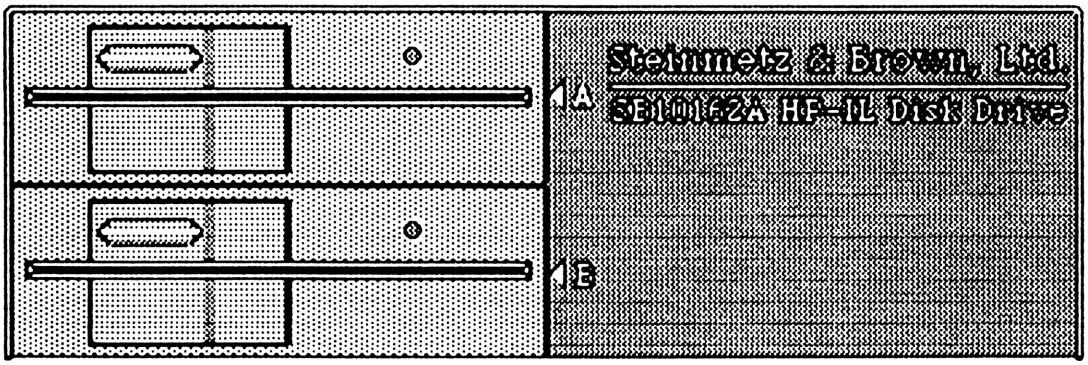
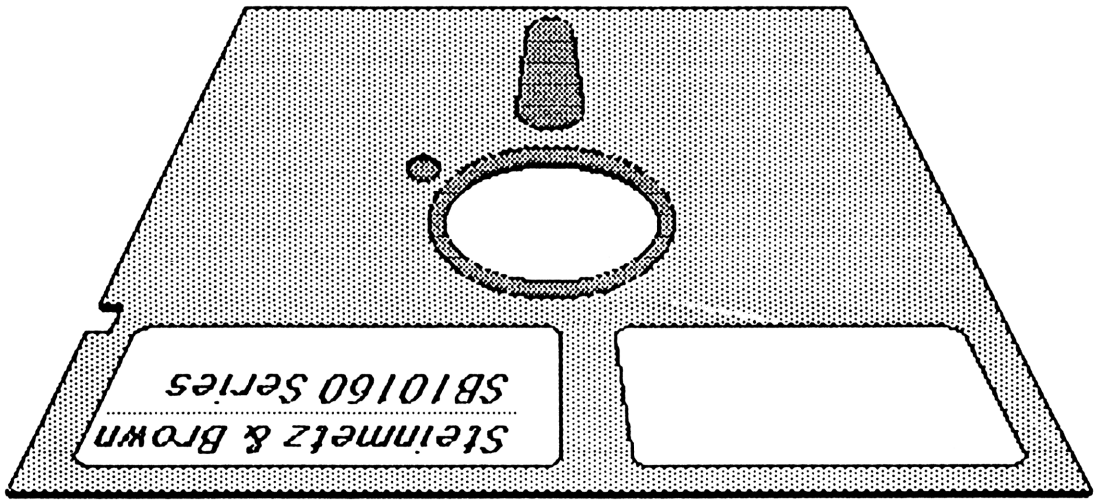
Steinmetz & Brown, Ltd.

# SB10161/SB10162

## HP-IL Compatible Disk Drive




**For use with the HP-41, HP-71, HP-75, HP-110 and other HP-IL computers**

# Congratulations!

In your SB10160 series disk drive you have perhaps the most versatile peripheral you can own. Your disk drive is a powerful enhancement to your HP-IL™ computer system offering the following features:

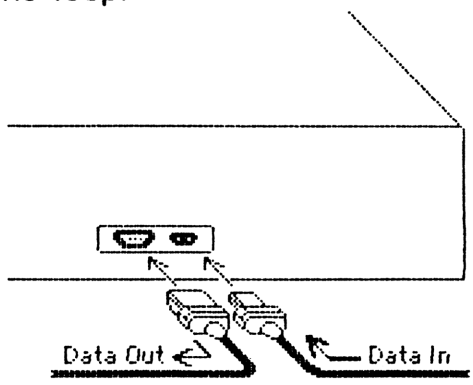
- Large storage capacity; over 368,000 bytes per disk.
- The most popular mass storage medium in the world.
- Fast access to all of your data; you're never more than 1/5 second away from your files–anywhere on the disk.
- If you own an HP-110, you can both read and write files for use on most IBM™ and other MS-DOS™ computers.
- If your drive is an SB10161, you have an affordable mass memory device and an economical upgrade path.
- If your drive is an SB10162, your advantages include the ability to directly backup your important files.
- Both models occupy less than one square foot of desk space and are stackable with the new generation of inkjet printers.
- Compatible with the full line of HP-IL™ computers.

# Table of Contents

# Getting Started

## Connecting The Drive To The Loop

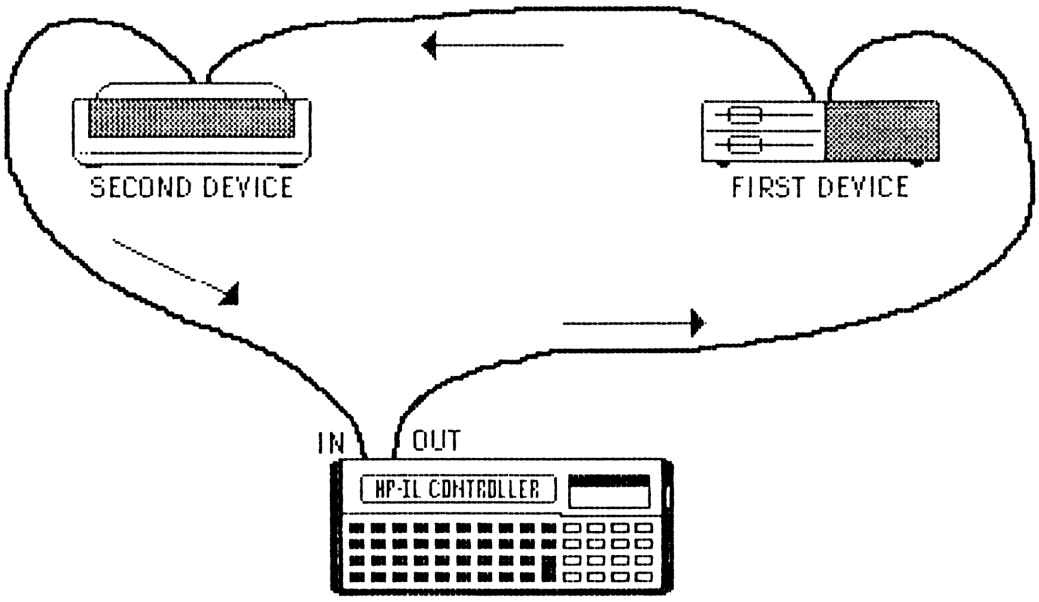
In order to use your disk drive with an HP-IL controller, the drive must be properly connected to the loop.




If the drive is the only peripheral to be attached to the controller, you will need only two HP-IL cables. Connect one end of each cable to the drive and the other end to the controller.

## Connecting Multiple Devices To The Loop

Many devices can be connected to the loop at the same time as long the cables connecting the devices form a complete loop.



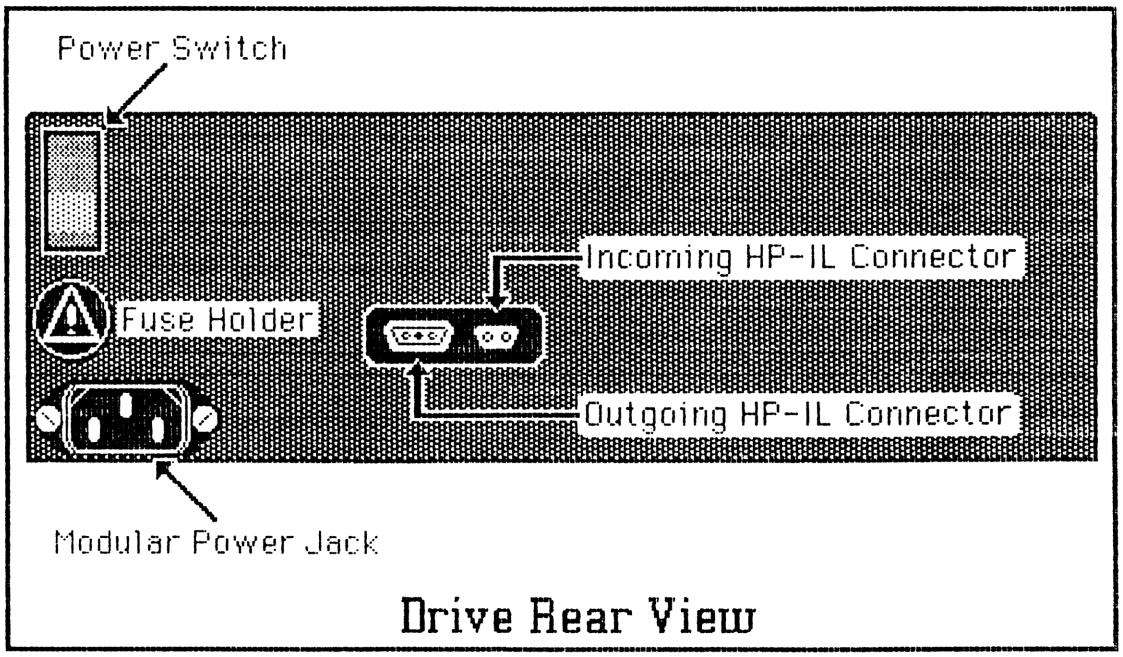

The cables cannot be connected incorrectly but be certain that both ends of a cable are not connected to the same device.

