User’s Guide

NVIDIA Control Panel & NVIDIA System Monitor

With ESA Support
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This Reviewer's Guide contains information on the NVIDIA® NVIDIA Control Panel and NVIDIA System Monitor.

Specifically, this guide discusses the following:

- **Section 1: Initial Walk-through** — An 7-step walkthrough
- **Section 2: Comprehensive Guide** — A detailed description of the NVIDIA Control Panel and NVIDIA System Monitor
- **Section 3: ESA Technology Brief** — The Enthusiast System Architecture (ESA)

We encourage you to browse all this information prior to testing and refer to it while you are writing your story. You can obtain photos, drivers, in-depth technical briefs, product demonstrations and other information from the NVIDIA Extranet site under your personalized Login at:

http://partners.nvidia.com

If you do not yet have a personalized Login please contact your NVIDIA PR representative

A Reviewer’s Guide does not take the place of personal contact, and we welcome your e-mails and phone calls if there is any additional information you need.

See NVIDIA Contact Information on page 46 for NVIDIA contact information.
Initial Walk-Through

Getting Started

Built upon the foundation of NVIDIA’s core motherboard and GPU technologies, the NVIDIA Control Panel and NVIDIA System Monitor software utilities bring consolidated control and reporting to the desktop in seamless fashion. Initially, you will simply configure NVIDIA System Monitor to track and log appropriate data and then utilize the new functionality of NVIDIA’s Control Panel to manipulate and optimize system settings and characteristics.

Basic Initial Process Outline

1. Open NVIDIA System Monitor
2. Choose component to monitor
3. Select desired data fields to monitor for that component and repeat for other devices
4. Enable logging (if desired)
5. Exit configuration mode to see real-time system information and graphs
6. Open NVIDIA Control Panel and navigate to Performance Group
7. Select desired performance parameters for each component
Using NVIDIA System Monitor

You can start NVIDIA System Monitor several ways:

- Double-click the NVIDIA System Monitor icon on the desktop.
- Click **Start**, then click **All Programs**Æ**NVIDIA Corporation**Æthen select **NVIDIA System Monitor**.

**NVIDIA System Monitor — Choose Component**

Once NVIDIA System Monitor loads, you are presented with a collection of system components. By clicking on a particular device, that component is selected and all available data fields are presented. As shown above, the CPU's presentation is comprised of key voltages, temperatures, and status information.
The process of configuring data fields to be reported real-time is extremely intuitive and concise. Simply double-clicking a particular field brings that data point to the top of the screen and queues it for display in the real-time view. Once you have selected all the desired fields for a given component, click on the next device you want to monitor and select additional fields.
By selecting “Global Properties” at the bottom of the page, you are able to further customize the application to suit your taste and needs. Here, you have the option to control appearances, customize event logging, and even specify custom hotkeys for key functionality within NVIDIA System Monitor.

By clicking on the Event Log section, you are presented with a list of all components that can be logged. Standard components are represented as a drop menu, with available data fields rolled-up below the device. In contrast, ESA-devices have a unique line item for each data field that can be logged. By checking appropriate boxes, you can dictate which system values will be logged and then customize the name of the ensuing output.
Once the appropriate configuration is selected, you must press the designated hotkey to begin the logging process.

Once you have completed all the necessary steps within the configuration view of NVIDIA System Monitor, you can switch to the real-time monitoring view. This is easily accomplished by clicking the arrow in the top-right portion of the screen or by pressing the appropriate hotkey configured within Global Settings (Ctrl-Alt-C by default).
NVIDIA System Monitor — Real-Time Graphs

From this point, you can switch views by clicking the appropriate arrow in the top-right portion of the screen or use the configured hotkey. In doing so, the selected data fields are positioned on the desktop. You are then able to drag data fields on top of one another to group them together.

If you want to remove a particular data point from a group but still have that data point be displayed, you can simply click the “scissor” icon within the data field and that will reposition that icon outside of the group.
Removing data fields from view is also extremely easy to accomplish. Simply click the top-right of the box in the same manner a Window is normally closed and that data field will be removed from the real-time desktop view.

By clicking an icon which appears to be the same icon used for “Global Properties” on the application’s 3D view, you can bring up specific options for a particular data field. It should be noted that these options will vary with the component.
Using the NVIDIA Control Panel

You can start NVIDIA Performance several ways:

- Double-click the Performance icon on the desktop.
- Right-click on the desktop and select “NVIDIA Control Panel”.
- From the Windows Control Panel, double-click the “NVIDIA Control Panel”.

