# MAINTENANCE MANUAL
# RF BOARD
# 19D902123G1 FOR TMX-8712



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## DESCRIPTION

The 800 MHz RF Board 19D902123G1 consists of the following circuits:

- A frequency synthesizer for generating the transmit carrier frequency and the receive circuit first mixer injection frequency.
- The transmit exciter and power control stages.
- The receive circuit front end, IF, and FM detector.
- Voltage regulators.

The RF Board is mounted in the bottom of the frame assembly. Refer to the Combination Manual for a mechanical layout of the radio. Figure 1 provides a block diagram of the synthesizer and Figure 2 of the receive and transmit circuits.

The transmitter and receiver adjustments are accessible from the top of the board. Chip components on the bottom of the board provide optimum RF performance, while being accessible for easy servicing by removing the friction fit bottom shields.

Selected use of sealed modules permits small board size as well as RF and mechanical protection for sensitive circuitry. Modules are not repairable and must be replaced if they are determined to be damaged.

## CIRCUIT ANALYSIS

### SYNTHESIZER CIRCUIT

The synthesizer generates all transmit and receive RF frequencies. The circuit uses a phase-locked VCO operating on the actual transmitter frequency of 806 to 825 MHz. In the direct (talk around) mode, the VCO is band shifted to operate at 851 to 870 MHz. The synthesizer's output signal is generated directly by the VCO module U201 and buffered

