PRICE $2.50

# SERVICE MANUAL


## PACE MODELS
## CB 110, 115 AND 125
## HANDHELD TRANSCEIVERS
## 27 MHz CITIZENS BAND

PATHCOM INC.
PACE TWO-WAY RADIO PRODUCTS
24049 S. Frampton Ave., Harbor City, California 90710

L2097-776

## TABLE OF CONTENTS

# LIST OF TABLES



# LIST OF ILLUSTRATIONS

# SECTION I
# GENERAL INFORMATION

## 1.1 GENERAL DESCRIPTION

This manual contains service and maintenance instructions for the PACE Models CB 110, CB 115 and CB 125 hand held Citizens Band transceivers manufactured by PATHCOM INC.

The circuits for these three units are approximately the same. Therefore, the tuning procedure and circuit descriptions will follow the circuit of the CB 125 transceiver since it is the most complex.

A comparison of the three units is given in Table 1-1.

**Table 1-1**
**Model Comparison Chart**

| FEATURE | CB 110 | CB 115 | CB 125 |
|---|---|---|---|
| RF Input | 1 W/100 mW | 1.5 W | 2.5 W |
| Battery Indicator | No | No | Yes |
| Speaker | Combined with Microphone | Combined with Microphone | Yes |
| Microphone | Combined with Speaker | Combined with Speaker | Yes |

**Table 1-2**
**Specifications CB 110/115/125**

### GENERAL

| | |
|---|---|
| Number of Channels | 3 channels |
| Frequency Range | 26.965 to 27.255 MHz |
| Frequency Tolerance | ± .0002% from −10 °C to +50 °C |
| Supply Voltage | 12.0 V DC nominal (Positive Ground) |
| Dimensions | 7-3/4" H x 2-3/4" W x 2" D |
| Weight | 1.8 lbs. |

### TRANSMITTER

| | | |
|---|---|---|
| Compliance | (CB 110) | FCC Type Number PACE CB 110, Part 95 |
| | (CB 115) | FCC Type Number PACE CB 115, Part 95 |
| | (CB 125) | FCC Type Number PACE CB 125, Part 95 |
| Power Input | (CB 110) | 1 W/100 mW |
| | (CB 115) | 1.5 W |
| | (CB 125) | 2.5 W |
| Impedance (at External Antenna) | | 50 Ω |
| Harmonic Suppression | | −47 dB |

### RECEIVER

| | |
|---|---|
| Sensitivity | Approximately 0.8 μV @ 10 dB $\frac{s+n}{n}$ |
| Squelch Sensitivity | 1.6 μV |
| AGC Characteristics (Input 74 dB) | 57 dB |
| Image Rejection | 21 dB |
| Selectivity | −37 dB @ 10 kHz |

All Specifications subject to change without notice.

## 1.2 SPECIFICATIONS

Specifications for the PACE Models CB 110/115/125 hand held transceivers are shown in Table 1-2.

## 1.3 CRYSTAL INFORMATION

All crystals supplied for use in PACE Models CB 110, 115 and 125 have been individually checked for activity, proper frequency, and freedom from spurious and parasitic oscillations. Use of any crystal not supplied by PACE cannot be insured against off-frequency operation, spurious radiation, substandard performance, or temperature drift; nor will defects, which in our opinion, were caused by use of such crystals be corrected under the warranty.

### CAUTION

*The Federal Communications Commission expressly prohibits the substitution or addition of any transmitter oscillator crystal unless the crystal manufacturer or PACE has determined that the crystal will provide the transmitter with the capability of operating within the specified frequency tolerance of 0.005%.*

A separate crystal is used for transmit and receive for each channel. These crystals may be installed at any time after the initial purchase. Refer to Section 2-3 for correct installation procedures. Crystal specifications are shown in Table 1-3.

**Table 1-3**
**Crystal Specifications**

| SPECIFICATIONS | TRANSMITTER CRYSTAL | RECEIVER CRYSTAL |
|---|---|---|
| Crystal Frequency | Channel Frequency (MHz) | Channel Frequency (MHz) — .455 |
| Temperature Tolerance | $\pm$ .005% (−10 °C to +50 °C) | $\pm$ .005% (−10 °C to +50 °C) |
| Correlation Tolerance | $\pm$ .003% @ 25 °C | $\pm$ .003% @ 25 °C |
| Mode | Series, 3rd Overtone | Parallel (3rd Overtone) |
| Drive Level | 2 mW | 2 mW |
| Resistance | 30 Ohms Maximum | 30 Ohms Maximum (Series Mode) |
| Load Capacity | — — | 20 pF |
| Holder | HC-25/U | HC-25/U |
| Marking | Top - Channel Number<br>Side - PACE & P5257T | Top - Channel Number<br>Side - PACE & P5257R |

# SECTION II
# INSTALLATION PROCEDURES

## 2.1 GENERAL

This section contains procedures for installation of crystals and batteries in the CB 110/115/125 units.

## 2.2 BATTERY INSTALLATION

Loosen the center screw on the back cover, then remove the cover and set aside. Insert eight standard type "AA" penlite cells observing polarity marked on the holder, and see that the batteries are firmly seated.

In some CB 115 and CB 125 Models, there is a 10-cell battery holder. When using regular carbon-zinc or alkaline cells, be sure the two shorting bars supplied are inserted in spaces for two cells. When using rechargeable Nicad cells, remove the two bars and insert 10 cells.

**CAUTION**

*Incorrect battery installation (reversed polarity) may seriously damage the transceiver. Always insert the batteries as shown.*

## 2.3 CRYSTAL INSTALLATION

Up to three pairs of crystals may be installed at one time. Refer to Figure 2-1 for crystal socket location.

**NOTE**

*When ordering new crystals refer to PACE P5257 and specify channel number.*

To install crystals, remove the back cover as described in Section 2-2. When installing crystals, do not insert them at an angle as this may cause the socket to lose its holding power. Always align the crystal directly over the socket and push straight in.

