be modified) through normal channels.

NSK ASSEMBLY MODIFICATION

1. Referring to the maintenance section of the basic radar manual, gain access to the NSK Assembly in the Indicator.

2. Remove the Resolver Drive (A9A1) and Exciter (A9A2) PCB assemblies from the NSK (A9) Assembly. Refer to the assembly drawing in the basic radar manual for location.

3. Locate the three 25 watt resistors, R1, R2, and R3 on the NSK Assembly.

4. Replace these resistors with 25 watt resistors of the proper value for the desired input voltage. See Table A-2.

5. Locate and replace R4 (2 or 3 watt resistor) with a resistor of the proper value and wattage as determined from Table A-2.

6. Using Table A-3, program the NSK Assembly for negative 28 volt steps.

RESOLVER DRIVE ASSEMBLY (A9A1) MODIFICATION

1. If necessary, replace the plug-in relay K1 with a relay of the correct voltage and coil resistance as specified in Table A-2.

NSK EXCITER ASSEMBLY (A9A2) MODIFICATION

1. Locate and replace the t watt resistors R1, R2, and R3 with ¼ watt resistors of the correct value for the desired input voltage per Table A-2. See the basic radar manual drawings for location.

2. Locate and replace the * watt resistors R14, R15, and R16 with ¼ watt resistors of the proper value per Table A-2.

3. Verify that integrated circuit U12 is P/N 167686-2. If not, refer to Field Change Notice FC-12/16-5 for instructions.

REASSEMBLY AND ALIGNMENT

1. Reinstall the Resolver Drive and NSK Exciter PCB assemblies on the NSK Assembly. Verify that all connections are secure.

2. Perform the NSK alignment procedures detailed in the maintenance section of the basic radar manual.

3. Reinstall the stress bar and upper access cover of the Indicator and return the unit to service.

DOCUMENTATION

Annotate the schematics and Replaceable Parts Lists of the NSK Assembly (A9) and the NSK Exciter PCB (A9A2) of the Instruction Manual to reflect the changed component values and part numbers.

ASSEMBLY REPLACEMENT

For ordering purposes, Table A-1 lists the part numbers of the complete assemblies which are factory assembled with the correct components for the four acceptable input voltages.

Table A-1 NSK Assemblies

Assembly	Part Number			
	70 Volt	50 Volt	35 Volt	28 Volt
NSK Assy (A9)	167210-1	167210-2	167210-3	167210-4
Resolver Drive Assy (A9A1)	167188-1	167188-2	167188-2	167188-2
NSK Exciter Assy (A9A2)	169456-1	169456-2	169456-3	169456-4

Table A-2 NSK Component Part Numbers

Assembly/ Component	70 Volt	50 Volt	35 Volt	28 Volt
A9-				
R1, R2, R3 (Part No.)	200 ohms 3%, 25W 586369-537	121 ohms 3%, 25W 586369-265	56.2 ohms 1%, 25W 586369-534	34.8 ohms 3%, 25W 586369-526
R4 (Part No.)	680 ohms, 2W 280-1147P67	470 ohms, 3W 27-397-89	200 ohms, 2W 280-1147P48	47 ohms, 2W 280-1147P25
A9A1K1 (Part No.)	48 volt 271-7188P8	24 volt 271-7188P7	24 volt 271-7188P7	24 volt 271-7188P7
A9A2-				
R1, R2, R3 (Part No.)	6.8K, 2W 280-1147P103	4.7K, 2W 280-1147P97	3.3K, 2W 280-1147P91	2.7K, 2W 280-1147P88
R14, R15, R16 (Part No.)	68K, TW 280-1145P139	47K, ½W 280-1145P133	33K, ½W 280-1145P127	27K, 2W 280-1145P124

Note: All resistor values are in ohms.

