System Implementation

SA 400/450 minifloppy® Diskette Storage Drives with an 8080A/FD 1771 Single Density System

Application Bulletin

Shugart Associates

Table of Contents

List of Illustrations

FOREWORD

Shugart Associates Applications Staff designed this 8080/1771 System as an aid to our users. Obviously there are many different methods of implementing the hardware and software of this system, but we feel that this is a general purpose method of implementation.

This Applications Bulletin is intended to be a concise statement of implementation, for a detailed description of the system elements refer to the following manuals:

- Intel 8080 Microcomputer Systems User's Manual, P/N 98-153B
- Western Digital FD1771A/B-01, FD1771A/B-02, Floppy Disk Formatter/ Controller
- SA400 minifloppy® Diskette Storage Drive OEM Manual, P/N 54102-1
- SA450 minifloppy® Double-Sided Diskette Storage Drive OEM Manual (available first quarter 1978).

The SA450 minifloppy® Double-Sided Diskette Storage Drive is presented for the first time in a systems environment. It should be noted that this drive is capable of MFM double-density encoding and has a track to track access time of 25 milliseconds. However, due to limitations imposed by the Western Digital Controller it functions as a SA400 with two sides.

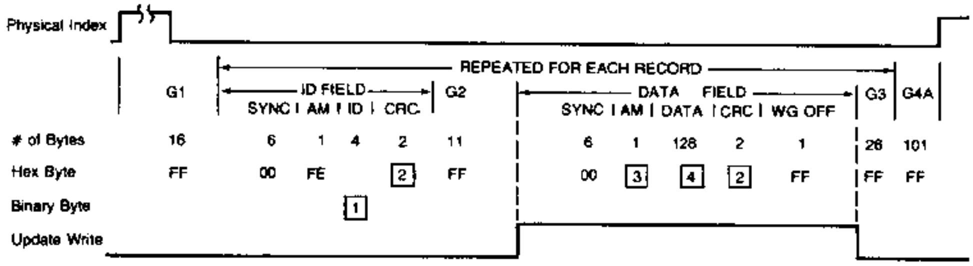
Shugart Associates does not assume responsibility for the use or implementation of this system nor any infringements of patents or other rights of third parties which may result from its use.

1.0 INTRODUCTION

1.1 General

This Application Bulletin briefly describes the parameters necessary to interface the SA400/450 minifloppy® Diskette Storage Drives with a Western Digital FD1771 Controller/Formatter, using an Intel 8080A Microcomputer System.

The discussion is based on a 16 sector, 128 byte per sector format as shown in Figure 1. It should be noted that when using a SA450 double-sided drive the ID field format is changed. Byte 2 of the ID now contains side select information instead of zeroes.



1 Track Addr, Side Select, Sector Addr, Zeroes

2 Generated by CRC Generator

3 FB for Data Field or F8 for Deleted Data Field

4 User Data

FIGURE 1. FM RECOMMENDED FORMAT — 128 Byte & 16 Records/Track.

2.0 SA400/450 MINIDISKETTE DRIVES

2.1 General

The SA400 minifloppy® Diskette Drive is a magnetic media storage device organized as 35 independent tracks with track zero being the outer most track with respect to the center of the disk.

Each track has a capacity of 3125 bytes (unformatted), hence a total disk capacity of 109.4 K bytes.

When formatted using the format shown in Figure 1, each track will have a user data capacity of 2048 bytes for a total user capacity of 71.68 K bytes.

The SA450 is an enhanced double-sided version of the SA400. The basic capacities are listed below:

- 70 tracks (two tracks per cylinder)
- 6250 bytes per cylinder, unformatted
- 4096 bytes per cylinder, formatted*
- 143.36 K bytes per diskette, formatted*

2.2 Drive Performance

The basic serial data rate of drive is 125 K bits per second which translates to 15.6 K bytes per second or 1 byte transferred every 64 microseconds.

The SA400/450 contains a D.C. spindle drive motor with an interface on/off control. To insure maximum motor life, the motor should be turned off when no further disk commands are anticipated. When turning the motor on, the host computer system should allow for a spindle motor up to speed and settle time of 1 second.

Each track of the disk drive can be accessed in 40 milliseconds with an additional 10 milliseconds of track settle time. The track settle time is non-cumulative, that is, when performing multiple steps it is added only to the last track accessed.

The head load can be activated either from the spindle motor "ON" control signal or by selecting the drive. With either method a delay of 75 milliseconds is necessary after head load.

2.3 Drive Interface

The SA400/450 is interfaced by 12 TTL compatible signals. The following interface signals are accompanied by a brief description:

Read Data (Output)—This signal is the digitized serial data, read from the diskette.

Write Data (Input)—This signal is the digitized serial data to be written on the diskette.

Write Gate (Input)—When activated, this signal causes 'write data' to be written on the diskette.

