TECHNICAL MANUAL

DIRECT SUPPORT MAINTENANCE MANUAL

RADIO SET, AN/PRC-132 (NSN 5820-01-320-8831) (EIC: N/A)

CONSISTING OF

RECEIVER-TRANSMITTER, RADIO RT-1648/PRC-132 (NSN 5820-01-320-3686) (EIC: N/A)

AND

BATTERY BOX CY-8629/PRC132 (NSN 6160-01-322-9366) (EIC: N/A)

HEADQUARTERS, DEPARTMENT OF THE ARMY

15 MAY 1992

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

1 DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2 IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

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

4 SEND FOR HELP AS SOON AS POSSIBLE

5 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

WARNING

INJURY CAN OCCUR IF THE FOLLOWING ARE NOT OBSERVED WHEN USING OR REPAIRING THE RADIO SET

WARNING

RF RADIATION HAZARD

Excerpts from the US. Government's Federal OSHA Standard 1910.97 of Title 29 of the Code of Federal Regulations for RF Hazards is provided as a guide in setting safety standards for operator and maintenance personnel.

WARNING

For normal environmental conditions, and for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the radiation protection guide is 10 mW/cm^2 (mW per square centimeter) as averaged over any 0.1 hour period. This means the following:

POWER DENSITY: Do not exceed 10 mW/cm^2 for periods of 0.1 hour or more.

ENERGY DENSITY: Do not exceed 1 $mW\text{-}Hr/cm^2$ (mW hour per square centimeter) during any 0.1 hour period.

This standard applies whether radiation is continuous or intermittent.

WARNING

RF VOLTAGE WARNING

Exposed metal transceiver parts can assume an RF potential to ground when antenna is tuned without grounding transceiver. To avoid potential RF burns, tie transceiver GND stud to ground.

WARNING

TRANSMIT POWER LIMITATION

Transmit power is limited to a maximum of 20 watts when operating with two BA-5590 batteries. When batteries are combined, transmit power may be limited dependent upon the relative state of the battery charge.

WARNING

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation is present.

WARNING

REMOVE ALL WATCHES, RINGS, NECKLACES, OR OTHER METAL ADORNMENTS FROM BODY

Dangerous voltages are present in the equipment and CAN RESULT IN SEVERE BURNS, INJURY, or EVEN DEATH if they come in contact with jewelry.

WARNING

GROUND THE SYSTEM

To minimize shock hazard, the equipment chassis must be connected to an electrical ground.

WARNING

KEEP AWAY FROM LIVE CIRCUITS

The antenna is a source of electrical and radio frequency energy. NEVER TOUCH THE ANTENNA WHEN THE RADIO SET IS IN USE. An RF burn may occur as a result of contact with an active antenna system.

WARNING

ACCIDENTAL CONTACT WITH DC LINE VOLTAGE

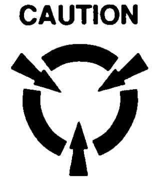
Use caution when performing equipment maintenance. Accidental **contact with DC line voltage can** cause injury.

WARNING

DO NOT REMOVE OR REINSERT MODULES OR PCBs
WITHOUT REMOVING PRIMARY POWER FROM EQUIPMENT

To prevent the possibility of damaging equipment during maintenance, always remove primary power from the transceiver when removing or reinserting modules, PCBs, or other plug-in assemblies.

CAUTION



CAUTION. CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).

WARNING

DO NOT SUBSTITUTE PARTS OR MODIFY SYSTEM

Do not install substitute parts or modify equipment in any manner.

WARNING

BERYLLIUM OXIDE WARNING

Beryllium oxide may be used as an electrical insulator/thermal conductor in some electronic components contained within this equipment. Beryllium oxide easily goes to powder when crushed, and in this form is a toxic health hazard. Avoid crushing components which may contain beryllium oxide. In the event that suspected beryllium oxide powder is inhaled or swallowed, obtain medical assistance immediately.

Dispose of items containing beryllium oxide in accordance with standard army procedure for beryllium oxide materials.

On Power Amplifier A13, transistors Q1, Q2, Q3, and Q4 contain beryllium oxide.

WARNING

Circuit card A13 contains BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH. For local guidance/assistance on disposal of unserviceable circuit card A13, contact your servicing Defense Reutilization and Marketing Office (DRMO).

WARNING

Al PROCESSOR BOARD WARNING

Processor board A1 contains a lithium battery. The lithium battery contains flammable organic materiels. Incorrect handling may cause explosion. DO NOT short battery leads together, expose to extreme heat for more than 5-10 seconds, immerse in water or any cleaning solution, make a mistake in polarity, drop, or strike the battery.

WARNING

A lithium-sulfur dioxide (LiSO2) battery used with the AN/PRC-132 contains pressurized sulfur dioxide (SO2) gas. The gas is toxic, and the battery MUST NOT be abused in any way which may cause the battery to rupture.

DO NOT heat, short circuit, crush, puncture, mutilate, or disassemble batteries.

DO NOT USE any battery which shows signs of damage, such as bulging, swelling, disfigurement, a brown liquid in the plastic wrap, a swollen plastic wrap, etc.

DO NOT test Li-SO2 batteries for capacity.

DO NOT recharge Li-SO2 batteries.

DO NOT dispose of lithium batteries with ordinary trash/refuse. Turn in batteries to your local servicing Defense Reutilization and Marketing Office.

WARNING

If the battery compartment becomes hot to the touch, if you hear a hissing sound (i.e., battery venting), or smell irritating sulfur dioxide gas, IMMEDIATELY Turn Off the equipment and leave the area.

1. Allow the equipment to cool at least one hour.

2. Remove and replace battery after the equipment has cooled to the touch.

3. If there is a safety incident, or if you believe a safety hazard exists, notify your local Safety Office/Officer, file a Quality Deficiency Report, SF Form 368, and notify the CECOM Safety Office, Ft. Monmouth, NJ at AV 995-3112.

WARNING

DO NOT use a HaIon type fire extinguisher on a lithium battery fire.

In the event of a fire, near a lithium battery(ies), rapid cooling of the lithium battery(ies) is important. Flood the equipment with water or use a carbon dioxide (CO2) extinguisher, Control of the equipment fire, and cooling, may prevent the battery from venting and potentially exposing lithium metal. In the event that lithium metal becomes involved in fire, the use of a graphite based Class D fire extinguisher is recommended, such as Lith-X or Met-L-X.

WARNING

DO NOT store batteries in unused equipment for more than 30 days.

DO NOT store lithium batteries with other hazardous materiels and keep them away from open flame or heat.

Technical Manual

No. 11–5820–1102–30

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 15 May 1992

DIRECT SUPPORT MAINTENANCE MANUAL

RADIO SET, AN/PRC-132 (NSN 5820-01-320-8831) (EIC: N/A)

CONSISTING OF

RECEIVER-TRANSMITTER, RADIO RT–1648/PRC-132 (NSN 5820-01-320-3686) (EIC: N/A) AND BATTERY BOX CY-8629/PRC-132 (NSN 6160-01-322-9366) (EIC: N/A)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028–2 located in back of this manual direct to: Commander, US Army Communications–Electronics Command and Fort Monmouth, ATTN: AMSEL–LC–LM–LT, Fort Monmouth, New Jersey 07703–5007.

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

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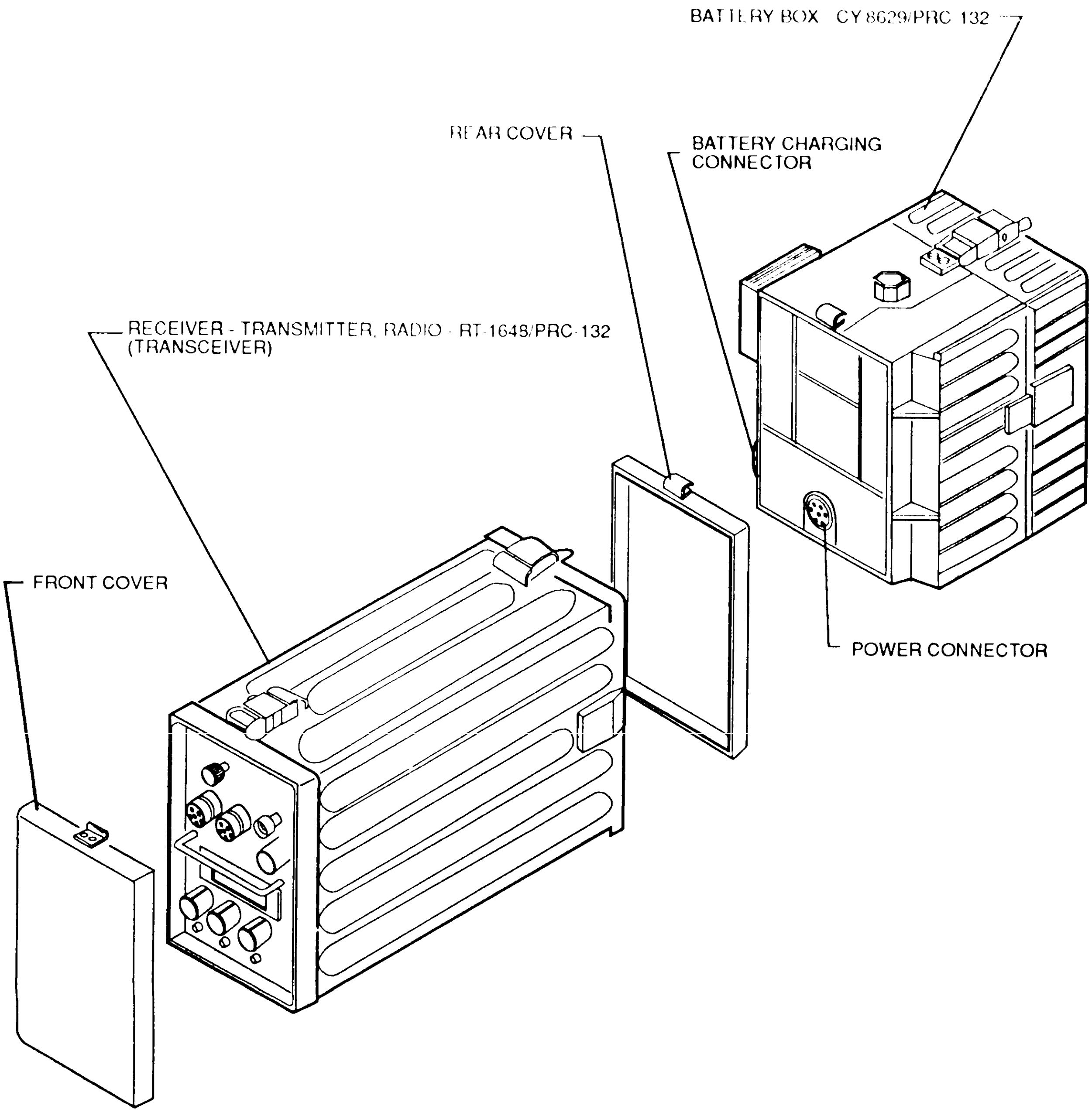


Radio Set-AN/PRC-132

CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE.

1–1.1 Type of Manual Direct Support Maintenance Manual.

1–1.2 Model Number and Equipment Name AN/PRC–132 Radio Set.

1–1.3 Purpose of Equipment The AN/PRC–132 manpack High Frequency/Very High Frequency (HF/VHF) (AM only) radio set is designed to provide data, voice, and Continuous Wave (CW) communications to support Special operations Forces (SOF) communications requirements.

1–2. MAINTENANCE FORMS. RECORDS, AND REPORTS.

1–2.1 Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used or equipment maintenance will be those prescribed by DA Pam 738–750, as contained in Maintenance Management Update.

1-2.2 Reporting of Item and Packaging Discrepancies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735–11–2/DLAR 4140.55/SECNAVINST 4355.18/AFR400–54/MCO4430.3J.

1 –1.3 Transportation Discrepancy Report (TDR) (SF 361). Fill out and forward Transportation Discrepancy Report (TDR) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCOP4610.19D/DLAR 4500.15.

1–3. DESTRUCTION OF ARMY ELECTRONICS MATERIEL.

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

1-4. NOMENCLATURE CROSS–REFERENCE LIST.

Common Name	Official Name
Radio Set	Radio Set – AN/PRC–132
Transceiver	Receiver-Transmitter, Radio–RT–1648/PRC-132
Battery Box	Battery Box – CY-8629/PRC-132

1–5. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your radio set 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 or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at:

Commander,
US Army Communications–Electronics Command
and Fort Monmouth
ATTN: AMSEL–ED-PH
Fort Monmouth, NJ 07703–5007.

We'll send you a reply.

Section II. EQUIPMENT DESCRIPTION AND DATA

1–6. EQUIPMENT CHARACTERISTICS. CAPABILITIES, AND FEATURES.

Refer to the AN/PRC–132 Radio Set Operator's and Unit Maintenance manual (TM 11–5820–1102–12) for general equipment characteristics, capabilities, and features.

The transceiver is of modular construction. Transceiver circuitry is housed within an aluminum case. Front panel circuitry and nine Printed Circuit Boards (PCBs) plug into an interconnection board. Each PCB is held in place by a combination of mating connectors, card cage guides, fastener hardware, and the housing itself. A card cage assembly uses card guides to support each PCB by the edges. card guides include beryllium copper spring contacts that provide additional retaining force and positive ground contact for each PCB. Individually shielded cavities provide isolation between each PCB.

A power amplifier is installed into the housing.

The housing acts as a fail–safe retainer by preventing the PCBs from disengaging far enough to lose electrical contact with mating connectors. The housing is designed with a bulkhead that separates the front cavity (where the card cage assembly is enclosed) from the rear cavity (where the power amplifier is enclosed). The housing conducts heat away from the power amplifier.

The transceiver has limited Built–In–Test (BIT) capabilities. Fuses provide current overload protection for the transceiver and for each PCB. The BIT function consists of a Light Emitting Diode (LED) located on the edge of each PCB that lights to indicate a blown fuse and lose of DC power.

The battery box is of two–piece construction, and is capable of accepting one or two BB–590 batteries, two BA-5590 batteries, or a combination of one BB–590 and one BA–5590.

Battery box half–sections fit together to form a watertight battery enclosure. The battery box housing interfaces with the transceiver and contains a PCB, connectors, and a pressure relief valve. The battery box rear cover forms the rear of the battery box and provides access to batteries. Battery box repair is limited as specified in the Maintenance Allocation Chart (MAC).

1–7. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

Refer to the AN/PRC–132 Radio Set Operator's and Unit Maintenance manual (TM 11–5820–1102-12) for location and description of major equipment components.

All replaceable units are electrically interchangeable. Refer to Figure 1–1 for internal component locations. The transceiver consists of the following replaceable units:

NOTE

Units marked with an asterisk (*) are not replaceable at the Direct Support level, and descriptions are included for information only.

a. Processor A1. Processor A1 controls most transceiver functions. It accepts operator input via front panel controls, and stores channel and frequency data in memory. Processor A1 controls synthesizers, LCD, and filter relays, It communicates with other units via a data bus.

b. 1st LO A2. 1st LO A2 provides a 73.80-122.19 MHz signal used in frequency conversion. It also provides a 5.12 MHz time base to product detector A7, to 2nd LO A3, and to processor A1. Output is +7 dBm, minimum.

c. 2nd LO A3. 2nd LO A3 provides a 82.4301 - 82.4400 MHz signal used in frequency conversion. Output is +7 dBm, minimum.

d. Product Detector A7. In receive mode, Product Detector A7 demodulates a filtered 10.24 MHz input and provides audio output to the front panel AUDIO connectors. In transmit mode, Product Detector A7 accepts audio input from the AUDIO connectors and generates a suppressed carrier double sideband signal at 10.24 MHz,

e. 2nd IF A8. 2nd IF A8 provides sideband filtering at 10.24 MHz, and transmit amplification.

f. 1st IF A9. In receive mode, 1st IF A9 provides first and second frequency conversion of the input RF signal. Its output is 10.24 MHz. In transmit mode, 1st IF A9 provides frequency conversion of a 10.24 MHz input to a 72,1901 -72.2000 MHz output.

g. 1st Mixer A10, 1st Mixer A10 is used in transmit only. It provides frequency conversion, wideband amplification, and filtering. It also provides Automatic Level Control (ALC) gain control circuitry.

h. 1st Filter A11. 1st Filter A11 provides harmonic rejection filtering for frequencies from 1.6000-11.4399 MHz.

i. 2nd Fitter A12. 2nd Filter A12 provides harmonic rejection filtering for frequencies from 11.4400 - 49.9999 MHz. It also contains ALC detector circuitry.

j. Power Amplifier A13. Power Amplifier A13 provides transmit power amplification up to 50 watts. Connection between the power amplifier (located on the transceiver housing) and the card cage is made through a floating connector mounted on the power amplifier assembly. The connector mates with the rear of the card cage when housing and card cage are assembled together. The transceiver rear housing plate contains a battery box interconnection, This connector is wired to the power amplifier, through the floating connector, and to the card cage. Refer to housing assembly in MAC for repair limitations.

k. Interconnect Board A14. Interconnect Board A14 provides interconnection between the plug-in circuit cards. Refer to chassis assembly in MAC for repair limitations.

l. Display Board A15.* Display Board A15 includes a Liquid Crystal Display (LCD) and its control circuitry. It also contains an EMI filter in the antenna path. Display Board A15 is a component of Control Panel Assembly A22.

m. Front Panel Board A16.* Front Panel Board A16 provides interface between front panel controls and Processor A1. Front Panel Board A16 is a component of Control Panel Assembly A22.

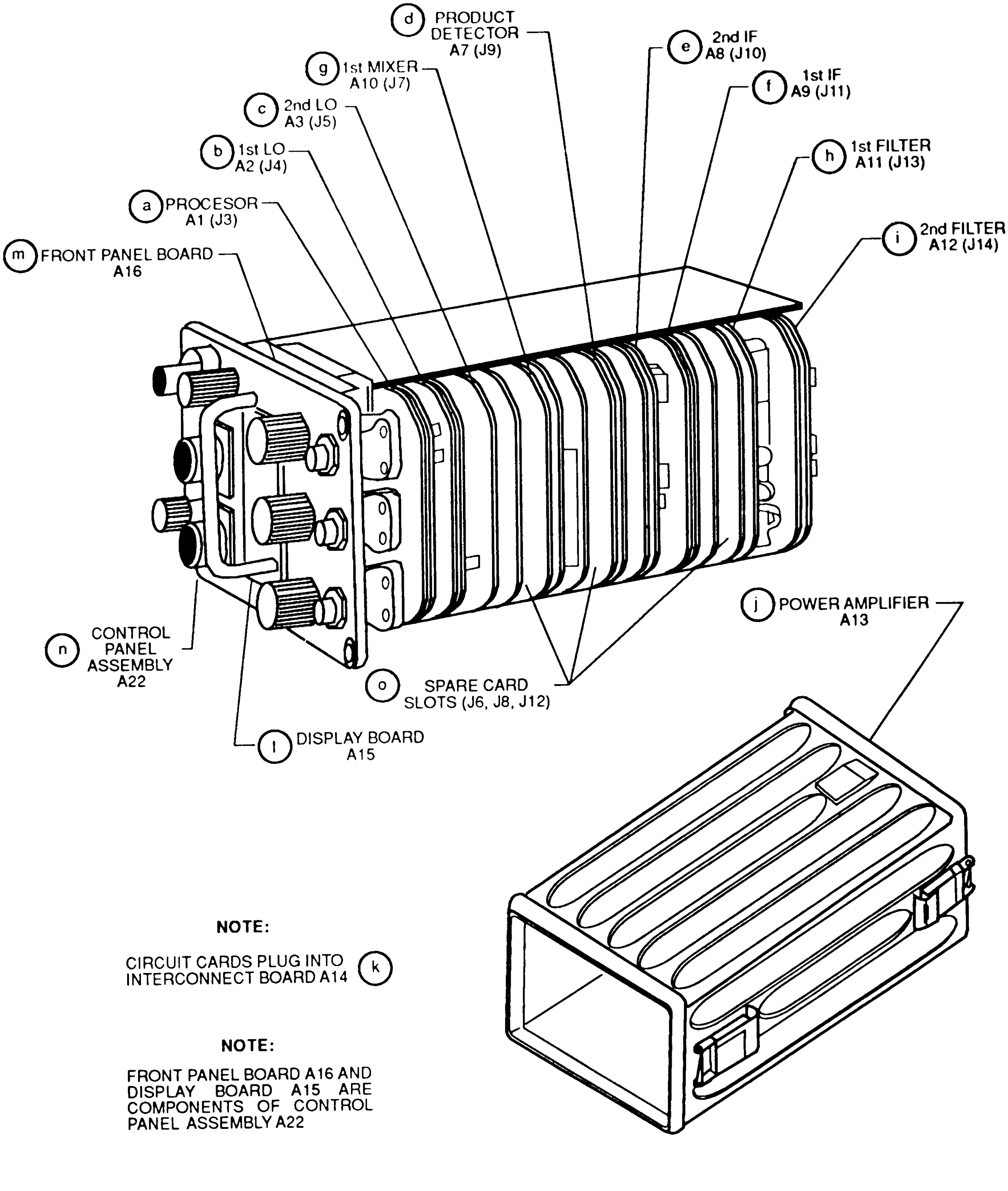


FIGURE 1-1. Transceiver, RT-1648 Internal components

n. Control Panel Assembly A22. Control Panel Assembly A22 includes Display Board A15 and Front Panel Board A16 as one replaceable unit for Direct Support maintenance. Viewing the transceiver from front panel to rear, Control Panel Assembly A22 is the first replaceable unit viewed.

o. Spare Card Slots. J6, J8, and J12 are not used at the present time.

