# OPERATION & MAINTENANCE MANUAL

# KACHINA MODEL MP-25(E)

# HF/SSB MANPACK TRANSCEIVER

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KACHINA MODEL MP-25 (E)
HF/SSB MANPACK TRANSCEIVER
828012 REVISION 8/95

ALSO APPLICABLE TO
SCIENTIFIC RADIO SYSTEMS
SR-MP-25

OPERATION & MAINTENANCE MANUAL
SERVICE MANUAL
OPERATION MANUAL
WITH DIAGRAMS AND SCHEMATICS

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## CHAPTER 5 - MAINTENANCE AND ALIGNMENT



## CHAPTER 6 - TROUBLE SHOOTING



## DIAGRAMS AND CHARTS

**FIGURE#**


MHz
KHz
X100 X10 X1 X.1
BAT. READ
LOW PWR.
Scientific Radio Systems, Inc.
Rochester, NY U.S.A.
PORT.
MOB.
DIPOLE
ANT. TUNE
VOLUME
USB
LSB
AM
CW
TUNE
CLA.
SR-MP-25
SR SYSTEMS
ON
SPEAKER
Made in U.S.A.
SR-MP-25-PSC
CABLE STORE
AC ON
AC 115/220
115V
CHARGE
BATTERY
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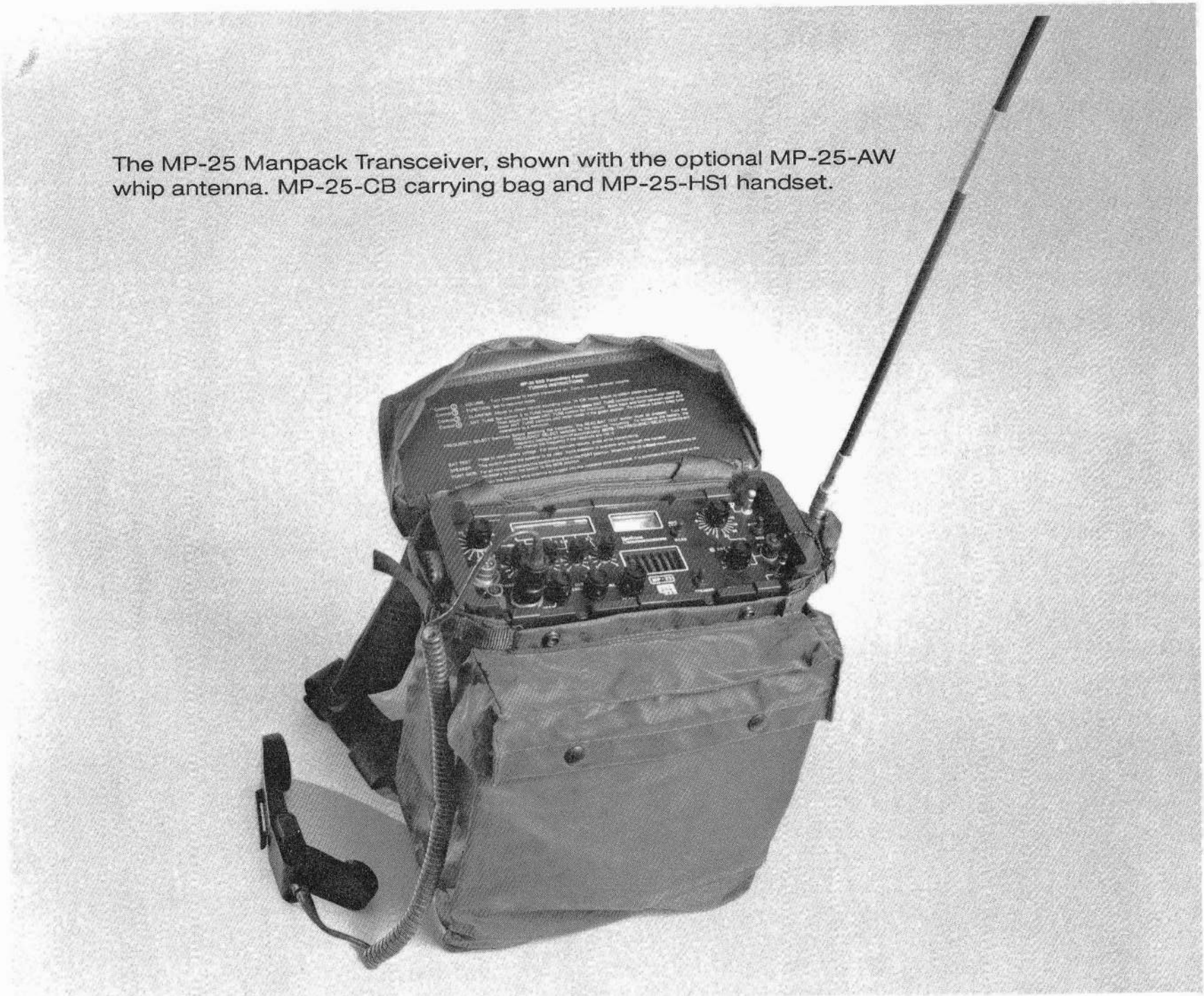
The MP-25 Manpack Transceiver, shown with the optional MP-25-AW whip antenna. MP-25-CB carrying bag and MP-25-HS1 handset.



# CHAPTER 1 - GENERAL INFORMATION

## 1-1 GENERAL

The MP-25 is a modern, state-of-the-art, manpack type transceiver which may be used for portable, mobile or fixed installations. The transceiver is designed to receive and transmit single sideband suppressed carrier (2R7J3E), semi-break-in telegraphy (350A1A), and compatible, amplitude modulation (2R7A3E) signals. In the latter mode, AM is received as SSB. Frequency coverage is 2,000.0 to 14999.9 kHz in 0.1 kHz steps.

The MP-25 is designed to operate over the temperature range -30 C to +55 C and is fully waterproof to 1 meter. The MP-25(E) battery pack clips on the transceiver without having to withdraw the transceiver from the case. Rechargeable sealed lead acid and nickel cadmium battery packs are available. Optional connecting leads allow the transceiver to operate from an external 12 volt D.C. source.

## 1-2 STANDARD FEATURES

- Modern single loop synthesizer design
- Built-in antenna tuner
- Multi-mode operation - USB, LSB, compatible AM, semi break-in CW, FSK
- Transmitter includes SWR bridge, automatic level control and 6 watt "tune" signal
- Transceiver is equipped with fast attack, slow release AGC system
- High/low power selector
- Internal speaker
- Resettable circuit breaker switch
- Rotating antenna base for whip antenna
- Audible alarm sounds when battery pack needs recharging

## 1-3 APPLICATIONS

The MP-25 transceiver is designed for short, medium and long path communications work. The transceiver will operate from a whip, longwire or dipole antenna. A built-in antenna coupler allows proper coupling to the whip and longwire antennas. Typical system application is given below.

**TABLE 1.1**

| CONFIGURATION | POWER SOURCE | ANTENNA TYPE | TYPICAL APPLICATIONS |
|---|---|---|---|
| Manpack | MP-25-BP Battery Pack | Whip | Infantry Patrol |
| Portable | MP-25-BP Battery Pack | Whip, Longwire | Field Stations |
| Mobile | Vehicle Battery | Whip | Moving or Stationary Comms. |
| Base | MP-25-PSC(E) Power Supply | Dipole, Longwire | Normal Base Station Service |

## 1-4 ACCESSORIES

The following accessories are available from the factory:

- **MP-25-HS2 Handset** - H-189/GR miniature military handset. Fully Waterproof. Dynamic, 150 ohm impedance.

- **MP-25-AW Whip Antenna** - Made of fiberglas. Collapsible and may be stored in carrying bag. Connects automatically when fitted to transceiver. Antenna may be rotated to any angle with respect to the transceiver and locked in place.

- **MP-25-AD Dipole Antenna** - This center fed dipole is wound on high impact plastic spools. A calibration chart is provided to show turns to be removed from the spools. Final adjustment is made using the MP-25 built-in SWR bridge. Antenna is provided with 10 meters of RG58-U coaxial cable. The dipole antenna may also be used as a longwire antenna. One section of the antenna is used as a ground plane.

- **MP-25-BP(LAE) Sealed Lead Acid Battery Pack** - Consists of two 6 amp hour, 6 volt, rechargeable, sealed, lead acid batteries in protective box. Clips on to rear of transceiver. Unlike nickel cadmium batteries, sealed lead acid batteries need not be deep discharged. Regulation inferior to nickel cadmium type.

- **MP-25-BP(NCE) Nickel Cadmium Battery Pack** - Clips on the rear of transceiver. If nickel cadmium batteries are not fully discharged they will develop a memory for the lower charge. Unlike sealed lead acid batteries, they should not be trickle charged. Their regulation is superior to that of the lead acid types.

- **MP-25-CB Carrying Bag** - Manufactured of nylon, the bag not only protects the transceiver, but, also provides pockets for the various accessories such as the microphone, folded whip antenna and other antenna accessories. Fitted with adjustable padded straps. Available in olive drab or green camouflage pattern.

- **MP-25-CW Telegraph Key** - May be positioned on senders knee or operated on a table or other surface.

- **MP-25-MB Mobile Mounting Bracket** - Heavy duty type, clamps around body of transceiver, allowing a strong attachment to the vehicle.

- **PN980014 Mobile D.C. Power Cord** - Allows the transceiver to be operated from a vehicle battery.

- **MP-25-AW1 Mobile Whip Antenna** - Stainless steel antenna approximately 2.5 meters long (9 Ft.).

- **MP-25-BL Ball Mount** - For attaching the MP-25-AW1 Mobile Whip Antenna to the vehicle.

- **MP-25-S2 Heavy Duty Spring** - designed to be used with the MP-25-BL Ball Mount and the MP-25-AW1 Mobile Whip antenna. Helps prevent antenna damage.

- **MP-25-PSC Power Supply/Charger** - Powers the radio in base station operation or charges one battery pack, either sealed lead acid or nickel cadmium. A front panel switch converts the base station power supply to a battery charger allowing the battery to be charged while attached to the transceiver. The supply allows operation from 110/220 volts, 50 or 60 Hz. A fuse and current limiting cut-out protect the power supply against short circuits. The supply is electronically regulated and current limited, and the output is over voltage protected. Contains built-in loud speaker for improved audio during base station operation of MP-25 Transceiver.

- **MP-25-CH Battery Charger** - Similar to MP-25-PSC(E) above but allows the simultaneous charging of 4 battery packs, either sealed lead acid or nickel cadmium. Will operate from 110/220 volts, 50 or 60 Hz.

- **MP-25-HG Hand Generator** - Designed to operate the MP-25 Transceiver and simultaneously charge the batteries. Batteries must be in place when operating the generator.

- **MP-25-MC Hand Microphone** - Military type M-80/U, rugged, dynamic type microphone. Used when transceiver is operated with the MP-25-PSC power supply speaker in base station operation.

- **PN980013 Extender Board Kit**. A set of extender boards that allow printed circuit modules to be extended above the transceiver for maintenance and service.

## 1-5 SPECIFICATIONS

**General**:

- Power Source: External 12 volt supply, negative ground only.
- Frequency Range: 2,000.0 - 14,999.9 kHz in 100 Hz steps.
- Modes: 2R7A1A (USB & LSB), 350A1A (CW), 2R7A3E (compatible AM).
- Operating Temperature Range: -30 C to +55 C.
- Waterproofing: Immersion to 1 meter (20 C).
- Size: (W X D X H) 32 X 34 X 11.5 cm.
- Weight, without batteries: 4.3 kg (9.6 lbs.).
- Weight, with sealed lead acid battery pack: 7.25 kg (16.1 lbs).
- Weight, with nickel cadmium battery pack: 7.29 kg (16.2 lbs.).

- Metering: Relative received signal strength.
  Relative transmitter power output.
  Reflected power (TUNE mode).
  Battery voltage.
- Antenna Tuner: Built-in. Capable of matching to whip or longwire antennas from 2 - 150 meters in length. Special provision to match mobile antenna.
- Lighting: Spring loaded switch activates readout display for approximately 10 seconds. Meter illuminated while switch held on. Meter illuminated when mode switch in *TUNE* position.
- Memory: Frequency change may be entered only when readout display is illuminated. Last four digits of second frequency may be switch programmed in readiness for a change. Will not activate until *READ* switch is activated.
- Out-of-Lock Indicator: Audio tone warns if synthesizer out-of-lock, such as when large changes in frequency are made or battery needs charging.

**Receiver:**

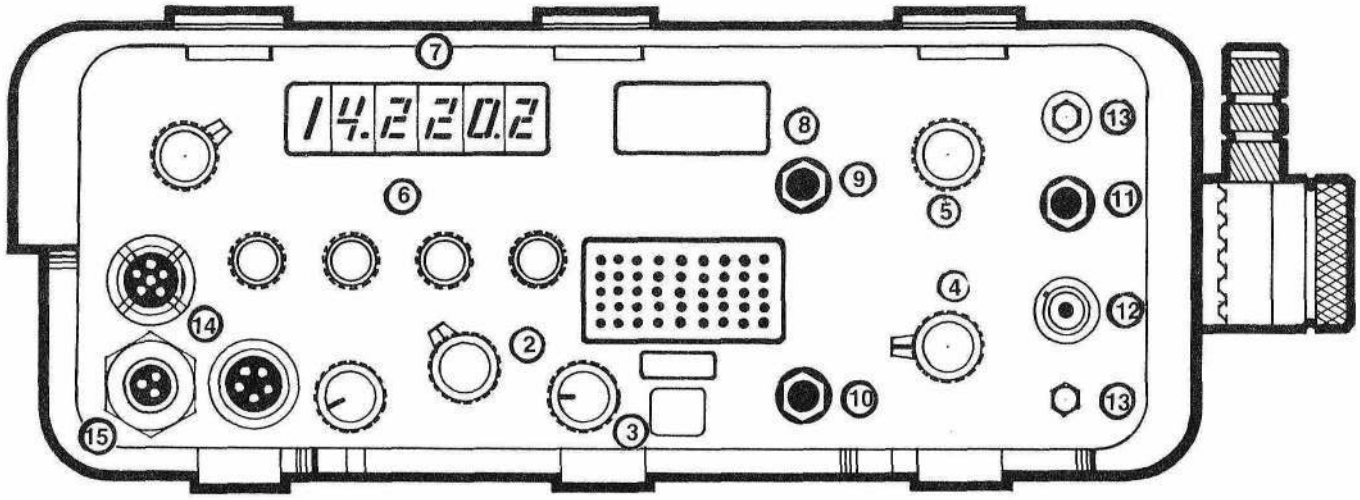
- Signal to noise: Better than 10dB for .5uV input signal.
- Sensitivity: More than .125 watts output for .5uV input signal.
- AGC: Less than 10dB variation in audio output from 5uV to 0.1V input signal.
- IF Rejection: 2 - 9.9 MHz Better than -90dB
  9.9 - 15 MHz Better than -60dB
- Image Rejection: Better than -90dB.
- Internal Spurious Signals: Not greater than the equivalent of .5uV except at 5 MHz = 3uV.
- Audio Output: 1 watt minimum with not more than 10% distortion.
- Clarifier: +/-50 Hz minimum.
- Current drain (readout display off, volume low): Typically 170mA.
- Current drain (readout display on, volume low): Typically 200mA.
- Current drain (readout display off, volume normal listening level): Typically 185mA.

*» Note: All measurements based upon 12.6 volt D.C. input voltage.*

Transmitter:

- Power Output: SSB - 25W P-P average. 20W minimum.
- CW - 10W (internally adjustable).
- AM - 6W (carrier).
- Intermodulation distortion: Not less than -26dB at 20 watts. Typically -30dB at 25 watts.
- Spurious Output: -50dB with reference to 25W level.
- Harmonic Suppression (50 ohm output): -40dB.
- Carrier Suppression: -40dB minimum.
- Frequency Stability:
  +/-100Hz from -10 C to +50 C
  +/-150Hz from -30 C to +55 C
- ALC: Limits output power to within 1dB of setting.
- Current Drain:
  Average voice: 1 - 2 amps.
  CW (Key down): 4 amps.
  CW (Average): 1 - 2 amps.
  AM: 1.5 amps.
- Microphone: H189/GR or equivalent.

*» Note: All measurements based upon 12.6 volt D.C. input voltage.*




① On/Off Volume
② Function Switch
③ Clarifier
④ & ⑤ Antenna Tune Controls
⑥ Frequency Selection Switches
⑦ Frequency Readout Display
⑧ Meter
⑨ Bat. Read/Low Power Selector
⑩ Speaker On/Off Switch
⑪ Port./Mob. Switch
⑫ Dipole Antenna Connector
⑬ Long Wire Antenna Connectors
⑭ Handset Connectors
⑮ + 12V External Power Connector

# CHAPTER 2 - INSTALLATION AND OPERATION

## 2-1 FRONT PANEL CONTROLS AND INDICATORS

- **ON/VOLUME.** The switch on the volume control turns the transceiver on. Turn clockwise to increase volume.
- **FUNCTION.** The function switch is used to select the required mode, LSB, USB, AM, CW or TUNE.
- **FREQUENCY SELECTION.** An illuminated LED read-out display shows the frequency selected.
- **CLARIFIER.** Adjusts the tone of the voice to compensate for differences between equipment and preferences.
- **ANTENNA TUNE CONTROLS.** These controls compensate for various lengths and types of antennas. See paragraph 2-3 through 2-6 for details of their operation.
- **BATTERY TEST/READ LOW POWER SWITCH.** This switch shows the condition of the battery and is used to select low transmitter power level. See paragraph 2-7 for details.
- **SPEAKER/ON SWITCH.** See paragraph 2-8.
- **PORT./MOB SWITCH.** See paragraph 2-9.
- **METER.** See paragraph 2-10.
- **FREQUENCY READ-OUT DISPLAY.** See paragraph 2-10.
- **EXTERNAL POWER CONNECTOR.** See paragraph 2-11.
- **HANDSET CONNECTOR.** See paragraph 2-12.

## 2-2 OPERATING PROCEDURES

1. The switch on the volume control turns the transceiver on. Turn clockwise to increase volume.

2. The function switch should be set to the required mode, LSB, USB, AM or CW. For the TUNE position see paragraphs 2-3 through 2-6.

3. When the transceiver is first turned on, the LED read-out display will be illuminated for approximately 10 seconds. The frequency selection should be entered within this period. If the display turns off before the frequency data is entered the spring loaded READ switch must be momentarily lifted. This action will activate the timer for an additional 10 seconds. *Frequencies programmed into the switches when the display is off will not be entered into the counter until the READ switch is activated.* This feature allows the last 4 digits of a second frequency to be entered while still using the first frequency. When the operator is ready to use the second frequency, the READ switch should be activated. (If the MHz switch is turned to disallowed frequencies when the read-out display is off, the transceiver will be disabled and a tone will be emitted by the handset receiver or speaker). The timing circuit has been incorporated into the MP-25 to save battery energy.

4. Adjust the clarifier to obtain natural sounding voice. In CW mode adjust to obtain pleasing tone.

## 2-3 ANTENNA TUNE CONTROLS

Dipole. The ANT TUNE controls should be set to DIPOLE. The whip or longwire antennas should be removed.

The dipole antenna should be erected as high as practical and, if possible, broadside to the signal source. The dipole length should be adjusted in accordance with the chart given in Figure 20. The function switch should then be set to TUNE and the dipole length fine adjusted for minimum meter reading. The reading should be within the green portion of the scale. It will often be found that raising or lowering the dipole ends will assist in obtaining a lower reading.

## 2-4 WHIP ANTENNA

The whip antenna is automatically connected when attached to the transceiver.

At this time, the left hand should *firmly* grasp the transceiver metal case to simulate, as much as possible, the ground that is obtained when the set is carried on the back. An approximate setting of the ANT TUNE controls may be obtained by adjusting for maximum received signal or noise pick up. In very quiet locations the READ switch, if activated, will provide a 15 second tuning noise. Figure 21 shows ANT TUNE control settings for various frequencies but is emphasized that these readings are approximate only. Final tuning should be performed as follows.

Still firmly grasping the case, set the function switch to TUNE and adjust the ANT TUNE controls back and forth to obtain a minimum meter reading. The reading should be within the green portion of the scale. In general, it will be found that the best reading will be obtained when the lower ANT TUNE control is between 1 and 2 on the 1 to 7 scale.

» *Note: If the fingers only* lightly *touch the metal portions of the case an unpleasant but not dangerous RF burn may be obtained at the point of finger contact. Unless the transceiver is operated from the metal tray or hood of a vehicle, continue to grasp the transceiver case when operating the radio.*

## 2-5 LONGWIRE ANTENNA

A longwire antenna must always be operated with an earth ground, or counterpoise earth ground, connected to the transceiver ground terminal. See Figure 22. One section of the dipole antenna is used as the longwire antenna. The remaining section may be used as a counterpoise earth ground if no metal waterpipe or similar earth ground is available. In general, it may be said that the longer the antenna the greater the signal capture area. The counterpoise, usually, but not always, provides best performance when placed on the ground under the antenna. Lay out as much ground wire, as physical conditions permit, especially when the ground is arid or rocky. An approximate setting of the ANT TUNE control may be obtained by adjusting for maximum received signal or noise static. In very quiet locations the READ switch, if activated, will provide a 15 second tuning noise.

Final tuning should be performed as follows: Set the function switch to TUNE and adjust the ANT TUNE controls back and forth, to obtain a minimum meter reading. The reading should be within the green portion of the scale. In certain cases, an improvement may sometimes be obtained, by switching the PORT./MOB., switch to MOB. In all normal cases the switch should be left in the portable position (PORT).

## 2-6 MOBILE ANTENNA

When the transceiver is fitted to the mounting bracket attached to a vehicle, care should be taken to ensure the transceiver is grounded to the vehicle chassis or body. It is especially important to be sure the ground does not make intermittent connection as erratic tuning and operational behavior may result.

The whip antenna should be connected to the transceiver with a short length of well insulated wire. It should be realized that the connecting wire will be part of the antenna system and prone to pick up ignition, generator or alternator interference.

The panel switch PORT./MOB., should be set to MOB. (Mobile).

The ANT TUNE controls should be adjusted for best received signal or noise, then in the TUNE position of the function switch readjusted. *Important: Also see Figure 21.*

## 2-7 BATTERY TEST/READ SWITCH

In the normal operating position of this switch the meter is caused to read relative signal strength in the receive mode and relative power output in the transmit mode. In the upper, spring loaded position of the switch, the following functions occur:

a. The meter is illuminated.

b. The meter reads the battery voltage.

c. The frequency read-out display is illuminated.

d. Frequencies programmed into the frequency selector switches are entered into the synthesizer.

The battery voltage is best read when transmitting, as this is a high current drain condition.

» *NOTE: The TUNE position of the function switch over-rides the battery test function of the BAT. TEST switch position.*

## 2-8 SPEAKER SWITCH

When the speaker switch is set to ON, the internal speaker is operational.

## 2-9 PORT./MOB. SWITCH

Unless the transceiver is mounted in a vehicle, the PORT./MOB. switch should be set to the portable, PORT. position. For mobile operation refer to paragraph 2-3-4.

## 2-10 FUNCTION SWITCH

In the USB, LSB, AM and CW positions of the function switch the meter reads signal strength in the receive mode and relative power output in the transmit mode.

In the TUNE position of the function switch the meter reads the antenna reflected power. In this position the ANT. TUNE controls are adjusted to give a minimum reading (green portion of scale.) To conserve battery, the display is automatically turned off approximately 10 seconds after the transceiver is turned on. The programming of the frequency selector switches should be performed during this time. Whenever the BAT. TEST/READ switch is momentarily activated, the display will be illuminated for an additional 10 seconds.

## 2-11 EXTERNAL POWER CONNECTOR

The external power connector allows operation of the MP-25 transceiver from an external power supply or battery. When the MP-25-PSC Power Supply/Charger is used in the CHARGE mode, the battery pack *must* be in place. The battery will charge whether the VOLUME/ON-OFF switch is on or off. Note that the MP-25-PSC Power Supply/Charger is voltage and current limited to prevent damage to the battery pack. The external connector also provides an output to an external speaker. A suitable speaker is built into the MP-25-PSC Power Supply/Charger.

## 2-12 HANDSET CONNECTORS

The transceiver is designed to be used with the MP-25-HS, HC189/GR type handset or equivalent. Alternately, a handset may be operated from one connector and a morse key (MP-25-CW) from the other.

# CHAPTER 3 - BRIEF TECHNICAL DESCRIPTIONS.

## 3-1 BLOCK DIAGRAMS

Refer to Figures 1, 2 and 3. Figure 1 shows a receive-mode block diagram and Figure 2 shows a transmit-mode block diagram. Components marked * are common to both modes. Figure 3 is a block diagram of the synthesizer used in both receive and transmit modes.

## 3-2 RECEIVER OPERATION

Refer to Figures 1 and 2. The antenna is fed to the ring diode mixer MX-101 through the following circuits: The antenna tuner, one of five low pass filters selected by the MHz switch, the antenna transmit/receive relay and a high pass filter designed to allow only the wanted signals, rejecting all those below 2 MHz. Two notch filters prevent 16 MHz IF feed through. A low pass filter prevents the reception of interference above 15 MHz.

The mixer, a low noise type, mixes the signal (2-15 MHz) with the local oscillator voltage supplied by the synthesizer (18-31 MHz) to produce an IF Frequency of 16 MHz.

The IF signal is amplified by transistor Q101 and applied to the crystal filters FL101 and FL102 and the following amplifiers, U101 and U102. One sideband only is selected when voltage is connected to the appropriate integrated circuit by the panel function switch. Outputs from U101 and U102 are combined in an IF transformer and fed to the product detector U201 where it is mixed with signal from the beat frequency oscillator Q201 and amplifier Q202. The resulting audio signal is then amplified by U202a and U202b. Signal from U202a is fed to the audio amplifier U205 through the transmit receive gate Q203 and the audio gain control. A panel switch connects the audio either to the speaker or to the handset. Output from U202b is rectified by AGC rectifiers CR205 and CR206, filtered, and amplified by DC amplifier Q104 before being used to control the gain of U101 and U102. An additional amplifier Q204 increases the audio signal from Q202a sufficient to drive the receiver S meter after rectification by diodes CR208 and CR209.

The receiver is contained within two plug-in printed circuit boards, PC101 and PC102. Integrated circuit regulators are fitted to each printed circuit board.

## 3-3 TRANSMITTER OPERATION

Refer to Figures 1 and 2. Audio from the microphone or CW tone oscillator U203 is amplified by transistors Q206, Q207 and applied to the balanced modulator consisting of diodes CR210 through CR213. The resultant double sideband suppressed carrier output is connected to the crystal filters FL101 and FL102 and corresponding IF amplifiers U101 and U102 via Q103, a transistor which functions as an ON gate in the transmit mode.

The function switch applies voltage to either U101 or U102 to select the wanted sideband. The paralleled output is fed to diode ring mixer MX-101 where it is combined with local oscillator voltage from the synthesizer (See Figure 3).

Output from the mixer (2-15 MHz) is amplified by transistor Q101. Signal from Q101 is passed through a notch filter to remove the IF component and a low pass filter to remove the image component. The signal is then fed to the linear amplifier module containing transistors Q301, Q302, Q303 and Q304.

The MHz switch selects one of five low pass filters which remove harmonics developed in the linear amplifier.

The filters are followed by a standing wave bridge. In the TUNE mode the reflected voltage is used to indicate a match to the antenna. By tuning for a null on the meter a correct match is obtained.

The antenna tuner consists of a simple L network, the adjustment of which allows a 50 ohm matched condition to prevail when using either the whip antenna or random lengths of wire. In the DIPOLE setting of the antenna tuner controls, if the function switch is set to the TUNE position the bridge will indicate a null if the antenna is adjusted to the correct length.

In the LSB, USB, AM and CW positions of the function switch, the SWR bridge supplies a voltage to the meter indicating relative output power.

In the CW mode the transmitter is turned on when the morse key is pressed and an 800 Hz tone is fed into the audio system. A built-in delay holds the transmitter on between morse characters. During a pause the transceiver will revert to the receive condition.

### 3-4 SYNTHESIZER OPERATION

The digital synthesizer is a modern, single loop system primarily built around two 28 pin integrated circuits, the HEF4750 and HEF4751 see Figure 3. The HEF4751 is based upon a multiple feedback dividing principal which is a development of the conventional pulse swallowing technique. The development has allowed external 10/11 prescalers to be combined with prescalers internal to U508, thus achieving a sizeable divider of simple design. The basic principle of operation is quite standard. Output from a voltage controlled oscillator (VCO) is divided down to approximately 1 kHz and compared with a 1 kHz signal from a reference source. A difference in frequency creates an error voltage which is used to correct the VCO frequency until lock is achieved. A simple example is shown in Figure 4. In this instance the VCO is operating at 10 MHz. The divider switches have been set to divide by 10. If the divider switches are set to divide by 9 an error voltage will occur and tune the VCO to 9 MHz. Obviously, in this synthesizer, the VCO can only be changed in 1 MHz steps. Note that when the division rate is 10, 10 cycles must pass before a change in the correction voltage is obtained. When, however, the VCO frequency is say 30 MHz and the step size 100 Hz, as in the MP- 25, 300,000 cycles must pass before a correction voltage is generated. Unless special techniques are employed the result would be considerable "jitter".

By combining 10/11 prescalers with the phase locked system shown in Figure 4 a greater division ratio is obtained without reduction in comparison frequency since it is no longer necessary to divide the reference frequency by the modulus of the prescaler.

The operation of the 10/11 prescaler shown in Figure 5 may be briefly explained:

In this instance there are two dividers or counters in addition to the 10/11 counter, "A", which counts units and "M", which counts 10's. Suppose we set the counter to divide by 73. If "A" is greater than 0 the following happens:

1. 10/11 counter is set to divide by 11 at start of cycle.

2. "A" counter will count 33 (3 X 11), cease counting and then reset the 10/11 to divide by 10.

3. "M" counter will now count 40 more. At the end of the count it will reset "A" whic · ill reset the 10/11 and start the cycle again. The count now is 73.

The MP-25 synthesizer contains 2 external 10/11 counters. An additional dual modulus counter is contained within U508. See Figure 3.

The first 10/11 counter is built around two 74F74 Fairchild Advanced Schottky TTL/(FAST) low current, high frequency integrated circuits, U502, U503, type D flip flops and 4 FAST gates internal to U501. The second 10/11 counter utilizes CMOS, type 4013 devices U504, U505 (also type D flip flops) CMOS gates and resyncing circuitry, U506, U507.

The five frequency selector switches directly control U508. The MHz frequency selector is a 13 position decimal type switch. 2 CMOS integrated circuits U401 and U402 convert the decimal function to BCD as required by U508. The remaining frequency selector switches are BCD.

Note that the frequency selector switches are actually connected in parallel. A strobe signal supplied by U602 and derived from the 5 MHz reference oscillator sequentially strobes the switch moving arms. The information is entered and stored in U508. Using this method, only 9 connections are required between the switches and the counters, whereas 25 connections would be required if strobing was not used. The strobing method is also applied to the light emitting diode (LED) readouts. Not only does this reduce the connections between the LEDs and the counters, from 40 to 12, the current drain is also reduced. A further advantage is that the strobing may be turned off and the frequency retained in memory, further reducing current drain.

A built-in timer turns the strobe off automatically. When the radio is first turned on strobing is applied for approximately 15 seconds allowing frequency to be read and/or selected. The time may be extended by pressing a panel switch. A 5 MHz crystal connected to U602 is used to establish reference frequency.

Internal dividers generate 1 kHz and 100 Hz reference and control signals. U602 contains two phase detectors, a coarse digital type detector and a fine sample and hold detector. Integrated circuit U601 is an active filter which combines the phase detector outputs and filters unwanted sidebands from the error signal.

A BCD to 7 segment converter, U404 and inverter U403, interface the counters to the LED readout.

A variable capacitance diode "pulls" the 5 MHz reference oscillators in the receive mode, "clarifying" the signal.

The VCO is a highly stable Colpitts type oscillator. A series of pin diodes, actuated by the MHz frequency selector switch, pre-sets the oscillator roughly to frequency. Additional inductance is added to the tuned circuit as the frequency is lowered.

### 3-5 SAFETY CONSIDERATIONS

Built-in safety systems prevent the transmission of spurious signals if the synthesizer is out-of-lock; when the frequency is being changed, for example, or when the battery voltage is too low. A warning tone is emitted by the loudspeaker or handset receiver.

Special regulators which allow an output voltage only 0.6 volts below the input voltage are used in critical parts of the circuit to prevent unwanted modulation of the VCO circuits.

Transmitter output transistors capable of generating more than 100 watts of CW or SSB signal are used in the linear amplifier, although operated at only 25 watts nominal in the SSB mode and 10 watts in the CW mode to ensure safe operation when the antenna is mismatched or disconnected.

# CHAPTER 4 - DETAILED FUNCTIONAL CIRCUIT DESCRIPTION

## 4-1 GENERAL

This chapter gives detailed descriptions of each circuit module. When reading this section refer to Chapter 3, the block diagrams and the appropriate schematic diagrams. Note that except in the case of the mother board, PC1, the first figure of a component nomenclature indicates the module to which it belongs. For example, C104 and L106 indicate that these components are located on PC101 module. When an asterisk (*) is placed alongside a component nomenclature in the block diagrams or Figures 1 and 2 it means that this component is common to both receive and transmit modes.

4-2 The MP-25 TRANSCEIVER consists of a main (or "mother") printed circuit board and 6 plug-in printed circuit boards. A low pass filter assembly consisting of a switch and printed circuit board is separately contained but readily removable for service. The antenna tuner section is attached to the front panel and also easily removed for service. The following list identifies the printed circuit boards, each by number and brief function:

- PC1 - Mother board. Provides connections between the various modules.
- PC101 - Receiver, transmitter mixer and IF functions.
- PC201 - BFO/Carrier generator, receiver and transmitter audio and balanced modulator functions.
- PC301 - Transmitter linear amplifier.
- PC401 - Converts BCD signals to readout, 7 segment information and decimal to BCD functions.
- PC501 - Universal divider.
- PC601 - Synthesizer VCO, master oscillator and detectors.
- PC701 - LED read-outs and frequency selector switches.
- PC801 - Low pass filters and MHz selector switch.
- P901 - Front panel section.

4-3 Not used.

## 4-4 PC1, STANDING WAVE BRIDGE CIRCUIT

This circuit is contained within the antenna tuner shielded section, located on the main printed board PC1. The bridge has two outputs. One output indicates the transmitter forward power into the antenna system and the second output indicates the power reflected from the antenna system. The VSWR bridge is a very important part of the MP-25 radio set in that it indicates accurately when a match between the transmitter linear amplifier and the antenna is obtained.

The VSWR bridge is shown in Figure 7. Components C7, C8, R4, and L3 constitute the forward reading part of the bridge and C4, C5, R1 and L3, the reflected part of the bridge.

The bridge reads forward power in the LSB, USB, CW and AM positions of the mode switch and reflected power in the TUNE position.

If CR4 and CR3 were replaced with an RF reading type meter, the bridge configuration would be easily visualized.

Resistors R5, R2 and R3 adjust the outputs to the required levels.

4-5 Not used

### 4-6 ALC CIRCUIT

Capacitor C24 samples antenna output power at the output side of the bridge transformer L3. This voltage is rectified by diodes CR1 and CR2 and applied to the base of transistor Q104 located on PC101, where it is used to control the gain of the IF amplifiers U101 and U102. C2, L1 and C1 are smoothing components. L2 is a frequency/voltage compensator.

### 4-7 RELAY K1

This relay is actuated whenever the handset push-to-talk switch is pressed. In the CW mode the relay is actuated when the morse key is first pressed, held in by C13 while characters are being sent, opening when a pause takes place. See Paragraph 4-35. The relay has two functions, a) to switch the antenna from the receiver to the transmitter and b) to put +12 volts upon the normally grounded control line when in the transmit mode. This line, marked CONTROL on the schematics, does most of the receiver/transmitter switching functions.

Diode CR13 absorbs spikes generated by the relay coil when the radio is switched back to receive.

4-8 Not used

### 4-9 SUPPLY LINE FILTERING CIRCUITS

The large current drain of the transmitter linear amplifier during the transmit mode may cause a considerable variation in battery voltage, especially when the batteries are nearly discharged. This variation can cause severe feedback into the sideband generating circuits and frequency modulation of the synthesizer section, unless filtered. Inductor L5 and Capacitor C14 are the filter components. These also function to prevent alternator whine or ignition noise being conducted through the power cord when the radio is used mobile.

### 4-10 PROTECTION CIRCUITS

Diode CR15 and thermal cut-out CB1 serve to protect the transceiver against destructive short circuits or incorrectly polarized power sources. CR15 will not conduct unless the power source polarity is reversed. In the event of reversal, the high current causes cut-out CB1 to trip. It must be manually reset. Any current exceeding 10 amps will trip CB1.

### 4-11 AM RELAY K2

When the MODE switch is set to AM, relay K2 is turned on allowing carrier generated in PC201 to be fed to the mixer MX-101 on PC101. See paragraph 4-41. Diode CR6 absorbs spikes generated by the relay coil when the relay is deactivated.

