CompuPro®

DISK 3™
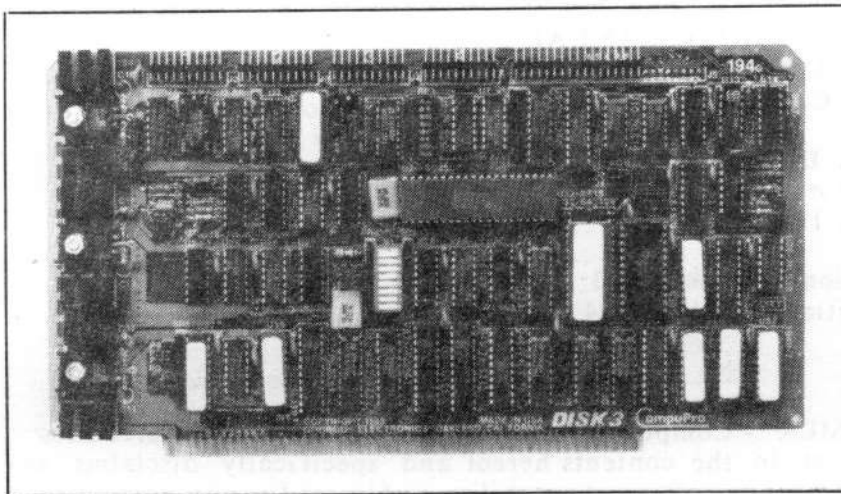## TECHNICAL MANUAL

$20.00

DISK 3
TECHNICAL MANUAL

HARD DISK CONTROLLER
FOR ST-506 COMPATIBLE DRIVES

DISK 3 TECHNICAL MANUAL
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Hayward, CA 94545

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CONTENTS

HOW TO GET YOUR DISK 3 UP AND RUNNING WITHOUT READING THE MANUAL

Eager to get your new DISK 3 running? Careful installation is needed to assure proper function of this board.

DISK 3 INSTALLATION PROCEDURES (For use with the CompuPro H40 Hard Disk Subsystem.)

STEP 1. UNPACK DISK 3 BOARD.

Along with the board, you will find an extra jumper shunt and two card ears in the plastic bag.

STEP 2. INSTALL CARD EARS.

a) Hold the board so the component side is toward you. (See diagram below.)

b) Insert the peg on the card ear into the hole in the <u>right</u> corner of the board. Fold the ear over the board's edge until the ear's hole snaps over the peg (make sure the long edge of the ear is along the top edge of the board.)

c) Repeat for <u>left</u> ear.
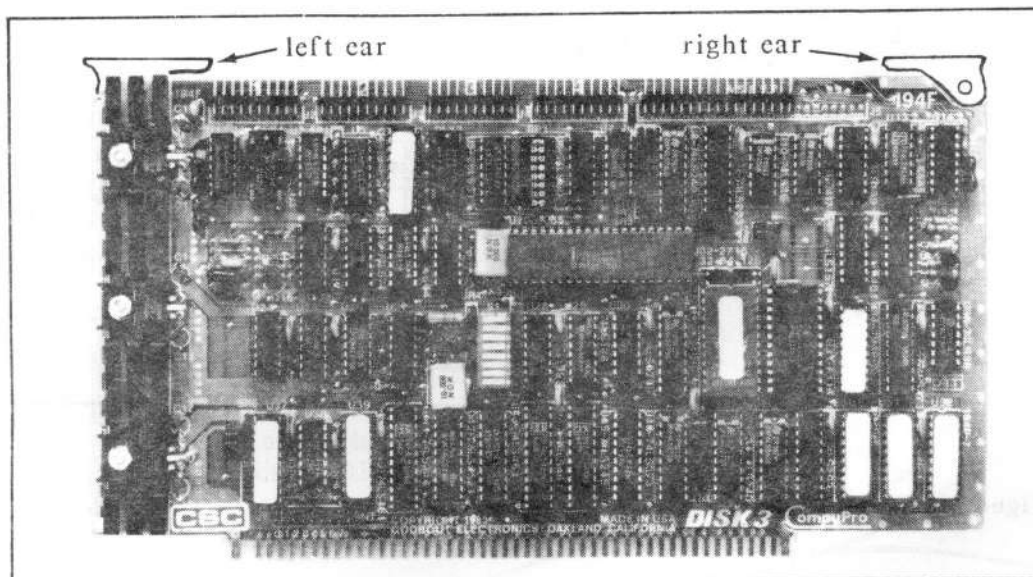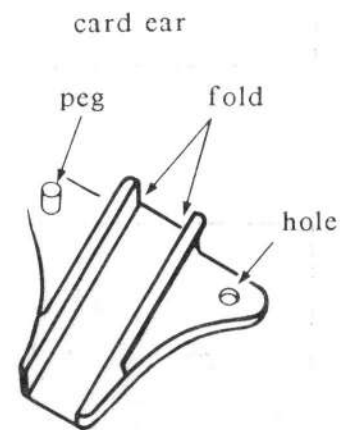
Figure 1: DISK 3 (Component Side)

STEP 3. SET SWICHES. Check the DISK 3 switch settings (see figure below for the location of S1. We recommend that switch positions which are NOT USED be set off. (The switch settings are for MP/M™ 8-16™ Version 2.1 1 and Concurrent DOS 8-16. Check your software documentation for the latest update on the switch settings).

The black dot (●) shows which side of the switch should be down.

SWITCH 1:

S1

POSITION	SET IT
1	OFF
2	ON
3	ON
4	OFF
5	ON
6	ON
7	ON
8	(NOT USED)
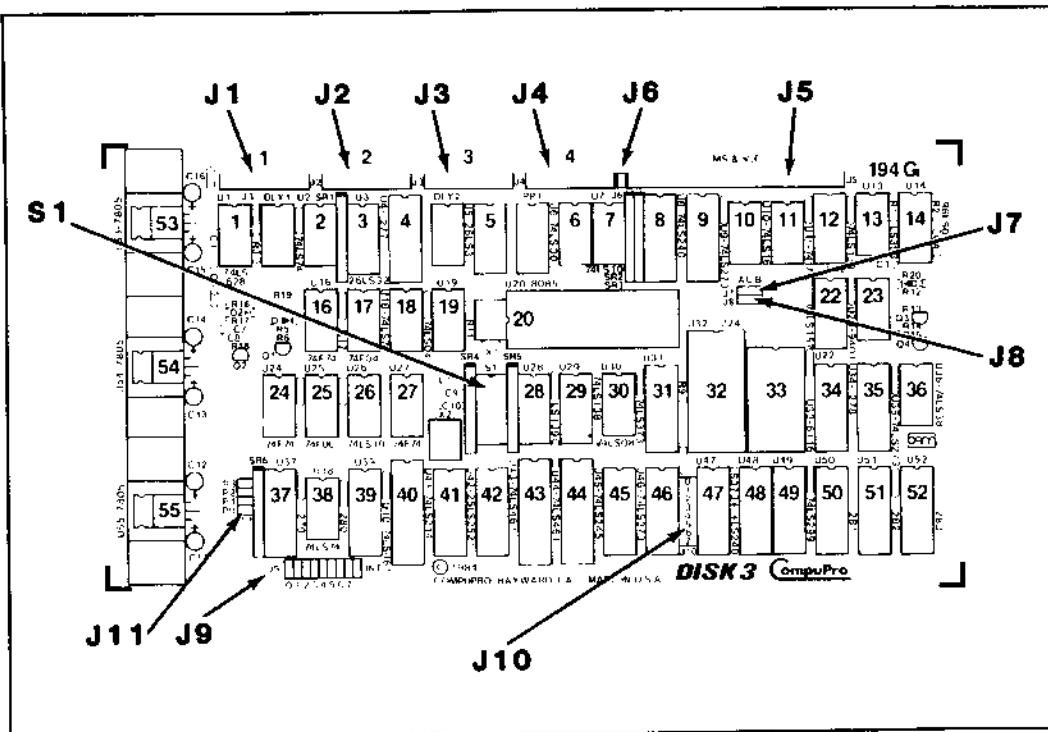
Figure 2. DISK 3 (jumper and switch location)