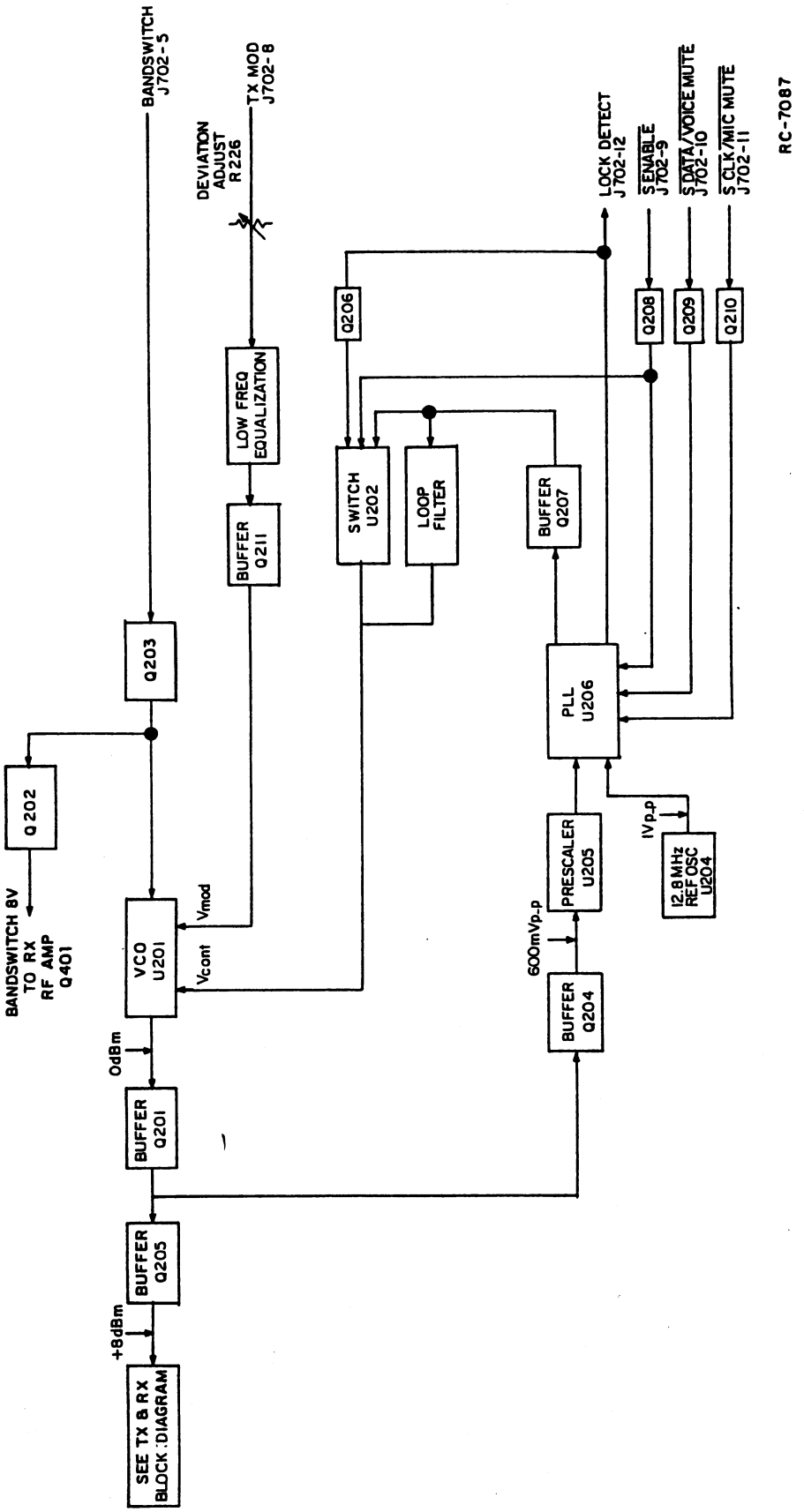



Figure 1 - Synthesizer Block Diagram

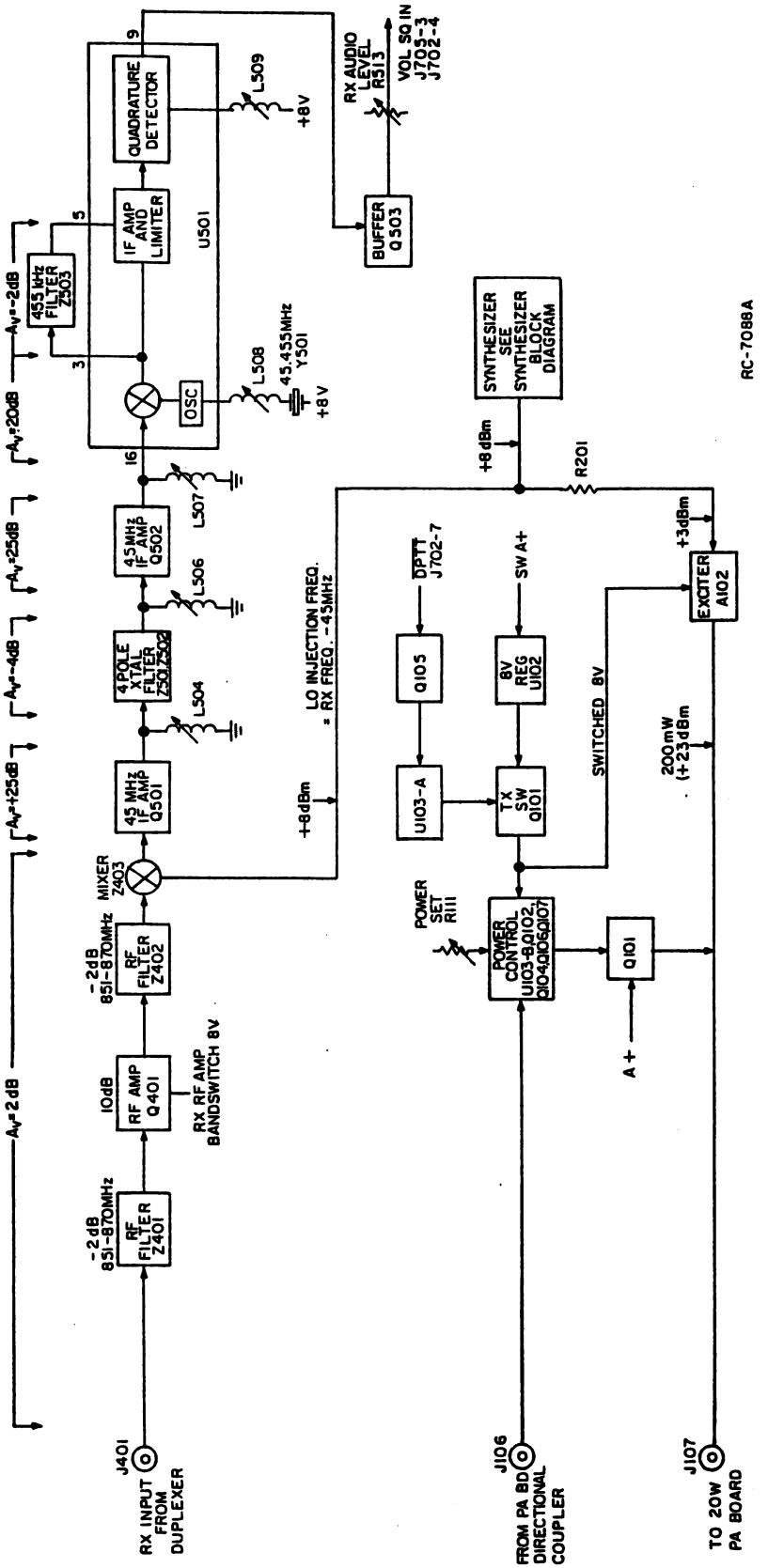



Figure 2 - Duplex Receive and Transmit Block Diagram

by Q201 and Q205 to a level of +8 dBm (6 mW). This signal feeds the receiver mixer directly and is attenuated to +3 dBm by R201 to feed the transmitter exciter module.

The synthesizer frequency is controlled by the microprocessor on the Logic Board (A1). Frequency stability is maintained by a temperature compensated crystal controlled oscillator (TCXO) module U204 operating at 12.8 MHz. The oscillator has a stability of ±2.5 PPM (0.00025%) over the temperature range of -30°C to +85°C and determines the overall frequency stability of the radio.

The buffered VCO output from Q201 is further buffered by Q204 to feed the divide by 128/129 dual modulus prescaler U205. The prescaler feeds the FIN input of the PLL U206. Within U206, the prescaled signal is further divided down to 12.5 kHz to be compared with a reference signal. This reference signal is derived from the 12.8 MHz TCXO module U204. U206 divides the 12.8 MHz signal down to the 12.5 kHz reference frequency.

Divider circuits in U206 are programmed by three inputs from the Logic Board (A1), which are buffered and inverted by transistors Q208, Q209, and Q210. The S ENABLE pulse activates switch U202 to allow more rapid channel acquisition during channel changes.

A LOCK DET signal from the PLL goes to the microprocessor for processing to prevent transmission when the VCO is not on frequency and to provide an error message to the user.

When the radio is used in the direct (talk around) mode, the VCO is bandswitched to transmit in the 851 to 870 MHz range. The BANDSWITCH line from the microprocessor is normally at a logic high and switches low during transmit in direct mode. Transistor Q203 buffers and inverts this signal to feed the VCO and Q202. Transistor Q202 provides the 8 volt supply voltage to the receiver RF preamp which is switched off when the BANDSWITCH line becomes active (logic low) during transmit in direct mode.

Audio modulation from the Audio Board (A3) is applied to the VCO module through DEVIATION ADJUST potentiometer R226 and buffer transistor Q211.

## TRANSMITTER CIRCUIT

The transmitter consists of a fixed tuned 200mW exciter module, a power control circuit, and a transmit voltage switch. A 20W Power Amplifier Board is housed in the Power Amplifier/Duplexer Assembly which is described in the maintenance manual for the assembly.

### Exciter Module

The synthesizer drives the receiver mixer at +8 dBm and is attenuated to +3 dBm for driving the exciter input. The exciter module A102 operates from a switched 8 volt supply. The exciter module bandwidth is sufficiently wide that both the 806 to 825 MHz and 851 to 870 MHz bands are allowed. No tuning is required. Both input and output ports operate at 50 ohms impedance. The exciter module provides typically 20 dB of gain and 200 mW of output power to drive the 20W Power Amplifier in the Power Amplifier/Duplexer Assembly. The exciter output and the PA control voltage output appear at J107.

### Power Control Circuit

The power control circuit samples the output power to maintain a constant power level across the band. Also, thermistors sense the heatsink temperature to throttle the power level down above +60°C. The circuit controls the supply voltage to the first amplifier stage of the PA module in the Power Amplifier/Duplexer Assembly. The control voltage is sent to the PA module via the exciter RF output jack J107.

The power control circuit receives a DC voltage from the directional coupler on the 20W PA Board via J106. This DC level, which is proportional to the output power, feeds the (-) input of amplifier U103-B. Power set pot R111 determines the DC level to the (+) input of U103-B. U103-B amplifies the difference between the (-) and (+) inputs, forcing the output power level to equal the power set level by varying the drive to Q102 and Q101. Q101 supplies the control voltage to the PA module U101. For example, if the output power level begins to drop below the power set level, the output of U103-B increases positively, causing Q102 to conduct less. The base of Q101 rises, increasing the control voltage to the PA module, which increases the output power level back to the desired set level.

Thermistors R118 and R129, buffered by Q106 and Q107, reduce the DC level to the (+) input of U103-B above 60°C. Q104, C123, and R105 improve the transient stability of the power control loop when the transmitter is keyed.

### Transmit Switch

During transmit, the Logic Board (A1) microprocessor pulls the DPTT line low which is buffered by Q105 before feeding U103-A. The output of U103-A goes low to turn on Q103 which supplies SWITCHED 8V to exciter module A102 and the power control circuit.

## RECEIVER CIRCUIT

The dual conversion receiver circuit consists of a front end section, a 45.0 MHz first IF, and a 455 kHz second IF with a FM detector. All audio processing and squelch functions are accomplished on the Audio Board (A3).

### Front End Section

RF from the RX port on the duplexer is coupled to receiver input J401. RF selectivity is provided by two filters Z401 and Z402 on the input and output of RF amplifier transistor Q401. The filters are fixed tuned, 3 pole dielectric resonators with a bandwidth greater than 20 MHz to cover the 851 to 870 MHz band. About 2 dB of passband ripple is typical for this filter pair. Approximately 50 ohm impedance levels exist at the input and output ports of the filters.

RF Amplifier transistor Q401 is a low noise bipolar transistor biased with DC feedback. The feedback allows a stable operating point of about 10 milliamps, while allowing direct emitter grounding. Input matching is obtained with stripline L402. The amplifier load is primarily filter Z402. C404, C405, C410, and stripline L403 provide a low Q match to the filter. Transistor Q202 supplies 8 volts to the RF amp which is switched off when the BANDSWITCH line goes low while transmitting in direct mode.

Mixer Z403 is a doubly balanced diode mixer. This mixer is driven by a local oscillator signal from the synthesizer at +8 dBm to provide good intermodulation performance, spurious performance, and local oscillator isolation. The mixer conversion loss is typically 6 dB.

### 45 MHz IF

The first 45 MHJz IF amplifier transistor Q501 is a junction FET operated in the common gate mode. This configuration offers a typical input impedance of 75 ohms. The output circuitry is tuned by L504 and loaded to provide the proper source termination for the four pole crystal filter which follows.

The output of the crystal filter is matched by second IF amplifier trransistor Q502. This port is also tuned by L506 and loaded to provide the proper filter termination. Transistor Q502 is a dual gate FET operating at a bias current of about 10 milliamps. The output of Q502 is tuned by L507 for maximum gain at 45 MHz and is loaded by the 2nd mixer in the U501 chip. This Q502 stage has a relatively high input and output impedance and has high isolation within the active device. The dual gate FET provides the isolation required.

### Converter/IF/Detector IC

U501 is a MC3361 IC. Pins 1 and 2 connect to an internally biased oscillator transistor. The external circuitry of this oscillator transistor includes crystal Y501 and forms an oscillator circuit operating at 45.455 MHz. The frequency of this third mode oscillator is adjusted by inductor L508. The oscillator drives the internal balanced mixer. The 45 MHz IF signal is translated to 455 KHz and appears at Pin 3 of U501. This IF signal is filtered by 6 pole ceramic filter Z503 and drives the internal 455 KHz amplifier and limiter. The limited 455 KHz in turn drives an internal quadrature detector. The phase shift network needed by the quadrature detector is provided by inductor L509. The audio output port is Pin 9 on U501. Inductor L509 is adjusted for maximum audio output level. The audio signal at Pin 9 is filtered by resistor R512 and capacitor C519 to reduce IF feedthrough. Buffer amplifier Q503 drives audio potentiometer R513. This allows a VOL/SQ HI signal whose amplitude may be set for proper system operation using R513.