## Power Requirements

Your drive may be plugged into any 110/120 volt grounded AC outlet for normal operation. Plug the power cord firmly into the modular power jack. Be sure to use a grounded outlet for safest operation.

## Turning The Drive On

The power switch is located at the top rear of the drive. After the drive has been plugged into a suitable power outlet it can be turned on by pressing the upper side of the power switch. Pressing the lower side of the power switch will turn the drive off.

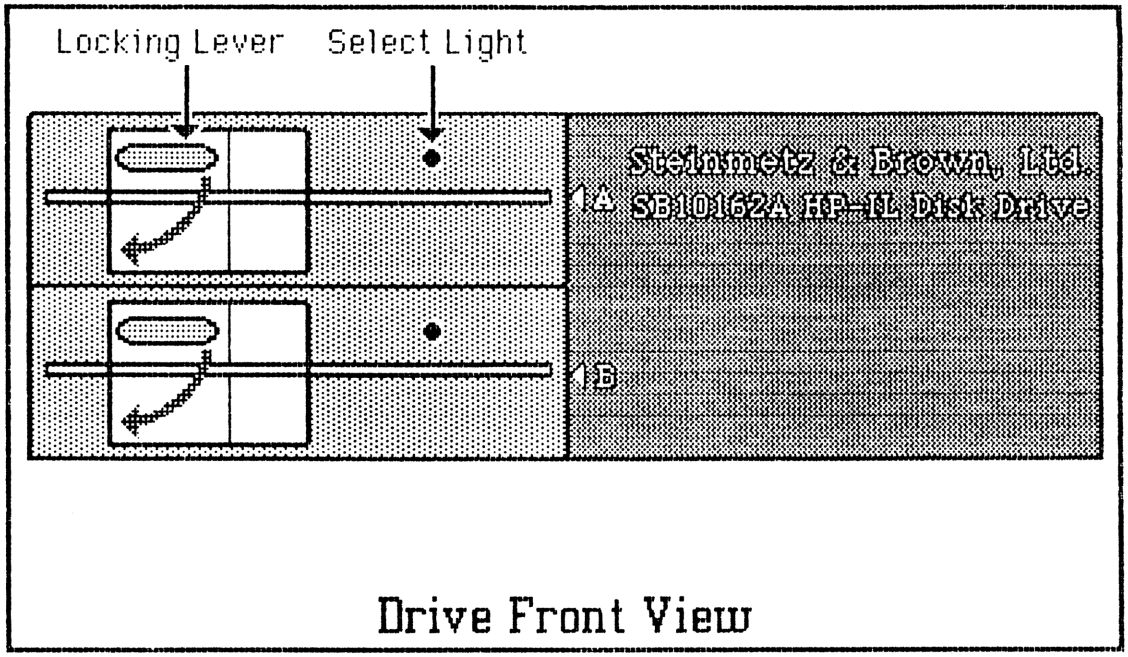



Drive Rear View

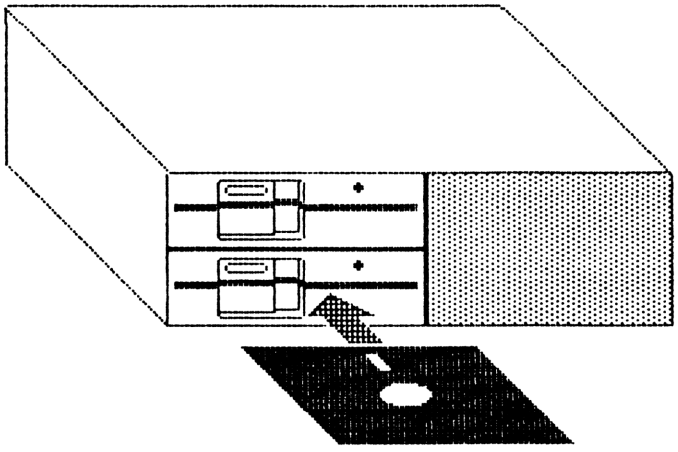
When the drive is turned on, the motor(s) will operate for a few seconds and the drive will perform a self-test to check for proper operation (technical users may wish to refer to Retrieving Drive Status). When the motor stops, you may insert a disk and begin using the drive.

## Inserting And Removing Disks

It is safe to insert or remove a disk whenever the select light is off on the drive affected. When the select light is on, the drive is accessing the disk.




Before Disks can be inserted or removed, the locking lever on the front of the drive must be in the horizontal position.



Once a disk has been inserted into the drive and the locking lever turned down to the vertical position, the drive will be ready for use.

For details on the operation of mass memory devices refer to your computer or HP-IL module owner's manual.


# Using your drive with the HP-41

The SB10161 behaves exactly like a cassette drive and the SB10162 behaves like two sequential cassette drives on the loop (though they are much faster, of course). If you refer to the Mass Storage Operations section of your HP-IL module owner's manual, you should have no trouble operating your drive. The Extended I/O module and the HP-IL Development module contain functions which permit direct control over the full storage capabilities of your drive though the HP-41 will automatically use 131,072 bytes of each disk's capacity. The HP-41 can typically move data to and from the drive at a rate of about 250 bytes per second. The next section details useful information about drive operation.

## HP-41 Special Considerations

- Due to the design of floppy disk drives, the drive does not know when one medium has been removed and another inserted. Sophisticated controllers will always consult the directory before accessing the disk; however, the HP-41 does not always do this. In normal operation, the HP-41 uses buffer 1 to maintain part of the directory. It is possible to swap disks and use the wrong directory for a medium. This can result in a read of unexpected data, overwriting records inappropriately, or a memory lost condition. To avoid this problem after changing diskettes, either turn the drive off and then on or try to read a nonexistent file.

- The HP-41 may under some circumstances fail to recognize the end of the directory or misread some entries when entries written by another controller are present. This may cause an apparently endless directory when doing a DIR command. For this reason it is recommended that media for the HP-41 not be used to hold files created by other controllers.

- The AUTO/DUP module for the HP-41 creates timing problems with some mass storage devices. If more than two drives are present on the loop at a time, it is possible that the mass copy function of the AUTO/DUP module will not operate properly.


## DDISK41—a program to display disk records with the HP-41

This program will permit an HP-41 to print the contents of disk records in both hexadecimal and character form. This permits viewing of the actual structure of stored information.

System requirements:

HP-41C/CV/CX
Extended I/O Module
HP-IL Module
any printer

Memory configuration:

SIZE 007 (or greater)
at least 40 program registers

Running DDISK41:

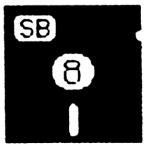
1. Carefully key in the program or load it from the diskette provided.
2. **XEQ ALPHA** D D I S K 4 1 **ALPHA**.
3. When the display shows RECORD? enter the number of the record you would like to see printed and press **R/S**.
   (The record will be printed during the next several minutes.)

