PROMISE®
TECHNOLOGY, INC.

UltraTrak

SX4000, SX8000, RM8000

User Manual

Version 8.0 Rev. A

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This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult Promise Technology, Inc. or an experienced radio/TV technician for help.

This device complies with Part 5 of the FCC Rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Only digital device equipment CERTIFIED CLASS B should be attached to this equipment and that must have shielded cables.

Table of Contents

Chapter 1: Introduction

Thank you for purchasing Promise Technology's UltraTrak SX4000, UltraTrak SX8000 or UltraTrak RM8000 external disk array system.

UltraTrak provides data storage solutions for applications where fault tolerance and data redundancy are required. The failure of any single drive will not affect data integrity or accessibility of the data. A defective drive may be replaced without interruption of data availability to the host computer. A hot spare drive will automatically replace a failed drive, securing the fault tolerant integrity of the array. The self-contained hardware-based array provides maximum performance in a compact external chassis.

The UltraTrak SX4000 is an external disk array with an expandable capacity of up to four individual disk drives. The UltraTrak SX8000 and RM8000 are external disk arrays with an expandable capacity of up to eight individual disk drives.

The standard LVD SCSI interface provides compatibility with any system that utilizes a SCSI interface.

Architectural Description

The UltraTrak disk array consists of either four (*SX4000*) or eight (*SX8000/RM8000*) disk drive bays, an enclosure with back plane, and the array controller. Multiple fans provide redundancy to ensure continued usage should a component fail. The array controller is hardware based and controls all array functions transparently to the host system. It appears to the system as a standard SCSI drive, and therefore does not require any special software drivers.

Warning

The electronic components within the UltraTrak disk array are sensitive to damage from ESD (Electro-Static Discharge). Appropriate precautions should be observed at all times when handling the array or its subassemblies.

Features and Benefits

Feature	Benefit
Maximum fault tolerance	Ensures uninterrupted data availability.
Supports RAID levels 0, 1, 3, 5, 0+1, 30, 50 and JBOD	Allows system to be tuned for maximum performance. RAID 30 and 50 are only supported on the SX8000 and RM8000.
S.M.A.R.T	Warns of disk drive degradation and potential failure.
Emulates standard SCSI-3 drive to host	Compatible with all SCSI-3 or SCSI-2/LVD host adapters. No special operating system drivers used.
Front panel LCD and LED indicators	Easy setup and quick response to problems, ensuring maximum up time and manageability.
Hot swap feature	Allows a defective drive to be replaced without interrupting data accessibility to the host system.
Hot-spare drive	Maintains full fault tolerant integrity by automatically rebuilding the data from a failed drive to an installed hot spare drive.
Automatic background data reconstruction when a drive is replaced	Array is quickly back on-line with minimal user intervention.
Redundant fans	Load sharing and full operation even with a failed fan
Redundant Power Supply (*SX/RM8000 only*)	Load sharing and uninterrupted operation with failure of one power supply.

Chapter 2: Getting Started

Warning

To prevent serious damage to the UltraTrak storage subsystem, be sure that the voltage-select switch on the back of the power supply is set to your local voltage (see Figure 10 on page 14).

Getting started with the UltraTrak consists of the following steps:

1. Unpack the UltraTrak storage subsystem (this page).
2. Mount UltraTrak RM8000 in a rack (page 4).
3. Install Hard Drives (page 6)
4. Connect the Null Modem Cable (page 8).
5. Connect the SCSI Cables (page 10).
6. Connect the Power Cable (page 14).
7. Enter the Password (page 15).
8. Assign a SCSI ID (page 16).
9. Configuring the UltraTrak (page 17).
10. Partition and Format the Array (page 28).

Unpack UltraTrak

Open the UltraTrak box and carefully remove the UltraTrak unit and accessories from the box. Be sure to remove the packing foam from within the UltraTrak door. The UltraTrak and accessories include the following items:

- UltraTrak unit
- Quick Start Guide
- Two drive-carrier keys
- Null Modem Cable
- SCSI Terminator (included when there is no internal SCSI termination)
- External LVD SCSI cable
- Power cord
- Screw sets for hard drives
- CD with PAM Utility and User Manual, UltraTrak User Manual
- (4) Rubber Feet (RM8000 only)
- (2) Rackmount Ears (RM8000 only)

Note

The Promise Array Management (PAM) utility provides monitoring and maintenance of your RAID through a graphic user interface (GUI) on your PC. Install PAM from the CD that comes with UltraTrak. You can also download it from the Promise website (www.promise.com).

PAM will manage one UltraTrak system per PC.

Mount UtraTrak RM8000 in Rack

The UltraTrak may be installed in any convenient location within the LVD SCSI cable length distance of the next SCSI device. The UltraTrak RM8000 is designed specifically for rack mount installation but may also serve on a bench top as well.

The UltraTrak RM8000 installs on a customer supplied standard 19-inch wide rack mount tray. Assemble the Mounting Brackets on each side of the RM8000 and set the unit onto an already installed rack mount tray and then secure it to the rack with four screws.

Assemble the Mounting Bracket and Handle before installing the UltraTrak RM8000 into a rack (see Figure 1).

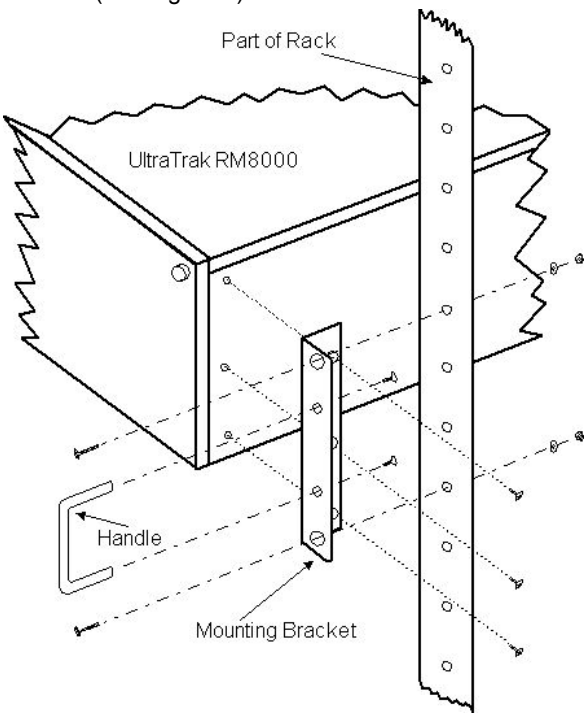


Figure 1. Mounting Bracket Assembly (only one of two sides shown)

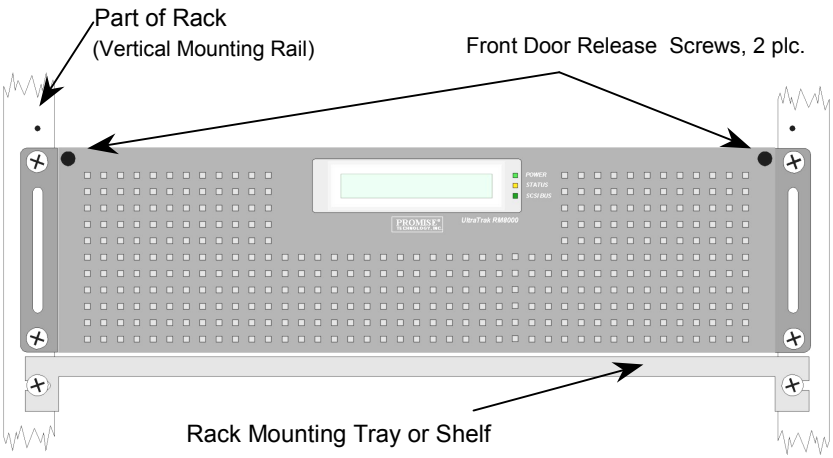


Figure 2. Rack Mounted RM8000

Install Hard Drives

Before using, the UltraTrak must first be populated with ATA hard drives. The UltraTrak can support hard drives in the configurations listed below.

RAID Configuration	Number of Hard Drives		
	Minimum	Max (*SX4000*)	Max (SX/RM*8000*)
RAID 0	2	4	8
RAID 1	2	2	2
RAID 3	3	4	8
RAID 5	3	4	8
RAID 0+1	4	4	8
RAID 30	6	–	8
RAID 50	6	–	8
JBOD (Single Drive)	1	4	8

You may mix manufacturer type and drive size – however, best performance is achieved when you populate the array with identical models.

Before installing a new hard drive, be sure the jumpers on the new hard drives are set for single or master operation. Consult the drive manual for the proper settings.

Install new hard drives into the UltraTrak by doing the following:

1. Open the Front Panel Door on the UltraTrak.
2. Unlock the Drive Carrier Latching Mechanism and remove an unused Drive Carrier on the UltraTrak. Begin at the top and work down (see Figure 3).
3. Attach the Drive Carrier power cable to the hard drive (see Figure 14 on page 33).
4. Attach the Drive Carrier ATA data cable to the hard drive (see Figure 14 on page 33).
5. Lower the hard drive into the Drive Carrier so that the screw holes on the bottom line up.
6. Insert screws through the holes in the Drive Carrier and into the bottom of the hard drive. Tighten each screw; be careful not to over tighten (see Figure 13 on page 32).
7. Slide the assembled Drive Carrier back into the UltraTrak and lock the Drive Carrier lock.
8. Repeat steps 2 through 7 until all of the new hard drives are installed.

Caution

If you plan to operate your UltraTrak SX4000 with less than four hard disk drives or your UltraTrak SX/RM8000 with less than eight hard disk drives, be sure to install all of the Drive Carriers into the Chassis, even if they are not holding a drive.

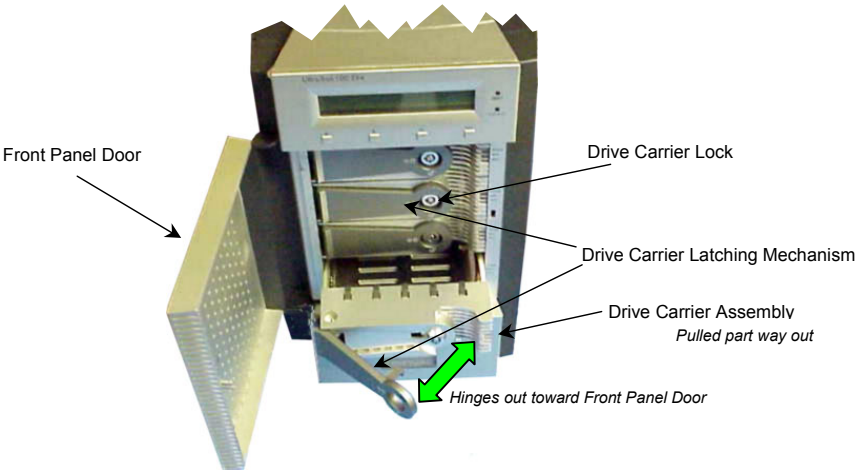


Figure 3. UltraTrak Disk Drive Access (SX4000 Shown)

Note

The Drive Carrier Latching Mechanism must be locked or the disk drive will not power up.

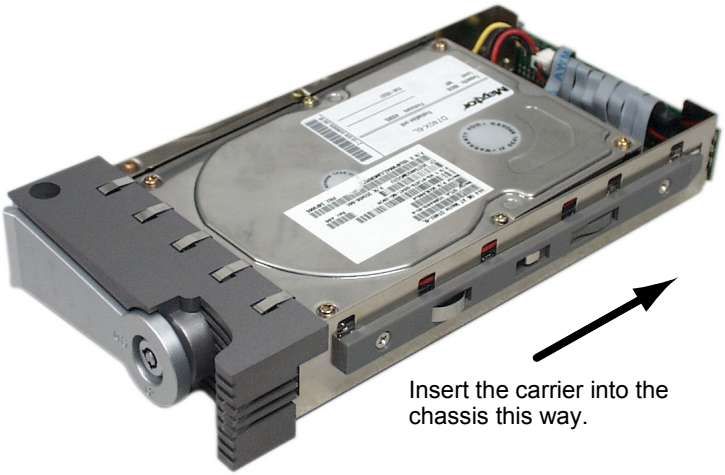


Figure 4. UltraTrak Drive Carrier

Connecting the Null Modem Cable

Attach one end of the Null Modem Cable to a COM Port on your PC or Workstation. Attach the other end to the COM Port on the UltraTrak.

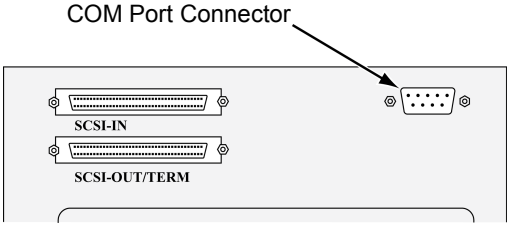


Figure 5. COM Port Connector on SX4000/8000. RM8000 similar.

SCSI Termination on UltraTrak

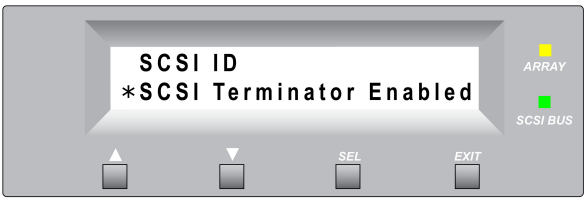
Your UltraTrak unit may have *internal* or *external* SCSI termination. Either method is equally effective. But you enable each one differently. Therefore, you must know which method your system has.

An UltraTrak with *internal* SCSI termination:

- Did not come with an external terminator.
- Has a SCSI Terminator function in the LCD menu.

  To access the internal SCSI Termination:

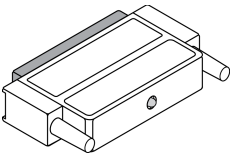
  1. Switch the power on and wait for the UltraTrak to initialize.
  2. Press the **SEL** button on the front panel.
  3. Press ▼ button to select **Configuration** mode, then press **SEL**.
  4. Enter the correct password (see page 15), then press **SEL**.
  5. Press ▼ button to select **Configure SCSI**, then press **SEL**.



  6. Press ▼ button to select **SCSI Terminator**, then press **SEL** to toggle between **Enabled** and **Disabled**.
  7. Press the **EXIT** button until you return to the **Idle** mode.

  When the SCSI Terminator is enabled, UltraTrak will terminate itself automatically.

An UltraTrak with *external* SCSI termination:



- Comes with an external terminator (right).
- Does not have a SCSI Terminator function in the LCD menu.
- Has a sticker on the back of the chassis (below).

