



SWSE5 Series 107/428 MB Solid State Disks with Data Retention

User's Guide

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Revision Record

This Revision Record provides a concise publication history of this manual. It lists the manual revision levels, release dates, and reasons for the revisions. It also describes how the changes to affected pages are marked in the manual.

The following revision history lists all revisions of this publication and their effective dates. The publication part number is included in the *Revision Level* column, with the last entry denoting the latest revision. This publication supports StorageWorks Storage Subsystems.

Revision Level	Date	Summary of Changes
EK-SM1SA-UG	May 1994	Original release. This release supports SWSE5-SA 107 MB and SWSE5-SB 428 MB Solid State Disks with Data Retention.

About This Guide

This section identifies the audience of this guide and describes the contents (chapter by chapter) and structure. In addition, this section includes a list of associated documents and the conventions used in this guide.

The SWSE5 Series Solid State Disks With Data Retention User's Guide

This guide provides the following:

- General description of solid state disks
- General functional description of the SWSE5 series solid state disks
- SWSE5 series solid state disk specifications
- Instructions for installing an SWSE5-SA or an SWSE5-SB into a StorageWorks Storage Subsystem
- Description of the data retention subsystem

Intended Audience

This guide is intended for Sun System Administrators and end users of the solid state disks. Installing the SWSE5 series solid state disks requires a general understanding of adding devices to a Sun workstation, and basic SCSI terminology.

Document Structure

This guide contains the following chapters:

Chapter 1: An Overview of Solid State Disks

An Overview of Solid State Disks discusses the definition of a solid state disk, its use, and provides a description of the SWSE5 series solid state disks.

Chapter 2: Installing an SWSE5 Series Solid State Disk into a StorageWorks Expansion Storage Pedestal

Installing an SWSE5 Series Solid State Disk into a StorageWorks Expansion Storage Pedestal discusses hardware requirements, the procedures for installing the SWSE5-SA or SWSE5-SB solid state disks into a StorageWorks Expansion Storage Pedestal, preparing the disks for use, and discusses the front panel status LEDs.

Chapter 3: Understanding the Data Retention Subsystem

Understanding the Data Retention Subsystem discusses the internal SCSI drive and battery subsystem components, and the function of the data retention subsystem.

Appendix A: Specifications for the SWSE5-SA 107 MB Solid State Disk

Specifications for the SWSE5-SA 107 MB Solid State Disk describes selected operating and design specifications for the SWSE5-SA solid state disk.

Appendix B: Specifications for the SWSE5-SB 428 MB Solid State Disk

Specifications for the SWSE5-SB 428 MB Solid State Disk describes selected operating and design specifications for the SWSE5-SB solid state disk.

Associated Documents

In addition to this guide, the following documentation is useful to the reader:

Table 1 Associated Documents

Document Title	Order Number
<i>StorageWorks Expansion Storage Pedestal Solid State Disks</i>	EK-SMCPA-UG.B01
<i>SPARC Hardware Owner's Guide</i>	From Sun
<i>System and Network Administration</i>	From Sun

Conventions

This guide uses the following conventions:

Table 2 Documentation Conventions

Style	Meaning
boldface monospace type	To be input by the user
plain monospace type	Screen text
<i>italic type</i>	For emphasis, manual titles, utilities, menus, and screens
#	Represents the SunOS system prompt, which should not itself be typed when it precedes information to be input by the user.

An Overview of Solid State Disks

This chapter describes solid state disk technology and how to use it. This chapter also describes the Digital SWSE5 series solid state disks with data retention, and some significant features including interface and MTBF.

1.1 What is a Solid State Disk?

A solid state disk is a mass storage device, which stores data on memory chips (Random Access Memory (RAM) semiconductor arrays) rather than on magnetic or optical disks. Utilizing memory chips, a solid state disk has no moving parts, and therefore, none of the significant seek and latency delays normally associated with magnetic disks. With access rates approaching the high speeds of computer memory, a solid state disk makes data quickly and easily accessible and is thus used to improve system I/O performance.

Unlike computer memory, however, some solid state disks are nonvolatile due to a data retention subsystem, often consisting of a battery pack and an internal magnetic disk drive.

