MAINTENANCE MANUAL

SYNTHESIZER/INTERCONNECT BOARD CLASSIC II 19D901441G1, G2

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DESCRIPTION

The system interconnect and frequency synthesizer board generates the synthesized RF frequency and the injection frequency. In addition it provides the interface with the various control and display functions on the control unit, the transmit-receive board the microprocessor on the logic board, and external functions such as the microphone, speaker and power cables. A Block Diagram is shown in Figure 1.

The synthesizer/interconnect board is mounted to the top side of the "H" frame chassis using 14 thread forming screws.

CIRCUIT ANALYSIS

I/O Interface (Input/Output)

The I/O interface circuit consists of I/O port expander, U2501. This port expander provides the interface between the microcomputer on the logic board and synthesizer. Other interface points on the port expander include detection of RF carrier, speaker audio mute, external alarm relay closure, and radio test mode operation.

The I/O port expander contains four 4-bit bi-directional static input-output ports and one 4-bit port to interface with the microcomputer. The 4-bit microcomputer interface port consisting of P20-P23 is paralleled to allow a maximum interchange of data. The function of data appearing on the microcomputer interface ports is identified by the status of the PROG lead. A high to low transition signifies that address and control information is available. A low to high transition signifies the presence of data.

On U2501, interface ports P40-P41 and P50-P51 complete the interface to the frequency synthesizer U2601 through buffer-high level driver transistors Q2501-Q2508. These eight port lines select one of 200 frequencies in the particular band. Transistors Q2501-Q2508 translate the TTL logic signals to 0-8.5V logic signals used by the frequency synthesizer. Port 60 is an input which detects the presence of RF carrier (CAS). Port 73 generates the audio mute signal to the external speaker audio amplifier. This line is buffered by Q2511.

Port 72 activates the external alarm relay. This signal is double buffered by Q2510 and Q2518 and is a closure to ground at the output of Q2518. The external alarm relay output is capable of sinking 400 milliamperes. Ports P61 and P62 are used to enable the test mode of operation, whereby the radio can be placed into a manual test mode.

FREQUENCY SYNTHESIZER

The frequency synthesizer consists of reference oscillator Y2601, synthesizer U2601, acquisition and filtering circuit Q2601 and Q2602, voltage controlled oscillator (VCO) Q2603 and Q2604, low pass filter L2605-L2607 and associated circuitry, dual modulus counter U2602 and lock detector Q2605 and Q2606. The synthesizer loop operates at frequencies between 41.6 and 44.0875 MHz and provides a minimum output signal of -4.5 dBm to the transmit/receive board.

CIRCUIT ANALYSIS

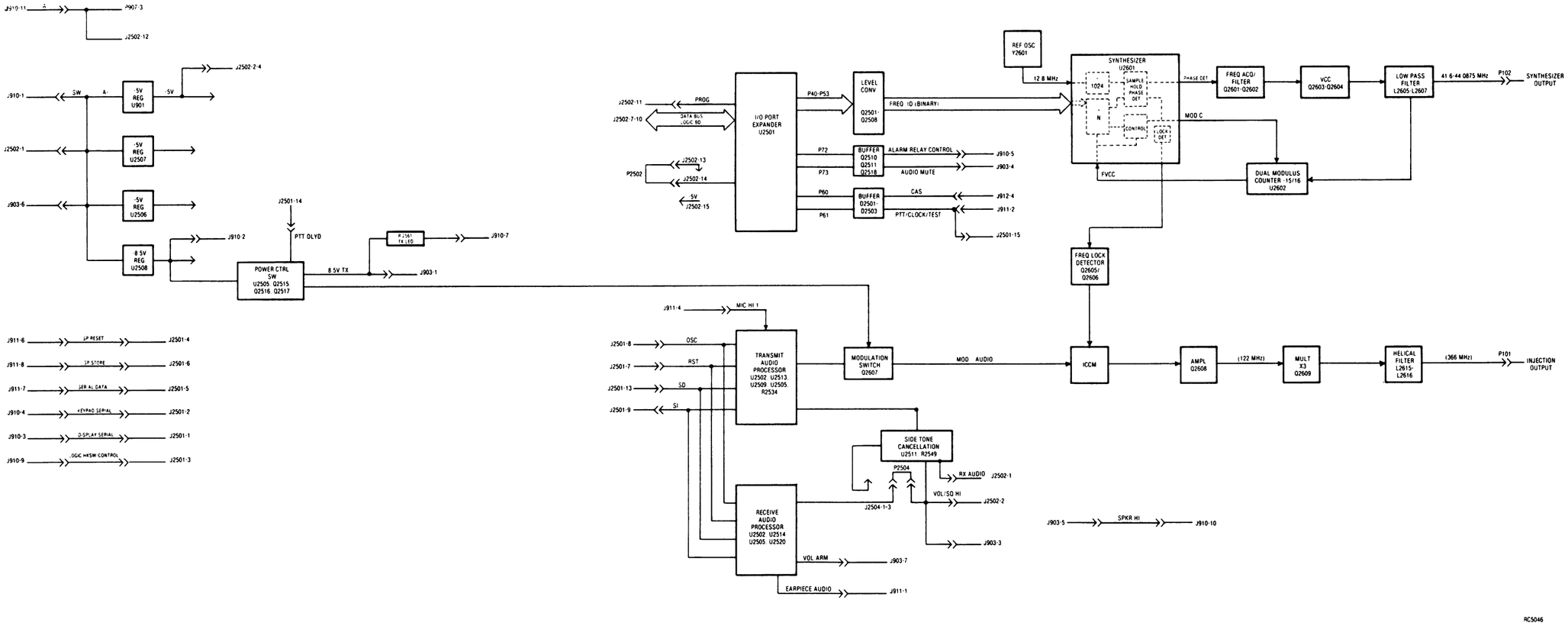

Figure 1 - Block Diagram

Reference Oscillator

The 5 PPM reference oscillator operates at a frequency of 12.8 MHz. Voltage for the oscillator compensator is obtained from the 8.5V continuous supply and is regulated down to 5.4 Volts by Zener diode D2601. Frequency compensation is provided by varactor D2603. Frequency is adjusted by C2607 while monitoring the synthesizer output at TP2602. The 12.8 MHz output signal is fed into the synthesizer IC on pin 27.

Synthesizer

The synthesizer U2601 contains a 1024 divider, phase detector, and a ÷N counter. The reference input frequency is divided by 1024 to obtain a 12.5 kHz channel spacing reference for the synthesizer. U2601-23 is the sample and hold phase detector output. The phase detector compares the 12.5 kHz signal from the ÷1024 counter and the output of the internal ÷N counter.

This comparison results in an ± error voltage when the phases differ and a constant output voltage when operating in phase. If a phase error is detected an error voltage is supplied to the VCO through the acquisition circuit to set the VCO frequency. The count of the internal ÷N counter is controlled by the frequency code received from the frequency PROM. Thus, when a different channel is selected an error voltage appears at the phase detector output, causing the phase lock loop to acquire the new frequency.

