PRICE $2.50

# SERVICE MANUAL

## PACE CB144
## MOBILE TRANSCEIVER
## 27 MHz CITIZENS BAND


**PATHCOM INC.**
PACE TWO-WAY RADIO PRODUCTS
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L2093-676

# TABLE OF CONTENTS

PACE

## LIST OF TABLES



## LIST OF ILLUSTRATIONS

# SECTION I
# GENERAL INFORMATION

## 1.1 GENERAL DESCRIPTION

This manual contains service and maintenance information for the PACE Model CB 144 Mobile Transceiver manufactured by PATHCOM INC.

It also includes a circuit description and all necessary information required to perform a troubleshooting analysis and a complete alignment of the PACE Model CB 144. The Model CB 144 is a 23-channel, crystal controlled HF/AM transceiver. It is a fully solid-state device and may be operated from any standard 13.8 volt DC negative or positive ground source. Internal protection is provided to prevent damage in the event that reverse polarity is applied.

## 1.2 SPECIFICATIONS

Technical specifications for the PACE Model CB 144 are shown in Table 1-1.

## 1.3 CRYSTAL INFORMATION

Frequency synthesized circuitry is used to obtain all 23 of the Class D Citizens Band channels. Crystal combinations to obtain synthesis are shown for the transmitter and receiver in Table 1-2. The frequency of each crystal is shown in Table 1-3.

**Table 1-1**
**Technical Specifications**
**CB 144**

| | |
|---|---|
| **GENERAL** | |
| Channels | 23 Channels, Frequency synthesized |
| Frequency Range | 26.965 MHz to 27.255 MHz Class D Citizens Band |
| Frequency Tolerance | ± 0.005% −20 °C to +50 °C |
| Operating Temperatures | −20 °C to +50 °C |
| Input Voltage | 13.8 V DC, ± gnd |
| Microphone | 500 ohm, Dynamic |
| Speaker | 8 ohm |
| Dimensions | 5.4 cm H x 15.2 cm W x 22.2 cm D<br>(2 1/8 in. H x 6 in. W x 8 3/4 in. D) |
| Weight | 2.3 kg (5 lbs.) |
| **TRANSMITTER** | |
| RF Power Output | 4 W |
| Output Impedance | 50 ohms |
| Spurious and Harmonic Emission | −50 dB Minimum |
| Modulation | 85% guaranteed, type 8A3, AM |
| Compliance | FCC Type Number 42220, FCC Part 95<br>DOC Type Number 197363138, Part RSS 136 |
| **RECEIVER** | |
| Input Impedance | 50 ohms |
| Sensitivity | 0.5 $\mu$V for 10 dB $\frac{s+n}{n}$ |
| Adjacent Channel Rejection | −60 dB Minimum |
| Squelch Sensitivity | 500 $\mu$V ± 6 dB (tight) |
| Spurious Rejection | −40 dB Minimum |
| Image Rejection | −50 dB Minimum |
| Audio Power Output | 3 W @ 10% Distortion |

All Specifications subject to change without notice.

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### Table 1-2
### Frequency Synthesizing System

| | RECEIVER | | | | TRANSMITTER | |
|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency | 1st Local Osc Crystal | 2nd Local Osc Crystal | 2nd IF Frequency | Crystal Combination | Synthesized Frequency |
| 1 | 26.965 MHz | X1 | X11 | 455 kHz | X1 - X7 | 26.965 MHz |
| 2 | 26.975 MHz | X1 | X12 | 455 kHz | X1 - X8 | 26.975 MHz |
| 3 | 26.985 MHz | X1 | X13 | 455 kHz | X1 - X9 | 26.985 MHz |
| 4 | 27.005 MHz | X1 | X14 | 455 kHz | X1 - X10 | 27.005 MHz |
| 5 | 27.015 MHz | X2 | X11 | 455 kHz | X2 - X7 | 27.015 MHz |
| 6 | 27.025 MHz | X2 | X12 | 455 kHz | X2 - X8 | 27.025 MHz |
| 7 | 27.035 MHz | X2 | X13 | 455 kHz | X2 - X9 | 27.035 MHz |
| 8 | 27.055 MHz | X2 | X14 | 455 kHz | X2 - X10 | 27.055 MHz |
| 9 | 27.065 MHz | X3 | X11 | 455 kHz | X3 - X7 | 27.065 MHz |
| 10 | 27.075 MHz | X3 | X12 | 455 kHz | X3 - X8 | 27.075 MHz |
| 11 | 27.085 MHz | X3 | X13 | 455 kHz | X3 - X9 | 27.085 MHz |
| 12 | 27.105 MHz | X3 | X14 | 455 kHz | X3 - X10 | 27.105 MHz |
| 13 | 27.115 MHz | X4 | X11 | 455 kHz | X4 - X7 | 27.115 MHz |
| 14 | 27.125 MHz | X4 | X12 | 455 kHz | X4 - X8 | 27.125 MHz |
| 15 | 27.135 MHz | X4 | X13 | 455 kHz | X4 - X9 | 27.135 MHz |
| 16 | 27.155 MHz | X4 | X14 | 455 kHz | X4 - X10 | 27.155 MHz |
| 17 | 27.165 MHz | X5 | X11 | 455 kHz | X5 - X7 | 27.165 MHz |
| 18 | 27.175 MHz | X5 | X12 | 455 kHz | X5 - X8 | 27.175 MHz |
| 19 | 27.185 MHz | X5 | X13 | 455 kHz | X5 - X9 | 27.185 MHz |
| 20 | 27.205 MHz | X5 | X14 | 455 kHz | X5 - X10 | 27.205 MHz |
| 21 | 27.215 MHz | X6 | X11 | 455 kHz | X6 - X7 | 27.215 MHz |
| 22 | 27.225 MHz | X6 | X12 | 455 kHz | X6 - X8 | 27.225 MHz |
| 23 | 27.255 MHz | X6 | X13 | 455 kHz | X6 - X10 | 27.255 MHz |

### Table 1-3
### Crystal Frequency Chart

| Crystal Number | Osc Frequency | Channel in Which Used | | | | | |
|---|---|---|---|---|---|---|---|
| X1 | 37.600 MHz | 1 | 2 | 3 | 4 | | |
| X2 | 37.650 MHz | 5 | 6 | 7 | 8 | | |
| X3 | 37.700 MHz | 9 | 10 | 11 | 12 | | |
| X4 | 37.750 MHz | 13 | 14 | 15 | 16 | | |
| X5 | 37.800 MHz | 17 | 18 | 19 | 20 | | |
| X6 | 37.850 MHz | 21 | 22 | 23 | | | |
| X7 | 10.635 MHz | 1 | 5 | 9 | 13 | 17 | 21 |
| X8 | 10.625 MHz | 2 | 6 | 10 | 14 | 18 | 22 |
| X9 | 10.615 MHz | 3 | 7 | 11 | 15 | 19 | |
| X10 | 10.595 MHz | 4 | 8 | 12 | 16 | 20 | 23 |
| X11 | 10.180 MHz | 1 | 5 | 9 | 13 | 17 | 21 |
| X12 | 10.170 MHz | 2 | 6 | 10 | 14 | 18 | 22 |
| X13 | 10.160 MHz | 3 | 7 | 11 | 15 | 19 | |
| X14 | 10.140 MHz | 4 | 8 | 12 | 16 | 20 | 23 |

## 1.4 OTHER PERTINENT INFORMATION

The Model CB 144 has been certified for Type Acceptance under FCC Part 95. It also meets Canadian DOC type approved regulations RSS 136, and EIA Standards for AM 27 MHz transceivers.