Write Protect (Output)—Indicates a write protected diskette has been inserted in the drive.

Step (Input)—For each step pulse, the R/W head moves one track.

Direction Select (Input)—Selects the direction of the R/W head will move when a pulse occurs on the 'step' line.

Track 00 (Output)—This signal indicates when the R/W head is positioned over track 0.

Drive Select (Input)—3 Lines to assign logical drive address.

Index/Sector (Output)—Pulse indicating that the physical index/sector hole of the diskette has passed over the index sensor.

Motor On (Input)—This signal controls spindle motor on/off.

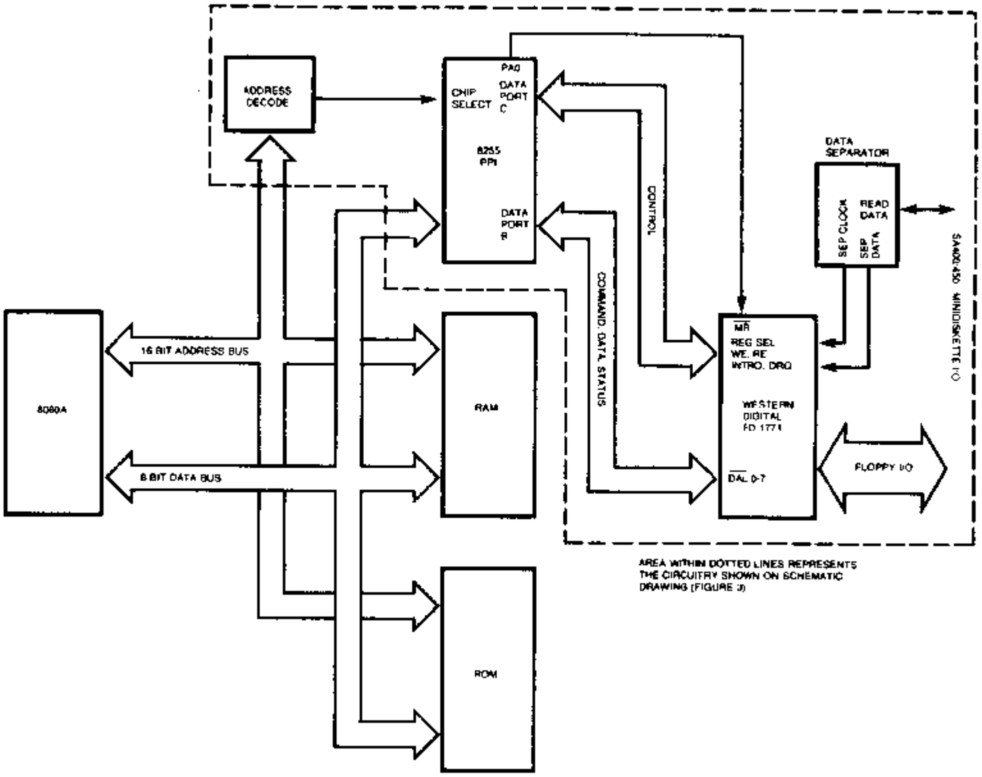
* When formatted as shown in Figure 1

3.0 HOST COMPUTER SYSTEM

3.1 General

The Intel 8080A Microprocessor (MPU) is a monolithic 8-bit microprocessor forming the host system. Peripheral I/O control is treated as a memory address (Memory Mapped I/O) as shown in Figure 2.

It should be noted that due to total system timing constraints, read/write routines must be performed within 56 μseconds. In order to accomplish this, bit 7 of the PPI Port C is tied to the Data Request line (DRQ) (Figure 3). By loading the Accumulator with DRQ status, it is possible to perform an inclusive OR of the Accumulator (ORA A) which results in the sign bit being set if there is a data request. Based on the status of the sign bit, a branch to the appropriate routine can be made. This technique eliminates the need to perform a separate check on the status bits using one of the logical instructions and results in a significant time savings.



AREA WITHIN DOTTED LINES REPRESENTS THE CIRCUITRY SHOWN ON SCHEMATIC DRAWING (FIGURE 3)

FIGURE 2. System Functional Block Diagram.