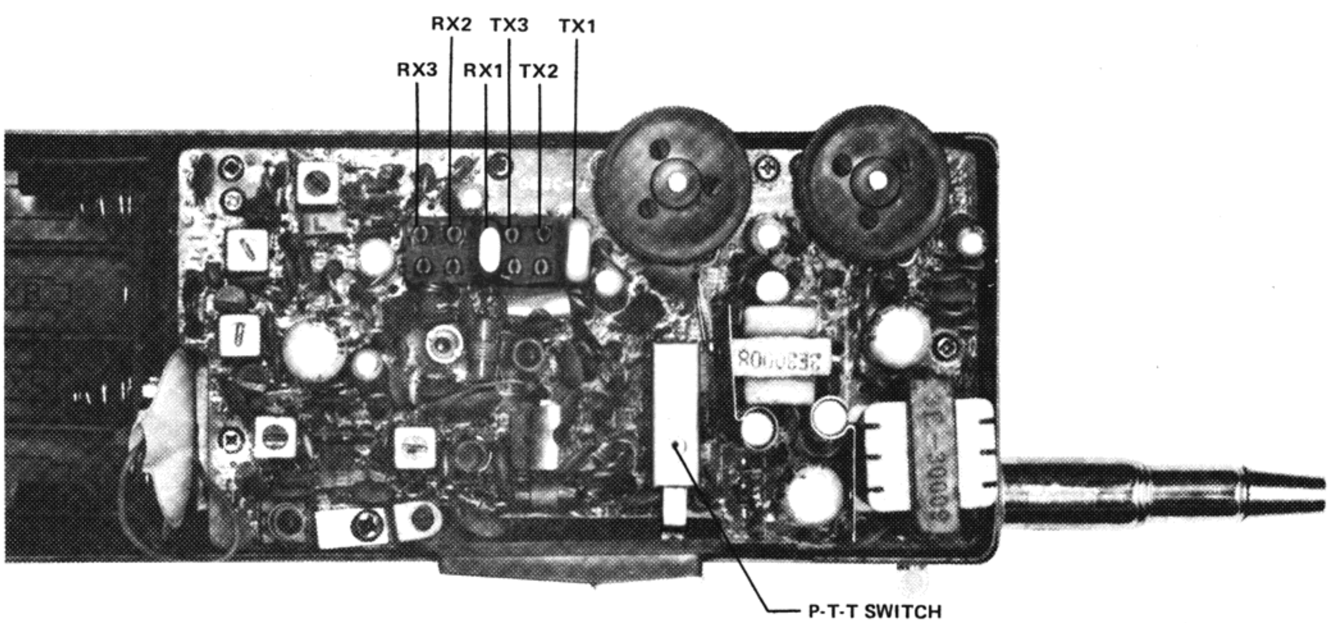


**Figure 2-1 Crystal Socket Locations**

NOTES

# SECTION III
# PRINCIPLES OF OPERATION

## 3.1 GENERAL

This section contains a general description of the CB 110, 115 and 125 operating principles. Major circuit functions and system operation are discussed. A block diagram of the CB 125 is shown in Figure 3-1.

## 3.2 RECEIVER

The receiver is a single conversion superheterodyne using a crystal-controlled modified Colpitts oscillator.

An RF signal from the antenna is fed to the RF amplifier Q1 where it is amplified. This signal is then mixed at Q2 with the local oscillator signal from Q5, to produce an IF signal of 455 kHz. The IF signal is amplified in Q3 and Q4. Q4 contains a ceramic filter in its emitter for improved selectivity. After amplification the IF signal is detected by D1 and the audio signal is coupled to pre-amplifier Q9. From Q9, the audio signal is fed to driver Q10 and then passed on to the push-pull audio power amplifier consisting of Q11 and Q12.

A portion of the IF signal is coupled to squelch switch Q6. When noise (with no signal) is present a high negative bias is applied to the base of audio pre-amplifier Q9, cutting off the audio. When a signal is present, no bias is applied to Q9 permitting the audio to pass through.

## 3.3 TRANSMITTER

Transmit frequency is produced in the crystal-controlled modified Colpitts oscillator Q8. The oscillator frequency is coupled to the RF final stage Q7, which operates Class C. The output from Q7 is coupled to the antenna via a matching network and harmonic filter.

Audio from the microphone is fed through the audio amplifier. Plus voltages are applied to Q8 and Q7 through the audio output transformer. Thus, high level modulation is applied to the transmitter.

## 3.4 SPEAKER AND MICROPHONE

Model CB 125 has a separate speaker and microphone. Each of the other two Models uses a single transducer which functions as a speaker in receive mode and a microphone in transmit.