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STEP 4. CHECK JUMPER SHUNT CONNECTORS

Make sure the jumper shunts are installed as listed below. (See figure 2 on previous page for location of jumper connectors labeled J7, J8, J9, J10 and J11). J6 is unused.

JUMPER SHUNTS
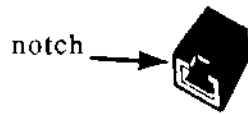
notch → A jumper shunt is a small plastic part used to connect two pins on the jumper connector. Jumper shunts should be installed notch side down.

A C B

← J7 should be connected from B-C.

← J8 should be connected from A-C.

0 1 2 3 4 5 6 7

J9 is for the interrupt selection. Use position 1 for VI1.

0 1 2 3 4 5 6 7

J10 selects the data bit for reset. The top position is for D0.

P3
P2
P1
P0

Jumper the middle two positions of J11

J11
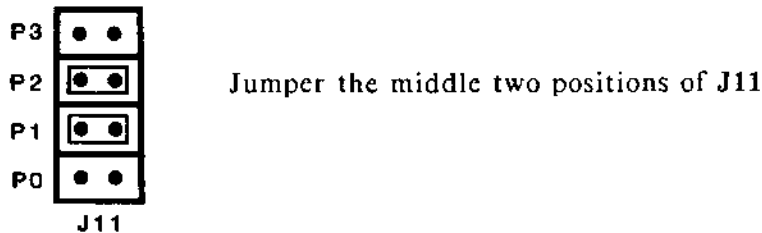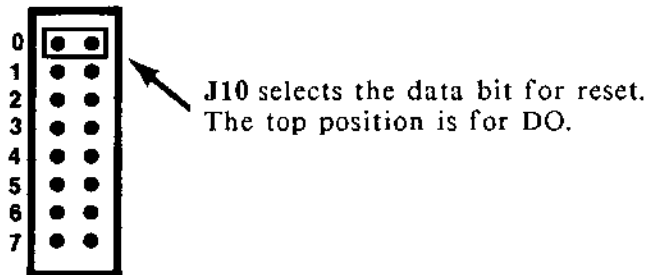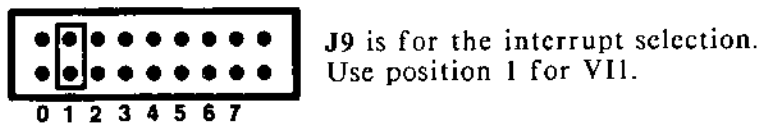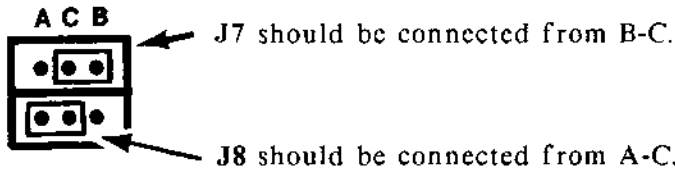
IF: The board is not correctly jumpered.

THEN: Use a pair of needle nose pliers to gently remove, and carefully replace the jumper into its proper location.

jumper shunt →
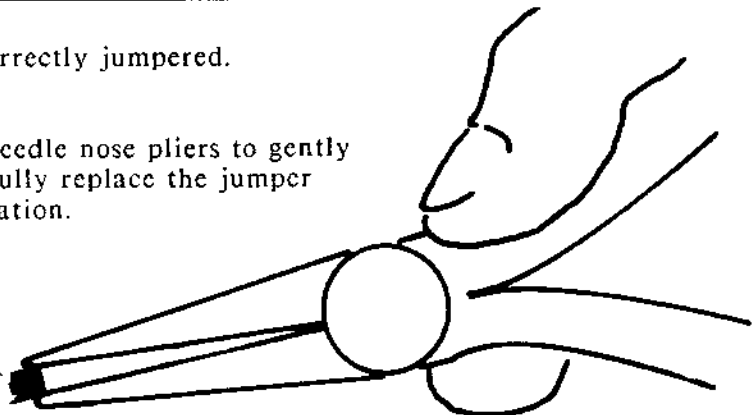
CONNECT THE CABLES FROM DISK 3 TO THE HARD DISK SUBSYSTEM.

Place your hard disk subsystem near your computer enclosure. Make sure it is on a stable surface to reduce vibration when the computer is working. Make sure it is not located near telephones and magnetic fields (like those created by a generator). If you need to remove the cover from the computer, do not use a magnetic screwdriver.

CABLE INSTALLATION. Cables must be connected correctly. Be sure that when you assemble the cables the red stripe is <u>always</u> on the same side, and the connector plugs are inserted properly. You could connect these cables in any order. We recommend the following procedure.

WARNING: BEFORE YOU OPEN YOUR COMPUTER
ENCLOSURE ALWAYS MAKE SURE THE POWER IS OFF
AND IT'S UNPLUGGED. REMOVE RINGS, WATCH, ETC.,
WHICH CAN CONDUCT ELECTRIC CURRENT. DO NOT
TOUCH THE POWER SUPPLY.

STEP 1. IDENTIFY CABLES.

CBL14 - short 20-pin cable.
CBL17 - long 20-pin cable.
CBL13 - short 34-pin cable.
CBL16 - long 34-pin cable.

