

TEXAS INSTRUMENTS
TI-99/4A MODEL PHC004A

MAIN BOARD



TI-99/4A MODEL PHC004A

TEXAS INSTRUMENTS
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CC 2

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PRELIMINARY SERVICE CHECKS
ENCLOSED

SAFETY PRECAUTIONS
See page 13.

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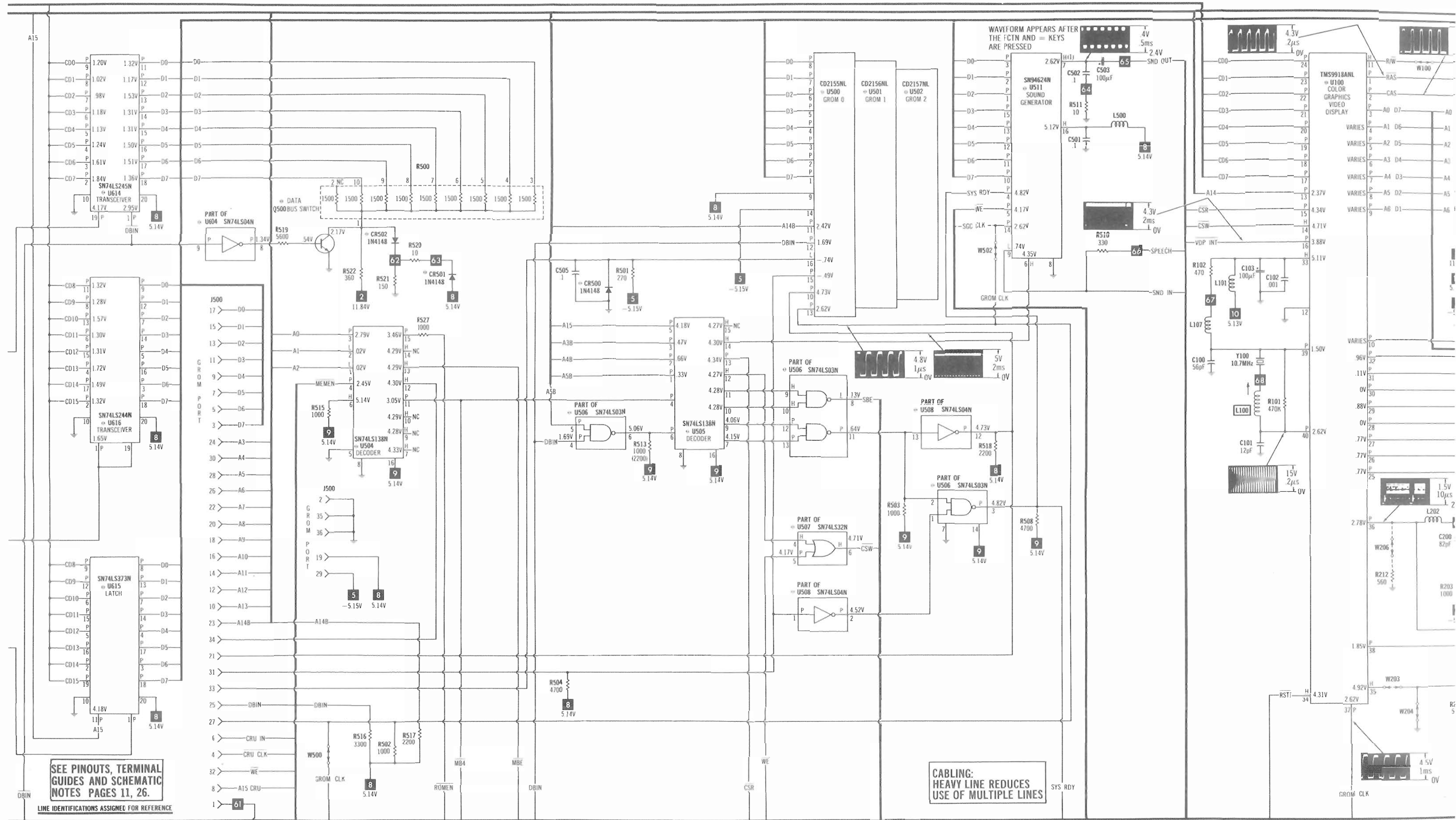
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COMPUTERFACTS-OF-THE-MONTH SET NO. CF1 FOLDER CC 2



A PHOTOFAC STANDARD NOTATION SCHEMATIC
 WITH **CIRCUITRACE**
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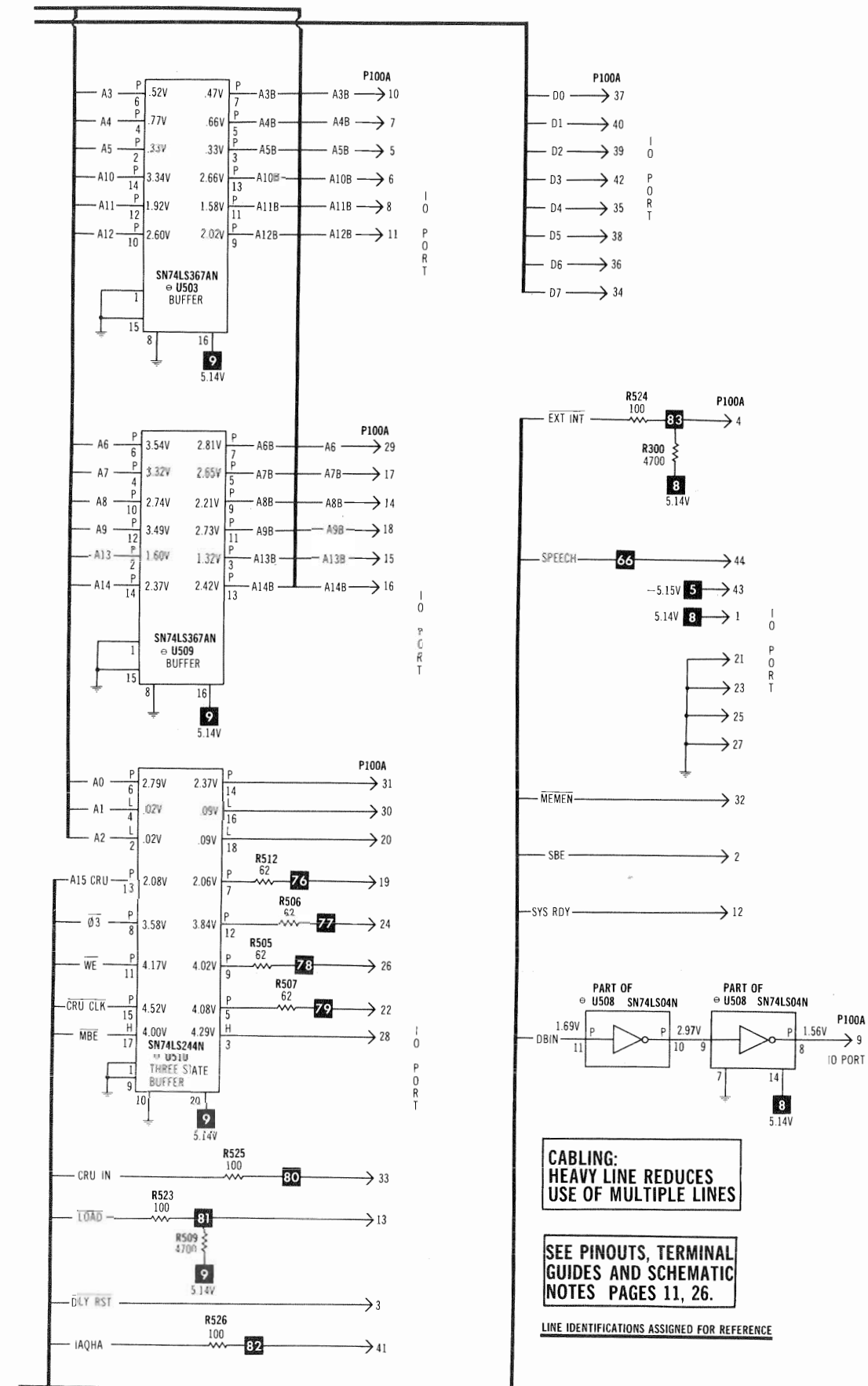
SEE LINE DEFINITIONS ON PAGE 13

