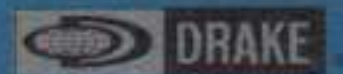


**R7A**  
**RECEIVER**

by







## LIMITED WARRANTY

*R. L. DRAKE COMPANY warrants to the original purchaser that this product shall be free from defects in material (except tubes and RF output transistors) or workmanship for ninety (90) days from the date of original purchase.*

*During the warranty period the R. L. DRAKE COMPANY or an authorized Drake service facility will provide free of charge both parts (except tubes and RF output transistors) and labor necessary to correct defects in material or workmanship.*

*To obtain such warranty service, the original purchaser must:*

- (1) Complete and send in the Warranty Registration Card.*
- (2) Notify R. L. DRAKE COMPANY or its nearest authorized service facility, as soon as possible after discovery of a possible defect, of:*
  - (a) The model number and serial number, if any;*
  - (b) The identity of the seller and the approximate date of purchase;*
  - (c) A detailed description of the problem, including details on the electrical connection to associated equipment and the list of such equipment.*
- (3) Deliver the product to the R. L. DRAKE COMPANY or the nearest authorized service facility, or ship the same in its original container or equivalent, fully insured and shipping charges prepaid.*

*Correct maintenance, repair and use are important to obtain proper performance from this product. Therefore, carefully read the Instruction Manual. This warranty does not apply to any defect that R. L. DRAKE COMPANY determines is due to:*

- (1) Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specifications of the original parts.*
- (2) Misuse, abuse, neglect or improper installation.*
- (3) Accidental or intentional damage.*

*All implied warranties, if any, terminate ninety (90) days from the date of the original purchase.*

*The foregoing constitutes R. L. DRAKE COMPANY'S entire obligation with respect to this product, and the original purchaser and any user or owner shall have no other remedy and no claim for incidental or consequential damages. Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation and exclusion may not apply to you.*

*This warranty gives specific legal rights and you may also have other rights which vary from state to state.*

**R. L. DRAKE COMPANY**  
540 Richard Street • Miamisburg, Ohio 45342





R. L. DRAKE COMPANY 1979  
PRINTED IN U.S.A.



# TABLE OF CONTENTS

## R7/R7A SUPPLEMENT

The following accessories and modifications have been added to update your R7 to an R7A for more versatility.

- 1) A noise blanker (NB7A) has been installed.
- 2) A 500 Hz filter (SL500) has been installed in selectivity position marked .5.
- 3) The selectivity position marked 4 has been adapted to provide a bandwidth of 9 kHz for AM reception.

		PAGE
<b>CHAPTER 1</b>	<b>INTRODUCTION</b> .....	1-1
1-1.	Description .....	1-1
1-2.	Accessories .....	1-4
<b>CHAPTER 2</b>	<b>INSTALLATION</b> .....	2-1
2-1.	Unpacking .....	2-1
2-2.	Location .....	2-1
2-3.	Mobile Installation .....	2-1
2-4.	Antenna Requirements .....	2-1
2-5.	Power Requirements .....	2-1
2-6.	Transceive Operation .....	2-3
2-7.	External Speaker Requirements .....	2-3
2-8.	Viewing Angle .....	2-3
<b>CHAPTER 3</b>	<b>OPERATION</b> .....	3-1
3-1.	Front Panel Controls .....	3-1
3-2.	Rear Panel Controls and Connections .....	3-5
3-3.	VFO Dial .....	3-7
3-4.	General Operating Information .....	3-7
<b>CHAPTER 4</b>	<b>THEORY OF OPERATION</b> .....	4-1
4-1.	Receiver Section .....	4-1
4-2.	Frequency Control .....	4-1
<b>CHAPTER 5</b>	<b>MAINTENANCE</b> .....	5-1
5-1.	Service Information .....	5-1

# DRY-STACKING



## DRY-STACKING

The following information is provided for your reference. It is intended to assist you in understanding the various components and their functions. The information is presented in a clear and concise manner, and is intended to be used as a guide. It is not intended to be a substitute for professional advice or engineering judgment. The information is provided as a service to our customers and is subject to change without notice. We reserve the right to modify or discontinue this information at any time without notice.

## DRY-STACKING

The following information is provided for your reference. It is intended to assist you in understanding the various components and their functions. The information is presented in a clear and concise manner, and is intended to be used as a guide. It is not intended to be a substitute for professional advice or engineering judgment. The information is provided as a service to our customers and is subject to change without notice. We reserve the right to modify or discontinue this information at any time without notice.

# ILLUSTRATIONS

## PAGE

Figure 1-1.	R7 H.F. Receiver.....	1-1
Figure 1-2.	IF Selectivity Board .....	1-5
Figure 2-1.	R7 Power Connection .....	2-2
Figure 2-2.	R7/TR7 Transceiver Interconnection Diagram .....	2-2
Figure 2-3.	Viewing Angle Options .....	2-4
Figure 3-1.	Front Panel Controls and Connections .....	3-3
Figure 3-2.	Rear Panel Controls and Connections .....	3-4
Figure 3-3.	Main Tuning Dial .....	3-7
Figure 4-1.	R7 Block Diagram .....	4-3
Figure 5-1.	R7 Top View (Covers Removed) .....	5-2
Figure 5-2.	R7 Bottom View (Covers Removed).....	5-3





**DRAKE**

**R7A**

Receiver

**OPERATOR'S  
MANUAL**



## CHAPTER 1 INTRODUCTION



Figure 1-1. R7 H.F. Receiver

### 1-1. DESCRIPTION

The R7 is a solid-state, broadband, SSB/CW/AM receiver which embodies several unique state-of-the-art design features. Due to its unique design, the R7 offers excellent sensitivity and selectivity, very high dynamic range and digital frequency readout combined with general coverage capability.

A front panel switch allows the operator to select any of five receiver selectivities. Standard bandwidth is 2.3 kHz, and other bandwidths are established using easily installed optional crystal filters.

The front panel passband tuning (PBT) control is a valuable aid in reducing or eliminating interfering signals. The PBT control electronically shifts the receiver intermediate frequency (IF). In addition, the third mixer injection frequency is simultaneously shifted, thus maintaining the operating frequency to which the receiver is tuned. Since the crystal filter passband is fixed, this allows the operator to electronically move interfering signals out of the receiver passband, providing maximum utilization of the excellent selectivity characteristics afforded by the eight pole crystal filters in the IF strip.

A high level double balanced mixer is used as the first receiver mixer in an up-conversion mode. The use of this device assures the reduction of both front-end overload and intermodulation to a minimum. Careful attention to filter matching and losses in the input circuit keeps the receiver noise figure low to insure good sensitivity.

The R7 features a high-stability linear permeability tuned VFO and frequency synthesizer for accurate frequency control. Both analog and digital frequency readouts are featured for maximum operator convenience and flexibility. The digital readout circuitry includes a store function. This function, selected by front panel pushbutton, allows the operator to store a frequency on the six-digit front panel LED display for later reference. In addition, two other pushbutton controls allow the R7 synthesizer to be stepped up or down in frequency in 500 kHz increments, thus allowing continuous frequency coverage from 10 kHz to 30 MHz.

For fixed frequency operation, an accessory programming board, the AUX-7, is available. This board also enables reception outside the ham bands without using the UP/DOWN pushbuttons.

The digital display reads out the received frequency to the nearest 100 Hz. It may also be

used as a 150 MHz frequency counter by depressing the COUNT button on the front panel.

While normal receiver sensitivity will usually be more than adequate, an internal preamp may be switched in for reception of satellites, use with an external low-gain VHF receiving converter, shortened or non-resonant antennas, or other extraordinary receiving conditions. The preamp increases receiver gain by about 10 dB and typically improves sensitivity by 5 to 6 dB.

The antenna selector switch allows selection of up to three antennas or receiving converters. When used with another receiver or transceiver, this switch also allows selection of either of two antennas for the external receiver, a special antenna splitter circuit is also included to allow

both receivers to use the same antenna simultaneously.

Other features include a notch filter for eliminating interfering heterodynes, switchable AGC with three selectable time constants with an OFF position, a built-in 25 kHz calibrator, speaker ON/OFF switch, provision for an accessory noise blanker (NB7A), a special low distortion AM detector, transceive operation with a TR7, receiver incremental tuning (for transceive operation) and operation on either DC or AC supply voltage.

The modular construction of the R7 reduces service time to a minimum. Each module is designed to perform a specific function, thus simplifying any required alignment and troubleshooting.

## SPECIFICATIONS

### GENERAL

Frequency Coverage (With DR7 Digital Readout/General Coverage Board):

Without AUX-7: .01 to 30 MHz, continuous.

With AUX-7: Same.

(Without DR7 Digital Readout/General Coverage Board:

.01-0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, 2.5-3.0, 3.5-4.0, 5.0-5.5, 7.0-7.5, 14.0-14.5, 21.0-21.5, 28.5-29.0 MHz  
Plus 8 additional 500 kHz ranges with AUX-7.\*

\*AUX-7 requires use of appropriate Range Modules.

Modes of Operation: USB, LSB, CW, RTTY, AM

Frequency Stability: Less than 1 kHz first hour. Less than 150 Hz per hour after 1 hour warm up. Less than 100 Hz  $\pm$  10 % line voltage change.

Frequency Readout Accuracy:

Analog: Better than  $\pm$ 1 kHz when calibrated at the nearest marker point.

Digital: 15 ppm  $\pm$  100 Hz.

External Counter Mode:

Maximum Input Frequency: 150 MHz

Input Level Range: 50 mV to 2 V, rms.

Power Supply Requirements:

100, 120, 200, 240 VAC,  $\pm$ 10% 50/60 Hz, 60 watts. 11-16 VDC (13.8 VDC nominal), 3 A Max.

Dimensions:

Depth: 13.0 in. (33.0 cm), excluding knobs and connectors.

Width: 13.6 in. (34.6 cm).

Height: 4.6 in. (11.5 cm, excluding feet.)

Weight: 18.4 lbs. (8.34 kg).



## RECEIVER

### Sensitivity (1.8-30 MHz Preamp OFF.)

SSB, CW (2.3 kHz BW)  
(Typically .25  $\mu$ V on 15 m & 10 m bands)

Less than 0.5  $\mu$ V for 10 dB  $\frac{S+N}{N}$ .

