TECHNICAL MANUAL

ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

COUNTERMEASURES SET AN/TLQ-15
(NSN 5865-00-878-2650),
IMPEDANCE MATCHING NETWORK CU-2193/TLQ-15
(NSN 5915-00-028-8595)
AND
COUNTERMEASURES SET TEST KIT MK-1809/TL0-15
(NSN 5865-01-027-7926)

This copy is a reprint which includes current pages from Changes 1 through 3. The title was changed to read as shown above by Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1976

WARNING

Before operating the AN/TLQ-15, ensure that all requirements of TB SIG 291 are met. Injury or DEATH could result from improper or careless operation.

RF RADIATION HAZARD

Dangerous rf power exists in and around the cm antenna and counterpoise during operation. Do not operate the AN/TLQ-15 with personnel in contact with or in close proximity to these components. Before attempting any adjustment or disassembly of the cm antenna or counterpoise, power should be removed from the equipment.

HIGH VOLTAGE

is used in the operation of the AN/TLQ-15.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.
Learn the areas containing high voltage in each piece of equipment.
Be careful not to contact high-voltage connections when installing or operating this equipment.
Before working inside the equipment, turn power off and ground points of high potential before touching them.

TM 11-5895-372-24
C5

CHANGE
NO. 5

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *10 August 1983*

Organizational, Direct Support,
And General Support
Maintenance Manual
COUNTERMEASURES SET AN/TLQ-15
(NSN 5865-00-878-2650),
IMPEDANCE MATCHING NETWORK
CU-21931TLQ-15(NSN 5915-00-028-8595)
AND COUNTERMEASURES SET TEST KIT
MK-1809/TLQ-15(NSN 5865-01-027-7926)

TM 11-5895-372-24, May 1976 is changed as follows:

1. Remove all pages and insert new pages as indicated below. New or changed material is indicated by a verticl bar in the margin of the new page.
2. Added or revised illustrations are indicated by a vertical bar adjacent to the illustration identification number.

Remove pages	*Insert pages*
2-1 through 2-4	2-1 through 2-4
C-5 through C-8	C-5 through C-8
Index 1 and Index 2	Index 1 and Index 2

3. File this change sheet in front of the Publication for reference purposes.

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

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ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with Special List.

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C4

CHANGE
NO. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *27 December 198*

Organizational, Direct Support, And General Support Maintenance Manual
COUNTERMEASURES SET AN/TLQ-15 (NSN 5865-00-878-2650),
IMPEDANCE MATCHING NETWORK CU-2193/TLQ-15 (NSN 5915-00-028-8595) AND
COUNTERMEASURES SET TEST KIT MK-1809/TLQ-15 (NSN 5865-01-027-7926)

TM 11-5895-372-24, 26 May 1976, is changed as indicated below.

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2. Added or revised illustrations are indicated by a vertical bar in front of the figure caption.
3. Changes to electrical diagrams are indicated by shaded areas.
4. Remove and insert as indicated in the page list below:

Remove Pages	*Insert Pages*
None	A and B
i, ii and iii	i, ii, and iii
1-1 through 1-4	1-1 through 1-4
3-9 and 3-10	3-9 and 3-10
4-1 and 4-2	4-1 and 4-2
4-10.5 through 4-12	4-10.5 through 4-12.1
4-43 and 4-44	4-43 and 4-44
4-85, 4-86 and 4-86.1	4-85, 4-86 and 4-86.1
4-90.3	4-90.3 and 4-90.4
A-1 and A-2	A-1 and A-2
B-1 through B-11	B-1 through B-19
Index 1 and 2	Index 1 and 2
FO-9	FO-9
FO-17	FO-17
FO-28	FO-28
None	FO-36

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WARNING

READ AND OBSERVE ALL WARNINGS AT BEGINNING OF THIS MANUAL

A REVIEW OF TB 385-4, SAFETY PRECAUTIONS FOR MAINTENANCE OF ELECTRICAL/ ELECTRONIC EQUIPMENT, IS RECOMMENDED

SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

5 **DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL**

1 **IF POSSIBLE, TURN OFF THE ELECTRICAL POWER**

2 **IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL**

3 **SEND FOR HELP AS SOON AS POSSIBLE**

4 **AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION**

5

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

TECHNICAL MANUAL
No. 11-5895372-24

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *26 May 1976*

ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL COUNTERMEASURES SET AN/TLQ-15 (NSN 5865-00-878-2650), IMPEDANCE MATCHING NETWORK CU-2193/TLQ-15 (NSN 5915-00-028-8595) AND COUNTERMEASURES SET TEST KIT MK-1809/TLQ-15 (NSN 5865-01-027-7926)

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual provides equipment functioning data and organizational, direct support, and general support maintenance instructions for Countermeasures Set AN/TLQ-15 and Impedance Matching Network CU-2193/TLQ-15 and Countermeasures Set Test Kit MK-1809/TLQ-15.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

1-3. 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 (TAMMS).

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 55-38INAVSUPINST 4610.33B/AFR 75-18/MCO 4610.19C/DLAR 4500.15.

1-3.1. 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 or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications-Electronics Command and Fort Monmouth ATTN: DRSEL-ME-MP, Fort Monmouth, NJ 07703. In either case, a reply will be furnished direct to you.

1-3.2. Reporting Equipment Improvement Recommendations (EIR)

If your equipment 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. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications/Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, NJ 07703. We'll send you a reply.

1-4. Destruction of Army Electronics Materiel

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

1-5. Administrative Storage and Disposition Instructions

a. Electronic equipment should be stored in accordance with Administrative Storage of Equipment (TM 740-90-1).

b. This equipment will not be disposed of in accordance with standard procedures. A request for disposition of this equipment is required and should be addressed to Commander, US Army Electronics Materiel Readiness Activity, Vint Hill Farms Station, Warrenton, Virginia 22186.

Section II. DESCRIPTION AND DATA

1-6. Description

Refer to TM 11-5895-372-10 for a general description and illustrations of the AN/TLQ-15.

1-7. Tabulated Data

Refer to TM 11-5895-372-10 for items comprising an operable equipment tabulated data pertinent to the AN/TLQ-15.

1-8. List of Equipment Common Names

A list of common names is provided in the following listing:

AN/TLQ-15 Common Names List

Ref. Des.	*Nomenclature*	*Common Name*
Unit 1	Receiver-Transmitter Group Countermeasures OZ-49/TLQ-15	
1A1	Coupler, Antenna	Hard mounted coupler
A1	Circuit card Assembly	RF detector card
1A2	Control, Countermeasures Transmitting Set C-6484/TLQ-15	Control unit
A1	Panel Assembly	Front panel
A2	Card Rack Assembly	Card rack
A1	Circuit Card Assembly	Relay card
A2	Circuit Card Assembly	Diode card
A3	Circuit Card Assembly	Audio amplifier and meter monitor card
A4	Circuit Card Assembly	Timing card
A5	Extender Card, Electronic Test	Extender card
A3	Reflectometer Assembly	Reflectometer assembly
A1	Circuit Card Assembly	Meter amplifier and swr sensing card
A2	Circuit Card Assembly	Meter amplifier and power supply card
A4	Lamp, Interrupt Assembly	Lamp interrupt card
A5	Electronic Components Assembly	Keying and audio card
1A3	Amplifier, Radio Frequency AM-4256fTLQ-15	Rfa
A1	Amplifier, Radio Frequency	Ipa
A1	Circuit Card Assembly	Ipa detector card
A2	Gear Train Assembly	Gear train assembly
A1	Tape Assembly, Readout	Readout tape assembly
1A4	Receiver-Transmitter, Radio RT-657/TLQ-15	RT unit
A1	Circuit Card Assembly	Filter 1 card
A2	Circuit Card Assembly	Filter 2 card
A3	Panel Assembly	Front panel
A2	Counter, Electronic, Digital Readout	Readout counter
A5	Panel	Edge-lit panel
A101	Circuit Card Assembly	Power attenuator card
A102	Circuit Card Assembly	Bandpass filters card
A103	Circuit Card Assembly	RF power amplifier card
A104	Circuit Card Assembly	Vexo and mixer card
A105	Circuit Card Assembly	Am. modulator and level control card
A201	Circuit Card Assembly	Timing and reference card
A202	Circuit Card Assembly	Second loop card
A203	Circuit Card Assembly	Afc and loop interface card
A204	Circuit Card Assembly	Main loop card
A205	Circuit Card Assembly	Programmable counter card
A206	Circuit Card Assembly	Meter amplifier card
A207	Circuit Card Assembly	Detection logic card
A208	Circuit Card Assembly	Modulation logic card
A210	Circuit Card Assembly	Sample and hold card
A301	Circuit Card Assembly	Attenuator and amplifier card
A302	Circuit Card Assembly	Audio amplifier card
A303	Circuit Card Assembly	Fm and afc detector card
A304	Circuit Card Assembly	Log amplifier and detector card
A305	Circuit Card Assembly	Ssb and cw detector card
A306	Circuit Card Assembly	Ssb filters card
A307	Circuit Card Assembly	Linear am. detector card
A308	Circuit Card Assembly	Second age amplifier card
A401	Circuit Card Assembly	Bandpass filter card
A402	Circuit Card Assembly	Limiter and attenuator card
A403	Circuit Card Assembly	Rf amplifier and mixer card
A404	Circuit Card Assembly	First if. amplifier and second mixer card
A405	Circuit Card Assembly	Oscillator and amplifier card
A406	Circuit Card Assembly	First agc amplifier card
A407	Circuit Card Assembly	Pan if. amplifier card
B1	Fan, Tubeaxial	Fan
FL1	Filter, Rfi	Rfi filter
PS1	Power Supply	Rt unit power supply
A1	Circuit Card Assembly	Regulator card
W1-W6	Cable Assembly	Bus bar
1A5	Coupler, Antenna CU-1408/TLQ-15	Soft mounted coupler
A1	Circuit Card Assembly	Diode logic card

AN/TLQ-15 Common Names List-(continued)

Ref Des.	*Nomenclature*	*Common Name*
A2	Circuit Card Assembly	Metering card
A3	Front Panel and Cam Assembly	Front panel and cam assembly
1A6	Power Supply PP-4253/TLQ-15	Lvps
1A7	Power Supply PP-4254/TLQ-15	Hvps
1A8	Telephone Set TA-312/PT	Telephone
1A9	Counter, Electronic, Digital Readout CP-1053/TLQ- 15	Digital counter
W1	Cable Assembly, Radio Frequency	
W2	Cable Assembly, Radio Frequency	
1A10	Key, Telegraph KY-1161U	Key
1A11	Rack, Electrical Equipment	Equipment rack
A1	Control Box, Electrical	Temperature control box
PS1	Power Supply	+ 28 vdc converter
S1-S5	Switch, Sensitive	Interlock switches
S6, S7	Switch, Thermostatic	Thermostatic switches
1A12	Shelter S-250/G (modified)	Shelter
A1	Light Assembly	Dome light (USA curbside)
A2	Light Assembly	Dome light (center)
A3	Interconnecting Box	Remote junction box
A4	Light Assembly	Dome light (roadside)
A5	Heater Assembly	Preheater
A6	Light, Ringer ID-1938/U	Ringer light
S1	Switch, Thermostatic	Operator's thermostatic switch (on wall)
S2	Switch, Push	Door interlock switch (outer)
S3	Switch, Push	Door interlock switch (inner)
TB1	Terminal Board	Terminal board (near door)
TB2	Terminal Board	Terminal board (near ringer light)
W1	Wiring Harness, Branched	Shelter harness
1A13	Distribution Box J-2534/TLQ-15	Power distribution box
A1	Circuit Card Assembly	Switch/delay/monitor card
A2	Monitor, Power	Power monitor
PS1	Power Supply	Auxiliary + 24 vdc converter
1A14	Fan, Ventilating	Personnel fan
A 15	Air Conditioner Assembly	Air conditioner
A1	Air Conditioner	
1A16	Modulator MX-8052/GLQ	Modulation source
1A17	Indicator, Panoramic IP-922/GLQ	Pan indicator
1A18	Enclosure Assembly, T-Sec	T-sec enclosure
1A19	Heater, Space, Electric HD-887/TLQ-15	Personnel heater
1A20	Control Assembly, Exhaust	Exhaust assembly
B1	Fan Ventilating, Propeller	Blower
B2	Fan, Ventilating, Propeller	Blower
B3	Actuator, Electrical, Mechanical, Rotary	Actuator
T1	Temperature Element, Resistance	Temperature sensor
T2	Temperature Element, Resistance	Temperature sensor
S1	Switch, Sensitive	Limit switch
S2	Switch, Airflow	Airflow switch
S3	Switch, Airflow	Airflow switch
TB1	Terminal Board	Terminal board
TB2	Terminal Board	Terminal board
1A21	Filter Assembly, Low Pass F-1300/TLQ-15	Low pass filter
A1	Electronic Components Assembly	Switch assembly
A2	Electronic Components Assembly	Filter 1
A1	Coil Assembly, RF	
A3	Electronic Components Assembly	Filter 2
A4	Electronic Components Assembly	Filter 3
A5	Electronic Components Assembly	Filter 4
A6	Electronic Components Assembly	Filter 5
1A22	Dummy Load DA-396/TLQ-15	Dummy load
1A23	Panel, Power Distribution	RF panel
1A24	Headset H-251A/U	CM headset
1A25	Handset H-189/GR	Comm handset
1A26	Microphone M-80/GR	CM mic
1A27	Drawer Assembly	Drawer
1A28	Shelf, Utility	Utility shelf
1A29	Chair, Folding	Chair

AN/TLQ-15 Common Names List-(continued)

Ref Des.	*Nomenclature*	*Common Name*
1A30	Fire Extinguisher, C02 Type 1 Size 5	Fire extinguisher
1A31	Ash Receiver, Tobacco	Ash tray
1A32	Handset/Headset H-338/TLQ-15	Secure comm handset/headset
1A33	Encoder/Decoder KYB-6/T-Sec	Encoder/decoder
1A34	Amplifier, Audio Frequency AM-4949/U	Secure comm mic amplifier
1A35	Amplifier, Loudspeaker AM-4979/GR	Secure comm speaker amplifier
1A36	Loudspeaker 1,S-454/U	Speaker
1A37	Control Box, Remote C-8156/TLQ-15	Comm control unit
1W1-1W21	Cable Assembly, Radio Frequency	RF cables
Unit 2	Communication-Power Generator Group, Trailer Mounted OP-139/TLQ-15	
2A2	Power Unit PU-681/TLQ-15	Generator
2A3	Cabinet, Electrical Equipment	AN/VRC-47 enclosure
A3	Detector Assembly, Low Voltage	Low voltage detector
FL1-4	Filter, RFI	Rfi filter
FL5	Filter, Band Pass	Band pass filter
FL6	Filter, High Pass	High pass filter
FL7	Filter, RFI	Rfi filter
PS1	Power Supply	+ 28 vdc power supply
2A4	Antenna AS-1729/VRC	Comm rt antenna
2A5	Case, Spare Parts Storage	Spare parts case
2A6	Antenna, AS-1738/TLQ-15	Cm antenna
A1	Antenna, Whip	Whip antenna
A2	Base, Antenna Support	Insulator
2A11	Stake, Guy, GP-25	Ground stakes
2A12	Cable Assembly and Reel RL-267/TLQ-15	Main power cable assembly
2A14	Counterpoise, Antenna MX-6727/TLQ-15	Counterpoise
A1-A4	Counterpoise, Antenna	Counterpoise set
A5-A8	Grounding Set, Transmission Line	Grounding set
2A15	Headset H-251/U	Spare cm headset
2A17	Radio Set AN/VRC-47	Comm radio set
	Receiver, Radio IR-442/VRC	Comm rcvr
	Receiver-Transmitter, Radio RT-524/VRC	Comm rt unit
	Antenna Assembly	Comm rcv antenna
2A18	Cable Assembly and Reel RL-268/TLQ-15	Comm cable
2A19	Hammer, Sledge	Sledge hammer
2A22	Interconnecting Box	Remote telephone junction box
2A23	Cable Assembly, Power, Electrical CS-12532/TLQ-15	Auxiliary Power cable
2A24	Suppressor Assembly	Suppressor
Unit 3	Cable Assembly Set, Electrical MX-8879/TLQ-15	Extender cables
Unit 4	Mounting Base, Electrical Equipment MT-4965/TLQ-15	Truck adapter kit
Unit 5	Impedance Matching Network CU-2193/TLQ-15	Impedance matching network
Unit 6	Test Kit, Countermeasures Set MK- 1809/TLQ-15	Test kit

1-9. Digital Counter 1A9 Modifications

Digital counter 1A9 is Digital Readout Electronic Counter AN/USM-207 modified for AN/TLQ-15 use. A prism has been added to the digital display to permit the operator to conveniently read the frequency count. A front panel extender plate and rack slides have also been added to permit rack-mounting of the digital counter. Electrical modifications include a wiring change to pick up a voltage level from the rf panel (1A23) in order to reset the monitored transmitter frequency count. Refer to TM 11-6625-700-10 and TM 11-6625-700-25 for digital counter operation and maintenance instructions. Refer to figure FO-27 for digital counter electrical wiring modification as applicable to AN/TLQ-15 use.

CHAPTER 2

ORGANIZATIONAL MAINTENANCE

Section I. GENERAL

2-1. Scope of Maintenance

This chapter describes the organizational maintenance requirements for the AN/TLQ-15. These requirements include preventive maintenance troubleshooting, adjustment, cleaning, inspection, repainting, lubrication, and installation in conjunction with operating personnel.

2-2. Maintenance Duties

Maintenance is limited to visual inspection, operating, testing, cleaning, repainting, and replacement of components. Organizational maintenance includes all of the preventive maintenance and corrective maintenance described in this chapter.

2-3. Tools and Equipment

All tools and equipment required for maintenance are listed in the maintenance allocation chart (app. B).

Section II. SERVICE UPON RECEIPT OF EQUIPMENT AND INSTALLATION

2-4. Unpacking

Unpacking of the equipment is concurrent with the installation instructions covered in TM 11-5895-372-10.

2-5. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364.

b. Check the equipment against the component listing in the operator's manual and the packing list to see if the shipment is complete. Report all discrepancies in accordance with SF 364. The equipment should be placed in service even though a minor assembly or part that does not affect proper functioning is missing.

c. Check to see whether the equipment has been modified. (Equipment which has been modified will have the MWO number on the front panel, near the nomenclature plate.) Check also to see whether all current applicable MWO's have been applied. (Current MWO's applicable to the equipment are listed in DA Pam 310-1.)

2-6. Installation

Installation procedures for the AN/TLQ-15 are covered in the operator's manual (TM 11-5895-372-10). Installation procedures must be made with the assistance of crew and organizational maintenance personnel.

2-7. Periodic Lubrication

The shelter and all equipment installed in the shelter do not require periodic lubrication. For lubrication of the trailer and the generator installed on the trailer, refer to technical manual TM 5-6115-365-15.

Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

2-8. General

Organizational PMCS of the AN/TLQ-15 is limited to the Impedance Matching Network CU-2193/TLQ-15.

Paragraph 2-9 deleted.

Paragraph 2-10 deleted.

All data on page 2-2 deleted.

Section IV. TROUBLESHOOTING

2-11. Organizational Troubleshooting

a. *General*. Organizational troubleshooting is limited to locating and changing lamps. Major repair and replacement procedures are to be accomplished at a higher category of maintenance and malfunctions should be reported to that activity.

b. *Interlock Indicators*. Located on the control unit are 20 interlock indicators that monitor the interlock circuits.

When a malfunction occurs in a given circuit, the associated indicator and all other indicators to the right of it go out; the last indicator to go out indicates the malfunctioning circuit. If any of the 20 interlock indicators go out and the equipment operates normally, an indicator lamp may be defective. If replacing that indicator lamp does not correct the trouble, higher category of maintenance is required.

2-12. Repair and Replacement Procedures

Organizational repair and replacement procedures consist of the replacement of equipment and shelter lamps. Less accessible indicator lamps are to be replaced at a higher category of maintenance. Indicator lamps not covered by this manual should be replaced in accordance with instructions given in the applicable technical manuals listed in appendix A.

a. *Shelter Dome Lights*. Each overhead dome light (1A12A1, 1A12A2, and 1A12A4) contains two incandescent lamps (DSl. and DS2), one red and one white. Change defective lamps as follows:

(1) Remove six screws from inner ring holding lense.

(2) Remove defective lamp and replace with new lamp, red or white, as required.

(3) Install lense and inner ring, reusing the six screws.

b. All Chrome Shield Red Panel Lights. Change defective red indicator lamp as follows:

(1) Pull chrome light shield off fixture from operator's side of front panel.

(2) Press in and disengage bayonet base and remove lamp.

(3) Insert and engage bayonet base of new lamp.

(4) Replace chrome light shield by pressing into place and turning it to direct light as required.

c. Control Unit.

(1) HIGH VOLTAGE switch lamp. Change defective lamps inside switch (1A2S4) as follows:

(a) Grasp light screen assembly and pull from lampholder.

(b) Remove defective lamp and replace with new lamp.

(c) Press light screen assembly securely onto lampholder.

d. Rt Unit. Change defective yellow lampbutton on FREQ LOCK switch as follows:

(1) Unscrew lamp counterclockwise.

(2) Remove defective lamp and replace with new lamp.

(3) Screw lamp clockwise into lampholder.

CHAPTER 3

FUNCTIONING OF EQUIPMENT

Section I. OVERALL SYSTEM DESCRIPTION

3-1. Overall System

This chapter provides maintenance personnel with a functional description of the AN/TLQ-15 system. This description presents the AN/TLQ-15 according to its five functional subsystems: receiving, transmitting, communication, turn-on and interlock, and primary power (fig. 3-1). Because of its complexity, the internal description of the rt unit is also included in a separate section.

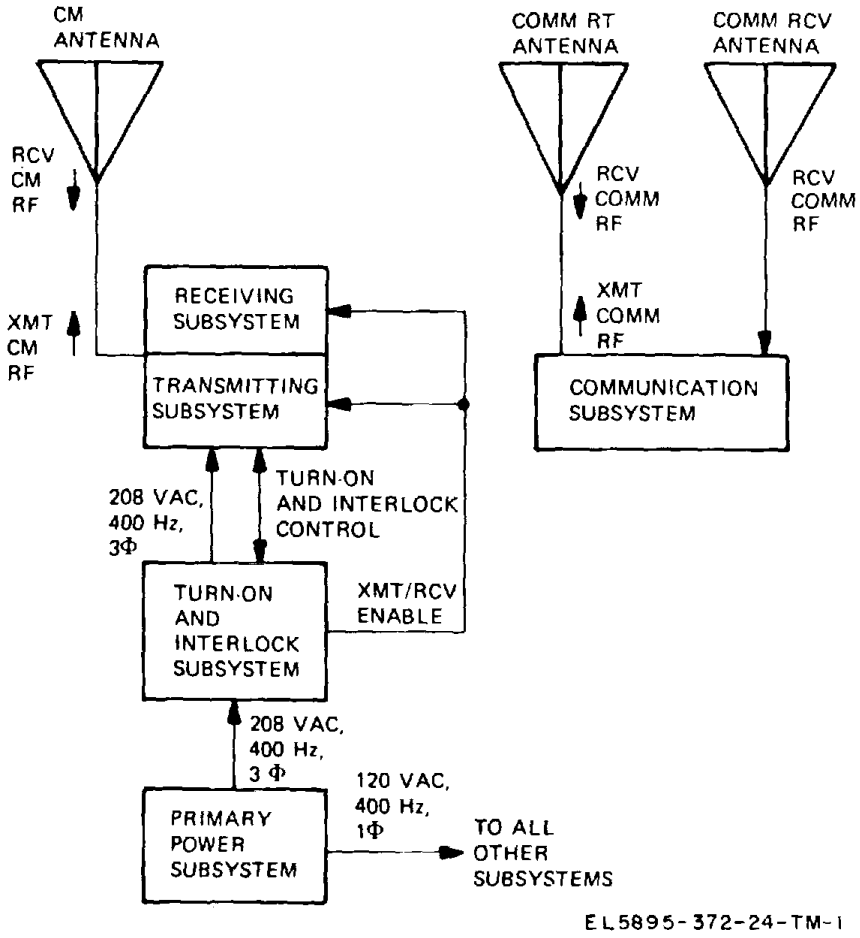


Figure 3-1. AN/TLQ-15, overall block diagram.

3-2. General Functioning of Subsystems

a. Receiving Subsystem. This subsystem is capable of receiving four types of am. signals between 1.5 and 20 MHz in three modes of operation: search, look thru, and sij. During search mode, the cm antenna is dedicated full time to provide rcv cm rf to the receiving subsystem. During look through mode, the cm antenna is time-shared by the receiving and transmitting subsystems to enable monitoring of the victim signal while transmitting. The timing for look through operations is controlled by the xmt/rcv enable signal from the turn-on and interlock subsystem. During sij mode, the preselected victim signal received via the cm antenna automatically initiates cm transmission in the normal look through mode.

b. Transmitting Subsystem. This subsystem is capable of transmitting two kw of rf power with seven types of am. and fm signals between 1.5 and 20 MHz in three modes of operation: continuous transmit, look, through and sij. During continuous transmit mode, the cm antenna is dedicated full time to radiating xmt cm rf from the transmitting subsytem.

During look thru and sij modes, the transmitting subsystem time-shares the cm antenna with the receiving subsystem time-shares the cm antenna with the receiving subsystem as previously described. The transmitting subsystem is turned-on and protected by the turn-on and interlock subsystem.

c. *Communication Subsystem*. This subsystem provides two communications functions. Two-way secure or unsecure vhf radio communications are made via the comm rf antenna; an unsecure receive only vhf radio communications link is also available via the comm rcv antenna. A 1-mile hard line field telephone link enables two way unradiated communications and also remote control of the transmitting subsystem if desired. A third communications link is provided by using the AN/TLQ-15 as a high-powered, two-way, hf voice communications set. During this mode of operation, the cm antenna is shared with the receiving and transmitting subsystems.

d. *Turn-on and Interlock Subsystem*. This subsystem provides protection against equipment damage and personnel harm. Equipment protection is achieved twofold: first, by controlling turn-on sequence for applying 208 vac, 400 Hz, 3 power to the transmitting subsystem; and, secondly, by automatic shutdown of the transmitting subsystem if abnormal electrical or thermal conditions occurs during operation. Personnel protection is achieved by automatic shutdown of the transmitting subsystem if units containing lethal voltages are opened by personnel not familiar with the equipment. Under an extreme emergency, the equipment and personnel protection features can be bypassed to enable transmission under battle-short conditions.

e. *Primary Power Subsystem*. This subsystem generates the 208 vac, 400 Hz, 3 power which is controlled by the turn-on and interlock subsystem for the transmitting subsystem. The primary power subsystem also generates and distributes 120 vac, 400 Hz, 1 power to all other subsystems.

Section II. RECEIVING SUBSYSTEM

3.3. General

The rf signal from the cm antenna is applied to the hard mounted coupler, With the AN/TLQ-15 operating in the look through or sij mode and initiated by a signal from the control unit, look through sij rf from the hard mounted coupler is applied to the frequency-selective, soft mounted coupler. Output from the soft mounted coupler is applied to transmitter/tune switching relays in the hard mounted coupler. Output from the hard mounted coupler is applied to the rf panel where this rf, or rf from the aux antenna, is selected by a control signal from the control unit. The selected rf is routed through the low pass filter to the rf panel where switching takes place between the transmitter output/receiver input and search rf signals. If the search mode is selected, search rf from the hard mounted coupler bypasses the previously described units and is applied directly to the rf panel. Either the search or look through sij signal from the rf panel is applied to the receiver in the rt unit. The receiver in the rt unit processes the signal and provides audio output to the speaker in the control unit, the cm headset, and the digital counter. Audio count from the rt unit is measured indirectly by the digital counter. The receiver pan if. signal from the rt unit is displayed on the pan indicator which also provides the look through activate signal to the rt unit. The received rf signal is also processed in the rt unit to provide transmitter keying signals when in the sij mode. Both the look through and sij sequencing signals from, the rt unit are applied through the control unit as timed sequencing signals for keying the transmit and/or receive functions, Both the look through and sij sequencing signals from the rt unit are applied to the control unit to generate timed sequencing signals, These timed sequencing signals control switching relays in the rf panel during transmit and/or receive functions. The control unit also supplies an exciter keying to activate the rt unit transmitter circuitry during the transmit function.

3-4. Detailed Description of Receiving Set (fig. FO-2)

a. *Look through Sij Mode*. To set up this mode, the turn-on and interlock subsystem provides a xmt select signal to energize relay K1 in the hard mounted coupler and K3 in the rf panel. Received rf from the cm antenna is routed thru the contact assembly in the hard mounted coupler and contacts of xmt search relay K1 to the antenna matching networks in the hard mounted coupler and the soft mounted coupler. Combinations of coils, coil taps, and capacitors are switched by relays K9 thru K17 in the hard mounted coupler and relays K1 through K16 in the soft mounted coupler. The relays are energized in various combinations as programmed by diode logic card A1 and BAND SELECT switch S1 in the soft mounted coupler.

The + 28 vdc to BAND SELECT switch S1 is provided thru relay K17 which is energized when ANTENNA COUPLER switch AIS10 on the control unit is closed thereby energizing the applicable coil of relay A2A1K2.

(1) Look through sij rf from the soft mounted coupler is applied through contacts of relays K7 and K8 in the hard mounted coupler to contacts of antenna selector relay K4 in the rf panel. Relay K4-B is controlled by relay A2A1K3 in the control unit. Closing ANTENNA COUPLER switch A1S10 energizes relay K4-B; closing either DUMMY LOAD switch A1S9 or AUX ANTENNA switch A1S11 will deenergize relay K4-B.

(2) Rf output from relay K4 in the rf panel is applied to the low pass filter which attenuates all harmonic frequencies above 30 MHz. Rf output from the low pass filter is applied to antenna switching relay K2 in the rf panel which switches the cm antenna between the receiver input and transmitter output. Voltage of +28 vdc is applied through closed contacts of relay A2A4K1 in the control unit to the antenna switching delay circuit which energizes relay K2 when in receive mode. When transmitting, the rt unit energizes relay A2A4K1, by the look through sij sequencing signal. This removes +28 vdc from the antenna switching delay circuit, deenergizes relay K2 and connects the antenna circuit to the transmitter output. The +28 vdc is then applied thru relay A2A4K1 and transmitter keying delay circuit Q1 through Q4. The resultant exciter keying signal activates the rt unit transmitter.

(3) Rf output from contacts of relay K2 in the rf panel is applied through contacts of relay K3 to the input of the receiver in the rt unit. The rt unit processes the signal and provides audio output to the speaker in the control unit, the cm headset, and the digital counter. Audiofrequency from the rt unit can be displayed by the digital counter. Receiver pan if. signals are applied to the pan indicator for display; the pan indicator also provides the look through activate signal to the rt unit for use when look through mode is selected. The rt unit provides look through mode is selected. The rt unit provides look through sij sequencing signal to the control unit for keying the transmit and/or receive functions.

b. *Search Mode*. Received rf from the cm antenna is routed through the contact assembly in the hard mounted coupler to the contacts of xmt/search relay K1. The coil of this relay and relay K3 in the rf panel now receive a search select signal from the turn-on and interlock subsystem, This deenergizes both relays and the search rf is routed directly to the receiver in the rt unit where it is processed the same as look through sij rf.

Section III. TRANSMITTING SUBSYSTEM

3.5. General Description (fig. FO-3)

a. The rf signal from the transmitter section of the rt unit can be displayed on the pan indicator for evaluation and its frequency can be displayed on the digital counter; the pan indicator also supplies a look through activate signal to the rt unit when this mode is selected. The cm headset can be used to monitor sidetone audio when the rt unit is transmitting or monitor a victim signal during the receive cycle of the look through mode. The modulation source provides a choice of various types of modulation for the transmitter and provides switching for application of external hand keying, voice modulation, and other external modulation sources. High/low power select signals from the control unit are applied to the rt unit to control the operating power mode. The control unit provides centralized control of on/off time and transmitting subsystem monitoring which includes the lvps, hvps, rf switching, and local/remote control functions.

b. Exciter rf from the rt unit is applied to the rf panel which can route the rf to the rfa for emplification or bypass the rfa back through the rf -panel for coupler tuning. Initial tuning of the transmitting subsystem involves tuning of the rt unit and rfa into the dummy load. During antenna coupler tuning the exciter rf bypasses the rfa and is applied directly to the antenna couplers. This action permits the couplers to be tuned at a very low rf level (5 watts). The control unit tune control signal switches relays in the rf panel to initiate this coupler tuning function. Exciter rf from the rf panel is applied to the rfa for amplification to the xmt level. The rfa receives ipa/fpa bias, ipa plate/screen, fpa plate/screen, and fpa filament blower voltages from the lvps and hvps. Xmt rf from the rfa (2kW or 800W) is applied to the rf panel where it can be switched to the dummy load or to the low pass filter. The low pass filter look through/sij rcv rf output can also be switched to the receiving subsystem when in the receive mode. Xmt rf is also monitored for vswr with the sampled fwd/refld power signals routed to the reflectometer assembly in the control unit.

c. Xmt rf or coupler tune rf from the rf panel is applied to the low pass filter for high frequency harmonic attenuation. Rf from the low pass filter is applied to the rf panel where the rf may be switched to the cm antenna through the couplers or to an aux antenna through the remote junction box; this antenna selection is controlled from the control unit. In normal operation, rf is routed through the hard mounted coupler, through the soft mounted coupler, and back through the hard mounted coupler where the impedance of the transmitted output is matched to the impedance of the cm antenna for each frequency band. Switching the cm antenna from the xmt rf to the search receiver input also takes place in the hard mounted coupler.

3-6. Detailed Description of Rf Section

(fig. FO-4)

a. The rf signal from the transmitter section of the rt unit can be displayed on the pan indicator for evaluation and its frequency can be displayed on the digital counter; the pan indicator also supplies a look through activate signal to the rt unit for use when look through mode is selected. Transmitter sidetone audio or the received victim signal during look through can be monitored on the cm headset. The modulation source provides various types of modulation for the transmitter and provides switching for application of external hand keying, voice modulation, and other external modulation sources. The HI RF LO RF switch A1S2 in the control unit selects either high (5 watts) or low (2.5 watts) power mode in the rt unit.

b. Exciter rf from the rt unit is applied to the rf panel where the rf can be switched to the rfa or bypass the rfa and be applied to the hard mounted coupler and soft mounted coupler. Relay K6 in the rf panel is deenergized when the transmitter is in the look through/sij mode. Output from the rf panel is applied to the ipa for amplification by A1V1. The ipa rf output is sampled and rectified by ipa detector card A1 and measured by IPA TUNE meter M1. The ipa rf output is applied to the fpa for further amplification; PA TUNE meter M2 provides a visual indication of pa cathode current for tuning and monitoring the rfa. The fpa is tuned by output tuning circuits L1 through L3, C5, C19 through C22, and coil tap switching relays K3 through K6 which are controlled by BAND SELECT switch S1. The ipa, fpa, and output tuning circuits are manually tuned by handcranks on the rfa front panel.

c. Xmt rf from the rfa is applied to dual line section Z1 which samples forward and reflected power and then rectifies and filters it. The rectified forward power sample is applied to meter amplifier U1 and U2 (P/O A3A1) in the control unit; the amplified fwd pwr monitor signal drives FORWARD POWER meter AlM1. The rectified reflected power sample is applied to meter amplifier U1, U2 (P/O A3A2) into the control unit; the amplified refid pwr monitor signal drives REFLECTED POWER meter A1M2. The forward and reflected power samples are also applied to swr sensing circuit U3, Q1, K1 which compares the two inputs and generates an swr ovld interlock signal when the difference exceeds a 3:1 vswr to initiate a transmitter turn-off sequence.

d. Output from the dual line section in the rf panel is applied to the low pass filter through contacts of relays K1, K2, and K7. Relay K1 switches the rf to either the dummy load or to contacts of relay K2. Relay K1 is controlled by relay A2AlK1 in the control unit which is controlled by closing ANTENNA COUPLER switch A1S10 or AUX ANTENNA switch AS11. Closing DUMMY LOAD switch A1S9 reverses the position of relay A2A1K1 which in-turn deenergizes relay K1 and switches the applied rf to the dummy load.

e. Rf output from contacts of relay K1 is applied to contacts of antenna switching relay K2 which switches the antenna circuit on a time-shared basis in look through and sij modes between the transmitter rf output and the receiver input. When transmitting, the rt unit energizes relay A2A4K1 in the control unit which removes +28 vdc from receive/transmit timing circuit Q5 through Q7; this deenergizes relay K2 in the rf panel and connects the cm antenna by means of the soft mounted coupler and hard mounted coupler to the transmitter rf output. When receiving, relay A2A4K1 deenergizes which in turn energizes relay K2 in the rf panel (thereby connecting the cm antenna through the soft mounted coupler and hard mounted coupler to the receiver input). Xmt rf output from the contacts of relay K2 is applied to contacts of relay K7 which switches the cm antenna (along with the soft mounted coupler and the hard mounted coupler) to the xmt rf or the coupler tune rf from relay K6 in the rf panel. Both relays K7 and K6 are controlled by PUSH TO TUNE switch S2 in the soft mounted coupler.

f. f output from contacts of relay K7 in the rf panel is applied to the low pass filter which attenuates all harmonic frequencies above 30 MHz. Low pass filter sections 1-5 selection is controlled by BAND SELECT switch S1 in rfa 1A3. Rf output from the low pass filter is applied to contacts of relay K4 in the rf panel which selects the cm antenna or the auxiliary antenna via the remote junction box.

The antenna selection is controlled by ANTENNA COUPLER switch A1S10 or AUX ANTENNA switch A1S11 via relay A2A1K3 in the control unit. Cm rf output from contacts of relay K4 in the rf panel is applied to contacts of relay K7 in the hard mounted coupler.

g. To tune the soft mounted coupler and hard mounted coupler, HIGH VOLTAGE switch A1S4 in the control unit must be set to off and PUSH TO TUNE switch S2 on the soft mounted coupler must be depressed; +28 vdc return is then applied to relay K6 in the rf panel and relays K7 and K8 in the hard mounted coupler. Relay K6 in the rf panel will then energize and the exciter rf from the rt unit will be routed to relay K7 in the rf panel, thereby bypassing the rfa. When relays K7 and K8 in the hard mounted coupler energize, cm rf is routed through rf bridge network R1, R2, R3. This network routes a sample of the cm rf to rf detector card A1 which applies the resulting detected level (dc) to RF POWER meter A2M1 on the soft mounted coupler; PUSH TO TUNE switch S2 selects the appropriate meter range.

h. To radiate after tuning, cm rf from contacts of relay K7 of the hard mounted coupler is routed through the antenna switching networks in the soft mounted coupler and the hard mounted coupler and through xmt relay K1 and the contact assembly to the cm antenna. The two antenna matching networks match the output impedance of the transmitter to the cm antenna in 14 frequency bands between 1.5 and 20 MHz. This is accomplished by combinations of coils and coil taps, and capacitors which are switched by relays in the hard mounted coupler and soft mounted coupler. The relays are energized in various combinations as programmed by diode logic card A1 and BAND SELECT switch S1 in the soft mounted coupler. The +28 vdc to BAND SELECT switch S1 is provided by relay K17 of the soft mounted coupler. ANTENNA COUPLER switch A1S10 provides excitation for relay A2A1K2 in the control unit. When energized for antenna coupler operation, relay A2A1K2, in turn, energizes relay K17 in the soft mounted coupler. The switching of relay K1 for rcv/xmt time-sharing of the cm antenna is controlled by the timing card in the turn-on and interlock subsystem.

3-7. Detailed Description of Dc Power Section

a. *Lvps*. The lvps functionally consists of three power supplies which generate regulated --75 vdc for the ipa bias, regulated --120 vdc for fpa bias, +250 vdc for the ipa screen, and +700 vdc for the ipa plate; the lvps is sequentially turned on by the turn-on and interlock subsystem including battle short operation.

(1) -75 vdc and -120 vdc bias (fig. FO-5). Primary power of 208 vac, 400 Hz, 30 is applied thru BIAS circuit breaker CB1 to filter C1, C2, and C13 to remove undesired signals from the power line. Output from the filter is applied to transformer T1, stepped down to 135 vac, 400 Hz, 30 and then applied to rectifier CR1. Rectifier output of --180 vdc with 2400 Hz ripple is applied to filter C3, C4, and L1; filtered output of - 175 vdc is applied to regulator VR2 and R1, providing-- 75 vdc regulated bias voltage to the ipa grid. Voltage divider R3, R4, and R5 provides -75 vdc monitor sample voltage to the primary power subsystem for front panel monitoring and ipa bias interlock voltage for the turn-on and interlock subsystem. Filtered output of--175 vdc is also applied to regulator VR1 and R2,providing regulated - 120 vdc bias voltage to the fpa grid. Voltage divider R6, R7, and R8 provides --120 vdc sample voltage to the primary power subsystem for front panel monitoring and fpa bias interlock for the turn-on and interlock subsystem.

(2) *+250 vdc ipa screen*. Primary power of 208 vac, 400 Hz, 30 is applied to +250 circuit breaker CB2. Output from the circuit breaker is applied to filter C5, C6, and C14 through contacts of relay K1. Relay K1 is energized from the turn-on and interlock subsystem through contacts of overload relay K2. Output from the filter is applied to transformer T2 which steps up the voltage to 251 vac, 400 Hz, 30. Output from the transformer is applied to rectifier CR2. The rectifier output of +320 vdc, 2400 Hz ripple is applied to filter C7, C8, and L2. Filtered output of +315 vdc is applied to regulator VR3, VR4, and R9, which provides regulated ipa screen voltage of +250 vdc. A +250 N dc monitor voltage is obtained from voltage (divider R10 and R11 and is routed to the primary power subsystem for front panel monitoring. A +250 vdc ipa interlock sample voltage is obtained from voltage divider R21 and is applied to the turn-on and interlock subsystem. Overload relay K2 in the + 250 vdc return circuit is tripped when more than a predetermined amount of current is required from the +250 volt power supply. When overload relay K2 is deenergized, primary power is removed and the +250 vdc power supply is disabled. The point at which overload relay K2 is tripped is determined by the setting of overload adjust potentiometer R26, RESET indicator lights red when overload relay K2 is tripped. The relay is reset by pressing RESET switch S6 which applies 28 vdc to the reset coil. The overload indicator (part of RESET switch 1A2A1S6) goes out when the relay is reset.

(3) *+ 700 vdc ipa plate*. Primary power of 208 vac, 400 Hz, 30 is applied to + 700 circuit breaker CB4. Output from the circuit breaker is applied to filter C9, C10, and C15 through contacts of relay K3.

Relay K3 is energized from the turn-on and interlock subsystem through the contacts of overload relay K4. Output from filter C9, C10 and C15 is applied to transformer T3, which steps up voltage to 525 vac, 400 Hz, 30. The output from the transformer is applied to rectifier CR3A and CR3B. Rectifier output of 665 vdc, 2400 Hz ripple is applied to filter C11, C12, L3, and R19 with its output of +700 vdc applied to the ipa plate. Voltage divider R12, R13, and R14 provides +700 vdc monitor sample voltage to the primary power subsystem for front panel monitoring. Voltage divider R15, R16, and R17 provides +700 vdc ipa interlock sample voltage to the turn-on and interlock subsystem. Overload relay K4 in the +700 vdc return circuit is tripped when more than a predetermined amount of current is required from the power supply. When overload relay K4 is open, relay K3 is deenergized, primary power is removed, and + 700 vdc power is disabled. The point at which overload relay K4 trips is determined by the setting of overload adjust potentiometer R23; RESET indicator lights red when overload relay K4 is tripped. The relay is reset by RESET switch S6 which applies 28 vdc to the reset coil; overload indicator (part of the RESET switch 1A2A156) goes out when the overload relay is reset.

(4) *Battle short operation*. When battle short operation is selected, an ipa screen/plate battle short signal from the turn-on and interlock sub-system through diodes CR9 and CR6 bypass the overload protection of relays K2 and K4 to keep primary power applied through relays K1 and K3.

b. Hvps. The hvps functionally consists of a filament and blower circuit in addition to two power supplies which generate +3500 vdc for the fpa plate and regulated +600 vdc for the fpa screen. The hvps is sequentially turned on by turnon and interlock subsystem including battle short operation.

(1) *Filament and blower circuit* (fig. FO-6). Primary power of 120 vac, 400 Hz, 10 is applied to FILAMENT circuit breaker CB3. One output from circuit breaker CB3 is applied to ipa and fpa tube filaments prior to high voltage turn-on. The second output from circuit breaker via starting capacitor C10 energizes blower B1 to provide cooling air for the hvps.

(2) *+3500 vdc fpa plate*. Primary power of 208 vac, 400 Hz, 30 is applied through 3500 V circuit breaker CB1, through contacts of relay K1, and then to filter C1 through C3. The output of the filter is applied to the primary winding of transformer T1. Contacts of overload relay K3, part of the overload sensing circuit, are in series with the coil of relay K1 which is part of the turn-on sequence. The battle short circuit bypasses overload relay K3. The 2630 vac output from transformer T1 is rectified by rectifier CR2 and the output (+3800 vdc with 2400 Hz ripple) is filtered by filter C4 through C6 and L1. The +3500 vdc output from the filter is utilized by the fpa plate. Variable voltage divider R1 through R4 provides +3500 vdc monitor sample voltage to the primary power subsystem for front panel monitoring. Voltage divider R5 through R10, R12, and R24 through R26 provides a +3500 v fpa interlock voltage for the turn-on and interlock subsystem. Overload relay K3 in the +3500 vdc return circuit is tripped when more than a predetermined amount of current is required from the +3500 vdc power supply. When overload relay K3 is open, relay K1 is deenergized, primary power is removed, and the +3500 vdc power supply is disabled. The point at which overload relay K3 is tripped is determined by the setting of overload adjust potentiometer R14. Overload indicator DS1 and DS2 (part of RESET switch 1A2A1S6) lights red when overload relay K3 is tripped. The relay is reset by RESET switch which applies 28 vdc to the reset coil. The overload indicator goes out when overload relay K3 is reset.

(3) *+600 vdc fpa screen*. Primary power of 208 vac, 400 Hz, 10 is applied through 600 V circuit breaker CB2 to the contacts of relay K2. The output of K2 is applied to the primary winding of transformer T2. Contacts of overload relay K4, part of the overload sensing circuit, are in series with the coil of relay K2 which is part of the turn-on sequence. The battle short circuit bypasses overload relay K4. The 600 vac output of transformer T2 is rectified by rectifier CR5 and the output (800 vdc with 800 Hz ripple) is filtered by filter C8, C9, and L2. The +800 vdc output from the filter is applied to regulator VR1 through VR8 and Q1. Voltage divider R20 and R21 provides +600 vdc monitor sample voltage to the primary power subsystem for front panel monitoring. A set of contacts on relay K2 provides ground return to the turn-on and interlock subsystem. Overload relay K4 in the +600 vdc return circuit is tripped when more than a predetermined amount of current is required from the +600 vdc power supply. When overload relay K4 is open, relay K2 is deenergized, primary power is removed, and the +600 vdc power supply is disabled. The point at which overload relay K4 is tripped is determined by the setting of overload adjust potentiometer R19. Overload indicator DS1 and DS2 (part of RESET switch 1A2A1S6) lights red when overload relay K4 is tripped. The relay is reset by RESET switch which applies 28 vdc to the reset coil.

The overload indicator goes out when overload relay K4 is reset.

(4) *Battle short operation*. When battle short operation is selected, fpa plate and screen battle short signals from the turn-on and interlock subsystem bypass the overload protection of relays K3 and K4 to keep primary power applied through relays K1 and K2.

Section IV. COMMUNICATION SUBSYSTEM

3-8. General

The communication subsystem provides two communications functions: a two-way vhf radio link with an additional receive only radio link, and a field telephone link. A two-way hf radio link is also available by using the cm transmit and receive functions.

3-9. Two Way Vhf Radio Link (fig. FO-7)

This radio link is capable of secure, unsecure, and mobile operation for transmitting and receiving with an additional receive only radio link.

a. Transmit. The mic audio signal is routed from the secure comm handset/headset to the secure comm mic amplifier for amplification. This audio is routed to the encoder/decoder which is controlled by the comm control unit. The comm control unit permits the operator to select secure or unsecure communications by means of the cipher/plain control signal. When the encoder/decoder is not installed in the t-sec enclosure, a bypass cable is installed to complete the audio circuit. The cipher/plain mic audio is routed from the encoder/decoder through the comm cable to the comm rt unit. The xmt comm rf signal is then applied through a high pass filter to the comm rt antenna.

b. Receive. The rcv comm rf from the comm rt antenna is routed through the high pass filter to the comm rt unit. After processing, the cipher/plain rcvr audio is routed through the comm cable to the encoder/decoder for decoding or through the bypass cable (if used). Rcvr audio from the encoder/decoder or the bypass cable is applied to the secure comm speaker amplifier for amplification; this output is applied to the self-contained loudspeaker. If the secure comm handset/headset is installed, the loudspeaker will be disabled.

c. Mobile Operation. The secure comm handset/headset, comm control unit, and the secure comm speaker amplifier are disconnected and reconnected to the truck adapter kit.

d. Receive Only Radio Link. The receive only radio link provides a one-way, unsecure radio communication link. The rcv comm rf from the comm rcv antenna is routed through a bandpass filter to the comm rcvr. After processing, the rcvr audio is routed through the comm cable to the speaker.

3-10. Field Telephone Link

In normal operation, audio from the telephone located in the shelter is routed through capacitor C1 and closed contacts of relay A1K1 in the power distribution box to the land line where the audio is routed thru the remote telephone junction box to the remote telephone. However, when the transmitter in the comm rt unit is keyed, and the AN/TLQ-15 rt unit is in the voice/rt mode, relay 1A13A1K1 is energized and the land line is shorted, disabling the field telephone link; another set of contacts on the relay disables the cm voice transmitter modulation. The field telephone link also provides a limited remote control of the transmitting subsystem as described in section V.

3-11. Two-Way Hf Radio Link

The cm receiving and transmitting subsystems can be used as a two kw, two-way, hf radio communications link. The rt unit, rfa and antenna couplers are tuned in the continuous transmit mode to the desired communications frequency. Setting the rt unit TRANSMIT MODE switch to VOICE R/T will provide the operator with a transceive capability. Depressing the cm mic pushto-talk switch will then energize relay A2A4K1 in the control unit (fig. FO-4) and thereby activate the transmitting subsystem. This cm mic keying is identical to the look through/sij sequencing/cont jam signal applied to relay A2A4K1 as shown in figure FO-4. Releasing the cm mic push-to-talk switch will deenergize relay A2A4K1 in the control unit (fig. FO-2) and activate the receiving subsystem; this keying is identical with the look through/sij sequencing signal applied to relay A2A4K1 as shown in figure FO-4. Routing and processing of communications rf is then identical to look through, sij or continuous transmit rf (fig. FO-1 through FO-4).

Section V. TURN-ON AND INTERLOCK SUBSYSTEM

3-12. General

The turn-on and interlock subsystem is functionally divided into three section: front panel lights; interlock consisting of personnel safety and equipment safety; and sequential turn-on.

3-13. Front Panel Lights Section (fig. FO-8)

Indicator and panel lights are provided a +28 vdc return circuit through contacts of relay lA2K1. Another set of contacts applies +28 vdc to a transistor in lamp interrupt card A4 to control the lamps in the rfa and soft mounted coupler. Opening either of two shelter entrance doors opens one of the door interlock switches and deenergizes relay 1A2K1 thus extinguishing all lights on the front panel of the control unit, rfa, and soft mounted coupler. DIMMER CONTROL A1RI and A1R2 (ganged), varies front panel lamp intensity. To prevent false front panel indications and/or relays energizing erroneously, a diode is connected in series with each indicator lamp and the variable +28 vdc source. For example if the variable +28 vdc is set low and the series diode were not there, current would flow from this source through a lamp, through a relay and to the hard wired +28 vdc; diode A2A2CR1 prevents current flow from this source.

3-14. Interlock Section

a. Personnel Safety. Personnel safety interlock circuits prevent access to lethal voltages by personnel not familiar with the equipment; the circuits also provide a front panel indication on the control unit for each interlock status. Interlock switches are mounted on the equipment rack to insure the following are secured: rfa; lvps; hvps; soft mounted coupler; hard mounted coupler access door; and the control unit. Any item improperly installed or opened during operation will prevent or disable equipment operation.

b. Equipment Safety.

(1) *Thermal*. Thermal safety interlocks are activated by temperatures or by air flow inside the equipment compartment. Temperatures are monitored by thermostatic switches and air flow is monitored by vane-operated microswitches. Abnormal conditions will prevent or disable equipment operation.

(2) *Electrical*. Electrical safety interlocks insure correct equipment start-up sequence and also shut-down sequence in case of electrical overload. A successful turn-on sequence results when the equipment has no serious malfunctions, units are correctly installed, operating temperatures are within tolerance, and correct tuning procedures have been performed in the correct sequence.

3-15. Sequential Turn-On Section

a. Normal Condition.

(1) *Primary power monitoring*. With 208 vac, 400 Hz, 30 power applied, the voltage, phase rotation, and frequency are monitored by power monitor assembly 1A13A2. When the three primary power parameters meet requirements, VOLTAGE PHASE FREQ indicator 1A2A1DS30 lights. Parameters out of tolerance will prevent or disable equipment operation.

(2) *Blower and rack interlocks*. With transmitter in standby mode, two equipment compartment blowers will operate; the equipment compartment air interlock switches 1A20S2 and 1A20S3 close and EQUIP. AIR indicator 1A2A1 DS1 lights. With the rfa, lvps, hvps, soft mounted coupler, hard mounted coupler access door, and the control unit secured in the equipment rack, interlock switches 1A11S5, 1A11S2, 1A11S1, 1A11S3, 1A1S1, and 1A11S4 (respectively) will be closed and the following indicators will be lighted: RFA RACK (DS2), LV PWR SUP RACK (DS4), HV PWR SUP RACK (DS3), ANT. COUPLER RACK (DS5), and CONTROL UNIT RACK (DS6). With the rfa blower operating, rfa air interlock switch 1A3S3 completes the circuit to light RFA AIR indicator DS7 and to energize rfa filament relay 1A3K2.

(3) *Rfa 3-minute time delay*. When relay 1A3K2 energizes, 120 vac, 400 Hz,01 is routed from the hvps to the ipa and fpa filaments. With the hvps blower operating, hvps air interlock switch 1A7S1 completes the circuit to light HV PWR SUP AIR indicator 1A2A1DS8. With the low pass filter blower operating, low pass filter air interlock switch 1A21S1 completes the circuit to light LP FILTER AIR indicator 1A2A1DS9. When the ambient temperature in the equipment compartment is below 150 degrees F, equipment rack thermostatic switch 1A11S7 completes the circuit to light EQUIP. AIR TEMP indicator 1A2A1DS100. The +28 vdc return circuit is also completed to 3 minute time delay 1A3K1 through previously closed contacts of relay 1A3K2. IF the three thermal interlocks were satisfied, relay 1A3K1 begins timing the 3 minutes at the same time relay 1A3K2 applies the filament voltage; this delays the application of high voltage to the ipa and fpa until filament warmup is completed. After three minutes, relay 1A3K1 energizes, RFA FIL indicator 1A2A1DS11 lights, and relay 1A13K5 is energized to route 208 vac, 400 Hz, 3∅ to the lvps and hvps.

The + 28 vdc return circuit is also completed for relay 1A13K4; the +28 vdc portion of this relay is completed by PREHEATER switch 1A2A1S3 when in the MAN position. When the switch is in the AUTO position, thermostatic switch 1A11S6 completes the series circuit when the equipment compartment temperature is below 70 degrees F. With relay 1A13K4 energized, the circuit is completed to light PREHEATER indicator 1A2A1DS18.

(4) *Rfa bias and dummy load*. Primary power of 208 vac, 400 Hz, 30 has been applied to the -75 vdc and 120 vdc bias supply in the lvps. If the --75 vdc bias is normal, the lvps provides an ips bias interlock signal to energize relay 1A2A2AlK4 completing the circuit to light IPA BIAS indicator 1A2A1DS21. If the -120 vdc bias is normal, the lvps provides an fpa bias interlock signal to energize relay 1A2A2A1K5 completing the circuit to light FPA BIAS indicator 1A2A1DS22. DUMMY LOAD TEMP indicator 1A2AlDS23 also lights if the AN/TLQ-15 is not in dummy load. If the transmitting subsystem is operating in the dummy load mode, relay 1A2A2A1K6 is energized by the dummy load select signal, and thermostatic switch 1A22S1 is switched into the interlock circuit. When the dummy load temperature exceeds 270 degrees F, thermostatic switch 1A22S1 opens, DUMMY LOAD TEMP indicator 1A2A1DS23 goes out and the equipment is disabled back to this point in the start-up sequence. With antenna tuning and coupling circuits correctly adjusted, relay 1A2A3A1K1 is deenergized and SWR OVLD indicator IA2A1DS24 lights.

(5) *System tuning*. If the transmitting subsystem is incorrectly tuned during operation causing the vswr to exceed 3:1, an swr ovld interlock signal will energize relay 1A2A3A1K1 opening the +28 vdc return to extinguish SWR OVLD indicator 1A2A1DS24; the equipment will be disabled back to this point in the start-up sequence. A second set of contacts of relay 1A2A3A1K1 provides +28 vdc return to light the overload indicator which is built into RESET switch 1A2A1S6. The interlock circuit is completed through the band switching circuits and BAND SELECT switch 1A3S1. Interlock switches 1A3S2 and 1A5S1 inhibit rf transmission during band changing on the rfa and soft mounted coupler; this is accomplished by removing the interlock signal which removes the high voltage.

(6) *High voltage turn-on*. Turn-on of the high voltage may be initiated locally in the shelter or remotely by the field telephone link. For local operation, REMOTE XMTR switch 1A2A1S12 is depressed, lights white, and routes the local hv control signal to HIGH VOLTAGE switch 1A2A1S4; when depressed, switch 1A2A1S4 lights yellow and routes the local hv control signal through keying and audio card A5 to energize relay 1A2K2 which applies the ipa plate control signal to turn on the + 700 vdc supply in the lvps.

(a) For remote operation, REMOTE XMTR switch 1A2A1S12 is depressed, lights green, disables HIGH VOLTAGE switch 1A2A1S4, and routes a remote hv control signal (+28 vdc return) through contacts of relay 1A13A1K1 and one conductor of the two-wire telephone line to the XMT TEL switch on the remote telephone junction box. When the XMT TEL switch is in XMT position, +28 vdc return is applied through the other telephone wire back to the shelter where it turns on transistor switch 1A13A1Q1 which energizes hv turn-on relay 1A2K1 to continue the turn-on sequence. Relay 1A13A1K1 is energized by the microphone pushto-talk switch of the comm radio set and is part of the radio secure circuit.

(*b*) When +700 vdc is present at the lvps, a +700 v ipa interlock signal energizes relay 1A2K3 which completes the circuit to light IPA PLATE indicator 1A2A1DS25. Relay 1A2K3 also provides an ipa screen control signal to turn on the +250 vdc supply in the lvps. When +250 vdc is present at the lvps, a +250 v ipa interlock signal energizes relay 1A2K4 which completes the circuit to light IPA SCREEN indicator 1A2A1DS26. Relay 1A2K4 also provides an fpa plate control signal to turn on the +3500 vdc supply in the hvps. When +3500 vdc is present at the hvps, a +3500 v fpa interlock signal energized relay 1A2K5 which routes a normal interlock signal through timing card 1A2A2A4 to light FPA PLATE indicator 1A2A1DS27 and to turn on the +600 v fpa interlock signal lights FPA SCREEN indicator 1A2A1DS28.

(7) *Mode control and transmitter keying*. When relay 1A2K5 energized previously, it also routed search/xmt select signal to select operating modes for the receiving and transmitting subsystems. Transmitter keying on and off for look through transmission is accomplished by the transmitter keying circuit part of timing card 1A2A2A4 which provides a pulsed fpa screen control signal to key the hvps +600 vdc output and thus the fpa rf output.

b. Battle Short Condition. BATTLE SHORT switch 1A2A1S1 bypasses the personnel and equipment safety interlock circuits when it is absolutely necessary to continue equipment operation. The switch provides an alternate +28 vdc return circuit for the air interlock switches, equipment rack interlock switches, thermal switches, and electrical overload relays in the lvps and hvps.

Circuit breakers on the lvps and hvps open to disable them if an overload is great enough to cause damage.

Section VI. PRIMARY POWER SUBSYSTEM

3-16. General

The primary power subsystem is functionally divided into two sections: primary power distribution section consisting of primary power generation, shelter lighting/utility power, primary power monitoring, miscellaneous unit powering, personnel compartment temperature control, equipment compartment temperature control, rfa filament turn-on, and reflectometer powering; and dc voltage monitoring section.

3-17. Primary Power Distribution Section (fig. FO-9)

a. Primary Power Generation. The gasoline engine driven generator on the trailer provides all primary power for the AN/TLQ-15. GENERATOR CONTROL switch 1A13S1, located in the shelter, remotely starts and stops the generator. Power of 208 vac, 400 Hz, 3∅ is routed to + 28 vdc power supply 2A3 which powers the comm radio set. Primary power of 208 vac, 400 Hz 3∅ from the generator is also routed into the power distribution box through line filters FL1 through FL3, and current from each phase. PHASE CURRENT switch S2 selects which phase is to be displayed by PHASE CURRENT meter M2.

b. Shelter Lighting Utility Power. Power of 120 vac, 400 Hz, 0 2 power is applied through LIGHTS ON-OFF circuit breaker CB7 and shelter doors interlock switches 1A12S2 and 1A12S3 to transformer T4 which steps the voltage down to 24 vac, 400 Hz. LIGHTS WHITE RED switch S4 selects either redor white lighting in shelter dome lights A1, A2, A4. For utility power, 120 vac, 400 Hz, 0 3 is routed through UTILITY circuit breaker CB8 to 120 V 400 outlet J2 on the side panel of the power distribution box.

c. Primary Power Monitoring. MAIN circuit breaker CB1 controls and provides overload protection for the remainder of the AN/TLQ-15. Power is applied to power monitor A2 for monitoring the voltage, phase rotation, and frequency of the input 208 vac 400 Hz, 3∅ power. If these conditions are correct, power is applied to auxiliary + 24 vdc converter PS1 which supplies + 24 vdc aux to a bus, the VOLTAGE, PHASE, FREQ indicator 1A2A1DS30 lights, STANDBY switch 1A2A1S8 lights white, and relay K1 energizes providing 208 vac, 400 Hz, 3∅ power to other circuits in the AN/TLQ-15. If any primary power parameter goes out of tolerance, power monitor A2 deenergizes and turns off PS1 which deenergizes relay K1 and shuts down the AN/TLQ-15. RESET switch 1A2A1S6 resets power monitor A2. Each phase of the 208 vac, 400 Hz, 3∅ power is rectified by meter monitor CR2 CR3, and CR4 and R3, R4, and R5 and applied as three ac monitoring voltages to VOLTAGE MONITOR meter 1A2A1M3 when those voltages are selected by VOLTAGE MONITOR switch 1A2A1S7.

d. Miscellaneous Unit Powering. Power of 120 vac, 400 Hz, 1∅ for the digital counter is applied through relay 1A2K1 which is controlled by shelter door interlock switches 1A12S2 and 1A112S3. Power of 120 vac, 400 Hz, 1∅ is applied directly to the rt unit. The pan indicator and personnel fan are supplied with 120 vac, 400 Hz, ∅ 2 power.

e. Personnel Compartment Temperature Control. Power of 208 vac, 400 Hz, 3∅ for the air conditioner is routed through AIR COND circuit breaker CB5. To power the personnel heater, 208 vac, 400 Hz, 3∅ is routed through HEATER circuit breaker CB6 to blower 1A19B1 and heater elements 1A19HR1 through 1A19HR3. When air flow produced by blower 1A19Bl is great enough to close vaneoperated switch 1A19S1, relay 1A19K1 is energized which closes the return circuit through PERSONNEL HEATER switch S3 to heater elements 1A19HR1 through 1A19HR3. Operator's thermostatic switch 1A12S1 controls the return circuit to blower 1A19B1. When blower 1S19B1 stops, airflow stops, vane-operated switch 1A19S1 opens, contacts of relay 1A19K1 open, and heater elements 1A19HR1 through 1A19HR3 are deenergized.

f. Equipment Compartment Temperature Control. Closing STANDBY switch 1A2A1S8 routes + 24 vdc aux to relay K2 blower delay A1Q2 through A1Q4. When relay K2 closes, 208 vac, 400 Hz, 3∅ power is applied through 30 BLOWERS circuit breaker CB4 to blowers in the low pass filter, exhaust assembly, and rfa, and power distribution box. When STANDBY switch A1S8 on the control unit is set to off during system shutdown, + 24 vdc aux is removed from blower delay A1Q2 through A1Q4 which keeps relay K2 energized for 3 minutes to maintain blower operation during equipment cool off.

(1) Closing STANDBY switch 1A2A1S8 also applies +24 vdc aux to relay K3 which applies 120 vac, 400 Hz, ∅3 power to the modulation source and permits turning on +28 vdc converter 1A11PS1 and preheater 1A12A5.

Power of 208 vac, 400 Hz, 3∅ is applied to PREHEATER circuit breaker CB3; PREHEATER AUTO-MAN switch 1A2A1S3 applies +28 vdc to relay K4 which routes the 208 vac, 400 Hz, 30 power to preheater 1A12A5.

(2) Power of 208 vac, 400 Hz, 3∅ is routed through CD CONV circuit breaker CB2 to +28 vdc converter PS1 which supplies power to the +28 vdc bus and temperature control box 1A11A11, Temperature sensors 1A20T1, 1A20T2 control power from temperature control box 1A11A1 to actuator 1A20B3 which controls the damper position. Ambient temperature inside the equipment compartment determines when air is recirculated or exhausted.

g. Rfa Filament Turn-On. Power of 120 vac, 400 Hz, ∅1 is routed through rfa fil relay 1A3K2 to filament transformers 1A3T1 and 1A3T2. When rfa fil relay 1A3K2 is energized by the turn-on and interlock subsystem, 120 vac, 400 Hz, ∅1 is applied to filament transformers 1A3T1 and 1A3T2, and a +28 vdc timing initiate signal starts the timing in 3-minute time delay relay1A3K1; after it timesout, relay 1A3K1 closes and energizes relay K5 which routes 208 vac, 400 Hz, 3∅ power to the lvps and hvps for rfa high voltage generation.

h. Reflectometer Powering. Power of 120 vac, 400 Hz, 1 is routed to reflectometer assembly 1A2A3 for conversion to the 15 vdc necessary to power the reflectometer assembly.

3-18. Dc Voltage Monitoring Section

Monitoring voltages from +28 vdc converter 1A11S1, lvps, and hvps are applied to audio amplifier and meter monitor card 1A2A2A3 which converts the input voltages to current levels of 0.76 ma to drive VOLTAGE MONITOR meter 1A2A1M3. VOLTAGE MONITOR switch 1A2A1S7 selects the dc voltage to be measured and provides automatic range compensation which enables the pointer to read in the green area of VOLTAGE METER 1A2A1M3 for all voltages which are normal.

Section VII. RT UNIT

3-19. Overall Description. (fig. FO-10)

a. General. The rt unit divided into six functional sections: receiver rf, detection and audio, transmitter, phase-locked loop (p11) frequency synthesizer, afc section, and power supply. The rt unit receive function is capable of receiving cw, am., usb, and aIsb signals in the 1.5 to 20 MHz frequency range. The transmitting function is in the same frequency range with capability of being modulated in the following modes: am., am./fm, fm, fm chirp, fsk, dsbsc, and dsbsc/fm. The p11 frequency synthesizer provides continuous incremental fine tuning in 10 Hz steps and continuous incremental coarse tuning in 3 kHz steps. A digital frequency counter, using a light emitting diode readout, displays the operating frequency of the rt unit. The power supply section converts 120 vac, 400 Hz primary power to the required dc operating voltages.

b. Rt Unit Frequency processing. In the receive function rcv rf is applied to the receiver rf section where it is amplified and heterodyned in the first if. frequency of 45 MHz. The first if. is amplified and then heterodyned in the second mixer with the 66.4 MHz crystal oscillator frequency to produce a second if. of 21.4 MHz. The second mixer supplied three 21.4 MHz, second if. signals: one for display on the pan indicator, one from which an afc voltage is derived, and one which is processed for its am. suppressed carrier, or cw modulation content.

(1) A 21.855 MHz crystal oscillator signal from the detection and audio section is heterodyned with the 21.4 MHz if. in the pan if. mixer. The difference frequency of 455 kHz is amplified and then displayed on pan indicator 1A17. For single sideband or double sideband operation the rcv second if. is heterodyned with the crystal oscillator frequency of 21. 855 MHz to produce a difference frequency of 455 kHz. This intermediate frequency is passed through the ssb filter where either the upper or lower sideband is removed and the remaining sideband is then applied to the cw/ssb detector. For cw reception, outputs from the 21.855 MHz crystal oscillator and the 21.4 MHz bfo are heterodyned in a mixer. The dirrerence frequency of 4556 kHz is applied to the cw/ssb detector where it is used as the reinserted carrier when in suppressed carrier operation. When in cw operation, the 21.4 MHz bfo signal is varied from the rt front panel to offset the bfo frequency to produce an audible tone.

(2) For reception of am. signals the 21.4 Mhz if. is detected by the am, detector. Audio from the detector is applied to the audio amplifier.

Audio output from both the am. and cw/ssb detectors is routed to an agc circuit where an agc dc voltage is derived. The dc voltage is applied to the 21.4 MHz if. amplifier. This circuit effectively controls the gain of the 21.4 MHz of. amplifier in accordance with the detected audio, thus maintaining a constant audio amplitude that is applied to the audio amplifier. The detected audio is then amplified and routed as headset audio to cm headset 1A24, as speaker audio to control unit 1A2, and as audio count to digital counter 1A9. For cw reception, the 21.855 MHz crystal oscillator output is mixed with a 21.4 MHz bfo output to generate a 455 kHz bfo signal. This 455 kHz bfo signal is applied to the cw detector circuits and permits the operator to adjust the tone of the received cw signal. For am. reception, the 21.4 MHz rcv second if. is detected by the am. detector and the resultant am. audio applied to the audio amplifier. Am. audio and ssb/cw audio are routed to an agc circuit to generate the controlling agc voltage for the 21.4 MHz if. amplifiers.

(3) In the transmit mode, modulation from modulation source 1A16 to the transmitter section modulates a 45 MHz vcxo. The modulated 45 MHz is mixed with the p11 frequency synthesizer output of 46.5 to 65 MHz to generate the transmitted operating frequencies. The 1.5 to 20 MHz rf output frequency may be also modulated by an am/dsb modulator, then amplified by a power amplifier and routed as exciter rf to rf panel 1A23.

(4) Receiver afc is accomplished by routing the 21.4 MHz rcv second if. from the receiver if. section to the afc section where it is amplified by a log amplifier and detected by an fm/afc detector. The resultant afc voltage is gated through a xmt/rcv gate and sample-and-hold circuit to the p11 frequency synthesizer for frequency control. If the received frequency is slightly higher or lower in frequency than the rt unit tuned frequency, the afc voltage will correct the p11 frequency synthesizer output applied to the first mizer in the receiver rf section.

(5) Transmitter frequency control is accomplished basically the same way as receiver afc. The 45 MHz vcxo output from the transmitter section is applied to the mixer in the afc section. The crystal oscillator 66.4 MHz output from the receiver rf section is also applied to this mixer. The resultant 21.4 MHz from the mixer is amplified by a log amplifier and detected by an fin/afc detector. The afc voltage is then gated through xmt/receive gate and xmt sample-and-hold circuit to the transmitter section 45 MHz vcxo as a correction voltage. The xmt afc circuit's basic purpose is to correct for frequency drift in the transmitter section vcxo over a period of time or due to temperature changes.

(6) The 21.4 MHz (xmt) from the mixer in the afc section is also routed to the pan if. mixer in the receiver if section. A 21.855 MHz crystal oscillator frequency from the detection and audio section is also applied to the pan if. mixer. The resultant 455 kHz signal is then routed to pan indicator 1A17 for operator visual display of the transmitted signal.

3-20. Receiver Rf Section (fig. FO-11)

a. The rcv rf signal from rf panel 1A23 is applied to bandpass filters card A401. The bandpass filters limit the required frequency response to the band in use which is selected by a band activate signal from programmable counter card A205. One of five band filters are selected by pairs of relays K1 and K2, or K3 and K4, or K5 and K6, or K7 and K8, or K9 and K10. The remaining four filters are in the circuit and have their inputs and outputs grounded by their respective relays.

b. Rf output from bandpass filters card A401 is routed through limiter and attenuator card A402 via the contacts of relays K1, K2, K3, and K4 to rf amplifier and mixer card A403. When any of the four relays are energized, the series circuit is broken and an attenuator is inserted in series with the line. Attenuator insertion requirements are determined by the rf signal level from rf amplifier and mixer card A403. After amplification of the rf by push-pull amplifier Q1, Q2, and T1 and coupling the output to push-pull amplifier Q3, Q4, and T4 through coupling transformers T2 and T3, the amplified rf is applied through emitter follower Q5 to rf detector CR3. The rf detector rectifies and filters the signal and supplies a detected level proportional to the amplitude of the received signal. This dc output is applied to sign detector U1-B and U3-D which determines if the up/down counter U8 is to count up or down. The detected level from the rf detector A403CR3 is also applied to window detector U2-A, U2-B, U5-B, and U5-C which gated the output of free running clock generator U4-A, U4-B, and U7-B. The clock generator output is applied to binary up/down counter U8 which counts only when a counter enable signal is present from receiver enable gate U6 and U7. The attenuator line signal selected is inverted and buffered by driver/inverter U9 and applied to the applicable relay driver circuit which, in turn, energizes the associated relay. Relays K1 through K4 and their associated attenuators comprise a variable attenuator that can be set by binary up/down counter U8, in increments of 1.3 dB, from 0 dB to 19.5 dB by the selection of any combination of relays.

c. The initiate signal from logic card A208 gates switch Q2 (also on rt logic card A208). The output of switch Q2 in turn gates receiver enable gate U6 and U7. This causes the attenuator to hold its attenuation setting during transmit periods.

d. The rcv/xmt select signal from control unit 1A2 is also applied to amplifier U2-C (on rt logic card A208) whose output is applied to diode switch control Q1 through Q6 (on meter amplifier card A206). Diode switch control Q1 through Q6, generates rcv/xmt control signals which control the spdt diode rf switch CR21 through CR24, to route synthesized rf (from main loop card A204) to either receive or transmit signal paths. A logic "zero" at the input of diode switch control Q1 through Q6, causes the rf output to be switched to the receive signal path; a logic "one" at the input causes the rf to be switched to the transmit signal path. In addition, output from control unit 1A2 is also applied to amplifier U2-A (on rf logic card A208) which gates switch Q3, energizing relay K1 on pan if. amplifier card A407 allowing the (xmt) pan if. signal to be displayed on pan indicator 1A17. With relay K1 deenergized, the (rcv) if. dignal is applied to pan indicator 1A17.

e. Rf output from limiter and attenuator card A402 is applied to push-pull amplifier Q1, Q2, and T1, on rf amplifier and mixer card A403. Amplifier output is applied to push-pull amplifier Q3, Q4, and T4 through coupling transformers T2 and T3. Output from push-pull amplifier Q3, Q4, and T4 is applied to mixer U1 through low pass filter L9 through L12, C17, C19, C21, C23, and C25. The same output is also applied to emitter follower Q5, which has been discussed previously.

f. The lo frequency from 46.5 to 65 MHz, gated by rf switching diodes CR21 through CR24, on meter amplifier and A206, is amplified by amplifier Q1 through Q3 (on oscillator and amplifier card A405), filtered by filter C8, C28 through C31, and L 13 through L 17 (on rf amplifier and mixer card A403), and then applied to mixer U1 through attenuator R28 through R30.

g. Received rf frequency of 1.5 to 20.0 MHz and synthesizer lo frequency of 46.5 to 65 MHz are heterodyned by mixer U1. A difference frequency of 45 MHz from the output of mixer U1 is the first if. which is applied to 45 MHz crystal filter FL1 through 3 dB attenuator R31 through R33.

h. The 45 MHz if. signal is amplified by the first if. amplifier Q1 on first if. amplifier and second mixer card A404. The amplifier output is coupled through the 55 MHz low pass filter FL1 to mixer U1. Filter FL1 provides rejection of the 66.4 MHz lo frequency to prevent feedback to the first mixer. The second local oscillator frequency is generated by crystal controlled oscillator A1 and Q4 on oscillator and amplifier card A405. This signal is applied to amplifier Q6 and Q7 through buffer Q5. One of the two 66.4 MHz outputs from amplifier Q6 and Q7 is applied to mixer U1 through 3 dB attenuator R7, and R8, and R11. The remaining 66.4 MHz output is applied through contacts of relay K1, when the relay is energized, to attenuator and amplifier card A301. Relay K1 is activated by a logic signal initiated by ZERO BEAT switch A3S2 via rt logic card A208.

i. First if. of 45 MHz and second local oscillator signal of 66.4 MHz are heterodyned by mixer U1 on first if. amplifier and second mixer card A404. The difference frequency of 21.4 MHz from the output of mixer U1 is the second if signal. The if signal is applied through 3 dB attenuator R9, R10, and R12 to 21.4 MHz bandpass filter C11 through C16, C21, and L3 through L5. The output then goes to the 3 dB hybrid coupler U2. One 21.4 MHz output is amplified by if. amplifier Q2 and routed to the first agc amplifier card A406. The remaining 21.4 MHz output from 3 dB hybrid coupler U2 is applied to pan if. amplifier card A407.

j. Differential cascade amplifier U1 accepts either the received 21.4 MHz pan if. signal or a synthesized transmit 21.4 MHz pan if. signal from attenuator and amplifier card A301. An enabling signal from rt logic card A208 determines the state of relay K1. Output from differential cascade amplifier U1 is applied to double-balanced mixer U2. A third local oscillator signal of 21.855 MHz generated by ssb filters card A306 is applied to double-balanced mixer U2 through attenuator R1 through R3. A difference frequency of 455 kHz from the output of double-balanced mixer U2 is the third if. signal. The if. signal is applied through filter network C9 through C11, L4 through L9, and R10 to gain-controlled if. amplifier U3. Output from this amplifier is applied through filter network C20 through C24, L14, and R14 through R19 to gain-controlled if. amplifier U4 and FL1. One output from the amplifier is routed directly to pan indicator 1A17. Pan if. agc is developed from the remaining 455 kHz output.

k. Output from gain-controlled if. amplifier U4 and FL1 is applied to agc detector CR4. The rectified output is applied to agc dc amplifier U5. Turn-on agc initializer Q3 prevents a saturated agc condition from occurring during initial turn-on. Dc output from the agc amplifier U5 is applied to the two gain-controlled if. amplifiers and the differential cascade amplifier U1.

3-21. Detection and Audio Section (fig. FO-12)

a. Agc. The if. frequency of 21.4 MHz is applied to one of two bandpass filters (12 kHz bandpass filter FL1 or 5.7 kHz bandpass filter FL2) on first agc amplifier card A406, through the contacts of relays K1 and K2.

With relays K1 and K2 deenergized, 12 kHz bandpass filter FL1 is in the circuit and the input and output of 5.7 kHz bandpass filter FL2 are grounded to prevent interaction. With relays K1 and K2 energized, 5.7 kHz bandpass filter FL2 is in the circuit and the terminals of 12 kHz handpass filter FL1 are grounded.

(1) Relays K1 and K2 are controlled by front panel IF BW switch A3S8. The signal from the switch is applied to relay drivers Q6 and Q8 on second agc amplifier card A308. Relay drivers control relays K1 and K2 selecting either the 5.7 kHz or 12 kHz filter.

(2) The if. signal output is applied to pin diode attenuator CR4 through CR6. The pin diode attenuator CR4 through CR6 is a pi-network constant impedance attenuator and supplies 20 dB of extra attenuation to very high level if. signals. Pin diode attenuator CR4 through CR6 does not function until levels greater than -10 dBm at the input are attained. For stronger signals, the output of integrator/amplifier U3 and Q7 (on second agc amplifier card A308) decreases, causing the pin diode attenuator CR4 through CR6 (on first agc amplifier A406) is applied to if. amplifier Q2 and Q3. The agc voltage from sample and hold card A210 controls the gain of 21.4 MHz if. amplifier Q2 and Q3. Output from amplifier (Q2 and Q3) is applied to emitter follower Q4, which supplies the low impedance drive for if. amplifier Q1 on second agc amplifier card A308. The agc input to if. amplifier Q2 an and Q3 (on first agc amplifier card A406) is also applied to if. amplifier A308 Q1. Output form the if. amplifier Q1 is applied to if. amplifier Q2. Gain of both if. amplifiers is controlled by agc voltage from sample and hold card A210.

(3) Output from if. amplifier Q2 is applied to hybrid combiner U1 through emitter follower Q3. As a tuning aid a 21.4 MHz zero beat signal from attenuator and amplifier card A301 is summed in hybrid combiner U1. When both signals applied to hybrid combiner U1 are the same frequency, no signal will be present. This indicates that the p11 frequency synthesizer is correctly tuned for transmitting purposes. With the zero beat circuit disabled, output from hybrid combiner U1 is applied to amplifier Q4 and Q5 through FL1. Output from amplifier Q4 and Q5 is applied to signal splitter U2. The signal splitter produces two outputs of 21.4 MHz each to drive the two different detectors.

(4) Receive mode switch (P/O A355) switch NAND gates U1-C. U2-B, and U3-C, on detection logic card A207. Output from the NAND gates is routed to linear am. detector card A307 and to ssb and CW detector card A305. The receive mode switch also switches gate U2-C. The output of U2-C is also routed to ssb and CW detector card A305.

b. Ssb/Cw Detection.

(1) One of two 21.4 MHz outputs from signal splitter U2 is applied to mixer U1 on ssb and cw detector card A305. Another signal is generated by 21.855 MHz oscillator Q3 and Y1 (on ssb filters card A306) amplified by amplifier Q4 and applied to amplifier Q9 and amplifier Q10 on ssb and cw detector card A306. Relay A305 K4 (through relay driver Q8) activates amplifier Q9 and amplifier Q10 when a control signal energizes relay A305 K4. Output from amplifier Q9 is applied to mixer U1 whose output of 455 kHz is applied to contacts of relay A305 K1. A logic signal from detection logic card A207 gates relay drivers Q1 and Q2 (on ssb and cw detector card A305), energizing relay A305 K1 when ssb operation is desired. The 455 kHz signal is switched to relay contacts of relay A306 K1. Relays A306 K1 and A306 K2, operating in unison, insert either the usb or lsb filter into the circuit. The relays are controlled by relay drivers Q1 and Q2 (on ssb filters card A306) which are gated by a logic signal from receive mode switch (P/O A3S5) through inverter U3-D (on detection logic card A207). The usb or lsb signal at contacts of relay A306 K2 is applied through contacts of relay A305 K2 (which is in the energized state), through 455 kHz filter (on ssb and cw detector card A305) C2 through C13, C58 through C60, and L1 through L3 to amplifier Q3. The output of amplifier Q3 is applied to product detector U2. A variable 455 kHz signal is heterodyned with the 455 kHz if. to produce an audio tone for reception of cw signals. The 455 kHz signal is also the reinserted carrier when in the ssb suppressed carrier mode. This signal is obtained from 21.855 MHz amplifier Q10 and is heterodyned with a front panel controlled variable 21.4 MHz signal by mixer U4 and then amplified by amplifier Q11. The output of amplifier Q11 (455 kHz) is fed to product detector U2 and the audio output from product detector U2 is applied to emitter follower Q5.

(2) The detected audio signal from product detector U2 is applied through amplifier Q4 to the peak detector Q6 and CR6, then to amplifiers U3and U3-B where a cw agc voltage is develope Zener diode VR5 limits the output voltage of the peak detector. The cw agc voltage is applied to agc sample and hold U1 on sample and hold card x A210. Relay A305K3 is energized when operating in the ssb/cw mode as determined by a logic signal applied to relay driver Q7. The agc sample and hold U1 is activated by an initiate signal from logic card A208 which gates switch Q2 which, in turn, activates agc sample and hold U1 on sample and hold card A210.

Agc voltage from agc sample and hold U1 is applied to all agc controlled if. amplifiers. AGC ON switch A351 on the front panel determines whether the agc voltage is applied to the amplifier by controlling relay A210 K1. When relay A210 K1 is energized, RF GAIN control A3R1 sets the gain of the if. stages.

c. Am. Operation. The second 21.4 MHz output from signal splitter U2 on second agc amplifier card A308 is applied to amplifier Q1 on linear am. detector card A307. Output from amplifier Q1 is applied to linear detector CR1. The deleted audio output is applied to agc amplifier U1 and U2 and the developed am. agc boltage is applied to the agc controlled if. circuits through contacts of relay A305 K3. Relay A305 K3 is deenergized as shown when in the am. mode. The output of linear detector CR1 (on linear detector card A307) is also amplified by ausio amplifier U3; the output of audio amplifier U3 is routed to audio amplifier card A302.

d. Audio Amplification. Ssb/cw level control R16, and am. level control R8 (on audio amplifier card A302) determine the preset level for the two incoming sudio signals. Choice of audio is determined by relay A302 K1 which is controlled by receive mode switch (P/O A3S5). This switch triggers gates U1-C, U2-B, and U3-A (on detection logic card A207) which trigger relay driver Q6 (on audio amplifier card A302) which in turn energizes relay A302 K1. Audio is applied to both audio count amplifier U1 and audio preamplifier U2 and Q1. Output from audio count amplifier U1 is routed to digital counter 1A9. Gain of audio preamplifier U2 and Q1 is controlled by AT GAIN control A3R5. The audio from preamplifier U2 and Q1 is amplified by driver Q2 and Q3 then the output is fed to complementary amplifier Q4 and Q5. Audio output from complementary amplifier Q4 and Q5 is applied to PHONES connectors J2 and J3 through audio transformer T2 and filter card A1. An additional audio output from audio transformer T2 is routed to control unit 1A2.

