MAINTENANCE MANUAL
FOR
GE-NET TMX™
RF BOARD 19D902132G1

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DESCRIPTION

The RF Board for the GE-NET TMX™ mobile radio consists of the following circuits:

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

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

Transmit circuit adjustments for frequency, power and deviation are accessible from the topside of the board, as are IF alignment, second oscillator and audio level adjustments for the receive circuit. Chip components on the bottom of theboard 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 RF transmit and receive LO frequencies. The circuit uses a phase locked, voltage-controlled oscillator (VCO) operating on the actual transmitter frequency (896-902 MHz) during transmit and receive. The synthesizer output signal is generated directly by VCO module U201, and buffered by Q201 and Q202 to a level of +8 dBm. The synthesizer output is applied to the receiver mixer,and is also attenuated to 0 dBm by R201 to feed the transmitter exciter module.

Microprocessor U703 on the Logic Board (A1) controls the synthesizer frequency. Frequency stability is maintained

by a temperature compensated crystal-controlled oscillator (TCXO) module. The oscillator has a stability of ±1.5 PPM (0.00015%) over the temperature range of -30*C to +75*C.

The VCO output is also buffered by Q207 and feeds the divide by 128/129 dual modulus prescaler U205. The prescaler output is applied to the F_{IN} input of the PLL U206. The prescaled signal is further divided down inside U206 to 12.5 KHz to be compared with a 12.5 KHz reference signal. This reference signal is derived from the 12.8 MHz TCXO module U204. U206 divides the 12.8 MHz TCXO 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 Q210, Q211, and Q212. The S ENABLE pulse (10 milliseconds) 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.

Audio modulation from Audio Board A3 is applied to the VCO module through R218 and DEVIATION ADJUST potentiometer R224. Q206 is used to short any signal present on the modulation line during receive.

TRANSMITTER CIRCUIT

The transmitter consists of fixed tuned exciter module U104, PA module U101, a pin diode switch (D104,D401), a low pass filter, a directional coupler, a power control circuit, and a transmit voltage switch.

Exciter Module

The Block Diagram (Figure 1) shows the synthesizer driving the receiver mixer at +8 dBm. R201 reduces the +8 dBm level to 0 dBm for exciter input drive. Exciter module U104 operates from a switched 8 volt supply and a variable supply. The variable supply is controlled by the power set circuitry. The fixed tuned exciter module bandwidth is sufficiently wide to cover 896 to 902 MHz. Both input and output ports operate at 50 ohms. The exciter module provides typically 23 dB of gain, and 200 milliwatts output power to drive the power amplifier module.

Power Amplifier Module

PA module U101 requires a drive of 200+ mW from the exciter module to deliver up to 15 Watts power output at the antenna. The output of U101 drives the Tx/Rx pin diode switch circuitry.

Pin Diode Switch, Low Pass Filter,and Directional Coupler

The output from the PA module feeds transmit pin diode switch D104 through J102. In transmit, switched 8 volts is applied through L102, turning on pin diodes D104 and D401. Diode current is set at 40 milliamperes by R104. D104 couples the PA module output from J102 to the lowpass filter composed of C108,L102,C107,L101 and C106.

Diode D401,C401,L401 and the cable connecting J401 and J104 form a quarter wave line. The line presents a high impedance at J104 thus minimizing loss of power due to the parallel RF path for the Rx input.

The low pass filter reduces the harmonic output from the transmitter and feeds the directional coupler W101/W102. The directional coupler provides a sample of transmitter power for the power control circuit. The coupler output is applied to antenna jack J101.

Power Control Circuit

Power control is provided by U103B and associated circuitry. The circuit samples the output power to the antenna to maintain a constant power level across the band. Also, a thermistor senses the heatsink temperature to reduce the power level down at heatsink temperatures above 70*C. The circuit controls the supply voltage to one of the amplifier stages in the exciter module to maintain a constant antenna output power.

A directional coupler (W101 and W102) provides a sample of transmitter power to diode D101. D101, R103, and C104 produce a positive DC voltage proportional to the transmitter output power level. This DC level feeds the (-) input of amplifier U103-B. Power set resistor R113 and thermistor R115 determine 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 Q103 and Q104. Q104 supplies the control voltage to the exciter module U104.

For example, if the output power level begins to drop below the power set level, the output of U103-B increases positively, causing Q103 to conduct less. The base voltage of Q104 rises, increasing the control voltage to the exciter module, which increases the output power level back to the desired set level.

Q102, C117, and R116 improve the transient stability of the power control loop when the transmitter is keyed.

Transmit Switch

When in the transmit mode, the Logic Board (A1) microprocessor pulls the DPTT line low causing the output of U103-A to go low. Q101 turns on to supply SW 8V to the exciter module, the power control circuit and the pin diode switch. At the same time, Q203 and Q213 are controlled by the DPTT line to remove the supply voltage to Rx pre-amp Q401.

RECEIVER CIRCUIT

The dual conversion receiver circuit consists of a front end section, a 39 MHz first IF, and a 455 kHz second IF with an FM detector. All audio processing and squelch functions are contained on the Audio Board.

Front End Section

The 935-941 MHz receive RF signal is 39 MHz above the transmit frequency. The receive signal is coupled from antenna jack J101 through the directional coupler and the low pass filter to pin diode D401. In the transmit mode, SW 8V is applied through L103, turning on pin diodes D104 and D401, completing the DC path through L401. D401 provides a RF path to ground for the receiver input while in transmit. In the receive mode, D401 is off, allowing the RF signal to pass by D401 unattenuated.

Preselector filters Z401 at the input of the RF pre-amplifier Q401, and Z402 at the output of the pre-amplifier, are fixed tuned three pole bandpass filters which determine the 8 MHz RF bandwidth selectivity for the receiver. Q401 is a low-noise amplifier with 10.5 dB gain. The amplifier is matched to provide approximately a 50-ohm input and output impedance for the preselectors.

Mixer Z403 is a doubly balanced diode mixer. The mixer is driven by a local oscillator signal (896-902 MHz) with a level of +8 dBm to provide good inter-modulation and spurious performance. The local oscillator frequency is the same as the transmit frequency. The mixer converts the receive signal to 39 MHz. The mixer conversion loss is typically from 6 to 7 dB.

39 MHz IF

The first 39 MHz 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 transistor 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 39 MHz, and is loaded by the 2nd mixer in IC U501. Amplifier Q502 has a relatively high input and output impedance, and provides high isolation between U501 and the 39 MHz crystal filter output.

Converter/IF/Detector

IF module U501 is an MC3361 chip. Pins 1 and 2 connect to an internally-biased oscillator transistor. The external circuitry of this oscillator transistor includes crystal Y501 operating at 39.455

MHz. The frequency of this third mode oscillator is adjusted by inductor L508. The oscillator drives the internal balanced mixer. The 39 MHz IF signal is translated to 455 kHz and appears at Pin 3 of U501. This IF signal is filtered by a 9 element ceramic filter Z503 and drives the internal 455 kHz amplifier and limiter. The limited 455 kHz signal 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 R514 and capacitor C521 to reduce IF feedthrough. Buffer amplifier Q503 drives audio potentiometer R515, which is used to set the amplitude of the VOL/SQ HI signal for proper system operation.

POWER DISTRIBUTION

Power (A+ = 13.6 Volts nominal) is provided to the radio through connectors J704 (pins 2 and 3) and J705 (pin 1) on the RF board.

Pin 2 of J704 supplies A+ to the power amplifier module U101, the power control transistor Q104, and the 20-Volt transient suppressor D105. D105 protects the radio from noise spikes and other overvoltage transients appearing on the input power cable.