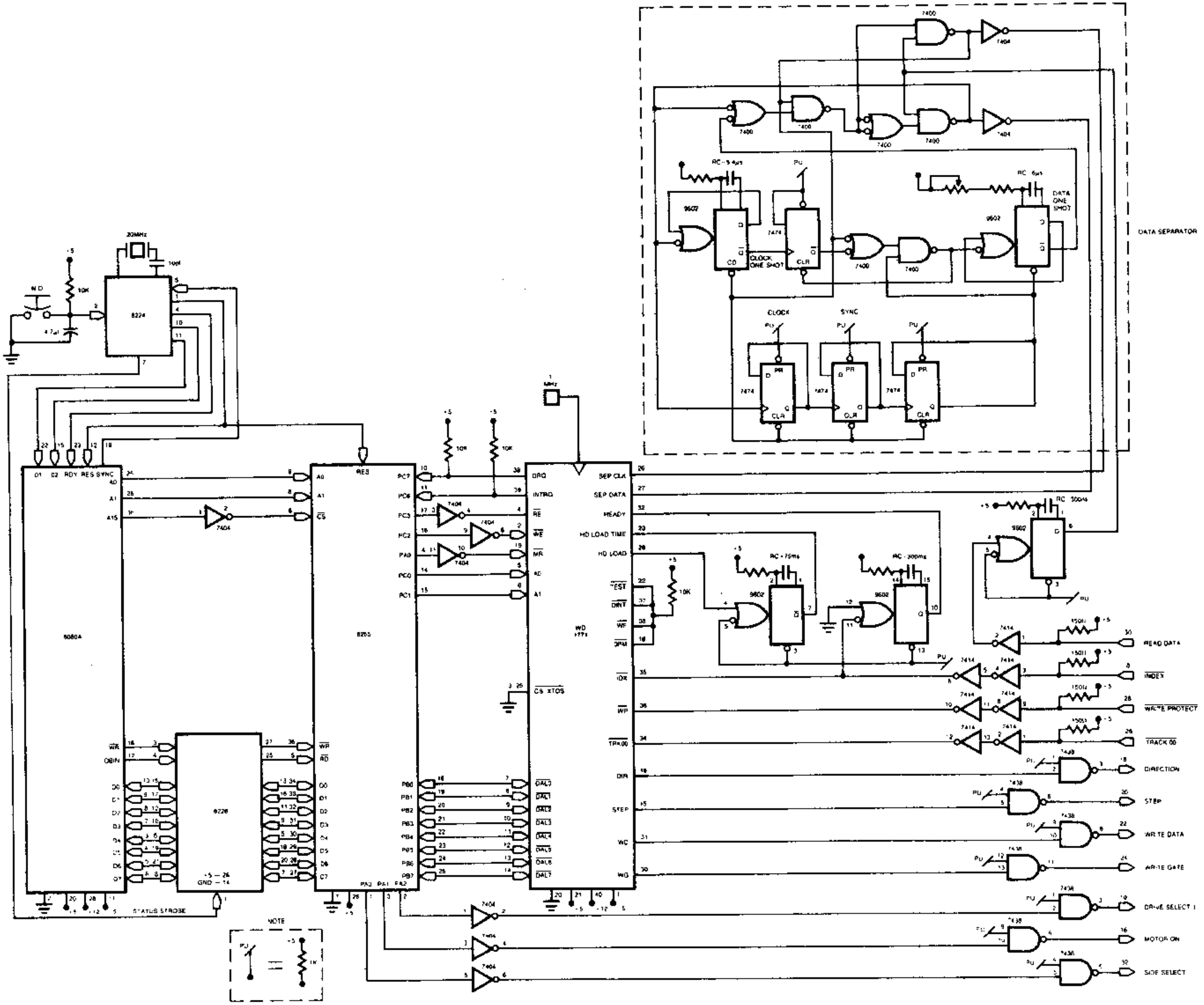


FIGURE 3. System Schematic.

3.2 Intel 8255 Programmable Peripheral Interface (PPI)

The FD1771 is interfaced to the 8080 through the 8255 Programmable Peripheral Interface (PPI) which is treated as a memory address (Figure 2). All commands, data, status, and controls are handled by the PPI using Mode 0. (Basic Input/Output)

The PPI provides a universal means of adapting peripheral devices to the 8080. The PPI interfaces the MPU data bus and Read and Write channels, through the 8228 System Controller and Bus Driver. Three address lines (A/O, A1, and $\overline{\text{A15}}$) of the 8080 are connected directly to the 8255. $\overline{\text{A15}}$ is connected to CS of the 8255 giving the PPI a memory address of 8000 (hex). A0 and A1 directly access registers in the 8255.

In this application Port B of the PPI will interface with the FD1771 data lines, Port C will handle the control lines and Port A will connect to FD1771 and the drive.

Six of the outputs of the PPI are inverted (PA0–PA3, PC2 and PC3). The inverters are necessary because when commanding the PPI Port B to change direction the outputs of all of the ports go low. This causes false signals to go to the FD1771 which in turn deselects the drive and turns off the motor.

As shown in Figure 3 the 8080 has an external clock. The 8224 Clock Generator/Driver provides the necessary timing and strobe signals for the 8080.

4.0 WESTERN DIGITAL FD1771 CONTROLLER/FORMATTER

4.1 General

The Western Digital FD1771 is a MOS/LSI device that performs the functions of a general purpose Floppy Disk Controller/Formatter. The FD1771 is compatible with the IBM 3740 Data Entry System Format, but can be programmed for variable formats.