1.2 Using Solid State Disks to Reduce System Bottlenecks

Solid state disks are designed to correct I/O bound system performance problems by allowing fast access to data. Users seeking to eliminate I/O bottlenecks and improve application performance often select solid state disks because it is the fastest hardware-based I/O device available. Solid state disks will not however, correct CPU bound performance problems, nor are solid state disks a solution for bandwidth limitation problems.

To reduce I/O bottlenecks with a solid state disk, you identify your most often referenced (hot) files with system evaluation software and then move those files, with file migration software, or system commands, to the solid state disk. Types of files that would benefit I/O performance if moved to a solid state drive include:

- Applications with heavy demand on a small number of files
- Files that, by design, reside on the same volume (such as files grouped in a single directory)
- Files that are too small to benefit from disk striping (RAID 0)
- Files accessed with synchronous I/O

1.3 Overview of the SWSE5 Series Solid State Disk Drives

The SWSE5 series solid state disks are packaged in an industry standard 5.25 inch form factor referred to as a StorageWorks System Building Block (SBB). They feature 107 (SWSE5-SA) and 428 (SWSE5-SB) Mbytes of formatted reliable user data with an average latency of 0.25 ms and a <1ms average access time. They are capable of 800 I/O requests per second throughput.

The SWSE5 series are nonvolatile solid state disks. A data retention subsystem retains user data on an internal SCSI disk when you turn off the unit power. The data retention subsystem provides nonvolatility and data protection in the event of an unplanned power loss. In addition, the subsystem provides continuous data retention while you have the unit power turned on to reduce time necessary to save data in the event of an unplanned power loss.

Other features include:

- 188 K hrs. MTBF
- Error recovery through an ECC algorithm and retry operations
- Command Tag Queuing
- Fast (10 Mb/sec) Small Computer System Interface (SCSI)-2
- UL/CSA
- FCC Class B

Installing an SWSE5 Series Solid State Disk into a StorageWorks Expansion Storage Pedestal

This chapter describes how to install a SWSE5 series solid state disk into a StorageWorks Expansion Storage Pedestal including setting the SCSI ID, charging the battery, and how to label and create a filesystem on the disk, if necessary.

2.1 Getting Started

Before starting your installation, verify that you received the following:

- One SWSE5-SA or SWSE5-SB solid state disk
- This guide

Also, check the box in which your drive was shipped for damaged components. Retain all boxes and packing material for reshipment.

2.2 System Requirements

The SWSE5 series solid state disk requires the following:

- A StorageWorks Expansion Storage Pedestal (SWXSE-02)
- 3 vacant, adjacent 3.5-inch StorageWorks Building Block (SBB) slots

2.3 Installing an SWSE5 Series Solid State Disk

To install an SWSE5 series solid state disk, you need to do the following:

- Set the SCSI address of the drive
- Load the drive into the storage pedestal
- Prepare the drive for use

NOTE

References in this chapter to SunOS and Solaris mean the following versions of these operating systems:

SunOS 4.1.x

Solaris 1.1

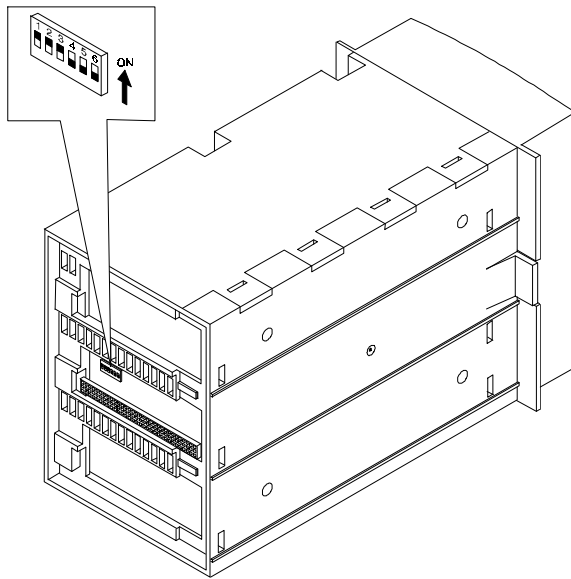
2.3.1 Setting the SCSI ID Address of the Solid State Disk

The SCSI-ID switches were preset at the factory to automatically adopt a SCSI ID device address. Therefore, a SWSE5 solid state disk automatically assumes the SCSI ID of the middle slot of the three storage pedestal slots in which you install it.