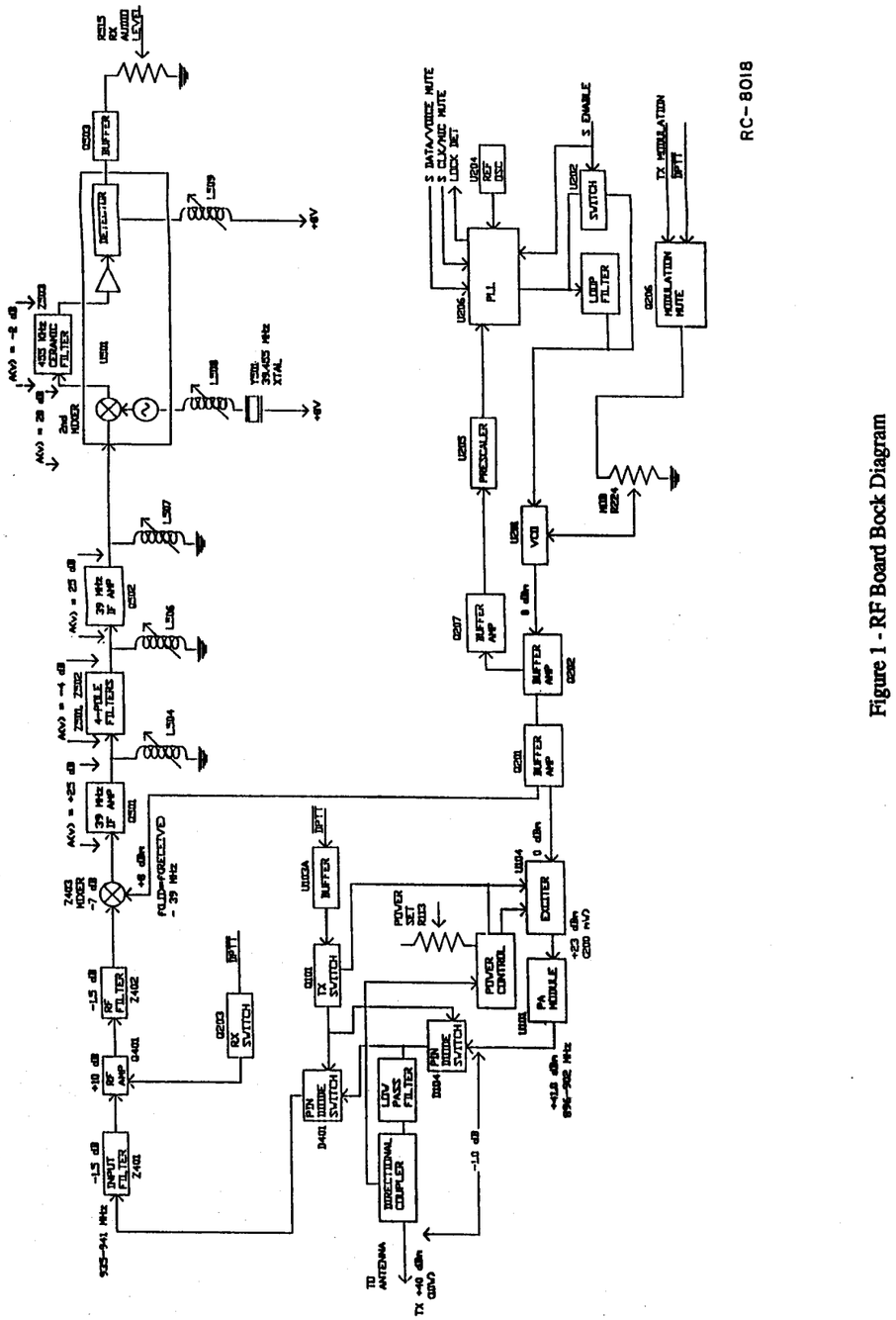


Figure 1 - RF Board Bock Diagram

Pin 3 of J704 supplies A+ to regulators U102 and U207. U102 supplies 8 Volts to the transmitter switch, synthesizer 5-Volt regulator U203, and the Logic Board through J702 pin 3. U207 supplies 8.3 Volts to the synthesizer.

Pin 1 of J705 supplies A+ to U502, which supplies 8 Volts to the receiver.

QUICKCHECKS

SYNTHESIZER CIRCUIT

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

DC Analysis

8.3 Vdc is supplied by regulator U207 which serves as the biasing voltage for transistor circuits Q201, Q202, Q207, Q208, Q209, Q210, Q211, and Q212. Resistor R211 decouples the 8.3 volts for use in the VCO module U201. The 10 milliamp current drain of this module results in approximately 6.5 volts DC on Pin 4.

Transistor Q202 draws approximately 10 milliamps, resulting in a collector voltage of 3 volts DC at the junction of resistor R209 and capacitor C206. Lack of VCO RF output will modify this voltage.

Transistors Q201 and Q207 have collector voltages of approximately 4 volts and 4.6 volts, respectively.

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

Waveforms

Waveforms associated with the synthesizer (see Figures 2-6) were measured with a 10-megohm, 30 pF probe with DC coupling . The waveforms in Figure 6 and Figure 7 are sent by the microcomputer on the logic board to the synthesizer to load a new channel.

For Figure 2, select a channel in the center of the band (channel 240 in this case, frequency = 899/128 = 7.02 MHz).

The top of the ramp is approximately 0.6 Volt DC greater than the control voltage on PD out, Pin 17. Channel 240 is shown.

Module Isolation

Reference Oscillator U204:

Look for a waveform similar to the reference (Figure 3) on Pin 2. If the waveform is not present, check the 5 volt regulator U203. If the oscillator is being supplied 5 volts and the waveform is not present, the oscillator module is probably defective.

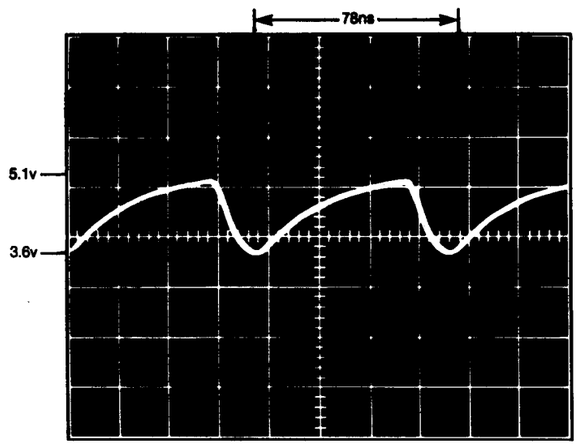


Figure 2 - Reference Oscillator (Input to U206, Pin 2)

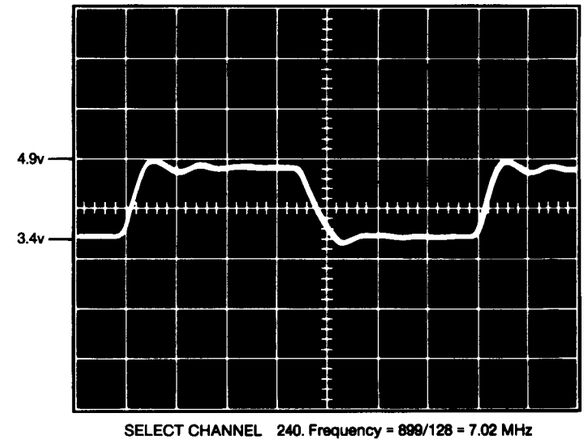


Figure 3 - Fin (Input to U206, Pin 10)

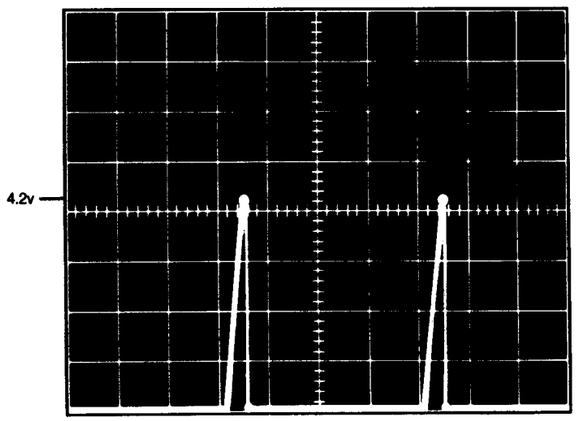


Figure 4 - Ramp (Output U206, Pin 3)

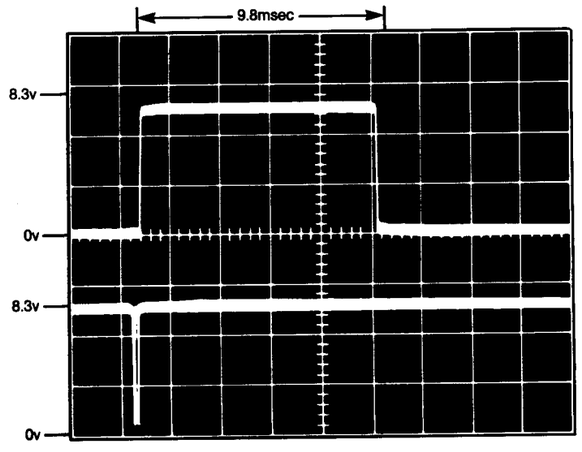


FIGURE 5 - Top - S ENABLE (Input U206, Pin 13) (Triggered on loading a new channel)
Bottom - S CLOCK (Input U206, Pin 11)

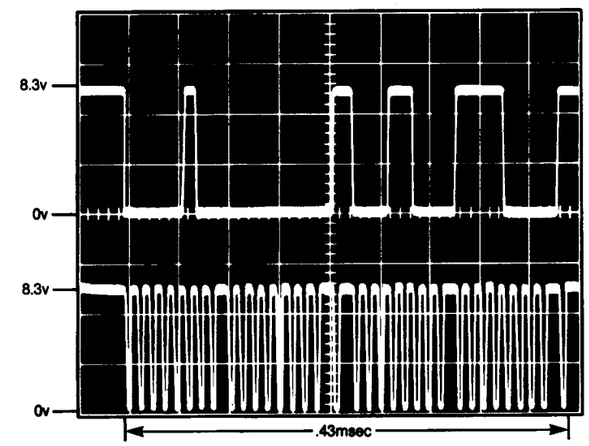


FIGURE 6 - Top - S DATA (Input U206, Pin 12) (Channel 240 being loaded)
Bottom - S CLOCK (Input U206, Pin 11)

VCO U201:

Disconnect control voltage circuitry from VCO, and connect a DC power supply to Pin 3. With 4.5 volts DC on pin 3, the output of U201 (pin 5) should be 899 MHz * 3 MHz.