1-8 EQUIPMENT DATA.

Refer to the AN/PRC-132 Radio Set Operator's and Unit Maintenance manual (TM 11-5820-1102-12) for general equipment data.

1-9 SAFETY, CARE, AND HANDLING.

Refer to the AN/PRC-132 Radio Set Operator's and Unit Maintenance manual (TM 11-5820-1102-12) for general safety, care, and handling requirements.

It is the technician's responsibility to understand and apply the following safety precautions during all phases of equipment operation, service, and repair. Failure to comply with these precautions, or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use.

Transceiver internal voltages exceeding 30 volts rms are those associated with transmitter RF power output. These voltages are present at Power Amplifier A13, 1st Filter A11, 2nd Filter A12, and at the coaxial interconnection to the Electromagnetic Interference (EMI) filter and antenna connector located on Control Panel Assembly A22.

1st Filter A11, 2nd Filter A12, and the coaxial interconnection to the antenna connector are located in the card cage assembly. Access to this circuitry can only be obtained by removing the card cage assembly from the housing.

When the card cage assembly is removed from the housing, all power is automatically disconnected from internal circuitry.

WARNING

Removal of safety shields or use of extender card on 1st Fitter A11 and 2nd Fitter A12 will expose voltages that may be dangerous. Use caution when working near exposed circuitry.

If external test cables are used to power the transceiver during maintenance, additional protection exists. 1st Fitter A11 and 2nd Filter A12, when plugged into their respective jack slots, limit technician access to the back of the board. Likewise, the coaxial interconnection to the EMI filter and antenna connector is guarded by shielded enclosures covering Interconnect Board A14.

Power Amplifier A13 is located in the rear cavity of the housing. Access to this cavity requires removal of the transceiver power source.

WARNING

Removal of safety shields will expose electrical currents that may be dangerous. Use caution when working near exposed circuitry.

The only high current source associated with the radio set is the battery power source. Normally, interconnecting cables to the battery power source are not exposed, except during equipment disassembly when the battery power source is disconnected from the transciever. When an external cable is used to interconnect a high current source to the removed card cage, the interconnecting wire from the power source to the front panel power switch is covered by a shield that encloses interconnect Board A14.

Refer to general warnings in front of manual before performing equipment maintenance.

Section Ill. PRINCIPLES OF OPERATION

1-10 GENERAL DESCRIPTION.

Refer to the AN/PRC-132 Radio Set Operator's and Unit Maintenance manual (TM 11-5820-1102-12) for a description of general principles of operation.

Transceiver control circuitry is based upon microprocessor control of timing and switching signals for frequency synthesis, filter switching, and transmit-receive (T/R) switching. The microprocessor is interrupt driven to minimize EMI from clock and data signals in receiver circuitry, and to reduce external spurious emissions. This means that the microprocessor and its associated circuitry are inactive until the operator pushes any of the three control buttons or the radio keyline push-to-talk (PTT), which causes an interrupt, At this time, control circuitry activates to perform the appropriate command, and then returns to the inactive state.

Front panel controls and radio keylines interface to an Erasable Programmable Logic Device (EPLD) located within transceiver circuitry. This device encodes the input commands into microprocessor logic signals and provides activation calls for the microprocessor. The microprocessor, along with associated Erasable Programmable Read Only Memory (EPROM) and Random Access Memory (RAM) circuitry, generates the required transceiver commands and outputs them through control bus drivers to associated circuitry. RAM stores channels and frequencies programmed by the operator. The LCD shows frequency and channel information.

Figure FO-1 illustrates a transceiver signal path block diagram. Within the transceiver, electrical circuitry is composed of five distinct subsections: receive path circuitry, transmit path circuitry, synthesizer circuitry, power supply and distribution circuitry, and control and interface circuitry.

Subsection placement puts interface and control circuitry near the transceiver front panel. Display Board Al 5 and Front Panel Board Al 6 are mounted to Control Panel Assembly A22, which is attached to the card cage assembly with four screws.

Processor A1 occupies J3 nearest Front Panel Board A16.

High power transmit circuitry placement is at the rear of the transceiver. High power circuitry includes 1st Filter A11 and 2nd Fitter A12. These PCBs occupy J13 and J14, respectively. This placement is necessary to keep transmit circuitry as close to the battery as possible due to the high current required for transmit operations. In addition, the bulkhead for the power amplifier provides a shield between it and other transceiver circuitry.

1-11 RECEIVE PATH CIRCUITRY.

All receiver circuitry is located on the A2, A3, A7, A8, A9, A11, and A12 PCBs. Refer to Figure 1-2.

Refer to Figures 1-2 and FO-1. The dual conversion receiver design features a passive front end with band-switched, low-pass filters. A 72.2 MHz narrow band first Intermediate Frequency (IF) establishes the receiver noise figure. A 10.24 MHz second IF provides optimal linear phase. Dual conversion allows the first IF to be well above the receiver frequency band where undesired signals, including image response, can easily be suppressed before receiver high gain and detector stages.

In the presence of undesired signal activity, passive front end circuitry helps prevent performance degradation by minimizing the propability thatstrong signals (desired or undesired) will saturate and desensitize the receiver.

On 1st Filter A11 and 2nd Filter A12, band-switched low pass filters provide an extra degree of protection by attenuating out-of-band signals to reduce receiver spurious responses, including response at IF and image frequencies. In addition, a fixed, 50 MHz low-pass filter on 1st IF A9 provides added attenuation to out-of-band response.

On 1st IF A9, the first IF low noise amplifier establishes the receiver noise figure at approximately 13 dB.

On 1st IF A9, the first IF narrow band crystal fitter has a bandwidth of 30 kHz, and provides filtering to those out-of-band signals close to the desired frequency that may not have been attenuated by the front end low-pass filters. To further enhance signal handling, first IF circuitry establishes the receiver noise figure with a minimum of gain.

On 1st IF A9 and 2nd IF A8, gain is minimized in forward receiver stages so that strong, undesired signals can be attenuated in fitters before they can reach the higher gain stages of Product Detector A7, and to reduce the level of strong desired signals with Amplitude Gain Control (AGC) circuitry before they reach the higher gain stages where strong levels can cause signal distortion.

As the block diagram illustrates,the first receiver AGC stage on 1st IF A9 is incorporated prior to the high gain stages of the second IF.

The second IF includes: upper and lower sideband crystal filters located on 2nd IF A8, a majority of receiver gain circuitry located on Product Detector A7, AGC detectors and amplifiers, and a product detector that demodulates the receive signal and produces an audio output that is then amplified in audio circuitry.

On 2nd IF A8, both upper and lower sideband crystal filters optimize receiver phase and attenuation characteristics to allow transceiver operation with data devices such as the Digital Message Data Group (DMDG). Phase distortion is minimized while maintaining adequate shape factors to provide a high degree of attenuation to out-of-band signals above and below the receiver pass band.

On Product Detector A7, AGC circuitry maintains a constant receiver audio output over a large input signal range and minimizes signal distortion. A product detector converts the 10.24 MHz single sideband signal to audio. This audio signal is then amplified by linear audio amplifiers to minimize distortion and provide a receiver audio output.

1-11.1 <u>Receive Frequency Conversion</u> Refer to Figure 1-2. The receive input frequency varies from 1.60000-49.9999 MHz in 100 Hz (.0001 MHz) increments.

On 1st Fitter A11, incoming RF in the range of 1.6000 - 11.4399 MHz is filtered by one of four filters. Input in the range of 11.4400 - 49.9999 MHz is filtered by one of three filters on 2nd Filter A12. The particular filter to be used is selected by a latching relay.

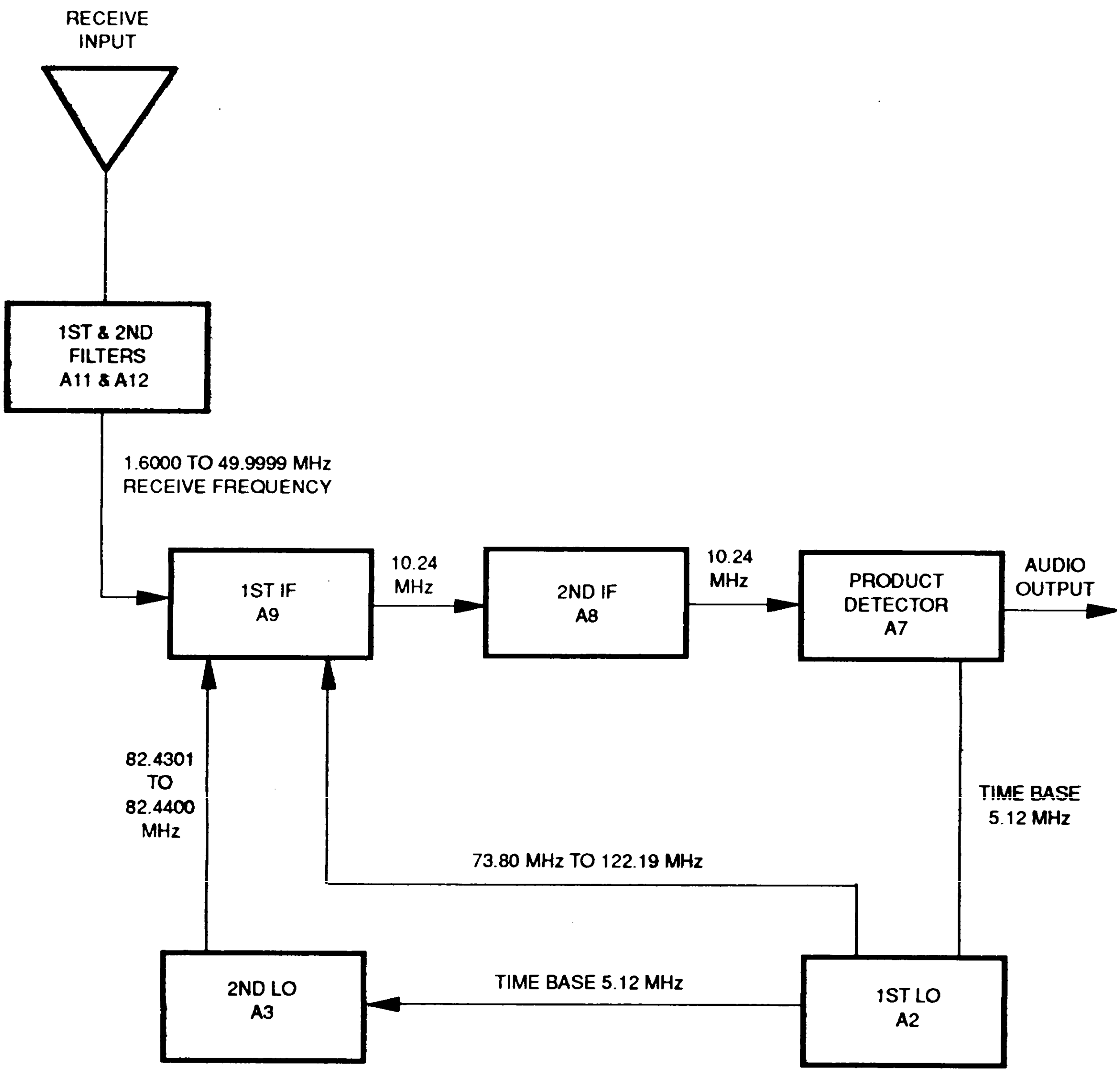


FIGURE 1-2. Transceiver, RT-1648 receive path block diagram

1st IF A9 provides frequency conversion of the input Radio Frequency (RF) signal. Refer to Table 1-1. The 1.6000-49.9999 MHz receiver frequency is mixed with a 73.80 - 122.19 MHz signal to produce a difference frequency of 72.1901 - 72.2000 MHz. The difference frequency is then mixed with a 82.4301 - 82.4400 MHz signal to produce a 10.24 MHz output.

The second intermediate frequency is always 10.24 MHz. The frequencies of 1st LO A2 and 2nd LO A3 vary as required to provide conversion from the reciever input to 10.24 MHz. 1st LO A2 provides conversion to two decimal places, and 2nd LO A3 provides conversion to four decimal places. For example, a receiver input frequency of 1.6000 Mhz is converted as follows:

1.6000 MHz is mixed with 73.80 MHz to produce a first intermediate frequency of 72.2000 MHz: 73.80-1.6000 = 72.2000.

72.2000 MHz is mixed with 82.4400 MHz to produce the second intermediate frequency of 10.24 MHz: 82.4400-72.2000 = 10.24.

Table 1-1. Receive Path Frequency Conversion Examples

Receive Input Frequency in MHz	1ST LO A2 Frequency in MHz	First Intermediate Frequency in MHz	2ND LO A3 Frequency in MHz	second Intermediate Frequency in MHz
1.6000	73.80	72.2000	82.4400	10.24
1.6100	73.81	72.2000	82.4400	10.24
1.6101	73.81	72.1999	82.4399	10.24
1.6199	73.81	72.1901	82.4301	10.24
49.9900	122.19	72.20008	82.4400	10.24
49.9901	122.19	72.19998	82.4399	10.24
49.9999	122.19	72.19018	82.4301	10.24

A receive input frequency of 1.6100 MHz is converted as follows:

1.6100 MHz is mixed with 73.81 MHz to produce a first intermediate frequency of 72.2000 MHz: 73.81 - 1.6100 = 72.2000. Note that this is the same first intermediate frequency that was obtained for a 1.6000 MHz input. The value of the first intermediate frequency depends on the value of the third and fourth decimal places of the receive input frequency. For example, receive input frequencies of 1.6000, 1.6100, and 49.9900 MHz all produce a first intermediate frequency of 72.2000 MHz.

72.2000 MHz is mixed with 82.4400 MHz to produce the second intermediate frequency of 10.24 MHz: 82.4400-72.2000 = 10.24.

A receive input frequency of 1.6101 MHz is converted as follows:

1.6101 MHz is mixed with 73.81 MHz to produce the first intermediate frequency of 72.1999 MHz: 73,81 -16.101 = 72,1999. Note that 1st LO A2 frequency is the same as that for a 1.6100 MHz input. The value of the 1st LO A2 frequency depends on the value of all but the third and fourth decimal places of the receive input frequency, For example, receive input frequencies of 1.6100, 1.6101, and 1.6199 MHz all require a 1st LO A2 frequency of 73.81 MHz.

72.1999 MHz is mixed with 82.4399 MHz to produce the second intermediate frequency of 10.24 MHz: 82.4399 - 72.1999 = 10.24. Note that the value of the 2nd LO A3 frequency vanes as required to produce a second intermediate frequency of 10.24 MHz.

Local Oscillator (LO) and intermediate frequencies may be calculated in the same way for any receive input frequency.

2nd IF A8 provides sideband filtering of the 10.24 MHz signal.

Product Detector A7 demodulates the filtered 10.24 MHz input and provides audio output to front panel AUDIO connectors.

1st LO A2 provides a 73.80 - 122.19 MHz signal to 1st IF A9 for first frequency conversion of the receive input. 1st LO A2 also provides a 5.12 MHz time base to Product Detector A7 and 2nd LO A3.

2nd LO A3 provides a 82.4301 - 82.440 MHz signal to 1st IF A9 for secondary frequency conversion of the receive input.

1-11.2 Receiver Sensitivity All receiver sensitivity determining circuitry is located on the A7, A8, A9, A11, and A12 PCBs.

Filtering provided by 1st Fitter A11, 2nd Filter A12, 1st IF A9, and 2nd IF A8 ensures that the probability of performance degradation due to strong out-of-band signals is minimized.

Transceiver noise figure is 13 dB. Noise figure includes the gain (or loss) and noise figures of individual stages in the receive path.

Correlating this noise figure with the theoretical noise floor of -174 dBm in a 1 Hz bandwith and the transceiver bandwidth of 2.4 KHz, it can be determined that the transceiver produces 10 dB Signal Into Noise And Distortion (SINAD) for a -117 dBm signal as shown below:

SINAD = Signal Plus Noise Plus Distortion/Noise Plus Distortion

Signal level for 10 dB SINAD is:

-174 dBm + 13 dB(NF) + 10 dB (SINAD) + 34 dB (2.4 kHz BW) = -117 dBm.

1-11.3 Receiver Selectivity Receiver selectivity circuitry is located on the A8 and A9 PCBs.

Selectivity is the measure of the ability of a receiver to select the desired signal and process information with a minimum amount of distortion.

The transceiver provides maximum rejection of out-of-band signals while maintaining a minimum of in-band amplitude variation and delay distortion. Selectivity is achieved by the use of precision, crystal filters in the first and second IF stages.

Refer to Figure FO-1. 1st IF A9 has a 30 kHz bandwidth and provides attenuation to out-of-band signals within the passband of the low pass fitters in the receiver front end. This filter also minimizes delay distortion to enhance the ability of the transceiver to operate with digital message devices.

2nd IF A8 provides upper sideband (USB) and lower sideband (LSB) crystal fitters. These fitters select the desired sideband for demodulation. The USB fitter is selected for USB and amplitude modulation equivalent

(AME) modes, and the LSB filter is selected for the LSB mode. Both filters have a 2.4 kHz, 6 dB bandwidth. They have a 50 dB bandwidth of 5 kHz, and provide attenuation to those signals within the bandwidth of the first IF filter and outside the desired receive channel. These fitters, like the 1st IF A9 crystal filter, minimize delay distortion.

1-11.4 IF Rejection IF rejection circuitry is located on the A9, A11, and A12 PCBs.

IF rejection is the measure of a receiver's ability to reduce the effect of a strong signal at the frequency of its first IF. This rejection is usually expressed as a ratio of the signal level required to produce a SINAD of 10 dB at the first IF frequency to the signal level required to produce a SINAD of 10 dB at the desired channel frequency.

Four factors contribute to the attenuation of an undesired signal appearing at the receiver front end at the first IF frequency.

First: Within 1st IF A9, the selection of 72.2 MHz for the first IF frequency is far above the highest receive frequency of 50 MHz to make filtering in subsequent stages more readily achievable.

