

Redundant Array of Independent Disks (RAID) on HP Compaq dc5750 Business PCs

Using ATI Array Management Software (WebPAM)



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Introduction

A RAID (Redundant Array of Independent Disks) is a data storage scheme that uses two or more drives accessed in combination to improve fault tolerance. Initially used with servers, desktop PCs are increasingly using RAID controller and extra ATA or SCSI disks. Newer system boards often have RAID controllers.

RAID technology takes advantage of Serial Advanced Technology Attachment (SATA) and the integration of RAID into ATI's Radeon Xpress 1150 chipset with SB600 technology. The HP Compaq dc5750 Business PC products incorporate RAID drive support through factory configurations. This white paper provides a basic overview of RAID technology, supported factory configurations of HP Compaq dc5750 Business PCs, and other supported RAID configurations.

Mirroring and Parity

Fault tolerance is achieved by mirroring or parity. Mirroring is 100% duplication of the data on two drives (RAID 1). Parity is used to calculate the data in two drives and store the results on a third drive (RAID 5). After a failed drive is replaced, the RAID controller automatically rebuilds the lost data from the other two drives. RAID systems may have a spare drive (hot spare) ready and waiting to be the replacement for a drive that fails.

Disk Striping

RAID improves performance by disk striping, which interleaves bytes or groups of bytes across multiple drives, so more than one disk is reading and writing simultaneously.

Basics of RAID Technology

Definitions

Table 1 Basic RAID Definitions

ATA	Advanced Technology Attachment.
BIOS	Basic Input/Output System, also known as system ROM.
Chipset	Term used to define a collection of integrated components required to make a PC function.
HDD	Hard disk drive.
IDE	Integrated Drive Electronics.
INF	Information file (.inf) used by Microsoft operating systems that support the Plug & Play feature. When installing a driver, this file provides the operating system needed information about driver filenames, driver components, and supported hardware.
Migration	Term used to describe the movement of data from one configuration or usage model to another.



NCCQ	Native Command Queuing.
Option ROM	Third-party module that is loaded by the System BIOS which provides extended support for a particular piece of hardware. The RAID Option ROM provides boot support for RAID volumes as well as a user interface for managing and configuring the system's RAID volumes.
PCI	Peripheral Components Interface.
PCIe	PCI express. A serial version of PCI.
PnP	Plug and Play.
RAID	Redundant Array of Independent Disks.
ROM	Read Only Memory.
SATA	Serial ATA.
Strip	Set of data on a single hard drive in a RAID 0 volume.
Stripe	Group of all strips going horizontally across all the hard drive members of a RAID 0 volume.

Table 2 RAID Drives

Mode	Purpose	Minimal HDD Required
RAID 0	Striped for Performance.	2
RAID 1	Mirrored for Protection.	2
RAID 0 + 1	Mirrored and Striped.	4*

* Not supported on HP Compaq dc5750 Business PCs.

NOTE: The following notes are important for RAID configuration:

- RAID 1 is the only RAID configuration that HP Compaq dc5750 Business PC products offer as factory configurations.
- The preconfigured systems:
 - Are complete RAID systems.
 - Have both drives installed.
 - Have the necessary Option ROM configuration.
 - Are preloaded and preinstalled with all required software.
 - Include a preinstalled operating system that is mirrored mode out of the box.

Basic RAID Types

This section provides a brief explanation of the supported RAID configurations for HP Compaq dc5750 Business PCs.

RAID 0 with two hard drives (Striped)

Even though HP supports RAID 0, it is not the recommended configuration for business PC users. Lack of redundancy causes less than half the reliability of a single hard drive system since the Mean Time Between Failure (MTBF) of RAID 0 is equal to the MTBF of an individual drive, divided by the number of drives.

Table 3 RAID 0 with two hard drives (Striped)

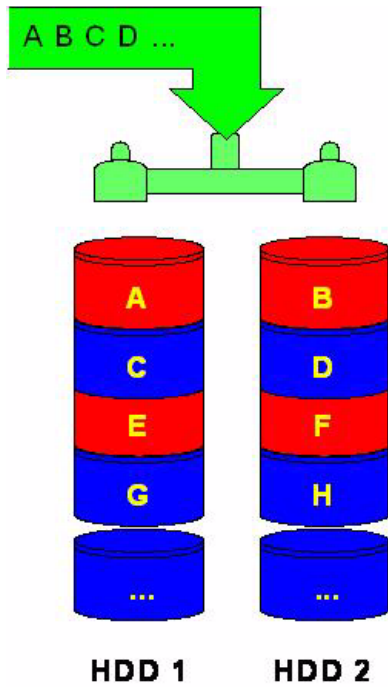
First Disk	Second Disk
Data Segment 1	Data Segment 2
Data Segment 3	Data Segment 4
Data Segment 5	Data Segment 6
Data Segment 7	Data Segment 8
Data Segment 9	Data Segment 10
Data Segment 11	Data Segment 12
Data Segment 13	Data Segment 14
Data Segment 15	Data Segment 16

In the previous table, each “Data Segment n” represents a group of data, known as a strip. In this case, each row represents a stripe. RAID 0 represented in the table above shows how information is segmented, made into chunks or strips, and stored across the stripes of the hard drive members of this RAID volume.