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 C207 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 frequency of the VCO at the connection of capacitor C210 and resistor R212. 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 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 Q202:

After checking for proper DC operation, measure the gain from the VCO, pin 5 to the synthesizer output C201/R201. The gain should be approximately 10 dB.

PA MODULE REPLACEMENT

To Remove PA Module U101:

1. Unsolder the five leads from U101, using either solder removal braid, or a mechanical de-soldering tool. These leads are fragile and can be bent very easily. Do NOT unsolder the shield that wraps around the module.

2. Remove the PA bracket screws and the RF board screws.

3. Remove the RF Board from the radio chassis assembly. Refer to the disassembly procedure provided in the Service Section. Carefully slide the module out of the shield, and away from the board.

To Install PA Module U101:

1. Apply some heat conducting silicone grease to the metal side of the replacement module.

2. Carefully insert the five leads from the module into the five corresponding PWB holes, and slide the module into the shield. Do NOT solder the leads yet.

3. Slide the RF Board assembly back into the radio frame. Reinstall all hardware, harnesses, cables, etc. Replace all screws.

4. Install the two PA bracket screws before soldering the five module leads. Trim excess wire.

TRANSMITTER CIRCUIT

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

Transmitter DC measurements:

1. Ensure that DPTT is low when the mic PTT is keyed low.

2. Check for approximately 8 volts at pin 5 of the Exciter module U104. If not present, troubleshoot the TX switch circuitry, Q101 and U103.

3. Check for approximately 0.7 volts across each pin diode D104 and D401. If not present, check the conduction path from L401 to the TX switch Q101.

4. Check for an adjustable voltage of 0 to 12 volts on pin 9 of the Exciter module U104. At maximum power, with Power Set adjustment R113 fully clockwise, pin 9 should be at 12 volts. If not present, check the power control circuitry: U103, Q102, Q103, and Q104.

5. Check for 13.6 volts on pins 2, 3, and 4 of the PA module U101, and ensure a good mechanical and electrical ground from the PA module to the bracket and casting.

RECEIVER CIRCUIT

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

RECEIVER CIRCUIT QUICKCHECKS

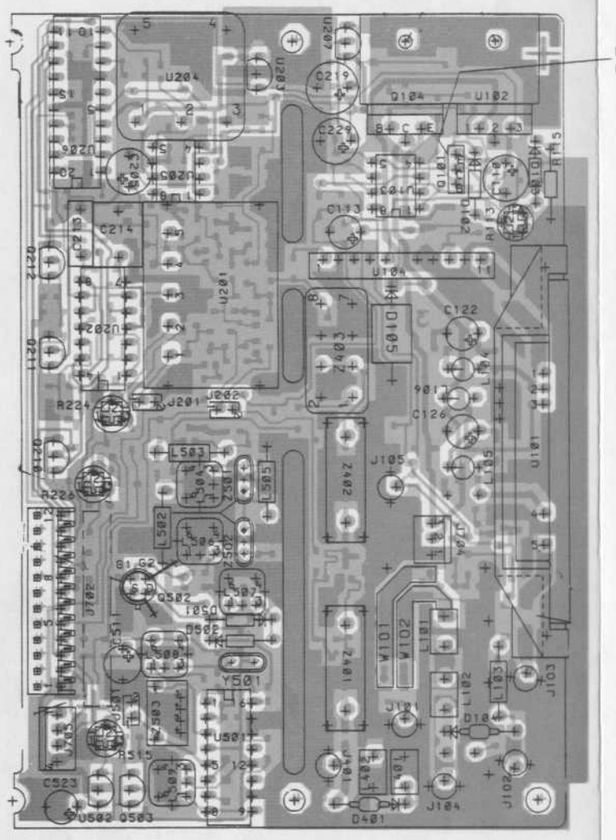
SYMPTOM:	CHECK:
No Audio	1. U502 regulator. 2. The level and frequency of the first mixer injection frequency. 3. The level and frequency of the second mixer injection frequency. 4. Quadrature detector circuit 5. Quadrature detector coil tuning (L509).
Poor SINAD	1. Troubleshoot receive circuit stage gains (see* Figure 1). 2. Input cable. 3. PIN Diode switch is shorted.
Distorted Audio	1. Both mixer injection frequencies. 2. Quadrature detector coil tuning. 3. Crystal filter source and load tuning. 4. Z503: 455 kHz ceramic filter.

GE Mobile Communications

General Electric Company
Lynchburg, Virginia 24502

Printed in U.S.A.

COMPONENT SIDE



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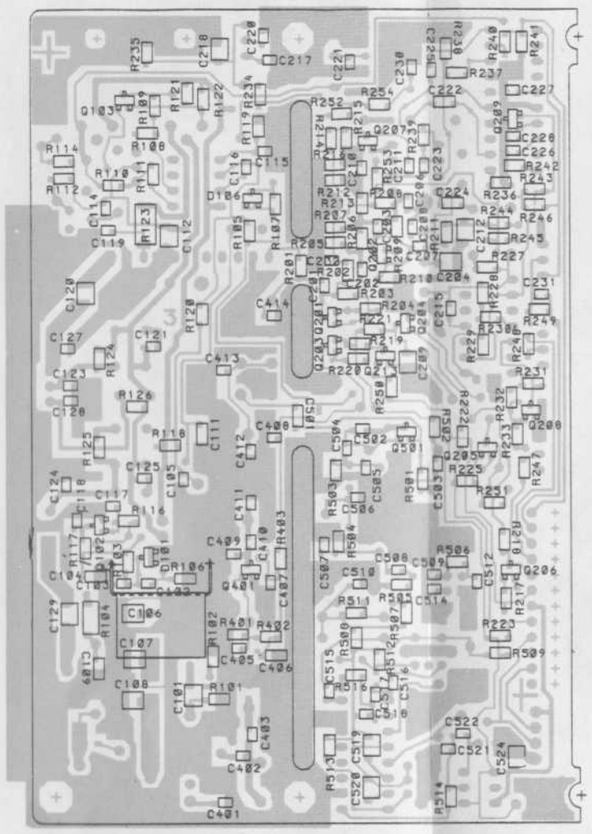
(19D902131, Sh. 4, Rev. 3)

SOLDER SIDE



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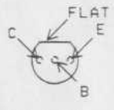
VIEW FROM BACKSIDE

(1) NOTES:

1. THE FOLLOWING ITEMS ARE ELECTROSTATIC SENSITIVE DEVICE REQUIRING SPECIAL CARE:
   U202, U206 AND Q502.
2. Z501 AND Z502 ARE A MATCHED PAIR OF CRYSTAL FILTERS WHICH MUST BE ORIENTATED WITH "B" RESONATOR AS SHOWN. "B" RESONATOR IS INDENTIFIED BY DOT ON CAN.

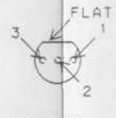
LEAD IDENTIFICATION FOR Q210, Q211, Q212, & Q503



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR U203, U207 & U502



IN-LINE
TOP VIEW

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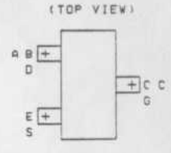
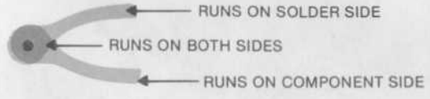
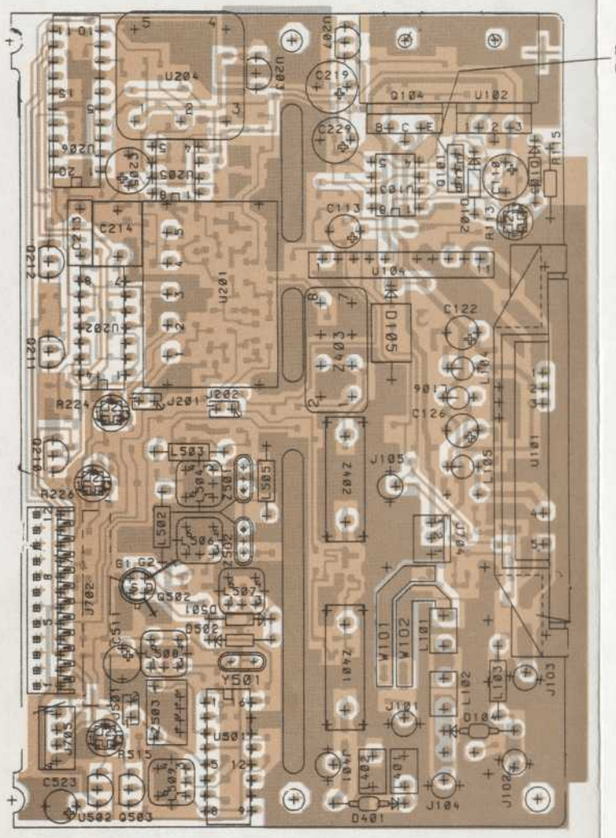
LEAD IDENTIFICATION FOR (SOT) TRANSISTORS AND DIODES