Second: Within 1st Filter A11 and 2nd Filter A12, band-switched, elliptical function, low pass fitters are used to attenuate undesired out-of-band signals. They provide significant attenuation to signals just above their passband cutoff frequency.

Third: Within 1st IF A9, the transceiver has an additional 7-section, elliptical function, 50 MHz low pass filter located immediately before the first receiver mixer to provide additional attenuation for those signals above the maximum operating frequency of the radio.

Fourth: Within 1st IF A9, the first mixer maximizes RF-to-IF isolation while minimizing noise figure and insertion loss.

Overall attenuation provided in the receive signal path to an undesired signal at the frequency of the first IF provides IF rejection in excess of 70 dB.

1-11.5 Image Rejection Image rejection circuitry is located on the A9, A11, and A12 PCBs.

Transceiver image frequencies fall in a band from 146.0 -194.4 MHz.

Rejection to image frequencies is achieved in much the same way as IF rejection. The switched, elliptical function, low pass filters in 1st Fitter A11 and 2nd Filter A12 greatly attenuate signals that fall in the image frequency band. In addition, the 50 MHz, 7-section elliptical function low pass filter located immediately before the first mixer on 1st IF A9 provides further attenuation to these signals.

The overall attenuation provided in the receive signal path to undesired signals at the image frequencies provides image rejection in excess of 70 dB.

Image rejection is usually expressed as a ratio of the signal level required to produce a SINAD of 10 dB at the image frequency to the signal level required to produce a SINAD of 10 dB at the desired frequency.

Image rejection is the measure of a receiver's ability to reject a signal whose frequency is defined by the following equation:

$F_{img} = F_{rf} + 2IF$

where:

F_{img} = The image frequency of the receiver

F_{rf} = The desired receive frequency of the receiver

IF = The first intermediate frequency of the receiver

1-11.6 Audio Distortion Audio distortion circuitry is located on the A7 PCB.

Audio distortion is the measure of a receiver's ability to process an incoming signal in a linear manner with minimum distortion. Audio distortion in the transceiver is less than 5%.

The receive path utilizes low noise, high dynamic range amplifiers. AGC is used in both the first and second IFs to reduce the level of strong desired signals and to reduce distortion in the later high gain RF and audio stages.

On Product Detector A7, audio amplification stages provide maximum audio output with minimum distortion.

1-12 TRANSMIT PATH CIRCUITRY.

Transmit path circuitry is located on the A2, A3, A7, A8, A9, A10, A11, A12, and A13 PCBs.

Refer to Figure 1-3. The dual conversion transmitter design features operator selectable power levels up to 50 watts, band-switched low pass fitters located on 1st Filter A11 and 2nd Filter A12 for harmonic and spurious attenuation, an audio Voice-Operated Gain Adjusting Device (VOGAD) located on Product Detector A7 for linearity, and power amplifier protection located on Power Amplifier A13 via ALC located on 1st Mixer A10. Modes of operation are USB, LSB, and AME. The radio provides for CW emission in LSB, USB, and AME via the CW keyline at front panel audio connectors.

On Product Detector A7, the transmit audio input enters VOGAD circuitry where it is amplified and gain-controlled to provide a constant level to a balanced modulator. Audio input is either voice or Frequency Shift Key (FSK) tone signal applied at either of the audio input connectors. Input can also be CW tone generated by an internal audio oscillator.

Radio keying is done on pins C or E of either audio connector. Voice and data audio accessories key the radio via pin C. CW keying accessories key the radio via pin E. When the radio is keyed via pin E, a CW audio oscillator is activated along with a hangtime circuit.

Refer to Figure FO-2 for audio connector pinouts, which include:

A = Ground
B = Receiver Audio Output
C = Keyline (ground when keyed)
D = Transmit Audio Input
E = CW Keyline (ground when keyed)
F = Not Used

On Product Detector A7, the CW audio oscillator generates a tone of approximately 1 kHz. The hangtime circuit provides a CW hangtime of approximately 1 second. CW can be transmitted in LSB, USB, or AME by keying the transceiver via pin E.

On Product Detector A7, VOGAD circuitry consists of an audio amplifier with automatic gain control. Level variations in the audio input are compensated to maintain a constant input level to a balanced modulator and prevent distortion due to overdriving circuitry in the transmit path. The VOGAD will maintain a constant output for input signal levels from 1 to 100 millivolts rms.

The balanced modulator modulates a 10.24 MHz carrier oscillator signal with the audio signal to produce a double sideband suppressed carrier of 10.24 MHz for the second IF. This signal is filtered by the selected sideband filter located on 2nd IF A8 to create a suppressed carrier, single-sideband, 10.24 MHz signal. Single sideband filters are the same as those used in the receive path. The LSB fitter is selected in the LSB mode. The USB filter is selected in USB and AME modes. If the AME mode is selected, the carrier signal is reinserted on 1st IF A9 back into the single sideband signal after it is filtered in the USB filter.

On 1st IF A9, the 10.24 MHz second IF signal goes to a mixer where it is mixed with the second LO and up-converted to a 72.2 MHz first IF signal. The 72.2 MHz signal is filtered in first IF crystal fitter circuitry to remove mixing products. It is then amplified and sent to another mixer located on 1st Mixer A10 where it is mixed with the first LO and down-converted to the final RF output frequency. At the output of this mixer, a 50 MHz lowpass filter removes mixing products before the signal is passed to high gain, broadband amplifier circuitry.

On Power Amplifier A13, final power amplifier output is passed to band-switched harmonic fitter circuitry located on 1st Filter A11 and 2nd Filter A12 to attenuate all harmonics. It then goes through forward and reflected power detectors located on 2nd Fitter A12, and on to an antenna connector located on the front panel.

The output of the forward power detector located on 2nd Fitter A12 is used in the ALC feedback loop on 1st Mixer A10 to maintain the output power at the selected level. The output of the reflected power detector on 2nd Filter A12 is proportional to the antenna Voltage Standing Wave Ratio (VSWR), and is used in the ALC feedback Imp to protect the power amplifier by reducing power in proportion to the VSWR magnitude. An external ALC input located on 1st Mixer A10 works in conjunction with battery box circuitry to limit the maximum current from the BA-5590 lithium batteries by controlling RF output power.

On Power Amplifier A13, power amplifier transistors are fully protected from any VSWR, including open and short circuits. Power amplifier transistors are also protected from excessive temperature by a thermostat mounted in the heatsink used for the final power amplifier transistors. This thermostat automatically reduces power output when heatsink temperature reaches 105°C. The thermostat is located on Power Amplifier A13. When the heatsink cools to 88 degrees C, the power will return to the selected power level.

The emmision of undesired harmonics and spurious signals is minimized to enhance Low Probability of Interrupt/Low Probability of Detection (LPI/LPD) characteristics. Two factors contribute to the low level of spurious and harmonic emmissions from the transmitter.

First: Dual conversion design allows intermediate frequencies to be chosen so that undesired mixing products and spurious signals can be easily attenuated prior to high gain, broadband power amplifier stages.

Second: Band-switched, elliptical function' low pass filters attenuate power amplifier harmonics and any spurious signals that do reach the power amplifier.

On 1st Fitter A11 and 2nd Fitter A12, harmonics are kept at a minimum of 50 dB below the desired output signal. Circuitry to suppress harmonics is located on 1st Filter A11 and 2nd Filter A12.

1-12.1 Transmit Frequency Conversion Refer to Figure 1-3. Product Detector A7 accepts audio input from the front panel AUDIO connectors and generates a suppressed carrier double sideband signal at 10.24 MHz.

2nd IF A8 provides sideband filtering of the 10.24 MHz signal.

1st IF A9 mixes the 10.24 MHz input with a 82.4301 - 82.4400 MHz signal from 2nd LO A3. It provides a difference frequency output of 72.1901 -72.2000 MHz.

1st Mixer A10 mixes the difference frequency with a 73.80 - 122.19 MHz signal to produce a transmit frequency output of 1.6 - 49.9999 MHz.

The transmitter output frequency varies from 1.6000 - 49.9999 MHz in 100 Hz (.0001 MHz) increments. Refer to Table 1-2. The first intermediate frequency is always 10.24 MHz. The frequencies of 2nd LO A3 and 1st LO A2 vary as required to provide conversion from 10.24 MHz to the transmit output frequency. 1st LO A2 provides conversion to two decimal places and 2nd LO A3 provides conversion to four decimal places. For example, a transmitter output frequency of 1.6000 MHz is converted as follows:

> 10.24 MHz is mixed with 82.4400 MHz to produce a second intermediate frequency of 72.2000 MHz: 82.4400 - 10.24 = 72.2000.
>
> 72.2000 MHz is mixed with 73.80 MHz to produce a transmit output frequency of 1.6000 MHz: 73.80 - 72.2000 = 1.6000.

Table 1-2. Transmit Frequency Conversion Examples

First Intermediate Frequency in MHz	2ND LO A3 Frequency in MHz	Second Intermediate Frequency in MHz	1ST LO A2 Frequency in MHz	Transmit output Frequency in MHz
10.24	82.4400	72.2000	73.80	1.6000
10.24	82.4400	72.2000	73.81	1.6100
10.24	82.4399	72.1999	73.81	1.6101
10.24	82.4301	72.1901	73.81	1.6199
10.24	82.4400	72.2000	122.19	49.9900
10.24	82.4399	72.1999	122.19	49.9901
10.24	82.4301	72.1901	122.19	49.9999

For a transmit output frequency of 1.6100 MHz, conversion is as follows:

> 10.24 MHz is mixed with 82.4400 MHz to produce a second intermediate frequency of 72.2000 MHz: 82.4400 - 10.24 = 72.2000. Note that this is the same frequency that was obtained for a 1.6000 MHz transmit output. The value of the second intermediate frequency depends on the value of the third and fourth decimal places of the transmit output frequency. For example, transmit frequencies of 1.6000, 1.6100, and 49.9900 MHz all require a second intermediate frequency of 72.2000 MHz.

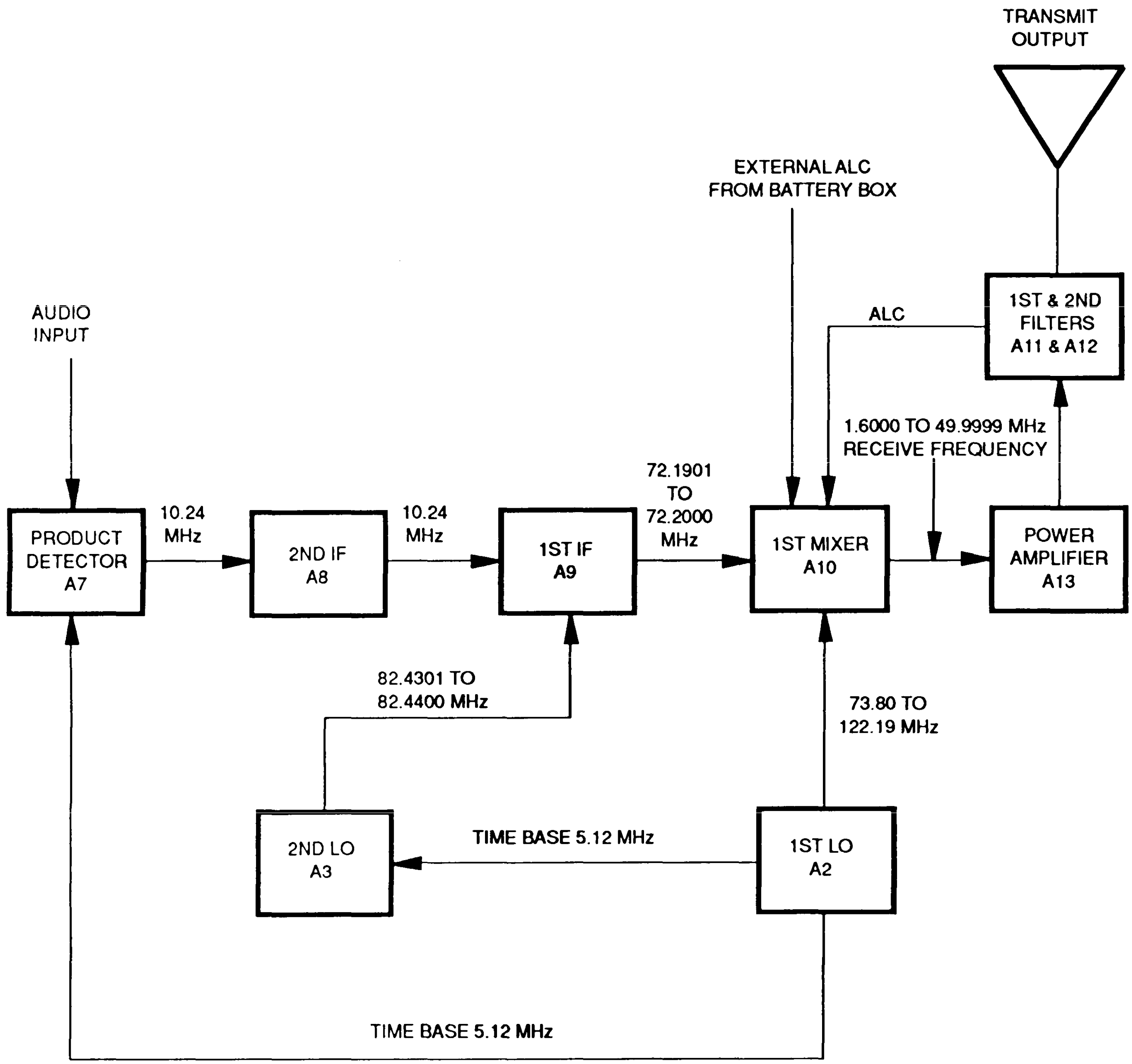


FIGURE 1-3. Transceiver, RT-1648 transmit path block diagram

72.2000 MHz is mixed with 73.81 MHz to produce the transmit output frequency: 73.81 - 72.2000 = 1.6100. The frequency value of 1st LO A2 depends on the value of all but the third and fourth decimal places of The transmit output frequency. For example, transmit output frequencies of 1.6100, 1.6101, and 1.6199 MHz all require a 1st LO A2 frequency of 73.81 MHz.

LO and intermediate frequencies may be calculated in the same way for any transmit output frequency.

Power amplifier A13 provides transmit power amplification up to 50 watts. Input is from 1st Mixer A10 at a level of +20 dBm, nominal.

Transmit output in the range of 1.6 - 11.4399 MHz is filtered by one of four filters on 1st Filter A11. Output in the range of 11,44 - 49.9999 MHz is filtered by one of three filters on 2nd Fitter A12. The filter to be used is selected by relay. ALC detectors on 2nd Filter A12 work with ALC attenuators on 1st Mixer A10 to maintain constant output power.

1st LO A2 provides a variable 73.80 - 122.19 MHz signal to 1st mixer A10. The 73.80 - 122.19 MHz is mixed with 72.1901 -72.2000 MHz to produce the final transmit frequency. 1st LO A2 also provides a 5.12 MHz time base to Product Detector A7 and 2nd LO A3.

2nd LO A3 provides a 82.4301 - 82.4400 MHz signal to 1st IF A9.

1-12.2 RF Output Power RF output power circuitry is located on the A13 PCB.

The transceiver is designed primarily for short burst transmissions, providing up to 50 watts Peak Envelope Power (PEP) and average power across the 1.6 to 50 MHz band while maintaining linearity. Power output is selectable at 5, 10, 20, and 50 watts.

1-12.3 Intermodulation Distortion Intermodulation distortion determining circuitry is located on the A13 PCB.

Transceiver intermodulation products are kept a minimum of 20 dB below the desired output level.

1-12.4 Carrier Suppression Carrier suppression circuitry is located on the A7 and A8 PCBs.

Transceiver carrier suppression is a sum of the attenuation at the carrier frequency (10.24 MHz) provided by the selected sideband filter plus the suppression obtained in the balanced modulator.

The attenuation provided by sideband fitters at the carrier frequency is less than 10 dB. The balanced modulator provides a minimum carrier suppression of 50 dB. Adding this to the attenuation provided by the sideband fitters results in a minimum carrier suppression greater than 50 dB.

1-12.5 Opposite Sideband Suppression Opposite sideband suppression circuitry is located on the A8 PCB.

Unlike carrier suppression, opposite sideband suppression is provided only in the selected sideband filter. A 10-pole crystal filter design is used to maintain opposite sideband suppression at 50 dB and to maintain a linear phase, The result is a minimum of 50 dB attenuation at 1 kHz from the carrier frequency in the opposite sideband of each fitter.

1-12.6 Output Load Impedance Output load impedance circuitry is located on the A13 PCB.

Transmitter output impedance is determined by power amplifier final stage output impedance and low pass harmonic filter impedances.

Power Amplifier A13 is designed for a 50 ohm output impedance. Filters are designed for both 50 ohm input and output impedances. This results in a nominal RF output load impedance at the antenna terminals of 50 ohms, unbalanced, with respect to ground.

1-12.7 Voltage Standing Wave Ratio (VSWR) VSWR circuitry is located on the A10, A12, and A13 PCBs.

The transceiver provides as much power as possible into antennas with high VSWR while still providing a high degree of protection to the final power amplifier transistors from the high reflected power associated with these antennas. This is done by ALC loop and reflected power detector circuitry which gradually degrades the forward power output as VSWR increases.

Forward output power is reduced by less than 1.5/VSWR for VSWRs greater than 2:1. Full forward power output is provided for VSWRs up to 2:1.

1-13 SYNTHESIZER CIRCUITRY.

All synthesizer circuitry is located on the A2 and A3 PCBs.

Transceiver synthesizer circuitry provides all LO, reference, and clock signals required by the radio. This includes the first LO and second LO signals used for frequency conversion in the receive and transmit paths, the 5.12 MHz signal doubled to generate the Beat Frequency Oscillator (BFO) signal used in the product detector in the receive path, the balanced modulator in the transmit path, and the clock signal for the microprocessor controller.

The synthesizer is of indirect digital design that combines low power Complementary Metal Oxide Semi-Conductor Very Large Scale Integration (CMOS VLSI) technology with custom hybrid microcircuitry and a high stability Temperature Compensated Crystal Oscillator (TCXO) reference. Synthesizer power dissipation is minimal.

Stability is attained by referencing all the synthesizer signals to the TCXO to maintain overall frequency accuracy and stability.

Figure 1-4 illustrates the synthesizer block diagram.

First LO circuitry is contained on the A2 module, and consists of a single Phase Locked Loop (PLL) with a 10 kHz reference.

The first LO signal varies from 73.80 - 122.19 MHz in 10 kHz steps. Two Voltage-Controlled Oscillators (VCOs) are used to cover the first LO range. These oscillators are of low-noise design, and are band-switched at a frequency of 25 MHz with each oscillator covering a range of approximately 25 MHz.

Second LO circuitry is contained on the A3 module, and consists of two PLLs mixed to provide the second LO output. One loop consists of an oscillator locked to an 8 kHz reference. This oscillator varies from 85.608 - 86.400 MHz in 8 kHz steps. This signal is then divided by 80 to produce a 1.0701 - 1.0800 MHz signal that varies in 100 Hz steps. The other loop consists of a fixed frequency, 81.36 MHz oscillator, locked to a 40 kHz reference. This signal is mixed with the 1.0701 - 1.0800 MHz signal to produce an 82.4301 - 82.44 MHz signal that is filtered and amplified to produce the second LO output signal.