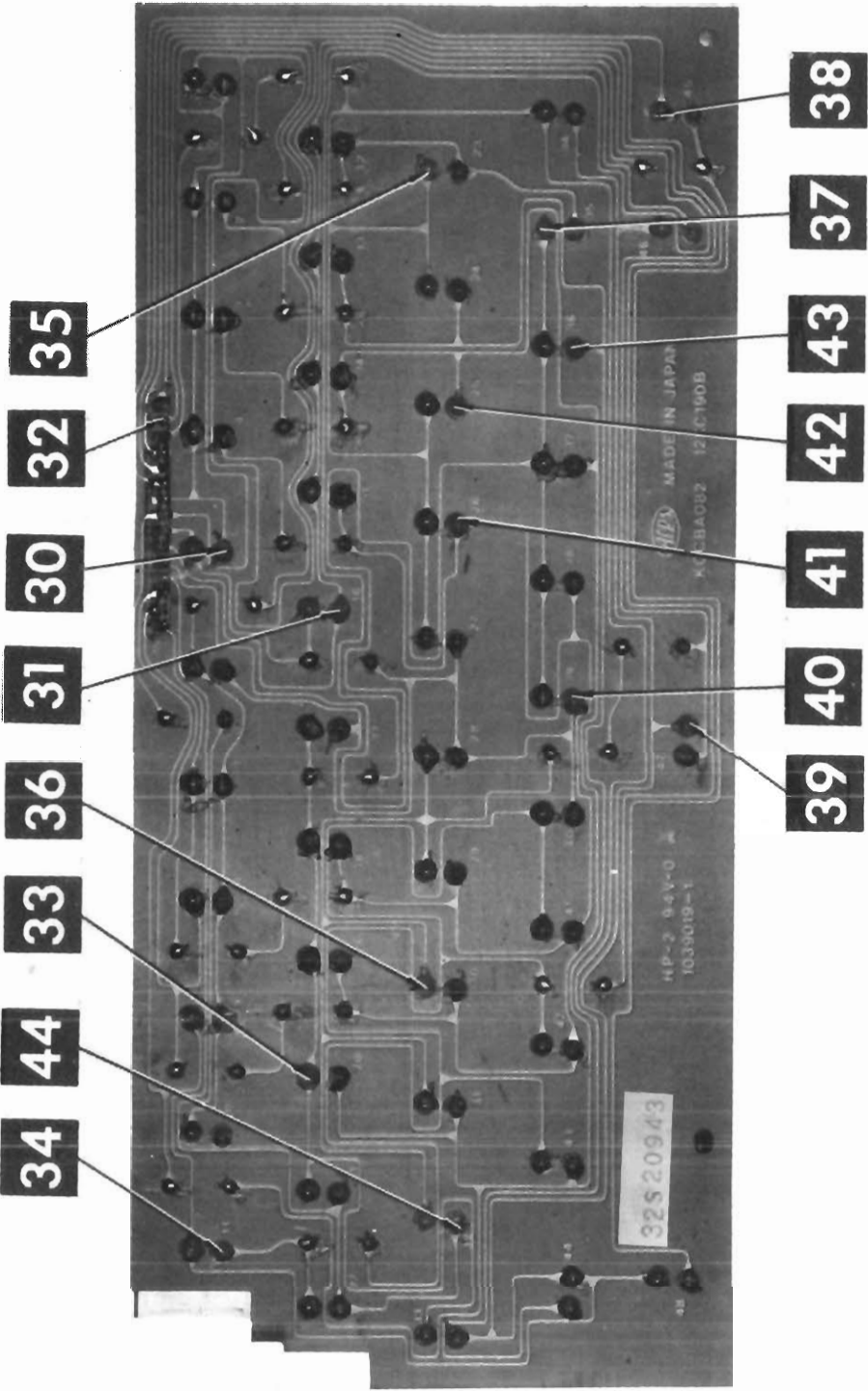


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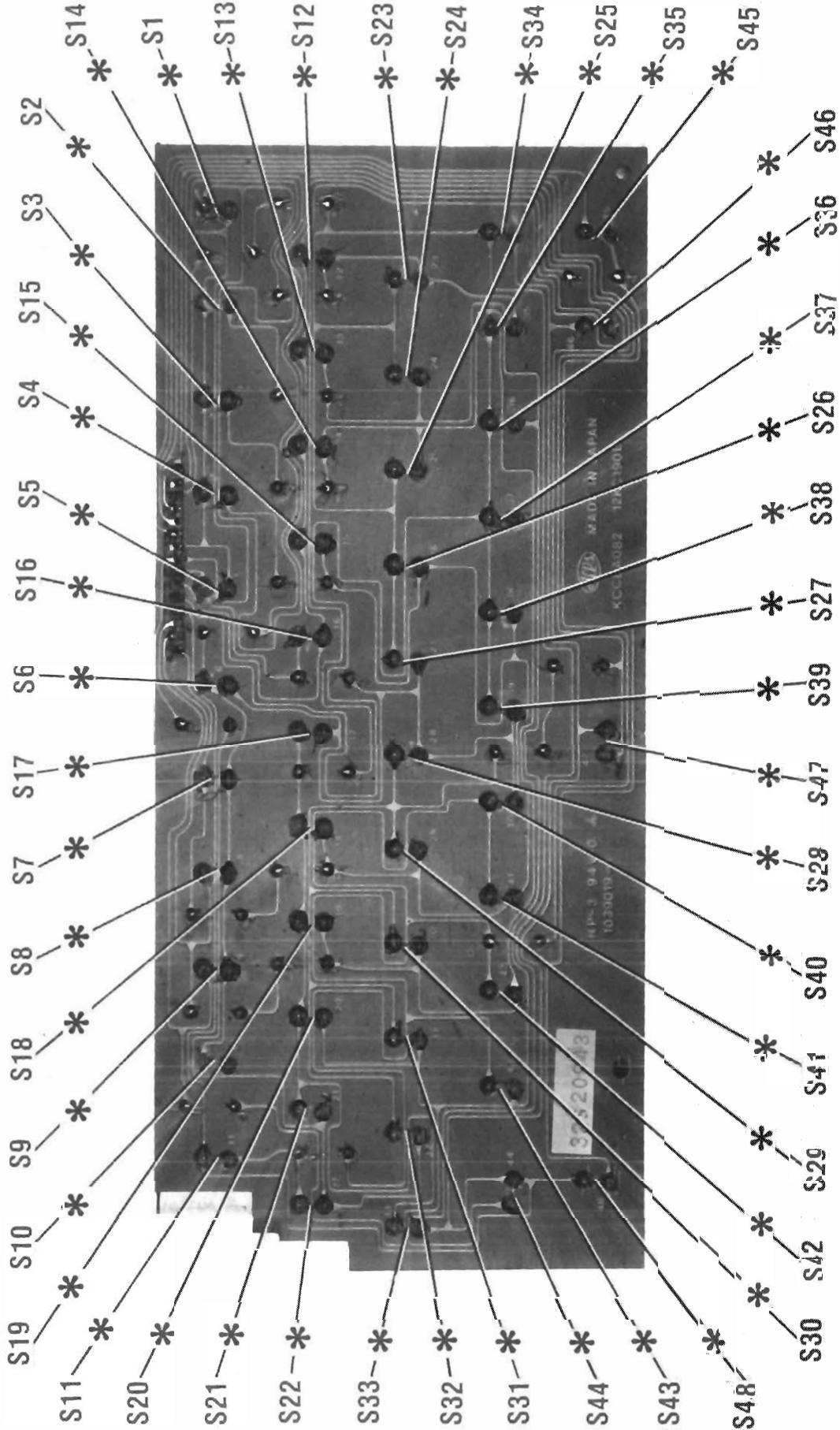
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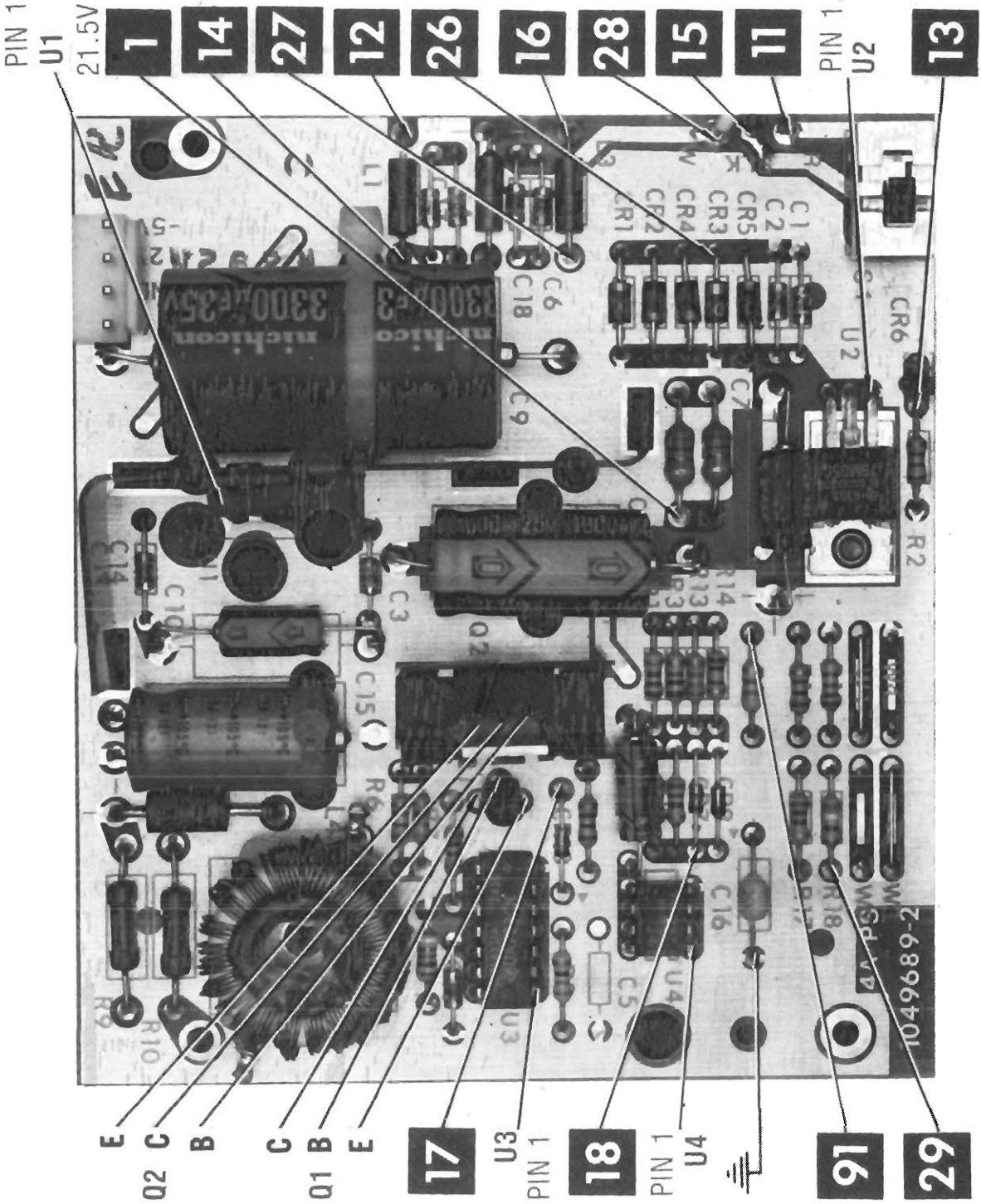
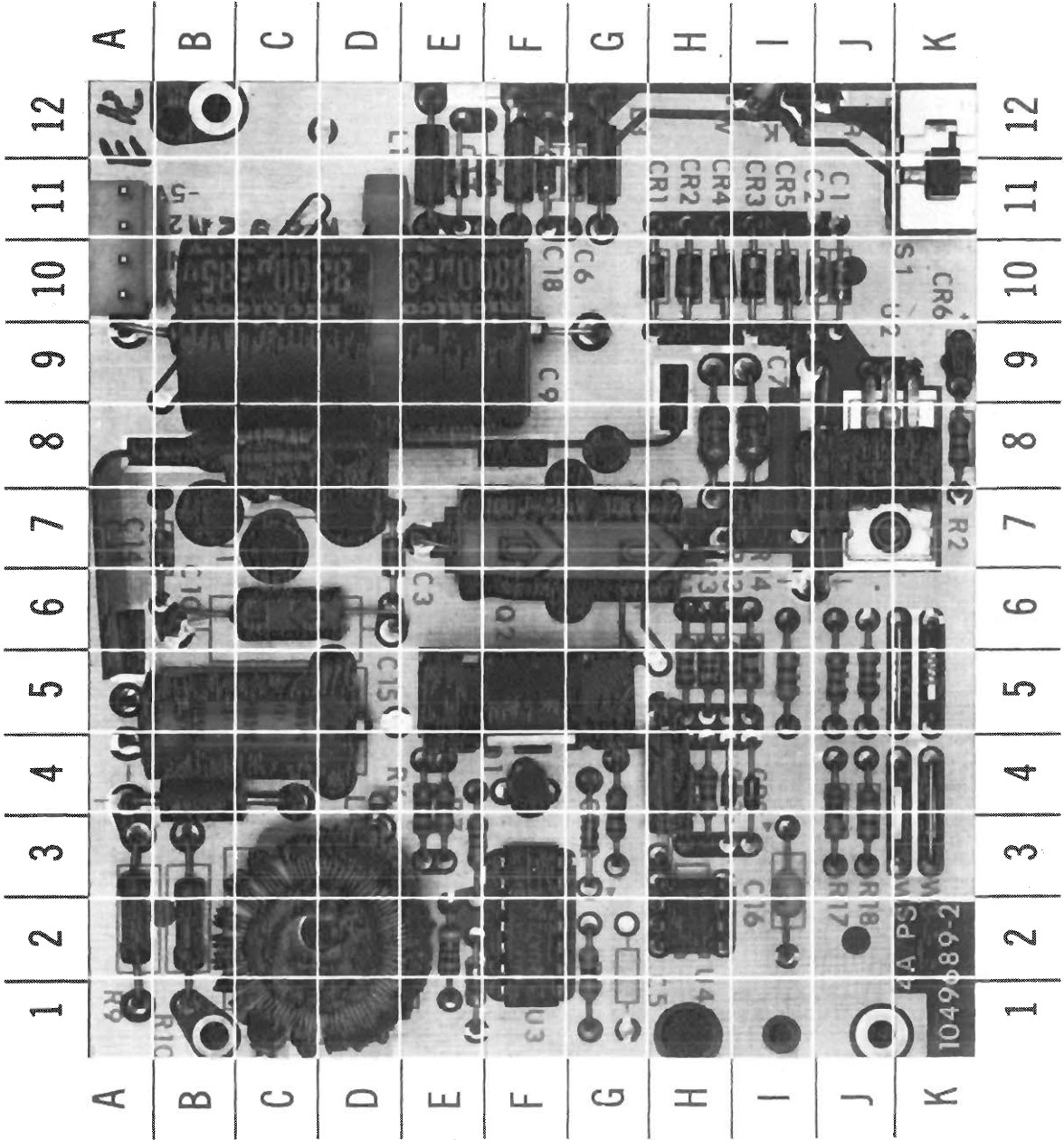