COMPONENT SIDE



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(19D902131, Sh. 3, Rev. 3)
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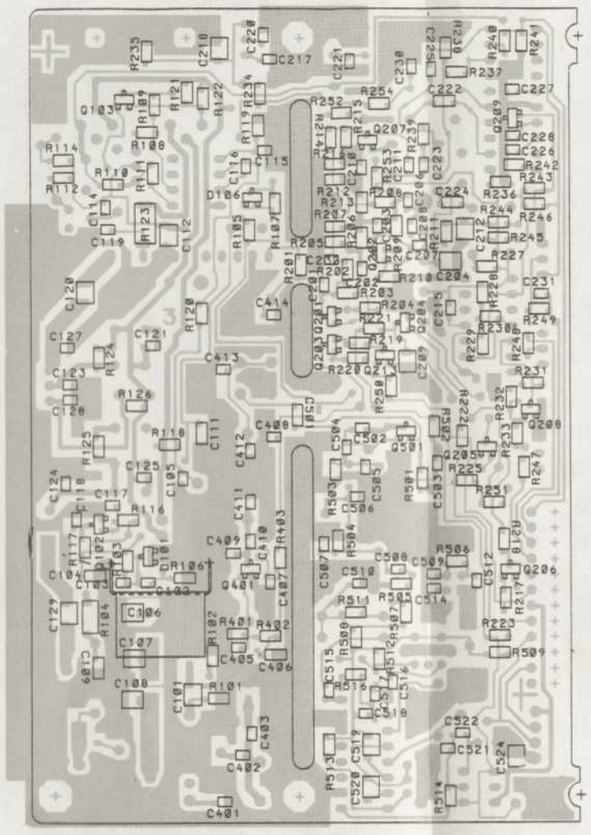
SOLDER SIDE



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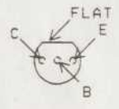
VIEW FROM BACKSIDE

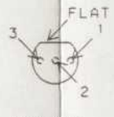
LEAD IDENTIFICATION FOR Q210,Q211,Q212,& Q503



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

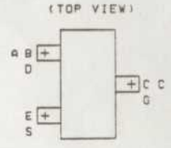
LEAD IDENTIFICATION FOR U203,U207 & U502



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR (SOT) TRANSISTORS AND DIODES



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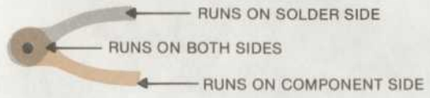
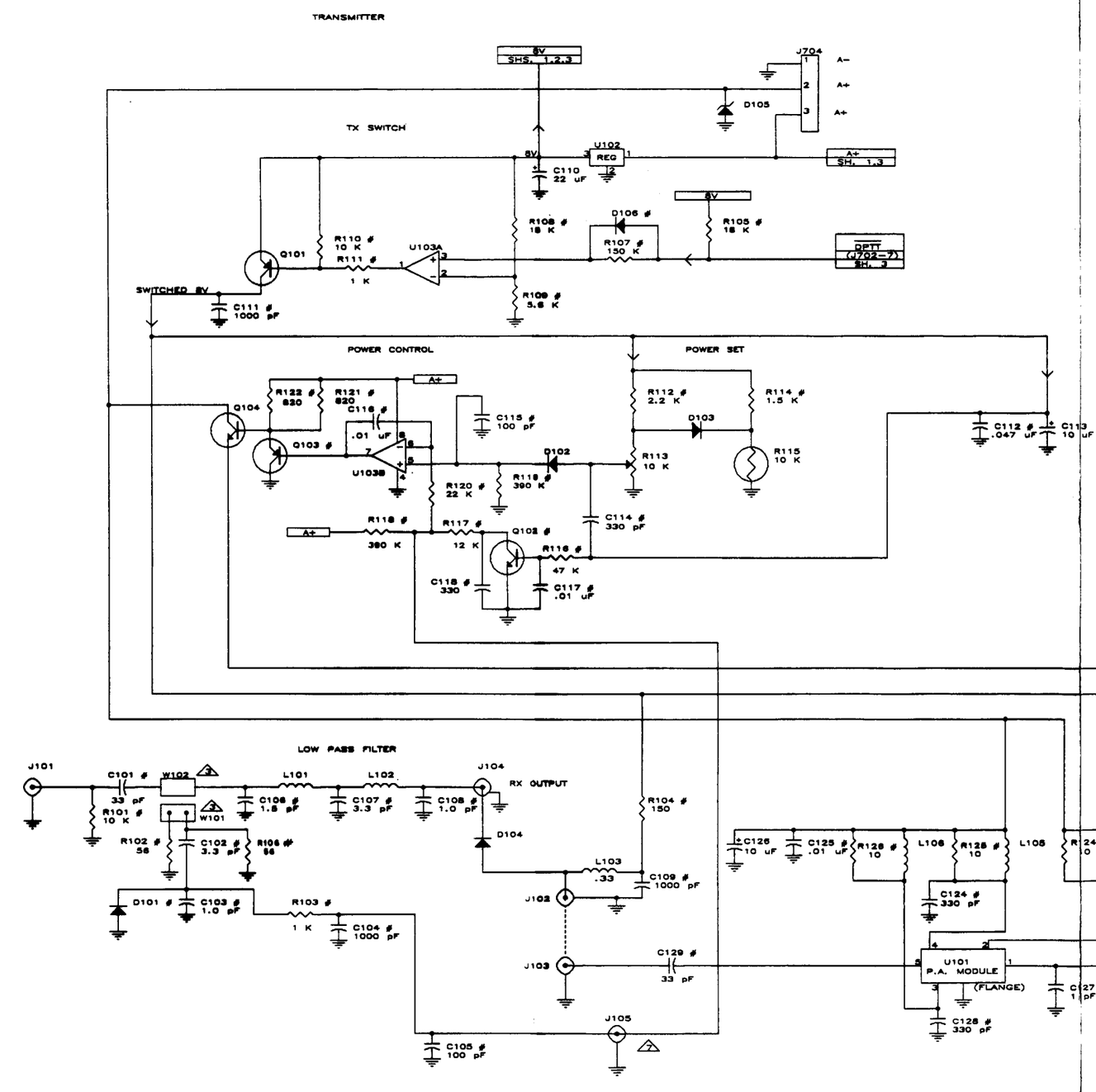


