



# INSTRUCTION MANUAL



# TR-33C

TRANSCEIVER



## LIMITED WARRANTY

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

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

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

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

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

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

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

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

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

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



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## CHAPTER I

## INTRODUCTION

## 1-1. GENERAL.

The TR-33C 2 meter FM transceiver is a versatile, compact, solid state unit for use in the 2 M amateur band. It has 12 channel capability requiring only one crystal per channel. Transmitter offset from the receive frequency is determined by a separate five position switch; simplex and two standard offsets are supplied. It will operate from its internal rechargeable nickel-cadmium batteries or from an external DC source. A charger for charging the nickel-cadmium batteries from 120 VAC is built in. The TR-33C uses a quarter wave length telescoping whip antenna which may be easily replaced by a shortened rubber helix whip or, an external 50 ohm antenna may be used. The receiver section employs an all FET front end design and a crystal filter in the first IF to minimize intermodulation interference.

## 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  | Preparation for Use. Describes the procedure to be followed prior to operation.   |
| Chapter III | Operation. Provides operating instructions for optimum performance.   |
| Chapter IV  | Theory of Operation. Describes the function of each stage and other critical networks.  |
| Chapter V   | Maintenance. Provides sufficient information for alignment by an experienced electronics technician, including component illustrations, and a complete schematic diagram. |



Figure 1-1. TR-33C Transceiver



## SPECIFICATIONS

### GENERAL:

Frequency Coverage: 146-148 MHz.

Power Requirements: 13.0 volts DC  $\pm$  15% from external supply or built in nickel-cadmium batteries.

Current Drain:

Batteries:	Squelched Receive: 30 mA
	Transmit: 400 mA
External Supply:	Squelched Receive: 75 mA
	Transmit: 445 mA

Antenna Impedance: 50 ohms.

Built in Battery Charger  
Voltage Required: 105-130 volts AC.

Dimensions: 5.45" (138 mm) X 2.28" (58 mm) X 8.5" (216 mm).

Weight: 4.4 pounds (2 kg).

### TRANSMITTER:

RF Output Power: 1.5 watts nominal with 13.0 volts DC supply.

Deviation: Direct frequency modulation adjustable to at least  $\pm$  7 kHz deviation.

Harmonics: All harmonics of transmitter output frequency down at least 50 dB.

Spurious Outputs  
Outside of 2M band: At least 60 dB down.

Spurious Outputs  
in 2M band: At least 70 dB down.





SPECIFICATIONS (continued)

RECEIVER:	
Sensitivity:	Less than .5 microvolt for 20 dB noise quieting.
Selectivity:	Adjacent channel ( $\pm$ 30 kHz) rejection greater than 75 dB.
Modulation Acceptance:	At least $\pm$ 7 kHz deviation.
Intermodulation Rejection:	65 dB referenced to sensitivity level.
First IF:	10.7 MHz with monolithic crystal filter.
Second IF:	455 kHz with ceramic filter.
Audio Output:	1 watt at less than 10% T.H.D.
Audio Output Impedance:	8 ohms.

## CHAPTER II

## PREPARATION FOR USE

## 2-1. UNPACKING.

Carefully remove the TR-33C 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 packing 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 that you have not overlooked any accessories. A complete list of accessories furnished with the TR-33C 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. LOCATION.

In general, the location of the TR-33C is not critical. However, extremely hot locations should be avoided.

The TR-33C is furnished with a shoulder strap for over-the-shoulder operation. In addition, it may be used as a mobile station or as a base station in the home. A versatile mounting bracket Model MMK-33 is available from the R.L. Drake Company at a nominal cost (see figure 2-1). The MMK-33 is furnished with 4 rubber feet for bench top use and with 4 No. 10 pan head sheet metal screws for mounting in a vehicle or elsewhere, at the user's option.

## 2-3. ANTENNA REQUIREMENTS:

The TR-33C has a self-contained antenna. It should be extended to its full length for proper operation. An external antenna connector is provided on the rear of the TR-33C for connection to an external 50 ohm antenna, if desired. The self-contained antenna should be retracted whenever an external antenna is in use. Optionally, the telescoping antenna may be unscrewed and replaced by a shortened rubber helix antenna for portable operation.

## 2-4. SPEAKER AND HEADPHONE REQUIREMENTS.

The TR-33C has a built-in speaker. An external 8 ohm headphone or speaker may be plugged into the miniature phone jack located on the rear panel. A miniature plug is furnished for this connection. Plugging an external speaker or headphone into this jack disables the built-in speaker. See figure 2-2.

## 2-5. MICROPHONE REQUIREMENTS.

A 500 ohm dynamic microphone with a push-to-talk switch is supplied with the TR-33C.

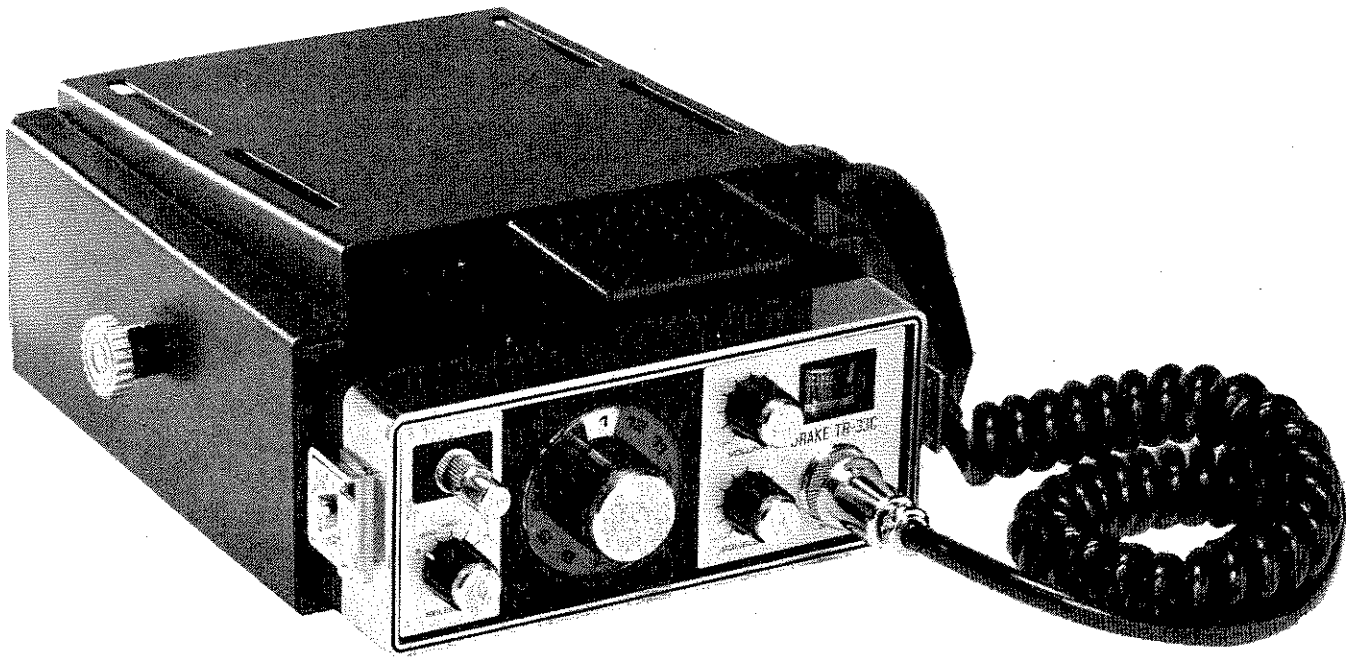


Figure 2-1. MMK-33 Mounting

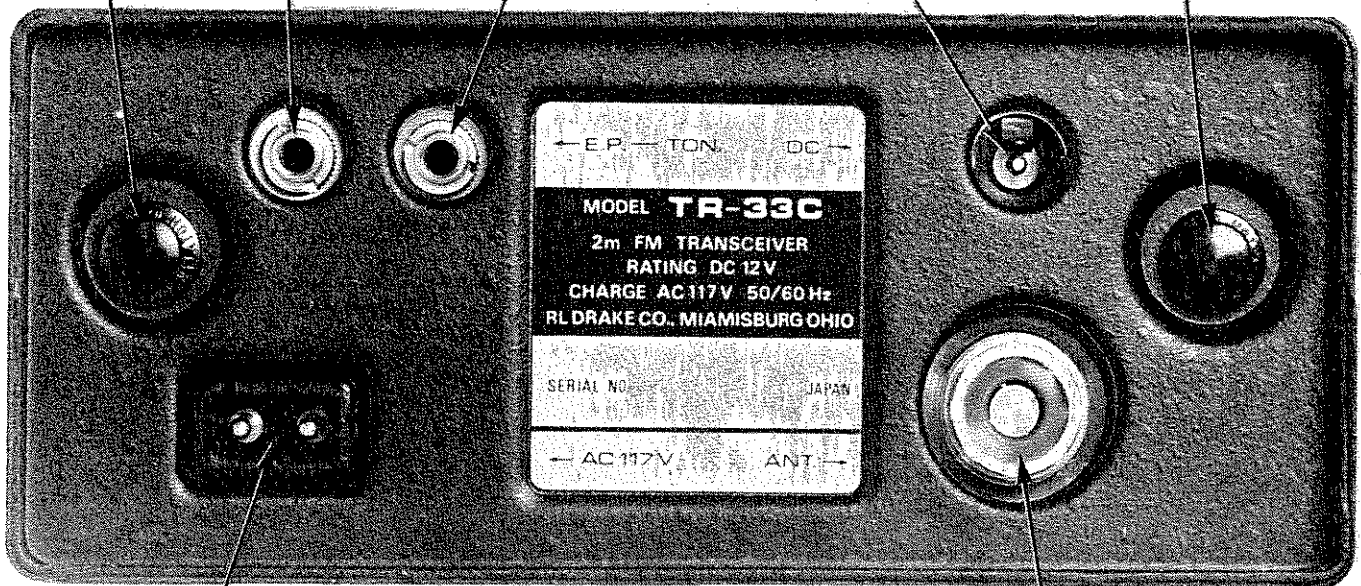
QUICK RELEASE  
FASTENER (PULL  
TO RELEASE CASE)

ACCESSORY JACK  
(FOR TONE INPUT, ETC.)