To better illustrate the concept of RAID 0 and striping, the following graphic shows how a sequence of data “ABCD...” is stored in a RAID 0 mode. In this example, each letter represents a segment or strip. The graphic shows how the various pieces of the information go to different hard drives. If any segment of RAID 0 fails, all information from all members is lost.



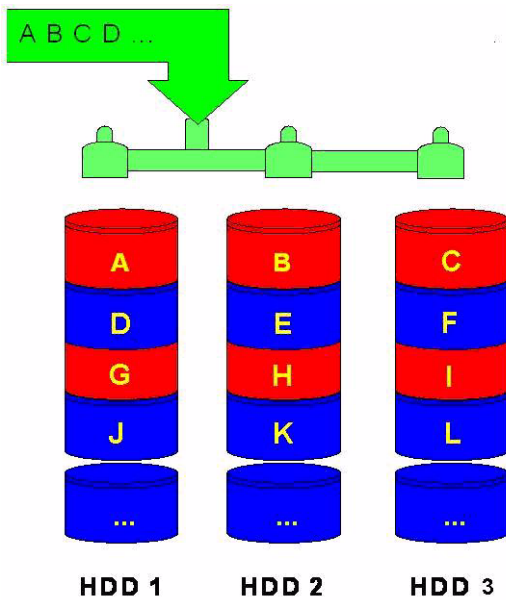
Figure 1 Performance - RAID 0 with two hard drives



The HP Compaq dc5750 Microtower also allows for RAID 0 with three hard drives. However, reliability is less than a RAID 0 configuration with two hard drives.

RAID 0 with three hard drives is shown in the following figure:

Figure 2 RAID 0 - Three hard drives



RAID 1 with two hard drives (Mirror)

Because it is a very cost-effective way to increase system storage reliability and a great value proposition, RAID 1 is the only RAID configuration that HP preconfigures for HP Compaq dc5750 Business PCs. RAID 1 provides high availability with minimal performance impact, as well as greater reliability compared to a single hard drive configuration.

RAID 1 has redundancy and hence is a true RAID. It more than doubles reliability because the MTBF of RAID 1 is equal to the MTBF of an individual drive multiplied by the number of drives (2). In other words, the probability of one hard drive failure on a given day is the square root of that same probability. Hypothetically, if the chances that a single hard drive fails is 1:2000, with RAID 1 the chance that both of your hard drives fail is 1:4,000,000.

Mirroring, segmentation, and striping have no real meaning in RAID 1. In the table and graphic, the data is arranged in rows for representation of different pieces of data.

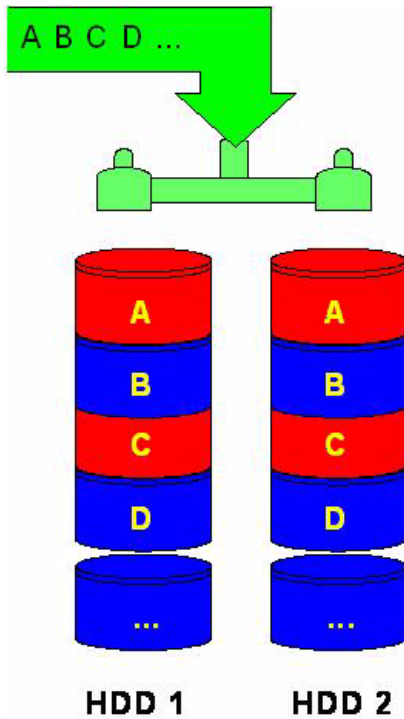
Table 4 RAID 1 with two hard drives (Mirror)

First Disk	Second Disk
Data Segment 1	Data Segment 1
Data Segment 2	Data Segment 2
Data Segment 3	Data Segment 3
Data Segment 4	Data Segment 4
Data Segment 5	Data Segment 5
Data Segment 6	Data Segment 6
Data Segment 7	Data Segment 7
Data Segment 8	Data Segment 8

In the previous table, each “Data Segment n” represents a group of data, known as a strip. In this case, each row represents a stripe. This table shows how information is duplicated in both hard drives. The size of the strips is mostly irrelevant and not a configurable option.

