

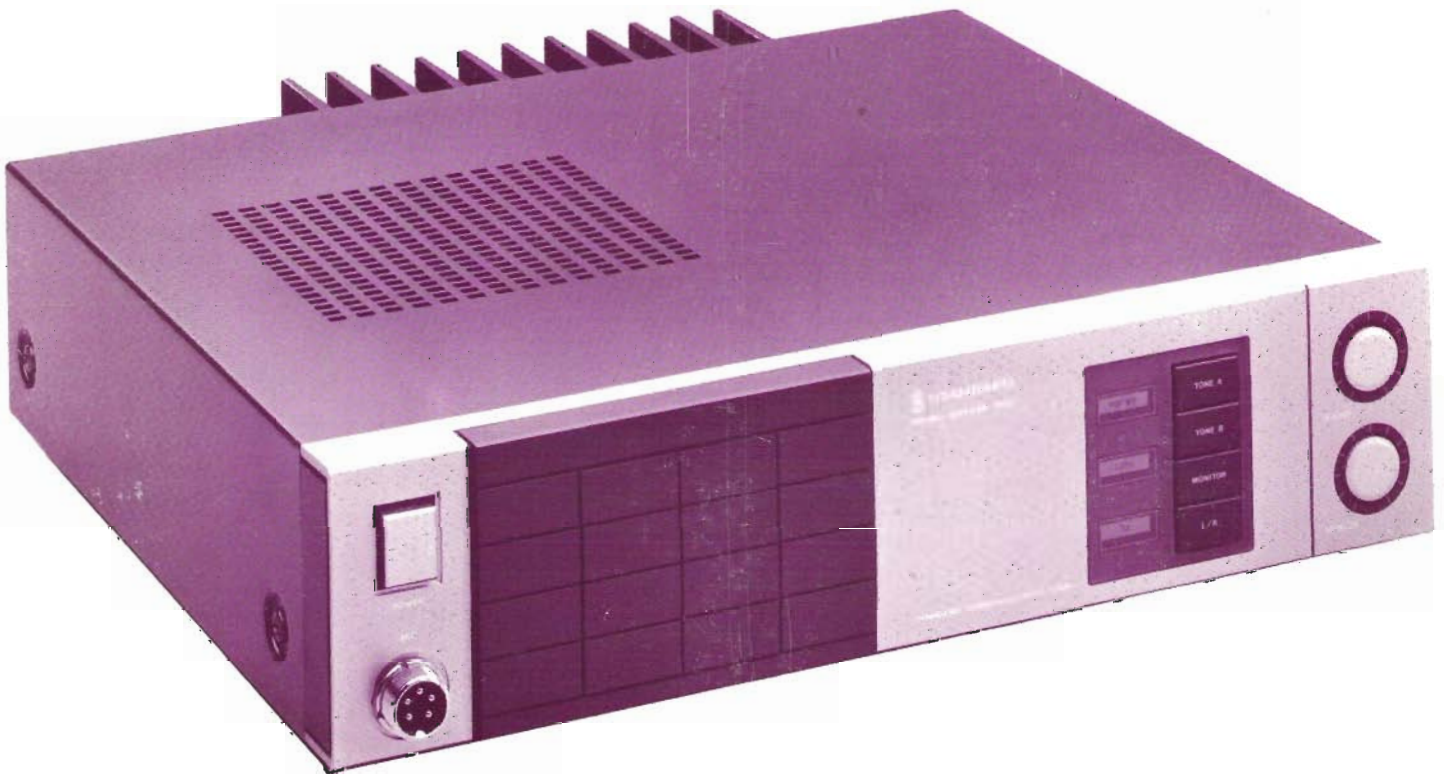
# RP70U

12 Watt  
UHF/FM  
Repeater/  
Base Station

## Contains:

- Specifications
- FCC Information
- Operation
- Installation
- Theory of Operation
- Performance Tests
- Alignment Procedure
- Complete Drawings
- Parts Lists

## Service Manual



# RP70U

## Twelve Watt UHF/FM Repeater/Base Station

This manual intended for use by qualified technicians and includes all necessary information pertaining to RP70U operation, installation, circuit design, and maintenance. Information on the installation of the TN34 tone board is also included. Changes which occur after the printed date will be incorporated.

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## 1.1 Description

The RP70U is a full duplex switchable repeater/base station designed for use in the frequency range of 450 to 470 MHz. It requires 120 VAC and develops an adjustable RF power output of 2W to 12W.

The RP70U is designed for desk-top use. Incorporated into the RP70U electronics are a time out timer and carrier drop out timer. The time out timer may be set from 1 to 10 minutes. The carrier drop out time is adjustable from .1 to 10 seconds.

The RP70U is all solid-state and is shipped ready for operation in the transmit and receive frequencies of the user's choice. One or two tone boards may be installed. Features include "POWER," "BUSY," and "TX" indicators, TONE selector switches, volume and squelch controls, an external terminal strip, and an accessory receptacle hole.

## 1.2 SPECIFICATIONS

Performance specifications are nominal, unless otherwise indicated, and are subject to change without notice.

### 1.2.1 General

Frequency Range .....	F3 450-470 MHz
Number of Channels .....	1
Input Voltage .....	120 VAC
Current Drain:	
Standby .....	100 mA max.
Receive .....	0.2 A max.
Transmit .....	1 A max.

Channel Spacing .....	25 kHz
TX/RX Separation .....	5 MHz only
Dimensions .....	3.18-H x
	12.59-W x
	12.55-D in.
Weight .....	16.75 lbs.
Compliance .....	FCC Parts 21,
	22, 90, 95
FCC Type Acceptance Numbers ....	APV9T20484
DOC Approval .....	363-192-3881

### 1.2.2 Transmitter

Measurements are made in accordance with EIA Standard RS-152-B.

RF Power Output .....	2W to 12W
	Adjustable
Spurious and Harmonic Emissions .....	-65 dB
FM Hum and Noise .....	-45 dB
Modulation .....	16F3
Audio Distortion .....	3% max.
Frequency Stability	
-30° to +60°C .....	±2.5 ppm max.

### 1.2.3 Receiver

Measurements are made in accordance with EIA Standard RS-204-B

Sensitivity:	
-12 dB SINAD .....	0.3 $\mu$ V
-20 dB Quieting .....	0.4 $\mu$ V
Squelch Sensitivity:	
Threshold .....	0.3 $\mu$ V max.
Modulation Acceptance Bandwidth ..	±7.0 kHz
Selectivity .....	-75 dB
Spurious and Image Rejection ....	-75 dB
Intermodulation Rejection .....	-75 dB
Audio Power Output at	
5% Distortion .....	4 W min.
Frequency Stability	
-30° to +60°C .....	±2.5ppm max.

### 1.2.4 Time Out Timer

Blocking/Desensitization .....	1 dB
Time Out Timer (adjustable) .....	1 to 10 min.
Carrier Dropout Timer (adjustable) .....	0.1 to 10 sec.
Auto Squelch .....	10 dBQS

## 1.3 LICENSING REQUIREMENTS

### 1.3.1 FCC Information

The RP70U complies with the Federal Communications Commission (FCC) requirements that regulate Business Radio Service and other services within the 450 to 470 MHz range. The user must know and comply with all applicable parts of the FCC Rules and Regulations. Rules applicable to each service may be ordered from:

SUPERINTENDENT OF DOCUMENTS  
Government Printing Office  
Washington, D.C. 20402

A valid station license and call sign are required before operating the RP70U. It is the user's responsibility to apply for and obtain and FCC radio license. The following data pertaining to the RP70U will be included on the FCC license application

Type Accepted ..... FCC Parts 21, 22, 90, 95  
Output Power ..... 12 Watts  
Emission ..... 16F3  
Frequency Range ..... 450 to 470 MHz  
Type Number ..... APV9T20484

### 1.3.2 FCC Requirements

The FCC requires that the modulation deviation and transmit frequency of the transmitter be checked annually.

---

## 2.1 General

1. Ensure that the following connections are made (see Figure 1):

- a. The power cord is connected to an appropriate AC power source.
- b. The antenna is connected to the jack marked "ANT" on the back of the repeater. The antenna SCC recommends selecting an antenna whose radiation pattern best matches the desired area of coverage. For maximum coverage, locate the antenna at the top of a high tower, hill or mountain. Use a low loss coaxial cable to connect the antenna to the repeater.
- c. The microphone is connected to the 5-prong jack on the front of the repeater. Either an MP601 base station microphone or an MP568 microphone may be used.

2. Ensure that nothing is placed directly on top of the repeater and that ample ventilation space exists above the repeater to allow for cooling.

## 2.2. Optional Instructions

The RP70U Repeater can accommodate one or two TN34 tone boards. For the installation of the TN34(s) into the RP70U repeater, perform the following procedures:

1. Remove the repeater bottom cover.
2. Use the two screws provided with each TN34 to secure the tone board atop the posts within the repeater's chassis. Install the tone board so that the crystal is closer to the power supply (see Figure 2).
3. This step is to be performed one or two ways depending on the number of tone boards installed in the the RP70U.

- When only one tone board is installed in the repeater, connect the shorter of the two repeater tone board connectors to the tone board connector in position A.
- When two tone boards are installed do as follows:

- a. Connect the longer of the two repeat tone board connectors to the tone board connector in position B.
- b. Remove QD15 from the RP70U switch PC board (PD02).

4. Program the tone board according to table in Figure 22. See the tone board adjustment instructions in Section 5.4.4.

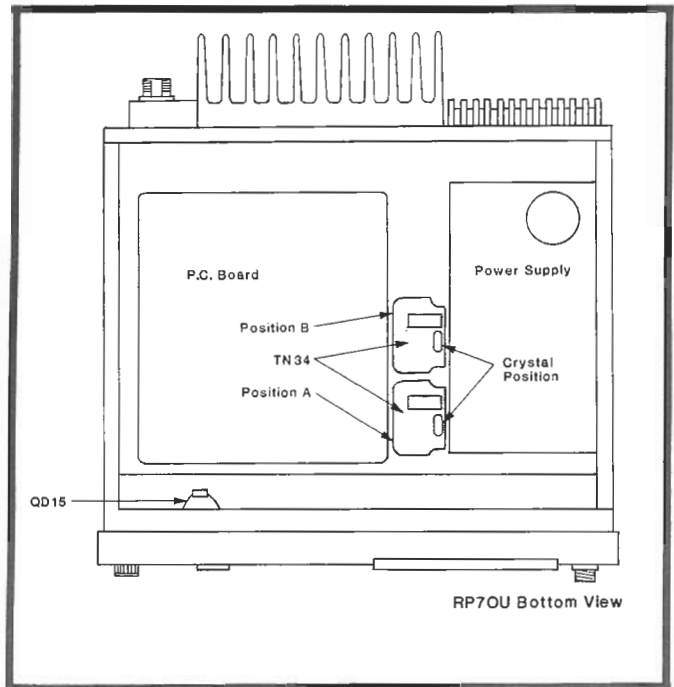


FIGURE 2. TONE BOARD INSTALLATION

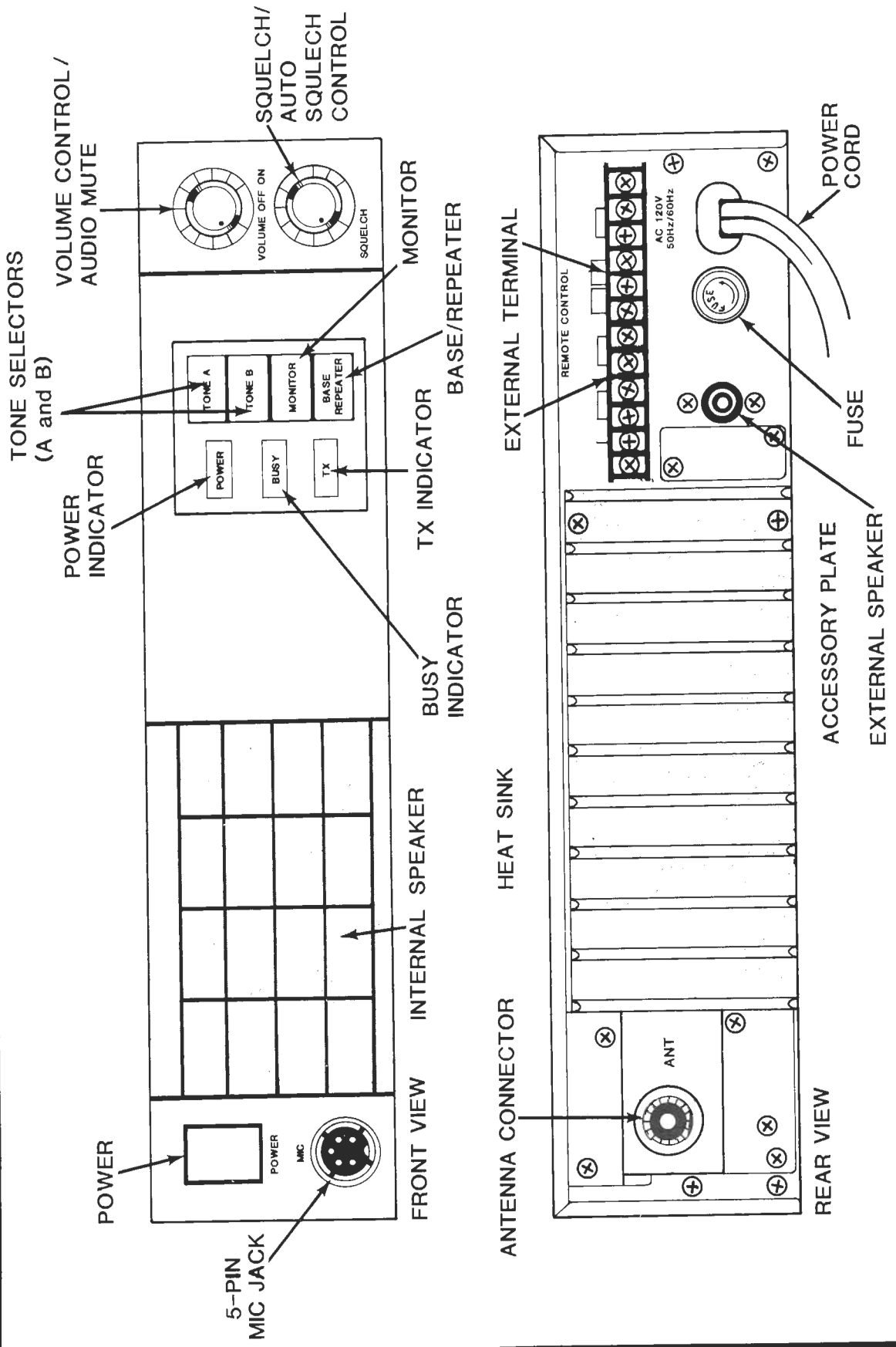


FIGURE 1. RP70U CONTROLS AND CONNECTIONS

## 3.1 CONTROLS AND CONNECTIONS

### 3.1.1 Repeater Mode

1. Select Repeater mode by releasing the Base/Repeater button to its outer position.
2. If CTCSS tone boards are installed:
  - a. Depress the "TONE A" button to enable the tone board in position A.
  - b. Depress the "TONE B" button to enable the tone board in position B.
  - c. Depress both buttons to enable both tone boards.

*NOTE: If no CTCSS tone board is installed, release both buttons. This will cause the repeater to re-transmit any signal on the repeater input frequency.*

3. Press the MON key to monitor (only if CTCSS boards are installed.)
4. If desired, connect an external speaker to the jack on the back of the repeater labeled "EXT SPKR".
5. Adjust the volume control to the desired volume.
6. Turn the squelch control clockwise to the point where the static disappears.
7. With the squelch set to any point, you may select the auto squelch control by depressing the squelch control button. This sets the squelch to the threshold point.
8. Depress the volume control button if monitoring of the repeater input frequency is not desired.
9. The Time Out Timer will cut off transmission after it has exceeded the set time limit.
  - a. The time limit has been factory-set for 3 minutes.
  - b. This may be adjusted within the range of 1 to 10 minutes.

10. The Carrier Drop Out Timer will cause the transmitter carrier to remain on for specified time after the reception of a signal has stopped.
  - a. The time limit has been factory-set for 5 seconds.
  - b. This may be adjusted within the range of .1 to 10 seconds.

### 3.1.2 Base Mode

1. Select Base mode by depressing the Base-Repeater button to its inner position.
2. If CTCSS tone boards are installed:
  - a. Press the "TONE A" button to enable the tone board in position A.
  - b. Press the "TONE B" button to enable the tone board in position B.
  - c. Press both buttons to enable both tone boards.

*NOTE: If no CTCSS tone board is installed, release both buttons.*

3. The FCC requires that a channel be monitored before transmitting. Press the MON button to monitor. Release the button when finished monitoring.

*NOTE: 1. If a CTCSS tone board is not installed, monitoring is constant and automatic.*

*2. If a base station microphone is used, the microphone's monitor button will not work. Use the MON button on the repeater.*

### 3.1.3 External Battery

The RP70U has external battery terminals for emergency power or field use.

1. Connect a heavy duty type battery with a capacity of at least 5 ampere/hour and a voltage of no less than 13.8 V.
2. When AC power is lost, the repeater automatically switches to the emergency power source.



### 3.1.4 Phone Patch Capabilities

The back terminal is used for the following functions (specifications given are for an open circuit):

1. RPT Audio:
    - a. 30 to 50 mV at 3 KHz deviation (1 kHz AF)
    - b. impedance: 560 ohms
  2. RX audio:
    - a. 120 to 160 mV at 3 kHz deviation (1kHz AF)
    - b. Impedance: 120 ohms
  3. External Mic
    - a. Impedance: 47 k ohms
    - b. Input: 30 to 60 mV at 3 kHz deviation  
60 to 100 mV at 5 kHz deviation
  4. External battery
  5. CTCSS defeat
-

## 4.1 RECEIVER

### 4.1.1 RF Stage

The incoming RF signal from the antenna passes through the duplexer and then the bandpass filter, and is amplified by RF amp Q103. The amplified signal passes through two more bandpass filters and is applied to the first mixer (Q104) (see Figure 3).

### 4.1.2 First Local Oscillator

The first local oscillator is an overtone circuit, comprised of Q105, a crystal, and other components. The first local oscillator produces the third harmonic of the original crystal frequency.

The frequency is then amplified by buffer Q106 and tripled again by Q107. The bandpass filter (L116 and L117) tunes the frequency to the third harmonic. This frequency then is fed to the first mixer Q104.

### 4.1.3 First Intermediate Frequency (IF)

The heterodyning action of the first mixer produces a 21.4 MHz intermediate frequency (first IF). This frequency passes through crystal filters F101 and F102, is amplified by Q111 and Q112, and then fed to Q119.

### 4.1.4 Second Local Oscillator

Crystal X101 generates a second local oscillator signal of 20.945 MHz.

### 4.1.5 Second Mixer, Second IF

The input signal of 21.4 MHz is mixed with the 20.945 MHz signal from the second local oscillator. Ceramic filters F103 and F104 extract the difference of the two signals producing a 455 kHz second IF.

### 4.1.6 Limiter Amplifier

After going through the limiter amplifier, this signal is detected by the quadrature detector circuit comprised of L126 and other components. The signal then leaves through pin 9 of Q119 as a low-frequency signal.

### 4.1.7 Recovered Audio

The low frequency signal is then divided into the audio/tone signal and the noise signal. The audio and tone signal is applied to the Q237 (1/4) de-emphasis circuit and then separated into the audio signal and the tone signal.

The audio signal passes through hi pass filter Q237 (2/4) and Q237 (3/4) to eliminate the tone signal. This audio signal is then fed to the TX AUDIO terminal on the terminal board (JG02 in the back of the unit).

The noise signal passes through hi pass filter Q118 and is fed to the noise amplifier within Q119. This amplifier also acts as a bandpass filter. Q118 and Q119 eliminate the audio signal. Noise output is detected by Q116 and Q117 and converted to direct current.