MODEL NO.	REV. LETTER
19D902132G1	B



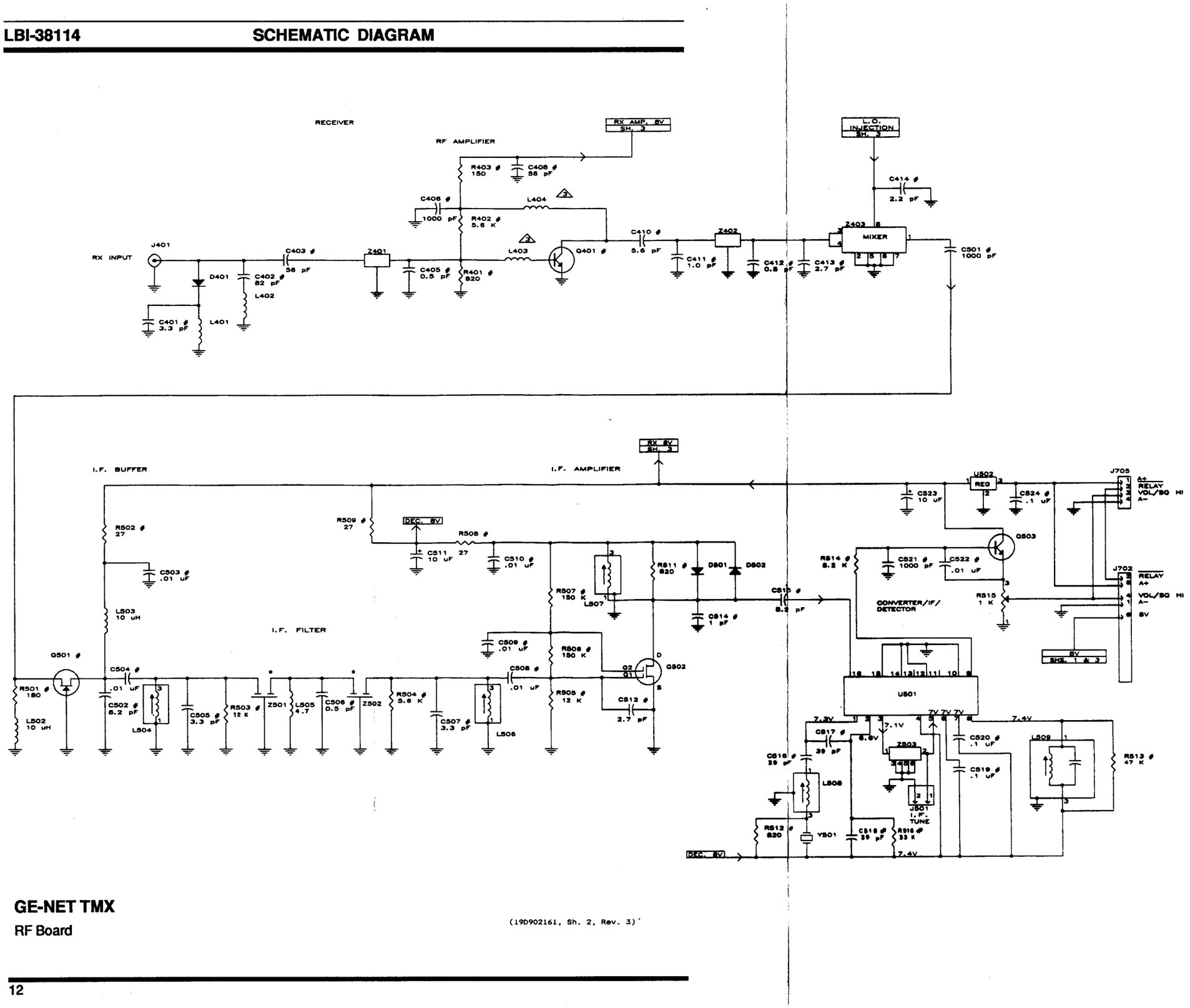
(19D902161, Sh. 1, Rev. 3)

NOTES:

1. ALL RESISTORS ARE 1/8 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 OR H = HENRYS.
2. # INDICATES CHIP COMPONENT LOCATED ON SOLDER SIDE OF PWB.
3. INDICATES PART OF PWB.
4. ● INDICATES CRYSTAL FILTER PAIRING. (DOTS APPEAR ON TOP OF FILTER CASE.)
5. USED ON BANDSWITCH RADIOS ONLY.
6. USED ON NON-BANDSWITCH RADIOS ONLY.
7. NOT CURRENTLY USED.

GE-NET TMX

RF Board



GE-NET TMX

RF Board

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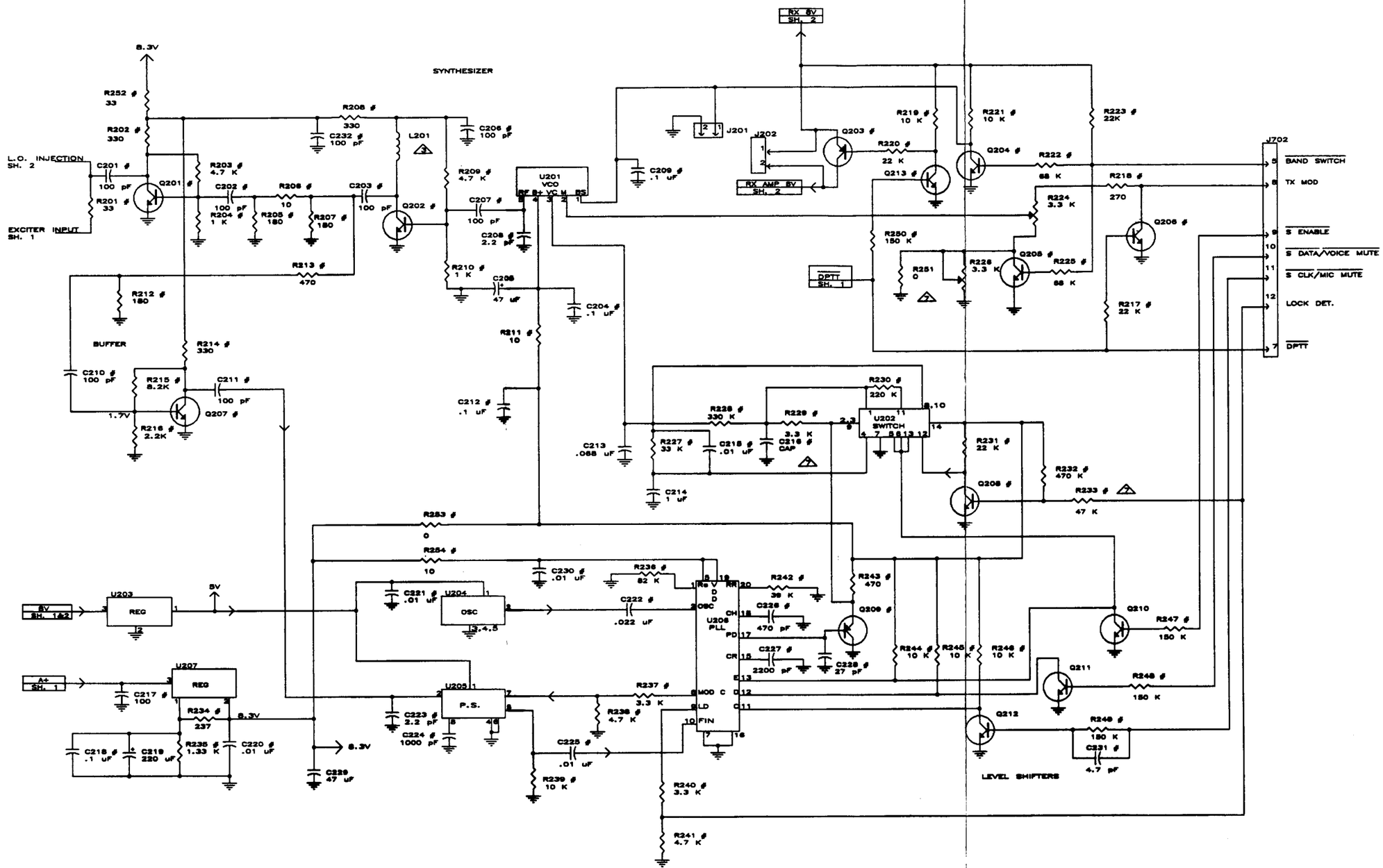


(19D902161, Sh. 3, Rev. 1)

