

COMPUTER :

TEXAS INSTRUMENTS TI-99/4A™

Model PHC004A



TECHNICAL SERVICE DATA FOR YOUR COMPUTER

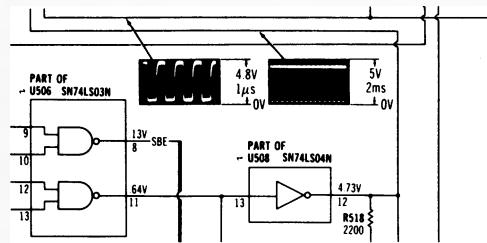


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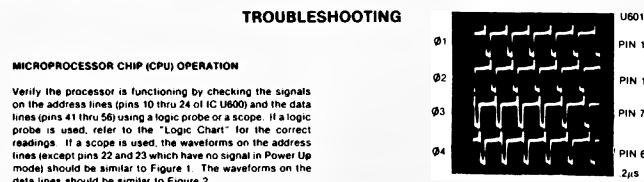
COMPUTERFACTS™ put easy to use, informative technical data right at your fingertips. Each edition includes specific service information on the individual component, along with some overall troubleshooting hints.

The following information is just a sample of the many valuable time saving features contained in this exclusive Sams COMPUTERFACTS publication:

- Preliminary Service Checks section is an easy to use, step by step guide for the experienced technician or hobbyist, and even beginners.
- SAMS famous industry accepted standardized notation schematics containing CIRCUITRACE®, GRIDTRACE,™ waveforms, voltages and stage identification.



- Step by Step Troubleshooting guides the technician through the necessary procedures to quickly locate the problem.

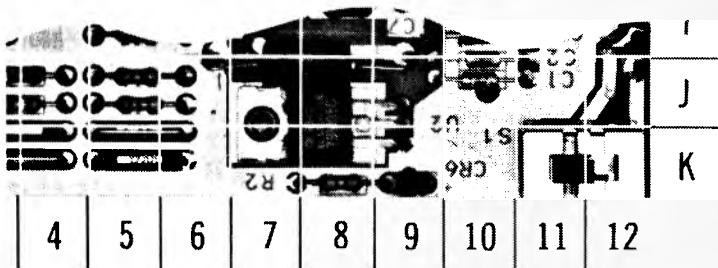


- Complete Components Parts List in an easy to use format with field replacements shown when possible. SAMS unique semiconductor, chip and IC cross-reference gives you many replacements to choose from and is available at your Electronic Distributor.

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA						
			ECG PART No.	GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NTE PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.
D102	1SS55	1149-2576	ECG519	GE-514	IN4935	NTE519	SK9091/177	WEP925/519	103-131
D103	1NG0FM	1149-2527	ECG109	IN60	NTE109	SK5088	WEP134/109	103-29001	
D201	1N4004GP	1201-4205	ECG116	GE-504A	IN4004	NTE116	SK5312	WEP157	212-76-02
D501 thru D503	1SS55	1149-2576	ECG519	GE-514	IN4935	NTE519	SK9091/177	WEP925/519	103-131

- Quick Component Location using the SAMS exclusive GRIDTRACE, CIRCUITRACE, and component photographs.



- Logic Chart containing logic probe readings to isolate defective circuitry and components.

LOGIC

PIN NO.	IC U100	PIN NO.	IC U100	PIN NO.	IC U102	IC U103	IC U104	IC U105	IC U106	IC U107	IC U108	IC U109
1	P	21	P	1	L	L	L	L	L	L	L	L
2	P	22	P	2	P	P	P	P	P	P	P	P
3	P	23	P	3	H	H	H	H	H	H	H	H

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TI-99/4A is a trademark of Texas Instruments, Inc.

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4300 West 62nd Street, Indianapolis, Indiana 46268

PRELIMINARY SERVICE CHECKS

This data provides the user with a time-saving service tool which is designed for quick isolation and repair of computer malfunctions.

Check all interconnecting cables for good connection and correct hook-up before making service checks.

Disconnect all peripherals except the monitor from the computer to eliminate possible external malfunctions.

Replacement or repair of the power supply board, RF modulator, keyboard, or connectors may be necessary after the malfunction has been isolated.

GENERAL OPERATING INSTRUCTIONS

POWER UP

When the computer is turned On, the main title screen will be displayed on the monitor. Press any key and a menu will be displayed.

The menu choices will be determined by the Solid State Cartridge used. Turn the computer Off when inserting or removing a Solid State Cartridge. Refer to the menu and press the key for the desired function.

For instructions to load and save programs on cassette tape, refer to "Cassette Operation". Run a basic program by typing RUN and press the ENTER key. Stop a program by holding down the FCTN key and press the number 4 key. The computer will return to the basic mode and the program will be unaffected. Reset the computer by holding down the FCTN key and press the = key. The computer will return to the main title screen and any program in memory will be lost.

CASSETTE OPERATION

Connect the cassette cable to the cassette plug on the rear of the computer. Connect the plug with the red wire to the Mic input on the recorder, the plug with the white wire to the Earphone output on the recorder and the plug with the black wire to the Remote input on the recorder.

NOTE: The remote control may not work on some recorders.

Set the Tone control on the recorder to Maximum and the volume control to mid-range. Verify the ALPHA LOCK key, on the computer, is in the down position and put the computer in BASIC mode.

Save a program by typing SAVE CS1, press the ENTER key and follow the instructions that appear on the monitor screen.

Load a program by typing OLD CS1, press the ENTER key and follow the instructions that appear on the monitor screen. If a program will not load, set the Volume control to a different level and try loading the program again.

When using two recorders, the recorder connected to the three plug section of the cable will be CS1 and the recorder connected to the two plug section will be CS2. CS2 can be used for saving programs or data only. Save a program on CS2 by typing SAVE CS2, press the ENTER key and follow the instructions that appear on the monitor.

SAMS Howard W. Sams & Co., Inc.
TM 4300 West 62nd Street, P.O. Box 7092, Indianapolis, Indiana 46206 U.S.A.

The listing of any available replacement part herein does not constitute in any case a recommendation, warranty or guarantee by Howard W. Sams & Co., Inc., as to the quality and suitability of such replacement part. The numbers of these parts have been compiled from information furnished to Howard W. Sams & Co., Inc., by the manufacturers of the particular type of replacement part listed.

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PRELIMINARY SERVICE CHECKS (Continued)

SERVICE CHECKS

SEE INTERCONNECTING DIAGRAM, PLACEMENT CHART, AND PHOTOS TO MATCH THE NUMBER IN THE CIRCLES WITH THOSE IN THE FOLLOWING DATA FOR SERVICE CHECKS TO BE PERFORMED.

① RF MODULATOR

- (a) Power computer and verify the power indicator LED is lit. NOTE: If the power indicator LED is not lit, refer to the "Power Supply Check" section.
- (b) Verify the channel select switch is on the same channel as the monitor, channel 3 or 4.
- (c) Verify the TV/modulator switch is in modulator position.
- (d) Check for bad connections and improper hook-up at the monitor and at the computer.
- (e) If the computer still does not come up when powered, check the RF Modulator by substitution.

② POWER SUPPLY

- (a) Power computer and measure the AC voltages, from the secondary of the Power Transformer (T1), on the power supply board. If there is no AC voltage, replace AC adaptor.
- (b) Disconnect P2 from power supply board. Measure the DC voltages at P2.
- (c) Measure the Regulator B + voltage (21.5V) at L6. If the voltages are not present or are incorrect, replace or repair the power supply board.

③ MAIN BOARD

- (a) Computer does not come up when powered. Check for -5.15V at pin 1, 5.14V at pins 2, 33, 59 and 64, and 11.84V at pin 27 of the Microprocessor IC U600. Verify the Timing Generator is functioning, by checking for pulses on pins 8, 9, 25, and 28 of the Microprocessor IC U600 using a logic probe.

(b) No sound, substitute the Sound Generator IC U511.

(c) Video problems, substitute the Color Graphics Video Display IC U100.

(d) Monitor remains blank when the computer is turned On. Substitute a monitor known to be good. Substitute GROM IC U500 and Video IC U100.

(e) Monitor displays insert cartridge after pressing the number 1 key. Substitute GROM IC U501.

(f) If there is no line feed when pressing the ENTER key, substitute GROM IC U502.

(g) Remote control line will not turn on CS1. Remove power to computer and check the resistance from the emitter to collector of Q401. The resistance should read low during the time the recorder is suppose to be running and open when not running. If these readings are correct check the cassette recorder.

(h) Check the resistance reading from the emitter to collector of Q403 if CS2 will not turn On.

(i) Keyboard fails to function. Disconnect the keyboard connector P100. Power computer and check the voltage and logic readings at J100. If the readings are correct, check the keyboard.

④ KEYBOARD

Substitute the keyboard or locate the bad key and clean the key switch with switch cleaner.

TEST EQUIPMENT AND TOOLS

TEST EQUIPMENT

Digital Volt/Ohm Meter
Logic Probe

TOOLS

Phillips Screwdriver
Small Screwdriver
Soldering Iron
Switch Cleaner

REPLACEMENT PARTS

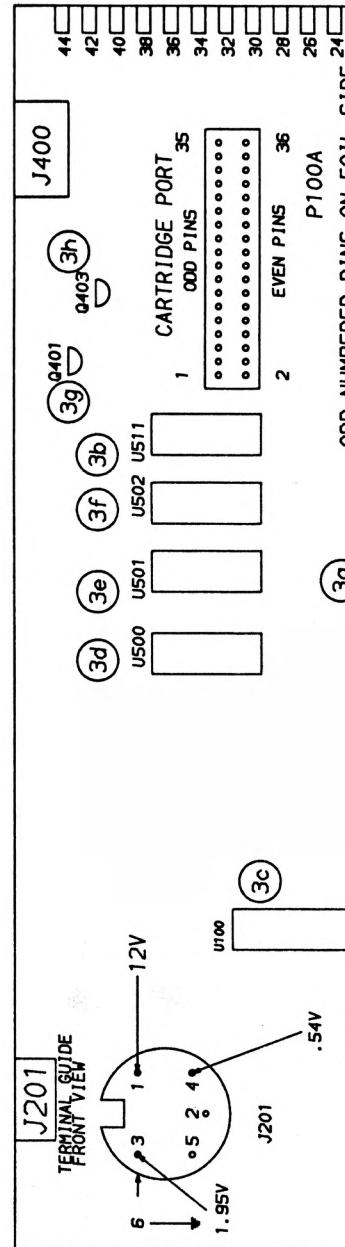
AC Adaptor Model AC9500

IC	TYPE NO.
U100	TMS9918A
U500	CD2155NL
U501	CD2156NL
U502	CD2157NL
U511	SN94624N

PRELIMINARY SERVICE CHECKS (Continued)

CASSETTE

1 → RF MODULATOR



MAIN BOARD

3

ODD NUMBERED PINS ON FOIL SIDE

I/O PORT

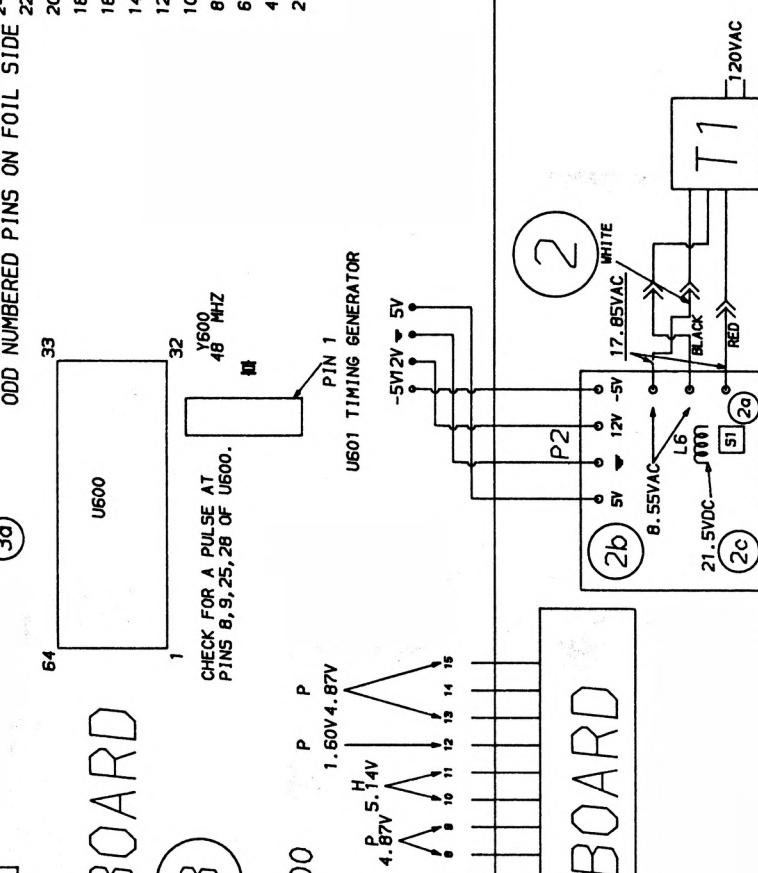
MEASUREMENTS TAKEN IN POWER-UP MODE
WITH A DIGITAL VOLTMETER

		P100A	
1	H	5.14V	L
2	L	.13V	24
3	H	4.50V	25
4	L	5.13V	P
5	P	.33V	3.84V
6	P	2.66V	L
7	P	.66V	28
8	P	1.58V	H
9	P	1.58V	2.81V
10	P	1.58V	L
11	P	.47V	32
12	P	2.02V	P
13	H	4.88V	34
14	P	5.13V	35
15	P	2.21V	P
16	P	1.32V	36
17	P	2.42V	37
18	P	2.65V	P
19	P	2.73V	40
20	L	1.98V	P
21	L	.09V	42
22	P	4.00V	L

LOGIC PROBE DISPLAY
L=LOW
H=HIGH
P=PULSE

POWER SUPPLY BOARD

J300



TERMINAL GUIDE
PIN VIEW
FRONT VIEW
1 2 3 4 5
6 5 2 4
3 2 1

INTERCONNECTING DIAGRAM

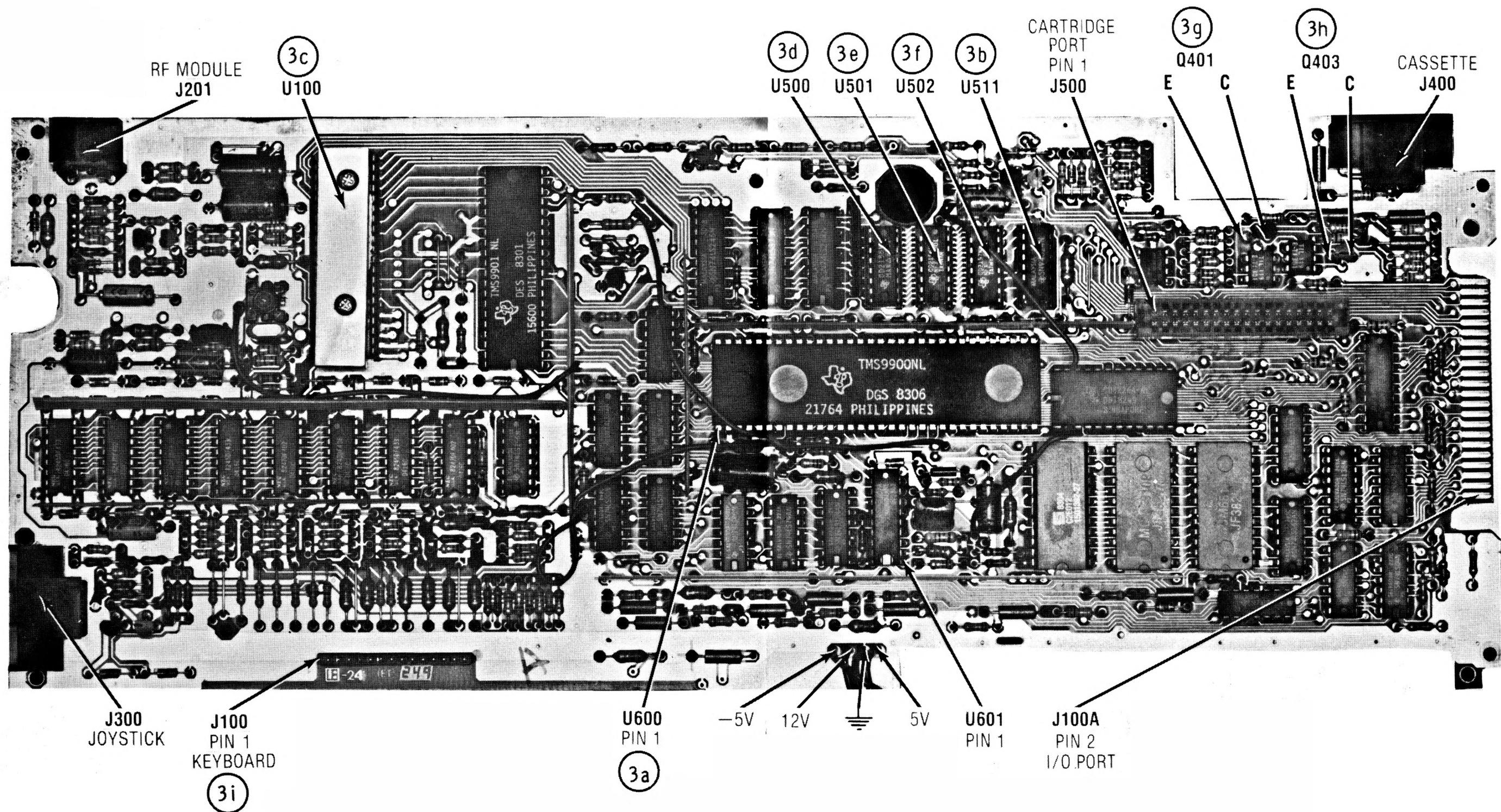
COMPUTERFACTS-OF-THE-MONTH SET NO. CF1 FOLDER CC 2

III

CC 2
TI-99/4A MODEL PHC004A
TEXAS INSTRUMENTS

PRELIMINARY SERVICE CHECKS (Continued)

PRELIMINARY SERVICE CHECKS (Continued)



PRELIMINARY SERVICE CHECKS (Continued)

DISASSEMBLY INSTRUCTIONS

CABINET BOTTOM REMOVAL

Remove the On-Off knob. Remove Phillips screws 1 thru 7 (See Figure 1) from the bottom and remove the cabinet bottom.

