DRAKE

TR-7
HF - Transceiver

Operators manual

TR7/TR7A SUPPLEMENT

The following accessories and modification have been added to update your TR7 to a TR7A for more versatility.

1) A noise blanker (NB7) has been installed.
2) A 500 Hz filter (SL500)) has been installed in selectivity position 'A'.
3) Selectivity 'B' has been adapted to provide a bandwidth of 9 kHz for AM reception.
4) A surge protection device has been added to the receive antenna input to provide additional protection from static discharges from lightning.
5) The phono jack input at the rear panel labelled 'TX' has been added to provide transmitter audio input from sources other than the microphone. Possible uses include phone patches and radioteletype terminal units. This jack is connected in parallel with pin 1 of the front panel microphone jack.

CONTENTS

ILLUSTRATIONS

Introduction

1-1. DESCRIPTION.

The TR-7 is a solid-state, broadband, SSB/CW/AM transceiver which embodies several unique state-of-the-art design features. Due to its unique design, the TR-7 offers excellent sensitivity and selectivity, very high dynamic range, digital frequency readout combined with general coverage receive capability, and exceptionally high transmitted signal quality.

Front panel pushbuttons allow the operator to select any of four receiver selectivities without affecting transmitter operation. Standard bandwidth is 2.3 kHz, and other bandwidths are established using easily installed optional crystal filters. In transmit, the standard 2.3 kHz crystal filter is automatically selected to insure proper signal characteristics.

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 beat frequency oscillator (BFO) 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.

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 TR-7 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 features 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 TR-7 synthesizer to be stepped up or down in frequency in 500 kHz increments, thus allowing continuous frequency coverage from 1.5 to 30 MHz.

Transmit operation is automatically inhibited in any range not including a legitimate amateur band. An accessory programming board, the AUX-7, is available for out-of-band operation and/or fixed frequency operation such as MARS, reception from 0 through 1.5 MHz, future amateur bands, etc. The digital display can also be used as a 150 MHz frequency counter, if desired.

The transmitter section of the TR-7 features a rugged, solid-state power amplifier section which has been designed for continuous duty in the SSB and CW modes. For more demanding duty cycles, such as SSTV or RTTY, the Model 1529 FA-7 cooling fan is available. The transmitter section also features very low harmonic and spurious output, and is equipped with automatic high VSWR protection.

The VOX controls for the TR-7 are located on the front panel, and feature separate delay controls for CW and SSB. VOX operation can be disabled with a front panel pushbutton.

Other features include a built-in directional wattmeter, selectable receiver AGC time constants, built-in 25 kHz calibrator, receiver incremental tuning (RIT), provision for an accessory noise blanker (NB-7), and transceive operation with a companion receiver.

The modular construction of the TR-7 reduces service time to a minimum. Each module is designed to perform a specific function, thus simplifying any required alignment and troubleshooting.

Figure 1-1. TR-7 H. F. Transceiver

GENERAL

Frequency Coverage:
(With DR-7 Digital Readout/General Coverage Board)

Receive:

Without AUX-7: 1.5 to 30 MHz, continuous.

With AUX-7:* Same, plus 0 to 1.5 MHz at reduced performance.

Transmit: *(0 to 1.5 MHz Receive only)*

Without AUX-7: 1.5-2.0, 3.5-4.0, 7.0-7.5, 14.0-14.5, 21.0-21.5, 28.0-30.0 MHz.

With AUX-7:* Above ranges, plus any eight 500 kHz segments between 1.5 and 30 MHz.

(Without DR-7 Digital Readout/General Coverage Board) 1.5-2.0, 2.5-3.0 (Receive only), 3.5-4.0, 5.0-5.5 (Receive only), 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.*

NOTE

Proof of license or other F.C.C. authorization must be submitted in order to obtain range modules which allow transceive operation outside an amateur band.

*AUX-7 requires use of appropriate Range Modules.

Modes of Operation: USB, LSB, CW, RTTY, AME (A-3H).

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

Frequency Readout Accuracy:

Analog: Better than ±1 kHz when calibrated at the nearest marker point.

Digital: 15 ppm ±100 Hz.

External Counter Mode:

Maximum Input Frequency: 150 MHz.

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

Power Supply Requirements: 11-16 VDC (13.6 VDC nominal), 3A receive, 25A transmit.

Dimensions:

Depth: 12.5 in. (31.75 cm), excluding knobs and connectors.

Width: 13.6 in. (34.6 cm).

Height: 4.6 in. (11.6 cm), excluding feet.

Weight: 17.1 lb. (7.75 kg.).

Specifications – page 2

RECEIVER

Sensitivity (1.8-30 MHz):

SSB, CW: *(Typically .25μV on 15m & 10m bands)*	Less than 0.5 uV for 10 dB $\frac{S+N}{N}$
AM (30% Mod.):	Less than 2.0 uV for 10 dB $\frac{S+N}{N}$
AGC:	Less than 4 dB output variation for 100 dB input signal change, referenced to AGC threshold.
Selectivity:	2.3 kHz at -6 dB and 4.1 kHz at -60 dB. (1.8:1 shape factor).
Ultimate Selectivity:	Greater than 100 dB.

**60 dB 1st. IF rejection from 22-30 MHz.*

Intermodulation: (100 kHz or greater spacing)	
Intercept Point:	+20 dBm.
Two-tone Dynamic Range:	99 dB.
IF Frequency:	
First IF:	48.05 MHz.
Second IF:	5.645 MHz.
Image and IF Rejection:	Greater than 80 dB.*
Spurious Response:	Greater than 60 dB down.
Internally Generated Spurious:	Less than 1 uV equivalent, except 3 uV equivalent from 5 to 6 MHz.
Audio Output:	2.0 watts @ less than 10% THD (4 ohm load).

TRANSMITTER

Power Input (Nominal):

SSB:	250 watts PEP.
CW:	250 watts.
AME (A-3H)	80 watts (carrier), plus upper sideband.
Load Impedance:	50 ohms, nominal.
Spurious Output:	Greater than 50 dB down.
Harmonic Output:	Greater than 45 dB down.
Intermodulation Distortion:	30 dB below PEP. (24 dB below one of two tones.)
Carrier Suppression:	Greater than 60 dB.
Undesired Sideband Suppression:	Greater than 60 dB @ 1 kHz.

Duty Cycle:	
SSB, CW, AM:	100%.
Tune, SSTV, RTTY: w/o FA-7 Fan:	33%, 5 minutes transmit, maximum.
with FA-7 Fan:	100%.
Microphone Input:	High impedance.
Wattmeter Accuracy:	±5% @ 100 watts (50 ohm load).
VSWR Turndown (Nominal):	
@ 1:1 :	0%
@ 2:1 :	10%
@ 3:1 :	25%
@ 4:1 :	50%
@ 5:1 and Above:	90%

1-2. ACCESSORIES.

The following accessory items provide additional operating capability and flexibility for the TR-7, and are available through R. L. Drake Company dealers.

A. C. POWER SUPPLY PS-7, MODEL 1502

Fixed station operation of the TR-7 requires a power supply capable of delivering 13.6 VDC at 25 amperes. The PS-7 power supply meets this requirement, and is packaged in an attractive enclosure similar to the TR-7. It may be placed on the operating desk, but is supplied with sufficiently long interconnecting cables to allow remote location on the floor. Additionally, the PS-7 offers shutdown protection if the current or voltage outputs exceed safe limits. A complete operators' manual, listing specifications and recommended operating procedures, is supplied with the unit.

COOLING FAN FA-7, MODEL 1529

Severe duty cycle applications of the TR-7, such as extended SSTV or RTTY transmissions require the use of external cooling air on the power amplifier heat sink. The Model 1529 FA-7 Cooling Fan has been matched to the TR-7 cooling air requirements, and features quiet operation and convenient installation. Full installation instructions are supplied with the unit.

NOISE BLANKER NB-7, MODEL 1537

Provision has been made in the TR-7 for plug-in installation of the NB-7 Noise Blanker. The NB-7 is useful in eliminating or reducing impulse noise (such as ignition noise) and some other types of interference (such as LORAN). Complete operating and installation instructions are supplied with the unit.

REMOTE VFO RV-7, MODEL 1338

The RV-7 Remote VFO offers the operator a high degree of frequency control flexibility. The RV-7 can be selected for transmit, receive or transceive frequency control or can be turned off to allow transceive frequency control from the TR-7. For added convenience, the TR-7 RIT control is applied to the RV-7 in the receive mode. The RV-7 also contains a pushbutton controlled "spot" function for easy zero-beat. The unit is housed in an enclosure which is styled to match the TR-7, and is supplied with complete operating and installation instructions.

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 TR-7. Possible applications include MARS operation, WWV reception, and zero through 1.5 MHz receive. In addition, a crystal socket is provided for each of the eight auxiliary ranges to allow fixed frequency receive and/or transmit within a selected range.

For receive only applications, programming is accomplished by using one RRM-7 Range Receive Module per band segment. For transceive operation, one RTM-7 Range Transceive Module per band segment is required.

NOTE

Proof of license or other F.C.C. authorization must be submitted in order to obtain RTM-7 Range Transceive Modules.

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

EXTERNAL SPEAKER MS-7, MODEL 1531

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

DESK MICROPHONE, MODEL 7077

The Model 7077 Desk Microphone is designed to match the audio characteristics of the TR-7. The unit features a convenient desk stand and PTT or VOX operation Complete operation and installation instructions are provided.

