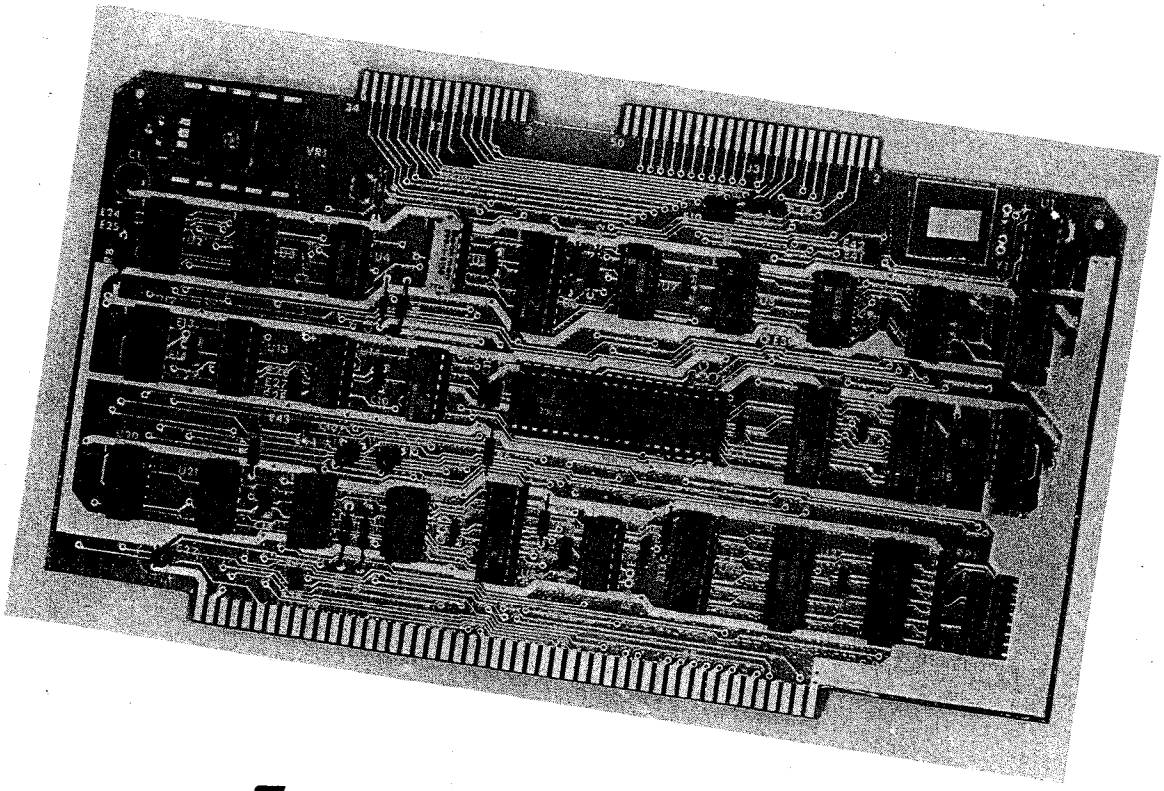
USER'S MANUAL

for the

VERSAFLOPPY™

THE VERSATILE FLOPPY DISK CONTROLLER



S.D. COMPUTER PRODUCTS

P.O. BOX 28810 • DALLAS, TEXAS 75228

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STATEMENT OF LIMITED WARRANTY

All components used in this board were purchased through normal OEM sources and any parts which do not function properly will be replaced at no charge for a period of sixty (60) days following the date of shipment.

If this kit does not function properly upon your completion of assembly, it may be returned to S.D. Sales for inspection and evaluation by our Engineering Department.

If the cause of mal or non-function is due to defective parts there will be no charge. If the cause is due to soldering, assemblying, etc. of the kit, the charge for inspection, evaluation, and repair will not exceed 10% of the purchase price without your approval. In the event the cost of this service will exceed 10% of sales price S.D. Sales will notify you of the estimated cost before proceeding.

This warranty is made in lieu of all other warranties expressed or implied and is limited in any case to the repair or replacement of the module involved.

The assembly of electronic components is essentially the exercise of the art of soldering. If the many connections are soldered properly, the resulting assembly will normally operate properly right from the first application of power. A hasty job here can mean endless hours trying to locate short circuits or intermittent connections. Be sure to read the soldering techniques suggested in Section V before attempting to build this kit.

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SECTION I

GENERAL INFORMATION

1-1 INTRODUCTION

VERSAFLOPPY the versatile floppy disk controller board from S.D. COMPUTER PRODUCTS, provides a low cost means of interfacing to many of the available floppy disk drives, including: Shugart SA400/SA450; Shugart SA800/SA850; MFE 700/750; Persci 70; Persci 277; GSI GS-105. VERSAFLOPPY operates with many 8080 and Z-80 CPU boards on the S-100 Bus. However, VERSAFLOPPY was designed to be used optimally with S.D.'s SBC-100, single board computer, and 32K Expandoram Boards to form a complete,low cost,disk based, computer.

1-2 GENERAL DESCRIPTION

At the heart of VERSAFLOPPY is the powerful Western Digital FD1771B-1 NMOS LSI controller chip. This device performs most of the timing and control functions required by floppy disk drives such as:

1. Head load/unload
2. Track seeking with verification
3. Address mark detection/generation
4. Serial to parallel data conversion during reads
5. Parallel to serial data conversion during writes
6. CRC error code checking/generation
7. IBM 3740 Soft sector compatible recording

During sector reading and writing, the data rate is synchronized with the CPU by inserting wait states until the FD1771B-1 is ready for the next word. On full size drives the data rate is one word (8bits) every 32 microseconds (31,250 words/sec). On mini-drives it is one word (8bits) every 64 microseconds (15,625 words/sec).

1-3 SOFTWARE CONSIDERATIONS

The control function has been designed to be evenly distributed between the hardware circuit and the control software allowing a great deal of flexibility for the user. A version of the control software is supplied with VERSAFLOPPY configured to run on the SBC-100 single board computer. This may be modified to meet the user's specific software interface requirements, such as register usage, parameter hand-offs and data formats.

Also available from S.D. COMPUTER PRODUCTS is a version of CP/M configured to run on the SBC-100, VERSAFLOPPY and 32K Expandoram board combination. This allows using several disk based versions of Fortran and Basic.

SECTION II

FUNCTIONAL DESCRIPTION

2-1 INTRODUCTION

Functionally, VERSAFLOPPY consists of two main parts: hardware, and the software which controls it. The hardware allows the computer to control the drive selection, head loading, track seeks, formating, reading and writing operations. The software, as described in Section 3, must direct the hardware in each of these operations. The major functions contained in the VERSAFLOPPY hardware are shown in the block diagram. (Fig. 2-1) Table 2-1 lists the S-100 Bus signals used by VERSAFLOPPY.

2-2 FD1771B-1

The FD1771B-1, floppy disk controller chip, performs track to track stepping timing, head load timing, serial to parallel data conversion; parallel to serial data conversion; error code checking/ generation, and IBM 3740 softsector compatible recording. After each operation is completed, the chip interrupts the CPU. (option) (For complete description, see Western Digital FD1771B-1 specification). I/O ports X4,X5,X6 and X7 (X=6 or E) are contained within this device.

2-3 DATA OUT BUS

The 8 bit DATA OUT BUS is the S-100 path for transferring data from the computer (CPU) to the output ports on the VERSAFLOPPY board.

2-4 DATA IN BUS

The 8 bit Data In Bus is the S-100 path for transferring data from the input ports on the VERSAFLOPPY board to the computer (CPU). Additionally, the interrupt vector is passed to the CPU on the Data In Bus during the interrupt acknowledge cycle.

2-5 A0-A7

The A0-A7 low order eight address lines are used by the computer (CPU) to select the various input/output ports on the board.

2-6 I/O CONTROL LINES AND READ/WRITE CONTROL

The I/O Control lines consist of $\overline{PWR}$, PDBIN, SOUT, SINP. These lines are used to control the input and output operations from/to the I/O ports on the board.

2-7 WAIT STATE CONTROL AND PRDY

The Wait State Generator is used by VERSAFLOPPY to delay the input and output operations until the FD1771B-1 chip is ready to transfer a word. This PRDY line puts the CPU in a wait state during the delay. Wait states are only generated during sector reads and writes (which use I/O port X7).

2-8 ADDRESS DECODER

The Address Decoder detects when a port address used on VERSAFLOPPY is present on (A0-A7) the low order eight bits of address from the CPU. The output of the decoder is used to gate read and write pulses to the I/O ports.

2-9 DATA IN BUFFER

The Data In Buffer isolates the Bi-Directional Data Bus used on the VERSAFLOPPY from the S-100 Data in Bus. This buffer is enabled during input port reads from ports on VERSAFLOPPY.

2-10 DATA OUT BUFFER

The Data Out Buffer isolates the Bi-Directional Data Bus used on the VERSAFLOPPY from the S-100 Data Out Bus. This buffer is enabled except during input port reads from ports on VERSAFLOPPY.

2-11 BI-DIRECTIONAL DATA BUS

The Bi-Directional Data Bus is a path for all transfers to and from the I/O ports on VERSAFLOPPY.

2-12 INTERRUPT CONTROL AND VECTOR GENERATOR

At the end of each disk operation the FD1771B-1 chip asserts the INTRQ line. Interrupt Control Circuit then, priority chain permitting, asserts the PINT line back to the CPU. When the interrupt is acknowledged by the CPU (SINTA), the PINT line is released and the Interrupt Vector Generator places the Vector (or restart code) on the Data In Bus. VERSAFLOPPY operates with or without interrupts, but the standard control software does not use interrupts.

2-13 OUTPUT PORT X3 (X=6 or E)

Output Port X3 is an 8 bit control register with several functions:

1. Bits 0-3 Drive Select 1,2,3,4,
2. Bit 4 Side Select for double sided drives
3. Bit 5 Restore Drive (optional)
4. Bit 6 Wait State Circuit Enable
5. Bit 7 Interrupt Control Circuit Enable

2-14 INPUT PORT X3 (X=6 or E)

Input Port X3 is used to read the present state of several control signals:

1. Bits 0-4 State of Output Port X3, Bits 0-4
2. Bit 5 State of "double sided" jumper
3. Bit 6 State of seek complete/doubled sided signal from drive
4. Bit 7 State of INTRQ from FD1771B-1

2-15 SELECT BUFFER

The Select Buffer supplies the current sinking drive for the drive and side select lines.

2-16 CONTROL BUFFER

The Control Buffer supplies the current sinking drive for $\overline{\text{WRITE DATA}}$, $\overline{\text{WRITE GATE}}$, $\overline{\text{DIRECTION}}$, $\overline{\text{STEP}}$, $\overline{\text{TRK43}}$, and $\overline{\text{HLD}}$.

2-17 SENSE BUFFER

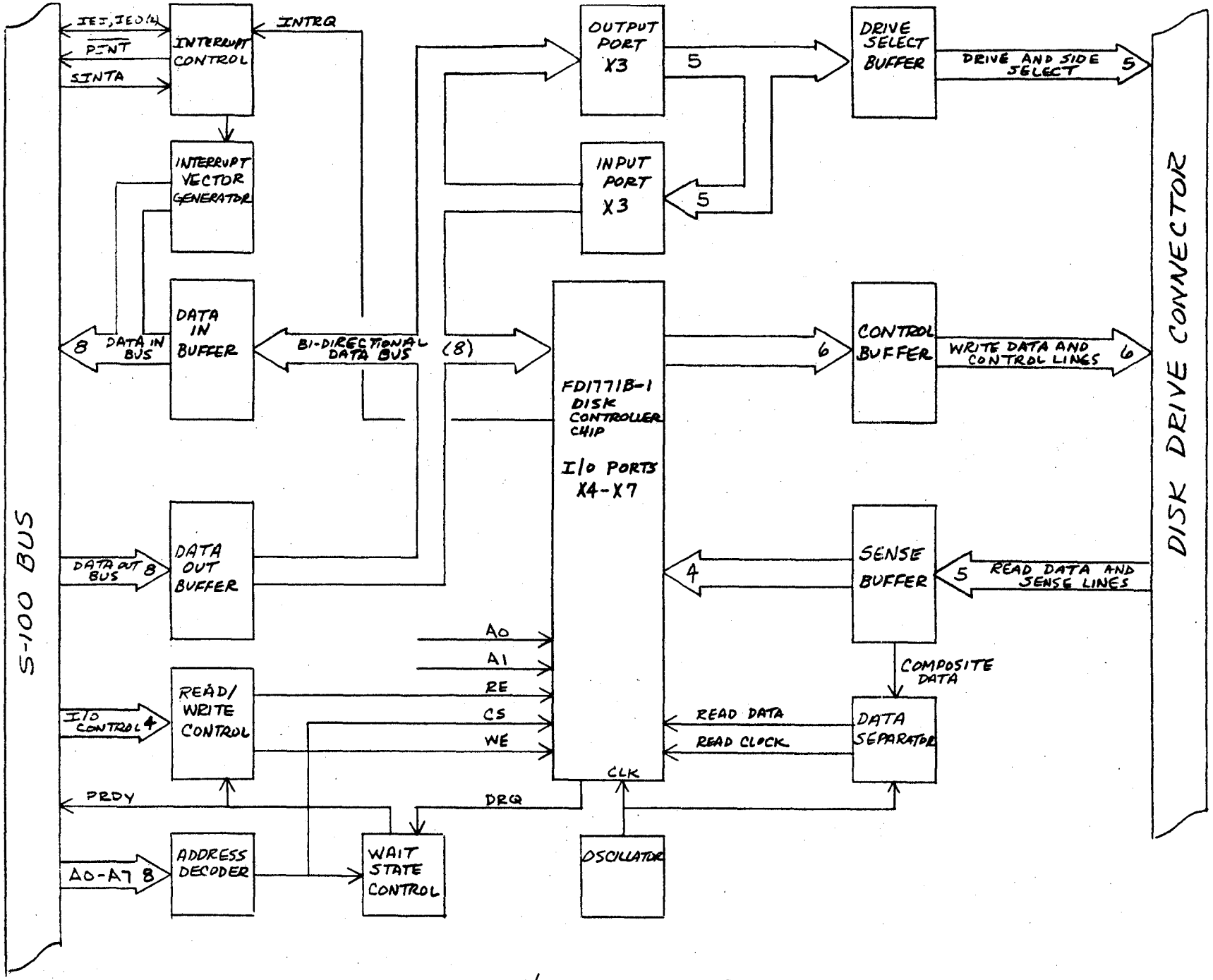
The Sense Buffer receives the $\overline{\text{READ DATA}}$, $\overline{\text{INDEX}}$, $\overline{\text{TRK00}}$, $\overline{\text{READY}}$, and $\overline{\text{WRTPRT}}$ signals from the selected disk drive. Each input is a Schmitt Trigger providing hysteresis noise immunity.

2-18 DATA SEPARATOR

The Data Separator circuit divides the composite FM READ DATA into separated Data and Clock signals required by the FD1771B-1 controller chip.

2-19 OSCILLATOR

The Oscillator circuit provides a crystal controlled squarewave used by the Data Separator and FD1771B-1. This may be jumpered for mini or full size disk drive data rate.



