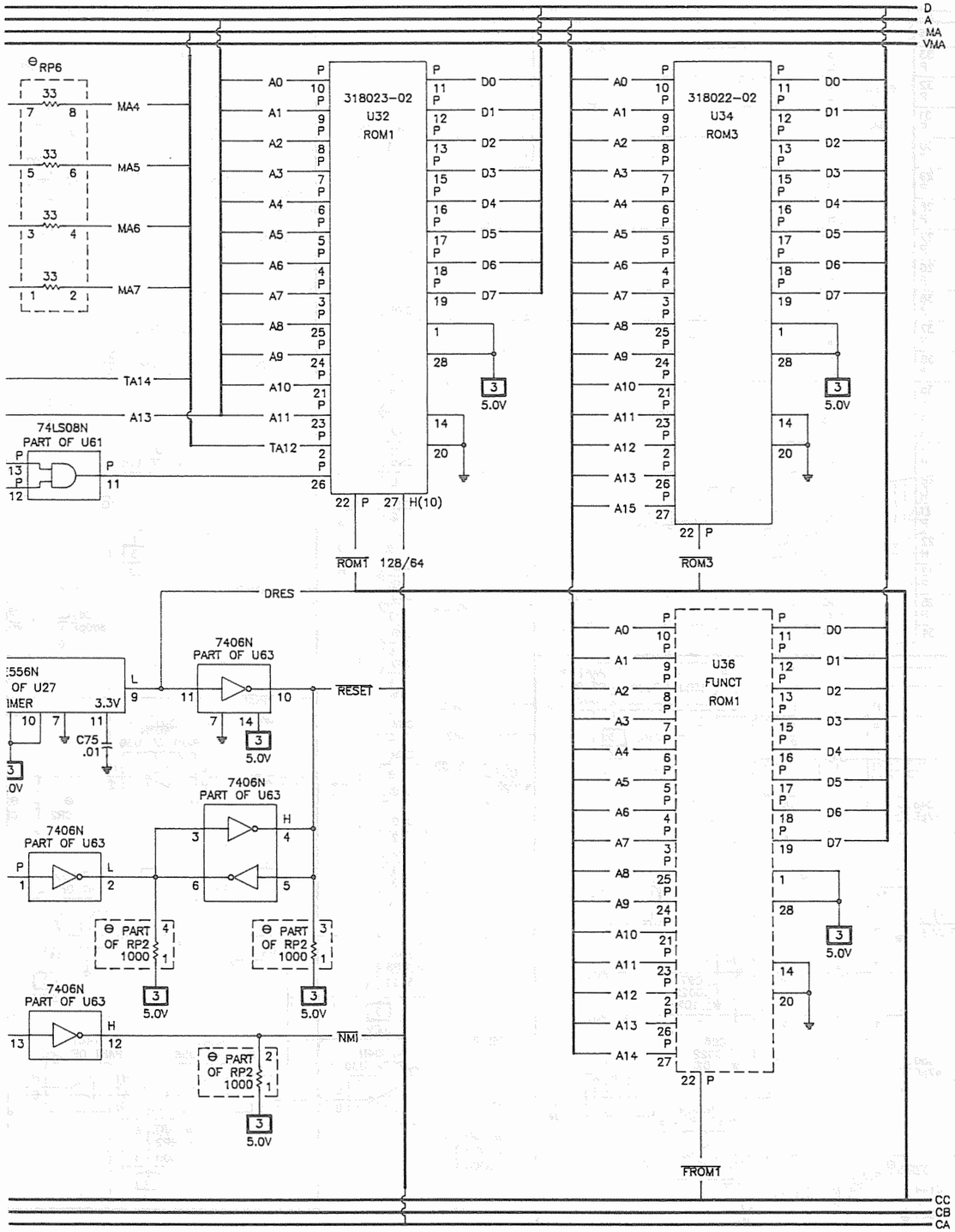
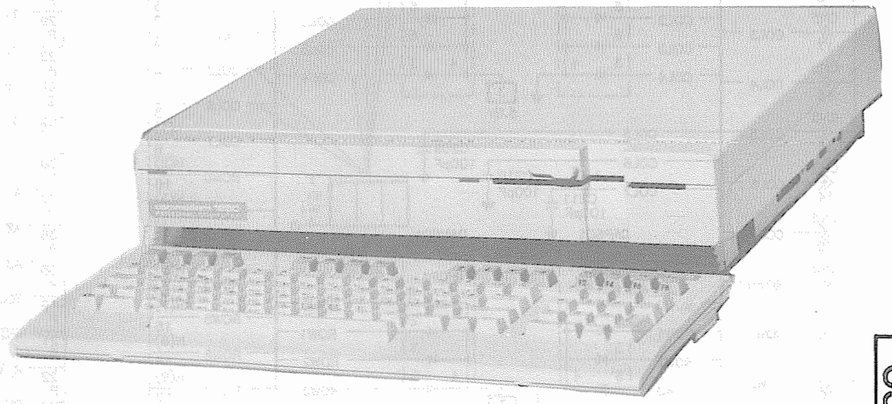


COMMODORE
MODEL C128D



CSCS25
COMMODORE
MODEL C128D

CSCS25
COMMODORE
MODEL C128D

SAFETY PRECAUTIONS See Page 16.

PRELIMINARY SERVICE CHECKS ENCLOSED

INDEX

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

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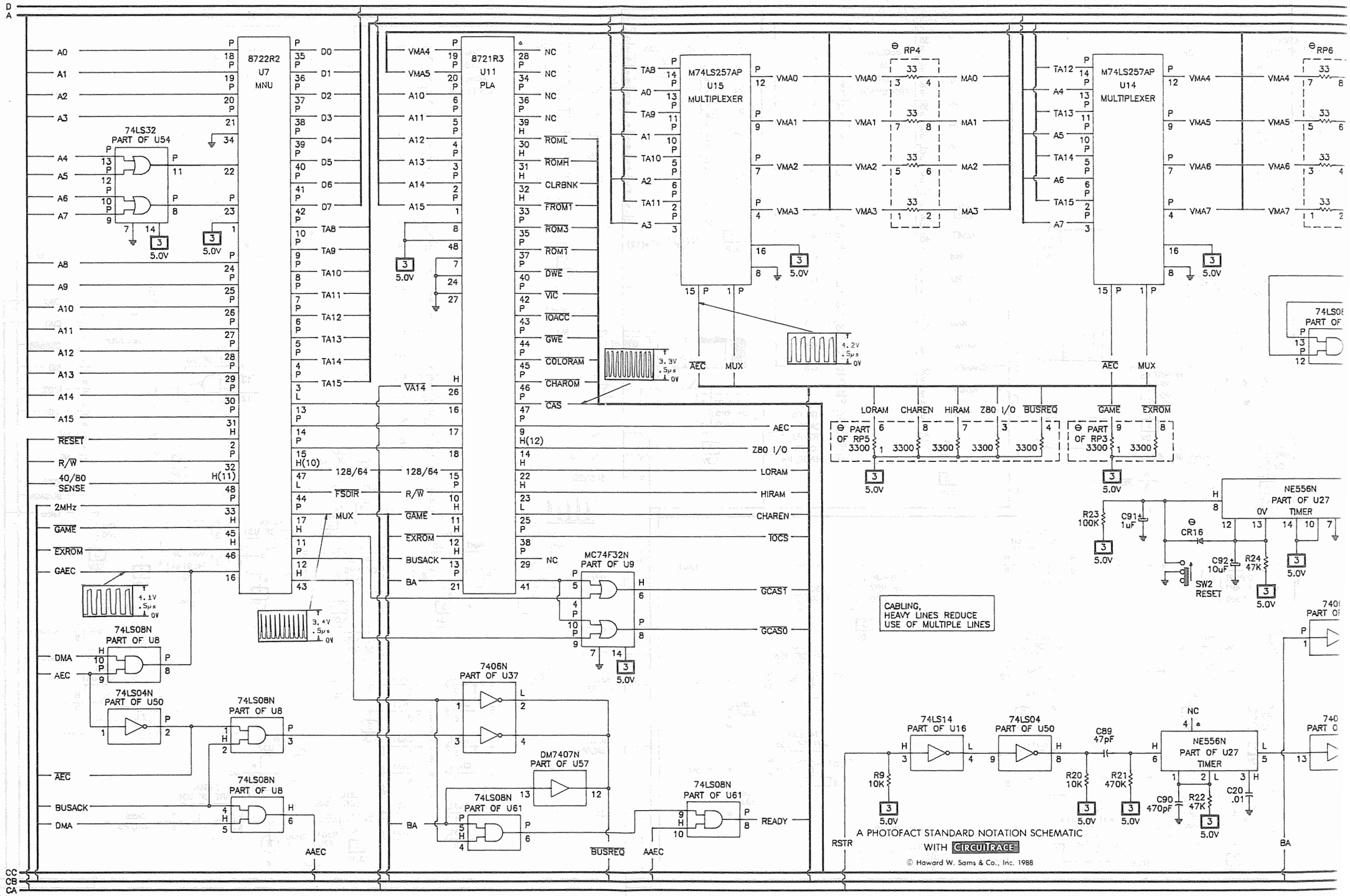
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MNU
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U11
PLA
M74LS257AP
U15
MULTIPLEXER
M74LS257AP
U14
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74LS32
PART OF U54
74LS08N
PART OF U8
74LS04N
PART OF U50
7406N
PART OF U37
DM7407N
PART OF U57
MC74F32N
PART OF U9
74LS14
PART OF U16
NE556N
PART OF U27
TIMER
RP4
RP6
RP5
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A0
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A2
A3
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RESET
R/W
40/80 SENSE
2MHz
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AEC
BUSACK
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VA14
128/64
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MUX
ROML
ROMH
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FROM1
ROM3
ROM1
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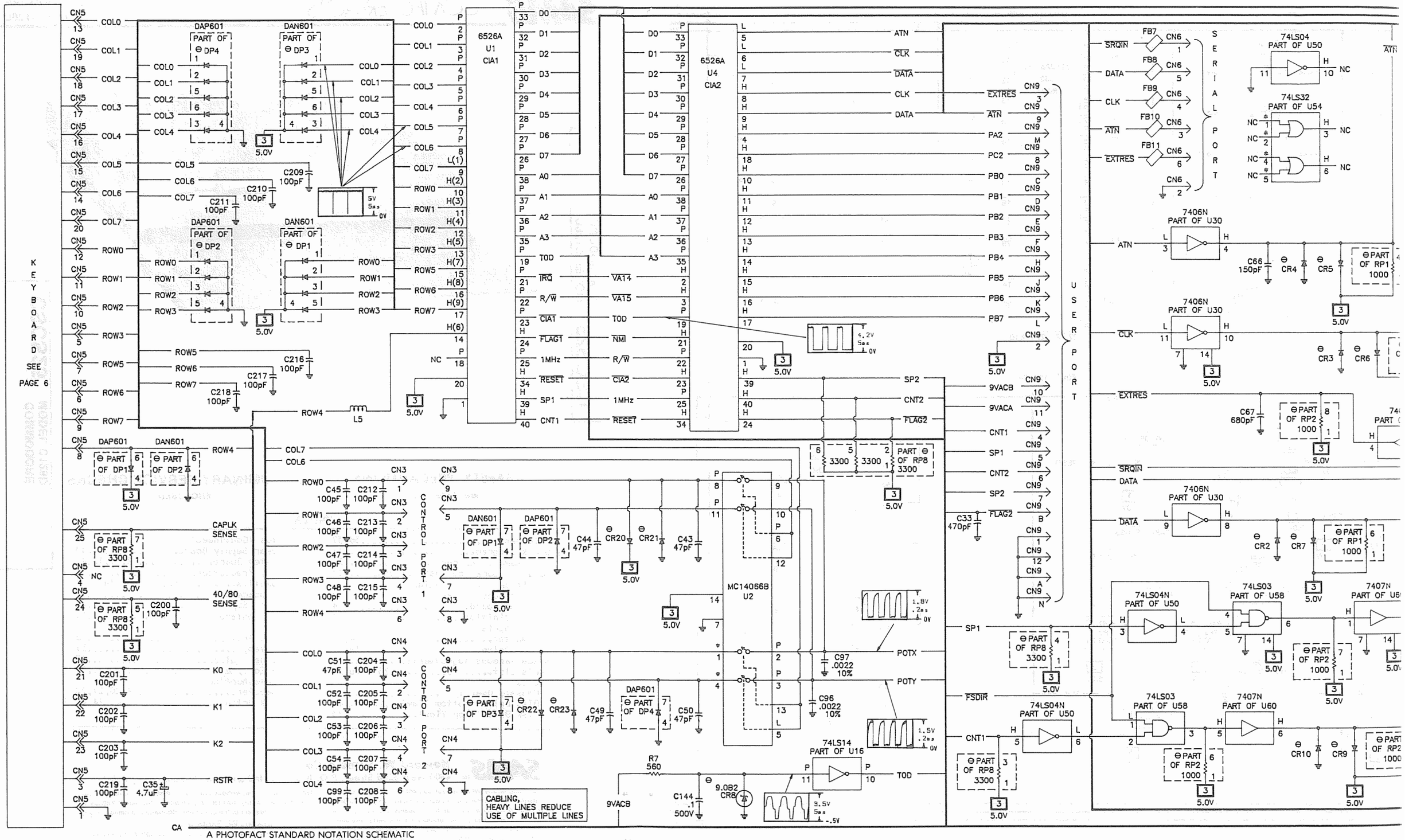
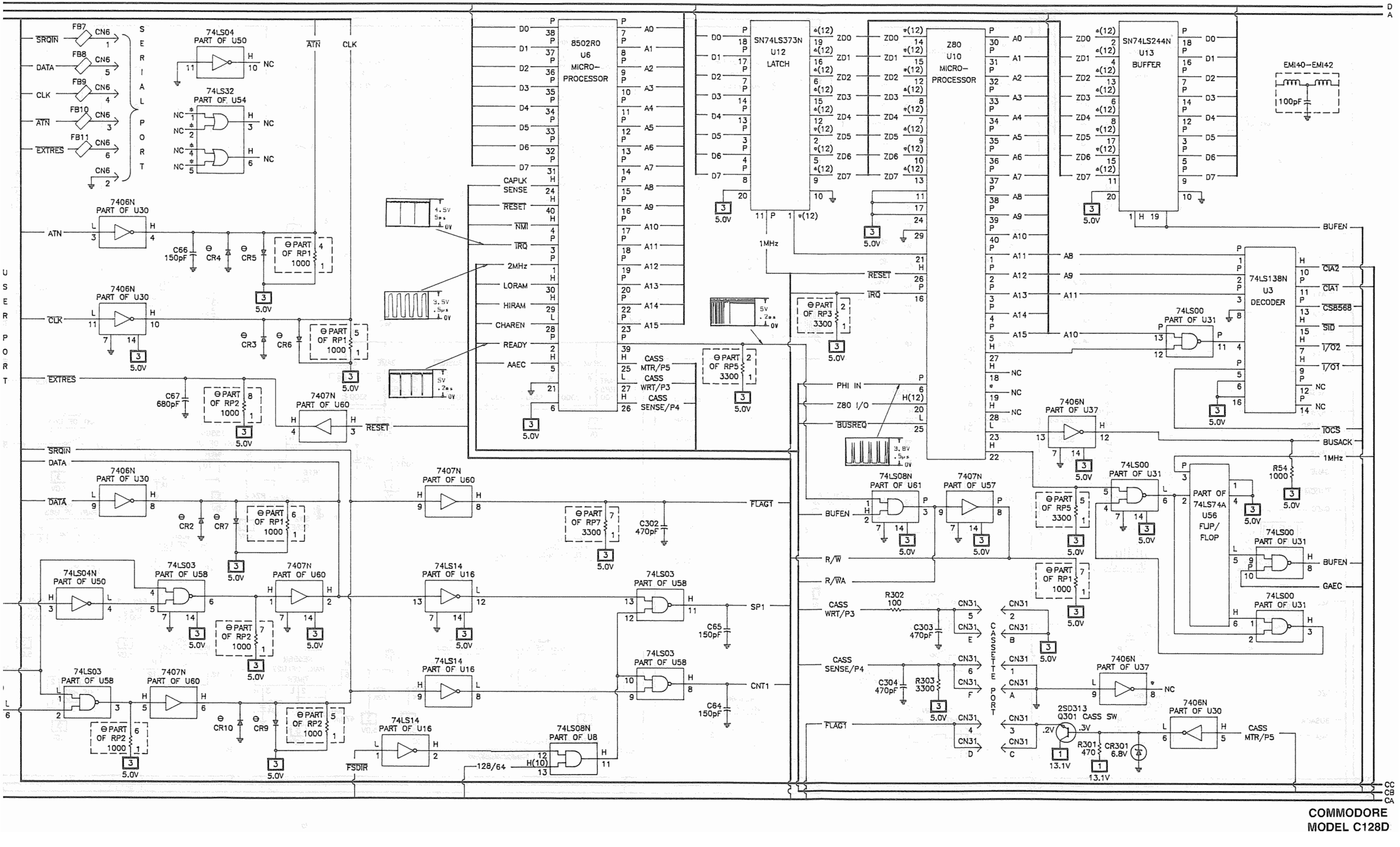
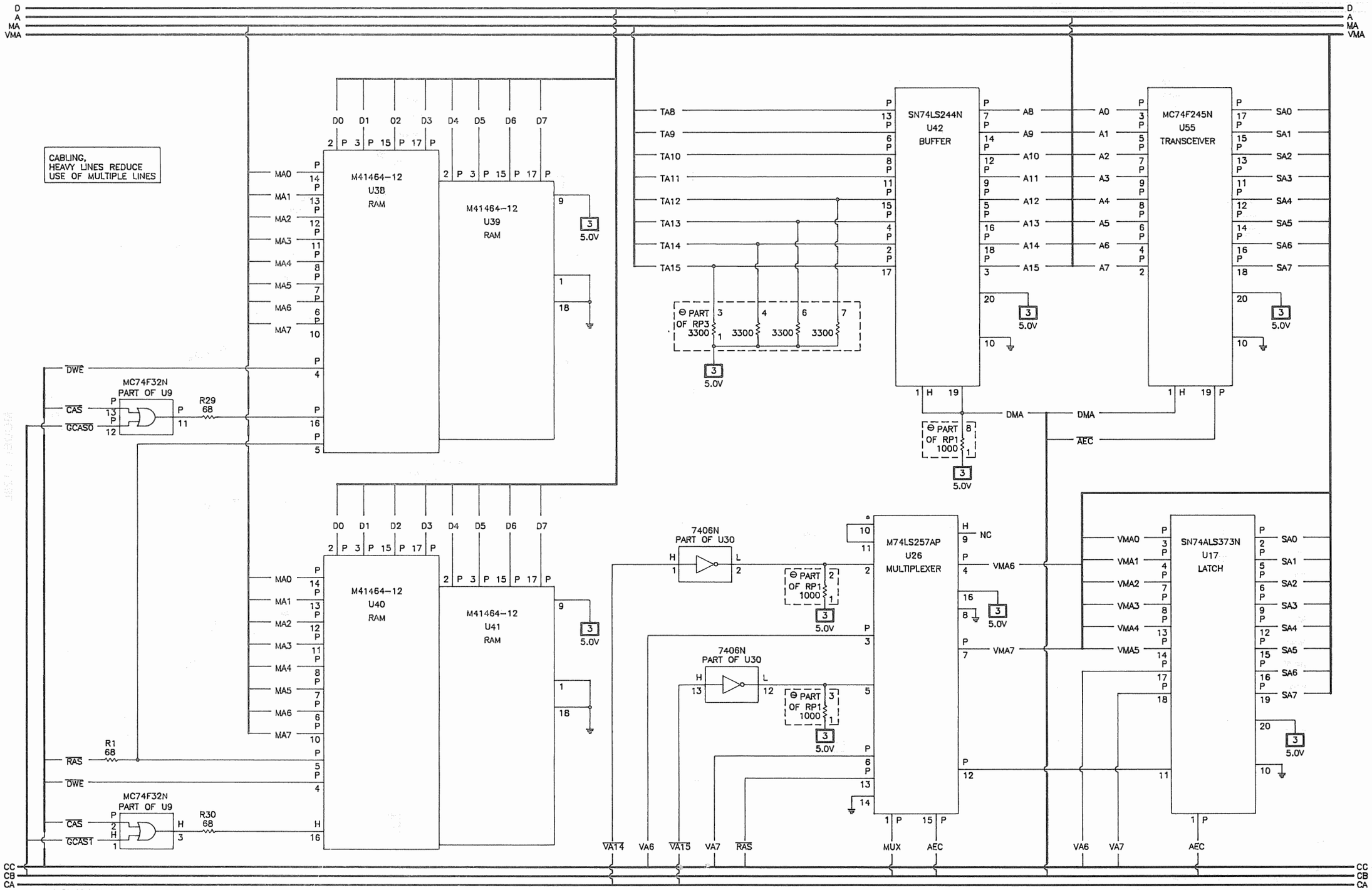
VIC
IOACC
GWE
COLORAM
CHAROM
CAS
NC
VMA0
VMA1
VMA2
VMA3
VMA4
VMA5
VMA6
VMA7
MA0
MA1
MA2
MA3
LORAM
CHAREN
HIRAM
Z80 I/O
BUSREQ
EXROM
TOCS
GCAST
GCAS0
READY
AAEC
RSTR
BA
5.0V
3.3V .5µs 0V
4.2V .5µs 0V
4.1V .5µs 0V
3.4V .5µs 0V
CABLING,
HEAVY LINES REDUCE
USE OF MULTIPLE LINES
A PHOTOFACT STANDARD NOTATION SCHEMATIC
WITH CIRCUITRACE
© Howard W. Sams & Co., Inc. 1988