If the display shows an error message (e.g. ERROR 14), there has been a problem reading data from the drive (perhaps no disk was inserted). To determine the source of the problem see Retrieving Drive Status in the Technical Description section of this manual.

| Program list: | | Comments: |
|---|---|---|
| 01 | LBL "DDISK41" | |
| 02 | LBL 00 | |
| 03 | "RECORD?" | Ask for the record# to be printed. |
| 04 | PROMPT | |
| 05 | STO Y | Convert the record# to two-byte form. |
| 06 | 256 | |
| 07 | / | |
| 08 | STO 01 | High order byte in register 01. |
| 09 | CLX | |
| 10 | LASTX | |
| 11 | MOD | |
| 12 | STO 02 | Low order byte in register 02. |
| 13 | CF 10 | |
| 14 | FS? 34 | Preserve addressing mode in flag 10. |

```
15  SF 10
16  16
17  STO 04          Save 16 for quick future reference.
18  CHS
19  FINDAID         Find the first mass memory device.
20  X=0?            If none, drop out with NO DRIVE error.
21  DIR
22  STO 06          Otherwise store its address in register 06.
23  SELECT          Select the drive.
24  ADROFF          Prevent the 41 from screwing things up.
25  LAD             Make the drive a listener.
26  4
27  DDL             Prepare to seek the desired record.
28  RCL 01
29  OUTXB           Send high order byte.
30  RCL 02
31  OUTXB           Send low order byte.
32  "SEEKING..."
33  CF 21
34  AVIEW           Inform the user that we are seeking.
35  FS? 55
36  SF 21
37  LBL 01
38  RCL 06
39  TAD             Make the drive a talker.
40  STAT            Ask for drive status.
41  ATOXL
42  ATOXL           Get status out of ALPHA.
43  32
44  X=Y?            Is the drive busy?
45  GTO 01          If so, repeat.
46  X<>Y
47  15
48  X<>Y
49  X>Y?            Has there been a drive error?
50  GTO 99          If so, go to the error display routine.
51  RCL 06
52  TAD             Otherwise make the drive a talker.
53  2
54  DDT             Read the desired record.
55  CLD
56  "RECORD: "
57  RCL 01
58  256
59  *
60  RCL 02
61  +               Reconstruct the record#.
62  XEQ 05          Call the number format routine.
63  PRA             Print the record#.
```

```
 64  ADV
 65  32
 66  STO ØØ          Store outer loop counter.
 67  4
 68  *
 69  STO Ø3          Save 128 for quick access in the loop.
 7Ø  55
 71  STO Ø1          Save 55 for quick access in the loop.
 72  48
 73  STO Ø2          Save 48 for quick access in the loop.
 74  LBL Ø2
 75  ADROFF
 76  RCL Ø6
 77  TAD             Make the drive a talker.
 78  CLX
 79  DDT             Send record in buffer Ø.
 8Ø  8
 81  INAN            Bring eight bytes into ALPHA.
 82  FC?C 1Ø         Restore addressing in case the user gets
 83  ADRON           bored and stops before we finish.
 84  1.ØØ8
 85  STO Ø5
 86  9
 87  LBL Ø3
 88  RCL Y           Use loop counter to point to character.
 89  ATOXX           Get character#.
 9Ø  STO Ø7          Save character# in register Ø7.
 91  RCL Ø4          Get 16.
 92  /               Divide to get the high order nibble.
 93  INT
 94  X>Y?            Is nibble > 9?
 95  RCL Ø1          If so, get 55 (ASCII table offset for A-F).
 96  X<=Y?           Is nibble <= 9?
 97  RCL Ø2          If so, get 48 (ASCII table offset for Ø-9).
 98  +               Add appropriate offset.
 99  ACCHR           Accumulate hex character.
1ØØ  RDN             Get 9.
1Ø1  RCL Ø7          Get character#.
1Ø2  RCL Ø4          Get 16.
1Ø3  MOD             Modulo to get the low order nibble.
1Ø4  X>Y?            Is nibble > 9?
1Ø5  RCL Ø1          If so, get 55 (ASCII table offset for A-F).
1Ø6  X<=Y?           Is nibble <= 9?
1Ø7  RCL Ø2          If so, get 48 (ASCII table offset for Ø-9).
1Ø8  +               Add appropriate offset.
1Ø9  ACCHR           Accumulate hex character.
11Ø  CLX             Hold stack position.
111  2
112  SKPCHR          Skip two character positions.
```




```
113  RDN          Restore stack order.
114  ISG Y
115  GTO Ø3       Repeat for all eight characters.
116  ADV
117  LBL Ø4
118  RCL Ø3       Get 128.
119  RCL Ø5       Use loop counter to point to character.
12Ø  ATOXX        Get current character#.
121  RCL Y        Get 128.
122  X<=Y?        Is character# >= 128?
123  -            If so, bring character# down by 128.
124  X>Y?         Is character# still in register Y?
125  X<>Y         If so, bring it to register X.
126  ACCHR        Accumulate character representation.
127  2
128  SKPCHR       Skip two character positions.
129  ISG Ø5
13Ø  GTO Ø4       Repeat for all eight characters.
131  ADV
132  DSE ØØ       Repeat for all thirty two blocks
133  GTO Ø2       of eight characters.
134  ADV
135  ADV
136  ADV
137  ADV
138  ADV          Advance the paper for easy viewing.
139  CLST
14Ø  CLA          Clean up.
141  RTN          Quit.
142  GTO ØØ       Start over at the beginning.
143  LBL Ø5       Number formatting routine.
144  FC?C 1Ø
145  ADRON        Restore addressing in case user quits.
146  FIX Ø
147  CF 29
148  ARCL X       Format number with no commas or points.
149  FIX 2
15Ø  SF 29        Restore a reasonable display format.
151  RTN          Return to calling routine.
152  LBL 99       Device error processing routine.
153  " ERROR "
154  XEQ Ø5       Call the number format routine.
155  CF 21
156  AVIEW        Display the drive error code.
157  FS? 55
158  SF 21
159  END          Quit.
```


## VOLID–a '41 program to view and change the disk volume ID

This program will display the six character volume ID on a disk and permit the ID to be changed at any time. When the '41 formats a disk, it does not normally put a meaningful ID on the disk. Using VOLID, any six character volume ID can be placed on the disk for future reference.

System requirements:

HP-41C/CV/CX
Extended I/O Module
HP-IL Module

Memory configuration:

SIZE ØØ1 (or greater)
at least 16 program registers

Running VOLID:

1. Carefully key in the program or load it from the diskette provided.
2. **XEQ ALPHA** V O L I D **ALPHA**.
3. When the display shows VOLID: followed by the current volume ID, you may enter a different volume ID (six characters or less) and press R/S to store the new ID on the disk.

Note that this program pays no attention to device errors and will appear to work properly even if no disk is in the drive. When using HP-IL commands the programmer must choose whether or not to do error checking and when. Unlike DDISK41, this program does no error checking.

| Program listing: | Comments: |
|---|---|
| Ø1 LBL "VOLID" | |
| Ø2 ADROFF | Keep the 41 from mucking with us. |
| Ø3 -16 | |
| Ø4 FINDAID | Find the first mass memory device. |
| Ø5 STO ØØ | Save its address in register ØØ. |
| Ø6 LAD | Make the drive a listener. |
| Ø7 4 | |
| Ø8 DDL | Prepare to seek. |
| Ø9 CLX | |
| 1Ø OUTXB | |
| 11 OUTXB | Seek record Ø. |
| 12 RCL ØØ | |
| 13 TAD | Make the drive a talker. |
| 14 2 | |

```
15  DDT          Read the record into buffer Ø.
16  RCL ØØ
17  LAD          Make the drive a listener.
18  3
19  DDL          Prepare to set the byte pointer.
2Ø  2
21  OUTXB        Set the byte pointer to position 2.
22  RCL ØØ
23  TAD          Make the drive a talker.
24  CLX
25  DDT          Send buffer Ø starting at byte 2.
26  6
27  INAN         Bring six characters into ALPHA.
28  ATOXL        Knock off the leading dummy character.
29  ASTO Ø1      Store the volume ID in register Ø1.
3Ø  "VOLID: "
31  ARCL Ø1
32  AON          Turn on ALPHA mode.
33  CF 23
34  ADRON        Restore addressing in case user quits.
35  PROMPT       Show the current volme ID.
36  ADROFF       Turn addressing off again.
37  AOFF         Turn ALPHA mode off.
38  FS? 23       Did the user enter a new volume ID?
39  ASTO Ø1      If so, store the new ID.
4Ø  RCL ØØ
41  LAD          Make the drive a listener.
42  4
43  DDL          Prepare to seek.
44  CLX
45  OUTXB
46  OUTXB        Seek record* Ø.
47  3
48  DDL          Prepare to set the byte pointer.
49  2
5Ø  OUTXB        Set the byte pointer to position 2.
51  6
52  DDL          Go to partial write mode.
53  "D"          Dummy leading character.
54  ARCL Ø1      Append the new volume ID.
55  OUTAE        Send the new volume ID to the drive.
56  8
57  DDL          Close the record (write to the disk).
58  ADRON        Restore normal addressing.
59  END          Quit.
```


# Using your drive with the HP-71

The SB10161 and SB10162 provide an excellent means for enhancing the speed and power of the HP-71. If you refer to the Mass Storage Operations section of your HP-IL module owner's manual, you will find that all mass storage functions work exactly as described there; including secondary addressing. The 368,640 byte capacity of each disk is immediately available for your storage needs. The HP-71 can typically move data to and from the drive at a rate of about 2000 bytes per second.