QUICK RELEASE  
FASTENER (PULL  
TO RELEASE CASE)

EXTERNAL SPEAKER OR  
HEADPHONE JACK

13 VOLT  
DC INPUT



BATTERY  
CHARGER  
117 VAC

50 OHM  
ANTENNA

Figure 2-2. Rear Connectors

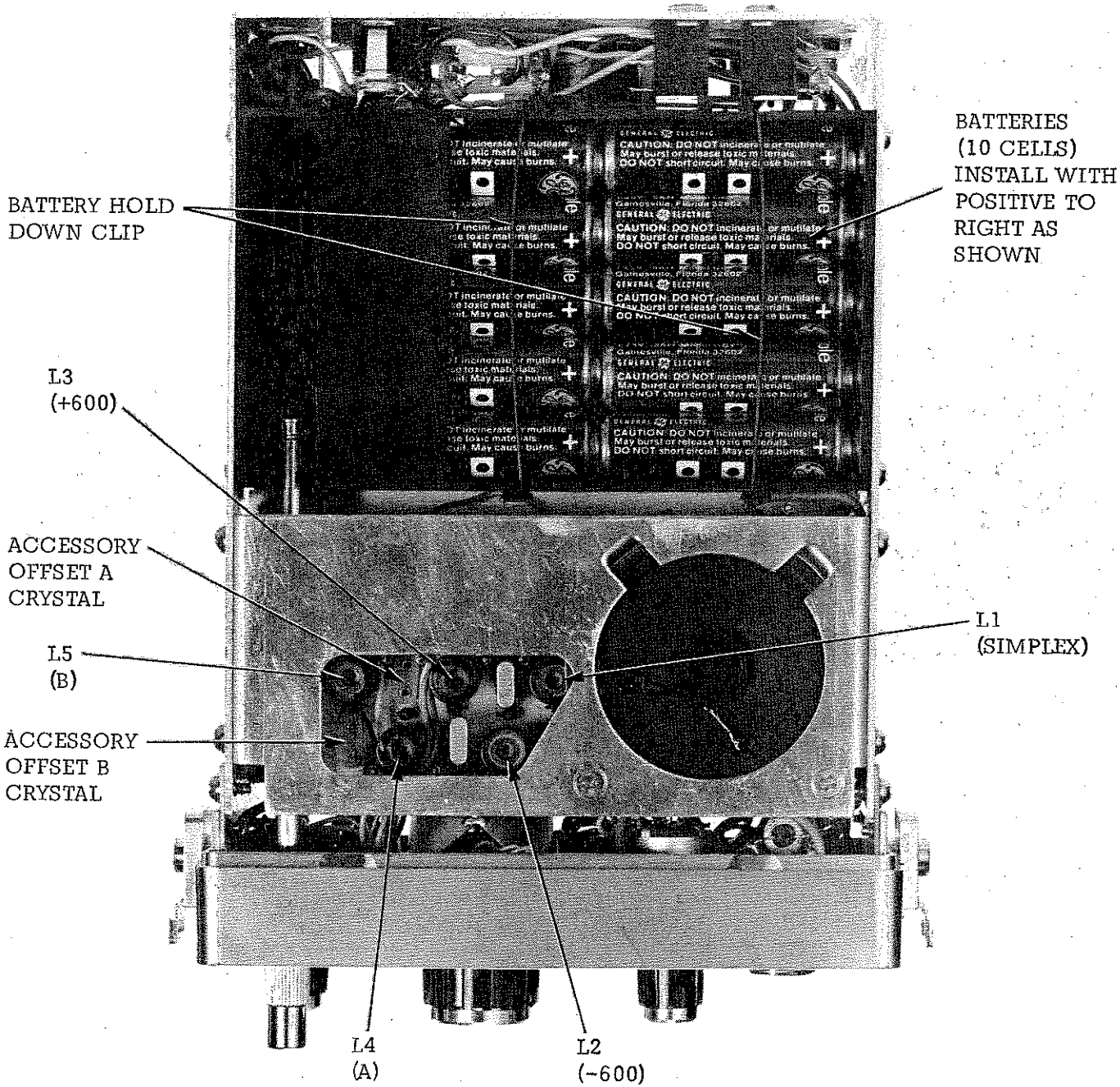


Figure 2-3. Battery and Offset Crystal Installation

## 2-6. POWER REQUIREMENTS.

The TR-33C may be operated from its internal batteries or from an external power source capable of supplying 13 volts DC at 450 mA. The DC cable furnished with the TR-33C is used for this purpose. When the DC power cord is plugged into the TR-33C, the internal batteries are disabled, but may be recharged from 120 volts AC with the built-in charger. For AC operation of the TR-33C, an external DC power supply such as the Drake Model AC-10 may be used. The AC-10 has enough current capacity to power the Drake Model AA-10 Power Amplifier as well as the TR-33C. The AA-10 Amplifier may be housed inside the case of the AC-10 Power Supply, and with the TR-33C positioned on top of the AC-10 cabinet, an efficient, compact arrangement results.

## 2-7. USE OF RECHARGEABLE NICKEL-CADMIUM BATTERIES.

The TR-33C is shipped with ten AA nickel-cadmium batteries of the highest quality. Because nickel-cadmium batteries self discharge after several months, the cells should be charged before using. Install the ten cells in the TR-33C as follows: Pull the two quick-release fasteners on the rear of the case and slide the TR-33C out of the case. Install batteries in the direction as indicated in the battery holder, see figure 2-3. Battery condition may be checked by turning the squelch control fully counterclockwise into the B. CH position. When the batteries are fully charged the meter will read approximately 80% of full scale. When battery voltage falls to 10 volts, the meter will fall to no deflection; this represents a fully discharged condition. Battery condition should be checked regularly when using. Operation should be suspended any time the meter falls below 1/4 scale in the B. CH position. Do not completely discharge the batteries, because if discharged too far under high current drain (transmit) the weakest cell in the string of ten may reverse polarity and be permanently damaged.

To charge the batteries, either turn the TR-33C off or connect it to an external DC supply. Plug the battery charger power cord into 120 volts AC. If batteries are near full discharge or their condition of charge is unknown, a full 16 hours of charge should be applied to fully charge the batteries. Charging the batteries for longer periods of time will not damage the batteries supplied with the TR-33C, but may damage some lower quality cells.

Operation from the batteries with the charger plugged in will result in some hum on the transmitted signal and little if any charging will result. The charger supplies 45 to 50 mA of current to the batteries while the transmitter draws 400 mA. The receiver draws only 30 mA squelched, but the current drain increases when receiving a signal and varies with the level of audio output.

## 2-8. USE OF CARBON ZINC BATTERIES.

The TR-33C may be operated on ten AA penlight carbon zinc cells if desired. Do not charge the dry cells with the TR-33C charger. Do not leave discharged dry cells in the TR-33C. Do not store the TR-33C for long periods with the dry cells installed and use only leakproof dry cells in the TR-33C.

### 2-9. USE OF ALKALINE BATTERIES.

Alkaline batteries may be used in the TR-33C. A new set of alkaline AA batteries may last up to four times as long as one charge on Ni-Cad batteries. Alkaline batteries are very useful for operating the TR-33C away from a source of power to recharge the Ni-Cad batteries. The alkaline batteries should not be recharged unless the battery manufacturer states that they are rechargeable. Do not leave discharged cells in the TR-33C.

### 2-10. EXTERNAL AC POWER.

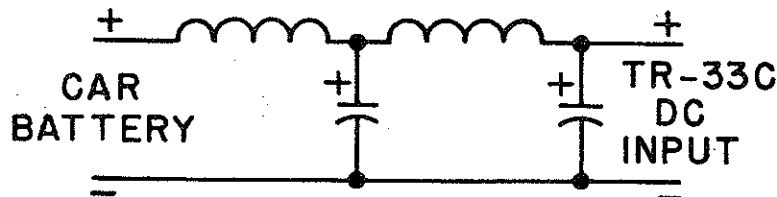
AC operation of the TR-33C may be accomplished only by use of a 13.0 volt DC power supply powered from 120 volts AC. This supply should have good voltage regulation and be capable of delivering 450 mA. Connection to the TR-33C should be made with the DC cord supplied. The R.L. Drake Model AC-10 Power Supply is available for this purpose with enough reserve current to power the AA-10, ten watt amplifier, in addition to the TR-33C.

### 2-11. EXTERNAL DC SOURCE.

The TR-33C may be operated from an external 13 volt  $\pm$  15% source, by plugging the DC cable supplied into the DC connector on the rear of the TR-33C. The gray stripe is positive lead. The internal batteries may be charged from AC while the DC plug is installed. The internal batteries cannot be charged from the external DC source.

### 2-12. AUTO GENERATOR/ALTERNATOR NOISE.

Some automobile electrical systems are not sufficiently filtered, and a slight whine in the TR-33C signal may be reported when operating mobile from the auto power. An external filter shown below will correct the situation: The RF chokes and capacitors are available from the R.L. Drake Company at a nominal cost.



Capacitors - 1000  $\mu$ F @ 15 V or more,  
Chokes - 1 mH or more @ 1/2 amp.

Figure 2-4. Noise Suppression Network

### 2-13. INSTALLING CHANNEL CRYSTALS.

Release the two quick-release fasteners on the rear panel and remove the case from the TR-33C. Remove the four screws holding the metal shield cover on the bottom

side of the radio. Two screws are located on each side. Remove the snap-on cover over the oscillator compartment. With the radio lying on a table with the speaker side down, and the front of the unit toward you, the rightmost crystal socket is channel 1. Progressing from right to left toward the center of the unit, sockets are in order for channels 1 to 12. After installing all crystals, adjust each trimmer for proper frequency as per paragraph 2-14 below. Reinstall snap-on cover, shield cover, and case. See figure 2-5.

#### 2-14. CHANNEL FREQUENCY ADJUSTMENT.

A trimmer is provided to set each channel crystal to its proper frequency. Looking into the oscillator compartment as in paragraph 2-13 above, trimmers for channels 1-12 progress from right to left. Before setting the channel trimmers, the offset oscillator must be on frequency. This can be checked as per paragraph 2-16 below if it is suspected that it may need alignment.