A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE



COMMODORE
MODEL C128D



A PHOTOFACT STANDARD NOTATION SCHEMATIC
WITH CIRCUITRACE®

D A MA VMA

390059-01 U18 CHARACTER ROM

SA0 SA1 SA2 SA3 SA4 SA5 SA6 SA7 TA8 TA9 TA10 TA11

D0 D1 D2 D3 D4 D5 D6 D7

J18 J15 J17 J16 J7A J7 J7B

128/64

CAPLK SENSE

CHAROM

5.0V

LC3517A-15 U19 COLOR RAM

CLRBNK COLORAM

D8 D9 D10 D11

PART OF RP7 3300 3300 3300 3300

8564R6V6 U21 VIC

VMA0 VMA1 VMA2 VMA3 VMA4 VMA5 TA8 TA9 TA10 TA11

D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11

K0 K1 K2 R/W ROW4 MUX AEC TOACC CAS VIC

8580R5 U5 SID

A0 A1 A2 A3 A4 POTX POTY R/W RESET 1MHz

D0 D1 D2 D3 D4 D5 D6 D7

EXT AUDIO

C83 .022 C82 .022

C95 470pF

2SC1815GR Q2 AUDIO OUT 5.3V 5.9V

R28 1DK C81 .001 R12 1000 C84 220pF 5%

C86 .1 C100 220uF CR17 11.9V C85 10uF

AUDIO OUT

3.3V .5µs 0V

CABLING, HEAVY LINES REDUCE USE OF MULTIPLE LINES

74LS74A PART OF U56 FLIP/FLOP

GWE NC

74LS04N PART OF U50

MUX 1MHz SID

3.5V .5µs 0V

FB19 FB20

J10 J11 R13 R14

3V 10µs 0V

1.6V 10µs 2.1V

M1 RF MOD. (SCHEM. ON P 35)

C63 100uF C21 .22 C72 .01 L4 C87 .01 C94 .22 L3

1.2V .5µs 0V

8701 U28 CLOCK

Y2 14.31818 MHz CT1 4-40pF J1

NC

4.1V .5µs 0V

7406N PART OF U37

FB18 DOT CLOCK R2 390

7407N PART OF U60

7407N PART OF U57

R35 180

RAS VA6 VA7 1MHz IRQ BA 2MHz

3.5V .5µs 0V

3.5V .2µs 0V

PHI IN

J1 EMI140 FILTER COMP OUT CN8 4

EMI141 FILTER SYNC/LUM OUT CN8 1

EMI142 FILTER CHROMA OUT CN8 6

FB14 CN8 3 NC CN8 7 CN8 2

FB13 CN8 8

FB15 EXT AUDIO CN8 5

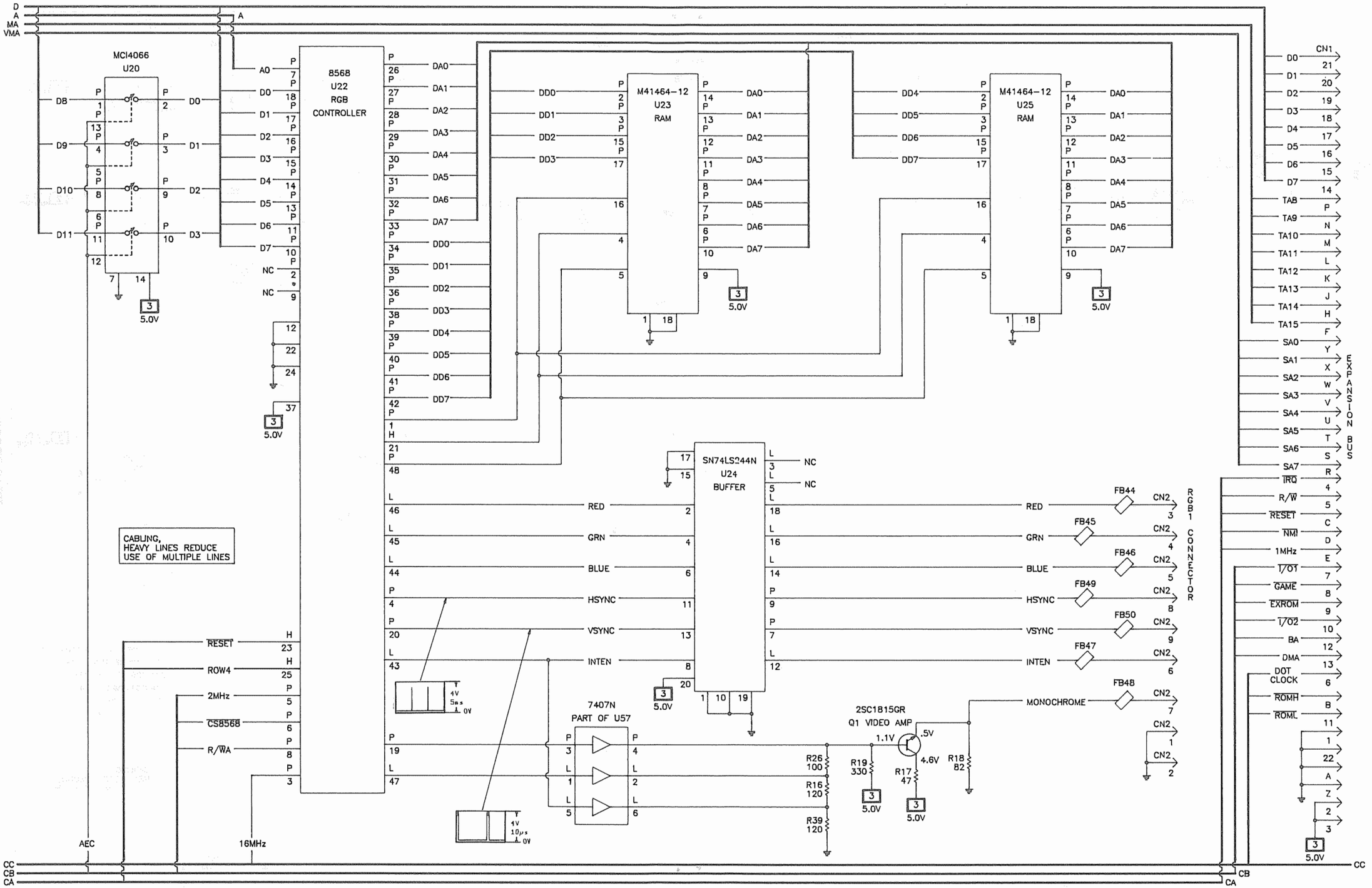
C29 100pF 500V R6 47K C93 .1 500V R25 100K

AUDIO OUT EXT AUDIO

VIDEO CONNECTOR

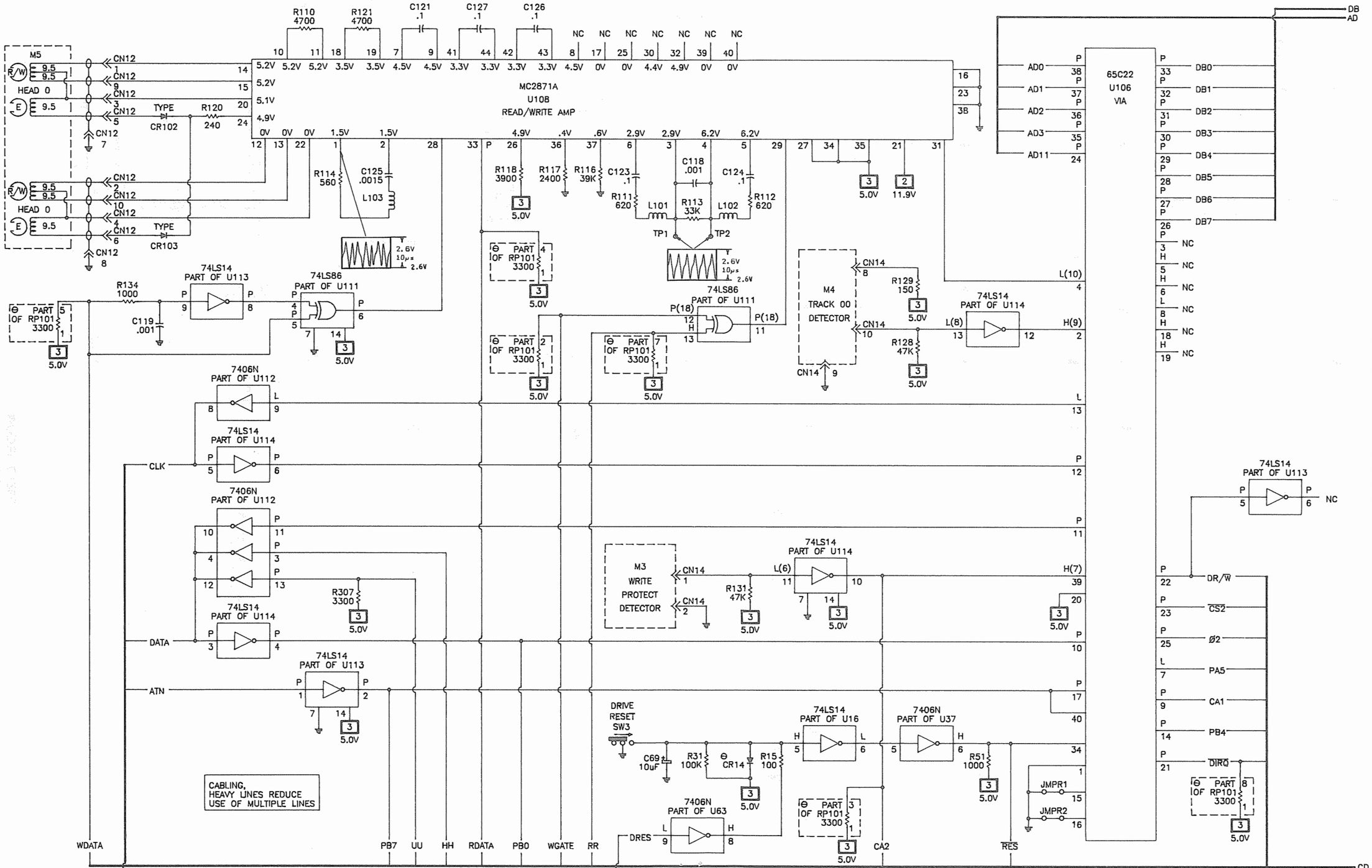
CC CB CA

A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE



A PHOTOFACT STANDARD NOTATION SCHEMATIC
WITH CIRCUITRACE®

CSCS25



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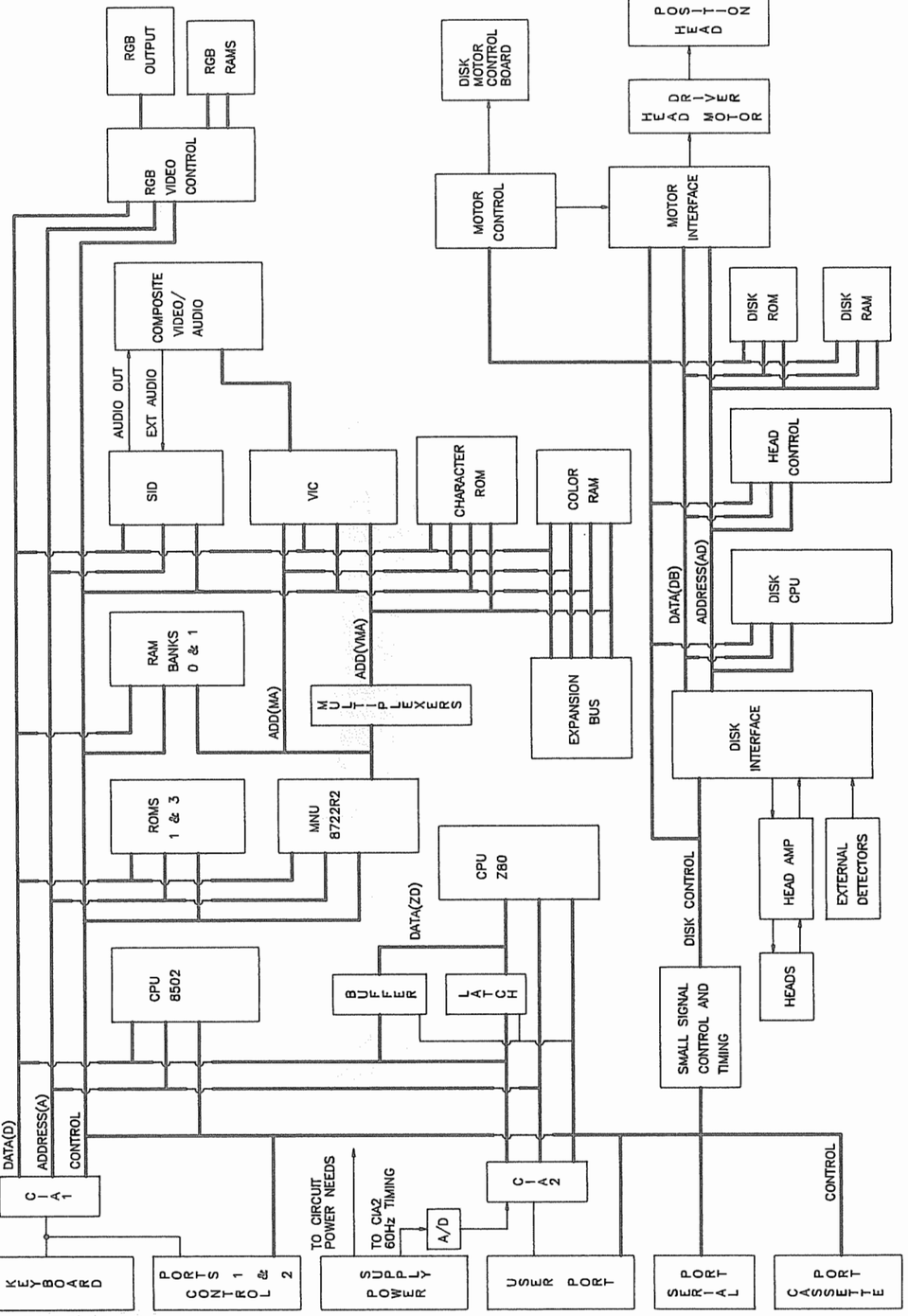
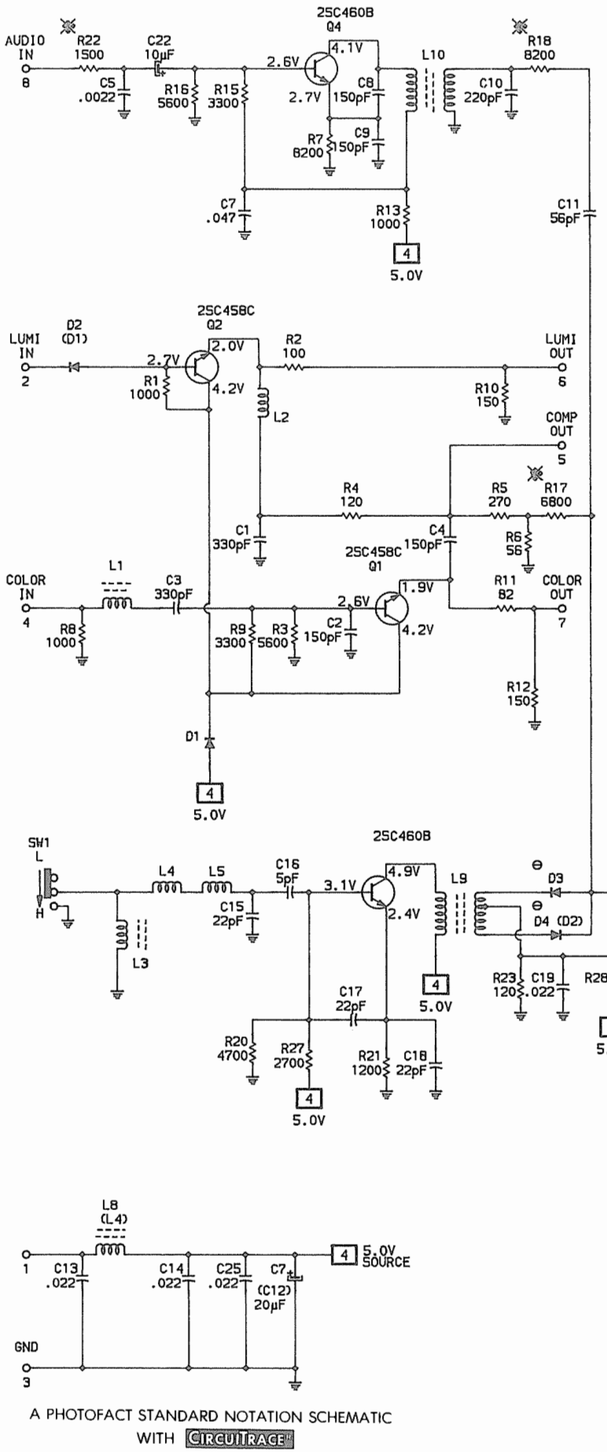


BLOCK DIAGRAM



Nominal value

A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE™

RF MODULATOR

CHASSIS - OVERALL VIEW

A Howard W. Sams CIRCUITRACE Photo

POWER SUPPLY BOARD

A Howard W. Sams GRIDTRACE™ Photo

LOGIC CHART (Continued)

PIN NO	IC U107	PIN NO	IC U107	PIN NO	IC U107	PIN NO	IC U108	PIN NO	IC U109	IC U110
1	P	21	P	41	P	21		1	L	H(1)
2	P	22	P	42	*	22		2	H(1)	H
3	P	23	P	43	L	23		3	L(1)	H
4	P	24	P	44	H	24		4	H(1)	H(1)
5	H	25	P	45	P	25		5	L(1)	L(1)
6	H	26	P	46	P	26		6	L(2)	
7	P	27	P	47	P	27		7	H	
8	P	28	P	48	P	28	P	8	L	L
9	P	29	P			29	P(18)	9	H	L
10	P	30	P			30		10	L	H
11	P	31	P			31	L(10)	11	H(3)	L(1)
12	L	32	P			32		12	H(1)	H(1)
13	H	33	P			33	P	13	L(1)	L(2)
14	P	34	P			34		14	H(1)	
15	P	35	L			35		15	L(1)	
16	P	36	H			36		16	*	H
17	P	37	P			37		17		
18	P	38	P			38		18		
19	P	39	H			39		19		
20	P	40	H			40		20		

PIN NO	IC U111	IC U112	IC U113	IC U114
1	H(1)	H(12)	P	P
2	L(1)	H(13)	P	P
3	H(1)	P	L(1)	P
4	P	P	H(1)	P
5	P	P	P	P
6	P	P	P	P
7	L	L	L	L
8	L(1)	P	P	P
9	L(1)	L	P	P
10	L(1)	P	L(1)	H(7)
11	P(18)	P	H(1)	L(6)
12	P(18)	P	H(1)	H(9)
13	H	P	L(1)	L(8)
14	H	H	H	H
15				
16				

GENERAL OPERATING INSTRUCTIONS

POWER UP

When Computer is turned On, it will come up in C128 mode ready to program in Basic. To bring Computer up in C64 mode, hold Commodore key down while turning Computer On. If Computer is already On, it can be switched from C128 mode to C64 mode by typing GO 64 and pressing RETURN key. When Computer responds with "ARE YOU SURE?", type y and press RETURN key. Press RESET button to go from C64 mode to C128 mode. Note: Any program in the Computer will be lost when the Computer is switched between C128 mode and C64 mode. Save the program before switching modes. To run a Basic program after it is loaded, type RUN and press RETURN key. Press RUN/STOP key to stop program. Press RUN/STOP and RESTORE keys at the same time to return the Computer to its standard condition.

CP/M MODE

To bring Computer up in CP/M mode, insert CP/M disk in the drive, then press RESET button. If the 40/80 Display Key is in the up position, CP/M will come up in 40 column mode on RF Modulator for connection to a TV and video output for connection to a monitor. If the 40/80 key is down, CP/M will come up on the RGB output for connection to an RGB Monitor.

40/80 COLUMN MODES

The 80 column mode works in C128 and CP/M modes only and works only on an RGB Monitor. To get 80 column mode, put the 40/80 key in down position and press RESET key. To get 40 column mode, leave the 40/80 key up. The 40 and 80 column modes can also be switched by pressing and releasing ESC key, then pressing the X key.

RESET AND DRIVE RESET

The Computer can be reset by pressing RESET button (SW2) on the right side of Computer. Any programs in Computer will be lost when RESET button is pressed. To reset Disk Drive only, press DRIVE RESET button (SW3) on the right side of Computer. Pressing DRIVE RESET button will not erase any programs.

MACHINE LANGUAGE MONITOR

The C128 has a built-in machine language monitor program to enable the user to write, edit, save and load machine language programs. To enter the monitor from Basic, either press F8 Function key, then press RETURN key or type the word MONITOR and press RETURN key. To exit from monitor to Basic, type X and press RETURN key.

CASSETTE OPERATION

Plug a Datasette cassette recorder onto Cassette Connector (CN31) on right side of Computer. Note: An ordinary cassette recorder will not work with the Commodore C128. To load a program, type LOAD, press RETURN key and follow instructions displayed on the Monitor screen. To save a program, type SAVE, press RETURN key and follow instructions displayed on the screen.

DISK OPERATION

IN C128 MODE: To get a directory of files on a diskette, type DIRECTORY (or press F3 Function key) and press RETURN key. To load a program from diskette, type DLOAD (or press F2 Function key), type the program name enclosed in quotes, then press RETURN key (DLOAD "name"). To save a program to diskette, type DSAVE (or press F5 Function key), type the program name enclosed in quotes, then press RETURN key.

A blank diskette must be formatted before it can be used. To format a diskette, use the following:

HEADER "diskette name",Iid,Ddrive#,Udevice#

The diskette name can be up to 16 characters. The I is followed by a two character identification. The D is followed by a drive number (0,1,2 or 3). The U is followed by a device number (8,9,10 or 11).
If the green LED on the front panel starts blinking, it means an error in operation has occurred and an error message has been stored in Disk Drive memory. To read the error message, type DS$ and press RETURN key.

