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Cobra 90LTD Service Manual

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SERVICE MANUAL

SERVICE MANUAL

MODEL 90 LTD



COBRA MODEL 90 LTD
LOW-PROFILE 40-CHANNEL
CB RADIO BASE STATION



Cobra Consumer Electronics Group
DYNASCAN CORPORATION
6500 W. Corland St.
Chicago, Illinois 60635
Phone 1-312-889-8870

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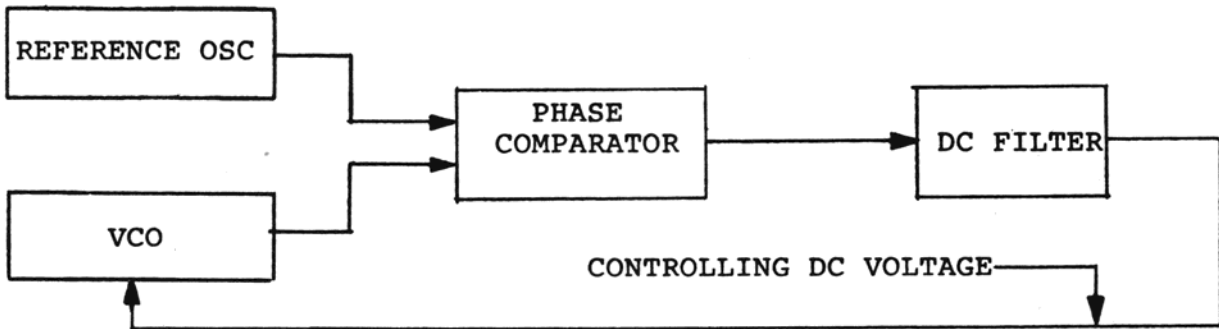
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OPERATING THEORY OF PLL FREQUENCY SYNTHESIZER
FOR MODEL 90LTD

1. Fundamental Theory Of PLL Circuitry

The purpose of PLL (Phase Locked Loop) circuit is to generate multiple number programable frequencies from a signal reference frequency with quartz crystal accuracy.

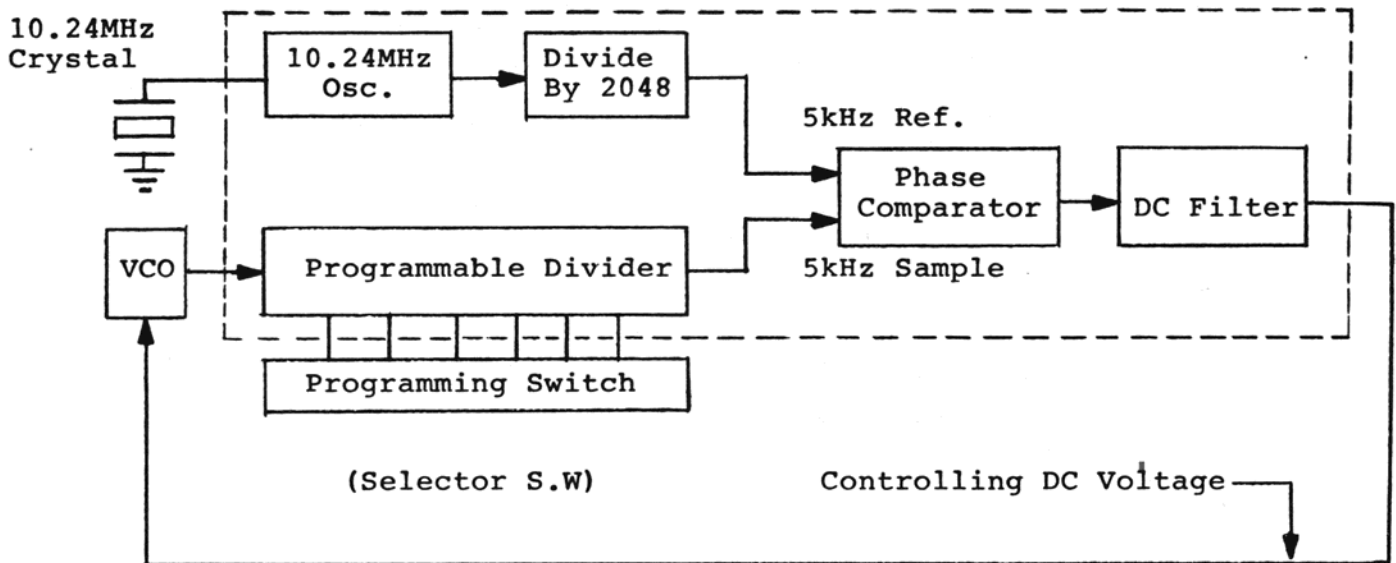
A basic PLL circuit consists of reference oscillator, VCO, phase comparator and DC filter (low pass filter).



