

19.Ø KAYPRO 16 — TAB FOR THIS SECTION—

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## 19.0 KAYPRO 16

The KAYPRO 16 is an Intel 8088 microprocessor based computer that supports 16-bit operations and runs at 4.77MHz. In addition to the 8088, the KAYPRO 16 uses the 8237A-5 DMA, the 8253-5 timer, the 8255A-5 peripheral interface, the 8259A interrupt controller, the 8284A clock, and the 8288 bus controller. Data sheets for these chips can be found in the Microprocessor and Peripheral Handbook by Intel Corporation, order number: 210844-001.

## KAYPRO 16 SPECIFICATIONS

CPU	Intel 8088, operating at 4.77MHz.
RAM	256K bytes standard; expandable to 640K bytes.
MAINBOARD	81-510-n series.
EXPANSION	Four slots. Three are used for the system, leaving one slot for user options.
DISK STORAGE	One 5-1/4 inch, double-density, double-sided, floppy disk drive providing 360K bytes of storage per diskette. One hard disk drive providing 10M bytes of storage.
KEYBOARD	Detachable, IBM compatible keyboard.
VIDEO SCREEN	Non-glare, 9-inch, green phosphor screen with a 25 row x 80 column display.
I/O CONNECTIONS	One DB-25S parallel port (for parallel devices), one DE-9S or DE-9P serial port (for serial devices), one DE-9S video port (for an external RGB monitor), one composite video connector.

## 19.1 CHASSIS

### CHASSIS HOOD REMOVAL

1. Turn off the machine.
2. Disconnect the AC power by unplugging the power cord from the wall outlet.
3. Remove the ten screws from the chassis hood; there are two on top and four on each side.
4. Remove the hood from the chassis.

### CHASSIS HOOD REPLACEMENT

1. Set the hood on the chassis so that the two holes on top of the hood are aligned with the two holes on top of the chassis.
2. Insert the two flat-head screws into the holes on top of the hood. Start them, but do not tighten them yet.
3. Insert the eight round-head screws, four on each side, and start them.
4. Tighten each screw securely.

## 19.2 SYSTEM BOARDS

The KAYPRO 16 includes a mainboard and three cards as the standard system.

The mainboard is socketed for 512K bytes of RAM, one half is populated and one half is left open for expansion. The mainboard contains the video decoder circuitry which decodes RGB into 16 grey levels of monochrome. Also on the mainboard is the interface between the bus and the WD1002 disk controller board.

Three cards are standard in the expansion chassis, leaving one slot open for an optional card.

The processor card contains the keyboard interface circuitry, the 8237A-5 DMA, the 8253-5 Timer, the 8255A Programmable Peripheral Interface, the 8259A Programmable Interrupt Controller, the 8288 Bus Controller and the 8284A Clock Generator. The processor card is also socketed for an Intel 8087 Numeric Data Co-Processor. The numeric co-processor is an option, therefore the socket is not populated.

The floppy-RAM-I/O card consists of the NEC uPD765 floppy disk controller, additional RAM sockets, and the I/O interfaces. There are two I/O connectors on this card, one is a DB-25S (parallel) and one is either a DE-9S or DE-9P (serial). The KAYPRO 16 uses the DB-25S connector for its parallel interface with peripherals. The DE-9S or DE-9P serial connector provides the interface for serial devices such as modems, plotters, or serial printers.

The color graphics card supplies the interface for an external RGB monitor through its DE-9S connector. There is also a connector for composite video on this card. Both of these connectors use industry standard cables.

## IC LIST, KAYPRO 16

Reference Designation		Description
<b>Mainboard, 81-511</b>		
U1 - U36	6665-AP15	64K x 1, 150ns dynamic RAM
U73, U95, U104	SN74LS244N	Tri octal buffer
U74, U90	74LS245	Tri octal transceiver
U77, U103	74LS74	Dual "D" flip flop
U78, U89, U92	74LS08	Quad AND gate
U79, U100	74LS00	Quad NAND gates
U80	74LS32	Quad OR gate
U81, U97, U101	74LS04	Hex inverter
U82, U96	74LS30	Eight-input NAND gate
U83	7406	Hex inverter buffer/driver
U84, U85	74S734N	Memory driver
U86, U93	74LS138N	Decoder/demultiplexer
U90	74S280	Parity generator/checker
U91	2764-25	EPROM
U98	74LS156	Decoder/demultiplexer
U102	74LS02	Quad NOR gate
<b>Floppy-RAM-I/O Card, 81-515</b>		
U29	74LS155	Decoder/demultiplexer
U30, U34, U37	74LS240	Octal inverter buffer
U31, U47	74LS174	Hex "D" flip-flop
U32	74LS125	Quad tri buffer
U33	MC1488	Quad line driver
U35	74LS175	Quad SCHMITT transceiver
U36	PAL16R6A	Programmable array logic
<b>Color Graphics Card, 81-517</b>		
U1, U13	74LS10	Triple 3-input NAND gate
U2, U18	74LS86	Quad exclusive-OR gate
U3	74LS51	AND-OR-Invert gate
U4, U52	74LS32	Quad 2-input OR gate
U5	74LS157	Multiplexer
U6	74LS02	Quad 2-input NOR gate
U8, U29	74LS164	Shift register
U9, U66	74LS00	Quad 2-input NAND gate
U10	74LS151	Multiplexer
U11, U30	74S174	Hex "D" flip-flop
U12	74LS08	Quad 2-input AND gate
U14, U15, U54	74LS04	Hex inverter
U16	74LS125	Quad tri-state buffer
U17, U53	74LS74	Dual "D" flip-flop
U19, U34, U39, U51, U63	SN74LS244N	Tri octal buffer
U20, U21, U26, U31	74S74N	Dual "D" flip-flop
U22, U32	74LS153	Multiplexer
U23, U25, U33, U55	74LS174	Hex "D" flip-flop

### Color Graphics Card, 81-517, con't.

U27, U41	74S00	Quad 2-input NAND gate
U28	74LS138N	Decoder/demultiplexer
U29	74LS393	Binary ripple counter
U35, U36, U45, U46, U49, U50, U61, U62	6665-AP15	64K x 1, 150ns dynamic RAM
U37, U44, U47, U48	74LS374	Octal "D" flip-flop
U40	6331	PROM
U42, U43, U59	SN74LS166N	Shift register
U56	74S163	Binary counter
U57	74S04	Hex inverter
U58	2732	EPROM
U60	74LS273	Octal "D" flip-flop
U64, U65	74LS30	8-input NAND gate
U67	74LS245	Octal transceiver

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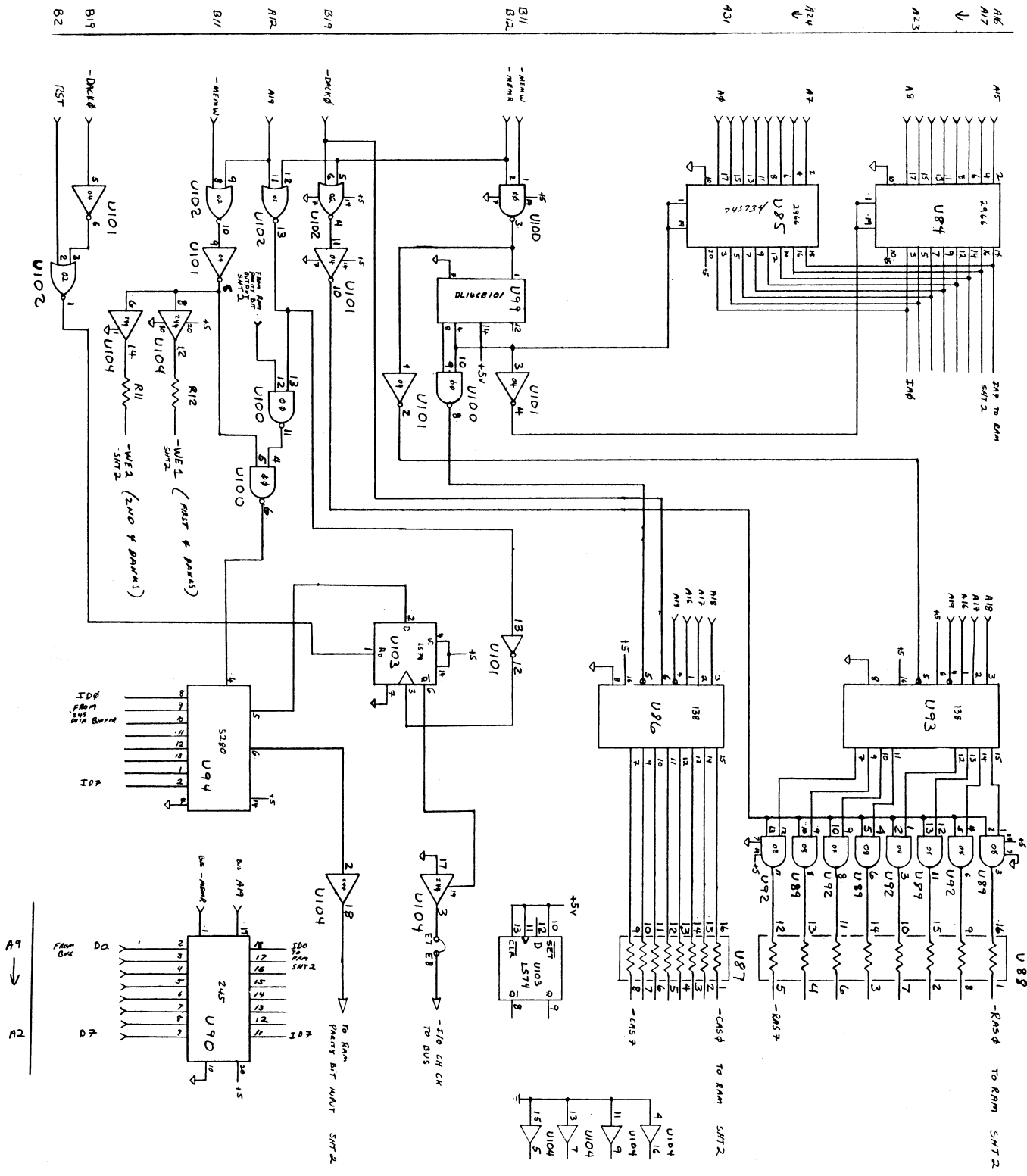
### Processor Card, 81-513

U1	74LS322A	8-bit shift register
U2	8255	Programmable peripheral interface
U3	2764-25	EPROM
U4	8237A-5	DMA controller
U6	74LS670	Register file
U7	74LS125	Quad tri buffer
U8, U17, U30	74LS74	Dual "D" flip-flop
U9, U27	74LS175	Quad "D" flip-flop
U10	8253-5	Programmable interval timer
U11, U16, U24, U25	74LS373	Octal latch
U12, U18, U22	SN74LS244N	Octal buffer
U13	8259A	Programmable interrupt controller
U14	8088	CPU
U15	8288	Bus controller
U19	74LS37	Quad NAND buffer
U20	74LS04	Hex inverter
U21	74LS32	Quad OR gate
U23, U26	74LS245	Octal transceiver
U28	74LS138N	Decoder/demultiplexer
U29	81-485	Programmable array logic
U31	74LS243	Quad transceiver
U32	81-484	Programmable array logic
U33	8284A	Clock generator/driver

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**SCHEMATICS: MAINBOARD**

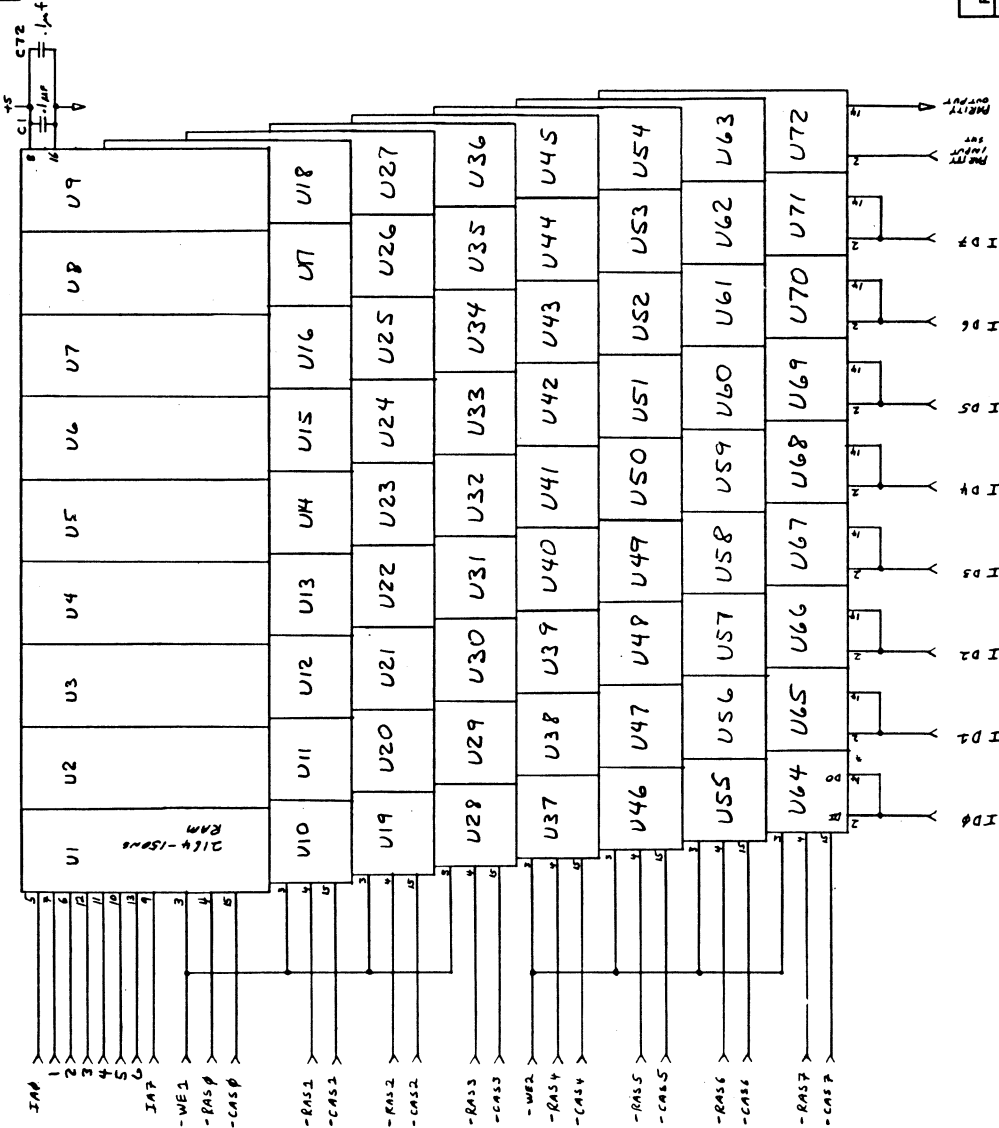


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS FRACTIONS SURFACE FINISHES DIMENSIONS DO NOT RELEASE DATE	DESIGNED BY: <b>H. BONE</b> CHECKED BY: <b>10-22-79</b> MATERIAL: <b>PPH</b> FINISH:	NATIONAL INVERTER SYSTEMS, INC. DEL MAR, CALIF. 92028 <b>SCHEMATIC, RAM SECTION</b> MAIN BOARD KAYPRO 16 33576 C 81-511 2A
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REVISION	DESCRIPTION	DATE	APPROVED
A	ALL SECTIONS OF U103 & U104. MOVED COM. FROM U99-12 TO U99-4. ADDED UNUSED	11-28-79	RWS

# SCHEMATICS: MAINBOARD

REVISIONS		DATE	APPROVED
ZONE	LTR. EFFECT.		