POWER SUPPLY BOARD REMOVAL

Remove Phillips screws 7 and 8 (See Figure 2) from the power supply board. Lift the board up, unplug the cable going to the main board and remove the power supply board.

MAIN BOARD REMOVAL

Remove Phillips screws 1, 2 and 3 (See Figure 2) holding the main board. Lift up the main board, unplug the keyboard and remove the main board.

To remove the shield, remove the two metal clamps (See Figure 2) and unplug the cartridge plug. Remove Phillips screws and nuts 4, 5 and 6 (See Figure 2) and remove the top and bottom shield.

KEYBOARD REMOVAL

Remove Phillips screws 9 thru 12 (See Figure 2) holding the keyboard. Unplug the keyboard from the main board and remove the keyboard.

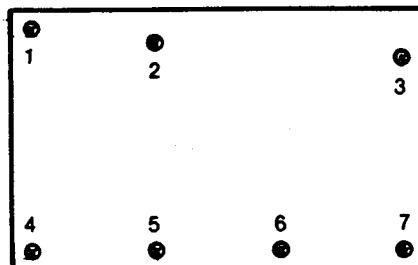


Figure 1
BOTTOM VIEW

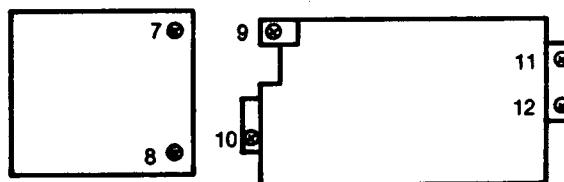
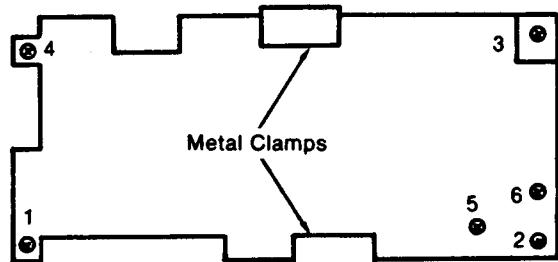
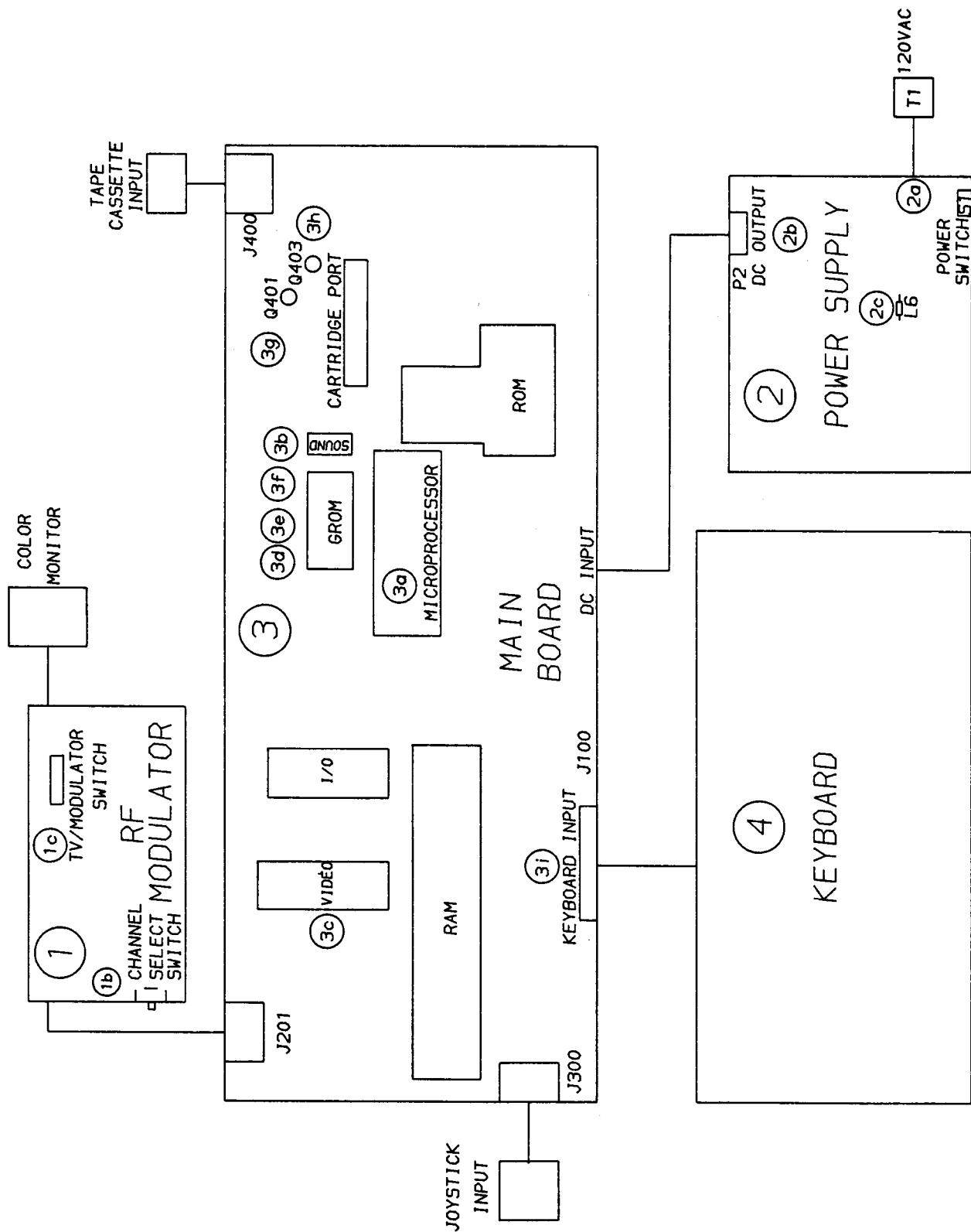


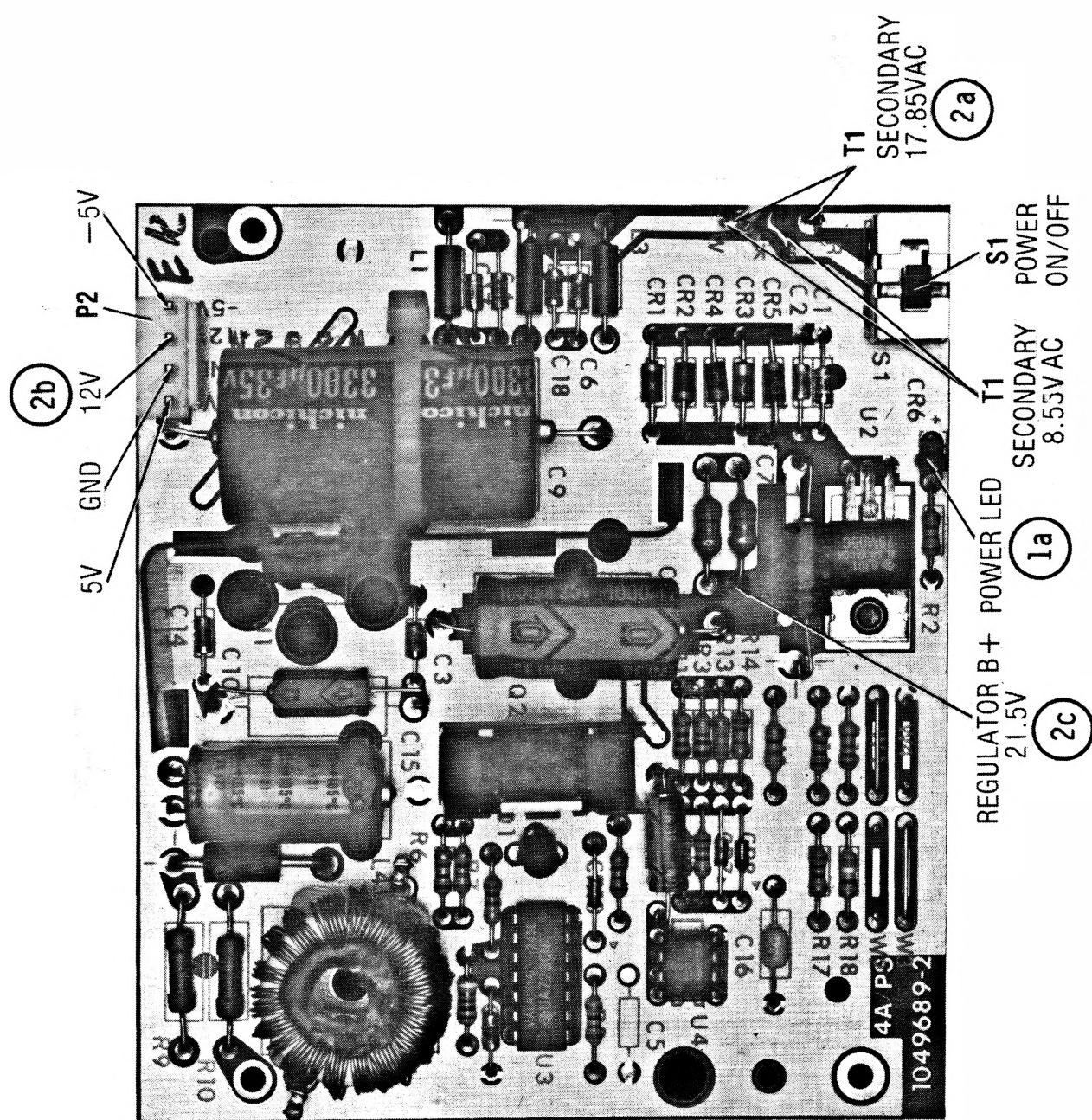
Figure 2
BOTTOM VIEW

PRELIMINARY SERVICE CHECKS (Continued)



PLACEMENT CHART

PRELIMINARY SERVICE CHECKS (Continued)



POWER SUPPLY BOARD



TI-99/4A MODEL PHC004A

PRELIMINARY SERVICE CHECKS

ENCLOSED

SAFETY PRECAUTIONS

See page 13.