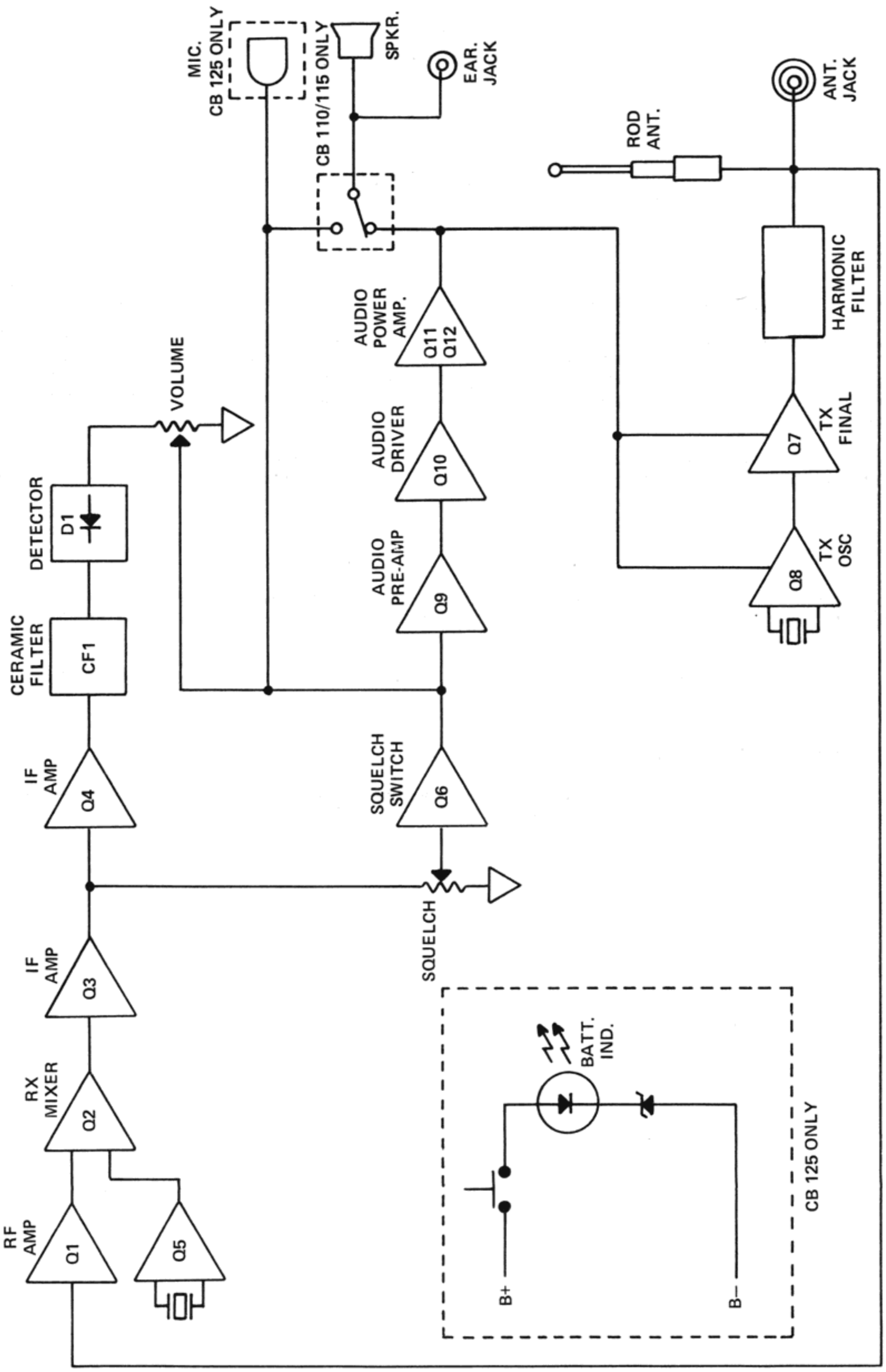


Figure 3-1 CB 110, 115, 125 Block Diagram

# SECTION IV
# MAINTENANCE

## 4.1 GENERAL

This section contains maintenance instructions for the PACE Models CB 110, 115 and 125 transceivers. The procedures given in this section assume a general knowledge of AM type communications receivers and a familiarization with transistors and integrated circuits.

### 4.1.1 Tools and Techniques

A list of recommended tools and test equipment required for maintenance operations is presented in Table 4-1. Aside from the items listed, hand tools and equipment commonly used in the maintenance of electronic equipment are sufficient for maintenance operations.

It is recommended that maintenance adjustments and repairs be performed only by experienced personnel familiar with the equipment. In some cases, minor changes in voltage levels may be corrected by adjusting potentiometers located in the affected circuits. Standard practices in the electronic industry should be observed in checking and/or replacing system components.

### 4.1.2 Parts Identification

For printed circuit (PC) board component location, refer to illustrations and schematics in Section VI.

## 4.2 PREVENTIVE MAINTENANCE

The receiver requires minimal maintenance due to the nonmechanical nature of the equipment. However, a preventive maintenance program consisting of electrical checks is recommended as an aid in obtaining maximum operating efficiency from the system.

**Table 4-1**
**Test Equipment Required**

| Item | Model or Description |
|---|---|
| Power Source | Regulated 12 V DC Power Supply (Hewlett-Packard Model 624B or Equivalent) |
| Wattmeter | 50 Ω, 5 W (Bird Electronics Model 43 or Equivalent) |
| Audio Generator | Frequency Range: 200 Hz to 5 kHz Minimum |
| Frequency Counter | DC to 30 MHz Minimum (Hewlett-Packard Model 4245L or Equivalent) |
| Oscilloscope | 30 MHz Bandpass or DC Coupled Scope with Detector (Tektronix Model 545B or Equivalent) |
| Vacuum Tube Voltmeter | 1 mV to 50 V AC or More (Hewlett-Packard Model 410B or Equivalent) |
| RF Signal Generator | Capable of Tuning 455 kHz and 27 MHz CB Frequencies (Hewlett-Packard Model 606B or Equivalent) |
| DC Voltmeter (Multimeter) | High Impedance Input (RCA Model WV-98C or Equivalent) |
| RF Probe | For Use with Multimeter |

PACE

## 4.3 CORRECTIVE MAINTENANCE

Corrective maintenance operations entail transceiver checks and adjustments which are not part of preventive maintenance procedures. Operational malfunctions which require corrective maintenance may usually be corrected by an adjustment or PC board replacement. If necessary to make repairs at the component level, such repairs should be made by maintenance technicians who are familiar with the equipment and electronic repair techniques. Refer to Section V for alignment and adjustment procedures.

## 4.4 TROUBLESHOOTING

It is recommended that a functional analysis approach be used to locate the cause of the receiver malfuntion. Troubleshooting can be simplified by reference to the schematic diagrams in Section VI.

Standard troubleshooting procedures, such as signal injection and signal tracing, should be used in locating faulty circuits. Once the trouble has been isolated to a particular circuit the defective component can be localized by voltage and resistance measurements. Refer to voltage chart in Table 4-2.

Before proceeding with the troubleshooting procedures, the entire installation should be checked for defective antenna connections and loose or broken supply cables and plugs.

Voltages were measured with an ohmmeter having a 20,000 ohm/volt sensitivity, with 12 volts ± 5% DC input. Mesurements were made in receive mode unless otherwise indicated. All voltages are negative unless otherwise indicated, and have a tolerance of ± 20%.

**NOTE**

*Voltage may vary between the different models, and/or with various meters used.*

**Table 4-2**
**DC Voltage Chart**

**(All voltages negative unless otherwise indicated).**

| | DC Voltage in Volts | | |
|---|---|---|---|
| Transistor | E | B | C |
| Q1 | 10.74 | 10.10 | 0.16 |
| Q2 | 10.82 | 10.22 | 0 |
| Q3 | 10.77 | 10.10 | 3.04 |
| Q4 | 10.94 | 10.26 | 0.07 |
| Q5 | 0 | 10.25 | 10.89 |
| Q7 | 11.9 | 11.74 | 2.04 |
| Q6 SQ | 0 | +0.65 | 0 |
| UNSQ | 0 | 0 | 1.22 |
| Q9 SQ | 0 | 0.01 | 11.48 |
| UNSQ | 0.59 | 1.20 | 8.66 |
| Q8 | 8.56 | 8.90 | 1.06 |
| Q10 | 0.68 | 0.82 | 11.6 |
| Q11 | 0 | 0.7 | 11.97 |
| Q12 | 0 | 0.7 | 11.97 |

## 4.5 MODULATION CHECK

There are three satisfactory methods of checking modulation:

1. A high frequency (30 MHz) oscilloscope, which can be directly coupled by a small capacitor to the antenna jack.

2. A low frequency scope with provisions for direct connection to the deflection plates. A twisted pair, with a 1 1/2 turn link on the end, should be used for coupling. Connect the open end to the deflection plates and then orient the link near the power amplifier coils in the transceiver to obtain a deflection on the screen.

3. A linear detector and a DC oscilloscope would probably be the easiest method to use, and the most accurate, unless a high frequency oscilloscope is available. A suitable detector is shown in Figure 4-1A.

Inexpensive modulation indicators of the meter type have been found to be of irregular accuracy and of no value in checking for parasitics, etc., and therefore, should not be relied upon.

If a high frequency scope is used, connect the probe directly to the antenna jack through a 20-50 pF capacitor. While transmitting a carrier only, adjust the gain to produce a pattern on the scope of about one-half the usable screen area. See Figure 4-2.