## POWER DISTRIBUTION

Unswitched 13.8 Volts (A+) is supplied to the RF Board through connector J704 and feeds the power control transistor Q101 and 20V transient suppressor D105. D105 provides reverse polarity protection and protects the module from noise spikes and other overvoltage transients appearing on the input power cable.

Switched 13.6 Volts (SW A+) is supplied to the RF Board through J704 and J705 and feeds regulators U102, U207, and U502. U102 supplies 8 Volts to the transmitter switch, the synthesizer 5 Volt regulator U203, and the Logic

Board (A1) through J702. U207 supplies 8.3 Volts to the synthesizer. U502 supplies 8 Volts to the receiver.

## SERVICE NOTES

### TRANSMITTER CIRCUIT

Most transmitter circuit problems can be isolated by checking the TX power gains shown in Figure 1 - RX and TX Block Diagram.

#### Transmitter DC Measurements

1. First ensure that the DPTT is low when the mic PTT is keyed low.
2. Check for approximately 8 Volts at L105 feeding the Exciter Module. If not present, troubleshoot the TX switch circuitry, Q103 and U103.
3. Check for an adjustable voltage of 0 to 12 volts on Q101 emitter. At maximum power, with Power Set adjustment R111 fully clockwise, the voltage should be 12 volts. If not present, check the power control circuitry: U103, Q101, Q102, Q104, Q106, and Q107.

### SYNTHESIZER CIRCUIT

Synthesizer troubleshooting consists of first checking for the proper DC levels, then determining if the proper waveforms are present and checking individual modules.

### RECEIVER CIRCUIT

To isolate a receiver circuit problem refer to the Receiver circuit Symptoms and Checks chart below.

RECEIVER CIRCUIT SYMPTOMS AND CHECKS

| SYMPTOMS | CHECKS |
|---|---|
| No Audio | 1. U502 regulator<br>2. The level and frequency of the first mixer injection frequency.<br>3. The level and frequency of the second mixer injection frequency.<br>4. Quadrature detector circuit<br>5. Quadrature detector coil tuning |
| Poor SINAD | 1. Consult Figure 2 - RX and TX Block Diagram for RX stage gains and troubleshoot.<br>2. Input cable |
| Distorted Audio | 1. Both mixer injection frequencies<br>2. Quadrature detector coil tuning<br>3. Crystal filter source and load tuning<br>4. Z503: 455 KHz ceramic filter |

## DC Analysis

8.3 Vdc is supplied by regulator U207 and serves as the biasing voltage for transistor circuits Q201, Q204, Q205, Q206, Q207, Q208 and Q210. Resistor R211 decouples the 8.3 volts for use in VCO module U201. The 10 milliamp current drain of this module results in approximately 8.1 volts DC on Pin 4.

Regulator U203 uses the 8 volts from transmitter regulator U102 to generate 5 volts for U204 and U205.

## Waveforms

Synthesizer waveforms in Figures 3 through 8 were measured with a 10 megohm, 30 pF probe. Use DC coupling.

## Module Isolation

### Reference Oscillator U204:

Look for a waveform similar to the reference (Figure 3) on Pin 2. If waveform is not present, the oscillator module is probably defective.

### VCO U201:

Connect a DC power supply to pin 3. With 2.5 Vdc on pin 3, the output of U201 (pin 5) should be approximately 803 MHz. With 6.5 Vdc on pin 3, the output should be approximately 828 MHz. Either transmit in direct mode or force the BANDSWITCH line to ground which will cause pin 1 to go to 8 volts. The frequencies for 2.5 Vdc and 6.5 Vdc should be approximately 45 MHz higher.

Power output of the VCO can be measured by connecting a coax directly to the module, between pin 5 and ground. The output should be approximately 0 dBm with C211 still connected in the circuit.

### Prescaler U205:

Connect pin 3 of the VCO to 4.5 volts DC. With the radio in receive, monitor the frequencies of the VCO at the connection of capacitor C201 and resistor R201. DC short pin 7 of U205 to ground to cause divide by 129 to occur. The frequency output at pin 5 should be the VCO frequency divided by 129. Tie pin 7 to pin 1 (5 volts) to cause divide by 128 to occur. Check pin 5 to verify that this occurs. Improper division may indicate a defective prescaler.

### Bilateral Switch U202:

The bilateral switch is used to short around parts of the loop filter during channel scan. A shorted (to ground or adjacent gate) gate may be isolated by comparing voltages through the loop filter to those of a functioning radio. Defective gates might be suspected when the radio does not change frequency quickly enough.

### Phase-Lock-Loop U206:

There are no other specific checks which aid in evaluation of U206. Usually, it is suspected only if all other checks are OK. Before changing, inspect chip components for mechanical damage and check resistances through the loop filter.

### Transistors Q201 and Q205:

After checking for proper DC operation, measure the gain from VCO pin 5 to R201/C201. The gain should be approximately 8 dB.

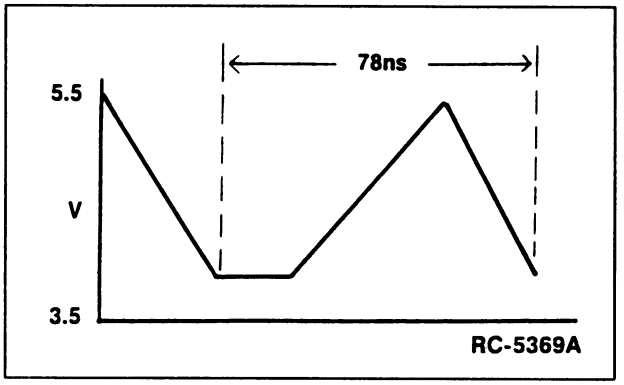



FIGURE 3 - REFERENCE OSCILLATOR (INPUT TO U206, PIN 2).

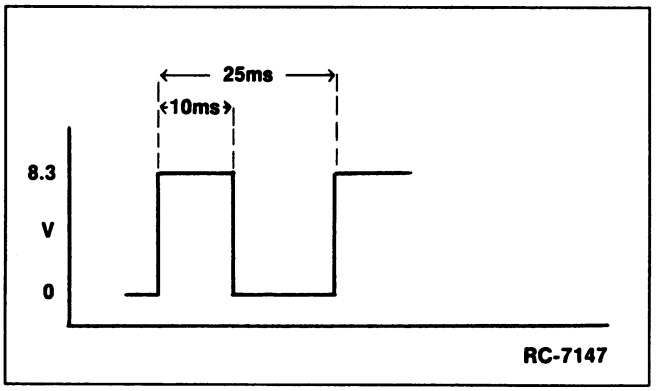



FIGURE 6 - S ENABLE (INPUT TO U206, PIN 13). USING TEST MODE FUNCTION S10.

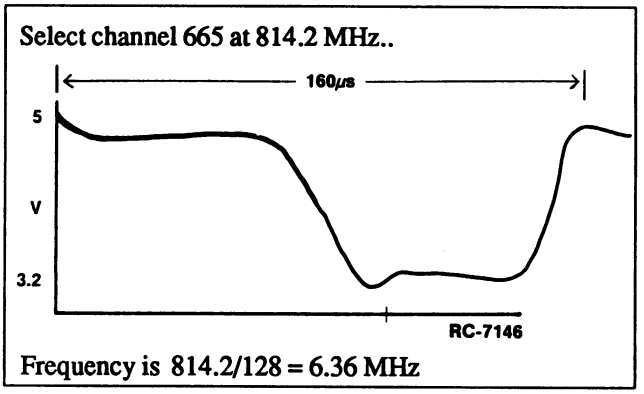



FIGURE 4 - $F_{IN}$ (INPUT TO U206, PIN 10).

