



INSTRUCTION MANUAL



TR-22C

TRANSCEIVER

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CHAPTER I

INTRODUCTION

1-1. GENERAL.

The TR-22C 2 meter FM Transceiver is a versatile, compact, solid state unit for use in the 2 meter amateur band. It has 12 channel capability (2 supplied) with crystal control for transmit and receive. 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 Volts AC is built into the TR-22C. The unit may be operated with its internal telescoping whip antenna or with an external 50 Ohm antenna. The receiver section employs a monolithic crystal filter at the first IF to reduce intermodulation products and to improve adjacent channel selectivity.

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 all critical circuits and networks.
Chapter V	Maintenance. Provides sufficient information for servicing by an experienced electronics technician including component location illustrations and a complete schematic diagram.

CHAPTER 1
INTRODUCTION

1-1. GENERAL
The TR-22C is a portable, rugged, self-contained, and reliable transceiver. It has 12 channels (6 transmit and 6 receive) and is designed for use in the field. It is powered by a 12-volt battery and has a built-in speaker. The TR-22C is designed for use in the field and is rugged enough to withstand the most severe conditions. It is also designed for use in the laboratory and is suitable for use in the classroom.



Figure 1-1. TR-22C Transceiver

SPECIFICATIONS

GENERAL:

Frequency Coverage:	144 through 148 MHz. 12 Channels, 2 supplied
	(1) Receive: 146.52 MHz
	Transmit: 146.52 MHz
	(2) Receive: 146.94 MHz
	Transmit: 146.34 MHz
Power Requirements:	13.0 Volts DC \pm 15%
Current Drain:	Transmit: 450 mA
	Receive: 45 mA
Antenna Impedance:	50 Ohms
Dimensions:	5-3/8" x 2-5/16" x 7-1/2"
Weight:	3.75 lbs (1.7 kg)
RECEIVER:	
Sensitivity:	Typically .5 microvolt for 20 dB quieting
IF Selectivity:	20 kHz at 6 dB down; \pm 30 kHz channel rejection greater than 75 dB down.
First IF:	10.7 MHz with 2-pole monolithic crystal filter.
Second IF:	455 kHz with ceramic filter.
Intermodulation Response:	At least 60 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:	1 Watt minimum
Frequency Deviation:	Adjustable to \pm 10 kHz maximum, factory set to \pm 6.0 kHz.
Multiplication:	12 Times

CHAPTER II

PREPARATION FOR USE

2-1. UNPACKING.

Carefully remove the TR-22C 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-22C 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-22C is not critical. However, extremely hot locations should be avoided and free circulation of air should be provided around the unit.

The TR-22C is furnished with a carrying case and 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-22 is available from the R. L. Drake Company at a nominal cost (see figure 2-2). The MMK-22 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-22C 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-22C for connection to an external 50 Ohm antenna, if desired. The self-contained antenna should be retracted whenever an external antenna is in use.

2-4. SPEAKER AND HEADPHONE REQUIREMENTS.

The TR-22C has a built-in speaker. An external 8 Ohm headphone or speaker may be plugged in the miniature phone jack located on the front panel just above the microphone jack. A miniature plug is furnished for this connection. Plugging an external speaker or headphone into this jack disables the built-in speaker.

2-5. MICROPHONE REQUIREMENTS.

A 500 Ohm dynamic microphone with a push-to-talk switch is supplied with the TR-22C.

2-6. POWER REQUIREMENTS.

The TR-22C 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-22C is used for this purpose. When the DC power cord is plugged into the TR-22C, the internal batteries are disabled but may be recharged from 120 Volts AC with the built-in charger. For AC operation of the TR-22C, 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-22C. The AA-10 Amplifier may be housed inside the case of the AC-10 Power Supply and, with the TR-22C positioned on top of the AC-10 cabinet, an efficient, compact arrangement results.

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

The TR-22C is shipped with ten Ni-Cad batteries. These batteries should be inserted into one 4-cell and one 6-cell holder (supplied with the TR-22C) and installed. The batteries should be charged before using the TR-22C. Charging is performed by plugging the AC cord supplied into the rear of the TR-22C and into a 120 Volt AC outlet. The batteries should be charged whenever the battery check meter reaches the right hand edge of the red scale. Battery condition may be checked by turning the TR-22C on and rotating the squelch control fully counterclockwise into the Battery Check position labeled B. CH. Battery condition should be checked each time before using the TR-22C and operation suspended if the battery condition is not within the black scale. Do not charge the batteries longer than 16 hours. Do not completely discharge the batteries (below 5 on the meter scale) because if discharged too far, the weakest cell in the string may reverse polarity and become permanently damaged. The TR-22C must be turned off in order for the batteries to take a charge unless the DC power cord has been inserted into the rear DC connector. Operation from the batteries while charging will result in a hum on the transmitted signal and the batteries will be further discharged because the charger can supply only 45 mA while 450 mA is required for transmitting. The receiver draws 45 mA squelched; therefore, no battery condition improvement can be expected while simultaneously charging and receiving unless an external DC supply is connected to power the TR-22C.

2-8. USE OF CARBON ZINC BATTERIES.

The TR-22C is supplied with an extra 4-cell battery holder so that it may be operated from penlite dry cells. Remove all of the Ni-Cad batteries. Fill both 4-cell battery holders with dry cells and install the 8 batteries in the TR-22C. Do not use more than 8 dry cells. Do not charge the dry cells with the TR-22C charger. Do not leave discharged dry cells in the TR-22C. Do not store the TR-22C for long periods with the dry cells installed and use only leakproof dry cells in the TR-22C.

2-9. USE OF ALKALINE BATTERIES.

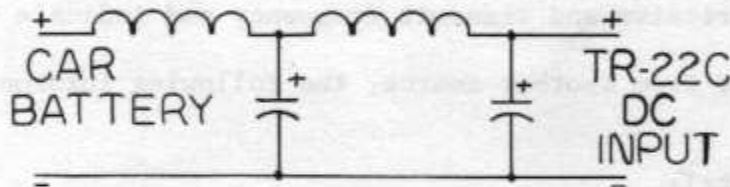
Alkaline batteries may be used in the TR-22C. A new set of alkaline AA batteries may last up to four times as long as one charge on Ni-Cad batteries. Alkaline batteries are very useful for operating the TR-22C when away from a source of power to recharge the Ni-Cad batteries. Only 8 alkaline batteries are required and these should be installed in the two 4-cell battery holders supplied with the TR-22C. The alkaline batteries should not be recharged unless the battery manufacturer states that they are rechargeable. Do not leave discharged cells in the TR-22C.

