
RAID User Guide

Edition

V1.0 P/N: 91-187-K84-A2-0E

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NVIDIA RAID

RAID Arrays

This section describes the following types of RAID arrays that NVIDIA RAID supports:

- RAID 0

RAID 0 defines a disk striping scheme that improves the disk read and write times for many applications.

- RAID 1

RAID 1 defines techniques for mirroring data.

- RAID 0+1

RAID 0+1 combines the techniques used in RAID 0 and RAID 1 arrays.

- Spanning (JBOD)

JBOD provides a method for combining drives of different sizes into one large disk.

Summary of RAID Configurations

Array	Advantages	Drawbacks	# Hard Disks	Fault Tolerance
RAID 0	High data throughput.	No fault tolerance.	multiple	None
RAID 1	100% data redundancy.	Requires two drives for the storage space of one drive.	2	Yes
RAID 0+1	Optimized for both 100% data redundancy and performance. Allows spare disks.	Requires two drives for the storage space of one drive—the same as RAID level 1.	4+	Yes
JBOD	Combines and uses the capacity of odd size drives.	Decreases performance because of the difficulty in using drives concurrently or to optimize drives for different uses.	multiple	No

NVIDIA RAID offers the following additional features:

- ***Free Disk and Dedicated Spare Disk***

A Free Disk or Dedicated Disk can be automatically used in case one drive of a fault-tolerant array fails. NVIDIA RAID defines a fault-tolerant array as either RAID 1 or RAID 0+1. A free disk can be used by any available fault-tolerant array, while a dedicated disk can be used only by the array to which it is assigned.

- ***RAID Across PATA and SATA***

NVIDIA RAID can span across both Parallel ATA as well as Serial ATA controllers. RAID operations can be performed on Parallel ATA hard drives, Serial ATA hard drives, or both Parallel and Serial ATA hard drives.

- ***Bootable RAID***

NVIDIA RAID can be configured in a way to make it bootable. For example, two hard drives can be configured as a bootable mirrored RAID array.

- ***RAID on Multiple Disk Controllers***

Unlike other RAID solutions that limits the user to a dedicated RAID controller, NVIDIA RAID software can use a drive on one RAID controller and another drive on a second RAID controller.

- ***Morphing***

Morphing is the ability to convert from one RAID mode to another RAID mode. This allows the user to upgrade their current disk or array for better performance, higher security, and increased capacity. More importantly, this is accomplished without having to go through multiple steps. The morphing feature gives the user an upgradeable option to manage storage easily.

- ***Hot Plug Array***

Hot plug, with respect to RAID, is the ability to add a disk to a system safely and without causing problems for the RAID software. For example, when a drive in a mirrored array fails, a user can launch the Hot Plug Array Wizard which instructs the user as to when a drive can be added safely to the system. As soon as the drive is added, the user can then finish running the RAID wizard and the drive becomes useable by the system.

Install Hard Disks

Install SATA hard disks:

STEP 1: Install one SATA hard disk into one drive bay.

STEP 2: Connect one end of the SATA data cable to the motherboard's one of SATA connectors.

STEP 3: Connect the other end of the SATA data cable to the SATA hard disk.

STEP 4: Connect the power cable to the SATA hard disk.

STEP 5: Following step 1/2/3/4 to install the other SATA hard disks.

Install Parallel hard disks:

STEP 1: Setting one IDE hard disks as Master/Slave mode.

STEP 2: Install the hard disks into one drive bay.

STEP 3: Connect one end of the IDE cable to the motherboard's one of IDE connectors.

STEP 4: Connect the other end of the IDE cable to the IDE hard disk.

STEP 5: Connect the power cable to the IDE hard disk.

STEP 6: Following step 1/2/3/4 to install the other IDE hard disks.