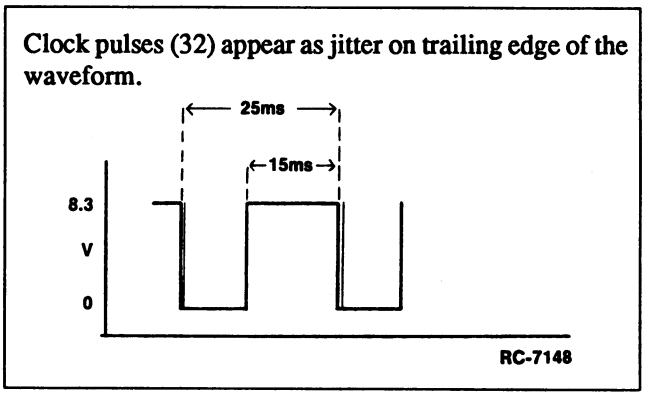



FIGURE 7 - S CLOCK (INPUT TO U206, PIN 11). USING TEST MODE FUNCTION S10.

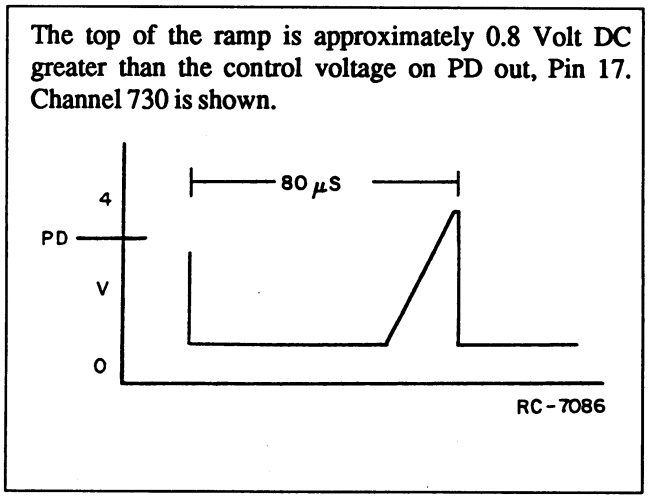



FIGURE 5 - RAMP (GENERATED IN U206 AND APPEARS ON PIN 15).

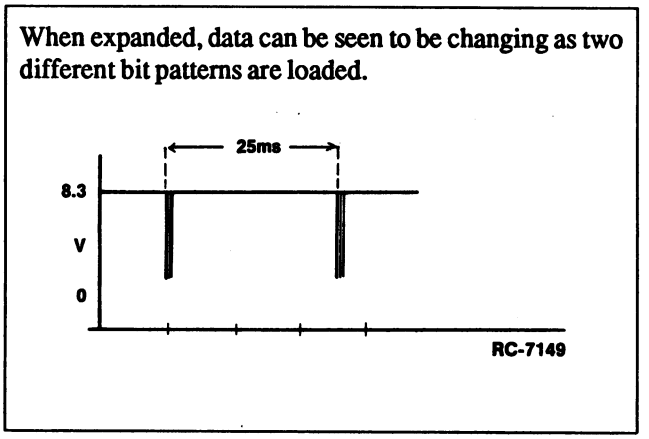



FIGURE 8 - S DATA (INPUT TO U206, PIN 12). USING TEST MODE FUNCTION S10.

## PARTS LIST

TMX8712 RF BOARD
19D902123G1

ISSUE 3

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| A102 | | EXCITER BOARD 19C851708G1 |
| | | - - - - - - - - - - CAPACITORS - - - - - - - - - - |
| C1 and C2 | 19A702061P45 | Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C3 | 19A702061P8 | Ceramic: 3.9 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C. |
| C4 | 19A702061P77 | Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C5 | 19A702061P45 | Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C6 | 19A702061P7 | Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C. |
| C7 and C8 | 19A702061P45 | Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C9 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C10 | 19A702061P45 | Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| | | - - - - - - - - - - INDUCTORS - - - - - - - - - - |
| L1 and L2 | | Part of PWB 19C851707P1. |
| L3 | 19B800891P2 | Coil, RF Choke: sim to Paul Smith SK-890-1. |
| | | - - - - - - - - - - TRANSISTORS - - - - - - - - - - |
| Q1 | 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. |
| Q2 | 19A705436P1 | Silicon, NPN: sim to Motorola MRF0211L. |
| Q3 | 19A701940P3 | Silicon, NPN: sim to SRF-5116. |
| | | - - - - - - - - - - RESISTORS - - - - - - - - - - |
| R1 | 19B801251P471 | Composition: 470 ohms ±5%, 150 VDCW, 1/8 w. |
| R2 | 19B801251P272 | Metal film: 2.7K ohm ±5%, 150 VDCW. |
| R3 | 19B801251P330 | Metal film: 33 ohm ±5%, 150 VDCW. |
| R4 | 19B801251P331 | Metal film: 330 ohm ±5%, 150 VDCW. |
| R5 | 19B801251P392 | Metal film: 3.9K ohm ±5%, 150 VDCW. |
| R6 | 19B800607P330 | Metal film: 33 ohms ±5%, 200 VDCW, 1/8 w. |
| R7 | 19B801251P471 | Composition: 470 ohms ±5%, 150 VDCW, 1/8 w. |
| R8 | 19B801251P332 | Metal film: 3.3K ohm ±5%, 150 VDCW. |
| R9 and R10 | 19B800607P470 | Metal film: 47 ohms ±5%, 200 VDCW, 1/8 w. |
| | | - - - - - - - - - - CAPACITORS - - - - - - - - - - |
| C105 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C107 | 19A701534P8 | Tantalum: 22 uF ±20%, 16 VDCW. |
| C110 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C111 | 19A703314P10 | Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series. |
| C114 | 19A702061P33 | Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C117 | 19A702052P22 | Ceramic: 0.047 uF ±10%, 50 VDCW. |
| C118 | 19A703314P10 | Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series. |
| C119 | 19A702061P61 | Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C121 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C122 | 19A702052P28 | Ceramic: 0.022 uF ±10%, 50 VDCW. |