PORTABLE/MOBILE MOUNTING KIT MMK-7, MODEL 1335

Provides the necessary brackets, mounting hardware and cabling for mobile installation of the TR-7. In addition, a new cabinet for the TR-7 is supplied which features a built-in carrying handle. The MMK-7 includes complete installation and operating instructions.

ANTENNA MATCHING NETWORK MN-7, MODEL 1538

Matches long wire and coax fed antennas on all bands, 160 – 10 meters. Optional Model 1510 Drake B-1000 balun allows use of balanced feed-lines and/or wide impedance range flexibility. The MN-7 handles 250 watts of input power and features a built-in rf wattmeter/VSWR bridge. A built-in antenna switch allows the selection of up to 3 antennas from the front panel.

ACCESSORY CRYSTAL FILTERS

Several accessory crystal filters are available for the TR-7 as follows:

MODEL	6 dB BAND-WIDTH	60 dB 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
7022 (Drake SL500)	0.5 kHz	1.1 kHz	CW
7021 (Drake SL300)	0.3 kHz	0.7 kHz	CW

These filters may be easily installed in the TR-7 in any combination of three units. Each filter is supplied with complete installation instructions.

PS75 POWER SUPPLY, MODEL 1570

The PS75 was designed primarily for SSB operation at current levels of 15 amperes average and 25 amperes peak and will provide reliable performance on CW at current levels of up to 15amperes. Operates from 100, 120, 200 or 240 VAC ± 10% 50-60 Hz supply at 25 amps intermittant and 13.6 VDC regulated at 3 amps.

SP75 SPEECH PROCESSOR, MODEL 1553

The SP75 Speech Processor is designed to provide an increase in average power/readability of a single sideband voice signal during weak signal, high interference conditions. The SP75 is connected between the microphone and microphone input of the single sideband transmitter, thus requiring no modification of the existing transmitter or transceiver. A front panel switch allows the processor to be switched in or bypassed as conditions warrant. Two additional inputs, such as a tape player or phone patch, may be front panel selected in place of the normal microphone input.

Installation

2-1. UNPACKING.

Carefully remove the TR-7 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 TR-7 is not critical. However, care should be taken to insure that adequate clearance is provided to allow free circulation of air around the power amplifier heat sink. 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 TR-7. The MMK-7 contains all necessary hardware and cables for mobile operation of the TR-7, and also includes detailed instructions covering installation and operation in a mobile or portable environment. The MMK-7 also includes an alternator whine filter and power line fuse for mobile applications.

The following paragraphs cover antenna, power, microphone, and speaker requirements for mobile installation.

2-3.1. ANTENNA REQUIREMENTS.

Install the mobile antenna as recommended by the antenna manufacturer. Connect a 50 ohm coaxial cable from the antenna to the SO-239 antenna connector at the rear of the TR-7. Pay close attention to the antenna manufacturer's instructions for tuning and matching to insure proper operation of the TR-7.

2-3.2. POWER REQUIREMENTS.

CAUTION
Operation of the TR-7 with an incorrect power source will result in serious damage and may void the warranty.

Operating voltage for the TR-7 is 11 to 16 VDC. Voltages outside this range may either damage the transceiver or cause improper operation. The nominal recommended operating voltage is 13.6 VDC at a current of 3 amperes in receive and 25 amperes peak in transmit.

The rear panel power connector (P-404-AB) has a mating receptacle (S-404-CCT) which is polarized. See figure 2-1 for proper connections, and figure 2-2 for rear panel connector locations. Be sure to wire the power connector exactly as shown to avoid damage to the transceiver. It is recommended that #10 stranded wire be used to wire the power connector directly to the vehicle battery, and that a fuse or circuit breaker rated at 30 amperes be installed in the positive supply line close to the battery.

A defective generator or alternator diode may cause excessive generator noise or alternator whine. Defective ignition wiring or components may result in an undesirable level of ignition noise in the receiver. Reference texts such as the *ARRL Handbook* provide additional details on treating these problems.

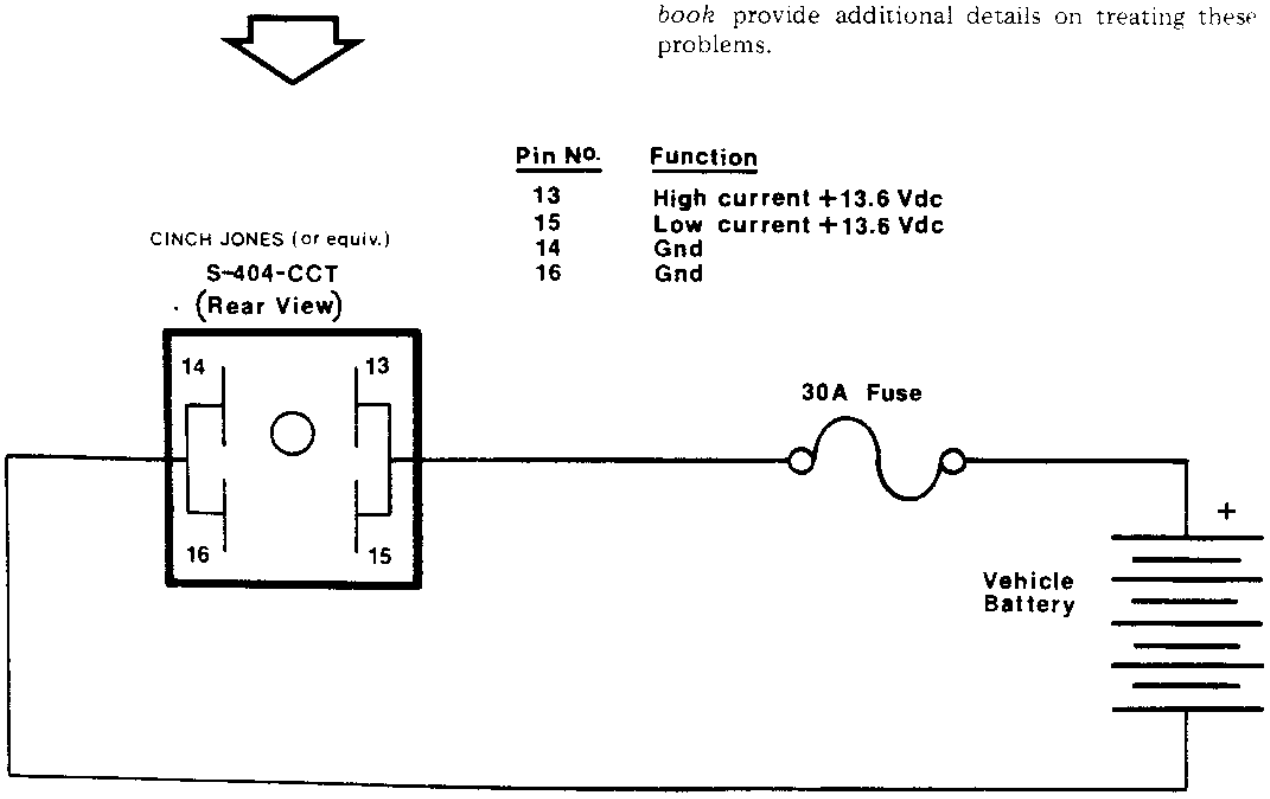


Figure 2-1. TR-7 Power Connection

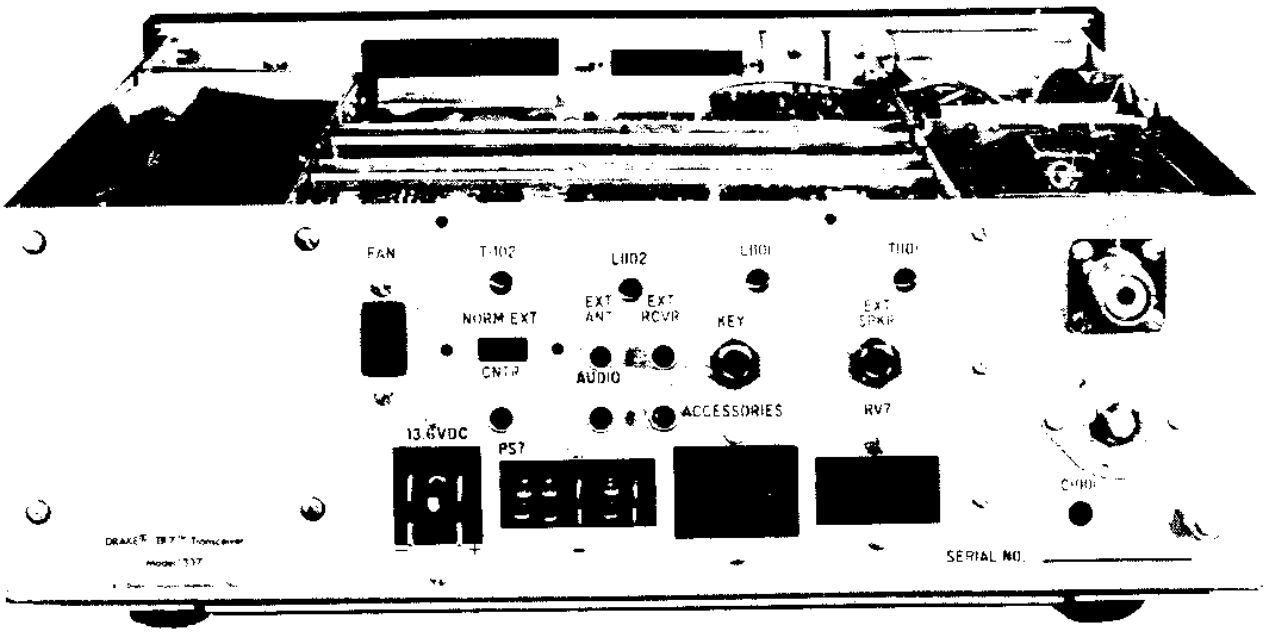


Figure 2-2. TR-7 Rear Panel

2-3.3 MICROPHONE REQUIREMENTS.