Basic Configuration Instructions

The following are the basic steps for configuring NVIDIA RAID:

Non-Bootable RAID Array

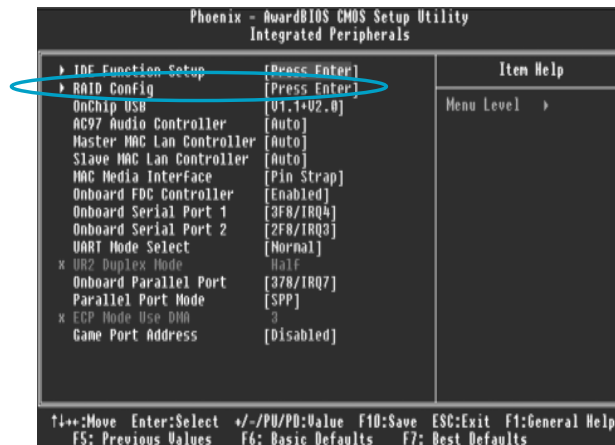
1. Choose the hard disks that are to be RAID enabled in the system BIOS.
2. Specify the RAID level, either Mirroring (RAID 1), Striping (RAID 0), Stripe Mirroring (RAID 0+1), or Spanning (JBOD) and create the desired RAID array.
3. Install the operating system on one hard disk, then reboot the computer.
4. Run the Windows nForce Setup application and install the RAID driver.
5. Initialize the NVRAID Array.

Bootable RAID Array

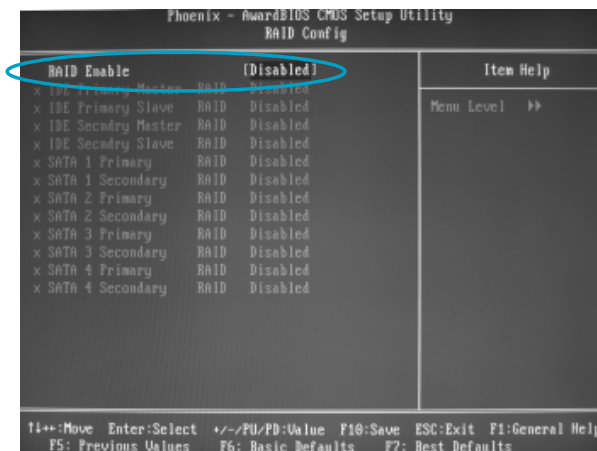
1. Choose the hard disks that are to be RAID enabled in the system BIOS.
2. Specify the RAID level, either Mirroring (RAID 1), Striping (RAID 0), Mirrored Striping (RAID 0+1), or Spanning (JBOD) and create the desired RAID array.
3. Boot from the Windows CD, then press F6 when the Windows Setup appears.
4. Insert the RAID driver floppy to Install the nForce RAID driver.
5. Initialize the NVRAID Array.

Setting Up the BIOS

1. Start up the computer, then press **Delete** to enter the BIOS setup. Use the arrow keys to select **Integrated Peripherals**, then press **Enter**.



2. Use the arrow keys to select the **RAID Config**, then press **Enter**.

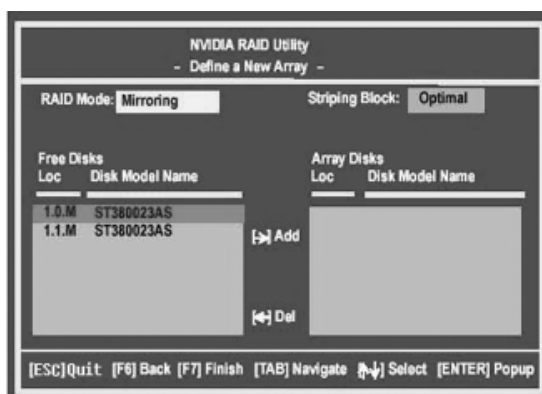


3. From the RAID Config window, enabled the RAID Enable, the other items would be light, then you can enable the disk that you want to use as RAID disks.

4. Press F10 to save the configuration and exit.

Entering the RAID BIOS Setup

1. After rebooting your PC, wait until you see the RAID software prompting you to press **F10**. The RAID prompt appears as part of the system POST and boot process prior to loading OS.
2. Press **<N>**, and the NVIDIA RAID Utility --- **Define a New Array** window will appear. The default **RAID Mode** is set to **Mirroring** and the default **Striping Block** is set to **Optimal**.



