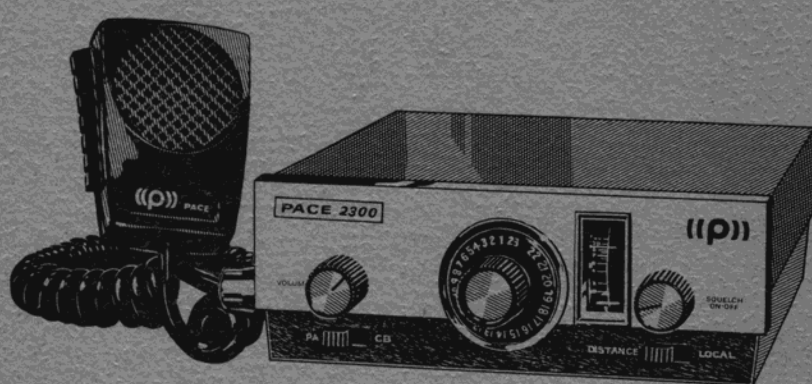
PRICE $2.50

SERVICE MANUAL

PACE MODELS
CB 2300 AND DX 2300B
TRANSCEIVERS
27 MHz CITIZENS BAND



PATHCOM INC.

PACE TWO-WAY RADIO PRODUCTS

24049 S. Frampton Ave., Harbor City, California 90710

L2087-476

TABLE OF CONTENTS

LIST OF TABLES

Table | Page

LIST OF ILLUSTRATIONS

Figure

SECTION I
GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

This manual contains installation, service, and maintenance information for the PACE Models CB 2300 (Mobile) and CB DX2300B (Base Station) transceivers manufactured by PATHCOM INC. located in Harbor City, California. It also includes a circuit description and all necessary information required to perform a troubleshooting analysis and a complete alignment of PACE Models CB 2300 and CB DX2300B.

Twenty-three channel CB operation (in both transmit and receive) is made possible with 14 crystals in a highly stable synthesizing circuit. Both transceivers are identical except for the following differences:

A. The CB 2300 is only operable from a 12 volt nominal DC, negative or positive ground source. The CB DX2300B is designed to operate from 117 volts AC source, and may be rewired for 220 volts AC operation.

B. The CB DX2300B has a delta tune control to improve off-frequency signal reception. This control is not included in the CB 2300.

C. The CB DX2300B has an On The Air indicator lamp, which is not included in the CB 2300.

1.2 SPECIFICATIONS

Technical specifications for the CB 2300 and CB DX2300B transceivers 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 for all models in both receive and transmit. The frequency of each crystal is shown in Table 1-2. Other synthesizer information is described in Section II.

All crystals supplied for use in PACE Models CB 2300 and CB DX2300B 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%.

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Table 1-1
Technical Specifications

GENERAL

Channels	23
Operating Voltage (CB DX2300B)	117 V AC or 220 V AC
(CB 2300)	12 V nominal DC ± ground
Frequency Range	26.965 to 27.255 MHz
Microphone	High impedance ceramic
Speaker	2" x 6", 3.2 Ω
Antenna Impedance	50 Ω
Size (CB DX2300B)	3-3/4" x 9-1/4" x 13-5/8"
(CB 2300)	6-3/4" x 2-1/2" x 8"
Weight (CB DX2300B)	13 pounds (with accessories)
(CB 2300)	6 pounds (with accessories)

TRANSMITTER

Compliance (CB DX2300B)	FCC Type Number TA2300B, Part 95
(CB2300)	FCC Type Number TA2300M, Part 95
Power Output	Typically 4 W
Modulation	85% minimum guaranteed sine wave 100% average speech

RECEIVER

Sensitivity	0.35 μV for 10 dB $\frac{s+n}{n}$
Squelch Sensitivity	0.25 μV minimum
Selectivity	6.0 dB bandwidth — 4.4 kHz minimum 50 dB bandwidth — 20 kHz minimum
Image Rejection	55 dB major image; 40 dB all others
Noise Limiter	Series gate, approximately 65% clipping level
Audio Output	2.25 W

Specifications subject to change without notice.

Table 1-2
Crystal Frequency Chart

Function	Crystal	Frequency in MHz
TX Only	Y1	8.006
	Y2	7.996
	Y3	7.986
	Y4	7.966
RX Only	Y5	8.461
	Y6	8.451
	Y7	8.441
	Y8	8.421
TX and RX	Y9	34.971
	Y10	35.021
	Y11	35.071
	Y12	35.121
	Y13	35.171
	Y14	35.221

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL

This section provides a general description of the PACE Model CB DX2300B transceiver which is also representative of the CB 2300 transceiver. Refer to the Schematic in Section V and the Block Diagram in Figure 2-1.

2.2 TRANSMITTER DESCRIPTION

The transmitter is comprised of two basic sections, the low level frequency generation section contained on the synthesizer output board (S.O.B.); the Driver, Intermediate Power Amplifier (I.P.A.), and Power Amplifier (P.A.) located on the main printed circuit board. The S.O.B. is connected to the main circuit board with a small coaxial cable and, therefore, may be checked and serviced as a separate unit quite readily.

The S.O.B comprises two oscillators, Q14 and Q15. Q14 operates at approximately 8.0 MHz and Q15 at 35. The difference of the two oscillators is obtained from mixer Q16 and passed through a bandpass filter-amplifier L7, L8, Q17, and L9. The output at L9 is coupled by coaxial cable to Driver Q18. Driver Q18 operates Class AB, i.e., a small forward bias exists with no signal and increases with drive power. The I.P.A. (Q19) and P.A. (Q20) are operated Class C. The more drive applied, the more reverse biased their base-emitters become. There is no current flow through Q19 or Q20 without drive applied. The transmitter output network is a three-section pi filter for maximum efficiency and harmonic rejection.

2.3 RECEIVER DESCRIPTION

The receiver is a double conversion superheterodyne. Both oscillators are crystal controlled and both are changed in frequency steps to obtain 23 channel operation. The 1st Mixer (Q2) uses high side injection obtained from oscillator Q15. (Oscillator Q15 works during both transmit and receive operation.) The 2nd Mixer (Q3) obtains injection from oscillator Q4. The output of Q3 is at 455 kHz and passes through the 6-stage filter T2 through T7. The signal is further amplified by Q5 and Q6 and detected by CR2/CR3.

2.3.1 AGC (Automatic Gain Control)

The output of the detector contains the rectified audio, and a DC component proportional to the carrier. The DC component is applied to the base of AGC amplifier Q7 through the filter network R23, R7 and C40. This positive voltage turns Q7 on causing its collector to go toward ground. Q1, Q2, Q3, and Q5 receive base bias from the collector of Q7. The negative going voltage reduces the bias and consequetly the gain of each of these stages. At maximum signal level, they will be turned completely off.

Bias for Q1 is taken directly from the collector of Q7 through R34, and bias for Q2 and Q5 is obtained from a voltage divider (R35/R36). The collector of Q7 is tapped into the top of the voltage divider between R33-R34 and increasing collector current reduces the base bias on Q1, Q2, and Q5.

AGC for the 2nd Mixer Q3 is derived from the emitter of Q2. Since the emitter of Q2 goes toward ground, this cuts off Q3. In this manner Q3 is the first amplifier to be cut off thereby reducing mixer noise more quickly with small increases in signal.

2.3.2 PA/LCL/DIST Switch

NOTE

This 3-position switch is used in the CB DX2300B only. The CB 2300 uses two separate switches to perform the same operations. The circuit description applies to both units.

Maximum sensitivity of the transceiver is derived with the switch set for DIST. This will improve reception of weak signals. In the LCL position, most extraneous noises (as well as skip-interference) is reduced. This position is useful when receiving very strong signals. The PA position provides a public address system through the microphone audio amplifier and a special external speaker.

The low side of the secondary of T1 is connected to the LCL/DIST switch. In the LCL position the DC base current of Q3 is shunted off through R85 to reduce its gain. A drop of approximately 15 dB occurs in this position.

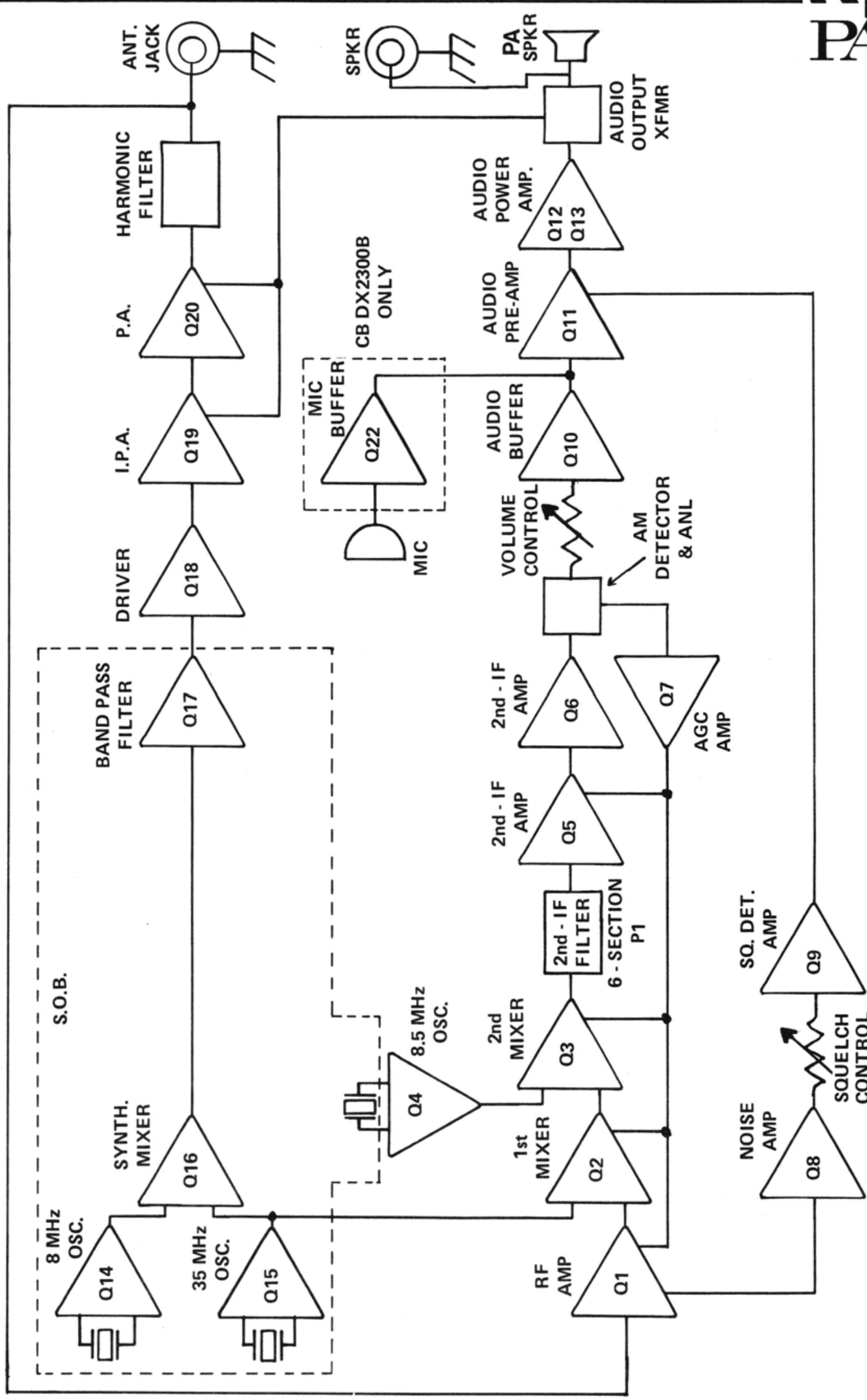

Figure 2-1 CB 2300/CB DX2300B Block Diagram

2.3.3 Noise Limiter

Noise limiting is accomplished with the network consisting of R26, R24, R27, R28, C35, and CR4. DC bias from the detector is applied to cathode of CR4 from the junction of divider R26/R24. It is also applied to the anode via R27 and R28. This forward biases CR4 for normal signal amplitudes and audio is coupled through CR4 to the volume control.