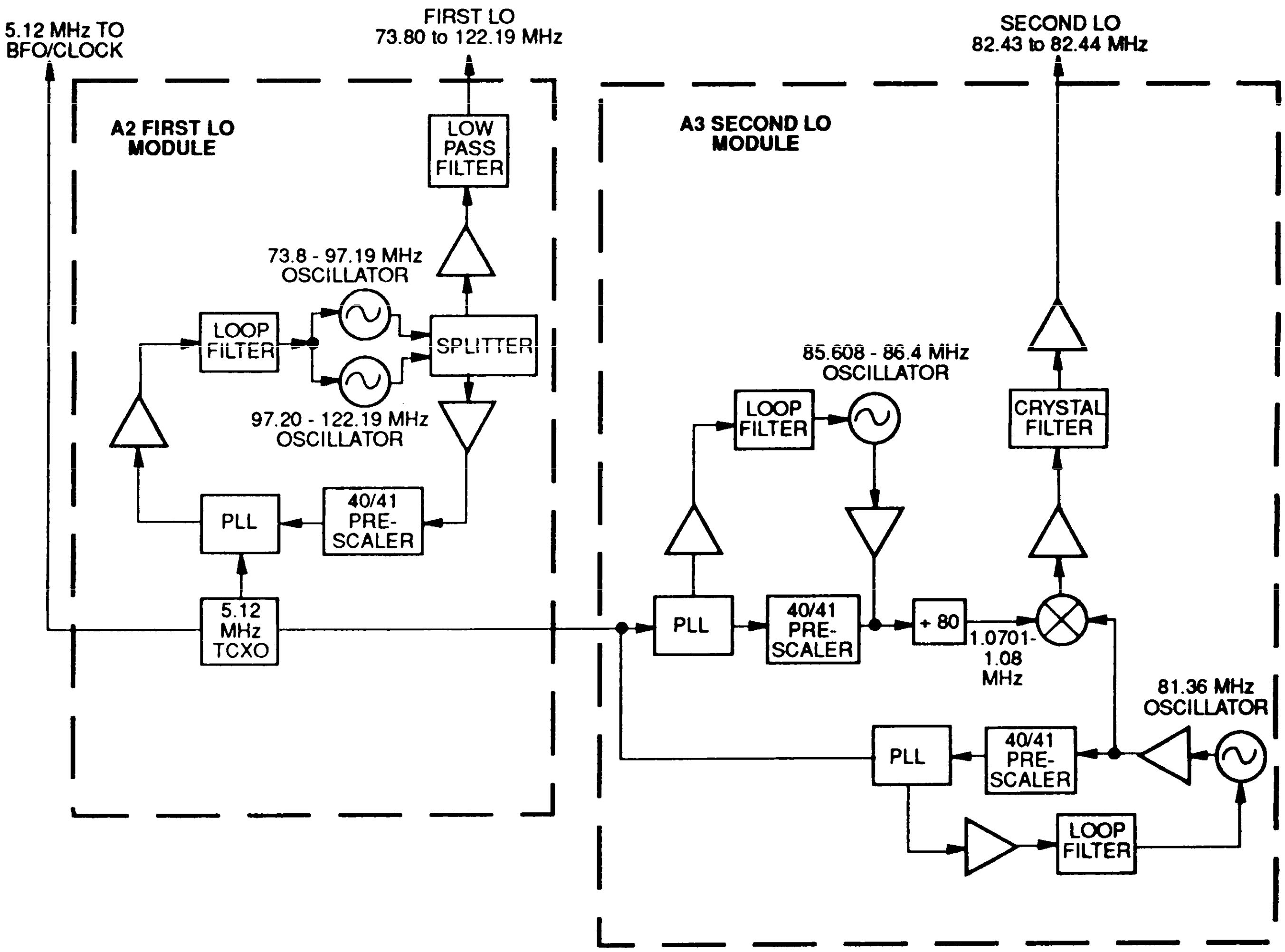


FIGURE 1-4. Transceiver synthesizer

On the A3 card, the crystal filter attenuates the sidebands from the mixer and insures the spectral purity of the second LO.

The TCXO reference oscillator is also located on the A2 module. It contains a thermistor feedback network to stabilize frequency over the operating temperature range. It provides reference frequencies for the PLLs, and a 5.12 MHz output for the BFO in the receiver/exciter and the clock in the controller circuitry.

1-13.1 Frequency Range Frequency range determining circuitry is located on the A2 and A3 PCBs.

The transceiver covers an expanded frequency range of 1.6-50 MHz in 100 Hz steps. The transceiver utilizes both 1st LO A2 and 2nd LO A3 to cover the frequency range.

1st LO A2 provides 10 kHz, 100 kHz, 1 MHz, and 10 MHz frequency steps.

2nd LO A3 provides 100 Hz and 1 kHz frequency steps.

In receive operations, the 1.6000 - 49.9999 MHz receive frequency is mixed with the 73.80 - 122.19 MHz first LO frequency to produce the first IF of 72.1901 - 72.2000 MHz. This signal is mixed with the 82.4301 - 82.44 MHz second LO frequency to produce the constant second IF of 10.24 MHz.

In transmit operations, the path is reversed but conversion frequencies are the same, with the modulated 10.24 MHz second IF signal being eventually up-converted to a 1,6000 - 49.9999 MHz output.

1-13.2 Frequency Accuracy Frequency accuracy determining circuitry is located on the A2 PCB.

To insure the highest level of frequency accuracy and stability, a TCXO is used as the reference oscillator. All other oscillators are locked to this reference. The TCXO has an overall stablity of 1 part per million (ppm), including the effects of variations in battery voltage and service conditions.

1-14 POWER SUPPLY AND DISTRIBUTION CIRCUITRY.

Power supply and distribution circuitry is located on all transceiver PCBs.

The transceiver does not contain a DC-to-DC converter. This greatly reduces EMI both internally and externally to the radio.

The transceiver utilizes three terminal series regulators on critical circuits to provide regulation and isolation.

1-14.1 Reverse Voltage Protection Reverse voltage protection is a mechanical function. The transceiver and battery box are mechanically keyed to prevent accidental application of reverse voltage to the transceiver.

1-14.2 Power Drain Power drain circuitry is located on all PCBs.

The transceiver is designed for low power consumption. Circuitry not needed for a particular function, whether transmit or receive, is switched off when not in use.

WARNING

Transmit power is limited to a maximum of 20 watts when operating with two BA-5590 batteries. When batteries are combined, transmit power may be limited dependent upon the relative state of the battery charge.

Four output power levels (5, 10, 20, and 50 watts) allow the operator to select minimum output power required to achieve reliable communications.

The battery box also contains power drain circuitry that is active only when the battery box is connected to the radio.

1-15 CONTROL AND INTERFACE CIRCUITRY.

All control and interface circuitry is located on the A1 PCB and A22 Assembly.

Refer to the AN/PRC-132 Radio Set Operator's and Unit Maintenance manual (TM 11-5820-1102-12) for a description of radio interfaces and controls.

1-15.1 Secure Lighting All secure lighting circuitry is located on the A22 Assembly.

Refer to the AN/PRC-132 Radio Set Operator's and Unit Maintenance manual (TM 11-5820-1102-12) for a description of secure lighting capabilities.

1-15.2 Electrical Interface All microprocessor control circuitry is located on the A1, A15, and A16 PCBs.

Electrical interfaces include external connections from the front and rear panels to internal radio circuitry, and internal control and signal interfaces within the transceiver.

External interfaces include the battery connector at the rear panel and the audio connectors and control push-buttons located at the front panel.

Refer to Figure 1-5. On Processor A1, microprocessor control of timing and switching signals is required for frequency synthesis on 1st LO A2 and 2nd LO A3, filter switching on 1st Fitter A11 and 2nd Filter A12, and T/R switching throughout. The microprocessor is interrupt-driven to minimize EMI from clock and data signals in receiver circuitry and to reduce external spurious emissions. This means that the processor and associated circuitry is inactive until the operator changes one of the front panel control inputs, and causes an interrupt. At this time, control circuitry activates to perform the appropriate command, and then returns to an inactive condition.

On 1st Fitter A11 and 2nd Filter A12, the microprocessor-based control system has a bus architecture and consists of the microprocessor, an EPLD, an EPROM, RAM, an LCD, and control bus drivers for interfacing internally to the other sections of the radio.

Front panel controls and radio keylines interface to the EPLD. The EPLD encodes input commands into processor logic signals and provides a wake-up call for the microprocessor.

The microprocessor, along with associated EPROM and RAM, generates the required radio commands and outputs them through control bus drivers to associated transceiver circuitry.

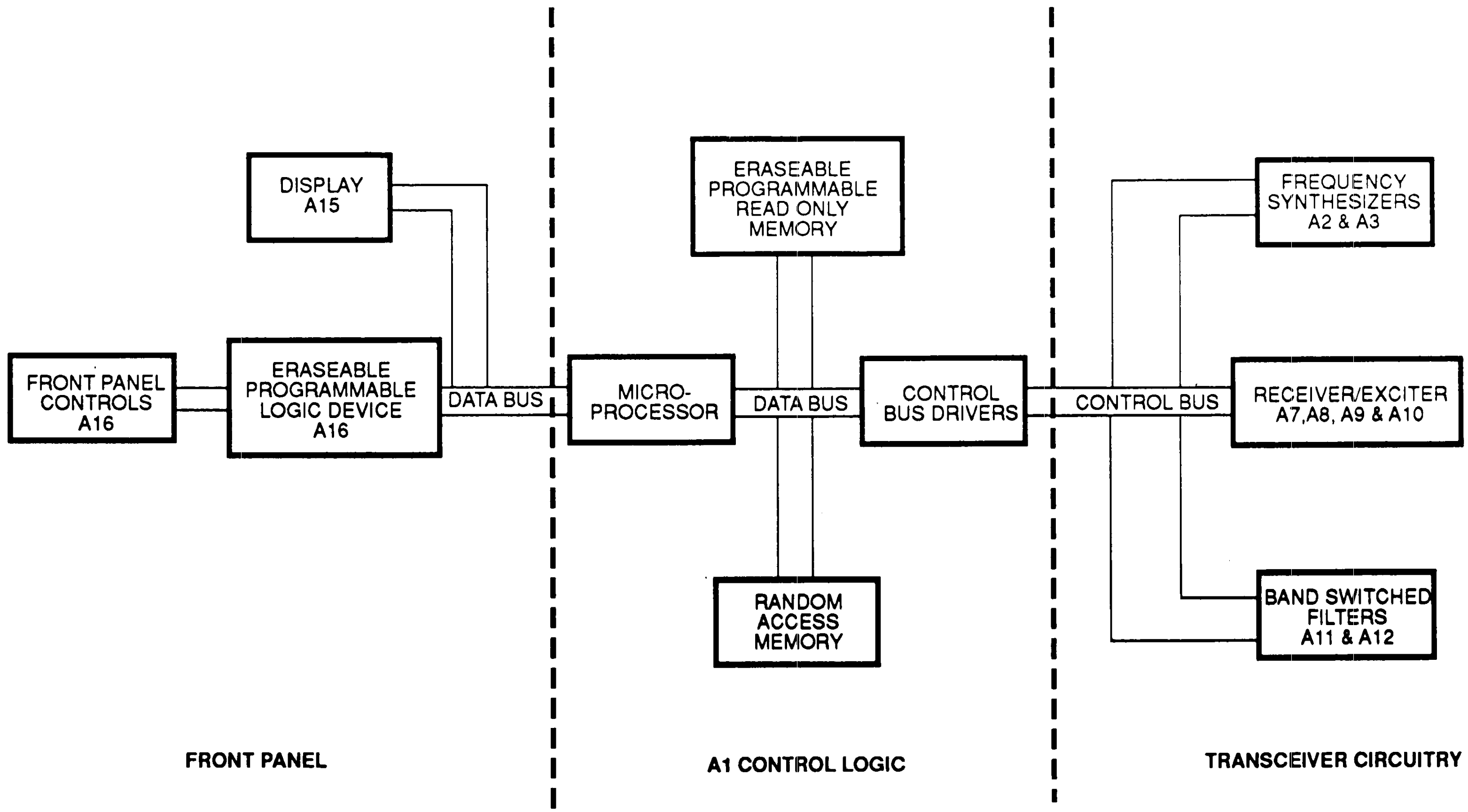


FIGURE 1-5. Block diagram, interface and control circuitry

The EPROM contains a system timing program. It contains the program required by the processor to perform desired functions.

The RAM stores parameters programmed by the operator, such as frequency and channel information. On Processor A1, the lithium battery provides backup power for RAM circuitry when the radio is off.

The LCD displays frequency and channel information, and includes a "T" annuciator to indicate when the radio is in transmit or when a transmit frequency is displayed.

All internal control interface to other radio sections is routed through the Interconnect Board A14.

CHAPTER 2

DIRECT SUPPORT MAINTENANCE

Section I. REPAIR PARTS AND SPECIAL TOOLS

2-1 COMMON TOOLS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

Refer to the Repair Parts and Special Tools List (TM 11-5820-1102-23P) and to the Maintenance Allocation Chart (TM 11-5820 -1102-1 2) for information concerning special tools requirements, TMDE, and support equipment requirements for Direct Support maintenance actions.

DIRECT SUPPORT
MAINTENANCE 2-1

Section II. MAINTENANCE PROCEDURES

2-2 ASSEMBLY AND DISASSEMBLY.

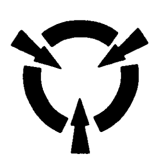
WARNING

Processor board A1 contains a lithium battery. The lithium battery contains flammable organic materiels. Incorrect handling may cause explosion. Do not short battery leads together in any fashion, expose to extreme heat for more than 5-10 seconds, immerse in water or any cleaning solution, make a mistake in polarity, drop, or strike the battery.

WARNING

Circuit A13 contains BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH. For local guidance/assistance on disposal of unserviceable circuit card A13, contact your servicing Defense Reutilization and Marketing Office (DRMO).

CAUTION



CAUTION. CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).

Transceiver circuitry is on replaceable units Printed Circuit Boards (PCBs) that do not require desoldering of wires or parts for access. PCBs can be tested in the radio with cables. All replaceable modules in the transceiver are electrically interchangeable at the Direct Support maintenance level. In all cases following module replacement, the transceiver is completely operational without alignment.

2-2.1 Card Cage Removal and Assembly

2-2.1.1 Disassembly.

a. To access plug-in circuit cards, remove four hex screws from the control panel. Refer to Figure 2-1.

b. Pull chassis out of housing. All plug-in circuit cards are keyed to prevent insertion in the wrong slot. Figure 2-1 also shows gasket and o-ring location.

2-2.1.2 Assembly. Assemble card cage in reverse order of disassembly.

2-2.2 Removal and Assembly of Interconnect Board A14

2-2.2.1 Disassembly.

a. Remove power from transceiver.

b. Remove all cards from transceiver Interconnect Board A14, except for Control Panel A22.

c. Remove 6 hex screws and A14 cover.

d. Remove 2 Phillips screws (Refer to Figure 2-2).

e. Lift Interconnect Board A14 from front to rear.

2-2.2.2 Assembly. To assemble, perform disassembly steps 2-5 in reverse order.

2-2.3 Removal and Assembly of Control Panel A22

2-2.3.1 Disassembly.

a Remove power from transceiver.

b. Refer to Figure 2-3. Unscrew and disengage 4 Phillips screws, but do not remove them.

c. With Interconnect Board A14 down, place transceiver on a flat surface.

d. Press firmly down on card cage while lifting Control Panel A22 up and away.

NOTE

Do not turn Control Panel A22 face down or allow removal screws to fall out.

2-2.3.2 Assembly.

a. Insure that all 4 stand-off posts and screws are properly aligned.

b. Place card cage assembly with Interconnect Board A14 facing you and J15 down. Insure card cage is level with J15 and guide pins extending beyond the flat surface.

c. Gently insert A22P2 and P1 (RF connector) into A14J2 and J1.