IN 64 MODE. To get a directory of files on a diskette, type LOAD "$",8 and press RETURN key. After the directory is loaded, type LIST and press RETURN key to view the directory on the Monitor screen. To load a program from diskette, type LOAD with the program name enclosed in quotes, followed by ,8 (for drive device number 8) and press RETURN key. Example: LOAD "SAMS",8. To save program to diskette, type SAVE with the program name enclosed in quotes, followed by ,8 and press RETURN key. Example: SAVE "SAMS",8. To format a blank diskette, type OPEN 1,8,15,"NO:name,Id"CLOSE 1 and press RETURN key. Note: The N inside the quotes is followed by a zero.
To read the error message when the green LED on the front panel flashes, type in and run the following program:

```
10 OPEN 15,8,15
20 INPUT #15,EN,E$,T,S
30 PRINT "ERROR # ";EN,E$
40 PRINT "TRACK # ";T,"SECTOR # ";S
50 CLOSE 15
```

The program displays the error number, message, track and sector where the error has occurred.

DISK DRIVE NOTES

DISK DRIVE INTERFACE

Voltages, Waveforms and logic readings taken while running the following Basic program. Readings were taken when the disk drive head is not moving (drive is in read or write mode) unless noted.
NOTE: Insert a formatted diskette (not write protected) in Drive before running the program.

```
10 OPEN 1,8,1,"@0:SAMS,$,W"
20 FOR X=1 TO 50
30 PRINT#1,"HOWARD W SAMS"
40 NEXT X
50 CLOSE 1
60 GOTO 10
```

(1) Probe indicates P when Head is moving.
(2) Probe indicates H when head is moving.
(3) Probe indicates L when head is moving.
(6) Probe indicates H if diskette is write protected.
(7) Probe indicates L if diskette is write protected.
(8) Probe indicates H when the head is on track 00 and L when off track 00.
(9) Probe indicates L when the head is on track 00 and H when off track 00.
(10) Probe indicates L when head 0 is selected, H when head 1 is selected.
(12) Probe indicates L when drive motor is off.
(13) Probe indicates H when drive motor is off.
(18) Probe indicates H when in write mode, L when in read mode.

TROUBLESHOOTING

POWER SUPPLY

Before servicing Power Supply, disconnect Connector CN7 from System Board to avoid possible System Board damage from high voltages that may occur while servicing Power Supply. Note: Do not operate Power Supply without a load. A #1129 lamp may be used as a load across the 5V Source (pins 3 and 4 of Connector CN7).
Power Supply dead. Check Fuse F1. If Fuse is open, check for possible shorts at Bridge Rectifier BR1 and Power Output Transistor Q1. If fuse is good, apply AC power and check for 120 VAC across Transformer T1 primary. If 120 VAC is missing, check Power Switch SW1 and Line Filter LF1. If 120 VAC is present, check for 156V at junction of Thermister TH1 and pin 4 of Transformer T2. If 156V is missing, check Bridge Rectifier BR1, Thermister TH1 and Capacitor C5. If 156V is present, check for waveform at base of Transistor Q1. If waveform is missing, check: voltages and components associated with Transistors Q1, Q3, Q4 and Q5; Optoisolator PC1; windings on Transformer T2.
No 12V Source. Check for 18V at pin 1 of 12V Regulator IC IC1. If 18V is missing, check Capacitors C11 and C51, Diode D9, and Transformer T2 winding continuity from pin 10 to 12. If 18V is present, check IC IC1 and Capacitors C19, C20, and C21.
No 5V Source. Check Coil L1, Diode D10 and Capacitors C12 and C14. Check continuity of Transformer T2 top winding .
No 9VAC Source. Check Fuse F2 and check continuity of windings on Transformer T1.
5V and 12V Sources are not correct. Check voltages and components associated with Error Amp IC IC2, Optoisolator PC1 and Regulator Transistor Q4.

MICROPROCESSOR (CPU) OPERATION

Computer does not boot up. Power supply checks good. Verify that oscillators and dividers are working properly (see "Oscillators and Dividers"). Check Reset circuit logic reading at pin 40 of IC U6. The reading should be logic low when Computer is turned On, then go high and stay high. The reading should go low when Reset Button (SW2) is pressed. If readings are not correct, check Reset Button (SW2), Capacitors C91 and C92, Diode CR16, Resistors R23 and R24, Timer IC U27 and IC U63.

OSCILLATORS AND DIVIDIERS

Verify the 14.318MHz oscillator by checking for 14.318MHz at pin 14 of Clock IC U28. If signal is missing or frequency not correct, check Crystal Y2, Trimmer CT1 and IC U28. If signal is good, check for 8.1818MHz at pin 6 and 14.318MHz at pin 8 of IC U28. If either signal is missing, check IC U28. If signals are present, check for pulses at pin 10 of IC U37. If pulses are missing, check IC U37. If pulses are present, check for 1.0MHz at pins 18 and 23 of VIC IC U21. If either signal is missing, check IC U21. If signals are present, check waveform at pin 6 of IC U10 and check for same waveform at pin 25 of IC U21. If waveform is missing at IC U10 and present at IC U21, check ICs U57 and U60. If waveform is missing at IC U21, check IC U21.
Verify the 16.0MHz Oscillator by checking for 16.0MHz waveform at pin 29 of IC U107. If waveform is missing or frequency not correct, check Crystal Y1, Capacitors C116 and C117, Resistor R108 and IC U107. If waveform is good, check for 16MHz signal at pin 30 of IC U107. If signal is missing, check IC U107.

KEYBOARD

Keyboard does not work. Check Connector CN5 for good connections. If connections are good, check waveforms at pins 2 thru 8 of CIA IC U1. If any waveforms are missing, check IC U1. If waveforms are present, check operation of the keyboard by observing the logic readings on pins 9 thru 17 of IC U1 while pressing keys associated with the pin being monitored. If any logic readings are not correct, check key contacts on the keyboard. If readings are correct, check IC U1.
RESTORE key does not work. Check for logic low at pin 3 of Connector CN5 while pressing RESTORE key. If reading is not correct, check contacts on RESTORE key. If reading is correct, check for logic high at pin 4 of IC U16 while pressing RESTORE key. If reading is not correct, check IC U16. If reading is correct, check for logic low at pinw 8 of IC U50 while pressing RESTORE key. If reading is not correct, check IC U50. If reading is correct, check for pulse at pin 6 of IC U27 when RESTORE key is pressed. If reading is not correct, check Capacitor C89 and Resistors R20 and R21. If reading is correct, check for pulse at pin 5 of IC U27 when RESTORE key is pressed. If reading is not correct, check Capacitors C20 and C90, Resistor R22 and IC U27. If reading is correct, check for pulse at pin 12 of IC U63 when RESTORE key is pressed. If reading is not correct, check IC U63.

C64-C128-CP/M MODES

Computer operates in C64 mode only (Commodore key held down while turning Computer On). CP/M and C128 modes do not work. Check ROM IC U34 and MMU IC U7.
C64 mode does not work. Check ROM IC U32 and IC U7.
CPM mode inoperative. If CP/M fails to boot with CP/M system disk in the Disk Drive when the Computer is turned On, check IC U7.

VIDEO

No video when using RF Modulator. Check waveform at pin 17 of VIC IC U21. If waveform is missing, check IC U21. If waveform is present, check for 5.0V at pin 1 of RF Modulator. If 5.0V is missing, check Coil L3. If 5.0V is present, check voltages and components associated with Transistors Q1, Q2 and Q3 on the RF Modulator board.
No video on a composite monitor connected to

ALIGNMENT

ALIGNMENT TEST SETUP

NOTE: Use a Dysan Analog Alignment Diskette 208-10 when an alignment diskette is specified in the alignment procedures. This alignment diskette has only alignment patterns on it and does not contain any alignment programs.

Use the following Track Seek program and procedure to step the head to a track when specified in the alignment procedure.

```
10 OPEN 15,8,15,"I"
20 OPEN 8,8,8,"#"
30 PRINT "TYPE 99 TO EXIT"
40 INPUT "TRACK";T
50 IF T=99 THEN 90
60 T=T + 1
70 PRINT#15,"U1:"8;0;T;0
80 GOTO 30
90 CLOSE 15: CLOSE 8
```

NOTE: Do not put any spaces in line 70.

Turn Disk Drive On. Run above program and step head to specified track with NO diskette in Disk Drive. The Disk Drive will try to find the track, then it will go back to Track 00. It will then go to the track specified and stop. After Disk Drive stops, insert Alignment Diskette into Disk Drive and close door. Connect a jumper from pin 3 of Plug CN17 to ground to keep Disk Drive running and perform alignment procedure. Whenever head must be set to a different track, remove jumper from pin 3 of Plug CN17 to stop Disk Drive, and remove Alignment Diskette. NOTE: If program does not work after removing diskette, type 99 to stop program, then type RUN to start program again.

SPINDLE SPEED CHECK

Center and paste strobe pattern, (see Figure 1) on Drive Motor on bottom of Disk Drive. Insert a diskette into Drive and close Drive door. Load a program from diskette or connect a jumper from pin 3 of Connector CN17 to ground to turn the motor On. Use outer section of pattern if 60Hz AC power is being used and inner section of pattern if 50Hz AC power is being used. Use a fluorescent light to view pattern. Speed is correct if pattern appears to stand still.

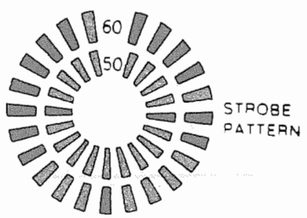


Figure 1

RADIAL HEAD ALIGNMENT

Connect channel A input of a dual trace scope to TP1 (pin 3 of IC U108) and channel B input to TP2 (pin 4 of IC U108). Set scope for external trigger mode and connect external trigger input to pin 4 of Connector CN14. Set scope to positive trigger slope, add mode, with channel B inverted, sweep time to 20ms, voltage to .2V/cm range and scope inputs to AC input. Set head to Track 16, see "Alignment Test Setup". Insert an Alignment Diskette into Disk Drive and connect a jumper from pin 3 of Connector CN17 to ground to keep Drive running. Observe catseye pattern (see Figure 2). The peak to peak amplitude of lobes should be within 70% of each other. If lobes are out of tolerance, loosen two screws holding Head Position Motor (M1) mounting bracket and rotate motor until lobes are within 90% of each other. Tighten mounting bracket screws.

Remove jumper from pin 3 of Connector CN17. Remove Alignment Diskette from Disk Drive. Use the Track Seek program, see "Alignment Test Setup" section, to set head to Track 34 and back to Track 16. Insert Alignment Diskette into Disk Drive. Connect jumper from pin 3 of Connector CN17 to ground and verify lobes are within tolerance when head is On Track 16. Repeat procedure again stepping head to Track 00 and back to Track 16. Check Track 00 Stop and Detector adjustments.

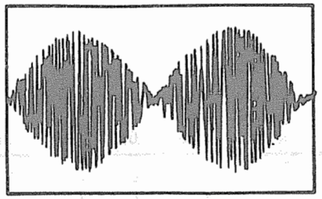


Figure 2

TRACK 00 STOP AND DETECTOR ADJUSTMENT

Check "Radial Head Alignment" before making Track 00 adjustments. Connect input of scope to TP1 (pin 3 of IC U108). Set sweep time to 10us voltage range to .2V. Set head to Track 00 (see "Alignment Test Setup"). Insert Alignment Diskette and close Drive door. Connect a jumper from pin 3 of Connector CN17 to ground to keep drive running. Verify head is On Track 00 by checking for a 125kHz waveform at TP1 (see Figure 3). If 125kHz signal is not present, step head forward or back until 125kHz signal is present.

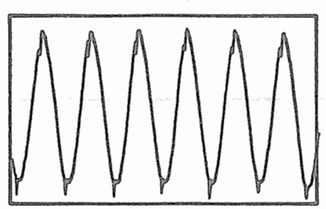


Figure 3

TROUBLESHOOTING (Continued)

```
60 GOTO 120
70 POKE X,0
80 IF PEEK(X) AND Z THEN 120
90 NEXT Y:RESTORE
100 NEXT X
110 PRINT "TEST COMPLETED":END
120 PRINT "BIT ";Y-1;" AT ADDRESS ";X;" CHECKS BAD"
130 GOTO 90
```

If color is not working at all, type in and run the following Basic program:

```
10 POKE 55300,8:GOTO 10
```

While the program is running, check for pulses at pins 18 and 21 of IC U19. If pulses are missing at pin 18, check PLA IC U11. If pulses are missing at pin 21, check IC U56. If pulses are present, check IC U19. Also see "Color" section.

SERIAL PORT (CN6)

Peripherals connected to Serial Connector (CN6) do not work. Check Connector CN6 for good connections. If connections check good, check for logic low at pin 4 of IC U60 while pressing Reset Button (SW2). If reading is not correct, check IC U60. If reading is correct, type in and run the following Basic program:

```
10 SCNCLR:POKE 56578,63
20 POKE 56576,63
30 PRINT PEEK(56576) AND 192
40 POKE 56576,3
50 PRINT PEEK(56576) AND 192
60 CHAR,0,0:GOTO 20
```

The program generates pulses at pins 5, 6 and 7 of CIA2 IC U4 and displays two numbers on the Monitor screen that indicate the status of pins 8 and 9 of IC U4.
The numbers should be 0 and 192. While the program is running, check for pulses at pin 23 of IC U4. If pulses are missing, check Decoder IC U3. If pulses are present, check for pulses at pins 5, 6 and 7 of IC U4. If pulses are missing, check IC U4. If pulses are present, check for pulses at pins 4, 8 and 10 of IC U30. If pulses are missing at pin 4, check Capacitor C66, Diodes CR4 and CR5, IC U30 and Resistor Pack RP1 from pin 4 to pin 1. If pulses are missing at pin 8, check Diodes CR2 and CR7, IC U30 and Resistor Pack RP1 from pin 6 to pin 1. If pulses are missing at pin 10, check Diodes CR3 and CR6, IC U30 and Resistor Pack RP1 from pin 5 to pin 1. If pulses are missing at all three pins, check IC U30. If pulses are present at all three pins and the numbers displayed on the Monitor are not correct, check IC U4.
If pulses are present at ICs U4 and U30 and the numbers on the monitor are correct, type in and run the following Basic program:

```
10 POKE 56324,0:POKE 56325,1
20 POKE 56334,87
30 POKE 56332,66:GOTO 30
```

While the program is running, check for pulses at pins 16, 39 and 40 of CIA1 IC U1. If pulses are missing at any pin, check IC U1. If pulses are present at all pins, check for pulses at pins 4 and 6 of IC U50. If pulses are missing, check IC U50. If pulses are present, press RUN/STOP and RESTORE keys at the same time to stop the program. With no diskette in the Disk Drive, check for pulse at pin 44 of MMU IC U7 each time Function key F3 (Directory) is pressed. If no pulse appears, check IC U7. If pulse appears, check for pulse at pins 3 and 6 of IC U56 each time the F3 key is pressed. If no pulse appears, check IC U56. If pulse appears, check for pulse at pin 2 of IC U16 each time the F3 key is pressed. If pulse is missing, check IC U16. If pulse is present, check for a pulse at pin 11 of IC U8 each time the F3 key is pressed. If pulse is missing, check IC U8. If pulse is present, check IC U60 and Diodes CR9 and CR10.

JOYSTICKS

Joysticks do not work. Check Control Ports 1 and 2 Connectors, CN3 and CN4, for good connections. If connections check good, type in and run the following Basic program:

```
10 PRINT CHR$(147)
20 P1=PEEK(56321) AND 31
30 P2=PEEK(56320) AND 31
40 PRINT "PORT 1=";P1
50 PRINT "PORT 2=";P2
60 PRINT CHR$(19):GOTO 40
```

The program displays the number 31 for each port with the joystick in the center position. The following numbers should appear with the joystick in the indicated position:

POSITION	NUMBER	PORT 1 CN3 PIN	PORT 2 CN4 PIN
UP	30	1	1
DOWN	29	2	2
LEFT	27	3	3
RIGHT	23	4	4
BUTTON	15	6	6

NOTE: Other numbers will appear if two switches on the joystick are closed at the same time.
If none of the numbers are correct, check CIA1 IC U1. If the number is not correct in only one position, check the Capacitors and Diodes connected to the pin with the incorrect number. If the Capacitors and Diodes check good, check IC U1.

PADDLES

The following Basic program can be used to check operation of the paddles:

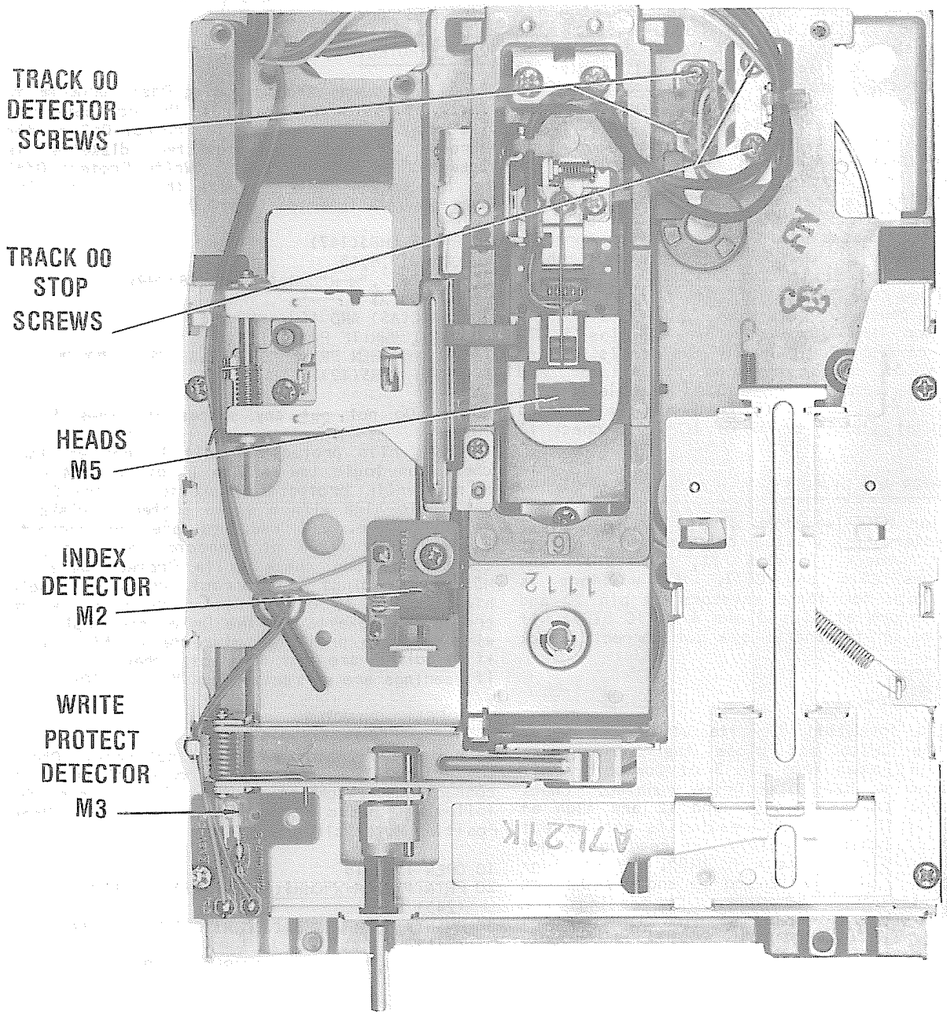
```
10 SCNCLR
20 FOR N= 1 TO 4
30 P(N)=POT(N):P$(N)=STR$(P(N)) + "  "
40 PRINT "PADDLE ";N;"=";P$(N)
50 NEXT N:CHAR,0,0:GOTO 20
```

The program displays, on the Monitor screen, a number for each of four paddles (paddles 1 and 2 connected to Port 1, paddles 3 and 4 connected to Port 2). The number should vary

LOGIC CHART (Continued)

PIN NO	IC U21	PIN NO	IC U21	PIN NO	IC U21	PIN NO	IC U22	PIN NO	IC U22	PIN NO	IC U22	PIN NO	IC U23
1	P	21	P	41	P	1	P	21	H	41	P	1	L
2	P	22	P	42	P	2	P	22	L	42	P	2	P
3	P	23	P	43	P	3	P	23	H	43	L	3	P
4	P	24	L	44	P	4	P	24	L	44	L	4	H
5	P	25	P	45	P	5	P	25	H	45	L	5	P
6	P	26	L	46	P	6	P	26	P	46	L	6	P
7	P	27	L	47	P	7	P	27	P	47	L	7	P
8	P	28	L	48	H	8	P	28	P	48	P	8	P
9	H	29	P			9	*	29	P			9	H
10	P	30	P			10	P	30	P			10	P
11	H	31	P			11	P	31	P			11	P
12	P	32	P			12	L	32	P			12	P
13	P	33	P			13	P	33	P			13	P
14	P	34	P			14	P	34	P			14	P
15	P	35	P			15	P	35	P			15	P
16	H	36	P			16	P	36	P			16	P
17	P	37	P			17	P	37	H			17	P
18	P	38	P			18	P	38	P			18	L
19	P	39	P			19	P	39	P			19	
20	P	40	P			20	P	40	P			20	