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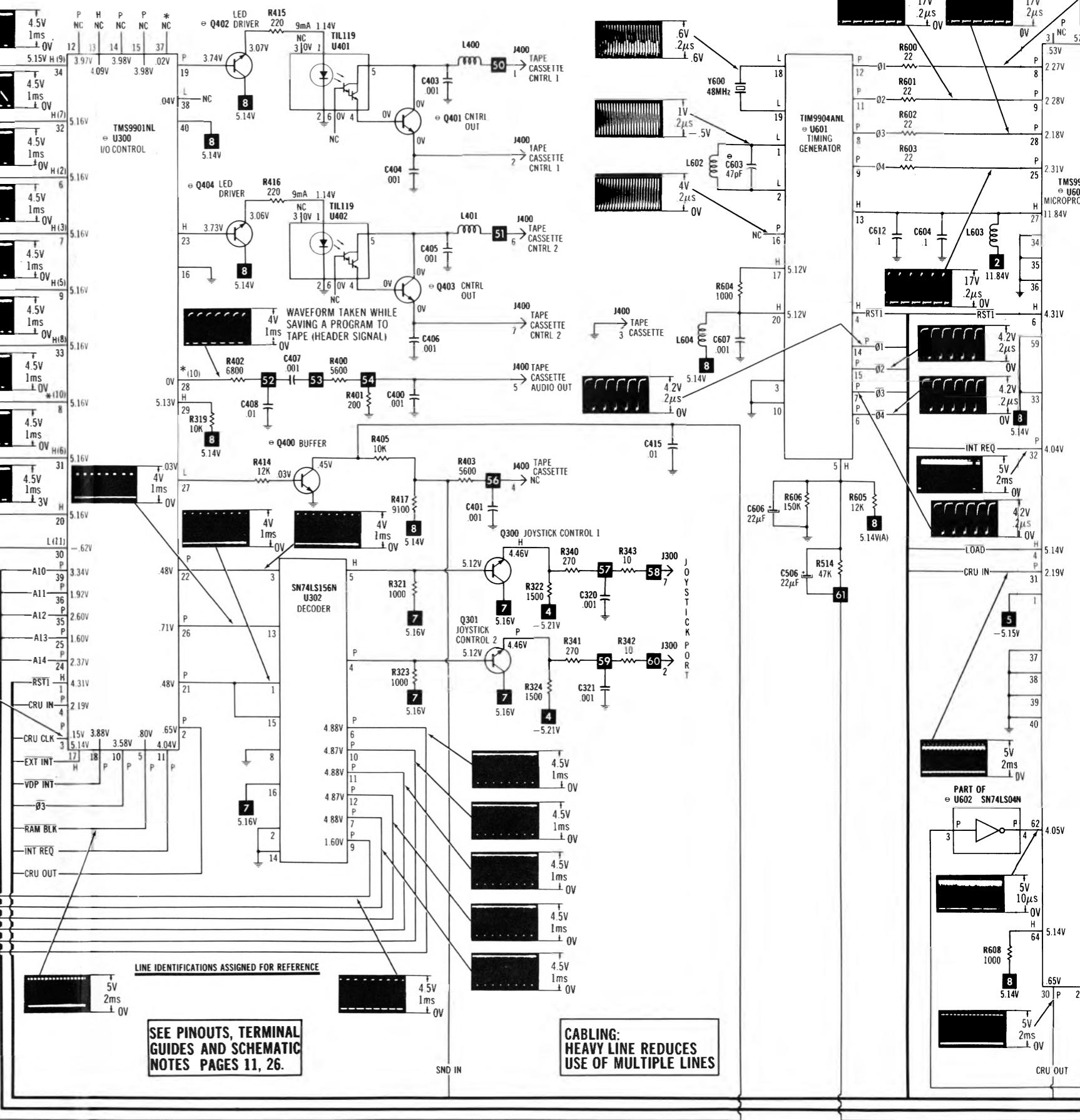
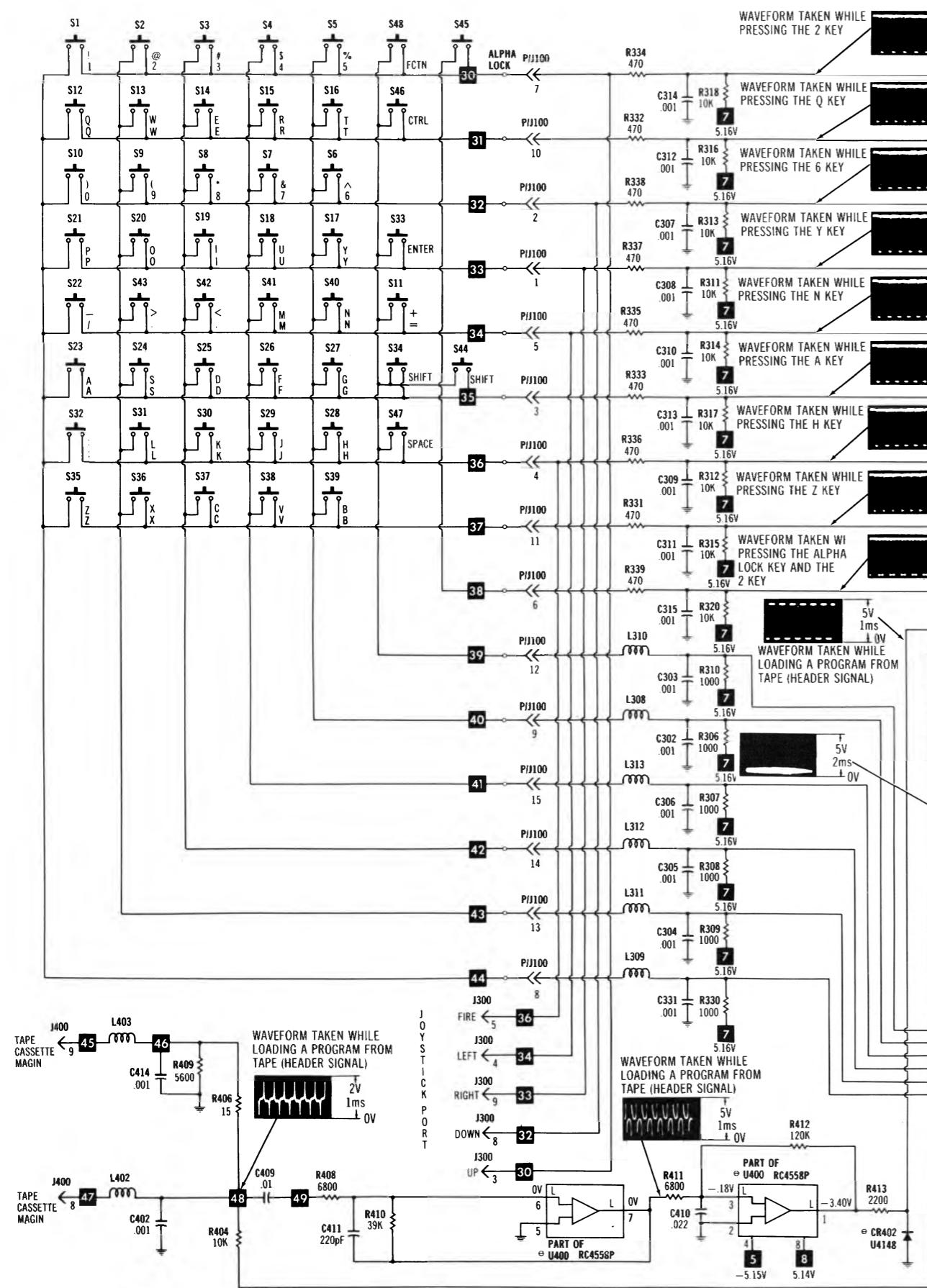
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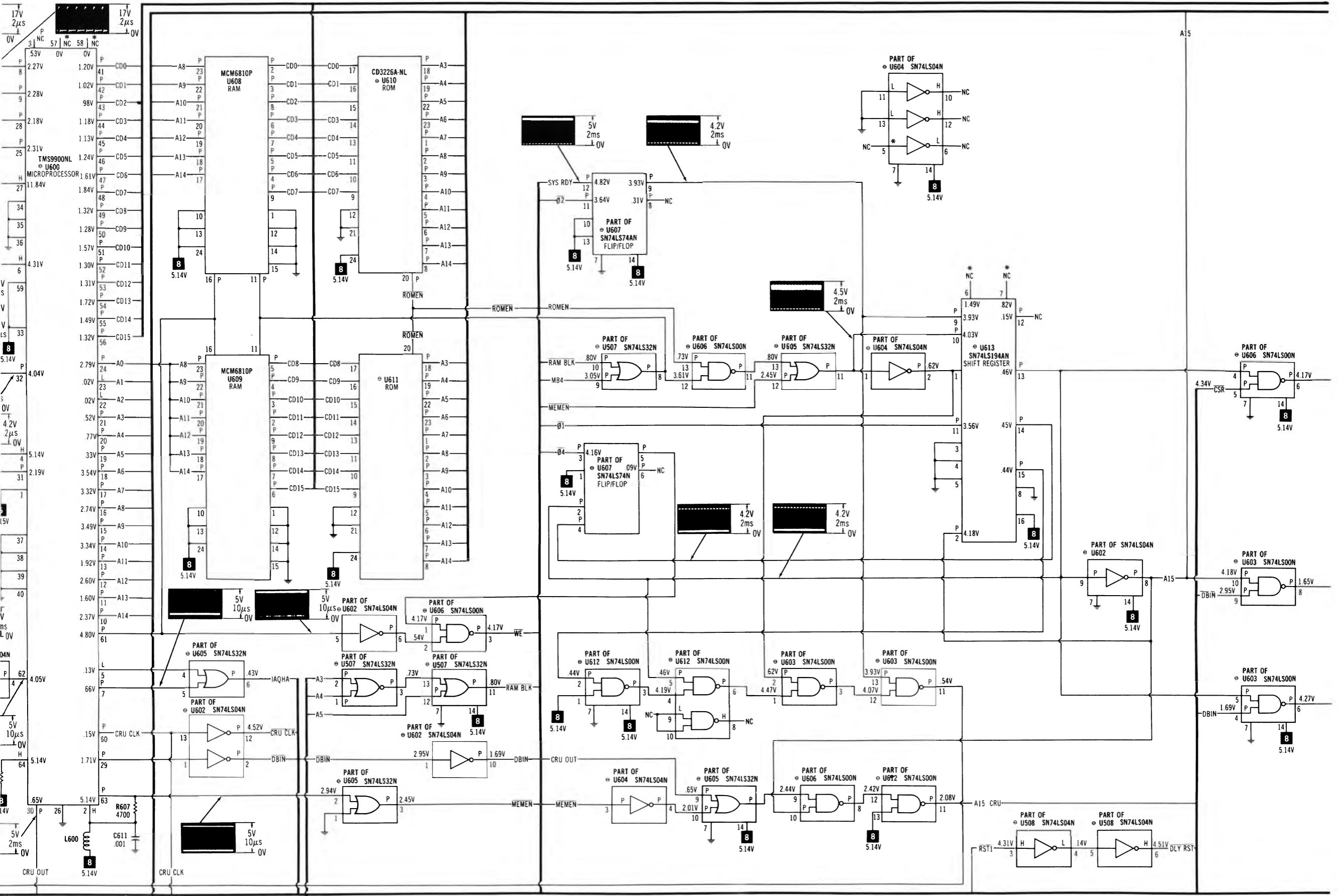
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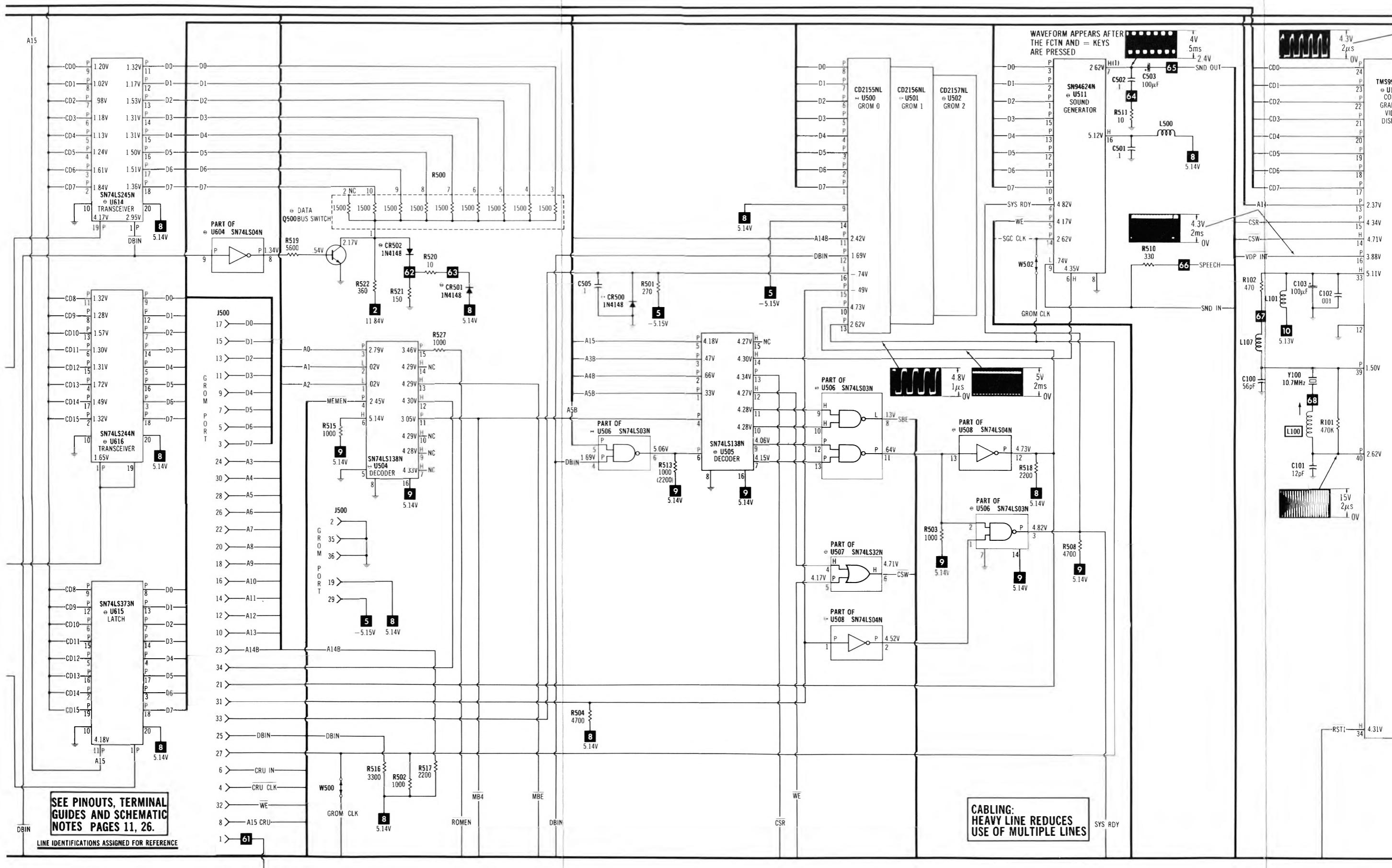
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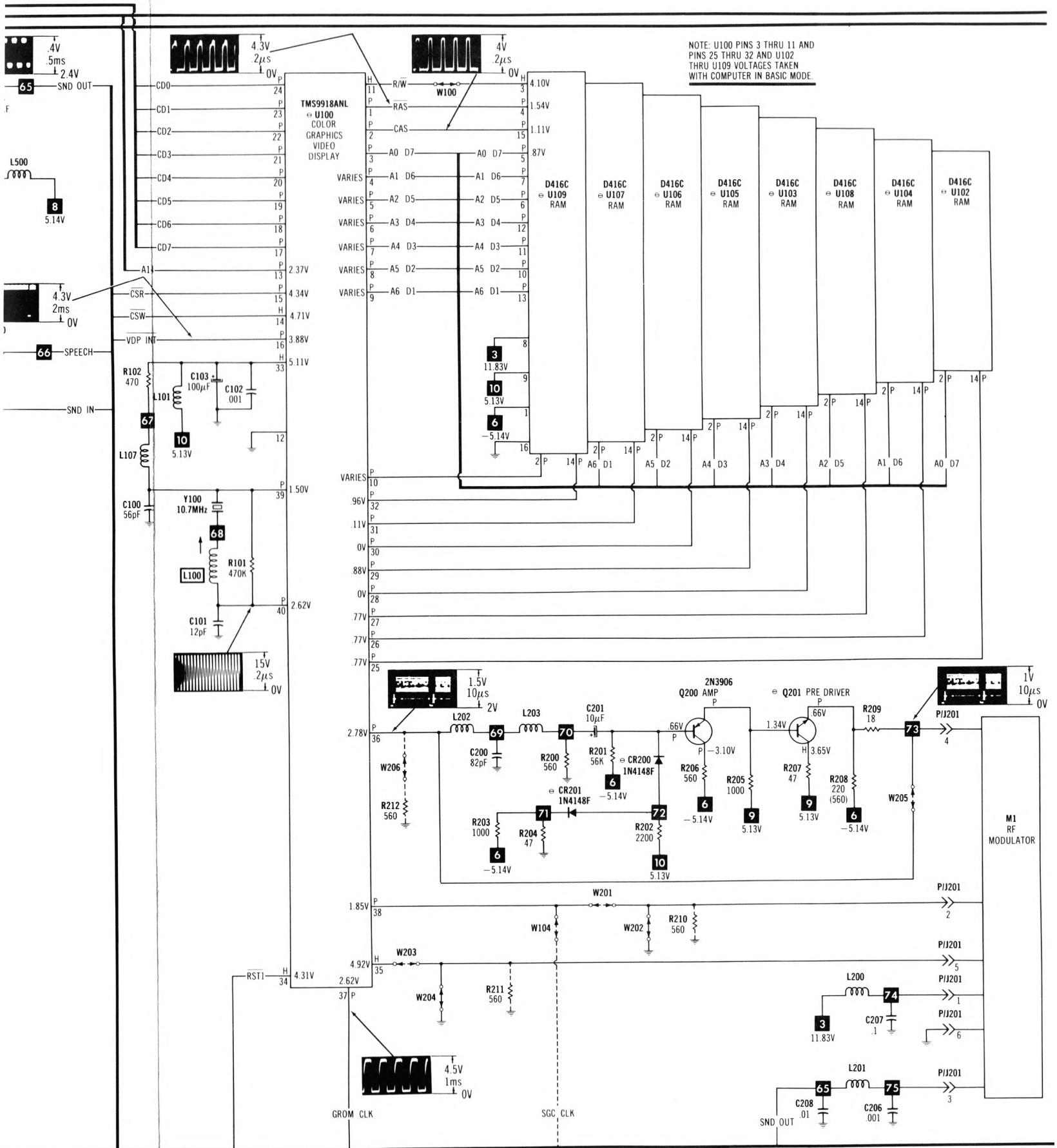
A PHOTOFAC T STANDARD NOTATION SCHEMATIC