When noise pulses are present in the signal, a higher positive bias is applied to the cathode of CR4. However, the bias to the anode is not increased because of the time constant presented by R27 and C35. This reverse biases CR4 so that the noise pulses are clipped off. Noise pulses are usually equal to three or four times the normal 100% modulated audio level and they will gate CR4 off. Clipping level is fixed at about 65%.

2.3.4 Audio Amplifier

The audio system is an all direct coupled single ended amplifier. The input stage Q10 is an emitter follower giving high input impedance. This high input impedance allows use of a standard ceramic microphone. The standard high impedance ceramic unit possesses better speech characteristics than the so-called low impedance types. Q10 is biased by a divider string in the collector of Q11 thus providing negative DC feedback around Q10 and Q11. This stabilized DC voltage drives Q12. Resistor R53 in the emitter of Q12 is selected to compensate for the difference in beta of Q13. R53 is selected to provide about 1.25 ampere current during transmit and/or public address functions. R54 is then selected to produce about 750 mA during receive condition.

Transformer coupling is used at the output of Q13. The secondary of T11 couples the audio signal to the speaker (or jacks) during receiver operation.

During transmit operation, audio for modulation of Q19 and Q20 is provided from the secondary of T11. This is further explained in part 2.4.

The CB DX2300B contains an additional transistor in the audio circuit. This transistor, Q22, acts as a buffer between the microphone input and audio amplifier. Its purpose is to prevent loading of the audio stage (in receive mode) when the transceiver is used with a microphone that grounds the audio input.

2.3.5 Squelch Amplifier

The squelch sensing voltage is taken from the collector of the RF amplifier Q1. With increasing signal strength the base of Q1 moves toward ground cutting off Q1. Because of DC load resistor R4, the voltage at the collector of Q1 increases in a positive direction. Since Q8 is a PNP transistor this positive going voltage cuts it off. The cut off or squelch point is determined by R38, the squelch control. As the control is moved toward the +10 volt supply, Q1 must be more nearly cut off (requiring a stronger signal) to cut off Q8. With Q8 cut off no current flows in R41-R42 and this in turn cuts off Q9.

Squelch operation is obtained by "starving" the divider string in the collector of Q11. The squelch transistor Q9 draws current through a 10 K resistor R49. This prevents any base current from reaching Q10, turning it off. This in turn shuts off Q11 and the only current then flowing through R50, 51, and 52 is the small amount flowing through R49 to Q9. This is insufficient to turn Q12 on and Q13 will also be off.

2.3.6 "S" Meter

The "S" Meter is in a bridge circuit in the collector of Q7, the AGC amplifier. With no signal, the voltage across the "S" Meter is nearly zero. With increasing signal strength, Q7 conducts, causing the voltage at its collector to go negative (towards ground) with respect to the junction of R31-R32, causing current flow through the "S" Meter.

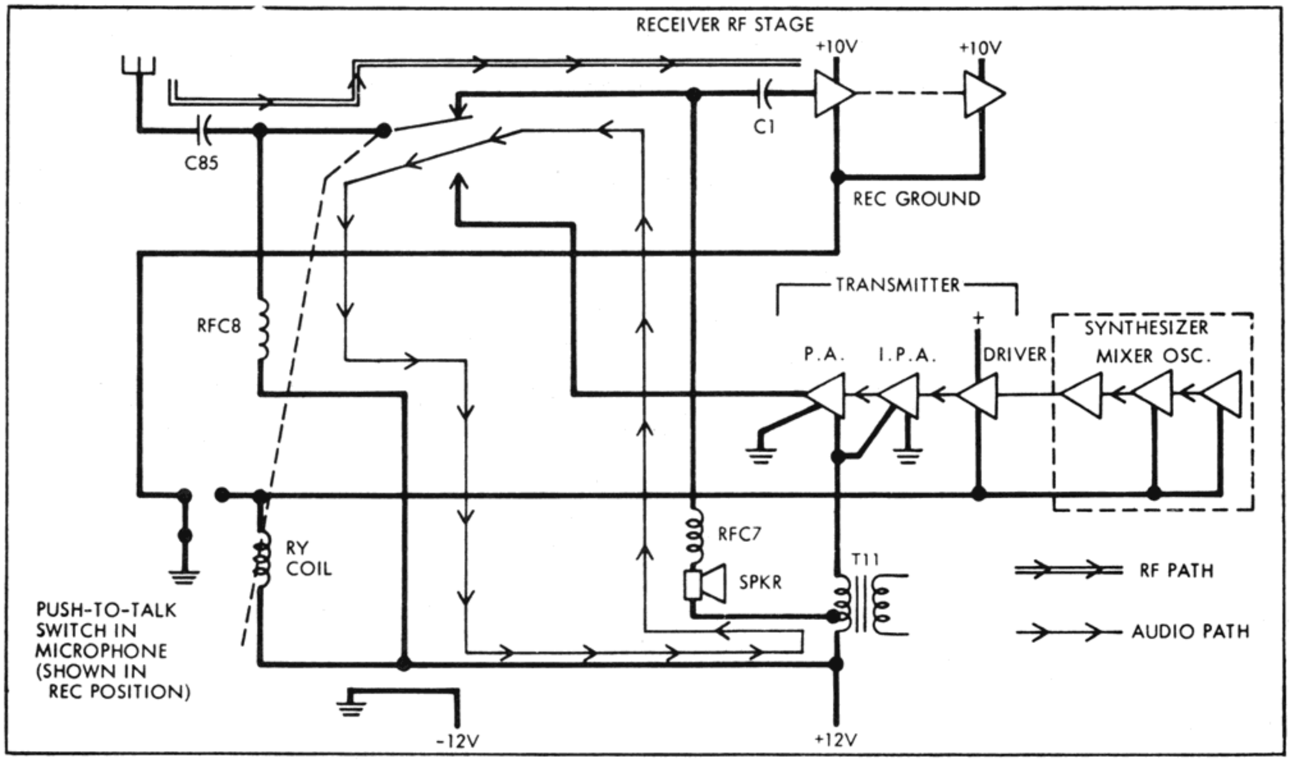

Figure 2-2 Transmit-Receive Switching Schematic

2.4 TRANSMIT-RECEIVE SWITCHING SYSTEM

The transmit-receive switching system is semi-electronic. The antenna and speaker circuits are switched by a SPDT relay. The transmitter oscillator and receiver are switched by the same microphone contacts that operate the relay. The antenna circuit is switched in the conventional manner; the speaker is also switched with the antenna relay contacts. Shunting of the RF circuit to ground through the audio system is prevented by a pair of isolation RF chokes, RFC7 and RFC8 (see Figure 2-2).

When the Push-To-Talk (P-T-T) switch is in the normal or receive position, the antenna is connected through C1 and C85 to the receiver RF stage while RFC7 and RFC8 present a high RF impedance so that no antenna currents will flow into the audio circuit. The speaker is connected across T11 because the RF chokes are essentially zero impedance at audio frequencies. Loss of audio through the antenna or RF stage is prevented by C1 and C85 which are very high impedances at audio frequencies.

When the P-T-T switch is depressed, the ground side of the receiver is opened, thereby disabling it. The relay coil, synthesizer mixer Q16, oscillator Q14, and driver Q18 are energized by completing their ground returns, the speaker is disconnected and the transmitter is connected to the antenna.

Note that +12 volts is applied to the transmitter I.P.A. and P.A. stages at all times (through T11). This is possible because these stages draw no current when drive is removed, i.e., the synthesizer is off. Receiver audio also appears on their collectors, but since they are drawing no current, they appear as a small capacity shunting T11.

2.5 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 channels. Refer to Section 1.3 for crystal information.

Oscillator Q15 is a crystal controlled Colpitts oscillator. Six crystals coupled to the base of this transistor are in the frequency range of 34.971 to 35.221 MHz. A different crystal is selected for each channel as shown in Table 2-1. This oscillator is active in both the transmit and receive modes of operation. The output, taken from the secondary winding of L6 is connected to the emitter of TX mixer Q16. Coupling to the emitter of 1st RX Mixer Q2 is taken from the primary of L6 through C67.

Table 2-1
Crystal Versus Channel Identifier

Channel No.	Crystals													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	T				R				B					
2		T				R			B					
3			T				R		B					
4				T				R	B					
5	T				R					B				
6		T				R				B				
7			T				R			B				
8				T				R		B				
9	T				R						B			
10		T				R					B			
11			T				R				B			
12				T				R			B			
13	T				R							B		
14		T				R						B		
15			T				R					B		
16				T				R				B		
17	T				R								B	
18		T				R							B	
19			T				R						B	
20				T				R					B	
21	T				R									B
22		T				R								B
23				T				R						B

T - Transmit
R - Receive
B - Transmit & Receive

See Table 1-2 for crystal frequency.

Oscillator Q4 is a crystal controlled modified Hartley oscillator. Four crystals, coupled to the base of this transistor, are in the frequency range of 8.421 to 8.461 MHz. A different crystal is selected for each channel as shown in Table 2-1. The output is taken from the collector of Q4 and coupled to the emitter of the receiver 2nd Mixer Q3. This frequency is then mixed with the output from the 1st Mixer (Q2) to obtain the 455 kHz IF. Q4 is activated in the receive mode only.

Oscillator Q14 is a tuned-collector crystal oscillator. Four crystals, coupled to the base of this transistor, are in the frequency range of 7.966 to 8.006 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 center tap of L5 is coupled via C57 to the base of transmitter mixer Q16. This frequency mixed with that from Q15 produces the channel frequency.

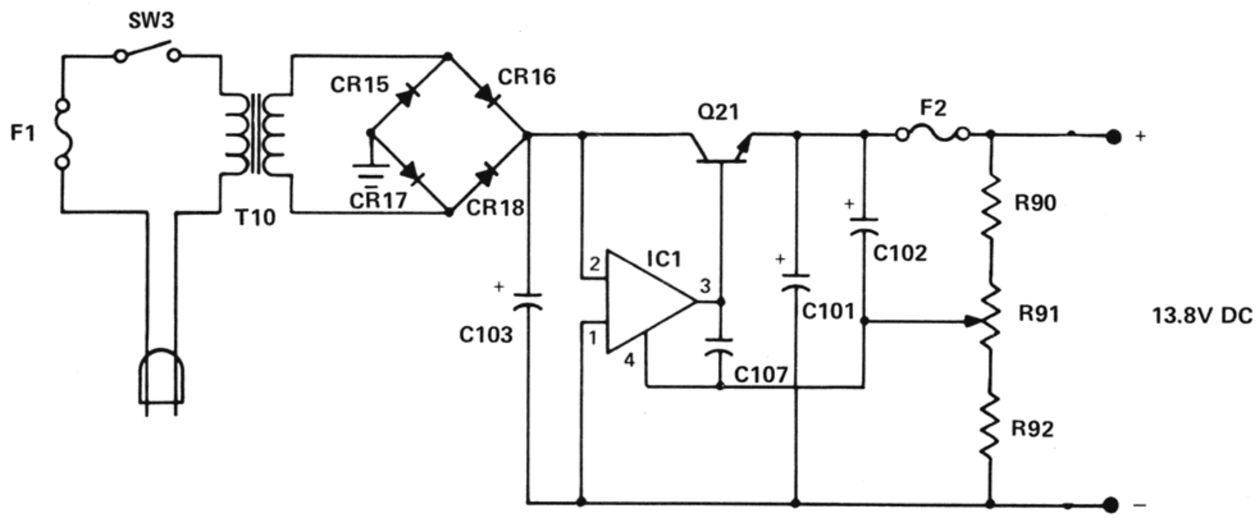

Figure 2-3 Power Supply Circuit

2.6 POWER SUPPLY (CB DX2300B ONLY)

The power supply used in the CB DX2300B is a constant voltage regulated DC supply (Figure 2-3). The 117 volt AC input is stepped down by power transformer T10, rectified by bridge circuit CR15 through CR18, and then filtered by C103.