PARTS LIST

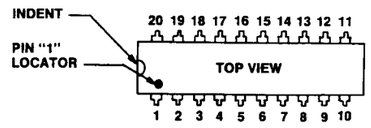
RF BOARD
19D902132G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A705108P25	Mica: 33 pF + or -5%, 500 VDCW.
C102	19A702061P7	Ceramic: 3.3 pF + or - 0.5 pF, 50 VDCW, temp coef 0 + or - 120 PPM.
C103	19A702236P6	Ceramic: 1.0 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C104	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C105	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C106	19A705108P203	Mica: 1.5 pF + or - .25 pF, 500 VDCW.
C107	19A705108P1	Mica: 3.3 pF + or - .25 pF, 500 VDCW.
C108	19A705108P201	Mica: 1.0 pF + or - .25 pF, 500 VDCW.
C109	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C110	19A701534P8	Tantalum: 22 uF + or -20%, 16 VDCW.
C111	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C112	19A702052P22	Ceramic: 0.047 uF + or - 10%, 50 VDCW.
C113	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C114	19A702061P73	Ceramic: 330 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C115	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C116 and C117	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C118 and C119	19A702061P73	Ceramic: 330 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C120	19A705108P25	Mica: 33 pF + or -5%, 500 VDCW.
C121	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C122	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C123 and C124	19A702061P73	Ceramic: 330 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C125	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C126	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C127	19A702236P6	Ceramic: 1.0 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C128	19A702061P73	Ceramic: 330 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C129	19A705108P25	Mica: 33 pF + or -5%, 500 VDCW.
C201 thru C203	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C204	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C205	19A701534P17	Tantalum: 47 uF + or -20%, 10 VDCW.
C206 and C207	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C208	19A702236P10	Ceramic: 2.2 pF + or -2.5 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C209	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C210 and C211	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C212	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C213	19A700004P1	Metallized polyester: 0.068 uF + or - 10%, 63 VDCW.
C214	19A700004P11	Metallized Polyester: 1.0 uF + or - 10%, 63 VDCW.
C215	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C217	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C218	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C219	19A703314P2	Tantalum: 220 uF, -10+50%, 10 VDCW.
C220 and C221	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C222	19A702052P28	Ceramic: 0.022 uF + or -10%, 50 VDCW.
C223	19A702236P10	Ceramic: 2.2 pF + or -2.5 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C224	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C225	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C226	19A702061P77	Ceramic: 470 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C227	19A702052P7	Ceramic: 2200 pF + or - 10%, 50 VDCW.
C228	19A702236P36	Ceramic: 27 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C229	19A701534P17	Tantalum: 47 uF + or -20%, 10 VDCW.
C230	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C231	19A702061P9	Ceramic: 4.7 pF + or - 0.5 pF, 50 VDCW, temp coef 0 + or - 60 PPM.
C232	19A702236P50	Ceramic: 100 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C401	19A702236P13	Ceramic: 3.3 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C402	19A702236P48	Ceramic: 82 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C403	19A702236P44	Ceramic: 56 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C405	19A702236P1	Ceramic: 0.5 pF + or -.1 pF, 50 VDCW, temp coef 0 + or -30 PPM.
C406	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C408	19A702236P44	Ceramic: 56 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C410	19A702236P19	Ceramic: 5.6 pF + or -.5 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C411	19A702236P6	Ceramic: 1.0 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C412	19A702236P1	Ceramic: 0.5 pF + or -.1 pF, 50 VDCW, temp coef 0 + or -30 PPM.
C413	19A702236P11	Ceramic: 2.7 pF + or -0.25 pF, 50 VDCW, temp coef 0 + or -30 PPM.
C414	19A702236P10	Ceramic: 2.2 pF + or -2.5 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C501	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C502	19A702236P23	Ceramic: 8.2 pF + or -.25 pF, 50 VDCW, temp coef 0 + or -30 PPM.
C503 and C504	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C505	19A702236P13	Ceramic: 3.3 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C506	19A702236P1	Ceramic: 0.5 pF + or -.1 pF, 50 VDCW, temp coef 0 + or -30 PPM.
C507	19A702236P13	Ceramic: 3.3 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C508 thru C510	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C511	19A701534P7	Tantalum: 10 uF + or -20%, 16 VDCW.
C512	19A702061P6	Ceramic: 2.7 pF + or - 0.5 pF, 50 VDCW, temp coef 0 + or - 120 PPM.
C514	19A702061P1	Ceramic: 1 pF + or -0.5 pF, 50 VDCW.
C515	19A702061P12	Ceramic: 8.2 pF + or - 0.5 pF, 50 VDCW, temp coef 0 + or - 60 PPM.
C516	19A702061P45	Ceramic: 47 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C517 and C518	19A702061P37	Ceramic: 33 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C519 and C520	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C521	19A702052P5	Ceramic: 1000 pF + or -10%, 50 VDCW.
C522	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C523	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C524	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D101	19A705377P1	Silicon, Hot Carrier: sim to Motorolla MMB0201.
D102 and D103	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D104	19J706892P2	Silicon, pin; sim to Unitrode UM9401.
D105	19A703588P3	Zener, transient suppressor: sim to 1N6278A.
D106	19A702526P2	Silicon. (Schottky Barrier); sim to BAT 17.
D401	19J706892P2	Silicon, pin; sim to Unitrode UM9401.
D501 and D502	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - JACKS - - - - - - - - - -
J101 thru J104	19B801341P1	RF Jack.
J201 and J202	19A700072P1	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021.
J401	19B801341P1	RF Jack.
J501	19A700072P1	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021.
J702	19A704779P12	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 - - - - - - - - - -
L101 and L102	19B800890P3	Coil, RF: 11.7 uH + or -5%, sim to Paul Smith SK-896-1.
L103	19A700024P7	Coil, RF: 330 nH + or - 10%.
L104 thru L106	19A704921P1	Coil.
L201		Part of PWB 19D902131P1.
L401	19B800890P8	Coil, RF: sim to Paul Smith SK-891-1.
L402	19B800890P3	Coil, RF: 11.7 uH + or -5%, sim to Paul Smith SK-896-1.
L403 and L404		Part of PWB 19D902131P1.
L502 and L503	M343CLP10022	Coil, Fixed: 10 uH + or - 10%.
L504	19B801413P4	Coil, 39 MHz.
L505	19A700024P21	Coil, RF, fixed: 4.7 uH + or -10%; sim to Jeffers 4436-8K.
L506 thru L508	19B801413P4	Coil, 39 MHz.
L509	19B801415P2	Transformer, 455 KHz.: sim to AEPD 162B3277P17.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101	19A704972P1	Silicon, PNP: sim to Motorola 2N4918.
Q102	19A700076P2	Silicon, NPN.
Q103	19A703197P2	Silicon, PNP; sim to MMBT4403 Low Profile Pkg.
Q104		Part of Heat Sink Assembly.
Q201 and Q202	19A704708P2	Silicon, NPN; sim to NEC 2SC3356.
Q203	19A700059P2	Silicon, PNP.
Q204 thru Q206	19A700076P2	Silicon, NPN.
Q207	19A704708P2	Silicon, NPN; sim to NEC 2SC3356.
Q208	19A700076P2	Silicon, NPN.
Q209	19A700059P2	Silicon, PNP.
Q210	19A700023P2	Silicon, NPN: sim to 2N3904.
Q211 and Q212	19A702084P2	Silicon, NPN: sim to MPS 2369.
Q213	19A700076P2	Silicon, NPN.
Q401	19A705622P1	High frequency, NPN: sim to MMBR951.
Q501	19A702524P3	N-Type, field effect; sim to MMBFJ310.
Q502	19A116818P3	N Channel, field effect; sim to Type 3N187?.
Q503	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R102	19B800607P560	Metal film: 56 ohms + or - 5%, 200 VDCW, 1/8 w.
R103	19B800607P102	Metal film: 1K ohms + or - 5%, 200 VDCW, 1/8 w.
R104	19B801486P151	Metal film: 150 ohms + or - 5%, 1/2 w.
R105	19B800607P183	Metal film: 18K ohms + or - 5%, 200 VDCW, 1/8 w.
R107	19B800607P154	Metal film: 150K ohms + or -5%, 200 VDCW, 1/8 w.
R108	19B800607P183	Metal film: 18K ohms + or - 5%, 200 VDCW, 1/8 w.
R109	19B800607P562	Metal film: 5.6K ohms + or - 5%, 200 VDCW, 1/8 w.
R110	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R111	19B800607P102	Metal film: 1K ohms + or - 5%, 200 VDCW, 1/8 w.
R112	19B800607P222	Metal film: 2.2K ohms + or - 5%, 200 VDCW, 1/8 w.
R113	19B800779P10	Variable: 10K ohms + or -25%, 100 VDCW, .3 watt.
R114	19B800607P152	Metal film: 1.5K ohms + or - 5%, 200 VDCW, 1/8 w.
R115	19A701864P4	Thermal 10K ohms + or -10%, sim to Midwest Components 2M-103.
R116	19B800607P473	Metal film: 47K ohms + or - 5%, 200 VDCW, 1/8 w.
R117	19B800607P123	Metal film: 12K ohms + or - 5%, 200 VDCW, 1/8 w.
R118 and R119	19B800607P394	Metal film: 390K ohms + or - 5%, 200 VDCW, 1/8 w.
R120	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R121 and R122	19B800607P821	Metal film: 820 ohms + or - 5%, 200 VDCW, 1/8 w.
R123	19B801479P120	Metal film: 12 ohms + or - 5%, 1 w.
R124 thru R126	19B800607P100	Metal film: 10 ohms + or -5%, 200 VDCW, 1/8 w.
R201	19B800607P330	Metal film: 33 ohms + or - 5%, 200 VDCW, 1/8 w.
R202	19B800607P331	Metal film: 330 ohms + or - 5%, 200 VDCW, 1/8 w.
R203	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.
R204	19B800607P102	Metal film: 1K ohms + or - 5%, 200 VDCW, 1/8 w.
R205	19B800607P181	Metal film: 180 ohms + or - 5%, 200 VDCW, 1/8 w.
R206	19B800607P100	Metal film: 10 ohms + or -5%, 200 VDCW, 1/8 w.
R207	19B800607P181	Metal film: 180 ohms + or - 5%, 200 VDCW, 1/8 w.
R208	19B800607P331	Metal film: 330 ohms + or - 5%, 200 VDCW, 1/8 w.
R209	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