### 4-12 CW HOLD CIRCUITS

See simplified schematic Figure 8. When the morse key is pressed, pin 13, PC201, is grounded, turning on the CW tone oscillator. Refer to paragraph 4-35. Simultaneously, the bottom of relay K1 is grounded through filter resistor R8, and diodes CR12 and CR14, switching the control line from ground to +12. The resultant ground connection at the bottom of C13 allows C13 to charge. When the morse key is released CR12 opens but CR14 remains closed due to the charge stored in C13. Thus, although the removal of the ground, from pin 13, PC201, turns off the tone oscillator, the transceiver stays in the transmit mode for a time determined by the resistance of K1 and the capacitance of C13.

4-13. Not used.

### 4-14 VOICE SIDETONE AMPLIFIER Q1 (See Figure 6)

Audio voltage from the microphone and the sidetone oscillator, U203, connection 21, at the front of PC Board PC1, is connected to Q1 via C10. After amplification, the signal is fedback to the input of receiver audio amplifier U205 on PC201 via pin 37 of printed board connector J5. Supply voltage to Q1 is supplied through R7 only when the speaker switch is in the off position, to prevent audio feedback between the speaker and the microphone.

### 4-15 PC101, INPUT NETWORK (See Figure 9.)

Due to the broadbanded nature of synthesized receivers, tuned circuits are impractical. To prevent cross modulation, filter circuits restrict the bandwidth as much as possible. Components L101 through L104 and C101 through C103 constitute a seven element high pass filter, effectively preventing signals below 2 MHz, especially broadcast stations, from causing interference. Components L105, L106, C104, C105 and C106 are tuned to 16 MHz, the IF frequency, notching out signals of this frequency which otherwise would interfere with the wanted signals. Components L107, L108, C107 and C108 form a low pass filter preventing signals above 15 MHz from entering the mixer. Additional filtering is provided by the LP filter circuits located on PC801.

### 4-16 RECEIVER/TRANSMITTER MIXER, MX101

Mixer MX-101 contains hot carrier diodes connected in a ring configuration forming a very low noise mixer in both receive and transmit functions. In the receive mode diode CR102 is turned on allowing the signal to enter. In the transmit mode CR102 is turned off and CR101 and CR103 turned on diverting the output signal through CR103 to amplifier Q101.

MX-101 is a two way device. Arrows on the schematic show the direction of signal travel for the receive and transmit modes. In the receive mode, signal is mixed with the local oscillator voltage provided by the synthesizer, producing a 16 MHz intermediate signal which is applied to Q102. In the transmit mode, a 16 MHz signal is fed to the mixer via CR104, producing a wanted signal at the anode of CR103 where it is passed on to Q101.

### 4-17 1ST IF AMPLIFIER Q102

Used only in the receive mode, Q102 amplifies the 16 MHz IF signal into a hybrid transformer, L116. In the transmit mode, a positive voltage is applied to the emitter via CR105, cutting the stage off. Simultaneously, diode CR106 open circuits, further disconnecting Q102 from the transformer L116.

### 4-18 HYBRID TRANSFORMER CIRCUIT

Inductor L116 and resistors R109 and R110 form a hybrid circuit allowing IF signal to be presented to both crystal filters, FL101 and FL102. The hybrid connection prevents interaction between filters.

### 4-19 CRYSTAL FILTERS

Crystal filters FL101, FL102 are each approximately 2.4 kHz wide at -6 dB points. FL102 is an upper sideband filter and FL101 a lower. It is very important to note that due to the mixing process a sideband inversion takes place and an upper sideband filter actually gives lower sideband output and vice versa. To alleviate errors, replacement filters should always be ordered by part number which is stamped on the can.

### 4-20 IF AMPLIFIERS U101 AND U102

These identical integrated circuit IF amplifiers amplify the outputs from the crystal filters FL101 and FL102. Their outputs are combined in transformer L117, tuned to the IF frequency, 16 MHz. Only one amplifier is activated at one time, when +8 volts is applied to either of the integrated circuits. The voltage is supplied through the mode switch on the front panel. Output from L117 is fed to the product detector located on PC201.

### 4-21 TRANSMITTER AMPLIFIER Q101

This device receives signal frequency from the mixer MX-101 via diode switch CR103. CR103 is turned on only in the transmit mode. Control voltage, from the control line (pin 9 of the PC board connector), turns Q101 on.

### 4-22 Q101, OUTPUT NETWORK

The output of Q101 contains many unwanted signals which must be removed when transmitting. Mainly, these are: The image signal, the local oscillator, the IF signal and many even and odd order mixer products. The image and local oscillator products, because they are above the signal frequency, are easily removed utilizing the 10 element low pass filter consisting of inductors L110 through L113 and C138 through C143. A notch circuit L114 and C137 is tuned to the IF frequency. The mixer, MX-101, itself attenuates this signal -30 to -40 dB and further attenuation is obtained through the low pass filter described above and those contained on PC801.

### 4-23 TRANSMIT, GATE Q103

This device acts as a simple switch. In the transmit mode it is turned on from the control line, via R122, allowing the double sideband suppressed carrier signal from the balanced modulator in PC201 to be applied through resistor R108 to hybrid transformer L116, the crystal filters FL101, FL102, integrated circuits U101, U102 and diode gate CR104. The signal is then fed to the mixer, MX-101. Q103 is inoperative in the receive mode.

4-24 AGC, amplifier Q104 is a high input impedance "Darlington" transistor. Its purpose is to receive AGC voltage from the AGC rectifier circuits on PC201 without loading the circuits. It supplies a low impedance control voltage to integrated circuits U101, U102. Q104 operates in the emitter follower mode, its output increasing positively with increasing signal. No-signal output is approximately 4 volts. Capacitors C146, C147 and resistors R125 and R126 are part of the AGC fast attack, slow release system. In the transmit mode this device amplifies ALC voltage supplied by the ALC circuit on PC1. Refer to paragraph 4-6.

### 4-25 VOLTAGE REGULATOR

U103 maintains a constant +8 volts on PC101.

### 4-26 DIODES CR101, CR102, CR103, CR104, CR105, CR106 AND CR107

These diodes are all used as switches, allowing transmit/receive functions. They operate as follows:

| | RX MODE | TX MODE |
|---|---|---|
| CR101 | OFF | ON |
| CR102 | ON | OFF |
| CR103 | OFF | ON |
| CR104 | OFF | ON |
| CR105 | OFF | ON |
| CR106 | ON | OFF |
| CR107 | ON | OFF |

Switching is accomplished when the control line is made positive during the transmit mode.

### 4-27 PC201, OSCILLATOR, Q201. (See Figure 10.)

Operating at a frequency of 16 MHz, Q201 provides a crystal controlled 16 MHz signal to the product detector U201 and the balanced modulator diodes, CR210 through CR213. Capacitor C202 allows some adjustment of frequency.

### 4-28 AMPLIFIER, Q202

Buffers output from Q201. Used in both transmit and receive modes.

### 4-29 PRODUCT DETECTOR

U201. An integrated circuit differential amplifier, this device, in this instance is used as a mixer or product detector. Oscillator voltage applied at pin 5 through CR201 is mixed with IF signal applied at pin 4. The difference voltage is in the audio range. Bypass capacitor C218 bypasses unwanted input signals from the output. In the transmit mode a positive voltage from the control line, applied to pin 5 through CR202, disables U201.

### 4-30 AUDIO AMPLIFIER, U202A AND U202B

Two sections of this quad amplifier device have their inputs connected to the output of product detector U201. Output from U202a is fed through audio gate Q203, through the volume control, to audio amplifier U205, and then to the handset or speaker. Output from U202b is rectified and used to generate an AGC voltage. The latter device is turned off in the transmit mode when a positive voltage from the control line, applied through diode CR203, saturates the device causing its output at Pin 10 to go to zero. When the output is at DC zero, CR204 conducts, shunting resistor R230 across the AGC line. Without CR204, a stored voltage on the AGC line, from a large received signal, would paralyze the IF amplifiers U101 and U102 until the charge had leaked away.

### 4-31 RECTIFIERS, CR205, CR206

These diodes rectify audio signal, generating a DC voltage which controls the gain of IF amplifiers U101 and U102. A voltage divider, formed by R225 and R226, supply a threshold voltage, preventing action of the AGC on small signals. It is important in SSB reception, that the AGC action not be effective too early or a very unpleasant "pumping" action will result as the atmospheric and man-made noise is raised to the level of the signal. DC output from diode CR205 is fed via the main board PC1, to AGC amplifier Q104, located on PC101.

### 4-32 AUDIO GATE, Q203

A field effect type transistor disconnects the audio in the transmit mode. This method of shutting off the receiver audio, unlike that used to disable U202b, does not create thumps or clicks in the headphones. The stage is disabled when the handset push-to-talk switch, or morse key, is pressed, by grounding the normally positive gate through diode CR207.

### 4-33 S METER AMPLIFIER, Q204

This stage further amplifies output from U202b providing a signal of sufficient level, after rectification, to operate the signal strength meter. It is not necessary to switch this stage off in the transmit mode as U202b has been disabled.

### 4-34 METER RECTIFIERS, CR208, CR209

These diodes rectify the audio signal from Q204. Capacitor C235 smoothes the output which is applied to the meter in the receive mode.

### 4-35 CW TONE OSCILLATOR, U203

This audio oscillator circuit generates a CW tone of approximately 800 Hz. Potentiometer R237 allows the oscillator to be adjusted so that a pure output is obtained and R240 allows the output level to be controlled. This method of producing CW generates an automatic 800 Hz offset, so that a receiver tuned to the carrier frequency will automatically receive the tone. Output from level potentiometer R240 is connected to the input of microphone amplifier Q206. Simultaneously, output is fed through R232 into the receiver audio volume control to allow sidetone.

### 4-36 CW GATE, Q205

This device functions as a switch, controlling the supply voltage to CW oscillator U203. When the mode switch is set to CW, +8 volts DC is connected to the emitter of Q205. When the morse key is pressed the base of Q205 is grounded through resistor R246 and Q205 conducts.

### 4-37 MICROPHONE AMPLIFIERS, Q206, Q207

These are conventional audio amplifiers supplying a low impedance audio to balanced modulator diodes CR210 through CR213.

### 4-38 BALANCED MODULATOR, CR210 THROUGH CR213

This conventional diode bridge circuit mixes audio voltage with carrier generated by Q201 producing a double sideband suppressed carrier output which is applied to transmit gate Q103 on PC101 via diode switch CR214. Potentiometer R258 and capacitor C246 are carrier balance controls.

4-39 Receiver audio amplifier, U205 is a 1 watt audio stage which drives either the speaker or handset. It receives its input from Q203 via the volume control on the front panel. In the transmit mode it serves to amplify CW sidetone, driving either the speaker or the handset.

### 4-40 U204, OUT-OF-LOCK/LOW VOLTAGE INDICATOR

Audio oscillator U204, emits a tone into the receiver audio circuit should the synthesizer be out-of-lock, a condition which may occur when the batteries have been discharged or when large shifts in frequency are made. If an out-of-lock condition exists, a positive voltage derived from U602 allows U204 to oscillate.

### 4-41 R259, AM CARRIER-ADJUST POTENTIOMETER

R259 obtains carrier voltage from the output of Q202 and feeds it to mixer MX-101 on PC101, where it is combined with the 16 MHz single sideband IF signal. This action generates a single sideband, AM type signal.

### 4-42 U206, REGULATOR

An on-card regulator supplies +8 volts regardless of input.

### 4-43 DIODES, CR201, CR202, CR203, CR204, CR207 AND CR214

These diodes function as switches. They operate as follows:

| | TRANSMIT | RECEIVE |
|---|---|---|
| CR201 | OFF | ON |
| CR202 | ON | OFF |
| CR203 | ON | OFF |
| CR204 | ON | OFF |
| CR207 | ON | OFF |
| CR214 | ON | OFF |

### 4-44 PC301, LINEAR AMPLIFIERS. (See Figure 11)

Amplifier Q301 is a conventional, common emitter, linear amplifier. Q301 receives its input from PC101 via the main board PC1. Resistor, R301, together with the input impedance of Q301, present a 50 ohm input. Resistor R304 and capacitor C303 allow frequency sensitive compensation.

4-45 L301 Inductor is a trifilar wound 4/1 step down transformer.

4-46 Q302, Driver transistor is a common emitter, class AB1 amplifier. Its bias is regulated by diode CR301.

4-47 L302, Inductor is a trifilar wound 4/1 impedance step up transformer.

### 4-48 Q303, Q304, FINAL AMPLIFIERS

These transistors are capable of each producing in excess of 60 watts output. In this instance however, voltage feedback obtained with components C310, R311, C311 and R312 restrict the power to a little more than 25 watts. This excess ability provides a considerable safety factor when severe mismatch conditions prevail such as when the antenna is being tuned.

Resistors R308, R309 and R310 compensate for impedance changes with frequency and loading, preventing unwanted and destructive oscillations. Regulated bias is provided by transistor Q305.

### 4-49 L304, L305, INDUCTORS

Bifilar wound L304 provides a means of supplying voltage to the collectors of Q303, Q304. Trifilar wound L305 provides a 1-4 step up in impedance from the push pull collector circuits to the antenna. Capacitors C312 and C315 tune out transformer leakage reactance.

### 4-50 Q305, BIAS REGULATOR

This important part of the circuit is responsible for holding a constant bias to Q303 and Q304 under different drive, supply voltage and temperature conditions. Diodes CR302, CR303 are physically located near transistors Q303 and Q304, sampling the rise in temperature generated by these devices. As the temperature increases, the resistance of the diodes decrease. Q305 is an emitter follower, its output voltage faithfully following the input voltage, less its base emitter junction drop, approximately 0.6 volts. Approximately 0.6 volts is applied to the bases of Q303, Q304 through bifilar choke L303. As Q303, Q304 base emitter functions in themselves tend to regulate the supplied bias voltage, adjustment to the bias must be monitored by reading Q303, Q304 no-signal collector current, as potentiometer R314 is adjusted.

4-51
through
4-59 Not used.

### 4-60 PC401, #1 SYNTHESIZER BOARD. BCD TO 7 SEGMENT CONVERTER (See Figure 12)

Integrated circuit U404 converts to BCD information at its input terminals, pins 1, 2, 6 and 7 to 7 segment information at the output. The latter information is transmitted via printed circuit socket J10 attached to the main ("mother") board, and a ribbon connector to PC701, the printed circuit module containing the light emitting diode read-outs. If the numeral 1, for example, is programmed into U404 by making pin 7 high, the voltage at output, pins 12 and 13 will cause 1 to appear on one of the LED read-outs (a and b). As mentioned in Chapter 3 of this manual and also covered in paragraph 4-100, the read-outs are multiplexed. The information presented to the input of U404 is constantly changing. Strobe signals applied to the switches and the common anode readout terminals ensure that the information is presented in the correct order.

Resistors R402 through R408 limit the readout current.

4-61 U403, Integrated circuit converts negative logic to positive logic required by U404.

4-62 U401, U402 Decimal to BCD converter.The 10 MHz and 1 MHz synthesizer programming functions are performed by the front panel MHz wafers (b) and (a) respectively. Wafer (b) only generates a numeral 1 when the switch is set to 10 through 14. This information is transmitted directly to the 10 MHz readout, passing through PC401 via J401 on switch line H. Wafer (a) causes the Figures 0 to 9 to be displayed and entered into the counter. The wafer output is decimal and is converted to BCD information by integrated circuits U401 and U402. When the switch is set to figure 9 for example, input pin 5 on U401 and input pin 10 on U402, will be brought low causing output pin 1, U401 and output pin 13, U402 to be low; binary 1 + 8 = 9. Diode CR401 allows the numeral 1 to be programmed without need for a third integrated circuit. Note that the numbers 1 to 9 shown on J401, the PC401 schematic, correspond to the decimal switch positions. Diodes CR402 through CR405 conduct only when the switch is being strobed, via line M, to J401.

### 4-63 U405, REGULATOR

An on-board integrated circuit, regulates the voltage to +8 volts.

4-64 Not used.

### 4-65 PC501, #2 SYNTHESIZER BOARD (See Figure 13)

To fully understand the operation of this module the synthesizer information presented in Chapter 3 should be read. This board is closely interconnected with modules PC401, PC601 and PC701. The heart of PC501 is the integrated circuit U508. Basically, it may be said, the main function of U508, in conjunction with the 10/11 counters, U504, U505, U502 and U503 is to divide the VCO signal, less an offset equal to the transceiver IF frequency. For example, the frequency 7250.0 kHz will actually require a VCO signal frequency of 7250.0 + 16000.0 (the IF frequency) for a VCO frequency of 23,250.0 kHz. When the switches are set to 7250.0 the synthesizer will actually divide by 23250 for an output of 1 kHz, which is further divided by 10 for an output of 0.1 kHz. When the two outputs are presented to the phase detectors on PC601, if the frequencies are not 1 kHz and 0.1 kHz, the phase detectors will develop a correcting error voltage.

### 4-66 Q501, SOURCE FOLLOWER

Field effect transistor Q501 serves to isolate the VCO on PC601 from the loading effects of the gate U501.

4-67 U501d, amplifier-gate, converts the analog output of Q501 to digital logic.

4-68 U502, U503, 1st prescaler, consists of four, FAST, TTL, Type D, flip flops. In conjunction with gates U501b, U501c and diodes CR501 and CR502, these devices form a 10 counter when pin 10 of U501c is low and a 11 counter when pin 10 is high. The 10/11 command signal is received from synthesizer integrated circuit, U508 and inverted to positive logic by U501a. The output of the counter, pin 9 U503b is converted to CMOS levels by the action of inductor L501. Resistors R519 and R507 together with clamp diode CR511 convert the CMOS levels to TTL.

### 4-69 U501, QUAD GATE. (See paragraphs 4-67, 4-68.)

### 4-70 U504, U505, 2ND PRESCALER

The prescaler consists of 4 CMOS, type D, flip flops. In conjunction with gates U506, U507 they form a 10 counter when pin 23 of U508 is high and a 11 counter when pin 23 is low. Output from U505b, the last flip flop in the chain, is connected to the universal divider stage U508.

### 4-71 U508, UNIVERSAL DIVIDER (See Figure 28)

U508 is based upon a multiple feedback dividing principal, a development of the conventional pulse swallowing technique. It enables a combination of internal and external prescalers to be cascaded to form a divider of considerable size. The basic U508 counter consists of three stages. The first is a fully programmable four bit counter which can be set to divide by any number from one to nine; its division ratio is increased by 1 when a pulse is applied to its control input. The second stage, within the device, is a fixed 10 counter that has four binary weighted rate outputs. These provide 1, 2, 4, or 8 pulses for each cycle of the counter. The third stage is a rate selector which assembles a pulse stream made up of selected rate inputs. The frequency of the pulse stream at the rate selector output will be: N FF, where N is the number programmed into the selector, to determine the selection of the rate inputs. The 10 circuit and the rate selector form a decimal rate multiplier. The addition of the two external prescalers allow an increase of the division ratio.

Programming of U508 is performed in a BCD parallel-bit serial decade format. To accommodate the 16 MHz IF, offset two numbers are input in parallel, one being subtracted from the other in the integrated circuit to produce a program.

The program input consists of data sequentially applied to the data A and B input pins of U508 (pins 1-4 and 16-19 respectively).

Diodes connecting pin 5 to pin 16 and pin 5 to pin 17 disable a 1/2 channel function not used in this instance. Diodes connecting pin 7 to pin 18 and pin 6 to pin 19 cause the counter to have a 16 MHz offset so that, if the panel switches are set to divide by say 7.250 MHz, the VCO frequency will actually be 23.250 MHz.

Programming information from the switches is entered via pins 1- 4. When new frequencies are being entered, pin 12 is held high. When this pin is low the information is stored within the device. Outputs to the phase detectors on PC601 are taken from pins 25 and 27.

### 4-72 U509, TIMER

As mentioned earlier, (paragraphs 4-60, 4-71) switches and read-outs are strobed and the information is entered sequentially within U508. Strobing action is stopped when pin 12 of U508 is taken to ground. U509, a monolithic timing circuit, is triggered into operation when pin 2 is grounded by the action of the front panel READ switch. Output at pin 3 will remain high for a time determined by components R516 and C514 in this instance, approximately 15 seconds.

To ensure that the timer is triggered when the transceiver is first turned on, capacitor C515 holds pin 2 at ground until after the supply voltage has reached the device.

### 4-73 U510, REGULATOR

This device sets the supply voltage to +5 volts.

### 4-74 U511, REGULATOR

This device sets the supply voltage to +8 volts.

4-75
through
4-79 Not used.

### 4-80 PC601, #3 SYNTHESIZER/VCO/PHASE DETECTOR BOARD

The circuitry on this board is closely associated with that on boards PC401 and PC501. To fully understand this module, the information presented earlier should be studied. See paragraph 4-60 and paragraph 4-65. (See Figure 14).

4-81 Q601, dual gate field effect transistor. Q601 is a highly stable low noise Colpitts type oscillator. Capacitors C614, C615 and inductors L602 through L608 constitute the tuned circuit. Pin diodes CR603 through CR608 function as switches, electrically adjusting the inductance in circuit. For example, when the MHz frequency panel selector is set to 8 MHz, diode CR606 is caused to conduct, connecting the right hand end of L605 to ground, placing inductors L603, L604 and L605 in circuit. This is known as pre-setting or presteering the VCO and may be considered a coarse frequency setting. CR601, the variable capacitance diode now need only fine tune the circuit over the range 5-6.999 MHz. The VCO is a highly important part of the phase locked loop system and largely determines the stability of the transceiver. L602 is always in circuit.

### 4-82 Q602, Q603, BUFFER AMPLIFIERS.

These amplifiers amplify the output from Q601 and provide isolation from the 10/11 prescalers and the mixer.

### 4-83 U602, PHASE DETECTOR/REFERENCE OSCILLATOR

Integrated circuit U602 receives two signals from the universal divider integrated circuit on PC501; one signal approximately 1 kHz and the other approximately 100 Hz, the result of output from VCO division. These signals are frequency and phase compared with the 100 Hz and 1 kHz reference signal, generated within U602. Difference of frequency or phase sends an error voltage through filter amplifier U601 to variable capacitance diode CR601. The built-in reference oscillator obtains its stability from crystal Y601 which operates at 5 MHz.

The internal reference divider has a programmable division ratio of 1 to 1023 in addition to a selectable ratio of 1, 2, 10 and 100. Ground or positive connections to pins 10 through 20 and pins 23 and 24 have set the total division ratio to 5000. A fine adjustment, capacitor C641 allows the oscillator to be set exactly to frequency. There are two phase comparators contained within U602. A very low noise sample and hold type comparator, PC1, and a second more conventional digital/frequency comparator, PC2. The latter may be considered a coarse control and provides rapid switching between channels. Outputs from PC1 and PC2 are summed in U601. When the VCO is off frequency, output from PC2 will rapidly bring the system within a few degrees of phase lock, at which point the PC2 output is inhibited and the loop is locked by PC1.

### 4-84 U601, LOOP FILTER INTEGRATED CIRCUIT

Phase comparator, PC2 produces positive going or negative going output pulses of varying width depending upon the phase relationship of the two inputs. These pulses are integrated in the loop filter stage U601 to produce a ramp between about 0 and 8 volts for +/- 360 phase difference at the inputs. PC1 output is permanently connected to the input of U601 through R627. U601 inverts, integrates and amplifies the signals from U602. Capacitance and resistance values associated with stage have been carefully chosen to filter unwanted spurious signals from the output.

4-85 CR601, Variable Capacitance Diode. See Paragraph 4-81 And 4-83.

4-86 U603, regulator is a special integrated circuit type regulator which supplies a regulated output of +8 volts for an input voltage as low as 8.6 volts. The VCO, Q601, is highly subject to frequency instability with variations in supply voltage and consequently must be provided with a stable source of DC voltage.

### 4-87 U604, REGULATOR

Any variation in voltage at pin 3 of U601 will be amplified by U601 and cause frequency instability. This terminal is therefore provided with double regulation. The output of U604 is further smoothed by C608.

**4-88** Not used.

### 4-89 Q604, MUTE TRANSISTOR

If an out-of-lock condition exists, such as when the transceiver frequency is being changed, an out-of-lock voltage is generated at pin 4 of U602. This voltage is used to saturate transistor Q604 causing a short circuit from the base of buffer amplifier Q603, and ground. VCO voltage is thus prevented from reaching the receiver mixer.

### 4-90 ALARM CIRCUIT

Refer to paragraph 4-89. The voltage at pin 4 of U602 is used to generate a tone when an out-of-lock condition exists. The voltage turns on alarm oscillator U204 located on PC201. Refer to paragraph 4-40.

### 4-91 CR609, CLARIFIER CIRCUIT

Although the MP-25 synthesizer generates 100 Hz frequency steps, a circuit which allows even smaller shifts in frequency, receive mode only, is provided. A front panel clarifier control varies the voltage on variable reactance diode, CR609. The resultant change in capacitance "pulls" the crystal Y601 in frequency approximately +/- 50 Hz. Reed relay, K601, substitutes fixed capacitor C637 during the transmit mode.

4-92
through
4-99 Not used.

### 4-100 PC701, LED READ-OUT AND FREQUENCY SELECTOR SWITCHES (See Figure 15)

This module is attached to the front panel by the selector switches S701 through S704. Connections to the main board PC1 are through a ribbon cable. Operation of the module may be explained as follows:

Assume the panel switches have been programmed to 12,345.6 kHz. The figure 12 will have been obtained from the MHz switch, see Figure 16, and converted to BCD format by U401 and U402 on PC401.

The A0, A1, A2 and A3 outputs from U401 and U402 are paralleled with the outputs from the switches S701, S702, S703 and S704, the latter switches providing the kHz x100, x10, x1 and x.1 information, in this case 345.6. The A0 - A3 information is delivered to the universal counter U508 on PC501. The lines A0 - A3 are also connected to the read-outs through BCD to 7 segment converter U403 and U404 on PC401. When the front panel READ switch is pressed, a sequential train of pulses is sent from the D terminals of U508, beginning with D5, D4, D3 and so on, down to D0. The information held in the switches: 1 2 3 4 5 6 corresponding to 12,345.6 kHz, is thus entered into the counter. Internal latches hold the information until an up-date or change of frequency is received.

The D5 through D0 pulses simultaneously turn on transistors Q701 through Q706 via resistors R703 through R709, causing the read-outs to display the frequency set by the switches. The strobe frequency of 1 kHz is too fast for the eye to follow and the impression is given that all LEDS are lit.

4-101 V701 - V706 read-outs. Refer to paragraph 4-100.

4-102 S701 - S704, switches. Refer to paragraph 4-100.

4-103 Q701 - Q706, transistors. Refer to paragraph 4-100.

### 4-104 CR701 - CR716, DIODES

These diodes isolate the switches from each other. Diodes are open circuit until a strobe pulse turns them on. If the numeral 3, for example, has been set into switch S701, a pulse received at D3 will turn on diodes CR701, CR702 sending the information 3 to the universal divider.

### 4-105 P801 MODULE, (PC BOARD 801, AND MHz SWITCH)

Refer to block diagrams 1, 2 and schematics diagrams 16 and 17. P801 module contains a 5 wafer 13 position switch assembly which performs the following functions:

Wafer (a) MHz frequency selector switch, numerals 0 through 9.
Wafer (b) 10s MHz frequency selector switch, numeral 1 only.
Wafer (c) VCO inductor selector, switching 3-5 MHz, 5-7 MHz, 7-9 MHz, 9-11 MHz, 11-13 MHz and 13-15 MHz.
Wafer (d) and (e), low pass filter selectors, selecting the following filters: 2-3 MHz, 3-5 MHz, 5-7 MHz, 7-10 MHz and 10-15 MHz.

4-106 S801 WAFER (a) receives a strobe pulse to its moving arm (a), through an attached ribbon connector, from universal divider U508. Output from the switch terminals 2-14 is fed back through the ribbon connector to U401, U402, decimal to BCD converter on PC401.

4-107 S801 WAFER (b) receives a strobe pulse to its moving arm from universal divider U508. Output from its switch terminals is fed through the attached ribbon connector to pin 4, U508, on PC501.

4-108 S801 WAFER (c) moving arm is grounded through attached ribbon connector terminal g. Output from the switch is fed via a second ribbon connector via the main PC board PC1 to the VCO board PC601, to one of the six diodes D603 through D608, presetting the VCO. Refer to paragraph 4-81.

4-109 S801 WAFERS (d) AND (e) select low pass filters. Refer to paragraph 4-105.

### 4-110 PC801, PRINTED CIRCUIT BOARD (See Figure 17)

This PC board contains 5 low pass filters (refer to paragraph 4-105). These filters attenuate harmonics generated in the transmitter linear amplifier when the transceiver is in the transmit mode and attenuate signals above the wanted pass band in the receive mode. The filters are selected by S801 wafers (d) and (e).

4-111
through
4-114 Not used.

### 4-115 FRONT PANEL, ASSEMBLY (See Figure 18)

To understand the function of many of the controls attached to the front panel it is necessary to refer to the panel schematic, Figure 18, the PC1 schematic, Figure 6 and the simplified schematics, Figures 19 and 20.

### 4-116 R901 AND S904, VOLUME CONTROL/ON/OFF SWITCH

The volume control connects directly to PC201 via the main board PC1. An attached switch S904 turns the transceiver diode CR609.

4-117 R902, clarifier control varies the frequency of the reference oscillator, part of U602, by varying the voltage on variable capacitance diode CR609.

### 4-118 S901, FUNCTION SWITCH

A five position, 4 pole switch, consists of two wafers. The front wafer contains switches (a) and (b) and the rear wafer (c) and (d).

4-119 S901 (a). This switch disconnects the microphone from the microphone amplifiers in the CW and TUNE modes.

4-120 S901 (b). In AM position of the function switch, AM relay K2 is actuated through CR7 connecting carrier from PC201 into PC101. Refer to paragraph 4-41. Diode CR6 suppresses relay back EMF. In the TUNE position of the function switch CR8, LCR9 and CR16 conduct. Relay K2 operates, providing a carrier for tune purposes, Lamp I901, illuminates the meter and the push-to-talk switch line is actuated, placing the transceiver in the transmit position.

4-121 S901(c). In the LSB, USB, AM and CW positions of the function switch, when in the transmit mode, the meter is connected to the forward reading output from the SWR bridge, through diode CR904. Output from the PC201, S meter rectifier system, supplies the meter through CR904 when in the receive mode. In the TUNE position, the meter is connected to the reflected reading output from the SWR bridge through CR904.

4-122 S901(d). In the LSB position of the function switch, the LSB IF amplifier is turned on. In the USB position the USB IF amplifier is turned on. In the CW position the USB IF amplifier is turned on through diode CR902 and the CW gate Q205, on PC201, is turned on. In the AM and TUNE modes the USB, IF amplifier is turned on through diode CR901.

### 4-123 S902, READ/BATTERY TEST/LOW POWER SWITCH

S902 is a two pole, three position toggle switch. The switch provides the functions detailed in paragraphs 4-124 through 4-126.

4-124 Upper, spring loaded position.

- (a) The meter is connected to the +12 volt source through resistor R9 and indicates the state of the battery. The battery voltage may be read when transmitting. However, to prevent the forward reading output from the SWR bridge confusing the reading, section (b) of S902 grounds the moving arm of S902 (c) through CR905. Refer to Figure 19.

- (b) The meter light is turned on by grounding one end of I901 through CR11.

- (c) The LED readout timer on PC501 is actuated through CR10. The timer will stay on until its cycle is completed, even when the switch is allowed to return to its normal neutral position.

4-125 Center, neutral position. The meter is caused to read signal strength in the receive mode and relative power output in the transmit mode. (except during TUNE. Refer to paragraphs 4-120, 4-121).

4-126 Lower, low power position. Refer to paragraph 4-125 above. In addition, a ground connection attenuates the drive to the linear amplifier module PC301, by increasing the ALC feedback voltage to IF amplifiers U101 and U102.

4-127 S903, speaker switch. Refer to Figures 6 and 18. In the ON position, S903 (a) connects the speaker in parallel with the handset headphone. At the same time, S903 (b) removes supply voltage from voice sidetone amplifier Q1, located on PC1, preventing audio feedback from speaker to microphone.

4-128 S904, ON/OFF SWITCH Refer to paragraph 4-116.

### 4-129 S905, ANTENNA TUNER SWITCH

S905 is part of an L network type antenna tuner consisting of capacitor C901 and inductor L901. Note that in the #23 position of the switch, L901 is shorted out for 50 ohm dipole operation.

### 4-130 C901, ANTENNA TUNER CAPACITOR

C901 is part of an L network type antenna tuner utilizing inductor L901. The capacitor is turned counter clockwise to minimum capacitance, for 50 ohm dipole operation.

### 4-131 S906, MOBILE/PORTABLE SWITCH

An L network type antenna tuner was chosen for the MP-25 because of its simplicity and ease of tuning. In this instance however, the antenna impedance must be greater than 50 ohms, a situation which normally exists. However, when the MP-25 is fitted to a vehicle using a short whip, the antenna impedance is likely to be less than 50 ohms, typically 18 to 25 ohms. By converting the L network to a pi type network, the tuner is able to match to less than 50 ohms. A pi network is obtained when capacitor C902 is switched into the circuit by switching the MOBILE/PORT switch to the MOBILE position.

### 4-132 M901, METER

Reads signal strength in the receive mode and relative power output in the transmit mode when the function switch is in the LSB, USB, AM and CW positions and S902 is in the neutral (center) and low power (lower) positions. In the TUNE mode the meter reads reflected power. Refer to paragraphs 4-120 - 4-123. In the READ/BATTERY TEST position the meter reads the battery condition through resistor R9. The condition of the battery should be read while transmitting, as this condition imposes greatest load upon the battery.

4-133 I901, Meter light. Refer to paragraph 4-124.

4-134 S901, Speaker. Refer to paragraph 4-127.

### 4-135 J901, J902, CONNECTORS

J901 and J902 are standard military type, parallel connected U-183/U panel receptacles, with the addition of a 6th center pin supplying +12 VDC for audio accessories. The U-183/U receptacle will mate with HC-250/U handset. The connector uses standard connections:

a. Chassis ground
b. Audio Output (headphone, speaker)
c. Push-to-talk switch
d. Audio input (dynamic microphone)
e. CW Key
f. +12 VDC nominal.

The microphone amplifiers are designed to operate from levels as low as -63 dB at an impedance of 150 ohms.

Audio output, pin B to ground is designed to drive standard 600 ohm headsets and is capable of driving 8 ohm and 16 ohm speakers.

4-136 Connector J903 allows the MP-25 to operate from an external 12 volt source when the battery is removed. If the MP-25 Power Supply/Charger is used, the battery may be charged while in place. Other chargers should not be used as damage to the transceiver may occur.

An audio output terminal is provided in S903 so that a speaker built into the MP-25-PSC Power Supply/Charger may be used in base station operation, J903 connections are as follows:

a. Chassis ground.
b. +12 Volts DC.
c. Speaker.

The transceiver is designed only for negative ground operation.

# CHAPTER 5 - MAINTENANCE & ALIGNMENT.

## 5-1 RECOMMENDED TEST EQUIPMENT

The following equipment is recommended for maintenance of the MP-25 transceiver:

- Oscilloscope (to 60 MHz). Tektronix Model 2213 or equivalent.
- Frequency counter.
- Signal generator.
- RF voltmeter
- Multimeter, capable of reading volts, current, ohms.
- Audio Voltmeter.
- Dummy load, 50 ohms, 50 watts.

## 5-2 RECOMMENDED TOOLS

The following tools are recommended for correct maintenance of the MP-25 transceiver:

- Soldering iron, pencil bit, 40 watt with ground wire.
- Pliers.
- Side cutters.
- Screw drivers, plain and philips heads.
- Set of allen wrenches.
- Solder sucker and solder wick.
- Set of hollow stem, nut drivers.

## 5-3 ROUTINE MAINTENANCE.

Routine maintenance includes periodic cleaning, damage checking and frequency accuracy testing. Refer to paragraph 5-26. Packsets are subject to extreme rough handling, often being thrown on the ground, carried on the beds of empty trucks and otherwise abused. Additionally, when used in desert conditions, over a period of time, sand and grit may cause malfunction of water seals.

## 5-4 REMOVING TRANSCEIVER FROM CASE

Removal is accomplished by unlatching the six retaining clips. Lift the transceiver from the case.

## 5-5 FUSE

The MP-25 is protected with an overload cut-out, CB1, in lieu of a standard fuse. When a current overload has been experienced, the overload cut-out will pop up. This is a black switch-like object accessible through a hole in the top cover. The cut-out may be reset by pushing the black toggle down. Do not repeat if the cut-out refuses to stay down or severe damage to the radio may be caused. Check the radio to find the cause of the problem. See Figure 32, for cut-out locations.

## 5-6 COVERS

To gain access to the plug-in circuit boards, two covers must be removed. See Figures 32 and 33.

## 5-7 EXTENDER BOARDS

Extender boards are necessary to properly maintain and troubleshoot the MP-25. These are available as a kit from the factory, part no. 980013. It is important that the PC board modules are properly positioned over the radio, so that they do not extend beyond the extender board in either direction.

Note that due to the longer ground paths and removal from shielded enclosures, there may be deterioration of some specifications when the extenders are used.

### 5-8 TEST POINTS

Printed Circuit boards PC101, PC201, PC401, PC501 and PC601 are equipped with numbered test pins which correspond to those shown on the respective schematics. Other printed board test areas are shown in the appropriate diagrams and photographs.