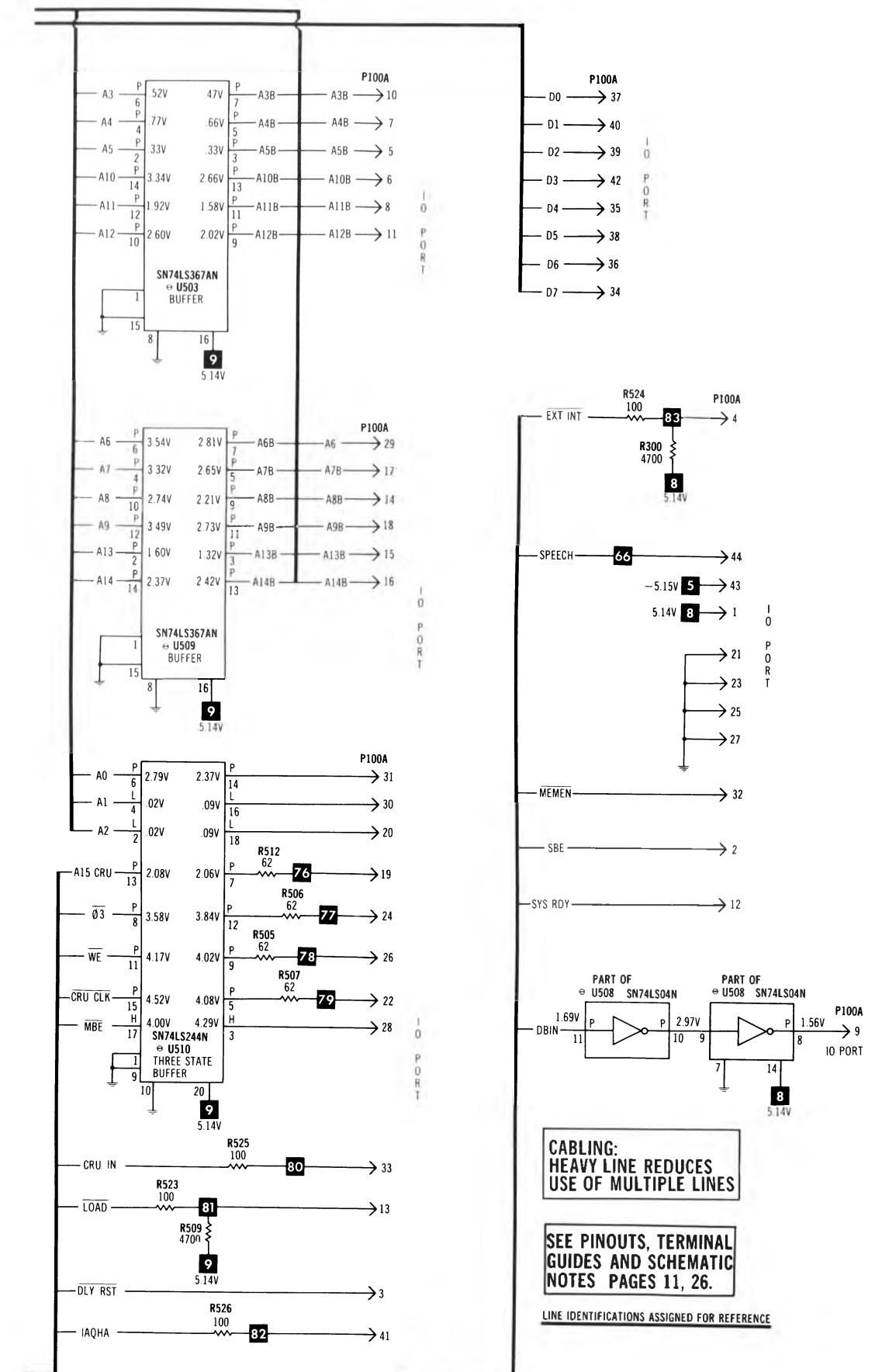
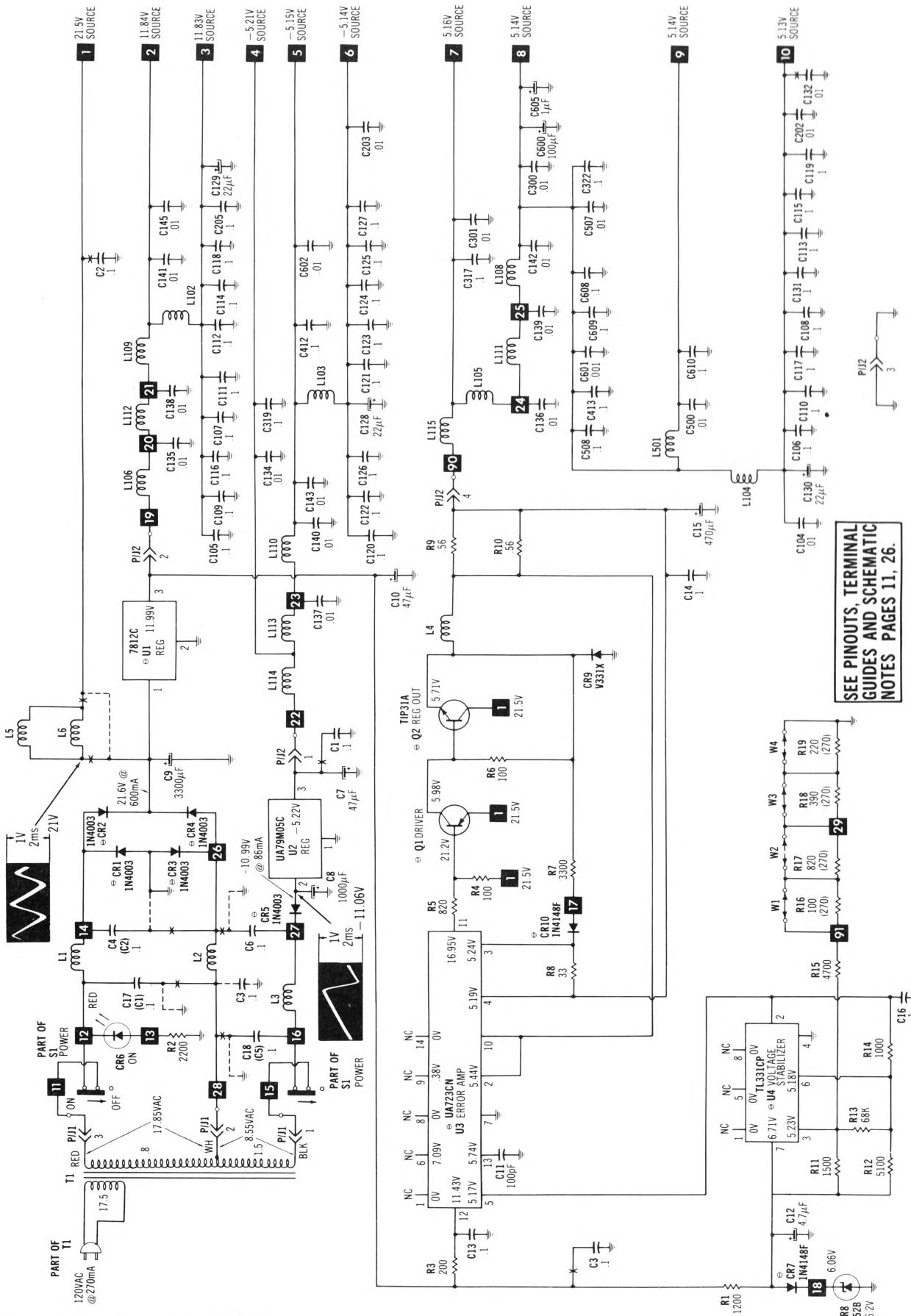
WITH CIRCUITTRACE™

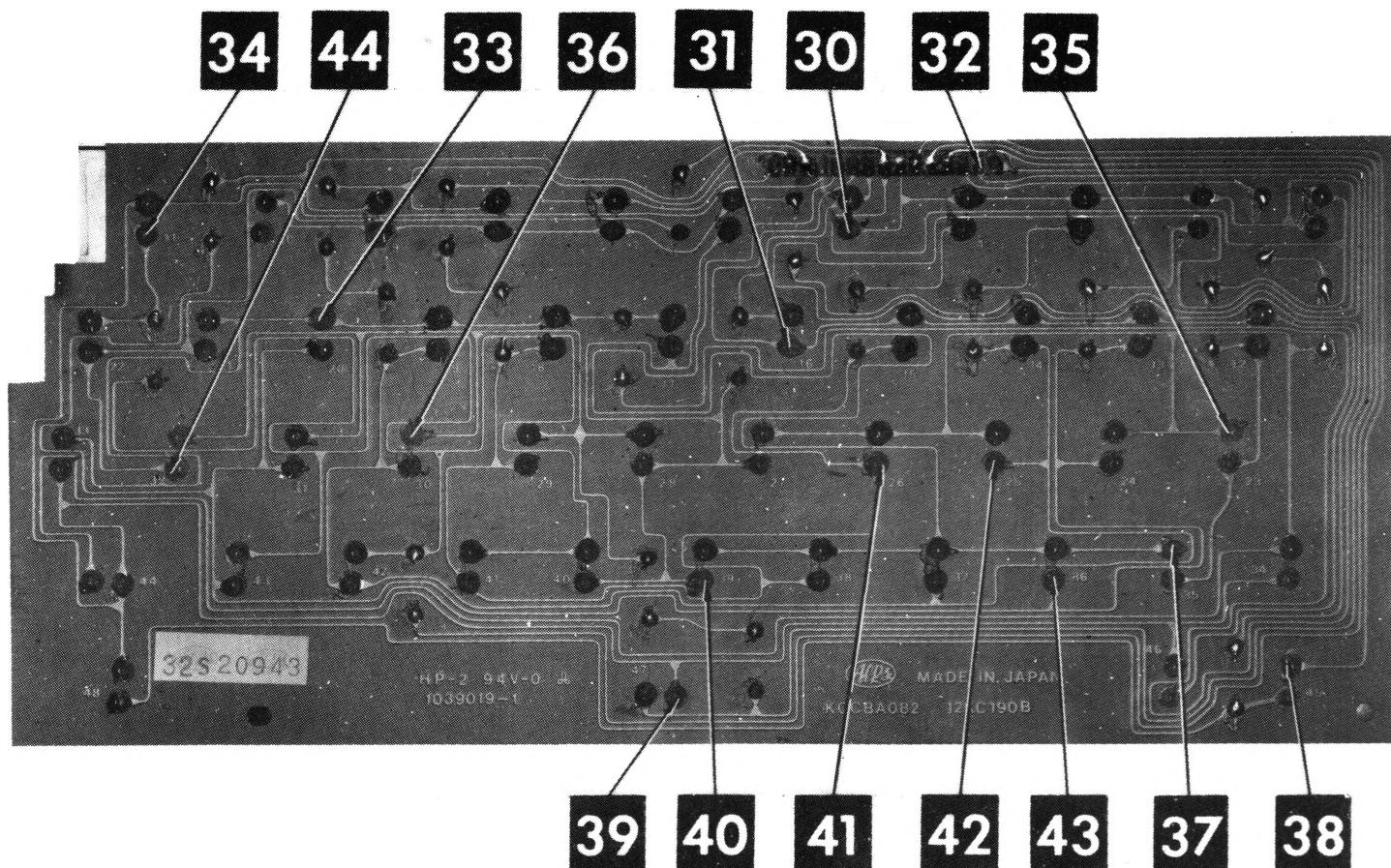
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MAIN BOARD

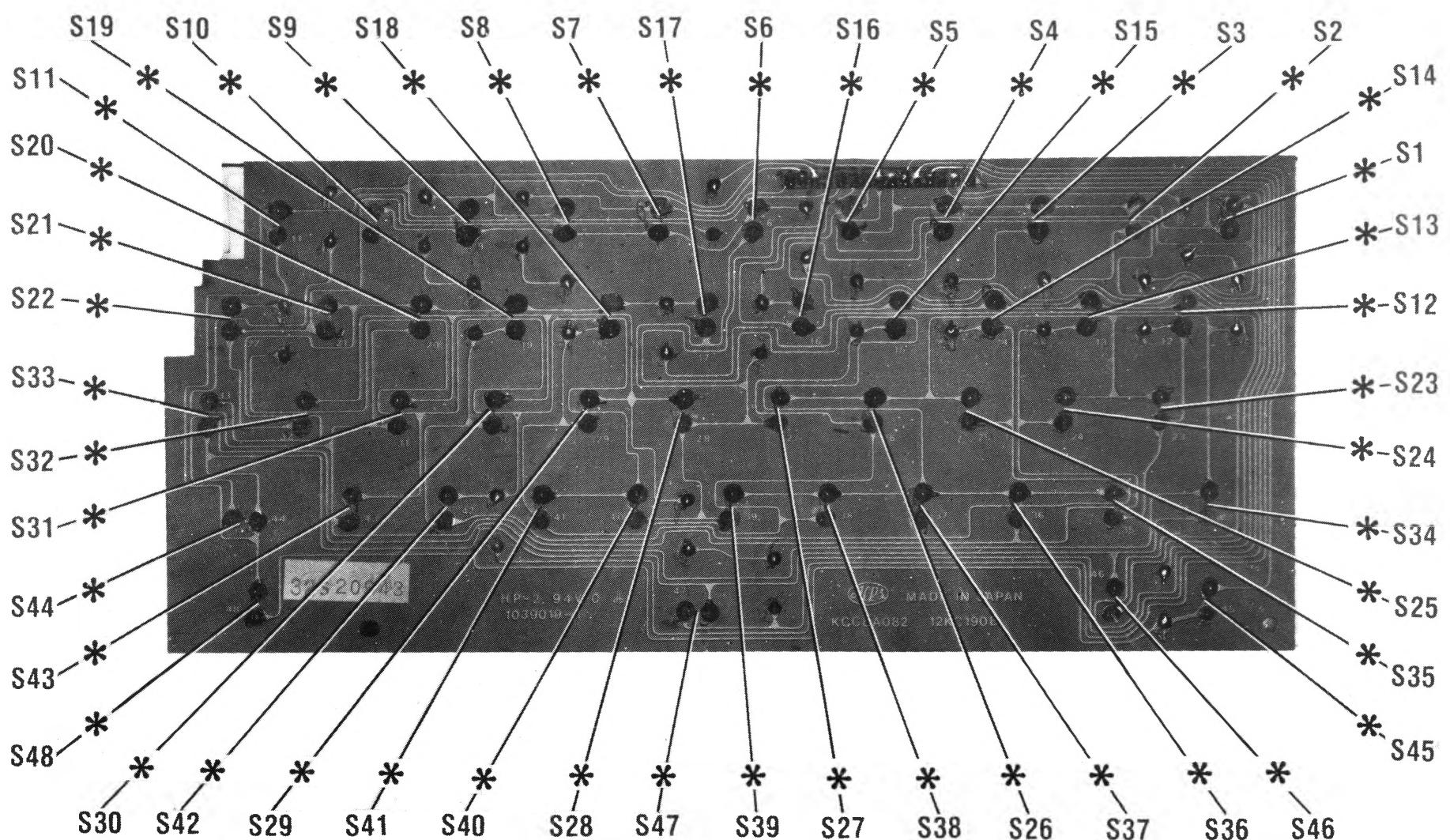
SEE LINE DEFINITIONS ON PAGE 13







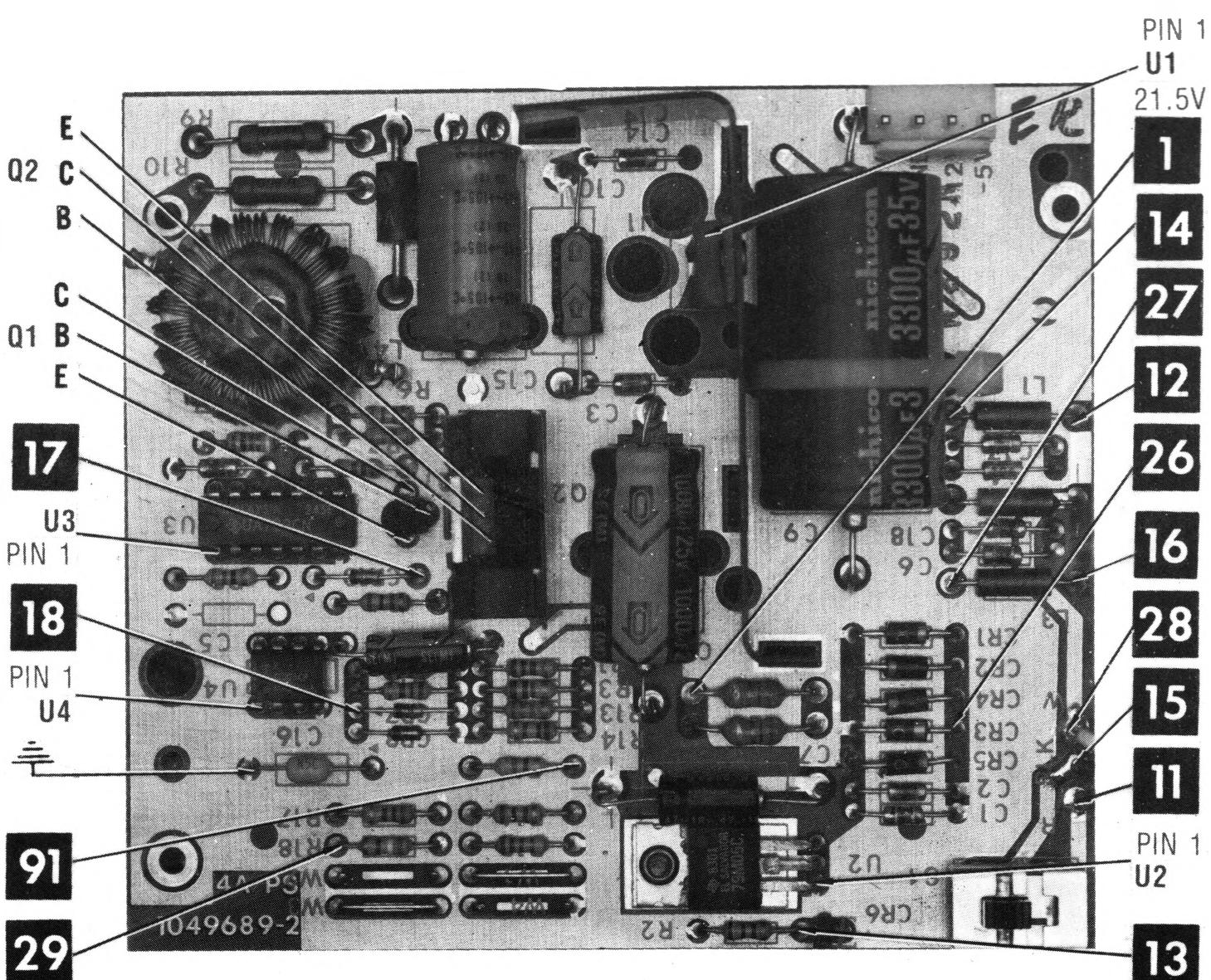
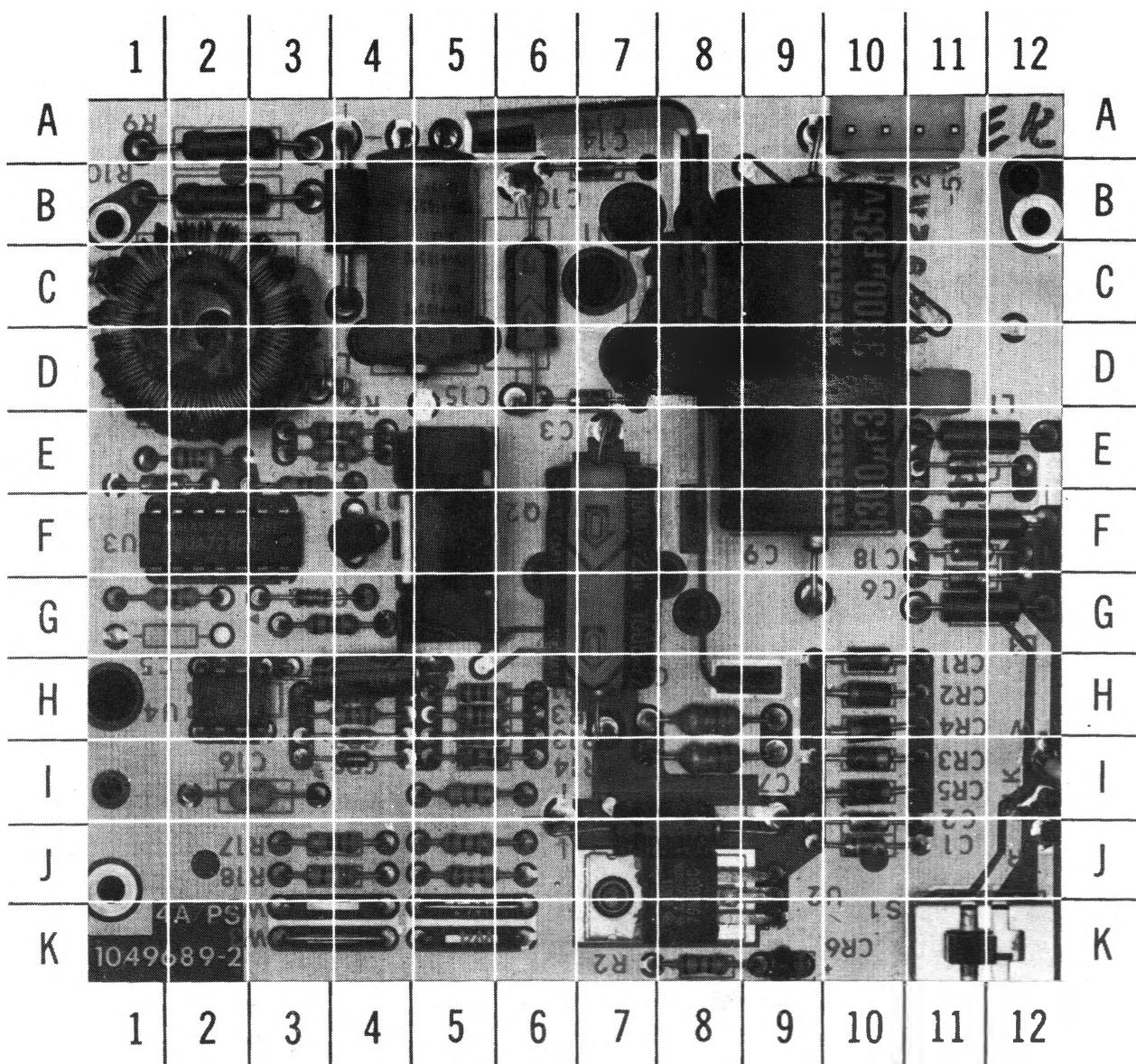
NOTE THERE IS NO GROUND ON KEYBOARD



