



Windows* PCI Hot-Plug Filter Driver Installation and User Guide



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Enterprise Platforms Group



Revision History

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1. Introduction

The PCI Hot Plug (PHP) filter driver layers filter devices (FIDOS) into PCI adapter devnodes to provide PCI Hot Plug functionality in 32-bit and 64-bit Windows* 2000 based operating systems. The creation of these devnodes is initiated by the Windows PCI bus driver (pci.sys) during enumeration of the PCI bus. Because the PHP ASIC is a PCI device, the PHP filter driver also acts as a WDM driver, controlling the PHP ASIC. The PHP filter driver takes advantage of Windows' Plug and Play support to implement hot addition, removal and replace operations (replace is actually a remove, followed by an add). The PHP filter driver is dependent on the Windows 2000 based architecture and will not function on previous Windows NT* versions.

This document explains the external requirements for the Windows PHP filter driver, as well as how to install and use it. Since the PHP driver supports several server systems and chipset implementations using the Compaq* based PHP controller, this document is not specific to any particular system implementation. This document is a generic document for the PHP filter driver. Users may also need to refer to the system and/or system BIOS user manuals.

2. PCI Hot Plug Filter Driver External Requirements

The following are system, BIOS, operating system, and adapter requirements for the PHP filter driver. The system and BIOS requirements are by no means a complete list of the design requirements, but are what the user should be aware of.

System:

The PHP system must contain either mechanical slot switches or pushbuttons (or both) for each PHP slot in the system. This is because the current version of Windows provides a way to power off slots but there is no User Interface (UI) mechanism to power them back on. The PHP filter driver relies on an interrupt that is generated by closing the slot switch or pushing the button to signify that it is time to initiate the power-on process.

For systems with mechanical slot switches, slot spacers should be present for empty slots that allow the slot switch to be fully closed. Verify that the slot switch is fully closed for empty slots during boot so that the PHP ASIC doesn't auto-power down the slot due to a slot switch being open. This may cause the slot to not power on correctly later. Note that a system may have a slot lever that is not mechanically connected to anything. This unconnected slot lever is just to hold the adapter in the slot and the driver does not recognize opening and closing it.

BIOS:

The system BIOS must contain a Hardware Resource Table (HRT). The HRT reserves PCI resources for empty slots so that cards can be hot added to the system. The HRT must be enabled by default in the BIOS or enabled via a BIOS setup option. Consult the BIOS or system users manual for details on how to enable the HRT, if necessary. In some systems, this is called "PHP Master Control". If you have a choice, "Minimum" padding is recommended and should be sufficient for the majority of adapters in the market. If the HRT is not detected by the PHP filter driver, the driver load will fail and an error will be logged to the Windows Event Viewer.

Operating System:

The PHP filter driver is designed for the 32-bit and 64-bit Windows 2000 based server family of operating systems. Windows 2000 Advanced Server has been used primarily for testing although no differences have been seen with limited testing of Windows 2000 Server.

Although the same source is used, there are separate driver binaries (.sys) for 32-bit and 64-bit Windows, built using their respective DDK's.

The PHP filter driver will not function under Windows NT 4.0 or Windows 9x.

Adapter Drivers:

Refer to <http://www.microsoft.com/hwdev/pci/hotplugpci.htm> regarding adapter driver requirements for Windows based PCI Hot Plug.

3. Installing the PCI Hot Plug Filter Driver

IMPORTANT: please refer to the section titled "Known Limitations and Troubleshooting Info" before installing the PHP filter driver.

To install or update the PHP filter driver (phpfltr.sys), follow the two-step process listed below. Currently, there is not an automated installation process available so the steps below must be followed in full. The following steps explain how to open the Device Manager and install the driver.

IMPORTANT: don't try to uninstall or update a device labeled "PCI Bus" or "PCI Bridge" because you would be updating the Windows PCI Bus driver (pci.sys). You need the pci.sys driver to boot, and for PCI to function.

You should only install, update, or uninstall the driver to a device labeled "Compaq PCI Hot Plug Controller", "WXB PCI Hot Plug Controller", or "PCI Hot Plug Controller (phpfltr installed)".

The PHP controller is recognized as "Compaq PCI Hot Plug Controller" or "WXB PCI Hot Plug Controller" by default in Windows before the PHP filter driver is installed. This is because there is an entry in machine.inf on the Windows operating system release that recognizes the PHP controller. It gives it the label and moves it to the system devices section so that you can pass WHQL without an actual driver installed (i.e. no unrecognized devices). There may be additional Intel® chipsets in the future that contain a PHP controller that will use this PHP filter driver and that device may have its own entry in machine.inf with a different name.