2-10. EXTERNAL AC POWER.

A. C. operation of the TR-22C 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-22C 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 capacity to power the AA-10, ten Watt amplifier, in addition to the TR-22C.

2-11. AUTO GENERATOR/ALTERNATOR NOISE.

Some automobile electrical systems are not sufficiently filtered and a slight buzz in the TR-22C signal may be reported when operating mobile from the auto battery. 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 ufd @ 15 V or more,
- Chokes - 1 mH or more @ 1/2 amp.

Figure 2-1. Noise Suppression Network

2-12. EXTERNAL DC SOURCE.

The TR-22C may be operated from an external 13 Volt \pm 15 % source by plugging the the DC cable supplied into the DC connector on the rear of the TR-22C. The wire with 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.

2-13. INSTALLING TRANSMIT CRYSTALS.

With the front panel facing you and the TR-22C upside down, transmitter crystals correspond to the channel numbers and are numbered left to right, 1 through 12. Crystal sockets are those located closest to the frequency adjusting trimmers.

2-14. FREQUENCY ADJUSTMENT.

Refer to figure 5-2. The bank of trimmer capacitors in back of the transmit crystal sockets allow transmit frequency adjustment left to right, channels 1 through 12. While transmitting, adjust the trimmer capacitor for correct frequency as observed on a frequency counter or a calibrated receiver.

2-15. INSTALLING RECEIVE CRYSTALS.

Refer to figure 5-2. With the front panel facing you and the TR-22C upside down, receiver crystals correspond to the channel numbers and are numbered left to right 1 through 12. No frequency adjustment is required for receive crystals.

2-16. TRANSMIT CRYSTAL JUMPERS.

One transmit crystal can be used on two channels by connecting a jumper wire from the terminal lug in front of the transmit crystal to the lug of the channel desired to be repeated. With the front panel facing you and the TR-22C upside down, the terminal lugs correspond to the channel numbers and are numbered left to right, 1 through 12.

2-17. RECEIVE CRYSTAL JUMPERS.

One receive crystal can be used on two channels by connecting a jumper wire from the terminal lug in front of the receive crystal to the lug of the channel that is desired to be repeated. With the front panel facing you and the TR-22C upside down, the terminal lugs correspond to the channel numbers and are numbered left to right 1 through 12.

2-18. CRYSTAL ORDERING INFORMATION.

Accessory channel crystals may be ordered from the R. L. Drake Company. To order, specify the desired receive and transmit frequency and indicate that they are for the TR-22C.

If you order crystals from another source, the following information should accompany your order:

a. Transmit Crystals

Fundamental mode parallel resonant with 42 pf load capacity in HC-25/U plug-in holder, and $\pm 0.003\%$ frequency tolerance.

R_s less than 25 Ohms.

Divide transmit frequency by 12 to obtain crystal frequency.

b. Receive Crystals

Parallel resonant, 3rd overtone mode with 35 pf load capacity in HC-25/U plug-in holder and $\pm 0.001\%$ frequency tolerance or better.

R_s less than 30 Ohms.

Crystal frequency = $\frac{\text{Operating frequency in MHz} - 10.7 \text{ MHz}}{12}$

3

2-19. 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.

2-20. DEVIATION CONTROL.

The deviation is factory set for peak limiting at ± 6 kHz. This setting may be increased or decreased by adjusting control VRT2 located about 2-1/2 inches back from the front towards the right side of the transmitter circuit board. As viewed from the front panel, rotation of VRT2 clockwise decreases deviation, rotation counterclockwise increases deviation. 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 ± 5 and ± 7 kHz) on a peak-reading deviation meter 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.

2-21. MICROPHONE GAIN CONTROL.

The peak deviation adjustment described in the above paragraph should be made before adjusting the microphone gain. Control VR1 adjusts the microphone gain. With the TR-22C upside down VR1 is located just to the right of the receiver crystal bank at the front edge of the transmitter circuit board. Rotation of the control clockwise as viewed from the volume control side of the unit increases gain.

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 50% of the peak value which was used in setting the deviation control. See paragraph 5-5. h. for additional information if using an audio generator for set up.