PIN NO	IC U24	IC U25	IC U26	IC U27	IC U28	IC U30	IC U31	IC U32	PIN NO	IC U32
1	L	L	P		*	H	H	H	21	P
2	L	P	L		L	L	L	P	22	P
3	L	P	P		*	L	H	P	23	P
4	L	H	P	*	L	H	H	P	24	P
5	L	P	L	L	H	H	H	P	25	P
6	L	P	P	H	P	L	L	P	26	P
7	P	P	P	L	H	L	L	P	27	H(1)
8	L	P	L	H	P	H	H	P	28	H
9	P	H	H	L	L	L	L	P		
10	L	P	*	H	*	H	P	P		
11	P	P	*		*	L	P	P		
12	L	P	P		H	L	H	P		
13	P	L	P		P	H	P	P		
14	L	P	L	H	P	H	H	L		
15	L	P	P		H			P		
16	L	P	P		H			P		
17	L	P	P	P	P	P		P		
18	L	L	L	L	L	P		P		
19	L							P		
20	H							L		



DISK DRIVE - TOP VIEW

LOGIC CHART

PIN NO	IC U1	PIN NO	IC U1	PIN NO	IC U2	IC U3	IC U4	PIN NO	IC U4	PIN NO	IC U5	PIN NO	IC U5
1	L	21	P	1	*	P	L	21	H	1	H	21	P
2	P	22	P	2	P	P	H	22	P	2	H	22	P
3	P	23	P	3	P	P	H	23	H	3	H	23	P
4	P	24	H	4	*	P	H	24	H	4	H	24	P
5	P	25	P	5	L	P	L	25	P	5	H	25	H
6	P	26	P	6	P	H	L	26	P	6	P	26	H
7	P	27	P	7	L	H	L	27	P	7	P	27	H
8	P	28	P	8	P	L	H	28	P	8	H	28	H
9	L(1)	29	P	9	P	H	H	29	P	9	P		
10	H(2)	30	P	10	P	H	H	30	P	10	P		
11	H(3)	31	P	11	P	P	H	31	P	11	P		
12	H(4)	32	P	12	P	P	H	32	P	12	P		
13	H(5)	33	P	13	L	P	H	33	P	13	P		
14	H(6)	34	H	14	H	P	H	34	H	14	L		
15	H(7)	35	P	15		H	H	35	P	15	P		
16	H(8)	36	P	16		H	H	36	P	16	P		
17	H(9)	37	P	17			H	37	P	17	P		
18	P	38	P	18			H	38	P	18	P		
19	P	39	H	19			P	39	H	19	P		
20	H	40	H	20			H	40	H	20	P		

PIN NO	IC U6	PIN NO	IC U6	PIN NO	IC U7	PIN NO	IC U7	PIN NO	IC U7	PIN NO	IC U8	IC U9
1	P	21	L	1	H	21	P	41	P	1	P	H
2	P	22	P	2	H	22	P	42	P	2	H	P
3	P	23	P	3	P	23	P	43	H	3	P	H
4	H	24	H	4	P	24	P	44	L	4	H	H
5	H	25	H	5	P	25	P	45	H	5	H	P
6	H	26	H	6	P	26	H	46	H	6	H	H
7	P	27	L	7	P	27	P	47	H(10)	7	L	L
8	P	28	L	8	P	28	P	48	H(11)	8	P	P
9	P	29	H	9	P	29	P			9	P	P
10	P	30	H	10	P	30	P			10	H	P
11	P	31	P	11	H	31	P			11	H	P
12	P	32	P	12	P	32	P			12	H	P
13	P	33	P	13	L	33	P			13	H(10)	P
14	P	34	P	14	P	34	L			14	H	H
15	P	35	P	15	P	35	P			15		
16	P	36	P	16	P	36	P			16		
17	P	37	P	17	P	37	P			17		
18	P	38	P	18	P	38	P			18		
19	P	39	P	19	P	39	P			19		
20	P	40	H	20	P	40	P			20		

DISK DRIVE TROUBLESHOOTING (Continued)

13 of IC U110. If pulses are missing, check IC U110, Capacitor C130 and Resistors R107 and R132. If pulses are present, check: IC U109; Capacitors C140 and C141; Switch Transistor Q101; Resistors R124 and R125; Head Position Motor (M1) windings for continuity.

DRIVE MOTOR

Drive motor will not run. Type in and run the following Basic program to turn the motor circuits On.

```
10 OPEN 15,8,15
20 PRINT#15,"M-W"CHR$(0)CHR$(28)CHR$(1)
   CHR$(244)
30 CLOSE 15
```

NOTE: Do not put any spaces in line 20. After running the program, check for logic high at pin 12 of VIA IC U104. If reading is not correct, check IC U104. If the reading is correct, check for logic low at pin 2 of IC U112. If reading is not correct, check IC U112. If reading is correct, check Connector CN17 for good connections and check the Motor Control Board.

TRACK 00 DETECTOR

Drive Heads bang against track 00 stop. Type in and run the following Basic program to check operation of Track 00 Detector (M4).

```
10 PRINT CHR$(147)
20 OPEN 15,8,15
30 PRINT#15,"M-R"CHR$(1)CHR$(24)CHR$(1)
40 GET#15,A$
50 X=ASC(A$) AND 1
60 IF X=0 THEN PRINT "ON ";:ELSE PRINT "OFF"
70 PRINT " TRACK 00"
80 PRINT CHR$(19):GOTO 30
```

NOTE: Do not put any spaces in lines 30 or 40. The program displays "On Track 00" on the screen if the Drive Head is manually pushed back to Track 00 and "Off Track 00" when the Drive Head is manually pushed off Track 00. If Track 00 Detector is not operating properly, check for logic low at pin 13 of IC U114 with the Head off Track 00 and logic high with the Head on Track 00. If readings are not correct, check pins 8 and 10 of Connector CN14 for good connections and check Track 00 Detector (M4). If readings are correct, check for logic high at pin 12 of IC U114 with the Head off Track 00 and logic low with the Head on Track 00. If readings are not correct, check IC U114. If the readings are correct, check VIA IC U106.

INDEX DETECTOR

To check Index Detector (M2), type in and run the program listed under "Drive Motor" to turn the Drive Motor On. Insert a diskette in the Drive and close the Drive door. While the Drive is running, check for pulses at pin 41 of IC U107. If pulses are missing, check: pins 4 and 5 of Connector CN14 for good connections; Index Detector (M2); Resistor R130.

PARTS LIST AND DESCRIPTION (Continued)

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

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	MFGR. PART No./ TYPE No.	NTE PART No.	ECG PART No.	TCE PART No.	ZENITH PART No.	NOTES
Q301	2SD313	NTE152	ECG152	SK3893/152	121-987-03	
U1	6526A					
U2	MC14066B	NTE4066B	ECG4066B	SK4066B	905-369	
U3	74LS138N	NTE74LS138	ECG74LS138	SK74LS138	HE-443-877	
U4	6526A					
U5	8580R5					
U6	8502R0					
U7	8722R2					
U8	74LS08N	NTE74LS08	ECG74LS08	SK74LS08	HE-443-780	
U9	MC74F32N					
U10	Z80	NTE3880	ECG3880	SK2880/3880	HE-443-881	
U11	8721R3					
U12	SN74LS373N	NTE74LS373	ECG74LS373	SK74LS373	HE-443-867	
U13	SN74LS244N	NTE74LS244	ECG74LS244	SK74LS244	HE-443-791	
U14,15	M74LS257AP	NTE74LS257	ECG74LS257	SK74LS257	HE-443-802	
U16	74LS14	NTE74LS14	ECG74LS14	SK74LS14	HE-443-872	
U17	SN74ALS373N					
U18	390059-01					
U19	LC3517A-15					
U20	MC14066B	NTE4066B	ECG4066B	SK4066B	905-369	
U21	8564R6V6					
U22	8568					
U23	M41464-12					
U24	SN74LS244N	NTE74LS244	ECG74LS244	SK74LS244	HE-443-791	
U25	M41464-12					
U26	M74LS257AP	NTE74LS257	ECG74LS257	SK74LS257	HE-443-802	
U27	NE556N	NTE978	ECG978	SK3689/978	221-Z9152	
U28	8701					
U30	7406N	NTE7406	ECG7406	SK7406	HE-443-698	
U31	74LS00	NTE74LS00	ECG74LS00	SK74LS00	HE-443-728	

PARTS LIST AND DESCRIPTION (Continued)

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

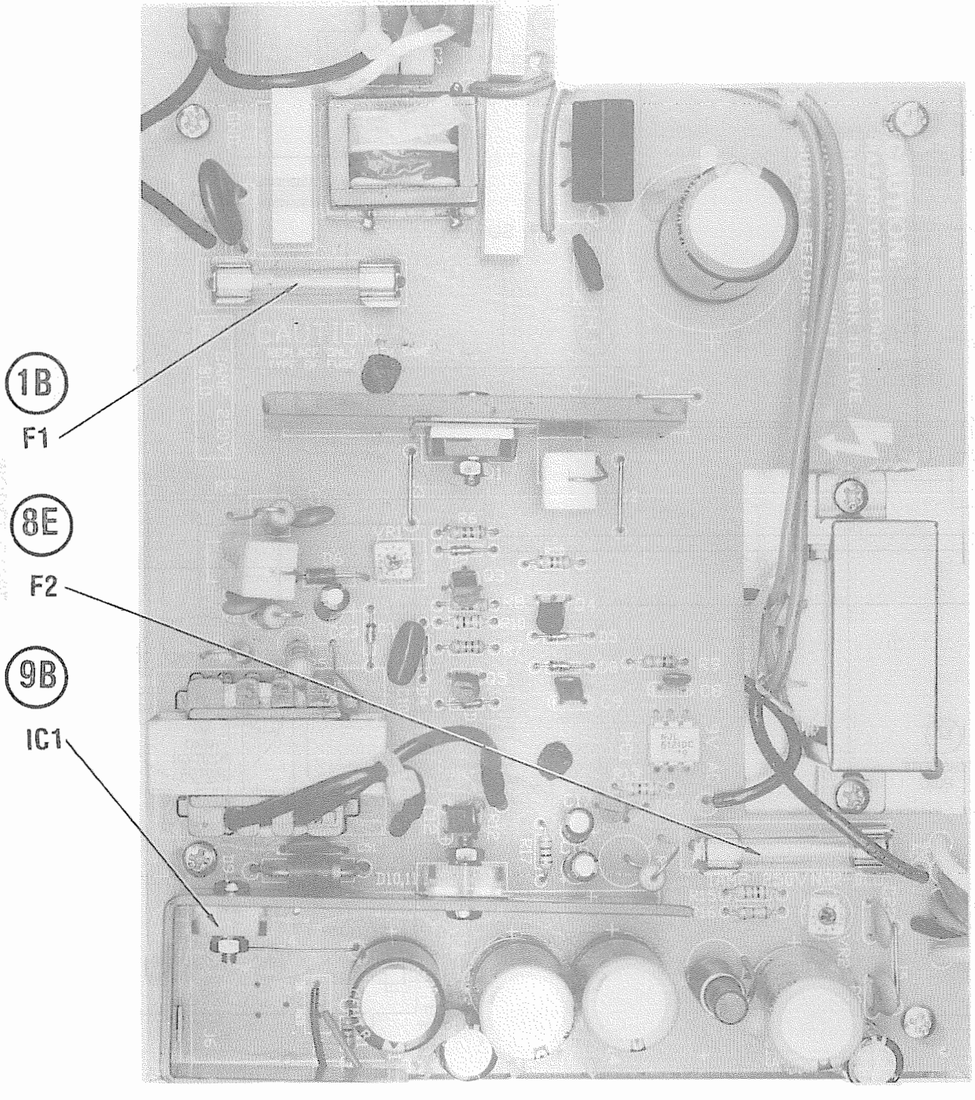
RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA MFGR. PART No.	NTE PART No.	
	POWER SUPPLY			
R1	15K 5% 5W WW			
R3	120 5% 3W Carbon Film	3W112		
R4	.33 5% 5W WW	5WD33		
R5	27 5% 3W Carbon Film	3W027		
R14	27 5% 3W Carbon Film	3W027		
TH1	12 Cold PTC			
TH1A	138 Cold PTC			
	SYSTEM BOARD			
RP1	Resistor Network (1)			
RP2	Resistor Network (1)			
RP3	Resistor Network (2)			
RP4	Resistor Network (3)			
RP5	Resistor Network (2)			
RP6	Resistor Network (3)			
RP7	Resistor Network (4)			
RP8	Resistor Network (2)			
RP101	Resistor Network (2)			

(1) 1000 5% X 7.
(2) 3300 5% X 7.
(3) 33 5% X 4.
(4) 3300 5% X 5.

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
	POWER SUPPLY		
D12	LED		Power Indicator (Red)
SW1	Switch		Power
	RF MODULATOR		
SW1	Switch		Low/High
	SYSTEM BOARD		
CR98	LED		Drive Indicator (Green)
EM140	Filter		
EM141	Filter		
EM142	Filter		
FB7 thru FB50	Ferrite Bead		
M1	Head Position Motor		
M2	Index Detector		
M3	Write Protect Detector		
M4	Track 00 Detector		
M5	Head		
SW2	Switch		Reset
SW3	Switch		Drive Reset
Y2	Crystal		14.31818MHz



POWER SUPPLY BOARD

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 the 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, System Board, Keyboard, Disk Drive or connectors may be necessary after the malfunction has been isolated.

TEST EQUIPMENT AND TOOLS

TEST EQUIPMENT

Digital Volt/Ohm Meter
Logic Probe
Frequency Counter
Monitor with audio Input
Disk Drive Tester or Test Program

TOOLS

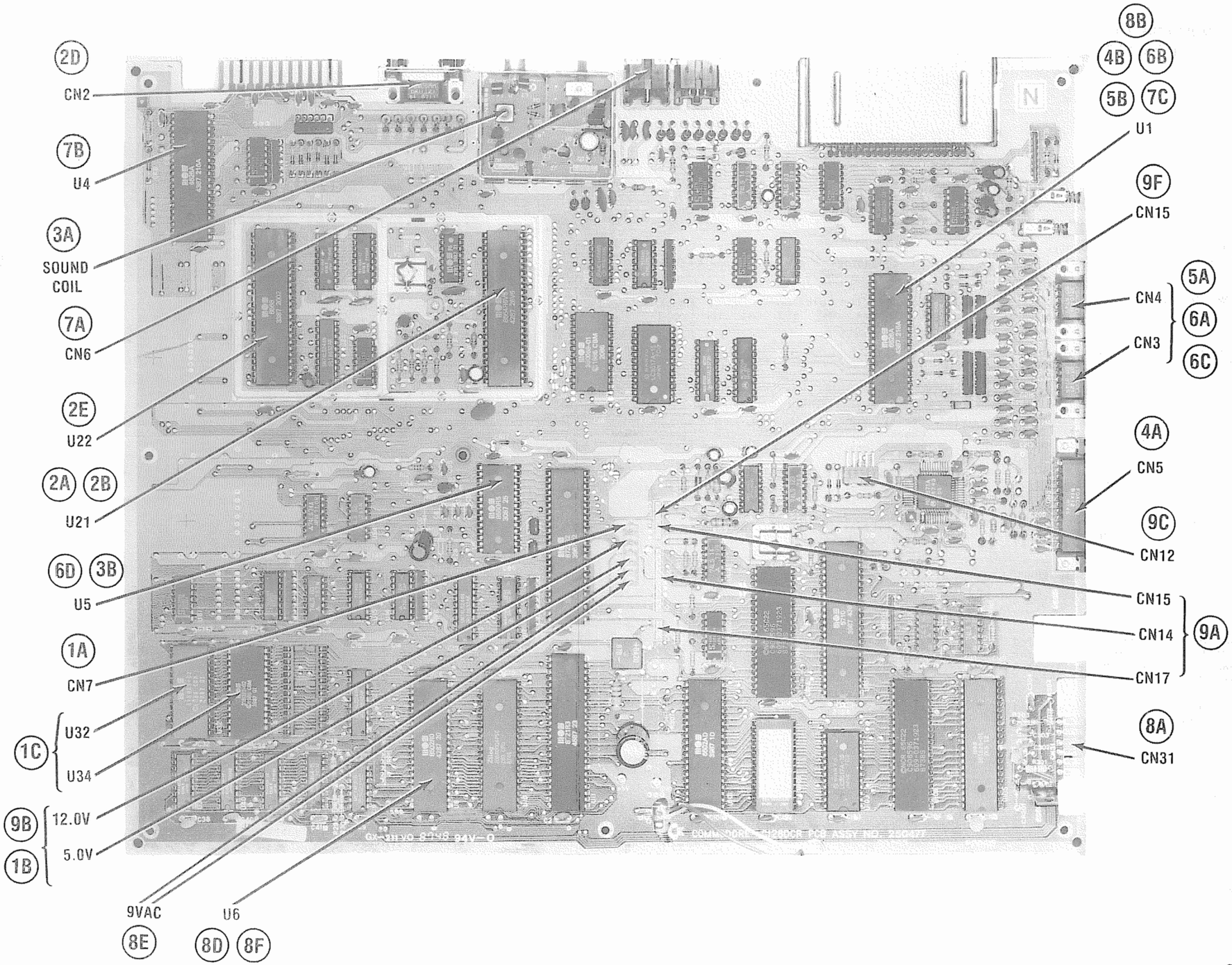
Head Cleaning Equipment
Contact and Switch Cleaner (non spray type)
Phillips Screwdriver
Flat Blade Screwdriver
IC Insertion and Removal Tools 28, 48 pin
Low Wattage Soldering Iron
Desoldering Equipment

REPLACEMENT PARTS

F1		Fuse 2A
M1	Head Position Motor	
U1	CIA1 IC	6526A
U5	SID IC	8580R5
U6	Microprocessor IC	8502R0
U21	VIC IC	8564R6V6
U22	Video Controller IC	
U32	ROM	318023-02
U34	ROM	318022-02

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

CSCS25 COMMODORE MODEL C128D


2D
CN2
7B
U4
3A
SOUND
COIL
7A
CN6
2E
U22
2A
2B
U21
6D
3B
U5
1A
CN7
1C
U32
U34
9B
12.0V
1B
5.0V
9VAC
8E
U6
8D
8F
8B
4B
6B
5B
7C
U1
9F
CN15
5A
CN4
6A
CN3
6C
4A
CN5
9C
CN12
CN15
CN14
9A
CN17
8A
CN31

GENERAL OPERATING INSTRUCTIONS

POWER UP

When Computer is turned On, it will come up in C128 mode ready to program in Basic. To bring Computer up in C64 mode, hold Commodore key down while turning Computer On. If Computer is already On, it can be switched from C128 mode to C64 mode by typing GO 64 and pressing RETURN key. When Computer responds with "ARE YOU SURE?", type y and press RETURN key. Press RESET button to go from C64 mode to C128 mode. Note: Any program in the Computer will be lost when the Computer is switched between C128 mode and C64 mode. Save the program before switching modes. To run a Basic program after it is loaded, type RUN and press RETURN key. Press RUN/STOP key to stop program. Press RUN/STOP and RESTORE keys at the same time to return the Computer to its standard condition.

CP/M MODE

To bring Computer up in CP/M mode, insert CP/M disk in the drive, then press RESET button. If the 40/80 Display Key is in the up position, CP/M will come up in 40 column mode on RF Modulator for connection to a TV and video output for connection to a monitor. If the 40/80 key is down, CP/M will come up on the RGB output for connection to an RGB Monitor.

40/80 COLUMN MODES

The 80 column mode works in C128 and CP/M modes only and works only on an RGB Monitor. To get 80 column mode, put the 40/80 key in down position and press RESET key. To get 40 column mode, leave the 40/80 key up. The 40 and 80 column modes can also be switched by pressing and releasing ESC key, then pressing the X key.

RESET AND DRIVE RESET

The Computer can be reset by pressing RESET button (SW2) on the right side of Computer. Any programs in Computer will be lost when RESET button is pressed. To reset Disk Drive only, press DRIVE RESET button (SW3) on the right side of Computer. Pressing DRIVE RESET button will not erase any programs.

MACHINE LANGUAGE MONITOR

The C128 has a built-in machine language monitor program to enable the user to write, edit, save and load machine language programs. To enter the monitor from Basic, either press F8 Function key, then press RETURN key or type the word MONITOR and press RETURN key. To exit from monitor to Basic, type X and press RETURN key.

CASSETTE OPERATION

Plug a Datasette cassette recorder onto Cassette Connector (CN31) on right side of Computer. Note: An ordinary cassette recorder will not work with the Commodore C128. To load a program, type LOAD, press RETURN key and follow instructions displayed on the Monitor screen. To save a program, type SAVE, press RETURN key and follow instructions displayed on the screen.

DISK OPERATION

IN C128 MODE: To get a directory of files on a diskette, type DIRECTORY (or press F3 Function key) and press RETURN key. To load a program from diskette, type DLOAD (or press F2 Function key), type the program name enclosed in quotes, then press RETURN key (DLOAD "name"). To save a program to diskette, type DSAVE (or press F5 Function key), type the program name enclosed in quotes, then press RETURN key.

A blank diskette must be formatted before it can be used. To format a diskette, use the following:

HEADER "diskette name",Iid,Ddrive#,Udevice#

The diskette name can be up to 16 characters. The I is followed by a two character identification. The D is followed by a drive number (0,1,2 or 3). The U is followed by a device number (8,9,10 or 11).
If the green LED on the front panel starts blinking, it means an error in operation has occurred and an error message has been stored in Disk Drive memory. To read the error message, type DS$ and press RETURN key.

IN 64 MODE. To get a directory of files on a diskette, type LOAD "$",8 and press RETURN key. After the directory is loaded, type LIST and press RETURN key to view the directory on the Monitor screen. To load a program from diskette, type LOAD with the program name enclosed in quotes, followed by ,8 (for drive device number 8) and press RETURN key. Example: LOAD "SAMS",8. To save program to diskette, type SAVE with the program name enclosed in quotes, followed by ,8 and press RETURN key. Example: SAVE "SAMS",8. To format a blank diskette, type OPEN 1,8,15,"NO:name,Id"CLOSE 1 and press RETURN key. Note: The N inside the quotes is followed by a zero.
To read the error message when the green LED on the front panel flashes, type in and run the following program:

```
10 OPEN 15,8,15
20 INPUT #15,EN,E$,T,S
30 PRINT "ERROR # ";EN,E$
40 PRINT "TRACK # ";T,"SECTOR # ";S
50 CLOSE 15
```

The program displays the error number, message, track and sector where the error has occurred.

