

**Heath**

**SS-9000**

**OWNER'S  
MANUAL**

## YOUR HEATH FACTORY ASSEMBLED PRODUCT ONE-YEAR LIMITED WARRANTY

Welcome to the Heath family. We believe you will be pleased with the performance of your new Heath assembled product. Please read this consumer protection plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

### HEATH'S RESPONSIBILITY

**PARTS** — Replacement for factory defective parts will be supplied free for one year from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616)982-3571. And we will pay the shipping charges to get those parts to you...anywhere in the world.

**SERVICE LABOR** — For a period of one year from the date of purchase, any malfunction caused by factory defective parts or workmanship will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation) or any of our authorized overseas distributors.

**TECHNICAL CONSULTATION** — You will receive free consultation on any problem you might encounter in the use of your Heath product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

**NOT COVERED** — Repair service, adjustments and calibration due to misuse, abuse or negligence are not covered by this warranty. Unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, installation, set-up time, loss of use, or unauthorized service.

This warranty covers only Heath factory assembled products and is not extended to other equipment and components that a customer uses in conjunction with our products.

SUCH REPAIR AND/OR PARTS REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORESEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

### OWNER'S RESPONSIBILITY

**EFFECTIVE WARRANTY DATE** — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

**OPERATING MANUAL** — Read your operating instructions carefully so that you will fully understand the proper operation and function of your unit.

**ACCESSORY EQUIPMENT** — Performance malfunctions involving connections to (or interfacing with) other non-Heath equipment are not covered by this warranty and are the owner's responsibility.

**SHIPPING UNITS** — Follow the packing instructions published in your manual. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor Mi 49022. He will make certain your problems receive immediate, personal attention.

# HF Synthesized Transceiver

Owner's Manual



Model SS-9000  
HEATH COMPANY  
BENTON HARBOR, MICHIGAN 49022  
595-2303

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NOTICE: This Manual is written as a user guide only. A separate Customer Service Manual is available that contains complete schematic diagrams, circuit description and troubleshooting information (see Page 52).

## INTRODUCTION

The Heath Model SS-9000 HF Synthesized Transceiver covers the high frequency amateur bands (plus approximately 75 kHz above and below most bands) from 1.8 to 29.7 MHz. This microprocessor-based Transceiver is entirely solid-state and delivers 100 watts to a 50 ohm load. Broadband tuning eliminates the necessity to "peak" circuits within a band. Just turn the Band switch and select the desired frequency.

A large, dual readout displays the operating frequency directly. (In split operation, the transmit and receive frequencies are displayed simultaneously.) A crystal-controlled time base provides high accuracy on all bands and eliminates the necessity of a calibrator. A smoked window, which provides subdued lighting and high visibility, covers the frequency display.

A VOX Delay control is conveniently located on the front panel to facilitate adjustments for operators who work both CW and SSB. VOX or PTT operation is switch selectable and you can switch the AGC action to fast, slow, or off. Jacks are provided on the rear panel for ALC input from an amplifier, and for remote switching an amplifier between transmit and receive.

Power for the Transceiver can be furnished by a power supply (such as the Heath Model PS-9000) or directly from an automobile battery.

The Transceiver's front panel meter always indicates S-units in receive. In transmit, you can select an indication of ALC, relative power, or compression.

Your Heath HF Synthesized Transceiver also gives you:

- Microprocessor circuitry that controls the entire operation of the Transceiver.
- An optical tuning encoder for smooth, linkage-free tuning with no backlash.
- Complete versatility in switching from transceive to split-frequency operation. In the split-frequency mode of operation, the display indicates the transmit and receive frequencies simultaneously on a large dual readout, and you can change the receive frequency while transmitting.
- Extended memory on each band. The internal memory stores the two frequencies indicated on the display plus an alternate frequency on each band. This results in a total of 27 selectable frequencies stored in RAM (random access memory). Also, a battery circuit keeps the memory alive during temporary power interruptions.
- An internal noise blanker to reduce impulse-type noise.
- An internal, front panel adjustable, RF speech processor.
- Two sideband filters for excellent receiver selectivity.
- Incremental plus and minus passband shift to help reduce adjacent frequency interference.

- RIT (receiver incremental tuning), which allows you to shift the receiver frequency without affecting the transmit frequency.
- Low-level RF, available for use with other station accessories.
- A VSWR, over-current, and thermally protected power amplifier.
- An internal diagnostic capability that indicates various malfunctions (if they occur) on the display.
- RTTY capability.
- **And the following accessory:**
  - Customer Service Manual.

# SPECIFICATIONS

## GENERAL

Frequency Readout .....	Two 6-digit electronic displays.
Readout Accuracy .....	To the nearest 100 Hz.
Frequency Control .....	Synthesized VFO, HFO, and BFO for stability and easy tuning.
Tuning .....	100 Hz per step, 5 kHz per knob rotation. Push-buttons provided for up/down tuning (rate is internally adjustable).
Operation .....	Split transmit/receive or transceive from either readout.
Synthesized Lock Indicator .....	Visual indication when the synthesizer is un-locked. Transmitter is disabled when the synthesizer is un-locked.
Frequency Coverage (megahertz) .....	1.8 to 2.0*. 3.5 to 4.0*. 7.0 to 7.3*. 10.1 to 10.15. 14.0 to 14.350*. 18.068 to 18.168*. 21.0 to 21.450*. 24.890 to 24.990. 28.0 to 29.7. WWV @ 15.0

\*Extended receiver coverage (above and below these bands).

Frequency Stability .....	Less than 3 ppm drift from turn-on for first 15 minutes. Less than 3 ppm/hour drift after 15 minutes warm-up. Less than 20 ppm drift from 0° C to +40° C. (Single crystal-controlled 10 MHz frequency standard.)
Modes of Operation .....	LSB. USB. CW-Wide. CW-Medium (400 Hz filter). CW-Narrow (200 Hz filter). RTTY (LSB, 400 Hz filter).
Operating Temperature Range .....	0° C to +40° C.
Speech Processing .....	Adjustable RF speech compressor.
IF Shift .....	Incremental plus and minus passband shift (– 600, – 400, – 200, – 100, 0, + 100, + 200, and + 400 Hz) in the SSB modes.
Power Requirements* .....	11 to 16 VDC with a nominal current maximum of 25 amperes at 100 watts CW output. Receiver current is 2 amperes nominal.
Front Panel Connectors .....	Microphone, headphones.
Rear Panel Connectors & Control .....	Antenna (SO-239). Linear ALC In. Linear ALC Adjust. Low Power Enable. Spares (5). DC Power Input. CW Key Jack. External Transmit Audio In (2). Speaker Out. External Receiver Audio. T/R In. T/R Out. <u>Mute</u> . Mute (inverted). External Relay (linear). RS-232 Computer interface.

\*All specifications are referenced to 13.8 VDC at 25°C ambient.



# HEATH

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Front Panel Meter .....	Receive: S units. Transmit (selectable: ALC, relative RF power, or speech compression).
Phone Patch Impedance .....	4 ohm output to speaker, high impedance input to transmitter.
Available Accessories .....	<b>AC power supply/speaker with built-in dual time 12/24-hour clock. Customer Service Manual.</b>
Cabinet Dimensions .....	6-1/8" high × 14" wide × 13-3/4" deep (15.6 × 35.6 × 34.9 cm).
Weight .....	35 lbs (15.9 kg).

## TRANSMITTER

RF Power Output .....	SSB: 100 watts PEP. CW & RTTY: 100 watts.										
Duty Cycle .....	100% with appropriate automatic power output reduction by an internal thermal sensor. This reduction is determined by the time factor and the ambient temperature. The nominal parameters are as follows:  Ambient Temperature: +25° C. Supply Voltage: +13.8 VDC. Frequency: 14.1 MHz. Mode: CW key down, 100% duty cycle.  Example:  <table border="0" style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;"><u>Power Output</u></th> <th style="text-align: left;"><u>Time</u></th> </tr> </thead> <tbody> <tr> <td>100 watts</td> <td>0 min.</td> </tr> <tr> <td>80 watts</td> <td>3 min.</td> </tr> <tr> <td>60 watts</td> <td>10 min.</td> </tr> <tr> <td>40 watts</td> <td>Infinite</td> </tr> </tbody> </table>	<u>Power Output</u>	<u>Time</u>	100 watts	0 min.	80 watts	3 min.	60 watts	10 min.	40 watts	Infinite
<u>Power Output</u>	<u>Time</u>										
100 watts	0 min.										
80 watts	3 min.										
60 watts	10 min.										
40 watts	Infinite										
Load Impedance .....	50 ohms.										
VSWR .....	This Transceiver is stable at any VSWR and load impedance. The VSWR cutback circuitry guarantees at least 80% of rated power at any VSWR less than 2:1 and a minimum of 15 watts at any VSWR.										
Transmitter Protection .....	Thermally protected. High VSWR cut-back. Over-current protection.										
Carrier Suppression .....	50 dB down from a 100 watt, single-tone (1000 Hz) output.										
Unwanted Sideband Suppression .....	55 dB down from a 100 watt, single-tone (1000 Hz) output.										
Harmonic Radiation .....	50 dB down below 50 MHz; 65 dB down above 50 MHz.										
Spurious Radiation .....	50 dB down, except at 17 meters (40 dB down).										
Third Order Distortion .....	30 dB down from a 100-watt, PEP, two-tone output.										
T/R Operation .....	SSB: PTT or VOX. CW: Semi break-in.										
CW Sidetone .....	To speaker or headphones (800 Hz tone, adjustable level).										
Microphone Input .....	High impedance (25 k ohm) with a rating of -55 dBm.										

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## RECEIVER

Sensitivity .....	0.3 $\mu$ V for 10 dB (S+N)/N SSB on the 40 thru 10 meter bands; 0.5 $\mu$ V on the 160 and 80 meter bands.
Selectivity .....	2.1 kHz at 6 dB down; 5 kHz at 60 dB down.
	CW filters:
	CWM: 400 Hz at 6 dB down; 1.5 kHz at 60 dB down.
	CWN: 200 Hz at 6 dB down; 1 kHz at 60 dB down.
Overall Gain .....	Less than 1 microvolt for a .25 watt audio output.
Audio Output .....	1.5 watts into 4 ohms at less than 10% THD.
AGC .....	Fast-attack with switch selectable Off, Fast, and Slow decay.
Intermodulation Distortion 20 kHz spacing .....	-70 dB.
Image Rejection .....	-80 dB (except -65 dB on the 17 and 12 meter bands).
Second IF Rejection .....	-90 dB.
First IF Rejection .....	-80 dB (except -60 dB on the 40 and 30 meter bands).
Internally Generated Spurious Signals .....	Generally below the noise level; all below 1 $\mu$ V equivalent.
RIT .....	$\pm$ 250 Hz.

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The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

# INSTALLATION

## GENERAL INFORMATION

Pictorial 1-1 (fold-out from Page 10) shows you how to connect your Transceiver to the matching Power Supply/Speaker/Dual Clock and a linear amplifier. We recommend that you use shielded cable for all equipment interconnections.

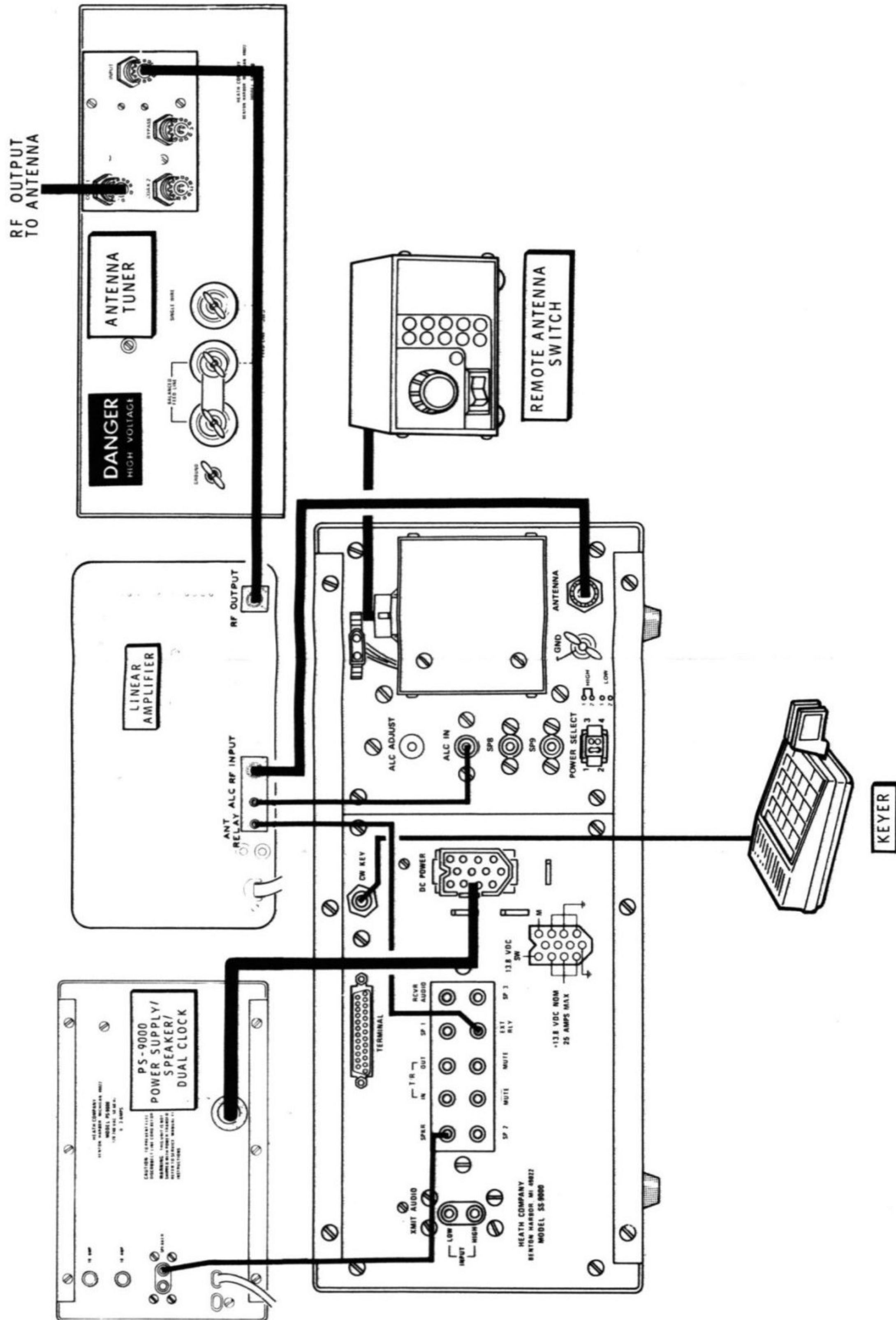
### LOCATION

Carefully choose an operating location for the Transceiver so air can circulate freely around and through the cabinet. Do not place any books, magazines, or equipment under or on top of the cabinet. This could impede the free flow of air.

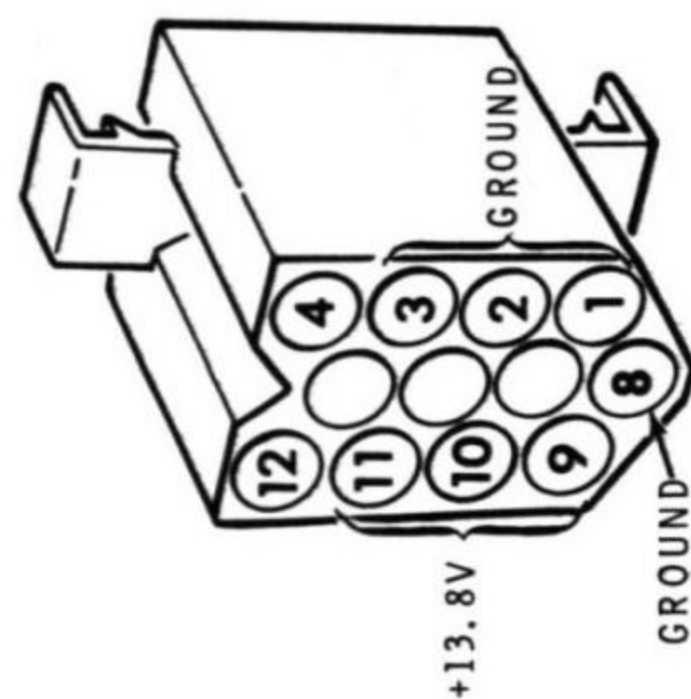
The location should also be dry and cool, and away from direct sunlight. Avoid extremes of heat and humidity.

### POWER REQUIREMENTS

This Transceiver was designed to be used with the Heath Model PS-9000 Power Supply/Speaker/Dual Clock. If you use any other power supply or an automobile battery to power your Transceiver, be sure it can supply 13.8 VDC at 25 amperes. Be sure to use an acceptable fuse (not supplied) in the power cable.



PICTORIAL 1-1



PICTORIAL 1-2

Pictorial 1-2 shows the pinouts for the power connector supplied with the Transceiver. NOTE: Due to the large amount of current drawn by the Transceiver while it is transmitting, several pins are provided for +13.8 VDC and ground. Be sure the cable wires you use can handle the current under transmit conditions.

Pins 4 and 12 of the connector are used to supply power to the Bandswitch motor.

# HEATH

## ANTENNA

Although your Transceiver cannot be damaged by an improper load at the antenna connector, under normal conditions, you should use a proper antenna for best results. For the best efficiency, use an antenna and feed line that presents a 50  $\Omega$  load with a standing wave ratio (SWR) of less than 2:1. **NOTE:** As the SWR goes up, the protection circuitry in the Transceiver will automatically reduce the power output.

Antennas are available commercially from the Heath Company, and from other sources, or you can construct your own. A discussion of antennas is beyond the scope of this Manual. Refer to one of the several good handbooks on this subject, such as the ARRL Antenna Book, available from most radio equipment dealers or from ARRL, 225 Main Street, Newington, CT. 06111.

A handy card is supplied with the Transceiver to show you how to install coaxial plugs on your feed line.

## GROUNDING

Connect a good earth or water pipe ground to the ground post on the rear of the Transceiver. Use the heaviest and shortest connection available.

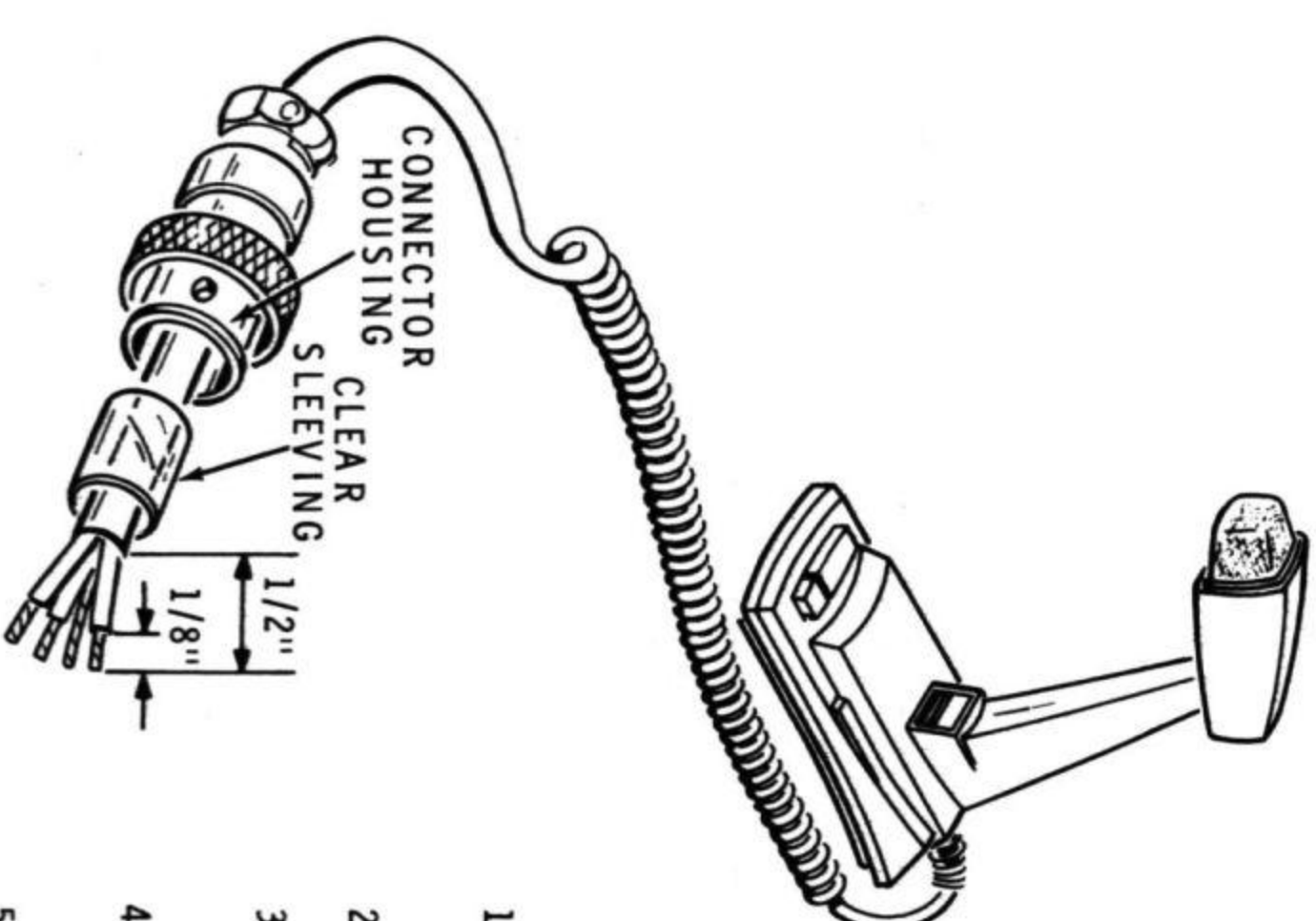
Before you use a water pipe ground, inspect the connections around your water meter and make sure that no plastic or rubber hose connections are present which would interrupt electrical continuity to the water supply line. Install a jumper around any insulating water connections you find. Use heavy copper wire and pipe clamps. It is best to ground all your equipment to one point at the operating position, and then ground this point as discussed above.

## KEY CONNECTIONS

In the CW mode, a positive voltage is present at the CW KEY jack on the rear panel of the Transceiver. If you use a keyer that has specific polarity requirements, be sure to connect the keyer to this jack properly.

## MICROPHONE CONNECTIONS

Use a high-impedance microphone equipped with a push-to-talk switch (such as the Heathkit Model HDP-242) with this Transceiver so you can use either PTT or VOX to turn on the transmitter. A 4-pin connector (#432-1100) is supplied for this purpose. Refer to Pictorial 1-3 (fold-out from Page 11), to install this connector on your microphone cable. **NOTE:** If you use a microphone other than the one listed above, and you wish to use VOX, be sure the microphone element is not switched by the PTT switch.



1. REMOVE 1/2" OF OUTER INSULATION FROM THE END OF THE MICROPHONE CABLE.

2. REMOVE 1/8" OF INSULATION FROM THE END OF EACH LEAD.

3. TWIST TOGETHER THE FINE WIRES OF EACH LEAD AND APPLY A SMALL AMOUNT OF SOLDER TO THE END OF EACH LEAD.

4. REMOVE THE THREE SCREWS AND THE CLAMP FROM THE CONNECTOR.

5. TWIST THE CONNECTOR HOUSING AND THE CONNECTOR BASE IN OPPOSITE DIRECTIONS AND REMOVE THE HOUSING.

6. SLIDE THE HOUSING AND THE CLEAR SLEEVING ONTO THE MICROPHONE CABLE.

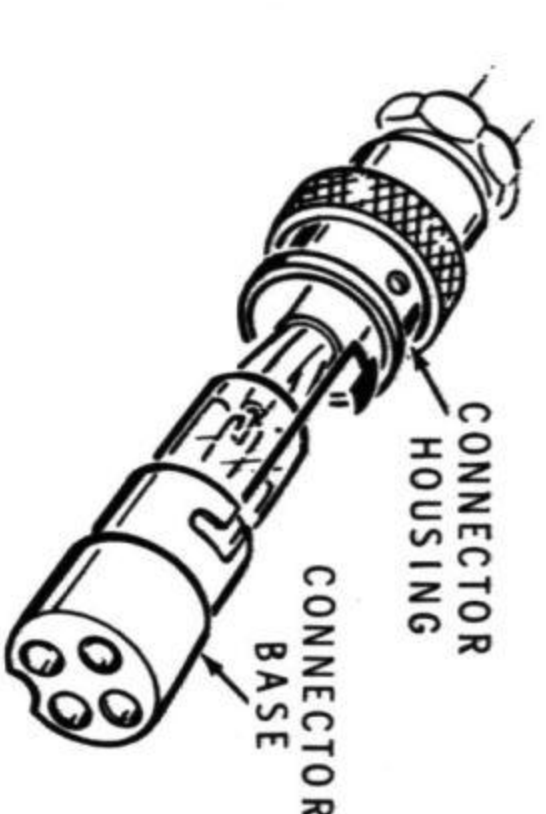
7. SOLDER THE LEADS TO THE LUGS OF THE CONNECTOR BASE AS FOLLOWS. **NOTE:** THE LUG NUMBERS ARE STAMPED INSIDE THE CONNECTOR BASE NEAR THE LUGS.

AUDIO LEAD TO LUG 1.

AUDIO SHIELD TO LUG 4.

EITHER PTT LEAD TO LUG 2.

