9324/9325/9326/9327 Disk Subsystem

Product Specification

61625

WARNING: This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, it may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his or her own expense, will be required to take whatever measures may be required to correct this interference.

DATAPOINT DISK SUBSYSTEM
9324/9325/9326/9327

Contents

General Description

The DATAPOINT 9324/25/26/27 family of disks provides data storage for DATAPOINT processors. Their compact design allows a multi-drive system to easily fit on a table top.

The 9325 (see Figure 1) consists of a 40 MB fixed disk drive, a 10 MB cartridge disk (see Figure 2), a controller, a microbus interface, and a power supply.

The 9324 is similar to the 9325, but contains two removable 10 MB disk drives that provide 20 MB of removable data storage.

Extension drives provide additional storage capability for a system. The 9326 contains one fixed 40 MB drive with space for another; the 9327 offers two fixed 40 MB drives for an additional 80 MB of on-line storage. The 9326 may be upgraded to make it equivalent to the 9327 disk subsystem. One 9326 or 9327 may be connected to either a 9324 or a 9325. The 9324, 9326 and 9327 units are contained in a desk top cabinet similar to the 9325 cabinet. (All information in this specification applies to the 9324, 9325, 9326 and 9327 units.)

The 9325 storage unit uses a fixed, oxide coated, 8-inch Winchester disk for high density recording. Both the fixed disk and the disk cartridge are supplied ready for use.

The removable media in the 9325 are easy-to-handle disk cartridges capable of storing 10 MB of data. These disk cartridges can be used for on-line data storage, system backup, or for data transport from one system to another. The cartridge features an automatically sealing head access door, designed to keep out dust and other particles. These light-weight compact disk cartridges are also easily stored and shipped.

The disk controller interprets all commands, performs the indicated action, places user data in the controller buffer, and informs the proccessor the task is complete. Selectable addresses, for the microbus interface, support up to four disk subsystems on one 8605 processor.

Figure 1. 9325 Cabinet

Top — This edge is first

Bottom

Write Protect Tab

Head Access Door
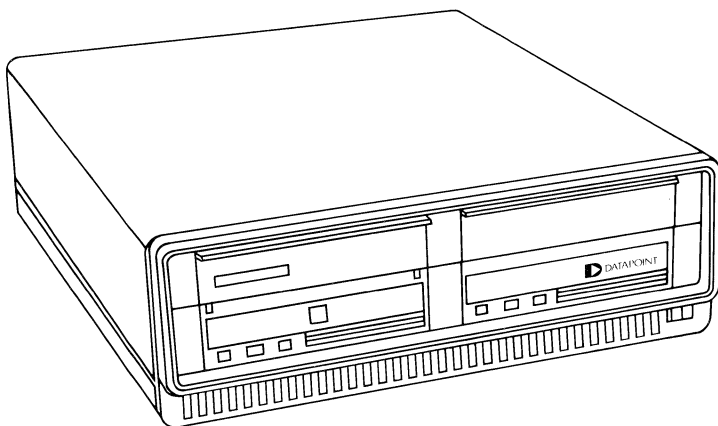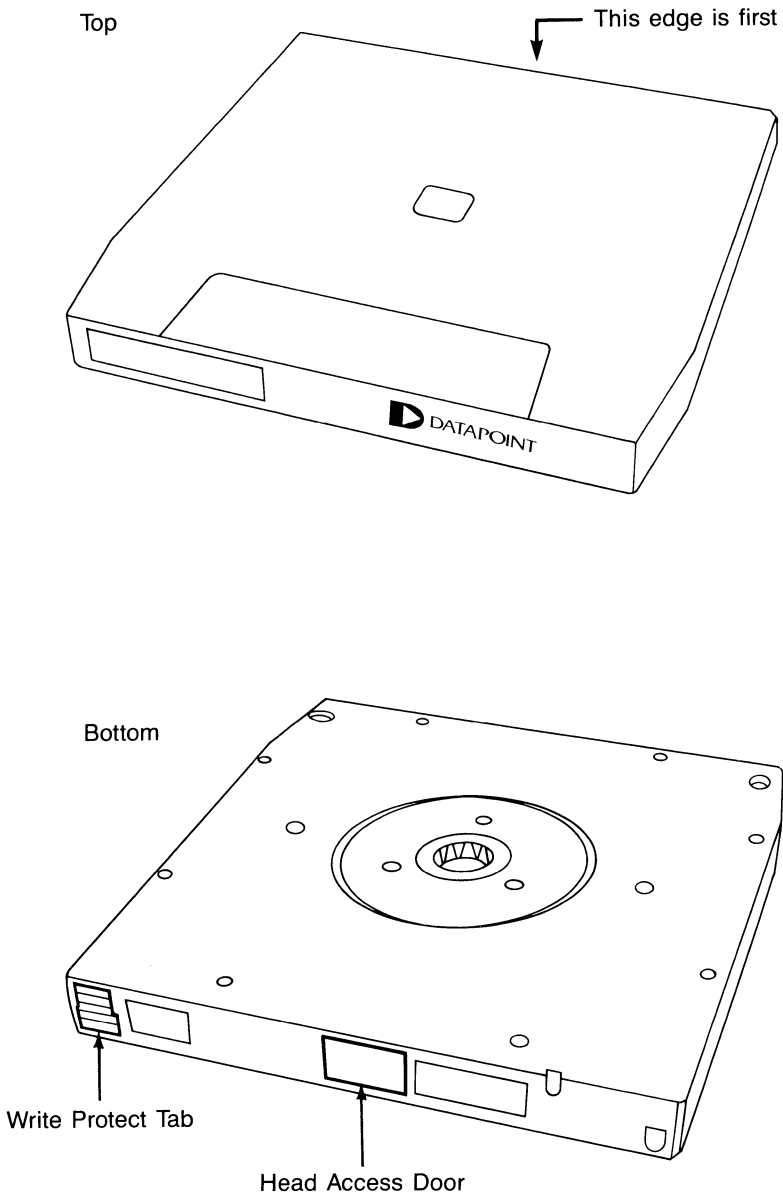
Figure 2. 9325 Disk Cartridge

System Requirements

All communications between the 9325 subsystem and
the processor are through the microbus. The microbus
is composed of an 8-bit command/address bus, an 8-bit
bidirectional data bus with parity, 2 strobe lines, an
interrupt acknowledge, and an interrupt request line.
The microbus can support multiple peripherals
connected in daisy chain fashion, through a
25-conductor flat shielded cable. The connectors are
female sockets with integral strain relief. Maximum
cable length is 90 inches. Two cables connect the basic
subsystem to the extension box. They are 50-conductor
flat shielded cables, a maximum of 84 inches in length.

Technical Description

Technical Specification

Fixed Disk Capacity (formatted)

Disk Type	fixed
Surfaces/Disk	4
Tracks/Surface	864
Sectors/Track	48
Bytes/Sector	256
Bytes/Track	12.3 KB
Bytes/Drive	40.0 MB (user capacity)

Fixed Disk Timing

Bit Transfer Rate:	875 KB per second (maximum instantaneous)
Rotation:	
Average Speed	3600 RPM
Average Delay	8.3 ms
Head Positioning:	
Average	60 ms
Track to track	15 ms
Maximum	150 ms
Start Time:	45 sec

Cartridge Disk Capacity (formatted)

Disk Type	removable
Surfaces/Disk	2
Tracks/Surface	432
Sectors/Track	48
Bytes/Sector	256
Bytes/Track	12.3 KB
Bytes/Drive	10.0 MB (user capacity)

Cartridge Disk Timing

Bit Transfer Rate:	875 KB per second (maximum instantaneous)
Rotation:	
Average Speed	3600 RPM
Average Delay	8.3 ms
Head Positioning:	
Average	60 ms
Track to track	15 ms
Maximum	110 ms
Start Time:	90 sec

Operator Controls and Indicators

The 9325 front panel switches and indicators provide basic operator control of the disk subsystem (see Figure 3). The 9325 has two sets of switches and indicators that control the operation of the two disks. Those associated with the removable cartridge are located on the left-hand side of the drive's front panel. The fixed disk's indicators and switches are on the right-hand side of the front panel. The main power switch, which controls power to both drives, is located on the front lower right-hand corner of the cabinet. The operator should become familiar with these controls and indicators before using the system. (Switches and indicators on the 9324, 9326 and 9327 are similar).