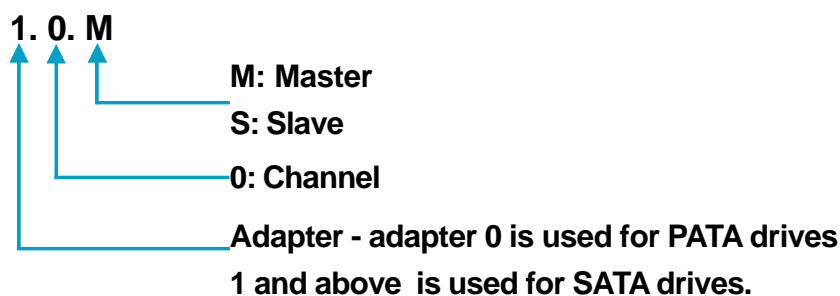
Understanding the “Define a New Array” Window

Use the Define a New Array window to

- Select the RAID Mode
- Set up the Striping Block
- Specify which disks to use for the RAID Array

Depending on the platform used, the system have one or more channels. In a typical system there are usually one controller and multiple channels, and each channel have a slave and a master.

The channel/controller/master/slave status of each hard disk is given in the Loc (location) columns of the Free Disks and Array Disks lists.



In the example above, 1.0.M means the hard drive is attached to Adapter 1, Channel 0, and the drive is set to Master. The following is a list of all possible combinations:

Parallel ATA

0.0.M Adapter 0, Channel 0, Master
0.0.S Adapter 0, Channel 0, Slave
0.1.M Adapter 0, Channel 1, Master
0.1.S Adapter 0, Channel 1, Slave

Serial ATA

1.0.M Adapter 1, Channel 0, Master
1.1.M Adapter 1, Channel 1, Master
2.0.M Adapter 2, Channel 0, Master
2.1.M Adapter 2, Channel 1, Master
3.0.M Adapter 3, Channel 0, Master
3.1.M Adapter 3, Channel 1, Master
4.0.M Adapter 4, Channel 0, Master
4.1.M Adapter 4, Channel 1, Master

Note: There is no such thing as Slave drive in Serial ATA. All drives are considered to be Master since there is a one to one connection between the drive and the controller.

Using the Define a New Array Window

If necessary, press the tab key to move from field to field until the appropriate field is highlighted.

• Selecting the RAID Mode

By default, this is set to [Mirroring]. Change to a different RAID mode, press the down arrow keys until the mode that you want appears in the RAID Mode box—either [Mirroring], [Striping], [Spanning], or [Stripe Mirroring].

• Selecting the Striping Block Size

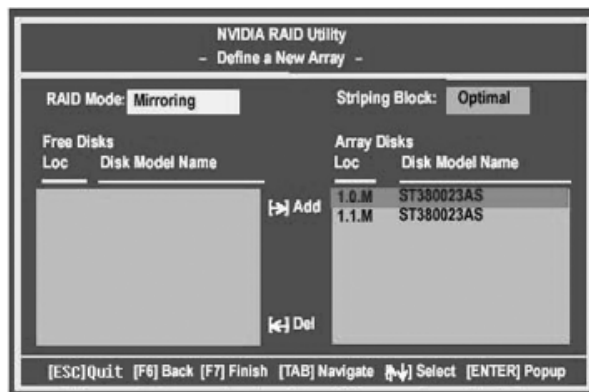
Striping Block size is given in kilobytes, and affects how data is arranged on the disk. It is recommended to leave this value at the default [Optimal], which is 32KB, but the values can be between [4 KB] and [128 KB].

• Assigning the Disks

The disks that you enabled from the RAID Config BIOS setup page appear in the **Free Disks** block. These are the drives that are available for use as RAID array.

To designate a free disk to be used as a RAID array:

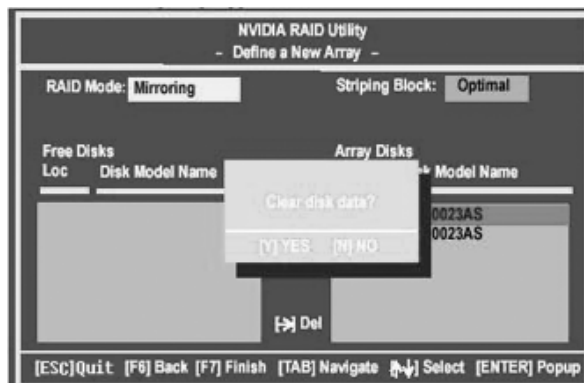
1. Tab to the **Free Disks** section. The first disk in the list is selected.
2. Move it from the Free Disks block to the Array Disks block by pressing the right arrow key (→). The first disk in the list is moved, and the next disk in the list is selected and ready to be moved.
3. Continue pressing the right-arrow key (→) until all the disks that you want to use as RAID array appear in the **Array Disks** block.