Set the transmitter offset selector to simplex (S). Connect the TR-33C through an appropriate attenuator or coupling arrangement to a frequency counter or other measuring device. Transmit and adjust the trimmer for the selected channel until the transmitted frequency is correct. No further adjustment is required to assure that the receiver is on frequency. Repeat the adjustment procedure for each channel as required.

#### 2-15. INSTALLING ACCESSORY TRANSMITTER OFFSET CRYSTALS.

With the TR-33C out of the case, remove the snap-on cover over the offset crystals. This cover is located next to the speaker. On units without the snap-on cover, remove the four screws holding the speaker mounting bracket to the sides of the transceiver and remove bracket. Referring to figure 2-3, install accessory offset crystals in positions A and/or B as desired. Replace speaker bracket or access cover. It is very important that the speaker bracket and access cover have been reinstalled before alignment of netting coils. See figure 2-3 to determine which coil adjusts each offset crystal frequency.

#### 2-16. OFFSET CRYSTAL FREQUENCY ADJUSTMENT.

Set the channel selector to a channel without a crystal or remove one channel crystal if all positions are full. Connect a frequency counter to the offset oscillator output coax at points A and B. See figure 2-5. Depress the push-to-talk switch with the channel switch on the unused channel. With the offset selector in the S position, L1 should be adjusted for 10.7000 MHz. With offset selector in the -600 position, L2 should be adjusted for 10.1000 MHz, in the +600 position, L3 is adjusted for 11.3000 MHz, and for positions A and B, coils L4 and L5 respectively should be adjusted for  $10.7000 + (\text{desired offset})$ . See paragraph 2-17 for crystal specifications. Note that the frequency stamped on the accessory offset crystals should be 30 kHz (.0300 MHz) higher than the desired offset oscillator frequency. Alignment of above frequencies should be adequate when set to within several hundred cycles of the desired frequency.



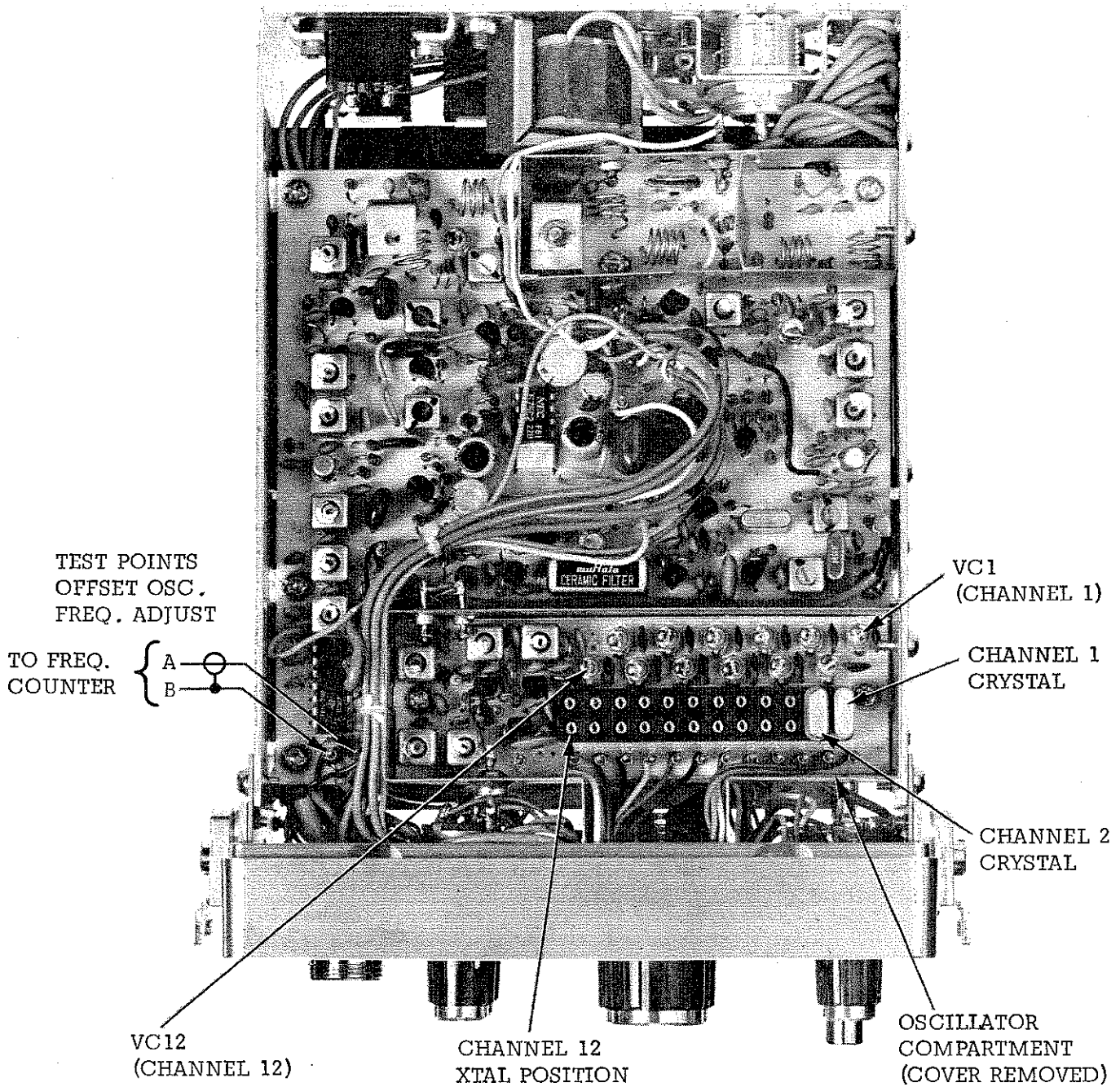


Figure 2-5. Channel Crystal Installation

## 2-17. CRYSTAL SPECIFICATIONS.

Accessory channel crystals or transmitter offset crystals can be ordered from the R.L. Drake Company. To order a channel crystal, specify the desired frequency between 146 and 148 MHz and that the crystal is for the TR-33C. To order a transmitter offset crystal specify the direction and amount of offset desired. If you must order crystals from another source, the following information should be supplied to the crystal manufacturer.

### A. Channel Crystals.

Fundamental Mode, parallel resonant with 32 pF load capacitance.  $\pm .002\%$  calibration tolerance. Rs less than 25 ohms. HC-25/u plug in holder.

$$\text{Crystal frequency} = \frac{\text{Operating (Receive) Freq.} - 10.7 \text{ MHz}}{9}$$

### B. Transmit Offset Crystals (for A & B offset sockets).

Fundamental Mode, parallel resonant with 30 pF capacitance.  $\pm .001\%$  calibration tolerance. Rs less than 25 ohms. HC-25/u plug in holder.

$$\text{Crystal frequency} = 10.7300 \text{ MHz} \pm \text{offset.}$$

Note 1: For replacement of simplex, -600, or +600 offset positions use HC-18 holder with wire leads.

Note 2: The offset crystal frequency required is 30 kHz higher than the actual offset oscillator oscillating frequency. This is taken into account by using 10.7300 instead of 10.7000 in the above formula.

#### Example:

Operation is desired for a repeater with 146.115 MHz input and 146.700 MHz output. To determine the channel crystal frequency to receive 146.700:

$$\text{Crystal freq.} = \frac{146.700 - 10.7}{9} = 15.1111 \text{ MHz}$$

Order a 15.1111 MHz crystal to the specifications listed above in A.

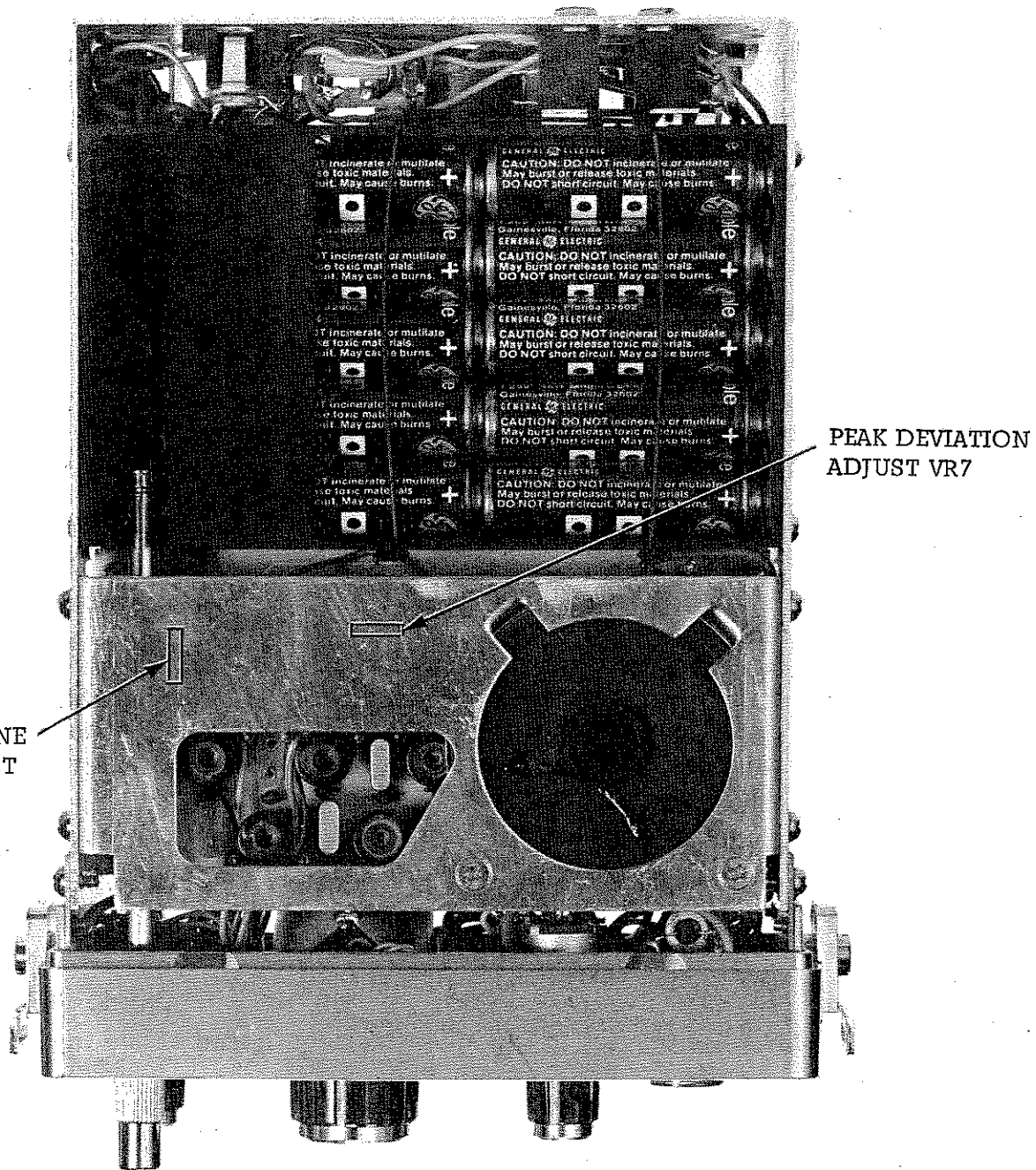
Next, determine transmit offset by subtracting the repeater output frequency from its input frequency.

