



Page Fault Monitor

by

Software Verify

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MAP File Browser

MAP file contents inspector

by Software Verify Limited

Welcome to the MAP File Browser software tool. MAP File Browser is a software tool that allows you to inspect the contents of MAP files.

We hope you will find this document useful.

Page Fault Monitor

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Part



1 How to get Page Fault Monitor

Page Fault Monitor is free for commercial use. Page Fault Monitor can be downloaded for Software Verify's website at <https://www.softwareverify.com/product/page-fault-monitor/>.

This help manual is available in Compiled HTML Help (Windows Help files), PDF, and online.

Windows Help <https://www.softwareverify.com/documentation/chm/pageFaultMonitor.chm>
PDF <https://www.softwareverify.com/documentation/pdfs/pageFaultMonitor.pdf>
Online <https://www.softwareverify.com/documentation/html/pageFaultMonitor/index.html>

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Part



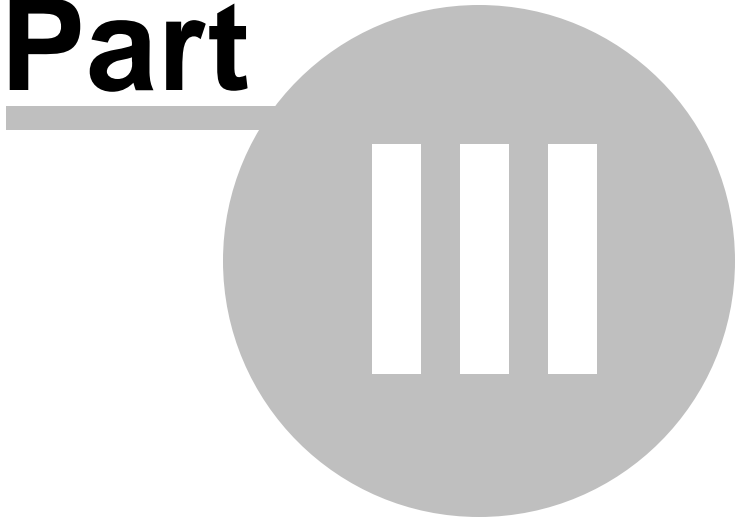
2 What does Page Fault Monitor do?

Page Fault Monitor allows you to view page fault data for a specific application in real time.

History

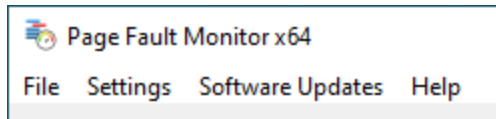
Page Fault Monitor has been an internal tool at Software Verify for many years. We recently decided to make it a bit more user friendly and to make it available for public use.

Part



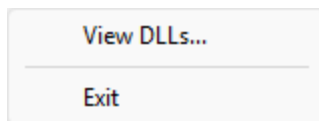
3 Menu

The main menu contains four menus, [File](#), [Edit](#), [Software Updates](#) and [Help](#).



3.1 File

The File menu controls viewing of DLLs and program exit.

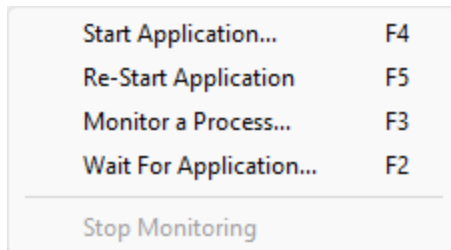


File menu > **View DLLs** > [view information](#) about the DLLs in the process.

File menu > **Exit** > closes Page Fault Monitor.

3.2 Launch

The Launch menu controls the monitoring of processes for Page Faults.



Launch menu > **Start Application...** > [start an application](#) and start monitoring it for page faults.

Launch menu > **Re-Start Application** > start the most recently started application and start monitoring it for page faults.

Launch menu > **Monitor a Process...** > [choose a process](#) and start monitoring it for page faults.

Launch menu > **Wait For Application...** > [wait for an application](#) to start and start monitoring it for page faults.

Launch menu > **Stop Monitoring** > stop monitoring a process for page faults.

3.3 Settings

The Settings menu controls editing settings.

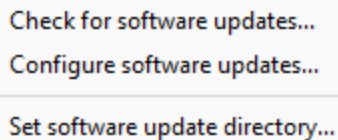


Settings menu > **Edit Settings...** > displays the [settings dialog](#).

3.4 Software Updates

The Software Updates menu controls how often software updates are downloaded.


If you've been notified of a new software release to Page Fault Monitor or just want to see if there's a new version, this feature makes it easy to update.



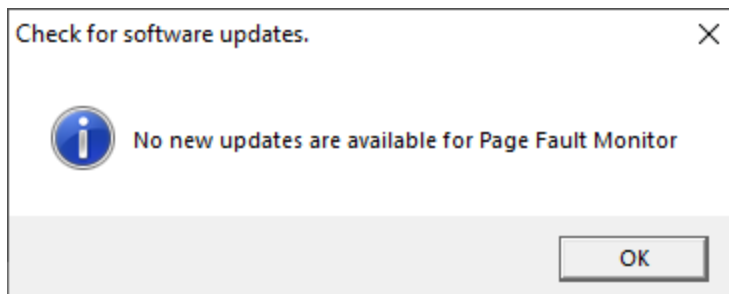
Check for software updates...
Configure software updates...
Set software update directory...

 **Software Updates** menu > **Check for software updates** > checks for updates and shows the software update dialog if any exist

An internet connection is needed to be able to make contact with our servers.