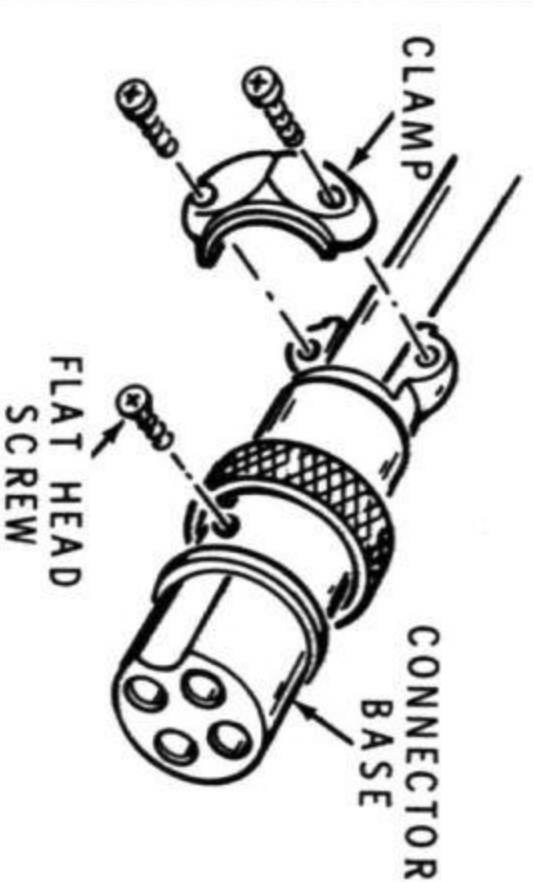
OTHER PTT LEAD TO LUG 3.



8. SLIDE THE CLEAR SLEEVING OVER THE BACK PORTION OF THE CONNECTOR BASE SO IT COVERS THE SOLDERED CONNECTIONS.

9. SLIDE THE HOUSING OVER THE CONNECTOR BASE AND FASTEN IT WITH THE FLAT HEAD SCREW YOU REMOVED EARLIER.

10. USE THE SCREWS YOU REMOVED EARLIER TO REMOUNT THE CLAMP ONTO THE CONNECTOR HOUSING. **NOTE:** IF YOUR CABLE IS TOO SMALL FOR THE CLAMP TO GRIP PROPERLY, USE BLACK TAPE OR SOMETHING SIMILAR TO BUILD UP THE DIAMETER OF THE CABLE.



Although protective circuitry of this nature is a valuable circuit element, it is not a substitute for proper adjustment of the exciter and its drive level to the amplifier. Be sure to refer to "ALC Adjust" in the "Operation" section of this Manual before you use this jack.

**SPEAKER CONNECTION**

A cable is provided with the Transceiver to connect between the Speaker jacks on the rear of the Model PS-9000 Power Supply/Speaker/Dual Clock and the Transceiver. If you use a different speaker, be sure it has an impedance between 4 and 8 ohms.

**LINEAR AMPLIFIER CONNECTIONS**

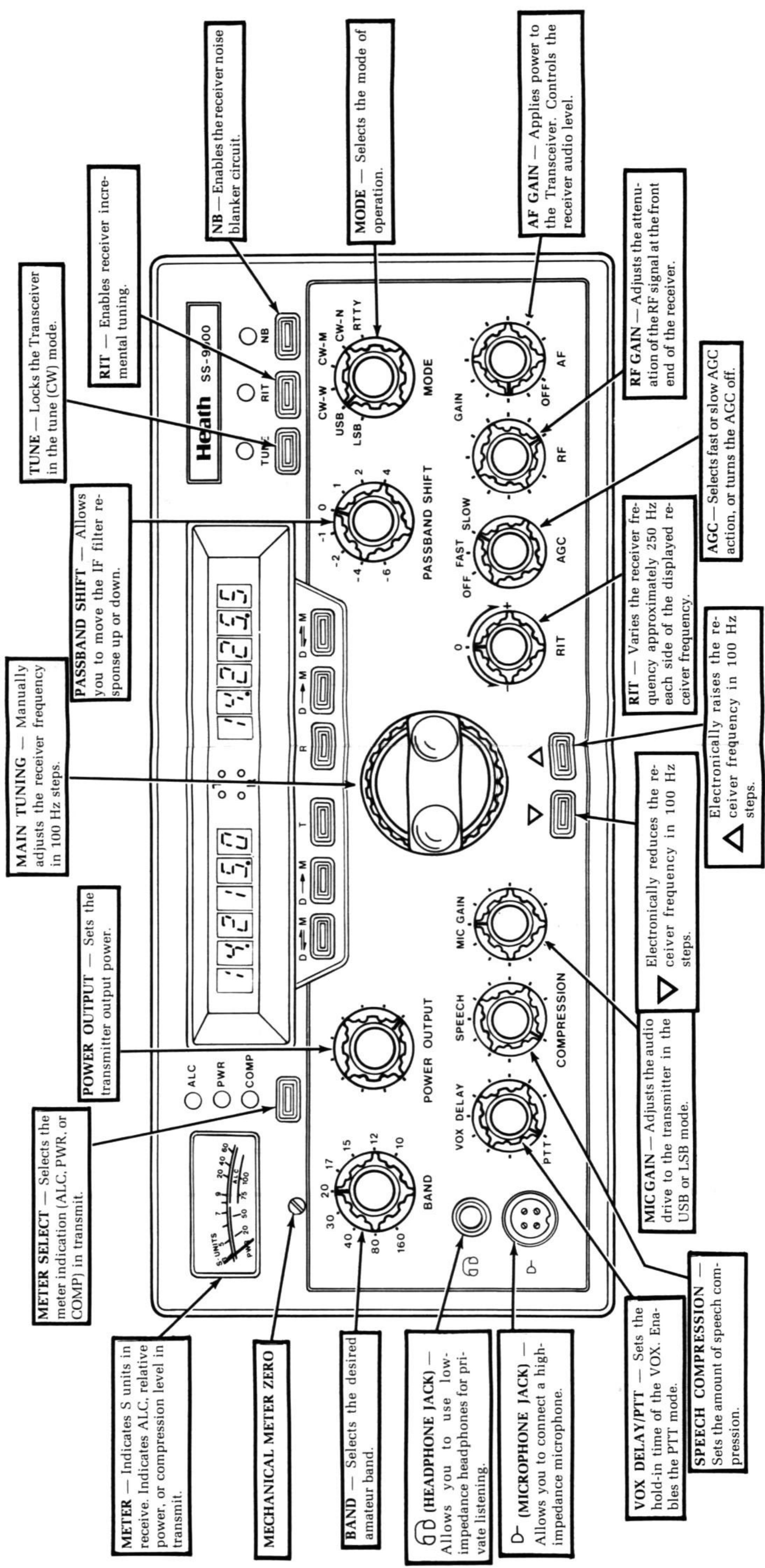
Pictorial 1-1 (fold-out from Page 10) shows the Transceiver connected to a typical amplifier.

**ALC**

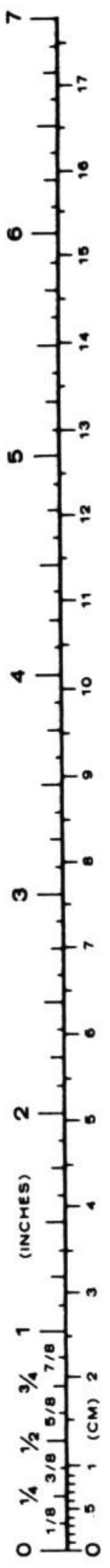
If your amplifier has ALC (automatic level control) output provisions, connect a cable between the ALC IN jack on the rear of the Transceiver and the linear amplifier. The ALC bias voltage from the amplifier helps prevent transmitter overloading and "splatter".

**Antenna Relay**

Many amplifiers have an internal transmit-receive relay which is actuated when the relay coil circuit is grounded. Heath amplifiers are of this type. This Transceiver has an electronic switch to operate the transmit-receive relay. You can use a shielded cable, connected between the EXT RLY jack on the rear of the Transceiver and the linear amplifier, for this grounding connection. NOTE: The jack will operate with either positive or negative grounding requirements in the amplifier.



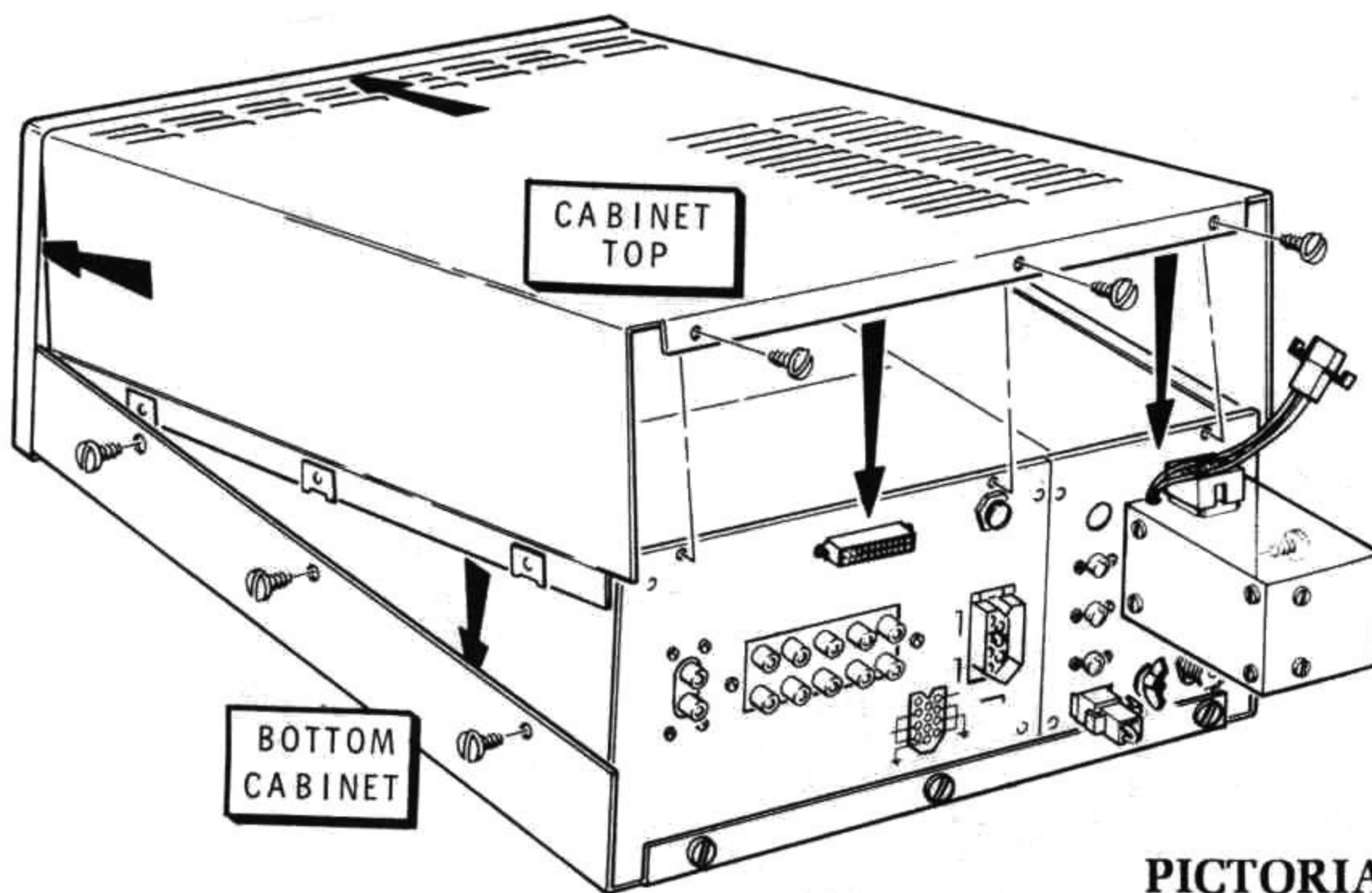
**PICTORIAL 2-1A**



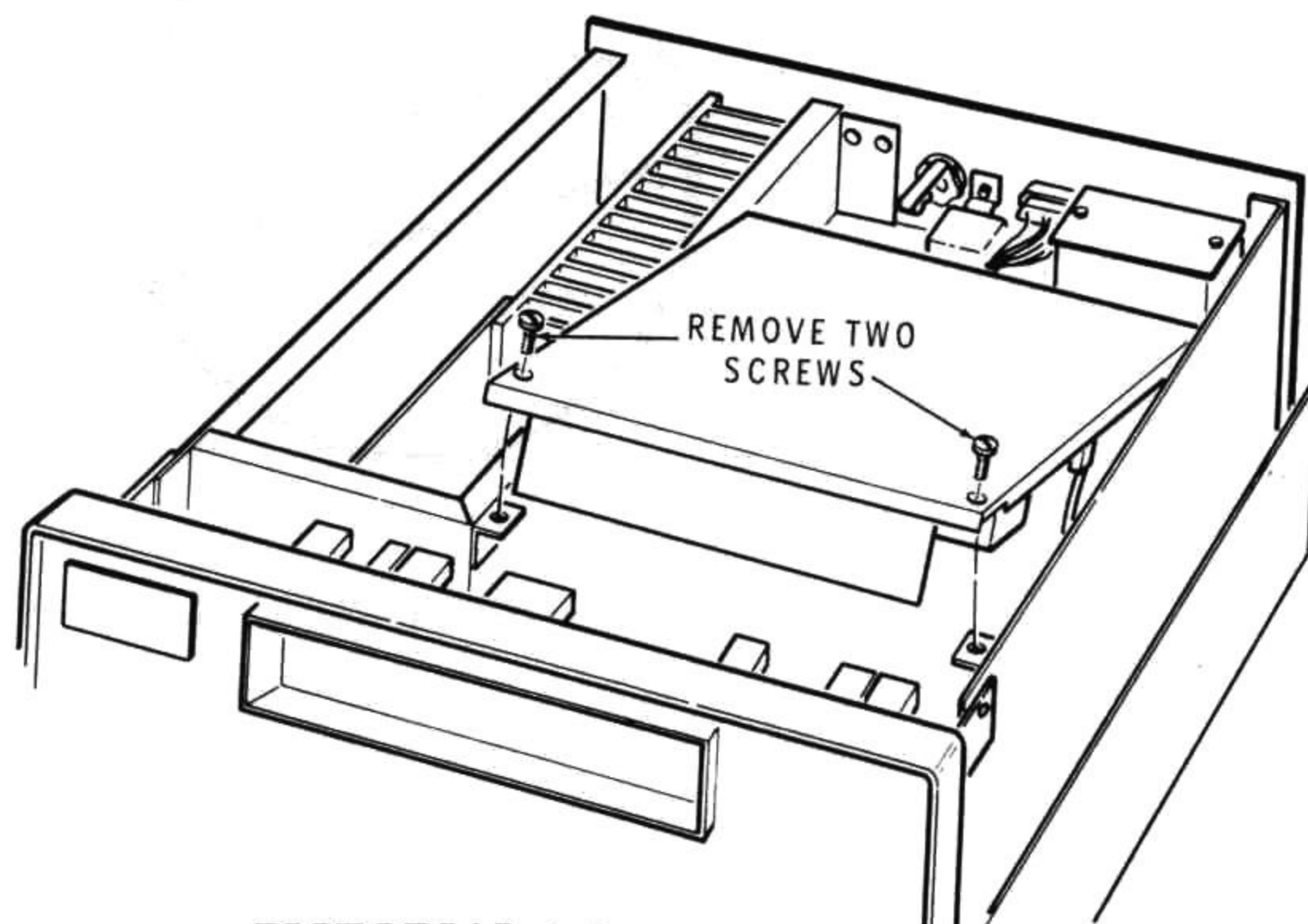
## BATTERY REPLACEMENT

As described in more detail in the "Operation" section of this Manual, this Transceiver "remembers" specific items (such as displayed frequencies, etc.) even when you turn the Transceiver off. Batteries were installed at the factory to keep the memory alive. These batteries (three "AA" size) should be replaced about once a year for the best results. For long life, we recommend that you use a good grade of alkaline batteries. To replace the batteries, use the following procedure:

1. Refer to Pictorial 1-4 and remove the three screws on each side of the cabinet and the three screws along the top rear edge of the cabinet. Then remove the cabinet top.
2. Refer to Pictorial 1-5 and remove the two screws in the front corners of the synthesizer circuit board assembly. Then raise up on the front edge of the assembly to gain access to the battery holders.

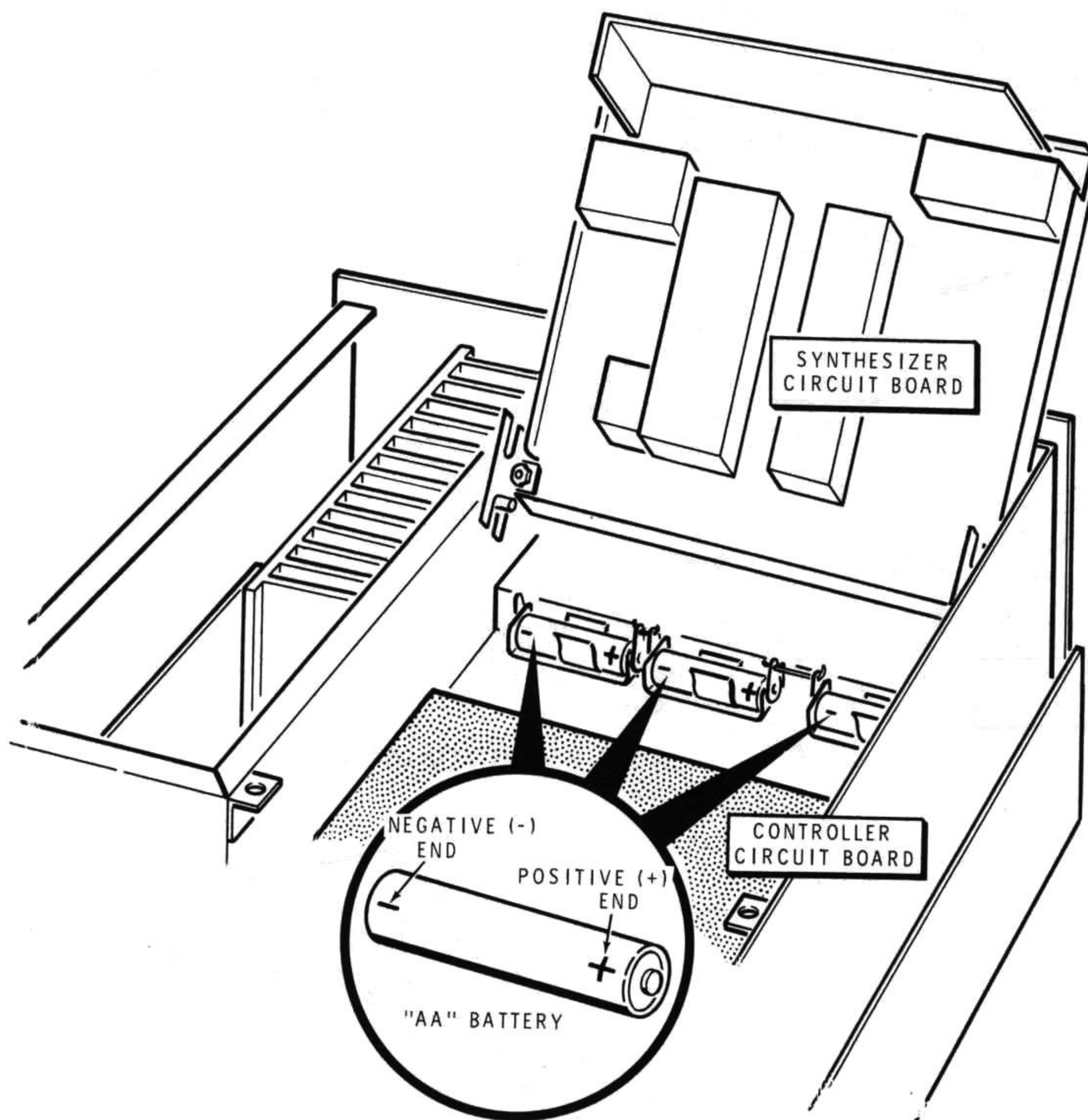


PICTORIAL 1-4



PICTORIAL 1-5

3. Refer to Pictorial 1-6 and remove the old batteries. Then install three new batteries in the holders as shown. Be sure the positive (+) marked end of each battery is positioned toward the right as shown.
4. Make sure all of the cables are still connected to the synthesizer and controller circuit boards.
5. Lower the synthesizer circuit board assembly back into position and secure it with the two screws removed earlier. Then reinstall the cabinet top and its hardware.



PICTORIAL 1-6



## OPERATION

**NOTE:** You must have an amateur radio operator license and a station license before you place the transmitter section of this Transceiver on the air. You can obtain information about licensing and amateur frequency allocations from publications of the Federal Communications Commission, as well as many other sources.

Operation of this Transceiver has been simplified as much as possible so you can make rapid adjustments.

Once you make the initial adjustments, it should not be necessary to readjust many of the controls. Read the following information carefully. Good operating techniques will provide good clean signals and long trouble-free life from this Transceiver.

### FRONT PANEL CONTROLS AND CONNECTORS

Refer to Pictorial 2-1A and 2-1B (fold-outs from Pages 12 & 17) for the locations of the following front panel controls and connectors.

#### METER

In the receive mode, the meter always indicates the strength of the incoming signal in S units (except when the AGC is OFF).

In the transmit mode, the meter indicates ALC, relative power, or compression level, as determined by the Meter Select pushbutton (just below and to the right of the meter). Indicators show which meter function is selected.

**ALC:** Audio peaks should be within the ALC scale limits when the Mic Gain control is properly adjusted.

**PWR:** Indicates relative power output on the lower scale.

**COMP:** Indicates the proper Mic Gain and Speech Compression control settings on the upper scale.

#### MECHANICAL METER ZERO

Allows you to adjust the meter pointer so it indicates exactly zero when the Transceiver is off.

#### DISPLAY

Displays two frequencies to the nearest 100 Hz. Either display can be used to control the receiver while the other display controls the transmitter, or either display can be used to control both the receiver and the transmitter.

#### T INDICATOR

This indicator indicates which display frequency is controlling the transmitter.

**R INDICATOR**

This indicator indicates which display frequency is controlling the receiver. NOTE: The MAIN TUNING only affects the receiver frequency. (If the T and R indicators are indicating the same display, the MAIN TUNING will affect both the receiver and the transmitter frequency.)

**D  $\rightleftharpoons$  M (left side)**

Exchanges the frequency shown on the left display with the frequency stored in memory. If no frequency was stored in memory since the last time the batteries were replaced, no change will occur.

**D  $\rightarrow$  M (left side)**

Copies the frequency shown on the left display into memory. Any frequency that may already be in memory is lost.

**T**

Toggles the T (transmit) Indicator between the two displays.

**R**

Toggles the R (receive) Indicator between the two displays.

**D  $\rightarrow$  M (right side)**

Copies the frequency shown on the right display into memory. Any frequency that may already be stored in memory is lost.

**D  $\rightleftharpoons$  M (right side)**

Exchanges the frequency shown on the right display with the frequency stored in memory. If no frequency was stored in memory since the last time the batteries were replaced, no change will occur.

**TUNE**

Locks the Transceiver in the tune (CW) mode. An indicator lights when the Transceiver is in this mode. Push this button again to return to the receive mode.

**RIT (Button)**

Enables the receiver incremental tuning circuit. An indicator lights when RIT is enabled.

**NB (Noise Blanker)**

Enables the receiver noise blanker circuit. An indicator lights when the noise blanker is enabled. The noise blanker helps reduce impulse (ignition type) noise.

**BAND**

Selects the desired amateur band. NOTE: WWV (National Bureau of Standards) at 15 MHz is available on the 20 meter band. The markings on the front panel indicate the amateur bands in meters.

**POWER OUTPUT**

Allows you to adjust the transmitter output to the desired level. Full clockwise is maximum power output (100 watts nominal).

**MAIN TUNING**

Manually adjusts the receiver frequency up or down in 100 Hz steps. One complete rotation of this knob changes the frequency 5 kHz.

**PASSBAND SHIFT**

Allows you to move the IF filter response up or down. The markings on the front panel are in 100's of hertz (-1 = -100 Hz, etc.). This switch is active only in the USB and LSB receive modes.

MODE

Selects the mode of operation:

LSB: Selects lower sideband and uses the regular SSB filter. Both the microphone and external audio inputs are active. CW operation is inhibited.

USB: Same as LSB except that the upper sideband is selected.

CW-W: Selects wide CW, USB mode, and uses the regular 2.1 kHz SSB filter. The CW sidetone oscillator is enabled, but the microphone and external audio inputs are inhibited. The transmitter can only be turned on with the Tune button or by a key connected to the Key jack on the rear panel.

CW-M: Same as CW-W, except it selects medium CW (which uses the 400 Hz CW filter).

CW-N: Same as CW-W, except it selects narrow CW (which uses the 200 Hz CW filter).

RTTY: Selects LSB mode, medium (400 Hz) CW filter and inhibits the key.

DP

Allows you to use low-impedance headphones for private listening. Automatically disconnects the speaker.

D-

Provides you with an easy-access connection for a high-impedance microphone. The mating connector is furnished with the Transceiver. Refer to the "Installation" section of this Manual for the proper connections.

VOX DELAY/PTT

Sets the hold-in time of the transmit cycle in the VOX or CW modes. When you turn this control fully counterclockwise, until it clicks, the VOX circuits are disabled and only the PTT switch will enable the transmitter.

SPEECH COMPRESSION

Sets the amount of speech compression. Maximum speech compression occurs when the control is fully clockwise.

MIC GAIN

Adjusts the audio drive to the transmitter in the USB or LSB mode.

▽

Allows you to electronically reduce the receiver frequency in 100 Hz steps. The scan rate is internally adjustable. NOTE: This pushbutton also affects the transmitter frequency if you select the same display for transmit and receive.