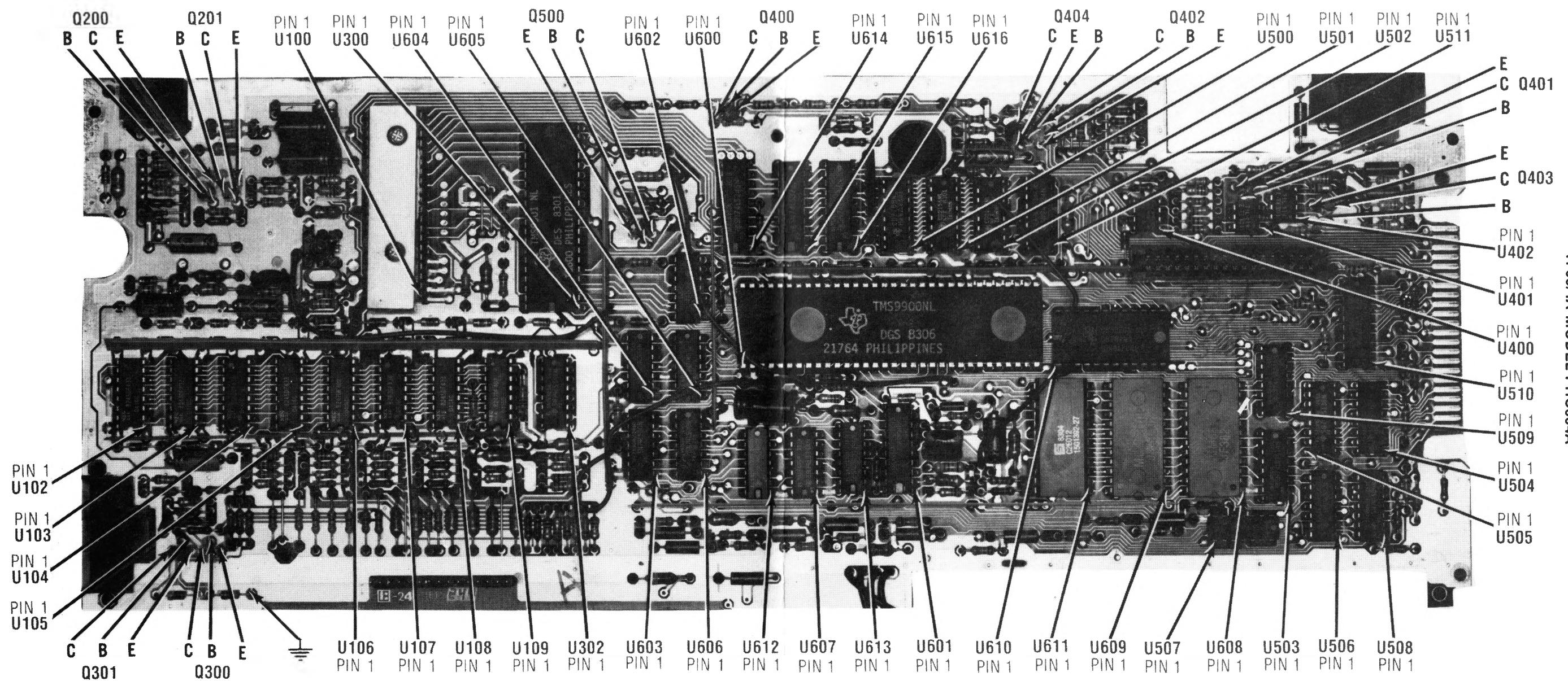
* LOCATED ON OTHER SIDE OF BOARD

**POWER SUPPLY
BOARD
GridTrace
LOCATION GUIDE**

C1	J-10
C2	J-10
C3	D-7
C4	F-11
C6	C-11
C7	J-8
C8	G-7
C9	D-9
C10	C-6
C11	E-2
C12	H-4
C13	E-1
C14	B-7
C15	C-5
C16	I-3
C17	E-11
C18	F-11
CR1	H-10
CR2	H-10
CR3	I-10
CR4	I-10
CR5	H-4
CR7	I-4
CR8	B-4
CR9	G-3
CR10	E-11
L1	F-11
L2	G-11
L3	D-2
L4	H-8
L5	I-8
L6	A-10
P/J2	F-4
Q1	F-5
Q2	H-5
R1	K-8
R2	H-5
R3	G-3
R4	E-3
R5	E-4
R6	E-3
R7	G-2
R8	A-2
R9	B-2
R10	H-4
R11	H-4
R12	H-5
R13	J-1
R14	J-5
R15	J-5
R16	J-3
R17	J-5
R18	J-5
R19	K-11
S1A	C-8
U1	8-2
U2	H-2
U3	J-2
U4	K-3
W1	K-3
W2	K-3
W3	K-3
W4	K-5



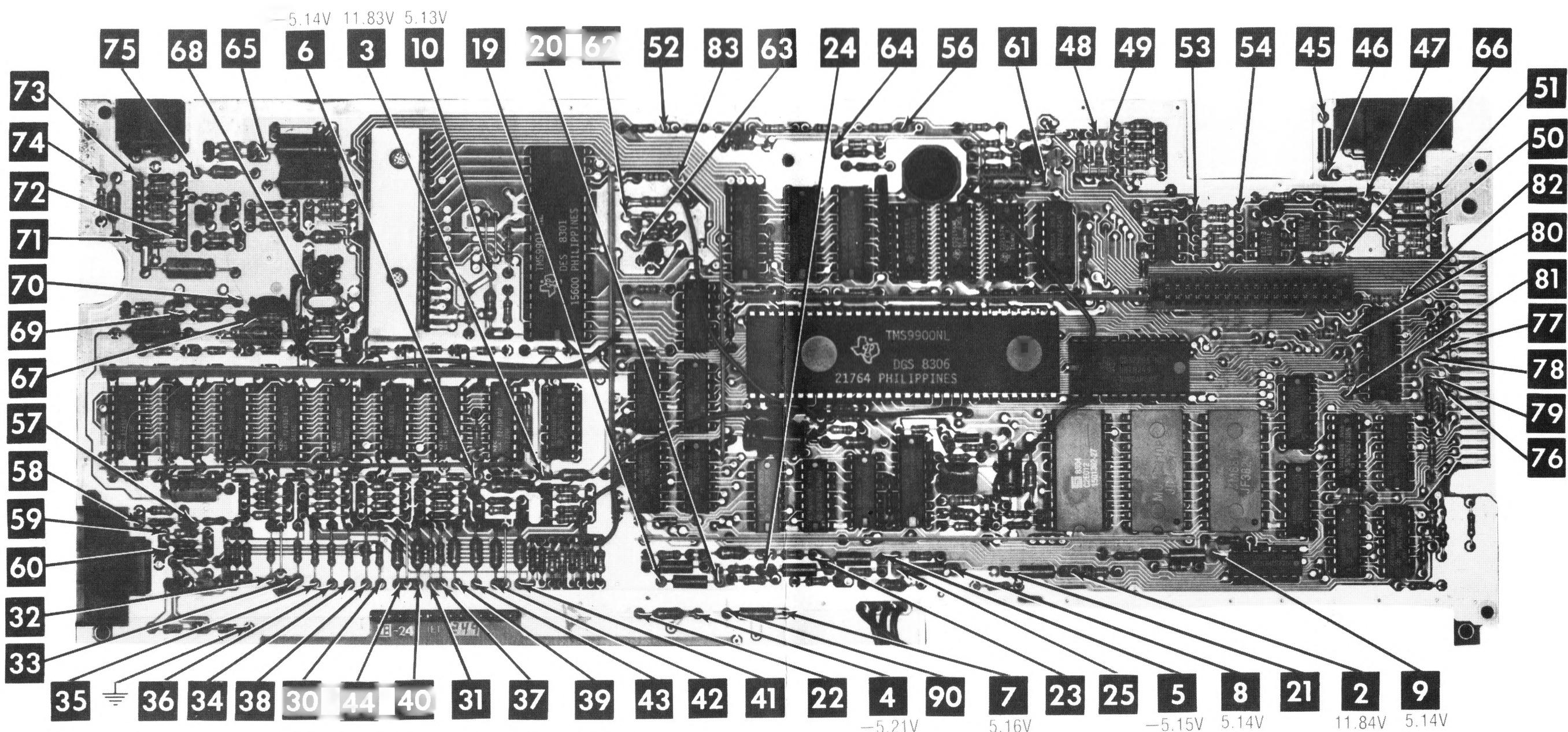
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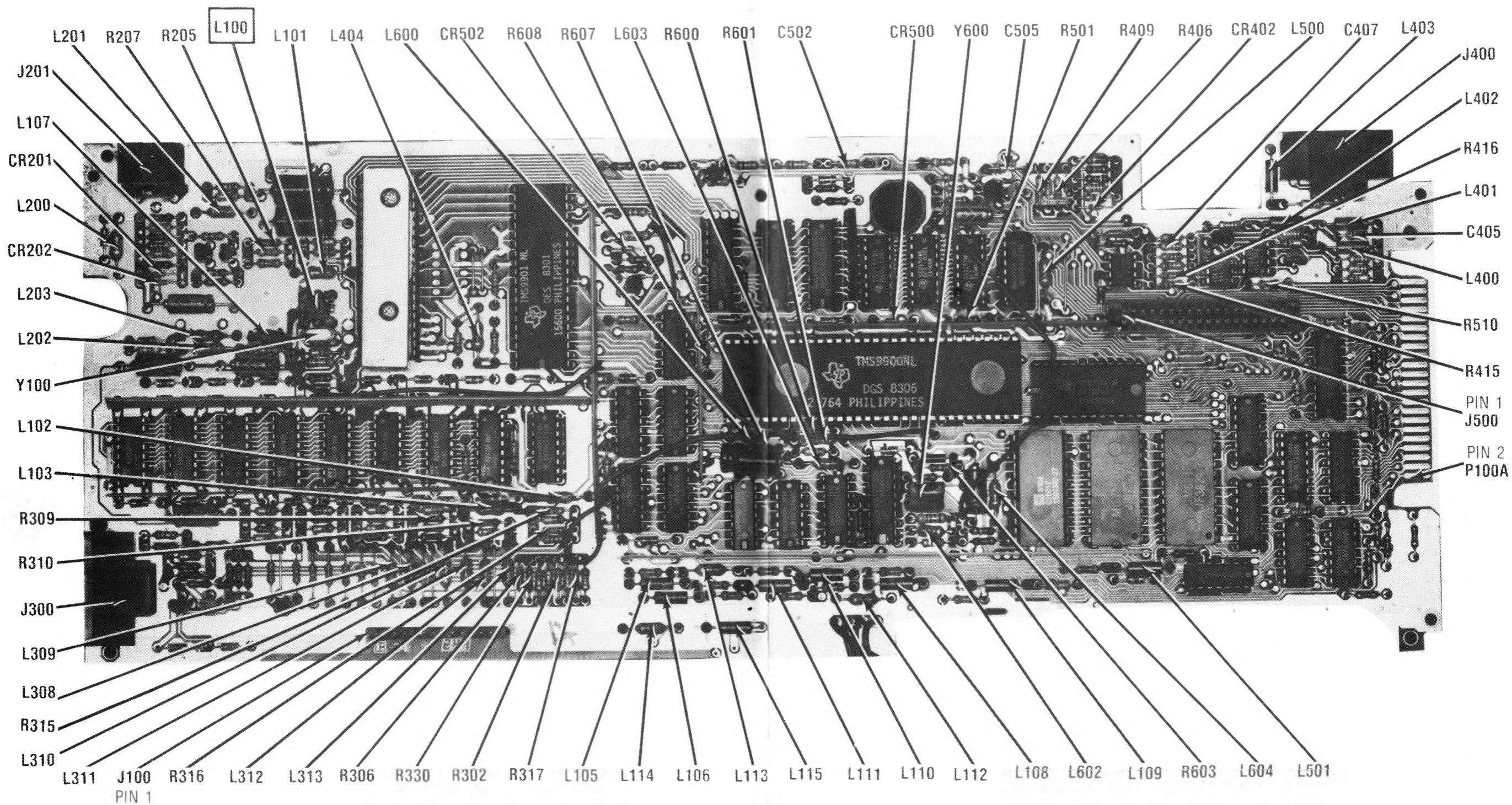
MAIN BOARD