If you update the "Compaq PCI Hot Plug Controller" or "WXB PCI Hot Plug Controller" device with the PHP filter driver from Intel, it will change the name of the device to "PCI Hot Plug Controller (phpfltr installed)".

You can then update or uninstall the driver for the "PCI Hot Plug Controller (phpfltr installed)" device.

If you uninstall the PHP driver for the "PCI Hot Plug Controller (phpfltr installed)" device, it will be labeled as the default "Compaq PCI Hot Plug Controller" or "WXB PCI Hot Plug Controller" after the next reboot. This is because Windows defaults to getting the info from machine.inf.

3.1 Step 1: Open the Device Manager

To open the Device Manager, follow the steps below:

1. Right click on "My Computer".
2. Select "Properties".
3. Select the "Hardware" tab.
4. Click on "Device Manager".
5. Expand "System Devices" by clicking +.

3.2 Step 2: Install the Filter Driver

There are two scenarios for installing the PHP filter driver, depending on how many PHP ASICs are present in the system (ONE time or MULTIPLE times).

IMPORTANT: after you install the PHP filter driver, you will need to reboot your server.

Scenario 1: there is only ONE instance of the PHP controller in the Device Manager window.

1. Double click on the PHP controller instance in the system devices section to show the Properties page.
2. Select the "Driver" tab.
3. Click on "Update Driver" to invoke the Update Wizard.
4. Select the "Display a list of the known drivers for this device so that I can choose a specific driver" radio button or the "Install from a list or specific location (Advanced)" radio button.
5. Click "Next".
6. Click on "Have Disk". On newer OS builds you may have to first select the "Don't search, I will choose the driver to install" radio button first before being able to click on "Have Disk".
7. Enter the path (or browse) to the directory that "phpfltr.sys" and "phpfltr.inf" are located.
8. Click "OK".
9. Select "PCI Hot Plug Controller (phpfltr installed)".
If any warnings show up about the driver not being digitally signed, they can be ignored.
10. Click "Next".
11. Click "Next".
12. Click "Finish".
13. Click "Close" in the device properties window.
14. A window will pop up asking for reboot, click "Yes" to reboot.

Scenario 2: there are MULTIPLE instances of the PCI Hot Plug controller in the Device Manager window.

1. Perform the above steps for each PHP controller instance in the system devices section but DO NOT REBOOT until you finish updating drivers for each of the controller instances.
2. Reboot your server.

CAUTION: before performing hot plug actions, verify that the PHP filter driver is correctly installed through the Device Manager. If the driver is installed properly, the PHP controller instances will be displayed as "PCI Hot Plug Controller (phpfltr installed)". Verify that none of these device instances are shown with a yellow exclamation point (bang). Confirm that all LED's are off on all unoccupied slots before continuing. Failure to take these steps may result in serious damage to your server.

4. Using the PCI Hot Plug Filter Driver

IMPORTANT: please refer to the section titled “Known Limitations and Troubleshooting Info” before using the PHP filter driver.

To use the PHP filter driver (phpfltr.sys), follow process listed below. Currently, there are three system configuration scenarios. You will need to first determine which system configuration you have and follow the correct user instructions.

Scenario 1: system has a mechanical slot switch but no hot plug buttons.

1. To hot add a PCI adapter to an unoccupied and powered off empty slot:
 - Open the slot switch and insert the PCI adapter.
 - Connect the appropriate cables to the adapter.
 - Close the slot switch. This will generate an interrupt to the hot plug driver and initiate the hot-add process.
 - Power to the slot will turn on and the driver will load automatically. If the adapter driver has not been installed before, you will see windows pop up with status.
 - If the operating system cannot find a compatible driver for the device, you may have to install the driver manually. The operating system will prompt you for the location of the driver as it does in a normal driver install scenario.
 - Check for status in the Device Manager and Event Viewer.
 - The network or storage device will need to be configured using the standard method used in a non-PHP operation.

2. To hot remove a PCI adapter:
 - Double-click on the unplug/eject icon in the icon tray of the task bar that will either bring up the Add/Remove Hardware Wizard or a list of the devices that can be removed.
 - Select a device to unplug and choose the appropriate "next" or "finish" and/or "OK". This initiates the driver unload and slot power-off process.
 - Once power has been removed from the slot and the green LED is off, you can now open the slot switch, disconnect the appropriate cables, and remove the adapter.

