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Hitachi TagmaStore®
Adaptable Modular Storage
and Workgroup Modular Storage

Performance Monitor Software
User's Guide

MK-95DF706-05

Trademarks

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Document Revision Level

Revision	Date	Description
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MK-95DF706-01	August 2005	Revision 1, supersedes and replaces MK-95DF706-00
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MK-95DF706-05	May 2007	Revision 5, supersedes and replaces MK-95DF706-04

Changes in this Revision

- Updated software version to 7.1 and higher
- Updated sections 2.1, 2.2, and 2.3

Preface

This document describes how to operate Performance Monitor software.

This document assumes the following:

- The user has a background in data processing and understands direct-access storage device (DASD) systems and their basic functions, and
- The user is familiar with the Hitachi Disk Array subsystem.
- The user has read and understands the *TagmaStore Storage Navigator User's Guide* (MK-94RD206).

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Software Version

This document revision applies to TagmaStore™ Adaptable Modular Storage and Workgroup Modular Storage versions 7.1 and higher.

Convention for Storage Capacity Values

Storage capacity values hard disk drives (HDDs) on the TagmaStore AMS/WMS are calculated based on the following values:

1 KB = 1,000 bytes
1 MB = $1,000^2$ bytes
1 GB = $1,000^3$ bytes
1 TB = $1,000^4$ bytes

Storage capacity values logical devices (LDEVs) on the TagmaStore AMS/WMS are calculated based on the following values:

1 KB = 1,024 bytes
1 MB = $1,024^2$ bytes
1 GB = $1,024^3$ bytes
1 TB = $1,024^4$ bytes
1 block = 512 bytes

Referenced Documents

- *Hitachi TagmaStore Storage Navigator User's Guide* (MK-94RD206)

Comments

Please send us your comments on this document. Make sure to include the document title, number, and revision. Please refer to specific section(s) and paragraph(s) whenever possible.

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Chapter 1 About Performance Monitor

Performance Monitor is a controller-based software application that acquires information on the performance of RAID groups, logical units, and other elements of the disk subsystem while tracking the utilization rates of resources such as hard disk drives and processors. Information acquired is displayed with line graphs in the Performance Monitor windows.

This chapter includes the following:

- Overview of Performance Monitor (section 1.1)
- About the Monitoring Process (section 1.2)

1.1 Overview of Performance Monitor

When the disk subsystem is monitored using Performance Monitor, utilization rates of resources in the disk subsystem (such as loads on the disks and ports) can be measured. When a problem such as slow response occurs in a host, the system administrator can quickly determine the source of the difficulty by using the Performance Monitor.

1.2 About the Monitoring Process

Table 1.1 describes the monitoring process.

Table 1.1 Event Sequence in the Monitoring Process

Item	Specifications
Acquisition of information	Performance Monitor acquires information on performance and resource utilization of the disk subsystem.
Graphic display	Performance Monitor displays acquired information with line graphs. It displays the graph as soon as it acquires the information or displays optional information later, after choosing from the information acquired.

Prerequisites for using the Performance Monitor are shown in Table 1.2.

Table 1.2 Performance Monitor Prerequisites

Item	Prerequisite
Setting monitoring parameters	Storage Navigator Modular (AMS) is required
Micro program revision	Micro program 0710/A or later is required.
Concurrent use with optional features	The optional features with which you want to use Performance Monitor

Note: If performance information is acquired from Performance Monitor, Write performance deteriorates up to as much as 10%.

Chapter 2 Preparing to Use Performance Monitor

This chapter explains how to prepare for Performance Monitor operations.

This chapter includes the following:

- Installing Performance Monitor (section 2.1)
- Uninstalling Performance Monitor (section 2.2)
- Enabling and Disabling Performance Monitor (section 2.3)

Because Performance Monitor is an optional software application, it must first be installed. **To install Performance Monitor, you need the key code or key file provided with purchase.**

Use the following instructions to install Performance Monitor. The Performance Monitor is installed and uninstalled using the modular version of Storage Navigator.

Note: The installation, uninstallation, enabling, and disabling of Performance Monitor must be performed separately for each disk subsystem.

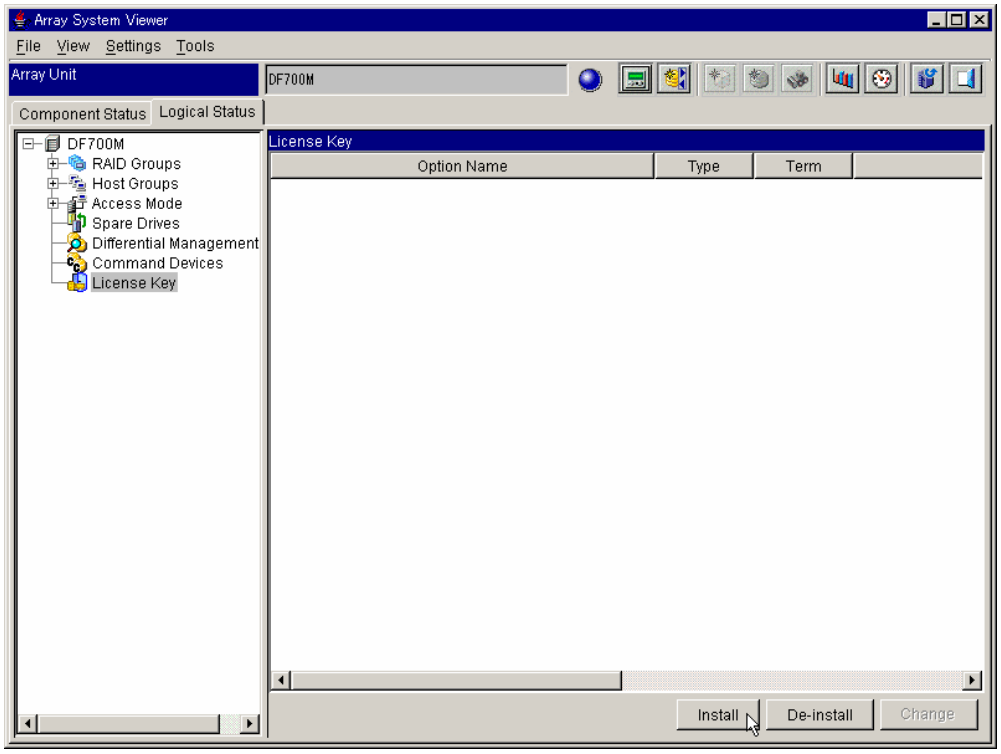
Note: Before installing and uninstalling, make sure that the subsystem is operating normally. Installation, uninstallation, enabling, and disabling of Performance Monitor cannot be performed if the subsystem has a failure.

2.1 Installing Performance Monitor

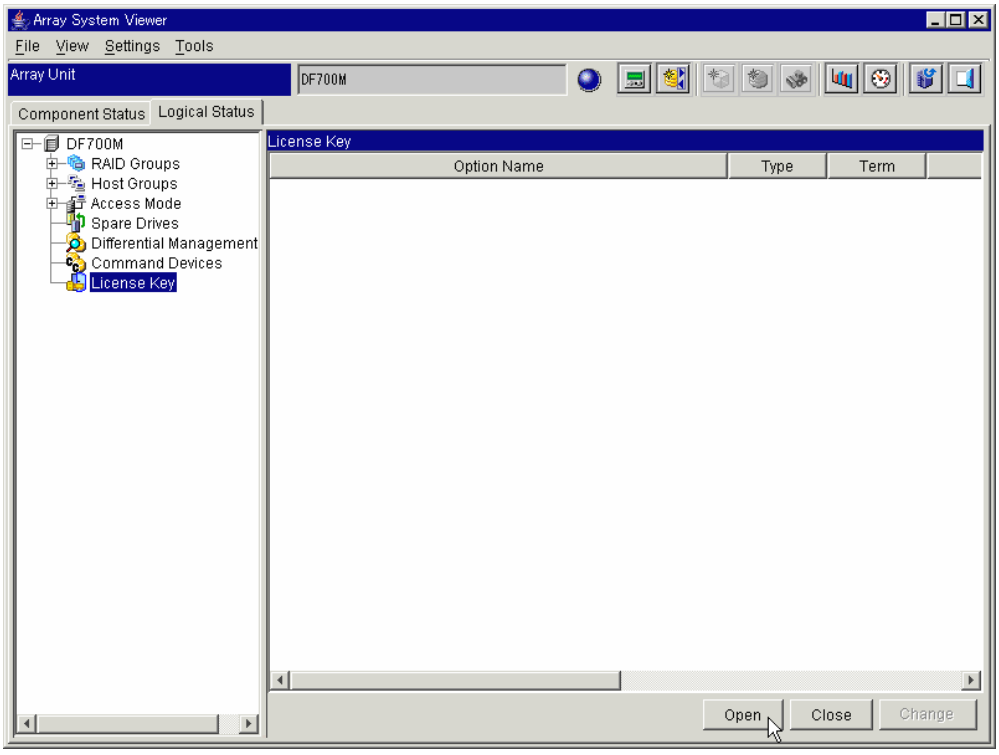
Performance Monitor software is included with the Disk Subsystem microcode. Installation is accomplished by unlocking the code. There is no additional software to install on the disk subsystem.