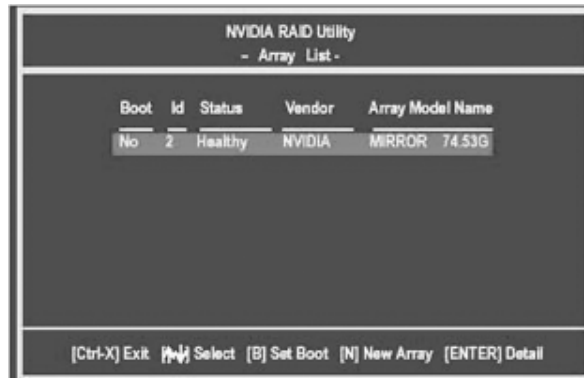
It shows that two disks have been assigned as RAID1 array disks in the figure above.

Completing the RAID BIOS Setup

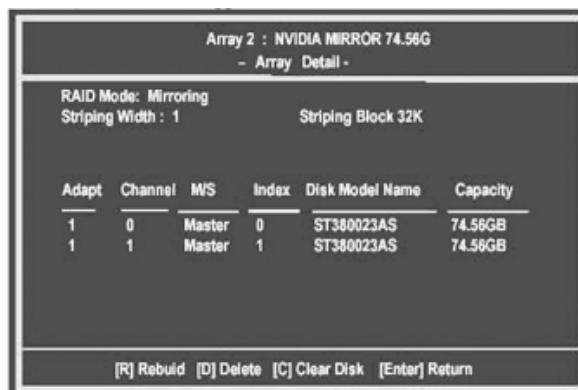
1. After assigning your RAID array mode, press **F7**. The Clear disk data windows prompt appears.



2. Press **Y** if you want to wipe out all the data from the RAID array, otherwise press **N**. You must choose **Yes** if the drives were previously used as RAID drives. The **Array List** window appears, where you can review the RAID arrays that you have set up.



3. Use the arrow keys to select the array that you want to set up, then press **Enter**. The **Array Detail** window appears.



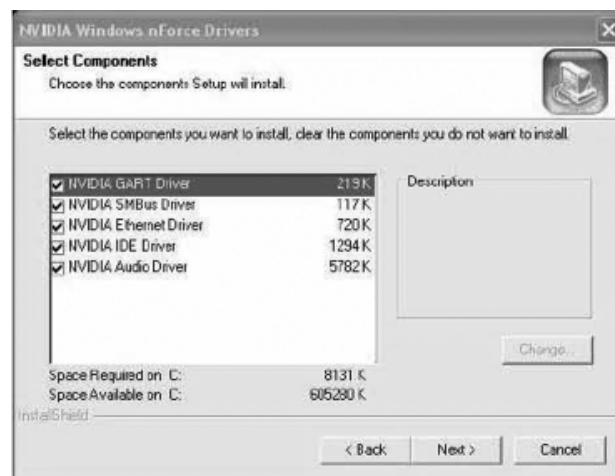
4. If you want to mark this disk as empty and wipe out all its contents then press **C**.
 5. At the prompt, press **Y** to wipe out all the data, otherwise press **N**.
 6. Press **Enter** again to go back to the previous window and then press **[Ctrl+X]** to exit the RAID setup.

NVIDIA RAID Utility Installation

Installing the NVIDIA RAID Software Under Windows (for Non-bootable RAID Array)

This section describes how to setup the application and install the RAID software which will upgrade the Windows IDE driver and install the RAID driver.