AM (4.0 kHz BW; 30% Mod.):

Less than 2.0  $\mu$ V for 10 dB  $\frac{S+N}{N}$ .

### Sensitivity (1.8-30 MHz Preamp ON.)

SSB, CW (2.3 kHz BW):

Less than 0.2  $\mu$ V for 10 dB  $\frac{S+N}{N}$ .

AM (4.0 kHz BW; 30% Mod.):

Less than 1.2  $\mu$ V for 10 dB  $\frac{S+N}{N}$ .

### Sensitivity (.01-1.5 MHz):

SSB, CW (2.3 kHz BW):

Less than 1.0  $\mu$ V for 10 dB  $\frac{S+N}{N}$ .

AM (4.0 kHz BW; 30% Mod.):

Less than 4.0  $\mu$ V for 10 dB  $\frac{S+N}{N}$ .

Selectivity: 2.3 kHz @ -6 dB and 4.2 kHz @ -60 dB (1.8:1 shape factor). With Accessory Filters, See Sect. 1-2.

Ultimate Selectivity: Greater than 100 dB.

### Intermodulation (1.8 — 30 MHz):

	Preamp OFF	Preamp ON
Two-Tone Dynamic * Range:	99 dB	95 dB
Third Order Intercept * Point:	+20 dBm	+10 dBm

Blocking: > 145 dB above noise floor.

### IF Frequency:

First IF: 48.05 MHz.  
Second IF: 5.645 MHz.  
Third IF: 50 kHz.

Image and IF Rejection: Greater than 80 dB.

AGC Performance: Less than 4 dB output variation for 100 dB input signal change, referenced to AGC threshold.

Attack Time: 1 millisecond.

Release Times: Slow - 2 seconds.  
Medium - 400 milliseconds.  
Fast - 75 milliseconds.  
OFF position is also provided.

### Antenna Input Impedance:

Nominal 50 ohms. (200 ohms on .01-.5 MHz Range).

### Audio Output:

2.5 watts with less than 10% T.H.D. into nominal 4 ohm load.

\* Measured at 100 kHz tone spacing.



## 1-2. ACCESSORIES

The following accessory items provide additional operating capability and flexibility for the R7 and are available through R.L. Drake Company dealers.

### NOISE BLANKER, MODEL

Provision has been made in the R7 for plug-in installation of the NB7A Noise Blanker. The NB7A is useful in eliminating or reducing impulse (such as ignition noise) and some other types of interference (such as LORAN). Complete operating and installation instructions are supplied with the unit.

### AUXILIARY PROGRAM BOARD AUX-7, MODEL 1536

The AUX-7 Auxiliary Program Board is a plug-in unit which allows the user to program up to 8 auxiliary 500 kHz frequency ranges for instant selection from the front panel of the R7. Possible applications include MARS operation and WWV reception. In addition, a crystal socket is provided for each of the eight auxiliary ranges to allow fixed frequency reception within a selected range. Programming is accomplished by using one RRM-7 Range Receive Module per band segment.

The AUX-7 is supplied with complete installation, programming and operating instructions.

### PORTABLE/MOBILE MOUNTING KIT MMK-7, MODEL 1335

Provides the necessary brackets and mounting hardware for mobile installation of the TR7 transceiver or R7 receiver. A new cabinet for the R7 is supplied which features a built-in carrying handle. The MMK-7 includes complete installation instructions.

### EXTERNAL SPEAKER MS-7, MODEL 1531

The MS-7 External Speaker is intended for use in lieu of the speaker built into the R7 in fixed station operation. The unit is housed in an enclosure which is styled to match the R7 in appearance. The impedance of the MS-7 is 4 ohms, and connection to the R7 is accomplished via a single plug.

## ACCESSORY CRYSTAL FILTERS

Several accessory crystal filters are available for the R7 as follows:

MODEL	6 dB BAND- WIDTH	60dB BAND- WIDTH	USE
7024 (Drake SL6000)	6 kHz	12 kHz	AM
7026 (Drake SL4000)	4 kHz	8 kHz	AM
7023 (Drake SL1800)	1.8 kHz	3.6 kHz	SSB, RTTY (Wide Shift)
7022 (Drake SL500)	0.5 kHz	1.1 kHz	CW, RTTY (170 Hz Shift)
7021 (Drake SL300)	0.3 kHz	0.7 kHz	CW

These filters may be easily installed in the R7 in any combination of four units. Each filter is supplied with complete installation instructions. For the R7, install the 4 or 6 kHz filter in leftmost (facing front of radio) position of the IF Selectivity board. Install the 1.8, 0.5 and 0.3 filters in descending order in the remaining three positions proceeding from left to right.

In choosing an accessory filter for AM reception, the following should be considered: the R7 synchro-phase AM detector, unlike conventional AM envelope detectors, allows the user to select either the upper or lower sideband of the transmitted AM

signal, without causing distortion. The 4.0 kHz (SL4000) filter will allow for maximum utilization of this feature. When a strong adjacent channel interfering signal is present, the sideband furthest away from the interfering signal may be selected by adjustment of the PBT control. Using the 4.0 kHz filter with the PBT control properly set, the audio response will extend to approximately 3000 Hz. The 6.0 kHz (SL6000) filter may be used in the R7 in place of the SL4000. This filter will allow wider audio frequency response as may be desired when receiving U.S. AM broadcast stations. Tuning is also less critical with the SL6000, although, as mentioned above, the SL4000 may be used to advantage in very severe interference situations.

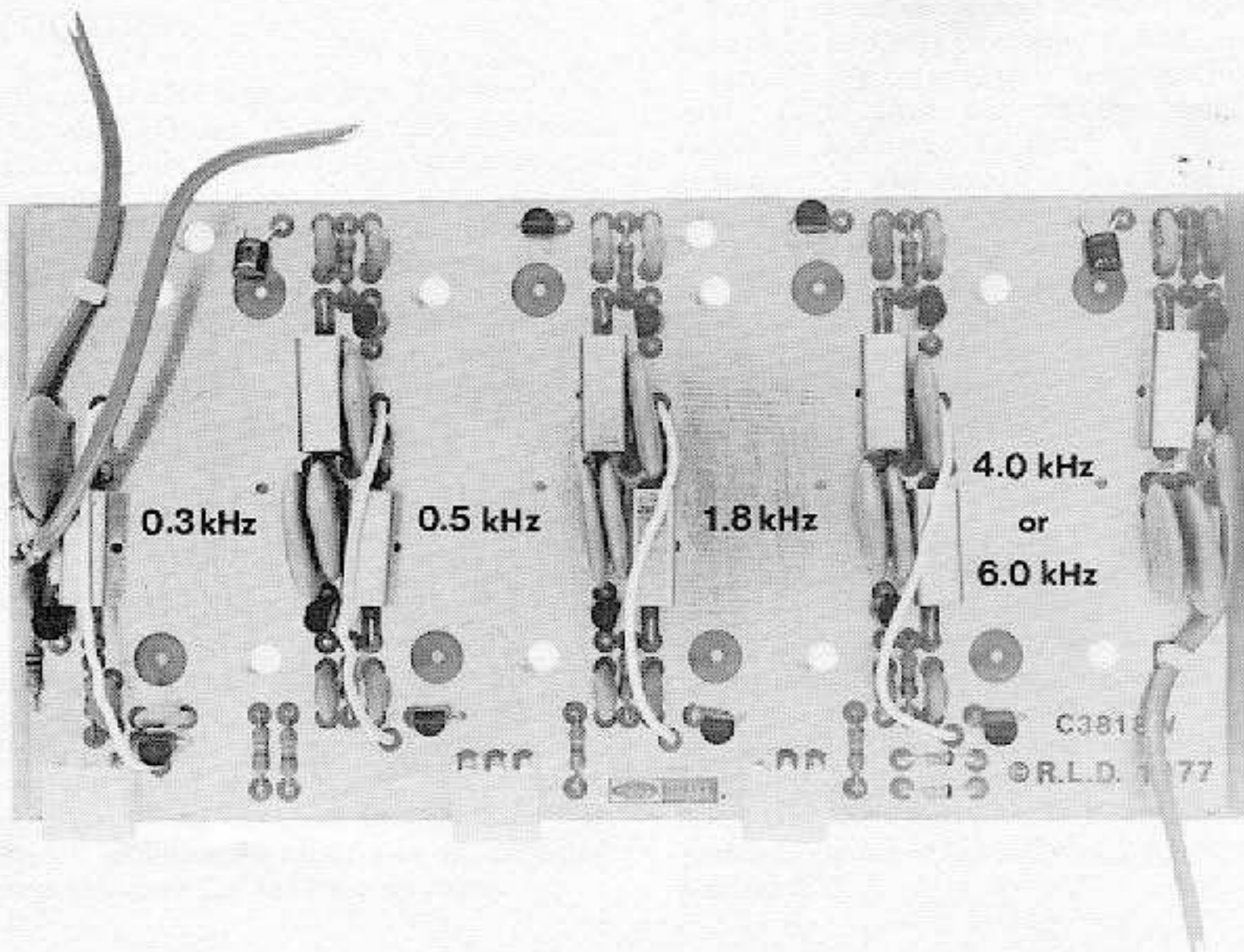


Figure 1-2 I.F. Selectivity Board

## NOTES:



## CHAPTER 2 INSTALLATION

### 2-1. UNPACKING

Carefully remove the R7 from the shipping carton and examine it for evidence of damage. If any damage is found, immediately contact the transportation company responsible for delivery of the unit or return the unit to the dealer where the unit was purchased. Keep the shipping carton and all packing material for the transportation company to inspect. The original carton and packing material will make it much easier to return the unit, if necessary. Inspect the packing material for any accessories or printed matter before storing. Locate the registration card, fill out immediately, and return to the R.L. Drake Company to insure registration and validation of the warranty.

### 2-2. LOCATION

The location of the R7 is not critical. However, care should be taken to insure that adequate clearance is provided to allow free circulation of air around the power supply compartment. Do not cover the vents on top of the cabinet with books, papers, or other equipment as overheating may result.

In addition, if a separate external speaker will not be used, be sure to provide clearance around the opening on the left-hand side of the cabinet to insure adequate sound dispersion.