VERSAFLOPPY BLOCK DIAGRAM

FIGURE 2-1

TABLE 2-1

S-100 BUS SIGNALS USED BY VERSAFLOPPY

PIN	SIGNAL NAME	DIRECTION	DESCRIPTION
1,51	+8 Volts		
2	+16 Volts		
6	VI2	OUTPUT	OPTIONAL
14	IEI	INPUT	OPTIONAL
24	Ø2	INPUT	PHASE 2 CLOCK
29-31, 79-83	AO-A7	INPUTS	LOW ORDER ADDRESS
35,36, 38-40, 88-90	DOØ-DO7	INPUTS	DATA OUT BUS
41-43, 91-95	DIØ-DI7	OUTPUTS	DATA IN BUS
45	SOUT	INPUT	PORT OUTPUT CYCLE
46	SINP	INPUT	PORT INPUT CYCLE
64	IEO	OUTPUT	OPTIONAL
72	PRDY	OUTPUT	READY
76	PSYNC	INPUT	OPTIONAL (8085)
77	$\overline{\text{PWR}}$	INPUT	WRITE
78	PDBIN	INPUT	DATA BUS IN
96	SINTA	INPUT	INTERRUPT ACKNOWLEDG
99	$\overline{\text{POC}}$	INPUT	POWER ON CLEAR
52	-16 Volts		
100,50	GROUND		

SECTION III

CONTROL SOFTWARE

3-1 INTRODUCTION

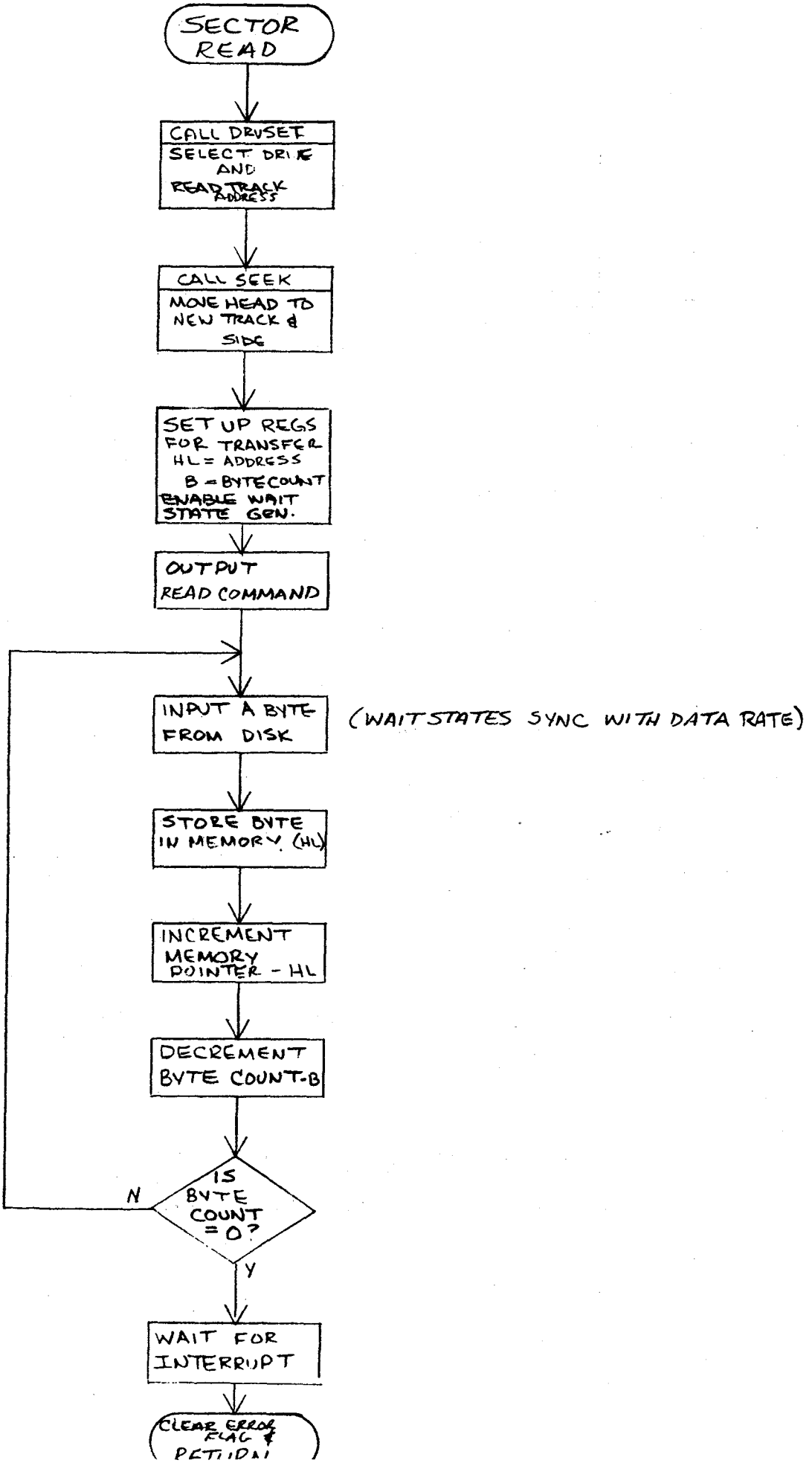
As was stated earlier, control on VERSAFLOPPY is divided evenly between hardware and the control software. Certain sequences must be executed to ensure proper operation of the disk drive. This section will cover the basic software sequences with verbal and graphic description. Program listings of the software in Z-80 source code (also runs on 8080) are included in appendix E.

The SECTOR READ and SECTOR WRITE sequences are the two main entries into the controling software. Before these sequences may be entered, the memory transfer address, drive select, track and sector, must have been stored in memory locations. When operating with CP/M® Disk Operating System, these parameters are set up when the SETDMA, SELDSK, SETTRK, and SETSEC entries, respectively, are called. The READ and WRITE CP/M entries are linkages to the SECTOR READ and SECTOR WRITE sequences, respectively. (CP/M® is a registered trade mark of Digital Research of Pacific Grove, California.)

3-2 SECTOR READ SEQUENCE (Figure 3-1)

The function of the SECTOR READ SEQUENCE is to do everything necessary to transfer the previously specified sector (128 BYTES) to the previously specified memory buffer (anywhere in system RAM).

FIG 3-1


SECTOR READ
CALL DRVSET
SELECT DRIVE AND READ TRACK ADDRESS
CALL SEEK
MOVE HEAD TO NEW TRACK & SIDE
SET UP REGS FOR TRANSFER
HL = ADDRESS
B = BYTECOUNT
ENABLE WAIT STATE GEN.
OUTPUT READ COMMAND
INPUT A BYTE FROM DISK
(WAIT STATES SYNC WITH DATA RATE)
STORE BYTE IN MEMORY (HL)
INCREMENT MEMORY POINTER - HL
DECREMENT BYTE COUNT-B
IS BYTE COUNT = 0?
N
Y
WAIT FOR INTERRUPT
CLEAR ERROR FLAG & RETURN

The DRVSET (section 3-4) and SEEK (section 3-5) subroutines are called to engage the requested drive and put the Read/Write head on the requested side and track.

The CPU registers are then set up with the memory address and byte count. Data from the disk is input a byte at a time, and stored in memory. This process is synchronized with the disk date rate by hardware inserted wait states.

When all 128 bytes of data have been read in, the program waits for the hardware to go "not busy". The End of Command Routine then checks for CRC and other error conditions. If no errors occured the program returns to the caller with the error flag cleared.

3-3 SECTOR WRITE SEQUENCE (figure 3-2)

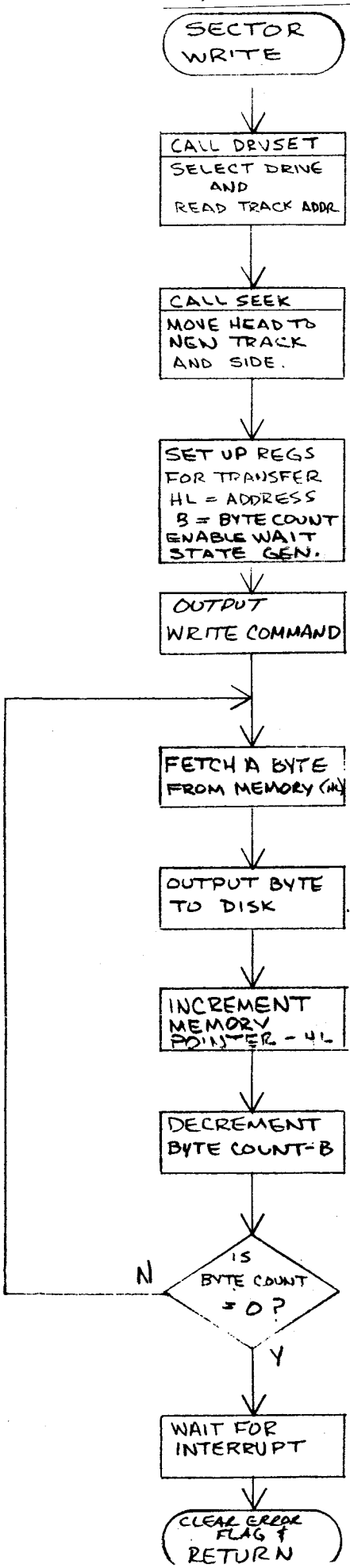
The function of the SECTOR WRITE SEQUENCE is to do everything necessary to transfer the previously specified memory buffer (128 bytes anywhere in system) to the previously specified disk sector.

The DRVSET (section 3-4) and SEEK (section 3-5) subroutines are called to engage the requested drive and put the read/write head on the requested side and track.

The CPU registers are then set up with the memory address and byte count. The data is output a byte at a time, to the disk. This process is synchronized with the disk data rate by hardware inserted wait states.

SECTOR WRITE SEQUENCE

FIG 3-2



(WAIT STATES SYNC WITH DATA RATE)

When all 128 bytes of data have been output, the program waits for the hardware to go "not busy". The End of Command Routine then checks for CRC and other error conditions. If no errors occured, the program returns to the caller with the error flag cleared.

3-4 DRIVE SELECTION SEQUENCE (figure 3-3)

The DRIVE SELECTION SEQUENCE checks to see if the requested drive is presently selected. If it is, the normal return is taken.

If the requested drive is not presently selected, the new selection is output followed by a 35 millisecond delay to allow for head settling.

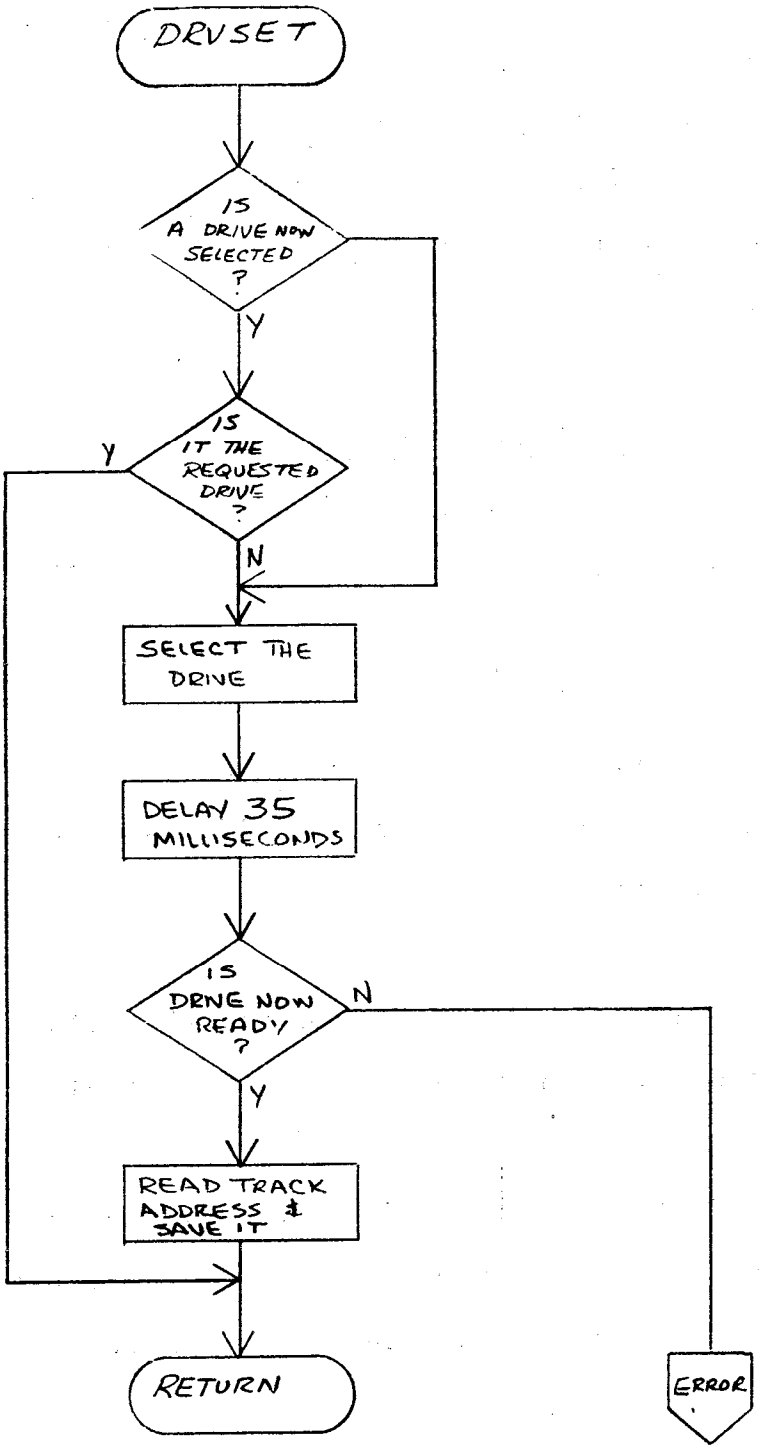
The status is then read to verify that the drive is now ready. If the drive is not ready, the error exit is taken.

If the drive is ready, the track address is read from the disk to inform the hardware of what track the new drive's read/write head is presently on. The routine normal return is then taken.

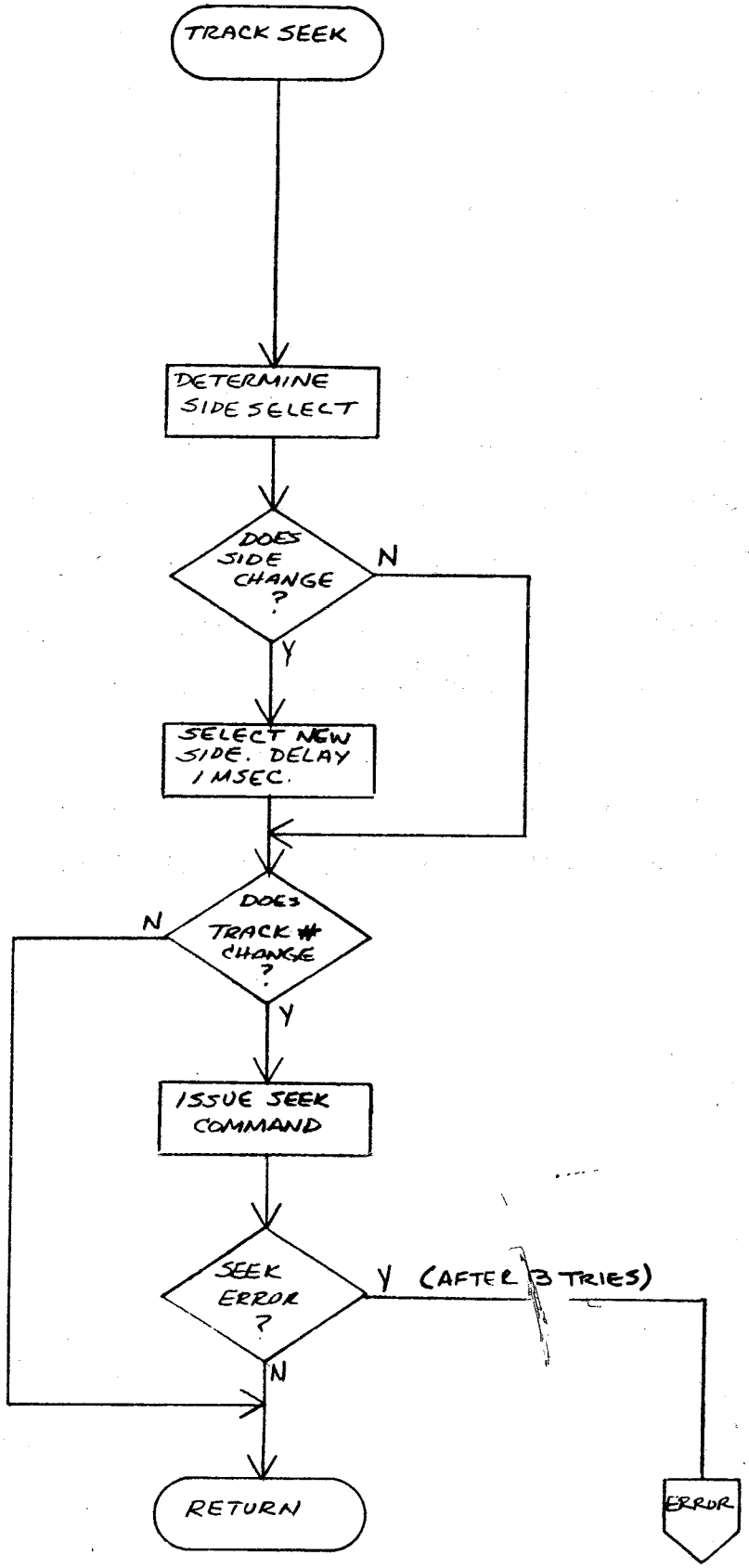
3-5 TRACK SEEK AND SIDE SELECT (figure 3-4)

The TRACK SEEK AND SIDE SELECT sequence is responsible for verifying that the requested track and sector are valid numbers, and in the case of the doublesided drives, select the proper side of the disk. Then the read/write head is moved to the requested track.