Use a microphone with a flat frequency response. The microphone should have a cardiod pattern to reduce pickup from the back and sides. Connect the microphone as shown in figure 2-3. If your microphone has a high output level, you may find it beneficial to use pin 4 of the microphone connector instead of pin 1. See Section 2-4.3 for details.

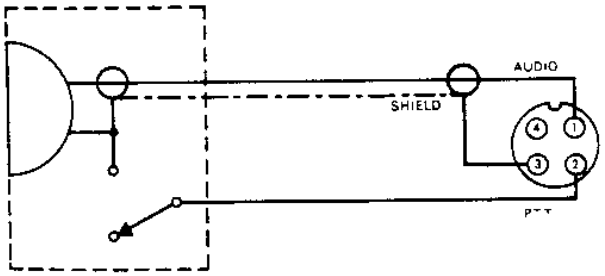


Figure 2-3. TR-7 Microphone Connection

2-3.4. EXTERNAL SPEAKER REQUIREMENTS.

The TR-7 has a built-in speaker. In high noise environments, however, it may be desirable to employ an external speaker located close to the operator. Use of an external speaker automatically disables the internal speaker.

DO NOT connect the TR-7 to the speaker of the car radio. Install a separate 4 ohm speaker capable of handling at least 2 watts of audio. See figure 2-2 for location of the external speaker jack, which accepts a standard 2-circuit phone plug wired such that the tip is 'hot'.

ALTERNATE MICROPHONE CONNECTIONS

(Transceivers above Serial No. 1400)

On TR-7 Transceivers with serial numbers above 1400, the front panel MIC connector has been wired to accommodate two types of microphones. For use with a dynamic microphone, such as the Drake Model 7077, the connections should be made as shown in Figure 2-3 of the TR-7 Operators Manual (the Model 7077 is wired in this manner at the factory).

For a high output, high impedance crystal or ceramic microphone, such as the Astatic Model D-104, microphone audio should be wired to pin 4 of the connector instead of pin 1. Pin 4 presents an input impedance of approximately 750 K ohms, and is 8 dB less sensitive than the pin 1 input.

If your operating habits are such that you 'close talk' a microphone, or if you have a very loud speaking voice, you may find it beneficial to rewire a dynamic microphone such as the Model 7077 by moving the audio lead from pin 1 to pin 4 inside the microphone connector. This will eliminate the chances of overdriving the TR-7 audio input in these instances.

2-4. FIXED STATION INSTALLATION.

See figures 2-4 and 2-5 for various configurations of TR-7 fixed station installations.

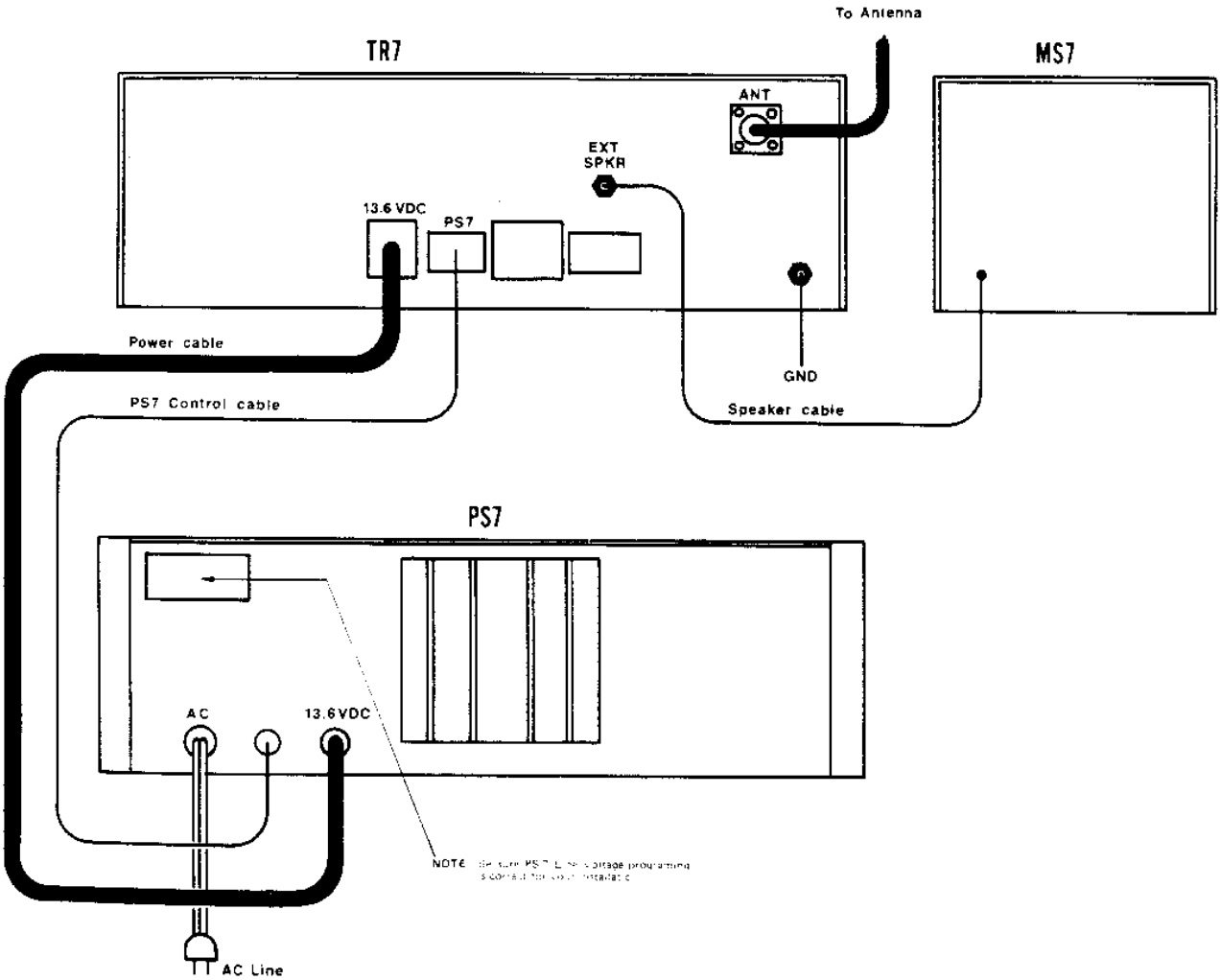


Figure 2-4. Connecting the PS-7 Power Supply and MS-7 Speaker

2-4.1. ANTENNA REQUIREMENTS.

The TR-7 is designed for use with antenna systems having a nominal impedance of 50 ohms. Care should be exercised to reduce the VSWR to the lowest possible value for best operation. If the VSWR exceeds 2:1, the transmitter output power will be reduced in accordance with the table shown in the SPECIFICATIONS section of this manual. When using antennas which do not present a low VSWR, the use of a matching network such as those manufactured by the R. L. Drake Company is recommended. Additional information on antennas can be found in reference texts such as the *ARRL Handbook*.

2-4.2. POWER REQUIREMENTS.

CAUTION

Operation of the TR-7 with an incorrect power source will result in serious damage and may void the warranty.

The PS-7 A.C. Power Supply is recommended for fixed station operation. It is designed to accommodate all operating requirements presented by the TR-7, and provides automatic overvoltage and overcurrent protection. See figure 2-4 for interconnection details.

For general information regarding power sources other than the PS-7, see section 2-3.2 of this manual.