△

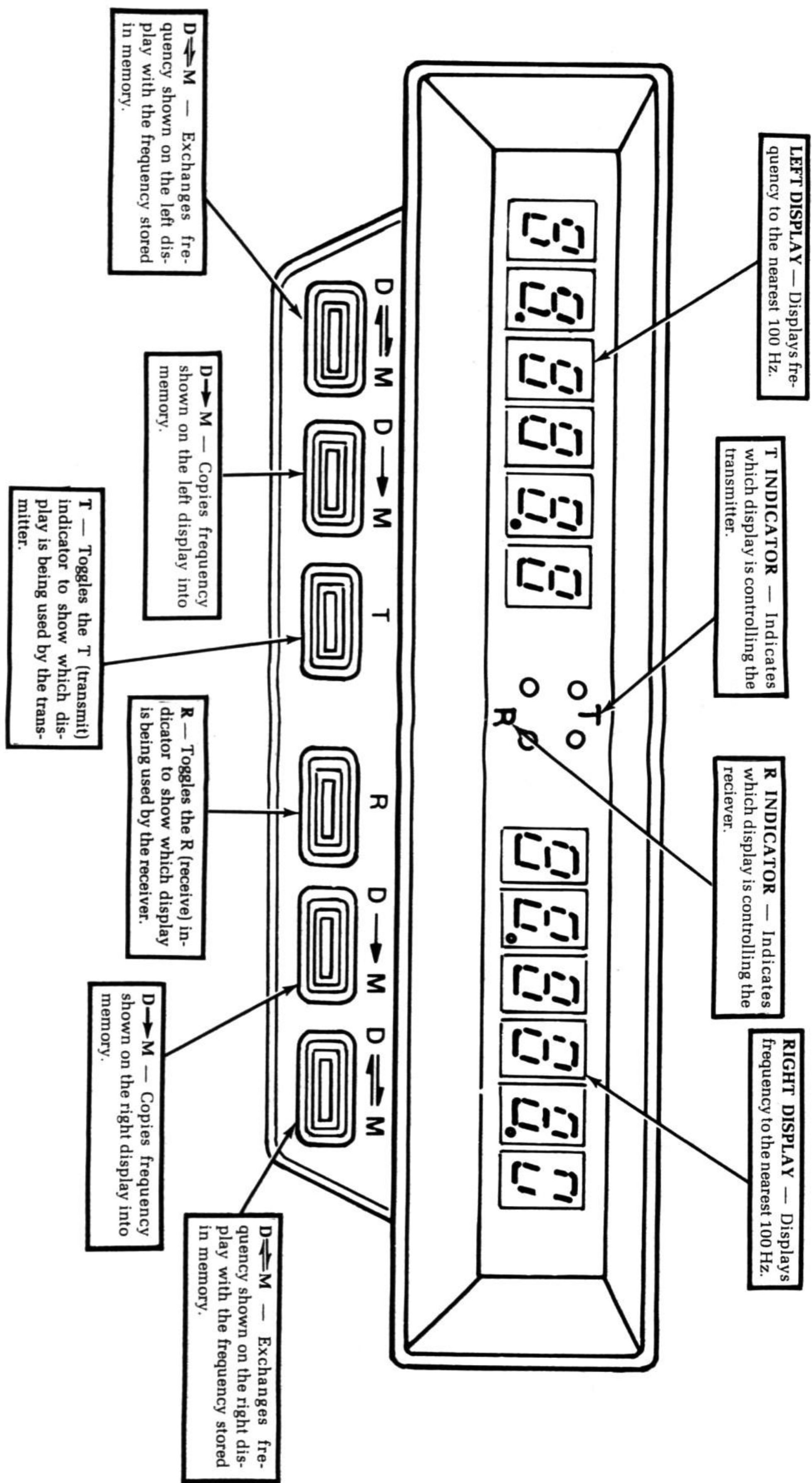
Allows you to electronically raise the receiver frequency in 100 Hz steps. The scan rate is internally adjustable. NOTE: This pushbutton also affects the transmitter frequency if you select the same display for transmit and receive.

RIT (control)

Varies the receiver frequency approximately 250 Hz each side of the displayed receiver frequency. Operates only when the RIT pushbutton is depressed. NOTE: This control does not alter the display indication or change the transmitter frequency.

AGC

Selects fast or slow AGC action or turns the AGC off.



PICTORIAL 2-1B

**RF GAIN**

Adjusts the attenuation of the RF signal at the front end of the receiver. Clockwise rotation increases the receiver sensitivity. Full clockwise is the normal setting for this control. Turn the control counterclockwise to reduce sensitivity when exceptionally strong signals are present, or reduce adjacent channel interference.

**AF GAIN**

Applies power to the Transceiver. Also controls the audio level of the received signal. The volume increases with clockwise rotation of this control.

**REAR PANEL CONTROLS AND CONNECTIONS**

**RCVR AUDIO**

Provides a low level receiver audio signal. The signal at this jack is tapped off before the AF Gain control on the front panel.

**XMIT AUDIO INPUT**

Provides both high and low level inputs to the transmitter for an external audio signal [such as a phone patch or RTTY tone (AFSK) signal].

**MUTE**

Allows you to mute an external device when the Transceiver is in the receive mode. This jack is grounded in the receive mode.

**MUTE**

Allows you to mute an external device when the Transceiver is in the transmit mode. This jack is grounded in the transmit mode.

**EXT RLY**

Allows you to key the relay in a linear amplifier ( $\pm 150$  VDC) with the Transceiver.

**TERMINAL**

This connector is part of the terminal interface and allows you to use an external terminal/computer to operate this Transceiver. (See "Terminal Interface," beginning on Page 30.)

**CW KEY**

Allows you to use a telegraph key or electronic keyer for the CW mode of operation.

**SPKR**

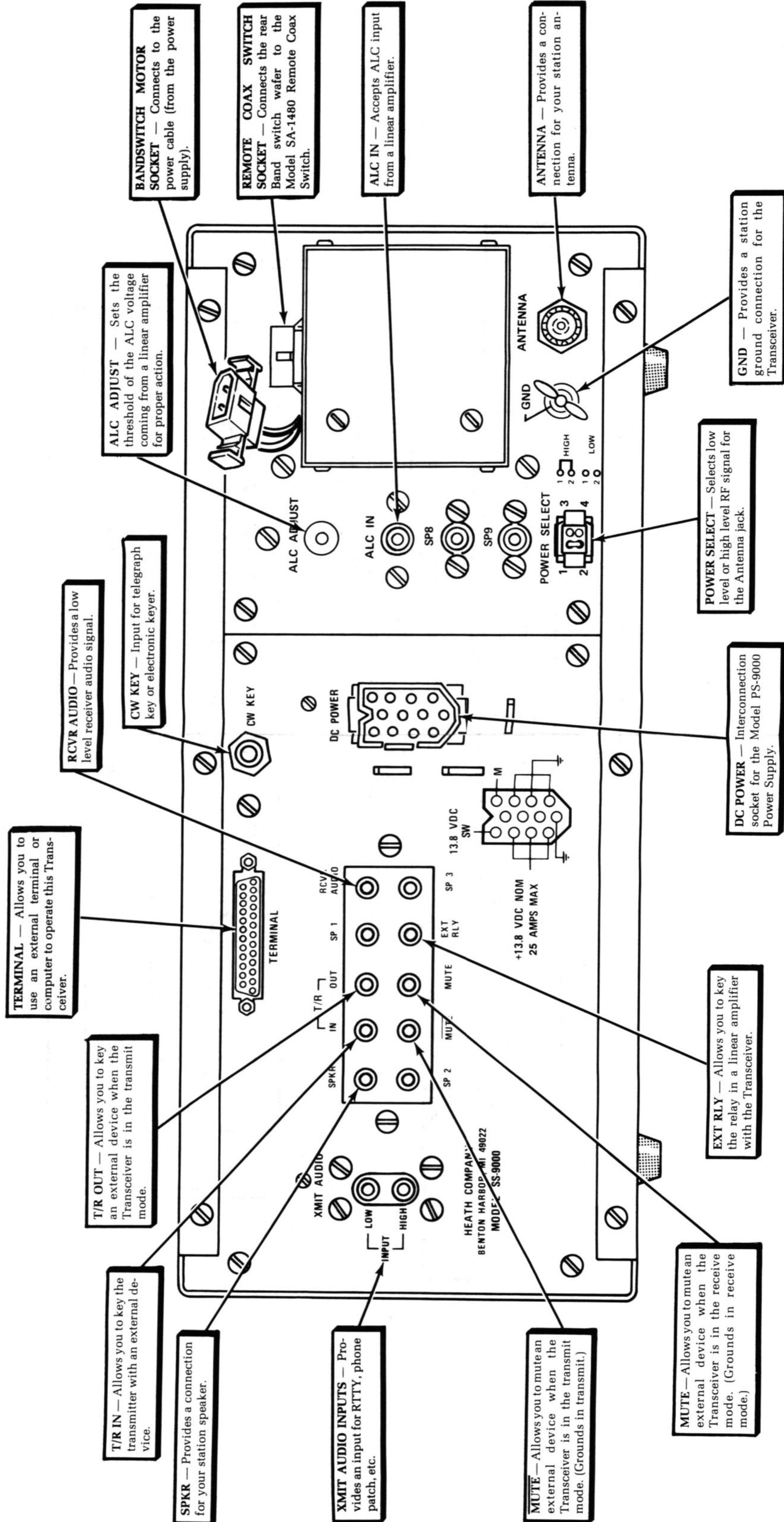
Provides a connection for your station speaker (4  $\Omega$ ).

**T/R IN**

Allows you to key the transmitter with an external device. Ground this jack to key the transmitter.

**T/R OUT**

Allows you to key an external device when the Transceiver is in the transmit mode. This jack is grounded in the transmit mode.



**PICTORIAL 2-2**

# HEATH

## DC POWER

Interconnect socket for the Model PS-9000 Power Supply.

## ALC ADJUST

Sets the threshold of the ALC voltage coming from a linear amplifier for proper action.

## ALC IN

Accepts ALC input from a linear amplifier.

## POWER SELECT

Selects whether a low level (for user accessories) or a high level RF signal is present at the Antenna jack.

This connector connects pins 1 and 2 together for high power. Open the connection (unplug the connector) for low power. NOTE: Pins 3 and 4 are not used.

## GND

Provides a station ground connection for the Transceiver.

## ANTENNA

Provides a connection for your station antenna.

## SP1, SP2, SP3, SP8, & SP9

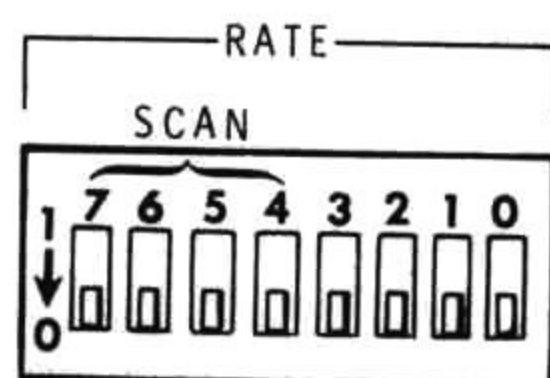
Provides spare jacks for user convenience.

## INTERNAL CONTROLS

Refer to Pictorial 2-3 (fold-out from Page 25) for the locations of the internal controls.

### RATE

The left four switches control the rate at which the frequency changes when you push the  $\Delta$  or  $\nabla$  pushbuttons. Set the switches as shown below for the desired rate.



RATE (kHz/sec.)	SWITCH 7654
2.5	1111
3.5	0111
5	1011
7	0011
9	1101
12.5	0101
20	1001
25	0001
30	1110
45	0110
60	1010
85	0010
110	1100
150	0100
210	1000
270	0000

NOTE: The right four switches are described under "Terminal Interface".

**SIDETONE LEVEL\***

Controls the loudness of the sidetone signal when you are transmitting CW (or when the TUNE button is depressed).

**ANTI-TRIP\***

Adjusts the VOX circuits so a received signal from the speaker will not feed back into the microphone and key the transmitter.

**VOX GAIN\***

Adjusts the input level at which the electronic voice-controlled relay circuits will operate. NOTE: VOX is defeated when the VOX Delay control on the front panel is at PTT.

## DISPLAY FUNCTIONS

This section explains in detail how the dual-display and the corresponding pushbuttons provide unique versatility in frequency control.

Keep in mind that the memory in this Transceiver will "remember" the frequencies shown on both displays, plus a third not-displayed frequency. The memory will retain these frequencies as long as the batteries inside the Transceiver are good, or until you change one of the frequencies as described below.

**EXAMPLES**

Assume that the three frequencies shown in Pictorial 2-4 (fold-out from Page 25) are currently on the display and stored in memory.

NOTE: The next two paragraphs show you how to use the  $D \rightleftharpoons M$  and the  $D \rightarrow M$  pushbuttons under the left display. The corresponding buttons under the right display work the same way.

To exchange the frequency shown on the left display with the frequency stored in memory, simply push the left  $D \rightleftharpoons M$  pushbutton. These frequencies will change places as shown in Pictorial 2-5 (fold-out from Page 25).

To copy the frequency shown on the left display into memory, simply push the  $D \rightarrow M$  pushbutton. The frequency on the left display is now stored in memory as shown in Pictorial 2-6 (fold-out from Page 25). Note that the frequency that was previously stored in memory is lost.

If you wish to exchange the frequency shown on the left display with the frequency shown on the right display, use the following procedure:

1. Push the  $D \rightleftharpoons M$  pushbutton under the left display. This exchanges the frequency on the left display with the frequency stored in memory (see Pictorial 2-7, Part A, fold-out from Page 25). NOTE: The frequencies happen to be the same in this example.

\*These controls are accessible through holes in the right side of the cabinet. See Pictorial 2-3 (fold-out from Page 25).

2. Push the D $\Rightarrow$ M pushbutton under the right display. This exchanges the frequency on the right display with the frequency stored in memory (see Pictorial 2-7, Part B, fold-out from Page 25).
3. Push the D $\Rightarrow$ M pushbutton under the left display. This again exchanges the frequency on the left display with the frequency stored in memory (see Pictorial 2-7, Part C, fold-out from Page 25). Note that the two frequencies that were previously on the displays changed places. Also note that the frequency stored in memory before you performed Step 1 is back in memory.

NOTE: The above procedure showed you how to exchange the frequencies shown on the two displays. If you were transmitting on one display and receiving on the other, and you wish to interchange these frequencies, you can do this more easily by simply pushing the T pushbutton and the R pushbutton once. The displays will not change but the functions will.

## PROTECTIVE SYSTEMS

When the Transceiver is in the transmit mode, the MAIN TUNING and all pushbuttons (except the METER pushbutton) are inactive. EXCEPTION: In the split frequency-mode, the Main Tuning scan functions, and memory functions on the receive side of the display are active.

If one of the synthesizer loops should go out of lock, the Transceiver will automatically return to the receive mode. In addition, the display will indicate which loop (or loops) are unlocked.


This Transceiver is also protected against high VSWR, overheating, and over-current.

## TUNE-UP

NOTE: Once you adjust your Transceiver controls for either SSB or CW operation, all that is necessary to place your Transceiver on the air is to turn the Transceiver on. Other than selecting your frequency, no other action is required.

### INITIAL ACTIONS

Before you attempt to use your Transceiver, check to make sure you have made all of the following connections:

1. An antenna for the band you intend to use should be connected to the Antenna jack on the rear panel.
2. A 4  $\Omega$  to 8  $\Omega$  speaker should be connected to the SPKR jack on the rear panel, or headphones should be plugged into the  jack on the front panel.

3. The Model PS-9000 Power Supply or suitable equivalent should be connected to the DC Power socket on the rear panel.
4. For best results, the Transceiver GND post should be connected to a good earth ground.
5. If you are using a linear amplifier:
  - A. You should connect the ALC output of the amplifier to the ALC jack on the rear panel of the Transceiver.
  - B. If the amplifier's transmit/receive relay is the type that is activated by grounding the relay coil, connect the amplifier's relay coil connection to the EXT RLY jack on the rear panel of the Transceiver.
  - C. Preset the ALC ADJUST control (on the rear panel) fully counterclockwise.

6. If you use an external receiver that has a mute circuit which must be grounded to allow the receiver to operate, you can connect this mute circuit to the Mute jack on the rear panel. Use the Mute jack if your receiver requires a ground to mute. (This circuit is limited to +13 VDC at 100 mA maximum.)

Preset the front panel controls and switches as follows (CW means fully clockwise, CCW means fully counterclockwise):

MIC GAIN	CCW.
RF GAIN	CW.
AF GAIN	CCW to OFF.
BAND	Desired band.
VOX DELAY	CCW until it clicks.
AGC	SLOW.
TUNE	Released.
RIT	Released.
NB	Released.
MODE	USB or LSB.
POWER OUTPUT	CCW
PASSBAND SHIFT	O
SPEECH COMPRESSION	CCW

NOTE: The settings of the other controls and switches are not important at this time.

## RECEIVING

The receiver in this Transceiver is broad banded and requires no preselector tuning. Use an antenna designed for a 50  $\Omega$  impedance, or use an antenna coupler for matching the antenna's impedance to 50  $\Omega$ .

1. Check the connections in "Initial Actions" on Page 21.
2. Turn the power supply on. Then use the AF GAIN control to turn on the Transceiver. Adjust this control for the desired audio output.
3. If you intend to use VOX operation, turn the VOX DELAY control to the center of its rotation. Set your station microphone in the position it will occupy during normal operation, and tune in a strong station. The receiver may cycle on and off with voice peaks of the strong station. If this occurs, turn the ANTI-VOX control (refer back to Pictorial 2-3), through the hole in the right side panel, clockwise until the cycling action ceases. Do not advance the control beyond this point.
4. You may adjust the AGC switch to another setting, but many SSB operators prefer SLOW. CW operators may prefer FAST or OFF.
5. Depress the NB pushbutton to activate the noise blanker, if you desire. NOTE: The noise blanker reduces impulse (ignition-type) noise.
6. If you desire, depress the RIT pushbutton and use the RIT control to fine tune a station.



## TRANSMITTING

The power amplifier in this Transceiver is designed for continuous service in any mode. It is protected by a thermal control circuit which maintains the temperature of the heat sink at a safe level. For best performance, you must keep the vents on the top and bottom of the Transceiver free of restrictions.

### SSB TRANSMISSION

1. Check the connections in "Initial Actions" on Page 21.
2. Turn the MODE switch to either LSB or USB and push the METER pushbutton until the ALC indicator lights.
3. Turn the BAND switch to the desired band.
4. For PTT (push-to-talk), use the switch on the microphone to operate the transmit/receive relay.
5. For VOX operation:
  - A. Advance the VOX DELAY control until it clicks (not at PTT).
  - B. Advance the VOX DELAY control further until the transmitter holds in for the desired length of time after you cease talking.
6. Speak into the microphone and advance the MIC GAIN control until the meter kicks up into the ALC scale on voice peaks. CAUTION: Do not advance the control beyond this point because it will not increase power output, and may overdrive the power amplifier, which will result in clipping of voice peaks and cause sideband "splatter".
7. Set the POWER OUTPUT control for the desired output.

8. To use the Speech Processor:
  - A. Push the METER pushbutton until the COMP indicator lights.
  - B. Push the TUNE pushbutton and note the meter indication at the desired output power. Then release the TUNE pushbutton.
  - C. Advance the SPEECH COMPRESSION control clockwise until the meter reaches the same meter indication on voice peaks (in USB or LSB).
9. This completes the SSB tune-up procedure and you can proceed to transmit.

### CW TRANSMISSION

1. Preset the controls as in "Initial Actions" on Page 21.
2. Turn the MODE switch to the desired CW mode.
3. Be sure a key is connected to the CW KEY jack on the rear panel.
4. Adjust the VOX DELAY control for the desired hold-in time.
5. Adjust the SIDETONE LEVEL control (see Pictorial 2-3, fold-out from Page 25), through a hole in the right side of the cabinet, for the desired volume with keying (or Tune).
6. Adjust the POWER OUTPUT control for the desired output.
7. This completes the CW tune-up procedure.

### AMPLIFIER

If you use an amplifier with this Transceiver, **DO NOT** advance the Transceiver's gain beyond the points where amplifier output ceases to increase with rotation of the POWER OUTPUT control.

Be sure you have the ALC ADJUST control, on the rear panel, set as follows:

1. Be sure all cables are connected as described in "Initial Actions" on Page 21. Also be sure you have the amplifier connected to the proper dummy load.
2. Tune up the Transceiver and the amplifier on 20 meters.
3. Advance the POWER OUTPUT control on the Transceiver to slightly overdrive the amplifier. (You can see this most easily by monitoring the grid current.)
4. Use the ALC ADJUST control on the rear panel to slightly reduce the grid current. (If you advance the POWER OUTPUT control further, you should now see little or no increase in grid current.)
5. Check the operation of the amplifier on other bands. The grid current should not be much greater than it was on 20 meters.