# SECTION II
# PRINCIPLES OF OPERATION

## 2.1 GENERAL

This section provides a general description of the Model CB 144 Mobile Transceiver. Refer to the block diagram, Figure 2-1, and the schematic in Section V.

## 2.2 TRANSMITTER DESCRIPTION

The transmitter is comprised of two basic sections: (a) the low level frequency generation section (synthesizer) and (b) the driver, intermediate power amplifier (I.P.A.) and power amplifier (P.A.).

The synthesizer consists of two oscillators, Q16 and Q20. Master oscillator Q16 operates at approximately 37.5 MHz and Q20 at 10.5 MHz. The difference of the two oscillators is obtained from mixer Q21 and passed through a bandpass filter comprised of T11, T12 and T13. The output (at T13) is coupled to RF driver Q22. RF driver Q22 operates Class AB so that a small forward bias exists with no signal and increases with drive power. The I.P.A. (Q23) and P.A. (Q24) are operated Class C. The more drive applied, the more reverse biased their base emitters become. There is no current flow in Q23 or Q24 without power applied. Audio, taken from the lower winding of T17 secondary, is applied to the collectors of Q23 and Q24. When the Push-To-Talk (P-T-T) switch is depressed, audio signals fed through the microphone provide high level modulation of these two transistors. The transmitter output network is a 3-section pi filter for maximum efficiency and harmonic rejection.

## 2.3 RECEIVER DESCRIPTION

The receiver is a double conversion superheterodyne. Two crystal-controlled oscillators are used, and both are changed in frequency steps to obtain 23-channel operation. The first mixer (Q2) uses high side injection obtained from master oscillator Q16 (this oscillator works during both receive and transmit operation). This first IF signal is then mixed with the output from second local oscillator Q17 at Q3. Output from second IF mixer Q3 is at 455 kHz and passes through the filter circuit comprised of T5 and ceramic filter FL1. This signal is amplified in two 2nd-IF stages, Q4 and Q5.

The output from IF amplifier Q5 is coupled from T7 through C23 to AM detector diodes CR3 and CR4. After detection, the audio signal passes through a noise limiter and is amplified through Q6 and coupled through C48 to the volume control.

### 2.3.1 Audio Amplifier

The audio amplifier uses AC coupling with a common emitter push-pull output stage. The audio from the collector of audio preamplifier switch Q12 is coupled to driver Q13 via C52. R-C combinations in the emitters of Q12 and Q13 boost low frequencies to compensate for losses (at those frequencies) in the transformers.

Transformer coupling is used at the input and output of the push-pull output stage. Resistors R62, R63 and R64 provide sufficient bias for Q14 and Q15 to prevent crossover distortion. The upper winding in the secondary of T12 couples the audio signal to the speaker (or jacks) during receive and P.A. modes. The lower winding couples audio (for modulation) to Q23 and Q24 during transmitter operation.

### 2.3.2 Squelch

Signal level for squelch is sensed at the emitter of Q1. With no signal and squelch control R87 on full (clockwise), there is high voltage across R4 and R87. This allows Q18 and Q19 to go on. When Q19 is on, a high voltage is applied to Q12 through CR9 and Q12 becomes reverse biased, thus allowing no audio signal to the amplifier. When an incoming signal is detected, Q18 switches off and Q19 follows. The Q12 emitter is grounded again through R57. With squelch off (counterclockwise), Q10 and Q19 are always off.

### 2.3.3 Noise Limiter

Noise limiting is accomplished with the network consisting of R26 through 29, C27 and CR5. The DC bias from the detector is applied to the cathode of CR5 from the junction of divider R26/R27. It is also applied to the anode via R28 and R29. This forward biases CR5 for normal signal amplitudes and the audio is coupled through CR5 to the gate of audio pre-amplifier Q6.

When noise pulses are present in the signal, a higher negative bias is applied to the cathode of CR5. However, the bias to the anode is not increased because of the time constant presented by R29 and C27. This reverse biases CR5 so that the noise pulses are clipped off.

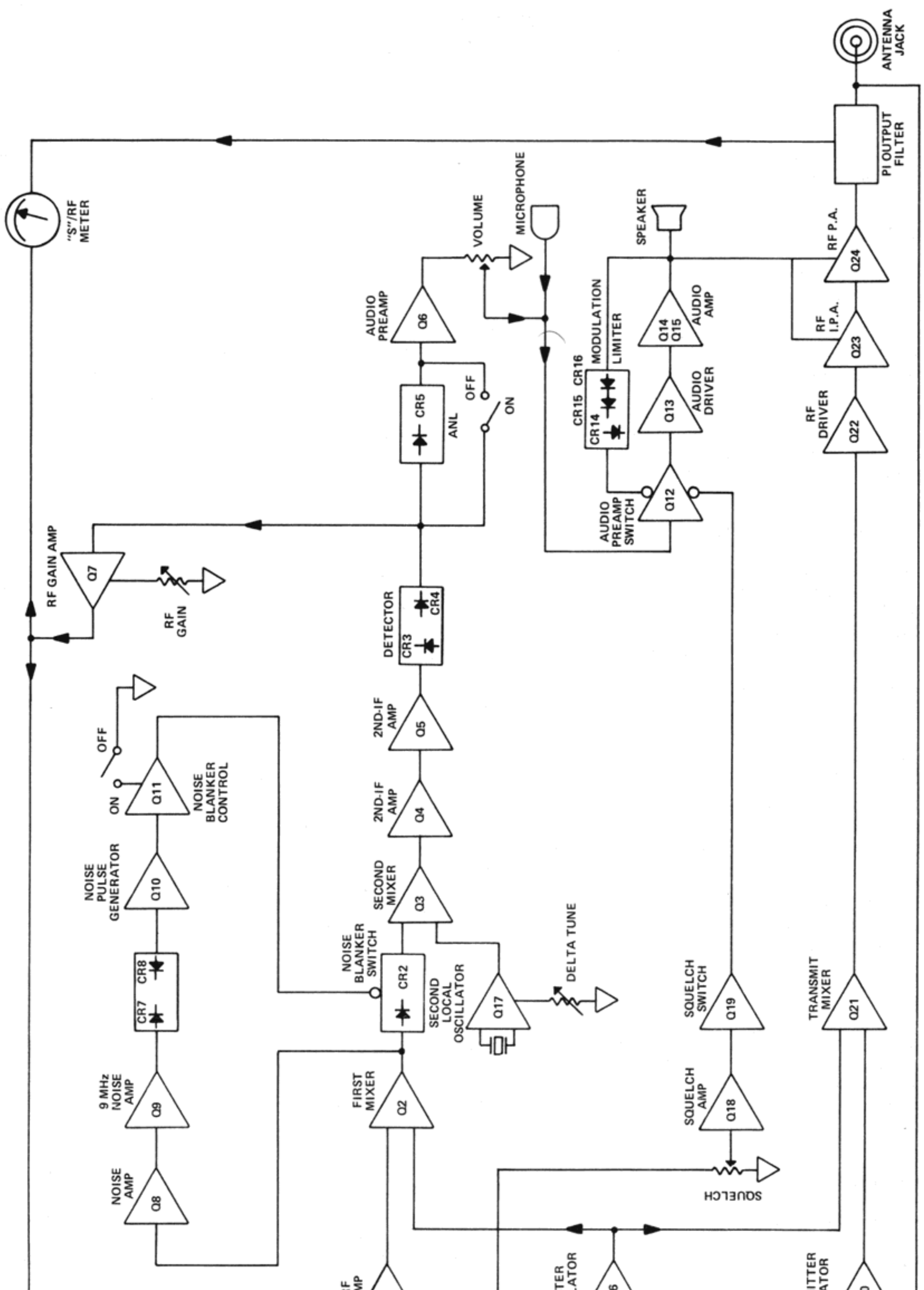


Figure 2-1 CB 144 Block Diagram

### 2.3.4 Noise Blanker

The 1st-IF signal (from point A of T3) is coupled to Q8 through C33. Q8 amplifies the 10 MHz IF signal and passes it onto Q9 which amplifies the signal again. The signal is passed through a 9 MHz filter and then rectified by CR7 and CR8. Q10 reacts to negative noise spikes and switches on. This provides a pulse to Q11 which turns on for an instant and thus reverse biases the noise switch, CR2. For that instant, no signal passes and the noise pulse is blanked.