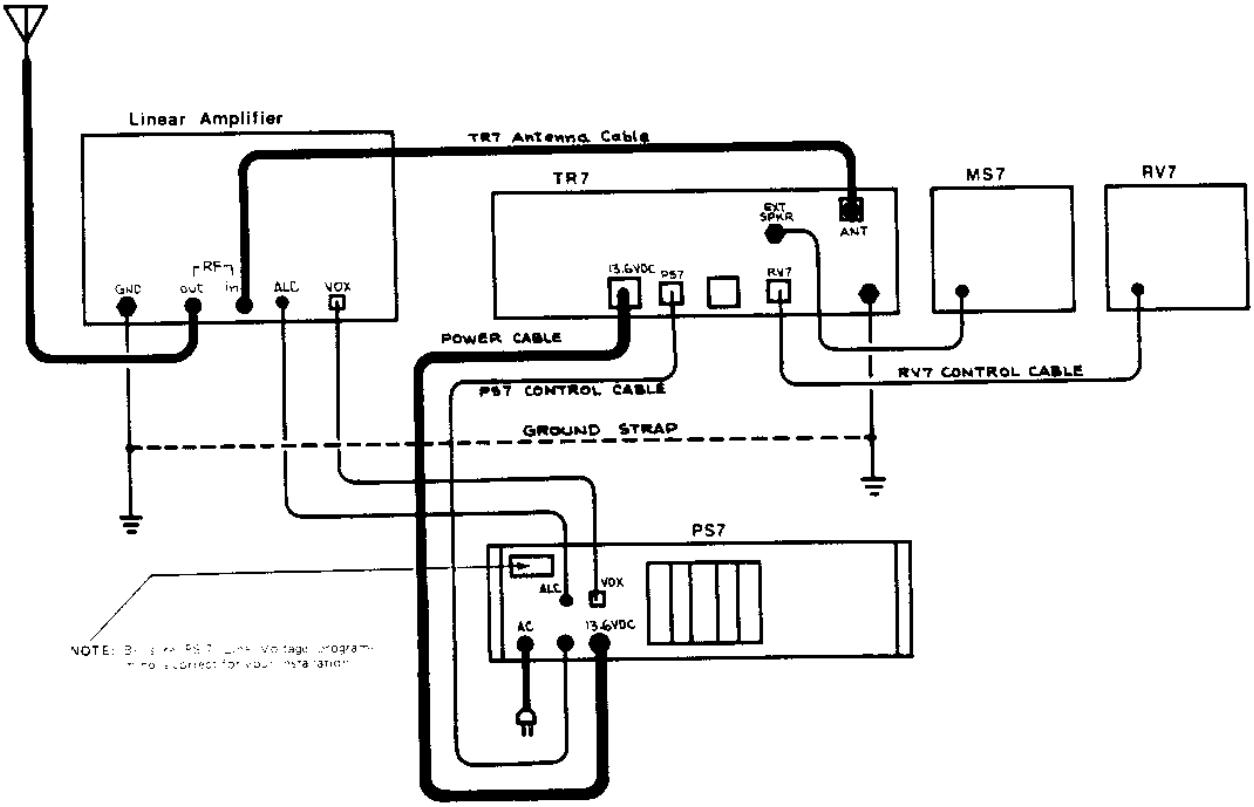


Figure 2-5. Connecting the RV-7 Remote VFO and a Linear Amplifier

2-4.3. MICROPHONE REQUIREMENTS.

The R. L. Drake Model 7077 Desk Microphone is recommended for use in fixed station applications. The unit is supplied wired with a mating connector for the TR-7.

The front panel MIC connector has been wired to accommodate two types of microphones. For use with a low output dynamic microphone the connections should be made as shown in figure 2-3 of this manual. For a high output, high impedance crystal or ceramic microphone, such as the Astatic Model D-104, the microphone audio should be wired to pin 4 of the connector instead of pin 1. Pin 4 presents an input impedance of approximately 750 K ohms, and is 8 dB less sensitive than the pin 1 input.

2-4.4. EXTERNAL SPEAKER REQUIREMENTS.

The TR-7 contains a built-in speaker; however, this speaker is located on the left-hand side of the radio. In many installations where the TR-7 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 4 ohm speaker, capable of handling at least 2 watts of audio. The internal TR-7 speaker is automatically disabled when an external speaker is connected.

2-4.5. VIEWING ANGLE.

Refer to figure 2-6 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 TR-7. Reinstall the cover by reversing this process.

CAUTION

Be sure that all power is removed before attempting any disassembly of the TR-7. Potentially lethal voltages are exposed when the covers are removed. It is suggested that all accessories be unplugged from the TR-7 before attempting to remove the covers.

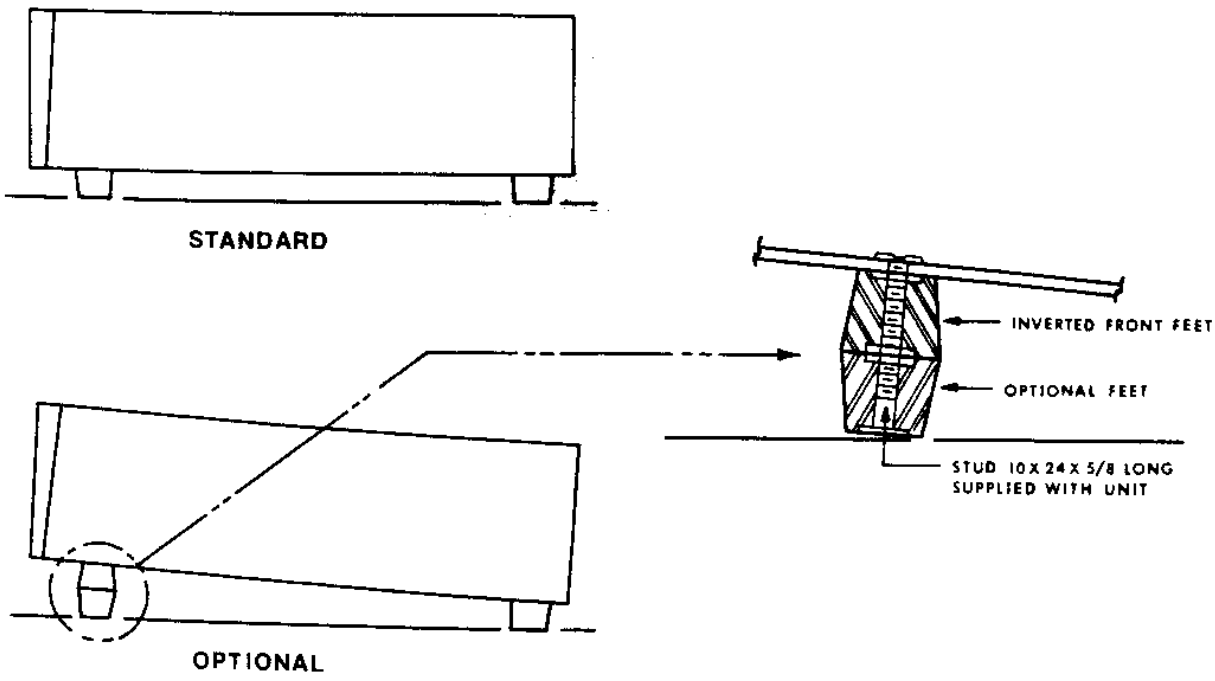


Figure 2-6. Viewing Angle Options

3-1. FRONT PANEL CONTROLS AND CONNECTIONS.

The following paragraphs describe all front panel controls and connections. Refer to figure 3-1 for the location of individual controls.

A. METER — Indicates relative level of received signals in receive mode. Indicates forward or reflected power output in transmit mode.

TR-7 'S' meter readings may not agree with other receivers due to differences in overall gain distribution. Such discrepancies are not indicative of relative sensitivity.

B. STATUS INDICATORS —

1. Fixed — Indicates fixed transmit and/or receive mode has been selected.
2. Set Band — Indicates the need to set the bandswitch to the proper range when using AUX-7 accessory.
3. RIT — Indicates that RIT is enabled.
4. PBT — Indicates that the front panel PBT control has control of passband positioning on receive, regardless of position of MODE switch.

C. REF/FWD SWITCH — Controls the meter function in transmit mode. With switch out, meter will read forward power. When switch is depressed, meter indicates reflected power.

NOTE: TR-7 wattmeter readings may not agree precisely with other high quality equipment due to slight non-linearities inherent in the TR-7 meter.

D. PTT/VOX SWITCH — When switch is out, VOX is enabled. Depressing the switch disables the VOX circuitry, leaving PTT enabled.

E. F/S SWITCH — Selects receiver AGC time constants. When switch is out, a slow decay time is selected. Depressing the switch selects a fast decay time. Additional AGC time constant tailoring is accomplished by the MODE switch, V.

F. & G. FIXED/VFO SWITCHES — Determine the source of frequency control for the TR-7 when the optional AUX-7 is installed and crystals are used for frequency control. Depressing the switches selects transmit or receive crystal control as labelled. In the out position, the transceiver reverts to VFO control.

NOTE: If crystals are not installed, or the AUX-7 is not installed, these switches must be in the out position for proper TR-7 operation.

H. PBT SWITCH — Selects the front panel receiver passband tuning control in the depressed position. In the out position, the transceiver passband tuning is internally controlled in conjunction with the MODE switch.

I & J NOTE: Neither UP or DOWN frequency control is enabled until after a preset delay time of 15-20 seconds each time power is initiated to the radio.

I. UP CONTROL — Each time this momentary contact pushbutton is depressed, the TR-7 operating frequency will increase 500 kHz. This action will continue until the upper limit of the selected band range (yellow numbers on BAND switch, Z) is reached, at which point the bandswitch must be reset to allow further increase. Transmission is automatically inhibited in any 500 kHz range which does not contain a legitimate amateur band or which has not been programmed for transmit by the optional AUX-7.

J. DOWN CONTROL — Operation is exactly the same as the UP control (I.), except that the operating frequency is decreased 500 kHz for each switch actuation.

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.

L. FREQUENCY READOUT — Presents a digital display of operating frequency to the nearest 100 Hz when the rear panel counter switch is in the NORM position. When the rear panel switch is in the EXT position, the display reads the frequency (150 MHz maximum) of a signal source connected to the rear panel COUNTER jack. For frequencies over 100 MHz, the hundred MHz digit is implied; i.e.: 146.9400 MHz will be displayed as 46940.0.

