

COMPUTERFACTS™

Technical Service Data

SINCLAIR/TIMEX®

MODEL 2068

COMPUTER



SINCLAIR/TIMEX
MODEL 2068

CC19



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SINCLAIR/TIMEX
MODEL 2068

SAFETY PRECAUTIONS

See Page 15

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Howard W. Sams & Co.

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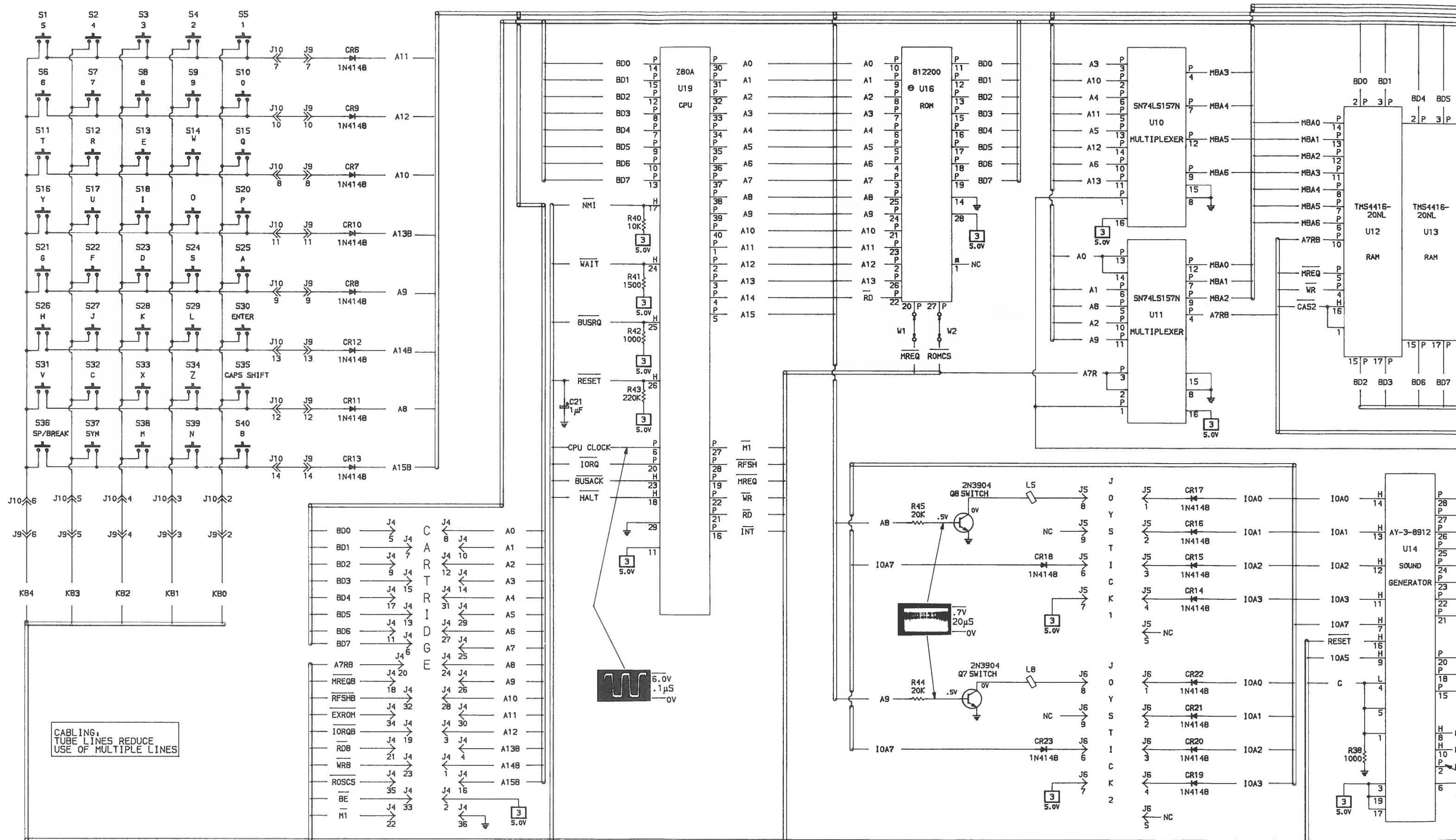
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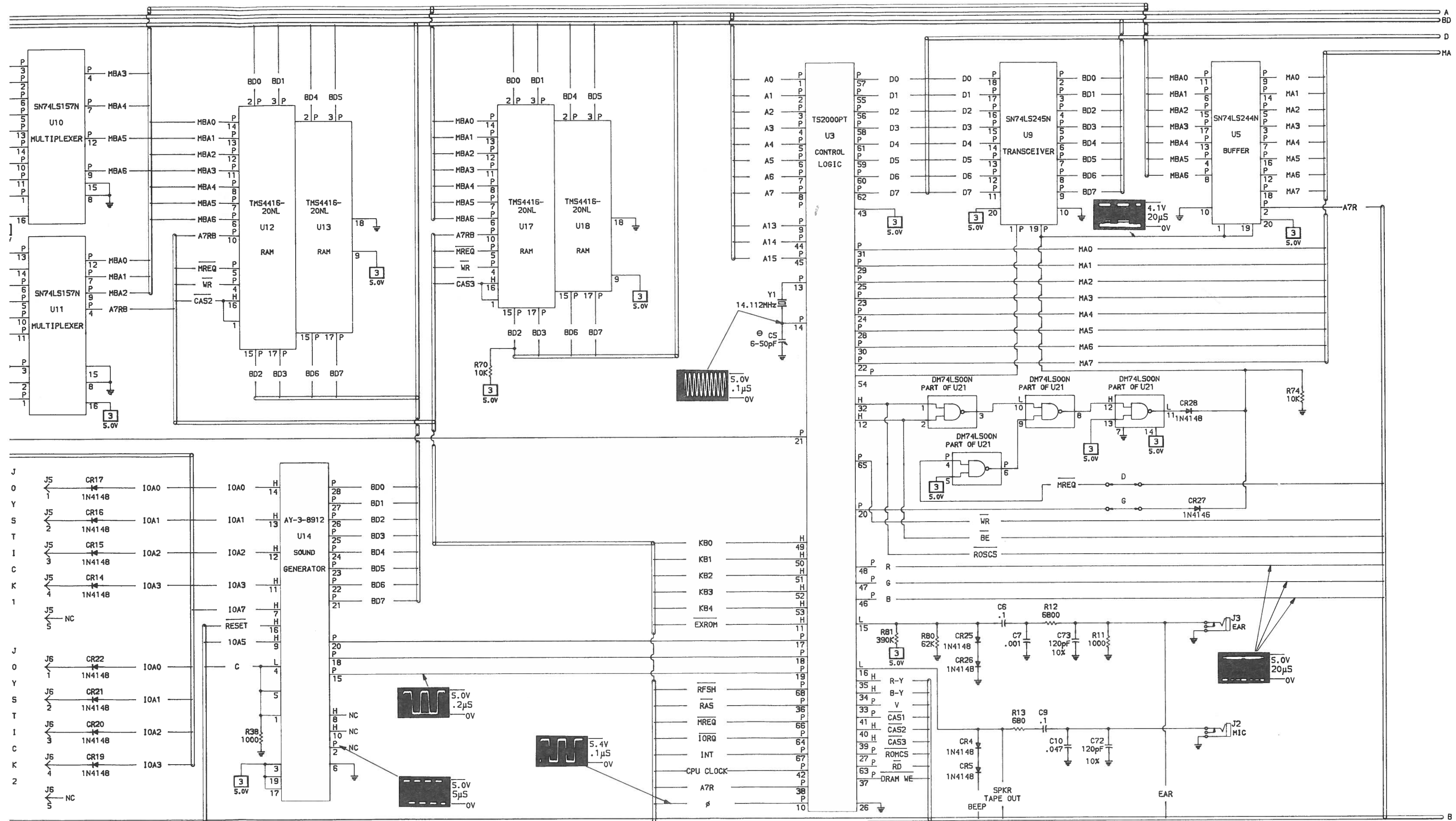
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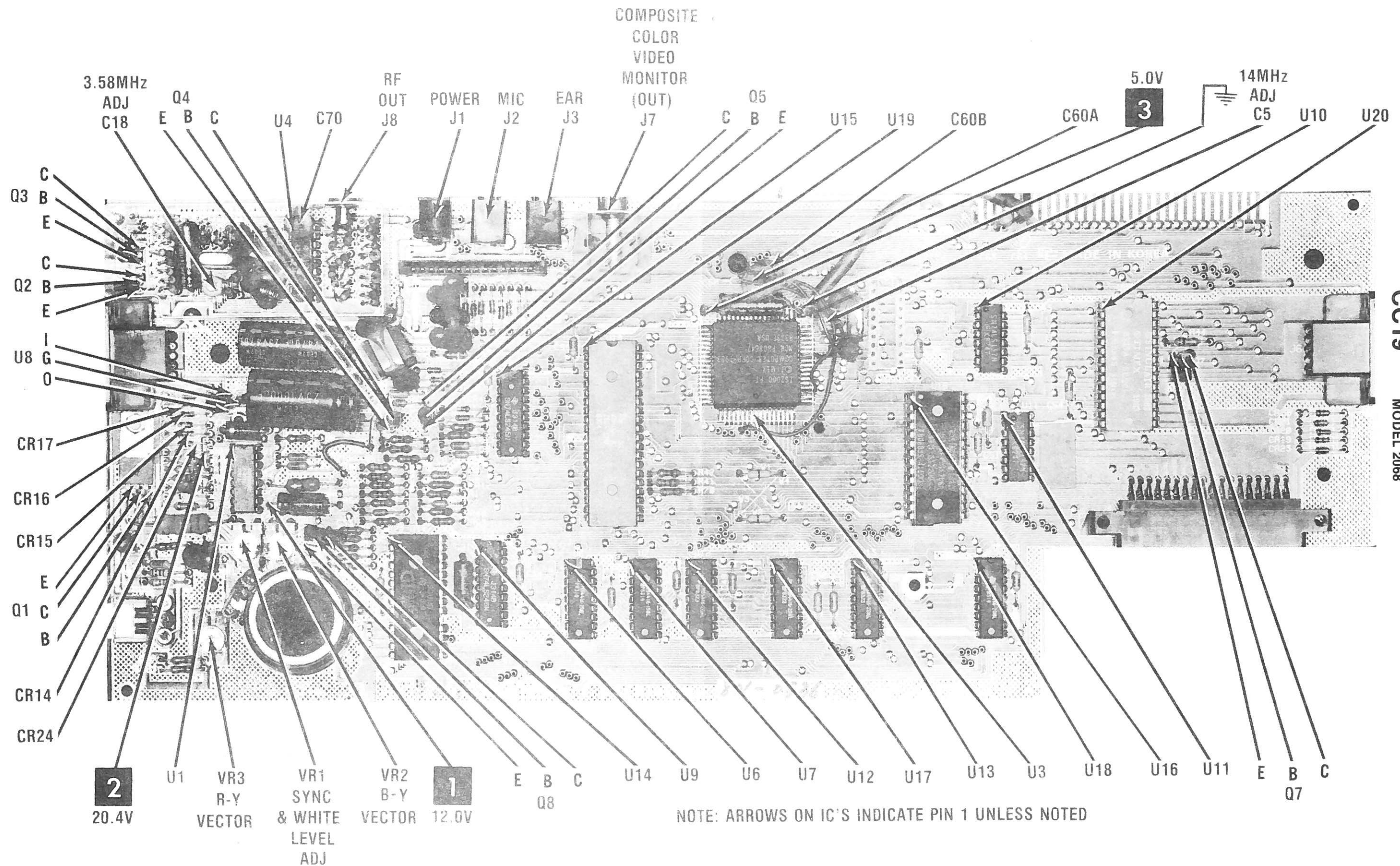
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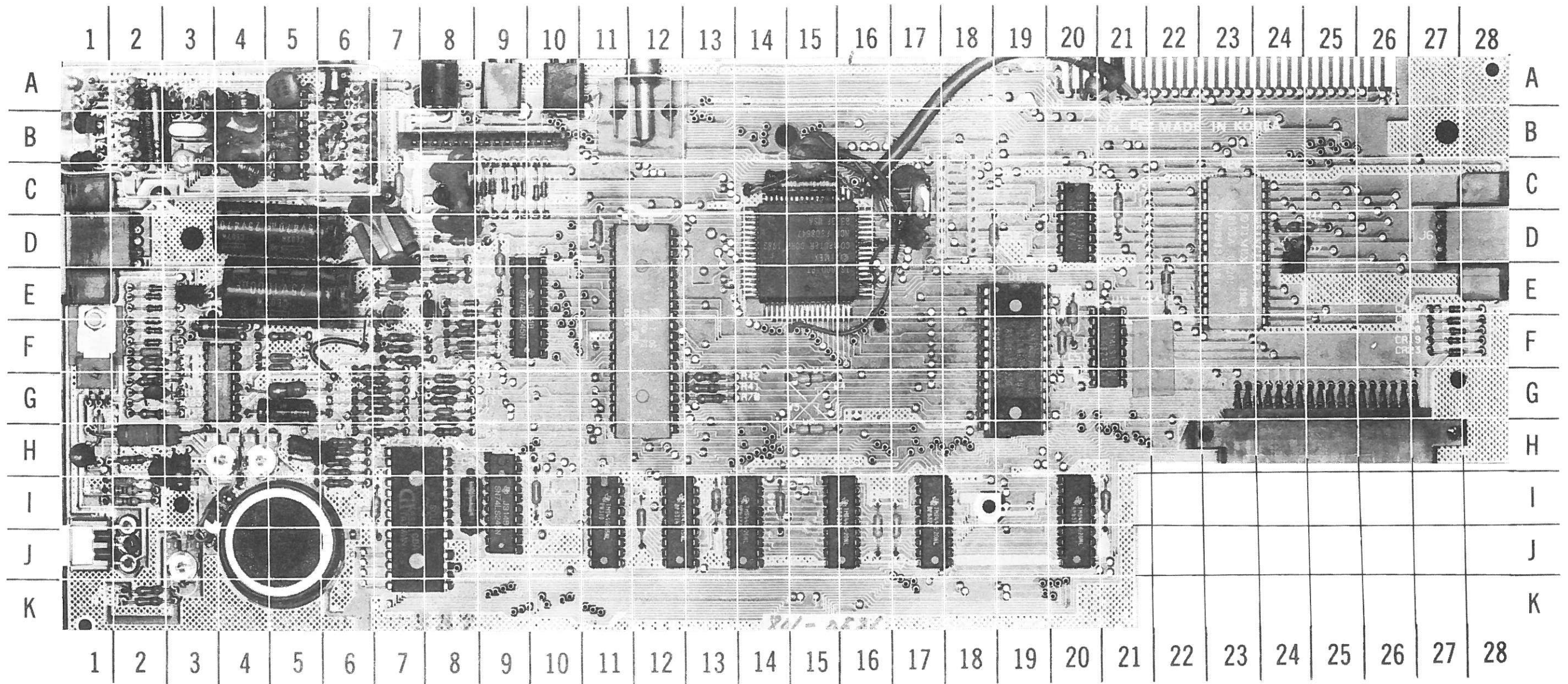
A PHOTOFAC STANDARD NOTATION SCHEMATIC
WITH **CIRCUITRACE**