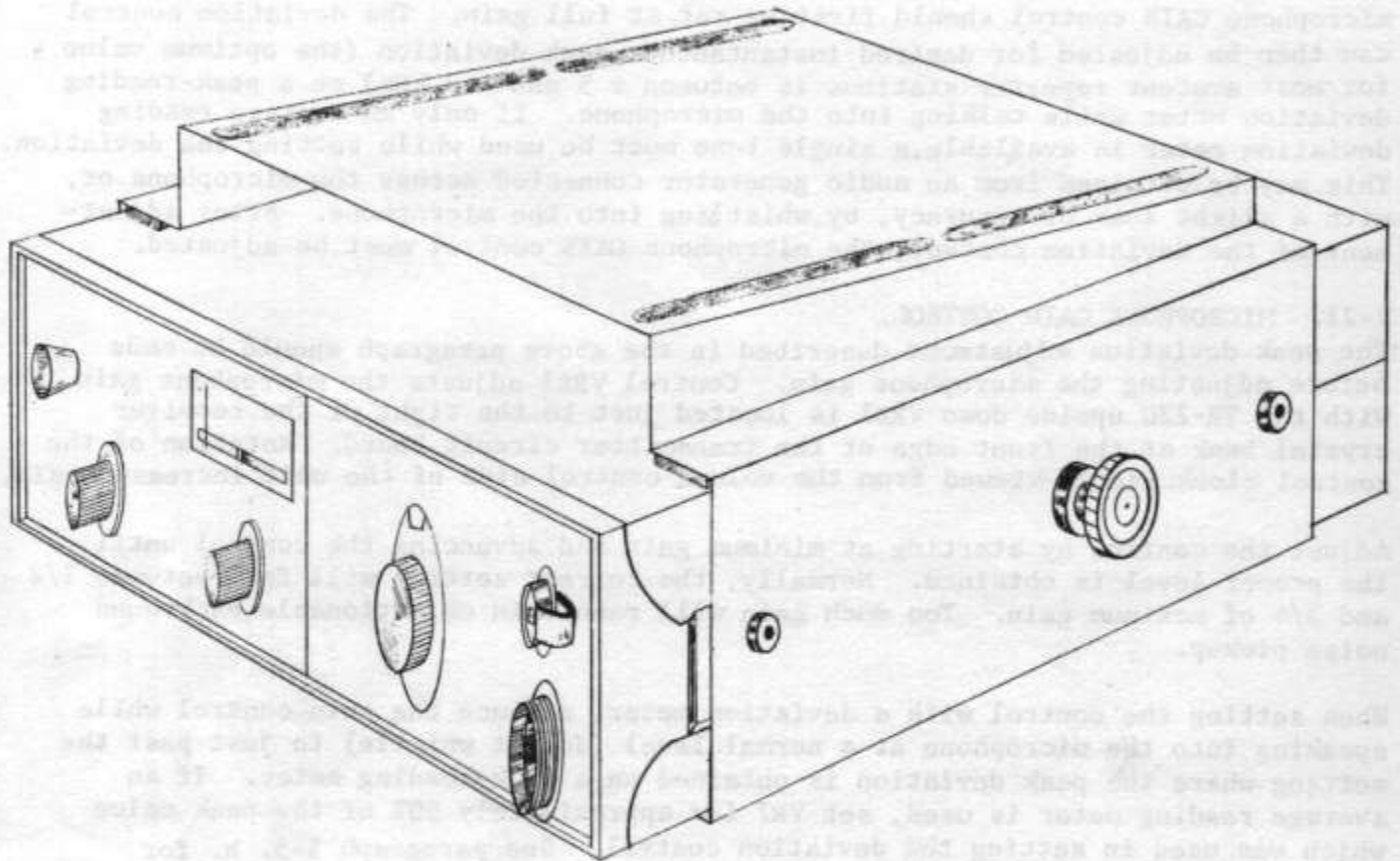


Figure 2-2. MMK-22 Mounting

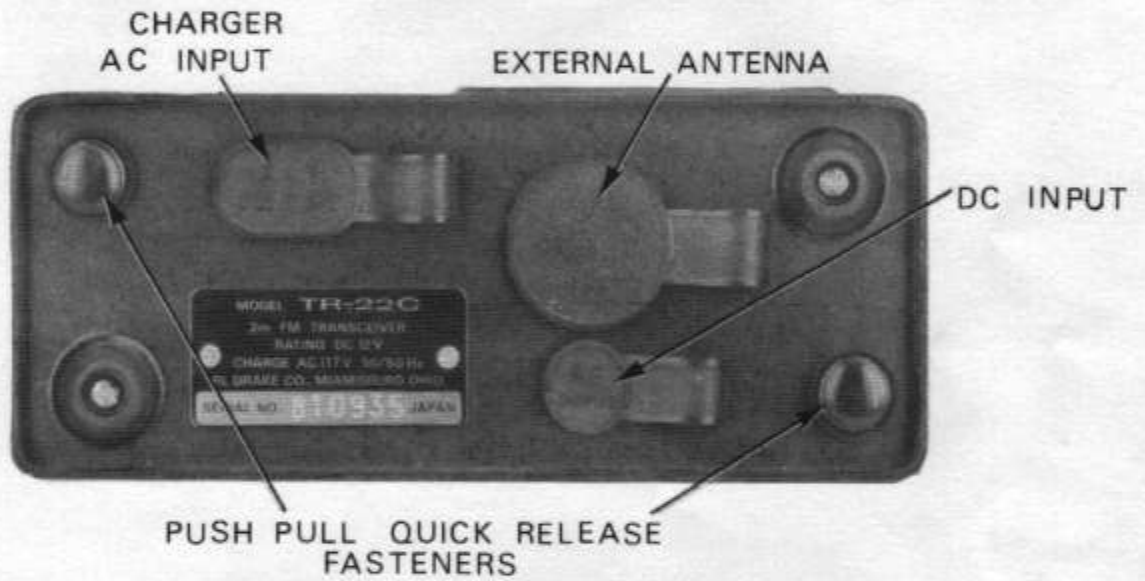


Figure 2-3. Rear Connectors

CHAPTER III

OPERATION

3-1.

The TR-22C is operated by turning the ON-OFF switch to ON, extending the built-in antenna and rotating the SQUELCH control clockwise until the receiver is muted. A channel with no stations transmitting must be selected in order to set the squelch control. An external antenna may be plugged into the connector on the rear of the TR-22C.

When using an external antenna, the built-in antenna must be retracted. Do Not transmit on the TR-22C with no external antenna connected and with the built-in antenna retracted. The TR-22C transmits when the button on the microphone is depressed.