### 2.3.5 RF Gain Control And Automatic Gain Control

Front panel potentiometer, R35, controls the gain of the receiver by controlling the bias to RF amplifier Q1 and 1st IF amplifier Q2. This sytem is also part of the automatic gain control Q7 which reduces receiver gain when a strong signal is received. Q7 monitors the DC voltage at the detector. As a signal gets stronger, the DC voltage at the anode of CR3 increases and Q7 turns on more. This reduces the bias to Q1 and Q2 in the receiver.

## 2.4 OSCILLATOR DESCRIPTION

Three separate oscillators are used with a total of 14 crystals. The crystals are combined in a synthesis circuit to obtain all 23 CB channels.

Master oscillator Q16 is a crystal-controlled tuned collector oscillator. Six crystals coupled to the base of this transistor are in the frequency range of 37.600 to 37.850 MHz. A different crystal is selected for each channel as shown in Table 1-2. This oscillator is active in both the transmit and receive modes of operation. The output, taken from the secondary of T9, is coupled to the base of receiver first mixer Q2 via C10 and to the base of transmitter mixer Q21 via C77.

Oscillator Q17 is a crystal-controlled R-C oscillator. Four crystals, coupled to the base of this transistor, are in the frequency range of 10.140 to 10.180 MHz. A different crystal is selected for each channel as shown in Table 1-2. The output is taken from the emitter of Q17 and coupled to receiver second mixer Q3. This frequency is then mixed with the output from the 1st-IF amplifier (Q2) to obtain the 455 kHz IF. Q17 is activated in the receive mode only. Also incorporated in the Q17 oscillator circuit is a varactor diode (CR21) Delta Tune circuit. Adjustment of the Delta Tune control R81, varies the frequency of Q17 by $\pm$ 1.5 kHz.

Transmitter oscillator Q20 is a crystal-controlled, tuned collector oscillator. Four crystals, coupled to the base of this transistor, are in the frequency range of 10.595 to 10.635 MHz. A different crystal is selected for each channel as shown in Table 2-1. This oscillator is only active in the transmit mode. The output taken from the secondary of T10 is coupled via C81 to the emitter of mixer Q21 where it is mixed with the frequency of Q16.

## 2.5 TRANSMIT-RECEIVE SWITCHING SYSTEM

The transmit-receive switching system is relay controlled using two sets of contacts. These contacts are energized when the P-T-T switch is depressed. B+ is continuously applied to the intermediate and power amplifiers in the transmitter through T17 and to the master oscillator Q16 through R78. It is also applied directly to the audio power amplifier so that it may be used in the Public Address (PA) mode.

When the P-T-T switch is in the normal (receive) position, the antenna is connected to the receiver RF amplifier Q1 through one set of relay contacts. At the same time, +9 volts, regulated by a zener diode CR11, is supplied to all receiver circuits including the second local oscillator, Q17.

Although power is being supplied to Q23 and Q24, no output occurs because they are operated Class C, which requires drive to allow output.

When the P-T-T switch is depressed (PA/CB switch in CB position), the relay is activated and the B+ to the receiver is cut off. It is then applied to the transmitter power line which activates Q20, Q21 and Q22. This voltage to Q20 and Q21 is regulated by zener diode CR17 to +9 volts. The antenna is switched away from the receiver to the output of the transmitter. This also removes audio ground from the upper coil on T17, thus rendering the speaker inactive.

Now, with drive applied to Q12, audio applied through the lower winding of T17 modulates the RF transmitter.

With the PA/CB switch in the PA position and the P-T-T switch depressed, the +12 volts is not applied to the relay and the internal speaker is switched to the external PA speaker. Thus, when the P-T-T switch is depressed, the upper winding of T17 stays grounded and the speaker stays in operation.

## 2.6 METER CIRCUITRY

The S/RF meter provides relative indications of both incoming signal strength and transmitted power.

In receive mode, a DC voltage level at the output of the detector proportional to the strength of the incoming signal is amplified by Q7 and filtered by C32. This positive DC voltage is then fed directly to the meter.

In the transmit mode, power output signals are coupled through C102 to CR19 and CR20 where it is rectified and filtered by C105. This positive DC voltage is then fed to the meter via limiting potentiometer R108.

# SECTION III
# MAINTENANCE PROCEDURES

## 3.1 GENERAL

This section contains maintenance instructions for the PACE Model CB 144 Mobile Transceiver. The procedures given in this section assume a general knowledge of AM type communications transceivers and a familiarization with transistors and integrated circuits.

It is recommended that maintenance adjustment 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 electronics industry should be observed in checking and/or replacing system components.

### 3.1.1 Parts Identification

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

## 3.2 PREVENTIVE MAINTENANCE

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

## 3.3 CORRECTIVE MAINTENANCE

Corrective maintenance operations entail receiver 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 IV for alignment and adjustment procedures.

## 3.4 TROUBLESHOOTING

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

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 charts in Table 3-1.

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 a Fluke 8000A digital voltmeter with a 4.7 $\mu$H choke in series with the probe. The input voltage was 13.8 volts DC $\pm$ 1%. Measurements were made in CB receive mode with minimum volume (CCW) and minimum squelch (CCW) unless otherwise noted. All voltages are positive unless otherwise noted and have a tolerance of $\pm$ 20%.

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**Table 3-1**
**DC Voltage Chart**

| Transistor | Function | | DC Voltage in Volts | | |
|---|---|---|---|---|---|
| RECEIVER | | | E | B | C |
| Q1 | RF Amplifier | | 3.5 | 3.1 | 9.3 |
| Q2 | First IF Mixer | | 1.2 | 1.8 | 9.6 |
| Q3 | Second IF Mixer | | 0.6 | 1.2 | 7.6 |
| Q4 | Second IF Amplifier | | 1.2 | 1.8 | 9.3 |
| Q5 | Second IF Amplifier | | 2.1 | 1.5 | 8.9 |
| Q7 | RF Gain Amplifier | | 0.0 | 7.3 | 0.3 |
| Q9 | 9 MHz Noise Amplifier | | 0.9 | 1.6 | 8.7 |
| Q11 | Noise Blanker Control | NB ON | 0.0 | 0.2 | 9.3 |
| | | NB OFF | 0.0 | 0.0 | 4.9 |
| Q12 | Audio Pre-Amp Switch | SQ. ON | 8.8 | 2.5 | 13.6 |
| | | SQ. OFF | 0.3 | 0.9 | 12.5 |
| Q13 | Audio Driver | | 1.0 | 1.6 | 13.2 |
| Q14 | Audio Amplifier | | 0.0 | 0.7 | 13.6 |
| Q15 | Audio Amplifier | | 0.0 | 0.7 | 13.6 |
| Q16 | Master Oscillator | | 2.2 | 1.6 | 12.4 |
| Q17 | Second Local Oscillator | | 0.7 | 1.3 | 9.3 |
| Q18 | Squelch Amplifier | SQ. ON | 0.0 | 0.7 | 0.1 |
| | | SQ. OFF | 0.0 | 0.0 | 9.6 |
| Q19 | Squelch Switch | SQ. ON | 9.5 | 9.5 | 0.1 |
| | | SQ. OFF | 0.0 | 9.6 | 9.6 |
| | | | S | G | D |
| Q6 | Audio Pre-Amp | | 0.63 | 0.02 | 7.3 |
| Q8 | Noise Amplifier | | 0.77 | 0.02 | 6.5 |
| Q10 | Noise Pulse Generator | NB ON | 0.72 | 0.03 | 7.6 |
| | | NB OFF | 0.02 | 0.03 | 0.03 |
| TRANSMITTER | | | | | |
| Q20 | Transmit Oscillator | | 1.5 | 2.1 | 9.0 |
| Q21 | Transmit Mixer | | 2.2 | 2.0 | 9.0 |
| Q22 | RF Driver | | 2.4 | 2.9 | 13.3 |
| Q23 | RF I.P.A. | | 0.0 | -0.48 | 13.0 |
| Q24 | RF P.A. | | 0.0 | -0.68 | 13.0 |