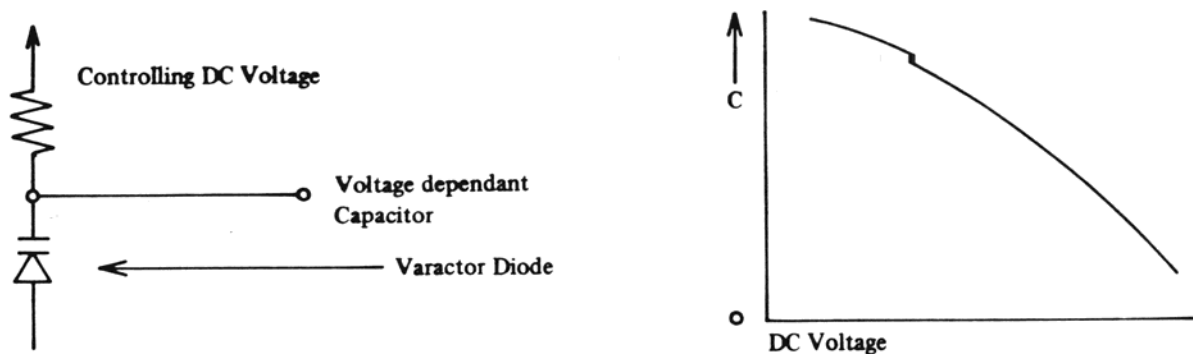
With the above circuit the VCO (Voltage Controlled Oscillator) frequency is effectively locked to the reference oscillator, and its accuracy is as good as the reference oscillator.

Since the CB radio's adjacent channel spacing is 10 kHz (or multiple of 5 kHz), our purpose should be to produce multiples of programable frequencies that are spaced apart by 10 kHz.

Therefore the basic PLL circuitry is expanded as follow:



The most important part of VCO circuitry is a voltage controlled variable capacitor called varicap or varactor diode whose capacitance depends on DC voltage applied to its cathode.



The varactor diode is responsible for setting VCO frequency, and once set it regulates the VCO frequency against the reference. The VCO frequencies are chosen in 16 to 17 MHz range as shown on table 1. To obtain transmit signal the VCO is mixed with 10.24MHz. As an example for channel 1:
 $10.24 + 16.725 = 26.965\text{MHz}$

For receiver mode the VCO is used as a first local oscillator. Example, channel 1:
 $26.965 - 16.27 = 10.695\text{MHz}$

The above first IF of 10.695MHz is mixed again with 10.24MHz crystal oscillator frequency which serves as the second local oscillator.
 $10.695 - 10.24 = 0.455\text{MHz}$

As can be seen above the VCO frequency shifts from 16.725 to 16.27MHz when changed from transmit to receive for the same channel 1. The shift is accomplished by "read only memory" incorporated inside the PLL IC-202 between the selector switch and the VCO divider (programmable). When transmit logic signal is applied to the IC-202 through pin 19, the programmable divider will divide incoming VCO frequency by 3345 to produce 5kHz sampling signal. $16,725 - 3345 = 5\text{kHz}$

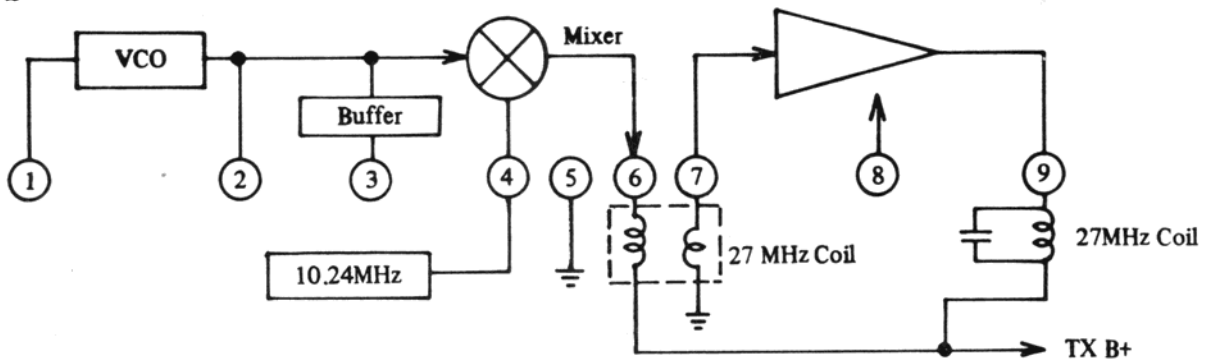
For the receiver mode the programmable divider will automatically change to divide the VCO frequency by 3254.
 $16270 - 3254 = 5\text{kHz}$

Note that the reference frequency of 5kHz is obtained by dividing the 10.24MHz by 2048 times. (5kHz reference is used instead of 10kHz for division convenience). See table 1 for transmit/receive mode VCO frequencies.