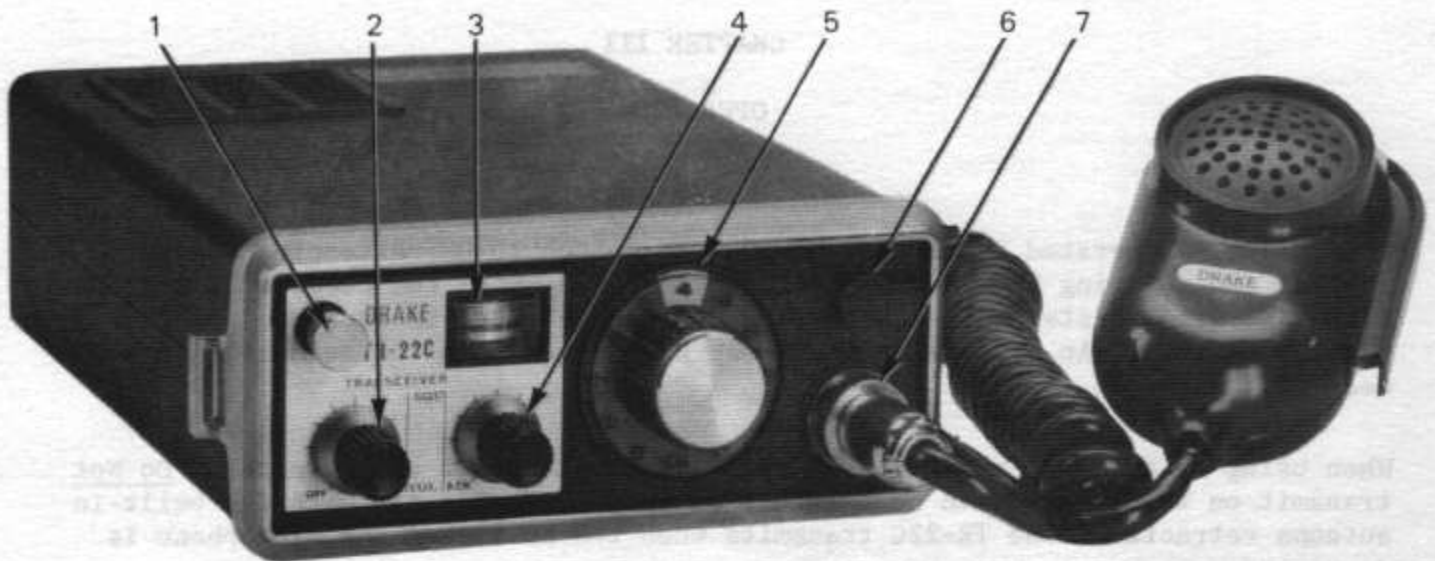


Figure 3-1. Front Panel Controls

1. Telescoping Whip Antenna: extends 18 inches.
2. On-Off switch and Volume control: Clockwise rotation turns the unit and increases receiver audio gain.
3. Signal Strength Meter, Relative Output Indicator and Battery Check Indicator: Graduated in relative units, 1 through 10 to indicate signal strength on receive and relative RF output on transmit. Red and black color bands indicate weak (Red) or adequate (Black) battery voltage level when squelch control (4) is in the B. CH position.
4. Squelch control and Battery check: Clockwise rotation increases signal level required to defeat the squelch circuit and allow reception. Full counter-clockwise position, labeled B. CH, displays battery strength on meter (3) when On-Off switch (2) is turned on.
5. Channel Selector: Selects one of twelve possible transmit and receive crystal pairs.
6. Headphone jack: Provides a connection for external 8 Ohm headphone or speaker.
7. Microphone connector: Provides a connection for microphone.

CHAPTER IV

THEORY OF OPERATION

4-1. RECEIVER SECTION.

Refer to schematic diagram figure 5-5. On receive, signals entering the antenna jack pass through the low-pass filter consisting of Lt21 and Lt22 and associated capacitors. Diodes Dt3 and Dt4 are not biased and thus allow the signal to pass through Lt20 to receiver RF amplifier input transformer Ls1. The signals in the two meter band are amplified by Qs1 and then coupled to the first mixer through the two tuned circuits Ls2 and Ls4. Injection at 10.7 MHz below the desired receive frequency is also coupled to the first mixer from tripler Rs8 through tuned circuits Ls9 and Ls10. Qs7 is a parallel mode crystal oscillator operating at 1/3 the injection frequency. Output from this oscillator is coupled from collector coil Ls8 to the base of the tripler Qs8.

Returning to the first mixer, Qs2, the collector is tuned to the IF frequency of 10.7 MHz by tuned circuit Ls5. A link on Ls5 couples to the 10.7 MHz monolithic crystal filter. Signals within the passband of this filter are then coupled to IF amplifier Qs3 via Ls17. The 10.7 MHz amplified output of Qs3 is coupled to second mixer Qs4 via Ls6 where it is mixed with output from the 10.245 MHz oscillator Qs9.

The difference frequency of 455 kHz appears at the collector of Qs4 and is further filtered by ceramic filter CFs2. This ceramic filter and the 10.7 MHz monolithic crystal filter mentioned above provide the basic selectivity of the receiver. Output of the ceramic filter is amplified and limited by stages Qs5 and Qs6 and coupled to the limiter integrated circuit Qs10 via Ls7. RF at the output of Qs6 is sampled by the diodes Ds1 and Ds2 to provide signal strength indication on the front panel meter. The limited output of Qs10 is applied to the ratio detector circuits Ls12, Ls13, Ds3, Ds4 and associated resistors and capacitors. High frequency noise components are filtered from the audio output of the detector by Ls14, Cs50, Cs51 and Ls15. These noise components are amplified by Qs13 and Qs14 and rectified by diodes Ds10 and Ds11. When noise is present due to absence of a signal, the DC output from Ds10 and Ds11 forward-biases Qs15 which shorts out the audio at the base of Qs16. The audio at the base of Qs16 is coupled from detector through low-pass filter and de-emphasises network Rs42 and Cs53. Qs16 is the audio preamplifier which drives the audio output integrated circuit through volume control VRs1.

4-2. TRANSMITTER SECTION.

On transmit, oscillator Qt1 oscillates at the crystal frequency in the 12 MHz range. Output from this oscillator is coupled to buffer stage Qt2. Output from Qt2 is then phase-modulated by the phase-modulation circuitry Lt1, Lt2, Ct11 etc. Audio is applied to the phase-modulator through network Rt32, Ct49, Ct50 and Ct51. Audio from the microphone is amplified and limited by integrated circuit Qt7. The output from the phase-modulator is amplified by Qt3 and coupled to doubler Qt4. The output of Qt4 at approximately 24 MHz is coupled to tripler Qt5. The 72 + MHz output of Qt5 is coupled to Qt6 and doubled to the 2 meter band. Stages Qt8 and Qt9 amplify the power level to the 1 Watt level. Diode Dt3 is forward-biased and couples the RF output to the low-pass filter and then to the antenna. Diode Dt4 is also forward-biased and prevents RF from the transmitter from reaching the receiver.

Transistors Qs11 and Qs12 electronically switch the supply voltage from the receiver to the transmitter stages when the push-to-talk switch is depressed.

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

5-2. DISASSEMBLY AND REASSEMBLY.

To remove the TR-22C from its outside case, pull out on the two quick-release fasteners which are on the rear panel opposite the rubber feet. Then slide the TR-22C out of its 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 address given above. When ordering replacement parts specify the serial number of your TR-22C, the schematic reference designations assigned to the components, and their values, tolerances, and voltage ratings, as applicable.