Prior to accessing the Performance segment of the NVIDIA Control Panel, you must first accept the End User License Agreement. This is accomplished by simply clicking the “Agree” radio button within the window.
NVIDIA Performance Group

NVIDIA Performance menus are located under the “Performance” section in the left column.

A great deal of functionality and control has been added to NVIDIA’s Control Panel through the arrival of the Performance segment. Under the Device Settings section, nearly every facet of each core system component can be monitored and adjusted in real-time.
**Performance — Device Settings — CPU**

Looking at the CPU options, you are presented with critical options and reporting information. Here, you can manipulate FSB speeds and raise voltages to increase performance, lower fan speed to reduce noise, and verify operating parameters to ensure system stability. Once the desired settings are selected, you simply click “Apply” to have those settings take effect immediately.
System Profiles

A convenient feature of the Control Panel is the ability to create custom profiles and rules. Each component under the Device Settings portion of the Control Panel offers you with an option to create a rule. Here, you can tailor that component’s performance and functionality according to a set of criteria which you create. These characteristics are then saved as a custom rule and can then be used in conjunction with a custom profile.
Once you have altered system settings beyond the stock configuration, you have the ability to save that configuration as a custom profile. Here, specific component settings and custom rules are incorporated into a single unified profile. In doing so, you are able to tailor system performance and operating characteristics to the applications they are using. When gaming where framerates are critical, you can opt to use a profile that pushes the hardware to its limits to extract the highest possible performance. In similar fashion, you can also change settings to minimize noise should you want to view a movie or use an application where the quietest system operation is desired.
NVIDIA System Monitor

NVIDIA System Monitor

NVIDIA System Monitor is a unique 3D presentation of core component values. For every supported device, a wide range of information ranging from temperature, frequency, and voltage are reported. Given the fact that NVIDIA System Monitor is based around an OpenGL foundation, there is nearly zero performance overhead associated with running the utility.

Users can effortlessly navigate through NVIDIA System Monitor by clicking on a particular component in order to view that hardware’s appropriate information. The selected component will come to the foreground and all supported information will be presented. Should you prefer an overhead view of the components in the system, you can utilize the mouse-wheel to control the angle of the display.

**Full 3D Interface**

NVIDIA System Monitor is a rich 3D presentation of the data being polled and collected within the system. All of the key components within the system are presented along with a wide array of status information to give you a clear real-time depiction of how the system is operating.
It is important to understand that the main screen is used to determine which parameters are to be monitored. Real time information may not necessarily be reported in this mode. Once parameters, or elements, are selected and added to the desktop, and the NVIDIA System Monitor front end is minimized or closed, the real-time reporting features will begin.

The degree of functionality and available options in these menus will vary according to specific make and model of the components. The screens below represent the available options for the specific hardware configuration being tested.

**NVIDIA System Monitor — CPU**

The CPU’s presentation is comprised of key voltages, temperatures, and status information.
NVIDIA System Monitor — GPU

The graphics card portion of NVIDIA System Monitor is simple and efficient with the critical operating values and status being indicated. The number of GPUs will change depending on the number of graphics cards present in the system. For example, with three GPUs installed and SLI enabled you will find an icon with three GPUs connected using the appropriate SLI bridge.

NVIDIA System Monitor — Motherboard
The motherboard’s presentation is comprised of key voltages, temperatures, and status information.

**NVIDIA System Monitor — Memory**

Memory modules make their operating frequency, voltage, and actual memory usage available for reporting.

**NVIDIA System Monitor — Hard Disk**

The hard drive device lists an overall disk usage percentage as well as a breakdown of read/write activity.
**NVIDIA System Monitor — Networking**

In addition to reporting overall network usage, this figure is also broken down into upstream and downstream percentages. It should be noted that the network icon will not be present if there is no physical connection with a cable.

**NVIDIA System Monitor — Water Cooling**

The CoolIT watercooling unit reports both the desired coolant temperature (Coolant x) as well as the actual current temperature (Coolant x Temp).
NVIDIA System Monitor — Power Supply

The power supply has a wealth of information display including voltages and amperage for 5V and 12V rails as well as PSU and coil temperatures.

NVIDIA System Monitor — Chassis

When selecting the chassis, you are presented with a variety of temperatures and fan speeds. Here, the percentage shown for fan speed is based off of a duty cycle and is not indicative of fan RPMs.
NVIDIA Control Panel

NVIDIA Control Panel allows you to adjust settings to minimize noise, optimize performance, and maximize system stability from a single convenient interface. In addition, a wealth of system information is readily available in a lush 3D presentation which is customizable to suit your taste.