Operation

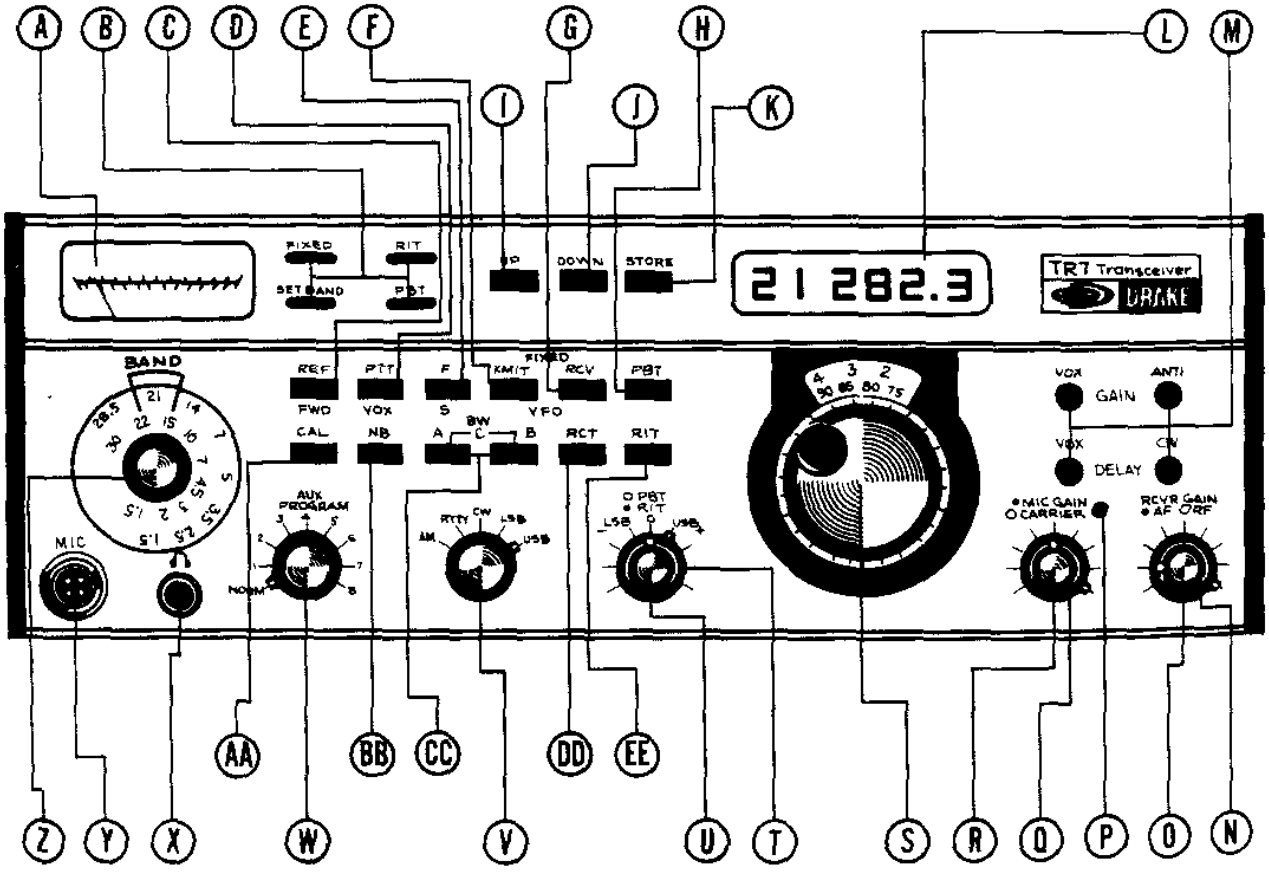


Figure 3-1. Front Panel Controls and Connections

M. VOX CONTROLS — Four VOX controls are provided on the front panel as follows:
   1. VOX GAIN — Adjusts the gain of the VOX amplifier when the PTT/VOX switch is in the out position (VOX operational).
   2. ANTI GAIN — Adjusts the gain of the ANTIVOX amplifier when the PTT/VOX switch is in the out position (VOX operational).
   3. VOX DELAY — Adjusts the VOX release time in the SSB and AM modes. Release time is variable from 0 to 3 seconds.
   4. CW DELAY — Adjusts the CW Delay release time in the CW mode. Release time is variable from 0 to 3 seconds.

N. R. F. 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 TR-7.

P. ALC INDICATOR — This green LED indicates that the transmitter ALC is controlling the output power. It is used to set up proper audio gain and carrier levels in the transmit mode.

Q. CARRIER CONTROL — Sets the carrier level in the CW and AM modes. Clockwise rotation increases the carrier level. It is deactivated in the SSB and RTTY modes.

R. MIC. GAIN — Adjusts the microphone gain in AM and SSB. Does not affect VOX settings.

S. TUNING DIAL — Adjusts frequency of transceiver. See section 3-3 of this manual for detailed description of dial readings.

T. PBT CONTROL — Shifts the receiver IF and BFO together, 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. When using accessory crystal filters, it may be desirable to use this control to reposition the receiver passband for the most pleasing receiver audio response.

U. RITCONTROL — When the RIT switch (EE) is depressed, this control allows the receiver frequency to be varied over a nominal ±3 kHz range without affecting the transmit frequency.

V. MODE SWITCH — Selects the desired mode of operation.

W. AUX PROGRAM SWITCH — Selects the desired auxiliary 500 kHz range and/or fixed frequency crystal when the AUX-7 accessory is installed.

NOTE: This control should remain in the NORM position if the AUX-7 is not installed.

X. (HEADPHONES) — Provides a connection for headphones. Internal or external speaker is muted when this jack is used.*

Y. MIC. JACK — Provides a connection for microphone or other transmitter audio source.

Z. 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 pushbuttons (I & J).

AA. 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.

BB. NB SWITCH — Enables the optional NB-7 noise blanker.

CC. BW SWITCHES — Select one of four crystal filters when the optional filters are installed as follows:

Switch A	Switch B	Filter Selected
Out	Out	2.3 kHz (Standard)
In	Out	A
Out	In	B
In	In	C

NOTE: The receiver will be inoperative in any BW position which does not have a filter.

DD. RCT SWITCH — Selects a remote transmitter frequency control source. Normally left in the out position.

EE. RIT SWITCH — Enables the front panel RIT control.

* If low impedance headphones are used, a 100 ohm resistor should be installed in series with the phones.

3-2. REAR PANEL CONTROLS AND CONNECTIONS.

A. FAN – 120 VAC outlet for use with Model 1529 FA-7 Fan accessory. Switched by front panel on/off switch when using the PS-7 AC Supply.

B. COUNTER FUNCTION – Switch selects between normal and external modes. External mode converts the display to a 150 MHz frequency counter. Apply the signal to be measured to the indicated jack. Counter sensitivity is 50 mV, and maximum input is 2 V. This feature is useful for accurately setting the frequency of two-meter crystal controlled radios.

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 0.1 volt at high impedance.

D. EXTERNAL ANTENNA – This jack is normally internally jumpered to the EXTERNAL RECEIVER jack. If a separate receiver antenna is desired, it should be connected to this jack and the internal jumper should be removed. Reverse this process to restore normal operation.

E. EXTERNAL RECEIVER – This jack is normally internally jumpered to the EXTERNAL ANTENNA jack. If a separate receiver is used with the TR-7, the separate receiver antenna terminals should be connected to this jack and the internal jumper removed. Due to the transmit/receive switching configuration necessary for proper operation of the TR-7, the EXTERNAL RECEIVER jack connects to the main antenna through the low-pass filter module (see figure 4-1). Because of this requirement, the operating frequency of the external receiver must be below the upper end of the operating range indicated in yellow numbers on the TR-7 bandswitch.

Reconnect the internal jumper to restore the TR-7 receiver to normal operation.

An external receiver may be muted during transmit by connecting the receiver mute line to pin 11 of the ACCESSORIES connector. Note that this line is grounded in receive and open in transmit; check to be sure that the receiver in use is compatible with such a connection. All receivers manufactured by the R. L. Drake Company can utilize this muting connection.

F. KEY – Connection for key or keyer for CW use. Keyer should be capable of handling a *positive* keyline voltage of 10 VDC @ 1ma. Keyers designed for grid-block keying (negative voltage) will not provide proper operation. Plug should be wired so that the insulated tip is positive and the sleeve is ground.

G. EXTERNAL SPEAKER – Connection for an external 4 ohm speaker rated at 2 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.'