3-22. Transmitter Section (fig. FO-13)

a. Modualtion Mode Selection. CHIRP RATE switch A3A1S1, MODULATION switch A3S4-B, and EXT AM MOD switch A3S1 are used to select the desired modulation mode for the transmitter section. The switches apply logic signals to modulation gating logic U1 through U8, which gates the logic signals to the appropriate component for the modulation mode selected. Figure TM 11-5895-372-24 FO-13 delineates the switch positions and the relays energized for each modulation mode.

(1) *Fsk mode*. When this mode is selected by use of modulation switch A3S4-B, relay driver Q1 on modulation logic card A209 is gated and A209 K1 is energized; contacts of relay A209 K1 initiate the fsk circuits in control unit 1A2.

(2) *Am. mode*. When this mode is selected, relays A209 K3 and A209 K5 are energized. Modulation from the modulation source is applied to connector J3 and is routed through modulation amplifier U10, the closed contacts of relay A209 K5, the closed contacts of relay A209 K3, and the contacts of relay A209 K4 to am. audio amplifier U9. AM MOD control A3R2-A adjusts gain of am. audio amplifier U9. AM ON indicator 1A2 A1DS19 in the control unit lights to indicate am. operation.

(3) *Am., am./fm, or dsbsc modes*. Selection of these modes selectively energized relays K2, K3, and K5. This mode operates in the same way as the am. mode previously described with the addition of relay A209 K2. With relay K2 energized, front panel AM MOD control A3R2-A is disconnected from the circuit and fixed gain adjust R12 through R14 is substituted.

(4) *External modulation.* When use of an external modulation source is desired, EXT AM MOD INPUT connector A3J1 accepts the external modulation. With EXT AM MOD switch A3S1 to ON position, relay driver Q5 (on modulation logic card A209) energizes relay K4. The external am. modulation is applied from EXT AM MOD INPUT connector A3S1 through filter card 2A2 card to external am. amplifier U12, through contacts of energized relay K4 to am. audio amplifier U9.

(5) *Am/fm, fm chirp, fsk*. Selection of these modes initiates energizing of relay K6 (by means of appropriate controls, modulation gating logic U1 through U8, and relay driver Q7) which routes output from linear four quadrant multiplier U13 to vcxo mixer and card A104. An fm enable logic signal from modulation gating logic U1 through U8 is applied to dc controlled variable gain amplifier U13. Gain of dc controlled variable gain amplifier is controlled by DEVIATION control A3R2-B on the front panel.

b. Modulation Processing. Amplitude, double sideband suppressed carrier, and fm are the basic modulation modes.

(1) Double sideband suppressed carrier. The modulation signal is applied to balanced modulator U1 (on am. modulator and level control card A105) with a synthesized if. signal. Carrier null adjust potentiometer R8 adjusts balanced modulator U1 so that the rf carrier is suppressed. Both the upper and lower sidebands are applied to rf level control amplifier U2 the gain of which is controlled by alc voltage from alc amplifier U7.

(a) Output from rf level control amplifier U2 is routed through emitter follower Q2 to rf amplifier Q3. The output from rf amplifier Q3 is applied through buffer amplifier Q1 (on rf power amplifier card A103) to push-pull rf amplifier Q2 and Q3. Push-pull rf amplifier Q2 and Q3 is activated when a digital signal from control circuit 1A2 provides an enable signal to gating logic U1-B, U1-C, U2-F, and Q1 (on rt logic card A208). The output triggers power supply switch Q6 (on rf power amplifier card A103) and turns on keyable current supply Q4 and Q5 which, in turn, activates push-pull rf amplifier Q2 and Q3. The output from push-pull rf amplifier Q2 and Q3 is routed through one of five band filters (on bandpass filters card A102) as selected by the programmable counter card A205. The output of the filter selected is applied to power attenuator card A101.

(b) The rf is routed through the two pairs of normally closed contacts of relay A101K1 and the output is applied to rf panel 1A23. When a low power output is required (i.e., such as when tuning high level transmitter circuits) a low power select signal from control unit 1A2 is applied to relay driver Q1 which energizes relay AlOlK1. Contacts of relay K1 insert the 3 db attenuators R4 thru R8 and R11 in series with the rf output to rf panel 1A23.

(2) Amplitude modulation. Amplitude modulation is accomplished in the same manner as double sideband suppressed carrier with the exception of the carrier suppression function. Carrier suppression is defeated by applying an unbalancing -8 volts dc signal directly to balanced modulator U1, allowing a continuous carrier to be modulated. Operation of MODULATION switch A3S4-B to the am. position provides a logic signal to relay driver Q1 which allows relay A105K1 to be energized, applying --8 vdc to balanced modulator U1 thru the closed contacts of relay A105K1.

(3) Frequency modulation. The audio signal from the dc controlled variable gain amplifier A209U13 is routed to afc amplifier U1, on vcxo. and mixer card A104, along with the transmitter afc signal generated from sample and hold card A210 and filtered by input filter C4, C34, and R3. Front panel AFC switch A3S6 applies AFC select signal to gate CR9 and CR10, which gates relay driver Q1 and causes relay A104K1 to deenergize. When in the chirp mode, the afc function is disabled by front panel MODULATION switch A3S4-A. The switch initiates a logic signal to gate CR9 and CR10. This action causes relay driver Q1 to energize relay A104K1. The contacts of relay K1 short the afc signal to ground. Offset control R11 acts as a balance control for afc amplifier U1. The output of afc amplifier U1 is the sum of the afc signal and the applied audio modulation. The output from afc amplifier U1 is applied to 45 MHx vcxo Y1 whose frequency varies proportionally to the applied frequency. The vcxo is enabled by a signal initiated from transmit mode switch A3S7 which actuates the transmit enable gates on rt logic card A208. A vcxo power enable signal from the transmit emable gates is used to activate repay driver Q3 on vcxo and mixer card A104. Relay driver Q3 energizes relay A104K2 which enables 45 MHz vcxo Y1. The appropriate transmit mode switch A3S7 determines if 45 MHz vcxo Y1 is keyed on or off by relay A104K1. The +15 vdc regulator (U5) and the --18 vdc regulator (Q2, VR1) supply regulated dc voltages for the agc amplifier and vcxo respectively.

(a) The transmit enable gates also develop look through or cont signals depending upon whether the transmit mode selected requires look through keying or continuous transmission. If look through is selected, relay K2 is energized by relay driver Q6 and the look through initiate signal from pan indicator 1A17 is selected for use in rt logic card A208. If continuous transmission is selected, relay K1 is energized by relay driver Q5 and a continuous keying voltage, developed in the 1A2 control unit, is selected for use in the rt logic card.

(b) To produce the frequency of 45 MHz with the desired stability and deviation capability, 45 MHz vcxo Y1 uses a 15 MHz oscillator the output of which is multiplied to 45 MHz. This process produces many undesirable harmonics above 45 MHz. Frequencies above 45 MHz are removed by low pass filter C37, C38 and L7. The filtered 45 MHz signal is applied to power splitter U2, which provides two outputs; one for processing and one for zero beating to aid tuning. When a zero beat signal is desired, ZERO BEAT switch A3S2 provides a logic signal to transmit enable gates (on rt logic card A208) which trigger relay driver Q4 on vcxo and mixer card A104 causing relay A104K3 to energize. The 45 MHz zero beat signal is routed through two sets of contacts of relay K3 to attenuator and amplifier card A301 to be used for the zero beat tuning function. The other output from power splitter U2 is applied to series bandpass filter C40 and L8, and then to mixer U3. Synthesizer lo rf from meter amplifier card A206 is routed through 3 dB pad R16, R17, and R18 and applied to mixer U3. The difference frequency from mixer U3 is then applied to low pass filter C10 through C19 and L1 through L4. The output of the filter is split into two rf signals by power splitter U4: the first output is coupled to balanced modulator U1 (on am. modulator and level control card A105) while the second output is amplified by rf amplifier Q5.

The output of rf amplifier Q5 is coupled through rear panel jack J8 to digital counter 1A9.

c. Alc Circuit. Rf applied to the input of power attenuator cord A101 from bandpass filters card A102 is split and routed to rf rectifier CR1. The rectified and unfiltered voltage from rf rectifier CR1 is applied to filter C3, C4, and L1 and the developed alc voltage is routed back to transmit sample and hold U5 on am. modulator and level control card A105. A transmitter keying signal from modulation source 1A16 is applied to gating logic U3-B and U1B on rt logic card A208. When a second logic signal, from TRANSMIT MODE switch A3S7, is applied to gating logic U1-D and U3-A, a pulse is provided which gates transmit keying delay logic U3-A and U4 (on am. modulator and level control card A105) which then turns on transmit sample and hold U5. The output alc voltage is then applied to alc amplifier U6 and then to alc amplifier U7. The output of alc amplifier U6 is also routed through the contacts of relay A206K2 (on meter amplifier card A206) to meter amplifier U2. When selected by METER SELECTOR switch A3S3, meter amplifier U2 provides the rf output level to METER SELECTOR meter A3M1. The meter indicates the peak voltage output level of the transmitter.

(1) The output of alc amplifier U6 is further amplified by alc amplifier U7 which also sums the rf level control voltage from RF OUTPUT control A3R3. The output of alc amplifier U7 is applied to rf level control amplifier U2. This voltage controls the gain of rf level control amplifier U2 and controls the output power level of the transmitter circuits.

(2) When no xmtr keying signals are received from rt logic card A208, the transmit keying delay logic U3-A and U4 develops an xmt inhibit signal which clamps the alc voltage to a level such that the rf level control amplifier U2 is held in a zerogain state. When an xmtr keying signal is applied, the xmt inhibit is removed and the gain of the rf level control amplifier is set by the alc voltage. This prevents spurious transmitter outputs from being generated (due to signals stored in sample and hold U5) when switching rt unit modes.

3-23. P11 Frequency Synthesizer (fig. FO-14)

a. Timing and Reference. Timing and reference card A201 generates the timing, tuning control, and reference frequencies for the p11 frequency synthesizer. The reference frequencies are derived from fundamental 10 MHz crystal oscillator Al and Q1. The output of 10 MHz crystal oscillator A1 and Q1 is buffered by buffer amplifier Q2, amplified by amplifier Q3 and wave-shaped by analog voltage comparator U1. The resultant 10 MHz frequency is then counted down to a 10 kHz reference frequency by 1000 counter U2 through U4. One 10 kHz output is routed to second loop card A202 via inverter U9-C to be used as the reference frequency for the p11 frequency synthesizer. Another 10 kHz output is further counted down by + 1000 counter U5 through U7 to produce a 10 Hz reference frequency. This 10 Hz reference frequency is applied to readout counter A3A2 via dual line driver U8 and U9-A and is used for timing purposes. A third 10 kHz output reference is also supplied to inverter/level shifter U9-D and U10-F.

(1) An optional external reference frequency source may be used for operation of the p11 frequency synthesizer via rear mounted connector J7. Setting EXT REF switch S1 to ON, will energize relay A201K1 and permit processing of the external reference frequency input the same way as previously listed, except that 10 Mhz crystal oscillator A1 and Q1 and buffer amplifier Q2 are bypassed.

(2) The tuning control circuits process the coarse tune and fine tune pulses from readout counter A3A2 and generate control signals to step up/down counter U10, up/down counter U11, and up/down counter U13 on second loop card A202, and up/down counter U1 through U4 on programmable counter card A205. The coarse tune encoder input and the fine tune encoder input from readout counter A3A2 are applied to tuning input logic U10-A through U10-E, U11-B through U11D, and U12-A through U12-C. The encoder inputs are generated by a shaft encoder when the COARSE TUNING control or FINE TUNING control is rotated. The coarse tune clock pulse and fine tune clock pulse from tuning input logic U10-A through U10-E, U11-B through U11-D, and U12-A through U12-C are used by dual flip-flop U13-A and U13-B and gate U11-A to generate an up/down enable signal. Depending on the frequency direction selected (up or down), up/down count generator U15-D, U18-A, U18-D, U19-A through U19-F, U20B, U21-B, and U22-A will provide a control signal to enable the p11 frequency synthesizer circuits to accordingly count up or count down in frequency. The up/down control signal is applied to up/down counter stages in second loop card A202 and programmable counter card A205.

(3) Coarse tune clock pulses from tuning input logic U10-A through U10-E, U11-B through U11-D, and U12-A through U12-C are also applied to strobe circuit U14-B and U15-C. A 10 kHz reference frequency from inverter/level shifter U9-D and U10-F is also applied to strobe circuit U14-B and U15-C.

(4) A pulse from tuning input logic U10-A through U10-E, U11-B through U11-D, and U12-A through U12-C will trigger U14-B in the strobe circuit thus enabling U15-C and allowing the 10 kHz reference to trigger one-shot multivibrator U15-A and U15-B.

The one-shot pulses are then counted by ÷ 3 counter U16 and U17-A through U17-D. After three pulses, U14-B in the strobe circuit is reset and U15-C is disabled, thus providing three pulses at the output of U15-B (on the one shot multivibrator) for each pulse from tuning input logic U10-A through U10-E, U11-B through U11-D, and U12-A through U12-C. The coarse tune output from the one shot multivibrator U15-A and U15-B is then delayed by delay U12-D and U12-E. The output of delay U12-D and U12-E is then applied to output gating U22-B. Fine tune clock pulses from tuning input logic are applied to delay U12-F and U18-F and then applied to output gating U22-C. Both the coarse tune clock pulse and fine tune clock pulse are delayed to permit the up/down control signal to be generated and enable all up/down counters in the p11 frequency synthesizer. As the up/down control signal continuously changes, up/down count generator U15D, U18-A, U18-D, U19-A through U19-F, U20-B, U21-B, and U22-A, will inhibit output gating U22B and output gating U22-C to prevent coarse and fine tune inputs from entering the applicable up/down counters until the up/down control signal is stabilized. When the up/down control signal is stabilized, the coarse tune and fine tune inhibit signals are removed and the coarse tune signal or fine tune signal are processed.

(5) Output gating U22-B and output gating U22-C will also be inhibited when a lower or upper bandstop limit (1.42 MHz and 20.52 MHz) is reached. An upper bandstop pulse or lower bandstop pulse from programmable counter card A205 is converted to a bandstop inhibit pulse by upper/lower bandstop logic U20-C and U21-A. This will cause output gating U22-B and output gating U22-C to become inhibited. After reaching a bandstop condition, tuning in the opposite direction will cause a reset pulse to be generated by up/down count generator U15-D, U18-A, U18D, U19-A through U19-F, U20-B, U21-B, and U22-A. This reset pulse will clear upper/lower bandstop logic U20-C which will clear the bandstop inhibit signal from output gating U22-B and output gating U22-C.

(6) Setting the FREQ LOCK switch on readout counter A3A2 to lock will inhibit the tuning input logic and prevent gating-in a new coarse tune encoder input or a fine tune encoder input. After the operating frequency has been tuned-in and the FREQ LOCK switch set to lock, the rt unit cannot be detuned by any inadvertent rotation of the front panel tuning controls.

(7) When AFC switch A3S6 is set to WIDE or NARROW, an afc signal is gated through sample and hold card A210 to the tuning input logic. The tuning input logic will be locked by the afc signal, thereby inhibiting any tuning (automatic or manual) of the p11 frequency synthesizer circuits. Setting AFC switch A3S6 to OFF enables the tuning input logic and permits tuning of the p11 frequency synthesizer circuits. The afc signal is automatically disabled when the receiver mode is set for usb or lsb signals.

(8) Initializing pulse generator Q4 generates a reset pulse when rt unit power is turned on. The reset pulse initially sets up/down count generator U15-D, U18-A, U18-D, U19-A through U19-F, U20-B, U21-B, and U22-A which triggers up/down counter U10, up/down counter U11, and up/down counter U13 (on second loop card A202) to a count of 2000 and sets up/down counter U1 through U4 (on programmable counter card A205) to a count of 148. This allows the p11 frequency synthesizer to be cleared and reset to a received frequency of 1.5 MHz.

b. Fine Tuning P11 Synthesizer. Rt unit fine tuning p11 synthesis is performed by second loop card A202. Basically, the circuitry of this card compares the frequency and phase between the divided down output of a vco and a 10 kHz reference frequency from timing and reference card A201. If the two signals differ in phase, an error voltage is generated to correct the output frequency of the vco. This correction procedure continues until a phase-lock is achieved and the vco output correlates to the desired fine-tuned frequency.

(1) The 10 kHz reference frequency from inverter U9-C on timing and reference card A201 is applied to phase detector U2 via buffer amplifier U1 on second loop card A202. When the rt unit is initially turned on, up/down counter U10, up/down counter U11, and up/down counter U13 will be set by the reset pulse from initializing pulse generator Q4 on timing and reference card A201. The up/down counters will then automatically store a count of 2000 (a prefix of 2 is always stored in the counter). Fine tune pulses are then added to or subtracted from the up/down counters' stored count when the FINE TUNING control is turned cw or ccw. The 20 MHz signal generated by analog voltage comparator U6 is fed into ÷ 10/÷ 11 prescaler U23-A, U25-A through U25-C, U26-A, U26-B, U27-A, and U27-B where it is divided down. With a stored count of "0" (actually bed 9) in up/down counter U10, the prescaler will not divide by 11 because the ÷ NMC modulus control counter U14-A through U14-D, U15-A through U15-D, U15-F, U16, U17-B, U17-C, U22-B, and Q4 will be in a “0” state.

The state of the ÷Np counter U12-A, U15-E, U18 through U20, U21-A, U21-B, U22-A, U23-C, U24-A, U2B, and U28 will then equal 200 (ten times the count in the ÷ Np counter, plus the count in the÷NMC modulus control counter (i.e., 200 (10) + 0 2000). The ÷10/÷11 prescaler will then divide this count by 10 until the count in the ÷Np counter is decremented to zero. The resultant ÷N count will be a 10 kHz frequency that is compatible in frequency and phase with the 10 kHz reference frequency and will be gated to phase detector U2. The output of phase detector U2 is set to an operable dc voltage level by level shifter U3 and filtered by active filter U4 and 10 kHz low pass filter C5 through C7, L1 and L2. The resulting output vco control voltage from the filter is fed to buffer amplifier US. The vco control voltage from buffer amplifier U5 receives additional filtering by 10 kHz notch filter R11 through R13 and C8 through C11. The output of the notch filter will be at a positive voltage level which corresponds to a vco output frequency of 20 MHz.

(2) As the FINE TUNING control is rotated in either direction, the up/down control signal to the up/down counters will enable the up/down counters to count up in frequency or count down in frequency. If the new frequency selected by the FINE TUNING control results in five pulses being added to the fine tune encoder input signal, then the up/down control signal will enable the up/down counters to count up; this will result in a count of 2005 being stored in the up/down counters and a count of 5 being stored in the ÷ NMC modulus control counter (on second loop card A202). The ÷10/÷11 prescaler will then divide-by-11 for five counts until the ÷NMC modulus control counter is decremented to zero. For every eleventh pulse into the ÷10/ ÷11 prescaler, both the ÷NMC modulus control counter and the ÷Np counter are decremented by 1. The ÷10/÷11scaler continues to divide-by-11 until the ÷NMC modulus control counter reaches the zero state. The modulus of the ÷10/÷11 prescaler then changes to 10, thereby dividing -by-10 for the remainder of the count left in the ÷Np counter. Finally, when this is completed, both the÷NMC modulus control counter and the ÷ Np counter are reset and the cycle repeats. The resultant ÷N count signal is then a signal representative of the new tuned frequency. This analog of the new tuned frequency is a 10 kHz signal. Phase detector U2 produces a dc level representing zero phase shift between the ÷N and 10 kHz reference signals. Phase shift other than zero will produce positive or negative pulses at a 10 kHz rate from phase detector U2. These pulses, when filtered, become the error voltage which adds to or subtracts from the vco quiescent control voltage to increase or decrease the vco frequency. This dc level from phase detector U2 is level shifted to zero by level shifter U3, then filtered by active filter U4, sent to 10 kHz low pass filter C5 through C7, L1, and L2, then amplified by buffer amplifier U5, and filtered by 10 kHz notch filter R11 through R13 and C8 through C11 to remove the 10 kHz components. Typical waveforms for a two modulus prescaler are shown in figure 3-2.

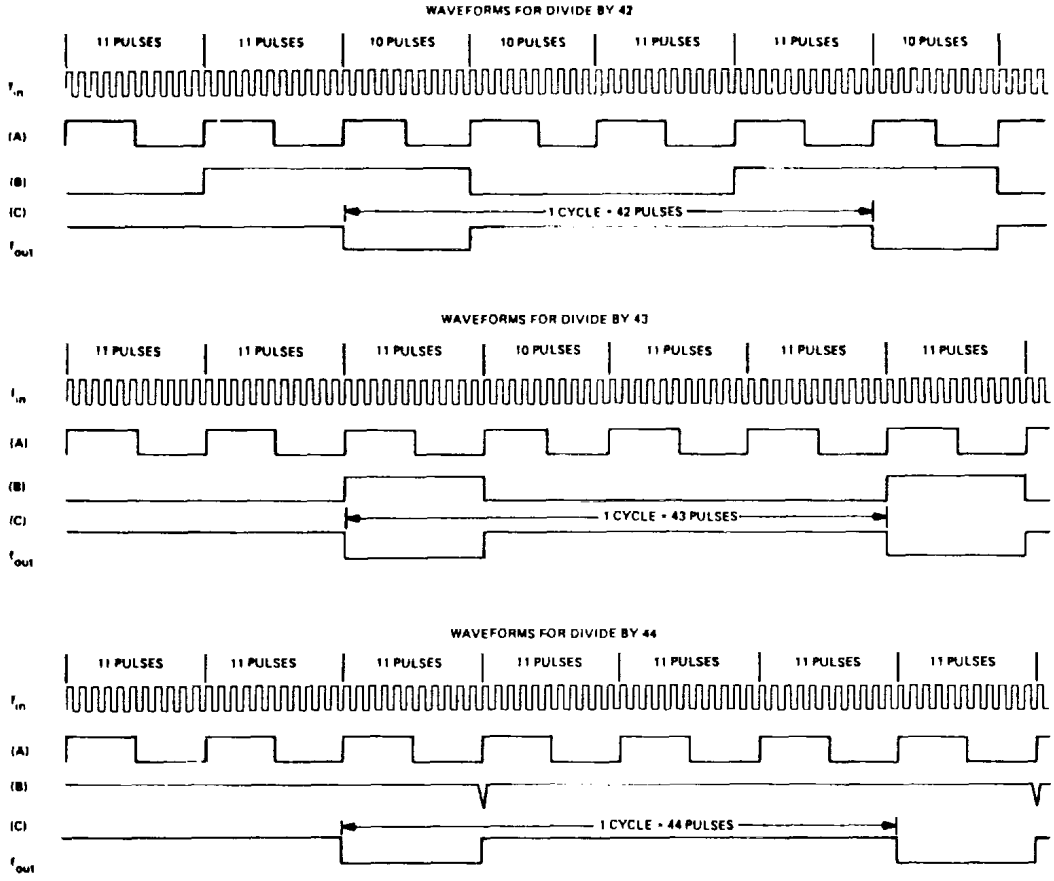


Figure 3-2. Two modulus prescaler, typical timing diagram.

(3) The vco control voltage from 10 kHz notch filter R11 through R13 and C8 through C11 applied to 20.00 to 29.99 MHz vco Q1, Q2, VR1, and CR2 will cause it to correct its output frequency in the direction required until lock is achieved (both inputs to phase detector U3 are 10 kHz). The vco control voltage is capable of raising or lowering the vco output frequency in 10 kHz increments.

(4) The corrected output frequency of 20.00 to 29.99 MHz vco Q1, Q2, VR1, and CR2 is routed through buffer amplifier Q3 to analog voltage comparator U6. The 20.00 to 29.99 MHz frequency output from analog voltage comparator U6 is further counted-down by ÷1000 counter U7 through U9.

The 20.00 to 29.99 kHz second loop output from 1000 counter U7 through U9 is then routed to buffer U5 on afc and loop interface card A203.

(5) As the FINE TUNING control and COARSE TUNING control is isolated, the RECEIVED FREQUENCY Mhz indicator (p/o readout counter A3A2) displays seven digits. The first four digits are affected by the operation of the COARSE TUNING control while the last three digits are affected by operation of the FINE TUNING control. Continuous operation of the FINE TUNING control will change the fine tune display from 000 to 999; the three digits displayed indicate 1 kHz, 100 Hz, and 10 Hz. However, as the FINE TUNING control is operated, the next fine tune pulse is fed to the up/down counters which count from 999 to 000 and the fine tune phase locked loop (on second loop card A202) returns to a vco frequency of 20 MHz. At the same time up/down counter U13, on second loop card A202, generates a main loop frequency control pulse to increment or decrement the coarse tune phase locked loop (on programmable counter card A205). This signal initiates the operation of the coarse tune phase locked loop.

(6) Rotating the COARSE TUNING control enables a coarse tune pulse from inverter U20-A on timing and reference card A201 to be fed to gate U12-B on second loop card A202. The signal is gated through buffer U12-C and U12-D to up/down counter U13 and counted. With up/down counter U13 controlling the highest digit (1 kHz) displayed for fine tuning operation and inverter U20-A (on timing and reference card A201) providing three coarse tune pulses for every one generated from the coarse tune shaft encoder, the RECEIVED FREQUENCY MHz indicator (1 kHz position) will change in 3 kHz increments and the output of up/down counter U13 controlling the coarse tune phased lock loop.

c. Loop Interface Circuits. Afc and loop interface card A203 generates a 45 MHz display offset signal and a 45 MHz ssb signal. Both outputs are utilized by main loop card A204 to generate display rf and control the coarse tuning phase-locked loop. The card assembly provides an interface between the second loop circuits, main loop circuits, and rt unit afc circuits.

(1) The 20.00 to 29.99 kHz signal from ÷1000 counter U7 through U9 on second loop card A202 is applied to mixer U4 on afc and loop interface card A203 through buffer amplifier U5, low pass filter C17 through C21 and L5 through L8, and attenuator R21 and R23. With AFC switch A3S6 set to OFF, relay A203 K1 will be energized, thereby grounding the input to amplifier U2; in this state, amplifier U2 has an output that is 0 volts to 45 MHz vcxo Y1. As no control voltage from amplifier U2 is applied to 45 MHz vcxo Y1, the output of 45 MHz vcxo Y1 is 45 MHz and is stable and independent of afc action. The 45 MHz vcxo Y1 output is filtered by 45 MHz filter C9, C10, and L2 and applied to signal splitter U3. One output of signal splitter U3 is filtered by 45 MHz filter C13 and L4 and then is routed to mixer U4 where the 45 MHz and 20.00 to 29.99 kHz second loop card A202 output are mixed. The mixer output will be 45 MHz plus and minus some difference frequency (Δ F). This difference frequency is somewhere between 20.00 kHz and 29.99 kHz, depending on the tuned frequency of second loop card A202. After attenuation by 3 dB attenuator R18 through R20, the 45 MHz $\pm\Delta$ F signal is applied to usb filter FL1 where the lsb and 45 MHz signals are filtered out. The 45 MHz $+\Delta$ F filter (ssb) output is amplified by output amplifiers Q2 through Q4 and the resultant 45 MHz ssb signal is routed to mixer U7 on main loop card A204.

(2) The other output of signal splitter U3 is filtered by 45 MHz filter C12, L3, L14, and L15 and is routed to mixer U10 on main loop card A204 as a 45 MHz display offset. This offset will be further processed to generate the received frequency for readout counter A3A2.

(3) When AFC switch A3S6 is set to WIDE or NARROW, the afc logic input from sample and hold card A210 deactivates relay driver Q1 on afc and loop interface and which in turn deenergizes relay A203 K1. The receive afc voltage from sample and hold card A210 is then amplified by amplifier U1, routed through the closed-contacts of relay A203 K1, and amplified again by amplifier U2. The control output of amplifier U2 is fed to 45 MHz vcxo Y1 and the output is dependent upon the afc signal received and the frequency control voltage to 45 MHz vcxo Y1 will then control the vcxo frequency output in the desired direction. Processing of the automatic frequency controlled 45 MHz output is identical to that explained previously.

d. Coarse Tuning P11 Synthesis.

(1) Coarse tuning p11 synthesis and display rf are accomplished by main loop card A204 and programmable counter card A205. The process is basically the same as the fine tuning p11 synthesis in that it also compares the frequency and phase between the divided output of a vco and a 10 kHz reference frequency. The main loop frequency control signal from up/down counter U13 on second loop card A202 is applied to up/down counter U1 thru U4 on programmable counter card A205. A count up/down control signal and a reset pulse both from timing and reference card A201 are also applied to up/down counter U1 through U4.

The up/down control signal enables up/down counter U1 through U4 to count in the required direction. The reset pulse clears and sets up/down counter U1 through U4 to a count of 148 upon initial application of power to the rt unit. The coarse tune loop operates in the same manner as the fine tune phase locked loop. The stored count from up/down counter U1 through U4 is applied to $\div N_{MC}$ modulus control counter U5, U9-A through U9-D, U11-B, U11-D, U12-A, and Q1. The ÷10/÷11 prescaler U14-C, U16-A through U16-C, U17-A, U17-B, U18-A, and U18-B, will divide the incoming rf from analog voltage comparator U8 on main loop card A204 by eleven until the N_{MC} modulus control counter is decremented to zero. Then ÷10/1 11 prescaler divides by 10 the remainder of the count in the N_p counter U6 through U8, U10-A, U10-B, U11-C, U12-B, U13-E, U14-B, and U15-A through U15-C. The count stored by U1 through U4 is directly related to the tuned frequency.

(2) The ÷N count from ÷Np counter on programmable counter card A205 is applied to phase detector U1 on main loop card A204. This count is compared with a 10 kHz reference frequency from buffer amplifier U1 on second loop card A202. Phase detector U1 produces a dc level representing zero phase shift between the÷N count and 10 kHz reference signals. Phase shift other than zero will produce positive or negative pulses at a 10 kHz rate at the output of phase detector U1. When filtered, these pulses become the error voltage which adds to, or subtracts from, the vco quiescent control voltage to increase or decrease the vco frequency. The output of the phase detector U1 is level shifted to zero by level shifter U2, filtered by active filter U3, and filtered further by 10 kHz notch filter C4 through C7 and R14 through R16. This signal is then buffered by buffer amplifier U4. The output of buffer amplifier U4 is then passed through 10 kHz low pass filter C10 through C12, L3, and L4 and buffered again by buffer amplifier U5. The resulting vco control voltage, or error voltage, is then applied to 46.5 to 65 MHz vco Q1 through Q3 to correct its output frequency in the required direction as determined by the ÷N count signal. The output of 46.5 to 65 MHz vco Q1 through Q3 is routed thru low pass filter C35 through C37, L10, and L11 and applied to power splitter U6. One 45.6 to 65 MHz lo output from power splitter U6 is routed to meter amplifier card A206 from where it is distributed to mixers in both the receiver rf section and transmitter section. The other power splitter U6 output is applied to amplifier Q4 through Q6 and amplified, then it is applied to power splitter U9. The 46.5 to 65 MHz output from power splitter U9 is mixed in mixer U7 with the 45 MHz ssb signal from output amplifiers Q2 through Q4 on afc and loop interface card A203. The resultant rf is then filtered by low pass filter C50 through C52, L16, and L17 (the filter passes the difference frequency). The difference frequency is then routed to amplifier Q7 and the output of amplifier Q7 is sent to analog voltage comparator U8 where the signal is converted to ttl rf square waves. This rf is then applied to÷10/÷11 prescaler on programmable counter card A205 to complete the p11. This cycle of correction will continue until phase-lock is achieved (i.e., the ÷N count signal is equal in frequency to the 10 kHz reference frequency).

e. *Frequency Display*. Display rf which is representative of the p11 frequency synthesizer tuned output is generated by circuitry in main loop card A204. The 45 MHz display offset from 45 Mhz filter C13 and L4 on afc and loop interface card A203 and the 46.5 to 65 MHz vco output from power splitter U9 on main loop card A204 are mixed together by mixer U10; the rf output of mixer U10 will always be at the frequency tuned. This rf is filtered by low pass filter C60 through C62, L20, and L21, routed to amplifier Q8 and then converted to ttl rf square waves by analog voltage comparator U11. Line driver U12 provides the required rf signal drive required by readout counter A3A2.

f. *Band Select Circuitry*.

(1) Up/down counter U1 through U4 on programmable counter card A205 is also used to generate band select logic for the receiver rf section and the transmitter section. The stored bed count in up/down counter U1 through U4 is converted to an equivalent decimal count by bed-to-decimal decoder U19 through U22. The decimal count is applied to band decoding logic U23 through U31 and it will enable the respective band line corresponding to the tuned frequency. The enable band line will then activate the corresponding band select logic line in latch and line drivers U32 through U34. The band select logic will then activate respective bandpass filters in the receiver rf section and transmitter section.

(2) Band decoding logic U23 through U31 on programmable counter card A205 also determines the upper and lower bandstops for tuning. When either the upper or lower bandstop limits are reached, an upper or lower bandstop signal will be routed to upper/lower bandstop logic U20-C on timing and reference card A201. The resultant bandstop inhibit will then inhibit the coarse tune and fine tune output gating circuits and prevent further tuning of the receiver until the tuning direction is reversed.

3-24. Afc Section (fig. FO-15)

Rf signals from either the transmitter or receiver are applied to attenuator and amplifier card A301. When in the receive mode and the zero beat function is selected, the frequency of 45 MHz from vcxo and mixer card A104 is applied to mixer U1 on attenuator and amplifier card A301. A local oscillator frequency of 66.4 MHz from oscillator and amplifier card A405 is also applied to mixer U1 through attenuator R27, R28, and R29. The difference frequency of 21.4 MHz is routed through the closed contacts of relay A301 K1 to second agc amplifier card A308. This signal is used as a tuning aid to zero beat the receiver to the victim signal.

a. When in the receive mode only, the 21.4 MHz if. signal from first age amplifier card A406 is applied thru the closed contacts of relay A301 K4 to the contacts of relay A301 K2. When in the transmit mode, output from mixer U1 is applied through the contacts of energized relay A301 K1, through attenuator R30, R31, and R32, through the contacts of energized relay A301 K4 to the contacts of relay A301 K2. The energizing of relays A301 K1 and A301 K4 is determined by a logic signal from switch Q2 on rt logic card A208 to relay driver Q1 which generates a relay drive signal to energize the relays.

b. The if. signal of 21.4 MHz (output of mixer U1), which is applied through contacts of relays A301 K2 and A301 K3, is normally applied directly to if. amplifiers Q4 thru Q6. If the amplitude of the received carrier is too great, the agc circuitry on sample and hold card A210 energizes relays A301 K2 and A301 K3 by means of a high range select signal to relay drivers Q2 and Q3. When the relays are energized 60 dB attenuator R10 thru R14 is inserted in series with the input to if. amplifiers Q4 thru Q6. Relays A301 K2 and A301 K3 are controlled by the receiver agc voltage from ssb and cw detector card A305. This agc voltage is applied to agc sample and hold U1 on sample and hold card A210. Sampled agc output is then applied to voltage comparator U2-B. Reference voltage source C5, C6, and R5 through R8 establishes the voltage level at which voltage comparator U2-B will be switched. The output of voltage comparator U2-B then gates relay drivers Q2 and Q3 on attenuator and amplifier card A301 and energizes relays S301 K2 and A301K3. The output from voltage comparator U2-B also provides gating for range indicator logic gate U3-A through U3-D and U11-D when the agc voltage is above a predetermined level. This condition changes the range of the meter circuitry on meter amplifier card A206 and is indicated when HIGH RANGE indicator A3DS1 lights.

c. Output from if. amplifiers Q4, Q5, Q6 on attenuator and amplifier card A301 is applied to 21.4 MHz crystal filter FL1 which has a bandwidth of 15 kHz; output from 21.4 MHz crystal filter FL1 is applied to log amplifiers U1 through U5 on log amplifier and detector card A304. The detected outputs from the amplifiers U1 through U5 are applied to amplifier U6 through summing amplifier Q1. Constant voltage source Q2, CR11, CR12, and R74 provides a stabilizing voltage for amplifier U6. The detected dc from amplifier U6 is applied to log amp sample and hold U8 and C25 on sample and hold card A210. The output is applied to meter amplifier U2 on meter amplifier card A206 through the contacts of relay A206K1. Relay A206K1 is controlled by relay driver U1-F which is gated by a signal from METER SELECTOR switch (P/O A3S3). The output from meter amplifier U2 is applied to METER SELECTOR meter A3M1 for display of the received signal level.

d. The 21.4 MHz rf output from log amplifiers U1 through U5 on log amplifier and detector card A304 is applied to amplifier Q1 and T1 on fm and afc detector card A303. The output is applied to either narrowband filter FL1 or 6 db attenuator R8, R12, and R13 (for wideband afc operation) through the contacts of relays A303K1 and A303K2. The logic signal from AFC switch (P/O A3S6) gates relay driver Q3 which, in turn, controls relays A303K1 and A303K2, switching in either narrowband filter FL1 or 6 dB attenuator R8, R12, and R13, as required. The output from the contacts of relay A303K2 is applied to amplifier U1 and T2. Output from amplifier U1 and T2 is applied to dc amplifier U2 through emitter follower Q2 and crystal discriminator FL2. Operation of dc amplifier U2 is stabilized by a reference voltage source.

e. One output from dc amplifier U2 is applied to rcv afc sample and hold U4 and C11 on sample and hold card A210. Output from rcv afc sample and hold U4 and C11 is routed to afc and loop interface card A203 to control the synthesizer vcxo in the receiver circuit. Rcv afc sample and hold U4 and C11 is gated by a rcv sample and hold delay signal from RT logic card A208 to provide afc operation during the receive mode and to lock the afc tuning voltage during the transmit mode.

f. The second output from dc amplifier U2 on fm and afc detector card A303 is applied to xmt afc sample and hold U6 and R43 on sample and hold card A210. This circuit is also gated by a xmt sample and hold delay signal from rf logic card A208. The output from xmt afc sample and hold U6 and R43 is routed to vcxo and mixer card A104 thru dc amplifier U5.

The output from dc amplifier U5 on sample and hold card A210 is also applied through the contacts of relay A206K4, on meter amplifier card A206 through meter amplifier U2 to METER SELECTOR meter A3M1 where the voltage displayed is the fm deviation of the modulation. Relay A206K4 is controlled by relay driver U1-A which is gated by a logic signal from METER SELECTOR switch (P/O A3S3).

g. The dscrm voltage output from dc amplifier U2 on fm and afc detector card A303 is also applied to dual differential comparator U10-A and U10-B on sample and hold card A210. The tune lower output signal is applied to amplifier U11-A and the output of amplifier U11-A is applied to TUNE LOWER indicator A3DS3. The tune higher output signal from dual differential comparator U10-A and U10-B is applied to amplifier U11-B and then to TUNE HIGHER indicator A3DS2. This circuit lights the appropriate indicator if the received frequency is too high or too low. Logic inputs from AFC switch (P/O A3S6) and gate/inverter U1-C, U2-A, U2-B, and U3-C on detection logic card A207 (controlled by receive mode selector switch A3S5), are applied to gate U9-B to provide an afc signal to amplifier U11-C. The output from amplifier U11-C lights AFC TRACK indicator A3DS4. Gate U9-B also provides an afc signal to timing and reference card A201 and to afc and loop interface card A203.

3-25. Power Supply Section (fig. FO-16)

a. *Voltage Conversion*. Power of 120 vac, 400 Hz, 1∅ is applied to transformer T1 through POWER ON circuit breaker A3CB1. Transformer T1 steps the voltage down to the ac voltages required by the three bridge rectifier circuits. Blower B1 is also energized by the 120 vac, 400 Hz, 1 ∅ power.

b. -24 Volt Regulated Supply.

(1) Power of 24 vac, 400 Hz 1∅ is applied to bridge rectifier CR1 and filter C1 (on heat sink A2) which provides -24 vdc unregulated output to voltage regulator Q1. The output from Q1 is applied to voltage regulator U2, Q6, and VR2 on regulator card Al. Voltage regulator U2, Q6 and VR2 develops a control voltage at the amplitude and polarity required to oppose the voltage change sensed at the output of Q1. This control voltage is applied to the base of Q1 and adjusts the voltage drop across Q1 from the power supply to the load.

(2) Temperature sensing thermal cutoff switch A3Sl activates when active elements of heat sink A2 overheat. The base voltage is removed from thermal switch Q7 by thermal cutoff voltage from thermal cutoff switch A251. This enables voltage regulator U2, Q6, and VR2 to turn off current regulator Q1.

c. Rt Unit Front Panel Lighting. Power of +28 vdc is used for front panel lighting. The +28 vdc is routed through DIMMER potentiometer R1 on front panel assembly A3 to dimmer transistor Q3 on heat sink A2. DIMMER potentiometer R1 applies a dimmer base control voltage to filterboard resistor R7. The dimmer base control varies the conductivity of dimmer transistor Q3 in order to control the current through the edge lit panel lighting circuit.

d. +5 Vdc Regulated Supply. Power of 24 vac, 400 Hz, 1 ∅ is applied through transformer T1 to bridge rectifier CR2 and filter C2 and C3 on heat sink A2. The +5 vdc unregulated output is applied to voltage regulator Q2. The output of regulator Q2 is applied to voltage regulator U3 on regulator card Al. Voltage regulator U3 develops a control voltage of the amplitude and polarity required to counteract the voltage change sensed at the output regulator Q2. This control voltage is applied to the base of regulator Q2 to maintain a constant voltage to the load.

e. +24 Vdc Regulated Supply. Power of 24 vac, 400 Hz 1∅ is applied to bridge rectifier CR1 and filter C1, C2, and C3 on heat sink A3. The +24 vdc unregulated output is applied to voltage regulator Q1. The output from regulator Q1 is applied to voltage regulator U1, Q1 through Q4, and VR1 on regulator card Al. Voltage regulator U1, Q1 through Q4, and VR1 develops a control voltage at the amplitude and polarity required to oppose the voltage change sensed at the output of regulator Q1. This control voltage is applied to Q1 to regulate the output voltage to the load. Temperature sensing thermal cutoff switch A3S1 activates when active elements of heat sink A3 overheat. The base voltage is removed from thermal switch Q5 by thermal cutoff voltage from thermal cutoff switch A3S1. This enables voltage regulator U1, Q1 through Q4, and VR1 to turn off current regulator Q1.

f. Ft Unit Readout. Normally closed contacts of relay K1 on regulator card Al to supply +5 vdc to rt readout counter A3A2. The lamp interrupt circuit on control panel 1A2 provides a -24 vdc voltage to the base of transistor Q1 on regulator card Al, turning it on. Relay K1 is energized, the relay contacts open, and + 5 vdc is removed from readout counter A3A2.

g. +12 Vdc Regulated Supply. Regulated +24 vdc from regulator Q1 on heat sink A3 is applies to voltage regulator Q2. Voltage regulator Q2 develops a sense voltage which acts to oppose any voltage change in the +12 vdc output.

CHAPTER 4

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

4-1. Scope of Direct Support Maintenance

The maintenance duties assigned to direct support (ds) maintenance personnel for the AN/TLQ-15 are listed below together with a reference to the section in this chapter concerning the specific maintenance function.

a. Direct support system troubleshooting (sec. III).
b. Direct support rt unit troubleshooting (sec. IV).
c. Adjustments (sec. V).
d. Removal and replacement (sec. VI).
e. Direct support testing (sec. VII).

4-2. Voltage and Resistance (V/R) Measurements

Voltage and resistance measurements are provided for those assemblies which are not readily replaceable. These measurements are used to locate a defective circuit component. All V/R measurements should be taken using Digital Voltmeter AN/GSM64. Before making the required resistance measurements, ensure that all power has been removed from equipment under test. Begin all voltage measurements using highest range indicated unless otherwise specified. Do not short-circuit any transistor leads to ground. Short circuits of any kind will damage a transistor. Be extremely careful to avoid these shorts. Use the following V/R charts in conjunction with schematic diagrams (fig. FO-19, FO-20 and FO-28) to localize the trouble to a defective component on the applicable assemblies.

a. Lamp Interrupt Card (1A2A4) Voltage Measurements.

Conditions

Voltage measurements taken with AN/TLQ-15 in operational mode and shelter doors closed. All voltage readings are measured to ground; tolerance is ±1 vdc.

Measurements

	Test point	*Voltage reading*
1.	E 3 (Q1 emitter)	+26 vdc
2.	Junction of Q1 base and R3	+25 vdc
3.	E1 (Q1 collector)	+26 vdc

b. Keying and Audio Card (1A2A5) Voltage

Condition

Voltage measurements taken with AN/TLQ-15 in operational mode Rt unit MODULATION switch set to FSK and TRANSMIT MODE switch to CONT. All voltage readings are measured to ground; tolerance is ±1 vdc.

	Test point	*Voltage reading*
1.	Transistor Q1	
	(a) Emitter-junction of Q1 emitter and Q2 base	+25.5 vdc
	(b) Base-junction of Q1 base and CR1 anode	+26 vdc
	(c) Collector-junction of Q1 collector and CR2 anode	+26 vdc
2.	Transistor Q2	
	(a) Emitter-E3	+25 vdc
	(b) Base-junction of Q1 emitter and Q2 base	+25.5 vdc
	(c) Collector-junction of Q2 collector and CR2 anode	+26 vdc

c. lpa Tube (1A3A1V1) V/R Measurements.

	Test point	*Voltage reading*	*Resistance reading*	*Conditions*
1.	Socket A1XV1, pin 5 (grid 1)	-50 vdc	20 K ohms	Voltage measurements taken with rf ex-
2.	Socket A1XV1, pin 2 (grid 2)	+250(±12) vdc	Infinity	citation removed Turn dc operating
3.	Socket A1XV1, across pins 3 and 4 (filaments)	6.3 vac	0	voltage off before connecting voltmeter to test point. Resistances are measured with
4.	Socket A1XV1, pin 3 to ground (cathode)	0	0	negative (-) lead to ground: all cables removed from rfa and tube installed.
5.	A1E6 (plate)	+670(±20) vdc	27 K ohms	Voltage reading for grid 1 (test point 1) is approximate and will depend on setting of bias adjustment R2

d. Fpa Tube (1A3V1) V/R Measurements.

	Test point	*Voltage reading*	*Resistance reading*	*Conditions*
1.	A1A1E10 (grid 1)	--115 vdc	27 K ohms	To make voltage measurements perform the following:
2.	Junction of R5 and V1 grid 2.	+ 600(±30)vdc	Infinity	1. Set control unit HIGH VOLTAGE switch to off (white) and BATTLE SHORT switch to on (up).
3.	Junction of L1 and C24 (plate)	+ 3500(±105)vdc	Infinity	2. Slide rfa out of rack and defeat rack interlock.
4.	Across transformer T2, pins 7 and 5 (filaments).	10 vac	0	3. Remove rfa side panel(s) as required and connect voltmeter to test point.
5.	Transformer T2, pin 7 and ground (Cathode)	+ 10 vdc	0	4. Replace rfa side panel being careful not to damage test leads.
				5. Set control unit BATTLE SHORT switch to off (down) and HIGH VOLTAGE switch to on (yellow).
				6. Repeat steps 1 thru 5 for each test point voltage measurement.
				Resistances are measured with negative (-) lead to ground; all cables removed from rfa and tube installed. Voltage reading for grid 1 (test point 1) is approximate and will depend on setting of bias adjustment R1.

e. Switch/Delay/Monitor Card (1A13A1) Voltage Measurements.

	Test point	*Voltage reading*	*Conditions*
1.	Transistor Q1		1. Conditions for Q1 voltage measurements:
	(a) Emitter-E4	+ 26 vdc	(a) Remote telephone junction box switch set to XMTR and telephone lines connected to shelter.
	(b) Base-junction of C2 and R2	0	(b) Control unit REMOTE XMTR switch to on (green).
	(c) Collector-junction of C2 and R1	+ 25.5 vdc	(c) AN/TLQ-15 in operational mode.
2.	Transistor Q2		2. AN/TLQ-15 in normal operational mode for Q2 and Q3 voltage measurements.
	(a) Emitter-junction of Q2 emitter and Q3 base.	+ 23.5 vdc	3. All voltage readings are measured to ground; tolerance is ± 1 vdc.
	(b) Base-junction of C3 and R7	+ 24 vdc	
	(c) Collector-anode of CR6	+ 24 vdc	
3.	Transistor Q3		
	(a) Emitter-junction of Q3 emitter and Q4 base.	+ 23 vdc	
	(b) Base-junction of Q2 emitter and Q3 base.	+ 23.5 vdc	
	(c) Collector-anode of CR6	+ 24 vdc	
4.	Transistor Q4		
	(a) Emitter--E17	+ 22.5 vdc	
	(b) Base-junction of Q3 emitter and Q4 base.	+ 23 vdc	
	(c) Collector-anode of CR6.	+ 24 vdc	

Section II. TOOLS AND EQUIPMENT

4-3. Tools, Test Equipment and Materials Required

a. The tools, test equipment and materials required for direct support maintenance are listed in the maintenance allocation chart (app B) and the repair parts and special tools list (TM 11-5895-372-24P).

b. An extender board, 1A2A2A5, is supplied with the control unit for use in performing test measurements on circuit cards. The extender board is located in card slot A5 of card rack assembly 1A2A2; refer to TM 11-5895-372-24P for location.

4-4. Description of Special Test Equipment

The special test equipment necessary to maintain the AN/TLQ-15 is Impedance Matching Network CU-2193/TLQ-15. Countermeasures Set Test Kit MK-1809/TLQ-15, and the AN/TLQ-15 extender cable set.

a. *Impedance Matching Network CU-2193/TLQ-15*. The CU-2193/TLQ-15 is used to test and troubleshoot the transmitting functions of the AN/TLQ-15 without actually radiating rf. The CU-2193/TLQ-15 accomplishes this by matching the varying output impedance of the hard mounted coupler to the fixed impedance of the 30 dB attenuator which dissipates the rf power. The items listed below comprise the CU-2193/TLQ-15 and also includes the common name and use of each item. Figures 4-1 through 4-3 illustrate the impedance matching network.

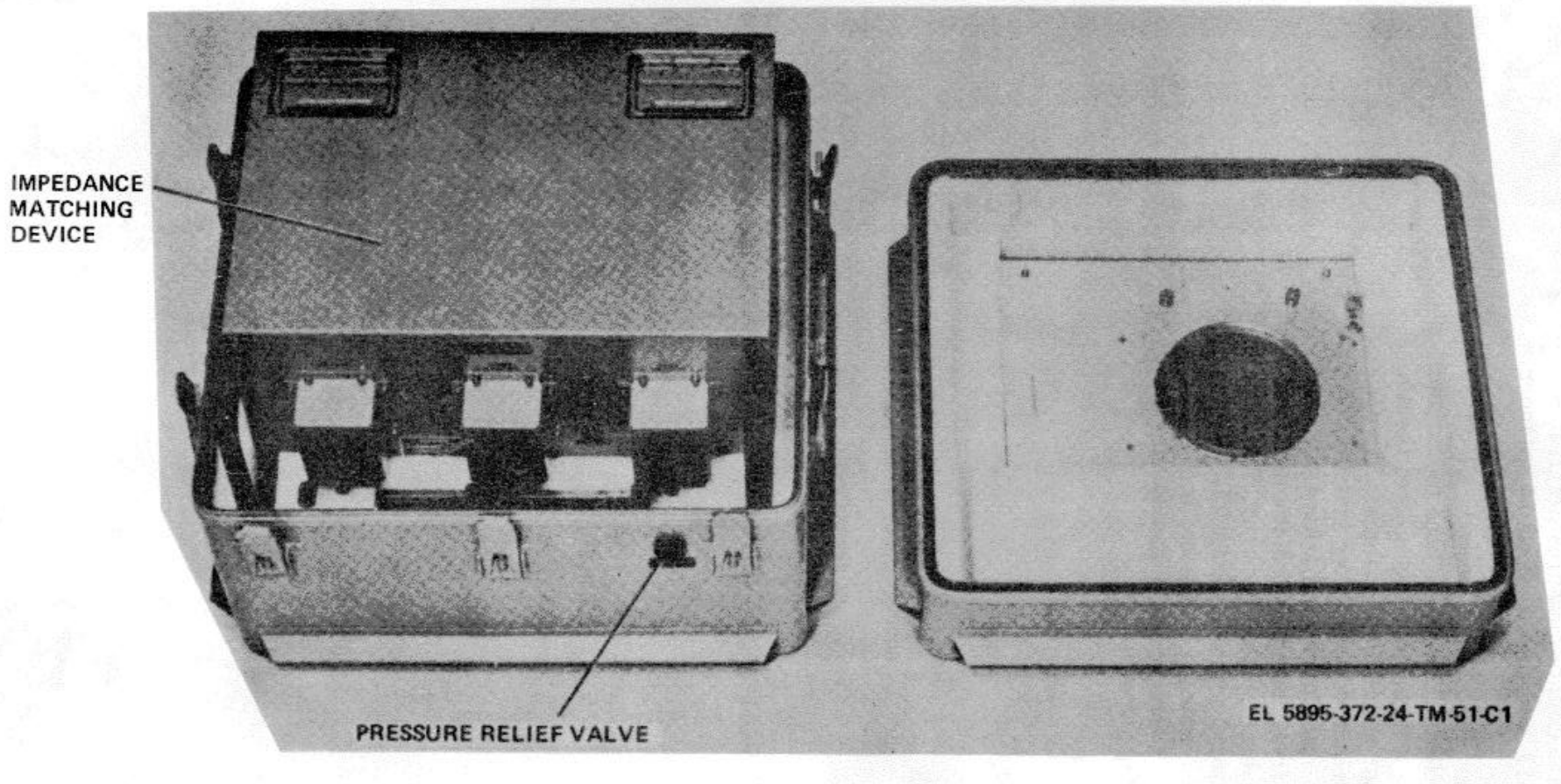


Figure 4-1. Impedance matching network, cover removed.

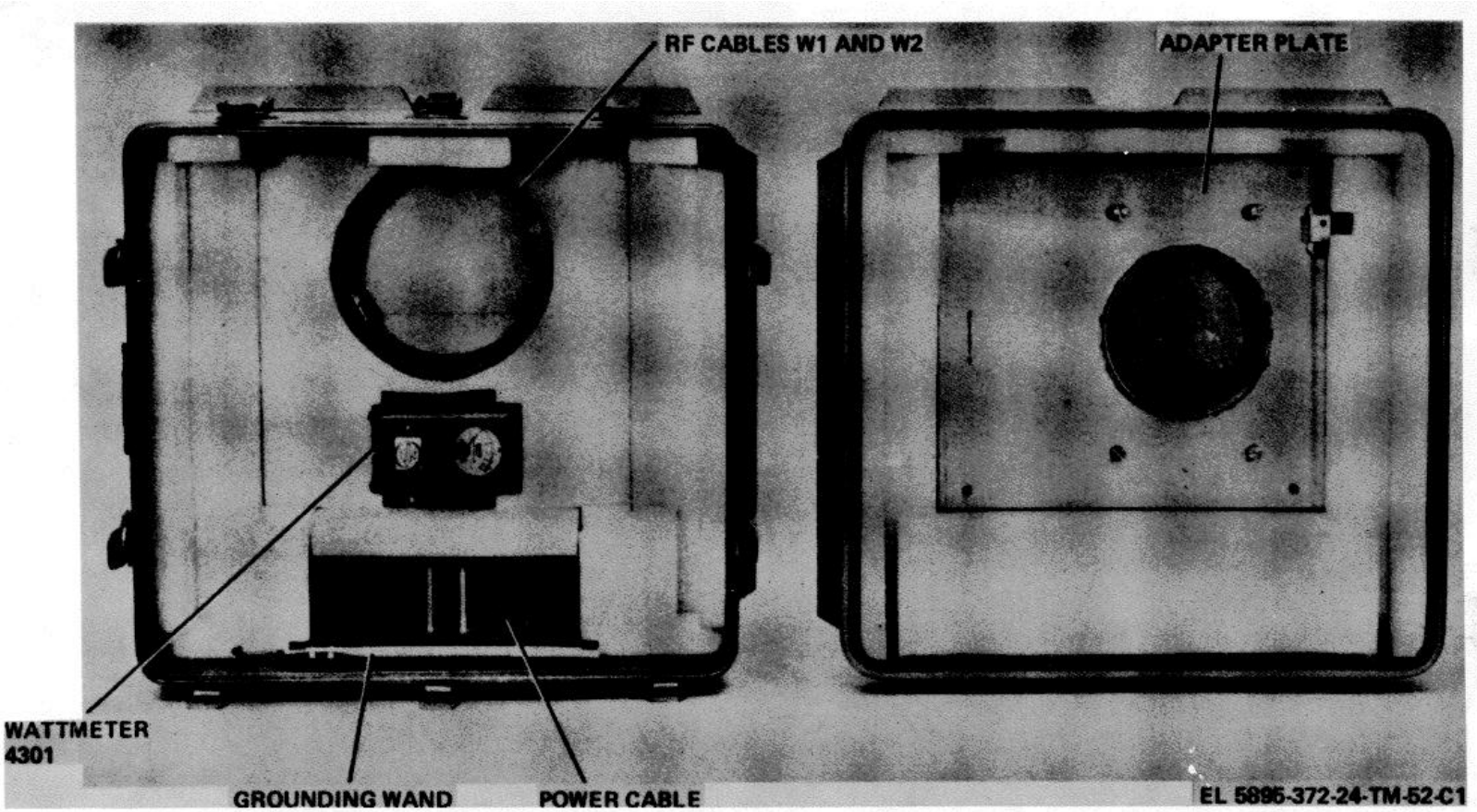


Figure 4-2. Impedance matching network, item storage locations.

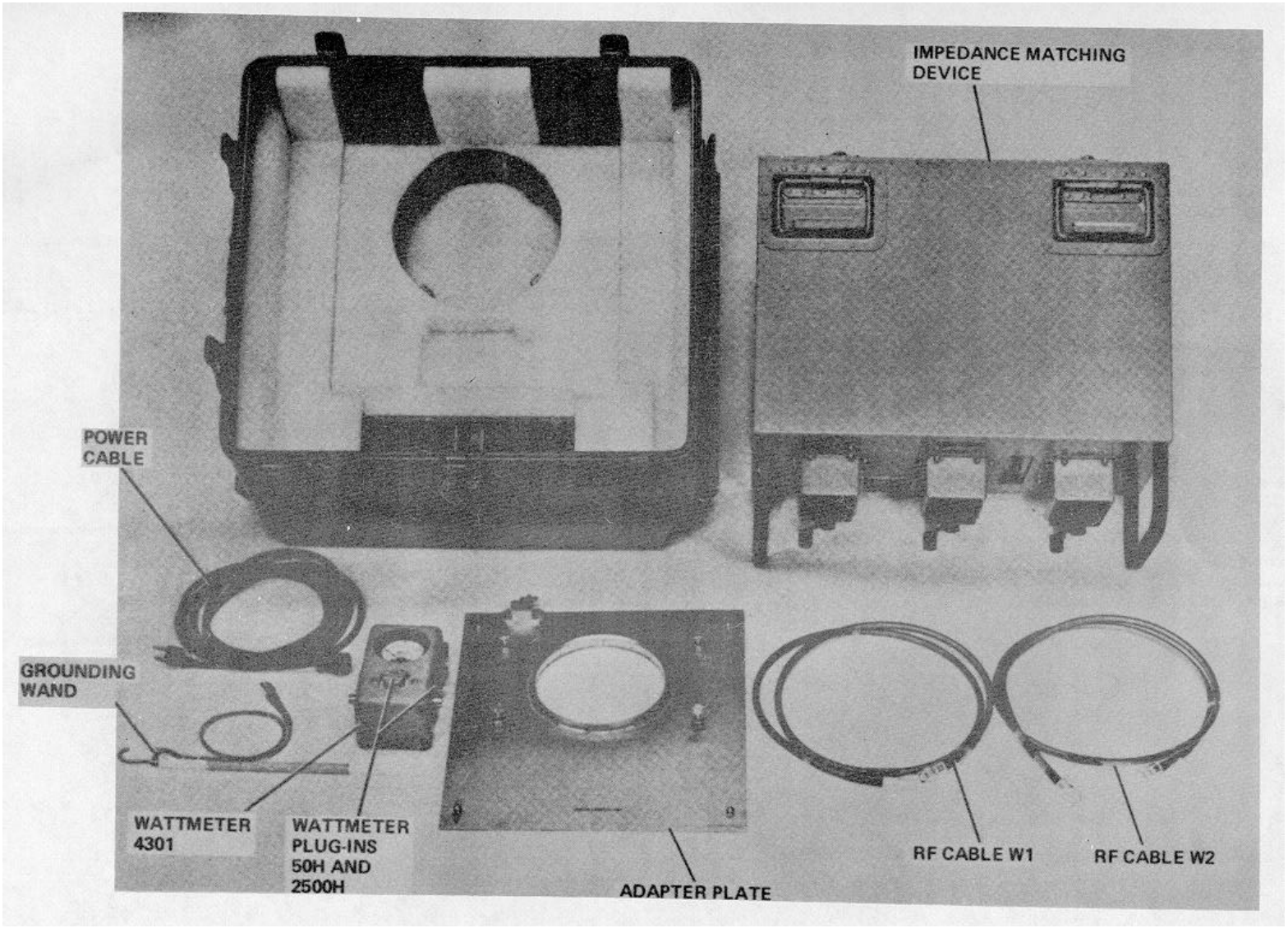


Figure 4-3. Impedance matching network, items displayed.

Item	*Common Name*	*Use*
Impedance Matching Network CU-2193/TLQ-15	Impedance matching network	
1. Impedance Matching Device	Impedance matching device	Permits testing and trouble-shooting of normal transmitting functions of the AN/TLQ-15 without actually radiating rf.
2. Adapter Plate	Adapter plate	Permits connection of impedance matching device to hard mounted coupler.
3. Rf Cable Assembly 3253880-501	Rf cable W1	Provides rf connection for system testing.
4. Rf Cable Assembly 3253880-502	Rf cable W2	Provides rf correction for system testing.
5. Electrical Cable Assembly 3253890-501	Power cable	Permits connection of AC power to impedance matching device.
Item	*Common Name*	*Use*
6. Grounding Wand	Grounding wand	Permits discharging of residual high voltages in impedance matching device and hard mounted coupler.
7. Power Meter 4301	Wattmeter 4301	Permits measurement of rf power during system testing.
8. Power Meter Plug-in 2500H	Wattmeter plug-in 2500H	Provides 2500 watt full scale operation of wattmeter 4301
9. Power Meter Plug-in 50H	Wattmeter plug-in 50H	Provides 50 watt full scale operation of wattmeter 4301.

b. Countermeasures Set Test Kit MK-1809/TLQ-15. The MK-1809/TLQ-15 is a group of special test equipment used to facilitate maintenance on the AN/TLQ-15; the major items in the group are illustrated in figures 4-4 through 4-6. The following lists all items comprising the MK-1809/TLQ-15 and also includes the common name and use of each item.

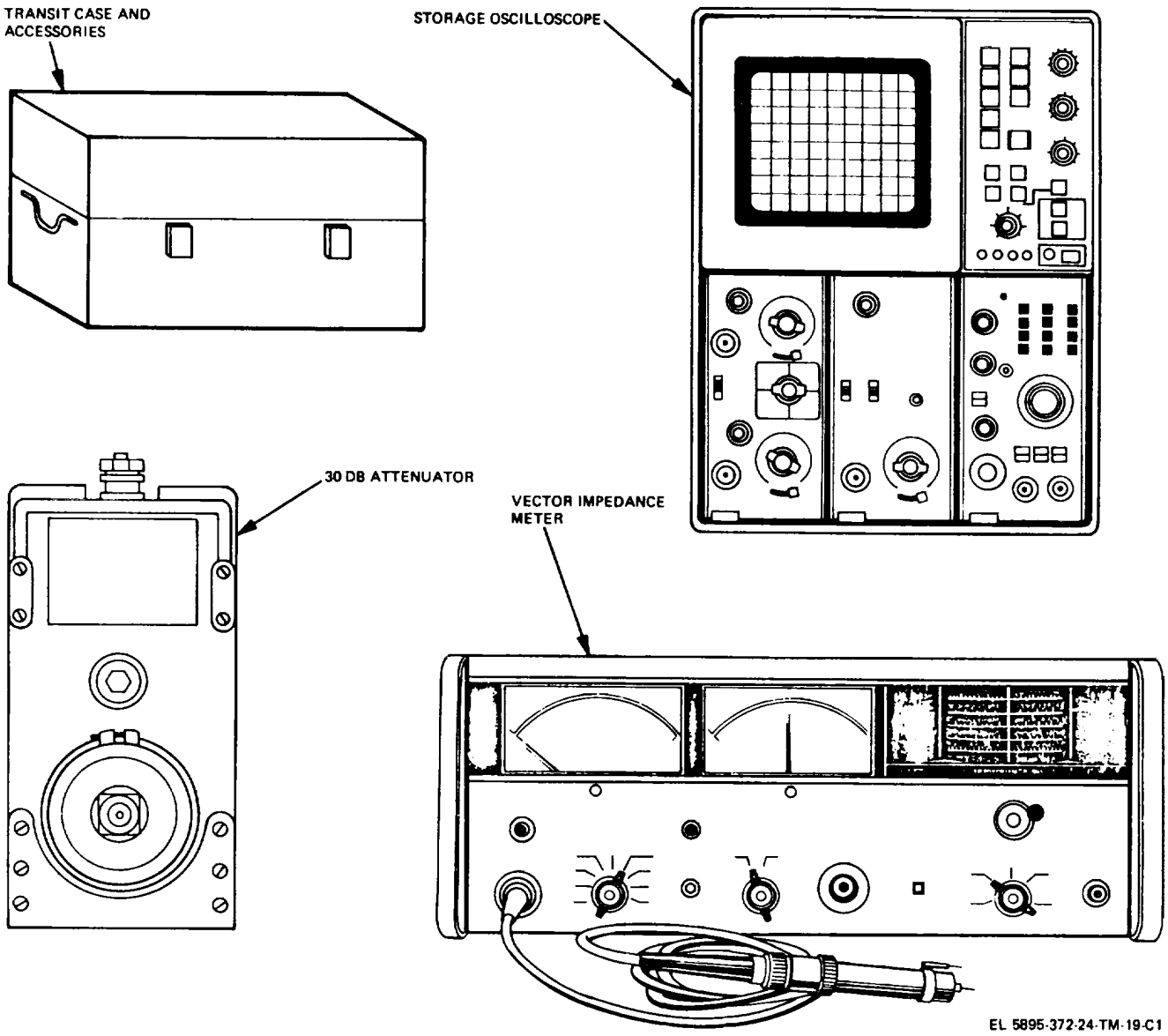


Figure 4-4. Countermeasures Set Test Kit MK-1809/TLQ-15, major items.
EL 5895-372-24-TM-19-C1

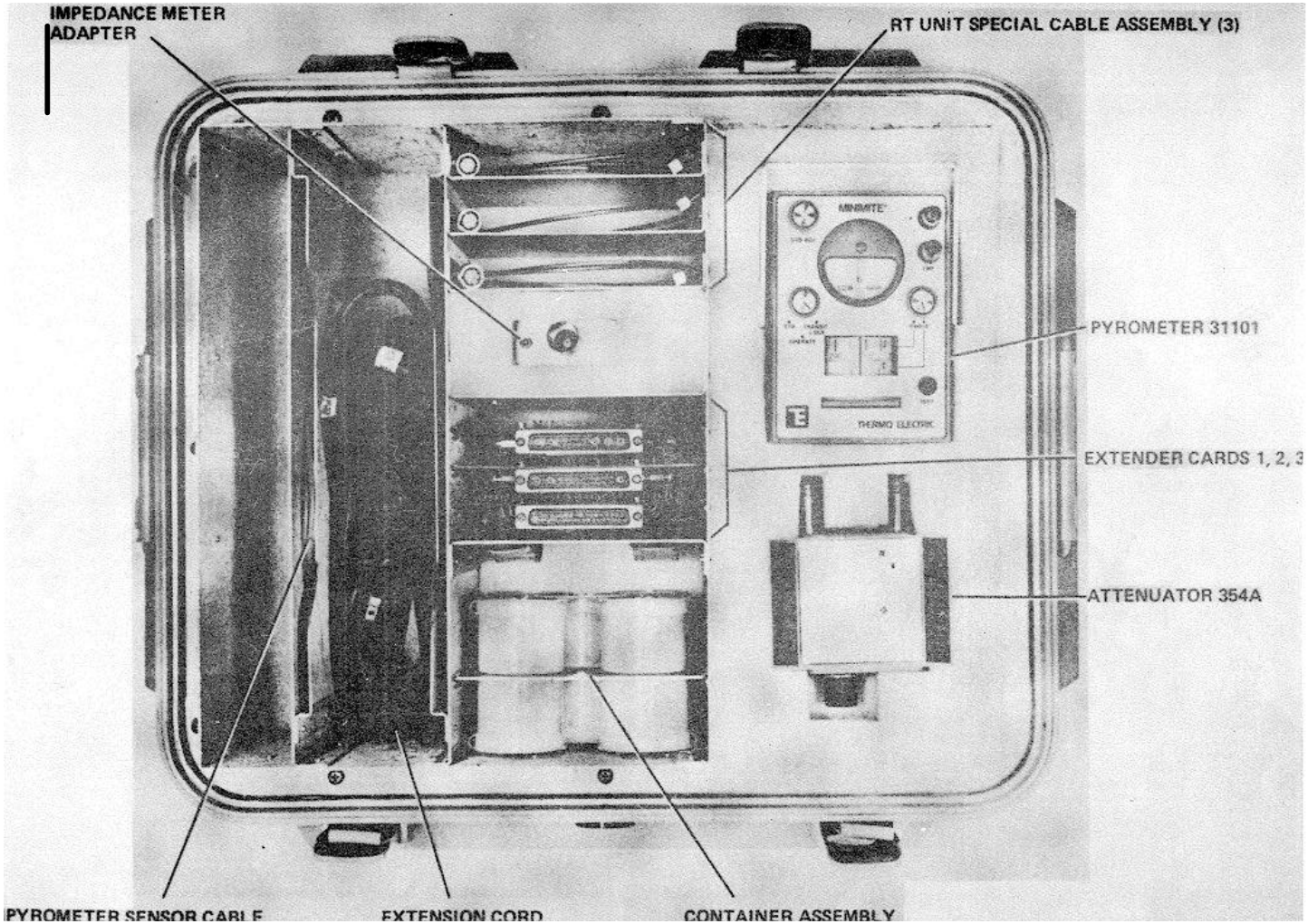


Figure 4-5. Transit case and accessories, items storage locations.

EL 5895-372-24-TM-20-C1

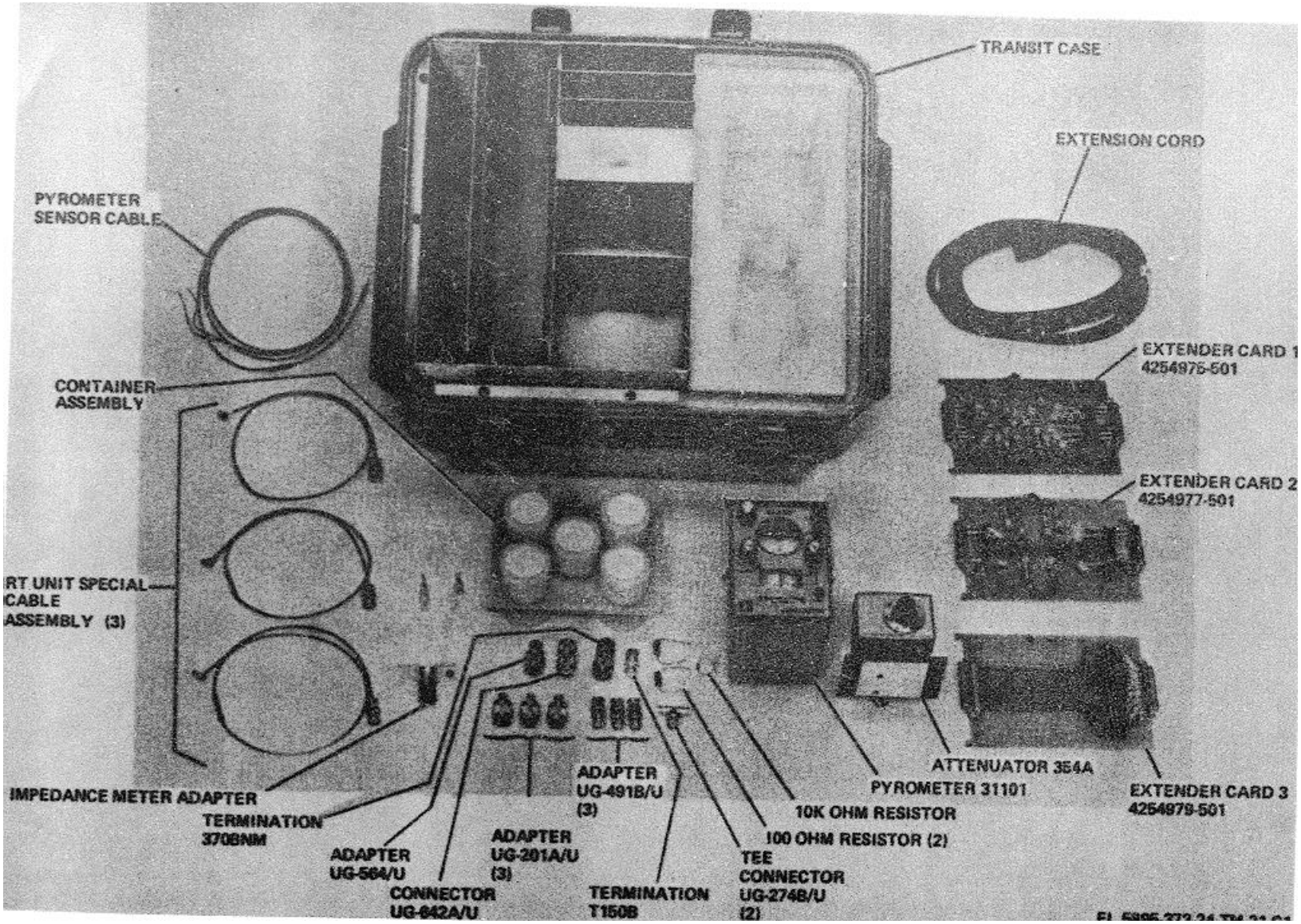


Figure 4-6. Transit case and accessories, items displayed.

Item	*Common Name*	*Use*
Countermeasures Set Test Kit MK-1809/TLQ-15	Test kit	
1. Transit Case and Accessories		
a. Adapter UG-491B/U	Adapter UG-491B/U	Provides male BNC to male BNC connection.
b. Adapter UG-642A/U	Adapter UG-642A/U	Provides male C to male C connection.
c Adapter UG-201A/U	Adapter UG-201A/U	Provides male N to female BNC connection.
d. Adapter UG-64/U	Adapter UG-564/U	Provides male N to female C connection.
e Attenuator 354A	Attenuator 354A	Provides variable attenuation.
f. Rf Cable Assembly, 3253766-501	Rt unit special assembly	Interconnects rt unit extender cards to test equipment.

Item	*Common Name*	*Use*
g. Thermocouple Cable Assembly, 8268898-501	Pyrometer sensor cable	Provides temperature sensing input to pyrometer.
h. Circuit Card Assy. 4254975-501	Extender card 1	Extends rt unit circuit card assemblies A101 through A106, A204, A301 through A808 and A401 through A407.
I. Circuit Card Assy. 4254977-501	Extender card 2	Extends rt unit circuit card assemblies A201, A202, A208, A205 and A206.
j. Circuit Card Assy. 4254979-501	Extender card 8	Extends rt unit circuit card assemblies A207 through A218.
k. Electrical plug Connector UG-274B/U	Tee connector UG-274B/U	Provides BNC tee connection.
l. Electrical Power Cable 17460	Extension cord	Extends ace power cables.
m. Impedance Test Probe Coupler	Impendance meter adapter	Permits connection of vector impedance meter to soft mounted coupler tuning capacitors.
n. Indicating Pyrometer 81101	Pyrometer	Permits measurement of AN/ TLQ-15 operating temperatures.
o. 10 k ohm Resistor 3/4 watt	10 k ohm resistor	Permits adjustment of reflectometer assembly.
p. 100 ohm Resistor 1 watt	100 ohm resistor	Simulates resistance of 1 mile long telephone lines.
q. Dummy Load T150B	Termination T15OB	Provides 60 ohm impedance for BNC termination.
r. Dummy Load 870 BNM	Termination 870 BNM	Provides 50 ohm termination impedance for 80 dB attenuator.
s. Transit Case	Transit case	Provides storage for accessories.

	Item	*Common Name*	*Use*
2.	Storage Oscilloscope 7623A including the following:	Storage oscilloscope	Permits adjustment of AN/TLQ-15 timing.
	(a) Vertical amplifier Plug-in 7A15A (2 required)	Vertical amplifier	
	(b) Dual Time Base Plug-in 7B53A	Dual time base plug-in	
	(c) X10 probe P6008	X10 probe	
3.	Rf Vector Impedance Meter HP-4815A with Probe Accessory Kit	Vector impedance meter	Permits adjustment of variable capacitors in soft mounted coupler.
4.	Fixed Attenuator, 3451286	30 dB attenuator	Permits measurement of AN/TLQ15 output rf power.

C. Extender Cable Set The extender cable set, which is furnished as unit 3 of the AN/TLQ-15, is used whenever more accessibility to unit components is deemed necessary by maintenance personnel for troubleshooting purposes. Seventeen extender cables are provided to interconnect applicable AN/TLQ-15 units back into the main system cabling harness. Interconnection data for each cable is listed below.

Cable ref. des.	*From*	*To*
3W1	1A12A4W1P1	1A2J1
3W2	1A12A4W1P2	1A2J2
3W3	1A12A4W1P3	1A2J3
3W4	1A12A4W1P4	1A2T4
3W5	1A12A4W1P5	1A17J1
3W6	1A12A4W1P6	1A16J7
3W7	1A12A4W1P7	1A4J4
3W8	1A12A4W1P8	1A4J1
3W9	1A12A4W1P9	1A9J11
3W10	1A12A4W1P10	1A9J12
3W11	1A12A4W1P11	1A6J1
3W12	1A12A4W1P12	1A3FL2
3W13	1A12A4W1P13	1A3FL1
3W14	1A12A4W1P14	1A3J5
3W15	1A12A4W1P15	1A5J2
3W18	1A12A4W1P18	1A7J1
3W20	1A12A4W1P20	1A7J10
3W24 thru 3W30	Rf cables 3W24 through 3W30 are RG-55B/U cable with BNC connectors and are used with the following units: Control unit 1A2 Rt unit 1A4 Digital counter 1A9 Modulation source 1A16 Pan indicator 1A17 Rf panel 1A23	
3W31	1A12A4A1W3P1	1A6J16
	1A12A4A1W3P2	1A3J1
3W32	1A12A4A1W4P1	1A3J2
	1A12A4A1W4P2	1A7J4
3W33	1A12A4A1W5P1	1A3J3

Section III. DIRECT SUPPORT SYSTEM TROUBLESHOOTING

4-5. General

a. The troubleshooting procedures given in this section enable maintenance personnel to localize a fault within the AN/TLQ-15 to an easily replaceable item (eri), except for the rt unit. Rt unit troubleshooting to an eri is given in section IV. The first step in troubleshooting the AN/TLQ-15 is visual inspection of controls, indicators and meters, The purpose of visual inspection is to locate faults without testing or measuring parameters. The second step is to perform applicable tests to aid in determining the exact nature of the fault.

b. Troubleshooting in this section is arranged in functional groups. A trouble sectionalization procedure is provided for each functional group. These procedures utilize test point measurements or visual observations in a logical sequence for systematic troubleshooting of a functional group. The Trouble symptom column lists the abnormal indication possibly observed. The Check, Probable trouble, and Corrective measures columns list the procedures to be performed and the malfunctioning item if checks indicate abnormal readings.

4-6. Primary Power Troubleshooting

a. Test Equipment Required. Multimeter AN/USM-223 is required for primary power troubleshooting.

b. Connections and Conditions. None required.

c. Primary Power Troubleshooting Procedure.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Generator will not start in remote mode.	Start generator in local mode	a. GENERATOR 2A2. b. If check is normal, remote start circuit is faulty.	a. Refer to TM 5115-615. b. Refer to TM 5-5115-365-15 and figure FO-28.
2	Primary voltage missing or incorrect on control unit, VOLTAGE MONITOR meter.	120 vac ±10% between L1 and L0, L2 and L0, and L3 and L0 on generator.	GENERATOR 2A2	Refer to TM 5-61116-6-15.
		120 vc ±10% between J1-E and -D, J1-B and -D, and J1-C and -D on power distribution box.	MAIN POWER CABLE ASSEMBLY 2A12	Make cable continuity measurements. Replace defective cable.
		120 vac ±10% between TB15-1 and -7, TB 15-2 and -7, and TB15-3 and -7 on power distribution box.	a. POWER DISTRIBUTION BOX 1A13. (1) Meter monitor circuits (PO/A1).	lsolate and replace defective component. Refer to figure FO-28.
			b. If check is normal, VOLTAGE MONITOR meter A1M3 or switch S7 defective on control unit	b. Isolate and replace defective component Refer to figure FO-19.
3	Generator frequency incorrect.	400 (±25) Hs on generator frequency meter.	GENERATOR 2A2. a. Refer to TM 5-64115-36-15.	Refer to TM 5-6115-365-15.
4	Generator phase rotation out of sequence.	120 vac ±10% between L1 and L0, L2 and L0, and L3 and L0 on generator 400 (±25) Hz on generator frequency meter.	a. GENERATOR 2A2. b. If check is normal power lines are reversed.	b. Reverse generator 01 and 03 power line
5	Blower B1 is inoperative.	Set MAIN circuit breaker on POWER DISTRIBUTION BOX 1A13 to the off position (pull out). Disconnect wire attached to top terminal on blower B1. Connect ohmeter between top terminal of terminal board on blower B1 and two remaining terminal of blower B1 in turn. Both measurements should indicate approximately 260 ohms	a. Blower B1 is defective Replace blower B1.	
			b. If check is normal capacitor C1 is defective.	Replace capacitor C1.