6

MAIN BOARD

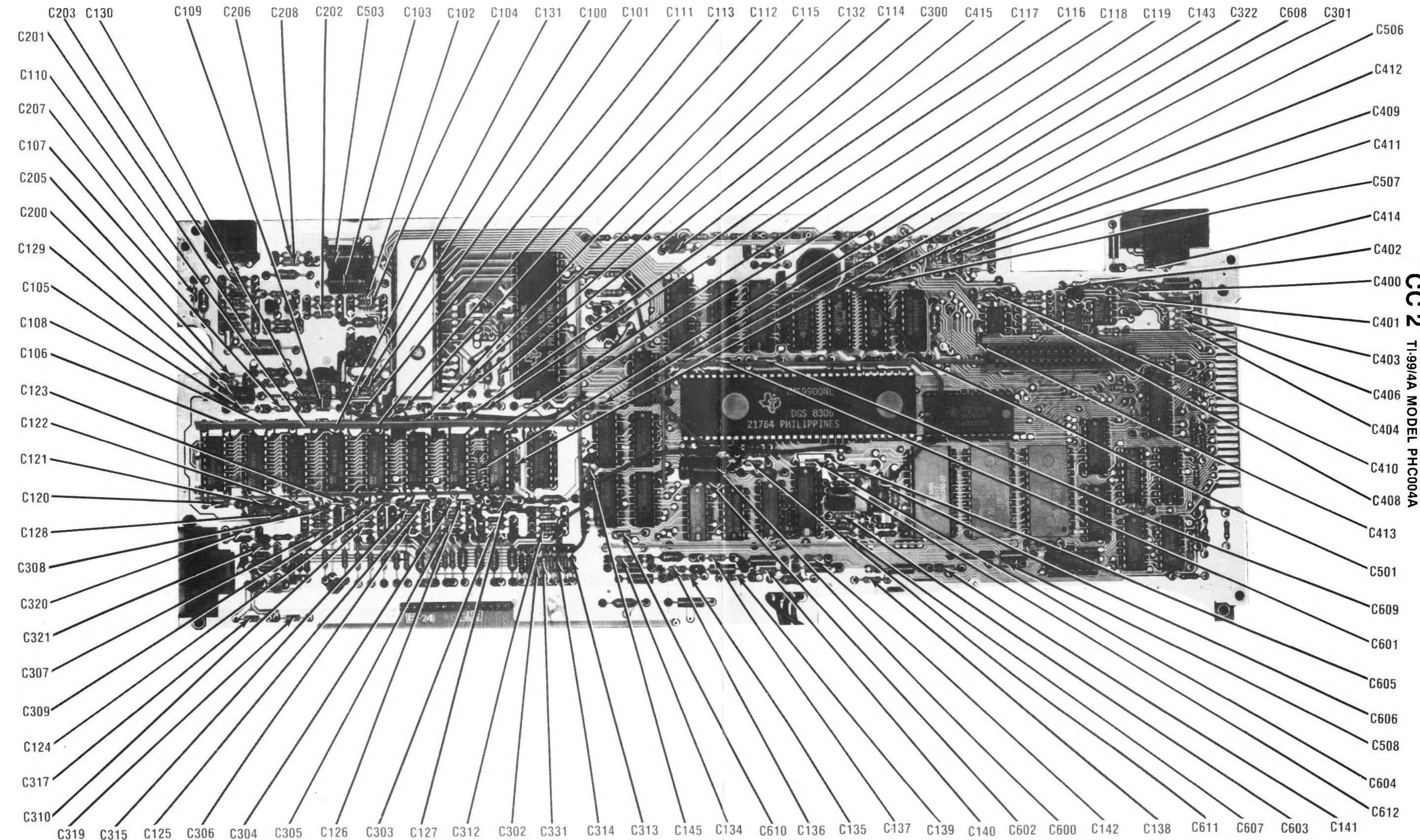


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CC 2

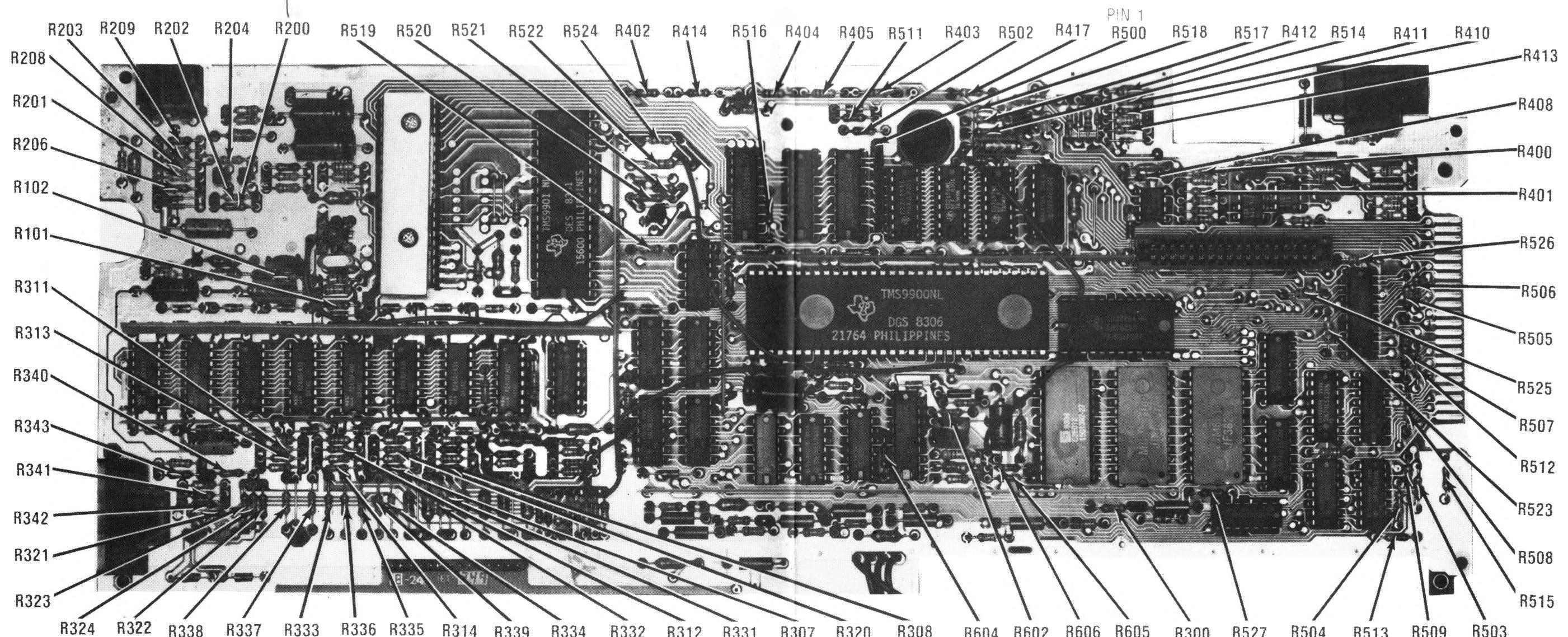
TI.99/4A MODEL PHC004A



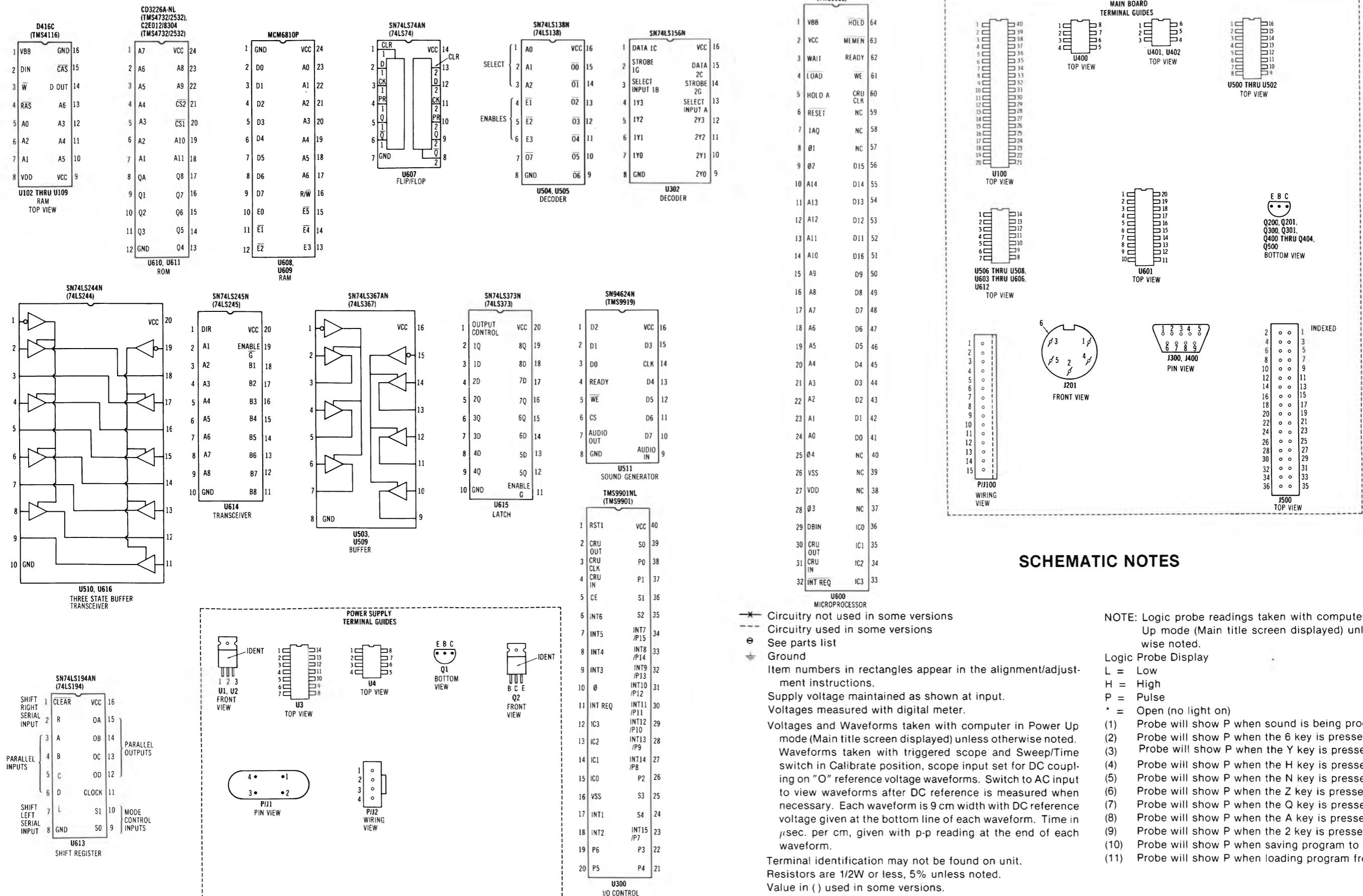
MAIN BOARD

MAIN BOARD

TEXAS INSTRUMENTS
TI-99/4A MODEL PHC004A



IC PINOUTS, TERMINAL GUIDES & SCHEMATIC NOTES



SCHEMATIC NOTES

- *— Circuitry not used in some versions
- Circuitry used in some versions
- See parts list
- Ground
- Item numbers in rectangles appear in the alignment/adjustment instructions.
- Supply voltage maintained as shown at input.
- Voltages measured with digital meter.
- Voltages and Waveforms taken with computer in Power Up mode (Main title screen displayed) unless otherwise noted.
- Waveforms taken with triggered scope and Sweep/Time switch set in Calibrate position, scope input set for DC coupling on "O" reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 9 cm width with DC reference voltage given at the bottom line of each waveform. Time in μ sec. per cm, given with p-p reading at the end of each waveform.
- Terminal identification may not be found on unit.
- Resistors are 1/2W or less, 5% unless noted.
- Value in () used in some versions.

NOTE: Logic probe readings taken with computer in Power Up mode (Main title screen displayed) unless otherwise noted.

Logic Probe Display

- L = Low
- H = High
- P = Pulse
- * = Open (no light on)

- (1) Probe will show P when sound is being produced.
- (2) Probe will show P when the 6 key is pressed.
- (3) Probe will show P when the Y key is pressed.
- (4) Probe will show P when the H key is pressed.
- (5) Probe will show P when the N key is pressed.
- (6) Probe will show P when the Z key is pressed.
- (7) Probe will show P when the Q key is pressed.
- (8) Probe will show P when the A key is pressed.
- (9) Probe will show P when the 2 key is pressed.
- (10) Probe will show P when saving program to tape.
- (11) Probe will show P when loading program from tape.

GENERAL OPERATING INSTRUCTIONS

POWER UP

When the computer is turned On, the main title screen will be displayed on the monitor. Press any key and a menu will be displayed.

The menu choices will be determined by the Solid State Cartridge used. Turn the computer Off when inserting or removing a Solid State Cartridge. Refer to the menu and press the key for the desired function.

For instructions to load and save programs on cassette tape, refer to "Cassette Operation". Run a basic program by typing RUN and press the ENTER key. Stop a program by holding down the FCTN key and press the number 4 key. The computer will return to the basic mode and the program will be unaffected. Reset the computer by holding down the FCTN key and press the = key. The computer will return to the main title screen and any program in memory will be lost.

CASSETTE OPERATION

Connect the cassette cable to the cassette plug on the rear of the computer. Connect the plug with the red wire to the Mic input on the recorder, the plug with the white wire to the Ear-

phone output on the recorder and the plug with the black wire to the Remote input on the recorder.

NOTE: The remote control may not work on some recorders.

Set the Tone control on the recorder to Maximum and the volume control to mid-range. Verify the ALPHA LOCK key, on the computer, is in the down position and put the computer in BASIC mode.

Save a program by typing SAVE CS1, press the ENTER key and follow the instructions that appear on the monitor screen.

Load a program by typing OLD CS1, press the ENTER key and follow the instructions that appear on the monitor screen. If a program will not load, set the Volume control to a different level and try loading the program again.

When using two recorders, the recorder connected to the three plug section of the cable will be CS1 and the recorder connected to the two plug section will be CS2. CS2 can be used for saving programs or data only. Save a program on CS2 by typing SAVE CS2, press the ENTER key and follow the instructions that appear on the monitor.

DISASSEMBLY INSTRUCTIONS

CABINET BOTTOM REMOVAL

Remove the On-Off knob. Remove Phillips screws 1 thru 7 (See Figure 1) from the bottom and remove the cabinet bottom.

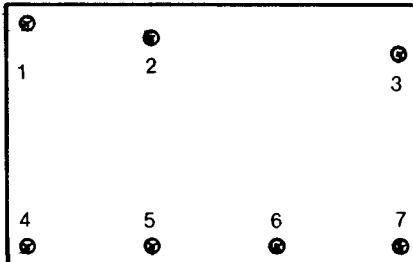


Figure 1
BOTTOM VIEW

POWER SUPPLY BOARD REMOVAL

Remove Phillips screws 7 and 8 (See Figure 2) from the power supply board. Lift the board up, unplug the cable going to the main board and remove the power supply board.

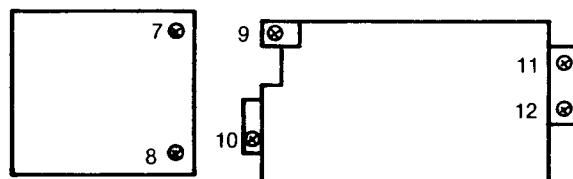
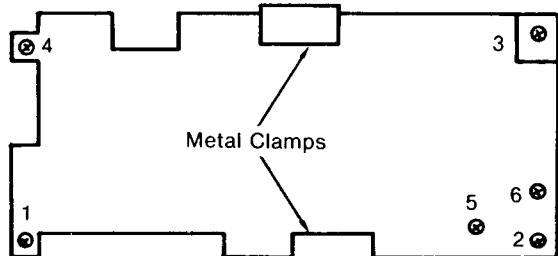


Figure 2
BOTTOM VIEW

SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove AC power from the computer before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.
5. Use a grounded-tip, low voltage soldering iron.
6. Use an isolation (times 10) probe on scope.
7. Do not remove or install boards, floppy disk drives, printers, or other peripherals with computer AC power On.
8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.
9. This computer is equipped with a grounded three-pronged AC plug. This plug must fit into a grounded AC power outlet. Do not defeat the AC plug safety feature.
10. Periodically examine the AC power cord for damaged or cracked insulation.
11. The computer cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.
12. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.
13. Never expose the computer to water. If exposed to water turn the unit Off. Do not place the computer near possible water sources.
14. Never leave the computer unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.
15. Do not allow anything to rest on AC power cord.
16. Unplug AC power cord from outlet before cleaning computer.
17. Never use liquids or aerosols directly on the computer. Spray on cloth and then apply to the computer cabinet. Make sure the computer is disconnected from the AC power line.

LINE DEFINITIONS

A0 Thru A15	Address Lines	MEMEN	Memory Enable
A0D7 Thru A6D1	Combined Address and Data Lines	R/W	Read/Write
A3B Thru A14B	Buffered Address Lines	RAM BLK	RAM Blanking
A15 CRU	Communications Register Unit Address 15	RAS	Row Address Strobe
CAS	Column Address Strobe	READY	Ready for Memory Access
CD0 Thru CD15	Converted Data Lines	RESET	Reset Computer and Peripherals
CRU CLK	Communication Register Unit Clock	ROMEN	ROM Enable
CRU IN	Communication Register Unit Data Input	RST 1	Reset
CRU OUT	Communication Register Unit Data Output	SBE	Speech Block Enable
CSR	Chip Select Video Display Processor Read	SGC CLK	Central Processing Unit Clock
CSW	Chip Select Video Display Processor Write	SND IN	Audio Input
D0 Thru D7	Bi-Directional Data Lines	SND OUT	Audio Output
DBIN	Data Bus Input	SPEECH	Speech Synthesizer Input
DLY RST	Delayed Reset	SYS RDY	System Ready
EXT INT	External Interrupt	VDP INT	Video Display Processor Interrupt
GROM CLK	Graphics ROM Clock	WE	Write Enable
IAQHA	Instruction Acquisition or Hold A	Ø1	Phase One
INT REQ	Interrupt Request	Ø2	Phase Two
LOAD	CPU executes a Non-Maskable Interrupt	Ø3	Phase Three
MBE	Memory Block Enable	Ø4	Phase Four
MB4	Memory Block Four		

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

TROUBLESHOOTING

MICROPROCESSOR CHIP (CPU) OPERATION

Verify the processor is functioning by checking the signals on the address lines (pins 10 thru 24 of IC U600) and the data lines (pins 41 thru 56) using a logic probe or a scope. If a logic probe is used, refer to the "Logic Chart" for the correct readings. If a scope is used, the waveforms on the address lines (except pins 22 and 23 which have no signal in Power Up mode) should be similar to Figure 1. The waveforms on the data lines should be similar to Figure 2.