STEP 2. ATTACH THE CABLES TO THE BACK PANEL OF COMPUTER ENCLOSURE.

a) Select CBL14. Insert male connector into the "Drive 1" slot of the computer enclosure. The pins face outward and the red stripe on the cable is on the side shown on the back panel illustration below.

red stripe
CBL14 inside
CBL17 outside

red stripe
CBL13 inside
CBL16 outside
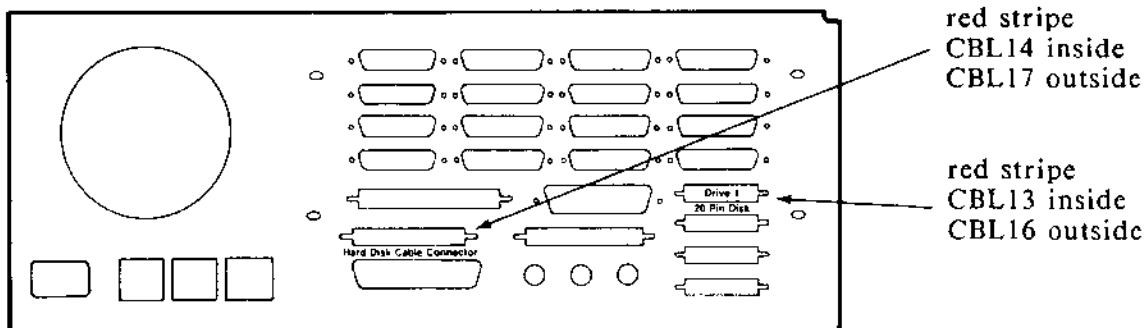
Figure 3. COMPUTER ENCLOSURE - (back panel outside)
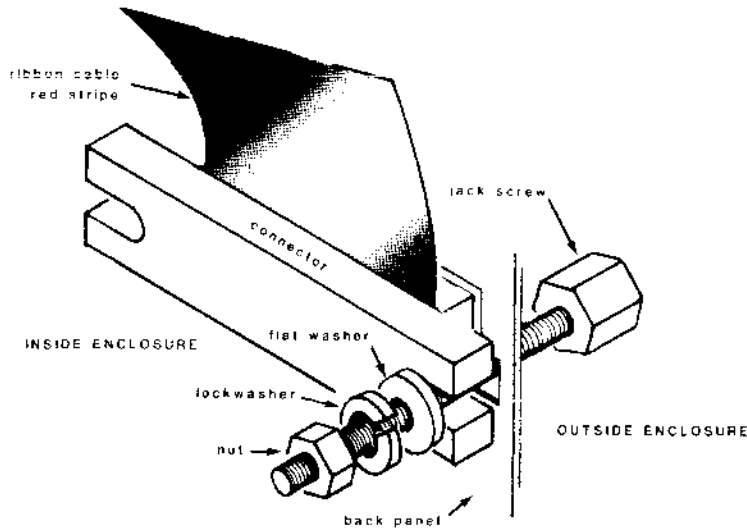
b) Attach connector to back panel with the hardware that came with the system. (Nut/lockwasher inside and jack screw/flat washer outside the enclosure.)

c) Select CBL13. Insert the male connector into the slot inside the back panel labeled for the 34-pin hard disk cable. (See diagram on the previous page.)

d) Attach the CBL13 connector to the back panel as in step b) above.

STEP 3. INSERT THE DISK 3 INTO THE MOTHERBOARD. Place the board into the slot closest to the back of the enclosure. The edge connector is offset, so that the DISK 3 will fit <u>only</u> with the component side facing the form panel of the enclosure. PUSH DOWN <u>GENTLY</u> UNTIL THE BOARD IS FIRMLY INSTALLED.

STEP 4. ATTACH THE CABLES TO THE DISK 3. (Face the component side of the board.)
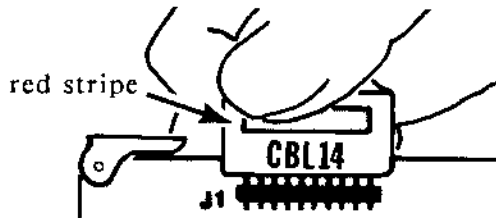
a) Pick up the female connector, of CBL14. Keep the red stripe on the cable to the left.

b) Gently slide the connector onto J1. (See component legend on the board or diagram on page 2 for location of J1.)

c) Next gently slide the connector of CBL13 onto J5. (See component legend on the board or diagram on page 2 for location of J5.) Keep the red stripe on the left side on the connector.

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STEP 5. ATTACH THE CABLES TO THE HARD DISK SUBSYSTEM.

a) Take CBL17 and insert one end into the 20-pin connector you attached to the enclosure. Match the red stripes.

b) Insert the other end of CBL17 into the back of the hard disk enclosure in the 20-pin connector (red stripe on the side away from the fan).

c) Now take CBL16 and insert one end into the 34-pin connector you attached to the enclosure. Match the red stripes.

d) Insert the other end of CBL16 in the 34-pin connector on the back of the hard disk, with the red stripe away from the fan.

TESTING.

IMPORTANT NOTE: Make sure the 50-pin floppy disk drive cable is attached from the disk enclosure to the DISK 1A board before the CONFIDENCE TEST is run.

IT IS NECESSARY TO RUN A CONFIDENCE TEST BEFORE YOU BEGIN TO USE YOUR NEW HARD DISK SUBSYSTEM.

Follow the steps below (using the floppy-based operating diskette) to format the hard disk and run the drive confidence test. (The operating system diskette sent by CompuPro is set up to run the floppies only.)

TO BEGIN THE CONFIDENCE TEST

(This test performs a rigorous examination of the hard drive and prepares an error map which is stored on the hard disk. The bad sector relocation is done at the end of the test. It takes approximately 16 hours to complete.)

STEP 1. Turn on your system.

STEP 2. Insert a single-user (CP/M®-type) operating system diskette.

STEP 3. Type: **DISK3 ALL** then press the return key.

STEP 4. The screen tell you that the DISK 3 will format for a Quantum 540 (Q540) disk drive, then ask you if you want to format the disk. If you do, type "Y", press the return key, and the disk will beging to format. (Go to STEP 6.) If you want to format for another hard disk, type "N", then a list of parameters will appear.

STEP 5. Enter the correct parameters, and when "Are all the above values correct (Y or N):" appears, answer Y, then press the return key.

STEP 6. The test formats the drive, verifies its contents, and performs the data and seek tests. You may hear a lot of noise during the seek test, but this is normal. DO NOT STOP THE TEST! Completing this test is your best guarantee that the DISK 3 and the hard disk subsystem will work properly. After the test is complete, DO NOT REFORMAT the disk as this will destroy the bad sector map.

IMPORTANT

If you have been using an SA1100-type hard disk and are now going to use the SA1100-compatible DISK 3, you will have to copy your files from your hard disk onto floppies, then reformat the hard disk as described above and copy the files back onto your hard disk. You do not have to do this if you have been using an ST506-type hard disk.

TROUBLE?

It is acceptable to have some hard errors, but you should have no more than a total of 40. Cylinder 0 should have no errors; no head should have more than 10 errors; no head should have more than 4 tracks with multiple defect errors; and there should be no more than 1 error per megabyte of unformatted storage (40 errors).

TROUBLESHOOTING.

IF: You are getting errors on every cylinder during the verify, the 20 pin cable is probably reversed.

THEN: Stop the test by pushing the RESET button. Check your cable to make sure it is correctly attached. If it is not, attach it properly and start the test again (as indicated above).

IF: The test does not work at all, the 34-pin cable is probably reversed.

THEN: Check your cable and start the test again.

CONCLUSION:

Now that the hard disk drive has been formatted and error mapped, you need to refer to your operating system manual to prepare a system diskette that will recognize the hard disk. Each operating system prepares its diskettes differently, so use your instructions for each operating system you have.