## 3.5 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 3-1a.

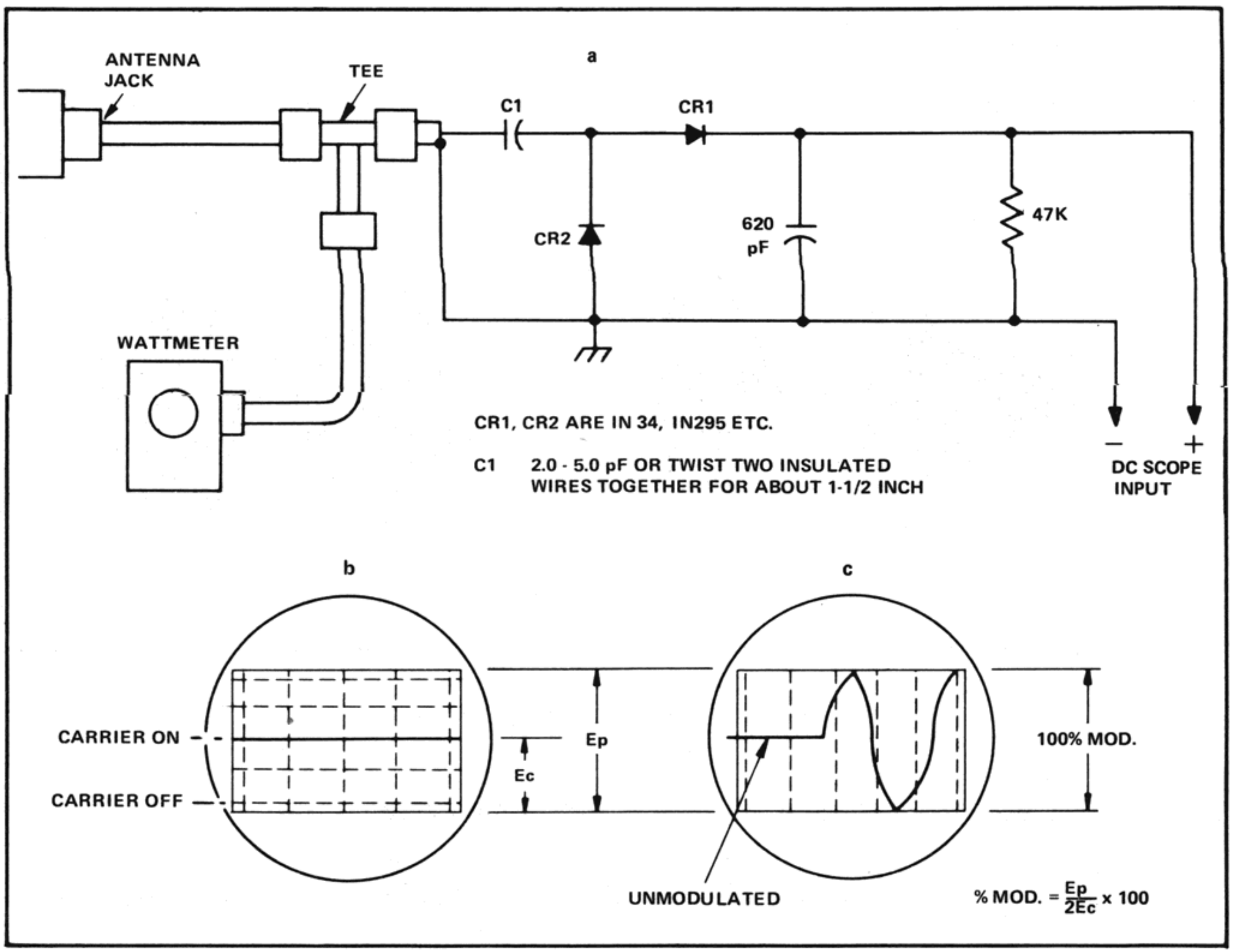



Figure 3-1 Modulation Detector

Inexpensive modulation indicators of the meter type have been found to be 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 to the antenna jack directly through a 20-50 pF capacitor. While transmitting a carrier only, adjust the gain to produce a pattern on the scope or about one-half the usable screen area. See Figure 3-2.

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 3-1a, 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 3-1b. 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 3-1c. 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.