Scenario 2: system has no mechanical slot switch, but does have hot-plug buttons.

1. To hot add a PCI adapter to an unoccupied and powered off empty slot:
 - Insert the PCI adapter.
 - Connect the appropriate cables to the adapter.
 - Push the PHP button for the correct slot.
 - The green LED will blink for approximately five seconds, at which time the power can be aborted on by pushing the button again.
 - If the power on is not aborted by pushing the button, power to the slot will turn on and the driver will load automatically. If the adapter driver has not been installed before, you will see windows pop up with status.

- If the operating system cannot find a compatible driver for the device, you may have to install the driver manually. The operating system will prompt you for the location of the driver as it does in a normal driver install scenario.
 - You can check for status in the Device Manager and Event Viewer.
 - The network or storage device will need to be configured using the standard method used in a non-PHP operation.
2. To hot remove a PCI adapter:
- Using hot plug buttons:
 1. Push the PHP button for the correct slot.
 2. The green LED will blink for approximately five seconds, at which time you can abort the power off by pushing the button again.
 3. If the power off is not aborted by pushing the button, power to the slot will turn off and the driver will unload automatically. You will see windows pop up with status.
 4. Once power has been removed from the slot and the green LED is off, you can disconnect the appropriate cables and remove the adapter.
 - Using Hardware Wizard:
 1. Double-click on the unplug/eject icon in the icon tray of the task bar that will either bring up the Add/Remove Hardware Wizard or a list of the devices that can be removed.
 2. Select a device to unplug and choose the appropriate "next" or "finish" and/or "OK". This initiates the driver unload and slot power off process.
 3. The driver will unload automatically. You will see windows pop up with status.
 4. Once power has been removed from the slot and the green LED is off, disconnect the appropriate cables and remove the adapter.

Scenario 3: system has both a mechanical slot switch and hot plug buttons.

1. To hot add a PCI adapter to an unoccupied and powered-off empty slot:
 - Insert the PCI adapter.
 - Connect the appropriate cables to the adapter.
 - Close the mechanical slot switch.
 - Push the PHP button for the correct slot.
 - The green LED will blink for approximately five seconds, at which time you can abort the power on by pushing the button again.
 - If the power on is not aborted by pushing the button, power to the slot will turn on and the driver will load automatically. If the adapter driver has not been installed before, you will see windows pop up with status.
 - If the operating system cannot find a compatible driver for the device, you may have to install the driver manually. The operating system will prompt you for the location of the driver as it does in a normal driver install scenario.
 - You can check for status in the Device Manager and Event Viewer.
 - You will need to configure the network or storage device using the standard method used in a non-PHP operation.
2. To hot remove a PCI adapter:

- Using hot plug buttons:
 1. Push the PHP button for correct the slot.
 2. The green LED will blink for approximately five seconds, at which time you can abort the power off by pushing the button again.
 3. If the power off is not aborted by pushing the button, power to the slot will turn off and the driver will unload automatically. You will see windows pop up with status.
 4. Once power has been removed from the slot and the green LED is off, open the slot switch, disconnect the appropriate cables, and remove the adapter.
- Using Hardware Wizard:
 1. Double-click on the unplug/eject icon in the icon tray of the task bar that will either bring up the Add/Remove Hardware Wizard or a list of the devices that can be removed.
 2. Select a device to unplug and choose the appropriate "next" or "finish" and/or "OK". This initiates the driver unload and slot power off process.
 3. The driver will unload automatically. You will see windows pop up with status.
 4. Once power has been removed from the slot and the green LED is off, you can open the slot switch, disconnect the appropriate cables, and remove the adapter.

5. Known Limitations and Troubleshooting Info

Refer also to the PHP filter driver's release notes for issues/info about a specific driver version.

Currently, there is no Graphical User Interface (GUI) specifically for PCI Hot Plug. A combination of slot interlock switches (if present), PHP pushbuttons (if present), and the Windows unplug/eject icon are used to perform PHP operations.

Important: if the system has a mechanical slot switch, it should not be opened when power, to the slot, is on. First, power down the slot before opening the slot switch (see below). If you open the switch without first powering down the slot, Windows may pop up an error message titled "Unsafe removal of device" and an error may be logged to the Event Viewer by the PHP filter driver. This, however, is not guaranteed and a system hang, crash, or data corruption could occur, instead, due to the hardware disappearing without its device driver knowing it. It is highly recommended to power off the slot through the UI (e.g., via the "unplug/eject" icon in the task bar); doing this cleanly stops the adapter driver before opening the switch to prevent possible data corruption.