DRIVE SELECTION SEQUENCE
FIG 3-3



TRACK SEEK AND SIDE SELECT
FIG 3-4



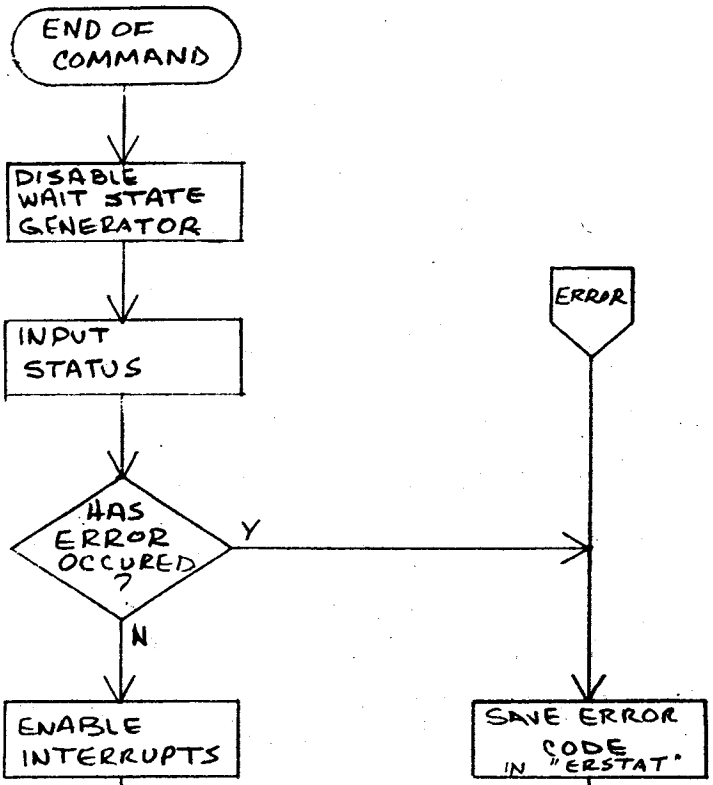
If there is a verification error after the track seek, the program moves the head to track 0 and then attempts to seek the track again. The standard control software makes two retries before taking the error exit.

3-6 END OF COMMAND ROUTINE (figure 3-5)

The END OF COMMAND ROUTINE is entered after both normal and error terminations of hardware executed commands. The routine waits for the FD 1771B-1 to become "not busy".The wait state generator is then disabled, and the status is input to check for errors. If no error occurred, then a normal return is taken.

If an error condition is detected, the error type is saved, error flag set and a return is taken directly back to the caller.

END OF COMMAND ROUTINE
FIG 3-5



SECTION IV

CONSTRUCTION

4-1 INTRODUCTION

The SD SALES Floppy Disk Controller Board Kit is intended for those people who have had some prior experience with kit building and digital electronics. If you do not fall into this category it is highly recommended that you either:

1. Find an experienced person to help you in assembly and check out the board or
2. Return the board to SD SALES and have the board assembled and tested.

Appendix B shows the parts list for the SD SALES Floppy Disk Controller board. Double check all parts against this parts list. If any differences are noted, please call SD SALES at 1-800-527-3460. (Toll free). NOTE: General construction information, assembly diagram and schematic diagram can be found in the Appendices.

4-2 ASSEMBLY PROCEDURE

1. Install the IC sockets in their proper locations.

   NOTE: No socket for DIP switch U29.

2. Install the resistors as follows:

   A. R1,R12,R14, 10K Ohm ¼W 10% (Brown,Black,Orange)
   B. R2,R5,R6,R7,R8,R11 3.3K Ohm ¼W 10% (Orange,Orange,Red)
   C. R3,R4, 820 Ohm ¼W 10% (Gray,Red,Brown)
   D. R9 390 Ohm ½W 10% (Orange,White,Brown)
   E. R10 120 Ohm ½W 10% (Brown,Red,Brown)
   F. R13 150 Ohm ¼W 10% (Brown,Green,Brown)
   H. RP 1 Resistor pack 3.3K Ohm 10 pin SIP
   NOTE: Pin 1 of this SIP is designated by a notch or a dot on the end of this package.

3. Install diodes CR1 and CR2 with the banded end as shown on the PC board.

   A. CR1 Zener diode 1N751-5V
   B. CR2 Zener Diode 1N472A-12V

4. Install the capacitors as follows:

   A. C1,C16,C17,C22,C23 10MF TANTALUM (note proper polarity)
   B. C2-C5,C8-C15 0.1 MF CERAMIC
      C18-C21
   C. C6 10PF MICA
   D. C7 .01 MF CERAMIC

5. Install the voltage regulator with this heat sink, using the 6-32 hardware supplies.

   VR1 +5V 7805/LM340T-5

6. Install the BERG HEADERS (On top side of board with long portion of Pin Up.)

   A. Install BERG 2 Pin Headers in the following locations:

      E13-E14
      E19-E20
      E24-E25
      E30-E31
      E35-E36
      E37-E38
      E39-E40
      E41-E42
      E43-E44

   B. Install BERG 3 Pin Headers in the following locations:

      a. E1,E2,E3
      b. E4,E5,E6
      c. E10,E11,E12
      d. E16,E17,E18
      e. E21,E22,E23
      f. E26,E27,E28
      g. E32,E33,E34

   C. Install BERG 4 Pin Header in E7,E8,E9,E29

   D. Install BERG 1 Pin Header in E15

7. Double check all solder connections for cold solder joints, unsoldered connections or shorted connections.

4-3 VOLTAGE CHECK

1. Install the board in the computer and measure the output of +5V regulator VR1, -5V and +12V of CR1 and CR2 respectively.

   A. VR1 = +5V (Bottom Pin)
   B. CR1 = =5V (Anode)
   C. CR2 - +12V (Cathode)

2. Measure the power supply voltages in the Floppy Disk Controller chip (any of the IC socket can be used.)

   A. Pin 1 U16 = -5V
   B. Pin 21 U16 = +5V
   C. Pin 40 V16 = +12V

   NOTE: Do not proceed with board check out until all power supply voltages are correct. The TTL and MOS Logic can be permanently damaged if improper voltages are applied.

3. Install the IC's in their sockets observing the Pin 1. designation on each socket marked on the PC board.

A.	U2,U20	74LS10
B.	U3,U8	74LS08
C.	U4	74LS38
D.	U5	Resistor 14 Pin MDL DIP 150 Ohm
E.	U6,U18,U24	74LS244
F.	U7,U9	7406
G.	U14,U25	74LS14
H.	U11	74LS193
I.	U12,U13,U19,U1	74LS74
J.	U15	74LS122
K.	U16	FD1771B-1
L.	U17	74LS273
M.	U21	74LS02
N.	U22,U23	74LS21
O.	U26,U27,U28	74LS40
P.	U29	Dip Dwitch 8 Position
Q.	U10	74LS04

4. Double check all IC's for proper orientation and location.

5. Refer to JUMPER OPTION SECTION V for proper configuration of jumper options and connect jumpers as required.

SECTION V

JUMPER OPTION SELECTION/INSTALLATION

5-1 INTRODUCTION

VERSAFLOPPY has been designed to accomodate a variety of disk drives and S-100 Z-80 and 8080 CPU boards. Care should be taken to install the correct jumpers for the user's specific computer system configuration. BERG PV Jumpers have been included for quick jumper installation and changes.

5-2 I/O PORT ADDRESS SELECTION

VERSAFLOPPY uses five I/O port address and these may reside at one of two possible places: 63H-67H (X=6) or $E3_H$ - $E7_H$ (X=E). Install the jumper for X=6 when using VERSAFLOPPY with the standard control software.

X	PORT ADDRESS	JUMPER
X=6	63H - 67H	E33-E34
X=E	E3H - E7H	E32-E33

5-3 CPU SELECTION

VERSAFLOPPY operates with Z-80, 8080 and 8085 CPU boards. Install all of the jumpers for the CPU to be used as follows:

CPU	JUMPERS
IMSAI/ALTAIR 8080	E24-E25, E27-E28
SDS Z-80	E27-E28
SBC-100	E27-E28
IMSAI 8085	E24-E25, E26-E27, E43-E44

5-4 INTERRUPT OPTIONS

There are several possible methods of handling interrupts with VERSAFLOPPY:

1. Interrupts not used. (Standard Software)
2. 8080 Mode using on board restart code.
3. 8080 Mode using a priority interrupt controller board.
4. Z-80 Mode 2 using on board vector code.
5. Z-80 Mode 2 using CTC interrupt circuit on SBC-100.

The Standard Control Software does not use interrupts. However in some cases it may be beneficial to inssue a command (such as seek track) and be interrupted when it is complete. When interrupts are used , VERSAFLOPPY must be given HIGHEST PRIORITY during SECTOR READS and SECTOR WRITES. An interrupt priority chain has been implemented for systems containing multiple sources of interrupts. This chain uses pin 14 for IEI (Interrupt Enable In) and pin 64 for IEO (Interrupt Enable Out). These will have to be used in conjunction with an S.D.S. motherboard which supports this chain.

The following table lists the jumpers for interrupt options:

INTERRUPT MODE	JUMPERS
INTERRUPTS NOT USED	NONE
8080 Mode Restart on board	E37-E38
8080 Mode using external controller	E13-E14 (usesVI2)
Z80 Mode 2 Using on board Vector	E37-E38
Z80 Mode 2 Using Off board CTC	E13-E14 (uses VI2)
If Priority Chain is used add	E30-E31 & E35-E36

5-5 DRIVE SELECTION

VERSAFLOPPY operates with several of the available floppy disk drives. Install the jumpers for the type of drive which is to be used.

DRIVE TYPE	JUMPERS
1 Shugart SA400	E22-E23,E1-E2,E41-E42,E16-E17
2 Shugart SA450	E22-E23,E1-E2,E19-E20,E41-E42,E16-E17
3 Shugart SA800 MFE 700,CDC9404*	E21-E22,E7-E8,E4-E5,E10-E11,E15-E17
4 Shugart SA850 MF 750, CDC9406*	E21-E22,E19-E20,E7-E8,E4-E5,E10-E11,E15-E17
5 Persci 70	E21-E22,E17-E18,E39-E40,E4-E5,E10-E11
6 Persci 277	E21-E22,E17-E18,E5-E6,E11-E12,E39-E40
7 GSI GS-105	Same as SA800 Plus E9-E29

* CDC Drives are not Pin for Pin compatible and require a Non Standard Cable.

SECTION VI

SOFTWARE OPTIONS

6-1 INTRODUCTION

The standard control software for VERSAFLOPPY is supplied in listing form (Appendix D) and also available in 2708 or 2758 PROM for an additional charge. This software is called BIOS (Basic I/O System) and is linked to the S.D. Modified CP/M disk operating system (Section 6-4) to reside at F000H. There are several parameters within BIOS that must be set up for the particular computer environment in which the VERSAFLOPPY is to operate.

6-2 CONSOLE PORT ADDRESS AND BIT MASKS

The minimum I/O configuration for CP/M to operate is a disk drive and a console or terminal. BIOS is set up to talk to the console via a UART type of interface. The port address of the UART (Data and STATUS) must be set up to match that of the console in the system. The following bytes within BIOS (version 1.0) must be set up:

ADDRESS	DESCRIPTION
F06B	Console Input Status Port Address
F06D	Console Input Data Ready Mask (RDA)
F079	Console Input Data Port Address
F07E	Console Output Status Port Address
F080	Console Output Ready Mask (TBE)
F086	Console Output Data Port Address

If a special type of console device, such as a VDM, is to be used, the following mods will allow jumping to the users software driver:

ADDRESS	DATA	DESCRIPTION
F006	.C3	Console Input Status Linkage-
F007	Low Order Address	This routine checks the console
F008	High Order Address	input to see if a character is ready to be read in. If a character is ready, return with ACC=FF. If not, ACC=0.
F009	C3	Console Input Linkage- This routine
F00A	Low Order Address	must input character from console
F00B	High Order Address	keyboard and return it in ACC.
F00C	C3	Console Output Linkage -
F00D	Low Order Address	This routine must output the
F00E	High Order Address	charater in C-reg to console.

6-3 DRIVE PARAMETER OPTIONS

Several software parameters must be set up for the type of drive (mini or full size) to be used:

	DATE (HEX)		
ADDRESS	MINI	FULL SIZE	DESCRIPTION
F03F	12	1A	Sectors per track
F040	23	4D	Tracks per side
F041	14	4C	Format Gap 1
F042	11	11	Format Gap 2
F043	OE	21	Format Gap 3
F044	03	OA	Restore Command
F045	17	1E	Seek Command
F046	13	1A	Seek with no verify
F047	4B	23	Head Load Delay

6-4 CLOCK RATE PARAMETER

The following byte must be set up for the system clock rate.

ADDRESS	2MHZ	2.5MHZ	3MHZ	4MHZ
F048	8E	B2	D8	00

6-5 BOOTING UP CP/M

In order to run CP/M disk operating system, a minimum of 16K of RAM must be in the system starting at address 0000 and the BIOS PROM must be at $F000_H$. Execute BIOS at F000 and CP/M will be booted and promp with "A>". Refer to the "AN INTRODUCTION TO CP/M FEATURES AND FACILITIES" manual for details of the CP/M commands.

SECTION VII

CHECK - OUT

7-1 INTRODUCTION

This section will describe some basic checks that should be made on the VERSAFLOPPY. NOTE: It is assumed at this point that the voltage checks described in Section 4 have been previously made. The following checks require that the CPU board also be plugged in to the Bus. Be sure to check all jumper options.

7-2 OSCILLATOR

Apply power to board and verify that there is a 4MHZ clock on E21.

7-3 $\overline{RE}$ AND $\overline{WE}$ PULSES

Verify that U16 Pin 4 pulses low during any Input instruction, and U16 Pin 2 pulses low during any output instruction.

7-4 I/O PORT WRITE/READ VERIFICATION

Using the monitor in the system or a short program, write data to port X5 (x=6 or E) and read it back . Verify that the data read back is the same as that written. This is done to test the

data path to and from the FD1771B-1 as well as the internal register. REPEAT this procedure for ports X6 and X7. Bits 0-4 of port X3 should also read back data that is written to them.

7-5 HEAD LOAD MONOSTABLE

After the diagnostic software is operating, check E15 for a 35 millisecond pulse (low) each time the head loads. This need not be tested when using mini drives.

SECTION VIII

DIAGNOSTIC SOFTWARE

8-1 INTRODUCTION

A diagnostic program for VERSAFLOPPY is supplied in listing form (APPENDIX E) and also available in 2708 or 2758 PROM for an additional charge. The diagnostic program is also on the diskette, when CP/M is purchased, under the file name of "VDIAG.COM". Once CP/M is operating, the diagnostic may be run by typing VDIAG (CR). The CP/M diskette should not be placed in the drive until the VERSAFLOPPY and disk drive(s) have been thoroughly checked out.

When running the diagnostic to check-out the VERSAFLOPPY, insert the PROM containing the diagnostic program in a PROM board which is addressed above the RAM. (16K minimum starting at 0000). Copy the contents (1K) of the PROM to the 1K block of memory starting at 100_H. The diagnostic uses the BIOS PROM for disk and console I/O, which must have been set up as described in Section VI.

8-2 DIAGNOSTIC TEST START-UP

Execute the diagnostic program at 100_H and the following message will print on the console:

TEST # DRV # (TTDD)

The program then waits for the test number and drive number to be entered from the console followed by a carriage return. NOTE: The test number and drive number are each two digits and MUST NOT be separated by a comma or space.

The test routines may be terminated at any time by entering a period (.) on the console keyboard. The diagnostic will then print the above prompting message and wait for further keyboard entries.

8-3 DIAGNOSTIC TEST 00 (SEEK TEST)

Test 00 is a simple routine to verify that the VERSAFLOPPY is receiving commands properly and that the track seek circuitry is functional. The selected drive should begin moving the head from track 00 to the inside track (76 for full size, 34 for mini) and back again. Enter a period on the keyboard to cause the test to cease.