There are two constraints for formatting with the FD1771. The first is the ID field, which must be 4 bytes long with byte 1 containing the Track Address and byte 3 containing the sector Address. The other is GAP 2 (the gap between the ID field and the Data Address Mark), which must contain 11 bytes of hex "FF" and a sync area of 6 bytes of zeros. Other gaps and data field lengths may be varied to suit individual format requirements.

4.2 FD1771 Interface

The FD1771 interface to the host system processor is through the 8 data lines and associated control signals.

By reading and writing selected registers within the FD1771 command, data, and status bytes are transferred between the host computer and the FD1771. This is accomplished by programming the register select pins A0, A1. For furhter information refer to the FD1771 data sheet.

4.3 Controller Command Initiation

The FD1771 will accept eleven macro commands which perform the various disk drive functions. These commands are divided into four types and are briefly described as follow:

Type 1 Commands.

Restore—Causes the addressed drive to seek to track zero.

Seek—Causes the addressed drive to position the R/W head over the track specified by the host computer.

Step—Causes the drive to step one track in the direction previously selected.

Step In—Causes the drive to step one track toward track 35.

Step Out—Causes the drive to step one track toward track zero.

Type II Commands.

Read Command—Transfers a full sector of data, a byte at a time, to the host computer.

Write Command—Transfers a full sector of data, a byte at a time, from the host computer to the disk drive.

Type III Commands.

Read Track—Transfers all bytes of data on a track to the host computer. Read begins with the first index pulse encountered.

Read Address—Transfers the next encountered ID field to the host computer (Refer to Figure 1), places the Sector Address into the sector register, and checks the two byte CRC field.

Write Track—In effect, this command is the format command. The host computer must supply all gap, ID field, and data bytes with the exception of the address marks and CRC bytes.

Type IV Command.

Force Interrupt—Any command may be terminated and an interrupt generated by the use of this command.

In order to initiate the FD1771 commands, the host computer must load the desired command byte into the command register. Prior to this, the data register or sector register must be loaded to provide the information required by the command. Refer to Figure 4 PPI initialize. During a data transfer between the FD1771 and the host computer, the 'DRQ', 'RE', and 'WE' signals will comprise the handshake lines. The data tranfer handshake is shown in Figures 6 and 7.

At the end of every operation a status handshake occurs where a status byte is available to the host computer. The 'INTRQ' and 'RE' lines are used in the status handshake. Refer to Figures 5, 6 and 7, for the status handshake.

4.4 Data Separation

The FD1771 is equipped with an internal data separator. But due to the fact that the internal data window is not synchronous with the serial data and can cause errors in worst case data patterns, an external separator of the type shown in Figure 3 is recommended.

The external data separator is of the type known as a 'hard' data separator. A one shot is triggered on the leading edge of the clock pulse. This 'window' extends into the middle of the bit cell. If a pulse is present in the area of the window, it is decoded as a '1' bit. Otherwise it is decoded as a zero bit.

It is possible for any data separator to get out of phase (decode clock pulses as data pulses). Therefore, a 4 bit counter is present to detect more than 3 missing clock pulses. In FM encoding the clock stream will never have more than 3 missing clock pulses in a row. Therefore, if 4 missing clock pulses occur, the data window is made to rephase on the next pulse in the stream (a clock pulse).

During address marks, the clock stream will have 3 missing clock pulses in a row. During this time data pulses are present, but due to the absence of clock pulses the data window would be terminated. Therefore, a 'false clock' circuit is present to generate a data window in the absense of clock pulses. This window is generated from the leading edge of each data pulse. If no clock pulse occurs, the trailing edge of the 'false clock' window will generate a data window to provide data decoding in the absence of clock pulses.