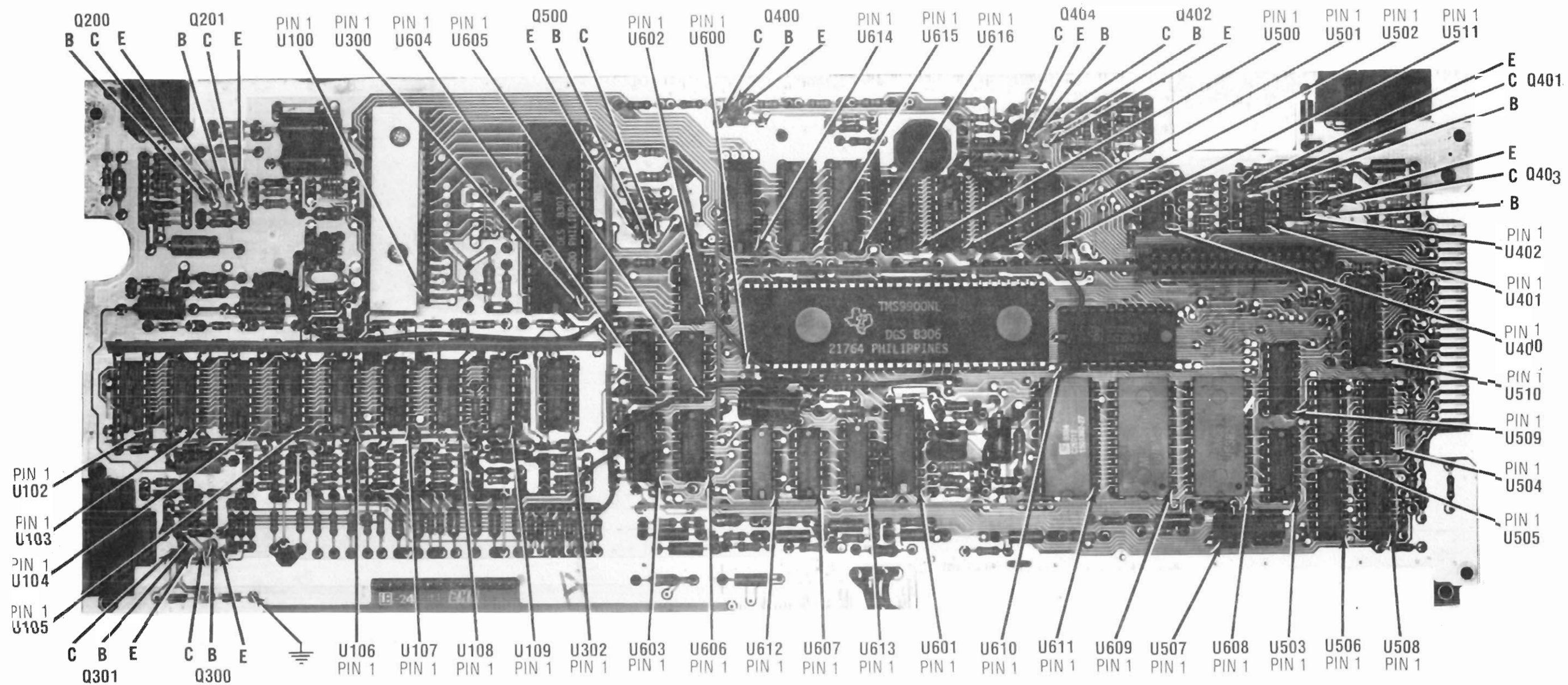


NOTE THERE IS NO GROUND ON KEYBOARD

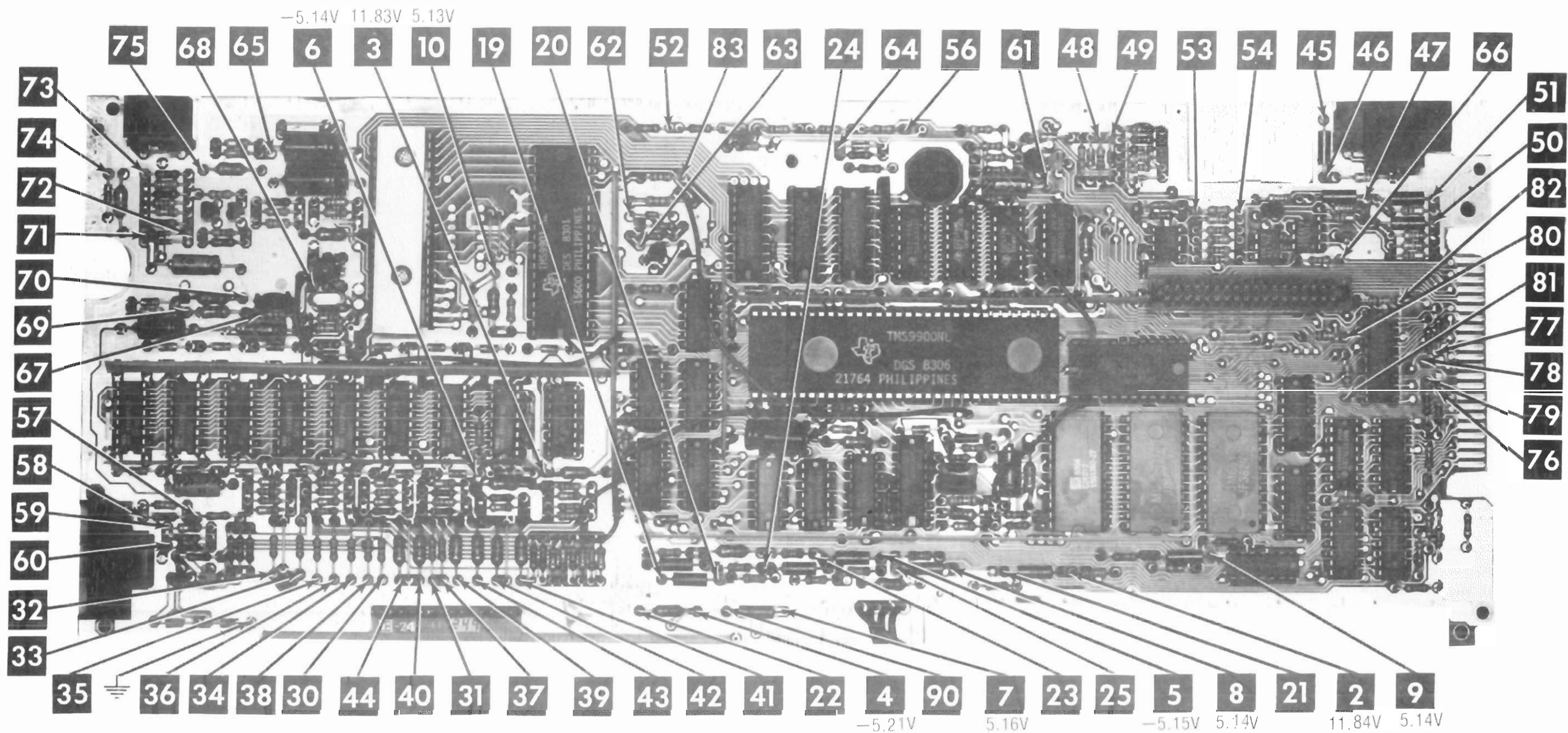


* LOCATED ON OTHER SIDE OF BOARD

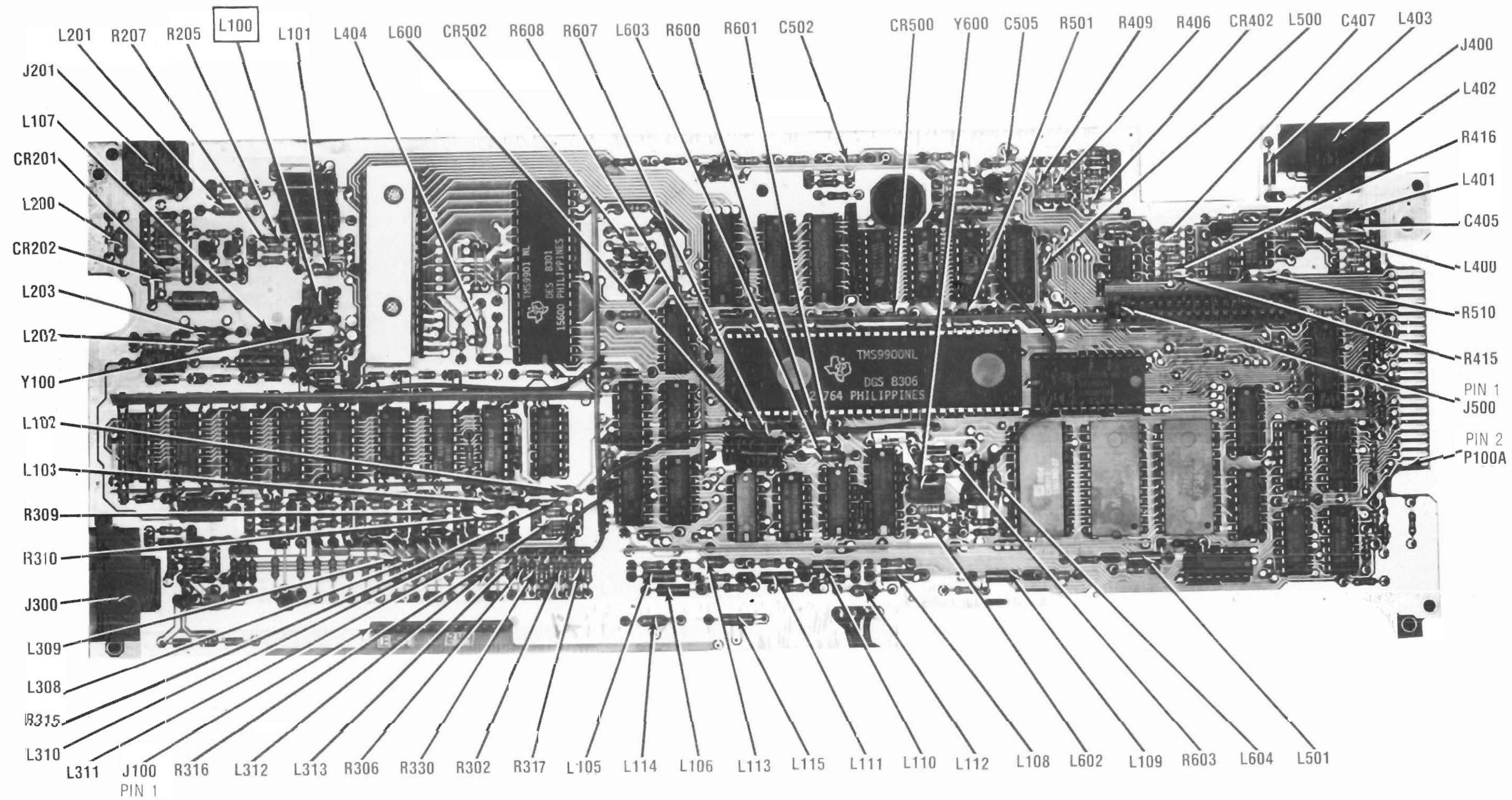




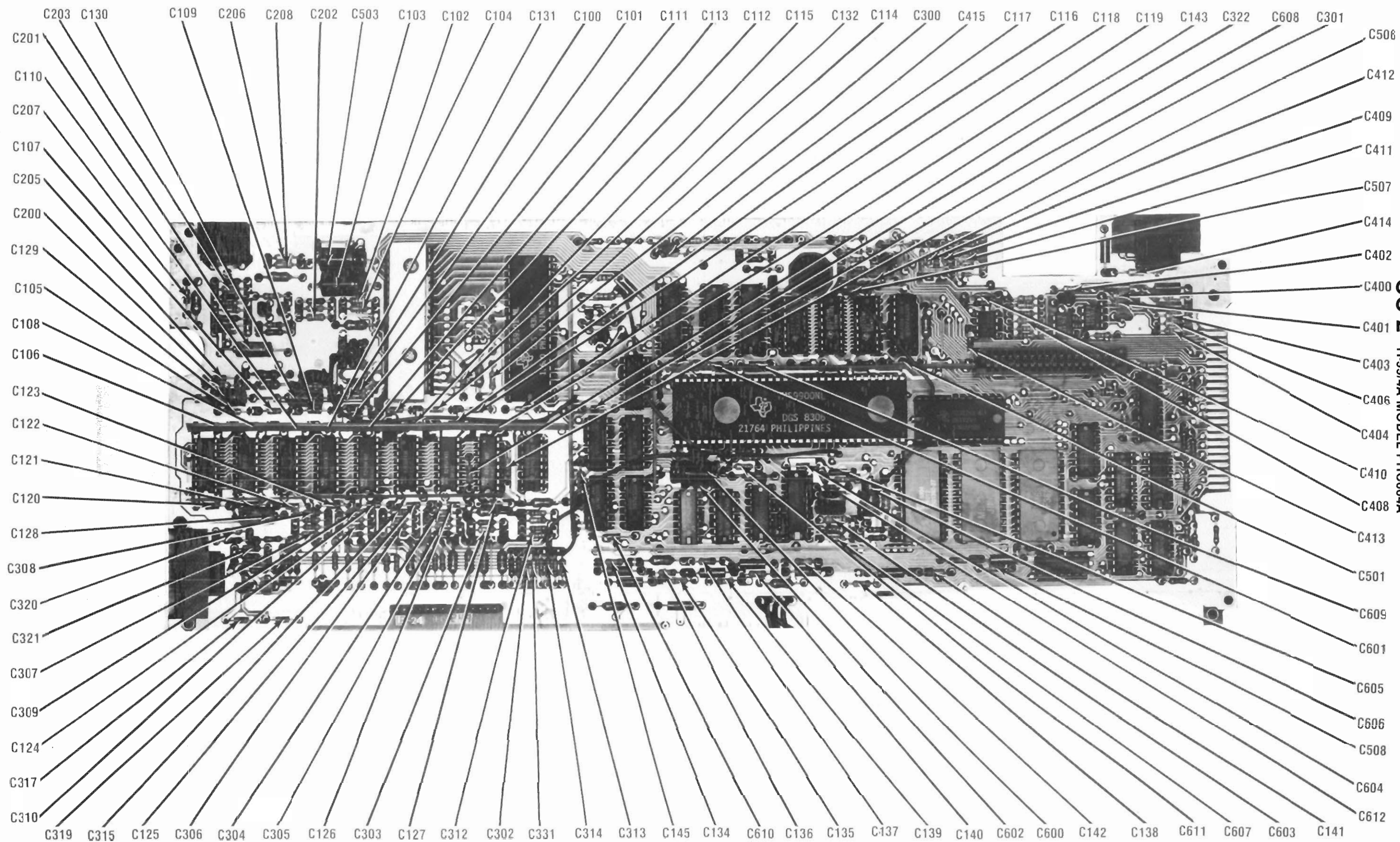
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TI-99/4A MODEL PHC004A