### 2-3. MOBILE INSTALLATION

An accessory mobile mounting kit, the MMK-7, is available for mobile installation of the R7. The MMK-7 contains all necessary hardware for mobile operation of the R7, and also includes detailed instructions covering installation. The MMK-7 also includes an alternator whine filter and power line fuse for mobile operations.

### 2-4. ANTENNA REQUIREMENTS

Install the antenna as recommended by the antenna manufacturer. Connect a 50 ohm coaxial cable from the antenna to the MAIN, ALT, or CONV antenna connector at the rear of the R7.

### 2-5. POWER REQUIREMENTS

The R7 receiver is designed to operate on either 11 to 16 VDC (13.8 V nominal) or on 100 VAC, 120 VAC, 200 VAC, or 240 VAC  $\pm$  10%, 50/60 Hz. Voltages outside of these ranges may either damage the receiver or cause improper operation.

The correct AC supply voltage may be selected with two switches located on the rear panel. (See figures 2-1 and 2-2.) To change the AC line voltage programming, remove the two screws holding the cover plate that secures the programming switches. Referring to figure 2-1, set the two switches for the correct voltage. Reinstall the cover plate. If programming is correct, the proper voltage will show through a cutout in the plate. It is recommended that the receiver not be operated without the cover plate in place to prevent inadvertent movement of the line voltage programming switches.

A 13.8 volt connector is also located on the rear panel (fig. 3-2). This connector may be used either to supply voltage to the receiver for 13.8 VDC operation, or to obtain voltage from the receiver when it is operated from the AC mains. In the latter mode, the receiver will supply up to 0.25 AMP at 13.8 VDC to power VHF converters or other accessories. It is recommended that any battery supply be disconnected from the connector whenever the receiver is to be run on AC unless provision is made to limit charging current in the battery.

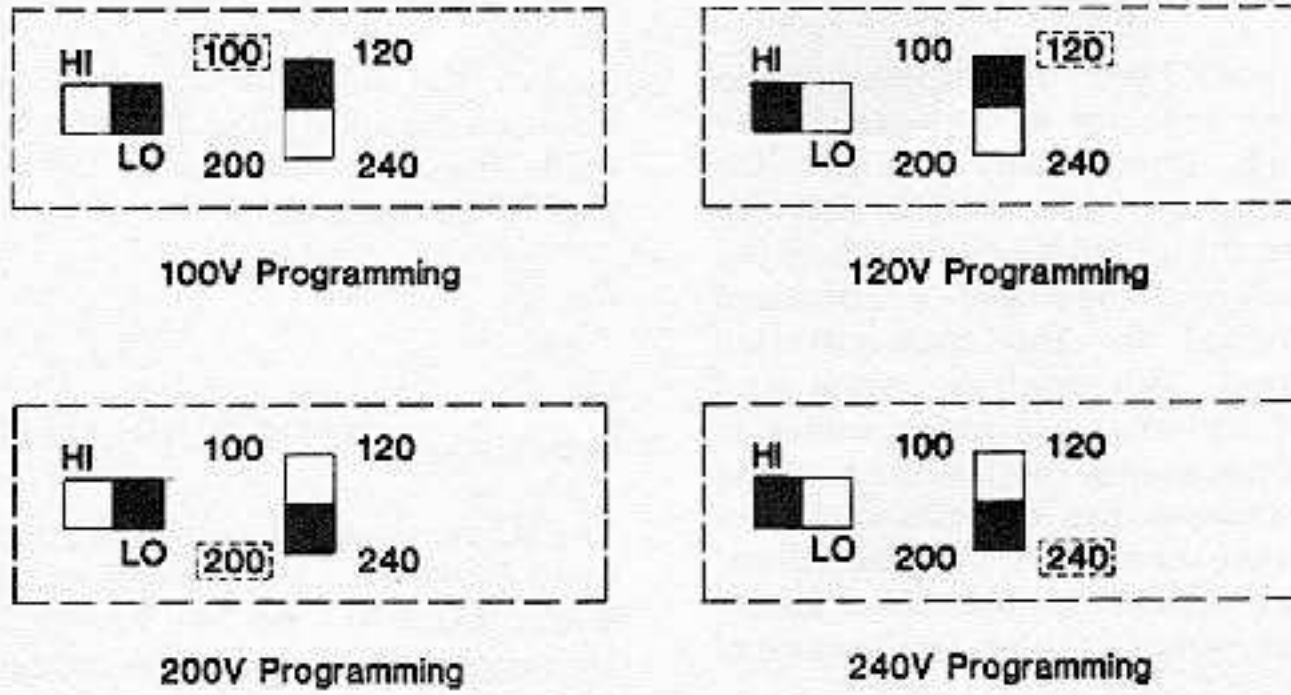


Figure 2-1. R7 Power Connection

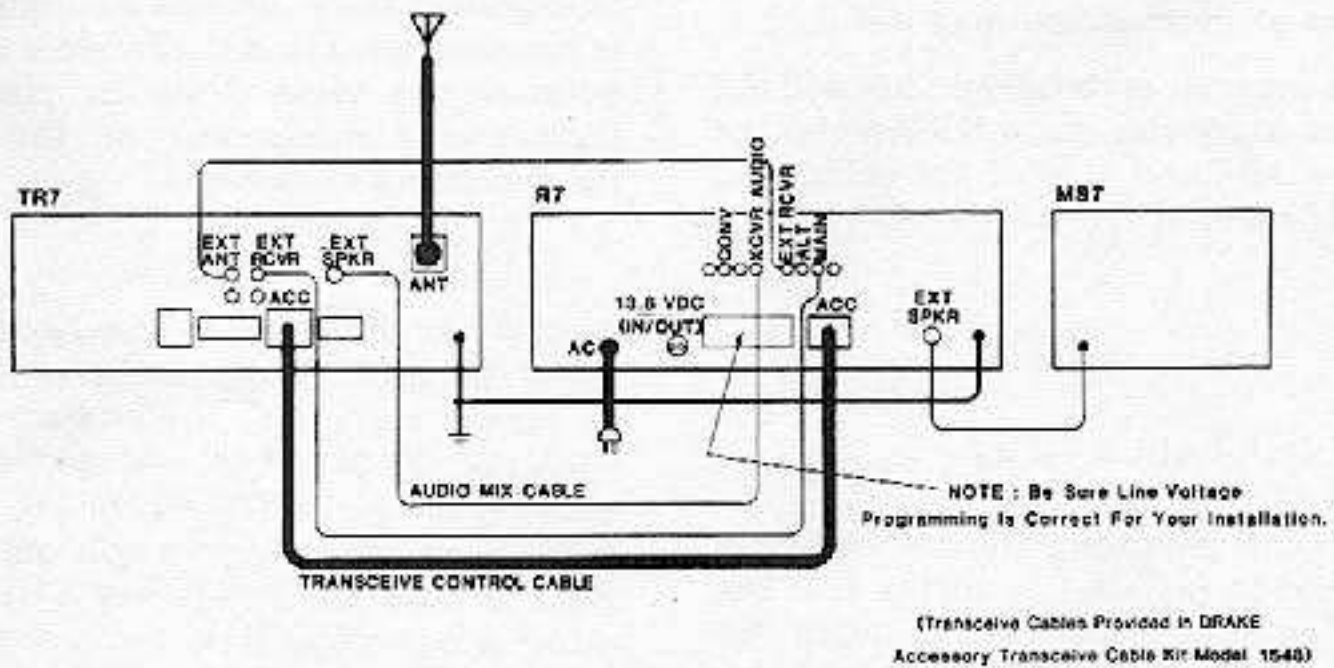


Figure 2-2. R7/TR7 Transceiver Interconnection Diagram



## 2-6. TRANSCEIVE OPERATION

Transceive operation with the Drake TR7 transceiver is possible by connecting the two units as shown in figure 2-2. With the two units connected in this way, the TR7 transmit frequency may be controlled either by its internal permeability-tuned oscillator (PTO) or by the PTO in the R7. The latter function may be selected by depressing the RCT (Remote Controlled Transmit) button on the TR7. If an RV7 Remote VFO is used with the TR7, it is disengaged (on transmit) when the RCT button is pushed.

Because the 40 MHz master oscillators in the TR7 and R7 are locked to the same frequency during transceive operation, the two units should be locked to almost exactly the same frequency. A small difference on the order of perhaps 10 Hz may be noticed, however. If this is objectionable, the 8.05 MHz heterodyne oscillator in the TR7 must be adjusted. To do this, remove the eight screws securing the TR7 cabinet to the bottom of the chassis, and slide the cabinet out the back. The 8.05 MHz oscillator adjustment control is C1030 located on the PBT/REF oscillator board. This capacitor is accessible through a hole in the shield located on the top of the chassis at the center rear of the radio. To make the adjustment, connect the TR7 and R7 as in figure 2-2 with a 50 ohm dummy load in place of the antenna. Also attach a microphone to the TR7 microphone jack. Depress the TR7 RCT button, and make sure the R7 mute button is in the "out" position. Adjust the R7 volume control for normal listening level, and turn up the TR7 microphone gain control to about 12 o'clock. Make sure both the receiver and transceiver are on the same sideband. Key the PTT switch on the microphone and hold it near the R7 speaker until you hear a "canary chirp" beat note. Adjust C1030 until the chirps slow down to a steady tone.

In transceive operation, the MUTE button on the R7 controls the mute function in the R7 only. When the button is depressed, the R7 stops receiving whenever the TR7 goes into transmit. When the button is out, the R7 receives continuously.

With the audio mix cable connected as in figure 2-2, both the TR7 receiver output and R7 audio can be heard simultaneously in the R7 speaker or headphones. The TR7 volume control continues to control the volume from the TR7 receiver section, and the R7 volume control continues to control audio gain from the R7 only. For example: in CW operation the audio sidetone level is adjustable by

the TR7 VOLUME control and is heard in the R7. The TR7 RF GAIN control may be adjusted full CCW to disable the TR7 on receive.