H. ANTENNA – Accepts standard PL-259 coax fitting for connection of main antenna to the TR-7.

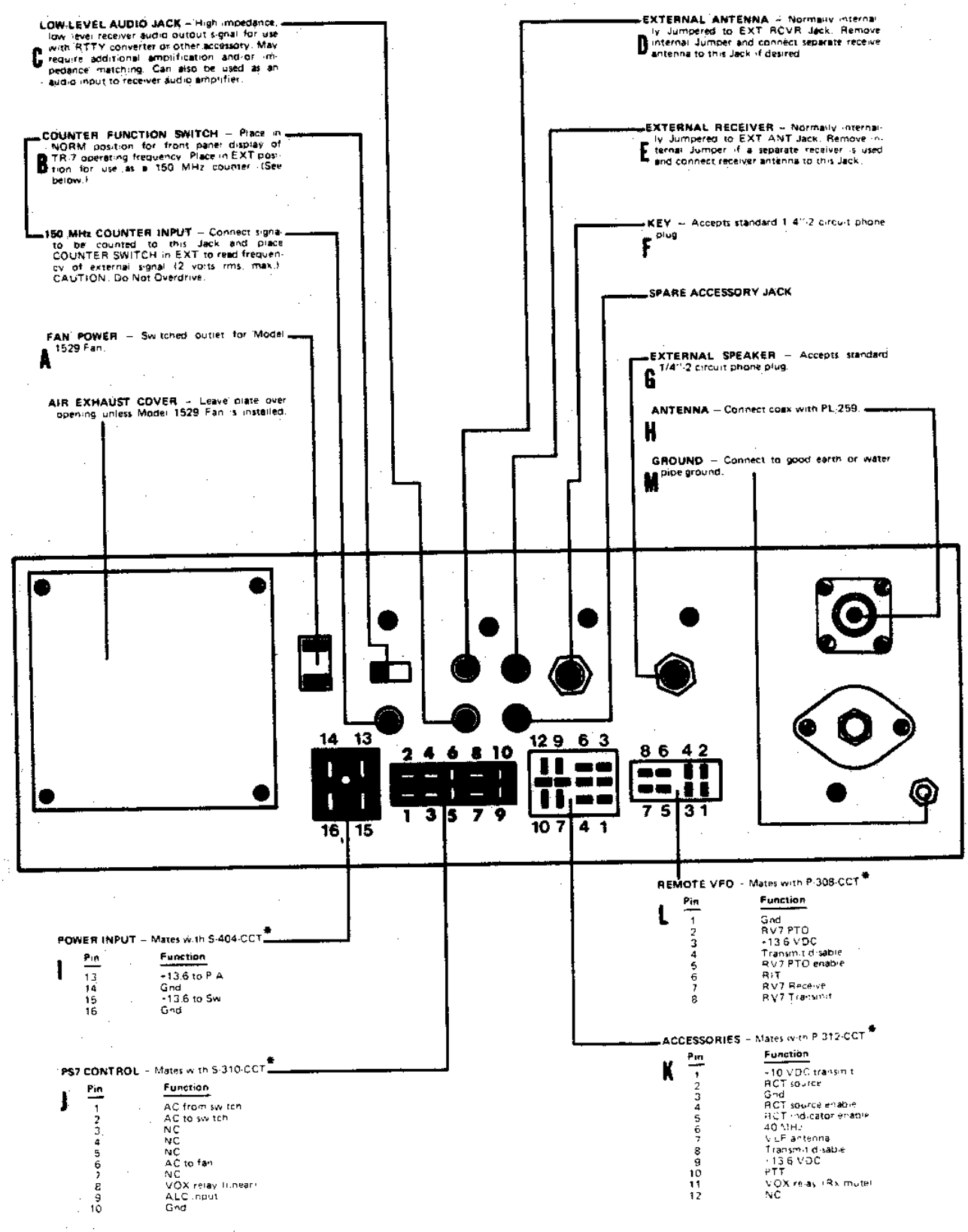
I. POWER INPUT – Mates with a S-404-CCT socket. See figure 2-1 for power connections.

J. PS-7 CONTROL – Mates with a S-310-CCT socket. VOX relay and linear amplifier ALC signals are available at this connector for use with accessories. When using the TR-7 with a PS-7, these signals are available on the rear of the PS-7.

K. ACCESSORIES – Mates with a P-312-CCT plug. This connector provides for a wide range of accessory interconnections.

L. RV-7 – Mates with a P-308-CCT plug. Provides all power, signal and control lines for the RV-7 Remote VFO.

M. GROUND – Connect to a good earth or water pipe ground to insure proper operation of the TR-7.



*CINCH JONES (or equiv.)

Figure 3-2. Rear Panel Controls and Connections

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 TR-7.

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

A. Depress the CAL switch (calibrator on).

B. Rotate the tuning knob to the nearest 25 kHz increment (0, 25, 50, or 75).

C. Hold the knob skirt stationary and rotate the knob until the calibrator signal is zero beat.

D. Turn off the calibrator.

3-4. GENERAL OPERATIONAL INFORMATION.

Because of the broadband design of the TR-7, there is no 'tune-up' required. It is desirable, however, that the load presented by the antenna be between 25 and 100 ohms (2:1 VSWR or less). If this is not the case, an antenna tuner can be used to provide the proper match.

In order to provide a carrier output to check VSWR or to adjust an antenna tuner, preset the front panel controls as follows:

MODE:	CW
BAND:	On Desired Range
TUNING:	Set to Desired Frequency
CARRIER:	Fully Counterclockwise
CW DELAY:	Fully Counterclockwise
AF GAIN:	Power On
REF FWD SWITCH:	Out (FWD)

Plug a key into the rear panel key jack. Close the key and increase the carrier control to get a full scale deflection on the VSWR meter of the antenna tuner or wattmeter. If an external meter is not available, set the carrier control for 10-20 watts output on the TR-7 meter. Follow the manufacturers instructions for adjusting the antenna tuner

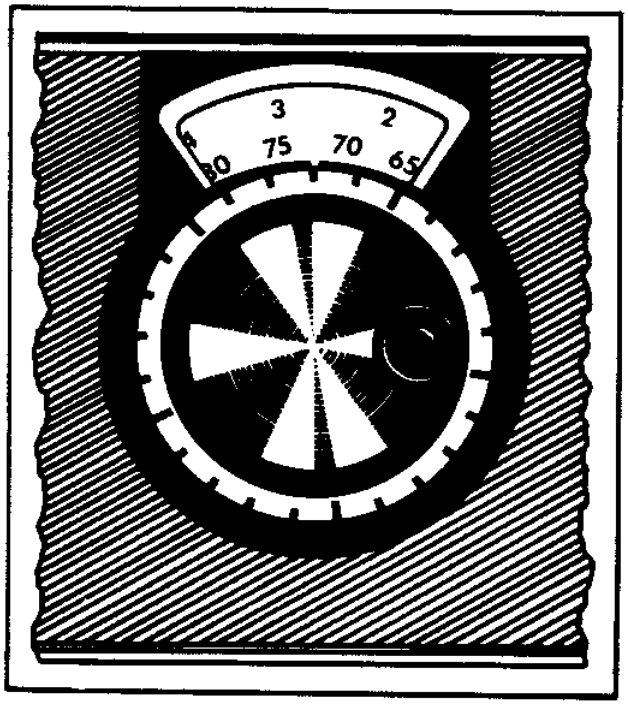


Figure 3-3. Main Tuning Dial

for minimim VSWR. Again, if an external meter is not available, depress the REF/FWD switch to read reflected power on the TR-7 meter. Be sure to observe the 5 minute maximum key-down time to avoid overheating the TR-7 power amplifier.

Once the antenna or tuner has been adjusted at reduced power, increase the carrier level until the green ALC light comes on. Proceed to optimize antenna and/or tuner adjustments, again observing maximum key-down limitations.

If a key is not available for these adjustments, a shorted plug may be inserted in the key jack. If this is done, the TR-7 can be switched from trans-

mit to receive by switching the mode switch from CW to any other mode.

The ALC system in the TR-7 is operative in all modes, and senses both forward and reflected power. As antenna line VSWR increases, the ALC will decrease the power input to the power amplifier to protect the output transistors. Thus, with high VSWR, the ALC indicator will light at lower power outputs, indicating that this circuit is working.

Transmission is inhibited if the TR-7 is not tuned to the correct band or the synthesizer becomes unlocked. In the event that the radio will not transmit, check to be sure that the frequency is correct, that the FIXED and RCT switches are in the out position, and that the AUX PROGRAM switch is in the correct position.

The PBT (Passband Tuning) control may be adjusted to emphasize low or high frequencies on a received signal. The adjustment of this control is largely one of operator preference, and the setting should be the one which produces the most pleasing audio response or minimum interference. When accessory crystal filters are in use, the PBT control can be used to place the receiver passband in the most advantageous position for interference rejection. Note that the setting of the PBT control has no effect on transmitter operation, since the transmitter passband is automatically selected by the MODE switch.

3-5. SSB OPERATION.

In the following discussion, it is assumed that the TR-7 has been matched to the antenna on the desired band as described in paragraph 3-4.

For single sideband operation of the TR-7, preset the front panel controls as follows:

MODE:	On Desired Sideband
BAND:	On Desired Range
TUNING:	Set to Desired Frequency
MIC. GAIN:	Fully Counterclockwise
RF GAIN:	Fully Clockwise
AF GAIN:	Fully Counterclockwise (do not turn off power)
VOX GAIN:	Fully Counterclockwise
ANTI-VOX:	Fully Counterclockwise
VOX DELAY:	Fully Counterclockwise
VOX/PTT SWITCH:	Out (VOX)

While speaking into the microphone in a normal voice, increase the VOX gain control until the TR-7 relay pulls in reliably with speech. Increase the VOX delay control for the desired drop out time. Increase the AF GAIN control until received signals are of the desired level. This may cause the transceiver to cycle back and forth between transmit and receive. Adjust the ANTI-VOX control until the cycling stops. The use of a microphone with a directional pick-up pattern will help to reduce undesired VOX tripping.

Again, speak into the microphone in a normal voice and increase the MIC GAIN control until the green ALC indicator comes on. Additional increase of the MIC GAIN control will not increase power output, and may result in distortion of the transmitted signal. If VOX operation is not desired, depress the VOX/PTT switch and use the PTT switch on the microphone for transmit/receive control.

On SSB, the TR-7 transmits on exactly the same frequency on which it receives (RIT off). Therefore, be sure that you have the signals tuned in so that voices sound normal before transmitting. Otherwise, you will not be transmitting exactly on frequency. Once contact has been established, the RIT control can be enabled and used for minor receive frequency corrections. The digital readout will show the operating frequency on both receive and transmit, thus indicating when reception and transmission are on different frequencies.