$$146.115 - 146.700 = (-) [146.700 - 146.115] = -585 \text{ kHz} = -.585 \text{ MHz.}$$

Or, in other words, the desired TR-33C transmit frequency is 585 kHz below the receive frequency so a (-) offset is required.

$$\text{Offset crystal freq.} = 10.7300 - .585 = 10.1450 \text{ MHz.}$$

Order a 10.1450 MHz crystal to specifications in B above.



MICROPHONE  
GAIN ADJUST  
VR6

PEAK DEVIATION  
ADJUST VR7

VR6 & VR7 ARE  
LOCATED ON P.C.  
BOARD BENEATH  
SPEAKER BRACKET

Figure 2-6. Deviation/Microphone Gain Adjustment

## 2-18. TRANSMITTER AUDIO ADJUSTMENT.

Both deviation control and microphone gain have been factory adjusted for optimum performance under typical operating conditions. However, if adjustment of either of these is considered necessary, follow the procedure outlined below.

## 2-19. DEVIATION CONTROL.

The deviation is factory set for peak limiting at  $\pm 5$  kHz. This setting may be increased or decreased by adjusting control VR7 located on the offset oscillator/modulator P.C. board. See figure 2-6 for location of VR7. To gain access to this control, it may be necessary to remove the battery holder. Do not remove speaker mounting bracket to adjust. When adjusting deviation, the microphone GAIN control should first be set at full gain. The deviation control can then be adjusted for desired instantaneous peak deviation (the optimum value for most amateur repeater stations is between  $\pm 5$  and  $\pm 6$  kHz) on a peak-reading deviation meter or scope while talking into the microphone. If only an average reading deviation meter is available, a single tone must be used while setting the deviation. This may be obtained from an audio generator connected across the microphone, or with a slight loss of accuracy, by whistling into the microphone. After adjustment of the deviation control, the microphone GAIN control must be adjusted.

## 2-20. MICROPHONE GAIN CONTROL.

The peak deviation adjustment described in the above paragraph should be made before adjusting the microphone gain. Control VR6 adjusts the microphone gain. See figure 2-6 for location of VR6. Access is possible through hole in side of chassis. Use an insulated adjustment tool. Adjust the control by starting at minimum gain and advancing the control until the proper level is obtained. Normally, the correct setting will fall between 1/2 and 3/4 of maximum gain. Too much gain will result in objectionable background noise pickup.

When setting the control with a deviation meter, advance the gain control while speaking into the microphone at a normal level (do not whistle) to just past the setting where the peak deviation is obtained on a peak-reading meter. If an average reading meter is used, set VR7 for approximately  $\pm 2.5$  kHz deviation. See paragraph 5-6D for additional information if using an audio generator for set-up.

NOTES

## CHAPTER III

## OPERATION

## 3-1. OPERATION.

Refer to figure 3-1, Front Panel Controls, for a description of the function of each control. To operate the TR-33C, turn the POWER/VOLUME Control clockwise to turn on the power and increase the receiver volume. Rotate the squelch control clockwise, until receiver noise just disappears on a channel where no station is being received. Further clockwise rotation of the squelch control will increase the signal level required to unmute the receiver audio.

Set the channel selector to the desired receive channel, either simplex or a repeater output frequency. For simplex operation set the selector (transmit offset selector) switch to S. For operation through a repeater, set the selector switch to -600 for repeaters with the input frequency 600 kHz below the output frequency; set to +600 for repeaters with the input 600 kHz above the output frequency; or set to one of the optional A or B offset positions if applicable.

With this method of frequency selection, it is possible to operate simplex on any channel. This is useful when a repeater is temporarily out of service, or there is no repeater operation on a particular repeater channel in the area.

It is only necessary to add one channel crystal for each additional simplex or repeater channel, as long as the repeater uses a standard offset. For non-standard repeater offsets an optional offset crystal can also be installed.

Before beginning operation either extend the telescoping whip antenna fully, install an optional rubber helix whip, or connect an external 50 ohm antenna to the SO-239 jack on the rear of the unit. Do not transmit without an external antenna connected and with the built-in antenna fully collapsed.

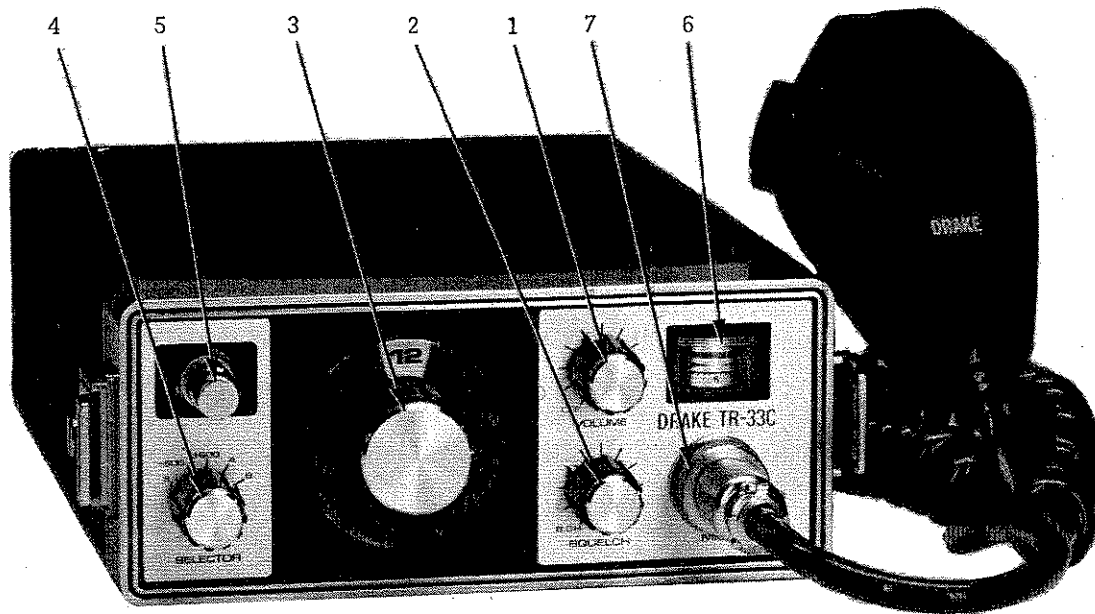


Figure 3-1. Front Panel Controls

1. On-Off Switch and Volume Control: Clockwise rotation turns the power on and increases receiver audio gain.
2. Squelch Control and Battery Check: Clockwise rotation increases signal level required to defeat the squelch circuit and allow reception. Full counterclockwise position, labeled B. CH, displays battery strength on meter (6) when On-Off switch (1) is turned on.
3. Channel Selector: Selects one of twelve possible channels. Receive frequencies are selected.
4. Selector: Determines relationship of transmit frequency to the receive frequency selected by the channel selector (3) above. S selects simplex which is transmitting on the same frequency as the receiver. -600 selects a transmitter frequency 600 kHz below the receiver frequency and +600 selects a transmitter frequency 600 kHz above the receive frequency. A and B are for optional transmit offset determined by the accessory offset crystals installed.
5. Telescoping Whip Antenna: Extends 19 inches. May be unscrewed and a shortened rubber helix antenna substituted.
6. Signal strength Meter, Relative Output Indicator and Battery Check Indicator: Indicates relative signal strength on receive and relative RF output on transmit. Also indicates battery voltage level when squelch control (2) is in the B. CH position.
7. Microphone Connector: Provides a connection for the microphone.