The external SCSI terminator attaches to the SCSI output connector of the last device in the SCSI chain, as explained on the following pages.

Connecting the SCSI Cables

Installation of the UltraTrak disk array is very similar to the installation of a standard SCSI drive. The SCSI connector accepts the standard 68-pin LVD SCSI connector used on most LVD SCSI devices. Refer to your system and/or SCSI host adapter manual for additional installation procedures that may apply to your system or host adapter.

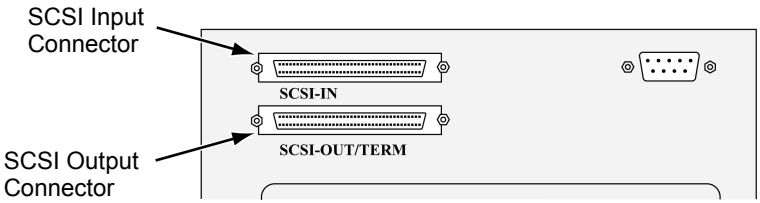


Figure 6. SCSI Connectors on SX4000/8000. RM8000 similar.

Caution

To prevent possible damage to the array or system, ensure that system power is OFF before connecting the cables.

SCSI Cable Connection and Termination

Two 68-pin wide SCSI connectors are provided on the back of the enclosure for connecting the array to the system. These connectors are used in one of two ways:

- If the UltraTrak disk array is the only external SCSI device, or is the last external device in a daisy-chained configuration, connect the incoming cable (the one attached to the PC's SCSI adapter) to the SCSI Input Connector.

  If the UltraTrak has *internal* SCSI termination, and this feature has been enabled, it will terminate itself automatically.

  If the UltraTrak has *external* SCSI termination, attach the external terminator to the SCSI Output Connector.

- If the array is to be placed in the middle of a daisy-chained configuration, attach the incoming cable (the one which is attached to the SCSI adapter) to the SCSI Input Connector and attach the outgoing cable (the one which continues on to other devices) to the SCSI Output Connector.

  No terminator is required at the UltraTrak. However, the last device in the daisy chain must be terminated, either internally or by attaching an external terminator.

Correct SCSI termination procedures require that the first and last devices on the SCSI bus be terminated. If the first or last device is not terminated, or if devices other than the first and last are terminated, erratic SCSI bus performance may occur.

Typically, the system or host adapter is the first device and is already terminated. When installing the UltraTrak disk array on a SCSI bus with other devices, make sure the above rules are observed with all devices on the SCSI bus. Consult your system and/or host adapter manual for additional information on correct termination procedure.

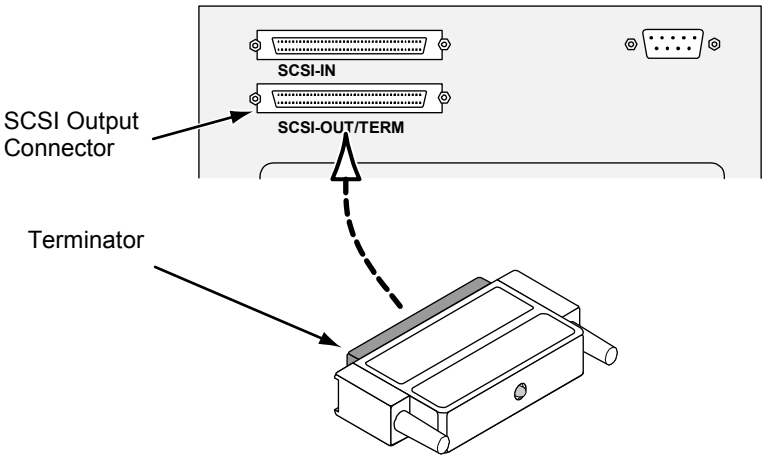


Figure 7. SCSI Terminator attaches to the SCSI Output Connector.

Caution

Improper system operation may occur if the SCSI termination is incorrect. Proper termination and SCSI-3 compliant cables must be used. A SCSI-3 compliant cable is included with the UltraTrak.

Daisy Chaining Multiple Arrays

Use a standard 68-pin SCSI-3 cable assembly to attach the array to the SCSI chain. Attach each cable to the individual units to be connected on the SCSI bus. Ensure that each device has a unique SCSI ID and that only the first and last devices are terminated.

If the last UltraTrak in the chain has internal SCSI termination (see page 9), be sure the termination feature is enabled.

If the last UltraTrak in the chain has external SCSI termination (see page 9), attach the external terminator to the SCSI Output Connector as shown in Figure 8.

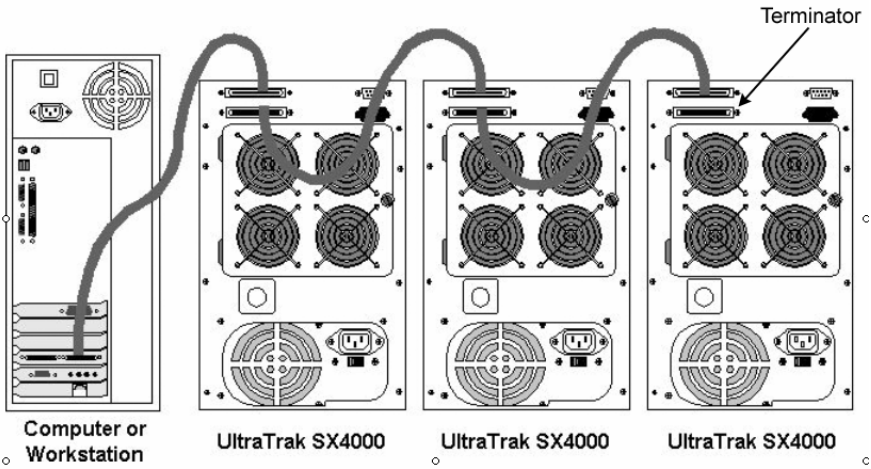


Figure 8. Daisy Chaining Several UltraTraks Together with an external terminator on the last unit.

Daisy Chaining with Other SCSI Devices

This procedure is essentially the same as the procedure outlined above for multiple arrays. Refer to the manual associated with the other device or devices for additional information that may be pertinent to that unit. Ensure that each device has a unique SCSI ID and that only the first and last devices are terminated.

If the last device in the chain has internal SCSI termination, be sure the termination feature is enabled. See the device's user manual to learn how it terminates the SCSI chain.

If the last device in the chain has external SCSI termination, attach an external terminator to the SCSI Output Connector as shown in Figure 9.

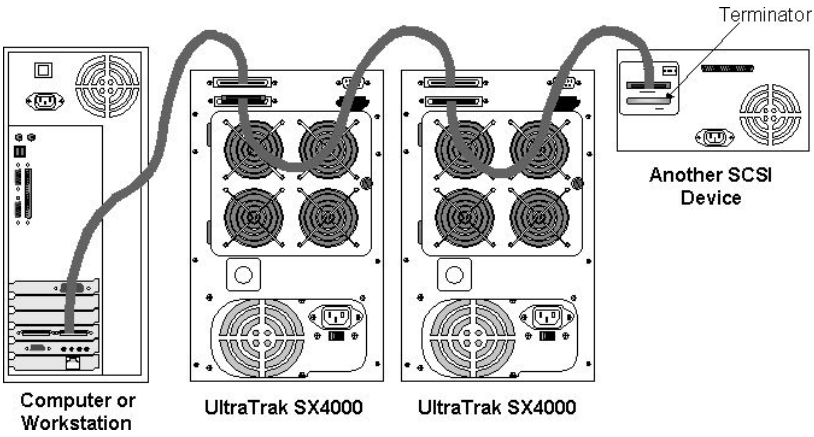


Figure 9. Daisy Chaining UltraTrak with Other SCSI Devices with an external terminator on last device.

Connect Power Cable and Switch Power On

The UltraTrak SX4000 disk array includes a single power supply; The UltraTrak SX8000 and RM8000 include two replaceable power supply modules.

Both systems will operate on either 115 volts AC or 230 volts AC. Ensure that the voltage switch on the back of each power supply is set to your local voltage. See Figure10.

Warning

To prevent serious damage to the UltraTrak, be sure that the voltage-select switch on the back of the power supply is set to your local voltage.

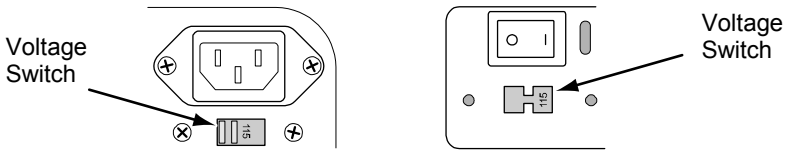
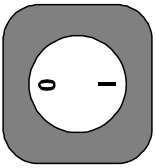


Figure 10. Voltage Switches on SX4000 (left) and RM/SX8000 (right).

Main Power Switch

The power switch is located on the back of cabinet (right). Switch the UltraTrak power on by pressing the portion of this switch marked "**I**". Switch the power off by pressing the portion of this switch marked "**O**".



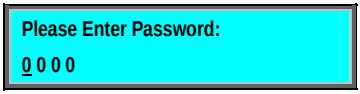
Main Power Switch

Enter or Change the Password

You are prompted for a password each time you access the UltraTrak Configuration Mode. A password consists of four digits. The default password is 0000.

Enter Password

You are prompted to enter the correct password each time you access the UltraTrak Configuration mode.



The active password digit is marked by an underscore.

Password entry begins with the left-most digit. You must enter the proper value before proceeding to the next digit. You change the value of the active password digit by pressing either the ▼ button or the ▲ button. The ▼ button increments the digit downward (as, 0, 9, 8, 7 …). The ▲ button increments the digit upward (as, 0, 1, 2, 3 …).

Press the **SEL** button to proceed to the next digit or to submit the password if you have just entered the last digit. You are given access to the **Configuration** menu if you entered the password correctly.

Change Password

You may change the password by doing the following procedure:

1. From the Idle mode display, use the ▼ button to select **Change Password**.
2. Press the **SEL** button.
3. Enter Old Password.
4. Enter New Password.
5. Press **Exit** at the **New password saved** prompt.

Reset to Default Password

You can reset the password back to its default value of 0000 by momentarily shorting pins 1 and 2 of the Password Reset Jumper located on the controller board. See Appendix E: Replacing the Controller Card at the end of this manual for information about accessing the controller board.

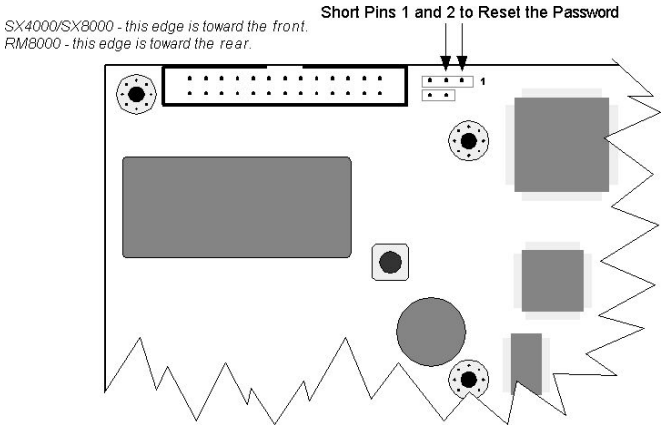


Figure 11. Location of Password Reset Jumper on Controller Board

Assign a SCSI ID

Each device on a SCSI chain must have a unique ID. The default SCSI ID setting of the UltraTrak is 0. If you need to change the SCSI ID setting of the UltraTrak, do the following:

1. From the Idle mode display, press the **SEL** button on the front panel.
2. Press ▼ button once to select **Configuration**, then press **SEL** button.
3. Enter the password at the prompt (see Enter Password on page 15).
4. At the **Configuration** menu, use the ▼ button to select **Configure SCSI**, and then press the **SEL** button. (See page 60 for more details.)
5. At the **Configure SCSI** menu, use the ▼ button to select the **SCSI ID**, and then press the **SEL** button. (See page 62 for more details.)
6. At the **SCSI ID** menu, use the ▲ and ▼ button to select the SCSI ID number, and then press the **SEL** button. (See page 62 for more details.)
7. Press the **EXIT** button until you return to the **Idle** mode. (See page 36 for more details.)

Configure the UltraTrak

The configuration procedures for the UltraTrak SX4000, UltraTrak SX8000 and UltraTrak RM8000 are exactly the same. The following procedures provide the basic steps needed to create an array and get your UltraTrak running quickly. Before beginning, you need to decide if you will create an array using the automatic setup features or if you will create the array manually. Both procedures are provided, but you can only use one of them.

You may want UltraTrak to create the array for you if you do not have a good technical understanding of various RAID technologies.

How to Automatically Create an Array

1. Ensure that the UltraTrak power is off.
2. Install the disk drives into the UltraTrak and lock the Drive Carrier lever.
3. Switch the power on and wait for the UltraTrak to initialize.
4. Press the **SEL** button on the front panel.
5. Press ▼ button once to select **Configuration**, then press **SEL** button.
6. Enter the password at the prompt (see Enter Password on page 15).
7. At **Configure Array**, press **SEL**.
8. **Array Setup** should be selected, press **SEL**.
   If the message "*No Free Disk" appears, it means that an array has already been configured. If you wish to re-create a new array, then you need to first delete the existing array before you can proceed. (See page 50, "Delete Array", for more details.)
9. With **RAID Level** selected, press **SEL**.
10. Use the ▼ and ▲ button to select the proper RAID level for your array, press **SEL** to choose the selected RAID level. See Choosing a RAID level on page 21 for help in choosing the proper RAID level.
11. Press **SEL** to create the array or press **EXIT** to cancel.
12. If you elected to create the array then you should see the message "Array has been created."
13. Switch the UltraTrak power off – wait a few seconds and switch the power back on.

You have successfully created an array automatically. If you haven't already done so, you need to select a SCSI ID before you can begin using the UltraTrak.

How to Manually Create an Array

1. Ensure that the UltraTrak power is off.
2. Install the disk drives into the UltraTrak and lock the Drive Carrier lever.
3. Switch the power on and wait about one minute for the UltraTrak to initialize.
4. Press the **SEL** button on the front panel.
5. Press ▼ button once to select **Configuration**, then press **SEL** button.
6. Enter the password at the prompt (see Enter Password on page 15).
7. At **Configure Array**, press **SEL**.
8. Press ▼ button twice to select **Define Array**, then press **SEL**.
9. With **RAID Level** selected, press **SEL**.
10. Use the ▼ and ▲ button to select the proper RAID level for your array, press **SEL** to choose the selected RAID level. See Choosing a RAID level on page 21 for help in choosing the proper RAID level.