To better illustrate the concept of RAID 1 and mirroring, the following figure shows how a sequence of data “ABCD...” is stored in a RAID 1 volume. In this example, each letter represents a data segment. The graphic shows how the various pieces are replicated for both of the hard drives; hence, if any one member of the RAID 1 volume fails, the information is kept in the surviving members. After a hard drive failure, the user interface sends a notification so the failed hard drive can be replaced. No user information is lost in this scenario.

Figure 3 Reliability: RAID 1 - Mirroring



Configurations

Recommended configurations

HP recommends factory configurations of the preinstalled RAID offerings for the HP Compaq dc5750 Business PCs.

The preinstalled RAID offering is a RAID 1 volume of two identical SATA hard drives, and either two SATA 80GB/8MB cache, two SATA 160GB/8MB cache, or two SATA 250GB/8MB cache drives.

NOTE: When the HP Compaq dc5750 Business PC products launch, the only supported operating system is Microsoft Windows XP Professional Service Pack 2 (SP2). RAID Configurations are only supported with this operating system. Hardware support is present to take advantage of the future Microsoft Vista operating system.

HP Compaq dc5750 Business PCs are based on the ATI Radeon Xpress 1150 chipset, which is a combined hardware and software RAID solution. The Radeon mass storage controller allows all drives to operate in IDE or RAID SATA modes. Each mode of the controller means a different PCI controller, with different device ID, class code, and driver support.

NOTE: HP recommends and only supports Microsoft's IDE driver stack based on ATAPI.SYS and ATI drivers for HP Compaq Business PC products, including all supported RAID configurations.

WARNING: The PCI Device ID of the mass storage controller changes after changing the BIOS “SATA Emulation” Computer Setup option. Changing SATA Emulation from IDE mode to RAID mode is the equivalent of connecting the hard drives to a new add-on RAID storage controller. The installed operating system on the hard drive is unaware of this new mass storage controller. If the operating system does not have the RAID drivers enumerated and PnP for the RAID controller, the operating system will fail to boot (blue screen) when Microsoft XP Professional (SP2) attempts to boot.

HP Backup and Recovery interactions

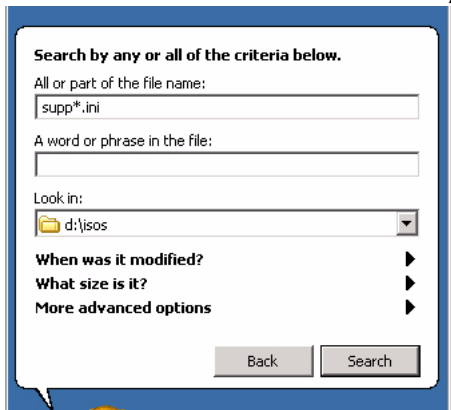
After enabling and configuring RAID, restore the system using backup CDs. After completing the restore, reinstall HP Backup and Recovery. These steps are necessary for the F11 restore to function properly.

HP recommends keeping the default options in the RAID Option ROM and in the Windows RAID application. Options like “chunk” size for changing the “stripe” size have more history in their defaults settings.

Additional technical information will be provided in the future for customers who want to add RAID software image deployment capabilities.

NOTE: Systems enabled with RAID require version 2.3i rev D of HP Backup and Recovery. Before proceeding, follow the steps below to identify which version shipped with your system.

1. Click **Start > Search**.
2. Click **All files and folders**.
3. Type `supp*.ini` in the name field.
4. Enter the drive letter of the HP Recovery partition and `\isos`. Example: `d:\isos`.



5. Click **Search**. Search results may locate more than one .ini file. Double click to open the .ini files until you locate the file containing HP Backup and Recovery.

Look for `CDPart#` to determine which version of HP Backup and Recovery shipped with your system and compare it to the table below. If your system did not ship CD Part #408640-B24, contact HP Support. See the instructions below to order the CD.

Table 5 HP Backup and Recovery

CD Part Number	Software Part Number	HPBR version
408640-B22	415500-B2B	2.3i rev B
408640-B23	415500-B2C	2.3i rev C
408640-B24	415500-B2D	2.3i rev D

To order a Recovery Disc Set, go to the following Web site, select your region, and click the **Technical support after you buy** link under the **Call HP** heading to obtain the support center telephone number for your region. You will need the computer model and serial number of your system before calling.

http://welcome.hp.com/country/us/en/wwcontact_us.html

Other supported configurations

The HP Compaq dc5750 Business PC products support two other RAID configurations:

- Two hard drive configuration.
 - Two equal size/type SATA hard drive RAID configurations in RAID 0 or RAID 1.
 - Maximum of two SATA optical drives.
- Three hard drive configuration (only on HP Compaq dc5750 Microtower).
 - Three equal size/type SATA hard drive RAID configurations in RAID 0.
 - Maximum of one SATA optical drive.