### RTTY

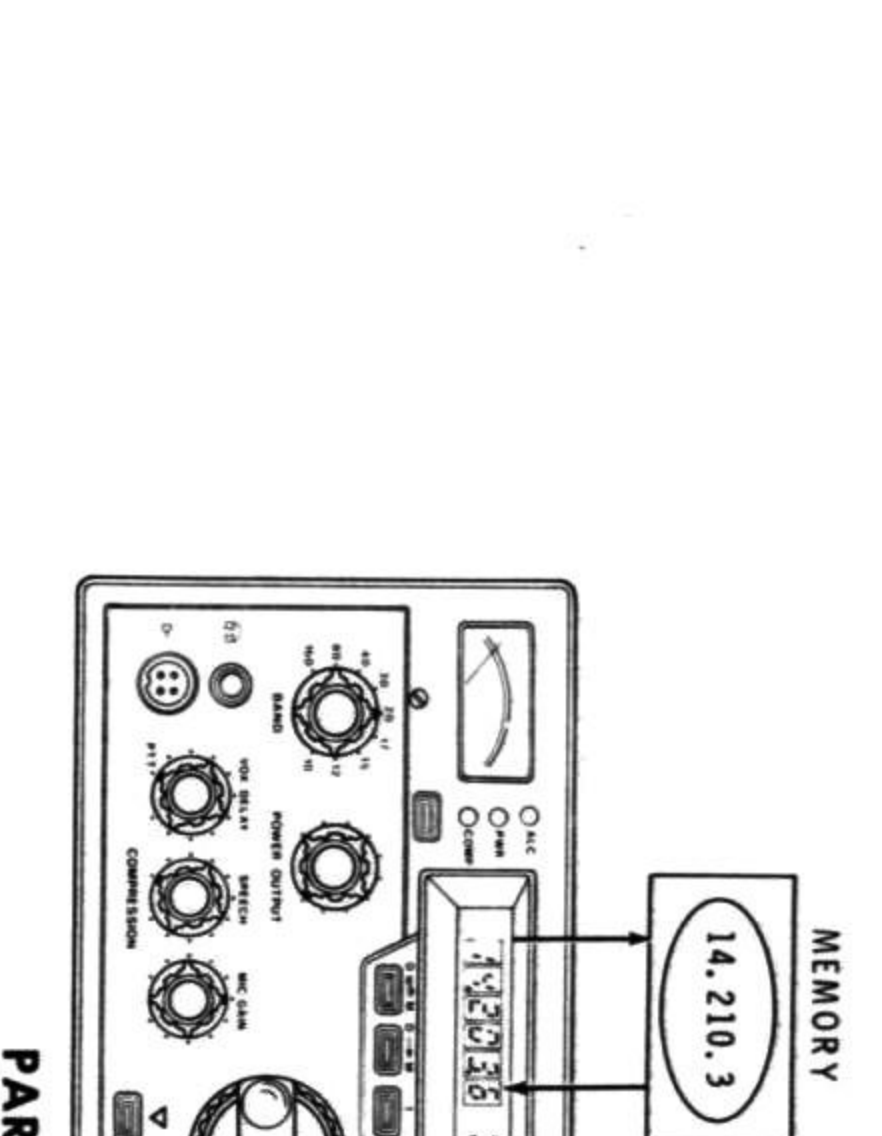
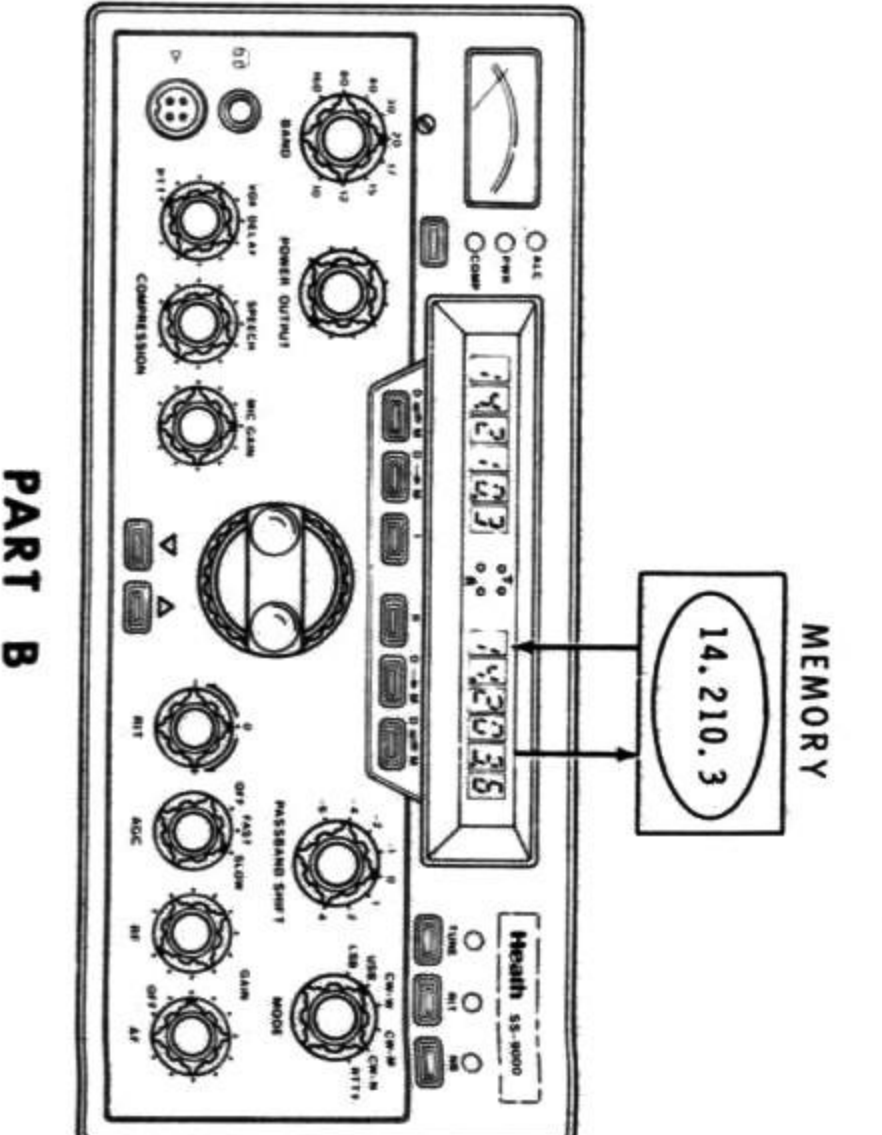
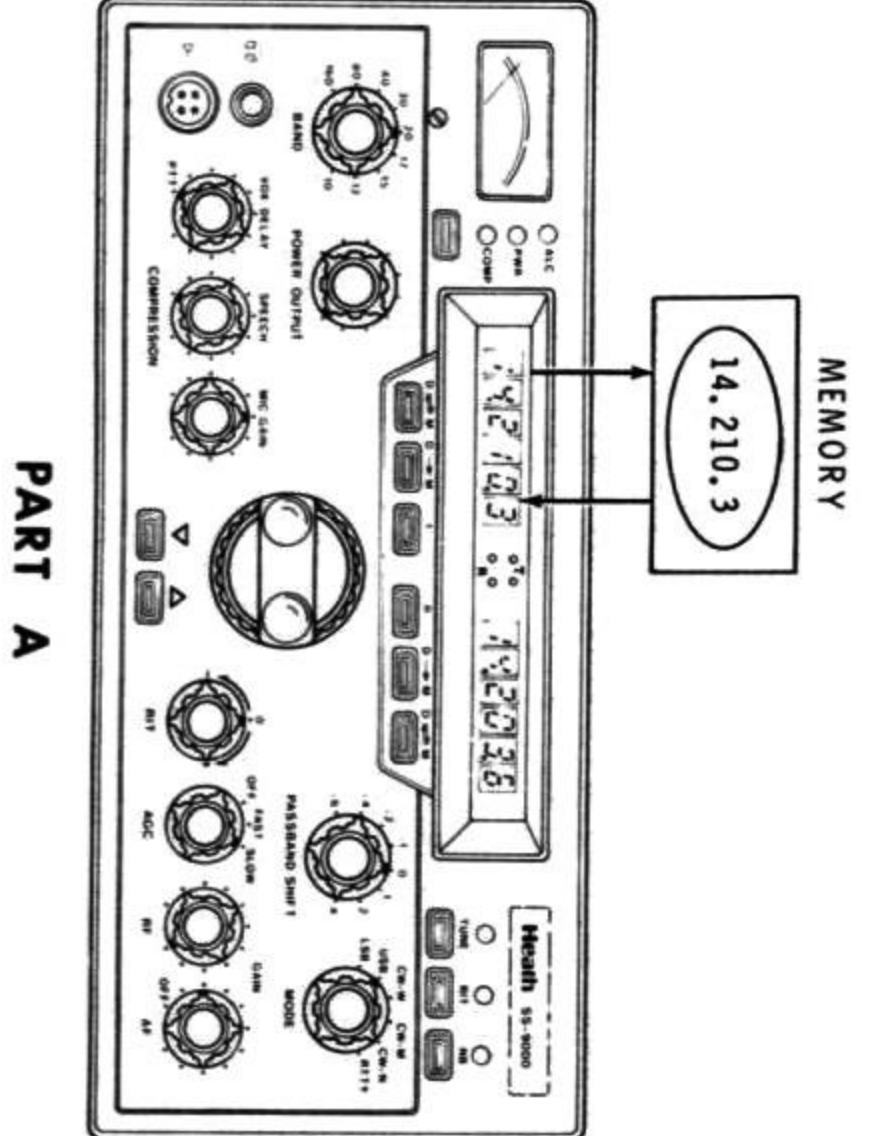
1. Preset the controls as in "Initial Actions" on Page 21.
2. Connect an audio-type RTTY terminal to the speaker terminals and to the proper XMIT AUDIO jack on the rear panel. **NOTE:** Be sure to disconnect your microphone when you use the rear panel XMIT AUDIO jacks.
3. Turn the VOX DELAY control clockwise until it clicks (not at PTT). **NOTE:** This allows you to key the transmitter by means of the VOX circuits. You can also key the transmitter with your own PTT line or via the T/R In jack on the rear panel.
4. Turn the MODE switch to RTTY and place the terminal in the transmit mode.
5. Adjust the POWER OUTPUT control for the desired output.

## IN CASE OF DIFFICULTY

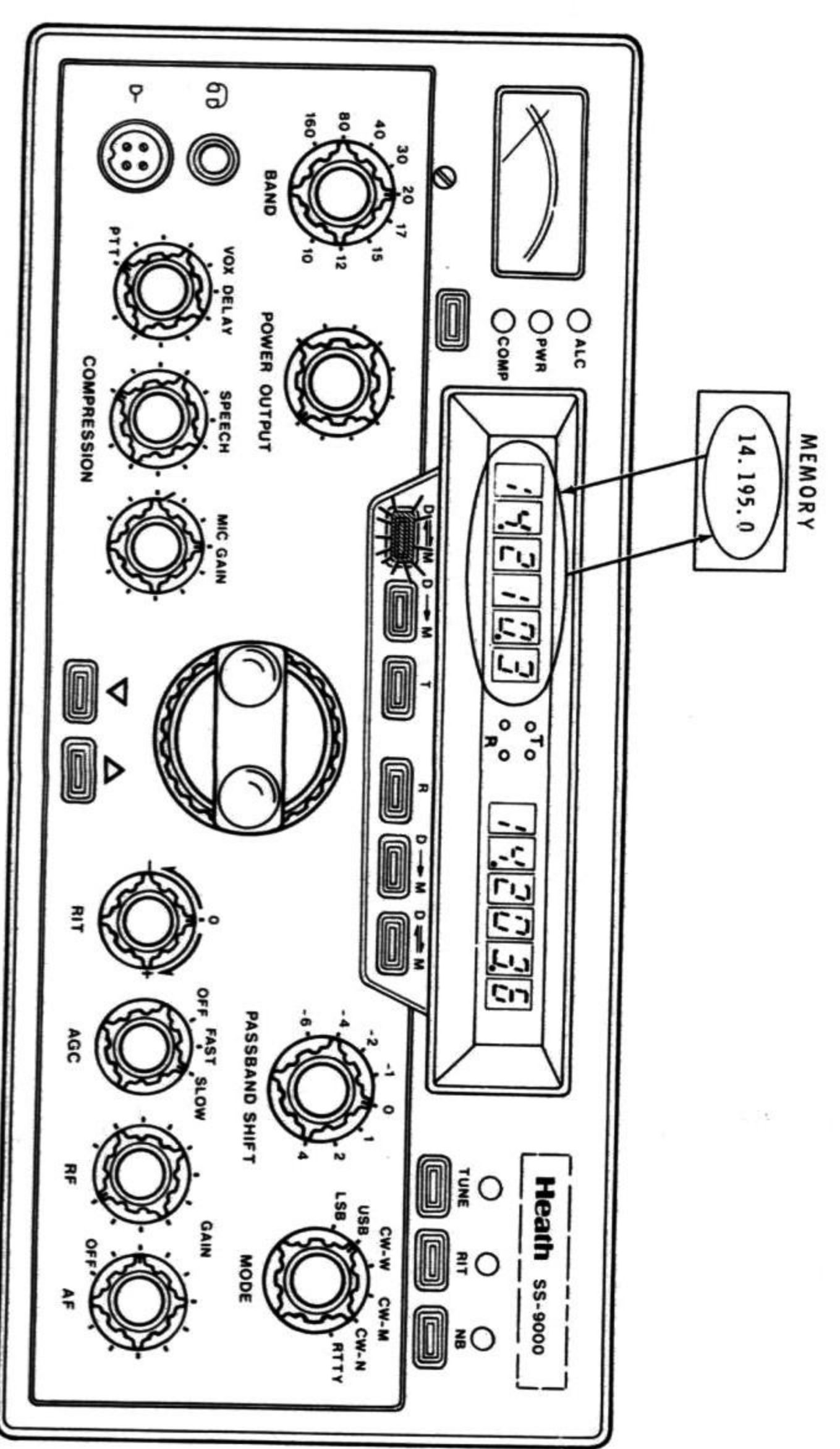
The following charts list some possible problems that you may encounter. NOTE: It is beyond the scope of this User Manual to troubleshoot the Transceiver or Power Supply to the component level.

In an extreme case where you are unable to resolve a difficulty, refer to "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

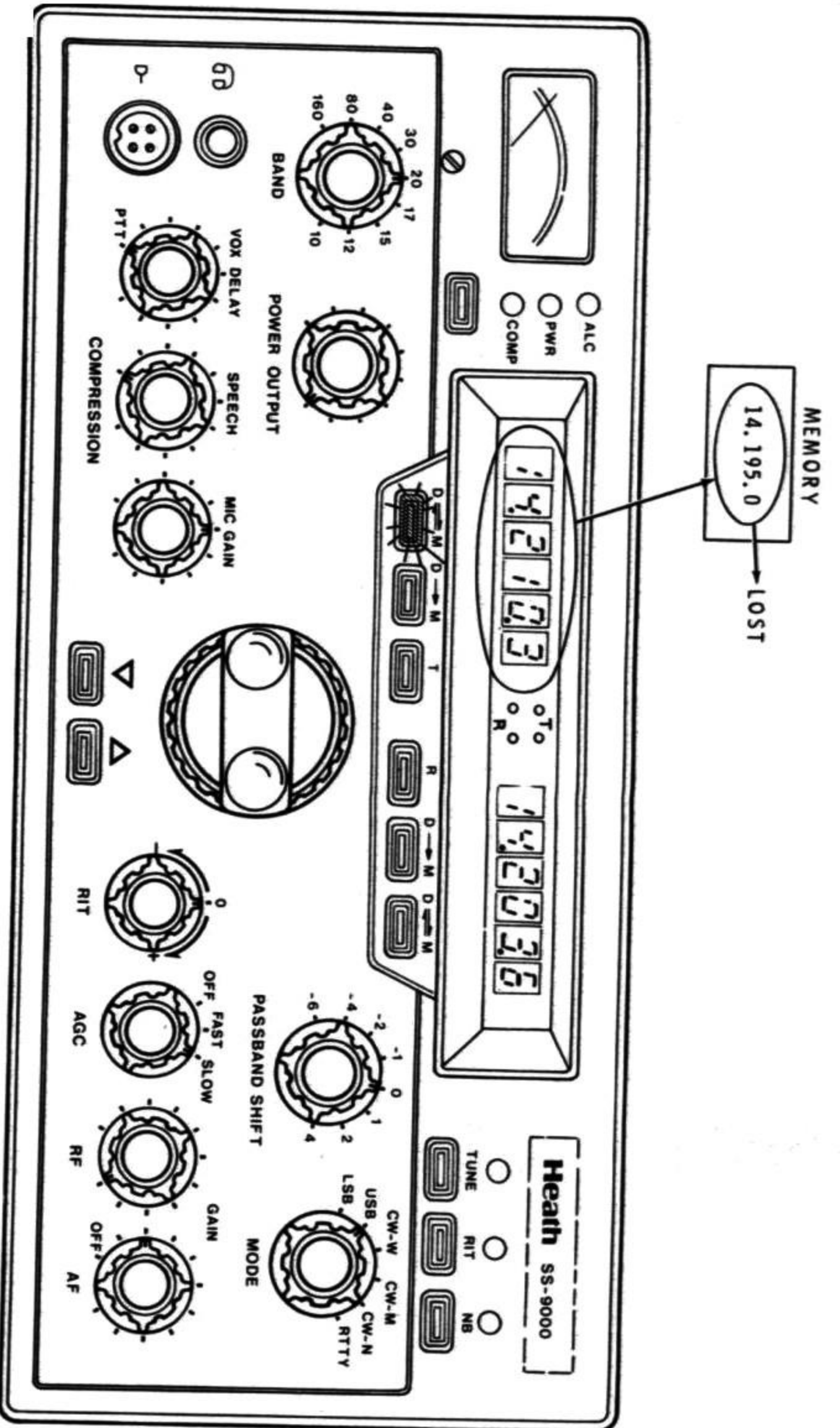
RECEIVER PROBLEMS	POSSIBLE CAUSE
No display or meter lights.	<ul style="list-style-type: none"> <li>A. Power supply not turned on.</li> <li>B. Transceiver not connected to the power supply.</li> <li>C. Open fuse in the Transceiver.</li> <li>D. Circuit breaker in the power supply. (Reset the main POWER switch on the bottom of the power supply. Then reset the circuit breakers.)</li> </ul>
No audio. Frequency display varies with tuning knob.	<ul style="list-style-type: none"> <li>A. Speaker not connected to the Transceiver.</li> </ul>
Audio is present. No receiver signals present. Frequency display varies with tuning knob.	<ul style="list-style-type: none"> <li>A. Antenna not connected to the Transceiver.</li> <li>B. Mode switch at wrong setting.</li> <li>C. Passband Shift switch at wrong setting.</li> </ul>
Low receiver volume. Weak signals.	<ul style="list-style-type: none"> <li>A. RF Gain control turned down.</li> <li>B. Mode switch setting.</li> <li>C. Speaker cable connected wrong.</li> <li>D. Passband shift switch setting.</li> </ul>
Sidetone level not as desired.	<ul style="list-style-type: none"> <li>A. See "CW Transmission" on Page 24.</li> </ul>



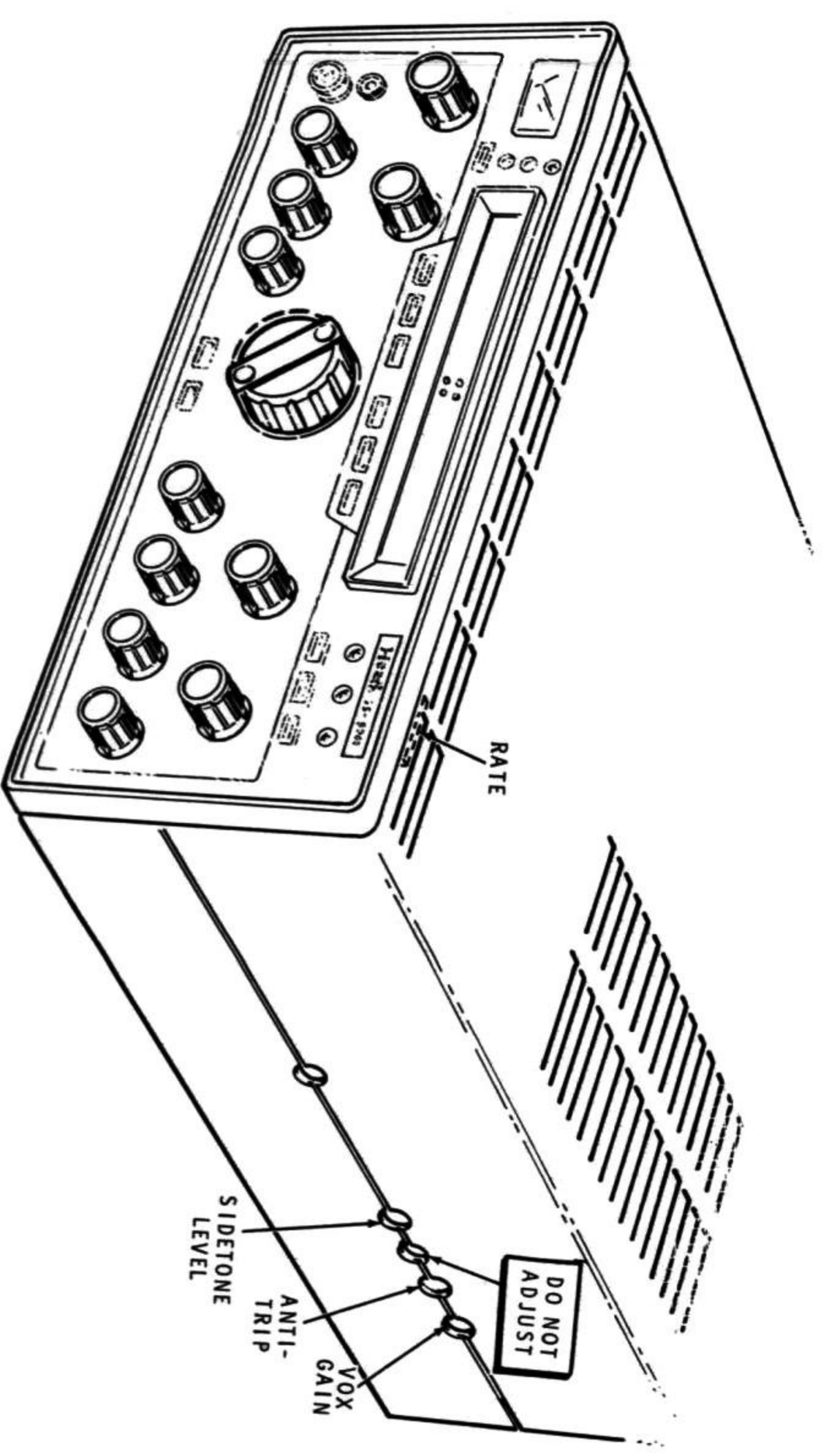
PICTORIAL 2-7



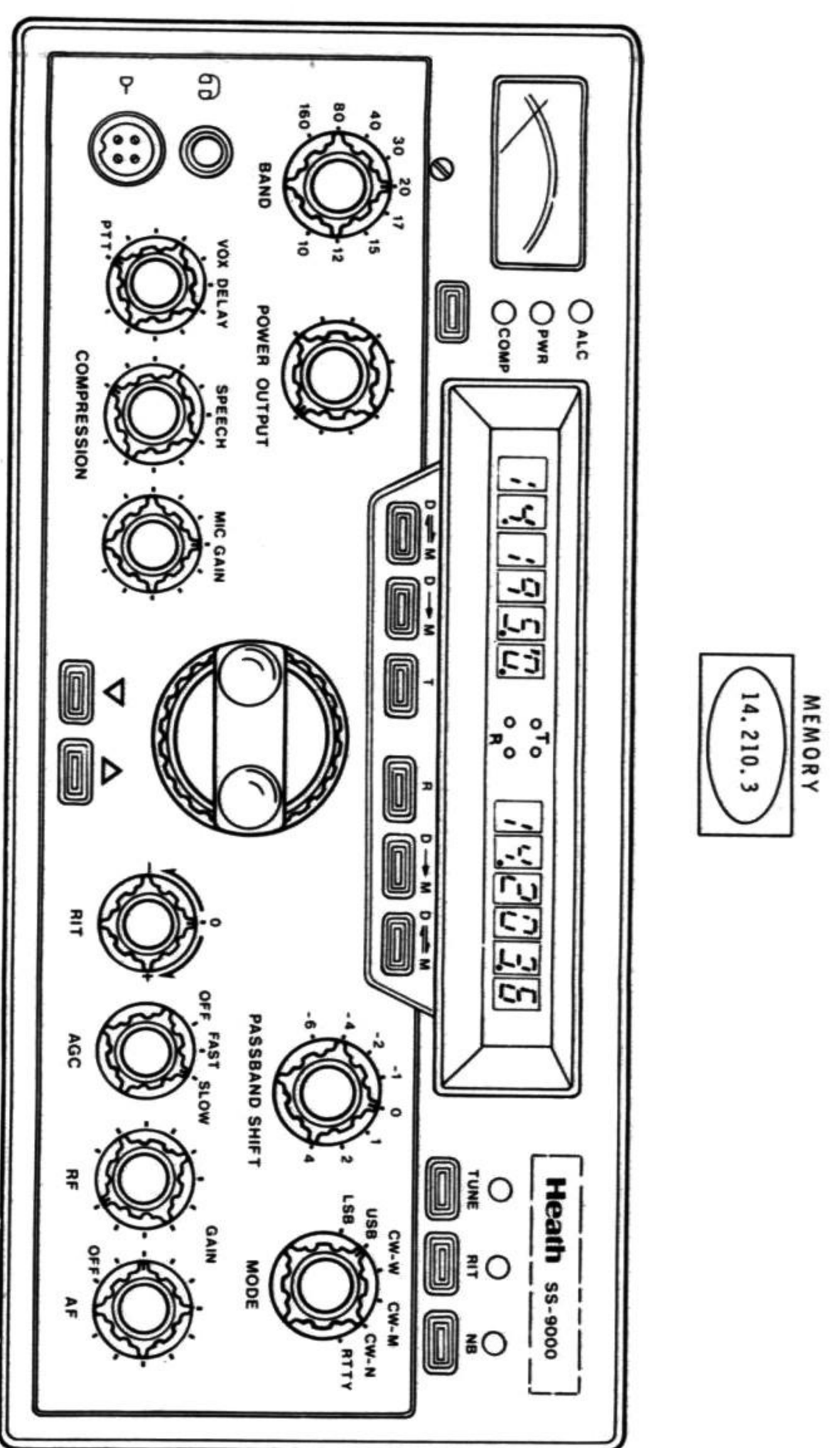
PICTORIAL 2-5



PICTORIAL 2-6



PICTORIAL 2-3



PICTORIAL 2-4

TRANSMITTER PROBLEMS	POSSIBLE CAUSE
Receives okay. Tune indicator lights. Transmit relay pulls in. No power or low power output.	<ul style="list-style-type: none"> <li>A. Power Output control setting.</li> <li>B. High VSWR.</li> <li>C. Thermal shut down.</li> </ul>
RF output but no SSB operation.	<ul style="list-style-type: none"> <li>A. Mode switch setting.</li> <li>B. MIC Gain control setting.</li> <li>C. Speech Compression control setting.</li> <li>D. Microphone incorrectly wired (see Page 11).</li> </ul>
RF output in Tune but no output in the CW mode.	<ul style="list-style-type: none"> <li>A. Mode switch setting.</li> <li>B. Key connections.</li> </ul>
Linear relay does not operate.	A. Linear not connected to EXT. Relay jack properly.
No linear ALC.	A. ALC control (rear panel) setting. See "Amplifier" on Page 24.
Receives but no RF output in any mode.	A. Tuned to an out-of-band frequency.

## THEORY OF OPERATION

Refer to the "Transceiver Block Diagram" (fold-in) as you read this "Theory of Operation." The component numbers are arranged in the following groups to help you locate specific parts.

1-99	Parts mounted on the chassis and meter circuit board.	1001-1099	Parts mounted on the inverter circuit board and subchassis.
101-199	Parts mounted on the synthesizer circuit board.	1201-1299	Parts mounted on the power interfac-circuit board.
201-299	Parts mounted on the transmit/receive (T/R) circuit board.	1400-1499	Parts mounted on the motor drive circuit board.
2001-2099	Parts mounted on the transmit/receive (T/R) circuit board.	1500-1599	Parts mounted on the Transmitter (TX) audio circuit board.
301-399	Parts mounted on the main audio circuit board.	1900-1999	Parts mounted on the ALC circuit board.
3001-3099	Parts mounted on the main audio circuit board.		
401-499	Parts mounted on the front panel and LED circuit boards.		
501-599	Parts mounted on the preamp circuit board.		
601-699	Parts mounted on the power amplifier (PA) circuit board.		
701-799	Parts mounted on the power amplifier (PA) circuit board.		
801-899	Parts mounted on the controller circuit board.		
901-974	Parts mounted on the bandpass filter circuit board.		
975-999	Parts mounted on the external ALC circuit board.		

This Transceiver is a conventional dual-conversion receiver/transmitter for CW, SSB and RTTY use. The first IF operates at approximately 9 MHz, while the second IF operates at 3.395 MHz.

Signals present at the antenna first pass through the low-pass and high-pass filters on the PA circuit board. These filters form a broad-band tuned circuit front end for the receiver. The signal passes through this tuned circuit before it is applied to the receiver preamplifier on the preamp circuit board. A PIN diode RF attenuator circuit on the preamp circuit board allows you to limit the amplitude of the signal by the RF Gain control before it is applied to the bandpass filter circuit board.

Nine electronically-switched, bandpass filters provide more filtering for the signal before it is applied to the first mixer on the T/R circuit board. In addition, the filter circuit board contains a 32 MHz low-pass filter and, on 20, 17, and 15 meters, a 22 MHz low-pass filter.

The incoming signal is mixed with the HFO signal to provide a 9 MHz IF signal. This 9 MHz signal (from the first mixer) is applied to the first IF amplifier (a dual-gate MOSFET stage with four poles of LC filtering) and then to the second mixer. Here, the first IF signal is mixed with a signal from the IFO (approximately 12.4 MHz) and a 3.395 MHz second IF signal results. The IFO frequency covers a 50 kHz range in 100 Hz steps.