Note

If you wish to make a RAID 0+1 array using 4, 6, or 8 drives you need to choose RAID 1 (mirroring) and then follow the steps below to create the array.

11. Press **SEL** to assign **Stripe Block Size**. 64KB is the default value and is optimum for most applications. Choosing the proper **Stripe Block Size** facilitates efficient data flow. You might want to choose a different value if you know the size of the cache buffer in your hard drives or the average data block size of the data you retrieve. See Choosing Stripe Block Size on page 20 for more information.
12. Press ▼ button to choose the **Gigabyte Boundary** feature. Press **SEL** to toggle between **Gigabyte Boundary ON** and **Gigabyte Boundary OFF**. The size of the array is always restricted by the size of the lowest capacity disk drive. **Gigabyte Boundary ON** (recommended) causes the size of the array to be rounded down to the nearest whole gigabyte. **Gigabyte Boundary OFF** does not round off the size of the array. (For example: Enabled—1.6GB = 1GB; Disabled—1.6GB = 1.6GB.) See Gigabyte boundary on page 20 for more information.

Note

The Gigabyte Boundary feature is only available for RAID levels 1, 0+1, 3, 5, 30 and 50.

13. Press ▼ button to choose the **Add/Remove Drives** feature then press **SEL**.
14. Use the ▼ and ▲ button to select each drive. Press **SEL** to toggle between adding or removing a drive. Press **EXIT** when done.
15. Press **SEL** to **Save Changes**
16. Press **SEL** to create the array or press **EXIT** to cancel.
17. If you pressed **SEL** to create the array then you should see the message "Array has been created."
18. Switch the UltraTrak power off – wait 5 seconds and switch the power back on.

You have successfully created an array manually. If haven't already done so, you need to select a SCSI ID before you can begin using the UltraTrak.

Gigabyte Boundary

The Gigabyte Boundary feature is designed for fault tolerant arrays (RAID 1, 0+1, 3, 5, 30, and 50) in which a drive has failed and the user cannot replace the drive with the same capacity or larger. Instead, the Gigabyte Boundary feature permits the installation of a replacement drive that is slightly smaller (within 1 gigabyte) than the remaining working drive (for example, a 20.5GB drive would be rounded down to 20GB). This can be helpful in the event that a drive fails and an exact replacement model is no longer available. Without this feature enabled, UltraTrak will NOT permit the use of a replacement drive that is slightly smaller than the remaining working drive.

For the Gigabyte Boundary feature to work, the Gigabyte Boundary feature must be set to ON when the original array is created. When enabled, the Gigabyte Boundary feature rounds the drive capacity of all drives to the common whole GB drive size. For example, with the Gigabyte Boundary feature enabled, the remaining working drives can be 20.5GB and the replacement drive can be 20.3, since all are rounded down to 20GB. This permits the smaller drive to be used. Please note that users will lose a small amount of available storage capacity from each drives in order to arrive at a common drive size.

Choosing Stripe Block Size

There are two issues to consider when selecting the Stripe Block Size.

First, you should choose a Stripe Block Size equal-to or smaller than the smallest cache buffer found on any array disk drive. Selecting a larger value slows the array down because disk drives with smaller cache buffers need more time for multiple accesses to fill their buffers.

Secondly, if your data retrieval consists of fixed data blocks, such as with some database or video applications – then you should choose that size as your Stripe Block Size.

Choosing a RAID Level

There are several issues to consider when choosing the RAID Level for your UltraTrak array. Appendix B: Technology Background on page 71 gives some technical insight regarding each RAID choice and the following discussion summarizes some advantages, disadvantages and applications for each choice.

RAID 0

Advantages	Disadvantages
Implements a striped disk array, the data is broken down into blocks and each block is written to a separate disk drive I/O performance is greatly improved by spreading the I/O load across many channels and drives No parity calculation overhead is involved	Not a true RAID because it is not fault-tolerant The failure of just one drive will result in all data in an array being lost Should not be used in mission critical environments

Recommended Applications for RAID 0

- Image Editing
- Pre-Press Applications
- Any application requiring high bandwidth

RAID 1

Advantages	Disadvantages
Simplest RAID storage subsystem design Can increase read performance by processing data requests in parallel since the same data resides on two different drives	High disk overhead - uses only 50% of total capacity

Recommended Applications for RAID 1

- Accounting
- Payroll
- Financial
- Any application requiring very high availability

RAID 3

Advantages	Disadvantages
High Read data transfer rate Disk failure has an insignificant impact on throughput	Parity drive can become bottleneck if a lot of data is being written to the array

Recommended Applications for RAID 3

- Image Editing
- Prepress Applications
- Any application requiring high throughput

RAID 5

Characteristics/Advantages	Disadvantages
High Read data transaction rate Medium Write data transaction rate Good aggregate transfer rate	Disk failure has a medium impact on throughput

Recommended Applications for RAID 5

- File and Application servers
- WWW, E-mail, and News servers
- Intranet servers
- Most versatile RAID level

RAID 0+1

Characteristics/Advantages	Disadvantages
Implemented as a mirrored array whose segments are RAID 0 arrays High I/O rates are achieved thanks to multiple stripe segments	High disk overhead - uses only 50% of total capacity

Recommended Applications for RAID 0+1

- Imaging applications
- Database servers
- General fileserver

RAID 30

Advantages	Disadvantages
High Read data transfer rate High reliability Supports large volume sizes	Higher disk overhead than RAID 3

Recommended Applications for RAID 30

- Image Editing
- Video streaming
- Any application requiring high availability and high speed

RAID 50

Characteristics/Advantages	Disadvantages
High Read data transaction rate Medium Write data transaction rate Good aggregate transfer rate High reliability Supports large volume sizes	Higher disk overhead than RAID 5

Recommended Applications for RAID 50

- File and Application servers
- Transaction processing
- Office application with many users accessing small files

JBOD

Characteristics/Advantages	Disadvantages
Uses 100% capacity of all hard drives	The failure of one drive will result in all data on that drive being lost Should not be used in mission critical environments

Recommended Applications for JBOD

- File archiving
- General fileserver

Expanding an Array

Expanding an array increases the array capacity without affecting data availability. You can expand an existing array by adding one or more free disk drives to the array using the Expand Array function.

Follow these steps to add a disk drive to the UltraTrak enclosure:

1. Ensure that the UltraTrak power is off.
2. Install the disk drives into the UltraTrak and lock the Drive Carrier lever.
3. Switch the power on and wait about one minute for the UltraTrak to initialize.

When the new disk drive is already installed in the UltraTrak cabinet, follow these steps to add the drive to an existing array:

1. Press the **SEL** button on the front panel.
2. Press ▼ button once to select **Configuration**, then press **SEL**.
3. Enter the password at the prompt (see Enter Password on page 15).
4. At **Configure Array**, press **SEL**.
5. Press ▼ button a few times to select **Expand Array** then press **SEL**.
6. At **Source Array ID**, press **SEL**.
   Choose the array you wish to expand and press **SEL**.
7. Press the ▼ button to select **Add New Drives** then press **SEL**.
   Choose the drive you wish to add then pres **SEL**.
8. Press the ▼ button twice to select **Save Changes** then press **SEL**.

RAID Conversion

Existing arrays can be converted to a different RAID level of equal or greater capacity to add flexibility, redundancy or for tuning an array for a different storage application. UltraTrak supports the following conversions:

From	To	Comments
RAID 50	RAID 30	Retains the same capacity but allows parity to be written to separate drives.
	RAID 5	Some reduction in performance, lower disk overhead.
	RAID 3	Some reduction in performance, lower disk overhead.
	RAID 0+1	Full redundancy instead of parity. 8 drives required.
	RAID 0	Increases capacity and performance but loses data redundancy.
RAID 30	RAID 50	Retains the same capacity but stripes parity all drives.
	RAID 5	Some reduction in performance, lower disk overhead.
	RAID 3	Some reduction in performance, lower disk overhead.
	RAID 0+1	Full redundancy instead of parity. 8 drives required.
	RAID 0	Increases capacity and performance but loses data redundancy.
RAID 5	RAID 50	Increases performance. 6 or 8 drives required.
	RAID 30	
	RAID 3	Retains the same capacity but allows parity to be written to only one drive.
	RAID 0+1	Full redundancy instead of parity. 4, 6 or 8 drives required.
	RAID 0	Increases the capacity and performance but loses the data redundancy.
RAID 3	RAID 50	Increases performance. 6 or 8 drives required.
	RAID 30	
	RAID 5	Retains the same capacity but stripes parity all drives.
	RAID 0+1	Full redundancy instead of parity. 4, 6 or 8 drives required.
	RAID 0	Increases capacity and performance but loses data redundancy.

From	To	Comments
RAID 1	RAID 50	Increases performance. 6 or 8 drives required.
	RAID 30	
	RAID 5	Adds performance, capacity and redundancy. 3 or more drives required.
	RAID 3	
	RAID 0+1	Adds performance and capacity. 4, 6 or 8 drives required.
	RAID 0	Increases capacity and performance but loses data redundancy.
RAID 0	RAID 50	Increases performance. 6 or 8 drives required
	RAID 30	
	RAID 5	Adds performance, capacity and redundancy. 3 or more drives required.
	RAID 3	
	RAID 0+1	Adds performance and capacity. 4, 6 or 8 drives required.
	RAID 1	Halves capacity but adds data redundancy. 2 drives required. Only single-drive arrays can be converted to RAID 1.

Important

- The Target array may require more disk drives than the Source array.
- If the Target array requires an even number of disk drives but the Source array has an odd number, add a disk drive as part of the conversion process.
- You cannot reduce the number of disk drives in your array, even if the Target array requires fewer disk drives than the Source array.

Note

RAID 1 (mirroring) works with two drives only. Only a single-drive RAID 0 or single-drive JBOD array can be converted to RAID 1. Other RAID Levels use too many drives.

You may need to add one or more drives to the array before you can perform a conversion. To add drives, see Expanding an Array, above.

Do the following steps to convert an array:

1. Press the **SEL** button on the front panel.
2. Press ▼ button once to select **Configuration**, then press **SEL**.
3. Enter the password at the prompt (see Enter Password on page 15).
4. At **Configure Array**, press **SEL**.
5. Press ▼ button a few times to select **RAID Conversion** then press **SEL**.
6. At **Source Array ID**, press **SEL**.
   Choose the array you wish to convert and press **SEL**.
7. Press the ▼ button to select **Target RAID Level** then press **SEL**.
   Choose the RAID level you wish to convert to, then pres **SEL**.
8. Press the ▼ button three times to select **Save Changes** then press **SEL**.

Hot Spare Drive(s)

A good precaution to protecting your array integrity in the event of drive failure is maintaining a hot spare drive. A hot spare is a drive that is connected to the array system, but is not assigned as a member of the array. In the event of the failure of a drive within a functioning fault tolerant array, the hot spare is activated as a member of the array. The spare drive effectively takes the place of the failed drive and the RAID system immediately begins to rebuild data on the drive. When the rebuild is complete, the array is returned to fault tolerant status. Once the failed drive is replaced, the new drive is automatically recognized as a hot spare in the event of a subsequent drive fault.

Partition and Format the Array

Like any other type of fixed disk media in your system, a RAID array must also be partitioned and formatted before use. Use the same method of partitioning and formatting on an array as you would any other fixed disk drive.

Depending on the operating system you use, there may or may not be various capacity limitations applicable for the different types of partitions.

Chapter 3: Array Maintenance

Drive Status Indicators

As shown in the figure below, each drive has three status LEDs.

Figure 12. Location of Drive Status Indicators (SX4000 shown)

Meaning of Status Indicators

Indicator	Color	Meaning
Power	Off	No disk drive power – power off or no disk installed.
	Green	Disk power on.
Status	Green	Normal
	Amber	Data is being rebuilt to this drive
	Red	Failed
Disk	Off	No drive installed or the drive has failed
	Green	This will blink on and off to indicate disk activity

Note

See Chapter 4 for a discussion of the Front Panel Interface.

Critical & Offline Arrays

A fault tolerant array goes “critical” when a drive is removed or fails. Due to the fault tolerance of the array, the data is still available and online. However, once the array goes critical, the array has lost its fault tolerance, and performance may be adversely affected. If the fault was caused by a drive that was removed, the drive should be replaced by another drive, either identical or larger, in order for the RAID system to rebuild and restore optimal configuration.

A non-fault tolerant array goes “offline” when a drive is removed or fails. Since the array is not fault tolerant, the data stored in the array is no longer accessible. If the drive was removed, then it should be replaced to restore accessibility to the array. If the drive failed, then the entire array must be deleted and re-initialized since all data is considered lost.

Rebuilding/Synchronizing Fault Tolerant Arrays

Though a critical array can continue storage operations, it no longer offers fault tolerance and should be addressed as soon as possible by replacing the missing or failed drive(s).

Rebuild takes a replacement drive, assigns it to the array, and then writes the redundancy data to it. Once the rebuild process is complete, the array status is upgraded from “critical” to “functional” and fault tolerance is restored.

Synchronization is a preventative maintenance measure used to avoid problems with data integrity. Synchronizing simply recalculates redundant data (similar to the rebuild process) and matches the data on the drive(s).

To synchronize the array, go to the **Configuration** menu and select **Configure Array**; then select **Advance Features** and choose **Synchronize Array**.

When a Disk Drive Fails

The UltraTrak provides both audible and visual indicators alerting you of a drive failure. The following occur when a disk drive fails or goes offline:

- Continuously produces short beeps every two seconds when a drive fails.
- Continuously produces long beeps every 15 seconds when a drive is offline.
- The Status LED on the front panel is yellow.
- The disk drive Status LED (inside front panel door) is red.
- The LCD displays a status message about the failure.

A fault tolerant array goes “offline” when two disk drives fail or are removed. It will also go “offline” when it encounters a bad sector on a disk drive while rebuilding (see page 58). The data stored in the array is intact but it is no longer accessible. At this point, you must determine the cause of the problem and take corrective action. Once the array is restored to “critical” condition, you can access your data. When restored to “functional” condition, fault tolerance is restored.

Replacing a Disk Drive Module

UltraTrak disk drive modules should not be removed unless it has been determined that a drive in the array has failed.

Generally, a disk drive that is a member of a fault tolerant array may be replaced at any time without affecting the availability of data to the system. Depending on the RAID type, drive removed, and type of access, performance may be reduced until the drive is replaced.