The degree of functionality and available options in these menus will vary according to specific make and model of the components. The screens below represent the available options for the specific hardware configuration being tested.
Looking at the CPU options, you are presented with critical options and reporting information. Here, you can manipulate FSB speeds and raise voltages to increase performance, lower fan speed to reduce noise, and verify operating parameters to ensure system stability.

**Performance — Device Manager — Motherboard**
In similar fashion to the options present for the CPU, the motherboard options control a variety of different voltages, clock speeds, and fan speeds in addition to reporting critical system parameters.

**Performance — Device Manager — Memory**

![Memory Settings](image)

Much like within the BIOS, all supported memory timings are made available to you in real-time. Here, system performance can be fine-tuned by tightening timings and raising appropriate voltage as necessary. As these settings are adjusted, key system status is reported for review.

**Performance — Device Manager — GPU**
The Graphics Card portion of the Performance segment allows you to change operating frequencies and vary fan speeds. You can also adjust GPU core and memory voltages on future supported video cards.

**Performance — Device Manager — Power Supply**
The Power Supply offers a large variety of operating information. Here, you can monitor key voltage rail data points being reported in real time. Future power supplies with ESA support may allow for the adjustment of fan speeds and voltage levels on a per rail basis.

### Performance — Device Manager — Chassis

The chassis is the second ESA device shown in the Performance segment and is equipped with basic fan control functionality. Future ESA-based chassis may offer the ability to monitor real-time temperatures based on zones or regions inside the case. When setting the sliders for fan speeds, the percentage shown represents a figure based off a duty-cycle and is not strictly dictated by fan RPMs.
You are presented with control over the coolant temperature while water temperature is also displayed. If you want the CPU temperature to be lowered at the expense of higher operating noise, you can move the slider to the left and adjust the desired operating temperature accordingly.

If at any time you make a change and want to go back to the default settings for your system components, you can simply click the appropriate area in the heading as seen above and the system will return to using stock operating conditions.
Performance — Dynamic BIOS Access

This page allows you to change your system BIOS settings. The changes do not go into effect until after you reboot your system. Since these changes are made to actual BIOS settings in the CMOS, the settings remain active until you change them again or restore the CMOS to the default settings.

In the Dynamic BIOS Access page, click the Available BIOS Pages list arrow and click the BIOS page that you want to edit. The BIOS page chosen determines which items on the page are available for changing. To edit an item, click the corresponding list arrow and then click one of the values from the list. When finished making your changes, click the “OK” or “Apply” button to have those changes take effect.

NOTE: This feature is available only with BIOS support from the motherboard manufacturer. Available screen and features will vary between different makes and models of motherboards.
The first page you can select is the “BIOS Features” segment. Here, the more generalized and basic settings are available ranging from boot up priorities to elementary configuration settings.

The next page available in the BIOS page drop-menu is “Chipset Features I”. This page includes a robust collection of critical system settings which are mainly focused around overclocking. From here, you can raise frequencies, alter memory timings, and manipulate chipset features. It should be noted that this is the only area within the
NVIDIA Control Panel where you can actually change the CPU multiplier. Any changes to this setting will not become active until the system is restarted.

Switching to the “Chipset Features II” page, you can access the various CPU features which are supported. In addition, a wealth of voltage options are available which will be critical for those of you looking to overclock using the Dynamic BIOS Access pages.
The “Peripherals” section of the available BIOS pages handles a wide range of onboard functionality. From this page, everything from SATA and IDE drive configuration to enabling onboard Audio can be adjusted.

The final option for the available BIOS pages is the “Power Management” section. This page deals strictly with the system’s power settings and functionality.
Performance — System Information

By selecting the “View System Information” segment of the NVIDIA Control Panel menu, you are presented with an exhaustive compilation of system hardware information. Although most information is strictly reported, the information listed within the white menus can be double-clicked to offer even more granular information regarding that particular component.

Performance — Creating Profiles

One of the key advantages of having the option to create custom operating profiles for your system is the ability to tune performance and operating noise to a given application. For this example, we will walk through the process of creating a specific profile for watching DVDs which will minimize system noise.
Since the intention of creating this profile is to minimize operating noise, one of the first steps is to lower the chassis fan speeds. By lowering the fan RPMs, you can significantly lower the noise output. For this example, we have lowered fan speeds to 45% which still ensures enough airflow throughout the case while keeping noise to a minimum.