Acquisition and Notch Filter

Q2601, Q2602 and associated circuitry comprise a twin TEE notch filter, low pass filter, and acquisition speed up circuit. The twin TEE notch filter (base side and emitter side of Q2601) remove the 12.5 kHz and 25 kHz reference spurs that are a product of the sample and hold phase detector output of the synthesizer. The low pass filter consists of R2620, R2621, C2623 and C2624 and controls the stability of the synthesizer loop.

The acquisition circuit consists of Q2601, Q2602, D2604-D2607, R2611 and C2616. During frequency acquisition the sample and hold and FS (frequency sense) outputs of the synthesizer generate an error voltage representative of the frequency change required of the VCO to achieve phase lock. The FS output provides corrections for large frequency changes while the sample and hold output is a sort of vernier control to correct for small phase differences to achieve phase lock. The FS error voltage is integrated by R2611 and C2616 and summed with the sample and hold output to permit rapid frequency acquisition.

Rapid acquisition is achieved by changing the charge on the VCO varicap D2608 as swiftly as possible. This is the function of D2604-D2607. When D2604 is conducting, it effectively shorts out R2620, Q2602 and all the components of the 2nd twin TEE filter. This permits a fast change in the DC level on the varicap. When D2605 is conducting it shorts out R2602 and allows a rapid discharge of the varicap through Q2602. When D2606 or D2607 are conducting, they allow for rapid charge or discharge of C2624.

When R2620 is shorted the closed loop bandwidth is greatly increased and permits frequency switching times of less than 25 milliseconds.

After phase lock is achieved no acquisition (error voltage) information is received from the FS output.

Test point TP2601 monitors the voltage applied to the varicap.

NOTE

When adjusting the VCO voltage, always be sure to use a high impedance meter (10 megohm input impedance minimum).

The voltage at TP2601 varies directly with frequency in the locked condition (as voltage increases the frequency increases) and typically may range from 4.0 to 6.0 volts.

VCO (Voltage Controlled Oscillator)

The VCO consists of two FET's, Q2603 and Q2604, L2602, D2608, C2629, C2625, R2661 and C2628. The free running frequency of the VCO is adjusted by L2602 and operates over the range of 41.6 MHz to 44.0875 MHz. The tuned circuit consists of L2602, D2608 and C2625. The capacitance of D2608 varies in proportion to the DC voltage applied to it from the acquisition circuit, thus controlling the operating frequency of the VCO. The output of the VCO is taken from the drain of Q2603 and routed to the transmit/receive board through a low pass filter and P102. The low pass filter removes the 2nd and 3rd harmonics of the VCO frequency.

Dual Modulus Counter

The VCO frequency is fed back to the dual modulus counter U2602 through R2629 and C2638. The counter divides the VCO frequency by 15 or by 16 under control of MOD C (modulus control) from the synthesizer. When MOD C is high the VCO is divided by 15 and is divided by 16 when

MOD C is low. The output of the dual modulus counter is applied to the synthesizer where it is divided down to 12.5 kHz by an internal N counter and compared in frequency and phase with the divided down frequency from the reference oscillator. The divide by N counter is controlled by the 8-bit binary frequency code received from the RF frequency PROM. When the PROG lead on the I/O expander is all zeros the VCO frequency should be 41.6 MHz at TP2602 and the voltage at TP2601 should be 3.75 ±0.1 VDC.

Lock Control

The lock control circuit consisting of Q2605 and Q2606 in conjunction with LD (lock detect) control the operation of the 2 PPM ICOM by switching its control line. Should the synthesizer become unlocked, negative pulses will be present on the LD lead which will turn Q2605 on, discharging C2645 and turning Q2606 off. The incoming negative pulses increase in frequency with an increase in the difference between the divided down VCO frequency and the divided down reference frequency. With Q2606 turned off the ICOM ENABLE lead is opened and the ICOM ceases operation.

Transmit Audio Processor

The transmit audio processor provides audio pre-emphasis with amplitude limiting and post limiter filtering. A total gain of approximately 24 dB is realized through the transmit audio processor. The Synthesizer/Interconnect board performs the transmit audio processing in conjunction with the digital signal processor on the logic board.

The basic components of the transmit audio processor consist of U2513 (codec), U2609 (op-amp), and U2502 (counter). The logic board contains a program-masked digital signal processor which performs the necessary filtering, limiting, and tone generation.

Power for the transmit audio processor is derived from U2507 (+5V regulator), U2506 (-5V regulator) and P901-3 (8.5V CONT FLTRD).

Audio from the control unit (handset) is coupled to the audio processor through C2505 and arrives at the codec through R2532 and R2533. The codec performs the analog to digital-serial-data stream transformation for use by the digital signal processor on the logic board. After digital processing, the logic board sends a digital serial data stream to the codec (U2513) for digital to analog conversion. R2534 sets up the proper deviation for audio and tones. This audio is buffered by U2509-A and coupled to the FM ICOM through C2507 and R2664. The logic board performs the pre-emphasis filtering and amplitude limiting via the digital signal processor. The post limiter filtering occurs in U2513 and U2509.

Modulation Switch

The output of the transmit audio processor is also applied to the collector of modulation switch Q2607. In the transmit mode, Q2607 is turned off. This permits the audio output of the audio processor to be applied to the ICOM through receive frequency adjust control R2663 (simplex radio) or coupling capacitor C2676 (duplex radio) via jumper P2503 on connector J2503.

In the receive mode, Q2607 is turned on, which shunts any audio or tone from the transmit audio processor to ground, preventing modulation of the oscillator in the receive condition. R2663 (in simplex radio) is adjusted to offset the receive IF frequency by 6.25 kHz.

FM ICOM

FM ICOM U2603 is a crystal controlled Colpitts oscillator that operates in the third overtone mode. A simplified ICOM diagram is shown in Figure 2.

Frequency modulation is accomplished by applying an audio signal (from the audio processor) to varicap D2. The audio varies the voltage at D2 which also varies its capacitance. This produces a changing resonant frequency at or near the oscillator's resonant frequency to provide direct frequency modulation.

The ICOM contains two tunable coils. The coil labeled FREQ is tuned to the desired output frequency. The coil labeled LEVEL is tuned for maximum output power at the desired frequency. The output level is monitored at TP2603.

CAUTION

All ICOMs are individually frequency compensated at the factory and cannot be repaired in the field. Any attempt to repair or change an ICOM frequency will void the warranty.

Buffer Amplifier/Multiplier

The oscillator output frequency, approximately 122 MHz, is applied to buffer-amplifier Q2608 for isolation, and then through a tuned circuit consisting of L2611 and C2667 to multiplier stage Q2609. L2611 is tuned to the ICOM frequency of approximately 122 MHz.