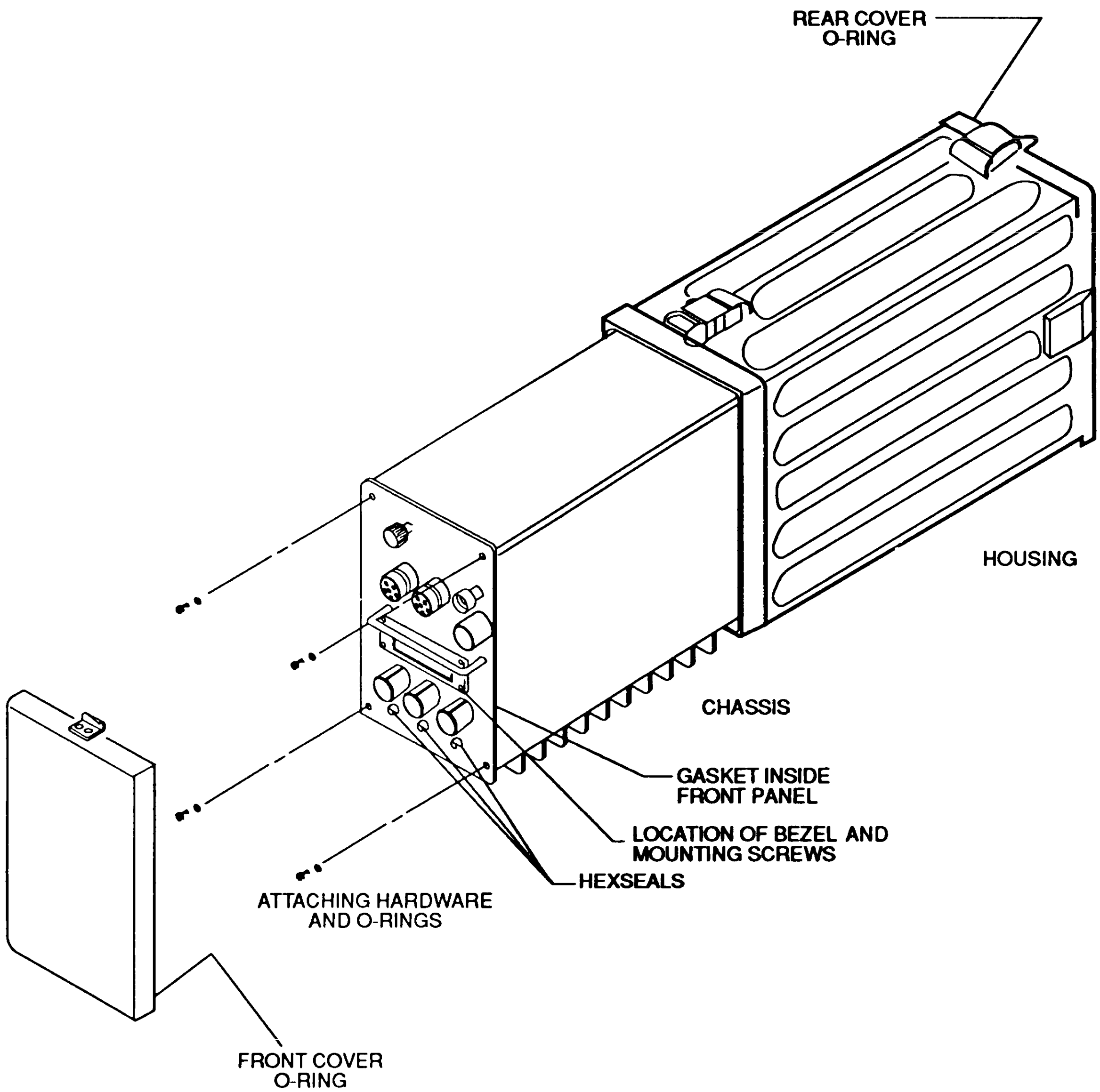


FIGURE 2-1. Removing chassis from housing, gasket and o-ring location

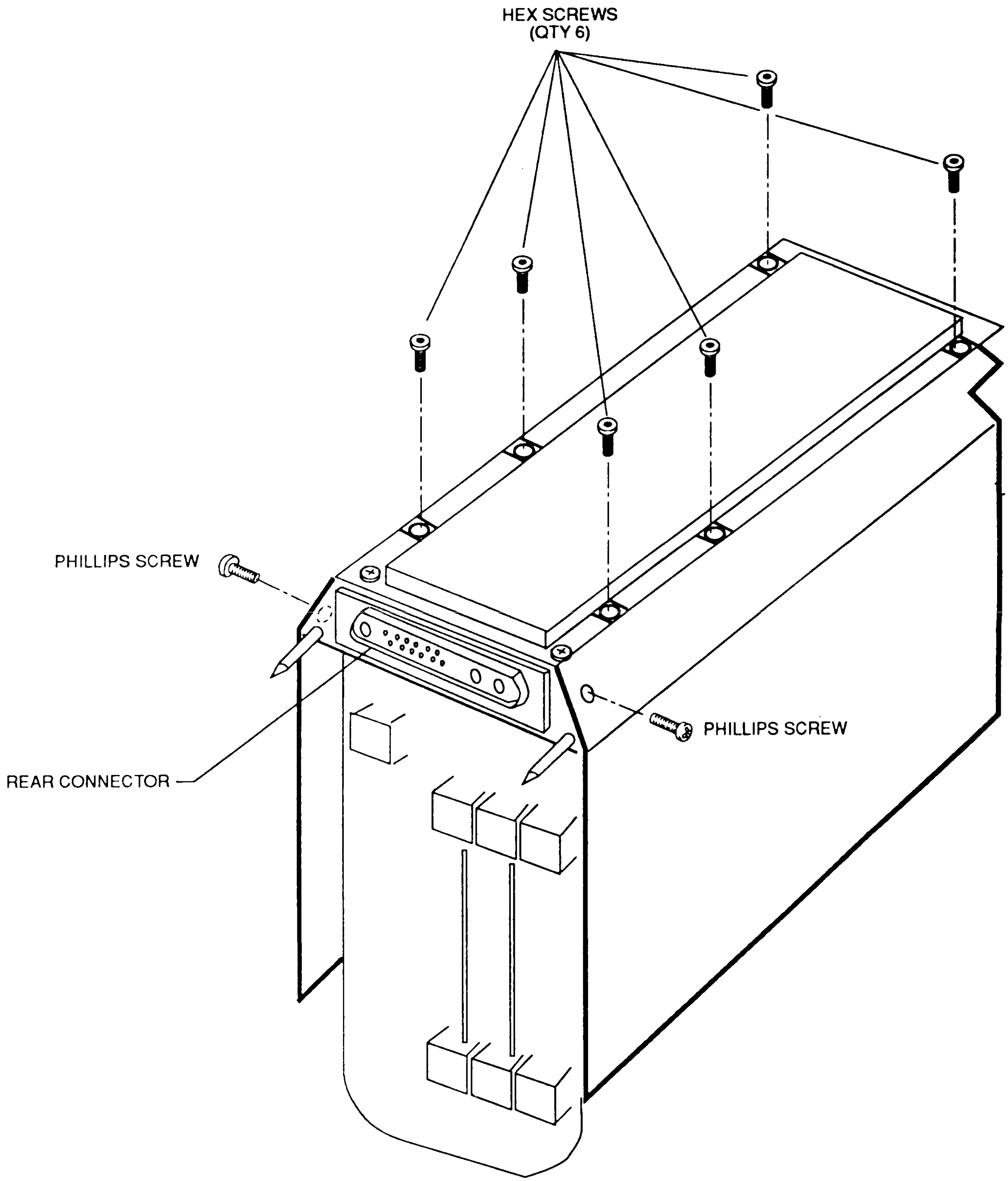


FIGURE 2-2. Location of Interconnect Board A14 hex and Phillips retaining screws

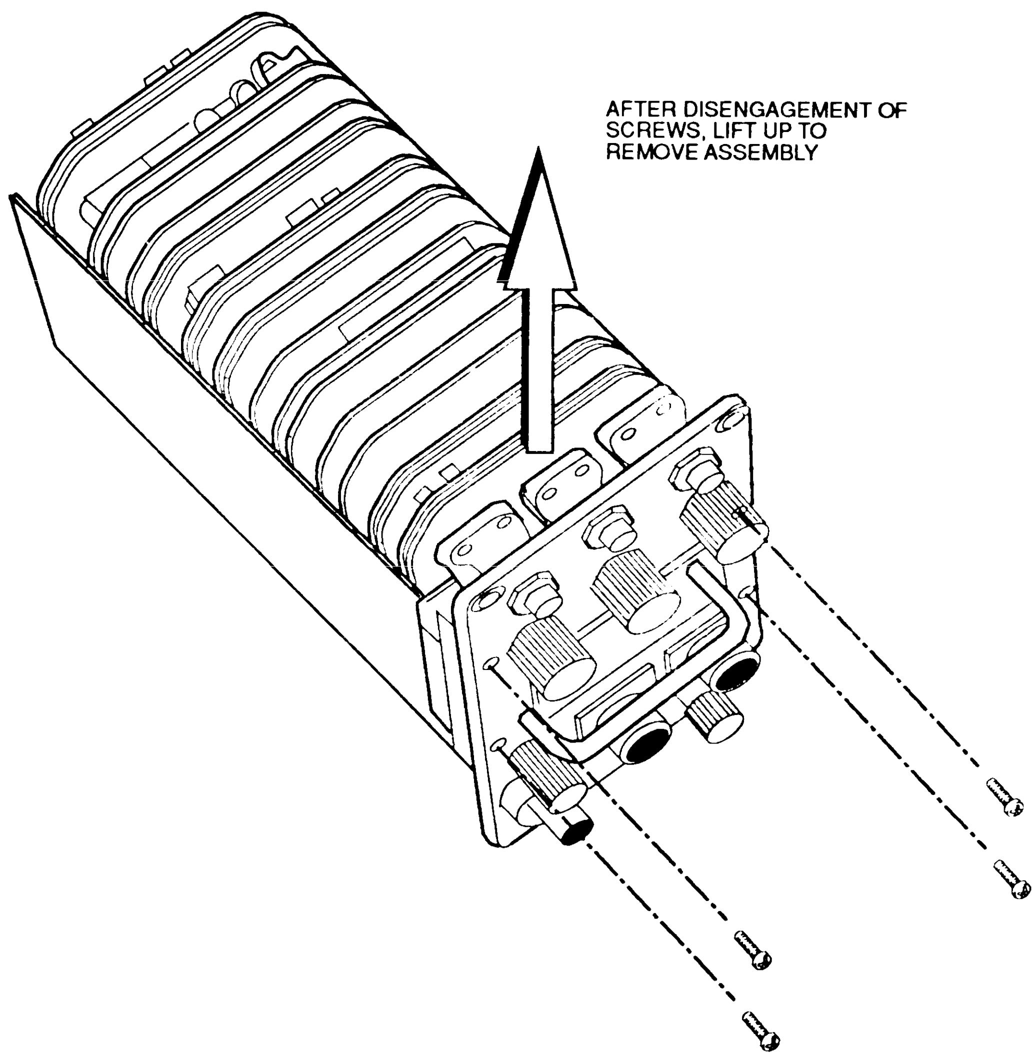


FIGURE 2-3. Front panel assembly removal

d. Insure all screws are alined with card cage and tighten.

2-2.4 Removal and Assembly of Front Panel Bezel

2-2.4.1 Disassembly.

a. Refer to Figure 2-1. Loosen the four bezel mounting screws.

b. Pull bezel out of front panel.

2-2.4.2 Assembly.

a. Place bezel in front panel.

b. Use mounting screws to attach bezel to front panel.

2-2.5 Removal and Assembly of Power Amplifier A13

2-2.5.1 Disassembly.

a. Remove power from transceiver.

b. Remove transceiver from case. Refer to Figure 2-1.

c. Place housing assembly on flat surface with battery plug (P2) facing away from you. Refer to Figure 2-4.

d. Remove 4 hex screws from Power Amplifier A13.

e. Carefully lift rear panel and hinge to left.

f. Loosen the 3 large PCB hex screws.

g. Position rear cover over assembly and, while holding in place, turn housing over.

h. Reach into housing assembly and gently push P15 until free from housing.

2-2.5.2 Assembly.

a Install Power Amplifier A13 and start, but do not tighten, the 3 PCB hex screws.

b. Insert transceiver snugly into housing and tighten A13 PCB hex screws.

c. Remove transceiver from case and reinstall to insure proper alinement of J15/P15.

d. If needed, change bad o-rings on rear panel screws.

e. Secure rear panel.

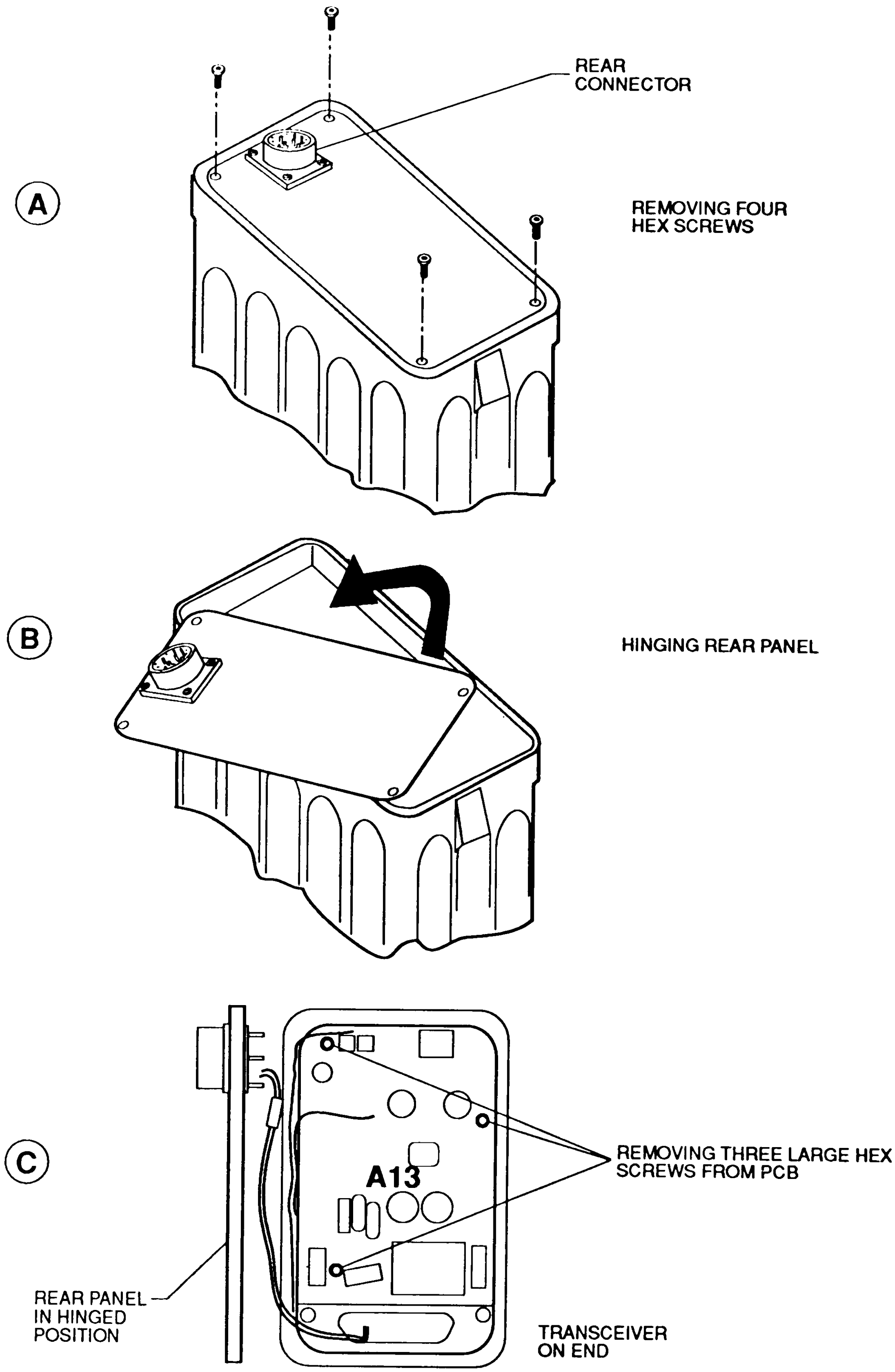


FIGURE 2-4. Removal of Power Amplifier A13

2-2.6 Disassembly and Assembly of Battery Box to Allow Access to Q1, CR1, and CR2

2-2.6.1 Disassembly.

a. Remove battery box rear cover.

b. Remove batter(ies) if installed.

c. Refer to Figure 2-5. Remove 6 hex screws and washers from the PCB retaining frame.

d. Grasp P2 and carefully lift PCB from battery box and rotate 90 degrees counterclockwise.

e. Hinge PCB over to left to allow access to Q1, A1A2A1CR1, A1A2A1CR2, P1, and P2.

f. To remove Q1, unsolder leads and unscrew the two Phillips screws, being sure to retain the thermal gasket under Q1.

g. To remove A1A2A1CR1 and A1A2A1CR2, unsolder wires from leads and unscrew.

2-2.6.2 Assembly. Assemble battery box in reverse order of disassembly.

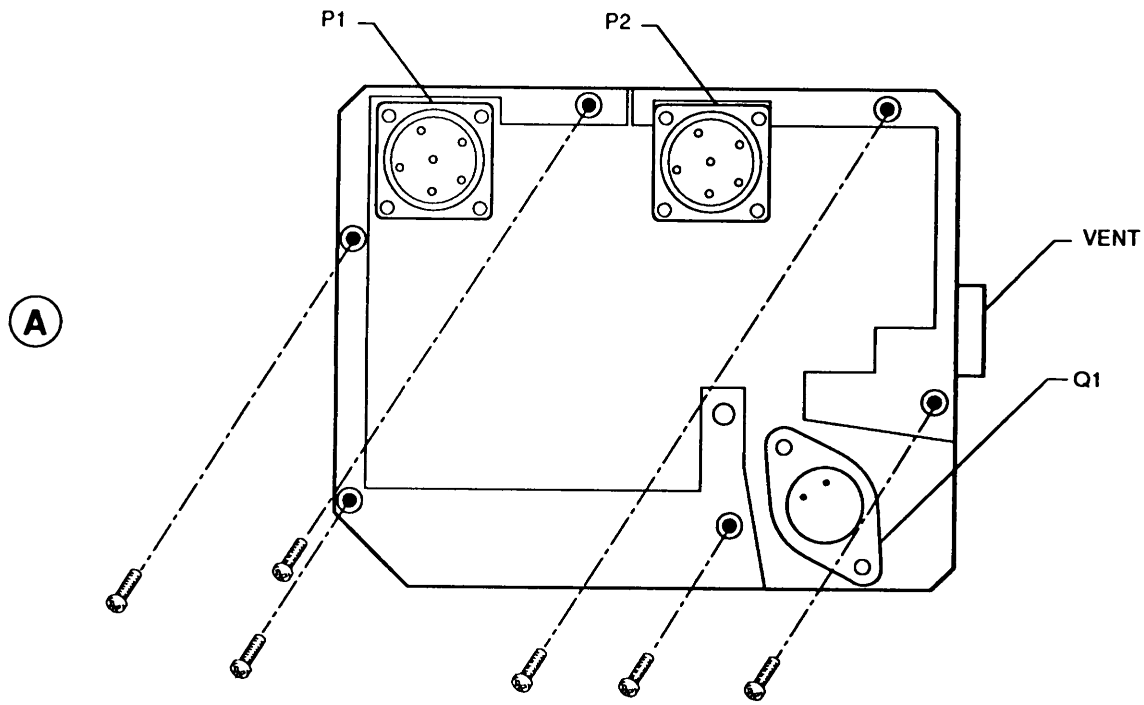
2-3 REPAIR.

Direct Support maintenance of the AN/PRC-132 Radio Set includes repair down to the card level.

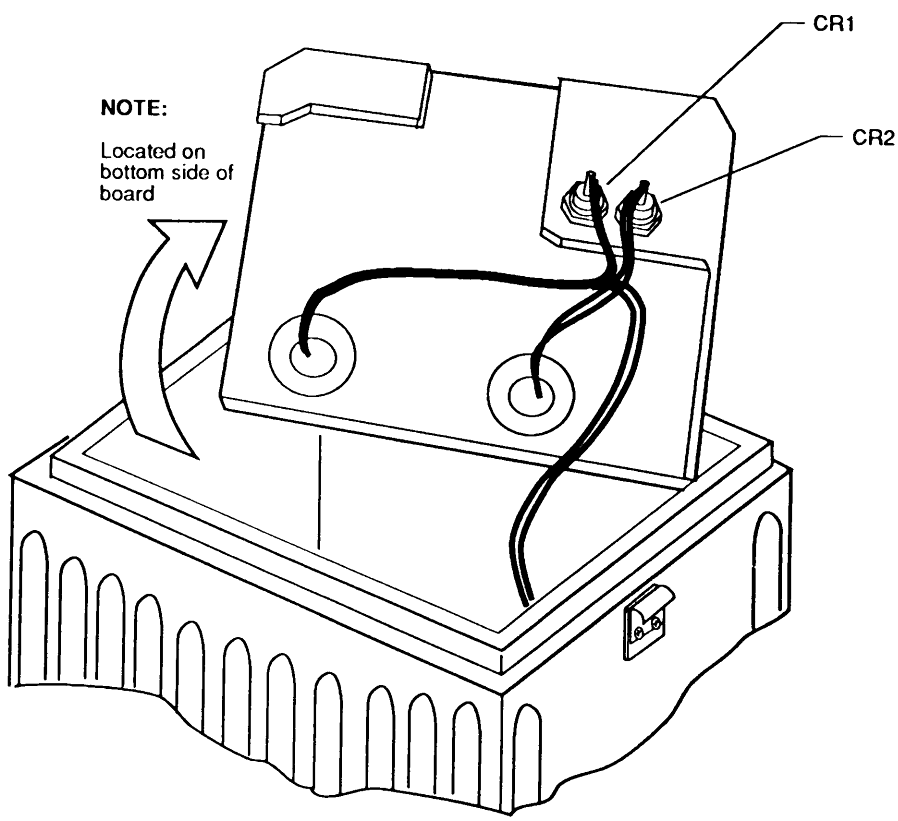
Flathead screws required in the card cage assembly are secured with retaining compound.

In addition, front panel knobs, front and rear cover O-rings, and hexseals used on the ENTER, FREQ SEL, and CHAN buttons can be removed and replaced for maintenance. These items are contained in a running spares kit. Set screws on flatted shafts are used to secure front panel control knobs.

Battery box repair includes replacement of batteries, Q1, A1A2A1CR1, A1A2A1CR2, and connectors P1 and P2.



Location of frame screws



Location of CR1 & CR2

FIGURE 2-5. Battery box disassembly

CHAPTER 3

TROUBLESHOOTING

Section I. GENERAL OPERATION TESTS

3-1 TEST CONDITIONS.

TROUBLESHOOTING
3-1

Input Voltage (Power Supply A)	12.60 VDC +/-0.1, measured at radio terminals. Refer to Figure 3-1.
Input Voltage (Power Supply B)	5 - 8 VDC +/-0.1, measured at radio terminals. Used only during Automatic Leveling Control (ALC) testing. Refer to Figure 3-4.

NOTE

Unless otherwise specified, all frequency measurements are referenced to 50 ohms.

Table 3-1 lists the equipment required for Direct Support Maintenance.

Table 3-1. Direct Support Maintenance Level Ground Support Equipment Required For Testing

Qty	Description	Manufacturer	Nomenclature
1	DC Power Supply	---	PP7545 B/U
1	Distortion Measurement Set	---	TS-4084/G
1	Spectrum Analyzer	---	PL-1392/U
1	Electronic Counter	---	AN/USM-459A
1	Power Meter	---	AN/USM-491
1	50H30-100 30 dB Attenuator	JFW	---
1	839 Step Attenuator	Kay	---
1	Signal Generator	---	SG-117/U
1	Multimeter	---	AN/USM 486
1	Radio DC Power Cable	---	---
1	Card Cage Extender Cabel	---	---

NOTE: Equivalent test equipment may be used.