If you do not want the solid state disk to automatically assume this SCSI ID, you can manually assign a device address. You assign a device address by changing the setting of the switches on the six-switch pack on the back of the drive. See Table 2-1 to see how to reset the SCSI ID device address.

If you choose to manually assign a SCSI ID when using SunOS, we recommend that you use SCSI IDs 0-3 to avoid having to rebuild the kernel.

Figure 2-1 Solid State Disk Drive SCSI ID Switches



CDROM-08

Table 2-1 Solid State Disk Drive SCSI ID Switch Settings

Address	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
0	Off	Off	Off	Off	Off	Off
1	On	Off	Off	Off	Off	Off
2	Off	On	Off	Off	Off	Off
3	On	On	Off	Off	Off	Off
4	Off	Off	On	Off	Off	Off
5	On	Off	On	Off	Off	Off
6	Off	On	On	Off	Off	Off
7*	On	On	On	Off	Off	Off
Automatic†	Off	Off	Off	On	On	On

* Normally reserved for host.

† Sets device address to storage pedestal slot number.

2.3.2 Loading the Drive into a StorageWorks Expansion Storage Pedestal

The Solid State Disk is housed in a StorageWorks SBB carrier. The 5.25-inch form factor occupies three standard 3.5-inch SBB slots in a StorageWorks Expansion Storage Pedestal.

You can install the drive using the *hot-swap* method where you keep the host system power turned on, or with the *cold-swap* method where you turn off the power to the host system. Consult your system administrator to ensure that your operating system supports the *hot-swap* method before using it.

To install the solid state disk, follow these steps:

1. Open the door on the front bezel of the StorageWorks Expansion Storage Pedestal.
2. Remove the bezel from the pedestal by pressing down on the locking tabs at the bottom of the bezel and pulling it forward.
3. Remove the filler panels from three adjacent device slots by squeezing the locking handles at the ends of the panels and pulling forward until the panels are free of the pedestal.
4. To connect the solid state disk to the pedestal, follow Step 4a for a hot-swap, or Step 4b for a cold-swap.

Hot-Swap

- a.
 - Slide the solid state disk into the guide grooves of the three open slots, as shown in Figure 2-2, firmly until the locking handles snap into place.
 - Watch the front panel of the drive for the green activity light to flash on and then go off. This indicates proper operation of the drive. If the amber, fault LED remains on, see NOTE following Step 4b.
 - To boot your system, enter the following
 - if running SunOS: **boot**
 - if running Solaris: **boot -r**

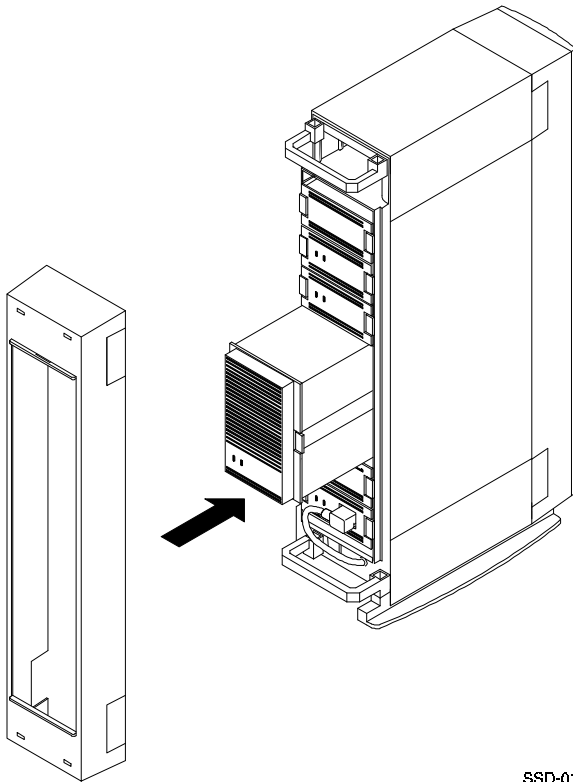
Cold-Swap

- b.
 - Turn off the system power.
 - After the system powers down, slide the solid state disk into the guide grooves of the three open slots, as shown in Figure 2-2, firmly until the locking handles snap into place.
 - Turn on the system power.
 - Watch for the solid state disk drive's green, activity LED to flash on and then go off. If the amber, fault LED remains on, see the following NOTE.