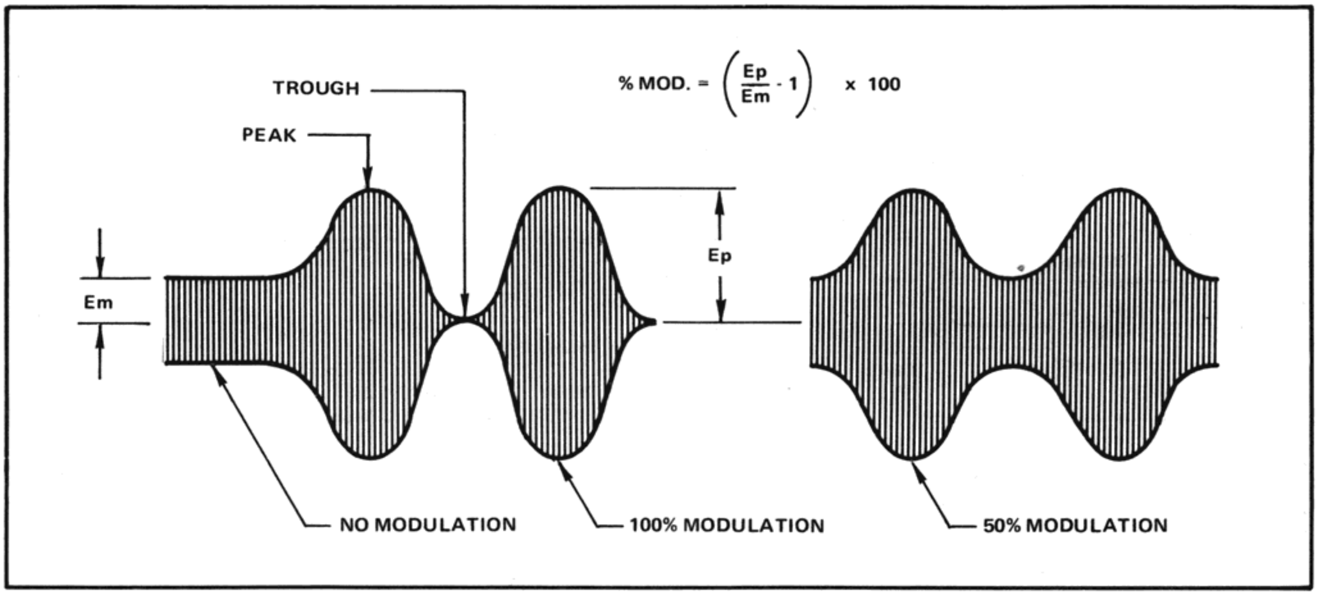



Figure 3-2 Direct Modulation Monitor

## 3.6 CHANNEL SELECT SWITCH SCHEMATIC AND WIRING DIAGRAM

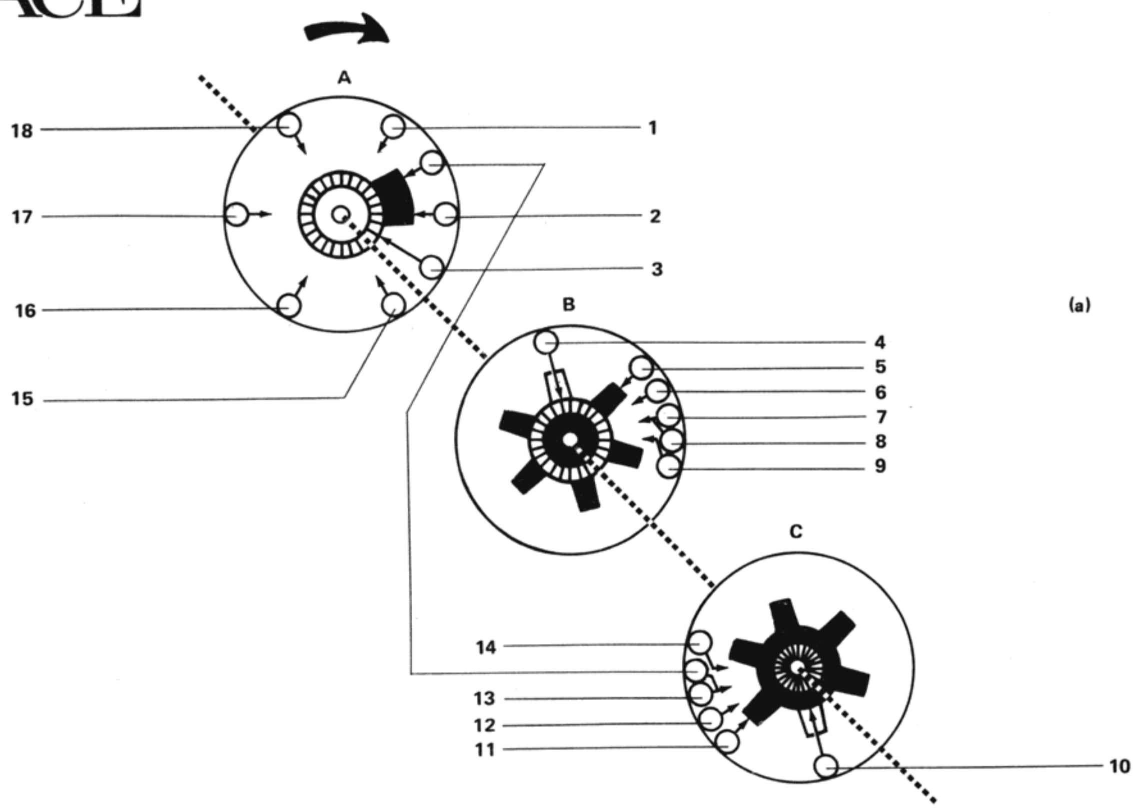
The channel select switch on the CB 144 is a dual wafer type with a total of three circuits.

The rear wafer controls the master oscillator Q16. This section selects one of 6 crystals ranging in frequency from 37.600 to 37.850 MHz in increments of 50 kHz.

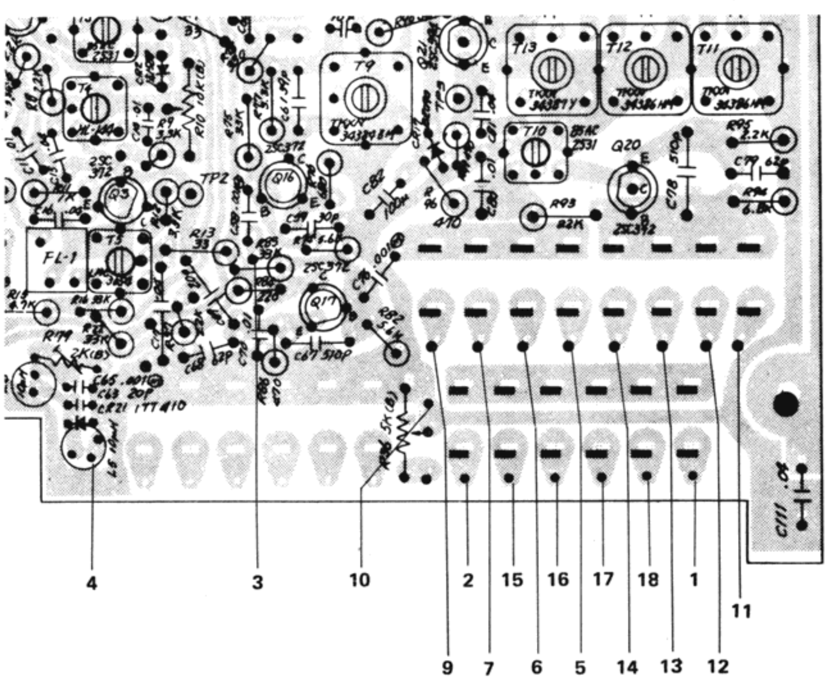
The front wafer has two circuits on its face. One is for the receive local oscillator Q17 consisting of 4 crystals from 10.140 to 10.180 MHz. The output from this switch goes to the DELTA TUNE control for varying receiver frequency by approximately ± 1.5 kHz.

The other is for the transmit oscillator Q20, with frequencies of 10.595 to 10.635 MHz. The function of this switch is to ground one side of the crystal as selected.

Figure 3-3 shows a schematic (not pictoral) representation of the switch (a) and its wiring and also the connection points (b) to the PC board.




(a)




NOTE

1) *Sections "B" and "C" are on the same wafer.*

2) *Connection No. 8 is open.*

3) *Shown in Channel 1 position.*

(b)

**Figure 3-3 (a) Connections to Wafers, (b) Connections to PC Board**

## NOTES

# SECTION IV
# ADJUSTMENT AND ALIGNMENT

## 4.1 GENERAL

The PACE CB 144 transceiver is factory aligned to provide optimum performance. It will not normally require realignment unless major components have been replaced or the receiver sensitivity has dropped below the specified 0.5 microvolts for 10 dB S/N or there is a malfuction of the transmitter.

**NOTE**

*Transmitter tuning adjustments may only be made by a technician holding an appropriate FCC license and the results entered in the station radio log.*

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.

## 4.2 TEST EQUIPMENT

The CB 144 transceiver alignment should not be undertaken unless precision equipment is available. Table 4-1 is a list of recommended test equipment.

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

| Item | Model or Description |
|---|---|
| Power Source . . . . . . . . . . . . . . . . . . . . . . | Regulated 13.8 V DC Power Supply rated @ 3 amperes (Hewelett-Packard Model 624B or equivalent) |
| Wattmeter . . . . . . . . . . . . . . . . . . . . . . . | 50 Ω, 10 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 (Hewelett-Packard Model 410B or equivalent) |
| RF Signal Generator . . . . . . . . . . . . . . . . | Capable of tuning 455 kHz, 10 MHz, 27 MHz CB and 37 MHz frequencies (Hewelett-Packard Model 606B or equivalent) |
| DC Voltmeter (Multimeter). . . . . . . . . . . . | High impedance input (RCA WV-98C or equivalent) |
| RF Probe* . . . . . . . . . . . . . . . . . . . . . . . | For use with multimeter |

*If no probe is available for the mutimeter, one may be fabricated as shown in Figure 4-2.

