



INSTRUCTION MANUAL



MODEL **TR-72**
2 METER FM TRANSCEIVER

Scanned by Loek d'Hont AC5XP



STANDARD WARRANTY

R. L. DRAKE COMPANY warrants each new product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use, and service discloses such defect, provided the unit is delivered by the owner to us or to our authorized dealer or wholesaler from whom purchased, intact, for our examination, with all transportation charges prepaid to our factory, within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective. Should a malfunction be suspected, write in detail to our Service Department for suggestions concerning the operation, repair or return of your unit if it should prove necessary.

This warranty does not extend to any of our products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside our factory, nor in cases where the serial number thereof has been removed, defaced or changed, nor to units used with accessories not manufactured or recommended by us.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

The R. L. DRAKE COMPANY reserves the right to make any improvements to its products which it may deem desirable without obligating itself to install such improvements in its previously manufactured products.



TABLE OF CONTENTS

		Page
CHAPTER I	INTRODUCTION	1-1
1-1.	GENERAL	1-1
1-2.	MANUAL COVERAGE	1-1
	SPECIFICATIONS	1-3
CHAPTER II	INSTALLATION	2-1
2-1.	UNPACKING	2-1
2-2.	MOBILE INSTALLATION	2-1
2-3.	POWER SUPPLY	2-1
2-4.	ANTENNA	2-1
2-5.	STATIONARY INSTALLATION	2-1
2-6.	POWER SUPPLY	2-1
2-7.	ANTENNA	2-1
2-8.	ORDERING AUXILIARY CRYSTALS	2-1
2-9.	AUXILIARY CRYSTAL INSTALLATION	2-2
2-10.	AUXILIARY CONNECTOR	2-3
2-11.	TOUCH TONE® PAD	2-3
CHAPTER III	OPERATION	3-1
3-1.	GENERAL	3-1
3-2.	TYPICAL OPERATING PROCEDURE	3-1
3-3.	FUNCTIONAL CHECKS	3-1
3-4.	CALL CHANNEL	3-1
3-5.	HI/LOW	3-1
	FRONT PANEL CONTROLS.	3-3
CHAPTER IV	THEORY OF OPERATION.	4-1
4-1.	RECEIVER	4-1
4-2.	TRANSMITTER	4-1

TABLE OF CONTENTS (continued)

	Page
CHAPTER V MAINTENANCE	5-1
5-1. SERVICE DATA	5-1
5-2. REPAIR AND REPLACEMENT	5-1
5-3. TEST EQUIPMENT	5-1
5-4. TROUBLESHOOTING	5-1
5-5. RECEIVER ALIGNMENT	5-1
5-6. INJECTION ALIGNMENT	5-1
5-7. HELICAL TUNER ALIGNMENT	5-2
5-8. ALTERNATE METHOD WITHOUT SWEEP GENERATOR	5-2
5-9. FIRST IF ALIGNMENT	5-2
5-10. S METER SENSITIVITY	5-2
5-11. SQUELCH THRESHOLD ADJUSTMENT	5-2
5-12. DETECTOR ALIGNMENT	5-2
5-13. RECEIVE CRYSTAL FREQUENCY ADJUSTMENT	5-2
5-14. TRANSMITTER ALIGNMENT	5-3
5-15. VOLTAGE REGULATOR ADJUSTMENT	5-3
5-16. MULTIPLIER ALIGNMENT	5-3
5-17. POWER ADJUSTMENT	5-3
5-18. S METER CALIBRATION	5-3
5-19. MODULATION ADJUSTMENT	5-3
5-20. LOW POWER ADJUSTMENT	5-3
5-21. PROTECTION CIRCUIT ADJUSTMENT	5-3
5-22. FREQUENCY ALIGNMENT	5-4
TROUBLESHOOTING CHART	5-5

LIST OF ILLUSTRATIONS

Figure		Page
1-1.	TR-72 2 METER TRANSCEIVER	1-2
2-1.	MOBILE MOUNTING OPTIONS	2-3
2-2.	REAR CHASSIS CONNECTORS	2-4
2-3.	RECOMMENDED TOUCH TONE® PAD CONNECTIONS	2-4
3-1.	FRONT PANEL CONTROLS.	3-2
4-1.	TR-72 BLOCK DIAGRAM	4-3
5-1.	TRANSMITTER ALIGNMENT LOCATIONS (TOP)	5-8
5-2.	RECEIVER ALIGNMENT LOCATIONS (BOTTOM)	5-9
5-3.	CONNECTIONS FOR HELICAL TUNER ALIGNMENT.	5-10
5-4.	HELICAL TUNER RESPONSE PATTERN	5-10
5-5.	CONNECTIONS FOR MODULATION ADJUSTMENT	5-10
5-6.	CONNECTIONS FOR PROTECTION CIRCUIT ADJUSTMENT	5-11
5-7.	MICROPHONE CORD CONNECTIONS	5-11
5-8.	TRANSMITTER PRINTED CIRCUIT BOARD	5-12
5-9.	RECEIVER PRINTED CIRCUIT BOARD	5-13
5-10.	TRANSMITTER CRYSTAL BOARD	5-14
5-11.	RECEIVER CRYSTAL BOARD.	5-15
5-12.	POWER AMPLIFIER BOARD	5-16
5-13.	AUTOMATIC PROTECTION CIRCUIT BOARD	5-17
5-14.	MODEL AC-10 POWER SUPPLY SCHEMATIC DIAGRAM	5-19
5-15.	TR-72 TRANSCEIVER SCHEMATIC DIAGRAM	5-19

CHAPTER I

INTRODUCTION

1-1. GENERAL.

The TR-72 2 Meter FM Transceiver is a compact, solid state unit engineered for use in the 2 meter amateur band. It has 23 channel capability (2 supplied) with crystal control for transmit and receive. The Receiver Section has exceptionally steep IF skirt selectivity and front end selectivity to minimize interference problems. The Call channel feature and monitor feature and the availability of connections at the Auxiliary connector on the rear of the unit provide additional convenience and flexibility. A unique mounting arrangement permits its use interchangeably as a mobile station or a fixed station.

1-2. MANUAL COVERAGE.

This manual is arranged in 5 chapters for the convenience of the operator and service technician.

- | | |
|-------------|---|
| Chapter I | Introduction. (Self Explanatory) |
| Chapter II | Installation. Describes the procedures to be followed prior to operation. |
| Chapter III | Operation. Provides operating instructions for optimum performance. |
| Chapter IV | Theory of Operation. Describes all critical circuits and networks. |
| Chapter V | Maintenance. Provides sufficient information for servicing by an experienced electronics technician including component location illustrations, equipment connection drawings for test and alignment, and a complete schematic diagram. |



Figure 1-1. TR-72 2 Meter Transceiver

SPECIFICATIONS

GENERAL:

Frequency Coverage:	144 through 148 MHz. 23 Channels, 2 supplied: (1) Receive: 146.52 MHz Transmit: 146.52 MHz (2) Receive: 146.94 MHz Transmit: 146.34 MHz
Power Requirements:	13.8 Volts DC \pm 15%
Current Drain:	Transmit: 2.7 Amperes High Power 1.2 Amperes Low Power Receive: 0.4 Amperes Squelched
Antenna Impedance:	50 Ohms.
Dimensions:	7-1/16" (180 mm) wide x 2-3/8" (60 mm) high x 9-7/16" (240 mm) deep.
Weight:	5.5 lbs. (2.5 kg)
RECEIVER:	
Sensitivity:	0.35 microvolt for 20 dB quieting (146 through 148 MHz).
IF Selectivity:	20 kHz at 6 dB down; \pm 30 kHz channel rejection greater than 80 dB down.
First IF:	10.7 MHz with 2-pole monolithic crystal filter and ceramic filter.
Second IF:	455 kHz with 11-element ceramic filter.
Image Rejection:	65 dB. Other spurious responses at least 70 dB down.
Intermodulation Response:	At least 70 dB down.
Modulation Acceptance:	\pm 7 kHz.
Audio Output:	At least 1 Watt at less than 10% distortion.
Audio Output Impedance:	8 Ohms.
TRANSMITTER:	
RF Output Power:	10 Watts minimum at 13.8 Volts DC at High Power. Approximately 1 Watt at Low Power (146 through 148 MHz).
Frequency Deviation:	Adjustable to \pm 15 kHz maximum, factory set to \pm 6.5 kHz.
Multiplication:	12 Times.
Spurious Outputs:	At least 60 dB down.

NOTES

CHAPTER II

INSTALLATION

2-1. UNPACKING.

Carefully remove the TR-72 from the shipping carton and examine it for evidence of damage. If any damage is discovered, immediately notify the transportation company that delivered it. Be sure to keep the shipping carton and packing material, as the transportation company will want to examine them. Keeping the carton and packing is recommended in any case, as having these available makes shipping the unit much easier should it ever be necessary to store it or return it to the factory for service. Inspect the packing material before putting it away to be sure you have not overlooked any accessories. A complete list of the accessories furnished with the TR-72 is included in the shipping carton.

NOTE

Fill out the enclosed registration card and return it to the factory immediately to insure registration and validation of the warranty.

2-2. MOBILE INSTALLATION.

Refer to figure 2-1 which illustrates 2 mobile mounting options. The mounting bracket must be mounted securely with the bolts, nuts and washers provided. Secure the TR-72 in the installed mounting bracket as follows:

- a. Release the 2 toggle clamps on the sides of the TR-72.
- b. Slide the TR-72 into the mounting bracket. Make sure that the 2 short guide rails on the sides of the TR-72 engage properly with the slide rails in the bracket.
- c. Tilt the TR-72 to the desired viewing angle (one of four detent positions).
- d. Hook the wire loops on the toggle clamps over the hooks on the mounting bracket slide rails and snap the toggle levers forward. Note that 2 metal loops protrude through the toggle levers when they are snapped forward. They provide a means of locking the unit to prevent tampering.

2-3. POWER SUPPLY.

Refer to figure 2-2. Connect the TR-72 Transceiver to the car battery with the power cord provided: red lead to plus and black lead to minus. An alternate method is through the cigarette lighter using a plug available in any auto supply store.

2-4. ANTENNA.

Install a 50 Ohm mobile antenna following the manufacturer's installation instructions. Connect the antenna to the transceiver with a 50 Ohm coaxial cable.

2-5. STATIONARY INSTALLATION.

Attach the accessory front support wire to elevate the front of the TR-72 when it is used on a table top in a stationary installation. Figure 3-1 shows the front support wire in position.

2-6. POWER SUPPLY.

The R. L. Drake Model AC-10 Power Supply provides the required voltage (13.8 Volts DC) and current (2.7 Amperes) for proper operation of the TR-72 in a stationary installation. See figure 5-14 for the schematic diagram of the AC-10. For price and delivery information, contact your local dealer or write directly to the R. L. Drake Company at the address given in Chapter V.

2-7. ANTENNA.

A 50 Ohm antenna and 50 Ohm coaxial cable connection to the TR-72 are required for operation as a stationary installation.

2-8. ORDERING AUXILIARY CRYSTALS.

Auxiliary crystals for any frequency in the 2 meter band may be installed. For price and delivery information contact your local dealer or write directly to the R. L. Drake Company at the address given in Chapter V.

If crystals are ordered from another source, the following information should accompany the order:

Transmit Crystals:

Parallel Resonant, 36 pf load capacity.

HC-25/U Plug In Holder.