2. Transmitter Circuit

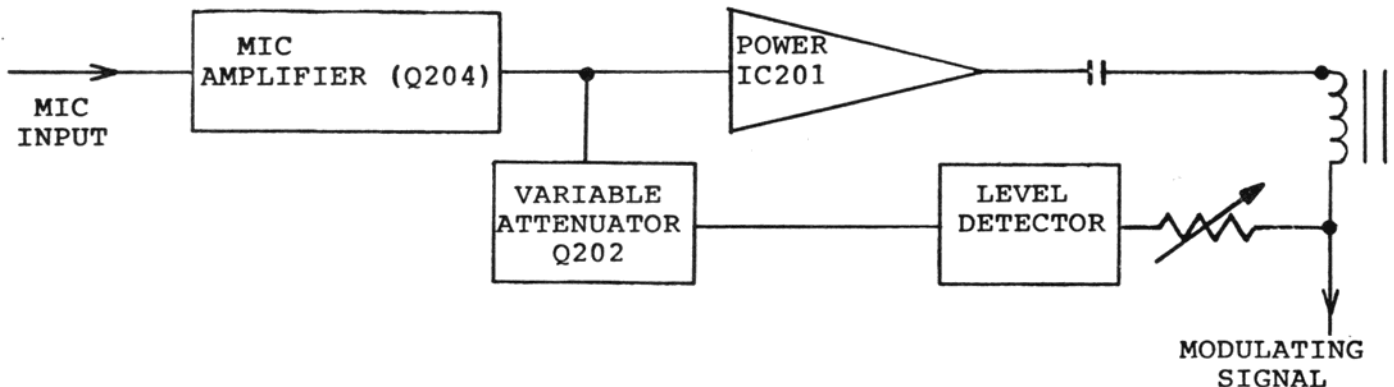
IC-202 (PLL-LSI), VCO section of IC-203 (pins 1,2, and 3) are operational regardless of the receive or transmit mode. When the radio is set to the transmit mode, mixer/amplifier section of IC-203 (pins 4,6,7 and 9), Q-206, Q-301, Q-302 and Q-303 are activated. The VCO frequency selected by the channel selector switch is mixed with 10.24MHz to generate desired transmit frequency. The mixing is done by a mixer circuit located inside the IC-203.

EQUIVALENT CIRCUIT OF IC-203



The resulting transmit frequency from pin 9 of IC-203 is filtered by L-301 and L-302. Q-301 is an amplifier/switch circuit. When VCO frequency is out of "LOCK" condition pin 14 of IC-202 pulls down bias voltage of Q-301 to ground disabling Q-301 from passing possible illegal frequencies. Q302 is a RF power driver circuit and Q-303 is the final RF power amplifier.

A modulation audio signal is applied to the collectors of Q-302 and Q-303 through an audio power transformer L-203. The audio signal (mic input) is amplified by a single power IC-201. The modulation limiting is accomplished by an automatic level control circuit which is as follows:



L-305 and C-350 are series resonator, and L-306,L-307,C-340, and C-344 make up PI-LOW pass filter. C-345 is factory selected and limits the RF output level to within the FCC limit of 4 watts.

3. Receiver Circuit

In the receiver mode of operation, Q-206 transistor is turned off. Also bias voltage is applied to Q-105 and a proper bias and AGC voltage is established to Q-101, Q-102, Q-103 and Q105. Q-101 is a 27MHz RF input amplifier and any excessive input signal is limited by diodes D-101 and D105. The amplified 27MHz is mixed with VCO frequency selected by channel switch. For channel 1 VCO is set at 16.27MHz. The resulting first IF is $26.965 - 16.27 = 10.695\text{MHz}$. Q102, Q103 is the first converter, and the 10.695MHz is sharply filtered by L-103 and a ceramic filter CF-1. The first IF is again mixed with a second local oscillator of 10.24MHz. $10.695 - 10.24 = 0.455\text{MHz}$. Q-108 is the second converter and the 455kHz. Second IF is filtered by a razor sharp ceramic filter of CF-2 coupled with L-105. Q-105 is a first 455kHz amplifier, with Q-106 being the last amplifier. D-108 is a detector diode which produces audio signal as well as a negative DC voltage for AGC action. The negative voltage also provides forward biasing to the cathode of ANL clipping diode of D-110. The biasing voltage has a time constance determined by R132 and C124. Therefore, any sharp negative going pulse from D-108 will back bias D-110 and be clipped.

ALIGNMENT PROCEDURE
FOR 90 LTD
CB TRANSCEIVER

1. Test Voltage

DC 13.8V +/- 5%, unless otherwise specified.

2. Test Equipment

All test equipment should be properly calibrated.