### NOTE

Whenever the two antenna patch cables are interconnected between the TR7 and R7, the following applies: To select, within the R7, the antenna connected to the TR7 SO-239 connector (antenna port), make certain that the TR7 Bandswitch is set to a position higher in frequency or equal to the setting of the R7 Bandswitch. If this is not done, signals sent to the R7 via the antenna patch cable (connected to the EXT RCVR port on TR7 end) will be attenuated. This is the case since the TR7 bandswitched low pass filter is connected in series with the SO-239 connector (TR7) and the EXT RCVR port (TR7) in the receive mode.

## 2-7. EXTERNAL SPEAKER REQUIREMENTS

The R7 contains a built-in speaker; however, this speaker is located on the left-hand side of the radio. In many installations where the R7 is placed directly alongside other equipment, the built-in speaker output will be blocked. In these instances, an external speaker is recommended. The MS-7 Matching Speaker is designed for this application. See figure 2-2 for location of the external speaker jack.

If a speaker other than the MS-7 is used, be sure that it is a 3.2 ohm or higher impedance speaker, capable of handling at least 2.5 watts of audio. The internal speaker is automatically disabled when an external speaker is connected.

## 2-8 VIEWING ANGLE

Refer to figure 2-3 for illustrations of viewing angle options. In order to change mounting feet, remove the bottom cover by removing the ten screws around the edge of the cover. Carefully slide the cover off toward the back of the R7. Reinstall the cover by reversing this process.

### CAUTION

Be sure all power is removed before attempting any disassembly of the R7. Potentially lethal voltages are exposed when the covers are removed. It is suggested that all external accessories be unplugged from the R7 before attempting to remove the covers.



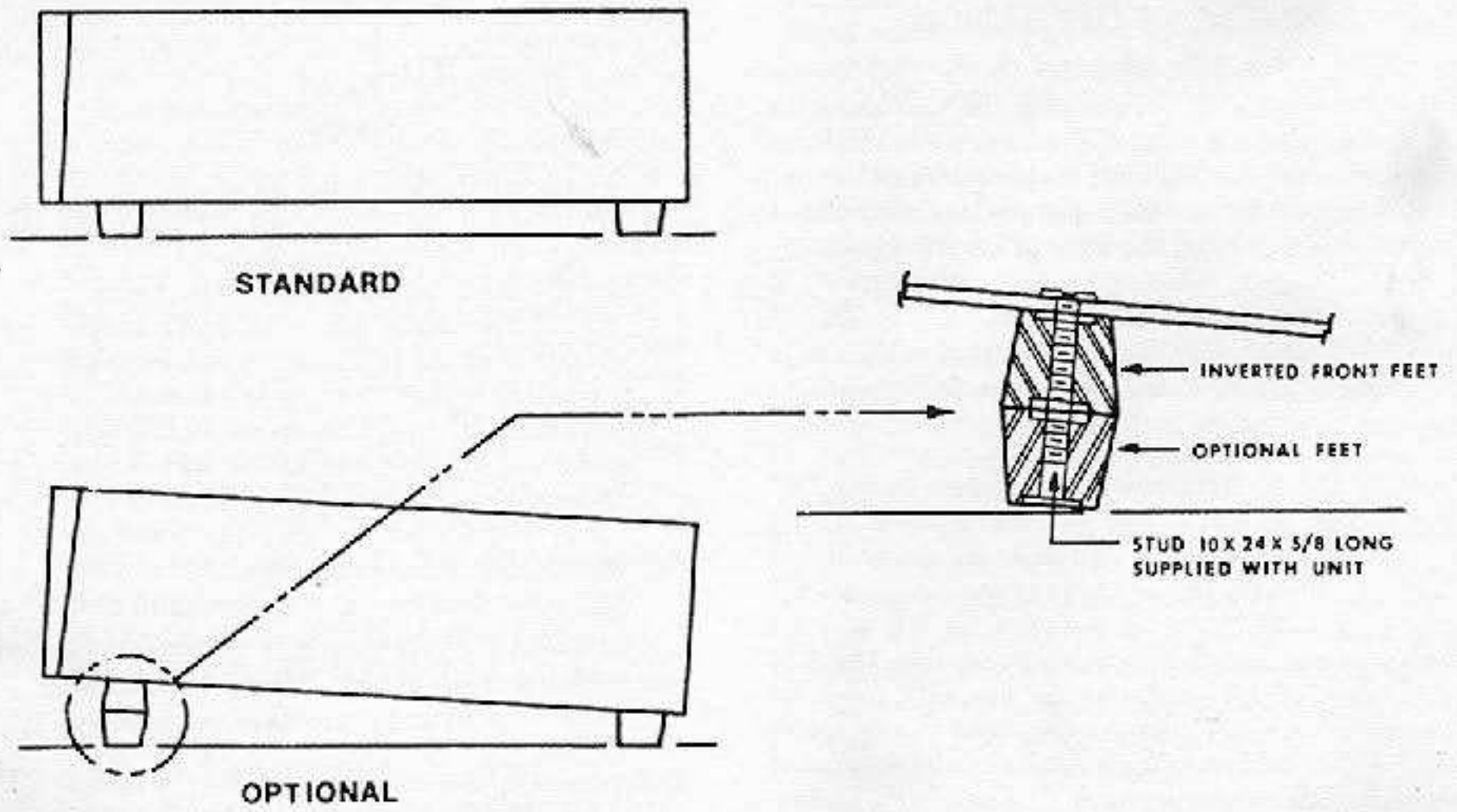


Figure 2-3. Viewing Angle Options

NOTES:

## CHAPTER 3 OPERATION

### 3-1. FRONT PANEL CONTROLS

- A. **METER** — Indicates relative level of received signals. Each S-unit is approximately 5 dB, with S9 equal to approximately 50  $\mu$ V (Preamp OFF).
- B. **STATUS INDICATORS**—
1. **FIXED** - Indicates fixed frequency operation has been selected (Requires AUX7 Accessory).
  2. **SET BAND** - Indicates the need to set the bandswitch to the proper range when using AUX7 Accessory.
  3. **RIT** - Indicates that RIT (Receiver Incremental Tuning) is enabled.
  4. **RCT** - Indicates that the TR7 TRANSMIT frequency is being controlled by the R7 VFO or R7 Fixed Oscillator (AUX7).
- C. **MUTE SWITCH** — With button depressed, receiver is muted. However, in transceive operation with TR7, receiver is muted during transmit only. With button out, receiver is operational continuously. To mute with a transmitter other than a TR7, merely supply a switched ground line to pin 11 of accessory connector. With button depressed and pin 11 grounded, receiver is operational. During transmit, remove ground.
- D. **PREAMP SWITCH** — Depressing button enables a 10 dB gain preamp following the input antenna filters. It is operational from 1.5 to 30 MHz and improves sensitivity approximately 5-6 dB. The receiver dynamic range is reduced slightly with the preamp on and thus it should be turned off when not needed. S-meter indication will increase approximately 2 S-units or 10 dB with preamp on with a signal applied. Preamp does not increase calibrator reading.
- E. **AM/SSB/CW Switch** - Depressing button enables AM mode of receiver operation. Refer to page 1-5 for a discussion of how to utilize the synchrophase AM detector feature of the R7 to its fullest extent. Additional comments concerning the AM mode of operation are made in Section 3-4.
- F. **SPKR SWITCH** — When depressed, internal or external speaker is disconnected. However, headphone jack is always operational in either switch position.
- G. **FIXED/VFO SWITCH** — Determines the source of frequency control for the R7 when the optional AUX-7 is installed and crystals are used for frequency control. Depressing the switch selects receive crystal control as labelled. In the out position, the receiver reverts to VFO control.  
NOTE: If crystals are not installed or the AUX-7 is not installed, this switch must be in the out position for proper R7 operation.
- H. **NOTCH SWITCH**—Enables notch control allowing IF null to be tuned approximately + 3 kHz from IF center frequency.
- I. **UP CONTROL** — Each time this momentary contact pushbutton is depressed, the R7 operating frequency will increase 500 kHz. This action will continue until the upper limit of the selected band range (yellow number on BAND switch, W) is reached, at which point the bandswitch must be reset to allow further increase.
- J. **DOWN CONTROL** — Operation exactly the same as the UP control (I), except that the operating frequency is decreased 500 kHz for each switch actuation.
- (I;J.) **NOTE:** Neither UP or DOWN frequency control is enabled until after a preset delay time of 15-20 seconds after each time power is initiated to the radio.
- K. **STORE CONTROL** — When depressed, this control will store the current operating frequency on the six digit display. Control of the operating frequency remains variable, and the analog dial must be used. This feature is useful as a 'scratch pad' for remembering net frequencies, DX stations, etc.  
NOTE: Each time power is initiated to the radio with the Store button already depressed, the display will be blank. Merely release the button for display operation.
- L. **FREQUENCY READOUT** — Presents a digital display of operating frequency to the nearest 100 Hz when the front panel COUNT switch is in the out position. When the front panel switch is in the COUNT position, the display reads the frequency (150 MHz maximum) of a signal source connected to the rear panel EXT COUNT jack. For frequencies over 100 MHz, the hundred MHz digit is implied; i.e., 146.9400 MHz will be displayed as 46940.0
- M. **ANTENNA SWITCH** — Works in conjunction with antenna ports on rear panel of radio. The MAIN, ALTERNATE and CONVERTER jacks are antenna inputs. The EXTRCVR jack is a switched antenna output. Depending



on the selected switch position, the appropriate antenna is selected for the R7 receiver's input (indicated by WHITE colored legend) and the same or another antenna is connected to the EXT RCVR jack (indicated by YELLOW colored legend). The EXT RCVR port becomes the antenna source for another receiver, e.g. TR7 in transceive mode. (See Fig. 2-2 for transceive interconnection diagram). The CONVERTER jack is connected to the R7 only and in one switch position only. This allows for a nominal 75 dB or greater isolation between the MAIN, ALTERNATE or EXT RCVR port and the R7 receiver input. The isolation between the R7 receiver input and the unused antenna port varies from 45 dB to 75 dB nominally in the first five (5) switch positions.