5-4. TEST EQUIPMENT.

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

- a. Deviation Meter
- b. Audio Generator (low impedance output)
- 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

5-5. TRANSMITTER ALIGNMENT.

- a. Connect the TR-22C to a power supply set at 13.0 Volts. Connect an RF watt-meter and a 50 Ohm dummy load to the external antenna connector. Set channel selector to 146.52 MHz.
- b. Connect an 11 megohm VTVM to the base of Qt4. Refer to figure 5-2. Scrape insulation from lead of base resistor. Key transmitter with the microphone push-to-talk switch and adjust Lt1 and Lt3 for maximum negative voltage as indicated by the VTVM.
- c. Adjust Lt2 for minimum negative voltage.
- d. Connect the VTVM probe to the base of Qt5 and adjust Lt4 and Lt5 for maximum negative voltage as indicated by the VTVM.
- e. Connect the VTVM probe to the base of Qt6 and adjust Lt6 and Lt7 for maximum negative voltage.
- f. Connect the VTVM probe to the base of Qt8 and adjust Lt8, Lt9 and Lt10 for maximum negative voltage.
- g. Disconnect the VTVM and adjust Tct1 and Tct2 for maximum RF output power. For less battery drain, tune Tct2 in the direction that reduces current drain until RF output drops 0.2 Watt.
- h. Connect an audio generator to the microphone connector. Set VRT1 to maximum. Adjust the generator so that it has an output of 25 mV at 1000 Hz. Adjust the deviation control VRT2 for peak deviation of ± 6 kHz as indicated on a deviation meter. Adjust the audio generator for an output of 5 mV. Adjust VRT1 for a deviation of ± 3.8 kHz as indicated by a deviation meter.
- i. With the transmitter keyed, reduce power supply voltage to 12.5 Volts or use a fully charged set of Ni-Cad batteries. Adjust VRT3 until the front panel meter indicates a relative output reading of 8.

5-6. RECEIVER ALIGNMENT.

5-7. LOCAL OSCILLATOR COIL.

- a. Set channel selector to 146.52 MHz.
- b. Turn the slug in Ls8 clockwise until the oscillator just stops oscillating.
- c. Turn the slug in Ls8 counterclockwise 360 degrees.
- d. Switch the Channel Selector between channels and make sure the receiver crystals start oscillating consistently on all channels. If not, slightly readjust Ls8 until the oscillator starts consistently.

5-8. RF ALIGNMENT.

- a. Connect a signal generator set at 146.52 MHz to the antenna connector. Set level for approximately half scale deflection on the signal strength meter.
- b. Adjust Ls1, Ls2, Ls4, Ls9, Ls10 and Tct3 for a maximum signal strength meter reading. Tct3 is located on the transmitter P. C. board.

5-9. 10.7 IF ALIGNMENT

- a. Connect the FM signal generator to the antenna connector.
- b. Set FM generator modulation to ± 10 kHz deviation with 1 kHz tone.
- c. Tune generator to the center of the receive channel and adjust level for half scale deflection of TR-22C signal strength meter.
- d. Tune Ls5, Ls17 and Ls6 for a maximum meter indication.

5-10. RATIO DETECTOR.

- a. Connect the FM generator to the antenna connector.
- b. Tune generator to center of a received channel. Set signal level to obtain a reading of 10 on the signal strength meter.
- c. Set FM generator modulation to ± 5 kHz deviation.
- d. Connect oscilloscope to TR-22C audio output, available at the jack on the front panel.
- e. Adjust Ls12 for maximum audio output.
- f. Adjust Ls13 for most symmetrical sine wave output. Make sure generator frequency is tuned to the exact center of received channel.

5-11. S METER ADJUSTMENT.

- a. Connect the signal generator with an output level of 50 μ V to the antenna connector.
- b. Adjust VRs1 on receiver board for a meter reading of 10.

5-12. BATTERY CHARGE INDICATOR ADJUST.

Set squelch control to the B. CH position. Set the power supply voltage to 10.8 Volts and adjust VRs3 so that meter reads on the border between red and black areas.

5-13. SQUELCH THRESHOLD ADJUST.

Set channel selector to a channel with no signal present. Adjust VRs2 on receiver P. C. board so that the receiver squelches when the front panel SQUELCH control is positioned somewhere between 11 o'clock and 2 o'clock.