Power Switch
Fixed Disk Drive
Power Indicator Light
Write Protect Switch
Ready Indicator Light

Ready Indicator Light
Start/Stop Toggle Switch
Load Indicator Light
Door Release Button
Removable Cartridge Drive
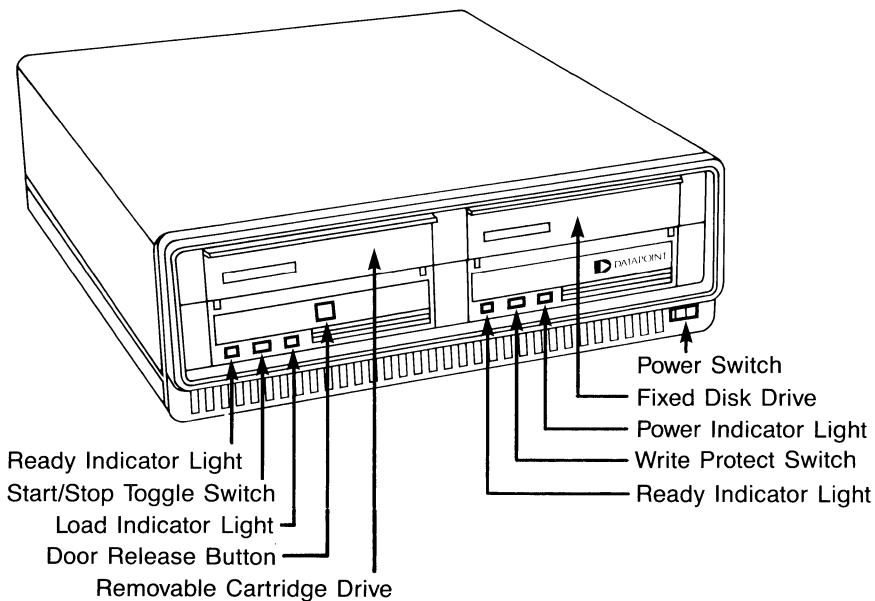
Figure 3. Operator Controls and Indicators

POWER Switch : The main POWER switch, located
on the lower right-hand corner of the 9325 front
panel, is a two-position rocker switch. Set the switch
to the ON position, to power on both drives in the
9325 and begin the start-up cycle for the fixed disk.

Before powering off the disks, ensure all tasks using
the 9325 are finished and the LOAD light is on,
indicating the cartridge drive is ready to load. To start
the cartridge unloading cycle, set the START/STOP
toggle switch to STOP and wait until the LOAD light
comes on before powering off the disks. This ensures
the read/write mechanism is unloaded from the disk
surface. If this sequence is not followed, the cartridge
door remains locked and the cartridge can not be
removed. To power off the disk, set the switch to the
OFF position.

NOTE: The disk subsystem and any expansion disk
cabinets connected must be powered on before the
processor and powered off after the processor.

Fixed Disk Drive

The fixed disk in the 9325 cabinet is on the right side
of the unit. The switches and indicators that control
this drive are described in the following paragraphs.

POWER Indicator Light: The red POWER light is
the rightmost indicator on the fixed drive. When
continuously lit, power is on (it is on whenever the
power switch is on). If the light starts flashing at a fast
rate, a power fault or improper rotation-speed
conditon exists. If this occurs, contact DATAPOINT
Customer Service.

WRITE PROTECT Switch: The WRITE PROTECT
switch is a two-position black toggle switch located
between the two-red indicator lights on the the front
panel. When the toggle switch is set to the WRITE
position, data can be transferred to or from the disk.
If the toggle switch is set to the PROTECT position,
data cannot be written on the disk. If an attempt is
made to write on the disk while the toggle switch is in
the PROTECT position, a disk FAULT error message
appears on the system display screen.

READY Indicator Light: The READY light is a red
indicator located just to the left of the WRITE
PROTECT switch. When lit, the start-up cycle is
complete and the drive is ready to operate. The
READY indicator lights about 45 seconds after the
POWER switch is set to ON.

Cartridge Disk Drive

The cartridge disk drive is on the left-hand side of the
9325 cabinet. On the 9324, both sides of the cabinet
contain cartridge drives. The switches and indicators
that control the drive are described in the following
paragraphs.

The disk cartridge has two features which should be noted:

● The head access door on the edge opposite the label is opened by a mechanism in the drive to allow a disk read or write. Once the disk is removed from the drive, this door should automatically close. If it does not, call DATAPOINT Customer Service.

● The cartridge has a physical **WRITE PROTECT** tab that can be removed to prevent writing on the disk.

DOOR RELEASE Button: The DOOR RELEASE button is a square black pushbutton located in the middle of the cartridge drive. This button opens the drive door for loading or unloading cartridges. While disk operations execute, the button automatically locks to prevent accidental door opening.

To remove the cartridge after disk operations have ended and the cartridge disk is spun down, push the DOOR RELEASE button, then press the cartridge back until it unlatches and pops out.

NOTE: Do not attempt to open the door unless the LOAD indicator is continuously lit.

START/STOP Switch: The START/STOP switch is a two-position black toggle switch located between two red indicator lights on the front panel. With a cartridge in place, set the toggle switch to the START position to begin start-up. Set the toggle switch to STOP to begin the cartridge unloading cycle and to spin down the cartridge disk.

NOTE: The complete start-up cycle takes about 90 seconds. During this cycle, the disk spins up and the air in the drive is circulated through a filter system to remove dust and particles. The disk then spins down, the read/write heads are loaded, and the disk spins back up.

READY Indicator Light: The READY light is a red indicator located on the far left-hand side of the front panel. When lit, the start-up cycle is complete and the drive is ready to operate. The READY indicator lights about 90 seconds after the START/STOP switch is set to START.

LOAD Indicator Light: The LOAD light is the red indicator located to the right of the START/STOP toggle switch on the front panel. After a cartridge is inserted and the START/STOP toggle switch is set to START, the LOAD light flashes twice per second. After 60 seconds, this light stops flashing for a moment. If the disk stops spinning at this time, wait 10 seconds for it to start spinning again. The LOAD light then begins flashing for about 30 seconds. The start-up cycle is in progress. During normal operations this light is off.

When the START/STOP toggle switch is set to STOP, the LOAD light flashes twice per second until it glows steadily, indicating the cartridge may be removed. If the LOAD light flashes rapidly, a power fault or rotation-speed fault has been detected. If this occurs, call DATAPOINT Customer Service.

WRITE PROTECT Control Tab: Included with each cartridge is an insertable tab that allows the operator to write (or not write) on the disk. The WRITE PROTECT tab is located on the right edge of the cartridge, opposite the identification label. To WRITE PROTECT the cartridge, remove the tab; this prevents accidental writing on the disk. To write on the disk, insert the WRITE PROTECT tab in its slot.

Cartridge Loading

When loading the cartridge, remember to handle the cartridge carefully. The disk is light-weight, about 1.6 pounds.

Before loading a cartridge, ensure all plugs and cords are secure on both the processor and the disk drive. If

power is interrupted while the drive is operating, the door of the disk drive remains locked until correct power is restored. To load the cartridge, take the following steps:

1. Power on the disk drive. Wait until the POWER indicator lights before proceeding.

2. Grasp the front of the cartridge so the WRITE PROTECT plug is on the end of the cartridge opposite your hand. The front of the cartridge is the edge with the DATAPOINT label (see Figure 4).
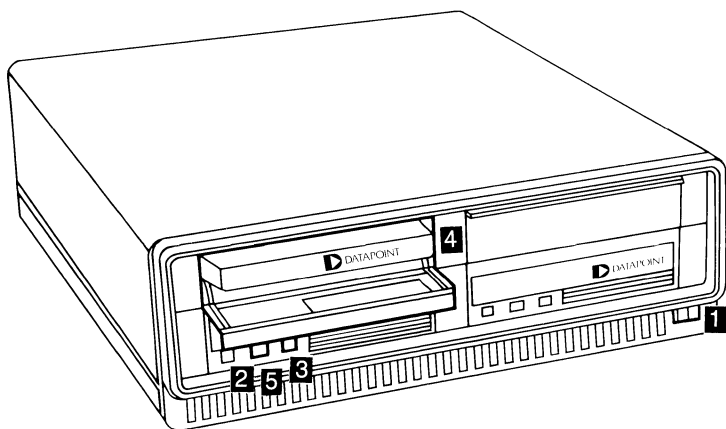
Step 1: Power On
Step 2: Set Start/Stop switch to Stop
Step 3: After Load light glows continuously, press Door Release button
Step 4: Gently push cartridge into place and close cartridge door
Step 5: Set Start/Stop switch to Start

Figure 4. Loading The Cartridge

3. Hold the cartridge right side up (the bottom of the cartridge has a circular hole in the center which should be facing down).

4. Set the START/STOP toggle switch to STOP and wait for the LOAD light to glow steadily. The LOAD light must always be glowing steadily before a cartridge can be inserted.

5. Press the DOOR RELEASE button, open the drive door, and carefully insert the the cartridge into the drive (see Figure 4).

6. Push the cartridge gently into the drive against spring pressure until the cartridge latches in place. Then slowly close the cartridge drive door.