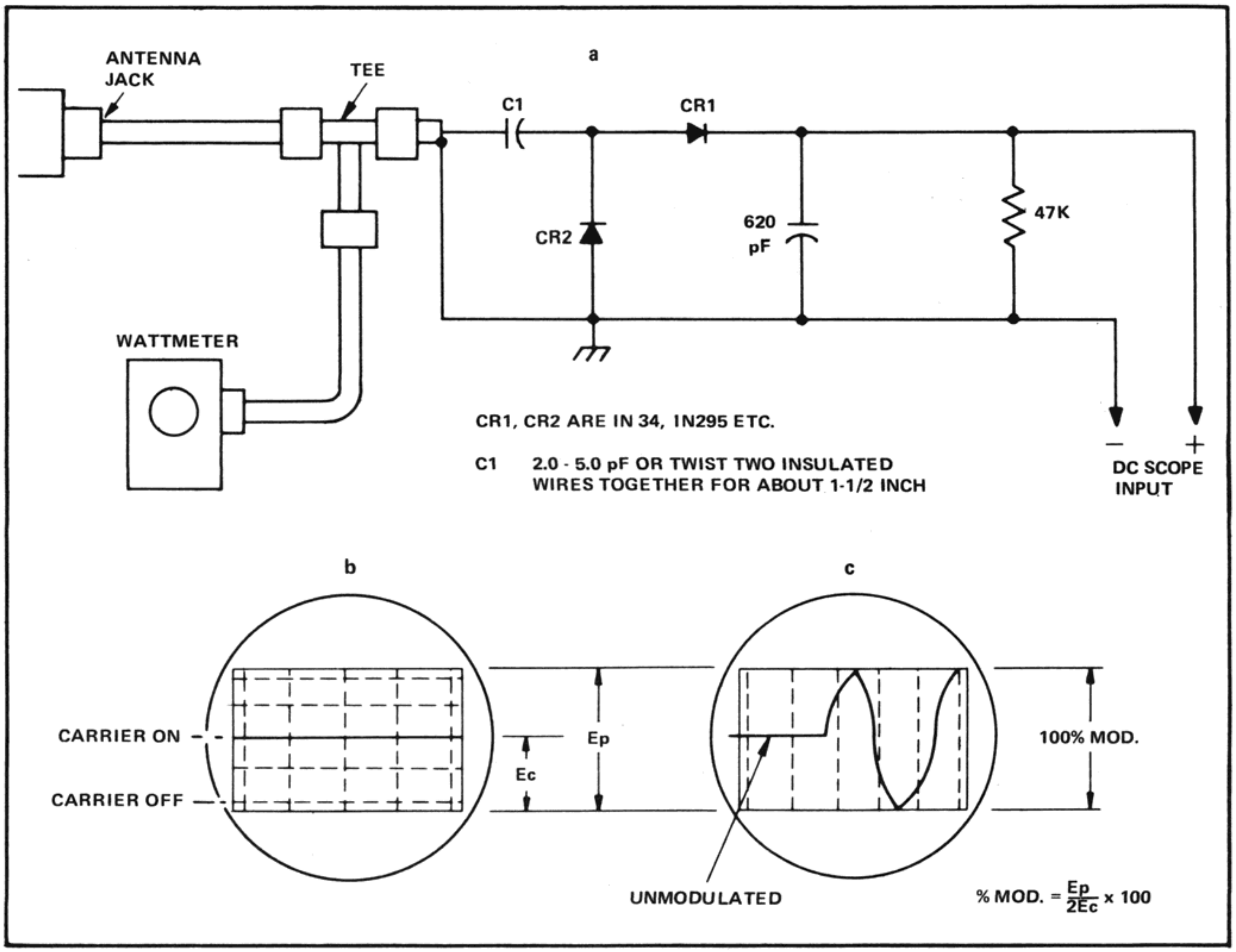


**Figure 4-1 Modulation Detector**

Apply modulation and observe the maximum height of the modulated waveform. For 100% modulation, EP = 2 EM, etc. It is more important that the peak (positive) going portion be analyzed since the "trough" or negative going portion will always perform correctly when the peaks are present.

If a low frequency scope using a direct connection to the plates is employed, the same adjustment procedures apply.

To use the DC scope and detector of Figure 4-1A adjust the position control with the carrier off to place the trace on a reference line near the bottom of the scope face. See Figure 4-1B. Then feed the unmodulated carrier to the detector and adjust the gain to place the trace in the center of the scope face. It may be necessary to switch the transmitter off and on several times to adjust the trace properly, since on most scopes the position and gain controls will interact.

A 100% modulated transmitter will produce a peak-to-peak envelope equal to twice the shift between the carrier and no carrier traces. See Figure 4-1C. When checking modulation, do not over-drive. Whistle into the microphone with increasing loudness so that maximum modulation is reached without clipping.

Talking into the microphone in a normal manner should produce continuous peaks of 80-95% modulation.

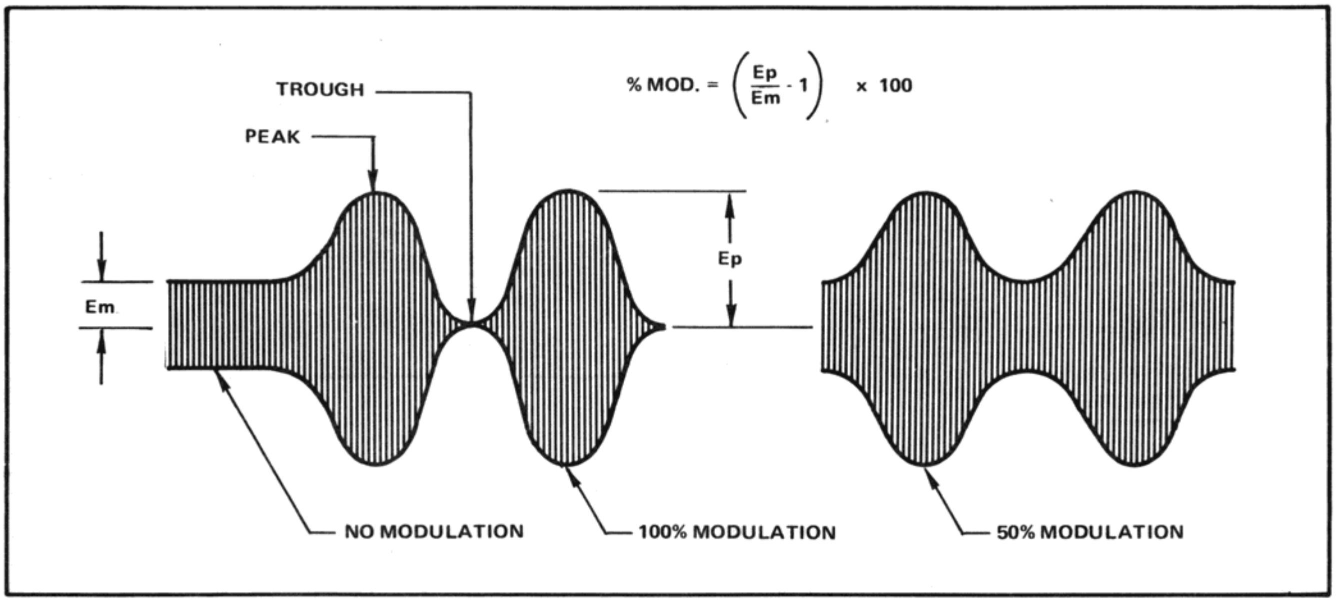


**Figure 4-2 Direct Modulation Monitor**

# SECTION V
# ADJUSTMENT AND ALIGNMENT

## 5.1 GENERAL

Transceiver circuitry is identical for the CB 110, 115 and 125, therefore, the alignment procedure is the same for all models.