- N. **RF GAIN** — Controls the R.F. gain of the receiver. Normally used in the fully clockwise position for maximum gain.
- O. **AF GAIN** — Controls the receiver audio gain. Turn fully counterclockwise to turn off the R7.
- P. **NOTCH** - With NOTCH pushbutton depressed, this controls the IF null frequency. Merely tune for minimum interference from an unwanted carrier or CW signal by listening for the audio null or observing the S-meter dip. The knob rotation sense is such that when the PBT control is CW of center, the notch control is CW of center and vice versa. Although the S-meter dip indicates only 20 dB notch depth, the actual audio null can be adjusted to approximately 40 dB depth.
- Q. **TUNING DIAL** — Adjusts frequency of receiver. See section 3-3 of the manual for detailed description of dial readings.
- R. **PBT CONTROL** — Shifts the receiver 2nd IF and 3rd IF injection together (BFO constant frequency), thus maintaining a constant receiver operating frequency. Since the crystal filter passband is fixed, this control can be used to position interfering signals outside the receiver passband. Front panel markings indicate nominal settings for various modes. When using accessory crystal filters, position the receiver passband for the most pleasing receiver audio response and/or best interference rejection.
- S. **RIT CONTROL** — When the RIT switch (BB) is depressed, this control allows the receiver frequency to be varied over a nominal  $\pm 3$  kHz range. In RCT transceive mode, this RIT function is disabled.
- T. **SELECTIVITY SWITCH** - Selects receiver pass-band width independent of mode or passband tuning position. Supplied with 2.3 kHz and 500 kHz wide selectivity filters. (See para 1-2 for options.)
- U. **AUX PROGRAM SWITCH** — Selects the desired auxiliary 500 kHz range and/or fixed frequency crystal when the AUX-7 accessory is installed.
- V. **HEADPHONES** — Provides a connection for headphones. Internal or external speaker is not muted when this jack is used. An internal 220  $\Omega$  resistor is installed in series with this jack. This jack is "hot" regardless of "SPKR" switch position.
- W. **BAND SWITCH** — Selects the desired band of operation. The yellow numbers within the yellow bracket indicate the total range which can be covered in any given bandswitch position. The white numerals in the center of the brackets indicate the lowest frequency of the 500 kHz range which is automatically selected when the bandswitch is turned to this position. Other 500 kHz ranges are selected using the UP and DOWN push-buttons (I & J).
- X. **CAL SWITCH** — Enables the built-in 25 kHz calibrator. Due to the nature of the calibrator signal, it is normal to experience some receiver intermodulation and spurious response when the calibrator is enabled.
- Y. **NB SWITCH** — Enables the optional NB7A noise blanker.
- Z. **AGC SWITCHES** — Selects one of the three AGC speeds and an OFF position. In the AGC "OFF" position, receiver gain must be controlled by the RF Gain control.

SWITCH "M"	SWITCH "F"	AGC RESPONSE
OUT	OUT	SLOW
IN	OUT	MEDIUM
OUT	IN	FAST
IN	IN	OFF

- AA. **COUNT SWITCH** — Depressing this switch converts the digital readout into a 150 MHz counter. RF input port is on rear panel marked EXT COUNT.  
NOTE: This switch must be in the "OUT" position for display to indicate receiver operating frequency.
- BB. **RIT SWITCH** — Enables the front panel RIT control.