7. Set the START/STOP toggle switch on the front panel to START. When the LOAD light stops flashing and the READY indicator lights, disk operations can begin. Once the START/STOP toggle switch is set to START, the LOAD light flashes for 60 seconds, pauses, then flashes again for 30 seconds. During this time, if the disk stops spinning, wait a few seconds and it should start spinning again (this is part of normal disk operations). After 90 seconds, the READY indicator should light and the disk cartridge can be used.

Cartridge Unloading

Before removing a cartridge, ensure all tasks using the 9325 are complete. If no data transfers are occurring, take the following steps to unload the cartridge:

1. Set the START/STOP toggle switch on the front panel to STOP. The LOAD indicator flashes for about 45 seconds.

2. Once the LOAD indicator glows continuously, push the DOOR RELEASE button to open the door. Press the cartridge (still in the drive) back until it unlatches; this ejects the cartridge about one-third of the way. Then grasp the front edge of the cartridge and gently pull it free (see Figure 5).

3. Place the cartridge in its dust jacket for protection.

4. Load another cartridge or completely close the door of the drive slot to safeguard the disk drive when not in use.

NOTE: If the door does not close properly, open it and remove the cartridge. Inspect the cartridge and the door; if they appear normal, try loading the cartridge again. If the cartridge or drive is defective, call DATAPOINT Customer Service.
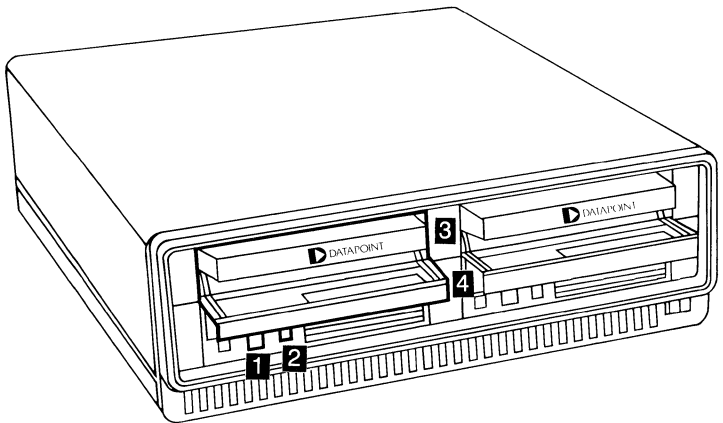
Step 1: Set Start/Stop switch to Stop
Step 2: Wait for Load light to glow continuously,
            push Door Release button
Step 3: Press cartridge in to unlatch
Step 4: Gently remove cartridge

Figure 5. Unloading the Disk Cartridge

Programming Considerations

Switch Selectable Options

A seven-position switch provides microbus address selection, parity enable, and loopback. This is a right angle DIP switch which is located at the card edge and is accessible from the rear of the subsystem. Switch assignments are:

```
OFF
1        2      3      4      5      6      7
ON

│        │      │      │      │      │      │
Microbus Address              (unused) Parity  Loopback
UAD3    UAD2  UAD1  UAD0              Disable
```

Microbus Address Assignment - Address selection is accomplished through the use of switches accessible from the rear of the unit. These switches correspond to the Microbus Address Byte bits UAD0 through UAD3 respectively. The controller responds to one of the 16 unique addresses that can be formed through binary combinations of address bits 0 thru 3. Addresses 010 to 013 octal (8 to 11 decimal) are for system use.

Bus Parity - The subsystem contains circuitry for checking and generating parity on the microbus. Parity is checked/generated on all microbus transfers including IACK Response. Odd parity is generated. Parity is generated/checked on 16 lines: 8 data, 4

command, and 4 address. These lines are sampled on the leading edge of USTB1.

The controller need not be addressed; it generates an interrupt upon receipt of bad parity no matter which peripheral device is addressed. The microbus parity interrupt is a non-maskable interrupt and generates an interrupt to the host processor even if the interrupt mask is set. If parity is incorrect, the command is ignored and a microbus parity error interrupt is generated. The switch allows enabling or disabling of microbus parity to the host processor.

Loopback - A switch setable loopback function allows the internal bus to be looped back to itself. This allows a processor to output a byte on the data bus and read it back. This tests 60% of the logic on the interface card. This provision is meant as an aid in troubleshooting; the interface does not operate with the disk in this mode. Loopback must be preceded by a software reset command to ensure the controller is in the idle state.

Microbus Command Formats

All communications between the 9325 disk controller and the DATAPOINT processor are through the microbus using the External Command instructions and the I/O register (A register) of the processor. The microbus is composed of an 8-bit command/address bus, an 8-bit data bus with parity, two command strobes, an interrupt acknowledge line, and an interrupt request line. For pin assignments see Interface Requirements.

The 8-bit command bus carries four bits of address and four bits of command from the processor to the 9325 controller. The command format is:

Processor A Register
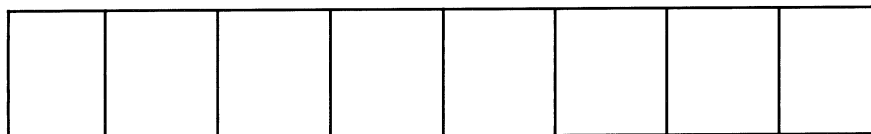
UCOM3	UCOM2	UCOM1	UCOM0	A3	A2	A1	A0

UCOM3 through UCOM0 contain the command and A0 through A3 contain the disk controller address.

The peripheral microbus commands are used by the processor to control the disk system. All commands are issued to the interface using Strobe 1. There are 16 possible commands; the following table shows the 8 acceptable commands:

Command Word	Command	Description
UCOM3 - UCOM0		
0 1 1 1	READ DATA	Read Status/Data from the disk
0 1 1 0	ENABLE INT	Clear Interrupt Mask Register
0 1 0 1	DISABLE INT	Set Interrupt Mask Register
0 1 0 0	SELECT	Issue SELECT to Disk
0 0 1 1	ID BYTE READ	Read the ID byte
0 0 1 0	WRITE DATA	Write Data/Command to disk

| 0 0 0 1 | ISTATUS READ | Read the Interface Status |
| 0 0 0 0 | RESET | Software Reset to Subsystem |

Bits A0 through A3 of the command byte address the controller. Legal addresses are:

A3	A2	A1	A0	Decimal Address
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11

• Microbus Command Definitions:

ENABLE INT/DISABLE INT - This command sets or clears the interrupt mask register. DISABLE INT disables all interrupts (except Microbus Parity error) to the processor. Interrupts are disabled at power up and as a result of a software reset.

SELECT - This command sets the select latch on the interface. Setting the select latch indicates to the controller the beginning of a command transfer. The select latch is cleared by the controller when it is ready to accept a command.

ID BYTE READ - This command returns a unique value of 004 to identify this member of the 9325 drive series within the defined microbus address space.

WRITE DATA/READ DATA - These commands put the interface in the data mode (data mode consists of all transfers: data, command, or status). They are used to transfer data both to or from the disk. The acknowledge latch is set by all data reads and writes to the disk. An acknowledge latch is reset by the disk upon completion of each data transfer. Acknowledge also serves to notify the processor of a transfer in progress.

ISTATUS READ - This command allows the host processor to read the interface status from the status latch. The status is returned on the microbus data lines.

RESET - This command provides for a software reset without powering off the system. It resets the interface, disk controller, and disk drives to the power-up state.

Interface Status Latch Information

A status latch allows the processor to read the interface status by issuing the ISTATUS READ command. The status is returned as an 8-bit word.

STATUS BIT	SIGNAL	DESCRIPTION
D7	I/O	I/O low transfer to disk high transfer from disk
D6	BUSY	BUSY (active, high)
D5	C/D	C/D high command trans low data transfer
D4	MSG	MSG (active, high)
D3	REQ	REQUEST (active, high)
D2	LACK	Latched acknowledge (active, high)
D1	UPARERR	Microbus Parity Error (active, high)
D0	SPARERR	SASI Bus Parity Error (active, high)

• Status Latch Definitions

I/O (Input/Output) - This bit indicates the direction of the data transfer across the SASI bus. A high level from the controller indicates information will be transferred to the host processor from the controller on the SASI bus. A low level from the controller indicates information will be transferred to the controller from the host processor on the SASI bus.

BUSY (Busy - active, high) - A high level by the controller indicates the controller has control of the SASI interface bus and cannot be interrupted.

C/D (Command/Data) - A high level from the controller indicates command or status information is to be transferred on the SASI data bus. A low level on this line indicates data information is to be transferred on the data bus.

MSG (Message - active, high) - A high level from the controller on the SASI bus indicates a status byte transfer has been accomplished. When the MESSAGE is high, REQUEST is also high to transfer an 8-bit byte, indicating the end of the operation. When the REQ/ACK handshake is complete, the controller resets all interface signal lines and returns to the IDLE state.