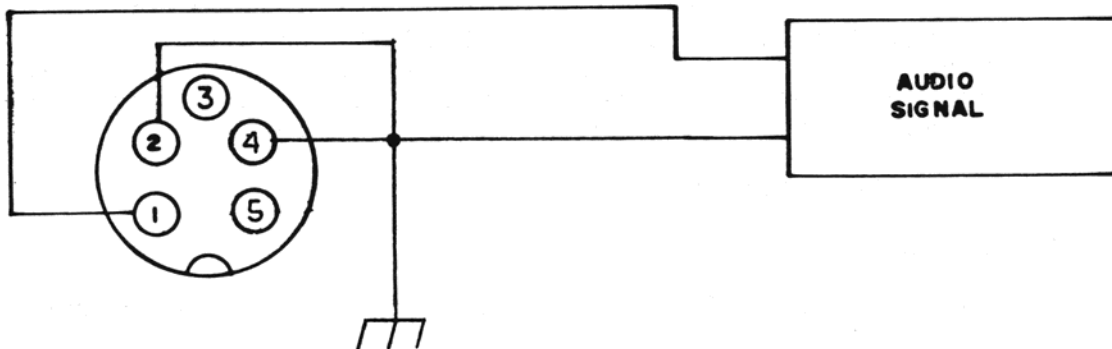
1. Audio signal generator. 10Hz-20kHz
2. VTVM 1mV measureable
3. AC ampere meter, 2A
4. Frequency counter, 0-40MHz, high input impedance type
5. RF VTVM probe type.
6. Oscilloscope, 30MHz, high input impedance type
7. RF watt meter, thermo-couple type, 50 Ohm, 5W
8. Standard signal generator, 100kHz-50MHz, -10-100dB, 50 ohm unbalanced.
9. Speaker dummy resistor, 8 ohm, 5W
10. Circuit tester, DC, 20K ohm/V.

3. Alignment of Transmitter Circuitry

3.1 Test Setup

Connect all test equipment as shown on set-up diagram.

- 3.2 To set the transceiver into transmit mode without the microphone, insert the plug wired as shown below into the mic jack on the transceiver. When applying the audio modulation signal to the microphone input circuit, also use the same plug.



3.3 PLL Circuit Alignment

PLL AND CARRIER SECTION

3.3.1 10.24MHz

Connect a frequency counter to the pin 12 and check to see if frequency is $10.240\text{MHz} \pm 100\text{Hz}$. When a defective crystal is replaced, if the frequency is outside these limits, the capacitance value of C304 must be adjusted to bring the frequency back within tolerance.

With a factory supplied crystal, a C304 value of 10pfd should be sufficient. On some sets minor value selection may be necessary.

3.3.2 VCO Alignment

1. Set the radio to channel 40 and in transmit mode (Make certain 50 ohm dummy load or wattmeter is connected to antenna terminal).
2. Connect a circuit tester between TP and ground.
3. Adjust L203 to obtain 5.0V DC.
4. Set the Radio to channel 1 and in receive mode.
5. Check to see that the TP DC voltage drops to a level between 0.3 to 1.0volt DC. As long as the DC level stays between 5.0V DC for transmit at channel 40 and 0.3 to 1.0V DC for receive at channel 1 the VCO is set properly. The magnitude of the TP voltage swing is determined by C312 at factory. The optimum value of C312 was found to be around 60pfd. C312 with value larger than 60pfd will reduce the voltage swing magnitude and vice versa for smaller value. If the lower value drops only to 1.5V DC, then the C312 of 60pfd should be reduced to increase the range. This shouldn't be necessary when factory supplied parts are used for D303 (varactor diode) and L203 (VCO tuning coil).

3.4 RF Driver Stage Alignment

1. Select channel "19"
2. Connect an oscilloscope to the base of Q301 and ground.
3. Adjust L301, L302 and L303 for maximum amplitude of scope display (27.185MHz signal).
4. Connect the scope to Q302 collector.
5. Adjust L304 for maximum amplitude of scope display.

3.5 RF Power Amplifier Alignment

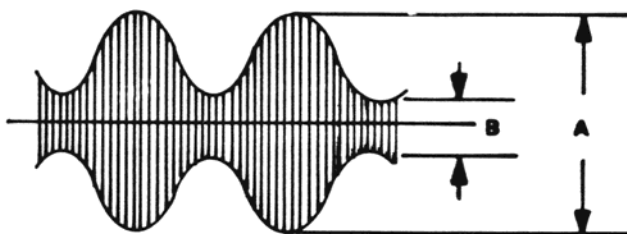
1. Set power supply voltage to AC 120V and set the radio into channel 19 position.
2. Connect a watt meter to the antenna connector.
3. Adjust L304, L305 and L306 for maximum power indication. Readjust L303, L302 and L301 to peak power.
4. When all coils are peaked, the power meter should indicate above 4.0 watts.
5. Turn L306 counterclockwise until the power reading of 3.8 watts is obtained.