Unsupported configurations

The HP Compaq dc5750 Business Desktop PC products only support the best user experience and highest possible reliability. As a result, HP does not support the following combinations of RAID hard drives:

- Different sizes.
- Different speeds (5400 rpm, 7200 rpm, etc.).
- Old and new technologies (SATA 1.5 GB and SATA 3.0 GB).
- NCQ hard drives and non-NCQ drives.
- Different cache size.
- RAID combinations of hard drives with any operating system other than Microsoft XP Pro (SP2) using Microsoft's IDE driver stack based on ATAPI.SYS and ATI drivers.



Configuring RAID on non-factory preinstalled configurations

The remaining sections of this white paper describe steps to set up supported RAID configurations where customers have not purchased factory preinstalled RAID configurations.

WARNING: Before configuring RAID, be sure to back up all data. Once a RAID configuration is executed and saved, data on the selected disks is no longer retrievable.

NOTE: You will need a floppy drive to use the downloaded HP softpaq required for Windows XP CD installation. The softpaq must be downloaded to a floppy diskette.

Required BIOS Version

If your system does not have a BIOS version of 1.53 or later, you will first need to update your system.

1. To download the latest BIOS softpaq go to the dc5750 software and drivers website at http://h18007.www1.hp.com/support/files/hpcpqdt/us/locate/64_6313.html#0.

To verify your system's version of BIOS:

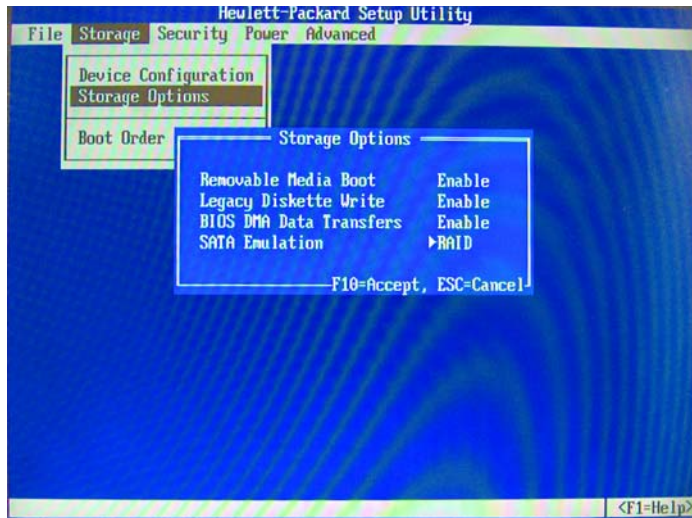
1. Turn on or restart the computer by clicking **Start > Shut Down > Restart the Computer**.
2. Press **F10** as soon as the monitor light turns green. If you do not press **F10** at the appropriate time, you must restart the computer, and then press **F10** again to access the utility.
3. Select your language from the list, and then press **Enter**.
4. Select **File > System Information** and press **Enter**.

If you are attempting to update the BIOS of a system already in RAID mode, the BIOS CD method is not supported. Refer to the BIOS softpaq documentation for details and alternate procedures.

Enabling RAID through F10 System BIOS

1. Turn on or restart the computer by clicking **Start > Shut Down > Restart the Computer**.
2. Press **F10** as soon as the monitor light turns green.
If you do not press **F10** at the appropriate time, you must restart the computer, and then press **F10** again to access the utility.
3. Select your language from the list, and then press **Enter**.
4. Use the arrow keys to select **Storage**.

5. Use the down arrow key to select **Storage Options**, and then press **Enter**.



6. On the **Storage Options** menu, use the down arrow key to select **SATA Emulation**.
7. Press the right arrow key until **RAID** displays, and then press **F10** to accept.
8. To apply and save changes, select **File > Save Changes and Exit**.
 - If you do not want to apply your changes, select **Ignore Changes and Exit**.
 - To reset to factory settings, select **Apply Defaults and Exit**.

NOTE: Applying default settings never changes or resets the SATA Emulation mode (RAID vs. IDE). This setting must always be changed by selecting the appropriate mode from the F10 Setup Utility under Storage Options.