Important: The PHP filter driver logs status and errors to the Windows Event Viewer. A description of these errors is explained in the section of this document titled "Event Logging". The Event Viewer should be checked after all hot plug operations to make sure that no errors occurred.

The power LED signifies power to the slot, and the amber LED signifies an error condition such as a slot power fault. Refer to the Windows Event Viewer for more info when errors occur.

The default is for empty slots to be powered down when the PHP filter driver loads. There is an entry in the `phpfltr.inf` file that can be modified in order to leave the empty slots powered on. This `.inf` entry change needs to be done before the PHP filter driver is installed. After the PHP filter driver is installed the modification can be done to the registry. Refer to the `phpfltr.inf` file for details.

The green LED will blink until Windows is done trying to load the newly added device's driver. If the device's driver does not load successfully, the amber LED will come on and the green LED may continue to blink. Always consult the Device Manager and Event Viewer to determine if the device's driver loaded properly.

Be sure to connect or disconnect the appropriate cables to the adapter before powering on or off the slot.

Powering down a card may fail if there is an application using the device. For example, if removal of a SCSI adapter is tried, and some application has a file open on a disk controlled by that device, it may fail. Stop all activity on the adapter before powering down the slot.

There are a few adapters that take a long time (sometimes a minute or two) for their driver to load during a hot add operation. During this time, the system will appear to be hung but actually it is just waiting for the driver adapter driver to load. Wait patiently. The PHP filter driver does not have control over this.

You have to have enough resources available for the card in order to hot add it. Because of the number of slots and busses on on some systems, the BIOS is only able to reserve a limited amount of I/O space per slot (i.e. 4K) in the HRT (there is only 64K available to start with). If a card requests more resources than what are reserved then the hot add operation will fail. The PHP driver will turn on the amber LED and write a msg in the Windows Event Viewer.

The PHP filter driver only allows hot adding cards with one level of PCI-PCI bridge. If a card has more than one level of PCI-PCI bridges then the hot add operation will fail. The PHP driver will turn on the amber LED and write a msg in the Windows Event Viewer.

The PHP filter driver does not allow the system to hibernate if the system configuration has changed (i.e. adapter hot added or removed). This should be considered before installing the PHP filter driver.

There are some storage software applications that don't allow the adapter driver to be removed. In this case you won't be able to hot remove the adapter without first uninstalling the storage software application. The PHP driver does not have control over this.

6. Event Logging

The following is a description of the PHP filter driver events that are logged to the Windows Event Viewer. Letters *aaa* and *bbb* indicate a specific operating speed of the bus, such as 33MHz, 66MHz, 66MHz PCI-X, 100MHz PCI-x, 133 MHz PCI-X. Letters *X*, *Y*, etc. indicate the specific slot in the system. Information under "Description in Event Viewer" is what is actually displayed in the Windows Event Viewer. Information under "Meaning" is a description of what the Event Viewer information means.

6.1 Informational

Description in Event Viewer:

aaaMHz capable slots X-Y are running at bbbMHz.

Meaning:

Slots X-Y are capable of running at aaaMHz but they are currently running at bbbMHz. This is either caused because the bus is empty and the BIOS setting is set to run empty busses at bbbMHz, or because there is an adapter present in the bus that is only capable of bbbMHz.

Description in Event Viewer:

aaaMHz capable slots X-Y are running at aaaMHz.

Meaning:

Slots X-Y are capable of running at aaaMHz and they are currently running at aaaMHz. This is either caused because the bus is empty and the BIOS setting is set to run empty busses at aaaMHz, or because there are no adapters present in the bus that are only capable of bbbMHz.

Description in Event Viewer:

PHP does not support hibernation if the system configuration has been changed since the last reboot. All hibernation requests will fail.

Meaning:

The PHP filter driver will not allow the system to hibernate if the PCI configuration has changed since the last reboot (i.e. a card added or removed). This is because the driver programs devices differently than the way BIOS does, and things will not be able to be configured correctly when the system comes back out of hibernation.

Description in Event Viewer:

The following device has been added in slot X.

Meaning:

A PCI adapter has been hot added to the system in slot X.

Description in Event Viewer:

The following device has been removed from slot X.

Meaning:

A PCI adapter has been hot removed from the system in slot X.