Feedback action alters the voltage drop across pass transistor Q21 so as to keep the DC output voltage constant despite load changes, unregulated DC, or other disturbances. Comparison amplifier IC1 monitors the difference between the DC voltage at its input and a sampling of the output voltage taken from the tap of R91. If these voltages are unequal, an amplified error signal is produced at the output of IC1 which changes the conduction of Q21, thereby changing the current through R90, R91, and R92. Thus, a constant DC output voltage is maintained. R91 is adjusted for a 13.8 V output.

SECTION III
MAINTENANCE

3.1 GENERAL

This section contains maintenance instructions for the PACE Models CB 2300 and CB DX2300B transceivers. The procedures given in this section assume a general knowledge of AM type communications receivers and a familiarization with transistors and integrated circuits.

3.1.1 Tools and Techniques

A list of recommended tools and test equipment required for maintenance operations is presented in Table 3-1. 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.

Table 3-1
Test Equipment Required

Item	Model or Description
RF Signal Generator	Capable of tuning 455 kHz and 27 MHz CB frequencies
DC Voltmeter	High impedance input
AC VTVM	HP 400 or equivalent
Oscilloscope	30 MHz bandpass or DC coupled scope with detector
Wattmeter	50 Ω, 5 watts
Power Source	Regulated 13.8 volts DC power supply capable of 2 amperes
Dummy Load	50 Ω type
RF Probe	For use with voltmeter

3.1.2 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 equipment. 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 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 transceiver malfuction. Troubleshooting can be simplified by reference to the schematic diagrams in Section V.

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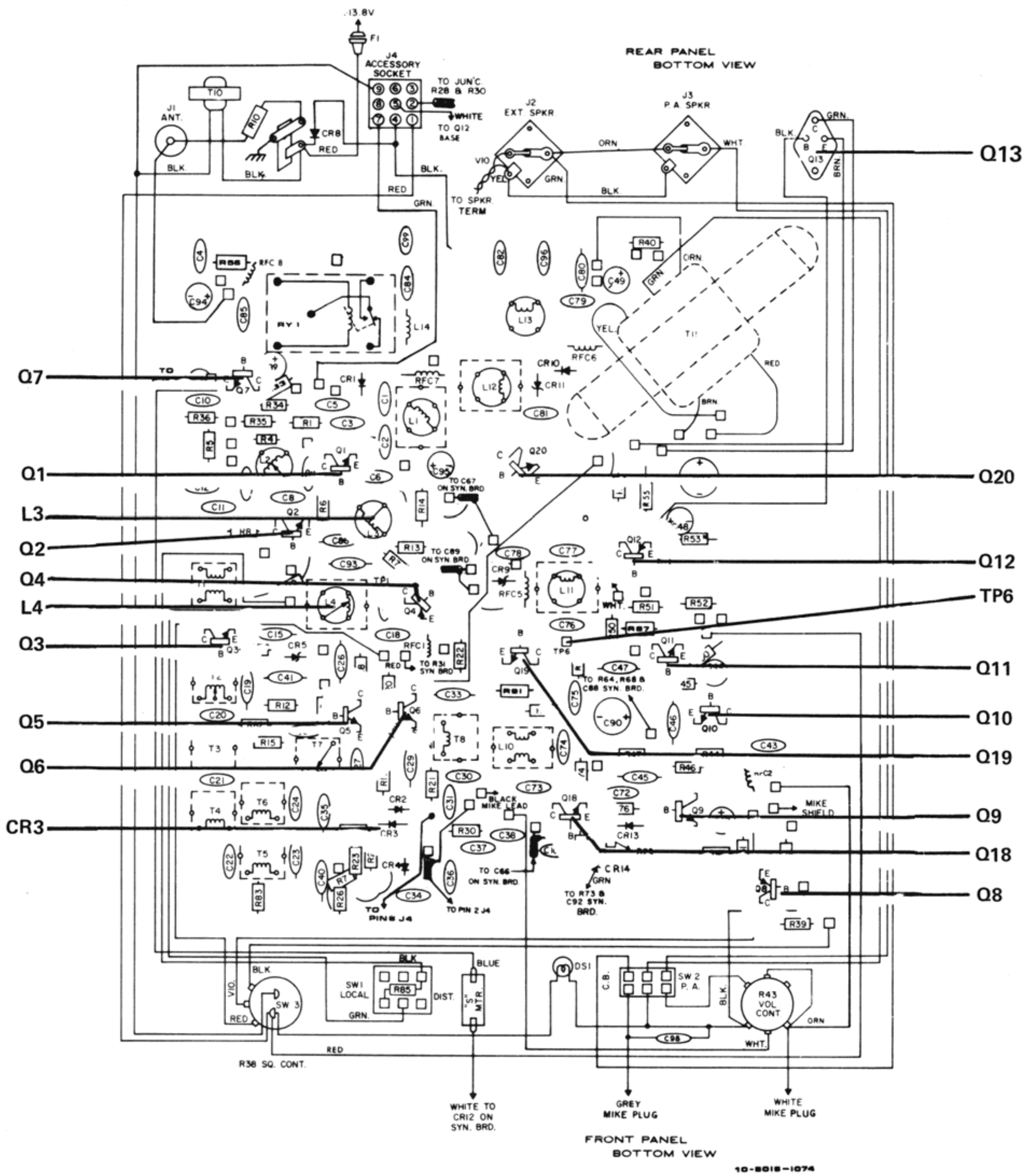


Figure 3-1 Test Point Locations for Voltage Charts

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.

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

3.5 RECEIVER SERVICING

3.5.1 General

There is little reason why a receiver will become badly mistuned and it is therefore seldom necessary to perform a complete realignment except after major service work.

Certain steps and careful observation can help pinpoint trouble before wasteful troubleshooting effort is expended. In case of a dead receiver, the following should be checked.

a. If the "S" Meter is working in a normal manner, i.e., it varies as channels are changed and is moving over the scale, then the receiver is probably okay. Trouble points could be in the audio, speaker, or speaker switching circuit.

b. If the "S" Meter is not working, the receiver oscillators should be checked as a normal part of the checkout procedure. If the transmitter is working properly, oscillator Q15 is okay. If both transmitter and receiver are inoperative (or off frequency), it is probable that Q15 is defective.

c. The audio may be checked in the PA position. Press the microphone P-T-T switch with the panel switch in PA position. The PA speaker should produce output when speaking into the microphone.

d. In case of dead audio, check the radio current in unsquelched condition (squelch control counterclockwise.) Current should be about 750 mA at 13.8 volts. If not, the radio is being held squelched or there is a defect in audio biasing.

Tables 3-2 through 3-7 provide voltage measurements to aid in troubleshooting the receiver portion. These voltages were measured with +13.8 volts DC applied to the input and the squelch control off unless otherwise noted.

NOTE

Voltage in the charts may vary as much as ± 20% according to the instrument used.

Figure 3-1 indicates locations for test points specified in the various tables. Test points specified in Section 3.5.2 through 3.5.7 are shown in Figure 3-2.

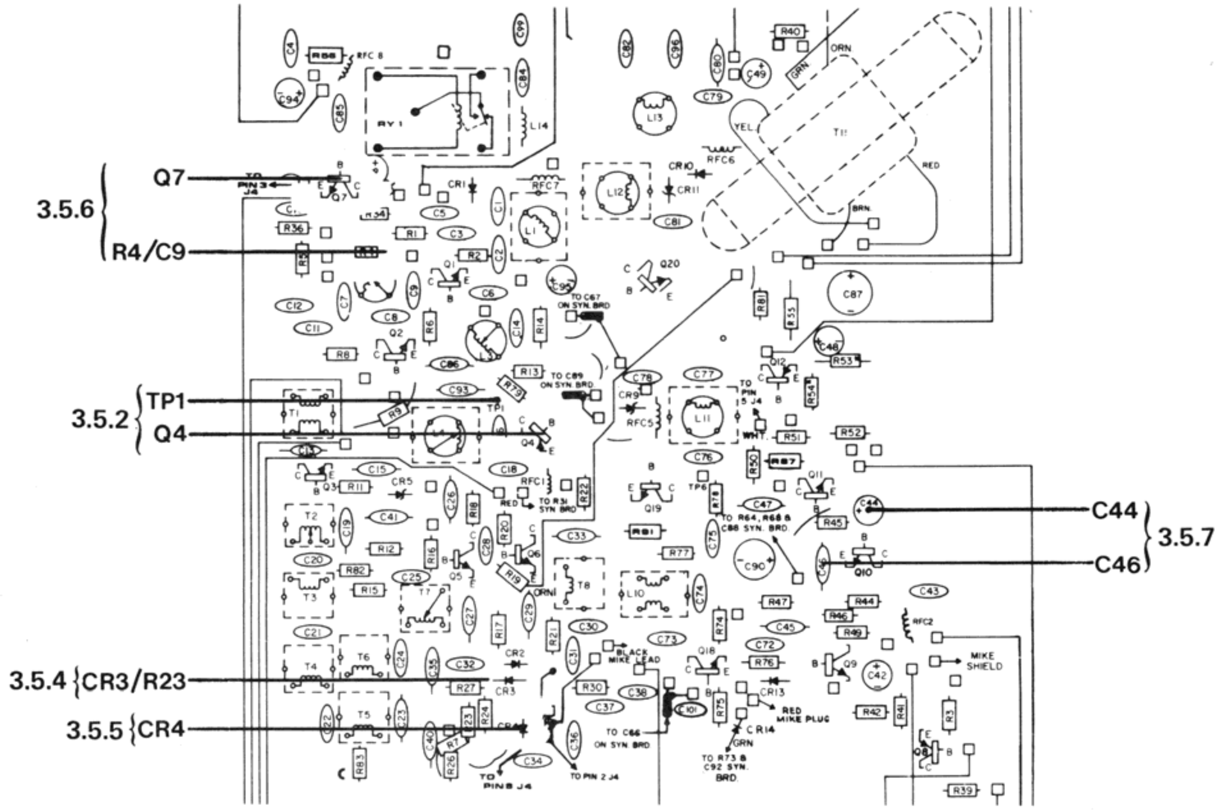
3.5.2 Oscillator Checks

Place the voltmeter probe at TP1 (0.5-3.0 V). Momentarily ground the collector of Q4 with a .005 or larger capacitor. If voltage at TP1 increases, Q4 is oscillating. Check operation on four successive channels to determine if crystals Y5 to Y8 are all operating. The synthesizer mixer oscillator may be checked in a similar manner. Place the voltmeter across R71, and ground Q15 collector with a capacitor. An increase in voltage indicates proper oscillation. If Q15 is suspected or being mistuned, check the transmitter troubleshooting section for correct modification and tuning procedure.