0.002% Frequency Tolerance.

$$\text{Crystal Frequency} = \frac{\text{Operating Frequency}}{12}$$

Receive Crystals:

Parallel Resonant, 32 pf load capacity.

HC-25/U Plug In Holder.

0.002% Frequency Tolerance.

$$\text{Xtal Freq.} = \frac{\text{Oper. Freq. (in MHZ)} - 10.7}{9} \text{MHZ}$$

2-9. AUXILIARY CRYSTAL INSTALLATION.

As shipped from the factory the TR-72 has crystals installed for transmit and receive on Channels 1 and 2. Crystal sockets are provided for 21 additional channels. To install additional crystals proceed as follows:

- a. Remove the top and bottom covers. Each cover is retained by 2 screws at the rear of the unit.
- b. Disconnect the speaker leads from the bottom of the unit.
- c. Refer to figures 5-1 and 5-2. Note that 2 crystals are installed in the second and third sockets in the transmit (top) and receive (bottom) sections. These crystals cover Channels 1 and 2, in that order, from left to right. The remaining 21 sockets in each section correspond to Channels 3 through 23 as selected by the Channel Selector switch on the front panel. One socket on the far left in the transmit and receive sections must remain empty. There are no connections to these 2 sockets.

NOTE

Channel 3 is the Call channel. The crystals for the frequency which is desired for the call channel must be installed in the Channel 3 position.

- d. Install crystals as desired in the appropriate sockets. Each crystal installed must receive a frequency adjustment as outlined in steps e and f below.

NOTE

Frequency adjustments for Channel 3 (Call channel) must be made first with the Call channel disabled (front panel CALL lamp off) and the Channel Selector set to 3. After adjustments for transmit and receive crystals have been made as described in steps e and f, push the CALL CH button on the front panel (CALL lamp will light) and repeat steps e and f except: adjust trimmers labeled Call Channel Trimmers on figure 5-1.

- e. Transmit crystals should be adjusted with a Frequency Counter and a Dummy Load as follows:
 1. Set Channel Selector to desired channel.
 2. Connect the Dummy Load to the TR-72 Antenna connector.
 3. Inductively couple the Frequency Counter input cable through 2 or 3 turns of a coil wound around the Dummy Load cable.
 4. Refer to figure 5-1. Adjust the crystal's associated trimmer until the counter displays the correct channel frequency when the transmitter is keyed.
- f. Receive crystals should be adjusted with a Frequency Counter as follows:
 1. Set Channel Selector to desired channel.
 2. Refer to figure 5-2. Connect the Counter to the terminal labeled ADJ on the Receiver PC Board.
 3. Adjust the crystal's associated trimmer until the Counter displays the correct channel frequency less 10.7 MHz.
- g. If a transmitter known to be on frequency is received, an alternate method of adjusting the receive crystals is as follows:
 1. Use a VTVM or VOM on the lowest voltage range for this adjustment.

2. Set the Channel Selector to the channel to be adjusted.
3. Connect the Voltmeter to test point CM on the receiver board (see figure 5-2) or to pin 9 on the Auxiliary connector.
4. Adjust the proper trimmer for zero volts on the Voltmeter.

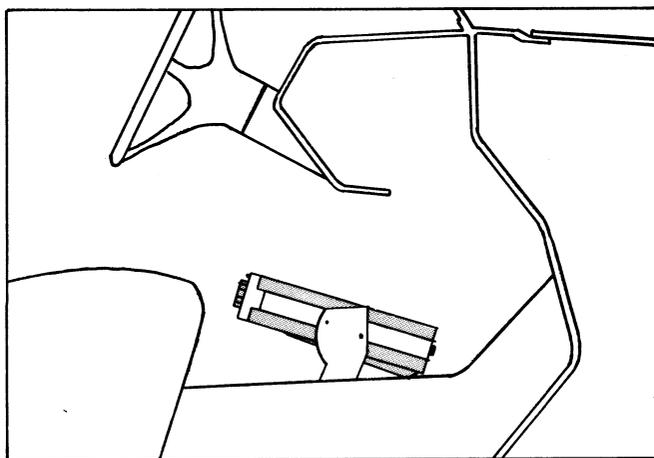
2-10. AUXILIARY CONNECTOR.

Refer to the schematic diagram figure 5-15. The

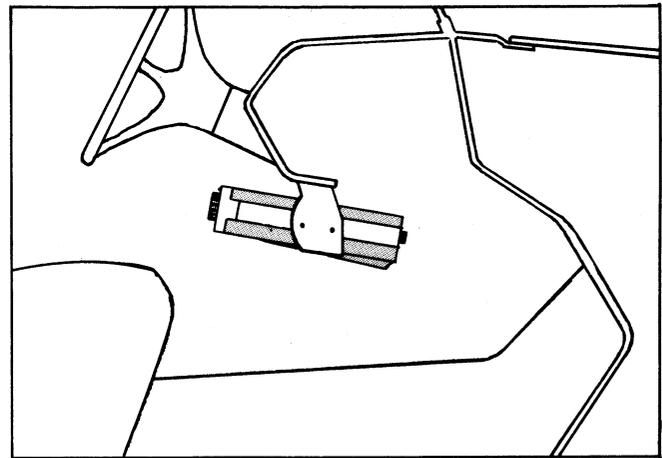
Auxiliary connector may be used to make any of the connections shown on the insert in the lower left hand corner of the schematic.

2-11. TOUCH TONE® PAD.

Figure 2-3 illustrates the network recommended for use with a Touch Tone® Pad.



OPTION A



OPTION B

Figure 2-1. Mobile Mounting Options

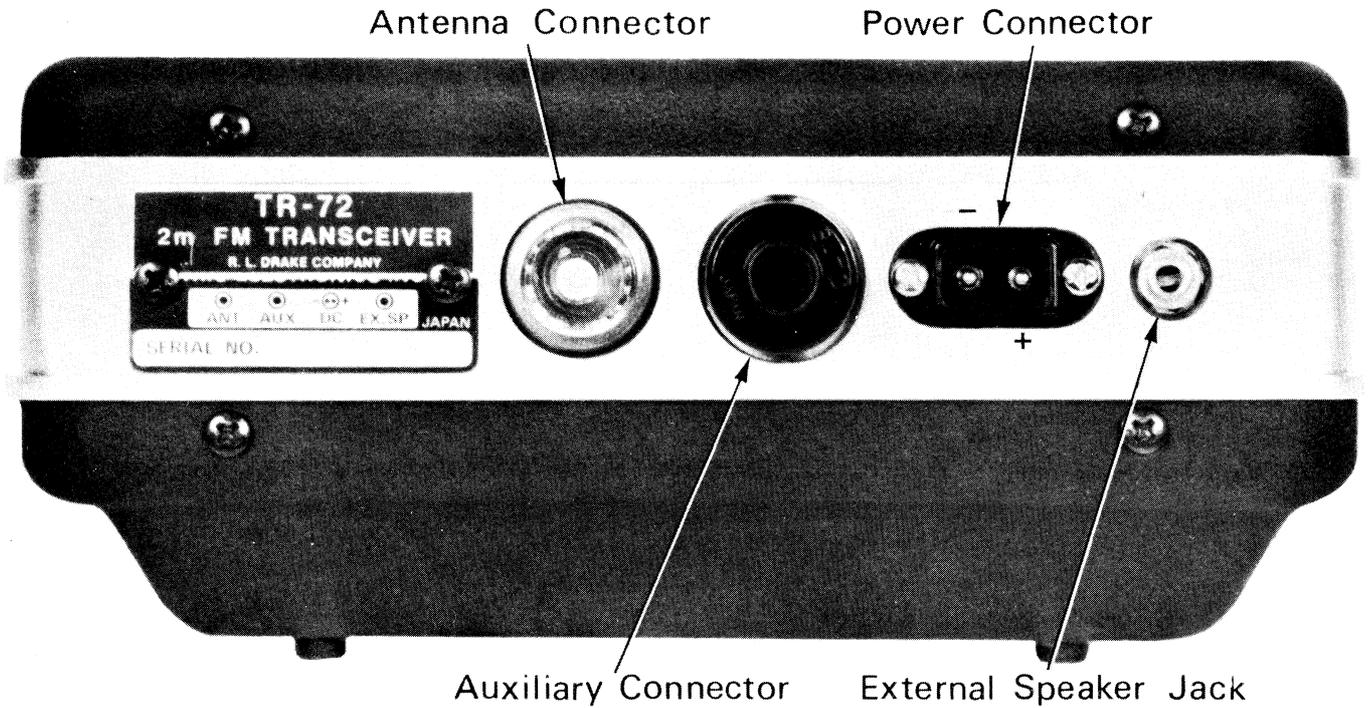
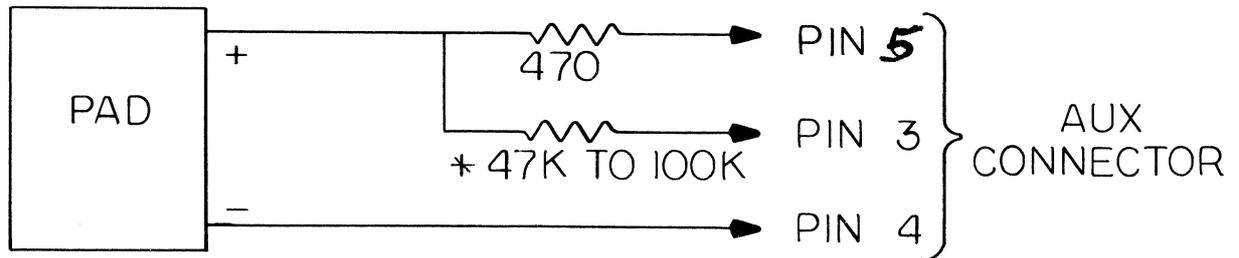


Figure 2-2. Rear Chassis Connectors



* SELECT FOR PROPER
DEVIATION LEVEL

Figure 2-3. Recommended Touch Tone® Pad Connections

CHAPTER III OPERATION

3-1. GENERAL.

Refer to figure 3-1 for a description of the front panel controls. The unit must be installed as described in Chapter II to insure proper operation.

CAUTION

Do not set the unit to the transmit mode with the antenna disconnected or with the antenna connector terminals shorted. Serious damage to the unit may result if this precaution is not observed.

3-2. TYPICAL OPERATING PROCEDURE.

- a. Push in the POWER/VOL knob. The channel display will indicate the selected channel.
- b. Turn the knob to obtain the desired sound volume.
- c. Set the Channel Selector to the desired channel.

NOTE

The following adjustment should be made on a channel with no input signal.

- d. Push in the SQUELCH knob. Turn the knob slowly clockwise until the background noise from the speaker is no longer heard.
- e. Depress the push-to-talk switch on the microphone to transmit. The ON AIR lamp will light.

3-3. FUNCTIONAL CHECKS.

To check the microphone, pull out the SQUELCH control. Set the Channel Selector to a simplex channel. The monitor circuit will reproduce audio from the speaker when the operator speaks into the microphone (without depressing the push-to-talk switch).

3-4. CALL CHANNEL.

Channel 3 is assigned as the CALL channel. This channel is immediately accessed from any other channel on the Channel Selector by depressing the CALL channel switch. The on-state of the push-button switch is indicated by lighting of the CALL lamp.

3-5. HI/LOW.