NOTE

If you see the amber, fault LED on, you may need to wait for the host software to initialize the drive before seeing a proper operation status. For more information on LED status, see Section 2.5.

Figure 2-2 Installing the Solid State Disk into a StorageWorks Expansion Storage Pedestal



SSD-01

2.4 Preparing an SWSE5 Series Solid State Disk for Use

After installing an SWSE5 series drive, prepare it for use by doing the following:

- Charging the Battery
- Adding an entry in the format.dat file for the disk (optional)
- Re-labeling the disk (optional)
- Creating a filesystem on the disk (optional)
- Mounting the filesystem

2.4.1 Charging the Battery

Leave the drive power turned on for four hours before storing data on the drive to charge the NiCAD battery employed in the data retention subsystem. The NiCAD battery may discharge during storage. If you find the drive write-protected upon receipt, this indicates an insufficient battery charge-level. For more information on the battery subsystem, see Section 3.1.2 of Chapter 3.

2.4.2 Adding an Entry to the format.dat file

The disk comes formatted, labeled, and partitioned by the factory. You need to add an entry to your format.dat file only if you reformat, relabel or repartition the drive.

To add an entry to the format.dat file, follow these steps:

1. Open the `/etc/format.dat` file with an editor.
2. Add the following lines indicated in Step 2a. for the SWSE5-SA under SunOS or Solaris, or Step 2b. for the SWSE5-SB under SunOS or Solaris:
 - a. SWSE5-SA

SunOS

```
disk_type = "DEC_EZ51" \
: ctlr = SCSI : fmt_time = 4 \
: ncyl = 1042 : acyl = 2 : pcyl = 1044 : nhead = 4 : nsect = 50 \
: rpm = 5400 : bpt = 200
```

```
partition = "DEC_EZ51" \
: disk = "DEC_EZ51" : ctlr = SCSI \
: a = 0, 16000 : b = 80, 28800 : c = 0, 208400 \
: g = 224, 163200 \
```

Solaris

```
disk_type = "DEC EZ51" \
: ctlr = XY450 : fmt_time = 4 \
: ncyl = 1042 : acyl = 2 : pcyl = 1044 : nhead = 4 : nsect = 50 \
: rpm = 5400 : bpt = 200
```

```
partition = "DEC EZ51" \
: disk = "DEC EZ51" : ctlr = XY450 \
: 0 = 0, 16000 : 1 = 80, 28800 : 2 = 0, 208400 \
: 6 = 224, 163200 \
```

b. SWSE5-SB

SunOS

```
disk_type = "DEC_EZ54" \  
: ctlr = SCSI : fmt_time = 4 \  
: ncyl = 2086 : acyl = 2 : pcyl = 2088 : nhead = 8 : nsect = 50 \  
: rpm = 5400 : bpt = 400
```

```
partition = "DEC_EZ54" \  
: disk = "DEC_EZ54" : ctlr = SCSI \  
: a = 0, 32000 : b = 80, 64000 : c = 0, 834400 \  
: g = 240, 738400 \  

```

Solaris

```
disk_type = "DEC EZ54" \  
: ctlr = XY450 : fmt_time = 4 \  
: ncyl = 2086 : acyl = 2 : pcyl = 2088 : nhead = 8 : nsect = 50 \  
: rpm = 5400 : bpt = 25600
```

```
partition = "DEC EZ54" \  
: disk = "DEC EZ54" : ctlr = XY450 \  
: 0 = 0, 32000 : 1 = 80, 64000 : 2 = 0, 834400 \  
: 6 = 240, 738400 \  

```

3. Close the `/usr/etc/format.dat` file.

NOTE

The above examples show the solid state disk with more than one head. This three dimensional configuration has proven to yield more space available for filesystem use.