**PARTS COUNT**  
 72 - 2164A-150MS  
 72 - 10ur CAPS

**NOTES:**

- IA0-IA7 ARE COMMON TO ALL RAM CHIPS
- POWER + GROUND PINS 8+16 ARE COMMON TO ALL CHIPS
- DATA INPUT + OUTPUT LINES, PINS 2+14, ARE COMMON TO ALL CHIPS ON A VERTICAL ROW

QTY. REQD.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

<b>NON-LINEAR SYSTEMS, INC.</b> DEL MAR, CALIFORNIA	
<b>SCHEMATIC MEMORY SECTION</b> <b>MAIN BOARD</b>	
SIZE CODE IDENT. NO. <b>C 03626</b>	81-511
KAYPRO 16	
SCALE	SHEET 2.B

CONTR. NO.	UNLESS OTHERWISE SPECIFIED
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	TOLERANCES ON
	DECIMALS ± .010
	ANGLES ± 0° 30'
	FRACTIONS ± 1/32

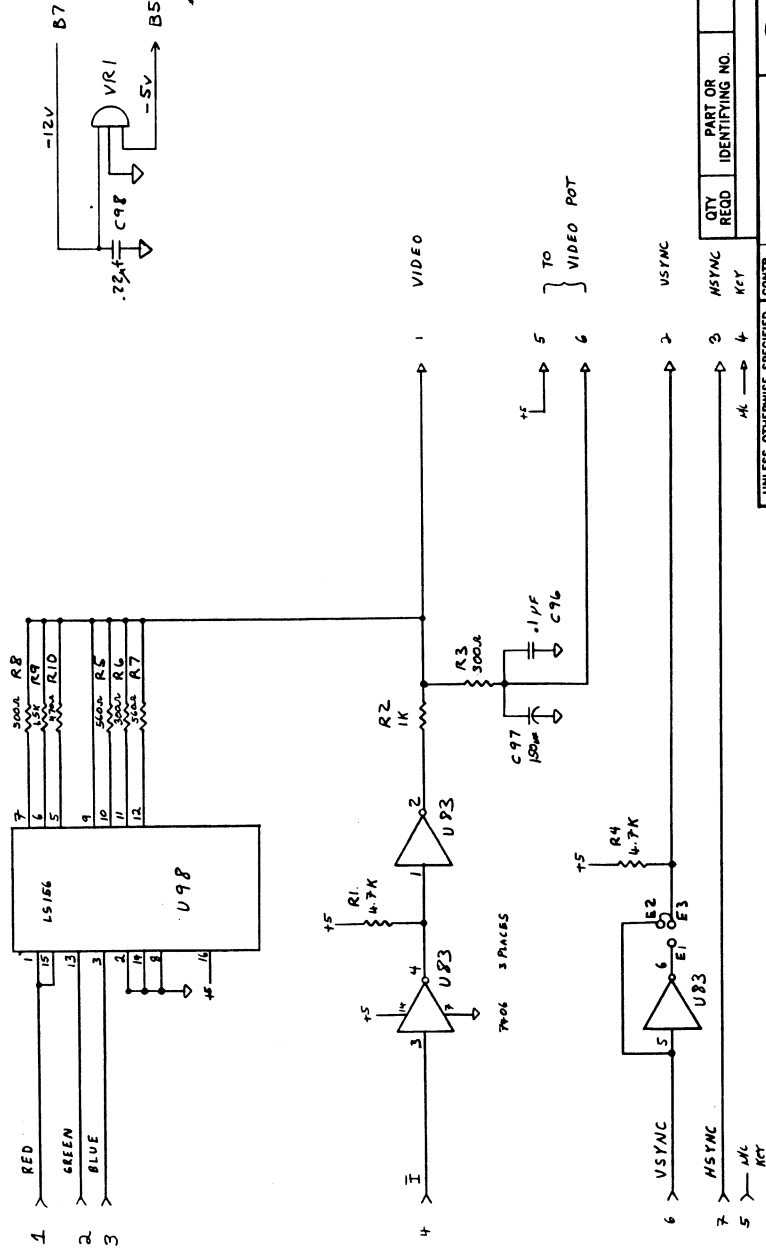
DRAWN	CHECK	APPR.	RELEASE DATE

APPLICATION	FINAL ASST.	NEXT ASST.	QTY.



**SCHEMATICS: MAINBOARD**

REVISIONS		DATE	APPROVED
ZONE	LTR. EFFECT.		



QTY	RECD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF. NO.

PARTS LIST	
NON-LINEAR SYSTEMS, INC.	
DEL MAR, CALIFORNIA	
SCHEMATIC, VIDEO SECTION	
MAIN BOARD	
KAYPRO 16	

SIZE	CODE IDENT. NO.	SCALE	WEIGHT	SHEET	ZD
C	03626			81-511	

UNLESS OTHERWISE SPECIFIED	
CONTR. NO.	
DRAWN	
CHECK	
APPR	
RELEASE DATE	

DIMENSIONS ARE IN INCHES	
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ANGLES	±0.50°
FRACTIONS	±.12

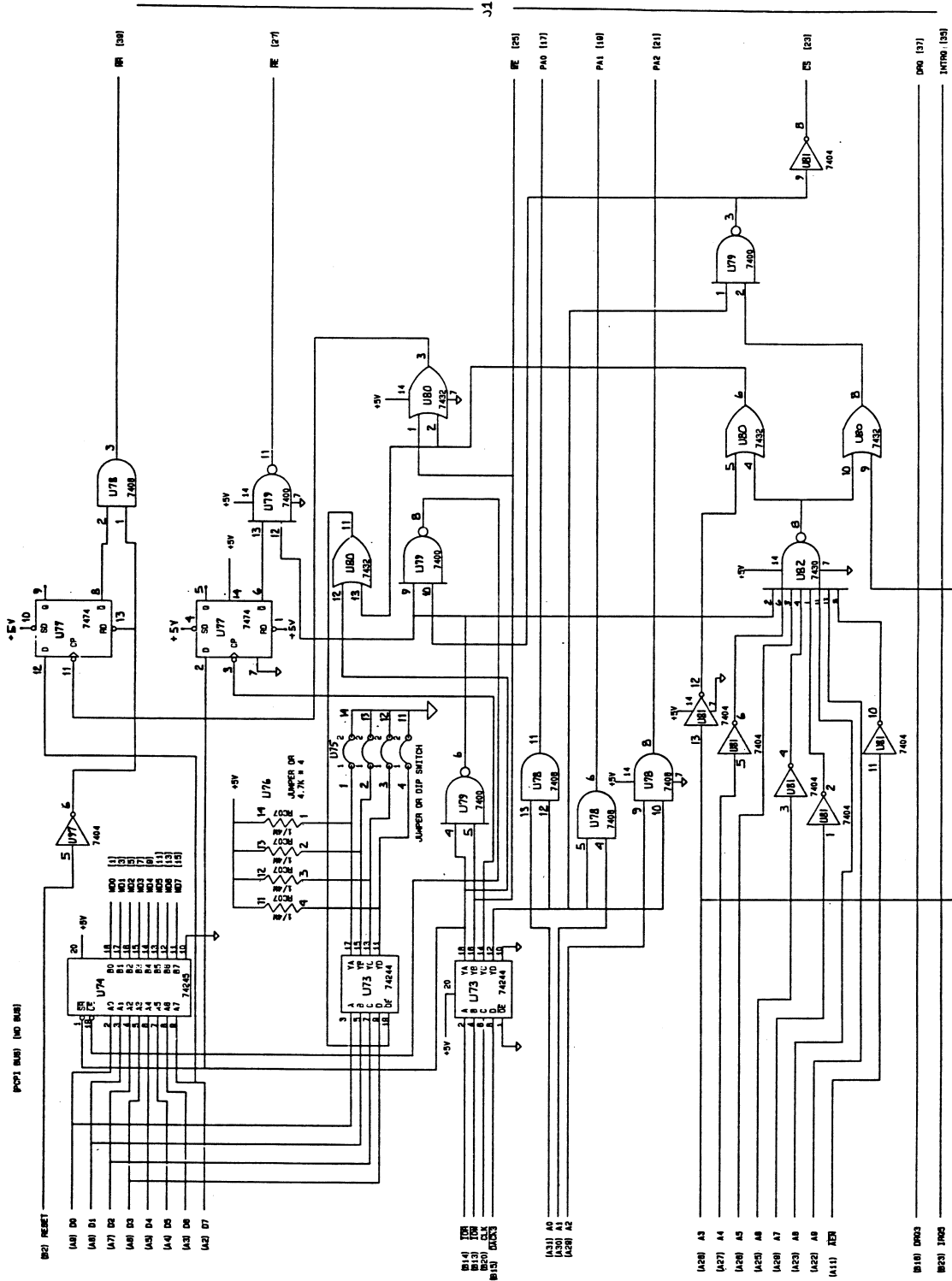
  

MATERIAL	

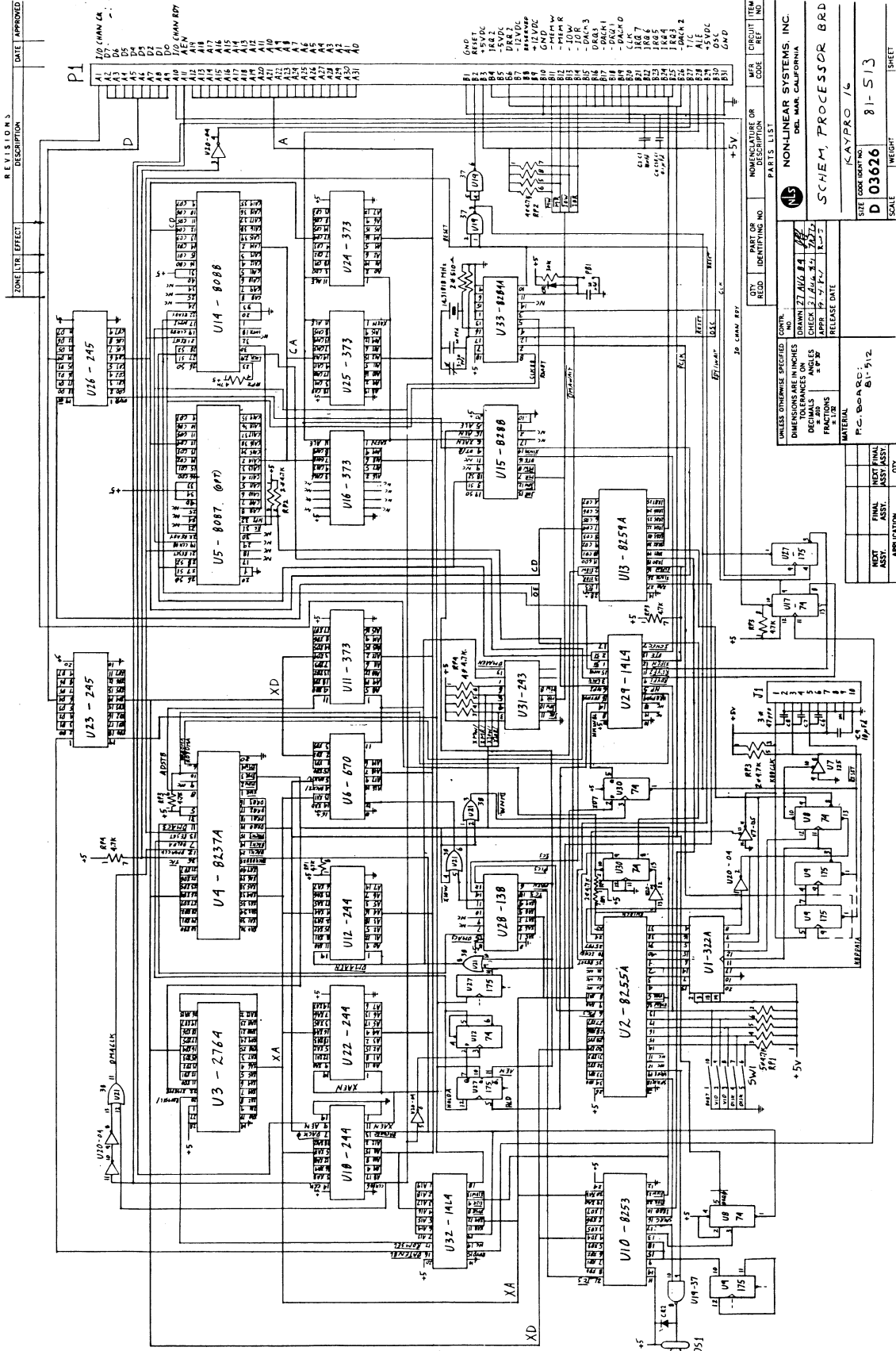
APPLICATION	QTY.