8-4 DIAGNOSTIC TEST 01 (WRITE/READ)

Diagnostic test 01 writes random data on each sector, reads the sector back and compares the data to verify that it is identical. Any errors which occur will be printed on the console. (see section 8) This is done to each sector sequentially, starting at track 00, sector 1, until reaching the innermost track. At that point it prints a "P" on the console, returns to track 00, and continues. Enter a period (.) to terminate this test.

NOTE: Diagnostic tests which read and write to disk may only be run after the diskette has been formatted using diagnostic 05. (See 8-8)

8-5 DIAGNOSTIC TEST 02 (READ TEST)

Test 02 reads every sector on the disk sequentially and checks for CRC errors, and seek errors. Errors will be reported on the console. This test should step from track to track at the same rate as when formatting a diskette.

8-6 DIAGNOSTIC TEST 03 (RANDOM WRITE/READ)

This test is similar to test 01 in that it writes, reads and compares data byte by byte. However, test 03 choses the sectors on a random basis in an attempt to simulate actual use. This test exercises only the specified drive.

8-7 DIAGNOSTIC TEST 04 (MULTI-DRIVE RANDOM WRITE/READ)

This test is identical to Test 03 except that it also selects a random drive (0 or 1)

8-8 DIAGNOSTIC TEST 05 (FORMATTING)

Test code 05 is actually not a diagnostic, but a program which formats a diskette with the IBM 3740 soft sectored data. This

must be done to all diskettes before further use. Note that on the distributed CP/M diskette there is a program which formats a diskette in drive B. This program has the filename "FORMAT.COM" and may be run by entering "FORMAT (CR)". Be sure to have a scratch or unformatted diskette in drive B when "FORMAT" is run because any previously written data will be lost.

8-9 DIAGNOSTIC TEST 10 (LOAD FROM DISK)

Test code 10 is not a diagnostic, but provides a means of loading absolute sectors into memory. Note the following interactive sequence: (all user entries are underlined)

CONSOLE INTERACTION	COMMENTS
TEST # DRV # (TTDD) : 1000 (CR)	Test code 10, Drive 00
ENTER LOAD ADDR: 2000 (CR)	Memory address for load=2000_H
ENTER TRACK/SECTOR (TTSS): 1205 (CR)	Start at TRK12, Sector 05
ENTER NUMBER OF SECTORS (NN): 20 (CR)	Load 20_H sectors

At this point, 20_H Sectors (32 x 128 bytes) starting at track 12_H sector 5 would load into memory starting at address 2000_H.

8-10 DIAGNOSTIC TEST 11 (SAVE ON DISK)

Test code 11 provides a means of saving the contents of memory on disk. The following sequence describes this:

CONSOLDE INTERACTION	COMMENTS
TEST # DRV # (TTDD) : 1100 (CR)	Test code 11, drive 00
ENTER SAVE ADDR: 2000 (CR)	Memory address for save=2000_H
ENTER TRACK/SECTOR (TTSS): 1205 (CR)	Start at Track 12_H Sector 05
ENTER NUMBER OF SECTORS (NN): 20 (CR)	Save 20_H sectors

At this point, 20_H sectors (32 x 128 bytes) would be written to disk from memory starting at address 2000_H.

8-11 DIAGNOSTIC TEST FF (JUMP)

Test code FF allows executing the diagnostic to anywhere in memory. The following sequence describes this:

CONSOLE INTERACTION	COMMENTS
TEST #, DRV # (TTDD): FF00 (CR)	
ADDRESS: 3000 (CR)	Jump to address 3000_H

8-12 DIAGNOSTIC ERROR REPORTING

If any errors occur during diagnostics 1,2,3, or 4, the errors will be reported on the console as follows:

```
CMD STAT DRV TRK SCTR> CC SS DD TT SS

where CC = The controller command being executed
      SS = The error status (type of error)
      DD = The drive being tested
      TT = The track being tested
      SS = The sector being tested
```

Table 8-1 lists the various controller commands and table 8-2 contains the definition of each bit in the error status byte.

TABLE 8-1

DISK CONTROLLER COMMAND CODES

MINI DISK CMD CODE	FULL SIZE CMD CODE	DESCRIPTION
03	0A	Restore Drive to TRK ØØ
17	1E	Track Seek
13	1A	Track Seek with No Verify
F4	F4	Format Track
88	88	Read Sector
8C	8C	Load Head, Then Read Sector
A8	A8	Write Sector
AC	AC	Load Head, Then Write Sector
C4	C4	Read Track Address

TABLE 8-2

ERROR STATUS DEFINITION

BIT #	DEFINITION
BIT Ø	Write Delected Sector has been read
BIT 1	DRQ Bit (Indicates Exessive noise on S100 Bus)
BIT 2	Data Lost
BIT 3	CRC Error
BIT 4	Sector Not Found
BIT 5	Track Seek Error
BIT 6	Write Protected Diskette
BIT 7	Drive Not Ready

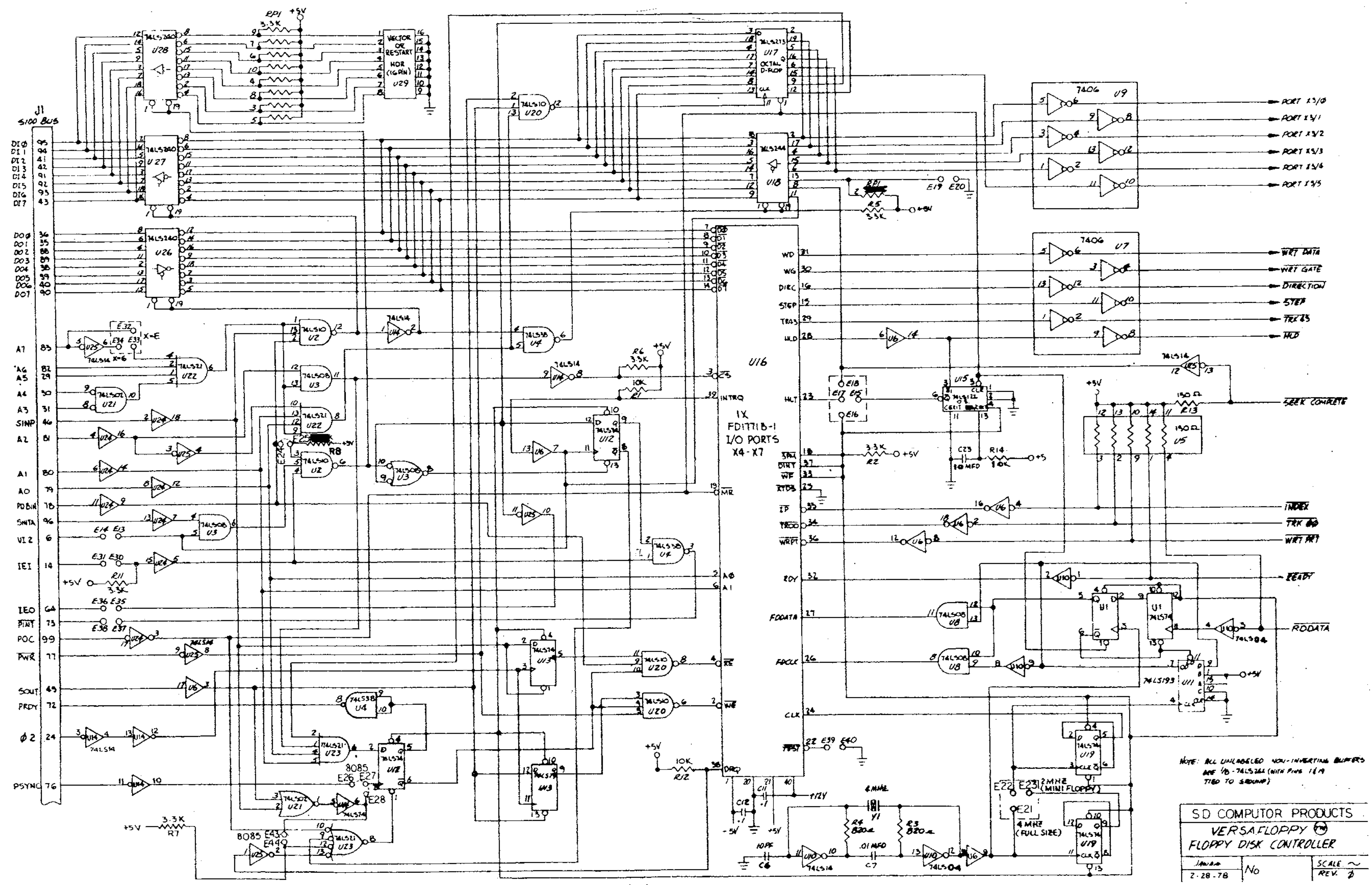
APPENDIX A

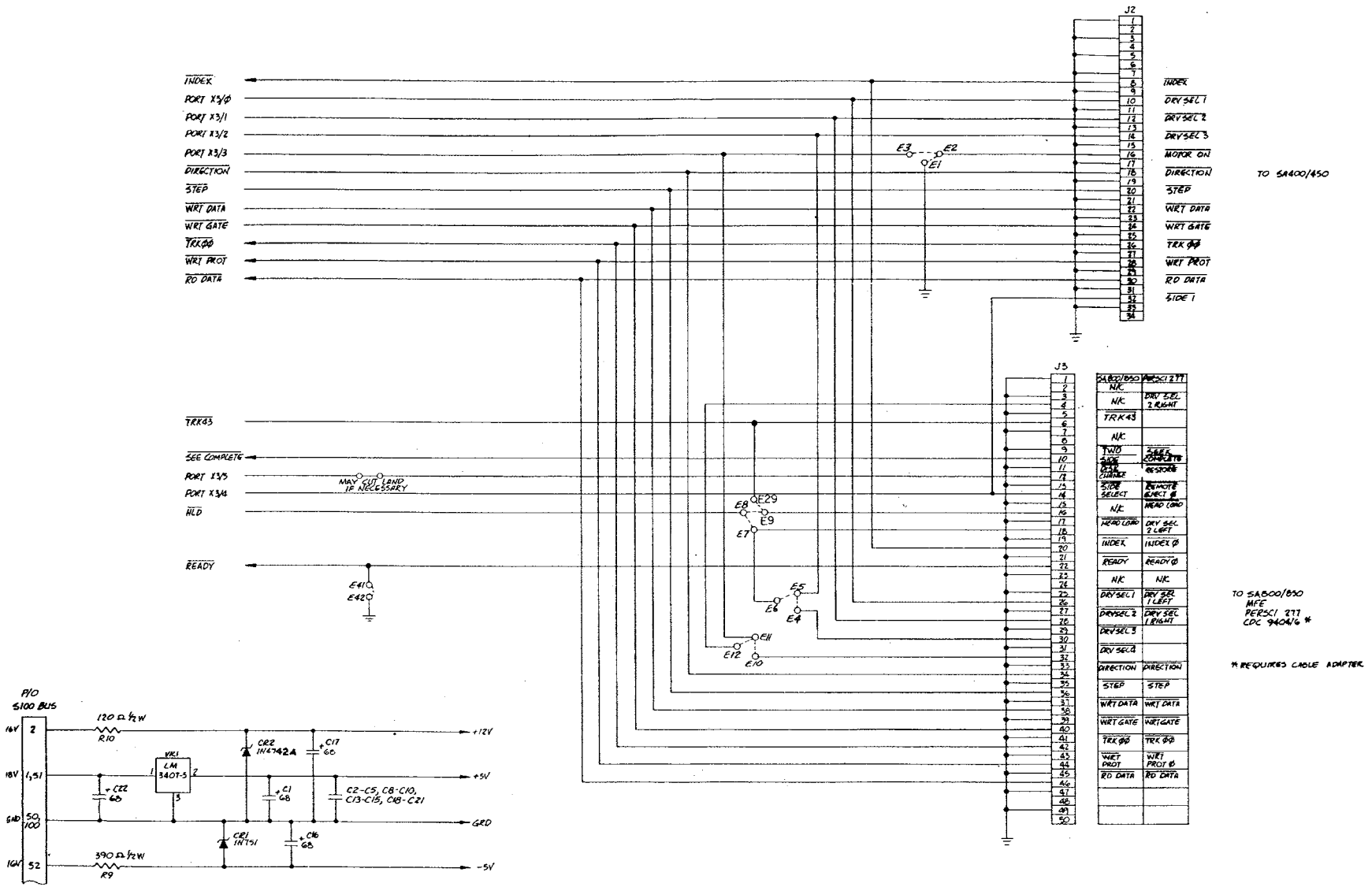
FLOPPY DISK CONTROLLER PARTS LIST

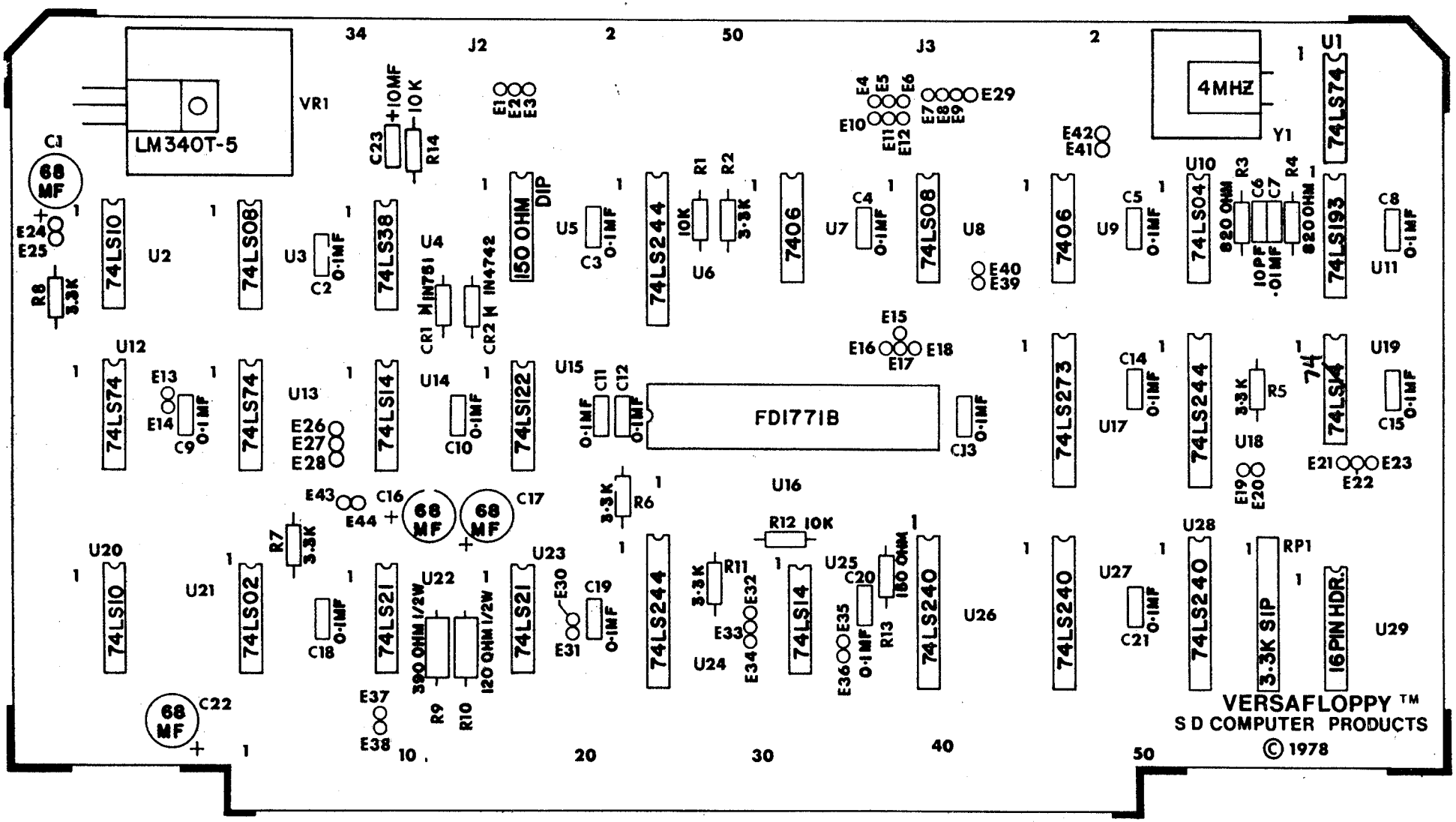
ITEM #	QUANTITY	DESCRIPTION	LOCATION
1	1	P.C. BOARD	
2	1	74LS02	U21
3	1	74LS04	U10
4	2	74LS08	U3,U8
5	2	74LS10	U2,U20
6	2	74LS14	U14,U25
7	2	74LS21	U22,U23
8	1	74LS38	U4
9	4	74LS74	U1,U12,U13,U19
10	1	74LS122	U15
11	1	74LS193	U11
12	3	74LS240	U26,U27,U28
13	3	74LS244	U6,U18,U24
14	1	74LS273	U17
15	2	7406	U7,U9
16	1	FD 1771B-1	U16
17	1	DIP SWITCH,8 POSITION	U29
18	18	SOCKET, 14 PIN	
19	1	SOCKET, 16 PIN	
20	7	SOCKET, 20 PIN	
21	1	SOCKET, 40 PIN	
22	1	RESISTOR MDL,14 PIN DIP 150 Ohm	U5
23	1	RESISTOR MDL,10 PIN SIP 3.3K	RP1
24	3	RESISTOR, 10K,¼W,10%	R1,R12,R14
25	6	RESISTOR,3.3K,¼W,10%	R2,R5-R8,R11
26	2	RESISTOR,820 Ohm,¼W 10%	R3,R4
27	1	RESISTOR,150 Ohm,¼W 10%	R13
28	1	RESISTOR,120 Ohm,¼W,10%	R10
29	1	RESISTOR,390 Ohm,¼W,10%	R9
30	5	CAPACITOR, 10 MFD,20V TANT.	C1,C16,C17,C22,C23
31	16	CAPACITOR, .1 MFD,16V MONOCERAMIC	C2-C5,C8-C15, C18-C21
32	1	CAPACITOR, .01 MFD,16V CERAMIC	C7
33	1	CAPACITOR, 10 PFD,16V MICA DIP	C6
34	1	ZENER DIODE, 1N751 5V	CR1
35	1	ZENER DIODE, 1N4742A, 12V	CR2
36	1	LM340T-5 VOLTAGE REGULATOR,5V	VR1
37	12	BERG 65474 PV JUMPERS	
38	1	HEAT SINK, 6106-14	
39	1	4 MHz CRYSTAL	Y1
40	1	BERG 65500-401 STRAIGHT HEADER (1PIN)	E15
41	9	BERG 65500-402 STRAIGHT HEADER (2PIN)	E13,E19,E24,E30 E55,E37,E39,E41 E43
42	7	BERG 65500-403 STRAIGHT HEADER (3PIN)	E1,E4,E10,E16 E21,E26,E32
43	1	BERG 65500-404 STRAIGHT HEADER (4PIN)	E7