The required data pulse width for the FD1771 (external separator mode) is 300 to 700 nanoseconds. Since the SA400 Drive generates a 1.2 microsecond nominal data pulse, this pulse must be reduced in width. In the circuit shown in Figure 3, the pulse width has been reduced to approximately 400 nanoseconds.

```
                 ; INIT
                 ;
                 ;THIS PROGRAM IS DESIGNED TO PERFORM SEEKS,
                 ;READS, WRITES AND FORMATS USING THE
                 ;WESTERN DIGITAL FD1771 FLOPPY CONTROLLER
                 ;CHIP INTERFACED TO AN SA400 AND A 8080 MPU
0091             CTRL      EQU        91H
                 ;CONTROL WORD FORMAT:
                 ;MODE=0
                 ;PORTA=DATA PORT (INPUTS)
                 ;PORTB=STATUS AND COMMAND LINES (OUTPUTS)
                 ;PORTC=INPUTS, 0-3
                 ;PORTC=OUTPUTS, 4-7
8000             PORTA     EQU        8000H         ;PORT A ADDRESS
8001             PORTB     EQU        8001H         ;PORT B ADDRESS
8002             PORTC     EQU        8002H         ;PORT C ADDRESS
8003             CWR       EQU        8003H         ;CONTROL WORD ADDRESS
0520             CHARS     EQU        520H          ;COMMAND CHARACTERS
                                                     ENTERED VIA CONSOLE
07D0             SEEK      EQU        7D0H          ;SEEK TRACK ROUTINE
0B10             READ      EQU        0B10H         ;READ SECTOR ROUTINE
0B80             WRITE     EQU        0B80H         ;WRITE SECTOR ROUTINE
0798             PIN       EQU 798H                 ;PORT B SET AS INPUTS
                                                     ROUTINE
        0600               ORG 600H
                 ;
                 ;INITIALIZE THE PPI (POWER UP)
                 ;
                 ;MR ALWAYS=1 AFTER INITIALIZATION
                 ;
0600    31FF0B   INIT     LXI SP,0BFFH        SET THE STACK
0603    CD9807            CALL PIN          ;PORTB INPUTS
0606    210080            LXI H,PORTA       ;PORTA ADRS
0609    3E01              MVI A,01H        ;MR=0,DR SEL,MOT ON         PPI
060B    77                MOV M,A          ;WRITE PORTA             INITIALIZE
060C    110280            LXI D,PORTC       ;LOAD PORTC ADRS
060F    3E00              MVI A,O           ;RE,WE=1
0611    12                STAX D            ;WRITE PORTC
                 ;
                 ;PPI INITIALIZATION DONE
                 ;RESTORE TO TRACK 0 IS AUTOMATIC
                 ;
0612    3E00     TRK0     MVI A,00H        ;MR=1
0614    77                MOV M,A          ;WRITE PORTA
0615    3E08              MVI A,08H         ;READ ENAB-STAT REG
0617    12                STAX D            ;(RE=0) WRITE PORTC
0618    3A0180            LDA PORTB        ;READ PORTB—GET
                                            STATUS
061B    4F                MOV C,A          ;SAVE STAT REG
061C    3E00              MVI A,00H        ;RE=1 (MR,WE=1)
061E    12                STAX D            ;WRITE PORTC
061F    79                MOV A,C           ;MOV STATUS TO A
0620    E604              ANI 4H            ;GET TRAK 0 STATUS
0622    FE04              CPI 4H            ;TRAK 0?
0624    CA1206            JZ TRKO           ;NO
```

FIGURE 4. Initialize Routine.

```
                  ;
                  ;DRIVE NOW AT TRACK 0 — TEST READY
                  ;
0627    79              MOV A,C         ;RESTOR STATUS IN A
0628    E680              ANI 80H         ;GET READY STATUS
062A    FE80              CPI 80H         ;READY?
062C    CA3506            JZ INTERP       ;YES GO TO IDLE LOOP
062F    010000          LXI B,OH        ;ERROR CODE
0632    CD0007          CALL ERROR
```

FIGURE 4. Initialize Routine (Continued).

```
                  ;THIS ROUTINE IS DESIGNED TO SEEK THE
                  ;DRIVE TO A TRACK SPECIFIED BY THE 3RD & 4TH
                  ;CHARACTERS ENTERED BY AN OPERATOR.
        8000      PORTA    EQU 8000H       ;PORT A ADDRESS
        8001      PORTB    EQU 8001H       ;PORT B ADDRESS
        8002      PORTC    EQU 8002H       ;PORT C ADDRESS
        0793      POUT     EQU 793H        ;PORT B SET AS OUTPUTS ROUTINE
        0798      PIN      EQU 798H        ;PORT B SET AS INPUTS ROUTINE
        0769      STATUS   EQU 769H        ;ROUTINE, CONVERTS STATUS TO
                                            ASCII PRINTABLE DATA
        0520      CHARS    EQU 0520H       ;COMMAND CHARACTERS ENTERED
                                             VIA CONSOLE.
                  ;
        07D0               ORG 7D0H        ;
                  ;
                  ;
                  ;FORM THE TRACK ADDRESS FROM THE 3RD & 4TH
                  ;CHARACTERS. 4TH CHARACTER MIGHT BE NEGATIVE
                  ;IF ONLY ONE CHAR WAS ENTERED.
                  ;
07D0    2A2205    SEEK     LHLD CHARS+2    ;GET BOTH CHARS
07D3    7C                 MOV A,H         ;XFR LS CHAR
07D4    B7                 ORA A           ;TERM ?
07D5    F2DC07             JP TWO          ;NO
07D8    7D                 MOV A,L         ;LOAD SINGLE CHAR
07D9    C3E207             JMP NEWTRK      ;YES
07DC    7D        TWO      MOV A,L         ;XFR MS CHAR
07DD    07                 RLC             ;SHIFT TO MS POSITION
07DE    07                 RLC
07DF    07                 RLC
07E0    07                 RLC
07E1    84                 ADD H           ;MERGE CHARS
```