## CHAPTER IV

### THEORY OF OPERATION

#### 4-1. RECEIVER SECTION.

Refer to the TR-33C Schematic Diagram, figure 5-6. On receive, signals entering the antenna pass through the low pass filter consisting of inductors L17, L18, capacitors C158, C159, and C160. Diode D1 is turned on by bias applied through switch Q3 and the antenna is thus coupled to antenna transformer T1. Two meter energy present at the secondary of T1 is amplified by RF amplifier Q1. Tuned circuits consisting of transformers T2, T3, T4, and associated components form a bandpass filter to reject out-of-band signals. The two meter energy is applied to gate 1 of first mixer Q2. Injection which is 10.7 MHz below the desired receive frequency is coupled to gate 2 of Q2. The drain circuit of Q2 is tuned to 10.7 MHz by the tuned circuit transformer T5 and associated capacitors. Capacitor C17 couples the mixer output to crystal filter XF1. The bandwidth of XF1 is approximately 15 kHz, thus, rejection of adjacent channel signals is obtained. Transformer T6 and capacitor C18 match and couple the crystal filter output to transistor Q4. Q4 amplifies the 10.7 MHz IF signal. Ceramic filter CF1 matches Q4 to Q5 and the selectivity improves image rejection. Q14 is a Colpitts oscillator, oscillating at 10.245 MHz. Transistor Q5 mixes the 10.7 MHz IF signal with the 10.245 MHz signal from Q14 to obtain the 455 kHz second IF signal. CF2 is a multi-section ceramic filter which provides the main selectivity for the receiver. Stages Q6, Q8, Q9, Q10, and Q15 amplify and limit the 455 kHz IF signal. Diodes D5 and D6 along with transformers T20 and T13 and other associated parts form the FM ratio detector to demodulate the 455 kHz IF signal. Stage Q7 amplifies some energy from Q6 to drive the signal strength meter detector diodes D9 and D10. Audio from the detector is applied to the de-emphasis network, resistor R49 and capacitor C73 and to the noise amplifier stages Q18 and Q19. Parts values in the noise amplifier stages are selected to form a high pass filter response to separate noise from the voice audio frequencies. Q20 operates as a threshold detector and Q21 and Q22 form a Schmitt trigger circuit to reduce popping of the squelch. De-emphasized audio from R49 and C73 is applied to the volume control VR3 and then amplified by Q16. Integrated circuit IC3 amplifies the audio to the level required to drive a speaker. When no signal is present, noise amplified by Q18 and Q19 exceeds the threshold of Q20 and causes it to conduct. The Schmitt trigger Q21 and Q22 is then turned off and the voltage at the collector of Q22 is applied to the IC3 control pin through D7 which mutes the audio output. When a signal is received and the noise drops below the threshold of detector Q20, integrated circuit IC3 is unmuted.

The injection frequency, for the first receive mixer Q2, is obtained from crystal oscillator Q11, tripler stages Q12, and Q13. Transistor Q11 oscillates in the 15 MHz range. The output of Q12 is tuned to approximately 45 MHz by transformers T8 and T9; Q13 triples this signal to the 135.3 to 137.3 MHz range to provide the





low side injection required. Transformers T10, T11, T12, and associated components form a bandpass filter to pass this range of frequencies. On receive, diode D2 is biased on to allow the injection to reach Q2.

#### 4-2. TRANSMITTER SECTION.

When the push-to-talk switch is depressed, the base of switch Q23 is grounded, thus, turning off the supply voltage to the receiver stages. Transistor Q24 is turned on, supplying voltage to the transmitter stages. Q25 is a Colpitts oscillator which oscillates at  $10.7 \text{ MHz} \pm 2 \text{ MHz}$ . The large inductors, in series with the crystal, pull the actual oscillator frequency to about 30 kHz below the crystal frequency, thus, crystals for this oscillator are cut 30 kHz above the desired offset oscillator frequency. Variable inductors L1 through L5 adjust the oscillator to the desired frequencies. Varicap diode D18, inductors L6, and L7 allow direct frequency modulation of the oscillator, as the capacitance of D18 is varied by the applied audio.

Integrated circuit IC1 amplifies the microphone audio to the level needed by D18. Capacitor C105 and resistor R78 determine the pre-emphasis required. The output of IC1 is internally limited to prevent overdeviation. Inductor L8 and capacitor C112 form a low pass filter to prevent any unnecessary high frequency components from creating excessive bandwidth. VR7 adjusts the amount of deviation.

The frequency modulated signal from Colpitts oscillator Q25 is amplified by transistors Q26 and Q27. After passing through the low pass filter, the offset oscillator signal is mixed with the injection in a double balanced mixer IC2. The output of IC2 is tuned to the desired sum frequency by transformers T14, T15, and T16. The resulting two meter signal is amplified by transistors Q28, Q29, Q30, and Q31. The output of Q31 is nominally 1.5 watts and is coupled to the antenna through the low pass filter.

## CHAPTER V

### MAINTENANCE

#### 5-1. SERVICE DATA.

The R.L. Drake Company maintains complete repair facilities at the factory. We will check and align your unit 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.  
Telex No. 288-017

R.L. Drake Company  
Western Sales and Service Center  
2020 Western Street  
Las Vegas, Nevada 89102  
ATTN: Customer Service Department  
Telephone: (Area Code 702) 382-9470

#### 5-2. DISASSEMBLY AND REASSEMBLY.

To remove the TR-33C from the outside case, pull out on the two quick-release fasteners which are on the rear panel. Then slide the TR-33C out of the case. To reassemble, reverse the process.

#### 5-3. REPAIR AND REPLACEMENT.

Refer to the schematic diagram included in this chapter for signal tracing and fault isolation. Component location drawings are keyed to the schematic diagram as an aid to parts identification.

Repair and adjustment should be made only by a qualified electronics technician. Replacement parts are available from the R.L. Drake Company at the addresses given above. When ordering replacement parts specify the serial number of your TR-33C, the schematic reference designations assigned to the components, their values, tolerances, and voltage ratings as applicable.

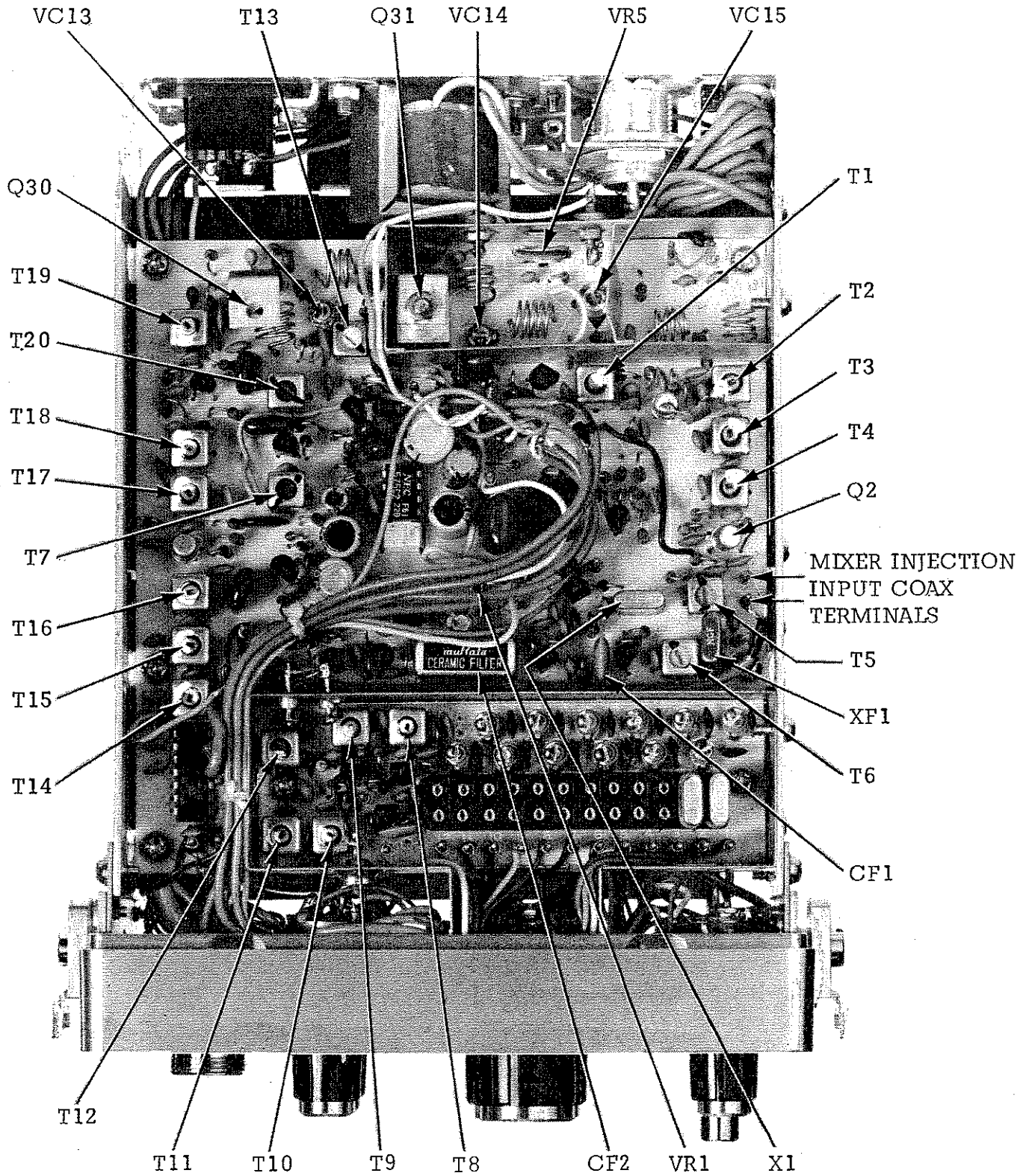


Figure 5-1. Bottom View With Case and Covers Removed

#### 5-4. TEST EQUIPMENT.

Following is a list of the test equipment needed for complete alignment of this unit.

- a. Deviation Meter
- b. Audio Generator (600 ohm output impedance)
- c. FM VHF Signal Generator with calibrated output.
- d. VTVM
- e. Audio VTVM
- f. Counter or Frequency meter accurate to 100 Hz at 2 meters.
- g. 50 Ohm Dummy Load with SWR of less than 1.1:1
- h. Low Power RF Wattmeter
- i. Audio Oscilloscope
- j. RF Voltmeter

#### 5-5. RECEIVER ALIGNMENT.

##### A. Injection Alignment.

1. Set the channel selector to 146.94 MHz.
2. Connect an RF voltmeter probe to the mixer injection input terminals near first mixer Q2. See figure 5-1.
3. Tune transformers T8, T9, T10, T11, and T12 for maximum RF voltage. Repeat several times until no further increase is obtainable.
4. Remove the RF voltmeter connection.

##### B. RF Alignment.

1. Connect the signal generator to the SO-239 antenna connector. The microphone should be disconnected to prevent accidental keying of the transmitter with the signal generator connected.
2. Set the channel selector to 146.94 MHz and tune the signal generator to this frequency.
3. Adjust generator level for 1/3 scale deflection on the signal strength meter.
4. Adjust transformers T1, T2, T3, and T4 for maximum meter reading. If meter indication goes above half scale, decrease generator level. Repeat procedure until no further increase is obtainable.
5. Check sensitivity, connect an audio VTVM to measure audio output. This connection can be made at jack J4 on the rear panel. With the squelch control fully CCW, receiver noise level with no signal input should drop at least 20 dB, when a .5 microvolt signal is applied at the antenna input.