APPENDIX B

VERSAFLOPPY SCHEMATIC DIAGRAM


S.D COMPUTOR PRODUCTS
VERSAFLOPPY
FLOPPY DISK CONTROLLER
2-28-78
SCALE ~
REV. 0
NOTE: ALL UNLABELED NON-INVERTING BUFFERS ARE 1/8 - 74LS244 (WITH PINS 1&19 TIED TO GROUND)
J1
S100 BUS
U16
1X
FD1771B-1
I/O PORTS
X4-X7
VECTOR OR RESTART
HDR (16 PIN)
U29
OCTAL D-FLOP
U17
U18
U28
U27
U26
RP1
+5V
3.3K
PORT X3/0
PORT X3/1
PORT X3/2
PORT X3/3
PORT X3/4
PORT X3/5
7406
U9
U7
WRT DATA
WRT GATE
DIRECTION
STEP
TRK 43
HLD
SEEK COMPLETE
INDEX
TRK 00
WRT PRT
READY
RDDATA
4MHZ
2MHZ (MINI FLOPPY)
4MHZ (FULL SIZE)
INTRQ
DRQ
DIØ
DI1
DI2
DI3
DI4
DI5
DI6
DI7
DOØ
DO1
DO2
DO3
DO4
DO5
DO6
DO7
A7
A6
A5
A4
A3
SINP
A2
A1
A0
PDBIN
SWTA
VI2
IEI
IEO
PINT
POC
PWR
SOUT
PRDY
Φ2
PSYNC


J2
INDEX
PORT X3/0
PORT X3/1
PORT X3/2
PORT X3/3
DIRECTION
STEP
WRT DATA
WRT GATE
TRK 00
WRT PROT
RD DATA
E3
E2
E1
INDEX
DRV SEL 1
DRV SEL 2
DRV SEL 3
MOTOR ON
DIRECTION
STEP
WRT DATA
WRT GATE
TRK 00
WRT PROT
RD DATA
SIDE 1
TO SA400/450
J3
TRK 43
SEC COMPLETE
PORT X3/5
PORT X3/4
HLD
MAY CUT LEND IF NECESSARY
E8
E29
E9
E7
E5
E6
E4
E11
E12
E10
READY
E41
E42
SA800/850
PERSCI 277
N.C.
DRV SEL 2 RIGHT
TRK 43
N.C.
TWO SIDED
SIDE SELECT
REMOTE DIRECT ϕ
N.C.
HEAD LOAD
DRV SEL 2 LEFT
INDEX
INDEX ϕ
READY
READY ϕ
N.C.
N.C.
DRV SEL 1
DRV SEL 1 LEFT
DRV SEL 2
DRV SEL 1 RIGHT
DRV SEL 3
DRV SEL 4
DIRECTION
DIRECTION
STEP
STEP
WRT DATA
WRT DATA
WRT GATE
WRT GATE
TRK 00
TRK 00
WRT PROT
WRT PROT ϕ
RD DATA
RD DATA
TO SA800/850 MFE PERSCI 277 CDC 9404/6 *
* REQUIRES CABLE ADAPTER
P/O S100 BUS
16V
18V
GND
16V
120 Ω ½W
R10
VR1
LM 340T-5
CR2 1N4742A
+C17 6D
+C22 6D
+C1 6B
C2-C5, C8-C10, C13-C15, C18-C21
CR1 1N751
+C16 6B
390 Ω ½W
R9
+12V
+5V
GRD
-5V



VERSAFLOPPY PARTS PLACEMENT DRAWING

APPENDIX D

VERSAFLOPPY CONTROL

SOFTWARE "BIOS"

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0002          NAME    BIOS
                 0003 ;
                 0004 ;        I/O DRIVERS FOR CP/M
                 0005 ;
                 0006 ;        VERSION 1.0     03/17/78
                 0007 ;        RUNS ON Z80, 8080, OR 8085
                 0008 ;
                 0009          PSECT   ABS
 >F000           0010          ORG     0F000H
                 0011 ;
                 0012 ;
 >0080           0013 NBYTES   EQU     128     ; BYTES PER SECTOR
                 0014 ;
                 0015 ;
 >0000           0016 RBASE    EQU     0000H           ; START OF RAM
 >0040           0017 TADDR    EQU     RBASE+40H       ; TRANSFER ADDRESS
 >0042           0018 UNIT     EQU     RBASE+42H       ; DRIVE #
 >0043           0019 SCTR     EQU     RBASE+43H       ; SECTOR
 >0044           0020 TRK      EQU     RBASE+44H       ; TRACK
 >0045           0021 NREC     EQU     RBASE+45H       ; # OF SECTORS
 >0046           0022 ERMASK   EQU     RBASE+46H       ; ERROR MASK
 >0047           0023 ERSTAT   EQU     RBASE+47H       ; ERROR STATUS
 >0048           0024 IDSV     EQU     RBASE+48H       ; 4 BYTES
 >004C           0025 CMDSV    EQU     RBASE+4CH       ; COMMAND SAVE
 >004D           0026 SPSV     EQU     RBASE+4DH       ; SP SAVE (2 BYTES)
 >0080           0027 SSTACK   EQU     RBASE+80H       ; SYSTEM STACK
 >0080           0028 COLD     EQU     RBASE+80H       ; COLD START ADDRESS
                 0029 ;
                 0030 ;
                 0031 ;        PORTS USED BY DISK CONTROLLER
                 0032 ;
 >0060           0033 X        EQU     60H
 >0063           0034 SELECT   EQU     X+3     ; DRIVE SELECT PORT
 >0064           0035 STATUS   EQU     X+4     ; STATUS PORT
 >0065           0036 TRACK    EQU     X+5     ; TRACK PORT
 >0066           0037 SECTOR   EQU     X+6     ; SECTOR PORT
 >0067           0038 DATA     EQU     X+7     ; DATA PORT
 >0064           0039 CMD      EQU     X+4     ; COMMAND PORT
                 0040 ;
                 0041 ;
                 0042 ;        SERIAL I/O PORTS
                 0043 ;
                 0044 ;
 >007C           0045 SDATA    EQU     07CH    ; SERIAL DATA PORT
 >007D           0046 SSTAT    EQU     07DH    ; SERIAL STATUS PORT
 >0002           0047 RXRMSK   EQU     02H     ; RX RDY MASK
 >0001           0048 TXRMSK   EQU     01H     ; TX RDY MASK
                 0049 ;
                 0050 ;
                 0051 ; DISK ERROR STATUS BITS (ERSTAT)
                 0052 ;
                 0053 ;
                 0054 ; BIT 7 - DRIVE NOT READY
                 0055 ; BIT 6 - WRITE PROTECTED
                 0056 ; BIT 5 - TRACK SEEK ERROR
                 0057 ; BIT 4 - SECTOR NOT FOUND
                 0058 ; BIT 3 - CRC ERROR
                 0059 ; BIT 2 - DATA LOST
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0060 ;  BIT 1 - DRQ BIT
                 0061 ;  BIT 0 - WRITE DELETED SECTOR READ
                 0062 ;
                 0063 ;
                 0064 ;  DISK CONTROLLER COMMAND CODES
                 0065 ;
                 0066 ;
>00C4            0067 RDACMD  EQU     0C4H    ; READ ADDRESS CMD
>0088            0068 RDCMD   EQU     88H     ; READ SECTOR CMD
>00A8            0069 WRCMD   EQU     0A8H    ; WRITE SECTOR CMD
>00F4            0070 WRTCMD  EQU     0F4H    ; WRITE TRACK CMD
                 0071 ;
                 0072 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0074 ;
                 0075 ;        CP/M SYSTEM LINKAGES
                 0076 ;
                 0077 ;
 F000  C349F0    0078 BIOS     JP       BOOT     ; COLD START ENTRY
 F003  C349F0    0079 WBOOTE   JP       BOOT     ; WARM START ENTRY
 F006  C36AF0    0080 CSE      JP       CONST    ; CONSOLE STATUS
 F009  C372F0    0081 CIE      JP       CONIN    ; READ CONSOLE
 F00C  C37DF0    0082 COE      JP       CONOUT   ; WRITE CONSOLE
 F00F  C37DF0    0083 LSTE     JP       LIST     ; WRITE PRINTER
 F012  C37DF0    0084 PCHE     JP       PUNCH    ; WRITE PUNCH
 F015  C372F0    0085 RDRE     JP       READER   ; READ READER
 F018  C388F0    0086 HME      JP       HOME     ; MOVE DISK TO TRK 00
 F01B  C39AF0    0087 SDSKE    JP       SELDSK   ; SELECT DISK DRIVE
 F01E  C39FF0    0088 STRKE    JP       SETTRK   ; SET DISK TRACK
 F021  C3A4F0    0089 SSECE    JP       SETSEC   ; SET DISK SECTOR
 F024  C3A9F0    0090 SDMAE    JP       SETDMA   ; SET MEM ADDR FOR READ/WRITE
 F027  C3AFF0    0091 RDE      JP       READ     ; READ A SECTOR
 F02A  C3BEF0    0092 WRE      JP       WRITE    ; WRITE A SECTOR
 F02D  C354F2    0093 LDE      JP       LOADER   ; LOAD 'N' SECTORS
 F030  C361F2    0094 SVE      JP       SAVER    ; SAVE 'N' RECORDS
 F033  C330F3    0095 FMATE    JP       FMAT     ; FORMAT A TRACK
 F036  C30CF3    0096 SCANE    JP       SCAN     ; SCAN FOR OPERAND
 F039  C3AEF2    0097 PTXTE    JP       PTXT     ; PRINT TEXT
 F03C  C3BAF2    0098 PACCE    JP       PACC     ; PRINT ACC
                 0099 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0101 ;
                 0102 ;         MINI / FULL SIZE VARIABLES
                 0103 ;
                 0104 ;         SET UP THESE BYTES FOR THE TYPE OF
                 0105 ;         DRIVE TO BE USED.  THESE ARE THE ONLY
                 0106 ;         SOFTWARE CHANGES WITHIN BIOS TO CONVERT
                 0107 ;         FROM MINI TO FULL SIZE DRIVES (OR VISA
                 0108 ;         VERSA).
                 0109 ;
                 0110 ;
                 0111 ;                                  MINI  FULL SIZE
                 0112 ;
F03F  12         0113 NSCTRS    DEFB     12H      ;  12    1A       SCTRS/TRK
F040  23         0114 NTRKS     DEFB     23H      ;  23    4D       TRACKS/SIDE
F041  14         0115 GAP1      DEFB     14H      ;  14    4C       FORMAT GAP1
F042  11         0116 GAP2      DEFB     11H      ;  11    11       FORMAT GAP2
F043  0E         0117 GAP3      DEFB     0EH      ;  0E    21       FORMAT GAP3
F044  03         0118 RSCMD     DEFB     03H      ;  03    0A       RESTORE CMD
F045  17         0119 SKCMD     DEFB     17H      ;  17    1E       SEEK CMD
F046  13         0120 SKNCMD    DEFB     13H      ;  13    1A       SEEK W/NO VER
F047  4B         0121 HLDLY     DEFB     4BH      ;  4B    23       HEAD LOAD DELAY
                 0122 ;
                 0123 ;
                 0124 ;         DELAY CONSTANT MUST BE SET UP FOR
                 0125 ;         THE CPU CLOCK RATE USED:
                 0126 ;
                 0127 ;                                  2MHZ  2.5MHZ  3MHZ  4MHZ
                 0128 ;
F048  8E         0129 DLYCON    DEFB     8EH      ;  8E    B2       D8       00
```