### 4.1.8 Squelch Circuit

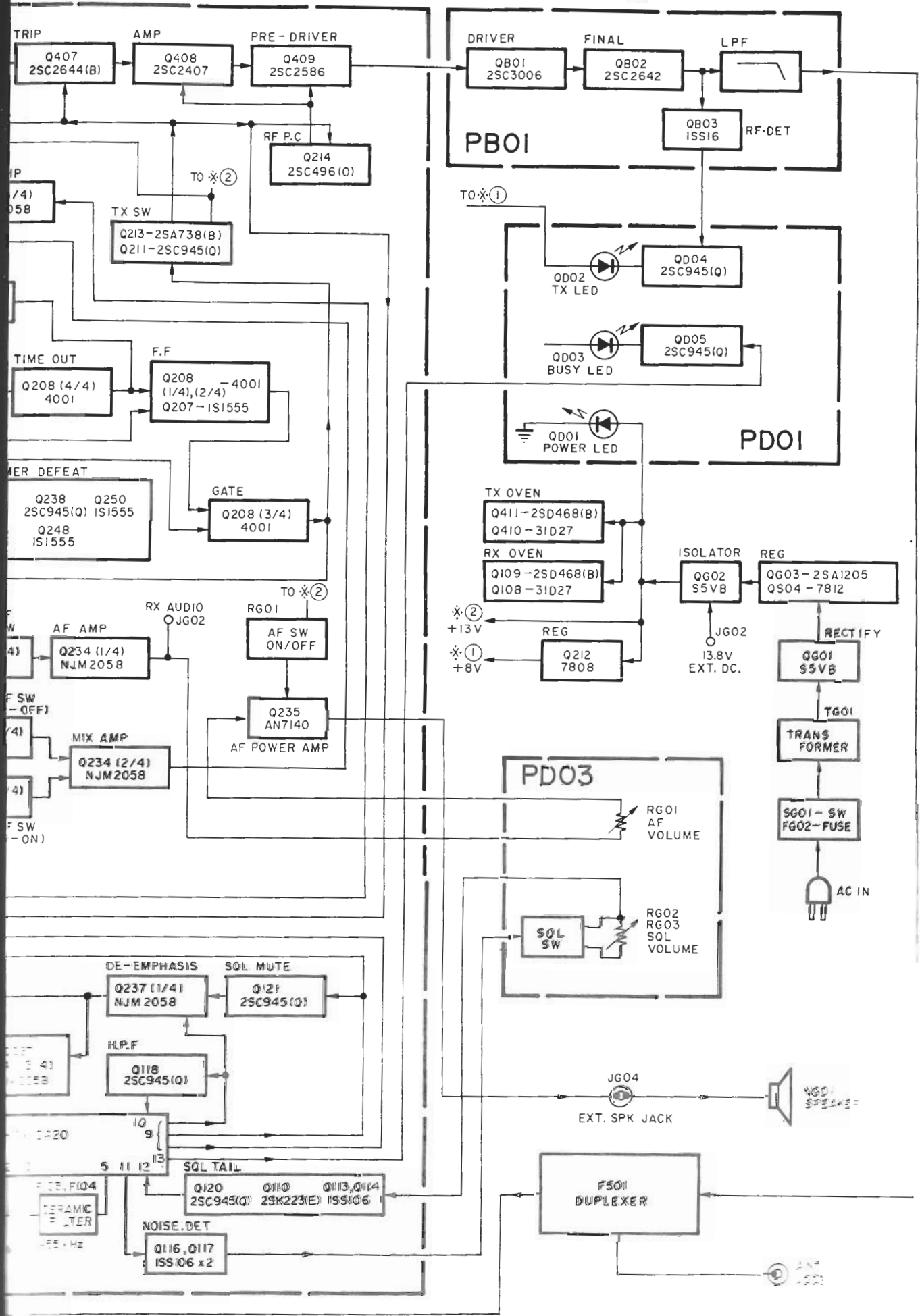
The voltage level is adjusted by the variable resistor RG02 or RG03 to the noise squelch control, and then fed to the variable squelch tail circuit (Q110, Q113, Q114, Q120, and other peripheral components).

The tail is altered by shifting the recharging time of C153, since the resistance between the drain-source varies depending on the voltage between the gate-source. C151 holds the squelch tail during a momentary absence of the received signal. This allows C153 to recharge the gate and source voltage corresponding to the received signal level.

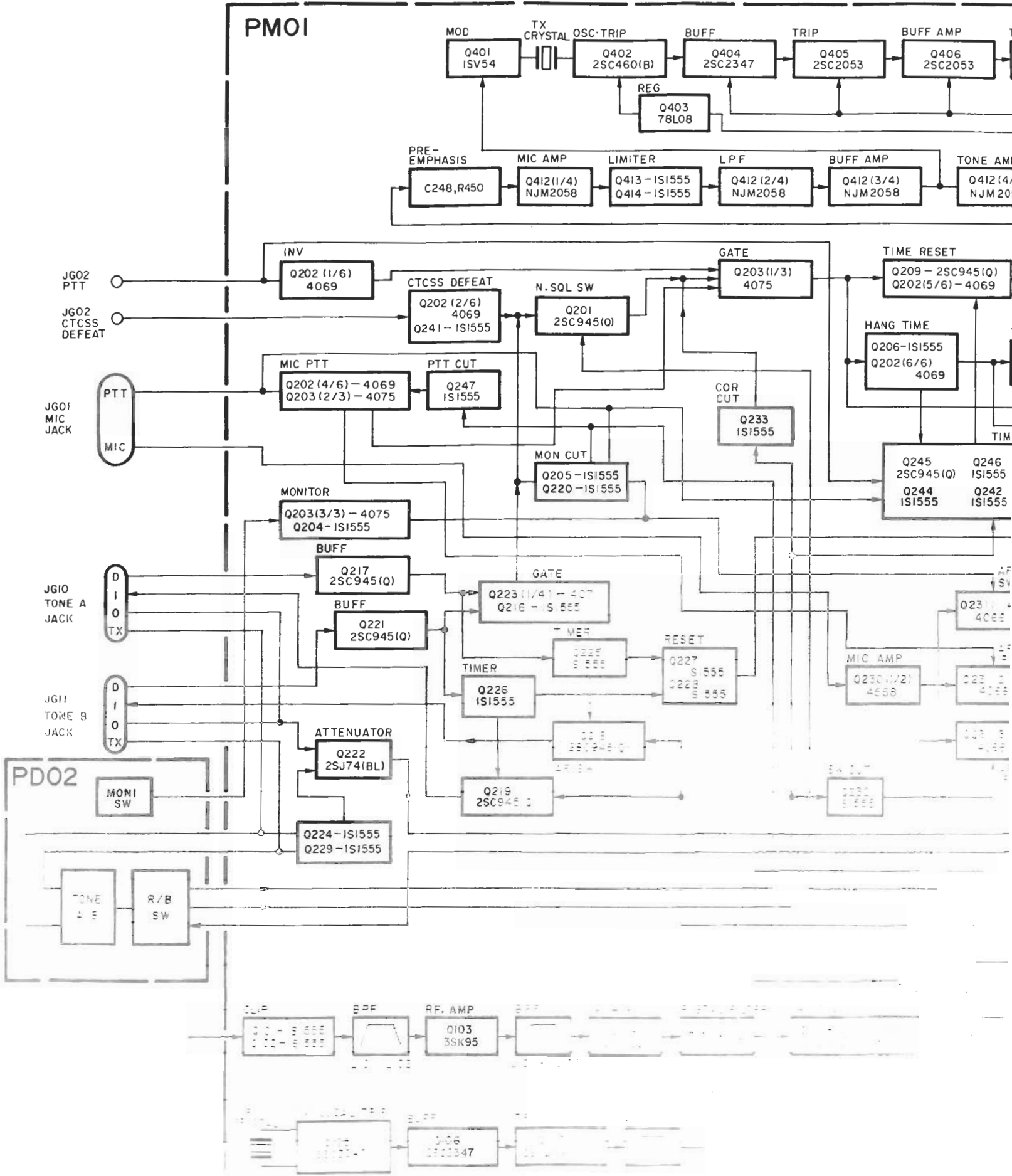
Q120 connects the C153 negative terminal to ground on a weak signal and disconnects it on a strong signal.

### 4.1.9 Schmitt Circuit

The positive terminal of C153 is connected to the input terminal of the IC's Schmitt Circuit (Pin 12 of Q119). Pins 13 and 14 of Q119 are the two points of output. Pin 13 controls the busy-indicator lamp. Pin 14 selects TX and RX of the tone circuit during the BASE mode operation. Also, pin 14 controls the transmission and monitor circuits through the noise squelch control circuit.



# PMOI



#### 4.1.10 AF Switching Local Mic Audio

When the microphone PTT switch is pressed a low will be placed on Pin 3 of Q202 (4/6) producing a high on pin 4 which will turn on Q231 (2/4) allowing microphone audio to pass to the microphone amplifier. When the BASE/RPT switch is in the RPT mode Q247 will be biased on preventing Q231 (2/4) from passing any audio.

During the repeat mode, the RX audio from the high pass filter Q237 (3/4) will be routed out to the back terminal strip JG02 then applied to the AF switch Q231 (3/4). In the repeat mode this switch will be turned on. In the base mode audio will be prevented from passing due to Q232's cathode being pulled low by the BASE/RPT switch.

The audio signal is sent to the monitor amplifier Q234 (1/4), via analog SW Q231 (1/4). This is activated by any one of the following conditions:

- monitor is switched on
- when noise squelch circuit is on
- CTCSS is defeated

During the local PTT Q220 is turned on muting any front panel audio during transmit to prevent feedback. When the radio is squelched Q121 will be biased on pulling pin 6 of Q231 (1/4) low via diode Q251 shutting off any audio.

During RPT Mode RX Audio from HPF Q237 (3/4) will be routed out to back terminal strip JG02 and back in, then it will be applied to AF SW Q231 (3/4). In RPT Mode this switch will be turned on. In Base Mode audio will be prevented from passing due to Q232's cathode being pulled low by Base/RPT SW.

#### 4.1.11 CTCSS Circuit

The AF signal from pin 9 of Q119 is applied to the de-emphasis circuit Q237 (1/4). Part of the output of the de-emphasis circuit is further amplified by Q237 (4/4). It is then separated into tone A and tone B, after the level of each tone is aligned and its noise components are reduced at clipping circuits Q239 and Q240.

Each tone system is then fed to the AF IN terminal of its tone board via AF switch circuits Q219 and Q218, respectively. The decoder output of each tone board is connected to the base of Q217 and Q221, respectively. In the absence of a tone input, the collectors of Q217 and Q221 remain low in potential, and there is no output from the OR GATE Q223 (1/4).

If there is an input of tone A while both switches for tone A and tone B are on, the voltage of the collector of Q217 increases by about 8 V. This recharges C213 via diode Q225 and then activates Q218 through Q223 (3/4) to cut off the input of tone B.

As the positive terminal of C213 is connected to the output end of the power control circuit Q208 (3/4), via diode Q228 and resistor R247, it discharges when the transmission power is turned off. Therefore, when there is tone A input, or during the hangtime when there is no tone A input, tone B is cut off and only the tone A signal is accepted.

While the circuit is on and the tone signal is being received, the cathode of diode Q216 registers a voltage of about 7 V.

#### 4.1.12 CTCSS ENCODE BASE MODE

When tone A or B is selected, B+ is supplied to pin 2 of the tone Board thru J007 pin 4, QD12 will be biased to turn on QD14, causing cathode of QD216 to be held low. Preventing noise squelch switch Q201 from turning on AF switch Q231 (1/4) in base mode when the PTT circuit turns on the Q213 TX switch. Approximately 6 volts is passed thru the BASE/REP switch to the tone board on pin 3 enabling the tone boards output. QB17 will be based on pulling Q203 low turning off local RX audio switch Q231.

With the tone board on, its output will be collected together by resistor R279, R280 and other resistors. The output of the tone board is higher during the BASE mode than during REP mode. Therefore, FET Q222 functions as an attenuator and lowers the output level to the equivalent of the output during the REP mode. During the BASE mode, the drain source in Q222 is off, and the signal is sent to the tone amplifier Q412 via resistor R276, C251, and R281.

This high of 7 V is applied to Q203 (3/3) pin 4 thus turning on AF switch Q231 (1/4) and opening up the local audio.

#### 4.1.13 CTCSS REP MODE

In the REPEAT mode with tone A or B selected when correct tone is received and decoded, the tone boards pin 8 will go low, turning off Q217 or Q218 putting a high on Q223 (1/4), Q216 cathode registers about 7 volts which is applied to Q203 (1/3) PTT circuit and Q203 (3/3) local AF switch.

## 4.2 TRANSMITTER

### 4.2.1 Modulation

Clipping distortion is eliminated by a roll-off filter Q412 (2/4), and the output is applied to modulation varicap Q401 together with the tone signal, via buffer amplifier Q412 (3/4).

### 4.2.2 Oscillator Circuit

The oscillator circuit is comprised of a crystal fitted to J401, J402, and Q402, modulation varicap Q401, and other components. The circuit oscillates at the fundamental crystal frequency. The collector of Q402 is fitted with a resonance circuit that produces the third harmonics of the fundamental frequency.

### 4.2.3 UHF Signal

The frequency is amplified by Q404 and Q405, and tuned to the third harmonics again by the collector of Q405. The frequency is amplified again by Q406 and then tuned to the third harmonics once more to reach the required frequency. The frequency is 27 times higher than the fundamental crystal frequency. This UHF is amplified by Q408 and Q409 and then fed to the booster amplifier.

The booster amplifier (QB01 and QB02) amplifies the UHF signal to 15 W, and a low pass filter eliminates the harmonics. The signal is then sent to the antenna terminal via the duplexer.

The UHF signal is applied to the booster amplifier (PB01) where it is amplified to 15W by QB01 and QB02. The signal is then sent through a low pass filter which eliminates the harmonics and then through a duplexer to the antenna. QB03 rectifies a portion of the TX signal which is used to turn on the TX lamp.

### 4.2.4 Exciter and Final Stage

The signal from the VCO is applied to the exciter stage Q202, Q203, and Q204 which are controlled by TX +6V. The TX +6V is synchronized to the PLL unlock circuit to prevent transmission when the VCO is unlocked.

The signal amplified by Q204 is further amplified by the power module Q205. The Q207 output power is controlled by adjusting C217, C215, and R215.

Higher harmonics are attenuated by 30 dB in the final circuit of C205. It is further attenuated by 60 dB at the two-stage pi-type filter of L209, C229, L210, L211, and C228.

### 4.2.5 Crystal Stability

Crystal X301 is the temperature controlled crystal oscillator circuit. The frequency drift of X101 is kept within  $\pm 2.5$  ppm.

### 4.2.6 Antenna Switching

The antenna is connected to a low pass filter applied directly to the output of the transmitter final. A quarter inch length matching coil L208 connects the transmitter output to the receiver. The bottom of this coil is grounded by Q207 in transmit making high impedance connections whenever TX +6V is present. In the receive mode, the ground is removed from the bottom of L208 and the receive signal is directed to the RF amplifier.

## 4.3 Control Circuits

The direct current from the cathode of the tone board diode Q216 is fed to the collector of noise squelch switching circuit Q201 via R213.

During received signal input, Q201 cuts the connection between the collector and the emitter. Q201 closes this connection during the absence of signal input.

During REPEATER mode operation, the direct voltage is fed to Q203 (1/3) via R208. The output of Q203 (1/3) is sent to the hang time circuit, the time out time circuit, and the transmitter power source control circuit. (See Figure 5).

The PTT circuit consists of four control lines: external push to talk; base microphone push to talk; COR and tone board detect. When either the base microphone or the external PTT is activated and inverted, the PTT circuit inverts the low to a high state. In the External PTT circuit, the circuit sends this voltage to pin 12 of OR GATE Q203 (see Figure 4). In the BASE MIC circuit, it sends this high state to pin 2 of OR GATE Q203, then to pin 11 of Q203 when in the Repeat mode. The COR control line is activated by the noise detector switch. If no tone boards are used, the COR line is held low until a tone of the correct frequency is decoded in which the PTT switches this line high.

When in the BASE mode the RPT/BASE switch grounds the cathode of Q233 thus pulling low the COR line and making it inoperable.

### 4.3.1 CTCSS Defeat

If the CTCSS DEFEAT terminal on the rear terminal board is connected to the ground, R207 and diodes Q202 (2/6) and Q241 supply voltage to the collector of the noise squelch switching circuit (Q201), just as when the tone circuit is activated.

### 4.3.2 TX Power Supply

When the PTT switch of JG02 is connected to the ground, voltage is applied to another input terminal of Q203 (1/3) via Q202 (1/6). This activates the transmitter power supply circuit.

The output of Q203 (1/3), a pulse voltage, enters and sets flip-flop circuit Q208 (1/4) and Q208 (2/4). At the same time, C203 is charged via diode Q206, reducing the output of Q202 (6/6) to zero. This in turn increases the voltage by approximately 8 V, activates the TX SW Q211 and Q213, and turns on the transmitter power supply.

### 4.3.3 Hang Time Circuit

The absence of a reception signal reduces Q203 (1/3) output to "0". This in turn causes C203 to discharge slowly via variable resistor R217 until its voltage is lowered to the threshold voltage of Q202 (6/6). At this point, the Q202 (6/6) output turns to "1". The Q208 (3/4) output therefore turns to "0" and switches off the transmitter power supply. This hang time is adjusted by R217.

### 4.3.4 Time Out Timer Circuit

During the continuous reception of a signal input, Q208 (4/4) output is "1". This slowly charges C204 via R298 and R219. When the C204 voltage has increased sufficiently, it reverses the flip-flop circuit, setting the Q208 (2/4) output at "1" and Q208 (3/4) at "0". This switches off the transmitter power supply.

During the absence of the received signal, the collector-emitter of Q209 turns on, C204 discharges via R304 to return to the original condition.

Q244, Q245, Q246, Q250, and related components stop the time out timer circuit during the BASE mode operation. When the PTT switch on the rear terminal board is switched on, the time out timer circuit is stopped by Q238, Q243, and related components.

When in the REPEAT mode with no signal present which means the unit is in standby operation, these conditions prevail:

1. Ext PTT, PTT, COR lines are low.
2. Lines A, B, and C are floating.

Pin 10 of IC Q202 is high, so Q209 is on and the time out timer is reset via the discharge of C204. When a signal is detected or when either the EXT PTT or the base microphone PTT is activated a high output on Q203 pin 10 exists. This shuts off the time out timer and the reset circuit allowing the time out timer function to operate. When a high exists on pin 10 of Q203 capacitor, C203 charges via diode Q206. The output of Q202 pin 8 is low which is tied to one of the two inputs of Q208 pin 13.

When the high condition first appears on pin 10 of Q203, pin 16 of capacitor C202 charges via resistor R216. As a result, a positive pulse is sent to pin 1 of Q208 to reset the flip-flop. At the same time, Q208 pins 8, 9, and 10 act as inverters, making a high on pin 10. Then C204 begins to charge via fixed resistor R219 and variable resistor R298 at a rate of the R298/C204 time constant. When the voltage of C204 builds up to a "high" condition on pin 6, the flip-flop is toggled into a set mode. This provides a "high" condition on pin 3 of Q208 and pin 12 of Q208, thus turning Q211 off.

When the BASE mode point C is low to keep the time out timer reset function on, point C disables the time out timer. When point B is low and the BASE microphone point A is high, Q245 turns on and disables the hang time function.

### 4.3.5 Power Supply Circuit

The two primary windings of the power transformer (TG01) are connected in parallel for a 115V and 120V power source. They are connected in series for a 230V and 240V power source.

The supplied power is rectified by diode bridge QG01, and is fed to the voltage regulator circuit. Fitted with a 3-lead regulator (QS04) for 12V use, and with the ground terminal grounded by diodes QS01, QS02, and QS03, the circuit produces 13.7 VDC. To increase the current capacity, a current booster circuit is used. Booster transistor QG03 is enclosed within the transmission booster shield to facilitate the heat discharge.