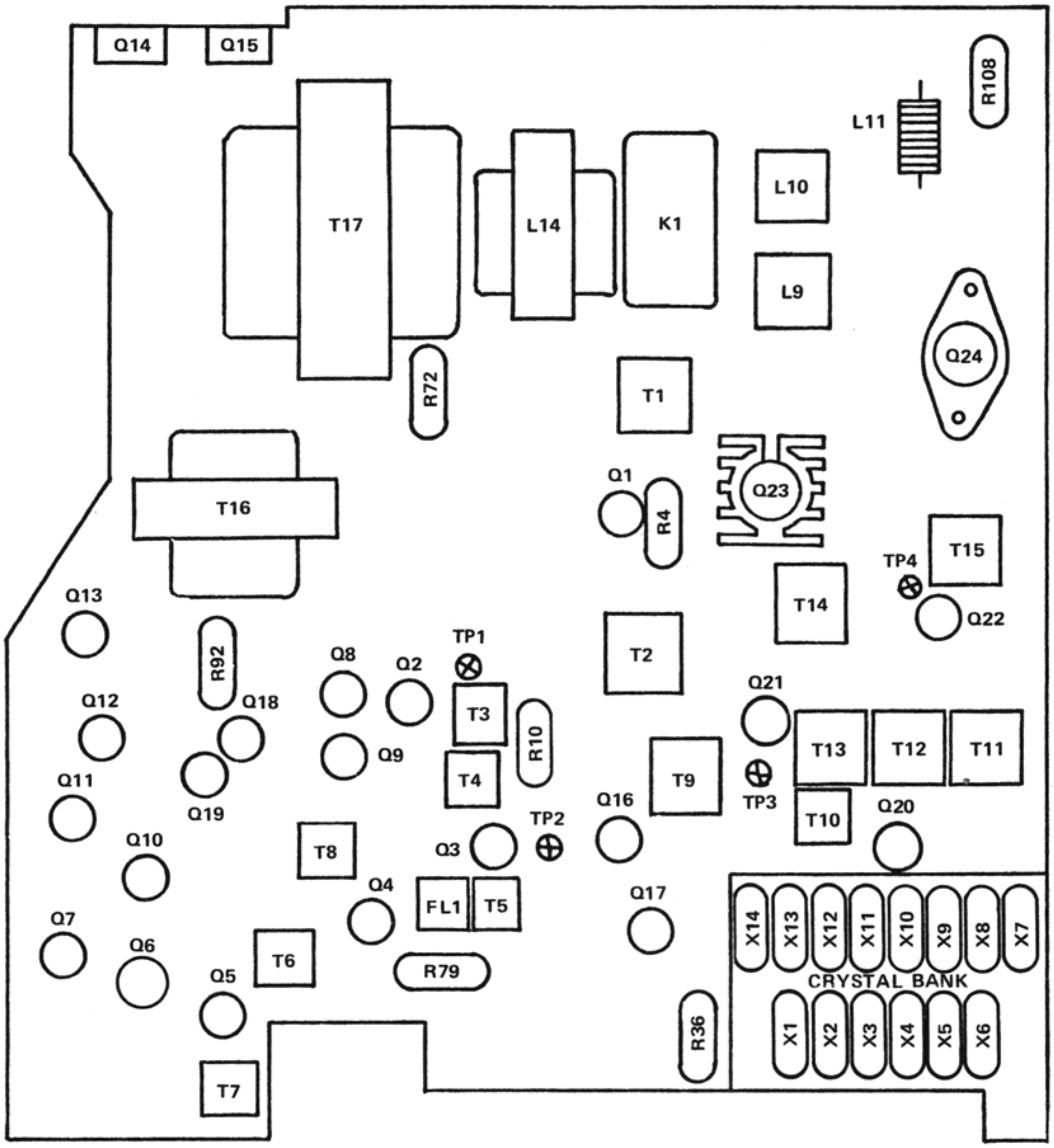



**Figure 4-1 Alignment And Test Point Locations**

## 4.3 PRELIMINARY SETUP

1. Set the front panel controls as follows:

| Control | Setting |
|---|---|
| VOLUME ON/OFF | Maximum CCW (Power Off) |
| SQUELCH | Maximum CCW |
| RF GAIN | Maximum CW |
| DELTA TUNE | Center Position |
| CB/PA Switch | CB Position |
| NB ON/OFF Switch | OFF Position |
| ANL | OFF Position |

2. Connect a regulated DC voltage source of 13.8 volts to the DC power cord (plus to red wire).
3. Connect a wattmeter to the antenna jack.
4. Connect a 50 ohm dummy load to the output of the wattmeter. Refer to Figure 4-1 for alignment and test point locations.

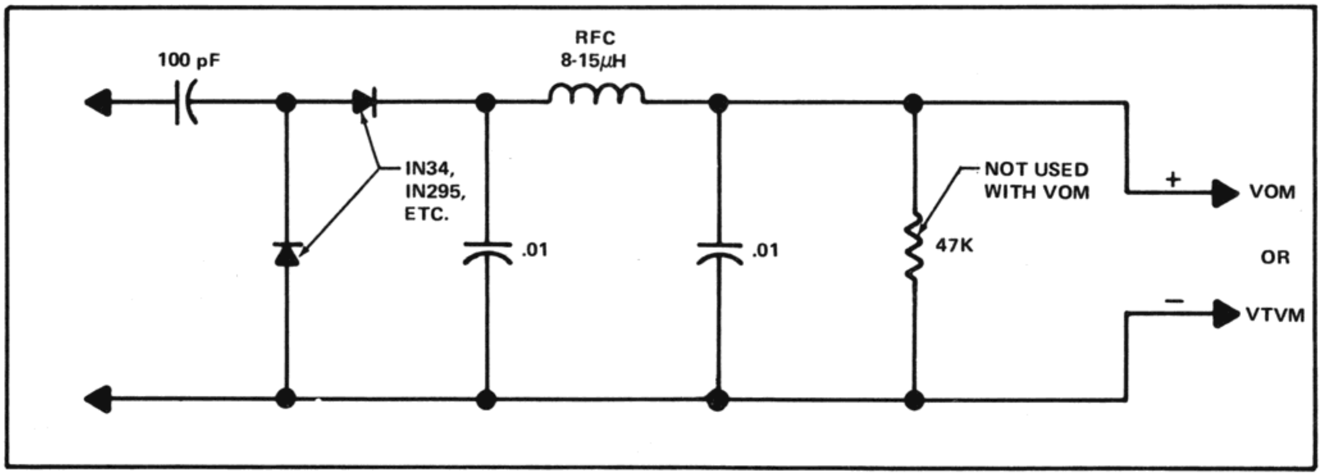



Figure 4-2 RF Probe

## 4.4 OSCILLATOR ADJUSTMENT

NOTE

*All oscillators have been precisely set at the factory. They should not be readjusted unless one of the critical tuning components associated with them have been replaced or tampered with.*

### 4.4.1 Q16 Master Oscillator Adjustment

a. Connect a VOM through an RF probe to TP1. If no probe is available, one may be fabricated as shown in Figure 4-2.

b. Set the CHANNEL SELECTOR switch to Channel 12.

c. Adjust T9 for a maximum reading on the voltmeter.

d. Check the voltage readings on Channels 1 and 24. These should be within ± 10% of that obtained in step "c". If not, "tweak" T9 to achieve this.