### 5-9 PC101, PC201, REMOVING

Refer to Figure 33. Loosen the three retaining bolts holding the PC boards to the interstage shields. Slide a small screwdriver under each of the two hex shaped spacers and lever the boards upward.

### 5-10 PC301, REMOVING

Unscrew the two small, philips head screws retaining the PC301 heat sink to the chassis rear panel. Slide a screwdriver under each end of the heat sink and lever the module upward.

### 5-11 PC401, REMOVING

This board is easily lifted upward with the fingers. If the ribbon connector is removed, be careful to observe the plug polarity. An arrow on the plug top corresponds to an arrow on the PC board.

### 5-12 PC501, PC601, REMOVING

Unscrew the shield cover retaining screws to expose the two boards, PC501, PC601. Slide a screwdriver from the right under the left hex spacer, lift a small amount, then reversing the screwdriver lift the right hex spacer. Work back and forth until the boards are free.

### 5-13 REMOVING PC701 FROM THE FRONT PANEL

Using a 1/16" allen wrench, remove the knobs from the kHz X 100, kHz X 10, kHz X 1 and kHz X .1 frequency selector controls located under the LED read-outs.

Using a nut driver (socket wrench) remove the switch retaining nuts. The module may now be partly withdrawn from the panel. To fully remove, unplug the ribbon connector from the rear and hinge down the front panel as described in paragraph 5-16.

### 5-14 REMOVING P801 LOW PASS FILTER MODULE

Hinge down the front panel as described in paragraph 5-16. Remove the two LP filter assembly retaining bolts from the left side of the chassis, refer to Figure 33. The P801 assembly may now be lifted upward.

### 5-15 REMOVING THE ANTENNA TUNER ASSEMBLY

Remove the three antenna tuner retaining bolts from the right side of the chassis. Hinge down the front panel as described in paragraph 5-16. The antenna tuner will hinge down with the panel. To remove from the panel, remove the antenna tuner switch knob and retaining nut and withdraw tuner assembly rearward.

## 5-16 REMOVING THE FRONT PANEL

Remove the three screws retaining the antenna tuner to the right hand side of the chassis. Loosen the set screws in the flexible coupling between the panel and the low pass filter switch. Next remove the two top screws retaining the panel to the chassis. The panel will now hinge downward. When the two bottom screws are removed the panel assembly may be separated from the chassis.

## 5-17 REMOVING THE SPEAKER

Remove the front panel as described in paragraph 5-16 above. Remove the knob from the antenna tuner control the variable capacitor C901. Remove the two screws holding the capacitor/speaker bracket and withdraw the bracket. The speaker will now be free.

## 5-18 REMOVING THE ANTENNA TUNE CAPACITOR, C901

Described in 5-17 above.

5-19
through
5-20 Not used.

## 5-21 PC101, ALIGNMENT

IF amplifier alignment.

a. Put PC101 on the board extender and set the ANT TUNE controls to DIPOLE.

b. Set the function switch to LSB or USB.

c. Connect the signal generator to the DIPOLE coaxial socket and the audio voltmeter across the speaker terminals available at the speaker, the handset connectors J901 and J902 (pins B) or the power connector J903, (pin C).

d. Set the transceiver to 7.2 MHz and set the generator to 7.201 MHz for USB or 7.199 MHz on LSB to obtain a 1 kHz beat note.

e. Set the generator level until the signal is just above the noise and adjust IF transformers L115 and L117 for maximum output. (Refer to Figure 34 for locations).

f. Measure the signal to noise ratio.

g. Set the generator to 0.5uV and adjust the VOLUME for about 1 volt on the audio voltmeter and note the reading.

h. Detune the generator until only the noise is heard and note the reading. The noise should be at least -10 dB below the signal.

i. Repeat measurements g and h (above) on USB.

j. Measure the AGC effectiveness. Set the controls as given in a, c, and d above.

k. Set the generator to give 5uV output and a beat note of approximately 1 kHz. Audio gain control should be set so that an output of less than .1 V RMS is obtained.

l. Advance the generator attenuator to .01uV and note the receiver audio increase. Increase in audio should be less than 10 dB.

m. Adjust the receiver notch traps L105, L106. These controls are factory set and should not need adjustment. Should this be necessary, proceed as follows:

n. Set the controls as for a, b and c above. Set the generator to 15.999 MHz on the USB or 16.001 MHz on LSB to obtain a 1 kHz beat note. Set the receiver to 13 MHz. Adjust the generator output so that the signal is no more than 10 dB above the noise. Tune L105 for a null, then L106, back to L105, back and forth, advancing the generator output as required. The 16 MHz signal should be at least 60 dB below a given .5uV input signal.

o. Adjust the transmitter notch trap L114. Set the controls as for a and b above. Remove the signal generator and connect a dummy load to the DIPOLE coaxial connector.

p. Remove the VCO board PC601 and connect an oscilloscope across the dummy load.

q. Set the MHz switch to 13 MHz and the function switch to TUNE, advancing the oscilloscope gain until a carrier is seen.

r. Adjust L114 for minimum carrier.

s. Replace PC601.

t. This completes PC101 alignment.

5-22
through
5-25 Not used.

## 5-26 PC201, ALIGNMENT. BFO/CARRIER GENERATOR FREQUENCY ADJUSTMENT

a. Place PC201 on the extender board and set the ANT TUNE controls to DIPOLE.

b. Set the function switch to LSB and the VOLUME control to a low setting.

*» NOTE: Due to the use of the extender board, a high setting of the VOLUME control may cause audio instability.*

c. Connect a frequency counter to test point 2 and adjust C202 for a frequency of 16,000.000 kHz (Refer to Figure 35).

d. Carrier balance. Remove the extender board and replace PC201 in the chassis. The retaining screws must be secured to prevent intermittent readings. Set the ANT TUNE controls to DIPOLE, the function switch to LSB and the frequency to 7.200 MHz.

e. Connect the dummy load and oscilloscope to the DIPOLE coaxial connector and press the handset push-to-talk switch.

f. Turn up the oscilloscope gain until carrier appears, remembering that noises picked up by the microphone will also appear on the oscilloscope. (A clip lead may be used to ground the push-to-talk line on the main board PC1, connection 2, instead of pressing the push-to-talk switch, thus avoiding noise pick-up). Alternately adjust capacitor C246 and potentiometer R258 for minimum carrier. See Figure 35. Adjust the capacitor a little past minimum and then readjust the potentiometer. If the carrier increases, adjust the capacitor a little the other side of minimum and adjust the potentiometer again. By working back and forth a definite minimum will be found.

g. Switch to USB and recheck the carrier level. If the carrier level has increased, repeat the adjustments given above. Carrier suppression should be at least -40 dB below full signal output.

h. Adjust CW tone and output. Set controls and test equipment as in d and e above then set the function switch to CW.

i. Connect RF VTVM across the dummy load (in parallel with the oscilloscope).

j. Press the morse key. If no output appears on the oscilloscope and no sidetone is present adjust potentiometer R237 until sidetone is heard. If sidetone is present but there is no carrier showing on the RF voltmeter or oscilloscope, adjust CW level potentiometer, R240, for 22 V RMS output (62 V peak-to-peak). Readjust R237 for minimum ripple on the carrier edges. This point is near where oscillation just begins. Send a series of dots to ascertain that oscillation is certain. Readjust CW level control, R240, if required, in order to obtain the 22 V RMS output. Note that this reading will vary somewhat with frequency. The control may be set to allow a lower CW output to conserve battery.

k. AM output adjustment. Set controls and test equipment as for d, e and i above and set the function switch to AM.

l. Press the push-to-talk switch and adjust AM CARRIER ADJ potentiometer, R259, for an output of 20 V RMS (56 V peak-to- peak). Speak into the microphone and note that the amplitude should nearly double. If the AM carrier level is too low the voice may sound like SSB on an AM receiver. It is better to have a little too much carrier than too little.

*» Note: AM operation draws four or five times the current of SSB, considerably shortening the battery life.*

m. This completes PC201 alignment.

5-27 Not used.

### 5-28 PC301, ALIGNMENT/BIAS ADJUSTMENT

a. Remove PC301 from the chassis. Unsolder and lift the bottom end of RF choke L309. Connect a multi-meter in series with the choke to read the Q303 and Q304 collector currents.

b. Disconnect L302 from the collector of Q302 to remove its collector voltage.

*» Note: Signal applied to the bases of Q303, Q304, will cause a false collector current reading.*

c. Key the transmitter and adjust R314 for a bias current of 30 MA.

d. Remove the meter and replace L302 and L309.

e. This completes PC301 adjustments.

### 5-29 PC401, ALIGNMENT

There are no adjustments required on PC401.

### 5-30 PC501, ALIGNMENT

There are no adjustments required on PC501.

### 5-31 PC601, ALIGNMENT. ALIGNMENT OF INDUCTORS L602-L608

a. Put PC601 on the extender board and set the ANT TUNE controls to DIPOLE.

b. Set the function switch to LSB.

c. Connect a VTVM to test point 4. Ground test point 9 with clip lead.

d. Adjust L602 - L607 to give 4.5 volts on TP4 at the following midrange frequencies, L608 should be adjusted for 4.75V on 2.5 MHz at TP4 in the order given. (see Figure 39).

| Set Transceiver Frequency To: | Adjust Inductor |
|---|---|
| 14 MHz | L602 |
| 12 MHz | L603 |
| 10 MHz | L604 |
| 8 MHz | L605 |
| 6 MHz | L606 |
| 4 MHz | L607 |
| 2.5 MHz | L608 |

» *NOTE: It is important to adjust inductors L602 - L608 from the highest frequency down. As the inductors are progressively seriesed, any readjustment of higher frequency inductors will affect the operation of the lower frequencies.*

e. Remove clip lead from test point 9.

f. Reference oscillator frequency adjustment: Set controls as for a and b above.

g. Set frequency selector controls to 10 MHz.

h. Connect frequency counter to test point 3 and press the push- to-talk switch.

i. Adjust capacitor C641 (See Figure 39) until the counter reads 26,000.000 kHz.

j. The reference oscillator may be read directly at test point 6. However, it will be found that most frequency counter probes will cause a small shift in frequency. The method described in e to i above is therefore recommended.

k. This completes PC601 alignment.

5-32
through
5-33 Not used.

### 5-34 PC701, ALIGNMENT

No alignment or adjustments are required on PC701.

### 5-35 PC801, ALIGNMENT

No alignment or adjustments are required on P801.

a. When the entire P801 module has been removed and is being replaced, it is important that the flexible coupling and knob be correctly indexed so that the pointer knob indicates the frequency programmed into the LED read-outs.

b. Note the polarity of the 6 pin connector when connecting the socket J11 located on the main board PC1 (see Figures 33, 34). The blue wire should be toward the rear of the chassis.

## 5-36 PC1, CHASSIS ADJUSTMENTS

There are only three adjustments on the main printed circuit board PC1. These are, a) forward power amplitude, b) reflected power amplitude and c) ALC adjustments. Adjustments should be performed as outlined in Paragraphs 5-37 through 5-39 below.

## 5-37 C24, ALC ADJUSTMENT

a. Set the function switch to LSB and the ANT TUNE controls to DIPOLE.

b. Set the frequency selector controls to 7,200.0 kHz.

c. Connect a dummy load and VTVM to read RF voltage output.

d. Press the push-to-talk switch and whistle into the microphone.

e. Adjust capacitor C24 to obtain an RF voltage of 36 - 38 volts RMS, representing 25 watts (E /R). An oscilloscope may be used instead of the VTVM. In this instance adjust C24 for a display of 105 volts, peak-to-peak (Ep-p/2) .707 = ERMS, E2/R=P.

*» Note: Wattmeter readings usually show average power and do not indicate peak power output.*

f. This completes ALC adjustments.

## 5-38 C7, FORWARD POWER ADJUSTMENT

a. Set the controls and equipment as in paragraph 5-37, a through d above.

b. Whistle into the microphone and adjust C7 until the meter reads full scale (top of red area).

c. This completes the forward adjustment.

## 5-39 C4, REFLECTED POWER ADJUSTMENT

a. Set the controls and equipment as in paragraph 5-37 a through d above.

b. Set the function switch to TUNE.

c. Adjust C4 until the meter reads zero (Bottom of green).

d. Recheck the adjustment at 12,000.000 kHz and rezero if necessary.

e. This completes the reflected power adjustment.

# CHAPTER 6 - TROUBLE SHOOTING

## 6-1 TYPICAL PROBLEMS

In finding problems in a transceiver, much time and trouble may be saved by determining if the problem exists in one mode or both the transmit and receive modes. If the trouble exists in both modes then obviously the problem is likely to be a component common to both modes.

Technicians are strongly urged to make use of substitute modules, to isolate problem areas. For example, low receiver sensitivity may occur if components are defective in modules PC101, PC201 or PC601 (in the latter case due to low local oscillator output). By substituting modules the defective module will be quickly recognized.

It is convenient to use a second good transceiver to compare voltage, waveforms or effects. This is especially true when trouble shooting the synthesizer section. Many synthesizer outputs are fast, transient waveforms, often difficult to see on an oscilloscope, and certainly next to impossible to photograph. If the second transceiver is set to the same mode and frequency, comparison measurements may be made.

The following information reflects the most likely problems, causes and cures.

## 6-2 RECEIVER PROBLEMS

a. Low Receiver Sensitivity

- Defective CR101, CR102, CR103 or incorrect supply voltages may also affect transmit mode.
- Defective Q102. Usually will not affect transmit mode.
- Defective U101 or U102. Only one sideband will be affected.
- No-signal AGC voltage to U101 and U102 too high. May be due to defective Q104 or C228.
- Defective mixer module or low local oscillator voltage from PC601 module, possibly caused by defective Q602 or Q603.
- Open circuit L105, L106, L107, L108, L115. Transmitter will not be affected.
- Defective L116, L117. Transmitter will also be affected.
- Defective U201 or low BFO voltage to U201.
- Defective crystal filter FL101 (or FL102). Only one sideband will be affected in both receive and transmit modes.
- Noisy mixer, MX101. If mixer is merely noisy the receiver will make AGC measurements but have poor signal to noise ratio. Generally, the transmitter will be unaffected. If however, the mixer is attenuating the signal, the signal to noise ratio, receiver and transmitter gain, will be affected.

b. Receiver AGC system.

- AGC may be affected by defective components as listed under 6-2 above. As the AGC system is a loop, any faulty components within the loop may affect operation.
- Shorted C145, C146, C147, C123 or C125.

- Defective U202b, CR205, CR206.

c. Low receive audio.

- Defective U202a, Q203, U205.
- Shorted C258, C259.
- Open C260.
- Defective speaker (If speaker switch in ON position).

d. Regeneration receive mode.

- CR104 shorted or voltages to it incorrect allowing output from L117 to be applied to L115 and on through Q102. May operate without problems in transmit mode.
- Control line not properly grounded, most likely due to dirty relay contacts, K1.

6-3
through
6-7 Not used.

## 6-8 SYNTHESIZER PROBLEMS.

Unless the technician has a good, strong background in digital and phase locked loop systems it is recommended that repairs to the synthesizer be confined to module replacement. Once the defective module is located, plug-in integrated circuits may be replaced one at a time until the problem is located. It is important to realize that the synthesizer is mostly constituted of CMOS devices which are prone to damage from static electricity and leaky soldering irons. Weller type soldering guns must never be used, or any iron of the type where the heating element is also the soldering tip. Ordinary pencil bit irons must be of the 3 wire cord type in which the frame of the iron is connected to earth ground. It is recommended that technicians become thoroughly familiar with the information presented in paragraph 3-4, Figures 3, 4, 5 and paragraphs 4-60 through 4-91 before attempting repair work.

PC boards PC401, PC501, PC601 and PC701 are closely interconnected so that a fault in PC601, for example, may affect the operation of all four boards. The first step therefore is to check which of the boards is defective by substituting known good boards.

a. Synthesizer Out-Of-Lock. Only one readout displaying. PC601 known defective.

- Defective reference oscillator. If this section of U602 is not oscillating, TP2, will show output, but at a random frequency. Out-of-lock, mute transistor, Q604 will turn on and prevent output at TP3. As a rule, only one readout will then display (provided the timer has been activated). Cause of the problem may be:
- Defective reference crystal Y601 or associated components.
- Defective U602.

b. Synthesizer Out-Of-Lock. Incorrect VCO frequency. Full display. PC601 known defective.

- In this instance it is assumed that the reference oscillator is operating correctly as proved by measuring the frequency and observing the wave form at TP6. Check TP2 and TP3. If the VCO is oscillating there will be output at TP2, but, as the frequency is incorrect, there will not be output at TP3 (See A. above).

Having established that the reference oscillator and the VCO are operating, it now becomes apparent that the problem must be in the phase detectors, the loop filter or, perhaps in the frequency determining portion of the circuit. The next step is to check the VCO across the entire frequency range. Refer to paragraph 5-31 and check whether the voltage at TP4 approximates 4.5VDC at the frequencies given in paragraph 5-31d. Assuming proper operation is not possible at any of the frequencies, one may assume that this area is not the problem. This will be especially true if a frequency counter connected to TP2 indicates a changing frequency as the MHz switch is rotated. Evidence now points to a defective phase detector or loop filter problem area. More specifically:

- Defective U602. Check whether the DC voltage at pins 8 and 9 change when the MHz switch is rotated. If small upward "kicks" in voltages are obtained, the indications are good that the device is not defective.

- Defective U601 or associate components. Check the DC voltage at pin 3. It should be close to 4 VDC. An incorrect voltage at this point will prevent proper operation and could be caused by a defective regulator U604 or capacitor C608. If the voltage at pin 3 of U601 is correct, a variable voltage applied to pin 2 and adjusted between ground and +8 VDC, should cause a large change in frequency measured at TP2 if U601 and the associated components, including variable capacitance diode CR601, are operating satisfactorily.

c. Synthesizer Out-Of-Lock. Some frequency bands only. PC601 known defective.

- On the highest frequency band, 13-15 MHz, (VCO frequency = 29- 31 MHz) only L602 is in circuit, diode CR603 having shorted the junction of L602, and L603 to ground for RF. The MHz frequency selector switch should be rotated to ascertain which portions of the tuned circuit are operating. It should be recognized that if one diode, say CR605, or one inductor, say L605, are not functioning correctly, then all the lower frequency tuned circuits will be rendered useless. Problems may be caused by any of the following:

- One of the inductors, L602 through L608, mistuned. Refer to paragraph 6-31a through 6-31d for realignment information.

- Defective diode, CR603 though CR608.

- Defective MHz switch contacts. Check that the appropriate diode cathodes CR603 through CR608 go to ground as the MHz switch is rotated.

- Defective regulator U605 or capacitor C623.

- Poor connections between the MHz switch and PC601.

d. Synthesizer In-Lock, but no output to mixer. PC601 known defective.

- Defective Q604. Base voltage should be zero when synthesizer is in-lock.

- Defective Q603.

- Defective L610.

e. No synthesizer output. PC601 Known defective.

- Defective regulator U603.

- Defective VCO Q601.

- Defective VCO amplifier Q602.

- Open circuit L602.

- Shorted C601.

f. Synthesizer Out-Of-Lock. Only one read-out display. PC501 known defective.

- Loss of strobe signal to pin 13 of U508.
- Defective U508.

g. Synthesizer Out-Of-Lock. Full read-out display. PC501 known defective.

- Defective transistor, Q501.
- Defective integrated circuits, U501, U502, U503, U504, U505, U506, U507. Devices should be replaced one at a time. If an integrated circuit is completely non-functional, this fact may be observed by tracing through the circuit with an oscilloscope, as there should be a signal up to the defective stage. Check for output at pins 5 and 9, U502, U503, (TP4, see figure 38). Check for output pins 1 and 13, U504 and pins 13 and 1, U505.
- Defective U508.
- Open or shorted diodes CR503 through CR508.
- Defective regulator, U510.
- Defective capacitor, C510.
- Defective timer, U509, or associated components:

  Pin 3 of U509 should go high (6.5 V) when the radio is first turned on due to the charging action of C515. If either R518 or C515 is open, pin 12 of U508 (PE) will not be enabled.

- Defective C509.

h. Synthesizer Out-Of-Lock. No Read-out display. PC401 known defective.

- Defective U405.

i. Synthesizer Out-Of-Lock. Full read-out display. PC401 known defective.

- Defective U401, U402.
- Defective CR402, CR403, CR404, CR405.

j. Incorrect or defective read-out display. PC401 known defective.

- Defective U403.
- Defective U404.

k. Incorrect frequency. Display Reading different from that shown on front panel. PC401, PC601, checked okay.

- Faulty frequency selector switches on PC701.
- Open or shorted diode CR701 through CR716, PC701.

l. One read-out not operating

- Defective Q701 through Q706, PC701.
- Defective readout V701 through V706, PC701.
- Poor connection on strobe lines D0 through D5, PC701 or connector to main board PC1.

m. One section of read-out not operating.

- Defective readout V701 through V706, PC701

## 6-9 TRANSMITTER PROBLEMS

a. Low transmitter power output.

Refer to paragraph 6-1. Before proceeding to isolate the fault it is helpful if it is first found whether the problem is also common to the receiver. If this is the case then refer to paragraph 6-2. Again, substitute known good modules for PC101, PC201 and PC301 to isolate the problem area. Problems could be caused by:

- Defective Q101.
- Open circuit choke, L110 through L113.
- Open circuit inductor L114.
- Open circuit diode CR103, CR104 or incorrect supply voltages.
- CR107 shorted or not opening due to incorrect supply voltages.
- Defective Q103.
- Defective Q206, Q207.
- Defective diode, CR210 through CR213.
- Defective CR214.
- Defective Q301, Q302.
- Defective Q303, Q304. Quite often only one transistor will fail and it is difficult to determine which is the defective transistor without replacing both. If a .1 mfd disc capacitor connected from one collector to ground causes an increase in transmitter output there is good reason to suppose that device is defective.
- Defective Q305 or misadjusted R314. If the bias is low, transmitter output will also be low and the oscilloscope waveform will be abnormally "spiky". The amplifier will tend to reproduce only large input signals with room noise noticeably absent. See paragraph 5-28 for bias adjustment.
- ALC control C24 incorrectly adjusted, not allowing the output to rise sufficiently. See paragraph 5-37 for procedure.
- Shorted antenna tuner variable capacitor plates, C901. These plates are closely spaced and easily bent.
- Low battery voltage.

b. Balanced modulator not balancing.

- Controls C246 or R258 out of adjustment. Refer to paragraph 5-26d for adjustment procedure.
- Defective diode CR210 through CR213.
- Carrier generator not on frequency. In this instance, one sideband only will show considerable carrier. Refer to paragraph 5-26 for adjustment procedure.
- Unwanted signal present: AM relay staying on. Oscillation or other spurious signal. Generally, when a frequency other than the BFO/Carrier generator is present, some ripple will be contained on the carrier. May also be caused by introduced 50 Hz or 60 Hz hum from external power supplies.

c. No AM carrier.

- Defective relay K2.
- Defective or misadjusted potentiometer R259.

d. No CW output.

- Defective Q205 or U203.
- R237 or R240 misadjusted. Refer to paragraph 5-26h - j.

e. No tune output.

- As for 6-8.

f. Antenna bridge. No reflected power indication.

- Check with antenna disconnected. If still no output check for defective diode CR3.

g. Antenna bridge. No forward power indication.

- Defective diodes CR4, CR5.

h. No ALC control.

- ALC control C24 not properly adjusted. See paragraph 5-37 for procedure.
- Defective ALC/AGC transistor Q104.
- Defective C145, C147.

i. Thermal relay, CB1, will not stay closed. Short on +12 volt line may be caused by the following:

- Defective C14.
- Defective Q302, Q303, Q304.
- Defective regulator or capacitor on one of the plug-in modules. Remove modules. If problem has cleared then replace modules one at a time until the defective module is found.