Table A-3. Wiring Changes Required for Negative 28 Volt Steps

Wire Color	Position + Steps (As Shipped)	New Position -Steps
BRN	A2P1-1	A2P1-9
RED	A2P1-2	A2P1-8
ORN	A2P1-3	A2P1-6
YEL	A2P1-4	A2P1-5
GRN	A2P1-5	A2P1-4
GRN	A2P1-6	A2P1-3
KEY PIN		
NO WIRE	A2P1-7	A2P1-7
GRN	A2P1-8	A2P1-2
GRN	A2P1-9	A2P1-1

ATTACHMENT B

TBK CONVERSION INSTRUCTIONS

For conversion to the TBK system, the following steps are necessary to assure proper operation of the stepper motor which provides compass information to the True Bearing Kit.

1. Remove all power to the indicator and the gyro line.

2. Locate and remove the three 25 watt resistors R1, R2 and R3. Note that these three resistors perform the same function as R1, R2, and R3 in the NSK Assembly (A9) of the Indicator.

3. Using the values listed for A9/R1, R2, R3 in Table A-2 of the NSK Conversion Instructions (Attachment A), select the correct replacement resistor values and part numbers.

4. Install the replacement resistors for R1, R2, and R3 in the TBK.

5. Document component changes in the radar manual.

APPENDIX B

REFERENCES

DA Pam 310-4	Index of Technical Publications
TM 11-5840-360-14-1-2	Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Radar Set AN/SPS-64(V)5 (NSN 5840-01-034-3946) (Relative Motion).
TM 11-5840-360-14-2	Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Radar Set AN/SPS-64(V)5 (NSN 5840-01-034-3946) (True Motion Anti-Collision) (to be published).
TM 11-6625-2725-14&P	Operator's, Organizational, Direct Support, and General Support Maintenance Manual Including Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Generator, Signal AN/URM-127A (NSN 6625-00-78:3-5965).
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX C
COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

C-1. Scope

This appendix lists integral components of and basic issue items for the AN/SPS-64(V)5 to help you inventory items required for safe and efficient operation.

C-2. General

This Components of End Item List is divided into the following sections:

a. Section II. Integral Components of the End Item. These items, when assembled, comprise the AN/SPS-64(V)5 and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III. Basic Issue Items. Not applicable.

C-3. Explanation of Columns

a. Illustration. This column is divided as follows:

(1) *Figure number*. Indicates the figure number of the illustration on which the item is shown.

(2) *Item number*. The number used to identify item called out in the illustration.

b. National Stock Number. Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Description. Indicates the Federal item name and, if required, a minimum description to identify the item. The part number indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. Following the part number, the Federal Supply Code for Manufacturers (FSCM) is shown in parentheses.

d. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

e. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

f. Quantity. This column is left blank for use during an inventory. Under the Rcvd column, list the quantity you actually receive on your major item. The Date columns are for your use when you inventory the major item.

(Next printed page is C-2)