6.2 Errors

Description in Event Viewer:

The system is not properly configured for PHP operation. Rrun System and/or BIOS Configuration and ensure that PHP is enabled. Cconsult system user manual for additional information.

Meaning:

The PHP filter driver was not able to read the HRT from BIOS. Consult the BIOS or system users manual for details on how to enable the HRT. In some systems the HRT is enabled by default and in some systems it enabled by on option in BIOS setup. This option is sometimes called "PHP Master Control". If you have a choice, "Minimum" padding is recommended and should be sufficient for the majority of adapters in the market. If the HRT is not present, then the PHP filter driver will not load.

Description in Event Viewer:

The newly inserted device in slot X cannot be started, because there are not enough available resources. If you still want to start this device, a reboot is required. Otherwise, remove this device. For additional information on increasing system resource for PHP addition operations, consult the system user manual.

Meaning:

There was not enough resources available for the newly inserted device. Although "Minimum" padding is recommended and should be sufficient for the majority of adapters in the market, the padding level in the HRT may need to be increased (if possible) if this error is encountered. Because of the number of PCI slots and busses in some systems, the amount of resources that are able to be reserved may be limited. This especially affects I/O space whre you have a limit to begin with of 64K. Some systems may only be able to reserve 4K of I/O space per slot.

Description in Event Viewer:

A PCI Hot-Add operation in slot X was unsuccessful because of a device failure.

Meaning:

There was an error with the adapter when trying to power it on and load the device driver. There could bea a possible hardware issue with adapter. The user may want to try another adapter.

Description in Event Viewer:

PHP operations are unavailable because the PHP driver was unable to initialize. Please consult Device Manager for additional information.

Meaning:

The PHP driver was not able to initialize. Various issues could cause this error. The user should look in the Device Manager for details.

Description in Event Viewer:

Device failure detected in slot X. Please consult Device Manager for additional information.

Meaning:

The PHP filter driver detected an adapter or slot failure. The amber LED will also be lit. The user should look in the Device Manager for details.

Description in Event Viewer:

Isolated power fault detected in slot X.

Meaning:

The PHP filter driver detected a slot power fault. The amber LED will also be lit.

Description in Event Viewer:

Adapter in slot X cannot be hot added. To insert this adapter, shut down the operating system, power off the system, add the adapter, and then power up the system.

Meaning:

The PHP filter Driver does not support more than a single bridge in a slot. This error will occur if trying to add an adapter with more than one level of bridges.

Description in Event Viewer:

Unable to hot add the aaaMHz device in slot X to the bus when the bus is running at bbbMHz. To insert a aaaMHz adapter, shut down the operating system, power off the system, add the adapter, and then power up the system.

Meaning:

This message will occur if the user tries to hot add an adapter that is only capable of running at aaaMHz into a bus running at bbbMHz. The PHP filter driver determines the adapters speed capability by reading the adapters M66EN pin.

Description in Event Viewer:

PHP does not support hibernation if an adapter is present and the slot lever is closed, but the adapter is not powered up completely or successfully. Please open the slot lever for slot X before hibernating the system.

Meaning:

The PHP filter driver will not let the system hibernate if an adapter is not powered up completely or successfully.

Description in Event Viewer:

Unsafe surprise removal of a device in slot X. Use the Hot Plug Applet or PCI Hot Plug Button (if equipped) to notify the operating system before removing an adapter. This could result in data loss or data corruption. Such actions are strongly not recommended.

Meaning:

If the system has a mechanical slot switch, it should not be opened when power to the slot is on. You need to first power down the slot before opening the slot switch. If you open the switch without first powering down the slot, Windows will pop up an error message titled "Unsafe removal of device". There will also be an error logged to the Event Viewer by the PHP filter driver. A system crash should not occur, but it is still highly recommended to power off the slot through the UI (which also cleanly stops the adapter driver) before opening the switch to prevent possible data corruption.

Description in Event Viewer:

PHP does not support hot adding of remote insight board in slot X. To add this adapter, please shut down the operating system, power off the system, add the adapter, and then power up the system.

Meaning:

The PHP filter driver does not support hot adding the Compaq* Remote Insight Board.

Appendix A: Glossary

| Word / Acronym | Definition |
|-----------------------|--------------------------|
| GUI | Graphical User Interface |
| HRT | Hardware Resource Table |
| PHP | PCI Hot Plug |
| UI | User Interface |
| WDM | Windows Driver Model |