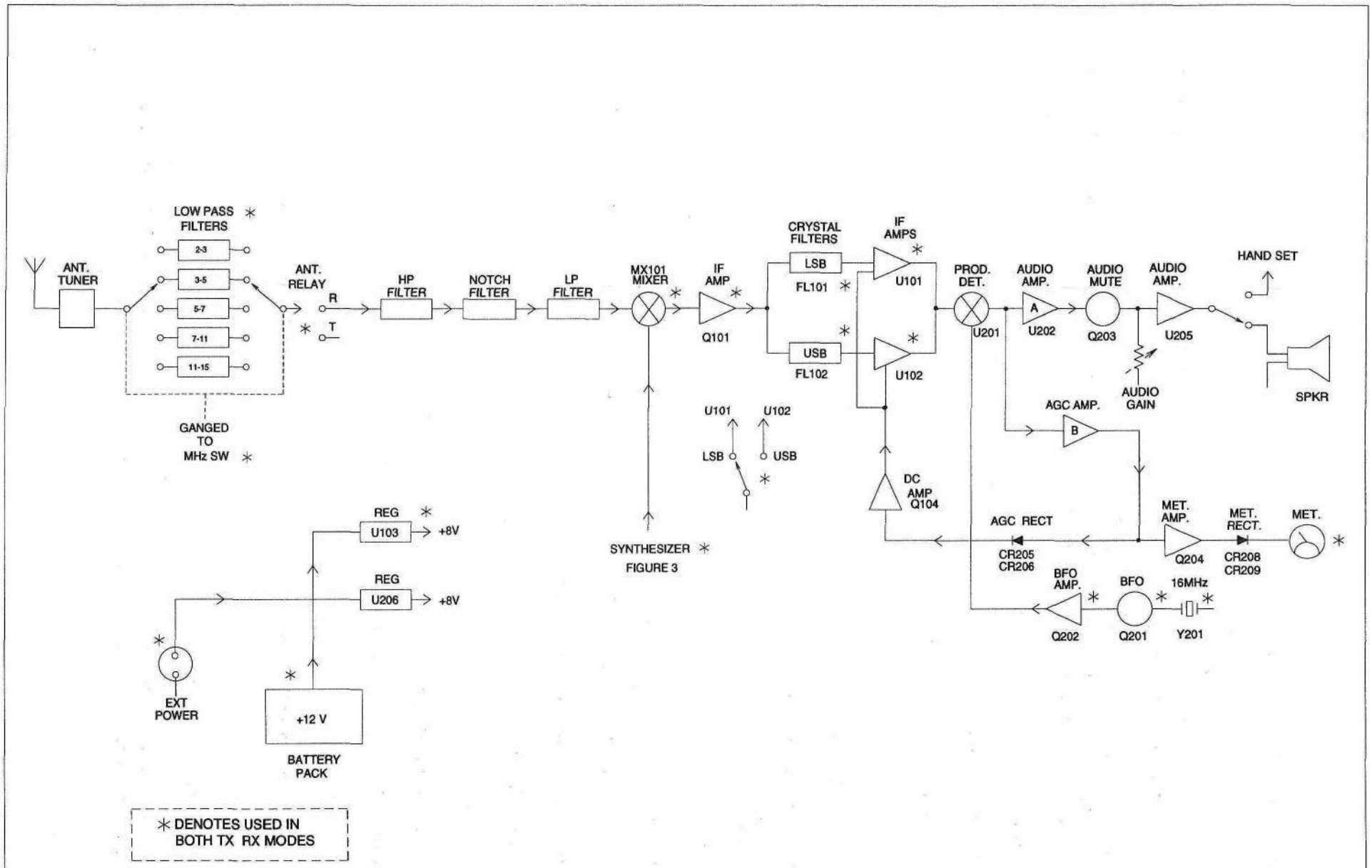



FIGURE 1-BLOCK DIAGRAM, RECEIVER

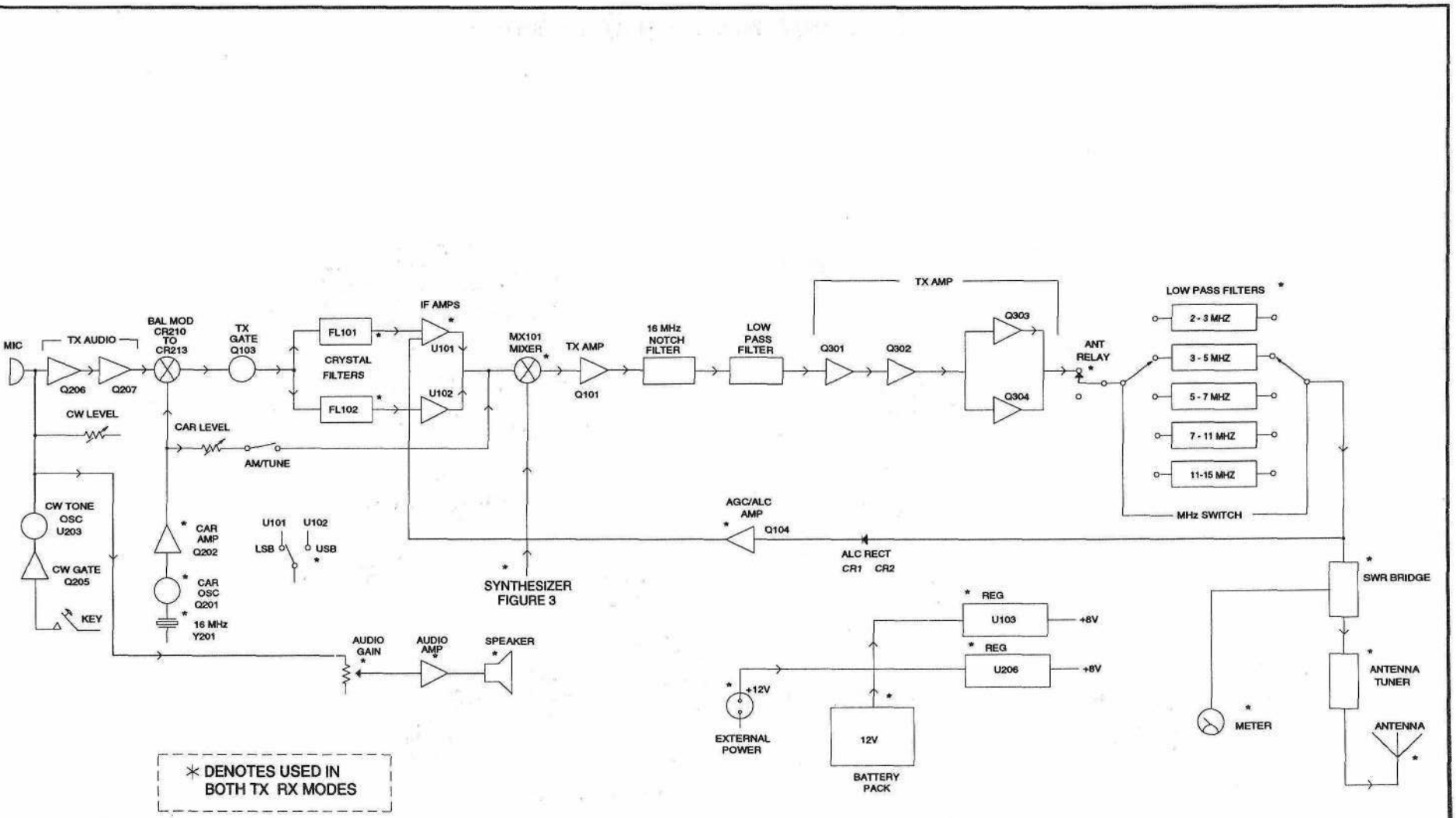



FIGURE 2-BLOCK DIAGRAM, TRANSMITTER

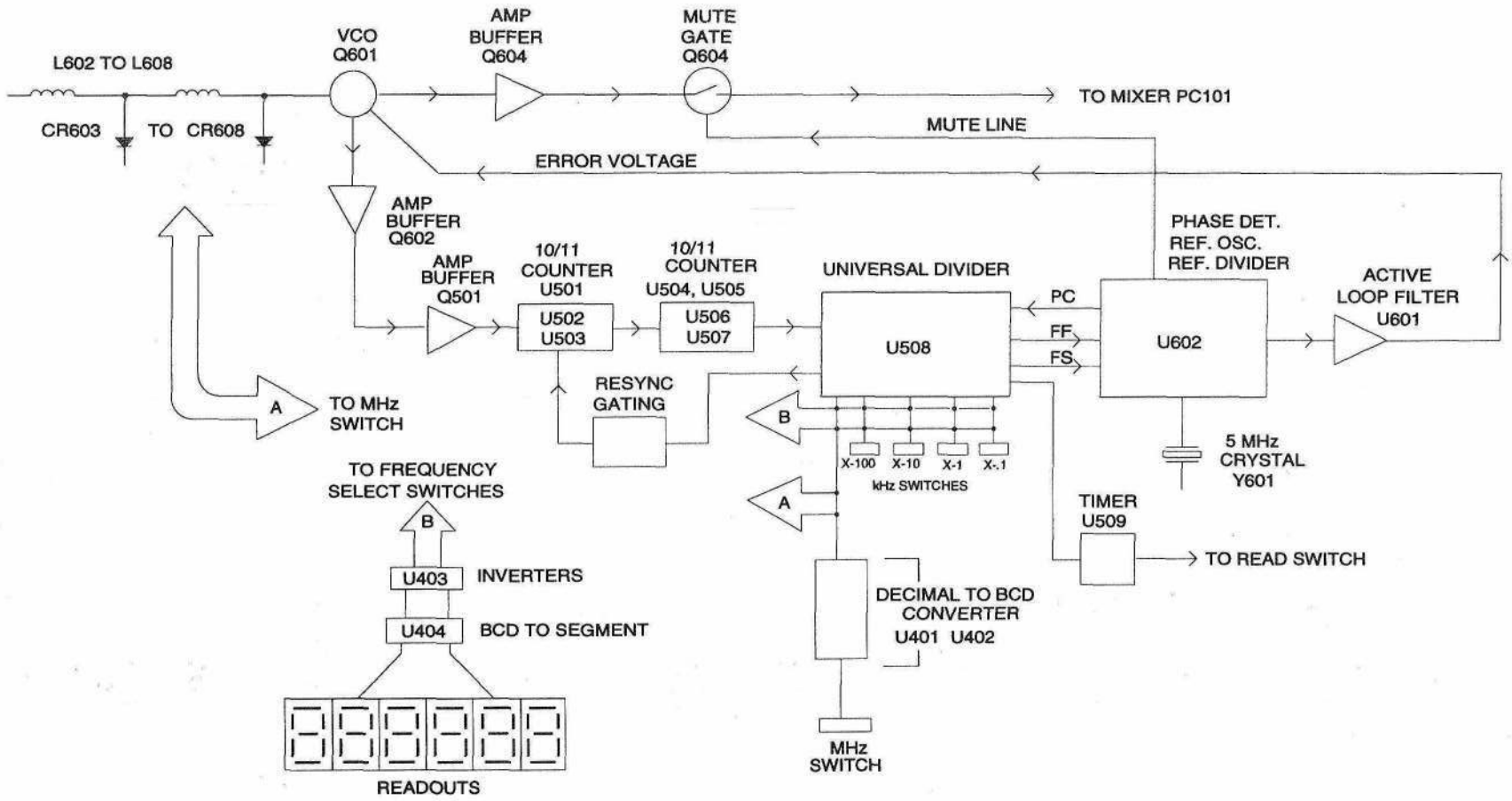



FIGURE 3-BLOCK DIAGRAM, SYNTHESIZER

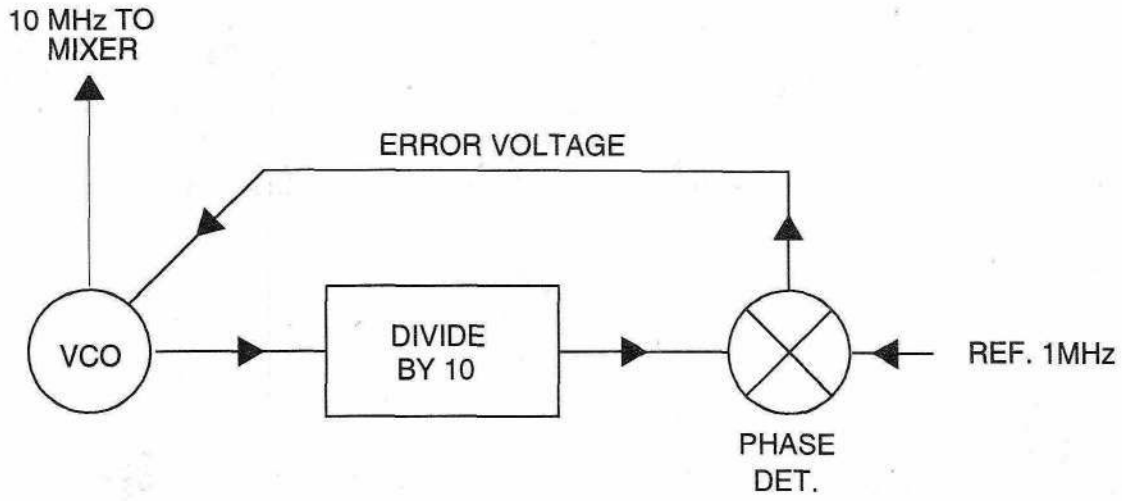



FIGURE 4-BLOCK DIAGRAM, TYPICAL PLL SYSTEM

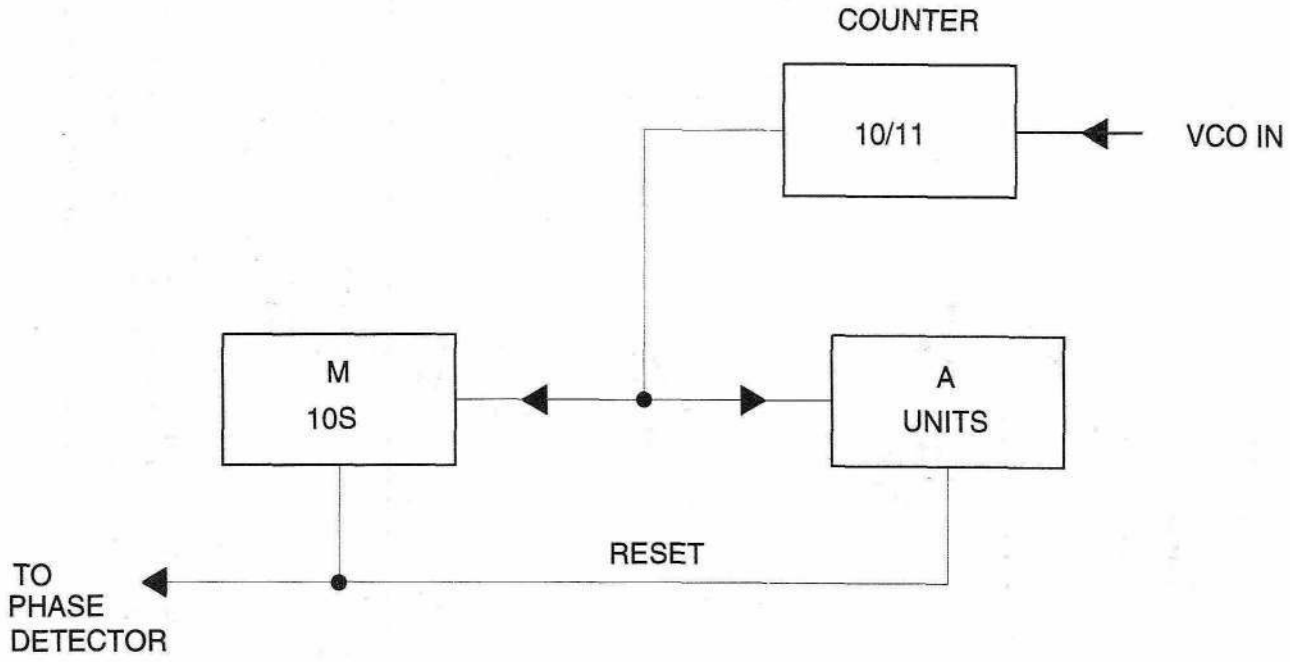



FIGURE 5-BLOCK DIAGRAM, TYPICAL 10/11 COUNTER

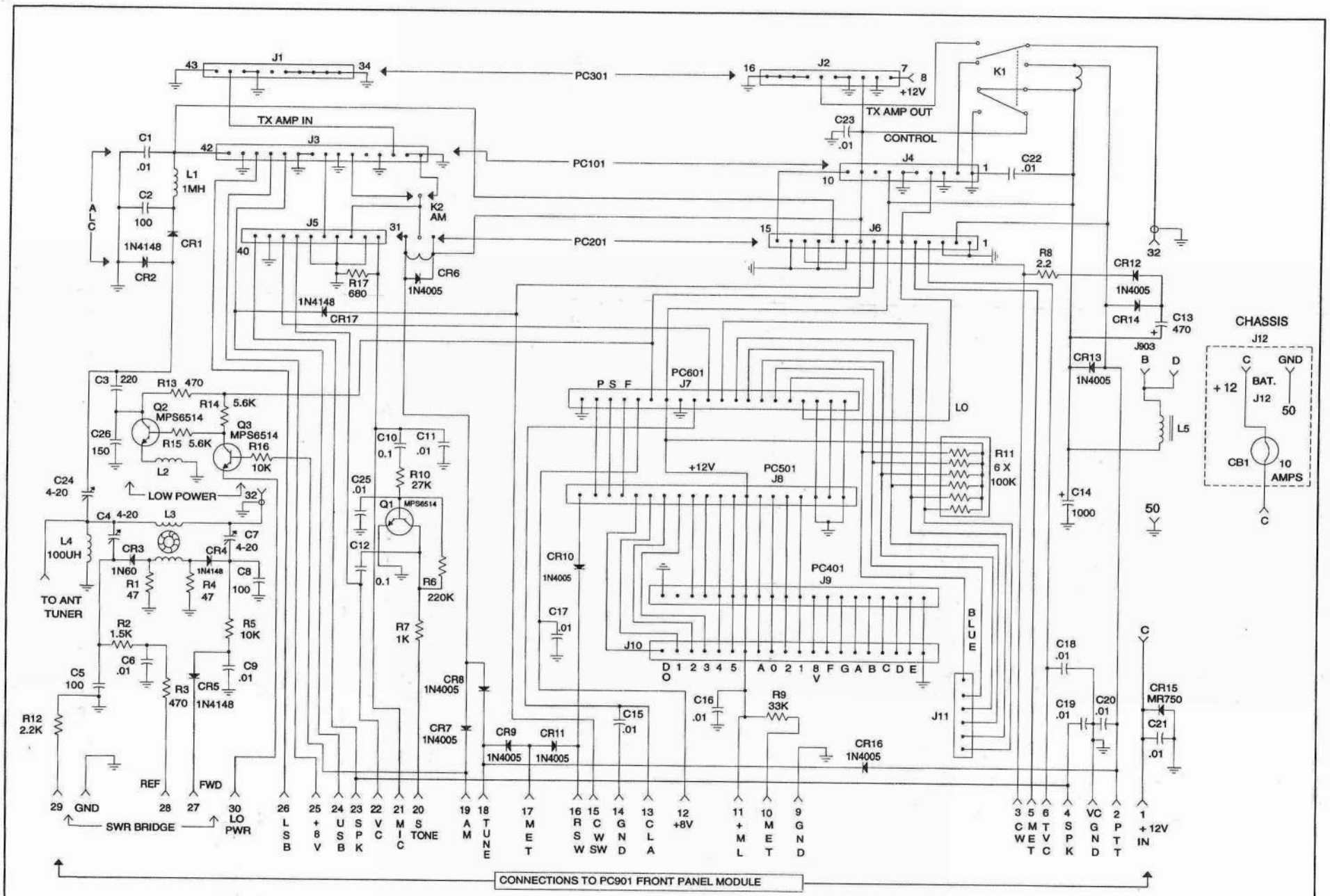



FIGURE 6-SCHEMATIC DIAGRAM, PC1, MOTHER BOARD

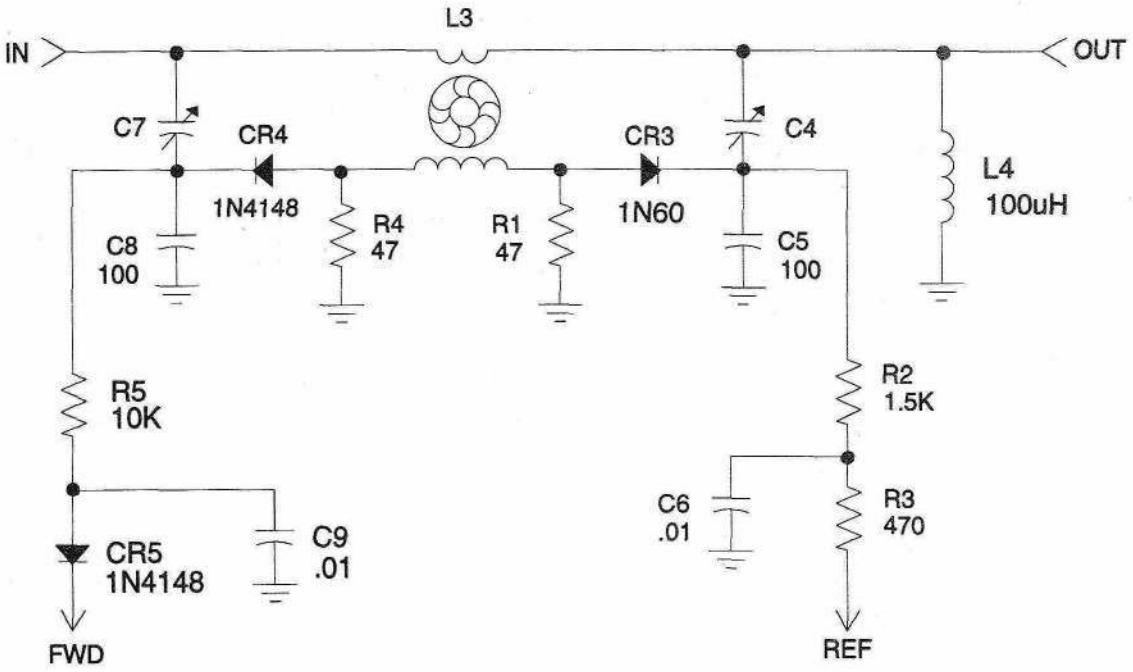



FIGURE 7-SCHEMATIC DIAGRAM, SWR BRIDGE

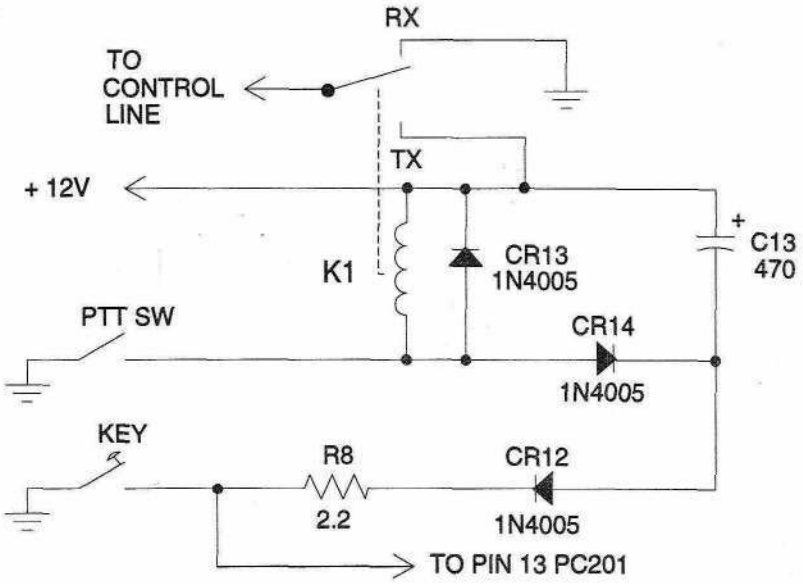



FIGURE 8-SCHEMATIC DIAGRAM, CW BREAK-IN CIRCUITRY

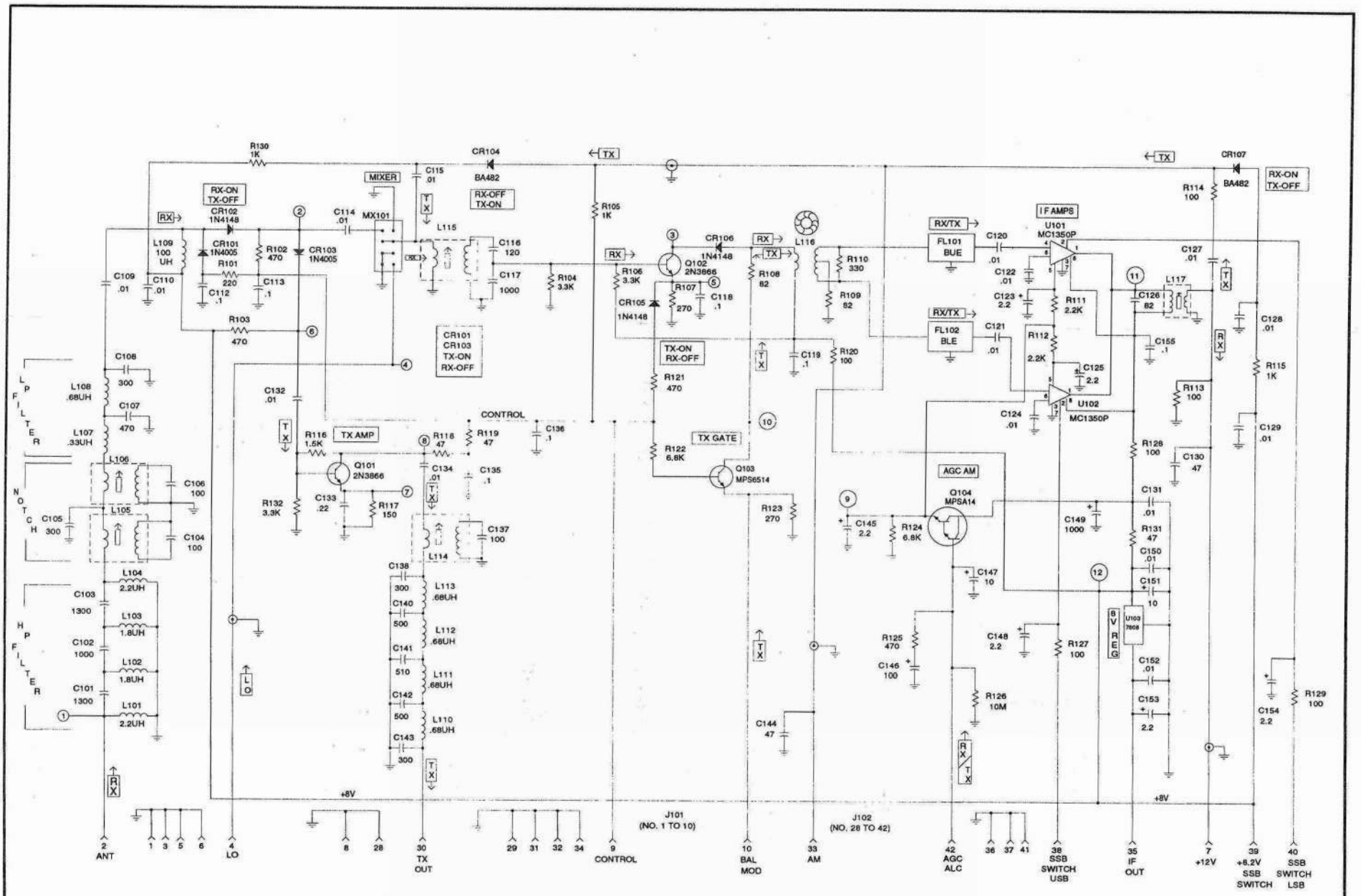



FIGURE 9-SCHEMATIC DIAGRAM, PC101, RECEIVER, TRANSMITTER, MIXER AND IF FUNCTIONS

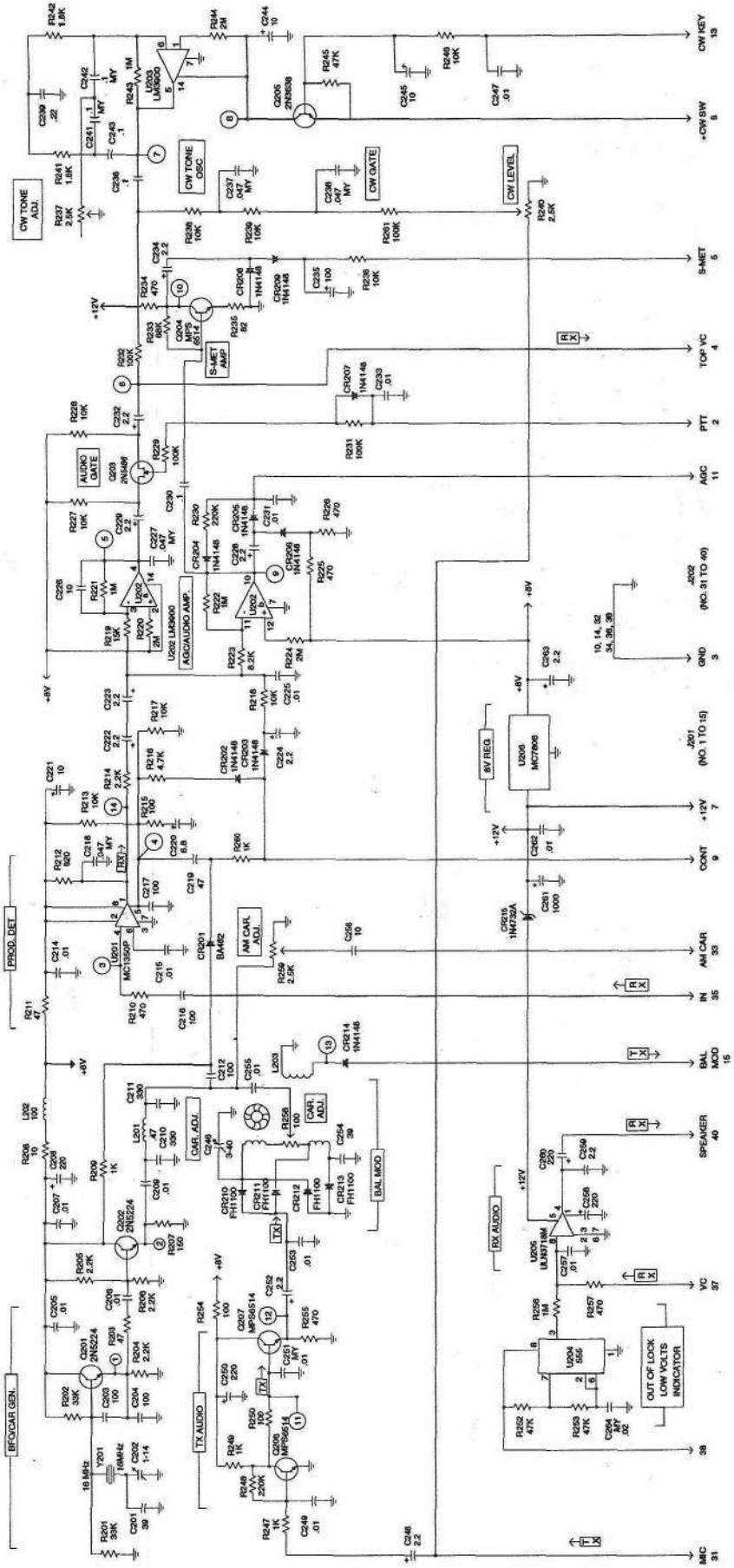



FIGURE 10-SCHEMATIC DIAGRAM, PC201, BFO/CARRIER GENERATOR

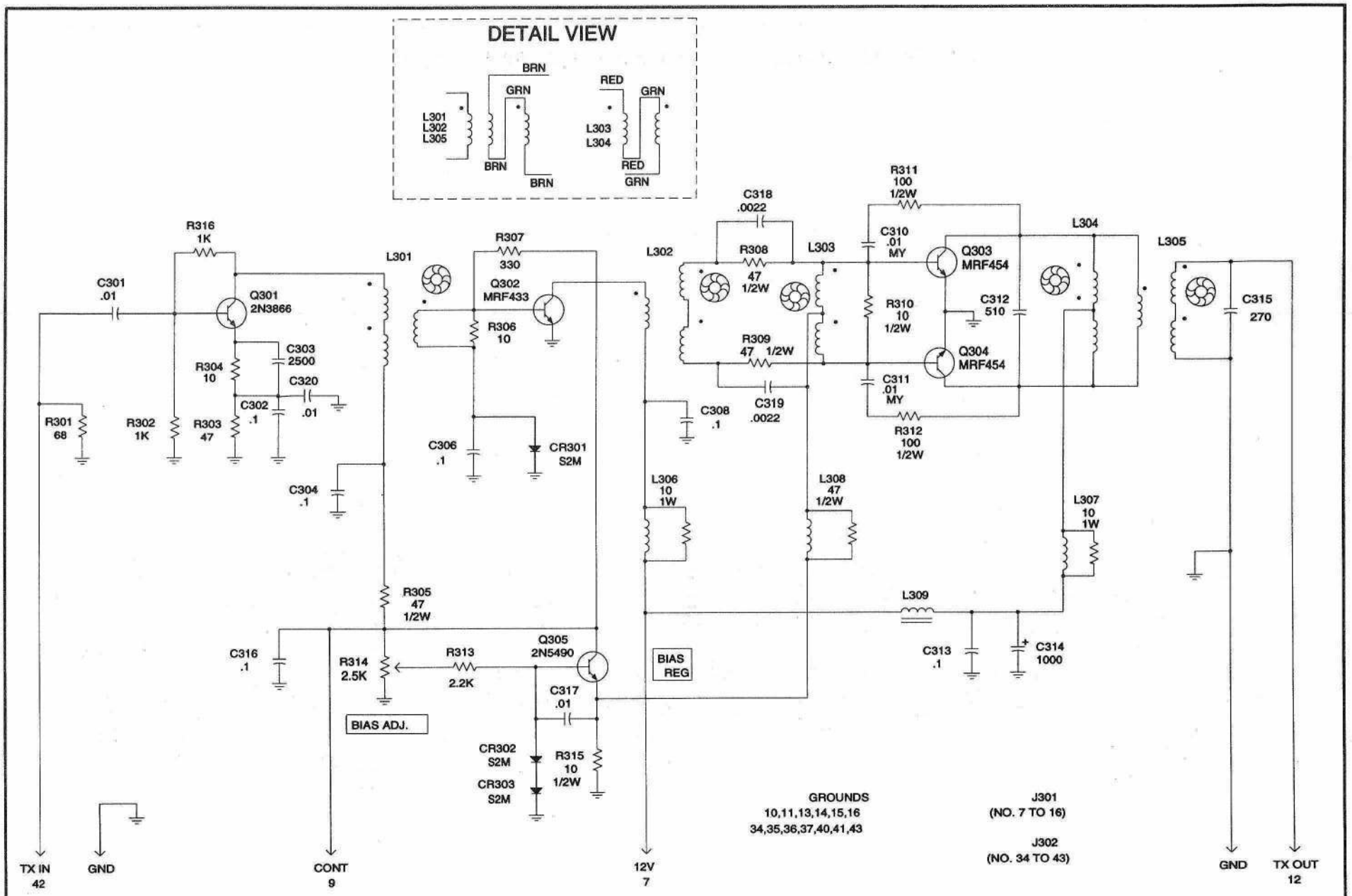



FIGURE 11-SCHEMATIC DIAGRAM, PC301, TRANSMITTER LINEAR AMPLIFIER

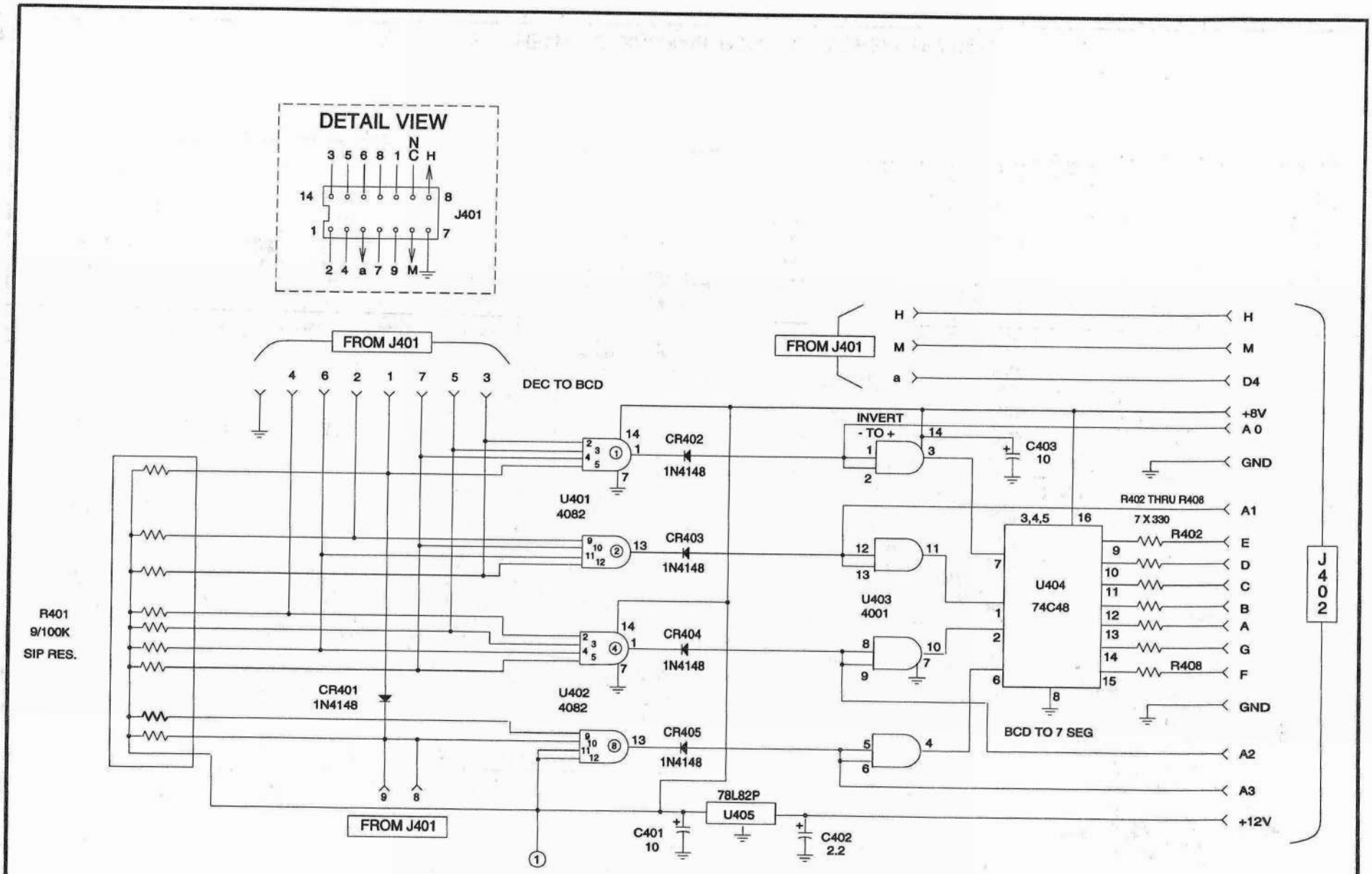



FIGURE 12-SCHEMATIC DIAGRAM, PC401, BCD SIGNAL CONVERTER

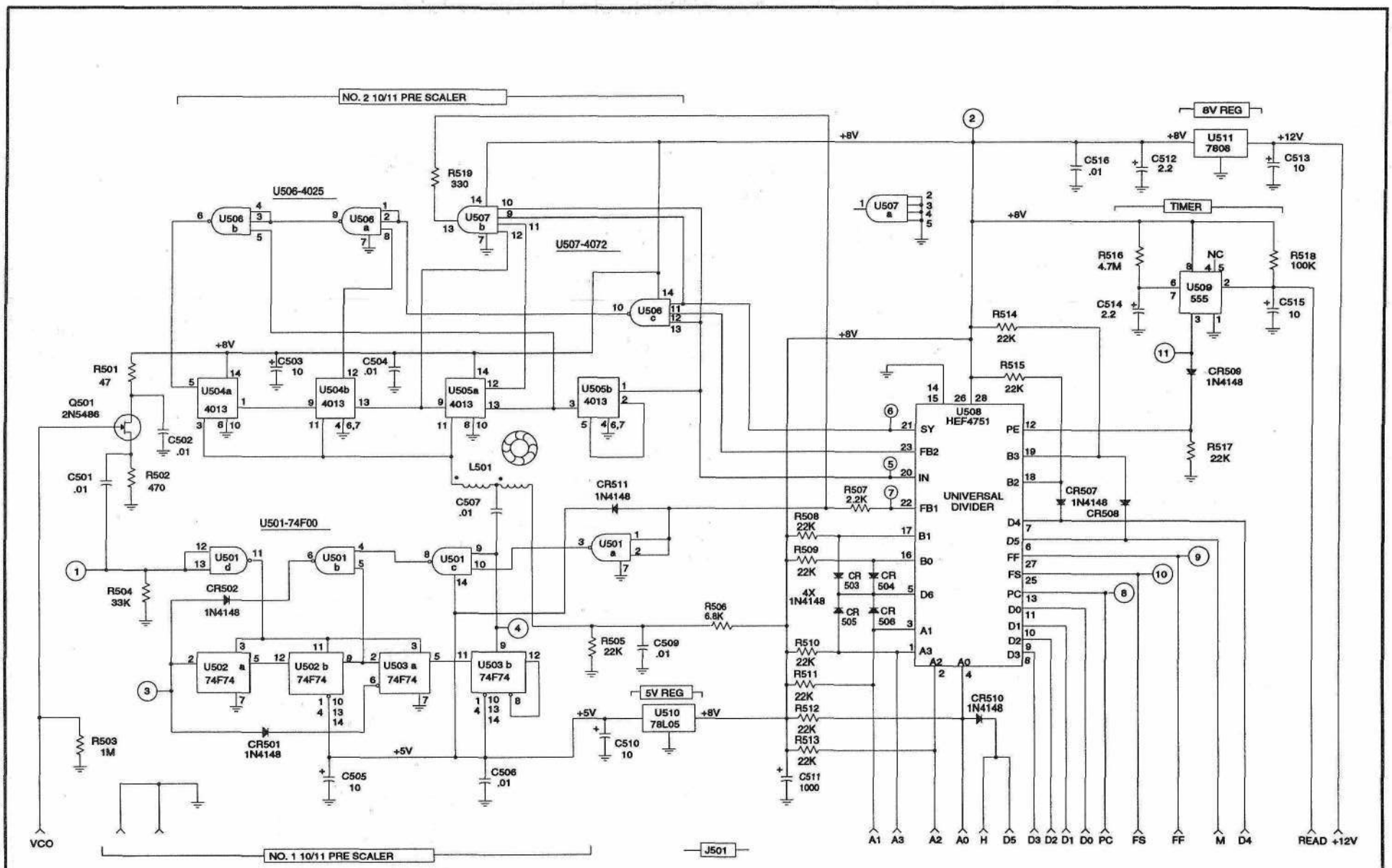



FIGURE 13-SCHEMATIC DIAGRAM, PC501, UNIVERSAL DIVIDER

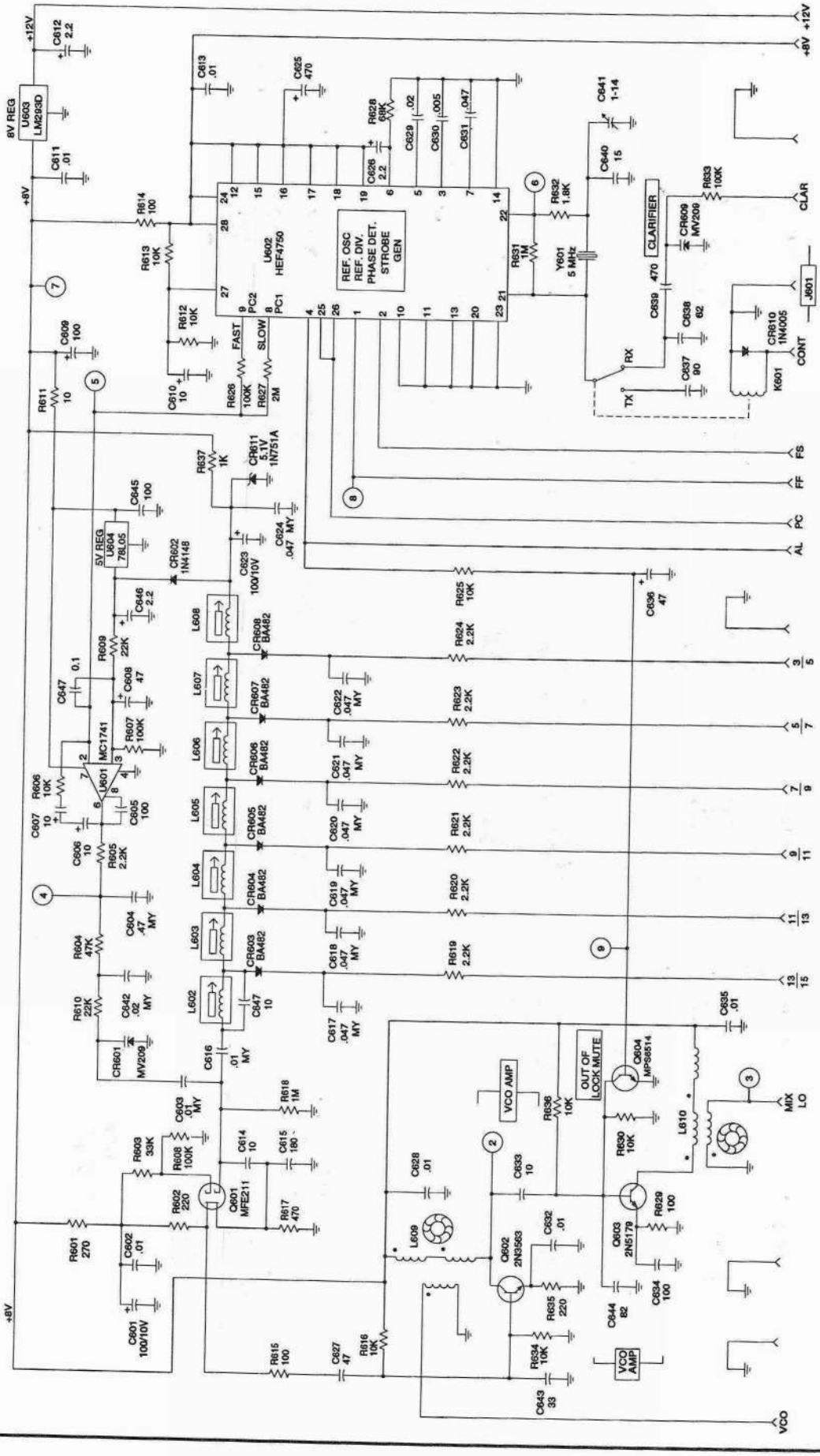



FIGURE 14-SCHEMATIC DIAGRAM, PC601, MASTER OSCILLATOR AND DETECTORS

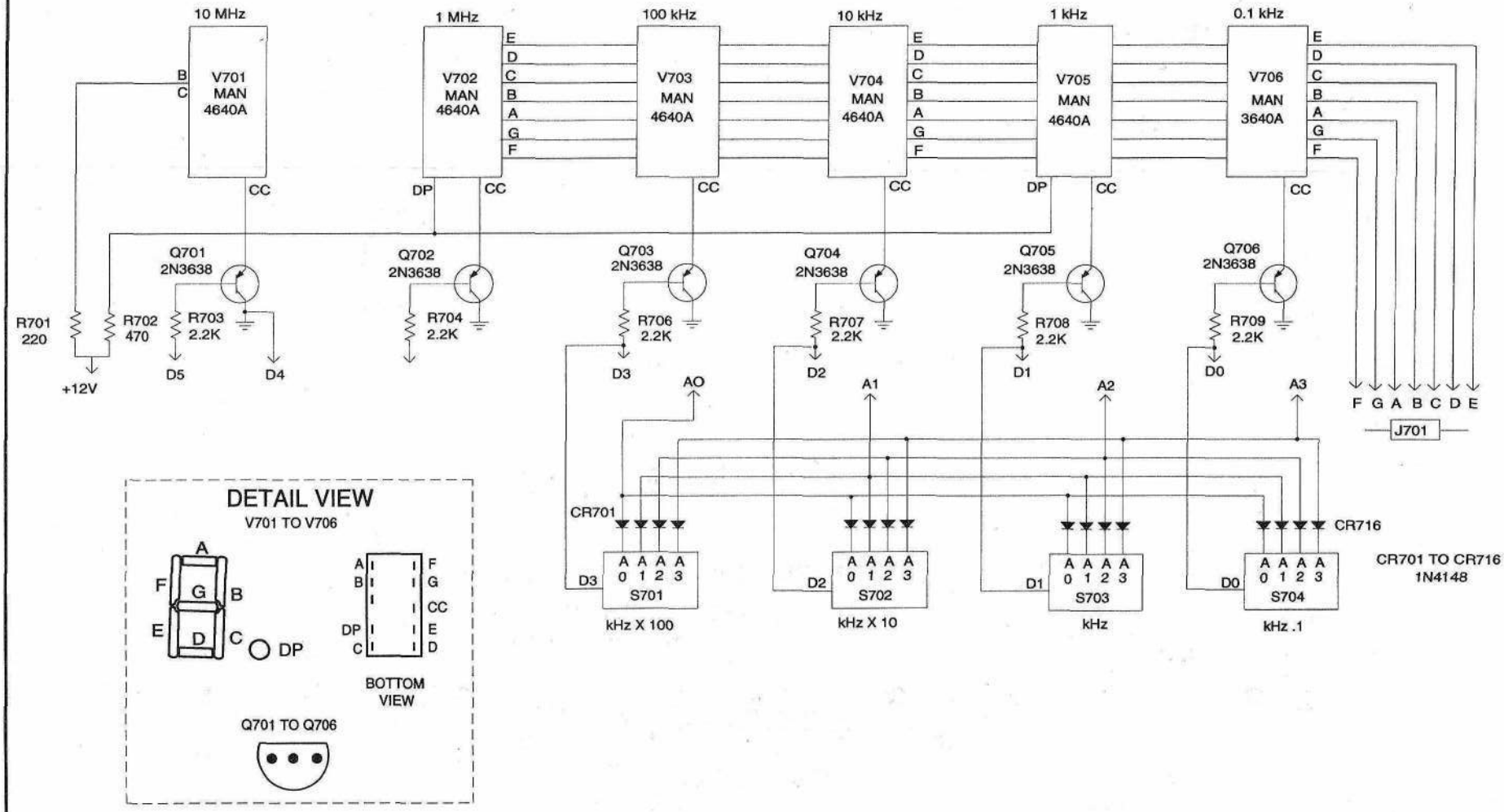



**FIGURE 15 - SCHEMATIC DIAGRAM, PC701, LED READ-OUTS AND FREQUENCY SELECTOR SWITCHES**

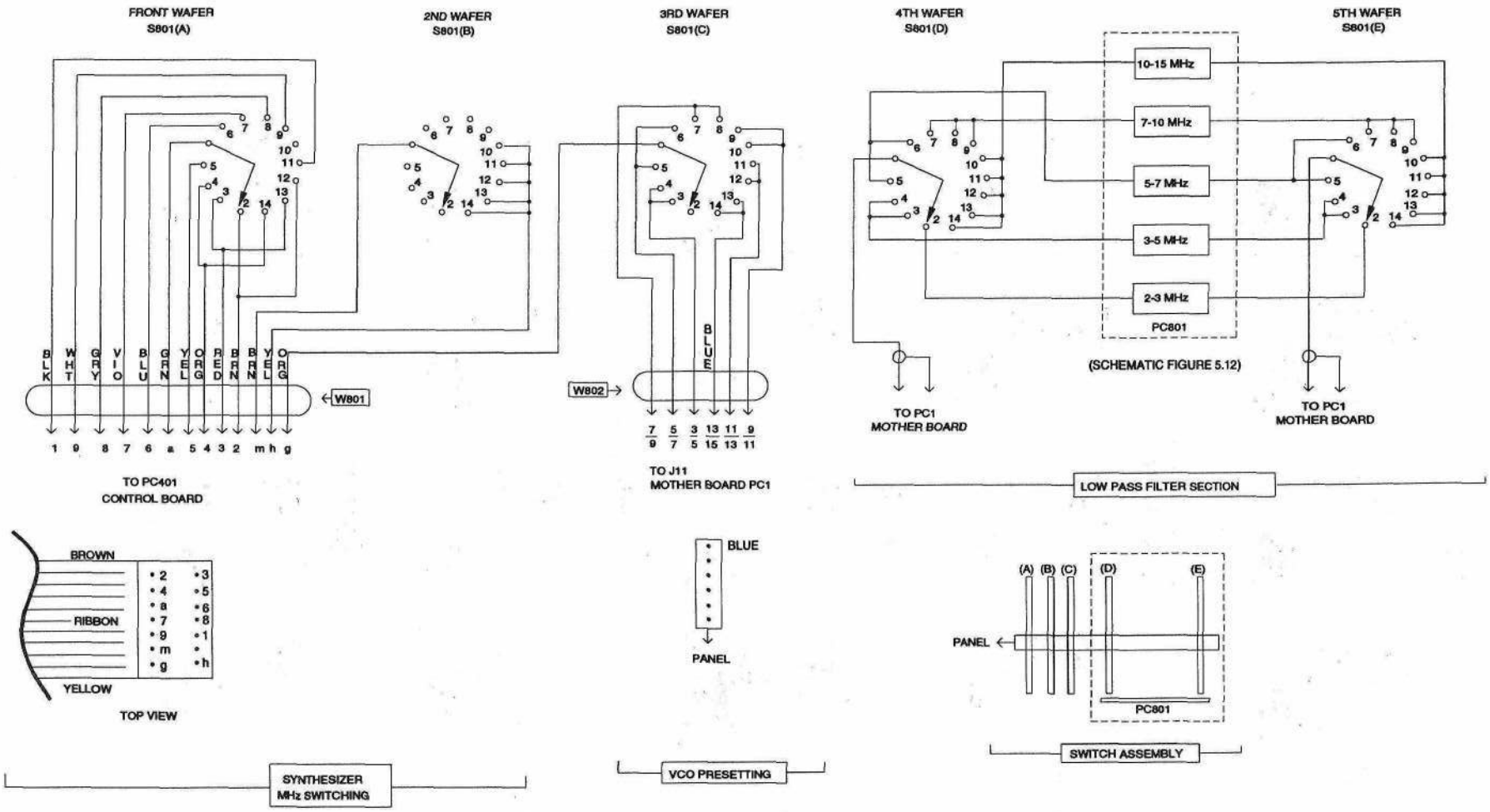



FIGURE 16-SCHEMATIC DIAGRAM, P801, PC801 AND S801 MHz SWITCH ASSEMBLY

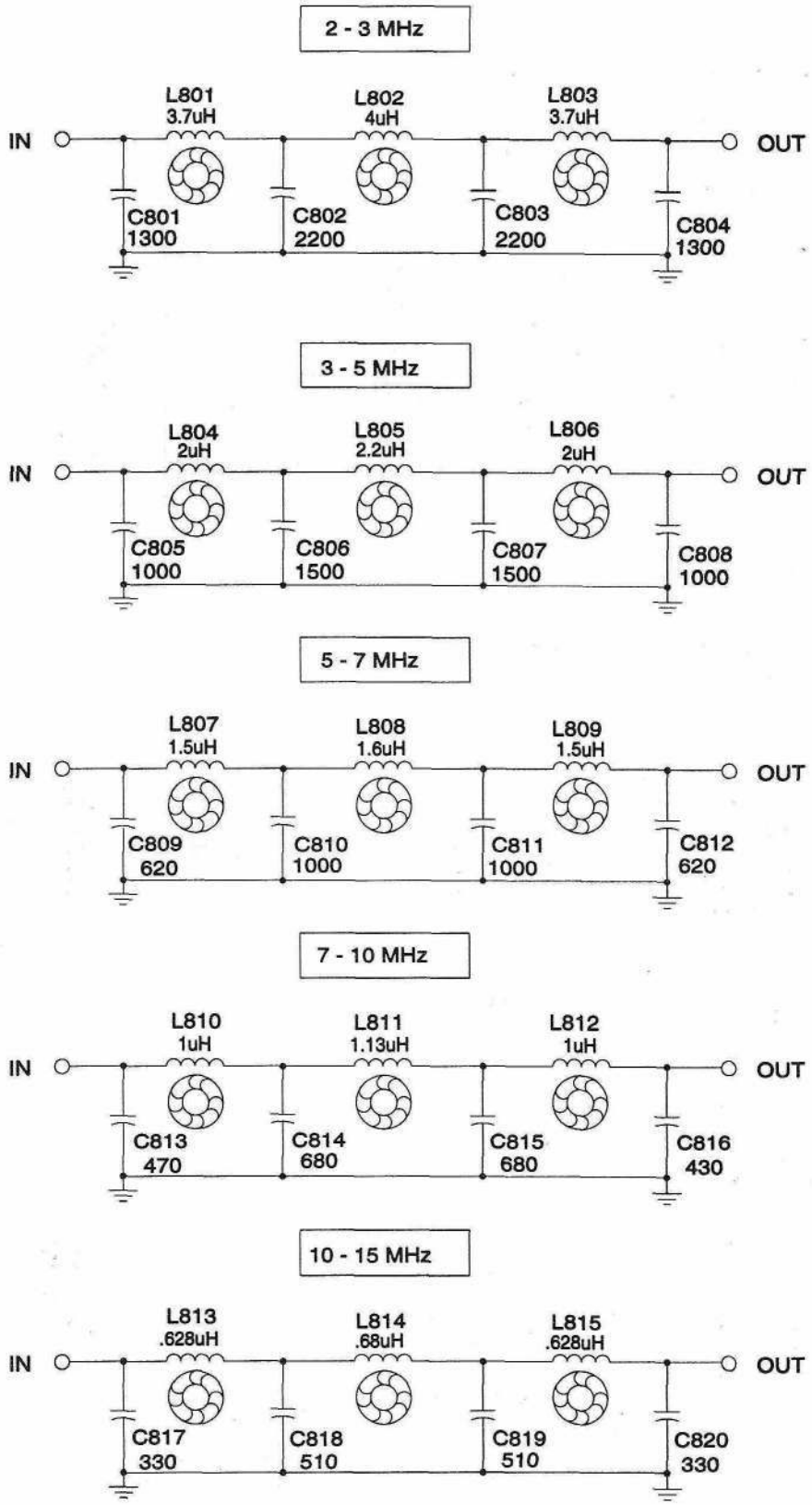
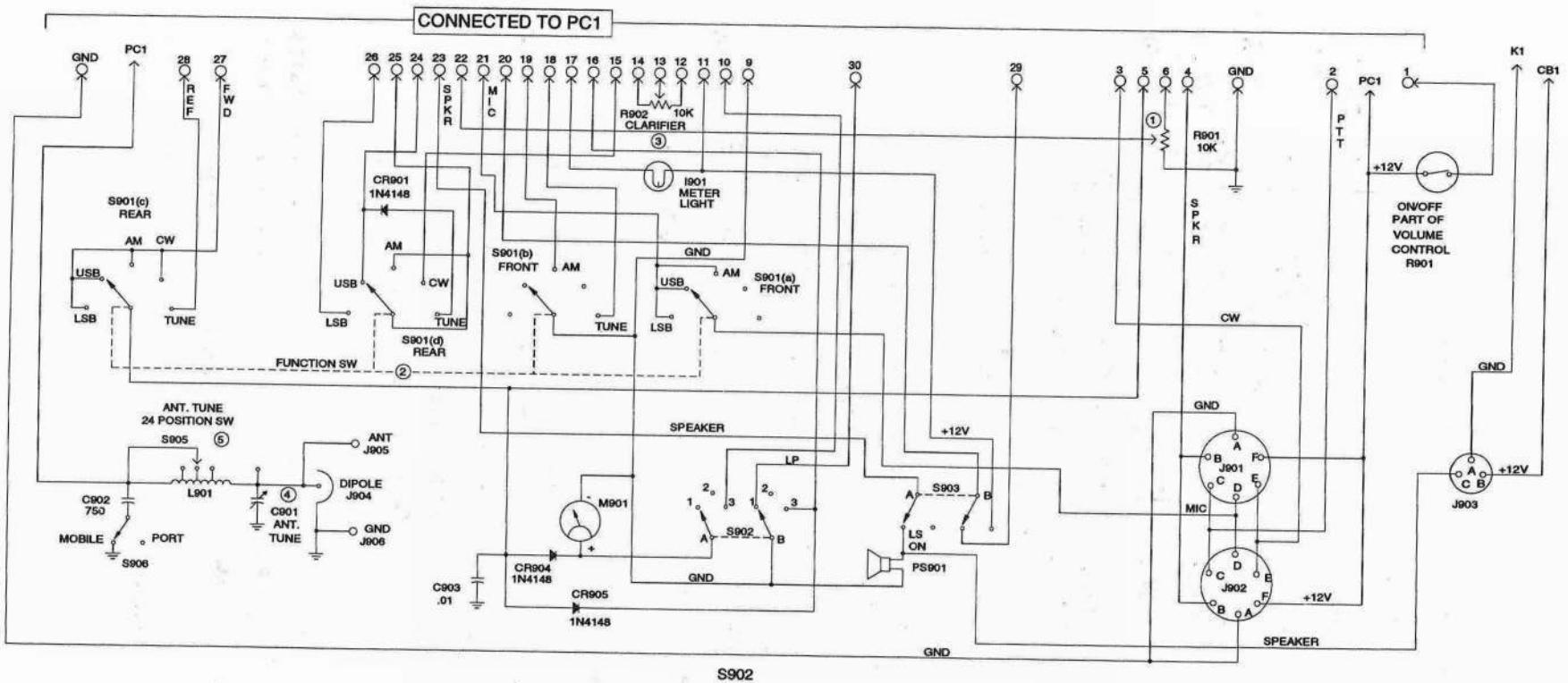



FIGURE 17-SCHEMATIC DIAGRAM, PC801 LOW PASS FILTER




S902

1 LOW POWER ON

2 OPERATE OFF

3 READ/BATTERY TEST (ON)

FIGURE 18-SCHEMATIC DIAGRAM, P901 FRONT PANEL

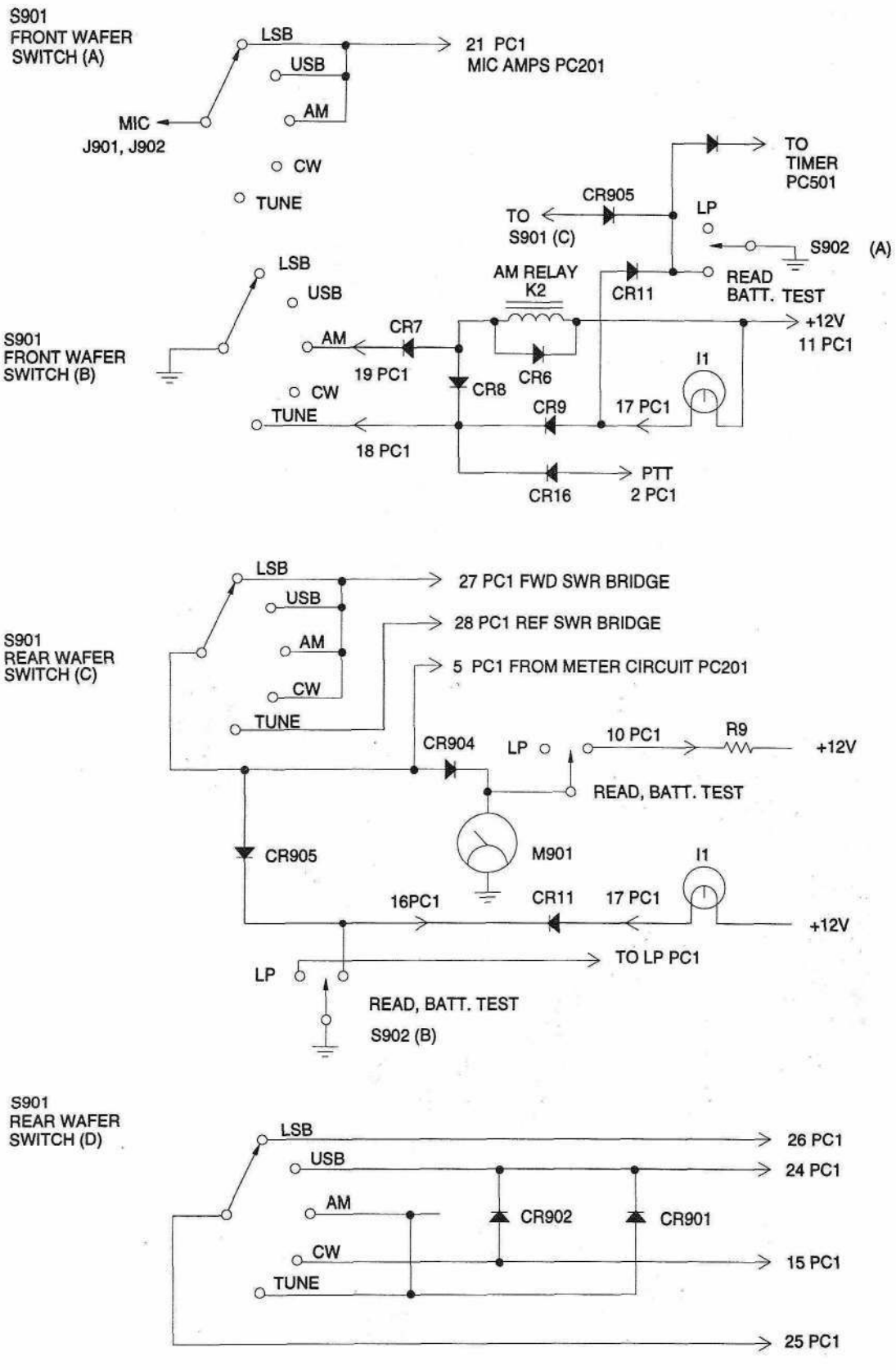



FIGURE 19-SCHEMATIC DIAGRAM, S901/S902 SIMPLIFIED SWITCH CONNECTIONS

| DIPOLE ANTENNA - APPROXIMATE NUMBER OF TURNS ALLOWED | | | | | |
|---|---|---|---|---|---|
| MHz | TURNS * | MHz | TURNS * | MHz | TURNS |
| 2.0 | 64 | 4.0 | 31 | 9.0 | 13 |
| 2.2 | 57 | 4.5 | 27 | 9.5 | 12 |
| 2.4 | 52 | 5.0 | 24 | 10.0 | 11 |
| 2.6 | 47 | 5.5 | 22 | 10.5 | 11 |
| 2.8 | 46 | 6.0 | 20 | 11.0 | 10 |
| 3.0 | 42 | 6.5 | 18 | 11.5 | 10 |
| 3.2 | 40 | 7.0 | 17 | 12.0 | 9 1/2 |
| 3.4 | 37 | 7.5 | 16 | 13.0 | 9 |
| 3.6 | 35 | 8.0 | 15 | 14.0 | 9 |
| 3.8 | 33 | 8.5 | 14 | 15.0 | 8 |

*Indicates number of turns REMOVED from each spool.
*» Note: A turn is a complete circle.*

1) Remove dipole turns in accordance with the table and install antenna as high as possible. Connect coax cable to DIPOLE socket.

2) Set ANT TUNE controls to DIPOLE and set transceiver to desired frequency.

3) Set FUNCTION switch to TUNE and note meter reading. If not in green portion of scale vary transceiver frequency each side of desired frequency. A lower meter reading obtained when the frequency is lowered indicates the antenna is too long. A lower reading, when the frequency is increased, indicates the antenna is too short. Always adjust for minimum reading (TUNE) position of FUNCTION switch only). Work back and forth until the meter needle is in the green section.

**FIGURE 20 - DIPOLE ANTENNA - APPROXIMATE NUMBER OF TURNS ALLOWED**

## WHIP ANTENNA APPROXIMATE CONTROL SETTINGS

| FREQUENCY | UPPER CONTROL | LOWER CONTROL |
|---|---|---|
| 2.0 MHz | 1 | 2 |
| 2.5 MHz | 2 | 2 |
| 3.0 MHz | 3 | 1 1/2 |
| 4.0 MHz | 6 | 1 1/2 |
| 5.0 MHz | 7 | 1 1/2 |
| 6.0 MHz | 9 | 1 1/2 |
| 7.0 MHz | 10 | 1 1/2 |

| FREQUENCY | UPPER CONTORL | LOWER CONTROL |
|---|---|---|
| 8.0 MHz | 11 | 1 |
| 9.0 MHz | 12 | 1 1/2 |
| 10.0 MHz | 13 | 1 |
| 11.0 MHz | 14 | 1 1/2 |
| 12.0 MHz | 16 | 2 |
| 13.0 MHz | 17 | 2 |
| 14.0 MHz | 18 | 2 |
| 15.0 MHz | 19 | 3 1/2 |

Operator should first tune upper control for maximum receiver noise or signal. Then set FUNCTION switch to TUNE and turn the upper ANT TUNE control for minimum meter reading. Next adjust the lower ANT TUNE control for minimum. Readjust upper control until the meter needle is in the green section.

**FIGURE 21 - WHIP ANTENNA APPROXIMATE CONTROL SETTINGS**

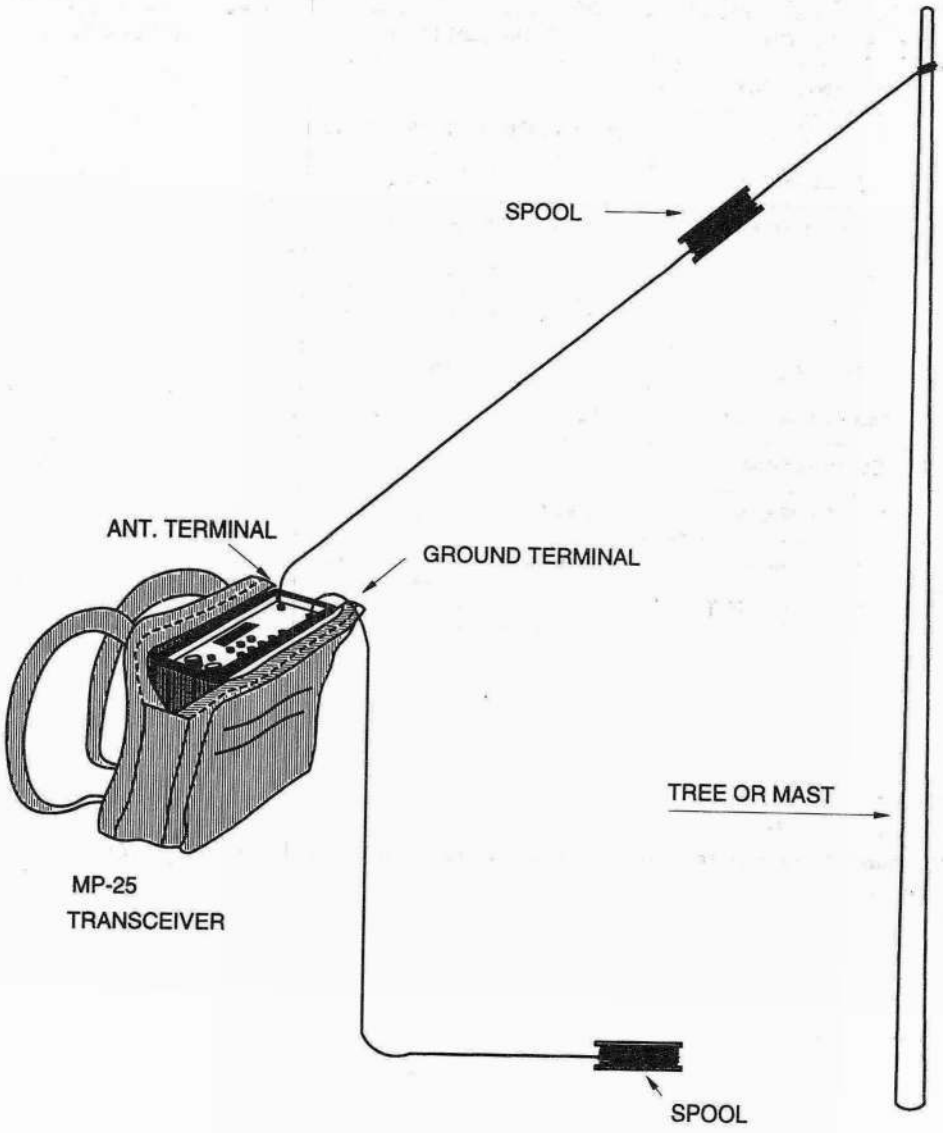



FIGURE 22-DRAWING, LONGWIRE ANTENNA

The following voltage charts were recorded using a Tektronix oscilloscope, Mode #2213, and a Hewlett Packard Model 410B VTVM. If other voltmeters are used they should be of a type not affected by RF. Many inexpensive multimeters are so affected. Due to component tolerances, readings may vary from those given.

**FIGURE 23 - VOLTAGE CHART, PC101 WITH PC301 REMOVED**

| TEST POINT | LOCATION | TRANSMIT MODE | RECEIVE MODE |
|---|---|---|---|
| 1 | ANTENNA INPUT | | SIGNAL INPUT |
| 2 | MIXER INPUT | 10.0 VVDC 0.15 V P-P SEE NOTE 1 | 7.0 VDC |
| 3 | COLLECTOR Q102 | 4.0 VDC | 6.0 VDC |
| 4 | L.O. VOLTAGE TO MIXER | 0.7 V P-P, SEE NOTE 2 | 0.7 V P-P |
| 5 | EMITTER Q102 | 4.0 VDC | 2.5 VDC |