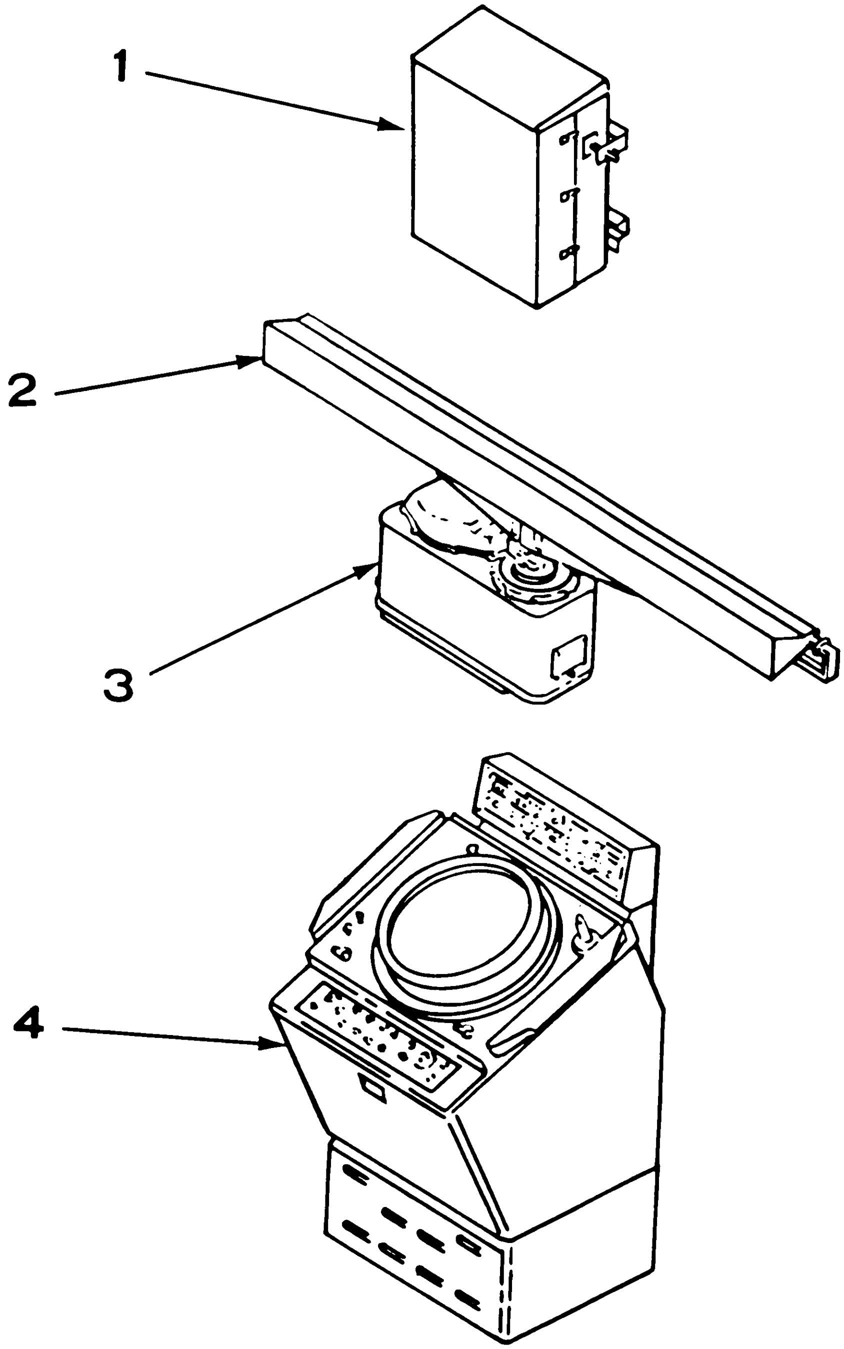


Figure C-1. Radar Set AN/APA-64(V)5 Major Units.

SECTION II INTEGRAL COMPONENTS OF END ITEM
RADAR SET AN/SPS-64(V)5

(1) ILLUS. (a) FIG NO.	(1) ILLUS. (b) ITEM NO.	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION PART NUMBER	(FSCM)	(4) LOCATION	(5) USABLE ON CODE	(6) QTY REQ'D	(7) QUANTITY REV'D	(7) QUANTITY DATE
C-1	1	5840-01-034-3945	RECEIVER-TRANSMITTER RT-1246/SPS-64(V)	(80058)			1		
C-1	2	5985-01-026-9676	ANTENNA AS-3194/SPS-64(V)	(80058)			1		
C-1	3	5840-01-049-1016	ANTENNA PEDESTAL AB-1247/SPS-64(V)	(80058)			1		
C-1	4	5840-01-034-3932	INDICATOR, AZIMUTH-RANGE IP-1302/SPS-64(V)	(80058)			1		

APPENDIX E
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

E-1. General

This appendix provides a summary of the maintenance operations for AN/SPS-64(V)5. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

E-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

E-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of task-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C-Operator/Crew
O-Organizational
F-Direct Support
H-General Support
D-Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

E-4. Tool and Test Equipment Requirements (Sec III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC.