# SCHEMATICS: MAINBOARD



NON LINEAR SYSTEMS, INC. 1011 MAR, CALIFORNIA		723 M 11-13 M 1059 M	DRAPPI K. BILINSKI LIEFER J. R. LEWON ADFER # 1027 MATERIAL	723 M 11-13 M 1059 M
SCHEMATIC HARD DISK INTERFACE SECTION, MAIN BOARD KAYPRO 16		03626 D	81-511	1011 2 E
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS TOLERANCES FRACTIONS DECIMALS DIMENSIONS UNLESS OTHERWISE SPECIFIED ARE IN INCHES DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS		✓	FIGURE	

# SCHEMATICS: PROCESSOR CARD



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84	U97-8254	1	1
85	U98-8254	1	1
86	U99-8254	1	1
87	U100-8254	1	1

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DATE	BY	CHKD	APP'D	RELEASE DATE
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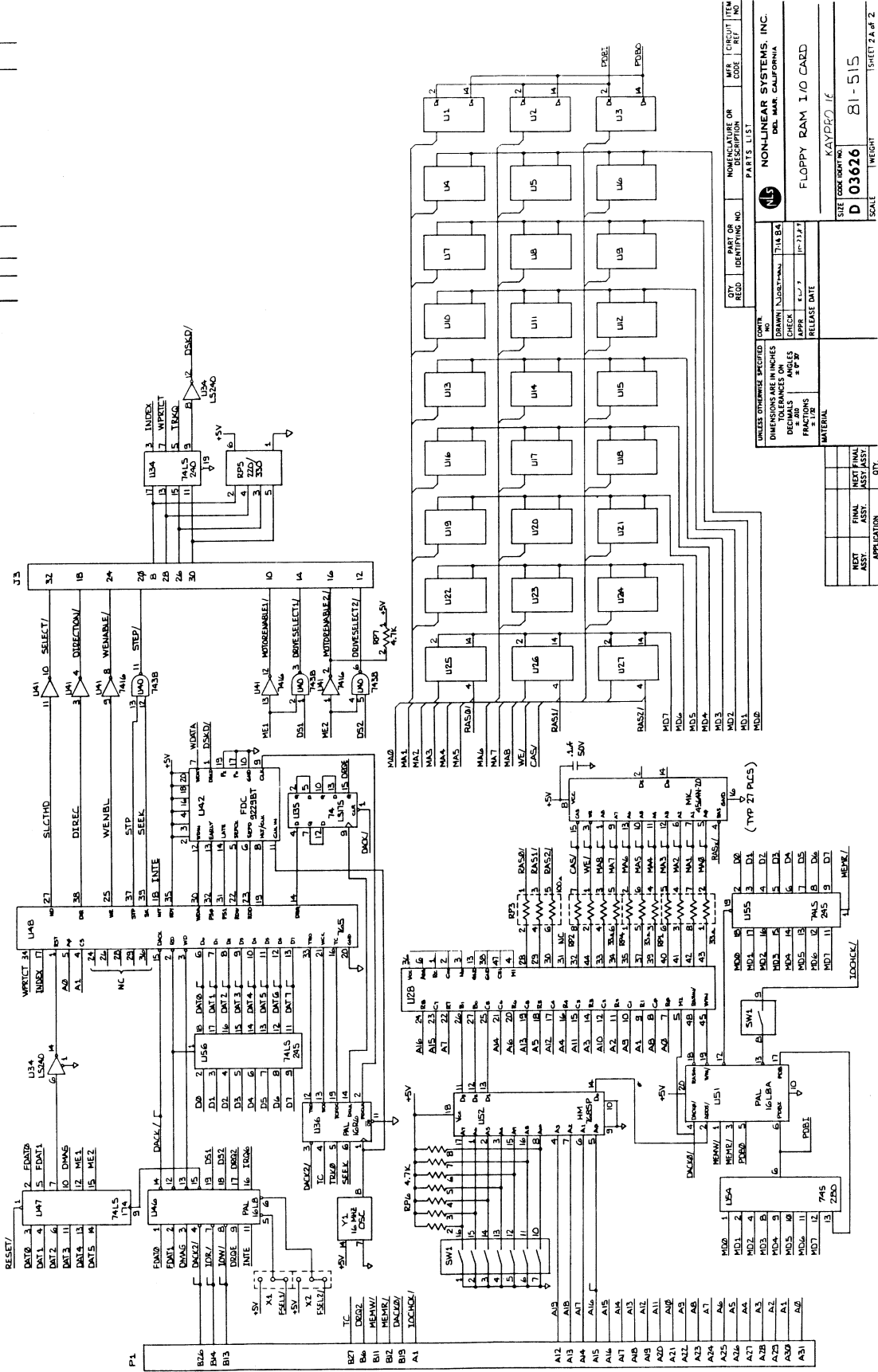
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CAPACITORS	1	CAP	
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DIODES	1	DI	
TRANSISTORS	1	TR	
RELAYS	1	REL	
CONNECTORS	1	CON	
WELDS	1	WEL	
OTHER	1	OTH	

SCALE	WEIGHT	SHEET
D 03626	81-513	

NON-LINEAR SYSTEMS, INC.  
DEL MAR, CALIFORNIA  
SCHEM. PROCESSOR BRD  
KAYPRO 16  
P.C. BOARD: 81-512  
MATERIAL: 81-512

# SCHEMATICS: FLOPPY-RAM-I/O CARD

ZONE	LT#	EFFECT	DESCRIPTION	DATE	APPROVED



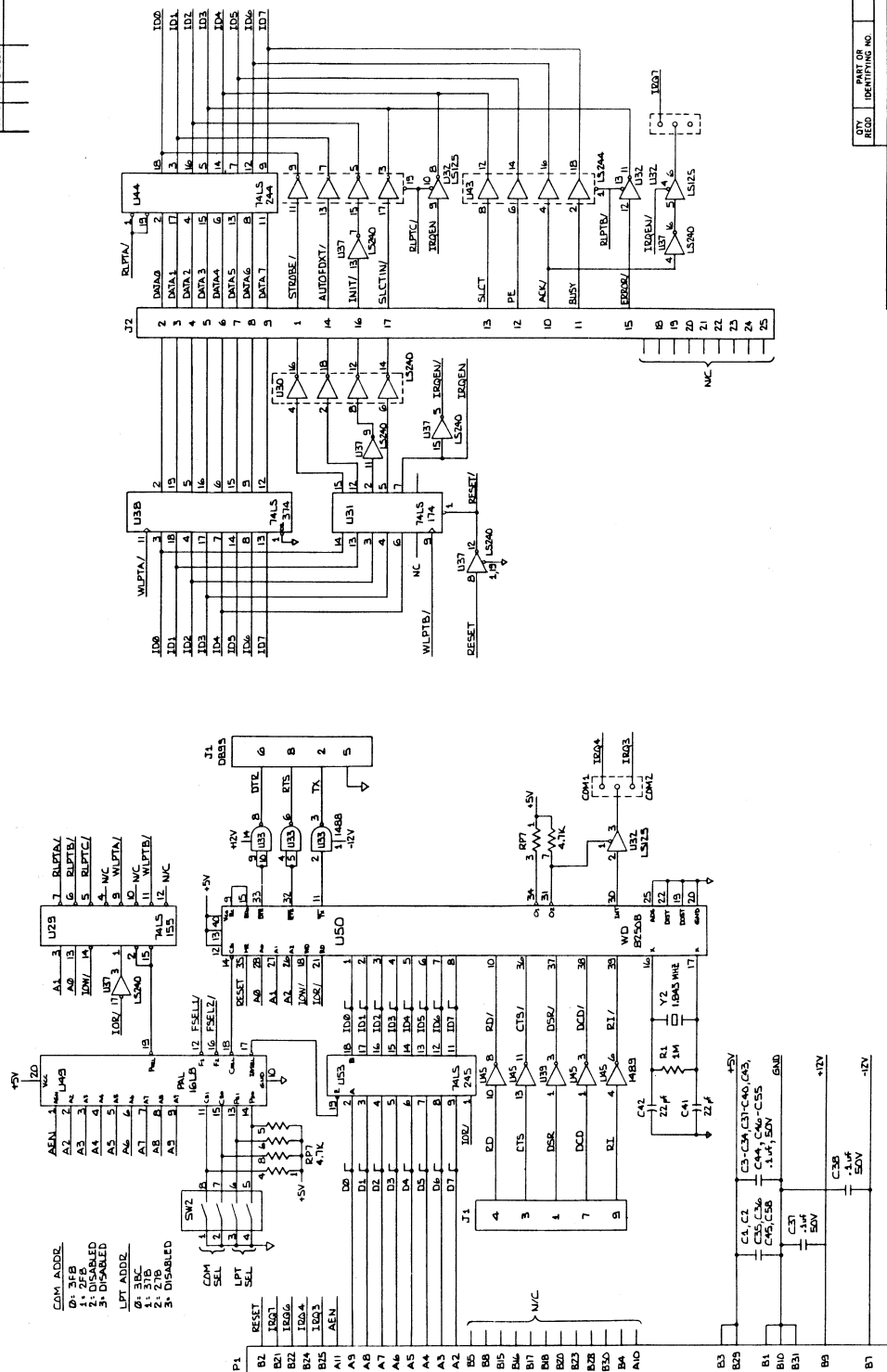
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DIMENSIONS ARE IN INCHES	7118 B4	DEL. MAR. CALIFORNIA
DECIMALS	ANGLES	FLOPPY RAM I/O CARD
FRACTIONS	RELEASE DATE	
MATERIAL		

SIZE	CODE	NO.	SCALE	WEIGHT	SHEET	OF
D	03626	81-515				

# SCHEMATICS: FLOPPY-RAM-I/O CARD

ZONE	I/O EFFECT	REVISIONS	DATE	APPROVED



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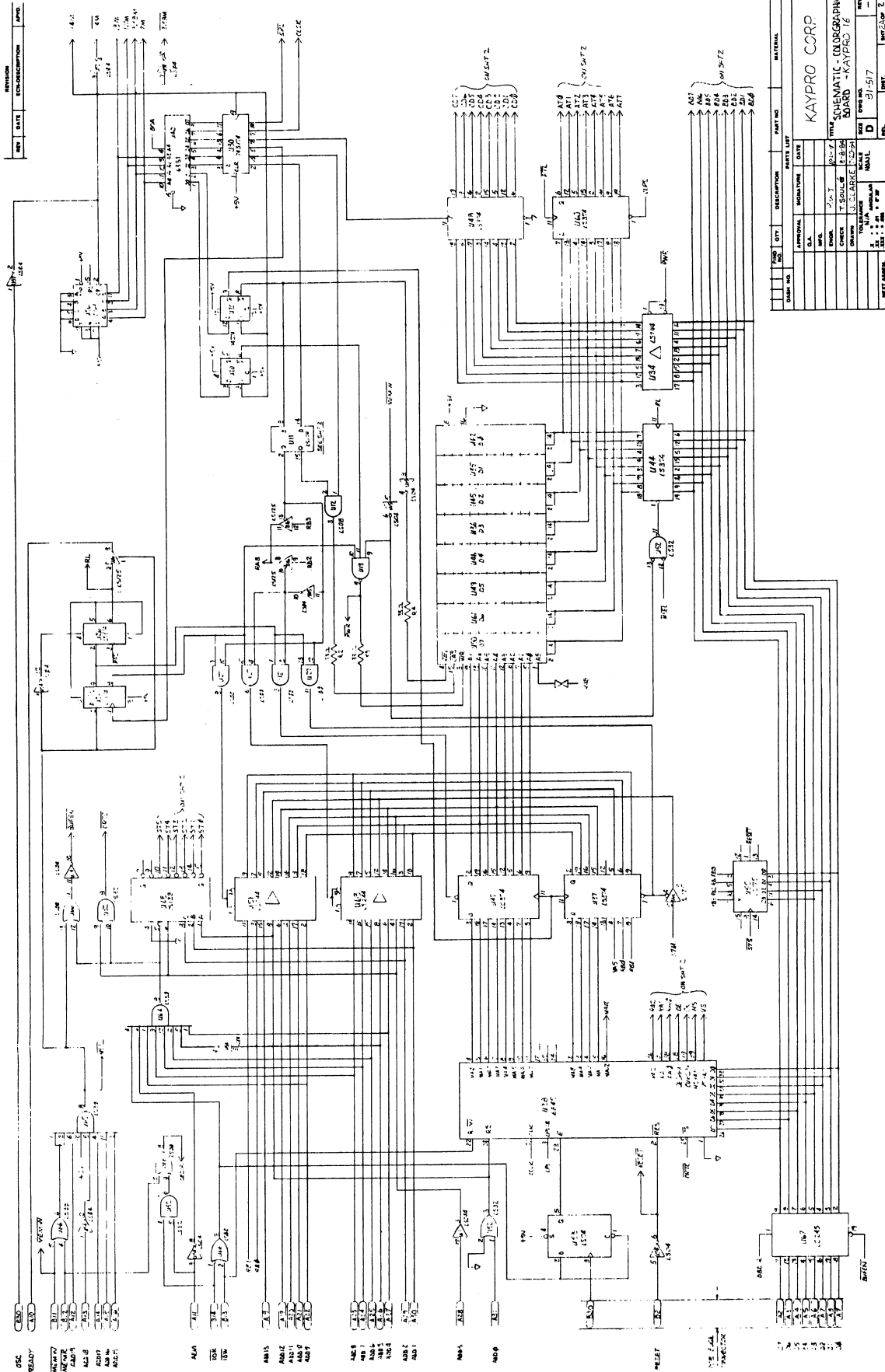
REVISION	DESCRIPTION