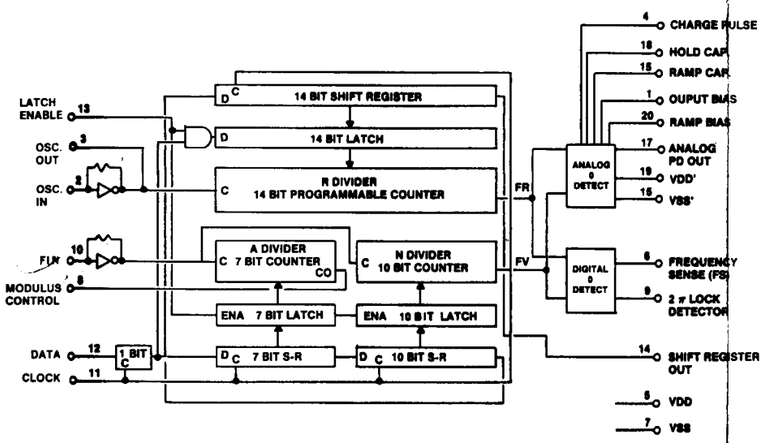
SYMBOL	GE PART NO.	DESCRIPTION
R210	19B800607P102	Metal film: 1K ohms + or - 5%, 200 VDCW, 1/8 w.
R211	19B800607P100	Metal film: 10 ohms + or -5%, 200 VDCW, 1/8 w.
R212	19B800607P181	Metal film: 180 ohms + or - 5%, 200 VDCW, 1/8 w.
R213	19B800607P471	Metal film: 470 ohms + or - 5%, 200 VDCW, 1/8 w.
R214	19B800607P331	Metal film: 330 ohms + or - 5%, 200 VDCW, 1/8 w.
R215	19B800607P822	Metal film: 8.2K ohms + or - 5%, 200 VDCW, 1/8 w.
R216	19B800607P222	Metal film: 2.2K ohms + or - 5%, 200 VDCW, 1/8 w.
R217	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R218	19B800607P271	Metal film: 270 ohms + or - 5%, 200 VDCW, 1/8 w.
R219	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R220	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R221	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R222	19B800607P683	Metal film: 68K ohms + or - 5%, 200 VDCW, 1/8 w.
R223	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R224	19B800779P7	Variable: 3.3K ohms + or -25%, 100 VDCW, .3 w.
R225	19B800607P683	Metal film: 68K ohms + or - 5%, 200 VDCW, 1/8 w.
R226	19B800779P7	Variable: 3.3K ohms + or -25%, 100 VDCW, .3 w.
R227	19B800607P333	Metal film: 33K ohms + or - 5%, 200 VDCW, 1/8 w.
R228	19B800607P334	Metal film: 330K ohms + or - 5%, 200 VDCW, 1/8 w.
R229	19B800607P332	Metal film: 3.3K ohms + or - 5%, 200 VDCW, 1/8 w.
R230	19B800607P224	Metal film: 220K ohms + or - 5%, 200 VDCW, 1/8 w.
R231	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R232	19B800607P474	Metal film: 470K ohms + or - 5%, 200 VDCW, 1/8 w.
R234	19A702931P137	Metal film: 237 ohms + or -1%, 200 VDCW, 1/8 w.
R235	19A702931P213	Metal film: 1330 ohms + or -1%, 200 VDCW, 1/8 w.
R236	19B800607P823	Metal film: 82K ohms + or -5%, 200 VDCW, 1/8 w.
R237	19B800607P332	Metal film: 3.3K ohms + or - 5%, 200 VDCW, 1/8 w.
R238	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.
R239	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R240	19B800607P332	Metal film: 3.3K ohms + or - 5%, 200 VDCW, 1/8 w.
R241	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.
R242	19B800607P393	Metal film: 39K ohms + or - 5%, 200 VDCW, 1/8 w.
R243	19B800607P471	Metal film: 470 ohms + or - 5%, 200 VDCW, 1/8 w.
R244 thru R246	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R247 thru R250	19B800607P154	Metal film: 150K ohms + or -5%, 200 VDCW, 1/8 w.
R252	19B800607P330	Metal film: 33 ohms + or - 5%, 200 VDCW, 1/8 w.
R253	19B800607P1	Metal Film: 0 ohms (50 Milli-ohms Max), 1/8 w.
R254	19B800607P100	Metal film: 10 ohms + or -5%, 200 VDCW, 1/8 w.
R401	19B800607P821	Metal film: 820 ohms + or - 5%, 200 VDCW, 1/8 w.
R402	19B800607P562	Metal film: 5.6K ohms + or - 5%, 200 VDCW, 1/8 w.
R403	19B800607P151	Metal film: 150 ohms + or - 5%, 200 VDCW, 1/8 w.
R501	19B800607P181	Metal film: 180 ohms + or - 5%, 200 VDCW, 1/8 w.
R502	19B800607P270	Metal film: 27 ohms + or - 5%, 200 VDCW, 1/8 w.
R503	19B800607P123	Metal film: 12K ohms + or - 5%, 200 VDCW, 1/8 w.
R504	19B800607P562	Metal film: 5.6K ohms + or - 5%, 200 VDCW, 1/8 w.
R505	19B800607P123	Metal film: 12K ohms + or - 5%, 200 VDCW, 1/8 w.
R506 and R507	19B800607P154	Metal film: 150K ohms + or -5%, 200 VDCW, 1/8 w.
R508 and R509	19B800607P270	Metal film: 27 ohms + or - 5%, 200 VDCW, 1/8 w.
R511 and R512	19B800607P821	Metal film: 820 ohms + or - 5%, 200 VDCW, 1/8 w.
R513	19B800607P473	Metal film: 47K ohms + or - 5%, 200 VDCW, 1/8 w.
R514	19B800607P822	Metal film: 8.2K ohms + or - 5%, 200 VDCW, 1/8 w.
R515	19B800779P4	Variable, 4.7 to 470 ohms + or -25%, 100 VDCW, .3 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U101	19A143904P3	Integrated circuit. 110.00
U102		Part of Heat Sink Assembly.
U103	19A701789P2	DUAL OP AMP; sim to LM358.
U104	19A704695P2	Integrated circuit.
U201	19A705616P1	Oscillator, voltage controlled.
U202	19A700029P44	Digital: BILATERAL SWITCH.
U203	19A704971P1	Voltage Regulator, 5 volt; sim to: Motorola MC78L05ACP.
U204	19B801351P12	Oscillator, crystal.
U205	19A704740P1	Divider; sim to Mitsubishi M54475P.
U206	19B800902P4	Synthesizer: CMOS Serial Input.
U207	19A701999P4	Linear, (Positive Voltage Regulator); sim to LM317LZ.
U501	19A704619P1	Linear: IF AMPLIFIER AND DETECTOR.
U502	19A704073P2	Voltage Regulator, positive.
		- - - - - - - - - - CABLES - - - - - - - - - -
W101 and W102		Part of PWB 19D902131P1.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y501	19B233066G10	Crystal, 39.455 MHz.
		- - - - - - - - - - FILTER - - - - - - - - - -
Z401 and Z402	19A704888P2	Filter, bandpass: sim to Murata DFC3R937-P008BTD.
Z403	19B801025P2	Balanced Mixer. sim to Mini-Circuits SBL-1X.
Z501	19A705613G2	Crystal filter, monolithic.
Z502		Part of Z501.
Z503	19B801021P4	Filter, band pass.
		HEAT SINK ASSEMBLY 19B801378G3
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q105	19A116742P2	Silicon, NPN.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U103	19A134717P3	Linear: POSITIVE VOLTAGE REGULATOR; sim to uA 7808U.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A705469P1	Insulator plate. (Part of Heat Sink Assembly).
	N402P5B6	Washer: narrow, steel. (Part of Heat Sink Assembly).
	N404P11B6	Lockwasher; internal: No. 4. (Part of Heat Sink Assembly).
	N80P9005B6	Machine screw: pan head, steel. (Part of Heat Sink Assembly).
	19A700068P1	Insulator, bushing. (Part of Heat Sink Assembly).
	19B801377G3	Heat Sink.
	19A702364P106	Machine screw: TORX Drive, No. M2 - 0.4 x 6.

SYNTHESIZER U1
19B800902P4



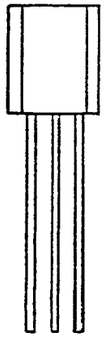
PIN DESCRIPTION

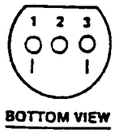
OUTPUT BIAS	1	20	RAMP BIAS
OSC. IN	2	19	VDD'
OSC. OUT	3	18	HOLD CAP.
CHARGE PVLSE	4	17	ANALOG PD OUT
VDD	5	16	VSS'
(FS) FREQ. SENSE	6	15	RAMP CAP.
VSS	7	14	SHIFT REGISTER OUPUT
MODULUS CONTROL	8	13	LATCH ENABLE
2 π LOCK DETECTOR	9	12	DATA IN
FIN	10	11	CLOCK