SERVICE CHECKS (Continued)

(B) If connections check good, check for 12.0V at pin 2 of Connector CN7. If 12.0V is missing, check 12V Regulator IC (IC1) in Power Supply.

(C) Drive operation is erratic. Check Connector CN12 for good connections.

(D) If connections check good, clean Drive Head with a cottom swab or lint free cloth dampened with 91% isopropyl alcohol.

(E) If cleaning Drive Head does not improve operation, check speed of spindle. See "Miscellaneous Adjustments".

(F) Head Position Motor does not operate. Check Connector CN15 for good connections.

(G) If connections check good, check Head Position Motor (M1) windings for continuity (48 ohms from pin 1 to pins 3 and 4 and from pin 2 to pins 5 and 6 of Connector CN15).

DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove two screws from the bottom front and three screws from the rear. Slide the cabinet top back about 1/2 inch and lift it up to remove.

DISK DRIVE REMOVAL

Disconnect connectors CN12, CN14, CN15 and CN17. Pull off the knob from the front of the Drive. Remove one screw from the left side and two screws from the right side of the Drive. Slide the Drive back and remove.

POWER SUPPLY REMOVAL

Remove one screw holding the Power LED to the front panel. Disconnect Connector CN7. Remove two screws from the left side, two screws from the rear right and one screw from the front right of the Power Supply. Lift the Power Supply out of the chassis.

MAIN SYSTEM BOARD REMOVAL

Remove one screw holding the Drive LED to the front panel. Remove one screw from the right side and one screw from the rear of the cabinet bottom that hold the Main System board. Remove eight screws from Connectors CN2, CN3 and CN4. Remove the hex spacer/screw that the Power Supply rested on. Remove seven screws holding the System board and lift the board out of the cabinet.

KEYBOARD DISASSEMBLY

Remove the six rubber feet and six screws from the Keyboard bottom and remove the bottom. Remove six screws holding the Keyboard to the top and remove the Keyboard.

MISCELLANEOUS ADJUSTMENTS

CHANGING DISK DRIVE DEVICE NUMBER

The Internal Disk Drive can be set to any device number from 8 to 11 by shorting or cutting two jumper pads located on the left side of IC U106 (as viewed from the front of Computer). Use the following chart to determine which pad to short or cut:
NOTE: Jumper 1 is the pad closest to the front of Computer.

Device Number	Jumper 1	Jumper 2
8	short	short
9	cut	short
10	short	cut
11	cut	cut

POWER SUPPLY VOLTAGE ADJUSTMENT

Connect the positive lead of a voltmeter to pin 4 of Connector CN7 and negative lead to ground. Turn Computer On and adjust 5V Adjust Control (VR2) for a reading of 5.0 volts.

14MHz OSCILLATOR

Connect input of a frequency counter to pin 8 of IC U28. Adjust Trimmer Capacitor CT1 for a frequency of 14.31818MHz.

RF MODULATOR SOUND COIL

Connect Computer to a TV Monitor. Set TV and Computer Channel Select Switch to Channel 3. Type in and run the following Basic program:

```
10 VOL 5
20 SOUND 1,500,100
30 GOTO 10
```

Adjust the sound coil for best sound with Minimum noise.

SPINDLE SPEED CHECK

Center and paste strobe pattern (see Figure 1) on Drive Motor on bottom of Disk Drive. Insert a diskette into Drive and close Drive Door. Load a program from diskette or connect a jumper from pin 3 of Connector CN17 to ground to turn the Motor On. Use outer section of pattern if 60HZ AC power is being used and inner section of pattern if 50Hz AC power is being used. Use a fluorescent light to view pattern. Speed is correct if pattern appears to stand still.

FIGURE 1

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-interruptible 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 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 clean 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 periods 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.

SERVICE CHECKS

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

(1) COMPUTER DEAD

(A) Check Connector CN7 for good connections.

(B) Check for 12.0V at pin 2 and 5.0V at pin 4 of Connector CN7 on System Board. If voltages are missing, check Fuse F1 in Power Supply. If Fuse checks good, troubleshoot Power Supply.

(C) Check ROM ICs U32 and U34.

(2) VIDEO

(A) No video on a Monitor connected to the RF Modulator. Check VIC IC U21.

(B) No video on a Monitor connected to the Video Output Connector (CN8). Check VIC IC U21.

(C) No video on an RGB Monitor or a Monochrome Monitor connected to RGB Connector CN2. Make sure the 40/80 Display Key is in 80 column position (down).

(D) If the 40/80 Key is set properly, check RGB Connector CN2 for good connections.

(E) If Connector CN2 checks good, check Video Controller IC U22.

(3) SOUND

(A) No sound on a TV Monitor connected to RF Modulator. Check adjustment of Sound coil. See "Miscellaneous Adjustments".

(B) No sound on a TV Monitor connected to RF Modulator or a Monitor connected to Video Output Connector (CN8). Check SID IC U5.

(4) KEYBOARD DEAD

(A) Check Connector CN5 for good connections and check keyboard cable for possible open circuits.

(B) If connector and cable check good, check CIA1 IC U1.

(5) JOYSTICKS DON'T WORK

(A) Check Connectors CN3 and CN4 for good connections.

(B) If Connectors check good, check CIA1 IC U1.

(6) PADDLES

(A) Paddle buttons don't work. Check Connectors CN3 and CN4 for good connections.

(B) If connectors check good, check CIA1 IC U1.

(C) Paddles Controls don't work. Check Connectors CN3 and CN4 for good connections.

(D) If connectors check good, check SID IC U5.

(7) SERIAL PORT

(A) Serial Port (CN6) does not work. Check Connector CN6 for good connections.

(B) If Connector checks good, check CIA2 IC U4.

(C) Serial Port (CN6) works only with peripherals that work in Slow mode (like Commodore 1541 Disk Drive), does not work in Fast mode (with 1571 Disk Drive). Check CIA1 IC U1.

(8) CASSETTE PORT

(A) Cassette port does not work. Check Connector CN31 for good connections.

(B) Computer will not load a program from cassette. Check CIA1 IC U1.

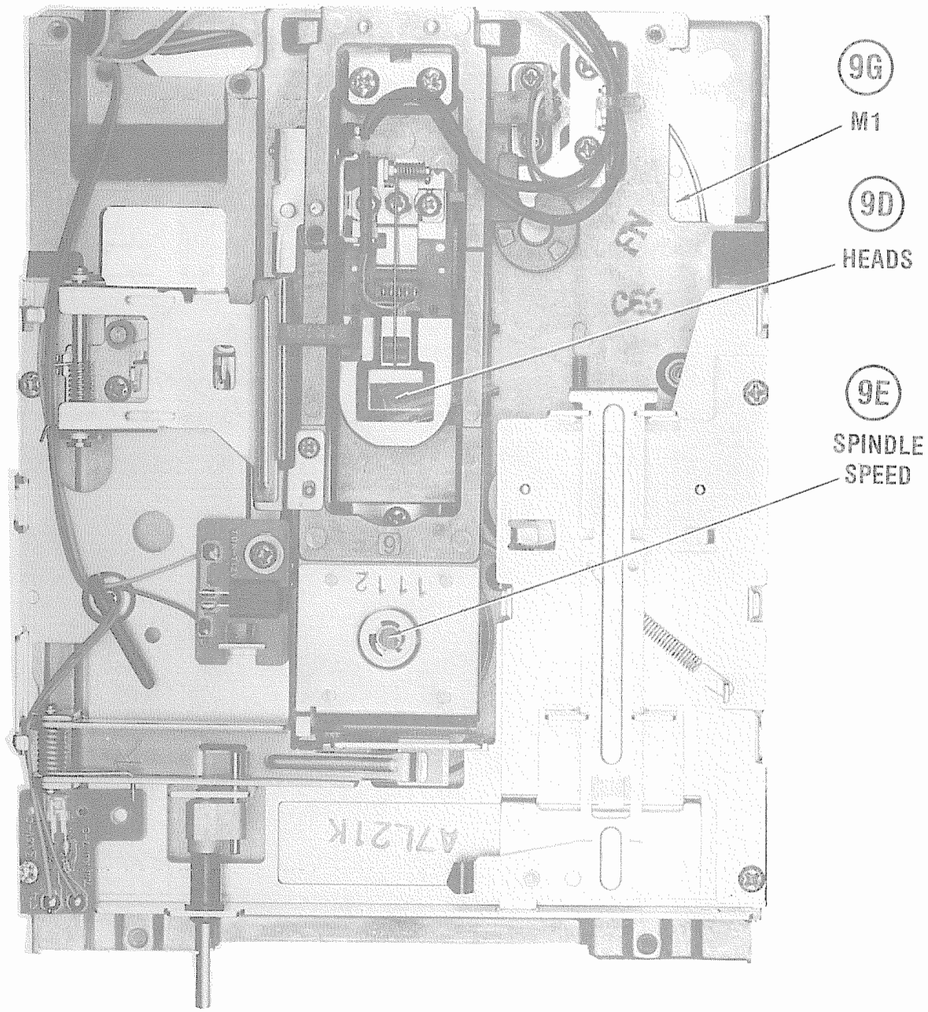
(D) Computer will not save a program to cassette. Check Microprocessor IC U6.

(E) Cassette motor will not turn On. Check for 9VAC from pin 5 to pin 6 of Connector CN7. If 9VAC is missing, check Fuse F2 in Power Supply.

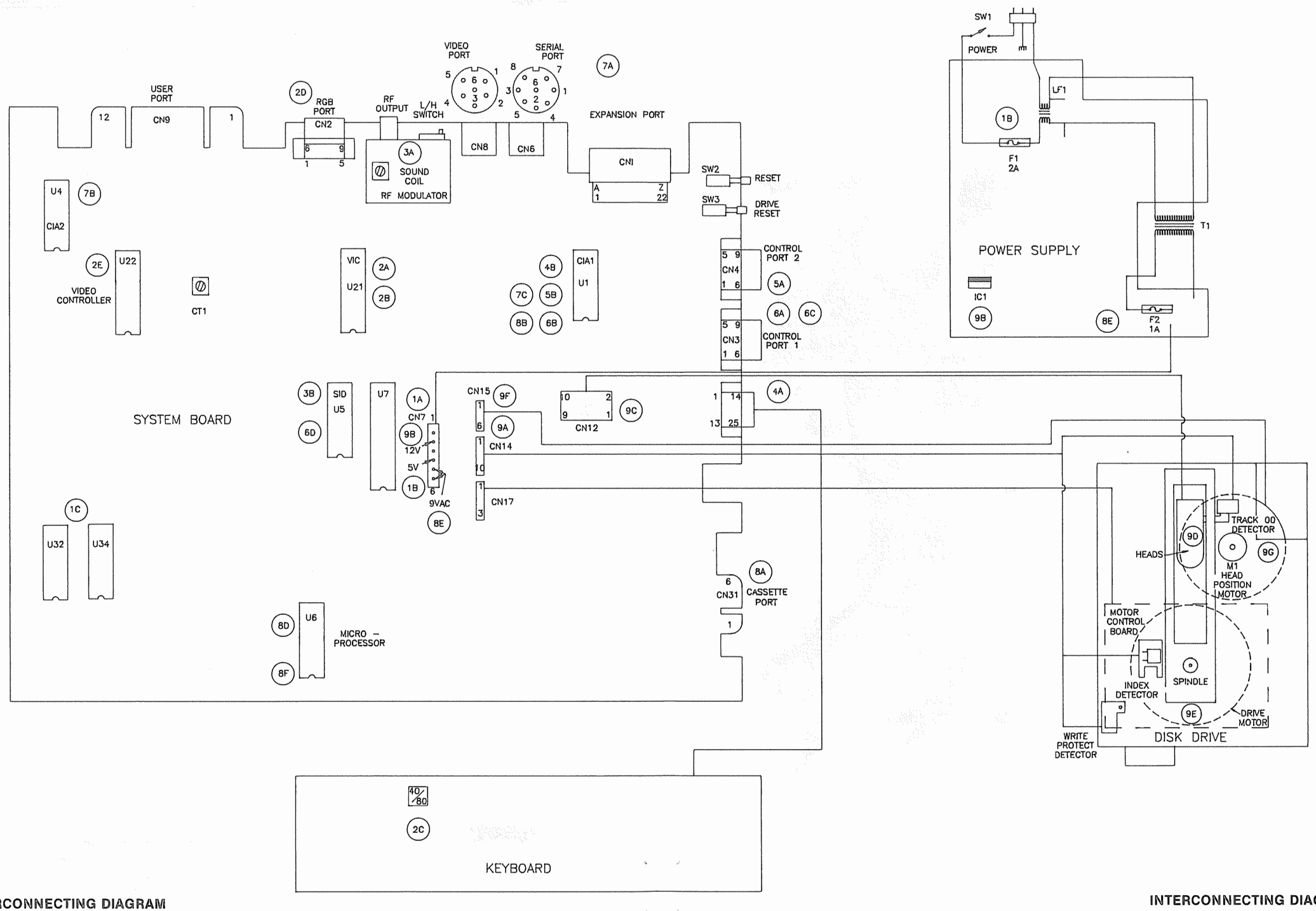
(F) If 9VAC is present, check Microprocessor IC U6.

(9) DISK DRIVE

(A) Drive dead. Check Connectors CN14, CN15 and CN17 for good connections.



DISK DRIVE


USER PORT
CN9
12
1
2D
RGB PORT
CN2
RF OUTPUT
L/H SWITCH
VIDEO PORT
SERIAL PORT
7A
EXPANSION PORT
3A
SOUND COIL
RF MODULATOR
CN8
CN6
CN1
A Z
1 22
SW2
RESET
SW3
DRIVE RESET
U4
7B
CIA2
2E
U22
VIDEO CONTROLLER
CT1
VIC
U21
2A
2B
4B
7C
5B
8B
6B
CIA1
U1
CONTROL PORT 2
CN4
5A
6A
6C
CONTROL PORT 1
CN3
SW1
POWER
LF1
1B
F1
2A
T1
POWER SUPPLY
IC1
9B
8E
F2
1A
SYSTEM BOARD
3B
SID
U5
6D
U7
1A
CN7
9B
12V
5V
1B
6
9VAC
8E
CN15
9F
9A
CN14
CN17
CN12
9C
4A
1C
U32
U34
8D
U6
8F
MICRO – PROCESSOR
8A
CN31
CASSETTE PORT
TRACK 00 DETECTOR
9D
9G
HEADS
M1
HEAD POSITION MOTOR
MOTOR CONTROL BOARD
INDEX DETECTOR
SPINDLE
9E
DRIVE MOTOR
WRITE PROTECT DETECTOR
DISK DRIVE
40/80
2C
KEYBOARD

PARTS LIST AND DESCRIPTION (Continued)

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

ELECTROLYTIC CAPACITORS

ITEM No.	RATING	MFGR. PART No.
C140	1 50V NP	
C141	1 50V NP	

Items Not Listed Are Normally Available At Local Distributors.

CAPACITORS

ITEM No.	RATING	MFGR. PART No.
	POWER SUPPLY	
C1	.1 125VAC 20%	
C2	.0047 250VAC 20%	
C3	.0047 250VAC 20%	
C4	.0047 250VAC 20%	
C24	.1 125VAC 20%	

ITEM No.	RATING	MFGR. PART No.
	SYSTEM BOARD	
CT1	4-40pF Trimmer	

Items Not Listed Are Normally Available At Local Distributors.

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

ITEM NO.	FUNCTION	RESISTANCE	MFGR. PART NO.	NOTES
VR1	Regulator ADJ	100		
VR2	5V ADJ	1000		

COILS (RF-IF)

ITEM No.	FUNCTION	MFGR. PART No.
	POWER SUPPLY	
L1	RF Choke	
LF1	Line Filter	
T1	Power Transformer	
T2	Power Transformer	
	RF MODULATOR	
L1	Peaking Coil	
L2	Peaking Coil	

ITEM No.	FUNCTION	MFGR. PART No.
L3	Peaking Coil	
L4	Peaking Coil	
L5	Peaking Coil	
L6	Peaking Coil	
L7	Peaking Coil	
L8	RF Choke	
L9	Oscillator Transformer	
L10	Transformer	

FUSE DEVICES

ITEM NO.	DESCRIPTION	MFGR. PART NO.		NOTES
		DEVICE	HOLDER	
F1	2 Amp @ 250VAC Slow Blow			
F2	1 Amp @ 250VAC Fast Acting			

PARTS LIST AND DESCRIPTION (Continued)

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

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	MFGR. PART No./ TYPE No.	NTE PART No.	ECG PART No.	TCE PART No.	ZENITH PART No.	NOTES
U32	318023-02					
U34	318022-02					
U36						
U37	7406N	NTE7406	ECG7406	SK7406	HE-443-698	USED SOME VERSIONS
U38 THRU U41	M41464-12					
U42	SN74LS244N	NTE74LS244	ECG74LS244	SK74LS244	HE-443-791	
U50	74LS04	NTE74LS04	ECG74LS04	SK74LS04	HE-443-755	
U54	74LS32	NTE74LS32	ECG74LS32	SK74LS32	HE-443-875	
U55	MC74F245N					
U56	74LS74A	NTE74LS74A	ECG74LS74A	SK74LS74A	HE-443-730	
U57	7407N					
U58	74LS03	NTE74LS03	ECG74LS03	SK74LS03	HE-443-745	
U60	7407N					
U61	74LS08N	NTE74LS08	ECG74LS08	SK74LS08	HE-443-780	
U63	7406N	NTE7406	ECG7406	SK7406	HE-443-698	
U101	6502AD	NTE6502	ECG6502			
U102	D27C256D-20					
U103	LC3517A-15					
U104	65C22					
U105	251828-01					
U106	65C22					
U107	5710	NTE229	ECG229	SK3246A/229	121-Z9021	*
U108	MC2871A					
U109	UPA2003C [uPA2003C]	NTE2013	ECG2013	SK9093/2013		
U110	74LS123	NTE74LS123	ECG74LS123	SK74LS123	HE-443-942	
U111	74LS86	NTE74LS86	ECG74LS86	SK74LS86	HE-443-891	
U112	7406N	NTE7406	ECG7406	SK7406	HE-443-698	
U113, 114	74LS14	NTE74LS14	ECG74LS14	SK74LS14	HE-443-872	

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
Shielded Hook-up Wire (Disk Drive Heads)..Use BELDEN No. 9534 (Four Conductor)

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	MFGR. PART No./ TYPE No.	NTE PART No.	ECG PART No.	TCE PART No.	ZENITH PART No.	NOTES
POWER SUPPLY						
BR1	RS204	NTE168	ECG168	SK3648/168	212-Z9001	
D1	FR155	NTE580	ECG580	SK5036/580	212-Z9000	
D2,3,4,5	1N4148	NTE519	ECG519	SK3100/519	103-131	
D6	FR105	NTE552	ECG552	SK9000/552	103-287	
D7,8	1N4148	NTE519	ECG519	SK3100/519	103-131	
D9	G1856	NTE580	ECG580	SK5036/580	212-Z9000	
D10	FEP16BT	NTE6240	ECG6240	SK5060/6240		
IC1	UA7812UC	NTE966	ECG966	SK3592/966	HE-442-674	
IC2	UA431AWC					
PC1	NJL5121DC					
Q1	2SC3679	NTE2309	ECG2309	SK9137/382	921-1114	*
Q3	2SD667C	NTE382	ECG382	SK3124A/289A	121-Z9065	*
Q4	2SC1815GR	NTE85	ECG85	SK9132	121-Z9003	*
Q5	2SA1015GR	NTE290A	ECG290A			
MAIN SYSTEM BOARD						
CR2 THRU CR7						
CR8	9.0B2					
CR9,10,13,14						
CR16,17						
CR20,21,22,23						
CR101	1N4002	NTE116	ECG116	SK3311	212-76-02	
CR102,3						
CR301						
DP1	DAN601					
DP2	DAP601					
DP3	DAN601					
DP4	DAP601					
Q1,2	2SC1815GR	NTE85	ECG85	SK3124A/289A	121-Z9065	*
Q101	5610					

LINE DEFINITIONS

A0 THRU A15 ..... Address Bits 0 Thru 15
AD0-AD15..... Disk Drive Address Bits 0 Thru 15
AEC .....Address Enable Control
ATN ..... Attention, Command Mode Selection
BA..... BUS Available
BUFEN.....Buffer Enable
BUSACK ..... BUS Acknowledge
BUSREQDS0 .....BUS Request
CAS .....Column Address Strobe
CE.....Chip Enable
CHAREN .....Character ROM Enable
CHAROM.....Charactor ROM Chip Select
CIA1,CIA2.....Complex Interface Adapter Select Lines 1 and 2
CLK .....Clock
CLRBNK .....Color RAM Bank Select
CNT1,CNT2.....Count Input, Internal Timer Reference
COL0 THRU COL7... Keyboard Input Data, Columns 0 Thru 7
COLORAM ..... Color RAM Chip Select
CS2.....Chip Select 2
CS8568 .....Chip Select 8568
D0 THRU D7.....Data, Bits 0 Thru 7
D0 THRU DD7 .....RGB RAM Data, Bits 0 Thru 7
DIRQ.....Disk Drive Interrupt Request
DMA.....Direct Memory Access
DRES..... Dynamic RAM Reset
DR/W ..... Disk Drive Read/Write
DWE.....Dynamic RAM Write Enable
EXROM ..... External ROM Enable
EXTRES.....External Reset
FLAG1,FLAG2..... Data Transfer Controls 1 and 2
FROM1..... Function ROM 1 Select
FSDIR..... Fast Serial Direction, Disk Interface
GAEC.....Gated Address Enable Control
GAME..... Game ROM Enable
GCAS0,GCAS1 .....Gated Column Address Strobe 0 and 1
GWE..... Gated Write Enable
HSYNC..... Horizontal Sync Pulse
I/01,I/02 ..... Input/Output Selects 1 and 2
INTEN.....Intensity
IOACC .....Input/Output Access
IOCS.....Input/Output Chip Select
IRQ..... Interrupt Request
MA0 THRU MA7 .....Multiplexed Address Bits 0 Thru 7
MTR/P5 .....Motor Control/Port Bit 5
MUX ..... Multiplexer
NMI..... Non-Maskable Interrupt
PA5..... Port A, Bit 5
PB0,PB4,PB7.....Port B, Bit 0, 4 and 7
POTX .....Game Paddle Control
POTY .....Game Paddle Control
R/W..... Read/Write
RAS .....ROW Address Strobe
RDATA..... Read Data
READY.....Ready, Current BUS Cycle Is To Be Completed
RES .....Reset
RESET.....Reset, Initializes Internal Registers
ROM1,ROM3 .....ROM Selects 1 and 3
ROMH .....External ROM Chip Select, High Status
ROML..... External ROM Chip Select, Low Status
ROW0 THRU ROW7.....Keyboard Input Data, Rows 0 Thru 7
SA0 THRU SA7.....Selected Address Bits 0 Thru 7
SID ..... Sound Interface Device Chip Select
TA8 THRU TA15.....Translated Address Outputs
VA14,VA15..... Video Address Bits 14 and 15
VIC ..... Video Interface Chip Select
VMA0 THRU VMA7.....VIC Multiplexed Address Bits 0 Thru 7
VSYNC..... Vertical Sync
WDATA ..... Write Data
WE ..... Write Enable
WGATE ..... Write Gate
Z80 I/O.....Z80 Input Requesting Input/Output Access
128/64 ..... C128 or C64 Operating Modes

SYSTEM NOTES

▽ Isolated ground
—*— Circuitry not used in some versions
--- Circuitry used in some versions
⊖ See parts list
⏚ Ground
⏦ Chassis

Voltages, logic readings and waveforms taken with Computer in Power Up mode, no diskette in drive, no keys pressed and all locking keys in up position unless otherwise noted.