REVISION	DESCRIPTION	DATE	BY	APPROVED

SIZE	CODE	NO.	HEIGHT
D	03626	81-515	



# SCHEMATICS: COLOR GRAPHICS CARD



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DESIGNED		
CHECKED		
DRAWN		

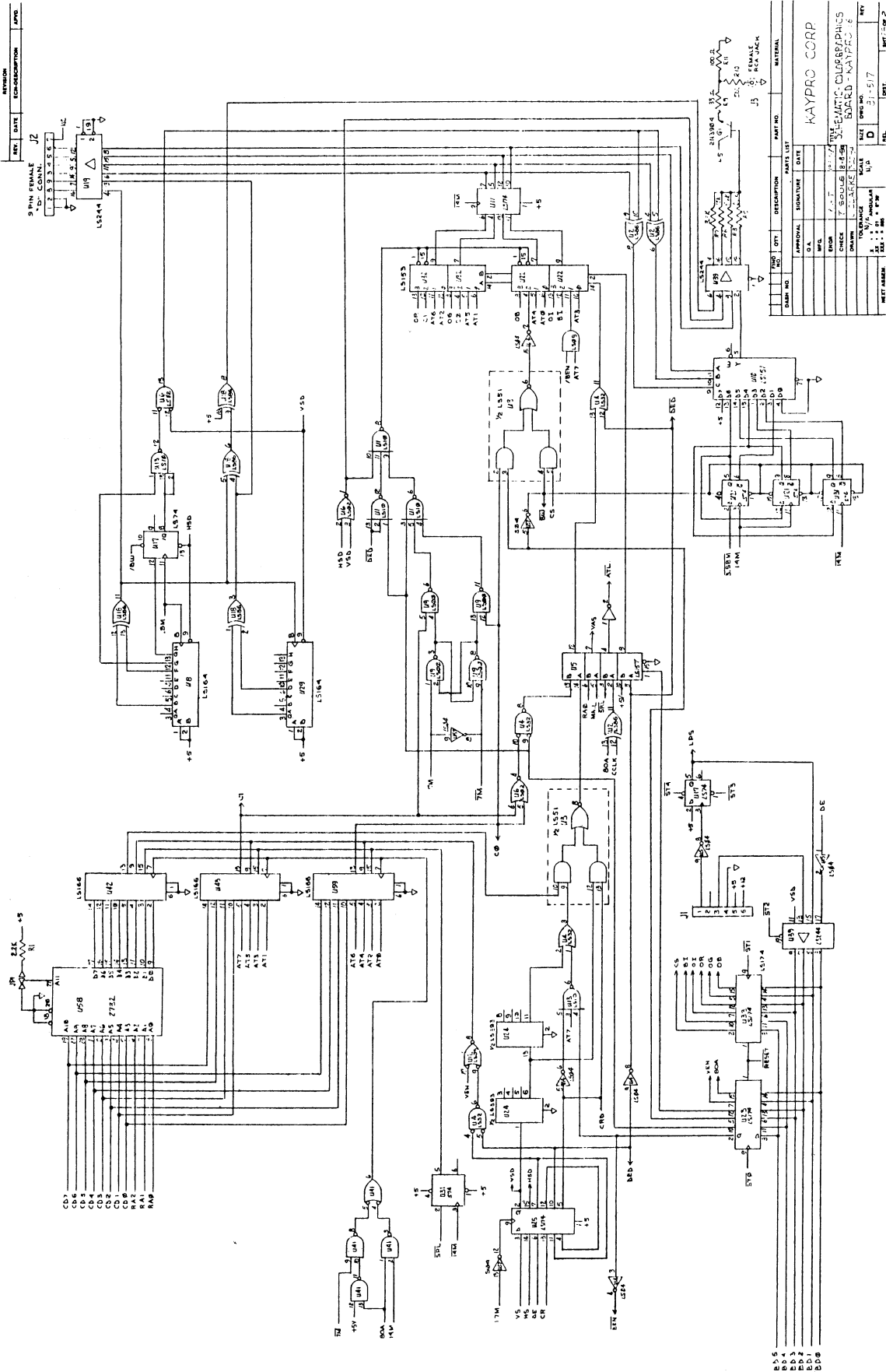
  

REV	DATE	DESCRIPTION
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REV	DATE	DESCRIPTION
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2		

# SCHEMATICS: COLOR GRAPHICS CARD



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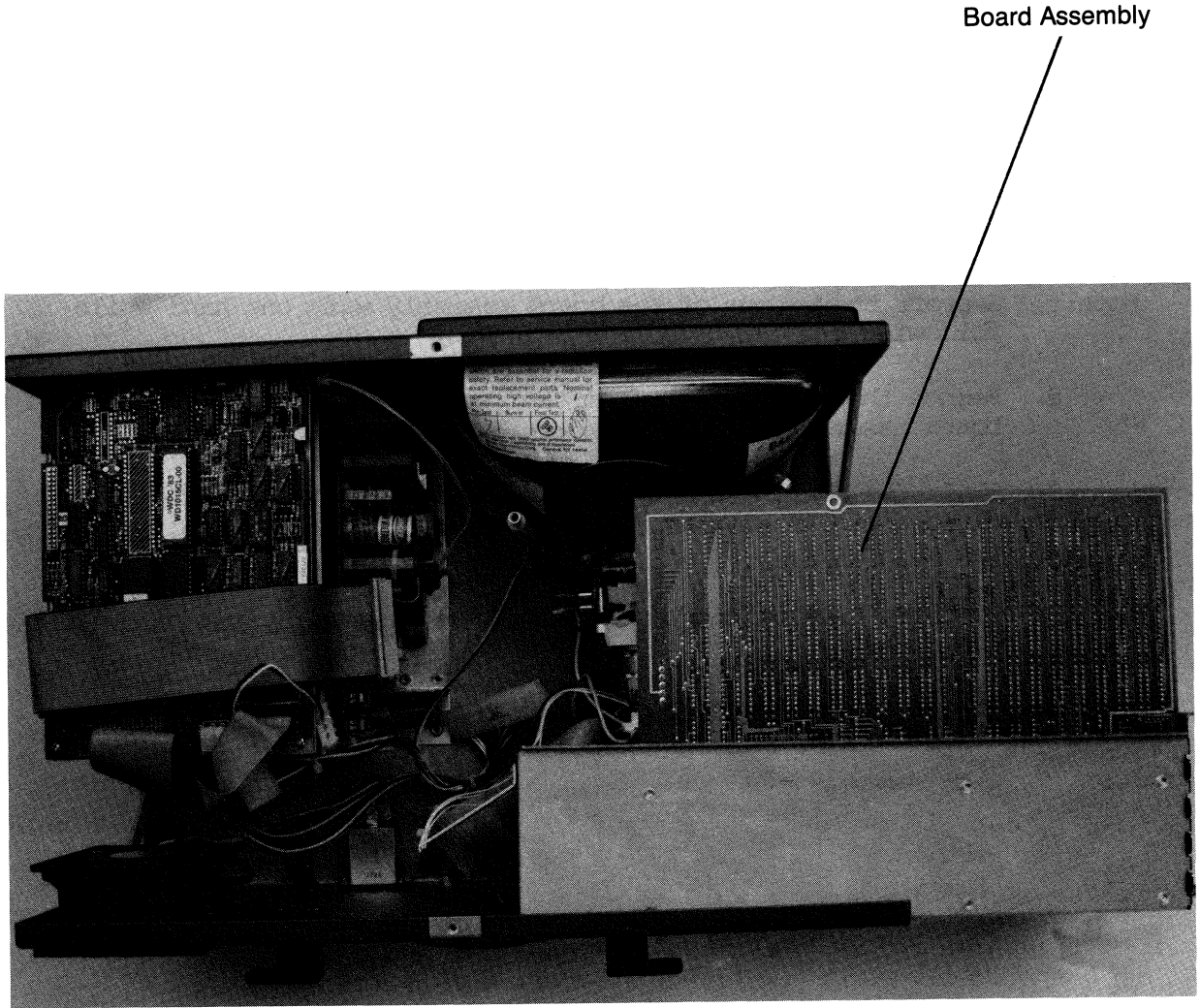


Figure 19.1  
Board Assembly Removal

## 19.23 BOARD ASSEMBLY REMOVAL

1. Remove the chassis hood (19.1).
2. Remove the screw that attaches the plastic standoff and the front, center of the mainboard.
3. Position the machine so that the rear of it is facing you.
4. Remove the two video plugs from the right side of the mainboard.
5. Remove the power connector from the disk controller board.
6. Remove the 40-pin ribbon cable from the disk controller board.
7. Remove the 34-pin ribbon cable from the floppy disk drive.

Note: Support the bottom of the board assembly with one hand while following the instructions in step 8.

8. Remove the four screws from the rear of the chassis that attach the board assembly and the computer chassis.
9. Slide the board assembly to the right about three inches and disconnect the power supply connector from the bottom, left side of the mainboard.
10. Continue sliding the board assembly to the right and remove it from the chassis.
11. Remove the keyboard connector from the processor card.

## BOARD ASSEMBLY INSTALLATION

1. With the rear of the computer facing you, set the board assembly on the rear of the machine chassis and connect the keyboard plug to the processor card. (J1 on the processor card)
2. Turn the board assembly so that the mainboard is parallel to the bottom of the machine and connect the plug from the power supply to the mainboard.
3. Position the board assembly inside the chassis so that the mounting holes are aligned with those in the rear of the machine chassis.
4. Insert two screws in the top mounting holes of the chassis, but do not tighten them yet.
5. Insert two screws in the bottom mounting holes of the chassis.
6. Tighten the four screws. (Occasionally, if two of the screws are tightened before the other two are inserted, the mounting holes won't align properly)
7. Replace the power connector on the disk controller board.
8. Replace the 40-pin ribbon cable on the disk controller board.
9. Replace the 34-pin ribbon cable on the floppy disk drive.
10. Replace the two video plugs on the side of the mainboard.
11. Replace and tighten the screw that connects the front of the mainboard and the plastic standoff.

## 19.24 CARD REMOVAL

1. Remove the chassis hood (19.1).
2. Remove the board assembly (19.23).
3. Refer to figure 19.13.
4. Position the board assembly so that the mainboard is parallel to the work surface and the component side of the board is face up.

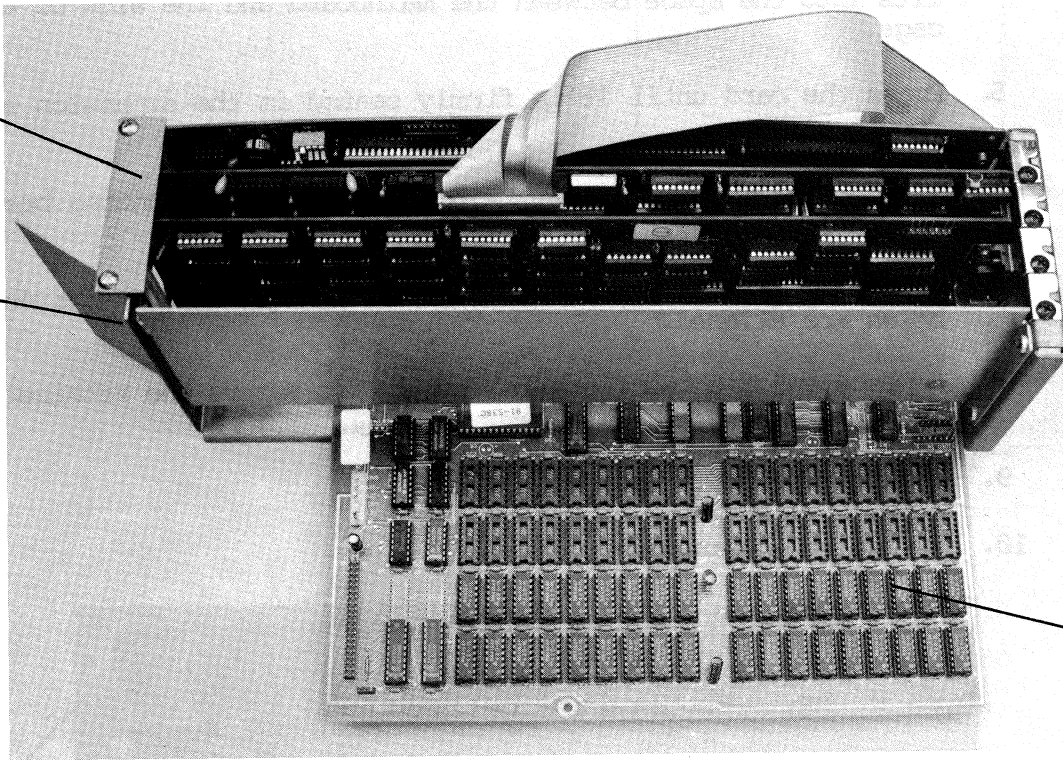
**Note:** The board assembly should now be in this position: The I/O connectors are on the right side of the board assembly and the air-flow louver is on the left side. The top, right side of the card cage has four screws. Three of these screws each hold a card in place and one holds a spacer for an optional card. The top, left side of the card cage has a retainer plate secured with two screws.