The 3.395 MHz IF signal passes through a SSB filter, a MOSFET IF amplifier, CW filters (if installed), a second MOSFET amplifier, a second IF filter, a third IF amplifier, and then to the product detector.

Audio from the product detector passes through a mute gate on the audio circuit board (which inhibits the receiver audio in the transmit mode), the AF Gain control, a low-pass filter (to restrict the audio bandpass), and the integrated circuit power amplifier. The resulting boosted audio is of sufficient amplitude to drive a speaker or headphones.

In the transmit mode, the transmitter audio (from the microphone, external audio input, or CW sidetone) is first applied to the transmitter audio preamp. The audio is then applied to the VOX circuit and the balanced modulator on the T/R circuit board.

The VOX circuit passes a "request to transmit" ( $\overline{T_{req}}$ ) to the microprocessor which, after checking the status of the other circuits, passes a  $\overline{T_{OK}}$  signal back to the timing circuit on the audio circuit board. This circuit generates the actual receive and transmit command signals required by the other circuits in the Transceiver.

On the T/R circuit board, the balanced modulator generates a double-sideband signal which, after filtering through FL204 and speech compression in the transmit second IF, is refiltered by FL201 before it is applied to the second mixer. Here, the signal is mixed with the IFO signal to produce a 9 MHz IF signal. The signal then passes through the first IF amplifier (in the opposite direction from the receive signal), the first mixer (where it is combined with the HFO signal), and the proper filter on the bandpass filter circuit board before it is applied to the preamp circuit board.

The signal from the preamp circuit board passes through a high-pass filter on the PA circuit board, and is then amplified again by the transmit driver and power amplifiers. The resulting 100-watt signal is then passed through a low-pass filter, a VSWR detector circuit, and a relative power sensor before it is applied to the antenna.

The local oscillator for the first mixer operates at a frequency which is above the first IF frequency. This local oscillator is called the HFO and tunes each of the nine amateur bands (160-10 meters) in 50 kHz steps. The actual HFO frequencies depend upon the band selected.

Protection circuits on the preamp, ALC, and PA circuit boards protect the transmitter circuits from high temperatures, over current, and high VSWR. These protection circuits all control the RF attenuator in the same manner as the RF Gain control in the receive mode.

A two-stage IF amplifier on the T/R circuit board provides speech compression for the transmitter audio. The output from the second IF amplifier is further amplified by another IF amplifier and applied to a detector stage. This detector applies an AGC voltage to the first two IF amplifiers and effectively holds the output of these stages constant. The time constant of this AGC loop determines the amount of speech compression.

A basic frequency standard and the three synthesizer loops for the voltage-controlled oscillator sections on the T/R circuit board (HFO, IFO, and BFO) form the synthesizer.

The HFO loop consists of a conventional frequency divider, which is programmed by the controller, and a phase detector that has a basic reference frequency of 25 kHz. Integrated circuit U202B (on the T/R circuit board) divides the 100 kHz to provide 50 kHz steps to the input of the first mixer.

The IFO loop contains a VCO and a divide-by-four stage. The IFO VCO operates at four times the IFO output frequency and is applied to the second mixer. This four times frequency (approximately 49.6 MHz) is mixed with 40 MHz, coming from the frequency standard, in a down mixer and results in a 9.6 MHz difference frequency. This frequency is applied to the divide-by-N2 divider and then to the phase detector, where it is locked against a 3.2 kHz reference. The combination of the divide-by-four stage and the fractional divide technique results in 100 Hz steps at the output of the IFO (this is the local oscillator input to the second mixer).

# HEATH

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The BFO loop operates similarly to the HFO loop in that it involves no mixing. The 3393.5 kHz BFO VCO is divided down by N3 and then drives the phase detector, which has a 1.6 kHz reference frequency. Like the IFO loop, however, this loop uses a fractional divide technique and produces 100 Hz steps.

**The main divider (U110-U113) provides the various reference frequencies for the three synthesizer loops plus a 2 MHz clock reference for the microprocessor. This divider uses the 10 MHz clock, which is the basic standard for the Transceiver.**

A controller circuit forms the "intelligent" heart of this Transceiver. This circuit performs an interface function between external requests, via front panel controls and terminal interface, and the internal circuits (on the synthesizer, T/R, and audio circuit boards). The controller consists of a CPU, a peripheral interface adapter, a static memory interface, a read only memory (for the program sequence), 256 bytes of CMOS RAM, and various latches and gates.

Signals from the Band, Mode, Passband Shift, and Frequency Scan switches, together with signals from the rotary shaft encoder, are decoded on the front panel circuit board. The visual outputs include status indicators and the 16-digit (12 actually used) vacuum fluorescent display tube.

Switching circuitry is also provided on the front panel circuit board to switch the meter between the various functions. These functions include S units in the receive mode and ALC, relative power, or compression level in the transmit mode.

Other support assemblies for this Transceiver include an inverter circuit board and a power interface circuit board. The inverter circuit board uses the +13.8 volt input source to provide a regulated +28 volts for the display circuits and the +12, -5, and -12 volts for the controller circuit board. The interface circuit board provides overvoltage and reverse polarity protection for the Transceiver, as well as keying and muting signals for external accessories.

The heart of the terminal interface circuit is an asynchronous communications element (ACE). This device performs the functions of the conventional UART; but in addition, it has an internal software programmable baud rate generator, as well as modem control and a self test function. The clock is derived from the 2 MHz CPU clock on the controller circuit board.



## TERMINAL INTERFACE

The Terminal Interface allows you to control and monitor the Transceiver from a video terminal (such as the Heath Model H-19 or the Zenith Model Z-19), hard-copy (teletype) terminal, or computer (such as the Heath Model H-89 or Zenith Model Z-89). You can also remotely control the Transceiver over the telephone line by use of a modem. The interface complies with EIA standard RS-232C. Commands

built into the Transceiver controller allow you to display and select the band, mode, operating frequencies, passband shift, scan rate, and baud rate. You can also place the Transceiver in the transmit or receive mode. When the available commands are combined in a computer program, many more useful functions may be implemented.

## INSTALLATION

If you are using the Transceiver with a Heath H-19 or Zenith Z-19 Terminal, proceed to the "Heath/Zenith System Configuration" section that follows. If you are using the Transceiver with a non-Heath or Zenith terminal, proceed to "Non-Heath/Zenith System Configuration" on Page 32.

If you will be using the Transceiver with a modem or a computer, proceed to the appropriate section which follows.

# HEATH

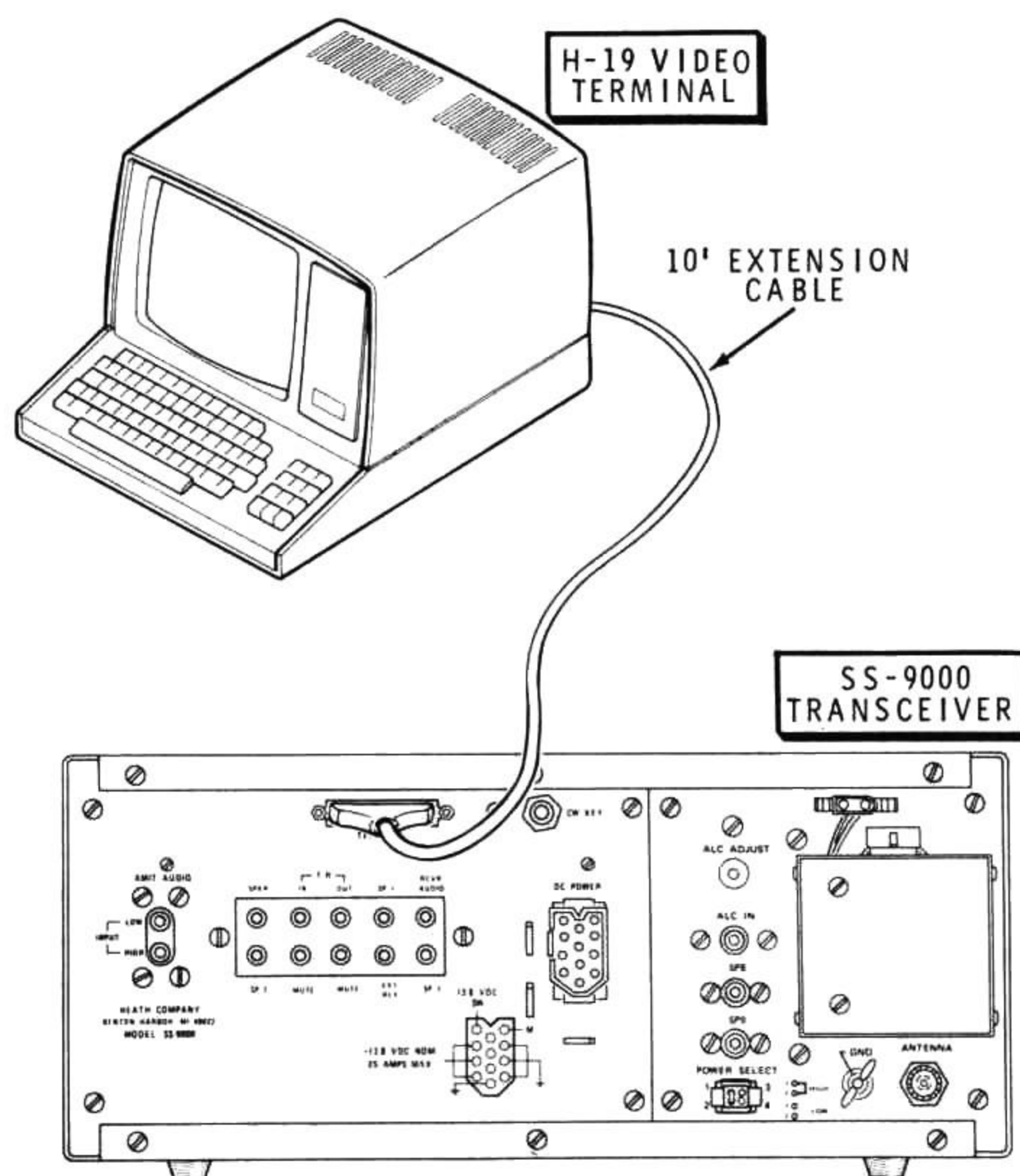
## HEATH/ZENITH SYSTEM CONFIGURATION

Refer to Pictorial 3-1 as you read the following information.

The terminal interface in your Transceiver communicates with your terminal through a serial interface at RS-232C signal levels. The 25-pin "D" connector on the rear panel conforms to RS-232C standards. It will mate with most equipment that conforms to this standard. Use the 10' extension cable supplied with your terminal to connect the two units together.

Plug the male connector at one end of the extension cable into the "D" connector on the rear panel of the Transceiver. Plug the other end of the extension cable into the "D" connector on the rear panel of the Terminal.

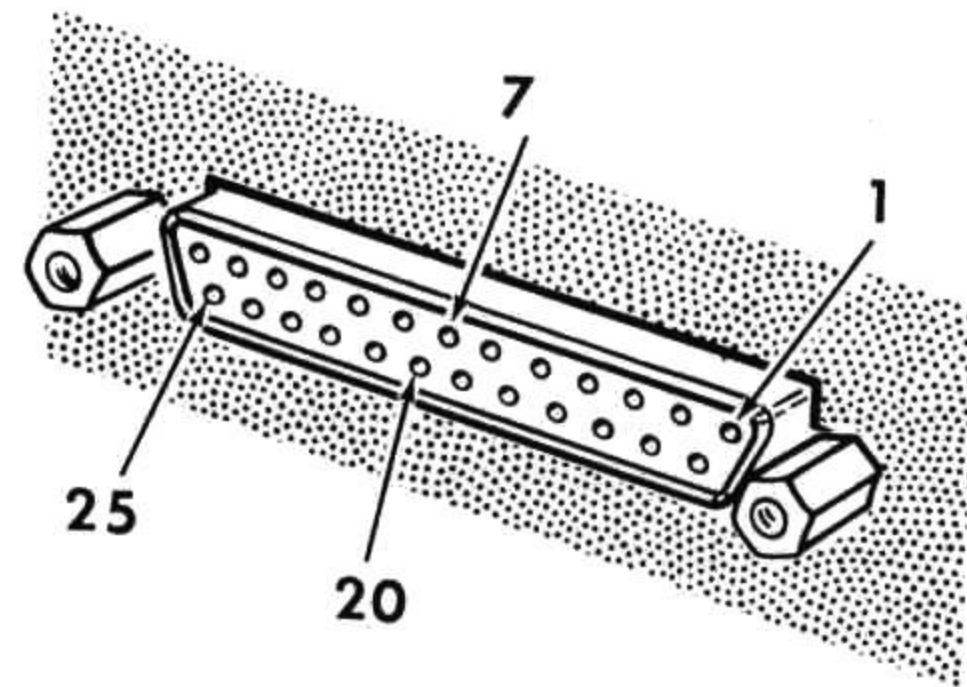
Proceed to "Operation" on Page 34.



PICTORIAL 3-1

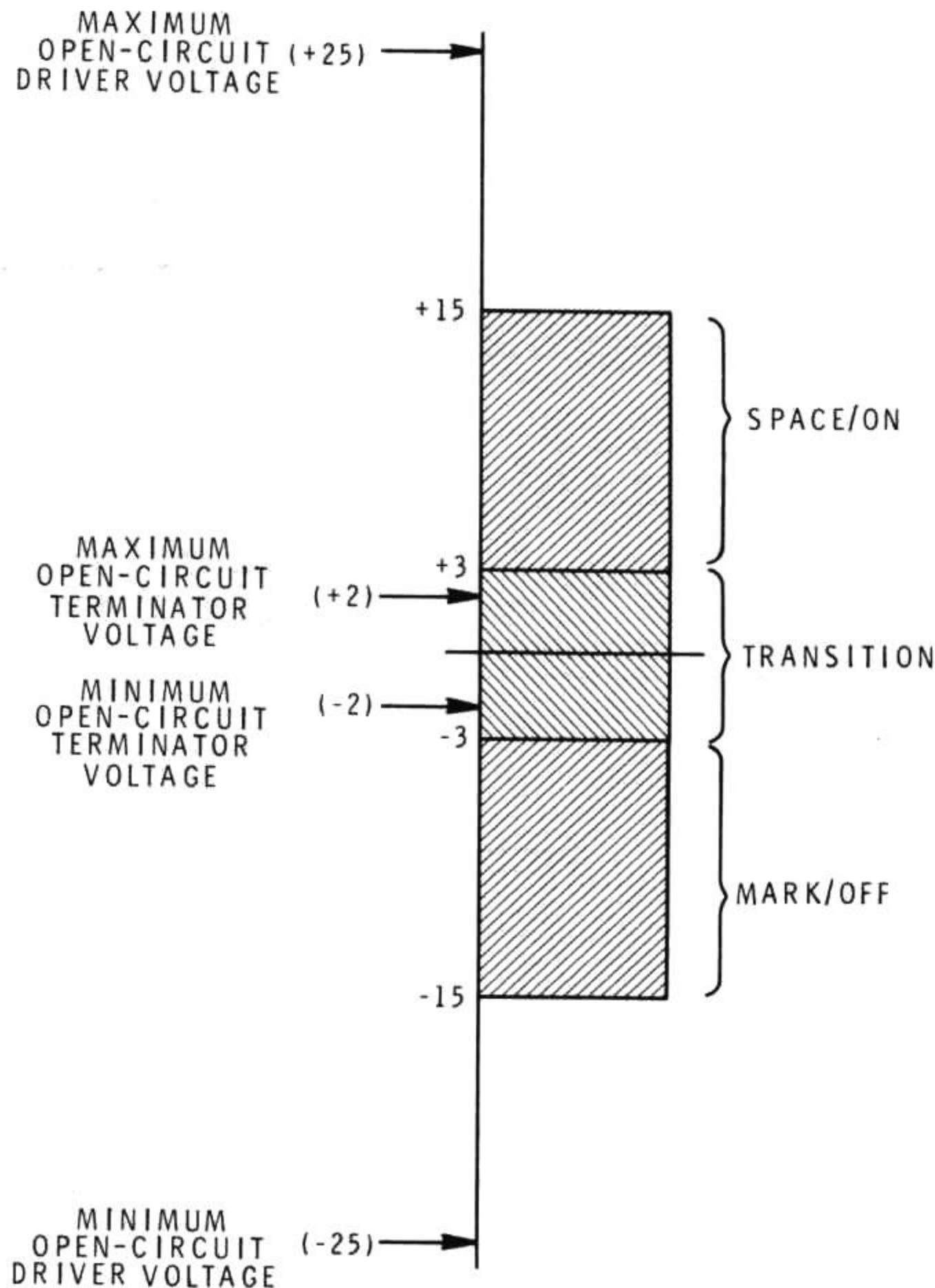
### NON-HEATH/ZENITH SYSTEM CONFIGURATION

The terminal interface in your Transceiver is designed to operate with serial I/O terminals that use the RS-232C standards of the Electronic Industries Association (EIA). This standard defines an asynchronous serial interface, its voltages (see Pictorial 3-2), its impedances, and its physical connectors.



PICTORIAL 3-3

The 25-pin "D" connector on the back panel of the Transceiver is a DCE (DB-25S) connector. Pictorial 3-3 shows the pin numbering of this connector. The following chart describes the DCE outputs of the rear panel connector:



PICTORIAL 3-2

RS-232C places all equipment into one of two general categories:

- DTE — Data Terminal Equipment
- DCE — Data Communications Equipment

Computers and modems are two types of DCE; while terminals, printers, and most peripherals are DTE. Always connect a DTE to a DCE. Never connect two like types together.

TERMINAL	INTERCONNECTION CABLE	TERMINAL INTERFACE
P GND	1 — 1	Protective Ground
S OUT	2 — 2	RS-232C Serial Output
S IN	3 ← 3	RS-232C Serial Input
RTS	4 — 4	Request To Send Output
CTS	5 ← 5	Clear To Send Input
DSR	6 ← 6	Data Set Ready
S GND	7 — 7	Signal Ground
RLSD	25 — 25	Received Line Signal Detect
DTR	20 — 20	Data Terminal Ready Output

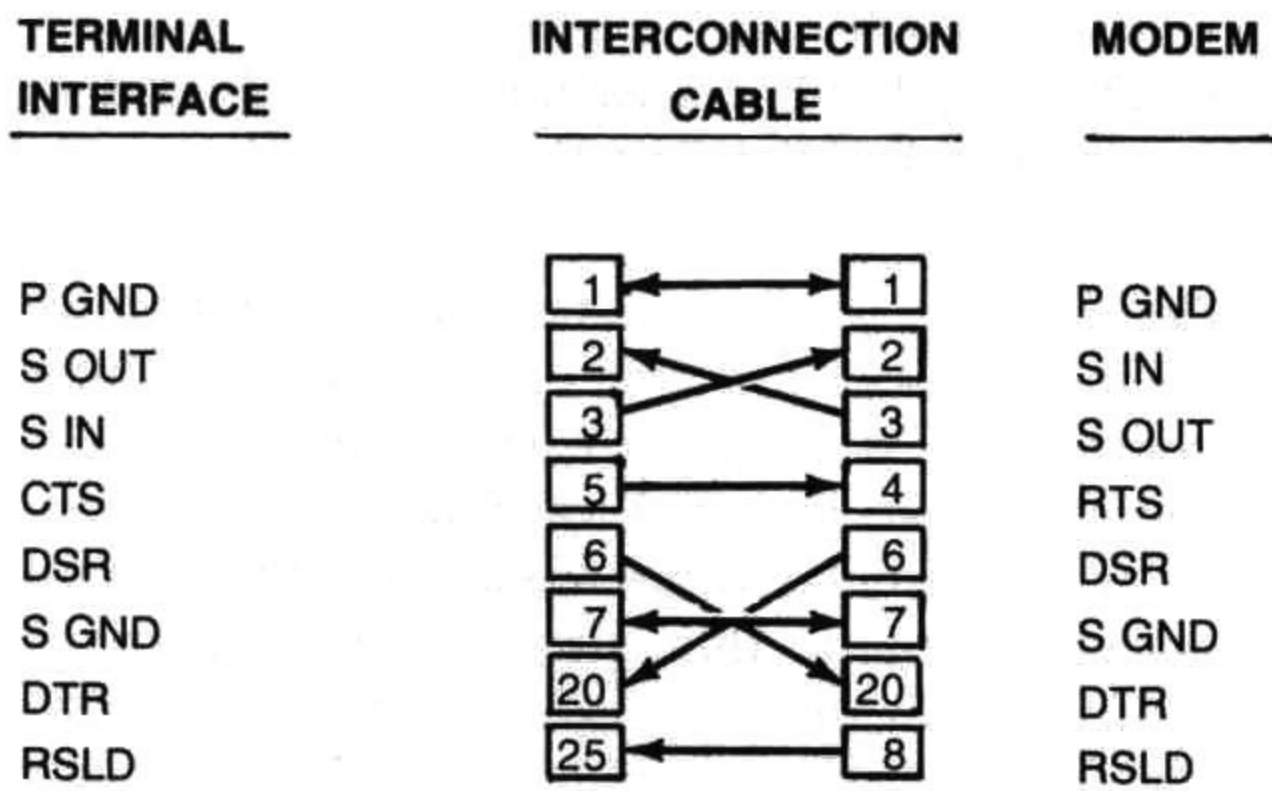
Make sure your terminal is configured as required by your terminal manual and operates at RS-232C signal levels. The baud rates of the terminal interface and terminal must be the same.

After you connect the terminal interface to your terminal, proceed to "Operation" on Page 34.

# HEATH

## CONNECTION TO A MODEM

The Transceiver is configured as DCE (Data Communication Equipment). Since modems are also DCE, you must change definition within the interconnecting cable in order to connect the two (as shown in the chart below). You can accomplish this by interchanging the wires at pins 2 and 3, 4 and 5, and 6 and 20 at **ONE END** of the cable. We recommend that pin 25 of the terminal interface connector be connected to pin 8 of the modem connector to provide RLSD (Receive Line Signal Detect).

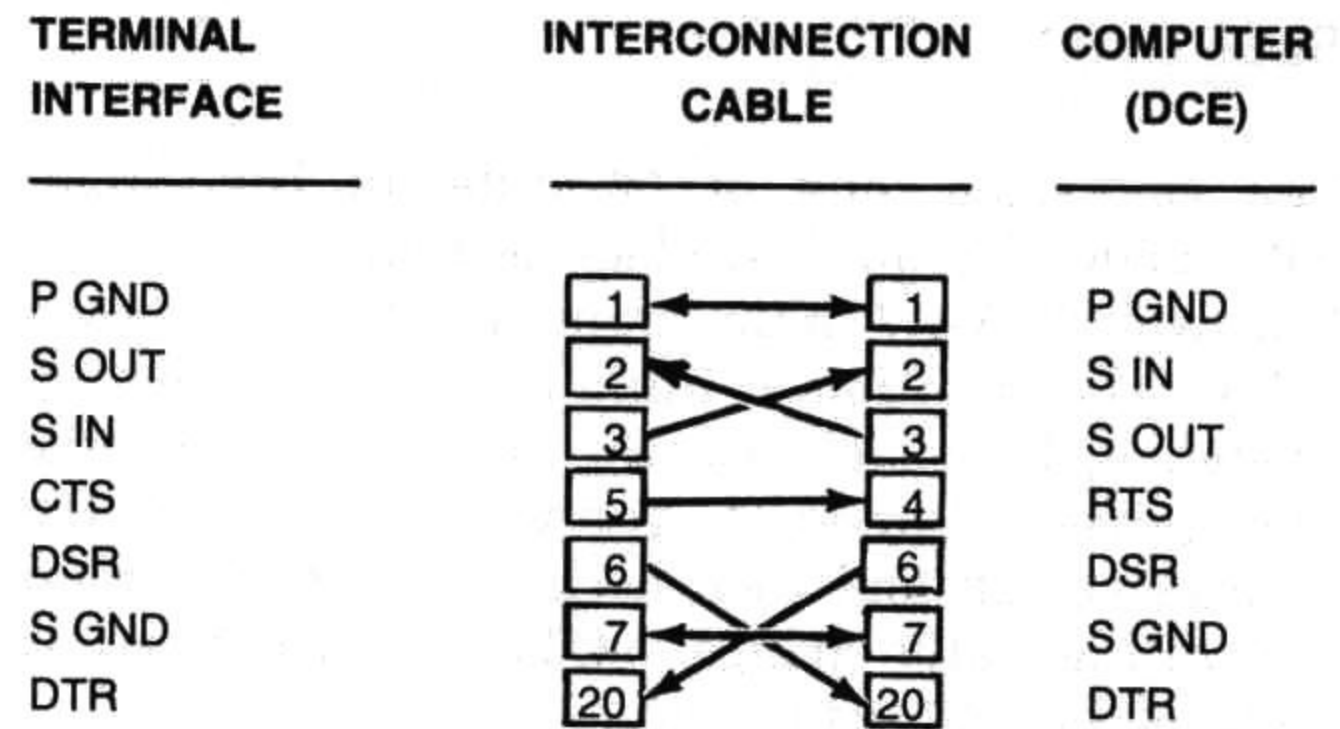


The modem holds RLSD "on" while it is receiving an acceptable carrier (audio tone) from the telephone line. The terminal interface monitors this line and forces the Transceiver into the receive mode should the carrier be lost. If you implement this option, you should remove the jumper on the controller circuit board inside the Transceiver (next to U818). Do not remove the jumper if you are not going to use this option.