The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e,. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

E-5. Remarks (Sec IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

(Next printed page is E-3)

SECTION II MAINTENANCE ALLOCATION CHART FOR RADAR SET AN/SPS-64(V)5

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINT. FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIP	(6) REMARKS
00	RADAR SET AN/SPS-64(V)5	Inspect	0.5						A
		Adjust		0.5				1,4	
		Service		0.5				1,4	
		Adjust			1.0			1 thru 9	
		Align			3.0			1 thru 9,12 thru 14	
		Replace			3.0			1 thru 14	
		Repair		2.0				1,4	B
		Repair			10.0			1 thru 14	
		Repair					15.0	1 thru 15	
		Overhaul					120.0	1 thru 15	C
01	ANTENNA AS-3194/SPS-64	Inspect			0.2			4	
		Replace			2.0			1,4 thru 6	
		Repair				5.0		1 thru 15	C
02	PEDESTAL ASSEMBLY AB-1247/SPS-64	Inspect			0.1			4 thru 6	
		Adjust			0.5			4 thru 6	D
		Align			0.75			4 thru 6	E
		Repair			2.0			1 thru 14	F
		Repair					4.0	1 thru 15	
0201	DATA UNIT ASSEMBLY	Adjust			0.5			4 thru 6	G
		Repair			1.0			1 thru 14	H
03	INDICATOR IP-1302/SPS-64	Inspect	0.3						
		Adjust		0.5				1,4	
		Adjust			0.7			1,4 thru 6	I
		Replace			2.0			1,4 thru 6	
		Repair		0.5				1,4	J
		Repair			3.0			1 thru 14	K
		Repair					15.0	1 thru 15	
0301	BEZEL ASSEMBLY	Repair		0.3				1,4	L
		Repair			2.0			1 thru 14	M
		Repair					2.0	1 thru 15	N
030101	CURSOR DRIVE ASSEMBLY	Replace			1.0			1 thru 14	
		Repair			0.5			1 thru 14	0
030102	VRM ENCODER ASSEMBLY	Adjust			0.25			1 thru 14	I
		Repair			0.5			1 thru 14	P
0302	VRM PCB	Replace			0.3			1 thru 14	
		Repair					3.0	1 thru 15	C
0303	POSITION PCB	Replace			0.3			1 thru 14	
		Adjust			0.1			1 thru 14	
		Repair					3.0	1 thru 15	C
0304	SWEEP GENERATOR PCB	Replace			0.3			1 thru 14	
		Adjust			0.1			1 thru 14	I
		Repair					3.0	1 thru 15	C
NFG	TIMING CONTROL PCB (NO REPAIR)	Replace			0.3			1 thru 14	
0305	DATA CONTROL PCB	Replace			0.3			1 thru 14	
		Adjust			0.1			1 thru 14	
		Repair					3.0	1 thru 15	C
NFG	COUNTER PCB	Replace			0.3			1 thru 14	
0306	PRF PCB	Replace			0.3			1 thru 14	
		Adjust			0.1			1 thru 14	
		Repair					3.0	1 thru 15	C
0307	VIDEO AMP PCB	Replace			0.3			1 thru 14	
		Adjust			0.1			1 thru 14	
		Repair					3.0	1 thru 15	C
0308	SWEEP OUTPUT ASSEMBLY	Repair			0.4			1 thru 14	K
0309	INDICATOR POWER SUPPLY	Repair			1.0			1 thru 14	K
		Adjust			0.2			1 thru 14	I
		Repair					2.0	1 thru 15	C