REQ (Request - active, high) - A high level from the controller indicates an 8-bit byte is to be transferred on the SASI data bus. REQUEST is reset by the controller following the setting of the acknowledge line.

LACK (Latched Acknowledge - active, high) - An acknowledge latch is set by all data reads and writes to the disk. An acknowledge latch is reset by the disk upon completion of each data byte transfer. LACK also serves to notify the processor of a transfer in progress.

UPARERR (Microbus Parity Error - active, high) -
This bit indicates the occurrence of a parity error on
the microbus. If and error occurs, the command is
ignored, the status bit set, and an interrupt is
generated.

SPARERR (SASI Bus Parity Error - active, high) -
This bit indicates the occurrence of a parity error in the
8-data bits on the SASI bus.

Additional controller status information may be
obtained from the SASI disk interface status lines. The
status register may be read and bits 4, 5, and 7 must
be decoded to obtain the controller status:

I/O	C/D	MSG	
0	1	0	Next Command
0	0	X	OUTPUT Data
1	0	X	INPUT Data
1	1	0	Disk Sense
1	1	1	Command Complete

For the Disk Sense Status, the processor must issue the
REQUEST SENSE Command to obtain status
information from the controller.

Interrupts

The microbus/SASI interface is an interrupt driven
device using the interrupt features of the microbus.
Interrupts may be generated by the interface and the
host processor is notified via the interrupt request line.
Interrupts are generated at the completion of an
operation or when an error has occurred which
requires service by the host processor.

Interrupts may also be selectively generated during
multisector I/O commands, by setting a flag bit in the
command string. Upon issuing an interrupt request to
the host processor, the subsystem waits for receipt of
the interrupt acknowledge strobe. Upon receipt of this

strobe, the interface provides an interrupt response byte. The interrupt response byte consists of the controller address and the interrupt status bits (see the following table). The interrupt request and the interrupt response byte are cleared at the trailing edge of the interrupt acknowledge strobe.

Interrupts may be disabled to the host by setting the interrupt mask register. This inhibits interrupts to the host, to allow polled mode operation. Microbus Parity Error is a nonmaskable interrupt and cannot be disabled.

Interrupt	Response Byte
BIT	Definition
7	I/O
6	Parity Error
5	C/D
4	MSG
3	Controller Address A3
2	Controller Address A2
1	Controller Address A1
0	Controller Address A0

Parity Error - This interrupt is generated whenever a parity error is detected by the interface logic. The interface status register must be read to determine the source of the error (two errors are possible, Microbus Parity or SASI Bus Parity). The interface need not be addressed to generate a Microbus Parity Error, therefore; multiple units may respond to this error.

I/O, C/D and MSG - These lines reflect the SASI bus status and must be decoded to obtain the proper interrupt response. Refer to Interface Status Latch for a detailed description.

Disk Formats

Standard Track Format

The standard track format for the 10 MB and 40 MB disk drives is 48 sectors per track with each sector containing 256 bytes of user data. Each sector consists of two fields separated by gaps to allow updating and recovery of the data. The first field in the sector is the ID FIELD. This field contains three data bytes which uniquely identify the sector. The three bytes are defined as:

• Cylinder Address

• Head Address

• Logical Sector Address

The second field contains the user data bytes.

10 MB/40 MB Sector Format
(Typical for 48 sectors)

```
Indel- S   V   S   I   E   V   S   D   E   G   Indel-
ible   P   F   Y   D   C   F   Y   A   C   U   ible
Area   L   O   N       C   O   N   T   C   A   Area
       C       C               C   A       R
           1               2               D
```

```
SPLC     = 1 byte of 00
VFO 1    = 3 bytes of 00
SYNC     = 1 byte of 04
ID       = 3 bytes
ECC      = 3 bytes
```

```
VFO 2    = 7 bytes of 00
SYNC     = 1 byte of 04
DATA     = 256 bytes of user data
ECC      = 3 bytes
GUARD    = 2 bytes of 00
         ─────────────────────
         280 bytes per sector
```

ID FIELD

Byte 1 — Bit 7-0   = Cylinder Address Low

Byte 2 — Bit 7   = Alternate Address Fla
           Bit 6   = 0
           Bit 5-4   = Head Address
           Bit 3   = Bad Sector Flag
           Bit 2   = Write Protect Flag
           Bit 1-0   = Cylinder Address High

Byte 3 — Bit 7-0   = Logical Sector Address

Total bytes/sector = 280 bytes

Total bytes/track = 13440

Defective Track Format

If a track is defective, the host processor can assign an alternate track. When the controller encounters a defective track with an alternate track assigned, the controller automatically seeks the assigned alternate track. In all sectors of the defective track, the alternate track address is contained in the first three bytes of the data field. A defective alternate track cannot specify another alternate track.

```
┌────────────────────────────────────────────────────────┐
│ 10 MB/40 MB Defective Track Format                     │
│ (Typical for 48 sectors)                               │
│ Indel-  S   V   S   I   E   V   S   D   E   G   Indel- │
│ ible    P   F   Y   D   C   F   Y   A   C   U   ible   │
│ Area    L   O   N       C   O   N   T   C   A   Area   │
│         C       C               C   A       R         │
│         1       2                           D         │
└────────────────────────────────────────────────────────┘
```

```
SPLC    = 1 byte
VFO 1   = 3 bytes
SYNC    = 1 byte
ID      = 3 bytes
ECC     = 3 bytes
VFO 2   = 7 bytes
DATA    = 3 bytes (ALT TRACK ADDR)
GUARD   = 255 bytes
```

Disk Command Operations

Whenever the host processor has a command for the controller, it performs a series of actions to gain controller attention. The sequence is:

• Select

• Command

• Data Transfer (if required)

• Status & Message

Each command follows this sequence. Command execution begins after 'Command'.

Command Sequence Information

SELECT - Following a reset or the completion of a command, the controller is in the IDLE state. The command sequence begins with the host processor issuing a SEL command. The subsystem interface asserts SEL and DB0 (controller address bit) on the

SASI bus indicating a command is ready for the controller. It then waits for the controller to respond with BUSY. Upon receipt of BUSY, the subsystem interface deasserts SEL. The controller now has control of the SASI bus.

COMMAND FETCH - After the subsystem interface deasserts select and DB0, the controller asserts C/D (indicating command mode transfer) and deasserts I/O (indicating output from the host) to fetch the command bytes from the host processor. The subsystem interface generates an interrupt to the host to indicate the controller is ready to accept the command transfer. The command bytes are transferred over the SASI bus with the REQ/ACK handshake protocol until all command bytes are transferred to the controller. (The command byte fetch mode ends after the last REQ pulse from the controller is deasserted.)

The subsystem interface must not assert ACK until REQ is asserted, and must not deassert ACK until after REQ is deasserted. The controller waits until the ACK from the previous byte transfer is deasserted before it reasserts REQ to transfer the next byte.

NOTE: This provides a means for the subsystem interface to regulate the byte transfer across the host bus.

DATA TRANSFER - If the command does not require a data transfer, this action is skipped. If a data transfer is required for the command, such as read or write, the following occurs. The controller deasserts the C/D line to indicate data mode. Depending on the command type (read/write disk), the I/O bit on the host bus is asserted or deasserted by the controller. The subsystem interface generates an interrupt to the host to indicate the controller is ready for the data transfer. The data is transferred (one byte at a time) with the same REQ/ACK handshake protocol used during Command Fetch. After all bytes are transferred the controller goes to the next step.

STATUS AND MESSAGE - After all the data bytes have been transferred, a completion status byte is placed on the data bus by the controller - C/D and I/O are asserted while MSG is deasserted. An interrupt is generated by the subsystem interface to identify the status phase to the host; the host must then read the status byte. REQ is asserted and the controller waits for an ACK from the subsystem interface. After the status byte transfer, the controller places zeros on the data bus and asserts C/D, I/O and MSG along with REQ to indicate to the host that the command is complete. An interrupt is generated by the subsystem interface to identify the message phase to the host; the host must then read the message byte. After the subsystem interface responds with ACK, the controller deasserts REQ, BUSY and all other lines. This completes the command execution and the controller is now ready to be selected for the next command.

Abnormal Termination

If no errors occur, the command proceeds as described above. However, if errors do occur, the controller terminates the command and immediately enters the status and message phase. Error conditions can be classified as:

Bus Parity Errors - Upon the detection of a SASI Bus Parity Error (command or data) the controller completes the command execution and generates an interrupt to the host processor. The interrupt status byte indicates a parity error has occurred and the host processor must read the interface status register to determine the error type. If the error is detected on the controller, the error is contained in the completion status bytes and the error code in the controller status bytes. If a Microbus Parity Error is detected, the command is terminated and an interrupt generated to the host. The host processor must read the interface status register to determine the error type.