2.4.3 Labeling or Relabeling the Disk

The disk comes labeled by factory default. You need to label the disk only if you reformat the drive. To label the disk, follow these steps.

1. Type: **cd /usr/etc**
2. Type: **/etc/format**
3. From the menu, choose **Type**. The *Available Drive Types* list appears.
4. Enter the number corresponding to the disk type that you entered in the format.dat file. For example, the number for DEC_EZ54. The *Available Disk Selection* list appears.
5. Enter the number corresponding to the disk with the designation *<drive type unknown>*. The *Format Menu* appears.
6. Type: format> **label**
The Ready to label disk prompt appears.
7. Type: Ready to label disk, continue? **yes**
The format> prompt appears.
8. Type: format> **quit**

2.4.4 Creating a Filesystem on the Disk

The disk comes with a filesystem on it by factory default. You need to create a filesystem for each partition on your drive only if you reformat the drive. To create a filesystem, follow these steps:

1. Type: **/usr/etc/newfs -v /dev/rdevicename**
where *rdevicename* is the raw device you indicated when labeling the disk including the letter of the partition on which you want to create a filesystem. For example:
For SunOS:
newfs -v /dev/rsd2c where c is the partition letter
For Solaris:
newfs -v /dev/rdisk/c0t2d0s2 where s2 is the partition number

2.4.5 Mounting the filesystem

To mount the filesystem, follow these steps:

1. Create a new directory */ssd* from root.
2. Type: **mount /dev/devicename /ssd**
where *devicename* is the block device you indicated when labeling the disk including the letter of the partition which you want to mount. For example:
For SunOS:
mount /dev/sd2c /ssd
For Solaris:
mount /dev/dsk/c0t2d0s2 /ssd

After mounting the filesystem, you have completed the installation and preparation of a SWSE5 series solid state disk. You can now use the drive.

2.5 Understanding Front Panel Status LEDs

The drive has two LED indicators, as shown in Figure 2-3, that display the status of the device. The LEDs have three states: *on*, *off*, and *flashing*.

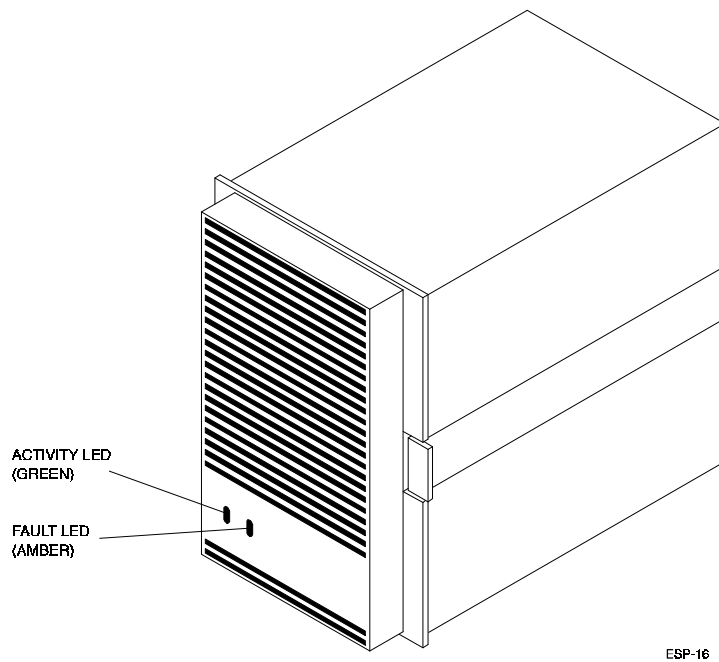
- The green, activity LED (left) indicates drive activity when on or *flashing*.
- The amber, fault LED (right) indicates an error condition when on or *flashing*.

Table 2-2 describes the drive status indicated by the LEDs.

CAUTION

Removing an SBB when the left, activity LED is on or flashing can cause the loss or corruption of data.