For this particular configuration, the CoolIT watercooler offers a great deal of configuration options. By selecting a higher temperature threshold of 50°C, the fan spins
at a lower RPM, and the noise output of the unit is dramatically reduced. This is accomplished with no negative effects upon system performance or stability.

Once all the component settings have been changed to the desired levels, all you need to do is select “Profile” from the top menu. From here you will click “save”.

![Device Settings](image)
Once the “save” selection is made, you are presented with a menu which allows you to name the custom profile. For our example, we will name the profile “Watch_DVD”. Once the profile is created, it can be loaded at any time by selecting the “Profile” section from the top menu and selected “Load” instead of “save” as seen earlier.

**Performance — Overclocking Devices**

![Overclocking Devices](image)

Given the amount of power and functionality provided within NVIDIA’s Control Panel, it is extremely easy to overclock various system components beyond their stock speed to obtain the highest possible performance. By default, all values shown for the components are their stock operating frequencies. By raising the appropriate sliders, you can increase frequencies, voltages, and fan speeds to obtain an increase in performance with no sacrifice in system stability. Note that no changes will take effect until the “Apply” radio button at the bottom of the page is selected.

In order to illustrate the process of overclocking, a simplified example will be depicted below. Here, we will look at the basic changes which will be required to overclock a CPU beyond its stock operating frequency.
**CPU Overclocking**

In the most basic sense, CPU overclocking essentially involves the raising of the Front-Side Bus (FSB) to obtain a higher overall CPU operating frequency. As we can see in the example above, the system relies upon a 333MHz FSB to achieve a CPU operating frequency of 3GHz. By raising the FSB, the CPU operating frequency will increase. However, it should be noted that this increase in frequency usually requires raising the CPU core voltage beyond the default value.
Motherboard Overclocking

Using the same example, we see the stock FSB of 333MHz being illustrated on the motherboard section of the Device Settings segment. Note that you will always find the same FSB value on both the CPU and Motherboard sections as they are one and the same. However, the motherboard does report the actual FSB of the processor as 1333MHz as the value represents a Quad-Data Rate value.
Memory Overclocking

Unlike the case within the BIOS, the memory frequency is permanently linked to the Front-Side Bus (FSB). As a result, any increase or decrease in FSB frequency will immediately affect the memory frequency as well. As was the case with overclocking the CPU, raising memory frequencies beyond their stock values typically requires an increase in voltage as well.

Hints and Cautions

• **Hints:**
  - When overclocking the system, it may be advantageous to increase the voltage level of the components to provide more operating margin.
  - For higher front side bus and memory bus adjustments, NVIDIA recommends increasing (relaxing) the memory timings to improve stability.
  - For higher front side bus and memory bus adjustments, NVIDIA recommends decreasing the CPU multiplier to improve stability.

• **Caution:**
  Increasing the voltage or the clock speed of a component may void its warranty due to exceeding recommended specifications. NVIDIA and the board manufacturers are not responsible for damage that may occur when component tolerances are exceeded.
Overclocking Glossary

Reference Clock (HTT) or (FSB)
Use this slider to control the reference clock rate of the HTT bus or FSB, which will also change the CPU core and memory bus frequencies. The actual frequency (shown at the right of the slider) will change as the slider is moved.

CPU Multiplier
The two values that determine the speed of the processor are the HTT bus (or FSB in some cases) frequency and CPU multiplier. The CPU multiplier is not a dynamic setting. The current multiplier setting is shown and may be changed in the BIOS setup or from the Dynamic BIOS Access page (if available).

HT Multiplier
Use in combination with the reference clock (HTT) to define the FSB speed, in most cases.

Reference Clock (AGP or PCI-Express)
• Reference clock (AGP)
  Use this slider to control the AGP bus speed. Higher frequencies create higher performance, but may not be as stable. This selection is not available on PCI-E configurations.
• SPP Reference clock (PCI-E)
  Use this slider to control the SPP PCI-Express bus speed for the x16 slot. Higher frequencies create higher performance, but may not be as stable. This option may not be available on all configurations.
• MCP Reference clock (PCI-E)
  Use this slider to control the SPP PCI-Express bus speed for the x16 slot. Higher frequencies create higher performance, but may not be as stable.