4-7. Interlocks Troubleshooting

a. Test Equipment Required. Multimeter AN/USM-223 is required for interlocks trouble-shooting.

b. Connections and Conditions. MAIN circuit breaker on and RESET switch pressed.

c. Interlocks Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	VOLTAGE PHASE FREQ and STANDBY indicators on control unit do not light.	VOLTAGE PHASE FREQ and STANDBY lamps on control unit.	VOLTAGE PHASE FREQ and STANDBY lamps defective.	Replace defective lamps.
		120 vac ±10% between terminals 1 and 2 of auxiliary 24 vdc power supply PS1 in power distribution box 1A13.	a. If check is normal, auxiliary 24 vdc power supply PS1 is defective.	*a*. Replace power supply.
			b. If check is abnormal: (1) PRIMARY POWER.	*b*(1) Refer to paragraph 4-6*c*, item 2.
			(2) Power monitor 1A13A2 is defective.	*b*(2) One at a time, replace following circuit cards of power monitor 1A13A2: *(a)* Frequency sensor A1. Power and phase sensor A2. *(c)* Voltage sensor A3. If circuit card replacement does not correct problem, replace entire power monitor.
1.1	VOLTAGE MONITOR meter does not indicate in green area when VOLTAGE MONITOR switch is set to VO 1, V0 2, and VO 3 positions.	Relay 1A13K1.	Relay 1A13K1 defective.	Replace relay 1A13K1.
2	a. EQUIP AIR indicator on control unit does not light; exhaust assembly fans are inoperative.	120 vac ±10% between TB8-4 and 2, TB8-6 and 2 on power distribution box.	POWER DISTRIBUTION BOX 1A13. a. 30 BLOWERS circuit breaker CB4. *b*. Relay K2. *c*. Blower delay circuit Q2 thru Q4. (P/O A1 assembly).	Check to see that STANDBY switch on control unit is set to on. Make voltage measurements to isolate defective component. Refer to paragraph 4-2e and fig. FO-28.
		0 vdc between TB1-5 and exhaust assembly.	EXHAUST ASSEMBLY 1A20. *a.* Fan B1 orB2. *b.* Air interlock switch S2 or S3.	Check to see that fans are running and that air interlock switches are closed. Make switch continuity measurements. Replace defective component.
	b. EQUIP AIR indicator on control unit does not light; exhaust assembly fans are operative.	+ 28 (±3) vdc between TP4 and A2XA2P1-4 on control unit.	Refer to figure FO-32. CONTROL UNIT 1A2. *a.* Diode card A2A2. *b*. EQUIP AIR indicator.	Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
3	RFA RACK indicator on control unit does not light.	+ 28 (±3) vdc between TP4 and A2XA2P1-5 on control unit.	*a*. Rfa rack interlock switch 1A11S5 defective.	*a.* Check to see that rfa is properly installed in equipment rack. Replace defective interlock switch.
			b. If check is normal, CONTROL UNIT 1A2 defective. (1) Diode card A2A2. (2) RFA RACK indicator.	*b*. Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
4	LV PWR SUP RACK indica-	+ 28 (±3) vdc between TP4	*a*. Lvps rack interlock	*a.* Check to see that lvps is

c. Interlocks Troubleshooting Procedures.-(continued)

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
	tor on control unit does not light.	and A2XA2P1-8 on control unit.	switch 1A11S2 defective.	properly installed in equipment rack. Replace defective interlock switch.
			b. If check is normal CONTROL UNIT 1A2 defective. (1) Diode card A2A2. (2) LV PWR SUP RACK indicator.	*b*. Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
5	HV PWR SUP RACK indicator on control unit does not light.	+ 28 (±3) vdc between TP4 and A2XA2P1-9 on control unit.	*a*. Hvps rack interlock switch 1A 1S1 defective.	*a*. heck to see that hvps is properly installed in equipment rack. Replace defective interlock switch.
			b. If check is normal, CONTROL UNIT 1A2 defective. (1) Diode card A2A2. (2) HV PWR SUP RACK indicator.	*b*. Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
6	ANT. COUPLER RACK indicator on control unit does not light.	+ 28 (±3) vdc between TP4 and A2XA2P1-12 on control unit.	*a*. Soft-mounted coupler rack interlock switch 1A11S3 defective.	*a*. Check to see that soft-mounted coupler is properly installed in equipment rack. Replace defective interlock switch.
			b. If check is normal, CONTROL UNIT 1A2 defective. (1) Diode card A2A2. (2) ANT. COUPLER RACK indicator.	*b*. Isolate and replace defective card on indicator lamp. Refer to figure FO-19.
7	CONTROL UNIT RACK indicator on control unit does not light.	+ 28 (±3) vdc between TP4 and A2XA2P1-13 on control unit.	*a*. Control unit rack interlock switch 1A1S4 defective.	*a*. Check to see that control unit is properly installed in equipment rack. Replace defective interlock switch.
			b. If check is normal CONTROL UNIT 1A2 defective. (1) Diode card A2A2. (2) CONTROL UNIT RACK indicator.	*b*. Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
8	RFA AIR indicator on control unit does not light.	+ 28 (±-3) vdc between TP4 and A2XA2P1-16 on control unit.	*a*. RFA 1A3. (a) Left or right access panel not securely fastened. (2) Air interlock switch S3. (3) Fan B3. (3) Fan B3. (4) Filter FL1.	*a*. Isolate and replace defective component. Refer to figure FO-20.
			b. If check is normal, fault in CONTROL UNIT 1A2. (1) Diode card A2A2. (2) RFA AIR indicator.	*b*. Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
9	HV PWR SUP AIR indicator on control unit does not light.	+ 28 (±3) vdc between TP4 and A2XA2P1-18 on control unit.	*a*. HVPS 1A7. (1) Circuit breaker CB3 off. (2) Air interlock switch S1.	*a*. Isolate and replace defective component. Refer to figure FO-26.

c. Interlocks Troubleshooting Procedures.-(continued)

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
			(3) Fan B1. (4) Capacitor C10. *b*. If check is normal, fault in CONTROL UNIT 1A2. (1) Diode card A2A2. (2) HV PWR SUP AIR indicator.	*b*. Isolate and replace defective card or indicator lamp. Refer to figure FO-19.

c. Interlocks Troubleshooting Procedures - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
10	LP FILTER AIR indicator on control unit does not light.	+28 (±3) vdc between TP4 and A2XA2P1-20 on control unit.	*a.* LOW PASS FILTER 1A21 faulty. *b.* If check is normal, fault in CONTROL UNIT 1A2. (1) Diode card A2A2. (2) LP FILTER AIR indicator.	*a.* Replace low pass filter. *b.* Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
11	EQUIP. AIR TEMP indicator on control unit does not light.	+28 (±3) vdc between TP4 and A2XA2P1-23 on control unit.	*a.* Temperature interlock switch 1A11S7 is faulty. *b.* If check is normal, fault in CONTROL UNIT 1A2. (1) Diode card A2A2. (2) EQUIP. AIR TEMP indicator.	*a.* Replace defective temperature interlock switch. *b.* Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
12	RFA FIL indicator on control unit does not light.	+28 (±3) vdc between TP4 and A2XA2P1-26 on control unit.	*a.* Three-minute time delay relay K1 in rfa 1A3 is faulty. *b.* If check is normal, fault in CONTROL UNIT 1A2. (1) Diode card A2A2. (2) RFA FIL indicator.	*a.* Make relay V/R measurements. Replace defective relay. Refer to figure FO-20. *b.* Isolate and replace defective card or indicator lamp. Refer to figure FO-20.
13	IPA BIAS indicator on control unit does not light.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to -75 V.	*a* -75 vdc (ipa bias) missing or incorrect. *b.* If check is normal, fault in CONTROL UNIT 1A2. (1) Relay card A2A1. (2) IPA BIAS indicator.	*a.* Refer to paragraph 4-8c, item 3. *b.* Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
14	FPA BIAS indicator on control unit does not light.	VOLTAGE MONITOR meter on control unit reads in green are with switch set to -120V.	*a.* -120 vdc (fpa bias) missing or incorrect. *b.* If check is normal, fault in CONTROL UNIT 1A2. (1) Relay card A2A1. (2) FPA BIAS indicator.	*a.* Refer to paragraph 4-8c, item 4. *b.* Isolate and replace defective card or indicator lamp. Refer to figure FO-19.
15	DUMMY LOAD TEMP indicator on control unit does not light in dummy load mode.	Set ANTENNA COUPLER switch on control unit to on. Observe if DUMMY LOAD TEMP indicator lights.	*a.* CONTROL UNIT 1A2. Relay card A2A1. DUMMY LOAD TEMP indicator. *b.* If check is normal, fault in DUMMY LOAD 1A22. Thermoswitch S1 defective.	*a.* Isolate and replace defective card or indicator lamp. Refer to figure FO-19. *b.* Replace defective thermoswitch.
16	*a.* SWR OVLD indicator on control unit does not light; norf excitation applied. *b.* SWR OVLD indicator on control unit does not light;rf excitation .applied.	*a.* Press RESET switch on control unit. RESET switch indicator should go out and SWR OVLD indicator should light. *b.* Same as a above.	*a.* CONTROL UNIT 1A2. Reflectometer assembly A3. Relay card A2A1. SWR OVLD indicator. RESET switch. *b.* Rfa overload fault	*a.* Isolate and replace defective assembly, indicator lamps, or switch. Refer to figure FO19. *b.* Refer to paragraph 4-10.

c. Interlocks Troubleshooting Procedures- Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
17	IPA PLATE indicator on control unit does not light.	+28 (±3) vdc between K3-X1 and TB2-1 on control unit.	*a.* LVPS 1A6. +700vdc (ipa plate) missing or incorrect.	*a.* Refer to paragraph 4-8c, item 5.
			b. If check is normal, fault in CONTROL UNIT 1A2. Relay K3. Relay card A2A1. IPA PLATE indicator.	*b.* Ensure that HIGH VOLTAGE switch on control unit is set to on. Make V/R measurements to isolate defective relay, indicator lamp or card. Refer to figure FO-19.
18	IPA SCREEN indicator on control unit does not light.	+28 (±3) vdc between K4-X1 and TB2-1 on control unit.	*a.* LVPS 1A6. +250 vdc (ipa screen)' missing or incorrect.	*a.* Refer to paragraph 4-8c, item 6.
			b. If check is normal, fault in CONTROL UNIT 1A2. Relay K4. Relay card A2A1. IPA SCREEN indicator.	*b.* Make V/R measurements to isolate defective relay, card or indicator lamp. Refer to figure FO-19.
19	FPA PLATE indicator on control unit does not light.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to 3500 V.	HVPS 1A7. +350vdc (fpa plate) missing or incorrect.	Refer to paragraph 4-8c, item 7.
		+28 (±3) vdc between A2XA4P1-39 and -36 in control unit.	*a.* RT UNIT 1A4.	*a.* Refer to paragraph 4-17 and paragraph 4-19.
			b. If check is normal, fault in control unit 1A2. Relay K5. Timing card A2A4. Relay card A2A1. FPA PLATE indicator.	*b.* Make continuity measurements to isolate defective relay, card or indicator lamp. Refer to figure FO-19.
20	FPA SCREEN indicator on control unit does not light.	VOLTAGE MONITOR meter reads in green area with switch set to 600 V.	*a.* HVPS 1A7. +600vdc (fpa screen) missing or incorrect.	*a.* Refer to paragraph 4-8c, item 8.
			b. If check is normal, fault in CONTROL UNIT 1A2. Diode card A2A2. FPA SCREEN indicator.	*b.* Make continuity measurements to isolate defective card or indicator lamp. Refer to figure FO-19.
21	Mode switching (auxiliary antenna, antenna coupler or dummy load) is accomplished with control unit HIGH VOLTAGE switch set to on. Rfa overload also takes place.	N/A	CONTROL UNIT 1A2. *a.* Relay K2, pins 3 and 9 defective. *b.* Relay card A2A1.	Make relay V/R measurements to isolate fault. Refer to figure FO-19.
22	All system indicators (except trace on pan indicator) fail to extinguish when shelter outer door or inner door are opened.	O vac between TB13-2 and TB4-7 on power distribution box. Open shelter outer and inner doors.	*a.* SHELTER 1A12. Outer door interlock switch S2. Inner door interlock switch S3.	*a.* Replace defective interlock switch.
			b. If check is normal, fault in CONTROL UNIT 1A2. Relay K1. Lamp interrupt card A4.	*b.* Make V/R measurements to isolate faulty relay or card. Refer to paragraph 4.2a and figure FO-19.

c. Interlocks troubleshooting Procedures- Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
23	Preheater fails to operate in manual mode and PREHEATER indicator on control unit does not light.	On control unit set HIGH VOLTAGE switch to off and PREHEATER switch to MAN. Check for +28 (±3) vdc between TB7-1 and TB3-4 on power distribution box. EQUIP. AIR TEMP indicator on control unit is lighted.	CONTROL UNIT 1A2. Relay K2. PREHEATER switch A1S3. HIGH VOLTAGE switch A1S4.	Check PRE-HEATER indicator lamp. Make continuity measurements to isolate defective relay or switch. Refer to figure FO-19.
			Temperature interlock fault.	Refer to paragraph 4-7*c*, item 11.
		120 vac ±10% between TB15-4 and -7; TB-15-5 and -7; and TB15-6 and -7.	*a*. POWER DISTRIBUTION BOX 1A13. Relay K4. Preheater circuit breaker CB3.	*a* Make continuity measurements to isolate defective relay on circuit breaker. Refer to figure FO-28.
			b. If check is normal, fault in preheater 1A12A5.	*b*. Replace defective preheater.
24	Preheater fails to operate in automatic mode and PRE-HEATER indicator on control unit does not light.	On control unit set HIGH VOLTAGE switch to on and PREHEATER switch to MAN. Preheater operates correctly and PRE-HEATER indicator lights.	*a*. Fault common to manual and automatic mode. Refer to item 23.	*a*. Refer to item 23.
			b. If check is normal, fault is defective temperature switch 1A11S6.	*b*. Replace defective temperature switch.
25	Exhaust assembly fails to operate correctly and DAMPER CLOSED indicator on control unit does not light.	Disconnect plug 1A12A4W1P23 from temperature control box 1A11A1. Connect jumper cable between TB2-2 and -9 on exhaust assembly. Observe that damper door closes and DAMPER CLOSED indicator lights. Remove jumper cable from TB2-9 and connect to TB2-10. Observe that damper door opens and DAMPER CLOSED indicator goes out.	*a*. EXHAUST ASSEMBLY 1A20. Actuator B3. Damper interlock switch S1. Damper door Actuator-to-damper door mechanical linkage.	*a*. Inspect mechanical linkage and damper door. Repair/replace defective part as required. Continuity check interlock switch and replace if required. Replace actuator. Refer to figure FO-32.
			b. If check is normal, fault in temperature sensor 1A20T1, temperature sensor 1A20T2 or temperature control box 1A11A1.	*b*. Replace defective temperature sensor or temperature control box. Refer to figure FO-32.
26	Exhaust assembly andrfa fans stop running as soon as STANDBY switch on control unit is set to off.	N/A	POWER DISTRIBUTION 1A13. Blower delay circuit A1Q2, A1Q3, A1Q4. Relay K2.	Make V/R measurements to isolate defective component or relay. Refer to paragraph 4-2*e* and figure FO-28.
27	Personnel heater inoperative in high mode of operation.	On power distribution box set PERSONNEL HEATER circuit breaker to on and set PERSONNEL HEATER switch to HIGH. Measure 208 vac ±10% between TB10-5 and TB15-10; TB10-6 and TB15-8; and TB10-7 and TB15-9 on power distribution box.	POWER DISTRIBUTION BOX 1A13. Circuit breaker CB6. Switch S3.	Make continuity measurements to isolate defective circuit breaker or switch. Refer to figure FO-28.

c. Interlocks Troubleshooting Procedures- Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
27 (Cont)		Personnel heater fan is operative (running).	PERSONNEL HEATER 1A19. Fan B1. Capacitor C1.	Replace defective part. Refer to figure FO-31.
		Continuity between relay K1-A1 and -A2 in personnel heater	PERSONNEL HEATER 1A19. Relay K1. Switch S1. If check is normal, element assembly A1 defective.	Make continuity measurements to isolate defective relay, switch or element assembly. Refer to figure FO-31.
28	Personnel heater inoperative in low mode of operation.	Check operation of personnel heater in high mode of operation. Refer to item 27 this table.	*a*. Refer to item 27.	*a*. N/A
			b. f check is normal, PERSONNEL HEATER switch 1A13S3 is defective.	*b*. Replace defective switch. Refer to figure FO-28.
29	Equipment panel lights cannot be dimmed; shelter doors closed.	Connect multimeter between TP2(+) and TP9(-) in control unit. Measure +15 to +22 vdc as DIMMER CONTROL is rotated.	CONTROL UNIT 1A2. DIMMER CONTROL A1R1 and A1R2. Lamp interrupt card A4.	Make V/R measurements to isolate defective control or component on lamp interrupt card. Refer to paragraph 4-2*a* and figure FO-19.
30	Equipment panel lights do not go out when shelter doors are opened.	N/A	CONTROL UNIT 1A2. Relay K1. SHELTER 1A12. Interlock switches S2 or S3.	Make continuity measurements to isolate defective relay or interlock switch. Refer to figure FO-19.

4-8. Dc Power Generation Troubleshooting

a. Test Equipment Required.

(1) Multimeter AN/USM-223.

(2) Oscilloscope AN/USM-281C.

b. Connections and Conditions. To troubleshoot the lvps or hvps, slide unit out of equipment rack and defeat rack interlock. Turn off unit circuit breakers before making any voltage measurements in the lvps or hvps; connect multimeter to required test points and then set applicable unit circuit breakers on. After making voltage measurement, be sure to turn off unit circuit breakers before removing multimeter leads from test point. Make all resistance measurements in lvps or hvps with unit circuit breakers set to off. To further facilitate troubleshooting in the lvps or hvps, extender cables 3Wll, 3W18, 3W20, 3W31 and 3W32 may be used. These extender cables permit the lvps or hvps to be physically removed from the equipment rack and still maintain all electrical and system interlock functions.

WARNING

High voltage in excess of 3000 vdc is used in the operation of the AN/TLQ-15. Be extremely careful when while measuring voltages in the lvps or hvps. Failure to comply with safety precautions may result in personnel injury or DEATH.

c. Dc Power Generation Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	+24 vdc missing or incorrect.	120 vac (±10%) between FL1-B1 and TB3-1 on power distribution box.	PRIMARY POWER.	Refer to paragraph 4-6c, item 2.
		120 vac (±10%) between terminals 1 and 2 on auxiliary +24 vdc power supply PS1.	*a.* POWER DISTRIBUTION BOX 1A13. Transformer T1. MAIN, circuit breaker CB1.	*a.* Isolate and replace defective component. Refer to figure, FO-28.
			b. If check is normal, auxiliary +24 vdc power supply 1A13PS1 defective.	*b.* Replace power supply.
2	+28 vdc missing or incorrect.	120 vac (±10%) between FL1-B1 and TB1-4; FL2-B1 and TB1-4; and FL3-B1 and TB1-4 in power distribution box.	PRIMARY POWER.	Refer to paragraph 4-6c, item 2.
		208 vac (±10%) between TB2-3 and -5, and TB2.5 and -7 on power distribution box.	POWER DISTRIBUTION BOX 1A13. Relay K1. Power monitor assembly A2.	Make V/R measurements and replace defective part. Refer to figure FO-28.
		120 vac (±10%) between TB4-1 and -7, TB4-3 and -7, and TB4-5 and -7 on power distribution box.	POWER DISTRIBUTION BOX 1A13. Relay K3.	Ensure that STANDBY switch on control unit is on. Make relay V/R measurements. Replace defective relay.
		120 vac (±10%) between P1-A and -D, P1-B and -D, and P1-C and -D on +28 vdc converter.	POWER DISTRIBUTION BOX 1A13. DC CONV circuit breaker CB 2.	Check to see that DC CONV circuit breaker on power distribution box is on. Replace defective circuit breaker.
		+28 (±3) vdc on output terminals of +28 vdc converter.	EQUIPMENT RACK 1A11. +28 vdc converter PSI.	Replace defective +28 vdc converter.
			If check is normal, fault in CONTROL UNIT 1A2. Audio amplifier and meter monitor card A2A3. VOLTAGE MONITOR meter A1M3.	Isolate and replace defective part. Refer to figure FO-19.
3	-75 vdc (ipa bias) missing or incorrect.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to 28 V.	+28 vdc missing or incorrect.	Refer to item 2.
		RFA FIL indicator on control unit is lighted.	RFA 1A3. Filament relay K2. Three-minute time delay relay K1.	Make relay V/R measurements. Replace defective relay. Refer to figure FO-20.
		208 vac (±10) between TB9-1 and -3 and TB9-3 and -5 on power distribution box.	POWER DISTRIBUTION BOX 1A13. Relay K5.	Make relay V/R measurements. Replace defective relay. Refer to figure FO-28.
			If check is normal, LVPS 1A6 is defective.	Refer to item 9.
4	-120 vdc (fpa bias) missing or incorrect.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to -75V.	-75 vdc (ipa bias) missing or incorrect.	Refer to item 3.
			If check is normal, LVPS 1A6 is defective.	Refer to item 10.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
5	+700 vdc (ipa plate) missing or in correct.	VOLTAGE MONITOR meter or control unit reads in green area with switch set to -75V.	-75 vdc (ipa bias) missing or in-correct.	Refer to item 3.
		Disconnect J6 from P6 located on the cut forward right, bottom side of rfa. Check for band interlock ground from rt unit at the following rfa points. 1A3 J6-e (Band 1) 1A3 J6-f (Band 2) 1A3 J6-b (Band 3) 1A3 J6-c (Band 4) 1A3 J6-d (Band 5)	RT Unit 1A4	Refer to paragraph 4-20.
		Check for band interlock ground at 1A3 P6-W on rfa. Reconnect P6 to J6 after test.	RFA 1A3. BAND SELECT switch S1 Interlock trip switch S2.	Make switch continuity measurements. Replace defective switch. Refer to figure FO-20.
		Check for band interlock ground at K2, pin 5 in control unit.	SOFT MOUNTED COUPLER 1A5. Bandswitch interlock switch S1.	Make switch continuity measurements. Replace defective switch. Refer to figure FO-17.
		0 vdc between K2-5 and - 12 on control unit.	CONTROL UNIT 1A2. Relay K2. HIGH VOLTAGE switch A1S4. REMOTE XMTTR switch A1S12.	Ensure that HIGH VOLTAGE switch is on and that REMOTE XMTR switch is set to local. Make relay V/R measurements. Replace defective relay or switch. Refer to figure FO-19.
			If checks are normal, LVPS 1A6 is defective.	Refer to item 12.
6	+250 vdc (ipa screen) missing or in-correct.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to 700 V.	*a* +700 vdc (ipa screen) missing or incorrect.	*a.* Refer to item 15.
			b. CONTROL UNIT 1A2. Relay K3.	b. Make relay V/R measurements. Replace defective relay. Refer to figure FO-19.
			c. If checks are normal, LVPS 1A6 is defective.	*c*. Refer to item 14.
7	+3500 vdc (fpa plate) missing or in-correct.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to -75 V.	--75 vdc (ipa bias) missing or in-correct.	Refer to item 3.
		VOLTAGE MONITOR meter on control unit reads in green area with switch set to 250 V.	*a*. CONTROL UNIT 1A2. Relay K4.	*a*. Make relay V/R measurements. Replace defective relay. Refer to figure FO-19.
			b. If checks are normal, HVPS 1A7 is defective.	*b*. Refer to item 16.
8	+600 vdc (fpa screen) missing or incorrect.	VOLTAGE MONITOR meter on control unit reads in green area with switch set to 3500 V.	*a*. +3500 vdc (fpa plate) missing or incorrect.	*a.* Refer to item 7.
			b. CONTROL UNIT 1A2. Relay K5.	*b*. Make relay V/R measurements. Replace defective relay. Refer to figure FO-19.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
8 (Cont)			*c*. If checks are normal, HVPS 1A7 is defective.	*c*. Refer to item 18.
		WARNING **Dangerous potentials up to 700 vdc are present in the lvps. Be extremly careful when working inside this unit.**		
9	VOLTAGE MONITOR meter on control unit does not read in green area with switch set to -75 V.	-75 (±5) vdc between TP6(--) and TP4(+) on ovps.	*a*. If check is normal: Resistor R5 open or changed valve. Resistor R3 or R4 open or changed value.	*a*. Isolate and replace defective component. Refer to figure FO-25. Visually inspect lvps for burned or damaged components. Make V/R measurements to isolate defective component. Replace defective component with known good component.
			b. If -75 vdc is missing or incorrect, bias voltage supply ofivps 1A6 is defective.	*b*. Refer to item 11.
10	VOLTAGE MONITOR meter does not read in green area with switch set to --120 V.	-120 (±6) vdc between TP(--) and TP4(+) onvps.	*a*. If check is normal: R resistor R6 open or changed valve. Resistor R7 or R8 open or changed valve.	*a*. Refer to item 9a for corrective measure.
			b. If -120 vdc is missing or incorrect, bias voltage supply of LVPS 1A6 is defective.	*b*. Refer to item 11.
		WARNING **Dangerous potentials up to 700 vdc are present in the lvps. Be extremly careful when working inside this unit.**		
11	Bias voltage supply oflvpa 1A6 is defective.	Observe polarity and measure the following voltages, in turn, to isolate missing or incorrect voltage. NOTE Use oscilloscope to measure peak-to-peak value of ripple voltage.		
		a. -75 (±5) vdc between TP6(-) and TP4(+) on lvps.	*a*. If only -75 vdc is missing or incorrect. Regulator VR2defective. Resistor R1 changed valve. Inductance of L1 low.	*a*. Isolate and replace defective component. Refer to figure FO-25. Visually inspect lvps for burned or damaged components.
		b. -120 (±6) vdc between TP5(--) and TP4(+) on lvps.	*b*. If only --120 vdc is missing or incorrect. Regulator VR1defec-. tive; resistor R2 changed value or inductance of L1 low.	*b*. Make V/R measurements to isolate defective component. Replace defective componentwith known good component.
		c. -175 vdc between TP 11(--) and TP4 (+) on vps.	*c*. If -75 vdc is missing, capacitor C4 shorted; inductor L1 open; circuit breaker CB1 open.	*c*. Make V/R measurements; isolate and replace defective components.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
11 (Cont)		*d.* -175 vdc between TP 11(-) and TP4 (+) on lvps.	*d.* If --175 vdc is low, capacitor C3 open; L1 changed value	*d.* Make V/R measurements; isolate and replace defective components.
		e. -175 vdc between TP 11(--) and TP4 (+) on lvp.	*e.* If -175 vdc is high, VR1 regulator circuit open; VR2 regulator circuit open; VR2 regulator circuit open.	*e.* Make V/R measurements, isolate and replace defective components.
		f. -180 vdc between the junction of E2(--) and TP3 (+) on lvps; ripple voltage is less than .02V peak to peak.	*f.* IF --180 vdc is missing or correct, capacitor C3 shorted; rectifier CR1 shorted; circuit breaker CB1 open.	*f.* Make V/R measurements, isolate and replace defective components.
		g. -180 vdc between the junction of E2 (-) and TPS(+) on lvps; ripple voltage is less than .02V peak to peak.	*g.* If --180 vdc is low, capacitor C3 open; one or more diodes in rectifier CR1 shorted. One or more contacts of circuit breaker CB1 defective. Transformer T1 has open or shorted turns.	*g.* Make V/R measurements, isolate and replace defective components.
		h. -180 vdc between the junction of E2 (-) and TP3 (+) on lvps; ripple voltage is less than .02V peak to peak.	*h.* -180 vdc is high inductance L1 open.	*h.* Make V/R measurements, isolate and replace defective components.
		I. 135 vac (±10%) between transformer T1, pins 6 and 5, and pins 5 and 4.	*i.* 135 vac is missing or incorrect circuit breaker CB1 open.	*i.* Make V/R measurements, isolate and replace defective components.
		j. 135 vac (±10%) between trans former T1 pins 6 and 5, and pins 5 and 4.	*j.* If 135 vac is low, transformer T1 has shorted secondary turns; one or more contact of circuit breaker CB1 defective.	*j.* Make V/R measurements, isolate and replace defective components.
		k. 135 vac (±10%) between transformer T1 pins 6 and 5, and pins 5 and 4.	*k.* 135 vac is high, transformer T1 changed value or has an open secondary.	*k.* Make V/R measurements; isolate and replace.
		L. 120 vac (±10%) between each phase of the input voltage and neutral em the lvps: TP1 to TP 10 TP2 to TP 10 TP3 to TP 10	*L.* If ac input voltage is missing or incorrect, primary power is faulty.	*L.* Make V/R measurement, isolate and replace.
		WARNING **Dangerous potentials up to 700 vdc are present in the lvps. Be extremly careful when working inside this unit.**		
12	VOLTAGE MONITOR meter or control unit does not read in green area with switch set to 700 V.	+670 (±20%) vdc between TP14 (+) and TP 19 (-) on lvps.	*a.* If check is normal, resistor R15 open or changed value; resistor R12, R13, or R14 open or changed value.	*a.* Isolate and replace defective component. Refer to figure FO-25. Visually inspect lvps for burned or damaged components. Replace as necessary.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
12 (Cont)			*b.* If +700 vdc is missing or incorrect, ipa plate voltage supply of lvps 1A6 is defective.	*b.* Refer to item 13.
		WARNING **Dangerous potentials up to 700 vdc are present in the lvps. Be extremly careful when working inside this unit.**		
13	Plate voltage supply of lvps 1A6 is defective	Observe polarity and measure the following voltages, in turn to isolate missing or incorrect voltages		Isolate and replace defective component. Refer to figure FO-25. Visually inspect lvps for burned or damaged components.
		NOTE **Use oscilloscope to measure peak-to-peak value of ripple voltage.**		
		a. +670 (20) vdc between TP14(+) and TP19(-) on lvps.	*a.* If +700 vdc is missing, capacitor C12 shorted. Resistor R24 open. Inductor L3 open. Overload relay K4 tripped.	*a.* Make V/R measurements to isolate defective component. Replace defective component with known good component.
		b. +670(±20) vdc between TP14(+) and TP19(--) on lvps	*b.* If +700 vdc is low: Resistor R19 changed value. Inductance of L3 low. Capacitor C11 open.	*b.* Make V/R measurements to isolate defective components.
		c. +670(±20) vdc between TP14(+) and TP19(-) on lvps	*c.* If +700 vdc is high: Resistor R19 open. Resistor R24 changed value.	*c.* Make V/R measurements to isolate defective components.
		d. +665 vdc (±10%) between junction of E32(+) and TP19(-) on lvps; ripple voltage is less than 3V peak to peak.	*d.* If +665 vdc is missing, Capacitor C11 shorted. Circuit breaker CB4 open. Relay K3 defective. Rectifier CR3 open.	*d.* Make V/R measurements to isolate defective components.
		e. +665 vdc (±10%) between junction of E32(+) and TP19(-) on lvps; ripple voltage is less than 3V peak to peak.	*e.* +665 vdc is low: One or more diodes in rectifier CR3A or CR3B open. One or more contacts of circuit breaker CB4 defective. Open or shorted turns of transformer T3.	*e.* Make V/R measurements to isolate defective components.
		f. +665 vdc (±10%) between junction of E32(+) and TP19(-) on lvps; ripple voltage is less than 3V peak to peak.	*f.* If +665 vdc is high: (a) Inductor L1 open.	*f.* Make V/R measurements to isolate defective components.
		g. 525 vac (±10%) between transformer T3, pins 6 and 5 and 1 between T3, pins 5 and 4.	*g.* If 525 vac is missing, circuit breaker CB4 open.	*g.* Make V/R measurements to isolate defective components.
		h. 525 vac (±10%) between transformer T3, pins 6 and 5 and 1 between T3 pins 5 and 4.	*h.* If 525 vac is low: Transformer T3 has shorted secondary turns. One or more contacts of circuit breaker CB4 defective.	*h.* Make V/R measurements to isolate defective components.
		I. 525 vac (±10%) between transformer T3 pins 6 and 5 and between T3 pins 5 and 4.	*i.* If 525 vac is high: Transformer T3 changed value or has opened secondary.	*I.* Make V/R measurements to isolate defective components.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
13 (Cont)		*j.* 120 vac (±10%) between each phase of the input voltage and neutral on the lvps: TP1 to TP10 TP2 to TP10 TP3 to TP10	*j.* If ac input voltage is missing primary power is faulty.	*j.* Make V/R measurements to isolate defective components.
		WARNING **Dangerous potentials up to 700 vdc are present in the lvps. Be extremely careful when working inside unit.**		
14	VOLTAGE MONITOR meter on control unit does not read in green area with switch set to 250 V.	*a.* +250 (±12) vdc between TP17(+) and TP8(-) on lvps.	*a.* If check is normal: Resistor R21 open or changed value. Resistor R10 or R11 open or changed value.	*a.* Isolate and replace defective component. Refer to figure FO-25. Visually inspect lvps for burned or damaged components. Make V/R measurements to isolate defective component. Replace defective component with known good components.
		b. +250 (±12) vdc between TP17(+) and TP8(-) on lvps.	*b.* If +250 vdc is missing or incorrect, ipa screen voltage supply of lvps defective.	*b.* Refer to item 15.
		WARNING **Dangerous potentials up to 700 vdc ire present in the lvps. Be extremely careful when working inside the unit.**		
		NOTE **Use oscilloscope to measure peak-to-peak value of ripple voltage.**		
15	Screen voltage supply of lvps 1A6 is defective	Observe polarity and measure the following voltages to isolate missing, or incorrect voltages.		
		a. +250 (12) vdc between TP17 (+) and TP8 (-) on lvps.	*a.* If +250 vdc is missing: Resistor R9 open. Regulators VR3, VR4 shorted. Capacitor C8 shorted. Overload relay K2 tripped.	*a.* Refer to figure FO-25. Visually inspect lvps for burned or damaged components. Replace defective components.
		b. +250 (±12) vdc between TP17 (+) and TP8 (-) on lvps.	*b.* If +250 is low: Resistor R9 changed value. Inductance of L2 low. Regulator VR3 or VR4 defective.	*b.* Refer to figure FO-25.
		c. +250 (±12) vdc between TP17 (+) and TP8 (-) on lvps.	*c.* If +250 vdc is high: Regulator VR3, VR4 open.	*c.* Refer to figure FO-25.
		d. +320 vdc between junction of and replace defective components. ripple voltage is less than 5V peak to peak.	*d.* If +320 is missing: Capacitor C7 shorted. Circuit breaker CB2 open. Relay K1 defective. Rectifier CR2 open.	*d.* Make V/R measurements; isolate

c. DC Power Generation Troubleshooting Procedures--Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
15 (Cont)		*e.* +320 vdc between junction of E17 (+) and TP15 (-) on lvps; ripple voltage is less than 5V peak-to-peak.	*e.* If +320 vdc is low: One or more diodes in rectifier CR2 open. One or more contacts of circuit breaker CB2 defective. If +251 vac is high: Transformer T2 change value or has opened secondary	*e.* Make V/R measurements: isolate and replace defective components. Refer to figure FO-25.
		f. 120 vac (±10%) between each phase of the input voltage and neutral on the lvps: TP1 to TP10 TP2 to TP10 TP3 to TP10	*f.* If ac input voltage is missing, primary power is faulty.	*f.* Make V/R measurements isolate and replace defective components.
		WARNING **Dangerous potentials up to 3500 vdc are present in the hvps. Do not connect or disconnect test equipment or cable when the power supply is energized. Be extremely careful when working inside unit.**		
16	VOLTAGE MONITOR meter on control unit does not read in green area with switch set to 3500 V.	+3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C6 in hvps.	*a.* If check is normal: Resistor in resistor assembly (R5 through R10, R12, R24 through R26) open or changed value. Voltage divider network (R1 through R4) open or changed value.	*a.* Isolate and replace defective component. Refer to figure FO-26. Visually inspect hvps for burned or damaged components. Make V/R measurements to isolate defective component. Replace defective component with known good component.
			b. If +3500 vdc is missing or incorrect, fpa plate voltage supply of hvps defective.	*b.* Refer to item 17.
		WARNING **Dangerous potentials up to 3500 vdc are present in the hvps. Do not connect or disconnect test equipment or cable when the power supply is energized. Be extremely careful when working inside unit.**		
17	Plate voltage supply of hvps 1A7 is defective.	Observe polarity and measure the following voltages, in turn, to isolate missing or incorrect voltage		
		NOTE **Use oscilloscope to measure peak-to-peak value of ripple voltage.**		
		a. +3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C6 on hvps.	*a.* If +3500 vdc is missing or incorrect at terminal 2 of L1: Capacitor C5 or C6 shorted. Inductor L1 open. Overload relay K3 is tripped.	*a.* Isolate and replace defective component. Refer to figure FO-26. Visually inspect hvps for burned or damaged components. Make V/R measurements to isolated defective component.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
17 (Cont)		*b.* +3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C6 on hvps.	*b.* If +3500 vdc is low at terminal 2 of L1: Resistor in voltage divider (R1 through R4) changed value. Inductance of L2 low.	*b.* Isolate and replace defective components. Refer to figure FO-26.
		c. +3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C6 on hvps.	*c.* If +3500 vdc is high at terminal 2 of L1: Resistor in voltage divider (R1 through R4) open.	*c.* Make V/R measurements to isolate defective components.
		d. +3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C4 on hvps; ripple voltage is less than 22V peak-to-peak.	*d.* If +3500 vdc is missing or incorrect at terminal 1 of L1: Regulator CR2 open. Circuit breaker C131 open. Relay K1 defective. Resistor R14 changed value. Capacitor C4 shorted.	*d.* Make V/R measurements to isolate defective components.
		e. +3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C4 on hvps; ripple voltage is less than 22 V peak to peak.	*e.* If +3500 vdc is low at terminal 1 of L1: One or more diodes in rectifier CR2 open. One or more contacts of circuit breaker CB1 open. Open or shorted turns of transformer T1. Capacitor C4 open.	*e.* Make V/R measurements to isolate defective components.
		f. +3500 vdc (±3%) between terminal 1 (+) and terminal 2 (-) of C4 on hvps; ripple voltage is less than 22 V peak to peak.	*f.* If +3500 vdc is high at terminal 1 of L1: Inductor L1 open.	*f.* Make V/R measurements to isolate defective components.
		g. 2350 vac (±10%) across CR2A, pin 2 and CR2B, pin 2; and between CR2B, pin 2 and CR2C, pin 2.	*g.* If 2350 vac is missing: Circuit breaker CB1 open.	*g.* Refer to figure FO-26.
		h. 2350 vac (±10%) across CR2A, pin 2, and CRB, pin 2; and between CR2B, pin 2 to CR2C pin 2.	*h.* If 2350 vac is low: Transformer T1 has shorted secondary turns. One or more contacts of circuit breaker CB1 defective.	*h.* Make V/R measurements to isolate defective components. Refer to figure FO-26.
		I. 2350 vac (±10%) across CR2A, pin 2 and CRB, pin 2; and between CR2B, pin 2 to CR2C, pin 2.	*I.* If 2350 vac is high: Transformer T1 changed value or has open secondary.	*I.* Make V/R measurements to isolate defective components. Refer to figure FO-26.
		j. 120 vac (±10%) between each phase of the input voltage and neutral on the hvps: TP9 to TP17 TP10 to TP17 TP11 to TP17	*j.* If ac input voltage is missing, primary power is faulty.	*j.* Make V/R measurements to isolate defective components.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
		WARNING **Dangerous potentials up to 3500 vdc are present in the hvps. Do not connect or disconnect test equipment or cables when the power supply is energized. Be extremely careful when working inside unit.**		
18	VOLTAGE MONITOR meter on control unit does not read in green area with switch set to 600 V.	*a.* +610 Vdc (±5%) between TP14 (+) and TP16 (-) on hvps.	*a.* If check is normal: Resistor R20 or R21 open or changed value. Relay K2 contacts A1, A2 open.	*a.* Isolate and replace defective component. Refer to figure FO-26. (1) Visually inspect hvps for burned or damaged components. (2) Make V/R measurement to isolate defective component.
		b. +610 vdc (±5%) between TP14 (+) and TP16 (-) on hvps.	*b.* If +600 vdc is missing or incorrect, fpa screen voltage supply of hvps defective.	*b.* Refer to item 19.
		WARNING **Dangerous potentials up to 3500 vdc are present in the hvps. Do not connect or disconnect test equipment or cables when the power supply is energized. Be extremely careful when working inside unit.**		
19	Screen voltage supply of hvps 1A7 is defective.	Observe polarity and measure the following voltages, in turn, to isolate missing or incorrect voltage. **NOTE** **Use oscilloscope to measure peak-to-peak value of ripple voltage.**		
		a. +610 vdc (±5%) between TP14 +) and TP16 (-) on hvps.	*a.* If +600 vdc is missing: Overload relay K4 tripped.	*a.* Isolate and replace defective component. Refer to figure FO-26. Visually inspect hvps for burned or damaged components.
		b. +750 vdc between TP12 (+) and TP16 (-) on hvps (terminal 2 of L2).	*b.* If +750 vdc is missing at terminal 2 of L2: Capacitor C9 shorted. Inductor L2 open. Bleeder network (R30 to R32) shorted.	*b.* Isolate and replace defective components. Refer to figure FO-26.
		c. +750 vdc between TP12 (+> and TP16 (-) on hvps (terminal 2 of L2).	*c.* If +750 vdc is low at terminal 2 of L2: Inductance of L2 low. Bleeder network (R30 to R32) changed value.	*c.* Isolate and replace defective components. Refer to figure FO-26.
		d. +750 vdc between TP12 (+) and TP16 (-) on hvps (terminal 2 of L2).	*d.* If +750 vdc is low at terminal 1 of L2: One or more diodes in rectifier CR5 open. Capacitor C8 open. One contact of circuit breaker CB2 open.	*d.* Isolate and replace defective components.

c. DC Power Generation Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
19 (Cont)			Open or shorted turns of transformer T2.	
		e. +750 vdc between TP12 (+) and TP16 (-) on hvps (terminal 2 of L2).	*e.* If +755 vdc is high at terminal 1 of L2: Inductance L2 open.	*e.* Isolate and replace defective components. Refer to figure FO-26.
		f. 600 vdc (±10%) across secondary of transformer T2 (terminals 3 and 4).	*f.* If 600 vdc is missing: *i* Circuit breaker CB2 open.	*f.* Isolate and replace defective components.
		g. 600 vdc (±10%) across secondary of transformer T2 (terminals 3 and 4).	*g.* If 600 vac is low: Transformer T2 has shorted secondary turns.	*g.* Isolate and replace defective components.
		h. 600 vdc (±10%) across secondary, of transformer T2 (terminals 3 and 4).	*h.* If 600 vac is high: Transformer T2 changed value or has opened secondary.	*h.* Isolate and replace defective components.
		I. 120 vac (±10%) between each phase of the input voltage and neutral on the hvps.	*I.* If ac input voltage is missing, primary power is faulty.	*I.* Make V/R measurements to isolate defective components.
		j. 120 vac (±0%) between each phase of the input voltage and neutral on the hvps: TP9 to TP17 TP10 to TP17 TP11 to TP17	*j.* If ac input voltage is missing, primary power is faulty.	*j.* Make V/R measurements and isolate defective components.

4-9. Rf Power Output Troubleshooting

a. Test Equipment Required.

(1) Wattmeter 4301.

(2) Wattmeter Plug-in 2500H.

(3) Multimeter AN/USM-223.

(4) 30 dB Attenuator.

(5) Impedance Matching Network.

b. Connections and Conditions. None required.

c. Rf Power Output Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Rf power level incorrect when operating into AN/TLQ-15 dummy, load mode.	VOLTAGE MONITOR meter on control unit indicate all ac and dc voltages are present and correct.	Dc power generation.	Refer to paragraph 4-8.
		Meter on rt unit indicates 5(±1) watts with METER SELECTOR switch set to RF OUTPUT.	RT UNIT 1A4.	Refer to paragraph 4-17.
		Check 0 vdc between TB1-4 and -6 on rf panel	CONTROL UNIT 1A2. Relay card A2A1. ANTENNA COUPLER switch A1S10.	Make switch continuity measurements. Replace rely card. Refer to figure FO-19.
		5 (±1) watts at port 1 an relay K6 in rf panel. Set rt unit RF OUTPUT control fully ccw. Disconnect W5P2 from J1 on Z1 line section in rf panel. Connect W5P2 to wattmeter. Connect other side of wattmeter to external 30 dB Attenuator. Set RF OUTPUT control for 2 kW output on wattmeter, relay K1 in rf panel Connect W6P1 to wattmeter.	RF PANEL 1A23. Relay K6.	Replace defective relay. Refer to figures FO-33 and FO-34.
		Other side of wattmeter must be connected to external 30 dB Attenuator. Set rt unit RF OUTPUT control for 2 kW output on watt-meter.	If check is normal, DUMMY LOAD A22 is defective.	Replace defective dummy load.
	Rf power level corrected when operating into auxiliary antenna mode.	*a.* On control unit, set HIGH VOLTAGE switch to off and set DUMMY LOAD switch to on. Set HIGH VOLTAGE switch to on. FORWARD POWER meter on control unit reds 800 watt for low power operation or 2000 watts for high power operation.	*a.* Rf power level into dummy load mode incorrect.	Refer to item 1.
	Rf power level incorrect when operating into auxiliary antenna mode	*b.* On control unit set HIGH VOLTAGE switch to off (white) and AUX ANTENNA switch to on(green). Connect multimeter to the following test points and measure +28 (±3) vdc: TB1-3 (+) to TB1-6 (-) TB2-3 (+) to TB1-6 (-) TB2-1 (+) to TBI-5 (-) Connect multimeter to TB14 (+) and TB1-6 (-) and measure 0 vdc.	*b.* CONTROL UNIT 1A2. Relay card A2A1. AUX ANTENNA. switch A1S11.	*b.* Make switch continuity measure-ments. Replace relay card if switch is good. Refer to figure FO-19.

c. RF Power Output Troubleshooting Procedures -Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
2 (Cont)	Rf power level incorrect when operating into auxiliary mode.	*c.* Measure continuity between 1A23K1-1N port and 1A23K7-1N port; and between 1A23K4-1N and 1A23K4-2 ports.	*c* RF PANEL 1A23: Relay K1. Relay K2. Relay K7. Relay K4.	*c.* Make continuity measurements to determine defective relay. Replace defective relay. Refer to figure FO-33.
		d. Check operation of low pass filter 1A21 in auxiliary antenna mode with 30 dB attenuator connected to AUX ANT J1. Adjust AN/TLQ-15 for normal operation at 2.5 MHz in band 1 on rfa 1A3. Control unit 1A2 FORWARD POWER meter indicates 2 kw and REFLECTED POWER meter indicates less than 200 watts.	*d* LOW PASS FILTER A21 band 1 circuitry:- Relay K1 or K2. Filter No. 1.	*d.* Make voltage and continuity measurements to determine defective relay. Refer to FO-4, FO-20 and FO-32.1. Replace defective relay. Visually check all circuit components for rf arcing, burnt areas, discoloration and loose connections. Tighten loose connection or replace filter No. 1 as necessary.
		e. Repeat step *d* at 42 MHz in band 2 on rfa 1A3.	*e.* LOW PASS FILTER 1A21 band 2 circuitry: Relay K3 or K4. Filter No. 2.	*e.* Make voltage and continuity measurements to determine defective relay. Refer to FO-4, FO-20 and FO-32.1. Replace defective relay. Visually check all circuit components for rf arcing, burnt areas, discoloration and loose connections. Tighten loose connection or replace filter No. 2 as necessary.
		f Repeat step *d* at 7.1 MHz in band 3 on rfa 1A3.	*f* LOW PASS FILTER 1A21 band 3 circuitry:- Relay K5 or K6. Filter No. 3.	*f* Make voltage and continuity measurements to determine defective relay. Refer to FO-4, FO-20 and FO-32.1. Replace defective relay. Visually check all circuit components for rf arcing, burnt areas, discoloration and loose connections. Tighten loose connection or replace filter No. 3 as necessary.
		g. Repeat step dat12.0 MHz in band 4 on rfa 1A3.	*g* LOW PASS FILTER A21band 4 circuitry:- Relay K7 or Kg. Filter No. 4.	*g.* Make voltage and continuity measurements to determine defective relay. Refer to FO-4, FO-20 and FO-32.1. Replace defective relay. Visually check all circuit, components for rf arcing, burnt areas, discoloration and loose connections. Tighten loose connection or replace filter No. 4 as necessary.
		h Repeat step *d* at 20.0 MHz in band 5 on rfa 1A3.	*h* LOW PASS FILTER 1A21 band 5 circuitry: Relay K9 or K10. Filter No. 5	*h* Make voltage and continuity measurements to determine defective relay. Refer to FO-4, FO-20 and FO-32.1. Replace defective relay. Visually check all circuit components

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
				for rf arcing, burnt areas, discoloration and loose connections. Tighten loose connection or replace filter No. 5 as necessary.
3	Rf power level incorrect when operating into antenna coupler mode.	*a.* Check operation of AN/TLQ-15 in dummy load mode.	*a.* Dummy load mode inoperative.	*a.* Refer to item 1.
		b. Check operation of AN/TQ-15 in auxiliary antenna mode using thru-line wattmeter and external 30 dB Attenuator.	*b.* Auxiliary antenna mode inoperative.	*b.* Refer to item 2.
	Rf power level incorrect when operating into antenna coupler mode.	*c* On control unit set HIGH VOLTAGE switch to off (white) and ANTENNA COUPLER switch to on (green) Connect multimeter to TB1-4 (+) and TB1-6 (-) and measure +28 (3) vdc.	*c* CONTROL UNIT 1A2: Relay card A2A1. ANTENNA COUPLER switch A1S10.	*c.* Make switch continuity measurements. Replace relay card if switch is good. Refer to figure FO-19.
		Measure continuity between 1A23K4-1N port and 1A23K4-1 port.	Rf panel 1A23: Relay K9 faulty. If check is normal, soft or hard mounted coupler defective.	Replace K4 relay. Refer to item 5.
4	Transmitter remotecontrol inoperative; local operation is normal.	N/A	POWER DISTRIBUTION BOX 1A13. Telephone/remote circuit Q1 and K1 (P/O A1 assembly)	Make V/R measurements to isolate defective component. Refer to paragraph 4-2*e* and figure FO-28.
5	Soft-mounted coupler/hard-mounted coupler output missing or incorrect.	*a.* Remove cm antenna and antenna base insulator. Install adapter plate. Place impedance matching network onto adapter plate. Connect test equipment per figure 4-12. Set POWER circuit breaker to ON. Tune impedance matching network per calibration chart. System in antenna coupler mode of operation. Set RT unit RF OUTPUT control full CW.	*a.* HARD-MOUNTED COUPLER 1A1. Relay K7 or K8. Bridge assembly A1.	*a.* Make continuity measurements to isolate defective relay or bridge assembly. Refer to figure FO-17.
		b. Rf power meter on soft-mounted coupler reads in green area when PUSH TO TUNE switch is depressed	*b.* SOFT-MOUNTED COUPLER 1A5. Relay K17. PUSH TO TUNE switch S2.	*b.* Make continuity measurements to isolate defective relay or switch. Refer to figure FO-17.
		c. Set rt unit RF OUTPUT control fully ccw. Set HIGH VOLTAGE switch on control unit to off (white). Make continuity measurements of relay contacts associated with defective band	*c.* SOFT-MOUNTED COUPLER 1A5. Relays K1 through K16 (as applicable). Diode logic card A1. BAND SELECT switch S1. Tuning circuits.	*c.* Make continuity measurements to isolate defective relay, card, or switch. Refer to figure FO-17. Visually check all circuit components for rf arcing, burnt areas, discoloration and loose connections.
		d. Refer to figure FO-17 for frequency band relay select chart.	*d.* HARD-MOUNTED COUPLER 1A1. Relays K1 through K17. Tuning circuits	*d.* Make continuity measurements to isolate defective relay or component. Refer to figure FO-17. Visually check all circuit components for rf arcing, burnt areas, discolorations and loose connections.

4-10. Rfa Overload Protection Troubleshooting

a. Test Equipment Required. Multimeter AN/USM-223 is required for rfa overload protection troubleshooting.

b. Connections and Conditions. None required.

c. Rfa Overload Protection Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Rfa continuously overloads with rf excitation applied.	SWR OVLD indicator on control unit is lighted.	If SWR OVLD indicator is out, problem is a high reflected-to-forward power ratio.	Refer to paragraph 4-11.
2	Rfa continuously overloads with rf excitation applied; FPA SCREEN indicator on control unit goes out on overload.	Set rt unit RF OUTPUT control fully ccw. Set Control unit HIGH VOLTAGE switch to on (yellow)., Rfa does not overload and FPA SCREEN indicator stays lighted.	HVPS 1A7. If check is normal, fault in RFA 1A3. Tube V1 circuitry defective.	Check hvps overload adjustment as per paragraph 4-31. Troubleshoot hvps as per item 8, paragraph4-8c. Make V/R measurements of para tube V1. Replace defective tube or circuit component. Refer to paragraph 4-2d and figure FO-20.
		WARNING **Dangerous potentials up to 3500 vdc are present in the hvps. Be extremely careful when working on this unit. Failure to comply can result in DEATH or injury.**		
3	Rfa continuously overloads with rf excitation applied; FPA PLATE indicator on control unit goes out on overload.	Set rt unit RF OUTPUT control fully ccw. Set control unit HIGH VOLTAGE switch to off (white). Remove cable from J4 on rear of hvps.	*a.* HVPS 1A7.	*a.* Check hvps overload adjustment as per paragraph 4-31. Troubleshoot hvps as per item 7, paragraph 4-8c.
		Set control unit HIGH VOLTAGE switch to on (yellow). Rfa does not overload and FPA PLATE indicator stays lighted.	*b.* If check is normal, fault in RFA 1A3. Tube V1 circuitry defective.	*b.* Make V/R measurements of para tube V1. Replace defective tube or circuit component. Refer to paragraph 4-2*d* and figure FO-20.
4	Rfa continuously overloads with rf excitation applied; IPA SCREEN indicator on control unit goes out on overload.	Set rt unit RF OUTPUT control fully ccw. Set control unit HIGH VOLTAGE switch to on (yellow). Rfa does not overload and IPA SCREEN indicator remains lighted.	*a.* LVPS 1A6. *b.* If check is normal, fault in RFA 1A3. Tube A1V1 circuitry defective,	*a.* Check lvps overload adjustment as per paragraph 4-30. Troubleshoot lvps as per item 6, paragraph 4-8c. *b.* Make V/R measurements of para tube A1V1. Replace defective tube or circuit component. Refer to paragraph 4-2c and figure FO-20.
5	Rfa continuously overloads with rf excitation applied; IPA PLATE indicator on control unit goes out on overload.	Set rt unit RF OUTPUT control fully ccw. Set control unit HIGH VOLTAGE switch to on (yellow). Rfa does not overload and IPA PLATE indicator stays lighted.	*a.* LVPS 1A6. *b.* If check is normal, fault in RFA 1A3. Tube A1V1 circuitry defective.	*a.* Check lvps overload adjustment as per paragraph 4-30. Troubleshoot lvps as per item 5, paragraph 4-8c. *b.* Make V/R measurements of para tube A1V1. Replace defective tube or circuit component. Refer to paragraph 4-2c and figure FO-20.
6	PA TUNE meter on rfa indicates more than 1.9 amps. Cathode current and rfa does not overload.	N/A	HVPS 1A7. Contacts of overload relay K3 not closing. Overload adjustment potentiometer' R14 not set correctly. Resistor R13 changed value.	Make V/R measurements to isolate defective relay or Replace defective component. Adjust hvps overload relays as per paragraph 4-31.
7	Overload occurs but overload indicator does not light.	*a.* +28 (31) vdc between TP13 and TP12 on lvps (K3 of + 700vdc supply).	*a.* LVPS 1A6. Contacts of relay K4 not closing. +700 V overload adjust potentiometer R23 not set correctly. Resistor R24 or - R19 changed value.	*a.* Make V/R measurements to isolate defective component. Replace defective component and adjust. overload relays. Refer to paragraph 4-30 and figure FO-25.

c. Rfa Overload Protection Troubleshooting Procedures-Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
7 (Cont)		*b.* +28 (±3) vdc between TP13 and TP16 on lvps (K1 of +250 vdc supply).	*b.* LVPS 1A6. Contacts of relay K2 not closing. +250V overload adjust potentiometer R26 not set correctly. Resistor R20 changed value.	*b.* Refer to item 7a.
		c. +28 (±3) vdc between TP3 and TP4 on hvps (K1 of +3500 vdc supply).	*c.* HVPS 1A7. Contacts of relay K3 not closing. +3500V overload adjust potentiometer R14 not set correctly. Resistor R13 or R15 changed value.	*c.* Make V/R measurements to isolate defective component. Replace defective component and adjust overload relays. Refer to paragraph 4-31 and figure FO-26.
		d. +28 (±3) vdc between TP3 and TP13 on hvps (K2 of +600 vdc supply).	*d.* HVPS 1A7. Contacts of relay K4 not closing. +600V overload adjustment potentiometer R19 not set correctly. Resistor R18 changed value.	*d.* Refer to item 7c.
8	Hvps overload relay(s) do not reset.	*a.* VOLTAGE MONITOR meter on control unit reads in green area with switch set to 600 V.	*a.* HVPS 1A7. 28 vdc line to reset coil of relay K4 open. Diode CR6 open. Relay K4 defective.	*a.* Isolate and replace defective component. Refer to figure FO-26.
		b. VOLTAGE MONITOR meter on control unit reads in green area with switch set to 3500 V.	*b.* HVPS 1A7. 28 vdc line to reset coil of relay K3 open. Diode CR4 open. Relay K3 defective.	*b.* Isolate and replace defective component. Refer to figure FO-26.
9	Lvps overload relay(s) do not reset.	*a.* VOLTAGE MONITOR meter on control unit reads in green area with switch set to 700 V.	*a.* LVPS 1A6. 28 vdc line to reset coil of relay K4 open. Diode CR7 open. Relay K4 defective	*a.* Isolate and replace defective component. Refer to figure FO-25.
		b. VOLTAGE MONITOR meter on control unit reads in green area with switch set to 250 V.	*b.* LVPS 1A6. 28 vdc line to reset coil of relay K2 open. Diode CR8 open. Relay K2 defective.	*b.* Isolate and replace defective component. Refer to figure FO-25.

4-11. VSWR Overload Protection Troubleshooting

a. Test Equipment Required. None required.

b. Connections and Conditions. None required.

c. VSWR Overload Protection Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Excessive reflected power (more than 3:1) noted on control panel REFLECTED POWER meter and system does not overload	N/A	Fault in CONTROL UNIT 1A2. Reflectometer assembly A3.	Replace reflectometer assembly A3. Align newly installed assembly as per paragraph 4-23.
2	System continuously overloads; SWR OVLD indicator on control unit goes out.	N/A	Interlocks.	Refer to paragraph 4-7*c*, item 16.

4-12. Modulation Troubleshooting

a. Test Equipment Required. None required.

b. Connections and Conditions. None required.

c. Modulation Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	One or more modulation modes missing or incorrect.	Perform operational checkout of modulation source as per TM 11-5895-502-15.	*a*. MODULATION SOURCE 1A16. *b*. If checks are normal, fault in RT UNIT 1A4.	*a*. Troubleshoot modulation source as per TM 11-5895-502-15. *b*. Refer to paragraph 4-18.

4-13. Look Through, SIJ and Search Trouble-shooting

a. Test Equipment Required.
(1) Oscilloscope AN/USM-281C.
(2) Multimeter AN/USM-223.
(3) Signal Generator AN/GRM-50.

b. Connections and Conditions. None required.

c. Look thru, S1J and Search Troubleshooting Procedure.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Look through mode inoperative.	Disconnect P7 from J4 on rear of RT unit. Connect oscilloscope probe to P7, pin T and observe the following look through pulses:	PAN INDICATOR 1A17.	Refer to TM 11-5895-503-16.
		a. Receive interval: 2 volts, peak-to- a. peak, 0.2 sec wide.	RT UNIT 1A4.	*a.* Refer to paragraph 4-19.
		b. Transmit interval: 15 volts peak-to-peak, 1.8 sec wide. +28 (±3) vdc sequencing signal between A2XA4P1-39 (+) and A2XA4P1-38 (-) on control unit.	*b.* If check is normal, fault in CONTROL UNIT 1A2. Timing card A2A4 defective.	*b.* Replace defective timing card A2A4. Align newly installed assembly as per paragraph 4-22.
2	SIJ mode inoperative.	Set rt unit TRANSMIT MODE switch to LOOK THRU. AN/TLQ-15 operates in look through mode.	*a.* Look through problem. *b.* If check is normal, RT UNIT 1A4 is faulty.	*a.* Refer to item 1. *b.* Refer to paragraph 4-19.
3	Receiving subsystem inoperative in search mode.	Connect signal generator to J2 on rt unit. Set frequency to 2 MHz. Set output for 5 μv at 30% modulation. Audio signal observed on pan indicator and heard on headset.	RT UNIT 1A4.	Refer to paragraph 4-16.
		Connect signal generator to 1A23K3, port 1. Signal generator frequency and output same as above. Set system to search mode. Audio signal observed on pan indicator and heard on headset	*a.* RF PANEL 1A23.	*a.* Make relay V/R measurements to isolate defective relay. Refer to figures FO-33 and FO-34.
			b. If check is normal, fault in HARD-MOUNTED COUPLER 1A1 or SOFT-MOUNTED COUPLER 1A5.	*b.* Make V/R measurements to isolate defective tuning component in antenna couplers. Check that all relays are activated for band selected. Refer to figure FO-17.

4-14. Radio Communications and Telephone Trouble-shooting

a. Test Equipment Required.
(1) Multimeter AN/USM-223.
(2) Signal Generator AN/GRM-50.
(3) Wattmeter AN/URM-120.
(4) Telephone Set TA-312/PT.

b. Connections and Conditions. None required.

c. Radio Communications and Telephone Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Faulty radio reception in unsecure mode of operation.	*a.* 28 (±3) vdc between TB1-2 (+) and TB1-1 (-) in AN/VRC-47 enclosure.	*a.* AN/VRC-47 ENCLOSURE 2A3. Power supply PS1. Low voltage detector assembly A3.	*a.* Make V/R measurements to isolate defective power supply or detector assembly. Refer to figure FO-35.
		b. Connect signal generator to input jack on high pass filter 2A3FL6. Set signal generator for a 5µvolt CW output at 50 MHz. SPEAKER switch on comm radio set to ON. Audio signal heard on comm radio set speaker.	*b.* COMM RADIO SET (RT) 2A17.	*b.* Refer to TM 11-5820-401-10 (to be published).
			c. HIGH PASS FILTER 2A3FL6.	*c.* Replace defective filter.
		d. Remove encoder/decoder and install bypass cable. Signal generator audio heard on secure comm handset/headset.	*d.* SECURE COMM SPEAKER AMPLIFIER 1A35.	*d.* Replace defective amplifier.
			SECURE COMM MIC AMPLIFIER 1A34.	Replace defective amplifier.
			If check is normal, ENCODER/' DECODER 1A33, COMM-CONTROL UNIT 1A37 or COMM RADIO SET (rt) 2A17 antenna defective.	Replace defective encoder/decoder or comm control unit. Check comm radio set (rt) antenna as per TM 11-5820-4-2-10. Refer to figure FO-30.
2	Faulty radio transmission in unsecure mode of operation.	a. +28 (±3) vdc between TB1-2 (+) and TB1-1 (-) in AN/VRC-47 enclosure.	*a.* AN/VRC-47 ENCLOSURE 2A3. Power supply PS1. Low voltage detector assembly A3.	Make V/R measurements to isolate defective power supply or detector assembly. Refer to figure FO-35.
		b. Connect rf absorption wattmeter to input jack on high pass filter 2A3FL6.	*b.* COMM RADIO SET (rt) 2A17.	*b.* Refer to TM 11-5820-401-10.
		c. Connect microphone to MIKE jack. Tune the R-442/VRC to same frequency as comm radio set. Talk into microphone. Output power is 15 to 35 watts. Voice audio heard on the R-442/VRC.	*c.* HIGH PASS FILTER 2A3FL6.	*c.* Replace defective filter.
		d. Remove encoder/decoder and install bypass cable. Connect secure comm handset/headset to secure comm mic amplifier. Establish two-way communications with another station.	*d.* SECURE COMM MIC AM-, PLIFIER 1A34.	*d.* Replace defective amplifier.
			SECURE COMM HANDSET/ HEADSET 1A32.	Replace defective handset/headset.
			If check is normal, ENCODER/ DECODER 1A33, COMM CONTROL UNIT 1A37, or COMM', RADIO SET (rt) 2A17 antenna defective.	Replace defective encoder/decoder of comm control unit. Check comm radio set (rt) antenna as per TM 11-5820-401-10. Refer to figure FO-30.
3	Faulty radio reception/transmission in secure mode of operation.	Check radio communications in unsecure mode. Refer to items 1 and 2 this table.	If check is normal, ENCODER/ DECODER 1A33 or COMM CONTROL UNIT 1A37 defective.	Replace defective encoder/decoder or comm control unit. Refer to items 1 and 2.

c. Radio Communications and Telephone Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
4	Faulty radio reception on comm radio set receiver (R-442/VRC).	*a.* Connect radio generator- to P1 on rear of AN/VRC-47 enclosure. Set signal generator for a 5µvolt CW output at 50 MHz. Connect headset to AUDIO jack on receiver. Audio signal heard on headset.	COMM RADIO SET (RECEIVER) 2A17. BANDPASS FILTER 2A3FL5. If check is normal, SPEAKER 1A36 or COMM RECEIVER ANTENNA defective.	Refer to TM 11-5820-401-10. Replace defective filter. Replace defective antenna on rear of trailer. Replace speaker if defective.
5	Faulty telephone communications.	Disconnect shelter telephone lines from terminals E1 and E2 on remote telephone junction box. Set switch on remote telephone junction box to TEL. Multimeter reads infinity: between E1 and E2 on remote telephone junction box. Set switch to XMTR. Check continuity between E1 and E2.	REMOTE TELEPHONE JUNCTION BOX 2A22. Switch S1. Capacitor C1. *a.* POWER DISTRIBUTION BOX 1A13. Filter FA4 or FL5 Telephone/remote circuitry (PO A1 assembly). *b.* Defective telephone lines. *c.* If check is normal, replace TELE-PHONE. 1A8 was defective.	Male continuity measurements to isolate defective part. *a.* Make V/R measurements to isolate defective components. Refer to paragraph 4-2*e* and figure FO-28. *b.* Have telephone lines checked at organizational category. *c.* Refer to Technical Manual 11-5805-201-35.

Section IV. DIRECT SUPPORT RT UNIT TROUBLESHOOTING

4-15. General

a. The troubleshooting procedures given in this section enable maintenance personnel to localize a fault within the rt unit to an easily replaceable item (eri). The first step in troubleshooting the rt unit is visual inspection of controls, indicators and meters. The purpose of visual inspection is to locate faults without testing or measuring parameters. The second step is to perform applicable tests to aid in determining the exact nature of the fault.

b. Troubleshooting in this section is arranged into functional operating modes. A trouble sectionalization procedure is provided for each functional group. These procedures utilize test point measurements or visual observations in a logical sequence for systematic troubleshooting of an rt unit functional operating mode. *The Trouble symptom* column lists the abnormal indication possibly observed. The *Check, Probable trouble*, and *Corrective measures* columns list the procedures to be performed and the malfunctioning eri if checks indicate abnormal readings.

c. Two card extractors are supplied with the rt unit for use in removing circuit cards. The card extractors are mounted on the inner surface of the top cover in the right-front section.

d. Rt unit troubleshooting requires the use of extender cards as described in section II of this chapter. Two sets of test points are given in the *Check* column of the following trouble sectionalization procedures; for example: A5 (J10). The first test point (in this example, A5) indicates the test point located on the applicable circuit card assembly under test. The test point enclosed in parenthesis (in this example, J10) indicates the corresponding extender card test point. Test equipment are connected to the extender card test points.

CAUTION

The following assemblies have components that may be damaged by static electrical charges; personnel and tools which come in contact with these assemblies must be grounded:

A105	A205	A402
A201	A207	A3A2
A202	A208	
A204	A209	

NOTE

RT unit circuit card assemblies serial No. 1A, 2A and 3A are of a different configuration from serial No. 4A and above. Although serial No. 1A, 2A, and 3A rt unit circuit card assemblies are physically different, they are electrically identical and interchangeable with serial No. 4A and above circuit card assemblies.

4-16. Search Mode Troubleshooting

a. Test Equipment Required

(1) Oscilloscope AN/USM-281C.
(2) Rt Unit Special Cable Assembly.
(3) Signal Generator AN/GRM-50.
(4) Extender Card 1.
(5) Extender Card 2.
(6) Extender Card 3.
(7) Termination T150B.
(8) Digital Voltmeter AN/GSM-64.

b. Connections and Conditions. Set POWER ON circuit breaker on rt unit to off (down position). Slide rt unit out of equipment rack. Remove top access cover from rt unit and set aside. Connect signal generator to J2 on rear of rt unit. Perform the following preliminary procedures:

(a) METER SELECTOR switch to RF INPUT.
(b) RECEIVE MODE switch to AM.
(c) AFC switch to OFF.
(d) AF GAIN control as required.
(e) RF GAIN control to AGC ON.
(f) IF BW switch to WIDE.
(g) TRANSMIT MODE switch to OFF.
(h) POWER ON circuit breaker to on (up position).

(2) Set signal generator controls for the following output parameters:

(a) Frequency: 2MHz.
(b) Modulation: none.
(c) Output level: 5 volts, cw.

c. Search Mode Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	No noise on pan indicator display.	Using oscilloscope, measure 455 kHz at 25mv at pan IF. output pin A5 (J10) on A407.	Defective components on circuit card assembly.	Replace defective pan if amplifier card A407.
2	Noise on pan indicator display. No received or transmitted signal on pan indicator display.	*a.* With TRANSMIT MODE switch set to CONT, verify presence of transmitter signal on pan indicator display.	*a.* If no transmitter signal on pan indicator display, perform check *b.* if signal is present, go to check c.	*a.* N/A.
		b. Using oscilloscope, measure 21.855 MHz (±100 Hz) oscillator output at pin A4 (J9) on A306.	*b.* Defective components on circuit card assembly.	*b.* Replace defective SSB filter card A306.
		c. Set signal generator fora -30 dBm cw output at 2 MHz. Connect oscilloscope to pin A5 (J10) on A404 and observe 21.4 MHz output.	*c.* Defective components on circuit card assembly.	*c.* Replace defective first if. amplifier and second mixer card A404.
		d. Connect oscilloscope to pin A3 (J8) on A405 and observe 66.4 MHz oscillator output.	*d.* Defective components on circuit card assembly.	*d.* Replace defective oscillator and amplifier card A405.
		e. Using oscilloscope check for 45 MHz at pin A3 (J8) on A403.	*e.* Defective components on circuit card assembly.	*e.* Replace defective rf amplifier and mixer card A403.
		f. Using oscilloscope check for 66.4 MHz at pin A3 (J8) on A405.	*f.* Defective components on circuit card assembly.	*f.* Replace defective circuit card assembly A405.
		g. Adjust signal generator for a --10dBm cw output at 2 MHz. Connect oscilloscope to pin A1 (J6) on A402. Connect 50-ohm termination across oscilloscope input. Oscilloscope indicates a 70 to 75 milli-volt rms signal.	*g.* Defective components on circuit card assembly.	*g.* Replace defective limiter and attenuator card A402.
		h. Adjust signal generator cw output for -10 dBm. Using oscilloscope check signal generator output at pin A5 (J10) on A401. Repeat above test for following frequencies: 3 MHz 5 MHz 9 MHz 16 MHz Adjust signal generator and rt unit frequency controls accordingly.	*h.* Defective components on circuit card assembly. If signal generator output cannot be measured at all frequencies. fault in p11 frequency synthesizer.	*h.* Replace defective bandpass filters card A401. Check p11 frequency synthesizer; refer to paragraph 4-20.
3	No received audio heard in headset; received signal displayed on pan indicator.	*a.* Tune rt unit to signal generator frequency; set rt unit METER SELECTOR switch to AUDIO. Adjust AF GAIN control fully cw. Rt unit METER SELECTOR meter indicates presence of audio.	*a.* Defective audio transformer T2.	*a.* Replace audio transformer T2.

c. Search Mode Troubleshooting Procedures - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
3 (Cont)		*b.* Connect cable from AF INPUT jack below digital counter to FREQ A input connector on digital counter. Digital counter indicates no audio count output.	*b.* If audio count is present, A302 defective.	*b.* Replace defective audio amplifier A302
		c et signal generator for 5µ volt cw signal at 2 MHz. Set RECEIVE MODE switch to CW. Vary BFO PITCH control. Tone as heard in headset should vary in pitch.	*c.* If tone does not vary, A307 defective. Check dc level on front panel control A3R4 as control is varied. DC level should vary from -7 vdc to +7 vdc.	*c.* Replace defective linear am. detector card A307 or front panel control A3R4.
		d. Set IF BW switch to WIDE. Connect oscilloscope to pin A4 (J9) of A30S and check for 21.4 MHz if. output.	*d.* Defective components on circuit card assembly.	*d.* Replace defective second agc amplifier card A308.
		e. Set IF BW switch to WIDE and RF GAIN control to 6. Connect oscilloscope to pin A4 (J9 on A406 and check for 21.4 MHz. Output level remains constant as IF BW switch is set to NARROW and then back to WIDE.	*e.* Defective components on circuit card assembly.	*e.* Replace defective first agc amplifier card A406.
		f. Using oscilloscope check for 21.4 MHz output at pin A4 (J9) on A404. Adjust cw output of signal generator for optimum display on oscilloscope.	*f.* Defective components on circuit card assembly.	*f.* Replace defective first if. amplifier and second mixer card A404.
4	Search cw/ssb reception inoperative; am. reception is good; received cw/ssb signal displayed on pan indicator.	*a.* Set signal generator controls for 5 µvolts cw signal at 2 MHz. Set RECEIVE MODE switch to CW. Using oscilloscope check for 21.4 MHz at pin AS (J10) on A307. Check that 21.4 MHz signal varies (±3 kHz) as BFO PITCH control A3R4 is varied. Control A3R4 varies -7vdc to +7vdc as control is rotated.	*a.* Defective vcxo on circuit card assembly.	*a* Replace defective linear an. detector card A307.
		b. Connect oscilloscope to pin A4 (J9) on A306. Connect 50 ohm termination - across oscilloscope. With rt unit in search mode, oscilloscope should indicate nominal level of 1.9 volts. peak-to-peak at a frequency of 21.855 MHz. Connect oscilloscope to pin A5 (J10) on A306. Connect 50 ohm termination across oscilloscope. Oscilloscope should indicate nominal level of 0.45 volts peak-to-peak.	*b.* Defective components on circuit card assembly.	*b.* Replace defective ssb filters card A306.

c. Search Mode Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
4 (Cont)		*c.* Connect oscilloscope to pin 4 (E4) on A305 and check for a sine wave whose frequency depends on the difference between 455 kHz and the oscillator frequency (for example: f_{out}=21.855-21.4=0.455 MHz).	*c.* Defective components on circuit card assembly. If all checks above are normal, A302 defective. If audio is obtained in am. mode but not in cw/ssb modes, A302 or A207 defective.	*c.* Replace defective ssb and cw detector card A305. Replace defective audio amplifier card A302 or detection logic card A207.
5	Search usb/lsb reception inoperative; cw reception is good; received usb/lsb signal displayed on pan indicator.	*a.* Set RECEIVE MODE switch to USB. Set signal generator for 5 µvolt, cw signal output at 2 MHz. Connect oscilloscope to pin A1(J6) on A306 and check for 455 kHz signal.	*a.* RECEIVE MODE switch A3S5, circuit card assembly A207, or circuit card assembly A305.	*a.* Replace defective switch A3S5, detection logic card A207, or ssb and cw detector card A305.
		b. Connect oscilloscope to pin A3 (J8) on A306 and check for 455 kHz ssb output.	*b.* Defective component on circuit card assembly.	*b.* Replace defective ssb filters card A306.
6	Afc inoperative; receiver functioning properly when not in afc mode.	*a.* Set AFC switch to OFF and TRANSMIT MODE switch to OFF Set METER SELECTOR switch to RF INPUT. Set signal generator for 5 µvolts cw signal at 2 MHz. Vary signal generator frequency ±3 kHz. TUNE HIGHER and TUNE LOWER indicators should light.	*a.* If indicators do not light, go to check c below.	*a.* N/A.
		b. Vary signal generator output level 5. and monitor rt unit METER SELECTOR meter. Meter indicator should track signal generator output level.	*b.* Defective components on A301 or A304 circuit cards assemblies amplifier card detector card A304.	*b.* Replace defective attenuator and amplifier card A301 or log
		c. Connect oscilloscope to pin A1 (J6) on A304 and check for a nominal 1 volt peak-to-peak 21.4 MHz signal.	*c.* Defective components on circuit card.	*c.* Replace defective log amplifier and detector card A304.
		d. Connect dvm to A304, pin 12(E12) and then pin 7(E7). Zero vdc reading should be obtained on both, test points.	*d.* A208 or A210 defective.	*d.* Replace defect ve rt logic card A208 or sample and hold card A210.
		e. Connect oscilloscope to pin A1(J6) on A301 and check for a low level 21.4 MHz signal.	*e.* Defective components on circuit card.	*e.* Replace defective attenuator and amplifier card A301.
		f. Connect dvm to pin 9 (E9) on A203 and check for +5 vdc (AFC switch OFF) and check for 0 vdc with AFC switch to WIDE or NARROW.	*f.* Defective components on circuit card.	*f.* Replace defective sample and hold card A210.
		g. Connect dvm to TP2 on A203. Vary signal generator frequency± 4 kHz. dvm reading should vary ± 0.5 volts in accordance with frequency variation.	*g.* Defective components on circuit card.	*g.* Replace defective afc and loop interface card A203.

c. Search Mode Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
7	No rf input indicated on front panel meter; receiver functioning properly.	*a.* TRANSMIT MODE and AFC switches to OFF. Set signal generator for 5µvolt cw signal output at 2 MHz. Vary signal generator frequency output above and below 2 MHz. Tune HIGHER and TUNE LOWER indicators light accordingly.	*a.* Afc inoperative. If indicators function properly, go to check b	*a.* Refer to item 6 above and trouble-shoot the A301, A303 and A304 portion of the afc circuitry.
		b. Set TRANSMIT MODE switch to VOICE R/T. Connect mic to modulation source Connect oscilloscope to pin 18 (E18) on A210 and check for the following: 2 volts peak-to-peak, mic not keyed. 0 volts peak-to-peak, mic keyed.	*b.* Defective components on circuit card assembly.	*b.* Replace defective sample and hold card A210.
		c. Equipment setup as in check a above. Connect dvm to following A206 pins, in turn, and measure the following: Pin 18 (E18): 0 volts Pin 11 (E11): 0 to 3 volts, varies as input level to rt unit varies.	*c.* Defective components on A206 circuit card assembly. If checks are normal, meter A3M1 defective.	*c.* Replace defective meter amplifier card A206. Replace defective meter A3M1.
8	No receiver output heard on headset; front panel meter indicates rf input present.	*a.* Set signal generator for 5µvolts, cw signal at 2 MHz. Set dvm to measure dc voltage. Set RECEIVE MODE switch to AM. Connect DVM to the following on A207 and check voltage: Pin 5(E5): 0 vdc Pin 24(E24): 0 vdc Pin 22(E22): 0 vdc Pin 26(E26): 0 vdc.	*a.* Defective components on circuit card.	*a.* Replace defective detection logic card A207.
		b. Set RECEIVE MODE switch to LSB. Connect dvm to the following on A207 and check voltage: Pin 8(E8): 0 vdc Pin 5(E5): +12 vdc Pin 24(E24): 0 vdc Pin 22(E22): 0 vdc Pin 26(E26): 0 vdc.	*b.* Defective components on A207 circuit card.	*b.* Replace defective detection logic card A207.
		c. Set RECEIVE MODE switch to CW. Connect dvm to the following on A207 and check voltage: Pin 5(E5): 0 vdc Pin 24(E24): +12 vdc	*c.* Defective components on A207 circuit card.	*c.* Replace defective detection logic card A207.

c. Search Mode Troubleshooting Procedures. - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
8 (Cont)		Pin 22(E22): 0 vdc Pin 26(E26): 0 vdc.		
		d. Set RECEIVE MODE switch to USB. Connect dvm to the following. on A207 and check voltage: Pin 8(E8): +12 vdc Pin 5(E5): +12 vdc Pin 24(E24): 0 vdc Pin 22(E22): 0 vdc Pin 26(E26): 0 vdc.	*d.* Defective components on A207 circuit card.	*d.* Replace defective detection logic card A207.
		e. N/A	*e.* If all checks are normal, receiver, audio fault.	*e.* Refer to item 3 above and trouble-shoot receiver audio circuitry.
9	Zero beat function inoperative; receiver audio functioning properly.	*a.* Disconnect signal generator from J2 on rt unit; reconnect system cable to J2. Set TRANSMIT MODE switch to CONT. Pan indicator displays transmitter signal.	A. If no display on pan indicator, go to check c.	*a.* N/A.
		b. Set ZERO BEAT switch to ON. Connect oscilloscope to A301 pin A2 (J7) and check for 21.4 MHz output.	*b.* Defective component on circuit, card assembly.	*b.* Replace defective attenuator and amplifier card A301.
		c. Connect dvm to A104, pin 4(E4) and then to pin 5(35); measure 5 volts.	*c.* A208 defective. A206.	*c.* Replace defective rt logic card
		d. Connect oscilloscope to pin A2(J7) on A104 and check for 45 MHz rf, output.	*d.* Defective components on circuit card assembly.	*d.* Replace defective vcxo and mixer card A104.

4-17. Rf Transmit Troubleshooting

a. Test Equipment Required.

(1) Oscilloscope AN/USM-281C.
(2) Rt Unit Special (cable Assembly.
(3) Wattmeter 4301.
(4) Wattmeter Plug-in, 50H.
(5) Extender Card 1.
(6) Extender Card 2.
(7) Extender Card 3.
8) Digital Voltmeter AN/GSM-64.

b. Connections and Conditions. Set POWER ON circuit breaker to off (down position). Slide rt unit out of equipment rack. Remove top access cover from rt unit and set aside. Set rt unit controls as follows:

(1) METER SELECT6R switch to RF OUTPUT.
(2) MODULATION switch to FSK.
(3) DEVIATION AM MOD control to 1.
(4) CHIRP RATE control to OFF.
(5) RF OUTPUT control to 5.
(6) TRANSMIT MODE switch to OFF.
(7) AFC switch to OFF.
(8) RF GAIN control to AGC ON.
(9) AF GAIN control as required.
(10) IF BW switch to WIDE
(11) POWER ON circuit breaker to on (up position).

c. Rf Transmit Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	No rf output.	*a.* Set TRANSMIT MODE switch to CONT; using dvm, check following pins on A208: *Pin* — *vdc (approx)* 37(E37) — + 12 17(E17) — +0.5 19(E19) — +0.5 16(E16) — +0.5 14(E14) — +0.5 31(E31) — + 12 10(E10) — +5.0 18(E18) — +5.0 2(E2) — + 24 7(E7) — + 12	*a.* A208 defective.	*a.* Replace defective rt logic card A208.
		b. Set MODULATION switch to AM/FM and check A104 output at pin A3(J8) with oscilloscope while varying DEVIATION control. Output should be same frequency as rt unit tuning and vary with setting - of DEVIATION control.	*b.* A104 defective; DEVIATION control A3R2A defective	*b.* Replace defective vcxo and mixer card A104; check A3R2A and replace as required.
		c. Using dvm, check for +12 vdc on . pin 9 E9) of A105; check for O vdc on pin 4(E4) of A105.	*c.* A208, A2, or RF OUT T control A3R3 defective.	*c.* Check control A3R3 and replace as required. Check filter card A2 and replace defective component as card. Replace defective rt logic card A205.
		d. Set RF OUTPUT control to minimum, connect oscilloscope to pin A4 (J10) on A105 and check for same frequency as rt unit tuning.	*d.* A105 defective and level control card A105.	*d.* Replace defective am. modulator
		e. Connect dvm to pin 12 (E12) on A03 and check for O vdc.	*e*. A208 defective.	*e*. Replace defective rt logic card A208.
		f. Using oscilloscope, check pin A5 (J10) on A103 for rf output varying as RF OUTPUT control is varied.	*f.* A103 defective; RF OUTPUT control A3R3 defective. and replace as required.	*f.* Replace defective rf power amplifier card A103; check A3R3
		g. Connect dvm to A102 pins given below. Tune rt unit to frequency indicated. dvm indicates +12 vdc on designated pins. *Pins* — *Rt Unit Freq*. 11 (E11) — 2.0 MHz 3 (E3) — 3.4 MHz 5 (E5) — 5.7 MHz 4 (E4) — 9.5 MHz 12 (E12) — 16.0 MHz Return rt unit frequency to 2 MHz.	*g*. A205 defective.	*g*. Replace defective programmable counter card A205.

c. Rf Troubleshooting Procedures. --Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1 (Cont)		*h.* Using oscilloscope. check for rf output at pin A5(J10) on A102.	*h*. A102 defective.	*h*. Replace defective bandpass filters card A102.
		I. Using oscilloscope, check for rf output at pin A1 (J6) on A101. Output varies with setting of RF OUTPUT control.	*I.* A101 defective.	*I.* Replace defective power attenuator card A101.
		j. Check with dvm for 0 to 1 vdc at E3 on A101 as RF OUTPUT control is varied.	*j.* A101 defective; RF OUTPUT control A3R3 is defective. and replace as required.	*j.* Replace defective power amplifier card A101; check A3R3
		k. Connect wattmeter to J5 on rear of rt unit. Set RF OUTPUT control for 5 watts on wattmeter. On control: unit set HI RF-LOW RF switch to LOW RF. Power should. drop to 2.5 (±1) watts as noted on watt meter. Meter indicates 5 watts with switch set to HI RF.	*k.* A101 defective	*k*. Replace defective power amplifier card A101.
2	Rf output good but no indication on front panel meter.	Set METER SELECTOR switch to RF OUTPUT; set RF OUTPUT control to 4. Set TRANSMIT MODE switch to CONT. Set modulation source VOICE switch to on (green). Measure voltage with dvm at the following pins on A206: Pin 20 (E20): 0 vdc Pin 16 (E16): vdc varies with setting of RF OUTPUT control. Pin 14 (EI4): vdc varies with setting of RF OUTPUT control.	A206 defective RF OUTPUT control A3R3 defective.-	Replace defective meter amplifier card A206. Check A3R3 card replace as required.
3	Rf output good but no transmitter signal displayed on pan indicator.	*a.* Connect signal gear to rt unit rf input connector J2. Set signal generator for 5 µvolts, cw signal at 2 MHz. Set TRANSMIT MODE switch to OFF and ZERO BEAT switch to ON. Check operation of zero beat function.	*a.* Zero beat circuitry inoperative.	Refer to search mode troubleshooting, paragraph 4-16c, item 9.
		b. Set TRANSMIT MODE switch to CONT. Set modulation source CONT KEYING switch to on (green). Using dvm, measure voltage at following pins of A208:	*b*. Probable trouble is	*b*. Proceed as follows:
		(1) Pin 13 (E13): 0 vdc	(1) FL1 defective.	(1) Check and replace rfi filter FL1.
		(2) Pin 36 (E36): 0 vdc	(2) FL1 defective.	(2) Check and replace rfi filter FL1.
		(3) Pin 35 (E35): 12 vdc	(3) FL1 defective.	(3) Check and replace rfi filter FL1.

c. Rf Transmit Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
3 (Cont)		(4) Pin 29 (E29): 0 vdc (5) Pin 11 (E11): 12 vdc *c.* Using dvm measure voltage at following pins of A208: (1) Pin 24 (E24): 12 vdc (2) Pin 17 (E17): 0 vdc (3) Pin 32 (E32): 0 vdc (4) Pin 19 (E19): 0 vdc (5) Pin 16 (E16): 0 vdc (6) Pin 14 (E14): 0 vdc (7) Pin 15 (E15): 0 vdc (8) Pin 37 (E37): 12 vdc (9) Pin 10 (E10): 12 vdc (10) Pin 18 (E18): 12 vdc (11) Pin 9 (E9): 12 vdc	(4) TRANSMIT MODE switch A3S7 defective. (5) FL1 defective. *c*. If any of these readings are incorrect, A208 is defective. If A208 checks are normal, A407 is defective.	(4) Check and replace A3S7 as required. (5) Check and replace rfi filter FL1. *c*. Replace rt logic card A208. Replace defective pan indicator if. amplifier card A407.