| 6 | INPUT Q101 | 8.7 VDC, 0.15 V P-P SEE NOTE 1 | 8.0 VDC |
| 7 | EMITTER Q101 | 4.5 VDC | - |
| 8 | COLLECTOR Q101 | 8.0 VDC, 1.5 V P-P SEE NOTE 1 | - |
| 9 | EMITTER Q104 | 2.5 VDC, SEE NOTE 3 | 2.5 VDC, SEE NOTE 3 |
| 10 | COLLECTOR Q103 | 1 VDC, 1.6 V P-P SEE NOTE 1 | 6.7 VDC |
| 11 | OUTPUT U101/U102 | 7.2 VDC, 1.5 V P-P SEE NOTE 1 | 7.2 VDC |
| 12 | REGULATOR OUTPUT | +8 V | +8 V |

*» NOTE 1: Loud Whistle*
*» NOTE 2: At a frequency of 4 MHz*
*» NOTE 3: No-signal condition. Will increase with received signal and in transmit mode when ALC is operating and PC301 operational.*

| FIGURE 24 - VOLTAGE CHART, PC201 WITH PC301 REMOVED | | | |
|---|---|---|---|
| **TEST POINT** | **LOCATION** | **TRANSMIT MODE** | **RECEIVE MODE** |
| 1 | EMITTER Q201 | 4.0 VDC, 2.2 V P-P | 4.0 VDC, 2.2 V P-P |
| 2 | EMITTER Q202 | 2.5 VDC, 2.1 V P-P | 2.5 VDC, 2.1 V P-P |
| 3 | INPUT U201 | 2.4 VDC | 2.4 VDC |
| 4 | U201 PIN 5 | 7.5 VDC | 3.7 VDC |
| 5 | OUTPUT U202a | O VDC | 4.4 VDC |
| 6 | OUTPUT Q203 | 0V DC | 50 MV P-P, SEE NOTE 1, SINEWAVE 2.8 V P-P, SEE NOTE 2 |
| 7 | OUTPUT U203 | 4 VDC, SEE NOTE 3, SINEWAVE 6 V, P-P, SEE NOTE 3 | 0V DC |
| 8 | COLLECTOR Q205 | 8.0 DC, SEE NOTE 3 | .5 VDC |
| 9 | OUTPUT U202b | 0 VDC | 4.2 VDC, 1.5 V P-P,. SEE NOTE 2 |
| 10 | COLLECTOR Q204 | 5.8 VDC | 5.8 VDC, 4.0 V P-P, SEE NOTE 2 |
| 11 | BASE Q207 | 4.2 VDC, 1.5V - 2 VDC, SEE NOTE 4 | 4.2 VDC |
| 12 | EMITTER 207 | 3.5 VDC, 1.5V - 2VDC, SEE NOTE 4 | 3.5 VDC |
| 13 | OUTPUT L203 | 0.4 - 0.6 V P-P, SEE NOTE 4 | 0V DC |
| 14 | U205 PIN 4 | 6.0V DC | 6.0 VDC |
| 15 | OUTPUT U205 PIN 8 | 0 VDC | 0V DC, 2.8V P-P, SEE NOTE 5 & 1 |
| 16 | PIN 11 OF PCB | 3.2 VDC | 3.5 VDC |
| 17 | CATHODE OF C209 | .2 VDC | 3.4 DC SEE NOTE 2 |

*» NOTE 1: Noise Only.*
*» NOTE 2: 100 uV input signal at 7 MHz.*
*» NOTE 3: CW position, key pressed*
*» NOTE 4: LSB, Loud Whistle.*
*» NOTE 5: 9.5 VDC input, volume set A maximum*

## FIGURE 25 - VOLTAGE CHART, PC301

| POSITION | CONDITION | TRANSMIT MODE |
|---|---|---|
| BASE Q301 | NO SIGNAL | 4.0 VDC |
| EMITTER Q301 | NO SIGNAL | 3.2 VDC |
| COLLECTOR Q301 | NO SIGNAL | 8.0 VDC |
| BASE Q302 | NO SIGNAL | 0.7 VDC |
| COLLECTOR Q302 | NO SIGNAL | 12.0 VDC |
| BASE Q303/Q304 | NO SIGNAL | 0.58 VDC |
| COLLCTOR Q303/Q304 | NO SIGNAL | 11.8 VDC |
| COLECTOR Q303Q304 | LOUD WHISTLE | 11.0 VDC, SEE NOTE 1 |
| BASE Q305 | NO SIGNAL | 1.1 V |
| EMITTER Q305 | NO SIGNAL | 0.58 V |
| COLLECTOR Q305 | NO SIGNAL | 12 V |

» *NOTE 1: This reading dependent upon state of battery.*

## FIGURE 26 - VOLTAGE CHARGE PC401

| TEST POINT | LOCATION | RECEIVE MODE |
|---|---|---|
| 1 | REGULATOR OUTPUT | +8 V |

## FIGURE 27 - VOLTAGE CHART, PC501

| TEST POINT | LOCATION | RECEIVE MODE |
|---|---|---|
| 1 | SOURCE Q501 | 2.0 VDC, 2.3 V P-P (SINEWAVE) |
| 2 | OUTPUT IC511 | 8.0 VDC |
| 3 | PIN 2, IC502a | 1 VDC, 2 V P-P, SEE FIGURE 6.4 |
| 4 | PIN 9 IC503b | 3.5 V P-P SEE FIGURE 6.5 |
| 5 | PIN 20, IC508 | 8.0 V P-P, SEE FIGURE 6.6 |
| 6 | PIN 21, IC508 | 8.0 V P-P, SEE FIGURE 6.7 |
| 7 | PIN 22, IC508 | 8.0 V P-P, SEE FIGURE 6.8 |
| 8 | PIN 13, IC508 | 8.0 V P-P, SEE FIGURE 6.9 |
| 9 | PIN 27, IC508 | 4.0 VDC, 8.0 V P-P, SEE FIGURE 6.10 |
| 10 | PIN 25, IC508 | 7.2 VDC, 8.0 V P-P, SEE FIGURE 6.11 |
| 11 | PIN 3, IC509 | 0 VDC (READ SW IN CENTER POSITION) 6.5 VDC (READ SW ACTIVIATED) |

## FIGURE 28 - VOLTAGE CHARTS, PC601

| TEST POINT | LOCATION | RECEIVE MODE |
|---|---|---|
| 1 | DRAIN Q601 | 7.5 VDC, AT 7 MHz, 0.3 - 0.4 V P-P AT 7 MHz (SINEWAVE) |
| 2 | COLLECTOR Q602 | 7.8 VDC, SEE FIGURE 6.12 4 - 6 V P-P AT 7 MHz |
| 3 | OUTPUT L601 | 1.5-2.5 V P-P AT 7 MHz |
| 4 | OUTPUT U601 (LOCK LINE) IN LOCK CONDITION | 3 VDC, AT 7 MHZ, 4.4 VDC AT 8 MHz, 5.9 VDC AT 8.999MHz |
| 5 | INPU Q601 (IN LOCK CONDITION) | 3.8 VDC AT 7 MHz |
| 6 | PIN 22, U602 95 MHz REF. OSC.) | 4.4 VDC, 8.0 V P-P (SINEWAVE) |
| 7 | REGULATOR OUTPUT | 8.0 VDC |
| 8 | PIN 1, U602 | 4.0 VDC, 8.0 V P-P, SEE FIGURE 6.13 |
| 9 | BASE Q604 (IN LOCK CONDITION) | 0 VDC |
| | BASE Q604 (OUT-OF-LOCK CONDITION) | 0.65 VDC |

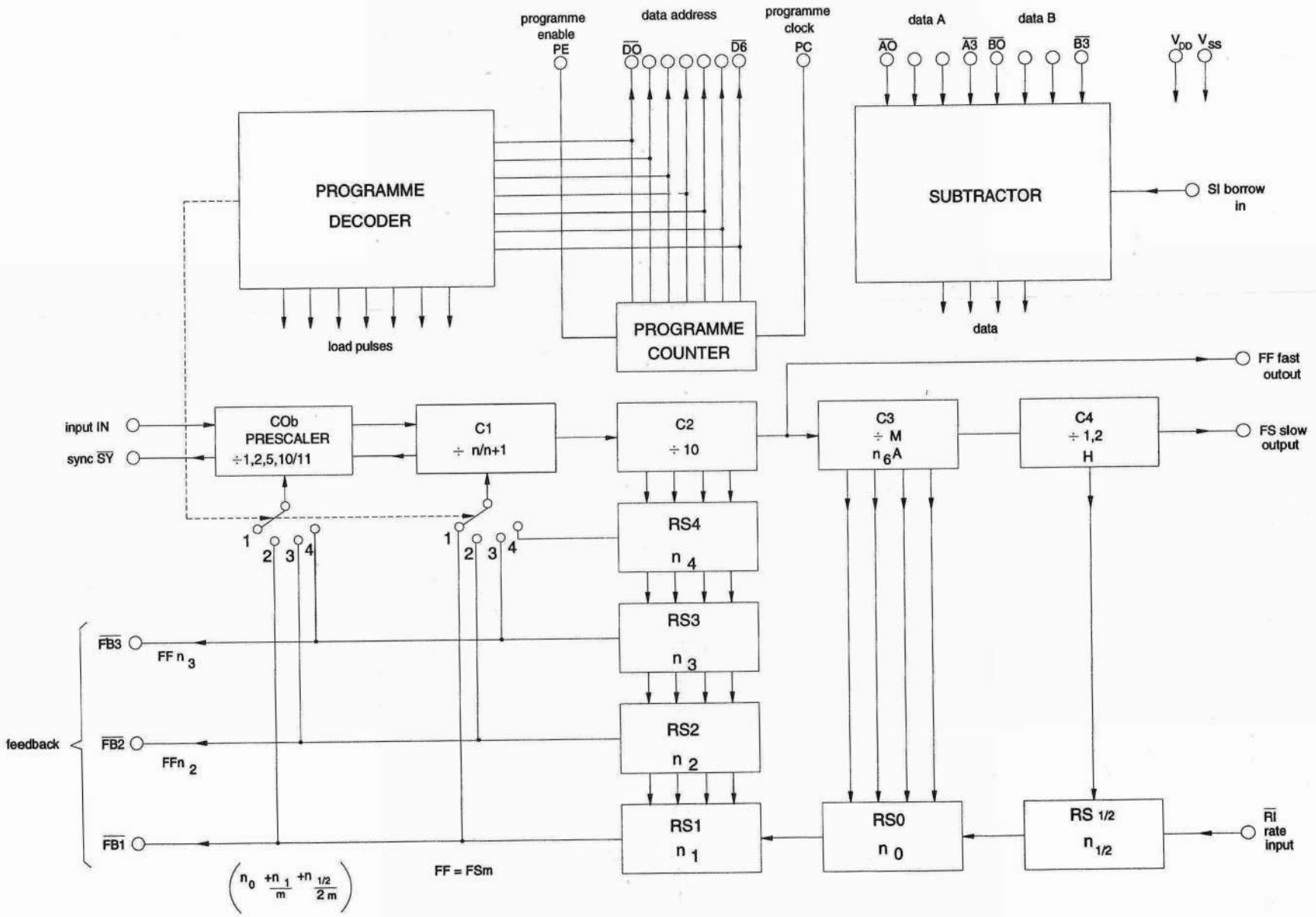
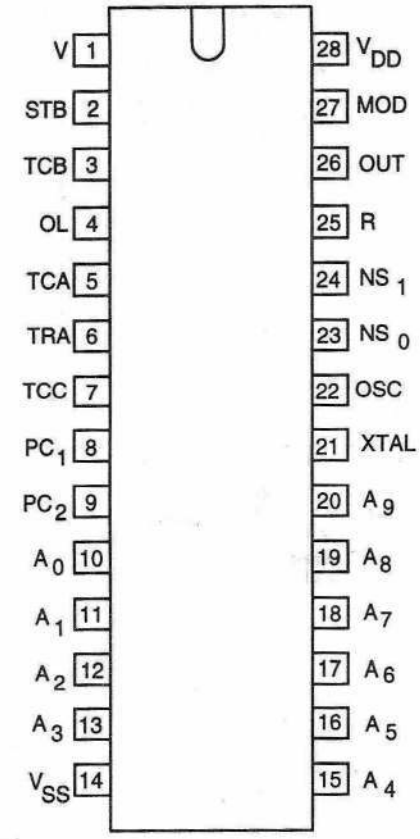


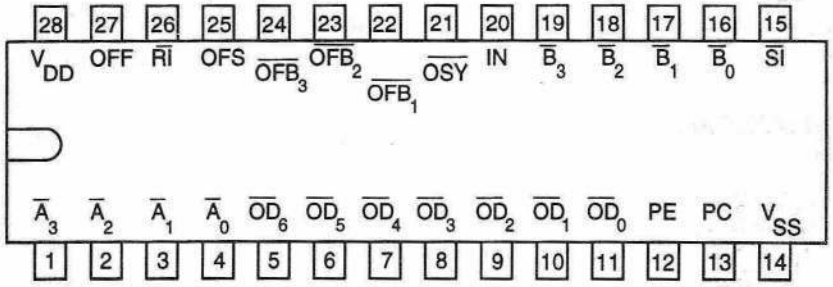

FIGURE 29-DIAGRAM, ORGANIZATION OF THE HEF7451 UNIVERSAL DIVIDER INTEGRATED CIRUIT



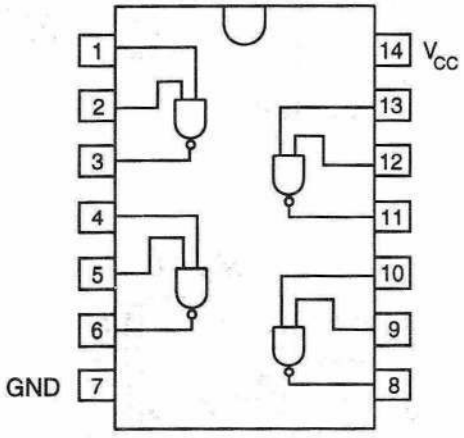

| | |
|---|---|
| R | phase comparator input, reference |
| V | phase comparator input |
| STB | strobe input |
| TCA | timing capacitor $c_A$ pin |
| TCB | timing capacitor $c_B$ pin |
| TCC | timing capacitor $c_C$ pin |
| TRA | biasing pin (resistor $R_A$) |
| $PC_1$ | analogue phase comparator, output |
| $PC_2$ | digital phase comparator, output |
| MOD | phase modulation, input |
| OL | out-of-lock indication |
| OSC | reference oscillator/buffer, input |
| XTAL | reference oscillator/buffer, output |
| $A_0$ to $A_g$ | programming inputs/programmable divider |
| $NS_0$ $NS_1$ | programmable inputs, prescaler |
| OUT | reference divider output |