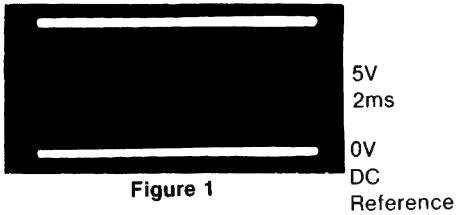


Figure 1

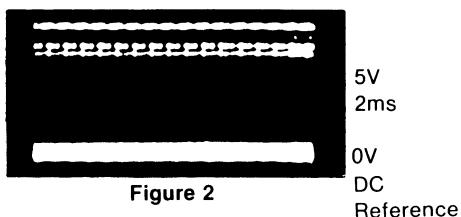


Figure 2

If the processor is not functioning, check the source voltages at pins 1, 2, 27, 33 and 59. Check the 48 MHz Oscillator Crystal (Y600) by checking the waveforms at pins 1 and 18 of IC U601. The frequency at pin 1 of IC U601 should measure 12.00MHz. Check the phase relationships of the ϕ_1 , ϕ_2 , ϕ_3 and ϕ_4 clocks at pins 12, 11, 8 and 9 of IC U601 (See Figure 3). Check the phase relationships of the ϕ_1 , ϕ_2 , ϕ_3 and ϕ_4 clocks at pins 14, 15, 7 and 6 of IC U601 (See Figure 4). Use a logic probe and check the readings at pins 4 thru 9, 25, 28, 29 and 61 thru 64 of IC U600 (See "Logic Chart").

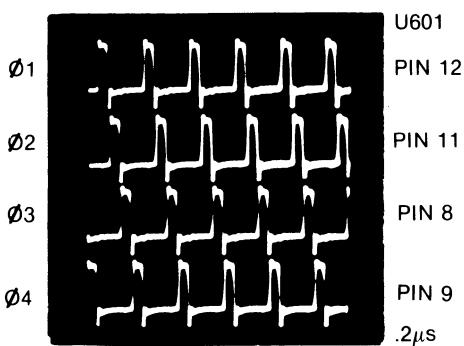


Figure 3

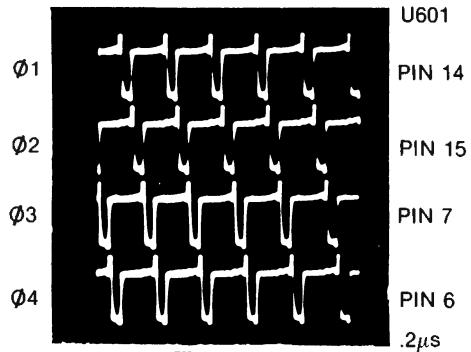


Figure 4

CRYSTAL OSCILLATORS

Connect a frequency counter to pin 1 of IC U601 to check the 48 MHz oscillator. The frequency should read 12.00 MHz. Connect a frequency counter to pin 39 of IC U100 to check the 10.7 MHz oscillator. The frequency should read 10.738635 MHz. The frequency of the 10.7 MHz oscillator can be adjusted by Coil L100.

VIDEO SIGNALS

Verify the operation of the video circuits by checking the waveforms at pin 36 of IC U100 and pin 4 of Jack J201. If the waveform is absent at pin 36 of IC U100, check the 10.7 MHz oscillator at pins 39 and 40 of IC U100 and check pins 1 thru 38 with a logic probe (See the "Logic Chart"). If the waveform at pin 4 of J201 is absent, check the voltages and components associated with Amp Transistor (Q200) and Predriver Transistor (Q201).

SOUND

Type in and run the following program if there is no sound. Check for a .7V p-p waveform at pin 7 of IC U511.

```
1 CALL SOUND (-400,200,2)
2 GOTO 1
```

If the waveform is present, check Capacitors C502, C503, C206 and C208 and Coil L201. If the waveform is absent, use a logic probe and check pins 1 thru 14 of IC U511. The readings should be the same as given in the "Logic Chart", except pin 6 will show pulses while the program is running. Check the clock waveform on pin 14 with a scope.

KEYBOARD

The computer comes up with the main title screen displayed on the monitor, but the keyboard has no effect when the keys are pressed. Check the waveforms on pins 1, 3, 6, 7, 9, 10, 11, 12 and 13 of IC U302 and pins 6, 7, 8, 9, 20, 31, 32, 33 and 34 of IC U300. Use a logic probe and check the readings on pins 1 thru 5, 10, 11, 17, 18, 24, 25, 35, 36, 39 and 40 of IC U300 (See "Logic Chart").

TROUBLESHOOTING (Continued)

JOYSTICKS

Type in and run the following program if the keys on the keyboard function but the joysticks do not. Check for the waveform shown in Figure 5 at the emitters of Joystick Control 1 and 2 Transistors (Q300 and Q301).

```
1 CALL JOYST (1, X, Y)
2 CALL JOYST (2, X, Y)
3 CALL KEY (1, X, Y)
4 CALL KEY (2, X, Y)
5 GOTO 1
```

The waveform shown in Figure 6 should appear at the emitters of Transistors Q300 and Q301 when the fire button is pressed. Transistor Q300 controls Joystick 1 and Transistor Q301 controls Joystick 2. If either waveform is absent, check the voltages and components associated with the transistor with the missing waveform.

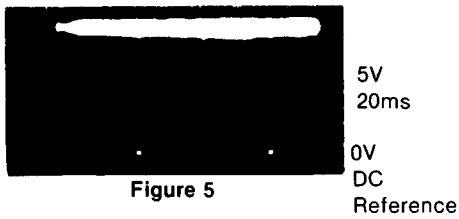


Figure 5

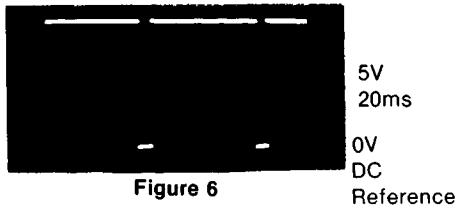


Figure 6

CASSETTE RECORDER

NOTE: Verify the recorder used can be turned On and Off by a computer in good working order. CS1 is the recorder connected to the three plug cassette cable. CS2 is the recorder connected to the two plug cassette cable.

The computer will not turn On CS1. Check the voltages and components associated with the Control Output Transistor (Q401), LED Driver Transistor (Q402) and Opto-isolator U401.

The computer will not turn Off CS1. Check for .02V at pin 19 of IC U300 when the recorder should be Off. If the voltage is good, check Transistor Q401, Transistor Q402 and Optoisolator U401.

The computer will not turn On CS2. Check the voltages and components associated with the Control Output Transistor (Q403), LED Driver Transistor (Q404) and Opto-isolator U402.

The computer will not turn Off CS2. Check for .02V at pin 23 of IC U300 when the recorder should be Off. If the voltage is good, check Transistors Q403 and Q404 and Optoisolator U402.

The computer will not load a program. Check the waveforms at pin 8 of Jack J400, pin 7 of IC U400 and pin 30 of IC U300 while loading a program. NOTE: The amplitude of the waveforms depends on the volume control setting of the recorder. If the waveform at pin 8 of J400 is absent, check Capacitor C402 and check for possible shorts to ground. If the waveform at pin 7 of IC U400 is absent, check the voltages and components associated with pins 4, 6, 7 and 8 of IC U400.

If the waveform at pin 30 of IC U300 is absent, check the voltages and components associated with pins 1, 2, 3, 4 and 8 of IC U400.

The computer will not save a program. Check the waveform at pin 28 of IC U300 while saving a program. If the waveform is good, check Capacitors C400, C403 and C407 and Resistors R400, R401 and R402.

RF MODULATOR

Verify the RF Modulator is getting the proper voltages and signals by checking for 11.78V at the red wire from the cable, 1.95V at the yellow wire and .54V at the clear wire. The clear wire should also have a 1V p-p video signal.

ADJUSTMENT

10.7 MHz OSCILLATOR

Connect the input of a frequency counter to pin 39 of IC U100 and adjust Coil L100 for a frequency of 10.738635 MHz.

6 PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part No., and Description

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA						
			ECG PART No.	GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NTE PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.
CR1 thru	1N4003		ECG116	GE-504A	1N4003	NTE116	SK3311	WEP156	212-76-02
CR5	1N4002		ECG116	GE-504A	1N4002	NTE116	SK3311	WEP155	212-76-02
CR7	1N4148F		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
CR8	PG1992 1N52B		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
		ECG5013A	GEZD-6.2		1N5234B	NTE5013A	SK6A2/5013A	WEP1414/5013	103-Z9008
CR9	V331X		ECG552	GE-511		NTE552	SK9000/552	WEP172/506	103-287
CR10	1N4148F		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
CR200,1	PG1992 1N4148F 1N4148		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131	
		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131	
CR402	1N4148		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
	PG1992		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
CR500	1N4148		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
CR501,2	PG1992 1N4148 1N914B		ECG519	GE-514	1N4935	NTE519	SK3100/519	WEP925/519	103-131
		ECG177	GE-300	1N4935	NTE177	SK9091/177	WEP1062/177	103-131	
Q1	578-2303		ECG159	GE-82	2N5401	NTE159	SK3466/159	WEP62/159	121-Z9003
	TIS93		ECG159	GE-82	2N5401	NTE159	SK3466/159	WEP62/159	121-Z9003
Q2	TIP31A		ECG291	GE-302	MJE15030	NTE291	SK3893/152	WEP780/291	121-Z9047
Q200	TIP31		ECG291	GE-302	MJE15030	NTE291	SK3893/152	WEP780/291	121-Z9047
	2N3906		ECG159	GE-82	2N5401	NTE159	SK3466/159	WEP62/159	121-Z9003
Q201	2472222		ECG123AP	GE-123AP	MPSA05	NTE123AP	SK3854/123AP	WEP736/123A	121-Z9000A
	2N2222		ECG123A	GE-20	MPSA05	NTE123A	SK3444/123A	WEP736/123A	121-Z9000A
Q300,1	501-4249		ECG123AP	GE-123AP	MPSA05	NTE123AP	SK3854/123AP	WEP736/123A	121-Z9000A
Q400 thru	501-4249		ECG123AP	GE-123AP	MPSA05	NTE123AP	SK3854/123AP	WEP736/123A	121-Z9000A
Q404	TIS92		ECG123AP	GE-123AP	MPSA05	NTE123AP	SK3854/123AP	WEP736/123A	121-Z9000A
Q500	501-4249		ECG123AP	GE-123AP	MPSA05	NTE123AP	SK3854/123AP	WEP736/123A	121-Z9000A
	TIS92		ECG123AP	GE-123AP	MPSA05	NTE123AP	SK3854/123AP	WEP736/123A	121-Z9000A
U1	78M12C		ECG966	GEVR-111	MC7812CT	NTE966	SK3592/966	WEP966L/966	HE-442-674
	UA7812C		ECG966	GEVR-111	MC7812CT	NTE966	SK3592/966	WEP966L/966	HE-442-674
U2	UA79M05C		ECG961	GE-961	MC7905CT	NTE961	SK3671/961		HE-442-630

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part No., and Description

SEMICONDUCTORS (Select replacement for best results) (cont)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA						
			ECG PART No.	GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NTE PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.
U3	UA723CN UA723C		ECG923D	GE IC-260 GEIC-260	MC1723CP MC1723CP	NTE923D NTE923D	SK3165/923D SK3165/923D	WEP2331/923D WEP2331/923D	221-Z9020 221-Z9020
U4	TL331CP TL331		ECG923D	GEIC-260					
U100	TMS9918ANL TMS9918A								
U102 thru U109	D416C TMS4116		ECG2117			NTE2117 NTE2117			HE-443-904 HE-443-904
U300	TMS9901NL TMS9901		ECG2117						
U302	SN74LS156N		ECG74LS156			NTE74LS156			
U400	RC4558P 4558		ECG778A	GE IC-220	MC1458CP1	NTE778A NTE778A	SK3465/778A SK3465/778A	WEP2053/778A WEP2053/778A	221-Z9034 221-Z9034
U401,2 U500	TIL119 CD2155NL TMC0430		ECG778A ECG3044	GE IC-220	MC1458CP1 TIL119	NTE3044			
U501	CD2156NL TMC0430								
U502	CD2157NL								
U503	SN74LS367AN 74LS367		ECG74LS367		SN74LS367AN SN74LS367AN	NTE74LS367 NTE74LS367	SK74LS367 SK74LS367		HE-443-857 HE-443-857
U504,5	SN74LS138N 74LS138		ECG74LS138		SN74LS138N	NTE74LS138	SK74LS138		HE-443-877 HE-443-877
U506	SN74LS03N 74LS03		ECG74LS03		SN74LS03N	NTE74LS03	SK74LS03		HE-443-745 HE-443-745
U507	SN74LS32N 74LS32		ECG74LS32		SN74LS32N	NTE74LS32	SK74LS32		HE-443-875 HE-443-875
U508	SN74LS04N 74LS04		ECG74LS04		SN74LS04N	NTE74LS04	SK74LS04		HE-443-755 HE-443-755
U509	SN74LS367AN 74LS367		ECG74LS367		SN74LS367AN	NTE74LS367	SK74LS367		HE-443-857 HE-443-857
U510	SN74LS244N 74LS244		ECG74LS244		SN74LS244N	NTE74LS244	SK74LS244		HE-443-791 HE-443-791
			ECG74LS244		SN74LS244N	NTE74LS244	SK74LS244		

18 PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part No., and Description

SEMICONDUCTORS (Select replacement for best results) (cont)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA						
			ECG PART No.	GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NTE PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.
U511	SN94624N TMS9919								
U600	TMS9900NL TMS9900								
U601	TIM9904ANL 74LS362								
U602	SN74LS04N 74LS04	ECG74LS04 ECG74LS04		SN74LS04N SN74LS04N	NTE74LS04 NTE74LS04	SK74LS04 SK74LS04			HE-443-755 HE-443-755
U603	SN74LS00N 74LS00	ECG74LS00 ECG74LS00		SN74LS00N SN74LS00N	NTE74LS00 NTE74LS00	SK74LS00 SK74LS00			HE-443-728 HE-443-728
U604	SN74LS04N 74LS04	ECG74LS04 ECG74LS04		SN74LS04N SN74LS04N	NTE74LS04 NTE74LS04	SK74LS04 SK74LS04			HE-443-755 HE-443-755
U605	SN74LS32N 74LS32	ECG74LS32 ECG74LS32		SN74LS32N SN74LS32N	NTE74LS32 NTE74LS32	SK74LS32 SK74LS32			HE-443-875 HE-443-875
U606	SN74LS00N 74LS00	ECG74LS00 ECG74LS00		SN74LS00N SN74LS00N	NTE74LS00 NTE74LS00	SK74LS00 SK74LS00			HE-443-728 HE-443-728
U607	SN74LS74AN 74LS74	ECG74LS74A ECG74LS74A		SN74LS74AN SN74LS74AN	NTE74LS74A NTE74LS74A	SK74LS74 SK74LS74			HE-443-730 HE-443-730
U608,9	MCM6810P CD3226A-NL	ECG6810		MCM6810P	NTE6810				
U610	TMS4732/2532								
U611	C2E012/8304 TMS4732/2532								
U612	SN74LS00N 74LS00	ECG74LS00 ECG74LS00		SN74LS00N SN74LS00N	NTE74LS00 NTE74LS00	SK74LS00 SK74LS00			HE-443-728 HE-443-728
U613	SN74LS194AN 74LS194				NTE74LS194 NTE74LS194				
U614	SN74LS245N 74LS245	ECG74LS245 ECG74LS245		SN74LS245N SN74LS245N	NTE74LS245 NTE74LS245	SK74C245 SK74C245			HE-443-885 HE-443-885
U615	SN74LS373N 74LS373	ECG74LS373 ECG74LS373		SN74LS373N SN74LS373N	NTE74LS373 NTE74LS373				HE-443-867 HE-443-867
U616	SN74LS244N 74LS244	ECG74LS244 ECG74LS244		SN74LS244N SN74LS244N	NTE74LS244 NTE74LS244	SK74LS244 SK74LS244			HE-443-791 HE-443-791