The cards are in this order in the slots:

- A. Empty space for optional card. (This should be closest to you)
  - B. Color Graphics card.
  - C. Floppy-RAM-I/O card.
  - D. Processor card. (This should be farthest from you)
5. Remove the two screws that secure the retainer plate to the card cage. (Top left side of the card cage)
  6. Remove the screw that secures the card being replaced. (Top right side of card cage)
  7. Remove the card from the card cage by sliding it upward until the edge connector is separated from the expansion slot receptacle and the card is out of the card cage.

Retainer Plate

Air-flow Louver



Mainboard

Figure 19.13  
Board Assembly

## CARD INSTALLATION

1. Refer to figure 19.13.
2. Position the card above the card cage so that the edge connector is above the expansion slot receptacle.
3. Refer to figure 19.2.
4. Lower the card into the card cage so that the mounting bracket tab fits into the space between the mainboard and the side of the card cage.
5. Press the card until it is firmly seated in the expansion slot receptacle.
6. Replace and tighten the screw that secures the mounting bracket and the card cage.
7. Position the retainer plate on the card cage so that the mounting holes are aligned.
8. Replace and tighten the two screws that secure the retainer plate and the card cage.
9. Replace the board assembly (19.23).
10. Replace the chassis hood (19.1).

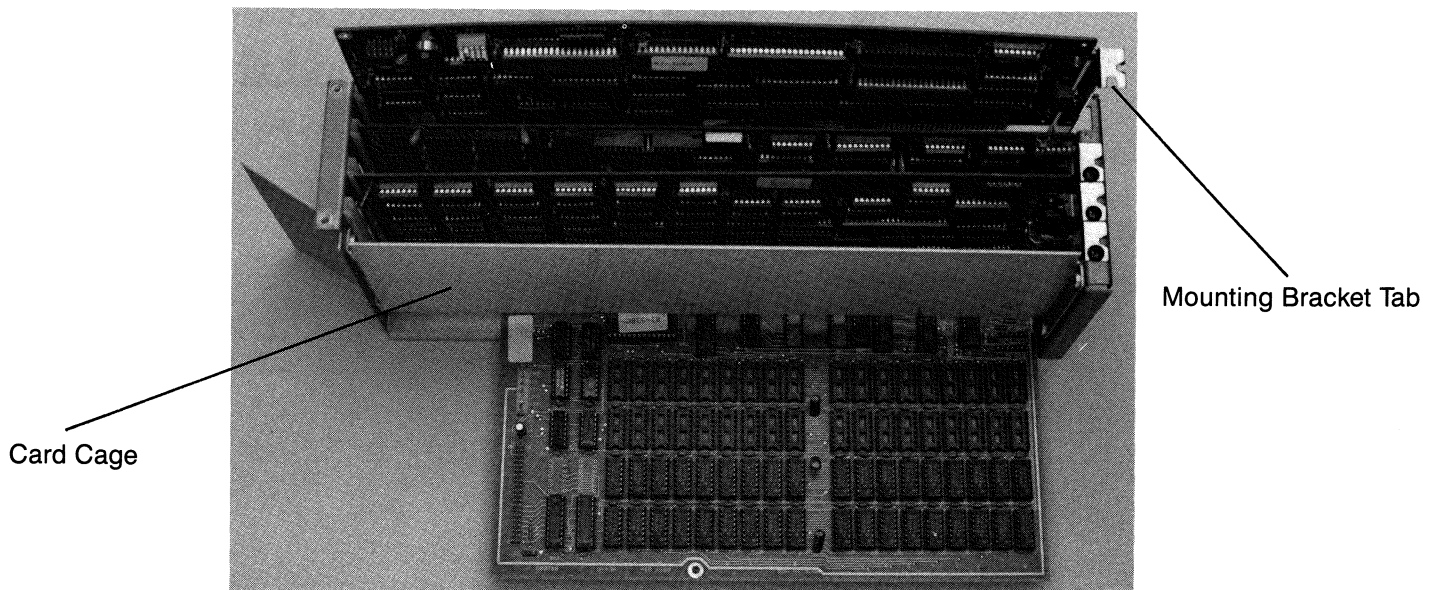


Figure 19.2  
Board Assembly



## **19.25 MAINBOARD REMOVAL**

1. Remove the chassis hood (19.1).
2. Remove the board assembly (19.23).
3. Remove the three cards from the card cage (19.24).
4. Remove the six screws that secure the mainboard to the card cage.
5. Slide the mainboard out of the card cage.

## **MAINBOARD INSTALLATION**

1. Slide the mainboard into the card cage and position it so that the mounting holes in the board are aligned with the standoffs on the cage.
2. Insert six screws into the mounting holes and tighten them.
3. Replace the three cards (19.24).
4. Replace the board assembly (19.23).
5. Replace the chassis hood (19.1).

## 19.26 DISK CONTROLLER BOARD REMOVAL

1. Remove the chassis hood (19.1).
2. Position the computer so that the front is facing you.
3. Remove the three ribbon cables from the disk controller board (40 pin, 34 pin and 20 pin).
4. Remove the power connector from the disk controller board.
5. Remove the three screws that secure the disk controller board to the drive shield. Notice that the front left corner of the disk controller board is not secured; instead, there is a black plastic screw inserted in the standoff; this screw should not be removed.
6. Remove the disk controller board.

## DISK CONTROLLER BOARD INSTALLATION

1. Position the disk controller board so that the mounting holes in the board are aligned with the standoffs on the drive shield.
2. Insert screws in three of the mounting holes and tighten them.
3. Replace the three ribbon cables (40 pin on J5, 34 pin on J7 and 20 pin on J2).
4. Replace the power connector.
5. Replace the chassis hood (19.1).

### 19.3 CRT ASSEMBLY

#### ADJUSTMENTS

The KAYPRO 16 uses a CRT assembly produced by Elston Electronics Corp. Even though other models of Kaypro computers use CRT assemblies made by Elston, they are not interchangeable, since the circuitry on the video board is different.

The adjustment points on the KAYPRO 16 video board are in the same position as those on the Elston CRT used in other Kaypro computers.

Refer to pages 7--1 and 7--2 in the Kaypro Technical Manual for adjustment procedures of this CRT assembly. The figure (7.2, Elston video board) on page 7--1 should be used to reference the adjustment points on the video board.

### 19.33 CRT REMOVAL

1. Remove the chassis hood (19.1).
2. Remove the board assembly (19.23).
3. With the rear of the computer facing you, remove the diagonal brace on the front, right side.
4. Position the computer so that the left side (the side with the drives) is on the work surface.
5. Remove three of the four screws that secure the video board and the bottom of the chassis (the black screws on the outside of the chassis).
6. Support the video board as the last screw is removed.
7. Position the computer so that the bottom is on the work surface.
8. Remove the video connector from the rear of the video board.
9. Remove the bottom two screws that attach the CRT to the front of the chassis.
10. Support the bottom of the CRT and remove the top two screws from the chassis.
11. Remove the CRT assembly from the chassis.

## CRT ASSEMBLY INSTALLATION

Note: Before starting with CRT installation, check to see if there are small plastic standoffs attached to the bottom of the video board. If not, use the ones from the old board.

1. Position the CRT assembly in the chassis so that the mounting holes on the front of the CRT are aligned with those on the chassis.
2. Support the bottom of the CRT and insert two screws in the top mounting holes. Partially tighten these screws.
3. Insert two screws in the bottom mounting holes of the CRT. Tighten these.
4. Tighten the top two screws completely.
5. Support the video board while positioning the computer so that the left side (the side with the drives) is on the work surface.
6. Insert four screws in the mounting holes on the chassis and into the standoffs on the bottom of the video board. Tighten these.
7. Position the computer so that the bottom is on the work surface.
8. Replace the video connector on the rear of the video board.
9. Replace the board assembly (19.23).
10. Replace the chassis hood (19.1).

#### 19.4 POWER SUPPLY

The power supply used in the KAYPRO 16 is an 85 Watt switching type made by either Boschert or Calif D.C. These power supplies are not interchangeable with the power supplies used in other models of KAYPRO computers.

Two fuses are associated with each computer. F1 (2A, 250 VAC) is located on the rear of the chassis and is accessible from outside the computer. The other fuse is located on the power supply board. The Boschert uses a 3A, 250VAC and the Calif D.C. uses a 5A, 250VAC fuse. If it's necessary to change a fuse, make sure the new one is the same size as the one being replaced and that the AC power has been disconnected from the computer. Use of a fuse replacement tool is recommended when changing the fuse on the power supply board due to the difficulty of reaching this component.

There are no authorized dealer repairs on any power supplies. The ONLY authorized dealer service to power supplies is 220V configuration.

## 220V CONFIGURATION

### Boschert Power Supply

Identified by the name "Boschert" on the component side of the board.

Locate the four-inch wire jumper that is soldered to point JP1. For 110V configuration the other end of the wire is attached to point E1.

For 220V configuration, remove the wire from point E1 and attach it to point E2. The wire jumper now connects point JP1 and point E2, and the power supply is configured for 220V use.

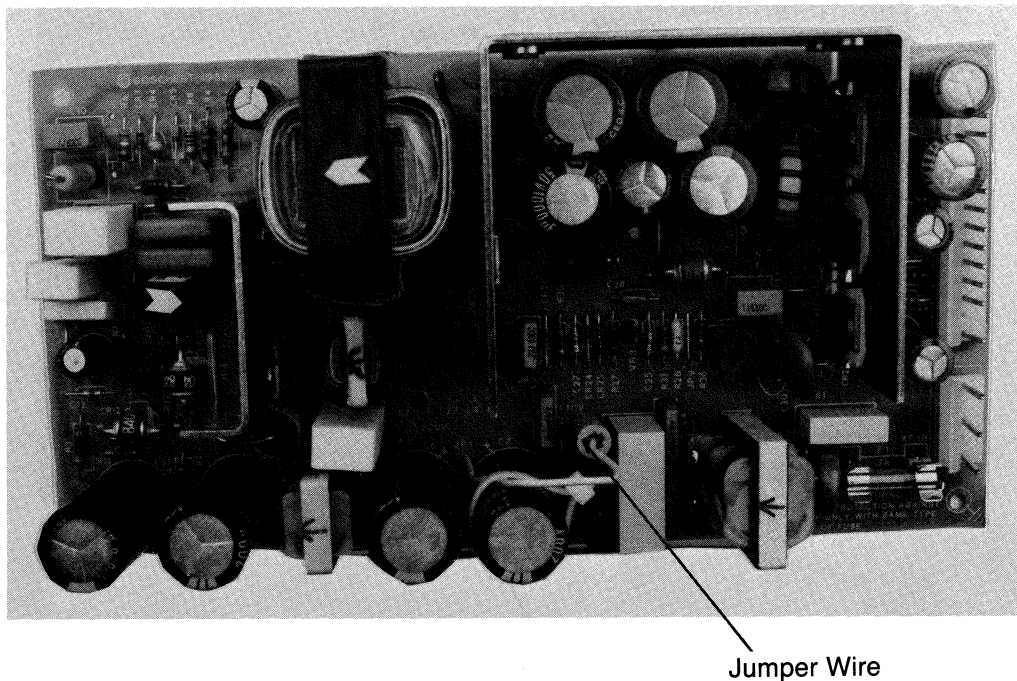


Figure 19.23  
Boschert Power Supply

## 220V CONFIGURATION

### Calif D.C. Power Supply

Identified by the name "Calif D.C." on the component side of the board.

Locate a jumper block labeled 115VAC and 230VAC. With the jumper in the 115VAC position, the power supply is configured for 110V.

For 220V use, remove the jumper from the socket labeled 115VAC and place it in the socket labeled 230VAC. The power supply is now configured for 220V use.

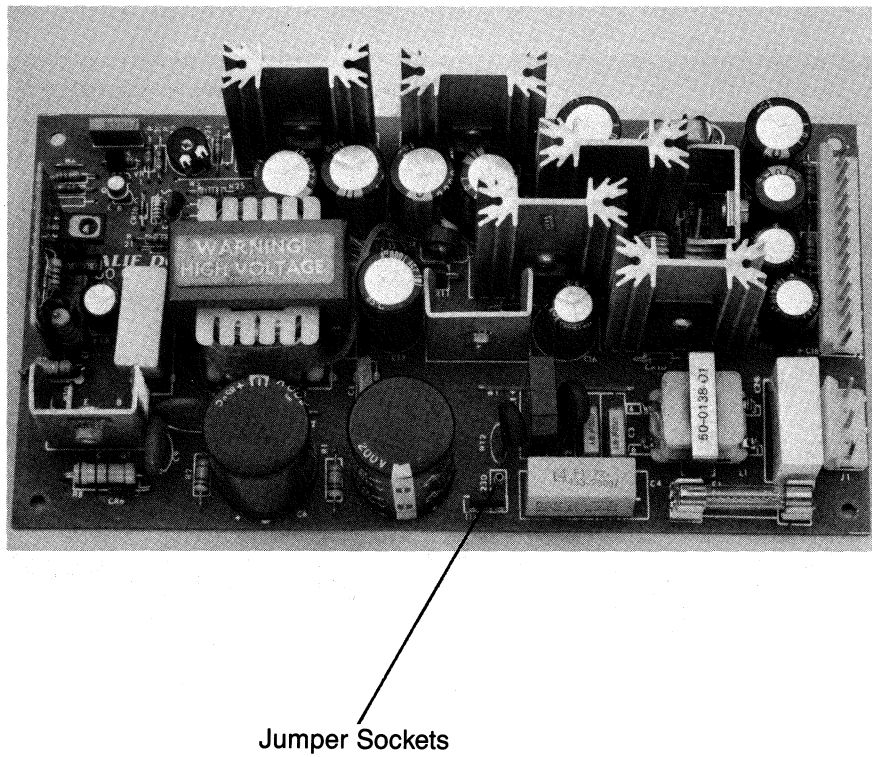


Figure 19.3  
Calif D.C. Power Supply



### **19.43 POWER SUPPLY REMOVAL**

1. Remove the chassis hood (19.1).
2. Remove the board assembly (19.23).
3. Position the computer so that the rear of it is facing you.
4. Set the computer so that the left side (the side with the drives) is on the work surface.
5. From outside the chassis, remove the four screws that connect the power supply shield and the bottom of the chassis.
6. Remove the power plug from the power supply.
7. Remove the power supply (with the shield still attached) from the chassis.
8. Remove the five screws that connect the power supply and the power supply shield.
9. Refer to figure 19.33.
10. Remove the power supply from the shield by depressing the sides of the four plastic standoffs and lifting the power supply off the shield.