4-18. Modulation Troubleshooting

a. Test Equipment Required.

(1) Oscilloscope AN/USM-281C.
(2) Digital Voltmeter AN/GSM-64.
(3) Extender Card 1.
(4) Extender Card 2.
(5) Extender Card 3.
(6) Rt Unit Special Cable Assembly.
(7) Signal Generator AN/GRM.50.
(8) Termination, T150B.

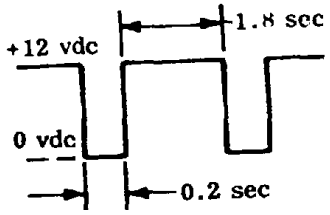
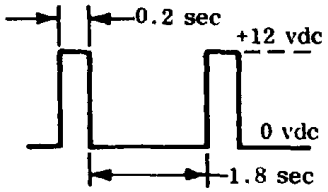
b. Connections and Conditions. Set POWER ON circuit breaker to off (down position). Slide rt unit out of equipment rack. Remove top access cover from rt unit and set aside. Set rt unit controls as follows:

(1) METER SELECTOR switch to RF OUTPUT.
(2) MODULATION switch to OFF.
(3) DEVIATION and AM MOD controls to 1.
(4) CHIRP RATE control to OFF.
(5) RF OUTPUT control to 5.
(6) AFC switch to OFF.
(7) TRANSMIT MODE switch to OFF.
(8) AF GAIN control as required.
(9) RF GAIN control to AGC ON.
(10) IF BW switch to WIDE.
(11) POWER ON circuit breaker to on (up position).

c. Modulation Troubleshooting Procedures

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	No keying in continuous random, hand, or periodic key modes.	*a.* Set TRANSMIT MODE switch to CONT. Set modulation source CONT KEYING switch to on (green). Using dvm, measure voltage at following input pins of A208:	*a.* Probable troubles are:	*a.* Proceed as follows:
		(1) Pin 13 (E13): 0 vdc (voice modulation).	(1) FL1 defective.	(1) Check and replace rfi filer FL1.
		(2) Pin 36 (E36): 0 vdc	(2) FL1 defective.	(2) Check and replace rfi filter FL1.
		(3) Pin 35 (E35): 12 vdc	(3) FL1 defective.	(3) Check and replace rfi filter FL1.
		(4) Pin 29 (E29): 0 vdc	(4) TRANSMIT MODE switch A3S7 defective.	(4) Check and replace A3S7.
		(5) Pin 11 (E11): 12 vdc	(5) FL1 defective.	(5) Check and replace rfi filter FL1.
		Using dvm, measure voltage at following output pins of A208: (1) Pin 24 (E24): 15 vdc to 28 vdc (2) Pin 17 (E17): 0 vdc (3) Pin 32 (E32): 0 vdc (4) Pin 19 (E19): 0 vdc (5) Pin 16 (E16): 0 vdc (6) Pin 14 (E14): 0 (+0.5) vdc (7) Pin 15 (E15): 0 vdc (8) Pin 37 (E37): 12 vdc (9) Pin 10 (E10): 12 vdc (10) Pin 18 (E18): 12 vdc (11) Pin 9 (E9): 12 vdc	If any of these readings are incorrect, A208 is defective.	Replace defective rt logic card A208.
		b. Set modulation source CONT KEYING switch to on (green). Set TRANSMIT MODE switch to LOOK THRU. Using dvm, check voltage at following input pins of A208:	*b.* Probable troubles are:	*b.* Proceed as follows:
		(1) Pin 13 (E13): 0 vdc (voice modulation)	(1) FL1 defective.	(1) Check and replace rfi filter FL1.
		(2) Pin 36 (E36): 0 vdc	(2) FL1 defective.	(2) Check and replace rfi filter FL1.
		(3) Pin 27 (E27): 0 vdc	(3) TRANSMIT MODE switch A3S7 defective.	(3) Check A3S7 and replace as required.
		c. Using oscilloscope, check the following input pins of A208.	*c.* Probable trouble:	*c.* Proceed as follows:
		(1) Pin 35 (E35): negative-going 0.2 sec pulse every 18 sec.	(1) FL1 defective.	(1) Check and replace rfi filter FL1.

c. Modulation Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1 (Cont)		 (2) Pin 23 (E23): negative-going 0.2 sec pulse every 1.8 sec. (3) Pin 24 (E24): negative-going 0.2 sec pulse every 1.8 sec (identical to pin 35).	(2) FL1 defective. (3) FL1 defective. If signal present on pin 23 (E23) but not present on pin 24 (E24), A208 is defective.	(2) Check and replace rfi filter FL1. (3) Check and replace rfi filter FL1; replace defective rt logic card A208.
		d. Using dvm, check voltage at following output pins of A208: (1) Pin 9 (E9): 12 vdc (2) Pin 32 (E32): 0 vdc (3) Pin 15 (E15): 0 vdc (4) Pin 10 (E10): 12 vdc (5) Pin 18 (E18): 12 vdc	*d.* If any readings are incorrect, A208 is defective.	*d.* Replace defective rt logic card A208.
		e. Using oscilloscope, check voltage at following output pins of A208: (1) Pin 37 (E37): 12 vdc to 0 vdc, pulsing at look thru rate. (2) Pins 17 (E17), 19 (E19), 16 (E16),and 14 (E14): 0 vdc going to 12 vdc at look thru rate. 	*e.* If any readings are incorrect A208 is defective.	*e.* Replace defective rt logic card A208.
		f. Set SIJ THRESHOLD control to 9. Set modulation source CONT KEYING switch to on (green). Set TRANSMIT MODE switch to SIJ. Using a dvm, check voltage at following input pins of A208:	*f.* Probable troubles are:	*f.* Proceed as follows:

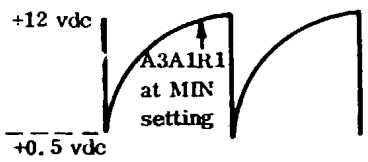
c. Modulation Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1 (Cont)		(1) Pin 28 (E28): 0 vdc	(1) TRANSMIT MODE switch A3S7 defective.	(1) Check and replace A3S7 as required.
		(2) Pin 22 (E22): 12 vdc	(2) If 12 vdc cannot be obtained - by varying SIJ THRESHOLD control, A210 is defective.	(2) Replace defective sample and hold card A210.
		(3) Pin 27 (E27): 12 vdc	(3) TRANSMIT MODE A3S7 switch defective.	(3) Check and replace A3S7 as required.
			N/A.	If A208 readings are all good, then rf transmit circuitry is defective. Refer to paragraph 4-17, rf transmit troubleshooting.
2	No fm deviation, no meter indication.	*a.* Control Settings. Set modulation source controls as follows: (1) TONES switch on (green). (2) TONE SEL KC/S switch to 1-3.5 KHZ. (3) TONE FREQ KC/S to 1.55 KHZ nominal. Set DEVIATION control to 10 and MODULATION switch to FM/CHIRP. Check A209 pin 4 (E4) with dvm for 0 vdc.	*a.* MODULATION switch A3S4 defective.	*a.* Check A3S4 and replace as required.
		b. Deviation Control Test. Check A209 pin 16 (E16) with dvm for 0 to +3 vdc as DEVIATION control is. varied.	*b.* DEVIATION control A3R2B defective.	*b.* Check A3R2B and replace as required.
		c. Modulation Output Test. Check A209 pin 25 (E25) with oscilloscope for 0 to 1.6 volts peak-to-peak as DEVIATION control is varied. Measurement should be same with TRANSMIT MODE switch set to AM/FM and DSBSC/FM.	*c.* A209 defective. logic card A209.	*c.* Replace defective modulation
		d. Frequency Modulation Test. Set TRANSMIT MODE switch to CONT. Set MODULATION switch to AM/FM. Check pin A3 (J8) on A104 with oscilloscope while varying DEVIATION control. Fm carrier should vary with DEVIATION, control.	*d.* A104 defective.	*d.* Replace defective vcxo and mixer card A104.
3	Fm tone/noise/voice modulation defective; deviation observed on pan indicator but no meter indication.	*a.* Using dvm check for +12 vdc at A301 pin 12 (E12).	*a.* A208 defective.	*a.* Replace defective rt logic card A208.
		b. Using dvm check for 0v at A301 pin 7 (E7).	*b.* A210 defective.	*b.* Replace defective sample and hold card A210.

c. Modulation Troubleshooting Procedures - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
3 (Cont)		*c.* Using oscilloscope, check for 21.4 MHz at A301 pin A5 (J10).	c. A301 defective.	c. Replace defective attenuator and amplifier card A301.
		d. Using oscilloscope check for 21.4 MHz at A304 pin A1 (J6).	*d.* A304 defective.	*d.* Replace defective log amplifier. and detector card A304.
		e. Connect signal generator to J2 on rt unit. Set generator for μvolt cw signal output at 2 MHz. Set TRANSMIT MODE switch to OFF. Set AFC switch to OFF. Check A303 pin A1 (J6) with dvm and vary signal generator frequency. Output varies ±800 mv for ±5 kHz variation of input signal. Remove signal generator from rt unit.	*e.* A303 defective	*e.* Replace defective fm and an afc defector card A33.
		f. Set TRANSMIT MODE switch to CONT. Set MODULATION switch to AM/FM. Using dvm, check A206 pin 22 (E22) for 0 vdc.	*f.* METER SELECTOR switch A3S3 defective.	*f.* Check switch A3S3 and replace as required.
		g. Check A206 pin 9 (E9) for 1.5 vac max that varies as DEVIATION control as varied.	*g.* A304 defective.	*g.* Replace defective log amplifier and detector card A304.
		h. Check A206 pin 14 (E14) for 4.45 vdc max that varies as DEVIATION control is varied.	*h.* A206 defective; if check is normal, meter A3M1 defective.	*h.* Replace defective meter amplifier card A206; replace defective meter A3M1.
4	Fak modulation inoperative.	*a.* Set MODULATION switch to FSK. Set DEVIATION control to 5. Set modulation source RANDOM, KEYING switch to on (green). MOD OFF switch to off (green). Check A209 pin 28 (E28) for 0v on dvm.	*a.* MODULATION switch A3S4 defective.	*a.* Check A3S4 and replace as required.
		b. Check A209 pin 25 (E26) with oscilloscope for square-wave pulse train. Amplitude (approximately 0.5v) varies with setting of DEVIATION control	*b.* A209 defective.	*b.* Replace defective modulation logic card A209.
		c. Check A104 pin A3 (J8) with oscilloscope while varying DEVIATION control Observe that: fm carrier is varying with setting of DEVIATION control	*c.* A104 defective.	*c.* Replace defective vcxo and mixer card A104.
5	Fm/chirp modulation inoperative.	*a.* Set MODULATION switch to FM/CHIRP, CHIRP RATE control to 5 and DEVIATION control to 5. Set modulation source RANDOM KEYING switch to on (green).	*a.* MODULATION switch A3S4 defective.	*a.* Check A3S4 and replace as required.

c. Modulation Troubleshooting Procedures. - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
5 Cont)		Check with dvm for 0 vdc (ground) on A209 pin 4 (E4).		
		b. Check with dvm for 0 vdc (ground) on A209 pin 27 (E27).	*b.* CHIRP RATE switch A3A1S1 defective.	*b.* Check A3A1S1 and replace as required.
		c. Check A202 pin 17 (E17) with oscilloscope for the following  Rise time of pulses depends on setting of CHIRP RATE control A3A1R1.	*c.* CHIRP RATE control A3A1R1 defective.	*c.* Check A3A1R1 and replace as required.
		d. Check A209 pin 25 (E25) with oscilloscope for sawtooth voltage of approximately 0.5 vdc amplitude and varying with settings of DEVIATION and CHIRP RATE controls (same waveform is step c above except different amplitude and off-set).	*d* A209 defective.	*d.* Replace defective modulation logic card A209.
		e. Set DEVIATION control to maximum. Check for fm carrier at A104 pin A3 (J8) with oscilloscope. Carrier should vary with setting of DEVIATION control.	*e.* A104 defective.	*e.* Replace defective vcxo and mixer card A104.
6	Am. voice/noise/tone modulation defective; meter indications are good.	*a.* Set modulation source TONES switch to on (green) TONE SEL KC/S switch to 1-3.5 KHz, and TONE FREQ kC/S to 1.55. Set AM MOD control to 9. Using oscilloscope, check A209 pin 12 (E12) for 0.4 volts peak-to-peak as MODULATION switch is set to AM, AM/FM, DSBSC and DSBSC/FM. Amplitude should vary as AM MOD control is varied.	*a.* A209 defective.	Replace defective modulation logic card A209.
		b. Set MODULATION switch to AM/FM. Tune rt unit to 1.9 MHz. Check A105 pin A4 (J9) with oscilloscope for am signal. display. Modulation index varies with AM	*b.* A105 defective. and level control card A105.	*b.* Replace defective am modulator

c. Modulation Troubleshooting Procedures - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
6 (Cont)		MOD control. Check for same output at 3.4, 5.7, 9.5 and 16.2 MHz.		
7	Am. noise/tone/voice modulation is good but no indication on meter.	*a.* Set METER SELECTOR switch to AM MOD and MODULATION switch to AM. Using dvm, check A206 pin 21 (E21) for 0 vdc.	*a.* METER SELECTOR switch A3S3 defective.	*a.* Check A3S3 and replace as required.
		b. Check A206 pin 8 (E8) with oscilloscope. Vary AM MOD control; reading should be 0 vac to 0.6 vac, p-p.	*b.* A206 defective.	*b.* Replace defective meter amplifier card A206.
		c. Check across pins 13 (E13) and 14 (E14) on A206 with dvm. Vary AM MOD control; reading should be 4.5 vdc to 0 vdc.	*c.* A206 defective; if check is normal, meter A3M1 is defective.	*c.* Replace defective meter amplifier card A206. Replace defective meter A3M1.
8	Dsbsc modulation inoperative.	*a.* Set MODULATION switch to DSBSC. Using dvm, check A209 pin 9 (E9) for 0 vdc (ground).	*a.* MODULATION switch A3S4 defective.	*a.* Check A3S4 and replace as indicated.
		b. Using dvm, check A209 pin 31 (E31) for 0 vdc. Using oscilloscope, check A105 pin A3 (J8) for dsbsc modulation. 	*b.* A209 defective. A105 defective.	*b.* Replace defective modulation logic card A209. Replace defective am. modlation and level control card A105.
9	Dsbsc/fm modulation inoperative.	*a.* Set TRANSMIT MODE switch to CONT and MODULATION switch to AM/FM. Set modulation source TONES switch to on (green) and CONT KEYING switch to on (green). Vary DEVIATION control while observing pan indicator display. Deviation noted on pan indicator display and METER SELECTOR meter. Check A104 pin A3 (J8) with oscilloscope for FM carrier.	*a.* Fm modulation inoperative.	*a.* Refer to item 2, 3, or 5 this procedure, as required.
		b. Check for DSBSC modulation as per item 8 above.	*b.* Dsbsc modulation inoperative. If fm and dsbsc modes are normal, A209 defective.	*b.* Refer to item 8. Replace defective modulation logic card A209.
10	Voice r/t transmit mode inoperative	*a.* Set TRANSMIT MODE switch to VOICE R/T. Connect mic to modulation source. Set modulation source VOICE switch to on (green).	*a.* Probable trouble is:	*a.* Proceed as follows:

c. Modulation Troubleshooting Procedures - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
10 (Cont)		Using a dvm, and with mic keyed, check the voltage of following input pins of A208:		
		(1) Pin 12 (E12): 0 vdc	(1) FL1 defective.	(1) Check and replace RF1 filter FL1.
		(2) Pin 8 (E8): 0 vdc	(2) TRANSMIT MODE switch A3S7 defective.	(2) Check and replace A3S7 as required.
		(3) Pin 11 (E11): 15 vdc	(3) FL1 defective.	(3) Check and replace rfi filter FL1.
		(4) Pin 35 (E35): 12 vdc	(4) FL1 defective.	(4) Check and replace rfi filter FL1.
		Using a dvm, and with mic keyed, check voltage of following output pins of A208: (1) Pin 32 (E32): 0 vdc (2) Pin 24 (E24): 12 vdc (3) Pin 17 (E17): 0 vdc (4) Pin 14 (E14): 0 vdc (5) Pin 37 (E37): 12 vdc (6) Pin 19 (E19): 0 vdc (7) Pin 16 (E16): 0 vdc (8) Pin 10 (E10): 5 vdc (9) Pin 15 (E15): 0 vdc (10) Pin 18 (E18): 5 vdc (11) Pin 9 (E9): 12 vdc	If any of the readings are incorrect, A208 is defective.	Replace defective RT logic card A208.

4-19. Look Through and SIJ Troubleshooting

a. Test Equipment Required.

(1) Oscilloscope AN/USM-281C.
(2) Digital Voltmeter AN/GSM-64.
(3) Extender Card 3.
(4) Rt Unit Special Cable Assembly.
(5) Signal Generator AN/GRM-50.

b. Connections and Conditions. Set POWER ON circuit breaker to off (down position). Slide rt unit out of equipment rack. Remove top access cover from rt unit and set aside. Set rt unit controls as follows:

(1) METER SELECTOR switch to RF INPUT.
(2) CHIRP RATE control to OFF.
(3) RF OUTPUT control to 5.
(4) TRANSMIT MODE switch to OFF.
(5) RECEIVE MODE switch to AM.
(6) AFC switch to OFF.
(7) AF GAIN control as required.
(8) RF GAIN control to AGC ON.
(9) IF BW switch to WIDE.
(10) SIJ THRESHOLD control to PRESET.
(11) POWER ON circuit breaker to on (up position).

c. Look Through and S1J Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Look through mode inoperative; receive and transmit functions good:	*a.* Set modulation source CONT KEYING switch to on (green). Set rt unit TRANSMIT MODE switch to LOOK THRU. Using dvm check, voltage of following input pins of' A208:	*a.* Probable troubles are:	*a.* Proceed as follows:
		(1) Pin 13 (E13): 0 vdc	(1) FL1 defective.	(1) Check and replace rfi filter FL1.
		(2) Pin 36 (E36): 0 vdc	(2) FL1 defective.	(2) Check and replace rfi filter FL1.
		(3) Pin 27 (E27): 0 vdc	(3) TRANSMIT MODE switch A3S7 defective.	(3) Check A3S7 and replace as required.
		b. Using oscilloscope, check the voltage of following input pins of A208.	*b.* Probable trouble:	*b.* Proceed as follows:
		(1) Pin 35 (E35): negative-going 0.2 sec pulse every 1.8 sec.	(1) FL1 defective.	(1) Check and replace rfi filter FL1.
		(2) Pin 23 (E23): negative-going; 0.2 sec pulse every 1.8 sec.	(2) FL1 defective.	(2) Check and replace rfi filter FL1.
		(3) Pin 24 (E24): negative-going 0.2 sec pulse every 1.8 sec.	(3) FL1 or A208 defective.	(3) Check and replace rf. filter FL1; replace defective rt logic card A208.
		c. Using dvm check voltage of following output pins of S208: (1) Pin 9 (E9): 12 vdc (2) Pin 32 (E32): 0 vdc (3) Pin 15 (E15): 0 vdc (4) Pin 10 (E10): 12 vdc (5) Pin 18 (E18): 12 vdc	*c.* If any readings are incorrect, A208 is defective.	*c.* Replace defective rt logic card A208.
		d. Using oscilloscope, check voltage of following output pins of A208: (1) Pin 37 (E37): 12 vdc to 0 vdc pulsing at look-thru rate. (2) Pin 17 (E17): 0 v to 1 v Pin 19 (E19): 0 v to 5 v Pin 16 (E16): 0.5 v to 24 v Pin 14 (E14): 0.5 to 24 v (nominal)	*d.* If any readings are incorrect, A208 is defective.	*d.* Replace defective rt logic card A208.
2	SIJ mode inoperative; receive and transmit function are good.	*a.* Set SIJ THRESHOLD control to 9 and TRANSMIT MODE switch to SIJ. Set modulation source CONT KEYING switch to on (green). Using a dvm, check voltage of following input pins of A208:	*a.* Probable troubles are:	*a.* Proceed as follows:
		(1) Pin Z8 (E28): 0 vdc	(1) TRANSMIT MODE switch A3S7 defective.	(1) Check and replace A3S7 as required.

c. Look Through and SIJ Troubleshooting Procedures - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
2 (Cont)		(2) Pin 22 (E22): +3 vdc	(2) If +3 vdc cannot be obtained by varying SIJ THRESHOLD control, A210 is defective.	(2) Replace defective sample and hold card A210.
		(3) Pin 27 (E27): +12 vdc	(3) TRANSMIT MODE A3S7 switch defective.	(3) Check and replace A3S7 as required.
		b. Using dvm, check voltage of following output pins of A208: (1) Pin 9 (E9): 12 vdc (2) Pin 32 (E32): 0 vdc (3) Pin 15 (E15): 0 vdc (4) Pin 10 (E10): 12 vdc (5) Pin 18 (E18). 12 vdc	*b.* If any readings are incorrect, A208 is defective.	*b.* Replace defective rt logic card A208.
		c. Using oscilloscope, check the following output pins of A208: (1) Pin 37 (E37): 12 vdc to 0 vdc pulsing at look-through rate. (2) Pins 17 (E17), 19 (E19), 16. (E16), and 14 (E14): o vdc going to 12 vdc at look through rate.	*c.* If any readings are incorrect, A208 is defective.	c. Replace defective rt logic card A208.
		d. Set TRANSMIT MODE switch to OFF. Check A210 pin 13 (E13) with dvm for +3 vdc.	*d.* A210 defective.	*d.* Replace defective sample and hold card A210.
		e. Connect signal generator to J2 or rt unit. Set signal generator to 2 MHz and at a level greater than 5 μV Tune rt unit to test signal. Check, A210 pin 13 (E13) with dvm. Reading should be +3 vdc when test input signal is greater than 5 μV and 0 vdc when test input signal ' is less than 5 A V.	*e.* A210 defective.	*e.* Replace defective sample and hold card A210.

4-20. Rt Unit Tuning Troubleshooting

a. Test Equipment Required.

(1) Oscilloscope AN/USM.281C.
(2) Digital Voltmeter AN/GSM-64,
(3) Extender Card 1.
(4) Extender Card 2.
(5) Rt Unit Special Cable Assembly.
(6) Termination T150B.

b. Connections and Conditions. An rt unit tuning malfunction indicates a problem in the p11 frequency synthesizer (circuit card assembly A201 thru A208) or readout counter (A3A2). To localize the faulty circuit card assembly, perform all the A201 through A205 systemic checks given in c below. Before troubleshooting the rt unit, perform the following:

(1) Set POWER ON circuit breaker to off (down).
(2) Slide rt unit out of equipment rack.
(3) Remove top sears cover from rt unit and set aside.
(4) Set AFC switch to OFF.
(5) Set EXT CAL switch on rear of rt unit) to OFF.
(6) Set FREQ LOCK switch to off (indicator out).
(7) TRANSMIT MODE switch to OFF.

c. Rt Unit Tuning Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Malfunction in rt tuning unit; faulty card assembly (A201-A205) readout counter (A3A2).	*a.* Connect oscilloscope to pin 13 (E13) on A201, and measure a nominal; +12v pulse of duration 1.5 (±1) sec. when rt unit POWER ON circuit breaker is set to on (up).	*a.* A201 defective.	*a.* Replace defective timing and reference card A201.
		b. Connect oscilloscope to E2 on A201. and observe a 10 Hz square wave with a minimum amplitude of, +2.4v. Use 50 ohm termination on. oscilloscope input.	*b.* A201 defective.	*b.* Replace defective timing and reference card A201.
		c. Connect oscilloscope to pin 22 (E22) on A201 and observe a 10 kHz square wave with a logic 1 between 2.5v and 5v and logic O between 0v, and 0.6v.	*c.* A201 defective.	*c.* Replace defective timing and reference card A201.
		d. While turning COARSE tuning control in either direction, observed; ttl square waves at pins 8 (E8) and 9 (E9) on A201.	*d.* Defective shaft encoder in readout counter.	*d.* Replace defective readout counter A3A2.
		e. Connect oscilloscope to pin 21 (E21) on A201 and measure nominal + 12 vdc.	*e.* Defective FREQ LOCK switch.	*e.* Replace defective FREQ LOCK switch A3A2S1.
		f. Connect oscilloscope to pin 4 (E4) on A201 and measure ttl logic level.	*f.* A210 defective.	*f.* Replace defective sample and hold card A210.
		g. While turning FINE TUNING control in either direction, observer ttl square waves at pins 10 (E10) and 11 (E11) on A201.	*g.* Defective shaft encoder in, readout counter.	*g.* Replace defective readout counter A3A2.
		h. Connect oscilloscope to pin 20 (E20) on A201 and observe nominal. +12v pulses while COARSE TUNING control is turned cw. Pulses are in groups of 3.	*h.* A201 defective.	*h.* Replace defective timing and reference card A201.
		I. Connect oscilloscope to pin 17 (E17) on A201 and observe nominal 12v pulses while FINE TUNING control is turned cw. (Normally high and pulses to gnd.)	*I.* A201 defective.	*I.* Replace defective timing and reference card A201.
		j. Connect oscilloscope to pin 16 (E16), on A201 and observe + 12v when COARSE or FINE TUNING control: is turned ccw and 0 vdc when either is turned cw.	*j.* A201 defective.	*j.* Replace defective timing and reference card A201.

c. Rt Unit Tuning Troubleshooting Procedures - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
2	Defective counter rt tuning unit.	Set POWER-ON circuit breaker to off (down). Wait 5 seconds and set POWER ON circuit breaker to on (up). Connect oscilloscope to pin 20 (E20) on A201 and observe same pulses as in item 10 while turning COARSE TUNING control ccw. Note that pulses stop within one revolution of the knob.	*a*. Probable troubles are:	*a*. Proceed as follows:
		If pulses do not stop, connect oscilloscope to pin 18 (E18) on A201. Set POWER ON circuit breaker to off (down). Wait 5 seconds and then set POWER ON circuit breaker to on (up). Pin 18 (E18) should be at +12v nominal within one turn of the COARSE TUNING control in the ccw direction. Pin 18 (E18) will either pulse low once, or remain high. Repeat check several times to be sure which condition exists.	*b*. If pin 18 (E18) is normally low instead of high, A205 defective. *c*. If pin 18 (E18) is normally high but never pulses low, A205 defective. *d*. If pin 18 (E18) pulses low momentarily, A201 defective.	*b*. Replace defective programmable counter card A205. *c*. Replace defective programmable counter card A205. *d*. Replace defective timing and reference card A201.
		Set POWER ON circuit breaker to off (down), connect oscilloscope to pin 13 (E13) on A201. Measure a nominal +12 vdc pulse of 1.5 sec duration when POWER ON circuit breaker is set to on (up).	*e*. A201 defective.	*e*. Replace defective timing and reference card A201.
		Connect oscilloscope to pin A3 (J6) on A201. Measure a nominal 4 vdc, 10 Hz square wave.	*f*. A201 defective.	*f*. Replace defective timing and reference card A201.
		Using oscilloscope, measure a nominal 5 vdc, 10 kHz square wave at pin 22 (E22) on A201.	*g*. A201 defective.	*g*. Replace defective timing and reference card A201.
		Connect oscilloscope to pin 22 (E22) on A201 and measure a nominal 5 vdc, 10 kHz square wave.	*h*. A201 defective.	*h*. Replace defective timing and reference card A201.
		Connect oscilloscope to pin 20 (E20) on A201. Measure a nominal 12 vdc pulse train, consisting of 5 pulses at a 10 kHz rate for each 3.6° rotation of the COARSE TUNING control.	*i* A201 defective.	*I*. Replace defective timing and reference card A201.
		Connect oscilloscope to pin 17 (E17) on A201. Measure a nominal +12 vdc pulse for each 3.6° rotation of FINE TUNING control	*j*. A201 defective.	*j*. Replace defective timing and reference card A201.

c. Rt Unit Tuning Troubleshooting Procedures - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
2 (Cont)		Connect oscilloscope, to pin 16 (E16): on A201. Measure a nominal +12 vdc level as rt unit is tuned down in frequency; measure 0 vdc as rt unit is tuned up in frequency.	*k*. A201 defective.	*k*. Replace defective timing and reference card A201.
3	Frequency adjustment and alignment malfunctions.	Connect oscilloscope channel 1 probe to pin 14 (E14) on A202. Connect. channel 2 probe to pin 11 (E11) on A202. Trigger oscilloscope on pin 14, (E41) signal. Rotate COARSE TUNING control in either direction and observe one pulse at pin 14 (E14) for every 10 pulses at pin 11 (E11). Pin 14 (E14) is normally high (+ 12 vdc).	*a.* A202 defective.	*a*. Replace defective second loop card A202.
		Connect digital counter 1A9 to pin 21 (E21) on A202. Observe that the frequency increases in 10 Hz steps when turning the FINE TUNING control cw. Frequency decreases in 10 Hz step when FINE TUNING control is turned ccw (3.6° of rotation/10 Hz). Frequency will change in 3 kHz steps when, COARSE TUNING control is turned cw or ccw. Note that frequency continually cycles between 20 kHz and 29.99 kHz. When the top is reached, the frequency jumps, back down. When tuning down and, 20 kHz is reached, the frequency: jumps back to the top of the band.	*b*. A202 defective.	*b*. Replace defective second loop card A202.
		Connect oscilloscope to pin 18 (E18) on A202. Measure a normally high (+12v) and low (0v) pulse for each 10 turns of FINE TUNING control, and 50 turns for each resolution of COARSE TUNING control.	*c.* A202 defective	*c*. Replace defective second loop card A202.
		Connect oscilloscope to pin 19 (E19) on A202. Measure a 5 vdc, 10 kHz square wave.	*d.* A202 defective.	*d*. Replace defective second loop card A202.
		Connect dvm to pin 9 (E9) on A203. Set AFC switch to NARROW and then to WIDE while checking for a nominal 0v (when AFC switch is OFF, pin 9 (E9) should be +5V).	*e*. A210 defective.	*e*. Replace defective sample and hold card A210.

c. Rt Unit Tuning Troubleshooting Procedures - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
3 (Cont)		Connect dvm to pin 1 (E1) and pin 11 (E11) on A203. With AFC switch set to either WIDE or NARROW, the voltage should be between ± 60 mv.	*f.* A210 defective.	*f.* Replace defective sample and hold card A210.
		Connect oscilloscope to pin A1 (J4) on A203. Set AFC switch to OFF. Measure 45 MHz signal.	*g.* A203 defective.	*g.* Replace defective afc and loop interface card A203.
		Connect oscilloscope to pin A3 (J6) on A203. Set AFC switch to OFF. Check for a 45.020 MHz to 45.02999 MHz signal as rt unit is tuned.	*h.* A203 defective.	*h.* Replace defective afc and loop interface card A203.
		Connect oscilloscope to pin A3 (J6) on A203. Set AFC switch to WIDE. Check for 45 MHz Signal that varies ± 3 kHz as rt unit tuning is varied.	*i* A203 defective.	*I.* Replace defective afc and loop interface card A203.
4	Frequency signals missing or unstable.	Connect oscilloscope to pin 10 (E10) or A204 and observe nominal +5v pulses at frequency of 10 kHz.	*a.* If pulses are missing or unstable either A204 or A205 is defective.	*a.* Replace main loop card A204 or programmable counter card A205 to determine defective circuit card assembly.
		Connect oscilloscope to pin 3 (E3) on A204 and observe ttl pulses in frequency range of 1.42 to 20.52 MHz.	*b.* If signal is absent or unstable down to Hz position (± 1 Hz), A204 or A205 is defective.	*b.* Replace main loop card A204 or programmable counter card A205 to determine defective circuit card assembly.
		Connect digital counter 1A9 to pin 3 (E3) to check frequency.	*c.* If frequency is not stable down to the Hz (± 1 Hz) position either A204 or A205 is defective.	*c.* Replace main loop card A204 or programmable counter card A205 to determine defective circuit card assembly.
		Connect digital counter 1A9 to pin A1 (J6) on A204.	*d.* If frequency is stable but level is low, A204 is defective.	*d.* Replace defective main loop card A204.
		Connect oscilloscope to pin A3 (J8) on A204 (A3 must be terminated in 50, ohm if cable is left hanging) and. observe +2v min square wave at a frequency between 1.42 20.52 MHz.	*e.* If frequency is unstable to Hz position (± 1 Hz) and all previous checks are good A204 is defective.	*e.* Replace defective main loop card A204.
		NOTE **Square wave may become quite rounded at the higher frequencies. The logic 0 level should not rise above 0.6v as the rt unit is tuned across the entire band.**		
		Connect digital counter 1A9 to pin A1 (J6) on A204. Set AFC switch to OFF. Measure 46.5 to 65 MHz as COARSE and FINE TUNING controls are varied.	*f.* A204 defective.	*f.* Replace defective main loop card A204.

c. Rt Unit Tuning Troubleshooting Procedures - Continued.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
4 (Cont)		Connect oscilloscope to pin A3 (J8) on A204. Check for nominal 3.5v p-p square waves as COARSE and. FINE TUNING controls are varied.	*g*. A204 defective.	*g*. Replace defective main loop card A204.
		Connect oscilloscope to pin 3 (E3) on. A204. Set AFC switch to OFF. Check for nominal 4v peak-to-peak square waves as COARSE and FINE TUNING controls are varied.	*h*. A204 defective.	*h*. Replace defective main loop card A204.
		Connect oscilloscope to pin 16 (E16) on A205. Set POWER ON circuit breaker to off (down). Wait 5 seconds and then set POWER ON circuit breaker to on (up). Check for a nominal +12 vdc level. Check that pins 15 (E15), 17 (E17), 18: (E18) and 19 (E19) on A205 are low (O vdc) and that pin 22 (E22) and pin 10 (E10) are high (+12 vdc).	*I*. A205 defective.	*I*. Replace defective programmable counter card A205.
5	Rt tuning unit timing and counter card malfunction.	Connect oscilloscope to pin 22 (E22) on A205 and observe nominal +12 vdc; level. Pin 22 (E22) will go to 0 vdc when COARSE TUNING control is rotated 1/2-turn ccw. No more than, one pin should be high (+ 12vdc) at any one time among pins 15 (E15), 16 (E16), 17 (E17), 18 (E18) and 19, (E19) on A205.	*a*. If pin 22 (E22) never went low, A205 defective. *b*. If pin 22 (E22) pulsed low immediately, A201 defective.	*a*. Replace defective programmable counter card A205. *b*. Replace timing and reference card A201.
		Connect oscilloscope channel 1 probe to pin 16 (E16) and channel 2 probe to pin 18 (E18) on A205. Set POWER ON circuit breaker to off (down), wait 5 seconds, and then set it to on (up). Pin 16 (E16) is at +12 vdc level and pin 18 (E18) is 0 vdc. Rotate COARSE TUNING control approximately two revolutions cw. Check that pin 16 (E16) goes to 0 vdc and pin 18 (E18) goes to +12 vdc. Immediately stop tuning when this change takes plate. Observe that pins 15 (E15), 17 (El7) and 19 (El9) on A205 are 0 vdc and pins 10 {E10) and 22 (E22) are +12 vdc.	*c*. A205 defective.	*c*. Replace defective programmable counter card A205.
		Connect oscilloscope channel 1 probe to pin 18 (E18) and channel 2 probe to	*d*. A205 defective.	*d*. Replace defective programmable counter card A205.

c. Rt Unit Tuning Troubleshooting Procedures - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
5 (Cont)		pin 17 (E17) on A205. Turn COARSE TUNING control cw until, pin 18 (E18) goes to 0 vdc and pin 17 (E17) goes to +12 vdc. This will occur in approximately 3.5 revolutions. Observe that pin 16 (E16), 17 (E17), 18 (E18) and 19 (E19) are 0 vdc and pins 10 (E10), 15 (E15) and 22 (E22) are + 12 vdc.		
		Connect oscilloscope channel 1 probe to pin 17 (E17) and channel 2 probe to pin 15 (E15) on A205. Turn COARSE TUNING control cw until pin 17 (E17) goes to 0 vdc and pin 15 (E15) goes to +12 vdc. This will occur in approximately 5 3/4 revolutions. Observe that pins 16 (E16), 17 (E17), 18 (E18) and 19 (E19) are 0 vdc and pins 10 (E10), 15 (E15) and 22 (E22) are +12 vdc.	*e*. A205 defective.	*e*. Replace defective programmable counter card A205.
		Connect oscilloscope channel 1 probe to pin 15 (E15) and channel 2 probe to pin 19 (E19) on A205. Turn COARSE TUNING control cw until pin 19 (E19) goes to +12 vdc and pin 15 (E15) goes to 0 vdc. This will occur in approximately 9 3/4 revolution. Observe that pins 16 (E16), 17 (E17), 18 (E18) and 15 (E16) are 0 vdc and pins 10 (E10), 19 (E19) and 22 (E22) are + 2 vdc.	*f*. A205 defective.	*f*. Replace defective programmable counter card A205.
		Connect oscilloscope channel 1 probe to pin 22 (E22) on A205. Turn COARSE TUNING control cw pin 10 (E10) on A205 goes to 0 vdc. This will occur in approximately 17.5 revolutions. Observe that pins 15 (E15), 16 (E16), 17 (E17). 18 (E18) and 10 (E10) on A205 are O vdc and pins 19 (19) and 22 (E22) on A205 am + 12 vdc.	*g*. A205 defective. *h*. If pin 22 (E22) goes low (0 vdc) and returns high (+12- vdc) while continuing to turn cw, A201 is defective.	*g*. Replace defective programmable counter card A205. *h*. Replace defective timing and reference card A201.
		Connect oscilloscope to pin 13 (E13) on A205. Observe ttl square wave in the frequency range of 1.40 to 20.50 MHz. Check frequency with digital counter 1A9.	*I*. If frequency is not stable down to the Hz position (±1 Hz), either A204 or A205' is defective.	*I*. Replace main loop card A204 or programmable counter card A205 to determine defective circuit card assembly.

c. Rt Unit Tuning Troubleshooting Procedures - Continued

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
5 (Cont)		Connect oscilloscope to pin 3 (E3) on A205. Observe +5v pulses with a repetition of 10 kHz.	*j.* If signal is unstable, either A204 or A205 is defective.	*j.* Replace defective main loop card A204 or programmable counter card A205.
			k. If unstable signal is present at pin 13 (E13) and no output from pin 3 (E3), A205 is defective.	*k.* Replace main loop card A204 or programmable counter card A205.
		Connect oscilloscope to pin 22 (E22) on, A205. Output of pin 22 (E22) is, +12 vdc dropping to 0 vdc when tuning lower than 1.4 MHz.	*l.* A205 defective.	*l.* Replace defective programmable counter card A205.
		Connect oscilloscope to pin 10 (E10) on A205. Output of pin 10 (E10) is 12 vdc dropping to 0 vdc when tuning higher than 20.52 MHz.		

4-21. Power Supply Troubleshooting

a. Test Equipment Required. Digital Voltmeter AN/GSM-64 is required to troubleshoot the rt unit power supply.

b. Connections and Conditions. None required.

c. Power Supply Troubleshooting Procedures.

Item No.	Trouble symptom	Check	Probable trouble (if check is abnormal)	Corrective measures
1	Rt unit completely inoperative.	Using dvm, check for +5 vdc between TB3 pin 4(+) and TB3 pin 7 (-).	*a*. PS1 A1 defective.	*a*. Replace PS1A1. If trouble remains, replace PS1.
		Using dvm, check for.+l2 vdc between A2E16 (+, orange) and A2E2 (-, black).	*b*. PS1 defective.	*b*. Replace PS1.
		Using dvm, check for +24 vdc between A2E1 (+, red) and A2E2(-, black).	*c*. PS1A1 defective.	*c*. Replace PS1A1. If trouble remains, replace PS1.
		Using dvm, check for -24 vdc between A2E6 (-, violet) and A2E2 (+, black).	*d*. PS1A1 defective.	*d*. Replace PS1A1. If trouble remains, replace PS1.

Section V. ADJUSTMENTS

4-22. Timing Card 1A2A2A4 Adjustment

a. General. Timing card 1A2A2A4 is adjusted while installed in the control unit for the proper look thru cycle. This adjustment must be performed whenever the timing card is replaced.

b. Test Equipment Required.

(1) Storage Oscilloscope 7623A.
(2) Dual Time Base Plug-in 7B53A.
(3) Vertical Amplifier Plug-in 7A15A (2 ea).
(4) X10 Probe P6008 (2 ea).
(5) 30 dB Attenuator
(6) Attenuator 354A.
(7) Tee-Connector UG-274B/U
(8) Signal Generator AN/GRM-50
(9) Termination T150B.

c. Procedure.

(1) Tune AN/TLQ-15 for 2 kW output at 2 MHz into system dummy load. Refer to operator's manual for tuning procedures.

(2) Set rt unit TRANSMIT MODE switch to LOOK THRU.

(3) Connect oscilloscope channel 2 probe to look through signal on pin 39 of timing card 1A2A2A4.

(4) Connect oscilloscope channel 1 probe to 1A2TP11 in control unit. Trigger scope on negative sweep.

(5) Adjust 1A2A2A4R7 so that rf switching pulse on channel 1 turns off 32 msec after termination of look through signal on channel 2 (A, fig. 4-7).

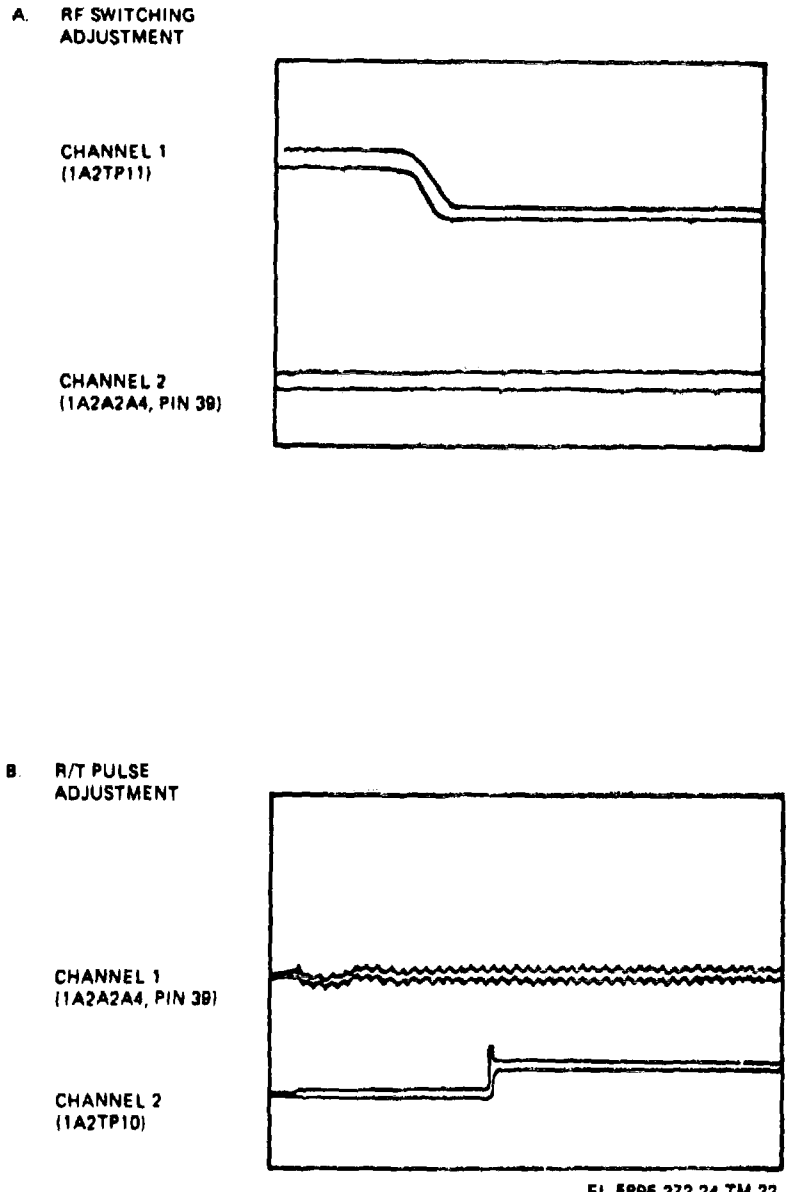


Figure 4-7. Look through timing diagram.

(6) Connect oscilloscope channel 2 probe to 1A2TP10 in control unit and channel 1 probe to pin 39 or 1A2A2A4. Trigger scope on positive sweep.

(7) Adjust 1A2A2A4R1 so that rt pulse on channel 2 turns on 35 ms after initiation of look through signal on channel 1 (B, fig. 4-7).

(8) Perform look through testing procedure given in paragraph 4-52.

4-23. Reflectometer Assembly 1A2A3 Adjustment

a. General. Reflectometer assembly 1A2A3 is adjusted while installed in the control unit for correct forward power readings and reflected power readings. The high swr overload trip point is also adjusted in this procedure. This adjustment must be performed whenever the reflectometer assembly is replaced.

b. Test Equipment Required.

(1) Wattmeter4301.
(2) Wattmeter Plug-in 2500H.
(3) Power Supply PP-3940/G.
(4) 10 K ohm Resistor.

(1) Remove blank panel below utility shelf and utility shelf from equipment rack.

(2) Connect through-line wattmeter between rfa and dummy load. Disconnect W6P1 from

1A23K1, port 1; connect wattmeter between 1A23K1 port 1 and W6P1. Set 2500 watt plug-in on wattmeter to measure forward power.

(3) Remove cover from reflectometer assembly.

(4) Tune AN/TLQ-15 for 2 kW output at 10 MHz into dummy load. Refer to operator's manual for tuning procedure. Use through-line wattmeter to set the 2 kW output level.

(5) Adjust rt unit RF OUTPUT control for 250 watts on wattmeter.

(6) Adjust 1A2A3A1R3 on reflectometer assembly for 250 on control unit FORWARD POWER meter.

(7) Adjust rt unit RF OUTPUT control for 2 kW on wattmeter.

(8) Adjust 1A2A3A1R5 on reflectometer assembly for 2kW on control unit FORWARD POWER meter.

(9) Check calibration of FORWARD POWER meter for output levels of 500, 1000 and 1500 watts.

(10) Repeat steps (5) through (9) above, until correct readings are attained.

(11) Set rt unit RF OUTPUT control fully ccw.

(12) Reverse reflective plug-in unit (right side of directional coupler looking into panel) on directional coupler 1A23Z1 in the rf panel.

(13) Set control unit BATTLE SHORT switch to on (hood up, switch up).

(14) Adjust rt unit RF OUTPUT control for 250 watts as indicated on wattmeter and control unit FORWARD POWER meter.

(15) Adjust 1A2A3A2R5 on reflectometer assembly for 0.25 on control unit REFLECTED POWER meter.

CAUTION

Do not exceed 750 watts output during the following adjustment. Failure to comply may result in equipment damage.

(16) Adjust rt unit RF OUTPUT control for 750 watts as indicated on wattmeter and control unit FORWARD POWER meter.

(17) Adjust 1A2A3A2R7 on reflectometer assembly for 0.75 on control unit REFLECTED POWER meter.

(18) Repeat steps (14) through (17) above as required until correct readings are attained.

(19) Set rt unit RF OUTPUT control fully ccw.

(20) Set control unit BATTLE SHORT switch to off (switch down, hood down), RESET switch off, and HIGH VOLTAGE switch on (yellow).

(21) Set reflective plug-in unit on directional coupler 1A23Z1 in rf panel to original position (arrow pointing towards rear of rf panel).

(22) Disconnect cable from 1A2J5 on rear of control unit.

(23) Connect power supply to 1A2J5 (+) and ground (-). Connect 10 k ohm, 1/4 watt resistor between power supply (+) lead and 1A2J5.

(24) Adjust rt unit RF OUTPUT control for 2 kW output as indicated on wattmeter and control unit FORWARD POWER meter.

(25) Adjust power supply output voltage until control unit REFLECTED POWER meter indicates 0.600.

(26) Adjust 1A2A3A1R13 on reflectometer assembly until control unit RESET switch lights red and swr overload occurs. SWR OVLD indicator and all interlock indicators to the right of it go out.

(27) Set power supply output to 0 volt.

(28) Set RESET switch to off (red light goes out).

(29) Slowly adjust power supply output and verify that swr overload and trip-out occur at 0.600 or control unit REFLECTED POWER meter. Repeat steps (25) through (28) if necessary.

(30) Set power supply output to 0 volts.

(31) Set control unit RESET switch to off.

(32) Remove power supply; reconnect cable to 1A2J5 and place AN/TLQ-15 in standby condition. Remove all test equipment and reconnect all system cables.

(33) Install cover on reflectometer assembly

4-24. Rfa Bias Adjustment

a. General. Accomplish this procedure whenever the lvps has been repaired or whenever an rfa tube has been replaced.

b. Test Equipment Required. Multimeter AN/USM-223.

c. Procedure.

(1) Remove four rfa control knobs. Loosen fasteners securing rfa front panel across door; open access door.

(2) On lvps, set BIAS circuit breaker to ON; set +250 and +700 circuit breakers to OFF.

(3) On hvps, set FILAMENT circuit breaker to ON; set 600V and 3500V circuit breakers to OFF.

(4) Connect multimeter between 1A3 TPI (-) and TP3 (+).

(5) Perform AN/TLQ-15 starting procedures as given in operator's manual.

(6) Adjust 1A3Rl for - 120 vdc on multimeter.

(7) Connect multimeter to 1A3 TP2 (-) and TP3 (+).

(8) Adjust 1A3R2 for -75 vdc on multimeter.

(9) Disconnect multimeter.

(10) Set control unit HIGH VOLTAGE switch to off (white); set all circuit breakers on lvps and hvps to OFF.

WARNING

Ensure high voltage is off at control

unit, ivps and hvps before performing step (11) below. Failure to comply may result in personnel injury or DEATH.

(11) Remove cable connector from 1A6J16 and connect multimeter in series with center conductor of J16 (-lead to J16 and + lead to TP14). Set multimeter to measure current (100 mA approx).

(12) Set all circuit breakers on Ivps and hvps to ON.

(13) On control unit, set HIGH VOLTAGE switch to on (yellow).

(14) Adjust 1A3R2 for 40 to 50 mA on multimeter.

(15) Adjust 1A3R1 for 0.6 ± 0.1 A on PA TUNE meter.

(16) Turn off AN/TLQ-15 and disconnect test equipment.

4-25. Rfa Neutralization

a. General. This procedure should be accomplished whenever the rfa final power tube (1A3V1) is replaced or whenever the rfa spontaneously oscillates.

b. Test Equipment Required.

(1) Oscilloscope AN/USM-281C.

(2) Alignment tool, 6-inch, nonmetallic.

c. Procedure.

(1) Remove rfa from shelter and install extender cables 3W12 through 3W14 and 3W31 thru 3W33.

(2) Tune AN/TLQ-15 into dummy load at 12 MHz for 2 kW output.

(3) Set RF OUTPUT control on rt unit for minimum output.

(4) Set control unit HIGH VOLTAGE switch to off (white).

(5) Connect oscilloscope to rfa rf output connector 1A3J3. Set oscilloscope for minimum sensitivity (20 volts/cm).

(6) On hvps, set 600V and 3500V circuit breakers to OFF.

(7) Remove upper access panel on left hand side of rfa.

(8) Set control unit HIGH VOLTAGE switch to on (yellow).

(9) Set RF OUTPUT control on rt unit until display on oscilloscope is approximately 3 cm in height. Adjust oscilloscope sensitivity as required.

(10) Using 6-inch nonmetallic alignment tool, adjust AA3C5 for minimum display on oscilloscope.

(11) Repeat steps (9) and (10) above until output at 1A3J3 is reduced to minimum.

4-26. Ipa Tuning Control Adjustment

a. General. The ipa tuning control and indicator dial on the rfa must be adjusted whenever 1A3A1L1 is replaced.

b. Test Equipment Required. None required.

c. Procedure.

(1) Slide rfa out of equipment rack and disconnect all cable connectors. Remove rfa from equipment rack.

(2) Cable rfa back into AN/TLQ-15 using extender cables 3W12 through 3W14 and 3W31 through 3W33.

(3) Remove both left and right rfa access covers.

(4) Loosen setscrews on coupling securing ipa tuning control shaft and 1A3A1L1 tuning shaft (fig. 4-8).

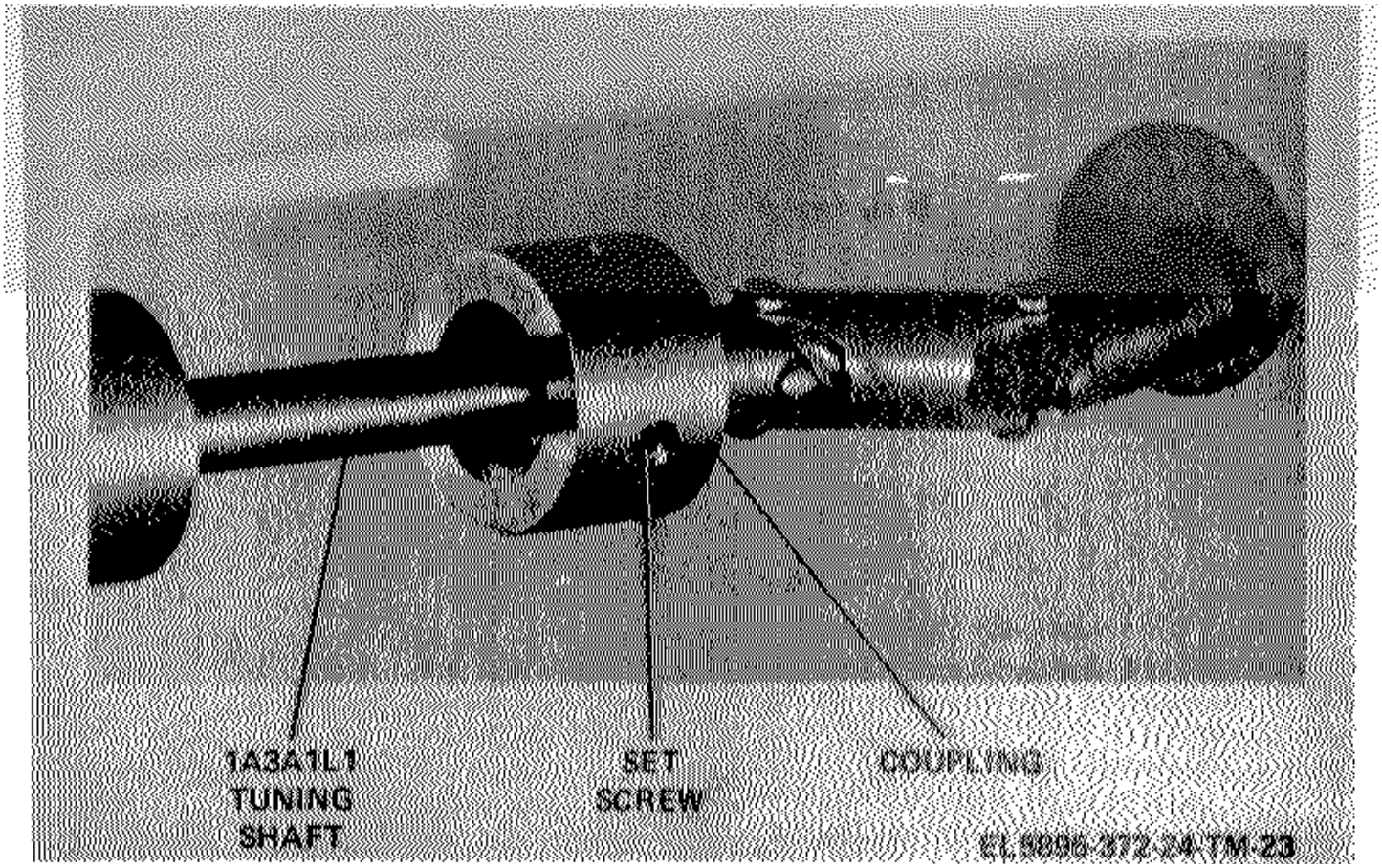


Figure 4-8. Ipa 1A3A1L1 tuning adjustment.

(5) Adjust ipa tuning control on rfa for 20 on IPA TUNING indicator dial.

(6) Adjust 1A3A1L1 tuning shaft until shorting tap on indicator is 1 1/4 turns from rear of inductor.

(7) Tighten setscrews on coupling securing ipa tuning control shaft and 1A3A1L1 tuning shaft (fig. 4-8). Ensure that shafts are pulled into coupling as far as possible to reduce side-play.

(8) Install both left and right rfa access covers.

(9) Tune AN/TLQ-15 for 2 kW at 20 MHz into dummy load. Refer to TM 11-5895-372-10 for tuning procedure.

(10) Set rt unit RF OUTPUT control fully ccw and set control unit HIGH VOLTAGE switch to off (white).

(11) Remove both left and right rfa access covers.

(12) Loosen setscrew on coupling securing ipa tuning control shaft and 1A3A1L1 tuning shaft (fig. 4-8).

(13) Adjust ipa tuning control for 20 on IPA TUNING indicator dial.

(14) Tighten setscrews on coupling securing ipa tuning control shaft and 1A3A1L1 tuning shaft (fig. 4-8). Ensure that shafts are pulled into coupling as far as possible to reduce side-play.

(15) Install both left and right rfa access covers.

(16) Set control unit HIGH VOLTAGE switch to on (yellow) and adjust rt unit RF OUTPUT control for 2 kW output.

(17) Tune rfa for 20 MHz and verify that IPA TUNING indicator dial is set at 20.

4-27. Fpa Plate Tune Control Adjustment

a. General. The fpa plate tune control and indicator dial on the rfa must be adjusted whenever 1A3A1C19 is replaced.

b. Test Equipment Required. None required.

c. Procedure.

(1) Slide rfa out of equipment rack and remove all cable connectors. Remove rfa from equipment rack.

(2) Cable rfa back into the AN/TLQ-15 using extender cables 3W12, 3W13, 3W14, 3W31, 3W32, and 3W33.

(3) Remove both left and right rfa access covers.

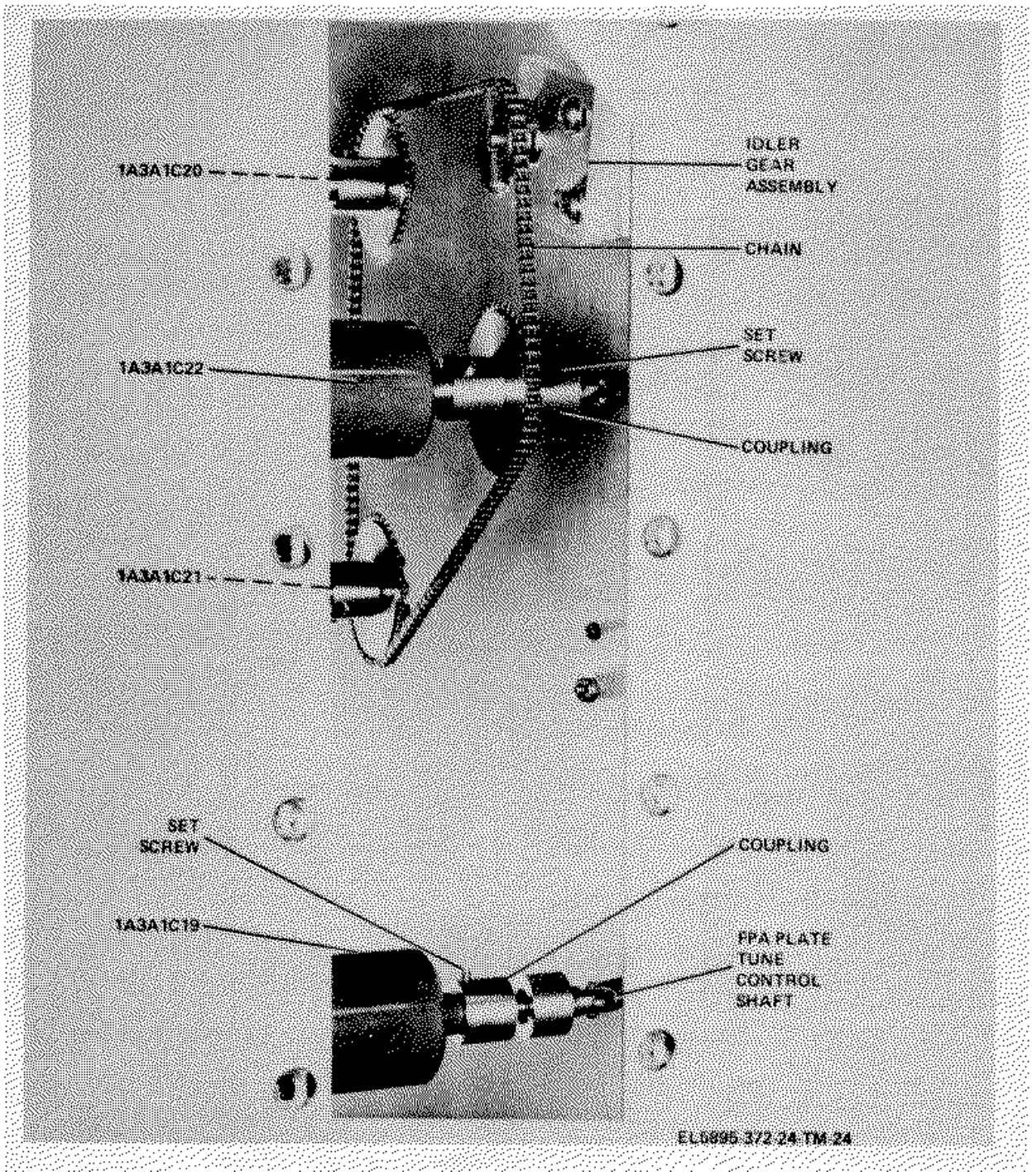


Figure 4-9. Fpa 1A3A1C19 tuning adjustment.

(4) Loosen setscrews on coupling securing fpa plate tune control shaft and 1A3A1C19 tuning shaft (fig. 4-9).

(5) Adjust fpa plate tune control on rfa for 20 on PA PLATE TUNE indicator dial.

(6) Adjust 1A3A1C19 tuning shaft until plates on capacitor are just barely separated.

(7) Tighten setscrews on coupling securing fpa plate tune control shaft and 1A3A1C19 tuning shaft (fig. 4-9).

(8) Install both left and right rfa access covers.

(9) Tune AN/TLQ-15 for 2 kW at 20 MHz into dummy load. Refer to TM 11-5895-372-10 for tuning procedure.

(10) Set rt unit RF OUTPUT control fully ccw

and set control unit HIGH VOLTAGE switch to off (white).

(11) Remove both left and right rfa access covers.

(12) Loosen setscrew on coupling securing fpa plate tune control shaft and 1A3A1C19 tuning shaft (fig. 4-9).

(13) Adjust fpa plate tune control for 20 on PA PLATE TUNE indicator dial.

(14) Tighten setscrew on coupling securing fpa plate tune control shaft and 1A3A1C19 tuning shaft (fig. 4-9).

(15) Install both left and right rfa access covers.

(16) Set control unit HIGH VOLTAGE switch to on (yellow) and adjust rt unit RF output control for 2kW output.

(17) Tune rfa for 20 MHz and verify that pa plate tune indicator dial is set at 20.

4-28. Fpa Load Tune Control Adjustment

a. General. The fpa load tune control and indicator dial on the rfa must be adjusted whenever capacitor 1A3A1C20, 1A3A1C21 or 1A3A1C22 is replaced. All three capacitors must be adjusted simultaneously for correct dial indications.

b. Test Equipment Required. None required.

c. Procedure.

(1) Slide rfa out of equipment rack and remove all cable connectors. Remove rfa from equipment rack.

(2) Cable rfa back into the AN/TLQ-15 using extender cables 3W12 3W13,3W14, 3W31,3W32 and 3W33.

(3) Remove both left and right rfa access covers.

(4) If capacitor 1A3A1C22 was replaced proceed as follows:

(a) Loosen setscrews securing coupling to fpa load tune control and capacitor linkage assembly shaft (fig. 4-9).

(b) Loosen screws on idler gear assembly (fig.4-9).

(c) Remove chain from capacitor shaft gear.

(d) Adjust capacitor shaft until plates are barely separated.

(e) Adjust fpa load tune control on rfa for 20 on PA LOAD TUNE indicator dial.

(f) Install chain onto capacitor shaft gear.

(g) Position idler gear assembly for proper chain tension and then tighten screws to secure idler gear assembly (fig. 4-9).

(h) Tighten setscrews securing coupling to fpa load tune control and capacitor linkage assembly shaft (fig. 4-9).

(5) If capacitor 1A3A1C20 or 1A3A1C21 was replaced, repeat steps (4 (b) through (h) above.

(6) Install both left and right rfa access covers.

(7) Tune the AN/TLQ-15 for 2 kW at 20 MHz into dummy load. Refer TM 11-5895-372-10 for tuning procedure.

(8) Set rt unit rf output control fully ccw and set control unit HIGH VOLTAGE switch to off (white).

(9) Remove both left and right rfa access covers.

(10) Loosen setscrew on coupling securing fpa load tune control shaft and capacitor linkage assembly shaft (fig 4-9).

(11) Adjust fpa load tune control for 20 on PA PLATE TUNE indicator dial.

(12) Tighten setscrew on coupling securing fpa load tune control shaft and capacitor linkage assembly shaft (fig.4-9).

(13) Install both left and right rfa access covers.

(14) Set control unit HIGH VOLTAGE switch to on (yellow) and adjust rt unit RF OUTPUT control for 2kW output.

(15) Tune rfa for 20 MHz and verify that PA LOAD TUNE indicator dial is set at 20.

4-29. Soft Mounted Coupler (1A5) Adjustment

a. General. This procedure provides the information necessary to adjust capacitors C1 through C4 in the soft mounted coupler(1A5).

b. Test Equipment Required.

(1) Impedance Meter, Vector, HP-4815A.

(2) Impedance Meter Adapter.

(3) Digital Counter CP-1053/TLQ-15.

c. Procedure.

(1) Remove soft mounted coupler from equipment.

(2) Remove both side panels from soft mounted coupler.

(3) Inspect all components of soft mounted coupler for physical integrity.

(4) Set TUNE control on soft mounted coupler fully counterclockwise.

(5) Connect test equipment as shown in figure 4-10. Calibrate vector impedance meter probe to read 100 ohms at a phase angle of 0°.

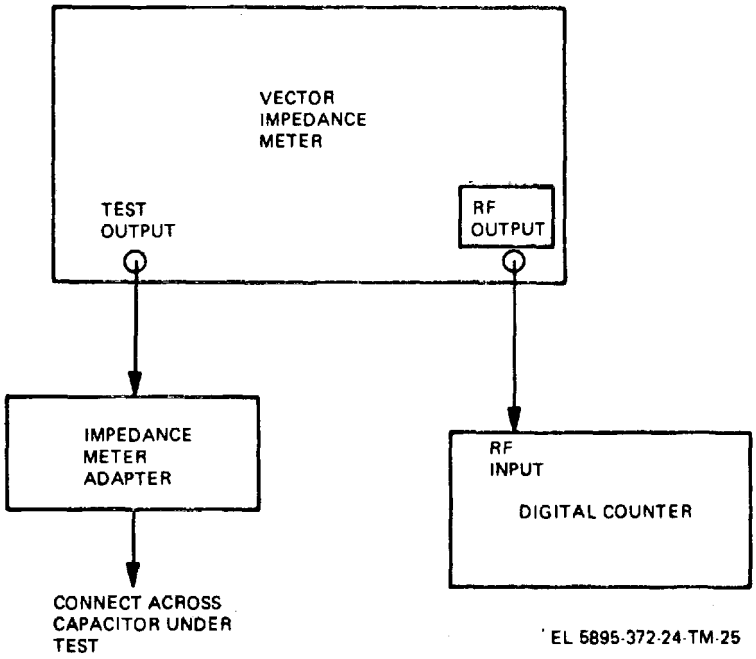


Figure 4-10. Soft mounted coupler (1A5) test equipment setup.

(6) Connect vector impedance meter output probe to top strap of capacitor C1. Connect probe shield to C1 base clamp screw.

(7) Tune vector impedance meter to 500 kHz as read on digital counter

(8) Read impedance and phase angle on vector impedance meter. Value should be 330 (±10 ohms at -90°.

(9) If value read is incorrect, grasp the capacitor cable shaft hex (at linkage end of cable) with a wrench and turn adjusting nut (using another wrench) until value in step (8) above is obtained (fig. 4-11).

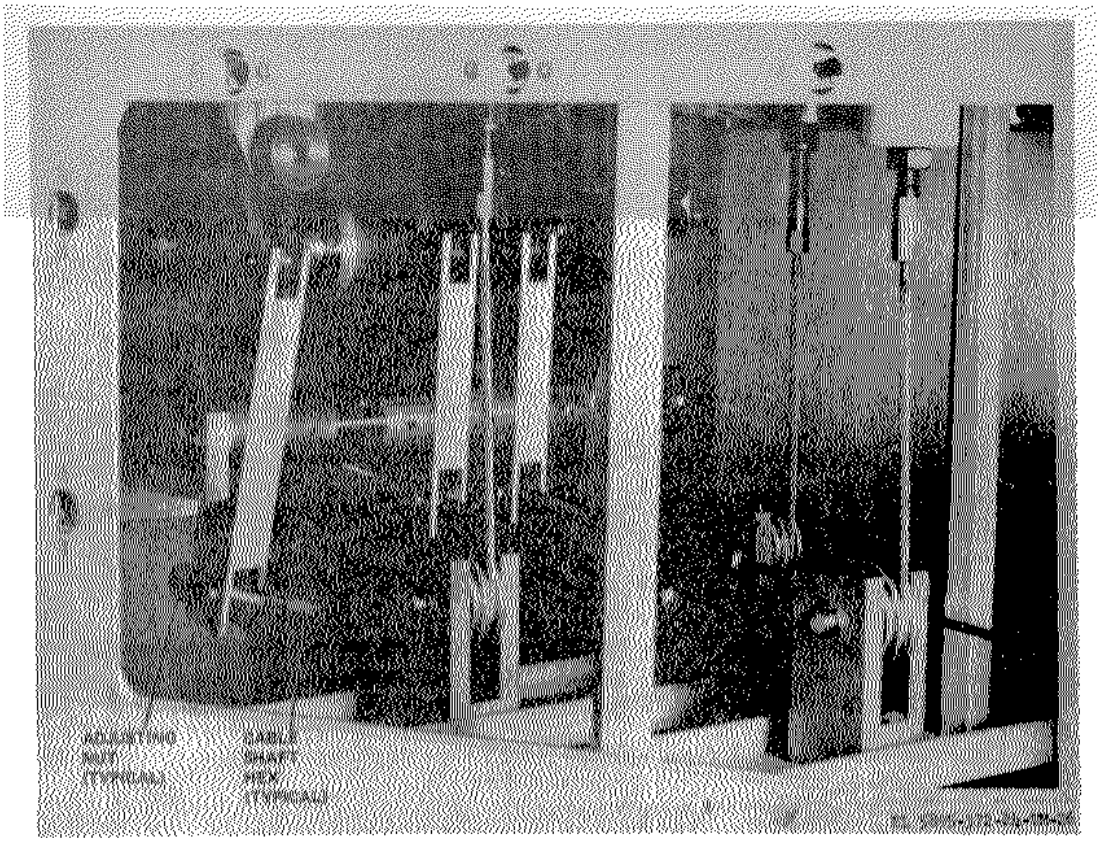


Figure 4-11. Soft mounted coupler (1A5) capacitor adjustment.

(10) Repeat steps (6) through (9) above for capacitors C2 through C4. Impedance values are:

Capacitor	*Impedance (Ohms at -90°)*
C2	410 (±10)
C3	420 (±10)
C4	6,900 (±10))

4-30. Lvps Overload Adjustments

a. General The lvps overload adjustments are made with the unit removed from the equipment rack and placed in a suitable work area.

WARNING

Using a grounding stick discharge all capacitors before proceeding with the adjustments. Failure to comply may result in personnel injury or DEATH.

b. Test Equipment Required.

(1) Multimeter AN/USM-233.

(2) Power Supply PP-3940/G.

c. +250 Vdc Overload. Gain access to the top of the lvps and proceed as follows:

WARNING

Using a ground stick, discharge all capacitors before proceeding with the following procedure. Failure to comply may result in personnel injury or DEATH.

(1) To insure that relay K2 is reset, connect +24 vdc to terminal E21 and then momentarily apply the 24 vdc ground return to test point TP8.

(2) Set multimeter to ohms (X1) scale and connect across terminals *t* and T of connector J1. Multimeter indicates infinity.

NOTE

If multimeter indicates 0 ohms, repeat step

(1) above

(3) Adjust power supply to zero volts output. Connect (-) terminal of power supply to test point TP15 and (+) vdc terminal to test point TP8.

(4) While observing multimeter, slowly advance voltage control of power supply until multimeter

indicates 0 ohms. Power supply volt-meter indicates + 24 vdc.

NOTE

If relay K2 closes before or after the +24 vdc point, proceed with the remaining steps.

(5) Repeat step (1) above to ensure that relay K2 is reset.

(6) Loosen locknut and adjust R26 fully clockwise.

(7) With power supply connected as m step (3) above, adjust power supply voltage control for an output of 24 vdc.

(8) Slowly adjust R26 counterclockwise while observing the multimeter. Stop adjusting R26 when multimeter indicates 0 ohm. Do not adjust R26 past this point. Tighten locknut on potentiometer.

(9) Repeat step (1) above to reset relay K2.

(10) Disconnect test equipment and install lvps in equipment rack.

d. + 700 V Overload. Gain access to the top of the lvps and proceed as follows:

WARNING

Using a grounding stick, discharge all capacitors before proceeding with the following procedure. Failure to comply may result in personnel injury or DEATH.

(1) To insure that relay K4 is reset, connect +24 vdc to terminal E40 and then momentarily apply 24 vdc ground return to test point TP19.

(2) Set multimeter to ohms (X1) scale and connect across terminals *p q* of connector J1. Multimeter indicates infinity.

NOTE

If multimeter indicates 0 ohm, repeat step (1) above.

(3) Adjust power supply to 0 volt output. Connect (+) terminal of power supply to test point TP19 and (-) vdc return to test point TP18.

(4) While observing multimeter, slowly advance voltage control of power supply until multimeter indicates 0 ohm. Power supply volt-meter indicates + 11 vdc.

NOTE

If relay K4 closes before or after the +11 vdc point, proceed with the remaining steps.

(5) Repeat step (1) above to insure that relay K4 is reset.

(6) Loosen locknut on R23 and adjust R23 fully clockwise.

(7) With power supply connected as in step (3) above, adjust power supply voltage for an output of + 11 vdc.

(8) Adjust R23 counterclockwise while observing the multimeter. Stop adjusting R23 when multimeter indicates 0 ohm. Do not adjust R23 past this point. Tighten locknut on potentiometer.

(9) Repeat step (1) above to reset relay K4.

(10) Disconnect test equipment and install lvps in equipment rack.

4-31. Hvps Overload Adjustments

a. General. The hvps overload adjustments are made with the unit removed from the equipment rack and placed in a suitable work area.

WARNING

Using a grounding stick, discharge all capacitors before proceeding with the adjustments. Failure to comply may result in personnel injury or DEATH.

b. Test Equipment Required.

(1) Multimeter AN/USM-223.

(2) Power Supply PP-3940/G.

c. +600 Vdc Overload. Gain access to the top of the hvps and proceed as follows:

WARNING

Using a grounding stick, discharge all capacitors before proceeding with the adjustments. Failure to comply may result in personnel injury or DEATH.

(1) To insure that relay K4 is reset, connect +24 vdc to pin P of J1 and momentarily apply the 24 vdc ground return to chassis ground.

(2) Set multimeter to ohms (X1) scale and connect across pins M and N of connector J1. Multimeter indicates infinity.

NOTE

If multimeter indicates 0 ohm, repeat step (1).

(3) Readjust power supply to 0 volt output. Connect (+) terminal of power supply to terminal 2 of resistor R18 and (-) vdc return to terminal 1 of resistor R18.

(4) While observing multimeter, slowly advance voltage control of power supply until multimeter indicates 0 ohm. Power supply voltmeter indicates + 16 volts.

NOTE

If relay K4 closes before or after the +16 vdc point, proceed with the remaining steps.

(5) Repeat step (1) above to insure that relay K4 is reset.

(6) Loosen locknut on R19; adjust R19 fully clockwise.

(7) With power supply connected as in step (3) above, adjust power supply voltage control for an output of +16 vdc.

(8) Slowly adjust R19 counterclockwise while observing multimeter. Stop adjusting R19 when multimeter indicates 0 ohm. Do not adjust R19 past this point. Tighten locknut on potentiometer.

(9) Repeat step (1) above to reset relay K4.

(10) Disconnect test equipment and install hvps in equipment rack.

d. +300 Vdc Overload Gain access to the top of the hvps and proceed as follows:

WARNING

Using a grounding stick, discharge all capacitors before proceeding with the following procedures. Failure to comply may result in personnel injury or DEATH.

(1) To insure that relay K3 is reset, connect +24 vdc to pin P of J1 and momentarily apply 24 vdc ground return to chassis ground.

(2) Set multimeter to ohms (X1) scale and connect across pins M and N of connector J1. Multimeter indicates infinity.

NOTE

If multimeter indicates 0 ohm, repeat step (1) above.

(3) Adjust power supply to zero volts output. Connect (+) terminal of power supply to terminal 1 of resistor R15 and (-) vdc return to terminal 2 of resistor R16.

(4) While observing multimeter, slowly advance voltage control of power supply until multimeter indicates 0 ohm. Power supply volt-meter indicates +15 volts.

NOTE

If relay K3 closes before or after the +15 vdc point, proceed with the remaining steps.

(5) Repeat step (1) above to ensure that relay K3 is reset.

(6) Loosen locknut on R14; adjust R14 fully clockwise.

(7) With power supply connected as in step (3) above adjust power supply voltage control for an output of + 15 vdc.

(8) Slowly adjust R14 counterclockwise while observing multimeter. Stop adjusting R14 when multimeter 0 ohm. Do not adjust R14 past this point. Tighten locknut on potentiometer.

(9) Repeat step (1) above to reset relay K3.

(10) Disconnect test equipment and install hvps in equipment rack.

4-32. Auxiliary +24 Vdc Converter (1A13PS1) Adjustment

a. General. This procedure provides instructions to adjust the output of the auxiliary +24 vdc converter.

b. Test Equipment Required

(1) Multimeter AN/USM-223.

(2) Digital Voltmeter AN/GSM-64.

c. Procedure.

(1) At power distribution box insure that MAIN 30 ampere circuit breaker is off (pushbutton pulled out and STANDBY switch on control unit goes out).

(2) Gain access to interior of power distribution-box and locate terminal-gal board TB14.

WARNING

Lethal voltages are present on some terminals in the distribution box. Failure to observe safety precautions may result in personnel injury or DEATH.

(3) Adjust multimeter to measure 120 vac.

(4) Connect multimeter across terminals 1 and 4 of TB1.

(5) Multimeter reads 120 (±10%) vac.,

(6) Disconnect multimeter from TB1.

(7) Connect positive lead of digital voltmeter to TB14-1 and negative lead to TB14-4.

(8) Set MAIN circuit breaker to on (in); STANDBY switch or control unit lights white.

(9) Digital voltmeter reads 24 (±1) vdc. If not, perform next step.

(10) Using small screwdriver, adjust potentiometer located at upper right corner of auxiliary +24 vdc. converter for a digital voltmeter reading of +24 (±1) vdc.

(11) Set MAIN circuit breaker to off (out); STANDBY switch on control unit goes out.

(12) Disconnect digital voltmeter from terminal board TB14 and close power distribution box.

4-33. Low Voltage Detector (2A3A3) Adjustment

a. General. This procedure provides instructions to adjust the low voltage detector threshold level.

b. Test Equipment Required.

(1) Multimeter AN/USM-223.

(2) Power Supply PP-3940/G.

c. Procedure.

(1) At generator, disconnect battery power cable connector W7P1 from J1.

(2) Connect power supply positive (+) lead to terminal FL2 and negative(-) lead to terminal FL1 at rear of AN/VRC-47 enclosure.

(3) Turn on power supply and adjust output for +24 vdc.

(4) Adjust multimeter for +24 vdc; connect positive (+) lead to TB1-2 and negative (-) lead to TBl-1 inside the AN/VRC-47 enclosure.

(5) Set RESET switch A3S1 to MOMENTARY ON position and then release. Multimeter reads +24 vdc.

(6) Slowly reduce supply output voltage and note the multimeter reading at which the voltage detector switches off (multimeter indication drops to zero). Switching level occurs at +22 vdc input as read or power supply voltage meter.

(7) If switching level does not occur as

required, adjust power supply for + 22 vdc output.

(8) Loosen locknut and adjust R1 on the low voltage detector for the switching level to occur at the + 22 vdc level.

(9) Repeat steps (7) and (8) as required to have the switching level occur as the voltage is lowered from + 24 vdc to + 22 vdc.

(10) Tighten locknut on R1, disconnect test equipment, and reinstall battery power cable connector W7P1 to J1.

Section VI. REMOVAL AND REPLACEMENT

4-34. Rt Unit Edge Lit Panel Removal and Replacement

a. General. Accomplish this procedure whenever the edge lit panel 1A4A3A5 of the rt unit requires replacement.

b. Tools Required. This procedure does not require the use of special tools. Only normally available handtools are required.

c. Removal Procedure.

(1) Loosen four screws securing rt unit to equipment rack.

(2) Slide rt unit out of equipment rack and remove all cable connectors. Remove rt unit from equipment rack.

(3) Remove all front panel knobs by using Allen wrench to loosen setscrews for 15 knobs.

(4) Remove shield from POWER ON circuit breaker by using Phillip's head screwdriver to remove two screws.

(5) Remove yellow lens from FREQ LOCK control by turning in a counterclockwise direction (ccw).

(6) Remove edge lit panel from front of rt unit using Phillip's head screwdriver to remove 14 recessed screws. Set rt unit aside.

(7) Remove left or right handle from edge lit panel using Phillip's head screwdriver to remove two screws. Repeat for other handle.

(8) Separate edge lit panel from backplate by using Phillip's head screwdriver to remove 14 screws. Set edge lit panel aside.

d. Replacement Procedure.

(1) Replace left or right handle on edge lit panel using Phillip's head screwdriver to replace two screws. Repeat for other handle.

(2) Secure edge lit panel to back plate by using Phillip's head screwdriver to replace 14 screws.

(3) Secure edge lit panel to front of rt unit using Phillip's head screwdriver to replace 14 screws in recessed holes.

(4) Replace FREQ LOCK control yellow lens by turning in a clockwise direction.

(5) Replace shield on POWER ON circuit breaker using Phillip's head screw driver to replace two screws.

(6) Replace all front panel knobs using Allen wrench to secure setscrews for 15 knobs.

(7) Slide rt unit into equipment rack and reconnect all cables.

(8) Tighten four screws to secure rt unit to equipment rack.

4-34.1. Rt Unit Edge Lit Panel Lamps Removal and Replacement

a. General. Perform this procedure whenever a lamp in rt unit edge lit panel 1A4A3A5 requires replacement.

b. Tools Required. This procedure does not require the use of special tools. Only normally available handtools are required.

c. Removal Procedure.

(1) Remove rt unit edge lit panel from rt unit (para 4-34c).

(2) Remove 17 screws that secure metal cover plate to edge lit panel and remove cover plate.

(3) Unsolder and remove defective lamps from edge lit panel printed circuit card.

d. Replacement Procedure.

(1) Solder new lamps to edge lit panel printed circuit card.

(2) Replace cover plate on edge lit panel and secure with 17 screws.

(3) Replace edge lit panel on rt unit (para 4-34*d*).

4-35. Ipa Tube Removal and Replacement

a. General. Accomplish this procedure whenever the ipa tube 1A3A1V1 in the preamplifier enclosure of the rfa unit requires replacement.

b. Tools Required. This procedure does not require the use of special hand tools. Only normally available handtools are required. A tube extractor is supplied with the rfa for use in removing and installing the ipa tube. The extractor is located in the lower left-rear corner of the unit and is accessible when the left side cover is removed.

c. Removal Procedure.

WARNING

High voltage up to 3500 vdc is present in the rfa. Exercise extreme care when working inside unit.

(1) On lvps, set BIAS circuit breaker to OFF,

and set +250 and +700 circuit breakers to OFF.

(2) On hvps, set FILAMENT circuit breaker to OFF, and set 600V and 3500 V circuit breakers to OFF.

(3) Use screwdriver to loosen 12 screws securing rfa to equipment rack.

(4) Slide rfa out of equipment rack, and remove all cable connectors.

(5) Use screwdriver to loosen 46 screws securing right side cover to rfa; remove cover.

(6) Use screwdriver to loosen 53 screws securing left side cover to rfa; remove cover.

WARNING

High voltage up to 3500 vdc is present in normal operation of rfa. Verify that equipment is deenergized and capacitors discharged before removing ipa tube.