## DDISK71—a program to display disk records with the HP-71

This program will permit an HP-71 to print the contents of disk records in both hexadecimal and character form. This permits viewing of the actual structure of stored information.

System requirements:

HP-71
HP-IL Module
any HP-IL printer

Memory requirements:

about 1400 bytes for program
about 500 additional bytes for data

Running DDISK71:

1. Carefully type in the program or load it from the diskette provided.
2. Type RUN DDISK71 **ENDLINE** .
3. When the display shows RECORD #, enter the number of the record you would like to see printed and press **ENDLINE** .
   (The record will be printed.)

If the display shows an error message (e.g. Device error #14), there has been a problem reading data from the drive (perhaps no disk was inserted). To determine the source of the problem see Retrieving Drive Status in the Technical Description section of this manual.

Program list:

```
 10   ! Program to print the contents of a disk record.
 20   ! 9/13/84 Steinmetz & Brown, Ltd.
 30   ! S - Status of the drive.
 40   ! M1 - Address of the first mass memory device.
 50   ! C - Number of bytes
100   DIM D$[256] ! Make D$ large enough to hold one record.
110   RESET HPIL @ ASSIGNIO * @ M1=DEVADDR(":MASSMEM(1)") ! Use first mass memory
120   SFLAG -23 ! Stop filling D$ when an ETO is received.
130   PRINTER IS :PRINTER ! Use the first printer on the loop.
140   ! 8 bytes per line if 82162A, else 16 per line.
150   IF DEVID$(":PRINTER")="" THEN N=8 ELSE N=16
160   INPUT "RECORD #";R
170   SEND LISTEN M1 MTA DDL 4 DATA R DIV 256, MOD(R,256) ! Seek record.
180   S=SPOLL(M1) @ IF S>=32 THEN 180 ! Wait for drive not busy.
190   IF S>15 THEN 400 ! If device error, display error #.
200   SEND TALK M1 MLA DDT 2 ! Read the record into buffer 0.
210   ENTER :LOOP ;D$ ! Fill D$ with contents of record.
220   S=SPOLL(M1) @ IF S>15 THEN 400 ! Check if data is OK.
230   PRINT "Record #";R @ PRINT
240   FOR I=1 TO 256 DIV N ! For each line...
250   PRINT DTH$((I-1)*N)[4,5];":  " ! Print relative address.
260   FOR J=1 TO N ! For each byte in this block...
270   PRINT DTH$(NUM(D$[(I-1)*N+J]))[4,5];"  "; ! Print hex representation of byte.
280   NEXT J
290   PRINT
300   FOR J=1 TO N ! For each character in block...
310   C=NUM(D$[(I-1)*N+J]) ! Number of character.
320   IF C>127 THEN C=C-128 ! No upper half characters.
330   IF C<32 THEN C=32 ! Substitute a space for control characters.
340   PRINT " ";CHR$(C);" ";
350   NEXT J
360   PRINT
370   NEXT I
380   PRINT
390   END
400   PRINT "Device error #";S @ BEEP
410   END
```

# Using your drive with the HP-75

The SB10160 series drives offer a fast and efficient means for enhancing the storage capacity of the HP-75 If you refer to your HP-75 owner's manual, you find that all mass storage functions work exactly as described there. You may immediately use the full 368,640 byte capacity of each disk to rapidly store and retrieve your files. The HP-75 typically moves data to and from the drive at a rate of about 500 bytes per second.

## DDISK75—a program to display disk records with the HP-75

This program will permit an HP-75 to print the contents of disk records in both hexadecimal and character form. This permits viewing of the actual structure of stored information.

System requirements:

HP-75
I/O Utilities LEX file
any HP-IL printer

Memory requirements:

about 1600 bytes for program
about 500 additional bytes for data

Running DDISK75:

1. Ensure that the drive to be used is assigned as M1 (using ASSIGNIO).
2. Carefully type in the program or load it from the disk provided.
3. Type RUN DDISK75 **RETURN**.
4. When the display shows RECORD #, enter the number of the record you would like to see printed and press **RETURN**.
   (The record will be printed.)

If the display shows an error message (e.g. Device error #14), there has been a problem reading data from the drive (perhaps no disk was inserted). To determine the source of the problem see Retrieving Drive Status in the Technical Description section of this manual.

Program list:

```
 10  ! Program to print the contents of a disk record.
 20  ! 9/13/84 Steinmetz & Brown, Ltd.
 30  ! This program presumes that the desired drive is called M1.
 40  ! Note: to use this program, the I/O Utilities LEX file must be present.
100  DIM A$[256] ! Make A$ large enough to hold one record.
110  N=8 ! Number of bytes per printed line.
120  DEF FNU$(I) ! Function to generate upper hexadecimal nibble.
130  I=I DIV 16 @ IF I<=9 THEN FNU$=CHR$(I+48) ELSE FNU$=CHR$(I+55)
140  END DEF
150  DEF FNL$(I) ! Function to generate lower hexadecimal nibble.
160  I=MOD(I,16) @ IF I<=9 THEN FNL$=CHR$(I+48) ELSE FNL$=CHR$(I+55)
170  END DEF
180  INPUT "RECORD #?";RØ
190  R1=RØ DIV 256 @ R2=MOD(RØ,256) ! Break record # into two bytes.
200  SENDIO ":M1","LAD#,DDL4",CHR$(R1)&CHR$(R2) ! Seek record.
210  A$=ENTIO$(":M1","TAD#,SST") @ IF NUM(A$)=32 THEN DISP "seeking" @ GOTO 210
220  IF NUM(A$)>15 THEN 380 ! If device error, display error #.
230  A$ =ENTIO$(":M1","TAD#,DDT2,SDA") ! Read the record into A$.
240  PRINT "Record: ";RØ
250  FOR B=1 TO 256 STEP N
260  FOR L=B TO B+N-1
270  A=NUM9A$[L,L]) @ PRINT FNU$(A)&FNL$(A)&"  "; ! Print hexadecimal bytes.
280  NEXT L @ PRINT
290  FOR L=B TO B+N-1
300  C=NUM(A$[L,L]) ! Get number of character.
310  IF C>127 THEN C=C-128 ! No upper half characters.
320  IF C<32 THEN C=32 ! Substitute a space for control characters.
330  PRINT "  ";CHR$(C);"  "; ! Print character representation.
340  NEXT L @ PRINT
350  PRINT
360  NEXT B
370  GOTO 180
380  PRINT "Device error #";NUM(A$)
390  END
```

# Using your drive with the HP-110

The SB10160 series drives can provide not only practical mass storage, but also the unique capability to read disks written by the IBM PC™ and write disks which can be read by the IBM PC™. Any double sided, nine sector per track IBM disk may be inserted into your drive and its files read by a compatible HP-110 application (e.g. a Lotus 1-2-3™ data file written on an IBM can be read by the Lotus 1-2-3™ application in the '110). The only limitations are that the disk must be in the format described above and, of course, you must have an application capable of reading the desired files.

Though it is technically possible to read applications programs written by IBM computers, this may not be practical in some cases. Applications programs usually vary subtly from one machine to the next and may not operate properly unless written explicitly for the HP-110.

## Configuring SB10160 series drives into the HP-110 system

Up to eight SB10161s or four SB10162s may be connected to the HP-110 simultaneously. Each drive configures media as double density, double sided, nine sector per track disks. Refer to your HP-110 owner's manual for details about configuring mass memory devices into your system.

# Technical Description

## Disk Format and Physical Storage of Data

The SB10161 and SB10162 use 5 1/4", double-sided, double-density, soft-sectored disks.