### **POWER SUPPLY INSTALLATION**

1. Position the power supply on the power supply shield so that the mounting holes on the power supply are aligned with the standoffs on the shield.
2. Press the power supply onto the shield with even pressure until the power supply is firmly seated on the shield.
3. Replace the five screws that attach the power supply and the shield.
4. Set the power supply (with the shield attached) in the chassis so that the mounting holes in the bottom of the shield are aligned with the mounting holes in the bottom of the chassis.
5. Insert four screws through the bottom of the chassis and into the mounting holes of the shield.
6. Tighten the screws securely.
7. Replace the power connector.
8. Replace the board assembly (19.23).
9. Replace the chassis hood (19.1).

Plastic Standoff

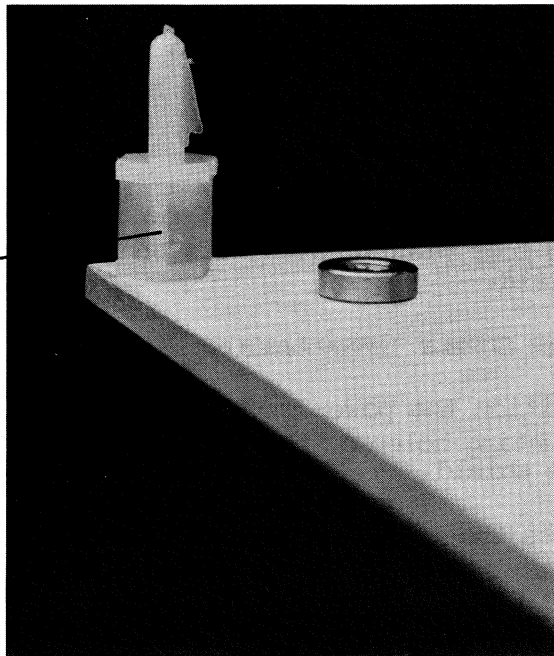


Figure 19.33  
Plastic Standoff

## 19.5 DISKETTE DRIVES

The KAYPRO 16 comes equipped with one of four brands of diskette drive; Epson, Shugart, Tokyo Electric, or Toshiba. These drives are all functionally the same as the drives used in other models of Kaypro computers.

Illustrations of the different drives are on pages 9--2 and 9--3 of the Technical Manual and should be used for reference.

All of the diskette drives used in the KAYPRO 16 are jumpered the same as the drives used for the B drive in other models of Kaypro computers. Refer to the diagrams on pages 9--5 through 9--8 of the Technical Manual and use the instructions for jumpering the B drive.

### 19.53 DISKETTE DRIVE REMOVAL

Note: The diskette drive and the hard disk drive are both housed in a single drive shield, making it necessary to remove both drives and the shield as one unit. The shield is composed of several individual pieces; figures 19.4 and 19.43 should be used for reference.

1. Remove the chassis hood (19.1).
2. Remove the board assembly (19.23).
3. Remove the disk controller board (19.26).
4. Remove the 34-pin ribbon cable, the power plug and the ground wire from the diskette drive.
5. Remove the 2 ribbon cables, the power plug, and the ground wire from the hard disk drive.
6. Remove the wire from the 10MB LED (gently pull it away from the LED).
7. Position the computer so that the rear of it is on the work surface and the bottom is facing you.
8. Remove the top three screws that secure the drive shield and the chassis.
9. Support the drives while removing the bottom three screws that secure the drive shield and the chassis.
10. Remove the drive assembly unit from the chassis.

Note: To remove the diskette drive from the drive shield unit, six screws need to be removed. Two on top of the shield, two on the side and two on the bottom.

11. Remove the two screws that attach the top of the drive and the drive shield. Refer to figure 19.4.
12. Remove the two screws on the side of the drive shield. Refer to figure 19.4.
13. Remove the two screws that attach the bottom of the drive and the drive shield.

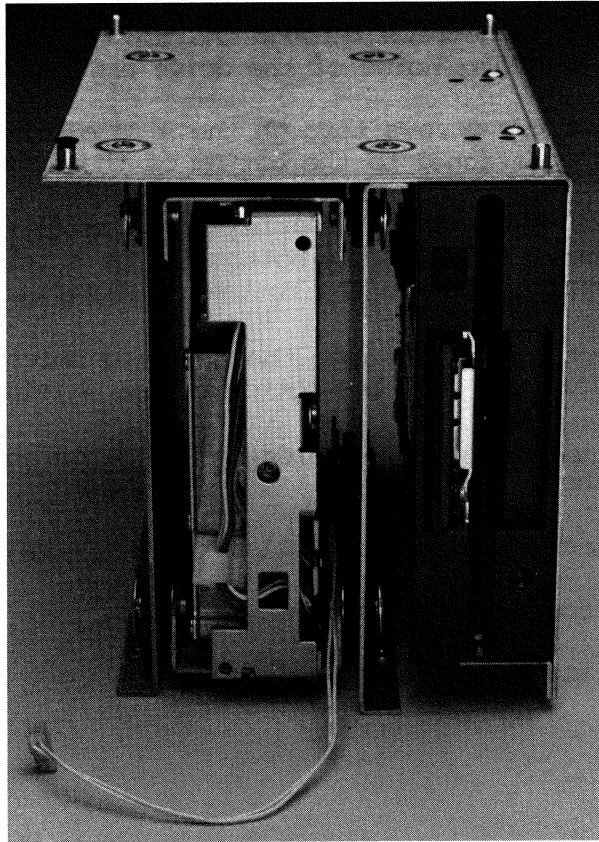


Figure 19.4  
Drive Assembly Unit

## DISKETTE DRIVE INSTALLATION

Note: Before installing a diskette drive, check to see if it's jumpered correctly.

1. Position the drive so that the drive shield and the mounting holes in the bottom of the drive are aligned.
2. Insert two screws through the shield and into the mounting holes and tighten securely.
3. Insert two screws through the top of the drive shield and into the top mounting holes of the drive and tighten.
4. Insert two screws through the side of the shield and into the shield that's attached to the bottom of the drive.
5. Position the drive assembly unit inside the chassis so that the mounting holes in the bottom of the shield are aligned with the mounting holes in the bottom of the chassis.
6. Insert six screws into the mounting holes on the bottom of the chassis and into the bottom of the shield. Tighten these securely.
7. Replace the ribbon cables, power plugs and the ground wires on the rear of the drives.
8. Replace the disk controller board (19.26).
9. Replace the board assembly (19.23).
10. Replace the chassis hood (19.1).

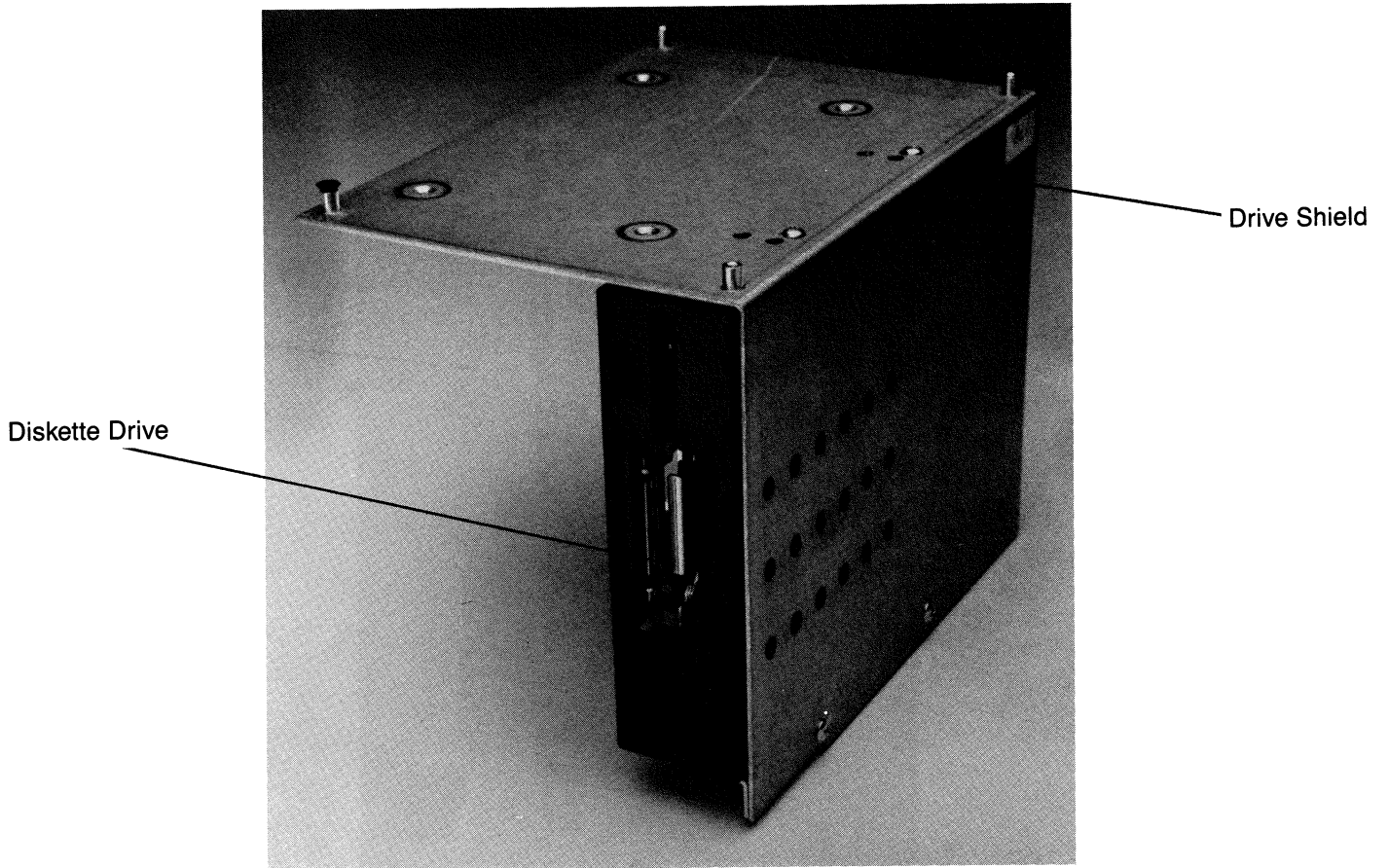


Figure 19.43  
Diskette Drive Shield

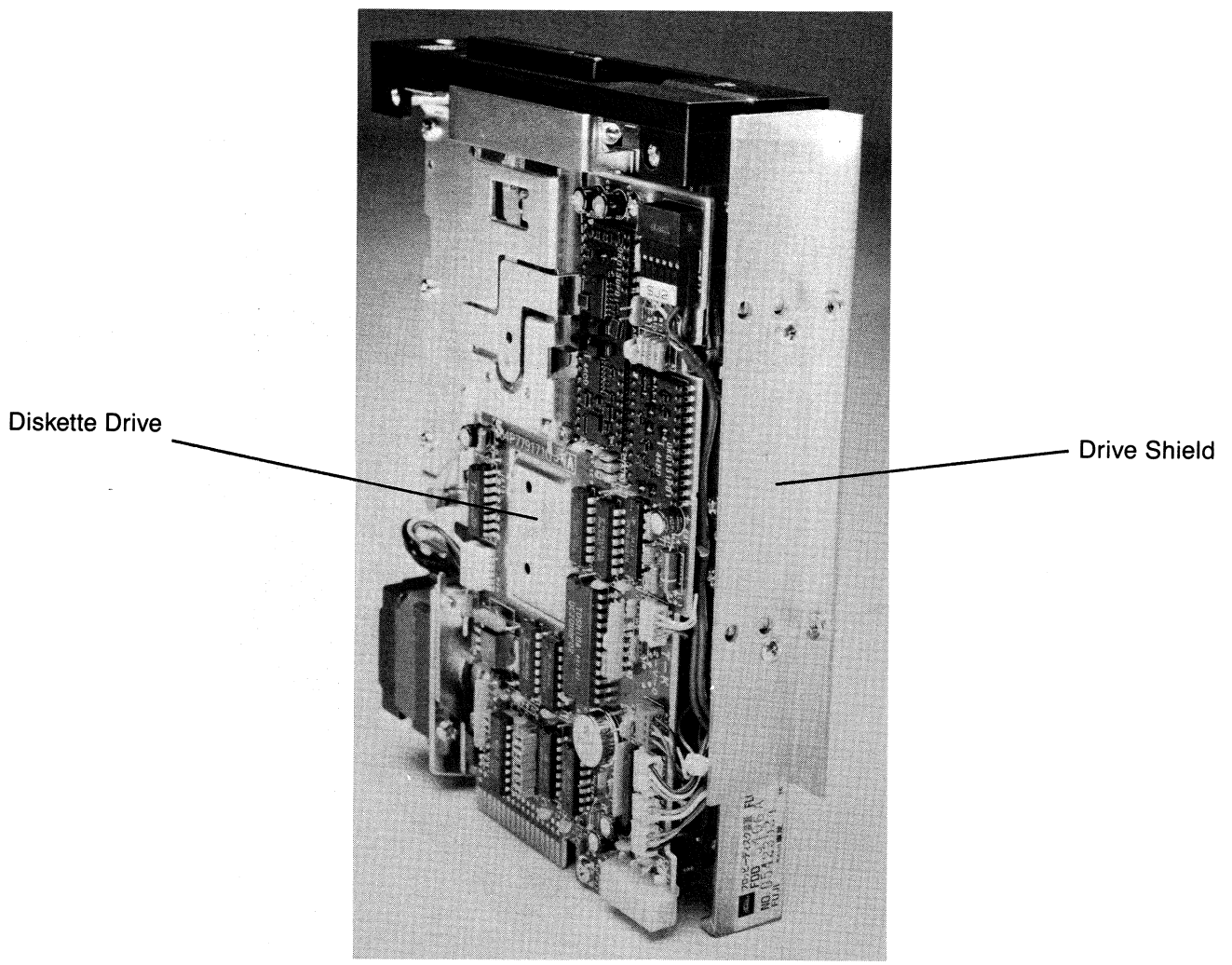


Figure 19.5  
Diskette Drive Shield



## 19.6 HARD DISK DRIVE

The KAYPRO 16 uses hard disk drives manufactured by either Seagate, Microscience, or Shugart. These are functionally the same as the hard drives used in the KAYPRO 10.