3-2 POWER ON TEST.

Ensure that transceiver will power on.

If this test fails, refer to item 1 of the troubleshooting index (Table 3-5).

3-3 FREQUENCY PROGRAMMING AND SECURE LIGHTING TEST.

Ensure that receive and transmit frequencies can be programmed, and that frequency and channel scan both work correctly. Ensure that secure lighting function works.

3-3.1 Load Frequencies for Channels 1-11 Refer to the matrix for loading channels 1-11.

CH	RECEIVE FREQUENCY	TRANSMIT FREQUENCY
1	2.8000	2.9000
2	2O.1000	20.1000
3	49.9999	49.9999
4	1.6000	1.6000
5	2.0100	2.0100
6	3.4500	3.4500
7	5.6400	5.6400
8	9.2200	9.2200
9	15.0750	15.0750
10	24.6500	24.6500
11	40.2900	40.2900

3-3.1.1 Setting Channels. Use the following procedures to load frequencies for each channel to be set.

NOTE

Leading zeros must be entered. Trailing zeros must be entered for channel. Leading zeros are displayed for channel.

a. Set POWER switch to RX position.

(1) Press CHAN to display current channel in the following format: “HL XX" (XX = two-digit channel number). If channel is correct, press enter.

(2) Perform the following to program a new channel.

(a) Turn select switch to the first digit of the desired channel number. Examples: To set channel 10, turn switch to 1. To set channel 09, turn switch to 0.

CAUTION

If the Liquid Crystal Display (LCD) shows a single letter "H" or series of the letter "H" when you press the FREQ SEL button, the transceiver is in the memory clear sequence. Press CHAN or turn the transceiver off to abort the clear operation. Then restart the procedure you were performing.

(b) Press FREQ SEL to display digit selected.

(c) Turn select switch to the second digit of the channel number. Examples: To set channel 10, turn switch to 0. To set channel 09, turn switch to 9.

(d) Press FREQ SEL to display selected channel.

(e) If the channel displayed is not correct, go back to step a(2)(a).

(f) Press ENTER to display current receive frequency for selected channel.

b. Program receive frequency as follows:

NOTE

Leading zeros must be entered. Trailing zeros need not be entered for frequency. Leading zeros are not displayed for frequency.

(1) If frequency shown on LCD is the desired receive frequency, press ENTER. Go to step c.

(2) If frequency shown is not the desired recieve frequency, proceed as follows:

(a) Turn select switch to the first digit of the recieve frequency. Examples: To set 20 MHz, turn switch to 2. To set 9.9999 MHz, turn switch to 0. In this second example, you are really setting 09.9999 MHz.

CAUTION

If the LCD shows a single letter "H" or series of the letter "H" when you press the FREQ SEL button, the transceiver is in the memory clear sequence. Press CHAN or turn the transceiver off to abort the clear operation. Then restart the procedure you were performing.

(b) Press FREQ SEL to display digit selected. If display is incorrect, press CHAN, then ENTER, and go back to step b(2)(a).

(c) Turn select switch to the next digit of the receive frequency and press the FREQ SEL button. LCD will show digit selected. Repeat this step until the required digits have been entered. If any entries are incorrect, press CHAN, then ENTER, and go back to step b(2)(a).

(d) When you have entered the required digits, press ENTER to store receive frequency in memory.

NOTE

At this point, LCD shows a small "T" above the decimal point of the frequency display. This indicates that frequency shown is the transmit frequency.

c. Program transmit frequency as follows:

(1) If frequency shown on LCD is the desired transmit frequency, press ENTER.

(2) If frequency shown is not the desired transmit frequency, enter a new transmit frequency in the same manner as you would a new receive frequency. When you have entered transmit frequency, press ENTER. Transmit frequency is now stored in memory.

If this test fails, refer to items 2 and 3 of the troubleshooting index Table 3-5).

3-3.2 Frequency and Channel Scan Perform the following to verify that frequencies and channels can be scanned.

3-3.2.1 Scanning Frequencies. To scan receive frequencies in steps of 100 Hz, proceed as follows.

a. Set POWER switch to any operating position and select operating mode.

b. Turn select switch to UDB position.

CAUTION

If the LCD shows a single letter "H" or series of the letter "H" when you press the FREQ SEL button, the transceiver is in the memory clear sequence. Press CHAN or turn the transceiver off to abort the clear operation. Then restart the procedure you were performing.

c. Press FREQ SEL to display the current channel in the following format: "PL XX" (XX = two-digit channel number).

d. If a different channel is required, proceed as follows:

(1) Turn select switch to the first digit of the desired channel number. Examples: To set channel 10, turn switch to 1. To set channel 09, turn switch to 0.

(2) Press FREQ SEL to display the digit selected.

(3) Turn select switch to the second digit of the channel number. Examples: To set channel 10, turn switch to 0. To set channel 09, turn switch to 9.

(4) Press FREQ SEL to display channel selected. If channel displayed is not correct, go back to step d(1).

e. Press ENTER to display the receive frequency.

f. At this point, frequency scan operation is enabled. To increase frequency, press FREQ SEL To decrease frequency, press ENTER.

g. To exit frequency scan, turn select switch to any number and press CHAN.

3-3.2.2 Scanning Channels. To scan through 11 channels, proceed as follows.

a. Set POWER switch to any operating position and select operating mode.

b. Press CHAN to display current channel in the following format: “HL XX” (XX = two-digit channel number).

NOTE

Receive frequency, not channel number, is displayed during scan.

c. If a different starting channel is required, proceed as follows:

(1) Turn select switch to the first digit of the desired channel number. Examples: To set channel 10, turn switch to 1. To set channel 09, turn switch to 0.

CAUTION

If the LCD shows a single letter "H" or series of the letter “H” when you press the FREQ SEL button, the transceiver is in the memory clear sequence. Press CHAN or turn the transceiver off to abort the clear operation. Then restart the procedure you were performing.

(2) Press FREQ SEL to display the digit selected.

(3) Turn select switch to the second digit of the channel number. Examples: To set channel 10, turn switch to 0. To set channel 09, turn switch to 9.

(4) Press FREQ SEL to display both digits selected. If the channel displayed is not correct, go back to step c(1).

d. Press ENTER. The receive frequency will be displayed.

e. Turn select switch to SCAN.

f. At this point, channel scan is enabled. Press FREQ SEL to increase the channel.

NOTE

Channel scan cycles through 11 channels. Each time FREQ SEL is pressed, one is added to the current channel until the eleventh channel is reached. After the eleventh channel, the scan returns to the first channel. For example, if the starting channel is 10, scan will be as follows: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 10, 11, etc.

Scanning stops at channel 99 even if fewer than eleven channels have been scanned. For example, if the starting channel is 95, scan will be as follows: 95, 96, 97, 98, 99, 95, 96, etc.

g. To exit channel scan, turn select switch to any number and press CHAN.

If this test fails, refer to items 2 and 3 of the troubleshooting index (Table 3-5).

3-3.3 Secure Lighting Perform the following procedure to verify that secure lighting function works:

a. Use CHAN button to turn LCD secure lighting on or off.

b. Press CHAN button twice to turn lighting on.

c. Press CHAN button twice to turn lighting off.

d. Be sure to turn secure lighting off when it is not needed to prolong battery life.

If this test fails, refer to items 2 and 3 of the troubleshooting index (Table 3-5).

3-4 RECEIVER TESTS.

CAUTION

Do not key transceiver during receive tests. Leave transceiver in RX only position. Test equipment attached to the ANT connector may be damaged if transceiver is keyed.

3-4.1 No RX If unable to receive, refer to item 4 of the troubleshooting index (Table 3-5).

3-4.2 Low Audio If audio is low or weak, refer to item 5 of the troubleshooting index (Table 3-5).

3-4.3 Sensitivity Test Perform sensitivity test as follows:

a. Connect transceiver to test equipment as shown in Figure 3-1.

b. Perform the following steps:

(1) Set transceiver to the frequency and mode listed in Table 3-2.

(2) Set signal generator to the frequency listed in Table 3-2.

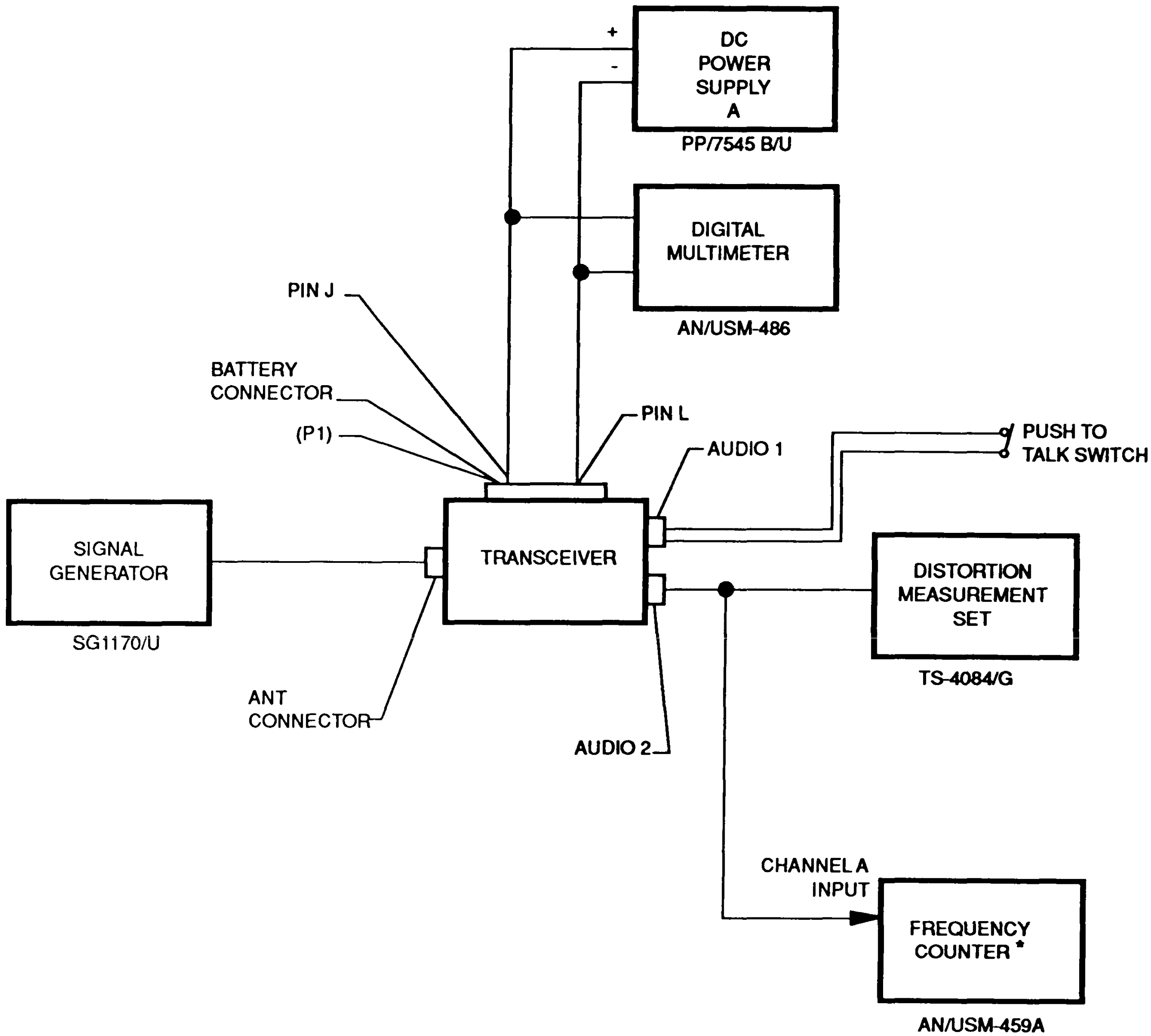
(3) Adjust signal generator output level to -117 dBm or +.316 microvolts and adjust volume to 1.5 Volts root-mean-square (Vrms) on distortion measurement set. With a 1 kHz receive tone, Signal Into Noise and Distortion (SINAD) reading on the distortion measurement set should be 10 dB or greater.

(4) Record SINAD output level.

c. Repeat steps b (1) through b(4) for each entry in Table 3-2.

d. If all recorded readings are greater than or equal to 10 dB SINAD, transceiver has passed sensitivity test.

e. If this test fails, refer to item 6 of the trouble shooting index (Table 3-5).



* FREQUENCY STABILITY MUST BE 0.1 ppm (1 x10^{-7}) OR BETTER

FIGURE 3-1. Test equipment setup for receive and sensitivity tests

Table 3-2. Settings for Sensitivity Test

Channel	Transceiver Frequency	Transceiver Mode	Signal Generator Frequency
5	2.0100 MHz	USB	2.0110 MHz
6	3.4500 MHz	LSB	3.4490 MHz
7	5.6400 MHz	LSB	5.6390 MHz
8	9.2200 MHz	AME	9.2210 MHz
9	15.0750 MHz	AME	15.0760 MHz
10	24.6500 MHz	USB	24.6510 MHz
11	40.2900 MHz	USB	40.2910 MHz

3-4.4 Audio Distortion Test Perform audio distortion test as follows:

a. Connect transceiver to test equipment as shown in Figure 3-1.

b. Perform the following steps:

(1) Set transceiver to frequency and mode listed in Table 3-2 (Channel 5).

(2) Set signal generator to channel 5 frequency listed in Table 3-2.

(3) Adjust signal generator output level to -80 dBm/22.4 microvolts.

(4) On the distortion measurement set, adjust volume output to 2.25 Vrms, minimum.

(5) A reading of no more than 5% should be shown on the distortion measurement set.

If this test fails, refer to item 7 of the troubleshooting index (Table 3-5).

3-5 TRANSMIT TESTS

CAUTION

Ensure all test equipment is properly adjusted before keying transceiver. Key transceiver for the minimum amount of time required to take a reading. Do not leave transceiver keyed for more than 60 seconds at a time, or exceed a 1:9 duty cycle. Failure to observe this caution may result in degraded performance, causing test failure.

NOTE

When keyed for an excessive period of time, the transceiver automatically protects itself against heat build-up by reducing the transmit power output level.

NOTE

All power readings in the following steps are adjusted for the 30 dB attenuator between the antenna output of the transceiver and the power meter. For 50 watts (+47 dBm) output from the transceiver, the power meter will read 50 milliwatts (+17 dBm). For 20 Watts (+43 dBm), the power meter will read 20 milliwatts (+13 dBm). For 10 watts (+40 dBm), the power meter will read 10 milliwatts (+10 dBm). For 5 watts (+37 dBm) the power meter will read 5 milliwatts (+7 dBm). For Amplitude Modulation Equivalent (AME) operations you will read 3 dB less than the listed levels when using an average power meter.

3-5.1 Transmit Power Out Test Perform transmit power out test as follows:

a. Connect transceiver to test equipment as shown in Figure 3-2.

b. Set transceiver for transmit at 50 watts.

c. Set the distortion measurement set audio generator for 1000 Hz at 5 millivolts root-mean-square (rms).

d. Perform the following steps:

(1) Program the transceiver to the frequency and mode listed in Table 3-3.

(2) Key the transceiver and record the output power for each setting.

e. Repeat steps d(l) through d(2) for each entry in Table 3-3.

Table 3-3. Settings for Transmit Power Output Test at 50 Watts

Channel	Transceiver Frequency	Transceiver Mode
5	2.0100 MHz	USB
6	3.4500 MHz	LSB
7	5.6400 MHz	USB
8	9.2200 MHz	LSB
9	15.0750 MHz	USB
10	24.6500 MHz	USB
11	40.2900 MHz	USB
3	49.9999 MHz	USB

f. If the output power, as read on the power meter, is in all cases between 40 and 63 milliwatts (+16 to +18 dBm), the transceiver has passed the transmit power output test at 50 watts.

NOTE

Allowable variation without attenuation from 50 watts is +47 dBm +/-1 dB.

g. Set transceiver for transmit at 5 watts and wait 5-10 seconds.

h. Perform the following steps:

(1) Set transceiver to frequency and mode listed in Table 3-4.

Table 3-4. Settings for Transmit Power Output Test at 5, 10, and 20 Watts

Channel	Transceiver Frequency	Transceiver Mode
1	2.8000 MHz	USB
2	20.1000 MHz	LSB
3	49.9999 MHz	USB

(2) Key transceiver and record the output voltage for each setting.

i. Repeat steps h(1) through h(2) for each entry in Table 3-4.

j. If the output power, as read on the power meter, is in all cases between 4.0 and 6.3 milliwatts (+6 to +8 dBm), the transceiver has passed the transmit power output test at 5 watts.

NOTE

Allowable variation without attenuation from 5 watts is +37 dBm +/-1 dB.

k. Set transceiver for transmit at 10 watts.

l. Perform the following steps:

(1) Set transceiver to the frequency and mode listed in Table 3-4

(2) Key transceiver and record the output voltage for each setting.

m. Repeat steps I(1) through I(2) for each entry in Table 3-4.

n. If the output power, as read on the power meter, is in all cases between 7.9 and 12.6 milliwatts (+9 to +11 dBm), the transceiver has passed the transmit power output test at 10 watts.

NOTE

Allowable variation without attenuation from 10 watts is +40 dBm +/-1 dB.

o. Set transceiver for transmit at 20 watts.

p. Perform the following steps:

Set transceiver to the frequency and mode listed in Table 3-4.

(2) Key transceiver and record the output voltage for each setting.

q. Repeat steps p(1) through p(2) for each entry in Table 3-4.

r. If the output power, as read on the power meter, is in all cases between 15.9 and 25.2 milliwatts (+12 to +14 dBm), the transceiver has passed the transmit power output test at 20 watts.

NOTE

Allowable variation without attenuation from 20 watts is +43 dBm +/-1 dB.

If this test fails refer to items 8, 9, 10, 11, 12, 13, 14, and 15 of the troubleshooting index (Table 3-5).

3-5.2 Frequency Accuracy Test Perform frequency accuracy test as follows:

a. Connect transceiver to test equipment as shown in Figure 3-3.

b. Perform the following steps:

(1) Place transceiver in 5 watt position/AME mode and select channel 3 (49.9999 MHz).

(2) Key transceiver and record frequency counter reading.

c. If output frequency is +/- 50 Hz of transmit frequency, the transceiver has passed the frequency accuracy test.

NOTE

Tolerance is 1 part per million (ppm), which is 1 Hz per MHz of the transceiver frequency.

If this test fails, refer to item 16 of the troubleshooting index (Table 3-5).

3-5.3 Automatic Leveling Control (ALC) Test Perform ALC test as fallows:

a. Connect transceiver to test equipment as shown in Figure 3-4.

b. Set transceiver to 50 watt and set to channel 11 (40.2900 MHz) mode USB.

c. Set distortion measurement set audio generator for 1000 Hz at 5 millivolts rms.

d. Set power supply B to +5.0 VDC.

CAUTION

Transceiver is keyed in steps e through g. Insure that transceiver does not remain keyed for longer than 60 seconds or exceed 1:9 duty cycle. Failure to observe this caution may result in degraded performance, causing test failure.