QSO between locals can be enjoyed with less interference and power consumption by reducing the output power to only the required value. This is accomplished by depressing the HI/LOW push-button switch, which reduces power from the normal 10 Watts to approximately 1 Watt, with the meter lighting turning to green. The brightness of the ON AIR lamp will remain unchanged. The meter indication will drop to 2. In the LOW position, the protection circuit is not operative.

ADDENDUM

The call channel on TR-72 transceivers has been changed from channel 3 to channel 1. All references to the call channel in this manual should be so amended.

The TR-72 is supplied with 146.52 MHz crystals on channel 1. If a different call channel frequency is desired, move 146.52 MHz crystals to a different channel and install the desired call channel crystals in channel 1 sockets.

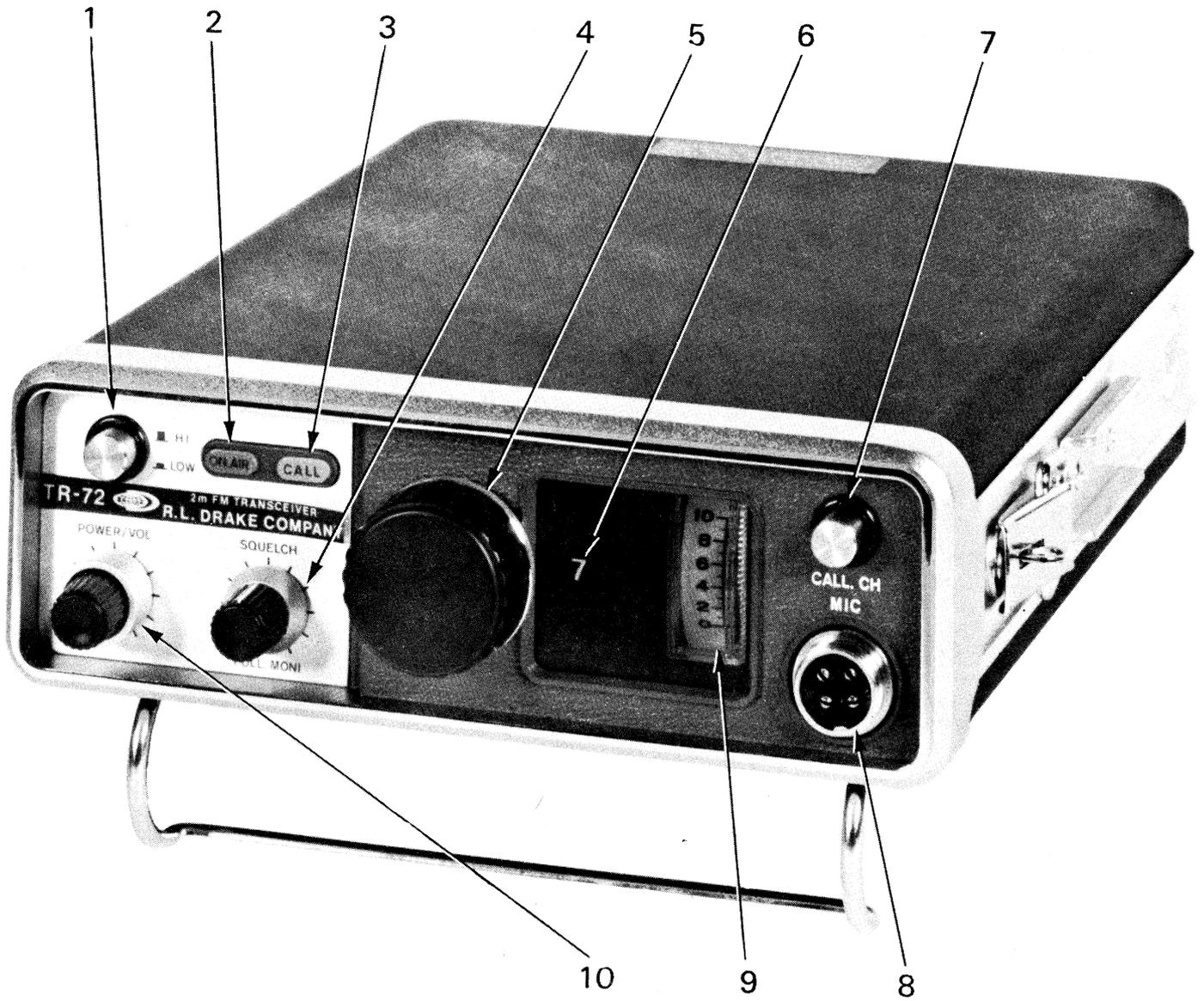


Figure 3-1. Front Panel Controls

FRONT PANEL CONTROLS

1. **HI/LOW Power Switch.** When pushed in, power is reduced to approximately one Watt. In the low power position, the S meter is illuminated green. When pushed again, the switch returns to the high power position and the S meter glows white.
2. **ON AIR Indicator.** Lamp lights when the unit is in the transmit mode.
3. **CALL Indicator.** Lamp lights when the call channel button has been depressed.
4. **SQUELCH Control.** Rotation of this control operates the squelch circuit. Advancing the control clockwise increases the signal level required to open the squelch. The monitor circuit is activated by pulling the SQUELCH knob out. This function allows monitoring the microphone or Touch Tone® Pad audio if a malfunction is suspected. In this position the low level transmitter RF and audio stages are activated without turning off the receiver. This allows monitoring of the transmitter audio in the receiver provided that the channel switch is set to a simplex channel. The PTT switch must not be depressed. This knob must be pushed in for normal operation.
5. **Channel Selector.** Knob selects one of 23 channels and displays the channel number in the Channel Display (6). Has no effect when the CALL Channel button has been activated.
6. **Channel Display.** Shows which channel has been selected with the Channel Selector (5). Position marked 'X' has no connection.
7. **CALL CHANNEL Push Button Switch.** When this button is pushed in, the transmit and receive frequencies which are installed in the CH 3 position are selected, regardless of the setting of the Channel Selector switch. This allows instant selection of one predetermined channel without rotating the Channel Selector. Therefore, crystals for the call channel frequency must be installed in the CH 3 crystal sockets. This frequency may also be selected by placing the Channel Selector in the Channel 3 setting. When the CALL Channel button has been activated, the front panel light marked "CALL" will light. To return to the frequency selected by the main Channel Selector dial, push the button again.
8. **MIC Connector.** Provides a connection for the microphone.
9. **S Meter.** Indicates relative received or transmitted signal strength.
10. **POWER/VOL Knob.** Receiver volume is increased by rotating knob clockwise. A single push of the button turns the power on, another push turns it off.

NOTES

CHAPTER IV

THEORY OF OPERATION

4-1. RECEIVER.

Refer to the block diagram figure 4-1 and the schematic figure 5-15. On receive, signals in the 2 meter band are amplified by RF amplifier Qs2. The amplified output from the RF amplifier is fed to a 3-section highly selective Helical Tuner consisting of Ls3, Ls4, and Ls5. The bandpass of this filter is slightly over 2 MHz wide and passes signals in the 146-148 MHz section of the 2 meter band. High attenuation of out-of-band signals results in excellent rejection of intermodulation interference from commercial transmitters. The output from the Helical Tuner is fed to gate 1 of the first mixer Qs3. Injection from Qs9 is mixed with the desired signal to produce a 10.7 MHz IF frequency. The injection is obtained from oscillator Qs7 and triplers Qs8 and Qs9. The 10.7 IF signal from Qs3 is fed immediately to a 2-pole crystal filter with a bandwidth of 20 kHz. This selectivity reduces the possibility of in-band intermodulation distortion which otherwise might occur in the 10.7 IF amplifiers or second mixer. Transistor Qs4 amplifies the 10.7 MHz IF signal and feeds a ceramic filter which provides additional selectivity for increased image rejection and spurious response attenuation. The output of the ceramic filter feeds the second mixer Qs5 where the 10.7 IF is subtracted from 11.155 MHz injection from Qs10 to produce an IF frequency of 455 kHz. This IF signal passes through the 11 element ceramic filter which has a bandwidth of 20 kHz and provides the main selectivity. The output from the filter is amplified by Qs6 and Qs7 and amplified and limited in Qs12. The limited 455 kHz IF signal is then

detected in the ratio detector formed by Ls16, Ls17, Ds4 and Ds5. The audio amplifier consists of Qs16 and Qs17. Audio from the detector is fed to a filter consisting of Ls18, Cs63, Ls19 and Cs64 to obtain the high frequency noise components. The noise is amplified by Qs13 and Qs14 and detected by Ds8 and Ds9. The resulting DC voltage is used to control squelch gate Qs15. RF from 455 IF amplifier Qs11 is detected by Ds2 and Ds3 to provide S meter indication.

4-2. TRANSMITTER.

On transmit, transistor Qt1 is a crystal controlled oscillator oscillating at 1/12 the desired transmit frequency. The output from Qt1 is buffered in stage Qt2. Dt1, Lt2 and Ct10 form the phase modulator. Audio is fed to the phase modulator from IC Qt9 which amplifies and limits the mic audio. After being phase modulated the 12 MHz signal is amplified in stage Qt3. The signal is multiplied as follows: X2 in stage Qt4, X3 in stage Qt5, X2 in the stage Qt6. The result is a signal on the desired frequency in the 2 meter band. The 2 meter signal is amplified in stages Qt6, Qt7, Qt8, Qf1 and Qf2. The power output from Qf2 is filtered in low-pass filter Lf7, Cf10 and Lf8 and applied to the antenna jack through the relay. LOW power output is obtained by reducing the supply voltage to stage Qf1. Voltage for the transmitter stages is obtained from regulator Qt12, Qt13 and Qt14. The reverse power protection circuit consists of detector Dr1. When the VSWR exceeds a dangerous level, voltage from Dr1 fires SCR Dt3 which shorts out the supply voltage to Qt4.