Refer to pages 10--1 to 10--3.1 in the Technical Manual for jumpering instructions for the hard drives. These drives should be jumpered the same as the hard disk drives used in the KAYPRO 10.

## 19.63 HARD DISK DRIVE REMOVAL

Note: The diskette drive and the hard disk drive are both housed in a single drive shield, making it necessary to remove both drives and the shield as one unit. The shield is composed of several individual pieces; figures 19.4, 19.6 and 19.63 should be used for reference. This unit will be referred to as the drive assembly unit in the instructions for removing and installing drives.

1. Remove the chassis hood (19.1).
2. Remove the board assembly (19.23).
3. Remove the disk controller board (19.26).
4. Remove the 34-pin ribbon cable, the power plug and the ground wire from the diskette drive.
5. Remove the 2 ribbon cables, the power plug, the ground wire and the wire from the 10MB LED from the hard drive.
6. Position the computer so that the rear of it is on the work surface and the bottom is facing you.
7. Remove the top three screws that secure the drive shield and the chassis.
8. Support the drives and remove the bottom three screws that secure the drive shield and the chassis.
9. Remove the drive assembly unit from the chassis.
10. Remove four screws from the top of the drive assembly unit. Refer to figure 19.4.
11. Remove the hard drive (still in its shield) from the drive assembly unit.
12. Remove the four mounting screws from the hard drive shield (two on the top and two on the bottom).

Note: The screw used in the top, front mounting hole is shorter than the other screws and must be used in the same mounting hole when installing a new hard drive.

13. Remove the hard drive from the drive shield.

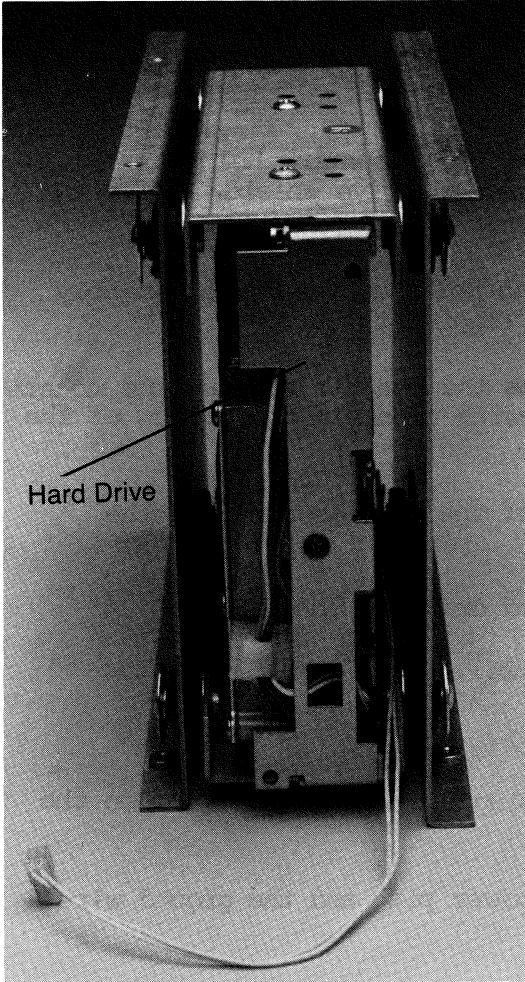


Figure 19.6  
Hard Drive in Drive Shield

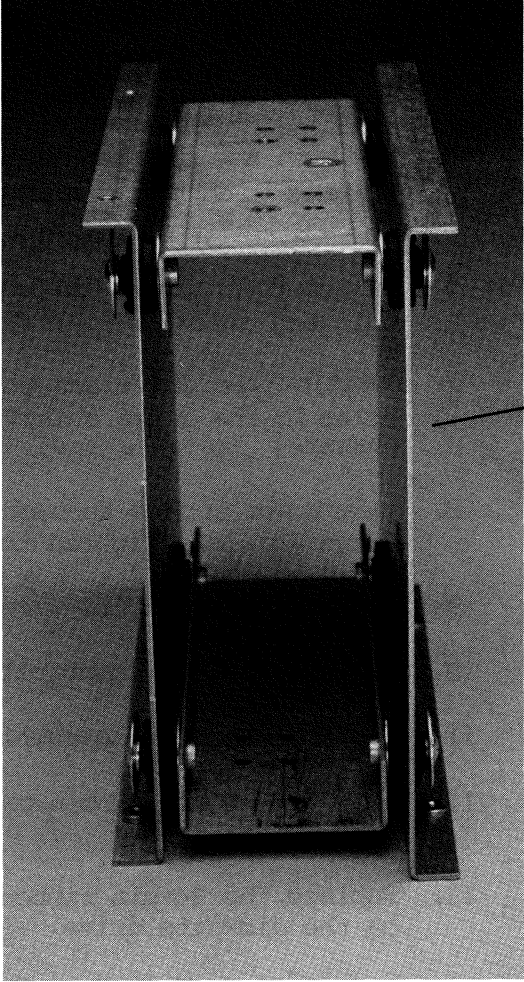


Figure 19.63  
Hard Drive Shield

## HARD DISK DRIVE INSTALLATION

1. Check the new hard drive to see if it's jumpered correctly.
2. Position the disk drive in the drive shield so that the mounting holes in the drive are aligned with those in the shield.
3. Insert two screws in the top mounting holes (the short screw is used in the top front mounting hole).
4. Insert two screws in the bottom two mounting holes and tighten these and the top two screws securely.
5. Position the drive assembly unit so that the mounting holes are aligned with the mounting holes in the hard drive shield. Refer to figure 19.4.
6. Insert four screws through the mounting holes of the drive assembly unit and into the hard drive shield. Tighten the screws.
7. Position the drive assembly unit inside the chassis so that the mounting holes in the drive shield are aligned with those in the bottom of the chassis.
8. Insert six screws through the bottom of the chassis and into the drive shield. Tighten the screws.
9. Connect the 10MB LED wire from the hard drive to the LED.
10. Replace the disk controller board (19.26).
11. Replace the board assembly (19.23).
12. Replace the two ribbon cables, power plug and the ground wire on the hard drive.
13. Replace the 34-pin ribbon cable, the power plug and the ground wire on the diskette drive.
14. Replace the chassis hood (19.1).

## 19.7 KEYBOARD

The keyboard has a five pin DIN connector with the following keyboard interface signals:

DIN	SIGNAL NAME
1	KEYBOARD CLOCK
2	KEYBOARD SERIAL DATA
3	RESET
4	GROUND
5	+5VDC

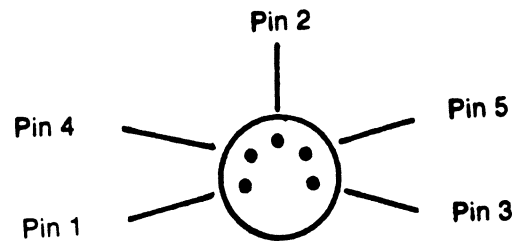


Figure 19.7  
DIN Connector

## 19.8 SYSTEM I/O

The KAYPRO 16 supports parallel and serial I/O operations through its DB-25 (parallel) and either DE-9S or DE-9P (serial) connectors. These are located on the left side of the machine and can be referenced using figure 19.73.

The pin assignments for the parallel and serial ports and cable pin-outs are on the following pages. Notice that although a serial printer and an external modem both use the serial port, they require different cables. If a serial plotter is used with a KAYPRO 16, a serial printer cable should be used.

### 19.81 PARALLEL PRINTER

#### PARALLEL PRINTER CABLE

DB-25 CONNECTOR (KAYPRO 16) PIN	SIGNAL	CENTRONICS (PRINTER) PIN
1	/STROBE	1
2	DATA 0	2
3	DATA 1	3
4	DATA 2	4
5	DATA 3	5
6	DATA 4	6
7	DATA 5	7
8	DATA 6	8
9	DATA 7	9
10	ACKNOWLEDGE	10
11	BUSY	11
12	PAPER END	12
13	SELECT	13
14	AUTO FEED	14
15	FAULT	32
16	/INITIATE	31
17	SELECT IN	36
18	GROUND	19
19	GROUND	20
20	GROUND	21
21	GROUND	23
22	GROUND	25
23	GROUND	27
24	GROUND	29
25	GROUND	30
N/C	SHIELD	17

NOTE: ALL CABLES USED ON THE KAYPRO 16 MUST BE SHIELDED IN ORDER TO COMPLY WITH FCC REGULATIONS.

/ indicates an active low signal.

## 19.82 I/O CONNECTORS

The following figure should be used as reference for the I/O interface between the KAYPRO 16 computer and any peripherals used with it. The figure also references the reset button.

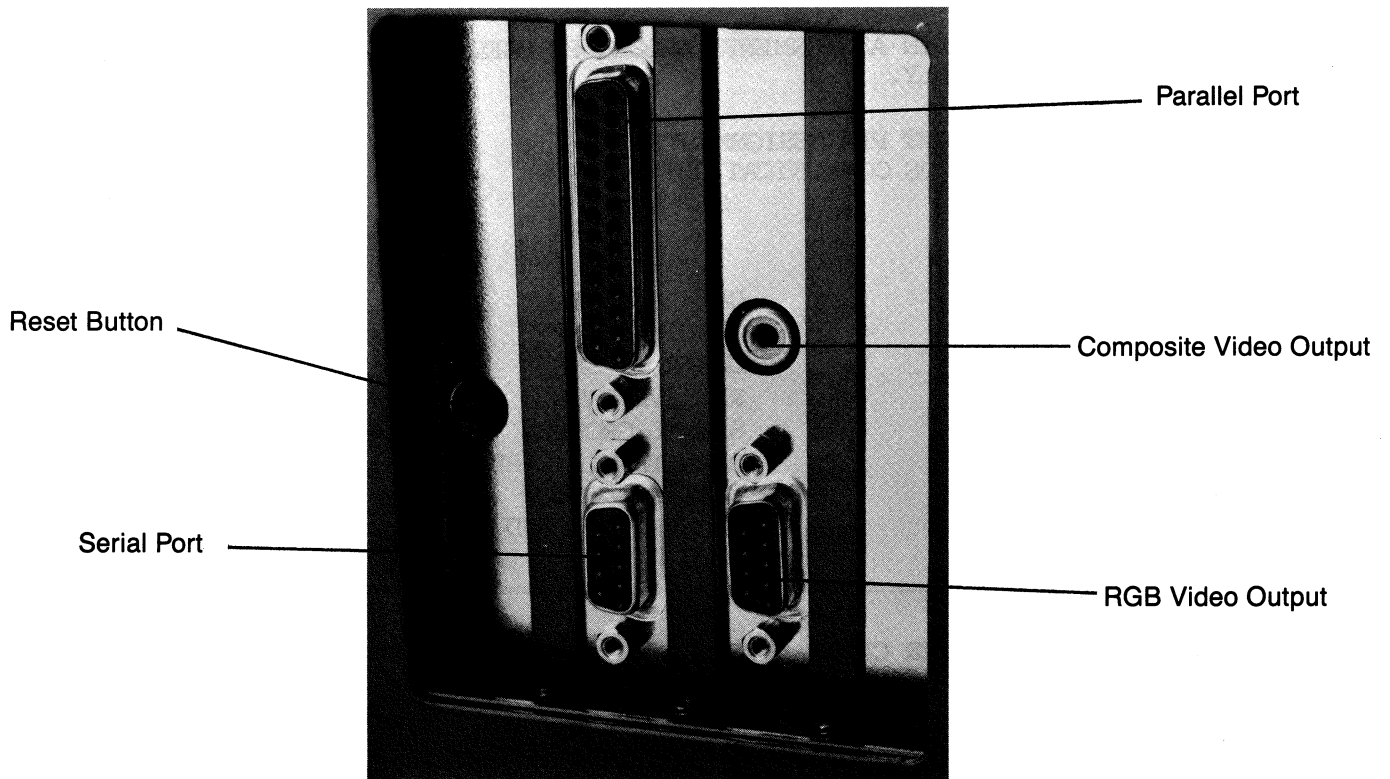


Figure 19.73  
I/O Connectors

### 19.83 SERIAL DEVICES

The serial port pin-out assignments on the KAYPRO 16 are implemented in two different manners. These are easily distinguished from each other by the connector itself; one is a DE-9S female connector, the other a DE-9P male connector. Since the pin-outs are different, two sets of serial port assignments are given for reference. Be sure to check the connector type before using the following information.