```
IOS   COPYRIGHT 1978 SD SALES COMPANY  MOSTEK FLP-80 ASSEMBLER V1.0 PAGE 0005
ADDR  OBJECT    ST # SOURCE STATEMENT

F049  DB7F      0131 BOOT    IN       A,(07FH)       ; CLEAR H.W.
F04B  318000    0132         LD       SP,SSTACK
F04E  218000    0133         LD       HL,COLD
F051  224000    0134         LD       (TADDR),HL
F054  3E01      0135         LD       A,1
F056  324500    0136         LD       (NREC),A
F059  324300    0137         LD       (SCTR),A
F05C  AF        0138         XOR      A
F05D  324200    0139         LD       (UNIT),A
F060  324400    0140         LD       (TRK),A
F063  CD54F2    0141         CALL     LOADER         ; BOOT IN CP/M (EXCEPT CBIOS
F066  CA8000    0142         JP       Z,COLD         ; JUMP TO COLD START
F069  76        0143         HALT                    ; IF BAD DISK, HALT
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0145 ;
                 0146 ;        NON-DISK I/O DRIVER LINKAGES TO MOSTEK'S DDT
                 0147 ;
 F06A  DB7D      0148 CONST    IN       A,(SSTAT)        ; CONSOLE STATUS
 F06C  E602      0149          AND      RXRMSK
 F06E  C8        0150          RET      Z
 F06F  3EFF      0151          LD       A,0FFH
 F071  C9        0152          RET
                 0153 ;
                 0154 ; CONSOLE INPUT
                 0155 ;
 F072  CD6AF0    0156 CONIN    CALL     CONST
 F075  CA72F0    0157          JP       Z,CONIN
 F078  DB7C      0158          IN       A,(SDATA)
 F07A  E67F      0159          AND      7FH
 F07C  C9        0160          RET
                 0161 ;
                 0162 ; CONSOLE OUTPUT
                 0163 ;
 F07D  DB7D      0164 CONOUT   IN       A,(SSTAT)
 F07F  E601      0165          AND      TXRMSK  ; TX BFR EMPTY
 F081  CA7DF0    0166          JP       Z,CONOUT
 F084  79        0167          LD       A,C
 F085  D37C      0168          OUT      (SDATA),A
 F087  C9        0169          RET
                 0170 ;
                 0171 ; READER INPUT
                 0172 ;
>F072            0173 READER   EQU      CONIN
                 0174 ;
                 0175 ; LISTING OUTPUT
                 0176 ;
>F07D            0177 LIST     EQU      CONOUT
                 0178 ;
                 0179 ;
                 0180 ; PUNCH OUTPUT
                 0181 ;
>F07D            0182 PUNCH    EQU      CONOUT
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0184 ;
                 0185 ;
                 0186 ;
                 0187 ;          DISK CONTROLLER LINKAGES
                 0188 ;
                 0189 ;
 F088  CD3AF1    0190 HOME       CALL    DRVSET  ; SELECT DRIVE
 F08B  210000    0191            LD      HL,0
 F08E  39        0192            ADD     HL,SP
 F08F  224D00    0193            LD      (SPSV),HL
 F092  3A44F0    0194            LD      A,(RSCMD)
 F095  CDCCF1    0195            CALL    CMDI
 F098  AF        0196            XOR     A
 F099  C9        0197            RET
                 0198 ;
                 0199 ;          SELECT DISK DRIVE
                 0200 ;
 F09A  79        0201 SELDSK     LD      A,C
 F09B  324200    0202            LD      (UNIT),A
 F09E  C9        0203            RET
                 0204 ;
                 0205 ;          SET TRACK NUMBER
                 0206 ;
 F09F  79        0207 SETTRK     LD      A,C
 F0A0  324400    0208            LD      (TRK),A
 F0A3  C9        0209            RET
                 0210 ;
                 0211 ;          SET SECTOR NUMBER
                 0212 ;
 F0A4  79        0213 SETSEC     LD      A,C
 F0A5  324300    0214            LD      (SCTR),A
 F0A8  C9        0215            RET
                 0216 ;
                 0217 ;          SET MEMORY TRANSFER ADDRESS FOR DISK READ/WRITE
                 0218 ;
 F0A9  C5        0219 SETDMA     PUSH    BC
 F0AA  E1        0220            POP     HL
 F0AB  224000    0221            LD      (TADDR),HL
 F0AE  C9        0222            RET
                 0223 ;
                 0224 ;          READ A SECTOR
                 0225 ;
 F0AF  060A      0226 READ       LD      B,10
 F0B1  C5        0227 READ1      PUSH    BC
 F0B2  CD6EF1    0228            CALL    RDSC    ; READ A SECTOR
 F0B5  C1        0229            POP     BC
 F0B6  C8        0230            RET     Z       ; RETURN IF NO ERROR
 F0B7  05        0231            DEC     B
 F0B8  C2B1F0    0232            JP      NZ,READ1 ; 10 RETRIES
 F0BB  AF        0233            XOR     A
 F0BC  3C        0234            INC     A
 F0BD  C9        0235            RET             ; ERROR RETURN
                 0236 ;
                 0237 ;          WRITE A SECTOR
                 0238 ;
 F0BE  060A      0239 WRITE      LD      B,10
 F0C0  C5        0240 WRITE1     PUSH    BC
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 F0C1  CD9DF1    0241          CALL    WRSC      ; WRITE A SCTR
 F0C4  C1        0242          POP     BC
 F0C5  C8        0243          RET     Z         ; RETURN IF NO ERROR
 F0C6  05        0244          DEC     B
 F0C7  C2C0F0    0245          JP      NZ,WRITE1
 F0CA  AF        0246          XOR     A
 F0CB  3C        0247          INC     A
 F0CC  C9        0248          RET               ; ERROR RETURN
                 0249 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0251 ;
                 0252 ;
                 0253 ;
                 0254 ;  END OF COMMAND
                 0255 ;
                 0256 ;
                 0257 ;
 FOCD  DB64      0258 END      IN        A,(STATUS)
 FOCF  E601      0259          AND       1
 FOD1  C2CDFO    0260          JP        NZ,END
 FOD4  CDFOF1    0261          CALL      DWAIT
 FOD7  DB64      0262          IN        A,(STATUS)
 FOD9  57        0263          LD        D,A
 FODA  3A4600    0264          LD        A,(ERMASK)
 FODD  A2        0265          AND       D          ;  CHECK FOR ERRORS
 FODE  C8        0266          RET       Z
 FODF  7A        0267 END1     LD        A,D
 FOEO  324700    0268 END2     LD        (ERSTAT),A        ;  SAVE ERROR BITS
 FOE3  F601      0269          OR        1
 FOE5  2A4DOO    0270          LD        HL,(SPSV)
 FOE8  F9        0271          LD        SP,HL
 FOE9  C9        0272          RET
                 0273 ;
                 0274 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0276 ;
                 0277 ;
                 0278 ;  SELECT SIDE AND SEEK TRACK
                 0279 ;
 F0EA  0600      0280 SEEK    LD      B,0
 F0EC  3A40F0    0281         LD      A,(NTRKS)
 F0EF  4F        0282         LD      C,A
 F0F0  3A4400    0283         LD      A,(TRK)
 F0F3  B9        0284         CP      C
 F0F4  DAFAF0    0285         JP      C,SEEK1
 F0F7  0610      0286         LD      B,10H    ;  SIDE 2
 F0F9  91        0287         SUB     C
 F0FA  4F        0288 SEEK1   LD      C,A      ;  SAVE NEW TRK #
 F0FB  DB65      0289         IN      A,(TRACK)        ;  PRESENT TRACK
 F0FD  B9        0290         CP      C
 F0FE  F5        0291         PUSH    AF
 F0FF  DB63      0292         IN      A,(SELECT)
 F101  2F        0293         CPL
 F102  5F        0294         LD      E,A
 F103  E610      0295         AND     10H      ;  CHECK SIDE SELECT
 F105  B8        0296         CP      B
 F106  CA15F1    0297         JP      Z,SEEK3  ;  IF SAME SIDE, JUMP
 F109  7B        0298         LD      A,E
 F10A  E60F      0299         AND     0FH
 F10C  B0        0300         OR      B
 F10D  2F        0301         CPL
 F10E  D363      0302         OUT     (SELECT),A  ;  SELECT NEW SIDE
 F110  3E01      0303         LD      A,1
 F112  CD26F2    0304         CALL    MSEC
 F115  F1        0305 SEEK3   POP     AF
 F116  C8        0306         RET     Z        ;  IF SAME TRK, RETURN
 F117  0603      0307         LD      B,3      ;  3 RETRIES
 F119  79        0308 SEEK2   LD      A,C      ;  TRK #
 F11A  D367      0309         OUT     (DATA),A
 F11C  3A45F0    0310         LD      A,(SKCMD)        ;  SEEK COMMAND
 F11F  C5        0311         PUSH    BC       ;  SAVE RETRY COUNT AND TRK #
 F120  CDCCF1    0312         CALL    CMDI
 F123  C1        0313         POP     BC
 F124  DB64      0314         IN      A,(STATUS)
 F126  E610      0315         AND     10H      ;  TEST FOR SEEK ERROR
 F128  C8        0316         RET     Z        ;  IF NO ERR, RET
 F129  3A44F0    0317         LD      A,(RSCMD)
 F12C  C5        0318         PUSH    BC
 F12D  CDCCF1    0319         CALL    CMDI     ;  RESTOR DISK
 F130  C1        0320         POP     BC
 F131  05        0321         DEC     B
 F132  C219F1    0322         JP      NZ,SEEK2
 F135  3E20      0323         LD      A,20H
 F137  C3E0F0    0324         JP      END2
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0326 ;
                 0327 ;
                 0328 ;  CHECK DRIVE SEL AND CHANGE IF DIFFERENT
                 0329 ;
                 0330 ;
 F13A  DB63      0331 DRVSET  IN      A,(SELECT)
 F13C  2F        0332         CPL
 F13D  E60F      0333         AND     0FH
 F13F  CA50F1    0334         JP      Z,DRVS1 ;  IF NONE,  JUMP
 F142  0EFF      0335         LD      C,0FFH
 F144  0C        0336 DRVSO   INC     C          ;  CONVERT TO DRV#
 F145  1F        0337         RRA
 F146  D244F1    0338         JP      NC,DRVSO
 F149  3A4200    0339         LD      A,(UNIT)
 F14C  E603      0340         AND     3
 F14E  B9        0341         CP      C
 F14F  C8        0342         RET     Z          ;  IF SAME DRV,  RETURN
 F150  CDFEF1    0343 DRVS1   CALL    DRSEL
 F153  AF        0344         XOR     A
 F154  3C        0345         INC     A
 F155  C9        0346         RET
                 0347 ;
                 0348 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0350 ;
                 0351 ;
                 0352 ;
                 0353 ;  READ PRESENT DISK ADDRESS (TRK &SCTR)
                 0354 ;
                 0355 ;
F156  214800     0356 IDRD     LD        HL,IDSV
F159  0604       0357          LD        B,4
F15B  3EF8       0358          LD        A,0F8H
F15D  324600     0359          LD        (ERMASK),A
F160  CDF7F1     0360          CALL      SWEB
F163  3EC4       0361          LD        A,RDACMD ;  'READ ADDRESS' CMD
F165  CD8BF1     0362          CALL      RDSCO    ;  READ ID
F168  3A4800     0363          LD        A,(IDSV)
F16B  D365       0364          OUT       (TRACK),A
F16D  C9         0365          RET
                 0366 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0368 ;
                 0369 ;
                 0370 ;  READ SECTOR COMMAND
                 0371 ;
                 0372 ;
 F16E  210000    0373 RDSC     LD        HL,0
 F171  39        0374          ADD       HL,SP
 F172  224D00    0375          LD        (SPSV),HL
 F175  CD3AF1    0376          CALL      DRVSET
 F178  C456F1    0377          CALL      NZ,IDRD ;NEW DRIVE
 F17B  CDEAF0    0378          CALL      SEEK     ; SEEK TRACK
 F17E  3EFE      0379          LD        A,0FEH
 F180  324600    0380          LD        (ERMASK),A
 F183  CD33F2    0381          CALL      TRINT
 F186  3E88      0382          LD        A,RDCMD ; READ COMMAND
 F188  CD40F2    0383          CALL      HLCHK    ; SET UP HEAD LOAD BIT
 F18B  324C00    0384 RDSC0    LD        (CMDSV),A
 F18E  D364      0385          OUT       (CMD),A ; OUTPUT COMMAND
 F190  DB67      0386 RDSC1    IN        A,(DATA)
 F192  77        0387          LD        (HL),A
 F193  23        0388          INC       HL
 F194  05        0389          DEC       B
 F195  C290F1    0390          JP        NZ,RDSC1
 F198  CDCDF0    0391          CALL      END
 F19B  AF        0392          XOR       A
 F19C  C9        0393          RET
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0395 ;
                 0396 ;
                 0397 ;  WRITE SECTOR COMMAND
                 0398 ;
                 0399 ;
F19D  210000     0400 WRSC     LD        HL,0
F1A0  39         0401          ADD       HL,SP
F1A1  224D00     0402          LD        (SPSV),HL
F1A4  CD3AF1     0403          CALL      DRVSET
F1A7  C456F1     0404          CALL      NZ,IDRD
F1AA  CDEAF0     0405          CALL      SEEK
F1AD  3EFC       0406          LD        A,0FCH
F1AF  324600     0407          LD        (ERMASK),A
F1B2  CD33F2     0408          CALL      TRINT
F1B5  3EA8       0409          LD        A,WRCMD
F1B7  CD40F2     0410          CALL      HLCHK
F1BA  324C00     0411          LD        (CMDSV),A
F1BD  D364       0412          OUT       (CMD),A ;  OUTPUT COMMAND
F1BF  7E         0413 WRSC1    LD        A,(HL)
F1C0  D367       0414          OUT       (DATA),A
F1C2  23         0415          INC       HL
F1C3  05         0416          DEC       B
F1C4  C2BFF1     0417          JP        NZ,WRSC1
F1C7  CDCDF0     0418          CALL      END
F1CA  AF         0419          XOR       A
F1CB  C9         0420          RET
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0422 ;
                 0423 ;
                 0424 ;
                 0425 ;  TYPE I COMMANDS
                 0426 ;
                 0427 ;
 F1CC  324C00    0428 CMDI     LD        (CMDSV),A          ; SAVE COMMAND
 F1CF  3E80      0429          LD        A,080H
 F1D1  324600    0430          LD        (ERMASK),A
 F1D4  DB64      0431 CMDI1    IN        A,(STATUS)
 F1D6  E601      0432          AND       1
 F1D8  C2D4F1    0433          JP        NZ,CMDI1           ; WAIT FOR NOT BUSY
 F1DB  DB63      0434          IN        A,(SELECT)
 F1DD  E61F      0435          AND       1FH
 F1DF  F660      0436          OR        60H
 F1E1  D363      0437          OUT       (SELECT),A         ; NO WAIT STATE ENBL
 F1E3  3A4C00    0438          LD        A,(CMDSV)
 F1E6  D364      0439          OUT       (CMD),A ; OUTPUT COMMAND
 F1E8  3E01      0440          LD        A,1
 F1EA  CD26F2    0441          CALL      MSEC      ; WAIT FOR STATUS
 F1ED  C3CDF0    0442          JP        END
                 0443 ;
                 0444 ;
                 0445 ;
                 0446 ;
                 0447 ;
                 0448 ;  DISABLE WAIT STATES
                 0449 ;
 F1F0  DB63      0450 DWAIT    IN        A,(SELECT)
 F1F2  F6E0      0451          OR        0E0H      ; NEG TRUE . AND.
 F1F4  D363      0452          OUT       (SELECT),A
 F1F6  C9        0453          RET
                 0454 ;
                 0455 ;
                 0456 ;  ENABLE WAIT STATES
                 0457 ;
                 0458 ;
 F1F7  DB63      0459 SWEB     IN        A,(SELECT)
 F1F9  E61F      0460          AND       1FH
 F1FB  D363      0461          OUT       (SELECT),A
 F1FD  C9        0462          RET
                 0463 ;
                 0464 ;
                 0465 ;  SELECT DRIVE
                 0466 ;
                 0467 ;
 F1FE  3A4200    0468 DRSEL    LD        A,(UNIT)
 F201  E603      0469          AND       3
 F203  B7        0470          OR        A          ; CHECK FOR ZERO
 F204  4F        0471          LD        C,A
 F205  3E01      0472          LD        A,1
 F207  CA0FF2    0473          JP        Z,DRSEL3           ; NO SHIFTING
 F20A  07        0474 DRSEL2   RLCA      ; SHIFT LEFT
 F20B  0D        0475          DEC       C
 F20C  C20AF2    0476          JP        NZ,DRSEL2
 F20F  2F        0477 DRSEL3   CPL
 F210  D363      0478          OUT       (SELECT),A
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 F212  3A47F0    0479          LD      A,(HLDLY)
 F215  CD26F2    0480          CALL    MSEC    ; DELAY 35 MILLISECS
 F218  DB64      0481          IN      A,(STATUS)
 F21A  E680      0482          AND     80H
 F21C  CA25F2    0483          JP      Z,DRSEL4
 F21F  F1        0484          POP     AF
 F220  3E40      0485          LD      A,40H   ; IF DRIVE NOT RDY, ERR
 F222  C3E0F0    0486          JP      END2
 F225  C9        0487 DRSEL4   RET
                 0488 ;
                 0489 ;
                 0490 ; DELAY (A REG) * 1 MILLISECOND
                 0491 ;
                 0492 ;
 F226  47        0493 MSEC     LD      B,A
 F227  3A48F0    0494 MSEC0    LD      A,(DLYCON)
 F22A  3D        0495 MSEC1    DEC     A
 F22B  C22AF2    0496          JP      NZ,MSEC1
 F22E  05        0497          DEC     B
 F22F  C227F2    0498          JP      NZ,MSEC0
 F232  C9        0499          RET
                 0500 ;
                 0501 ;
                 0502 ; INITIALIZE FOR DISK TRANSFER
                 0503 ;
                 0504 ;
 F233  2A4000    0505 TRINT    LD      HL,(TADDR)
 F236  0680      0506          LD      B,NBYTES
 F238  3A4300    0507          LD      A,(SCTR)
 F23B  D366      0508          OUT     (SECTOR),A      ; SELECT SECTOR
 F23D  C3F7F1    0509          JP      SWEB
                 0510 ;
                 0511 ;
                 0512 ;
                 0513 ; CHECK FOR HEAD LOADED, IF NOT SET
                 0514 ; 'H' BIT IN COMMAND.
                 0515 ;
                 0516 ;
 F240  57        0517 HLCHK    LD      D,A     ; SAVE COMMAND IN D
 F241  3ED0      0518          LD      A,0D0H
 F243  D364      0519          OUT     (CMD),A ; 'FORCE INTERRUPT' CMD
 F245  3E04      0520          LD      A,4
 F247  3D        0521 HLCHK0   DEC     A
 F248  C247F2    0522          JP      NZ,HLCHK0
 F24B  DB64      0523          IN      A,(STATUS)
 F24D  E620      0524          AND     20H
 F24F  7A        0525          LD      A,D     ; RESTORE COMMAND
 F250  C0        0526          RET     NZ      ; IF HEAD LOADED, RET
 F251  F604      0527          OR      4       ; SET 'H' BIT
 F253  C9        0528          RET
```