NOTES

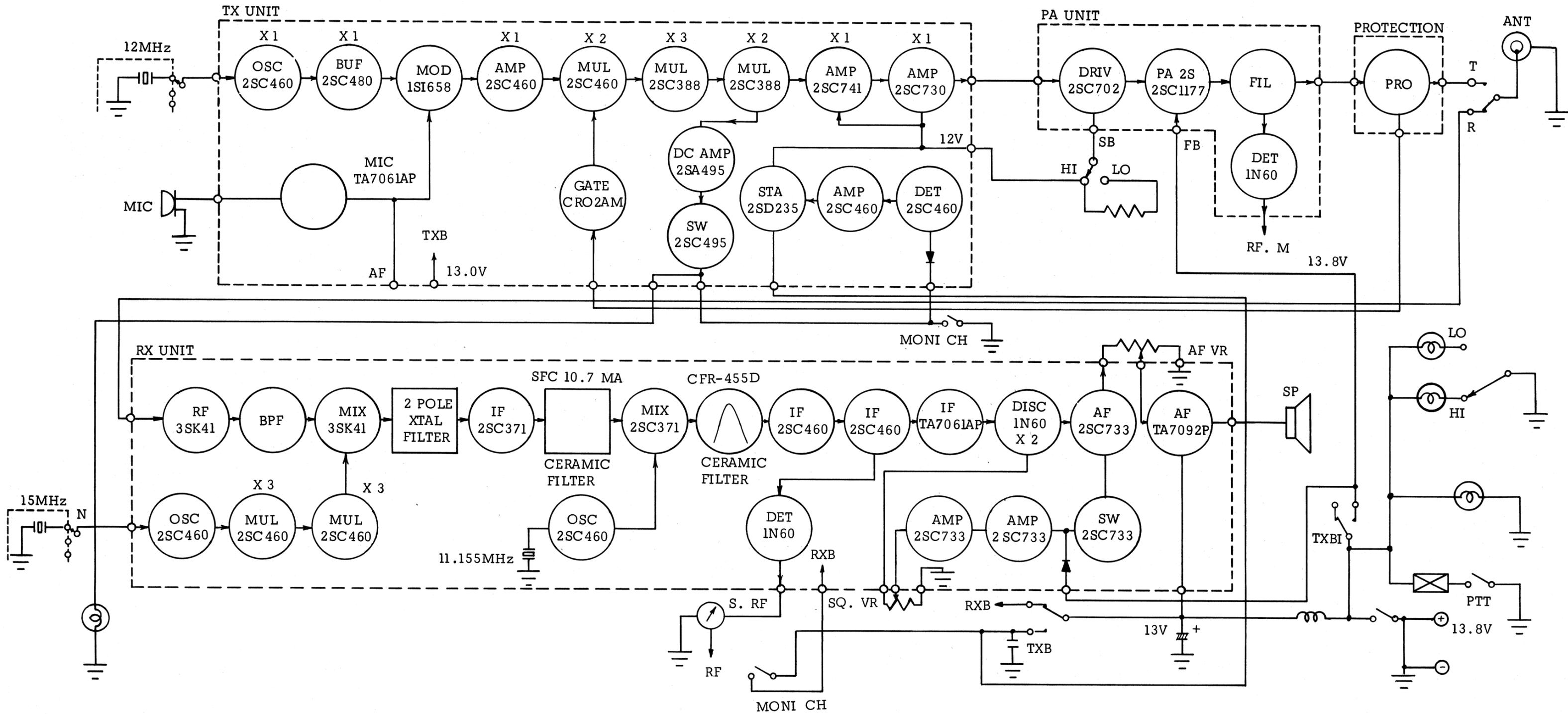


Figure 4-1. TR-72 Block Diagram

CHAPTER V

MAINTENANCE

5-1. SERVICE DATA.

We will check and align your TR-72 at the factory for a nominal fee if it has not been tampered with. Transportation charges are extra. Any necessary repairs will be made on a time and material basis. Please write or call the factory for authorization before returning your unit for alignment or service. Address your request for authorization to:

R. L. Drake Company
540 Richard Street
Miamisburg, Ohio 45342
ATTN: Customer Service Department
Telephone: (Area Code 513) 866-3211
Code-A-Phone Service after
1630 Hours E.S.T.

5-2. REPAIR AND REPLACEMENT.

Repair and adjustment should be made only by a qualified electronics technician. Replacement parts are available from the R. L. Drake Company at the address given above. When ordering replacement parts specify the serial number of your TR-72, the schematic reference designations assigned to the components, and their values, tolerances, and voltage ratings, as applicable.

5-3. TEST EQUIPMENT.

Following is a list of test equipment recommended for troubleshooting, alignment and test:

- a. RF Vacuum Tube Voltmeter
 - Input impedance: 1 Megohm or more, 20 pF or less.
 - Voltage range: 10 mV to 300 Volts full scale
 - Measuring frequency range: 200 MHz or more
- b. Frequency Counter
 - Minimum input voltage: 50 Mv or less
 - Measuring frequency range: 130 to 150 MHz
- c. Sweep Generator (Optional)
- d. Oscilloscope (Optional)

- e. FM Signal Generator

- Must oscillate at approximately 147 MHz and have a means for frequency modulation and level attenuation.

- FM deviation adjustable to ± 10 kHz

- f. AF Vacuum Tube Voltmeter

- Measuring frequency: 50 to 10 kHz

- Input resistance: 1 Megohm or more

- Voltage range: 10 mV to 30 Volts full scale

- g. DC Power Supply

- Voltage: 9 to 16 Volts

- Current: 3 Amperes or more.

- h. Voltmeter

- Input resistance: 11 Megohms

- Voltage range: 1 to 50 Volts DC full scale

- i. Power Meter

- 50 Ohm input impedance, 20 Watts (or more) on 2 Meter band.

- j. AF Signal Generator

- Frequency range: 300 Hz to 5 kHz

- Output: 1 Volt maximum

- k. Two Alignment Loads

- Consisting of a 4.7 K resistor in series with a 0.001 uf capacitor.

- l. Transmit Crystal

- For a frequency within 100 kHz of 147.0 MHz (for transmitter alignment).

5-4. TROUBLESHOOTING.

Troubleshooting procedures for the TR-72 are outlined in the Troubleshooting Chart table 5-1.

5-5. RECEIVER ALIGNMENT (55-1010-00).

5-6. INJECTION ALIGNMENT.

- a. Set controls on the front panel to receive 146.94 MHz.

- b. Refer to figure 5-2. Connect an RF VTVM to terminal labeled ADJ and adjust Ls10, Ls11, Ls12, and Ls13 for maximum meter deflection.

5-7. HELICAL TUNER ALIGNMENT.

- a. Set Channel Selector to an open channel.
- b. Other controls in any position for reception.

NOTE

TCs1 through TCs3 adjustments must be made with extreme care due to the sensitivity of these components.

- c. Make connections as shown in figure 5-3.
- d. Adjust TCs1 and TCs2 alternately until the receiver bandpass is centered on 147 MHz.
- e. Adjust TCs3 for a maximum output.
- f. Adjust Ls1 for a good, symmetrical response pattern with maximum sensitivity (see figure 5-4).
- g. Repeat adjustments d, e and f 2 or 3 times.
- h. Repeak Ls13 for maximum meter deflection.

5-8. ALTERNATE METHOD WITHOUT SWEEP GENERATOR.

- a. Set Channel Selector to 146.94 MHz Channel.
- b. Adjust TCs2 fully counterclockwise.
- c. Apply adequate signal from signal generator on 146.94 MHz.
- d. Adjust TCs1 and TCs3 for maximum S meter reading. Alternate between the two until no further improvement results.
- e. Detune Ls3 and Ls5 by connecting alignment loads from point 1 and point 2 to ground (see figure 5-1). Do not readjust TCs1 or TCs3.
- f. Tune TCs2 for maximum S meter reading.
- g. Remove alignment loads connected in step e.
- h. Adjust Ls1 for maximum S meter reading.
- i. Repeak Ls13 for maximum S meter reading.

5-9. FIRST IF ALIGNMENT.

- a. Set Channel Selector to 146.94 MHz channel.
- b. Other controls in any position for reception.

- c. Connect the FM Signal Generator output to the Antenna connector and inject a 145 MHz signal.
- d. Carefully tune in Signal Generator to exact center of a channel.
- e. Set Signal Generator deviation to ± 10 kHz and set level for 5 on S meter.
- f. Tune Ls6 and Ls7 for maximum S meter reading.

5-10. S METER SENSITIVITY.

- a. Set Channel Selector to 146.94 MHz channel.
- b. Other controls in any position for reception.
- c. Connect an FM Signal Generator to the Antenna connector.
- d. Adjust VRs1 (50 K Ohm) so that an input of 30 μ V is read as 10 on the S meter.

5-11. SQUELCH THRESHOLD ADJUSTMENT.

- a. Set Channel Selector to any channel with no signal present.
- b. Turn SQUELCH control to the 11:30 o'clock position.
- c. Adjust VRs2 until noise just disappears.

5-12. DETECTOR ALIGNMENT.

- a. Apply signal from Signal Generator on any channel with ± 5 kHz FM deviation.
- b. Tune Ls16 for maximum audio output. Measure voltage across speaker with VTVM on AC scale.
- c. Remove input signal. Receive output should be noise only.
- d. Use VTVM or VOM on lowest voltage range for this measurement. Tune Ls17 for zero Volts at test point CM or pin 9 on Auxiliary connector.

5-13. RECEIVE CRYSTAL FREQUENCY ADJUSTMENT.

Either one of two methods may be used to adjust the receive crystal frequency.

- a. Use a VTVM or VOM on the lowest voltage range for this adjustment. Set Channel Selector to channel which is to be adjusted. If a transmitter known to be on frequency is being received,

adjust the trimmer corresponding to the proper channel (see figure 5-2) for zero Volts on test point CM on receiver board or pin 9 on the Auxiliary connector.

- b. Connect Frequency Counter to test point ADJ on receiver board. Adjust trimmer for proper injection frequency:

$$f_{inj} = \text{oper. freq.} - 10.7 \text{ MHz}$$

5-14. TRANSMITTER ALIGNMENT (X56-1060-00).

5-15. VOLTAGE REGULATOR ADJUSTMENT.

- a. Set Channel Selector on an open channel.
- b. Other controls in any position for transmission.
- c. Microphone PTT switch on.
- d. Connect a Voltmeter to the 12 Volt terminal on the transmitter board.
- e. Adjust VRt3 for a Voltmeter reading of 12 Volts.

5-16. MULTIPLIER ALIGNMENT.

- a. Set Channel Selector on 146.94. A transmit crystal for 146.94 MHz or a frequency close to 147.0 MHz should be used for transmit alignment.
- b. Select transmit mode.
- c. Apply 10 Volts power supply voltage.
- d. Adjust Lt4, Lt5, Lt6 and Lt7 so that the ON AIR lamp lights with stability.
- e. Confirm that the ON AIR lamp lights with stability on any channel.
- f. Increase the power supply voltage to 13.8 Volts.
- g. Connect an RF VTVM to terminal labeled OUT on Transmit Board.
- h. Set the Channel Selector to 146.94 MHz channel.
- i. Adjust Lt8, Lt9, Lt10 and TCt1 for a maximum VTVM reading. Trimmer TCt2 should be set to maximum capacitance.
- j. Connect an RF VTVM to the base of transistor Qt4 and adjust Lt1 and Lt3 for maximum Voltmeter reading. Adjust Lt2 for minimum Voltmeter reading.

5-17. POWER ADJUSTMENT.

- a. Connect a Power Meter to the Antenna connector.
- b. Set HI-LOW switch to the HI position.
- c. Set CALL channel to the OFF position.
- d. Other controls in any position for transmission.
- e. Repeatedly adjust TCf1, TCf2, TCf3, and TCf4 on the power amplifier until the meter reads a maximum of 146.94. Also adjust TCt1 and TCt2 on the Transmitter Board in the same manner.

5-18. S METER CALIBRATION.

Adjust VRf1 so that the S meter indicates 9 at 146.94 MHz at a power voltage of 13.8 Volts.

5-19. MODULATION ADJUSTMENT.

- a. Set controls to any position for transmission.
- b. Make connections shown in figure 5-5.
- c. Set VRt1 in center of range.
- d. Apply a 1 kHz input signal of 30 mV and adjust VRt2 until the frequency deviation is ± 6.5 kHz (or desired peak deviation).
- e. Reduce the microphone input to 3 mV and adjust VRt1 until a frequency deviation of approximately 60% of step d is obtained. This is an average microphone gain setting for most circumstances.

5-20. LOW POWER ADJUSTMENT.

- a. Set HI-LOW switch to the LOW position.
- b. Other controls in any position for transmission.
- c. Connect a Power Meter to the Antenna connector.
- d. Adjust VRt4 (5 K Ohm) on the Transmit Board for an output power of 1 Watt.

5-21. PROTECTION CIRCUIT ADJUSTMENT (X54-1060-00).

- a. Set Channel Selector on any channel.
- b. Other controls in any position for transmission.

NOTE

This measurement should be finished within 30 seconds.