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SYSTEM BOARD GridTrace LOCATION GUIDE

C2	C-7	CR14	F-2	R49	F-2
C3	D-5	CR15	F-2	R50	I-6
C5	C-16	CR16	E-2	R52	F-7
C6	G-8	CR17	E-2	R53	G-7
C7	G-8	CR18	E-2	R54	G-7
C9	F-8	CR19	F-27	R55	G-7
C10	F-8	CR20	F-27	R56	A-2
C11	A-3	CR21	F-27	R57	A-2
C12	C-6	CR22	E-27	R58	A-1
C13	B-6	CR23	F-27	R60	G-2
C14	C-6	CR24	F-2	R61	F-7
C16	F-5	CR25	D-8	R62	F-7
C18	B-3	CR26	E-8	R63	H-8
C19	A-3	J1	A-8	R64	G-7
C20	A-3	J2	A-9	R65	A-6
C21	I-8	J3	A-10	R66	A-6
C23	G-2	J4	H-25	R67	C-2
C24	F-2	J5	D-1	R68	B-2
C25	A-4	J6	D-28	R69	B-2
C27	B-6	J7	A-11	R70	G-13
C28	B-6	J8	A-6	R71	A-6
C29	B-6	J9	B-8	R80	E-8
C30	D-19	L1	C-8	R81	D-8
C31	I-12	L2	D-7	SPKR	J-5
C32	B-4	L3	B-6	SW1*	A-1
C33	G-7	L4	B-6	SW2	J-1
C34	I-10	L5	H-5	U1	F-4
C35	I-13	L6	C-4	U3	D-15
C36	H-3	L7	A-4	U4	B-5
C37	I-2	L8	D-24	U6	I-11
C39	F-5	P1	A-22	U7	I-12
C40	E-5	Q1	G-1	U8	E-3
C41	G-5	Q2	B-1	U9	I-9
C43	C-21	Q3	B-1	U10	D-20
C44	E-7	Q4	E-7	U11	F-21
C45	A-6	Q5	E-8	U12	I-14
C46	A-2	Q7	D-24	U13	I-17
C47	B-2	Q8	H-6	U14	I-7
C48	E-20	R1	H-2	U15	E-9
C49	I-14	R2	F-5	U16	F-19
C50	I-7	R4	G-5	U17	I-16
C51	F-20	R5	I-2	U18	I-20
C52	I-16	R6	I-2	U19	E-12
C53	I-21	R9	K-2	U20	C-24
C54	E-22	R11	G-8	VR1	H-4
C55	D-11	R12	G-8	VR2	H-4
C56	D-9	R13	F-8	VR3	J-3
C57	I-17	R14	G-2	W1	G-15
C58	B-2	R15	G-2	W2	H-15
C59	H-1	R16	F-8	Y1	C-17
C60A	B-15	R19	H-2	Y2	B-3
C60B	B-15	R22	H-7		
C61	F-7	R23	F-7		
C62	E-7	R24	B-2		
C63	A-20	R26	B-6		
C64	A-21	R27	B-6		
C65	A-21	R28	B-2		
C67	C-15	R29	B-6		
C70	A-5	R30	A-6		
C71	B-5	R31	C-3		
C72*	A-8	R32	B-3		
C73*	A-10	R33	A-3		
C74	B-5	R34	A-3		
CR1	F-4	R35	H-6		
CR4	E-8	R36	K-2		
CR5	E-8	R38	H-6		
CR6	C-8	R40	G-8		
CR7	C-9	R41	G-13		
CR8	C-9	R42	G-13		
CR9	C-9	R43	H-6		
CR10	C-9	R44	D-24		
CR11	C-9	R45	H-6		
CR12	C-10	R46	C-6		
CR13	C-10	R48	F-2		

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GENERAL OPERATING INSTRUCTIONS

POWER UP

When Computer is turned On, it will display a copyright notice on the Monitor screen. To use Basic, press ENTER key. To run a program, press RUN key, then ENTER key. To stop a program, hold CAPS SHIFT key down and press BREAK key.

KEYBOARD OPERATION

Basic commands are entered into Computer with one keystroke or a series of keystrokes instead of typing the command itself. To execute the first command printed on key top, press key. To execute the second command on key top (white on black letters), hold SYMBL SHIFT key down and press desired key. To execute the command printed above key, hold CAPS SHIFT key down and press SYMBL SHIFT key (the cursor letter will change from K to E), then press desired key. To execute the command printed below key, hold CAPS SHIFT key down and press SYMBL SHIFT key, then hold CAPS SHIFT key down and press desired key.

CASSETTE OPERATION

To SAVE a program to tape, press SAVE key and type program name enclosed in quotes. Then press ENTER key, start tape recorder and press any key to start SAVE operation. To LOAD a program from tape, press LOAD key and type program name enclosed in quotes, then press ENTER key and set up tape recorder in play mode. The border of screen will alternate between cyan and red while searching for program. The name of program will appear on screen when found and border will become a pattern of blue and red colors. The pattern lines will become thinner while program is being loaded.

NOTE: Adjust tape recorder Volume and Treble Tone Controls to Maximum. If program will not load properly, try different settings of Volume Control until a setting is found that will work.

DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove seven screws from cabinet bottom. Turn Computer right side up and lift front edge of cabinet top up. While holding top, carefully pull flat keyboard ribbon out of connector and remove cabinet top.

MAIN BOARD REMOVAL

Remove three screws holding Main Board and lift board out of cabinet bottom.