To install Performance Monitor using the GUI version of Storage Navigator:

1. Start Storage Navigator and change the operation mode to **Management Mode** (administrator mode).
2. Register the subsystem in which you want to install the Performance Monitor feature.
3. Connect to the subsystem.
4. Click the **Logical Status** tab.
5. Click the **License Key** icon.



Navigator: Version 5.00 or later

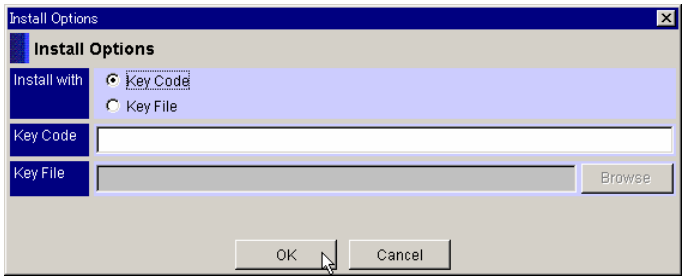


Navigator: Less than 5.00 version

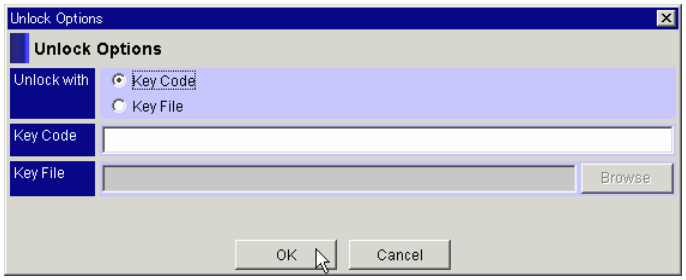
Figure 2.1 Array System Viewer Window (Logical Status Tab)

6. Click **Install**. The **Install Options** dialog box is displayed. (Navigator: Version 5.00 or later)

   Click **Open**. The **Unlock Options** dialog box is displayed. (Navigator: Less than 5.00 version)



Navigator: Version 5.00 or later



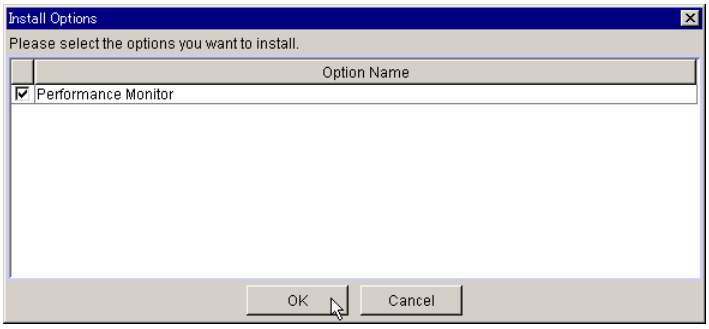
Navigator: Less than 5.00 version

Figure 2.2 Install/Unlock Options Dialog Box

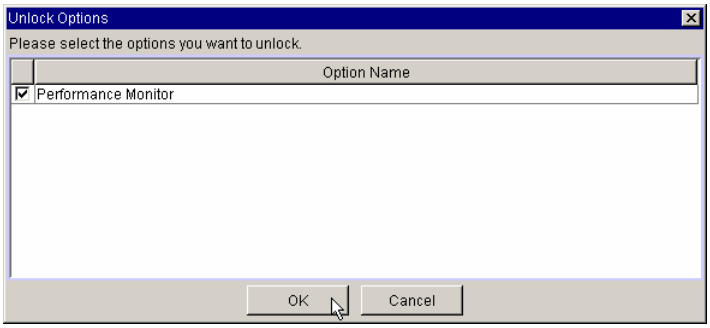
7. When you install the options using a key code, click the **Key Code** radio button, then enter the key code. When you install the options using a key file, click the **Key File** radio button, set up the path for the key file, and click **OK**.

   Use the **Browse** button to set the path to easily select the correct key file path.

8. When you install the options using the key file, a list appears in the **Option Name** window. Verify the **Option Name** and click **OK**.



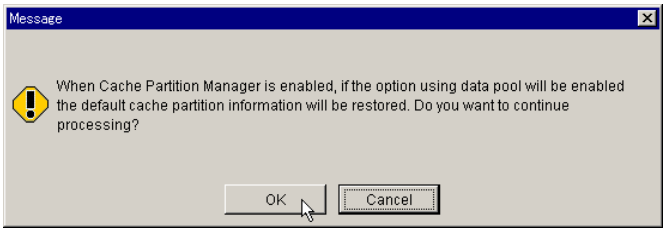
Navigator: Version 5.00 or later



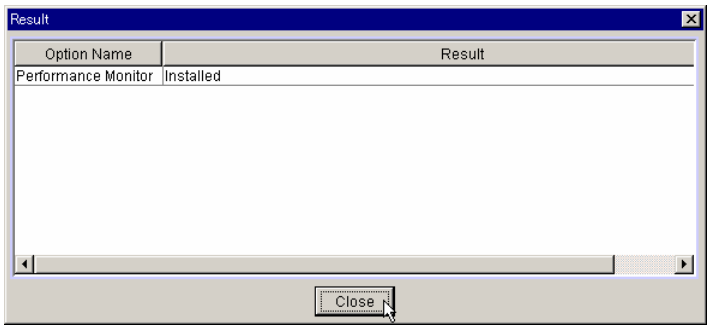
Navigator: Less than 5.00 version

Figure 2.3 Install/Unlock Options – Option Name Dialog Box

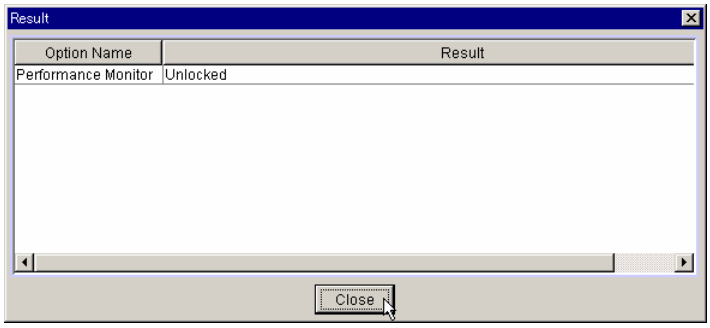
9. A screen requesting confirmation to install Performance Manager is displayed. Click **OK**.
10. When Navigator version is 3.00 or later and Cache Partition Manager is enabled, the following message is displayed. Since Performance Monitor does not use the data pool, click the **OK** button at this point without doing anything else.