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TI-99/4A MODEL PHC004A



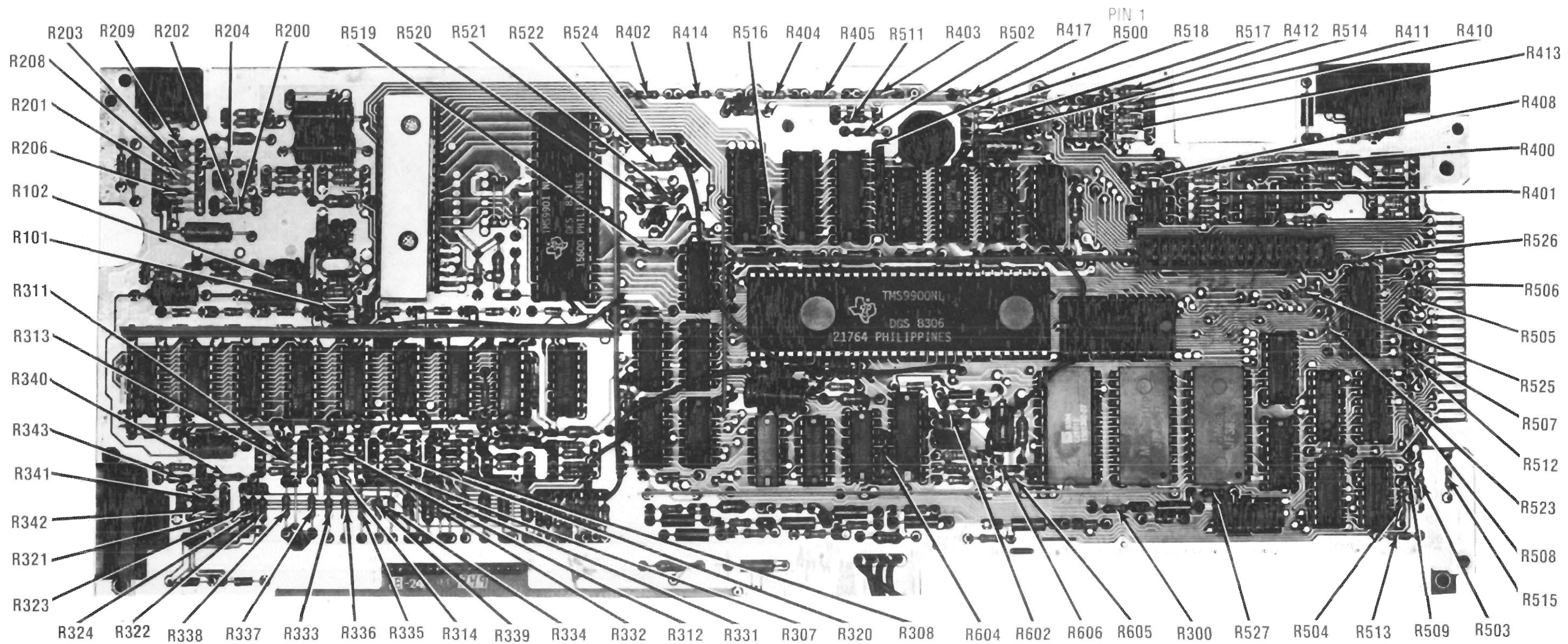
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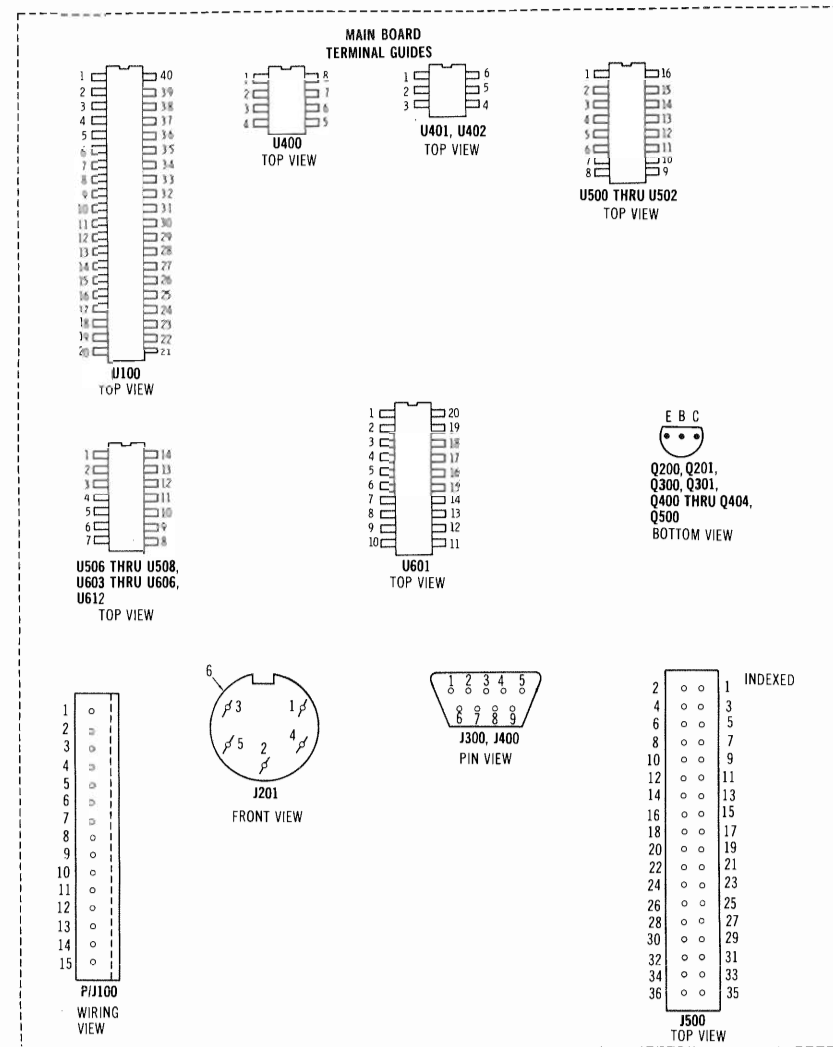
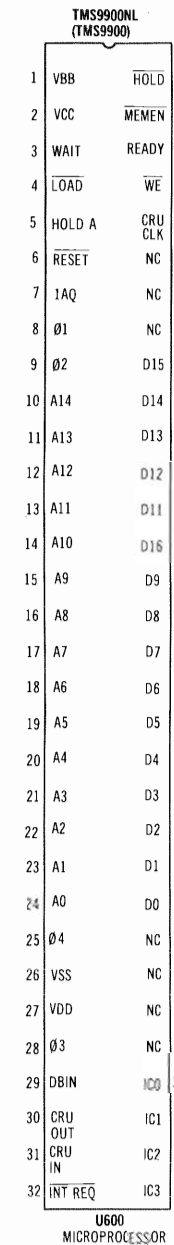
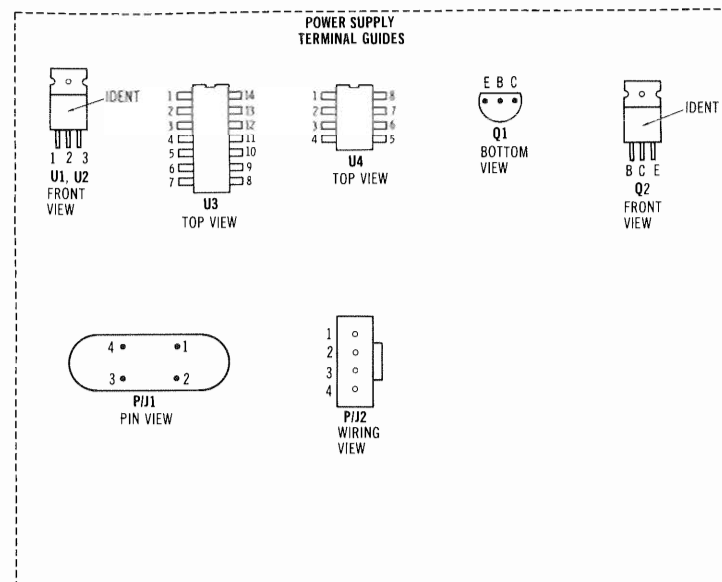
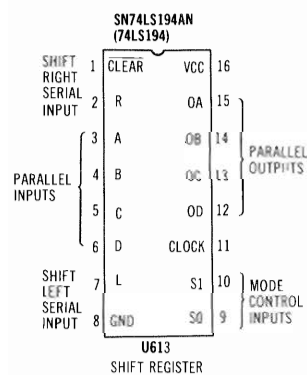
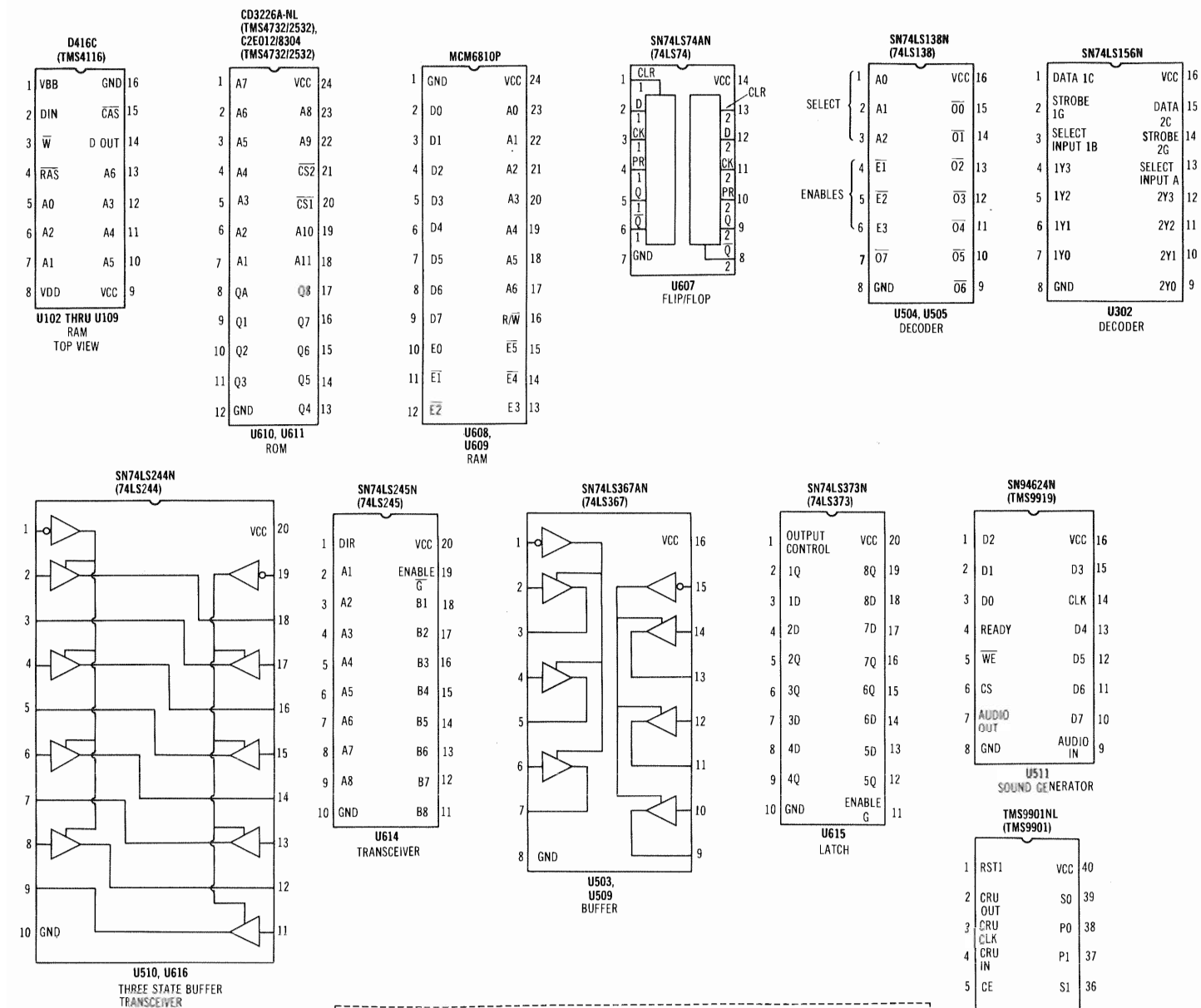
MAIN BOARD

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 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.

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.

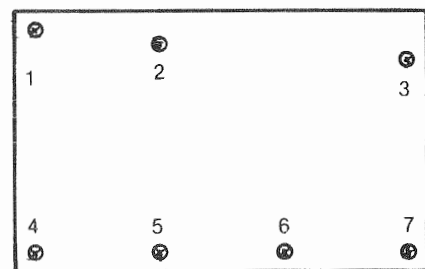


Figure 1