If the modem does not require handshaking signals, you may simplify the wiring by removing the wires at pins 5, 6, and 20 of the terminal interface plug and installing a jumper between pins 6 and 20.

## CONNECTION TO A COMPUTER

You can interface the Transceiver to a computer such as the Heath Model H-89 or the Zenith Model Z-89 using a standard RS-232 cable, if you use a computer port that is configured as DTE (Data Terminal Equipment). The software package that is furnished with the terminal interface is written for connection to port 330Q (octal). This is the AT (Alternate Terminal) port, and requires that an ACE and RS-232 interface integrated circuits be installed on the serial interface circuit board in the computer. If you desire to use a DCE port, see "Connection to a Modem" and the chart below regarding rewiring the interface cable.



The software demonstration package (5-1/4" diskette), included with the terminal interface, represents only one of many ways of providing communication between a computer and the Transceiver. It consists of a program, written in MBASIC, and aUSR assembly language routine. Refer to "I/O Routine" for the listing of the USR routine.

## OPERATION

Be sure the Terminal Interface is connected as directed in "Installation" on Page 30. Then proceed to the "Switch Settings" section below.

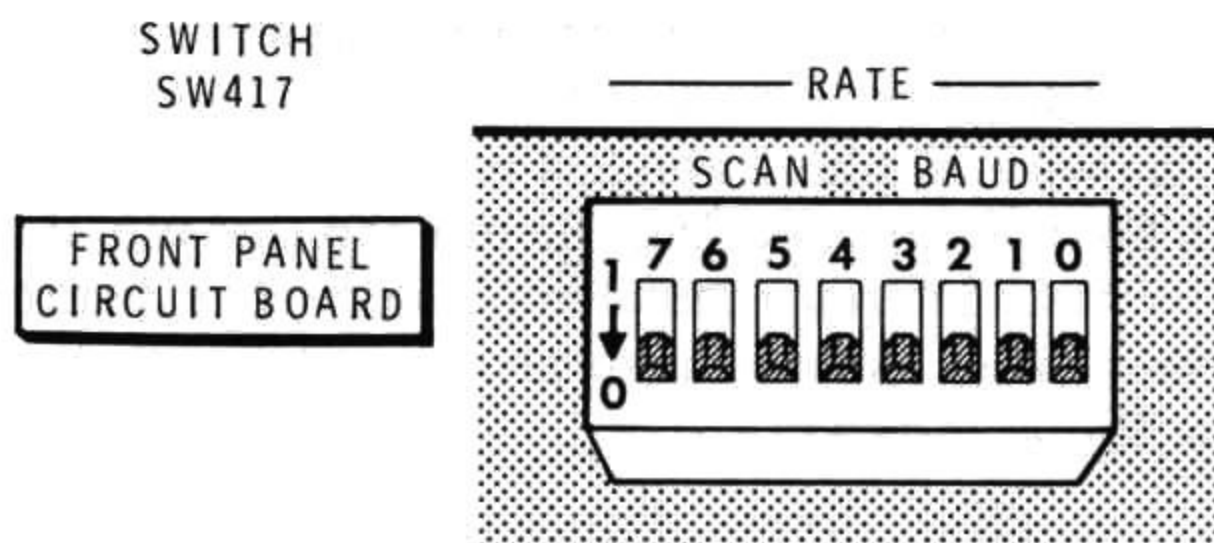
### SWITCH SETTINGS

Refer to Pictorial 2-3 (fold-out from Page 25) and Pictorial 3-4 and remember that, as you look at switch SW417 on the front panel circuit board, you select the one (1) positions of the switch by pushing the switches up, and you select the zero (0) positions by pushing the switches down.

### Baud Rate

You can select any of 16 different baud rates (50 – 9600). To do this, place sections 0, 1, 2, and 3 of switch SW417 in the proper positions as shown below. The baud rate is initialized upon power-up. Therefore, if you change the baud rate while the Transceiver is turned on, you will have to turn the Transceiver off and then back on before the baud rate will actually change. NOTE: The baud rate is preset at the factory to 4800.

BAUD RATE	SWITCH SECTION			
	3	2	1	0
50	0	1	0	0
75	1	0	0	0
110	1	1	1	1
134.5	0	0	0	1
150	1	0	1	1
300	0	1	1	1
300	0	0	0	0
600	0	0	1	1
1200	1	1	0	1
1800	0	1	0	1
2000	1	0	0	1
2400	1	1	1	0
3600	0	1	1	0
4800	1	0	1	0
7200	0	0	1	0
9600	1	1	0	0



**PICTORIAL 3-4**

NOTE: The four left-hand switches (7, 6, 5, and 4) are described under "Rate" on Page 19.

1. Commands are provided to control and monitor all functions of the Transceiver that are under control of the microprocessor. You can use the same commands that allow you to set a parameter to a particular value to examine the current set value. To do this, simply enter a carriage return <RET> (or line feed) immediately following the "=". For example, BA=15<RET> sets the band to 15 meters, while BA=<RET> returns the current band. In the list below, the characters in brackets are optional.

NOTE: Setting a parameter to "SW" returns it to its physical setting. Setting a parameter to "L" locks it to its current setting.

2. If you send a command to the Transceiver that is not in the proper syntax, the terminal will display one of 12 error codes in the form ERR #n. These error codes are listed on Page 38.
3. The normal system prompt is ">", which indicates that the interface is ready to receive a command. If this prompt appears as "U>", along with a bell (or beep), one or more of the phase-locked loops in the Transceiver is unlocked.

# HEATH

---

4. Terminate each command with a carriage return or a line feed. (These are not shown in the list of commands below.) You may issue commands even during the time that the interface is returning a response to an earlier command. All commands are processed in the order received. See "Interface Protocol" below. If you type the wrong character by mistake, you can use the DELETE or BACKSPACE keys to correct the error before you press the <RET> key.

## COMMANDS

BR[ate]=	Prints the current Baud Rate setting.
BR[ate]=n	Sets the Baud Rate setting.
	where: n = 50, 75, 110, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, or 9600.
BA[nd]=	Prints the current Band switch setting.
BA[nd]=n	Rotates the Band switch to the n meter band.
	where: n = 16[0], 8[0], 4[0], 3[0], 2[0], 17, 15, 12, or 1[0].
MO[de]=	Prints the current Mode switch setting.
MO[de]=n	Sets the Mode to n.
	where: n = LO[wer], UP[per], W[ide], M[edium], N[arrow], or R[TTY].
SH[ift]=	Prints the current PASSBAND SHIFT switch setting.
SH[ift]=n	Sets the Passband Shift to n.
	where: n = -6[00], -4[00], -2[00], -1[00], 0, 1[00], 2[00], 4[00].
S[can]=	Prints the current SCAN switch setting.
S[can]=n	Sets the Scan rate to n.
	where: n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, or 16. NOTE: 1 = approximately 2.5 kHz per second; 16 = approximately 300 kHz per second.
SW[itc]h=	Releases all switches to their physical settings. NOTE: This includes the BAUD RATE switches.
L[ock]	Locks all switches to their current state.

**Commands (Cont'd.)**

PS[witch]	Prints the switch settings. NOTE: An "L" (locked) appears after any switch setting that was set from the terminal.
PF[req]	Prints the frequencies in memory for all bands.
PF[req]<band>	Prints the frequencies in memory for <band>, where <band> is one of the values for n listed in the BA[nd] command (see above). NOTE: The frequencies that are selected for receive and transmit are indicated by R and T, respectively.
RI[ndicator]	Toggles the receive indicator for the current band.
RI[ndicator] <band>	Toggles the receive indicator for <band>.
TI[ndicator]	Toggles the transmit indicator for the current band.
TI[ndicator] <band>	Toggles the transmit indicator for <band>.
RE[ceive]	Sets the Receive mode.
TR[ansmit]	Sets the Transmit mode.

# HEATH

## EXPRESSIONS

Expressions provide you with the flexibility to specify frequencies for either the display or memory.

### A. Symbols

- A Represents the left display frequency.
- B Represents the right display frequency.
- M Represents the memory frequency.
- T Represents the frequency in the display that is selected for transmit.
- R Represents the frequency in the display that is selected for receive.

NOTE: Each of these symbols may be followed by a band specifier. For example: M12 represents the memory frequency on the 12 meter band.

### B. Operators

- + Addition.
- Subtraction.
- = Assignment.
- X Exchange.

### C. Constants

Constants may be in the range of 0.0 to 99999.9, where only one digit to the right of the decimal point is selected.

Expressions may be in one of the following general forms, where <S> and <C> are symbols and constants, respectively.

a.  $\langle S \rangle = \langle S1 \rangle + \langle S2 \rangle + \dots + \langle Sn \rangle + \langle C \rangle + \langle C1 \rangle + \langle C2 \rangle + \dots + \langle Cn \rangle$

This evaluates the expression to the right of the "=" and assigns the result to <S>.

b.  $\langle S \rangle X \langle S1 \rangle + \langle S2 \rangle + \dots + \langle Sn \rangle + \langle C \rangle + \langle C1 \rangle + \langle C2 \rangle + \dots + \langle Cn \rangle$

This exchanges the values on each side of the X. In the above case, the first symbol encountered on the right side, <S1>, assumes the value of <S>, and <S> assumes the value of the entire expression.

c.  $\langle S1 \rangle + \dots + \langle Sn \rangle + \langle C1 \rangle + \dots + \langle Cn \rangle =$

This evaluates the expression and prints the result.

NOTE: The memory in this Transceiver allows you to store frequencies for one band in locations allocated for a band you do not intend to use. This allows you to store more than three frequencies on a given band in memory. If you later turn the Band switch to the band where you have these frequencies stored, however, the frequency will change to the nearest band edge and the previous stored frequency will be lost.

Examples of legal commands are:

1. R16=A1+5.1 Which adds 5.1 kHz to the frequency in the left display on the 10-meter band and inserts this value into the display currently selected for receive on the 160-meter band.
2. A8×R4+2 Which increments by 2 kHz the value in the display that is selected for receive on the 40-meter band, stores this value in the left display on the 80-meter band, and stored the frequency that was on the left display on the 80-meter band in the display that is selected for receiver on the 40-meter band.

### NOTES:

1. If an expression evaluates to a number outside of the allowed range for constants, the closest limit value (0 or 99999.9) is used.
2. When a band is selected where the receive frequency has been set outside of the allowed limits for that band, the band edge that is closest to the set value is substituted.



## CONTROL FUNCTIONS

Several control functions are provided. To send these functions from the terminal, hold down the CTRL key while you type the letter.

CTRL-B	Toggles an echo of the typed characters.
CTRL-O	Toggles the printout of the response from the interface.
CTRL-S	Suspends the printout.
CTRL-Q	Resumes the printout.
CTRL-U	Kills the command line.
ESC	The ESCape key disables communications with the Transceiver.
ESC1	This enables communications with the Transceiver. It also resets the control functions.

NOTE: If you press the ESCape key (or the ESCape character sent to the interface via a computer program) without immediately following it with a "1", the communications with the Transceiver will be lost until you send ESCape 1. Communications is **NOT** automatically re-established upon power-up. If the Transceiver does not respond, and you are sure the baud rates match, type (or send) the ESC1 code.

## D. ERROR CODES

Error codes are returned by the interface in the form ERR #n, where n may be 0 through 11, as indicated below:

- 1 Operation is not allowed in transmit.
- 2 X operator is being used improperly.
- 3 = operator is being used improperly.
- 4 - operator is being used improperly.
- 5 Improper operator is following a symbol or a constant.
- 6 + operator is being used improperly.
- 7 A switch command is being used improperly.
- 8 A switch value is illegal or missing.
- 9 An unrecognized command.
- 10 The BAND switch is inoperative.
- 11 A constant is greater than 99999.9.
- 12 You are attempting to transmit out-of-band.

## E. INTERFACE PROTOCOL

The interface provides a 16-character buffer for the input commands and a 64-character buffer for the output response. For normal terminal functions, there is little danger of them overflowing and losing characters. If the input buffer should fill up, the interface will respond with a BELL character to the terminal for any character that is not accepted.

When a computer is in control, the chance of overflowing the buffer is much greater. To protect against lost characters, the interface sends a CTRL-S and removes RTS (Request to Send) when the input buffer fills to 75% of its capacity (12 characters). When the input buffer empties to 25% of its capacity (4 characters), the interface sends a CTRL-Q and asserts RTS. These control characters are sent immediately after detection of the appropriate fullness condition, regardless of the current output conditions (CTRL-S in effect, output buffer full, etc.).

The DSR (Data Set Ready) input can be used as a hardware handshake for suspending the output in the same manner as receiving a CTRL-S from the computer.

In computer-controlled applications you should send an ESCape1, followed by a single CTRL-B, to disable the echo. When the echo is disabled, the interface also sends a CTRL-R whenever any display or switch changes state. This can be used to request the computer to interrogate the Transceiver to determine what changed. NOTE: Many CTRL-R's are sent when you rotate the tuning knob or push a scan pushbutton.

Briefly, the RS-232 handshake line states are as follows:

### INPUT:

DSR	Low to inhibit output, high to enable output.
CTS	Not implemented.

### OUTPUT:

DTR	Always high.
RTS	Low when input buffer is more than 75% full, high when less than 25% full.

# HEATH

---

## F. RUNNING THE DEMONSTRATION PROGRAM

NOTE: Although the following information refers to the H/Z-89 Computer, the demonstration program will also work with an H-8, H-19, and H-17 system. You will also need a Multiport Serial I/O Card in your Computer.

1. Hardware/software requirements:
  - A. H/Z-89 with 48 kilobytes of RAM.
  - B. 3-port serial interface, with accessory IC's installed at 330Q.
  - C. HDOS, MBASIC
2. Boot up an HDOS system disk, and use INIT and SYSGEN to make a new Demonstration disk. Then copy MBASIC and SSDEMO.BAS onto it. Store the original disk in a safe place.
3. Connect the Transceiver to the Power Supply, if this has not already been done.
4. Connect the proper output port (330Q) on the H/Z-89 to the terminal interface port on the Transceiver. Make sure the Transceiver is set to 4800 baud. Now boot up your system and, when the system prompt ">" appears, type:

MBASIC SSDEMO<CR>

## IN CASE OF DIFFICULTY

PROBLEM	POSSIBLE CAUSE
Display indicates "IC2".	A. Problem on the controller circuit board.
Display indicates "IC3".	A. Problem on the controller circuit board.
Keyboard operates but nothing prints on the terminal.	A. Suspended output. Type CTRL-Q. B. Problem on the controller circuit board.
Terminal has no effect.	A. Disabled communications. Type <ESC>1. B. Different baud rates. C. Defective cable. D. Problem on the controller circuit board.
Terminal prints double characters.	A. Terminal is set for half duplex.

### OTHER TERMINAL INTERFACE PROBLEMS (With H-19 or Z-19 Terminal)

1. Pressing <CR> on the keyboard does not cause display of the ">" prompt.
  - A. Check the baud rate settings of the terminal and the Transceiver to make sure they match.
  - B. Make sure the interface cable is wired as shown in the "Operation" section of this Manual.
  - C. Make sure the terminal is "on line".
  - D. Press <ESC>1 to insure that communications with the Transceiver was not accidentally disabled. NOTE: Many of the keys on the terminal send ESCape sequences when you press them (which will disable communications). Also note that when the terminal interface is so disabled, it will **NOT** be automatically re-enabled upon turn-on.

### COMPUTER INTERFACE PROBLEMS (Model H-89 or Z-89 Computer)

1. Demonstration program will not run.

- A. The Transceiver must be turned on and connected to the computer. The baud rate switch in the Transceiver must match the baud rate set for the serial port in the computer before you RUN the program. NOTE: The serial port is set to 4800 baud in lines 420 and 430 of the BASIC program.
- B. The interface cable must be connected to port 330Q (octal). This is the lowest of the three ports (plug P605) on the 3-port serial card. The interrupt jumper should be connected to OFF to use the program as is.
- C. If the program still does not run after you check the above items, you can configure the Computer as a terminal. To do this, remove the 15-pin socket from plug P605 on the serial card and connect it to plug P404 on the terminal logic circuit board in the computer. Be sure to connect this socket with the gray wire down. Then proceed with the checks above under "Terminal Interface Problems".

NOTE: Since the terminal interface conforms with EIA standard RS-232, it should be possible to interface the Transceiver with other manufacturer's equipment. The Heath Company, however, cannot offer assistance in solving interface problems that you may encounter with other than Heath/Zenith products.

## I/O ROUTINE

ACE330 - I/O ROUTINE FOR H-89 & SS-9000  
GENERAL INFORMATION

INFO

HEATH HBASH V1.5 07/28/81  
08:13:57 10-DEC-81

PAGE 1

```
9 * This routine allows communication between the H-89 computer and the
10 * SS-9000 transceiver via port 3300. This port is configured as DTE
11 * (Data Terminal Equipment). The SS-9000 is configured as DCE (Data
12 * Communication Equipment). Therefore, a standard EIA RS-232 interface
13 * cable may be used for interconnection. If you want to use a
14 * different port, you can change the address in the EQUate table.
15 * If you use a port which is configured as DCE, the interconnecting
16 * cable must have connectors with male pins on each end, and it must
17 * be wired as shown on Page 33, "Connection to a Computer".
18 *
19 * You may poke the routine into memory as a USR subroutine from an
20 * MBASIC program like the one provided, and call it by assigning the
21 * string to be transmitted to the SS-9000 to a string variable, such as
22 * O$, and making this variable the argument of the USR function call.
23 * The string must terminate with a line-feed character (CHR$(10)) to
24 * indicate 'end-of-command' to the SS-9000. When the SS-9000 responds
25 * to the command, it will end its response with a '>' character. This
26 * character terminates this I/O routine and leaves the SS-9000's
27 * response in memory as follows: the length of the response (number of
28 * characters, not including the '>') is stored in memory at decimal
29 * addresses 45440 (low byte) and 45441 (high byte). The actual response
30 * begins at address 45442. The MBASIC program returns this response by
31 * PEEKing.
32 *
33 * Note the extra '+' on the end of the string sent to the radio. This
34 * is recommended in the MBASIC manual to insure that the string is
35 * passed to the USR routine properly.
36 *
37 * Note also that the port is initialized from the Basic program. In the
38 * demonstration program provided, the baud rate is set to 4800. The
39 * SS-9000 MUST be set to the same baud rate before running the program!
40 * The demonstration program was written to run under HDOS version 2.0
41 * and MBASIC version 4.7, on a 48 kB system.
42 *
43 * More pertinent information can be found in Appendix E of the Microsoft
44 * Basic manual, the H-89 Operation manual, and 'REMark', Issue 12.
```

ACE330 - I/O ROUTINE FOR H-89 & SS-9000  
EQUATES

EQU

HEATH HBASM V1.5 07/28/81  
08:13:57 10-DEC-81

PAGE 2

```

48 *      EQUATES
49
50 **     SOME 8250 (ACE) EQUIVALENCES
51
000.330 52 PORT   EQU    3300      PORT ADDRESS
000.330 53 R.DR   EQU    PORT+0    DATA REGISTER
000.334 54 R.MC   EQU    PORT+4    MODEM CONTROL REGISTER
000.335 55 R.LS   EQU    PORT+5    LINE STATUS REGISTER
000.336 56 R.MS   EQU    PORT+6    MODEM STATUS REGISTER
57
58 *      R.MC BIT DEFINITIONS
59
000.001 60 MC.DTR  EQU    00000001B   DATA TERMINAL READY
000.002 61 MC.RTS  EQU    00000010B   REQUEST TO SEND
62
63 *      R.LS BIT DEFINITIONS
64
000.001 65 LS.DR   EQU    00000001B   DATA READY
000.040 66 LS.THE  EQU    00100000B   TRANSMITTER HOLDING REGISTER EMPTY
67
68 *      R.MS BIT DEFINITIONS
69
000.020 70 MS.CTS  EQU    00010000B   CLEAR TO SEND
000.040 71 MS.DSR  EQU    00100000B   DATA SET READY
72
73 **     MISC. DEFINITIONS
74
000.076 75 EOT    EQU    '>'        END OF TEXT FROM SS-9000
000.177 76 H.PAR  EQU    01111111B   PARITY MASK
261.200 77 RAM    EQU    45440      FIRST ADDRESS FOR RETURNED STRING DATA
003.350 78 MAXL   EQU    1000        MAXIMUM INPUT STRING LENGTH PERMITTED
000.022 79 CTL.R  EQU    18         CONTROL-R
000.000 80 NULL   EQU    0          NULL

```

## HEATH

ACE330 - I/O ROUTINE FOR H-89 & SS-9000  
I/O ROUTINE

10

HEATH HBASM V1.5 07/28/81  
08:13:58 10-DEC-81

PAGE 3

```

84
85 *      I/O ROUTINE
86 *
87 *      ENTER: [D,E] POINTS TO 'STRING DESCRIPTOR' (3 BYTES):
88 *              BYTE 0: LENGTH OF STRING (0 TO 255 BYTES)
89 *              BYTE 1: LOW BYTE OF STRING STARTING ADDR
90 *              BYTE 2: HIGH BYTE OF STRING STARTING ADDR
91 *      EXIT:  # OF CHARACTERS RECEIVED FROM SS-9000 STORED AT RAM & RAM+1:
92 *              RAM: LOW BYTE OF #; RAM+1: HIGH BYTE OF #.
93 *      CHARACTERS RECEIVED FROM SS-9000 STORED BEGINNING AT RAM+2.
94 *      (EXITS WHEN '>' IS RECEIVED FROM SS-9000).
95
260.000  96      ORG      45056
97
98 **     OUTPUT SECTION
99
260.000  353    100  OUTPUT  XCHG      SAVE STRING POINTER
260.001  106    101      MOV      B,M      LENGTH OF INPUT STRING TO B
260.002  043    102      INX      H        POINT TO LSB OF STRING ADDR
260.003  136    103      MOV      E,M      LSB TO E
260.004  043    104      INX      H
260.005  126    105      MOV      D,M      MSB TO D
260.006  353    106      XCHG      RESTORE STRING POINTER
107
108 *     READY TO SEND CHARACTERS TO RADIO
109
260.007  076 002  110      MVI      A,MC.RTS
260.011  323 334  111      OUT      R,MC      SET REQUEST TO SEND BIT
260.013  333 336  112  OUT.1  IN       R,MS
260.015  346 020  113      ANI      MS.CTS    RADIO READY TO RECEIVE A CHAR?
260.017  312 013 260 114      JZ       OUT.1    LOOP TILL READY
260.022  333 335  115  OUT.2  IN       R,LS
260.024  346 040  116      ANI      LS.THE    COMPUTER PORT READY?
260.026  312 022 260 117      JZ       OUT.2    LOOP TILL READY
118
119 *     SEND A CHARACTER
120
260.031  176    121      MOV      A,M      GET CHARACTER FROM MEMORY
260.032  323 330  122      OUT      R,DR      TO DATA REGISTER
260.034  043    123      INX      H        POINT TO NEXT
260.035  005    124      DCR      B        ANY CHARACTERS LEFT?
260.036  302 013 260 125      JNZ     OUT.1    YES
126
127 *     STRING HAS BEEN TRANSMITTED
128
260.041  076 000  129      MVI      A,0
260.043  323 334  130      OUT      R,MC      CLEAR RTS
131
132 **     INPUT SECTION
133
260.045  041 202 261 134  INPUT  LXI      H,RAM+2    POINT TO FIRST CHARACTER LOCATION
260.050  001 000 000 135      LXI      B,0        CLEAR CHARACTER COUNTER
260.053  076 001  136      MVI      A,MC.DTR   SET DATA TERMINAL READY
260.055  323 334  137      OUT      R,MC
138
139 *     READY TO RECEIVE CHARACTERS