3.6 Transmit Frequency Check

1. Set the radio into transmit mode with no modulation.
2. Connect the frequency counter to the antenna load or to the tab provided at the watt meter.
The frequency should be within +/-800Hz from each channel center frequency as tabulated in the freq.table attached.

3.7 Modulation Sensitivity Alignment

1. Set the unit into transmit mode and apply 20mV, 1kHz signal to the Mic input circuit.
2. RV 201 should be adjusted to obtain 85% modulation at this condition.
3. Next, decrease signal input to 6mV and observe that the modulation ratio is keeping the value higher than 60%.



$$\text{MODULATION} = \frac{A-B}{A+B} \times 100 (\%)$$

3.8 RF Meter Alignment

Adjust RV202 so that the meter pointer indicates the same wattage as the reading obtained on the watt meter. Refer to "3.6" in this alignment procedure.

4. Alignment of Receiver Circuitry

4.1 Test Set-Up (See Separate Diagram)

4.2 Receiver Sensitivity Alignment

1. Set the signal generator at 27.185MHz, 1kHz, and 30% modulation. Set the radio to channel 19 position.
2. Adjust L101, L102, L108, L103, L104, L105, L106, and L107 for maximum audio output across the 8 ohm dummy load resistor. This alignment should be performed by gradually decreasing the signal generator output signal to a minimum level required for tuning to avoid inaccurate alignment due to AGC action.

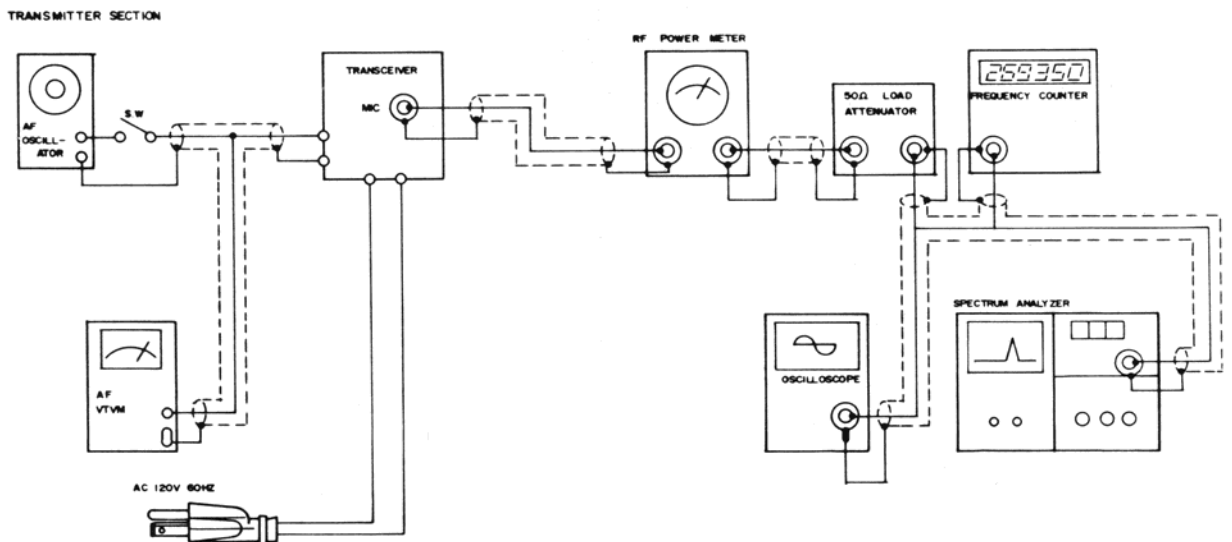
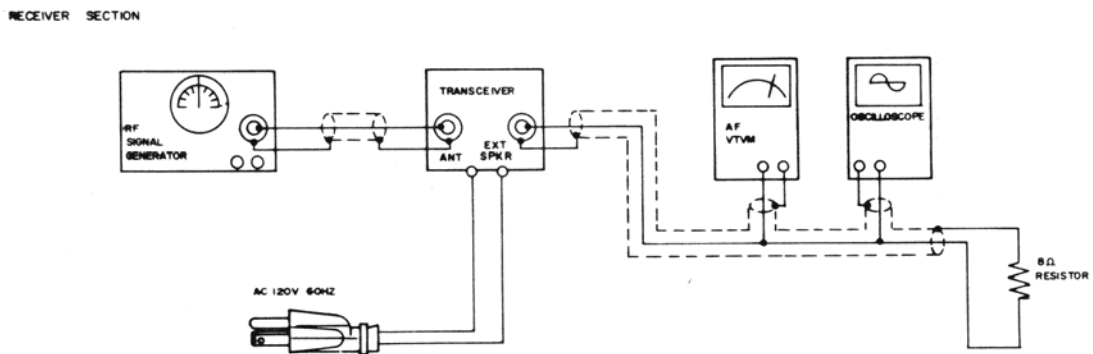
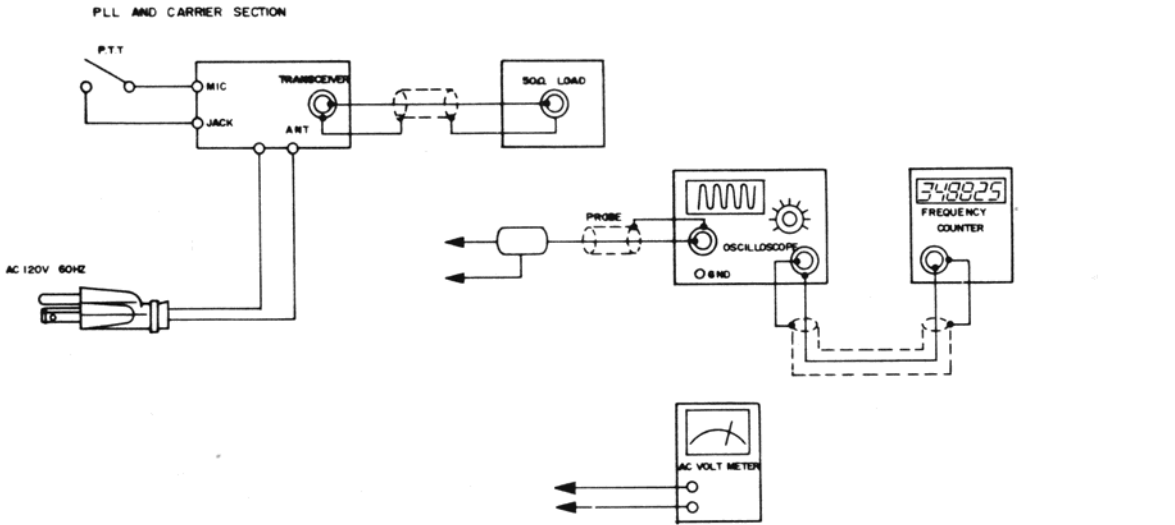
4.3 Squelch Circuit Alignment