The PACE transceivers are factory aligned to provide optimum performance. They will not normally require realignment unless major components have been replaced or if the receiver sensitivity has dropped below the specified 0.8 microvolts for 10 dB signal to noise, or if there is a malfunction of the transmitter.

**NOTE**

*Transmitter tuning adjustments must be made by a technician holding an appropriate FCC license.*

It is recommended that the transceiver be returned to the factory for realignment. However, correct alignment procedures are given in the following paragraphs where this is not feasible.

## 5.2 TEST EQUIPMENT

Every effort has been made to keep the required instruments necessary to align and service as simple as possible. It must be realized that the degree of accuracy attained in measurement is directly related to the quality of instruments used. Where a lower quality instrument than the one suggested is used, allowance must be made for possible error in readings. Refer to Table 4-1 for a list of recommended test equipment.

## 5.3 PRELIMINARY SETUP

1. Set the front panel controls as follows:

| CONTROL | SETTING |
|---|---|
| Volume | Maximum CCW |
| Squelch | Maximum CCW |

2. Connect a regulated DC voltage source of 13.8 volts through the AC adapter jack.
3. Connect a 50-ohm dummy load to the antenna jack.
4. Connect a wattmeter across the dummy load.

## 5.4 TRANSMITTER ALIGNMENT

Transmitter adjustment should not be attempted unless the unit exhibits very low power, instability or audio distortion. Follow the tuning procedure carefully. Failure to do so may result in excessive dissipation with resultant loss of a driver or output transistor.

Refer to Figure 5-1 for transmitter adjustment and test point locations.

1. Key the transmitter and peak L7 and L9 for maximum power output indication on the wattmeter (CB 110, 700 mW; CB 115, 1.0 W; CB 125, 1.5 W).
2. Adjust L9 for best upward modulation with the most harmonic rejection.

## 5.5 RECEIVER ALIGNMENT (Refer to Figure 5-1)

1. Connect an RF generator, tuned to 27.085 MHz at 10 $\mu$V, to the antenna input. Make sure the transceiver is switched to Channel 11.
2. Connect an AC VTVM (use 2-10 volts scale) across the speaker leads and adjust the volume control for a mid-scale reading on the meter.
3. Adjust L2, VR3, L3, L4, L5 and L6 for a minimum meter reading.
4. Disconnect all test equipment.

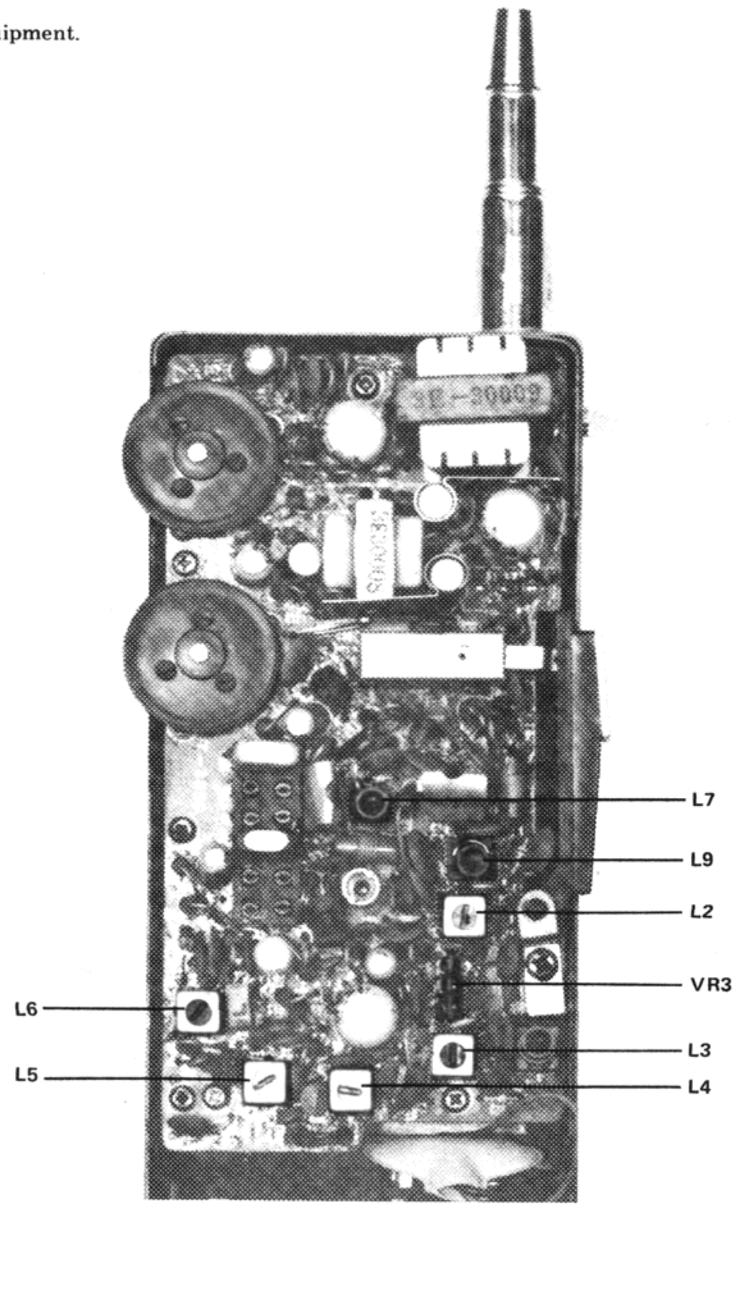


Figure 5-1 Adjustment Locations

# SECTION VI
# ILLUSTRATIONS AND PARTS LIST

## 6.1 GENERAL

The schematics and parts locators in this section are for the PACE Models CB 110, 115 and 125 mobile transceivers. Part numbers and descriptions are keyed to schematic reference numbers and are listed for these components. The parts list includes components that are identical for all models. Where a part is listed for one model only, it is so designated.

Standard value resistors and capacitors may be purchased from any electronic parts distributor, and are not listed. If desired, these parts may be ordered from PATHCOM by specifying the schematic reference number and its full description. When ordering parts from PATHCOM, please specify the model and serial number of the transceiver.