BOTTOM VIEW

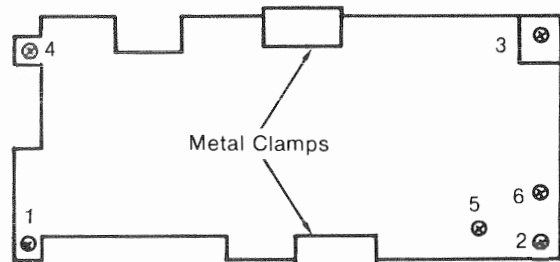
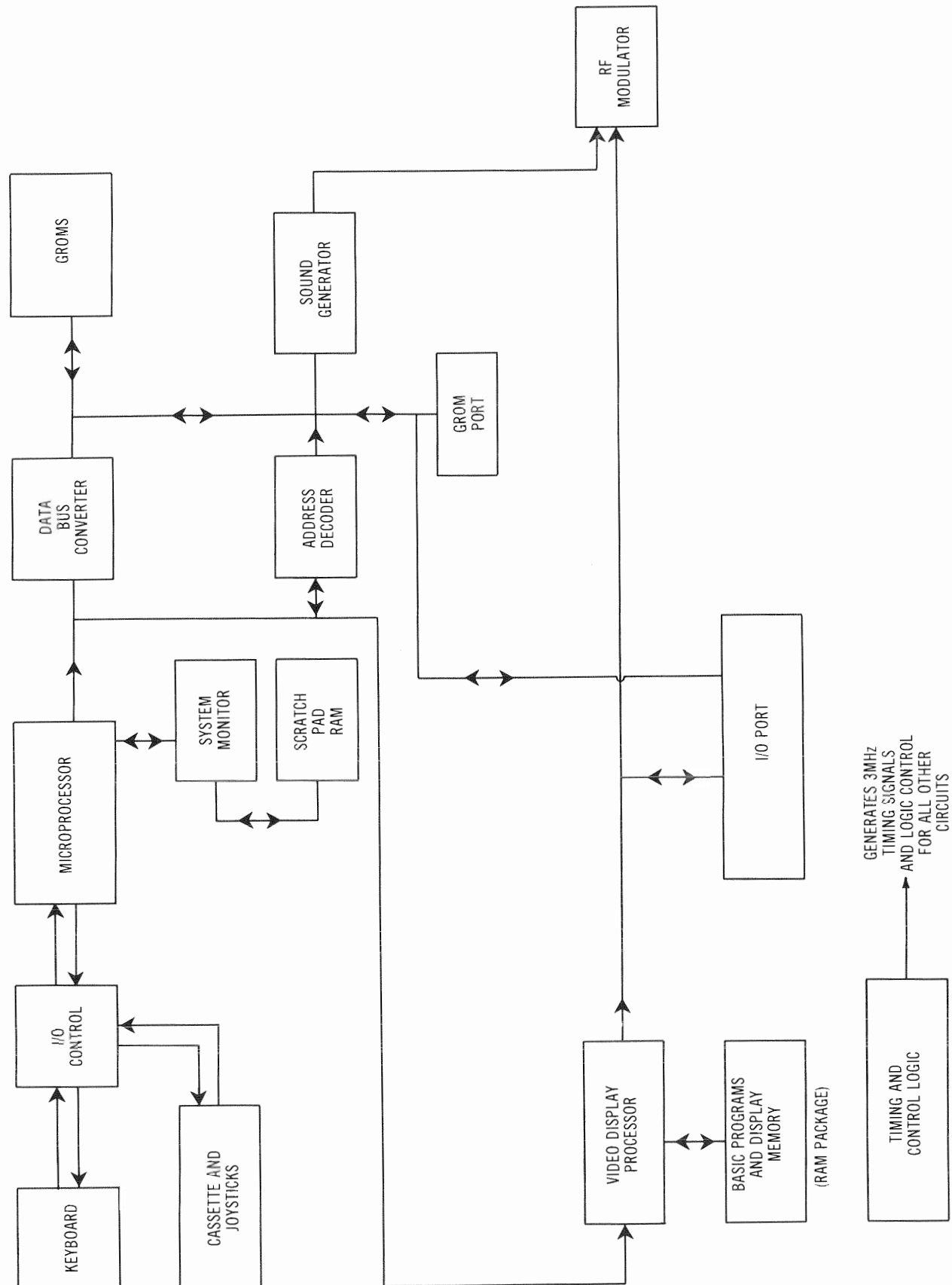


Figure 2
BOTTOM VIEW



BLOCK DIAGRAM

TEXAS INSTRUMENTS
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LOGIC (Continued)

PIN NO.	IC U614	IC U615	IC U616	LEAD	Q200	Q201	Q300	Q301
1	P	P	P	E	P	P	H	P
2	P	P	P	B	P	P	H	P
3	P	P	P	C	P	H	H	H
4	P	P	P					
5	P	P	P					
6	P	P	P					
7	P	P	P					
8	P	P	P					
9	P	P	P					
10	L	L	L					
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	P					
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

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.