##### C. IF Alignment.\*

1. Connect an FM signal generator to the antenna input.
2. Set generator modulation to  $\pm 10$  kHz deviation with 1 kHz modulation frequency.
3. Tune the generator to the center of receive channel and adjust level for half scale deflection of signal strength meter.
4. Tune transformers T5 and T6 for maximum meter indication.
5. Tune transformer T7 for maximum audio output, measuring audio output with an audio VTVM or oscilloscope.



#### D. Ratio Detector Alignment.\*

1. Connect an FM signal generator to the antenna input.
2. Tune generator to the center of received channel. Set RF level to 1 mV. Set modulation level to  $\pm 5$  kHz deviation. Set audio frequency to 400 Hz.
3. Connect the oscilloscope to the audio output at jack J4. Set the volume control for average listening level.
4. Adjust transformer T20 for maximum audio output.
5. Adjust transformer T13 for the most symmetrical sine wave output on the oscilloscope.

\* Note: For IF and detector alignment, it is important that the injection oscillator is on the correct frequency. Therefore, before proceeding with IF and/or detector alignment, the oscillator should be set as per instructions in transmitter alignment, given below, or the frequency may be checked and adjusted by connecting a frequency counter to the injection output coax. For 146.94 MHz, the injection frequency should be set to 136.2400 MHz.

#### E. Signal Strength Meter Adjustment.

1. Connect a signal generator to the antenna input. Set signal level to 100 microvolts.
2. Adjust variable resistor VR1 for full scale meter reading, but do not adjust such that the meter is pinned. This adjustment prevents the meter from being damaged, by hitting the full scale stop, each time a strong signal is received.

### 5-6. TRANSMITTER ALIGNMENT.

#### A. Injection Alignment.

Before proceeding with transmitter alignment perform the injection alignment, as per paragraph 5-5 A above, if this has not already been done.

#### B. Offset Oscillator Frequency Adjustment.

See paragraph 2-16 for procedure.

#### C. RF Alignment.

1. Connect the TR-33C to an external DC supply of 12.0 volts DC.
2. Set the channel selector to 146.94 MHz and the offset selector to simplex (S).
3. Connect the SO-239 antenna connector to a low power RF watt meter and 50 ohm dummy load.
4. Depress the microphone push-to-talk switch to activate the transmitter.
5. Adjust transformers T14, T15, T16, T17, T18, T19, variable capacitors VC13, VC14, and VC15 for maximum RF output. Repeat until no further increase is obtainable. The wattmeter must be observed very carefully, to see the peak when adjusting the lower level stages. If the transmitter is so far out of alignment that no output is obtained, align one stage at a time by connecting an RF voltmeter to the base of the stage following the one being aligned,

and adjust for maximum RF voltage. When output power is obtained, remove the RF voltmeter and repeat alignment for maximum output power.

6. Increase the power supply to 13.0 volts DC.
7. Telescoping antenna should be installed and fully collapsed into the TR-33C.
8. Repeak T19, VC13, VC14, and VC15 for maximum power output.
9. Adjust variable resistor VR5 for a relative output meter indication 3/4 of full scale.

#### D Audio Setup.

For deviation adjustment see section 2-18 or the following procedure may be used:

Connect an audio generator to the microphone input. Set the mic. gain potentiometer VR6 to maximum gain. Adjust generator output to 25 millivolts and generator frequency to 1000 Hz. Adjust the peak deviation limit potentiometer VR7 for  $\pm 5$  kHz deviation (or other desired level) as read on a deviation meter coupled to the transmitter output. Set generator output level to 3 mV. Adjust microphone gain potentiometer VR6 for  $\pm 4$  kHz deviation or 80% of the peak deviation setting.

Note: The speaker mounting bracket and crystal cover must be in place before making deviation adjustment.

#### 5-7. BATTERY CHECK METER ALIGNMENT.

- A. Turn the squelch control fully CCW to the B. CH position. Turn the power/volume control on.
- B. With a fully charged set of nickel-cadmium batteries, or with an external 13.0 volt supply connected, adjust variable resistor VR2 for a meter reading 80% of full scale.