A terminal for an external battery is located on the rear terminal board. The power is supplied to the main unit circuits via diode bridge QG02. This prevents reverse current. QS05 and QS06 prevent reverse battery connection. When connected incorrectly, fuse FS01 cuts off the connection.

To increase current capacity during high current usage QG03 will be biased on allowing more current to be drawn through QG03.

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RP70U

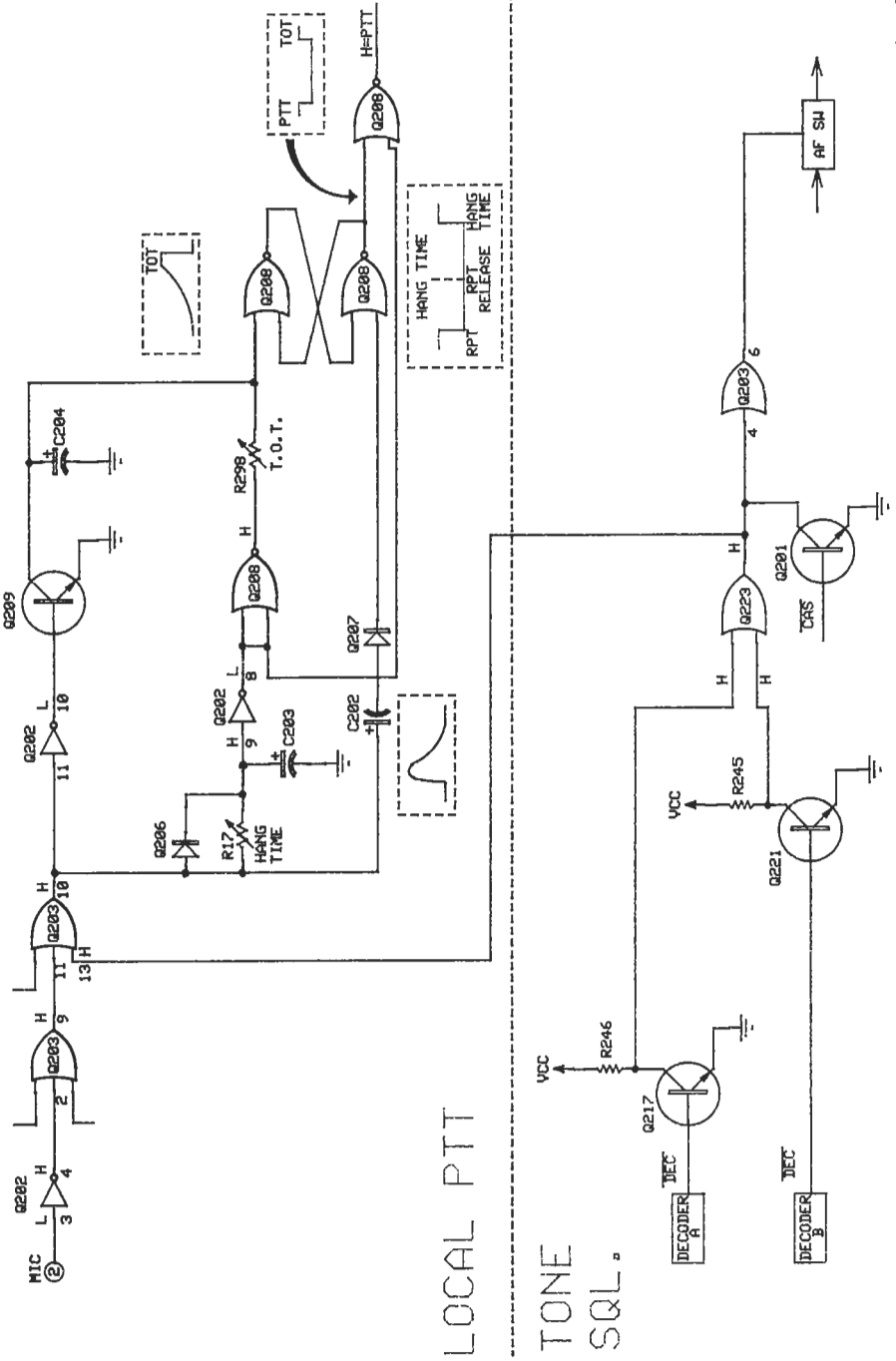


FIGURE 4. LOCAL PTT AND TONE SQUELCH CIRCUITS

## 5.1 Precautions

The inherent quality of the solid-state components used in this transceiver will provide many years of continuous use. Take the following precautions to prevent damage to the transceiver.

1. Never key the transmitter unless an antenna or suitable dummy load is connected to the transceiver's antenna receptacle.
2. Ensure that the input voltage is 120 VAC.

## 5.2 Test Applications

- **Performance test:** conducted to check overall transceiver operation. This should be performed before transceiver sale/installation.
- **Alignment:** conducted if the transceiver fails the performance test or if a critical electrical component has been replaced. SCC recommends that alignment be performed whenever maintenance is performed.
- **Troubleshooting:** conducted in the event of a failure to isolate to isolate a fault in the transceiver.

## 5.3 Test Equipment

The following test equipment, or its equivalent is necessary for RP70U maintenance.

- |   |                       |
|---|-----------------------|
| FM Communications Monitor (service monitor) ..... | IFR1200               |
| RF Wattmeter with 50 load.....                    | Bird 6154             |
| Tone Generator .....                              | Service Monitor       |
| Voltmeter .....                                   | Fluke Model 73/77     |
| Frequency Counter .....                           | Hewlett Packard 5314A |
| Oscilloscope .....                                | Dual Trace, 20 MHz    |
| Digital Voltmeter .....                           | Fluke Model 73/77     |

## 5.4 Alignment Procedure

The RP70U alignment points are shown in Figures 5 and 6. After connecting the test equipment, ensure that the supply voltage is 120 VAC.

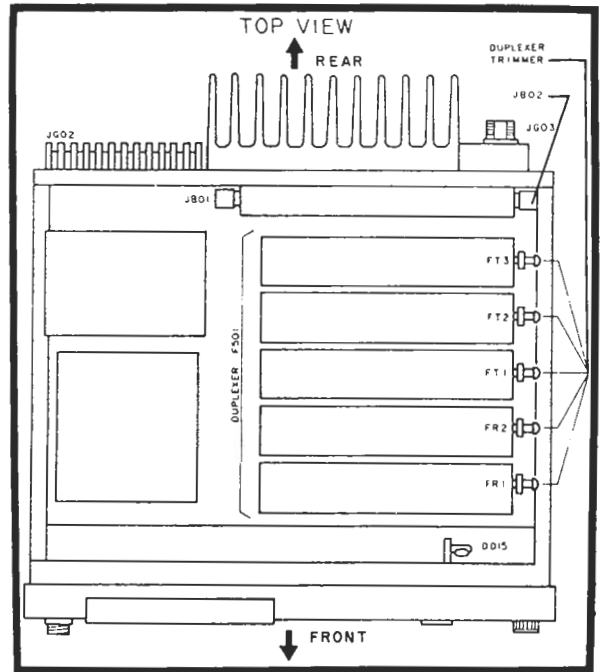


FIGURE 5. RP70U ALIGNMENT POINTS (TOP VIEW)

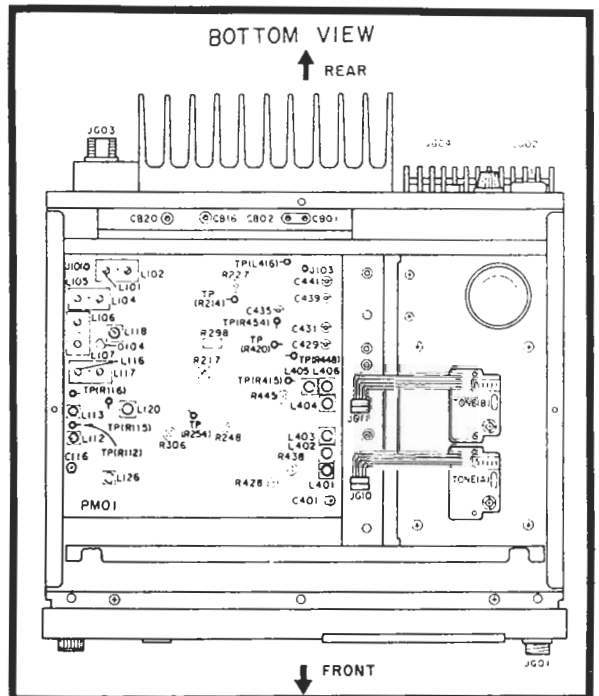


FIGURE 6. RP70U ALIGNMENT POINTS (BOTTOM VIEW)

### 5.4.1 Receiver

1. Connect the test equipment as shown in Figure 7.

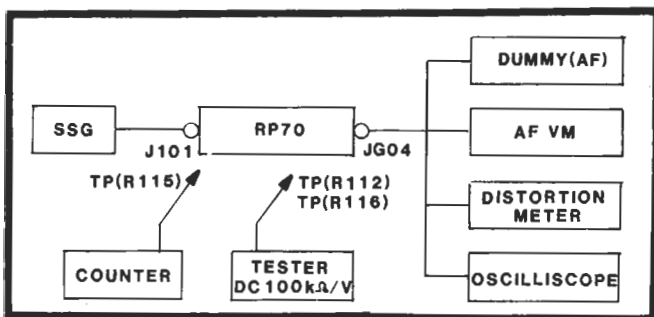


FIGURE 7. RX TEST SETUP

2. Turn the squelch control fully counterclockwise.
3. Attach the Standard Signal Generator (SSG) to RX jack J101, and set the standard signal generator output to the RX frequency. Set the output for slight RF quieting.
4. Select base mode with the Base/Repeater button.
5. Connect a voltmeter between TPR112 and the chassis.
6. Adjust L112 for a maximum meter reading (voltage is approximately 1V  $\pm 10\%$ ).
7. Connect a voltmeter between TPR116 and the chassis.
8. Adjust L113 for a maximum meter reading (voltage is approximately 1V  $\pm 10\%$ ).
9. Connect a frequency counter to TPR115.
10. Adjust C116 until the desired frequency is indicated.
11. Confirm the maximum meter readings of Steps 6 and 8.
12. Set the standard signal generator to the RX frequency and raise the output of the standard signal generator (at standard modulation) until an AF signal is heard.
13. Adjust L126 for maximum AF output and minimum distortion.
14. Obtain the best possible S/N ratio by adjusting L120, L118, L116 and L117, and then L107, L106, L105, L104, L102, and

L101. Lower the standard signal generator output during adjustment to maintain the S/N ratio at around -12 dB.

15. Readjust L126 as in Step 13.

16. Set the standard signal generator modulation to OFF and adjust L101, L102, L104, L105, L106, L107, L116, and L117 for maximum QS level.

### 5.4.2 Transmitter

1. Connect the test equipment as shown in Figure 8. (Remove the coaxial cable which goes to the power stage).

NOTE: J403 is the TX Pre-Driver output jack in Figure 8.

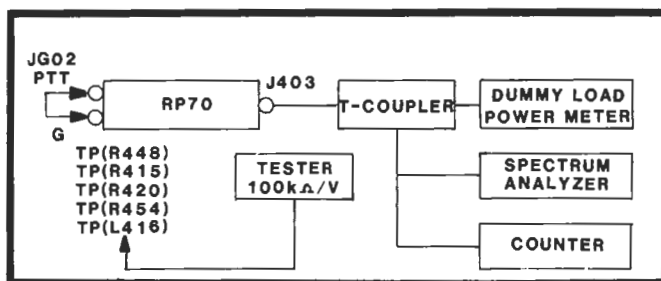


FIGURE 8. TX TEST SETUP

2. Rotate the power control (R227) fully clockwise.
3. Set the Repeater to the BASE mode.
4. Connect the PTT terminal of the JG02 10-pin connector (located on the rear of the RP70U) to the GND terminal or the chassis (key the transmitter).
5. Connect a voltmeter between TPR415 and ground.
6. Adjust L402, L403, and L404 for a minimum meter reading.
7. Adjust L405 for a maximum meter reading.
8. Connect a voltmeter between TPR420 and ground.
9. Adjust L406 for a minimum meter reading.
10. Connect a voltmeter between TPR454 and ground.
11. Adjust C429 and C431 for a minimum meter reading.

12. Repeat step 11 several times.
13. Connect a power meter to J403.
14. Adjust C435, C439, and C441 for a maximum power meter reading at J403. (The power will be 800 mW to 1.2 W).
15. Repeat Step 14 several times.
16. Connect the frequency counter to the TX-coupler.
17. Set trimmer C401 to the mechanical center.
18. Pre-tune L401 approximately to a desired frequency
19. Fine tune C401 to the exact frequency desired.
20. Turn the power supply off and connect the measurement equipment as shown in Figure 9.

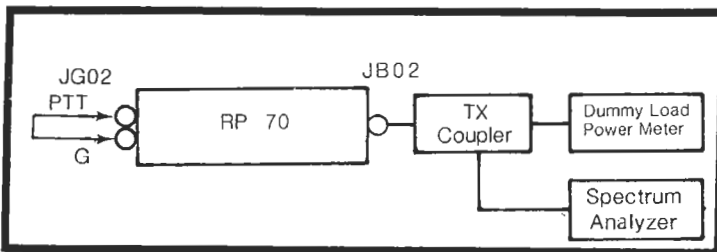


FIGURE 9. MODIFIED TX TEST SETUP

21. Connect JB01 (Booster Input) and J403 (TX Pre-Driver out) with the coaxial cable (WG11).
22. Turn the power on again, and adjust CB01, CB02, CB16, and CB20 for the maximum power indication (wattage is 16 W to 18 W).
23. Connect the Duplexer cable between J101 (RX) and JB02 (TX).
24. Connect the measurement equipment as shown in Figure 13.
25. Rotate R227 to set the power output to 12 W.

#### 5.4.3 Modulation

1. Connect the test equipment as shown in Figure 10.
2. Set the variable resistors R428, R438, R306, R248, and R445 to the center position.

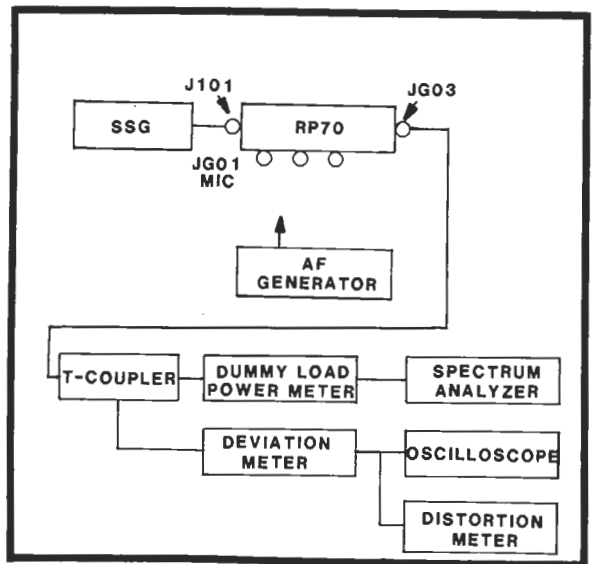


FIGURE 10. MODULATION TEST SETUP

3. Set the Repeater/Base button to the base station position.
4. Apply a 5 mV, 1kHz sine-wave signal to the MIC input of the handheld microphone input terminal of JG01.
5. Connect PTT (terminal # 2) of JG01 MIC jack to the GND terminal or the chassis.
6. Adjust R428 to obtain a deviation of  $\pm 3.0$  kHz.
7. Set the audio generator output to 50 mV.
8. Adjust R438 to obtain a deviation of  $\pm 4.5$  kHz.
9. Repeat Steps 4 through 8 several times.
10. Set the Base/Repeater button to the Repeater position.
11. Rotate the squelch control fully clockwise.
12. Modulate the standard signal generator output level by  $\pm 3$  kHz with a 1 kHz tone.
13. Set the standard signal generator output level to -60 dBm.
14. Connect J101 (RX) to the standard signal generator.
15. Turn off the TONE A and TONE B switches.
16. Adjust R306 to obtain a TX deviation of  $\pm 3$  kHz.

## 5.4.4 Tone

### Encoder Alignment

*NOTE: When only one tone board is used, use Tone A. When both tone boards are used, remove QD15 (IS1555) on the switch P.C. Board.*

1. Connect the test equipment as shown in Figure 11. Ensure that the power supply is set to 120 VAC.

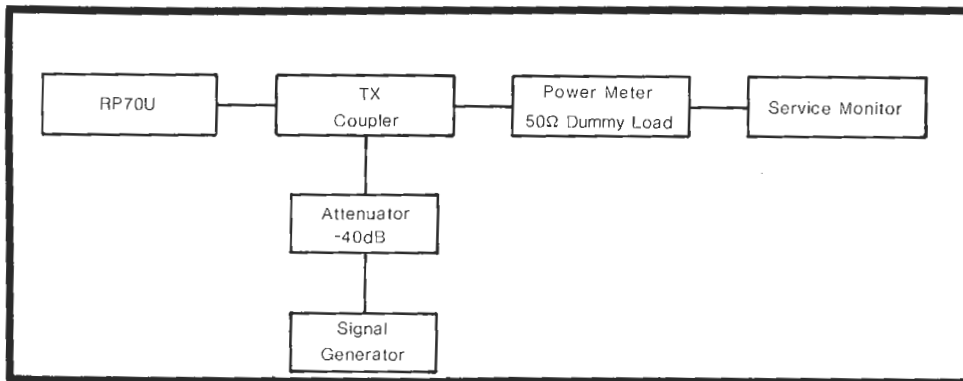


FIGURE 11. TN34 ENCODER TEST SETUP

2. Connect the tone board to tone connectors JG10 and JG11.
3. Set the Base/Repeater button to the Repeater position.
4. Set the standard signal generator output to -60 dBm. The modulation is the tone frequency of the tone board with a  $\pm 600$  Hz deviation.
5. Turn on the power supply and confirm that the Repeater is set to the TX mode.
6. Adjust the tone board potentiometer RA07 to obtain a  $\pm 600$  Hz deviation.
7. When one of the two tones is lower than  $\pm 600$  Hz, adjust repeater potentiometer R445 to obtain a deviation of +600 Hz for the lower level tone board.
8. Perform Steps 4 through 7 for both Tone A and Tone B.
9. Set the Base/Repeater button to the Base position.
10. Turn off the standard signal generator output.

11. Key the transmitter and confirm that the deviation is within  $\pm 600$  to  $\pm 750$  Hz. Set the tone board switch to either A or B.

### Decoder Test

1. Connect the test equipment as shown in Figure 12.

2. Set the controls on the RP70U as follows:

Power Switch ..... ON

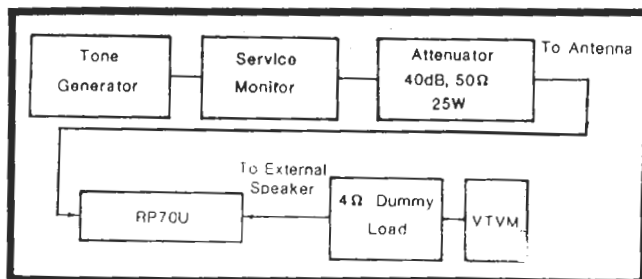


FIGURE 12. TN34 DECODER TEST SETUP

Mode ..... BASE  
 Volume Control ..... 3rd Line Mark  
 Squelch Control ..... Threshold Point  
 Tone Switch ..... A or B according  
 to the TN34 location  
 Monitor Switch ..... ON

3. Set the tone generator to the TN34 frequency.
4. Set the standard signal generator to the RP70U RX frequency.
5. Set the standard signal generator output level to -60 dBm.
6. Adjust the tone generator level and confirm that the squelch opens with tone deviation of  $\pm 50$  Hz to  $\pm 300$  Hz.