(7) Using a screwdriver, release retainer clamp on ipa tube.

(8) Firmly grasp top cap of ipa tube with tube extractor and remove tube from socket by turning in a counterclockwise (ccw) direction.

NOTE

It may be helpful at this time to observe position of tube with respect to plate retaining ring and make alignment mark with pencil to aid in replacement.

(9) Remove ipa tube by pulling straight back until clear of socket hardware and plate retaining ring.

d. Replacement Procedure.

NOTE

Transfer alignment mark to replacement ipa tube.

(1) Firmly grasp top cap of ipa tube with tube extractor and carefully insert in socket, make sure plate fins are not damaged by plate retaining ring or socket hardware.

(2) Secure ipa tube in socket by turning in clockwise direction (cw). Verify alignment of ipa tube and plate retaining ring.

(3) Observe bottom of ipa tube, and verify positive socketing of all terminal surfaces. Repeat steps (1) and (2) above if positive socketing is not obtained.

(4) Remove tube extractor from ipa tube and place in storage location in lower left-rear corner of rfa.

(5) Secure left side cover to rfa using 53 screws.

(6) Using screwdriver, secure retainer clamp on ipa tube.

(7) Secure right side cover to rfa using 46 screws.

(8) Replace all cable connectors, and slide rfa back into equipment rack.

(9) Secure rfa to equipment rack using 12 screws.

(10) Accomplish rfa bias adjustment (para 4-24) before placing rfa in normal operation.

4-36. Fpa Tube Removal and Replacement

a. General. Accomplish this procedure whenever the fpa tube 1A3V1 in the rfa unit requires replacement.

b. Tools Required. This procedure does not require the use of special hand tools. Only normally available hand tools are required.

c. Removal Procedure.

WARNING

High voltage up to 3500 vdc is present in the rfa. Be extremely careful when working inside unit.

(1) On lvps set BIAS circuit breaker to OFF, and set +250 and +700 circuit breakers to OFF.

(2) On hvps set FILAMENT circuit breaker to OFF, and set 600V and 3500V circuit breakers to OFF.

(3) Use screwdriver and loosen 12 screws securing rfa to equipment rack.

(4) Slide rfa out of equipment rack, and remove all cable connectors. Remove rfa from equipment V rack.

(5) Loosen 53 screws securing left side cover to rfa; remove cover.

WARNING

High voltage up to 3500 vdc is present in normal operation of rfa. Verify capacitor discharge before removing fpa tube.

NOTE

It may be helpful at this time to observe position of tube with respect to plate retaining ring and fiberglass tube support. Make three alignment marks with pencil to aid in replacement.

(6) Remove three hex head screws from plate retaining ring using 7/16 nut driver.

(7) Use 11/32 nut driver to remove hex nut securing coil L2, and connecting strap from capacitor C19 to plate retaining ring. Provide maximum clearance for plate retaining ring by moving, L2 and connecting strap aside.

(8) Raise plate retaining ring to clear socket hardware by straight up motion until plate retaining ring is withdrawn a minimum of 1/4 inch above fiberglass tube support.

(9) Firmly grasp fpa tube, and release from

socket by tuning in a counterclockwise direction (ccw) for 1/8 turn. Maintain clearance of plate retaining ring.

NOTE

It may be helpful at this time to observe position of hex head screw holes on plate retaining ring with respect to plastic tube support, and make alignment marks with pencil to aid in replacement.

(10) Remove fpa tube and plate retaining ring by firmly grasping tube and lifting straight up.

(11) Separate fpa tube from plate retaining ring by pushing down on tube. Use care not to damage tube or retaining plate.

d. Replacement Procedure.

NOTE

Transfer alignment marks to replacement fpa tube.

(1) Join fpa tube and plate retaining ring by observing alignment marks and inserting base of fpa tube through plate retaining ring. Be careful not to damage finned external anode.

(2) Place fpa tube and plate retaining ring on plastic tube support by firmly grasping tube and using a straight down motion to clear tube socket hardware while maintaining position of alignment marks.

(3) Secure fpa tube to socket by firmly grasping tube and turning in a clockwise direction (cw) for 1/8 turn.

(4) Observe bottom of fpa tube, and verify positive socketing is of all terminal surfaces. Repeat steps (2) and (3) above if positive socketing is not obtained.

(5) Secure plate retaining ring by using 7/16 nut driver to secure three 3/4=20 hex head screws.

Repeat steps (2), (3), and (4) above if hex head screw holes are misaligned.

(6) Secure coil L2 and connecting strap from capacitor C19 to plate retaining ring by using 11/32 nut driver to secure hex nut.

(7) Secure three retaining clamps by using Phillips head screw driver to secure three screws on each clamp. Be careful not to damage plate fins.

(8) Place rfa on equipment rack slide and replace all cables. Replace side cover.

(9) Perform rfa bias adjustment (para 4-24) and rfa naturalization (para 4-25) before placing rfa in normal operation.

4-37. Variable Pa Tune Capacitor Removal and Replacement

a. General. Accomplish this procedure whenever the variable pa tune capacitor 1A3C19 in the rfa unit requires replacement.

b. Tools Required. This procedure does not require the use of special hand tools. Only normally available hand tools are required.

c. Removal Procedure.

WARNING

High voltage up to 3500 vdc is present in the rfa. Be extremely careful when working inside unit.

(1) On lvps set BIAS circuit breaker to OFF, and set + 250 and + 700 circuit breakers to OFF.

(2) On hvps set FILAMENT circuit breaker to OFF, and set 600V and 3500V circuit breaker to off.

(3) Loosen 12 screws securing rfa to equipment rack.

(4) Slide rfa out of equipment rack, and remove all cable connectors. Remove rfa from equipment rack.

(5) Loosen 53 screws securing left side cover to rfa, and remove cover.

WARNING

High voltage up to 3500 vdc is present in normal operation of rfa. Verify capacitor discharge before continuing procedure.

(6) Use allen wrench to loosen two setscrews securing capacitor 1A3C19 to shaft adapter. Push out securing pin (if used).

(7) Remove connecting strap from capacitor 1A3C19 by using Phillips head screwdriver and nut driver to remove screw and hex nut.

(8) Remove capacitor 1A3C5 by using Phillips head screw driver to remove screw securing capacitor to chassis.

(9) Remove fpa tube by accomplishing steps (6) through (11) above of fpa tube removal and replacement procedure (para 4-36c).

(10) Remove fpa fiberglass tube support by using nut driver to remove three hex head screws and three hex nuts.

CAUTION

The glass variable capacitor 1A3C19 is heavy, but fragile. Be careful to avoid damaging capacitor.

(11) Use Phillips head screwdriver and nut driver to remove two screws and two hex nuts securing lower section of glass epoxy capacitor retainer to rfa chassis.

(12) Use Phillips head screwdriver to remove five screws securing lower section of glass epoxy capacitor retainer to side support brackets.

(13) Pull glass epoxy capacitor retainer straight back until capacitor clears front clamp.

(14) Loosen clamp securing capacitor to glass epoxy capacitor retainer.

(15) Remove capacitor 1A3C19 from glass epoxy capacitor retainer using phillips screw driver and nut driver to remove six screws and six hex nuts.

d. Replacement Procedure.

(1) Secure capacitor to glass epoxy capacitor retainer using Phillips head screw driver and nut driver to secure six screws and six hex nuts.

(2) Tighten rear clamp.

(3) Secure glass epoxy capacitor retainer to side support brackets using Phillips head screwdriver to secure five screws.

(4) Secure glass epoxy capacitor retainer to rfa chassis using Phillips head screw driver and nut driver to secure two screws and two hex nuts.

(5) Secure fpa fiberglass tube support by using nut driver to secure three hex head screws and three hex nuts.

(6) Accomplish replacement procedure for fpa tube by performing steps of fpa tube removal and replacement procedure (para 4-36d (2) through (7)).

(7) Secure capacitor IA3C5 to chassis using Phillips head screw driver to secure screw.

(8) Secure connecting strap to capacitor 1A3C19 using Phillips head screw driver and nut driver to secure screw and hex nut.

(9) Secure capacitor 1A3C19 to shaft adapter using Allen wrench to secure two setscrews. Replace covers.

(10) Place rfa on equipment rack slide. Reconnect all cable connectors and slide rfa into equipment rack.

(11) Perform rfa bias adjustment (para 4-24), rfa neutralization (para 4-25) and fpa plate tune control adjustment (para 4-27) before placing rfa in normal operation.

4-38. Variable Pa Load Capacitor Removal and Replacement

a. General. Accomplish this procedure whenever

a variable pa load capacitor (1A3C20 through 1A3C22) in the rfa unit requires replacement.

b. Tools Required. This procedure does not require the use of special hand tools. Only normally available hand tools are required.

c. Removal Procedure.

WARNING

High voltage up to 3500 vdc is present in the rfa. Be extremely careful when working inside unit.

(1) On lvps set BIAS circuit breaker to OFF, and set +250 and +700 circuit breakers to OFF.

(2) On hvps set FILAMENT circuit breaker to OFF, and set 600V and 3500V circuit breakers to OFF.

(3) Loosen 12 screws securing rfa to equipment rack.

(4) Slide rfa out of equipment rack and remove all cable connectors. Remove rfa from equipment rack.

(5) Loosen 53 screws securing left side cover to rfa, and remove cover.

WARNING

High voltage up to 3500 vdc is present in normal operation of rfa. Verify capacitor discharge before continuing procedure.

(6) Slide idler sprocket wheel to left, and remove tension on roller chain using Phillips head screwdriver to loosen two screws securing flat idler plate to idler bracket.

(7) Remove roller chain from sprocket wheels on capacitors 1A3C20 and 1A3C21.

(8) Loosen two setscrews securing capacitor 1A3C22 to shaft adapter. Push out securing pin (if used).

(9) Move connecting straps for inductor 1A3SL and relay 1A3K3 aside using nut driver to remove hex nut from capacitor 1A3C21.

(10) Move inductor 1A3L2 aside using nut driver and Phillips head screwdriver to remove hex nut securing 1A3L2 to fpa retaining ring and screw securing 1ASL2 to standoff insulator assembly.

(11) Remove air filter using Phillips head screwdriver to remove 12 screws.

(12) Remove glass epoxy brace secured to outside capacitor retainer using Phillips head screwdriver to remove seven screws.

(13) Loosen front clamps on capacitors 1A3C20 through 1A3C22 by loosening three clamp screws.

CAUTION

The glass variable capacitors 1A3C20 through. 1A3C22 are heavy, but, fragile. Two men are required to remove them from the rfa when secured to glass epoxy capacitor retainer.

(14) Remove 10 screws from top section of glass epoxy capacitor retainer.

(15) Pull glass epoxy capacitor retainer straight back until sprocket wheels clear front clamp. Be careful to avoid damaging capacitors or attached hardware.

(16) Loosen clamp on capacitor to be removed.

(17) Remove capacitor by removing six screws and six hex nuts.

(18) If capacitor 1A3C20 or 1A3C21 is to be replaced, remove shaft adapter and sprocket wheel using Allen wrench to remove two setscrews.

d. Replacement Procedure.

(1) If applicable, secure shaft adapter and sprocket wheel to replacement capacitor using two set screws.

(2) Secure capacitor to glass epoxy capacitor retainer using six screws and six hex nuts.

(3) Tighten rear clamp.

(4) Secure glass epoxy capacitor retainer to rfa chassis using 10 screws.

(5) Apply a 1-inch long bead of Type II Silicone Adhesive Sealant (MIL-A-46146) between front clamp and capacitors 1A3C20 thru 1A3C22.

(6) Tighten front clamp on capacitors 1A3C20 thru 1A3C22.

(7) Secure glass epoxy brace to outside, capacitor retainer using seven screws.

(8) Secure air filter using 12 screws.

(9) Secure inductor 1A3L2 to standoff insulator assembly and fpa plate retaining ring using screw and hex nut.

(10) Secure connecting straps for inductors 1A3L3 and relay 1A3K3 to capacitor 1A3C21 using hex nut.

(11) Secure capacitor 1A3C22 to shouldered shaft adapter by tightening two set screws.

(12) Engage roller chain on sprocket wheel of capacitors 1A3C20 and 1A3C21.

(13) Slide idler sprocket wheel to right and apply tension on roller chain. Secure flat idler plate to idler bracket using two screws.

(14) Place rfa on equipment rack slide. Reconnect all cable connectors, and slide rfa into equipment rack.

(15) Perform rfa load tune control adjustment (para 4-28) before placing rfa in normal operation.

4-39. Rfa Gear Train Assembly Removal and Replacement

a. General. Accomplish this procedure whenever the gear train assembly 1A3A2 in the rfa requires replacement.

b. Tools Required. This procedure does not

require the use of special hand tools. Only normally available hand tools are required.

c. Removal Procedure.

WARNING

High voltage up to 3500 vdc is present in the rfa. Be extremely careful when working inside unit.

(1) On lvps set BIAS circuit breaker to OFF, and set +250 and +700 circuit breakers to OFF.

(2) On hvps set FILAMENT circuit breaker to OFF, and set 600V and 3500V circuit breakers to OFF.

(3) Loosen 12 screws securing rfa to equipment rack.

(4) Slide rfa out of equipment rack, and remove all cable connectors. Remove rfa from equipment rack.

(5) Remove four rfa controls knobs using allen wrench to loosen two set screws on each knob.

(6) Remove left side cover by loosening 53 fasteners.

(7) Remove right side cover by loosening 46 fasteners.

(8) Loosen ten fasteners securing door to rfa; open door.

WARNING

High voltage up to 3600 vdc is present in normal operation of rfa. Verify capacitor discharge before continuing procedure.

(9) Loosen two setscrews securing universal joint to sprocket wheel of capacitor 1A3C22.

(10) Loosen two setscrews securing universal joint to shouldered shaft adapter of capacitor 1A3C19.

(11) Loosen two setscrews securing rigid coupling shaft to straight shaft of IPA TUNING control.

(12) Disconnect lamp DS2 by removing two screws from terminal board.

(13) Disconnect lamp DS6 by unsoldering two leads on lamp.

(14) Loosen eight screws to release gear train assembly sufficiently to permit access to lamp DS3 connections.

(15) Disconnect lamp DS3 by unsoldering two leads on lamp.

(16) Remove eight screws and remove gear train assembly. Use care not to damage universal joints or bend coupling shafts.

d. Replacement Procedure.

(1) Secure gear train assembly using eight screws. Leave sufficient play to permit access to terminals of lamp DS3.

(2) Reconnect lamp DS3 by soldering two leads to lamp.

(3) Tighten eight screws securing gear train to fpa.

(4) Reconnect lamp DS6 by soldering two leads to lamp. Verify wiring between lamps DS6 and DS1.

(5) Reconnect lamp DS2 by securing two leads to terminal board.

(6) Tighten two setscrews securing rigid coupling shaft to straight shaft of IPA TUNING control.

(7) Tighten two setscrews securing universal joint to shouldered shaft adapter of capacitor 1A3C19.

(8) Tighten two setscrews securing universal joint to sprocket wheel of capacitor 1A3C22.

NOTE

Perform step (15) below if rfa is to be immediately placed in normal operation; otherwise, proceed with step 9.

(9) Secure door to rfa using ten fasteners.

(10) Secure right side cover to rfa using 46 fasteners.

(11) Secure left side cover to rfa using 53 fasteners.

(12) Secure four rfa control knobs tightening two setscrews on each knob.

(13) Place rfa on equipment rack slide. Reconnect all cable connectors, and slide rfa into equipment rack. Replace covers.

(14) Secure rfa to equipment rack using 12 screws.

(15) Perform ipa tuning control adjustment (para 4-26), ipa plate tune control adjustment (para 4.27) and fpa load tune control adjustment (para 4-28) before placing rfa in normal operation.

4-40. Soft Mounted Coupler Capacitor Removal and Replacement

a. General. Accomplish this procedure whenever a variable capacitor (lASC1 thru 1A5C4) in the soft mounted coupler requires replacement.

b. Tools Required. This procedure does not require the use of special hand tools. Only normally available hand tools are required.

c, Removal Procedure.

WARNING

Before working inside the equipment, turn power off and ground points of high potential before touching them.

(1) Loosen 12 screws securing soft mounted coupler to equipment rack.

(2) Slide soft mounted coupler out of equipment rack, and remove all cable connectors. Remove soft mounted coupler from equipment rack.

(3) Loosen 31 screws securing right side cover to soft mounted coupler; remove cover.

(4) Loosen 31 screws securing left side cover to soft mounted coupler; remove cover.

(5) Set TUNE control on soft mounted coupler fully counterclockwise (ccw).

(6) Loosen loop clamp on capacitor. Set electrical lead aside.

(7) Loosen wire rope assembly from spacer sleeve in cam assembly by loosening hex nut. Use wrench to hold wire rope assembly while removing tension on wire rope assembly.

CAUTION

Be careful not to damage standoff insulator between adapter and hex nut on capacitors 1A5C2 and 1A5C4.

(8) Remove wire rope assembly secured to capacitor by removing hex nut. Use wrench to hold wire rope assembly while removing hex nut.

(9) Remove adapter and standoff insulator by unscrewing adapter from capacitor. Set adapter and standoff insulator aside. Delete this step when removing capacitors 1A5C1 and 1A5C3.

(10) Loosen screw on clamp securing capacitor to chassis.

(11) Firmly grasp capacitor and remove.

d. Replacement Procedure.

(1) Secure capacitor to chassis using clamp screw.

(2) Place standoff insulator on wire rope assembly and secure to adapter by screwing them together. Delete this step when replacing capacitors 1A5C1 and 1A5C3.

(3) Secure wire rope assembly to capacitor using wrench to secure hex nut. Use wrench to hold wire rope assembly while securing hex nut.

(4) Secure wire rope assembly to spacer sleeve in cam assembly using wrench to secure hex nut. Use wrench to hold wire rope assembly while securing hex nut.

(5) Use screwdriver to secure loop clamp on capacitor.

NOTE

Perform step (10) below if soft mounted coupler is to be immediately placed in normal operation; otherwise proceed with step (6) below.

(6) Secure left side cover to soft mounted coupler using 31 screws.

(7) Secure right side cover to soft mounted coupler using 31 screws.

(8) Place soft mounted coupler on equipment rack slide. Reconnect all cable connectors, and slide soft mounted coupler into equipment rack.

(9) Secure soft mounted coupler to equipment rack by tightening 12 screws.

(10) Perform soft mounted coupler (1A5) adjustment (para 4-29) before placing soft mounted coupler in normal operation.

4-40.1. Cable Repair

Perform cable repairs in accordance with the instructions contained in TM 55-1500-323-25.

4-40.2. Low Pass Filter Section Removal and Replacement

a. General. Perform this procedure whenever a section of low pass filter 1A21 requires replacement. Refer to figure 4-11.1 for filter locations and both figures 4-11.1 and 4-11.2 for location of parts discussed in removal procedures.

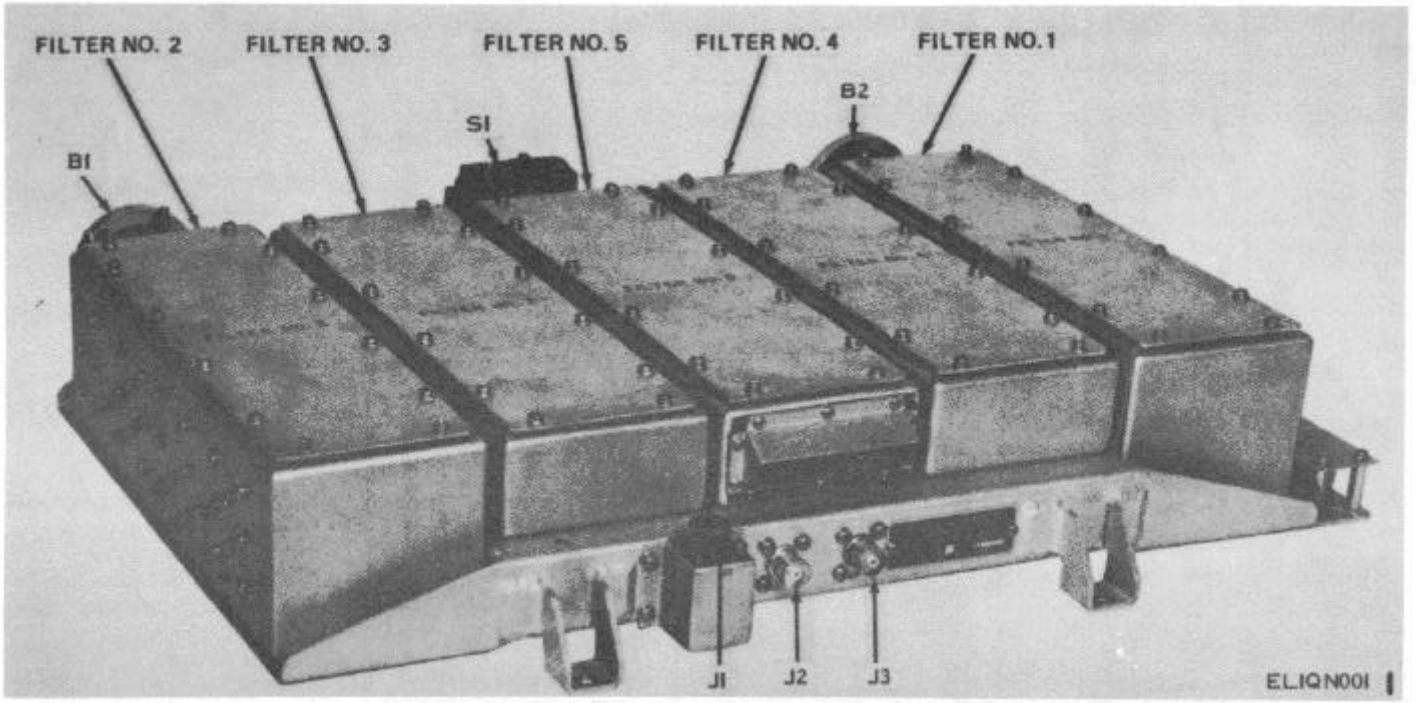


Figure 4-11.1. Low pass filter 1A21, top view.

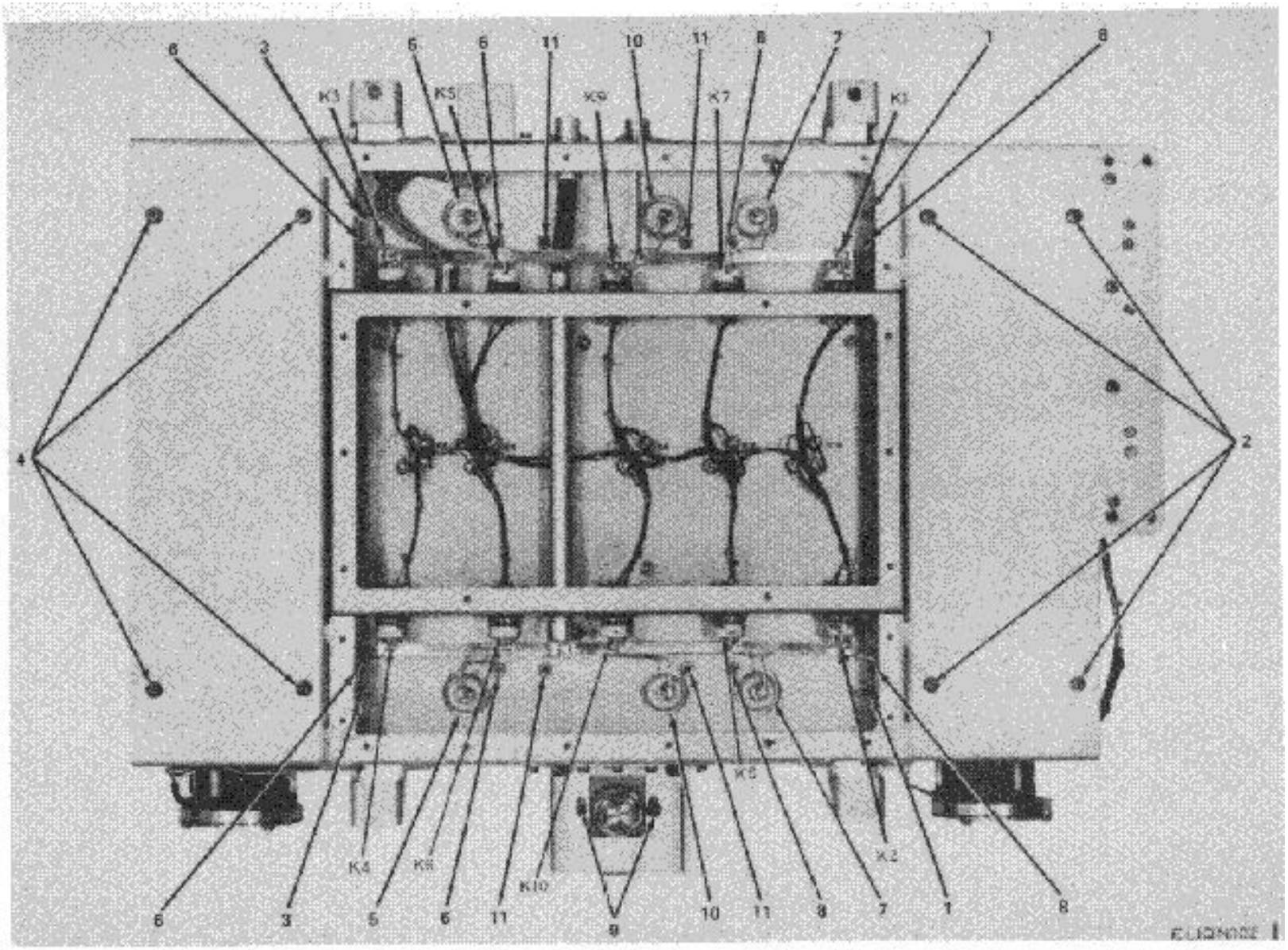


Figure 4-11.2. Low pass filter bottom view with cover removed.

b. Tools Required This procedure does not require the use of special tools. Only normally available handtools are required.

NOTE

When removing a filter, note the original position of the airflow gaskets and retain gaskets for reuse.

c. Removal Procedure for Filter No. 1.

(1) Unsolder three leads from fan B2 attached to filter No. 1. Tag leads so that they can be reconnected to proper terminals.

(2) Remove three screws and remove screen from fan.

(3) Remove three screws and remove fan.

(4) Remove 26 screws and remove bottom panel from low pass filter assembly.

(5) Remove locknuts and connections from insulated feedthroughs (1).

(6) Remove four screws (2) from bottom of filter No. 1.

(7) Tilt outside edge of filter No. 1 upward and carefully pull filter out.

d. Removal Procedure for Filter No. 2.

(1) Unsolder three leads from fan B1 attached to filter No. 2. Tag leads so that they can be reconnected to proper terminals.

(2) Remove three screws and remove screen from fan.

(3) Remove three screws and remove fan.

(4) Remove 26 screws and remove bottom panel from low pass filter assembly.

(5) Remove locknuts and connections from insulated feedthroughs (3).

(6) Remove four screws (4) from bottom of filter No. 2.

(7) Carefully slide filter out.

e. Removal Procedure for Filter No. 3.

(1) Remove filter No. 2 (d above).

(2) Remove locknuts and connections from insulated feedthroughs (5).

(3) Remove four screws (6) from bottom of filter No. 3.

(4) Carefully lift filter out.

f. Removal Procedure for Filter No. 4.

(1) Remove filter No. 1 (c above).

(2) Remove locknuts and connections from insulated feedthroughs (7).

(3) Remove four screws (8) from bottom of filter No. 4.

(4) Carefully lift filter out.

g. Removal Procedure for Filter No. 5.

(1) Remove two screws (9) from airflow switch.

(2) Remove filters 1 and 4 or filters 2 and 3.

(3) Remove locknuts and connections from insulated feedthroughs (10).

(4) Remove four screws (11) from bottom of filter No. 5.

(5) Carefully lift filter out.

(6) Remove airflow switch from filter No. 5.

h. Replacement Procedure for Filter Sections. Replacement of each filter section is the reverse of removal.

CAUTION

Be careful to insure that the airflow gaskets are replaced in their original positions and do not restrict airflow or allow air leakage; otherwise, damage to equipment can result.

4-40.3. Low Pass Filter Armature Relay Removal and Replacement

a. General. Perform this procedure whenever a low pass filter armature relay requires replacement.

b. Tools Required. This procedure does not require the use of special tools. Only normal available handtools are required.

c. Removal Procedure.

(1) Unsolder four leads from relay. Two leads are on top of relay and two leads are on bottom of relay.

(2) Remove two locknuts from bottom of relay.

(3) Lift relay out of mounting hole.

d. Replacement Procedure.

(1) Place relay in mounting hole. Orient relay so that leads removed can be resoldered to correct terminals.

(2) Replace and tighten two locknuts on bottom of relay.

(3) Carefully solder leads to correct terminals of relay.

CAUTION

Do not use a large soldering iron. Excess heat used when soldering may crack relay or destroy contacts.

4-40.4. Power Distribution Box Power Supply Removal and Replacement

a. General. Perform this procedure whenever power supply 1A13PS1 needs to be replaced.

b. Tools and Materials Required This procedure does not require the use of special tools. Only normal available handtools are required. The replacement procedure requires use of thermal joint compound, part number 1650242-1.

c. Removal Procedure.

(1) Unsolder and tag four wires from terminals of power supply 1A13PS1.

(2) Remove two self-locking nuts and flat washers that secure mounting bracket and circuit card assembly 1A13A1 to power distribution box.

(3) Remove power supply with attached mounting bracket from power distribution box 1A13.

(4) Remove mounting bracket from mounting side of power supply.

d. Replacement Procedure.

(1) Coat mounting side of power supply 1A13PS1 with thermal joint compound, part number 1650242-1 and fasten power supply mounting plate to mounting side of power supply.

(2) Carefully position mounting bracket and attached circuit card assembly out of the way to permit reinstallation of power supply.

CAUTION

Ensure that all wires and wire bundles are clear of power supply mounting area before proceeding.

(3) Secure power supply and attached mounting plate.

(4) Carefully solder leads to proper terminals of power supply.

(5) Reinstall mounting bracket and attached circuit card assembly.

4-40.5. Power Distribution Box Power Monitor Removal and Replacement

a. General. Perform this procedure whenever power monitor 1A13A2 or any of its circuit card assemblies needs to be replaced.

b. Tools and Materials Required. In addition to normally available handtools, the following tools are required for this procedure:

(1) Socket, thin-wall, extra-deep, 5/16 inch, part number 9GT-43575.

(2) Universal joint, part number 9GT-428.

c. Removal Procedure.

(1) Disconnect plug P1 from power monitor assembly 1A13A2.

(2) Using 5/16-inch extra-deep thin-wall socket and universal joint, remove four self-locking nuts and flat washers that secure power monitor to power distribution box 1A13. Use a wrench extension as required.

(3) Remove power monitor from power distribution box.

d. Circuit Cards Replacement.

(1) With power monitor 1A13A2 removed from power distribution box, remove four flathead screws that secure cover to power monitor.

(2) Remove cover from power monitor.

(3) To replace either frequency sensor or voltage sensor (circuit card assembly Al or A3), withdraw it from its connector and install new card in its place.

(4) To replace power supply and phase sensor circuit card assembly A2:

(a) Withdraw frequency sensor circuit card assembly A1 from its connector.

(b) Remove Phillips head screw and hardware that secures thick spacer across side plates.

(c) Remove thick spacer.

(d) Withdraw power supply and phase sensor circuit card assembly A2 from its connector and install new card in its place.

(e) Reverse steps (a), (b) and (c).

(5) Replace cover on power monitor and secure it using four flathead screws.

e. Replacement Procedure.

(1) Position power monitor assembly 1A13A2 in its location within power distribution box.

(2) Using 5/16-inch extra-deep thin-wall socket and universal joint with a wrench extension as required, fasten power monitor to power distribution box 1A13 with four self-locking nuts and flat washers.

(3) Reconnect plug P1 to power monitor assembly 1A3A2.

Section VII. DIRECT SUPPORT TESTING PROCEDURES

4-41. General

Direct support testing procedures in this section are performed to determine the acceptability of repaired equipment within a functional chain or group. These procedures set forth specific requirements that the functional group must meet before it is returned to system operational status. Comply with the instructions preceding each procedure before performing it. Perform each step in sequence. Do not vary the sequence. For each test, perform all the actions required in the Input parameter and Equipment under test control setting columns; perform each specific test procedure and verify it against its performance standard. If the functional group does not meet the specific performance standards, refer to troubleshooting sections of this chapter.

4-42. Physical Tests and Inspection

a. Test Equipment and Materials. None required.

b. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	N/A	Inspect Controls and mechanical assemblies on all units for loose or missing hardware. Inspect that all meters are not broken or damaged.	Hardware must be tight; none missing. Meter faces and needles not broken or deformed.
2	N/A	N/A	*a*. Inspect main power cable assembly connector for looseness and damage. *b*. Inspect main power cable for insulation damage. *c*. Inspect main power cable assembly terminals for looseness or damage.	*a.* Connector tight and properly connected to shelter receptacle. *b*. Cable insulation not cracked, aged, or broken. *c.* Cable terminals are tightly, properly secured and connected to generator terminal lugs.
3	N/A	N/A	Inspect all units for correct cable installation; inspect for damage.	All cables correctly connected to units. No damaged connectors.
4	N/A	N/A	Inspect all unit for correct equipment rack installation. Ensure that no cables are pinched or bent with units installed in equipment rack.	All units correctly installed in equipment rack.
5	N/A	N/A	Inspect controls, meters and indicators for dirt and corrosion.	All controls, meters and indicators are clean and operable; all hardware tight and none missing.

4-43. Primary Power Testing

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions.

(1) Insure that main power cable assembly is properly connected between shelter and generator.

(2) Insure all circuit breakers on power distribution box are set to off.

(3) Set generator controls as follows:

(a) REMOTE LOCAL switch to LOCAL

(b) NORMAL EMER.RUN EMER. STOP switch to NORMAL

c. Initial Test Equipment Settings. None required.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	None	a. Start generator locally by- setting START STOP switch to START. *b.* Check engine oil pressure on PRESS gage. *c.* Check engine battery charge-discharge rate on AMPERES meter. *d.* Check generator output frequency on frequency meter.	a. Generator starts and operates normally. *b.* PRESS gage indicates between 30 and 60. *c.* AMPERES meter indicates 0. *d.* 400 (±25) Hz.
2	N/A	*a.* Generator: set VOLT. SEL. switch to V^{1-3} *b.* Generator: set VOLT. SEL. switch to V^{1-2}. *c.* Generator: set VOLT. SEL. switch to V^{2-3}. *d.* Generator: set VOLT. SEL. switch to V^{0-3}, V^{02} and V^{0-1}, respectively.	*a.* Adjust VOLT. ADJ. control on generator for 208 vac on voltage meter. *b.* Adjust VOLT. ADJ. control on generator for 208 vac on voltage meter. *c* adjust VOLT. ADJ. control on generator for 208vac on voltage meter. *d.* Check for 120 vac per phase on generator voltage meter as VOLT. SEL. switch is set to each position.	*a.* 208 vac±10%. *b.* 208 vac±10%. *c.* 208 vac±10%. *d.* 120 vac±10%.
3	N/A	Generator: set AMP. SEL. switch to I_1, I_2, and I_3, respectively.	Check reading on generator current meter as AMP SEL. switch is set to each position.	100% (L. OFF)
4	N/A	Generator set START STOP switch to STOP.	Stop generator locally by setting START STOP switch to STOP.	Generator stops.
5	N/A	Generator: set REMOTE LOCAL switch to REMOTE and CIRCUIT BREAKER to on.	None.	None.
6	N/A	Power Distribution Box: set GENERATOR CONTROL switch to START.	Start generator remotely by momentarily setting GENERATOR CONTROL switch on power distribution box to START. When generator starts, release switch. GENERATOR CONTROL switch should then be in RUN position.	Generator starts and operates normally
7	N/A	*a.* Power Distribution Box:set PHASE CURRENT switch to ϕ1. *b.* Power distribution Box: set PHASE CURRENT switch to ϕ2. *c.* Power Distribution Box: set PHASE CURRENT switch to ϕ3.	*a.* Measure phase 1 ac current on PHASE CURRENT meter. *b.* Measure phase 2 ac current on PHASE CURRENT meter. *c.* Measure phase 3 ac current on PHASE CURRENT meter.	*a.* 0 amp. *b.* 0 amp. *c.* 0 amp.
8	N/A	Power Distribution Box: set MAIN circuit breaker to on.	Monitor VOLTAGE PHASE FREQ indicator on control unit.	VOLTAGE PHASE FREQ indicator lights.
9	N/A	Control Unit: set VOLTAGE MONITOR switch to Vϕ 1, Vϕ 2 and Vϕ 3, respectively.	Monitor phase 1, 2 and 3 primary ac voltage input on control unit VOLTAGE MONITOR meter.	VOLTAGE MONITOR meter reads in green area for each monitored phase.

4-44. Interlocks Testing

a. Test Equipment and Materials.

(1) Pyrometer

(2) Pyrometer sensor cable

b. Test Connections and Conditions.

(1) On power distribution box set WHITE RED switch to WHITE; and ON OFF circuit breaker to ON. Set all other circuit breakers and switches on power distribution box to off position.

(2) Set hvps circuit breakers as follows:

(a) FILAMENT to ON.

(b) 600 V to ON.

(c) 3500 V to ON.

(3) Set following lvps circuit breakers to ON:

(a) BIAS.

(b) +250.

(c) + 700.

(4) Set rt unit controls as follows:

CAUTION

Set TRANSMIT MODE switch to OFF before setting POWER ON circuit breaker to on. Failure to comply will damage the rt unit.

(a) TRANSMIT MODE switch to OFF.

(b) POWER ON circuit breaker on (up).

(c) DIMMER control to midposition.

(d) MODULATION switch OFF.

(e) DEVIATION control ccw.

(f) ZERO BEAT switch OFF.

(g) CHIRP RATE control OFF.

(h) RF OUTPUT control ccw.

(I) AFC switch OFF.

(j) RF GAIN control ccw.

(k) AF GAIN control ccw.

(l) IF BW switch to WIDE.

(5) Set control unit controls as follows:

(a) BATTLE SHORT switch to off (down) with hood down.

(b) VOLTAGE MONITOR switch to 28V.

(c) DIMMER CONTROL to midposition.

(d) PREHEATER switch to AUTO.

(e) Audio switch to OFF.

(6) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 1.60 MHZ)

(7) Set rfa BAND SELECT switch to 1.

(8) Set digital counter controls as follows:

(a) SENSITIVITY switch to .1V.

(b) FUNCTION switch to FREQ.

(c) Time base switch (black) to 1 sec gate time.

(d) DISPLAY control to MIN.

(e) POWER switch to OFF.

(9) Set modulation source PWR switch to ON.

(10) Set pan indicator Power INPUT switch to ON.

(11) Install thermocouple elements on pyrometer cable next to exhaust assembly temperature elements (located behind rfa).

c. Initial Test Equipment Settings. None Required.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	208 vac, 3ϕ 400 Hz from generator.	N/A	Set power distribution box MAIN circuit breaker to on (in) and close shelter door. **NOTE** **If VOLTAGE PHASE FREQ indicator does not light, depress RESET switch on control unit.**	VOLTAGE PHASE FREQ indicator on control unit lights. Shelter overhead lights turn on (white).
2	N/A	Power Distribution Box: set following circuit breakers to on (in): 3 ϕ-BLOWERS DC CONV UTILITY PREHEATER	None.	None.
3	N/A	Control Unit: set STANDBY switch to on (green).	None.	Blowers and +28 vdc converter operation audible; INTERLOCKS indicators up to and including EQUIP. AIR TEMP light
4	N/A	*a.* Control Unit: set fdlowing switches to off (white): ANTENNA COUPLER AUX ANTENNA REMOTE XMTR HIGH VOLTAGE	*a.* None.	*a.* All switches light (white).
		b. Control Unit: set DUMMY LOAD switch to on (green).	*b.* None.	*b.* None.
			c. After 3-minute delay, observe that additional INTERLOCKS indicators on control unit light.	*c.* Following indicators light in sequence: RFA FIL IPA BIAS FPA BIAS DUMMY LOAD TEMP SWR OVLD
5	N/A	Control Unit: set HIGH VOLTAGE switch to on (yellow).	Observe INTERLOCKS indicators on control unit.	HIGH VOLTAGE switch lights yellow. Following indicators light in sequence: IPA PLATE IPA SCREEN FPA PLATE FPA SCREEN
6	N/A	N/A	*a.* Loosen retaining screws securing rfa to equipment rack. Slide rfa out of equipment rack until interlock switch- clears chassis. Observe INTERLOCKS indicators on control unit.	*a.* RFA RACK indicator and all to the right of it up to and including FPA SCREEN, go out.

d. Procedure-Continued

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
6 (Cont)			*b*. Defeat interlock by pulling out interlock switch stem. Observe INTERLOCKS indicators on control unit.	*b*. All INTERLOCKS indicators light, up to and including EQUIP. AIR TEMP.
			c. Slide rfa back into equipment rack and tighten retaining screws.	*c*. None.
7	N/A	N/A	Repeat step 6 above using hvps. Observe INTERLOCKS indicators on control unit.	HV PWR SUP RACK indicator and all interlock indicators to the right of it go out. All INTERLOCKS indicators light up to and including EQUIP. AIR TEMP when interlock switch is defeated.
8	N/A	N/A	Repeat step 6 above using lvps. Observe INTERLOCKS indicators on control unit.	LV PWR SUP RACK indicator and all interlock indicators to the right of it go out. All INTERLOCKS indicators light up to and including EQUIP. AIR TEMP when interlock switch is defeated.
9	N/A	N/A	Repeat step 6 above using soft mounted coupler. Observe INTERLOCKS indicators on control unit.	ANT. COUPLER RACK indicator and all interlock indicators to the right of it go out. All INTERLOCKS indicators light up to and including EQUIP. AIR TEMP when interlock switch is defeated.
10	N/A	N/A	Repeat step 6 above using control unit. Observe INTERLOCKS indicators on control unit.	CONTROL UNIT RACK indicator and al interlock indicators to the right of it go out. All INTERLOCKS indicators light up to and including EQUIP. AIR TEMP when interlock switch is defeated.
11	N/A	Power Distribution Box: set 3 ϕ BLOWERS circuit breaker to off (out).	Observe INTERLOCKS indicators on control unit; reset 3ϕ, BLOWERS circuit breaker to on (in).	EQUIP. AIR indicator and all interlock indicators to the right of it go out. All INTERLOCKS indicators light up to including EQUIP. AIR TEMP when circuit breaker is reset.
12	N/A	N/A	Wait 3-minutes for rfa time delay to time-in	
13	N/A	Control Unit: depress ANTENNA COUPLER and DUMMY	Verify that switches do not change color and dummy load mode is maintained.	ANTENNA COUPLER switch remains lighted (white); DUMMY LOAD switches. LOAD switch remains lighted (green).

d. Procedure-Continued

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
14	N/A	Control Unit: set switches in sequence as follows: HIGH VOLTAGE to off (white); ANTENNA COUPLER to on (green).	Verify that antenna coupler mode is selected, and dummy load mode is off-line.	IPA PLATE indicator and all interlock indicators to the right of it go out. ANTENNA COUPLER switch lights (green); DUMMY LOAD switch lights (white).
15	N/A	Control Unit: set HIGH VOLTAGE switch to on (yellow). Depress AUX ANTENNA and DUMMY LOAD switches.	Verify that switches do not change color and that antenna coupler mode is maintained.	IPA PLATE indicator and all interlock indicators to the right of it light, AUX ANTENNA and DUMMY LOAD switches remain lighted (white).
16	N/A	Control Unit: set switches in sequence as follows: HIGH VOLTAGE to off (white); DUMMY LOAD to on (green).	Verify that dummy load mode is selected and antenna coupler mode is off-line.	IPA PLATE indicator and all interlock indicators to the right of it go out. ANTENNA COUPLER switch lights white; DUMMY LOAD switch lights (green).
17	N/A	Control Unit: set HIGH VOLTAGE switch to on (yellow). Depress ANTENNA COUPLER and AUX ANTENNA switches.	Verify that switches do not change color and that dummy load mode is maintained.	IPA.PLATE indicator and all interlock indicators to the right of it light. ANTENNA COUPLER and AUX ANTENNA switches remain lighted white
18	N/A	Control Unit: set switches in sequence as follows: HIGH VOLTAGE to off (white); AUX ANTENNA to on (green).	Verify that auxiliary antenna mode is selected and dummy load mode is off-line.	IPA PLATE indicator and all interlock indicators to the right of it go out. DUMMY LOAD switch lights white; AUX ANTENNA switch lights green.
19	N/A	Control Unit: set HIGH VOLTAGE switch to on (yellow). Depress ANTENNA COUPLER and DUMMY LOAD switches.	Verify that switches do not change color and that the auxiliary antenna mode is maintained.	IPA PLATE indicators to the right of it light. ANTENNA COUPLER and DUMMY LOAD switches remain lighted white.
20	N/A	Repeat steps 13 and 14	Repeat steps 14 and 15.	Same as steps 14 and 15.
21	N/A	N/A	Open outer shelter door. Verify that all indicators and shelter lights (except pan indicator crt trace) go out. Defeat outer shelter door interlock switch.	All indicators and shelter lights (except pan indicator crt trace) go out. All indicators and shelter lighting light when interlock switch is defeated.
22	N/A	N/A	Repeat step 21 using inner shelter door.	Same as in step 21.
23	N/A	Control Unit: HIGH VOLTAGE switch to off (white) and PREHEATER switch to MAN. Power Distribution Box: PRE. HEATER circuit breaker to on (in).	Verify that PREHEATER indicator on control unit lights.	PREHEATER indicator lights.

d. Procedure-Continued

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
24	N/A	Power Distribution Box: 3 BLOWERS circuit breaker to off (out).	Verify that PREHEATER indicator on control unit goes out; reset 3 BLOWERS circuit breakers to on. NOTE Wait 3 minutes for rfa time delay to time out.	PREHEATER indicators goes out; lights when circuit breaker is reset. EQUIP. AIR indicator and all interlock indicators to the right of it go out.
25	N/A	Control Unit: HIGH VOLTAGE switch to on (yellow).	Verify PREHEATER indicator on control unit goes out.	PREHEATER indicator goes out.
26	N/A	N/A	Close shelter exterior air intake and exhaust access doors.	None.
27	N/A	Operate AN/TLQ-15 for a frequency of 1.5MHz. Adjust output power to 2 kw operating into the dummy load. Refer to operator's manual for operating instructions.	Monitor pyrometer. Verify that damper vane is fully closed at temperatures up to 70°F.	At temperatures up to 70°F, DAMPER CLOSED indicator on control unit lights; damper vane is fully closed. Pyrometer indicates below 70°F.
28	N/A	Open air exhaust port above rfa by pulling out PULL FOR HEAT control	Verify that hot air is vented from port.	Hot air vented from port into operator area.
29	N/A	Close air exhaust port by pushing in PULL FOR HEAT control.	Check to see that at approximately 70°F and above damper vane gins to open.	DAMPER CLOSED indicator on be. control unit goes out; damper door begins to open; pyrometer indicates 70°F or above.
30	N/A	Rt Unit: set RF OUTPUT control fully ccw. Control Unit: set HIGH VOLTAGE switch to off (white).	Open shelter exterior air intake and exhaust access doors. Ensure louver panels are properly installed. Allow equipment blowers to run for approximately 15 minutes.	None.
31	N/A	Control Unit: set STANDBY switch to off (white).	Verify that blowers stop three to 4 minutes after STANDBY switch is set to off. Remove pyrometer and pyrometer cable.	Blowers shut off within three to four minutes.
32	N/A	Set personnel heater thermostat above existing operator area temperature. Power Distribution Box: set PHASE CURCRENT selector switch to 01, HEATER circuit breaker to on (in) and PERSONNEL HEATER switch to HIGH.	Note reading on PHASE CURRENT meter.	Meter indicates 4 amps; personnel heater operates at high fan speed and provides hot air flow into operator areas.
33	N/A	Set personnel heater thermostat below operator area temperature.	Note reading on PHASE CURRENT meter.	0.5 amps; personnel heater shuts off.
34	N/A	Power Distribution Box: set PERSONNEL HEATER switch to OFF and HEATER circuit breaker to off nit. It	Note reading on PHASE CURRENT meter.	Meter indicates 0 amps; personnel heater shuts off.

d. Procedure--Continued

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
35	N/A	Power Distribution Box: AIR COND circuit breaker to on (in). Air Conditioner: Switch to OFF and HI SPEED LO SPEED switch to HI SPEED.	None.	None.
36	N/A	Air Conditioner:		
		a. Switch to VENTILATE.	*a*. Check air conditioner operation.	*a*. Plain air vented from air conditioner.
		b. Switch to COOL.	*b*. With shelter thermostat set to 40, check air conditioner operation.	*b*. Cold air vented from air conditioner.
		c. Switch to HI-HEAT.	*c*. Check air conditioner operation.	*c* Hot air vented from air conditioner.
		d. Switch to LO-HEAT.	*d*. Check air conditioner operation.	*d*. Warm air vented from air conditioner.
		e. Switch to OFF.	*e*. Check air conditioner operation.	*e*. Air conditioner shuts off.
37	N/A	Personnel Fan: release on-off switch (chain operated).	Verify operation of personnel fan.	Personnel fan exhaust hood opens; fan operates correctly.
38	N/A	Personnel Fan secure on-off switch (chain operated).	None.	Personnel fan exhaust hood closes; fan shuts off.

4-45. Dc Power Generation Testing

a. Teat Equipment and Materials. The only test equipment required is Multimeter/AN/USM-223.

b. Test Connections and Condition.

(1) Set power distribution box controls as follows:
- *(a)* MAIN circuit breaker to on (in).
- *(b)* DC CONV circuit breaker to on (in).
- *(c)* Set BLOWERS circuit breaker to on (in).
- *(d)* WHITE RED switch to WHITE.
- *(e)* ON OFF circuit breaker to ON.

(2) Set hvp circuit breakers as follows:
- *(a)* Filament to ON.
- *(b)* 600V to ON.
- (c) 3500V to ON.

(3) Set Ivps circuit breaker as follows:
- *(a)* BIAS to ON.
- *(b)* +250 to ON.
- *(c)* +700 to ON.

(4) Set rt unit controls as follows:

CAUTION

Check to Me that TRANSMIT MODE switch is met to OFF before setting POWER ON circuit breaker to on. Failure to comply will damage the rt unit.

- *(a)* TRANSMIT MODE switch to OFF.
- *(b)* POWER ON circuit breaker on (up).
- *(c)* DEVIATION control ccw.
- *(d)* CHIRP RATE control OFF.
- *(e)* METER SELECTOR switch to RF OUTPUT.
- *(f)* MODULATION switch OFF
- *(g)* RF OUTPUT control CCW.
- *(h)* DIMMER control to midposition.
- *(I)* ZERO BEAT switch OFF.
- *(j)* RF GAIN control ccw.
- *(k)* AFC switch OFF.
- *(l)* AF GAIN control ccw.
- *(m)* IF BW switch to WIDE.

(5) Set control unit controls as follows:
- *(a)* STANDBY switch to on (green).
- *(b)* HI RF-LOW RF switch to HI RF.
- *(c)* DUMMY LOAD switch to on (green).
- *(d)* After 3-minute time delay, set HIGH VOLTAGE switch to on (yellow).

(6) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).

7) Set rfa BAND SELECT switch to 1.

c. Initial Test Equipment Settings. None required.

d. Procedure - Continued

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	Set multimeter to measure +24 vdc	N/A	At power distribution box, measure output of auxiliary +24 vdc converter at TB14 pins 2(+) and 3(-).	+24 (±1) vdc.
2	N/A	Control unit: set VOLTAGE MONITOR switch to 29V.	Observe control unit VOLTAGE MONITOR meter.	VOLTAGE MONITOR meter indicates in green area
3	N/A	Control Unit: sequentially set VOLTAGE MONITOR switch to following position -75 -120V Vϕ 1 Vϕ-2 Vϕ-3 250V 700V 3500V	Observe control unit VOLTAGE MONITOR meter.	VOLTAGE MONITOR meter indicates in green area for each switch position selected
4	N/A	Operate AN/TLQ-15 for full power output (2 kW) into dummy load at 2 MHz. Refer to operator's manual for operating procedure	None.	2 kW rf output at 2 MHz into dummy load
5	N/A	Control Unit: repeat steps 2 and 3 above	0bserve control unit VOLTAGE MONITOR meter.	VOLTAGE MONITOR meter indicates in green area for each switch position selected under load conditions.

4-46. RF Power Output Testing

a. Test Equipment and Materials.

(1) Impedance Matching Device.
(2) Wattmeter 4301.
(3) Wattmeter Plug-in 2500H.
(4) Rf cables WI and W2.
(5) Power cable W1.
(6) Grounding wand.
(7) 30 dB Attenuator.
(8) 100 ohms Resistor (2 each).
(9) Termination 370 BNM.

b. Test connections and conditions.

(1) Install impedance matching device as follows:

WARNING

Do not touch center conductor of J1 or J2 on impedance matching device prior to grounding in step (c). Otherwise, personal injury may result.

(a) Remove impedance matching device from transit case.

(b) Attach grounding wand lead to GND connector on impedance matching device.

(c) Touch grounding wand book to center conductor of J1 on impedance matching device.

(d) Remove AN/TLQ-15 shelter cover plate or cm antenna and antenna base insulator if installed; position adapter plate so that grounding block is toward curbside of shelter and fasten to shelter roof by tightening four 3/8-inch screws with screwdriver.

(e) Place impedance matching device with controls toward shelter curbside in position on top of adapter plate so that locking slide tabs of adapter plate engage with impedance matching device.

(f) Using screwdriver, tighten impedance matching device grounding screw to adapter plate grounding block. Push four slide tabs into locked position.

(2) Connect equipment as shown in figure 4-12 except for remote telephone junction box. (Attenuator should be placed on shelter roof.)

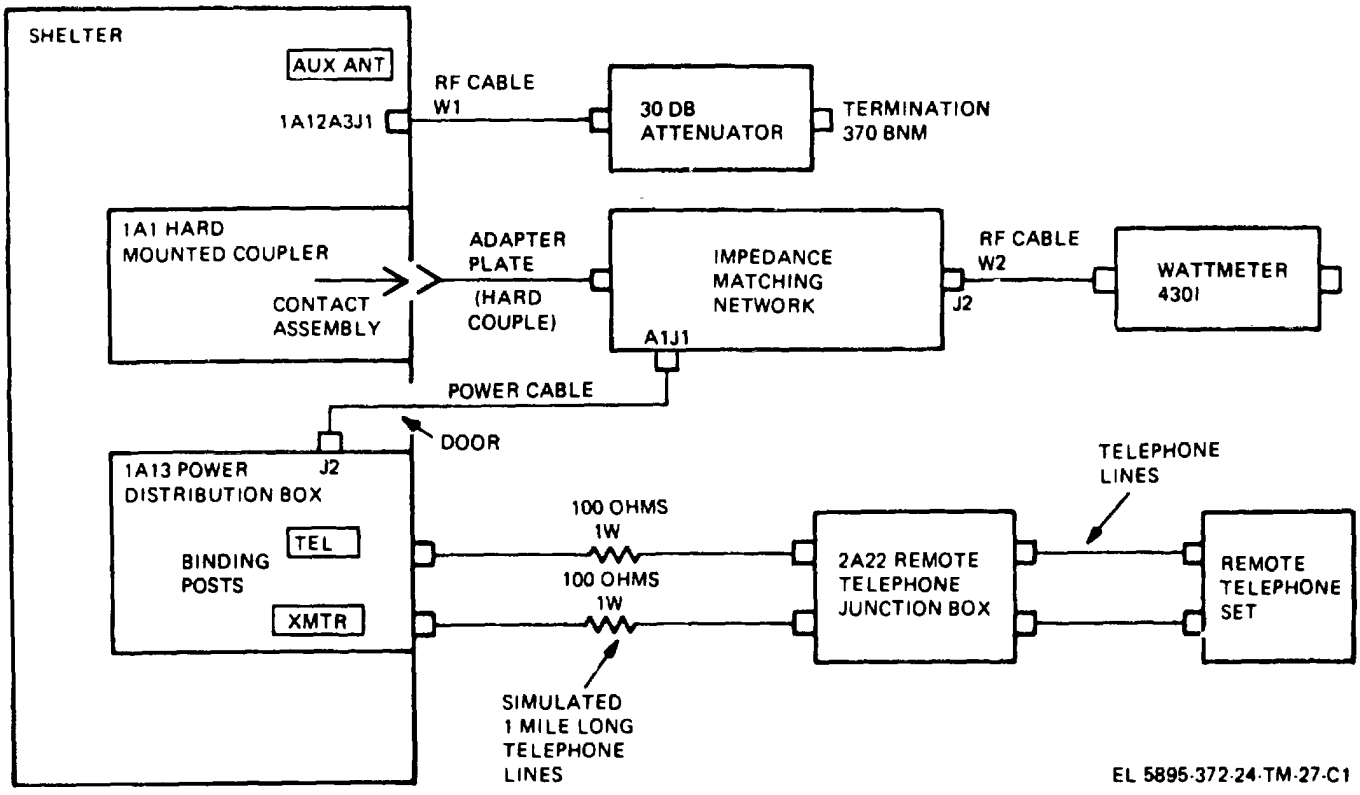


Figure 4-12. Test Setup, rf power output testing.

(3) Set the following controls on the impedance matching device:

(a) Power switch to ON.

(b) Loosen lock nuts on controls by turning lock fully ccw. and set SHUNT CONT switch and INDUCTOR, SERIES CAPACITOR and SHUNT CAPACITOR controls in accordance with calibration chart for 1.5 MHz.

(4) Set power distribution box controls as follows:

(a) MAIN circuit breaker on (in).
(b) DC CONV circuit breaker on (up).
(c) LIGHTS ON OFF circuit breaker ON.
(d) 3 BLOWERS circuit breaker on (in).
(e) LIGHTS WHITE/RED switch to WHITE.
(f) UTILITY circuit breaker on (in).
(g) All other circuit breakers off.

(5) Set following lvps circuit breakers to ON:

(a) BIAS.
(b) +250.
(c) +700.

(6) Set following hvps circuit breakers to IN:

(a) FILAMENT.
(b) 600V.
(c) 3500V.

(7) Set rf unit controls as follows:

CAUTION

Check to see that TRANSMIT MODE switch is set to OFF before setting POWER ON circuit breaker to ON. Failure to comply will damage the rt unit.

(a) TRANSMIT MODE switch to OFF.
(b) POWER ON circuit breaker on (up).
(c) TRANSMIT MODE switch to CONT.
(d) DEVIATION control ccw.
(e) CHIRP RATE control OFF.
(f) METER SELECTOR switch to RF OUTPUT.
(g) MODULATION switch OFF.
(h) RF OUTPUT control ccw.
(i) DIMMER control to midposition.
(j) ZERO BEAT switch OFF.
(k) RF GAIN control AGC ON.
(l) AFC switch OFF.
(m) AF GAIN control ccw.
(n) IF BW switch WIDE.

(8) Set control unit controls as follows:

(a) PREHEATER switch to AUTO.
(b) Audio switch to OFF.
(c) Depress RESET switch once momentarily; VOLTAGE PHASE FREQ indicator lights green.
(d) Depress STANDBY switch once (white to green).
(e) HI RF-LOW RF switch to LOW RF.
(f) REMOTE XMTR switch off (white).
(g) AUX ANTENNA switch on (green).
(h) HIGH VOLTAGE switch on (yellow).

(9) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 1.60 MHz).

(10) Set rfa BAND SELECT switch to 1.

(11) Set digital counter controls as follows:

(a) SENSITIVITY switch to .1V.
(b) FUNCTION switch to FREQ.
(c) Time base switch (black) to 1 sec gate time.
(d) DISPLAY control to MIN.
(e) POWER switch to STORE.

(12) Set modulation source controls as follows:

(a) PWR switch to ON,
(b) MOD OFF switch OFF (green).
(c) CONT KEYING switch on (green).
(d) NOISE BW KC/S switch to 3.5.
(e) N/T RATIO control to midposition.
(f) TONE SEL KC/S switch to .3-1.3.
(g) SPEED WPM-CPS control to 10.
(h) RANDOM RATIO control to midposition.
(l) TONE FREQ KC/S control to midposition.

(13) Set pan indicator controls as follows:

(a) POWER INPUT switch to ON.
(b) All controls set to midposition.

(14) Set remote telephone junction box TEL XMTR switch to TEL.

c. Initial Test Equipment Settings. Be sure impedance matching device controls are set as described in paragraph 4-46*b* (3).

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	Tune AN/TLQ-15 at 1.5 MHz for 800 watts output into auxiliary antenna. Refer to TM 11-5895-372-10 for tuning procedures.	Observe control unit FORWARD POWER meter and REFLECTED POWER meter.	FORWARD POWER meter indicates 800 watts; REFLECTED POWER meter indicates 1:1.
2	N/A	Control unit: set HI RF-LOW RF switch to HI RF.	Observe control unit FORWARD POWER meter.	FORWARD POWER meter indicates 1200 watts (min.).
3	N/A	Retune rfa. Refer to TM 11-5895-372 -10 for tuning procedures.	Observe control unit FORWARD POWER meter.	FORWARD POWER meter indicates 2 kW.
4	N/A	Rt Unit: set RF OUTPUT control fully ccw. Control Unit: set HIGH VOLTAGE switch to off (white) and depress ANTENNA COUPLER switch (green).	Disconnect rf cable W1 from auxiliary antenna connector 1 A12 A3 J1 ; reconnect remaining connector on wattmeter 4301.	None
5	N/A	Tune AN/TLQ-15 at 1.5 MHz for 800 watts output into impedance matching device via antenna couplers. Refer to TM 11-5895-372-10 for tuning procedures.	Observe wattmeter 4301.	Wattmeter indicates 400 watts (min.).
6	N/A	Control Unit: set HI RF-LOW RF switch to HI RF.	Observe wattmeter 4301.	Wattmeter indicates approximately 600 watts (min.).
7	N/A	Retune rfa and soft-mounted coupler for 2 kW. Refer to TM 11-5895-372-10 for tuning procedures.	Observe wattmeter 4301.	Wattmeter indicates 900 watts (min.).
8	N/A	Control Unit: set HIGH VOLTAGE switch to off (white) and REMOTE XMTR switch to on (green).	None.	None.
9	N/A	Remote Telephone Junction Box: set TEL XMTR switch to XMTR.	Verify that high voltage is turned on remotely; observe control unit FORWARD POWER meter.	On control unit, all INTERLOCKS indicators are lighted (green); FORWARD POWER meter indicates 2 kW.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
10	N/A	N/A	Upon completion of test, completely shut-down AN/TLQ-15. **WARNING** **Do not touch center conductor of J1 or J2 on impedance matching device prior to grounding. Otherwise, personal injury could result.**	N/A
11	N/A	N/A	Disconnect r cable W2 from J2 of impedance matching device. Touch grounding wand hook to center con-ductor of J2 on impedance matching device for 10 seconds.	N/A
12	N/A	N/A	On impedance matching device, set POWER circuit breaker to OFF and disconnect power cable W1 from connector A1 J1.	N/A
13	N/A	N/A	Pull out slide tabs, unscrew grounding screw, and remove impedance match-ing device from adapter plate.	N/A
14	N/A	N/A	Touch grounding wand hook to center conductor of J1 on impedance matching device for 10 seconds.	N/A

4-47. Rfa Overload Protection Testing

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions.

(1) Set power distribution box controls as follows:

(a) MAIN circuit breaker to on (in).
(b) DC CONV circuit breaker to on (in).
(c) WHITE RED switch to WHITE.
(d) 30 BLOWERS circuit breaker to on (in).
(e) ON OFF circuit breaker to ON.

(2) Set hvps circuit breakers as follows:

(a) Filament to ON.
(b) 600V to ON.
(c) 3500 to ON.

(3) Set lvps circuit breakers as follows:

(a) BIAS to ON.
(b) +250 to ON.
(c) +700 to ON.

(4) Set rt unit controls as follows:

CAUTION

Check to see that TRANSMIT MODE switch is set to OFF before setting POWER ON circuit breaker to on. Failure to comply will damage the rt unit.

(a) TRANSMIT MODE switch to OFF.
(b) POWER ON circuit breaker on (up).
(up).
(c) DEVIATION control ccw.
(d) CHIRP RATE control OFF.
(e) METER SELECTOR switch to RF output.
(f) MODULATION switch OFF.
(g) RF OUTPUT control ccw.
(h) DIMMER control to midposition.
(I) ZERO BEAT switch OFF.
(j) RF GAIN control ccw.
(k) AFC switch OFF.
(l) AF GAIN control ccw.
(m) IF BW switch to WIDE.

(5) Set control unit controls as follows:

(a) STANDBY switch to on (green).
(b) HI RF-LOW RF switch to HI RF.
(c) DUMMY LOAD switch to on (green).
(d) HIGH VOLTAGE switch to on (yellow).

(6) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).

(7) Set rfa BAND SELECT switch to 1.

c. Initial Test Equipment Settings. None required

d. Procedure.

Step No.	Equipment under test: Input parameter	Equipment under test: control setting	Test procedure	Performance standard
1	N/A	Tune AN/TLQ-15 for 2 kW at 1.3 MHz into dummy load Refer to TM 11-5895-372-10 for tuning procedure.	None.	None
2	N/A	Rt Unit: Set RF OUTPUT control fully ccw.	None.	No rf output.
3	N/A	Rfa; detune fpa plate tune controls from proper setting for frequency in use.	None. **CAUTION** **Do not set rf excitation beyond 1.5 amps reading on rfa PA TUNE meter. Failure to comply may damage equipment.**	None.
4	N/A	Rt Unit: Slowly turn RF OUTPUT controls cw.	As rf excitation is increased, verify that rf overloads at approximately 1.5 amps plate current; observe PA TUNE meter on rfa and indicators on control unit.	Rfa overloads at approximately 1.5 amps as noted on PA TUNE meter. Front panel controls and indicators on control unit are as follows: *a*. RESET switch on (red). *b*. FPA PLATE interlock indicator and all indicators to the right of it go out.
5	N/A	RT Unit: Set RF OUTPUT control ccw. Control Unit: set RESET switch to off.	None.	FPA PLATE interlocks indicator and all indicators to the right of it light.

4-48. VSWR Overload Protection Testing

a. Test Equipment and Materials. None required.

b. Test Connections and Conditions.

(1) Set power distribution box controls as follows:

(a) MAIN circuit breaker to on (in).
(b) DC CONV circuit breaker to on (in).
(c) WHITE RED switch to WHITE.
(d) 30 BLOWERS circuit breaker to on (in).
(e) ON OFF circuit breaker to ON.

(2) Set hvps circuit breakers as follows:

(a) FILAMENT to ON.
(b) 600V to ON.
(c) 3500V to ON.

(3) Set lvps circuit breakers u follows:

(a) BIAS to ON.
(b) +260 to ON.
(c) +700 to ON.

(4) Set rt unit controls as follows:

CAUTION

Check to see that TRANSMIT MODE switch is set to OFF before setting POWER ON circuit breaker to on. Failure to comply will damage the rt unit.

(a) TRANSMIT MODE switch to OFF.
(b) POWER ON circuit breaker on (up).
(c) DEVIATION control ccw.
(d) CHIRP RATE control OFF.
(e) METER SELECTOR switch to RF OUTPUT.
(f) MODULATION switch OFF
(g) RF OUTPUT control ccw.
(h) DIMMER control to midposition.
(I) ZERO BEAT switch OFF.
(j) RF GAIN control ccw.
(k) AFC switch OFF.
(l) AF GAIN control ccw.
(m) IF BW switch to WIDE.

(6) Set control unit controls as follows:

(a) PREHEATER switch to AUTO.
(b) Audio switch to OFF.
(c) STANDBY switch on (green).
(d) HI RF-LOW RF switch to LOW RF.
(e) REMOTE XMTR switch off (white).
(f) DUMMY LOAD switch on green).
(g) HIGH VOLTAGE switch on (Yellow

(6) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).

(7) Set rfa BAND select switch to 1.

(8) No antenna should be connected to auxiliary antenna connector 1A12A3J1.

c. Initial Test Equipment Settings. None required.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	Tune AN/TLQ-15 for 2 kW output at 1.5 MHz into dummy load. Refer to TM 11-5894-372-10 for tuning procedure.	None.	None.
2	N/A	Rt Unit: Set RF OUTPUT control fully ccw.	None.	None.
3	N/A	Control Unit: sequentially set controls as follows: *a.* HIGH VOLTAGE switch to off (white). *b.* AUX ANTENNA switch to on (green). *c.* HIGH VOLTAGE switch to on (Yellow).	None.	None.
4	N/A	Rt Unit: slowly adjust RF OUTPUT control cw.	Observe REFLECTED POWER meter on control unit as rf poweris applied; note vswr reading when transmitter overloads and goes off.	Transmitter overloads at approximately 350 as noted on REFLECTED POWER meter. RESET SWITCH lights (red). SWR OVLD, IPA PLATE, IPA SCREEN, FPA PLATE, and FPA SCREEN INTERLOCKS indicators go out.
6	N/A	Rt Unit: set RF OUTPUT control ccw. Control Unit: set RESET switch to off (no light).		All INTERLOCKS indicator light.

4-49. Modulation Testing

a. Test Equipment and Materials.

(1) 3dB Attenuator.

(2) Test receiver Hallicrafters SX-99 or equivalent.

b. Test Connections and Conditions.

(1) Connect equipment as shown in figure 4-13.

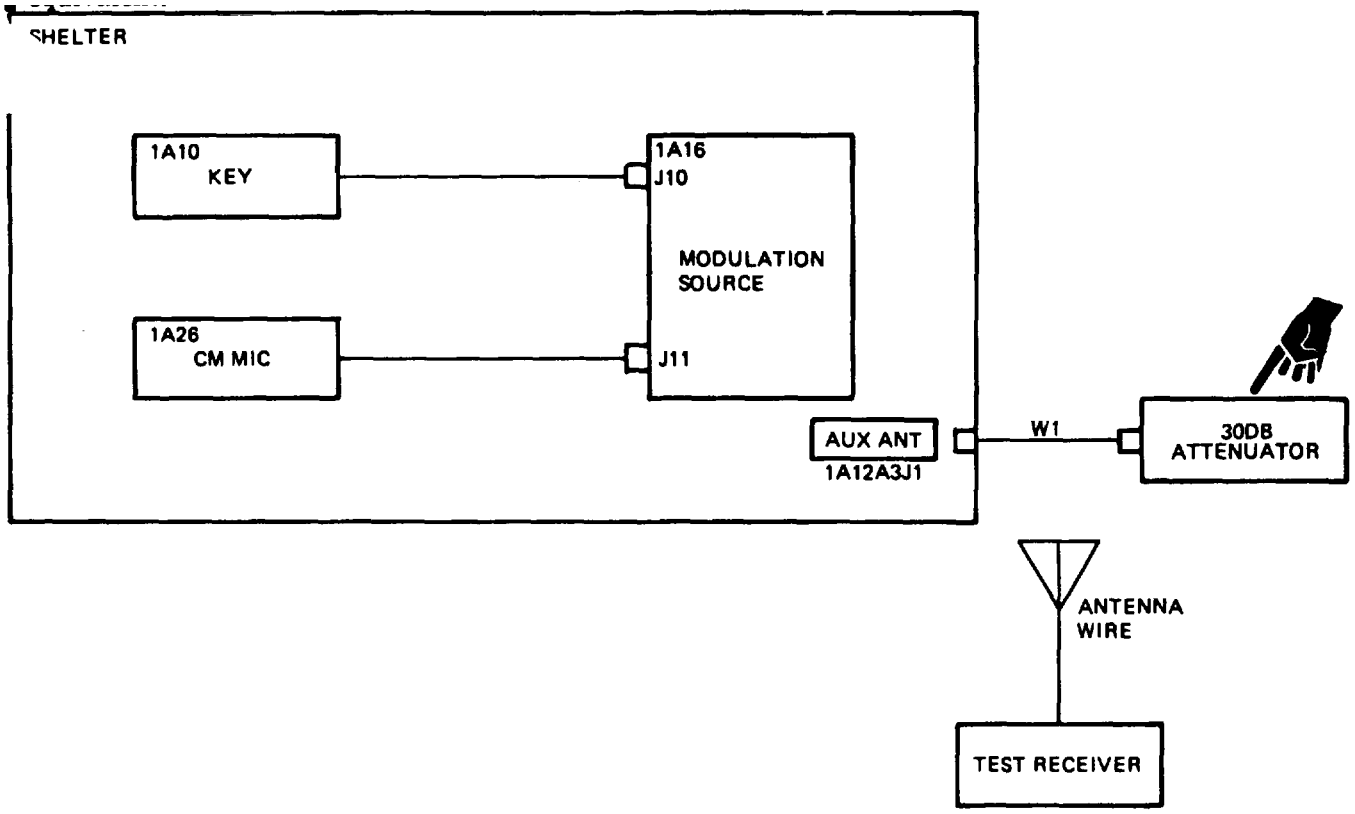


Figure 4-13. Test setup, modulation testing. EL 5895-372-24-TM-28-C1

(2) Set power distribution box controls as follows:
- *(a)* MAIN circuit breaker on (in).
- *(b)* DS CONV circuit breaker on (in).
- *(c)* Lights ON OFF circuit breaker ON.
- *(d)* 30 BLOWERS circuit breaker on (in).
- *(e)* WHITE RED switch to WHITE.
- *(f)* All other circuit breakers off.

(3) Set following lvps circuit breakers to ON:
- *(a)* BIAS.
- *(b)* +250.
- *(c)* +700.

(4) Set following hvps circuit breakers to ON:
- *(a)* FILAMENT.
- *(b)* 600V.
- *(c)* 3500 V.

(5) Set rt unit controls as follows:

CAUTION

Check to see that TRANSMIT MODE switch is set to OFF before POWER ON circuit breaker is set to on. Failure to comply will damage rt unit.

(a) TRANSMIT MODE switch TO OFF.

(b) POWER ON circuit breaker on (up).

(c) DEVIATION control ccw.

(d) CHIRP RATE control OFF.

(e) METER SELECTOR switch to RF OUTPUT.

(f) MODULATION switch to OFF.

(g) RF OUTPUT control ccw.

(h) DIMMER control to midposition.

(I) ZERO BEAT switch OFF.

(j) RF GAIN control midposition.

(k) AFC switch OFF.

(l) AF GAIN control midposition.

(m) IF BW switch to WIDE.

(6) Set control unit controls as follows:
- *(a)* PREHEATER switch to AUTO.
- *(b)* Audio switch to OFF.
- *(c)* STANDBY switch on (green).
- *(d)* HI RF-LOW RF switch to HI RF.
- *(e)* REMOTE XMTR switch off (white).
- *(f)* AUX ANTENNA switch on (green).
- *(g)* HIGH VOLTAGE switch on (yellow).

(7) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).

(8) Set rfa BAND SELECT switch to 1.
(9) Set digital counter controls as follows:
(a) SENSITIVITY switch to .1V.
(b) FUNCTION switch to FREQ.
(c) Time base switch (black) to 1 sec gate time.
(d) DISPLAY control to MIN.
(e) POWER switch to STORE.
(10) Set modulation source controls as follows:
(a) PWR switch to ON.
(b) MOD OFF switch OFF (green)
(c) CONT KEYING switch off (white).
(d) NOISE BW KC/S switch to 3.5.
(e) N/T RATIO control to midposition.
(f) TONE SEL KC/S switch to .3-1.3.
(g) SPEED WPM-CPS control to 10.
(h) RANDOM RATIO control to midposition.
(I) TONE FREQ. KC/S control to midposition.
(11) Set pan indicator controls as follows:
(a) POWER INPUT switch to ON.
(b) All controls set to midposition.
(12) Connect one end of wire antenna to test receiver antenna input terminals; place other end of wire antenna in vicinity of 30 dB attenuator connected to auxiliary antenna connector (fig. 4-13).

c. Initial Test Equipment Settings. None required.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	Tune test receiver to 1.5 MHz.	Tune AN/TLQ-16 for 2 kW output at 1.5 MHz into auxiliary antenna. Refer to TM 11-5895-372-10 for tuning procedure.	None.	None.
2	Set controls on test receiver to receive cw signals.	*a*. Set equipment controls as per *e* below to select cw continuous keying mode. *b*. Set equipment controls as per *e* below to select random keyed cw mode. *c*. None. *d*. None. *e*. Set equipment controls as per *e* below to select hand keyed cw mode.	Perform the Following: *a*. Check to see that continuous keyed signal is heard on test receiver. *b*. Check to see that random keyed signal is heard on test receiver. *c*. Check to see that random keying rate is variable using SPEED WPM-CPS control. *d*. Check to see that random keying dot/dash ratio is variable using RANDOM RATIO control. *e*. Send hand code using key. Check that hand keying is heard on test receiver.	*a*. Continuous keyed cw signal heard on test receiver. Control unit XMTR KEYED indicator lights. *b*. Random rate CW keying is audible on test receiver. Control unit XMTR KEYED indicator flashes on and off with keying rate. *c*. Random keying rate as heard on test receiver varies with SPEED WPM-CPS control setting. *d*. Random keying dot/dash ratio as heard on test receiver varies with RANDOM RATIO control setting. *e*. Hand keying signals heard on test receiver. Control unit XMTR KEYED indicator flashes on and off with hand keying rate.
3	Set controls on test receiver to receive am. signals.	Set equipment controls as per *e* below to select am.-tone keying modes.	Perform the following: *a*. Repeat procedures given in step 2 above, except check for keyed am.-tone signals. *b*. Check to see that tone frequency is variable using TONE SEL KC/S and TONE FREQ KC/S controls.	*a*. Am.-tone performance standards same as step 2 above; AM ON indicator on control unit lights. *b*. Tone frequency as heard on test receiver varies with the control settings.
4	N/A	Set equipment controls as per *e* below to select am.-noise keying modes.	Perform the following: *a*. Repeat procedures given in step 2 above, except for keyed am.-noise signals. *b*. Check to see that noise bandwidth is variable using NOISE BW KC/S control.	*a*. Am.-noise performance standards same as step 2 above; AM ON indicator on control unit lights. *b*. Noise bandwidth as heard on test receiver varies with NOISE BW KC/S control setting.
5	N/A	Set equipment controls as per *e* below to select am.-tone and noise keying modes.	Perform the following: *a*. Repeat procedure given in step 2 above, except check for keyed am.-tone and noise signals. *b*. Check to see that tone frequency is variable using TONE SEL KC/S and TONE FREQ KC/S controls.	*a*. Am.-tone and noise performance standards same as step 2 above; AM ON indicator on control unit lights. *b*. Tone frequency as heard on test receiver varies with control settings.

d. Procedure - Continued.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
5 (Cont)			*c*. Check to see that noise bandwidth is variable using NOISE BW KC/S control. *d*. Check to see that the desired combination of noise and tone can be obtained using N/T RATIO control.	*c*. Noise bandwidth as heard on test receiver varies with NOISE BW KC/S control setting. *d*. Ratio of noise-to-tone as heard on test receiver varies with N/T RATIO control setting.
6	N/A	Set equipment controls as per *e* below to select am.-voice mode.	Depress mic push-to-talk switch and talk into mic; check that am. voice signals are heard on test receiver.	Am. voice signal heard on test receiver. XMTR KEYED and AM ON indicators on control unit light.
7	Set controls on test receiver to receive am./fm signals.	Set equipment controls as per *e* below to select am./fm-tone keying modes.	Perform the following: *a*. Repeat procedures given in step 2 above, except check for keyed am./fm tone signals. *b*. Check to see that tone frequency is variable using TONE SEL KC/S and TONE FREQ KC/S controls. *c*. Check to see that test receiver audio volume varies as rt unit AM MOD and DEVIATION controls are varied.	*a*. Am,/fm tone performance standards same as step 2 above; AM ON indicator on control unit lights. *b*. Tone frequency as heard on test receiver varies with control settings. *c*. Test receiver audio volume varies with control settings.
8	N/A	Set equipment controls as per *e* below to select am./fm noise keying modes.	Perform the following: *a*. Repeat procedures given in step 2 above, except check for keyed am./fm noise signals. *b*. Check to see that noise bandwidth is variable using Noise BW KC/S control. *c*. Check to see that test receiver noise volume varies as rt unit AM MOD and DEVIATION controls are varied.	*a*. Am./fm noise performance standards same as step 2 above; AM ON indicator on control unit lights. *b*. Noise bandwidth as heard on test receiver varies with control setting. *c*. Test receiver noise volume varies with control settings.
9	N/A	Set equipment controls as per *e* below to select am./fm-tone and noise keying modes.	Perform the following: *a*. Repeat procedures given in step 2 above, except check for keyed am./fin tone and noise signals. *b*. Check to see that tone frequency is variable using TONE SEL KC/S and TONE FREQ KC/S controls. *c*. Check to see that noise bandwidth is variable using, NOISE BW KC/S control. *d*. Check to see that the desired combination of noise and tone can be obtained using N/T RATIO control. *e*. Check to see that test receiver audio volume varies as rt unit AM MOD and	*a*. Am./fm-tone and noise performance standards same as step 2 above; AM ON indicator on control unit lights. *b*. Tone frequency as heard on test receiver varies with control settings. *c*. Noise bandwidth as heard on test receiver varies with control setting. *d*. Ratio of noise-to-tone as heard on test receiver varies with control setting. *e*. Test receiver audio volume varies with control setting

d. Procedure - Continued.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
10	N/A	Set equipment controls as per *e* below to select am./fm-voice mode.	Depress mic push-to-talk switch and talk into mic; check that some form of voice signal can be heard on test receiver.	Voice signal heard on test receiver. XMTR KEYED and AM ON indicators on control unit light.
11	Set controls on test receiver to receive fm signals.	Set equipment controls as per *e* below to select fm-tone keying modes.	Perform the following: *a.* Repeat procedures given in step 2 above, except check for keyed fm-tone signals. *b.* Check to see that tone frequency is variable using TONE SEL KC/S and TONE FREQ KC/S controls. *c.* Check to see that test receiver audio volume varies as rt unit DEVIATION control is varied.	*a.* Fm-tone performance standards same as step 2 above. *b.* Tone frequency as heard on test receiver varies with the control settings. *c.* Test receiver audio volume varies with control setting.
12	N/A	Set equipment controls as per *e* below to select fm-noise keying modes.	Perform the following: *a.* Repeat procedures given in step 2 above, except check for keyed fm-noise signals. *b.* Check to see that noise bandwidth is variable using NOISE BW KC/S control. *c.* Check to see that test receiver audio volume varies as rt unit DEVIATION control is varied.	*a.* Fm-noise performance standards same as step 2 above. *b.* Noise bandwidth as heard on test receiver varies with NOISE BW KC/S control setting. *c.* Test receiver audio volume varies with control setting.
13	N/A	Set equipment controls as per *e* below to select fm-tone and noise keying modes.	Perform the following: *a.* Repeat procedures given in step 2 above, except check for keyed fm-tone and noise signals. *b.* Check to see that tone frequency is variable using TONE SEL KC/S and TONE FREQ KC/S controls. *c.* Check to see that noise bandwidth is variable using NOISE BW KC/S control. *d.* Check to see that the desired cornbination of noise and tone can be obtained using N/T RATIO control. *e.* Check to see that test receiver audio volume varies as rt unit DEVIATION control is varied.	*a.* FM-tone and noise performance standards same as step 2 above. *b.* Tone frequency as heard on test receiver varies with control settings. *c.* Noise bandwidth as heard on test receiver varies with NOISE BW KC/S control setting. *d.* Ratio of noise-to-tone as heard on test receiver varies with N/T RATIO control setting. *e.* Test receiver audio volume varies with control setting.
14	N/A	Set equipment controls as per *e* below to select fm-voice mode.	Depress mic push-to-talk switch and talk into mic; check to see that fm voice signal is heard on test receiver.	Fm voice signal heard on test receiver.
15	N/A	Set equipment controls as per *e* below to select fm/chirp keying modes.	Perform the following: *a.* Repeat procedures given in steps 2*b, c*, and *d* above, except check for fm/chirp signal.	*a.* Fm/chirp performance standards same as steps 2b, c, and d

d. Procedure-Continued.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
15 (Cont)			*b.* Check to see that chip decay rate is visible using rt unit CHIRP RATE *c.* Check to see that amount of frequency change with chirp is variable using rt unit DEVIATION control. *d.* Send very slow hand code using key. Check for chirp signal on test receive.	*b.* Chip decay rate as heard on test receiver varies with control *c.* Amount of frequency change with chirp as heard on test receiver varies with control setting. *d.* Fast rise, slow decay chirp signal is audible on test receiver.
16	N/A	Set equipment controls as per *e* below to select ftk modes.	Perform the following *a.* Check for periodic fsk signal on test receiver. *b.* Check to see that periodic fsk speed is variable using SPEED WPM ICPS control. *c.* Check to see that periodic fsk frequency is variable using rt unit DEVIATION control. *d.* Check to see that random fsk dot-dash ratio is variable using RANDOM RATIO control *e.* Send hand code using key. Check for hand-keyed fsk signal on test run.	*a.* Periodic fsk signal is audible on test receivers. *b.* Periodic fsk speed varies with control setting. *c.* Periodic fsk frequency varies with control setting. *d.* Random fsk dot-dash ratio varies with control setting. *e.* Hand-keyed fsk signal is audible on test receiver.
17	Set controls on test receiver to receive ssb signal.	Set equipment controls as per *e* below to elect dsbsc keying mode	Repeat procedures given in steps 3 through 6 above, except tune test receiver to detect an usb and lsb signal	An usb and lsb signal is audible as test receiver is tuned on either side of center frequency.
18	N/A	Set equipment controls as per *e* below to select dsbsc/	Repeat procedures given in steps 7 through 10 above, except check for dsbsc/fm	Complex modulation signal heard on test receiver.