LINE DEFINITIONS

A0 THRU A15 Address Bits 0 Thru 15
A13B, A14B, A15B Address Bits A13B, A14B, A15B
A7R Address Refresh
A7RB Address Refresh, Buffered
B Blue, Video Color Signal
B-Y Blue Intensity
BD0 THRU BD7 Data Bits 0 Thru 7
BE Bank Enable, Memory
BEEP, C Sound Tone Control Channels, Frequency
BUSACK Bus Acknowledge
BUSRQ Bus Request
CAS1, CAS2, CAS3 Column Address Strobe, Memory
CPU CLOCK Clock Timing Pulse, Central Processing Unit
D0 THRU D7 Data Bits 0 Thru 7
DRAM WE Dynamic Random Access Memory Write Enable
EAR Earphone Analog Sound Signal
EXROM Extension ROM Enable
G Green, Video Color Signal
HALT Halt State, Central Processing Unit
INT Interrupt Request
IOA0 THRU IOA3 Input/Output Address Bits 0 Thru 3
IOA5, IOA7 Input/Output Address Bits 5, 7
IORQ Input/Output Request

IORQB Input/Output Request, Buffered
KB0 THRU KB4 Keyboard Data Bits 0 Thru 4
M1 Machine Cycle 1
MA0 THRU MA7 Memory Address Bits 0 Thru 7
MBA0 THRU MBA6 Memory Address Bits 0 Thru 6
MREQ Memory Request
MREQB Memory Request, Buffered
NMI Non-Maskable Interrupt
R Red, Video Color Signal
R-Y Red Intensity
RAS Row Address Strobe
RD Read, Memory Or I/O Device
RDB Read, Buffered
RESET Reset
RFSH Refresh Address for Dynamic Memory
RFSHB Refresh Address for Dynamic Memory, Buffered
ROMCS Read Only Memory Chip Select
SOUND Sound Analog Signal
SPKR TAPE OUT Speaker Or Tape Sound Analog Output
V Color Level
VIDEO Composite Video Signal
WAIT Wait, Memory Or I/O Not Ready To Send Data
WR Write, Data Bus Info Stored In Memory Or I/O
WRB Write, Buffered

MISCELLANEOUS ADJUSTMENTS

14MHz ADJUSTMENT

Connect input of a frequency counter to pin 6 of CPU IC (U19). Adjust 14MHz Adjust Trimmer (C5) for 3.528MHz.

3.58MHz ADJUSTMENT

Connect input of a frequency counter to pin 17 of RF Modulator IC (U4). Adjust 3.58MHz Adjust Trimmer (C18) for 3.5795MHz.

SYNC/WHITE LEVEL ADJUSTMENT

Connect input of scope to Composite Video Output Jack (J7). Set voltage range to .5V/cm and horizontal sweep time to 20uS/cm. Adjust the Sync/White Level Control (VR1) for a sync pulse amplitude of .5 volt, see Figure A.

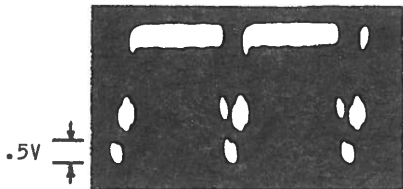


Figure A

B-Y AND R-Y VECTOR ADJUSTMENTS

Connect Channel A Input of a dual trace scope to pin 4 and Channel B input to pin 2 of RF Modulator IC (U4). Set scope voltage range to 2V/cm with DC input and horizontal sweep time

to 10uS/cm. Turn Computer On. Adjust B-Y Vector Control (VR2) for a 5.0V level on Channel A at base of sync pulse, see Figure B. Switch the scope to Channel B and adjust R-Y Vector Control (VR3) for a 5.0V level on Channel B at base of sync pulse, see Figure B.

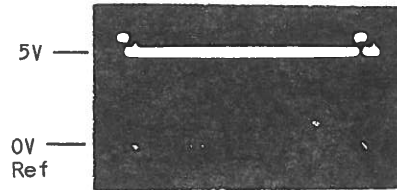


Figure B

The following program can be used to check the blue, red and green colors. The program will display blue, red and green vertical bars on Monitor connected to Composite Video Jack (J7).

NOTE: Make sure Color and Tint Controls are set properly on Monitor.

NOTE: Put 10 spaces between the quotes in line 30 and 11 spaces between the quotes in lines 40 and 50.

```
10 BORDER 0
20 FOR X=1 TO 22
30 PAPER 1:PRINT "          "
40 PAPER 2:PRINT "          "
50 PAPER 4:PRINT "          "
60 NEXT X
70 GOTO 70
```

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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 turned On, no keys pressed, unless otherwise noted.

Waveforms taken with triggered scope and Sweep/Time Switch in Calibrate position, scope input set for DC coupling on "0" reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 9cm width with DC reference voltage given at the bottom line of each waveform.

Time in usec. 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 turned On, no keys pressed, unless otherwise noted.

Logic Probe Display
L=Low
H=High
P=Pulse
*=Open (No lights On)

TEST EQUIPMENT

Test Equipment listed by Manufacturer illustrates typical or equivalent equipment used by SAMS' Engineers to obtain measurements and is compatible with most types used by field service technicians.

TEST EQUIPMENT (COMPUTERFACTS)

Equipment	B & K Precision Equipment No.	Sencore Equipment No.	Notes
OSCILLOSCOPE	1570A,1590A,1596	SC61	
LOGIC PROBE	DP51,DP21		
LOGIC PULSER	DP101,DP31		
DIGITAL VOM	2830,2806	DVM37,DVM56,SC61	
ANALOG VOM	277,111,116		
ISOLATION TRANSFORMER	TR110,1604,1653,1655	PR57	
FREQUENCY COUNTER	1803,1805	FC71,SC61	
COLOR BAR GENERATOR	1211A,1251,1260,1249	CG25,VA62	
RGB GENERATOR	1260,1249		
FUNCTION GENERATOR	3020,3011,3030		
HI-VOLTAGE PROBE VOM/DMM Accessory probes	HV-44 PR-28(HV)	HP200	
TEMPERATURE PROBE	TP-28,TP-30		
CRT ANALYZER	467,470	CR70	
DIGITAL IC TESTER	560,550,552		
CAPACITANCE ANALYZER		LC53,LC75,LC76 LC77	
INDUCTANCE ANALYZER		LC53,LC75,LC76 LC77	

TROUBLESHOOTING

POWER SUPPLY

Power supply dead. Check for 20.4V at Connector J1. If 20.4V is missing, check Connector J1 and check AC adapter. If 20.4V is present, check for 20.4V at input pin of 12V Regulator IC (U8). If 20.4V is missing, check Coil L1 and On/Off Switch (SW2). If 20.4V is present, check for 12.0V at output pin of IC U8. If 12.0V is missing, check IC U8. If 12.0V is present, check for 5.2V at collector of 5V Regulator Transistor (Q1). If 5.2V is missing, check voltages, waveforms and components associated with pins 8 thru 16 of Switching Regulator IC (U1) and check Transistor Q1.

MICROPROCESSOR (CPU) OPERATION

Check reset logic reading at pin 26 of CPU IC (U19) while turning Computer On. Logic should read Low when Computer is turned On, then immediately go High and stay High. If reading is not correct, check Capacitor C21, Resistor R43 and IC U19.

Check for 3.528MHz waveform at pin 6 of IC U19. If waveform is missing, check for a 14.112MHz waveform at pin 14 of Control Logic IC (U3). If waveform is missing at pin 14, check Crystal Y1, Trimmer C5 and IC U3. If waveform is present at pin 14, check IC U3.

KEYBOARD

Keyboard does not work. Check keyboard ribbon cable and check Connector J9. If cable and

connector are good, check Diodes CR6 thru CR13. If Diodes are good, check for pulses at pins 49 thru 53 of Control Logic IC (U3) while pressing key associated with the pin of IC U3 being checked. If pulses are missing, check Keyboard. If pulses are present, check IC U3.

VIDEO RAM

RAM IC's (U6 and U7) are used to store video information that appears on Monitor screen. If some locations on Monitor screen always have the wrong information, check IC's U6 and U7.

VIDEO

No video output at Composite Video Jack (J7). Check waveform at base of Video Amp Transistor (Q5). If waveform is missing, check adjustment of Sync/White Level Control (VR1), see "Miscellaneous Adjustments" and check Control Logic IC (U3). If waveform is present at Q5, check waveform at base of Video Amp Transistor (Q3). If waveform is missing, check voltages and components associated with Transistors Q4 and Q5. If waveform is present, check voltages and components associated with Transistors Q2 and Q3.

No video on a TV Monitor connected to RF Output Jack (J8). Video is good at Composite Video Output Jack (J7). Make sure Channel Switch (SW1) and TV are set on same channel (Channel 2 or 3). If Channel Switch is set properly, check voltages and components asso-

TROUBLESHOOTING (Continued)

clated with pins 1 thru 18 of RF Modulator IC (U4).

COLOR

No color on a Monitor connected to Composite Video Output Connector (J7) or RF Output Connector (J8). Check Connectors J7 or J8. If connectors are good, check waveforms at pins 2 and 4 of IC U4. If waveforms are missing, check Resistors R29 and R30 and Control Logic IC (U3). If waveforms are present, check adjustments of B-Y and R-Y Vector Controls (VR2 and VR3), see "Miscellaneous Adjustments". If adjustments check good, check 3.58MHz waveform at pin 17 of IC U4. If frequency is not correct, check adjustment of 3.58MHz Adjust Trimmer, see "Miscellaneous Adjustments". If waveform is missing, check Crystal Y2, Trimmer C18, Capacitors C11, C19 and C20, IC U4 and Resistors R31 thru R34. If waveform is present, check IC U4.

SOUND

No sound from internal speaker when BEEP command is used in a program. Type in and run the following Basic program to produce a continuous sound:

```
10 BEEP 10,10:GOTO 10
```

While program is running, check for a 5V peak to peak waveform of about 500Hz at anode of Diode CR4. If waveform is missing, check Control Logic IC (U3). If waveform is present, check for a 1.3V peak to peak waveform at pin 6 of Sound Amp IC (U1). If waveform is missing, check Diodes CR4, CR5 and Resistors R49, R16 and R60. If waveform is present, check for a 11V peak to peak waveform at pin 4 of IC U1. If waveform is missing, check IC U1. If waveform is present, check Speaker SP1, Diode CR24, Resistors R14, R15, R19, R50 and Capacitor C23.

No sound from internal speaker when SOUND command is used in a program but there is sound when BEEP command is used. Check Resistor R48 and Sound Generator IC (U14).

JOYSTICKS

The following Basic program can be used to check operation of Joysticks.