**Table 6-1***
**CB 110/115/125 Parts List**

| Reference | Description | Part Number |
|---|---|---|
| **CAPACITORS** | | |
| C17, 43 | Electrolytic, 4.7 μF 16 V | IP 22-0003 |
| C20, 45, 49 | Electrolytic, 100 μF 16 V | IP 22-0008 |
| C21, 44 | Electrolytic, 33 μF 16 V | IP 22-0005 |
| C26 | Electrolytic, 10 μF 6.3 V | IP 22-0004 |
| **RESISTORS** | | |
| VR1 | Potentiometer, 5 k Ω (Squelch) | IP 24-0028 |
| VR2 | Potentiometer, 5 k Ω (Volume) | IP 24-0027 |
| VR3 | Trimmer, 1 k Ω | IP 24-0007 |
| **INDUCTORS** | | |
| L1 | RF Coil, Variable | IP 21-0163 |
| L2 | RF Transformer, Variable (Pink Dot) | IP 21-0141 |
| L3 | IF Transformer, Variable (Blue Dot) | IP 21-0142 |
| L4 | IF Transformer, Variable (Yellow Dot) | IP 21-0135 |
| L5 | IF Transformer, Variable (White Dot) | IP 21-0136 |
| L6 | IF Transformer, Variable (Black Dot) | IP 21-0137 |
| L7 | RF Transformer, Variable | IP 21-0164 |
| L8 | RF Coil | IP 21-0165 |
| L9 | RF Coil, Variable | IP 21-0166 |
| L10, 11 | RF Coil | IP 21-0167 |
| L12 | RF Choke, Power | IP 21-0168 |
| L13 | RF Choke, Power | IP 21-0169 |
| T1 | AF Input Transformer | IP 21-0153 |
| T2 | AF Output Transformer | IP 21-0154 |

(Continued)

*Order unlisted components by description and reference numbers.

# Table 6-1
## (Continued)

| Reference | Description | Part Number |
|---|---|---|
| **TRANSISTORS AND DIODES** | | |
| Q1, 5 | Transistors, 2SC710(D) | IP 20-0003 |
| Q2 | Transistors, 2SC710(C). | IP 20-0002 |
| Q3, 4 | Transistors, 2SC710(B). | IP 20-0001 |
| Q6 | Transistor, 2SA628 | IP 20-0130 |
| Q7 (CB 125 Only) | Transistor, 2SC1018 | IP 20-0123 |
| (CB 110, 115) | Transistor, 2SC1017 | IP 20-0131 |
| Q8 (CB 125 Only) | Transistor, 2SC1017 | IP 20-0131 |
| (CB 110, 115) | Transistor, 2SC620 | IP 20-0122 |
| Q9 | Transistor, 2SA495 | IP 20-0132 |
| Q10 | Transistor, 2SB54 | IP 20-0072 |
| Q11, 12 | Transistor, 2SA562 | IP 20-0046 |
| D1 | Diode, 1N60. | IP 20-0060 |
| D2 | Diode, KB265. | IP 20-0128 |
| D3 | Diode, M8513A | IP 20-0071 |
| D4 | Diode, WZ-061 | IP 20-0062 |
| D5 | Diode, SCT-24 (LED). | IP 28-0008 |
| **MISCELLANEOUS** | | |
| CF1 | Filter, Ceramic (BFB 455). | IP 31-0054 |
| J1 | Jack, Earphone | IP 26-0005 |
| J2 | Jack, External Power | IP 26-0020 |
| J3 | Jack, Charger | IP 26-0018 |
| S1 | Switch, P-T-T | IP 25-0029 |
| S2 | Switch, Channel (3-Position Slide) | IP 25-0026 |
| S3 | Switch, Power (Part of Volume Control) | |
| S4 | Switch, Call/Battery (Momentary) | IP 25-0027 |
| XR | Crystal, Receive (Specify Channel) | P5257 |
| XT | Crystal, Transmit (Specify Channel) | P5257 |
| | Antenna, Rod (Telescopic) | IP 33-0001 |
| | Button, P-T-T | IP 30-0031 |
| | Case, Front | IP 30-0023 |
| | Jack, External Antenna | IP 26-0012 |
| | Socket, 6-Crystal | IP 34-0005 |
| | Speaker, 8 Ω | IP 29-0013 |
| | Strap, Hand | IP 30-0019 |
| | Bezel Assembly (CB 110) | IP 30-0020 |
| | (CB 115, 125). | IP 30-0021 |
| | Lower Half (CB 125) | IP 30-0022 |
| | Side Jack (CB 110) | IP 30-0024 |
| | (CB 115, 125). | IP 30-0025 |
| | Rear Case Cover (CB 110, CB 125). | IP 30-0026 |
| | (CB 115). | IP 30-0027 |
| | Label (CB 110). | IP 30-0028 |
| | (CB 115). | IP 30-0029 |
| | (CB 125). | IP 30-0030 |