SECTION II MAINTENANCE ALLOCATION CHART
FOR
RADAR SET AN/SPS-64('S5

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINT. FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIP	(6) REMARKS
NFG	POT CAP PCB	Replace			0.2			1 thru 14	
		Adjust			0.1			1 thru 14	
030901	CONTROL PCB	Replace			0.3			1 thru 14	
		Align			0.2			1 thru 14	I
		Repair					3.0	1 thru 15	C
NFG	HV PCB	Replace			0.2			1 thru 14	
		Adjust			0.1			1 thru 14	I
030902	PASSIVE PCB	Replace			0.2			1 thru 14	
		Adjust			0.2			1 thru 14	I
		Repair					3.0	1 thru 15	C
04	RECEIVER TRANSMITTER RT-1246/SPS-64	inspect	0.2						A
		Adjust		0.5				1,4	
		Adjust			0.5			1 thru 14	
		Align			2.0			1 thru 14	
		Replace			2.0			1 thru 14	
		Repair		0.5				1,4	F
		Repair			5.0			1 thru 14	K
		Repair					20.0	1 thru 15	C
0401	AMPLIFIER	Inspect			0.5			1 thru 14	
		Repair		0.5				1,4	B
		Repair			1.5			1 thru 14	
040101	IF DETECTOR	Repair			1.0			1 thru 14	Q
0402	PULSE [,RIVER	Adjust			0.5			1 thru 14	
		Replace			1.0			1 thru 14	
		Repair			1.5			1 thru 14	
NFG	MODULATOR TUBE	Replace			2.0			1 thru 14	R
NFG	MAGNETRON	Replace			2.0			1 thru 14	R
NFG	LOCAL OSCILLATOR (GUNN DIODE)	Replace			0.5			1 thru 14	
		Adjust			1.0			1 thru 14	
0403	POWER SUPPLY	Replace			0.5			1 thru 14	R
		Repair			1.5			1 thru 14	
NFG	CONTROL PCB	Adjust			0.5			1 thru 14	
		Replace			0.5			1 thru 14	
05	PLOTTER	Replace			0.5			1 thru 14	
		Repair			0.5			1 thru 14	5
		Repair			1.0			1 thru 15	C
06	NORTH STABILIZATION KIT	Align			1.0			1 thru 14	
		Repair			1.5			1 thru 14	T
		Repair			2.5			1 thru 15	C
0601	STABILIZ2ATION ASSEMBLY	Align			1.0			1 thru 14	
		Repair			1.5			1 thru 14	
060101	NSK EXCITER PCB	Replace			1.0			1 thru 14	
		Repair			1.5			1 thru 15	C
NFG	NSK RESOLVER DRIVE PCB	Replace			1.0			1 thru 14	
		Align			0.5			1 thru 14	
NFG	NSK RESOLVER	Replace			0.5			1 thru 14	
		Align			1.0			1 thru 14	U
07	TRUE MOTION UNIT	Align			1.0			1 thru 14	V
		Align			2.0			1 thru 14	W
		Repair			3.0			1 thru 14	
		Repair			2.5			1 thru 15	
0701	CARD BASKET ASSEMBLY	Repair			1.0			1 thru 14	
070101	DIGITAL FCB	Replace			0.3			1 thru 14	
		Repair				1.5		1 thru 15	C

SECTION II MAINTENANCE ALLOCATION CHART FOR RADAR SET AN/SPS-64(V)5

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINT. FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIP	(6) REMARKS
070102	ANALOG PCB	Replace			0.3			1 thru 14	
		Repair					1.5	1 thru 15	C
070103	PROCESSOR PCB	Replace			0.3				
		Repair					1.5	1 thru 15	C
070104	MEMORY PCB	Replace			0.3			1 thru 14	
		Repair					1.5	1 thru 15	C
0702	TRUE MOTION EBL ASSEMBLY	Repair			1.0			1 thru 14	
		Align			1.5			1 thru 14	
NFG	EBL TM PCB	Replace			0.3			1 thru 14	
		Align			1.0			1 thru 14	R,V
NFG	SIN-COS POT	Replace			0.5			1 thru 14	
		Align			1.0			1 thru 14	V
0703	HEAD SET ASSEMBLY	Repair			1.0			1 thru 14	
		Repair					2.0	1 thru 15	
070301	SWITCH & LAMP BUFFER PCB	Replace			0.3			1 thru 14	
		Repair					1.0	1 thru 15	C
070302	DISPLAY DRIVER PCB	Replace			0.3			1 thru 14	
		Repair					1.5	1 thru 15	C
NFG	TIME DISPLAY ASSEMBLY	Replace			0.3			1 thru 14	
0704	TM POWER SUPPLY	Replace			1.0			1 thru 14	
		Repair			0.3			1 thru 14	
		Repair					1.5	1 thru 15	
070401	TM CONTROL PCB	Replace			0.3			1 thru 14	
		Repair					1.5	1 thru 15	C
NFG	SIN-COS DRIFT POT	Replace			0.5			1 thru 14	
		Align			1.0			1 thru 14	R,V