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

(1) Probe indicates P when any key except RESTORE is pressed.
(2) Probe indicates P when key 1, 3, 5, 7, 9, +, £, HELP, ESC, ALT, or INST/DEL is pressed.
(3) Probe indicates P when key W, R, Y, I, P, *, — , RETURN or numeric keypad key 8, +, 0 is pressed.
(4) Probe indicates P when key A, D, G, J, L, ;, CONTROL, CRSR or numeric keypad key 5, -, . is pressed.
(5) Probe indicates P when key 2, 4, 6, 8, 0, -, F7, CLR/HOME, TAB, LINE FEED, or ↑ is pressed.
(6) Probe indicates P when key Z, C, B, M, F1, ., R, SHIFT, SPACE, ↓, or numeric keypad key 2 or ENTER is pressed.
(7) Probe indicates P when key S, F, H, K, F3, :, =, ↑, —, or numeric keypad key 4 or 6 is pressed.
(8) Probe indicates P when key Q, E, T, U, O, F5, @ , ↓, — or numeric keypad key 7 or 9 is pressed.
(9) Probe indicates P when key X, V, N, ,,/,L.SHIFT, RUN/STOP, NO SCROLL, CRSR or numeric keypad key 1 or 3 is pressed.
(10) Probe indicates L in C64 mode.
(11) Probe indicates L in 80 column mode.
(12) Probe indicates P in CP/M mode.

DISK DRIVE TROUBLESHOOTING

MICROPROCESSOR (CPU) OPERATION

Check Reset circuit logic reading at pin 6 of IC U37 while turning the Computer On and again while pressing Drive Reset button (SW3). The reading should be low when Computer is turned On, then go high and stay high. The reading should go low when Drive Reset button is pressed. If reading is not correct when Computer is turned On, check reading at pin 9 of IC U63 while turning Computer On. The reading should be high when Computer is turned On, then go low and stay low. If reading is not correct, refer to "Microprocessor (CPU) Operation" troubleshooting section for the Computer. If reading is correct, check pin 5 of IC U16 for a logic low that goes high while turning Computer On, and check for logic low whenever the Drive Reset button is pressed. If reading is not correct, check IC U63, Capacitor C69, Diode CR14, Switch SW3 and Resistors R15 and R31. If reading is correct, check pin 6 of IC U16 for logic high while pressing Drive Reset button (SW3). If reading is not correct, check IC U16. If reading is correct, check IC U37.
Check for 1MHz clock waveform at pins 3, 37 and 39 of CPU IC U101. If waveform is missing at pin 37, refer to the "Oscillator and Dividers" section of this troubleshooting guide. If waveform is good at pin 37 and missing at pins 3 or 39 of IC U101, check IC U101.

OSCILLATOR AND DIVIDERS

Check for 16MHz waveform at pin 29 of IC U107. If waveform is missing or frequency is not correct, check Crystal Y1, IC U107 and Capacitors C116 and C117. If waveform is good, check for 16MHz waveform at pin 30 and 1MHz waveform at pins 3 and 4 of IC U107. If waveforms or freqencies are not correct, check IC U107.

READ CIRCUIT

Insert a formatted diskette with data on it into the Drive and close the Drive door. Connect a jumper from pin 3 of Connector CN17 to ground to keep Disk Drive running. Check for logic low at pins 11 and 12 and high at pin 13 of IC U111. If reading is not correct at pin 13, check IC U107. If reading is not correct at pin 12, check IC U105. If readings are correct at pins 12 and 13 and not correct at pin 11, check IC U111. If readings are correct, check waveforms at pins 3, 4 and 33 of Read/Write Amp IC U108. There should be a noticeable change in the pulses at pin 33 when the Drive door is opened and closed. If waveforms are not correct, check: voltages and components associated with IC U108; Connector CN12 for good connections; Head (M5) windings for continuity.

WRITE CIRCUIT

Will not write. Verify the Write Protect circuits are working properly (see "Write Protect"). Check for pulses at pin 8 of IC U113 and pin 6 of IC U111 while injecting pulses at pin 9 of IC U113 with a logic pulser. If pulses are missing at pin 8 of IC U113, check IC U113. If pulses are present at pin 8 of IC U113 and missing at pin 6 of IC U111, check IC U111. If pulses are present at both pins, check for pulses at pin 6 of IC U111 while injecting pulses at pin 5 of IC U111 and check for pulses at pin 11 of IC U111 while injecting pulses at pins 12 and 13 (one pin at a time). If pulses are missing, check IC U111. If pulses are present, check VIA IC U104 and Controller IC U105.

WRITE PROTECT

Type in and run the following Basic program to check operation of the Write Protect detector. The program displays "Write Protect On" on the screen if a write protected diskette is inserted in the Drive and "Write Protect Off" on the screen if a diskette that is not write protected is inserted in the Drive.

```
10 PRINT CHR$(147)
20 OPEN 15,8,15
30 PRINT#15,"M-R"CHR$(0)CHR$(28)CHR$(1)
40 GET#15,A$
50 X=ASC(A$) AND 16
60 PRINT "WRITE PROTECT ";
70 IF X=0 THEN PRINT "ON ":ELSE PRINT "OFF"
80 PRINT CHR$(19):GOTO 30
```

NOTE: Do not put any spaces in lines 30 or 40.
If the write protect circuit is not working, check for logic low at pin 11 of IC U114 with a not write protected diskette in the Drive and logic high with a write protected diskette in the Drive. If readings are not correct, check Pins 3 and 4 of Connector CN14 for good connections and check Write Protect Detector M3. If readings are correct, check for logic high at pin 10 of IC U114 with a not write protected diskette in the Drive and logic low with a write protected diskette in the Drive. If readings are not correct, check IC U114. If readings are correct, check VIA IC U104.

HEAD POSITION MOTOR

Head Position motor (M1) does not work. Check Connector CN15 for good connections. If connections check good, type in and run the following Basic program to activate Head Position Motor circuits.

```
10 OPEN 15,8,15
20 PRINT#15,"M-W"CHR$(0)CHR$(28)CHR$(1)CHR$
   (243)
30 PRINT#15,"M-W"CHR$(0)CHR$(28)CHR$(1)CHR$
   (241)
40 PRINT#15,"M-W"CHR$(0)CHR$(28)CHR$(1)CHR$
   (240)
50 GOTO 20
```

NOTE: Do not put any spaces in lines 20,30 or 40
While the above program is running, check for pulses at pins 10 and 11 of VIA IC U104. If pulses are missing, check IC U104. If pulses are present, check for pulses at pins 4, 10 and 12 of IC U113. If pulses are missing, check IC U113. If pulses are present, check for pulses at pins 3 and 8 of IC U111. If pulses are missing, check IC U111. If pulses are present, check for pulses at pins 12 and

LOGIC CHART (Continued)

PIN NO	IC U10	PIN NO	IC U10	PIN NO	IC U11	PIN NO	IC U11	PIN NO	IC U11	PIN NO	IC U12	IC U13	IC U14
1	P	21	*(12)	1	P	21	P	41	P	1	*(12)	H	P
2	P	22	H	2	P	22	H	42	P	2	*(12)	*(12)	P
3	P	23	L	3	P	23	H	43	P	3	P	P	P
4	P	24	H	4	P	24	L	44	P	4	P	*(12)	P
5	P	25	L	5	P	25	L	45	P	5	*(12)	P	P
6	P	28	H	6	P	26	H	46	P	6	*(12)	*(12)	P
7	*(12)	27	H	7	L	27	L	47	P	7	P	P	P
8	*(12)	28	H	8	H	28	*	48	H	8	P	*(12)	L
9	*(12)	29	L	9	P	29	P			9	*(12)	P	P
10	*(12)	30	P	10	P	30	H			10	L	L	P
11	H	31	P	11	H	31	H			11	P	*(12)	P
12	*(12)	32	P	12	H	32	H			12	*(12)	P	P
13	*(12)	33	P	13	H	33	H			13	P	*(12)	P
14	*(12)	34	P	14	H(12)	34	P			14	P	P	P
15	*(12)	35	P	15	H(10)	35	P			15	*(12)	*(12)	P
16	P	36	P	16	L	36	P			16	*(12)	P	H
17	H	37	P	17	P	37	P			17	P	*(12)	
18	H	38	P	18	P	38	P			18	P	P	
19	*	39	P	19	P	39	P			19	*(12)	H	
20	H(12)	40	P	20	P	40	P			20	H	H	

PIN NO	IC U15	IC U16	IC U18	IC U18	PIN NO	IC U18	PIN NO	IC U19	PIN NO	IC U19	PIN NO	IC U20
1	P	L	P	P	21	H	1	H	21	P	1	P
2	P	H	P	P	22	P	2	P	22	P	2	P
3	P	H	P	P	23	P	3	P	23	P	3	P
4	P	L	P	P	24	H	4	P	24	H	4	P
5	P	H	P	P			5	P			5	P
6	P	P	L	P			6	P			6	P
7	P	L	P	P			7	P			7	L
8	L	L	P	P			8	P			8	P
9	P	H	P	P			9	P			9	P
10	P	P	L	P			10	P			10	P
11	P	P	P	P			11	P			11	P
12	P	L	P	L			12	L			12	P
13	P	H	P	P			13	P			13	P
14	P	H	P	P			14	P			14	H
15			P	P			15	P			15	
16	H		P	P			16	P			16	
17			P	P			17	P			17	
18			P	P			18	P			18	
19			P	P			19	H			19	
20			H	P			20	P			20	

TROUBLESHOOTING (Continued)

from 0 to 255 as a paddle is operated and should be greater than 255 whenever a paddle button is pressed.
If numbers are not correct, check Connectors CN3 and CN4 for good connections. If buttons do not work, check Capacitors and Diodes connected to pins 3 and 4 of Connectors CN3 and CN4. If Capacitors and Diodes check good, check CIA1 IC U1. If paddles do not work, check Capacitors and Diodes connected to pins 5 and 9 of Connectors CN3 and CN4. If Capacitors and Diodes check good, check for pulses at pins 5 and 6 of IC U2 while the above program is running. If pulses are missing, check CIA1 IC U1. If pulses are present, check for a variation in waveforms at pins 2 and 3 of IC U2 while operating paddles (with program running). If there is no variation, check IC U2. If waveforms are missing, check Capacitors C96 and C97 and SID IC U5.

CASSETTE PORT

Type in the following Basic program and run it while performing the tests in the following paragraphs:

```
10 POKE 0,47
20 PRINT PEEK(56333) AND 16,
30 PRINT PEEK(1) AND 16
40 POKE 1,123:POKE 1,83
50 GOTO 20
```

NOTE: Disconnect the Cassette Recorder from Connector CN31 when running this program.
The program displays two columns of numbers on the Monitor screen. The number in the first column indicates the status of cassette read pin (pin 4) of Cassette Connector CN31 and should change between 0 and 16 when a jumper is connected from pin 4 to pin 5 of Connector CN31. The number in the second column indicates the status of cassette sense pin (pin 6) of Connector CN31 and should change from 16 to 0 whenever pin 6 of Connector CN31 is shorted to ground. The program also generates pulses at pins 3 and 5 of Connector CN31.
Check Connector CN31 for good connections. Verify Cassette Sense pin (pin 6) of Connector CN31 is working by observing the number in the second column on the Monitor while shorting pin 6 to ground. If the number on the Monitor screen does not change from 16 to 0, check Capacitor C304, Resistor R304 and Microprocessor IC U6.
Computer will not save a program to tape. Check for pulses at pin 27 of IC U6. If pulses are missing, check Capacitor C303, Resistor R302 and IC U6.

Computer will not load a program from cassette tape. Connect a jumper from pin 4 to pin 5 of Connector CN31. The number in the first column should be changing between 0 and 16. If the number does not change, check Capacitor C302, Resistor Pack RP7 from pin 7 to pin 1 and IC U1.

Cassette motor will not start or will not stop. Check for 9VAC from pin 5 to pin 6 of Connector CN7. If 9VAC is missing, check Capacitors C78 and C79 and check Fuse F2 and Transformer T1 in the Power Supply. If 9VAC is present, check for 13.1V at the Collector of Cassette Switch Transistor Q301. If voltage is missing, check Capacitor C88, Rectifier CR13 and Resistor R5. If the voltage is present, check for pulses at pin 25 of IC U6. If pulses are missing, check IC U6. If pulses are present, check IC U30, Zener Diode CR301, Cassette Switch Transistor Q301 and Resistor R301.

DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove two screws from bottom front and three screws from the rear. Slide the cabinet top back about 1/2 inch and lift up to remove.

DISK DRIVE REMOVAL

Disconnect connectors CN12, CN14, CN15 and CN17. Pull the knob from the front of the Drive. Remove one screw from the left side and two screws from the right side of the Drive. Slide the Drive back and remove.

POWER SUPPLY REMOVAL

Remove one screw holding Power LED to front panel. Disconnect Connector CN7. Remove two screws from left side, two screws from rear right and one screw from front right of Power Supply. Lift Power Supply out of the chassis.

HEAD CLEANING INSTRUCTIONS

Use a lint free cloth or swab dampened with 91% isopropyl alcohol to clean disk drive heads. Dry with a lint free cloth.

MAIN SYSTEM BOARD REMOVAL

Remove one screw holding Drive Led to front panel. Remove one screw from right side and one screw from rear of cabinet bottom to release Main System board. Remove eight screws from Connectors CN2, CN3 and CN4. Remove hex spacer/screw that Power Supply rested on. Remove seven screws holding System board and lift board out of the cabinet.

KEYBOARD DISASSEMBLY

Remove six rubber feet and six screws from Keyboard bottom and remove the bottom. Remove six screws holding Keyboard to the top and remove Keyboard.

LOGIC CHART (Continued)

PIN NO	IC U34	PIN NO	IC U34	PIN NO	IC U37	IC U38	IC U39	IC U40	IC U41	IC U42	IC U50	IC U54	IC U55
1	H	21	P	1	H	L	L	L	L	H	P	*	H
2	P	22	P	2	L	P	P	P	P	P	P	*	P
3	P	23	P	3	P	P	P	P	P	P	P	H	P
4	P	24	P	4	L	P	P	P	P	P	L	*	P
5	P	25	P	5	L	P	P	P	P	P	H	*	P
6	P	26	P	6	H	P	P	P	P	P	L	H	P
7	P	27	P	7	L	P	P	P	P	P	L	L	P
8	P	28	H	8	P	P	P	P	P	P	H	P	P
9	P			9	L	H	H	H	H	P	L	P	P
10	P			10	P	P	P	P	P	L	H	P	L
11	P			11	P	P	P	P	P	P	L	P	P
12	P			12	H	P	P	P	P	P	P	P	P
13	P			13	L	P	P	P	P	P	P	P	P
14	L			14	H	P	P	P	P	P	H	H	P
15	P			15		P	P	P	P	P			P
16	P			16		P	P	H	H	P			P
17	L			17		P	P	P	P	P			P
18	P			18		L	L	L	L	P			P
19	P			19						H			P
20	L			20						H			H

PIN NO	IC U56	IC U57	IC U58	IC U60	IC U61	PIN NO	IC U63
1	H	L	L	H	P	1	P
2	L	L	L	H	H	2	L
3	P	P	L	H	P	3	L
4	H	P	L	H	H	4	H
5	L	L	L	H	P	5	H
6	H	L	H	H	P	6	L
7	L	L	L	L	L	7	L
8	P	P	L	L	P	8	H
9	P	P	L	H	P	9	L
10	P	P	H	P	H	10	H
11	P	P	H	P	L	11	L
12	P	L	H	P	P	12	H
13	H	P	L	P	P	13	L
14	H	H	H	H	H	14	H
15						15	
16						16	

Connector CN8. Check waveform at pin 17 of IC U21. If waveform is missing, check IC U21. If waveform is present, check the voltages and components associated with Transistors Q1 and Q2 on the RF Modulator board and check Filter EMI40.
No video on Connector CN2 connected to an RGB Monitor. Make sure the 40/80 Display key is in 80 column mode (down). Check Video Controller IC U22 horizontal sync waveform at pin 4, vertical sync waveform at pin 20, and pulses at pins 44 and 45. If waveforms or pulses are missing, check IC U22 and RAM IC's U23 and U24. If waveforms and pulses are present, check Buffer IC U24.
No video on Connector CN2, connected to a Monochrome Monitor, RGB works. Check for pulses at pins 43 and 47 of IC U22. If pulses are missing, check IC U22. If pulses are present, check IC U57 and check voltages and components associated with Video Amp Transistor Q1.

VIDEO SYNC

No vertical or horizontal sync to a Monitor connected to the RF Modulator or to Video Connector CN8. Check VIC IC U21.
Vertical or horizontal sync missing on Connector CN2 connected to RGB Monitor. Check for pulses at pins 4 and 20 of Video Controller IC U22. If pulses missing, at either pin, check IC U22. If pulses are present, check Buffer IC U24.
Vertical or horizontal sync missing on Connector CN2 connected to Monochrome Monitor. Check for pulses at pin 19 of IC U22. If pulses are missing, check IC U22. If pulses are present, check IC U57 and check voltages and components associated with Video Amp Transistor Q1.

TIME OF DAY CLOCKS

CIA ICs U1 and U4 contain 24 hour time of day clocks that are used by some programs. If a program that displays or uses the time of day does not display or use time properly, use the following Basic program to check the clocks in ICs U1 and U4:

```
10 FOR X=56331 TO 56328 STEP -1
20 POKE X,5:POKE X+256,5:NEXT X
30 PRINT CHR$(147)
40 PRINT CHR$(19)
50 PRINT,"U1","U4"
60 PRINT "TENTHS ",HEX$(PEEK(56328)),HEX$
   (PEEK(56584))
70 PRINT "SECONDS ",HEX$(PEEK(56329)),HEX$
   (PEEK(56585))
80 PRINT "MINUTES ",HEX$(PEEK(56330)),HEX$
   (PEEK(56586))
90 PRINT "MINUTES ",HEX$(PEEK(56330)),HEX$
   (PEEK(56586))
100 GOTO 40
```

The program puts the number 5 in the Tenths, Seconds, Minutes and Hours registers, then start displaying time from both IC U1 and continuously. If neither IC U1 or IC U4 is keeping proper time, check the waveforms at pins 10 and 11 of IC U16. If the waveform is missing at pin 11, check Capacitors C79, C80 and C144, Resistor R7 and Zener Diode CR8. If the waveform is present at pin 11 and missing at pin 10, check IC U16. If only one of the ICs is not keeping the correct time, check the IC (U1 or U49 that is not keeping correct time.

COLOR

No color to a monitor connected to the RF Modulator or to Video Connector CN8. Check color clock waveform at pin 29 of VIC IC U21. If waveform is missing, check IC U28. If waveform is present, check waveform at pin 16 of VIC IC U21. If waveform is missing, check IC U21. If waveform is present, check voltages and components associated with Transistor Q1 and check Transistor Q1. Also see "Color RAM".

One or more colors missing on Connector CN2 connected to an RGB Monitor . Type in and run the following Basic program:

```
10 COLOR 5,3:PRINT "RED"
20 COLOR 5,6:PRINT "GREEN"
30 COLOR 5,7:PRINT "BLUE"
```

After running the program, check for pulses at pins 44, 45 and 46 of IC U22. If pulses are missing at any pin, check IC U22. If pulses are present, check Buffer IC U24.

SOUND

No sound. Type in and run the following Basic program to produce a continuous sound:

```
10 VOL 15
20 SOUND 1,10000,100
30 GOTO 10
```

While the program is running, check for pulses at pin 15 of Decoder IC U3. If pulses are missing, check IC U3. If pulses are present, check for 600Hz, .8V peak to peak at pin 27 of SID IC U5. If waveform is missing, check Capacitors C82 and C83 and IC U5. If waveform is present, check voltages and components associated with Audio Output Transistor Q2.