Drive Interface or Controller Related Errors - These errors occur after the command bytes have been transferred to the controller. Upon the detection of the error condition (Drive Fault, Drive Not Ready, Illegal Command, etc.), the subsystem interface generates an interrupt to the host processor. The completion status indicates the occurrence of an error and the controller status bytes contain the error code.

Read/Write Channel Errors - Upon detection of these errors (such as Read Data Error and Record Not Found), the controller may transfer a sector or more of data before the error is reported. The command terminates in a normal manner and the completion status indicates the occurrence of an error. The error code may be obtained from the controller status bytes.

During Drive Interface/Controller Related or Read/Write Channel errors, a REQUEST SENSE command may be issued to retrieve error information. In either case, any other command may be issued if the host system does not accept the errors.

Controller Operation

Following the controller selection sequence, the controller always requests a Device Command Field (DCF) which is either 6 or 10 bytes in length. The first byte of the DCF must always contain the command. The remaining bytes specify the drive's Logical Unit Number (LUN), logical sector address, number of sectors to be transferred, and a control byte.

The controller checks the validity of all incoming DCF's and, unless disabled, also checks both DCFs and data for odd parity. An error in the command structure terminates the command and causes a status

byte transfer to occur upon completion of the DCF transfer.

After power-up or after any RESET command, the controller rejects all commands except REQUEST SYNDROME (02), REQUEST SENSE (03), and REQUEST DRIVE TYPE (0C). This state is indicated by setting bit 2 of the COMPLETION STATUS BYTE to 1, and it is maintained until an ASSIGN DRIVE TYPE (C1) command is received by the controller. Acceptance of the ASSIGN DRIVE TYPE command sets bit 2 of the COMPLETION STATUS BYTE to 0. This sequence may be used to determine if a Power-on Reset (POR) has occurred to the controller since the last drive access.

Command Format

	7	6	5	4	3	2	1	0
BYTE 1			COMMAND CODE					
BYTE 2	LUN			LOGICAL ADDR 2 (MS)				
BYTE 3			LOGICAL ADDR 1					
BYTE 4			LOGICAL ADDR 0 (LS)					
BYTE 5								
BYTE 6			CONTROL FIELD					
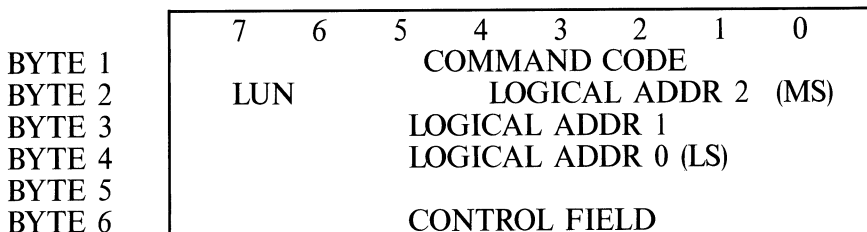
NUMBER OF SECTORS/INTERLEAVE CODE

	Bit		
	7	6	5
Drive Select 1 = LUN 1	0	0	0
Drive Select 2 = LUN 2	0	0	1
Drive Select 3 = LUN 3	0	1	0
Drive Select 4 = LUN 4	0	1	1

LOGICAL ADDRESS (byte 2, bits 0 to 4, byte 3, and byte 4) contain the logical sector address of the

specified sector. Logical address 0 is the Least Significant Byte (LSB). Sectors start at cylinder 0, head 0, sector 0 and continue through cylinder 0, head 1; cylinder 0, head 2, etc.

When the end of a cylinder is reached, the next logical sector is located on cylinder 1, head 0, sector 0.

The logical address is computed using the following formula:

LOGICAL ADDRESS = (CYADR * HDCYL + HDADR) * SETRK + SEADR

CYADR = cylinder address
HDADR = head address
SEADR = physical sector address
HDCYL = number of heads per c
SETRK = number of sectors per

The NUMBER OF SECTORS (byte 5) specifies the number of sectors to transfer per command. A value of 0 transfers 256 sectors.

This byte also specifies the interleave factor for certain commands, (i.e. FORMAT DRIVE). An interleave factor of 0 defaults to an interleave factor of 1. Interleave factors greater than one half the number of sectors per track are invalid. An example of the interleave mechanism for a track with 32 sectors and an interleave factor of 10 is:

Phy. Sec.	0	1	2	3	4	5	6	7	8	9	10
Log. Sec.	0	10	20	30	1	11	21	31	2	12	22

Phy. Sec.	11	12	13	14	15	16	17	18	19	20	21
Log. Sec.	3	13	23	4	14	24	5	15	25	6	16

Phy. Sec.	22	23	24	25	26	27	28	29	30	31
Log. Sec.	26	7	17	27	8	18	28	9	19	29

Control Field Operation

The CONTROL FIELD (byte 6) contains information relating to the method by which the controller processes the command.

CONTROL FIELD

```
              7   6   5   4   3   2   1   0
BYTE 6        X   X   X   0   0   0   X   0
              |   |   |                 |
              |   |   |  flag ──────────|
              |   |   └── disable overlap seek = 1
              |   └────── disable error correction = 1
              └────────── disable retry = 1
```
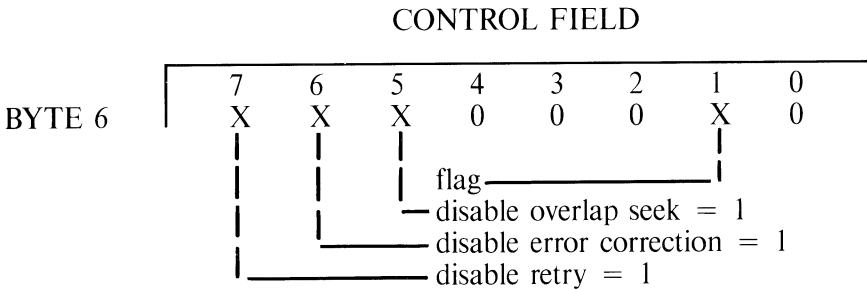
If the flag bit is set during any READ or WRITE DATA command, the MSG line is set to the alternate state for each sector transferred. The MSG line is toggled one microsecond prior to the first REQ asserted. At the conclusion of the data transfer sequence, the MSG line is always deasserted. A zero value disables this function. This function may be used to notify the host processor a sector is available during multisector I/O instructions.

If the DISABLE OVERLAP SEEK bit is SET, the controller waits until the drive completes the seek before returning completion information to the host processor. If the bit is NOT SET, the controller returns the completion information immediately following the issuance of the SEEK command to the drive.

If the DISABLE ERROR CORRECTION bit is SET and an ECC correctable or uncorrectable data error occurs, the controller does not attempt to correct the data read from the disk. If the transfer is a multisector transfer, the command is aborted and the error reported. The sector in which the error was detected is not transferred.

If the DISABLE ERROR CORRECTION bit is NOT SET and a correctable data error occurs, the controller corrects the data and transfers the data to the host. A multisector transfer continues and the error is reported at the completion of the transfer. An uncorrectable data error aborts a multisector transfer. The sector in which an uncorrectable data error occurred is not transferred and the error is reported upon termination.

If the DISABLE RETRY bit is SET, the controller does not attempt to retry the command. If the bit is NOT SET, the controller retries the command up to eight times before reporting an error. If the retry attempt is successful, the error is not reported.

The DISABLE ERROR CORRECTION bit and the DISABLE RETRY bit perform independent functions and may be used in any combination.

Completion Status Byte

At the termination of a command, the controller transfers a status byte from the controller to the host processor. Bit 0 is set to 1, if a parity error is detected. Bit 1 is set to 1, if the controller detects an error condition during command execution. Bit 2 is set to 1, if a reset or power-up has occurred. Bits 5 and 6 represent the LUN of the device where the error occurred. If no error occurs, bits 0 through 4 are set to 0.

Following status byte transfer, the MSG line is asserted to indicate a completion message. This message consists of a single byte transfer with all bits set to 0 if no error occurred. If an error occurred, the message contains the error code.