Oscillator injection voltages are provided in Table 3-2 as a troubleshooting aid.

Table 3-2
Oscillator Injection Voltage Chart

Stage	Location	RF Voltage (RMS)
Q4	Emitter	0.6 to 1.3
L3	Tap	0.8 to 1.4
L4	Tap	0.1 to 0.25



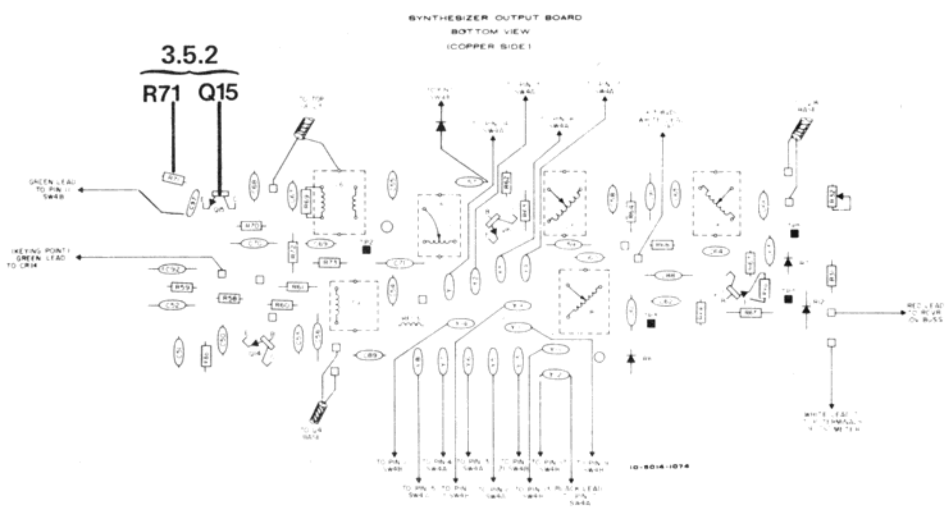


Figure 3-2 Test Points Listed in Sections 3.3.2 Thru 3.5.7

3.5.3 AGC Servicing

Severe overload, distortion, failure of the squelch system, or "S" Meter operation may be caused by an inoperative AGC System. Refer to Section 2.3.1 for a complete circuit description of the AGC System. The use of Tables 3-3 and 3-4 will aid in localizing the defective circuit.

3.5.4 Detector Check

Detector diodes CR2 and CR3 can be checked easily with an ohmmeter. Using a low ohms scale, connect the ohmmeter to the junction of CR3 and R23 and ground. A reading of several hundred ohms should result; if it is much higher, reverse the ohmmeter leads. If very low (less than 100 ohms) or greater than 1000 ohms, check the diodes individually. Detector output voltages for various input signal levels are given in Table 3-5.

3.5.5 Noise Limiter Check

If the noise limiter diode is suspected of being faulty, short it out momentarily. If audio comes through, replace the diode and/or check R24, C35, R28, and R23. To check limiter operation, observe the audio between CR 4 anode and ground on an oscilloscope. Limiting should occur at about 65% modulation.

Table 3-3
Receiver RF-IF Voltage Chart

Transistor Stage		Input Signal, μV		
		0	100	1 k
Q1	C	7.6	9.0	9.5
	B	4.5	1.7	1.25
	E	3.9	1.0	0.7
Q2	C	5.4	8.3	9.4
	B	1.8	0.6	0.5
	E	1.3	0.3	0.2
Q3	C	9.7	10.	10.
	B	1.3	0.4	0.3
	E	0.7	0.15	0.1
Q4	C	2.7	2.7	2.7
	B	9.5	9.5	9.5
	E	10.	10.	10.
Q5	C	4.8	8.8	9.7
	B	1.8	0.7	0.6
	E	1.2	0.2	.05
Q6	C	9.2	9.2	9.2
	B	2.5	2.6	2.6
	E	2.0	2.0	2.0
Q7	C	9.2	3.9	2.2
	B	0.1	0.7	0.6
	E	0	0	0

Table 3-4
Receiver Injection Voltages

Location	Frequency	Level
Antenna Jack	27 MHz	0.4 μV
Q1 Base	27 MHz	6-9 μV
Q3 Base	8.5 MHz	12-18 μV
Q3 Collector	455 kHz	2500 μV
Q5 Base	455 kHz	300 μV
Q6 Base	455 kHz	2000 μV

NOTE

All values to produce 2.2 volts or greater at junction of CR3, and R24.

CAUTION

Use isolation capacitor of .05 μF or larger to prevent DC voltages from being shunted by signal generator.

Table 3-5
Detector Output Voltage
(at junction of CR3, C32)

Signal Input	+ DC Det Volts
0	0.1-0.3
100 μV	4.8
1000 μV	5.1

3.5.6 Squelch Check

Refer to the squelch circuit description in Section 2.3.5. Troubleshooting of the squelch circuit will be simplified by using Table 3-6.

Connect a signal generator to ANTENNA jack, and turn generator output to zero (or tune off-channel). With volume at center position, rotate the squelch control clockwise to the point that just silences the audio output completely. Bring up signal generator output slowly, and observe that the squelch breaks at 0.35 μV or less.

If the squelch does not break, check the DC voltage at CR3 and R23. The squelch requires 2.0-2.5 volts (measure with VTVM) to operate. If this voltage is less, gain is too low.

If the voltage at CR3 and R23 is adequate, check that the collector voltage at Q7 will vary from 0.4 volts while varying signal generator from zero to 0.35 μV. If it does not, check Q7 and its associated circuitry. If Q7 checks okay, check voltage at R4 and C9. This voltage varies only slightly, about 0.1 volts for a 2 to 1 signal input change, i.e., going from 0.5 μV to 1.0 μV. If R4 and C9 voltage appears correct, check voltage at Q8 collector by adjusting squelch control R38. The proper values are shown on the voltage chart (Table 3-6). Continue voltage tracing at Q9 and Q12.

Table 3-6
Squelch Amplifier DC Voltage Chart

Transistor	Mode	DC Voltage in Volts		
		Emitter	Base	Collector
Q8	SQ	10.0	8.8	9.5
	UNSQ	4.4	8.0	0
Q9	SQ	1.6	2.2	1.6
	UNSQ	0	0	3.5

3.5.7 Audio Troubleshooting

Audio and squelch troubleshooting can be effectively carried out by careful use of the voltage chart (see Tables 3-6 and 3-7). If all voltages are satisfactory but the audio is weak or distorted, all capacitors (particularly C44 and C48) should be paralleled by good ones.

About 25 millivolts of audio applied to the audio input should produce 80 to 100% modulation. If this is satisfactory, but modulation is still poor, check the output from the microphone. Normal close talking should produce 13 to 30 millivolts on a 1 meg-ohm input audio voltmeter. It should be possible to obtain 150 to 300 millivolts when whistling loudly into a good microphone.

Table 3-7
Audio Amplifier DC Voltage Chart

Transistor	Mode	DC Voltage in Volts		
		Emitter	Base	Collector
Q10	SQ	0.3	0.5	12
	UNSQ	0.6	1.2	9.2
Q11	SQ	0	0.3	9.5
	UNSQ	0	0.6	3.5
Q12	SQ	9.0	11.0	0.3
	UNSQ	8.0	7.5	1.0
Q13	SQ	0	0.3	13.7
	UNSQ	0.4	1.0	13.2

3.6 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 3-3A.

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 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 of about one-half the usable screen area.

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 3-3A, 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 3-3B. 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.