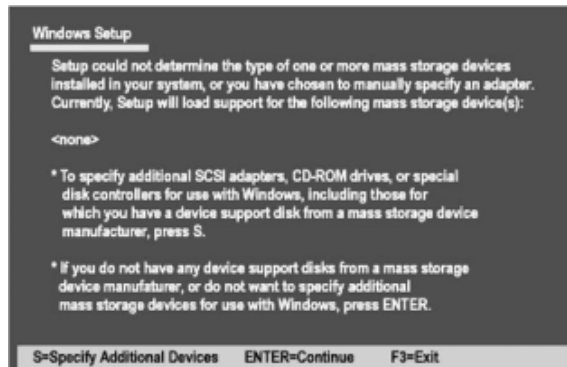
1. Start the nForce Setup program to open the NVIDIA Windows nForce Drivers page.



2. Select the modules that you want to install. Select the relative options that you have configured.
3. Click **Next** and then follow the instructions.
4. After the installation is completed, be sure to reboot the PC.
5. After the reboot, initialize the newly created array.

Installing the RAID Driver (for bootable RAID Array)

1. After you complete the RAID BIOS setup, boot from the Windows CD, and the Windows Setup program starts.
2. Press **F6** and wait for the Windows Setup screen to appear.



3. Specify the NVIDIA drivers:

- (1) Insert the floppy that has the RAID driver, press S, then press Enter. The Windows Setup screen appears as below:



- (2) Select "NVIDIA RAID CLASS DRIVER" and then press **Enter**.
- (3) Press **S** again at the Specify Devices screen, then press **Enter**.
- (4) Select "NVIDIA NForce Storage Controller" and then press **Enter**. The following Windows Setup screen appears listing both drivers:



4. Press Enter to continue with operating system Installation. Be sure to copy the files from the floppy is complete, then take out the floppy.

5. Follow the instructions on how to install operating system. During the GUI portion of the installation you might be prompted to click Yes to install the RAID driver. Click Yes as many times as needed in order to finish the installation. This will not be an issue with a signed driver.

Note: Each time you add a new hard drive to a RAID array, the RAID driver will have to be installed under Windows once for that hard drive. After that, the driver will not have to be installed.

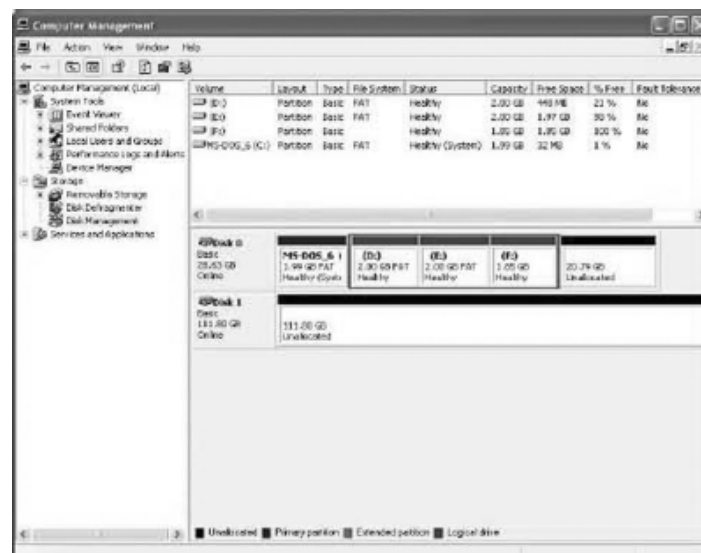
Initializing and Using the Disk Array

The RAID array is now ready to be initialized under Windows.

1. Launch Computer Management by clicking “Start” → “Settings” → “Control Panel” then open the “Administrative Tools” folder and double click on “Computer Management”.



2. Follow screen instructions to install. While finished, the “Computer Management” window appears.



The actual disks listed will depend on your system, and the unallocated partition is the total combined storage of two hard disks. You must format the unallocated disk space in order to use it.

3. Format the unlocated disk space. Right click “Unallocated space”, select “New Partition...” and follow the wizard. After the drive has been formatted, it is ready for use.