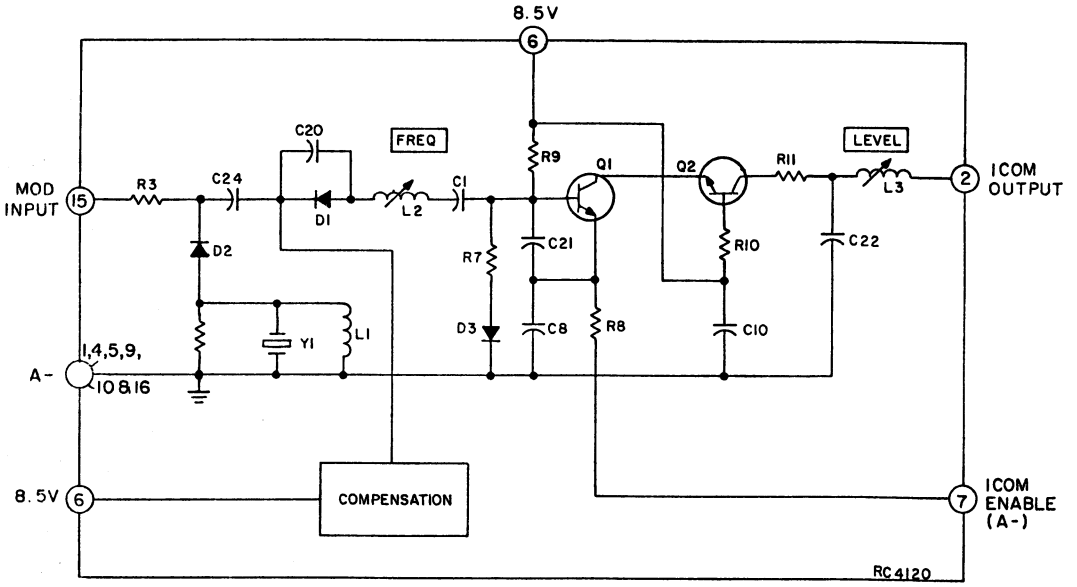

Figure 2 - FM ICOM

The output of multiplier Q2609 is tuned to the 3rd harmonic of the ICOM frequency, passed through three poles of filtering to remove spurious harmonics, and then applied to the transmit/receive board through P101. TP2604 is the monitoring point (typically 0.5 volts) when tuning the multiplier and filters of the injection chain. RF output applied to the Tx/Rx board is 1.0 dBm minimum.

Receive Audio Processor

The receive audio processor provides busy tone (standard and alternate) notch filtering, tone detection, tone generation and volume control.

The basic components of the receive audio processor consist of U2514 (codec), U2510 (op-amp), and U2502 (counter). The logic board contains a program-masked digital signal processor which performs the necessary filtering and tone generation.

Power for the receive audio processor is derived from U2507 (+5V regulator), and U2506 (-5V regulator).

Audio from the T/R board is coupled to the audio processor through C2511 and arrives at the codec through R2540 and R2554. The codec performs the analog to digital-serial-stream transformation for use by the digital signal processor on the logic board. After digital processing, the logic board sends a digital serial data stream to the codec (U2514) for digital to analog conversion. U2510-B provides buffer of VOL ARM to the T/R board. U2510-A provides de-emphasis filtering for the audio to the handset speaker. VOL ARM is de-emphasized on the T/R board. R2562, R2539, C2539 and C2512 provide the de-emphasis at U2510-A.

The input to the receive audio processor is derived from the T/R board (VOL SQ HI) or the sidetone cancellation circuit (U2511).

Binary Counter

The binary counter, U2502, generates the necessary timing for the transmit audio processor, receive audio processor and the logic board.

This device derives its clock input (8.192 MHz) from the logic board. Q1 is a divide-by-two of the clock input and each successive Q output is a divide-by-two of the previous stage.

The codecs require a 2.048 MHz master clock, a 128 kHz bit clock and an 8.0 kHz sampling clock. A 64 kHz clock is used to generate -5V power to the analog circuits. A 128 kHz serial clock is shipped to the logic board for serial transfers.

The binary counter is reset by the microcomputer on the logic board.

Sidetone Cancellation

The sidetone cancellation circuit used in duplex operation reduces the transmitted audio heard over the handset and external speakers. This sidetone is caused by transmitted audio modulation of the 2 PPM FM ICOM.

The transmit audio cancellation circuit consists of an audio delay circuit (U2511-A), level adjuster (R2549), and summer-amplifiier (U2511-B).

The transmitted audio (U2509-A) is applied to the audio time delay circuit at R241. The transmitted audio is delayed by an amount equal to that which exists between the output of U2509-A and the detected audio on VOL/SQ HI (680 + 100 uS. This time delay is determined by C2522, C2523, R2546 and R2542. The inverted output of U2511-A is applied to the summer-amplifier through sidetone cancelling control R2549.

The VOL/SQ HI line from the T/R board is routed through the audio cancellation circuit. Audio present on the VOL/SQ HI line consists of received and transmitted audio, and is summed with the delayed transmitted audio at the input to the summer-amplifier. R2549 is adjusted to cancel the transmitted audio on VOL/SQ HI. The resultant received audio at U2511-B is returned to 3-pin connector J2504.

P2504 jumpers either VOL/SQ HI (simplex radio) or the sidetone cancellation output (duplex radio) to the receive audio processor.

Power for the sidetone cancellation circuit is derived from U2508 (8.5V regulator).

Antenna Relay/Power Control Switch

Antenna relay switch Q2517 is turned on by PTT DYLD from the logic board when the radio is in the transmit mode. PTT DYLD is inverted by U2505-C. When the PTT switch is operated, PTT DYLD turns on Q2517 and applies A- to the antenna relay through J901-4 and to power control switch Q2516. The antenna relay in the T/R board picks up and 8.5V power is applied to the emitter of Q2516 and to P907-1 after a 20-25 msec delay determined by R2553 and C2526 to provide a transmitter attack time compatible with GE-MARC V and V E signalling.

Alarm Relay Control

Alarm relay control transistor, Q2518 is controlled by the microcomputer through U2501-15 (port 72). When an alarm condition exists, port 72 goes low, Q2510 turns off and Q2518 is turned on with A- applied to the customer supplied alarm relay through J910-5. Current required to operate the relay should not exceed 400 milliamperes.

5 Volt Regulator

The 5 Volt regulator, U901, receives switched A+ through J912-1 and supplies +5 Volt regulated power to the logic and Synthesizer/Interconnect boards. Diodes D902 and D903 provide reverse polarity protection for A+ and A+ SW.

8.5 Volt Regulator

The 8.5 Volt regulator, U2508, receives switched A+ through J912-1 and supplies 8.5 Volts to the sidetone cancellation circuit, the transmit audio processor (U2509), and 8.5V Tx and delayed 8.5V Tx to the T/R board.

+5.0 Volt Regulators

The +5 Volt regulator, U2507, receives switched A+ through J912-1 and supplies +5 Volt regulated power to the codecs (U2513, U2514) and the receive audio processor (U2510).

The -5 Volt regulator, U2506, receives power from the oscillator-inverter circuit (Q2512, Q2513) and supplies -5 Volt regulated power to the codecs (U2513, U2514), and the transmit and receive audio processors (U2509, U2510).

The oscillator-inverter obtains a 64 kHz TTL waveform from the binary counter (U2502). The output at the collectors of Q2512 and Q2513 is a 64 kHz waveform which swings from A- to A+. C2516, D2506, D2507, and C2517 are used to sink charge out of U2506-2 and maintain a negative voltage of approximately -11 Volts for a nominal 13.8V A+. U2506 regulates this negative voltage to -5 Volts.

Interconnect to Handset

The Synthesizer/Interconnect board routs signals to/from handset and logic for operator control functions. These include the serial communication data lines, hookswitch and push-to-talk.