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
RADAR SET AN/SPS-64(V)5

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	0, F, H, D	MULTIMETER ME-303A/U	6625-00-969-4105	
2	F, H. D	GENERATOR SIGNAL AN/URM-127	6625-00-783-5965	
3	F, H. D	OSCILLOSCOPE AN/USM-281C	5625-00-106-9622	
4	0, F, H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	6180-00-064-5174	
5	F, H, D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
6	F, H. D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	
7	F, H. D	FREQUENCY WAVEMETER FR-126/U	6625-00-787-0248	-HPX5028
8	F, H, D	X-BAND THERMISTOR MOUNT MX-7772/U	6625-00-886-1955	-HP-4/UA
9	F, H, D	METER, POWER	6625-00-436-4883	
10	F, H, D	MULTIMETER, DIGITAL AN/USM-451	6625-01-060-6804	
11	F, H, D	PROQUE, HI VOLTAGE	6625-00-101-8759	
12	F, H, D	CRYSTAL DETECTOR RF-210/U	6625-00-783-5758	
13	F, H, D	ATTENUATOR, VARIABLE CN-713( )/U	5985-00-889-0012	
14	F, H, D	DIRECTIONAL COUPLER CU-1515/U	5895-00-679-0645	
15	D	DEPOT TEST EQUIPMENT		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	VISUAL INSPECTION
B	O-REPLACE FUSES, LAMPS ETC.
C	DEPOT MAINTENANCE ONLY
D	ADJUST V-BELT & RESOLVER
E	ALIGN RESOLVER
F	REPLACE BELT, RESOLVER, MOTOR AND ROTARY JOINT
G	ADJUST REEDSWITCH
H	REPLACE ARM ASSY
I	ADJUST C1 AFTER REPLACING PCB'S
J	REPAIR BY REPLACEMENT OF VIEWING HOOD, FUSES, ETC.
K	REPLACEMENT OF PCB'S; CRT & MISC ELECTRICAL COMPONENTS
L	REPLACEMENT OF BEZEL GASKET, KNOBS, ETC.
M	REPLACEMENT OF INDICATORS, GASKET, LED ASSY, SWITCHES, ETC.
N	REPAIR CIRCUIT CARD HOLDER
0	REPLACE "O" RINGS
P	REPLACE AND ADJUST POSITION LED
Q	REPLACE IF AMP PCB
R	REQUIRES ALIGN OF RADAR SET UPON REPLACEMENT
S	REPAIR BY REPLACEMENT OF LAMP
T	REPAIR BY REPLACEMENT OF PCP, RESOLVER AND MOTOR STEPPER
U	ALIGN NSK
V	ALIGN TMU
W	ALIGN RADAR SET

APPENDIX F
EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

F-1. Scope
This appendix lists expendable supplies and materials you will need to operate and maintain the These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

F-2. Explanation of Columns

a. Column 1-Item number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. D).

b. Column 2-Level. This column identifies the lowest level of maintenance that requires the listed item.

O-Organizational Maintenance/Aviation Unit Maintenance

F-Direct Support Maintenance/Aviation Intermediate Maintenance

c. Column 3-National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column 4-Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by a part number.

e. Column 5--Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

(Next printed page is F-2)

SECTION II EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION FSCM AND PART NO	(5) UNIT OF MEAS
			GEAR BOX LUBRICANT, MIL-L-6086 GRADE M 980131-1	
			OIL, LUBRICATING, LIGHT MACHINE 230-7176P1	
			GREASE MIL G23827 230-1158P8	
			GASKET COMPOUND FORM-A-GASKET	
			ANTI-SEIZE COMPOUND QUICKSILVER ANTI-CORROSION GREASE	
			HEAT SINK COMPOUND 95-981	

☆U.S. GOVERNMENT PRINTING OFFICE: 1981-505-028:1393

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, Untied States Army
The Adjutant General

Distribution:
To be distributed in accordance with special mailing list.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 050270-000