Disk drives may be replaced while UltraTrak is running; special circuitry is designed into the UltraTrak that protects the components and notifies the processor.

Only a failed drive should be removed from the array. Removing any other drive may cause the array to become unavailable. The replacement drive must be of equal capacity or larger than the failed drive.

In arrays where a hot spare is already installed, the hot spare automatically replaces the failed drive. When the failed drive is replaced, the new drive becomes the new hot spare.

Reconstruction begins automatically as soon as a replacement drive becomes available to the array. However, if the replacement drive was formerly part of another array, then the previous array information must be deleted (from the replacement drive – see page 50, “Delete Array”, for more details) before reconstruction begins.

Warning

The electronic components within the UltraTrak disk array are sensitive to damage from ESD (Electro-Static Discharge). Appropriate precautions should be observed at all times when handling the array or its subassemblies.

Drive Replacement

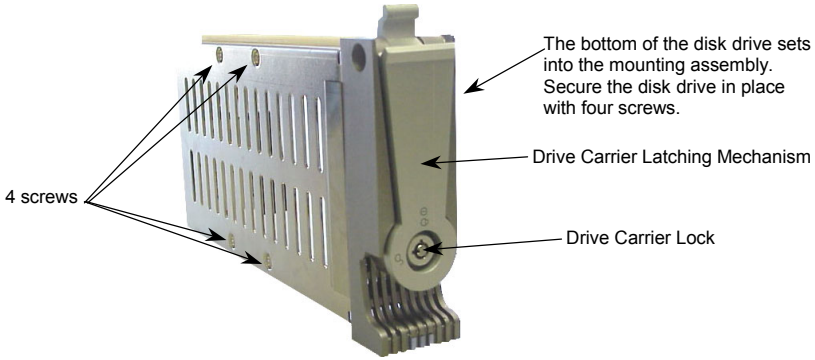


Figure 13. Drive Carrier

Caution

Do not replace the bad drive while reconstruction of the hot spare drive is in progress. Wait until the System LED and all the drive LEDs (except the failed drive) are green before replacing the failed drive.

Do the following to replace an ATA hard drive:

1. Open the Front Panel Door on the UltraTrak.
2. Remove the hard drive you wish to replace from the UltraTrak by unlocking the Drive Carrier lock and sliding out the Drive Carrier.
3. Unplug the power cable and the ATA data cable from the old hard drive.
4. Remove the four screws that secure the hard drive to the Drive Carrier and remove the old hard drive from the Drive Carrier.
5. Prepare to install the new hard drive by ensuring that the jumpers on the new hard drive are set for single or master operation. Consult the drive manual for the proper settings.
6. Attach the Drive Carrier power cable to the new hard drive.
7. Attach the Drive Carrier ATA data cable to the new hard drive.
8. Lower the new hard drive into the Drive Carrier so that the screw holes on the bottom line up.
9. Insert screws through the holes in the Drive Carrier and into the bottom of the new hard drive. Tighten each screw; be careful not to over tighten.
10. Slide the assembled Drive Carrier back into the UltraTrak and lock the Drive Carrier lock.

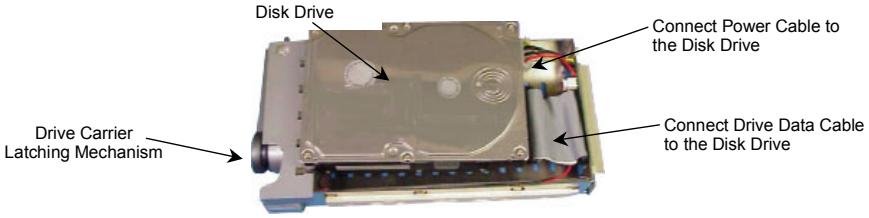


Figure 14. Connecting Cables to Disk Drive

Warning

Only qualified service personnel should remove and replace a power supply module.

Replacing a Power Supply Module (–*8000 series only*)

The UltraTrak SX8000 and RM8000 disk array contains two hot-swappable redundant power supplies. Normally, these supplies share the load between them. However each power supply is capable of providing the power needed to maintain the array's normal operation. Each power supply LED should be on. An off or blinking LED on the power supply indicates that the power supply has failed and should be replaced. A power supply failure is also accompanied by an audible alarm.

Note

Press the Power Supply Alarm Reset button to turn off the alarm. See Figure 15.

Contact your dealer or reseller for additional details and assistance in obtaining a replacement supply.

These power supplies are accessible from the rear of the unit (see Figure 15 on the next page). The power supply may be removed and replaced with an identical power supply while the array remains in operation. To protect the electronic circuits, special sensing circuitry is incorporated into the design of the UltraTrak 8000 series disk array that detects the insertion or removal of a power supply.

Only trained and qualified personnel should remove the power supplies from the UltraTrak units.

1. Switch the failed power supply OFF.
2. Remove the power supply locking screw.
3. Using the pull handle on the power supply pull it from the chassis.
4. Insert the new power supply into the chassis and switch the power supply power ON.
5. Check that the Power LED indicator is illuminated.
6. Insert and tighten the power supply locking screw.

Warning

Risk of electrical shock. When either power supply module is removed from the chassis, AC power is accessible at the circuitry in the power supply chassis. Only trained and qualified personnel should remove the power supplies.

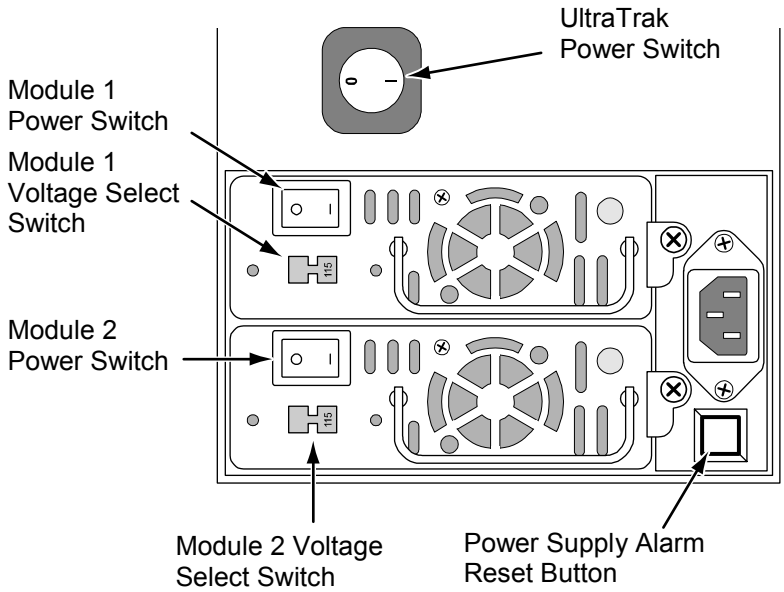
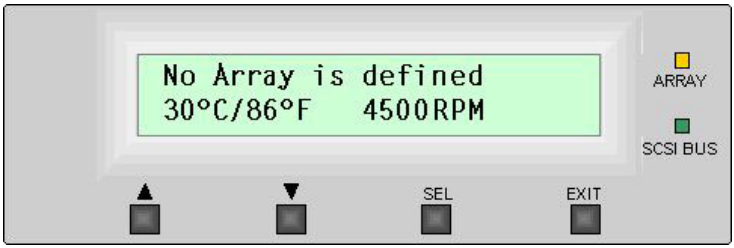


Figure 15. Back of UltraTrak SX8000 showing the Power Supplies (RM8000 is similar).

Chapter 4: Front Panel Interface

The front panel interface for the UltraTrak consist of following items:

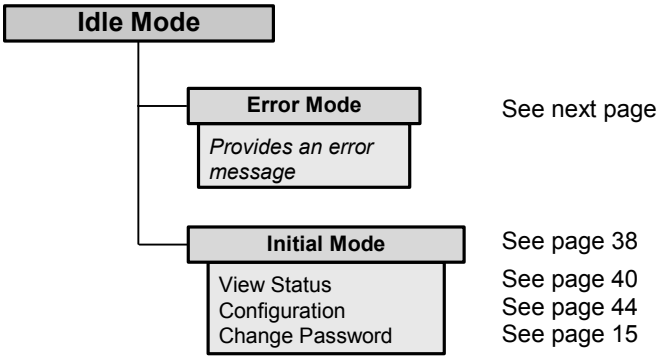


Type of Interface	Name	Comments
LED Indicators	Power	Power Indicator
	Status	Activity Indicator Green Enclosure functioning normally. Amber An array is critical, a power supply has failed, or a fan has failed. Red An array is offline or the enclosure is too hot.
	SCSI Bus	Activity Indicator blinks to indicate activity on the SCSI bus.
Liquid Crystal Display	Message Display Panel	This is a 24-character by 2-row LCD that displays various setup, status, and error messages.
Control Buttons	▲	Pressing this button scrolls any available messages up through the LCD and activates a message for the Select button.
	▼	Pressing this button scrolls any available messages down through the LCD and activates a message for the Select button.
	SEL	Pressing this button selects the LCD's active message.
	EXIT	Pressing this button exits the active message display to the previous level.

The LCD Messages

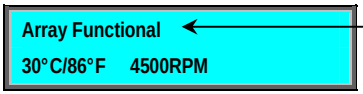
The UltraTrak LCD message display panel has the following modes of operation:

- Idle mode
- Error mode
- Initial mode



Idle Mode

The Idle mode message, such as shown below, is displayed during normal operation of the UltraTrak when there are no problems or buttons being pressed:



Array status may be:

- Array Functional
- Array Critical
- Array Offline
- No array is defined

What you can do:

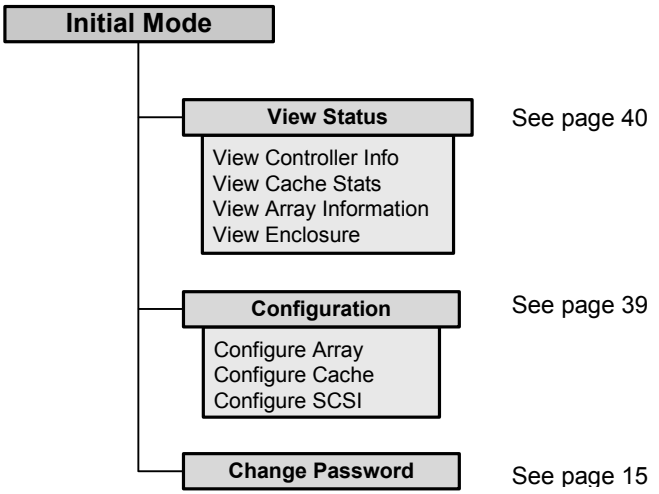
Press **SEL**:	Press to enter **Initial** mode menu.
Press ▲:	Press to enter **Initial** mode menu.
Press ▼:	Press to enter **Initial** mode menu.
Press **EXIT**:	Do nothing.

The first line of the Idle mode menu will display one of the following status messages:

Array Functional	The array is fully operational, and no problems are present.
Array Critical	The array is operational, but has lost its fault tolerance. For RAID array levels 1, 0+1, 3, 5, 30, and 50 the array contains a failed drive. The user should identify and replace the failed drive.
Array Offline	The array is no longer operational. The array must be rebuilt from the last tape backup or other device. For RAID levels 1, 0+1, 3, 5, 30, and 50 at least two or more drives in the array have failed. For a RAID 0 array, at least one drive has failed. The user should identify and replace the failed drives.
No array is defined	An array has not been defined. The user should define an array for the UltraTrak to be functional.

The second line of the Idle mode menu can also provide the following error information:

Fan Error	Fan speed is <2000RPM or >5500RPM
Array Rebuilding xx%	At least one array is rebuilding
Array Synchronizing xx%	At least one array is synchronizing



Initial Mode Menu

You may select one of the following functions from the Initial mode menu:

Press ▲ or ▼ to move these items on the LCD.

What you can do:

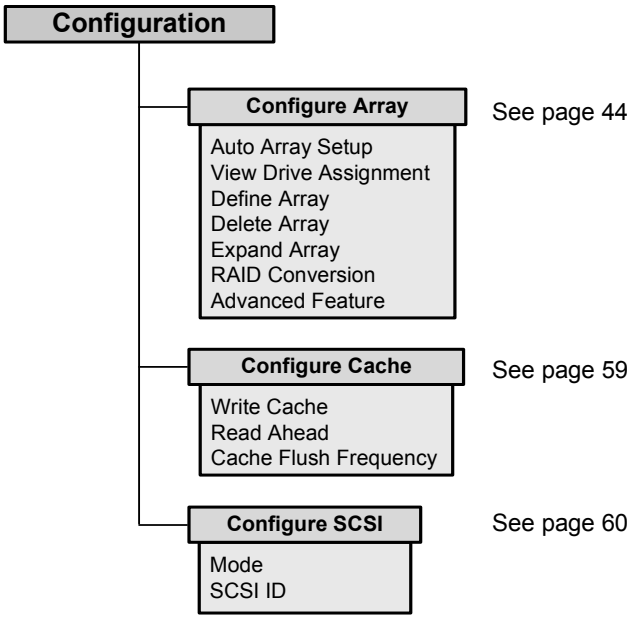
Press **SEL**: Selects one of the following active functions:

View Status	Moves the display to the **View Status** menu.
Configuration	Moves the display to the **Please Enter Password** menu and then to the **Configure Array** menu.
Change Password	Moves the display to the **Change Password** menu.

Press ▲: Moves the active message line up. (Active is marked by *.)

Press ▼: Moves the active message line down. (Active is marked by *.)

Press **EXIT**: Returns to the **Idle** mode.



Configuration Menu

You enter the Configuration mode after entering the correct password. In Configuration mode you may view the status of the UltraTrak system and configure both UltraTrak hardware and arrays. The main configuration menu allows the user to select the following menus:

Configure SCSI

Press ▲ or ▼ to move these items on the LCD.