- c. Make connections shown in figure 5-6. Unsolder the shielded wire as shown.
- d. Refer to figure 5-2. Adjust VRr1 (500 Ohm) for minimum Voltmeter reading.
- e. Set the power supply to 11.5 Volts, disconnect the antenna completely and adjust VRr2 so that the Voltmeter reads 1.0 Volt.
- f. Re-solder the shielded wire to terminal labeled PRO.
- g. Confirm that the Protection Circuit operates when the Antenna connector is open at a supply

voltage of from 11.5 to 16.0 Volts.

5-22. FREQUENCY ALIGNMENT.

- a. Set Channel Selector to channel requiring alignment.
- b. Other controls in any position for transmission.
- c. Connect a Power Meter to the Antenna connector.
- d. Inductively couple a Frequency Counter input cable through 2 or 3 turns of a coil wound around the Power Meter cable.
- e. Tune the crystal's associated trimmer until the counter displays the correct frequency when the transmitter is keyed.

Table 5-1. Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE	CORRECTION
1. No background noise.	<p>A. Squelch is on.</p> <p>B. Defective AF IC (Qs17) TA7092 on X55-1010-00.</p> <p>C. Open circuit in the speaker cord or disconnection at the intermediate connector.</p>	<p>A. Turn the squelch control for operating noise.</p> <p>B. Check voltages with a multi-meter.</p> <p>C. Check for continuity.</p>
2. Low Sensitivity.	<p>A. Defective relay contacts or relay.</p> <p>B. Local oscillator is dead or oscillation is weak.</p> <ol style="list-style-type: none"> 1. Defective crystal unit. 2. Defective rotary switch contacts or open circuit in the wires to the switch. <p>C. Detuned Helical tuner.</p>	<p>A. Check for continuity or replace the relay (RL).</p> <p>B. Check voltage on Qs7 through Qs9.</p> <ol style="list-style-type: none"> 1. Replace the crystal unit that has low sensitivity. 2. Check for continuity. <p>NOTE: The 1st local oscillator normally delivers an output of approximately 1.0 mV (rms) when measured with an RF VTVM connected to terminal ADJ on the Receive Board. The 2nd local oscillator delivers an output of approximately 1.1 V (rms) when measured with an RF vacuum tube voltmeter connected to the emitter of Qs10. 2SC460 (B) on the same unit.</p> <p>C. Readjust the tuner referring to Paragraph 5-7.</p>
3. Low meter sensitivity.	<p>A. Defective (open) meter.</p> <p>B. Improper VR1 adjustment.</p> <p>C. Defective Qs6, Qs11, and Qs12 (X55-1010-00).</p>	<p>A. Check for continuity or replace the meter.</p> <p>B. Readjust the control referring to Receive and Transmit Alignment instructions.</p> <p>C. Replace the transistors.</p>

Table 5-1. Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CORRECTION
<p>4. No Transmission.</p>	<p>A. Defective antenna. (A high SWR will trip the protection circuit, making transmission impossible.)</p> <p>B. Improper protection circuit adjustment.</p> <p>C. Defective relay or PTT circuit if the relay does not operate with PTT action.</p> <p>D. Defective crystal oscillator circuit.</p> <p>1. Open wires to the rotary switch.</p> <p>2. Defective crystal unit.</p> <p>E. Defective final transistor Qf2, 2SC1177.</p> <p>F. The PTT circuit is ineffective when the monitor is on.</p>	<p>A. Check continuity.</p> <p>B. Readjust the circuit referring to Transmit Alignment.</p> <p>C. Check for continuity.</p> <p>D.</p> <p>1. Check for continuity.</p> <p>2. Replace the crystal unit.</p> <p>E. Replace the transistor.</p> <p>F. The transceiver is designed that way. Push in squelch control.</p>
<p>5. ON AIR Lamp does not light. (RF meter deflects.)</p>	<p>A. Defective lamp.</p> <p>B. Defective Qt10 and Qt11 on X56-1060-00.</p> <p>C. Improper Lt6 and Lt7 adjustment (X56-1060-00).</p>	<p>A. Replace the lamp (PL 5).</p> <p>B. Replace the transistors.</p> <p>C. Readjust the coils referring to Transmit Alignment instructions.</p>
<p>6. No modulation.</p> <p>Monitor output:</p> <p>Microphone output should be heard through the speaker when the monitor is on and PTT switch off on simplex channel.</p>	<p>A. Defective microphone.</p> <p>B. Defective Qt9 (TA-7061 AP) on X56-1060-00.</p> <p>C. Open microphone circuit at the connector.</p>	<p>A. Replace the microphone.</p> <p>B. Replace the transistor (or check voltages).</p> <p>C. Check for continuity.</p>

Table 5-1. Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CORRECTION
7. The Voltage at terminal labeled 12V on the Transmit Board does not vary when pot VRt3 is adjusted.	<p>A. Short-circuited Qt7, Qt8 (X56-1060-00) or Qf1 (X45-1000-00), or grounded Lf2 (X45-1000-00).</p> <p>B. Defective Qt12, Qt13, or Qt14 (X56-1060-00).</p> <p>C. Grounded Qt12 heat sink (X56-1060-00).</p>	<p>A. Replace defective parts or check for continuity.</p> <p>B. Replace defective parts or check for continuity.</p> <p>C. Check for continuity and repair.</p>
8. Transmission with the monitor on.	A. Defective Dt5 or Dt6 (X56-1060-00).	A. Replace defective diodes.
9. Malfunction in the LOW mode.	<p>A. Defective R102 (33 Ohms), R103 (56 Ohms).</p> <p>B. Defective S101.</p> <p>C. Open wiring.</p> <p>D. Open LOW lamp (PL2, green).</p> <p>E. Defective VRt4 (5K)</p>	<p>A. Replace.</p> <p>B. Replace.</p> <p>C. Check for continuity.</p> <p>D. Replace.</p> <p>E. Replace.</p>
10. Increased spurious radiation.	<p>A. Improper adjustment of Lt8, Lt9, Lt10, or TCt1 (X56-1060-00).</p> <p>B. Improper adjustment on TCf1, TCf2, or TCf3 (X45-1000-00).</p> <p>C. Open circuit in the wires to the relay.</p>	<p>A. Readjust the controls referring to Alignment.</p> <p>B. Readjust the controls referring to Alignment.</p> <p>C. Check for open circuit visually or with a Voltmeter.</p>
11. No switching from transmission to reception.	<p>A. Defective D101 (SR1FM-2).</p> <p>B. Diode D101 shorted by energy of parasitic oscillation in the TX section.</p>	<p>A. Replace the diode.</p> <p>B. Readjust the TX section referring to Alignment.</p>
<p>12. Squelch</p> <p>1. Impossible to adjust SQUELCH.</p> <p>2. Malfunction in squelch (transmission to reception).</p>	<p>A. Defective Qs15 (X55-1010-00) switching transistor.</p> <p>B. Loss of noise amplifier gain due to defective Qs13 or Qs14 (X55-1010-00).</p> <p>C. Defective Ds9 (X55-1010-00) or incorrect connections.</p>	<p>A. Replace the transistor.</p> <p>B. Replace defective transistors.</p> <p>C. Replace the diode or correct the connections.</p>
13. No monitoring.	<p>A. Wrong crystal units in the Transmit and Receive circuits.</p> <p>B. Defective Dt7 (X56-1060-00) or incorrect connections.</p>	<p>A. Rearrange the crystal units.</p> <p>B. Replace the diode or correct the connections.</p>

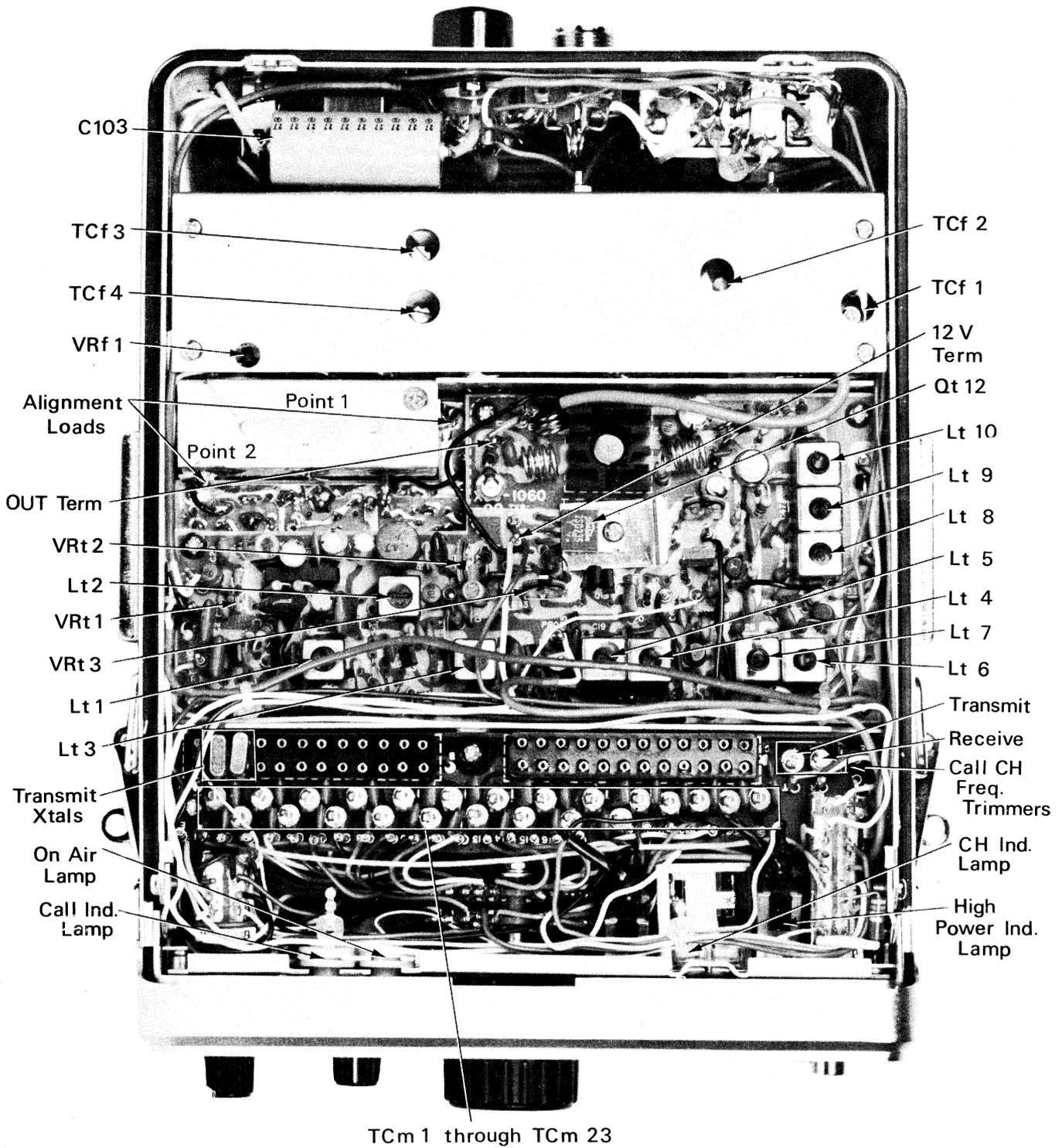


Figure 5-1. Transmitter Alignment Locations (Top)