FIGURE 5. Seek Routine.

```
                    ;NOW PUT NEW TRACK ADDRESS IN
                     FDC DATA REGISTER
                    ;
07E2    322008      NEWTRK    STA TRACK    ;SAVE TRACK ADDRESS
07E5    CD9307                CALL POUT    ;PORTB=OUTPUTS
07E8    210280                LXI H,PORTC  ;GET PORT C ADRS
07EB    0603                  MVI B,03H    ;A0,A1=1
07ED    70                    MOV M,B      ;WRITE PORTC
07EE    3A2008                LDA TRACK    ;TRAK ADRS
07F1    2F                    CMA          ;INVERT FOR WD BUS
07F2    320180                STA PORTB    ;WRITE PORTB
07F5    0607                  MVI B,07H    ;WRITE TO DATA REG    COMMAND
07F7    70                    MOV M,B      ;WRITE PORTC          HANDSHAKE
07F8    0600                  B,00H
07FA    70                    MOV M,B      ;WRITE PORTC
                    ;
                    ;INITIATE SEEK COMMAND
                    ;
07FB    3E1F                  MVI A,1FH    ;SEEK 40 MS STEP
07FD    2F                    CMA
07FE    320180                STA PORTB    ;WRITE PORTB
0801    0604                  MVI B,04H    ;WRITE TO CMD REG
0803    70                    MOV M,B      ;WRITE PORTC
0804    0600                  MVI B,00H    ;RE,WE = 1
0806    70                    MOV M,B      ;WRITE PORTC
                    ;
                    ;WAIT FOR END OF SEEK —
                     THEN REPORT STATUS
                    ;
0807    CD9807                CALL PIN
080A    7E          WAIT      MOV A,M      ;WAIT FOR END OF SEEK
080B    E640                  ANI 40H
080D    CA0A08                JZ WAIT
0810    3E08                  MVI A,08H    ;STAT REG READ        STATUS
0812    77                    MOV M,A      ;WRITE PORTC          HANDSHAKE
0813    3A0180                LDA PORTB    ;BRING STATUS
0816    0600                  MVI B,00H    ;RE,WE=1
0818    70                    MOV M,B      ;WRITE PORT B
0819    2F                    CMA          ;INVERT
081A    E618                  ANI 18H      ;SEEK AND CRC BITS
                    ;
081C    CD6907                CALL         ;REPORT TO CONSOLE
                              STATUS
081F    C9                    RET
                    ;
0820    00          TRACK     BYTE 0
        07D0                  END SEEK
```

FIGURE 5. Seek Routine (Continued).

```
                ;READ READ SECTOR ROUTINE
                ;
                ;READ SECTOR ROUTINE INITIATES THE READ
                ;COMMAND AND TRANSFERS ALL THE DATA FOR A
                ;SELECTED SECTOR TO THE BOTTOM OF MEMORY
                ;BEGINNING AT LOCATION 5FF
                ;R,XX READ SECTOR, SECTOR ADRS
        8000    PORTA       EQU 8000H     ;PORT A ADDRESS
        8001    PORTB       EQU 8001H     ;PORT B ADDRESS
        8002    PORTC       EQU 8002H     ;PORT C ADDRESS
        0793    POUT        EQU 793H      ;PORT B SET AS OUTPUTS ROUTINE
        0798    PIN         EQU 798H      ;PORT B SET AS INPUTS ROUTINE
        0769    STATUS      EQU 769H      ;ROUTINE CONVERTS STATUS TO
                                           ASCII PRINTABLE DATA
        05FF    DATBUF      EQU 5FFH      ;BEGINNING ADRS OF "READ"
                                           DATA BUFFER
        0520    CHARS       EQU 520H      ;COMMAND CHARACTERS ENTERED
                                           VIA CONSOLE
                ;
        0B10                ORG 0B10H
                ;
0B10    2A2205  READ        LHLD CHARS+2;GET BOTH CHARS
0B13    7C                  MOV A,H       ;XFER LS CHAR
0B14    B7                  ORA A         ;TERM?
0B15    F21C0B              JP TWO        ;NO
0B18    7D                  MOV A,L       :LOAD SINGLE CHAR
0B19    C3220B              JMP SECTOR
0B1C    7D      TWO         MOV A,L       ;XFER MS CHAR
0B1D    07                  RLC           ;SHIFT TO MS POSITION
0B1E    07                  RLC
0B1F    07                  RLC
0B20    07                  RLC
0B21    84                  ADD H         ;MERGE CHARS
0B22    327C0B  SECTOR      STA SECSTR    ;STOR SECTOR
0B25    CD9307              CALL POUT     ;PORTB OUTPUTS
0B28    210280              LXI H,PORTC   ;GET PORTC ADRS
0B2B    0602                MVI B,02H     ;SECTOR REGISTER
0B2D    70                  MOV M,B       ;WRITE PORTC
0B2E    3A7C0B              LDA SECSTR    ;SECTOR ADRS
0B31    2F                  CMA           ;INVERT FOR WD BUS
0B32    320180              STA PORT B    ;WRITE PORTB
0B35    0606                MVI B,06H     ;WRITE TO SECTOR
                                           REG
0B37    70                  MOV M,B       ;WRITE PORTC          COMMAND
                ;                                                   HANDSHAKE
                ;INITIATE THE READ COMMAND
                ;
0B38    0600                MV B,0        ;SEL CMD REG
0B3A    70                  MOV M,B       ;WRITE PORTC
0B3B    3E88                MVI A,88H     ;READ CMD
0B3D    2F                  CMA           ;INVRT FOR WD BUS
0B3E    320180              STA PORTB     ;WRITE PORTB
0B41    0604                MVI B,04H     ;ISSUE READ TO
                                           CMD REG
0B43    70                  MOV M,B       ;WRITE PORTC
```