Figure 2-3 5.25-inch SBB LEDs



ESP-16

Table 2-2 SBB Status LEDs

Activity Status LED	Fault Status LED	Indication
On	Off	Device is operating properly.
Off	Off	Device is inactive and operating normally. There is no fault.
On	On	Fault status, device is hung up. Recommend replacing the device. Contact your solid state disk drive vendor.
Off	On	Fault status, device is inactive and spun down. Recommend replacing the device. Contact your solid state disk drive vendor.
On	Flashing	Fault status, device is active and spinning down due to the fault.
Flashing, one time per second	Off	Saving data under battery power.
Flashing, two times per second	Off	Restoring data in the off-line state.

Understanding the Data Retention Subsystem

This chapter describes the data retention subsystem and its components inside of a SWSE5 series solid state disk drive. The data retention subsystem consists of an internal SCSI disk drive, battery and battery charger.

3.1 Introduction to the Data Retention Subsystem

The data retention subsystem consists of the following components:

- An internal SCSI magnetic disk drive
- A battery subsystem

3.1.1 The Internal SCSI Drive

An SWSE5 series drive contains a low profile disk for retention of the entire data contents of the solid state disk memory arrays.

3.1.2 The Battery Subsystem

The battery subsystem (BSS) powers the drive upon loss of AC power until the drive transfers modified data from the memory arrays to the internal SCSI disk. The battery subsystem consists of the following components:

- 7-cell NiCAD stack rechargeable battery, providing 45 minutes of charge
- Battery charging circuit

3.1.2.1 Retaining Charge

The following provides you with information about the NiCAD battery in the battery subsystem retaining its charge.

- The battery provides 45 minutes of charge.
- The battery may discharge during storage, or when the unit's AC power remains turned off for more than one month.
- Table 3-1 displays the number of saves a fully charged battery can accommodate in a 24 hour period with no battery recharging between cycles.

Table 3-1 Number of Full Save Cycles Attainable Without Battery Recharging

Disk	Maximum Time Required to Save all Data in Array	Minimum Number of Full Save Cycles Attainable Without Recharging
SWSE5-SA	2 minutes	15 cycles
SWSE5-SB	8 minutes	3 cycles

3.1.2.2 Charging Battery

The SWSE5 series disks employ a fast-charge battery charge circuit which does the following:

- Fully charges a discharged battery
To charge a discharged battery, turn on the unit's AC power; the charge-circuit replaces 90% of a fully discharged battery in four hours.
- Trickle-charges a battery to maintain the charge-level while AC power is applied
To maintain the battery charge, leave the AC power turned on.

3.1.2.3 Monitoring Charge

When you turn on the power to the drive, the drive checks the condition of the battery charge and voltage. Table 3-2 describes what the drive does if it detects a low charge or voltage:

Table 3-2 How the Drive Responds to a Low Battery Charge or Voltage

If the drive determines a Low status for:	The drive does the following:
Charge	Assesses the battery is okay, write protects the data, recharges the battery, and removes the write protect after recharging the battery.
Voltage	Assesses the battery may be damaged, write protects the unit.

3.2 Understanding the Function of the Data Retention Subsystem

The data retention subsystem provides the following storage benefits:

- Non-volatility
- Data protection during unplanned power loss

3.2.1 Non-volatility

An SWSE5 series solid state disk achieves non-volatility by retaining user data on an internal SCSI disk when you turn off power to the unit.

When you turn on power to the unit, the drive begins restoring data from the internal SCSI drive to the memory arrays. The drive gives user's request for data priority over its restore function. If a user requests data that the drive has not yet restored to the memory arrays, the drive immediately restores the requested data.

3.2.2 Data Protection

Whenever you turn off the power to an SWSE5 series disk, the battery subsystem powers the drive until the drive transfers all modified data from the memory arrays to the internal SCSI disk. Therefore, in the event of an unplanned power loss, the drive proceeds with its normal process of retaining data and prevents loss of data.

To minimize the amount of time necessary to save data in the event of an unplanned power loss, as a part of its routine operation, the data retention subsystem continuously tracks modifications to the data in the memory arrays and periodically saves modified data to the internal SCSI disk.