What you can do:

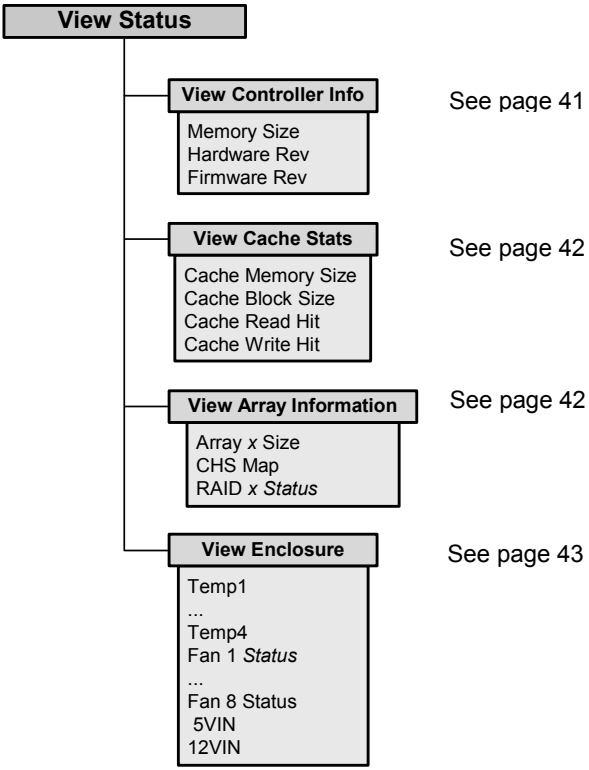
Press **SEL**: Selects one of the following active functions:

Configure Array	Moves the display to the **Configure Array** menu.
Configure Cache	Moves the display to the **Configure Cache** menu.
Configure SCSI	Moves the display to the **Configure SCSI** menu.

Press ▲: Moves the active message line up. (*Active is marked by *.*)

Press ▼: Moves the active message line down. (*Active is marked by *.*)

Press **EXIT**: Returns to the **Idle** mode.


View Status
View Controller Info
Memory Size
Hardware Rev
Firmware Rev
See page 41
View Cache Stats
Cache Memory Size
Cache Block Size
Cache Read Hit
Cache Write Hit
See page 42
View Array Information
Array x Size
CHS Map
RAID x Status
See page 42
View Enclosure
Temp1
...
Temp4
Fan 1 Status
...
Fan 8 Status
5VIN
12VIN
See page 43

View Status Menu

The View Status menu allows the user to select the information he wishes to view with the following menu:

View Array Information
View Enclosure

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

View Controller Info.	Moves the display to the **View Controller Info** menu.
View Cache Stats	Moves the display to the **View Cache Stats** menu.
View Array Information	Moves the display to the **View Array Information** menu.
View Enclosure	Moves the display to the **View Enclosure** menu.

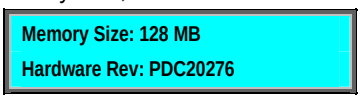
Press ▲: Moves the active message line up. (*Active is marked by **.)

Press ▼: Moves the active message line down. (*Active is marked by **.)

Press **EXIT**: Returns to the **Configuration** mode.

View Controller Information

The View Controller Information mode displays UltraTrak firmware revision, memory size, and hardware revision:



Where the values shown are simply examples.

Firmware Rev: 1.0.0.15

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Does nothing.

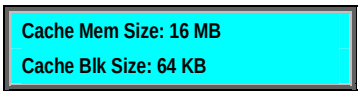
Press ▲: Moves the active message line up.

Press ▼: Moves the active message line down.

Press **EXIT**: Returns to the **Configuration** mode.

View Cache Stats

The View Cache Stats mode displays the cache memory size, cache block size, the cache read hit percentage rate and the cache write hit percentage rate.



Where the values shown are simply examples.

Cache Read Hit : 10%
Cache Write Hit : 15%

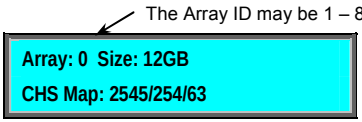
Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**:	Does nothing.
Press ▲:	Moves the active message line up.
Press ▼:	Moves the active message line down.
Press **EXIT**:	Returns to the **Configuration** mode.

View Array Information

The View Array Information mode displays the array ID, array size, RAID level and array status (Functional, Critical, Offline, Rebuilding and Synchronizing). If these modes of display require more than 2 lines to display information the up and down keys will be used to scroll the display.



Where the values shown are simply examples.

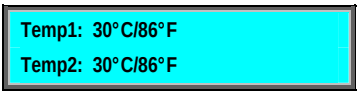
RAID 0	Functional – Array is Functioning properly
RAID 1	Critical – The array is in a degraded mode
RAID 3	Rebuilding *x*% – Array is rebuilding – *x*% done
RAID 5	Offline – Array is down
RAID 30	Synchronizing *x*% – Array is synchronizing – *x*% done
RAID 50	
RAID 0+1	
JBOD	

What you can do:

Press **SEL**:	Does nothing.
Press ▲:	Moves the active message line up.
Press ▼:	Moves the active message line down.
Press **EXIT**:	Returns to the **View Status** mode.

View Enclosure

The View Enclosure menu displays the following information:



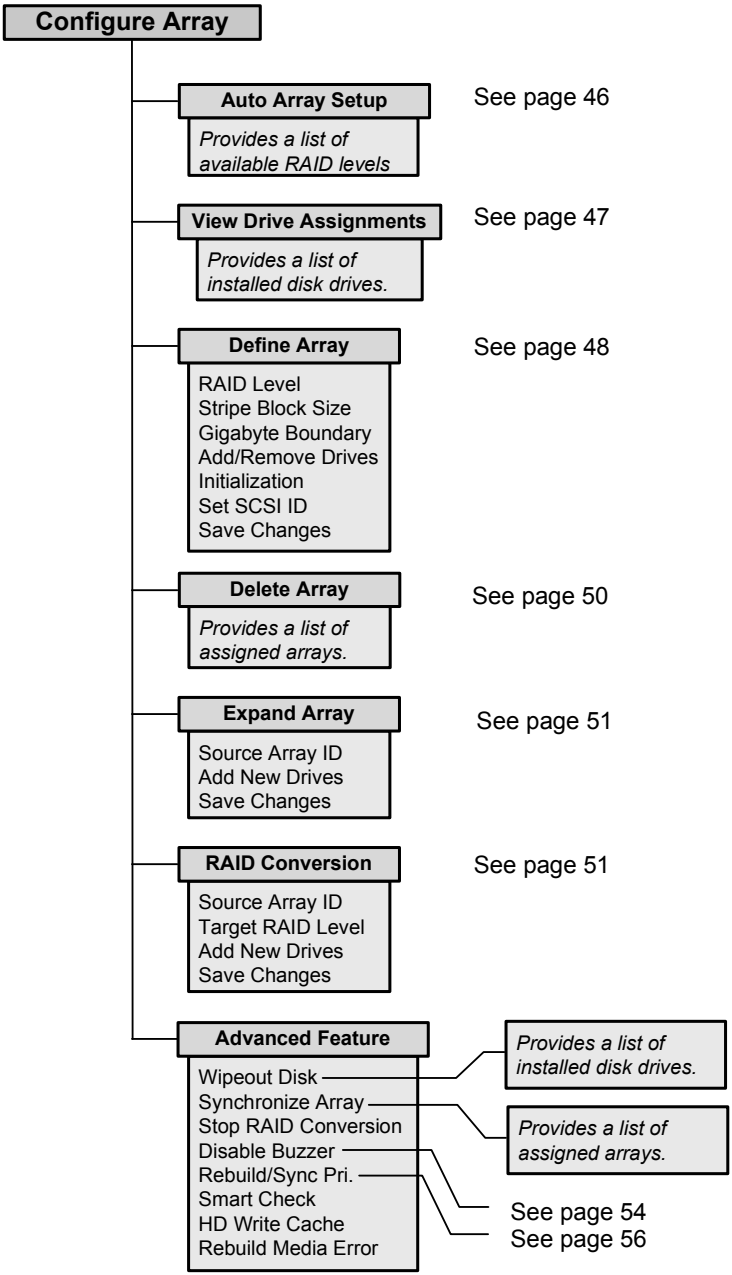
Where the values shown are simply examples.

Temp3: 30°C/86°F
FAN 1 : 4782 RPM
… …
FAN 8 : 4983 RPM
5VIN: 5.07V
12VIN: 12.02V

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**:	Does nothing.
Press ▲:	Moves the active message line up.
Press ▼:	Moves the active message line down.
Press **EXIT**:	Returns to the **Configuration** mode.


Configure Array
Auto Array Setup
Provides a list of available RAID levels
See page 46
View Drive Assignments
Provides a list of installed disk drives.
See page 47
Define Array
RAID Level
Stripe Block Size
Gigabyte Boundary
Add/Remove Drives
Initialization
Set SCSI ID
Save Changes
See page 48
Delete Array
Provides a list of assigned arrays.
See page 50
Expand Array
Source Array ID
Add New Drives
Save Changes
See page 51
RAID Conversion
Source Array ID
Target RAID Level
Add New Drives
Save Changes
See page 51
Advanced Feature
Wipeout Disk
Synchronize Array
Stop RAID Conversion
Disable Buzzer
Rebuild/Sync Pri.
Smart Check
HD Write Cache
Rebuild Media Error
Provides a list of installed disk drives.
Provides a list of assigned arrays.
See page 54
See page 56

Configure Array

The Configure Array menu will allow the creation and deletion of arrays. The configure array menu contains the following sub menus:

Define Array
Delete Array
Expand Array
RAID Conversion
Advanced Feature

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

Auto Array Setup	Moves the display to the **Auto Array Setup** menu. Pressing **SEL** goes to the **RAID Level** menu; press **SEL** again to get to the **Auto Array Setup** menu.
View Drive Assignments	Moves the display to the **View Drive Assignments** menu.
Define Array	Moves the display to the **Define Array** menu.
Delete Array	Moves the display to the **Delete Array** menu.
Expand Array	Moves the display to the **Expand Array** menu.
RAID Conversion	Moves the display to the **RAID Conversion** menu.
Advanced Feature	Moves the display to the **Advanced Feature** menu.

Press ▲: Moves the active message line up.

Press ▼: Moves the active message line down.

Press **EXIT**: Returns to the **Configuration** mode.

Auto Array Setup Function

The Auto Array Setup function provides a list of the available RAID levels. Select the RAID level that you wish to configure your array with.

Only the available RAID levels are displayed.

RAID 3
RAID 5
RAID 30
RAID 50
JBOD

What you can do:

Press **SEL**:	Pressing **SEL** will create the array with the selected RAID level. (See next display.)
Press ▲:	Moves the active message line up.
Press ▼:	Moves the active message line down.
Press **EXIT**:	Press **EXIT** to cancel this function and return to the **Configure Array** menu.

You will see the following choice after you have selected a RAID level:

What you can do:

Press **SEL**:	Pressing **SEL** will create the array. Cycle the UltraTrak power switch when told “Please restart UTRAK.”
Press ▲:	Does nothing.
Press ▼:	Does nothing.
Press **EXIT**:	Press **EXIT** to cancel this function and return to the **Configure Array** menu.

You will see the following message if all of the drives are already configured:

What you can do:

Press **SEL**:	Pressing **SEL** will save the array.
Press ▲:	Does nothing.
Press ▼:	Does nothing.
Press **EXIT**:	Press **EXIT** to cancel this function and return to the **Configure Array** menu.

View Drive Assignments

The View Drive Assignments mode lists each installed drive by model and identifies its array ID or that it is free (if it is not assigned to an array). Each drive is displayed on one line.

Where the values shown are simply examples.

3 MAXTOR Asgn In Ary 3
4 VENDOR-U Free

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**:	Does nothing.
Press ▲:	Moves the active message line up.
Press ▼:	Moves the active message line down.
Press **EXIT**:	Returns to the **Configure Array** menu.

Define Array

The Define Array menu defines array parameters for the selected array. An array number is selected by using the up/down key to select the array number field. The **SEL** key is then used to select array number 1-4.

The parameter to be configured, RAID Level or Stripe Block size, is then selected with up/down keys. Once the parameter is selected, the value is selected with the up/down keys and then set by hitting the **SEL** key. If the **Exit** key is hit instead of the **SEL** key the parameter value is not modified and the user may then select a different parameter.

← *Stripe Block Size setting is not available in RAID 1.*

Gigabyte Boundary ON
Add/Remove Drives
Initialization ON
Save Changes

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

RAID Level	Moves the display to the **RAID Level** menu.
Stripe Block Size	Moves the display to the **Stripe Block Size** menu.
Gigabyte Boundary ON	Toggles between **ON** and **OFF**.
Add/Remove Drives	Moves the display to the **Add/Remove Drives** menu.
Initialization ON	Toggles between **ON** and **OFF**.
Set SCSI ID	Choose a SCSI ID number from 0 to 15.
Save Changes	Moves the display to the **Save Changes** menu.

Press ▲: Moves the active message line up. (*Active is marked by *.*)

Press ▼: Moves the active message line down. (*Active is marked by *.*)

Press **EXIT**: Returns to the **Configure Array** menu.

You will see the following message if the array is already defined:

What you can do:

Press **SEL**: Pressing **SEL** will save the array.

Press ▲: Does nothing.

Press ▼: Does nothing.

Press **EXIT**: Press EXIT to cancel this function and return to the **Configure Array** menu.

Stripe Block Size

The Stripe Block Size menu allows you to select a Stripe Block Size between 4KB and 64KB:

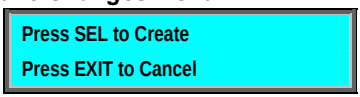
16KB
32KB
64KB

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**:	Selects one of the active Stripe Block Size:
Press ▲:	Moves the active message line up. (*Active is marked by **.)
Press ▼:	Moves the active message line down. (*Active is marked by **.)
Press **EXIT**:	Returns to the **Define Array** menu.

Save Changes Menu

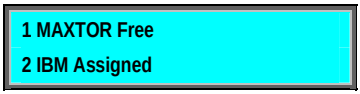


What you can do:

Press **SEL**:	Pressing **SEL** will create the array.
Press ▲:	Does nothing.
Press ▼:	Does nothing.
Press **EXIT**:	Press **EXIT** to cancel this function and return to the **Configure Array** menu.

Add/Remove Drives

The Add/Remove Drives menu assigns and removes drives from arrays. All free drives are displayed as one drive per line format. The **SEL** key toggles the drive between free and assigned. Assigned drives are designated by the word Assigned and free drives are designated by the word Free.



Where the values shown are simply examples.

3 MAXTOR Free
4 IBM Free

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Toggles the selected drive between **Free** and **Assigned**.

Press ▲: Moves the active message line up.

Press ▼: Moves the active message line down.

Press **EXIT**: Returns to the **Define Array** menu.

Delete Array

The Delete Array menu allows the user to select an array and delete the configuration information for that array. This will also free any drives that have been assigned to that array.

Only existing Array IDs are Displayed.

Array ID: 3
Array ID: 4

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Displays a **Delete Array** confirmation message.

Press ▲: Moves the active message line up. (*Active is marked by *.*)

Press ▼: Moves the active message line down. (*Active is marked by *.*)

Press **EXIT**: Returns to the **Configure Array** menu.