NOTE: Put one space between the quotes in lines 50 and 70.

```
10 PRINT:PRINT "LEFT JOYSTICK"
20 PRINT "LEFT BUTTON"
30 PRINT "RIGHT JOYSTICK"
40 PRINT "RIGHT BUTTON"
50 PRINT AT 1,16; STICK (1,1); " "
60 PRINT AT 2,16; STICK (2,1)
70 PRINT AT 3,16; STICK (1,2); " "
80 PRINT AT 4,16; STICK (2,2)
90 GOTO 50
```

Program displays numbers on Monitor screen that indicate position of joysticks and whether button is pressed or not. Use the following chart to determine numbers that should appear on Monitor as joysticks are operated:

<u>Joystick Positions</u>		<u>Button</u>
0=Center	2=Down	0=Not Pressed
1=Up	10=Right/Down	1=Pressed
5=Up/Left	8=Right	
4=Left	9=Up/Right	
6=Down/Left		

If joysticks are not working, check Connectors J5 and J6. If connectors are good, check for pulses at pins 7, 11, 12, 13 and 14 of Sound Generator IC (U14) while operating either joystick. Use the following chart to determine which joystick position goes to the pin of IC U9 being checked:

<u>Joystick Position</u>	<u>U14 Pin No.</u>
Right	11
Left	12
Down	13
Up	14
Button	7

If pulses are missing for left joystick, check Switch Transistor (Q8), Coil L5, Resistor R45 and Diodes CR14 thru CR18. If pulses are missing for right joystick, check Switch Transistor (Q7), Coil L8, Resistor R44 and Diodes CR19 thru CR23. If pulses are present for both joysticks but numbers on Monitor screen are not correct, check IC U14.

CASSETTE

Computer will not save a program to cassette tape. Type in any short program and save it to tape. While program is being saved, check for a .6V peak to peak audio waveform at pin 16 of Control Logic IC (U3). If waveform is missing, check Extension ROM IC (U20) and IC U3. If waveform is present, check Resistor R13 and Capacitors C9, C10, C72 and C80. Also check Connector J2 for good connections.

Computer will not load a program from tape. Inject a 1.0kHz 5V peak to peak signal at Earphone Jack (J3). Turn Computer On and check for a 1.8V peak to peak square waveform at anode of Diode CR25. If waveform is missing, check Capacitors C6, C7, C73, Diodes CR25, CR26 and Resistors R11, R12, R80 and R81. If waveform is present, check Extension ROM IC (U20) and Control Logic IC (U3).

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5 PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	MFG. PART No./ TYPE No.					NOTES
		NTE PART No.	ECG PART No.	RCA PART No.	ZENITH PART No.	
CR1	1N5821		ECG156	SK3051/156	212-Z9000	
CR4 THRU CR28	1N4148	NTE519	ECG519	SK3100/519	103-131	
Q1	D432C1					
Q2	PN2222	NTE123AP	ECG123AP	SK3854/123AP	121-Z9000A *	
Q3	PN2907	NTE159	ECG159	SK3466/159	121-Z9003 *	
Q4, 5	PN2222	NTE123AP	ECG123AP	SK3854/123AP	121-Z9000A *	
Q7, 8	2N3904	NTE123AP	ECG123AP	SK3854/123AP	121-Z9000A *	
U1	UA78S40PC					
U3	TS2000PT					
U4	LM1889N	NTE846	ECG846	SK9178/846		
U5	SN74LS244N	NTE74LS244	ECG74LS244	SK74LS244	HE-443-791	
U6, 7	TMS4416-15NL				HE-443-1165	
U8	78L12A	NTE950	ECG950	SK9169/950	HE-442-644	
U9	SN74LS245N	NTE74LS245	ECG74LS245	SK74LS245	HE-443-885	
U10, 11	SN74LS157N	NTE74LS157	ECG74LS157	SK74LS157	HE-443-799	
U12, 13	TMS4416-20NL					
U14	AY-3-8912					
U15	SN74LS245N	NTE74LS245	ECG74LS245	SK74LS245	HE-443-885	
U16	812200					
	23128					
U17, 18	TMS4416-20NL					
U19	Z80A	NTE3880	ECG3880	SK2880/3880	HE-443-881	
U20	812201					
	2364					
U21	DM74LS00N	NTE74LS00	ECG74LS00	SK74LS00	HE-443-728	

* Lead configuration may vary from original.

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

CAPACITORS

ITEM No.	RATING	MFGR. PART No.
C5 C18	6 - 50 Trimmer 6 - 50 Trimmer	

ITEM No.	RATING	MFGR. PART No.
C25 C32	62 NPO 50V 5% 75 NPO 50V 5%	

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA		
		MFGR. PART No.	NTE PART No.	WORKMAN PART No.
R1 R5 R6	.110 5% 3W WW 3320 1% 1/4 Metal Film 1100 1% 1/4 Metal Film			

CONTROLS (All wattages 1/2 watt, or less, unless listed)

ITEM NO.	FUNCTION	RESISTANCE	MFGR. PART NO.	NOTES
VR1 VR2 VR3	Sync/White Level B-Y Vector Control R-Y Vector Control	10K 10K 10K		

COILS (RF-IF)

ITEM No.	FUNCTION	MFGR. PART No.
L1 L2 L3	Line Filter RF Choke Choke	

ITEM No.	FUNCTION	MFGR. PART No.
L4 L6 L7	Choke Peaking Peaking	

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SPEAKER

ITEM No.	TYPE	REPLACEMENT DATA		NOTES
		MFGR. PART No.	QUAM PART No.	
SP1	1.5 Inch, CM 45 Ohms			

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
L5 L8 M1 S1 thru S40 SW1 SW2 Y1 Y2	Ferrite Bead Ferrite Bead Power Pack Switch Switch Switch Crystal Crystal		Keyboard Channel Select Power 14.112MHz 3.58MHz

WIRING DATA

Shielded Hook-up Wire Use BELDEN No. 8401 or 8421 (Single-Conductor)
8208 (Two-Conductor)
General-use Unshielded Hook-up Wire Use BELDEN No. 8529 (Solid) Available in 13 Colors
8522 (Stranded) Available in 13 Colors

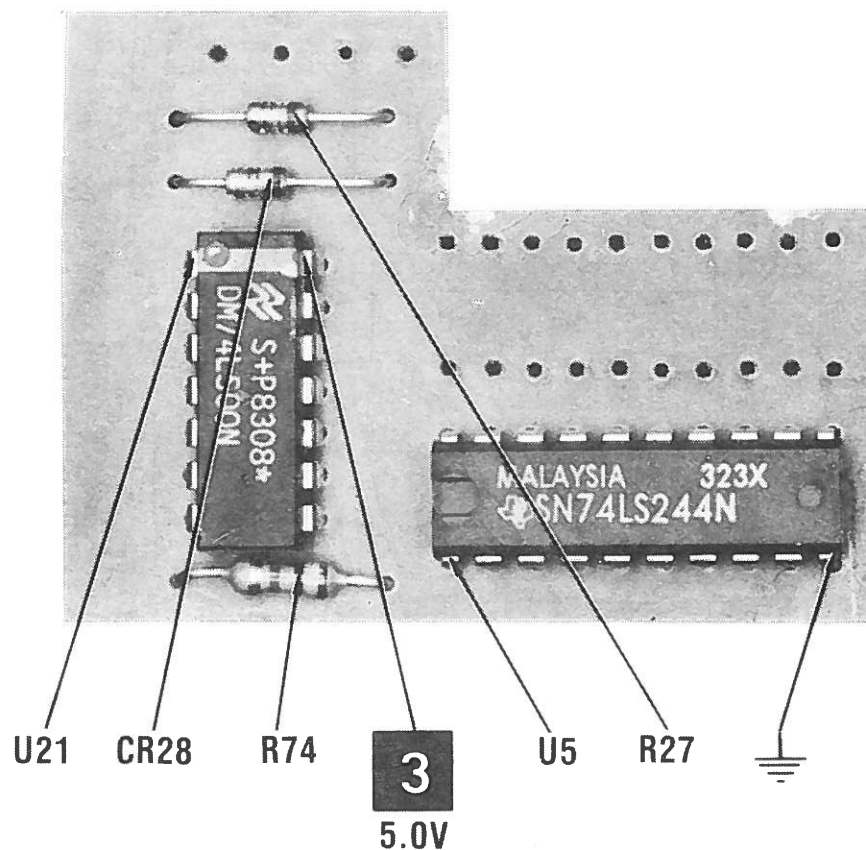
LOGIC CHART

PIN NO.	IC U3	PIN NO.	IC U3	PIN NO.	IC U3	PIN NO.	IC U3	PIN NO.	IC U5	IC U6	IC U7	IC U9
1	P	21	P	41	P	61	P	1	P	P	P	P
2	P	22	P	42	P	62	P	2	P	P	P	P
3	P	23	P	43	H	63	P	3	P	P	P	P
4	P	24	P	44	P	64	P	4	P	P	P	P
5	P	25	P	45	P	65	P	5	P	P	P	P
6	P	26	L	46	P	66	P	6	P	P	P	P
7	P	27	P	47	P	67	P	7	P	P	P	P
8	P	28	P	48	P	68	P	8	P	P	P	P
9	P	29	P	49	H			9	P	H	H	P
10	P	30	P	50	H			10	L	P	P	L
11	H	31	P	51	H			11	P	P	P	P
12	H	32	H	52	H			12	P	P	P	P
13	P	33	P	53	H			13	P	P	P	P
14	P	34	H	54	P			14	P	P	P	P
15	L	35	H	55	P			15	P	P	P	P
16	L	36	P	56	P			16	P	P	P	P
17	P	37	P	57	P			17	P	P	P	P
18	P	38	P	58	P			18	P	L	L	P
19	P	39	H	59	P			19	P			P
20	P	40	H	60	P			20	H			H

PIN NO.	IC U10	IC U11	IC U12	IC U13	IC U14	PIN NO.	IC U14	PIN NO.	IC U15	IC U16	PIN NO.	IC U16	PIN NO.	IC U17
1	P	P	H	H	L	21	P	1	H	*	21	P	1	H
2	P	P	P	P	P	22	P	2	P	P	22	P	2	P
3	P	P	P	P	H	23	P	3	P	P	23	P	3	P
4	P	P	P	P	L	24	P	4	P	P	24	P	4	P
5	P	P	P	P	L	25	P	5	P	P	25	P	5	P
6	P	P	P	P	L	26	P	6	P	P	26	P	6	P
7	P	P	P	P	H	27	P	7	P	P	27	P	7	P
8	L	L	P	P	H	28	P	8	P	P	28	H	8	P
9	P	P	H	H	H			9	P	P			9	H
10	P	P	P	P	H			10	L	P			10	P
11	P	P	P	P	H			11	P	P			11	P
12	P	P	P	P	H			12	P	P			12	P
13	P	P	P	P	H			13	P	P			13	P
14	P	P	P	P	H			14	P	L			14	P
15	L	L	P	P	P			15	P	P			15	P
16	H	H	H	H	H			16	P	P			16	H
17	P		P	P	H			17	P	P			17	P
18	L		L	L	P			18	P	P			18	L
19					H			19	L	P				
20					P			20	H	P				