Using The NVRAIDMAN Utility

About the NVIDIA RAID Management Utility

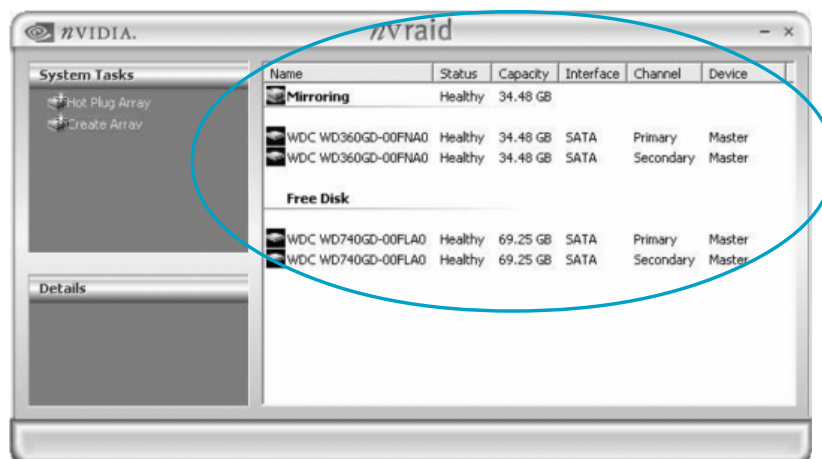
The NVIDIA RAID software ships with an application called NVRAIDMAN. This chapter describes the NVRAIDMAN tasks in the following sections:

- Viewing RAID Array Configurations
View an array configuration (mirrored, striped, mirrored-striped, JBOD, or any supported combination)
- Setting Up a Spare RAID Disk
 - View free and/or dedicated free disks
 - Designate a free disk to a particular array
- Rebuilding a RAID Array
 - Rebuild a broken mirrored array
 - Watch the progress of rebuilding of an array

Viewing RAID Array Configurations

To view your RAID configuration from Windows, launch the NVIDIA RAID Management utility by double-clicking NVRAIDMAN that in the driver cd.

The RAID configuration information appears in the right-side pane, as shown in following picture:



Setting Up a Spare RAID Disk

You can designate a hard drive to be used as a spare drive for a RAID 1 or RAID 0+1 array². The spare drive can take over for a failed disk. NVIDIA RAID supports two types of spare drives:

- **Free Disk**

A free disk is a disk that is not part of any RAID array, but can be used by any available RAID 1 or RAID 0+1 array that requires a particular disk when one of its disks crashes or becomes unusable. The process is automatic and doesn't require any user interaction.

For example, if you have a system with four hard disks where one disk is used to boot the OS, two hard drives are set up in a mirrored array, and a fourth hard disk is set up as a free disk, then if one of the mirrored array drives fails, the free disk will be automatically assigned to the mirrored array to be used instead of the failed disk.

- **Dedicated Disk**

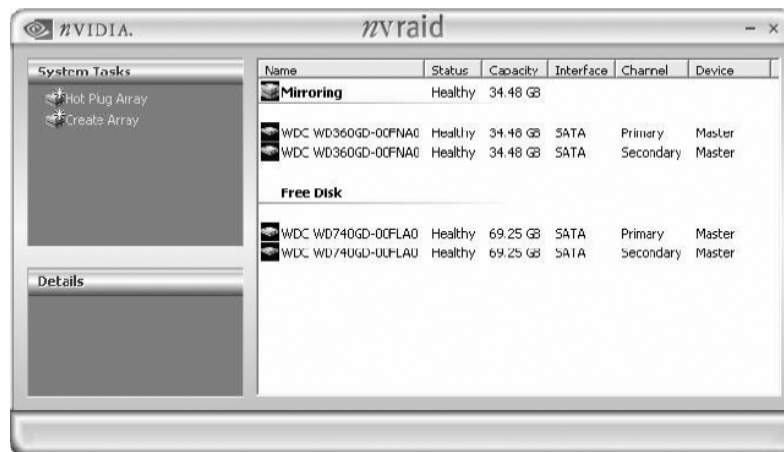
A dedicated free disk is a disk that is assigned to a RAID 1 or RAID 0+1 array and that disk is used by that array only when needed, for example during a system crash where a RAID mirrored drive is broken. The dedicated disk can be used only by the array that it is assigned to and not by any other array, unlike a free disk which can be used by any available RAID 1 or RAID 0+1 array.

Note: You must have at least two RAID arrays to use this feature.