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| C123 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C125 | 19A702061P33 | Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C133 thru C139 | 19A702061P33 | Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C141 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C142 | 19A701534P10 | Tantalum: 10 uF ±20%, 25 VDCW. |
| C143 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C201 thru C203 | 19A702061P61 | Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C204 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C205 | 19A701534P17 | Tantalum: 47 uF ±20%, 10 VDCW. |
| C206 | 19A702061P9 | Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C207 and C208 | 19A701534P17 | Tantalum: 47 uF ±20%, 10 VDCW. |
| C209 | 19A702061P5 | Ceramic: 2.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C. |
| C210 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C211 | 19A702061P9 | Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C212 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C213 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C215 | 19A700004P1 | Metallized polyester: 0.068 uF ±10%, 63 VDCW. |
| C216 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C217 | 19A700004P11 | Metallized Polyester: 1.0 uF ±10%, 63 VDCW. |
| C220 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C221 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C222 | 19A702061P99 | Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C223 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C224 | 19A702061P77 | Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C225 | 19A702061P99 | Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C226 | 19A701534P17 | Tantalum: 47 uF ±20%, 10 VDCW. |
| C227 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C228 | 19A702061P9 | Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C229 | 19A702061P61 | Ceramic: 100 pF ±5%, 50 VDCW; temp coef 0 ±30 PPM/°C. |
| C230 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C231 | 19A703314P2 | Tantalum: 220 uF, -10+50%, 10 VDCW. |
| C232 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C233 * | 19A702061P9 | Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C402 | 19A702061P61 | Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C403 | 19A702061P99 | Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C404 | 19A702236P1 | Ceramic: 0.5 pF ±.1 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C405 | 19A702236P21 | Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C407 | 19A702061P25 | Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C409 and C410 | 19A702236P9 | Ceramic: 1.8 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C411 | 19A702236P10 | Ceramic: 2.2 pF ±2.5 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C502 | 19A702061P99 | Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C503 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C504 * | 19A702061P12 | Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C505 * | 19A702061P41 | Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| C506 | 19A701534P7 | Tantalum: 10 uF ±20%, 16 VDCW. |
| C507 thru C509 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C510 | 19A702061P6 | Ceramic: 2.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C. |
| C511 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C512 | 19A702061P1 | Ceramic: 1 pF ±0.5 pF, 50 VDCW. |
| C513 | 19A702061P12 | Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. |
| C514 | 19A702061P33 | Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C515 and C516 | 19A702061P29 | Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. |
| C517 and C518 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| C519 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |
| C520 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C521 | 19A703314P10 | Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series. |
| C522 | 19A702052P26 | Ceramic: 0.1 uF ±10%, 50 VDCW. |
| | | - - - - - - - - - - DIODES - - - - - - - - - - |
| D105 | 19A703588P3 | Zener, transient suppressor: sim to 1N6278A. |
| D106 | 19A134587P2 | Silicon, fast recovery: 100 mW; sim to Ampere BAV 70 Series. |
| D107 | T324ADP1041 | Silicon: general purpose. |
| D201 | 19A702525P2 | Silicon. |
| D501 and D502 | 19A700028P1 | Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148. |
| | | - - - - - - - - - - JACKS - - - - - - - - - - |
| J106 and J107 | 19B801341P1 | RF Jack. |
| J201 | 19A700072P28 | Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-27-2021. |
| J401 | 19B801341P1 | RF Jack. |
| J501 | 19A700072P1 | Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021. |
| J702 | 19A704779P11 | Connector; sim to Molex 22-17-2122. |
| J704 | 19A700072P29 | Printed wire: 3 contacts rated at 2.5 amps; sim to Molex 22-27-2031. |
| J705 | 19A700072P30 | Printed wire: 4 contacts rated at 2.5 amps; sim to Molex 22-27-2041. |
| | | - - - - - - - - - - INDUCTORS - - - - - - - - - - |
| L104 and L105 | 19A704921P1 | Coil. |
| L107 | 19A700024P1 | Coil, RF: 100 nH ±10%, 0.08 ohms max DC res, 100 w. |
| L401 thru L403 | | Part of PWB 19D902124P1. |
| L502 and L503 | N343CLP10022 | Coil, Fixed: 10 uH ±10%. |
| L504 | 19B801413P4 | Coil, 39 MHz. |
| L505 | 19B209420P21 | Coil, RF: 4.7 uH ±5%, 1.20 ohms max DC res; sim to Jeffers 4436-82. |
| L506 thru L508 | 19B801413P4 | Coil, 39 MHz. |
| L509 | 19B801415P2 | Transformer: 455 KHz; sim to AEPD 162B3277P17. |
| | | - - - - - - - - - - TRANSISTORS - - - - - - - - - - |
| Q101 | 19A116742P2 | Silicon, NPN. |
| Q102 | 19A703197P2 | Silicon, PNP: sim to MMBT4403 Low Profile Pkg. |
| Q103 | 19A704972P1 | Silicon, PNP: sim to Motorola 2N4918. |
| Q104 thru Q107 | 19A700076P2 | Silicon, NPN. |

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| Q201 | 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. |
| Q202 | 19A700059P2 | Silicon, PNP. |
| Q203 | 19A700076P2 | Silicon, NPN. |
| Q204 and Q205 | 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. |
| Q206 | 19A700076P2 | Silicon, NPN. |
| Q207 | 19A700059P2 | Silicon, PNP. |
| Q208 | 19A700023P2 | Silicon, NPN: sim to 2N3904. |
| Q209 and Q210 | 19A702084P2 | Silicon, NPN: sim to MPS 2369. |
| Q211 | 19A700076P2 | Silicon, NPN. |
| Q401 | 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. |
| Q501 | 19A702524P2 | N-Type, field effect: sim to MMBFU310. |
| Q502 | 19A116818P3 | N Channel, field effect: sim to Type 3N1877. |
| Q503 | 19A700023P2 | Silicon, NPN: sim to 2N3904. |
| | | - - - - - - - - - - RESISTORS - - - - - - - - - - |
| R103 | 19B800607P821 | Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w. |
| R104 | 19B800607P223 | Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w. |
| R105 | 19B800607P473 | Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w. |
| R107 | 19B800607P393 | Metal film: 39K ohms ±5%, 200 VDCW, 1/8 w. |
| R108 | 19B800607P122 | Metal film: 1.2K ohms ±5%, 200 VDCW, 1/8 w. |
| R109 | 19B800607P394 | Metal film: 390K ohms ±5%, 200 VDCW, 1/8 w. |
| R110 | 19B800607P153 | Metal film: 15K ohms ±5%, 200 VDCW, 1/8 w. |
| R111 | 19B800779P10 | Variable: 10K ohms ±25%, 100 VDCW, .3 w. |
| R112 | 19B800607P103 | Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w. |
| R113 | 19B800607P102 | Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w. |
| R114 | 19B800607P154 | Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w. |
| R115 | 19B800607P562 | Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 w. |
| R116 | 19B800607P183 | Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w. |
| R117 | 19B800607P562 | Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 w. |
| R118 | 19A701864P4 | Thermal: 10K ohms ±10%, sim to Midwest Components 2K-103. |
| R120 | 19B800607P100 | Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w. |
| R122 | 19B800607P473 | Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w. |
| R126 | 19B800607P821 | Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w. |
| R129 | 19A701864P4 | Thermal: 10K ohms ±10%, sim to Midwest Components 2K-103. |
| R130 | 19B800607P183 | Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w. |
| R131 | 19B800607P680 | Metal film: 68 ohms ±5%, 200 VDCW, 1/8 w. |
| R132 | 19B800607P221 | Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w. |
| R133 | 3R151P100J | Composition: 10 ohms ±5%, 1/8 w. |
| R201 | 19B800607P330 | Metal film: 33 ohms ±5%, 200 VDCW, 1/8 w. |
| R202 | 19B800607P331 | Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w. |
| R203 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R204 | 19B800607P102 | Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w. |
| R205 | 19B800607P151 | Metal film: 150 ohms ±5%, 200 VDCW, 1/8 w. |
| R206 | 19B800607P390 | Metal film: 39 ohms ±5%, 200 VDCW, 1/8 w. |
| R207 | 19B800607P151 | Metal film: 150 ohms ±5%, 200 VDCW, 1/8 w. |
| R208 | 19B800607P331 | Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w. |
| R209 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R210 | 19B800607P102 | Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w. |
| R211 | 19B800607P100 | Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w. |
| R212 | 19B800607P560 | Metal film: 56 ohms ±5%, 200 VDCW, 1/8 w. |
| R213 | 19B800607P221 | Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w. |
| R214 | 19B800607P331 | Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w. |
| R215 | 19B800607P822 | Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w. |
| R216 | 19B800607P222 | Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w. |
| R217 | 19B800607P101 | Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w. |