The Synthesizer/Interconnect board also generates the earpiece audio and receives the microphone input from the handset.

Programmer TQ2310

The Classic II radio is able to interface with programmer, TQ2310, through connectors J910 and J911.

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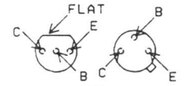
CAUTION

OBSERVE PRECAUTIONS FOR HANDLING

ELECTROSTATIC SENSITIVE DEVICES

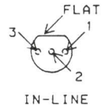
LEAD IDENTIFICATION
FOR Q2601,Q2602,Q2605,
Q2606,Q2607,Q2609,Q2501-
Q2508 & Q2510-Q2518



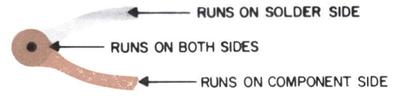
TOP VIEW

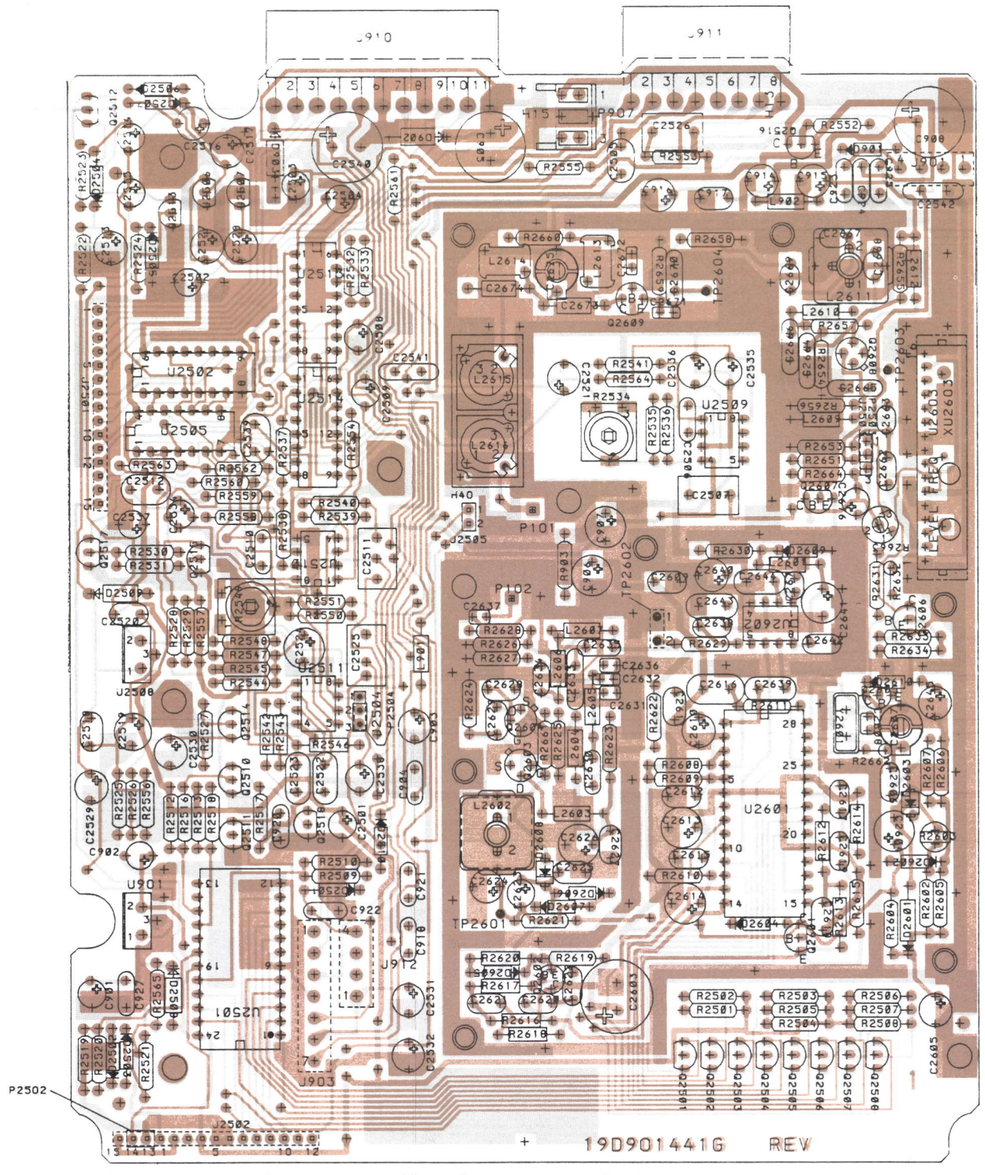
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION
FOR U2506 &U2507