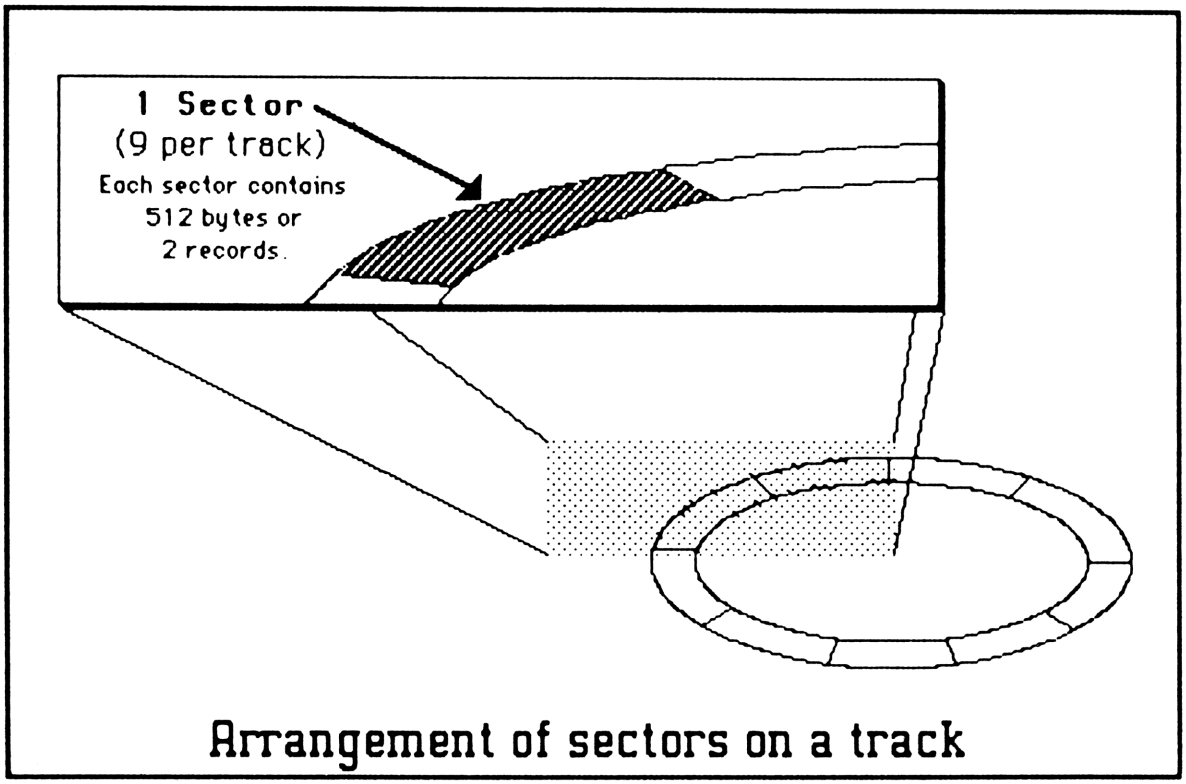
Before a new disk can be used it must be "formatted". Formatting is normally started by the controller whenever you give a NEWM or INITIALIZE command. The format command can also be invoked by the HP-IL message DDL5 (see HP-IL Messages). When the drive receives a format command it destroys any existing information on the disk and creates forty "tracks" on each side of the disk.

A track is a ring-shaped area on the disk which stores information. Tracks are arranged concentrically on the disk from the outside in. Each track is divided into nine "sectors".

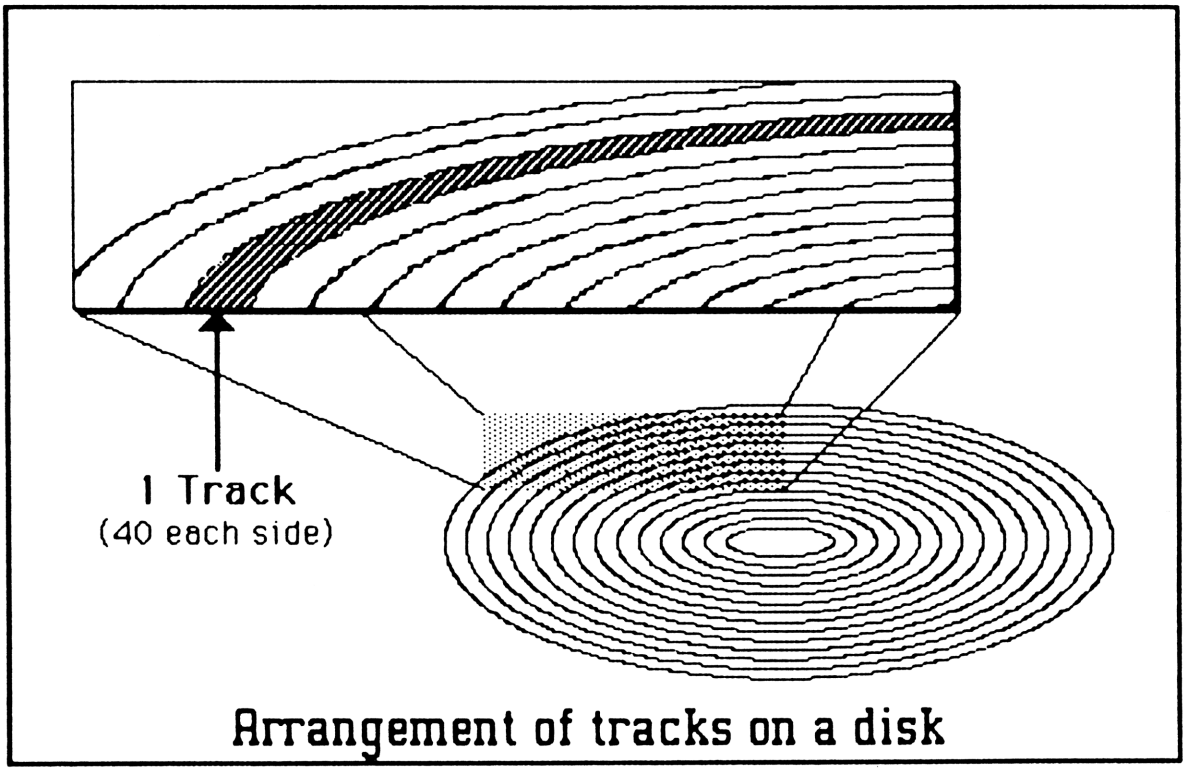
A sector holds 512 bytes of information. Whenever the drive stores or retrieves information it does so in whole sectors at a time. If only part of a sector needs to be modified the entire sector is read from the disk, the pertinent part is modified, and the entire modified sector is written back to the disk. Most HP-IL controllers use blocks of information smaller than sectors. These are called "records".

A record contains 256 bytes of information. Each sector holds two records. The disk contains 1440 records numbered from 0 to 1439. Frequently, the controller will send a series of sequential records to the drive to be stored on the disk. Since the disk buffer (see Buffers and Disk I/O) holds two records at a time, the disk is usually updated only once for every two records received. The disk is also updated when the controller ends the writing session. This ensures that the last information sent is saved on the disk even if it does not fill an entire sector

The diagram on the following page illustrates how tracks, sectors, and records are physically arranged on the disk.




Arrangement of sectors on a track




Arrangement of tracks on a disk

## Buffers and Disk I/O

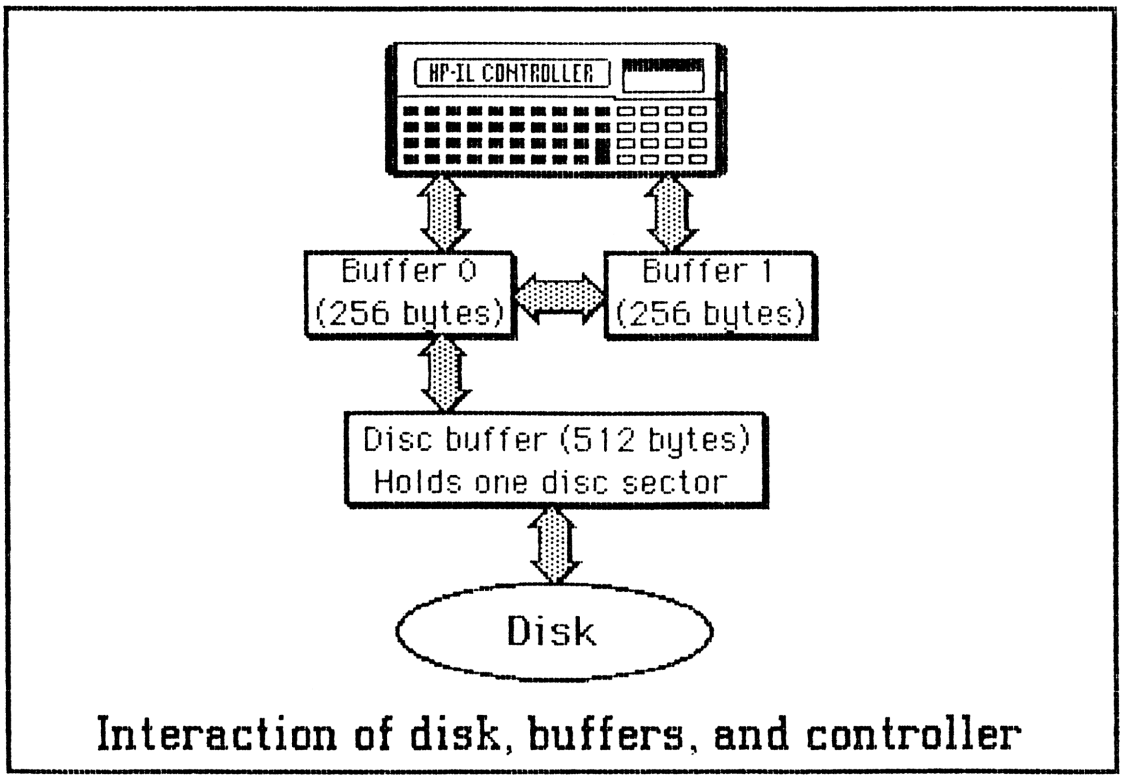
When the controller needs to read from or write to the disk it uses memory areas in the drive called buffers. Buffers are blocks of memory which can temporarily hold information until it is needed. There are three buffers in each drive:

The disk buffer holds a 512 byte sector immediately after it has been read from the disk and while the sector is being modified before it is written back to the disk.