### 4.4.2 Q17 Local Oscillator Adjustment

a. Connect a frequency counter to the emitter of Q17 through a 10 pF capacitor.

b. Set the CHANNEL SELECTOR switch to Channel 12. Rotate front panel DELTA TUNE control R80 to center notch position.

c. Adjust R79 so that there is equal deviation (approximately ± 1.5 kHz) from the center frequency when R80 is turned to either of its extremes.

d. Return R80 to its center position.

e. Connect a VTVM across the speaker terminals. Attach an RF signal generator to the antenna and adjust for an output of about 1 μV at 27.105 MHz (Channel 12).

f. Adjust volume to give a midscale reading on the voltmeter (about 1-2 volts).

g. Adjust trimmer capacitor C66 for a dip on the VTVM.

h. Disconnect test equipment.

### 4.4.3 Q20 Transmitter Oscillator Adjustment

a. Connect the VOM through the RF probe used in Section 4.4.1 to TR3.

b. Set the CHANNEL SELECTOR switch to Channel 12.

c. Depress the P-T-T switch and adjust T10 for a maximum reading on the voltmeter.

d. Check the voltage readings on Channels 1 and 24. These should be within ± 10% of that obtained in step "c". If not, "tweak" T10 to achieve this.

e. Move probe to test point TP4. Return to Channel 12.

f. Depress the P-T-T switch and adjust T11, T12 and T13 for a maximum reading on the voltmeter.

g. Check the voltage readings on Channels 1 and 23. These should be within ± 10% of that obtained in step "f". If not, "tweak" T11, T12 and T13 to achieve this.

## 4.5 TRANSMITTER ALIGNMENT

1. Set the channel selector switch to Channel 12.
2. Confirm that a dummy load of 50 ohms is connected to the antenna connector of the set.
3. Turn the power switch on, and key the transmitter. The TX lamp should light up.
4. Adjust L9 and L10 for maximum RF output indication on the wattmeter.
5. If power output exceeds 4 watts, adjust T15 for legal output power of 4 watts.
6. With output of 4 watts, adjust R108 for a 2/3 full scale meter reading.
7. Check the frequency of each channel with the frequency counter connected to the 50 ohm dummy load through an appropriate attenuator. The frequency of each channel should be within ± 0.005% of the frequencies listed in Table 1-2.
8. Disconnect the wattmeter and frequency counter.

## 4.6 RECEIVER ALIGNMENT

1. Connect an RF signal generator to the antenna jack.
2. Set the selector switch to Channel 12.
3. Set the signal generator to 27.105 MHz with 30% modulation at 1 kHz.
4. Adjust the generator output for an approximate mid-scale indication (5) on the "S" meter.
5. Adjust T3, T4, T5, T6 and T7 for maximum indication on the "S" meter. Reduce the generator output, as necessary, to keep the "S" meter at its approximate mid-scale.
6. Set the output of the signal generator to 100 microvolts and adjust R72 for a reading of 9 on the "S" meter.

### 4.6.1 Tight Squelch Sensitivity Adjustment

1. Set the generator frequency to 27.105 MHz (Channel 12) with 30% modulation at 1 kHz.
2. Adjust the output level to 1,000 microvolts and set the squelch control fully clockwise.
3. Set R4 to the point where less than 1,000 microvolts does not open squelch.

### 4.6.2 Noise Blanker Adjustment

1. Reset the RF signal generator frequency to 25 MHz without modulation. Adjust the output level to more than 10,000 microvolts.
2. Connect the RF probe from the oscilloscope to the collector of Q9.
3. Adjust T8 for a maximum indication on the oscilloscope.
4. Change the frequency of RF signal generator to any desired CB frequency.
5. Adjust R10 for a minimum noise at speaker.

# SECTION V
# ILLUSTRATIONS AND PARTS LIST

## 5.1 GENERAL

The schematic and parts locator in the section are for the PACE Model CB 144 Mobile Transceiver. Part numbers and descriptions are keyed to schematic reference numbers and are listed for these components. Order all unlisted parts by reference number and description.

### Table 5-1
### CB 144 Parts List

| Reference | Description | Part Number |
|---|---|---|
| **CAPACITORS** | | |
| C30 | Electrolytic, 33 $\mu$F, 25 V | IP 22-0005 |
| C32, 49, 62, 71, 73, 74 | Electrolytic, 10 $\mu$F, 25 V | IP 22-0004 |
| C50 | Electrolytic, 220 $\mu$F, 25 V | IP 22-0009 |
| C51 | Electrolytic, 1000 $\mu$F, 25 V | IP 22-0011 |
| C52, 75 | Electrolytic, 4.7 $\mu$F, 25 V | IP 22-0003 |
| C54, 113 | Electrolytic, 47 $\mu$F, 25 V | IP 22-0006 |
| C55 | Electrolytic, 1 $\mu$F (non-polar), 63 V | IP 22-0031 |
| C57, 82 | Electrolytic, 100 $\mu$F, 25 V | IP 22-0008 |
| **RESISTORS** | | |
| R4, 10 | Trimmer, 10 k ohm (R10 may be a fixed resistor) | IP 24-0005 |
| R35, 52 | Dual Potentiometer, 5 k ohm one w/switch | IP 24-0038 |
| R36 | Trimmer, 5 k ohm | IP 24-0035 |
| R66 | 4.7 ohm 1 W | IP 23-0006 |
| R67 | 10 ohm, 1 W | IP 23-0003 |
| R72, 79, 92 | Trimmer, 2 k ohm | IP 24-0040 |
| R81, 87 | Dual Potentiometer, 10 k ohm —50 k ohm | IP 24-0039 |
| R108 | Trimmer, 50 k ohm | IP 24-0006 |

(Continued)

## Table 5-1
## (Continued)

| Reference | Description | Part Number |
|---|---|---|
| **INDUCTORS, CHOKES, AND TRANSFORMERS** | | |
| T1, 11, 12 | Coil, RF, var., TKXN-34386HM | IP 21-0019 |
| T2, 13 | Coil, RF, var., TKXN-34387Y | IP 21-0020 |
| T3, 8, 10 | Transformer, IF, var., 85AC-2531A | IP 21-0038 |
| T4 | Transformer, IF, var., HL 144 | IP 21-0321 |
| T5 | Transformer, IF, var., LMC3054-153 | IP 21-0032 |
| T6 | Transformer, IF, var., LPC 4201A | IP 21-0033 |
| T7 | Transformer, IF, var., LMC 4202A | IP 21-0034 |
| T9 | Coil, RF, var., TKXN-34384BM | IP 21-0021 |
| T14 | Transformer, var., HL 128 | IP 21-0117 |
| T15 | Coil, RF, var., TKXN-34385HM | IP 21-0022 |
| T16 | Transformer, AF, Input, EI 24-003 | IP 21-0045 |
| T17 | Transformer, AF, Output, EI 41-002 | IP 21-0046 |
| L1 | Choke, RF, 270 μH | IP 21-0216 |
| L2, 3 | Choke, RF, 1 mH | IP 21-0185 |
| L4, 5, 6 | Choke, RF, 10 μH | IP 21-0073 |
| L7, 12, 13 | Choke, RF, HL 109 | IP 21-0027 |
| L8 | Choke, RF, HL 140 | IP 21-0215 |
| L9, 10 | Coil, RF, HL 129 | IP 21-0118 |
| L11 | Coil, RF, HL 112 | IP 21-0029 |
| L14 | Choke, AF, EI 24-002 | IP 21-0037 |
| **TRANSISTORS AND DIODES** | | |
| Q1 | Transistor, 2SC784 | IP 20-0037 |
| Q2, Q21 | Transistor, 2SC394 | IP 20-0038 |
| Q3, Q4, Q5, Q7, Q9, Q11, Q12, Q16, Q17, Q18, Q20 | Transistor, 2SC372 | IP 20-0039 |
| Q6, Q8, Q10 | Transistor, 2SK19 | IP 20-0035 |
| Q13, Q22 | Transistor, 2SC735 | IP 20-0041 |
| Q14, Q15 | Transistor, 2SD360 | IP 20-0083 |
| Q19 | Transistor, 2SA562 | IP 20-0046 |
| Q23 | Transistor, 2SC776 | IP 20-0004 |
| Q24 | Transistor, 2SC1239 | IP 20-0005 |
| CR1, 2, 5, 7, 8, 9, 14 | Diode, 1S1588 | IP 20-0061 |
| CR3, 4, 12, 15, 16, 19, 20 | Diode, 1N60P | IP 20-0016 |
| CR6 | Diode, 1S1885 | IP 20-0054 |
| CR10 | Diode, MV3 | IP 20-0055 |
| CR11, 17 | Diode, Zener, BZ-090 | IP 20-0019 |
| CR13 | Diode, G1-300B | IP 20-0167 |
| CR18 | Diode, ME116R | IP 28-0006 |
| CR21 | Diode, Varactor, ITT410 | IP 20-0235 |