COMPLETION STATUS BYTE FORMAT

7	6	5	4	3	2	1	0
0	LUN		0	0	X	X	X

reset or power-up = 1 ─────┘ │ │
command error = 1 ──────────┘ │
SASI parity error = 1 ────────┘
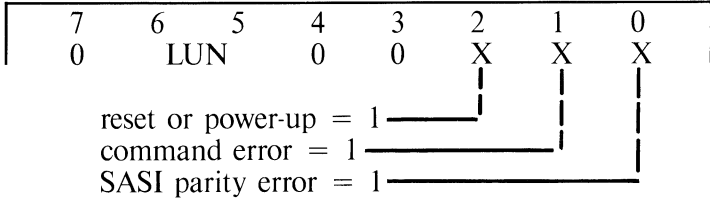
Bit 0   Parity error
Bit 1   Error occurred during command execution
Bit 2   Reset or power-up occurred
Bit 3-4 Spare (set to 0)
Bit 5-6 Logical unit number
Bit 7   Spare (Set to 0)

Type 0 Commands

TEST DRIVE READY   (HEX 00)   00000000

The device addressed by the LUN is selected and tested
for ready. The completion status byte indicates the
state of the addressed device.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	0	0	0
BYTE 2	0	LUN			NOT USED			
BYTE 3				NOT USED				
BYTE 4				NOT USED				
BYTE 5				NOT USED				
BYTE 6				CONTROL FIELD				

7	6	5	4	3	2	1	0
0	LUN		0	0	0	X	X

0 = device ready ─────────┘ │
1 = parity error ───────────┘
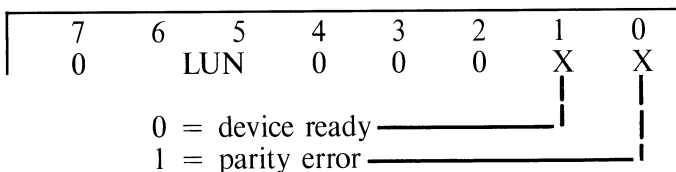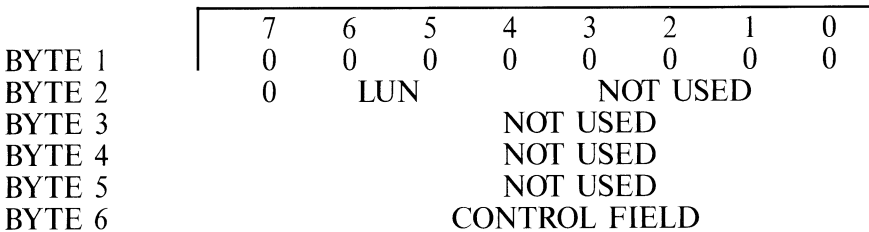
RECALIBRATE (HEX 01)   00000001

The drive specified by the LUN is stepped toward the outside track until either:

1. Track 0 flag is detected or
2. More steps have been issued than available tracks for the device type.

Since no steps are overlapped, the RECALIBRATE command steps and looks for track 0. The RECALIBRATE command is not executed until the next command to that LUN is issued.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	0	0	0
BYTE 2	0	LUN			NOT USED			
BYTE 3				NOT USED				
BYTE 4				NOT USED				
BYTE 5				NOT USED				
BYTE 6				CONTROL FIELD				

REQUEST SYNDROME (HEX 02)   00000010

The controller transfers to the processor four bytes of ECC correction data - two bytes of data indicating byte displacement and two bytes of data indicating the error correction pattern.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	0	1	0
BYTE 2		LUN			NOT USED			
BYTE 3				NOT USED				
BYTE 4				NOT USED				
BYTE 5				NOT USED				
BYTE 6				CONTROL FIELD				

The format of these four bytes is:

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	0	0	0
BYTE 2	BYTE DISPLACEMENT
BYTE 3	CORRECTION PATTERN (MS)
BYTE 4	CORRECTION PATTERN (LS)

Byte displacement is from the beginning of the record counting the first byte as zero. An exclusive OR operation must be performed on the least significant correction pattern byte with the byte at the indicated displacement. The most significant correction pattern byte must be an exclusive OR with displacement plus one.

A special case is encountered when byte displacement is 255 (HEX FF). In this case, the error is fully contained in the last data byte and byte 3 is always zero. If the correction pattern was automatically applied to the data passed to the processor, the two correction pattern bytes are zero. Byte 1 is not used with 256-byte records.

REQUEST SENSE   (HEX 03)   00000011

This command causes the controller to transfer four bytes of sense data to the processor. A description of the sense byte format follows in the section on Error Codes.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	0	1	1
BYTE 2	0	LUN		NOT USED				
BYTE 3	NOT USED
BYTE 4	NOT USED
BYTE 5	NOT USED
BYTE 6	CONTROL FIELD

FORMAT DRIVE   (HEX 04)   00000100

This command formats the specified LUN using the interleave factor specified in byte 5. Formatting starts from track 0 of cylinder 0 and continues until all tracks have been written. Data fields are written with an EX E5. Invalid interleave factors are those greater than one half the number of sectors per track. An interleave factor of 0 is set to 1. Track and cylinder overflow is handled automatically by the controller.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	1	0	0
BYTE 2	0	LUN			NOT USED			
BYTE 3	NOT USED							
BYTE 4	NOT USED							
BYTE 5	INTERLEAVE FACTOR							
BYTE 6	CONTROL FIELD							

CHECK TRACK FORMAT   (HEX 05)   00000101

The track specifed by the logical sector address in bytes 2 through 4 is checked to see that its interleave scheme matches that specified by the interleave factor in byte 5. Reading begins with the first sector after index.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	1	0	1
BYTE 2	0	LUN		LOGICAL ADDR 2 (MS)				
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	INTERLEAVE FACTOR							
BYTE 6	CONTROL FIELD							

FORMAT TRACK   (HEX 06)   00000110

This command formats the track specified by the logical sector address in bytes 2 through 4 using the interleave factor specifed in byte 5. The track is written starting with index and all data fields are filled with a HEX E5. The first sector after index is always sector 0. The second sector is 0 plus the interleave factor. Interleave factors greater than one half the number of sectors per track are invalid. bret

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	1	1	0
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	INTERLEAVE FACTOR							
BYTE 6	CONTROL FIELD							

FORMAT BAD TRACK   (HEX 07)   00000111

This command sets the defective bit in the ID field (bit 3 of byte 2) of the specifed sector. The data field is not changed.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	0	1	1	1
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	NOT USED							
BYTE 6	CONTROL FIELD							

READ DATA   (HEX 08)   00001000

This command transfers the number of sectors specifed by byte 5 to the processor. The starting sector is specifed by the logical sector addresses in bytes 2, 3,

and 4. When the SECTOR XFER COUNT is zero, 256 sectors are transferred with a single read command.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	1	0	0	0
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	SECTOR XFER COUNT							
BYTE 6	CONTROL FIELD							

WRITE PROTECT SECTOR   (HEX 09)   00001001

This command sets the write-protected bit in the ID field (bit 2 of byte 2) of the sector. A FORMAT TRACK or FORMAT DRIVE command is the only way to remove the write-protect bit.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	1	0	0	1
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	NOT USED							
BYTE 6	CONTROL FIELD							

WRITE DATA   (HEX 0A)   00001010

The number of sectors specified in byte 5 are written to the selected LUN beginning with the sector specifed by the logical sector addresses in bytes 2, 3, and 4.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	1	0	1	0
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	SECTOR XFER COUNT							
BYTE 6	CONTROL FIELD							

SEEK   (HEX 0B)   00001011

This command causes the device addressed by the
LUN to be physically positioned to the cylinder as
defined by the logical sector address in bytes 2, 3, and
4. The cylinder address is automatically computed by
the controller.

No attempt to verify seek position is made until a
READ or WRITE command is issued. Unless the
DISABLE OVERLAP SEEK bit is set, completion
status is returned to the processor immediately after
receipt of the SEEK command.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	1	0	1	1
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	NOT USED							
BYTE 6	CONTROL FIELD							

REQUEST DRIVE TYPE   (HEX OC)   00001100

This command returns six bytes of controller, drive,
and track format information to the processor. If this
command is issued after a power-up or reset and

before ASSIGN DRIVE TYPE command, it returns default parameters as set by the dip switch. If issued after the ASSIGN DRIVE TYPE command, it returns the user defined drive type.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	1	1	0	0
BYTE 2	0	LUN		NOT USED				
BYTE 3				NOT USED				
BYTE 4				NOT USED				
BYTE 5				NOT USED				
BYTE 6				CONTROL FIELD				

The information is returned to the processor in data form. The data format is:

	7	6	5	4	3	2	1	0
BYTE 1				CONTROLLER TYPE				
BYTE 2				VERSION NUMBER				
BYTE 3				DRIVE TYPE CODE				
BYTE 4	0	0	0	0	0	0	0	0
BYTE 5	0	0	0	0	0	0	0	0
BYTE 6	0	0	0	0	0	0	0	0

CONTROLLER TYPE is the code for the model number of the controller. VERSION NUMBER is the controller firmware revision number and DRIVE TYPE CODE is the type of drive connected to the specified LUN.