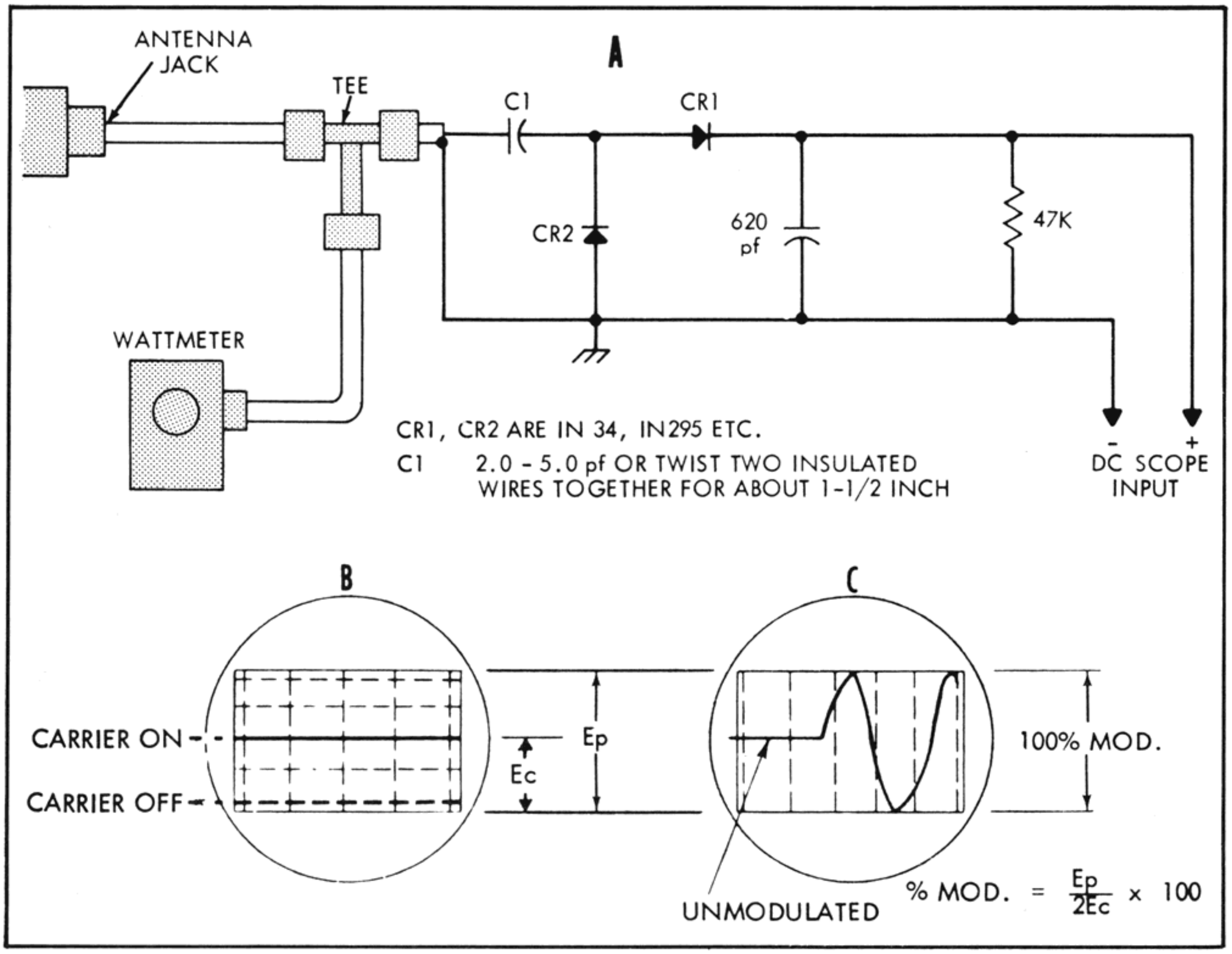


Figure 3-3 Modulation Detector

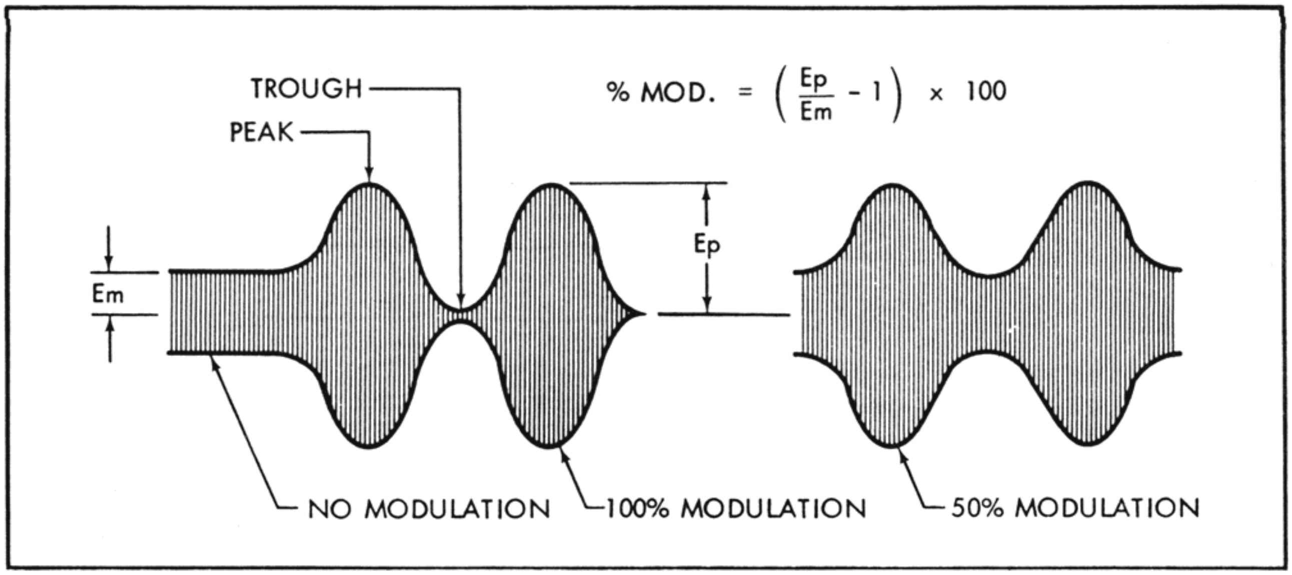


Figure 3-4 Direct Modulation Monitor

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 3-3C. 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.

3.7 TRANSMITTER SERVICING

Refer to Figure 3-5 for test point locations specified in the following sections.

3.7.1 General

CAUTION

Do not attempt any adjustments on the Synthesizer Output Board without following this procedure carefully.

If the transmitter is inoperative, check as follows:

a. Blows Fuses — Check for shorted Q19 or Q20. Check TP6 (—0.5 to —0.6 volts). If okay, check for trouble between Q19 and antenna. Use VTVM, or VOM with 10-20 μH choke in series with probe and check for —3.5 to —4.0 volts at base of Q20. If okay, trouble is in output circuit or Q20 has open collector.;

b. No Voltage at TP6 — Check TP5 (1.5 to 3.0 volts) on S.O.B. If okay, trouble is in coax cable connecting S.O.B. to main PC board or in Q18 stage. Note that Q18 emitter is at about 1.6-1.9 volts during transmit but jumps to about 3.5 volts when key is released.

c. No Voltage or Incorrect Voltage at TP5 — If no voltage at TP5, check TP4 (—0.1 to —0.5 volts) and TP3 (0.3 to 1.5 volts). If all are zero volts, either 8 MHz oscillator Q14 or 35 MHz oscillator, Q15 is dead.

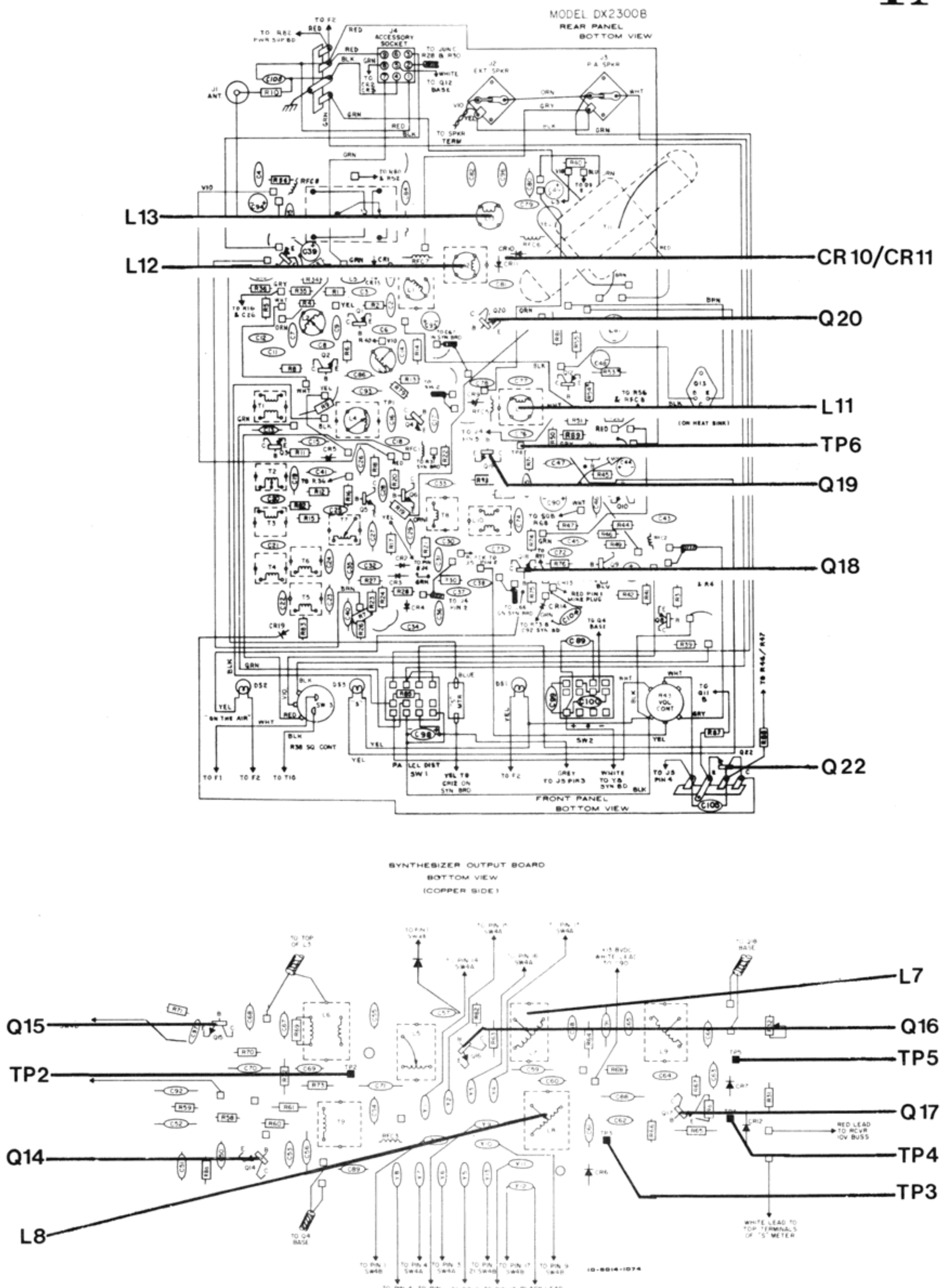


Figure 3-5 Test Point Locations for Transmitter Troubleshooting

3.7.2 Oscillator Check

To check Q15 oscillator, place VOM probe in series with choke at emitter of Q15. It is not necessary to key the transmitter for this check. Meter should indicate 1.4 to 2.5 volts. Touch a .01 μF or larger capacitor from base of Q15 to ground; voltage should jump up. If there is no voltage jump, Q15 is not oscillating. Try other channels to determine if a crystal is bad. See Synthesizer Crystal Frequency Chart (Table 2-1) to locate crystals in use.

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.

The same probe may be used to check Q14 for oscillation. With the transmitter keyed several volts of RF should appear at the emitter of Q14 (Q14 emitter will be about 1.2 volts DC (TX keyed) and Q15 emitter at about 2.5 to 3.0 volts DC).

If both Q14 and Q15 are oscillating okay but voltage at TP3 is low or zero, check voltage at TP2 (2.5 to 3.0 volts) to determine if Q16 is mixing properly. Test voltage at TP2 will increase slightly when transmit key is depressed.

CAUTION

Alignment of L7 and L8 should not be attempted until it has been determined that there are no component or transistor failures. If Q16 or Q17 is replaced, only slight touch up may be needed, but if L7 or L8 is replaced, alignment must be carried out as described in Section 4.5.4.

3.7.3 Final Stages Failure Analysis

In the event that an I.P.A. (Q19) or P.A. (Q20) has failed, it should be determined that:

a. CR9, CR10, and CR11 are not defective.

b. The synthesizer is properly tuned.

c. VSWR is no more than 2 to 1.

d. Input voltage does not exceed 16.8 volts.

e. The transmitter is properly tuned, particularly L11, L12, and L13.

NOTE

In some units L13 is not tuneable.

f. The transmitter operates on frequency and without parasitics down to at least 10.5 V DC input.

g. The relay is not affected by vibration.

3.7.4 Transmitter Circuit Troubleshooting

To assist in troubleshooting the transmitter, DC voltages for all transistors are given in Table 3-8.

Table 3-8
Transmitter DC Voltage Chart

Transistor			DC Voltage in Volts		
			Emitter	Base	Collector
On Synthesizer	Q14	RX	5.5	6.0	12.4
		TX	3.2	3.8	11.2
	Q15		3.5	4.0	11.0
	Q16	RX	5.2	3.0	12.0
		TX	2.5	2.6	11.6
	Q17	RX	0	0.4	12.0
		TX	0.2	0.2	11.8
	Q18	RX	3.6	4.0	13.5
		TX	2.0	1.2	13.4
	Q19	RX	0	0	13.8
		TX	0	0	13.2
	Q20	RX	0	0	13.8
		TX	0	0	13.2
	Q22	RX	0.8	1.2	0.8
		TX	0.9	1.4	9.5

Test Point	Condition	DC Voltage in Volts
Junction of CR10 and CR11	RX Modulated	13.8
Junction of CR10 and CR11	RX Unmodulated	13.8
Junction of CR10 and CR11	TX Modulated	68
Junction of CR10 and CR11	TX Unmodulated	36

SECTION IV
ADJUSTMENT AND ALIGNMENT

4.1 GENERAL

The PACE Models CB 2300 and CB DX2300B 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 0.35 microvolts for 10 dB quieting.

NOTE

Transmitter tuning adjustments must 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

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 3-1 for a list of recommended test equipment.

4.3 TRANSMITTER ALIGNMENT

Transmitter adjustment should not be attempted unless very low power, instability, or audio distortion is present. Follow the tuning procedure carefully. Failure to do so may result in excessive dissipation with resultant loss of a driver or output unit. Remember that when a battery or battery eliminator is used, the current supply is nearly unlimited, and it is therefore inadvisable to operate the transceiver without the fused power cord.