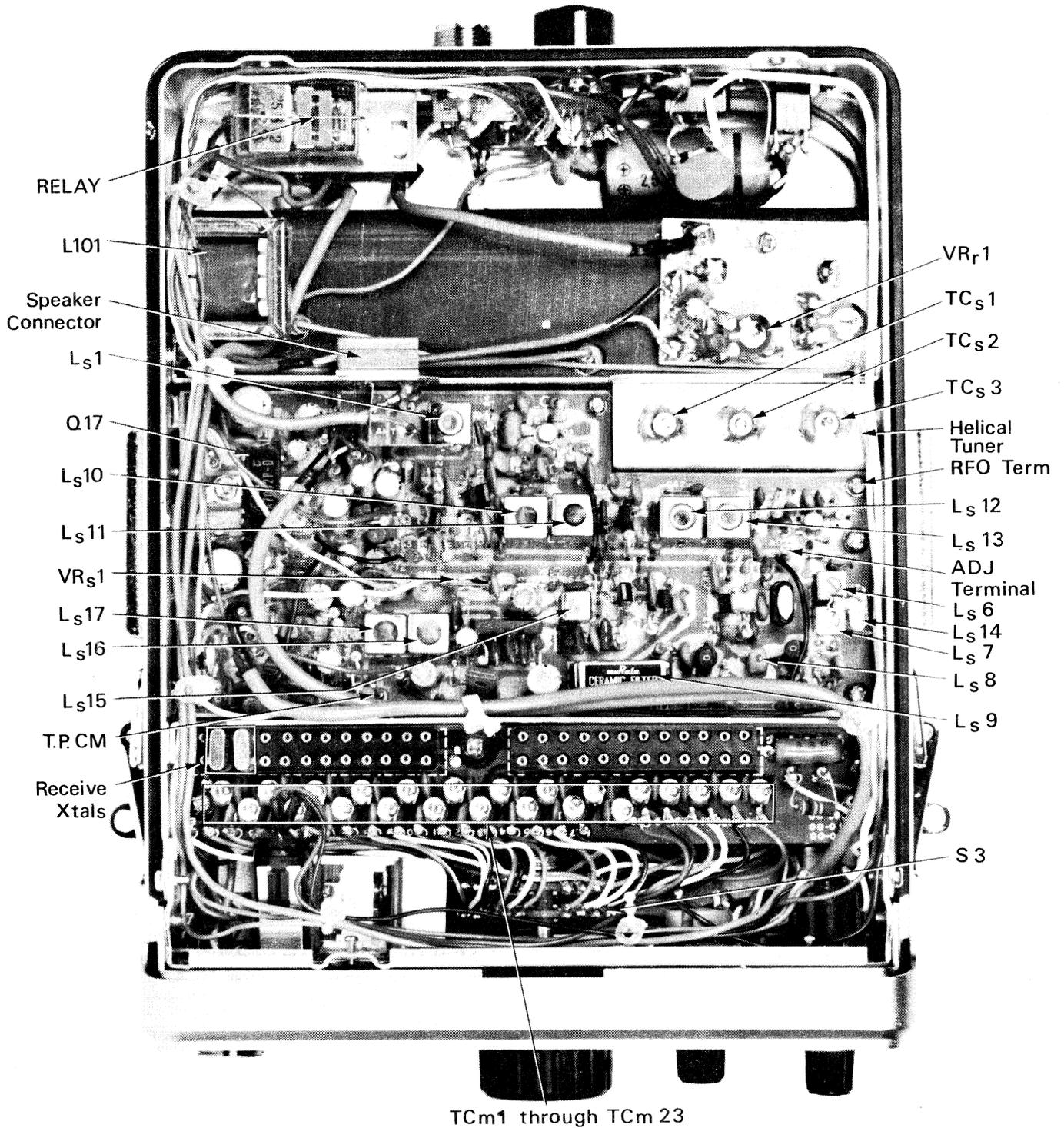


Figure 5-2. Receiver Alignment Locations (Bottom)