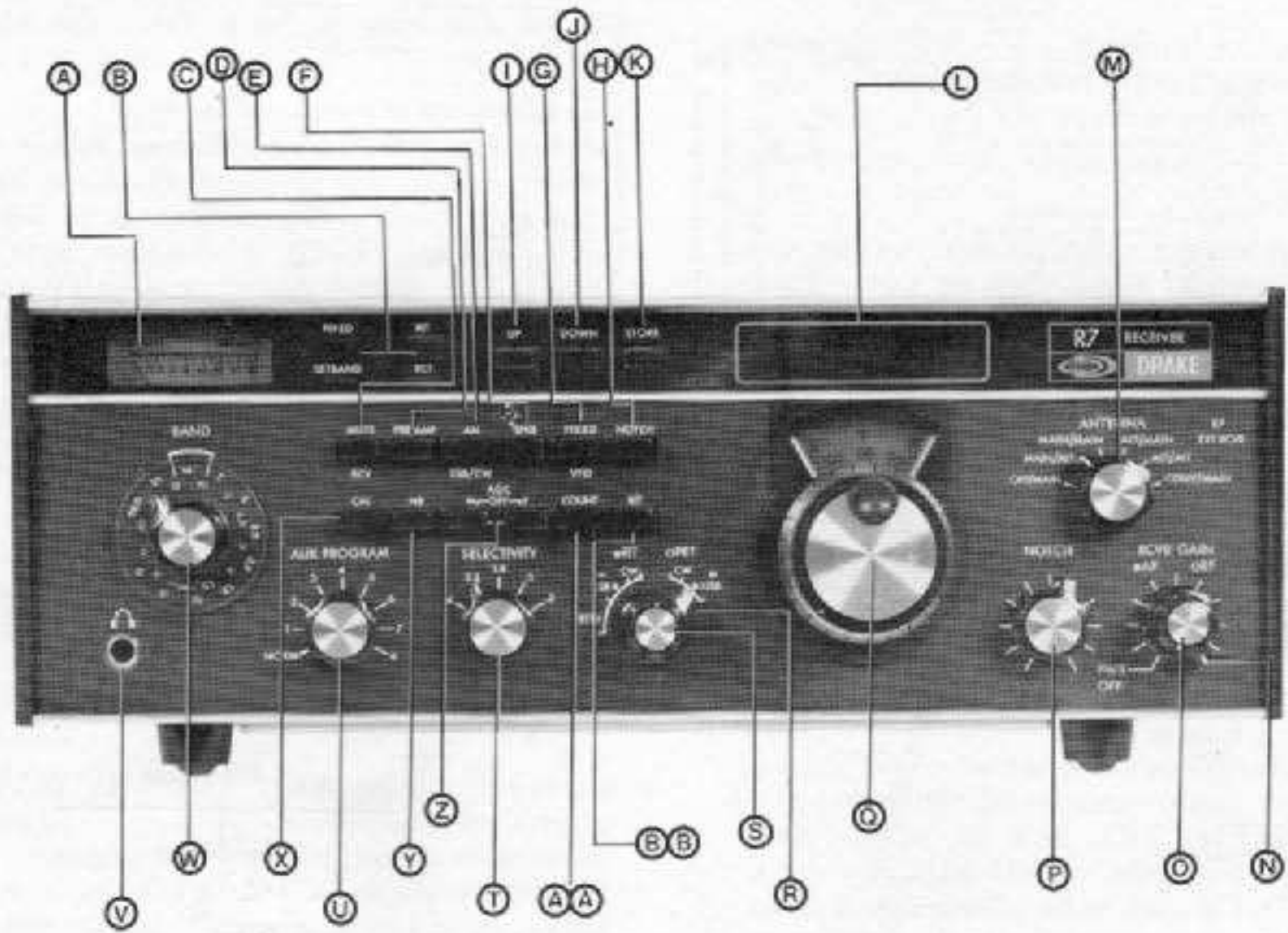


Figure 3-1. Front Panel Controls and Connections



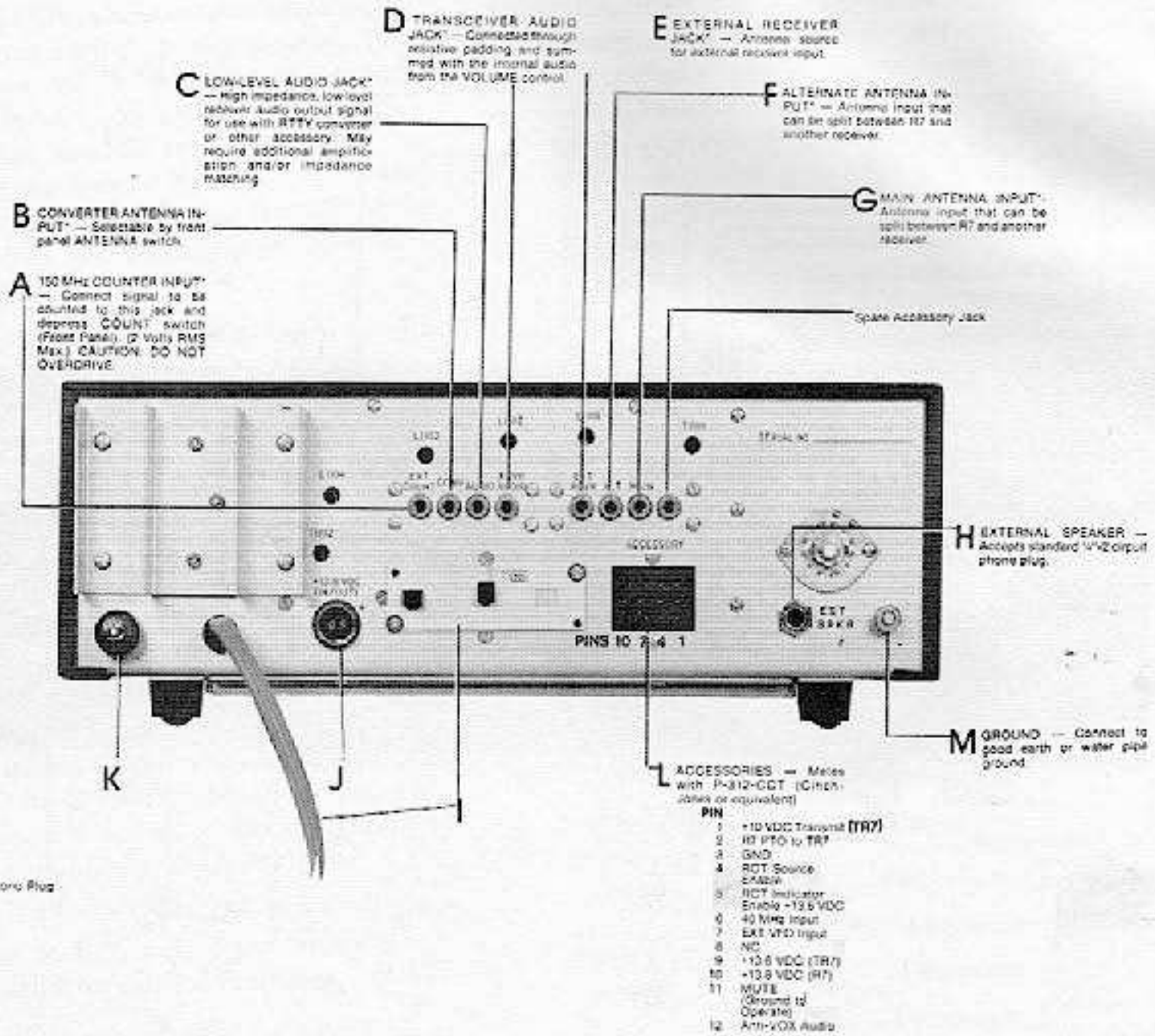


Figure 3-2. Rear Panel Controls and Connections

### 3-2. REAR PANEL CONTROLS AND CONNECTIONS

- A. **EXT COUNT JACK** — This port accepts a signal to be measured up to 150 MHz. By depressing the COUNT switch on front panel, the display converts to a frequency counter. Sensitivity is 50 mV, and maximum input is 2 V. This feature is useful for accurately setting the frequency of two-meter hand held radios, etc.
- B. **CONV JACK** — Antenna input port selected by ANTENNA switch located on front panel. This particular input is selectable to R7 receiver only.
- C. **AUDIO JACK** — Connected to the top of the AF GAIN control. As such, this jack can be used for audio input to the receiver audio amplifier or audio output to accessories such as tape recorders or RTTY terminal units. Output level is nominally 0.5 volt RMS at high impedance.
- D. **XCVR AUDIO JACK** — Connected through resistive padding and summed with the internal audio from the volume control. As such, this jack can be used for audio mixing of internal audio and audio from TR7, for example. In the TR7/R7 transceive mode, connecting audio from TR7 EXT SPKR jack to R7 XCVR AUDIO jack provides sidetone when in CW transmit mode. Sidetone level is adjustable by TR7 VOLUME control. (See Fig. 2-2)
- E. **EXT RCVR JACK** — Connected to one of the main or alternate receiver jacks either directly or through the built-in antenna splitter, depending on antenna switch position located on front panel. This port should be connected to the external antenna input of an external receiver.
- F. **ALT JACK** — Alternate antenna input connected to R7 receiver input in two (2) antenna switch selectable positions and connected to the external receiver jack in two (2) positions.
- G. **MAIN JACK** — As its name implies, this jack is the normal R7 receiver antenna input. It is connected to the R7 receiver in two (2) antenna switch selectable positions and connected to the external receiver jack in four (4) positions.
- H. **EXTERNAL SPEAKER** — Connection for an external 4 ohm speaker rated at 2.5 watts or more, such as the MS-7. Internal speaker is automatically muted when external speaker is connected. Plug should be wired so tip is 'hot'.
- I. **POWER INPUT** — Primary AC power is provided to the receiver via the line cord. The programming plate window should indicate the proper supply operating voltage (see fig. 2-1).
- J. **DC POWER CONNECTOR** - Supplies regulated +13.8 VDC at .25 AMP when receiver is being operated on AC power mains. (Mating connector available from R. L. Drake Service Department.) With line cord disconnected from AC source, the receiver can be powered via this connector by +13.8 VDC at 3 AMPS maximum. Observe proper polarity
- K. **FUSE** — Unit should be fused 3/4 AMP SLO-BLO for 100, 120 VAC input and 3/8 AMP SLO-BLO for 200, 240 VAC input.
- L. **ACCESSORIES** — Mates with a P-312-CCT plug. This connector provides for a wide range of accessory interconnections, primarily connection to the TR7 ACCESSORY CONNECTOR. If it is desired to mute the R7 with a transmitter other than a TR7, disconnect ground to pin 11 during transmit (MUTE button depressed). The TR7/R7 transceive accessory cable (part of Model 1548) will automatically provide this function when in TR7/R7 transceive.
- M. **GROUND** — Provides for grounding receiver cabinet to good earth or water pipe ground.



## NOTES:

### 3-3. VFO DIAL

This dial consists of two concentric discs, which rotate at different speeds, and the skirt on the main tuning knob. Zero to 100 kHz in 5 kHz increments is indicated on one disc and hundreds of kHz on the other. The knob skirt is calibrated in one kHz increments. The operating frequency is the sum of the frequencies indicated by the BAND switch and the VFO dial.

The VFO dial is illustrated in figure 3-3. In this illustration, the dial is read as follows:

100 kHz dial	.200 MHz
+ 5 kHz dial	.070 MHz
+ Knob Skirt	.002 MHz

---

.272 MHz

Therefore, adding 0.272 MHz to the BAND setting will result in the operating frequency of the R7.

The dial may be calibrated over a short range by the following procedure:

- Depress the CAL switch (calibrator on).
- Rotate the tuning knob to the nearest 25 kHz increment (0, 25, 50, or 75).
- Hold the knob skirt stationary and rotate the knob until the calibrator signal is zero beat.
- Turn off the calibrator.

### 3-4. GENERAL OPERATING INFORMATION

For normal SSB CW receiver operation, preset the receiver controls as follows:

All 15 Pushbuttons:	Out position
AUX PROGRAM:	NORM
SELECTIVITY:	2.3
PBT Knob:	USB or LSB as desired
RF Gain:	Fully Clockwise
AF Gain:	Adjust for comfortable listening level.
ANTENNA:	To Desired Antenna

If the frequency display of the R7 is blank when the receiver is first turned on, check to be sure that the STORE and COUNT buttons are in the out position. If the LED frequency readout is displaying randomly varying numbers check to be sure the AUX PROGRAM knob is either in the NORM position, or is set to a channel programmed for the proper band as selected by the band switch. Also check that the FIXED/VFO switch is in the proper position. If no audio is heard with the RF and AF gain controls set at normal listening level, check to be sure that the MUTE and SPKR switches are in the out position and that an antenna is connected to the proper jack on the back panel as selected by the ANTENNA switch.

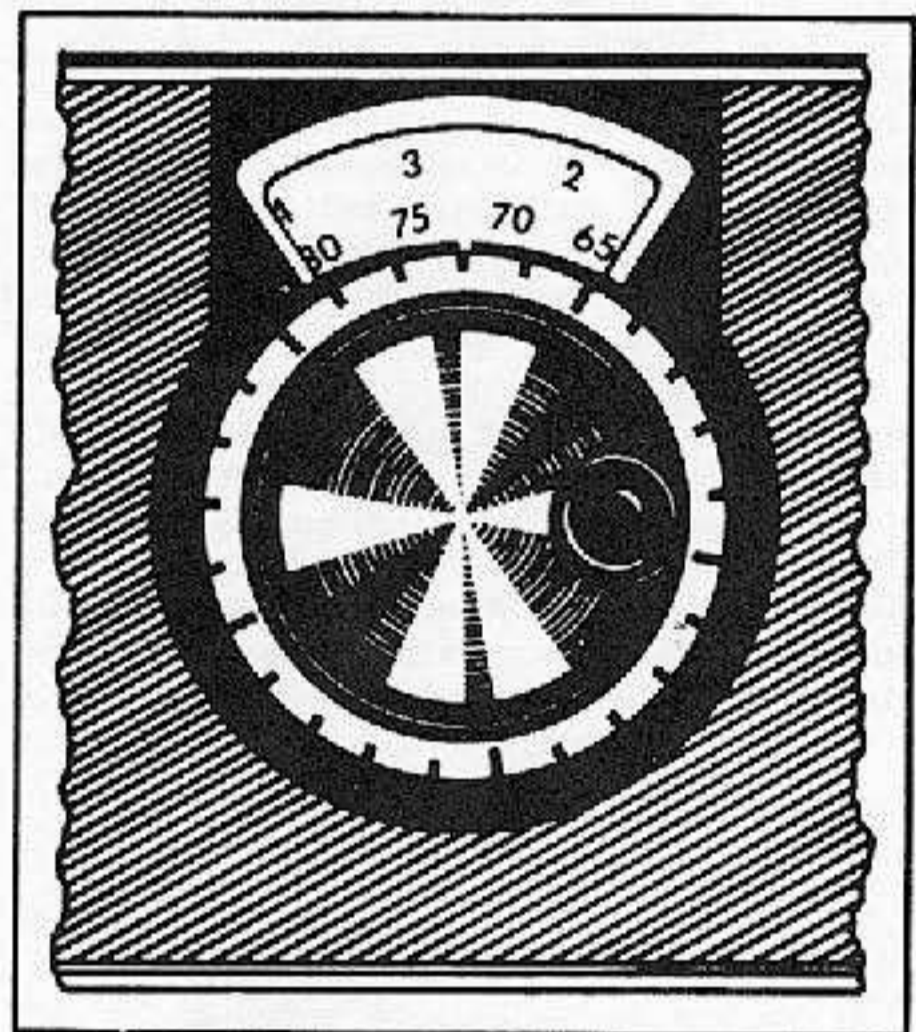


Figure 3-3. Main Tuning Dial

The PBT (Passband Tuning) control may be adjusted to emphasize the high or low frequencies on a received SSB signal. The adjustment of this control is largely one of operator preference, and should be one that produces the most pleasing audio response with minimum interference. In particular, use of the accessory 1.8 kHz filter in conjunction with careful adjustment of the PBT control will often greatly improve reception of SSB signals under conditions of heavy interference.

For receiving AM under high interference



conditions, the 4 kHz accessory filter may be useful. The PBT control is tuned to select either the upper or lower sideband, depending on interference. The 4 kHz filter may also be useful for quality SSB reception under strong signal conditions. Refer to section 1-2, Accessory Crystal Filters, for additional discussion of filters for AM use.

AM operation without an accessory filter is possible, however performance will suffer under high interference conditions. A 150 ohm 1/2 watt resistor jumper can be connected in the 4.0 kHz IF selectivity position. Selectivity of 8-10 kHz is provided by the four pole monolithic 48.05 MHz crystal filter. Adding the NB7A accessory will provide an additional two poles of selectivity. Fidelity, of course, would certainly be excellent with the 150 ohm resistor jumper.

For AM reception within the 0.5 to 1.5 MHz range (U.S.A. broadcast) the following applies. Because of the wide variation in antennas used on this range, an attenuator pot (R1502), located on the input filter module (#15) is provided to allow the R7 to be optimized for the particular antenna in use (see figure 5-1). This adjustment is factory preset to the middle of its range, and as such, reduces the sensitivity within this band. To increase or decrease the sensitivity simply adjust the pot (accessible from the top of radio after removing the wraparound cabinet) while observing the S-meter reading. For instance, if the R7 is connected to a long wire antenna resulting in some cross modulation, adjust the pot until interference disappears. Conversely, sensitivity can be increased for distant DX reception when shorter antennas are used.