NOTE

The synthesizer oscillator circuit must be properly aligned (Section 4.5) prior to transmitter alignment.

Refer to Figure 4-1 for transmitter test point and adjustment locations.

4.3.1 Preliminary Setup

a. Connect a 50 ohm dummy load to the antenna terminals.

b. Connect a wattmeter across the dummy load.

c. Preset the coils as follows:

L10 slug in approximately 1/8 inch from top of coil form.
L11 slug approximately flush with top of coil form.
L12 slug approximately flush with top of coil form.
L13 slug approximately flush with top of coil form.

NOTE

In some production models L13 is not tuneable.

d. Set selector switch to Channel 23.

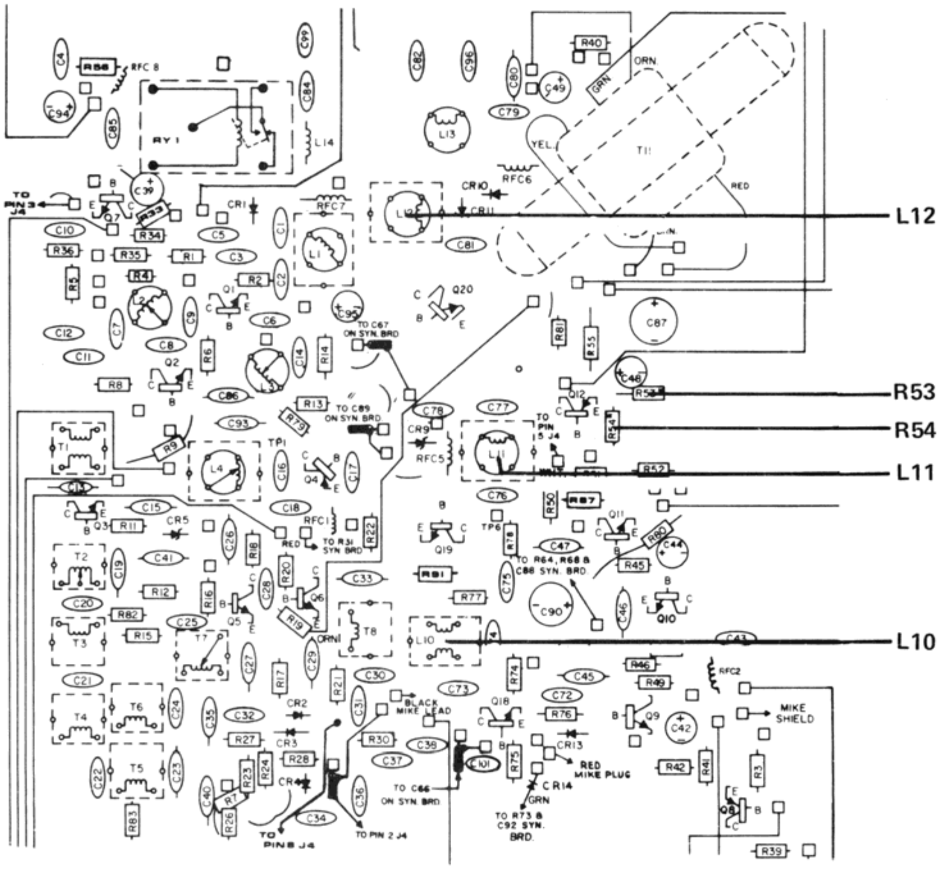


Figure 4-1 Test Point and Adjustment Locations for Transmitter Alignment

4.3.2 Alignment Procedures

a. Key the transmitter and adjust L10 through L13 for maximum RF output indication on the wattmeter.

NOTE

Ignore steps pertaining to L13 in those units where L13 is not tuneable.

b. Repeat step a at least two times.

c. Readjust L11 (in a clockwise direction only) for a reading of 4 watts on the wattmeter. This results in the best modulation with the lowest harmonic content.

d. Check the power output on all channels. These should be within 0.5 watts of that obtained in step C. If not, adjust L8 and L9 to achieve this reading on the appropriate channel (s).

4.3.3 Modulation Check

Check modulation by whistling into the microphone and observing the waveform on an oscilloscope (see Section 3.6). Upward modulation should reach at least 100%.

At final adjustment, the power output should not be less than 3.3 watts, and maximum current not more than 2.1 amperes.

4.4 RECEIVER ALIGNMENT

This section assumes that the Synthesizer Output Board is operating properly (Section 3.5.2). If not, refer to Section 4.5.1 for 1st local oscillator adjustment and Section 4.4.1 for 2nd local oscillator adjustment. See Figure 4-2 for receiver test point and adjustment locations.

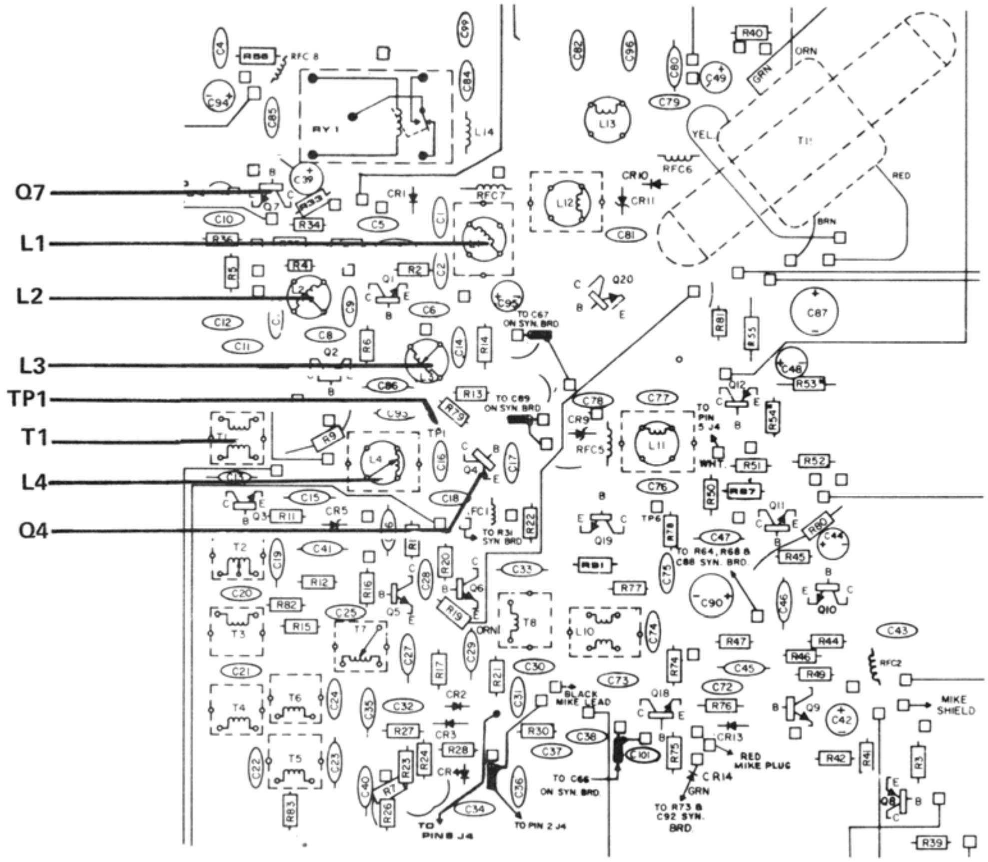


Figure 4-2 Test Point and Adjustment Locations for Receiver Alignment

4.4.1 2nd Local Oscillator Adjustment

a. Connect the DC voltmeter to TP1. See Figure 4-2.

b. Adjust L4 for a null on the meter.

NOTE

Two null points may be observed. Tune to the null that occurs with the core set towards the top of the coil. Use the most sensitive scale on the meter, as the null appears on a small dip in the curve. It is adviseable to tune through both sides of the null to make sure that the reading rises on either side of it.

4.4.2 Receiver RF and IF Alignment

a. Connect an AM signal generator to the antenna terminals.

b. Connect a DC voltmeter to the collector of Q7.

c. Set the selector switch to Channel 12.

d. Set the signal generator to 27.105 MHz with 40% modulation at 1 kHz.

e. Adjust the generator output for about 100 microvolts. (Select the proper meter scale to provide an approximate mid-scale indication.)

f. Adjust L1, L2, L3, and T1 for minimum indication on the meter. Reduce the generator output, as necessary, to keep the collector voltage at about 6.5 to 7.5 volts.

g. Disconnect the voltmeter from TP1.

CAUTION

Do not adjust T2 through T8. These coils are precisely aligned at the factory using a sweep generator with 5 markers. If it is necessary to replace one of the coils, only the coil replaced should be peaked at 455 kHz.

4.4.3 Sensitivity Check

a. Set the generator output for 0.35 microvolts.

b. Connect an AC voltmeter (with dB scale) across the speaker terminals.

c. Adjust the transceiver volume control for 2.7 volts across the speaker terminals. Use a convenient meter reference such as zero to +2 dB on the scale.

d. Turn the signal generator modulation off. (Do not disturb the RF output.) Output indication on the AC VTVM should drop at least 10 dB. If this is not obtained, repeak L1, L2, L3, and T1, then repeat steps c and d.

4.5 SYNTHESIZER OUTPUT BOARD ADJUSTMENT

Refer to Figure 4-3 for test point and adjustment locations.

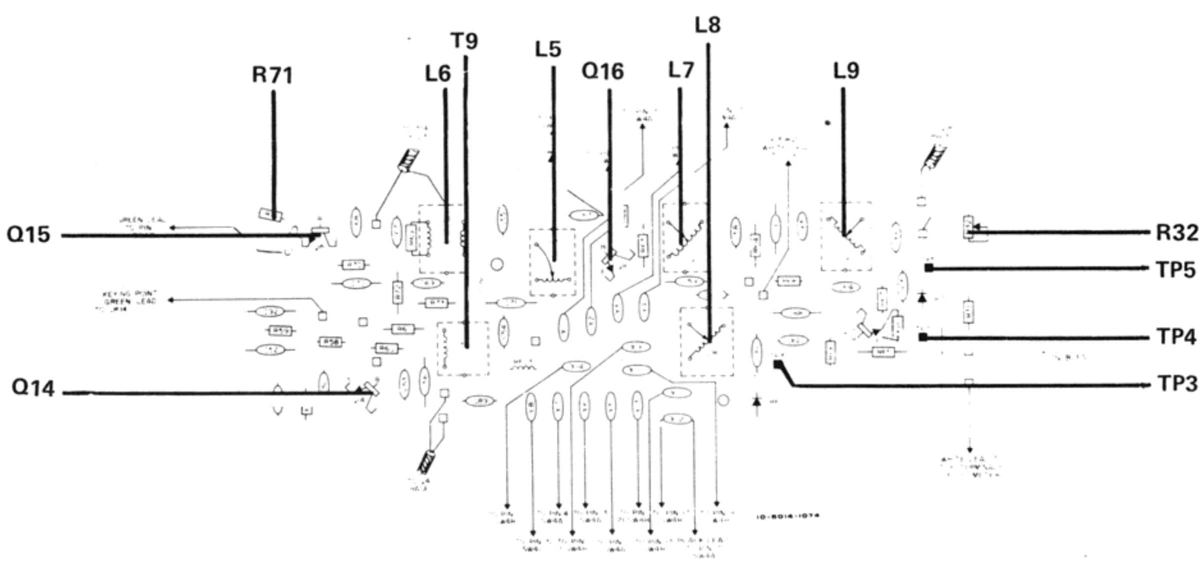


Figure 4-3 Test Point and Adjustment Locations for Synthesizer Board Alignment

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 has been replaced or tampered with.