DISK 3 TECHNICAL INFORMATION

INTRODUCTION

The CompuPro DISK 3 is an intelligent, high performance Winchester disk controller. It will accept up to four soft-sectored hard disks (Seagate 506 interface or equivalent), providing controller and DMA interface functions to the IEEE 696/S-100 bus. All real time disk interactions are handled by the on board processor, eliminating the need for real time code in the host system. The only real time requirement of the host is the ability to handle the DMA transfer rate.

HARDWARE INTERFACE

The DISK 3 host interface consists of a single write-only port called an "attention" port. You can choose the address of the port by changing positions 1-7 on Switch 1. The port appears as a pair of I/O addresses. CompuPro's software expects to see the Disk 3 set at I/O port 90 hex. Set Switch 1 for the standard I/O port locations of 90 and 91 hex: Turn all Switch 1 positions ON, except for positions 1 and 4, which should be OFF. (If you followed the instructions for How To Get Your DISK 3 Up and Running Without Reading the Manual, you've already done this.)

To hold the local 8085 processor in a reset state: write a 01h. This will reset the first controller set at I/O port 90h. An FFh will reset all controller boards set at this I/O port. An attention signal may be sent to the DISK 3 by writing 00h to the attention port.

Up to eight DISK 3 or equivalent controllers may share the attention port address. Each of the eight data bits written to the port resets one controller. The first controller should be jumpered so that it is reset by data bit zero, the second by bit one, etc. Jumper J10 is used to select the appropriate bit for each board. The data bits D0-D7 correspond to jumper positions 0-7 which are between U46 and U47 top to bottom. Use position 0 for the first board, position 1 for the second board, etc. Thus, with only one board at position 0, output a byte with data bit 0, 0 to sent the attention signal to the DISK 3.

The DISK 3 may be directed to generate an interrupt on completion of a command. The interrupt line to be used is selected by the installation of jumper J9 positions 0-7, and INT. These correspond to Vectored Interrupt lines VI0-VI7 and the bus INT signal line. Use the VI1 jumper (position 1 of J9) for operation in a CompuPro multi-user system.

All other communications between the DISK 3 and host system are handled via DMA. The priority with which the board will arbitrate for the bus to perform its DMA cycles is selected by Switch 2 positions 1-4. The DISK 3 is set to a priority of 9 which is selected by turning positions 2 and 3 ON and all others OFF.

On the present units, the firmware is contained in a 2732 or equivalent EPROM. The board is socketed for accepting either a 2716, 2764, or 27128. Jumpers J7 and J8 must be set according to the size of EPROM used.

	2716	2732	2764	27128
J7	B-C	B-C	B-C	A-C
J8	B-C	A-C	A-C	A-C

SOFTWARE OVERVIEW

Since the DISK 3 is an intelligent controller there is a sequence which is performed upon receiving an attention pulse from the bus master. This process is executed for each attention pulse. The bus master should verify that the DISK 3 is not busy performing the previous task when a new operation is desired. The sequence is as follows:

1) The DISK 3 will fetch the last three bytes from the previous IOPB (which starts at 50 hex after an initial reset).

2) The DISK 3 fetches 13 bytes from the current IOPB which was specified in the three bytes read in step 1.

3) The DISK 3 will interpret the command and perform the task or terminate in an error state if there is some problem.

4) The DISK 3 will write the STATUS byte in the IOPB to let the bus master know the status of the last operation, and an interrupt will be generated if it was requested.

SOFTWARE INTERFACE

The DISK 3 and host system communicate with one another through a main memory resident structure called Input Output Parameter Blocks (IOPBs). When the host system wishes to have a disk operation performed by the DISK 3, it assembles the command and any required arguments into an IOPB and signals the DISK 3 by writing the attention port. The DISK 3 will copy the IOPB to its internal RAM and interpret the command. Any required data transfers will be made automatically to the address indicated in the IOPB. When it has finished the command, the DISK 3 inserts the resulting status in the IOPB and optionally generates an interrupt.

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The IOPB is a 16 byte data structure which may begin anywhere in the 16 megabyte address space of the IEEE 696/S-100 bus. It consists of the following byte fields:

BYTE	NAME	FUNCTION
0	COMMAND	The command to be executed.
1	STATUS	Initialized by the host to zero to indicate busy. The DISK 3 will insert the resulting status when the command has been completed.
2	DRIVE	Command is executed on this logical drive.
3	ARG1	The contents of the arguments field
4	ARG2	are command dependent.
5	ARG3	
6	ARG4	
7	ARG5	
8	ARG6	
9	ARG7	
10-12	DATA	This field contains the DMA address for any required data transfers.
13-15	LINK	This field contain the starting address of the next IOPB to be interpreted.

COMMAND - This byte contains a valid command in the range of 0 to 3F hex, along with an interrupt flag in the most significant bit position. A range check will be performed on the operation code, and if an invalid operation code is detected, the command is terminated with an argument range error. The most significant bit of the command byte is a flag which is used to indicate if an interrupt is to be generated on completion of the command. Each of the operation codes are described below in the OPERATION CODE section along with their required arguments.

STATUS - The status byte provides a handshake between the host system and the DISK 3 as well as returning the resulting status of an operation. This byte is set to zero by the host before an attention signal is issued. In non interrupt driven systems, the status byte may be polled by the host system, the zero indicating "busy" until the actual completion status is provided. A status of FF hex indicates successful completion of the command. Other possible results are operation code dependent and are listed on the next page.

STATUS CODE*	DESCRIPTION
0	Busy - DISK 3 has not completed current command.
1	Argument range error - something is wrong in the IOPB.
2	Drive not ready.
3	Time out (header not found).
4	Data CRC error.
5	Write fault.
6	Overrun on bus.
7	Header CRC error.
8	Map full.
FF	Completed with no errors.

*These status codes may also appear as error message numbers.

DRIVE - This is the physical drive number of the drives as con-
nected to the DISK 3 board. The first drive is drive 0 and the
last drive on the first DISK 3 board will be drive 3. If there
are more than one DISK 3 boards in your system they would be
numbered sequentially. A range check will be performed on the
contents of the DRIVE byte, and if the selected drive is not
within the range specified for the DISK 3 board, an argument
range error is indicated and the command is terminated. Other-
wise, the indicated drive is selected for the current command
and the command is executed.

ARG1-ARG7 - These bytes contain command--specific information
described in the OPERATION CODE section of the manual. Commands
which interact with the drives (seek, read, or write) will
first test DRIVE READY and may terminate with a NOT READY
status.

DATA - This three byte field contains the starting address for the
DISK 3 data transfer. It is used for both reading information
from the disk and writing information to the disk.

LINK - When the DISK 3 receives an attention, it clears any inter-
rupt that it may be asserting and then fetches the three byte
LINK field of the last IOPB executed. It then proceeds to the
address indicated by the LINK and fetches the first thirteen
bytes of the new IOPB. For many applications, the interface to
the DISK 3 will use a single IOPB after leaving the original
LINK address at 50 hex. If using a single IOPB, the LINK field
is simply pointed to the start of the IOPB and not altered from
one command to the next.