Computer generated sound works, external sound input (pin 5 of Video Connector CN8) does not work. Check Capacitor C93, Resistor R25 and IC U5.

COLOR RAM

RAM IC U19 is used to hold color information that goes to a composite monitor connected to the RF Modulator or to Video Connector CN8. If there is a problem with color on a composite monitor, the following Basic program can be used to check Color RAM IC U19:

```
10 DATA 1,2,4,8
20 FOR X= 55296 TO 56295
30 FOR Y= 1 TO 4
40 READ Z:POKE X,Z
50 IF PEEK(X) AND Z THEN 70
```

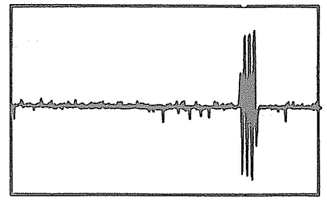

With head on Track 00, check for a gap of .01 inches between the Track 00 stop and the post on the Head Position Motor Pulley. If the Track 00 stop is out of adjustment, loosen the two screws holding the Track 00 stop bracket and adjust the bracket for a gap of .01 inches with the head on Track 00. Tighten the Track 00 stop bracket screws.

To check Track 00 Detector Adjustment, connect positive lead of voltmeter to pin 10 of Connector CN14. Check for 5.0V when head is On Track 1 and .2V when head is On Track 2. If Detector is out of adjustment, set head to Track 1 and loosen screws holding Track 00 Detector bracket. Adjust Track 00 Detector backward until voltmeter indicates .2V, then adjust it forward until voltmeter indicates 5.0V. Tighten Track 00 Detector bracket screw.

INDEX SENSOR ADJUSTMENT

Connect channel A input of a dual trace scope to TP1 (pin 3 of IC U108) and channel B input to TP2 (pin 4 of IC U108). Set scope for external trigger mode and connect external trigger input to pin 4 (index pulse) of Connector CN14. Set scope to negative trigger slope, add mode with channel B inverted, sweep time to 50us, voltage range to .2V/cm and scope input to AC input. Set Drive Head to Track 34 (see "Alignment Test Setup"). Insert Alignment Diskette into drive and close door. Connect jumper from pin 3 of Connector CN17 to ground to keep drive running. Confirm timing between start of sweep (negative going edge of index pulse at pin 4 of Connector CN14 and first pulse of timing burst is 200us ±100us (see Figure 4). If timing is not within tolerance, loosen screw holding Index Sensor (M2). Adjust Index Sensor until timing is correct and tighten screw.
NOTE: The leading edge of the index pulse has a very wide slope. This makes it difficult to do an accurate adjustment. View the index pulse with the scope and set the trigger point as close to the top of the leading edge of the pulse as possible and then do the above adjustment.

Figure 4



AZIMUTH CHECK

Connect channel A input of a dual trace scope to TP1 (pin 3 of IC U108) and channel B input to TP2 (pin 4 of IC U108). Set scope for external trigger mode and connect external trigger input to pin 4 of Connector CN14. Set scope to negative trigger slope, add mode, with channel B inverted, sweep time to .5ms, voltage range to .2V/cm and scope inputs to AC input. Set Drive head to Track 34 (see "Alignment Test Setup"). Insert an Alignment Diskette into drive and close drive door. Connect a jumper from pin 3 of Connector CN17 to ground to keep drive running. Pattern shown in Figure 5 should be displayed on scope.

Amplitude of bursts 1 and 4 must be equal to or less than amplitude of bursts 2 and 3.

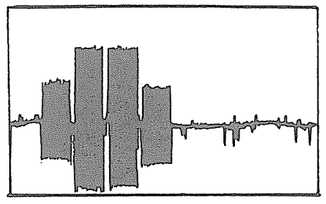


Figure 5

MISCELLANEOUS ADJUSTMENTS

CHANGING DISK DRIVE DEVICE NUMBER

The Internal Disk Drive can be set to any device number from 8 to 11 by shorting or cutting two jumper pads located on the left side of IC U106 (as viewed from the front of Computer). Use the following chart to determine which pad to short or cut:
NOTE: Jumper 1 is the pad closest to the front of Computer.

Device Number	Jumper 1	Jumper 2
8	short	short
9	cut	short
10	short	cut
11	cut	cut

POWER SUPPLY VOLTAGE ADJUSTMENT

Connect the positive lead of a voltmeter to pin 4 of Connector CN7 and negative lead to ground. Turn Computer On and adjust 5V Adjust Control (VR2) for a reading of 5.0 volts.

14MHz OSCILLATOR

Connect input of a frequency counter to pin 8 of IC U28. Adjust Trimmer Capacitor CT1 for a frequency of 14.31818MHz.

RF MODULATOR SOUND COIL

Connect Computer to a TV Monitor. Set TV and Computer Channel Select Switch to Channel 3. Type in and run the following Basic program:

```
10 VOL 5
20 SOUND 1,500,100
30 GOTO 10
```

Adjust the sound coil for best sound with Minimum noise.

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

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	

LOGIC CHART

PIN NO	IC U101	PIN NO	IC U101	PIN NO	IC U102	PIN NO	IC U102	PIN NO	IC U103	PIN NO	IC U103
1	L	21	L	1	H	21	P	1	P	21	P
2	H	22	P	2	P	22	P	2	P	22	P
3	P	23	P	3	P	23	P	3	P	23	P
4	P	24	P	4	P	24	P	4	P	24	H
5	*	25	P	5	P	25	P	5	P		
6	H	26	P	6	P	26	P	6	P		
7	P	27	P	7	P	27	P	7	P		
8	H	28	P	8	P	28	H	8	P		
9	P	29	P	9	P			9	P		
10	P	30	P	10	P			10	P		
11	P	31	P	11	P			11	P		
12	P	32	P	12	P			12	L		
13	P	33	P	13	P			13	P		
14	P	34	P	14	L			14	P		
15	P	35	*	15	P			15	P		
16	P	36	*	16	P			16	P		
17	P	37	P	17	P			17	P		
18	P	38	P	18	P			18	P		
19	P	39	P	19	P			19	P		
20	P	40	H	20	L			20	P		

PIN NO	IC U104	PIN NO	IC U104	PIN NO	IC U105	PIN NO	IC U105	PIN NO	IC U106	PIN NO	IC U106
1	L	21	P	1	H	21	P	1	L	21	P
2	P	22	P	2	P	22	P	2	H(9)	22	P
3	P	23	P	3	P	23	P	3	P	23	P
4	P	24	P	4	P	24	P	4	L(10)	24	P
5	P	25	P	5	P	25	L	5	H	25	P
6	P	26	P	6	P	26	L	6	H	26	P
7	P	27	P	7	P	27	L	7	L	27	P
8	P	28	P	8	P	28	*	8	L	28	P
9	P	29	P	9	P	29	P	9	P	29	P
10	L(1)	30	P	10	L	30	H	10	P	30	P
11	L(1)	31	P	11	H	31	P	11	P	31	P
12	H(12)	32	P	12	H	32	L	12	P	32	P
13	H	33	P	13	H	33	L	13	L	33	P
14	H	34	H	14	H	34	P	14	P	34	H
15	H(1)	35	P	15	H(1)	35	P	15	L	35	P
16	H	36	P	16	H	36	P	16	L	36	P
17	P	37	P	17	P	37	P	17	P	37	P
18	P	38	P	18	P	38	P(18)	18	H	38	P
19	P	39	P	19	P	39	P	19	H	39	H(7)
20	H	40	P	20	L	40	P	20	H	40	P

SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.

2. Maintain AC line voltage at rated input.

3. Remove AC power from the Computer system 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 system AC power On.

8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.

9. This Computer system 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 system 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.

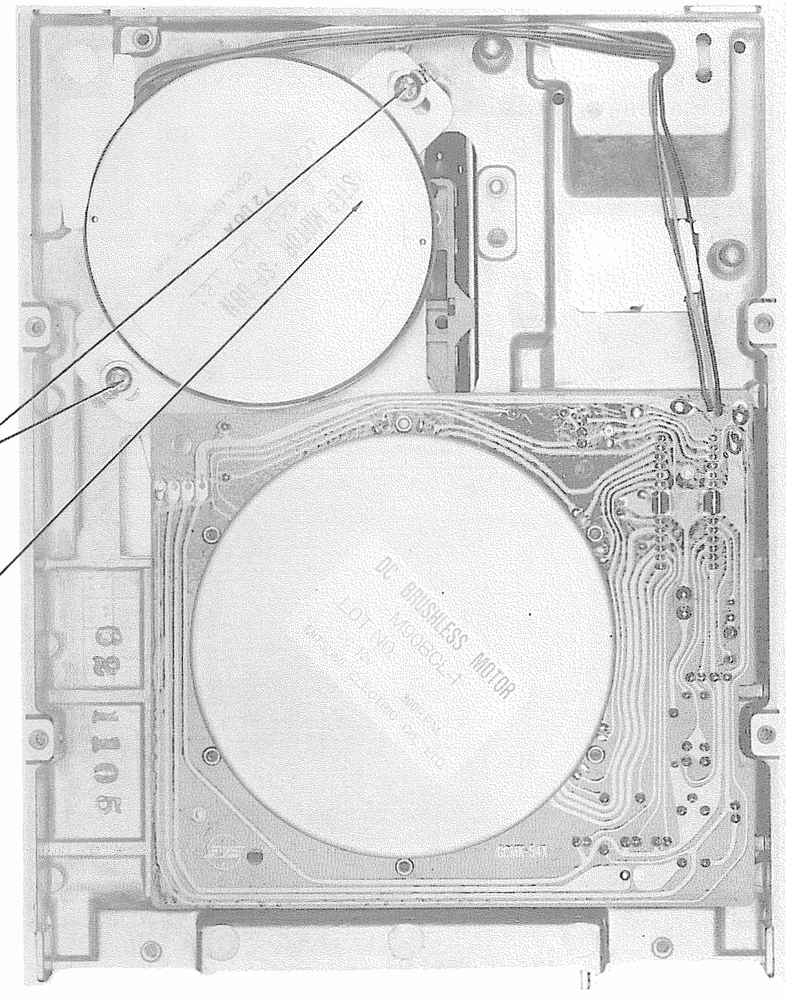
13. Never expose the Computer system to water. If exposed to water, turn the unit Off. Do not place the Computer system near possible water sources.

14. Never leave the Computer system 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 system.

17. Never use liquids or aerosols directly on the Computer system. Spray on cloth and then apply to the Computer system cabinet. Make sure the Computer system is disconnected from the AC power line.

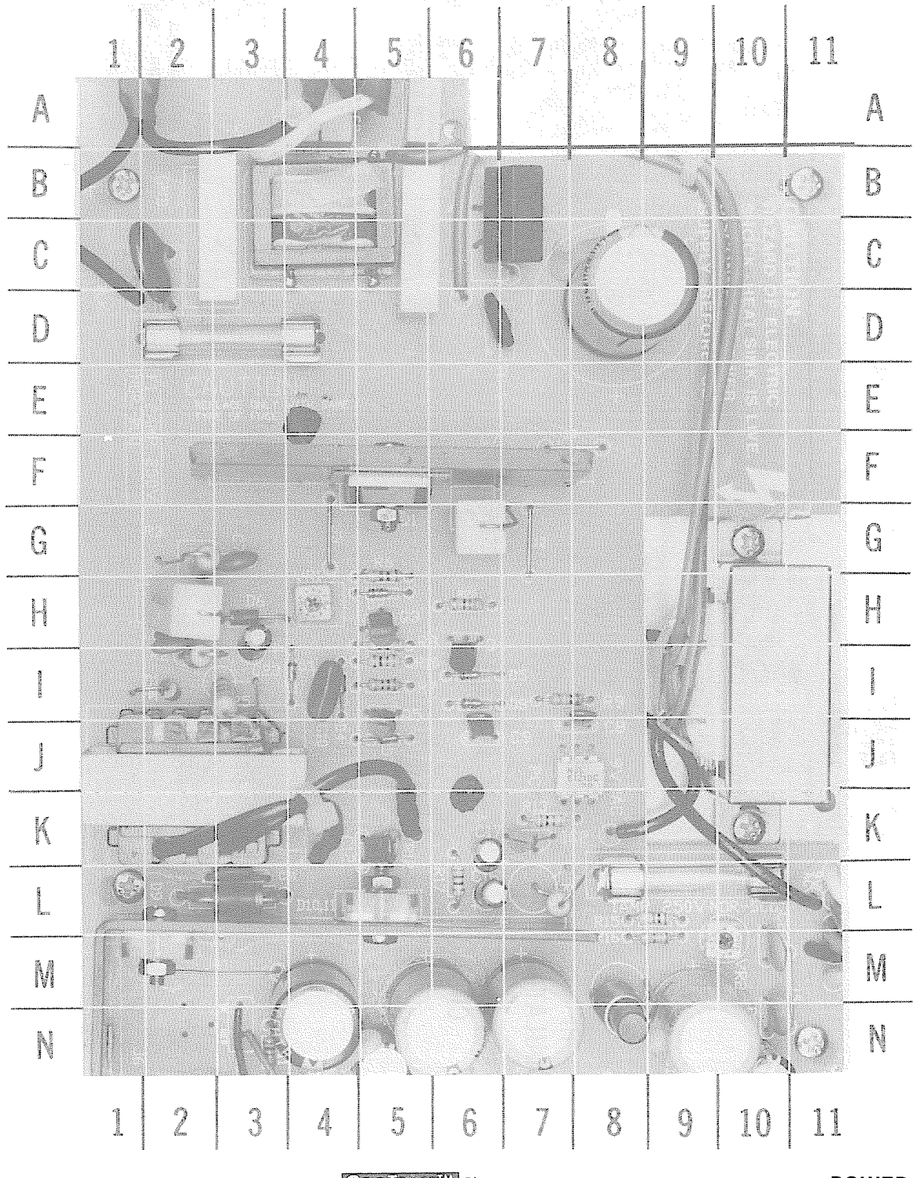


DISK DRIVE - BOTTOM VIEW

C2	S-11	C79	B-1	C219	H-22	J15	H-11	RP4	M-4
C3	N-4	C81	K-8	C301	Q-22	J16	H-11	RP5	Q-6
C4	E-2	C82	L-10	C302	Q-22	J17	H-11	RP6	M-8
C5	J-9	C83	L-10	C303	Q-22	J18	H-11	RP7	E-14
C6	O-8	C84	J-8	C304	P-22	L3	D-13	RP8	B-5
C7	N-11	C85	J-6	CN1	C-19	L4	G-9	RP101	N-19
C8	D-17	C86	L-9	CN2	A-8	L5	I-21	SW2	D-23
C9	S-6	C87	D-12	CN3	N-23	L101	L-22	SW3	E-22
C10	O-9	C88	Q-13	CN4	F-23	L102	L-22	U1	H-19
C11	O-11	C89	D-19	CN5	K-23	L103	L-21	U2	G-20
C12	N-10	C90	E-19	CN6	A-14	L104	O-17	U3	M-4
C13	O-9	C91	D-21	CN7	L-13	Q1	G-7	U4	C-2
C14	N-7	C92	D-21	CN8	A-13	Q2	K-8	U5	K-9
C15	N-6	C93	C-13	CN9	A-4	Q101	K-14	U6	R-8
C16	D-15	C94	D-12	CN12	J-18	Q301	R-22	U7	N-11
C17	I-14	C95	J-8	CN14	M-13	R1	Q-5	U8	D-17
C18	I-12	C96	K-9	CN15	L-13	R2	E-14	U9	R-6
C19	I-13	C97	K-8	CN17	N-13	R5	P-12	U10	R-9
C20	D-19	C99	F-22	CN31	Q-23	R6	J-5	U11	R-11
C21	I-9	C100	L-8	CR2	C-5	R7	B-1	U12	N-10
C22	I-4	C101	S-14	CR3	C-5	R9	C-16	U13	M-9
C23	F-5	C102	S-16	CR4	C-5	R12	J-7	U14	M-7
C24	G-5	C103	S-18	CR5	C-6	R15	C-20	U15	M-6
C25	F-6	C104	S-19	CR6	C-5	R16	H-7	U16	D-15
C26	F-13	C105	S-21	CR7	C-5	R17	H-8	U17	H-14
C27	C-19	C106	P-16	CR8	C-1	R18	G-8	U18	G-12
C28	F-8	C107	N-17	CR9	C-14	R19	H-8	U19	H-13
C29	D-9	C109	J-15	CR10	C-14	R20	C-20	U20	F-12
C30	D-4	C110	J-16	CR13	O-12	R21	D-20	U21	F-10
C31	N-5	C111	O-20	CR14	C-23	R22	E-19	U22	F-4
C32	Q-2	C112	O-14	CR16	D-21	R23	C-22	U23	E-5
C33	B-5	C113	O-21	CR17	J-10	R24	D-21	U24	G-5
C34	Q-3	C114	M-14	CR20	F-21	R25	C-14	U25	E-6
C35	D-16	C115	J-15	CR21	F-21	R26	H-7	U26	F-13
C36	Q-5	C116	L-17	CR22	H-20	R28	L-8	U27	D-19
C38	S-2	C117	L-16	CR23	H-20	R29	R-5	U28	E-8
C39	S-4	C118	L-22	CR101	K-14	R30	R-6	U30	C-4
C40	S-3	C119	O-20	CR102	K-17	R31	C-23	U31	M-5
C41	S-5	C120	O-21	CR103	K-18	R35	K-14	U32	O-2
C42	Q-6	C121	J-21	CR301	R-22	R39	G-8	U34	O-3
C43	F-22	C123	K-21	CT1	F-8	R51	E-16	U37	F-15
C44	F-22	C124	K-21	DP1	G-21	R54	H-16	U38	R-2
C45	G-22	C125	K-21	DP2	G-21	R107	K-17	U39	R-4
C46	G-22	C126	L-20	DP3	H-21	R108	L-17	U40	R-3
C47	F-22	C127	L-20	DP4	H-21	R110	J-21	U41	R-5
C48	G-22	C130	K-16	EMI40	B-13	R111	K-22	U42	P-6
C49	E-22	C133	K-19	EMI41	B-12	R112	K-21	U50	F-16
C50	E-22	C134	L-20	EMI42	B-13	R113	K-21	U54	K-6
C51	F-22	C140	K-15	FB7	B-14	R114	L-21	U55	H-15
C52	F-22	C141	J-15	FB8	B-15	R116	M-19	U56	K-5
C53	F-22	C142	F-12	FB9	B-15	R117	L-19	U57	H-6
C54	E-22	C143	N-2	FB10	B-15	R118	K-19	U58	D-16
C55	I-15	C144	D-14	FB11	B-15	R120	K-18	U60	D-14
C56	L-5	C145	L-6	FB13	B-14	R121	J-20	U61	M-2
C57	G-6	C200	L-22	FB14	B-14	R122	L-15	U63	D-20
C58	D-16	C201	I-22	FB15	B-13	R124	K-15	U101	R-14
C59	C-21	C202	I-22	FB18	C-15	R125	K-14	U102	R-16
C60	D-14	C203	I-22	FB19	B-12	R128	L-14	U103	R-18
C61	H-5	C204	L-22	FB20	B-11	R129	M-14	U104	R-19
C63	H-9	C205	H-22	FB44	B-7	R130	O-14	U105	R-21
C64	A-4	C206	H-22	FB45	B-8	R131	L-14	U106	O-16
C65	A-4	C207	H-22	FB46	B-8	R132	J-16	U107	O-18
C66	A-4	C208	G-22	FB47	B-7	R133	O-19	U108	K-20
C67	B-6	C209	G-22	FB48	B-7	R134	N-20	U109	K-16
C69	C-21	C210	G-22	FB49	B-9	R150	N-14	U110	K-17
C70	E-8	C211	I-22	FB50	B-8	R161	N-21	U111	N-20
C71	E-22	C212	L-22	FB106	M-18	R301	Q-22	U112	N-15
C72	H-9	C213	I-22	J1	F-9	R302	P-23	U113	N-21
C73	G-20	C214	I-22	J7	J-12	R303	P-22	U114	M-15
C75	D-18	C215	H-22	J7A	J-12	R307	P-13	Y1	L-16
C76	A-5	C216	H-22	J7B	J-12	RP1	C-4	Y2	F-7
C77	J-11	C217	H-22	J10	C-8	RP2	C-22		
C78	B-3	C218	I-22	J11	C-8	RP3	N-10		