1. Set the signal generator to provide an RF input signal of 60dB (1kHz, 30 % modulation 1mV).
2. Rotate the squelch control fully clockwise.
3. Temporarily adjust RV101 for maximum audio output, and note the audio output level. Then adjust RV101 so that the audio output level decreases by 6 dB.

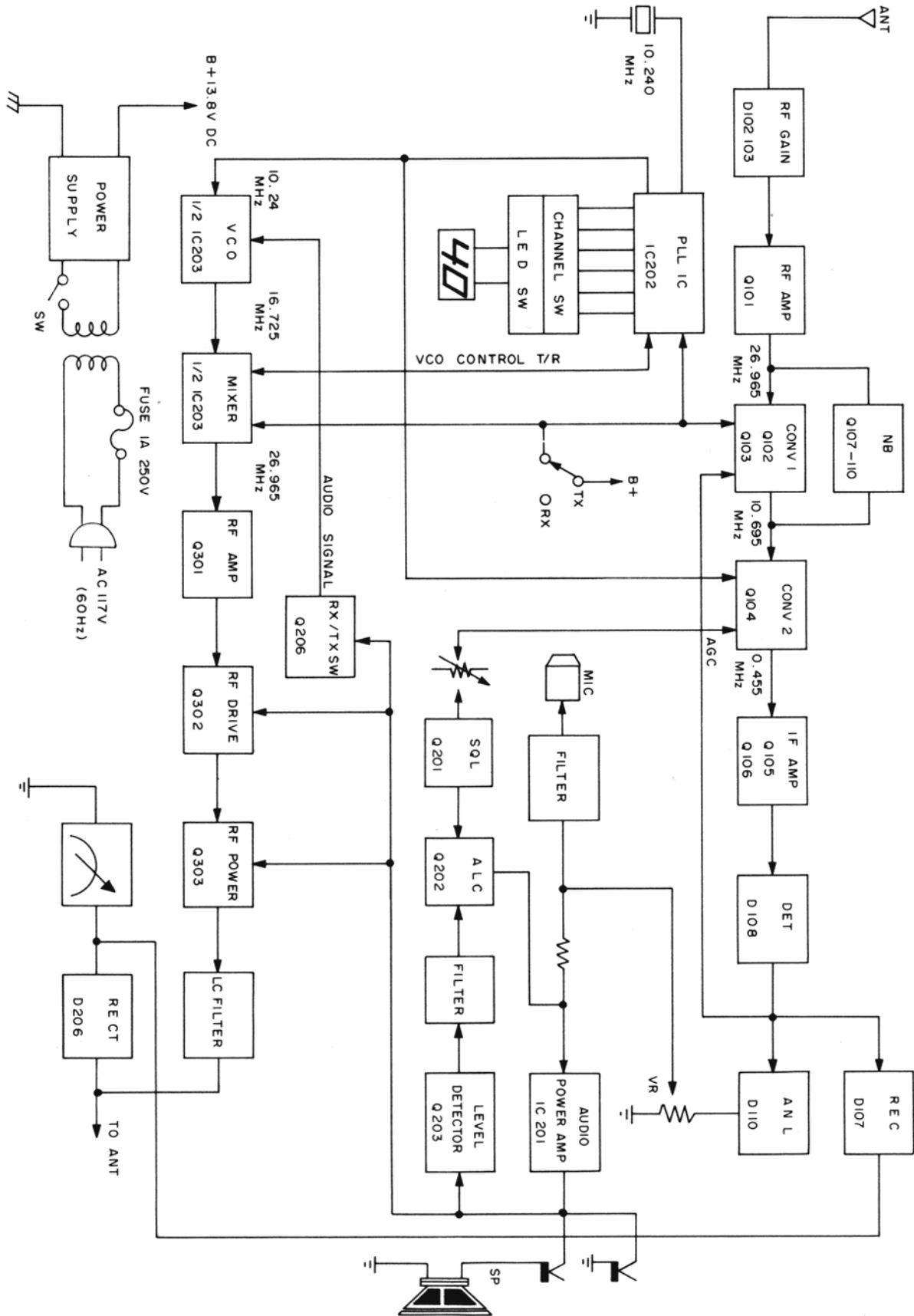
4.4 S-Meter Adjustment

1. Set the signal generator to provide 40 dB (100uV) signal output.
2. Adjust RV102 to S "9" on the meter provided on the front panel.