#### NOTES:

## CHAPTER 4

### THEORY OF OPERATION

#### 4-1. RECEIVER SECTION

Incoming signals from the antenna pass through a bandswitched bandpass filter module, the limits of which are defined by the yellow numerals on the front panel BAND switch.

The bandpass filter output is routed to a preamplifier which may be switched in or out as desired. The output of the preamp along with the 25 kHz calibrator output is connected to the input of the Up-Converter. Signals at the input of the Up-Converter module are mixed with the output of the synthesizer VCO to create a 48.05 MHz intermediate frequency (IF) signal. Conversion is accomplished by a high-level, double balanced mixer to provide a very wide dynamic range. The output of this mixer is amplified by a low-noise, high dynamic range junction FET amplifier to insure adequate receiver sensitivity. This stage is followed by a four-pole monolithic 48.05 MHz crystal filter. The purpose of this filter is to attenuate signals removed more than  $\pm 4$  kHz from 48.05 MHz, thus protecting the remaining stages of the receiver from strong interfering signals. In this manner, optimum receiver dynamic range is preserved while providing excellent sensitivity.

The output of the Up-Converter module is routed to the input of the 2nd mixer module. This module provides additional gain at the 48.05 MHz 1st IF frequency and converts this signal to the 5.645 MHz 2nd IF frequency. Additional gain is provided at 5.645 MHz in the selectivity positions designated .5 kHz and .3 kHz. This is to offset the loss added by these narrow accessory filters. Automatic gain control (AGC) voltage is applied to the 1st IF amplifier to supplement the control range supplied by later stages.

The 5.645 MHz signal from the 2nd mixer module is routed through the noise blanker module to the IF selectivity module. When installed, the accessory NB7A noise blanker acts on noise pulses prior to the IF crystal filters to prevent ringing in these filters from stretching the pulses. Maximum noise blanker effectiveness is thus assured. If the accessory NB7A is not installed, the 2nd IF signal is passed through a jumper board in the same location for interconnection.

The IF selectivity module contains provisions for 4 accessory crystal filters in addition to the standard 2.3 kHz filter. These filters determine the overall bandwidth of the receiver, and are selected by PIN diode switching controlled from the receiver front panel. Careful attention has been given to the switching circuit design and physical layout of this module to minimize stray coupling paths which would degrade the ultimate selectivity of the receiver. The result is extremely high rejection of unwanted off-channel signals.

Following the IF selectivity module, the 5.645 MHz signal is routed to the 2nd IF module. This module amplifies the 5.645 MHz signal and converts it to 50 kHz, after which it passes through the notch filter circuitry and further amplification. The signal is then demodulated using an AM or product detector, depending on mode.

The demodulated signal is then amplified to a level sufficient to drive a speaker by an integrated circuit audio amplifier. AGC voltage, developed prior to demodulation, is used to control the gain of the IF stages. The same AGC signal is used to drive the S-meter circuit to provide signal strength indication. AGC decay time constants are selected by the front panel AGC switches.

#### 4-2. FREQUENCY CONTROL

The R7 features synthesizer control of the operating frequency. This allows the receiver to cover a wide frequency range without the use of range crystals or other frequency determining circuits.

The reference for the synthesizer is generated by a 40 MHz crystal oscillator on the PBT/Reference Oscillator module. The output of this oscillator is divided by 80 to produce 500 kHz. These two signals (40 MHz and 500 kHz) are routed to the synthesizer modules, which are described later in this section. When the Cal switch is depressed, the 500 kHz signal is divided by 20 to produce a 25 kHz signal which is rich in harmonics. This signal is connected to the input of the Up-Converter



module, and produces calibration marker signals at 25 kHz intervals.

The passband tuning control is connected to a 13.695 MHz voltage-controlled crystal oscillator (VCXO). By adjustment of this control, the frequency of the oscillator is moved over a limited range (approximately  $\pm 3$  kHz) centered on 13.695 MHz. This signal is then mixed with the 40 MHz crystal oscillator signal to produce 53.695 MHz. The 13.695 MHz signal is also mixed with an 8 MHz signal derived from the 40 MHz divider chain to produce 5.695 MHz. The BFO, derived from the 40 MHz divider chain, is a fixed frequency 50 kHz signal.

The 53.695 MHz signal is used for injection to the 2nd Mixer module, where it converts the 48.05 MHz IF signal to 5.645 MHz. The 5.695 MHz signal is fed to the third mixer, converting the 5.645 MHz second IF signal down to the third IF, 50 kHz. Since the 13.695 MHz oscillator is used to generate both signals, it can be moved in frequency without changing the receiver operating frequency. Therefore, as the third mixer injection frequency is changed (by changing the PBT control voltage), the 53.695 MHz injection signal is changed by an equal amount. This allows the 2nd IF to be positioned anywhere within a  $\pm 3$  kHz range with respect to the crystal filter passband while the receiver remains tuned to the incoming signal. This technique provides the passband tuning feature.

Injection for the Up-Converter module is supplied by the VCO module. This module includes a voltage-controlled oscillator (VCO) which operates over the range of 48.05 MHz to 78.05 MHz. When mixed with the 0-30 MHz incoming signals, the result is the 48.05 MHz IF frequency. The VCO is tuned by a filtered control voltage derived from a phase detector which compares the frequency and phase of the 500 kHz reference from the PBT/Reference Oscillator module and a 500 kHz signal from the Translator module.

The Translator module combines the 40 MHz reference signal and the 5.05-5.55 MHz output of the permeability-tuned oscillator (PTO) which is controlled by the main tuning dial. The resulting 45.05-45.55 MHz signal is filtered and mixed with the VCO signal to produce a 3.0-33.0 MHz signal, depending on operating frequency. This signal is filtered, amplified, and applied to a programmable

divider ( $\div N$ ) which is programmed by the Digital Control Module. The output of the  $\div N$  is exactly 500 kHz when the VCO is tuned to the correct frequency, thus satisfying the phase detector and locking the synthesizer loop.

The Digital Control module generates programming information for the  $\div N$  by processing information from both the BAND switch and the frequency programmer on the DR-7 display module. The BAND switch information generates the proper  $\div N$  load number for the frequency range indicated by the white bandswitch numerals. The DR-7 frequency programmer is then used to increment this load number UP or DOWN by the desired amount.

The following example will help to illustrate the operation of the synthesizer:

Operating Frequency:	14.2835 MHz
	+48.0500 MHz
VCO Frequency:	62.3335 MHz
PTO Frequency:	
	5.05 MHz + 0.2835 MHz = 5.3335 MHz
	+40.0000 MHz
Variable Reference Frequency:	45.3335 MHz
$\div N$ Input Frequency:	
	(62.335 MHz - 45.335 MHz) = 17 MHz
$\div N$ Output:	.5 MHz
	(Load Number = 34)

It can be seen from the above that each time the  $\div N$  load number is increased or decreased by one, the VCO frequency will be forced to change by 500 kHz to satisfy the phase detector and maintain phase lock.

The DR-7 Frequency Display module contains a counter with a six digit LED readout. In the normal mode, this counter is connected to the VCO output and is programmed to subtract 48.05 MHz from the resulting count. In this manner, operating frequency is displayed on the LED readout. In the COUNT mode, the 48.05 MHz subtraction is removed, and the counter input is connected to the rear panel counter input jack, resulting in a 150 MHz six digit counter for test purposes.