Expand Array

The Expand Array menu allows the user to add free drives to an existing array – thus increasing the storage capacity of the array.

Save Changes

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

Source Array ID	Moves the display to the **Source Array ID** menu.
Add New Drives	Moves the display to the **Add New Drives** menu.
Save Changes	Moves the display to the **Save Changes** menu.

Press ▲: Moves the active message line up. (Active is marked by *.)

Press ▼: Moves the active message line down. (Active is marked by *.)

Press **EXIT**: Returns to the **Configure Array** menu.

RAID Conversion

The RAID Conversion menu allows the user to convert an existing array to a different RAID level.

Add New Drives
Save Changes

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

Source Array ID	Moves the display to the **Source Array ID** menu.
Target RAID Level	Moves the display to the **Target RAID Level** menu.
Add New Drives	Moves the display to the **Add New Drives** menu.
Save Changes	Moves the display to the **Save Changes** menu.

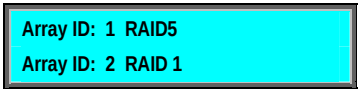
Press ▲: Moves the active message line up. (Active is marked by *.)

Press ▼: Moves the active message line down. (Active is marked by *.)

Press **EXIT**: Returns to the **Configure Array** menu.

Source Array ID

The Source Array ID menu lists the defined arrays and their current RAID level. Select array you wish to modify.



Only existing Array IDs are Displayed.

Array ID: 3 ... ...
Array ID: 4 ... ...

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Pressing **SEL** will choose the active array.

Press ▲: Moves the active message line up. (Active is marked by *.)

Press ▼: Moves the active message line down. (Active is marked by *.)

Press **EXIT**: Returns to the previous menu.

Add New Drives

The Add New Drives menu lists the available free drives. Select the drives you wish to add.

Only free drives are Displayed.

7 IBM Free

8 IBM Free

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Pressing **SEL** will choose the active drive.

Press ▲: Moves the active message line up. (Active is marked by *.)

Press ▼: Moves the active message line down. (Active is marked by *.)

Press **EXIT**: Returns to the previous menu.

Target RAID Level

The Target RAID Level menu lists the available RAID levels that you may convert your existing array to.

Only available RAID Levels are Displayed.

Press ▲ or ▼ to move these items on the LCD.

RAID 3
RAID 5
RAID 0+1
JBOD

What you can do:

Press **SEL**:	Pressing **SEL** will choose the active RAID level.
Press ▲:	Moves the active message line up. (Active is marked by *.)
Press ▼:	Moves the active message line down. (Active is marked by *.)
Press **EXIT**:	Returns to the previous menu.

Advanced Feature

Wipe out disk
Synchronize Array
Stop RAID Conversion
Disable Buzzer
Rebuild/Sync Pri.
Smart Check Enabled
HD Write Cache Enabled
Rebuild Media Err Abort

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

Wipe out disk	Moves the display to the Wipe out disk menu.
Synchronize Array	Moves the display to the Synchronize Array menu.
Stop RAID Conversion	Press to **SEL** stops a RAID conversion that is in progress. The conversion process will continue when the UltraTrak is restarted.
Disable Buzzer	Pressing **SEL** toggles between **Enable** and **Disable**.
Rebuild/Sync Pri.	Moves the display to the **Rebuild/Sync Pri.** menu.
Smart Check	Pressing **SEL** toggles between **Enabled** and **Disabled**.
HD Write Cache	Pressing **SEL** toggles between **Enabled** and **Disabled**.
Rebuild Media Err	Pressing **SEL** toggles between **Abort** and **Skip**.

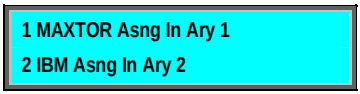
Press ▲: Moves the active message line up. (*Active is marked by **.)

Press ▼: Moves the active message line down. (*Active is marked by **.)

Press **EXIT**: Returns to the **Configure Array** menu.

Wipe Out Disk

The Wipe Out Disk menu allows the user to delete the area on the hard drive that contains array information used exclusively by the UltraTrak controller. It may be necessary to wipe out a disk if the disk was previously a member of an UltraTrak array and you wish to use the disk in a different UltraTrak array. To wipe out a disk, go to the **Configuration** menu and select **Configure Array**; then select **Advance Features** and choose **Wipe Out Disk**.



Where the values shown are simply examples.

3 MAXTOR Asng In Ary 3
4 IBM Asng In Ary 4

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Displays a **Wipe out disk** confirmation message.

Press ▲: Moves the active message line up. (*Active is marked by *.*)

Press ▼: Moves the active message line down. (*Active is marked by *.*)

Press **EXIT**: Returns to the **Advance Feature** menu.

Caution

The **Wipe Out Disk** option will delete all data on the drive that is selected.

Synchronize Array

The Synchronize Array menu allows the user to synchronize the data on each drive. Synchronization is a maintenance procedure for fault tolerant arrays (RAID 1, 0+1, 3, 5, 30, and 50) to maintain data consistency on all drives. To synchronize the array, go to the **Configuration** menu and select **Configure Array**; then select **Advance Features** and choose **Synchronize Array**.

Only existing Array IDs are Displayed.

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Displays a **Synchronize Array** confirmation message.

Press ▲: Moves the active message line up. (*Active is marked by *.*)

Press ▼: Moves the active message line down. (*Active is marked by *.*)

Press **EXIT**: Returns to the **Advance Feature** menu.

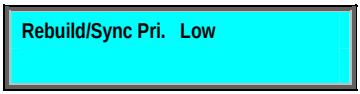
Important

Promise Technology suggests synchronizing an array once a month.

Synchronization is a preventative maintenance measure used to avoid problems with data integrity. Synchronizing simply recalculates redundant data (similar to the rebuild process) and matches the data on the drive(s).

Rebuild/Sync Priority

Assigns the amount of importance that UltraTrak gives to rebuilding/ synchronizing data in the background. A **High** setting assigns most of UltraTrak's resources to the rebuild process at the expense of responding to ongoing read/write data requests by the operating system. A **Low** setting gives priority to ongoing read/ write data requests by the operating system at the expense of the rebuild/ synchronization process and will typically result in longer rebuild/synchronization times. The default setting is **High**. To set the Rebuild/Sync priority, go to the **Configuration** menu and select **Configure Array**; then select **Advance Features** and choose **Rebuild/Sync Pri.**



What you can do:

Press **SEL**: Toggles the **Rebuild/Sync** priority between **High** or **Low**

Press ▲: Does nothing.

Press ▼: Does nothing.

Press **EXIT**: Returns to the **Advance Feature** menu.

Smart Check

SMART is Self-Monitoring Analysis and Reporting Technology, a function of the disk drives that gathers performance information used to predict a pending drive failure. With this option enabled, the Controller will check the status of the disk drives and report any problems**.** Under most conditions, there will be no apparent difference in array performance with Smart Check enabled.

What you can do:

Press **SEL**: Toggles the **Smart Check** between **Enabled** or **Disabled**

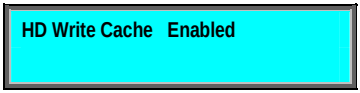
Press ▲: Does nothing.

Press ▼: Does nothing.

Press **EXIT**: Returns to the **Advance Feature** menu.

HD Write Cache

The Write Cache records data at the same time as the hard disk. If the same data is needed right away, it is sent from the cache, rather than reading is from the disk, speeding up read performance.



What you can do:

Press **SEL**: Toggles the **HD Write Cache** between **Enabled** or **Disabled**

Press ▲: Does nothing.

Press ▼: Does nothing.

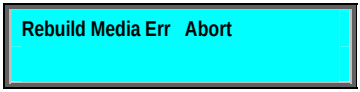
Press **EXIT**: Returns to the **Advance Feature** menu.

Rebuild Media Error

Rebuild Media Error refers to whether the Controller will rebuild an array when it encounters a media error (a bad sector) on one of the disk drives. This event will cause the array to go “offline”.

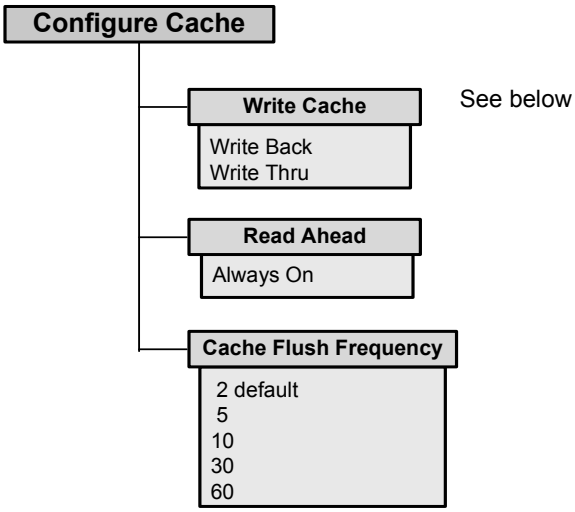
When **Abort** is selected, the Controller will stop a rebuild operation if it encounters a bad sector. You must replace the disk drive with the bad sector to restore array function.

When **Skip** is selected, the Controller will continue rebuilding and work around the bad sector and restore array function with the existing disk drive.



What you can do:

Press **SEL**:	Toggles the **Rebuild Media Err** between **Abort** or **Skip**
Press ▲:	Does nothing.
Press ▼:	Does nothing.
Press **EXIT**:	Returns to the **Advance Feature** menu.



Configure Cache

The Configure Cache menu will allow the setting of cache parameters. The following parameter is set in the Configure Cache menu:

Cache Flush Frequency

What you can do:

Press **SEL**: Selects one of the following active functions:

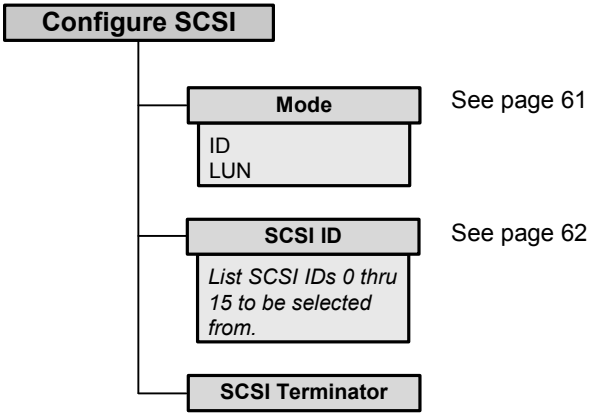
Write Cache	Toggles between **Write Thru** and **Write Back**.
Cache Flush Frequency	Moves the display to the **Cache Flush Frequency** menu.

Press ▲: Moves the active message line up. (*Active is marked by **.)

Press ▼: Moves the active message line down. (*Active is marked by **.)

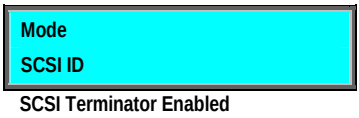
Press **EXIT**: Returns to the **Configuration** menu.

Setting the Write Cache to **Write Back** improves performance, because a write to the high-speed cache is faster than to disk. Data normally written to disk is first written into the UltraTrak's cache, allowing the system CPU to continue with other tasks while the UltraTrak handles writing data from its cache to the array. However, write-back cache data is lost if power fails before the data has been saved to disk. Setting the Write Cache to **Write Thru** forces UltraTrak to immediately save all writes to the drive.



Configure SCSI

The Configure SCSI menu will allow the setting of SCSI parameters. The following parameters are set in the configure SCSI menu:



What you can do:

Press **SEL**: Selects one of the following active functions:

Mode	Move the display to the **Mode** menu.
SCSI ID	Move the display to the **SCSI ID** menu.
SCSI Terminator	Pressing **SEL** toggles between **Enabled** and **Disabled**.

Press ▲: Moves the active message line up. (*Active is marked by **.)

Press ▼: Moves the active message line down. (*Active is marked by **.)

Press **EXIT**: Returns to the **Configuration** menu.

Caution

The SCSI Terminator feature pertains to UltraTraks with *internal* SCSI termination. UltraTraks with *external* SCSI termination do not have this feature and use an externally attached terminator instead. See page 9.

Mode

Select one of the following SCSI ID modes:

Selected toggles between these two when **SEL** is pressed.

What you can do:

Press **SEL**: Selects one of the following active functions:

- **ID** — Select device **ID** mode.
- **LUN** — Select **LUN** (logical unit number) mode.

Press ▲: Moves the active message line up. (*Active is marked by *.*)

Press ▼: Moves the active message line down. (*Active is marked by *.*)

Press **EXIT**: Returns to the **Configure SCSI** menu.

When using **ID** mode, if you have multiple arrays within an UltraTrak unit, each array will use a separate SCSI ID. When using **LUN** mode, each UltraTrak unit will use a single SCSI ID, with the first array being LUN 0, the second array being LUN1, etc. Enable Multiple LUN support in your SCSI adapter if you choose **LUN** mode. In most cases it is preferable to use **ID** mode.

SCSI ID

Select a SCSI ID between 0 and 15:

2
...
15

Press ▲ or ▼ to move these items on the LCD.

What you can do:

Press **SEL**: Selects one of the following active functions:

from a list of numbers between 1 and 15. Selects the **SCSI ID** – The word **Selected** appears next to the selected ID.

Press ▲: Moves the active message line up. (*Active is marked by **.)

Press ▼: Moves the active message line down. (*Active is marked by **.)

Press **EXIT**: Returns to the **Configure SCSI** menu.

Note

If you have multiple arrays and are using **ID** mode, be aware that each array will use a SCSI ID. If, for example, you have created two separate arrays and have selected **SCSI ID** 4, array 1 would have **SCSI ID** 4 and array 2 would have **SCSI ID** 5.

Chapter 5: Support

Contacting Technical Support

Promise Technical Support provides several support options for Promise users to access information and updates. We encourage you to use one of our electronic services, which provide product information updates for the most efficient service and support.

If you decide to contact us, please have the following information available:

- Product model and serial number
- BIOS and driver version numbers
- A description of the problem / situation
- System configuration information, including: motherboard and CPU type, hard drive model(s), ATA/ATAPI drives & devices, and other controllers.

Technical Support Services

Promise Online™ Web Site	http://www.promise.com (tech documents, drivers, utilities, etc.)