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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.

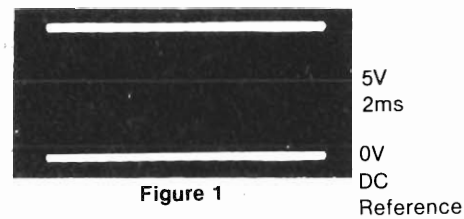


Figure 1

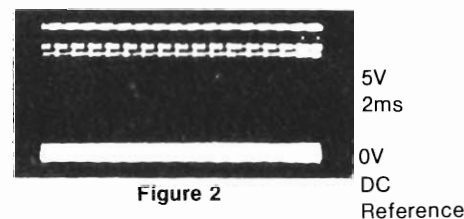


Figure 2

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 $\phi 1$, $\phi 2$, $\phi 3$ and $\phi 4$ clocks at pins 12, 11, 8 and 9 of IC U601 (See Figure 3). Check the phase relationships of the $\phi 1$, $\phi 2$, $\phi 3$ and $\phi 4$ 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").

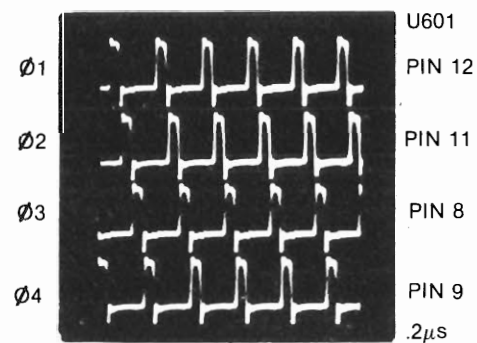


Figure 3

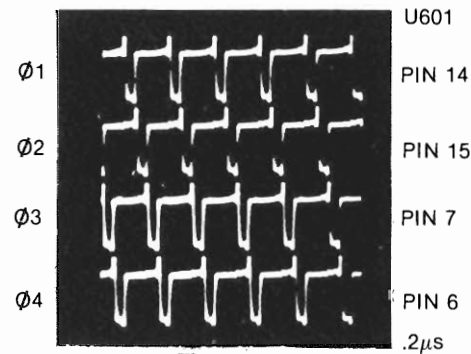


Figure 4

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").

LOGIC (Continued)

PIN NO.	IC U507	IC U508	IC U509	IC U510	IC U511	PIN NO.	IC U600	PIN NO.	IC U600	PIN NO.	IC U600	PIN NO.	IC U600
1	P	P	L	L	P	1	L	21	P	41	P	61	P
2	P	P	P	L	P	2	H	22	L	42	P	62	P
3	P	H	P	H	P	3	P	23	L	43	P	63	P
4	H	L	P	L	P	4	H	24	P	44	P	64	H
5	P	L	P	P	P	5	L	25	P	45	P		
6	H	H	P	P	H	6	H	26	L	46	P		
7	L	L	P	P	H(1)	7	P	27	H	47	P		
8	P	P	L	P	L	8	P	28	H	48	P		
9	P	P	P	P	L	9	P	29	P	49	P		
10	P	P	P	P	P	10	P	30	P	50	P		
11	P	P	P	P	P	11	P	31	P	51	P		
12	P	P	P	P	P	12	P	32	P	52	P		
13	P	P	P	P	P	13	P	33	H	53	P		
14	H	H	P	P	P	14	P	34	L	54	P		
15			L	P	P	15	P	35	L	55	P		
16			H	L	H	16	P	36	L	56	P		
17				H		17	P	37	L	57	*		
18				L		18	P	38	L	58	*		
19				L		19	P	39	L	59	H		
20				H		20	P	40	L	60	P		
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	L	P	P	P	L	P	H	L	L	P	P	H	P
2	L	P	P	P	P	P	P	P	P	P	P	P	P
3	L	P	P	P	P	P	P	P	P	P	P	P	P
4	H	P	P	P	L	P	P	P	P	P	P	P	L
5	H	P	P	*	P	P	P	P	P	P	P	P	L
6	P	P	P	L	L	P	P	P	P	P	P	P	*
7	P	P	P	L	L	P	P	P	P	P	P	P	*
8	P	P	P	L	P	P	P	P	P	P	P	P	L
9	P	P	P	P	P	P	P	P	P	P	P	P	P
10	L	P	P	P	P	P	P	P	P	P	P	P	P
11	P	P	P	P	P	P	P	P	P	P	P	P	P
12	P	P	P	H	P	P	P	L	L	L	L	P	P
13	H	P	P	L	P	P	H	H	H	P	P	H	P
14	P	H	H	H	H	H	H	L	L	P	P	H	P
15	P							L	L	P	P		P
16	P							P	P	P	P		P
17	H							P	P	P	P		P
18	L							P	P	P	P		P
19	L							P	P	P	P		P
20	H							P	P	P	P		P
21								P	P	L	L		
22								P	P	P	P		
23								P	P	P	P		
24								H	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
* = Open (no light on)
(1) Probe will show P when sound is being produced.

TEXAS INSTRUMENTS
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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	H	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	P	P	P	P	P
11	H	31	P	11	P	P	P	P	P	P	P	P
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	L	L	L	L	L	L	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	L	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	L	P	P
6	H(2)	26	P	6	P	P	P	P	P	H	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	L	L	L	L
9	H(5)	29	H	9	P	H	H	H	P	H	P	H
10	P	30	L(11)	10	P	P	P	P	P	H	H	H
11	P	31	H(6)	11	P	P	P	P	P	H	H	P
12	P	32	H(7)	12	P	P	P	P	P	H	H	P
13	H	33	H(8)	13	P	P	P	P	P	H	P	P
14	P	34	H(9)	14	L	L	L	L	P	H	H	H
15	P	35	P	15	P	L	L	L	L	H	H	H
16	L	36	P	16	H	L	L	L	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.

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

5V
20ms
0V
DC
Reference

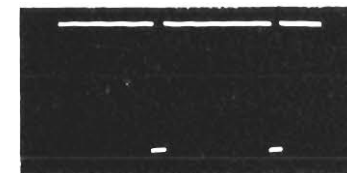


Figure 6

5V
20ms
0V
DC
Reference

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 Opto-isolator 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 52 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.

16

PARTS LIST AND DESCRIPTION (Continued)

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

ELECTROLYTIC CAPACITORS

ITEM No.	RATING	MFGR. PART No.	ITEM No.	RATING	MFGR. PART No.
C7	47 16V 20%		C129	22 25V 20%	
C8	1000 25V 20%		C130	22 25V	
C9	3300 35V 20%		C201	10 16V 20%	
C10	47 16V 20%		C503	100 16V 20%	
C12	4.7 35V 20%		C506	22 25V	
C15	470 12V		C600	100 16V 20%	
C103	100 16V 20%		O605	1	
C128	22 25V		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.	ITEM No.	FUNCTION	MFGR. PART No.
L1	RF Choke (90uH)		L115	RF Choke	
L2	RF Choke (90uH)		L200	RF Choke (6.8uH)	
L3	RF Choke (90uH)		L201	Peaking (6.8uH)	
L4	RF Choke (1mH)		L202	Peaking (22uH)	
L5	RF Choke (8.2uH)		L203	Peaking (8.2uH)	
L6	RF Choke (8.2uH)		L308	Peaking (6.8uH)	
L100	Oscillator (2-4.5uH)		L309	Peaking (6.8uH)	
L101	RF Choke (6.8uH)		L310	Peaking (6.8uH)	
L102	RF Choke (6.8uH)		L311	Peaking (6.8uH)	
L103	RF Choke (6.8uH)		L312	Peaking (6.8uH)	
L104	RF Choke (6.8uH)		L313	Peaking (6.8uH)	
L105	RF Choke		L400	Peaking	
L106	RF Choke		L401	Peaking	
L107	Peaking		L402	Peaking	
L108	RF Choke		L403	Peaking	
L109	RF Choke		L500	RF Choke (6.8uH)	
L110	RF Choke		L501	RF Choke	
L111	RF Choke		L600	RF Choke (6.8uH)	
L112	RF Choke (6.8uH)		L602	Peaaking (.33uH)	
L113	RF Choke (6.8uH)		L603	RF Choke (6.8uH)	
L114	RF Choke (6.8uH)		L604	RF Choke (6.8uH)	

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								
			EGG PART No.	GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NTE PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.		
U3	UA723CN		ECG9230	GE IC-260	MC1723CP	NTE9230	SK3165/9230	WEP2331/9230	221-Z9020		
U4	UA723C		ECG9230	GE IC-260	MC1723CP	NTE9230	SK3165/9230	WEP2331/9230	221-Z9020		
U100	TL331										
	TMS9918ANL										
	TMS9918A										
U102 thru	D416C		ECG2117			NTE2117			HE-443-904		
U109	TMS4116		ECG2117			NTE2117			HE-443-904		
U300	TMS9901NL										
	TMS9901										
U302	SN74LS156N			ECG74LS156			NTE74LS156				
U400	RC4558P		ECG778A	GE IC-220	MC1458CP1	NTE778A	SK3465/778A	WEP2053/778A	221-Z9034		
	4558		ECG778A	GE IC-220	MC1458CP1	NTE778A	SK3465/778A	WEP2053/778A	221-Z9034		
U401,2	TL119		ECG3044		TL119	NTE3044					
U500	CD2155NL										
	TMC0430										
U501	CD2156NL										
	TMC0430										
U502	CD2157NL										
U503	SN74LS367AN			ECG74LS367		SN74LS367AN	NTE74LS367	SK74LS367	HE-443-857		
	74LS367			ECG74LS367		SN74LS367AN	NTE74LS367	SK74LS367	HE-443-857		
U504,5	SN74LS138N		ECG74LS138		SN74LS138N	NTE74LS138	SK74LS138	HE-443-877			
	74LS138		ECG74LS138		SN74LS138N	NTE74LS138	SK74LS138	HE-443-877			
U506	SN74LS03N		ECG74LS03		SN74LS03N	NTE74LS03	SK74LS03	HE-443-745			
	74LS03		ECG74LS03		SN74LS03N	NTE74LS03	SK74LS03	HE-443-745			
U507	SN74LS32N		ECG74LS32		SN74LS32N	NTE74LS32	SK74LS32	HE-443-875			
	74LS32	ECG74LS32		SN74LS32N	NTE74LS32	SK74LS32	HE-443-875				
U508	SN74LS04N		ECG74LS04		SN74LS04N	NTE74LS04	SK74LS04	HE-443-755			
	74LS04		ECG74LS04		SN74LS04N	NTE74LS04	SK74LS04	HE-443-755			
U509	SN74LS367AN		ECG74LS367		SN74LS367AN	NTE74LS367	SK74LS367	HE-443-857			
	74LS367		ECG74LS367		SN74LS367AN	NTE74LS367	SK74LS367	HE-443-857			
U510	SN74LS244N		ECG74LS244		SN74LS244N	NTE74LS244	SK74LS244	HE-443-791			
	74LS244	ECG74LS244		SN74LS244N	NTE74LS244	SK74LS244	HE-443-791				