11. When you install the options using the key file, the **Result** dialog box is displayed. Click **Close**.



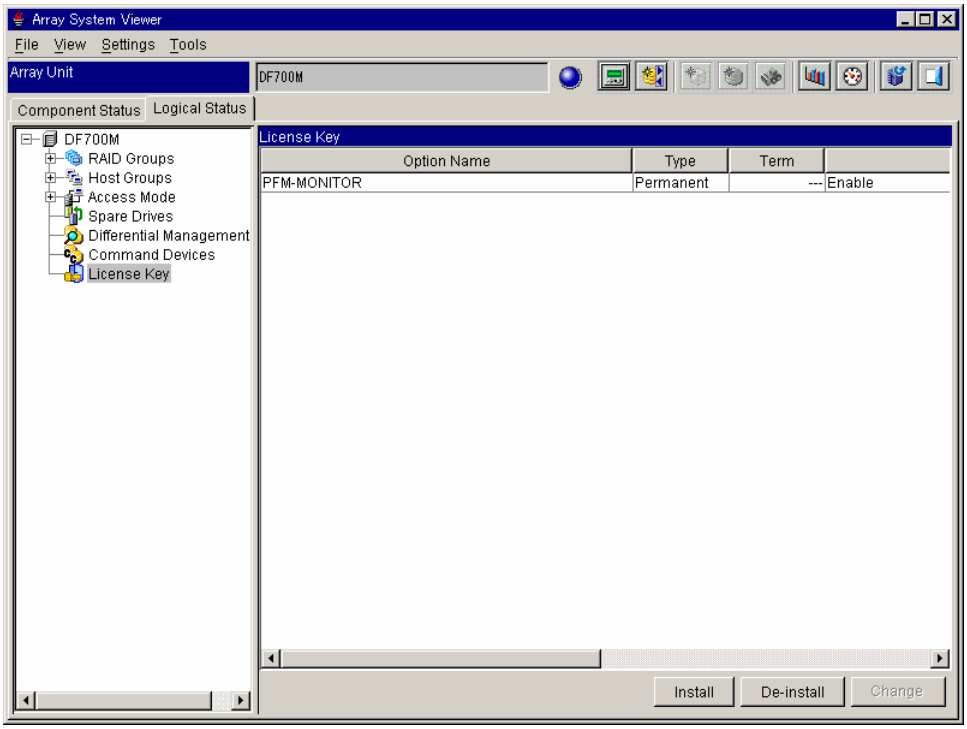
Navigator: Version 5.00 or later



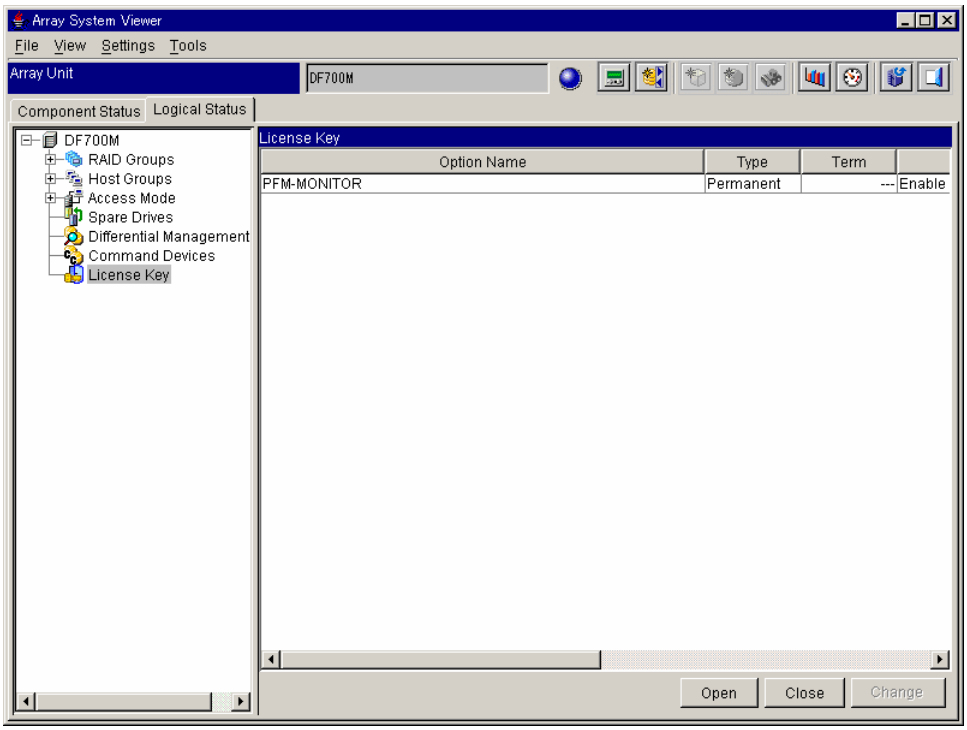
Navigator: Less than 5.00 version

Figure 2.4 Result Dialog Box

In the **Option Name** window, **PFM-MONITOR** is displayed; the status is **Enable** (see Figure 2.5).



Navigator: Version 5.00 or later



Navigator: Less than 5.00 version

Figure 2.5 Array System Viewer Window (Logical Status Page Option: Enable)

Performance Monitor is now ready for use.

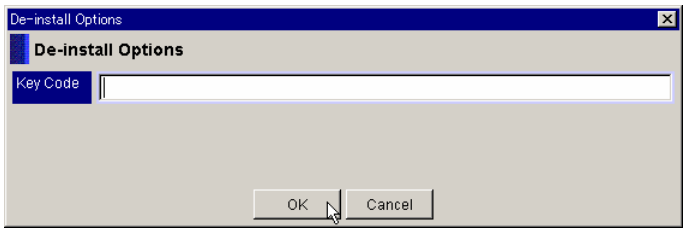
2.2 Uninstalling Performance Monitor

Follow the instructions below to uninstall Performance Monitor. Once uninstalled, Performance Monitor is not available until it is installed by the key code or key file provided by HDS.

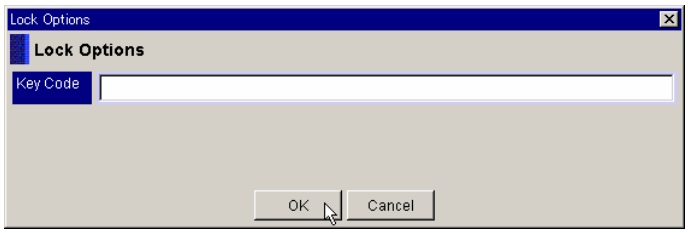
1. Start Storage Navigator Modular and change the operation mode to Management Mode (administrator mode).
2. Register the subsystem in which you will uninstall the Performance Monitor feature and connect to the subsystem.

   The **Array System Viewer** window displays, showing the connected subsystem.
3. Click the **Logical Status** tab.
4. Click the **License Key** icon.
5. Click **De-install**. The **De-install Options** dialog box is displayed. (Navigator: Version 5.00 or later)

   Click **Close**. The **Lock Options** dialog box is displayed. (Navigator: Less than 5.00 version)



Navigator: Version 5.00 or later



Navigator: Less than 5.00 version

Figure 2.6 De-install/Lock Options Dialog Box

6. Enter the appropriate key code in the text box and click **OK**.
7. A screen displays requesting you to confirm the uninstalling of Performance Monitor. Click **OK**.

The Performance Monitor feature is now uninstalled and unavailable.

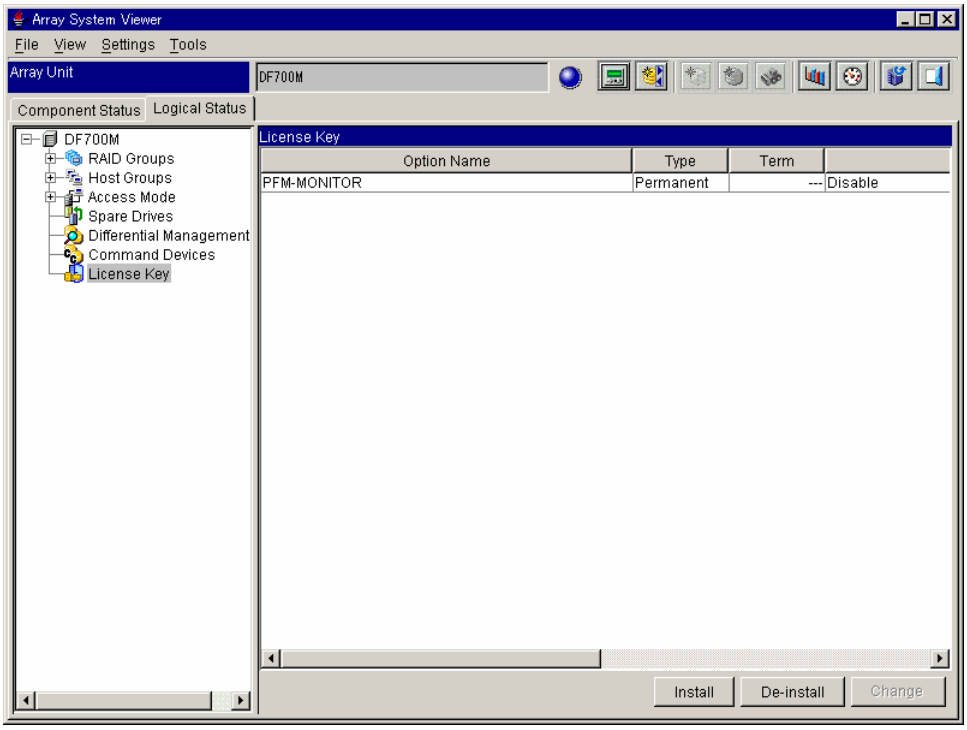
2.3 Enabling and Disabling Performance Monitor

The Performance Monitor feature can be set to enable or disable when it is installed.