4.5.1 Q15 Oscillator Adjustment

a. Connect a VOM, through an RF probe, across R71 in the emitter of Q15. If no probe is available, one may be fabricated as shown in Figure 4-4.

b. Set the channel selector switch to Channel 12.

c. Adjust L6 for a null on the meter and note this voltage.

NOTE

Use the most sensitive scale on the meter, as the null appears as a small dip in the curve. It is adviseable to tune through both sides of the null to make sure that the reading rises on either side of it.

d. Check the voltage readings on Channels 1 and 23. These should be within ± 10% of that obtained in step c. If not, "tweak" L6 to achieve this.

4.5.2 Q14 Oscillator Adjustment

a. Connect the VOM, through the RF probe, to the junction of C54 and C55.

b. Depress the P-T-T switch and adjust T9 for a maximum reading on the voltmeter. Then detune slightly in a clockwise direction to decrease the reading by approximately 0.1 volt.

c. Check the voltage readings on Channels 1 and 23. These should be within ± 10% of that obtained in step c. If not, "tweak" T9 to achieve this.

4.5.3 Synthesizer Mixer Alignment

a. Connect the VOM, through the RF probe, to TP4.

b. Depress the P-T-T switch and adjust L5 for a maximum indication on the voltmeter.

c. Disconnect the shielded S.O.B. output cable from the main PC board and connect the VOM, through the RF probe, to the disconnected cable.

d. Adjust L7, L8, and L9 for a maximum indication on the meter.

e. Disconnect the VOM and reconnect the cable to the PC board.

If L7 or L8 has been replaced, the mixer must be aligned as described in the following section.

4.5.4 Mixer Alignment If L7 or L8 Has Been Replaced

a. Disable oscillator Q15 by rotating the core of L6 clockwise until it is almost all the way out of L6.

b. Connect an RF signal generator (through an 0.002 μF or larger capacitor) to the base of Q16.

c. Connect a DC voltmeter to TP3.

d. Tune the signal generator for an unmodulated RF output of 27.00 MHz and set for maximum output.

e. Turn the core of L7 to its maximum clockwise position, then adjust counterclockwise until a peak is noted at TP3.

f. Move the VTVM probe to TP5.

g. Turn the cores of L8 and L9 to their maximum counterclockwise positions, then adjust L8 and L9 clockwise to obtain a peak reading at TP5.

If the peak reading exceeds 3.0 volts, reduce the generator output to obtain about 2.0 to 2.5 volts, and touch up L7, L8, and L9.

h. Tune oscillators Q14 and Q15 (as described in Sections 4.5.1 and 4.5.2), and check voltage at TP5 with transmitter keyed. Readjust L9 slightly to obtain a peak reading at TP5.

4.6 "S" METER ADJUSTMENT

a. Connect an AM signal generator to the antenna input terminals.

b. Set the selector switch to Channel 12.

c. Set the signal generator to 27.105 MHz, unmodulated.

d. Adjust the generator output to 100 μV.

e. Adjust R32 (Figure 4-3) for an indication of S9 on the "S" Meter.

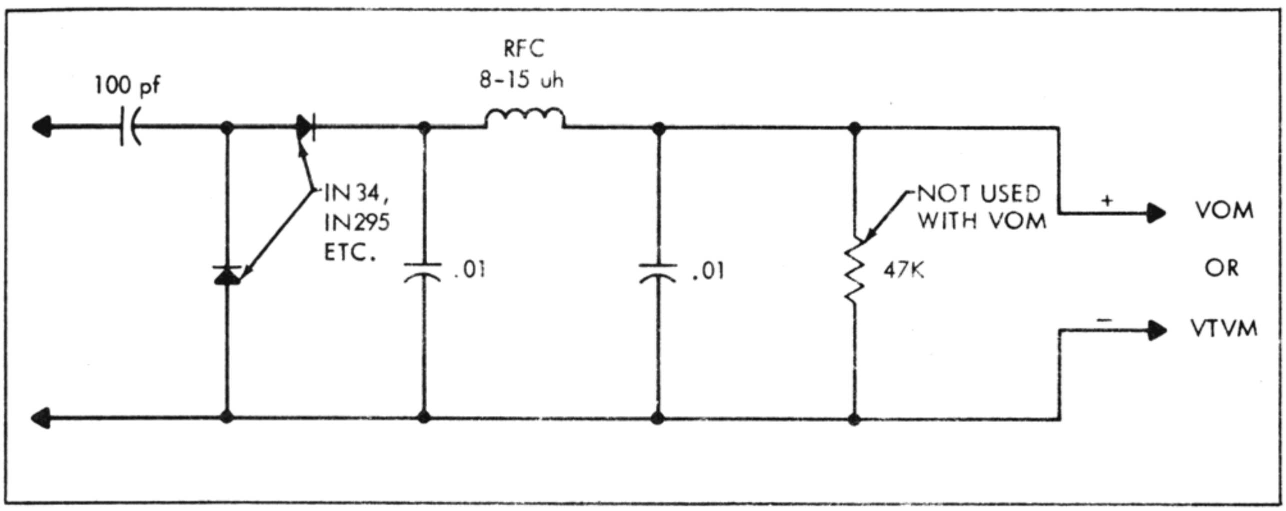


Figure 4-4 RF Probe

SECTION V
ILLUSTRATIONS AND PARTS LIST

5.1 GENERAL

The schematics and parts locators in this section are for the PACE Models CB 2300 and CB DX2300B transceivers. Part numbers and descriptions are keyed to the schematic reference numbers and are listed for these components.

Table 5-1
Parts List*

NOTE: Referenced parts in parentheses are in the CB DX2300B only. All others are common to both models.

Reference Number	Description	Part Number
CAPACITORS		
C39, 42, 44, 48, 94, 95, 98, (102)	Electrolytic, 50 μF 15 V	19-0129
C49	Electrolytic, 2 μF 25 V	19-0049
C87, 90	Electrolytic, 1000 μF 15 V	19-0052
(C101)	Electrolytic, 220 μF 15 V	19-0132
(C103)	Electrolytic, 5000 μF 30 V	19-0058
RESISTORS		
R32	Trimmer, 5 k Ω	14-0007
R38	Potentiometer w/Sw, 5 k Ω (SQUELCH)	15-0034
R43	Potentiometer, 2 M Ω (VOLUME)	15-0055
R53, 54	Selected Value	
R55	Wire Wound, 0.5 Ω 1 W	14-0010
R56	68 Ω 2 W	14-0020
(R91)	Trimmer, 500 Ω	14-0007-1
DIODES, INTEGRATED CIRCUITS, AND TRANSISTORS		
CR1, 2, 3, 6, 7, 12	Diode, Germanium, 1N295X	13-0004
CR4, 10, 13, 14, (19), (20)	Diode, Silicon, 1N3600	13-0003
CR5	Diode, Zener 10 V	13-0002
CR8 (CB 2300 only)	Diode, Rectifier, Silicon	13-0050
CR9	Diode, Zener, 36 V	13-0017
CR11	Diode, Zener, 68 V	13-0106
(CR15 thru 18)	Diode, Rectifier, Silicon	13-0099
(IC1)	Integrated Circuit, MFC4060	13-0098
Q1, 16	Transistor, MPS6511	13-0065
Q2, 6	Transistor, FRS3693	13-0062-1
Q3, 5, 9, 14, 15, 17	Transistor, MPS3693	13-0062
Q4, 8, 12	Transitor, MPS6534	13-0061
Q7, 10, (22)	Transitor, MPS6514	13-0022
Q11	Transistor, MPS3694	13-0063
Q13	Transistor, SJ2095	13-0014
Q18	Transistor, MPS3646	13-0064
Q19, 20	Transistor, Non-Commercial	13-0079
(Q21)	Transistor, MJE3055	13-0097

PACE

Table 5-1
(Continued)

Reference Number	Description	Part Number
CHOKES, INDUCTORS, AND TRANSFORMERS		
L1	Coil, Antenna (Brown Dot)	17-0019
L2	Coil, Amplifier, RF (Gray Dot)	17-0018
L3, 8, 9	Coil, Mixer; Bandpass; Buffer (Green Dot)	17-0025
L4, 5	Coil, Oscillator; Bandpass (Orange Dot)	17-0017
L6, 10	Coil, Oscillator; Driver (Double Red Dots)	17-0028
L7	Coil, Mixer (Black Dot)	17-0032
L11	Coil, Tuning, I.P.A. (Blue Dot)	17-0021
L12, 13	Coil, P.A. Tuning; P.A. Loading (Double Violet Dots)	17-0020
L14	Coil, Filter, Transmitter	17-0015
RFC1, 2	Choke, 33 μH	17-0016
RFC3	Choke, 4.7 μH	17-0041
RFC4	Not Used	
RFC5 thru 8	Choke, 3.0 mH	17-0026
T1, 9	Transformer, IF; Oscillator (Blue Dot)	16-0007
T2	Transformer, Filter, Input (Red Dot)	16-0005
T3 thru 6	Transformer, Filter, IF (Black Dot)	16-0003
T7	Transformer, Filter, Output (Green Dot)	16-0006
T8	Transformer, Output, IF (Brown Dot)	16-0013
(T10)	Transformer, Power	16-0033
T10 (CB 2300 only)	Choke, Filter	16-0021
T11	Transformer, Modulation, Audio	16-0016
MISCELLANEOUS		
DS1, 2, (3)	Lamp, Pilot	13-0019
(F1)	Fuse, 1A	15-0021
(F2) F1 in CB 2300	Fuse, 2.5A	15-0016
J1	Jack, Antenna	27-0060
J2, 3	Jack, Speaker	27-0037
J4	Jack, Accessory	27-0076
J5	Jack, Microphone	27-0118
(M1)	Meter, "S"	36-0020
M1 (CB 2300 only)	Meter, "S"	36-0007
P5	Plug, Microphone	27-0117
RY1	Relay	21-0008
SP1	Speaker, 3.2 Ω	22-0013
(SW1, 2)	Switch, Slide	15-0072
SW1, 2 (CB 2300 only)	Switch, Slide	15-0010-2
SW3	Part of R38	
SW4	Switch, Channel Selector	15-0073
Y1	Crystal, 8.0006 MHz	20-0006-5
Y2	Crystal, 7.996 MHz	20-0006-6
Y3	Crystal, 7.986 MHz	20-0006-7
Y4	Crystal, 7.966 MHz	20-0006-8
Y5	Crystal, 8.461 MHz	20-0007-5
Y6	Crystal, 8.451 MHz	20-0007-6
Y7	Crystal, 8.441 MHz	20-0007-7
Y8	Crystal, 8.421 MHz	20-0007-8
Y9	Crystal, 34.971 MHz	20-0008-7
Y10	Crystal, 35.021 MHz	20-0008-8
Y11	Crystal, 35.071 MHz	20-0008-9
Y12	Crystal, 35.121 MHz	20-0008-10
Y13	Crystal, 35.171 MHz	20-0008-11
Y14	Crystal, 35.221 MHz	20-0008-12
	Microphone	22-0016
	Heat Sink (Q19)	25-0171
	(Power Cord)	30-0045

*Order unlisted components by description and reference numbers.