USA Tech Support Center

E-mail Support	support@promise.com
Fax Technical Support	(408) 228-6401 Attention: Technical Support
Phone Technical Support	(408) 228-6402 7:30-5:30pm M-F Pacific Standard Time
If you wish to write us for support:	Promise Technology, Inc. Attn: Technical Support 1745 McCandless Drive Milpitas, CA 95035, USA

European Tech Support

E-mail Support	support@promise.nl
Fax Technical Support	+31 (0) 40 256 94 63 Attention: Technical Support
Phone Technical Support	+31 (0) 40 256 94 61 8:30-5:00pm The Netherlands Time
If you wish to write us for support:	Promise Technology Europe B.V. Attn: Technical Support 1European Business Centre, Unit 1.25 Luchthavenweg 81 5657 EA Eindhoven, The Netherlands

Pacific Rim Sales Office

E-mail Support	support@promise.com.tw
Fax Technical Support	+886 3 578 23 90 Attention: Technical Support
Phone Technical Support	+886 3 578 23 95 9:00-6:00pm Taiwan Time
If you wish to write us for support:	Promise Technology, Inc. Attn: Technical Support 2F, No.30, Industry E. Road IX Science-Based Industrial Park Hsin-Chu, Taiwan R.O.C.

China Office

E-mail Support	support-china@promise.com
Fax Technical Support	+86 (0) 10 6872 3940 Attention: Technical Support
Phone Technical Support	+86 (0) 10 6872 3942 9:00-6:00pm China Time
If you wish to write us for support:	Promise Technology China Attn: Technical Support Room 3217, No. 15, Bai Shi Qiao Road Hai Dian District Beijing 100081 P.R. China

Limited Warranty

Promise Technology, Inc. (“Promise”) warrants that for two (2) years from the time of the delivery of the product to the original end user:

a) the product will conform to Promise’s specifications;

b) the product will be free from defects in material and workmanship under normal use and service.

This warranty:

a) applies only to products which are new and in cartons on the date of purchase;

b) is not transferable;

c) is valid only when accompanied by a copy of the original purchase invoice.

This warranty shall not apply to defects resulting from:

a) improper or inadequate maintenance, or unauthorized modification(s), performed by the end user;

b) operation outside the environmental specifications for the product;

c) accident, misuse, negligence, misapplication, abuse, natural or personal disaster, or maintenance by anyone other than a Promise or a Promise-authorized service center.

Disclaimer of other warranties

This warranty covers only parts and labor, and excludes coverage on software items as expressly set above.

Except as expressly set forth above, Promise disclaims any warranties, expressed or implied, by statute or otherwise, regarding the product, including, without limitation, any warranties for fitness for any purpose, quality, merchantability, non-infringement, or otherwise. Promise makes no warranty or representation concerning the suitability of any product for use with any other item. You assume full responsibility for selecting products and for ensuring that the products selected are compatible and appropriate for use with other goods with which they will be used.

Promise does not warrant that any product is free from errors or that it will interface without problems with your computer system. It is your responsibility to back up or otherwise save important data before installing any product and continue to back up your important data regularly.

No other document, statement or representation may be relied on to vary the terms of this limited warranty.

Promise's sole responsibility with respect to any product is to do one of the following:

a) replace the product with a conforming unit of the same or superior product;

b) repair the product;

c) recover the product and refund the purchase price for the product.

Promise shall not be liable for the cost of procuring substitute goods, services, lost profits, unrealized savings, equipment damage, costs of recovering, reprogramming, or reproducing of programs or data stored in or used with the products, or for any other general, special, consequential, indirect, incidental, or punitive damages, whether in contract, tort, or otherwise, notwithstanding the failure of the essential purpose of the foregoing remedy and regardless of whether Promise has been advised of the possibility of such damages. Promise is not an insurer. If you desire insurance against such damage, you must obtain insurance from another party.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, so the above limitation may not apply to you.

This warranty gives specific legal rights, and you may also have other rights that vary from state to state. This limited warranty is governed by the State of California.

Your Responsibilities

You are responsible for determining whether the product is appropriate for your use and will interface with your equipment without malfunction or damage. You are also responsible for backing up your data before installing any product and for regularly backing up your data after installing the product. Promise is not liable for any damage to equipment or data loss resulting from the use of any product.

Returning Product For Repair

If you suspect a product is not working properly, or if you have any questions about your product, contact our Technical Support Staff through one of our Technical Services, making sure to provide the following information:

- Product model and serial number (required)
- Return shipping address
- Daytime phone number
- Description of the problem
- Copy of the original purchase invoice

The technician will assist you in determining whether the product requires repair. If the product needs repair, the Technical Support Department will issue an RMA (Return Merchandise Authorization) number.

Return ONLY the specific product covered by the warranty (do not ship cables, manuals, diskettes, etc.), with a copy of your proof of purchase to:

USA and Canada:	Promise Technology, Inc. Customer Service Dept. Attn.: RMA # _____ 1745 McCandless Drive Milpitas, CA 95035
Other Countries:	Return the product to your dealer or retailer. Contact them for instructions before shipping the product.

You must follow the packaging guidelines for returning products:

Use the original shipping carton and packaging.

- Include a summary of the product's problem(s)
- Write an attention line on the box with the RMA number
- Include a copy of proof of purchase

You are responsible for the cost of insurance and shipment of the product to Promise. Note that damage incurred due to improper transport or packaging is not covered under the Limited Warranty.

When repairing returned product(s), Promise may replace defective parts with new or reconditioned parts, or replace the entire unit with a new or reconditioned unit. In the event of a replacement, the replacement unit will be under warranty for the remainder of the original warranty term from purchase date, or 30 days, whichever is longer.

Promise will pay for standard return shipping charges only. You will be required to pay for any additional shipping options (such as express shipping).

Appendix A: Technical Specifications

Disk Array Features

- Supported RAID Levels:
  - RAID 0 – striping for performance
  - RAID 1 – disk mirroring
  - RAID 0+1 – mirrored stripe set
  - RAID 3 – striped data + dedicated parity
  - RAID 5 – striped data + striped parity
  - RAID 30 – striped data over two RAID 3 arrays + dedicated parity1
  - RAID 50 – striped data over two RAID 5 arrays + striped parity[1]
- Hardware XOR accelerator
- Supports up to four logical drives (SX4000) or eight logical drives (SX/RM8000)
- Supports variable stripe block sizes
- Supports standard ATA drives (Ultra ATA, Ultra DMA)
- Supports Ultra ATA/100, Ultra ATA/66
- Large LBA support for drives above 137GB
- Drive fault detection
- Supports hot-swap of failed drives
- Supports hot-spares[2]
- Offers transparent data recovery and rebuilds drive in background
- BIOS/Driver support for rounding actual drive capacities to nearest gigabyte[3]
- Data handling optimizations include tagged command queuing, elevator seek and load balancing
- Supports adding drives to the array on-the-fly
- Supports changing RAID levels on-the-fly
- Optimized caching algorithm for parity calculations (RAID 3, 5, 30 and 50)
- Remote monitoring of all arrays from network stations
- Local maintenance of arrays with drag-and-drop support
- Monitors enclosure temperature, fan, and power

[1] Applies to SX8000 and RM8000 models only.
[2] Requires standby disk of equal or greater capacity.
[3] Allows for replacing a failed drive with a drive of a slightly less capacity (within 999 MB difference).

Hardware Features

- Dual redundant hot-swap power supplies[4]
- Supports multiple, concurrent data requests from OS
- Ultra SCSI 160 LVD controller

System Requirements

- Ultra SCSI 160 LVD controller

Operating System Support

- Microsoft Windows NT, 2000, XP
- Redhat Linux, SuSE Linux, OpenLinux, TurboLinux
- Netware 4.2, 5.1
- MacOS 9, X

Advanced Utilities

- Auto configuration and optimization
- View/Create/Delete/Expand array
- Rebuilds data on replacement disks

Physical & Environmental

- Size

Model	Height	Width	Depth
SX4000	12.5 in. (320 mm)	7.0 in. (180 mm)	12.9 in. (330 mm)
SX8000	18.5 in. (470 mm)	7.8 in. (200 mm)	12.9 in. (330 mm)
RM8000 (3RU)	5.1 in. (130 mm)	17.5 in. (445 mm)	20.4 in. (518 mm)

- Operating temperature: 32° to 122°F (0° to 50°C)
- Relative humidity: 5% to 90% non-condensing
- Universal (5V and 3.3V) PCI Signaling Environment

[4] Applies to SX8000 and RM8000 models only.

Appendix B: Technology Background

Introduction to RAID

RAID (Redundant Array of Independent Disks) allows multiple hard drives to be combined together to form one large logical drive or “array”. As far as the operating system is concerned, the array represents a single storage device, and treats it as such. The RAID software and/or controller handle all of the individual drives on its own. The benefits of a RAID can include: higher data transfer rates for increased server performance, increased overall storage capacity for a single drive designation (such as, C, D, E, etc.), data redundancy/fault tolerance for ensuring continuous system operation in the event of a hard drive failure.

Different types of arrays use different organizational models and have varying benefits. The following outline breaks down the properties for each type of RAID array:

RAID 0: Striping

When a disk array is striped, the read and write blocks of data are interleaved between the sectors of multiple drives. Performance is increased, since the workload is balanced between drives (or “members”) that form the array. Identical drives are recommended for performance as well as data storage efficiency. The disk array's data capacity is equal to the number of drive members multiplied by the smallest array member’s capacity.

For example, one 100GB and three 120GB drives will form a 400GB (4 x 100GB) disk array instead of 460 GB. The stripe block size value can be set logically from 4KB, 8KB, 16KB, 32KB, and 64KB. This selection will directly affect performance. Larger block sizes are better for random disk access (like email, POS, or web servers), while smaller sizes are better for sequential access.

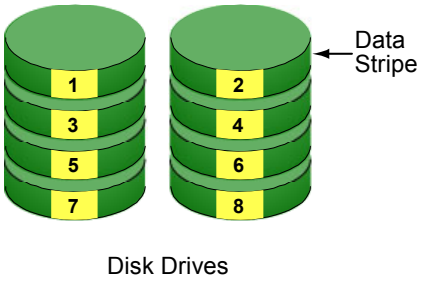


Figure 16. RAID 0 Striping Interleaves Data Across Multiple Drives

RAID 1: Mirroring

When a disk array is mirrored, identical data is written to a pair of drives, while reads are performed in parallel. The reads are performed using elevator seek and load balancing techniques where the workload is distributed in the most efficient manner. Whichever drive is not busy and is positioned closer to the data will be accessed first.

With RAID 1, if one drive fails or has errors, the other mirrored drive continues to function. This is called Fault Tolerance. Moreover, if a spare drive is present, the spare drive will be used as the replacement drive and data will begin to be mirrored to it from the remaining good drive.

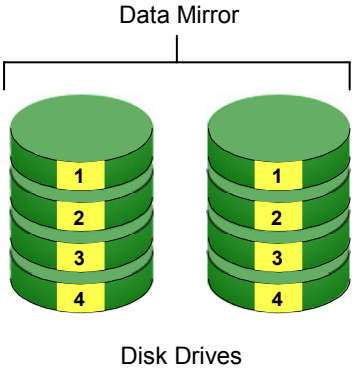


Figure 17. RAID 1 Mirrors Identical Data to Two Drives

Due to the data redundancy of mirroring, the drive capacity of the array is only the size of the smallest drive. For example, two 100GB drives which have a combined capacity of 200GB instead would have 100GB of usable storage when set up in a mirrored array. Similar to RAID 0 striping, if drives of different capacities are used, there will also be unused capacity on the larger drive.

RAID 0+1: Striping/Mirroring

Striping/mirroring combines both of the previous array types. It can increase performance by reading and writing data in parallel while protecting data with duplication. At least four drives are needed for RAID 0+1 to be installed. With a four-drive disk array, drive pairs are striped together with one pair mirroring the first pair. The data capacity is similar to a standard mirroring array, with half of the total storage capacity dedicated for redundancy. An added plus for using RAID 0+1 is that, in many situations, such an array offers double fault tolerance. Double fault tolerance may allow your data array to continue to operate depending on which two drives fail.

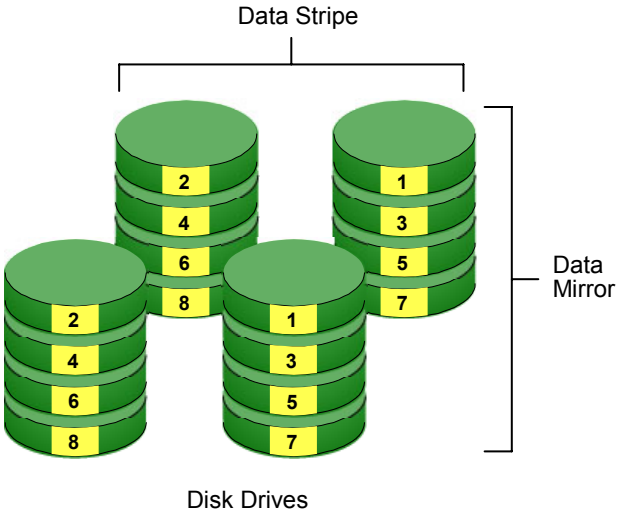


Figure 18. RAID 0+1 Striping and Mirroring of Two Drive Pairs

RAID 3: Block Striping with Parity Drive

RAID level 3 organizes data across the physical drives of the array, and stores parity information on to a drive dedicated to this purpose. This organization allows increased performance by accessing multiple drives simultaneously for each operation, as well as fault tolerance by providing parity data. In the event of a hard drive failure, data can be re-calculated by the RAID system based on the remaining drive data and the parity information.

The adjustable block size of the RAID 3 array allows for performance tuning based on the typical I/O request sizes for your system. The block size must be set at the time it is created and cannot be adjusted dynamically. Generally, RAID Level 3 tends to exhibit lower random write performance due to the heavy workload going to the dedicated parity drive for parity recalculation for each I/O.

The capacity of a RAID 3 array is the smallest drive size multiplied by the number of drives less one. Hence, a RAID 3 array with (4) 100 GB hard drives will have a capacity of 300GB. An array with (2) 120GB hard drives and (1) 100GB hard drive will have a capacity of 200GB.