DRIVE TYPE E   (HEX)

10 MB (removable) 02
40 MB (fixed) 03

ASSIGN ALTERNATE TRACK   (HEX 0E)   00001110

This command assigns an alternate track address to a
specified track. If an attempt is made to use the
original track, the controller automatically switches to
the alternate track. The command sets the alternate
track flags and writes the alternate track address in all
sectors on the defective track. An alternate track can
be assigned to one level only. An alternate track
cannot have another alternate track assigned to it.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	0	1	1	1	0
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	INTERLEAVE FACTOR							
BYTE 6	CONTROL FIELD							

The alternate track is passed to the controller as data
using the following format:

	7	6	5	4	3	2	1	0
BYTE 1	0	0	0	LOGICAL ADDR 2 (MS)				
BYTE 2	LOGICAL ADDR 1							
BYTE 3	LOGICAL ADDR 0 (LS)							
BYTE 4	0	0	0	0	0	0	0	0

Type 1 Commands

COPY COMMAND   (HEX 20)   00100000

This command copies a given number of records from
a source LUN to a destination LUN without processor
intervention. Upon completion (with or without
errors), the controller returns the source LUN number
in the completion status byte. Source and destination

LUNs may be the same. SRC is the SOURCE LUN and DST is the DESTINATION LUN.

	7	6	5	4	3	2	1	0
BYTE 1	0	0	1	0	0	0	0	0
BYTE 2	0	SRC LUN		LOGICAL ADDR 2 (MS)				
BYTE 3				LOGICAL ADDR 1				
BYTE 4				LOGICAL ADDR 0 (LS)				
BYTE 5				SECTOR XFER COUNT				
BYTE 6	0	DST LUN		LOGICAL ADDR 2 (MS)				
BYTE 7				LOGICAL ADDR 1				
BYTE 8				LOGICAL ADDR 0 (LS)				
BYTE 9				NOT USED				
BYTE 10				CONTROL FIELD				

Type 6 Commands

ASSIGN DRIVE TYPE   (HEX C1)   11000001

This command assigns a drive type to a particular LUN if the drive is different from the default as defined by the dipswitch.

NOTE: After a power-up or reset, this must be the first command issued to any LUN.

	7	6	5	4	3	2	1	0
BYTE 1	1	1	0	0	0	0	0	1
BYTE 2	0	LUN			NOT USED			
BYTE 3				NOT USED				
BYTE 4				NOT USED				
BYTE 5				DRIVE TYPE CODE				
BYTE 6				NOT USED				

DRIVE TYPE CODE is the type of drive conncected to the specified LUN.

DRIVE TYPE CODE is the type of drive connected to the specified LUN.

DRIVE TYPE CODE (HEX)

10 MB (removable) 02
40 MB (fixed) 03

Type 7 Commands

WRITE ECC   (HEX E1)   11100001

This command allows testing of the ECC logic. One sector (256 = 253 bytes of data + 3 bytes of ECC) is transferred to the controller which writes it on the disk, offset by 3 bytes. The offset consists of 3 bytes of 0s. The usual 3 bytes of ECC are not written.

Sending 256 bytes of 0s results in a data field of 256 bytes of 0s and an ECC field of 3 bytes of 0s. This is a readable data sector with no ECC error. If the data sent has 1 bit set, this is read as a 1 bit error (correctable). If the data sent has 5 bits set, this is read as a 5 bit error (uncorrectable).

	7	6	5	4	3	2	1	0
BYTE 1	1	1	1	0	0	0	0	1
BYTE 2	0	LUN		LOGICAL ADDR 2 (MS)				
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	NOT USED							
BYTE 6	CONTROL FIELD							

READ IDENTIFIER   (HEX E2)   11100010

The ID field of the sector given by the physical sector address is transferred to the processor. Only one sector is processed. The data length is four bytes.

	7	6	5	4	3	2	1	0
BYTE 1	1	1	1	0	0	0	1	0
BYTE 2	0	LUN			PHYSICAL ADDR 2 (MS)			
BYTE 3	PHYSICAL ADDR 1							
BYTE 4	PHYSICAL ADDR 0 (LS)							
BYTE 5	NOT USED							
BYTE 6	CONTROL FIELD							

The data returned to the processor is in the following format:

	7	6	5	4	3	2	1	0
BYTE 1	ID BTYE 3							
BYTE 2	ID BTYE 4							
BYTE 3	ID BTYE 5							
BYTE 4	ECC BTYE 1							
BYTE 5	ECC BTYE 2							
BYTE 6	ECC BTYE 3							

## READ SECTORS WITHOUT DATA TRANSFER (HEX E5)
11100101

This command is identical to the READ command except no data is transferred. The ID fields and the data field are checked for errors and the errors are reported.

	7	6	5	4	3	2	1	0
BYTE 1	1	1	1	0	0	1	0	1
BYTE 2	0	LUN			LOGICAL ADDR 2 (MS)			
BYTE 3	LOGICAL ADDR 1							
BYTE 4	LOGICAL ADDR 0 (LS)							
BYTE 5	NOT USED							
BYTE 6	CONTROL FIELD							

Error Codes

Disk Drive and Controller Sense Bytes

Following an error indication from the status byte, the processor may send a REQUEST SENSE (HEX 03) command to obtain more detailed information about the error. The REQUEST SENSE command transfers four bytes of error information to the processor.

	7	6	5	4	3	2	1	0
BYTE 1				ERROR	CODE			
BYTE 2	0		LUN		LOGICAL	ADDR	2	(MS)
BYTE 3				LOGICAL	ADDR	1		
BYTE 4				LOGICAL	ADDR	0	(LS)	

7	6	5	4	3	2	1	0
X	0	TYPE		CODE			
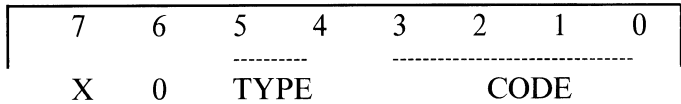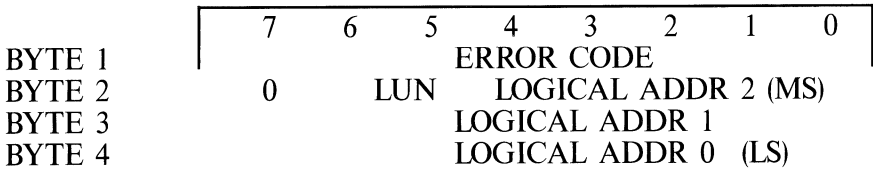
Sector address valid

Sector Address Valid indicates the logical sector address in bytes 2, 3, and 4 and contains the sector where the error occurred.

ERROR TYPE bits 4 and 5 are decoded as:

Bits 5   4

0	0	Drive errors
0	1	Data errors
1	0	Command errors
1	1	Miscellaneous errors

DRIVE ERROR CODE bits 0, 1, 2, and 3 are decoded as:

Bits	3	2	1	0	
	0	0	0	0	No error
	0	0	0	1	No index
	0	0	1	0	No seek complete
	0	0	1	1	Write fault
	0	1	0	0	Drive not ready
	0	1	0	1	Drive not selected
	0	1	1	0	No seek complete on restore
	0	1	1	1	Multiple drive selected
	1	0	0	0	No address acknowledge
	1	0	0	1	Reserved
	1	0	1	0	Tag sequence fault
	1	0	1	1	No data transitions
	1	1	0	0	
		through			
	1	1	1	1	Reserved

DATA ERROR CODE bits 0, 1, 2, and 3 are decoded as:

Bits	3	2	1	0	
	0	0	0	0	ECC error in ID field
	0	0	0	1	Uncorrectable error in data field
	0	0	1	0	No ID address mark detected
	0	0	1	1	No data address mark detected
	0	1	0	0	No record found
	0	1	0	1	Seek error
	0	1	1	0	Reserved
	0	1	1	1	Write protected
	1	0	0	0	Correctable data error
	1	0	0	1	Bad track or sector flag set
	1	0	1	0	Track fromat error
	1	0	1	1	Reserved
	1	1	0	0	Unable to read alt. track data
	1	1	0	1	
		through			
	1	1	1	1	Reserved

COMMAND ERROR CODE bits 0, 1, 2 and 3 are decoded as:

Bits 3   2   1   0

      0   0   0   0   Invalid command
      0   0   0   1   Illegal sector address
      0   0   1   0   Illegal function for drive type
      0   0   1   1
              through
      1   1   1   1   Reserved

MISCELLANEOUS ERROR CODE bits 0, 1, 2, and 3 are decoded as:

Bits 3   2   1   0

      0   0   0   0   RAM error
      0   0   0   1
              through
      0   0   1   0   Reserved

Error Handling Routine

The error codes listed below are drive related and no error recovery is performed.

01 NO INDEX FOUND - controller timeout after waiting 52 msecs for an index pulse.

02 NO SEEK COMPLETE - controller timeout after waiting 800 msecs for seek completes.

03 DRIVE FAULT - drive is tested for a 'drive fault' condition before turning on the write gate and after turning off write gate.

04 DRIVE NOT READY - drive is tested for 'ready' before all drive-related commands and during

command execution.