LOGIC CHART (Continued)

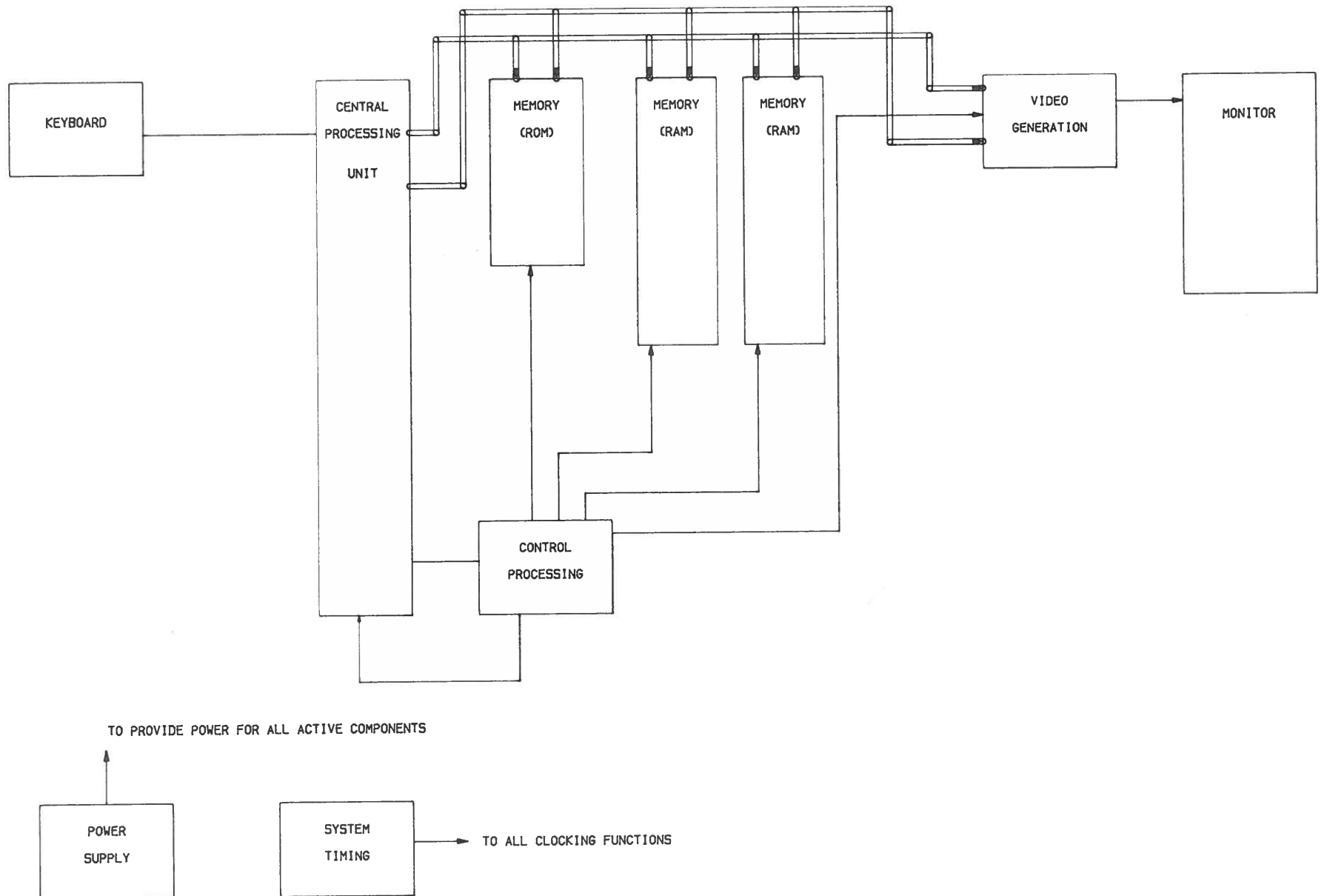
PIN NO.	IC U18	IC U19	PIN NO.	IC U19	PIN NO.	IC U20	PIN NO.	IC U20	PIN NO.	IC U21
1	H	P	21	P	1	*	21	P	1	H
2	P	P	22	P	2	P	22	P	2	H
3	P	P	23	H	3	P	23	P	3	L
4	P	P	24	H	4	P	24	P	4	P
5	P	P	25	H	5	P	25	P	5	H
6	P	P	26	H	6	P	26	P	6	P
7	P	P	27	P	7	P	27	P	7	L
8	P	P	28	P	8	P	28	H	8	H
9	H	P	29	L	9	P			9	P
10	P	P	30	P	10	P			10	L
11	P	H	31	P	11	P			11	L
12	P	P	32	P	12	P			12	H
13	P	P	33	P	13	P			13	H
14	P	P	34	P	14	L			14	H
15	P	P	35	P	15	P				
16	H	P	36	P	16	P				
17	P	H	37	P	17	P				
18	L	H	38	P	18	P				
19		P	39	P	19	P				
20		P	40	P	20	H				



NOTE: ARROWS ON IC'S INDICATE PIN 1 UNLESS NOTED

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BLOCK DIAGRAM
14

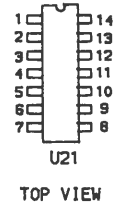
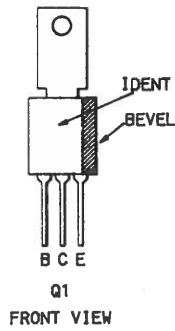


SAFETY PRECAUTIONS

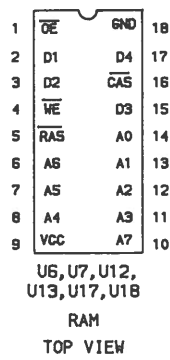
1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove AC power from the Computer before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
4. Use extreme 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.

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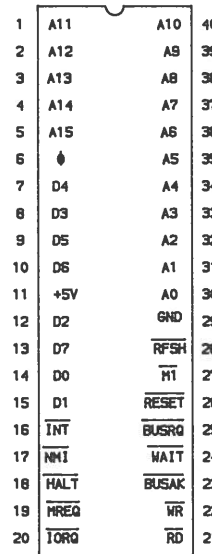
IC PINOUTS & TERMINAL GUIDES



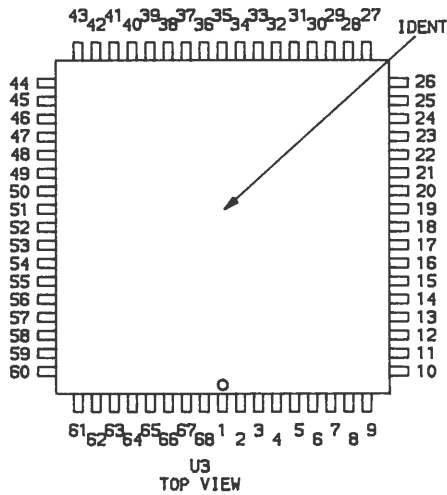
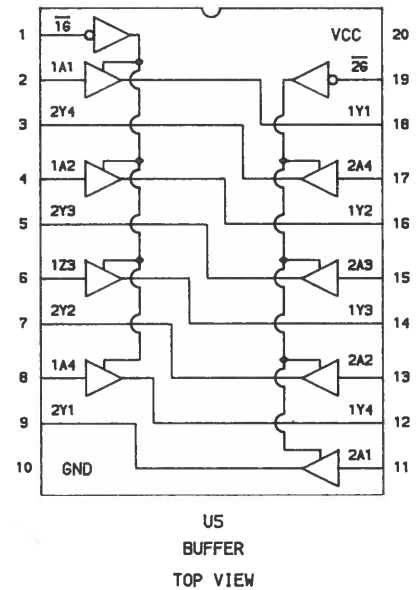
TMS4416-15NL,
TMS4416-20NL



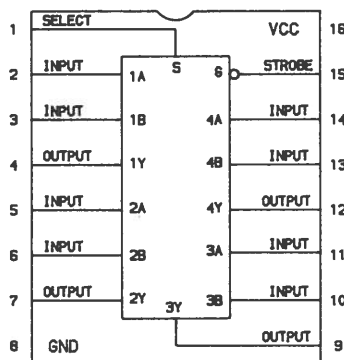
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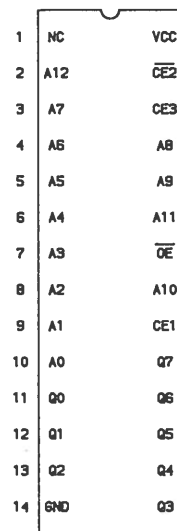
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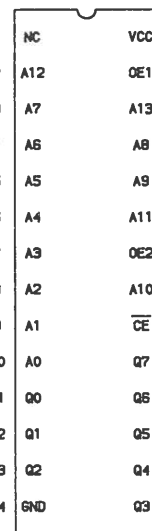
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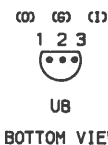
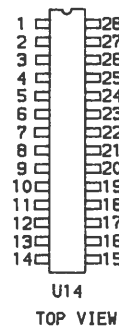
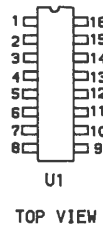
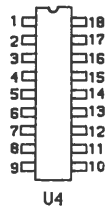
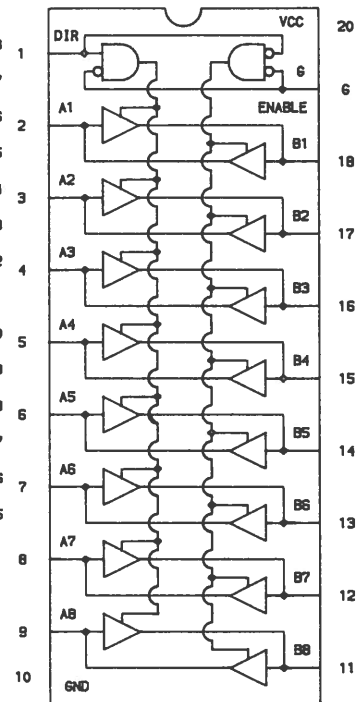
812201