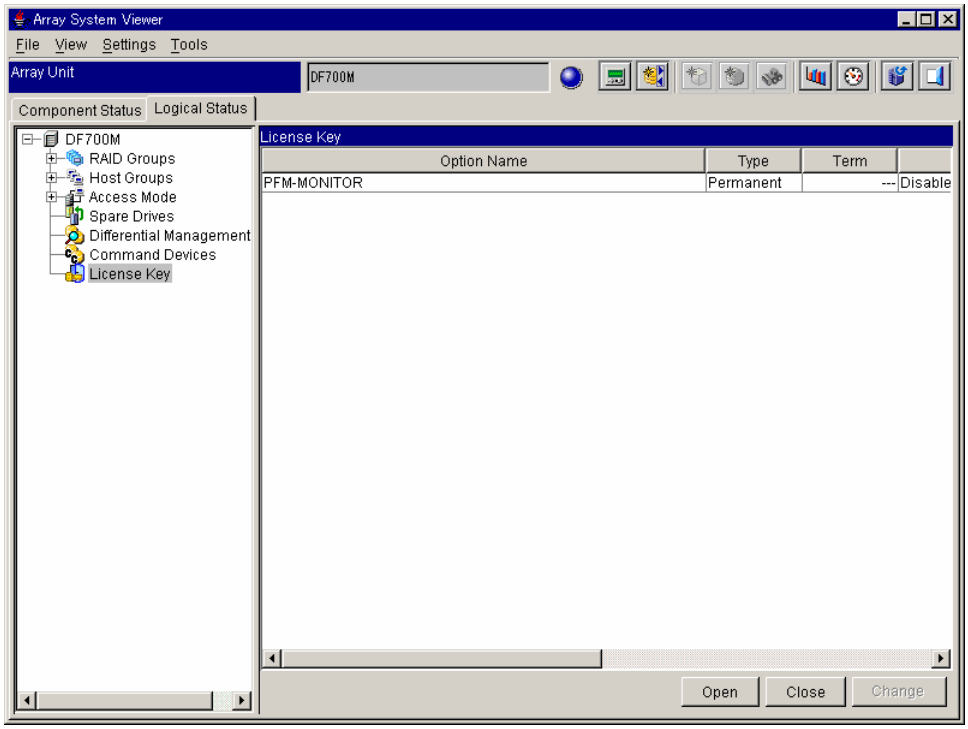
Follow the instructions below to enable/disable Performance Monitor:

1. Start Storage Navigator Modular and change the operation mode to Management Mode (administrator mode).
2. Register the subsystem in which you will change the status of the Performance Monitor feature.
3. Connect to the subsystem.

   The **Array System Viewer** window is displayed showing the connected subsystem.
4. Click the **Logical Status** tab.
5. Click the **License Key** icon.
6. From the **Option Name**, select **PFM-MONITOR** and click **Change**. A message confirming that you want to change the status (enable or disable) is displayed.
7. Click **OK**.



Navigator: Version 5.00 or later



Navigator: Less than 5.00 version

Figure 2.7 Array System Viewer Window (PFM Monitor: Disable)

The status of the Performance Monitor feature is now changed (enabled/disabled).

Chapter 3 Using Performance Monitor

Once enabled, Performance Monitor is ready to acquire resource information and to display the acquired information with line graphs.

This chapter includes the following:

- Specifying Information to be Acquired (section 3.1)
- Acquiring Performance Monitoring Information (section 3.2)
- Using Graphic Displays (section 3.3)
- Output of Performance Monitor Information to a File (section 3.4)
- Optimizing Performance from Acquired Information (section 3.5)

3.1 Specifying Information to be Acquired

Follow the procedure below to specify what information is to be acquired.

1. Start Storage Navigator Modular and change the operation mode to Management Mode (administrator mode).
2. Register the subsystem in which you want to set the acquisition information. Connect to the subsystem.

   The **Array System Viewer** window displays, showing the connected subsystem.
3. From the Tools menu, select **Performance → Settings**.

   The **Performance Statistics** window is displayed.

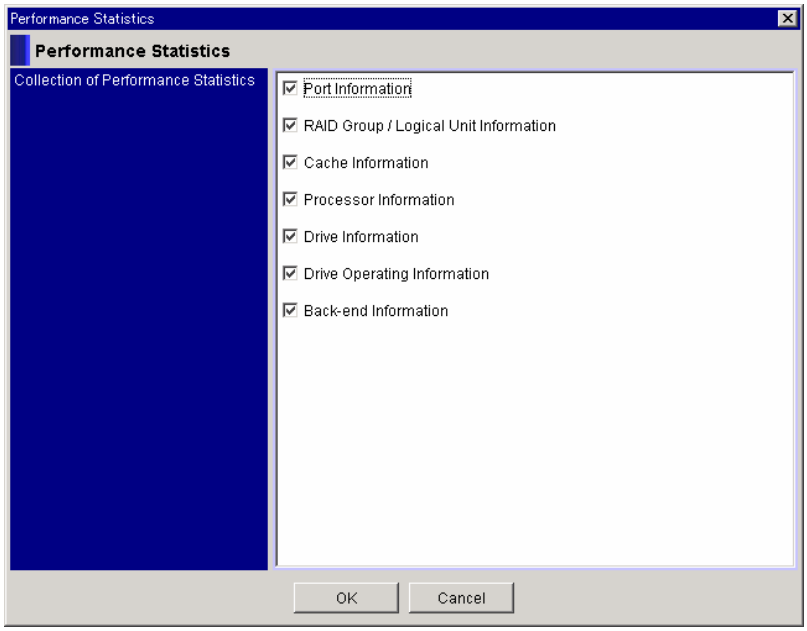


Figure 3.1 Performance Statistics Window

4. A list of available information is displayed. Select the check boxes associated with the information to acquire.
5. Click **Apply**.

6. A message appears, click **OK** (twice).
   - Port Information

     Storage Navigator acquires port I/O and data transfer rates for all Read and Write commands received from a host. It can also acquire the number of commands that made cache hits and cache hit rates for all Read and Write commands.
   - RAID Group/Logical Unit Information

     Storage Navigator acquires all subsystem RAID Group of logical units the I/O and data transfer rates for all Read and Write commands received from a host. In addition, it will also acquire the number of commands that made cache hits and cache hit rates for all Read and Write commands.
   - Cache Information

     Storage Navigator can display the ratio of data in a write queue to the entire cache data and utilization rates of the clean, middle, and physical queues.
     - The clean queue consists of a number of segments of data that have been read from the drives and exist in cache.
     - The middle queue consists of a number of segments that retain write data, have been sent from a host, exist in cache, and have no parity data generated.
     - The physical queue consists of a number of segments that retain data, exist in cache, and have parity data generated, but not written to the drives.
     - For the Cache Hit parameter of the Write command, a Hit is defined as a response to the host that has completed a Write to the Cache (Write-After). Miss is defined as a response to the host that has completed a Write to the drive (Write-Through). When the Cache use volume is large or the battery unit fails, Write-Through is more likely.
   - Processor Information

     Storage Navigator can acquire and display the utilization rate for each processor.
   - Drive Information

     Storage Navigator can acquire the I/O and data transfer rates for all Read and Write commands issued to each drive installed in the disk subsystem. It can also acquire the I/O rate of the online verify command executed in each drive.
   - Drive Operating Information

     Storage Navigator can acquire the drive operation rate and the number of tags. The drive operation time is the period of time from when a command is issued to the drive, to when the command has completed execution. The number of tags is the maximum number of tags per second.
   - Back-end Information

     Storage Navigator can acquire the I/O and the data transfer rates regarding all Read and Write commands issued to each loop of the back end of the disk subsystem. It can also acquire the I/O rate of the online verify command issued to each loop.

3.2 Acquiring Performance Monitoring Information

The procedure for acquiring performance information with Storage Navigator is explained below.

Note: If the performance information is acquired from the Performance Monitor, the Write performance can deteriorate as much as 10 percent.

Information is acquired for each controller.

1. On the **Tools** menu, select **Performance → Display Graph**.

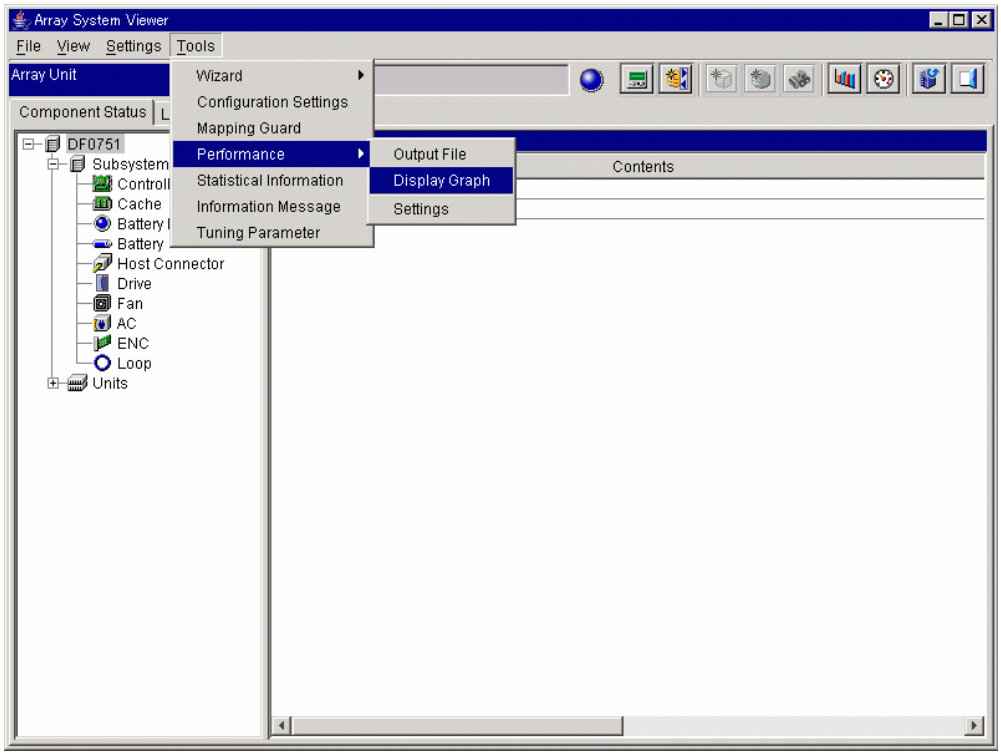


Figure 3.1 Array System Viewer – Tools Menu

The **Performance Monitor** dialog box is displayed.