### 5.4.5 Hang Time

1. Set the Base/Repeater button to the Repeater position.
2. Rotate the squelch control fully clockwise.
3. Connect the clip lead between TPR254 and TPR214 to turn on the transmit mode. Removing the clip turns off the transmit code after a determined length.
4. Remove the clip lead.
5. Adjust R217 to stop the transmit signal at the desired time.
  - a. Each mark on the R217 designates approximately one second.
  - b. Rotating R217 fully counterclockwise increases the desired time.
  - c. The hang time is pre-set to 5 seconds.

### 5.4.6 Time out Timer

1. Set the Base/Repeater button to the Repeater position.
2. Rotate the squelch control fully clockwise.
3. Connect the clip lead between TP(R254) and TP(R214) to turn on the transmit mode. Confirm that the time out timer turns off the transmit mode after a determined length of time.
4. Adjust R298 to stop the transmit signal to the desired time.
  - a. Each rotation of R298 designates to approximately 45 seconds.
  - b. Rotating R298 counterclockwise increases the desired time.
5. Repeat Step 3.

### 5.4.7 Duplexer Alignment With Spectrum Analyzer

The frequency is assumed to be the following:

- o RX: 462.5 MHz
- o TX: 457.5 MHz

1. Turn off the repeater power.
2. Remove the plugs from the duplexer which is connected to the RX jack (J101) and to the booster output jack (JB02) (see Figure 13).
3. Connect the standard signal generator to the repeater antenna connector.
4. Connect a spectrum analyzer or an RF voltmeter to the RX side of the duplexer.
5. Connect a 50 ohm dummy load to the TX side of the duplexer.
6. Set the standard signal generator output approximately 100 dB and the TX frequency to 457.500 MHz.
7. Adjust duplex trimmers FT1, FT2, and FT3 several times for the minimum reading on the spectrum analyzer or RF voltmeter.
8. Connect a spectrum analyzer or an RF voltmeter to the TX side of the duplexer.
9. Connect a 50 ohm dummy load to the RX side of the duplexer.
10. Set the standard signal generator output to 100 dB and the RX frequency to 462.500 MHz.
11. Adjust duplex trimmers FT1, FT2, and FT3 several times for the minimum reading on the spectrum analyzer or RF voltmeter.

## 5.5 PERFORMANCE TEST

### 5.5.1 Transmitter

1. Connect a wattmeter with a 50 ohm load to the antenna receptacle, and set the repeater/base button to the base position.
2. Key the transmitter by pressing the microphone PTT switch.

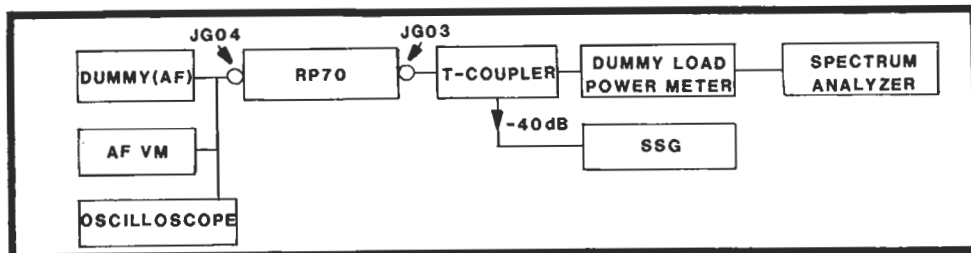


FIGURE 13. DUPLEXER TEST SETUP

3. Verify that the power output is at least 12 Watts.
4. Set the FM communications monitor to measure the exact transmitter frequency of the unit.
5. Key the transmitter and verify that the FM monitor indicates the exact transmitter frequency  $\pm 500$  Hz.
6. Set the FM communications monitor to measure transmitter deviation.
7. Key the transmitter and speak into the microphone. Deviation must not exceed  $\pm 5.0$  kHz.
8. If tone boards are installed, check tone deviation and frequency (when the tone button is out, the tone is disabled; when the tone button is in, the tone is enabled.)

### 5.5.2 Receiver

1. Connect an FM standard signal generator to the antenna receptacle.
2. Connect an AC voltmeter to the speaker jack with an 8 ohm, 2 watt resistor in parallel.
3. Turn the squelch control counterclockwise for maximum noise. The squelch control must be in the out position.
4. Adjust the volume control for a voltmeter reading of 2.0 VAC. The volume control must be in the out position.
5. With the standard signal generator set at the receive frequency (no modulation), slowly increase the signal level until the voltmeter reading is reduced to 0.2 VAC (20 dB decrease). Verify that the signal generator output does not exceed  $0.5 \mu V$ .
6. Reduce the standard signal generator output to zero.
7. Adjust the squelch control to the point where the speaker noise just cuts out (threshold).
8. Set the standard signal generator modulation to  $\pm 3$  kHz with a 1 kHz tone.
9. Increase the standard signal generator output until speaker noise returns.
10. Turn the squelch control fully clockwise (maximum quieting).

11. Increase the standard signal generator output until the audio is recovered at the speaker again. Verify that the signal level of the standard signal generator is below  $5 \mu V$ .
12. Depress the squelch control to the in position. Ensure that speaker noise returns with a standard signal generator input no more than  $0.3 \mu V$ .
13. If the tone boards are installed, select board A or B by depressing the appropriate tone button. Ensure that audio is only passed to the speaker upon injection of approximately  $\pm 300$  Hz of the appropriate tone.

### 5.5.3 Repeater Operation

1. Connect a wattmeter with a 50 ohm load to the antenna receptacle.

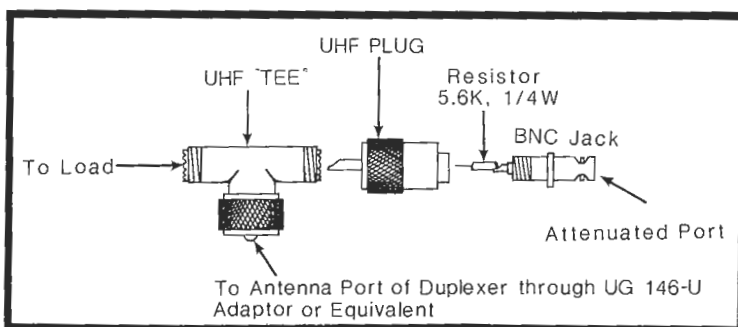


FIGURE 14. "DESENSE T" ASSEMBLY

2. Set the Repeater/Base button to the Repeater position and select a tone if applicable.
3. Air-couple the standard signal generator to the antenna line by using a "desense T." Figure 14 and the following steps describe the assembly of the "desense T".
  - a. Cut one resistor lead to  $3/16$ " and cut the other to  $1/2$ ".
  - b. Insert a  $3/16$ " resistor lead into the BNC jack and solder.
  - c. Screw the BNC jack flange to the UHF plug.
  - d. Solder the BNC jack flange to the UHF plug.
  - e. Solder the resistor lead to the UHF plug center plug.
  - f. Screw the above assembly into the UHF "Tee".

**WARNING:** *If these steps are not followed precisely, the transceiver may be damaged.*

4. Inject a signal at the repeater receive frequency with  $\pm 600$  Hz of the appropriate tone deviation. Ensure that the repeater keys up.
5. Disconnect injected signal and ensure that the repeater stays keyed-up for the designated hang up time.

#### 5.5.4 Desense Check

1. Connect the test equipment as shown in Figure 15.

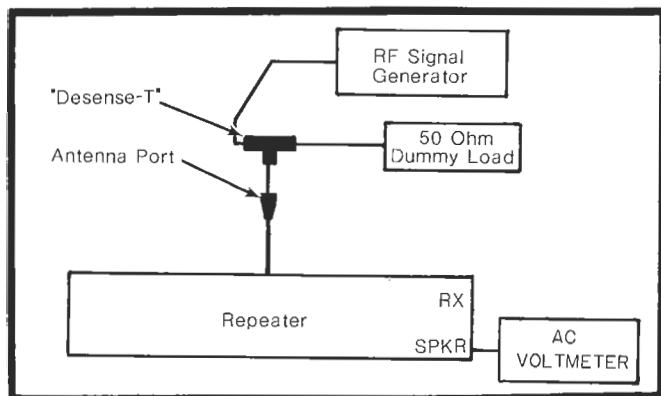


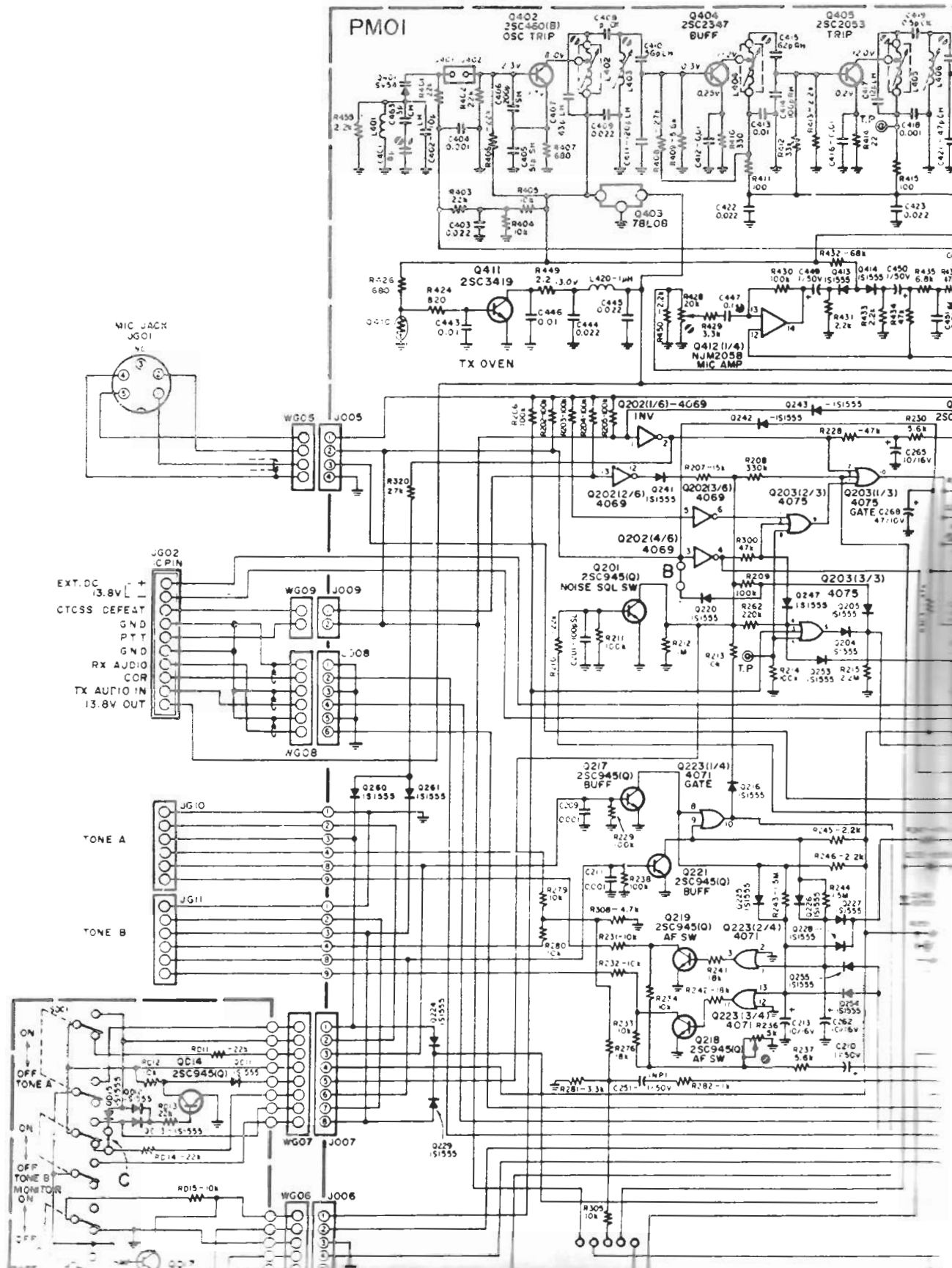
FIGURE 15. DESENSE TEST SETUP

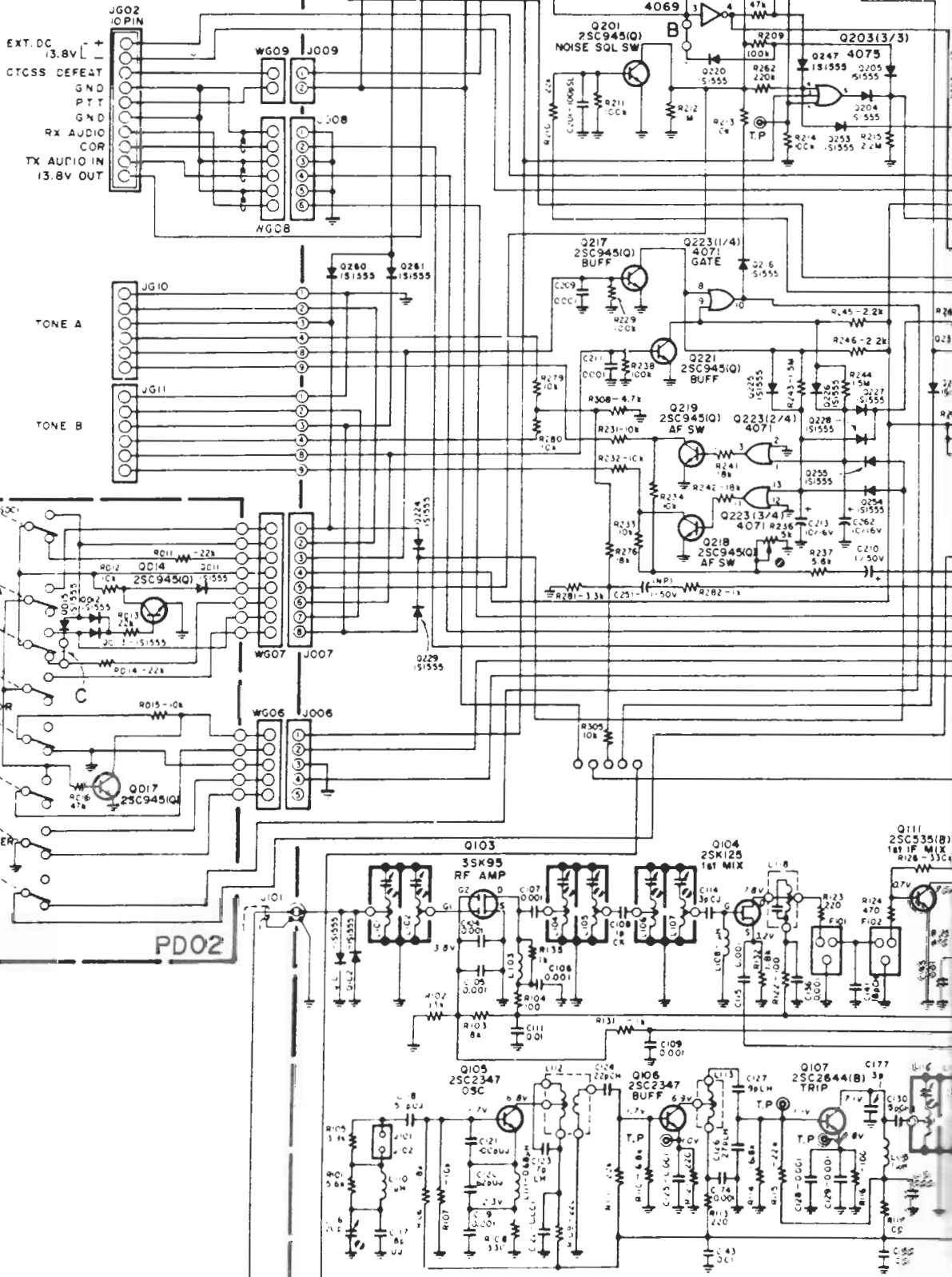
2. Set the Repeater/Base button to the base position.
  3. Connect an AC voltmeter to the speaker.
  4. Inject a sufficient signal to give 10 dB quieting. The volume control must be in the out position.
  5. Set the Repeater/Base button to the Repeater position. Receive sensitivity should not drop more than 2 dB.
-