Buffer Ø is used to hold one of the 256 byte records from the disk buffer or information which will replace one of the records in the disk buffer.

Buffer 1 serves as a 256 byte workspace for the controller.

The controller can put information into or take information out of buffer Ø or buffer 1. The disk buffer is not directly accessible to the controller. This diagram illustrates how the buffers work.

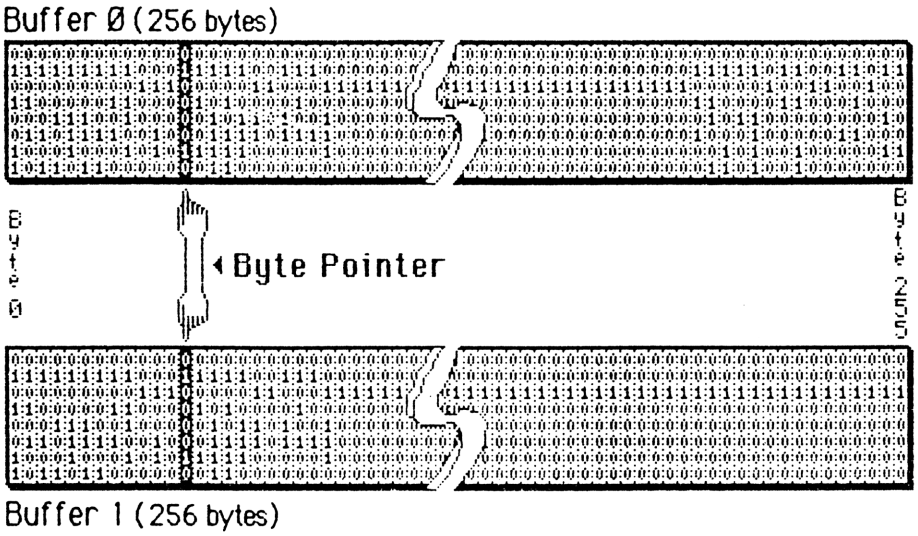



Interaction of disk, buffers, and controller

## The Byte Pointer

When the controller needs to modify only part of contents of a buffer or when it needs to read only a portion of a buffer, it uses the byte pointer to select the start of the desired segment.

### Buffers and the Byte Pointer

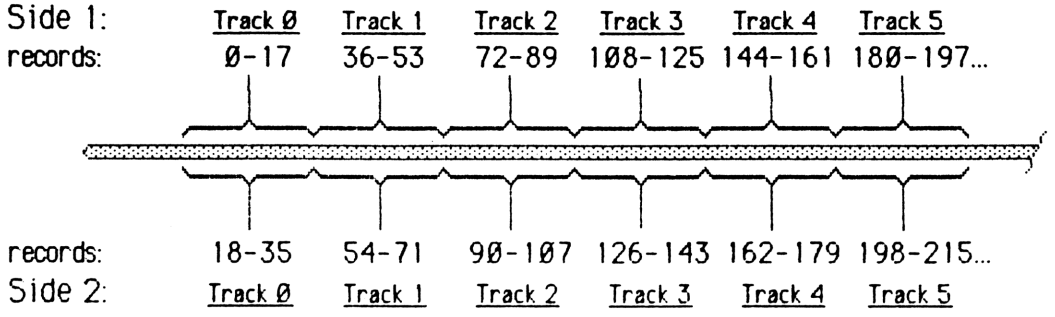



## Record Addresses and Their Physical Locations

In order to minimize motion of the drive heads, the drive switches sides when accessing sequential tracks of data. Since each track contains eighteen records, this means that each consecutive block of eighteen records is on the side opposite the previous block:

### Location of records on the disk

(cross-sectional view of the disk)



# HP-IL Messages

Normally, technical details of drive operation are handled automatically by the controller. You need only give a command to move a file to or from the disk and the controller does the rest. It is possible, however, to control the drive using individual HP-IL messsages.

HP-IL messages are far more primitive than the commands you normally use to operate mass storage devices. Such a message might do no more than send a single character to the drive or ask if the drive is busy. Collectively, they permit direct control over information and its placement on the disk. The controller and the drive exchange hundreds or thousands of HP-IL messages to transfer even a small file. They are the "words" in the language HP-IL devices use to communicate with one another. This language is called the HP-IL Protocol. A proper discussion of the HP-IL Protocol is beyond the scope of this manual. The protocol is presented more thoroughly in the documents listed in appendix C.

**–Caution–**

Improper use of HP-IL Messages can alter information on the disk or render files irretrievable by normal commands. This is true even of secured files. Before experimenting with HP-IL messages you should remove from the drive any disks containing important information.

## Drive Response to HP-IL Messages

This section details the operation of HP-IL messages on the SB1Ø161 and SB1Ø162. Familiarity with the HP-IL protocol is a prerequisite for a thorough understanding of this material.

| HP-IL Message | | Drive Response |
|---|---|---|
| Command Group | | |
| **IFC** | Interface Clear | Removes the drive from talker or listener status. |
| **DCL** | Device Clear | Record pointer is set to zero, recording mode cleared, and sending of data terminated. |
| **SDC** | Selected Device Clear | If a listener, the drive is cleared as with DCL. |
| **GTL** | Go To Local | No response. |
| **LLO** | Local Lockout | No response. |
| **REN** | Remote Enable | No response. |
| **NRE** | Not Remote Enable | No response. |
| **PPE** | Parallel Poll Enable | No response. |
| **PPD** | Parallel Poll Disable | No response. |
| **PPU** | Parallel Poll Unconfigure | No response. |
| **GET** | Group Execute Trigger | No response. |
| **LPD** | Loop Power Down | No response. |
| **EAR** | Enable Asynchronous Requests | No response. |
| **AAU** | Auto Address Unconfigure | Address set to two. |
| **LAD** | Listen address Ø-31 | If address matches, the drive is removed from talker status & made a listener. |
| **UNL** | Unlisten | Drive is removed from listener status. |
| **DDL** | Device Dependent Listener | Executes specified listener command (Ø-11). |
| **TAD** | Talk address Ø-31 | If address matches, the drive is removed from listener status & made a talker. |
| **UNT** | Untalk | Drive is removed from talker status. |
| **DDT** | Device Dependent Talker | Executes specified talker command (Ø-7). |
| **SAD** | Secondary Address | Drive uses SAD* as its secondary address, increments SAD* & passes SAD to next device. A subsequent AAD provides the drive with its primary address. |
| **ELN** | Enable Listener Not Ready | No response. |
| **NOP** | No Operation | No response. |
| **NUL** | Null | No response. |

| HP-IL Message | Drive Response |
|---|---|
| Ready group | |
| **TCT** Take Control | No response. |
| **RFC** Ready For Command | Current command is completed & RFC is passed to next device. |
| **SDA** Send Data | If talker, begins sending data bytes as previously selected. |
| **SST** Send Status | If talker, sends one status bytes (refer to Testing Drive Status). |
| **SDI** Send Device ID | If talker, sends SB10161A or SB10162A. Though the letter "A" may be replaced by a different revision code in some drives. |
| **SAI** Send AccessoryID | If talker, sends one byte with the value 16. |
| **NRD** Not Ready for Data | If talker, data transmission halts. Drive waits for last data byte to return before sending an End of Transmission OK (ETO) frame. |
| **ETO** End Transmission OK | If talker, sent at end of data. |
| **ETE** End Transmission Error | If talker, sent immediately if a data byte is received not as sent |
| **AAD** Auto Address 0-31 | If not already addressed, the drive takes AAD# as its primary address, increments AAD# & passes AAD to next device. |
| **AEP** Auto Extended Primary 0-31 | If not already addressed, if drive previously received AES, uses AEP# as its address. |
| **AES** Auto Extended Secondary 0-31 | If not already addressed, drive assumes AES# as its secondary address, increments AES# & passes AES to next device. |
| **AMP** Auto Multiple Primary 0-31 | No response |
| Identify Group | |
| **IDY** Identify | No response |
| Data Group | |
| **DAB** Data byte | If talker, checks if frame received as sent & sends next byte. If listener, accepts byte & passes it on to the next device. |
| **END** End | If listener, accepts byte, records buffer 0 contents onto the disk. |

## Device Dependent Commands

Since HP-IL devices can have greatly varying functions from one another there is a need for messages by which the controller can access the specific features of each device. Device Dependent Commands are HP-IL messages which function differently depending the device receiving them. There are two kinds of Device Dependent Commands; Device Dependent Listeners (DDLs) which tell devices in listener mode to perform a task (e.g. Rewind), and Device Dependent Talkers (DDTs) which tell devices in talker mode to perform a task (e.g. Send Position). If the drive receives any DDL or DDT not listed here, it ignores all Data and End bytes until a subsequent DDL or DDT tells it to do otherwise. This prevents accidental data erasure.