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| R218 | 19B800607P102 | Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w. |
| R219 | 19B800607P103 | Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w. |
| R220 | 19B800607P274 | Metal film: 270K ohms ±5%, 200 VDCW, 1/8 w. |
| R221 | 19B800607P104 | Metal film: 100K ohms ±5%, 200 VDCW, 1/8 w. |
| R222 | 19B800607P333 | Metal film: 33K ohms ±5%, 200 VDCW, 1/8 w. |
| R223 | 19B800607P564 | Metal film: 560K ohms ±5%, 200 VDCW, 1/8 w. |
| R224 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R225 | 19B800607P272 | Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R226 | 19B800779P4 | Variable: 4.7 to 470 ohms ±25%, 100 VDCW, .3 w. |
| R227 | 19B801251P473 | Metal film: 47K ohm ±5%, 150 VDCW. |
| R228 | 19B800607P223 | Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w. |
| R229 | 19B800607P823 | Metal film: 82K ohms ±5%, 200 VDCW, 1/8 w. |
| R230 | 19B800607P332 | Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w. |
| R231 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R232 | 19B800607P103 | Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w. |
| R233 | 19B800607P332 | Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w. |
| R234 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R235 | 19B800607P683 | Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w. |
| R236 | 19B800607P471 | Metal film: 470 ohms ±5%, 200 VDCW, 1/8 w. |
| R237 thru R239 | 19B800607P103 | Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w. |
| R240 | 19B801251P154 | Metal film: 150K ohm ±5%, 150 VDCW. |
| R241 and R242 | 19B800607P154 | Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w. |
| R243 | 19A702931P137 | Metal film: 237 ohms ±1%, 200 VDCW, 1/8 w. |
| R244 | 19A702931P213 | Metal film: 1330 ohms ±1%, 200 VDCW, 1/8 w. |
| R245 and R246 | 19B800607P272 | Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R247 | 19B800607P271 | Metal film: 270 ohms ±5%, 200 VDCW, 1/8 w. |
| R248 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R249 | 19B800607P1 | Metal Film: 0 ohms (50 Milli-ohms Max), 1/8 w. |
| R403 | 19B800607P562 | Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 w. |
| R404 | 19B800607P821 | Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w. |
| R405 | 19B800607P151 | Metal film: 150 ohms ±5%, 200 VDCW, 1/8 w. |
| R501 | 19B800607P181 | Metal film: 180 ohms ±5%, 200 VDCW, 1/8 w. |
| R502 | 19B800607P270 | Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w. |
| R503 * | 19B800607P822 | Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w. |
| R504 | 19B800607P270 | Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w. |
| R505 | 19B800607P683 | Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w. |
| R506 | 19B800607P823 | Metal film: 82K ohms ±5%, 200 VDCW, 1/8 w. |
| R507 | 19B800607P183 | Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w. |
| R508 | 19B800607P101 | Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w. |
| R509 | 19B800607P272 | Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w. |
| R510 | 19B800607P270 | Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w. |
| R511 | 19B800607P473 | Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w. |
| R512 | 19B800607P822 | Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w. |
| R513 | 19B800779P4 | Variable: 4.7 to 470 ohms ±25%, 100 VDCW .3 w. |
| R514 * | 19B800607P103 | Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w. |
| R515 | 19B800607P821 | Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w. |
| | | - - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - - - - |
| U102 | 19A134717P3 | Linear: 8 volt regulator; sim to uA7808U. |
| U103 | 19A701789P2 | Linear: Dual Op Amp; sim to LM358. |
| U201 | 19A704902P1 | Linear: Dual Band VCO, 806-825 MHz, 851-870 MHz; sim to ALPS URAA. |
| U202 | 19A700029P44 | Digital: Bilateral Switch. |
| U203 | 19A704971P1 | Linear: 5 volt regulator; sim to Motorola MC78L05ACP. |
| U204 | 19B801351P12 | Crystal Oscillator: 12.8 Mhz ±3 PPM/°C. |

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| U205 | 19A704740P1 | Digital: Prescaler; sim to Mitsubishi M54475P. |
| U206 | 19B800902P4 | Digital: PPL Synthesizer, CMOS Serial Input. |
| U207 | 19A701999P4 | Linear: Voltage regulator; sim to LM317LZ. |
| U208 | 19A704971P1 | Linear: 5 volt regulator; sim to Motorola MC78L05ACP. |
| U501 | 19A704619P1 | Linear: IF Amplifier and Detector. |
| U502 | 19A704073P2 | Linear: 8 volt regulator. |
| | | - - - - - - - - - - CRYSTALS - - - - - - - - - - |
| Y501 | 19A705376P5 | Crystal Unit: 45.455 Mhz. |
| | | - - - - - - - - - - FILTER - - - - - - - - - - |
| Z401 and Z402 | 19A704888P1 | Bandpass: 851-871 MHz; sim to Murata DFC3R861P020BTD. |
| Z403 | 19B801025P2 | Balanced Mixer: sim to Mini-Circuits SBL-1X. |
| Z501 | 19A705328P1 | Monolithic crystal: 45.000 MHz; sim to Toyocom 45B282. |
| Z502 | | Part of Z501. |
| Z503 | 19B801021P2 | Bandpass: 455 kHz ±1.5; sim to Murata CFW-455E. |
| | | - - - - - - - - - - MISCELLANEOUS - - - - - - - - - - |
| | 19B801378G3 | Heat Sink Assembly. (With Q101 and U102). |
| | 19B801490P1 | Ground Strap. |
| | 19A702364P106 | Machine screw: TORX Drive, No. M2 - 0.4 x 6. |
| | 19B801566P1 | Shield. |

**PRODUCTION CHANGES**

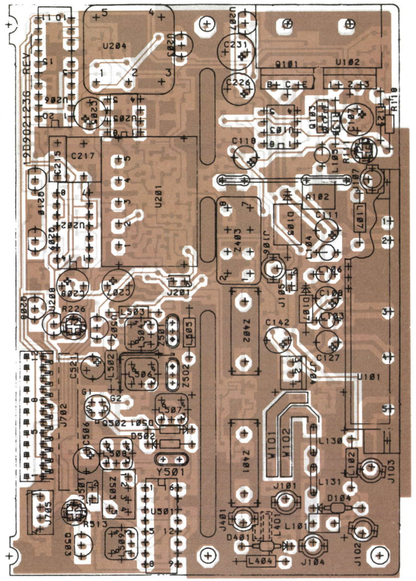
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

REV. A - TMX8712 RF BOARD 19D902123G1
To improve receiver sensitivity margin, changed C504, C505, R503 and R514. Old parts were:
C504: 19A702061P29 Ceramic: 22 pF ±5%, 50 VDCW.
C505: 19A702061P25 Ceramic: 18 pF ±5%, 50 VDCW.
R503: 19B800607P682 Metal film: 6.8K ohms ±5%.
R514: 19B800607P682 Metal film: 6.8K ohms ±5%.

REV. B - TMX8712 RF BOARD 19D902123G1
To improve upper band receiver sensitivity, added C233 from the collector of Q205 to ground.

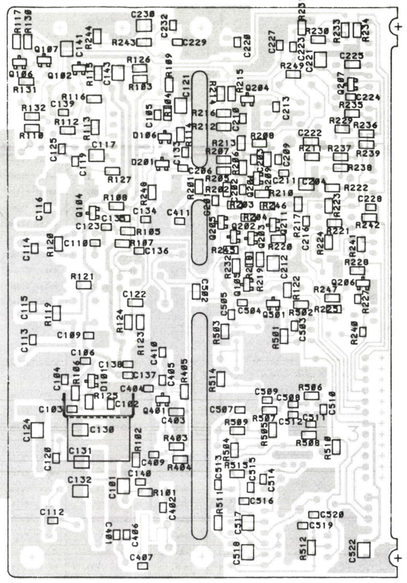
RF BOARD

## COMPONENT SIDE



(19D902123, Sh. 1, Rev. 4)
(19D902124, Sh. 1, Rev. 3)
(19D902124, Sh. 2, Rev. 3)

## CHIP COMPONENT SIDE



(19D902123, Sh. 1, Rev. 4)
(19D902124, Sh. 2, Rev. 3)

LEAD IDENTIFICATION FOR D201


IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR Q208,Q209,Q210,& Q503


IN-LINE
TOP VIEW

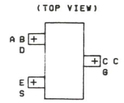
NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR U203,U207 & U502