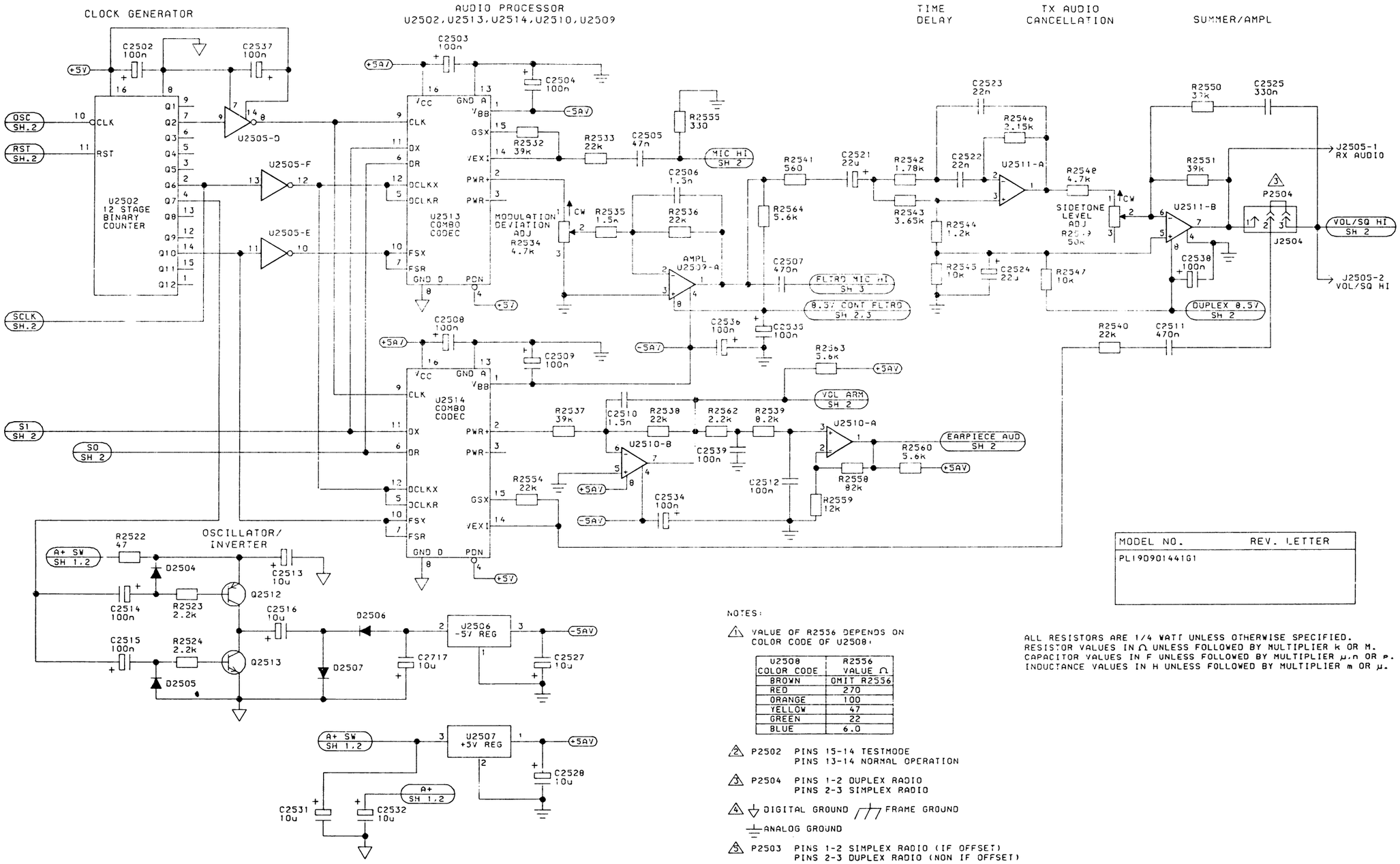
TOP VIEW





(19D901443, Sh. 1, Rev. 2)
(19A704262, Sh. 1, Rev. 1)
(19A704262, Sh. 2, Rev. 1)

OUTLINE DIAGRAM



MODEL NO.	REV. LETTER
PLI9D90144IG1	

NOTES:

1. VALUE OF R2536 DEPENDS ON COLOR CODE OF U2508:

U2508 COLOR CODE	R2536 VALUE Ω
BROWN	OMIT R2536
RED	270
ORANGE	100
YELLOW	47
GREEN	22
BLUE	6.0

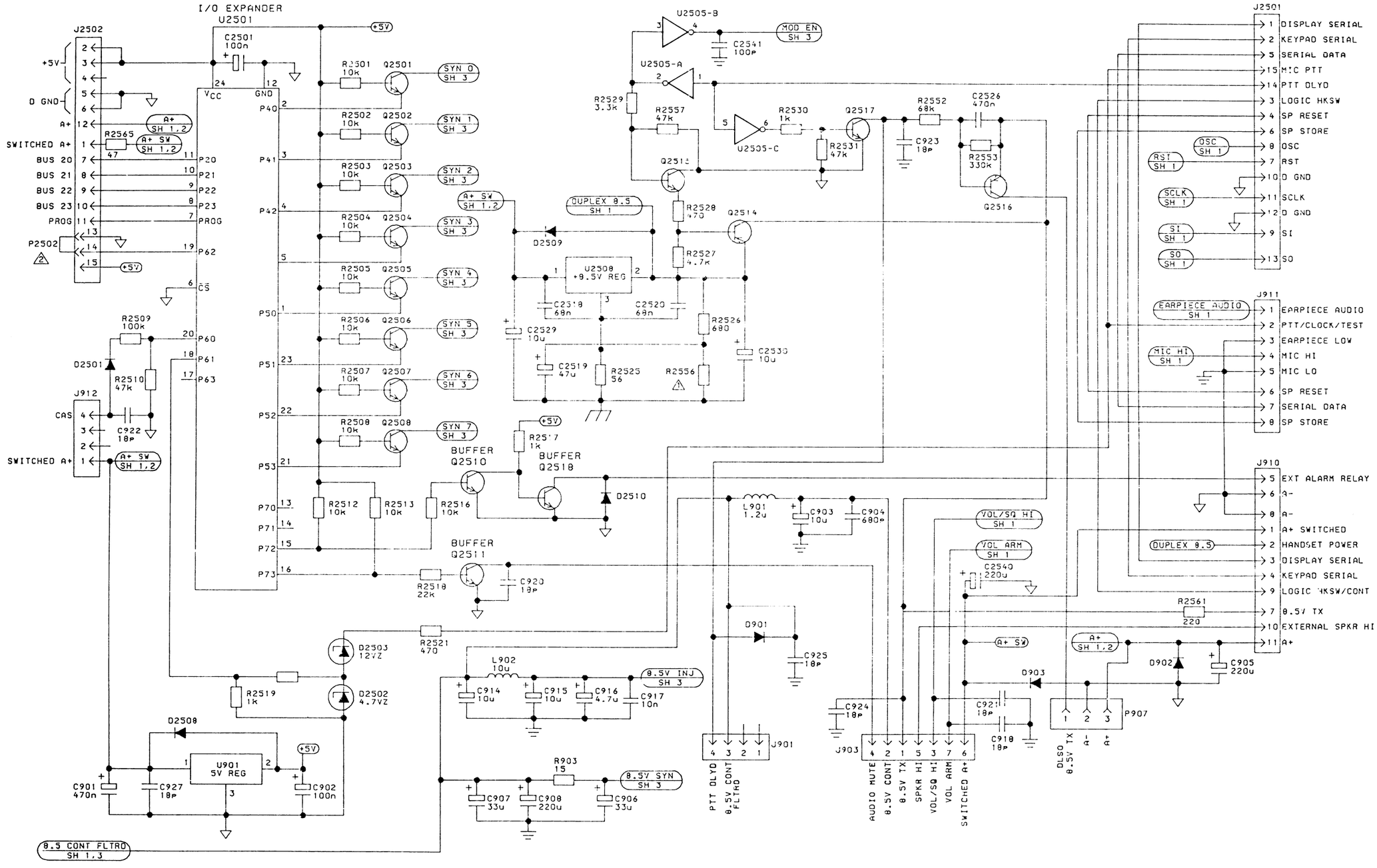
2. P2502 PINS 15-14 TESTMODE
   PINS 13-14 NORMAL OPERATION
3. P2504 PINS 1-2 DUPLEX RADIO
   PINS 2-3 SIMPLEX RADIO
4. DIGITAL GROUND, FRAME GROUND, ANALOG GROUND
5. P2503 PINS 1-2 SIMPLEX RADIO (IF OFFSET)
   PINS 2-3 DUPLEX RADIO (NON IF OFFSET)

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ,n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR µ.