OPERATION CODES - The following operation codes are available in
part #223B EPROM. Note that the code numbers are specified in Hex.

CODE	FUNCTION	DESCRIPTION
00	NOOP	May be used to LINK to a new IOPB or to clear an interrupt.
01	VERSION	This command will return the current version of the internal firmware in the EPROM on the DISK 3 board in ARG1 as a hex number.
02	GLOBAL	ARG1-ARG7 contain global information which is true for all drives connected to the DISK 3. This information is: ARG1 - Mode of operation. If Mode is 0FFH then a 32 bit field specifying an absolute sector number to be read or written will be used for the read/write command. If Mode is Zero then two 16 bit fields containing logical sector and logical track are used for the read/write command. ARG2 - Number of retries which should be performed before returning an error status to the system. ARG3 - Number of drives connected to all the DISK 3 boards in the system.
03	SPECIFY	A table of parameters for the selected drive will be loaded from the main memory address indicated by DATA. See "SPECIFY" FORMAT on the following pages for the format of this table.
04	SET-MAP	Used to read a bad sector map into the internal RAM of the DISK 3 board. Data field contains the address of the relocation map which is 256 bytes long. See the Appendix for the structure of the relocation map.
05	HOME	Drive byte contains the drive number to be "homed" to track zero at a low step rate.
06	SEEK	Drive byte contains the drive number which will be selected. Then the selected drive will move the R/W head to the cylinder specified by arguments 1 & 2.
07	READ-HEADER	The hardware will attempt to read any header from the presently selected track. If an error is detected in the mark or CRC, the operation will be repeated. If a valid header is found, the four physical address bytes will be transferred to DATA. If a valid header cannot be found, the command will timeout.

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08	R/W	This command is used for all sector reading and writing. It is a block transfer command capable of transferring from 1 to 64K sectors. The Drive byte contains the drive number. Argument 1 contains a read/write flag where one indicates a disk read, zero indicates a disk write. Arguments 2-5 contain either a 32 bit absolute sector number or two 16 bit fields, the first of which is a sector number whose value ranges from zero to the number of sectors per track minus one. The second 16 bit field is the logical track number, which is the cylinder number times the number of heads per cylinder plus the head number. Arguments 2-5 are dependent on the Mode byte as explained above in the GLOBAL command. Both cylinders and heads are numbered from zero. Arguments 6 & 7 contain the number of sectors to be transferred, which must be at least 1. If the command completes without error, the track and sector arguments will be left pointing to the last sector transferred plus one, the count will be zero and the DATA address will be pointing to the last byte transferred plus one. If a hard error occurs, the arguments in the IOPB will be left so that the command may be retried by simply clearing the status and sending an attention. The track and sector will point to the sector in which the error occurred. The count will indicate the number of sectors yet to be transferred and the DATA address will indicate the next byte to be used.
09	RELOCATE	Used for relocating bad sectors found during use of the drive. This command is normally used during block R/W commands. If a hard error occurs during R/W, the STATUS byte is cleared, the command byte is replaced with RELOCATE, and attention is generated. The track entry is placed into the internal relocation map and the drive copy of the map is updated. Any data buffers that should have been written to the bad track are written to the new track, and any data already on the bad track is moved to the new track. Then the original contents of the data buffer are restored. After RELOCATE, the status byte and command bytes can be replaced with the R/W command and execution continued if further transfers are to be performed.

0A	FORMAT	This command will format one track. Before it can be issued, the heads must be placed on the appropriate cylinder using the SEEK command and the appropriate head must be selected with the SELECT command. Argument 1 must contain the length of GAP 3 and argument 2 must contain the fill character to be used in the data field. ARG3 must contain the head number to format.
0B	FORMAT-BAD	This command will mark the track given in Arguments 2-5 as BAD. Usually used in a format program.
0C	STATUS	The physical drive status port on the DISK 3 is read and it is written in ARG1 of the IOPB.
0D	SELECT	The contents of ARG1 are transferred to the DISK 3 physical drive control ports.
0E	EXAMINE	The local memory of the DISK 3 addressed by arguments 1 & 2 will be dumped to external RAM as addressed by DATA for a count as indicated in arguments 3 & 4.
0F	MODIFY	A block of data will be transferred from main memory starting at the address indicated by DATA to the memory address within the DISK 3 indicated by arguments 2 & 3 for a count as indicated by arguments 4 & 5.

All two byte arguments are stored low byte first.

INITIALIZATION - To initialize the DISK 3, a software reset should be performed by pulsing the appropriate reset bit in the attention port. An initial IOPB must be constructed at 50h where all but the LINK field bytes are don't care. The LINK field must point to the first actual IOPB. Following a reset, the head must be positioned over cylinder 0 by the HOME command before the drive can be accessed. If the drive has not been previously formatted a SPECIFY command must be issued to complete the initialization. If the drive has not been previously formatted, a SPECIFY command must be issued and the drive must be given a bad sector map. Cylinder 0, head 0, sectors 0 and 1 must be read into memory at the same time. Sector 0 begins with the string "CompuPro", which can be used to insure that the drive has been formatted with a CompuPro DISK3 format program. 16 bytes into sector 0 is the specify block for this drive. This specify block should be sent to the controller with the SPECIFY command. The first 256 bytes of Sector 1 contain the bad sector relocation map for this drive. The relocation map

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should be sent to the controller with the SET-MAP command. The GLOBAL command should then be issued to complete the initialization. It is important that the sector relocation map be read in to memory and saved BEFORE the specify command is issued, since the SPECIFY command will most likely set a skew factor and reserve some of the begining tracks, thus making the relocation map difficult or impossible to find.

"SPECIFY FORMAT"

The SPECIFY command is used to load drive relative parameters when the DISK 3 is initialized. The format for the table loaded by this command is described below. Each entry corresponds to two bytes stored low byte first. The table is twenty-two bytes long. Note that some of the values are scaled.

BYTE	FUNCTION	DESCRIPTION
0	STEP-RATE	The step time to be used for seek. This is the time in 100 micro-second increments. Use zero for drives with 3 us buffered seek.
2	SETTLE-TIME	The head settle time to wait following seek complete before a [read] or write is attempted. This is the time in 100 micro-second increments. Use zero if head settle time is included in seek complete.
4	SECTOR-SIZE	The number of bytes per sector.
6	SEC/TRK	The number of sectors per track.
8	TRK/CYL	The number of tracks per cylinder, or the number of heads.
10	MAXTRK	The number of cylinders.
12	PRECOMP	Begin using the precompensated write data at this cylinder number.
14	REDUCE	Begin using the reduced write current at this cylinder number.
16	RESERVED	
18	RES-TRACKS	The number of tracks reserved for bad sector remapping.
20	POSITION	This should always be set to zero.