4-50. Search Mode Testing

a. Test Equipment and Materials. The only test equipment required for this test is Signal Generator AN/GRM-60.

b. Test Connections and Conditions.

(1) Connect Signal Generator AN/GRM-50 to auxiliary antenna connector 1A12A3J1.

(2) Set power distribution box controls as follows:

(a) MAIN circuit breaker to on (in).
(b) DC CONV circuit breaker to on (in).
(c) LIGHTS ON-OFF circuit breaker ON.
(d) 30 BLOWERS circuit breaker on (in).
(e) WHITE RED switch to WHITE.
(f) All other circuits breakers to off.

(3) Set all lvps circuit breakers to ON.

(4) Set all hvps circuit breakers to ON.

(5) Set rt unit controls as follows:

CAUTION

Check to see that TRANSMIT MODE switch is set to OFF before setting POWER ON circuit breaker to on. Failure to comply will damage rt unit.

(a) TRANSMIT MODE switch to OFF.
(b) POWER ON circuit breaker on (up).
(c) DEVIATION control ccw.
(d) CHIRP RATE control OFF.
(e) METER SELECTOR switch to RF INPUT.
(f) MODULATION switch OFF.
(g) RF OUTPUT control ccw.
(h) DIMMER control to midposition,
(I) ZERO BEAT switch OFF.
(j) RF GAIN control ccw to AGC ON position.
(k) AFC switch OFF.
(l) AF GAIN control to midposition.
(m) IF BW switch to WIDE.
(n) FREQ LOCK switch to off (indicator off).
(o) RECEIVE MODE switch to AM.

(6) Set control unit controls as follows:

(a) PREHEATER switch to AUTO.
(b) Audio switch to RCVR.
(c) STANDBY switch on (green).
(d) HI RF-LOW RF switch to LOW RF.
(e) REMOTE XMTR switch off (white).
(f) AUX ANTENNA switch on (green).
(g) HIGH VOLTAGE switch on (yellow).
(h) Audio GAIN control midposition.

(7) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).

(8) Set rfa BAND SELECT switch to 1.

(9) Set digital counter controls as follows.

(a) SENSITIVITY switch to .IV.
(b) FUNCTION switch to FREQ.
(c) Time base switch (black) to 1 sec gate time.
(d) DISPLAY control to MIN.
(e) POWER switch to STORE.

(10) Set pan indicator controls as follows:

(a) POWER INPUT switch to ON.
(b) All controls set to midposition.

c. Initial Test Equipment Settings. Set controls on Signal Generator AN/GRM-50 for the following output parameters:

(1) Frequency: 2 MHz.

(2) Output level: 5 μVolts.

(3) Modulation: 1kHz, 50%, am.

(4) Remove coax cable from RF INPUT connector on digital counter.

(5) Connect coax cable between signal generator output connector and digital counter RF INPUT connector,

(6) Adjust signal generator frequency control for 2 MHz as noted on digital counter.

(7) Remove coax cable between signal generator and digital counter.

(8) Reconnect coax cable that was removed in setup (4) above to digital counter RF INPUT connector.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	Rt Unit: adjust COARSE TUNING and FINE TUNING controls for 2.00000 on RECEIVED FREQUENCY MHz indicator; adjust AF GAIN control for desired audio volume level.	Check to see that am. signal is heard on control unit loudspeaker. Adjust rt unit AF GAIN control for desired audio volume; adjust pan indicator controls for optimum display.	A 1kHz audio tone is audible on control unit loudspeaker. Rt unit METER SELECTOR meter indicator approximately 5.6 volts. Audio signal observed on pan indicator.
2	N/A	Rt Unit: set ZERO BEAT switch to ON and then to OFF.	Check to see that audible tone is heard on control unit loudspeaker and is variable.	Audible tone heard on control unit loudspeaker. Tone variable with ZERO BEAT switch ON and OFF.
3	N/A	Rt Unit: set RECEIVE MODE switch to LSB.	Check to see that lower sideband signal is heard on control unit loudspeaker.	Lower sideband audio tone is audible on control unit loudspeaker. Audio signal observed on pan indicator.
4	N/A	Rt Unit: set RECEIVE MODE switch to USB.	Check to see that upper sideband signal is heard on control unit loudspeaker.	Upper sideband audio tone is audible on control unit loudspeaker. Audio signal observed on pan indicator.
5	Set signal generator controls for a 5 µvolt cw output at 2 MHz.	Rt Unit: set RECEIVE MODE switch to CW; vary BFO PITCH control cw and ccw.	Check to see that cw signal is heard on control unit loudspeaker and pitch of received signal is variable.	Cw signal is audible on control unit loudspeaker. Pitch of cw signal varies with BFO PITCH control setting. Audio signal observed on pan indicator.
6	N/A	Rt Unit: set IF BW switch to NARROW and then to WIDE.	None.	None.
7	N/A	Rt Unit: set FREQ LOCK switch to on (yellow).	Check readout on RECEIVED FREQUENCY MHz indicator.	'2.00000.
8	N/A	Rt Unit: set AFC switch to WIDE.	None.	None.
9	Slightly increase and then decrease signal generator output frequency (2 MHz ± 2 kHz).	N/A	Observe rt unit track indicator, and METER SELECTOR meter.	AFC TRACK indicator lights. TUNE HIGHER indicator lights when signal generator frequency is increased. TUNE LOWER indicator lights when signal generator frequency is decreased. Audio display on pan indicator shifts to the left as signal generator is tuned high; shifts to right as frequency is tuned low. METER SELECTOR meter indication drops to zero when signal generator frequency exceeds 3 kHz on either side of 2 MHz.
10	Reset signal generator output to 2 MHz; refer to para 4-50c, steps (4) thru (8).	Rt Unit: set AFC switch to NARROW.	None	None.

d. Procedure - Continued.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
11	Repeat step 9 above.	N/A.	Repeat procedures given in step 9 above.	Same as step 9 above, except bandpass is 1 kHz on either side of 2 MHz.
12	Set signal generator output frequency to approximately 3.4 MHz; repeat procedures given in paragraph 4-50c (2) through (8).	Rfa: set BAND SELECT switch to 5. Rt Unit: set controls as follows: *a.* AFC switch to OFF. *b.* FREQ LOCK switch to off (indicator out). *c.* COARSE TUNING and FINE TUNING controls for signal in vicinity of 3.4 MHz. *d.* RECEIVE MODE switch to AM. *e.* TRANSMIT MODE switch to CONT.	Check to see that am. signal is heard on control unit loudspeaker. Observe digital counter.	A1 kHz audio tone is audible on control unit loudspeaker. Rt unit METER SELECTOR meter indicates approximately 5, volts. Audio signal observed on pan indicator. Digital counter readout and rt unit RECEIVED FREQUENCY MHz indicator readout are within 50 Hz of each other.
13	Set signal generator output frequency to 5.6 MHz; repeat processdures given in paragraph 4-50c (2) through (8).	Rt Unit: adjust COARSE TUNING and FINE TUNING controls for approximately 5.60000 as read on RECEIVED FREQUENCY MHz indicator.	Repeat procedure given in step 12 above.	Same as step 12 above.
14	Set signal generator output frequency to 16.0 MHz; repeat procedures given in paragraph 4-50c (2) through (8).	Rt Unit: adjust COARSE TUNING and FINE TUNING controls for approximately 16.00000 as read on RECEIVED FREQUENCY MHz indicator.	Repeat procedure given in step 12 above.	Same as step 12 above.

4-51. Sij Testing

a. Test Equipment and Materials.

(1) Signal Generator AN/GRM-50.
(2) Attenuator 354A.
(3) 30 dB Attenuator
(4) RF Voltmeter AN/URM-145.

b. Test Connections and Conditions.

(1) Connect test equipment as shown in figure 4-14. All cables used are part of AN/TLQ-15 Unit 3 extender cable set.

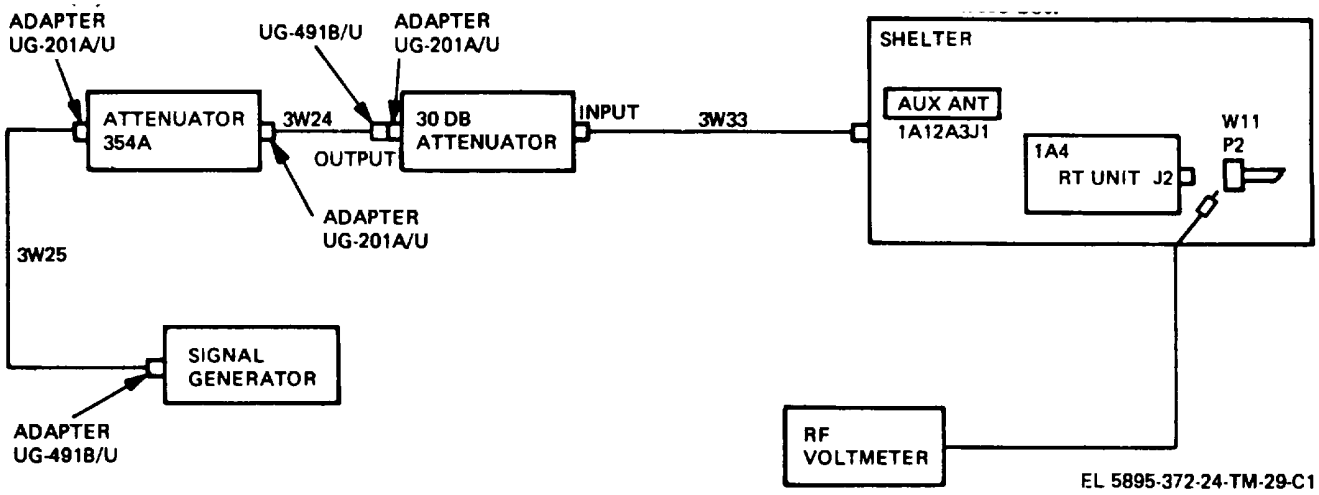


Figure 4-14. Test setup, sij testing.

(2) Set power distribution box controls as follows:
(a) MAIN circuit breaker to on (in).
(b) DC CONV circuit breaker to on.
(c) Lights ON-OFF circuit breaker to ON.
(d) 30 BLOWERS circuit breaker to on (in).
(e) WHITE-RED switch to WHITE.
(3) Set all lvps circuit breakers to ON.
(4) Set all hvps circuit breakers to ON.
(5) Set rt unit controls as follows:

WARNING

Check to see that TRANSMIT MODE switch is set to OFF before setting POWER ON circuit breaker to ON. Failure to comply will damage rt unit.

(a) TRANSMIT MODE switch to OFF.
(b) POWER ON circuit breakers to on (up).
(c) DEVIATION control to ccw.
(d) CHIRP RATE control to OFF.
(e) METER SELECTOR switch to RF INPUT
(f) MODULATION switch to fm/CHIRP.
(g) RF OUTPUT control to ccw.
(h) DIMMER control to midposition.
(I) ZERO BEAT switch to OFF.
(j) RF GAIN control to cw.
(k) AFC switch to OFF.
(l) AF GAIN control to midposition.
(m) IF BW switch to WIDE.
(n) SIJ THRESHOLD control to PRESHELTER
(6) Set control unit controls as follows:
(a) PREHEATER switch to AUTO.
(b) Audio switch to RCVR.
(c) STANDBY switch on (green)
(d) HI RF-LOW RF switch to LOW RF
(e) REMOTE XMTR switch to off (white)
(f) DUMMY LOAD switch to on (green)
(g) HIGH VOLTAGE switch on (yellow)
(h) Audio GAIN control to cw.
(7) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).
(8) Set rfa BAND SELECT switch to 1.
(9) Set digital counter controls as follows:
(a) SENSITIVITY switch to .1V
(b) FUNCTION switch to FREQ.
(c) Time base switch (black) to 1 sec gate time.
(d) DISPLAY control to MIN.
(e) POWER switch to STORE.
(10) Set modulation source controls as follows:
(a) PWR switch to ON.
(b) MOD OFF SWITCH ON (white).
(c) CONT KEYING switch to on (green).
(d) NOISE BW KC/S switch to 3.5.
(e) N/T RATIO control to midposition.
(f) TONE SEL KC/S switch to .3-1.3.
(g) SPEED WPM-CPS switch to 10.
(h) RANDOM RATIO control to midposition.
(I) TONE FREQ KC/S control to midposition.
(j) TONES switch on (green).

(11) Set pan indicator controls as follows:

(a) POWER INPUT switch to ON.

(b) All controls set to midposition.

c. Initial Test Equipment Settings.

(1) Set signal generator controls for the following output parameters:

(a) Frequency: 2 MHz.

(b) Output Level: 5 volts.

(c) Modulation: 1 kHz, 50%AM.

(2) Disconnect cable WllP2 from 1A4J2 at rear of rt unit.

(3) Connect rf voltmeter to WllP2 and set range control to measure 10 μvolts.

(4) Adjust signal generator output in conjunction with step attenuator for 5 volts on rf voltmeter.

(5) Disconnect rf voltmeter and connect cable W11P2 to 1A4J2.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	Tune AN/TLQ-15 for 2 kW output at 2 MHz into dummy load mode. Refer to TM 11-5895-372-10 for tuning procedures.	None.	None.
2	N/A	Rt Unit: set RF OUTPUT control ccw.	None.	None.
3	N/A	Control Unit: sequentially set controls as follows: *a*. HIGH VOLTAGE switch off (white). *b*. AUX ANTENNA switch on (green). *c*. HIGH VOLTAGE switch on (yellow).	None.	None.
4	N/A	Rt Unit: adjust COARSE TUNING and FINE TUNING controls for 2 MHz, 1 kHz, 50% am. signal from signal generator.	Check that am. audio signal is heard on control unit loudspeaker.	Audio signal heard on control unit loudspeaker.
5	N/A	Rt Unit: set RF OUTPUT control fully ccw.	Observe control unit FORWARD POWER and REFLECTED POWER meters.	2 kW forward power. Reflected power is 1:1.
6	N/A	Rt Unit: set TRANSMIT MODE switch to SIJ.	Observe pan indicator to verify transmitter status. Adjust pan indicator controls for optimum displays.	Transmitter is turned on and off at a periodic rate as viewed on pan indicator. On pan indicator transmitter signal appears below the centerline on the screen during transmit interval. The received signal appears at the same location above the centerline during the receive interval.

4-52. Look through Testing.

a. Test Equipment and Materials.

(1) 30 dB Attenuator
(2) Attenuator 354A
(3) Tee Connector UG-274B/U
(4) Storage Oscilloscope 7623A
(5) Dual Time Base Plug-in 7B53A
(6) Vertical Amplifier Plug-in-7A15A SHELTER (2 ea)
(7) Signal Generator AN/GRM-50
(8) Termination T150B

b. Test Connections and Conditions.

(1) Connect equipment as shown in figure 4-15.

All cables used are part of AN/TLQ-15 Unit 3 extender cable set.

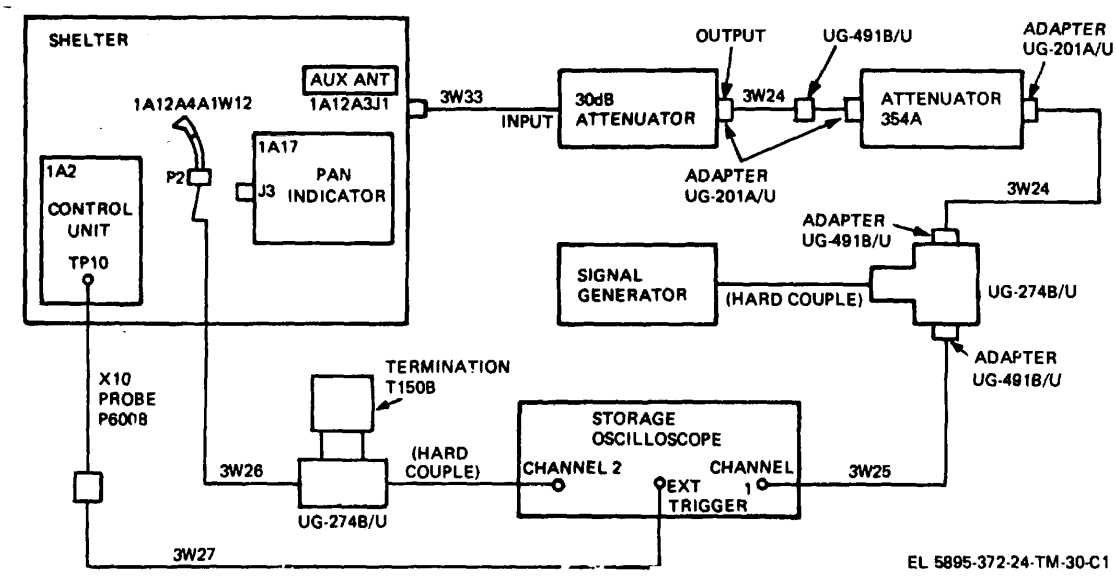


Figure 4-15. Test setup, look through testing.

(2) Set power distribution box controls as follows:
(a) MAIN circuit breaker to on (in).
(b) DC CONV circuit breaker to on (in).
(c) Lights ON OFF circuit breaker to ON.
(d) 30 BLOWERS circuit breaker to on (in).
(e) WHITE RED switch to WHITE.
(3) Set all lvps circuit breakers to ON.
(4) Set all hvps circuit breakers to ON.
(5) Set rt unit controls as follow:

CAUTION

Check to see that TRANSMIT MODE switch is set to OFF before setting POWER ON circuit breaker to ON. Failure to comply will damage rt unit.

(a) TRANSMIT MODE switch to OFF.
(b) POWER ON circuit breaker on (up).
(c) DEVIATION control to ccw.
(d) CHIRP RATE control OFF.
(e) METER SELECTOR switch to RF INPUT.
(f) MODULATION switch to OFF.
(g) RF OUTPUT control ccw.
(h) DIMMER control to midposition.
(I) ZERO BEAT switch OFF.
(j) RF GAIN control cw.
(k) AFC switch OFF.
(l) AF GAIN control midposition.
(m) IF BW switch to WIDE.
(n) SIJ THRESHOLD control to PRESET.
(6) Set control unit controls as follows:
(a) PREHEATER switch to AUTO.
(b) Audio switch to RCVR.
(c) STANDBY switch on (green).
(d) HI RF-LOW RF switch to LOW RF.
(e) REMOTE XMTR switch off (white).
(f) DUMMY LOAD switch to on (green).
(g) HIGH VOLTAGE switch on (yellow)
(h) Audio GAIN control ccw.
(7) Set soft mounted coupler BAND SELECT switch to position 1 (1.50 to 2.50 MHz).
(8) Set rfa band select switch to 1.
(9) Set digital counter controls as follows:
(a) SENSITIVITY switch to .1V.
(b) FUNCTION switch to FREQ.
(c) Time base switch (black) to 1 sec gate time.

(d) DISPLAY control to MIN.
(e) POWER switch to STORE.
(10) Set modulation source controls as follows:
(a) PWR switch to ON.
(b) MOD OFF SWITCH TO OFF (green).
(c) CONT KEYING switch to on (green).
(d) NOISE BW KC/S switch to 3.5.
(e) N/T RATIO control to midposition.
(f) TONE SEL KC/S switch to .3-1.3.
(g) SPEED WPM-CPS control to 10.
(h) RANDOM RATIO control to midposition.
(I) TONE FREQ KC/S control to midposition.
(11) Set pan indicator controls as follows:
(a) POWER INPUT switch to ON.
(b) All controls set to midposition.
c. Initial Test Equipment Settings.
(1) Set signal generator controls for the following output parameters:
(a) Frequency: 2 MHz.
(b) Output level: 30 volts.
(c) Modulation: 1 kHz, 60% am.
(2) Set attenuator 354A for 30 dB.
(3) Set oscilloscope controls to display one complete look through cycle (2 seconds) with rf trace on channel 1 and if. trace on channel 2.

d. Procedure

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	Tune AN/TLQ-15 for 2 kW output at 2 MHz into dummy load mode. Refer to TM 11-5895-372-10 for tuning		
2	N/A	Rt Unit set RF OUTPUT control ccw.	None.	None.
3	N/A	Control Unit: Sequentially set controls as follows: *a.* HIGH VOLTAGE switch off (white). *b.* AUX ANTENNA switch on (green). *c.* HIGH VOLTAGE switch on	None.	None.
4	N/A	Rt Unit: Set TRANSMIT MODE switch to OFF. Adjust COARSE TUNING and FINE TUNING controls for 2 MHz, 1 kHz, 50% am.	Check to see that AM audio signal is heard on control unit loudspeaker. Adjust rt unit AF GAIN control for desired audio volume.	Audio signal heard on control units loudspeaker.
5	N/A	Rt Unit: Set TRANSMIT MODE switch to CONT. Set RF OUTPUT control fully ccw.	Observe control unit FORWARD POWER and REFLECTED POWER meters.	2 kW forward power. Reflected power is 1:1.
6	N/A	RT Unit: set TRANSMIT MODE switch to LOOK THRU.	Observe oscilloscope to verify transmitter status. Adjust oscilloscope controls for optimum displays.	Transmitter and receiver are sequentially turned on and off at a periodic rate as viewed on oscilloscope. See figure 4-16 for look through timing diagram.

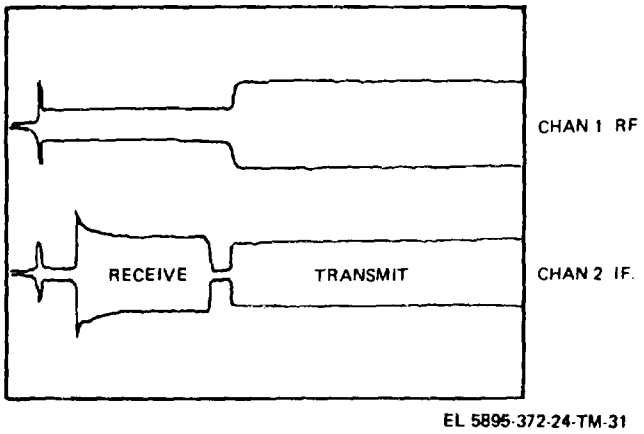


Figure 4-16. Look through timing diagram.

4-53. Radio Communications and Telephone Testing

a. Test Equipment and Materials.

(1) Test Telephone Set TA-312/PT.

(2) Test Transceiver AN/VRC-47.

(3) Resistor, 100 ohms, 1 watt (2 each).

b. Test Connections and Conditions.

(1) Insure that telephone is connected to telephone wires in the shelter.

(2) Connect test Telephone Set TA-312/PT to the remote telephone junction box.

(3) Connect a length of field telephone wire between TEL XMTR binding posts on the power distribution box and the LINE terminals on the remote telephone junction box. Simulate the resistance of one mile of wire by connecting a 100-ohm resister in each telephone line (see fig. 4-12 for typical setup).

(4) Set power distribution box controls as follows:

(a) Main circuit breaker to on (in).

(b) 30 blowers circuit breaker to on (in).

(c) DC CONV circuit breaker to on (in).

(d) WHITE-RED switch to WHITE.

(e) Lights ON-OFF circuit breaker to ON.

(5) Set control unit controls as follows:

(a) STANDBY switch to on (green).

(b) HI RF-LOW RF switch to LOW RF.

(c) HIGH VOLTAGE switch to off (white).

(d) DUMMY LOAD switch to on (green).

(6) Inside t-sec enclosure, ensure that equipment controls are set as follows:

(a) Set secure com mic amplifier POWER SWITCH to ON; set VOLUME control to midposition.

(b) Set secure comm speaker amplifier ON OFF switch to ON.

(7) Set comm control unit controls as follows:

(a) PLAIN-CIPHER switch to PLAIN.

(b) Power switch to on (up).

(8) Set comm rt unit (in trailer) controls as follows:

(a) BAND switch to 53-75.

(b) MC TUNE and KC TUNE controls for 54.00.

(c) POWER switch to LOW.

(d) SQUELCH switch to NEW ON.

(e) VOLUME control fully ccw.

(f) SPEAKER switch to OFF.

(9) Set comm rcvr controls as follows:

(a) BAND switch to 53-75.

(b) MC-KC tune controls for 55.00.

(c) Adjust bandpass filter (on top of comm rcvr) tuning control to 55.

(d) POWER switch to ON-RESET.

(e) VOLUME control to midposition.

(f) SQUELCH control to NEW ON.

(g) Momentarily set RESET switch (on exterior right side of AN/VRC-47 enclosure) to MOMENTARY ON and release.

c. Initial Test Equipment Settings. Set the test AN/VRC-47 rt unit to the same control settings given for the comm rt unit (b) (8) above. Attach antenna to test AN/VRC-47. Set TEL-XMT switch on remote telephone junction box to TEL.

d. Procedure.

Step No.	Input parameter	Equipment under test control setting	Test procedure	Performance standard
1	N/A	None.	Establish voice communication via the telephone in the shelter.	Communications established at remote location using test Telephone Set TA-312/PT.
2	N/A	None.	Rotate handcrank on test Telephone Set TA-312/PT and verify telephone ringing circuit in the shelter is operational.	Audible ringing indication noted on shelter telephone. Ringer lights (located on upper roadside wall of shelter) flash on and off.
3	N/A	None.	Using test AN/VRC-47, establish communications with comm rt unit.	Two-way communications established.
4	N/A	None.	Adjust MC TUNE and KC TUNE controls on test AN/VRC-47 for 5500. Transmit a short test message using the test AN/VRC47. Verify reception on comm rcvr.	Test message received via comm rcve.

4-54. Truck Adapter Kit Testing

a. Test Equipment and Materials. The only test equipment required is Multimeter AN/USM-223.

b. Test Connections and Conditions. None required.

c. Initial Test Equipment Settings. Set multimeter for continuity measurements.

d. Procedures. Refer to figure 4-17 and perform continuity measurements to locate open or short circuits. Check front-to-back resistance ratio of CR1; ratio should be 1000:1, minimum.

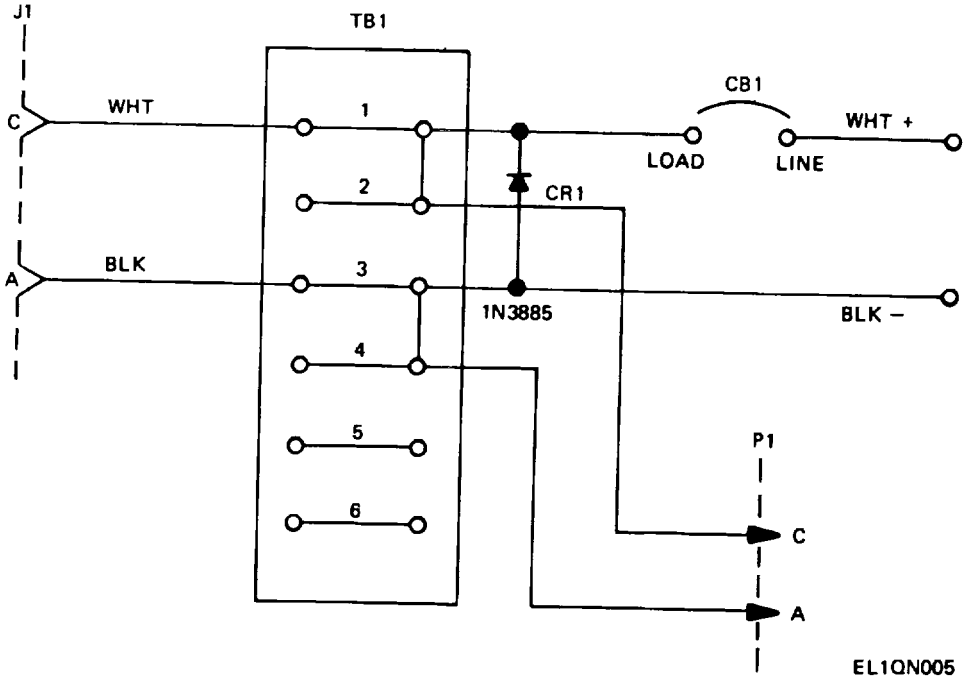


Figure 4-17. Truck adapter kit schematic diagram.

CHAPTER 5

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

5-1. Scope of General Support Maintenance

General support maintenance of the AN/TLQ-15 will include overhaul of major components and those items requiring repair over and above the capability of direct support maintenance personnel.

5-2. Disposition of Equipment

Major components or items of equipment requiring repair or overhaul will not be disposed of in accordance with standard operating procedures. Submit request for disposition of equipment to Commander, Tobyhanna Army Signal Depot, Tobyhanna, Pennsylvania. Requests for services are to be coordinated with Tobyhanna Army Signal Depot, Tobyhanna, Pennsylvania.

5-3. Tools, Test Equipment, and Materials Required

Tools, test equipment, and materials required for general support maintenance are listed in the maintenance allocation chart (app B).

APPENDIX A
REFERENCES

AR 40-583	Control of Potential Hazards to Health From Microwave and Radio Frequency Radiation.
DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
SB 11-628	Headset, Electrical H-251/U, FSN 5965-043-3460 for Use with Radar Set AN/PPS-5.
TB 9-2300-280-30	Tactical Vehicles: Installation of Universal Tiedown Anchors.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 9-2330-202-14P	Operator's, Organizational, Direct Support, and General Support Maintenance Manual: (Including Repair Parts and Special Tools List) for Trailer, Cargo: 3/4-Ton, 2-Wheel M101 (2330-738-9509) and MlOlA1 (2330-898-6779); Chassis: Trailer: 3/4-Ton, 2-Wheel M116 (2330-542-5987) and M116A1 (2330-898-6780).
TM 11-5805-201-12	Operator and Organizational Maintenance Manual: Telephone Set TA-312/PT (NSN 5805-00-543-0012).
TM 11-5805-201-35	DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Telephone Set TA-312/PT (NSN 5805-00-543-0012).
TM 11-5820-401-12	Operator's and Organizational Maintenance Manual (Including Repair Parts and Special Tools List): Radio Sets AN/VRC-12 (5820-223-7412) AN/VRC-43 (5820-223-7415), AN/VRC-44 (5820-223-7417), AN/VRC-45 (5820-223-7418), AN/VRC-46 (5820-223-7433), AN/VRC-47 (5820-223-7434), AN/VRC-48 (5820-223-7435), AN/VRC-49 (5820-223-7437), AN/VRC-54 (5820-223-7567), and AN/VRC-55 (5820-402-2265); Mounting MT-1029/VRC (5820-893-1323) and Mounting MT-1898/VRC (5820-893-1324); Antenna AT-912/VRC (5820-897-6357); Control, Frequency Selector C-2742/VRC (5820-892-3343) and Control, Radio Set C-2299/VRC (5820-892-3340).
TM 11-5820-401-35	DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Radio Sets AN/VRC-12 and AN/VRC-43, -44, -45, -46, -47, -48, and -49.
TM 11-5895-502-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual: Modulation Signal Source MX-8052/GLQ (NSN 5865-00-133-8991).
TM 11-5895-502-24P	Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools): Modulation Signal Source MX-8052/GLQ (NSN 5865-00-133-8991).
TM 11-5895-503-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Indicator, Panoramic IP-922/GLQ (NSN 5895-00-133-8992).
TM 11-5895-503-24P	Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools): Panoramic Indicator IP-922/GLQ (NSN 5895-00-133-8992).
TM 11-5965-257-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Handsets H-138/U (FSN 5965-892-0972).
TM 11-5965-280-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Handset H-189/GR (NSN 5965-00-069-8886).
TM 11-5985-262-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual: Antenna AS-1729/VRC (NSN 5985-00-985-9024).
TM 11-6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207 (NSN 6625-00-911-6368).
TM 11-6625-700-25	Organizational, DS, GS, and Depot Maintenance Manual: Digital Readout, Electronic Counter AN/USM-207 (NSN 6625-00-911-6368).
TM 11-6625-700-25P	Organizational, DS, GS, and Depot Maintenance Repair Parts and Special Tool Lists: Counters, Electronic Digital Readout AN/USM-207 (NSN 6625-00-911-6368) and AN/USM-207A.

TM 38-750	The Army Maintenance Management System (TAMMS).
TM 55-1500-323-25	Organizational, DS, GS, and Depot Maintenance Manual: Installation Practices for Aircraft Electric and Electronic Wiring.
TM 740-90-1	Administrative Storage of Equipment.
TM 750-5-32	Army Equipment Data Sheets: Generator Sets and Electric Power Plants, Truck and Trailer Mounted.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX B
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations for the AN/TLQ-15. 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.

B-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, with 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 or 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.

B-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 time opposite the particular code.

B-4. Tool and Test Equipment Requirements (Sect. 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.

B-5. Remarks (Sect. 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 B-3)

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1)	(2)	(3)	(4) MAINTENANCE CATEGORY					(5)	(6)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	C	O	F	H	D	TOOLS AND EQUIPMENT	REMARKS
00	COUNTERMEASURES SET AN/TLQ-15	Install	2.0	2.5				1,10	A
		Inspect	0.5	0.8				10	A
		Test	0.2					1,10	A
		Test			4.1			1 thru 9,11 thru 17,19	A,B
		Service	0.4	0.6	0.9			10	A
		Adjust			3.6			10	
		Repair			1.0			1 thru 9, 11 thru 17,19	
		Overhaul					136.0	1 thru 9, 11 thru 22	
01	RECEIVER-TRANSMITTER GROUP, COUNTERMEASURES OZ-49/TLQ-15 (SHELTER, UNIT 1)	Inspect	0.2	0.2				10	A
		Service	0.2	0.2				10	A
		Repair			0.9			14	
0101	COUPLER, ANTENNA (HARD MOUNTED COUPLER, 1A1)	Repair			1.0			1,2,6,14,19	
010101	CIRCUIT CARD ASSEMBLY (1A1A1)	Replace			0.4			10	
		Repair					0.9	18	
		Test					0.8	18	
010102	CABLE ASSEMBLY (1A1W1)	Inspect	0.2						
		Replace			1.0			14	
		Repair			0.5			1,14	
0102	CONTROL, COUNTERMEASURES TRANSMITTING SET C-6484/TLQ-15 (CONTROL UNIT, 1A2)	Repair			0.5			1,2,6,7,8, 13,14,19	
		Replace			0.2			14	
010201	CIRCUIT CARD ASSEMBLY (RELAY CARD, 1A2A2A1)	Replace			0.1			14	
		Repair					0.4	18	
		Test					0.2	18	
010202	CIRCUIT CARD ASSEMBLY (DIODE CARD, 1A2A2A2)	Replace			0.1			14	
		Repair					0.4	18	
		Test					0.2	18	
010203	CIRCUIT CARD ASSEMBLY (AUDIO AMPLIFIER AND METER MONITOR CARD, 1A2A2A3)	Replace			0.2			14	
		Repair					0.7	18	
		Test					0.5	18	
		Adjust					0.2	18	
010204	CIRCUIT CARD ASSEMBLY (TIMING CARD, 1A2A2A4)	Replace			0.2			14	
		Repair					0.6	18	
		Test					0.4	18	
010205	ELECTRONIC TEST EXTENDER CARD (IA2A2A5)	Test					0.4	1	
		Replace			0.2			14	
		Repair					0.6	1	
010206	REFLECTOMETER ASSEMBLY (1A2A3)	Test					0.5	1	
		Replace			0.2			11	
		Repair					0.7	14,18	
01020601	CIRCUIT CARD ASSEMBLY (METER AMPLIFIER AND SWR SENSING CARD, 1A2A3A1)	Replace					0.2	14	
		Repair					0.5	13	
		Test					0.3	13	
01020602	CIRCUIT CARD ASSEMBLY (METER AMPLIFIER AND POWER SUPPLY CARD, 1A2A3A2)	Replace					0.2	14	
		Repair					0.5	18	
		Test					0.3	18	

SECTION II MAINTENANCE ALLOCATION CHART FOR COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
010207	ELECTRONIC COMPONENTS ASSEMBLY (1A2A4)	Test					0.5	18	
		Replace			0.2			14	
		Repair					0.6	18	
010208	ELECTRONIC COMPONENTS ASSEMBLY (1A2A5)	Test					0.6	18	
		Replace			0.3			14	
		Repair					0.9	18	
01020801	CABLE ASSEMBLY (1A2W1)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
01020801	CABLE ASSEMBLY (1A2W2)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
0103	AMPLIFIER, RADIO FREQUENCY AM-4256/TLQ-15 (RFA, 1A3)	Adjust			1.0			1,6,14	C
		Repair			1.0			1,2,6,7,8, 11,13,19	D
		Align			2.0			14	E
010301	RADIO FREQUENCY AMPLIFIER (1A3A1)	Adjust			0.5				F
		Test					0.8	18	
		Replace			0.4			14	
		Repair					1.0	18	G
01030101	CIRCUIT CARD ASSEMBLY (1A3A1A1)	Replace			0.4			14	
		Repair					1.3	18	
		Test					0.8	18	
010302	GEARTRAIN ASSEMBLY (1A3A2)	Replace			0.5			14	
		Repair					2.2	14	
010303	CABLE ASSEMBLY (1A3W1)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
010304	CABLE ASSEMBLY (1A3W2)	Inspect	0.2						
		Replace			0.2			14	
		Repair			O.5			1,14	
010305	CABLE ASSEMBLY (1A3W3)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
0104	RECEIVER-TRANSMITTER,RADIO RT-657/ TLQ-15 (RT UNIT, 1A4)	Repair			1.0			1,2,6,7,8 13,14,19	
		Replace			0.2			14	
010401	CIRCUIT CARD ASSEMBLY (1A4A1)	Replace			0.3			14	
		Repair					1.0	18	
		Test					0.8	18	
010402	CIRCUIT CARD ASSEMBLY (1A4A2)	Replace			0.2			14	
		Repair					1.3	18	
		Test					0.7	18	
010403	PANEL ASSEMBLY (1A4A3)	Repair			1.1			14	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
01040301	PANEL, INDICATOR LIGHT (EDGE LIT PANEL, 1A4A3A5)	Inspect		0.1					
		Replace			2.0			14	
		Repair			0.5			1,14	
01040302	COUNTER ELECTRONIC, DIGITAL READOUT (READOUT COUNTER 1A4A3A2)	Test					0.4	18	
		Replace			0.3			14	
		Repair					12.0	1,14,18	
0104030201	CIRCUIT CARD ASSEMBLY (1A4A3A2A1)	Repair					0.4	14,18	
0104030202	CIRCUIT CARD ASSEMBLY (1A4A3A2A2)	Repair					0.4	14,18	
0104030203	CIRCUIT CARD ASSEMBLY (1A4A3A2A3)	Repair					0.4	14,18	
0104030204	CIRCUIT CARD ASSEMBLY (1A4A3A2A4)	Repair					0.4	14,18	
010404	CIRCUIT CARD ASSEMBLY (POWER ATTENUATOR CARD, 1A4A101)	Replace			0.2			14	
		Repair					0.7	18	
		Test					0.3	18	
010405	CIRCUIT CARD ASSEMBLY (BANDPASS FILTERS CARD, 1A4A102)	Replace			0.2			14	
		Repair					3.0	18	
		Test					0.2	18	
010406	CIRCUIT CARD ASSEMBLY (RF POWER AMPLIFIER CARD, 1A4A103)	Replace			0.3			14	
		Repair					1.0	18	
		Test					0.5	18	
		Adjust					0.1	18	
010407	CIRCUIT CARD ASSEMBLY (VCXO AND MIXER CARD, 1A4A104)	Replace			0.2			14	
		Repair					1.5	18	
		Test					0.5	18	
		Adjust					0.5	18	
010408	CIRCUIT CARD ASSEMBLY (AM, MODULATOR AND LEVEL CONTROL CARD, 1A4A105)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.2	18	
		Adjust					0.2	18	
010409	CIRCUIT CARD ASSEMBLY (TIMING AND REFERENCE CARD, 1A4A201)	Replace			0.2			14	
		Repair					2.0	18	
		Test					0.5	18	
010410	CIRCUIT CARD ASSEMBLY (SECOND LOOP CARD, 1A4A202)	Replace			0.1			14	
		Repair					1.5	18	
		Test					0.2	18	
		Adjust					0.2	18	
010411	CIRCUIT CARD ASSEMBLY (AFC AND LOOP INTERFACE CARD, 1A4A203)	Replace			0.1			14	
		Repair					1.5	18	
		Test					0.3	18	
		Adjust					0.3	18	
010412	CIRCUIT CARD ASSEMBLY (MAIN LOOP CARD, 1A4A204)	Replace			0.1			14	
		Repair					1.5	18	
		Test					0.4	18	
		Adjust					0.2	18	
010413	CIRCUIT CARD ASSEMBLY (PROGRAMMABLE COUNTER CARD, 1A4A205)	Replace			0.2			14	
		Repair					2.5	18	
		Test					0.6	18	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
010414	CIRCUIT CARD ASSEMBLY (METER AMPLIFIER CARD, 1A4A206)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.3	18	
		Adjust					0.4	18	
010415	CIRCUIT CARD ASSEMBLY (DETECTION LOGIC CARD, 1A4A207)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.2	18	
010416	CIRCUIT CARD ASSEMBLY (RT LOGIC CARD, 1A4A208)	Replace			0.2			14	
		Repair					0.5	18	
		Test					0.4	18	
010417	CIRCUIT CARD ASSEMBLY (MODULATION LOGIC CARD, 1A4A209)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.5	18	
		Adjust					0.4	18	
010418	CIRCUIT CARD ASSEMBLY (SAMPLE AND HOLD CARD, 1A4A210)	Replace			0.2			14	
		Repair					1.5	18	
		Test					1.0	18	
		Adjust					0.4	18	
010419	CIRCUIT CARD ASSEMBLY (ATTENUATOR AND AMPLIFIER CARD, 1A4A301)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.4	18	
		Adjust					0.2	18	
010420	CIRCUIT CARD ASSEMBLY (AUDIO AMPLIFIER CARD, 1A4A302)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.4	18	
		Adjust					0.4	18	
010421	CIRCUIT CARD ASSEMBLY (FM AND AFC DETECTOR CARD, 1A4A303)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.4	18	
		Adjust					0.2	18	
010422	CIRCUIT CARD ASSEMBLY (LOG AMPLIFIER AND DETECTOR CARD, 1A4A304)	Replace			0.2			14	
		Repair					1.5	18	
		Test					0.2	18	
		Adjust					0.4	18	
010423	CIRCUIT CARD ASSEMBLY (SSB AND CW DETECTOR CARD, 1A4A305)	Replace			0.2			14	
		Repair					1.0	14	
		Test					0.5	18	
		Adjust					0.2	18	
010424	CIRCUIT CARD ASSEMBLY (SSB FILTERS CARD, 1A4A306)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.4	18	
		Adjust					0.4	18	
010425	CIRCUIT CARD ASSEMBLY (LINEAR AM DETECTOR CARD, 1A4A307)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.3	18	
		Adjust					0.2	18	
010426	CIRCUIT CARD ASSEMBLY (SECOND AGC AMPLIFIER CARD, 1A4A308)	Replace			0.1			14	
		Repair					1.0	18	
		Test					0.3	18	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
010427	CIRCUIT CARD ASSEMBLY (BANDPASS FILTERS CARD, 1A4A401)	Replace			0.1			14	
		Repair					3.0	18	
		Test					0.2	18	
010428	CIRCUIT CARD ASSEMBLY (LIMITER AND ATTENUATOR CARD, 1A4A402)	Replace			0.1			14	
		Repair					1.5	18	
		Test					0.5	18	
010429	CIRCUIT CARD ASSEMBLY (RF AMPLIFIER AND MIXER CARD, 1A4A403)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.5	18	
010430	CIRCUIT CARD ASSEMBLY (FIRST IF. AMPLIFIER AND SECOND MIXER CARD, 1A4A404)	Replace			0.2			14	
		Repair					1.0	18	
		Test					0.3	18	
010431	CIRCUIT CARD ASSEMBLY (OSCILLATOR AND AMPLIFIER CARD, 1A4A405)	Replace			0.2			14	
		Repair					1.5	18	
		Test					0.4	18	
		Adjust					0.4	18	
010432	CIRCUIT CARD ASSEMBLY (FIRST AGC AMPLIFIER CARD, 1A4A406)	Replace			0.1			14	
		Repair					1.0	18	
		Test					0.4	18	
010433	CIRCUIT CARD ASSEMBLY (PAN IF. AMPLIFIER CARD, 1A4A407)	Replace			0.1			14	
		Repair					1.0	18	
		Test					0.3	18	
		Adjust					0.2	18	
010434	POWER SUPPLY (RT UNIT POWER SUPPLY, 1A4PS1)	Test					0.4	18	
		adjust					0.4	18	
		Replace			0.2			14	
		Repair			0.5			1,14	H
		Repair					2.0	1,14,18	
01043401	CIRCUIT CARD ASSEMBLY (REGULATOR CARD, 1A4PS1A1)	Replace			0.1			14	
		Repair					1.0	18	
		Test					0.2	18	
		adjust					0.2	18	
01043402	ELECTRONIC COMPONENTS ASSEMBLY (1A4PS1A2)	Repair					0.5	1,14,18	
01043403	ELECTRONIC COMPONENTS ASSEMBLY (1A4PS1A3)	Repair					0.5	1,14,18	
0105	COUPLER, ANTENNA CU-1408/TLQ-15 (SOFT MOUNTED COUPLER, 1A5)	Repair			1.0		1.6	1,2,6,7,8, 11,14,18	
010501	CIRCUIT CARD ASSEMBLY (DIODE LOGIC CARD, 1A5A1)	Replace			0.2			14	
		Repair					0.4	18	
		Test					0.2	18	
010502	PANEL ASSEMBLY	Repair			0.5			1,14	I
010502	Power Supply PP-4253/TLQ-15 (LVPS< 1A6)	Repair			0.5			1,2,6,12,14,	
		Replace			0.2			14	

SECTION II MAINTENANCE ALLOCATION CHART FOR COUNTERMEASURES SET AN/TLQ-15

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE CATEGORY C	O	F	H	D	TOOLS AND EQUIPMENT	REMARKS
0107	POWER SUPPLY PP-4254/TLQ-15 (HVPS, 1A7)	Repair			0.6			1,2,6,12,14, 19	
		Replace			0.2			14	
010701	CHASSIS	Repair			1.0			14	
0108	TELEPHONE SET TA-312/PT (TELEPHONE, 1A8 (SEE TM 11-5805-201-12)	Replace			0.1			14	
0109	COUNTER, ELECTRONIC, DIGITAL READOUT CP-1053/TLQ-15 (DIGITAL COUNTER, 1A9)	Repair			0.1			14	
010901	COUNTER, ELECTRONIC DIGITAL READOUT CP-814/USM-207 (SEE TM 11-6625-700-10, -25, -25P)	Replace			0.5			14	
010902	RACK MOUNT ASSEMBLY	Replace			0.5			14	
		Repair			1.0			14	
010903	CABLE ASSEMBLY (1A9W1)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
010904	CABLE ASSEMBLY (1A9W2)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
0110	KEY AND CABLE ASSEMBLY (KEY, 1A10)	Replace			0.1			14	
		Repair			0.2			14	
0111	RACK, ELECTRICAL EQUIPMENT (EQUIPMENT RACK, 1A11)	Repair			1.6			14	
0112	SHELTER S-250/G (MODIFIED) (SHELTER, 1A12) (SEE TB 750-240 AND TM 11-5410-214-15P)	Replace		0.1					
011201	INTERCONNECTING BOX (1A12A3)	Inspect		0.2	0.2			1,10	A,B
		Replace			0.4			1,14	
		Repair					2.2		
011202	HEATER ASSEMBLY (1A12A5)	Inspect	0.2	0.2				1,10	A
		Replace			0.5			14	
		Repair					2.3	1,14	
011203	LIGHT, RINGER ID-1938/U (RINGER LIGHT, 1A12A6)	Inspect		0.1					
		Replace			0.3			10	
		Repair			0.5			1,14,15	
011204	BRANCH WIRING HARNESS (1A12W1)	Inspect	0.2	0.2				1,10	A
		Replace			0.4			14	
		Repair					2.3	1,14	
0113	DISTRIBUTION BOX J-2534/TLQ-15 (POWER DISTRIBUTION BOX, 1A13)	Repair			0.7			1,14	
		Overhaul					1.9	1,14	
011301	CIRCUIT CARD ASSEMBLY (SWITCH/DELAY/ MONITOR CARD, 1A13A1)	Replace			0.5			14	
		Repair			0.2			1,14	
011302	POWER MONITOR (1A13A2)	Replace			1.1			3,4,5,14	
		Repair			1.2			14	J
0114	FAN ASSEMBLY (PERSONNEL FAN, 1A14)	Replace			0.5			14	
		Repair			0.2			1,14	
0115	AIR CONDITIONER (1A15A1) (SEE TM 5-4120-289-15)	Replace			1.0			14	

SECTION II MAINTENANCE ALLOCATION CHART FOR COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0116	MODULATOR MX-8052/GLQ (MODULATION SOURCE, 1A16) (SEE TM 11-5895-502-15)	Replace			0.2			14	
0117	INDICATOR, PANORAMIC IP-922/GLQ (PAN INDICATOR, 1A17) (SEE TM 11-5895-503-15)	Replace			0.2			14	
0118	ENCLOSURE ASSEMBLY, TSEC (1A18)	Repair			0.5			1,2,5,9,14	
011801	CABLE ASSEMBLY (1A18W1)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011802	CABLE ASSEMBLY (1A18W2)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011803	CABLE ASSEMBLY (1A18W3)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011804	CABLE ASSEMBLY (1A18W4)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011805	CABLE ASSEMBLY (1A18W5)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011806	CABLE ASSEMBLY (1A18W6)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011807	CABLE ASSEMBLY (1A18W7)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011808	CABLE ASSEMBLY (1A18W8)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011809	CABLE ASSEMBLY (1A18W9)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011810	CABLE ASSEMBLY (1A18W10)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011811	CABLE ASSEMBLY (1A18W11)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
011812	CABLE ASSEMBLY (1A18W12)	Inspect	0.2						
		Replace			1.0			14	
011813	CABLE ASSEMBLY (1A18W13)	Inspect	0.2						
		Replace			1.0			14	
0119	HEATER, SPACE ELECTRIC HD-887/TLQ-15 (PERSONNEL HEATER, 1A19)	Replace			0.2			14	
		Repair			0.5			1,14	
0120	CONTROL ASSEMBLY, EXHAUST (EXHAUST ASSEMBLY, 1A20)	Repair			0.8			1,14	

SECTION II MAINTENANCE ALLOCATION CHART FOR COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
012001	CABLE ASSEMBLY (1A20W1)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
012002	CABLE ASSEMBLY (1A20W2)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
0121	FILTER ASSEMBLY, LOW PASS F-1300/TLQ-15 (LOW PASS FILTER, 1A21)	Replace			0.5			14	
		Repair			3.0			1,14	
012101	ELECTRONIC COMPONENTS ASSEMBLY (FILTER NO. 1)	Replace			0.5			14	
		Repair					1.0	1,6,8,11,14	
012102	ELECTRONIC COMPONENTS ASSEMBLY (FILTER NO. 2)	Replace			0.5			14	
		Repair					1.0	1,6,8,11,14	
012103	ELECTRONIC COMPONENTS ASSEMBLY (FILTER NO. 3)	Replace			0.8			14	
		Repair					1.0	1,6,8,11,14	
012104	ELECTRONIC COMPONENTS ASSEMBLY (FILTER NO. 4)	Replace			0.8			14	
		Repair					1.0	1,6,8,11,14	
012105	ELECTRONIC COMPONENTS ASSEMBLY (FILTER NO. 5)	Replace			1.0			14	
		Repair					1.0	1,6,8,11,14	
012106	CHASSIS ASSEMBLY (1A21A1)	Repair			0.5			14	
0122	DUMMY LOAD DA-396/TLQ-15 (1A22)	Replace			1.0			14	
		Repair					0.5		
0123	PANEL, POWER DISTRIBUTION (RF PANEL, 1A23)	Repair			0.7			1,13,14	
012301	CABLE ASSEMBLY (1A23W1)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
012302	CABLE ASSEMBLY (1A23W2)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
0124	HEADSET H-251A/U (COMM HEADSET, 1A24) (SEE SB 11-628)	Replace	0.1						
0125	HANDSET H-189/GR (COMM HANDSET, 1A25) (SEE TM 11-5895-280-15)	Replace	0.1						
0126	MICROPHONE M-80/GR (CM MIC, 1A26)	Replace	0.2						
0127	HEADSET-MICROPHONE H-338/TLQ-15 (SECURE COMM HANDSET/HEADSET, 1A32)	Replace		0.1				11	
		Repair			0.7			1,14	
012701	CABLE ASSEMBLY (1A32W1)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	
012702	CABLE ASSEMBLY (1A32W5)	Inspect	0.2						
		Replace			0.2			14	
		Repair			0.5			1,14	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0128	ENCODER/DECODER KYB-6(ENCODER/DECODER 1A33)	Replace			0.5			14	
0129	AMPLIFIER, AUDIO FREQUENCY AM-4949/U (SECURE COMM MIC AMPLIFIER, 1A34)	Replace			0.2			14	
0130	AMPLIFIER, LOUDSPEAKER AM-4979/GR (SECURE COMM SPEAKER AMPLIFIER, 1A35)	Replace			0.2			14	
0131	LOUDSPEAKER LS-454/U (SPEAKER, 1A36)	Replace			0.2			14	
0132	CONTROL BOX, REMOTE C-8156/U (COMM CONTROL UNIT, 1A37)	Replace			0.1			14	
0133	CABLE ASSEMBLY (1W1)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0134	CABLE ASSEMBLY (1W2)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0135	CABLE ASSEMBLY (1W3)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0136	CABLE ASSEMBLY (1W4)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0137	CABLE ASSEMBLY (1W5)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0138	CABLE ASSEMBLY (1W6)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0139	CABLE ASSEMBLY (1W7)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0140	CABLE ASSEMBLY (1W8)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0141	CABLE ASSEMBLY (1W9)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0142	CABLE ASSEMBLY (1W10)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0143	CABLE ASSEMBLY (1W11)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0144	CABLE ASSEMBLY (1W12)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	

SECTION II MAINTENANCE ALLOCATION CHART FOR COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0146	CABLE ASSEMBLY (1W14)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0147	CABLE ASSEMBLY (1W15)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0148	CABLE ASSEMBLY (1W16)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0149	CABLE ASSEMBLY (1W17)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0150	CABLE ASSEMBLY (1W18)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0151	CABLE ASSEMBLY (1W19)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0152	CABLE ASSEMBLY (1W20)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0153	CABLE ASSEMBLY (1W21)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
02	COMMUNICATION-POWER GENERATOR GROUP, TRAILER MOUNTED OP-139/TLQ-15 (TRAILER, UNIT 2)	Replace		0.4				11	
020101	CABLE ASSEMBLY (2A1W1)	Inspect	0.2						
		Replace			1.0			14	
		Repair			2.0			1,14	
020102	CABLE ASSEMBLY (2A1W2)	Inspect	0.2						
		Replace			1.0			14	
		Repair			2.0			1,14	
0202	GENERATOR SET, GASOLINE ENGINE, TRAILER MOUNTED PU-681/TLQ-15 (GENERATOR, 2A2) (SEE TM 750-5-32)	Replace			0.4			14	
0203	CABINET, ELECTRICAL EQUIPMENT (AN/VRC-47 ENCLOSURE, 2A3)	Inspect		0.2					
		Repair			0.5			1,14	
020301	DETECTOR, LOW VOLTAGE ASSEMBLY (2A3A3)	Repair			0.6			1,2,4	
		Replace			0.4			14	
020302	CABLE ASSEMBLY (2A3W1)	Inspect	0.2						
		Replace			1.0			14	
020303	CABLE ASSEMBLY (2A3W2)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
020304	CABLE ASSEMBLY (2A3W3)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
020305	CABLE ASSEMBLY (2A3W4)	Inspect	0.2						
		Replace			1.0			14	
		Repair			1.0			1,14	
0204	ANTENNA AS-1738/TLQ-15 (CM ANTENNA, 2A6)	Inspect	0.3						A
		Replace			0.2			1,14	
020401	ANTENNA, HIP (2A6A1)	Inspect	0.1						
		Replace			0.2			1,14	
		Repair			0.5			14	
020402	BASE, ANTENNA MOUNTING (INSULATOR, 2A6A2)	Inspect	0.1						
		Replace		0.2				14	
		Repair			0.6			14	
0205	CABLE ASSEMBLY AND REEL RL-267/TLQ-15	Inspect	0.2						
	(MAIN POWER CABLE ASSEMBLY, 2A12)	Replace			0.5			14	
		Repair			8.0			1,14	
		Overhaul			16.0			1,14	
020501	CABLE ASSEMBLY (2A12W1)	Inspect	0.2						
		Replace			1.0			14	
		Repair			2.0			1,14	
020502	CABLE ASSEMBLY (2A12W2)	Inspect	0.2						
		Replace			1.0			14	
		Repair			2.0			1,14	
0206	COUNTERPOISE ASSEMBLY MX-6727/TLQ-15	Inspect	0.2						
	(COUNTERPOISE, 2A14)	Replace			0.3			10	
		Repair			8.0			14	
0208	RADIO SET AN/VRC-47 (COMPI RADIO SET, 2A17) (SEE TM 11-5820-401-12)	Replace	0.3					14	
0209	CABLE ASSEMBLY AND REEL RL-26B/TLQ-15	Inspect	0.2						
	(COMM CABLE, 2A18)	Replace			0.5			14	
		Repair			3.0			1,14	
020901	CABLE ASSEMBLY (2A18WI)	Inspect	0.2						
		Replace			1.0			14	
		Repair			2.0			1,14	
0210	INTERCONNECTING BOX (REMOTE TELEPHONE	Replace	0.3					14	
	JUNCTION BOX, 2A22)	Repair			0.2			1,14	
0211	CABLE ASSEMBLY, POWER, ELECTRICAL CX-12532/	Inspect	0.1						
	TLQ-15 (AUXILIARY POWER CABLE, 2A23)	Replace	0.1						
		Repair			0.5			1,13	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
021101	CABLE ASSEMBLY (2A23W1)	Inspect	0.2						
		Replace			1.0			14	
		Repair			2.0			1,14	
0212	SUPPRESSOR ASSEMBLY (2A24)	Test			0.2			1	
		Repair			0.6			1,14	
021001	CABLE ASSEMBLY (2A24W1)	Inspect	0.2						
		Replace			1.0			14	
03	CABLE ASSEMBLY SET, ELECTRICAL MX-8879/ TLQ-15 (EXTENDER CABLES, UNIT 3)	Inspect		3.0					
		Replace			1.0				
		Repair			1.0				
0301	CABLE ASSEMBLY (3W1)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0302	CABLE ASSEMBLY (3W2)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0303	CABLE ASSEMBLY (3W3)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0304	CABLE ASSEMBLY (3W4)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0305	CABLE ASSEMBLY (3W5)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0306	CABLE ASSEMBLY (3W6)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0307	CABLE ASSEMBLY (3W7)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0308	CABLE ASSEMBLY (3W8)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0309	CABLE ASSEMBLY (3W9)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0310	CABLE ASSEMBLY (3W10)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0311	CABLE ASSEMBLY (3W11)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0312	CABLE ASSEMBLY (3W12)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0313	CABLE ASSEMBLY (3W13)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0314	CABLE ASSEMBLY (3W14)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0315	CABLE ASSEMBLY (3W15)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0316	CABLE ASSEMBLY (3W18)	inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0317	CABLE ASSEMBLY (3W20)	Inspect		0.1					
		Replace			3.1				
		Repair			2.0			1,14	
0318	CABLE ASSEMBLY (3W24)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0319	CABLE ASSEMBLY (3W25)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0320	CABLE ASSEMBLY (3W26)	Inspect		3.1					
		Replace			0.1				
		Repair			2.0			1,14	
0321	CABLE ASSEMBLY (3W27)	Inspect		0.1					
		Replace			3.1				
		Repair			2.0			1,14	
0322	CABLE ASSEMBLY (3W28)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0323	CABLE ASSEMBLY (3W23)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0324	CABLE ASSEMBLY (3W30)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0325	CABLE ASSEMBLY (3W31)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0326	CABLE ASSEMBLY (3W32)	Inspect		0.1					
		Replace			0.1				
		Repair			2.0			1,14	
0327	CABLE ASSEMBLY (3W33)	Inspect		0.1					
		Replace			2.1				
		Repair			2.0			1,14	
04	MOUNTING BASE, ELECTRICAL EQUIPMENT MT-4965/TLQ-15 (TRUCK ADAPTER KIT, UNIT 4)	Inspect	0.2						
		Install		0.5				14	
		Replace		0.2				14	
		Repair			1.0			1, 14	
05	IMPEDANCE MATCHING NETWORK CU-2193/TLQ-15 (UNIT 5)	Inspect			0.3			14	
		Install			0.5			14	
		Replace			0.5			14	
		Repair			2.0			1,8,11,14, 20,21,22	

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0501	IMPEDANCE MATCHING DEVICE (6250416-501) (5A1)	Replace			0,2			14	
		Repair			2.0			1,2,11,14,20, 21,22	
		Test			0.5			1,8,20,21,22	
050101	CONTROL ASSEMBLY (5A1A1) (424255387-501),	Replace			2.0			14	
		Repair			0.7			1,14	
0502	ADAPTER PLATE (5252744-501) (5A2)	Replace			0.3			14	
		Repair			1.0			1,14	
0503	GROUNDING WAND (3253062-501) (5A3)	Replace			0.1			14	
		Repair			0.5			1,14	
		Test			0.2			1	
0504	METER, POWER (WATTMETER, 5A4)	Replace			0.1				
		Repair			0.2				
0505	ELECTRICAL CABLE ASSEMBLY (3253890-501) (5W1)	Replace			0.1			14	
		Repair			0.7			14	
		Test			0.7			14	
0506	RADIO FREQUENCY CABLE ASSEMBLY (3253880-501) (5W2)	Replace			0.1			14	
		Repair			0.7			1,14	
		Test			0.2			1	
0507	RADIO FREQUENCY CABLE ASSEMBLY (3253880-502) (5W1)	Replace			0.1			14	
		Repair			0.7			1,14	
		Test			0.2			1	
06	TEST KIT, COUNTERMEASURES SET MK-1809/ TLQ-15 (UNIT 6)	Inspect			0.2			14	
		Replace			0.5			1,14	
		Repair			1.0			1	
0601	CIRCUIT CARD ASSEMBLY (4254975-501)(6A1)	Replace			0.1			14	
		Repair			1.0			1,14	
		Test			0.3			1	
0602	CIRCUIT CARD ASSEMBLY (4254977-501) (6A2)	Replace			0.1			14	
		Repair			1.0			1,14	
		Test			0.3			1	
0603	CIRCUIT CARD ASSEMBLY (4254977-501) (6A3)	Replace			0.1			14	
		Repair			1.0			1	
		Test			0.3			1	
0604	RADIO FREQUENCY CABLE ASSEMBLY (3253766-501), (6W1)	Replace			0.1			14	
		Repair			0.7			1,14	
		Test			0.2			1	
0605	THERMOCOUPLE CABLE ASSEMBLY (3253898-501) (6W2)	Replace			0.1				
		Repair			0.5			1,14	
0606	IMPEDANCE TEST PROBE COUPLER (3253871-501) (6A4)	Replace			0.1				
		Repair			0.5			1,14	
0607	OSCILLOSCOPE OS-262P/U	Replace			0.1				
		Repair					2.0		
0608	AMPLIFIER, SINGLE TRACE	Replace			0.1				
		Repair					1.0		
0609	DUAL TIME BASE	Replace			0.1				
		Repair					1.0		
0610	PROBE, X10, TEK MODEL P6008	Replace			0.1				
		Repair					1.0		

SECTION II MAINTENANCE ALLOCATION CHART
FOR
COUNTERMEASURES SET AN/TLQ-15

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
0611	METER, IMPEDANCE, TS-3351/U	Replace			0.1				
		Repair					2 0		
0612	ATTENUATOR, FIXED	Replace			0.1				
		Repair					2.0		

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR COUNTERMEASURES SET AN/TLQ-15

(1) TOOL OR TEST EQUIPMENT REF CODE	(2) MAINTENANCE LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	O,F,D	MULTIMETER AN/USM-223	6525-00-999-7465	
2	F,D	TEST KIT, COUNTERMEASURES MK-1809/TLQ-15	5865-00-027-7926	
3	F,D	SOCKET, THIN, WALL, EXTRA DEEP, 5/16 IN. 9GT-43575		
4	F,D	SOCKET, THIN WALL, EXTRA DEEP, 3/8; IN. 9GT-43577		
5	F,D	UNIVERSAL JOINT 9GT-4280		
6	F,D	OSCILLOSCOPE AN/USM-281C	6625-00-228-2201	
7	F,D	RECEIVER, HALLICRAFTERS SX999, RECEIVER, RADIO R-390A/URR OR EQUIVALENT	5820-00-538-7555	
8	F,D	SIGNAL GENERATOR AN/GRM-50	6625-00-868-8358	
9	F,D	RADIO SET- AN/GRM-47	5820-00-223-7434	
10	O,F,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	
11	O,F,D	DIRECT READING LC METER AN/USM-357	6625-00-713-9077	
12	F,D	POWER SUPPLY PP-.3940/G	6130-00-953-7500	
13	F,D	VOLTMETER, DIGITAL AN/GSM-64	6625-00-022-7894	
14	O,F,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-064-5178	
15	F,D	TELEPHONE SET TA-312/PT	5805-00-543-0012	
16	F,D	VOLTMETER, RF AN/URM-145	6625-00-973-3986	
17	F,D	WATTMETER, RF ABSORPTION AN/URM-120	6625-00-813-8430	
18	D	TEST SET, COUNTERMEASURES TS-3661/TLQ-15	5865-01-028-7134	
19	F,D	IMPEDANCE MATCHING NETWORK. CU-2193/TLQ-15	5915-01-028-8595	
20	F.D	COUNTER, ELECTRONIC, DIGITAL READOUT AN/USM-207	6625-00-044-3228	
21	F,D	RF 8RIDGE, GENERAL RADIO TYPE 1606-B	6625-00-113-2040	
22	F,D	VOLTMETER, ME-30	6625-00-643-1670	
23	F,D	CABLE ASSEMBLY SET, ELECTRICAL, MX-8879/TLQ-15	5995-00-626-9053	

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	OPERATIONAL ONLY.
B	SYSTEM TEST BY FUNCTION, USING THOSE TESTS REQUIRED TO LOCATE FAULTY MODULES, COMPONENTS. WIRING AND CABLE PROBLEMS.
C	WHENEVER LVPS HAVE BEEN REPAIRED OR EITHER RFA TUBE HAS BEEN REPLACED, ADJUST RFA BIAS. WHENEVER FPA TUBE HAS BEEN REPLACED OR IF RFA SPONTANEOUSLY OSCILLATES, ADJUST RFA NEUTRALIZATION.
D	REPAIR BY REPLACEMENT OF FPA TUBE, VARIABLE PA TUNE CAPACITOR, VARIABLE PA LOAD CAPACITOR, GEAR TRAIN ASSEMBLY, RADIO FREQUENCY AMPLIFIER, OR CABLE ASSEMBLIES 1A3W1, 1A3W2, AND 1A3W3. **NOTE** **THE FPA TUBE, VARIABLE PA TUNE CAPACITOR, AND VARIABLE PA LOAD CAPACITOR ARE THROWAWAY ITEMS. THEY ONLY APPEAR IN THIS MAC NOTE.**
E	WHENEVER GEAR TRAIN OR READOUT TAPE ARE REPLACED, MECHANICALLY ALIGN GEAR TRAIN WITH RFA TUNING COMPONENTS .
F	WHENEVER 1A3A1L1 IS REPLACED, ADJUST IPA TUNING CONTROL AND INDICATOR DIAL. WHENEVER 1A3A1C19 IS REPLACED, ADJUST FPA PLATE TUNE CONTROL. WHENEVER 1A3A1C20 or C21 or C22 IS REPLACED, ADJUST FPA LOAD TUNE CONTROL.
G	REPAIR BY REPLACEMENT OF IPA TUBE. **NOTE** **THE IPA TUBE IS A THROWAWAY ITEM. IT ONLY APPEARS IN THIS MAC NOTE**
H	REPAIR IS LIMITED TO REPLACEMENT OF REGULATOR CIRCUIT CARD 1A4PS1A1.
I	REPAIR IS BY REPLACEMENT OF PANEL-MOUNTED COMPONENTS.
J	REPLACE CARDS ONLY.

APPENDIX C

IMPEDANCE MATCHING NETWORK CU-2193/TLQ-15 OPERATION, MAINTENANCE AND REPAIR

C-1. General

This appendix contains instructions for installation, operation, and repair of the impedance matching network. The common names and the use of each item in the impedance matching network are listed in paragraph 4-4*a.* Common names for the AN/TLQ-15 are listed in paragraph 1-8.

C-2. Description

The impedance matching network (fig. 4-1 through 4-3) consists of a tuneable impedance network of capacitance and inductance capable of withstanding high voltage potential present at the output of the AN/TLQ-15 hard mounted coupler. The impedance matching network includes an adapter plate and rf components necessary to connect the impedance matching device to the hard mounted coupler output. The impedance matching device can be adjusted to simulate the electrical characteristics of the AN/TLQ-15 cm antenna. Using the impedance matching device in place of an antenna permits normal system operation without high power rf radiation.

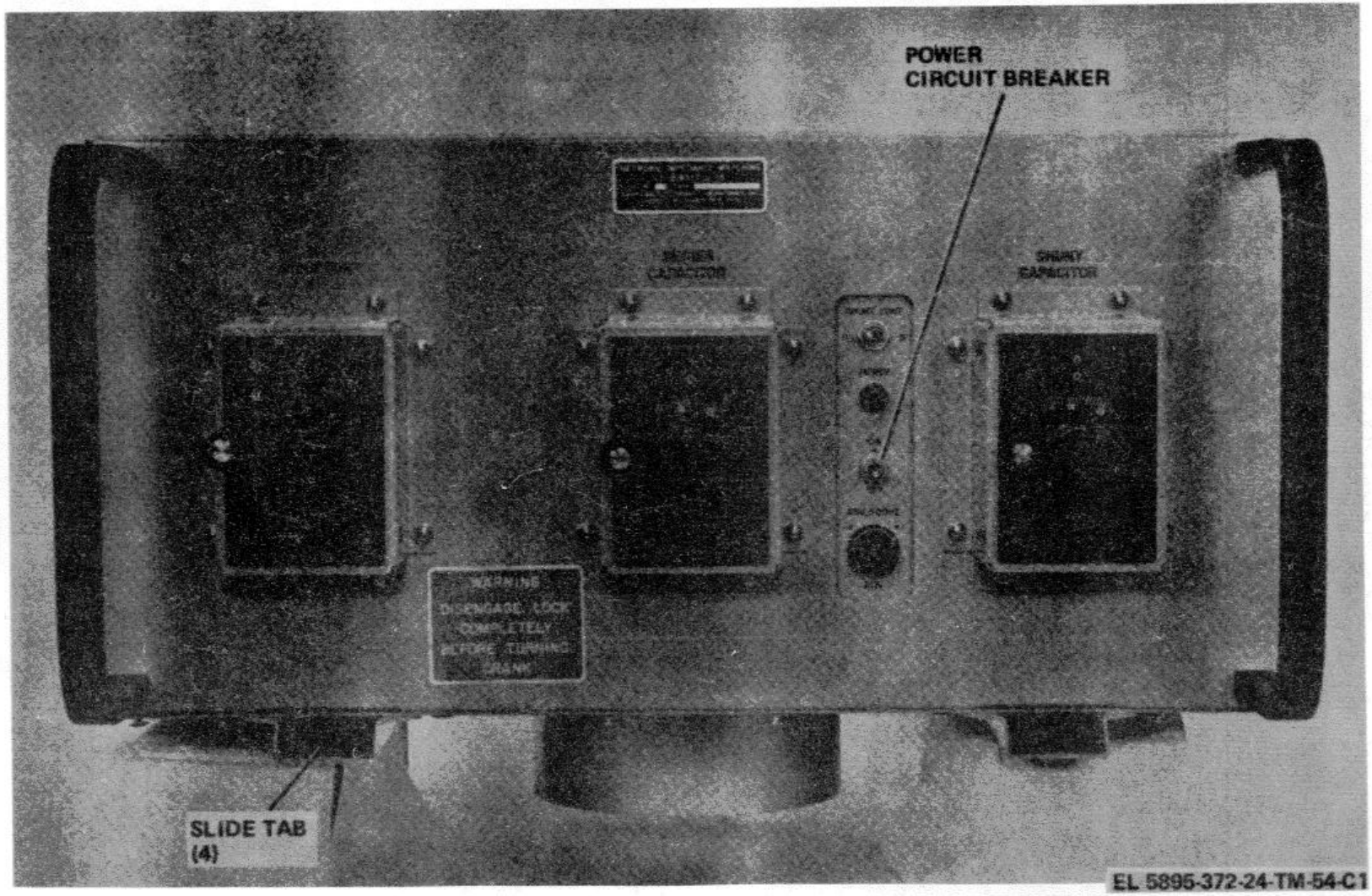


Figure C-1. Impedance matching device, front panel view.

Figure C-1. Impedance matching device, front panel view.

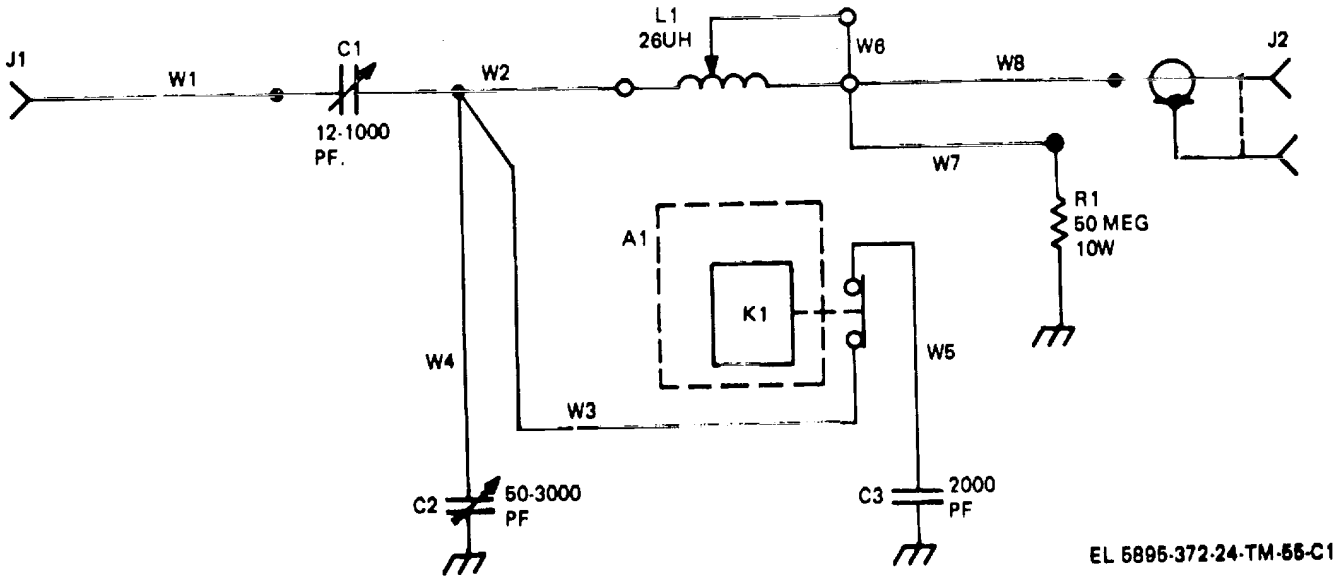


Figure C-2. Impedance matching device, rf diagram.

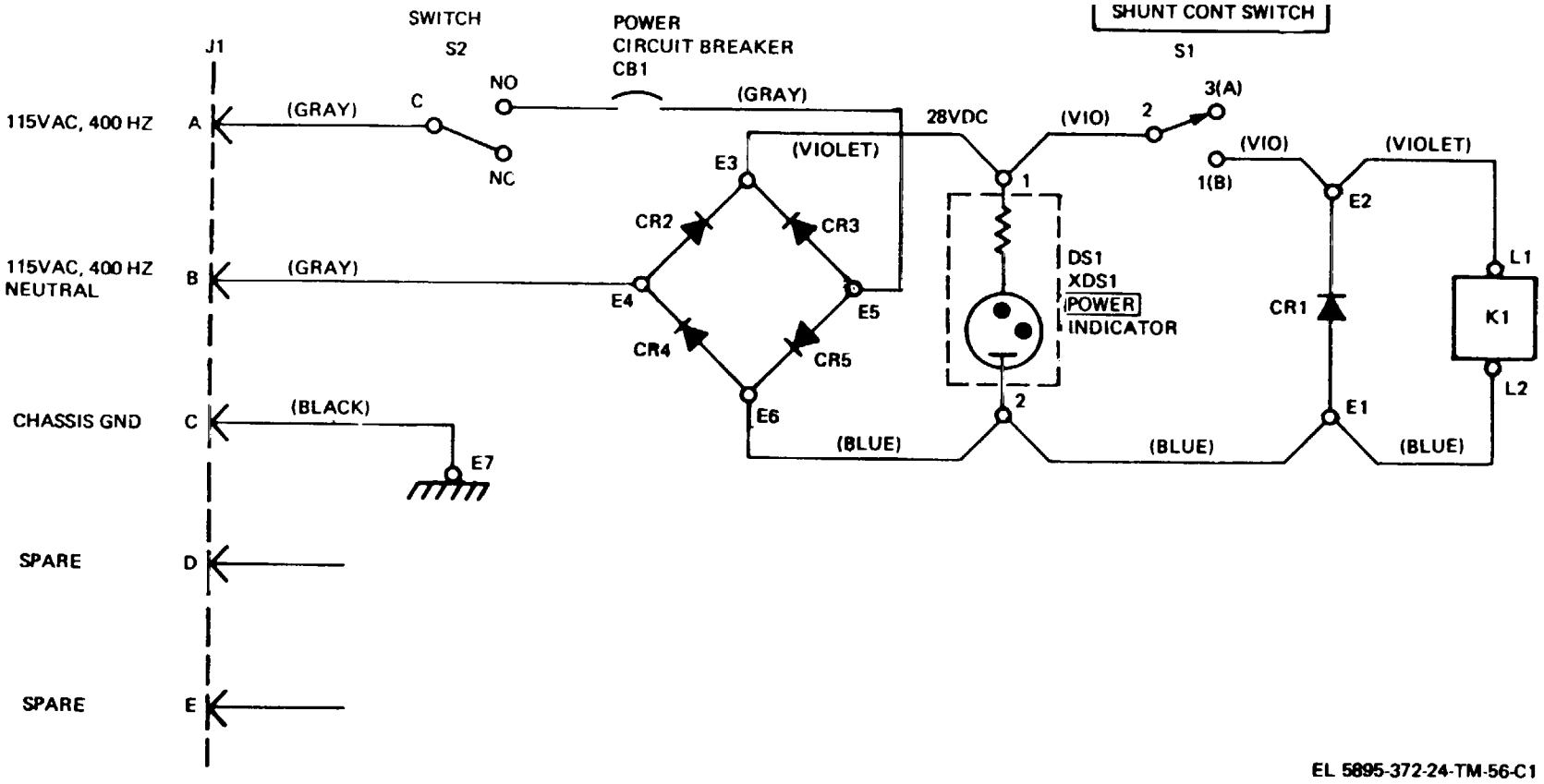


Figure C-3. Impedance matching device, control diagram.

C-3 Tabulated Data

a. Technical Characteristics. The technical characteristics of the impedance matching device are:

Frequency coverage .....1.5 to 20 MHz
Frequency tuning .....Adjustment of variable capacitors and inductor, as well as capacitor shunt control switch.
Rf power input.....2000 watts cw max
Impedance.....Variable real impedance values between 5 to 395 ohms and imaginary impedance values between negative 800 to positive 59 ohms.
Rf power output.....Approx. 50% of input rf power
Monitoring.....Dial readings of INDUCTOR, SERIES CAPACITOR and SHUNT CAPACITOR.
Primary power.....115 v ac, 400 Hz, 30 watts

b. Items Comprising an Operable Equipment:

Item	*Quantity*
Impedance matching device	1
Adapter plate	1
Grounding wand	1
Power cable	1
Wattmeter 4301	1
Wattmeter plug-in 2500H	1
Wattmeter plug-in 50H	1
Rf cable W1	1
Rf cable W2	1

C-4 Impedance Matching Device Controls and Indicators (fig. C-1)

Controls/indicators	***Function***
Power circuit breaker	When set to ON, POWER indicator lights and voltage is applied to SHUNT CONT switch.
POWER indicator	When lighted, indicates power is applied.
SHUNT CONT switch	a. When set to position A, includes C3 in tuned circuit. b. When set to position B, removes C3 from tuned circuit.
INDUCTOR control	Permits adjustment of inductor L1.
SERIES CAPACITOR control	Permits adjustment of capacitor C1.
SHUNT CAPACITOR control	Permits adjustment of capacitor C2.

C-5 Installation and Operating Instructions

Install and operate the impedance matching network in conjunction with the AN/TLQ-15 as described in paragraph 4-46.

NOTE

Before loosening latches on transit case, press pressure relief valve to depressurize case.

C-6. Functioning of Equipment

a. Rf Section (fig. C-2). The rf section tuneable pi network is adjustable to provide the real and imaginary components of antenna impedance associated with specific frequency over the operating range of 1.5 to 20 MHz. The tuneable network consists of capacitors C1, C2 and inductor L1. Capacitor C3 is added to the tuned circuit whenever SHUNT CONT switch is set to position B. Resistor RI is used to provide a safety discharge path for capacitors C1, C2, and C3. The purpose of the grounding wand is to speed this discharge by providing a short circuit across the capacitors.

b. Control Section (fig. C-3). The control section provides operating power and control for relay K1. Power circuit breaker CB1 controls application of 115 vac power and provides overload protection. Interlock switch S2 interrupts ac power whenever the control assembly is removed from the impedance matching device. Bridge rectifier circuit consisting of CR2 through CR5 provides 28 vdc control voltage to SHUNT CONT switch S1 which enables K1 whenever S1 set to position B. Diode CR1 suppresses transients and noise during switching of relay K1.

C-7. Preventive Maintenance Checks and Services for Impedance Matching Network.

a. Refer to table C-1 for Preventive Maintenance Checks and Services chart.

b. Routine checks like CLEANING, LUBRICATION, DUSTING, WASHING, CHECKING FOR FRAYED CABLES, STOWING ITEMS NOT IN USE, COVERING UNUSED RECEPTACLES, CHECKING FOR LOOSE NUTS AND BOLTS AND CHECKING FOR COMPLETENESS are not listed as PMCS checks. They are things that you should do any time you see they must be done. If you find a routine check like one of those listed in your PMCS, it is because other operators reported problems with this item.

NOTE

When you are doing any PMCS or routine checks, keep in mind the warnings and cautions.

WARNINGS

Never operate the generator or shelter until it has been properly grounded. Electrical defects in the load lines or equipment can cause death by electrocution when contact is made with an ungrounded system.

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLORO-TRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

Compressed air is dangerous and can cause serious bodily harm if protective means or methods are not observed to prevent a chip or particle (of whatever size) from being blown into the eyes or unbroken skin of the operator or other personnel. Goggles must be worn at all times while cleaning with compressed air. Compressed air shall not be used for cleaning purposes except where reduced to less than 29 pounds per square inch gage (psig) and then only with effective chip guarding and personnel protective equipment. Do not use compressed air to dry parts when trichlorotrifluoroethane has been used.

NOTES

The PROCEDURES column in your PMCS charts instruct how to perform the required checks and services. Carefully follow these instructions and, if tools are needed or the chart so instructs, get organizational maintenance to do the necessary work.

If your equipment must be in operation all the time, check those Items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.

c. Deficiencies that cannot be corrected must be reported to higher category maintenance personnel. Records and reports of preventive maintenance must be made in accordance with procedures given in TM 38-750.

C-8. Troubleshooting

a. General. The impedance matching device is operated as an integral part of AN/TLQ-15 testing; therefore, determining that the impedance matching device is defective is best achieved through the use of trouble symptoms obvious during AN/TLQ-15 testing. Typical symptoms are when the AN/TLQ-15 soft mounted coupler exhibits tuning difficulty such as: vswr overload, arcing, or reduces efficiency during testing with the impedance matching device.

b. Troubleshooting Procedure. The procedures for troubleshooting to a defective part in the impedance matching device are contained in Table C-2. *The Operational trouble symptom* column lists the most probable trouble symptoms to occur when the impedance matching device is operated during AN/TLQ-15 testing. The *Bench check* columns provide the procedure for isolating

Table C-1. Organizational Preventive Maintenance Checks and Services

Q - Quarterly

Item No.	Interval Q	Item to be Inspected	Procedures
1	•	Impedence Matching Network CU-2193/TLQ-15	Perform operational checks on the AN/TLQ-15 equipment antenna coupling. Repair if VSWR indications under dummy load indicates trouble.

the trouble after the impedance matching device is disconnected from the AN/TLQ-15 and placed on a work bench.