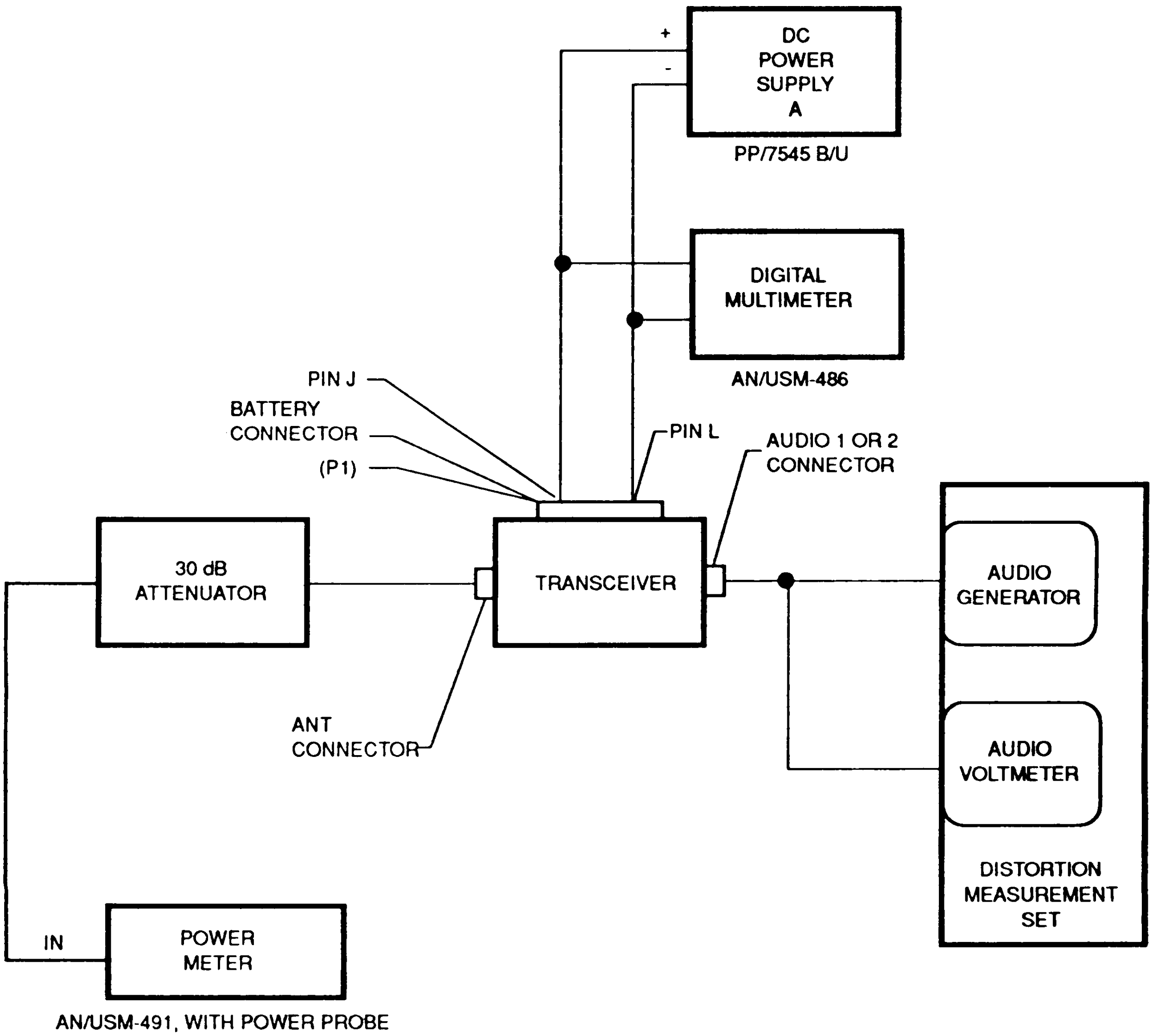
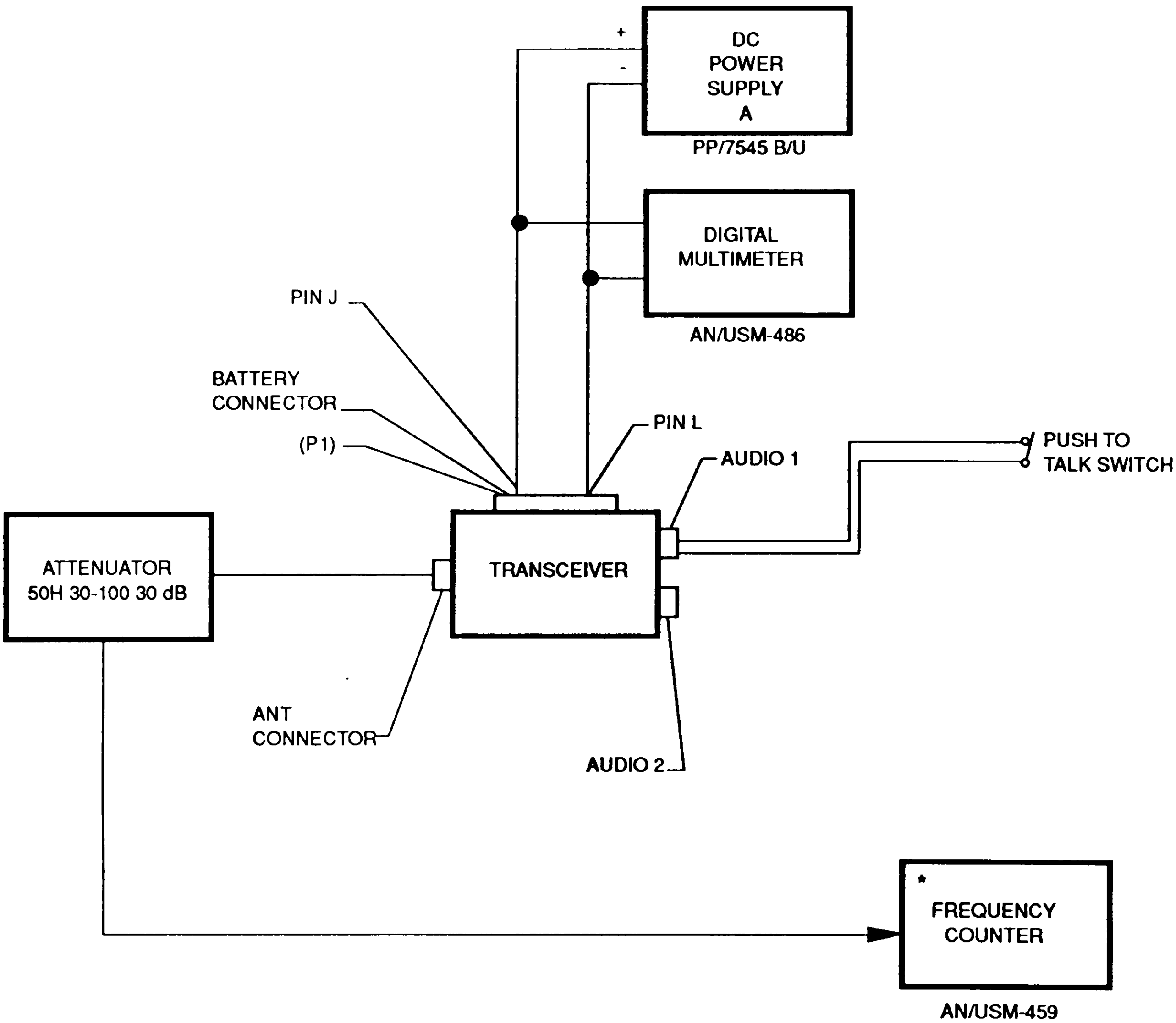


FIGURE 3-2. Test equipment setup for transmit power out test



* FREQUENCY STABILITY MUST BE 0.1 ppm (1 x 10^{-7}) OR BETTER

FIGURE 3-3. Test equipment setup for frequency accuracy test

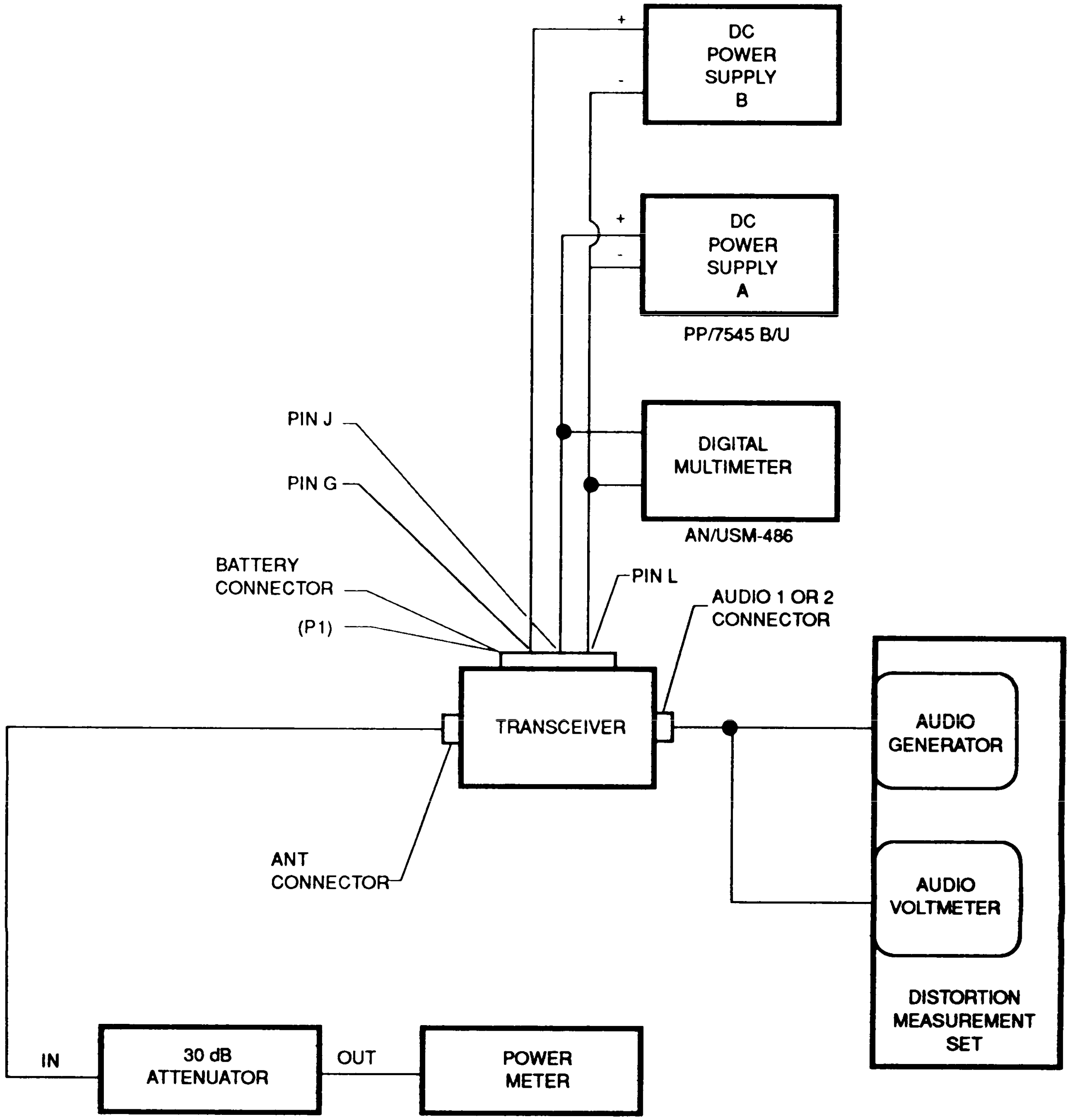


FIGURE 3-4. Test equipment setup for automatic leveling control test

e. Key transceiver and verify reading on power meter is between 40 and 63 milliwatts (+16 to +18 dBm).

f. With transceiver keyed, adjust power supply B to +8 VDC. Verify no power output on power meter.

g. While transceiver is still keyed, readjust power supply B to +5.0 VDC and verify reading on power meter is between 40 and 63 milliwatts (+16 to +18 dBm).

h. Unkey transceiver. If transceiver output has no power out at +8 VDC, and power output returns at +5 VDC, transceiver has passed the ALC test.

If this test fails, refer to item 17 of the troubleshooting index (Table 3-5).

Section II. TROUBLESHOOTING PROCEDURE

3-6 TROUBLESHOOTING.

Tests performed during Direct Support maintenance level troubleshooting include:

- Power On
- Frequency Programming and Secure Lighting
- Receive
- Transmit

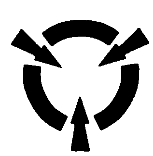
WARNING

Processor board A1 contains a lithium battery. The lithium battery contains flammable organic materiels. Incorrect handling may cause explosion. DO NOT short battery leads together, expose to extreme heat for more than 5-10 seconds, immerse in water or any cleaning solution, make a mistake in polarity, drop, or strike the battery.

WARNING

Circuit card A13 contains BERYLLIUM OXIDE (BeO) CERAMICS. The dust or fumes from BERYLLIUM OXIDE CERAMICS are HIGHLY TOXIC and breathing them can result in serious personal injury or DEATH. For local guidance/assistance on disposal of unserviceable circuit card A13, contact your servicing Defense Reutilization and Marketing Office (DRMO).

CAUTION



CAUTION. CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).

To troubleshoot the AN/PRC-132 Radio Set, perform the general operation tests to identify the failed test. Then refer to the troubleshooting index, which lists the replacement sequence for each failed test. Only Direct Support level repaceable units are listed.

The unit most likely to cause a given failure is listed first, and should be substituted first. If the unit does not correct the failure, reinstall original PCB and substitute the next unit on the list. Continue substitution, in the order listed in the troubleshooting index, until the failure is corrected.

When substitution of a unit corrects failure, assume that the unit is defective and set it aside for repair. After each replacement, recheck the transceiver to ensure that the original failure has not returned.

After completion of this procedure, perform general operational tests before returning the radio set to service. Forward failed unit(s) to the Depot Maintenance facility for repair.

If replacement of all units listed does not solve the problem, forward the entire transceiver or battery box, as applicable, to depot maintenance for repair.

Table 3-5. Troubleshooting Index, RT-1648/PRC-132

NOTE

Refer to paragraph 2-2.5 for removal of Power Amplifier A13. Refer to paragraph 2-2.2 for removal of Interconnect Board A14. Refer to paragraph 2-2.3 for removal of Control Panel Assembly A22.

Item	Indication	Probable Trouble	Procedure
1	Won't power up.	Power source.	Insure 12 VDC is applied between pins J and L on P1. Replace power source. Retest. Refer to Table 3-6 for battery box troubleshooting. **OBSERVE POLARITY.** NOTE: Insure 12.6 VDC is present between P15, pins 4 and 5. If voltage is not present, replace A13. Retest. **OBSERVE POLARITY.**
		Input voltage present on pins J and L of P1, but no current is drawn.	Remove all Printed Circuit Boards (PCBs). Replace control panel A22. Apply power and verify Light Emitting Diode (LED) lit and current is drawn.*
		With PCBs removed and A22 replaced, transceiver still does not power up.	Replace A22 and A14. Verify LED lit and current is drawn.*
		* Shorted PCBs.	PWR down. Install PCBs in the following sequence powering transceiver after each PCB is installed to insure PCB is not shorted: A1, A2, A3, A7, A8, A9, A10, A11, A12. If after any PCB is installed the transceiver fails to power up, replace the shorted PCB and the A22. Continue this procedure until all PCBs are installed.
2	Cannot load frequencies into transceiver, and manual scan and secure lighting inoperative.	Bad A2, oscillator.	Power down. Remove PCB A2. Install replacement PCB A2 and power up. Load frequencies.
		Bad A1, processor.	Power down. Remove PCB A1. Install replacement PCB A1. Power up. Load frequencies.

Table 3-5. Troubleshooting Index, Transceiver RT-1648/PRC-132 - CONT

Item	Indication	Probable Trouble	Procedure
3	Cannot load frequencies into transceiver or manual scan or secure lighting inoperative.	Bad A22.	Power down. Remove Assembly A22. Install replacement Assembly A22. Power up. Retest.
		Bad A14.	Power down. Remove PCB A14. Install replacement PCB A14. Retest.
4	Will not receive.	Bad PCB fuse.	Visually check each PCB LED for M condition. Power down. Remove affected PCB. Install replacement PCB. Power up. Check to insure non-lit condition of PCB LED.
		Bad A11, filter relays.	Power down. Remove PCB A11. Install replacement PCB A11. Power up. Retest.
		Bad A12, fitter relays.	Power down. Remove PCB A12. Install replacement PCB A12. Power up. Retest.
		Bad A2, LO1.	Power down. Remove PCB A2. Install replacement PCB A2. Power up. Retest.
		Bad A3, LO2.	Power down. Remove PCB A3. Install replacement PCB A3. Power up. Retest.
		Bad A9, IF mixer.	Power down. Remove PCB A9. Install replacement PCB A9. Power up. Retest.
		Bad A8, fitter.	Power down. Remove PCB A8. Install replacement PCB A8. Power up. Retest.
		Bad A7, detector.	Power down. Remove PCB A7. Install replacement PCB A7. Power up. Retest.
		Bad A22, control panel.	Power down. Remove Assembly A22. Install replacement Assembly A22. Power up. Retest.
		Bad A14, wiring.	Power down. Remove PCB A14. Install replacement PCB A14. Power up. Retest.
5	Low receive audio.	Bad A7, detector.	Power down. Remove PCB A7. Install replacement PCB A7. Power up. Retest.
		Bad A9, IF mixer.	Power down. Remove PCB A9. Install replacement PCB A9. Power up. Retest.

Table 3-5. Troubleshooting Index, Transceiver RT-1648/PRC-132 - CONT

Item	Indication	Probable Trouble	Procedure
		Bad A8, filter.	Power down. Remove PCB A8. Install replacement PCB A8. Power up. Retest.
		Bad A22, control panel.	Power down. Remove Assembly A22. Install replacement Assembly A22. Power up. Retest.
		Bad A14, wiring.	Power down. Remove PCB A14. Install replacement PCB A14. Power up. Retest.
6	Receive sensitivity test failure.	Bad A9, IF.	Power down. Remove PCB A9. Install replacement PCB A9. Power up. Retest
		Bad A7, detector.	Power down. Remove PCB A7. Install replacement PCB A7. Power up. Retest.
		Bad A8, filter.	Power down. Remove PCB A8. Install replacement PCB A8. Power up. Retest.
		Bad A22, control panel.	Power down. Remove Assembly A22. Install replacement Assembly A22. Power up. Retest.
		Bad A14, wiring.	Power down. Remove PCB A14. Install replacement PCB A14. Power up. Retest.
7	Failure of audio distortion test.	Bad A2, LO1.	Power down. Remove PCB A2. Install replacement PCB A2. Power up. Retest.
		Bad A9, IF.	Power down. Remove PCB A9. Install replacement PCB A9. Power up. Retest.
		Bad A7, detector.	Power down. Remove PCB A7. Install replacement PCB A7. Power up. Retest.
		Bad A8, filter.	Power down. Remove PCB A8. Install replacement PCB A8. Power up. Retest.
		Bad A22, control panel.	Power down. Remove Assembly A22. Install replacement Assembly A22. Power up. Retest.
		Bad A14, wiring.	Power down. Remove PCB A14. Install replacement PCB A14. Power up. Retest.
8	Failure of transmit power out test on all channels with less than 3 amps current drawn.	Bad A13, PA.	Power down. Remove PCB A13. Install replacement PCB A13. Power up. Retest.