APPENDIX

DISK STRUCTURE CREATED BY THE FORMATTER
(This structure will vary for each drive.)
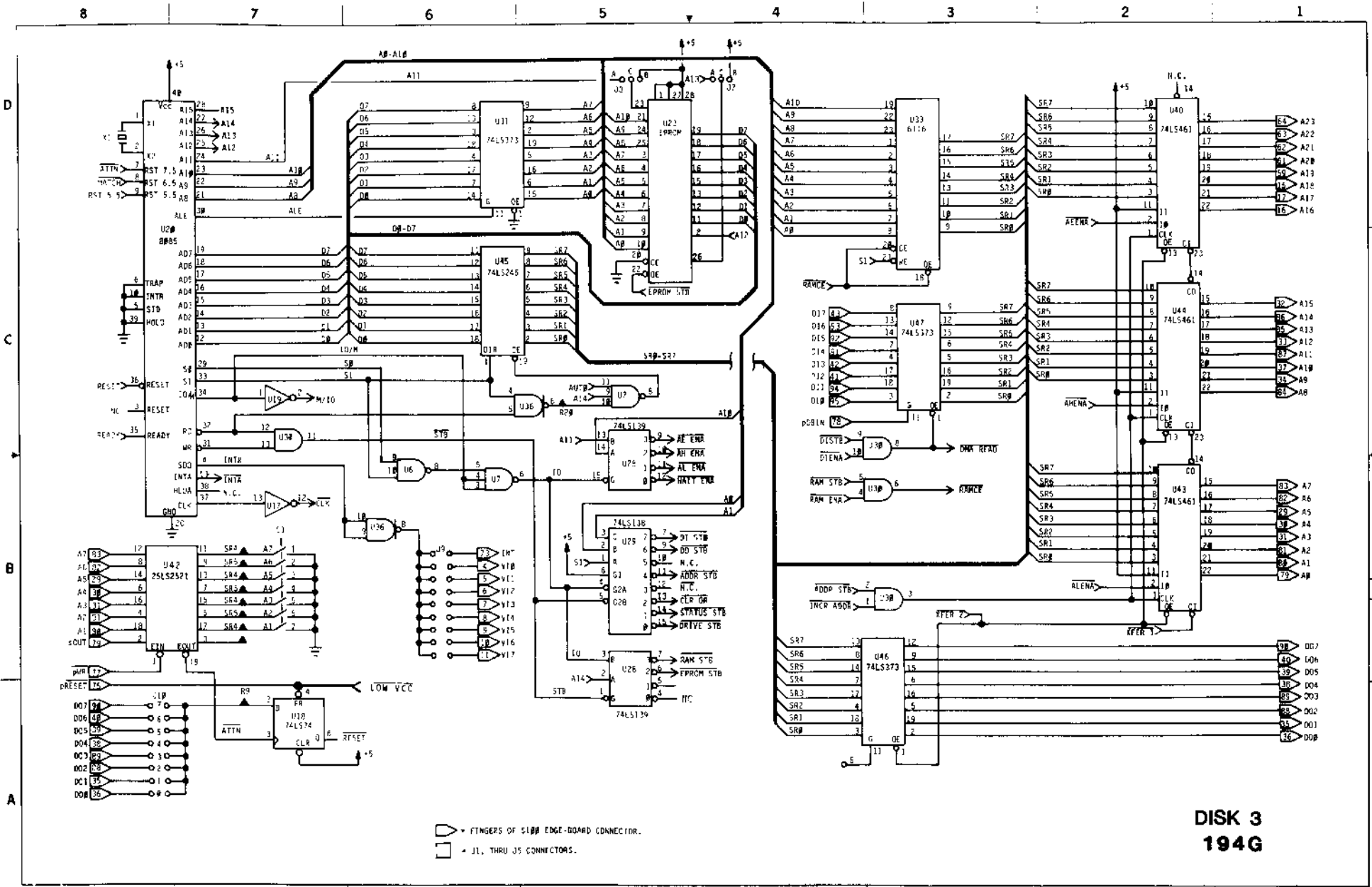
Example: QUANTUM Q540 40 MB hard disk

Cylinder	Head	Sector	Length	Description
0	0	0	8	"CompuPro."
0	0	0	8	Disk 3 revision date.
0	0	0	20	Specify block for this drive.
0	0	1	256	Sector relocation map, organized as words with the low byte first. Possible values for each word are:

			0	Marks this entry as available for dynamic sector relocation.
			-1	Marks the end of the map.
			Other value	Contains the logical track of the relocated bad sector. The offset within the map entry indicates the track number of the reserved track to use.

Cylinder	Head	Sector		Description
0	1	0		First reserved track for relocated sectors.
.	.	.		
0	7	8		
1	0	0		
.	.	.		
1	7	8		
2	0	0		
.	.	.		
2	5	8		Last possible reserved track.
2	6	0		First data track. Normally the previous tracks are invisible and this one is treated as cylinder 0, head 0 by the software.