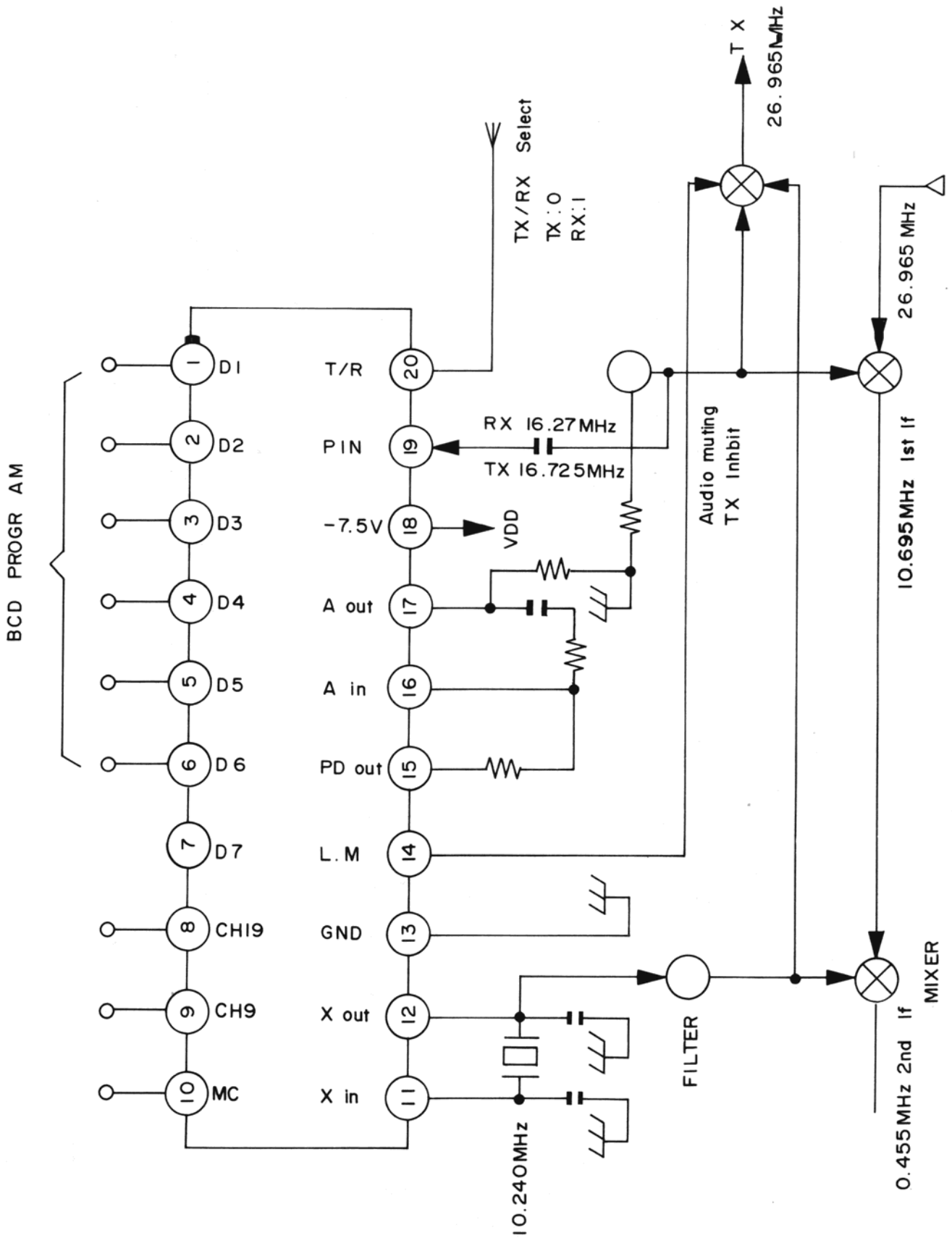
Test Equipments Setup



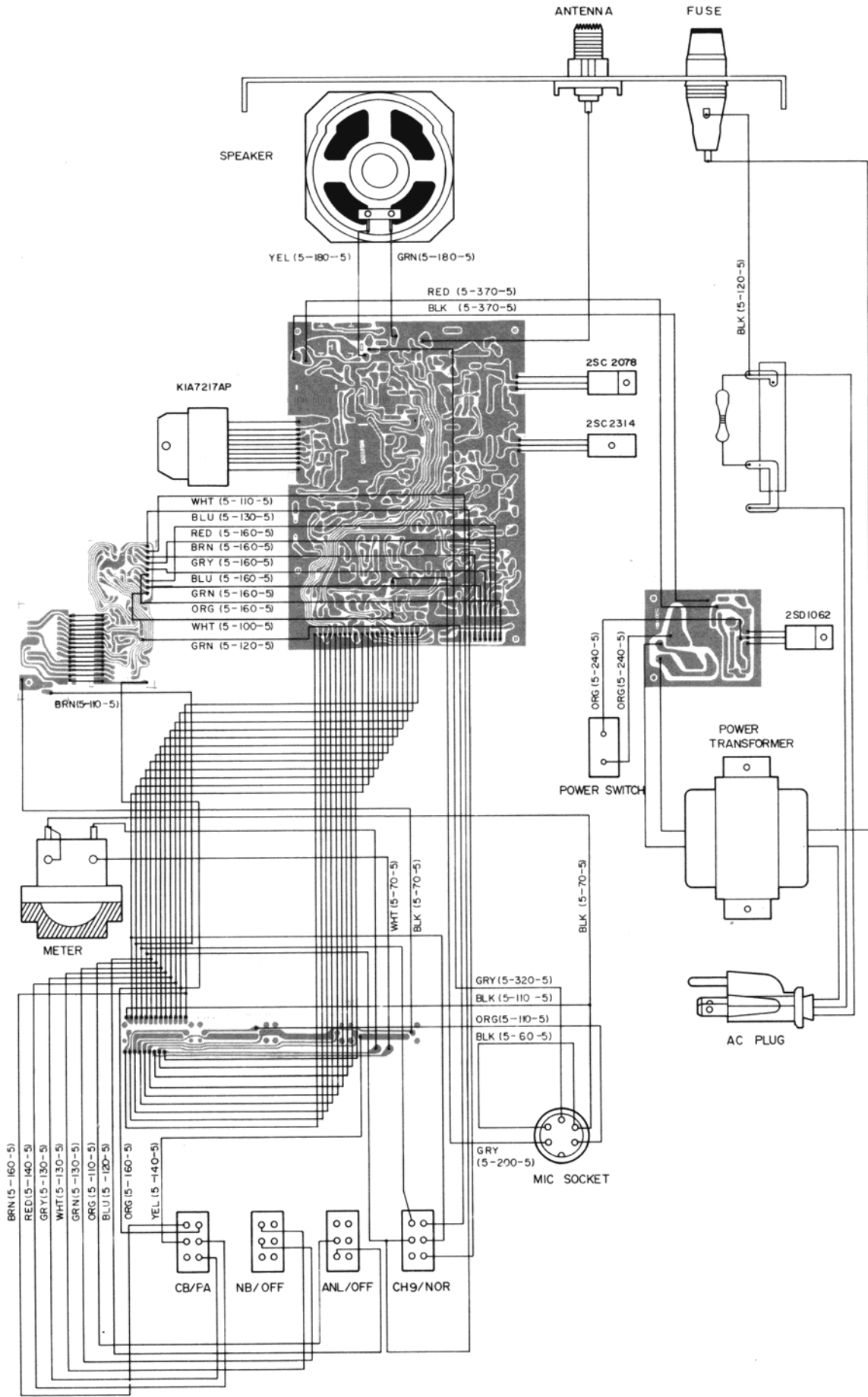
Block Diagram



PLL Circuit Block Diagram



Wiring Diagram



PARTS LAYOUT, MAIN PCB 401052-C TOP VIEW