05 DRIVE NOT SELECTED - drive is tested for 'selected' condition before all drive-related commands. 'Selected' must respond to 'drive select' within 1 usec.

06 NO TRACK ZERO FOUND - drive is tested for 'track zero' during a recalibration sequence.

   10/40 MB - timeout approximately 17 seconds after toggling the 'restore' line to drive.

07 MULTIPLE DRIVES SELECTED - drive is tested for more than one (1) 'selected' signal approximately 1 usec after selecting the drive.

08 NO ADDRESS ACKNOWLEDGE - drive is tested for 'address acknowledge' 4 msec after setting the 'restore' line.

0A TAG SEQUENCE FAULT - drive is tested for 'address acknowledge' before starting a seek or restore sequence or a seek/restore sequence failure.

97 WRITE PROTECT SECTOR - the specified ID field has the write protect bit set.

99 BAD TRACK OR BAD SECTOR FLAG SET - 10/40 MB - the specified ID field has the bad sector bit set.

9A TRACK FORMAT ERROR - the sectors on a specified track are not interleaved with the same factor as specified in the command.

20 INVALID COMMAND - the command operating code is not valid.

21 DEVICE PARAMETER VIOLATION - the controller has received a parameter exceeding the drive volume.

22 ILLEGAL DRIVE FUNCTION - the command

or drive type code is invalid for the specified drive type.

The following error codes are position related and the controller performs up to eight recalibrations and reseeks.

90 ECC ERROR IN ID FIELD - at least one ID field had an ECC error.

92 NO ID ADDRESS MARK FOUND - controller was unable to find any address mark.

94 NO RECORD FOUND - controller was unable to find the specified ID field.

95 SEEK ERROR - the ID field contains a head or cylinder mismatch.

The following error codes are data related and the controller performs up to eight rereads.

91 UNCORRECTABLE ERROR IN DATA FIELD - ECC is unable to correct the data error.

93 MISSING DATA ADDRESS MARK - controller is unable to find the data field address mark.

98 CORRECTABLE DATA ERROR - with correction disabled, the data field error is correctable by ECC, but is not corrected. With correction enabled, the data error is corrected.

9C ALTERNATE TRACK ERROR - after finding the ID field with the alternate track bit set, the controller is unable to read the alternate track data due to either a missing data address mark or a data field ECC error.

Physical Description

9325 Disk Drive

Figure 6 shows the dimensions of the 9325, which weighs approximately 95 pounds (43.09 kg).

Height 7.40 in. (18.79 cm)
Width 21.80 in. (55.37 cm)
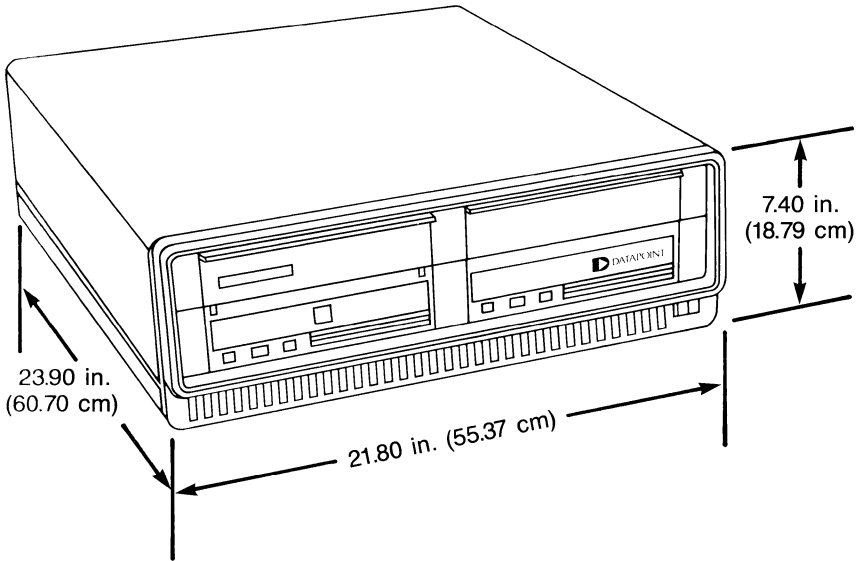Depth 23.90 in. (60.70 cm)

Figure 6. 9325 Dimensions

9325 Cartridge Disk

Figure 7 shows the dimensions of the 9325 10 MB Cartridge, which weighs approximately 1.6 pounds (.73 kg)

Height 1.0 in. (25.40 mm)
Length 8.3 in. (211.50 mm)
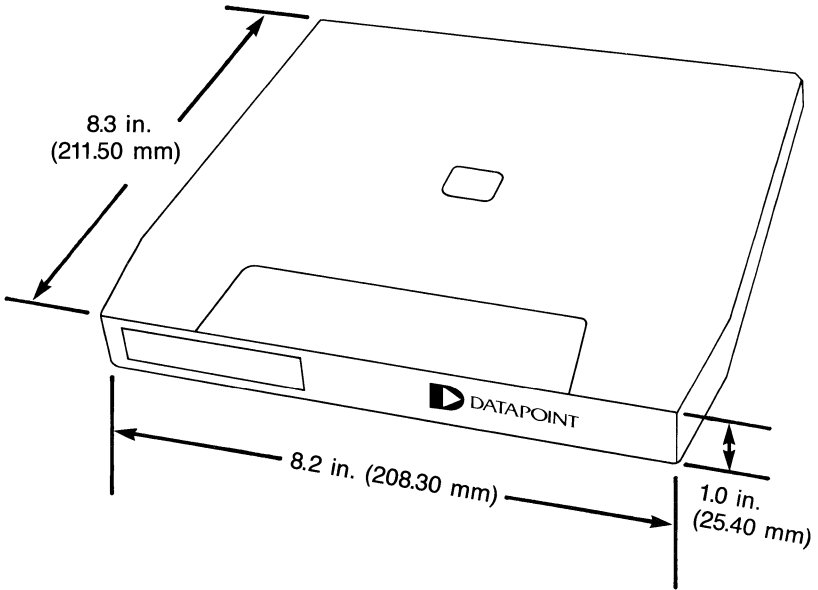Width 8.2 in. (208.30 mm)

Figure 7. Cartridge Dimensions

Environmental Requirements

Temperature:	50 to 100 degress Fahrenheit
	10 to 38 degrees Celsius
Humidity:	20 to 80% relative, noncondensing
Altitude:	0 to 6,500 feet
Heat Dissipation:	1400 BTU/hour, maximum
Acoustic Noise:	55 dB PNC

Interface Requirements

Microbus Pin Assignment

PIN	SIGNAL	DESCRIPTION
1	Ground	Signal return
2	Strobe 1	Micro Command Strobe 1
3	Ground	Signal return
4	Strobe 2	Micro Command Strobe 2
5	Ground	Signal return
6	IACK	Interrupt Acknowledge
7	Ground	Signal return
8	Address 0	Microbus Address Bit 0
9	Address 1	Microbus Address Bit 1
10	Address 2	Microbus Address Bit 2
11	Address 3	Microbus Address Bit 3
12	COMM 0	Microbus Command Bit 0
13	COMM 1	Microbus Command Bit 1
14	COMM 2	Microbus Command Bit 2
15	COMM 3	Microbus Command Bit 3
16	*PARITY	Microbus Parity Bit
17	Interrupt Req	Interupt request
18	DATA 0	Microbus Data Bit 0
19	DATA 1	Microbus Data Bit 1
20	DATA 2	Microbus Data Bit 2
21	DATA 3	Microbus Data Bit 3
22	DATA 4	Microbus Data Bit 4
23	DATA 5	Microbus Data Bit 5
24	DATA 6	Microbus Data Bit 6
25	DATA 7	Microbus Data Bit 7
26	+5 Power Indication	Voltage sensing signal

* Required on all new designs (formerly spare pin)

Primary Power

The 9325 disk and cartridge drive, as supplied by DATAPOINT, operates at 120 VAC (+/− 10% VAC), 60 Hz (+/− 2%).

Current in amps @ 120 VAC: 4 amps

NOTE: The 9324, 9325, and extension units are field strappable to operate at a frequency of 50 or 60 Hz (+/− 2%) and the following voltages:

100 VAC (+/− 10% VAC)
220 VAC (+/− 10% VAC)
240 VAC (+/− 10% VAC)

Power consumption is 400 watts (maximum)

Options

9324 Two 10 MB cartridge disk drives and a controller

9325 One 40 MB disk drive, one 10 MB cartridge disk drive and a controller

9326 One 40 MB disk drive with space for another disk

9327 Two 40 MB disk drives

Shipping List

Quantity	Item
1	9325 40 MB Disk and 10 MB Cartridge Disk Unit
1	9325 Product Specification

NOTE: This shipping list is provided for information purposes only and may be amended at any time by DATAPOINT Corporation.

DATAPOINT