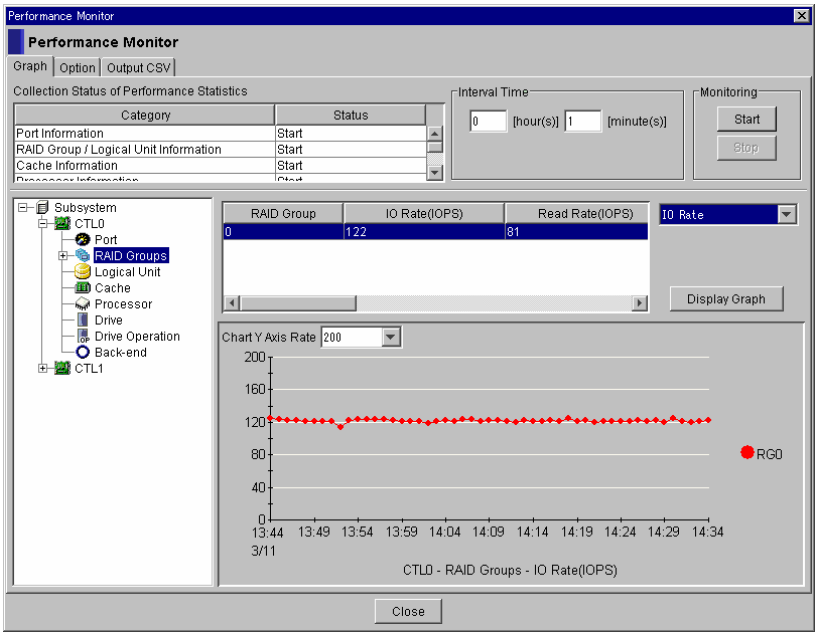


Figure 3.2 Performance Monitor Dialog Box

– Collection Status of Performance Statistics

  Category and Status are displayed according to the selection made in the **Graph - Collection Status of Performance Statistics** tab. For the items listed in the Category column, Start is displayed in the Status column.

– Interval Time

  Specify an interval for acquiring the information by designating units of minutes within a range from one minute to 23 hours and 59 minutes. The default interval is one minute.

– Tree View

  The objects acquired are displayed graphically using icons. When a certain icon is clicked, the details of the corresponding icon are displayed in a list. The icons are explained in Table 3.1.

Table 3.1 Tree View

Icon	Name	Contents
	Subsystem	This icon represents the subsystem. When this icon is clicked, a tree view of icons that belong to the subsystem is displayed. Information on this icon is not displayed in the list.
	CTL0/CTL1	This icon represents the controller. When this icon is clicked, a tree view of icons that belong to the controller is displayed. Information on this icon is not displayed in the list. For a single controller system, an icon of the CTL 1 is not displayed. When one of the controllers is registered with Navigator for a dual controller system, only the icon of the connected controller is displayed.
	Port	Information on the port is displayed in the list.
	RAID Group	Information on the RAID groups that have been defined are displayed in the list.
	RG-nn	Information on the logical units that belong to the each RAID group are displayed in the list.
	Logical Unit	Information on the logical units that have been defined are displayed in the list.
	Cache	Information on the cache is displayed in the list.
	Processor	Information on the processor is displayed in the list.
	Drive	Information on the drive is displayed in the list.
	Drive Operation	Information on the drive operation is displayed in the list.
	Back-end	Information on the back-end is displayed in the list.

– List

Details of items selected in the tree view are displayed (see Table 3.2). The configuration of the disk subsystem and the defined configuration are displayed. During the monitoring process, the display is updated automatically at regular intervals. If the definition of the RAID group or logical unit is changed during the monitoring process, the change produces no effect on the list. Before monitoring is started, the list is blank. After monitoring is started, if the information cannot be acquired due to excessive LAN traffic, etc. when the specified interval has elapsed, "---" is displayed. When an item has not yet been acquired, “N/A” is displayed.

Table 3.2 List Items

Selected Item	List Items	Contents
Port	Port	Port number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	IO Rate (IOPS)	Received number of Read/Write commands per second
	Read Rate (IOPS)	Received number of Read commands per second
	Write Rate (IOPS)	Received number of Write commands per second
	Read Hit (%)	Rate of cache-hitting within the received Read command
	Write Hit (%)	Rate of cache-hitting within the received Write command
	Trans. Rate (MB/s)	Transfer size of Read/Write commands per second
	Read Trans. Rate (MB/s)	Transfer size of Read commands per second
	Write Trans. Rate (MB/s)	Transfer size of Write commands per second
	CTL CMD IO Rate (IOPS)	Number (per second) of sent TrueCopy Initiator control commands. Acquired local side only. Also see ***Note 1***
	Data CMD IO Rate (IOPS)	Number (per second) of sent TrueCopy Initiator data commands. Acquired local side only. Also see ***Note 1***
	CTL CMD Trans. Rate (KB/s)	Transfer size (per second) of TrueCopy Initiator control commands. Acquired local side only. Also see ***Note 1***
	Data CMD Trans. Rate (MB/s)	Transfer size (per second) of TrueCopy Initiator data commands. Acquired local side only. Also see ***Note 1***
	CTL CMD Time (microsec.)	Average response time of TrueCopy Initiator control commands. Acquired local side only. Also see ***Note 1***
	Data CMD Time (microsec.)	Average response time of TrueCopy Initiator data commands. Acquired local side only. Also see ***Note 1***
	CTL CMD Max Time (microsec.)	Maximum response time for TrueCopy Initiator control commands. Acquired local side only. Also see ***Note 1***
	Data CMD Max Time (microsec.)	Maximum response time for TrueCopy Initiator data commands. Acquired local side only. Also see ***Note 1***
RAID Group	RAID Group	RAID group number that have been defined
	IO Rate (IOPS)	Received number of Read/Write commands per second
	Read Rate (IOPS)	Received number of Read commands per second
	Write Rate (IOPS)	Received number of Write commands per second
	Read Hit (%)	Rate of cache-hitting within the received Read command
	Write Hit (%)	Rate of cache-hitting within the received Write command
	Trans. Rate (MB/s)	Transfer size of Read/Write commands per second
	Read Trans. Rate (MB/s)	Transfer size of Read commands per second
	Write Trans. Rate (MB/s)	Transfer size of Write commands per second
Logical Unit	LUN	Logical unit number that have been defined

Selected Item	List Items	Contents
	IO Rate (IOPS)	Received number of Read/Write commands per second
	Read Rate (IOPS)	Received number of Read commands per second
	Write Rate (IOPS)	Received number of Write commands per second
	Read Hit (%)	Rate of cache-hitting within the received Read command
	Write Hit (%)	Rate of cache-hitting within the received Write command
	Trans. Rate (MB/s)	Transfer size of Read/Write commands per second
	Read Trans. Rate (MB/s)	Transfer size of Read commands per second
	Write Trans. Rate (MB/s)	Transfer size of Write commands per second
	Tag Count	Tag Count per second
	Data CMD IO Rate (IOPS)	Number (per second) of sent TrueCopy Initiator control commands. Acquired local side only. Also see ***Note 1***
	Data CMD Trans. Rate (MB/s)	Transfer size (per second) of TrueCopy Initiator data commands. Acquired local side only. Also see ***Note1***
Cache	Write Pending Rate (%) (See ***Note 2***)	Rate of cache usage capacity within the cache capacity
	Clean Queue Usage Rate (%) (See ***Note 2***)	Clean cache usage rate
	Middle Queue Usage Rate (%) (See ***Note 2***)	Middle cache usage rate
	Physical Queue Usage Rate (%) (See ***Note 2***)	Physical cache usage rat
	Total Queue Usage Rate (%)	Total cache usage rate
Processor	Usage (%)	Operation rate of the processor
Drive	Unit	Unit number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	HDU	HDU number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	IO Rate (IOPS)	Received number of Read/Write commands per second
	Read Rate (IOPS)	Received number of Read commands per second
	Write Rate (IOPS)	Received number of Write commands per second
	Trans. Rate (MB/s)	Transfer size of Read/Write commands per second
	Read Trans. Rate (MB/s)	Transfer size of Read commands per second
	Write Trans. Rate (MB/s)	Transfer size of Write commands per second
	Online Verify Rate (IOPS)	Number of Online Verify commands per second
Drive Operation	Unit	Unit number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	HDU	HDU number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	Operating Rate (%)	Operation rate of the drive

Selected Item	List Items	Contents
	Tag Count	Tag Count
Back-end	Path	Path number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	Loop	Loop number (The maximum numbers of resources that can be installed in the subsystem are displayed.)
	IO Rate (IOPS)	Received number of Read/Write commands per second
	Read Rate (IOPS)	Received number of Read commands per second
	Write Rate (IOPS)	Received number of Write commands per second
	Trans. Rate (MB/s)	Transfer size of Read/Write commands per second
	Read Trans. Rate (MB/s)	Transfer size of Read commands per second
	Write Trans. Rate (MB/s)	Transfer size of Write commands per second
	Online Verify Rate (IOPS)	Number of Online Verify commands per second

Note 1: The term TrueCopy includes TrueCopy remote replication and TrueCopy Extended Distance.