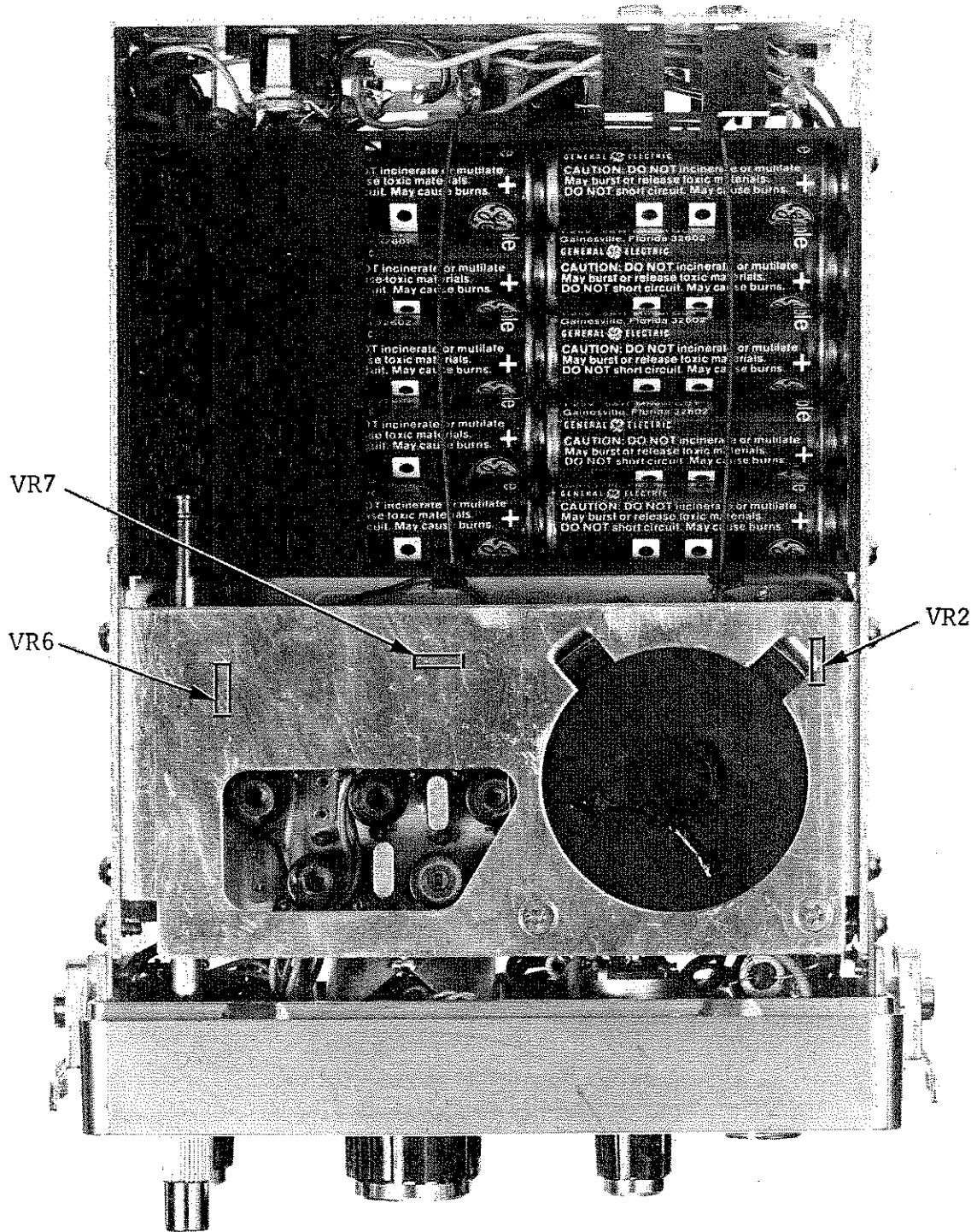


Figure 5-2. Top View With Case and Cover Removed

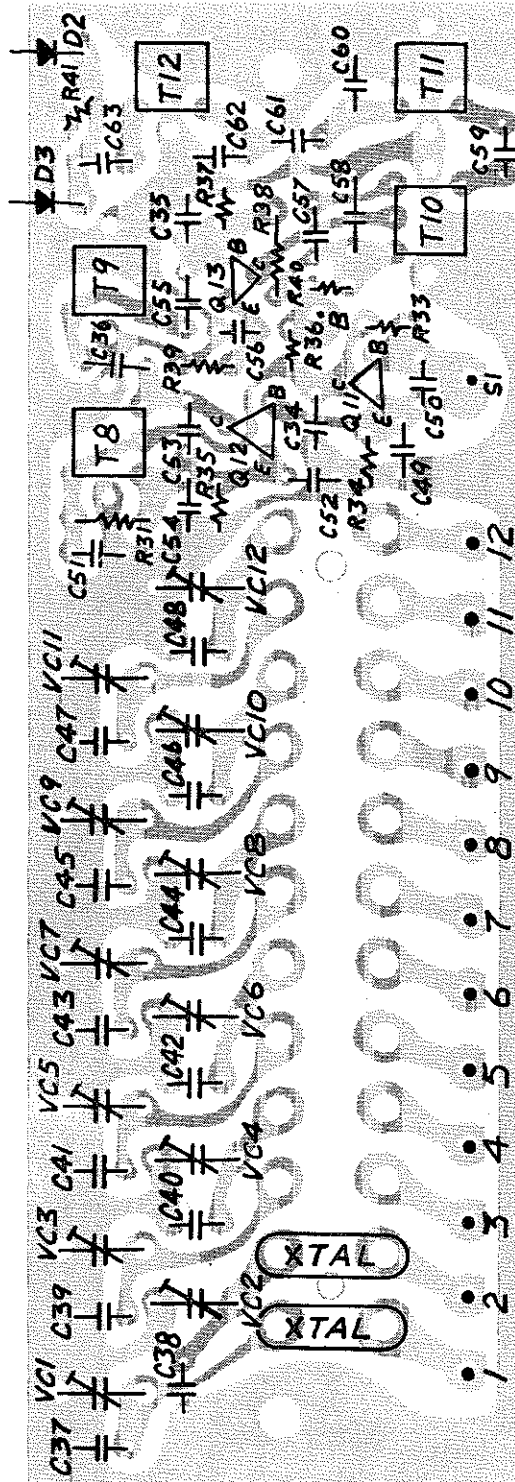


Figure 5-3. Channel Oscillator P.C. Board



*Handwritten note:* Actual board of 1968

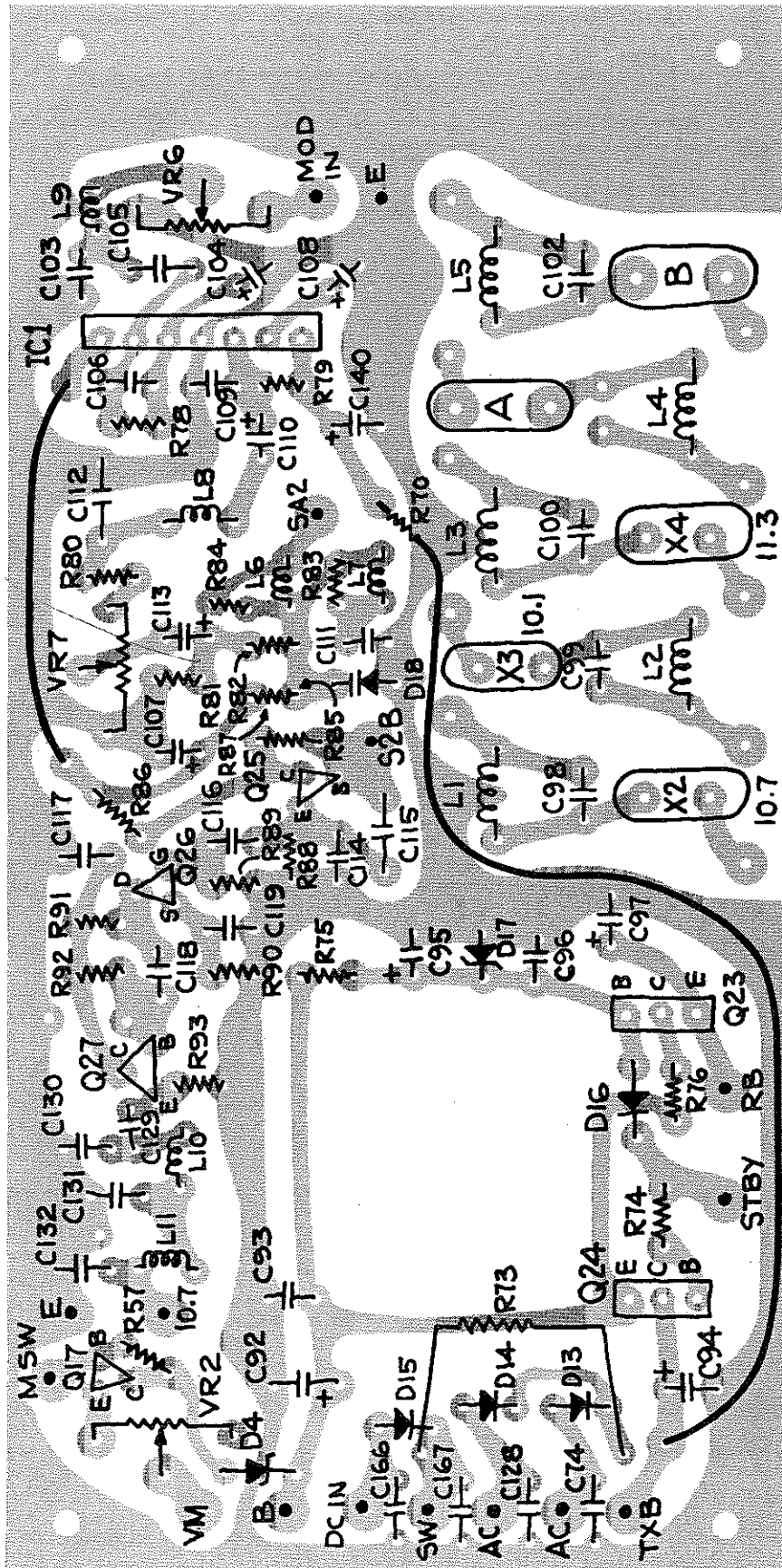


Figure 5-4. Offset OSC/MOD P.C. Board

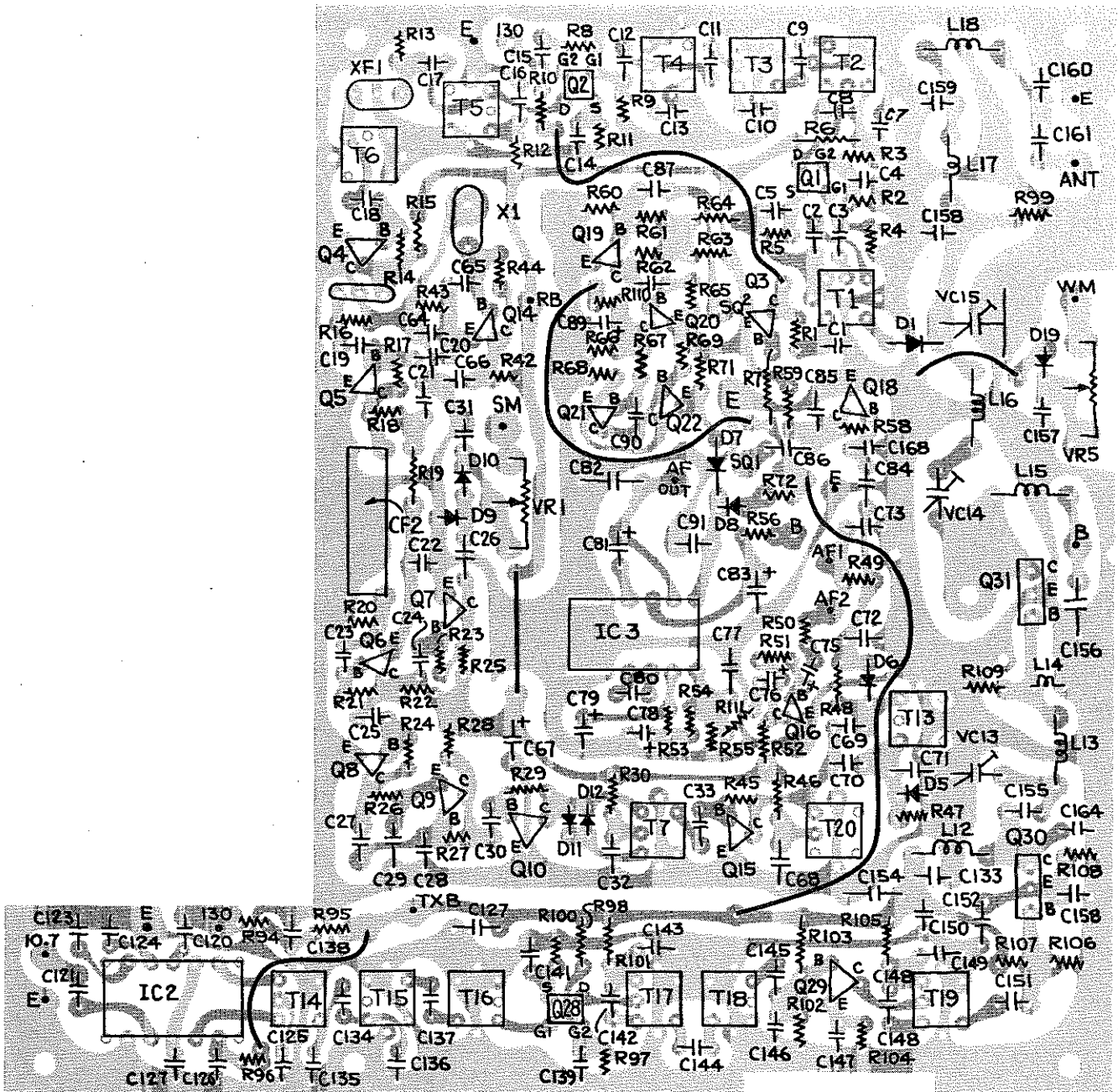
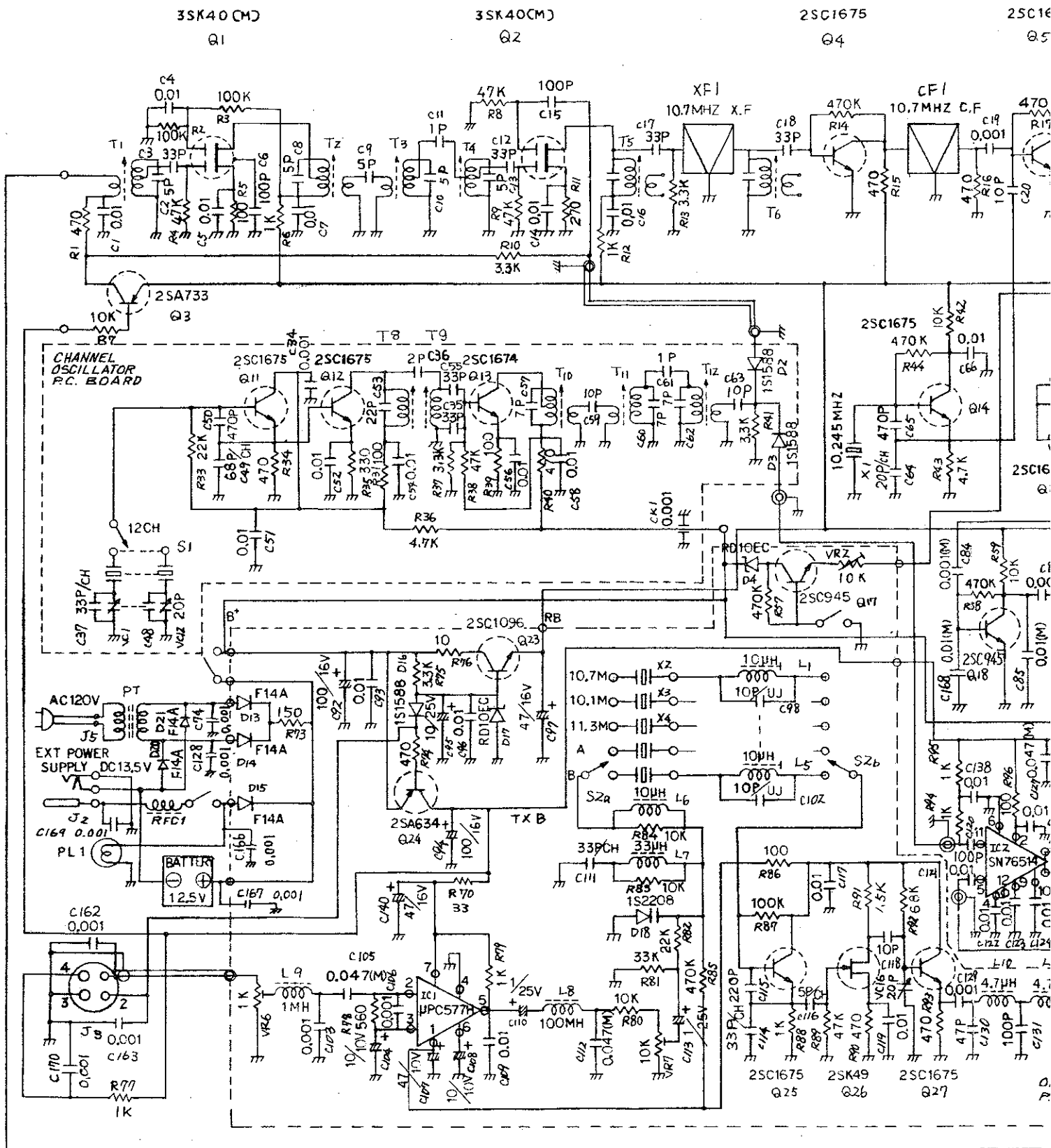