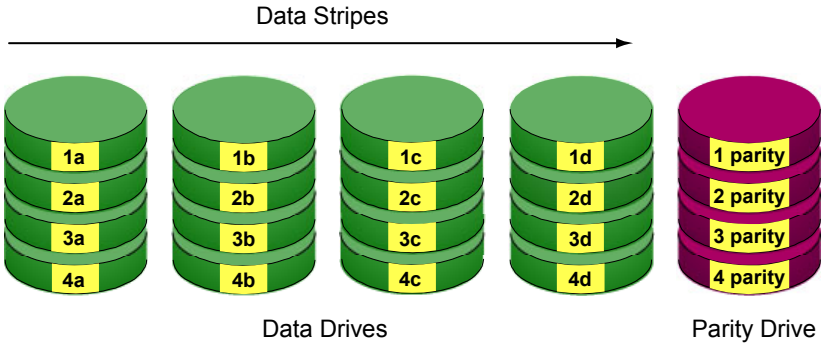


Figure 19. RAID 3 Multiple Drives Stripe Data w/ One Dedicated Parity Drive

RAID 5: Block and Parity Striping

RAID 5 is similar to RAID 3 as described above except that the parity data is rotated across the physical drives along with the block data. Having the parity data striped across all the physical drives in this manner removes the random write performance bottleneck of RAID 3. The total capacity of a RAID 5 array is calculated the same as a RAID 3 array.

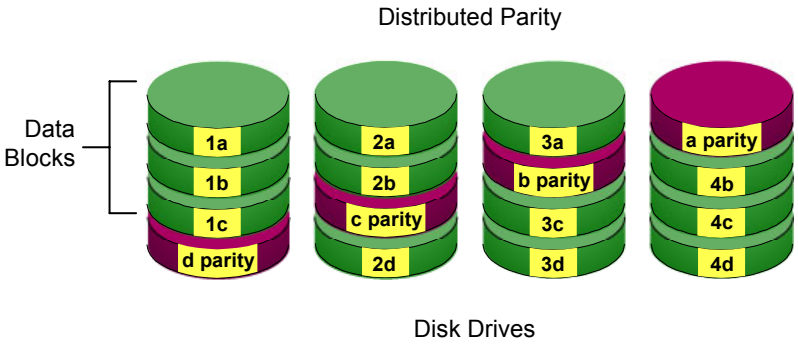


Figure 20. RAID 5 Stripes all Drives with Data and Parity Information

RAID 30: Striping of Dedicated Parity Arrays

RAID 30 combines both RAID 3 and RAID 0 features. Data is striped across disks as in RAID 0, and it uses dedicated parity as in RAID 3. RAID 30 provides high fault tolerance and supports larger volume sizes. RAID 30 also provides high reliability because data is still available even if two physical disk drives fail (one in each array). RAID 30 requires a minimum of six disk drives.

Figure 21. RAID 30 Striping of Dedicated Parity Arrays

RAID 50: Striping of Distributed Parity Arrays

RAID 50 combines both RAID 5 and RAID 0 features. Data is striped across disks as in RAID 0, and it uses distributed parity as in RAID 5. RAID 50 provides data reliability, good overall performance and supports larger volume sizes. RAID 50 also provides high reliability because data is still available even if two physical disk drives fail (one in each array). RAID 50 requires a minimum of six disk drives.

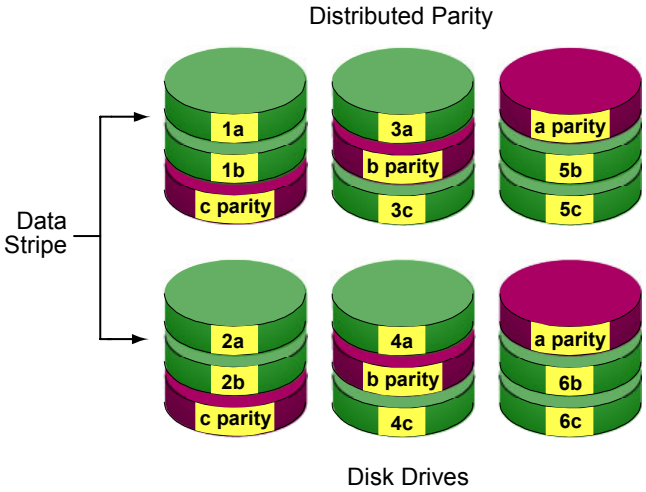


Figure 22. RAID 50 Striping of Distributed Parity Arrays

JBOD: Single Drive

An alternative to RAID, Just a Bunch of Disks (JBOD) capacity is equal to the sum of all drives in the group, even if the drives are of different sizes. JBOD appears in the User Interface as one or more individual drives. There are no performance or fault tolerance features. When a disk fails, all data on the disk is lost. Other disks are unaffected.

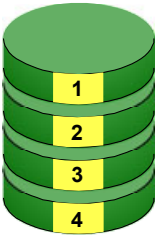


Figure 23. JBOD manages drives Individually, unlike RAID

Appendix C: Frequently Asked Questions

This section lists frequently asked questions involving pre-installation, drive issues, installation, and post-installation.

Q. What kind of hard drives can I use for an UltraTrak array?

A. You can use any Ultra ATA/133/100/66/33 hard drive(s) to create arrays on the UltraTrak. You should use matching drives for multiple-drive arrays to maximize capacity usage as well as performance. (NOTE: Ultra ATA/133 hard drives can be used in the UltraTrak units. However, they will run at Ultra ATA/100 speed)

Q. Can I add a drive to an UltraTrak RAID array via hot-swap and dynamically adjust the array size/configuration?

A. No. The UltraTrak does not support dynamically adjustable RAID size/configurations.

Q. Can I take a set of drives that make up an array created on one UltraTrak and move it to another UltraTrak?

A. Yes. All UltraTrak's read the arrays the same way. Once the drives are all connected, you must restart the system for it to recognize the newly-inserted array configuration.

Q. Can I take a drive used in an UltraTrak array and access it directly with a different controller, such as the one integrated on the motherboard?

A. Yes, but only under certain configurations. The following array configurations will allow the drive(s) to be accessed individually on another controller: mirror (RAID 1), or single drive striped (RAID 0). Multiple drives striped will not work.

Q. How can I be sure that write-back cache has flushed before I reboot after partitioning and formatting an array?

A. A cache flush is always triggered immediately following any write from the int 13h BIOS. This level of array support is what FDISK and FORMAT use to access the drive from MSDOS. With no delay in the write operation, there is no cached data waiting to be written. If you are running from Windows NT/2000 or other operating systems, as usual, make sure to shut down Windows properly so that the operating system can trigger and flush the cache as necessary. NOTE: powering off before a proper shutdown is complete may result in the loss of unwritten data in the cache, possibly causing problems in a subsequent boot or access to the data that was unwritten.

Q. Why can't I see the drives on the UltraTrak under FDISK?

A. If you have not created an array, the physical drive(s) attached to the UltraTrak card will not be recognized by the operating system. The UltraTrak controller is dedicated to RAID array management and does not provide any means of addressing individual hard drives through the int 13h interface used by FDISK. In order to access drives on the UltraTrak from MSDOS at all, you must first create a RAID array.

Q. Why can't I see the array I just created in the Windows NT/2000/XP Disk Administrator?

A. Since Windows NT/2000/XP does not yet support any method of dynamically adding and/or removing logical devices to/from the system, you must restart Windows. The next boot will show the new array under Disk Administrator.

Appendix D: Update UltraTrak Firmware

Caution

Be sure that you are using the correct firmware file for your particular model of UltraTrak. Using an incorrect file will cause the unit not to function.

Note

This procedure requires a computer capable of booting from an MS-DOS diskette.

Update UltraTrak firmware by performing the following steps:

1. Download the firmware upgrade package from www.promise.com.
2. With UltraTrak power off, connect a Null Modem Cable between the COM1 connector on the back of the UltraTrak and a powered down computer (connect to either COM1 or COM2). The computer must be capable of booting from an MS-DOS floppy.
3. Insert a DOS Boot diskette into the computer, power it on and allow it to boot to DOS.
4. Remove the DOS Boot diskette.
5. Insert a diskette containing the firmware upgrade executable and the UltraTrak firmware binary file. At the DOS prompt, type **dir** and press **Enter** to be sure that you have the correct files, such as, `txbxx.bin` and `ultra.exe` (where *xx* is the firmware version number).
6. At the DOS prompt, type **ultra** and press **Enter**.
7. At the "`Which COM Port is connected to UltraTrak?`" prompt type **COMx** and press **Enter** (where *x* is either a "**1**" or a "**2**" depending upon which COM port you are connected to).
8. Follow the instruction presented on the monitor and power on the UltraTrak.
   a. The following menu should display:

      ```
      1.  Upload Image to UltraTrak
      2.  Download Image to UltraTrak
      3.  RESET FLASH
      4.  EXIT
      ```

   b. Press **2**. (This is a safety precaution to ensure you have a copy of the current level firmware). When done, it will return to the above menu choices. Reinstall the **Promise Firmware Diskette**, press choice **1** and answer **Y** to proceed.

   c. When prompted, enter the file name for the binary file, such as `txbxx.bin` (where *xx* is the version number) and press **Enter**.

   d. If prompted, choose the model number of your UltraTrak.

e. Press **4** to **Exit** when the upload is finished.

f. Remove the diskette and mark it as your firmware back-up copy.

9. Switch off the UltraTrak power. Disconnect the Null Modem Cable, remove the diskette and power off the computer. Allow about a few seconds before switching the UltraTrak power back on. The firmware upgrade is complete.

Appendix E: Replacing the Controller Card

This document explains how to access, remove and install the UltraTrak controller board.

The controller board is accessible by opening the UltraTrak cabinet. The controller board is located on top. Switch the UltraTrak power off and remove the power cord before servicing the controller board.

Warning

The electronic components within the UltraTrak disk array are sensitive to damage from ESD (Electro-Static Discharge). Appropriate precautions should be observed at all times when handling the array or its subassemblies.

Remove the Controller Board

Use the following instructions to remove the controller board:

1. Unplug both controller board cables.
2. With your fingers on the Slide Grip, slide the board toward the front of the cabinet.
3. Remove the seven mounting screws from the controller board.
4. Lift the board from the cabinet.

Install the Controller Board

Use the following instruction to install a controller board:

1. Slide the controller board mounting bracket toward the front of the cabinet.
2. Set the controller board on to the controller board mounting bracket
3. Insert and tighten the seven mounting screws from the controller board.
4. With your fingers on the Slide Grip, slide the board toward the back of the cabinet.
5. Plug in the controller board cables.

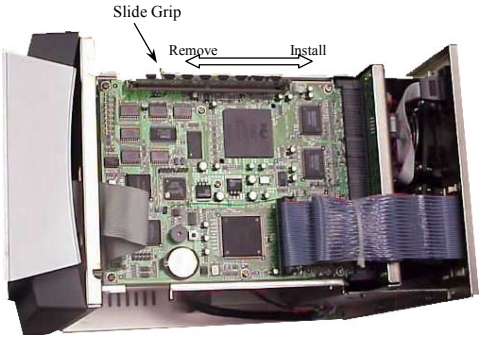


Figure 24. Location of UltraTrak Controller Board

Appendix F: Configuration Console Software

The UltraTrak Configuration Software creates a Console for managing your UltraTrak array. The Console is an alternative to managing your UltraTrak array using the two-line LCD readout on the enclosure. The Console uses any terminal emulation program, such as Windows HyperTerminal, on your PC to interact with the UltraTrak. Change your PC's Port settings to agree with the following:

- Bits per second: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: none

The UltraTrak Console is ready as soon as your terminal emulator connection is established. However, nothing shows in the terminal emulator window until you type a command.

Password

Most commands require you to enter your password when you first make your connection. The default password is **0000** (four zeros). To input your password:

1. Type the letters **pw**.
2. Press the spacebar once.
3. Type your password and press Enter.

If your password was correct, UltraTrak responds with **Correct Password!**. You may then use any of the functions.

To see a list of functions, type **help** or **?** (question mark). Note that none of the commands are case-sensitive.

Listing Functions

The following commands cause UltraTrak to report specific information. They do not require you to enter a password, so you may skip that step if information gathering is all you want to do. Type the command, then press the Enter key.

To obtain information about:	Type this command:
Arrays, listed by ID number	**la**
Firmware version	**ls**
Events	**lv**
Hard Drives	**ld**
RAID Controller	**lc**
RAID Enclosure	**le**

Event List

The following is a list of error strings that can be generated using the **lv** command. The expression "%d" represents the name of a drive or array.

- Disk Set Down: %d.
- Disk Plugged in: %d.
- Reserved Sector Error: Disk %d.
- Array %d has bad sector at LBA 0x%08x, which is generated by drive %d at LBA 0x%08x.
- Rebuild begun on Drive %d of Array %d.
- Automatic rebuild begun by Engine on Drive %d or Array %d.
- Array %d, Rebuild Completed on Disk %d.
- Synchronization begun for Array %d.
- Synchronization halted by user on Array %d at %d percent completed.
- Retry drive access in Array %d Drive %d.
- Create a new array %d.
- Delete array %d.
- Array %d was set down.
- Array %d has entered degraded mode.
- Rebuild successfully completed for Drive %d in Array %d.
- Synchronization successfully completed on Array %d.
- Drive %d of Array %d has Read Write Error ch%d.
- Temperature out of range.
- Fan error for Enclosure
- Expansion started for Array #%d.
- Conversion started for Array #%d.

Tasking Functions

The following commands cause UltraTrak to perform specific tasks. They require you to enter your password first. They also require you to type in options or additional parameters. Type the command alone to see a prompt listing the items you must specify.

For example, to create an array, you must also type in an array name, RAID level, number of disks in the array, the identification numbers of the individual disks you want in the array and the stripe block size in kilobytes.

To illustrate, if you type: **ca arry0 5 3 2 3 4 64**, UltraTrak will create a new array named **arry0**, it will be RAID 5 with three drives: drive numbers 2, 3 and 4; with a block size of 64 KB.

Note that commands such as create an array may take well over an hour to complete, depending on the size of the array. In most cases, you can perform a second task while waiting for the first. Type the command and options, then press the Enter key.

To do this task:	Type this command:
Create an array	**ca**
Delete an array	**da**
Synchronize an array	**sa**
Rebuild an array	**ra**
Stop rebuilding an array	**sb**
Add disks to an existing array	**ea**
Stop disk adding process	**sc**
Enable/disable SMART checking	**es**
Set buffer to write through or write back	**sw**
Get cache statistics	**gs**
Enable/disable array initialization	**ei**
Clear events	**ec**
Enable/disable the warning beep	**eb**
Enable/disable gigabyte boundary	**eg**
Set rebuild priority low or high	**ep**
Enable/disable the disk write cache	**ed**
Wipe a disk	**WipeoutDisk**
Set a new password	**NewPassword**
Exit the Console software	**Quit**

An explanation of these functions is found elsewhere in this *User Manual*.

Disconnecting

Be sure to close your terminal emulation program after you exit the Console software. If possible, save the connection parameters for future use.