Memory Controller Timing Group
The memory controller timing section lets you control essential timings in order to maintain stability when overclocking the front side bus and memory bus. Increasing (relaxing) these parameters should allow for increased margins when performing overclocking functions.
• Row Address Strobe (tRAS)
  This is the amount of time between a row being activated by precharge and then deactivated. The shorter the time, the faster the performance, but if it is set too low, it can cause data corruption.
• RAS to CAS Access (tRCD)
  This is the amount of time, in cycles, between issuing an active command and then issuing the read/write commands.
• Memory Bank Switch (tRP)
  This is the minimum time between active commands and the read/writes of the next bank on the memory module.
• Row Cycle Time (tRC)
  This is the minimum time, in cycles, that it takes a row to complete a full cycle. This can be determined by \( tRC = tRAS + tRP \). If this is set too low it can cause corruption of data. If it is too high, it will increase stability but cause a loss in...
performance.

- **Write Recovery Time (tWR)**
  This is the memory timing that determines the delay between a write command and a precharge command sent to the same bank of memory.

- **RAS to RAS Delay (tRRD)**
  This is the amount of cycles that it takes to activate the next bank of memory. It is the opposite of tRAS. The lower the timing, the better the performance, but it can cause instability.

- **Read to Write Delay (tRWT)**
  When a write command is received, this is the amount of cycles for the command to be executed.

- **Write to Read Delay (tWTR)**
  This is the amount of cycles required between a valid write command and the next read command. Lower values result in better performance, but can cause instability.

- **Write to Read Time (tWRRD)**
  This is the number of clock cycles between the last write data pair and the subsequent READ command to the same physical bank.

- **Write to Write Time (tWRWR)**
  This is the number of clock cycles between the last write and the subsequent WRITE command to the same physical bank.

- **Read to Read Time (tRDRD)**
  This is the number of clock cycles between the last read and the subsequent READ command to the same physical bank.

- **Refresh Timing (tREF)**
  This is the amount of time, in microseconds (µs), it takes before a charge is refreshed so it does not lose its charge and become corrupted.

The following settings require a reboot and must be set in the BIOS Setup or using the Dynamic BIOS Access page if available.

- **Command Per Clock (tCPC)**
  This is the amount of time in cycles between when the chip select is executed and when the commands can be issued. A lower value (1T) results in faster performance, but 2T is used to maintain system stability.

- **Column Address Strobe (tCAS)**
  This controls the amount of time in cycles between sending a reading command and acting on it. From the beginning of the CAS to the end of the CAS is the latency. The lower the time, in cycles, the higher the memory performance.
What is ESA?

Enthusiast System Architecture, or ESA for short, is a new open, royalty-free industry standard for controlling and monitoring real-time devices, with goal of providing a much more immersive experience for enthusiasts.

By implementing ESA, PC manufacturers and do-it-yourself enthusiasts can now build finely-tuned and higher performance PCs than they could have with existing proprietary solutions.

ESA is very similar to any another mechanism for the communication between devices. The difference is, ESA enables devices that do not have a mechanism for communication today such as PC power supplies, chassis, and water-cooling systems.
Essential data, such as temperature, thermal, voltage, and air flow attributes are made available in real-time and are critical to obtaining maximum PC performance and overclocking.

ESA provides a standard way of communicating with these devices. ESA brings these remaining PC components into the same domain of devices that already have a means to communicate with the system.

**How Does ESA Work?**

ESA specifies an information protocol that system components can use to “communicate” with each other to adjust operating parameters, and relay important system information back to the user.

Inside ESA devices, there is a micro-controller that monitors and acts like a logic analyzer. It communicates to the motherboard via a simple 4-pin internal USB connector.

We use a micro controller that embeds many different sensors, controlled by a firmware that we developed, to take analog data and convert into a digital link.

We are embedding intelligence inside each of the ESA components to communicate real-time information to better understand why a system becomes flakey during an overclock when heat is building up inside the system.

The ESA specification tells component manufacturers how to communicate with the system. It is up to the decision of the component manufacturer as to what is monitored and controlled. This is what allows ESA component manufacturers to differentiate.

Refer to the ESA Technical Brief for more information about how ESA works.

**ESA Logo and Certification Program**

Cross-device compatibility and compliance with the ESA specification will be handled by Allion, a leading IT testing organization based in Taiwan.

If component manufacturers create ESA devices, they will have to submit those devices to Allion for compliance and compatibility testing.
Products that have passed the Allion certification process will incorporate the new ESA logo, providing consumers with a valuable tool in their purchasing decision.

## ESA Vendor Contact Information

Please contact these vendors for more information regarding current and upcoming ESA components.

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