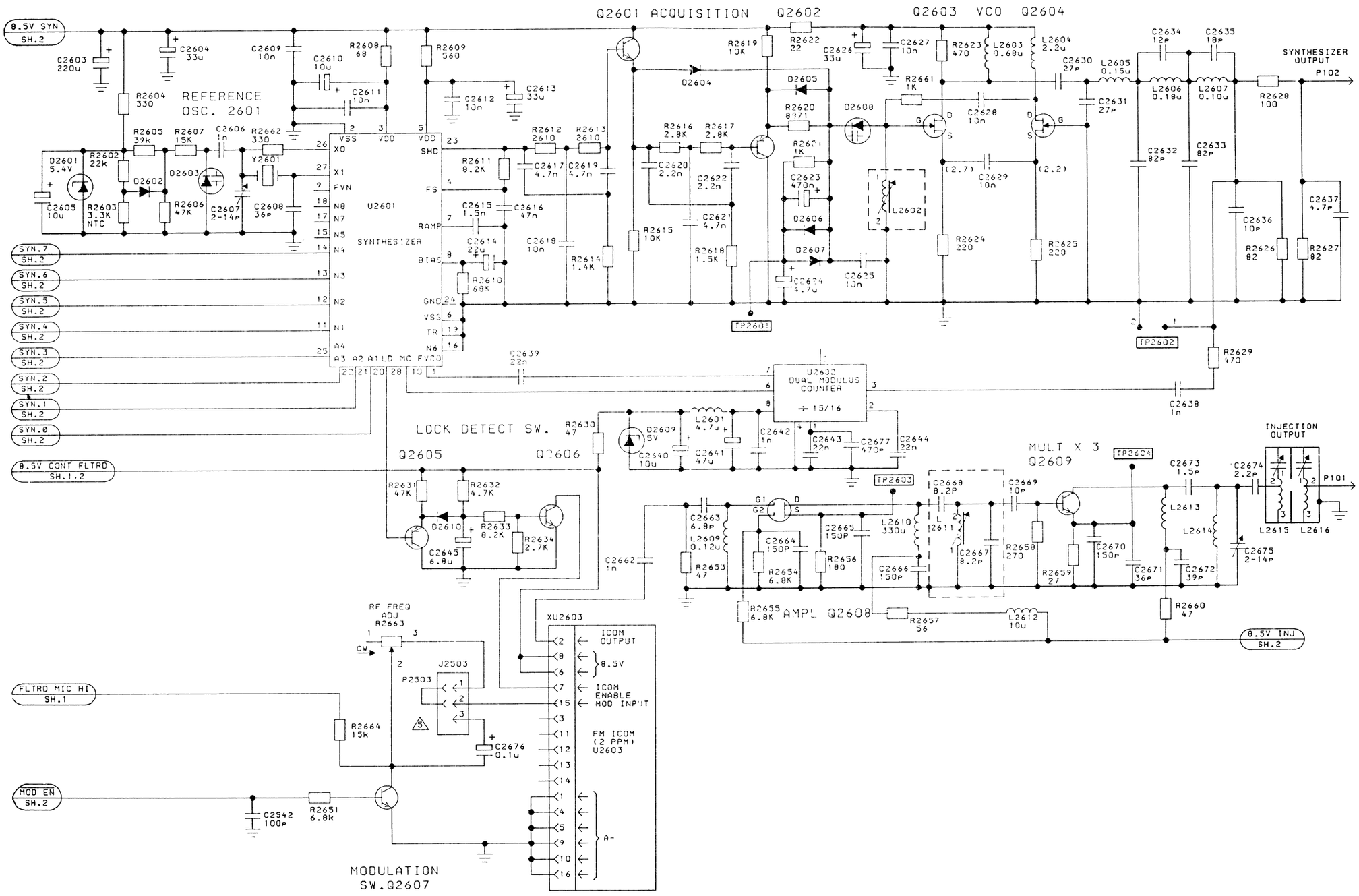
SCHEMATIC DIAGRAM

Synthesizer/Interconnect Board

(19D901425, Sh. 1, Rev. 3)



(19D901425, Sh. 2, Rev. 2)



SCHEMATIC DIAGRAM

Synthesizer/Interconnect Board

(19D901425, Sh. 3, Rev. 2)