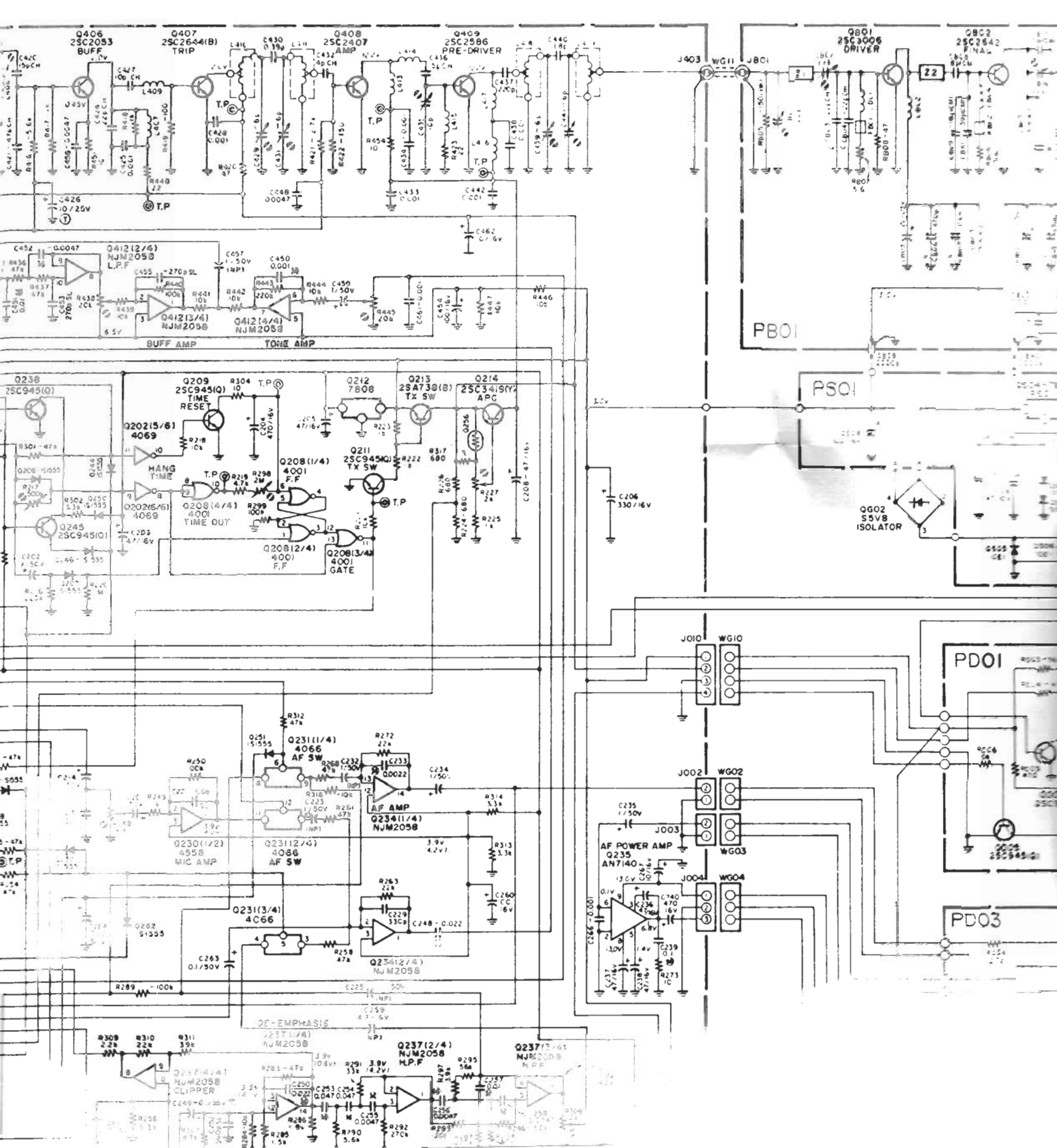


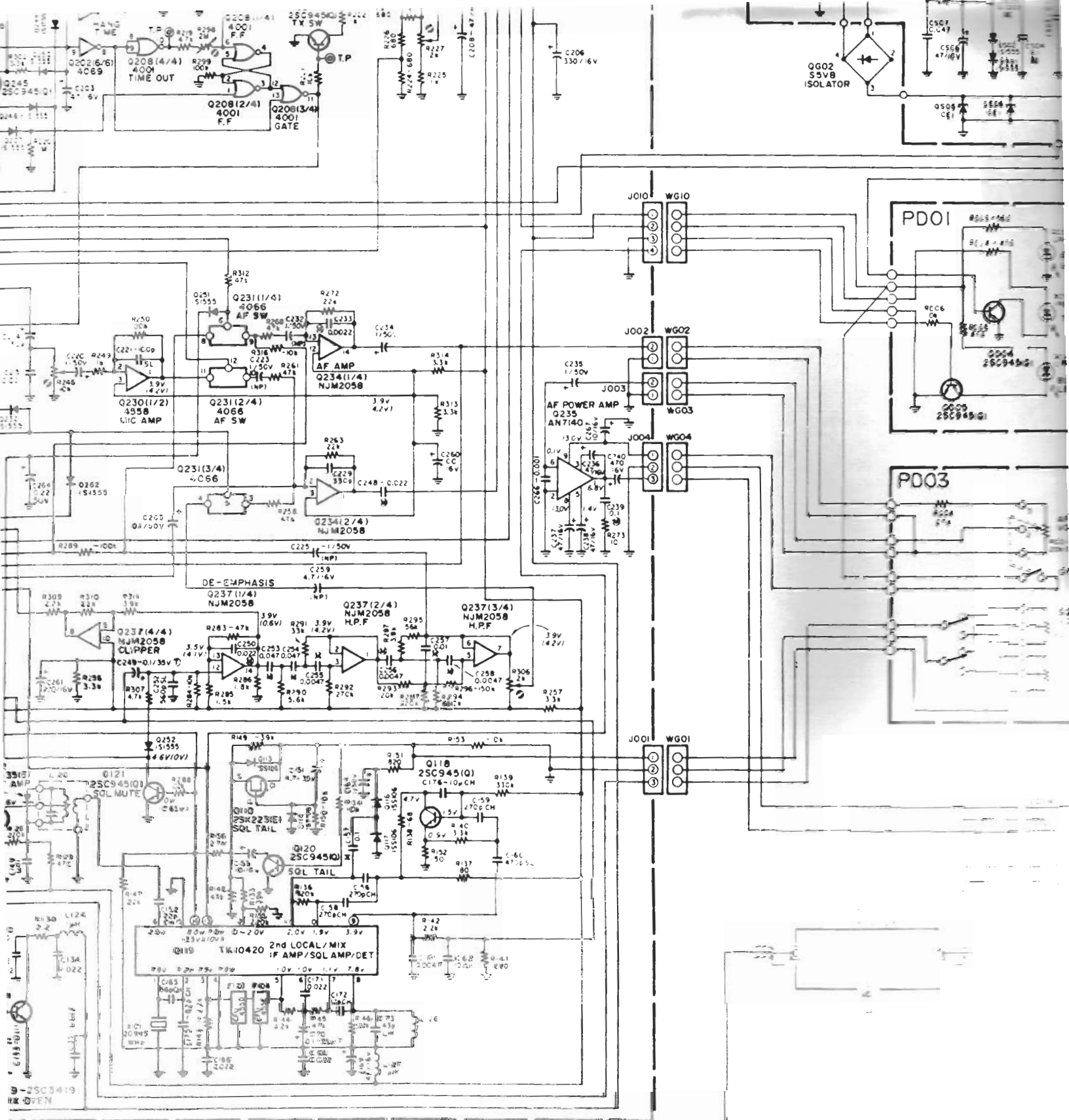
## 6.1 Drawings

The drawings in this section show the electrical and mechanical parts locations and interconnections of the RP70U. The values of most electrical parts are indicated on the schematic diagrams.

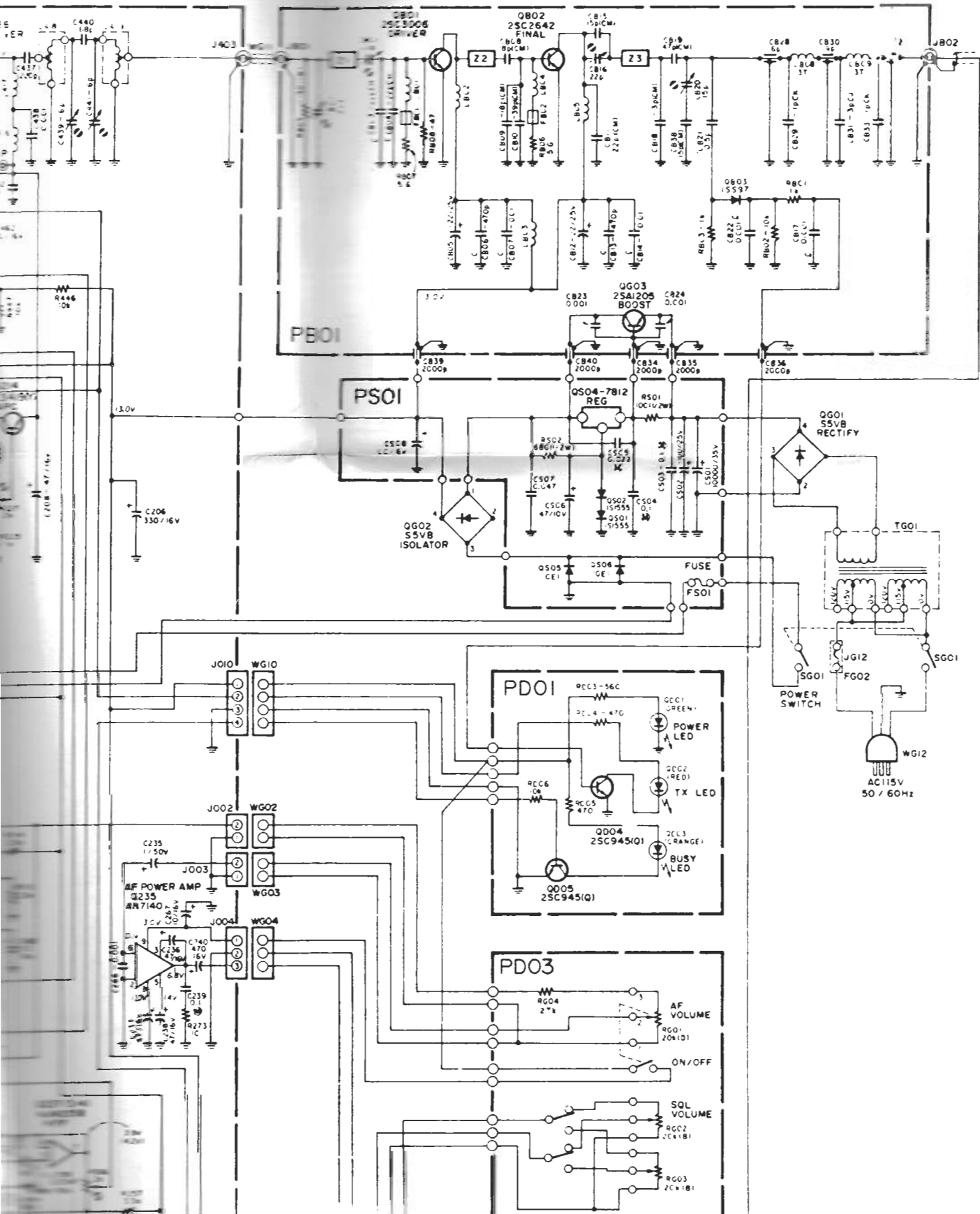








9-2SC945G  
HX-OVEN



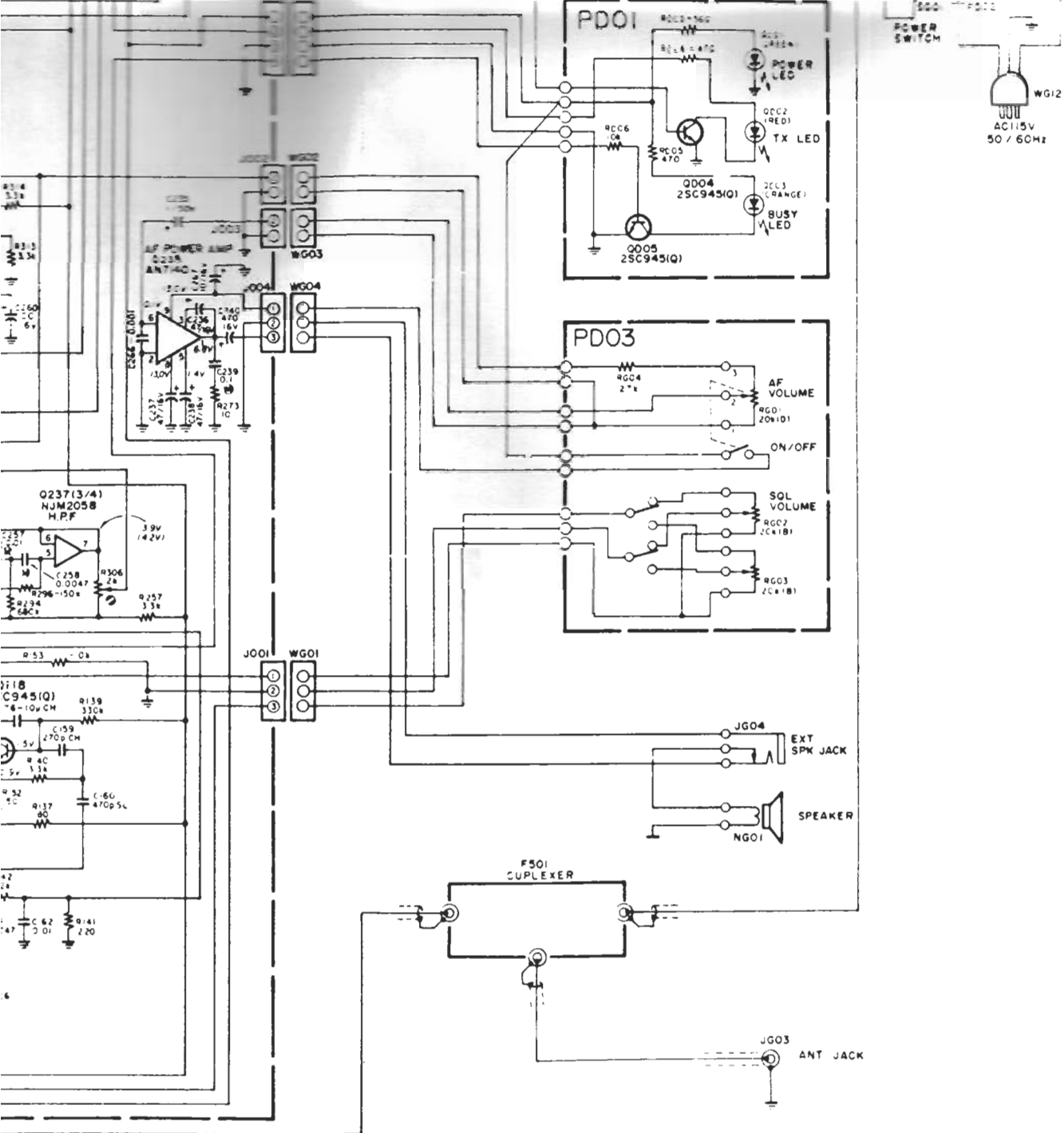
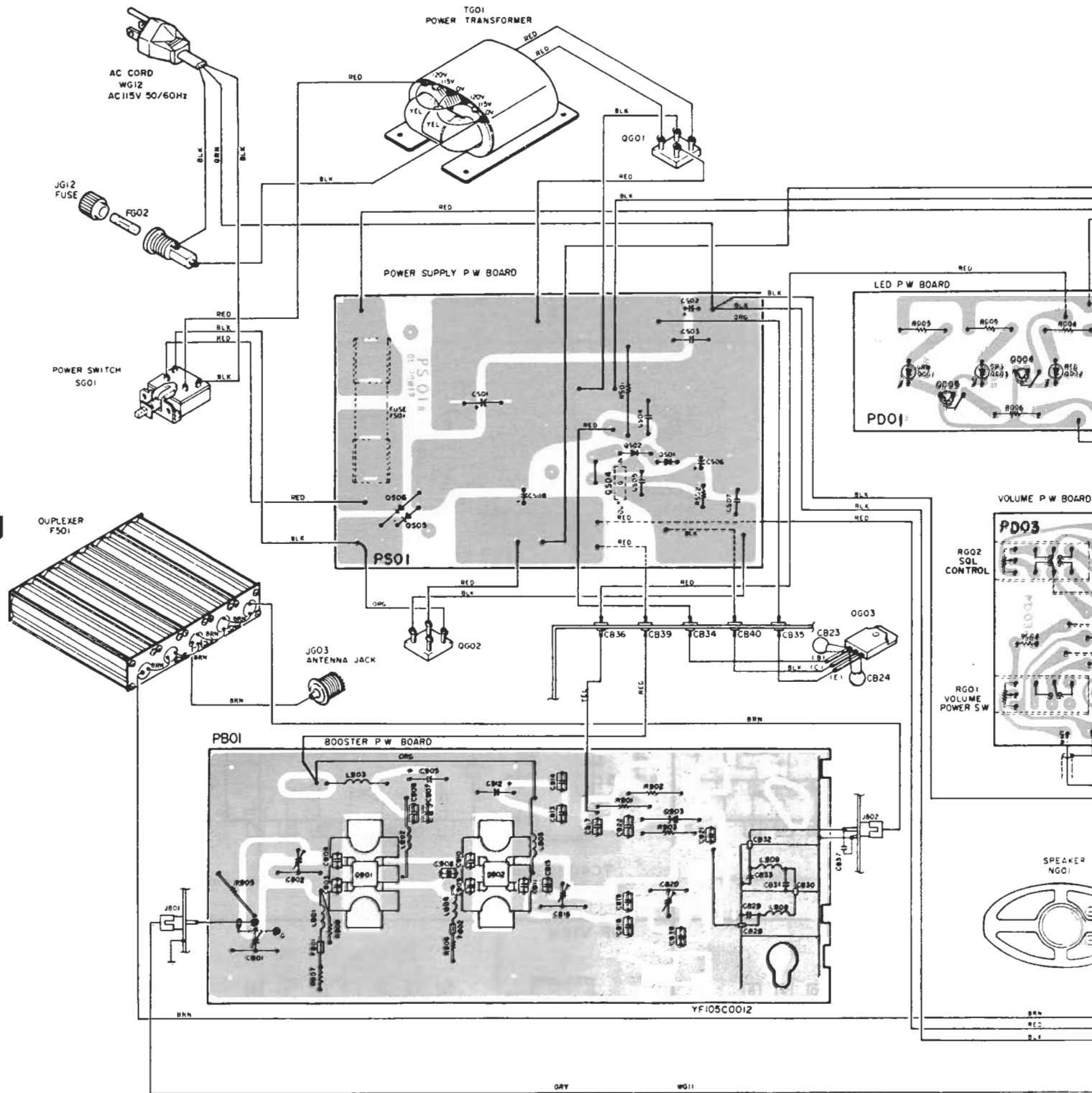


FIGURE 16. RP70U SCHEMATIC DIAGRAM



TGO1  
POWER TRANSFORMER

AC CORD  
WG12  
AC115V 50/60HZ

JG12  
FUSE  
FG02

POWER SWITCH  
SGO1

OUPLEXER  
FSO1

JG03  
ANTENNA JACK

PBO1

BOOSTER P.W. BOARD

YF105C0012

LED P.W. BOARD

PDO1

VOLUME P.W. BOARD

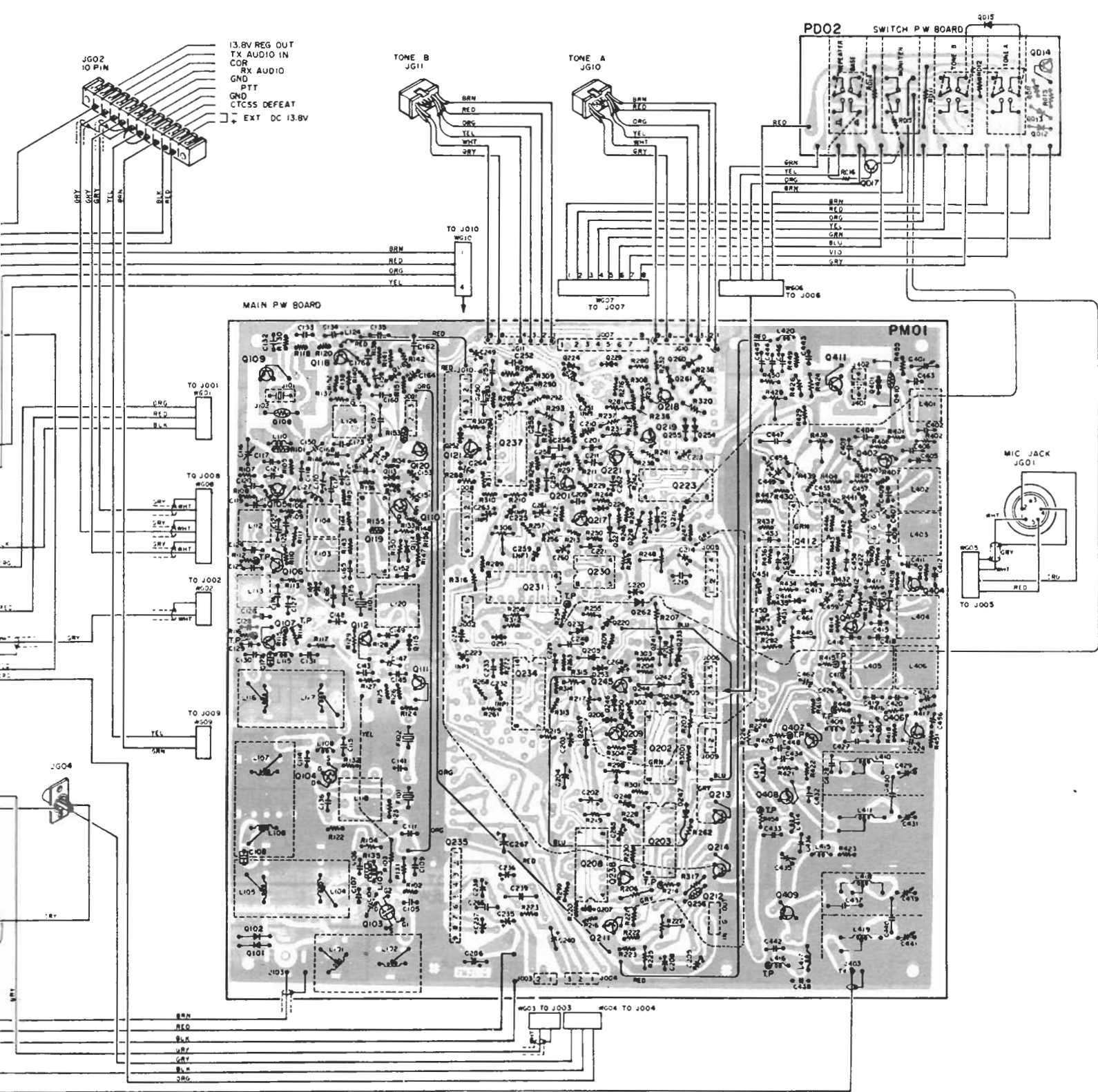
PDO3

RG02  
SQL  
CONTROL

RG01  
VOLUME  
POWER SW

SPEAKER  
NGO1





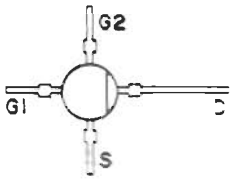
3 DIAGRAM OF RP70U(AA)

S  $\Delta$  15 P  $\Delta$  2 (0114)  
U23 LOT ~

(50) 1989 - 9 - 14 (SG)