Table 3-5. Troubleshooting Index, Transceiver RT-1648/PRC-132 - CONT

Item	Indication	Probable Trouble	Procedure
		Bad A10, mixer.	Power down. Remove PCB A10. Install replacement PCB A10. Power up. Retest.
9	Failure of transmit power out test on all channels with more than 17 amps drawn.	Bad A12, filter relay.	Power down, Remove PCB A12. Install replacement PCB A12. Power up. Retest.
		Bad A11, filter relay.	Power down. Remove PCB A11. Install replacement PCB A11. Power up. Retest.
10	Failure of transmit power out test on channels 5, 6, 7, or 8.	Bad A11, filter relay.	Power down. Remove PCB A11. Install replacement PCB A11. Power up. Retest.
		Bad A2, LO1.	Power down. Remove PCB A2. Install replacement PCB A2. Power up. Retest.
11	Failure of transmit power out test on channels 9, 10, or 11.	Bad A12, filter relay.	Power down. Remove PCB A12. Install replacement PCB A12. Power up. Retest.
		Bad A2, LO1.	Power down. Remove PCB A2. Install replacement PCB A2. Power up. Retest.
12	Failure of transmit power out test on all frequencies (low power).	Bad A10, mixer.	Power down. Remove PCB A10. Install replacement PCB A10. Power up. Retest.
		Bad A12, filter relay.	Power down. Remove PCB A12 Install replacement PCB A12. Power up. Retest.
		Bad A8, fitter.	Power down. Remove PCB A8. Install replacement PCB A8. Power up. Retest.
		Bad A9, 1st IF.	Power down. Remove PCB A9. Install replacement PCB A9. Power up. Retest.
		Bad A13, power amplifier.	Power down. Remove PCB A13. Install replacement PCB A13. Power up. Retest.
13	Failure of transmit power out test (low power) channels 5, 6, 7, or 8.	Bad A11, filter relay.	Power down. Remove PCB A11. Install replacement PCB A11. Power up. Retest.

Table 3-5. Troubleshooting Index, Transceiver RT-1648/PRC-132 - CONT

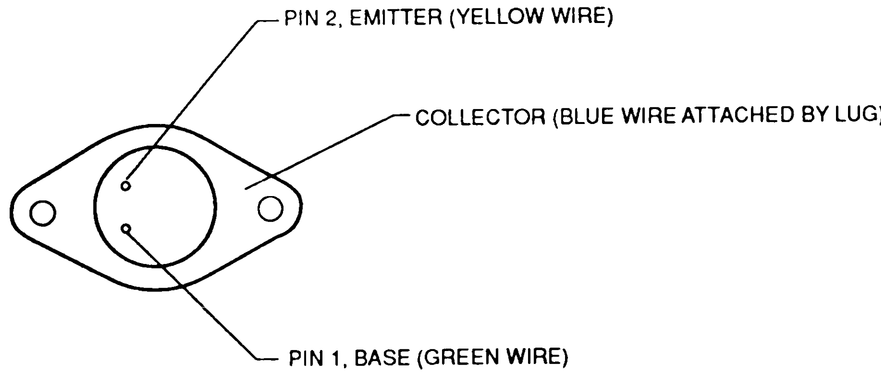
Item	Indication	Probable Trouble	Procedure
		Bad A13, power amplifier.	Power down. Remove PCB A13. Install replacement PCB A13. Power up. Retest.
14	Failure of transmit power out test (low power) channels 9, 10, or 11.	Bad A12, fitter relay.	Power down. Remove PCB A12. Install replacement PCB A12 Power up. Retest.
		Bad A9, 1st IF.	Power down. Remove PCB A9. Install replacement PCB A9. Power up. Retest.
		Bad A8, filter.	Power down. Remove PCB A8. Install replacement PCB A8. Power up. Retest.
		Bad A13, power amplifier.	Power down. Remove PCB A13. Install replacement PCB A13. Power up. Retest.
15	Failure of transmit power out test (exceeds maximum power output limit).	Bad A12, filter relay.	Power down. Remove PCB A12. Install replacement PCB A12 Power up. Retest.
		Bad A10, mixer.	Power down. Remove PCB A10. Install replacement PCB A10. Power up. Retest.
		Bad A22, control panel.	Power down. Remove Assembly A22. Install replacement Assembly A22 Power up. Retest.
		Bad A14, wiring.	Power down. Remove PCB A14. Install replacement PCB A14. Power up. Retest.
16	Fails frequency accuracy test output. Frequency is greater than +/-50 Hz (1 ppm) of the transmit frequency.	Bad A2, LO1.	Power down. Remove PCB A2. Install replacement PCB A2. Power up. Retest.
		Bad A3, LO2.	Power down. Remove PCB A3. Install replacement PCB A3. Power up. Retest.
		Bad A10, mixer.	Power down. Remove PCB A10. Install replacement PCB A10. Power up. Retest.

Table 3-5. Troubleshooting Index, Transceiver RT-1648/PRC-132 - CONT

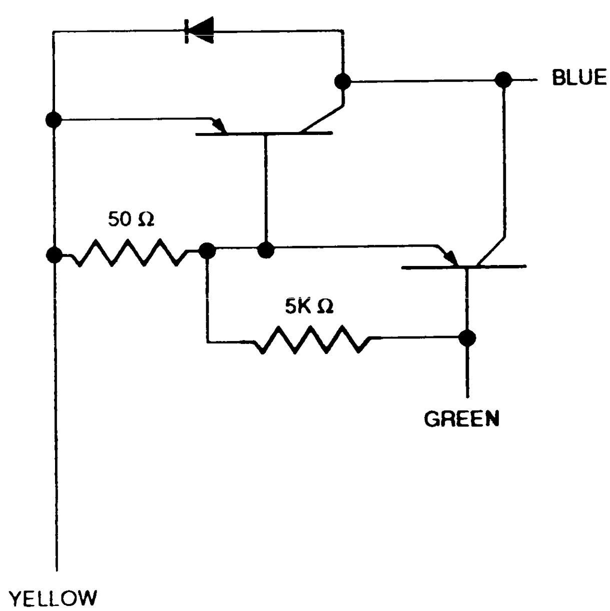
Item	Indication	Probable Trouble	Procedure
17	Fails Automatic Leveling Control test (ALC). Full power out when power supply B is adjusted to 8 VDC, or power out does not return when power supply B is returned to 5 VDC.	Bad A13.	Power down. Remove PCB A13. Install replacement PCB A13. Power up. Retest.
		Bad A10.	Power down. Remove PCB A10. Install replacement PCB A10. Power up. Retest.
		Bad A22.	Power down. Remove Assembly A22. Install replacement Assembly A22. Power up. Retest.
		Bad A14.	Power down. Remove PCB A14. Install replacement PCS A14. Power up. Retest.

Table 3-6. Troubleshooting Index, Battery Box CY-8629/PRC-132

Item	Indication	Probable Trouble	Procedure
1	No output between pin J and L of J1.	Bad batteries.	Replace batteries with known good batteries.
		Bad connector.	Check wiring to J-1. Replace as needed.
		Q1	Test Q1. Refer to Figure 3-5. Replace if bad.
		A1A2A1CR1, A1A2A1CR2	Test CR1. Forward bias resistance should be 5.5 ohms. Reverse bias resistance should be 95 kilohms. Test CR2. Forward bias resistance should be 5.5 ohms. Reverse bias resistance should be 95 kilohms. Replace faulty diodes.
		Bad A1A2A1 PCB.	Replace battery box.



Q1, GRAPHIC



Q1, ELECTRICAL

FIGURE 3-5. Q1, graphic and electrical diagrams

APPENDIX A - REFERENCES

A-1. SCOPE

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A-2. FORMS

DA Form 2028-2	Recommended Changes to Publications and Blank Forms
SF 361	Transportation Discrepancy Report
SF 364	Report of Discrepancy
SF 368	Quality Deficiency Report

A-3. TECHNICAL MANUALS

TM 11-5820-1102-23P	Repair Parts and Special Tools List
TM 11-5820-1102-12	AN/PRC-132 Radio Set Operator's and Unit Maintenance Manual
TM 750-244-2	Destruction of Army Electronics Materiel to Prevent Enemy Use

A-4. MISCELLANEOUS PUBLICATIONS

DA PAM 738-750	The Army Maintenance Management System (TAMMS)

APPENDIX B - EXPENDABLE SUPPLIES AND MATERIELS LIST

Section I. INTRODUCTION

E-1. SCOPE. This appendix lists expendable supplies and materiels you will need to operate and maintain the AN/PRC-132. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable items.

E2. EXPLANATION OF COLUMNS

a. Column (1) - Item number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the materiel (Eg., "Use cleaning compound, item 5, app. D").

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column (3) - National Stock Number. This is the national stock number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (eg., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II, Expendable/Durable Supplies and Materiels List

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
			(Guidance TBS by CECOM)	

GLOSSARY

Section I. ABBREVIATIONS

AC	Alternating Current
AGC	Automatic Gain Control
ALC	Automatic Level Control
AME	Amplitude Modulation Equivalent
ANT	Antenna
BFO	Beat Frequency Oscillator
BIT	Built-In-Test
BW	Bandwidth
CMOS	Complementary Metal Oxide Semiconductor
CW	Continuous Wave
dB	decibels
DC	Direct Current
DMDG	Digital Message Data Group
ECM	Electronic Counter Measures
EMI	Electromagnetic Interference
EPLD	Erasable Programmable Logic Device
EPROM	Erasable Programmable Read Only Memory
FSK	Frequency Shift Key
GND	Ground (electrical)
HF/VHF	High Frequency/Very High Frequency
Hz	Hertz
IF	Intermediate Frequency
kHz	Kilo Hertz
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LO	Local Oscillator
LPI/LPD	Low Probability of Interrupt/Low Probability of Detection
LSB	Lower Sideband
NF	Noise Factor
PCB	Printed Circuit Board
PEP	Peak Envelope Power
PLL	Phase Locked Loop
PTT	Push To Talk
RAM	Random Access Memory
RF	Radio Frequency
RE	Receiver Exciter
rms	root-mean-square
SINAD	Signal into Noise and Distortion
TCXO	Temperature Compensated Crystal Oscillator
T/R	Transmit-Receive
USB	Upper Sideband
VCO	Voltage Controlled Oscillator
VLSI	Very Large Scale Integration
VOGAD	Voice Operated Gain Adjustable Device
Vrms	Volts root-mean-square
VSWR	Voltage Standing Wave Ratio

Section II. DEFINITION OF UNUSUAL TERMS

SINAD = Signal Plus Noise Plus Distortion/Noise Plus Distortion

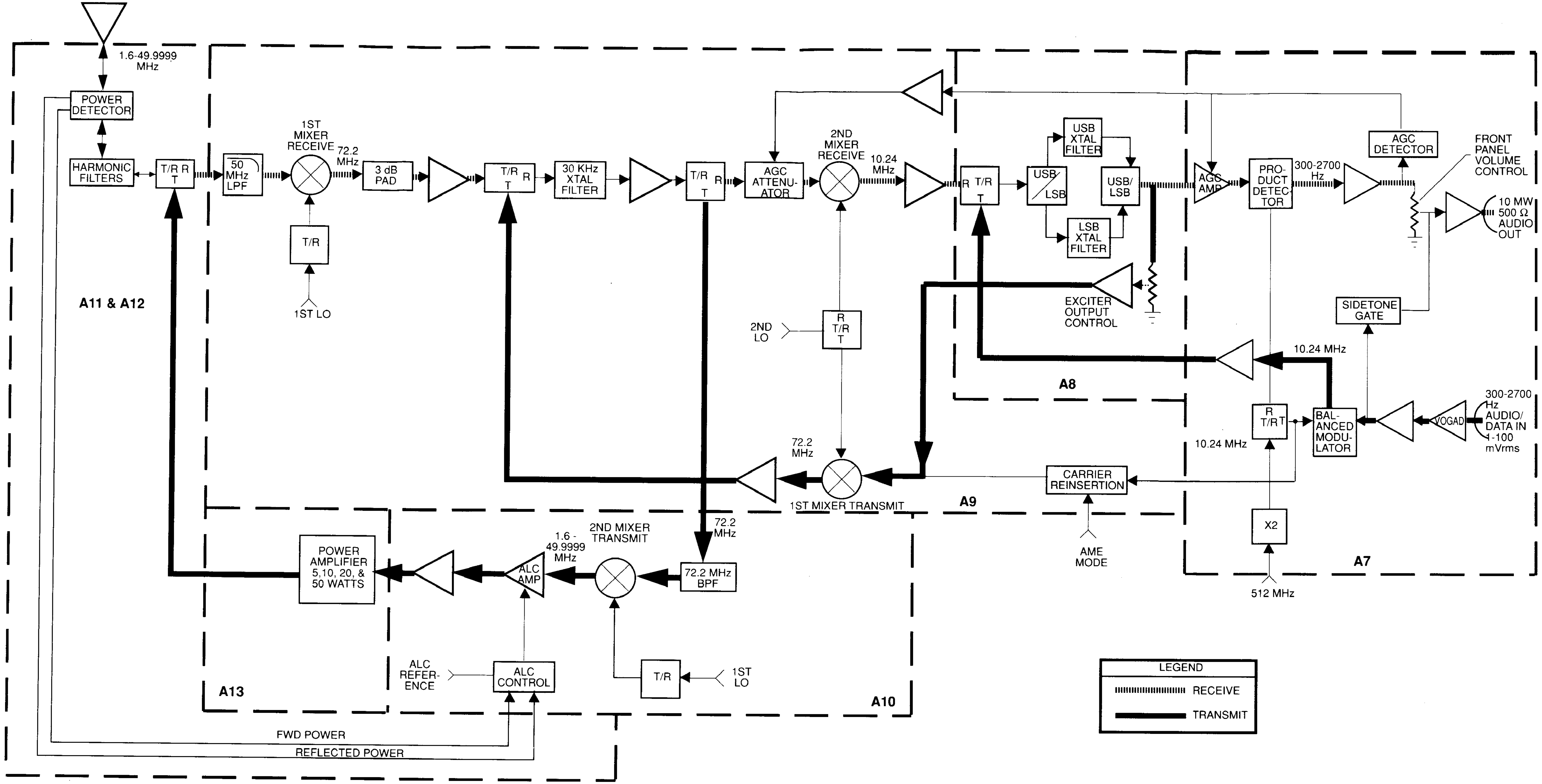
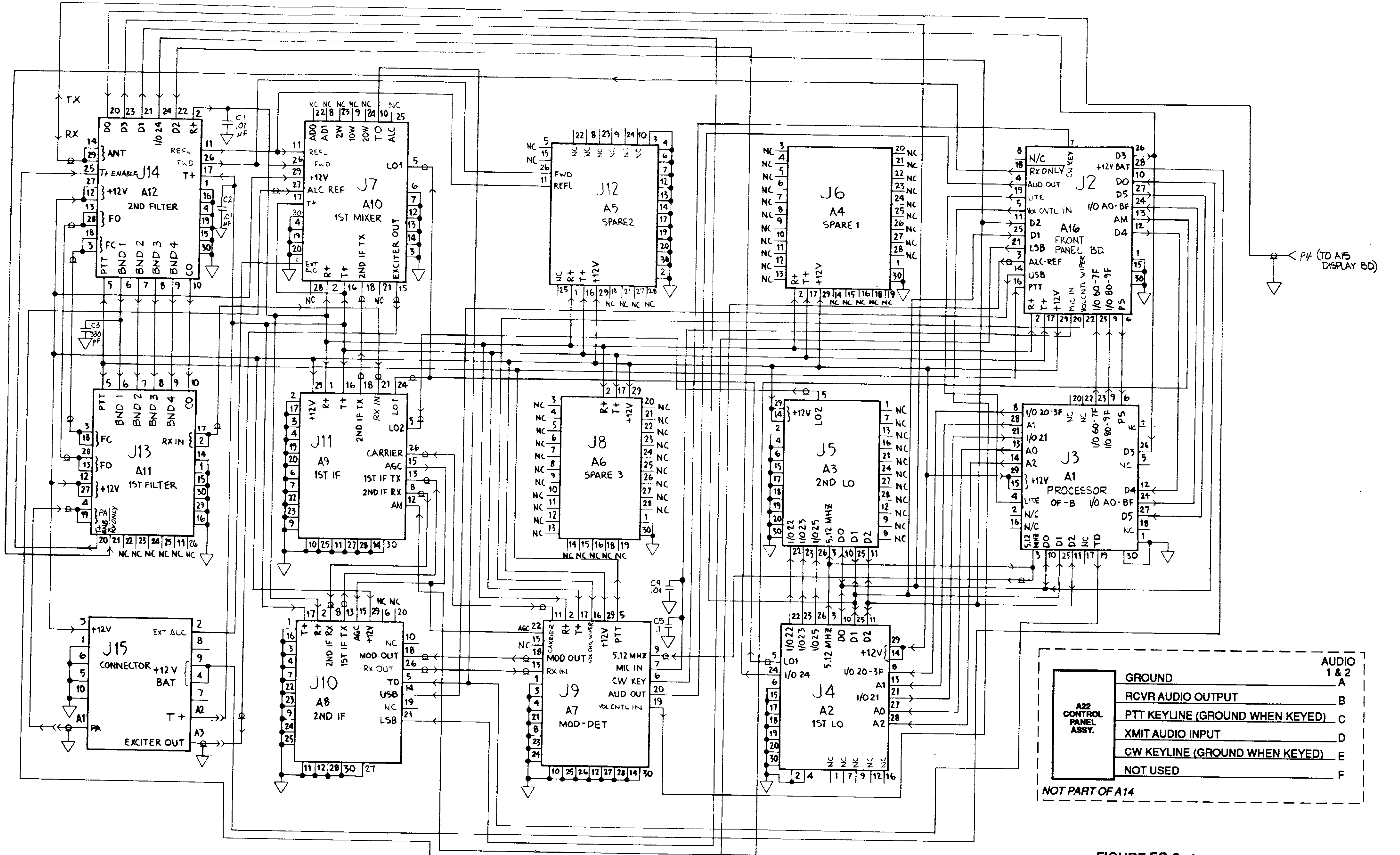


FIGURE FO-1. Transceiver, RT-1648 block diagram



1. CAPACITANCE IN MICROFARADS.

FIGURE FO-2. Interconnect board A14 to PCB interconnection diagram

ALPHABETICAL INDEX

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V

1

2

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

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FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)
Commander
Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703-5007

DATE SENT
10 July 1975

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 11-5840-340-12	23 Jan 74	Radar Set AN/PRC-76

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2^{o} IFF antenna lag rather than 1^{o}. REASON: Experience has shown that with only a 1^{o} lag, the antenna servo system is too sensitive to wind gusting in excess of 25 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2^{o} without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		FO3		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. +24 VDC is the input voltage.

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
SSG I. M. DeSpiritof 999-1776

SIGN HERE
SSG I. M. DeSpiritof

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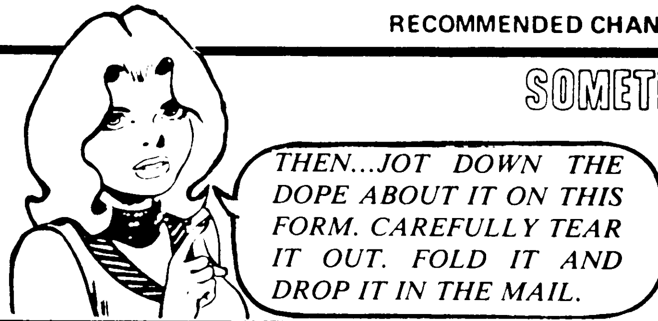

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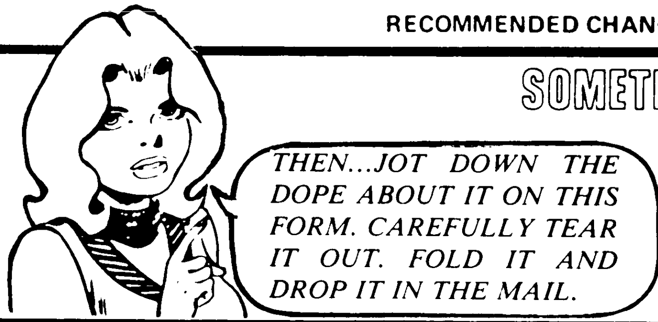

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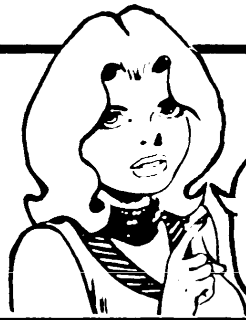

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