PARTS LIST

SYNTHESIZER/INTERCONNECT BOARD
19D901441G1, G2

ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C901	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW.
C902	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C903	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C904	19A700233P6	Ceramic: 680 pF ±20%, 50 VDCW.
C905	19A703893P11	Electrolytic: 220 uF, -10% +50%, 25 VDCW.
C906 and C907	19A143486P5	Tantalum: 33 uF ±20%, 10 VDCW.
C908	19A703893P11	Electrolytic: 220 uF, -10% +50%, 25 VDCW.
C914 and C915	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C916	19A701534P6	Tantalum: 4.7 uF ±20%, 35 VDCW.
C917	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C918	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C920 thru C925	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C927	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C2501 thru C2504	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C2505	19A702250P111	Polyester: 047 uF ±10%, 50 VDCW.
C2506	19A700233P8	Ceramic: 1500 pF ±20%, 50 VDCW.
C2507	19A700004P6	Metallized polyester: 0.47 uF ±10%, 63 VDCW.
C2508 and C2509	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C2510	19A700233P8	Ceramic: 1500 pF ±20%, 50 VDCW.
C2511	19A700004P6	Metallized polyester: 0.47 uF ±10%, 63 VDCW.
C2512	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C2513	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2514 and C2515	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C2516 and C2517	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2518	19A700234P6	Polyester: 6800 pF ±10%, 50 VDCW.
C2519	19A703314P4	Electrolytic: 47 uF -10+50% tol, 16 VDCW; sim to Panasonic LS Series.
C2520	19A700234P6	Polyester: 6800 pF ±10%, 50 VDCW.
C2521	19A703314P5	Electrolytic: 22 uF -10+50% tol, 25 VDCW; sim to Panasonic LS Series.
C2522 and C2523	19A700234P9	Polyester: 0.022 uF ±10%, 50 VDCW.
C2524	19A701534P8	Tantalum: 0.47 uF ±20%, 35 VDCW.
C2525	19A700004P5	Metallized polyester: 0.33 uF ±10%, 63 VDCW.
C2526	19A700004P6	Metallized polyester: 0.47 uF ±10%, 63 VDCW.
C2527 thru C2532	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2533 thru C2535	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C2536	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2537 and C2538	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C2539	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW.
C2540	19A703893P11	Electrolytic: 220 uF, -10% +50%, 25 VDCW.
C2541 and C2542	19A700235P25	Ceramic: 100 pF ±5%, 50 VDCW.
C2603	19A703893P11	Electrolytic: 220 uF, -10% +50%, 25 VDCW.
C2604	19A143486P5	Tantalum: 33 uF ±20%, 10 VDCW.
C2605	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2606	19A700234P1	Polyester: 1000 pF ±10%, 50 VDCW.
C2607	19A700008P2	Variable: 2.28 to 14.13 pF; sim to EF Johnson 187-0109-005.
C2608	19A700225P48	Ceramic: 36 pF ±5%, 100 VDCW, temp coef -470 PPM.
C2609	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C2610 thru C2612	19A700534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2613	19A143486P5	Tantalum: 33 uF ±20%, 10 VDCW.
C2614	19A701534P8	Tantalum: 0.47 uF ±20%, 35 VDCW.
C2615	19A700234P2	Polyester: 1500 pF ±10%, 50 VDCW.
C2616	19A700234P11	Polyester: 0.047 uF ±10%, 50 VDCW.
C2617	19A700234P5	Polyester: 4700 pF ±10%, 50 VDCW.
C2618	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C2619	19A700234P5	Polyester: 4700 pF ±10%, 50 VDCW.
C2620	19A700234P3	Polyester: 2200 pF ±10%, 50 VDCW.
C2621	19A700234P5	Polyester: 4700 pF ±10%, 50 VDCW.
C2622	19A700234P3	Polyester: 2200 pF ±10%, 50 VDCW.
C2623	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW.
C2624	19A701534P6	Tantalum: 4.7 uF ±20%, 35 VDCW.
C2625	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C2626	19A143486P5	Tantalum: 33 uF ±20%, 10 VDCW.
C2627 thru C2629	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C2630	19A700235P18	Ceramic, disc: 27 pF ±5%, 50 VDCW.
C2631	19A700224P44	Ceramic: 27 pF ±5%, 100 VDCW.
C2632	19A700224P62	Ceramic: 82 pF ±5%, 100 VDCW.
C2633	19A700235P24	Ceramic: 82 pF ±5%, 50 VDCW.
C2634	19A700235P14	Ceramic, disc: 12 pF ±5%, 50 VDCW.
C2635	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C2636	19A700219P26	Ceramic: 10 pF ±5%, 100 VDCW, temp coef 0 PPM.
C2637	19A700219P18	Ceramic: 4.7 pF ±5%, 100 VDCW, temp coef 0 PPM.
C2638	19A700234P1	Polyester: 1000 pF ±10%, 50 VDCW.
C2639	19A700234P9	Polyester: 0.022 uF ±10%, 50 VDCW.
C2640	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C2641	19A701534P9	Tantalum: 47 uF ±20%, 6.3 VDCW.
C2642	19A700234P1	Polyester: 1000 pF ±10%, 50 VDCW.
C2643 and C2644	19A700234P9	Polyester: 0.022 uF ±10%, 50 VDCW.
C2645	19A701534P16	Tantalum: 6.8 uF ±20%, 35 VDCW.
C2662	19A700234P1	Polyester: 1000 pF ±10%, 50 VDCW.
C2663	19A700235P11	Ceramic: 6.8 pF ±0.25 pF, 50 VDCW, temp coef N150 PPM.
C2664 thru C2666	19A700235P27	Ceramic: 150 pF ±5%, 50 VDCW.
C2667 and C2668	19A700235P12	Ceramic: 8.2 pF ±0.25 pF, 50 VDCW.
C2669	19A700235P13	Ceramic: 10 pF ±5%, 50 VDCW.
C2670	19A700235P27	Ceramic: 150 pF ±5%, 50 VDCW.
C2671	19A700219P48	Ceramic: 36 pF ±5%, 100 VDCW.
C2672	19A700219P50	Ceramic: 39 pF ±5%, 100 VDCW, temp coef 0 PPM.
C2673	19A700013P15	Phenolic: 1.50 pF ±5%, 500 VDCW.
C2674	19A700013P17	Phenolic: 2.2 pF ±5%, 500 VDCW.
C2675	19A700008P2	Variable: 2.28 to 14.13 pF; sim to EF Johnson 187-0109-005.
C2676	19A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.
C2677	19A700121P7	Ceramic: 470 pF ±20%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D901	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D902 and D903	19A704142P1	Rectifier, silicon; general purpose.
D2501	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2502	19A700025P5	Silicon, zener: 400 mW max; sim to BZX55-C4V7.
D2503	19A700025P11	Silicon, zener: 400 mW max; sim to BZX55-C12.
D2504 thru D2507	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2508 and D2509	19A704142P1	Rectifier, silicon; general purpose.
D2510	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2601	4036887P5	Zener: 500 mW, 5.4 v. nominal.
D2602	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2603	19A700073P1	Silicon; sim to BB409.
D2604	19A700047P2	Silicon, 100 mW, continuous dissipation; sim to DO-15.
D2605	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D2606 and D2607	19A700047P2	Silicon, 100 mW, continuous dissipation; sim to DO-15.
D2608	19A700073P1	Silicon; sim to BB409.
D2609	19A700025P6	Silicon, zener: 400 mW max; sim to BZX55-C5V1.
D2610	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J901	19J706214P4	Connector: 4 contacts rated @ 7 amps; sim to Molex 09-67-1042.
J903	19J706214P7	Flat wafer: 7 contacts rated @ 7 amps; sim to Molex 09-67-1072.
J910	19A116659P151	Connector, printed wiring: sim to Molex 09-75-1111.
J911	19A116659P145	Connector, printed wiring: sim to Molex 09-75-1081.
J912	19J706214P4	Connector: 4 contacts rated @ 7 amps; sim to Molex 09-67-1042.
J2501 and J2502	19A703248P5	Contact, electrical.
J2503 and J2504	19A700072P2	Printed wire: 3 contacts rated @ 2.5 amps; sim to Molex 22-03-2031.
J2505	19A700072P1	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L901	19A700024P14	Coil, RF: 1.2 uH ±10%.
L902	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L2601	19A700024P2	Coil, RF: 120 nH ±10%.
L2602	19A134729P3	Coil, RF: Freq, variable, wire size 24 SP AWG.
L2603	19A700024P11	Coil, RF: 680 nH ±10%.
L2604	19A700024P17	Coil, RF: 2.2 uH ±10%.
L2605	19A700024P3	Coil, RF: 1.0 uH ±10%.
L2606	19A700024P4	Coil, RF: 180 nH ±10%.
L2607	19A700024P1	Coil, RF: 100 nH ±10%, 0.08 ohms DC res max, 100 v.
L2609	19A700024P2	Coil, RF: 120 nH ±10%.
L2610	19A700024P7	Coil, RF: 330 nH ±10%.
L2611	19J706083P22	Coil, RF: freq, variable.
L2612	19A700024P25	Coil, RF: 10.0 uH ±10%, 3.70 ohms DC res max.
L2613	19J706085P2	Coil, RF: sim to Paul Smith LM-2.
L2614	19J706085P7	Coil, choke: 0.018 uH ±30%; sim to Paul Smith LM2.
L2615 and L2616	19J706154P11	RF Coil: sim to Paul Smith SK802-1.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P101 and P102	19A701785P3	Contact, electrical.
P907	19A700102P10	Printed wire: 3 contacts; sim to Molex 09-52-3032.
P2502 thru P2503	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; sim to Berg 65474-002.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - - -
Q2501 thru Q2508	19A700023P2	Silicon, NPN: sim to 2N3904.
Q2510 thru Q2513	19A700023P2	Silicon, NPN: sim to 2N3904.
Q2514	19A702504P2	Silicon, PNP; sim to 2N4403.
Q2515	19A700023P2	Silicon, NPN: sim to 2N3904.
Q2516	19A700022P2	Silicon, PNP: sim to 2N3906.
Q2517 and Q2518	19A702503P2	Silicon, NPN.
Q2601	19A700023P2	Silicon, NPN: sim to 2N3904.
Q2602	19A700022P2	Silicon, PNP: sim to 2N3906.
Q2603 and Q2604	19A700060P1	N-Type, field effect.
Q2605	19A700022P2	Silicon, PNP: sim to 2N3906.
Q2606 and Q2607	19A700023P2	Silicon, NPN: sim to 2N3904.
Q2608	19A700075P1	N-CHANNEL, field effect. (MOS DUAL GATE).
Q2609	19A116201P3	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R903	19A700019P15	Deposited carbon: 15 ohms ±5%, 1/4 w.
R2501 thru R2508	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2509	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R2510	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2512 and R2513	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2516	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2517	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R2518	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2519	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2520	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2521	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R2522	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2523 and R2524	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R2525	19A700019P22	Deposited carbon: 56 ohms ±5%, 1/4 w.
R2526	19A700019P35	Deposited carbon: 680 ohms ±5%, 1/4 w.
R2527	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R2528	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R2529	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R2530	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2531	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2532	19A700019P56	Deposited carbon: 39K ohms ±5%, 1/4 w.
R2533	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2534	19A700185P3	Variable: 5000 ohms +20%, temp coef -450+150 PPM, 1/3 w; sim to CTS Series 268.
R2535	19A700019P39	Deposited carbon: 1.5K ohms ±5%, 1/4 w.
R2536	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2537	19A700019P56	Deposited carbon: 39K ohms ±5%, 1/4 w.
R2538	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2539	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 1/4 w.
R2540	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2541	19A700019P34	Deposited carbon: 560 ohms ±5%, 1/4 w.
R2542 and R2543	19A701250P225	Metal film: 1780 ohms ±1%, 1/4 w.
R2544	19A700019P38	Deposited carbon: 1.2K ohms ±5%, 1/4 w.
R2545	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2546	19A701250P233	Metal film: 2.15K ohms ±1%, 1/4 w.
R2547	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2548	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R2549	19A700185P6	Variable: 50K ohms ±20%, 1/3 w.
R2550 and R2551	19A700019P56	Deposited carbon: 39K ohms ±5%, 1/4 w.
R2552	19A700019P59	Deposited carbon: 68K ohms ±5%, 1/4 w.
R2553	19A700019P67	Deposited carbon: 0.33M ohms ±5%, 1/4 w.
R2554	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.
R2555	19A700019P31	Deposited carbon: 330 ohms ±5%, 1/4 w.
R2556A	19A700019P30	Deposited carbon: 270 ohms ±5%, 1/4 w.
R2556B	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R2556C	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2556D	19A700019P17	Deposited carbon: 22 ohms ±5%, 1/4 w.
R2556E	19A700019P11	Deposited carbon: 6.8 ohms ±5%, 1/4 w.
R2557	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2558	19A700019P60	Deposited carbon: 82K ohms ±5%, 1/4 w.
R2559	19A700019P50	Deposited carbon: 12K ohms ±5%, 1/4 w.
R2560	19A700019P46	Deposited carbon: 5.6K ohms ±5%, 1/4 w.
R2561	19A700019P29	Deposited carbon: 220 ohms ±5%, 1/4 w.
R2562	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R2563 and R2564	19A700019P46	Deposited carbon: 5.6K ohms ±5%, 1/4 w.
R2565	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2602	19A700019P53	Deposited carbon: 22K ohms ±5%, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
R2603	19A701828P1	Thermistor: 3.3K ohms ±5%; sim to Philips 2322-642-63332/
R2604	19A700019P31	Deposited carbon: 330 ohms ±5%, 1/4 w.
R2605	19A700019P56	Deposited carbon: 39K ohms ±5%, 1/4 w.
R2606	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2607	19A700019P51	Deposited carbon: 15K ohms ±5%, 1/4 w.
R2608	19A700019P23	Deposited carbon: 68 ohms ±5%, 1/4 w.
R2609	19A700019P34	Deposited carbon: 560 ohms ±5%, 1/4 w.
R2610	19A700019P59	Deposited carbon: 68K ohms ±5%, 1/4 w.
R2611	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 1/4 w.
R2612 and R2613	19A701250P241	Metal film: 2610 ohms ±1%, 1/4 w.
R2614	19A701250P215	Metal film: 1400 ohms ±1%, 1/4 w.
R2615	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2616 and R2617	19A701250P244	Metal film: 2.8K ohms ±1%, 1/4 w.
R2618	19A701250P218	Metal film: 1.5K ohms ±1%, 1/4 w.
R2619	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2620	19A701250P292	Metal film: 8870 ohms ±1%, 1/4 w.
R2621	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2622	19A700019P17	Deposited carbon: 22 ohms ±5%, 1/4 w.
R2623	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R2624 and R2625	19A700019P29	Deposited carbon: 220 ohms ±5%, 1/4 w.
R2626 and R2627	19A700019P24	Deposited carbon: 82 ohms ±5%, 1/4 w.
R2628	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R2629	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R2630	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2631	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R2632	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R2633	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 1/4 w.
R2634	19A700019P42	Deposited carbon: 2.7K ohms ±5%, 1/4 w.
R2651	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 1/4 w.
R2653	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2654 and R2655	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 1/4 w.
R2656	19A700019P28	Deposited carbon: 180 ohms ±5%, 1/4 w.
R2657	19A700019P22	Deposited carbon: 56 ohms ±5%, 1/4 w.
R2658	19A700019P30	Deposited carbon: 270 ohms ±5%, 1/4 w.
R2659	19A700019P18	Deposited carbon: 27 ohms ±5%, 1/4 w.
R2660	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R2661	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R2662	19A700019P31	Deposited carbon: 330 ohms ±5%, 1/4 w.
R2663	19A700016P7	Variable, cermet: 10K to 100K ohms ±10%, 1/2 w.
R2664	19A700019P51	Deposited carbon: 15K ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP2601	19A700152P1	Contact.
TP2602	19A700152P1	Contact. (Quantity 2).
TP2603 and TP2604	19A700152P1	Contact.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U901	19A134717P1	4K PROGRAMMED MEMORY.
U2501	19A703862P1	Digital: I/O EXPANDER.