## Device Dependent Listener Commands

| # | Name | Description |
|---|---|---|
| Ø | Write Buffer Ø | Subsequent data bytes are stored in buffer Ø starting at the byte pointer. When the buffer fills, its contents are copied to the disk buffer. After each odd-numbered record is copied, the disk buffer is automatically written to the disk according to the current recording mode. Addtitional bytes are stored in buffer Ø starting at position Ø. An End byte is stored as a data byte and the contents of buffer Ø are copied to the disk buffer which is then written to the disk. |
| 1 | Write Buffer 1 | Subsequent data bytes are stored in buffer 1 starting at the byte pointer. When the buffer fills, additional bytes replace those already in the buffer starting at position Ø. End bytes are treated as data bytes. (DDL1 also clears partial write mode) |
| 2 | Continuous Write | The byte pointer is set to position Ø of buffer Ø. As subsequent data bytes fill buffer Ø its contents are copied to the disk buffer. After each odd-numbered record is copied, the disk buffer is written to the disk and the record pointer is updated to the next record. When an End or Close Record (DDL8) is received, the contents of buffer Ø are copied to the disk buffer which is then written to the disk. |

| | | |
|---|---|---|
| 3 | Set byte pointer | Subsequent bytes redefine the byte pointer (from Ø-255). The last byte received is used. |
| 4 | Seek | The next two bytes are interpreted as a record number (Ø-1439). The record pointer is set to that record and the sector containing the record is read into the disk buffer. Buffer Ø is not changed. (DDL4 also clears partial write mode.) |
| 5 | Format | The value 255 is written to all records of the disk. When the format function begins executing, the RFC frame is passed to the next device on the loop. After the format, the record pointer is set to zero. (DDL5 also clears partial write mode.) Additionally, due to the requirements of the HP11Ø, HP71, and HP75 controllers, special information will be written to the disk during subsequent write commands. To prevent this from occuring , send the drive a Device Clear (DCL) or Selected Device Clear (SDC) command before performing any writes. |
| 6 | Partial Write | The drive is set to partial write mode. The current record is read from the disk buffer into buffer Ø and the record pointer remains unchanged. Subsequent data bytes replace the contents of buffer Ø starting at the byte pointer. When buffer Ø is full it is copied to the disk buffer. If the record copied is odd-numbered, the disk buffer is then written to the disk. The record pointer is then advanced, the next record is copied to buffer Ø and the byte pointer is set to Ø. This continues until a Close Record (DDL8) or End byte is received. A Close Record causes buffer Ø to be copied to the disk buffer which is then written to the disk without advancing the record pointer. An End byte will be placed in buffer Ø which is then copied to the disk buffer which is written to the disk without advancing the record pointer—unless the End byte fills buffer Ø in which case buffer Ø is copied to the disk buffer which is written to the disk, the next record is copied to buffer Ø and the record pointer will be set to that record. |

| | | |
|---|---|---|
| 7 | Rewind | The record pointer is set to record Ø. |
| 8 | Close Record | The contents of buffer Ø are copied to the disc buffer which is written to the disc. Following a Write command (DD2), Close Record advances the record pointer. Close Record doesn't advance the record pointer following a Partial Write command (DDL6). |
| 9 | Transfer Buffer | The contents of buffer Ø are copied to buffer 1 and the byte pointer is set to Ø. |
| 1Ø | Exchange Buffers | The contents of buffer Ø and buffer 1 are exchanged and the byte pointer is set to Ø. |
| 11 | Verify | The next two data bytes are used as the number of records to be verified. The drive starts at the current record pointer position and reads records until the number of records specified have been read or the end of the disk is reached or an error occurs while reading. If the number of records specified are read successfully, the drive stops and its status is Ø. If the end of the disk is reached first, the drive rewinds to record zero and its status is set to Ø. If an error occurs while reading, the drive stops, the record pointer is set to the record at which the error occurred, and its status is set to reflect the type of error. |

## Device Dependent Talker Commands

| # | Name | Description |
|---|---|---|
| Ø | Send Buffer Ø | A subsequent Send Data message (SDA) will cause the contents of Buffer Ø to be sent. The data stream will begin with the byte pointed to by the byte pointer. When the end of the buffer is reached, the next record is copied from the Disk Buffer into Buffer Ø (If the next record is even-numbered, it and the following record are first read from the disk into the Disk Buffer) which is then sent on the loop. This continues until the end of the disk is reached, a Not Ready for Data message (NRD) is received, or any frame other than the transmitted data byte is received. (DDTØ also clears partial write mode.) |
| 1 | Send Buffer 1 | A subsequent Send Data message (SDA) will cause the contents of Buffer 1 to be sent. The data stream will begin with the byte pointed to by the byte pointer. When the end of the buffer is reached, data transmission is terminated and the byte pointer is set to Ø. This continues until a Not Ready for Data message (NRD) is received or any frame other than the transmitted data byte is received. |
| 2 | Read | The next record is copied from the Disk Buffer (If the next record is even-numbered, it and the following record are first read from the disk into the Disk Buffer). A subsequent Send Data message (SDA) will cause the contents of Buffer Ø to be sent starting with the first byte in the buffer. When the end of Buffer Ø is reached, the next record is copied to Buffer Ø and sent on the loop. This continues until the end of the disk is reached, a Not Ready for Data message (NRD) is received, or an any frame other than the transmitted data byte is received. (DDT2 also clears partial write mode.) |

| | | |
|---|---|---|
| 3 | Send Position | A subsequent Send Data (SDA) message will cause the drive to return three bytes: the first two bytes represent the record pointer (Ø-1439). The third byte represents the byte pointer. |
| 4 | Exchange Buffers | The contents of Buffer Ø are exchanged with the contents of buffer 1 and the byte pointer is reset to Ø. |
| 5 | Transfer Buffer | The contents of buffer Ø are copied to buffer 1 and the byte pointer is set to Ø. |
| 6 | Send Physical Attributes | A subsequent Send Data (SDA) message will cause the drive to return twelve bytes; the first four represent the number of tracks per surface (Ø, Ø, Ø, 4Ø), the second four represent the number of surfaces per medium (Ø, Ø, Ø, 2), and the third four represent the number of records per track (Ø, Ø, Ø, 18) |
| 7 | Send Highest Record* | A Subsequent Send Data (SDA) message will cause the drive to return two bytes representing the number of the last record on the medium (5, 159). |

## Retrieving Drive Status

The Send Status command (SST) tells the drive to return a byte indicating its current status (e.g. busy, idle, error has occurred). The SST frame is replaced by one Data Byte (DAB) representing the status of the drive at the time the Data Byte is sent on the loop. Very long running operations such as Format (DDL5) and Verify (DDL11) may delay the processing of a status request by a second or two. The drive only signals an error condition once after it occurs, so controllers must pay attention to error status indications for every status byte they read.