CAUTION: Do NOT turn the computer power off while the ROM is saving the F10 Computer Setup changes because the CMOS could become corrupted. Only turn the computer off after exiting the F10 Setup screen.

Configuring RAID Option ROM

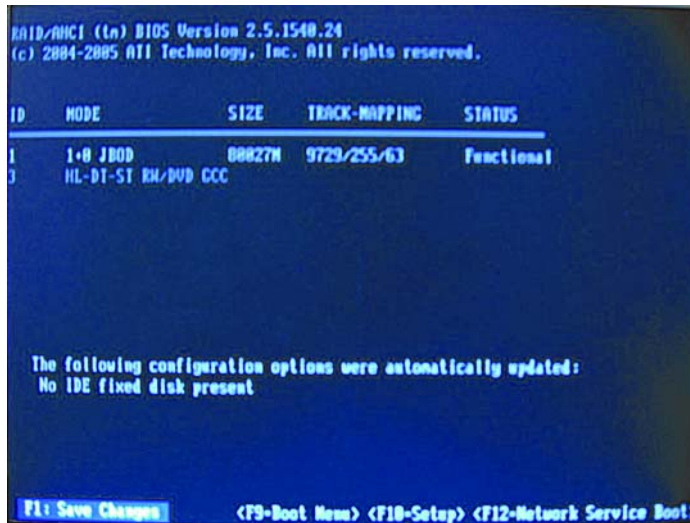
Before proceeding you will need the following:

- Microsoft Windows XP CD-ROM and Product Key.
- RAID driver floppy. To create one, go to www.hp.com/support. Select your country and language, select **Download drivers and software**, enter the model number of the computer, and press **Enter**. Download SP33899 to create the driver floppy.

You can only access Computer Setup at system startup. To access the Computer Setup Utilities menu and enable RAID:

1. Turn on or restart the computer by clicking **Start > Shut Down > Restart the Computer**.
2. Press **Ctrl + F** as soon as the monitor light turns green to enter the RAID configuration utility. If you do not press **Ctrl + F** at the appropriate time, you must restart the computer, and then press **Ctrl + F** again to access the utility.

The screen below displays briefly during boot up. The RAID configuration utility is English only. To configure RAID in other languages, use the Web-based RAID configuration utility. For more information refer to the comprehensive [WebPAM User Manual](#).



Configuring RAID Volume using the Option ROM

Once you are in the Option ROM you can access the FastBuild Utility Main Menu.

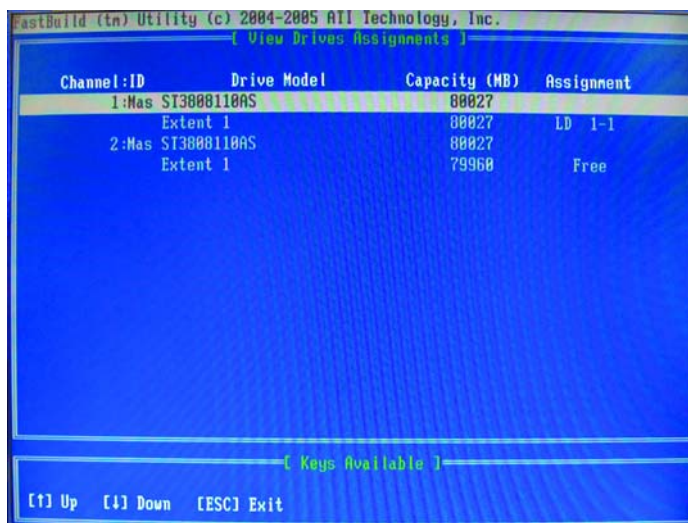
WARNING: Before configuring RAID, be sure to back up all data. Once a RAID configuration is executed and saved, data on the selected disks will no longer be retrievable.



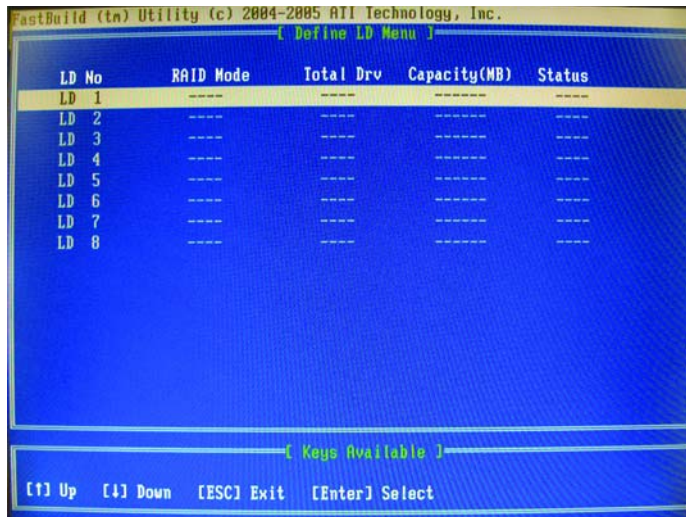
- From the Main Menu press **3** to access the **Delete LD** screen. Use the arrow keys to select the drives. Press **Del** or **Alt + D** to delete the drives. At the prompt, press **Ctrl + Y** to delete or any other key to abort. Repeat until all drives are deleted. Press **Esc** to return to the main menu.