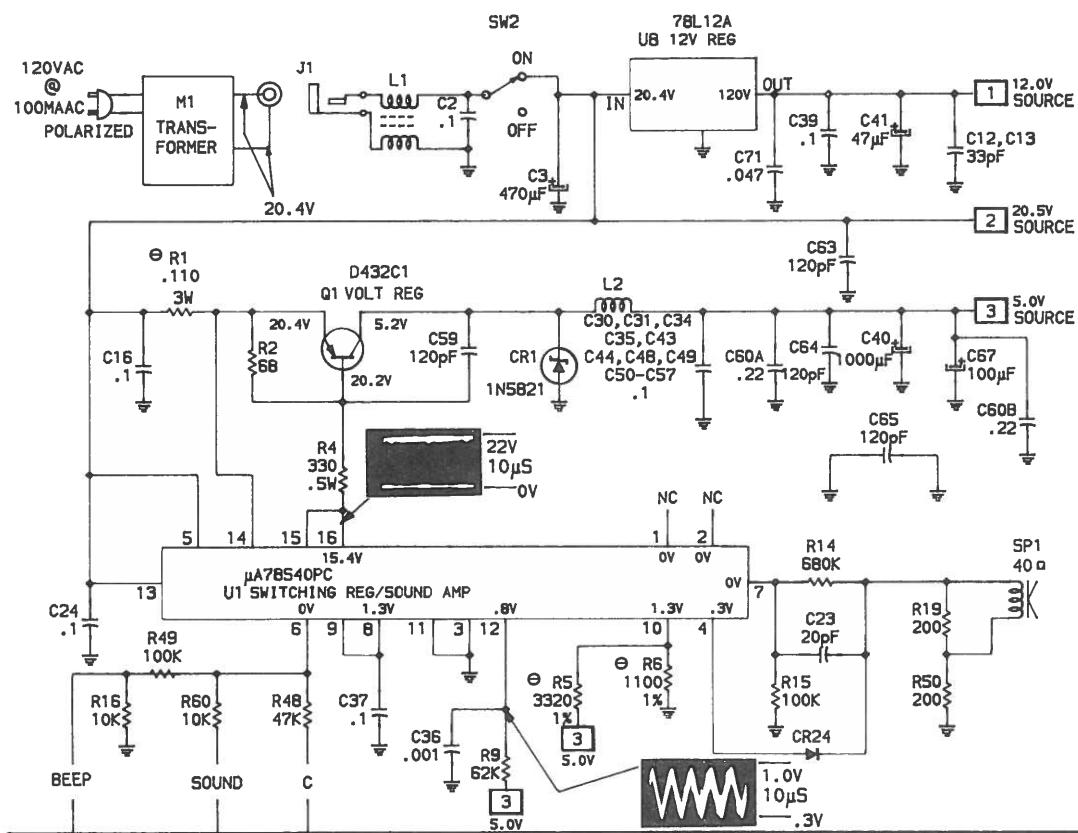
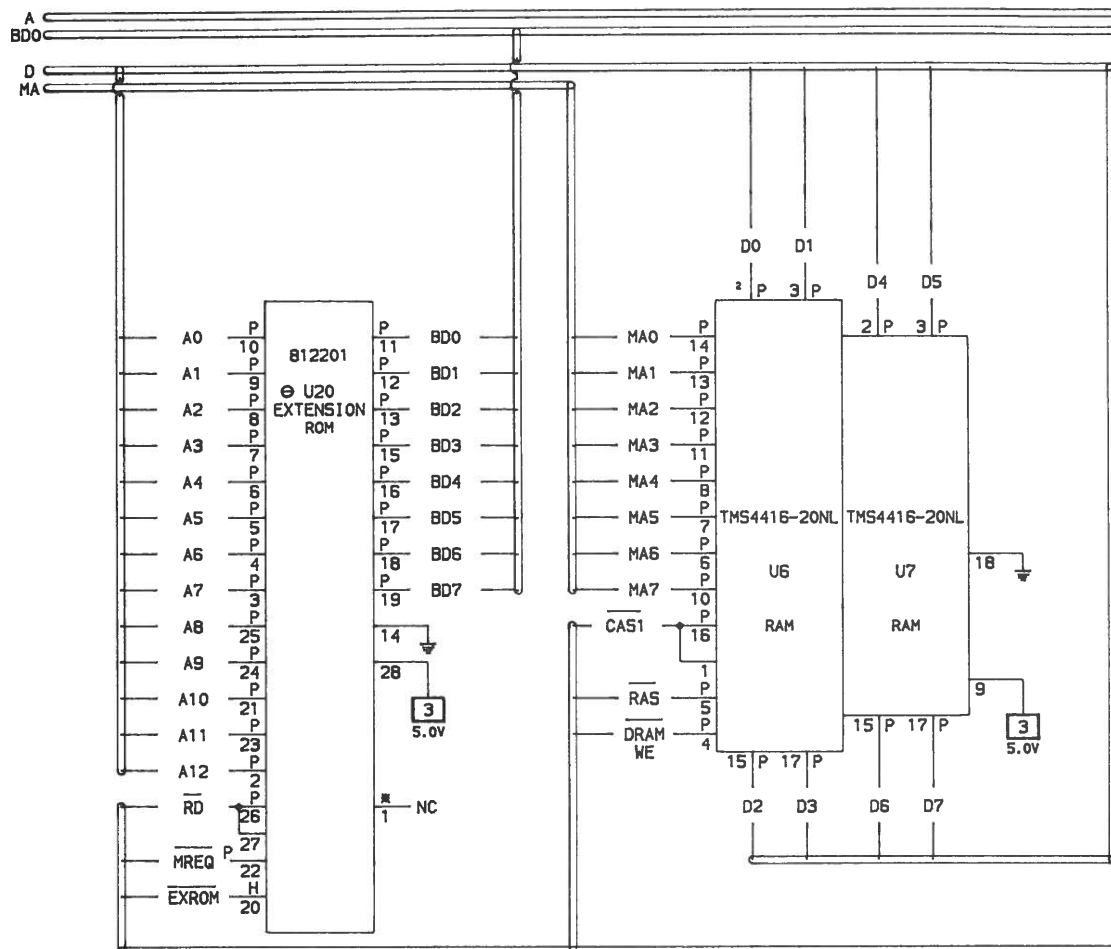


812200



SN74LS245N





A PHOTOFAC STANDARD NOTATION SCHEMATIC
WITH **CIRCUITRACE**

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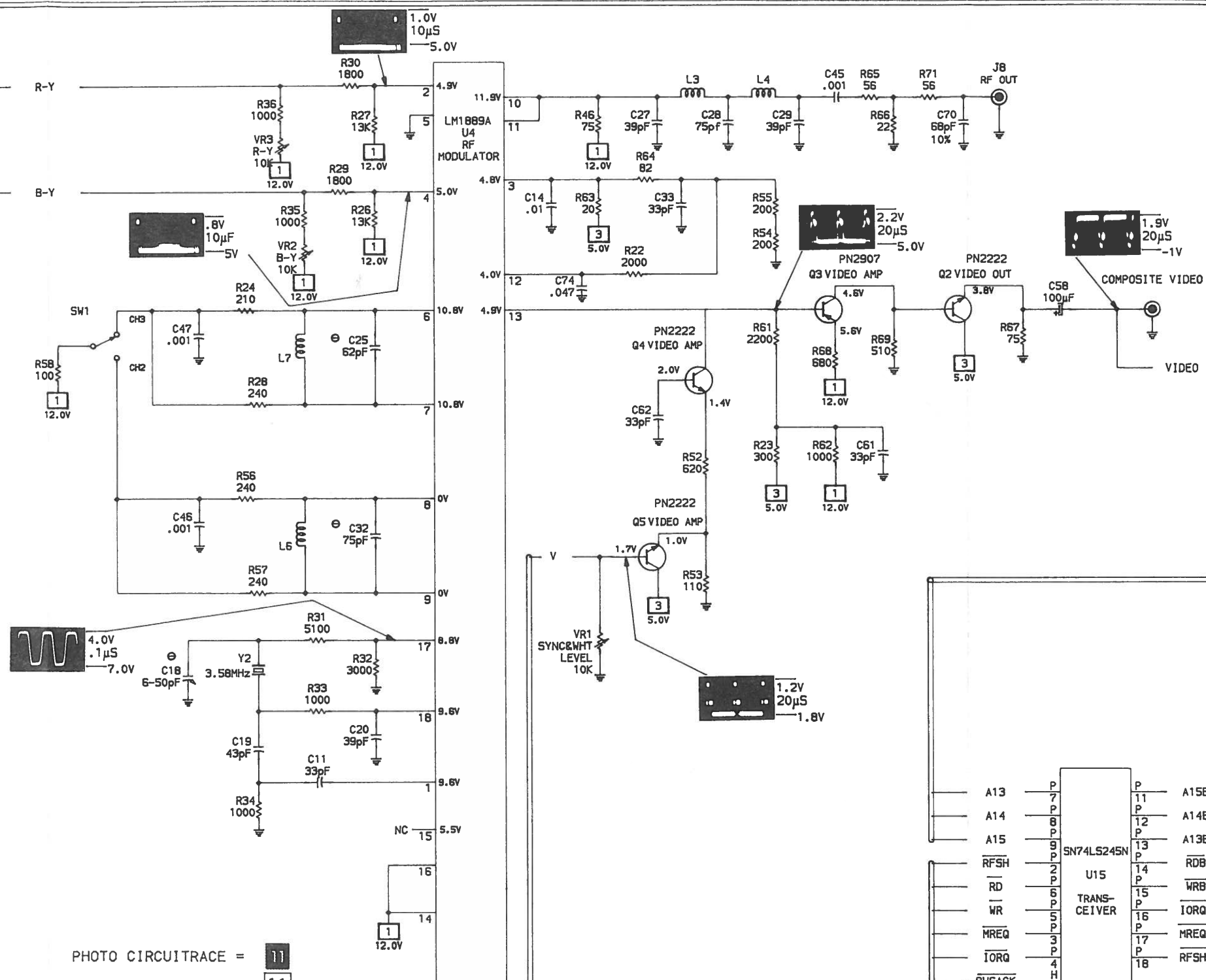
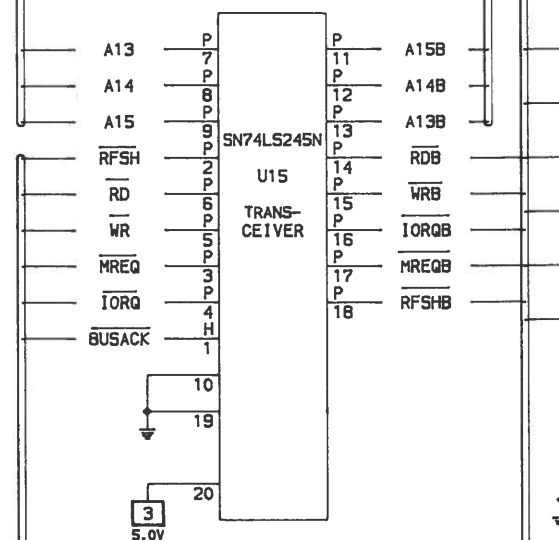
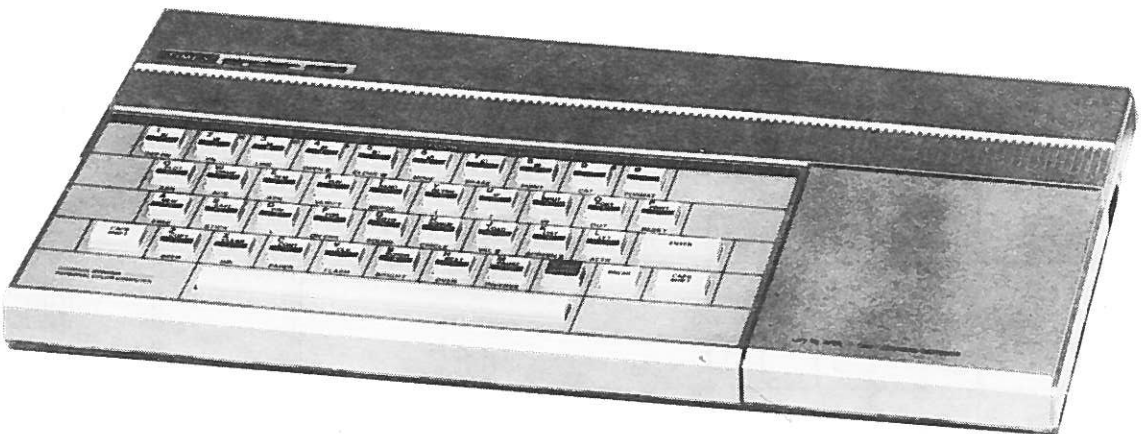