RC-5863A

VOLTAGE REGULATOR
(U207)
19A701999P4





BOTTOM VIEW

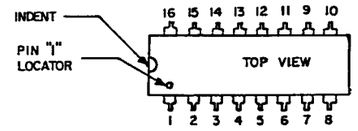
PIN INDENTIFICATION

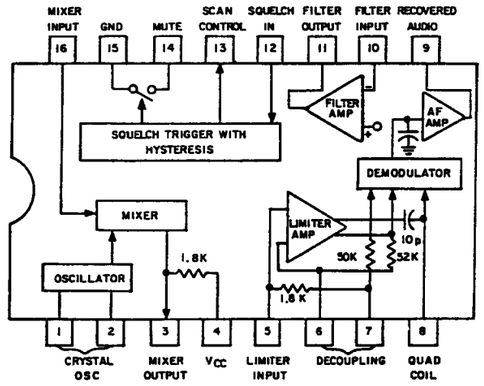
PIN 1 ADJUST
PIN 2 OUTPUT
PIN 3 INPUT

RC-5846

IF AMPLIFIER AND DETECTOR
(U501)
19A704619P1

PIN CONFIGURATION



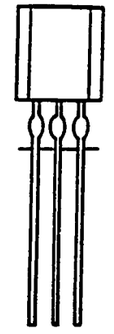


BLOCK DIAGRAM

RC-8023

VOLTAGE REGULATORS

19A704073P2



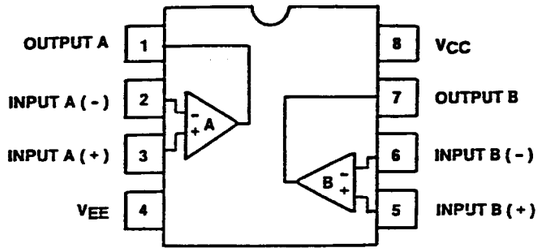
BOTTOM VIEW

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

RC-5289

OPERATIONAL AMPLIFIER

19A701789P2

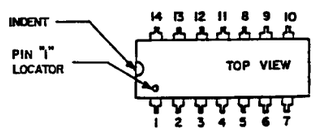


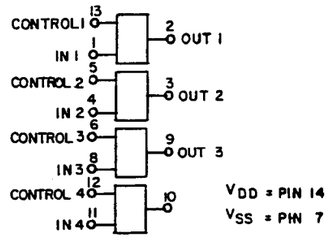
RC-8024

QUAD BILATERAL SWITCH (U202)

19A700029P44

PIN CONFIGURATION



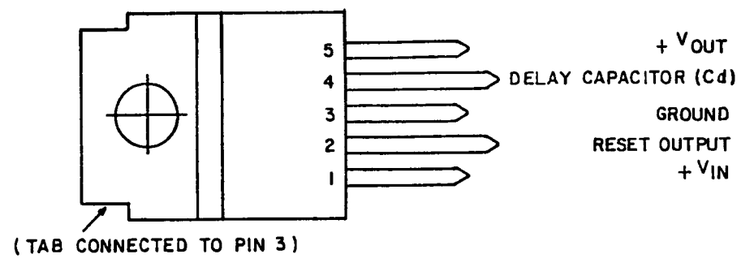


RC-5842

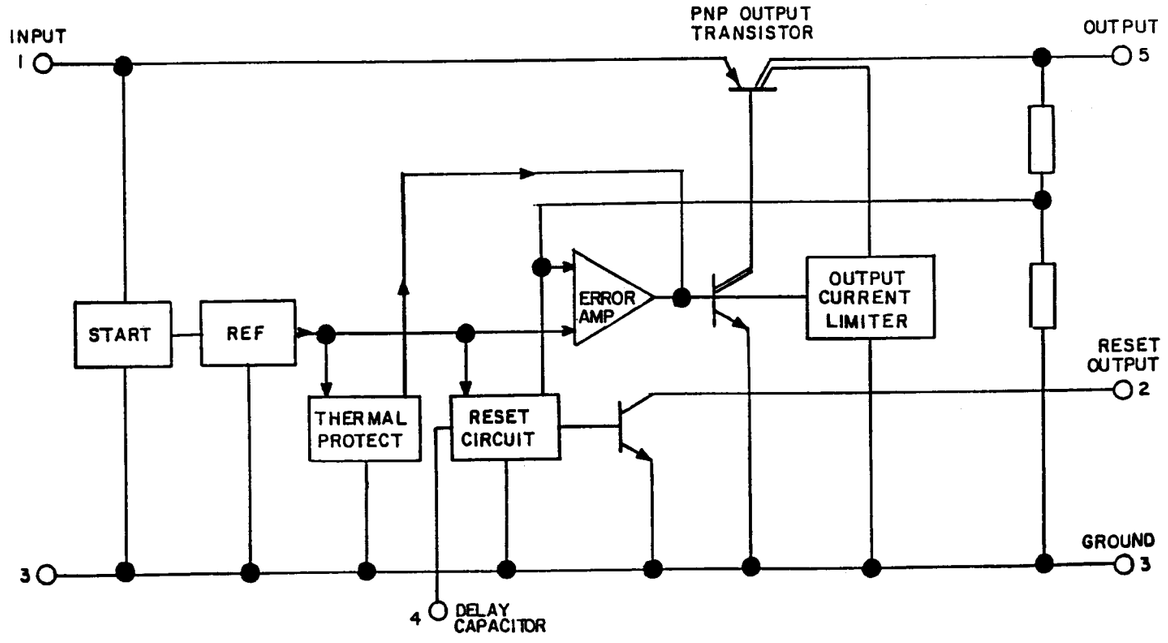
VOLTAGE REGULATOR

19A704971P1

PIN CONFIGURATION

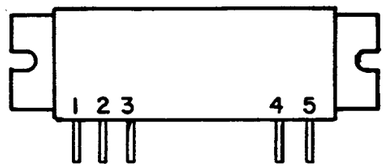


FUNCTION DIAGRAM



RC-5854

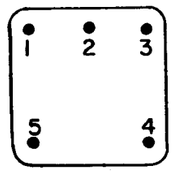
POWER AMPLIFIER MODULE (U101) 19A143904P3



1. Pin
2. Vcc 1
3. Vcc 2
4. Vcc3
5. Pout

RC-8046

OSCILLATOR 19B801351P2



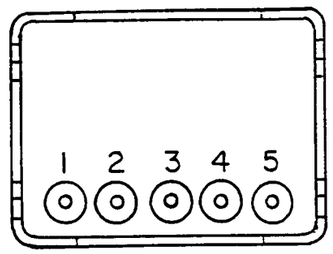
PIN CONNECTIONS

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

* PIN 4 IS PERMISSABLE BUT NOT NECESSARY FOR OPERATION.

RC-8006

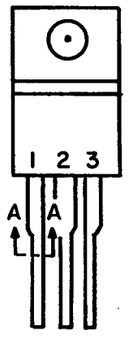
VOLTAGE CONTROLLED OSCILLATOR (U201) 19A705616P1



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

RC-8022

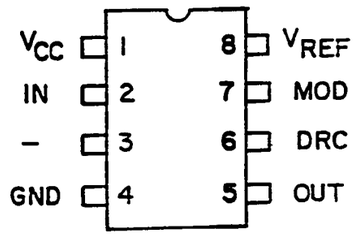
VOLTAGE REGULATOR (U102) 19A134717P3



1. INPUT
2. OUTPUT
3. COMMON

RC-8044

PRESCALER (U205) 19A704740P1



1 V_{CC} POWER SUPPLY (+5V)

2 IN SIGNAL INPUT

3- NO CONNECTION

4 GND GROUND

5 OUT SIGNAL

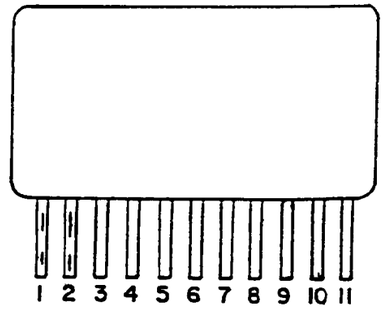
6 DRC DIVISION RATIO CONTROL (V_{CC}: 64/65, OPEN 128/129)

7 MOD MODULUS CONTROL INPUT

8 V_{REF} REFERENCE BIAS INPUT

RC-8043

RF AMPLIFIER MODULE (U104) 19A704695P2



1- P_{IN}
10, 6, 7, 8, 2, 3, 4 -GROUND
5 - V_{CC1}
9 - V_{CC2}
11 - P_{OUT}

RC-8039

ADDENDUM NO. 1 TO LBI-38114
(PCDT)

This addendum incorporates information concerning Revision B to GE-NET TMX RF board 19D902132G1 into Maintenance Manual LBI-38114.

REV. A - RF Board 19D902132G1

To improve operation by reducing excessive current drain. Changed inductor L103 from 19A700024P7 (330 nH) to 19A700024P1 (100 nH).

ADDENDUM NO. 2 TO LBI-38114
(PCDT)

This addendum covers revision letter changes made to RF Board 19D902132G1 to improve squelch operation.

REV C - RF BOARD 19D902132G1

Add:	R106	19B800607P560	Metal Film: 56 ohms ±5%, 1/8 W
	R516	19B800607P333	Metal Film: 33K ohms ±5%, 1/8 W
Changed	C516 thru C518	19A702061P41	Ceramic: 39 pf ±5%, 50 VDCW