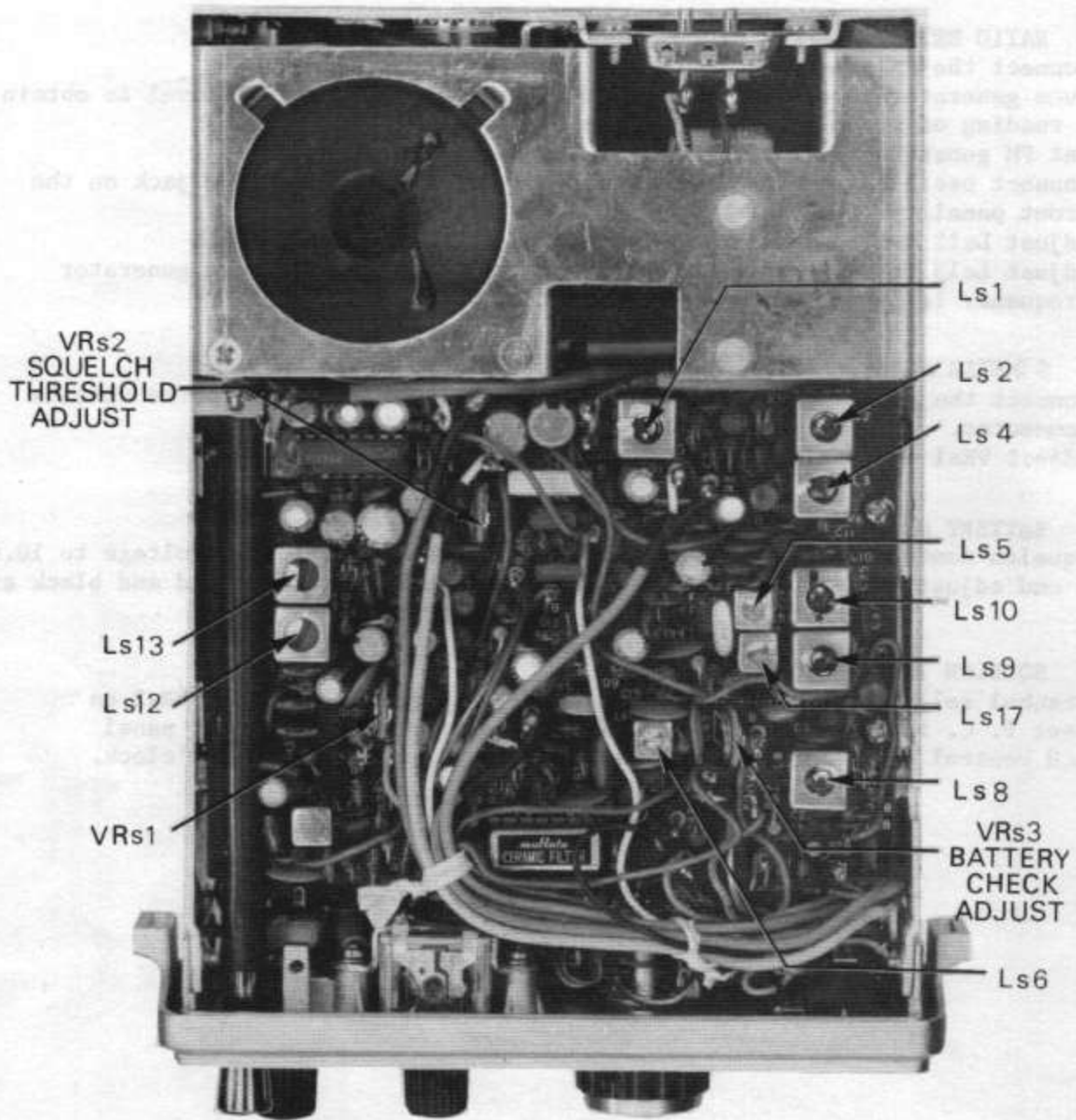


Figure 5-1. Receiver Section, Top View

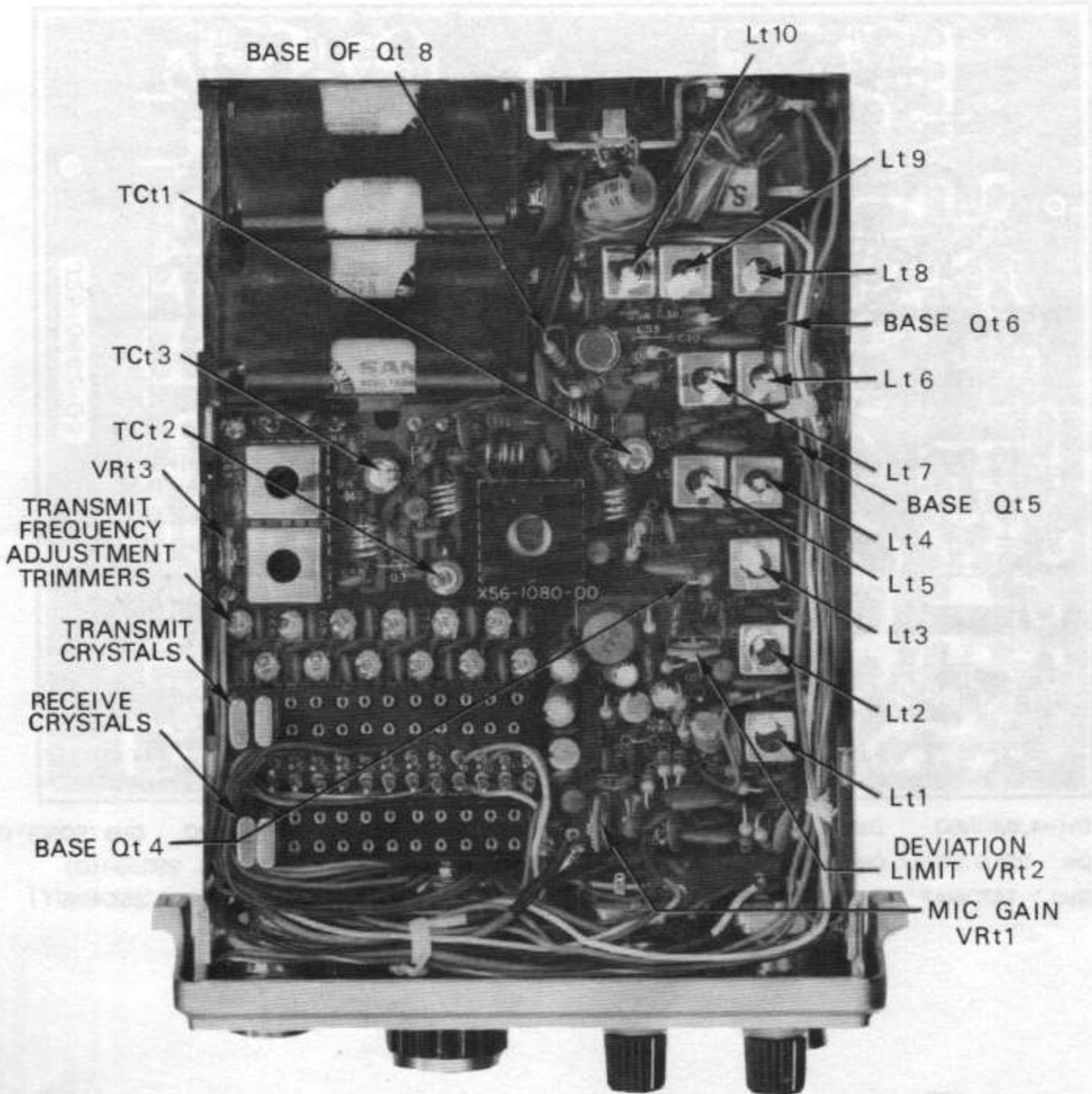