GridTrace LOCATION GUIDE

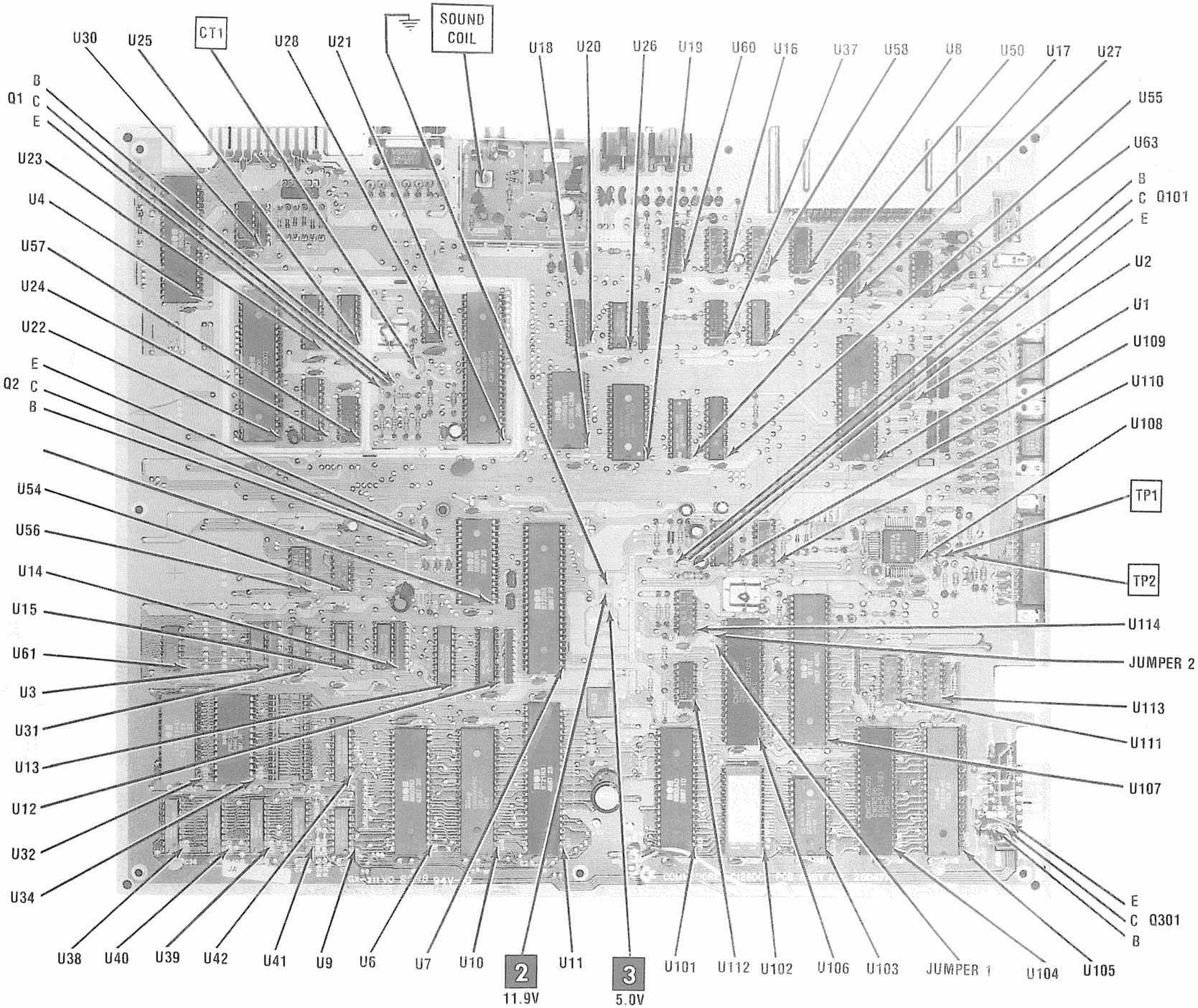
BR1	B-7	C12	K-5	C51	L-3	F2	L-9	R3	G-2	R15	L-9
C1	B-3	C13	N-6	D1	I-2	IC1	M-2	R4	G-6	R16	M-9
C2	A-4	C14	N-7	D2	H-5	IC2	K-7	R5	I-3	R17	L-6
C3	A-4	C15	N-9	D3	I-4	L1	N-8	R6	G-5	R20	H-6
C4	A-5	C16	L-6	D4	I-4	LF1	B-4	R7	I-5	T1	H-10
C5	C-8	C17	K-6	D5	I-6	PC1	J-8	R8	H-5	T2	J-1
C6	H-2	C19	N-5	D6	H-3	Q1	F-5	R9	I-7	TH1	D-6
C7	G-3	C20	N-10	D7	J-5	Q3	H-5	R10	I-5	VR1	H-4
C8	I-8	C21	N-10	D8	I-6	Q4	I-6	R11	N-3	VR1A	C-2
C9	J-6	C22	M-10	D9	L-3	Q5	I-5	R12	K-5	VR2	M-10
C10	I-4	C23	H-3	D10	L-5	R1	H-2	R13	K-7		
C11	N-4	C24	C-5	F1	D-3	R2	I-2	R14	L-7		

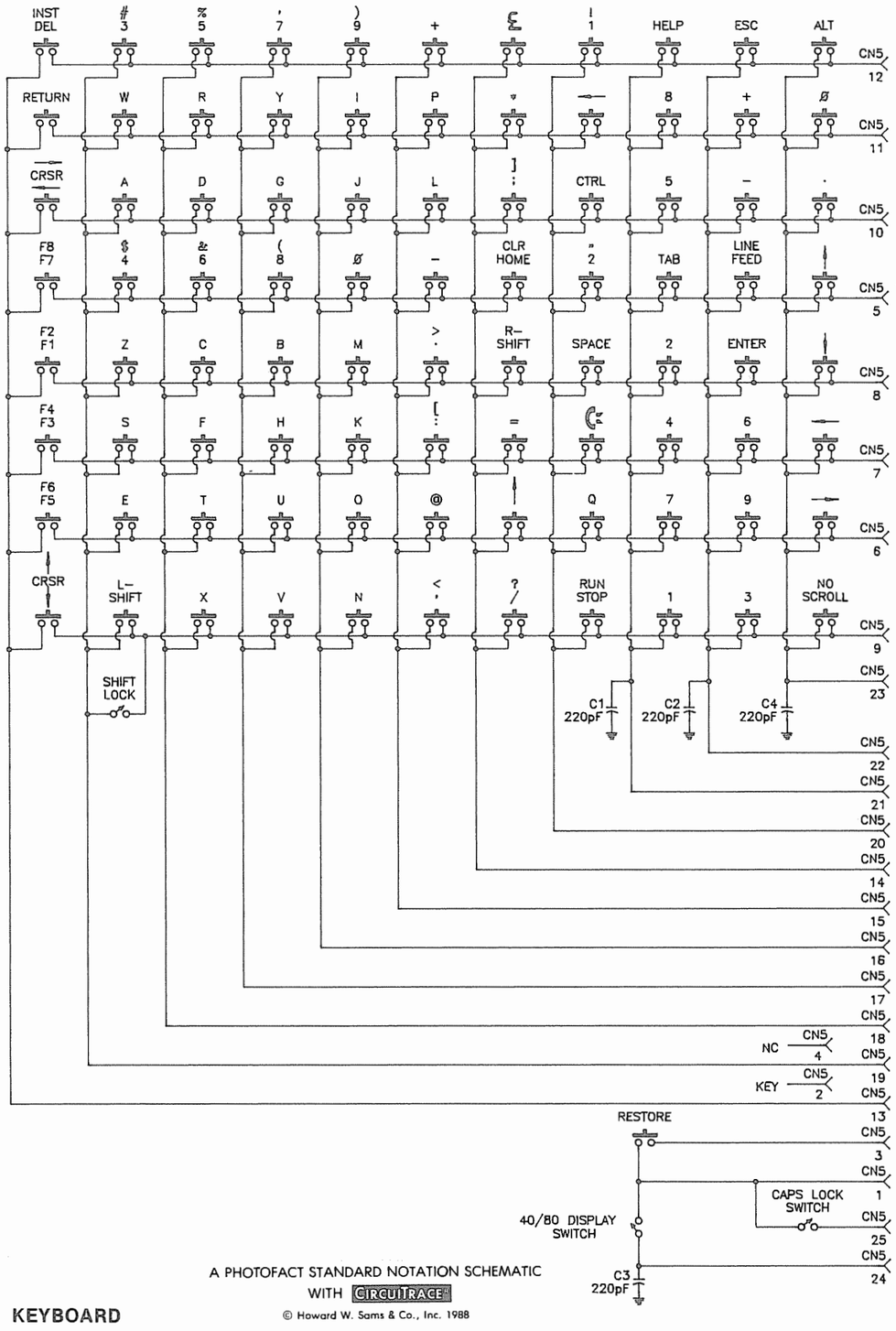


A Howard W. Sams GRIDTRACE™ Photo

COMMODORE
MODEL C128D

POWER SUPPLY



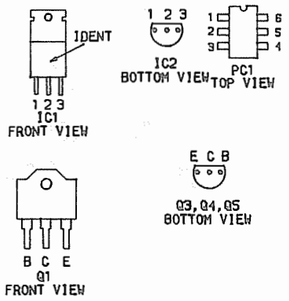


A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE™

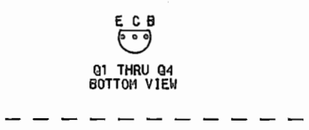
KEYBOARD

TERMINAL GUIDES

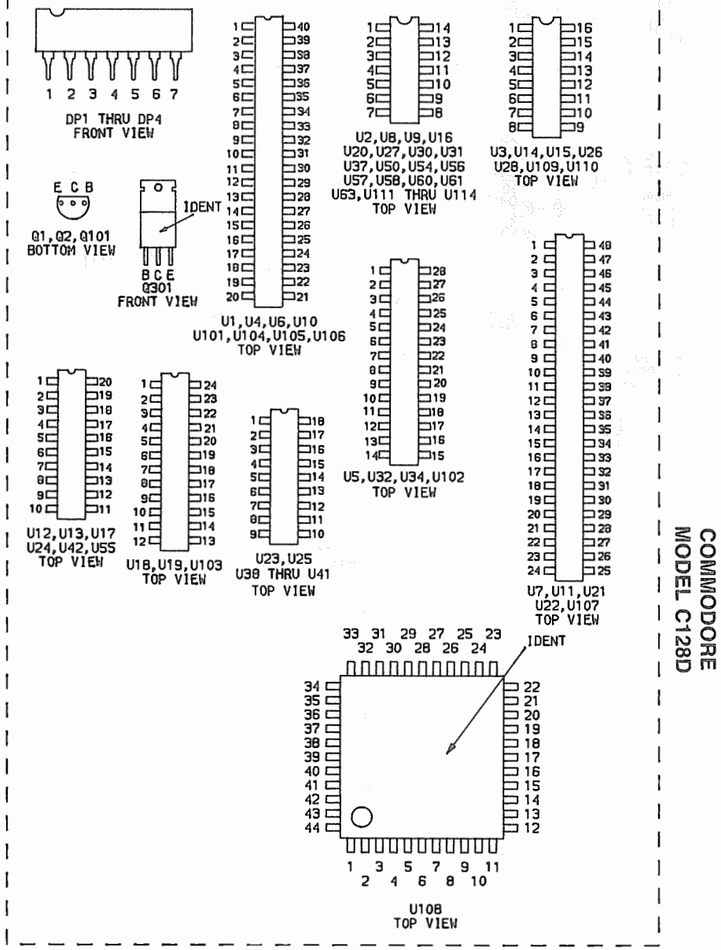
POWER SUPPLY



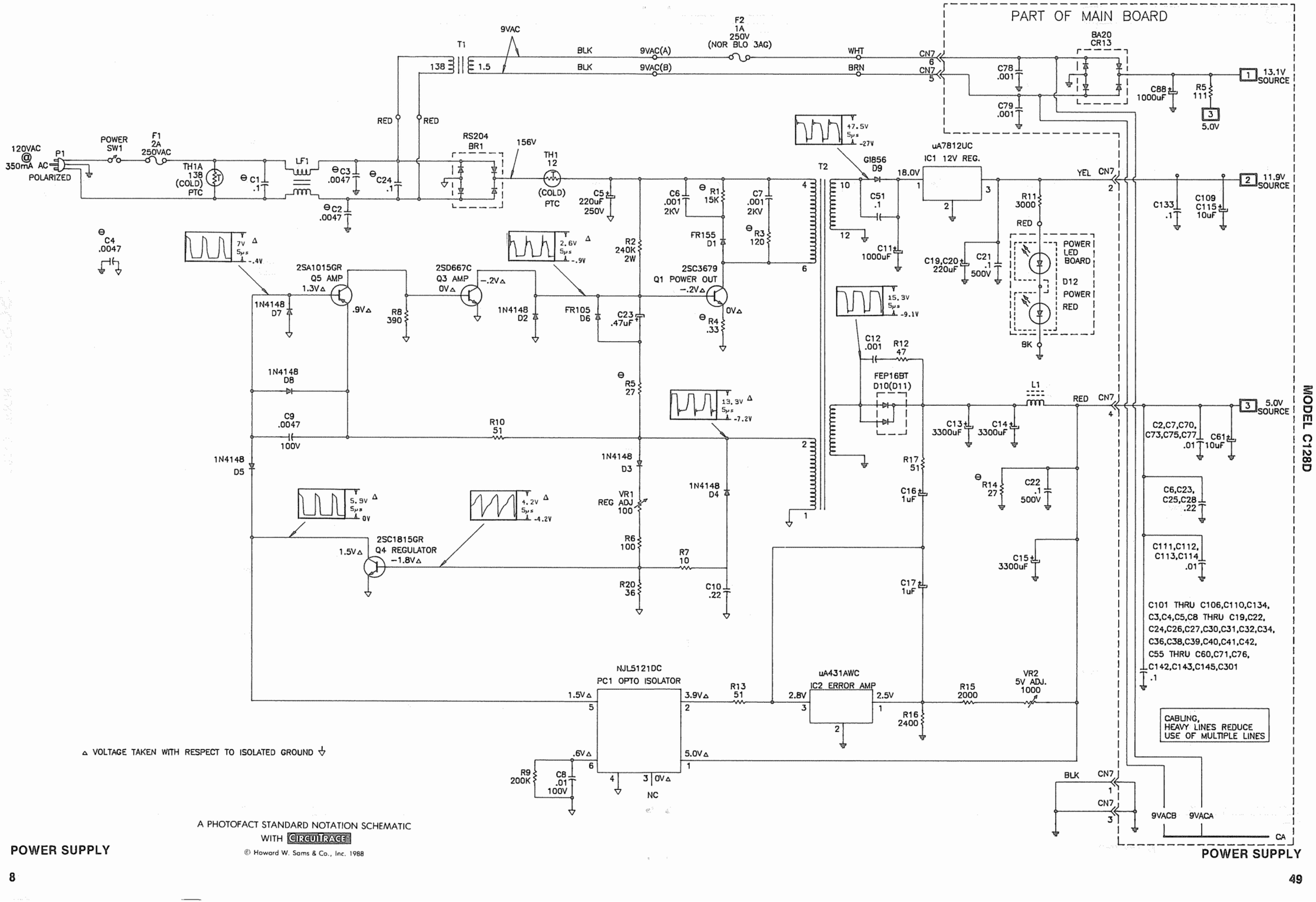
RF MODULATOR



MAIN SYSTEM BOARD



COMMODORE MODEL C128D



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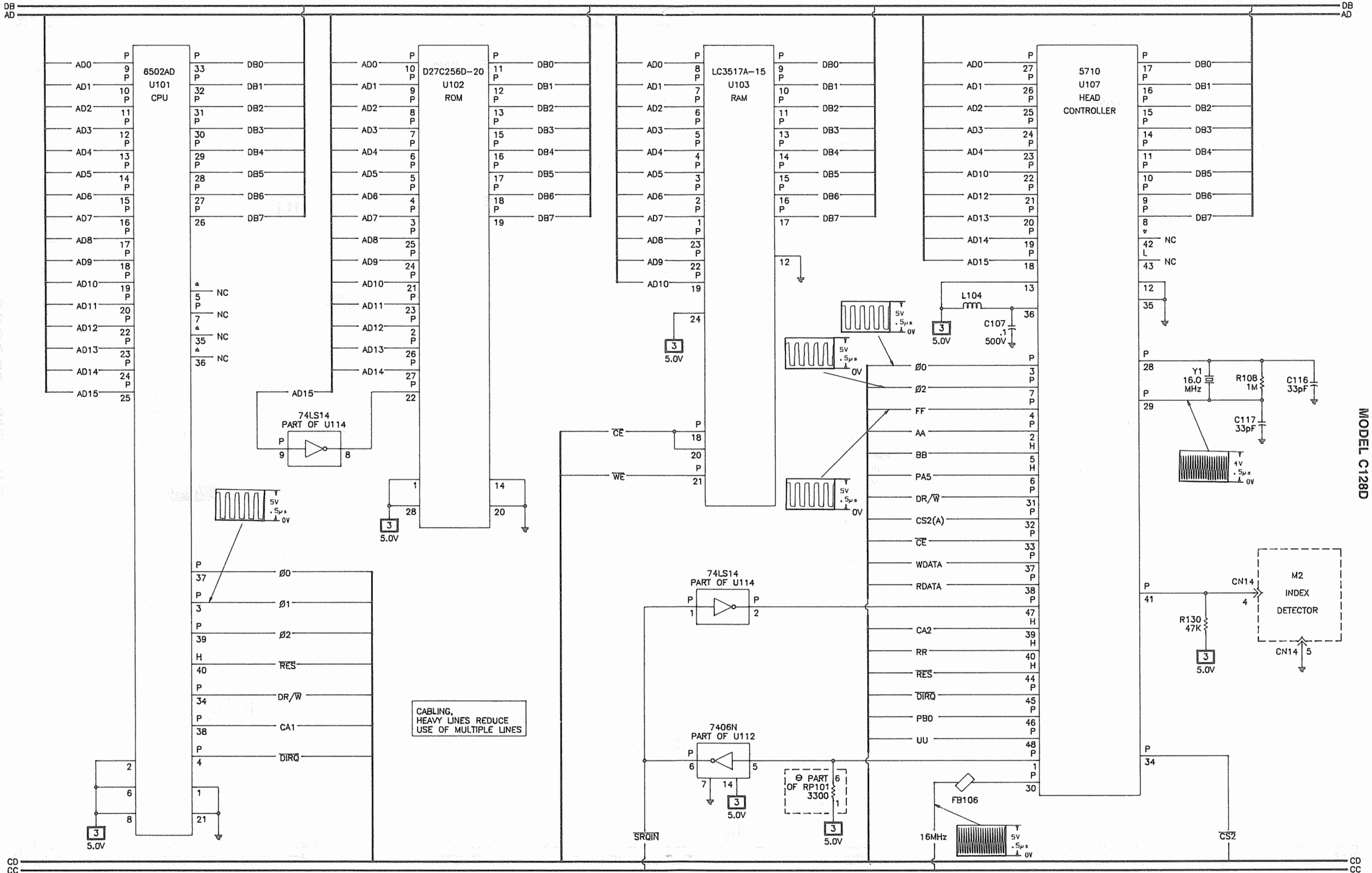

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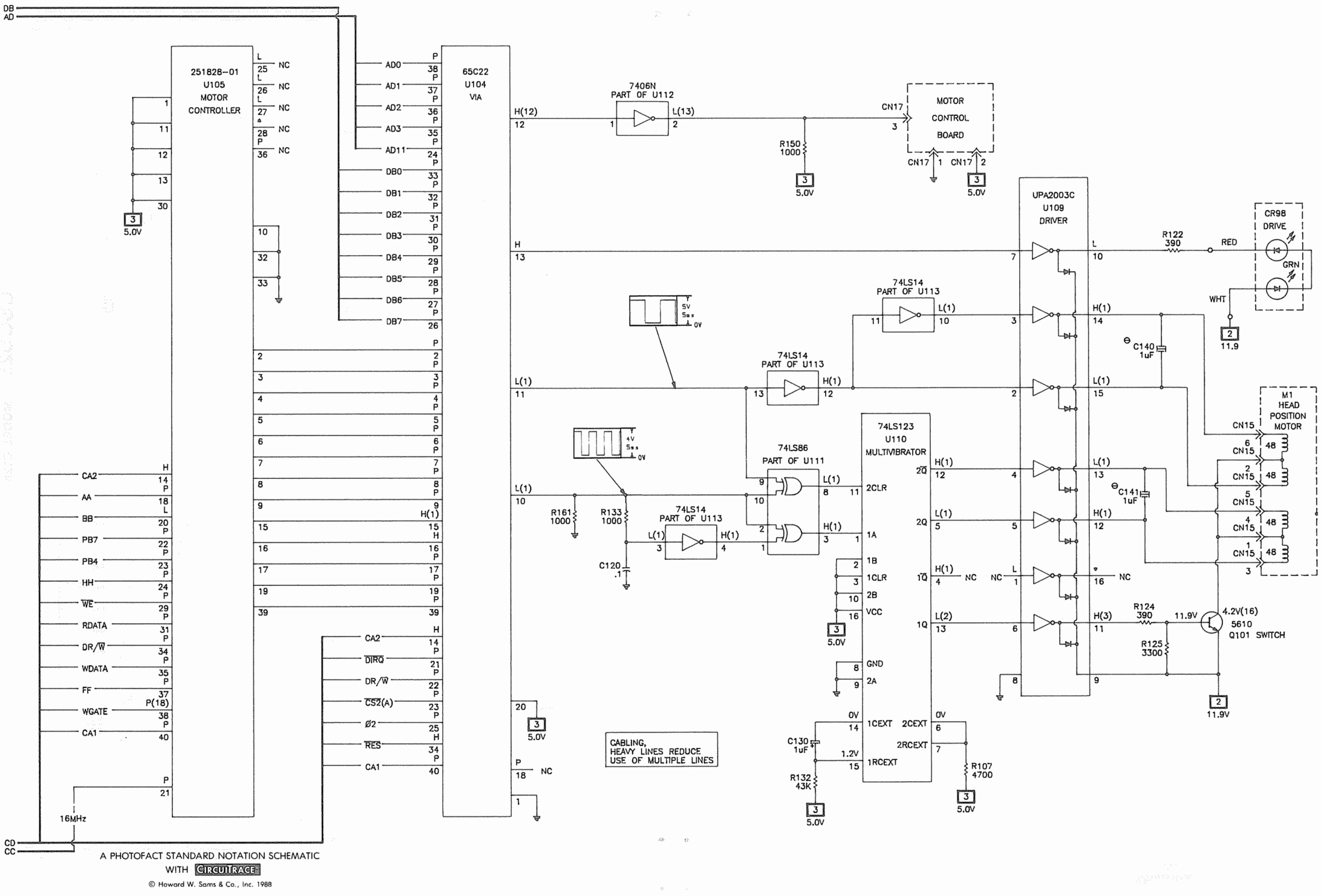

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