3-6. CW OPERATION.

To operate CW, connect a key to the KEY jack. If an electronic keyer is used, connect it for cathode keying; i.e., a *positive* keyline voltage. Wire the keyer plug so that the tip of the plug is 'hot.' Leave the key in the open condition. The TR-7 uses shifted carrier CW. With this system, it is possible to transmit on the received station's frequency without being zero beat while receiving. The transmit frequency is shifted from the receive frequency by approximately 800 Hz. The frequency display reads the correct frequency of a receive signal when the signal is tuned for zero beat.

To receive CW signals, place the MODE switch in the CW position. Tune in a CW signal for an audio pitch of about 800 Hz and adjust the AF GAIN control for a comfortable listening level. If PBT control is in use, it must be positioned in the USB area for on frequency transceive operation.

To transmit, close the key and adjust the CARRIER control until the green ALC indicator comes on. Increasing the CARRIER control further will not increase power output, and may result in undesirable keying characteristics. The CW sidetone level is adjustable with the front panel AF GAIN control.

The TR-7 uses automatic transmit/receive switching. This means that it will automatically transmit when the key is depressed and return to the receive condition when the key is released. The delay time from transmit to receive is adjustable with the front panel CW DELAY control. At minimum delay, the TR-7 allows break-in operation between words at keying speeds up to 20 wpm. Maximum delay is approximately 3 seconds.

Manual transmit/receive switching in the CW mode can be accomplished by connecting an external switch to the push-to-talk circuit of the MIC jack or to pin 10 of the rear panel ACCESSORIES connector.

3-7. AM OPERATION.

For AM operation, place the MODE switch in the AM position. Tune in AM signals for most pleasing audio. This will not necessarily coincide with maximum S-meter reading, particularly when using crystal filters narrower than the accessory 6 kHz filter. To transmit, depress the microphone push-to-talk switch and adjust the CARRIER control for a forward wattmeter reading of 1/3 the output available in the CW mode. For example, if the maximum available output in CW is 150 watts, the CARRIER control should be set for 50 watts output in the AM mode. After setting the carrier level, increase the MIC GAIN while speaking into the microphone. The MIC GAIN should be set at the point where normal speech causes the green ALC indicator to be on. Additional increase in the MIC GAIN setting will result in distortion, so care should be used when making this adjustment. Also, excessive carrier level settings will result in a low percentage of modulation due to the ALC action of the TR-7.

Note that the TR-7 operates in A-3H in AM transmit. This means that only one sideband (the upper) is transmitted with the carrier. This system is fully compatible with all AM receivers, but SSB receivers must be used on USB to properly detect the TR-7 AM transmit signal.

3-8. RTTY OPERATION.

For RTTY operation, place the MODE switch in the RTTY position. The transceiver passband is automatically set to LSB for standard mark-space tones of 2125 and 2295 Hz (narrow shift) and 2125 and 2975 Hz (wide shift) in the RTTY mode. Receive audio for the terminal unit can be taken from the external speaker jack or the rear panel AUDIO connector. If the AUDIO connector is used, care must be taken to provide a high impedance load capable of operation with a 0.1 volt signal.

In transmit, an AFSK signal should be connected to the MIC connector, and the push-to-talk line used to key the transceiver. The VOX circuitry is disabled in the RTTY mode. Adjust the gain controls as described for SSB operation. Care should be taken to observe the maximum transmission time (5 minutes) limit. The model 1529 FA-7 fan accessory is recommended if long RTTY transmissions are contemplated.

3-9. OPERATION NEAR BAND EDGES.

When operating near the edge of an amateur band, be sure that the entire transmitted signal is within the band. On SSB, be sure to use the sideband that will be away from the band edge. On CW, the transmitted carrier will be approximately 800 Hz higher than the indicated dial frequency when the received signal is tuned for zero beat. On AM, the transmitted signal will be as wide as the highest modulating frequency (approximately 3 kHz). The RTTY mode places the mark-space tones on the *lower* side of the carrier (dial) frequency.

3-10. OPERATION WITH A LINEAR AMPLIFIER.

The TR-7 has sufficient output power to drive most linear amplifiers. However, since the TR-7 is

rated at 250 watts PEP input, it is doubtful that it would be worthwhile to use a linear amplifier with a power input rating of less than 1000 to 2000 watts PEP. A triode type grounded grid linear amplifier will present a satisfactory load to the TR-7. See figure 2-5 for typical interconnections.

If the linear amplifier is of the grounded cathode type with high impedance and/or high sensitivity input, it will be necessary to install a resistive pad between the TR-7 and the amplifier input that will present a 50 ohm load impedance to the TR-7. Such a pad must have adequate power handling capability.

Operation in the various modes is exactly as described in previous sections. Follow the instructions provided with the amplifier for tune-up. Care should be taken to avoid overdriving the linear amplifier. If the amplifier has an ALC output, it can be connected to the ALC input on the PS-7 rear panel to prevent overdrive, *provided that the amplifier in use generates a negative ALC voltage.*

The amplifier relay control line should be plugged into the indicated connector on the PS-7. Be sure to observe polarity when connecting the linear amplifier relay control line. Note that one side of this line is ground; if the linear in use requires an isolated set of relay contacts, a separate relay will be required.

NOTE

Be sure that your amplifier presents a 50 ohm characteristic in the standby or bypass mode to avoid activating the VSWR protection circuitry in the TR-7 when operating low power.

3-11. RECEPTION BELOW 1.5 MHz.

The optional AUX-7 Program Board will allow reception over the 0-1.5 MHz range when programmed with RRM-7 Range Receive Modules. Since the filters in the antenna input of the TR-7 cut off below 1.5 MHz, the rear panel ANTENNA connector will not provide satisfactory operation in this range.

A separate VLF antenna input is provided on the rear panel ACCESSORIES connector for reception below 1.5 MHz (See figure 3-2). This input bypasses the built-in antenna line filters. A long wire or similar antenna connected to this input will provide satisfactory operation in this range, although receiver sensitivity will be somewhat degraded.

CAUTION

Any antenna connected to the VLF antenna input of the TR-7 must be removed before attempting to transmit. In addition, an antenna connected to the VLF input will degrade receiver performance above 1.5 MHz.

Theory of Operation

The theory of operation of the TR-7 is discussed in the following paragraphs. Refer to figure 4-1, TR-7 Block Diagram, (foldout from pg. 4-5), for aid in following this discussion. The discussion is divided into three sections (receiver, transmitter, and frequency control) for clarity.

4-1. RECEIVER SECTION.

Incoming signals from the antenna pass through a bandswitched low-pass filter module, the transmit/receive antenna switching, and a bandswitched high-pass filter module. These filters create an input bandpass filter, the limits of which are defined by the yellow numerals on the front panel BAND switch. A separate receiver and/or receive antenna can be connected in this path by removing the jumper between the EXT RCVR and EXT ANT jacks on the rear panel and making the appropriate connections.

The output of the high-pass filter is connected to the input of the Up-Converter module, along with the VLF antenna input and the 25 kHz calibrator output. The VLF antenna is connected through a 20 dB attenuator due to the fact that the input antenna filters are bypassed by this input. 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 ±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. 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 acessory NB-7 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 NB-7 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 3 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 transceiver 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 demodulates it 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 MODE switch and front panel F.S switch.

4-2. TRANSMITTER SECTION.

In the transmit mode, audio signals from the MIC jack are applied to the Transmit Exciter module, where they are amplified and used to drive the balanced modulator and VOX circuits. The VOX section automatically controls the transmit/receive switching in the AM and SSB modes. A push-to-talk (PTT) input is also provided for manual control.

The 5.645 MHz double sideband output of the balanced modulator is routed through the Noise Blanker module to the IF Selectivity module. The signal is passed straight through the noise blanker for interconnection purposes only. The IF selectivity module rejects the undesired sideband, using the 2.3 kHz crystal filter. This is accomplished by correct positioning of the double sideband signal relative to the crystal filter.

The 5.645 MHz single sideband signal from the IF Selectivity module is connected to a summing amplifier on the 2nd IF module. In the SSB and RTTY modes, the signal is passed through to a variable attenuator. In the AM mode, the signal is summed with the BFO signal to create an AM signal before being passed to the variable attenuator. In the CW mode, the balanced modulator is disabled, and a **5.6458** MHz crystal oscillator is keyed to create an offset CW signal for application to the variable attenuator.

The variable attenuator consists of a PIN diode which is controlled by the ALC circuitry. The outputs of the forward and reflected wattmeter and the CARRIER control are connected to the ALC module. These signals are summed to create a controlling signal for the attenuator, thus controlling the transmitter drive level. VSWR protection is accomplished in this manner, as well as providing gain control to prevent flat topping and overdrive.

The 5.645 MHz transmit IF signal developed in the 2nd IF module is connected to the 2nd mixer module. The signal is converted to 48.05 MHz and amplified, then routed to the Up-Converter module.

In the Up-Converter module, the transmit signal is filtered by the 4-pole 48.05 MHz crystal filter to remove any spurious content, amplified, and converted to the operating frequency by mixing it with the output of the synthesizer VCO.

The output of the Up-Converter module is filtered by the high-pass filter module, and routed through the transmit/receive switching to the Power Amplifier module, where it is amplified to the final output level. The signal is then routed by the transmit/receive switching to the low-pass filter module to attenute the harmonics developed in the power amplifier. The transmit signal then passes through the wattmeter to the antenna jack.