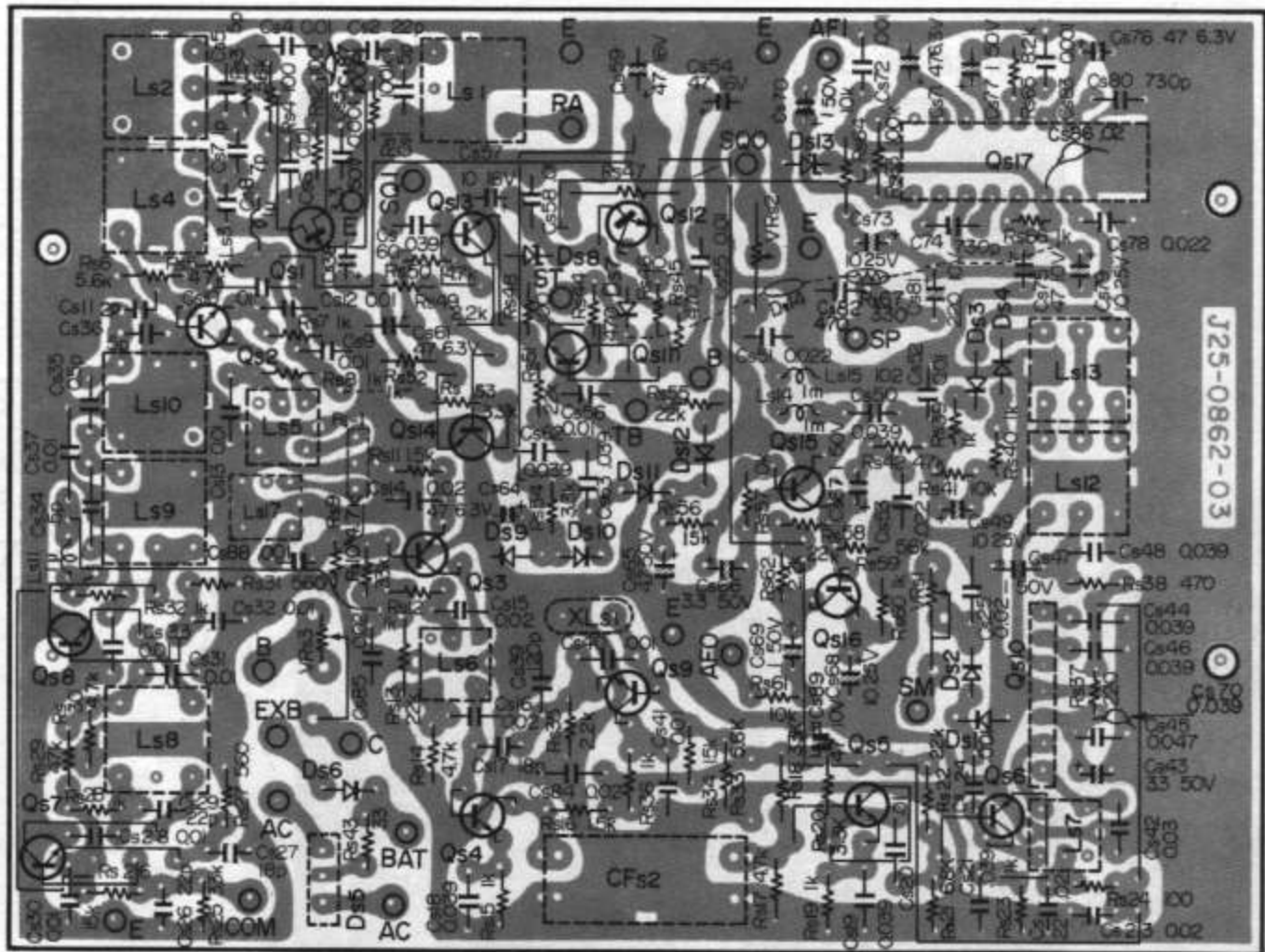
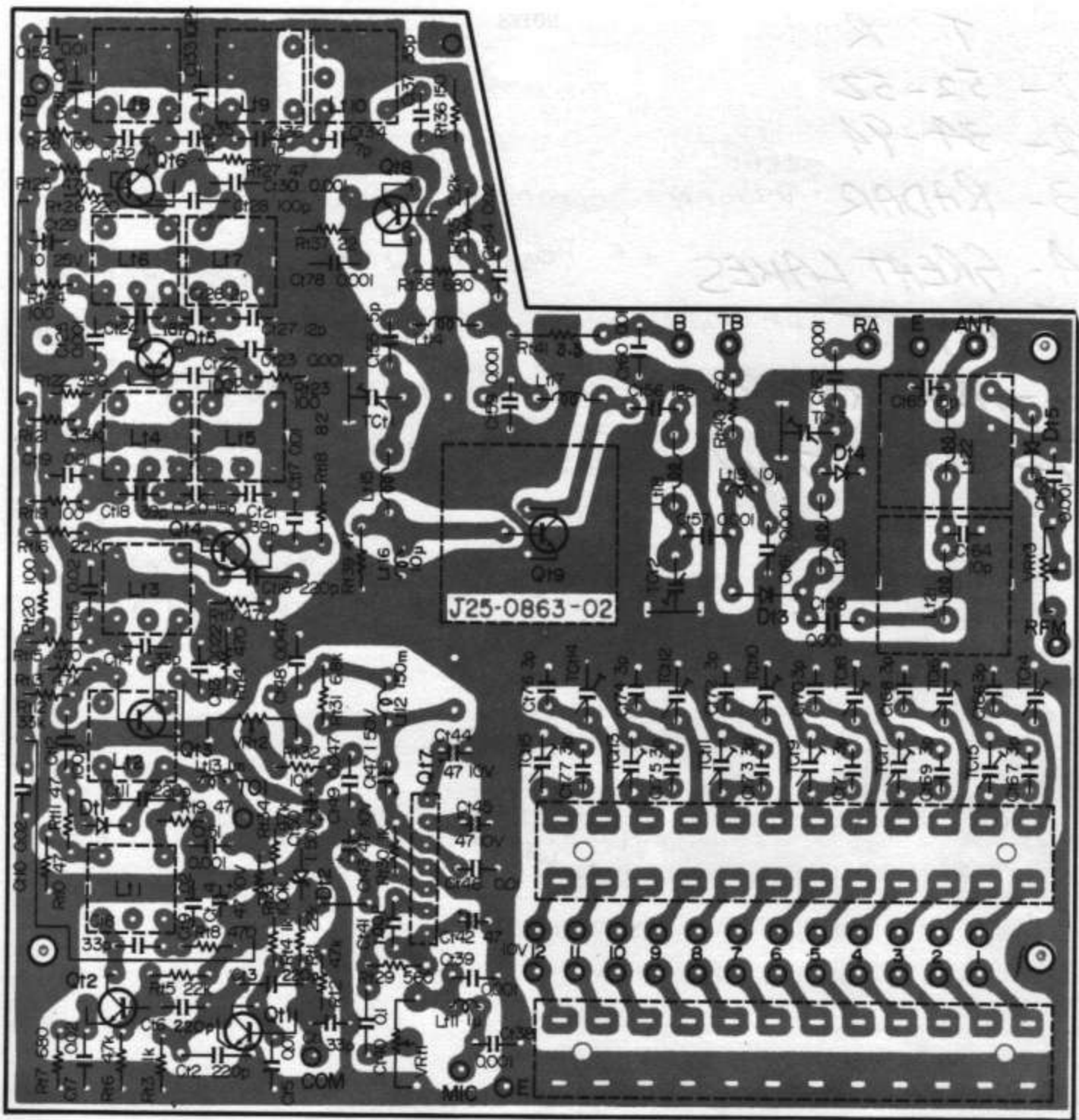