```

ACE330 - I/O ROUTINE FOR H-89 & SS-9000  
I/O ROUTINE

IO

HEATH HBASH V1.5 07/28/81  
08:13:58 10-DEC-81

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```

140
260.057 333 335 141 IN.1 IN R.LS
260.061 346 001 142 ANI LS.DR HAVE A CHARACTER YET?
260.063 312 057 260 143 JZ IN.1 NOT YET
260.066 333 330 144 IN R.DR YES - GET IT
260.070 346 177 145 ANI M.PAR STRIP PARITY
260.072 376 076 146 CPI EOT IS IT THE '>'?
260.074 312 130 260 147 JE FINISH YES - WE'RE ALMOST DONE
148
149 * SAVE RECEIVED CHARACTER
150
260.077 376 022 151 CPI CTL.R CONTROL-R?
260.101 312 057 260 152 JE IN.1 YES - IGNORE IT
260.104 376 000 153 CPI NULL NULL?
260.106 312 057 260 154 JE IN.1 YES - IGNORE IT
260.111 167 155 MOV M,A SAVE IT
260.112 003 156 INX B BUMP CHARACTER COUNTER
260.113 043 157 INX H AND CHARACTER POINTER
260.114 170 158 MOV A,B
260.115 376 003 159 CPI MAXL/256 COMPARE HIGH BYTE OF LENGTH WITH MAX ALLOWED
260.117 332 057 260 160 JC IN.1 NOT TOO LONG YET - READ ANOTHER
260.122 171 161 MOV A,C
003.000 162 SET MAXL/256*256
260.123 376 350 163 CPI MAXL-. COMPARE LOW BYTE OF LENGTH
260.125 332 057 260 164 JC IN.1 READ ANOTHER
165
260.130 041 200 261 166 FINISH LXI H,RAM
260.133 161 167 MOV M,C SAVE LOW BYTE,
260.134 043 168 INX H AND HIGH BYTE OF STRING LENGTH
260.135 160 169 MOV M,B RETURN TO BASIC PROGRAM
260.136 311 170 RET
171
260.137 172 END
ASSEMBLY COMPLETE
172 STATEMENTS
0 ERRORS DETECTED
15690 BYTES FREE

```

# REMOTE COAX SWITCH

This Transceiver has the capability of being connected to the Heathkit Model SA-1480 Remote Coax Switch. This allows you to change antennas (up to five) automatically when you turn the Band switch on the Transceiver. Except for the loss of one antenna position, no modifications are required in the SA-1480 Switch, and it will still function normally.

## INSTALLATION

**NOTE:** Be sure you complete your SA-1480 Switch kit at least up to the "Operation" section before you proceed with the following steps.

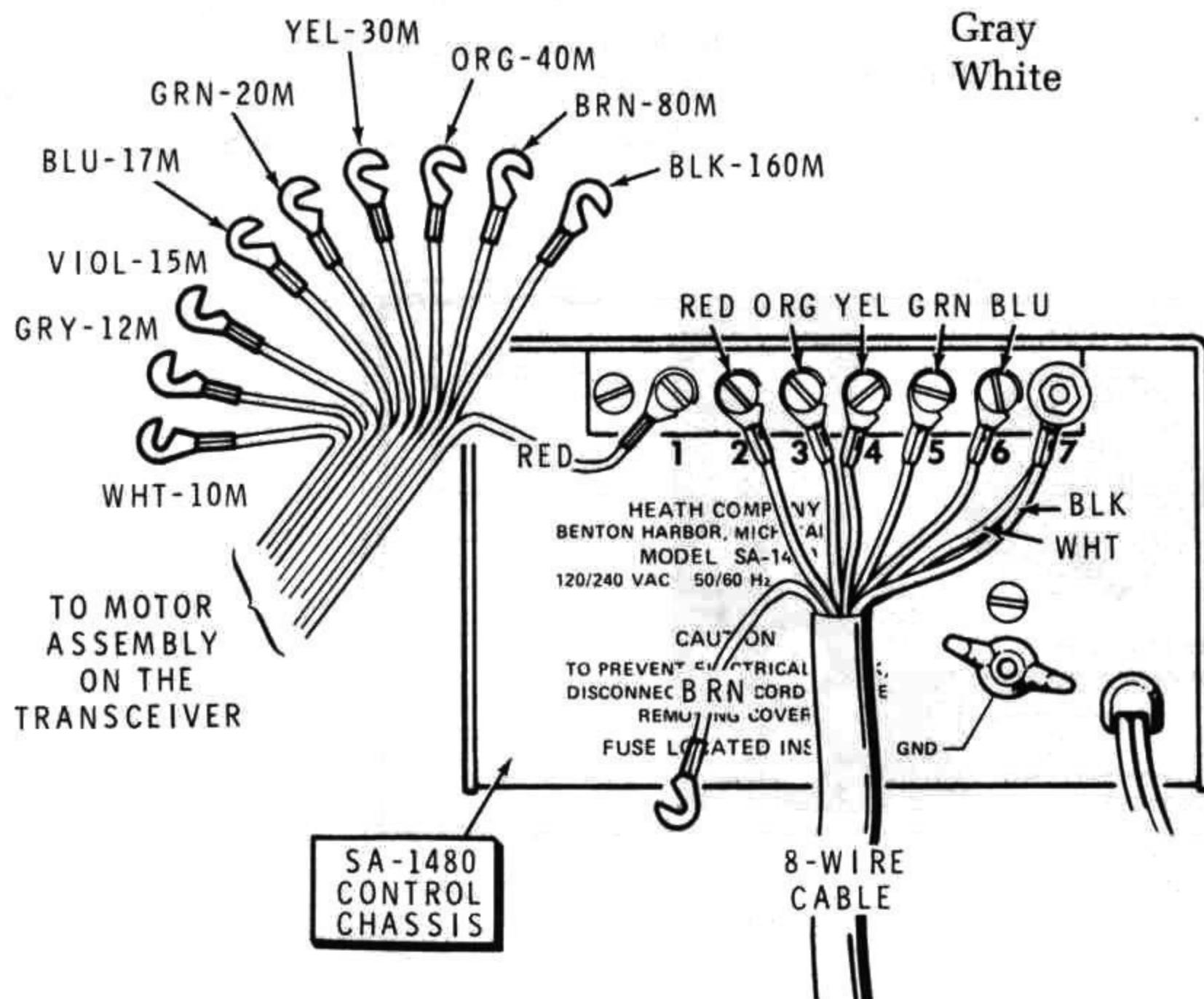
Refer to Pictorial 4-1 for the following steps.

1. Remove the brown wire from terminal 1 on the rear of the SA-1480 Switch control chassis. **NOTE:** You will not be able to select an antenna connected to socket J1 on the remote chassis with the switch on the front of the control chassis. You will, however, be able to select socket J1 with the BAND switch on your Transceiver.

2. Connect the solder lug on the end of the red wire coming from the flat cable to terminal 1 on the back of the control chassis.

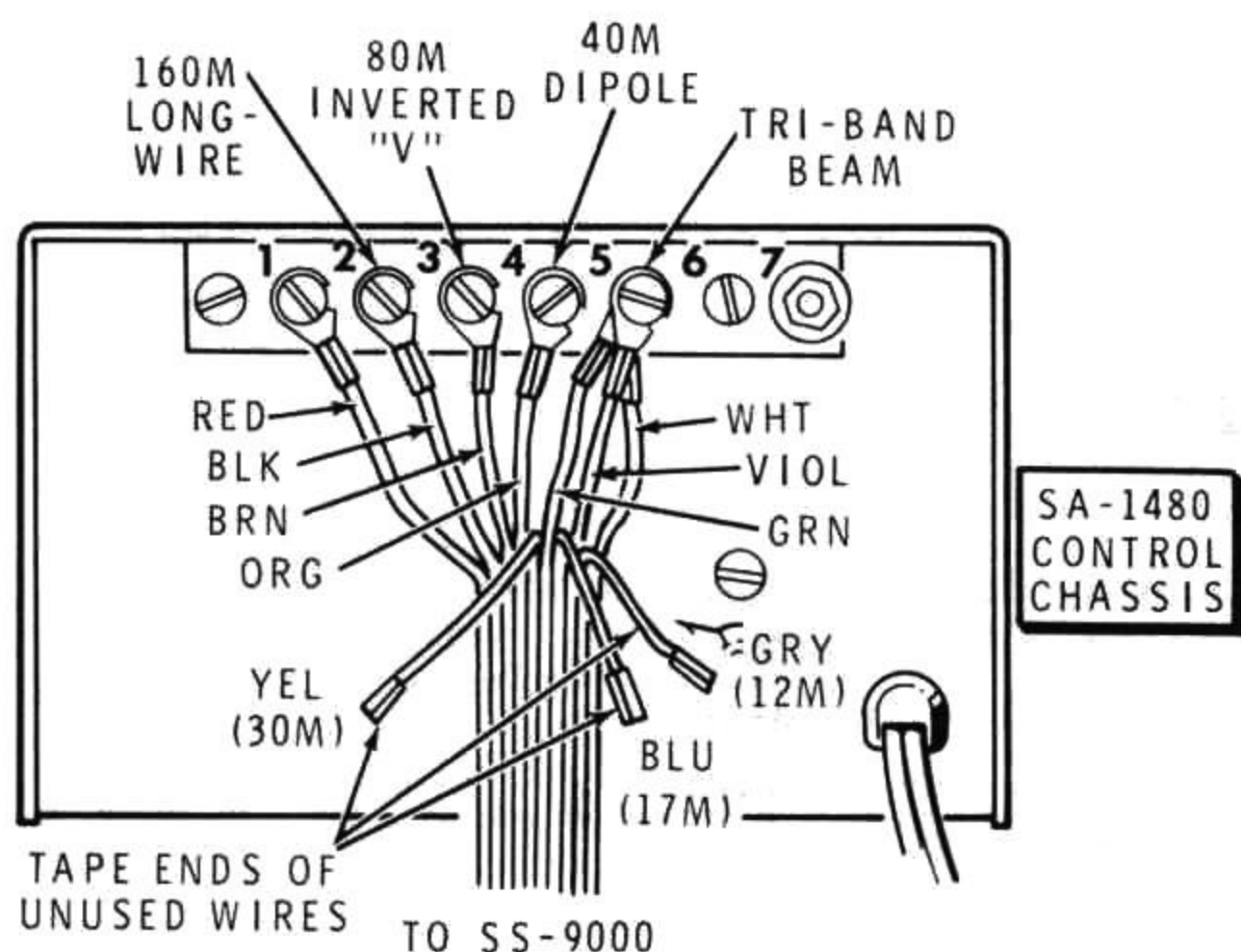
**NOTE:** The remaining flat cable wires correspond to the following Band switch positions:

Black	160 meters
Brown	80 meters
Orange	40 meters
Yellow	30 meters
Green	20 meters
Blue	17 meters
Violet	15 meters
Gray	12 meters
White	10 meters

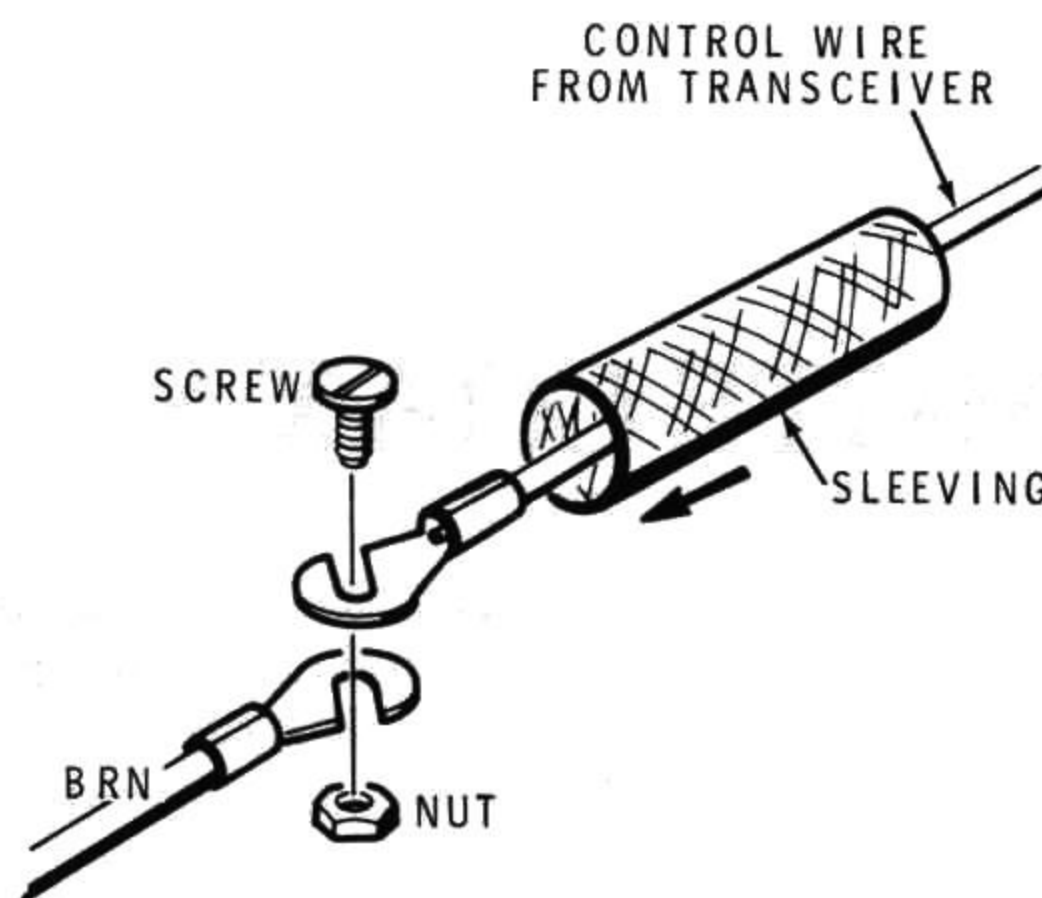


PICTORIAL 4-1





**Detail 4-1A**

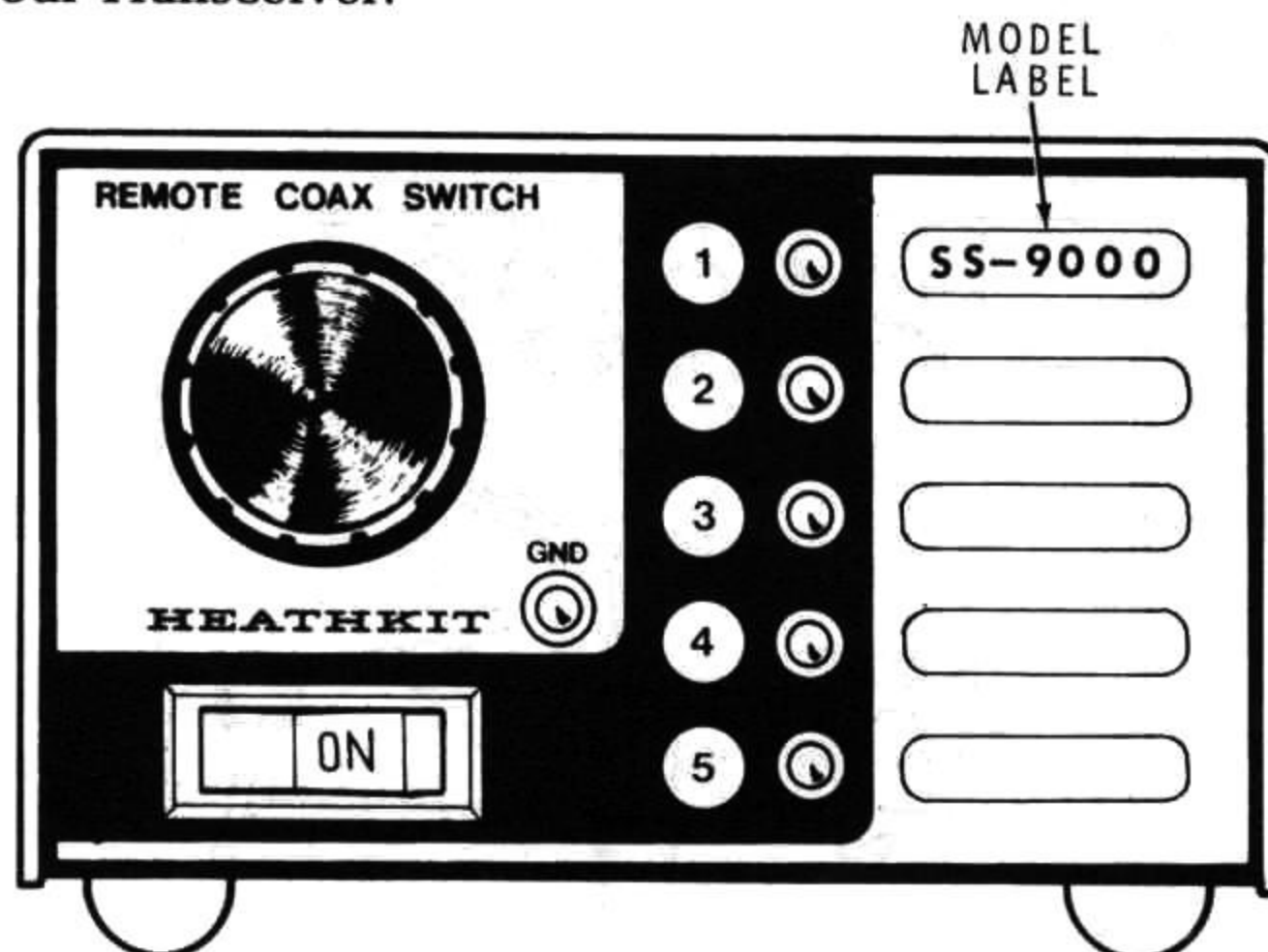


**Detail 4-1B**

3. Connect the remaining flat cable wires to the terminals on the back of the Remote Coax Switch control chassis as follows. NOTE: If you have five different antennas, you will not be able to select one of them from the SA-1480 Switch. Do not connect the fifth control wire yet. If you desire to use a single antenna on more than one band, such as tri-band beam, connect the control wires for those bands to the same terminal (see Detail 4-1A for a typical hookup).
4. If you have a fifth antenna which you wish to switch from the Transceiver, refer to Detail 4-1B and connect the control wire from your Transceiver to the brown wire (removed from terminal 1 on the back of the control chassis earlier) as shown. NOTE: The hardware shown is not supplied with your Transceiver.

5. Push the 9-pin female shell on the free end of the control cable onto the corresponding connector on the back of your Transceiver, if this has not already been done. See Pictorial 2-2 (fold-out from Page 18).
6. If you have anything written in the blank beside indicator 1 on the front of your Remote Coax Switch (see Pictorial 4-2), erase it.
7. Refer again to Pictorial 4-2 and carefully peel the backing paper from the SS-9000 model label. Then press the label in the space on the front of your Remote Coax Switch.

This completes the connection of your Transceiver to the Remote Coax Switch. Refer to the "Operation" section of this Manual for information concerning operation of the Remote Coax Switch.



**PICTORIAL 4-2**

## OPERATION

**NOTE:** Connect your Transceiver and Remote Coax Switch together as directed in the "Installation" on Page 45.

When you connect your Transceiver to the Model SA-1480 Switch, the Switch will still operate as it did before. The only exception is that position 1 now causes the Transceiver to be in control. You cannot control an antenna in this position.

To change antennas automatically from your Transceiver, simply turn the Remote Coax Switch on and

turn the switch to position 1. Indicator 1 should now be lit. This indicates that the Transceiver is in control.

One of the other indicators may also be lit at this time. This shows you which antenna is selected. When you turn the BAND switch on your Transceiver, the Remote Coax Switch will automatically select the corresponding antenna.

To ground all of your antennas, simply turn the switch on the front of your Remote Coax Switch fully clockwise.

# POWER SUPPLY (MODEL PS-9000)

## INTRODUCTION

The Model PS-9000 Power Supply/Speaker/Dual Clock is an AC-operated power supply in a matching cabinet. This Power Supply also contains a built-in dual clock for displaying both local and UTC times and a speaker.

## SPECIFICATIONS

### GENERAL

Output Voltage .....	13.8 VDC, regulated.
Maximum Output Current .....	25 amperes intermittent (50% duty cycle, 10 minutes on-off); 15 amperes continuous.
Power Requirements .....	110 to 130 VAC at 6 amperes, 50/60 Hz. Can be wired for 220 to 260 VAC at 3 amperes.
Regulation .....	Less than 4% from no load to 25 amperes.
Ripple .....	Less than 2% at 25 amperes.
Circuit Breaker .....	20 amperes for 110 to 130 VAC primary; 10 amperes for 220 to 260 VAC primary.
Current Limiting .....	Over-current protected (set typically for 28 amperes).
Thermal Protection .....	Automatic shutdown with over-temperature sensing on the heat sink.

Cabinet Dimensions .....	6-1/8" high × 9-5/8" wide × 13-3/4" deep (15.6 × 24.4 × 34.9 cm)
Weight .....	33 lbs (15 kg).

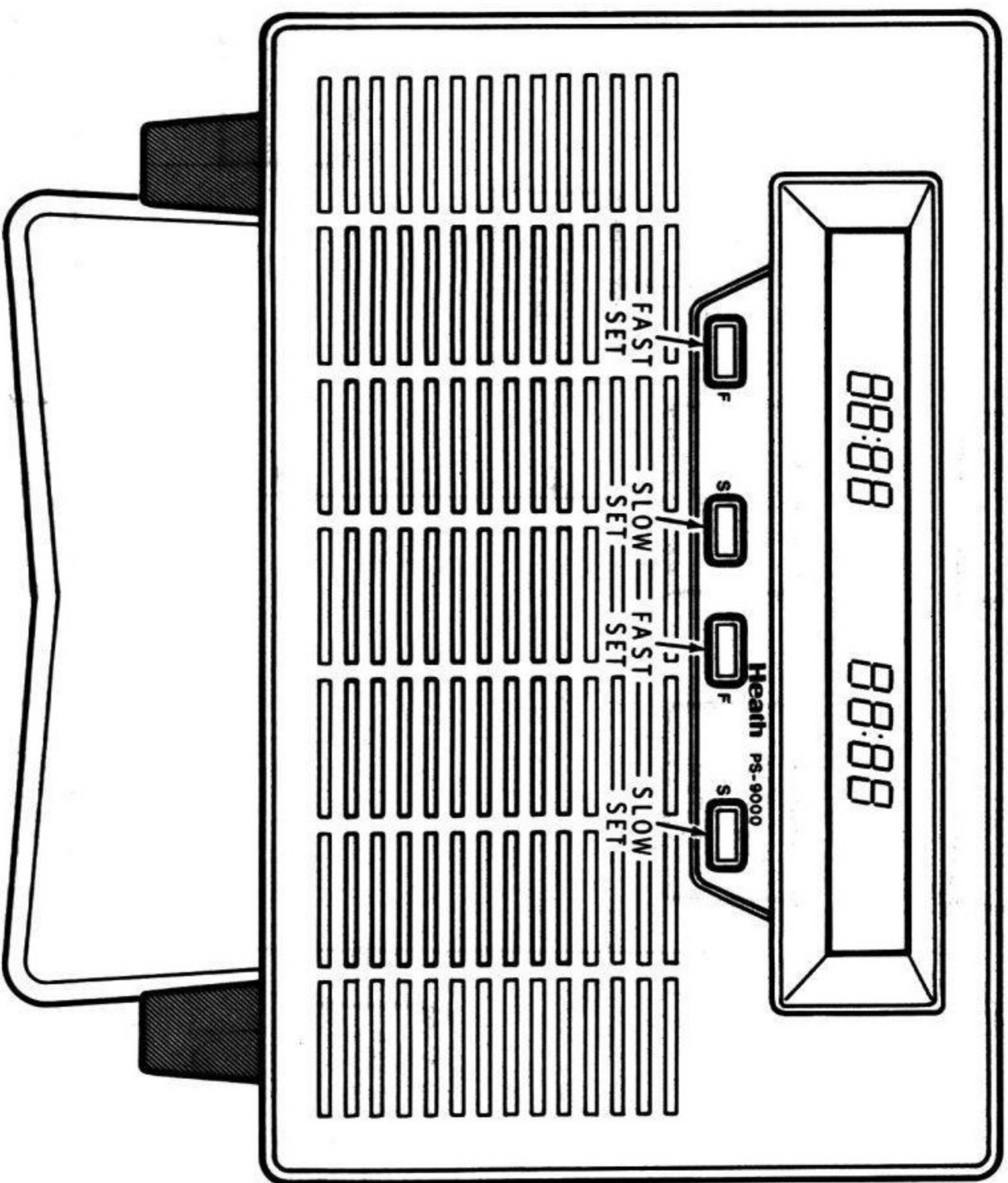
**DUAL CLOCK**

Display .....	Two independent vacuum fluorescent readout tubes. Each contains four digits and a colon.
Clock Format .....	12- or 24-hour display (each clock). Supplied with 24-hour format (see "Operation" section).
Accuracy .....	Determined by the line frequency.
Power Requirements .....	120 VAC, 50 or 60 Hz, 3.5 watts. Can be wired for 240 VAC.

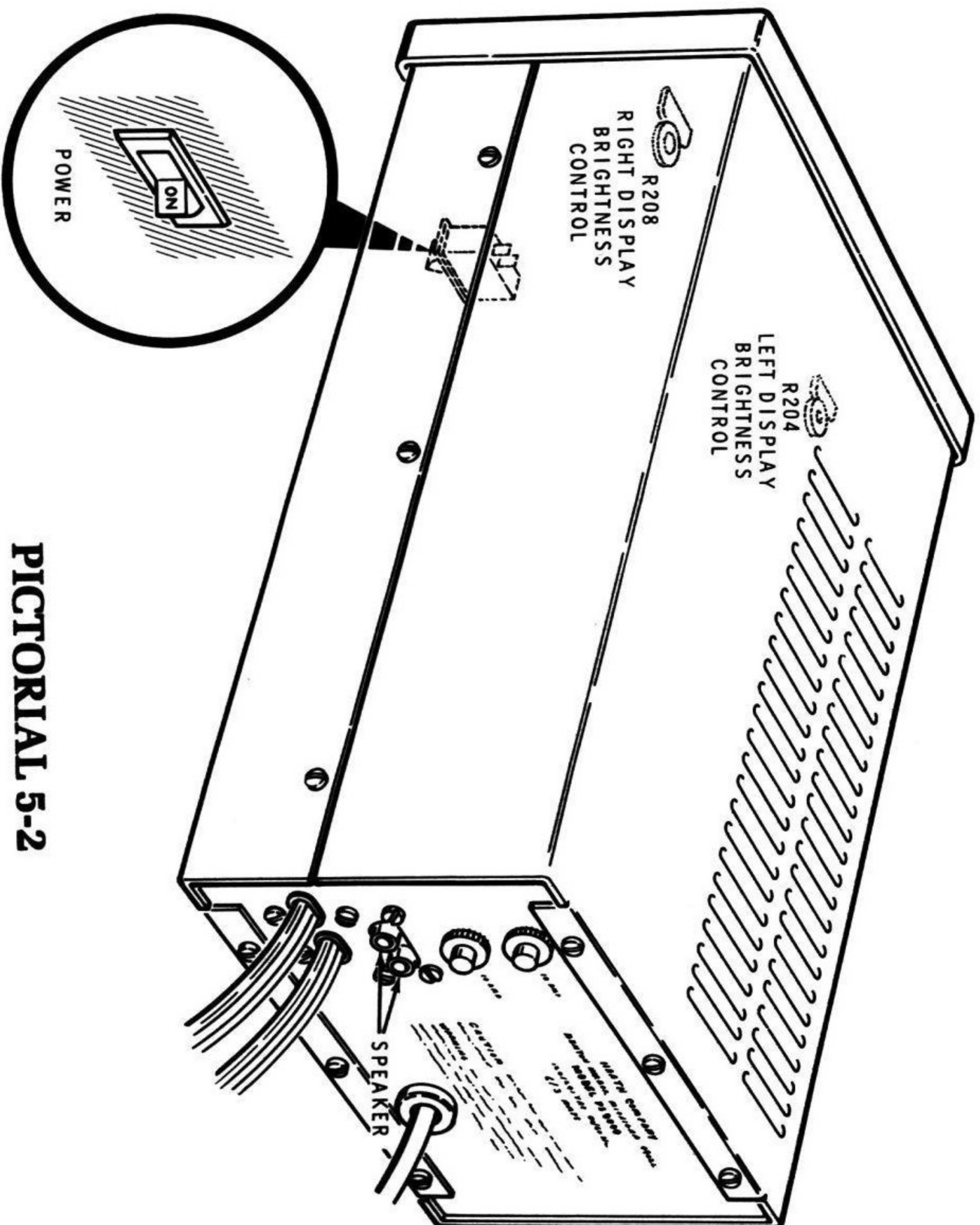
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The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

\*Specifications apply when the Power Supply is used with the Model SS-9000 Transceiver.



PICTORIAL 5-1



PICTORIAL 5-2

## OPERATION

Refer to Pictorials 5-1 and 5-2 (fold-out from Page 51), for the locations of the controls and connections on the Power Supply.

To turn the Power Supply on and off, you can use either its own POWER switch or a master switch for your whole rig.

The Power Supply output is 13.8 volts DC. Control R131 inside the Power Supply adjusts this output voltage. This control was preset at the factory and readjustment should not be necessary.

In the case of an output overload (short circuit or overcurrent), the Power Supply will automatically shut down. To reset the Power Supply, turn the POWER switch OFF and then back ON. If the thermal shut down circuit activates, there will be a delay (while the heat sink cools) before the Power Supply resets. If the circuit breakers happen to trip, turn the POWER switch OFF, reset the breakers, and turn the POWER switch back ON.

NOTE: The Power Supply may be wired for 240 VAC operation. Refer to the "Power Supply Schematic" for the proper connections.

### SETTING THE DUAL CLOCK

Each display has two pushbuttons mounted directly below it.

The F (fast set) button advances the displayed time at the rate of approximately 60 "minutes" of displayed time per second.

The S (slow set) button advances the displayed time at the rate of approximately 3 "minutes" of displayed time per second.

To set the clock, use the F (fast set) pushbutton under each display to advance the time until the display is within about 20 minutes of the actual time. Then use the S (slow set) pushbutton to advance the display to the actual time.

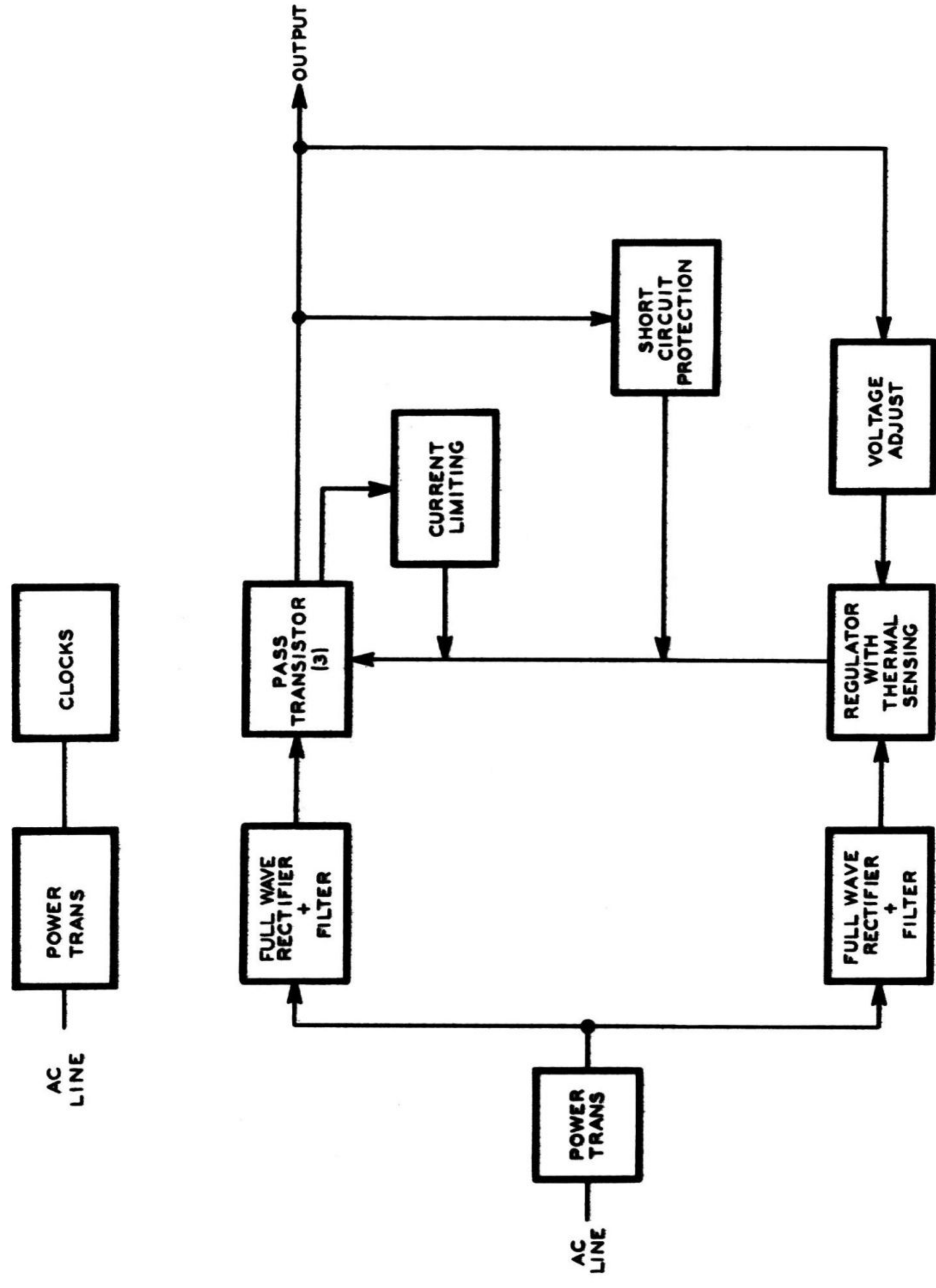
Any loss of power can cause the displayed time to change. The new time shown could be any possible time of day. If there is a digit in the left-most digit in each display, the number will flash on and off until you reset the time.

#### NOTES:

1. Both clocks have jumper wires installed so they indicate in a 24-hour format. You can change the clocks individually to 12-hour formats by removing jumper wires from the clock circuit board. Refer to the "Power Supply Schematic" (fold-out from Page 53) for the proper jumpering.