(Continued)

## Table 5-1
## (Continued)

| Reference | Description | Part Number |
|---|---|---|
| **MISCELLANEOUS** | | |
| FL1 | Filter, Ceramic, LF-B6 | IP 31-0048 |
| K1 | Relay, MTS-2 | IP 32-0004 |
| RT1, 2 | Thermistor, 33D26 | IP 20-0057 |
| | Upper Cover | IP 30-0054 |
| | Lower Cover | IP 30-0055 |
| | Crystal, 10.140 MHz | IP 31-0014 |
| | Crystal, 10.160 MHz | IP 31-0013 |
| | Crystal, 10.170 MHz | IP 31-0012 |
| | Crystal, 10.180 MHz | IP 31-0011 |
| | Crystal, 10.595 MHz | IP 31-0010 |
| | Crystal, 10.615 MHz | IP 31-0009 |
| | Crystal, 10.625 MHz | IP 31-0008 |
| | Crystal, 10.635 MHz | IP 31-0007 |
| | Crystal, 37.600 MHz | IP 31-0001 |
| | Crystal, 37.650 MHz | IP 31-0002 |
| | Crystal, 37.700 MHz | IP 31-0003 |
| | Crystal, 37.750 MHz | IP 31-0004 |
| | Crystal, 37.800 MHz | IP 31-0005 |
| | Crystal, 37.850 MHz | IP 31-0006 |
| | Front Panel, Bezel | IP 30-0141 |
| | Front Plate | IP 30-0142 |
| | Microphone | IP 29-0010 |
| | Lamp, Pilot | IP 28-0002 |
| | Meter, H1264, 12C, 12H w/Lamp | IP 27-0010 |
| | Knob, Small (for VOLUME, SQUELCH) | IP 30-0152 |
| | Knob, Small (for RF GAIN, DELTA TUNE) | IP 30-0153 |
| | Knob, Big (for Channel) w/Channel Bezel | IP 30-0140 |
| | Mounting Bracket | IP 30-0058 |
| | Mounting Screw | IP 30-0057 |
| | Plate, FCC | IP 30-0143 |
| | Microphone Hanger Clip | IP 30-0061 |
| | Socket (4-Crystal) | IP 34-0003 |
| | Socket (6-Crystal) | IP 34-0005 |
| | Heat Sink (for 2SC776) | IP 30-0110 |
| | Heat Sink (for 2SC1239) | IP 30-0111 |
| | Switch, Rotary | IP 25-0010 |
| | Switch, Slide, 3-2-S-(C) | IP 25-0040 |
| | Jack, Microphone | IP 26-0014 |
| | Plug, Microphone | IP 26-0017 |
| | Jack, Antenna | IP 26-0002 |
| | Speaker | IP 29-0003 |
| | Jack, Speaker | IP 26-0005 |
| | Plug, Speaker w/Cord | IP 26-0010 |

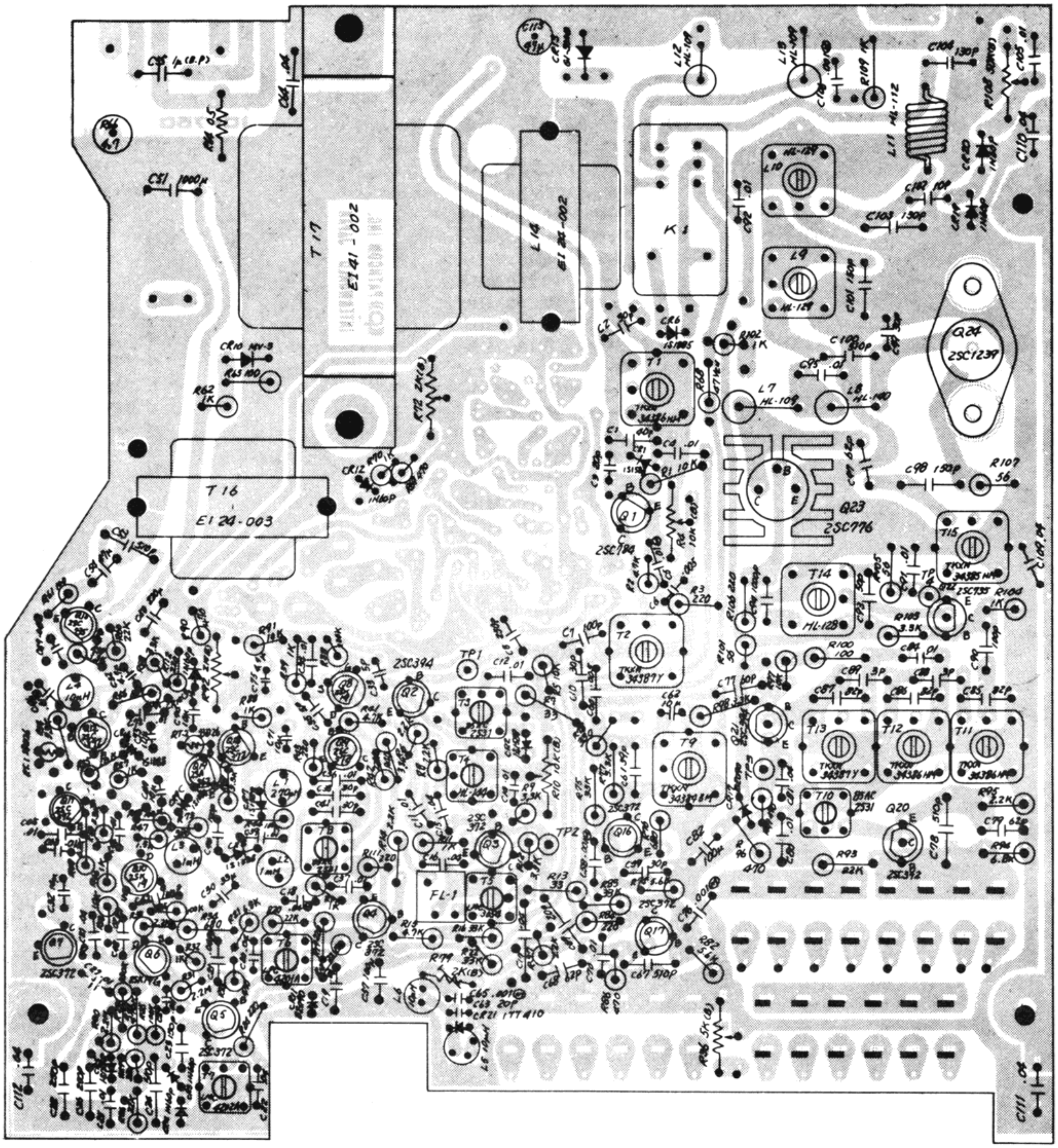



Figure 5-1 CB 144 Parts Locator