FIGURE 17. RP70U INTERCONNECTION WIRING DIAGRAM

TOP VIEW



3SK95  
Q103



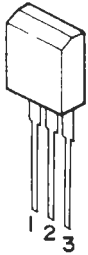
2SK125  
Q104



2SK223(E)  
Q110



2SJ74(BL)  
Q222



1. OUTPUT  
2. GND  
3. INPUT  
μPC78L08  
Q403

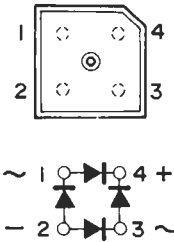


1. OUTPUT  
2. GND  
3. INPUT  
NJM7808  
Q212



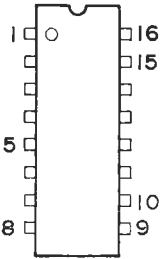
1. OUTPUT  
2. GND  
3. INPUT  
NJM7812  
Q504

TOP VIEW



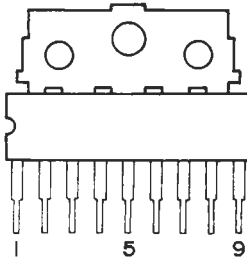
S5VB  
QG01, QG02

TOP VIEW



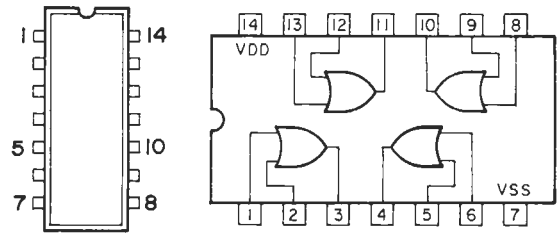
TK10420  
Q119

FRONT VIEW



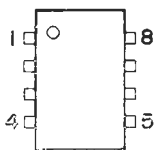
AN7140  
Q235

TOP VIEW

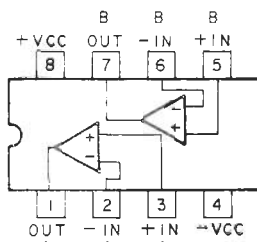


TC4071(CMOS)  
Q223

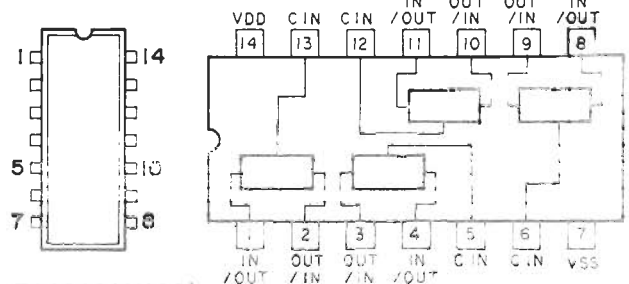
TOP VIEW



NJM4558  
Q230



TOP VIEW



TC4066(CMOS)  
Q231

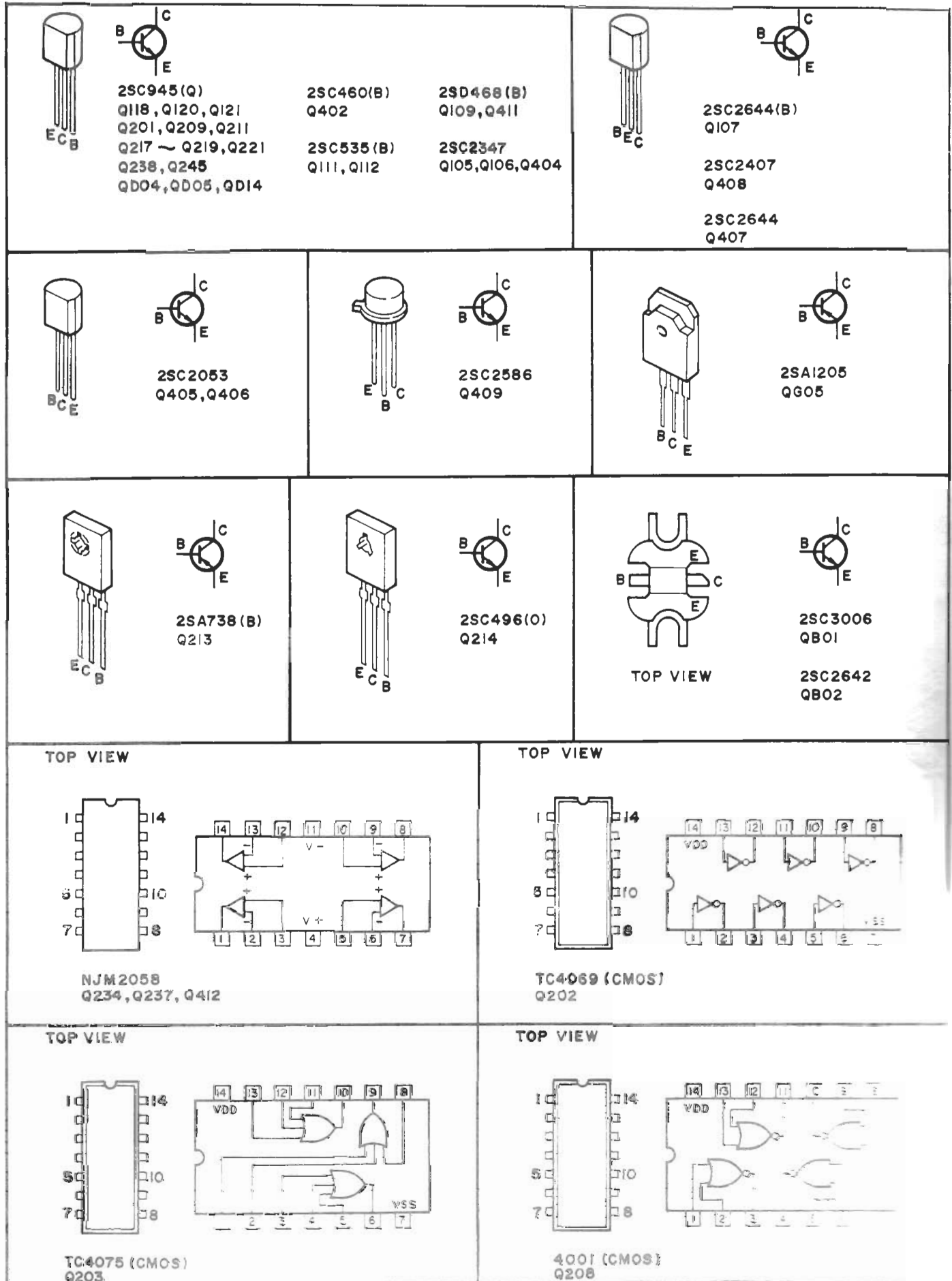
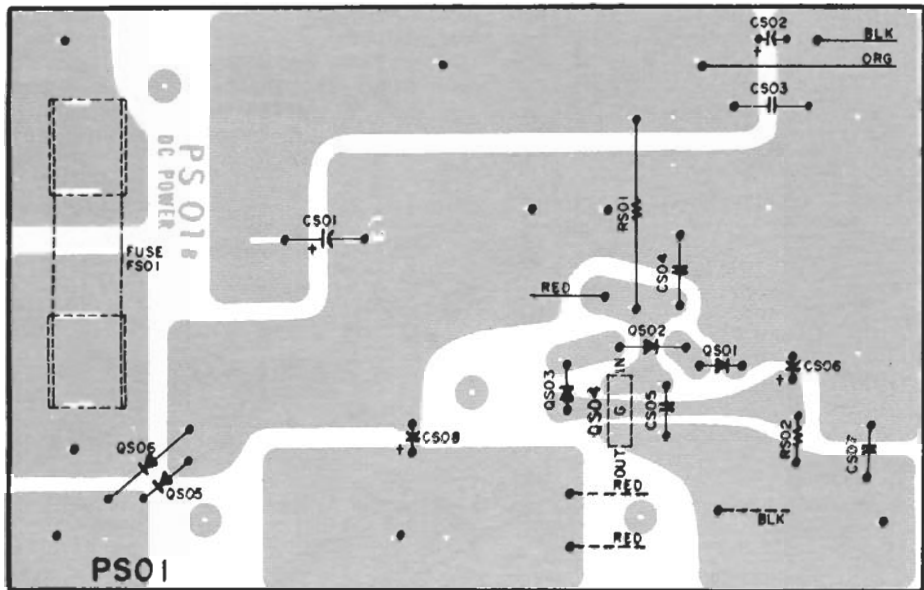


FIGURE 1 B. SEMICONDUCTOR PIN DETAIL



PB01

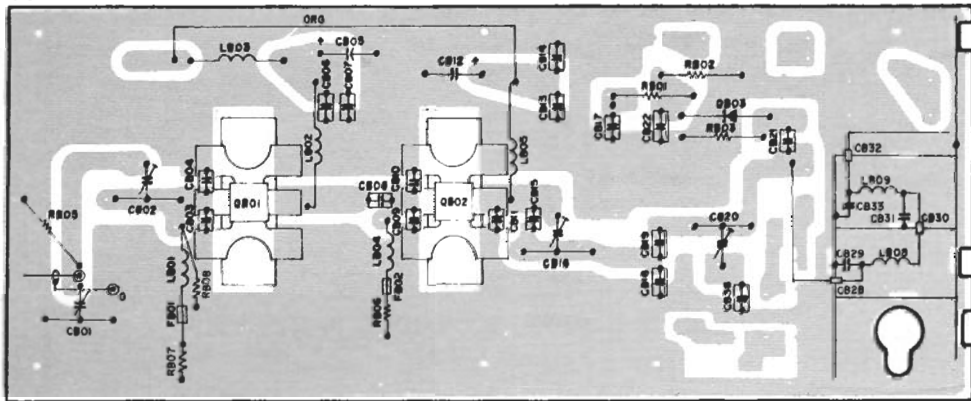


FIGURE 19. RP70U BOOSTER, POWER SUPPLY P.C. BOARDS



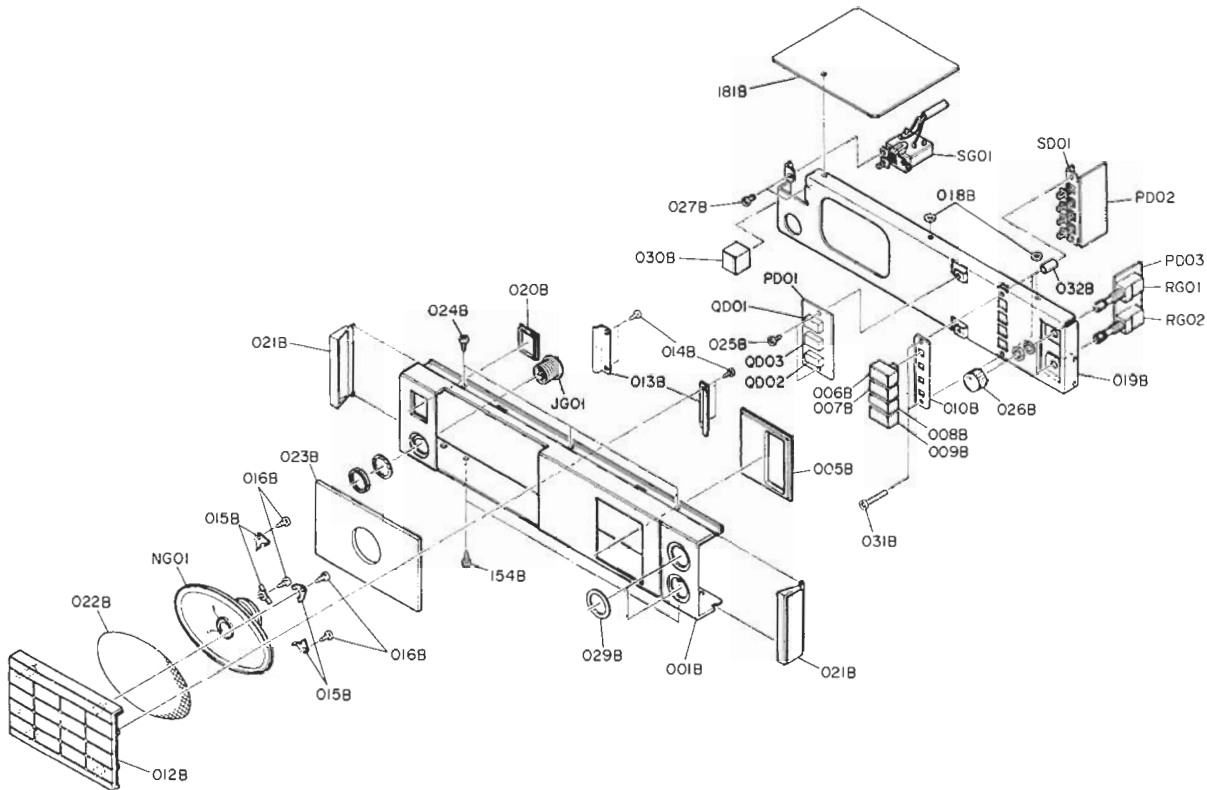


FIGURE 20-2. RP70U EXPLODED PARTS VIEW

PMOI BOTTOM VIEW

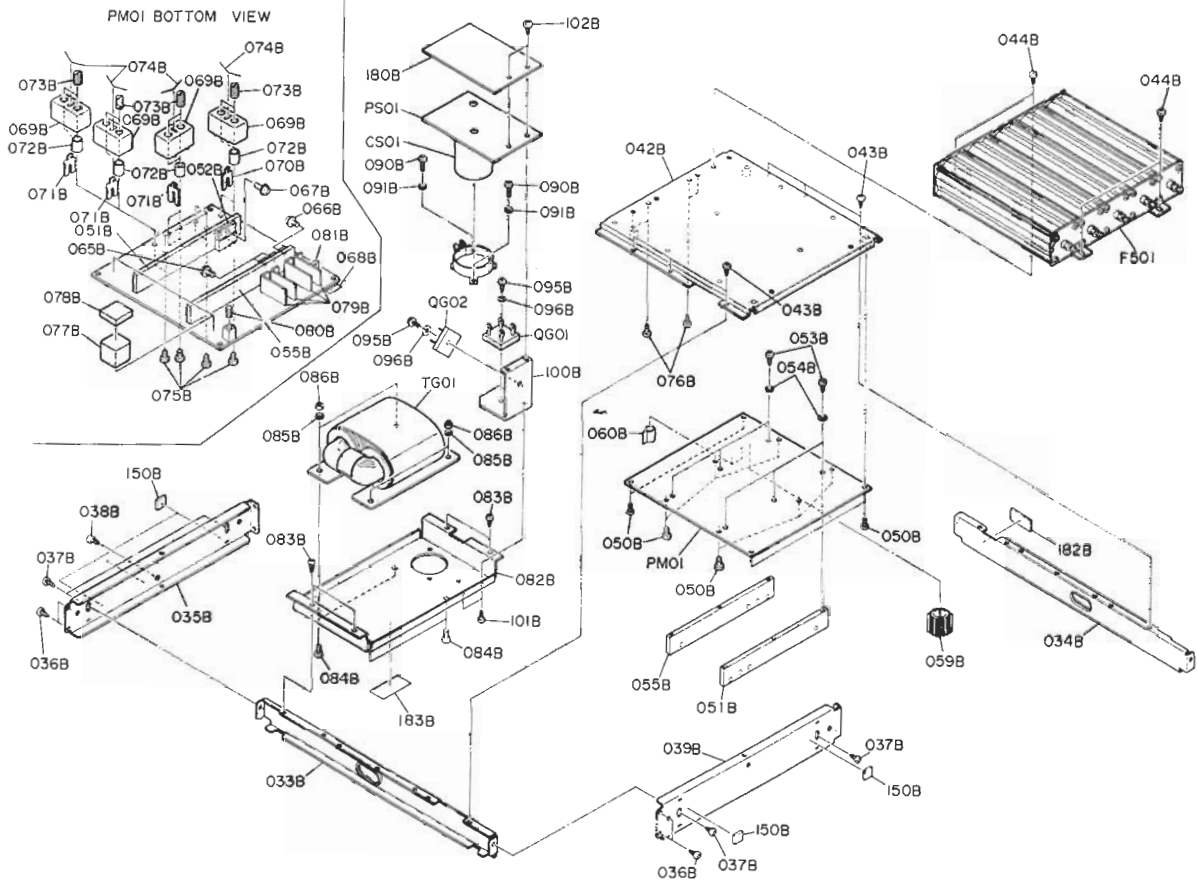


FIGURE 20-3. RP70U EXPLODED PARTS VIEW

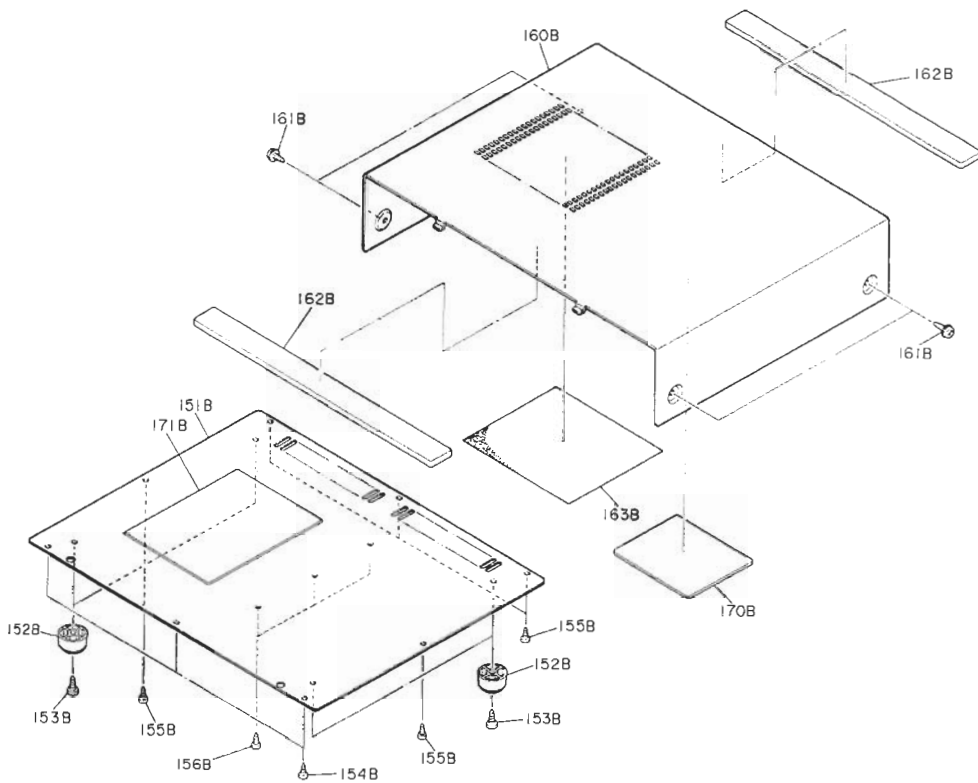


FIGURE 20-4. RP70U EXPLODED PARTS VIEW



Logic 0=S.W. ON, Logic 1=S.W. OFF						
Tone frequency (Hz)	S.W. No.					
	1	2	3	4	5	6
67.0	1	0	1	1	1	0
71.9	0	0	1	1	1	0
74.4	1	1	0	1	1	0
77.0	0	1	0	1	1	0
79.7	1	0	0	1	1	0
82.5	0	0	0	1	1	0
85.4	1	1	1	0	1	0
88.5	0	1	1	0	1	0
91.5	1	0	1	0	1	0
94.8	1	0	0	1	1	1
100.0	0	0	0	1	1	1
103.5	1	1	1	0	1	1
107.2	0	1	1	0	1	1
110.9	1	0	1	0	1	1
114.8	0	0	1	0	1	1
118.8	1	1	0	0	1	1
123.0	0	1	0	0	1	1
127.3	1	0	0	0	1	1
131.8	0	0	0	0	1	1
136.5	1	1	1	1	0	1
141.3	0	1	1	1	0	1
146.2	1	0	1	1	0	1
151.4	0	0	1	1	0	1
156.7	1	1	0	1	0	1
162.2	0	1	0	1	0	1
167.9	1	0	0	1	0	1
173.8	0	0	0	1	0	1
179.9	1	1	1	0	0	1
186.2	0	1	1	0	0	1
192.8	1	0	1	0	0	1
203.5	0	0	1	0	0	1
210.7	1	1	0	0	0	1
218.1	0	1	0	0	0	1
225.7	1	0	0	0	0	1
233.6	0	0	0	0	0	1
241.8	1	1	1	1	1	0
250.3	0	1	1	1	1	0

Frequency Cutting Chart	
67 - 120 Hz	120 - 250.3 Hz
RA25 Cut	RA23 Not Cut

FIGURE 21. TN34 PROGRAM TRUTH TABLE

## 6.2 Parts List

### 6.2.1 General

Information on most electrical and mechanical parts is included in the parts lists. The parts are listed by reference designators in alphanumeric order.