HEF4750V

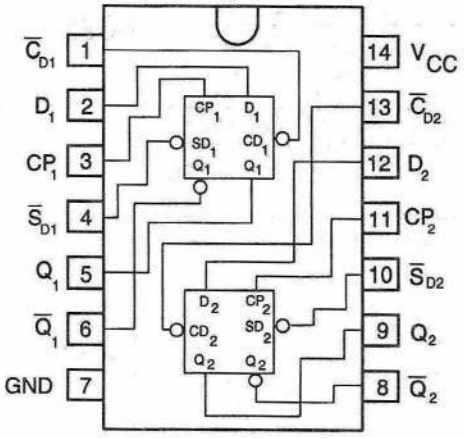
# TOP VIEWS




HEF4751V



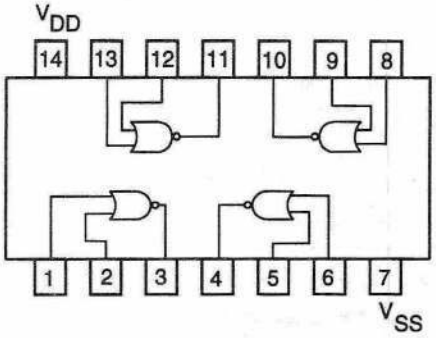

74F00



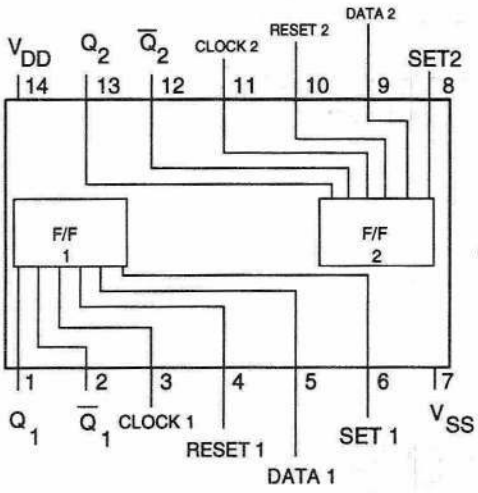

74F74

FIGURE 30-DIAGRAM, INTEGRATED CIRCUIT PIN CONNECTIONS

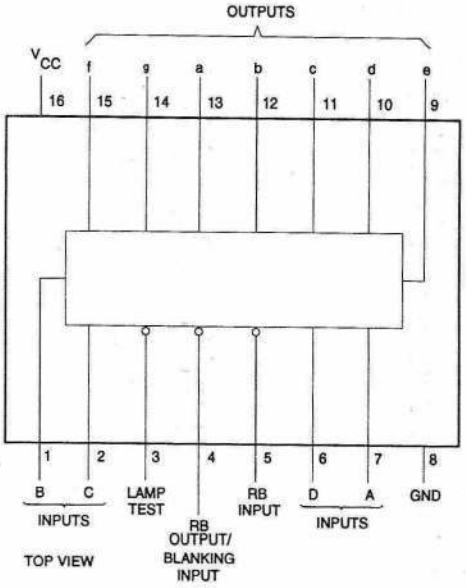
LOGIC AND CONNECTION DIAGRAM
DIP (TOP VIEW)



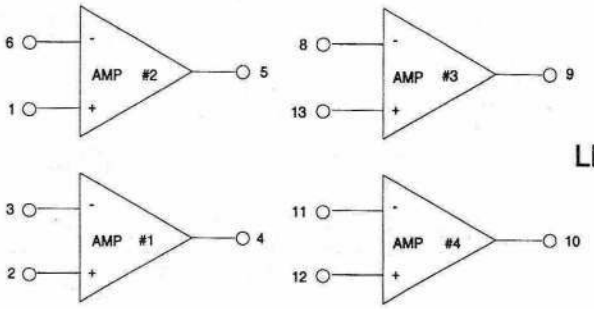

4001




4013

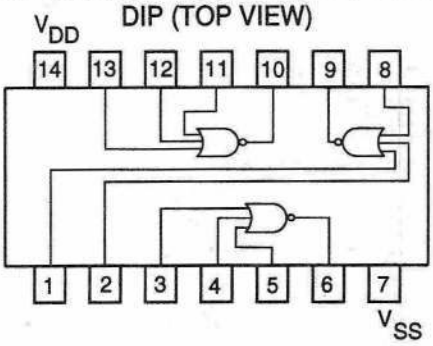



74C48

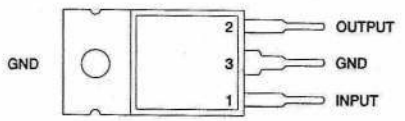



LM3900

LOGIC AND CONNECTION DIAGRAM
DIP (TOP VIEW)

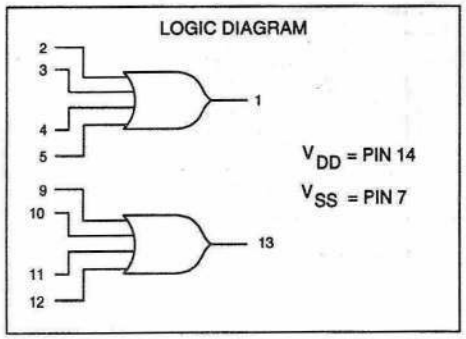



4025




7808
LM2930

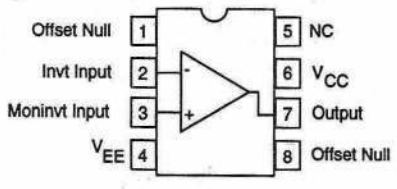
TOPVIEW




4072

4082

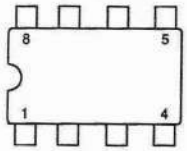
uA741




(TOP VIEW)

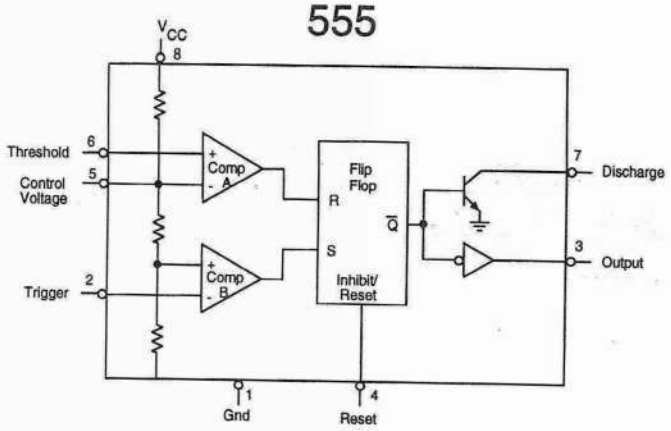
FIGURE 30-DIAGRAM, INTEGRATED CIRCUIT PIN CONNECTIONS, (CONTINUED)

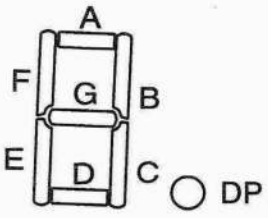
555




1. GROUND
2. TRIGGER
3. OUTPUT
4. RESET
5. CONTROL VOLTAGE
6. THRESHOLD
7. DISCHARGE
8. $V_{CC}$

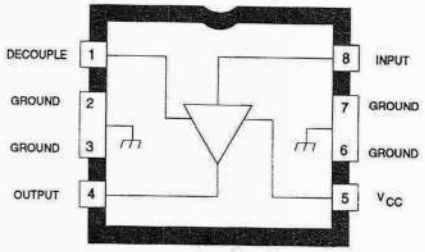
555




MAN4640A

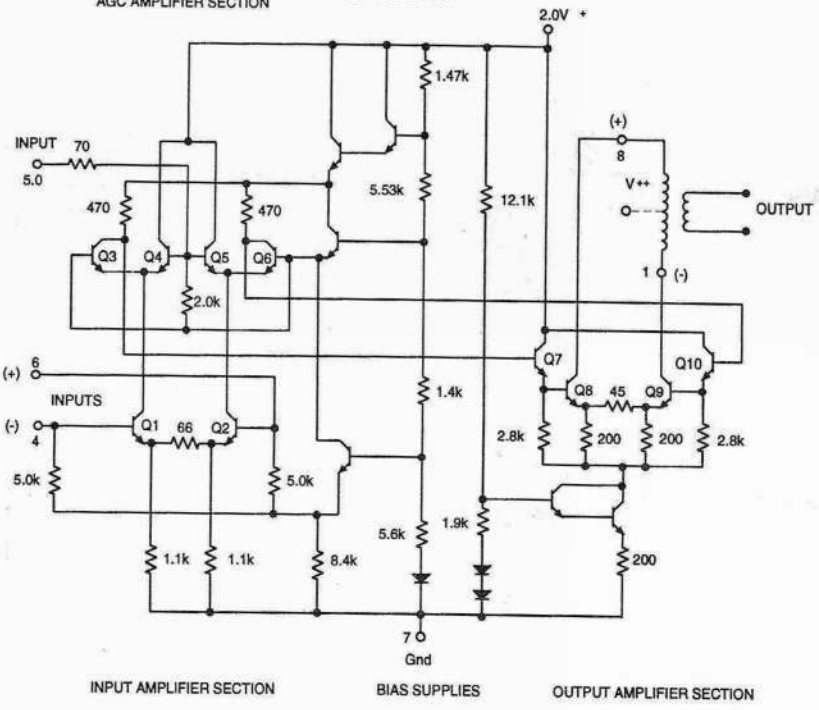
Anode F
Anode G
No Pin
Common Cathode
No Pin
Anode E
Anode D
Anode C
Anode DP
No Pin
No Pin
Common Cathode
Anode B
Anode A



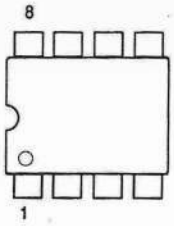

3718ULN

SCHEMATIC

MC1350P



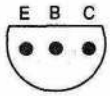

MC1350P



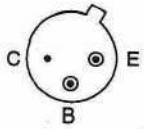

(TOP VIEW)

FIGURE 30-DIAGRAM, INTEGRATED CIRCUIT PIN CONNECTIONS, (CONTINUED)

MPS6514/2N3904
MPSA14 2N3638
2N3836



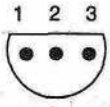

BOTTOM VIEW



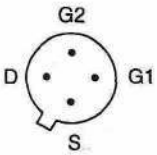

2N2866

78LO8AC 78LO5AC

1. OUTPUT
2. GROUND
3. INPUT



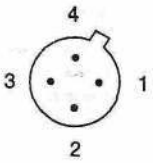

BOTTOM VIEW




MFE211

2N5486

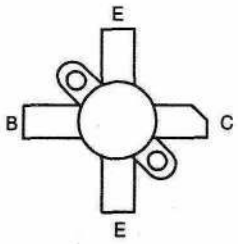

BOTTOM VIEW



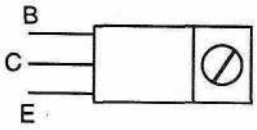

2N5179

1. EMITTER
2. BASE
3. COLLECTOR
4. CASE

MRF454

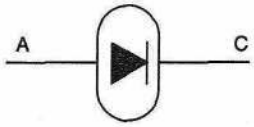



TOP VIEW




2N5490

MR750

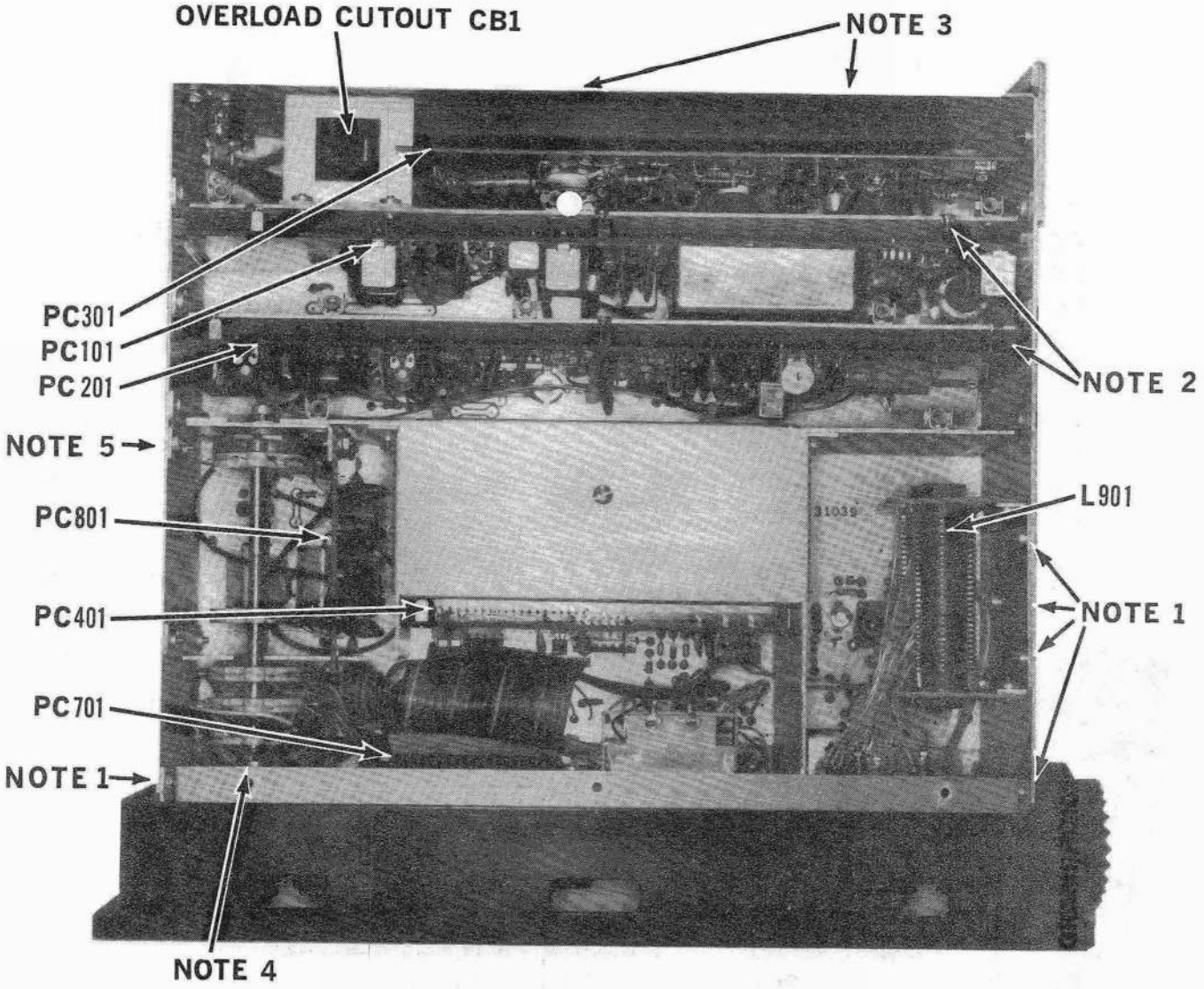



DIODE


DIODES

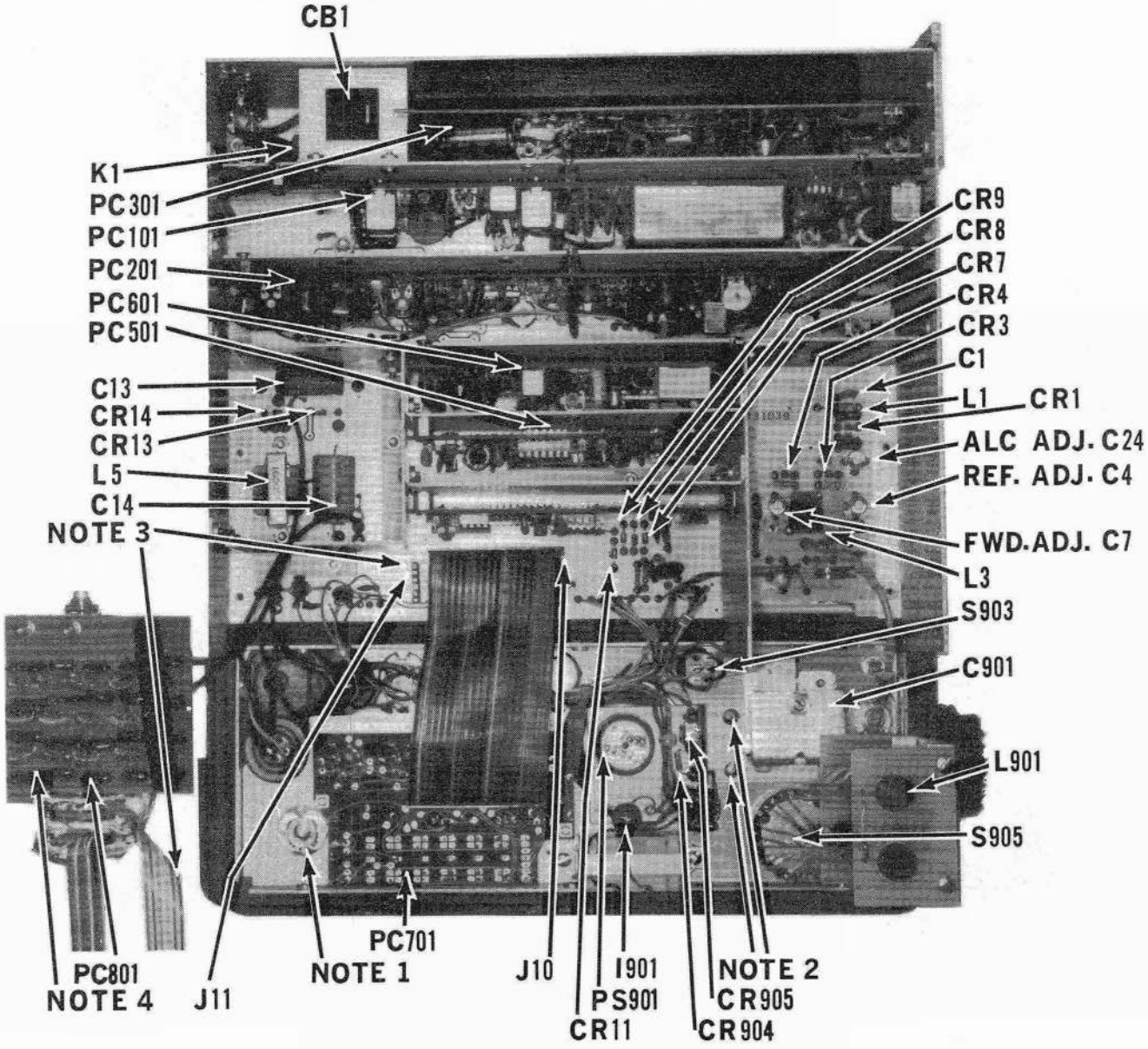
1N4148 BA282
1N4005 SM2

FIGURE 31-DIAGRAM, DEVICE PIN CONNECTIONS




- Note 1. Remove screws (5) to lower panel. Also see Note 4 and Chapter 5. To entirely remove panel also remove the lower two panel retaining screws
- Note 2. Retaining screws.
- Note 3. Remove screws (4) to remove PC301.
- Note 4. Flexible shaft coupler. Loosen rear set screws (2) to remove panel. Observe proper switch indexing when replacing.
- Note 5. Remove screws (2) to allow low pass filter module and MHz switch selector to be lifted and removed after having first loosened flexible shaft coupling. See Note 4 above.

**FIGURE 32 - PHOTOGRAPH, TRANSCEIVER TOP VIEW, BATTERY BOX AND TOP COVER REMOVED**




- Note 1. Set screws must be loosened from flexible shaft coupler to lower panel.
- Note 2. To remove speaker and capacitor C901, remove two retaining bracket screws.
- Note 3. Blue wire must go to rear when 6 ribbon cable from MHz selector is plugged into J1 on the main printed circuit board, PC1.
- Note 4. The low pass filter board and MHz selector switch have been removed from the chassis. See Note 4 and 5, Figure 32.