Note 2: Total cache usage rate and cache usage rate per partition are displayed.

- Displayed Items

  Specify items to be graphically illustrated by selecting them from the listed items. Items listed in the drop-down list are determined according to the selection made in the tree view. Details of the items available to be selected in the tree view are displayed in Table 3.3.

Table 3.3 Displayed Items

Selected Item	Displayed Items
Port	IO Rate
	Read Rate
	Write Rate
	Read Hit
	Write Hit
	Trans. Rate
	Read Trans. Rate
	Write Trans. Rate
	CTL CMD IO Rate
	Data CMD IO Rate
	CTL CMD Trans. Rate
	Data CMD Trans. Rate

	CTL CMD Time
	Data CMD Time
	CTL CMD Max Time
	Data CMD Max Time
RAID Group	IO Rate
	Read Rate
	Write Rate
	Read Hit
	Write Hit
	Trans. Rate
	Read Trans. Rate
	Write Trans. Rate
Logical Unit	IO Rate
	Read Rate
	Write Rate
	Read Hit
	Write Hit
	Trans. Rate
	Read Trans. Rate
	Write Trans. Rate
	Tag Count
	Data CMD IO Rate
	Data CMD Trans. Rate
Cache	Write Pending Rate (See ***Note***)
	Clean Queue Usage Rate (See ***Note***)
	Middle Queue Usage Rate (See ***Note***)
	Physical Queue Usage Rate (See ***Note***)
	Total Queue Usage Rate
Processor	Usage
Drive	IO Rate
Back-end	Read Rate
	Write Rate
	Trans. Rate
	Read Trans. Rate
	Write Trans. Rate

	Online Verify Rate
Drive Operation	Operating Rate
	Tag Count

Note: Total cache usage rate and cache usage rate per partition are displayed.

2. Specify the Interval Time.
3. When starting the monitoring process, select the items you want represented as a graph from those in the list.

   You can select one to eight items.
4. Click **Start**.

   When the first interval elapses, the graph is displayed.

   Note: If the following phenomena occur during monitoring, invalid data may be displayed.

   - subsystem power off
   - controller failure
   - Storage Navigator Modular could not acquire data by a network obstacle
5. While the information is being acquired, you can change the display of the graph.

   The graduations on the Y-axis of the graph are changed by selecting values from the pull-down menu of the maximum value on the Y-axis. When the item to be displayed is selected from the pull-down menu and **Display Graph** is clicked, the displayed graph changes. When you want to refer to other information that has been acquired, select the items displayed in the list by clicking the icon in the tree view (the displayed graph briefly disappears). Select the item to be displayed, and then click **Display Graph**. When the graphic display changes, the acquisition of information is continued.
6. To stop the acquisition, click **Stop**.

3.3 Using Graphic Displays

The procedure for displaying the graphs using Storage Navigator is explained below.

1. Acquire the information.

   Information will be lost when the **Performance Monitor** dialog box is closed; therefore, examine each graph after information for it has been acquired.

2. Select the item you want to display from those in the list, then click **Display Graph**.

   The selected item is displayed.

   Note: The data of the graphic display cannot be saved. Copy the display on the screen, when necessary. When Version 10.05 or later of Resource Manager 9500V is used, the information can be stored in the CSV file.

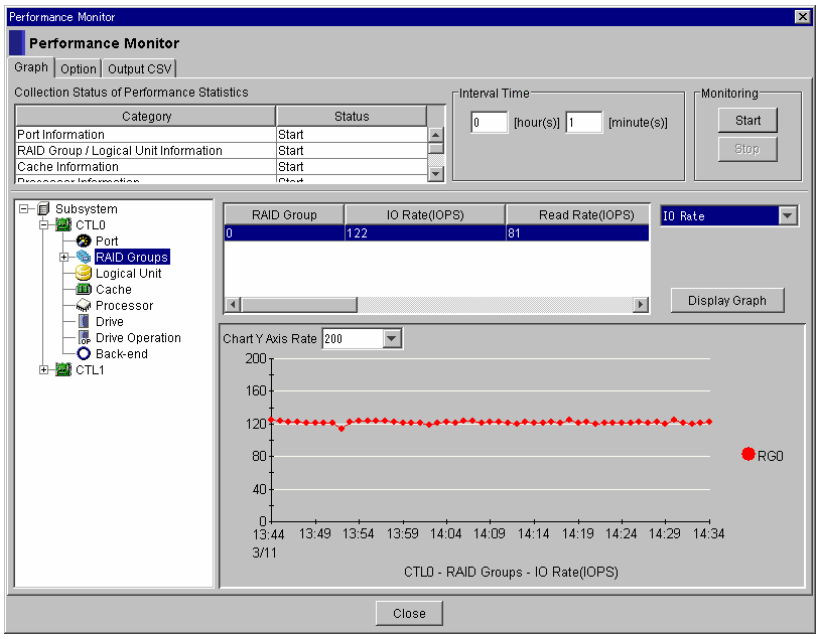


Figure 3.3 Performance Monitor Dialog (Graph)

The time and date when the information was acquired is displayed on the axis of the abscissa. The axis of the ordinate is determined by selecting the maximum value on the Y-axis. Selectable values vary according to the item selected. The relationship between the displayed items and the maximum values on the Y-axis is shown in Table 3.4. The underlined values are default settings. In the graph, five datum corresponding to particular intervals are plotted per one graduation, and the name of the item being displayed is shown below the graph.

Note: If the following phenomena occur during monitoring, invalid data may be displayed.

- subsystem power off
- controller failure
- Storage Navigator Modular could not acquire data by a network obstacle

Table 3.4 Graphic Display

Selected Item	Display Items	Selectable Y Axis Value
Port	IO Rate	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000,
	Read Rate	100000, 150000
	Write Rate	
	Read Hit	20, 50, 100
	Write Hit	
	Trans. Rate	0, 20, 50, 100, 200, 500, 1000, 2000
	Read Trans. Rate	
	Write Trans. Rate	
	CTL CMD IO Rate	10, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000
	Data CMD IO Rate	10, 50, 100, 500, 1000, 2000, 5000, 10000, 20000, 50000
	CTL CMD Trans. Rate	10, 20, 50, 100, 200, 500, 1000, 5000, 10000, 50000, 100000, 150000
	Data CMD Trans. Rate	10, 20, 50, 100, 200, 400
	CTL CMD Time	100, 500, 1000, 5000, 10000, 20000, 50000, 100000, 200000, 500000, 1000000, 5000000, 10000000, 60000000
	Data CMD Time	100, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000, 500000, 1000000, 5000000, 10000000, 60000000
	CTL CMD Max Time	100, 500, 1000, 5000, 10000, 50000, 100000, 200000, 500000,
	Data CMD Max Time	1000000, 2000000, 5000000, 10000000, 60000000
RAID Group	IO Rate	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000,
	Read Rate	100000, 150000
	Write Rate	
	Read Hit	20, 50, 100
	Write Hit	
	Trans. Rate	0, 20, 50, 100, 200, 500, 1000, 2000
	Read Trans. Rate	
	Write Trans. Rate	
Logical Unit	Write Rate	
	Read Hit	20, 50, 100
	Write Hit	
	Trans. Rate	0, 20, 50, 100, 200, 500, 1000, 2000
	Read Trans. Rate	
	Write Trans. Rate	
	Tag Count	500, 1000, 2000, 5000, 10000, 20000, 50000, 100000

	Data CMD IO Rate	10, 50, 100, 500, 1000, 2000, 5000, 10000, 20000, 50000
	Data CMD Trans. Rate	10, 20, 50, 100, 200, 400
Cache	Write Pending Rate ***Note***	20, 50, 100
	Clean Queue Usage Rate ***Note***	
	Middle Queue Usage Rate ***Note***	
	Physical Queue Usage Rate ***Note***	
	Total Queue Usage Rate	
Processor	Usage	
Drive	IO Rate	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000
	Read Rate	
	Write Rate	
	Trans. Rate	10, 20, 50, 100, 200, 500, 1000, 2000
	Read Trans. Rate	
	Write Trans. Rate	
	Online Verify Rate	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000
Drive Operation	Operating Rate	20, 50, 100
	Tag Count	
Back-end	IO Rate	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000
	Read Rate	
	Write Rate	
	Trans. Rate	10, 20, 50, 100, 200, 500, 1000, 2000
	Read Trans. Rate	
	Write Trans. Rate	
	Online Verify Rate	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000

Note: Total cache usage rate and cache usage rate per partition are displayed.