#### 19.84 DE-9S SERIAL PORT

THESE SERIAL PORT PIN ASSIGNMENTS SHOULD BE USED FOR KAYPRO 16 COMPUTERS WITH DE-9S CONNECTORS ONLY.

##### KAYPRO 16 SERIAL PORT PIN ASSIGNMENTS (PRIMARY ASYNCHRONOUS COMMUNICATIONS)

DE-9S CONNECTOR PIN	SIGNAL
1	DATA SET READY
2	TRANSMIT DATA
3	CLEAR TO SEND
4	RECEIVE DATA
5	SIGNAL GROUND
6	DATA TERMINAL READY
7	CARRIER DETECT
8	REQUEST TO SEND
9	RING DETECT

---

---

#### 19.85 SERIAL PRINTER CABLE (DCE)

DE-9P CONNECTOR (KAYPRO) PIN	SIGNAL	DB-25P CONNECTOR (PRINTER) PIN
1	DATA SET READY	20
2	TRANSMIT DATA	3
3	CLEAR TO SEND	4
4	RECEIVE DATA	2
5	SIGNAL GROUND	7
6	DATA TERMINAL READY	8
7	CARRIER DETECT	6
8	REQUEST TO SEND	5
9	RING INDICATOR	22

---

---



## 19.86 MODEM CABLE (DTE)

DE-9P CONNECTOR (KAYPRO) PIN	SIGNAL	DB-25P CONNECTOR (MODEM) PIN
1	DATA SET READY	6
2	TRANSMIT DATA	2
3	CLEAR TO SEND	5
4	RECEIVE DATA	3
5	SIGNAL GROUND	7
6	DATA TERMINAL READY	20
7	CARRIER DETECT	8
8	REQUEST TO SEND	4
9	RING DETECT	22

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### 19.87 DE-9P SERIAL PORT

THESE SERIAL PORT PIN ASSIGNMENTS SHOULD BE USED FOR KAYPRO 16 COMPUTERS WITH DE-9P CONNECTORS.

#### KAYPRO 16 SERIAL PORT PIN ASSIGNMENTS (PRIMARY ASYNCHRONOUS COMMUNICATIONS)

DE-9P CONNECTOR PIN	SIGNAL
1	CARRIER DETECT
2	RECEIVE DATA
3	TRANSMIT DATA
4	DATA TERMINAL READY
5	SIGNAL GROUND
6	DATA SET READY
7	REQUEST TO SEND
8	CLEAR TO SEND
9	RING INDICATOR

---

---

### 19.88 SERIAL PRINTER CABLE (DCE)

DE-9S CONNECTOR (KAYPRO) PIN	SIGNAL	DB-25P CONNECTOR (PRINTER)
1	CARRIER DETECT	6
2	RECEIVE DATA	2
3	TRANSMIT DATA	3
4	DATA TERMINAL READY	8
5	SIGNAL GROUND	7
6	DATA SET READY	20
7	REQUEST TO SEND	5
8	CLEAR TO SEND	4
9	RING INDICATOR	22

---

---

### 19.89 MODEM CABLE (DTE)

DE-9S CONNECTOR (KAYPRO) PIN	SIGNAL	DB-25P CONNECTOR (MODEM)
1	CARRIER DETECT	8
2	RECEIVE DATA	3
3	TRANSMIT DATA	2
4	DATA TERMINAL READY	20
5	SIGNAL GROUND	7
6	DATA SET READY	6
7	REQUEST TO SEND	4
8	CLEAR TO SEND	5
9	RING DETECT	22

---

---

## 19.9 VIDEO CONNECTOR FOR EXTERNAL RGB MONITOR

### PIN ASSIGNMENTS

1. GROUND
  2. GROUND
  3. RED INPUT
  4. GREEN INPUT
  5. BLUE INPUT
  6. INTENSITY
  7. NO CONNECTION
  8. HORIZONTAL SYNC
  9. VERTICAL SYNC
- 
- 

### 19.91 VIDEO CONNECTOR FOR COMPOSITE VIDEO MONITOR

This connector uses a standard composite video cable.

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## 19.92 I/O PORT ADDRESSES

<u>PORT # (HEX)</u>	<u>DEVICE/FUNCTION</u>
000-00F	DMA Chip 8237A-5
020-021	Interrupt 8259A
040-043	Timer 8253-5
060-063	PPI 8255A-5
080-083	DMA Page Registers
0A0-0AF	NMI Mask Register
2F8-2FF	Asynchronous Communications (Secondary)
320-32F	Hard Disk
378-37F	Parallel Printer
3D0-3DF	Color/Graphics
3F0-3F7	Floppy Diskette
3F8-3FF	Asynchronous Communications (Primary)

19.93 MEMORY MAP OF THE KAYPRO 16 COMPUTER

MEMORY MAP OF THE KAYPRO 16 COMPUTER

FFFFh	System ROM, BIOS
FE00h EFFFFh	Reserved
CC00h CBFFFh	Hard Disk Control
C800h C7FFFh	Reserved
BC00h BBFFFh	Video I/O Buffer
B800h B7FFFh	Reserved
A000h 9FFFFh	MEMORY EXPANSION*
4000h 3FFFFh	USER MEMORY
0000h	

\* AVAILABLE AS AN OPTION

## 19.94 SWITCH SETTINGS

The KAYPRO 16 uses several DIP switches that are preset at the factory. The switches and their functions are in this section for reference and as an aid in troubleshooting, check to see if they're in the proper position before replacing a card. Notice that there are two DIP switches labeled "SW1", but that they're on different cards.

---

---

SW1 on the PROCESSOR CARD:

Position 1 is used to specify the numeric processor option.  
Positions 2 and 3 are used to specify the size and type of display interface.  
Positions 4 and 5 are used to specify the number of disk drives.

The settings for SW1 on the processor card are:

Position 1 is on.  
Position 2 is off.  
Position 3 is on.  
Position 4 is on.  
Position 5 is on.

---

---

SW1 on the FLOPPY-RAM-I/O CARD:

Positions 1, 2, 3, and 4 are used to specify the starting address for the RAM on the FLOPPY-RAM-I/O card (the memory expansion).  
Positions 5 and 6 indicate the number of RAM banks on the FLOPPY-RAM-I/O card.  
Position 7 is used to specify whether those banks contain 64K or 256K.  
Position 8 is used to enable or disable parity checking.

The settings for SW1 on the FLOPPY-RAM-I/O card are:

Position 1 is off.  
Position 2 is on.  
Position 3 is on.  
Position 4 is on.  
Position 5 is on.  
Position 6 is off.  
Position 7 is on.  
Position 8 is on.

256K  
1  
1  
1  
1  
1  
2  
2

---

---

SW2 on the FLOPPY-RAM-I/O card:

Positions 1 and 2 are used to select the serial port.  
Positions 3 and 4 are used to select the parallel port.

The settings for SW2 on the FLOPPY-RAM-I/O card are:

Position 1 is on.  
Position 2 is on.  
Position 3 is on.  
Position 4 is off.

---

---

### Serial Port Select

This jumper is located on the FLOPPY-RAM-I/O card and can be referenced using figure 19.8. It should be set in the "COM1" position.

---

---

### Parallel Port Select

This jumper is located on the FLOPPY-RAM-I/O card and can be referenced using figure 19.8. It should be set in the "IRQ7" position.

---

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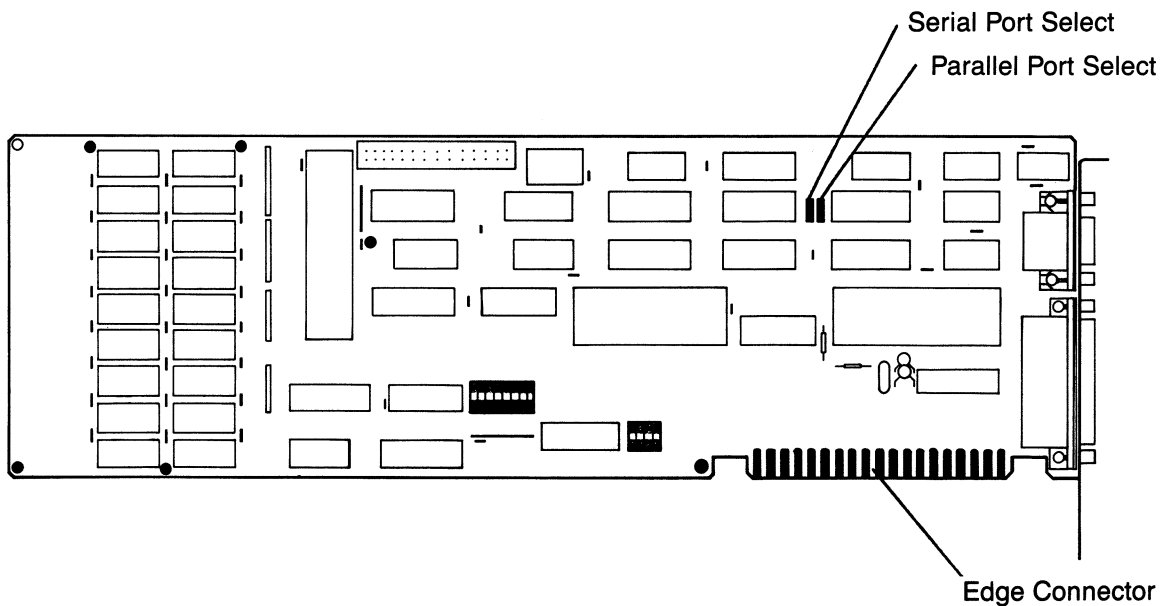


Figure 19.8  
Floppy-RAM-I/O Card

## 19.95 MEMORY EXPANSION

The mainboard on the KAYPRO 16 is populated with 256K bytes of RAM and is socketed for an additional 256K bytes. By populating the additional 256K RAM on the mainboard, the total dealer serviceable memory expansion is completed. The additional 256K bytes of RAM on the mainboard can be implemented by populating the sockets with 64K x 1, 150ns, RAM chips. The additional RAM chips need to be installed in these positions: U37-U45, U46-U54, U55-U63, U64-U72.

The RAM expansion from 512K to 640K is a "factory only upgrade". Kaypro does not support memory expansion from 512K to 640K unless it is done at Kaypro.



## 20.0 KAYPRO 16/2

The KAYPRO 16/2 is an Intel 8088 microprocessor based computer that is similar in many ways to the KAYPRO 16 computer. Because of these similarities, Section 19 in the Technical Manual is used as a reference for the KAYPRO 16/2. The KAYPRO 16/2 is equipped with two double-density, double-sided disk drives providing 360K of storage per diskette. This is the main difference between the KAYPRO 16/2 and the KAYPRO 16.

The three cards that are used in the KAYPRO 16/2 are the same as those used in the KAYPRO 16 with one exception: SW1 on the processor card is set differently.

The settings for SW1 on the processor card are:

- Position 1 is on.
- Position 2 is off.
- Position 3 is on.
- Position 4 is on.
- Position 5 is off.

The mainboard is the same with these exceptions: J1, U73, U74, U77, U78, U79, U80, U81, U82, U91, U95, U96 and U97 are deleted.

The keyboard, CRT assembly, power supply and fan are the same as those used in the KAYPRO 16.

Refer to Section 19 in the Technical Manual for adjustment procedures, removal/replacement of components and information regarding the following topics for the KAYPRO 16/2:

CHASSIS HOOD REMOVAL/REPLACEMENT	19--3
SYSTEM BOARDS	19--4
IC LIST, KAYPRO 16	19--4.1
BOARD ASSEMBLY REMOVAL/REPLACEMENT	19--16
CARD REMOVAL/REPLACEMENT	19--18
MAINBOARD REMOVAL/REPLACEMENT	19--21
CRT ASSEMBLY ADJUSTMENTS	19--23
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## **DISKETTE DRIVES**

The diskette drives in the KAYPRO 16/2 are the same double-density, double-sided drives used in other models of Kaypro computers. The brands that are currently being used are Epson, Shugart, Tokyo Electric and Toshiba. These drives are all functionally the same and therefore interchangeable.

Refer to the illustrations of the drives on pages 9--2 through 9--8 of the Technical Manual for identification and jumpering instructions.

The diskette drives used in the KAYPRO 16/2 are both jumpered using the instructions for jumpering the B drive, with one exception; the drive in the B position needs a terminating resistor and the drive in the A position does not. The B drive is the drive farthest from the CRT assembly and is the last drive on the ribbon cable.

## **DISKETTE DRIVE REMOVAL**

1. Follow the instructions on page 19--3 of the Technical Manual and remove the chassis hood.
2. Remove the 34-pin ribbon cable, the power plug and the ground wire from the diskette drive.
3. Position the computer so that the rear of it is on the work surface and the bottom is facing you.
4. Remove three of the four screws that attach the drive shield and the bottom of the chassis.
5. Support the drives while removing the final screw that attaches the drive shield and the chassis.
6. Remove the two diagonal braces from the side of the chassis.
7. Remove the drive shield unit (the drives are still attached) from the chassis.
8. Remove the four screws that attach the bottom of the drives to the drive shield. Remove this portion of the drive shield.
9. There are two screws that attach each drive to the drive shield. Remove the two screws that attach the drive being replaced and the drive shield.
10. Remove the drive from the drive shield.

## **DISKETTE DRIVE REPLACEMENT**

For diskette drive replacement, verify that the drive is jumpered correctly and reverse the preceding instructions.

Note: The ribbon cable has two twists in it for wires 10 through 16. A standard point to point cable will not work.

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