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part No., and Description

CAPACITORS

ITEM No.	RATING	MFGR. PART No.
C1	.1 50V	
C2	.1 50V	
C3	.1 50V	
C4	.1 50V	
C6	.1 50V	
C11	100 50V 5%	
C13	.1 50V	
C14	.1 50V	
C16	.1	
C17	.1 50V	
C18	.1 50V	
C100	56 NPO 50V 5%	
C101	12 NPO 50V 5%	
C102	.001 50V 10%	
C104	.01 25V	
C105	.1 50V	
C106	.1 50V	
C107	.1 50V	
C108	.1 50V	
C109	.1 50V	
C110	.1 50V	
C111	.1 50V	
C112	.1 50V	
C113	.1 50V	
C114	.1 50V	
C115	.1 50V	
C116	.1 50V	
C117	.1 50V	
C118	.1 50V	
C119	.1 50V	
C120	.1 50V	
C121	.1 50V	
C122	.1 50V	
C123	.1 50V	
C124	.1 50V	
C125	.1 50V	
C126	.1 50V	
C127	.1 50V	
C131	.1 50V	
C132	.01 25V	
C134	.01 25V	
C135	.01 25V	
C136	.01 25V	
C137	.01 25V	
C138	.01 25V	
C139	.01 25V	
C140	.01 25V	
C141	.01 25V	
C142	.01 25V	
C143	.01 25V	
C145	.01 25V	
C200	82 50V 5%	
C202	.01 25V	
C203	.01 25V	
C205	.1 50V	
C206	.001 50V 10%	
C207	.1 50V	

ITEM No.	RATING	MFGR. PART No.
C208	.01 25V	
C300	.01 25V	
C301	.01 25V	
C302	.001 50V 10%	
C303	.001 50V 10%	
C304	.001 50V 10%	
C305	.001 50V 10%	
C306	.001 50V 10%	
C307	.001 50V 10%	
C308	.001 50V 10%	
C309	.001 50V 10%	
C310	.001 50V 10%	
C311	.001 50V 10%	
C312	.001 50V 10%	
C313	.001 50V 10%	
C314	.001 50V 10%	
C315	.001 50V 10%	
C317	.1 50V	
C319	.1 50V	
C320	.001 50V 10%	
C321	.001 50V 10%	
C322	.1 50V	
C331	.001 50V 10%	
C400	.001 50V 10%	
C401	.001 50V 10%	
C402	.001 50V 10%	
C403	.001 50V 10%	
C404	.001 50V 10%	
C405	.001 50V 10%	
C406	.001 50V 10%	
C407	.001 50V 10%	
C408	.01 25V	
C409	.01 15V 5%	
C410	.022 15V 5%	
C411	220 50V 10%	
C412	.1 50V	
C413	.1 50V	
C414	.001 50V 10%	
C415	.01 25V	
C500	.01 25V	
C501	.1 50V	
C502	.1 50V	
C505	.1 50V	
C507	.01 25V	
C508	.1 50V	
C601	.001 50V 10%	
C602	.01 25V	
C603	47 NPO 50V 5%	
	22 50V	
C604	.1 50V	
C607	.001 50V 10%	
C608	.1 50V	
C609	.1 50V	
C610	.1 50V	
C611	.001 50V 10%	
C612	.1 50V	

TEXAS INSTRUMENTS
TI-99/4A MODEL PHC004A

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part No., and Description

ELECTROLYtic CAPACITORS

ITEM No.	RATING	MFGR. PART No.
C7	47 16V 20%	
C8	1000 25V 20%	
C9	3300 35V 20%	
C10	47 16V 20%	
C12	4.7 35V 20%	
C15	470 12V	
C103	100 16V 20%	
C128	22 25V	

ITEM No.	RATING	MFGR. PART No.
C129	22 25V 20%	
C130	22 25V	
C201	10 16V 20%	
C503	100 16V 20%	
C506	22 25V	
C600	100 16V 20%	
C605	1	
C606	22 25V 20%	

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA		
		MFGR. PART No.	WORKMAN PART No.	REMARKS
R500	Resistor Network	1501633-8 (1)		

(1) Number on unit.

COILS (RF-IF)

ITEM No.	FUNCTION	MFGR. PART No.
L1	RF Choke (90uH)	
L2	RF Choke (90uH)	
L3	RF Choke (90uH)	
L4	RF Choke (1mH)	
L5	RF Choke (8.2uH)	
L6	RF Choke (8.2uH)	
L100	Oscillator (2-4.5uH)	
L101	RF Choke (6.8uH)	
L102	RF Choke (6.8uH)	
L103	RF Choke (6.8uH)	
L104	RF Choke (6.8uH)	
L105	RF Choke	
L106	RF Choke	
L107	Peaking	
L108	RF Choke	
L109	RF Choke	
L110	RF Choke	
L111	RF Choke	
L112	RF Choke (6.8uH)	
L113	RF Choke (6.8uH)	
L114	RF Choke (6.8uH)	

ITEM No.	FUNCTION	MFGR. PART No.
L115	RF Choke	
L200	RF Choke (6.8uH)	
L201	Peaking (6.8uH)	
L202	Peaking (22uH)	
L203	Peaking (8.2uH)	
L308	Peaking (6.8uH)	
L309	Peaking (6.8uH)	
L310	Peaking (6.8uH)	
L311	Peaking (6.8uH)	
L312	Peaking (6.8uH)	
L313	Peaking (6.8uH)	
L400	Peaking	
L401	Peaking	
L402	Peaking	
L403	Peaking	
L500	RF Choke (6.8uH)	
L501	RF Choke	
L600	RF Choke (6.8uH)	
L602	Peaking (.33uH)	
L603	RF Choke (6.8uH)	
L604	RF Choke (6.8uH)	

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part No., and Description

TRANSFORMER (Power)

ITEM No.	RATING			REPLACEMENT DATA		
	PRI.	SEC. 1	SEC. 2	MFGR. PART No.	THORDARSON PART No.	NOTES
T1	120V AC @ 270mA AC	26.40V AC @ 686mA DC Tapped @ 17.85V AC @ 600mA DC				

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
CR6	LED		
M1	Switch		TIL220 RF Modulator Part of Keyboard
S1			
Thru			
S48			
S1A	Switch		
Y100	Crystal		Power
Y600	Crystal		10.7MHz 48MHz

CABINETS & CABINET PARTS (When ordering specify model, chassis & color)

WIRING DATA

General-use Unshielded Hook-up Wire	Use BELDEN No. 8529 (Solid) Available in 13 Colors 8522 (Stranded) Available in 13 Colors
300-Ohm Input Lead	Use BELDEN No. 8225
75-Ohm Input Lead	Use BELDEN No. 8241

LOGIC

PIN NO.	IC U100	PIN NO.	IC U100	PIN NO.	IC U102	IC U103	IC U104	IC U105	IC U106	IC U107	IC U108	IC U109
1	P	21	P	1	L	L	L	L	L	L	L	L
2	P	22	P	2	P	P	P	P	P	P	P	P
3	P	23	P	3	H	H	H	H	H	H	H	H
4	P	24	P	4	P	P	P	P	P	P	P	P
5	P	25	P	5	P	P	P	P	P	P	P	P
6	P	26	P	6	P	P	P	P	P	P	P	P
7	P	27	P	7	P	P	P	P	P	P	P	P
8	P	28	P	8	H	P	H	H	H	H	H	H
9	P	29	P	9	H	H	H	H	H	H	H	H
10	P	30	P	10	P	P	P	H	P	H	H	H
11	H	31	P	11	P	P	P	P	P	P	H	H
12	L	32	P	12	P	P	P	P	P	P	P	P
13	P	33	H	13	P	P	P	P	P	P	P	P
14	H	34	H	14	P	P	P	P	P	P	P	P
15	P	35	H	15	P	P	P	P	P	P	P	P
16	P	36	P	16	L	P	P	P	P	P	P	L
17	P	37	P	17								
18	P	38	P	18								
19	P	39	P	19								
20	P	40	P	20								
PIN NO.	IC U300	PIN NO.	IC U300	PIN NO.	IC U302	IC U500	IC U501	IC U502	IC U503	IC U504	IC U505	IC U506
1	H	21	P	1	P	P	P	P	L	L	P	P
2	P	22	P	2	L	P	P	P	P	P	P	P
3	P	23	H	3	P	P	P	P	P	P	P	P
4	P	24	P	4	P	P	P	P	P	P	P	P
5	P	25	P	5	H	P	P	P	P	P	P	P
6	H(2)	26	P	6	P	P	P	P	P	P	P	P
7	H(3)	27	L	7	P	P	P	P	P	H	P	P
8	H(4)	28	*(10)	8	L	P	P	P	P	L	P	L
9	H(5)	29	H	9	P	H	H	H	P	H	H	H
10	P	30	L(11)	10	P	P	H	P	P	H	H	H
11	P	31	H(6)	11	P	P	P	P	P	P	H	P
12	P	32	H(7)	12	P	P	P	P	P	H	H	H
13	H	33	H(8)	13	P	P	P	P	P	H	P	H
14	P	34	H(9)	14	L	P	P	P	P	H	H	P
15	P	35	P	15	H	P	P	P	P	H	P	H
16	L	36	P	16	H	P	P	P	H	H	H	H
17	H	37	*	17								
18	P	38	L	18								
19	H	39	P	19								
20	H	40	H	20								

NOTE: Logic probe readings taken with computer in Power Up mode (Main title screen displayed) unless otherwise noted.

Logic Probe Display

L = Low

H = High

P = Pulse

* = Open (no light on)

(2) Probe will show P when the 6 key is pressed.

(3) Probe will show P when the Y key is pressed.

(4) Probe will show P when the H key is pressed.

(5) Probe will show P when the N key is pressed.

(6) Probe will show P when the Z key is pressed.

(7) Probe will show P when the Q key is pressed.

(8) Probe will show P when the A key is pressed.

(9) Probe will show P when the 2 key is pressed.

(10) Probe will show P when saving program to tape.

(11) Probe will show P when loading program from tape.

LOGIC (Continued)

PIN NO.	IC U507	IC U508	IC U509	IC U510	IC U511	PIN NO.	IC U600							
PIN NO.	IC U601	IC U602	IC U603	IC U604	IC U605	IC U606	IC U607	IC U608	IC U609	IC U610	IC U611	IC U612	IC U613	
1 2 3 4	P P P H	P P P H	L P P L	L L H L	P P P P	1 2 3 4	L H P H	21 22 23 24	P L L P	41 42 43 44	P P P P	61 62 63 64	P P P H	
5 6 7 8	P H L P	L H L P	P P P L	P P P P	P H (1) L	5 6 7 8	L H P P	25 26 27 28	P L H H	45 46 47 48	P P P P			
9 10 11 12	P P P P	P P P P	P P P P	P L P P	L P P P	9 10 11 12	P P P P	29 30 31 32	P P P P	49 50 51 52	P P P P			
13 14 15 16	P H	P H	P P L H	P P L H	P P P H	13 14 15 16	P P P P	33 34 35 36	H L L L	53 54 55 56	P P P P			
17 18 19 20				H L L H		17 18 19 20	P P P P	37 38 39 40	L L L L	57 58 59 60	* * H P			
1 2 3 4	L L L H	P P P P	P P P P	P P P P	L P P L	P P P P	H P P P	L P P P	L P P P	P P P P	H P P P	P P P L	P P P L	
5 6 7 8	H P P P	P P L P	P P L P	*	L L P	P P L P	P P L P	P P P P	P P P P	P P P P	P P P P	P P P P	P P L H	L * * L P P P
9 10 11 12	P L P P	P P P P	P P P P	P H L H	P H L H	P P P P	P H P P	P H P P	P H P L	P H P L	P P P L	P P P P	P P P L	L L P P
13 14 15 16	H P P P	P H	P H	L H	P H	P H	H H	H H	H L L P	H L L P	P P P P	P P P P	P P P P	H H
17 18 19 20	H L L H								P P P P	P P P P	P P P P	P P P P	P P P P	
21 22 23 24									P P P H	P P P H	L P P H	L P P H	L P P H	

NOTE: Logic probe readings taken with computer in Power Up mode (Main title screen displayed) unless otherwise noted.

Logic Probe Display

H = High

P = Pulse

* = Open (no light on)

(1) Probe will show P when sound is being produced.

LOGIC (Continued)

PIN NO.	IC U614	IC U615	IC U616	LEAD	Q200	Q201	Q300	Q301
1	P	P	P					
2	P	P	P	E	P	P	H	P
3	P	P	P	B	P	H	H	P
4	P	P	P	C				
5	P	P	P					
6	P	P	P					
7	P	P	P					
8	P	P	P					
9	P	P	P					
10	L	L	P					
11	P	P	P					
12	P	P	P					
13	P	P	P					
14	P	P	P					
15	P	P	P					
16	P	P	P					
17	P	P	P					
18	P	P	P					
19	P	P	H					
20	H	H	H					

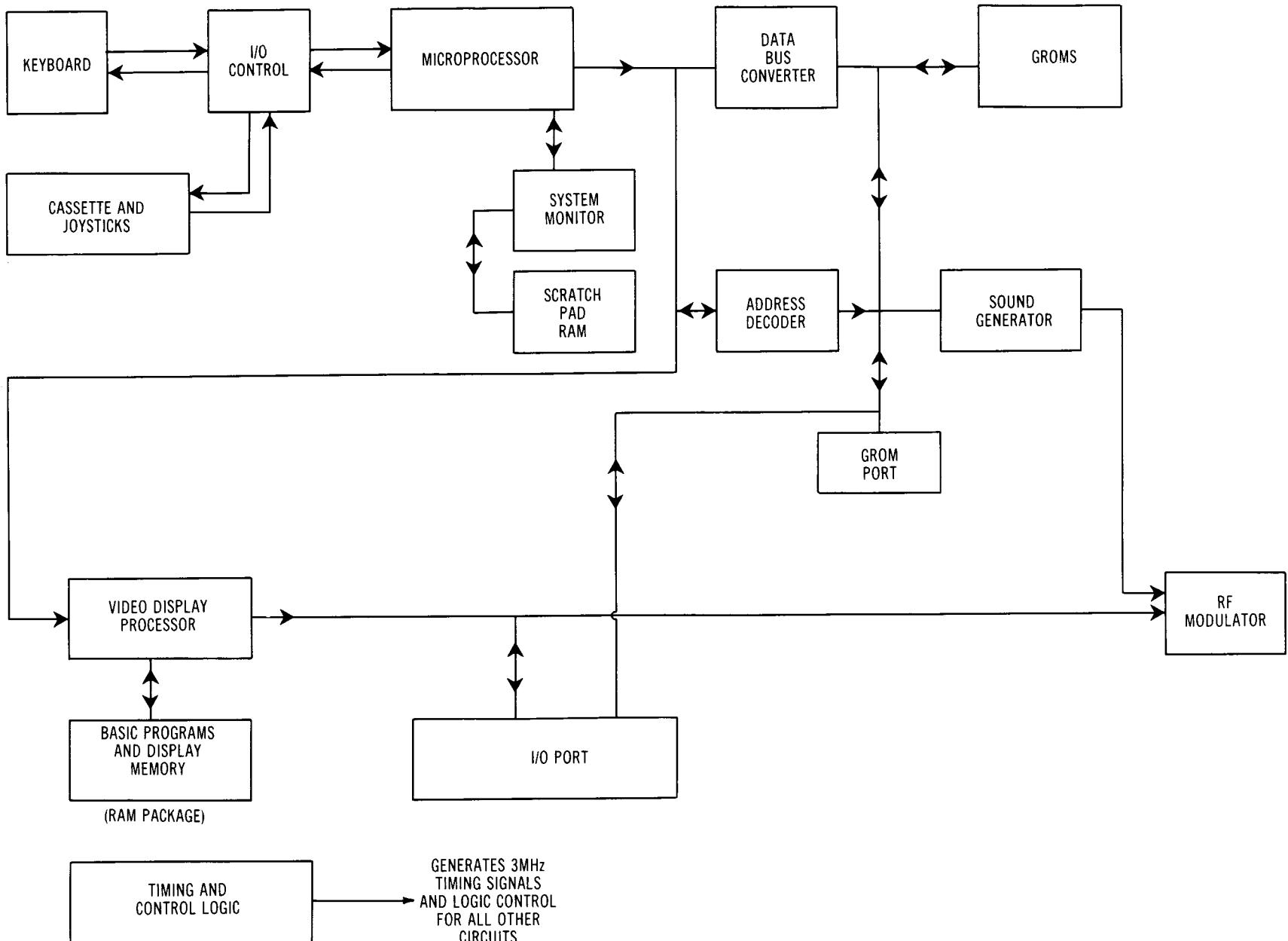
NOTE: Logic probe readings taken with computer in Power Up mode (Main title screen displayed) unless otherwise noted.

Logic Probe Display

L = Low

H = High

P = Pulse



TI-99/4A MODEL PHC004A
TEXAS INSTRUMENTS