Figure 5-2. Transmitter Section, Bottom View



Ds1~4,10,11:IN60 Ds5 : DS-17 Ds6 : SRIFM-2 Ds7,9,12,14:SI555 Ds8 : WZ-090 Ds13 :EQBOI-17
 Qs1 : 2SK19(GR) Qs2 : 2SC388A Qs3,4 : 2SC372 Qs5~7,9 : 2SC460(B) Qs8 : 2SC384(O)
 Qs10 : TA706IAP Qs11 : 2SA496(Y) Qs13~16 : 2SC733Y Qs17 : μ PC-20C Qs12:2SC496(Y)

Figure 5-3. Component Locations, Receiver Section



Dt1 : ISI658-1 Dt2 : WZ-090 Dt3,4 : MI30I Dt5 : IN60 Qt1~3 : 2SC460
 Qt4 : 2SC535(B) Qt5,6 : 2SC388 A Qt7 : TA706IAP Qt8 : 2SC74I Qt9 : 2SC1479

Figure 5-4. Component Locations, Transmitter Section

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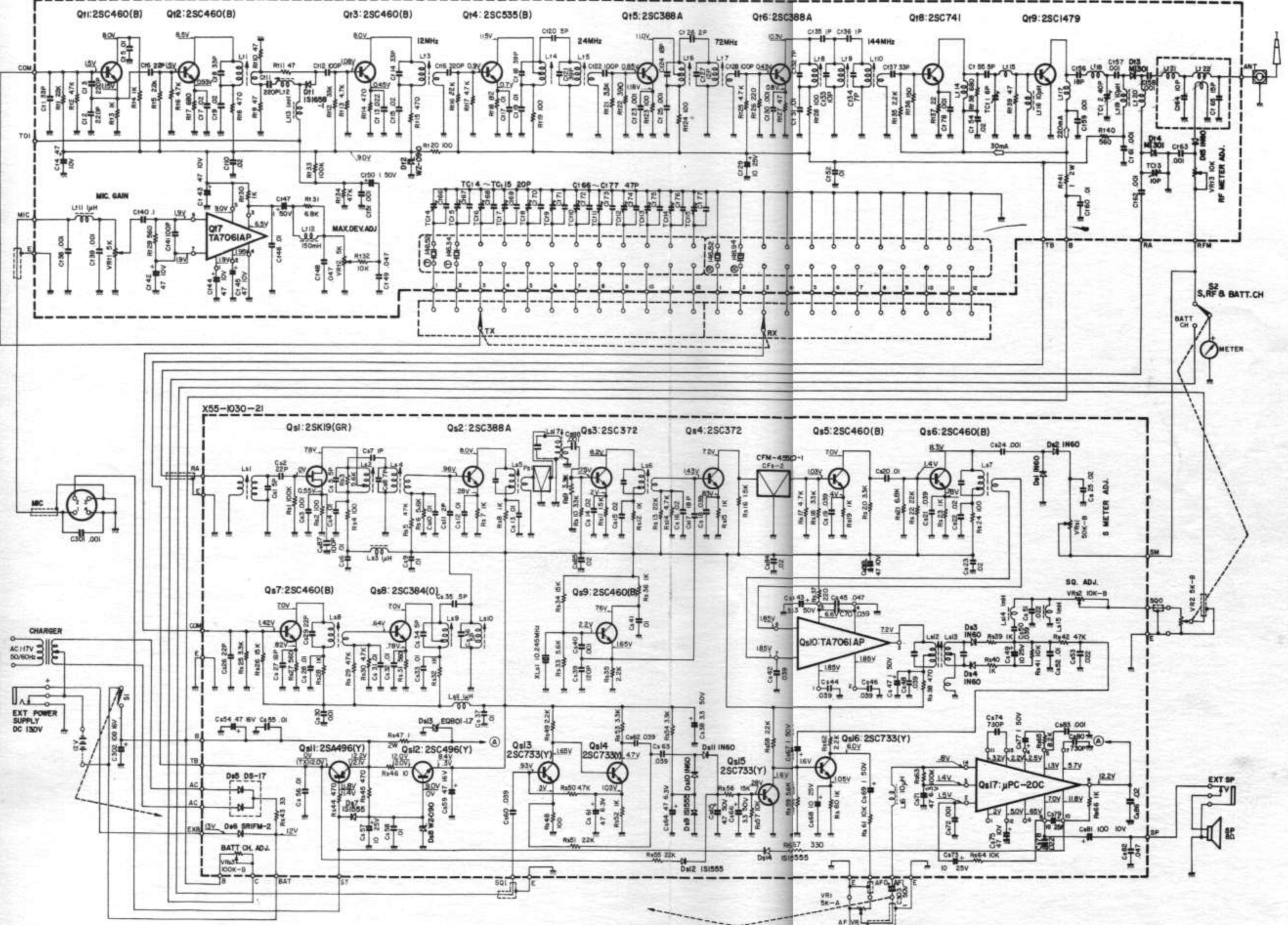


Figure 5-5. TR-22C Transceiver Schematic Diagram