2. The clock may be wired for 240 VAC operation. Since the clock contains its own power cord and power transformer, this power source does not necessarily have to be the same as the power source for the Power Supply. Refer to the "Power Supply Schematic" for the proper connections.
3. The dual line cord allows you to connect the Power Supply and the clock to different power circuits. This allows you to turn the Power Supply off from a master switch and not interrupt the operation of the clock.

IN CASE OF DIFFICULTY

PROBLEM	POSSIBLE CAUSE
No output voltage.	A. Circuit breaker CB1 or CB2. B. Output shorted.
Output voltage drops to zero whenever a load (Transceiver) is connected.	A. Excessive load.
Clock display does not light.	A. Controls R204 or R208 on the clock circuit board are set too low. B. Fuse F1 inside the Power Supply.
Display is very dim.	A. Controls R204 or R208 on the clock circuit board are set too low.
Clock gains or loses about 12 minutes per hour.	A. Clock is wired for wrong line frequency (50 or 60 Hz). Refer to "Operation" on Page 51.
The "1" digit at the left of the display flashes on and off.	A. Power to the clock has been interrupted; reset the clock.

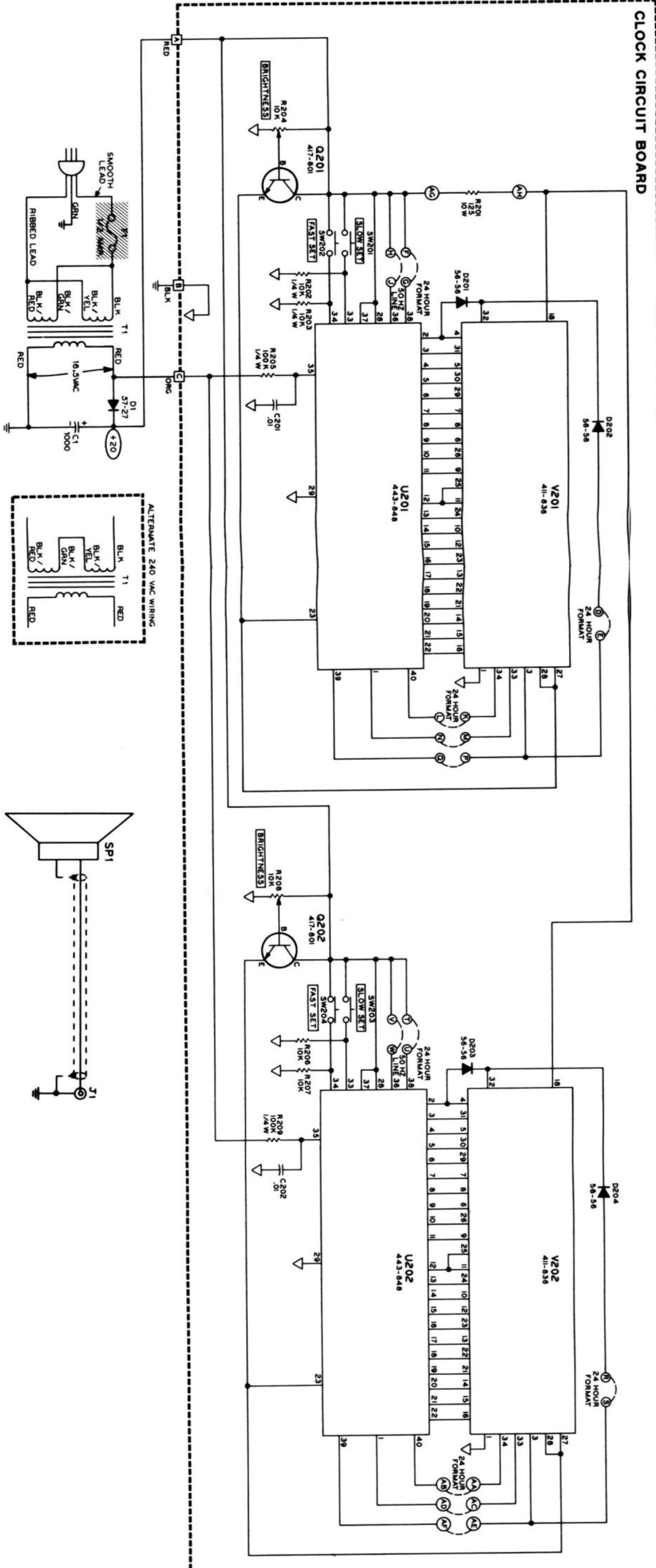
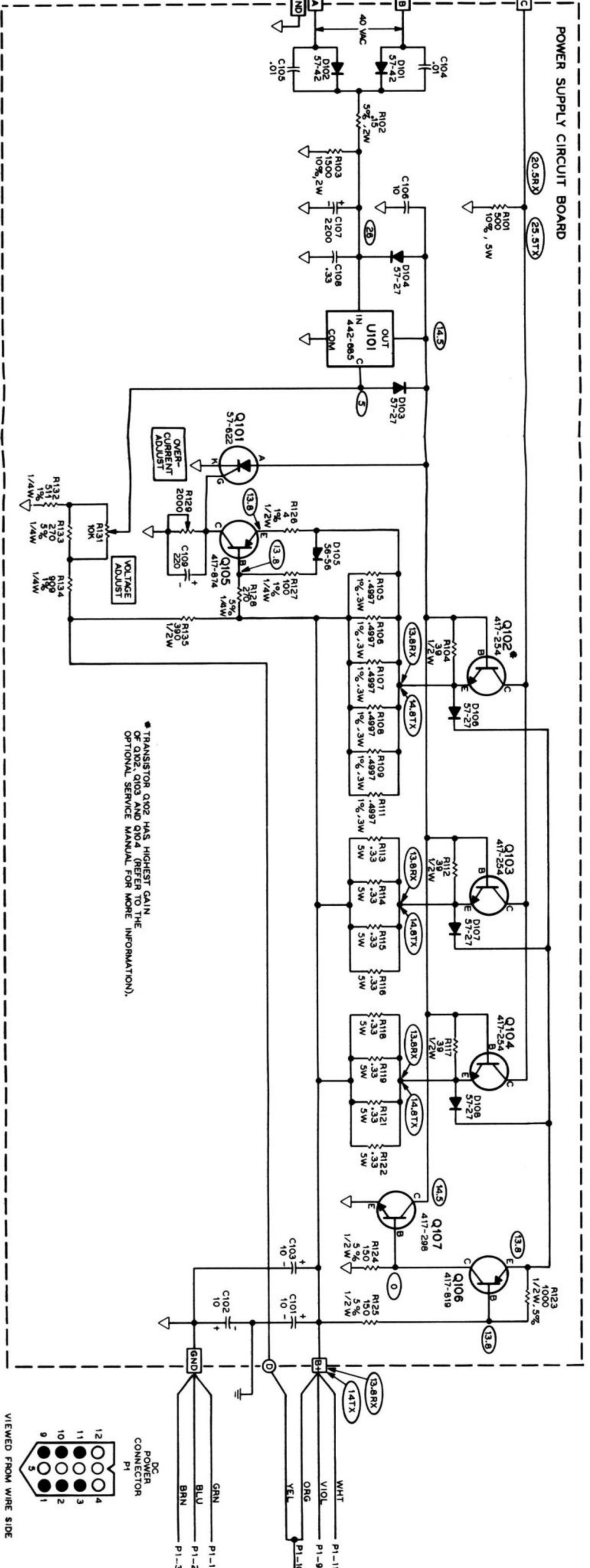
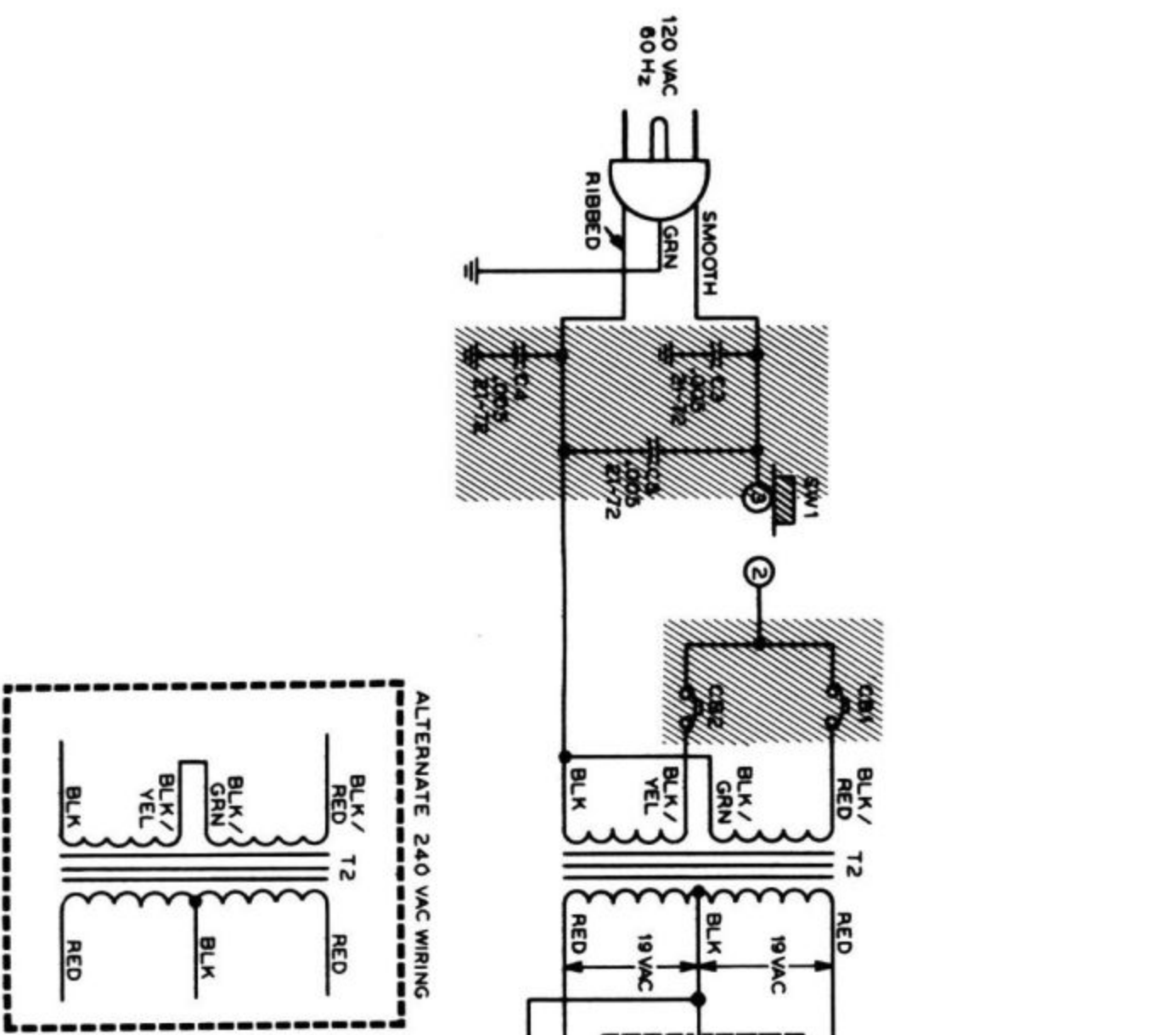


POWER SUPPLY BLOCK DIAGRAM

# SCHEMATIC OF THE HEATHKIT® POWER SUPPLY Model PS-9000

- COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS:  
1-99 PARTS MOUNTED ON THE CHASSIS.  
100-199 PARTS MOUNTED ON THE POWER SUPPLY CIRCUIT BOARD.  
200-299 PARTS MOUNTED ON THE CLOCK CIRCUIT BOARD.
- ALL RESISTORS ARE IN OHMS (K = 1000).
- ALL CAPACITORS ARE IN  $\mu$ F.
- THIS SYMBOL WITH A LETTER IN IT INDICATES A WIRE CONNECTION TO THE CIRCUIT BOARD.
- THIS SYMBOL INDICATES CIRCUIT BOARD GROUND.
- THIS SYMBOL INDICATES CHASSIS GROUND.
- THIS SYMBOL WITH A NUMBER IN IT INDICATES THE DC VOLTAGE TO CHASSIS GROUND FROM THE POINT INDICATED. READINGS SHOULD BE VALID FOR ALL NORMAL POWER SUPPLY OPERATING CONDITIONS.
- COMPONENTS IN THE SHADED AREAS ARE CRITICAL TO CONTINUED PRODUCT SAFETY. REPLACE THEM ONLY WITH PARTS OF THE SAME RATING OR WITH PROPER HEATH REPLACEMENT PARTS.
- THE CLOCKS MAY BE INDIVIDUALLY CHANGED TO INDICATE IN A 12-HOUR FORMAT. TO CHANGE THE CLOCKS, REMOVE OR CUT THE FOLLOWING JUMPER WIRES:

- LEFT-HAND CLOCK
  - K TO L
  - M TO N
  - P TO Q
  - F TO G
  - D TO E
- RIGHT-HAND CLOCK
  - AA TO AB
  - AC TO AD
  - AE TO AF
  - R TO S
  - T TO U



\* TRANSISTOR Q102 HAS HIGHEST GAIN. RECOMMENDED FOR USE IN THE OPTIONAL SERVICE MANUAL FOR MORE INFORMATION.



## THEORY OF OPERATION

Refer to the "Power Supply Block Diagram" (fold-out from Page 52) and the "Power Supply Schematic" (fold-out from Page 53) as you read the following description. The component numbers are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and chassis:

- 1-99 Parts mounted on the chassis.
- 101-199 Parts mounted on the power supply circuit board.
- 201-299 Parts mounted on the clock circuit board.

The Model PS-9000 Power Supply provides all of the power required by the Model SS-9000 Transceiver.

A dual-primary power transformer supplies voltage to the bridge rectifier and to the pass transistor circuits, as well as to the voltage regulation and protection circuits.

The output from diodes D2 and D3 is filtered and then applied to three pass transistors, which are controlled by the voltage adjust and regulator circuits.

A common heat sink is used for the regulator and pass transistors to allow high temperature protection. If the heat sink temperature exceeds the safe operating limit for the regulator, the regulator begins to shut down. This rebias the pass transistors and reduces their output. If this should happen, a period of time is required for the heat sink temperature to reduce before full output is again provided.

The surge current protection circuit monitors the base-to-emitter current of the pass transistors. If this surge current exceeds the safe current handling capability of the pass transistors, the circuit rebias the transistors for the duration of the current surge.

A short protection circuit monitors the output voltage line, turns on a transistor and fires an SCR if the output current exceeds a preset value. This pulls the output of the regulator to ground and rebias the pass transistors. If this happens, you must turn the Power Supply On-Off switch Off and then On again to reset the SCR.

### DUAL CLOCK

The dual clock is referenced to the line frequency and each clock has independent 12- or 24-hour capability.

Single integrated circuits control the operation of each clock. A transistor controls the brightness of each display.

A jumper is provided so you can set the clocks to operate on either 50 or 60 Hz.

# CUSTOMER SERVICE MANUAL

A separate Service Manual for your Transceiver and Power Supply is available from the Heath Company. This Manual contains an in-depth circuit description, additional troubleshooting information, a complete replacement parts list, instrument alignment procedures, and parts locating aids (circuit board x-ray views, photographs, etc.)

The Service Manual is contained in an easy-to-use 3-ring binder that allows you to remove schematics and other large illustrations for convenience. There is even room in the binder for this Owner's Manual so you can keep the Manuals together.

To order your Service Manual, cut out the order form below and fill in the necessary information. Then send the order form with your remittance to:

**Heath Company  
Benton Harbor  
Michigan 49022  
ATTN: Parts Department**

Phone (Replacement parts only): (616) 982-3571

CUT ALONG DOTTED LINE

**SPECIAL PARTS ORDER FORM**  
(For Service Manual only)

1. Include remittance or permission for COD shipment     CASH     COD

2. Use a separate sheet of paper for all correspondence.

3. Prices may change to reflect current manufacturing costs.

QTY.	PART NUMBER	DESCRIPTION	PRICE
1	850-1	SS-9000 Service Manual	\$35.00
HANDLING AND SHIPPING			3.50
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

PLEASE DO NOT WRITE IN THIS SPACE

THIS FORM IS FOR U.S. CUSTOMERS ONLY. OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR.

## SERVICE INFORMATION

The following Heath Company services are available if you need them: Replacement Parts, Technical Consultation, and Factory Service. Address all correspondence to:

**HEATH COMPANY**

Benton Harbor, Michigan 49022

For prompt service, use a separate letter for each department you write to.

Replacement parts and repair service are also available at your nearest Authorized Service Center or Heath Electronic Center. These Centers are listed in your Heath Catalog.

### REPLACEMENT PARTS

If a replacement part is needed, please include the following information in your letter:

1. Part number and description.
2. Model Number and Series Number of the equipment.

If your equipment is in the Warranty period, add:

3. Date of purchase.
4. Nature of defect.

Heath Company will fill your order promptly. Please **DO NOT RETURN PARTS** unless they are requested. Parts that are damaged through carelessness or misuse by the customer will not be replaced without cost.

### TECHNICAL CONSULTATION

You can write to our Technical Consultants for help with any Heath equipment, or for answers to any questions about the use of this equipment.

The completeness and accuracy of the advice mailed back to you depends entirely on the information in your letter. Be sure to include:

1. The Model Number and Series Number of the equipment (on blue and white identification label).
2. Date of purchase.

3. An exact description of the difficulty. Include switch positions, connections to other units, operating procedures, voltage reading, and any other information you think might be helpful.
4. List everything you have done in attempting to correct the difficulty.

### FACTORY SERVICE

If you do not have qualified repair services at your disposal, you can return your equipment to the Heath Company Service Department to have it repaired for a minimum service fee. (Equipment that has been modified will not be accepted for repair.) Refer to Shipping Instructions for details on how to package and ship the equipment.

To be eligible for replacement parts under the terms of the Warranty, equipment returned for factory service must be accompanied by the invoice or the sales slip, or a copy of either. (If you send the original invoice or sales slip, it will be returned to you.)

### SHIPPING INSTRUCTIONS

Check the equipment to see that all parts are in place. Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least three inches of resilient packing material (shredded paper, excelsior, etc.) on all sides between the equipment and the carton.

Seal the carton with gummed paper tape and tie it with a strong cord. Ship it by prepaid Express or insured Parcel Post to:

**HEATH COMPANY**

Benton Harbor, Michigan 49022

Attach a letter, containing the following information to the outside of the carton:

1. Your name and return address.
2. Date of purchase.
3. A brief description of the difficulty.
4. Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the Warranty.

**Free Manual**

**Not to be resold**

**Technology  
Systems**

**PLEASE REPORT VOILATIONS TO  
[WWW.TECH-SYSTEMS-LABS.COM](http://WWW.TECH-SYSTEMS-LABS.COM)**