HARDWARE SECTION

DISK 3
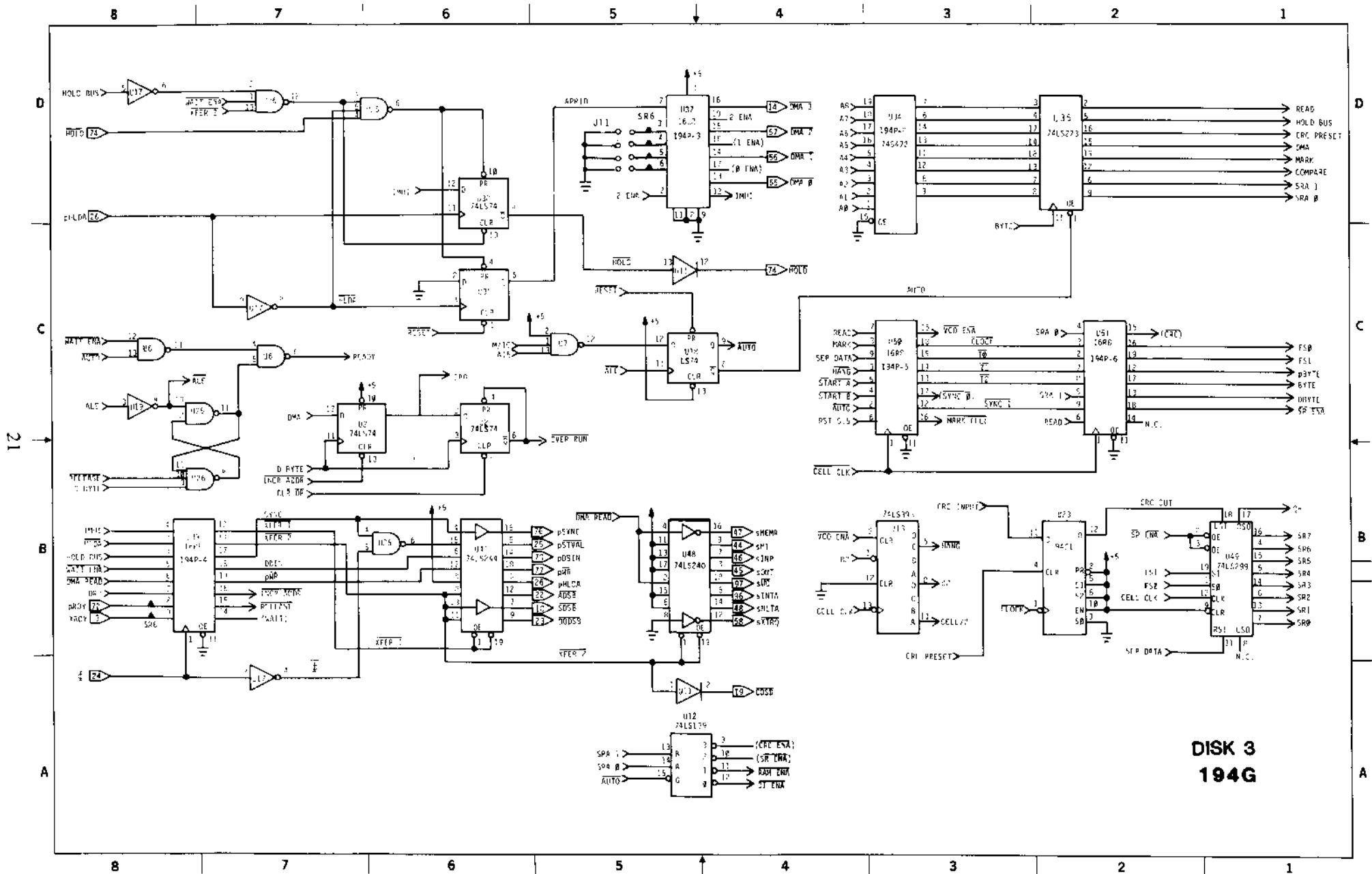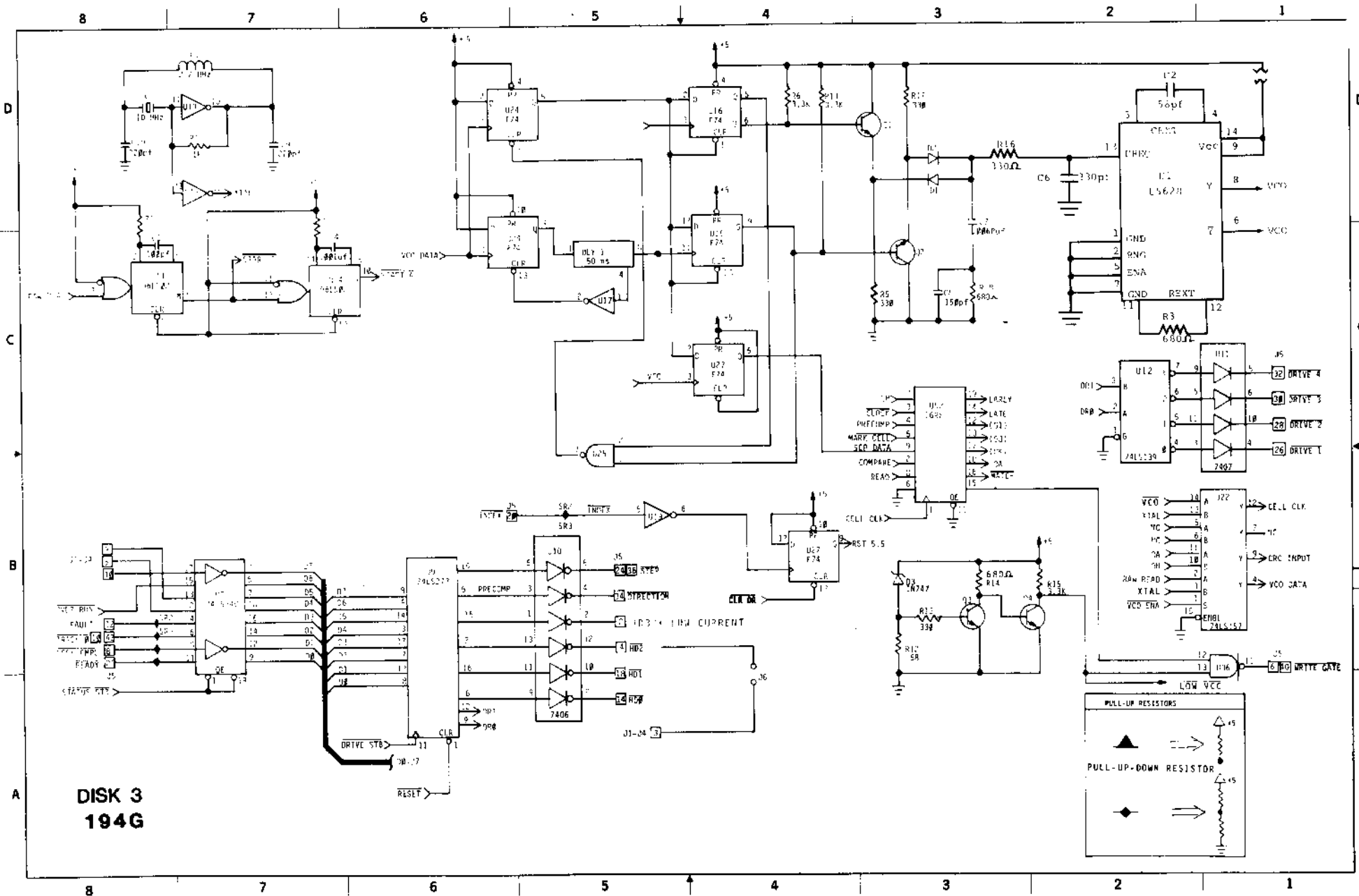**194G**

DISK 3
194G
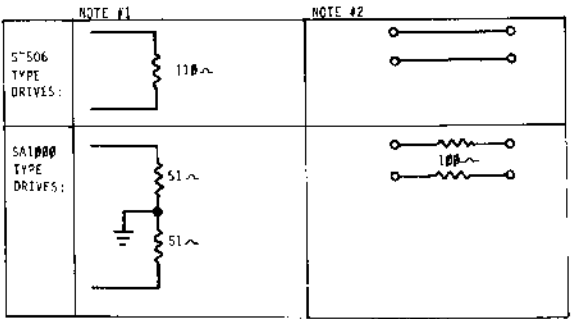
DISK 3
194G

DISK 3
194G

PARTS LIST

SEMICONDUCTORS

D1-D2	IN914
D3	IN747
Q1,Q3,Q4	2N3904
Q2	2N3906
U1	74LS628
U2,U18,U38	74LS74
U3	26LS32
U4	194P-1
U5	26LS31
U6	74LS00
U7,U26	74LS10
U8,U48	74LS240
U9,U35	74LS273
U10	7406 or 7416
U11	7407 or 7417
U12	74LS139
U13	74LS393
U14	96LS02
U16,U24,U27	74F74
U17	74F04
U19	74LS04
U20	8085AH-1
U22	74LS157
U23	9401
U25	74F00
U28	74LS139
U29	74LS138
U30	74LS08
U31,U46,U47	74LS373
U32	D3-PROM
U33	6116-2
U34	194P-2
U36	74LS38
U37	194P-3
U39	194P-4
U40,U43,U44	74LS461
U41	74LS244
U42	25LS2521
U45	74LS245
U49	74LS299
U50	194P-5
U51	194P-6
U52	194P-7A
U53-U55	7805 regulators
DLY1,DLY2	21198
	(Potter Number)