SYMBOL	GE PART NO.	DESCRIPTION
U2502	19A703987P1	Digital Logic. (HIGH SPEED CMOS COUNTERS).
U2505	19A700037P313	Digital: HEX SCHMITT-TRIGGER INVERTER.
U2506	19A704013P1	Voltage Regulator. (NEGATIVE). Sim to MC97L05CP.
U2507	19J706031P1	Linear: POSITIVE VOLTAGE REGULATOR.
U2508	19A138414G1	Regulator: 8.5 V.
U2509 thru U2511	19A701789P2	DUAL OP AMP; sim to LM358.
U2513 and U2514	19A703924P1	Encoder-Decoder. Sim to Intel 2916.
U2601	19B800726P1	Custom CMOS Synthesizer.
U2602	19A700107P1	Custom, Dual In-Line 8-Pin Mini-Dip Package.
U2603	19A701712G10	Oscillator. 820-825 MHz. 2 PPM. (AUSTRALIA).
	19A701712G11	Oscillator. 811-816 MHz. 2 PPM. (USA-2).
	19A701712G12	Oscillator. 816-820 MHz. 2 PPM. (USA-1).
	19A701712G13	Oscillator. 806-811 MHz. 2 PPM. (USA-3).
	19A701712G14	Oscillator. 811-816 MHz. 2 PPM. (MEXICO).
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XU2603	19D900097P1	Connector: 16 terminals.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y2601	19A701565G1	Crystal unit, Quartz: 12.800 MHz at 25°C, temp range -30°C to +75 °C.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C850619G2	Casting.
	19A700069P1	Can. (Used with L2602 & L2611).
	19A702364P106	Machine screw: TORX Drive, No. M2 - 0.4 x 6. (Secures L2615, L2616 Casting).
	19A138451P1	Tuning slug. (Used with L2615 & L2616).
	19A701886P1	Spring. (Used with L2615 & L2616).
	19A701538P1	Gasket. (Located under L2616).
	19A701400P1	Insulated spacer. (Used with P101).