Specifications for the SWSE5-SA 107 MB Solid State Disk

A.1 SWSE5-SA Specifications

The following Table A-1 displays selected SWSE5-SA specifications.

Table A-1 SWSE5-SA Selected Operating and Design Specifications

Physical Configuration	
Formatted Capacity	106.9 MB
Data Sectors	208,800
Sector Capacity	512
Interface	SCSI-2
Cylinders	4176
Tracks/Cyl	1
Sectors/Track	50

Power Requirements	
@ 12V \pm 5%	2.0A during disk spinup 1.5A during battery charging 1.1A during normal operation
@ 5V \pm 5%	

Performance	
Interface transfer rate:	
Synchronous	10 MB/Sec
Asynchronous	5 MB/Sec
Media Transfer Rate	2 MB/Sec
I/O Requests	800 per sec
Access Time	<1ms

Physical	
Height	82.6 cm/3.25 inches
Width	14.6 cm/5.75 inches
Length	20.32 cm/8.0 inches
Weight	5lbs, 10oz

Environmental	
Non-Operating:	
Temperature	-40° C to +66°C
Humidity (RH)	8% to 95% noncondensing
Operating:	
Temperature	-10° C to +40°C
Humidity (RH)	10% to 90% noncondensing
Shock	10 G peak half-sine 10 ms duration
Vibration	22-500 Hz @ 0.5 G peak
Acoustics (in DRS units):	
LNPE (Noise Power Emission Level) 4.5	
LPA (Sound Pressure Level) @ FOP* 35	
LPA @ FBP* 31	
*FOP - typical table top product Front Operator Position: 1.2m above floor, 0.25m back from product	
*FBP - typical floor mounted product Front Bystander Position: 1.5m above floor, 1.0m back from product	

Typical Power Dissipation	
13W	

Specifications for the SWSE5-SB 428 MB Solid State Disk

B.1 SWSE5-SB Specifications

The following Table B-1 displays selected SWSE5-SB specifications.

Table B-1 SWSE5-SB Selected Operating and Design Specifications

Physical Configuration	
Formatted Capacity	427.7 MB
Data Sectors	835,200
Sector Capacity	512
Interface	SCSI-2
Cylinders	16706
Tracks/Cyl	1
Sectors/Track	50

Power Requirements	
@ 12V \pm 5%	2.4A during disk spinup 1.8A during battery charging 1.4A during normal operation
@ 5V \pm 5%	

Performance	
Interface transfer rate:	
Synchronous	10 MB/Sec
Asynchronous	5 MB/Sec
Media Transfer Rate	2 MB/Sec
I/O Requests	800/Sec
Access Time	<1ms

Physical	
Height	82.6 cm/3.25 inches
Width	14.6 cm/5.75 inches
Length	20.32 cm/8.0 inches
Weight	5lbs, 10oz

Environmental	
Non-Operating: Temperature -40° C to +66°C Humidity 8% to 95% (RH) noncondensing	
Operating: Temperature -10° C to +40°C Humidity 10% to 90% (RH) noncondensing	
Shock	10 G peak half-sine 10 ms duration
Vibration	22-500 Hz @ 0.5 G peak
Acoustics (in DRS units): LNPE (Noise Power Emission Level) 4.5 LPA (Sound Pressure Level) @ FOP* 35 LPA @ FBP* 31 *FOP - typical table top product Front Operator Position: 1.2m above floor, 0.25m back from product *FBP - typical floor mounted product Front Bystander Position: 1.5m above floor, 1.0m back from product	

Typical Power Dissipation	
17W	

Reader's Comments

Manual Order Number:

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Manual Rating	Excellent	Good	Fair	Poor
Accuracy (correct presentation of facts)	[]	[]	[]	[]
Completeness (adequate information)	[]	[]	[]	[]
Clarity (easy to understand)	[]	[]	[]	[]
Organization (logical sequence of information)	[]	[]	[]	[]
Layout (easy to follow subject matter)	[]	[]	[]	[]
Indexing (easy to locate desired information)	[]	[]	[]	[]

Errors Noted (include page, paragraph, table or figure number)

Most-Liked Features

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Suggestions for Improvement

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