Assigning a Free Disk

To mark a disk as free, or not a part of any array,

1. Enter the system BIOS setup and make sure that the drive that you want to mark as free is RAID enabled.
2. Enter the RAID BIOS and make sure that the drive is not part of any array (if one exists).
3. Boot into Windows and run the NVRAIDMAN program. The drive appears under the Free Disk section.



Assigning a Dedicated Disk

To mark a disk as dedicated, or reserve it for use by a specific array, you must have at least one free disk and you must also have at least two RAID 1 or RAID 0+1 arrays created. In this example, there are four SATA drives and two PATA drives which are RAID enabled. Four SATA drives are used to create two mirrored arrays, while two PATA drives are used as free disks.

Step 1: Mark the Disk as a Free Disk

1. Enter the system BIOS setup and make sure that the drive that you want to mark as free is RAID enabled.
2. Boot into Windows and run the NVRAIDMAN program. If the disk is not part of any RAID array, then it will appear under the Free Disk section of the RAID GUI.

Step 2: Dedicate the Free Disk to an Array

While running NVRAIDMAN, dedicate a free disk to an array by doing the following:

1. Right click one of the available free disks under the Free Disk section.



2. Select Designate Spare from the menu to launch the Spare Disk Allocation Wizard.
3. Click **Next**. The RAID Array Selection page appears.
4. From the RAID Array Selection page, select one of the arrays from the list. This is the array to which you want to allocate the dedicated free disk.
5. Click **Next**. The Completing the NVIDIA Spare Disk Allocation page appears.
6. Click **Finish**.

Removing a Dedicated Disk

Once a dedicated disk has been assigned to a particular array, it can be removed at any time. To remove the disk, right click on the dedicated disk and select the option to remove it.

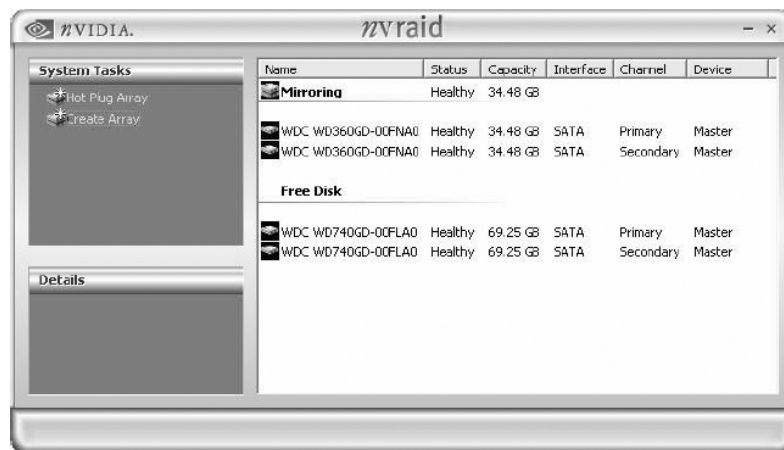
Rebuilding a RAID Array

Rebuilding is the process of recovering data from one hard drive to another. All data is copied from one hard drive to another and then the data is synchronized between the two hard drives. This applies only to RAID 1 as well as a RAID 0+1 arrays.

Rebuilding Instructions

After creating a mirrored array, you can rebuild the array using the following steps:

1. Go to Windows and run the NVIDIA RAID Management utility. Below picture shows an example of a system with one mirrored array and two free disks.



2. Right-click on Mirroring. The pop-up menu appears.
3. From the popup menu, click Rebuild Array. The NVIDIA Rebuild Array Wizard appears.
4. Click **Next**. The Disk Selection page appears.
5. Select the drive that you want to rebuild by clicking it from the list, then click **Next**. The Completing the NVIDIA Rebuild Array page appears.
6. Click **Finish**.

The array rebuilding starts after a few seconds, and a small pop-up message appears towards the bottom right corner of the screen. When the rebuilding process is finished you will see the pop up box.

During the rebuilding process, the NVIDIA RAID Management utility screen shows the status under the System Tasks and Details sections.

More About Rebuilding Arrays

- **Rebuilding Occurs in the Background**

The rebuilding process takes some time to complete, and occurs in the background so as not to affect the performance of the system.