FIGURE 6. Read Routine.

```
                   ;
                   ;WAIT FOR END OF READ — THEN REPORT
                   ;
0B44   0603                 MVI B,03H      ;SEL DATA REG
0B46   70                   MOV M,B        ;WRITE PORTC
0B47   CD9807               CALL PIN       ;PORTB = INPUTS
0B4A   11FF05               LXI D,DATBUF   ;FWA OF DATA
0B4D   0603                 MVI B,03H      ;RE,WE=1
0B4F   C35C0B               JMP DLOOP
0B52   3E0B       GD        MVI A,0BH      ;RE=0              DATA
0B54   77                   MOV M,A        ;WRITE PORTC       TRANSFER
0B55   3A0180               LDA PORTB      ;GET DATA          HANDSHAKE
0B58   2F                   CMA            ;INVERT DATA
0B59   12                   STAX D         ;SAVE IT
0B5A   1B                   DCX D          ;BUMP INDEX
0B5B   70                   MOV M,B        ;RE=1,PORTC
0B5C   7E         DLOOP     MOV A,M        ;GET STATUS
                                            PORTC
0B5D   B7                   ORA A          ;DRQ=1?
0B5E   FA520B               JM GD          ;YES
0B61   E640                 ANI 40H        ;INTRQ SET?
0B63   CA5C0B               JX DLOOP       ;NO
                   ;
                   ;READ DONE — GET STATUS
                   ;
0B66   3E00                 MVI A,O        ;ADRS STAT REG
0B68   77                   MOV M,A        ;WRITE PORTC
0B69   3E08                 MVI A,08H      ;STROBE RE=0
0B6B   77                   MOV M,A        ;WRITE PORTC
0B6C   EB                   XCHG                              STATUS
0B6D   227E0B               SHLD ISAVE     ;SAVE INDEX TO     HANDSHAKE
                                            DATA
0B70   EB                   XCHG           ;RESTOR PORTC
                                            ADRS
0B71   3A0180               LDA PORTB      ;GET STAT BYTE
0B74   0600                 MVI B,0        ;STAT HANDSHAKE
0B76   70                   MOV M,B        ;WRITE PORTC
0B77   2F                   CMA            ;INVERT STAT
                                            BYTE
0B78   CD6907               CALL STATUS    ;REPORT STATUS
0B7B   C9                   RET
                   ;
0B7C   0000       SECSTR    WORD 0         ;SECTOR ADRS
0B7E   0000       ISAVE     WORD 0         ;DATA INDEX
                                            STORAGE AREA
       0B10                 END READ
```

FIGURE 6. Read Routine (Continued).

```
;WRITE WRITE SECTOR ROUTINE
;
;WRITE SECTOR ROUTINE INITIATES THE WRITE
;COMMAND AND TRANSFERS ALL THE DATA FOR A
;SELECTED SECTOR
;
;W,XX = WRITE SECTOR,SECTOR ADRS
```