CAPACITORS

C1	56pF (2%)
C3	100pF
C4	.001uF
C6	330pF
C7	.0068uF
C8	150pF
C9,C10	220pF
C11-C16	1.5uF
UNMARKED	.01uF

RESISTORS

R1,R20	4.7 K
R2	10 K
R3,R6,R14,R18	680 Ohms
R15,R19	3.3 K
R5,R13	
R16,R17	330 Ohms
R9	1.5 K
R11	1 K
R12	68 Ohms

SIP RESISTORS

SR1	110 Ohms
SR2	220
SR3	330
SR4,SR5	5.1 K
SR6	1.5 K
RP1	16 Pin Socket only with Dip Shunt

MISCELLANEOUS

X1,X2	10 MHz Crystal
L1	2.2 uH Inductor
S1	8 position dip switch
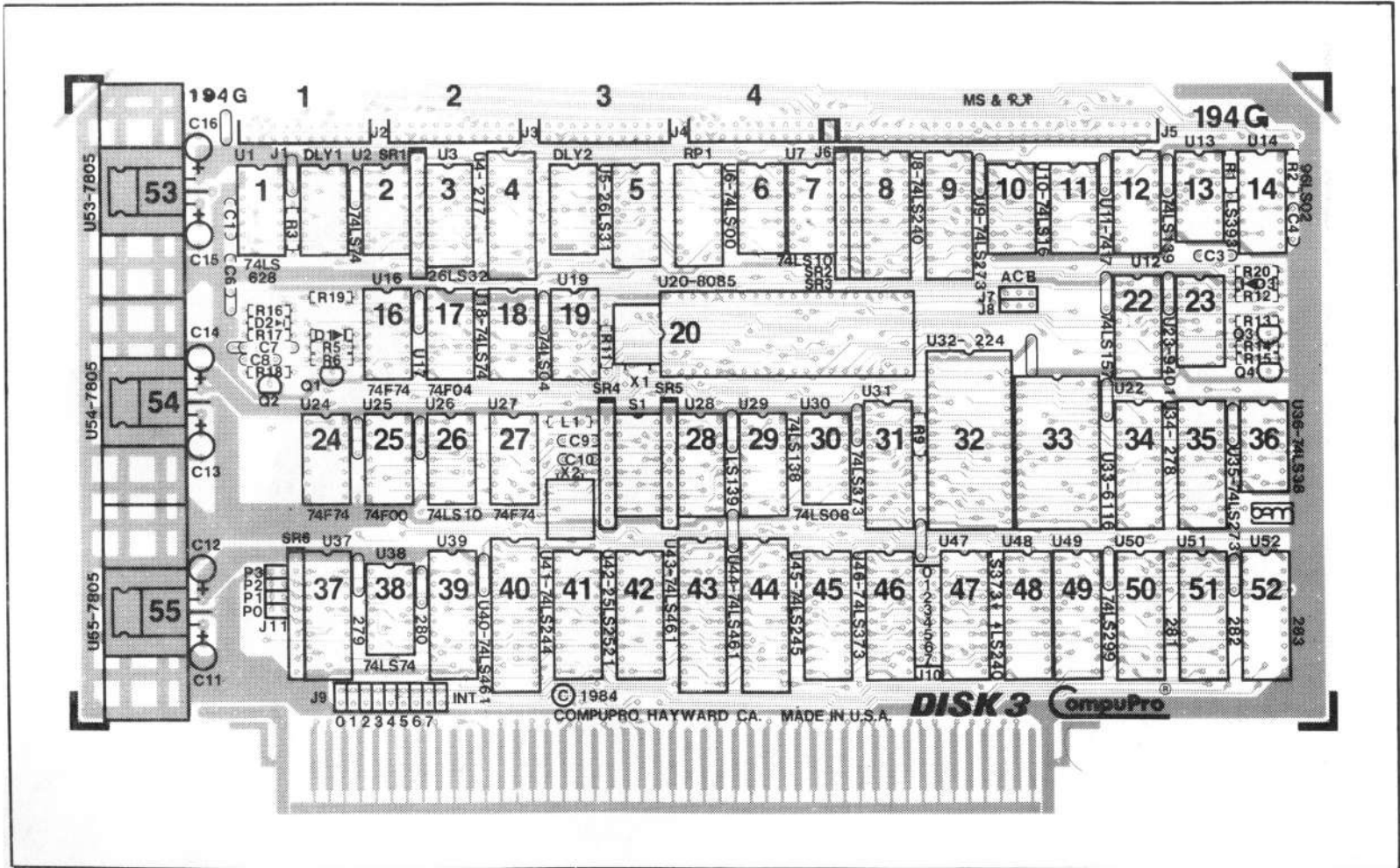
COMPONENT LAYOUT

NOTES

LIMITED WARRANTY

COMPUPRO warrants this computer product to be in good working order for a period of one (1) year, (two [2] years CSC and six [6] months for disk drives) from the date of purchase by the original end user. Should this product fail to be in good working order at any time during this warranty period, COMPUPRO will, at its option, repair or replace the product at no additional charge except as set forth below. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. All replaced parts and products become the property of COMPUPRO. This limited warranty does not include service to repair damage to the product resulting from accident, disaster, misuse, abuse, or unauthorized modification of the product.

If you need assistance, or suspect an equipment failure, always contact your COMPUPRO System Center or dealer first. COMPUPRO System Center technicians are factory trained to provide prompt diagnosis and repair of equipment failures. If you prefer, or if you are not satisfied by the actions taken by your System Center/dealer, you may return the product to COMPUPRO for warranty service. Please call COMPUPRO at (415) 786-0909 to obtain a Return Material Authorization (**RMA**) number, or, write to COMPUPRO at 3481 Arden Road, Hayward, California 94545, Attn.: RMA. Be sure to include a copy of the original bill of sale to establish purchase date. If the product is delivered by mail or common carrier, you agree to insure the product or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty service location (System Center or COMPUPRO) and to use the original shipping container or equivalent. Contact your COMPUPRO System Center/dealer or write to COMPUPRO at the above address for further information.

ALL EXPRESS AND IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE (1) YEAR FROM THE DATE OF PURCHASE, AND NO WARRANTIES, WHETHER EXPRESS OR IMPLIED, WILL APPLY AFTER THIS PERIOD. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

IF THIS PRODUCT IS NOT IN GOOD WORKING ORDER AS WARRANTED ABOVE, YOUR SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. IN NO EVENT WILL COMPUPRO BE LIABLE TO YOU FOR ANY DAMAGES, INCLUDING ANY LOST PROFITS, LOST SAVINGS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF OR INABILITY TO USE SUCH PRODUCT, EVEN IF COMPUPRO OR A COMPUPRO FULL SERVICE SYSTEM CENTER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

COMPUPRO
3481 Arden Road
Hayward, CA 94545
(415) 786-0909

Note: This warranty supersedes all previous warranties, and all other warranties are now obsolete.

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