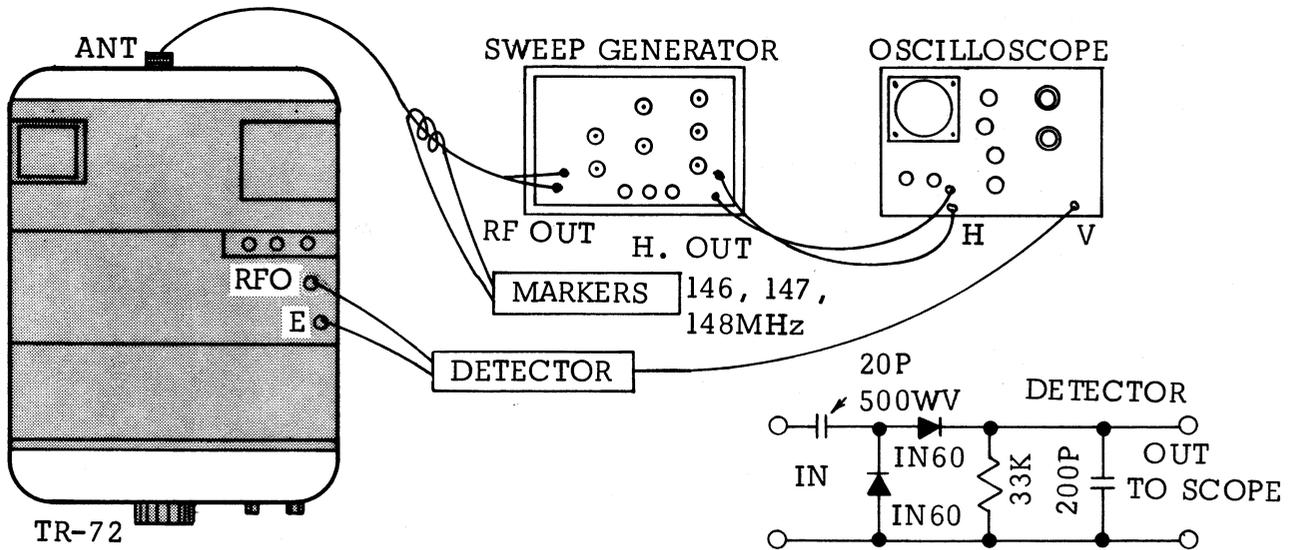


Figure 5-3. Connections for Helical Tuner Alignment

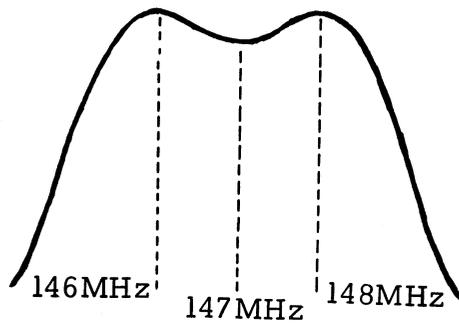


Figure 5-4. Helical Tuner Response Pattern

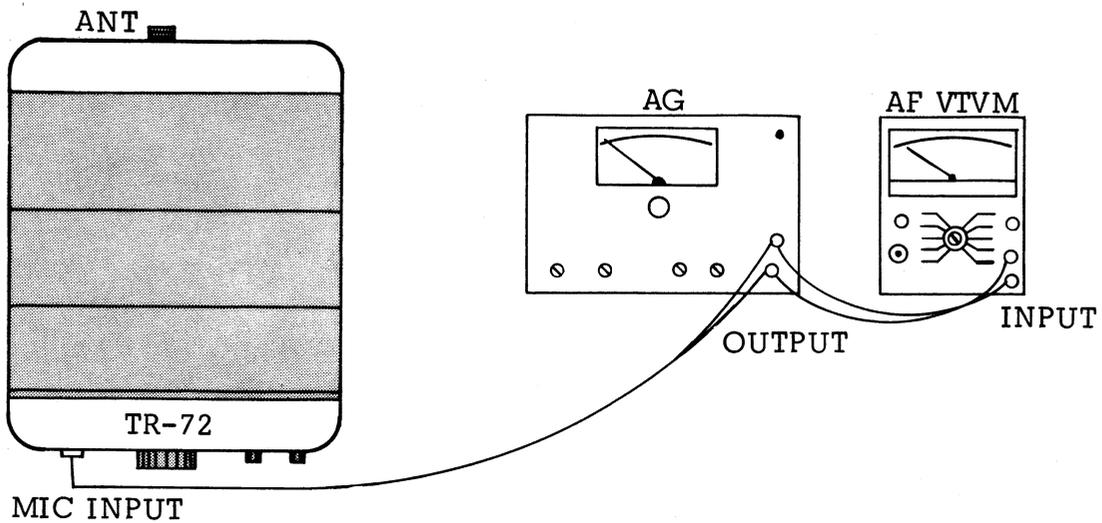


Figure 5-5. Connections for Modulation Adjustment

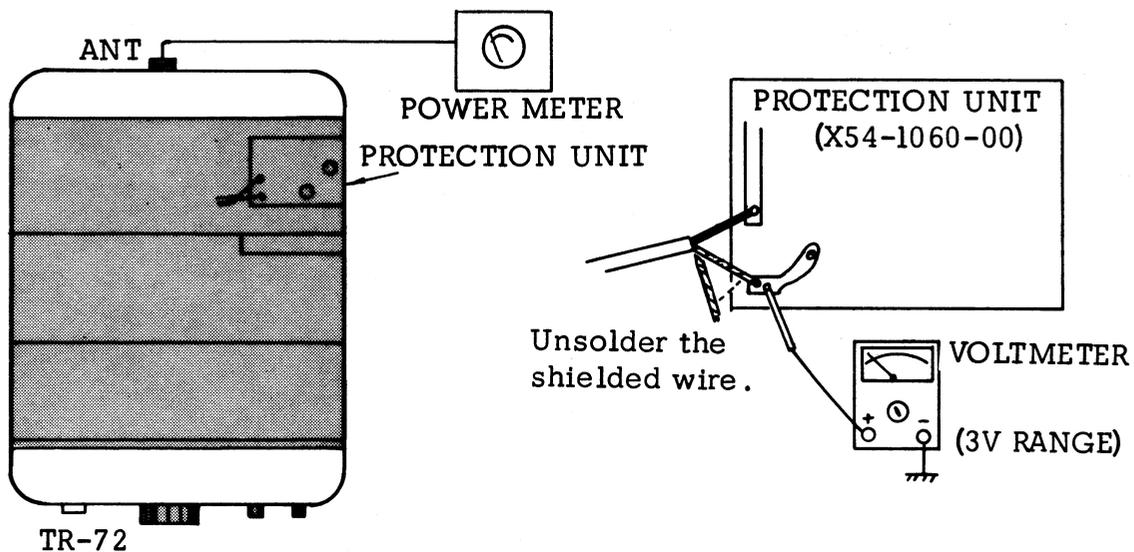


Figure 5-6. Connections for Protection Circuit Adjustment

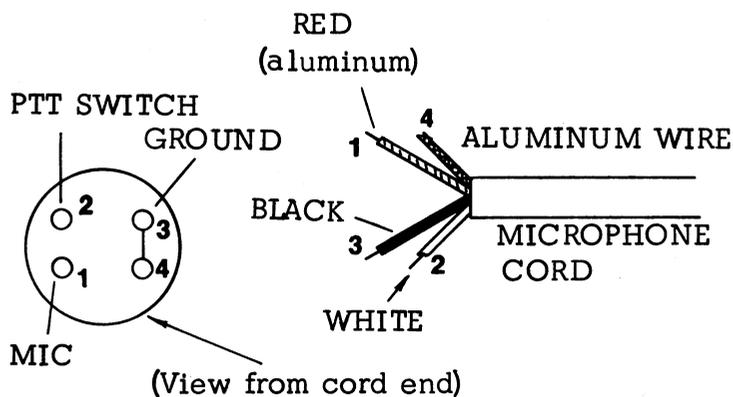


Figure 5-7. Microphone Cord Connections

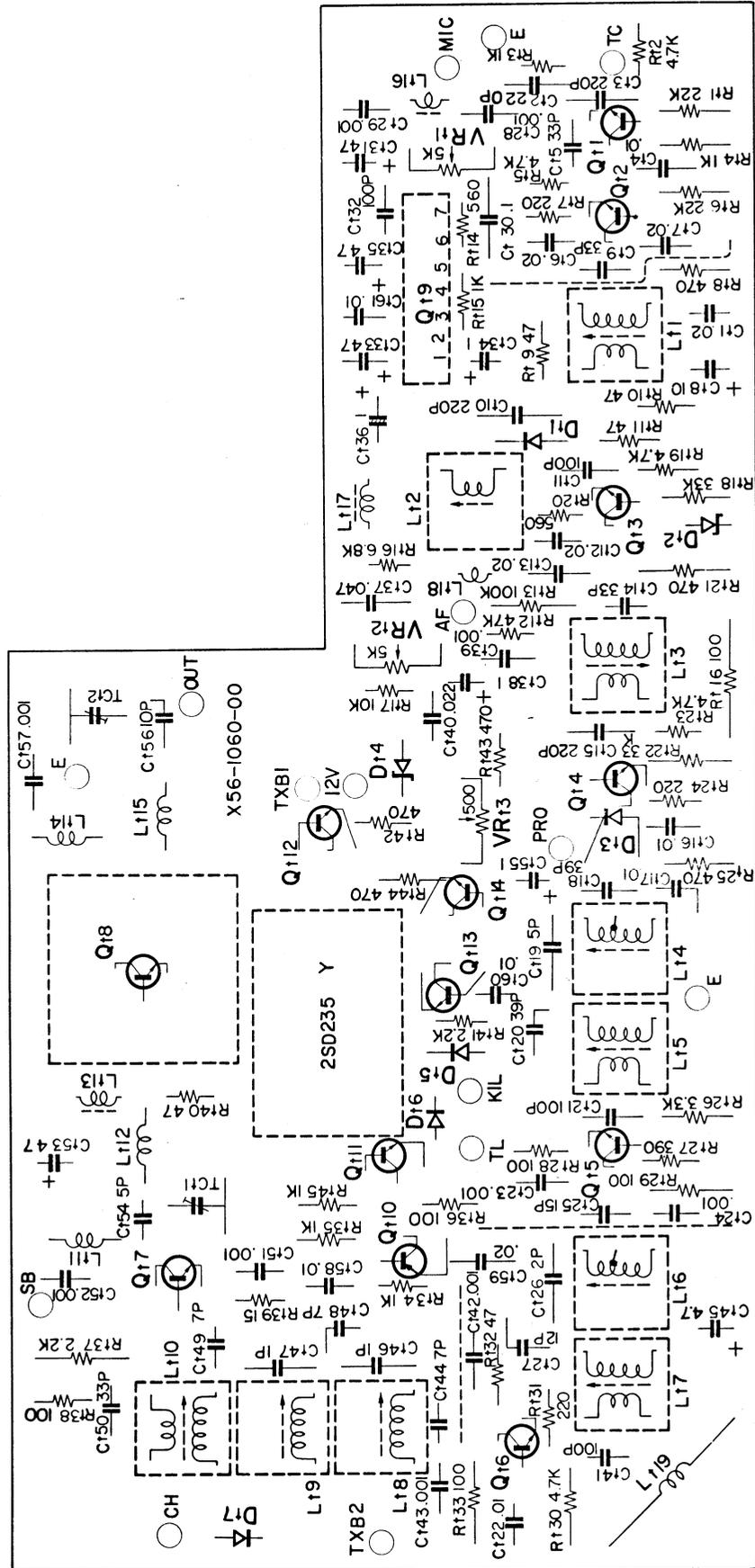


Figure 5-8. Transmitter Printed Circuit Board

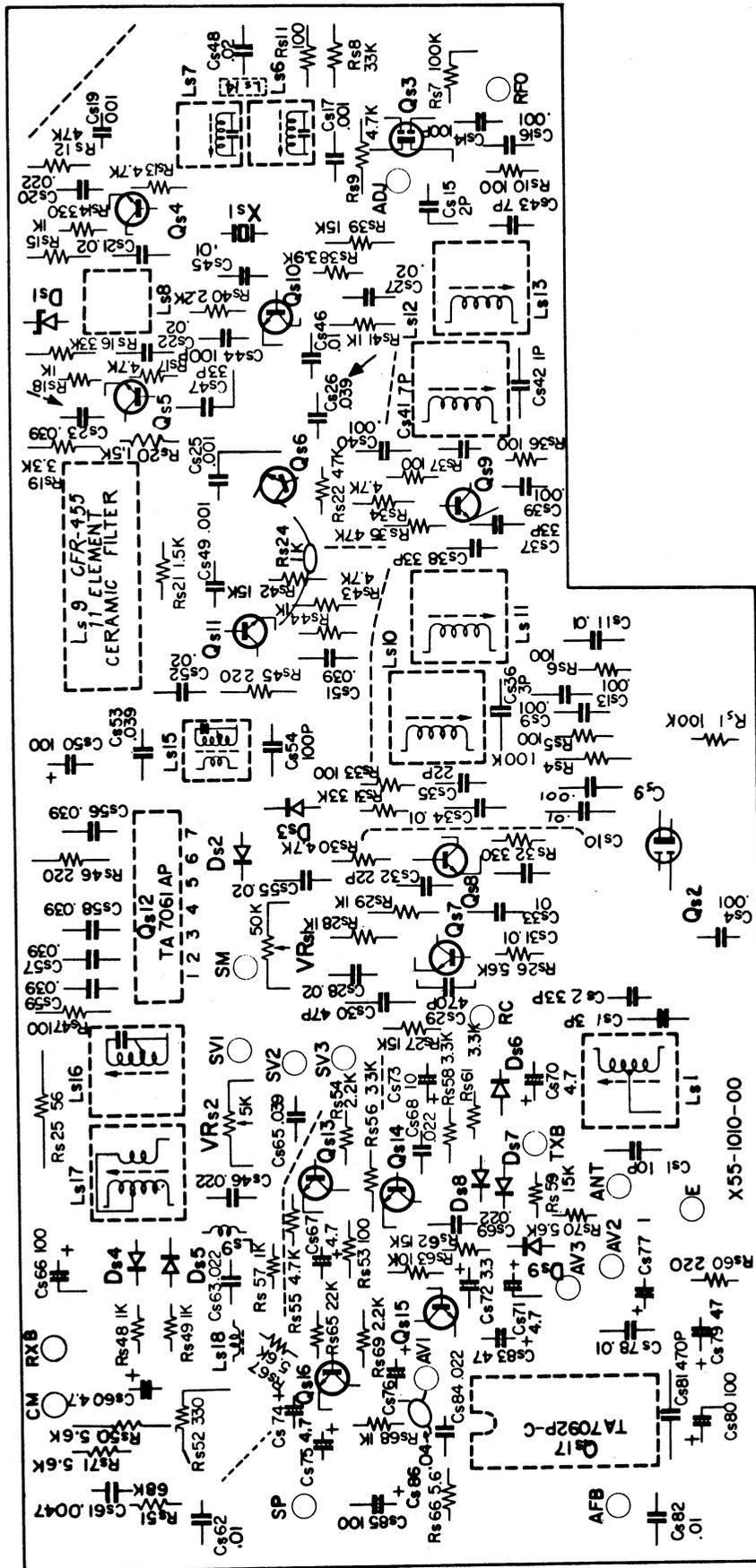


Figure 5-9. Receiver Printed Circuit Board

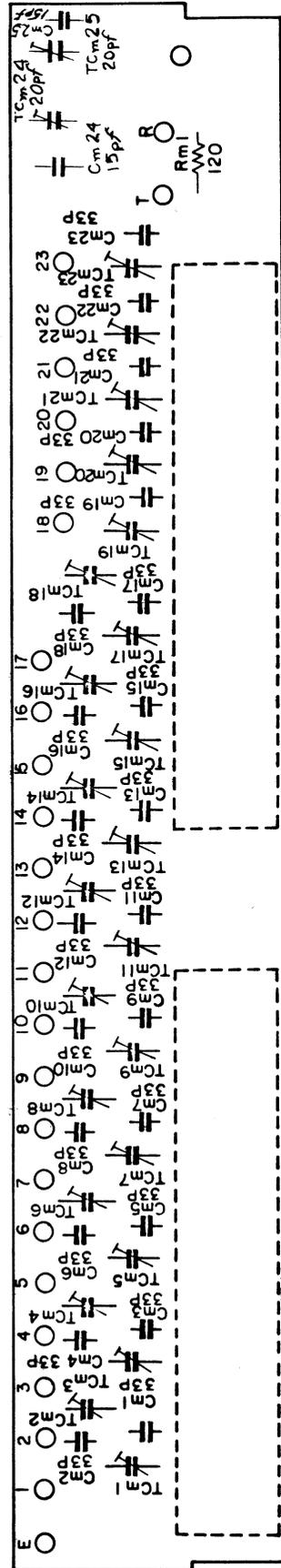


Figure 5-10. Transmitter Crystal Board

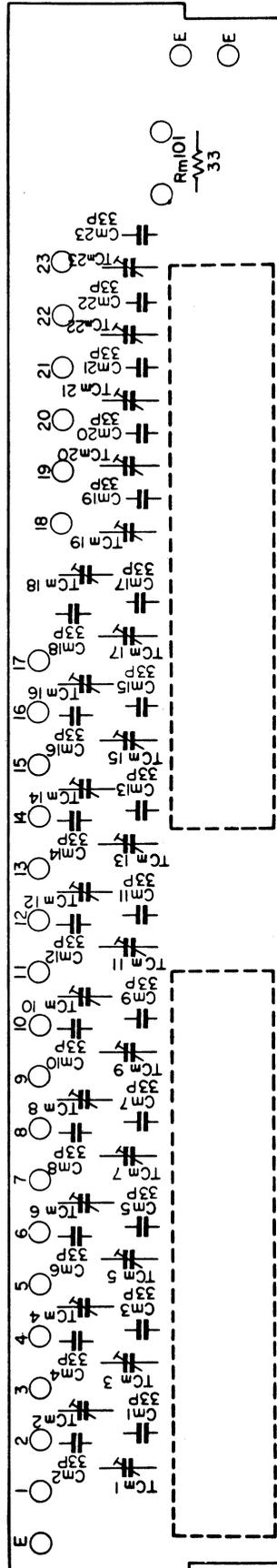


Figure 5-11. Receiver Crystal Board

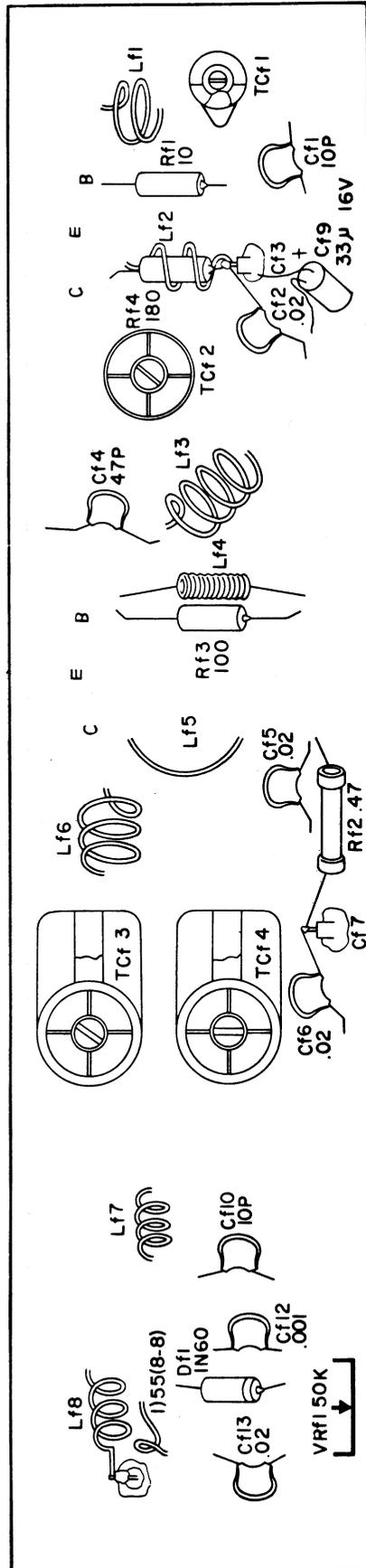


Figure 5-12. Power Amplifier Board

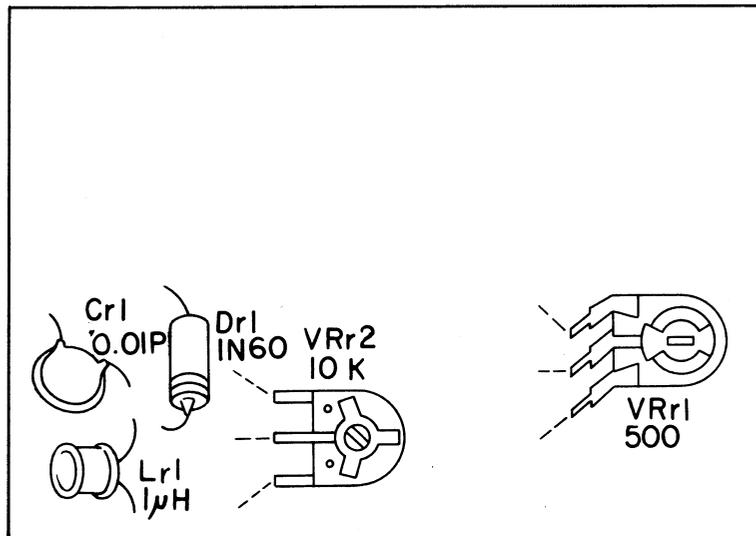


Figure 5-13. Automatic Protection Circuit Board

NOTES

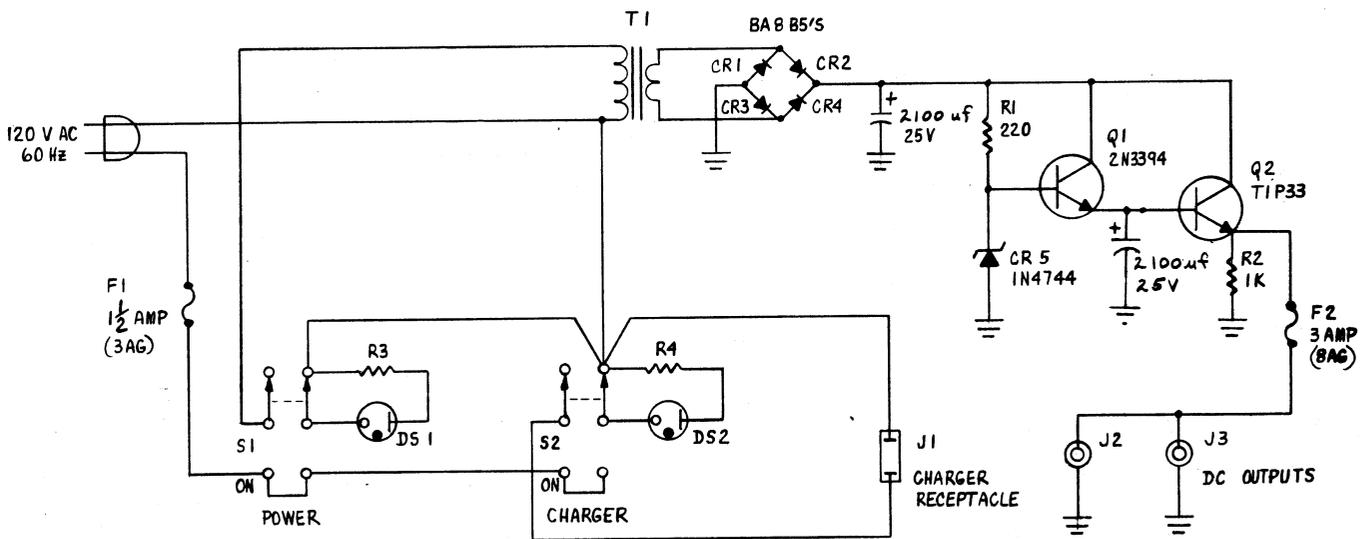


Figure 5-14. Model AC-10 Power Supply Schematic Diagram

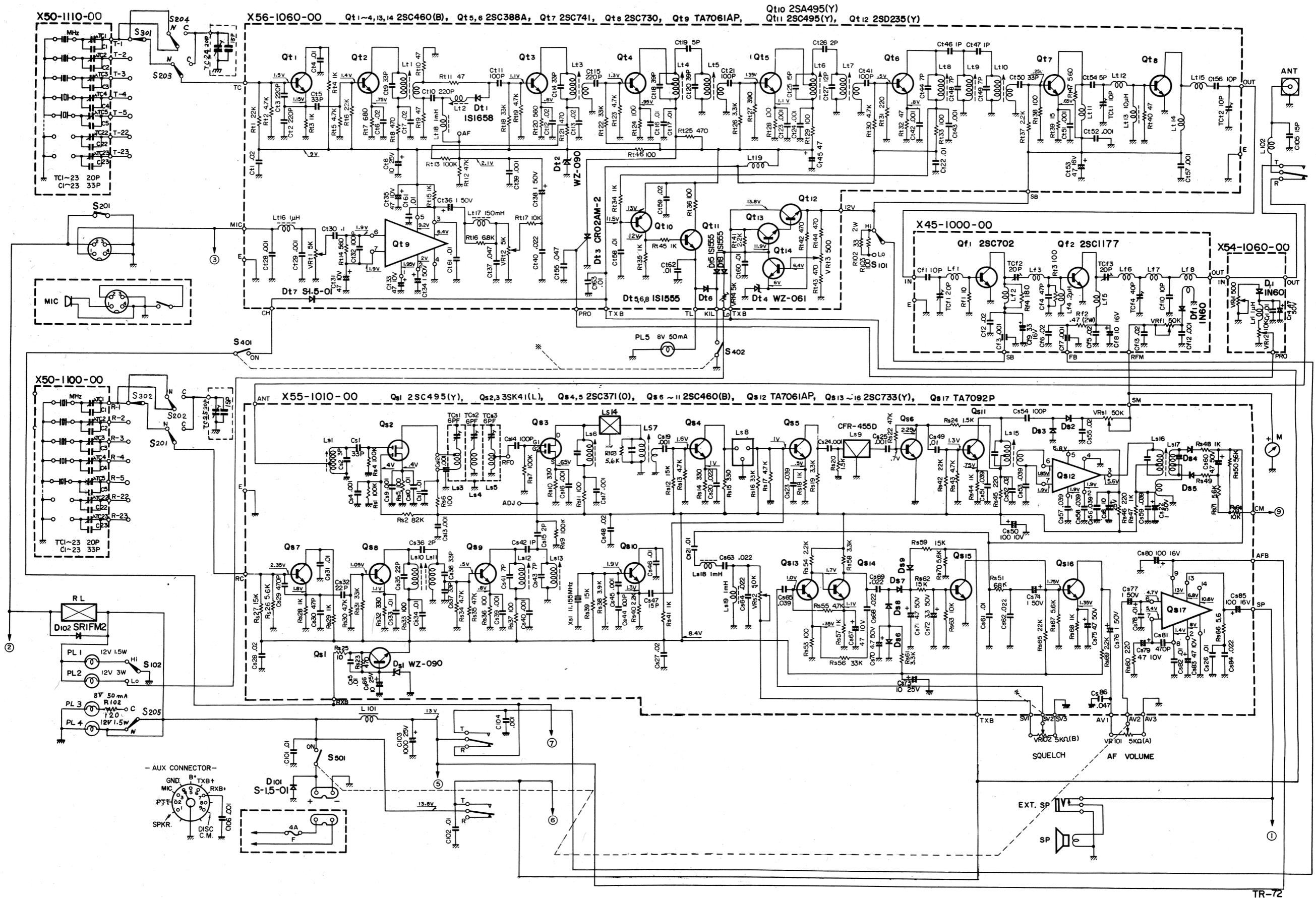


Figure 5-15. TR-72 Transceiver Schematic Diagram



OTHER DRAKE AMATEUR PRODUCTS

- R-4C Receiver covers the 160 meter through 10 meter amateur bands and up to fifteen additional 500 kHz ranges. It has 8-pole crystal filter selectivity with passband tuning and transceives with the T-4XC with excellent sensitivity.*
- TR-4C Transceiver, 300 Watt high frequency single-sideband unit covers the 80 meter through 10 meter amateur bands. Includes AM and CW modes, a linear, permeability tuned VFO and two 8-pole crystal lattice filters.*