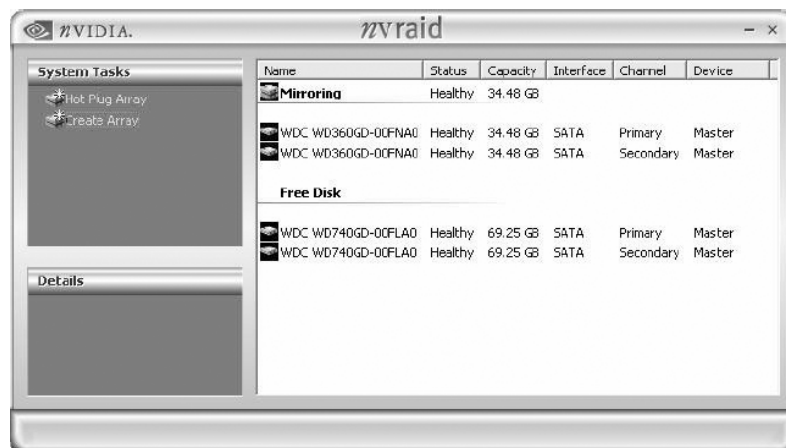
- **Rebuilding Applies Only to RAID 1 or RAID 0+1 Arrays**

Rebuilding an array works only when using RAID 1 and/or RAID 0+1. Rebuilding does not apply to RAID 0 and JBOD arrays.

- **Rebuilding applies to a degraded fault tolerant array**

You can rebuild a degraded mirrored array using any available Free Disk or Dedicated Disk.

For example, below picture shows a mirrored array using two 34.48 GB drives while having two Free Disks each 55.90 GB large.



To use one of these available free disks to rebuild your array, follow the same steps as explained in “Rebuilding a RAID Array” except when prompted to select a disk, choose one of the two available free disks.

Win2K Limitation with Bootable RAID

In Windows 2000 (Service Pack 2 or previous versions), the end user cannot install this operating system to a bootable RAID volume.

There are two solutions to resolve this issue.

I) Use the NVRAID Tool to convert the boot volume to a RAID array.

Here are the detailed step by step instructions:

1. Install Windows 2000 on a selected hard drive.
2. Download and install Windows 2000 Service Pack 4 from Microsoft's website.
3. Reboot the system, press the **DEL** key as the system is rebooting to enter into the system BIOS.
4. Select **Integrated Peripherals** → **RAID Config**.
5. Enable RAID Config for the selected drive (the one containing the Windows 2000 operating system). Then press **F10** to exit and save settings in the system BIOS (This action reboots the System).
6. Press **F10** as the system is rebooting to go into the RAID ROM(The system directs you into the NVIDIA RAID Utility).
7. Select **Striping** under **RAID Mode**. Press **TAB** to go into the **Free Disk** menu. You can use the Right Arrow key to add the desired disk.
8. After that, Press **F7** to finish. Select **N** (NO) when asked to **Clear Disk Data**.
9. Then Press **Ctrl-X** to exit. The system reboots into Windows 2000.
10. Install the NVIDIA nForce Driver Package while in Windows 2000. Then reboot the system.
11. Go to **START>Programs>NVIDIA Corporation** and select **NVRAID Manager**. You should see the single disk RAID array (in striping mode) that was created from the boot disk.
12. Select the single boot disk RAID Array by clicking on it.
13. Select **Convert Array** under the **System Tasks**. The **Convert Array** wizard is displayed. Then Select **Next**.
14. Select the desired type of RAID array you want to convert. Then Select **Next**.

15. You are prompted to select the desired **Free Disk(s)** to add to the bootable RAID array. Click **Finish**.

At this point, NVRAID starts converting the single disk RAID array into a multi-disk RAID array in a bootable format.

Note: Conversion may take 1-2 hours depending on disk size.

II) The user must create a combination installation CD that includes Windows 2000 and SP3 or SP4 fixes integrated in. To create the combination installation CD, refer to the following website:

<http://www.microsoft.com/windows2000/downloads/servicepacks/sp4/HFdeploy.htm>

Note: If the end user chooses not to install Windows 2000 Service Pack 3 or 4, RAID is still supported on Windows 2000. However, the end user will not be able to create a bootable RAID volume.