Select the maximum value on the Y-axis from the line graph displayed. When the maximum value on the Y-axis is too small, data larger than the maximum value cannot be displayed. When **Display Graph** is clicked, the maximum value on the Y-axis is set as the default value. However, when the item to be displayed is not changed, the graph displayed is based on the maximum value on the previously used Y-axis.

3. The item to be displayed can be changed through the following operation.

   Graduations on the graph's Y-axis are changed by selecting values from the pull-down menu of the maximum value on the Y-axis. When the item to be displayed is selected from the pull-down menu and **Display Graph** is clicked, the displayed graph is changed. To refer to other information that has been acquired, select the items displayed in the list by clicking the icon in the tree view (the displayed graph briefly disappears). Select the item to be displayed, then click **Display Graph**. When the graphic display is changed, the acquisition of information is continued.

4. To terminate the graphic display, click **Close**.

   The **Performance Monitor** dialog box is closed.

3.4 Output of Performance Monitor Information to a File

The procedure for storing the monitoring data to the CSV file is shown.

1. Select the **Option** tab in the **Performance Monitor** dialog box, and place a check mark in the **Save Monitoring Data** check box.

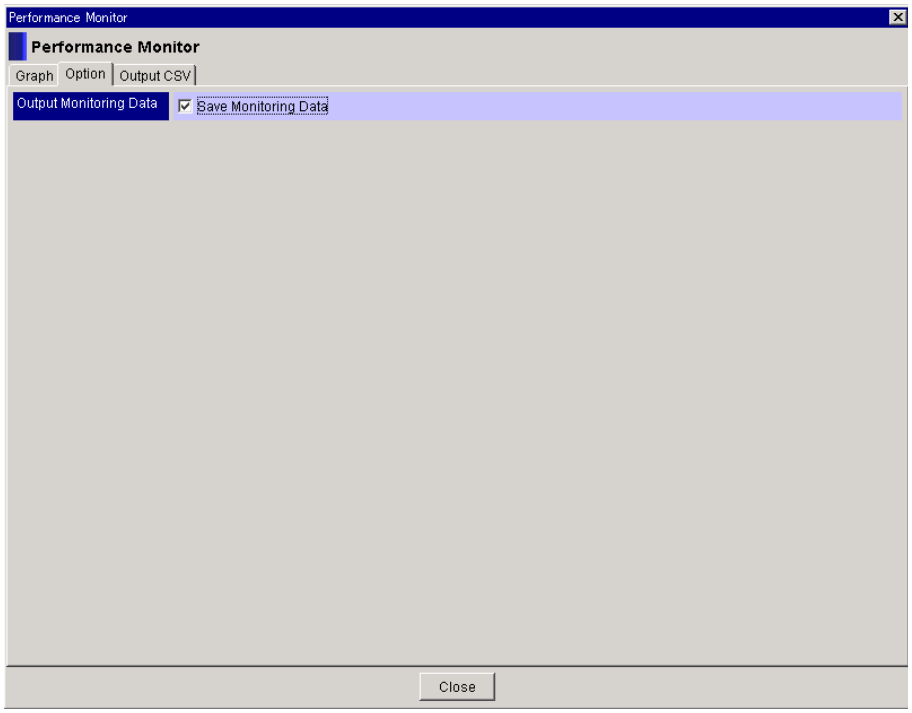


Figure 3.4 Performance Monitor – Save Monitoring Data

2. Return to the **Graph** tab window and start monitoring.
3. When you have collected the monitoring data, click **Stop**.

4. Click the **Output CSV** tab and select the **Output Item**(s) you want to output.

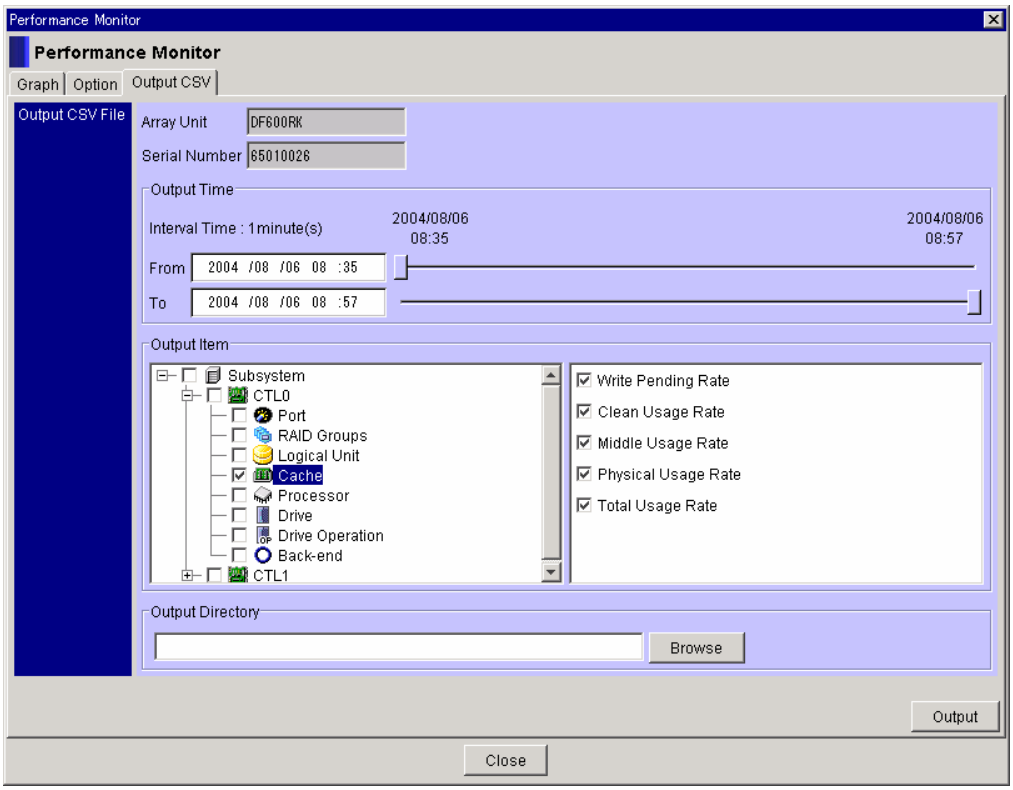


Figure 3.5 Performance Monitor - Output CSV

- **Array Unit**: A name of the disk array subsystem, from which the data was collected, is displayed.
- **Serial Number**: A serial number of the disk array subsystem, from which the data was collected, is displayed.
- **Output Time**: Specify the period, when the data to be output is produced, using the From and To sliders. Interval Time: An interval between the data collections is displayed.
- **Output Item**: Check on the item(s) you want to output.
- **Output Directory**: Specify a directory under which the CSV file is to be output. It can be specified by clicking **Browse**.

5. Click **Output**.

Table 3.5 displays a list of the CSV files to be output.

Table 3.5 CSV File Name

Selected Item	List Items	CSV File Name
Port	IO Rate	CTL0_Port_IORate.csv
	Read Rate	CTL0_Port_ReadRate.csv
	Write Rate	CTL0_Port_WriteRate.csv
	Read Hit	CTL0_Port_ReadHit.csv
	Write Hit	CTL0_Port_WriteHit.csv
	Trans. Rate	CTL0_Port_TransRate.csv
	Read Trans. Rate	CTL0_Port_ReadTransRate.csv
	Write Trans. Rate	CTL0_Port_WriteTransRate.csv
	CTL CMD IO Rate	CTL0_Port_CTL_CMD_IORate.csv
	Data CMD IO Rate	CTL0_Port_Data_CMD_IORate.csv
	CTL CMD Trans. Rate	CTL0_Port_CTL_CMD_TransRate.csv
	Data CMD Trans. Rate	CTL0_Port_Data_CMD_TransRate.csv
	CTL CMD Time	CTL0_Port_CTL_CMD_Time.csv
	Data CMD Time	CTL0_Port_Data_CMD_Time.csv
	CTL CMD Max Time	CTL0_Port_CTL_CMD_Max_Time.csv
	Data CMD Max Time	CTL0_Port_Data_CMD_Max_Time.csv
RAID Group	IO Rate	CTL0_RG_IORate.csv
	Read Rate	CTL0_RG_ReadRate.csv
	Write Rate	CTL0_RG_WriteRate.csv
	Read Hit	CTL0_RG_ReadHit.csv
	Write Hit	CTL0_RG_WriteHit.csv
	Trans. Rate	CTL0_RG_TransRate.csv
	Read Trans. Rate	CTL0_RG_ReadTransRate.csv
	Write Trans. Rate	CTL0_RG_WriteTransRate.csv
Logical Unit	IO Rate	CTL0_LU_IORate*nn.csv*
	Read Rate	CTL0_LU_ReadRate*nn.csv*
	Write Rate	CTL0_LU_WriteRate*nn.csv*
	Read Hit	CTL0_LU_ReadHit*nn.csv*
	Write Hit	CTL0_LU_WriteHit*nn.csv*
	Trans. Rate	CTL0_LU_TransRate*nn.csv*
	Read Trans. Rate	CTL0_LU_ReadTransRate*nn.csv*
	Write Trans. Rate	CTL0_LU_WriteTransRate*nn.csv*
	Tag Count	CTL0_Luex_TagCountnn.csv