```
 ADDR   OBJECT    ST # SOURCE STATEMENT

                  0530 ;
                  0531 ;
                  0532 ; LOAD # OF SECTORS IN (NREC)
                  0533 ;
                  0534 ;
 F254   CDAFF0    0535 LOADER  CALL    READ     ; READ A SECTOR
 F257   C28CF2    0536         JP      NZ,ERR
 F25A   CD6EF2    0537         CALL    INCP     ; INC TRK/SCTR
 F25D   C254F2    0538         JP      NZ,LOADER
 F260   C9        0539         RET
                  0540 ;
                  0541 ;
                  0542 ;
                  0543 ;
                  0544 ; SAVE # OF SECTORS IN (NREC)
                  0545 ;
                  0546 ;
 F261   CDBEF0    0547 SAVER   CALL    WRITE
 F264   C28CF2    0548         JP      NZ,ERR
 F267   CD6EF2    0549         CALL    INCP
 F26A   C261F2    0550         JP      NZ,SAVER
 F26D   C9        0551         RET
                  0552 ;
                  0553 ; INC SECTOR AND TRACK
                  0554 ;
                  0555 ;
 F26E   2A4000    0556 INCP    LD      HL,(TADDR)
 F271   118000    0557         LD      DE,NBYTES
 F274   19        0558         ADD     HL,DE
 F275   224000    0559         LD      (TADDR),HL
 F278   214500    0560         LD      HL,NREC ; POINT TO NREC
 F27B   35        0561         DEC     (HL)
 F27C   C8        0562         RET     Z
 F27D   2B        0563         DEC     HL
 F27E   2B        0564         DEC     HL       ; POINT TO SCTR
 F27F   34        0565         INC     (HL)     ; INC SCTR #
 F280   3A3FF0    0566         LD      A,(NSCTRS)
 F283   3C        0567         INC     A
 F284   BE        0568         CP      (HL)     ; LAST SCTR ON TRK ?
 F285   C0        0569         RET     NZ       ; IF NOT, RETURN
 F286   3601      0570         LD      (HL),1   ; SET TO SCTR 1
 F288   23        0571         INC     HL       ; POINT TO TRK
 F289   34        0572         INC     (HL)     ; INC TRK #
 F28A   B7        0573         OR      A
 F28B   C9        0574         RET
                  0575 ;
                  0576 ;
                  0577 ; ERROR MESSAGE 'DISK ERR# '
                  0578 ;
                  0579 ;
 F28C   21A3F2    0580 ERR     LD      HL,ERMSG
 F28F   CDAEF2    0581         CALL    PTXT
 F292   3A4700    0582         LD      A,(ERSTAT)
 F295   CDBAF2    0583         CALL    PACC
 F298   0E0A      0584         LD      C,0AH
 F29A   CD7DF0    0585         CALL    CONOUT
 F29D   0E0D      0586         LD      C,0DH
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 F29F  C37DF0    0587          JP      CONOUT
 F2A2  C9        0588          RET
               0589 ;
 F2A3  4449534B  0590 ERMSG    DEFM    'DISK ERR# '
       20455252
       2320
 F2AD  03        0591          DEFB    3
               0592 ;
               0593 ;
               0594 ; PRINT TEXT
               0595 ;
               0596 ;
 F2AE  7E        0597 PTXT     LD      A,(HL)  ; FETCH A BYTE
 F2AF  FE03      0598          CP      3
 F2B1  C8        0599          RET     Z
 F2B2  4F        0600          LD      C,A
 F2B3  CD7DF0    0601          CALL    CONOUT
 F2B6  23        0602          INC     HL
 F2B7  C3AEF2    0603          JP      PTXT
               0604 ;
               0605 ;
               0606 ; PRINT ACCUMULATOR
               0607 ;
               0608 ;
 F2BA  F5        0609 PACC     PUSH    AF
 F2BB  0F        0610          RRCA
 F2BC  0F        0611          RRCA
 F2BD  0F        0612          RRCA
 F2BE  0F        0613          RRCA
 F2BF  CDC3F2    0614          CALL    PRVAL
 F2C2  F1        0615          POP     AF
               0616 ;
               0617 ;
 F2C3  E60F      0618 PRVAL    AND     0FH
 F2C5  C690      0619          ADD     A,90H
 F2C7  27        0620          DAA
 F2C8  CE40      0621          ADC     A,40H
 F2CA  27        0622          DAA
 F2CB  4F        0623          LD      C,A
 F2CC  C37DF0    0624          JP      CONOUT  ; PRINT IT
               0625 ;
               0626 ;
               0627 ; ASCII TO BINARY CONVERSION
               0628 ;
               0629 ;
 F2CF  D630      0630 ASBIN    SUB     30H
 F2D1  FE0A      0631          CP      10
 F2D3  F8        0632          RET     M
 F2D4  D607      0633          SUB     7
 F2D6  C9        0634          RET
               0635 ;
               0636 ;
               0637 ; CHECK FOR VALID HEX CHARACTER
               0638 ;
               0639 ;
 F2D7  FE30      0640 AORN     CP      '0'
 F2D9  DAEDF2    0641          JP      C,AORN2 ; JUMP IF < 30H
 F2DC  FE3A      0642          CP      '9'+1
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 F2DE  DAEBF2    0643          JP      C,AORN1 ; JUMP IF < 3AH
 F2E1  FE40      0644          CP      'A'-1
 F2E3  DAEDF2    0645          JP      C,AORN2 ; JUMP IF < 'A'
 F2E6  FE47      0646          CP      'F'+1
 F2E8  D2EDF2    0647          JP      NC,AORN2 ; JUMP IF < 'G'
 F2EB  AF        0648 AORN1    XOR     A
 F2EC  C9        0649          RET             ; VALID DATA RET
 F2ED  AF        0650 AORN2    XOR     A
 F2EE  3C        0651          INC     A
 F2EF  C9        0652          RET             ; NOT HEX CHAR
                 0653 ;
                 0654 ;
                 0655 ; CHECK FOR TERMINATOR
                 0656 ;
                 0657 ; SPACE, COMMA, OR CARRIAGE RETURN
                 0658 ;
                 0659 ;
 F2F0  FE20      0660 TERMCK   CP      ' '
 F2F2  C8        0661          RET     Z
 F2F3  FE2C      0662          CP      ','
 F2F5  C8        0663          RET     Z
 F2F6  FE5E      0664          CP      '^'
 F2F8  CA03F3    0665          JP      Z,TCHKO
 F2FB  FE2E      0666          CP      '.'
 F2FD  CA03F3    0667          JP      Z,TCHKO
 F300  FE0D      0668          CP      0DH
 F302  C0        0669          RET     NZ
 F303  C5        0670 TCHKO    PUSH    BC
 F304  0E0A      0671          LD      C,0AH
 F306  CD7DF0    0672          CALL    CONOUT
 F309  C1        0673          POP     BC
 F30A  AF        0674          XOR     A
 F30B  C9        0675          RET
                 0676 ;
                 0677 ;
                 0678 ; SCAN FOR OPERAND FROM KEYBOARD
                 0679 ;
                 0680 ;
                 0681 ; EXIT WITH DATA IN HL, AND TERMINATOR
                 0682 ; IN C.  IF VALID DATA, RETURN WITH
                 0683 ; ZERO FLAG SET.  B CONTAINS # OF CHARACTERS ENTERED.
                 0684 ;
                 0685 ;
 F30C  210000    0686 SCAN     LD      HL,0
 F30F  45        0687          LD      B,L
 F310  CD29F3    0688 SCAN1    CALL    ECHO
 F313  04        0689          INC     B       ; INC CHAR COUNT
 F314  CDF0F2    0690          CALL    TERMCK
 F317  C8        0691          RET     Z       ; IF TERMINATOR, RETURN
 F318  CDD7F2    0692          CALL    AORN    ; VALID DATA CHECK
 F31B  C0        0693          RET     NZ      ; IF NOT RETURN
 F31C  79        0694          LD      A,C
 F31D  CDCFF2    0695          CALL    ASBIN   ; CONVERT TO BINARY
 F320  29        0696          ADD     HL,HL
 F321  29        0697          ADD     HL,HL
 F322  29        0698          ADD     HL,HL
 F323  29        0699          ADD     HL,HL   ;P SHIFT 4 BITS
 F324  85        0700          ADD     A,L
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 F325  6F        0701          LD      L,A
 F326  C310F3    0702          JP      SCAN1
                 0703 ;
                 0704 ;
                 0705 ;
 F329  CD72F0    0706 ECHO     CALL    CONIN
 F32C  4F        0707          LD      C,A
 F32D  C37DF0    0708          JP      CONOUT
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0710 ;
                 0711 ;
                 0712 ;
                 0713 ;  FORMAT A TRACK ( IBM MINI DISK FORMAT )
                 0714 ;
                 0715 ;
 F330  3A4400    0716 FMAT     LD      A,( TRK )
 F333  D367      0717          OUT     ( DATA ),A
 F335  3A46F0    0718          LD      A,( SKNCMD )
 F338  CDCCF1    0719          CALL    CMDI
 F33B  2E01      0720          LD      L,1
 F33D  3A3FF0    0721          LD      A,( NSCTRS )
 F340  67        0722          LD      H,A
 F341  3A41F0    0723          LD      A,( GAP1 )
 F344  47        0724          LD      B,A
 F345  AF        0725          XOR     A
 F346  324600    0726          LD      ( ERMASK ),A
 F349  CDF7F1    0727          CALL    SWEB
 F34C  3EF4      0728          LD      A,WRTCMD
 F34E  324C00    0729          LD      ( CMDSV ),A
 F351  D364      0730          OUT     ( CMD ),A          ;  OUTPUT COMMAND
 F353  AF        0731          XOR     A
 F354  D367      0732 FMAT3    OUT     ( DATA ),A         ;  GAP1
 F356  05        0733          DEC     B
 F357  C254F3    0734          JP      NZ,FMAT3
 F35A  3EFE      0735 FMAT5    LD      A,0FEH             ;  ID ADDRESS MARK
 F35C  D367      0736          OUT     ( DATA ),A
 F35E  DB65      0737          IN      A,( TRACK )
 F360  D367      0738          OUT     ( DATA ),A         ;  TRACK #
 F362  AF        0739          XOR     A
 F363  D367      0740          OUT     ( DATA ),A         ;  0 GAP
 F365  7D        0741          LD      A,L
 F366  D367      0742          OUT     ( DATA ),A         ;  SECTOR #
 F368  AF        0743          XOR     A
 F369  D367      0744          OUT     ( DATA ),A         ;  SECTOR LENGTH = 128
 F36B  3EF7      0745          LD      A,0F7H             ;  SEND CRC ( 2 BYTES )
 F36D  D367      0746          OUT     ( DATA ),A
 F36F  3A42F0    0747          LD      A,( GAP2 )
 F372  47        0748          LD      B,A
 F373  AF        0749          XOR     A
 F374  D367      0750 FMAT6    OUT     ( DATA ),A         ;  GAP2
 F376  05        0751          DEC     B
 F377  C274F3    0752          JP      NZ,FMAT6
 F37A  3EFB      0753          LD      A,0FBH             ;  DATA ADDRESS MARK
 F37C  D367      0754          OUT     ( DATA ),A
 F37E  3EE5      0755          LD      A,0E5H
 F380  0680      0756          LD      B,128D
 F382  D367      0757 FMAT7    OUT     ( DATA ),A         ;  128 E5'S IN DATA FIELD
 F384  05        0758          DEC     B
 F385  C282F3    0759          JP      NZ,FMAT7
 F388  3EF7      0760          LD      A,0F7H
 F38A  D367      0761          OUT     ( DATA ),A         ;  CRC  ( 2 BYTES )
 F38C  3A43F0    0762          LD      A,( GAP3 )
 F38F  47        0763          LD      B,A
 F390  AF        0764          XOR     A
 F391  D367      0765 FMAT8    OUT     ( DATA ),A         ;  GAP3
 F393  05        0766          DEC     B
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 F394  C291F3    0767          JP      NZ,FMAT8
 F397  2C        0768          INC     L                       ; INC SECTOR #
 F398  25        0769          DEC     H                       ; CHECK FOR LAST SECTO
 F399  C25AF3    0770          JP      NZ,FMAT5                ; WRITE ALL SECTORS
 F39C  CDCDF0    0771          CALL    END
 F39F  AF        0772          XOR     A
 F3A0  C9        0773          RET
```

APPENDIX E

VERSAFLOPPY DIAGNOSTIC

SOFTWARE

```
 ADDR  OBJECT     ST # SOURCE STATEMENT

                  0002          NAME    VDIAG
                  0003 ;
                  0004 ;        VERSION 1.0     3/17/78
                  0005 ;        RUNS ON Z80, 8080, AND 8085
                  0006 ;
                  0007          PSECT   ABS
 >0100            0008          ORG     100H
                  0009 ;
                  0010 ;        BIOS LINKAGES
                  0011 ;
 >F000            0012 BIOS     EQU     0F000H
 >F006            0013 CSE      EQU     BIOS+6
 >F009            0014 CIE      EQU     BIOS+9
 >F00C            0015 COE      EQU     BIOS+0CH
 >F018            0016 HME      EQU     BIOS+18H
 >F027            0017 RDE      EQU     BIOS+27H
 >F02A            0018 WRE      EQU     BIOS+2AH
 >F02D            0019 LDE      EQU     BIOS+2DH
 >F030            0020 SVE      EQU     BIOS+30H
 >F033            0021 FMATE    EQU     BIOS+33H
 >F036            0022 SCANE    EQU     BIOS+36H
 >F039            0023 PTXTE    EQU     BIOS+39H
 >F03C            0024 PACCE    EQU     BIOS+3CH
 >F03F            0025 NSCTRS   EQU     BIOS+3FH
 >F040            0026 NTRKS    EQU     BIOS+40H
 >F046            0027 SKNCMD   EQU     BIOS+46H
                  0028 ;
 >0000            0029 RBASE    EQU     0000H   ; RAM START
 >0040            0030 TADDR    EQU     RBASE+40H
 >0042            0031 UNIT     EQU     RBASE+42H
 >0043            0032 SCTR     EQU     RBASE+43H
 >0044            0033 TRK      EQU     RBASE+44H
 >0045            0034 NREC     EQU     RBASE+45H
 >0046            0035 ERMASK   EQU     RBASE+46H
 >0047            0036 ERSTAT   EQU     RBASE+47H
 >0048            0037 IDSV     EQU     RBASE+48H
 >004C            0038 CMDSV    EQU     RBASE+4CH
 >0039            0039 RQST     EQU     RBASE+39H
 >0038            0040 RANDS    EQU     RBASE+38H
 >003A            0041 NUMB     EQU     RBASE+3AH
                  0042 ;
                  0043 ;
 >0800            0044 BFFR1    EQU     RBASE+800H
 >0880            0045 BFFR2    EQU     RBASE+880H
 >0080            0046 USRSP    EQU     RBASE+80H
 >0080            0047 NBYTES   EQU     128
                  0048 ;
                  0049 ;
 >0060            0050 X        EQU     60H
 >0064            0051 STATUS   EQU     X+4
 >0064            0052 CMD      EQU     X+4
 >0067            0053 DATA     EQU     X+7
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0055 ;
                 0056 ;
                 0057 ;
                 0058 ;
                 0059 ; DISK DRIVE EVALUATION EXEC
                 0060 ;
                 0061 ;
 0100  318000    0062 DEXEC   LD      SP,USRSP
 0103  213101    0063         LD      HL,MSG1
 0106  CD39F0    0064         CALL    PTXTE    ; "ENTER REQUEST #, DRIVE # "
 0109  CD36F0    0065         CALL    SCANE
 010C  C22601    0066         JP      NZ,INERR
 010F  7D        0067         LD      A,L
 0110  324200    0068         LD      (UNIT),A
 0113  7C        0069         LD      A,H
 0114  323900    0070         LD      (RQST),A
 0117  CD5001    0071         CALL    DECODE   ; DECODE AND EXECUTE CMD
 011A  CD18F0    0072         CALL    HME
 011D  214401    0073         LD      HL,MSG3
 0120  CD39F0    0074         CALL    PTXTE    ; "TASK COMPLETE"
 0123  C30001    0075         JP      DEXEC
                 0076 ;
 0126  0E3F      0077 INERR   LD      C,'?'
 0128  CD0CF0    0078         CALL    COE
 012B  CD3103    0079         CALL    CRLF
 012E  C30001    0080         JP      DEXEC
                 0081 ;
 0131  54455354  0082 MSG1    DEFM    'TEST#DRV# (TTDD): '
       23445256
       23202854
       54444429
       3A20
 0143  03        0083         DEFB    03
 0144  5441534B  0084 MSG3    DEFM    'TASK DONE'
       20444F4E
       45
 014D  0D0A      0085         DEFW    0A0DH
 014F  03        0086         DEFB    03
```