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

SEMICONDUCTORS (Select replacement for best results) (cont)

ITEM No.	TYPE No.	MFG. PART No.	REPLACEMENT DATA						ZENITH PART No.
			EGG PART No.	GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NTE PART No.	RCA PART No.	WORKMAN PART No.	
U511	SN94624N TMS9919	74LS04	ECG74LS04		SN74LS04N	NTE74LS04	SK74LS04		HE-443-755 HE-443-755 HE-443-728 HE-443-728 HE-443-755 HE-443-755
U600	TMS9900NL								
U601	TIM9904ANL 74LS362								
U602	SN74LS04N								
U603	SN74LS00N								
U604	SN74LS04N								
U605	SN74LS32N								
U606	SN74LS00N								
U607	SN74LS74AN								
U608,9	MCM6810P								
U610	CD3226A-NL	74LS00	ECG6810		MCM6810P	NTE6810			HE-443-875 HE-443-875 HE-443-728 HE-443-728 HE-443-755 HE-443-755
U611	TMS4732/2532								
U612	SN74LS00N								
U613	SN74LS194AN								
U614	SN74LS245N								
U615	SN74LS373N								
U616	SN74LS244N								
U617	SN74LS244								
U618	SN74LS00N								
U619	SN74LS194								
U620	SN74LS245								
U621	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U622	SN74LS244N								
U623	SN74LS244								
U624	SN74LS00N								
U625	SN74LS194								
U626	SN74LS245								
U627	SN74LS373								
U628	SN74LS244								
U629	SN74LS00N								
U630	SN74LS194								
U631	SN74LS245								
U632	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U633	SN74LS244								
U634	SN74LS00N								
U635	SN74LS194								
U636	SN74LS245								
U637	SN74LS373								
U638	SN74LS244								
U639	SN74LS00N								
U640	SN74LS194								
U641	SN74LS245								
U642	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U643	SN74LS244								
U644	SN74LS00N								
U645	SN74LS194								
U646	SN74LS245								
U647	SN74LS373								
U648	SN74LS244								
U649	SN74LS00N								
U650	SN74LS194								
U651	SN74LS245								
U652	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U653	SN74LS244								
U654	SN74LS00N								
U655	SN74LS194								
U656	SN74LS245								
U657	SN74LS373								
U658	SN74LS244								
U659	SN74LS00N								
U660	SN74LS194								
U661	SN74LS245								
U662	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U663	SN74LS244								
U664	SN74LS00N								
U665	SN74LS194								
U666	SN74LS245								
U667	SN74LS373								
U668	SN74LS244								
U669	SN74LS00N								
U670	SN74LS194								
U671	SN74LS245								
U672	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U673	SN74LS244								
U674	SN74LS00N								
U675	SN74LS194								
U676	SN74LS245								
U677	SN74LS373								
U678	SN74LS244								
U679	SN74LS00N								
U680	SN74LS194								
U681	SN74LS245								
U682	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U683	SN74LS244								
U684	SN74LS00N								
U685	SN74LS194								
U686	SN74LS245								
U687	SN74LS373								
U688	SN74LS244								
U689	SN74LS00N								
U690	SN74LS194								
U691	SN74LS245								
U692	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U693	SN74LS244								
U694	SN74LS00N								
U695	SN74LS194								
U696	SN74LS245								
U697	SN74LS373								
U698	SN74LS244								
U699	SN74LS00N								
U700	SN74LS194								
U701	SN74LS245								
U702	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-791 HE-443-791
U703	SN74LS244								
U704	SN74LS00N								
U705	SN74LS194								
U706	SN74LS245								
U707	SN74LS373								
U708	SN74LS244								
U709	SN74LS00N								
U710	SN74LS194								
U711	SN74LS245								
U712	SN74LS373	74LS373	ECG74LS373		SN74LS373N	NTE74LS373	SK74C245		HE-443-885 HE-443-885 HE-443-867 HE-443-867 HE-443-

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.

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 guaranty 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.

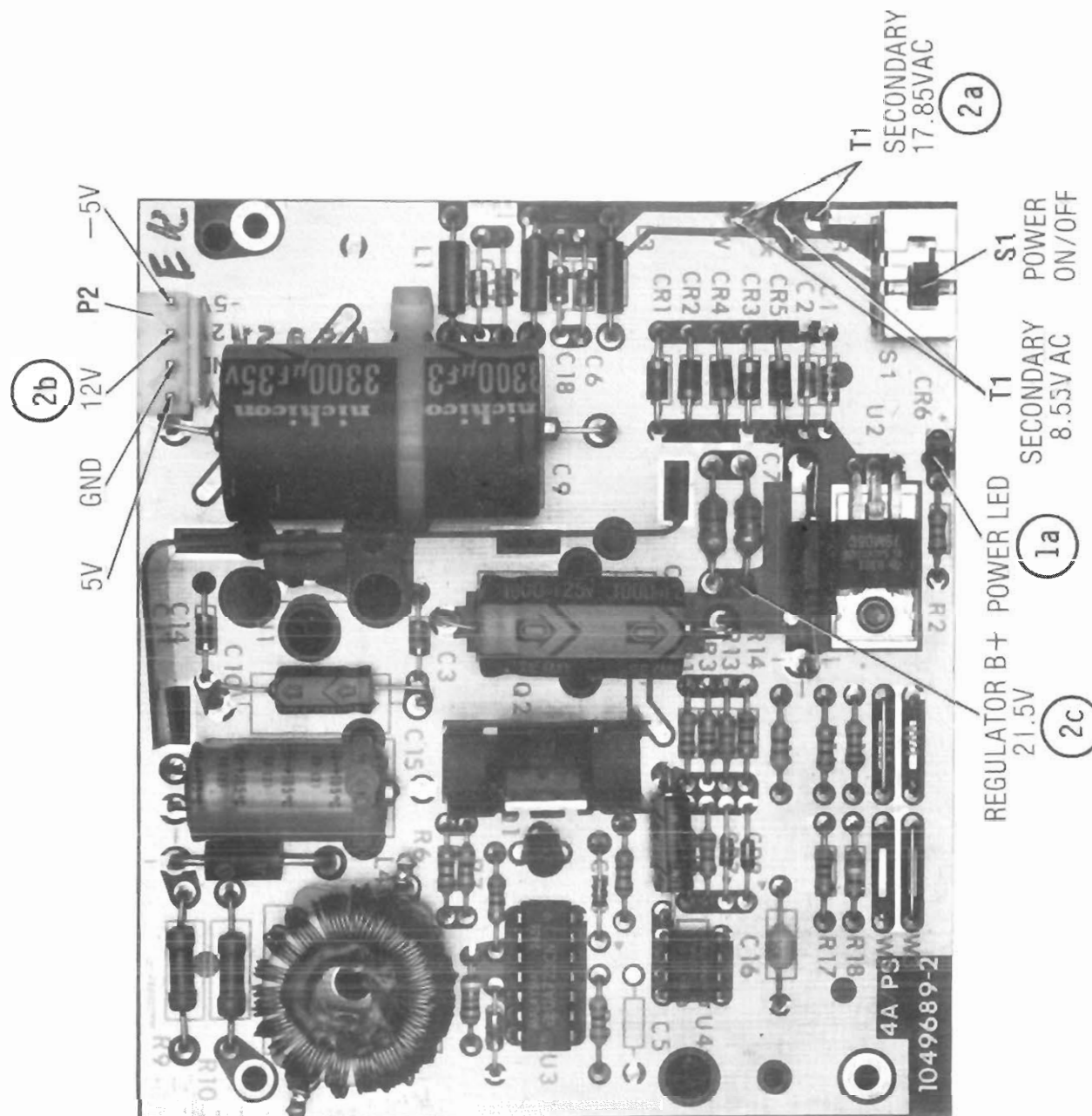
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COMPUTERFACTS OF THE MONTH SET NO. CF1 FOLDER CC 2

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

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



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.

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.