Selected Item	List Items	CSV File Name
	Data CMD IO Rate	CTL0_LU_Data_CMD_IORate*nn*.csv
	Data CMD Trans. Rate	CTL0_LU_Data_CMD_TransRate*nn*.csv
Cache	Write Pending Rate	CTL0_Cache_WritePendingRate.csv
	(per partition)	CTL0_CachePartition_WritePendingRate.csv
	Clean Usage Rate	CTL0_Cache_CleanUsageRate.csv
	(per partition)	CTL0_CachePartition_CleanUsageRate.csv
	Middle Usage Rate	CTL0_Cache_MiddleUsageRate.csv
	(per partition)	CTL0_CachePartition_MiddleUsageRate.csv
	Physical Usage Rate	CTL0_Cache_PhysicalUsageRate.csv
	(per partition)	CTL0_CachePartition_PhysicalUsageRate.csv
	Total Usage Rate	CTL0_Cache_TotalUsageRate.csv
Processor	Usage	CTL0_Processor_Usage.csv
Drive	IO Rate	CTL0_Drive_IORare*nn.csv*
	Read Rate	CTL0_Drive_ReadRate*nn.csv*
	Write Rate	CTL0_Drive_WriteRate*nn.csv*
	Trans. Rate	CTL0_Drive_TransRate*nn.csv*
	Read Trans. Rate	CTL0_Drive_ReadTransRate*nn.csv*
	Write Trans. Rate	CTL0_Drive_WriteTransRate*nn.csv*
	Online Verify Rate	CTL0_Drive_OnlineVerifyRate*nn.csv*
Drive Operation	Operating Rate	CTL0_DriveOpe_OperatingRate*nn.csv*
	Tag Count	CTL0_DriveOpe_TagCount*nn.csv*
Back-end	IO Rate	CTL0_Back-end_IORate*nn.csv*
	Read Rate	CTL0_Back-end_ReadRate*nn.csv*
	Write Rate	CTL0_Back-end_WriteRate*nn.csn*
	Trans. Rate	CTL0_Back-end_TransRate*nn.csv*
	Read Trans. Rate	CTL0_Back-end_ReadTrans*nn.csv*
	Write Trans. Rate	CTL0_Back-end_WriteTrans*nn.csv*
	Online Verify Rate	CTL0_Back-end_OnlineVerifyRate*nn.csv*

Note 1: In case of controller1, CSV file name is changed to *CTL1*.

Note 2: *nn* denotes a serial number from 01 to 99.

Note 3: Utilize the CSV files by making graphs of them by using Excel or a similar program.

Note 4: If the following phenomena occur during monitoring, invalid data may be displayed.

- subsystem power off
- controller failure
- Storage Navigator Modular could not acquire data by a network obstacle

3.5 Optimizing Performance from Acquired Information

This section describes optimizing performance from acquired information.

3.5.1 The Method of Performance Optimization

If a performance problem occurs, review and analyze the cause of the unbalanced performance, then reach a solution based on performance information acquired from the Performance Monitor (displayed in Figure 3.6).

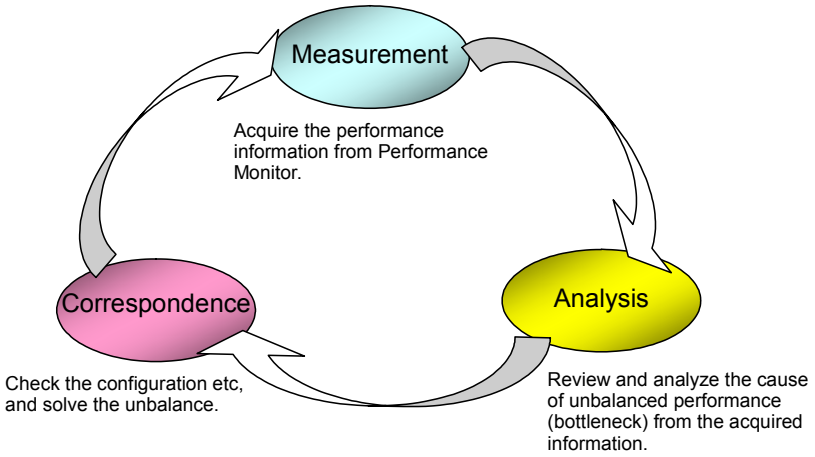


Figure 3.6 The Method of Performance Optimization

3.5.2 Performance Imbalance and the Solution

Performance can be imbalanced in the following locations:

- Between Control Units
- Between Ports
- Between RAID Groups
- Between Back-ends

This section provides methods for resolving this problem and attaining balanced, optimized performance.

- Between the Control Units

  Each Control Unit load can be determined from the Processor operation rate and each Cache use rate. If the load per Control Unit differs widely, the load of the whole system may be redistributed by changing the Logical Unit of each Control Unit. The load of Logical Unit can be determined from the I/O Rate and the Transfer Rate per Logical Unit. The load between the Control Units can be redistributed by changing the owner of the controller of the Logical Unit with the larger load to a Control Unit with a smaller load.

- Between Ports

  Each Port load in the disk subsystem can be determined from the I/O Rate and the Transfer Rate of Port. If the load per Port varies widely, the load of the whole disk subsystem may be redistributed by transferring the Logical Unit, which belongs to the Port with the larger load, to a Port with a smaller load.

- Between RAID Groups

  Each RAID Group load in the disk subsystem can be determined from the I/O Rate and the Transfer Rate of the RAID Group information. If the load per RAID Group varies widely, the load of the drive may be redistributed by transferring the Logical Unit, which belongs to the RAID Group with the larger load, to a Raid Group with a smaller load.

- Between Back-ends

  Each Back-End Loop load in the disk subsystem can be determined from the I/O Rate and the Transfer Rate of the Back-end information. If the load per Back-end Loop varies widely, the load can be redistributed by transferring the RAID Group and the Logical Unit, which belong to the Back-end Loop with the larger load, to a Back-End Loop with a smaller load. For a Back-end Loop transfer, the method of changing the owner of the controller of each Logical Unit is effective, but an unbalance between the Control Units may occur.

Note: When changing the owner of the controller of a Logical Unit, the host disk subsystems may need to be reconnected, depending on the configuration.

Acronyms and Abbreviations

AMS	Adaptable Modular Storage
CSV	comma separated value
GUI	graphical user interface
HDS	Hitachi Data Systems
HDU	hard disk unit
I/O	Input/Output
LAN	local area network
LU	logical unit
MB	megabyte
LUN	logical unit number
RAID	redundant array of inexpensive disks
WMS	Workgroup Modular Storage

Glossary

Capacity

Capacity is the amount of information (in bytes) that can be stored on a disk drive. The capacity of a hard disk drive is usually expressed in megabytes. Capacity is the measure of the potential contents of a device; the volume it can contain or hold. In communications, capacity refers to the maximum possible data transfer rate of a communications channel under ideal conditions.

Configuration

Configuration for hardware involves setting various switches and jumpers. For software it means defining the values of parameters. For hardware and software respectively, configuration is the arrangement of the components that make up the system or the set up and set values of the software.

L

Logical

Logical is used to describe a user's view of the way data or systems are organized. The opposite of logical is physical, which refers to the real organization of a system. A logical description of a file is that it is a quantity of data collected together in one place. The file appears this way to users. Physically, the elements of the file could live in segments across a disk.

M

Microcode

Microcode is the lowest-level instructions directly controlling a microprocessor. Microcode is generally hardwired and cannot be modified.

P

Parity

The quality of being either odd or even. The fact that all numbers have a parity is commonly used in data communications to ensure the validity of data. This is called parity checking. So parity provides an error detection scheme that uses an extra checking bit, called the parity bit, to allow the receiver to verify that the data is error free.

S

Service

A service is the set of functions that one of the seven (7) Open Systems Interconnection (OSI) model layers delivers to the layer above it. For example, the TCP layer provides a reliable byte-stream service to the application layer above it.

V

Volume

A volume is the basic unit of storage that includes recovery logs and storage pools. A volume can be a logical volume management (LVM) logical volume, a standard file system file, a tape cartridge, or an optical cartridge. The various types of defined volumes include: external, internal, copy source, copy destination, reserve, data, journal, virtual, pool, system, LUSE, copy pair, and USP.

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