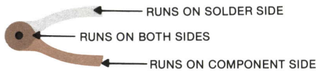

IN-LINE
TOP VIEW

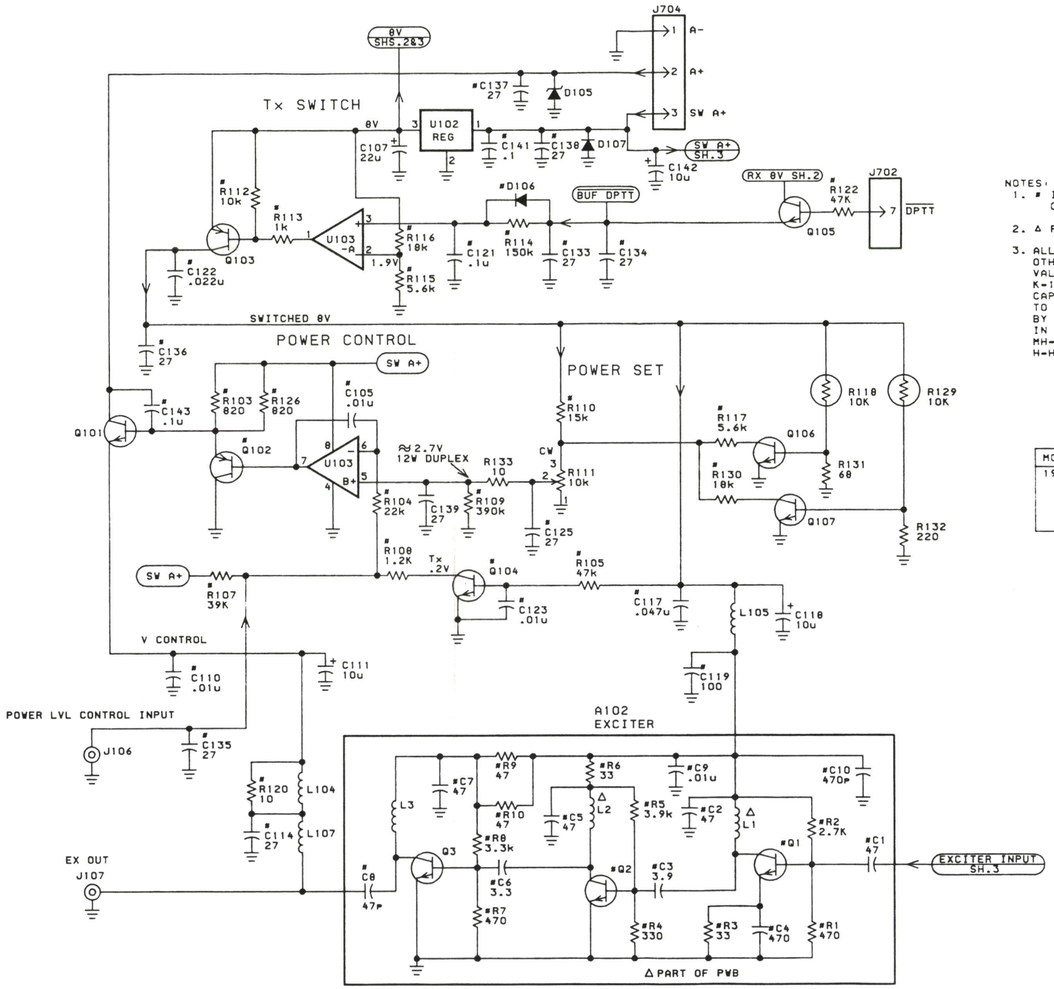
NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR (SOT) TRANSISTORS AND DIODES




**RF BOARD**
19D902123G1

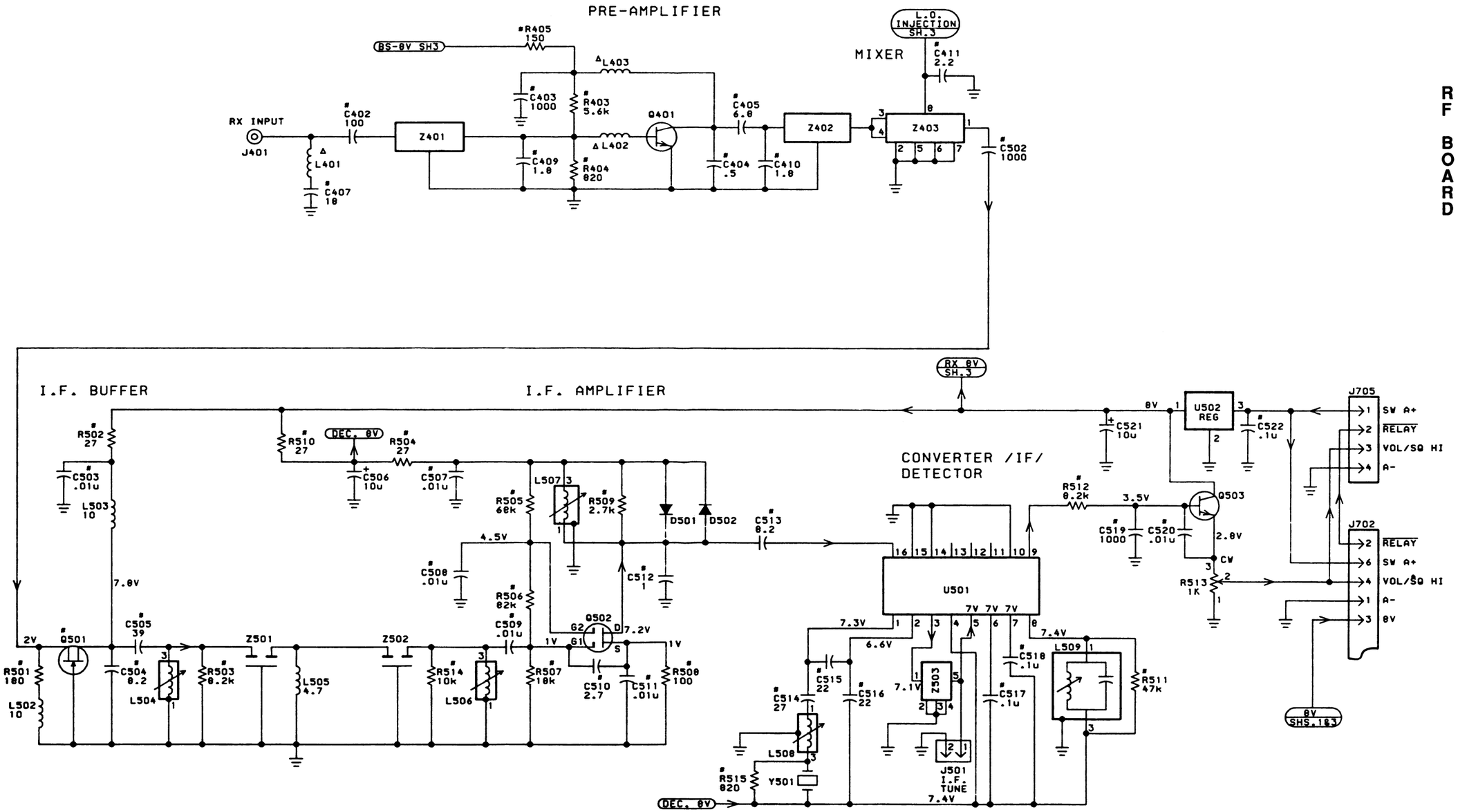



NOTES:
1. # INDICATES CHIP COMPONENT LOCATED ON SOLDER SIDE OF P.W.B.
2. Δ PART OF P.W.B.
3. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR M-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY U-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS, NH-NANOHENRYS OR H-HENRYS.