FIGURE 7. Write Routine.

```
        8000    PORTA     EQU 8000H    ;PORT A ADRS
        8001    PORTB     EQU 8001H    ;PORT B ADRS
        8002    PORTC     EQU 8002H    ;PORT C ADRS
        0793    POUT      EQU 793H     ;PORT B SET AS
                                        OUTPUTS
                                        ROUTINE
        0798    PIN       EQU 798H     ;PORT B SET AS
                                        INPUTS ROUTINE
        0769    STATUS    EQU 769H     ;ROUTINE
                                        CONVERTS
                                        STATUS TO ASCII
                                        PRINTABLE DATA
        0520    CHARS     EQU 520H     ;COMMAND CHAR-
                                        ACTERS ENTERED
                                        VIA CONSOLE
                ;
        0B80              ORG 0B80H
                ;
0B80    2A2205  READ      LHLD CHARS   ;GET BOTH CHARS
                          +2
0B83    7C                MOV A,H      ;XFER LS CHAR
0B84    B7                ORA A        ;TERM?
0B85    F28C0B            JP TWO       ;NO
0B88    7D                MOV A,L      ;LOAD SINGLE
                                        CHAR
0B89    C3920B            JMP SECTOR
0B8C    7D      TWO       MOV A,L      ;XFER MS CHAR
0B8D    07                RLC          ;SHIFT TO MS
                                        POSITION
0B8E    07                RLC
0B8F    07                RLC
0B90    07                RLC
0B91    84                ADD H        ;MERGE CHARS
0B92    32E50B  SECTOR    STA SECSTR   ;STOR SECTOR
0B95    CD9307            CALL POUT    ;PORTB OUTPUTS
0B98    210280            LXI H,PORTC  ;GET PORTC ADRS
0B9B    0602              MVI B,02H    ;SECTOR
                                        REGISTER
0B9D    70                MOV M,B      ;WRITE PORTC
0B9E    3AE50B            LDA SECSTR   ;SECTOR ADRS
0BA1    2F                CMA          ;INVERT FOR WD
                                        BUS
0BA2    320180            STA PORTB    ;WRITE PORTB       COMMAND
0BA5    0606              MVI B,06H    ;WRITE TO          HANDSHAKE
                                        SECTOR REG
0BA7    70                MOV M,B      ;WRITE PORTC
                ;
                ;INITIATE THE READ COMMAND
                ;
0BA8    0600              MVI B,O      ;SEL CMD REG
0BAA    70                MOV M,B      ;WRITE PORTC
0BAB    3EA8              MVI A,0A8H   ;WRITE CMD
0BAD    2F                CMA          ;INVRT FOR WD
                                        BUS
0BAE    320180            STA PORTB    ;WRITE PORTB
0BB1    0604              MVI B,04H    ;ISSUE READ TO
                                        CMD REG
0BB3    70                MOV M,B      ;WRITE PORTC
```

FIGURE 7. Write Routine (Continued).

```
                   WAIT FOR END OF READ — THEN REPORT

0BB4   0603                   MVI B,03H      ;SEL DATA REG      )
0BB6   70                     MOV M,B        ;WRITE PORTC       |
0BB7   110180                 LXI D,PORTB    ;PORTB ADRS        |
0BBA   0603                   MVI B,03H      ;RE,WE=1           |
0BBC   C3C70B                 JMP DLOOP                         |
0BBF   3E8D      GD           MVI A,8DH      ;LOAD DATA         |
0BC1   2F                     CMA            ;INVRT DATA        |  DATA
0BC2   12                     STAX D         ;WRITE PORT B      }  TRANSFER
0BC3   3E07                   MVI A,07H      ;WE=0              |  HANDSHAKE
0BC5   77                     MOV M,A        ;WRITE PORTC       |
0BC6   70                     MOV M,B        ;RE=1,PORTC        |
0BC7   7E        DLOOP        MOV A,M        ;GET STATUS        |
                                              PORTC             |
0BC8   B7                     ORA A          ;DRQ=1             |
0BC9   FABF0B                 JM GD          ;YES               |
0BCC   E640                   ANI 40H        ;INTERQ SET        |
0BCE   CAC70B                 JZ DLOOP       ;NO                )
                   READ DONE — GET STATUS

0BD1   CD9807                 CALL PIN       ;PORTB INPUTS      )
0BD4   3E00                   MVI A,0        ;ADRS STAT REG     |
0BD6   77                     MOV M,A        ;WRITE PORTC       |
0BD7   3E08                   MVI A,08H      ;STROBE RE=0       }  STATUS
0BD9   77                     MOV M,A        ;WRITE PORTC       |  HANDSHAKE
0BDA   3A0180                 LDA PORTB      ;GET STAT BYTE     |
0BDD   0600                   MVI B,0        ;STAT HANDSHAKE    |
0BDF   70                     MOV M,B        ;WRITE PORTC       )
0BEO   2F                     CMA            ;INVERT STAT
                                              BYTE
0BE1   CD6907                 CALL STATUS    ;REPORT STATUS
0BE4   C9                     RET

0BE5   0000      SECSTR       WORD 0         ;SECTOR ADRS
       0B80                   END READ
```

FIGURE 7. Write Routine (Continued).

Shugart Associates

415 Oakmead Parkway, Sunnyvale, California 94086
Phone: (408) 733-0100 TWX: 910 339 9355 SHUGART SUVL

11/77 39003

PRINTED IN U.S.A.