4-3. FREQUENCY CONTROL.

The TR-7 features synthesizer control of the operating frequency. This allows the transceiver 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 controls are connected to a 13.695 MHz voltage-controlled crystal oscillator (VCXO) through a switching circuit. Control of this oscillator is thus switched between the front panel PBT control and the internal controls which are selected by the MODE switch. Although this oscillator is crystal controlled, it is designed to allow the frequency to be moved over a limited range (approximately ±3 kHz) centered on 13.695 MHz. This signal is then mixed with the 40 MHz crystal oscillator signal to produce 53.695 MHz, and with an 8.05 MHz crystal oscillator to produce 5.645 MHz.

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 5.645 MHz signal is used as a BFO signal for the generation and demodulation of SSB, CW, and RTTY signals. 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 BFO 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 ±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 in addition to sideband selection.

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

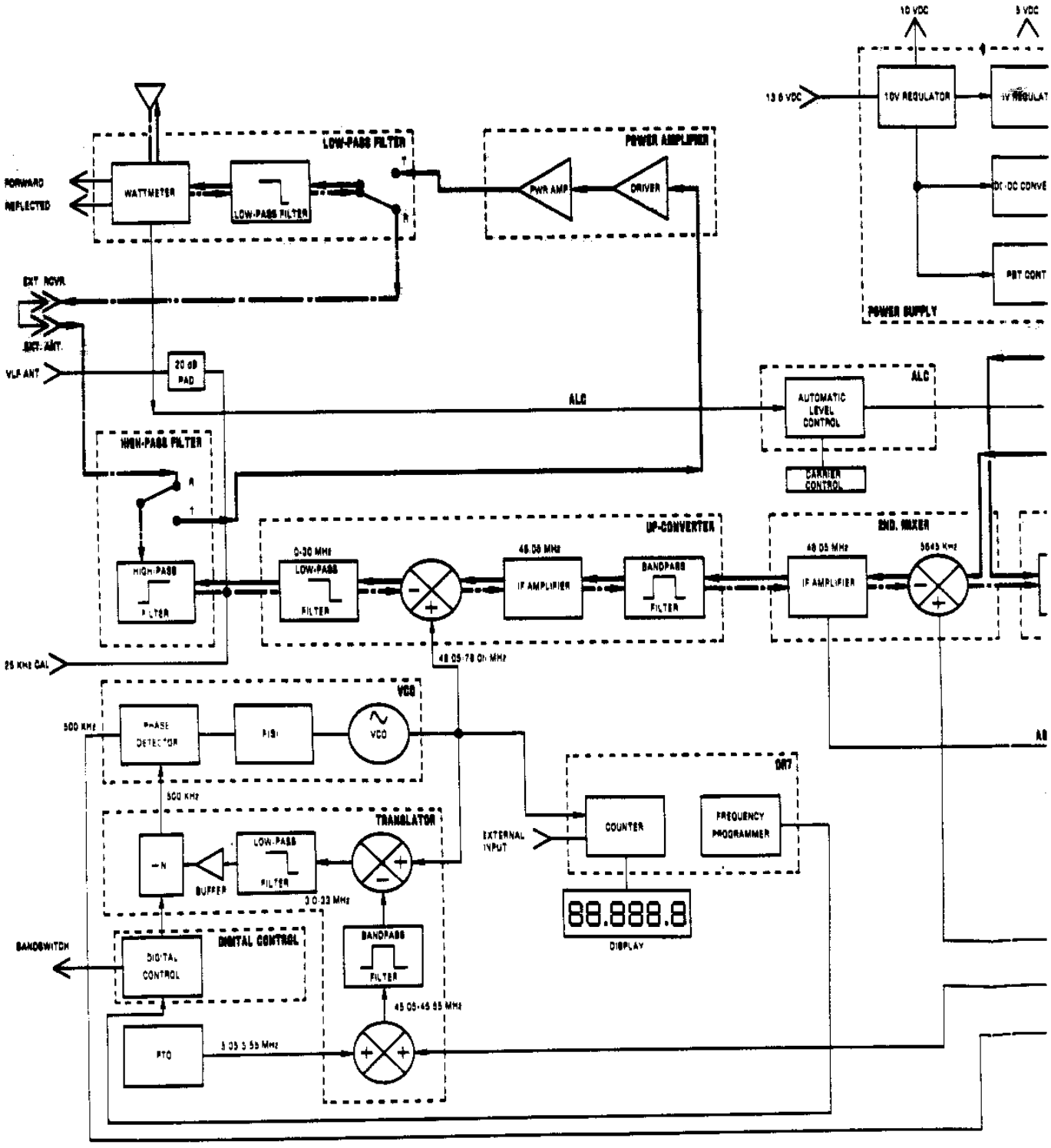
The Digital Control module generates programming information for the ÷ N by processing information from both the BAND switch and the frequency programmer on the DR-7 display module. The BAND switch information generates the proper ÷ N load number for the frequency range indicated by the white bandswitch 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
÷ N Input Frequency:	
62.3335 MHz -45.3335 MHz =	17 MHz
÷ N Output:	.5 MHz
(Load number = 34)	

It can be seen from the above that each time the ÷ 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 a locked condition. By the same token, as the PTO is tuned, the VCO must follow exactly to 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 external 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.



BLOCK DIAGR
. TRT SIDEBAND

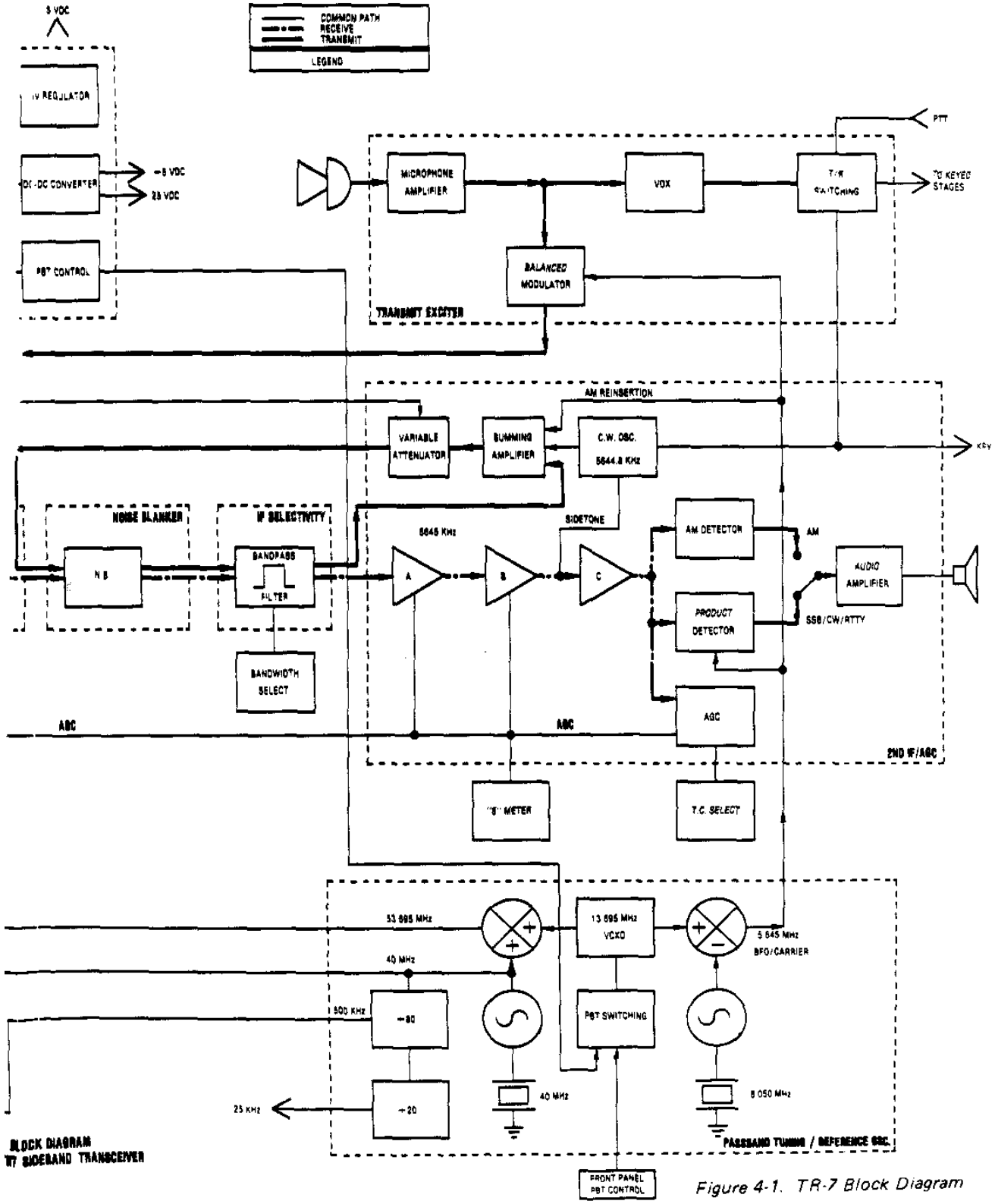


Figure 4-1. TR-7 Block Diagram

Maintenance

5-1. SERVICE INFORMATION.

The TR-7 Transceiver 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 wraparound 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 transceiver is properly interconnected to other equipment.

If problems still 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, Ohio 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 available from either of the above addresses.