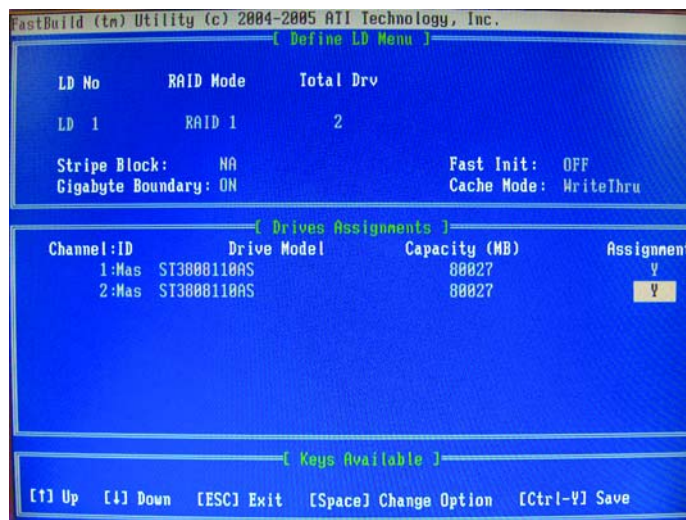
- Press **1** to access the **View Drive Assignments** screen. The screen displays a detailed description of available physical drives, including channel, size and status. Press **Esc** to exit and return to the main menu.



- Press **2** to access the **Define LD** screen. This screen allows you to configure RAID settings and assignments.



- Use the arrow keys to scroll to the desired LD number and press **Enter**. The following screen appears. RAID 1 configurations should accept HP default settings. For all other configurations:
 - Use up and down arrow keys to toggle and the space bar to view and change options.
 - Under **Assignment**, select **Y** to enable the drive(s).
 - Press **Ctrl + Y** to save your settings.
 - At the prompt, press **Ctrl + Y** to Modify Array Capacity or press any other key to use maximum capacity.
 - Press **Esc** to exit and return to the main menu.



- Press **Esc** to exit. At system prompt, press **Y** to reboot or any other key to go back.

Select boot order

Only the first optical drive is bootable in RAID mode. To set up your system to boot from the CD, you will need to change the boot order.

1. Turn on or restart the computer by clicking **Start > Shut Down > Restart the Computer**.
2. Press **F10** as soon as the monitor light turns green.
If you do not press **F10** at the appropriate time, you must restart the computer, and then press **F10** again to access the utility.
3. Select your language from the list, and then press **Enter**.
4. Use the arrow keys to select **Storage**.
5. Use the down arrow key to select **Boot Order**, and then press **Enter**.
6. Use the down arrow key to select **ATAPI CD-ROM Drive**, and then press **Enter**. Press the arrow key up to the desired position in the boot order. Press **Enter** again and **F10** to accept the change.
7. To apply and save changes, select **File > Save Changes and Exit**.
 - If you do not want to apply your changes, select **Ignore Changes and Exit**.
 - To reset to factory settings, select **Apply Defaults and Exit**. This option restores the original factory defaults.

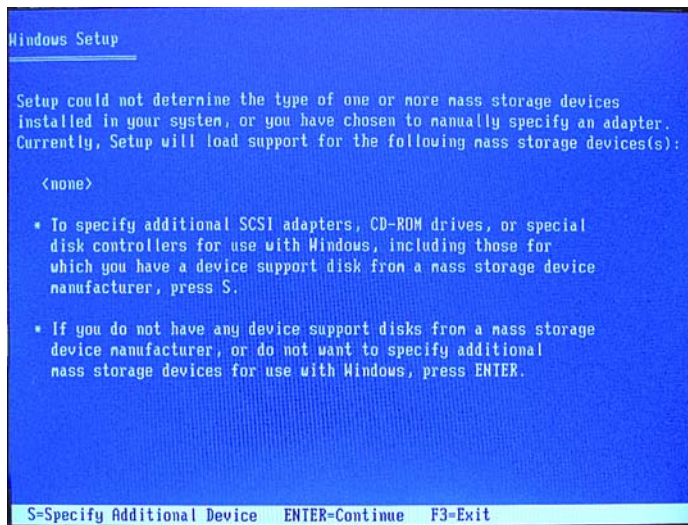
Notes for operating system installation

After creating a RAID disk volume in the option ROM and selecting the boot order, the operating system can be installed. Before proceeding, you will need the following:

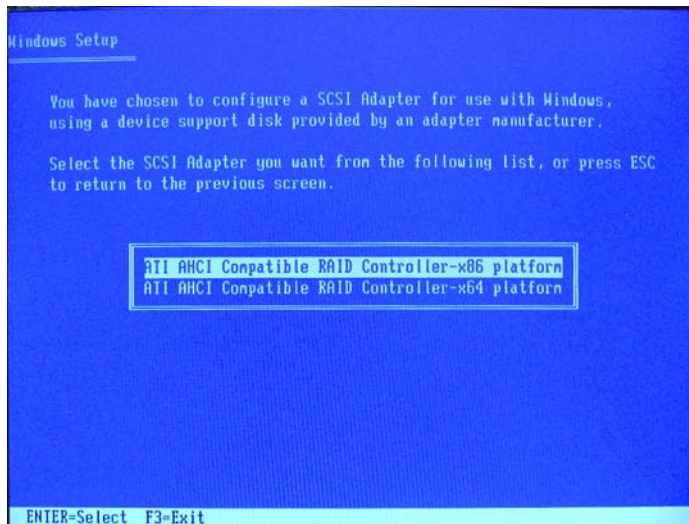
- Microsoft Windows XP CD-ROM and Product Key.
 - RAID driver floppy. To create one, go to www.hp.com/support. Select your country and language, select **Download drivers and software**, enter the model number of the computer, and press **Enter**. Download SP33899 to create the driver floppy.
1. Insert the Windows XP CD-ROM and reboot the computer.
 2. Press **F6** at the prompt to begin installation.



3. Press **S** at the prompt to Specify Additional Device.



4. Insert the RAID driver floppy and press **ENTER** to select the RAID driver.



5. Press **ENTER** to complete the Microsoft Windows installation.

WARNING: Customer-created images MUST account for the RAID controller.

Failure to install and enumerate the RAID driver after enabling the RAID controller (with or without creating a volume) will result in a Windows boot failure (blue screen) for inaccessible boot device.

WARNING: The PCI Device ID of the mass storage controller changes after changing the BIOS "SATA Emulation" Computer Setup option. Changing SATA Emulation from IDE mode to RAID mode is the equivalent of connecting the hard drives to a new add-on RAID storage controller. The installed operating system on the hard drive is unaware of this new mass storage controller. If the operating system does not have the RAID drivers enumerated and PnP for the RAID controller, the operating system will fail to boot (blue screen) when Microsoft XP Professional (SP2) attempts to boot.

Additional technical information will be provided in the future for customers who want to add RAID SW image deployment capabilities.

ATI Array Management Software (WebPAM)

This section of the paper focuses on how to configure RAID using ATI Array Management Software (WebPAM). Note that HP does not support RAID migration using WebPAM.

Java Runtime Environment

WebPAM will install JRE 1.4 on your system unless you already have JRE versions 1.3.0 or 1.4.

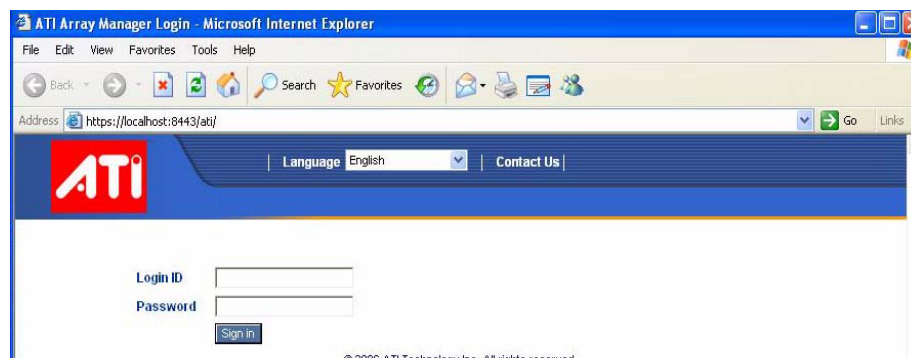
Console Software Installation

HP provides a softpaq for the ATI WebPAM utility installation. To download the softpaq, go to http://h18007.www1.hp.com/support/files/hpcpqdt/us/locate/64_6313.html#14.