Figure 5-5. Main Transceiver P.C. Board



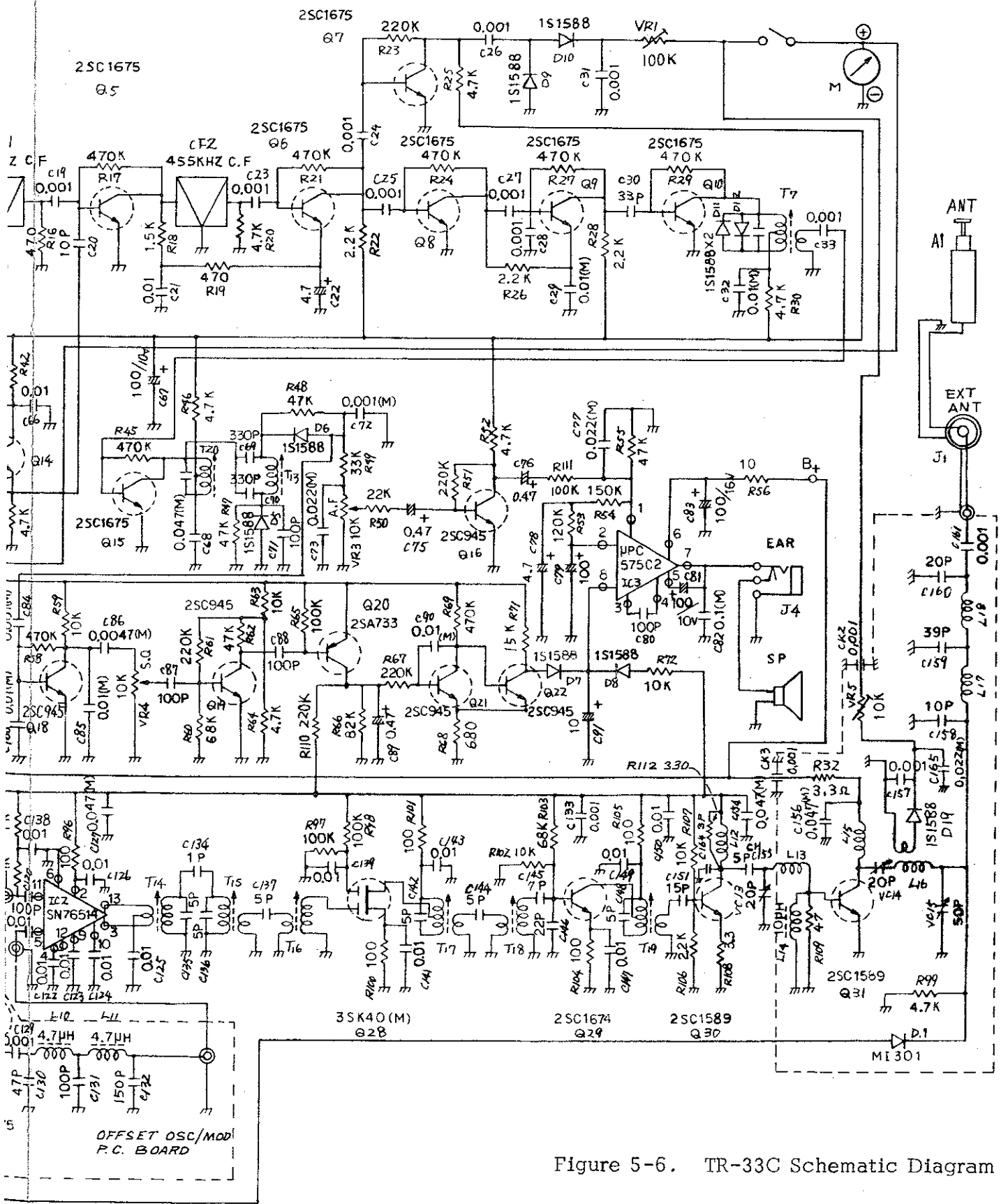


Figure 5-6. TR-33C Schematic Diagram

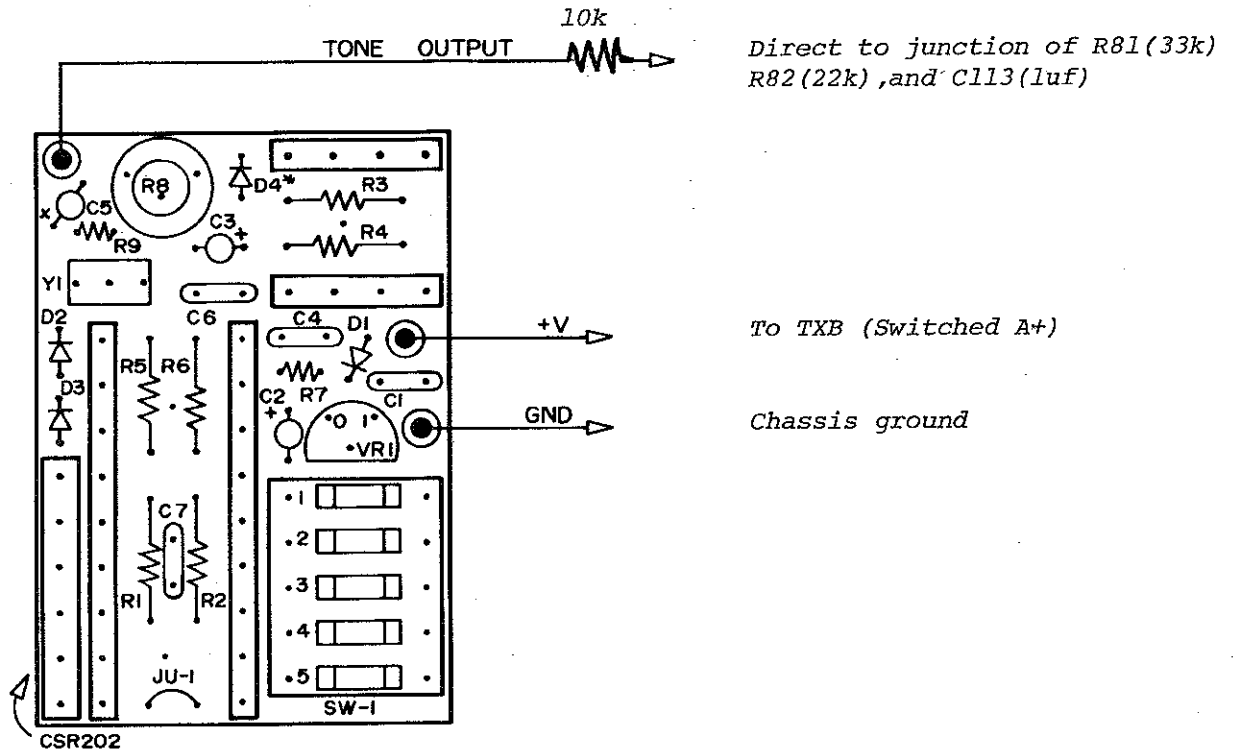


## DRAKE AMATEUR PRODUCTS

- 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.
- T-4XC* Transmitter, covers the 160 through 10 meter amateur bands and most other frequencies between 1.5 and 30 MHz. It has 8-pole crystal filters for sideband selection. It may be used to transceive with the R-4C.
- 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.
- L-4B* Linear Amplifier, 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 front panel.
- W-4* Wattmeter, reads forward and reflected power directly in Watts (VSWR from nomograph). Range: 200 and 2000 Watts full scale, 1.8 to 54 MHz.
- WV-4* Wattmeter, reads forward and reflected power directly in Watts (VSWR from nomograph). Range: 100 and 1000 Watts full scale, 20 to 200 MHz.
- TR-22C* Transceiver, 2 meter VHF-FM, portable. Twelve channels, self-contained batteries and attached microphone.
- RCS-4* Remote Coax Switch, provides remote selection of up to five antennas, using only one main feedline. Allows grounding of unused antennas. Motor driven switches controlled from station located console.
- SSR-1* General Coverage Receiver, 0.5-30 MHz continuous. All solid state.

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.





PARTS LIST

1- 10k 1/4 resistor