### 6.2.2 Ordering Replacement Parts

Crystal orders should be referred to the Frequency Management Department at (213)532-5300 ext. 251, or write:

Standard Communications Corp.  
Frequency Management Department  
P. O. Box 92151  
Los Angeles, CA 90009-2151

All other parts orders should be referred to the Parts Department at (213) 532-5300 ext. 248, or you may write to:

Standard Communications Corp.  
Parts Department  
P. O. Box 92151  
Los Angeles, CA 90009-2151

Please note that SCC may not be able to fill replacement parts orders without such identifying information as:

- reference designator
- value
- description
- part number
- unit model number

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
CAPACITORS				
C104			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C105			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C106			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C107			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C108			CAPACITOR, CERAMIC CHIP 1 PF	DD50010300
C109			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C111			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C114			CAPACITOR, CERAMIC 3 PF	DD10030300
C115			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C116			CAPACITOR, TRIMMING 20 PF	CT12000090
C117			CAPACITOR, CERAMIC 8 PF	DD11080360
C118			CAPACITOR, CERAMIC 51 PF	DD15510360
C119			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C120			CAPACITOR, CERAMIC 62 PF	DD15620330
C121			CAPACITOR, CERAMIC 100 PF	DD15101360
C122			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C123			CAPACITOR, CERAMIC 7 PF	DD11070310
C124			CAPACITOR, CERAMIC 22 PF	DD15220300
C125			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C126			CAPACITOR, CERAMIC 27 PF	DD15270310
C127			CAPACITOR, CERAMIC 9 PF	DD11090310
C128			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C129			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C130			CAPACITOR, CERAMIC 5 PF	DD10050300
C131			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C132			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C133			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C134			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C135			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C136			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C141			CAPACITOR, CERAMIC 18 PF	DD15180300
C143			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C145			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C147			CAPACITOR, CERAMIC 100 PF	DD15101370
C148			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C149			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C150			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C151			CAPACITOR, ELECT 4.7 UF 35V	EA47503510
C152			CAPACITOR, CERAMIC 22 PF	DD15220300
C153			CAPACITOR, ELECT 10 UF 16V	EA10601690
C156			CAPACITOR, CERAMIC 270 PF	DD15271370
C157			CAPACITOR, FILM 0.1UF 50V	DF16104310
C158			CAPACITOR, CERAMIC 270 PF	DD15271370
C159			CAPACITOR, CERAMIC 270 PF	DD15271370
C160			CAPACITOR, CERAMIC 470 PF 50V	DD15471370
C161			CAPACITOR, CERAMIC 10 PF	DD11100300
C162			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C164			CAPACITOR, ELECT 1 UF 50V	EA10505090
C165			CAPACITOR, CERAMIC 56 PF	DD15560300
C166			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C168			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C169			CAPACITOR, ELECT 47 UF 16V	EA47601690
C170			CAPACITOR, TANTALUM 0.1 UF 35V	EV10403560
C171			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C172			CAPACITOR, CERAMIC 12 PF	DD15120300
C173			CAPACITOR, CERAMIC 43 PF	DD15430310
C174			CAPACITOR, CERAMIC 0.001 UF	DK16102300

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
CAPACITORS				
C175			CAPACITOR, CERAMIC 82 PF	DD15820300
C176			CAPACITOR, CERAMIC 10 PF	DD11100300
C177			CAPACITOR, CERAMIC CHIP 3 PF	DD50030300
C201			CAPACITOR, CERAMIC 100 PF	DD15101370
C202			CAPACITOR, ELECT 1 UF 50V	EA10505090
C203			CAPACITOR, ELECT 47 UF 16V	EA47601690
C204			CAPACITOR, ELECT 470 UF 16V	EA47701690
C205			CAPACITOR, ELECT 47 UF 16V	EA47601690
C206			CAPACITOR, ELECT 330UF 16V	EA33701690
C208			CAPACITOR, ELECT 47 UF 16V	EA47601690
C209			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C210			CAPACITOR, ELECT 1 UF 50V	EA10505090
C211			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C213			CAPACITOR, ELECT 10 UF 16V	EA10601690
C214			CAPACITOR, ELECT 1 UF 50V	EA10505090
C215			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C216			CAPACITOR, ELECT 1 UF 50V	EA10505090
C217			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C218			CAPACITOR, ELECT 1 UF 50V	EA10505090
C219			CAPACITOR, CERAMIC 100 PF	DD15101300
C220			CAPACITOR, ELECT 1 UF 50V	EA10505090
C221			CAPACITOR, CERAMIC 100 PF	DD15101370
C223			CAPACITOR, ELECT 1 UF 50V	EQ10505030
C224			CAPACITOR, ELECT 1 UF 50V	EQ10505030
C225			CAPACITOR, ELECT 1 UF 50V	EQ10505030
C229			CAPACITOR, CERAMIC 330 PF	DD15331010
C232			CAPACITOR, ELECT 1 UF 50V	EQ10505030
C233			CAPACITOR, FILM 0.0022 UF 50V	DF16222310
C234			CAPACITOR, ELECT 1 UF 50V	EA10505090
C235			CAPACITOR, ELECT 1 UF 50V	EA10505090
C236			CAPACITOR, ELECT 47 UF 16V	EA47601690
C237			CAPACITOR, ELECT 47 UF 16V	EA47601690
C238			CAPACITOR, ELECT 47 UF 16V	EA47601690
C239			CAPACITOR, FILM 0.1UF 50V	DF16104310
C240			CAPACITOR, ELECT 470 UF 16V	EA47701690
C241			CAPACITOR, ELECT 1 UF 50V	EA10505090
C242			CAPACITOR, ELECT 1 UF 50V	EA10505090
C244			CAPACITOR, ELECT 22 UF 16V	EA22601690
C245			CAPACITOR, ELECT 47 UF 16V	EA47601690
C246			CAPACITOR, ELECT 470 UF 16V	EA47701610
C248			CAPACITOR, FILM 0.0022 UF	DF16223310
C249			CAPACITOR, TANTALUM 0.1 UF 35V	EV10403560
C250			CAPACITOR, FILM 0.0022 UF	DF16223310
C251			CAPACITOR, ELECT 1 UF 50V	EQ10505030
C252			CAP DISC 560PF 5% 50V	DD15561370
C253			CAPACITOR, FILM 0.047 UF 50V	DF16473310
C254			CAPACITOR, FILM 0.0047 UF	DF16472310
C254			CAPACITOR, FILM 0.047 UF 50V	DF16473310
C255			CAPACITOR, FILM 0.0047 UF	DF16472310
C256			CAPACITOR, FILM 0.0047 UF	DF16472310
C257			CAPACITOR, FILM 0.01 UF	DF16103350
C258			CAPACITOR, FILM 0.0047 UF	DF16472310
C259			CAPACITOR, ELECT. 4.7 UF 16V	EQ47501610
C260			CAPACITOR, ELECT 100UF 16V	EA10701610
C261			CAPACITOR, ELECT 220 UF 10V	EA22701010
C261			CAPACITOR, ELECT 220 UF 16V	EA22701690
C262			CAPACITOR, ELECT 10 UF 16V	EA10601690

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
CAPACITORS				
C263			CAPACITOR, ELECT 0.1 UF 50V	EA10405010
C264			CAPACITOR, ELECT 0.22 UF 50V	EJ22405010
C265			CAPACITOR, ELECT 10 UF 16V	EA10601690
C266			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C267			CAPACITOR, ELECT 10 UF 16V	EA10601690
C268			CAPACITOR, ELECT 4.7 UF 25V	EA47502590
C401			CAPACITOR, TRIMMING 8 PF	CT10800050
C402			CAPACITOR, CERAMIC 10 PF	DD11100360
C403			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C404			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C405			CAPACITOR, CERAMIC 51 PF	DD15510340
C406			CAPACITOR, CERAMIC 51 PF	DD15510340
C407			CAPACITOR, CERAMIC 43 PF	DD15430310
C408			CAPACITOR, CERAMIC 1 PF	DD10010300
C409			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C410			CAPACITOR, CERAMIC 56 PF	DD15560310
C411			CAPACITOR, CERAMIC 120 PF	DD15121310
C412			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C413			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C414			CAPACITOR, CERAMIC 100 PF	DD15101330
C415			CAPACITOR, CERAMIC 62 PF	DD15620330
C416			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C417			CAPACITOR, CERAMIC 12 PF	DD15120300
C418			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C419			CAPACITOR, CERAMIC 0.5 PF	DD10005370
C420			CAPACITOR, CERAMIC 15 PF	DD15150300
C421			CAPACITOR, CERAMIC 47 PF	DD15470300
C422			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C423			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C424			CAPACITOR, CERAMIC 22 PF	DD15220300
C425			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C426			CAPACITOR, TANTALUM 10 UF 25V	EV10602560
C427			CAPACITOR, CERAMIC 10 PF	DD11100300
C428			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C429			CAPACITOR, TRIMMING 6 PF	CT10600100
C430			CAPACITOR, MINIC 0.39 PF	DM15339510
C431			CAPACITOR, TRIMMING 6 PF	CT10600100
C432			CAPACITOR, CERAMIC 4 PF	DD10040300
C433			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C434			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C435			CAPACITOR, TRIMMING 10 PF	CT11000130
C436			CAPACITOR, CERAMIC 3 PF	DD10030300
C437			CAPACITOR, CERAMIC 220 PF	DA16221010
C438			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C439			CAPACITOR, TRIMMING 6 PF	CT10600100
C440			CAPACITOR, TUBULAR 6.8 PF	DM15068010
C441			CAPACITOR, TRIMMING 6 PF	CT10600100
C442			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C443			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C444			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C445			CAPACITOR, CERAMIC 0.022 UF	DK18223310
C446			CAPACITOR, CERAMIC 0.01 UF	DK18103300
C447			CAPACITOR, FILM 0.1UF 50V	DF16104310
C448			CAPACITOR, CERAMIC 10 PF	DD11100300
C449			CAPACITOR, ELECT 1 UF 50V	EA10505090
C450			CAPACITOR, ELECT 1 UF 50V	EA10505090
C451			CAPACITOR, FILM 0.01 UF	DF16103350

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
CAPACITORS				
C452			CAPACITOR, FILM 0.0047 UF	DF16472310
C453			CAPACITOR, CERAMIC 270 PF	DD15271370
C454			CAPACITOR, ELECT 100 UF 16V	EA10701690
C455			CAPACITOR, CERAMIC 270 PF	DD15271370
C456			CAPACITOR, CERAMIC 10 PF	DD11100300
C457			CAPACITOR, ELECT 1 UF 50V	EQ10505030
C458			CAPACITOR, FILM 0.001UF	DF16102300
C459			CAPACITOR, ELECT 1 UF 50V	EA10505090
C461			CAPACITOR, CERAMIC 0.001 UF	DK16102300
C462			CAPACITOR, ELECT 10 UF 16V	EA10601690
C463			CAPACITOR, CERAMIC 3 PF	DD10030300
INDUCTORS				
L101			COIL, AIR	MK08010010
L102			COIL, AIR	MK08010020
L103			COIL, CHOKE 5T	LC16200010
L104			COIL, AIR	MK08010020
L105			COIL, AIR	MK08010020
L106			COIL, AIR	MK08010020
L107			COIL, AIR	MK08010020
L108			COIL, CHOKE 1UH	LC11020070
L110			COIL, CHOKE 1 UH	LC11020060
L111			COIL, CHOKE 0.68 UH	LC16810040
L112			COIL, ANTENNA	LA70196140
L113			COIL, ANTENNA	LA70196140
L115			COIL, CHOKE 1UH	LC11020070
L116			COIL, AIR	MK08010030
L117			COIL, AIR	MK08010030
L118			COIL, DOUBLER	LW10187010
L120			COIL, DOUBLER	LW10187010
L124			COIL, CHOKE 1 UH	LC11020020
L126			I.F.T.	LI71016090
L127			COIL, CHOKE 1UH	LC11020070
L401			COIL, CHOKE 6.8 UH	LC16820070
L402			COIL, DOUBLER	LW10436040
L403			COIL, DOUBLER	LW10436030
L404			COIL, DOUBLER	LW10436040
L405			COIL, DOUBLER	LW10436020
L406			COIL, DOUBLER	LW10436010
L407			COIL, CHOKE 0.030 UH	LC13000050
L409			COIL, CHOKE 0.030 UH	LC13000050
L410			COIL, CHOKE 0.025 UH	LC12500060
L411			COIL, CHOKE 0.025 UH	LC12500060
L413			COIL, AIR CORE	LL635006A0
L414			COIL, CHOKE 0.050 UH	LC15000110
L415			COIL, CHOKE 0.20 UH	LC12010010
L416			COIL, CHOKE 0.20 UH	LC12010010
L417			COIL, AIR-CORE	LL635004A0
L418			COIL, CHOKE 0.025 UH	LC12500060
L419			COIL, CHOKE 0.025 UH	LC12500060
L420			COIL, CHOKE 1 UH	LC11020020

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
SEMICONDUCTORS				
Q101			DIODE, 1S1555	HD20011050
Q102			DIODE, 1S1555	HD20011050
Q104			FET 2SK125B	HF201251B0
Q105			TRANSISTOR 2SC2347	HT32347100
Q106			TRANSISTOR 2SC2347	HT32347100
Q107			TRANSISTOR 2SC2644	HT326441B0
Q108			THERMISTOR ERT-D2FFL251S	HH00020020
Q110			FET 2SK223	HF202231A0
Q111			TRANSISTOR 2SC535	HT305351B0
Q112			TRANSISTOR 2SC535	HT305351B0
Q113			DIODE, ISS106	HD20016010
Q114			DIODE, ISS106	HD20016010
Q115			DIODE, ISS106	HD20016010
Q116			DIODE, ISS106	HD20016010
Q117			DIODE, ISS106	HD20016010
Q118			TRANSISTOR 2SC945	HT309451R0
Q119			I.C. TK10420	HC10007420
Q120			TRANSISTOR 2SC945	HT309451R0
Q121			TRANSISTOR 2SC945	HT309451R0
Q201			TRANSISTOR 2SC945	HT309451R0
Q202			I.C. TC4069UBP	HC406905B0
Q203			I.C. TC4069UBP	HC406905B0
Q204			DIODE, 1S1555	HD20011050
Q205			DIODE, 1S1555	HD20011050
Q206			DIODE, 1S1555	HD20011050
Q207			DIODE, 1S1555	HD20011050
Q208			I.C. LC4001B	HC400103B0
Q209			TRANSISTOR 2SC945	HT309451R0
Q211			TRANSISTOR 2SC945	HT309451R0
Q212			I.C. NJM-7808	HC38908090
Q213			TRANSISTOR 2SA738	HT107381B0
Q214			TRANSISTOR 2SC3419	HT334191Y0
Q216			DIODE, 1S1555	HD20011050
Q217			TRANSISTOR 2SC945	HT309451R0
Q218			TRANSISTOR 2SC945	HT309451R0
Q219			RESISTOR CRBN FLM 4.7K OHM 1/4W	GD05472140
Q219			TRANSISTOR 2SC945	HT309451R0
Q220			DIODE, 1S1555	HD20011050
Q221			TRANSISTOR 2SC945	HT309451R0
Q223			I.C. TC4071BP	HC407105B0
Q224			DIODE, 1S1555	HD20011050
Q225			DIODE, 1S1555	HD20011050
Q226			DIODE, 1S1555	HD20011050
Q227			DIODE, 1S1555	HD20011050
Q228			DIODE, 1S1555	HD20011050
Q229			DIODE, 1S1555	HD20011050
Q230			I.C. RC4558	HC1RC4558S
Q231			I.C. TC4066BP	HC406605B0
Q232			DIODE, 1S1555	HD20011050
Q233			DIODE, 1S1555	HD20011050
Q234			I.C. QUAD OP. AMP NJM2058D	HC10031090
Q235			I.C. AN7140	HC10060020
Q236			I.C. AN7140	HC10060020
Q237			I.C. QUAD OP. AMP NJM2058D	HC10031090
Q238			TRANSISTOR 2SC945	HT309451R0
Q241			DIODE, 1S1555	HD20011050
Q242			DIODE, 1S1555	HD20011050

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
SEMICONDUCTORS				
Q243			DIODE, 1S1555	HD20011050
Q244			DIODE, 1S1555	HD20011050
Q245			TRANSISTOR 2SC945	HT309451R0
Q246			DIODE, 1S1555	HD20011050
Q247			DIODE, 1S1555	HD20011050
Q248			DIODE, 1S1555	HD20011050
Q250			DIODE, 1S1555	HD20011050
Q251			DIODE, 1S1555	HD20011050
Q252			DIODE, 1S1555	HD20011050
Q253			DIODE, 1S1555	HD20011050
Q254			DIODE, 1S1555	HD20011050
Q255			DIODE, 1S1555	HD20011050
Q256			THERMISTOR ERT-D2FFL251S	HH00020020
Q260	U110001		DIODE, 1S1555	HD20011050
Q261	U110001		DIODE, 1S1555	HD20011050
Q262	U110001		DIODE, 1S1555	HD20011050
Q401			VARICAP 1SV54GH	HD40019090
Q402			TRANSISTOR 2SC460	HT304601B0
Q403			I.C. UPC78L08	HC10022060
Q404			TRANSISTOR 2SC2347	HT32347100
Q405			TRANSISTOR 2SC2053	HT32053000
Q406			TRANSISTOR 2SC2053	HT32053000
Q407			TRANSISTOR 2SC2644	HT326441B0
Q408			TRANSISTOR 2SC2407	HT32407100
Q409			TRANSISTOR 2SC2586	HT32586100
Q410			THERMISTOR M2325 1K	HH00002120
Q412			I.C. QUAD OP. AMP NJM2058D	HC10031090
Q413			DIODE, 1S1555	HD20011050
Q414			DIODE, 1S1555	HD20011050

## RESISTORS

R101			RESISTOR, CHIP 5.6K OHM 1/10W	NI05562110
R102			RESISTOR, CRBN FLM 33K OHM 1/4W	GD05333140
R103			RESISTOR, CRBN FLM 18K OHM 1/4W	GD05183140
R104			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R105			RES, CARBON FILM 3.9K OHM 1/4W	GD05392140
R106			RESISTOR, CRBN FLM 18K OHM 1/4W	GD05183140
R107			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R108			RESISTOR, CRBN FLM 330 OHM 1/4W	GD05331140
R109			RESISTOR, CRBN FLM 220 OHM 1/4W	GD05221140
R110			RESISTOR CRBN FLM 6.8K OHM 1/4W	GD05682140
R111			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R112			RESISTOR, CRBN FLM 220 OHM 1/4W	GD05221140
R113			RESISTOR, CRBN FLM 220 OHM 1/4W	GD05221140
R114			RESISTOR CRBN FLM 6.8K OHM 1/4W	GD05682140
R115			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R116			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R117			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R118			RESISTOR, CRBN FLM 820 OHM 1/4W	GD05821140
R120			RESISTOR, CRBN FLM 680 OHM 1/4W	GD05681140
R122			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R123			RESISTOR, CRBN FLM 220 OHM 1/4W	GD05221140
R124			RESISTOR, CRBN FLM 470 OHM 1/4W	GD05471140
R125			RESISTOR, CRBN FLM 470 OHM 1/4W	GD05471140
R126			RES, CARBON FILM 330K OHM 1/4W	GD05334140



REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
RESISTORS				
R127			RESISTOR, CRBN FLM 470 OHM 1/4W	GD05471140
R128			RESISTOR CRBN FLM 220K OHM 1/4W	GD05224140
R129			RESISTOR, CRBN FLM 470 OHM 1/4W	GD05471140
R138			RESISTOR, CRBN FLM 68 OHM 1/4W	GD05680140
R130			RESISTOR,CRBN FLM 2.2OHM 1/4W	GD05022140
R131			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R132			RES, CARBON FILM 1.8K OHM 1/4W	GD05182140
R133			RESISTOR, CRBN FLM 39K OHM 1/4W	GD05393140
R134			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R135			RESISTOR, CHIP 1K OHM 1/8W	RI05102180
R136			RESISTOR, CRBN FLM 820K OHM 1/4	GD05824140
R137			RESISTOR, CRBN FLM 180 OHM 1/4W	GD05181140
R139			RES, CARBON FILM 330K OHM 1/4W	GD05334140
R140			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R141			RESISTOR, CRBN FLM 220 OHM 1/4W	GD05221140
R142			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R143			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R144			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R145			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R146			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R147			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R148			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R149			RESISTOR, CRBN FLM 39K OHM 1/4W	GD05393140
R150			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R151			RESISTOR,CRBN FLM 820 OHM 1/4W	GD05821140
R152			RESISTOR, CRBN FLM 150 OHM 1/4W	GD05151140
R153			RESISTOR, CHIP 10K OHM 1/8W	RI05103180
R155			RESISTOR, CHIP 220K OHM 1/8W	RI05224180
R202			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R203			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R204			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R205			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R206			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R207			RESISTOR, CRBN FLM 15K OHM 1/4W	GD05153140
R208			RES, CARBON FILM 330K OHM 1/4W	GD05334140
R209			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R210			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R211			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R212			RESISTOR, CRBN FLM 1M OHM 1/4W	GD05105140
R213			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R214			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R215			RES, CARBON FILM 2.2M OHM 1/4W	GD05225140
R216			RES, CARBON FILM 2.2M OHM 1/4W	GD05225140
R217			RESISTOR, TRIMMING 500K OHM	RA05040150
R218			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R219			RESISTOR CRBN FLM 4.7K OHM 1/4W	GD05472140
R220			RESISTOR, CRBN FLM 1M OHM 1/4W	GD05105140
R221			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R222			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R223			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R224			RESISTOR, CRBN FLM 680 OHM 1/4W	GD05681140
R225			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R226			RESISTOR, CRBN FLM 680 OHM 1/4W	GD05681140
R227			RESISTOR, TRIMMING 2.2K OHM	RA02220190
R228			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R229			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R230			RESISTOR,CRBN FLM 5.6K OHM 1/4	GD05562140

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
RESISTORS				
R231			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R232			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R233			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R234			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R236		U110001	RESISTOR, TRIMMING 5K OHM	RA05020350
R237		U120001	RESISTOR, CRBN FLM 5.6K OHM 1/4	GD05562140
R238			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R241			RESISTOR, CRBN FLM 18K OHM 1/4W	GD05183140
R242			RESISTOR, CRBN FLM 18K OHM 1/4W	GD05183140
R243			RESISTOR, CRBN FLM 1.5M 1/4W	GD05155140
R244			RESISTOR, CRBN FLM 1.5M 1/4W	GD05155140
R245			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R246			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R247			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R248			RESISTOR, TRIMMING 10K OHM	RA01030070
R249			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R250			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R251			RESISTOR, TRIMMING 10K OHM	RA01030070
R254			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R255			RESISTOR CRBN FLM 4.7K OHM 1/4W	GD05472140
R256			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R257			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R258			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R261			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R262			RESISTOR CRBN FLM 220K OHM 1/4W	GD05224140
R263			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R268			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R272			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R273		U120001	RESISTOR, CRBN FLM 10 OHM 1/4W	GD05100140
R274			RESISTOR, TRIMMING 10K OHM	RA01030070
R276			RESISTOR, CRBN FLM 18K OHM 1/4W	GD05183140
R279			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R280			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R281			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R282			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R283			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R284			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R285			RESISTOR CRBN FLM 1.5K OHM 1/4W	GD05152140
R286			RES, CARBON FILM 1.8K OHM 1/4W	GD05182140
R287			RESISTOR CRBN FLM 220K OHM 1/4W	GD05224140
R288			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R289			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R290			RESISTOR, CRBN FLM 5.6K OHM 1/4	GD05562140
R291			RESISTOR, CRBN FLM 33K OHM 1/4W	GD05333140
R292			RES CF 270K 5% 1/4W	GD05274140
R293			RESISTOR CRBN FLM 120K OHM 1/4W	GD05124140
R294			RES CF 680K 5% 1/4W	GD05684140
R295			RESISTOR, CRBN FLM 56K OHM 1/4W	GD05563140
R297			RES, CARBON FILM 3.9K OHM 1/4W	GD05392140
R298			RESISTOR, TRIMMING 2M OHM	RA02050010
R299			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R300			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R301			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R302			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R303			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R304			RESISTOR, CRBN FLM 10 OHM 1/4W	GD05100140
R305			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
RESISTORS				
R306			RESISTOR, TRIMMING 2.2K OHM	RA02220190
R307			RESISTOR CRBN FLM 4.7K OHM 1/4W	GD05472140
R308			RESISTOR CRBN FLM 4.7K OHM 1/4W	GD05472140
R309			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R310			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R311			RES, CARBON FILM 3.9K OHM 1/4W	GD05392140
R312			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R313			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R314			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R316			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R317			RESISTOR, CRBN FLM 680 OHM 1/4W	GD05681140
R320		U110001	RESISTOR CRBN FLM 27K OHM 1/6W	GD05273160
R401			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R402		U230001	RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R403			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R404			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R405			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R406			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
R407			RESISTOR, CRBN FLM 680 OHM 1/4W	GD05681140
R408			RESISTOR, CRBN FLM 27K OHM 1/4W	GD05273140
R409			RESISTOR, CRBN FLM 5.6K OHM 1/4	GD05562140
R410			RESISTOR, CRBN FLM 330 OHM 1/4W	GD05331140
R411			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R412			RESISTOR, CRBN FLM 330 OHM 1/4W	GD05331140
R413			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R414			RESISTOR, CRBN FLM 22 OHM 1/4W	GD05220140
R415			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R416			RESISTOR, CRBN FLM 5.6K OHM 1/4	GD05562140
R417			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R418			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
R419			RESISTOR, CRBN FLM 100 OHM 1/4W	GD05101140
R420			RES MO 47 OHM 5% 1/2W	NK05470120
R421			RES, CARBON FILM 2.7K OHM 1/4W	GD05272140
R422			RESISTOR, CRBN FLM 150 OHM 1/4W	GD05151140
R423			RESISTOR, CRBN FLM 22 OHM 1/4W	GD05220140
R424			RESISTOR, CRBN FLM 820 OHM 1/4W	GD05821140
R426			RESISTOR, CRBN FLM 680 OHM 1/4W	GD05681140
R428			RESISTOR, TRIMMING 22K OHM	RA02230040
R429			RESISTOR CRBN FLM 3.3K OHM 1/4W	GD05332140
R430			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R431			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R432			RES CF 68K 5% 1/4W	GD05683140
R433			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R434			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R435			RESISTOR CRBN FLM 6.8K OHM 1/4W	GD05682140
R436			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R437			RESISTOR, CRBN FLM 47K OHM 1/4W	GD05473140
R438			RESISTOR, TRIMMING 22K OHM	RA02230040
R439			RESISTOR, TRIMMING 22K OHM	RA02230040
R440			RES, CARBON FILM 100K OHM 1/4W	GD05104140
R441			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R442			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R443			RESISTOR CRBN FLM 220K OHM 1/4W	GD05224140
R444			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R445			RESISTOR, TRIMMING 22K OHM	RA02230040
R446			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
R447			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
RESISTORS				
R448			RESISTOR, CRBN FLM 22 OHM 1/4W	GD05220140
R449			RESISTOR, CRBN FLM 2.2OHM 1/4W	GD05022140
R450			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
R451			RESISTOR, CRBN FLM 10 OHM 1/4W	GD05100140
R454			RESISTOR, CRBN FLM 10 OHM 1/4W	GD05100140
R455			RESISTOR CRBN FLM 2.2K OHM 1/4W	GD05222140
MISCELLANEOUS ELECTRICAL				
F101			CRYSTAL FILTER 21.4 MHZ	XU421400N5
F102			CRYSTAL FILTER 21.4 MHZ	XU421400N5
F103			FILTER, CERAMIC 455D KHZ	FG455304D0
J001			JACK	YJ07001400
J002			JACK	YJ07001390
J003			JACK	YJ07001390
J004			JACK	YJ07001400
J005			JACK	YJ07001410
J006			JACK	YJ07001420
J007			JACK	YJ07001400
J008			JACK	YJ07001440
J009			JACK	YJ07001390
J010			JACK	YJ07001410
J101			JACK	YJ03000040
J102			JACK	YJ03000040
J103			JACK	YJ03000040
J401			JACK	YJ03000040
J402			JACK	YJ03000040
J403			JACK	YJ07000360

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
CAPACITORS				
CB01			CAPACITOR, TRIMMING 22 PF	CT12200010
CB02			CAPACITOR, TRIMMING 22 PF	CT12200010
CB03			CAPACITOR, CERAMIC CHIP 22 PF	DD45220300
CB04			CAPACITOR, CERAMIC CHIP 22 PF	DD45220300
CB05			CAPACITOR, ELECT 22 UF 25V	EA22602590
CB06			CAPACITOR, CERAMIC CHIP 470 PF	DK46471300
CB07			CAPACITOR, CERAMIC CHIP 0.01 UF	DK46103300
CB08			CAPACITOR, MICA 18 PF	DF95180500
CB09			CAPACITOR, MICA 18 PF	DF95180500
CB10			CAPACITOR, MICA 39 PF	DF95390500
CB11			CAPACITOR, MICA 22 PF	DF95220500
CB12			CAPACITOR, ELECT 22 UF 25V	EA22602590
CB13			CAPACITOR, CERAMIC CHIP 470 PF	DK46471300
CB14			CAPACITOR, CERAMIC CHIP 0.01 UF	DK46103300
CB15			CAPACITOR, MICA 15 PF	DF95150500
CB16			CAPACITOR, TRIMMING 22 PF	CT12200010
CB17			CAPACITOR, CERAMIC CHIP 0.001UF	DK46102300
CB18			CAPACITOR, MICA 3 PF	DF90030500
CB19			CAPACITOR, MICA 47 PF	DF95470500
CB20			CAPACITOR, VARIABLE 15 PF	CM11500020
CB21			CAPACITOR, CERAMIC CHIP 0.5 PF	DD40005300
CB22			CAPACITOR, CERAMIC CHIP 0.001UF	DK46102300
CB23			CAPACITOR, CERAMIC 0.001 UF	DK16102300
CB24			CAPACITOR, CERAMIC 0.001 UF	DK16102300
CB28			CAPACITOR, FEEDTHRU 6 PF	DC11060010
CB29			CAPACITOR, CERAMIC 1 PF	DD10010300
CB30			CAPACITOR, FEEDTHRU 9 PF	DC11090010
CB31			CAPACITOR, CERAMIC 3 PF	DD10030300
CB32			CAPACITOR, FEEDTHRU 9 PF	DC11090010
CB33			CAPACITOR, CERAMIC 1 PF	DD10010300
CB34			CAPACITOR, FEEDTHRU 2000 PF	DC18202060
CB35			CAPACITOR, FEEDTHRU 2000 PF	DC18202060
CB36			CAPACITOR, FEEDTHRU 2000 PF	DC18202060
CB38			CAPACITOR, MICA 15 PF	DF95150500
CB39			CAPACITOR, FEEDTHRU 2000 PF	DC18202060
CB40			CAPACITOR, FEEDTHRU 2000 PF	DC18202060
INDUCTORS				
LB01			COIL, CHOKE 0.20 UH	LC12010010
LB02			COIL, CHOKE 0.025 UH	LC12500040
LB03			COIL, CHOKE 0.20 UH	LC12010010
LB04			COIL, CHOKE 0.20 UH	LC12010010
LB05			COIL, CHOKE 0.025 UH	LC12500040
LB08			COIL, CHOKE 0.070 UH	LC17000110
LB09			COIL, CHOKE 0.070 UH	LC17000110
SEMICONDUCTORS				
QB03			DIODE 1SS16	HD20005060
QG03			TRANSISTOR 2SA1205	HT11205100

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
RESISTORS				
RB01			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
RB02			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
RB03			RESISTOR, CRBN FLM 1K OHM 1/4W	GD05102140
RB05			RESISTOR,MTL OXD FLM 150 OHM 1W	GJ05151010
RB06			RES CF 5.6 OHM 5% 1/4W	GD05056140
RB07			RES CF 5.6 OHM 5% 1/4W	GD05056140
RB08			RESISTOR, CRBN FLM 47 OHM 1/4W	GD05470140

## MISCELLANEOUS ELECTRICAL

FB01			CORE, FERRITE	FC90050010
FB02			CORE, FERRITE	FC90050010

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
CAPACITORS				
CS01			CAPACITOR, ELECT. 10000 UF 35V	EC10903520
CS02			CAPACITOR, ELECT 100 UF 25V	EA10702590
CS03			CAPACITOR, FILM 0.1UF 50V	DF16104310
CS04			CAPACITOR, FILM 0.1UF 50V	DF16104310
CS05			CAPACITOR, FILM 0.0022 UF	DF16223310
CS06			CAPACITOR, ELECT 47 UF 10V	EA47601010
CS07			CAPACITOR, CERAMIC 0.047 UF	DK18473310
CS08			CAPACITOR, ELECT 100 UF 16V	EA10701690
SEMICONDUCTORS				
QS01			DIODE, 1S1555	HD20011050
QS02			DIODE, 1S1555	HD20011050
QS04			I.C. UPC7812H	HC10043060
QS07			DIODE 10E1	HD20023100
QS08			DIODE 10E1	HD20023100
RESISTORS				
RG04			RESISTOR, CRBN FLM 27K OHM 1/4W	GD05273140
RS01			RESISTOR, METAL 100 OHM 1/2W	NK15101120
RS02			RESISTOR, METAL 680 OHM 1/2W	NK15681120
MISCELLANEOUS ELECTRICAL				
FS01			FUSE, 6 AMP	FS10600600

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
RESISTORS				
RD03			RESISTOR, CRBN FLM 560 OHM 1/4W	GD05561140
RD04			RESISTOR, CRBN FLM 470 OHM 1/4W	GD05471140
RD05			RESISTOR, CRBN FLM 470 OHM 1/4W	GD05471140
RD06			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140



REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
SEMICONDUCTORS				
QD11			DIODE, 1S1555	HD20011050
QD12			DIODE, 1S1555	HD20011050
QD13			DIODE, 1S1555	HD20011050
QD14			TRANSISTOR 2SC945	HT309451R0
QD15			DIODE, 1S1555	HD20011050
RESISTORS				
RG01			RESISTOR, VARIABLE 20K OHM	RB12030130
RG02			RESISTOR, VARIABLE 20K OHM	RB12030050
RG03			RESISTOR, TRIMMING 22K OHM	RA02230160
MISCELLANEOUS ELECTRICAL				
SD01			SWITCH, PUSH E1501392M	SP02040320
WG01			CONNECTIVE CORD	YB00320150

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
SEMICONDUCTORS				
QD01			LED LD603VR	HI10027210
QD02			LED LD603DU	HI10028210
QD03			LED LD603MG	HI10026210
QD04			TRANSISTOR 2SC945	HT309451R0
QD05			TRANSISTOR 2SC945	HT309451R0
QD17			TRANSISTOR 2SC945	HT309451R0
RESISTORS				
RD11			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
RD12			RESISTOR, CRBN FLM 10K OHM 1/4W	GD05103140
RD13			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
RD14			RESISTOR, CRBN FLM 22K OHM 1/4W	GD05223140
RD15			RESISTOR CRBN FLM 100K OHM 1/6W	GD05104160
RD16			RESISTOR CRBN FLM 47K OHM 1/6W	GD05473160
MISCELLANEOUS ELECTRICAL				
WG06			CONNECTIVE CORD	YB00330060
WG07			CONNECTIVE CORD	YB00250320

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
MISCELLANEOUS ELECTRICAL				
FG02			FUSE, 3A	FS10300500
F501		U130001	ASSY., DUPLEXER	ZK269Z001R
JG02			JACK	YJ01001860
JG03			JACK, ANTENNA PANEL MOUNT	YJ10001580
JG04			TERMINAL	YT02010080
JG10			JACK, 9P FOR TN15	YJ10000520
JG11			JACK, 9P FOR TN15	YJ10000520
JG12			JACK, FUSEHOLDER	YJ08000120
JS01			JACK	YJ08000170
JS02			JACK	YJ08000170
SG01			SWITCH, PUSH	SP02011340
WG02			CONNECTIVE CORD	YB00380110
WG05			CONNECTIVE CORD	YB00330060
WG08			CONNECTIVE CORD	YB00400450
WG12			POWER CORD, AC	YC02000180

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
MISCELLANEOUS MECHANICAL				
006B			KNOB	135H154200
007B			KNOB	135H154210
008B			KNOB	135H154220
009B			KNOB	135H154220
010B			GUIDE	269Z051010
014B			B.H. TAP. SCREW	51282606B0
019B			BRACKET	269Z160060
026B			KNOB	218C154040
027B			B.H.M. SCREW	51100306A9
030B			KNOB	415H154130
031B			B.H.M. SCREW	51100318A9
032B			COLLAR	269Z055010
033B			BRACKET	122C160020
039B		U120001	BRACKET, LEFT SIDE	122C160170
042B			BRACKET	269Z160010
051B			HEATSINK	269Z267010
053B			B.H.M. SCREW	51100308B9
054B			T.L. WASHER OR	54050300R0
059B			HEATSINK	107C267020
076B			B.H.M. SCREW	51102606B0
077B			BUFFER	101C056010
078B			BUFFER	269Z056010
082B			BRACKET	269Z160020
083B			B.H. TAP. SCREW	51280306B0
084B			B.H.M. SCREW	51100408B9
085B			SPRING WASHER	54040402A0
086B			NUT, HEXAGON	53110403A9
091B			WASHER	54020301A0
096B			SPRING WASHER	54040302A0
100B			BRACKET	269Z160040
101B			B.H. TAP. SCREW	51280306B0
102B			B.H. TAP. SCREW	51280306B0
111B			COVER, REAR BRACKET	122C053010
115B			B.H.M. SCREW	51100308S9
116B			HEXAGON NUT	53110303A9
120B			BUSHING	1455259080
122B			SHIELD	101C109220
123B			BRACKET, ANT	269Z160030
124B			SCREW, B.H. TAP.	51280306U0
125B			HEATSINK, MAIN	122C267090
150B			BUFFER	122C056020
151B			LID, BOTTOM	122C257060
152B			LEG	2908057010
153B			B.H. TAP. SCREW	51280412U0
180B			INSULATOR, PWR BRD	269Z120050
181B			INSULATOR, PWR SW	269Z120060
182B			INSULATOR, FUSE	005C120020

REF DES	MODEL EFF	SERIAL NO EFFECTIVITY	DESCRIPTION	PART NUMBER
MISCELLANEOUS ELECTRICAL				
PB01			ASSY., BOOSTER PWB	ZZ269Z0020
PD01			ASSY., LED PWB	ZZ269Z142R
PD02			ASSY., SWITCH PWB	***ZZ269Z143R
PD03			ASSY., VOLUME/SQUELCH PWB	ZZ269Z141R
PM01			ASSY., MAIN PCB	ZZ269Z001R
PS01			ASSY., POWER SUPPLY PWB	ZZ269Z144R