- MS-4 Matching Speaker contains 5" x 7" heavy magnet speaker and provides space inside the cabinet for the AC-4 Power Supply.*
- L-4B Linear Amplifier is built for continuous duty at full capacity. 2000 Watts PEP on SSB. 1000 Watts on AM, CW and RTTY. Covers the 80 meter through 10 meter bands.*
- C-4 Station Console—matches Drake's T-4XC, R-4C and TR-4C.*
- MN-4 Antenna Matching Network matches 50 Ohm transmitter output to coax antenna feedline with VSWR up to 5:1. An integral Wattmeter reads forward power in Watts and VSWR directly. 200 Watts continuous duty output.*
- MN-2000 Antenna Matching Network. Same as MN-4 except: 1000 Watts continuous duty output (2000 Watts PEP) and 3 antenna connectors switch-selectable from the front panel.*
- W-4 Wattmeter reads forward and reflected power directly in Watts (VSWR from nomograph). Two scales in each direction, 200 W and 2000 W full scale.*
- AC-4 AC Power Supply provides the required voltages for the TR-4C Transceiver and the T-4XC Transmitter with the proper filtering and regulation. It may be operated from 120 or 240 Volts AC, 50 or 60 Hz.*
- DC-4 DC power supply transforms 12 Volts DC to the voltages required by the TR-4C Transceiver or T-4XC Transmitter. A 115 Volt AC receptacle permits operation of compatible receive/transmitter combinations.*

For information on any of our products, please feel free to write our Sales Department, 540 Richard Street, Miamisburg, Ohio 45342 or call direct, 513-866-2421.