Table C-2. Troubleshooting Procedures-Impedance Matching Device

Item No.	Operational trouble symptom	Bench check: Isolation procedure	Bench check: Probable trouble (0f check is abnormal)	Bench check: Corrective measures
1	Power Circuit breaker trips.	Reset power circuit breaker.	Rectifiers CR2 through CR5 defective.	Replace defective rectifier (para C-9e).
2	Power indicator does not light.	Measure continuity from J1-A to terminal E5 on control assembly (fig. C-3).	Interlock S2 or CB1 is defective.	Replace defective S2 or CB1 (para C-9e).
3	Vswr overload	a. Control settings	a. IMN controls improperly adjusted	a. Adjust controls to settings indicated on Calibration chart provided.
		b. Rf connections.	b. Loose rf connections.	b. Tighten loose rf connections
		c. Internal arcing.	c. Loose internal connections.	c. Tighten loose internal connections.
4	Reduced antenna coupler efficiency	a. Control settings.	a. Controls improperly adjusted.	a. Refer to item 3.
		b. Visually inspect capacitors for cracks.	b. Variable capacitor defective.	b. Replace defective variable capacitor (para C-9).
		c. Check variable capacitor range.	c. Mechanical end stop defective.	c. Adjust or replace defective mechanical end stop (para C-10).
		d. Measure continuity across contacts of relay K1 (fig. C-2 and C-3).	d. Relay K1 or control circuit defective.	d. Replace defective component.

C-9. Replacement Instructions

NOTE

The access cover must be removed prior to performing the replacement instructions contained in this paragraph. Loosen 22 cover fastening screws and carefully lift cover to permit removal of 10, 32-inch screw attaching output connecting strap to J1.

a. Replacement of C1 (fig. C-4).

(1) Loosen two 6/32 x 0.75-inch setscrews in coupling between C1 and shaft coupling.

(2) Disconnect insulator plate from main chassis by removing two 10/32 x 0.50-inch screws.

(3) Loosen variable flange at rear end of C1 by loosening flange adjusting screw.

(4) Remove rear insulator plate assembly.

(5) Hold capacitor C1 securely and loosen variable end flange at front end of C1.

(6) Carefully slide C1 out of mounted position.

(7) Connect capacitance meter across replacement capacitor and adjust for 14 pF.

(8) Carefully insert capacitor into flange opening and tighten front flange adjusting screw until capacitor is secure.

(9) Install insulator plate to main chassis and to rear end of capacitor and tighten two 10/32 x 0.50=inch mounting screws.

(10) Tighten rear capacitor flange by adjusting screw until snug.

(11) Adjust SERIES CAPACITOR dial for 000.

(12) Tighten two 6,/32 x 0.25=inch set- screws on C1 coupling.

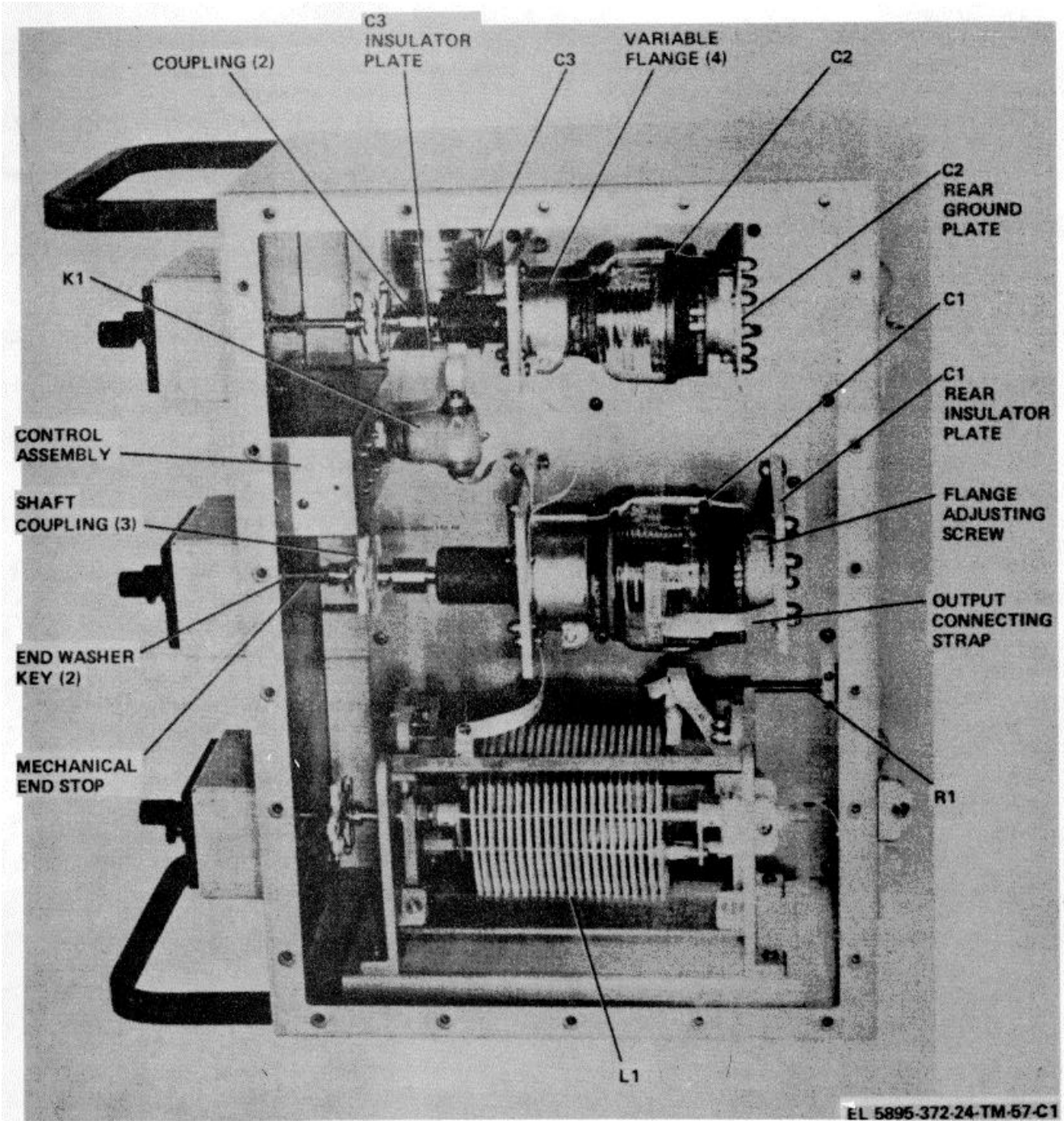


Figure C-4. Impedance matching device, parts location.

b. Replacement of C2 (fig. C-4).

(1) Remove C2 in accordance with steps (1) through (6) of paragraph C-9a.

(2) Connect capacitance meter across replacement capacitor and adjust for-54 pF.

(3) Replace C2 in accordance with steps (8) through (12) of paragraph C-9a.

c. Replacement of C3 (fig. C-4).

(1) Remove 8/32 x 0.25-inch screw attaching connecting strap from C3 at K1.

(2) Remove two 10/32 x 0.50-inch screws attaching C3 insulator plate to chassis.

(3) Loosen variable flange on C3 insulator plate by loosening flange adjusting screw.

(4) Hold capacitor C3 securely and remove insulator plate.

(5) Loosen variable flange on C3 ground plate and carefully remove C3 from unit.

(6) Carefully insert replacement capacitor into variable flange on ground plate.

(7) Tighten ground plate variable flange adjusting screw.

(8) Install insulator plate to C3 and main chassis and tighten two 10/32 x 0.50 screws.

(9) Tighten insulator plate variable flange adjusting screw.

(10) Reconnect strap to K1 by tightening 8/32 x 0.25 -inch screw.

d. Replacement of L1 (fig. C-4).

(1) Place impedance matching device on left side.

(2) Remove 10/32 x 0.50-inch screws from three connecting straps.

(3) Loosen two 6/32 x 0.25-inch setscrews in coupling between L1 and shaft coupling.

(4) Remove four 10/32 x 0.75-inch screws attaching L1 mounting bracket to chassis.

(5) Carefully lift L1 from unit.

(6) Adjust replacement L1 wiper CCW to the end stop nearest the control end.

(7) Install L1 in unit and fasten to chassis using four 10/32 x 0.75-inch screws.

(8) Set INDUCTOR dial to 000.

(9) Tighten two 6/82 x 0.26-inch set-screws in coupling between L1 and shaft coupling.

(10) Attach three connecting straps using 10/82 x 0,60-inch screws.

e. Replacement of Control Assembly (fig.C-4).

(1) Remove two 8/32 x 0.25-inch screws attaching connecting straps to K1,

(2) Hold control assembly securely and remove six 6/32-inch locking hex-nuts fastening assembly to chassis.

(3) Carefully lift control assembly from unit.

(4) Install replacement control assembly into front panel cut-out. Ensure A1J1 is at bottom of impedance matching device.

(5) Hold control assembly and tighten six 6/32-inch locking hex-nut fasteners.

(6) Attach connecting straps to K1 and tighten two 8/32 x 0.25-inch screws.

C-10. Mechanical End-stop Adjustments (fig. C-4)

a. Capacitor C1 Mechanical End Stop.

(1) Adjust SERIES CAPACITOR dial for 000.

(2) Loosen two 6/32 x 0.25-inch setscrews on C1 coupling.

(3) Loosen two 10/32 x 0.25-inch set-screws on C1 shaft coupling.

(4) Position end-stop washer keys so that they are all touching and snug against end washer key at counterclockwise limit.

(5) Ensure that end washer key is inserted in chassis detent and that all end-stops are at the limit of their counterclockwise travel.

(6) Remove C1 connecting straps.

(7) Connect capacitance meter across capacitor C1 and adjust for 14 pF.

(8) Tighten two 6/32 x 0.25-inch set-screws on C1 coupling.

(9) Tighten two 10/32 x 0.25-inch set-screws on C1 shaft coupling.

b. Capacitor C2 Mechanical End-Stop.

(1) Adjust SHUNT CAPACITOR dial for 000.

(2) Repeat steps (2) through (7) of a, above except step (7) should read 54 pF.

C-11. Testing Procedure

a. Test Equipment and Materials.

(1) Signal Generator AN/GRM-50.

(2) Rf Bridge General Radio GR-1606B.

(3) Frequency Counter AN/USM-207.

(4) Receiver R-390/URR.

(5) Termination Narda 870 NM.

(6) Ac Voltmeter ME-80/U.

(7) Test Cable (W1-W4) RG-58/U cable, 86 inches long (approx), BNC connectors.

(8) (W5) accessory lead (P/O, GF-1606B).

(9) Lead clip W6 (Alligator clip and spade lug P/O Lead Set 6625-00-856-0223, fabricated as shown in fig. C-5).

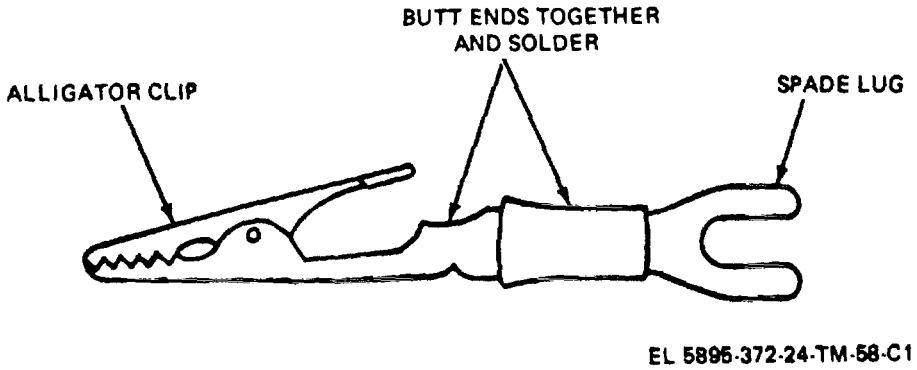


Figure C-5. Fabrication of lead clip.

(10) Adapter UG-565A/U, C plug to N jack.
(11) Adapter UG-274B/U T connector.
(12) Calibration chart P/O Impedance Matching Network.

b. Test Connections and Conditions. Connect the equipment as shown in figure C-6. Turn on the test equipment and allow it to warm up for 15 minutes before proceeding. Consult calibration chart for test frequencies and control settings for both impedance matching device and rf bridge. Zero adjustment must be made for each frequency checked as part of the test procedure. Sign reactance given in ohms reactance column on the calibration chart determines the procedure for zero adjustment of rf bridge.

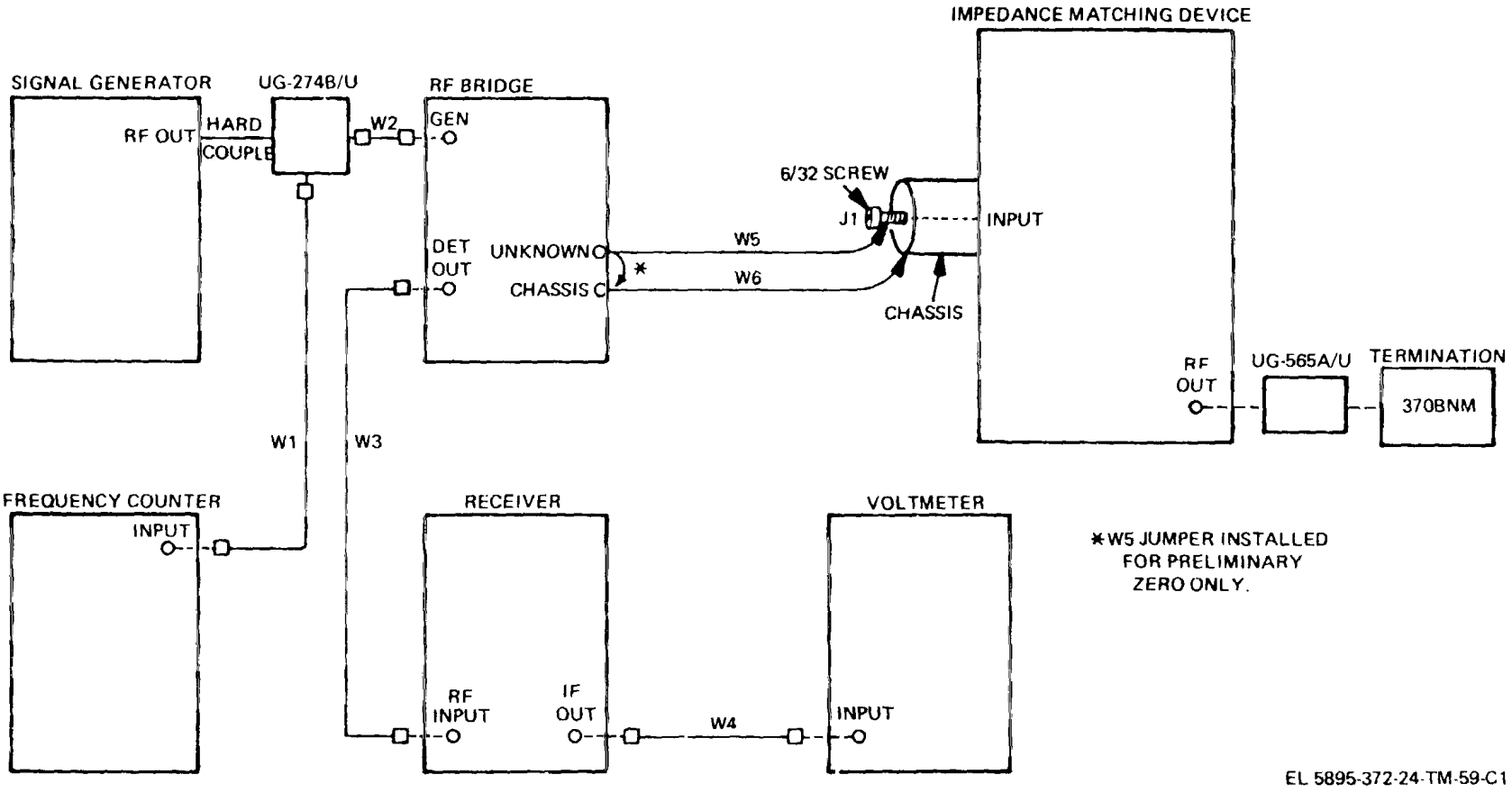


Figure C-6. Impedance matching device, bench test setup.

c. Procedure for Zero Adjustment of Rf Bridge.

NOTE

Unless otherwise specified, all controls and control settings refer to the impedance matching network.

(1) Set signal generator frequency to 1.5 MHz±200 Hz using frequency counter with output level at 3.0 volts rms unmodulated.

(2) Connect power cord to A1J1 and set power circuit breaker to ON.

(3) Set SHUNT CONT switch in accordance with calibration chart.

(4) Set receiver to check frequency and tune for maximum signal level indication at voltmeter.

(5) Adjust ohms resistance and ohms reactance on rf bridge as indicated on the calibration chart.

(a) Negative sign (-) reactance on calibration chart.

Initial balance switch	- high
Ohms resistance control -	- 0
Ohms reactance control	- 5000

(b) Positive sign (+) reactance on calibration chart.

Initial balance switch	- low
Ohms resistance control	0
Ohms reactance control	0

(6) Adjust initial balance resistance and reactance controls for minimum signal indication at receiver and voltmeter.

(7) Remove short at unknown terminal of rf bridge and connect terminal to input (J1) on the impedance matching device.

d. Procedure for Testing Impedance Matching Device.

(1) Loosen locknuts on impedance matching device.

(2) Adjust impedance matching device INDUCTOR, SERIES, AND SHUNT CAPACITOR controls in accordance with calibration chart.

(3) Adjust rf bridge controls in accordance with calibration chart.

(4) Carefully readjust rf bridge controls for minimum signal indication at voltmeter and receiver input level meter.

(5) Record rf bridge settings. Dials should read within tolerance specified on calibration chart.

(6) Repeat steps given in paragraphs 8 and 9 for each frequency on the calibration chart.

APPENDIX D

REPAIR OF COUNTERMEASURES SET TEST KIT MK-1809/TLQ-15

NOTE

Prior to loosening latches on transit case, depress pressure relief valve to depressurize case.

The direct support repair of test kit items is limited to repair of extender cards, and 2, and repair of rt unit special cable assembly. Repair of extender cards and extender cables requires replacement of defective rf cable and connectors. Consult TM 11-5895-372-24P for necessary parts and materials and TM 55-1500-323-25 for general instructions and methods of repairing rf cables.

INDEX

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SAAD (30)
TOAD (14)
SHAD (3)
Unit org under fol TOE:
(1 cy each unit)
29-134
29-136
32-67

***NG*: None.**

***USAR:* None**

For explanation of abbreviations used, see AR 310-50.

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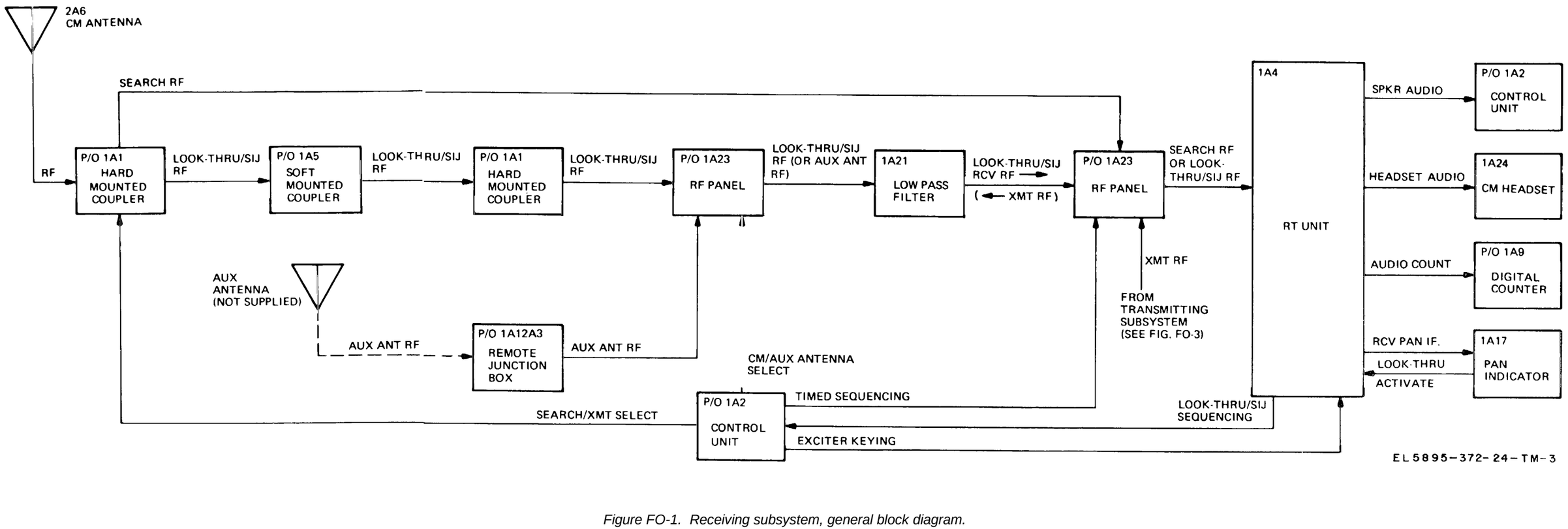

Figure FO-1. Receiving subsystem, general block diagram.

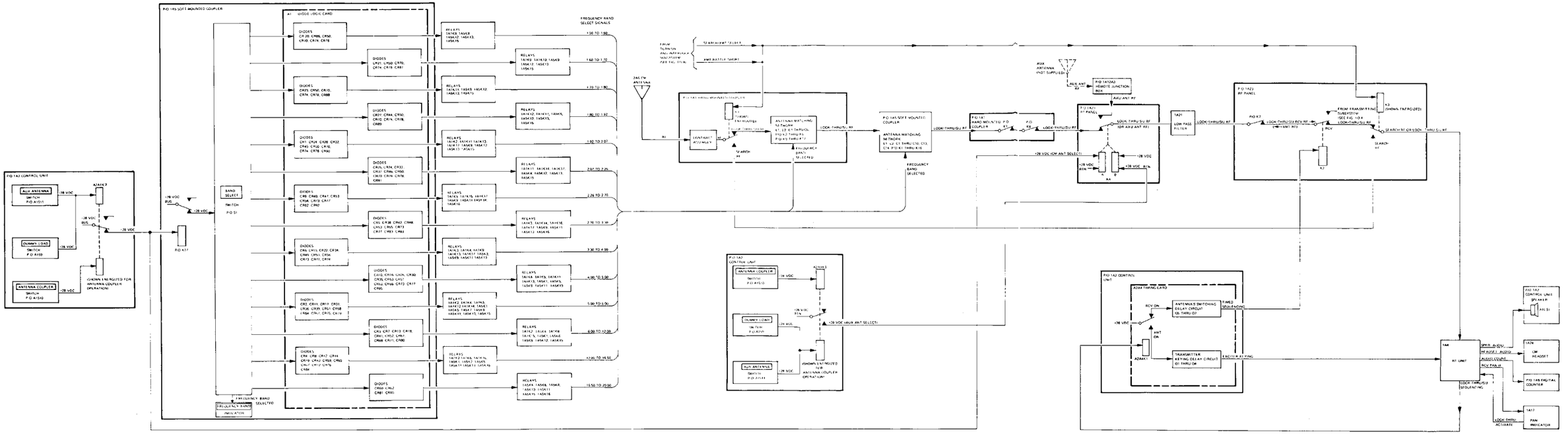

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Figure FO-2. Receiving subsystem, detailed block diagram.

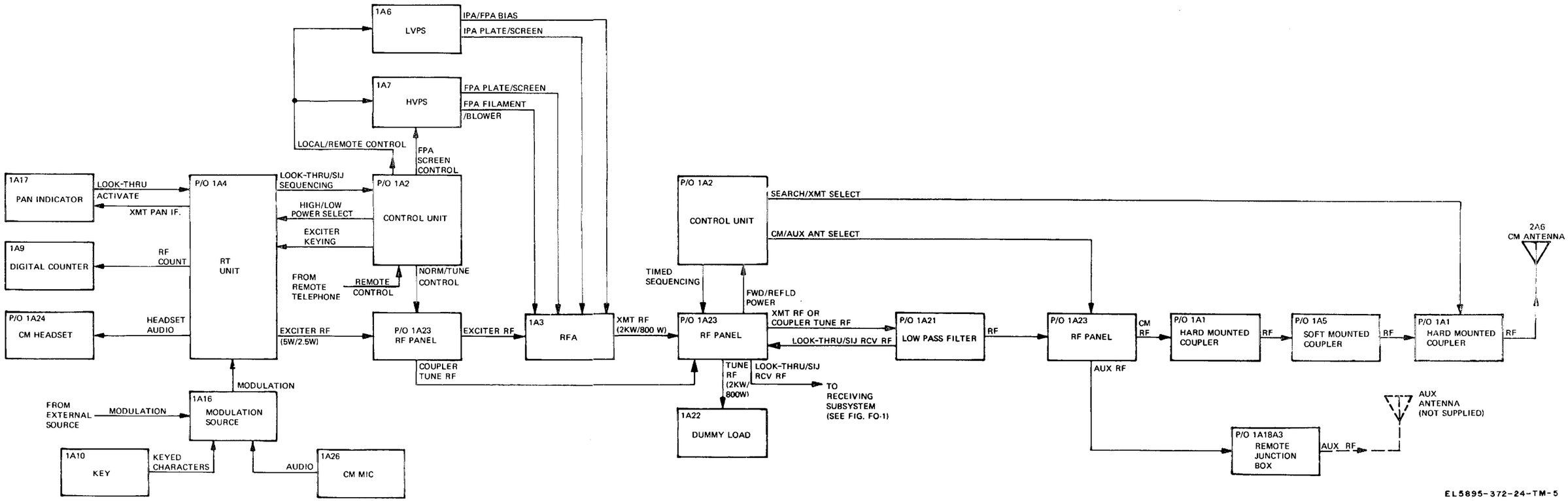


Figure FO-3. Transmitting subsystem, general block diagram.

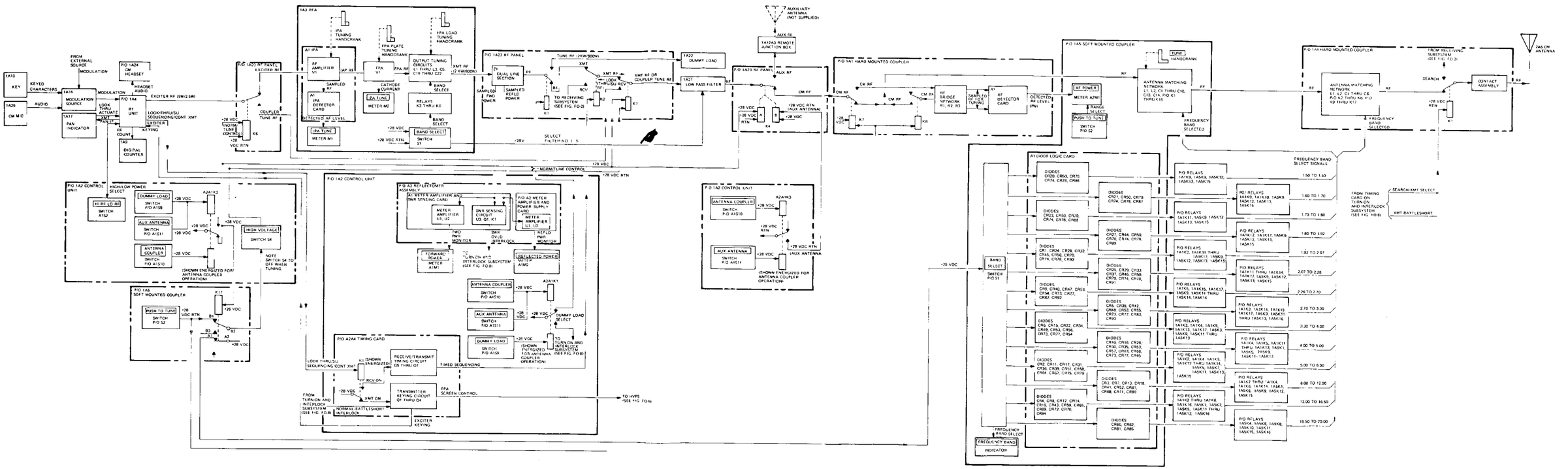


Figure FO-4. Transmitting subsystem, detailed block diagram.

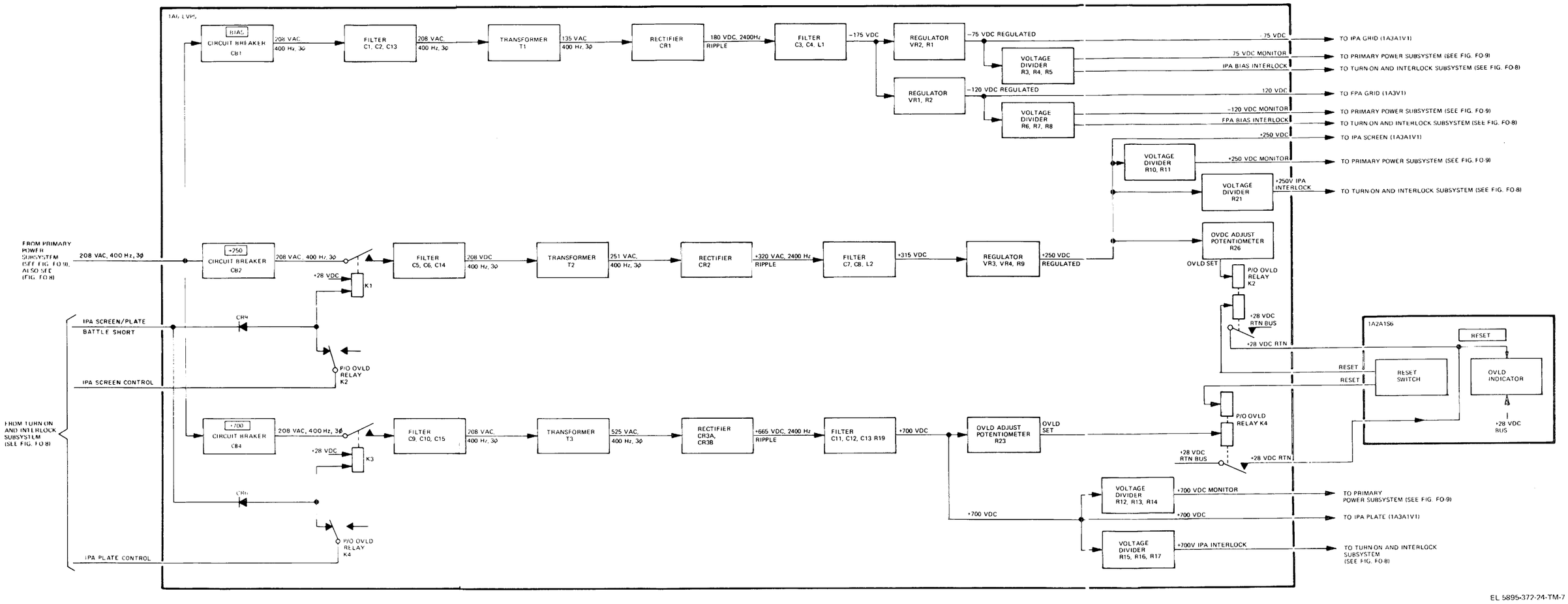


Figure FO-5. Lvps, block diagram.

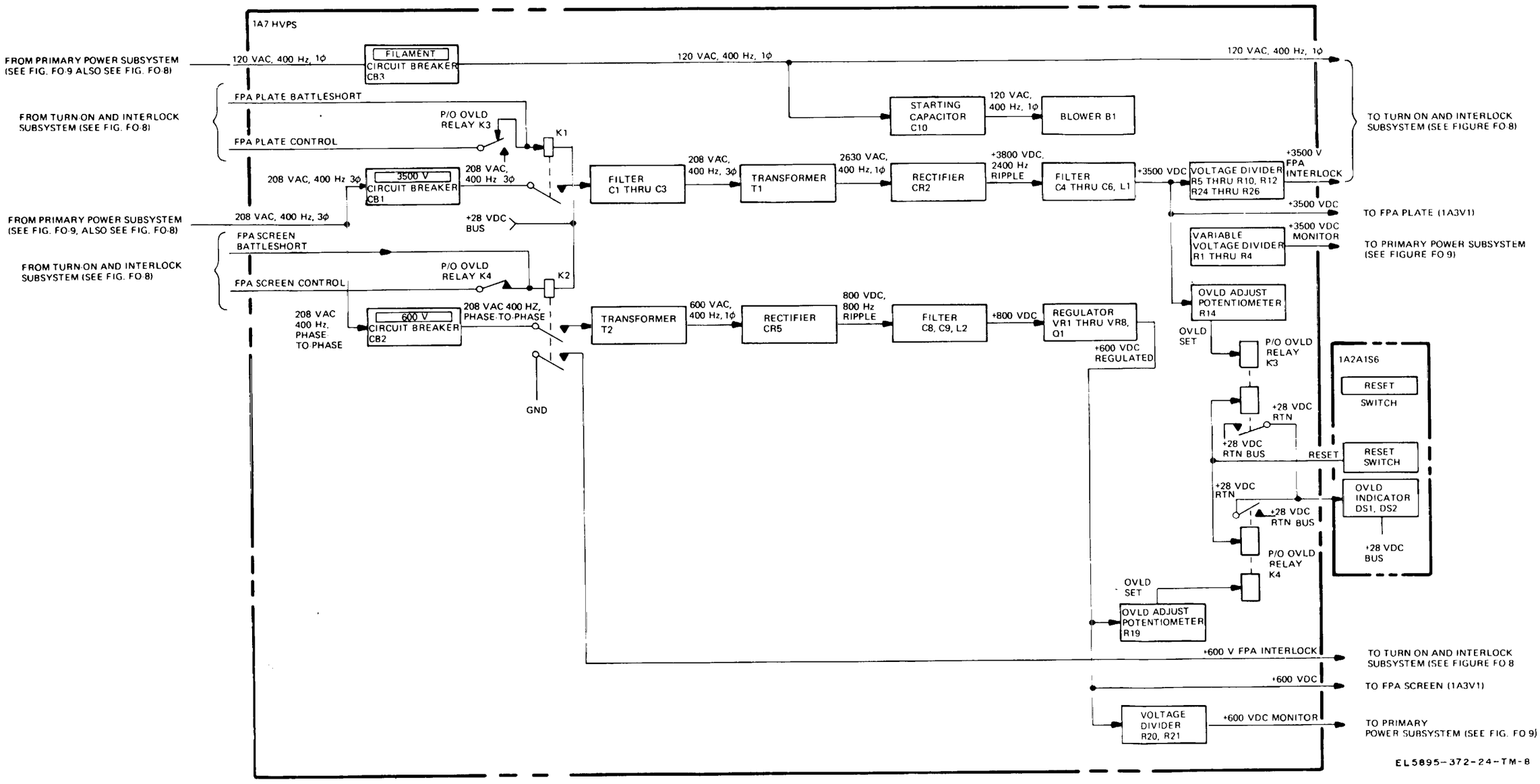


Figure FO-6. Hvps, block diagram.

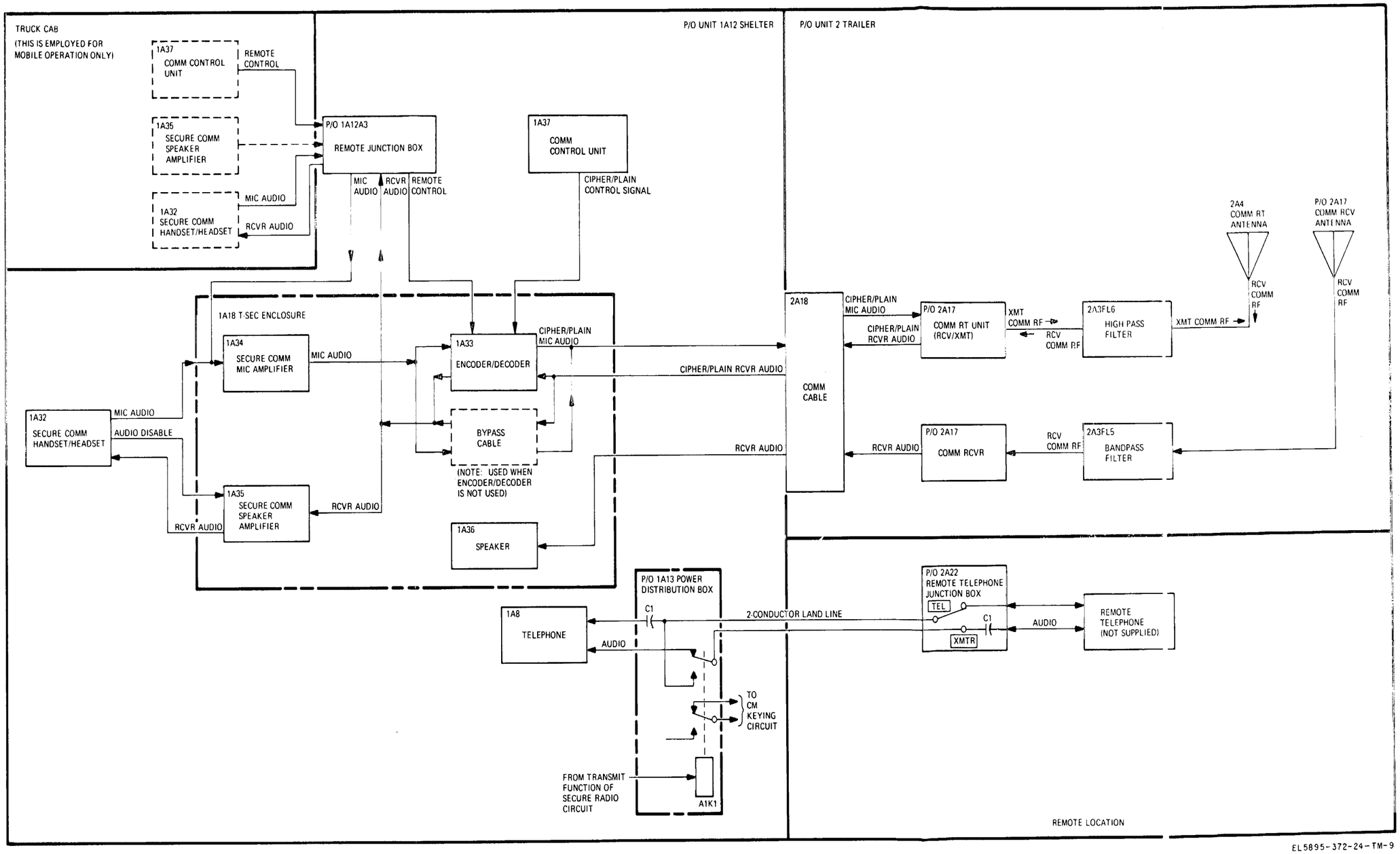


Figure FO-7. Communication subsystem, block diagram.

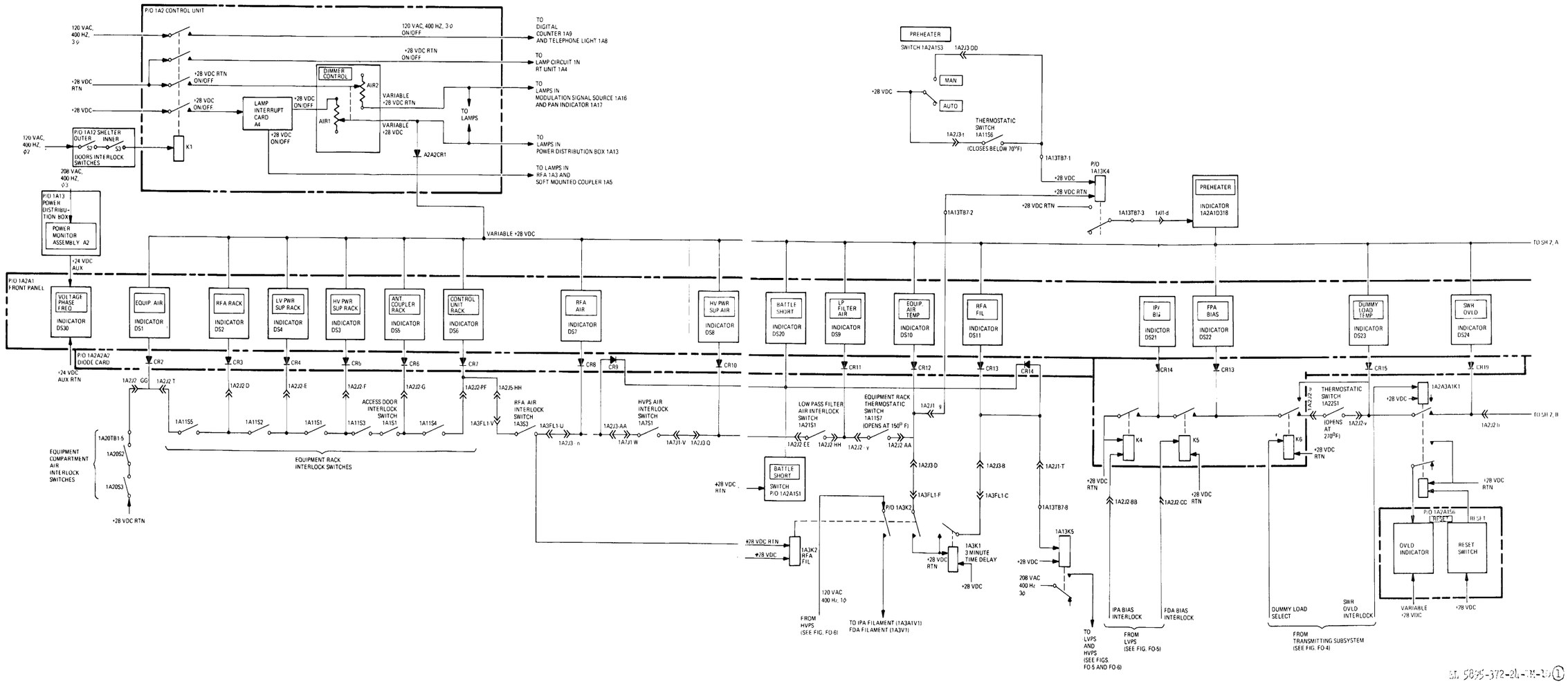


Figure FO-8 (1). Turn-on and interlock subsystem block diagram (sheet 1 of 2).

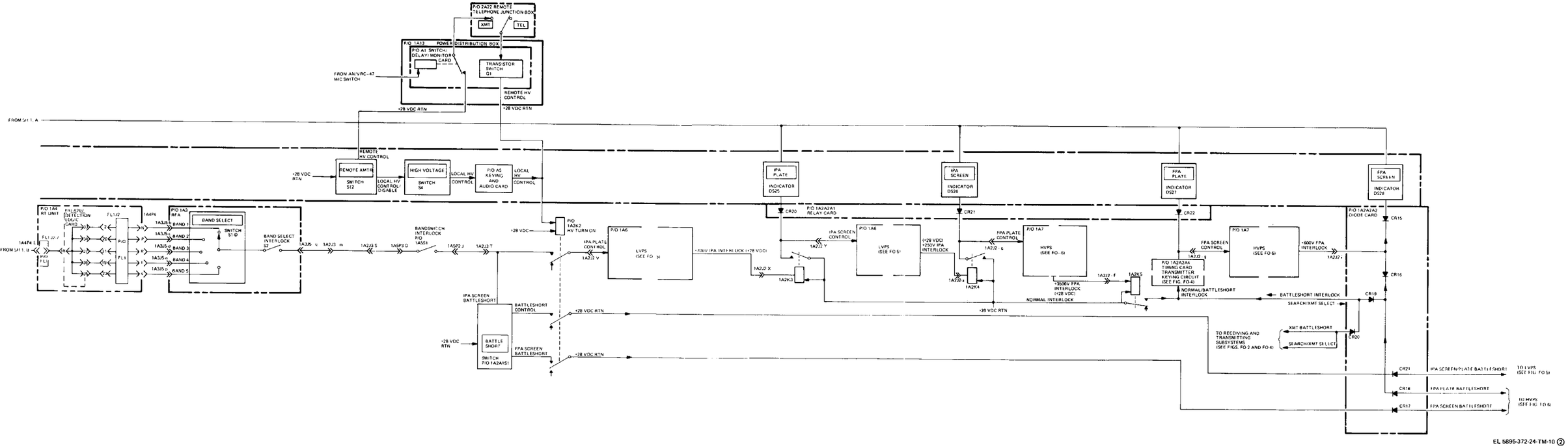
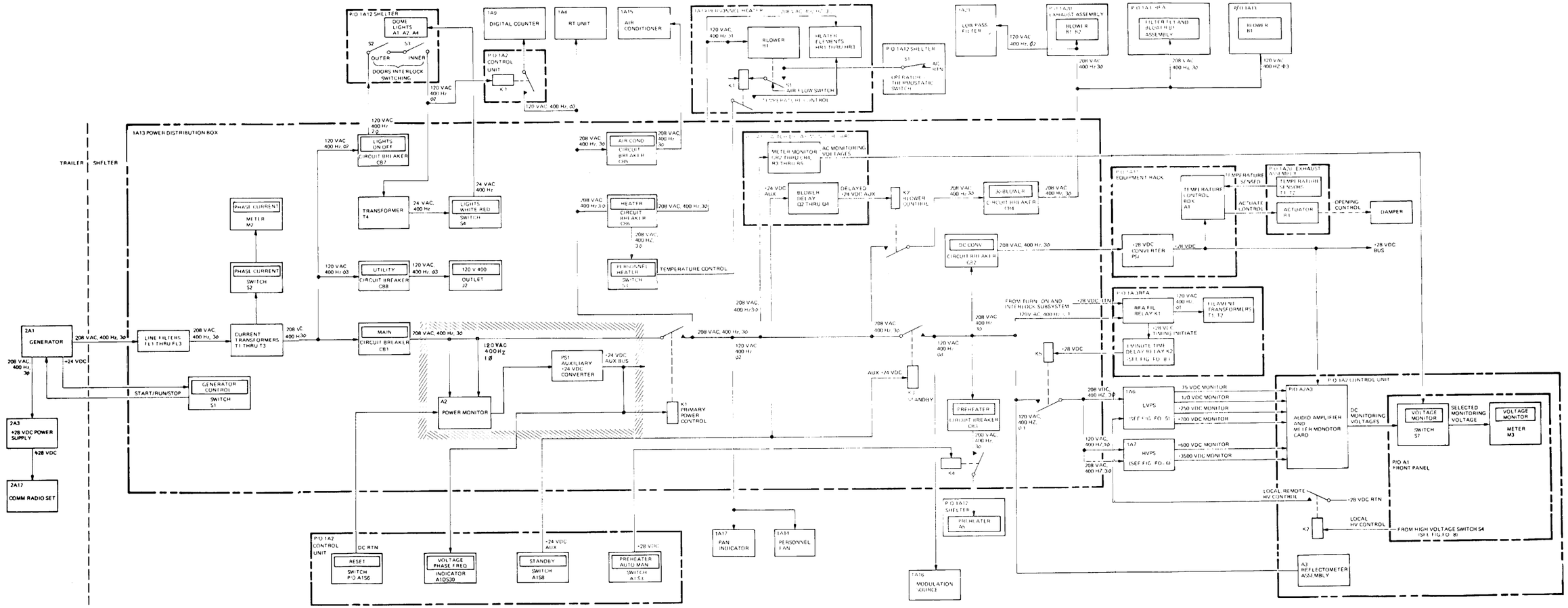


Figure FO-8 (2). Turn-on and interlock subsystem block diagram (sheet 2 of 2).



EL 1QN007

Figure FO-9. Primary Power Subsystem, Block diagram.

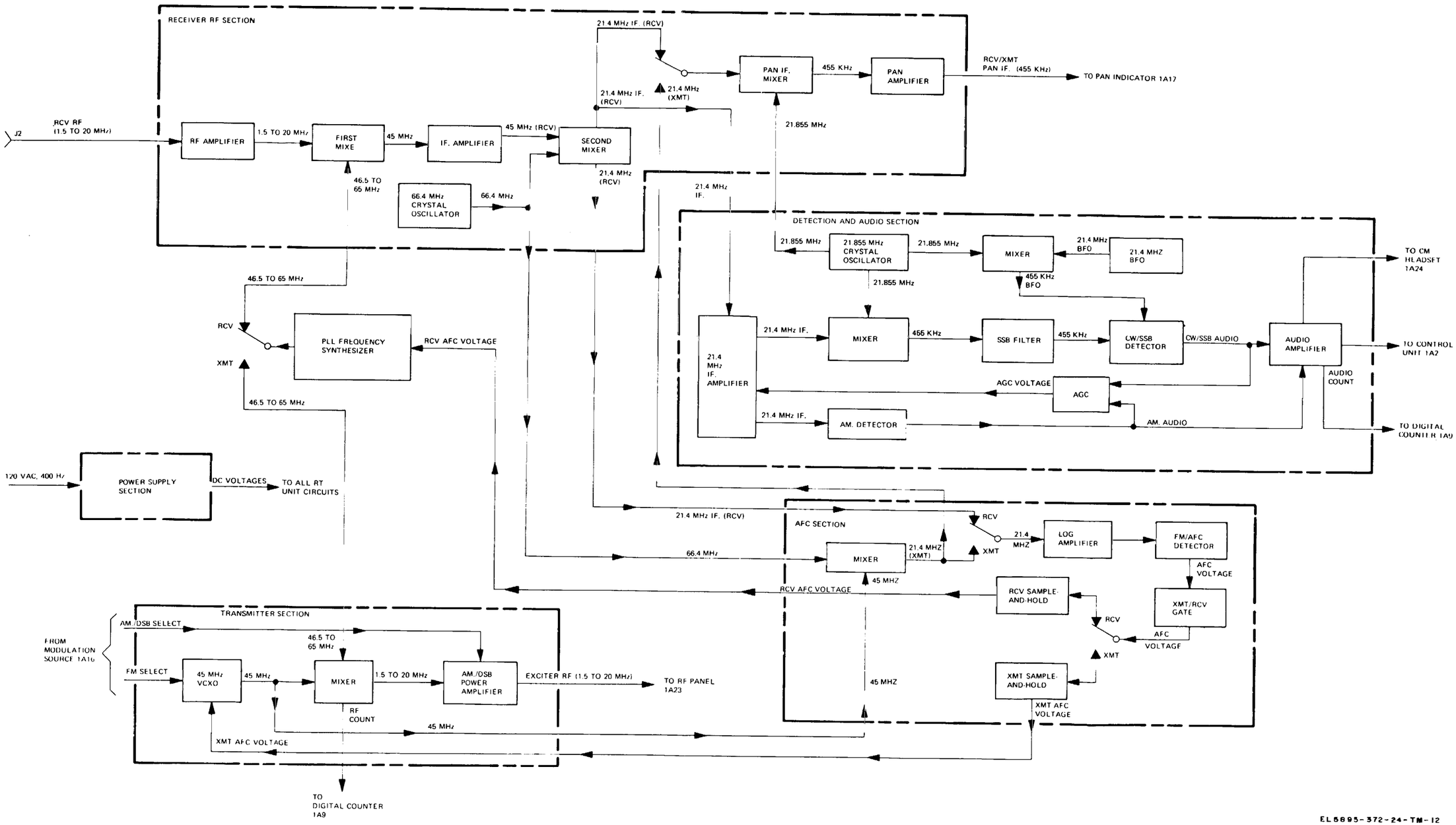
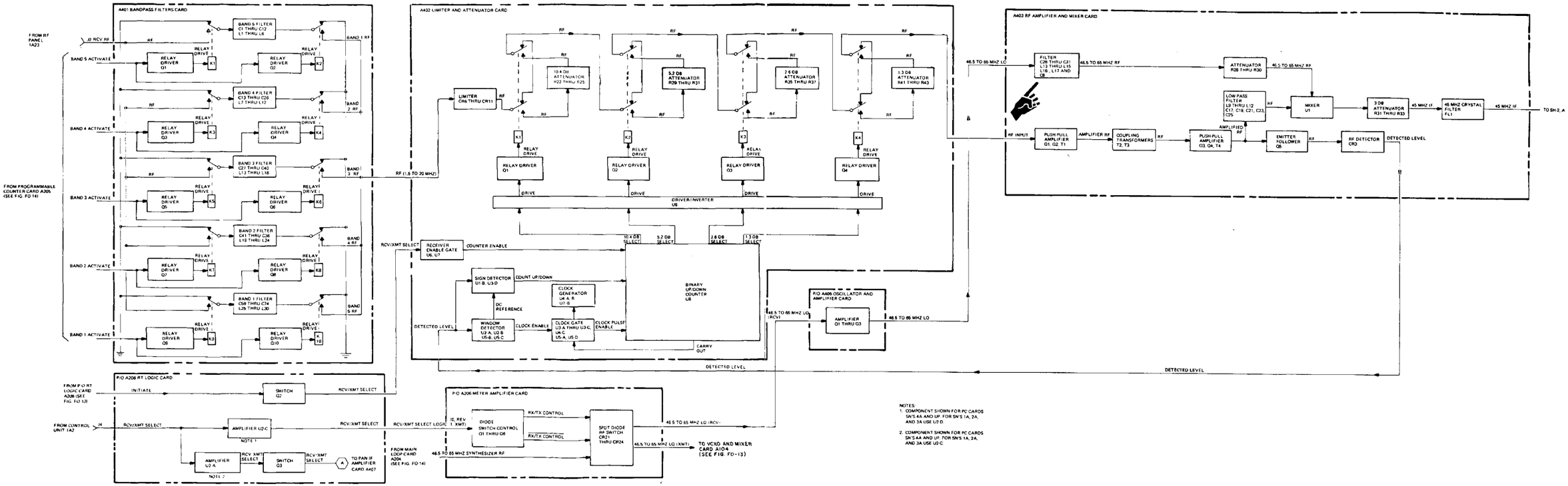
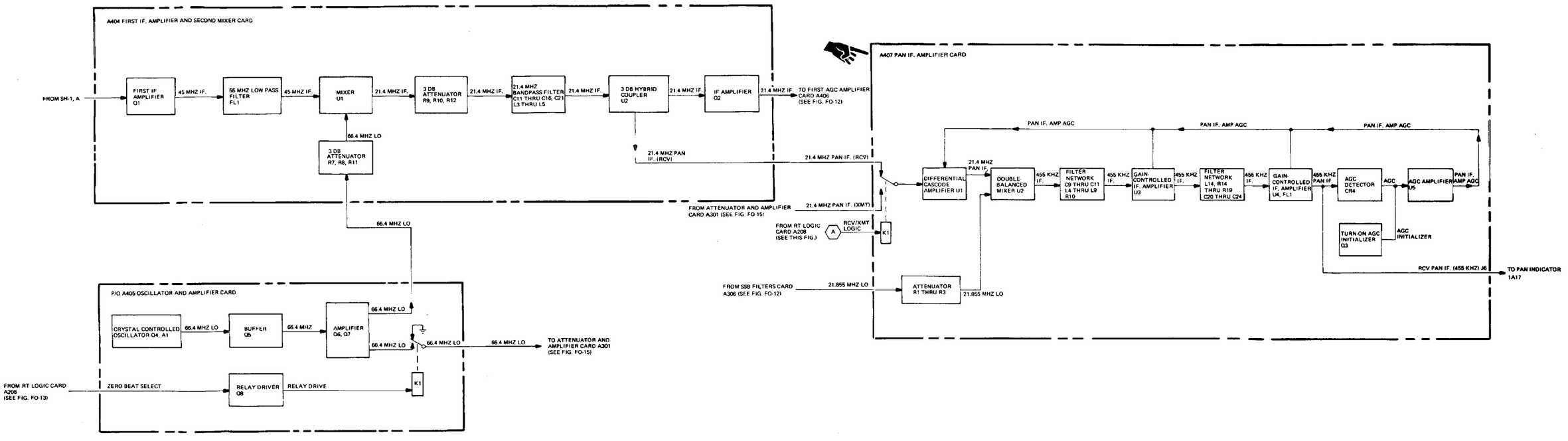


Figure FO-10. Rt unit, overall block diagram.



EL 5895-372-24-TM-13-(1)-C1

Figure FO-11 (1). Receiver rf section, block diagram (sheet 1 of 2).



EL 5895-372-24-TM-13-(2)-C1

Figure FO-11 (2). Receiver rf section, block diagram (sheet 2 of 2).

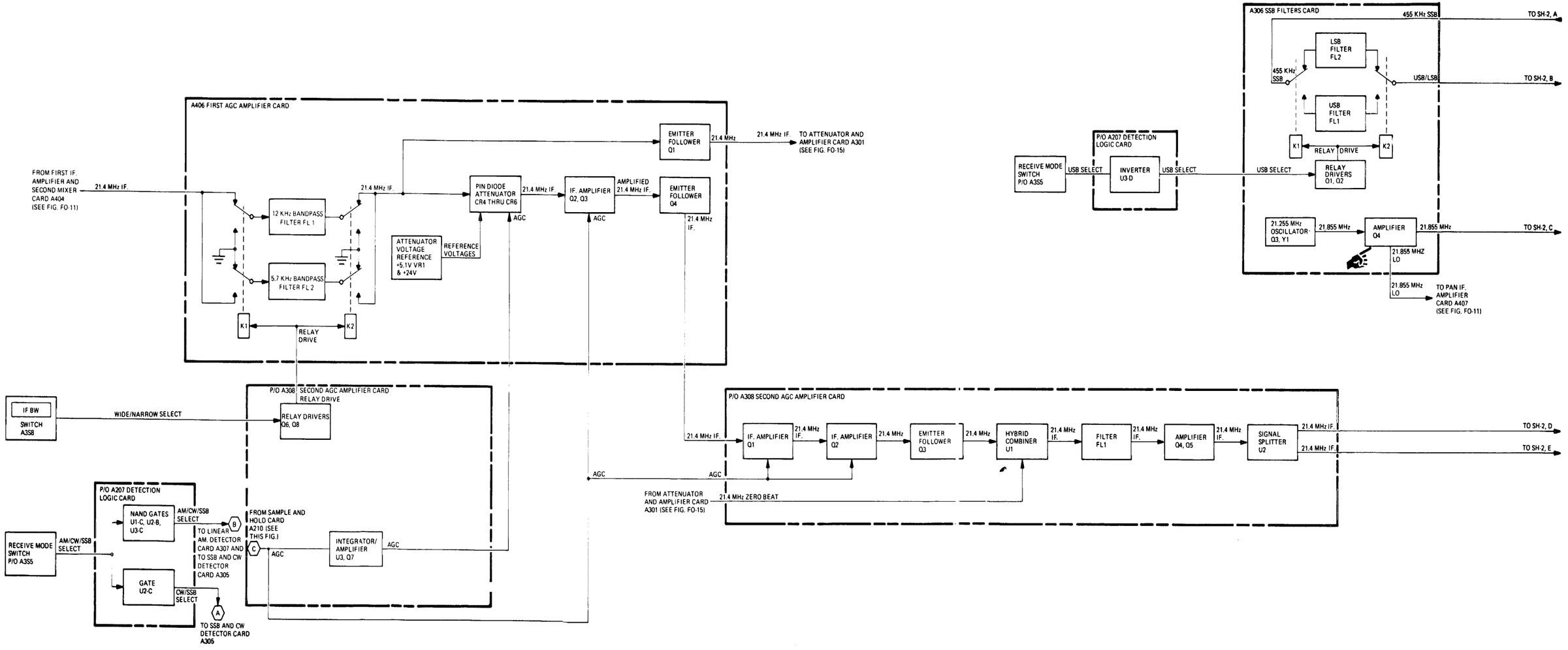


Figure FO-12(1). Detection and audio section, block diagram (sheet 1 of 2).

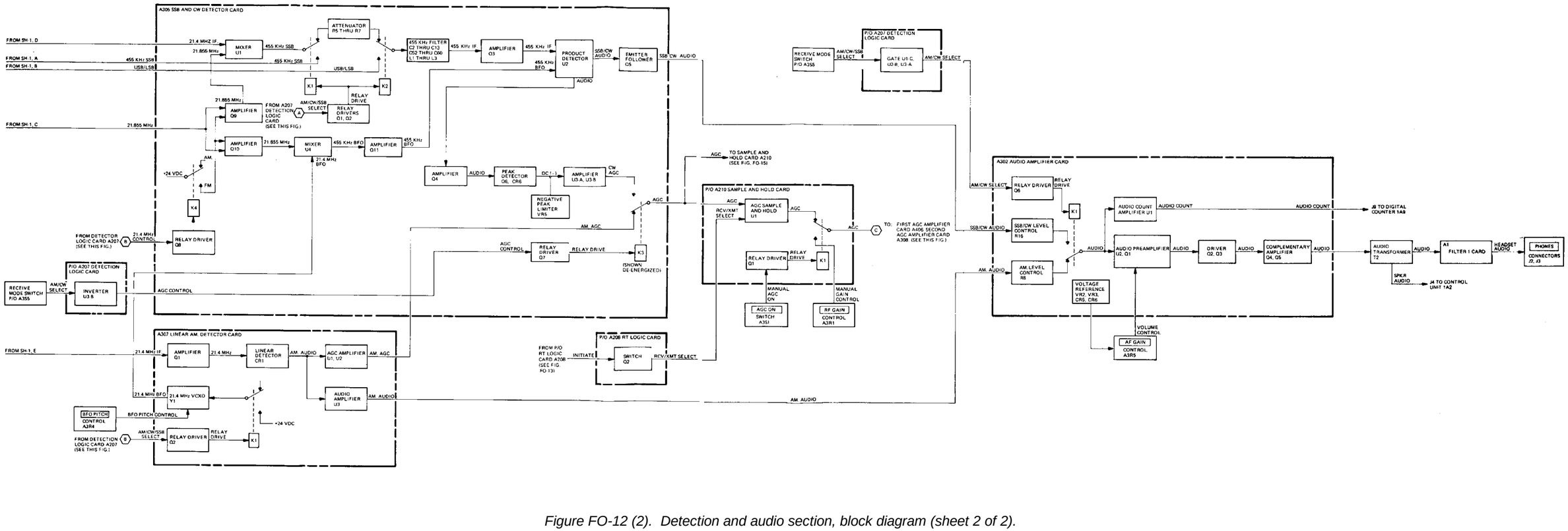


Figure FO-12 (2). Detection and audio section, block diagram (sheet 2 of 2).

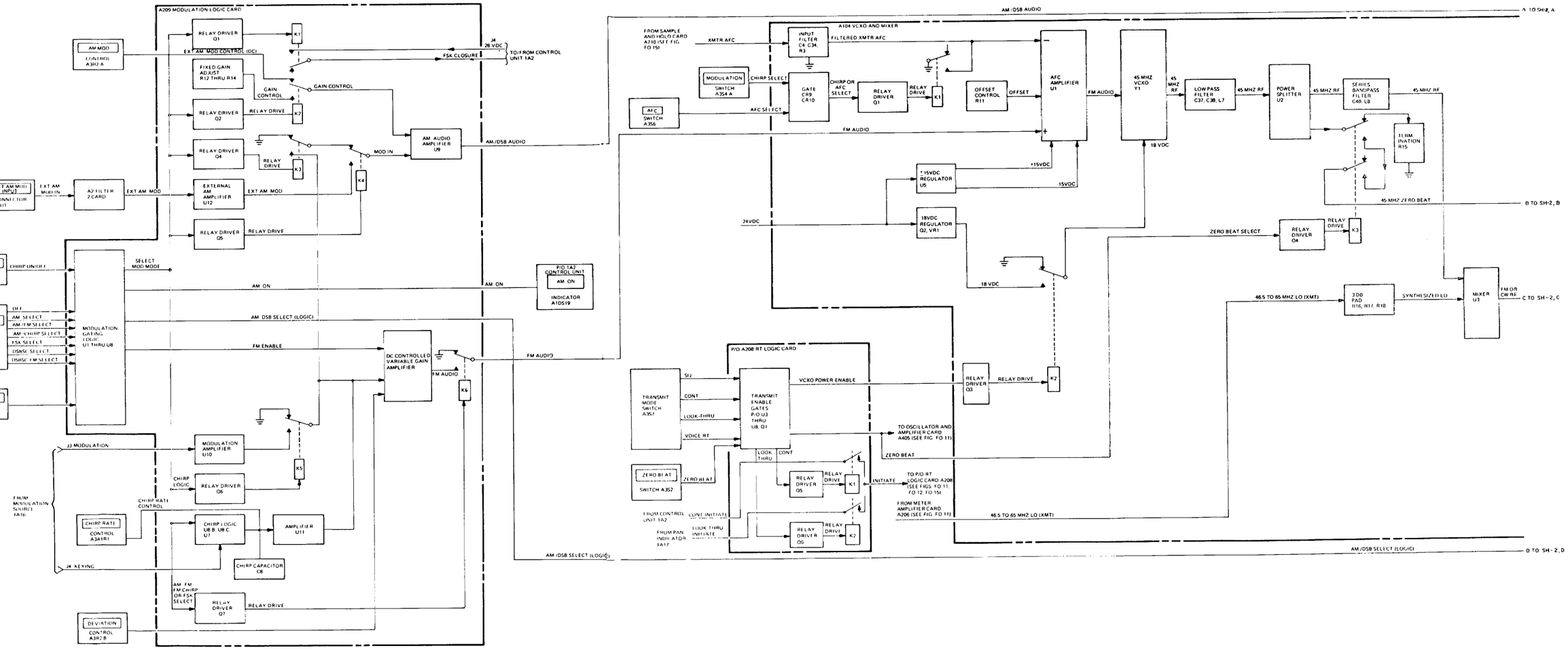


Figure FO-13 (1). Transmitter section, block diagram (sheet 1 of 2).

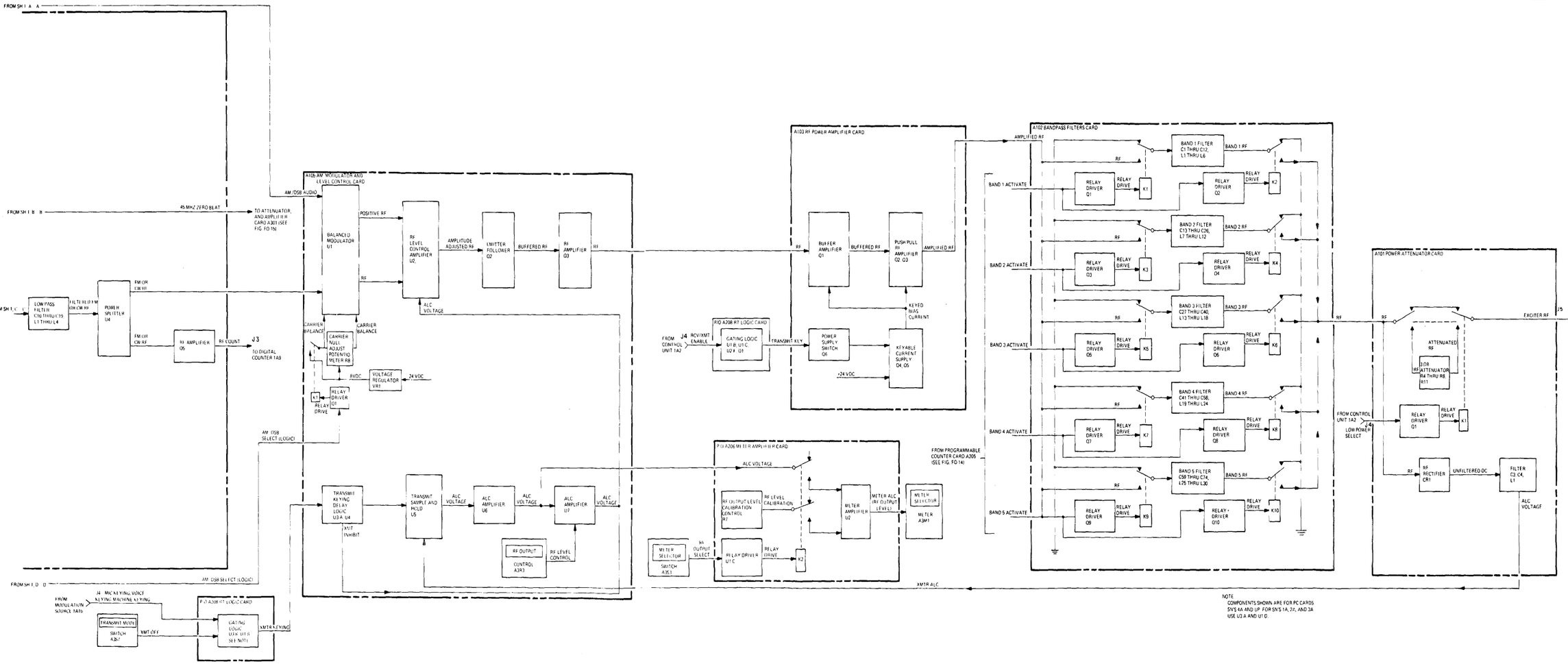
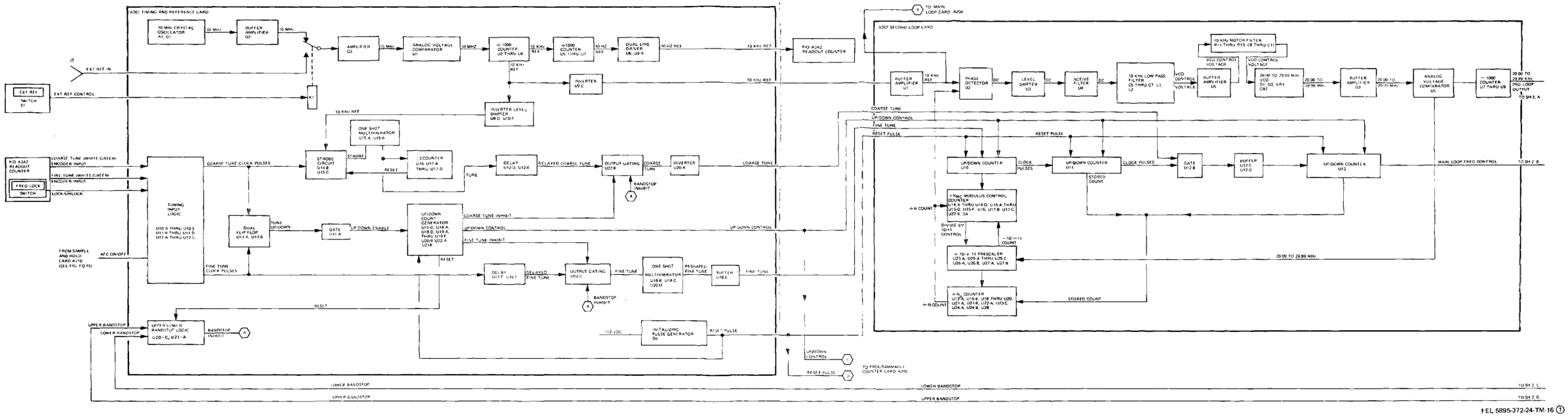


Figure FO-13 (2). Transmitter section, block diagram (sheet 2 of 2).



EL 5895-372-24-TM-16 (1)

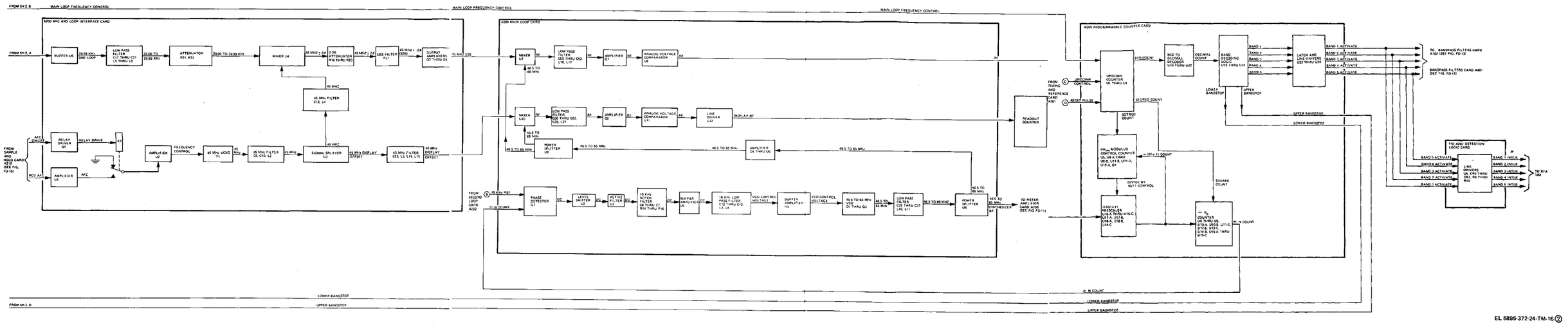


Figure FO-14(2). P11 Frequency synthesizer section, block diagram (sheet 2 of 2).

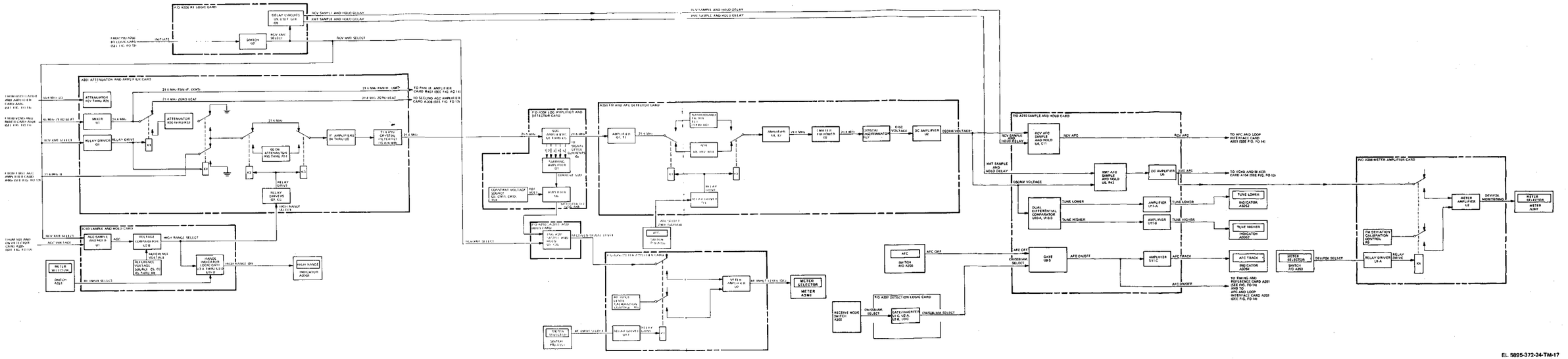


Figure FO-15. Afc section, block diagram.

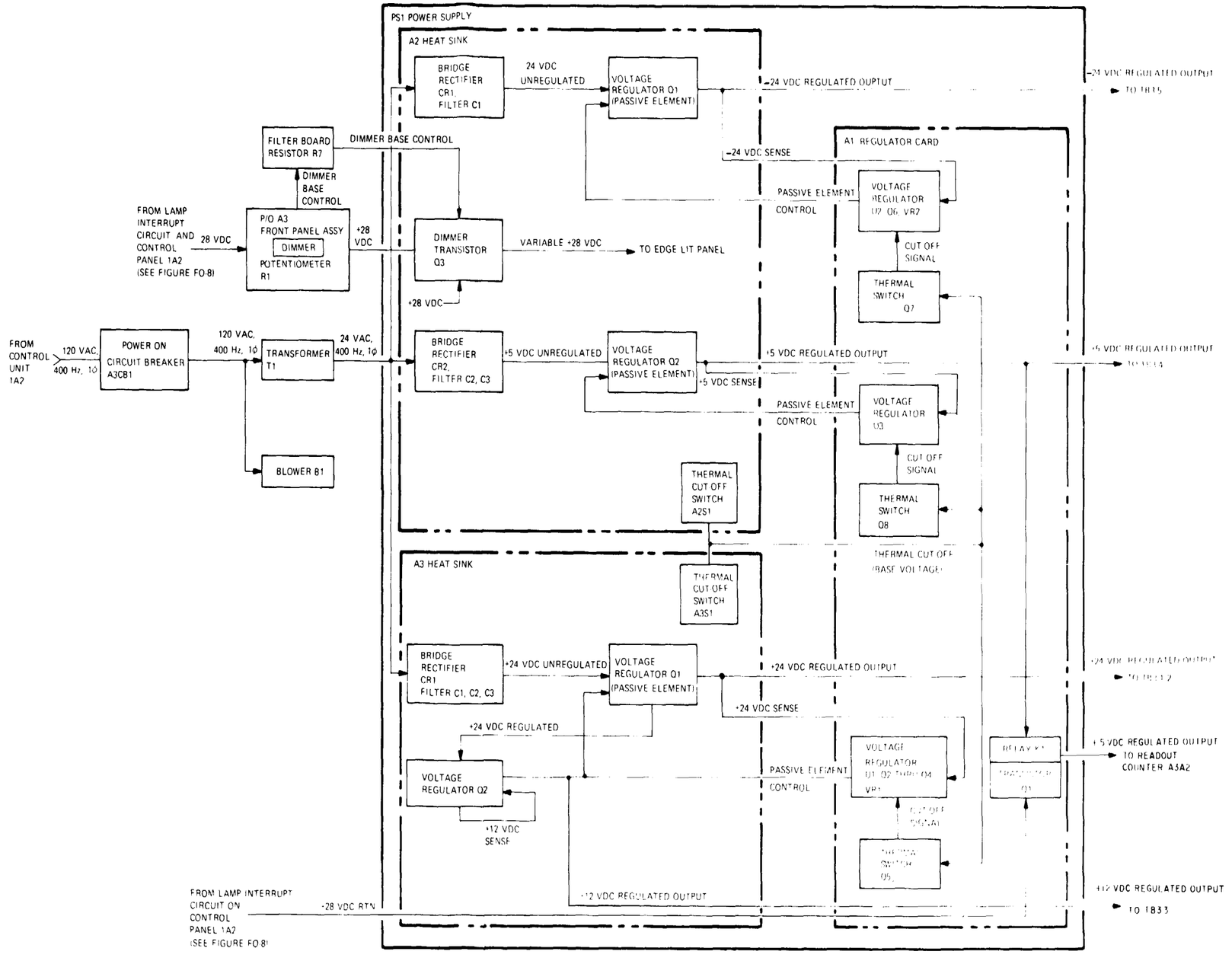


Figure FO-16. Power supply section, block diagram.

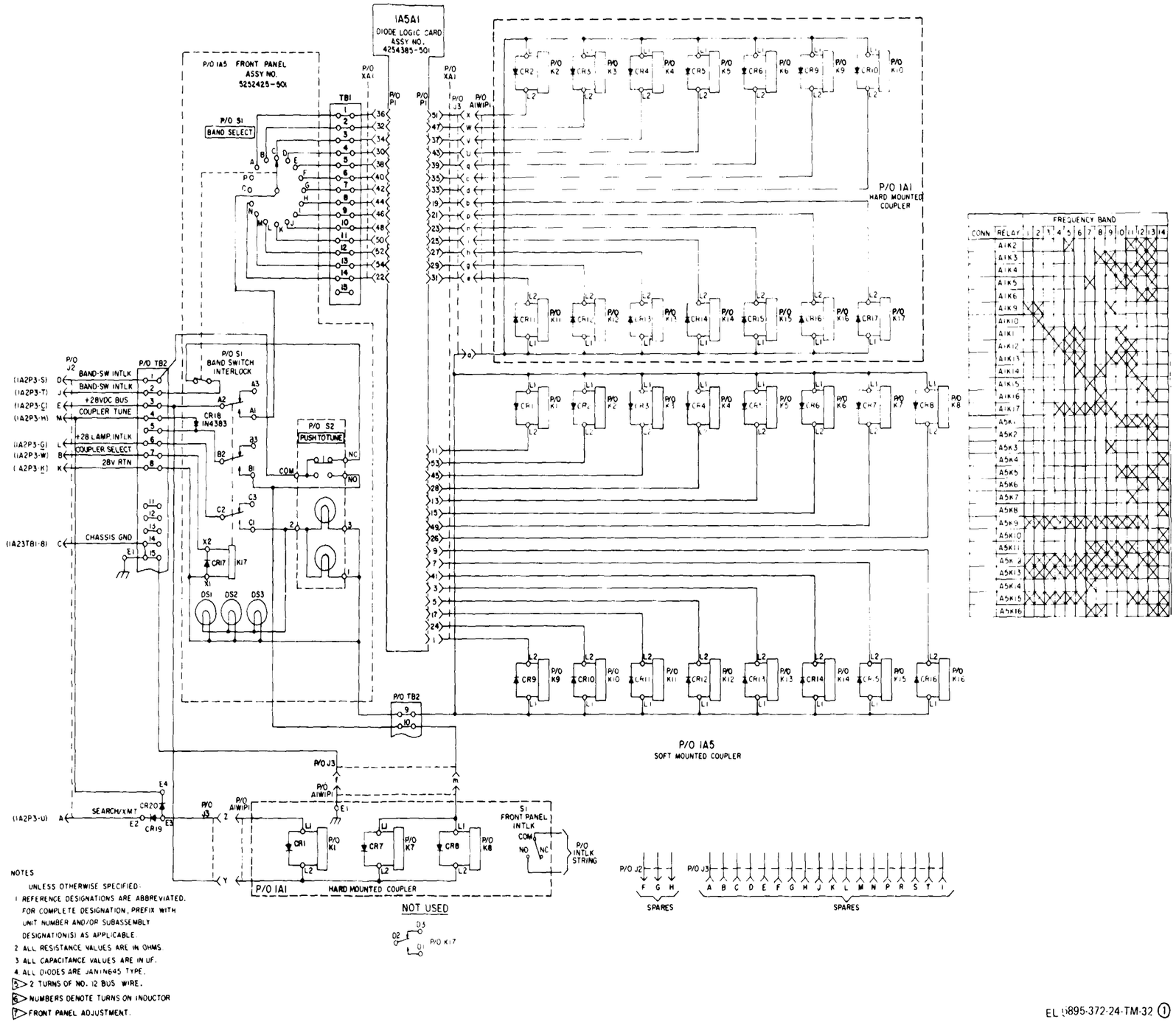


Figure FO-17(1). Hard mounted coupler 1A1/soft mounted coupler 1A5, schematic diagram (sheet 1 of 2).

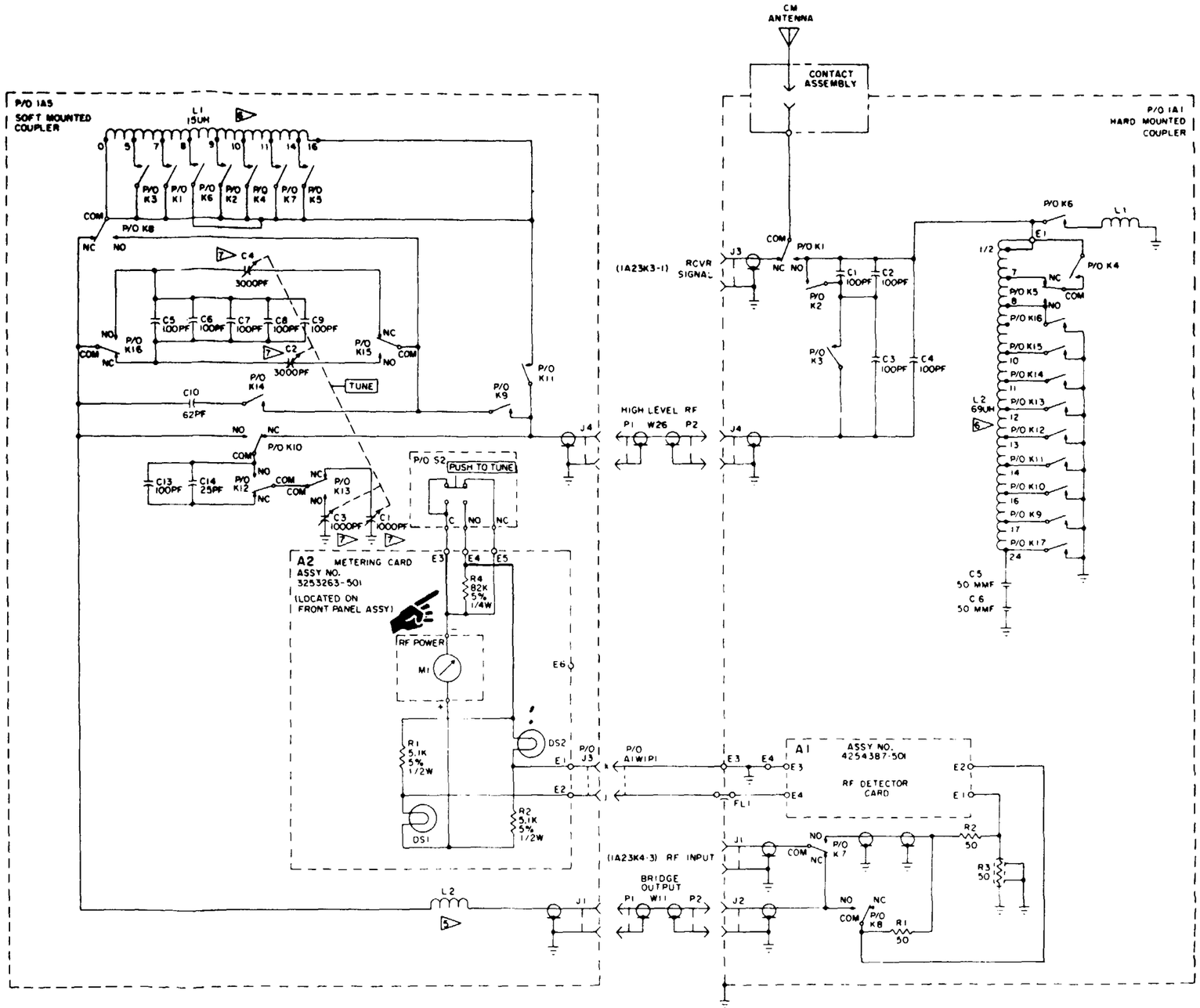


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Figure FO-17(2). Hard mounted coupler 1A1/soft mounted coupler 1A5, schematic diagram (sheet 2 of 2).