Log-in to WebPAM

1. Double-click on the WebPAM icon on your desktop.

On the internet browser toolbar, go to **Tools > Internet Options > Connections > LAN Settings**. Select **Bypass Proxy server for local addresses**. Click **OK**.



2. When the opening screen appears, type **admin** in the Login ID field. Type **admin** in the Password field. Note: The WebPAM login and password are case sensitive.
3. Click the **Sign in** button.

Recommended Initial Settings

These settings are recommended and now is the best time to make them. You can change them later as necessary.

Administrator's Settings

To make the Administrator's password and notification settings:

1. In Tree view, under Administrative Tools, click on the **User Management** icon.



2. In the Management Window, click on the **admin** link.
3. Click on the **Settings** tab.



The screenshot shows the 'User Management' window with the 'Settings' tab selected. The 'User Settings' section includes fields for 'User ID' (admin), 'Display Name' (Super user), '*Password', 'New Password', 'Retype Password', and 'Email'. The 'Host User Rights' section shows a table of rights for the host 'hewlett-0c2dffd'.

Host Name	Creation Rights	Deletion Rights	Maintenance Rights	Notification Rights
hewlett-0c2dffd	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Buttons for 'Submit' and 'Reset' are located at the bottom of the window.

4. If you want to change the default password, type the new password into the New Password field. Use up to 8 letters and numbers but no spaces or other characters.
5. Type the same password into the Retype Password field.
6. If you plan to set up Event Notification, type the Administrator's email address in the Email field.
7. Click on the **Submit** button. If the action was successful, the Management Window will display the message "Update Success."

8. If you plan to set up Event Notification, click on the **Events** tab.

Select Events

Information Settings **Events**

hewlett-0c2dff(16.100.161.252)

Email Notification

Select All Events

Select All Information Events Select All Warning Events Select All Error Events

Disk Events

<input type="checkbox"/> Disk Plugged In	<input type="checkbox"/> Disk BSL Update	<input type="checkbox"/> Disk BSL Cleared
<input type="checkbox"/> Disk Error Fixed	<input type="checkbox"/> Disk Patrol Progress	<input type="checkbox"/> Disk Media Patrol Started
<input type="checkbox"/> Disk Media Patrol Completed	<input type="checkbox"/> Disk Media Patrol Paused	<input type="checkbox"/> Disk Media Patrol Resumed
<input checked="" type="checkbox"/> Disk Media Patrol Aborted	<input type="checkbox"/> Disk Unplugged	<input type="checkbox"/> Disk Timeout
<input type="checkbox"/> Task Error	<input checked="" type="checkbox"/> Disk Media Patrol Aborted with Error	<input type="checkbox"/> Bad Block Remapped

The image above was shortened to fit into the available space.

9. Check the boxes of the notification events that you want to have reported to you via email and popup messages. To select events by their severity, check one of the four Select Events boxes at the top of the window.
10. Click the **Submit** button. For more information about Event Notification, see the [WebPAM User Manual](#).

Utility Configuration

If you plan to set up Event Notification, you must make these settings.

1. In Tree View, under Administrative Tools, click on the **Utility Configuration** icon.

Utility Configuration

Settings Configuration

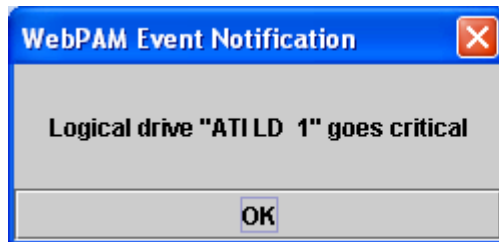
Email Sender	<input type="text"/>	Email Sender Desc.
Email Server	<input type="text"/>	Email Server Desc.
Email Subject	Promise Controller Error	Email Subject Desc.
Event Frame Refresh Time	30 secs	Event Frame Refresh Time Desc.

2. Enter the Sender's address in the Email Sender field. Be sure the sender has an account in your email system.
3. Enter your email server in the Email Server field.
4. Keep or change the Email Subject line.

5. Click the **Submit** button when you are done.

Degradation

In the unlikely event that one of your hard drives malfunctions, WebPAM reports the condition with popup messages. If Event Notification is set up, WebPAM also reports the conditions with email messages.



For More Information

A comprehensive *WebPAM User Manual* is available at www.hp.com/support. Select your country and language, select **See support and troubleshooting information**, enter the model number of the computer, and press **Enter**. In the Resources category, click **Manuals (guides, supplements, addendums, etc.)**. Under **Quick jump to manuals by category**, click **White papers**.

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