PHOTO CIRCUITRACE = 11
SCHEMATIC CIRCUITRACE = 11

CABLING,
TUBE LINES REDUCE
USE OF MULTIPLE LINES





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CC19
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SAFETY PRECAUTIONS

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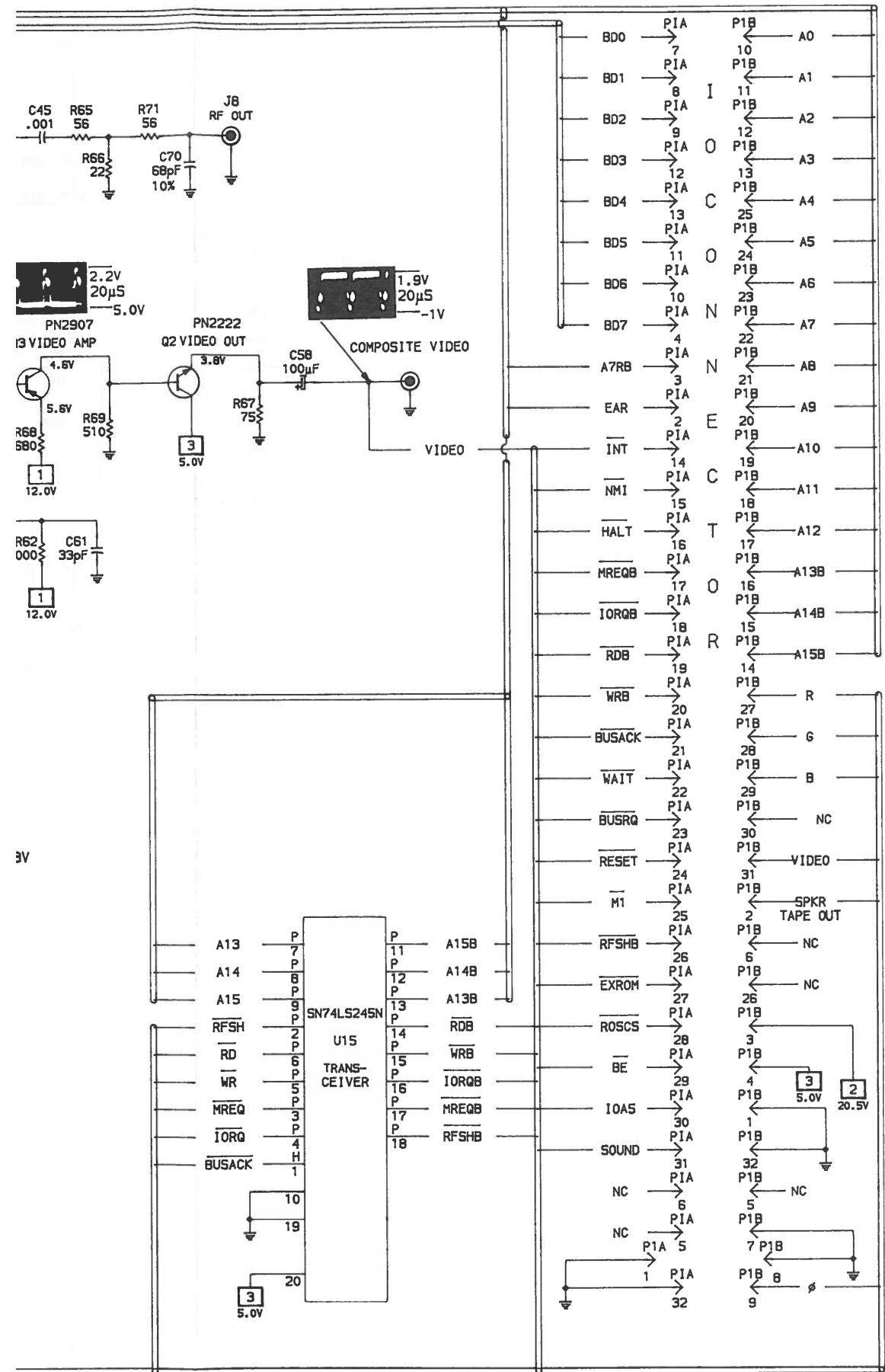
SAMS™ **Howard W. Sams & Co.**
4300 West 62nd Street, P.O. Box 7092, Indianapolis, Indiana 46206 U.S.A.

The listing of any available replacement part herein does not constitute in any case a recommendation, warranty or guaranty by Howard W. Sams & Co. 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. by the manufacturers of the particular type of replacement part listed.

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88CC19022 DATE 1-88



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PRELIMINARY SERVICE CHECKS

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

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

Always turn Computer Off before connecting or disconnecting connectors, boards or peripherals.

Disconnect all external peripherals from the Computer system to eliminate possible external malfunctions.

Replacement or repair of the Power Supply, Main Board, Keyboard or connectors may be necessary after the malfunction has been isolated.

TEST EQUIPMENT

Digital Volt/Ohm Meter
Logic Probe
Frequency Counter
Monitor

TOOLS

Contact and Switch Cleaner (non-spray type)
Phillips Screwdriver
Flat Blade Screwdriver
IC Insertion and Removal Tools 28 pin
Low Wattage Soldering Iron
Desoldering Equipment