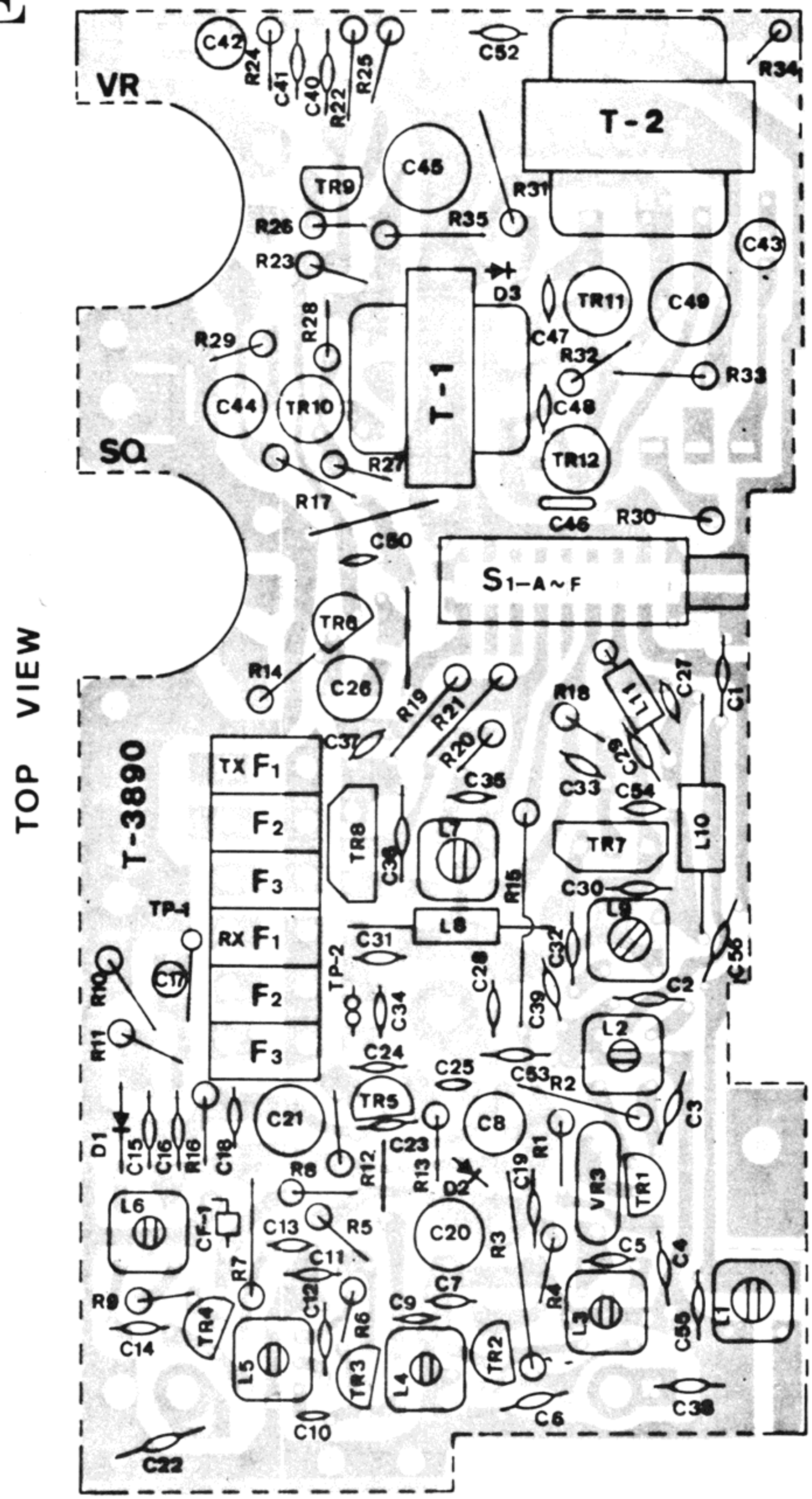


Figure 6-1 Parts Locator (All Models)