| MODEL NO. | REV. LETTER |
|---|---|
| 19D902123G1 | B |

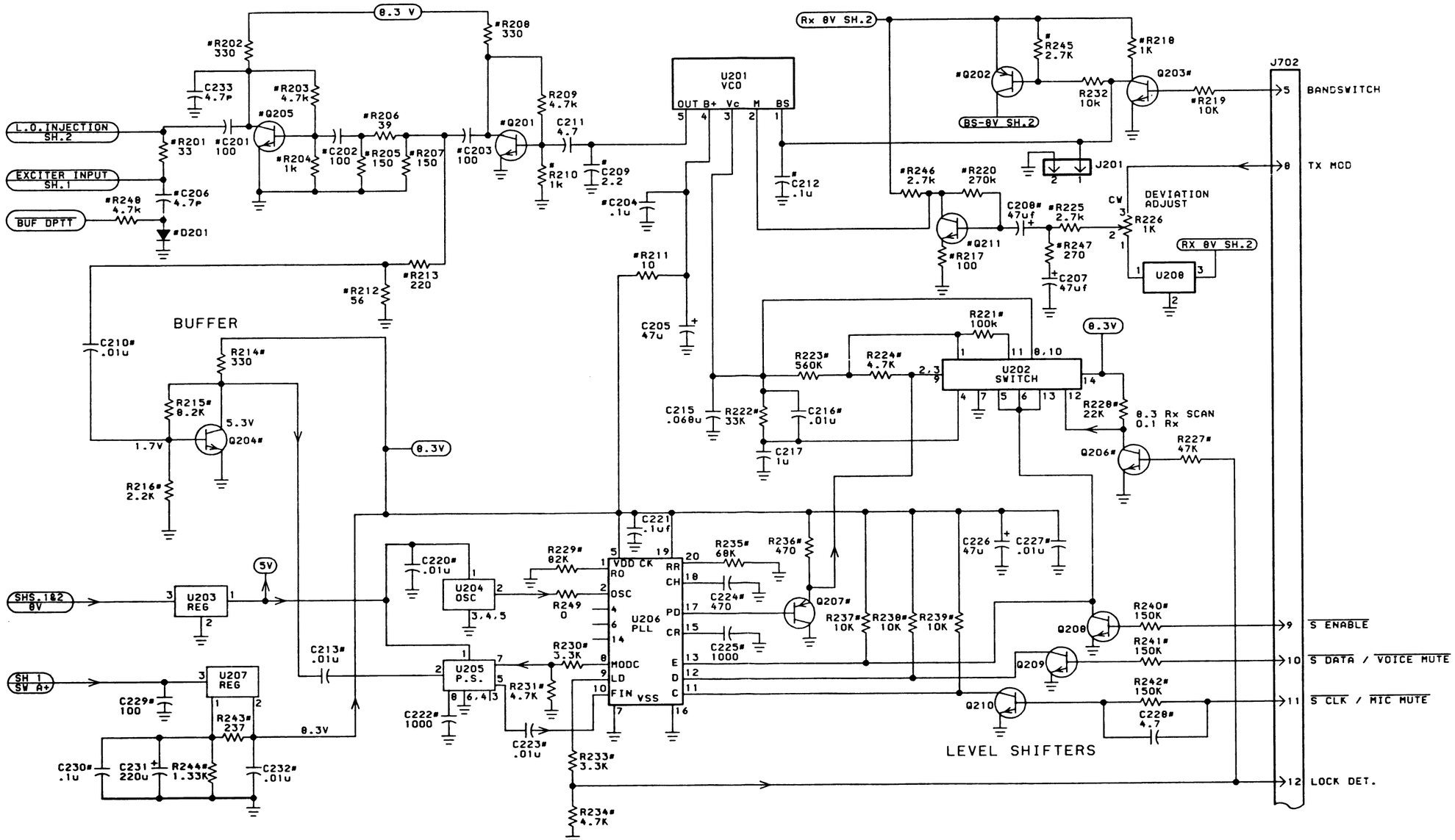
(19D902228, Sh. 1, Rev. 3)




(19D902228, Sh. 2, Rev. 1)

**RF BOARD**

19D902123G1

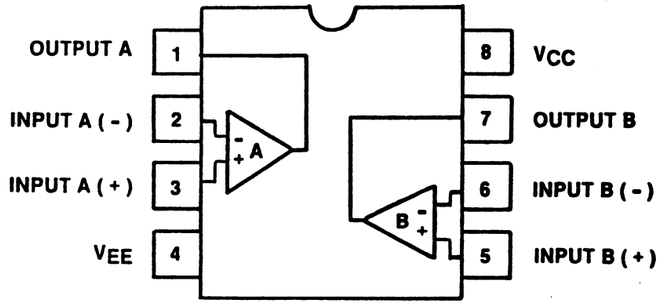



(19D902228, Sh. 3, Rev. 1)

**RF BOARD**

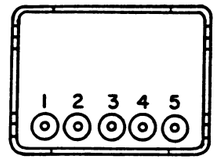
19D902123G1

## OPERATIONAL AMPLIFIER
## (U103)
## 19A701789P2




RC-5750

## VOLTAGE CONTROLLED OSCILLATOR
## (U201)
## 19A704902P1

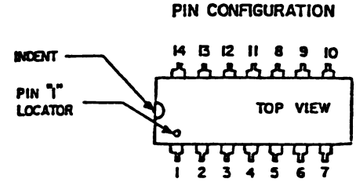


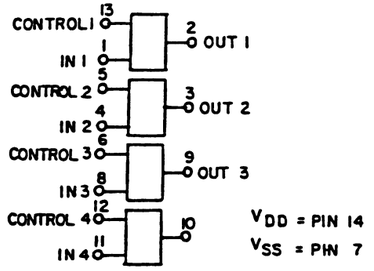

| PIN | FUNCTION |
|---|---|
| 1 | SWITCH |
| 2 | MOD |
| 3 | CONTROL |
| 4 | Vcc |
| 5 | OUTPUT |

RC-8008

## QUAD BILATERAL SWITCH
## (U202)
## 19A700029P44

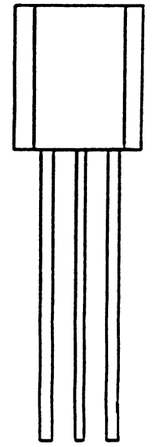
PIN CONFIGURATION



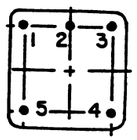

RC-5842

## VOLTAGE REGULATOR
## (U203)
## 19A704971P1



RF BOARD

## CRYSTAL CONTROLLED OSCILLATOR
## (U204)
## 19B801351P3

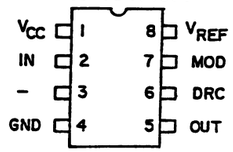



**PIN CONNECTIONS**

1. + VCC
2. OUTPUT
3. COMMON & CASE
4. COMMON & CASE *
5. COMMON & CASE

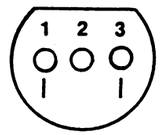
* PIN 4 IS PERMISSABLE NOT NECESSARY FOR OPERATION.

## PRESCALER
## 19A704740P1




1 $V_{CC}$ POWER SUPPLY (+5V)
2 IN SIGNAL INPUT
3- NO CONNECTION
4 GND GROUND
5 OUT SIGNAL
6 DRC DIVISION RATIO CONTROL ($V_{CC}$: 64/65, OPEN 128/129)
7 MOD MODULUS CONTROL INPUT
8 $V_{REF}$ REFERENCE BIAS INPUT

RC-8043




**BOTTOM VIEW**

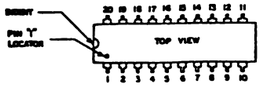
**PIN INDENTIFICATION**

PIN 1 ADJUST
PIN 2. OUTPUT
PIN 3. INPUT

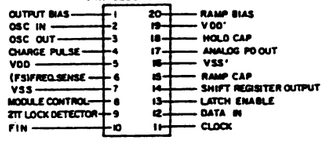
RC-5854A

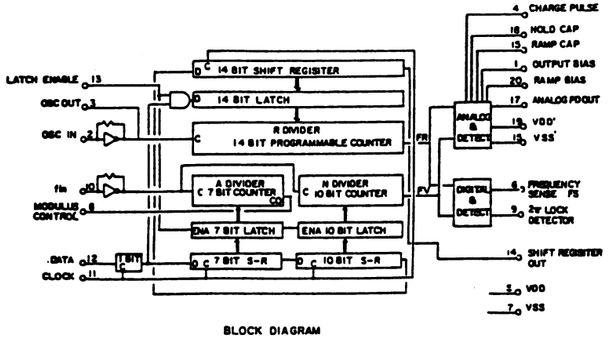
## PHASE-LOCK-LOOP MODULE
(U206)
19B800902P4

PIN CONFIGURATION




PIN DESCRIPTION



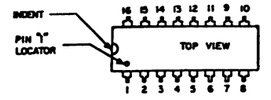



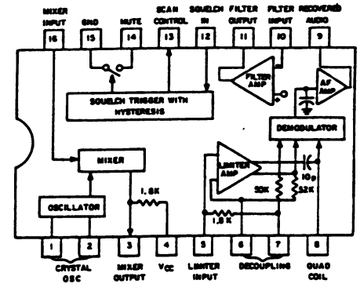

BLOCK DIAGRAM

RC-5843

## IF AMPLIFIER AND DETECTOR
(U501)
19A704619P1

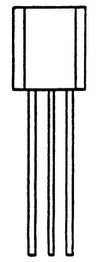
PIN CONFIGURATION




BLOCK DIAGRAM

## VOLTAGE REGULATOR
(U207)
19A701999P4



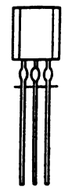

BOTTOM VIEW

PIN INDENTIFICATION

PIN 1 ADJUST
PIN 2. OUTPUT
PIN 3. INPUT

RC-5846

## VOLTAGE REGULATOR
(U502)
19A704073P2



BOTTOM VIEW

PIN 1 - OUTPUT
PIN 2 - GROUND
PIN 3 - INPUT

RC-5289