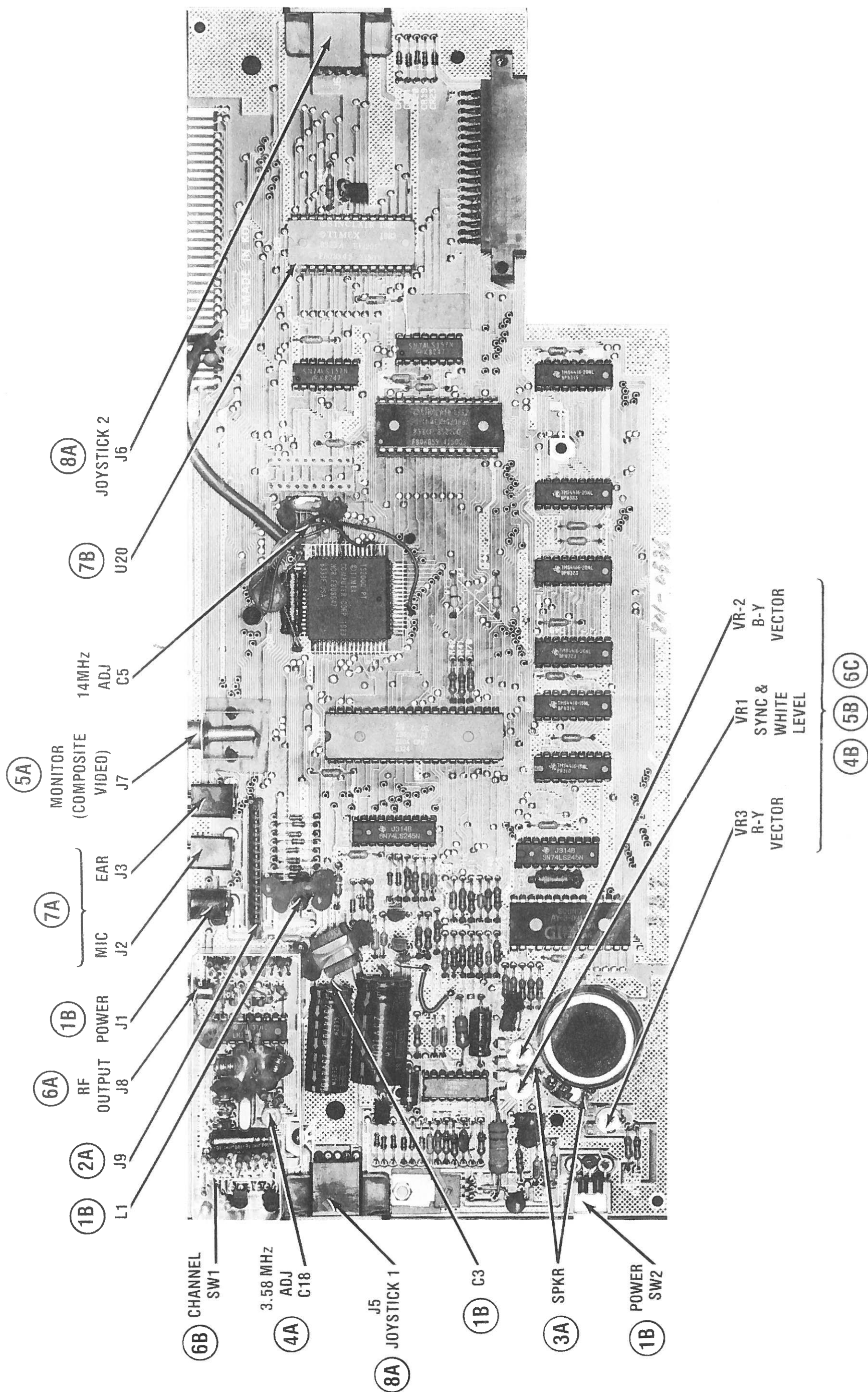
REPLACEMENT PARTS

M1	AC Adapter
SW2	On-Off Switch
U20	Extension ROM

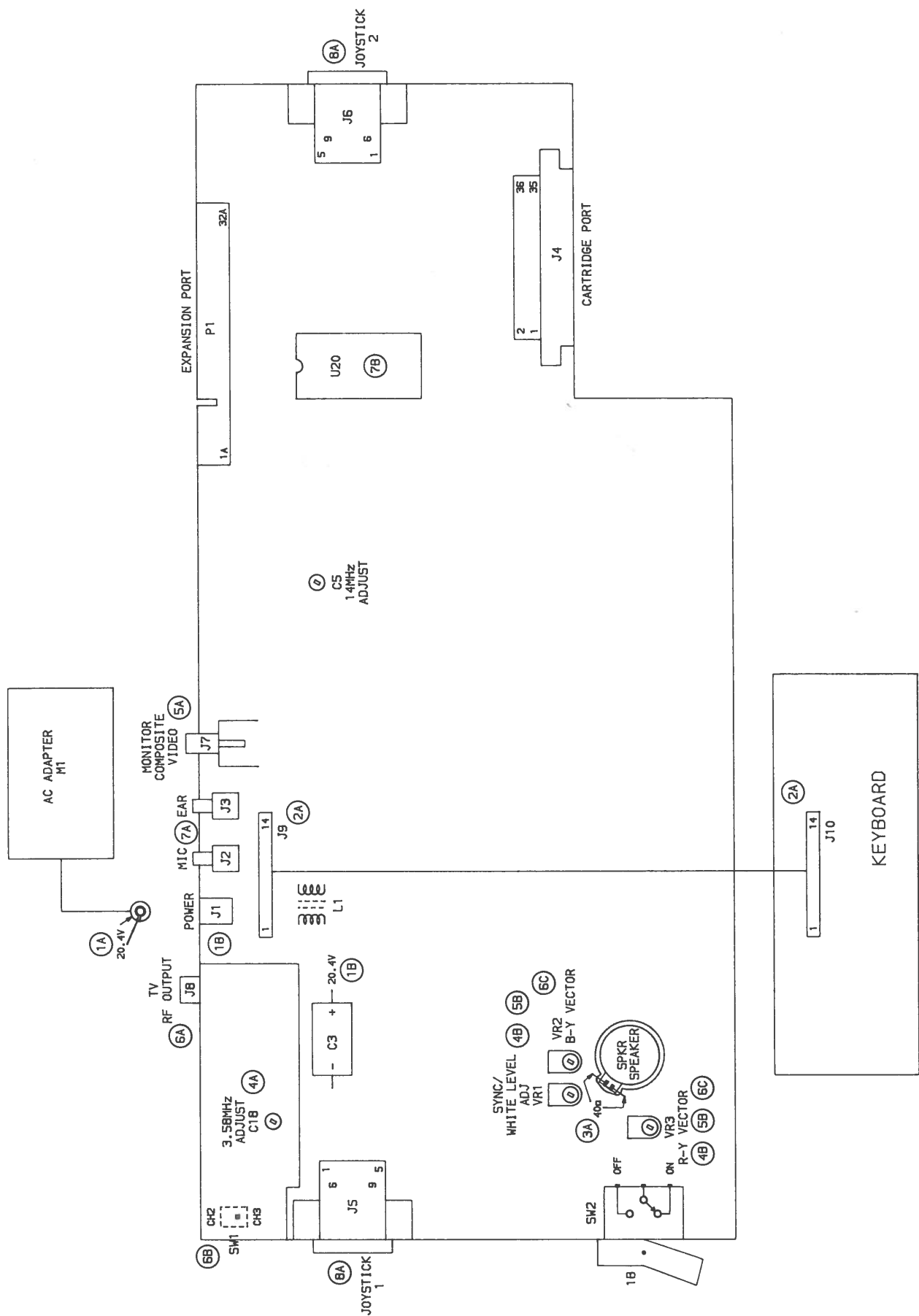
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CC19

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==



PRELIMINARY SERVICE CHECKS (Continued)



INTERCONNECTING DIAGRAM

PRELIMINARY SERVICE CHECKS (Continued)

SERVICE CHECKS

MATCH THE NUMBERS ON THE INTERCONNECTING DIAGRAM AND PHOTOS WITH THE NUMBERS ON THE SERVICE CHECKS TO BE PERFORMED.

① POWER SUPPLY DEAD

- (A) Check for 20.4V at output of AC Adapter (M1). If 20.4V is missing, check adapter cord for possible breaks. If no breaks are found, replace AC Adapter (M1).
- (B) Check for 20.4V at positive end of Capacitor C3. If 20.4V is missing, check On-Off Switch (SW2). Connector J1 and Coil L1.

② KEYBOARD DOES NOT WORK

- (A) Check keyboard ribbon cable and Connectors J9 and J10.

③ NO SOUND FROM INTERNAL SPEAKER

- (A) Check Speaker SP1 winding for continuity (40 ohms).

④ NO COLOR OR INCORRECT COLORS

- (A) Check adjustment of the 3.58MHz Adjust Trimmer (C18), see "Miscellaneous Adjustments".
- (B) Check Sync/White Level Control (VR1), B-Y Vector (VR2) and R-Y Vector (VR3) Controls for proper adjustment, see "Miscellaneous Adjustments".

⑤ COMPOSITE VIDEO MONITOR DOES NOT WORK

- (A) Check Connector J7.
- (B) Check Sync/White Level Control (VR1), B-Y Vector (VR2) and R-Y Vector (VR3) Controls for proper adjustment, see "Miscellaneous Adjustments".

⑥ TV MONITOR DOES NOT WORK

- (A) Check Connector J8.
- (B) Check channel setting of TV. It should be same as Switch SW1 (Channel 2 or 3) on Computer.
- (C) Check Sync/White Level Control (VR1), B-Y Vector (VR2) and R-Y Vector (VR3) Controls for proper adjustment, see "Miscellaneous Adjustments".

⑦ CASSETTE SAVE OR LOAD DOES NOT WORK

- (A) Check Connectors J2 and J3.
- (B) Check Extension ROM IC (U20) by substitution.

⑧ JOYSTICK DOES NOT WORK

- (A) Check Connectors J5 and J6.

PRELIMINARY SERVICE CHECKS (Continued)

GENERAL OPERATING INSTRUCTIONS

POWER UP

When Computer is turned On, it will display a copyright notice on the Monitor screen. To use Basic, press ENTER key. To run a program, press RUN key, then ENTER key. To stop a program, hold CAPS SHIFT key down and press BREAK key.

KEYBOARD OPERATION

Basic commands are entered into Computer with one keystroke or a series of keystrokes instead of typing the command itself. To execute the first command printed on key top, press key. To execute the second command on key top (white on black letters), hold SYMBL SHIFT key down and press desired key. To execute the command printed above key, hold CAPS SHIFT key down and press SYMBL SHIFT key (the cursor letter will change from K to E), then press desired key. To execute the command printed below key, hold CAPS SHIFT key down and press SYMBL SHIFT key, then hold CAPS SHIFT key down and press desired key.

CASSETTE OPERATION

To SAVE a program to tape, press SAVE key and type program name enclosed in quotes. Then press ENTER key, start tape recorder and press any key to start SAVE operation. To LOAD a program from tape, press LOAD key and type program name enclosed in quotes, then press ENTER key and set up tape recorder in play mode. The border of screen will alternate between cyan and red while searching for program. The name of program will appear on screen when found and border will become a pattern of blue and red colors. The pattern lines will become thinner while program is being loaded.

NOTE: Adjust tape recorder Volume and Treble Tone Controls to Maximum. If program will not load properly, try different settings of Volume Control until a setting is found that will work.

DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove seven screws from cabinet bottom. Turn Computer right side up and lift front edge of cabinet top up. While holding top, carefully pull flat keyboard ribbon out of connector and remove cabinet top.

MAIN BOARD REMOVAL

Remove three screws holding Main Board and lift board out of cabinet bottom.

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PRELIMINARY SERVICE CHECKS (Continued)

PREVENTATIVE MAINTENANCE

ENVIRONMENT

Computers perform best in a clean, cool area that is below 80 degrees Fahrenheit and free of dust and smoke particles. Even though home Computers are not affected by cigarette smoke as much as commercial Computers are affected, it is better to maintain a smoke-free area around the Computer. Do not block cabinet vents of Computer, Monitor, Printer, or other power devices.

ELECTRICAL POWER

Variations in the line voltage can affect the Computer. Try to avoid these fluctuations by using an AC receptacle that is on a power line not used by appliances or other heavy current demand devices. A power-surge protector, power-line conditioner, or non-interruptable power supply may be needed to cure the problem. **Do not** switch power On and Off frequently.

KEYBOARD

Liquids spilled into the Keyboard can ruin it. Immediately after a spill occurs, disconnect the Computer power plug from AC power outlet. Then, if circuitry or contacts are contaminated, disassemble the Keyboard and carefully rinse the Keyboard printed circuit board with distilled water and let it dry. Use a cotton swab to clean between the keys. Use a non-abrasive contact cleaner and lint-free wipers on accessible connectors and contacts.

DISK DRIVES

Clean the read/write heads of the Disk Drives about once a month or after 100 hours usage. Use only an approved head cleaning kit.

Handle carefully to preserve proper disk head alignment. A sudden bump or jolt to the Disk Drives can knock the disk head out of alignment. If Disk Drive must be transported, place an old disk in slot and close door during transport.

Store disks in their protective covers and never touch the disk surface. Observe the disk handling precautions usually found on the back of disk protective covers.

PRINTERS

Carefully vacuum the Printer regularly. Wipe surface areas clean using a light all-purpose cleaner. Do not oil the machine. The oil will collect abrasive grit and dust. The dust will act as a blanket. This can cause components to overheat and fail.

STATIC ELECTRICITY

Static electricity discharge can affect the Computer. In order to minimize the possibility, use anti-static mats, sprays, tools and materials, and maintain good humidity in the Computer environment.

MONITOR

Use an isolation transformer with any Monitor that does not come as part of the system since some Monitors use a HOT chassis (chassis connected to one side of the AC line). The face of the Monitor should never be left on for long period of time at high brightness level except when pattern is being changed periodically. Use caution when cleaning anti-glare screens, to preserve the glare-reduction feature.

PRELIMINARY SERVICE CHECKS (Continued)

NOTES