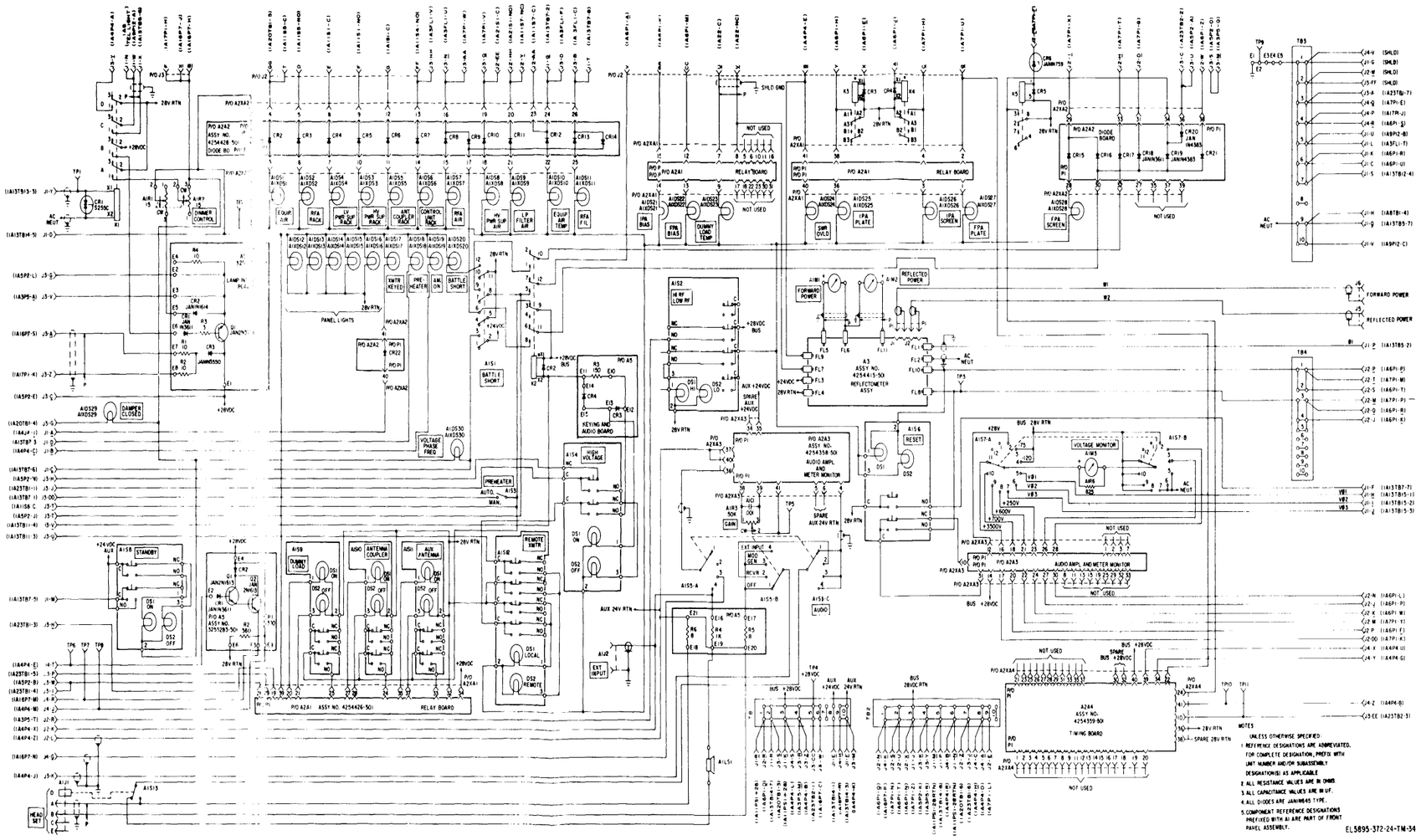

Figure FO-19. Control unit 1A2, schematic diagram.

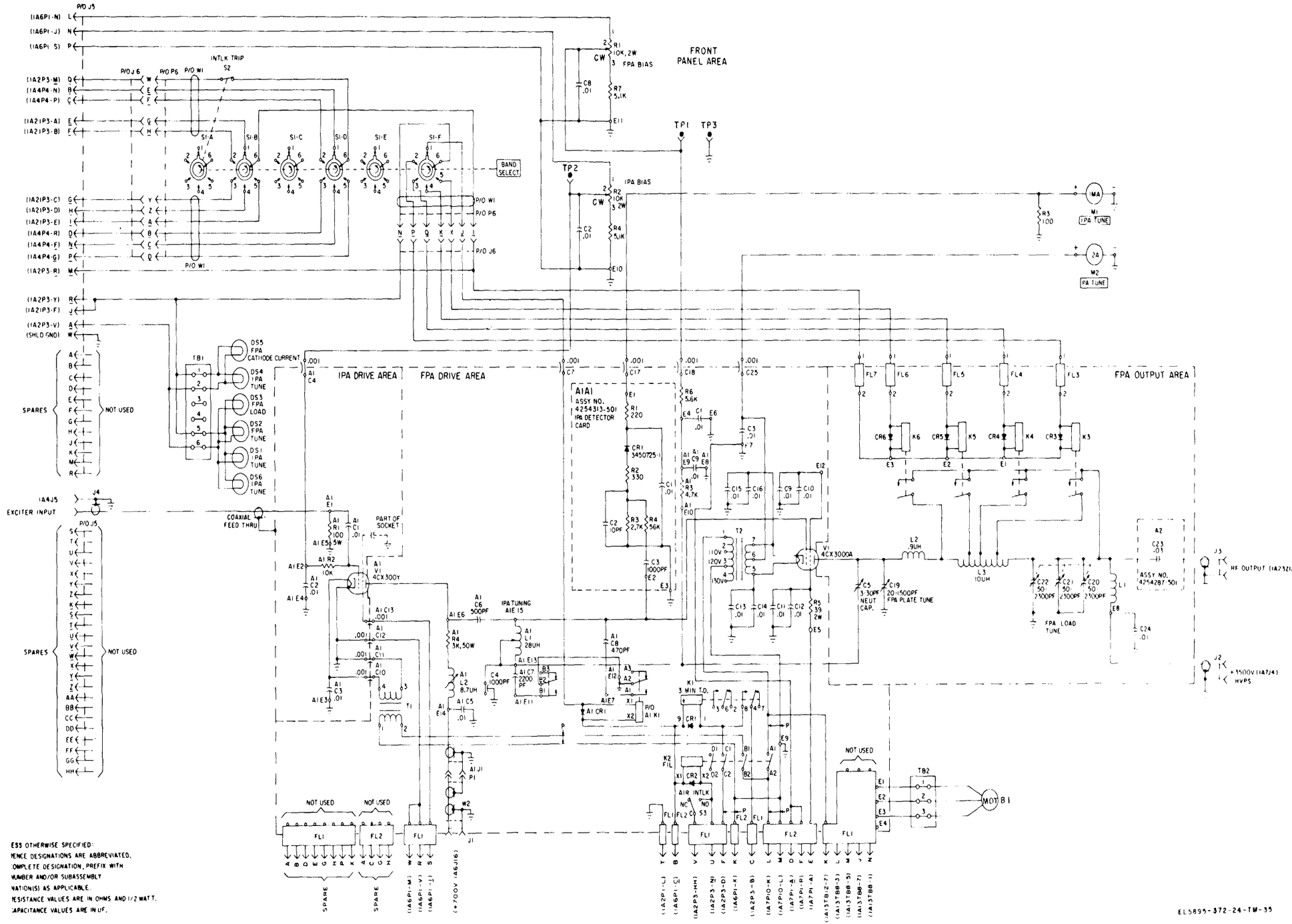

Figure FO-20. Rfa 1A3, schematic diagram.

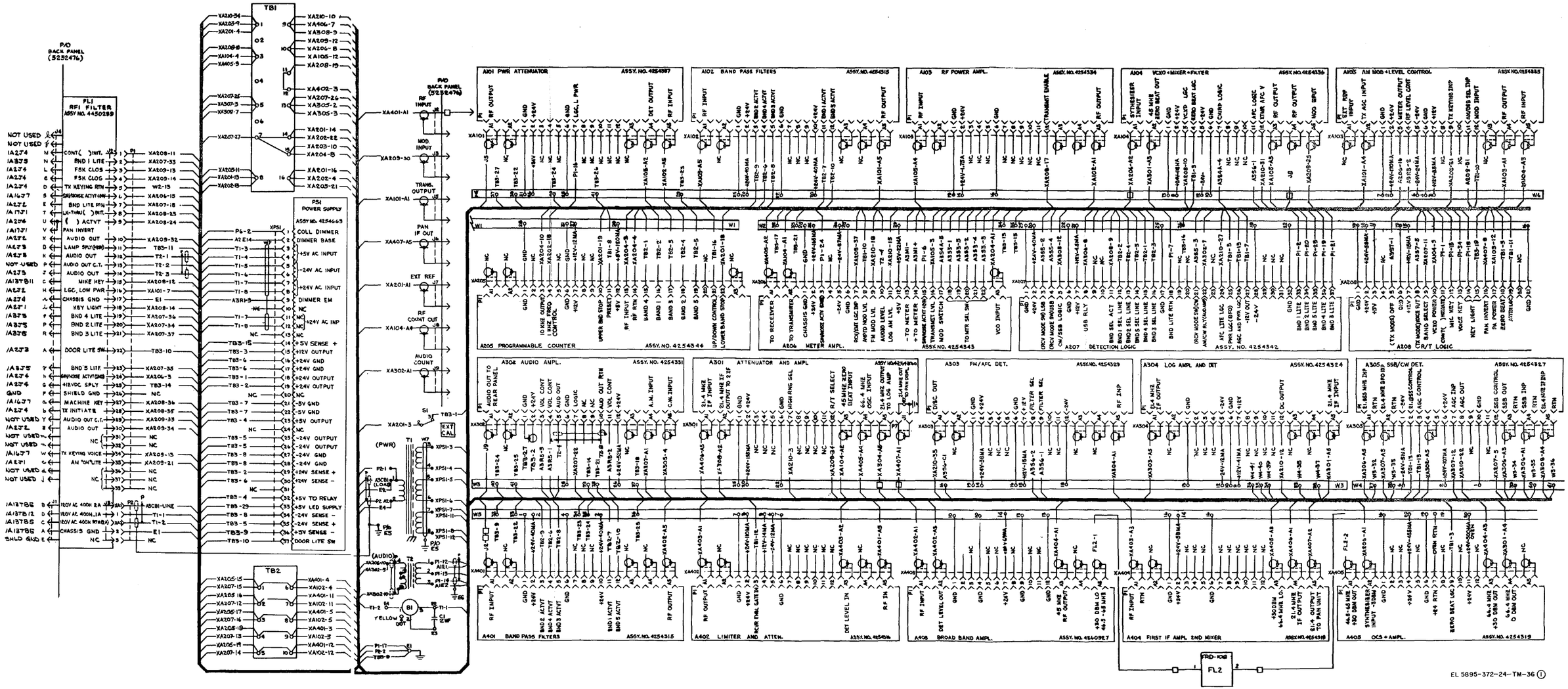

Figure FO-21(1). Rf unit 1A4, interconnection diagram (sheet 1 of 2).

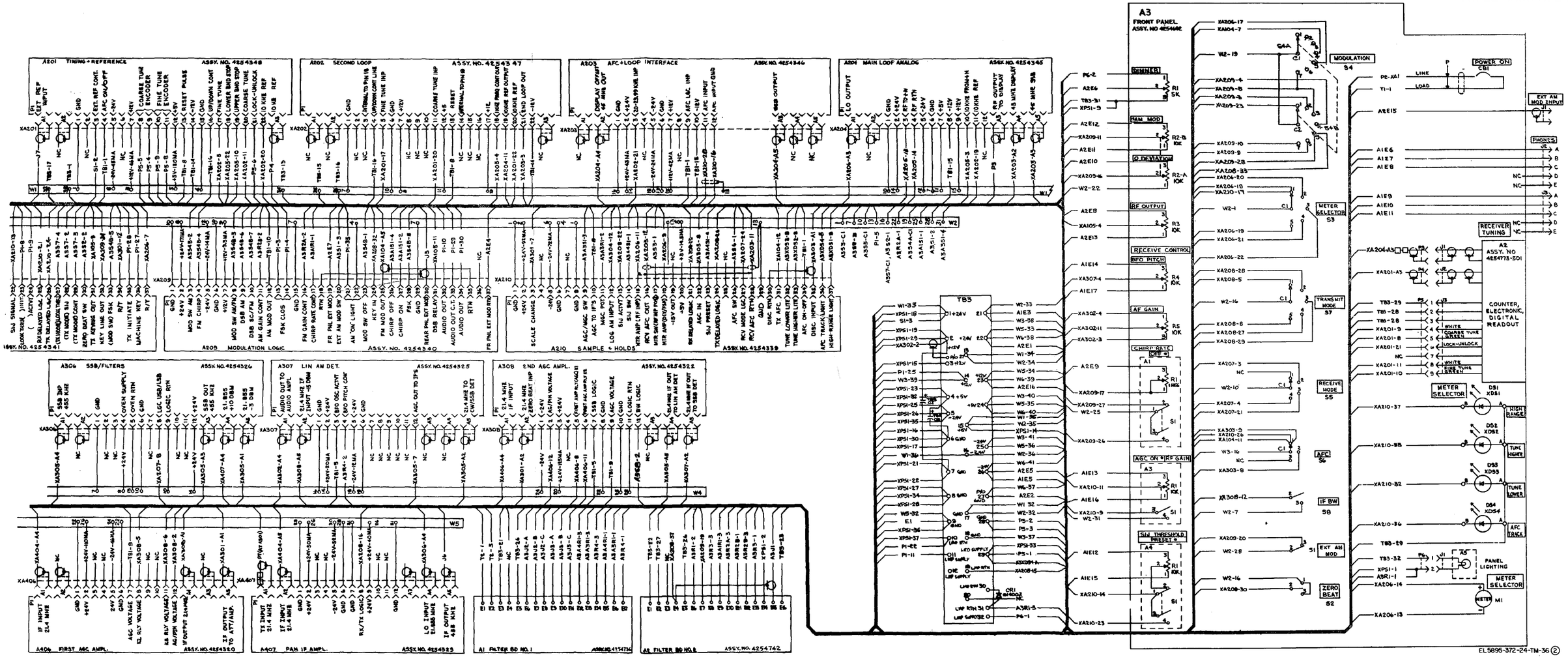

Figure FO-21(2). Rf unit 1A4, interconnection diagram (sheet 1 of 2).

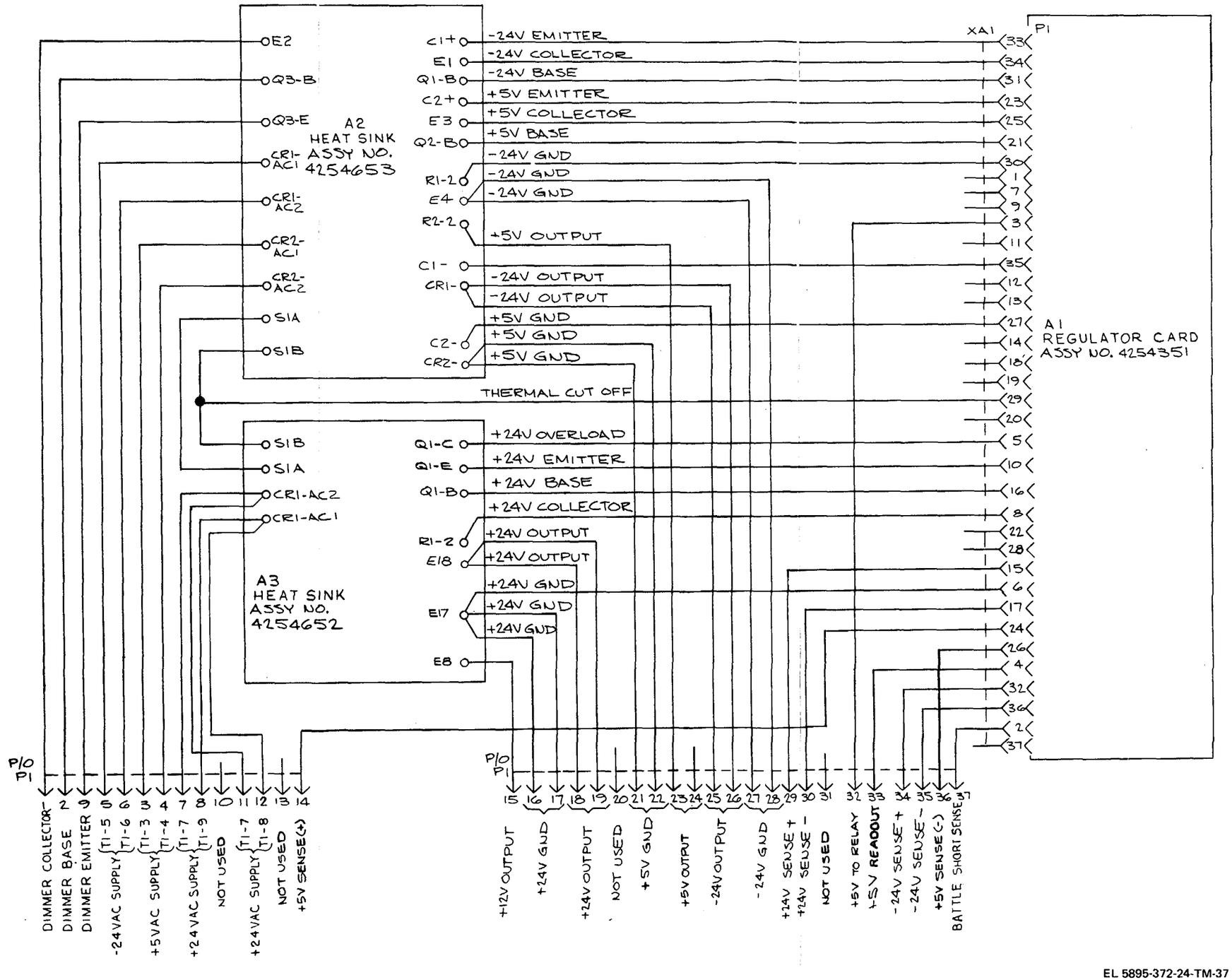

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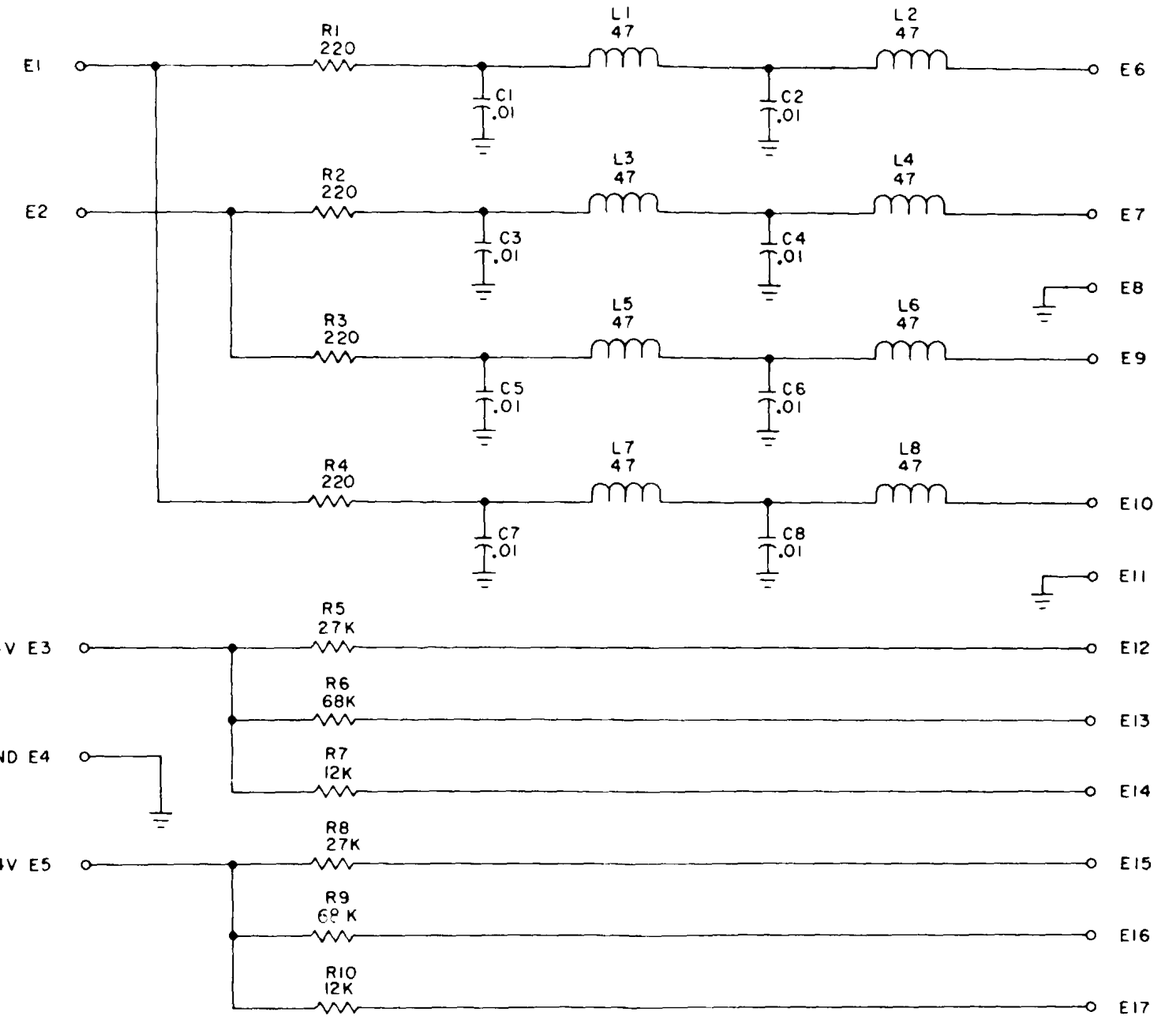
Figure FO-22. Rf unit power supply 1A4PS1, interconnection diagram.

COMPONENT REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C 8	
E17	
L8	
R10	



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL CAPACITANCE VALUES ARE IN UF.
4. ALL INDUCTANCE VALUES ARE IN UH.

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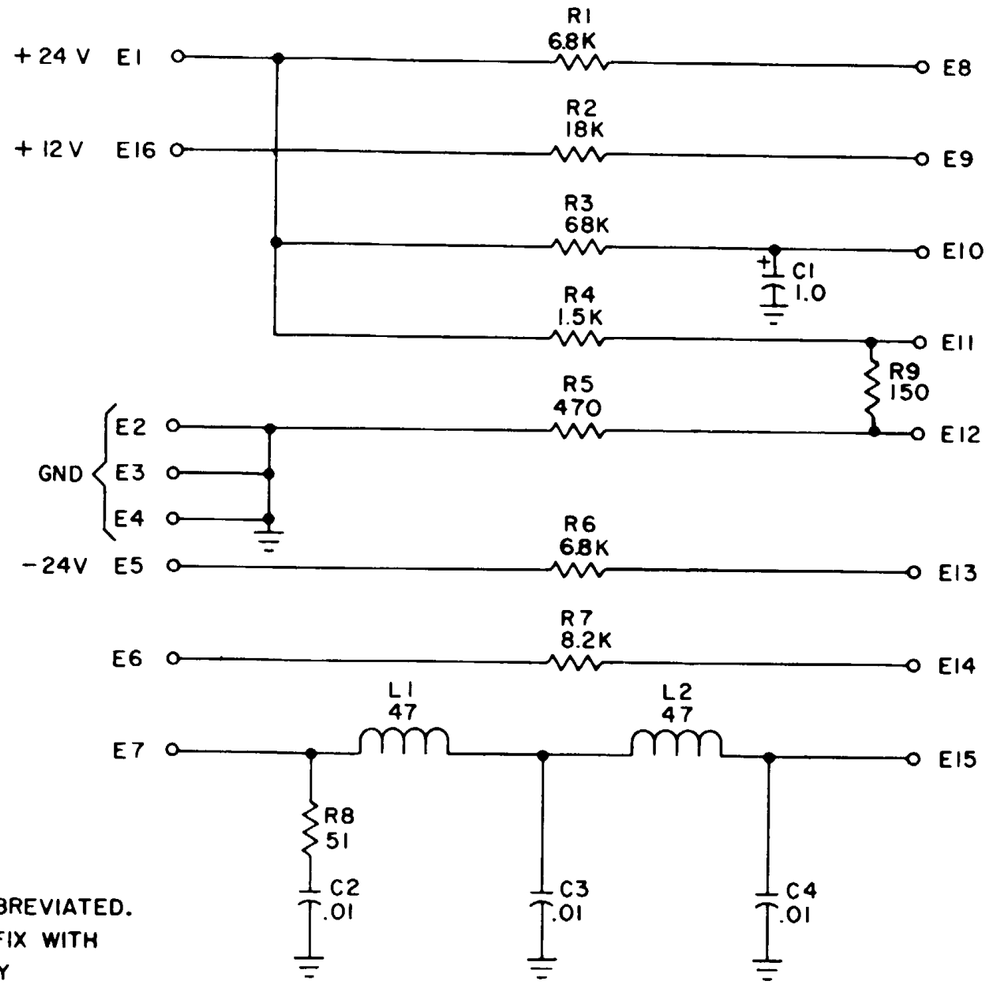
Figure FO-23. Filter 1 card 1A4A1, schematic diagram.

COMPONENT REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C4	
E16	
L2	
R9	



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL CAPACITANCE VALUES ARE IN UF.
4. ALL INDUCTANCE VALUES ARE IN UH.

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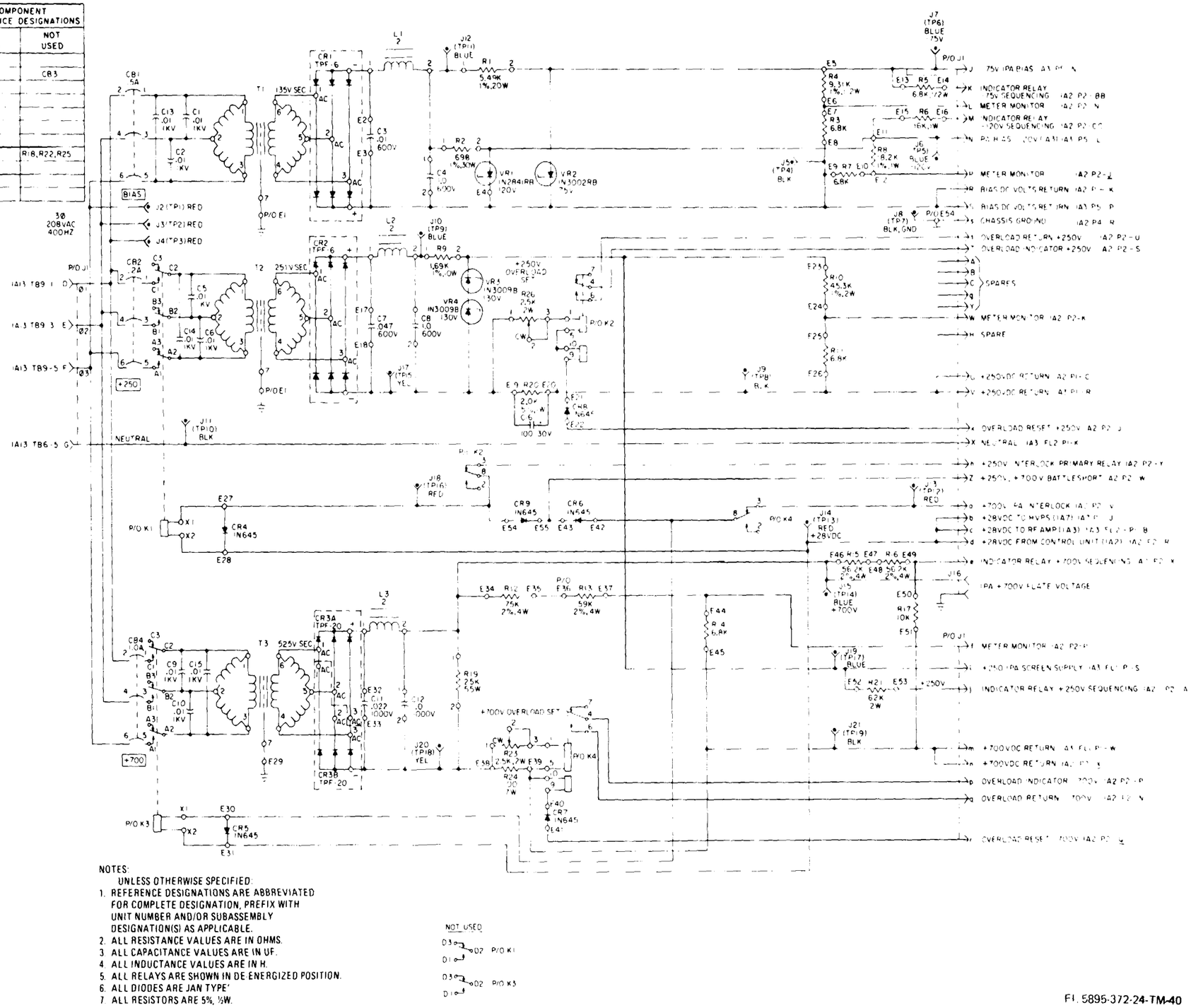
Figure FO-24. Filter 2 card 1A4A2, schematic diagram.

COMPONENT REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C16	
CB4	CB3
CR8	
E55	
J21	
K4	
L3	
R26	R18,R22,R25
T1	
TP19	
VR4	



NOTES:
UNLESS OTHERWISE SPECIFIED:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL CAPACITANCE VALUES ARE IN UF.
4. ALL INDUCTANCE VALUES ARE IN H.
5. ALL RELAYS ARE SHOWN IN DE-ENERGIZED POSITION.
6. ALL DIODES ARE JAN TYPE'
7. ALL RESISTORS ARE 5%, ½W.

FI. 5895-372-24-TM-40

Figure FO-25. Lvps 1A6, schematic diagram.

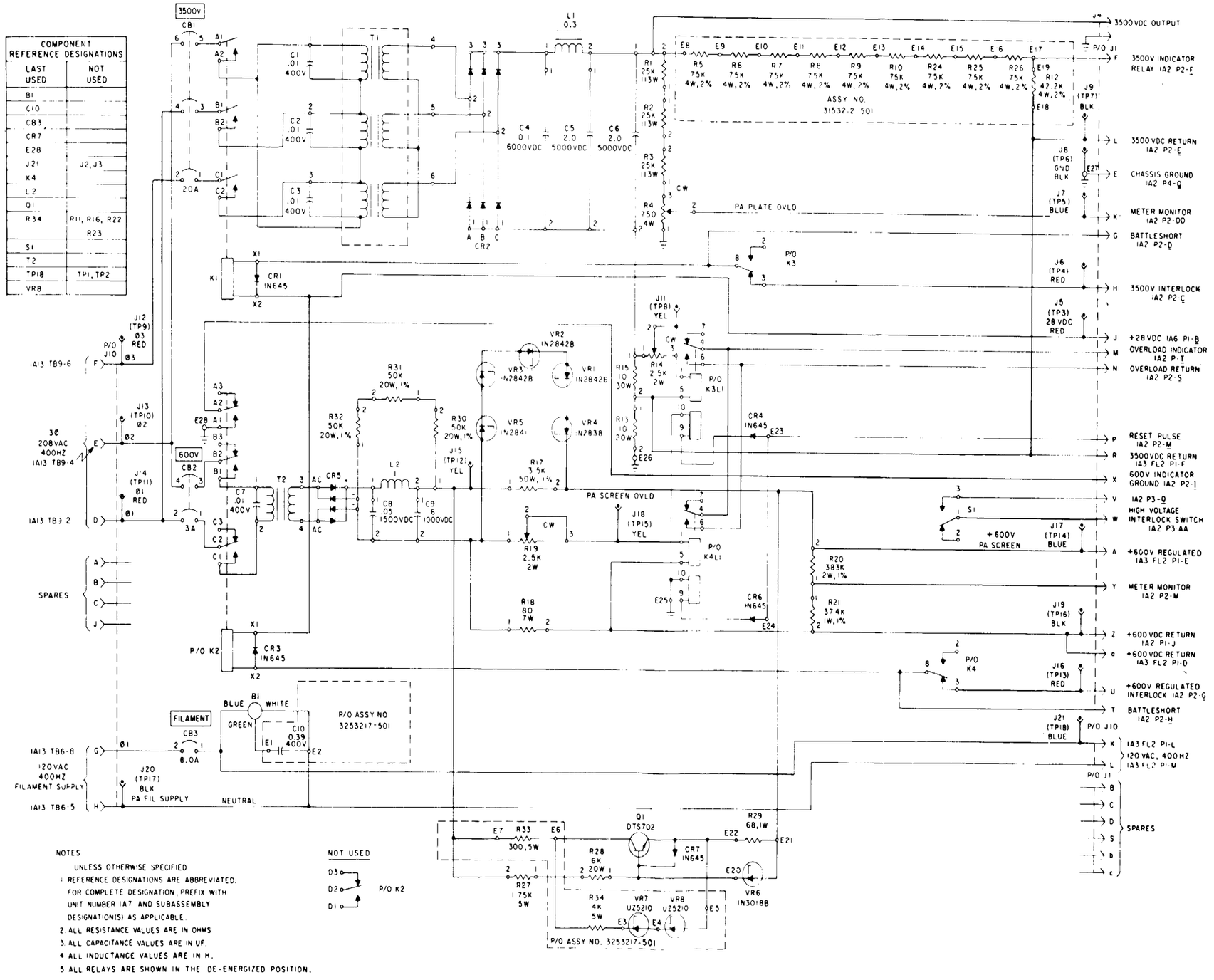
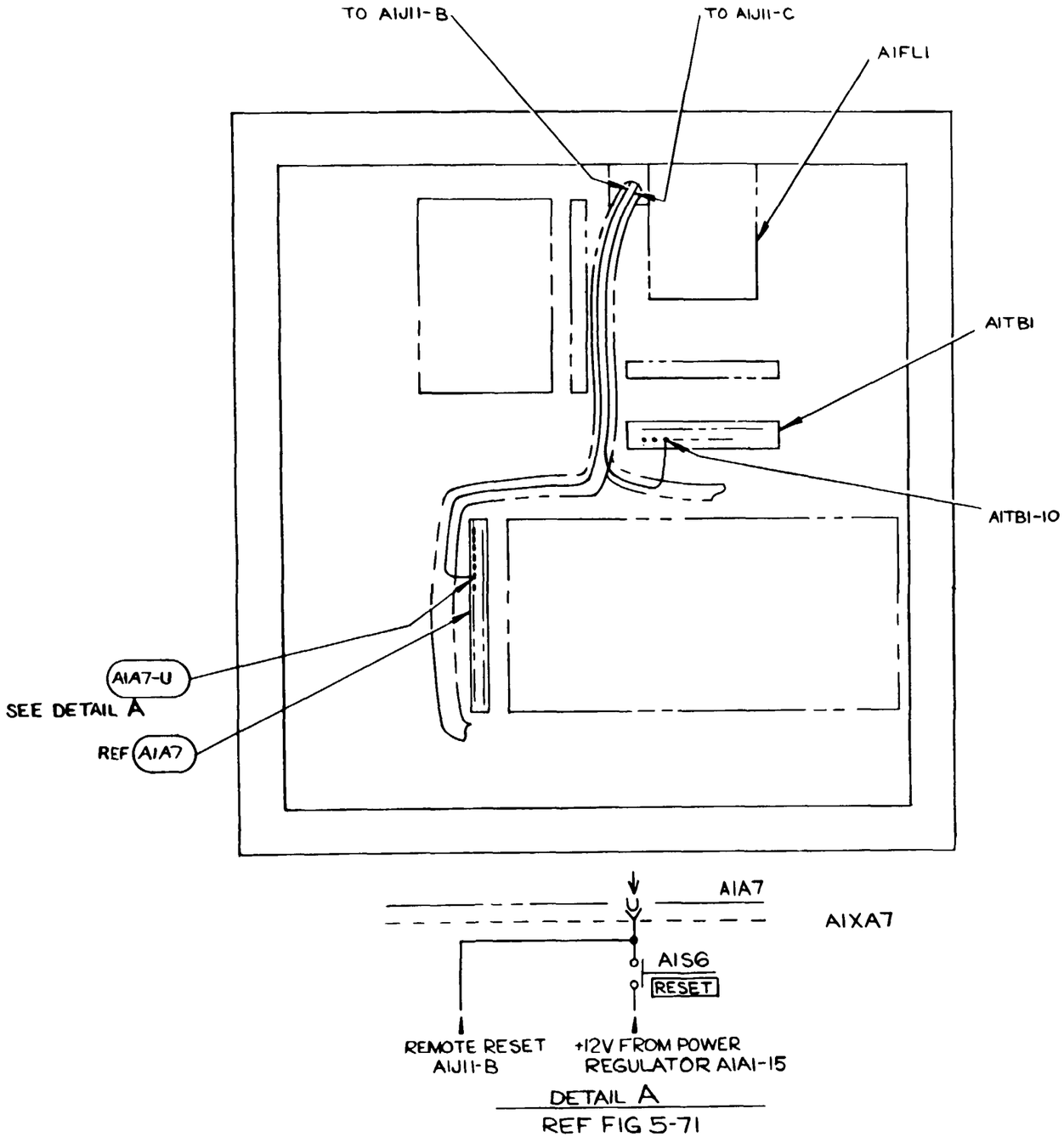


Figure FO-26. Hvps 1A7, schematic diagram.



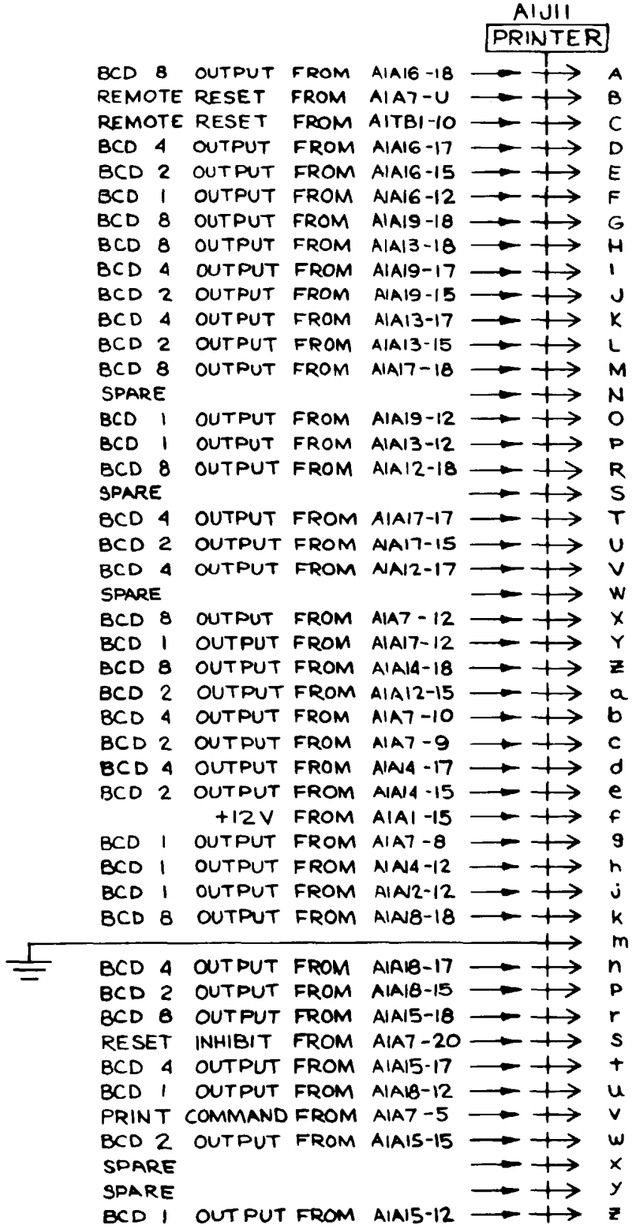


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Figure FO-27. Digital counter 1A9, modification diagram.

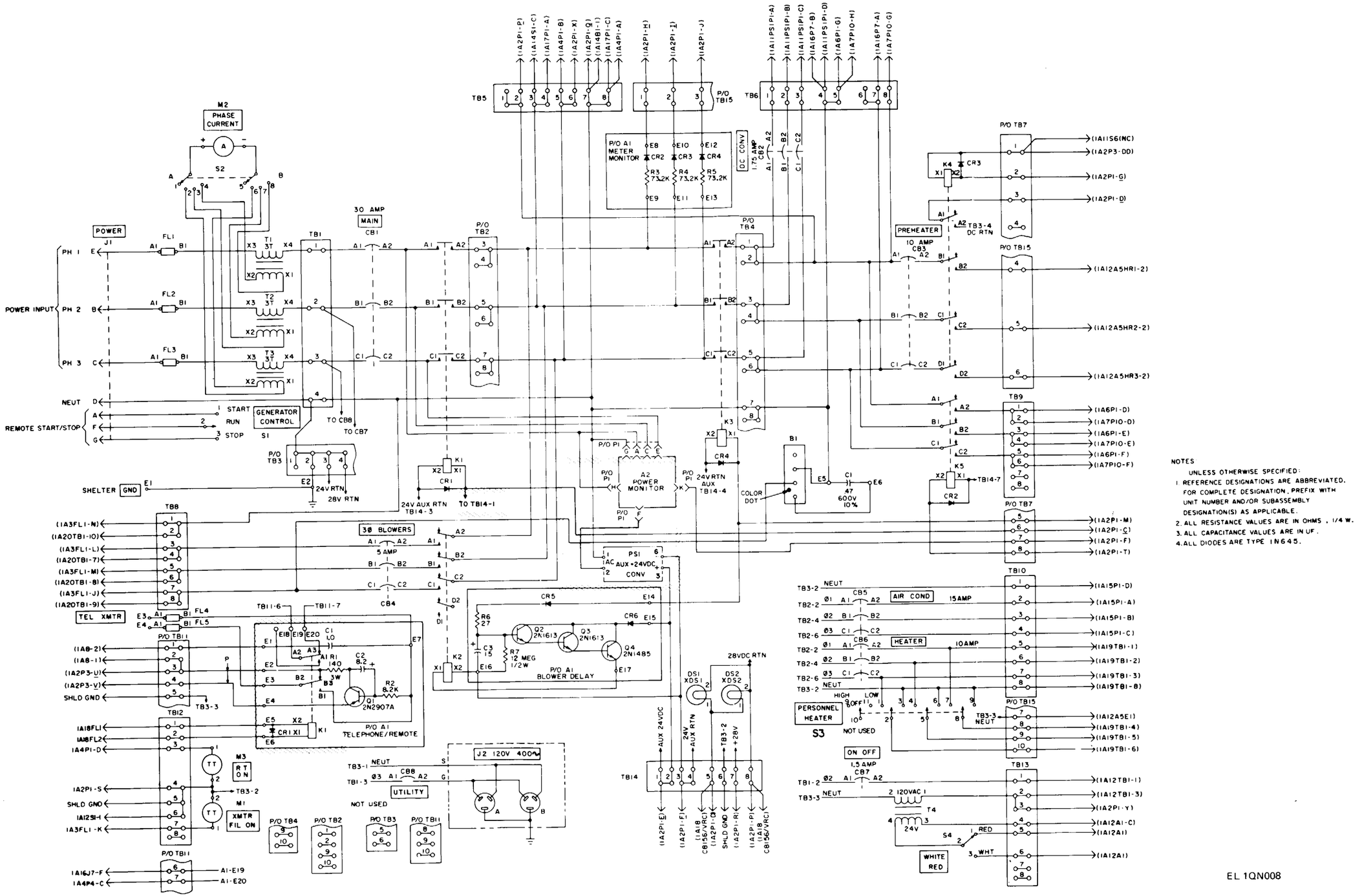
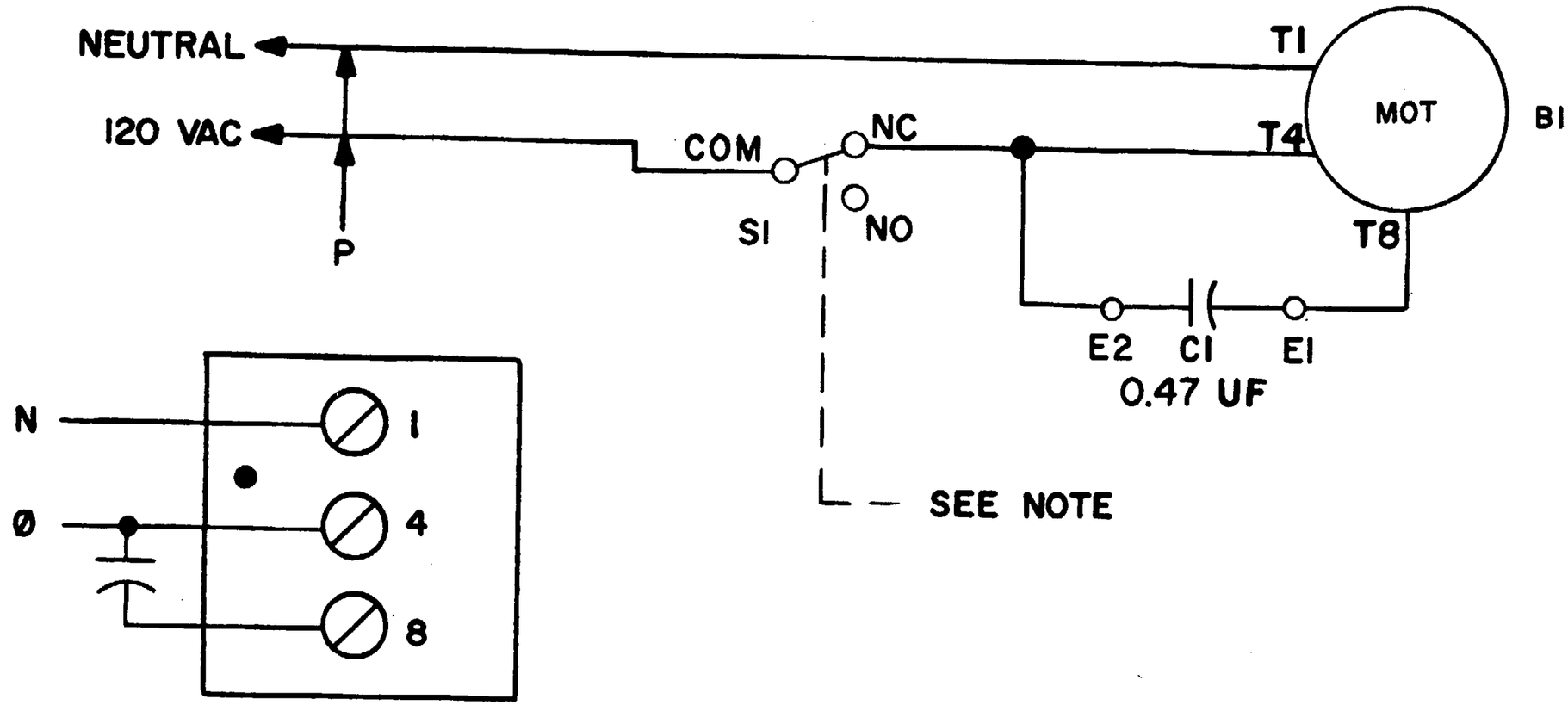


Figure FO-28. Power Distribution Box 1A13, Schematic diagram.

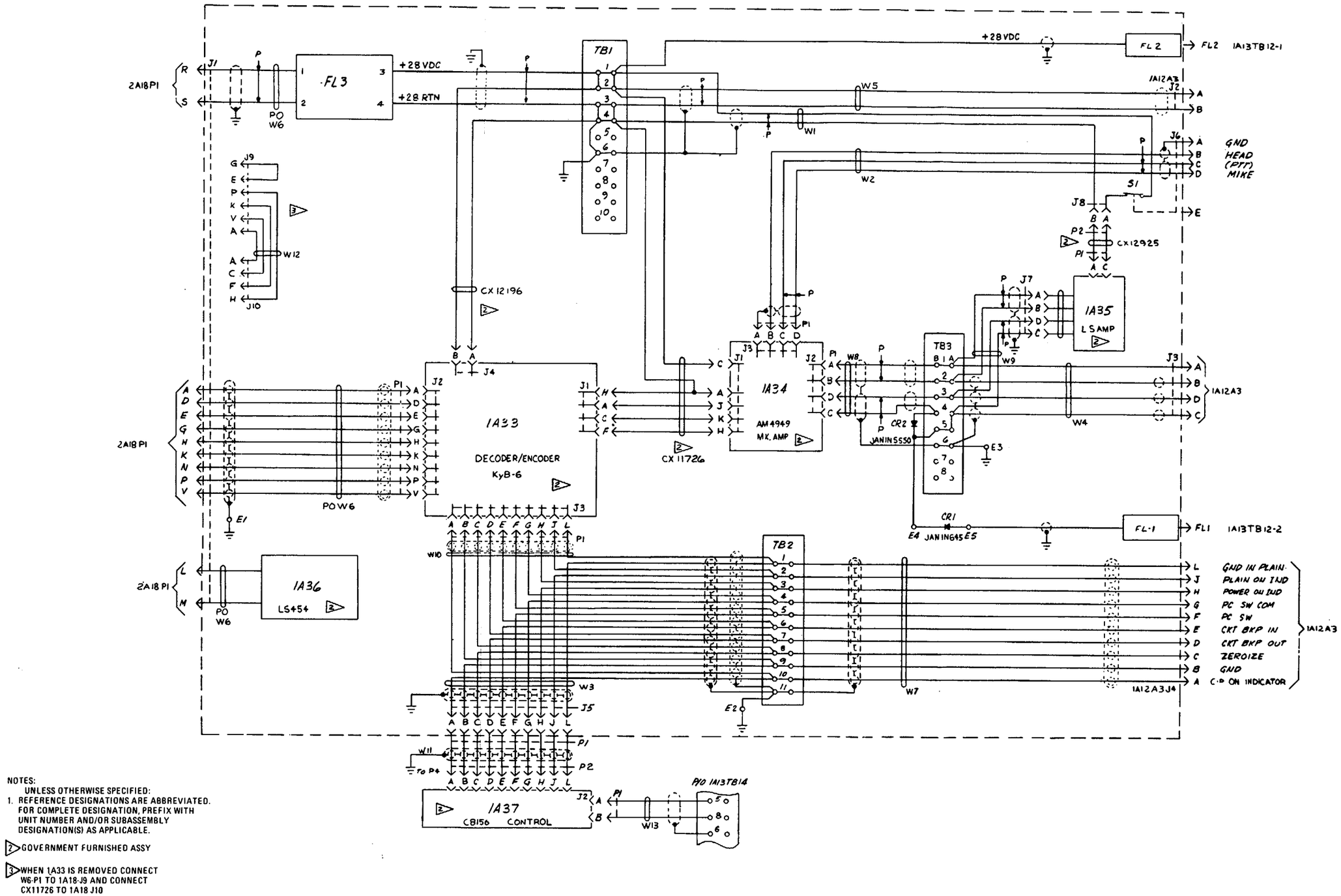


NOTES:

SWITCH SI ACTUATED BY EXHAUST FAN COVER, SWITCH SHOWN WITH COVER IN OPEN POSITION.

EL 5895-372-24-TM-44

Figure FO-29. Personnel fan 1A14, schematic diagram.

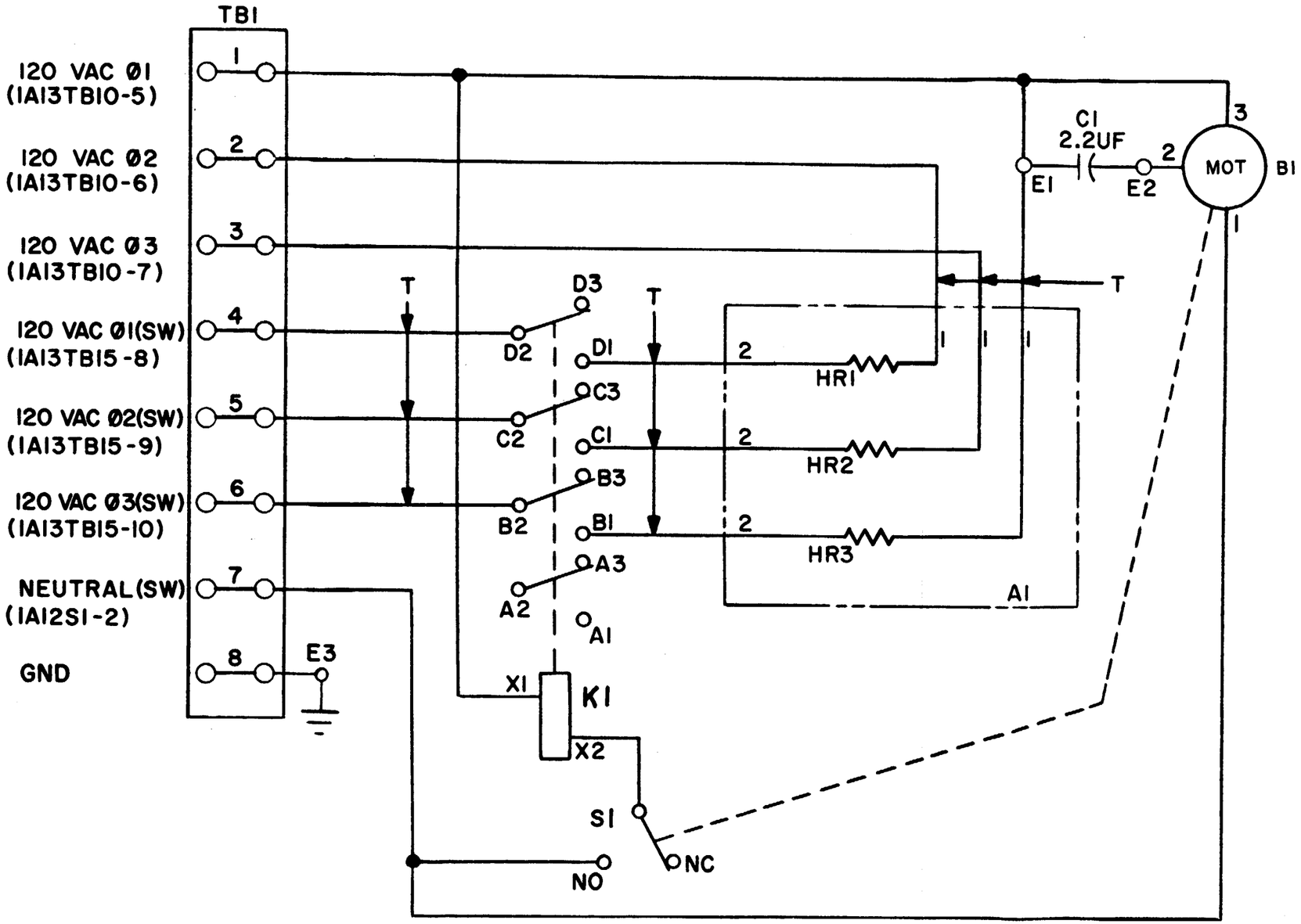


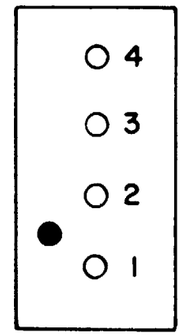
NOTES:
UNLESS OTHERWISE SPECIFIED:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.

[2] GOVERNMENT FURNISHED ASSY

[3] WHEN 1A33 IS REMOVED CONNECT W6-P1 TO 1A18-J9 AND CONNECT CX11726 TO 1A18 J10

Figure FO-30. T-sec enclosure 1A18, interconnection diagram.

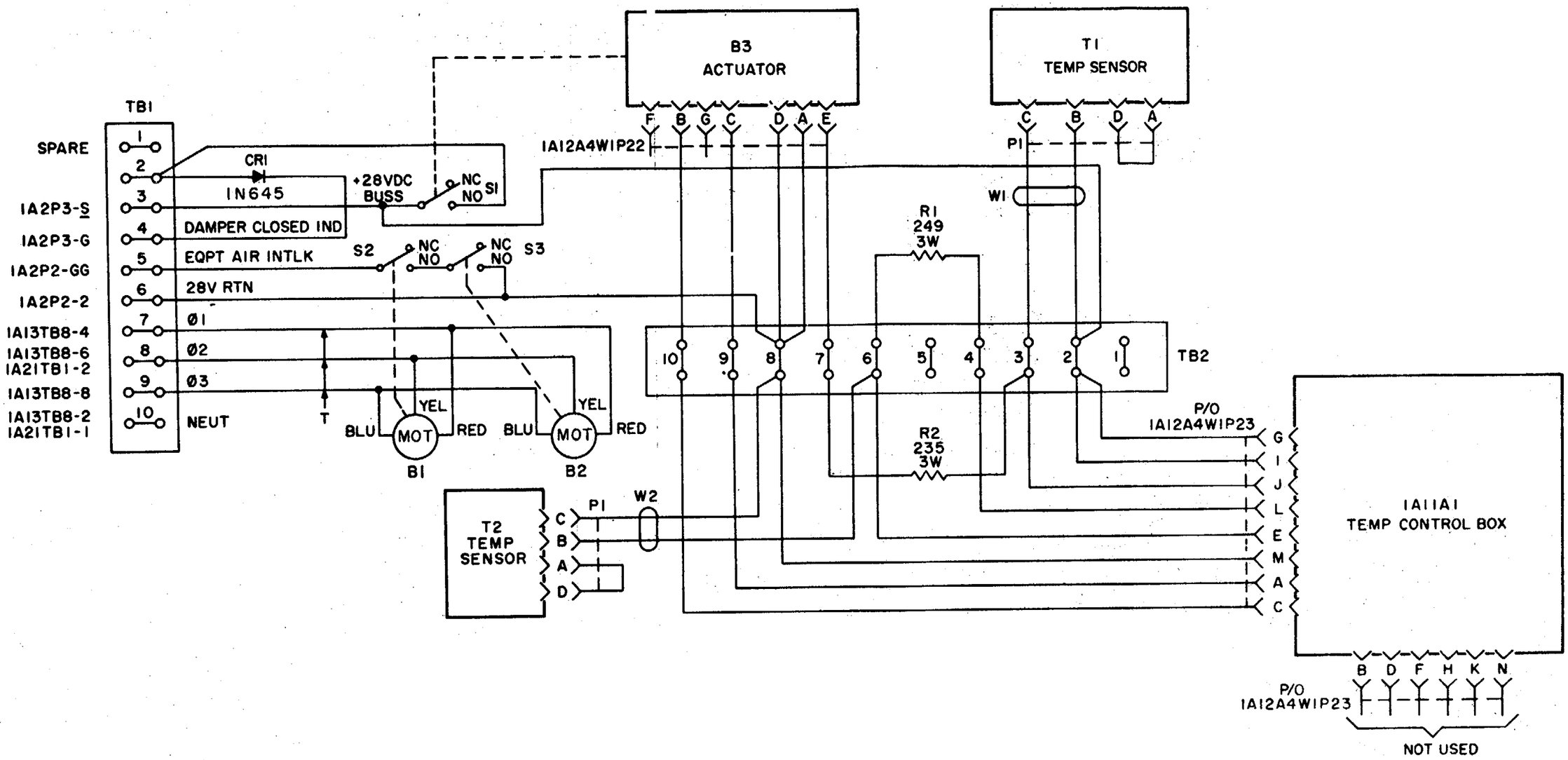




BLOWER TERMINALS

EL 5895-372-24-TM-46

Figure FO-31. Personnel heater 1A19, schematic diagram.



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL CAPACITANCE VALUES ARE IN UF.

EL 5895-372-24-TM-17

Figure FO-32. Exhaust assembly 1A20, schematic diagram.

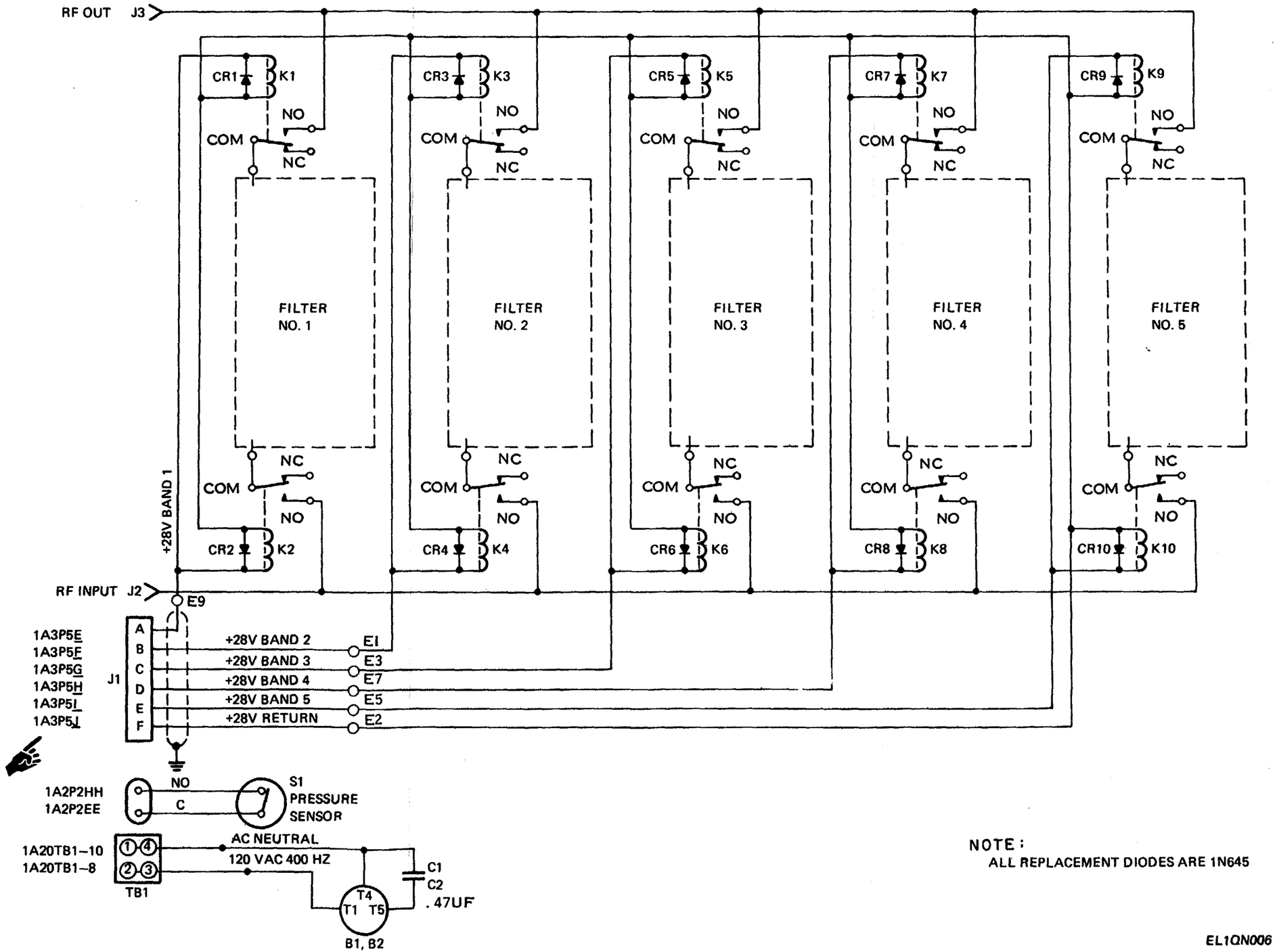
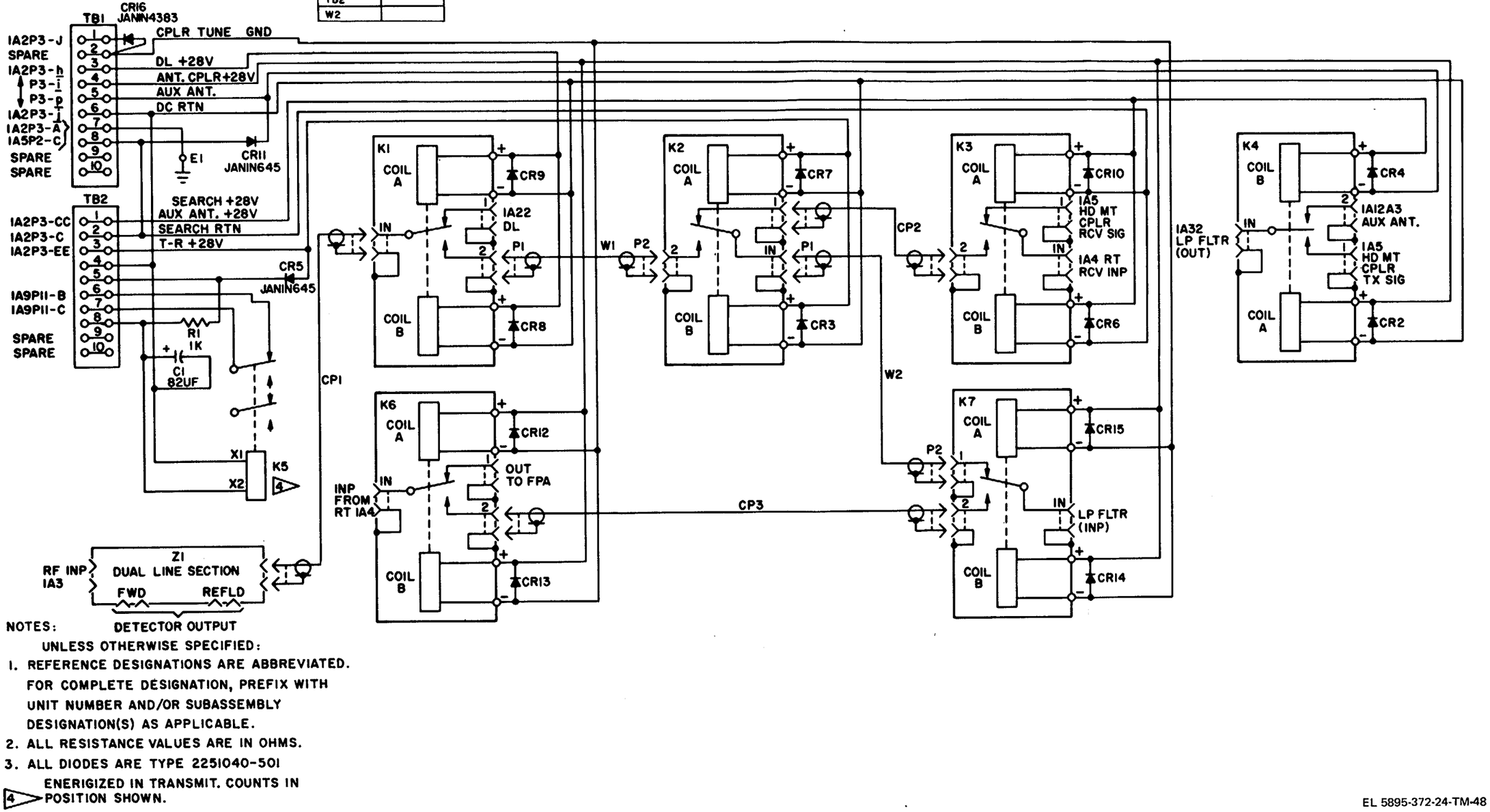


Figure FO-32.1. Low pass filter 1A21, schematic diagram.

COMPONENT REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C1	
CP3	
CR16	CR1
E1	
K7	
R1	
TB2	
W2	



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL DIODES ARE TYPE 2251040-501

4 ENERGIZED IN TRANSMIT. COUNTS IN POSITION SHOWN.

EL 5895-372-24-TM-48

Figure FO-33. Rf panel 1A23, schematic diagram.

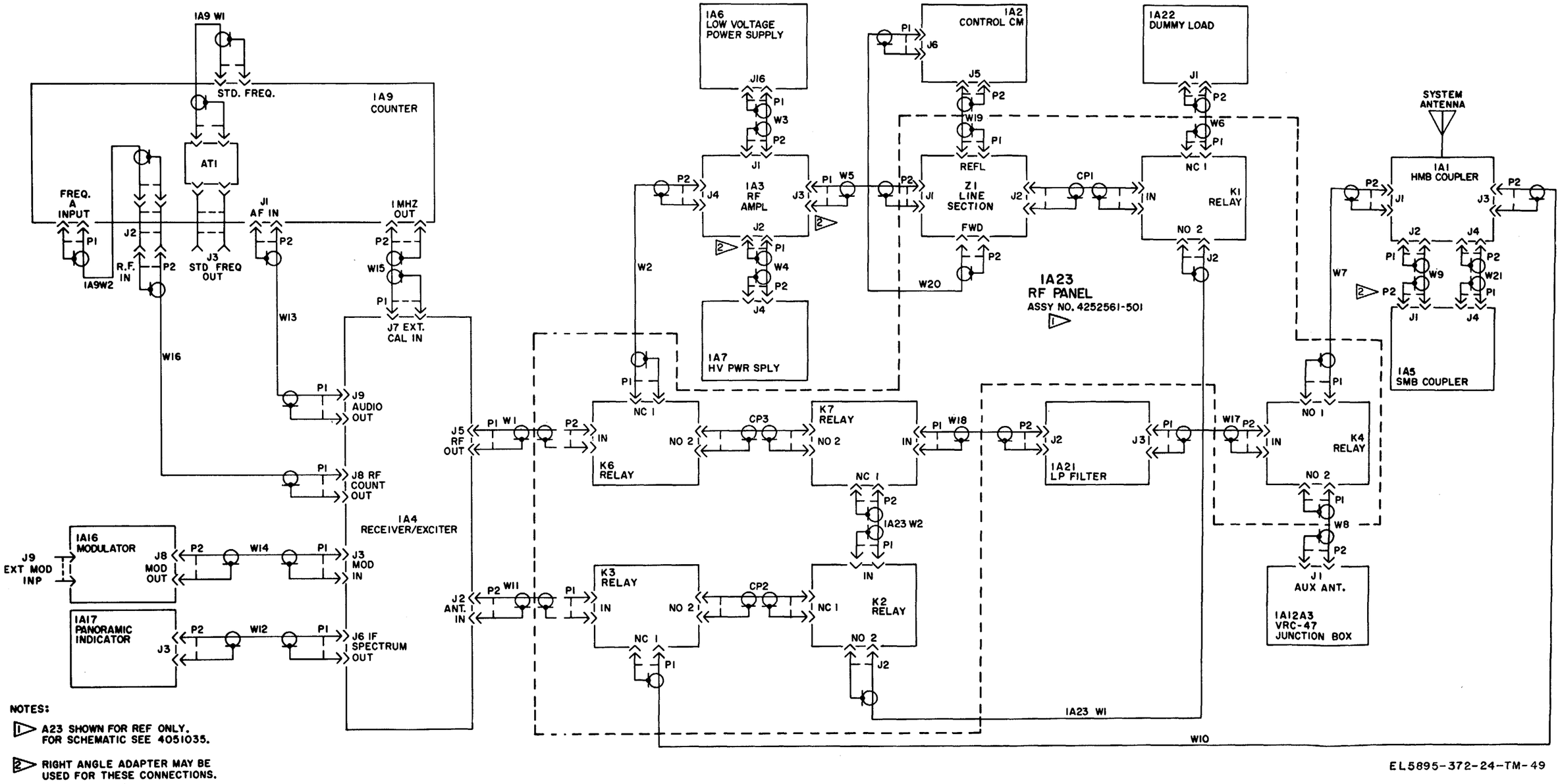
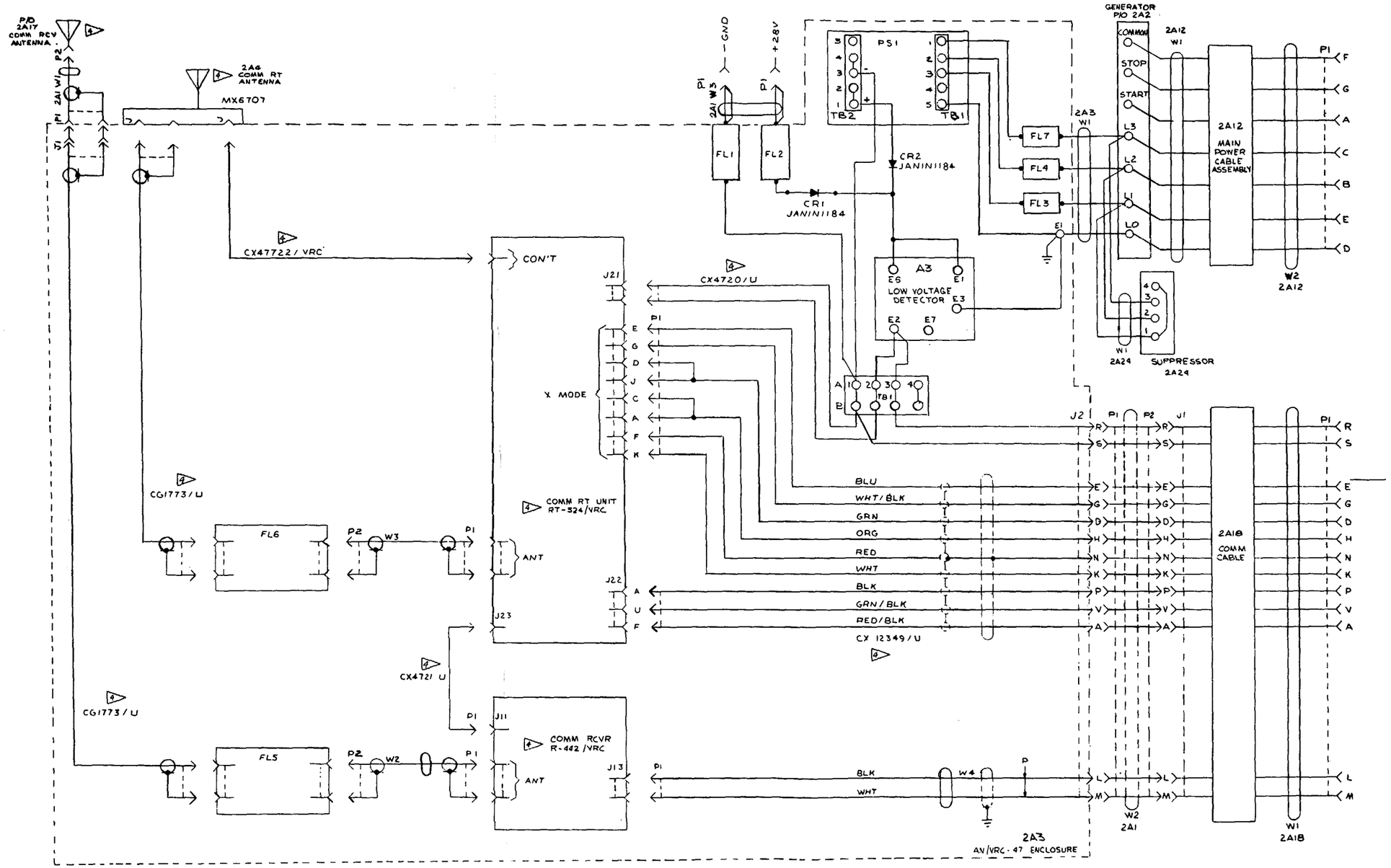


Figure FO-34. Rf interconnection diagram.

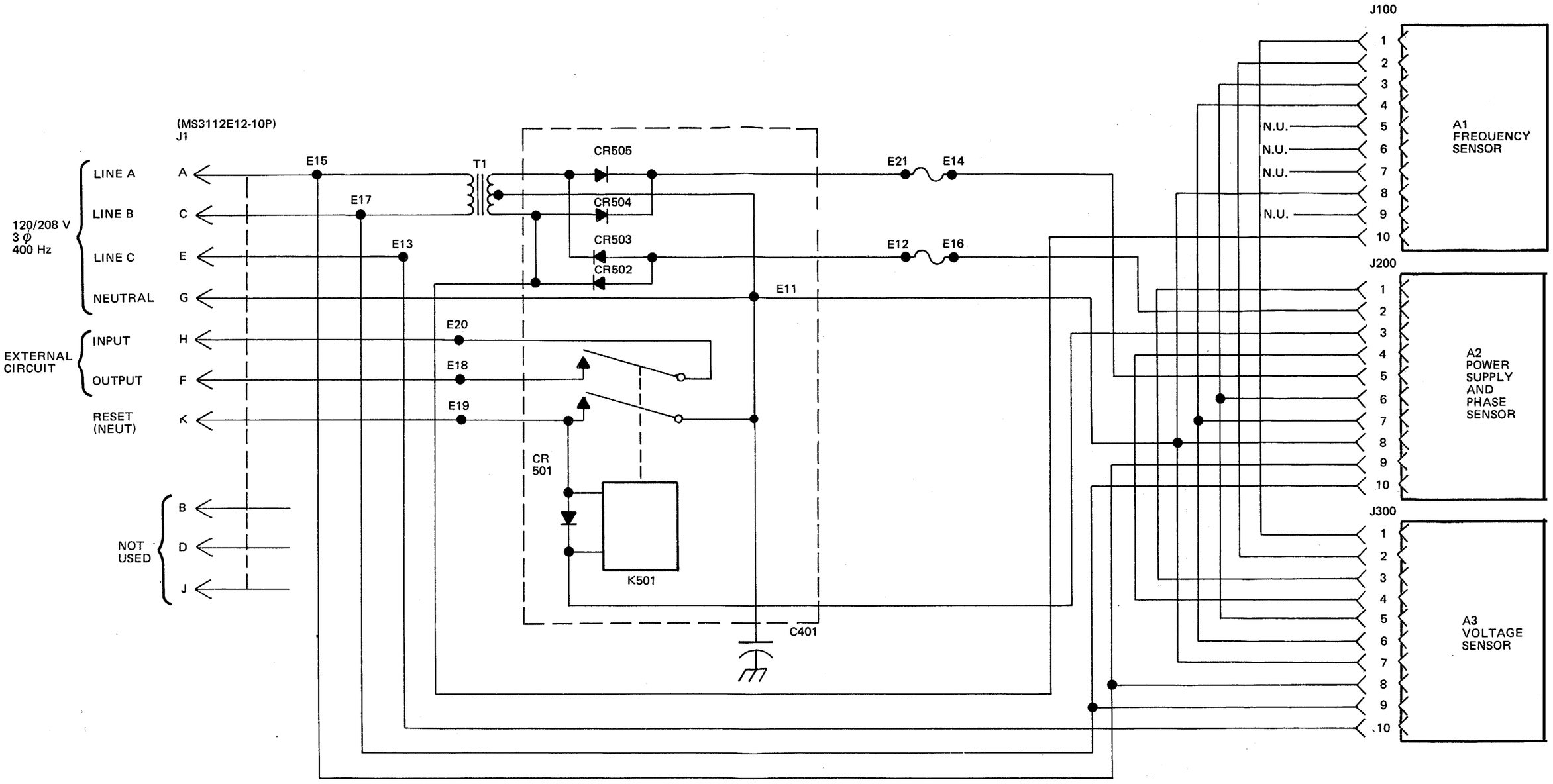


NOTES:
UNLESS OTHERWISE SPECIFIED:
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.
2. ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL CAPACITANCE VALUES ARE IN UF

GOVERNMENT FURNISHED ASSY

EL 5895-372-24-TM-50

Figure FO-35. Trailer, interconnection diagram.



NOTES:
1. DIAGRAM IS PROVIDED FOR INFORMATION ONLY. REPAIRS CANNOT BE VERIFIED EXCEPT BY MANUFACTURER.
2. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE DESIGNATIONS, PREFIX WITH UNIT NUMBER AND/OR SUBASSEMBLY DESIGNATION(S) AS APPLICABLE.

Figure FO-36. Power Monitor Assembly 1A13A2, Schematic Diagram.

e. Modulation Selection Chart.

		Modulation Source														Rt Unit				
Mode	Keying	Cont. Keying	Periodic Keying	Random Keying	Hand Keying	Voice	Noise	Tones	Mod Off	Noise BW KC/S	M/T Ratio	TONE SEL KC/S	TONE FREQ KC/s	Speed WPM-CPS	Random Ratio	Modulation	Meter Selector Switch	AM Mod	Deviation	Chirp Rate
CW	Continuous	On							Off							Off				
	Random			On					Off					AR	AR	Off				
	Hand				On				Off							Off				
AM-Tone	Continuous	On						On	On			AR	AR			AM	AM Mod	AR		
	Random			On				On	On			AR	AR	AR	AR	AM	AM Mod	AR		
	Hand				On			On	On			AR	AR			AM	AM Mod	AR		
AM-Noise	Continuous	On					On		On	AR						AM	AM Mod	AR		
	Random			On			On		On	AR				AR	AR	AM	AM Mod	AR		
	Hand				On		On		On	AR						AM	AM Mod	AR		
AM-Tone and Noise	Continuous	On					On	On	On	AR	AR	AR	AR			AM	AM Mod	AR		
	Random			On			On	On	On	AR	AR	AR	AR	AR	AR	AM	AM Mod	AR		
	Hand				On		On	On	On	AR	AR	AR	AR			AM	AM Mod	AR		
AM-Noise	Hand				On		On	On	On	AR	AR	AR	AR			AM	AM Mod	AR		
AM-Voice						On			On							AM	AM Mod	50% Mod.		

NOTE: AR is abbreviation for "as required".

e. Modulation Selection Chart - Continued.

		Modulation Source														Rt Unit				
Mode	Keying	Cont. Keying	Periodic Keying	Random Keying	Hand Keying	Voice	Noise	Tones	Mod Off	Noise BW KC/S	M/T Ratio	TONE SEL KC/S	TONE FREQ KC/S	Speed WPM-CPS	Random Ratio	Modulation	Meter Selector Switch	AM Mod	Deviation	Chirp Rate
AM/FM Tone	Continuous	On						On	On			AR	AR			AM/FM	AM Mod and then DEV/FSK	AR	AR	
	Random			On				On	On			AR	AR	AR	AR	AM/FM	AM Mod and then DEV/FSK	AR	AR	
	Hand				On			On	On			AR	AR			AM/FM	AM Mod and then DEV/FSK	AR	AR	
AM/FM Noise	Continuous	On					On		On	AR						AM/FM	AM Mod and then DEV/FSK	AR	AR	
	Random			On			On		On	AR				AR	AR	AM/FM	AM Mod and then DEV/FSK	AR	AR	
	Hand				On		On		On	AR						AM/FM	AM Mod and then DEV/FSK	AR	AR	
AM/FM Noise and Tone	Continuous	On					On	On	On	AR	AR	AR	AR			AM/FM	AM Mod and then DEV/FSK	AR	AR	
	Random			On			On	On	On	AR	AR	AR	AR	AR	AR	AM/FM	AM Mod and then DEV/FSK	AR	AR	
	Hand				On		On	On	On	AR	AR	AR	AR			AM/FM	AM Mod and then DEV/FSK	AR	AR	
AM/FM Voice						On			On							AM/FM	AM Mod and then DEV/FSK	50% Mod.	AR	
FM-Tone	Continuous	On						On	On			AR	AR			FM/Chirp	DEV/FSK		AR	Off
	Random			On				On	On			AR	AR			FM/Chirp	DEV/FSK		AR	Off
	Hand				On			On	On			AR	AR			FM/Chirp	DEV/FSK		AR	Off

e. Modulation Selection Chart - Continued.

Mode	Keying	Modulation Source														Rt Unit				
		Cont. Keying	Periodic Keying	Random Keying	Hand Keying	Voice	Noise	Tones	Mod Off	Noise BW KC/S	N/T Ratio	TONE SEL KC/S	TONE FREQ KC/S	Speed WPM-CPS	Random Ratio	Modulation	Meter Selector Switch	AM Mod	Deviation	Chirp Rate
FM/ Noise	Continuous	On					On		On	AR						FM/Chirp	DEV/FSK		AR	Off
	Random			On			On		On	AR				AR	AR	FM/Chirp	DEV/FSK		AR	Off
	Hand				On		On		On	AR						FM/Chirp	DEV/FSK		AR	Off
FM-Tone and Noise	Continuous	On					On	On	On	AR	AR	AR	AR			FM/Chirp	DEV/FSK		AR	Off
	Random			On			On	On	On	AR	AR	AR	AR	AR	AR	FM/Chirp	DEV/FSK		AR	Off
	Hand				On		On	On	On	AR	AR	AR	AR			FM/Chirp	DEV/FSK		AR	Off
FM-Voice						On			On							FM/Chirp	DEV/FSK		AR	Off
FM/ Chirp	Random			On					Off					AR	AR	FM/Chirp	DEV/FSK		AR	AR
	Hand				On				Off							FM/Chirp	DEV/FSK		AR	AR
FSK	Periodic		On						Off					AR		FSK	DEV/FSK		AR	
	Random			On					Off					AR	AR	FSK	DEV/FSK		AR	
	Hand				On				Off							FSK	DEV/FSK		AR	
DSBSC	Same modulation/keying modes and equipment control settings as AM.															DSBSC	RF Output			
DSBSC/ FM	Same modulation/keying modes and equipment control settings as AM/FM.															DSBSC/ FM	DEV/FSK		AR	

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