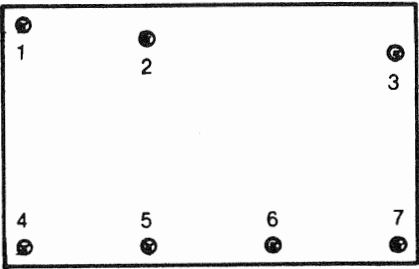


Figure 1
BOTTOM VIEW

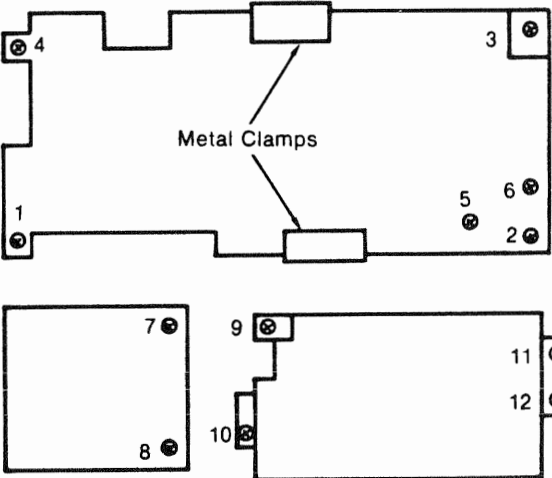


Figure 2
BOTTOM VIEW

TEST EQUIPMENT AND TOOLS

TEST EQUIPMENT

Digital Volt/Ohm Meter
Logic Probe

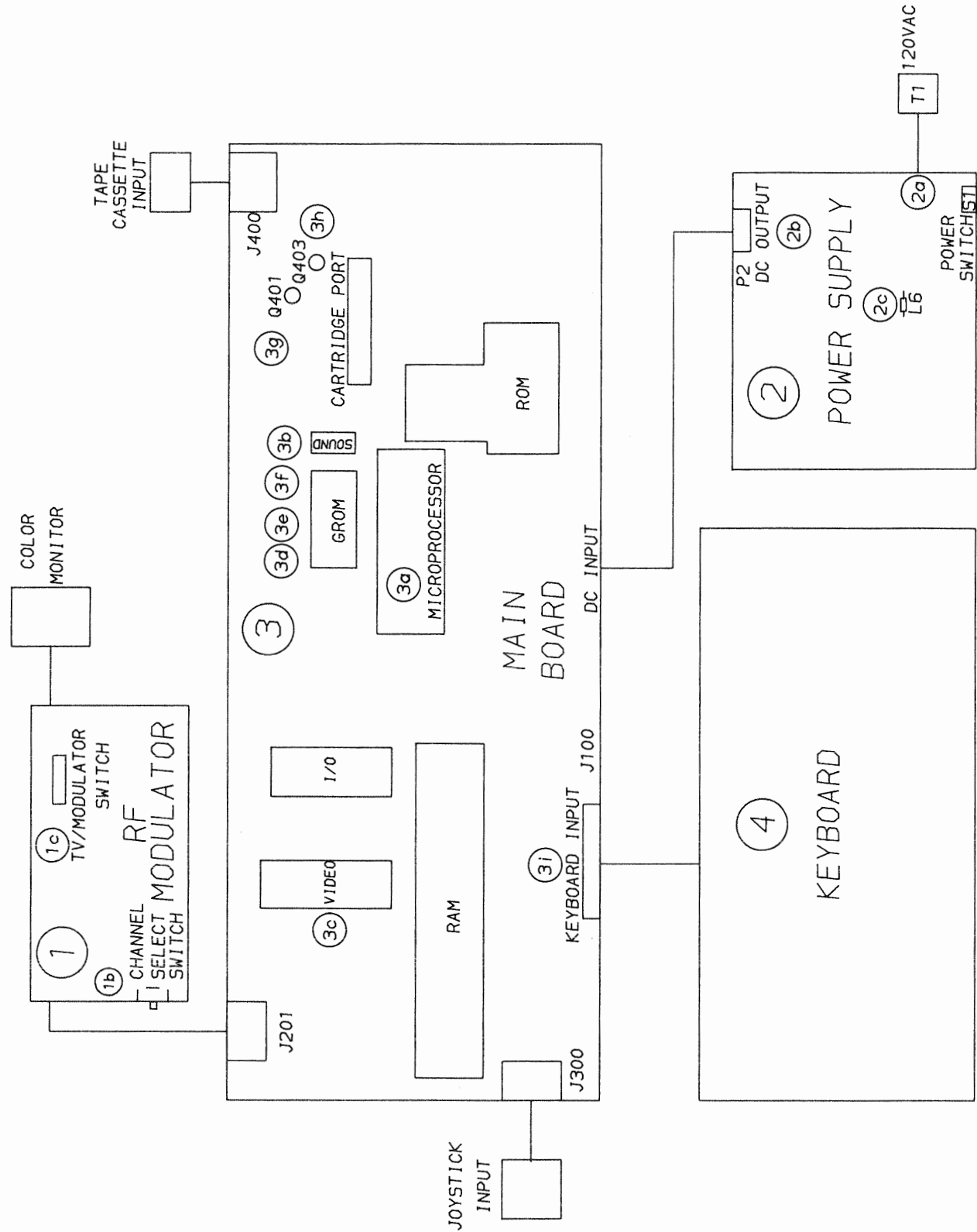
TOOLS

Phillips Screwdriver
Small Screwdriver
Soldering Iron
Switch Cleaner

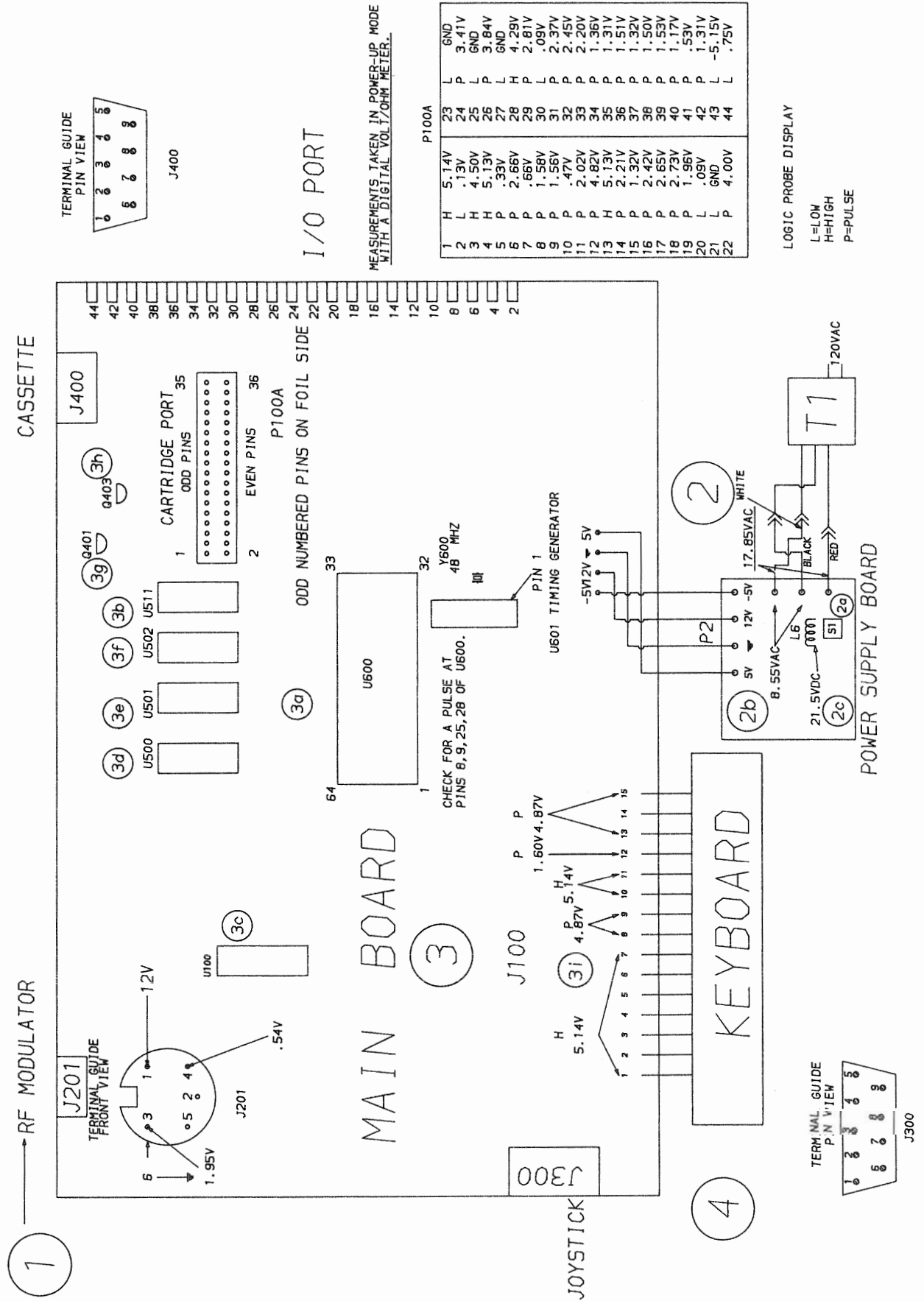
REPLACEMENT PARTS

AC Adaptor Model AC9500

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

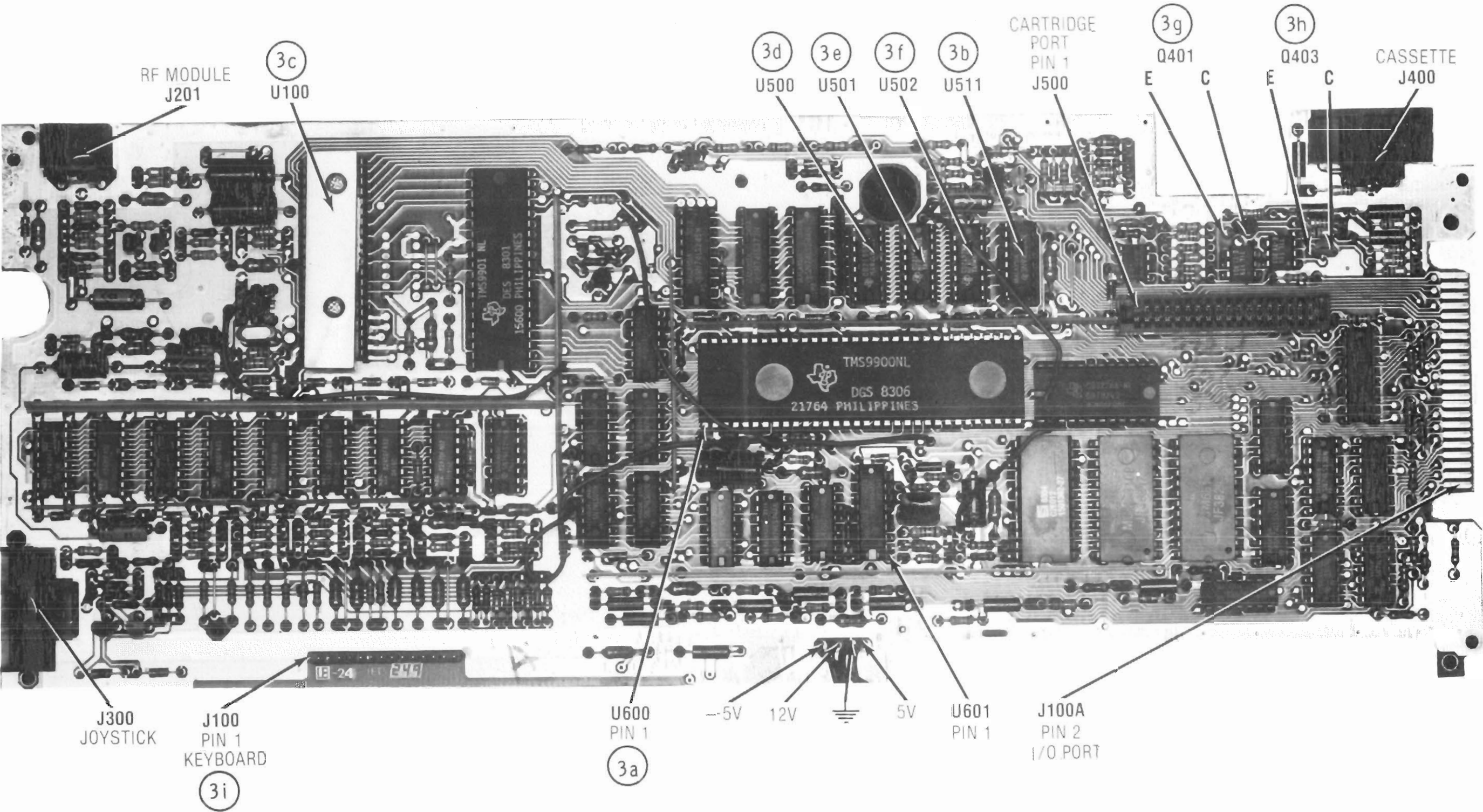


PRELIMINARY SERVICE CHECKS (Continued)



PRELIMINARY SERVICE CHECKS (Continued)

PRELIMINARY SERVICE CHECKS (Continued)



TEXAS INSTRUMENTS
TI-99/4A MODEL PHC004A