```
 ADDR   OBJECT     ST # SOURCE STATEMENT

                   0088 ;
                   0089 ;
                   0090 ; DECODE REQUEST AND EXECUTE IT
                   0091 ;
 0150  FE00        0092 DECODE   CP       0
 0152  CA1403      0093          JP       Z,TSTSK ; SEEK TEST
 0155  FE01        0094          CP       1
 0157  CAFC01      0095          JP       Z,DIAG
 015A  FE02        0096          CP       2
 015C  CAFC01      0097          JP       Z,DIAG
 015F  FE03        0098          CP       3
 0161  CAFC01      0099          JP       Z,DIAG
 0164  FE04        0100          CP       4
 0166  CAFC01      0101          JP       Z,DIAG
 0169  FE05        0102          CP       5
 016B  CA8F01      0103          JP       Z,FORMT
 016E  FE10        0104          CP       10H
 0170  CA4003      0105          JP       Z,LOAD
 0173  FE11        0106          CP       11H
 0175  CA5B03      0107          JP       Z,SAVE
 0178  FEFF        0108          CP       0FFH
 017A  C0          0109          RET      NZ
 017B  218501      0110          LD       HL,MSG2
 017E  CD39F0      0111          CALL     PTXTE
 0181  CD36F0      0112          CALL     SCANE
 0184  E9          0113          JP       (HL)
                   0114 ;
                   0115 ;
 0185  41444452    0116 MSG2     DEFM     'ADDRESS:
       4553533A
       20
 018E  03          0117          DEFB     3
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0119 ;
                 0120 ; FORMAT A DISKETTE
                 0121 ;
                 0122 ;
 018F  AF        0123 FORMT   XOR     A
 0190  324400    0124         LD      (TRK),A
 0193  3C        0125         INC     A
 0194  324300    0126         LD      (SCTR),A
 0197  CD18F0    0127         CALL    HME
 019A  CD33F0    0128 FORMT1  CALL    FMATE
 019D  C2B001    0129         JP      NZ,ERROR
 01A0  3A4400    0130         LD      A,(TRK)
 01A3  3C        0131         INC     A
 01A4  324400    0132         LD      (TRK),A
 01A7  47        0133         LD      B,A
 01A8  3A40F0    0134         LD      A,(NTRKS)
 01AB  B8        0135         CP      B
 01AC  C29A01    0136         JP      NZ,FORMT1
 01AF  C9        0137         RET
                 0138 ;
                 0139 ;
                 0140 ;
                 0141 ;
                 0142 ; ERROR PRINT ROUTINE
                 0143 ;
                 0144 ;
 01B0  21E401    0145 ERROR   LD      HL,ERMSG
 01B3  CD39F0    0146         CALL    PTXTE   ; "DISK ERROR . . ."
 01B6  3A4C00    0147         LD      A,(CMDSV)
 01B9  CD3CF0    0148         CALL    PACCE   ; PRINT COMMAND
 01BC  CD3B03    0149         CALL    SPACE
 01BF  3A4700    0150         LD      A,(ERSTAT)
 01C2  CD3CF0    0151         CALL    PACCE   ; PRINT STATUS
 01C5  CD3B03    0152         CALL    SPACE
 01C8  3A4200    0153         LD      A,(UNIT)
 01CB  CD3CF0    0154         CALL    PACCE   ; UNIT #
 01CE  CD3B03    0155         CALL    SPACE
 01D1  3A4400    0156         LD      A,(TRK)
 01D4  CD3CF0    0157         CALL    PACCE
 01D7  CD3B03    0158         CALL    SPACE
 01DA  3A4300    0159         LD      A,(SCTR)
 01DD  CD3CF0    0160         CALL    PACCE
 01E0  CD3103    0161         CALL    CRLF
 01E3  C9        0162         RET
                 0163 ;
                 0164 ;
 01E4  434D4420  0165 ERMSG   DEFM    'CMD STAT DRV TRK SCTR> '
       53544154
       20445256
       2054524B
       20534354
       523E20
 01FB  03        0166         DEFB    03
                 0167 ;
                 0168 ;
                 0169 ;
                 0170 ; READ / WRITE DIAGNOSTIC
```

```
ADDR  OBJECT    ST # SOURCE STATEMENT

                0171 ; CONTINUES UNTIL A '.' IS ENTERED FROM KEYBOARD
                0172 ;
                0173 ;
                0174 ;
01FC  AF        0175 DIAG   XOR    A
01FD  324400    0176        LD     (TRK),A
0200  3C        0177        INC    A
0201  324300    0178        LD     (SCTR),A
0204  C35202    0179        JP     DIAG1
0207  210008    0180 DIA10  LD     HL,BFFR1
020A  224000    0181        LD     (TADDR),HL
020D  CD2AF0    0182        CALL   WRE
0210  C4B001    0183        CALL   NZ,ERROR
0213  218008    0184 DIA11  LD     HL,BFFR2
0216  224000    0185        LD     (TADDR),HL
0219  CD27F0    0186        CALL   RDE
021C  C4B001    0187        CALL   NZ,ERROR
021F  3A3900    0188        LD     A,(RQST)
0222  FE02      0189        CP     2
0224  CA3402    0190        JP     Z,DIAG3
0227  FE03      0191        CP     3
0229  CACA02    0192        JP     Z,RINCR
022C  FE04      0193        CP     4
022E  CABB02    0194        JP     Z,DINCR
0231  CD7302    0195        CALL   COMPR    ; IF DIAG 1, COMPARE
0234  214300    0196 DIAG3  LD     HL,SCTR
0237  34        0197        INC    (HL)     ; INC SECTOR
0238  3A3FF0    0198        LD     A,(NSCTRS)
023B  3C        0199        INC    A
023C  BE        0200        CP     (HL)
023D  C25202    0201        JP     NZ,DIAG1 ; IF NOT END OF TRK, JMP
0240  3601      0202        LD     (HL),1   ; SET TO SCTR 1
0242  23        0203        INC    HL       ; POINT TO TRK
0243  34        0204        INC    (HL)     ; INC TRK #
0244  3A40F0    0205 DIAG4  LD     A,(NTRKS)
0247  BE        0206        CP     (HL)
0248  C25202    0207        JP     NZ,DIAG1
024B  3600      0208        LD     (HL),0   ; SET TO TRK 00
024D  0E50      0209        LD     C,'P'
024F  CD0CF0    0210        CALL   COE      ; PRINT 'P' EVERY COMPLETE PASS
0252  CD06F0    0211 DIAG1  CALL   CSE
0255  CA5E02    0212        JP     Z,DIAG2
0258  CD09F0    0213        CALL   CIE
025B  FE2E      0214        CP     '.'
025D  C8        0215        RET    Z
025E  3A3900    0216 DIAG2  LD     A,(RQST)
0261  FE02      0217        CP     2
0263  CA1302    0218        JP     Z,DIA11
0266  FE01      0219        CP     1
0268  CA0702    0220        JP     Z,DIA10
026B  FE03      0221        CP     3
026D  CA0702    0222        JP     Z,DIA10
0270  C30702    0223        JP     DIA10
                0224 ;
                0225 ;
                0226 ;
0273  210008    0227 COMPR  LD     HL,BFFR1
0276  118008    0228        LD     DE,BFFR2
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 0279  0680      0229          LD      B,NBYTES
 027B  1A        0230 CMPR1    LD      A,(DE)
 027C  BE        0231          CP      (HL)
 027D  3EFF      0232          LD      A,0FFH
 027F  324700    0233          LD      (ERSTAT),A
 0282  C2B001    0234          JP      NZ,ERROR
 0285  23        0235          INC     HL
 0286  13        0236          INC     DE
 0287  05        0237          DEC     B
 0288  C27B02    0238          JP      NZ,CMPR1
 028B  CD8F02    0239          CALL    INCRD
 028E  C9        0240          RET
                 0241 ;
                 0242 ;
                 0243 ;
                 0244 ;
                 0245 ;
                 0246 ;
                 0247 ;
 028F  110008    0248 INCRD    LD      DE,BFFR1
 0292  0640      0249          LD      B,NBYTES/2
 0294  3A3800    0250          LD      A,(RANDS)
 0297  FE01      0251          CP      1
 0299  CA9D02    0252          JP      Z,HERE
 029C  13        0253          INC     DE
 029D  CDF502    0254 HERE     CALL    PRAND
 02A0  12        0255          LD      (DE),A
 02A1  13        0256          INC     DE
 02A2  13        0257          INC     DE
 02A3  05        0258          DEC     B
 02A4  C29D02    0259          JP      NZ,HERE
 02A7  3A3800    0260          LD      A,(RANDS)
 02AA  FE01      0261          CP      1
 02AC  CAB502    0262          JP      Z,SKIP
 02AF  3E01      0263          LD      A,1
 02B1  323800    0264          LD      (RANDS),A
 02B4  C9        0265          RET
 02B5  3E00      0266 SKIP     LD      A,0
 02B7  323800    0267          LD      (RANDS),A
 02BA  C9        0268          RET
                 0269 ;
                 0270 ;
                 0271 ;
 02BB  CD7302    0272 DINCR    CALL    COMPR
 02BE  CDF502    0273          CALL    PRAND
 02C1  34        0274          INC     (HL)      ; INC SEED
 02C2  E601      0275          AND     1
 02C4  324200    0276          LD      (UNIT),A  ; RANDOM UNIT
 02C7  C3CD02    0277          JP      RINCR1
 02CA  CD7302    0278 RINCR    CALL    COMPR
 02CD  3A3FF0    0279 RINCR1   LD      A,(NSCTRS)
 02D0  3C        0280          INC     A
 02D1  47        0281          LD      B,A
 02D2  CDF502    0282          CALL    PRAND
 02D5  E61F      0283          AND     01FH
 02D7  B7        0284          OR      A
 02D8  CACD02    0285          JP      Z,RINCR1                ;SECTOR 0 ILLEGA
 02DB  324300    0286          LD      (SCTR),A
```

```
 ADDR   OBJECT    ST # SOURCE STATEMENT

02DE   B8        0287         CP      B
02DF   D2CD02    0288         JP      NC,RINCR1        ;IF NO>NSCTRS TRY AGAIN
02E2   3A40F0    0289 ONCM    LD      A,(NTRKS)
02E5   47        0290         LD      B,A
02E6   CDF502    0291         CALL    PRAND
02E9   E67F      0292         AND     07FH
02EB   324400    0293         LD      (TRK),A
02EE   B8        0294         CP      B
02EF   D2E202    0295         JP      NC,ONCM          ;IF NO>NTRKS TRY AGAIN
02F2   C35202    0296         JP      DIAG1
                 0297 ;
                 0298 ;
                 0299 ;
                 0300 ;       PSEUDO RANDOM NUMBER GENERATOR
                 0301 ;
                 0302 ;
02F5   D5        0303 PRAND   PUSH    DE
02F6   C5        0304         PUSH    BC
02F7   213A00    0305         LD      HL,NUMB ; LOCATION OF SEED
02FA   0E00      0306         LD      C,0
02FC   7E        0307         LD      A,(HL)
02FD   A7        0308         AND     A
02FE   C20303    0309         JP      NZ,NEXT
0301   3EFF      0310         LD      A,0FFH
0303   57        0311 NEXT    LD      D,A
0304   E61D      0312         AND     1DH
0306   EA0B03    0313         JP      PE,PAR
0309   0E80      0314         LD      C,80H
030B   7A        0315 PAR     LD      A,D
030C   0F        0316         RRCA
030D   E67F      0317         AND     7FH
030F   81        0318         ADD     A,C
0310   77        0319         LD      (HL),A
0311   C1        0320         POP     BC
0312   D1        0321         POP     DE
0313   C9        0322         RET
                 0323 ;
                 0324 ;
                 0325 ;
                 0326 ;
0314   CD18F0    0327 TSTSK   CALL    HME
0317   3A40F0    0328         LD      A,(NTRKS)
031A   3D        0329         DEC     A
031B   D367      0330         OUT     (DATA),A
031D   3A46F0    0331         LD      A,(SKNCMD)       ; SEEK (NO VERIFY)
0320   D364      0332         OUT     (CMD),A
0322   CD06F0    0333         CALL    CSE
0325   CA1403    0334         JP      Z,TSTSK
0328   CD09F0    0335         CALL    CIE
032B   FE2E      0336         CP      '.'
032D   C8        0337         RET     Z
032E   C31403    0338         JP      TSTSK
                 0339 ;
                 0340 ;
                 0341 ;
                 0342 ;
0331   0E0D      0343 CRLF    LD      C,0DH
0333   CD0CF0    0344         CALL    COE
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

 0336  0E0A      0345          LD      C,0AH
 0338  C30CF0    0346          JP      COE
               0347 ;
               0348 ;
 033B  0E20      0349 SPACE    LD      C,' '
 033D  C30CF0    0350          JP      COE
               0351 ;
               0352 ;
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

                 0354 ;
                 0355 ;
                 0356 ;
                 0357 ;          LOAD 'N' SECTORS
                 0358 ;
                 0359 ;
0340  214903     0360 LOAD       LD      HL,LDMSG
0343  CD7603     0361            CALL    STUFF
0346  C32DF0     0362            JP      LDE
                 0363 ;
0349  454E5445   0364 LDMSG      DEFM    'ENTER LOAD ADDR: '
      52204C4F
      41442041
      4444523A
      20
035A  03         0365            DEFB    3
                 0366 ;
                 0367 ;
                 0368 ;
                 0369 ;          SAVE 'N' SECTORS
                 0370 ;
                 0371 ;
035B  216403     0372 SAVE       LD      HL,SVMSG
035E  CD7603     0373            CALL    STUFF
0361  C330F0     0374            JP      SVE
                 0375 ;
0364  454E5445   0376 SVMSG      DEFM    'ENTER SAVE ADDR: '
      52205341
      56452041
      4444523A
      20
0375  03         0377            DEFB    3
                 0378 ;
                 0379 ;
                 0380 ;
                 0381 ;          STUFF DISK PARAMS
                 0382 ;
                 0383 ;
                 0384 ;
0376  CD39F0     0385 STUFF      CALL    PTXTE
0379  CD36F0     0386            CALL    SCANE
037C  C22601     0387            JP      NZ,INERR
037F  224000     0388            LD      (TADDR),HL
0382  21A203     0389            LD      HL,TSMSG
0385  CD39F0     0390            CALL    PTXTE
0388  CD36F0     0391            CALL    SCANE
038B  C22601     0392            JP      NZ,INERR
038E  224300     0393            LD      (SCTR),HL       ; SECTOR & TRACK
0391  21BE03     0394            LD      HL,SZMSG
0394  CD39F0     0395            CALL    PTXTE
0397  CD36F0     0396            CALL    SCANE
039A  C22601     0397            JP      NZ,INERR
039D  7D         0398            LD      A,L
039E  324500     0399            LD      (NREC),A        ; # OF SECTORS
03A1  C9         0400            RET
                 0401 ;
03A2  454E5445   0402 TSMSG      DEFM    'ENTER TRACK/SECTOR (TTSS): '
```

```
 ADDR  OBJECT    ST # SOURCE STATEMENT

       52205452
       41434B2F
       53454354
       4F522028
       54545353
       293A20
 03BD  03        0403          DEFB    3
 03BE  454E5445  0404 SZMSG    DEFM    'ENTER NUMBER OF SECTORS (NN): '
       52204E55
       4D424552
       204F4620
       53454354
       4F525320
       284E4E29
       3A
 03DB  03        0405          DEFB    3
```

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