**FIGURE 33 - TOP VIEW, BATTERY BOX, TOP COVER AND SYNTHESIZER COVER REMOVED.**

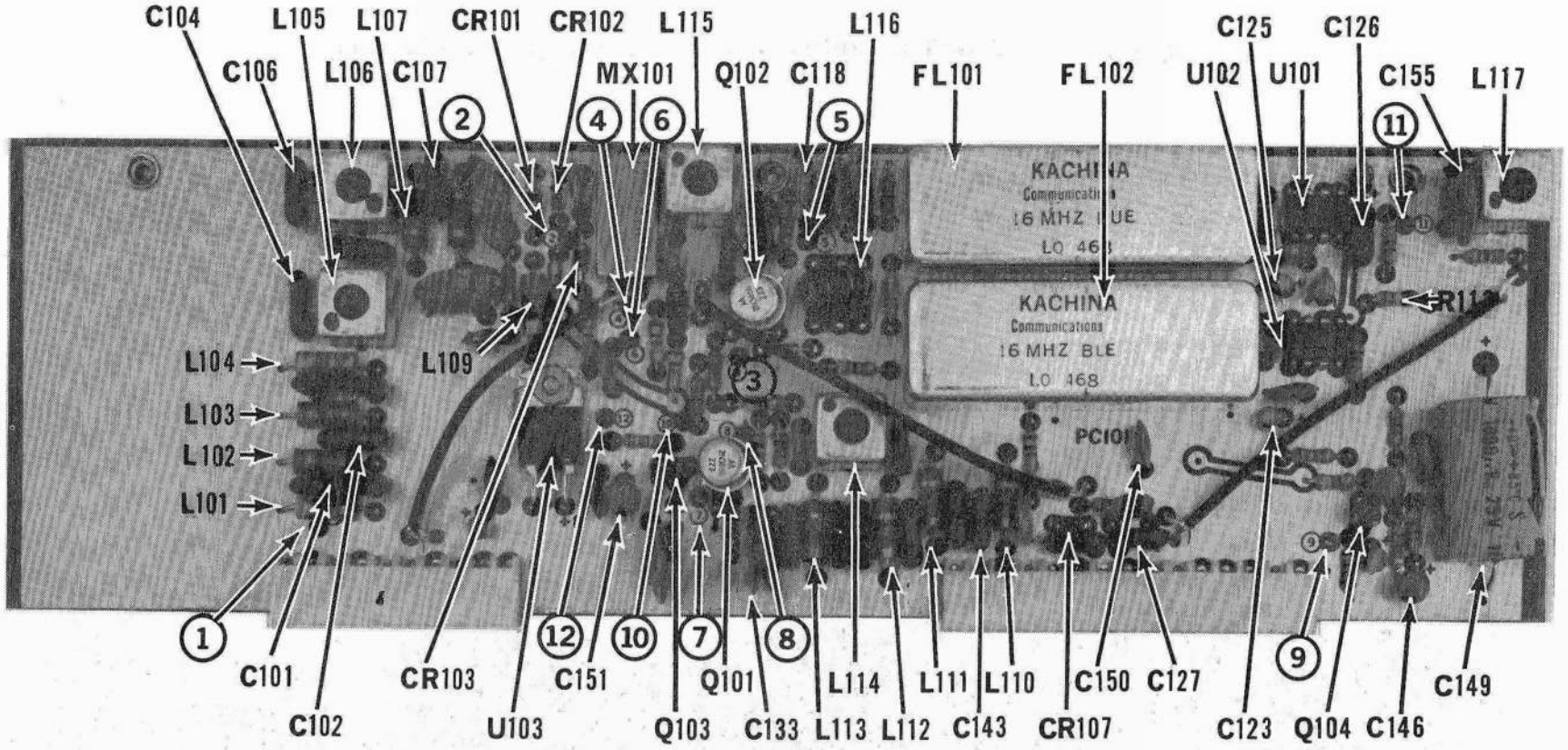



**FIGURE 34 - PHOTOGRAPH, PC101, SHOWING COMPONENT LOCATIONS**

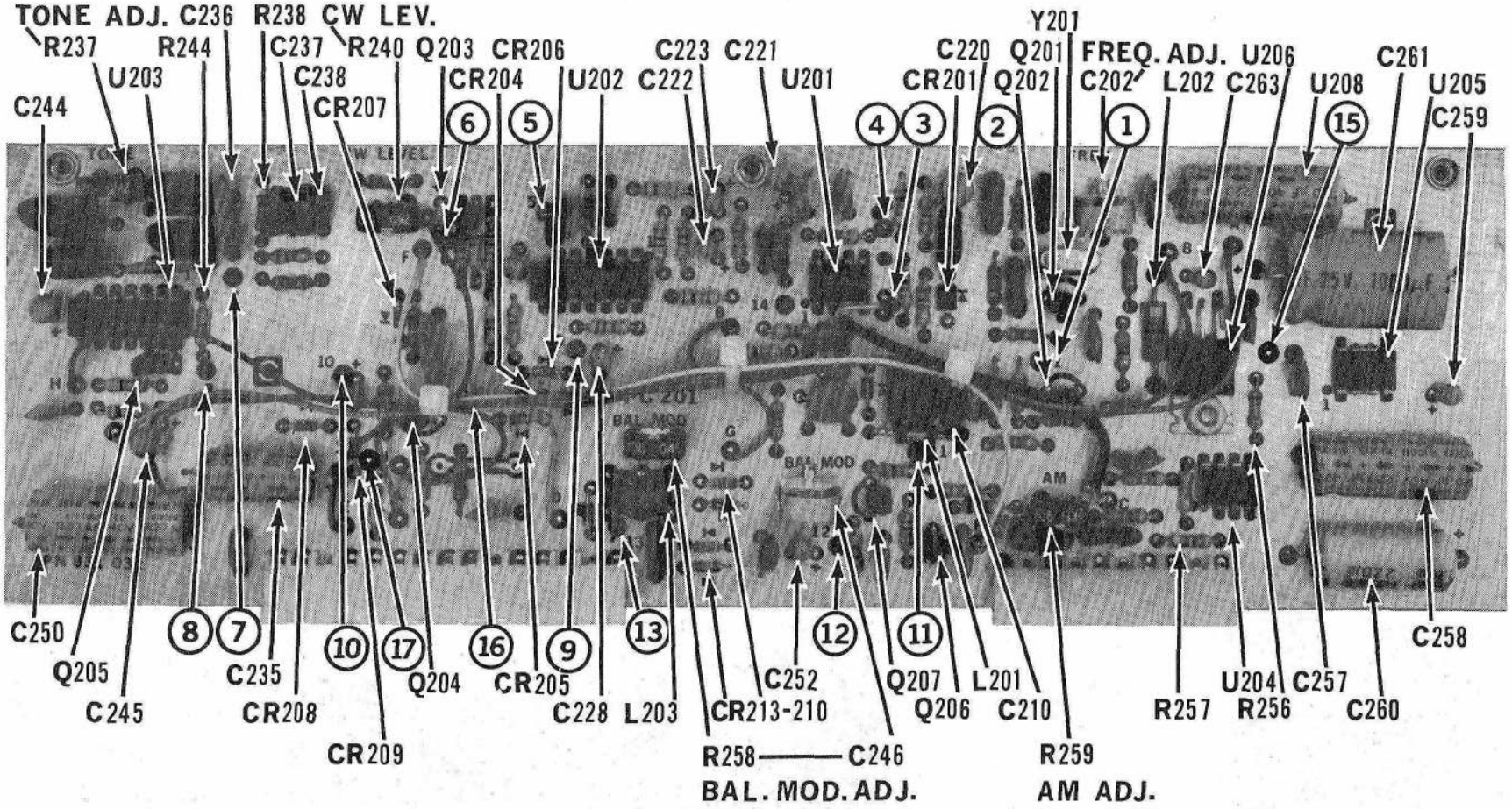



FIGURE 35 - PHOTOGRAPH, PC201, SHOWING COMPONENT LOCATIONS

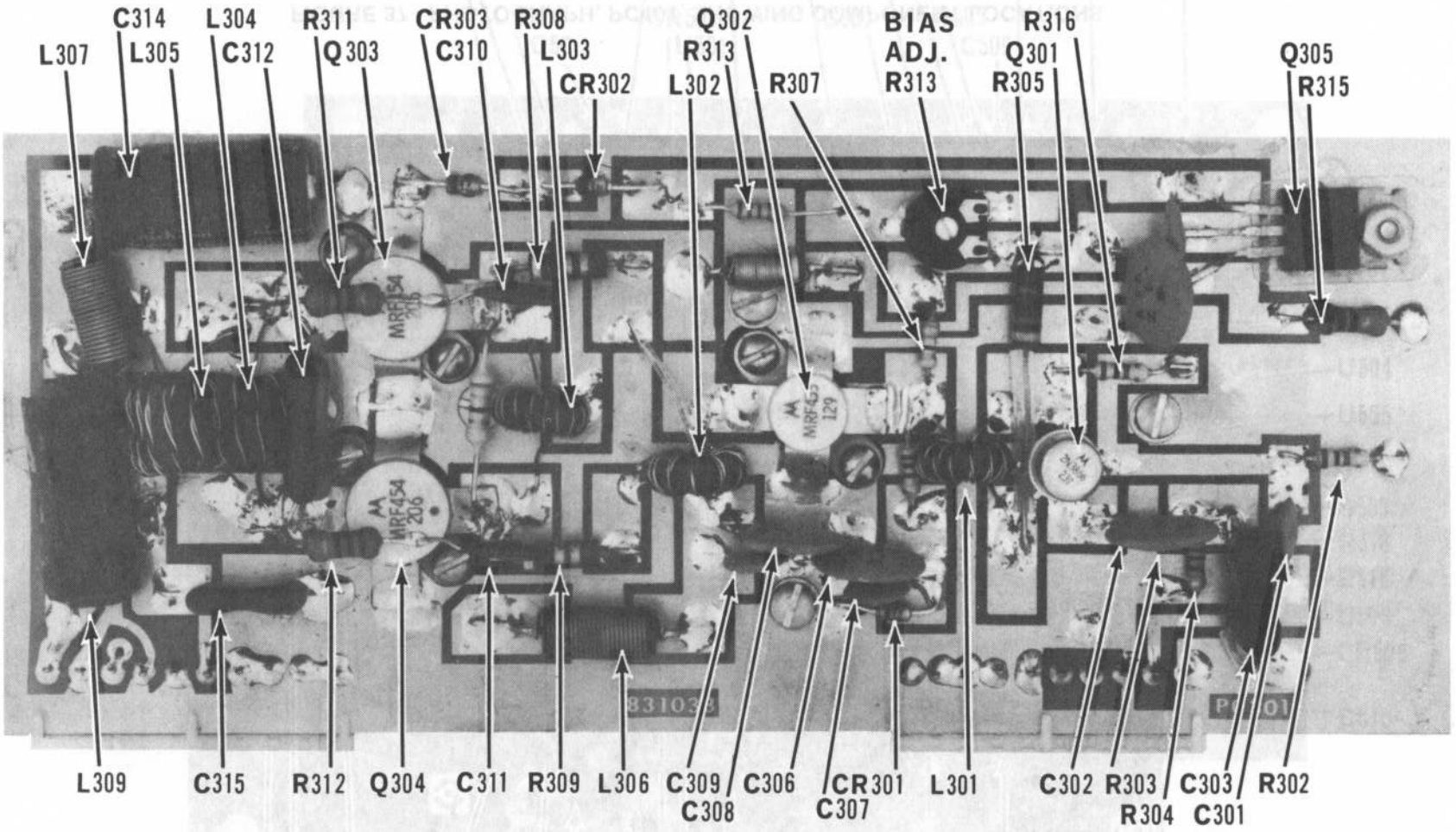



FIGURE 36 - PHOTOGRAPH, PC301, SHOWING COMPONENT LOCATIONS

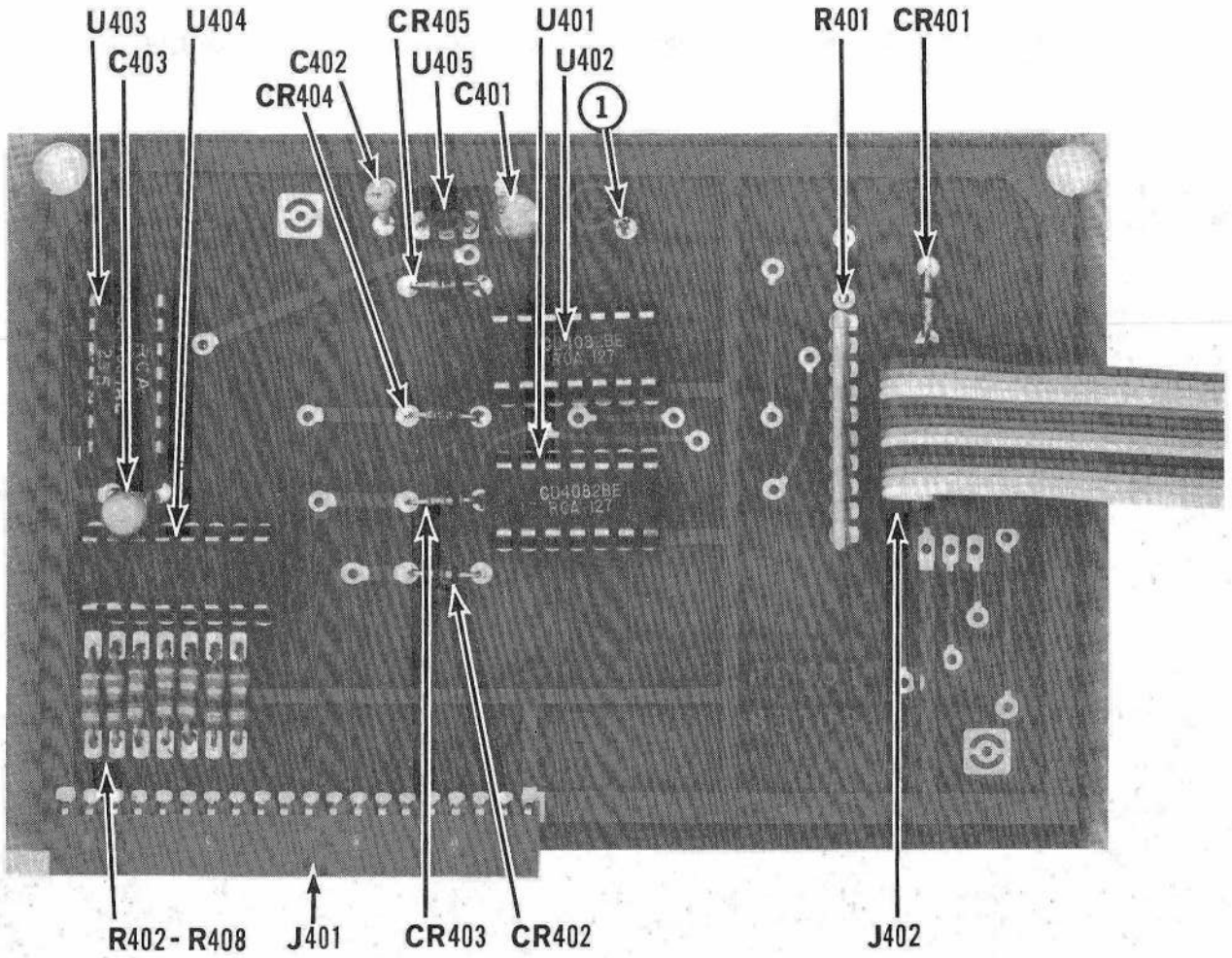



FIGURE 37 - PHOTOGRAPH, PC401, SHOWING COMPONENT LOCATIONS

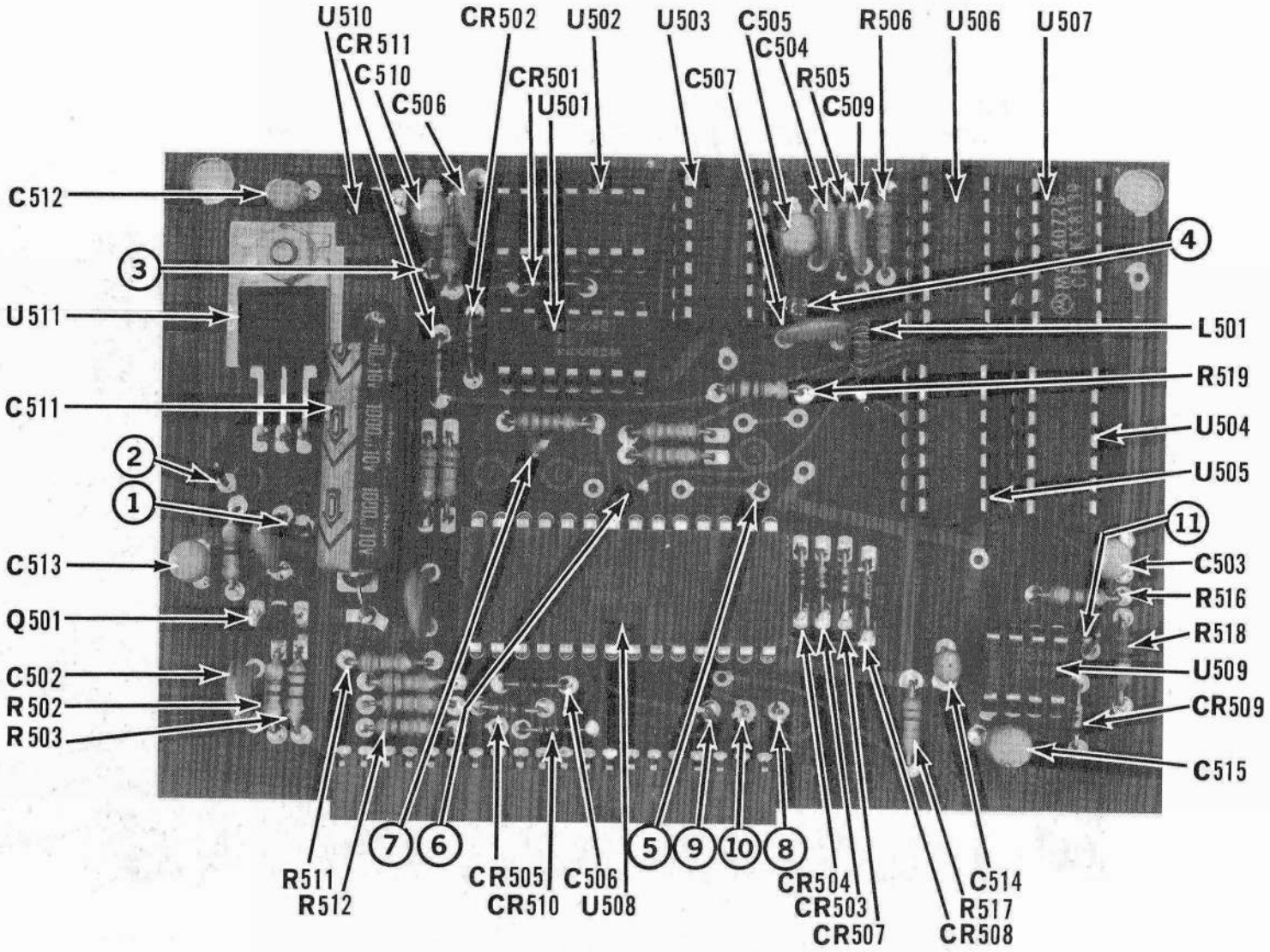



FIGURE 38 - PHOTOGRAPH, PC501, SHOWING COMPONENT LOCATIONS

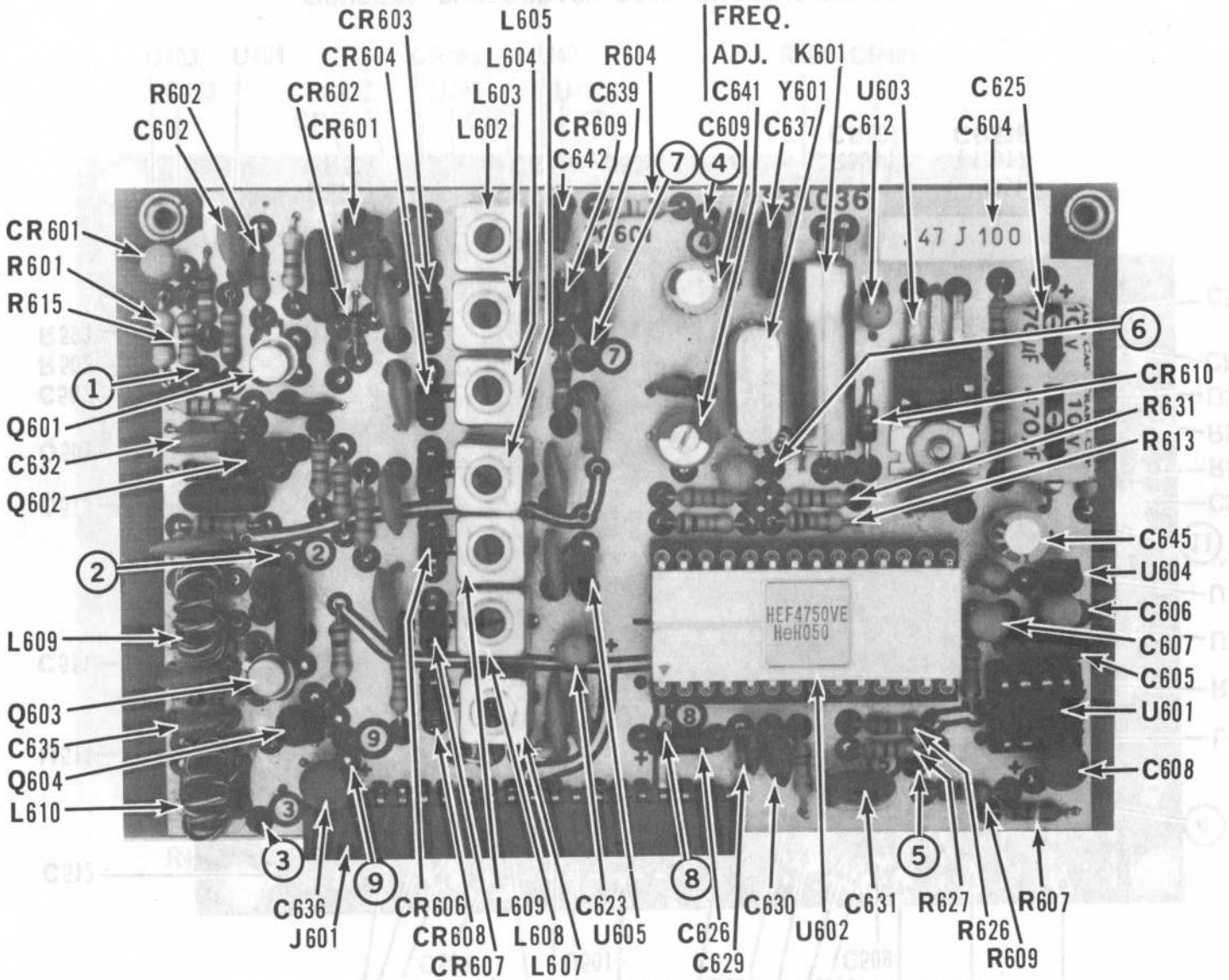



FIGURE 39 - PHOTOGRAPH, PC601, SHOWING COMPONENT LOCATIONS

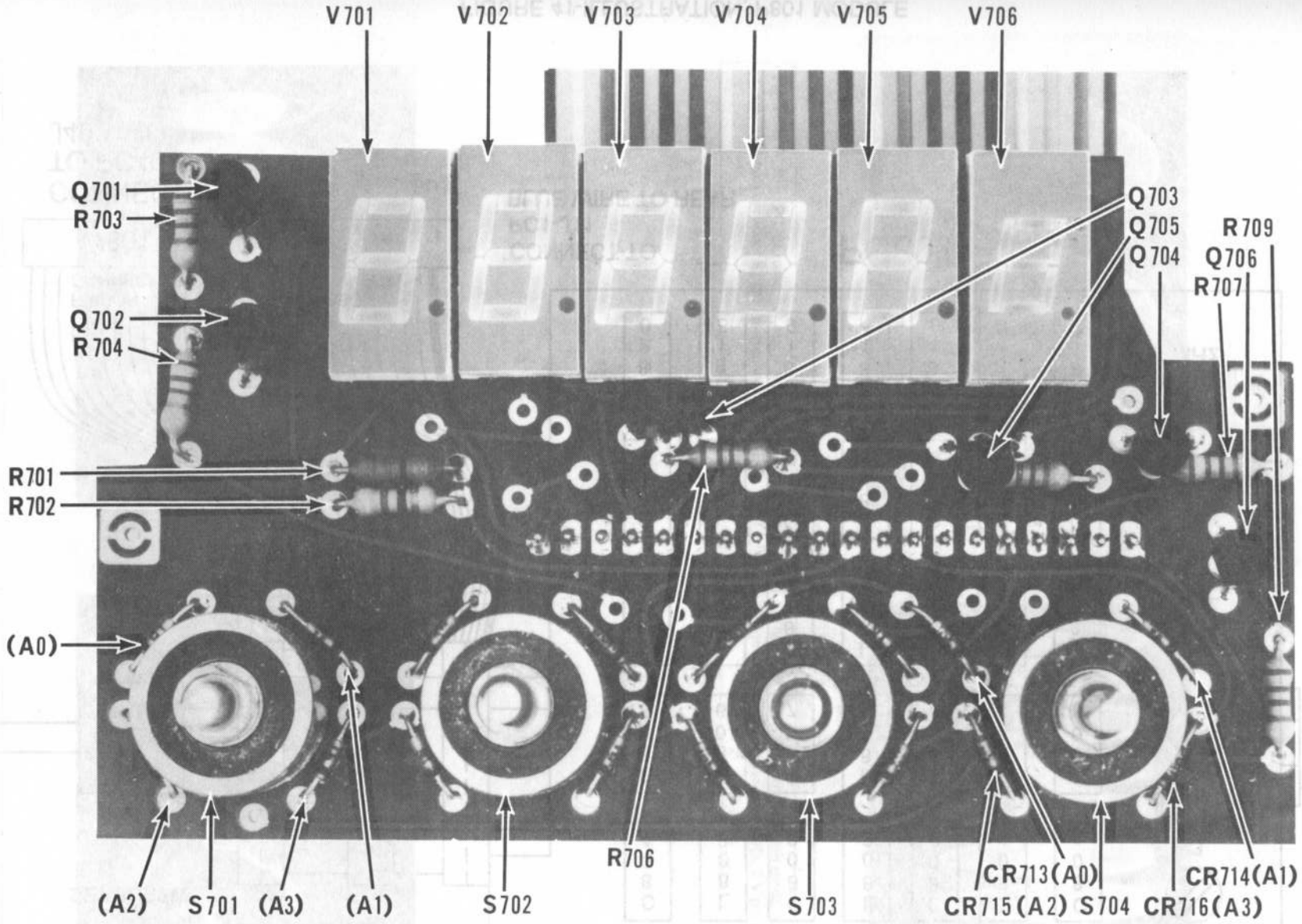



FIGURE 40 - PHOTOGRAPH, PC701, SHOWING COMPONENT LOCATIONS

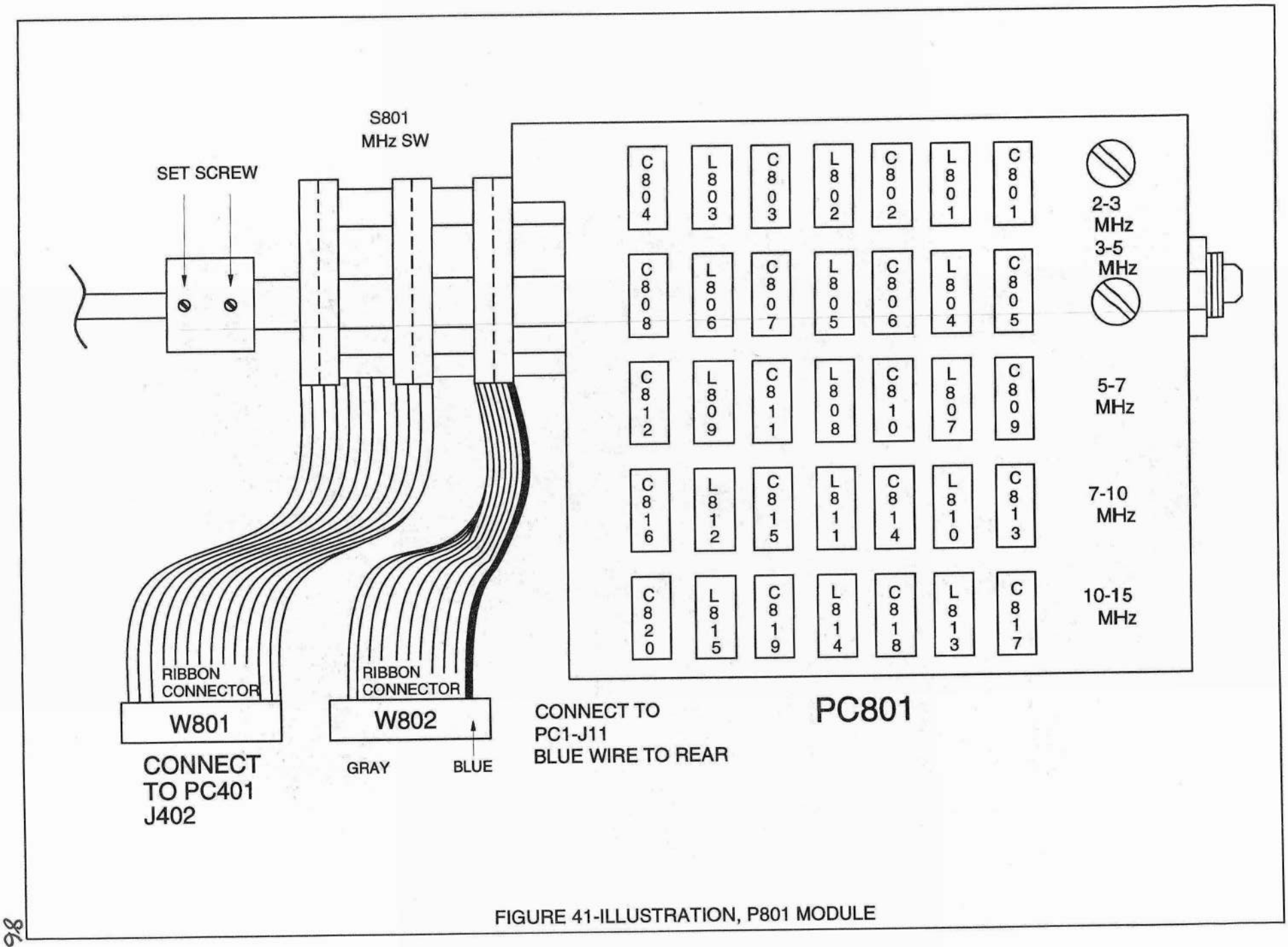



FIGURE 41-ILLUSTRATION, P801 MODULE

The following oscilloscope waveforms were photographed from a Tektronix oscilloscope model #2213 and a model P6120 10/1 attenuator probe.

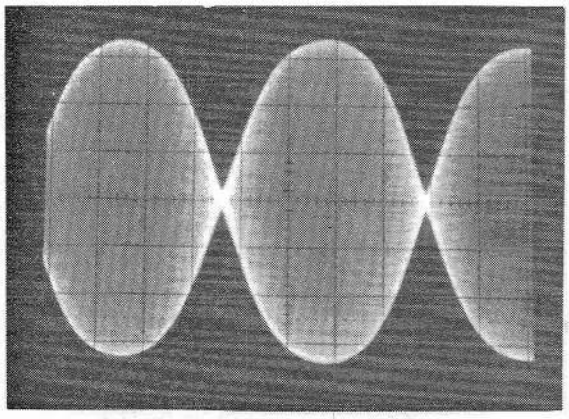


**Figure 42** PC101, (PC301 removed), test point 11, 0.2V P-P per cm. Two tone oscillator input to microphone 20 MV P-P.

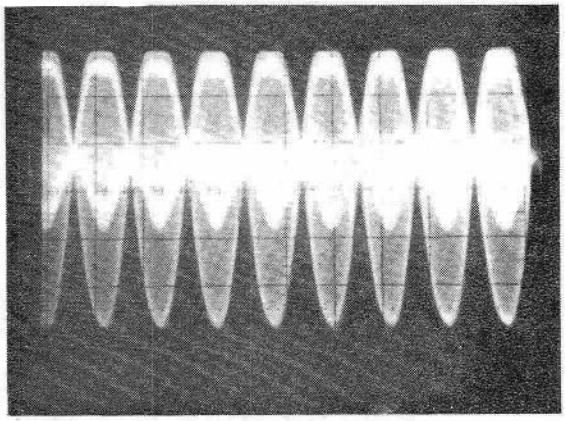


**Figure 43** PC301, two tone transmit mode. Collector Q302 typical wavefor. Frequency 7 MHz. 2 V per cm. .5 ms per division.

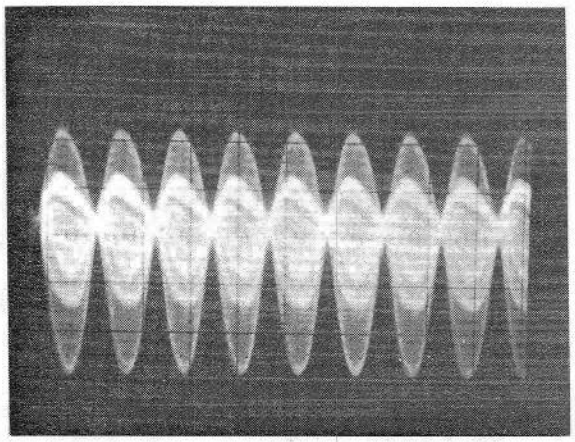


**Figure 44** PC301, collector Q303. Typical waveform. Frequency 7 MHz. 5 V per cm. .5 ms per division.

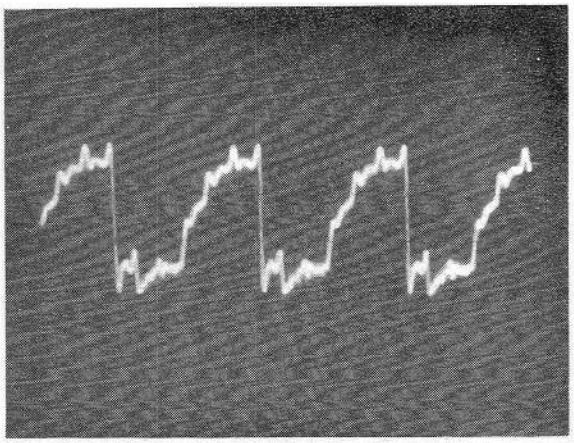


**Figure 45** PC501, test point 3. Frequency 7 MHz. .5 V per cm. .05 ms per division.

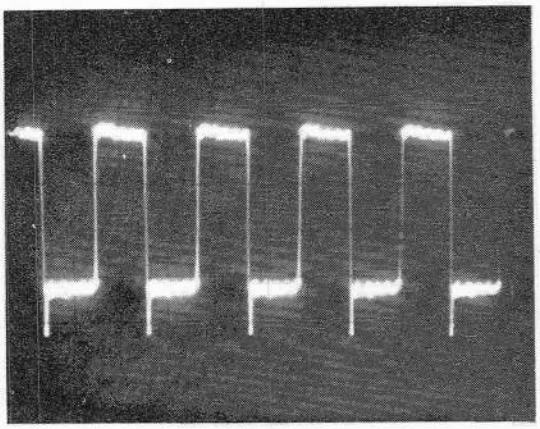


**Figure 46** PC501, test point 4, frequency 7 MHz. 1 V per cm. 2 us per division.

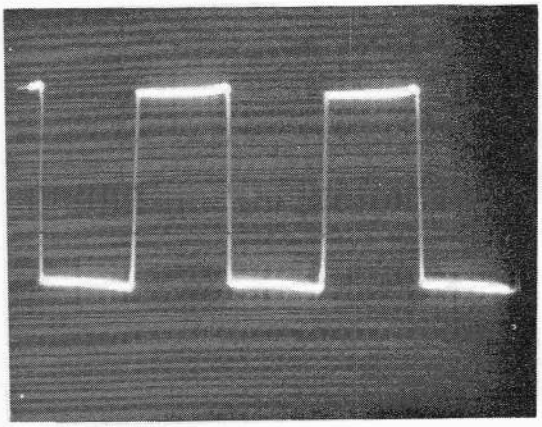


**Figure 47** PC501, test point 5, frequency 7 MHz. 2 V per cm. 1 us per division.

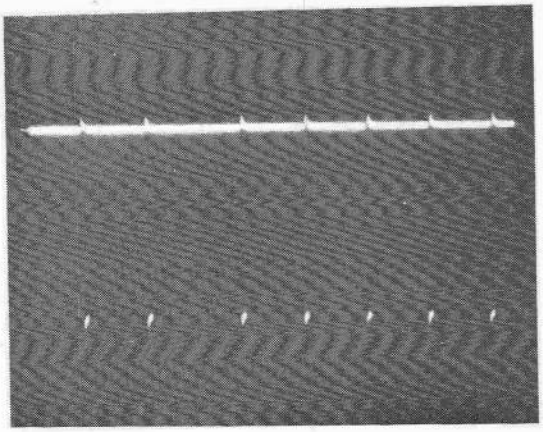


**Figure 48** PC501, test point 6, frequency 7 MHz. 2 V per cm. 50 us per division.

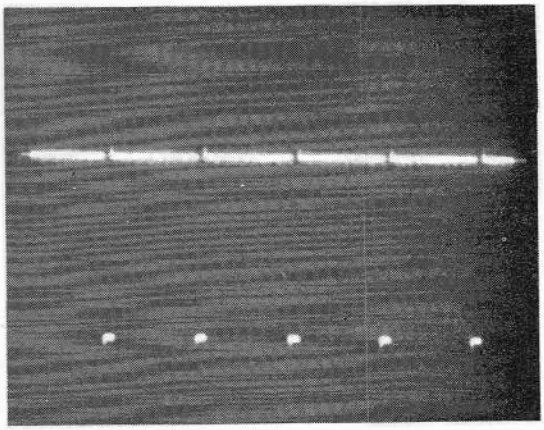


**Figure 49** PC501, test point 7, frequency 7001.0 MHz. 2 V per cm. .5 ms per division. Note that the kHz X 1 figure is set to 1 and not 0.

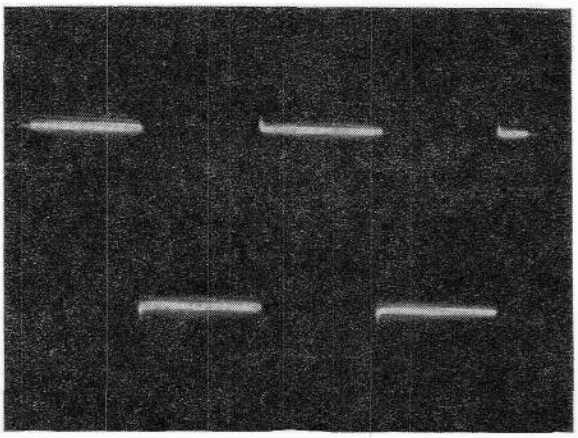


**Figure 50** PC501, test point 8, frequency 7 MHz. 2 V per cm. .2 ms per division.

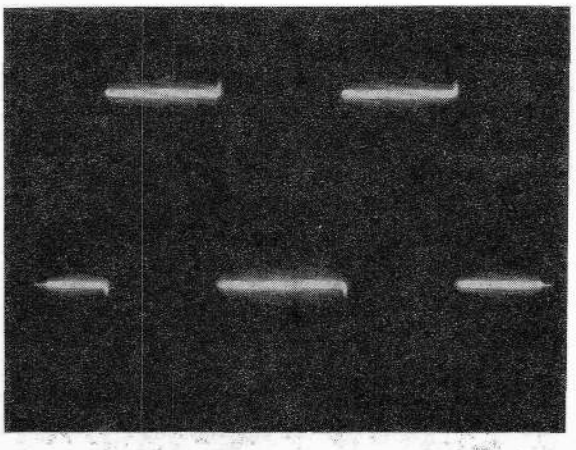


**Figure 51** PC501, test point 9, frequency 7 MHz. 2 V per division. .2 ms per division.

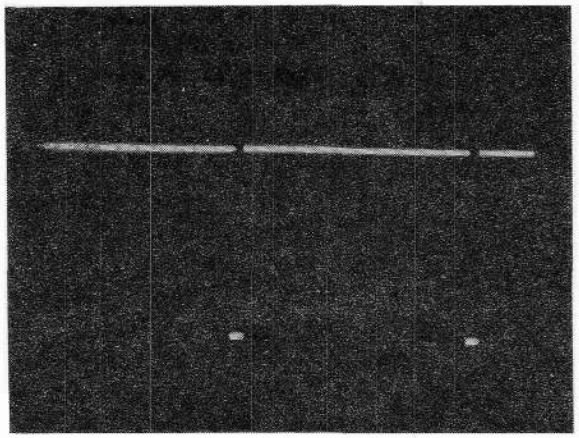


**Figure 52** PC501, test point 10, frequency 7 MHz. 2 V per cm. 2 ms per division.

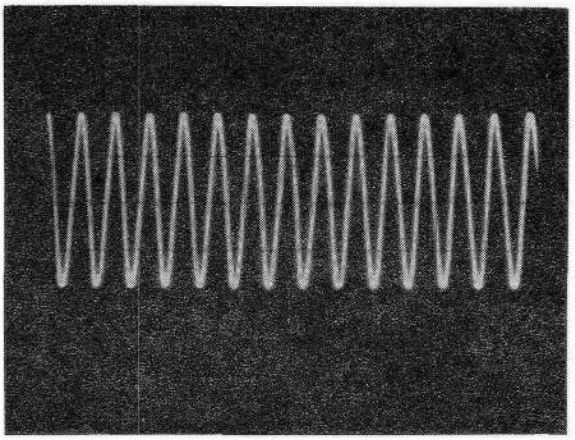


**Figure 53** PC501, test point 2, frequency 7 MHz. 1 V per cm. .05 ms per division.

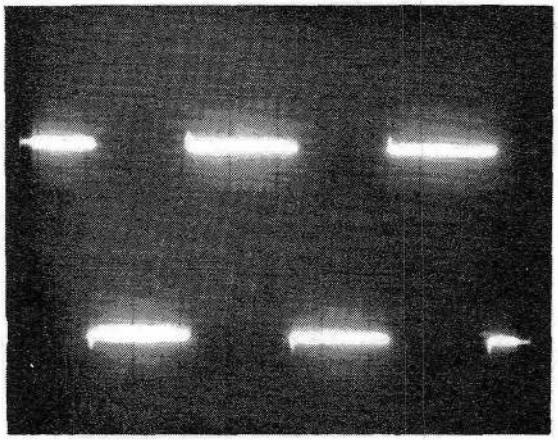


**Figure 54** PC601, test point 8, frequency 7 MHz. 2 V per cm. .2 ms per division.

# FIGURE 55

# SPECIFICATIONS, PART NUMBER A951019

# BFO/CARRIER GENERATOR CRYSTAL

## 1. TYPE CR18/U

The crystal described by this specification is in essence a CR18/U in a HC-25/U holder. Major specifications are listed below for reference.

| | |
|---|---|
| Holder | HC-25/U |
| Frequency | 16,000.00 kHz |
| Capacitance, shunt | 7pF maximum |
| Frequency setting tolerance | 0.002% at 26 C |
| Operating temperature range | +/-10 ppm from -30 C to +60 C |
| Frequency change with temperature | +10 ppm at 25 C |
| Equivalent resistance | Less 15 ohms |
| Mode of operation | Fundamental |
| Antiresonance, load capacitance | 32 pF +/- 0.5 pF |

### SHOCK

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |
| Equiv. resistance change permitted | +/- 10% |

### VIBRATION

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |
| Equiv. resistance change permitted | +/- 10% |

### TEMPERATURE CYCLE

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |
| Equiv. resistance change permitted | +/- 10% |

### AGING

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |

## 2. MARKING

Each crystal shall contain the following markings:

a) Vendor's code
b) Last 3 digits of Part Number
c) Frequency

# FIGURE 56

# SPECIFICATIONS, PART NUMBER A951020

# MASTER OSCILLATOR CRYSTAL

## 1. TYPE CR18/U

The crystal described by this specification is in essence a CR18/U in a HC-12/U holder. Major specifications are listed below for reference.

| | |
|---|---|
| Holder | HC12/U |
| Frequency | 5,000.000 kHz |
| Capacitance, shunt | 7 pF maximum |
| Frequency setting tolerance | 0.002% at 26 C |
| Operating temperature range | -30 C to +60 C |
| Frequency change with temperature | Standard CR18/U Curve |
| Equivalent resistance | 50 ohms maximum |
| Mode of operation | Fundamental |
| Antiresonance, load capacitance | 32 pF +/- 0.5 pF |

### Shock

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |
| Equiv. resistance change permitted | +/- 10% |

### VIBRATION

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |
| Equiv. resistance change permitted | +/- 10% |

### TEMPERATURE CYCLING

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |
| Equiv. resistance change permitted | +/- 10% |

### AGING

| | |
|---|---|
| Frequency change permitted | +/- 0.0005% |

## 2. MARKING

Each crystal shall contain the following markings:

a) Vendor's code
b) Last 3 digits of Part Number
c) Frequency

# APPENDIX A - PARTS LIST

PC 1 "MOTHER BOARD" MODULE

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C1 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C2 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C3 | 125221 | CAPACITOR, DM15, 220PF, 5%, 500V |
| C4 | 162004 | CAPACITOR, TRIMMER, N750, 4.0-20PF |
| C5 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C6 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C7 | 162004 | CAPACITOR, TRIMMER, N750, 4.0-20PF |
| C8 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C9 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C10 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C11 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C12 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C13 | 140017 | CAPACITOR, ELECTROLYTIC, 470 MFD, 16V |
| C14 | 140018 | CAPACITOR, ELECTROLYTIC, 1000 MFD, 16V |
| C15 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C16 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C17 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C18 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C19 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C20 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C21 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C22 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C23 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C24 | 162004 | CAPACITOR, TRIMMER, N750, 4.0-20PF |
| C25 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C26 | 125151 | CAPACITOR, DM15, 150PF, 5%, 500 |
| CR1 | 410000 | DIODE, SILICON, 1N4148 |
| CR2 | 410000 | DIODE, SILICON, 1N4148 |
| CR3 | 410003 | DIODE, GERMANIUM, 1N60 |
| CR4 | 410000 | DIODE, SILICON, 1N4148 |
| CR5 | 410000 | DIODE, SILICON, 1N4148 |
| CR6 | 420008 | DIODE, SILICON, 1N4005 |
| CR7 | 420008 | DIODE, SILICON, 1N4005 |
| CR8 | 420008 | DIODE, SILICON, 1N4005 |
| CR9 | 420008 | DIODE, SILICON, 1N4005 |
| CR10 | 420008 | DIODE, SILICON, 1N4005 |
| CR11 | 420008 | DIODE, SILICON, 1N4005 |
| CR12 | 420008 | DIODE, SILICON, 1N4005 |
| CR13 | 420008 | DIODE, SILICON, 1N4005 |
| CR14 | 420008 | DIODE, SILICON, 1N4005 |
| CR15 | 420004 | DIODE, SILICON, MR750 |
| CR16 | 420008 | DIODE, SILICON, 1N4005 |
| CR17 | 410000 | DIODE, SILICON, 1N4148 |
| J1 | 630001 | CONNECTOR, PC BOARD, MALE, 10 PIN |
| J2 | 630001 | CONNECTOR, PC BOARD, MALE, 10 PIN |
| J3 | 630003 | CONNECTOR, PC BOARD, MALE, 15 PIN |
| J4 | 630001 | CONNECTOR, PC BOARD, MALE, 10 PIN |
| J5 | 630001 | CONNECTOR, PC BOARD, MALE, 10 PIN |
| J6 | 630003 | CONNECTOR, PC BOARD, MALE, 15 PIN |

PC 1 "MOTHER BOARD" MODULE

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| J7 | 630005 | CONNECTOR, PC BOARD, MALE, 20 PIN |
| J8 | 630005 | CONNECTOR, PC BOARD, MALE, 20 PIN |
| J9 | 630005 | CONNECTOR, PC BOARD, MALE, 20 PIN |
| J10 | 821045A | CABLE, ASSEMBLY, RIBBON, 20 PIN,ECN 68 |
| J11 | 630008 | CONNECTOR, PC BOARD, MALE, 6 PIN,ECN 68 |
| J12 | 827030A | ASSEMBLY, CONNECTOR, POWER, KACHINA |
| K1 | 730005 | RELAY, PCB, DPDT, 12V |
| K2 | 730002 | RELAY, REED, SPDT, 12V |
| L1 | 330093 | INDUCTOR, RFC, 1 MH, 5% |
| L3 | 330048 | INDUCTOR, TOROID |
| L4 | 330036 | INDUCTOR, RFC, 100UH |
| L5 | 330051 | INDUCTOR, FILTER |
| PC1 | 831039B | PC BOARD, MP-25, PC1, MOTHER BOARD |
| Q1 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904 |
| Q2 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904,ECN 62 |
| Q3 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904,ECN 62 |
| R1 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R2 | 215152 | RESISTOR, CARBON FILM, 1.5K OHM, 5%, 1/4W |
| R3 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R4 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R5 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R6 | 215224 | RESISTOR, CARBON FILM, 220K OHM, 5%, 1/4W |
| R7 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R8 | 215022 | RESISTOR, CARBON FILM, 2.2 OHM, 5%, 1/4W |
| R9 | 215333 | RESISTOR, CARBON FILM, 33K OHM, 5%, 1/4W |
| R10 | 215273 | RESISTOR, CARBON FILM, 27K OHM, 5%, 1/4W,ECN 64 |
| R11 | 200001 | RESISTOR, SIP NETWORK, 6 X 100K OHM |
| R12 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W,ECN 61 |
| R13 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W,ECN 62 |
| R14 | 215562 | RESISTOR, CARBON FILM, 5.6K OHM, 5%, 1/4W,ECN 62 |
| R15 | 215562 | RESISTOR, CARBON FILM, 5.6K OHM, 5%, 1/4W,ECN 62 |
| R16 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W,ECN 62 |
| R17 | 215681 | RESISTOR, CARBON FILM, 680 OHM, 5%, 1/4W,ECN 64 |

PC101 RECEIVER, TRANSMITTER, MIXER AND IF FUNCTIONS

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C101 | 135132 | CAPACITOR, DM19, 1300PF, 5%, 500V |
| C102 | 125102 | CAPACITOR, DM15, 1000PF, 5%, 300V |
| C103 | 135132 | CAPACITOR, DM19, 1300PF, 5%, 500V |
| C104 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C105 | 125301 | CAPACITOR, DM15, 300PF, 5%, 500V |
| C106 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C107 | 125471 | CAPACITOR, DM15, 470PF, 5%, 500V |
| C108 | 125301 | CAPACITOR, DM15, 300PF, 5%, 500V |
| C109 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C110 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C112 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C113 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C114 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C115 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C116 | 125121 | CAPACITOR, DM15, 120PF, 5%, 500V |
| C117 | 125102 | CAPACITOR, DM15, 1000PF, 5%, 300V |
| C118 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C119 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C120 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C121 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C122 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C123 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C124 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C125 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C126 | 125820 | CAPACITOR, DM15, 82PF, 5%, 500V |
| C127 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C128 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C129 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C130 | 125470 | CAPACITOR, DM15, 47PF, 5%, 500V |
| C131 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C132 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C133 | 182010 | CAPACITOR, MYLAR, 0.22 MFD, 10%, 63V,ENC 60 |
| C134 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C135 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C136 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C137 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C138 | 125301 | CAPACITOR, DM15, 300PF, 5%, 500V |
| C140 | 125501 | CAPACITOR, DM15, 500PF, 5%, 500V |
| C141 | 125511 | CAPACITOR, DM15, 510PF, 5%, 500V |
| C142 | 125501 | CAPACITOR, DM15, 500PF, 5%, 500V |
| C143 | 125301 | CAPACITOR, DM15, 300PF, 5%, 500V |
| C144 | 125470 | CAPACITOR, DM15, 47PF, 5%, 500V |
| C145 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C146 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C147 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C148 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C149 | 140018 | CAPACITOR, ELECTROLYTIC, 1000 MFD, 16V |
| C150 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C151 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |

PC101 RECEIVER, TRANSMITTER, MIXER AND IF FUNCTIONS

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C152 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C153 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C154 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C155 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| CR101 | 420008 | DIODE, SILICON, 1N4005 |
| CR102 | 410000 | DIODE, SILICON, 1N4148 |
| CR103 | 420008 | DIODE, SILICON, 1N4005 |
| CR104 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65, ECN 72 |
| CR105 | 410000 | DIODE, SILICON, 1N4148 |
| CR106 | 410000 | DIODE, SILICON, 1N4148 |
| CR107 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65, ECN 72 |
| FL101 | 952006 | FILTER, CRYSTAL, 16 MHZ, #BUE |
| FL102 | 952005 | FILTER, CRYSTAL, 16 MHZ, #BLE |
| J101 | 630000 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| J102 | 630002 | CONNECTOR, PC BOARD, FEMALE, 15 PIN |
| L101 | 330092 | INDUCTOR, RFC, 2.2 UH, 5% |
| L102 | 330091 | INDUCTOR, RFC, 1.8 UH, 5% |
| L103 | 330091 | INDUCTOR, RFC, 1.8 UH, 5% |
| L104 | 330092 | INDUCTOR, RFC, 2.2 UH, 5% |
| L105 | 330044 | INDUCTOR, SHIELDED, VAR., 1 UH |
| L106 | 330044 | INDUCTOR, SHIELDED, VAR., 1 UH |
| L107 | 330087 | INDUCTOR, RFC, 0.33 UH, 5% |
| L108 | 330089 | INDUCTOR, RFC, 0.68 UH, 5% |
| L109 | 330036 | INDUCTOR, RFC, 100UH |
| L110 | 330089 | INDUCTOR, RFC, 0.68 UH, 5% |
| L111 | 330089 | INDUCTOR, RFC, 0.68 UH, 5%,ECN 60 |
| L112 | 330089 | INDUCTOR, RFC, 0.68 UH, 5%,ECN 60 |
| L113 | 330089 | INDUCTOR, RFC, 0.68 UH, 5% |
| L114 | 330044 | INDUCTOR, SHIELDED, VAR., 1 UH |
| L115 | 330044 | INDUCTOR, SHIELDED, VAR., 1 UH |
| L116 | 330085 | INDUCTOR, TOROID, TRIFILAR |
| L117 | 330044 | INDUCTOR, SHIELDED, VAR., 1 UH |
| MX101 | 380000 | MIXER, DOUBLE BALANCED, SBL-1 |
| PC101 | 831031A | PC BOARD, MP-25-PC101 |
| Q101 | 440000 | TRANSISTOR, SILICON, 2N3866 |
| Q102 | 440000 | TRANSISTOR, SILICON, 2N3866 |
| Q103 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904 |
| Q104 | 440010 | TRANSISTOR, SILICON, MPSA14 |
| R101 | 215221 | RESISTOR, CARBON FILM, 220 OHM, 5%, 1/4W |
| R102 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R103 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R104 | 215332 | RESISTOR, CARBON FILM, 3.3K OHM, 5%, 1/4W |
| R105 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R106 | 215332 | RESISTOR, CARBON FILM, 3.3K OHM, 5%, 1/4W |
| R107 | 215271 | RESISTOR, CARBON FILM, 270 OHM, 5%, 1/4W |
| R108 | 215820 | RESISTOR, CARBON FILM, 82 OHM, 5%, 1/4W |
| R109 | 215820 | RESISTOR, CARBON FILM, 82 OHM, 5%, 1/4W |
| R110 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R111 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |