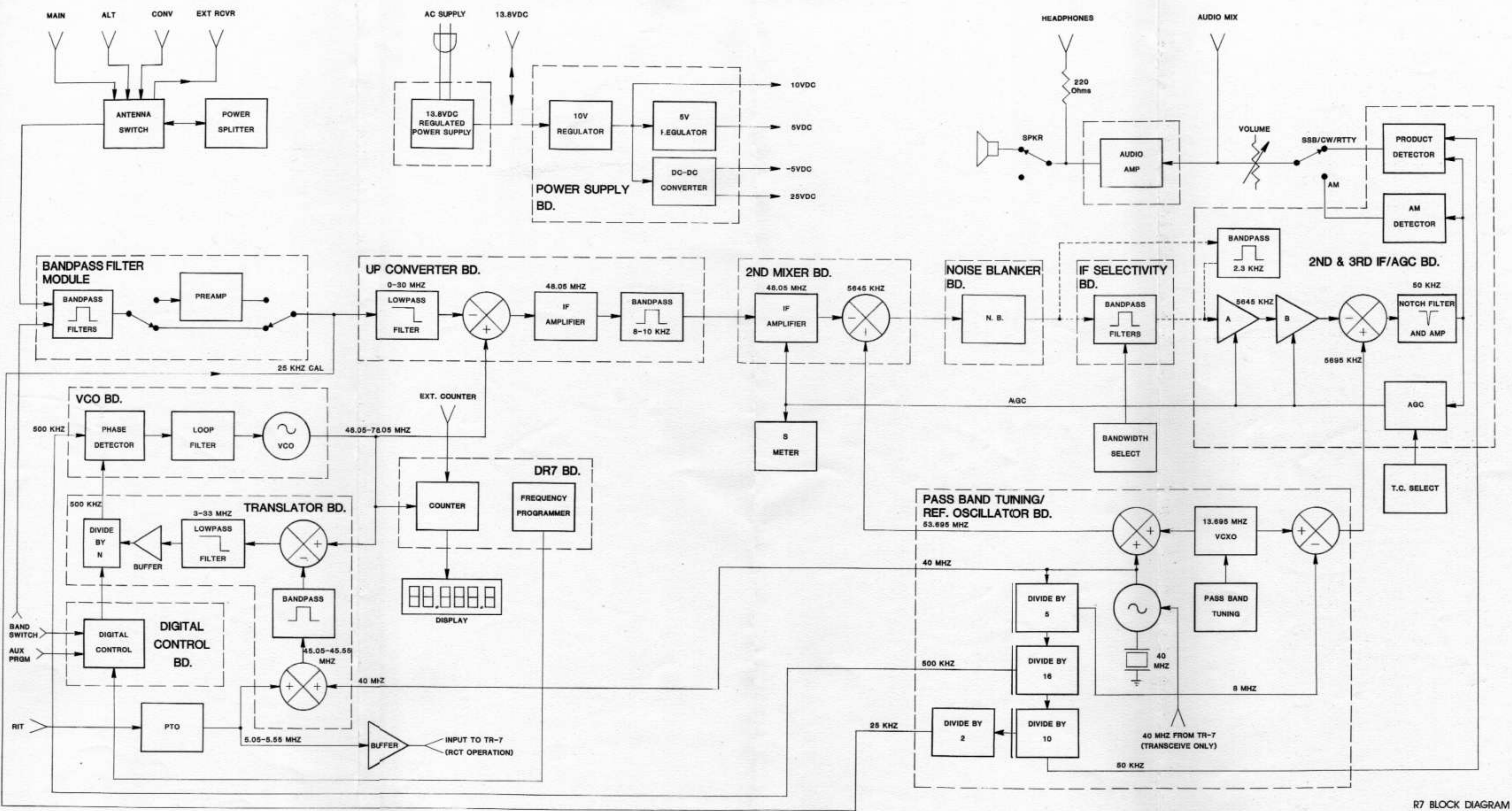


Figure 4-1. R7 Block Diagram

R7 BLOCK DIAGRAM



## CHAPTER 5 MAINTENANCE

### 5-1. SERVICE INFORMATION

The R7 Receiver utilizes sophisticated circuitry which requires elaborate test equipment for troubleshooting. It is therefore suggested that any unit displaying abnormal operating characteristics be returned to the R.L. Drake Company or an authorized service center.

Before returning the unit for repair, remove the cabinet wrap-around and bottom cover. Check for broken or pinched wires, blown fuses, and be sure that all circuit boards are properly seated in their respective sockets. Check all external connections to be sure that the receiver is properly interconnected to other equipment. Refer to Fig. 5-1 for placement and description of various boards and modules within the R7.

If problems persist, advise the factory of the difficulties and obtain authorization to return the unit for service. Address your request for authorization to:

R.L. DRAKE COMPANY  
540 Richard Street  
Miamisburg, OH 45342  
ATTN: Customer Service Department  
Telephone: (513) 866-3211  
Telex No.: 288-017

A detailed service manual, containing alignment instructions, schematic diagrams and troubleshooting information is also available.

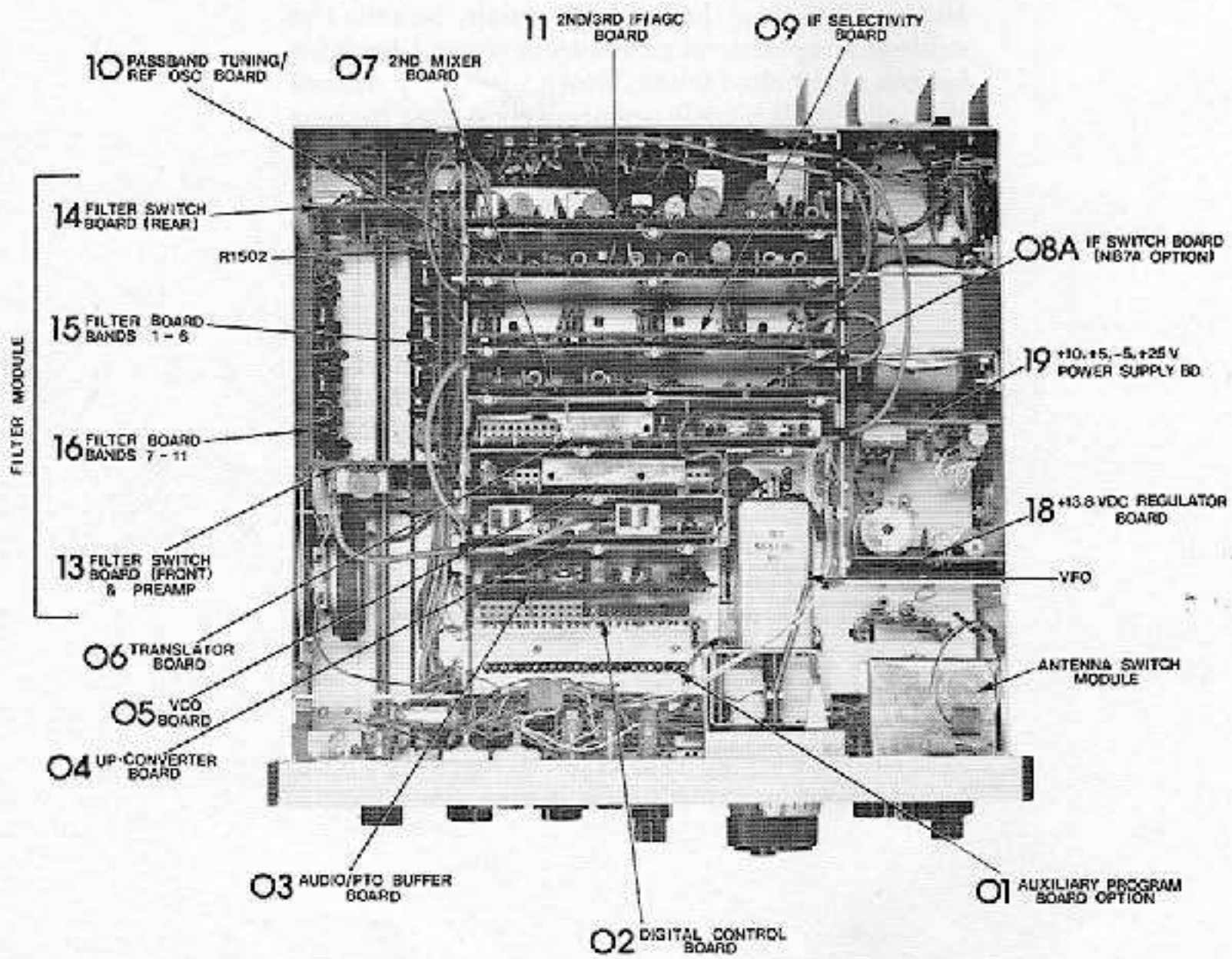


Figure 5-1. R7 Top View (Covers Removed)



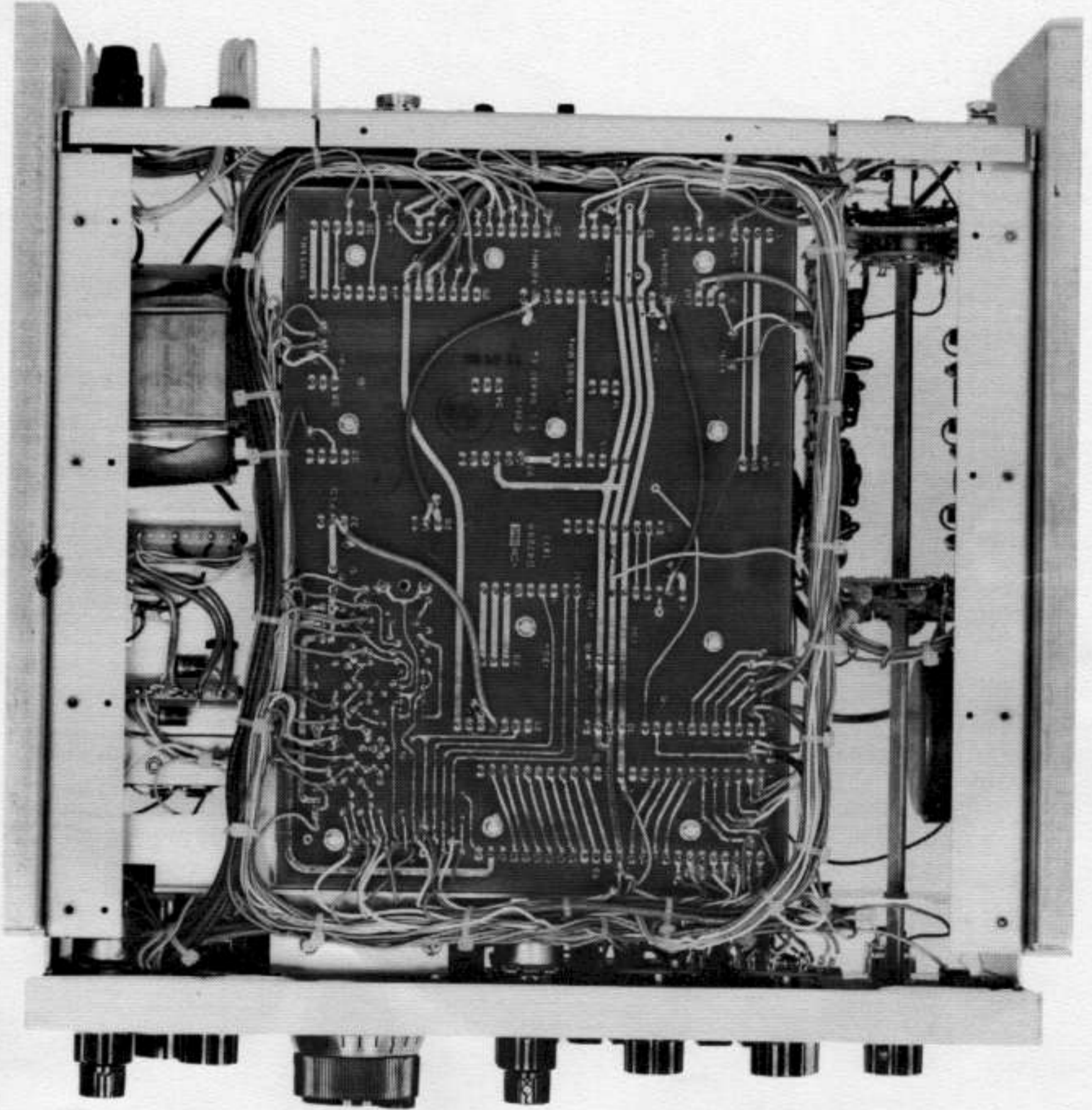


Figure 5-2 R7 Bottom View (Covers Removed)