This table shows the meaning all status bytes which might be returned by the drive:

Status Byte

| Binary* | Decimal | Hex | Condition | Meaning |
|---|---|---|---|---|
| 0000**** | 0-15 | 0-F | Idle Condition | No error and not executing any command. |
| 00010000 | 16 | 10 | Protected Disk | Disk is physically write-protected. |
| 00010001 | 17 | 11 | | Not used. |
| 00010010 | 18 | 12 | | Not used. |
| 00010011 | 19 | 13 | | Not used. |
| 00010100 | 20 | 14 | No Disk Error | No disk is in the drive. |
| 00010101 | 21 | 15 | | Not used. |
| 00010110 | 22 | 16 | Device Error | Device may require service. |
| 00010111 | 23 | 17 | | Not used. |
| 00011000 | 24 | 18 | | Not used. |
| 00011001 | 25 | 19 | Record* Error | Record cannot be retrieved. |
| 00011010 | 26 | 1A | Checksum Error | Computed checksum doesn't match stored checksum. |
| 00011011 | 27 | 1B | Record Type Error | Unexpected record type found. |
| 00011100 | 28 | 1C | Size Error | Attempt to access a record* greater than 1439. |
| 00011101 | 29 | 1D | Lost Data Error | Data lost during current operation. |
| 00011110 | 30 | 1E | | Not used. |
| 00011111 | 31 | 1F | | Not used. |
| 001***** | 32-63 | 20-3F | Busy Condition | Drive is executing a command. |

*The Eight bits shown are in order from the most significant (on the left) to the least significant (on the right). The symbol * indicates any binary digit (0 or 1).

# Appendix A: Care, Warranty, & Service

## Care of Your Disk Drive

Though it can be put in a briefcase, your disk drive was designed primarily for desk-top use. As with all disk drives, it should not be subjected to excessively dusty environments or mechanical shock. When you transport the unit, you should insert the protective cards into all drives present.

## Care of Disks

Disks should be kept in their protective jackets away from dust, smoke, grease and strong magnetic sources. Be careful not to emboss disks while marking them. –i Always make backups of important information !–

## Limited 90 Day Warranty

Your drive is warranted by Steinmetz & Brown, Ltd. against defects in materials and workmanship for a period of ninety days from the date of original purchase. During the warranty period we will repair or, at our option, replace a unit that proves to be defective, provided that you return the unit, shipping prepaid, to Steinmetz & Brown.

This warranty does not cover damage to the unit caused by accident or misuse or by service by other than an authorized Steinmetz & Brown service center.

Steinmetz & Brown, Ltd. makes no other express warranty. The repair or replacement of a unit is your exclusive remedy. **Any other implied warranty of merchantability or fitness is limited to the ninety-day duration of this written warranty.** Some states and provinces do not recognize limitations on the duration of an implied warranty, so the limitation above may not apply to you. **In no event shall Steinmetz & Brown, Ltd. be liable for incidental or consequential damages.** Some states and provinces do not permit the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which are interpreted differently from state to state and province to province.

## Service

If your unit needs repair at any time, it may be returned to:

Steinmetz & Brown, Ltd.
Service Department
2675 University Ave
St Paul, MN 55114

There is a charge for repairs made after the ninety day warranty period. Costs and arrangements for shipping, and in the case of international service, reimportation and customs are your responsibility. If possible, repack your drive in its original packing materials and insure it as needed.

## Potential for Radio/Television Interference

The SB10161A/SB10162A Disk Drive generates and uses radio frequency energy and, if not installed and used properly (that is, in strict accordance with the instructions in this manual), may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with protection against such interference in a residential installation. If the disk drive does cause interference to radio or television reception, which can be determined by turning the drive off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the disk drive away from the receiver.
- Move the drive away from the receiver.
- Plug the drive into a different outlet so it and the receiver are on different branch circuits.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet helpful: **How to identify and Resolve Radio-TV Interference Problems**. This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 004-000-00345-4.

# Appendix B: Accessories & Specifications

## Single Drive to Dual Drive Upgrade

Single drive SB10161s can be upgraded to dual drive SB10162s at any time for a modest charge. To have your drive upgraded contact:

Steinmetz & Brown, Ltd.
2675 University Ave Suite 202
St Paul, MN 55114

## Accessories

Steinmetz & Brown offers the following accessories for your drive:

9400-0004 Owner's Manual
9000-0002 Dual Sided, Dual Density Diskettes
9300-0001 Detachable Power Cord
9200-0003 Fuse (3AG, 0.5 Amp, 250 Volt, slow blow)

## Physical Specifications :

Dimensions:

| | | |
|---|---|---|
| Width: | 29.5 cm | (11.65 in) |
| Depth: | 28.5 cm | (11.25 in) |
| Height: | 9.5 cm | (3.75 in) |

| Environmental limits | Operating | Storage |
|---|---|---|
| Ambient temperature | 10 to 40°C (50 to 104°F) | -40 to 60°C (-40 to 144°F) |
| Humidity (non-condensing) | 20 to 80 % | 1 to 95 % |

Electrical specifications (powerline)

| | |
|---|---|
| Nominal | 115 VAC @ 60 Hz |
| Maximum | 125 VAC @ 60 Hz |
| Minimum | 105 VAC @ 60 Hz |

Fuse type: 3AG, 0.5 Amp, 250 Volt, slo-blow

## Data rates *

Maximum seek time: 0.2 sec (motor on), 1.2 sec (motor off)

Frame transfer rate:

Maximum: 2560 frames/sec (11 bits/frame, 256 byte burst)
Average: 2160 frame/sec

File transfer rate:

About 2,000 frames/sec (excluding directory lookups)

| Typical transfer time: | 0K file | 8K file | 16K file | 32K file |
|---|---|---|---|---|
| Reading: | 1.5 sec | 5.25 sec | 9.5 sec | 17.25 sec |
| Writing: | 2.25 sec | 7 sec | 11.25 sec | 19 sec |

*The HP-41 and the HP-75 cannot transfer data at the drive's peak rate.

## Diskette type

5 1/4" Dual Density, Double Sided diskette (DD DS)
48 TPI

## Diskette format

40 tracks per side, 9 sectors per track.
Sectors are numbered 1-9 on each track.
Records 0-17 on side 0, track 0.
Records18-35 on side1, track 0 etc.

## Storage capacity : (formatted)

SB10161A–368,640 bytes
SB10162A–737,280 bytes (using two disks)

# Appendix C: References & Further Reading

## The HP-IL System

by Gerry Kane, Steve Harper, and David Ushijima

Published by OSBORNE/McGraw-Hill

## The HP-IL Interface Specification

(Part # 82166-90017)

Hewlett-Packard
1000 NE Circle Blvd.
Corvallis, OR 97330

## The PPC Journal

The Personal Programming Center (PPC) was the first portable computer support group and remains the foremost organization of its kind. It comprises a diverse and dedicated worldwide membership. The monthly PPC Journal presents the most recent discoveries and techniques relating to portable computers and their applications.

For information send $1 or
a 9"x12" envelope and postage for 3 ounces to:

Personal Programming Center
PO Box 9599
Fountain Valley, CA 92728-9599

# Appendix D: In Case of Difficulty

# Don't Panic.

**Symptom: drive does not come on;**
Check the following:

1 Is the power cable firmly connected to modular jack on the drive and to a working, grounded, 110/120 Volt outlet?

2 Is the drive power switch turned on (in the upper position)?

3 Is the fuse good?
To check the fuse: turn off the drive,
twist off the fuse cover (below the power switch),
remove and examine the fuse.
The fuse should be a 3AG 0.5 Amp 250 Volt Slo-blow fuse.
If the fuse is not this type, appears smokey or does not show a strip of unbroken wire inside, replace it with a new one.

If all of these check out OK and the motors still do not operate or the drive select lights do not go on when the drive is first turned on, your drive may require service.

**Symptom: cannot store or retrieve data to or from the drive;**
Check the following:

1 Do the HP-IL cables form a complete loop from the controller to the drive and back. Be sure that neither device has both ends of a cable connected to itself and that all other devices are on and functioning (remove all other devices if there is any doubt).

2 Is the disk inserted properly (see Getting Started).

3 Was the disk formatted by a compatible controller?
(HP Series 40/70 disks are not interchangeable with HP-110 disks)

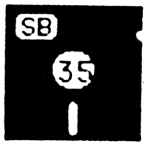
4 Is the disk damaged or severly worn?

5 Are the correct commands being used? (see your computer owner's manual for syntax and usage)

If all of these check out OK and you still cannot access the disk, your drive may require service.

**Symptom: cannot write data to the disk;**

Check the procedures above; additionally check to ensure that the write-protect tab is removed.
If these check out OK and you still cannot write to the disk, your drive may require service.




# Acknowledgements

We would like to express our thanks to Dave Guggisberg and Harry Pheney. They will always have a place to stay in the Twin Cities.

Our fullest gratitude to our friends at the St Paul office of Hewlett-Packard; if they tired of seeing us, they were tactful enough not to say so.

We extend our appreciation to Dennis Sweet for practical advice when we were drowning in esoterica.

Last but never least, we thank the staff and membership of PPC whose comments, complaints, and pipe dreams have inspired and guided us.