PC101 RECEIVER, TRANSMITTER, MIXER AND IF FUNCTIONS

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| R112 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R113 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R114 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R115 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R116 | 215152 | RESISTOR, CARBON FILM, 1.5K OHM, 5%, 1/4W |
| R117 | 215151 | RESISTOR, CARBON FILM, 150 OHM, 5%, 1/4W |
| R118 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R119 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R120 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R121 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R122 | 215682 | RESISTOR, CARBON FILM, 6.8K OHM, 5%, 1/4W |
| R123 | 215271 | RESISTOR, CARBON FILM, 270 OHM, 5%, 1/4W |
| R124 | 215682 | RESISTOR, CARBON FILM, 6.8K OHM, 5%, 1/4W |
| R125 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R126 | 215106 | RESISTOR, CARBON FILM, 10M OHM, 5%, 1/4W |
| R127 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R128 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R129 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R130 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R131 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R132 | 215332 | RESISTOR, CARBON FILM, 3.3K OHM, 5%, 1/4W |
| U101 | 460000 | INTEGRATED CIRCUIT, MC1350P |
| U102 | 460000 | INTEGRATED CIRCUIT, MC1350P |
| U103 | 460010 | INTEGRATED CIRCUIT, 7808ACT |

PC201 BFO/CARRIER GENERATOR

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C201 | 125500 | CAPACITOR, DM15, 50PF, 5%, 500V |
| C202 | 162002 | CAPACITOR, TRIMMER, 3.9-49PF |
| C203 | 115049 | CAPACITOR, DISC, CERAMIC, N470, 100PF, 5%, 1KV |
| C204 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C205 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C206 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C207 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C208 | 140005 | CAPACITOR, ELECTROLYTIC, 220 MFD, 25V |
| C209 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C210 | 125331 | CAPACITOR, DM15, 330PF, 5%, 500V |
| C211 | 125331 | CAPACITOR, DM15, 330PF, 5%, 500V |
| C212 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C214 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C215 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C216 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C217 | 115015 | CAPACITOR, DISC, CERAMIC, NPO, 100PF, 5%, 50V |
| C218 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C219 | 115012 | CAPACITOR, DISC, CERAMIC, NPO, 47PF, 5%, 50V |
| C220 | 150004 | CAPACITOR, TANTALUM, 6.8 MFD, 35V |
| C221 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C222 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C223 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C224 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C225 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C226 | 115001 | CAPACITOR, DISC, CERAMIC, NPO, 10PF, 10%, 1KV |
| C227 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C228 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C229 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C230 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C231 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C232 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C233 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C234 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C235 | 140003 | CAPACITOR, ELECTROLYTIC, 100 MFD, 25V |
| C236 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C237 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C238 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C239 | 182010 | CAPACITOR, MYLAR, 0.22 MFD, 10%, 63V |
| C241 | 182004 | CAPACITOR, MYLAR, 0.1 MFD, 10%, 63V |
| C242 | 182004 | CAPACITOR, MYLAR, 0.1 MFD, 10%, 63V |
| C243 | 110023 | CAPACITOR, DISC, CERAMIC, 0.1 MFD, 100V |
| C244 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C245 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C246 | 162002 | CAPACITOR, TRIMMER, 3.9-49PF |
| C247 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C248 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C249 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C250 | 140005 | CAPACITOR, ELECTROLYTIC, 220 MFD, 25V |
| C251 | 182006 | CAPACITOR, MYLAR, 0.01 MFD, 10%, 63V |

PC201 BFO/CARRIER GENERATOR

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C252 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C253 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C254 | 125390 | CAPACITOR, DM15, 39PF, 5%, 500V |
| C255 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C256 | 115001 | CAPACITOR, DISC, CERAMIC, NPO, 10PF, 10%, 1KV |
| C257 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C258 | 140005 | CAPACITOR, ELECTROLYTIC, 220 MFD, 25V |
| C259 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C260 | 140005 | CAPACITOR, ELECTROLYTIC, 220 MFD, 25V |
| C261 | 140018 | CAPACITOR, ELECTROLYTIC, 1000 MFD, 16V |
| C262 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C263 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C264 | 182007 | CAPACITOR, MYLAR, 0.022 MFD, 10%, 63V |
| CR201 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65 |
| CR202 | 410000 | DIODE, SILICON, 1N4148 |
| CR203 | 410000 | DIODE, SILICON, 1N4148 |
| CR204 | 410000 | DIODE, SILICON, 1N4148 |
| CR205 | 410000 | DIODE, SILICON, 1N4148 |
| CR206 | 410000 | DIODE, SILICON, 1N4148 |
| CR207 | 410000 | DIODE, SILICON, 1N4148 |
| CR208 | 410000 | DIODE, SILICON, 1N4148 |
| CR209 | 410000 | DIODE, SILICON, 1N4148 |
| CR210 | 410005 | DIODE, HOT CARRIER, HP-5082-2835 |
| CR211 | 410005 | DIODE, HOT CARRIER, HP-5082-2835 |
| CR212 | 410005 | DIODE, HOT CARRIER, HP-5082-2835 |
| CR213 | 410005 | DIODE, HOT CARRIER, HP-5082-2835 |
| CR214 | 410000 | DIODE, SILICON, 1N4148 |
| J201 | 630002 | CONNECTOR, PC BOARD, FEMALE, 15 PIN |
| J202 | 630000 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| L201 | 330088 | INDUCTOR, RFC, 0.47 UH, 5% |
| L202 | 330036 | INDUCTOR, RFC, 100UH, 10% |
| L203 | 330115 | INDUCTOR, TOROID, TRIFILAR |
| L204 | 330080 | INDUCTOR, RFC, 27 UH, 10% |
| PC201 | 831032E | PC BOARD, MP-25-PC201 |
| Q201 | 440002 | TRANSISTOR, SILICON, 2N3563/MPS3563 |
| Q202 | 440012 | TRANSISTOR, SILICON, 2N5224/MPS2369 |
| Q203 | 450001 | TRANSISTOR, FET, 2N5486 |
| Q204 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904 |
| Q205 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| Q206 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904 |
| Q207 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904 |
| R202 | 215333 | RESISTOR, CARBON FILM, 33K OHM, 5%, 1/4W |
| R203 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R204 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R205 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R206 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R207 | 215151 | RESISTOR, CARBON FILM, 150 OHM, 5%, 1/4W |
| R208 | 215100 | RESISTOR, CARBON FILM, 10 OHM, 5%, 1/4W |
| R209 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |

PC201 BFO/CARRIER GENERATOR

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| R210 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R211 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R212 | 215821 | RESISTOR, CARBON FILM, 820 OHM, 5%, 1/4W |
| R213 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R214 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R215 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R216 | 215472 | RESISTOR, CARBON FILM, 4.7K OHM, 5%, 1/4W |
| R217 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R218 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R219 | 215153 | RESISTOR, CARBON FILM, 15K OHM, 5%, 1/4W |
| R220 | 215205 | RESISTOR, CARBON FILM, 2M OHM, 5%, 1/4W |
| R221 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R222 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R223 | 215822 | RESISTOR, CARBON FILM, 8.2K OHM, 5%, 1/4W |
| R224 | 215205 | RESISTOR, CARBON FILM, 2M OHM, 5%, 1/4W |
| R225 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R226 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R227 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R228 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R229 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R230 | 215224 | RESISTOR, CARBON FILM, 220K OHM, 5%, 1/4W |
| R231 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R232 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R233 | 215683 | RESISTOR, CARBON FILM, 68K OHM, 5%, 1/4W |
| R234 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R235 | 215820 | RESISTOR, CARBON FILM, 82 OHM, 5%, 1/4W |
| R236 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R237 | 260007 | POTENTIOMETER, 2.5K OHM, PCB, VERT. MT. |
| R238 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R239 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R240 | 260007 | POTENTIOMETER, 2.5K OHM, PCB, VERT. MT. |
| R241 | 215182 | RESISTOR, CARBON FILM, 1.8K OHM, 5%, 1/4W |
| R242 | 215182 | RESISTOR, CARBON FILM, 1.8K OHM, 5%, 1/4W |
| R243 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R244 | 215205 | RESISTOR, CARBON FILM, 2M OHM, 5%, 1/4W |
| R245 | 215473 | RESISTOR, CARBON FILM, 47K OHM, 5%, 1/4W |
| R246 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R247 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R248 | 215224 | RESISTOR, CARBON FILM, 220K OHM, 5%, 1/4W |
| R249 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R250 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R252 | 215473 | RESISTOR, CARBON FILM, 47K OHM, 5%, 1/4W |
| R253 | 215473 | RESISTOR, CARBON FILM, 47K OHM, 5%, 1/4W |
| R254 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R255 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R256 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R257 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R258 | 260006 | POTENTIOMETER, 100K OHM, PCB, VERT. MT. |
| R259 | 260007 | POTENTIOMETER, 2.5K OHM, PCB, VERT. MT. |

PC201 BFO/CARRIER GENERATOR

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| R260 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R261 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| U201 | 460000 | INTEGRATED CIRCUIT, MC1350P |
| U202 | 460002 | INTEGRATED CIRCUIT, LM3900P |
| U203 | 460002 | INTEGRATED CIRCUIT, LM3900P |
| U204 | 460014 | INTEGRATED CIRCUIT, 555P |
| U205 | 460013 | INTEGRATED CIRCUIT, ULN2283B |
| U206 | 460010 | INTEGRATED CIRCUIT, 7808ACT |
| Y201 | 951019 | CRYSTAL, 16 MHZ, NON-OVEN, AGED |

PC301 TRANSMITTER LINEAR AMPLIFIER

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C301 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C302 | 105002 | CAPACITOR, MONOLITHIC CERAMIC, X7R, 0.1 MFD, 50V |
| C303 | 135252 | CAPACITOR, DM19, 2500PF, 5%, 500V |
| C304 | 105002 | CAPACITOR, MONOLITHIC CERAMIC, X7R, 0.1 MFD, 50V |
| C306 | 105002 | CAPACITOR, MONOLITHIC CERAMIC, X7R, 0.1 MFD, 50V |
| C308 | 105002 | CAPACITOR, MONOLITHIC CERAMIC, X7R, 0.1 MFD, 50V |
| C310 | 182006 | CAPACITOR, MYLAR, 0.01 MFD, 10%, 63V |
| C311 | 182006 | CAPACITOR, MYLAR, 0.01 MFD, 10%, 63V |
| C312 | 135511 | CAPACITOR, DM19, 510PF, 5%, 500V |
| C313 | 105002 | CAPACITOR, MONOLITHIC CERAMIC, X7R, 0.1 MFD, 50V |
| C314 | 140018 | CAPACITOR, ELECTROLYTIC, 1000 MFD, 16V |
| C315 | 135271 | CAPACITOR, DM19, 270PF, 5%, 500V |
| C316 | 105002 | CAPACITOR, MONOLITHIC CERAMIC, X7R, 0.1 MFD, 50V |
| C317 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C318 | 182011 | CAPACITOR, MYLAR, 0.002 MFD, 10%, 100V |
| C319 | 182011 | CAPACITOR, MYLAR, 0.002 MFD, 10%, 100V |
| C320 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| CR301 | 420001 | DIODE, SILICON, S2M |
| CR302 | 420001 | DIODE, SILICON, S2M |
| CR303 | 420001 | DIODE, SILICON, S2M |
| J301 | 630000 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| J302 | 630000 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| L301 | 330127 | INDUCTOR, TOROID, TRIFILAR |
| L302 | 330127 | INDUCTOR, TOROID, TRIFILAR |
| L303 | 330114 | INDUCTOR, TOROID, BIFILAR |
| L304 | 330110 | INDUCTOR, TOROID, BIFILAR |
| L305 | 330086 | INDUCTOR, TOROID, TRIFILAR |
| L306 | 330094 | INDUCTOR, RFC, SPECIAL |
| L307 | 330094 | INDUCTOR, RFC, SPECIAL |
| L308 | 330049 | INDUCTOR, RFC |
| L309 | 330105 | INDUCTOR, RFC, DC FILTER |
| PC301 | 831033C | PC BOARD, MP-25, PC301, POWER AMP |
| Q301 | 440000 | TRANSISTOR, SILICON, 2N3866 |
| Q302 | 440011 | TRANSISTOR, SILICON, MRF433 |
| Q303 | 440007 | TRANSISTOR, SILICON, MRF454 |
| Q304 | 440007 | TRANSISTOR, SILICON, MRF454 |
| Q305 | 440005 | TRANSISTOR, SILICON, 2N5490 |
| R301 | 215680 | RESISTOR, CARBON FILM, 68 OHM, 5%, 1/4W |
| R302 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| R303 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R304 | 215100 | RESISTOR, CARBON FILM, 10 OHM, 5%, 1/4W |
| R305 | 225470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/2W |
| R306 | 215100 | RESISTOR, CARBON FILM, 10 OHM, 5%, 1/4W |
| R307 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R308 | 225470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/2W |
| R309 | 225470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/2W |
| R310 | 225100 | RESISTOR, CARBON FILM, 10 OHM, 5%, 1/2W |
| R311 | 225101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/2W |
| R312 | 225101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/2W |

PC301 TRANSMITTER LINEAR AMPLIFIER

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| R313 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R314 | 260005 | POTENTIOMETER, 2.5K OHM, PCB, HOR. MT. |
| R315 | 225100 | RESISTOR, CARBON FILM, 10 OHM, 5%, 1/2W |
| R316 | 215102 | RESISTOR, CARBON FILM, 1K OHM, 5%, 1/4W |
| | 817204B | HEAT SINK, TRANSISTOR, WAS B822035B ECN 105 |

PC401 BCD SIGNAL CONVERTER

| SYMBOL | PART # | DESCRITPION |
|---|---|---|
| C401 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C402 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C403 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| CR401 | 410000 | DIODE, SILICON, 1N4148 |
| CR402 | 410000 | DIODE, SILICON, 1N4148 |
| CR403 | 410000 | DIODE, SILICON, 1N4148 |
| CR404 | 410000 | DIODE, SILICON, 1N4148 |
| CR405 | 410000 | DIODE, SILICON, 1N4148 |
| J401 | 630004 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| J401 | 630004 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| J402 | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| PC401 | 831034 | PC BOARD, MP-25, PC401, #1 SYNTH |
| R401 | 200000 | RESISTOR, SIP NETWORK, 9 X 100K OH, |
| R402 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R403 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R404 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R405 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R406 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R407 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| R408 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| U401 | 460017 | INTEGRATED CIRCUIT, 4082BP |
| U402 | 460017 | INTEGRATED CIRCUIT, 4082BP |
| U403 | 460016 | INTEGRATED CIRCUIT, 4001BP |
| U404 | 460018 | INTEGRATED CIRCUIT, 74C48P |
| U405 | 460015 | INTEGRATED CIRCUIT, 78L82P |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640011 | SOCKET, INTEGRATED CIRCUIT, 16 PIN |

PC501 UNIVERSAL DIVIDER

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C501 | 110002 | CAPACITOR, DISC, CERAMIC, 0.001 MFD, 100V |
| C502 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C503 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C504 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C505 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C506 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C507 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C509 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C510 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C511 | 140018 | CAPACITOR, ELECTROLYTIC, 1000 MFD, 16V |
| C512 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C513 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C514 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C515 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C516 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| CR501 | 410000 | DIODE, SILICON, 1N4148 |
| CR502 | 410000 | DIODE, SILICON, 1N4148 |
| CR503 | 410000 | DIODE, SILICON, 1N4148 |
| CR504 | 410000 | DIODE, SILICON, 1N4148 |
| CR505 | 410000 | DIODE, SILICON, 1N4148 |
| CR506 | 410000 | DIODE, SILICON, 1N4148 |
| CR507 | 410000 | DIODE, SILICON, 1N4148 |
| CR508 | 410000 | DIODE, SILICON, 1N4148 |
| CR509 | 410000 | DIODE, SILICON, 1N4148 |
| CR510 | 410000 | DIODE, SILICON, 1N4148 |
| CR511 | 410000 | DIODE, SILICON, 1N4148 |
| J501 | 630004 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| J501 | 630004 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| L501 | 330113 | INDUCTOR, TOROID, BIFILAR |
| PC501 | 831035A | PC BOARD, MP-25, PC501, #2 SYNTH |
| Q501 | 450001 | TRANSISTOR, FET, 2N5486 |
| R501 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R502 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R503 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R504 | 215333 | RESISTOR, CARBON FILM, 33K OHM, 5%, 1/4W |
| R505 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R506 | 215682 | RESISTOR, CARBON FILM, 6.8K OHM, 5%, 1/4W |
| R507 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R508 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R509 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R510 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R511 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R512 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R513 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R514 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R515 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R516 | 215475 | RESISTOR, CARBON FILM, 4.7M OHM, 5%, 1/4W |
| R517 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R518 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |

PC501 UNIVERSAL DIVIDER

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| R519 | 215331 | RESISTOR, CARBON FILM, 330 OHM, 5%, 1/4W |
| U501 | 460021 | INTEGRATED CIRCUIT, 74F00P |
| U502 | 460020 | INTEGRATED CIRCUIT, 74F74P |
| U503 | 460020 | INTEGRATED CIRCUIT, 74F74P |
| U504 | 460019 | INTEGRATED CIRCUIT, 4013BP |
| U505 | 460019 | INTEGRATED CIRCUIT, 4013BP |
| U506 | 460023 | INTEGRATED CIRCUIT, 4025BP |
| U507 | 460022 | INTEGRATED CIRCUIT, 4072BP |
| U508 | 460025 | INTEGRATED CIRCUIT, HEF4751VDF |
| U509 | 460014 | INTEGRATED CIRCUIT, 555P |
| U510 | 460011 | INTEGRATED CIRCUIT, 78L05P |
| U511 | 460010 | INTEGRATED CIRCUIT, 7808ACT |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640010 | SOCKET, INTEGRATED CIRCUIT, 28 PIN |
| | 640012 | SOCKET, INTEGRATED CIRCUIT, 8 PIN |

PC601 SYNTHESIZER VCO, MASTER OSCILLATOR AND DETECTORS

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C601 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C602 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C603 | 182006 | CAPACITOR, MYLAR, 0.01 MFD, 10%, 63V |
| C604 | 182009 | CAPACITOR, MYLAR, 0.47 MFD, 10%, 63V |
| C605 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C606 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C607 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C608 | 150005 | CAPACITOR, TANTALUM, 47 MFD, 10V |
| C609 | 140019 | CAPACITOR, ELECTROLYTIC, 100 MFD, 16V |
| C610 | 150001 | CAPACITOR, TANTALUM, 10 MFD, 25V |
| C611 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C612 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C613 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C614 | 115001 | CAPACITOR, DISC, CERAMIC, NPO, 10PF, 5%, 1KV |
| C615 | 125181 | CAPACITOR, DM15, 180PF, 5%, 500V |
| C616 | 182006 | CAPACITOR, MYLAR, 0.01 MFD, 10%, 63V |
| C617 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C618 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C619 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C620 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C621 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C622 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C623 | 1400 MFD, 25V | |
| C624 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C625 | 140017 | CAPACITOR, ELECTROLYTIC, 470 MFD, 16V |
| C626 | 150006 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C627 | 115012 | CAPACITOR, DISC, CERAMIC, NPO, 47PF, 5%, 50V |
| C628 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C629 | 182007 | CAPACITOR, MYLAR, 0.022 MFD, 10%, 63V |
| C630 | 182008 | CAPACITOR, MYLAR, 0.0047 MFD, 10%, 63V |
| C631 | 182003 | CAPACITOR, MYLAR, 0.047 MFD, 10%, 63V |
| C632 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C633 | 115001 | CAPACITOR, DISC, CERAMIC, NPO, 10PF, 5%, 1KV |
| C634 | 125101 | CAPACITOR, DM15, 100PF, 5%, 500V |
| C635 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| C636 | 150005 | CAPACITOR, TANTALUM, 47 MFD, 10V |
| C637 | 115047 | CAPACITOR, DISC, CERAMIC, NPO, 90PF, 5%, 50V |
| C638 | 115048 | CAPACITOR, DISC, CERAMIC, NPO, 62PF, 5%, 50V |
| C639 | 125471 | CAPACITOR, DM15, 470PF, 5%, 500V |
| C640 | 115046 | CAPACITOR, DISC, CERAMIC, N330, 15PF, 5%, 100V |
| C641 | 162004 | CAPACITOR, TRIMMER, N750, 4.0-20PF |
| C642 | 182007 | CAPACITOR, MYLAR, 0.022 MFD, 10%, 63V |
| C643 | 115011 | CAPACITOR, DISC, CERAMIC, NPO, 33PF, 5%, 50V |
| C644 | 125820 | CAPACITOR, DM15, 82PF, 5%, 500V |
| C645 | 140019 | CAPACITOR, ELECTROLYTIC, 100 MFD, 16V |
| C646 | 150000 | CAPACITOR, TANTALUM, 2.2 MFD, 25V |
| C647 | 115001 | CAPACITOR, DISC, CERAMIC, NPO, 10PF, 5%, 1KV |
| CR601 | 470001 | DIODE, VARACTOR, MV209 |
| CR602 | 410000 | DIODE, SILICON, 1N4148 |

PC601 SYNTHESIZER VCO, MASTER OSCILLATOR AND DETECTORS

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| CR603 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65 |
| CR604 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65 |
| CR605 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65 |
| CR606 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65 |
| CR607 | 410002 | DIODE, PIN, BA-482/BA282,ECN 65 |
| CR609 | 470001 | DIODE, VARACTOR, MV209 |
| CR610 | 420008 | DIODE, SILICON, 1N4005 |
| J601 | 630004 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| J601 | 630004 | CONNECTOR, PC BOARD, FEMALE, 10 PIN |
| K601 | 730002 | RELAY, REED, SPDT, 12V |
| L602 | 330106 | INDUCTOR, SHIELDED, VAR., 0.52 UH |
| L603 | 330107 | INDUCTOR, SHIELDED, VAR., 0.157 UH |
| L604 | 330108 | INDUCTOR, SHIELDED, VAR., 0.17 UH |
| L605 | 330108 | INDUCTOR, SHIELDED, VAR., 0.17 UH |
| L606 | 330109 | INDUCTOR, SHIELDED, VAR., 0.225 UH |
| L607 | 330109 | INDUCTOR, SHIELDED, VAR., 0.225 UH |
| L608 | 330108 | INDUCTOR, SHIELDED, VAR., 0.17 UH |
| L609 | 330127 | INDUCTOR, TOROID, TRIFILAR |
| L610 | 330127 | INDUCTOR, TOROID, TRIFILAR |
| PC601 | 831036F | PC BOARD, MP-25, PC601, #3 SYNTH |
| Q601 | 450005 | TRANSISTOR, FET, MFE211 |
| Q602 | 440002 | TRANSISTOR, SILICON, 2N3563/MPS3563 |
| Q603 | 440019 | TRANSISTOR, SILICON, 2N5179 |
| Q604 | 440001 | TRANSISTOR, SILICON, MPS6514/2N3904 |
| R601 | 215470 | RESISTOR, CARBON FILM, 47 OHM, 5%, 1/4W |
| R602 | 215221 | RESISTOR, CARBON FILM, 220 OHM, 5%, 1/4W |
| R603 | 215333 | RESISTOR, CARBON FILM, 33K OHM, 5%, 1/4W |
| R604 | 215473 | RESISTOR, CARBON FILM, 47K OHM, 5%, 1/4W |
| R605 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R606 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R607 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R608 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R609 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R610 | 215223 | RESISTOR, CARBON FILM, 22K OHM, 5%, 1/4W |
| R611 | 215100 | RESISTOR, CARBON FILM, 10 OHM, 5%, 1/4W |
| R612 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R613 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R614 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R615 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R616 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R617 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R618 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R619 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R620 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R621 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R622 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R623 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R624 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R625 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |

PC601 SYNTHESIZER VCO, MASTER OSCILLATOR AND DETECTORS

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| R626 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R627 | 215205 | RESISTOR, CARBON FILM, 2M OHM, 5%, 1/4W |
| R628 | 215683 | RESISTOR, CARBON FILM, 68K OHM, 5%, 1/4W |
| R629 | 215101 | RESISTOR, CARBON FILM, 100 OHM, 5%, 1/4W |
| R630 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R631 | 215105 | RESISTOR, CARBON FILM, 1M OHM, 5%, 1/4W |
| R632 | 215182 | RESISTOR, CARBON FILM, 1.8K OHM, 5%, 1/4W |
| R633 | 215104 | RESISTOR, CARBON FILM, 100K OHM, 5%, 1/4W |
| R634 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R635 | 215221 | RESISTOR, CARBON FILM, 220 OHM, 5%, 1/4W |
| R636 | 215103 | RESISTOR, CARBON FILM, 10K OHM, 5%, 1/4W |
| R637 | 215152 | RESISTOR, CARBON FILM, 1.5K OHM, 5%, 1/4W |
| U601 | 460026 | INTEGRATED CIRCUIT, 741P |
| U602 | 460024 | INTEGRATED CIRCUIT, HEF4750VDF |
| U603 | 460012 | INTEGRATED CIRCUIT, LM2930T-8 |
| U604 | 460011 | INTEGRATED CIRCUIT, 78L05P |
| U605 | 460011 | INTEGRATED CIRCUIT, 78L05P |
| Y601 | 951020 | CRYSTAL, 5 MHZ, NON-OVEN, AGED |
| | 640010 | SOCKET, INTEGRATED CIRCUIT, 28 PIN |
| | 640012 | SOCKET, INTEGRATED CIRCUIT, 8 PIN |

PC701 LED READ-OUTS AND FREQUENCY SELECTOR SWITCHES

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| CR701 | 410000 | DIODE, SILICON, 1N4148 |
| CR702 | 410000 | DIODE, SILICON, 1N4148 |
| CR703 | 410000 | DIODE, SILICON, 1N4148 |
| CR704 | 410000 | DIODE, SILICON, 1N4148 |
| CR705 | 410000 | DIODE, SILICON, 1N4148 |
| CR706 | 410000 | DIODE, SILICON, 1N4148 |
| CR707 | 410000 | DIODE, SILICON, 1N4148 |
| CR708 | 410000 | DIODE, SILICON, 1N4148 |
| CR709 | 410000 | DIODE, SILICON, 1N4148 |
| CR710 | 410000 | DIODE, SILICON, 1N4148 |
| CR711 | 410000 | DIODE, SILICON, 1N4148 |
| CR712 | 410000 | DIODE, SILICON, 1N4148 |
| CR713 | 410000 | DIODE, SILICON, 1N4148 |
| CR714 | 410000 | DIODE, SILICON, 1N4148 |
| CR715 | 410000 | DIODE, SILICON, 1N4148 |
| CR716 | 410000 | DIODE, SILICON, 1N4148 |
| J701 | 630005 | CONNECTOR, PC BOARD, MALE, 20 PIN,ECN 68 |
| PC701 | 831037 | PC BOARD, MP-25, PC701 |
| Q701 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| Q702 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| Q703 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| Q704 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| Q705 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| Q706 | 440008 | TRANSISTOR, SILICON, 2N3638 |
| R701 | 215221 | RESISTOR, CARBON FILM, 220 OHM, 5%, 1/4W |
| R702 | 215471 | RESISTOR, CARBON FILM, 470 OHM, 5%, 1/4W |
| R703 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R704 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R706 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R707 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R708 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| R709 | 215222 | RESISTOR, CARBON FILM, 2.2K OHM, 5%, 1/4W |
| S701 | 720017 | SWITCH, ROTARY, BCD, 10 POSITION |
| S702 | 720017 | SWITCH, ROTARY, BCD, 10 POSITION |
| S703 | 720017 | SWITCH, ROTARY, BCD, 10 POSITION |
| S704 | 720017 | SWITCH, ROTARY, BCD, 10 POSITION |
| V701 | 400002 | LED, DISPLAY, MAN4640A |
| V702 | 400002 | LED, DISPLAY, MAN4640A |
| V703 | 400002 | LED, DISPLAY, MAN4640A |
| V704 | 400002 | LED, DISPLAY, MAN4640A |
| V705 | 400002 | LED, DISPLAY, MAN4640A |
| V706 | 400003 | LED, DISPLAY, MAN3640A |
| W701 | 821045A | CABLE, ASSEMBLY, RIBBON, 20 PIN,ECN 68 |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |
| | 640002 | SOCKET, INTEGRATED CIRCUIT, 14 PIN |

APPENDIX A - PARTS LIST (Continued)

PC801 LOW PASS FILTERS AND MHz SELECTOR SWITCH

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C801 | 135132 | CAPACITOR, DM19, 1300PF, 5%, 500V |
| C802 | 135222 | CAPACITOR, DM19, 2200PF, 5%, 500V |
| C803 | 135222 | CAPACITOR, DM19, 2200PF, 5%, 500V |
| C804 | 135132 | CAPACITOR, DM19, 1300PF, 5%, 500V |
| C805 | 125102 | CAPACITOR, DM15, 1000PF, 5%, 300V |
| C806 | 135152 | CAPACITOR, DM19, 1500PF, 5%, 500V |
| C807 | 135152 | CAPACITOR, DM19, 1500PF, 5%, 500V |
| C808 | 125102 | CAPACITOR, DM15, 1000PF, 5%, 300V |
| C809 | 125621 | CAPACITOR, DM15, 620PF, 5%, 500V |
| C810 | 125102 | CAPACITOR, DM15, 1000PF, 5%, 300V |
| C811 | 125102 | CAPACITOR, DM15, 1000PF, 5%, 300V |
| C812 | 125621 | CAPACITOR, DM15, 620PF, 5%, 500V |
| C813 | 125471 | CAPACITOR, DM15, 470PF, 5%, 500V |
| C814 | 125681 | CAPACITOR, DM15, 680PF, 5%, 300V |
| C815 | 125681 | CAPACITOR, DM15, 680PF, 5%, 300V |
| C816 | 125431 | CAPACITOR, DM15, 430PF, 5%, 500V |
| C817 | 125331 | CAPACITOR, DM15, 330PF, 5%, 500V |
| C818 | 125511 | CAPACITOR, DM15, 510PF, 5%, 500V |
| C819 | 125511 | CAPACITOR, DM15, 510PF, 5%, 500V |
| C820 | 125331 | CAPACITOR, DM15, 330PF, 5%, 500V |
| L801 | 330103 | INDUCTOR, TOROID, 3.7 UH, 5% |
| L802 | 330104 | INDUCTOR, TOROID, 4 UH, 5% |
| L803 | 330103 | INDUCTOR, TOROID, 3.7 UH, 5% |
| L804 | 330101 | INDUCTOR, TOROID, 2 UH, 5% |
| L805 | 330102 | INDUCTOR, TOROID, 2.2 UH, 5% |
| L806 | 330101 | INDUCTOR, TOROID, 2 UH, 5% |
| L807 | 330099 | INDUCTOR, TOROID, 1.5 UH, 5% |
| L808 | 330100 | INDUCTOR, TOROID, 1.6 UH, 5% |
| L809 | 330099 | INDUCTOR, TOROID, 1.5 UH, 5% |
| L810 | 330097 | INDUCTOR, TOROID, 1 UH, 5% |
| L811 | 330098 | INDUCTOR, TOROID, 1.13 UH, 5% |
| L812 | 330097 | INDUCTOR, TOROID, 1 UH, 5% |
| L813 | 330095 | INDUCTOR, TOROID, 0.628 UH, 5% |
| L814 | 330096 | INDUCTOR, TOROID, 0.68 UH, 5% |
| L815 | 330095 | INDUCTOR, TOROID, 0.628 UH, 5% |
| PC801 | 831038A | PC BOARD, MP-25, PC801 LOW PASS FILTERS |

PC901 FRONT PANEL

| | | |
|---|---|---|
| PC801 | 990208 | MP-25, PC801, BUILT AND TESTED |
| S801 | 720015 | SWITCH, ROTARY, 5 POLE, 18 POSITION |
| W801 | 821028 | CABLE, ASSEMBLY, CONNECTOR & RIBBON |
| W802 | 821046A | CABLE, ASSEMBLY, RIBBON, 6 PIN,ECN 68 |

APPENDIX A - PARTS LIST

PC901 FRONT PANEL

| SYMBOL | PART # | DESCRIPTION |
|---|---|---|
| C901 | 171004 | CAPACITOR, VARIABLE, 410PF |
| C902 | 135751 | CAPACITOR, DM19, 750PF, 5%, 500V |
| C903 | 110012 | CAPACITOR, DISC, CERAMIC, 0.01 MFD, 100V |
| CR901 | 410000 | DIODE, SILICON, 1N4148 |
| CR904 | 410000 | DIODE, SILICON, 1N4148 |
| CR905 | 410000 | DIODE, SILICON, 1N4148 |
| I901 | 520006 | LAMP, 12 VOLT |
| J901 | 610035 | CONNECTOR, RECEPTACLE, 6 CONTACT, WATERPROOF |
| J902 | 610035 | CONNECTOR, RECEPTACLE, 6 CONTACT, WATERPROOF |
| J903 | 610036 | CONNECTOR, RECEPTACLE, 3 CONTACT |
| J904 | 610038 | CONNECTOR, RECEPTACLE, BNC, BULKHEAD |
| J905 | 816305 | POST, PUSH, RED |
| J906 | 816306 | POST, PUSH, BLACK |
| M901 | 960001 | METER, 0 - 500UA 0.58' X 1.37' |
| PS901 | 910003 | SPEAKER, WATERPROOF, 2', 8 OHMS |
| R901 | 260015 | POTENTIOMETER, 10K OHM, PANEL MT. |
| R902 | 260016 | POTENTIOMETER, 10K OHM, PANEL MT. |
| S901 | 720014 | SWITCH, ROTARY, 4 POLE, 5 POSITION |
| S902 | 710006 | SWITCH, TOGGLE, MOMENTARY, 6 AMP |
| S903 | 710005 | SWITCH, TOGGLE, DPDT, 6 AMP |
| S904 | 260015 | POTENTIOMETER, 10K OHM, PANEL MT. |
| S906 | 710004 | SWITCH, TOGGLE, SPDT, 6 AMP |
| | 818005 | KNOB, 1/2' DIA, 1/8' SHAFT, W/POINTER |
| | 818005 | KNOB, 1/2' DIA, 1/8' SHAFT, W/POINTER |
| | 818005 | KNOB, 1/2' DIA, 1/8' SHAFT, W/POINTER |
| | 818006 | KNOB, 23/32' DIA, 1/8' SHAFT, W/POINTER |
| | 818006 | KNOB, 23/32' DIA, 1/8' SHAFT, W/POINTER |
| | 818006 | KNOB, 23/32' DIA, 1/8' SHAFT, W/POINTER |
| | 818007 | KNOB, 23/32' DIA, 1/4' SHAFT, W/POINTER |
| | 818008 | KNOB, 23/32' DIA, 1/8' SHAFT |
| | 818008 | KNOB, 23/32' DIA, 1/8' SHAFT |
| | 818500 | BUSHING, PANEL, 1/8 IN. SHAFT X .3125 L |
| | 818501 | BUSHING PANEL, 1/8 IN. SHAFT X 7/16 |
| | 818700 | SHAFT, 1/8' X 1.25' |
| | 821048A | STRAP, RETAINER, METER |
| | 821058 | PLATE, ANTENNA, BASE |
| | 821059A | LENS, LED, RED |
| | 821060 | RATCHET, ANTENNA |
| | 821061A | DIAPHRAM, SPEAKER, GORTEX |
| | 821062 | CLOTH, SPEAKER, CLOTH |
| | 822033 | BRACKET, CAPACITOR, SPEAKER |
| | 823041C | PANEL, SUB |
| | 823042B | PANEL, OVERLAY |
| | 824035G | PANEL, FRONT, LEXAN |
| | 825000 | OVERLAY, PANEL, BLACK ANODIZED,ECN 66 |
| | 970000 | HARNESS, WIRING |