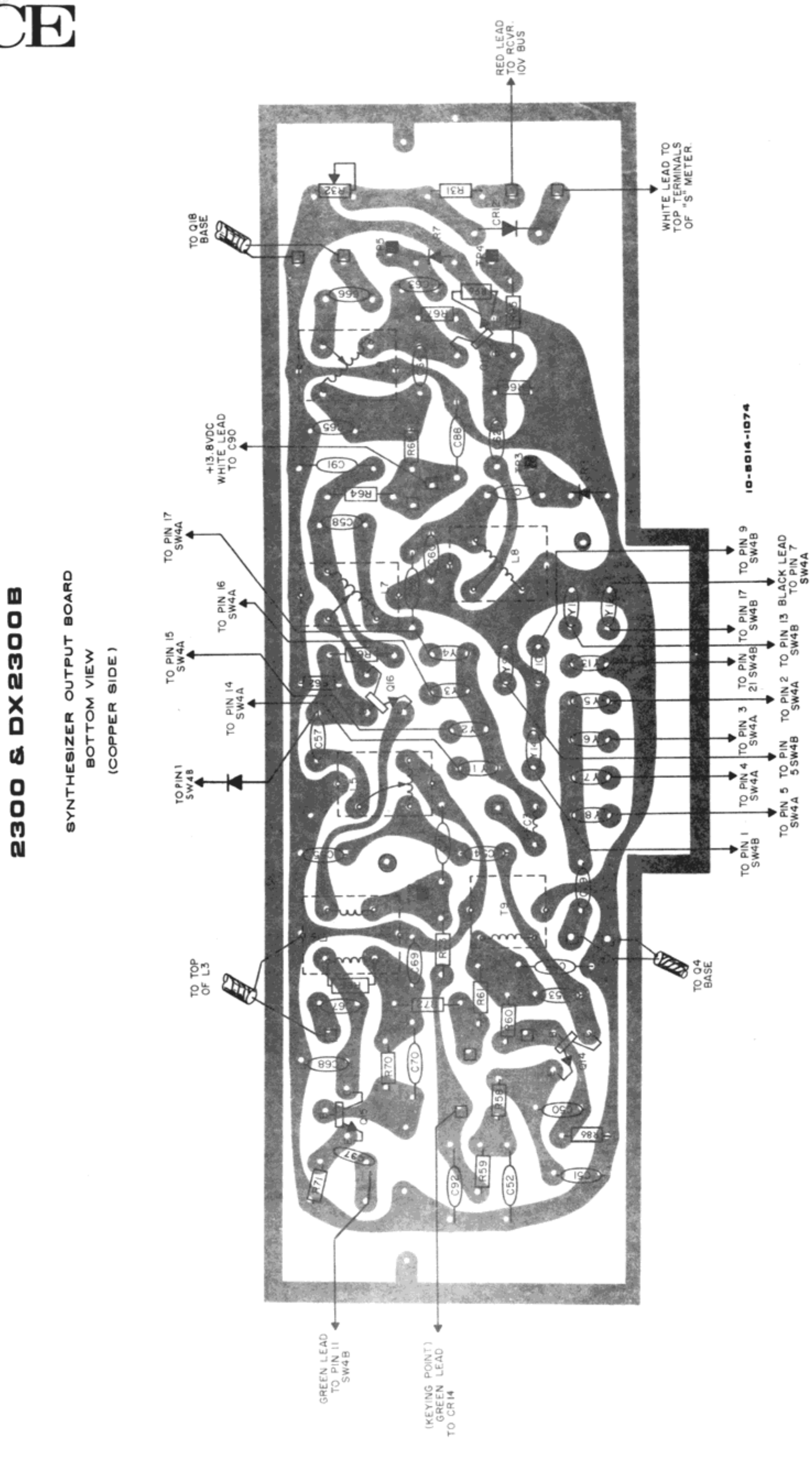


Figure 5-1 Synthesizer Parts Locator (Both Models)

2300

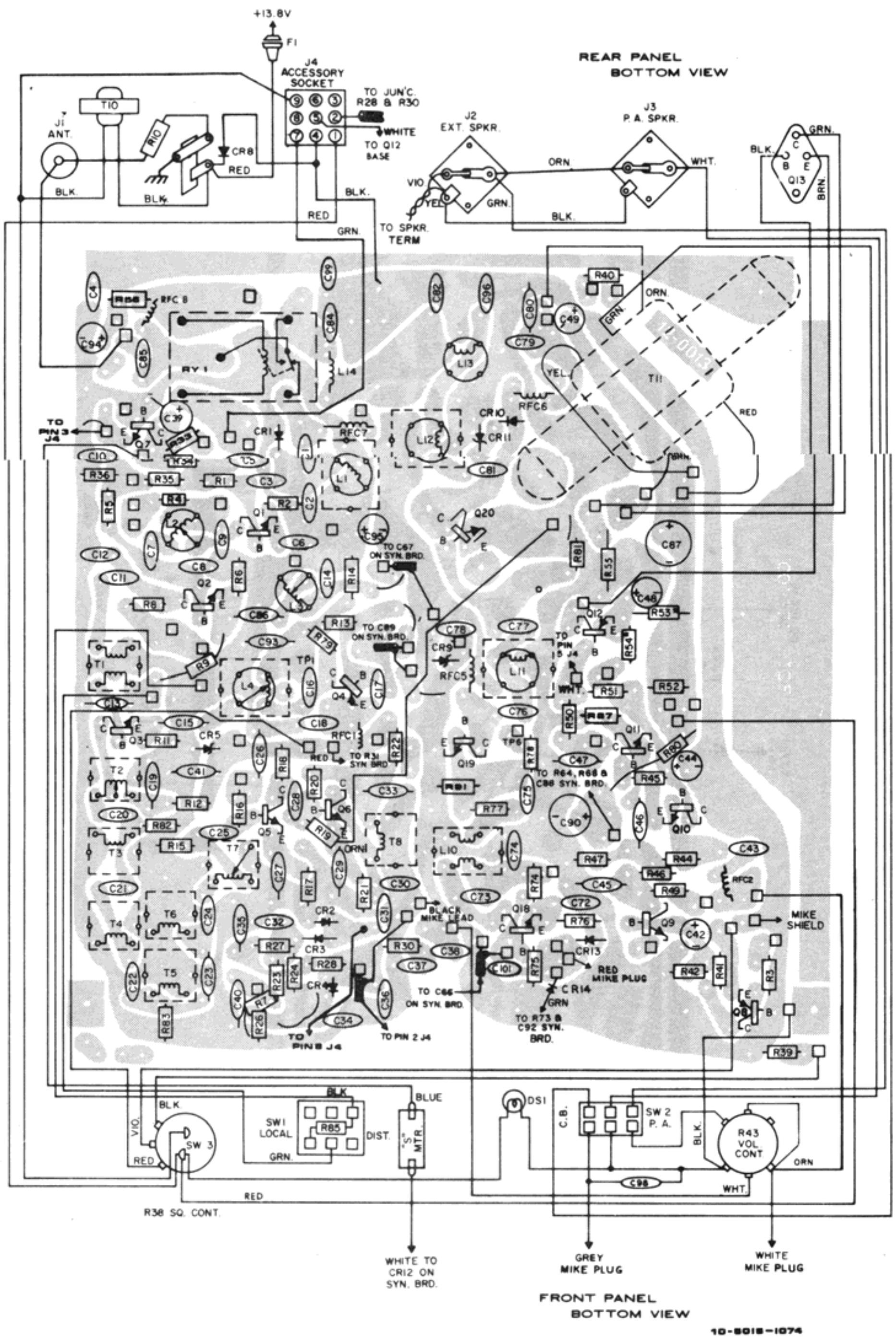


Figure 5-2 Main Board Parts Locator (CB 2300)

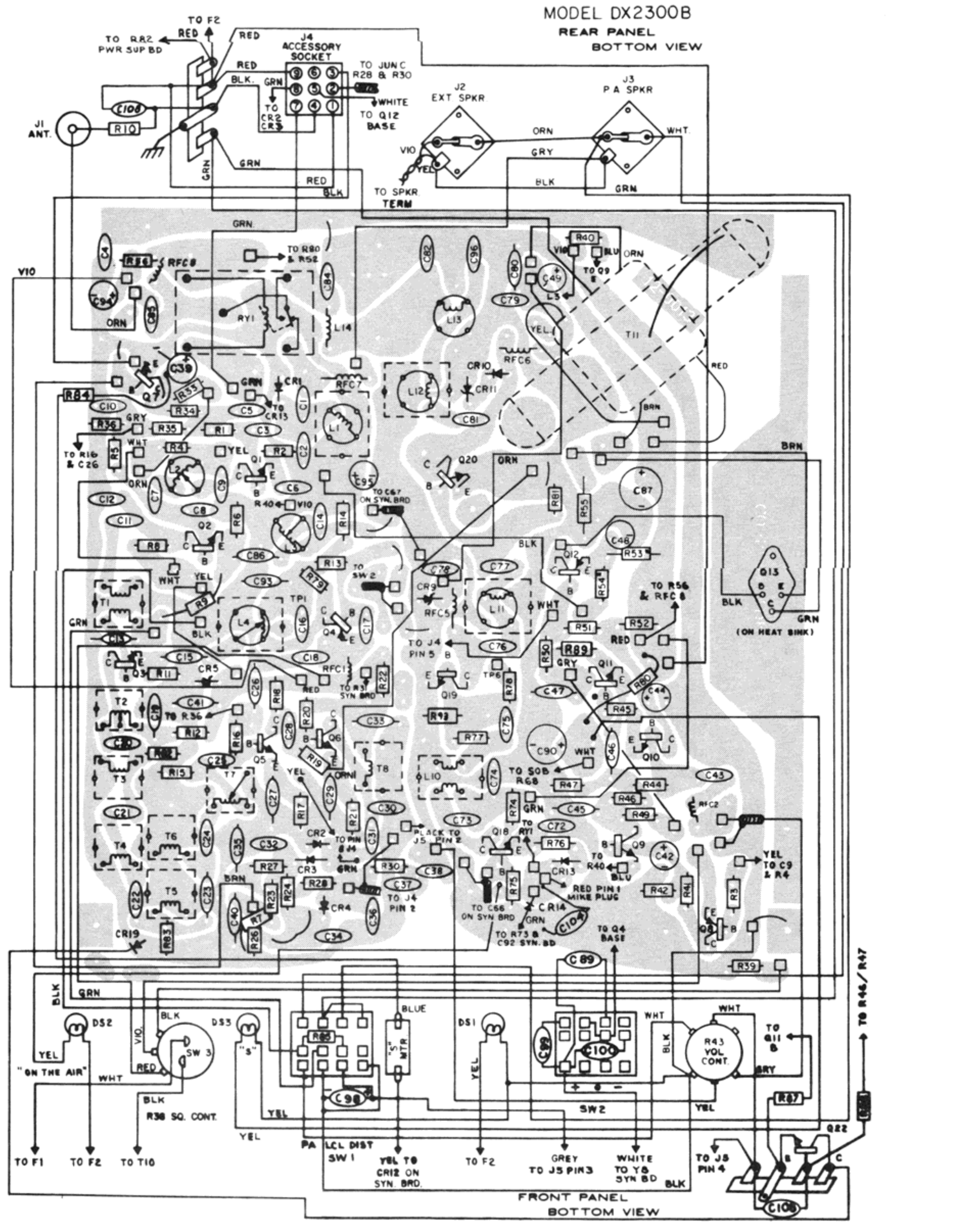


Figure 5-5 Main Board Parts Locator (CB DX2300B)

NOTES