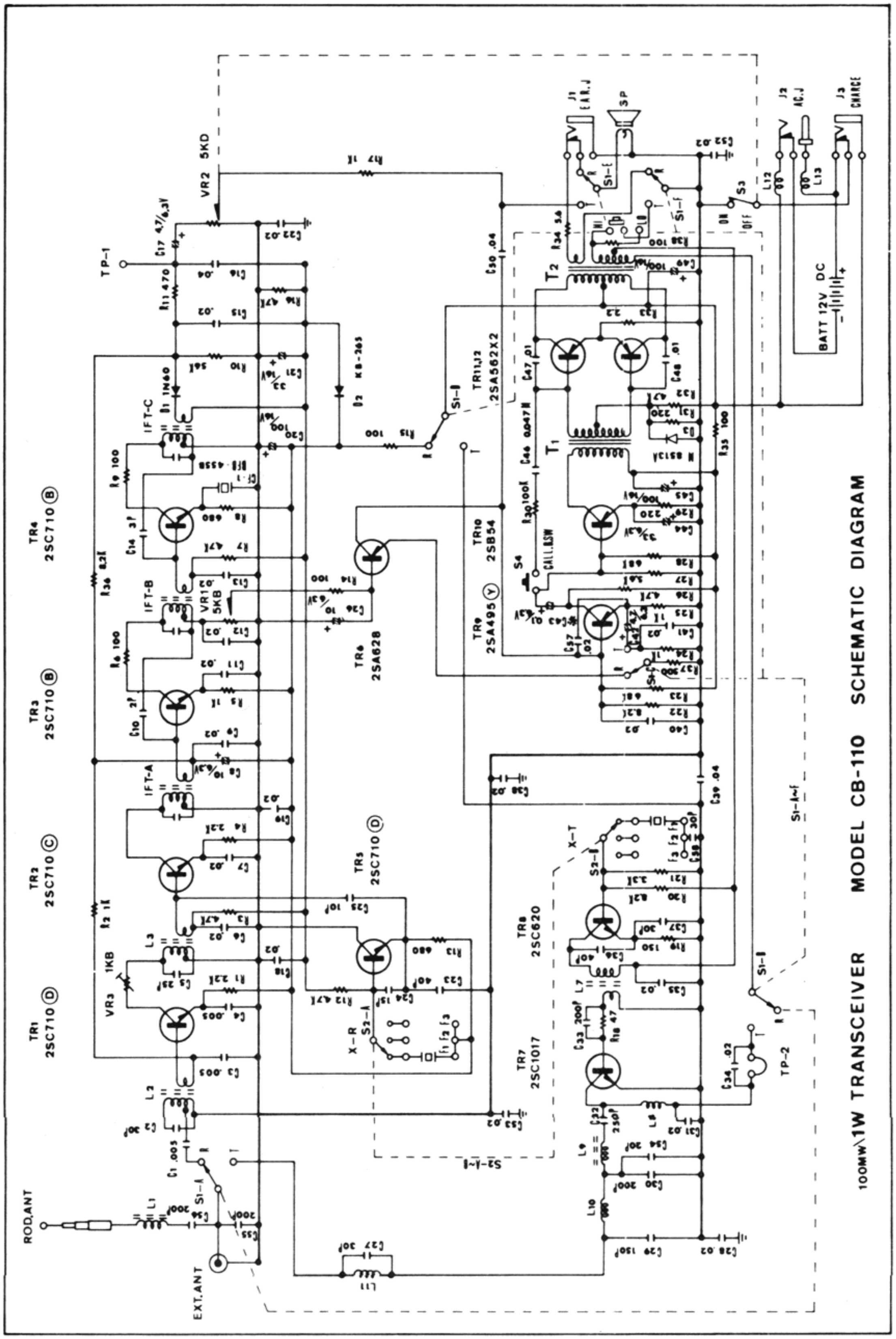


Figure 6-2 CB 110 Schematic

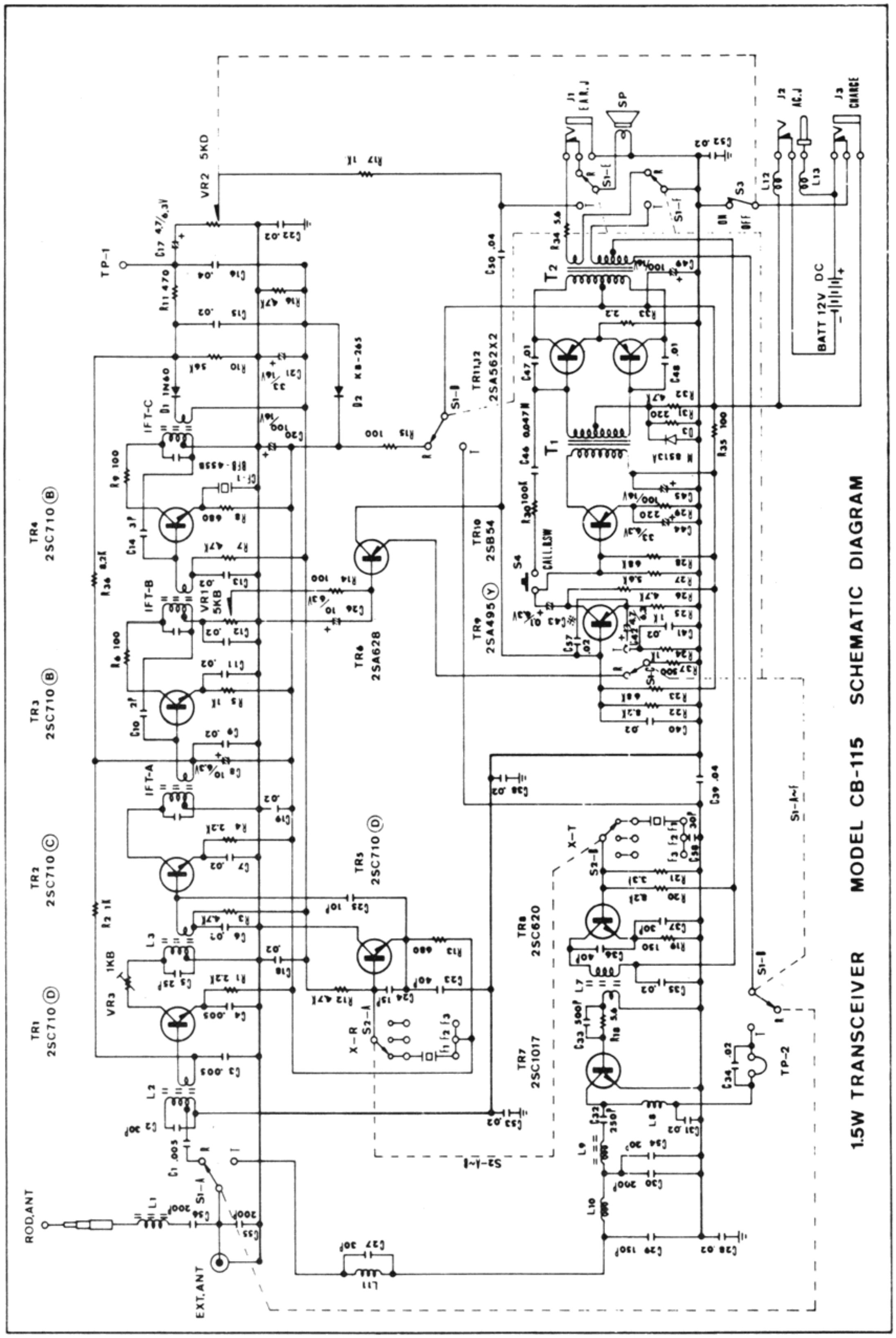


Figure 6-3 CB 115 Schematic

PACE

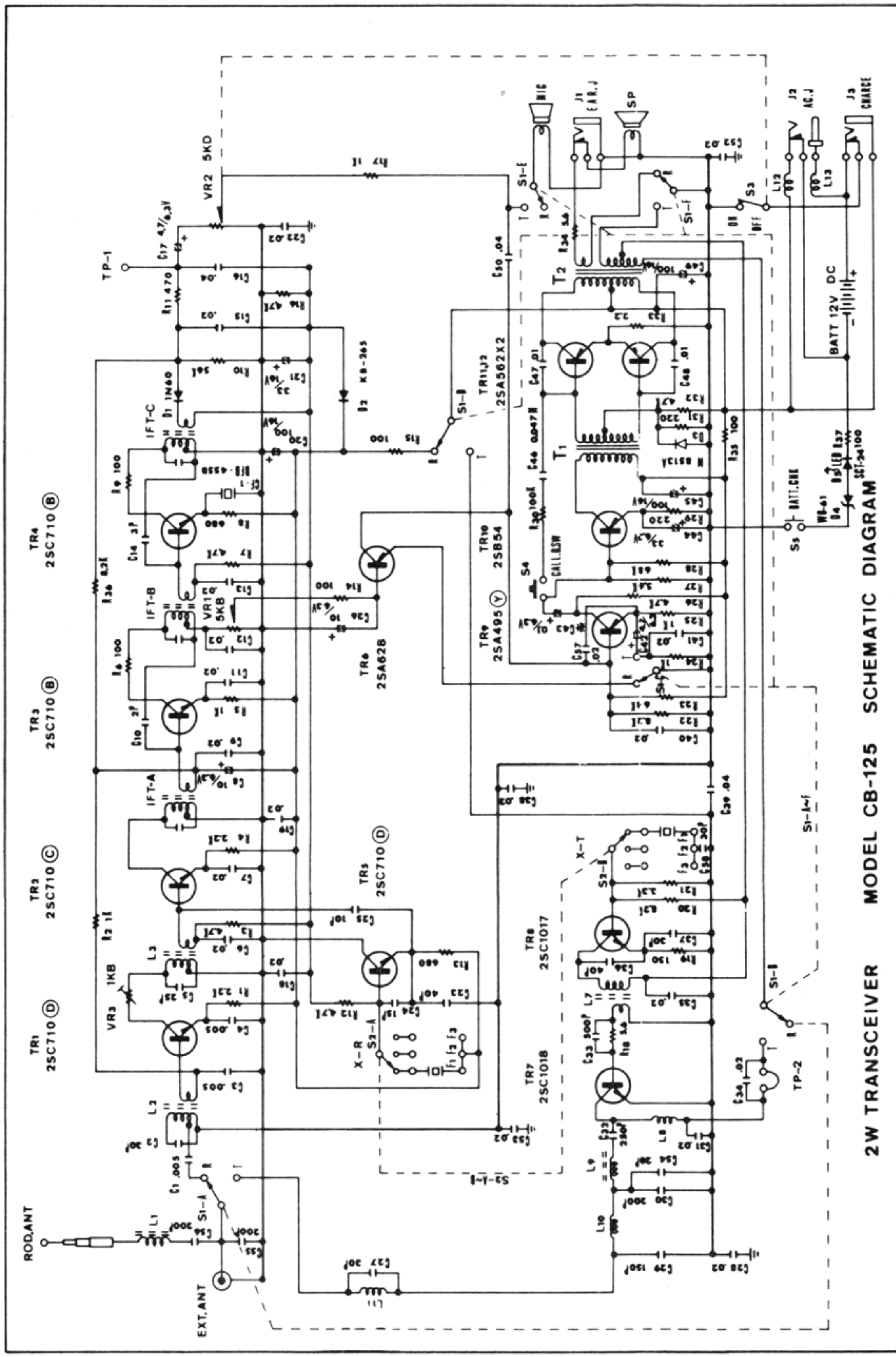


Figure 6-4 CB 125 Schematic