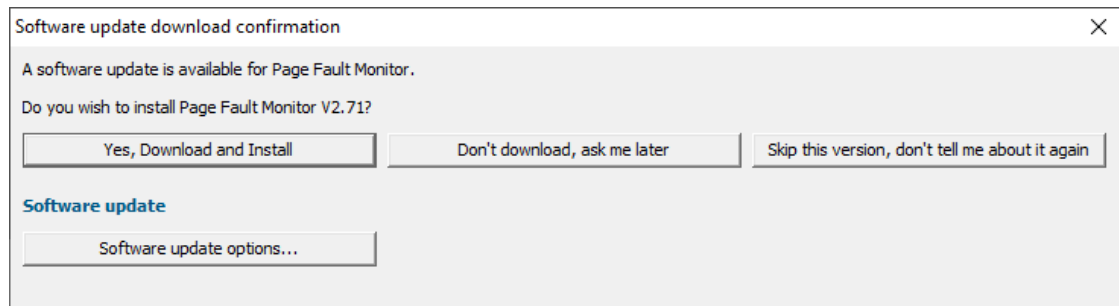
 Before updating the software, close the help manual, and end any active session by closing target programs.

If no updates are available, you'll just see this message:

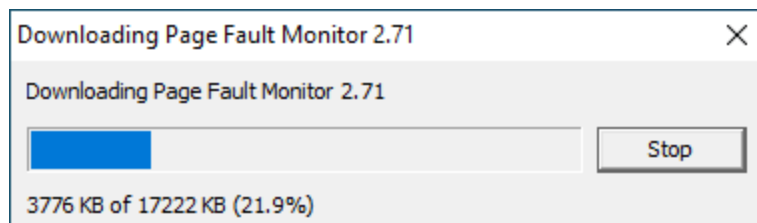


Software Update dialog

If a software update is available for Page Fault Monitor you'll see the software update dialog.



- **Download and install** > downloads the update, showing progress



Once the update has downloaded, Page Fault Monitor will close, run the installer, and restart.

You can stop the download at any time, if necessary.

- **Don't download...** > Doesn't download, but you'll be prompted for it again next time you start Page Fault Monitor
- **Skip this version...** > Doesn't download the update and doesn't bother you again until there's an even newer update
- **Software update options...** > edit the [software update schedule](#)

Problems downloading or installing?

If for whatever reason, automatic download and installation fails to complete:

- Download the latest installer manually from the software verify website.

Make some checks for possible scenarios where files may be locked by Page Fault Monitor as follows:

- Ensure Page Fault Monitor and its help manual is also closed
- Ensure any error dialogs from the previous installation are closed

You should now be ready to run the new version.

Software update schedule

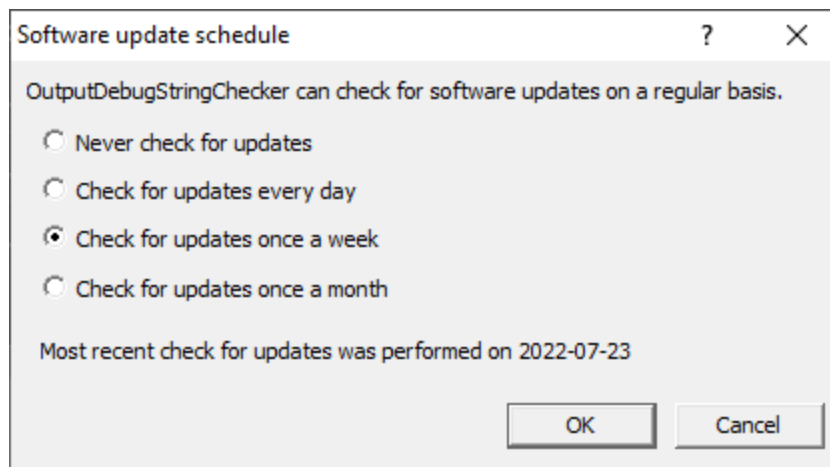
Page Fault Monitor can automatically check to see if a new version of Page Fault Monitor is available for downloading.

 **Software Updates** menu > **Configure software updates** > shows the software update schedule dialog

The update options are:

- never check for updates
- check daily (the default)
- check weekly
- check monthly

The most recent check for updates is shown at the bottom.

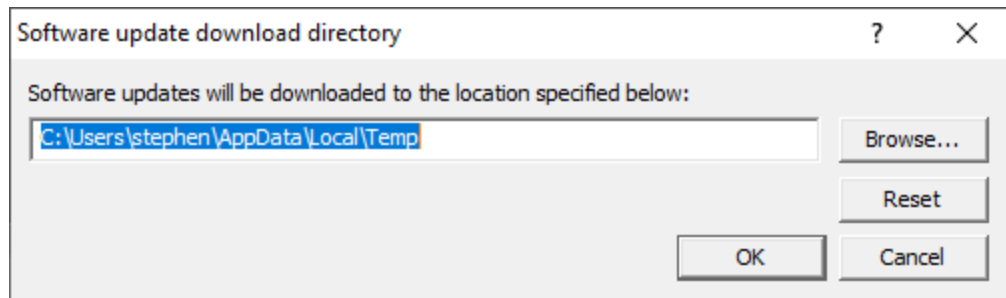


Software update directory

It's important to be able to specify where software updates are downloaded to because of potential security risks that may arise from allowing the `TMP` directory to be executable. For example, to counteract security threats it's possible that account ownership permissions or antivirus software blocks program execution directly from the `TMP` directory.

The `TMP` directory is the default location but if for whatever reason you're not comfortable with that, you can specify your preferred download directory. This allows you to set permissions for `TMP` to deny execute privileges if you wish.


 **Software Updates** menu > **Set software update directory** > shows the Software update download directory dialog



An invalid directory will show the path in red and will not be accepted until a valid folder is entered.

Example reasons for invalid directories include:

- the directory doesn't exist
- the directory doesn't have write privilege (update can't be downloaded)
- the directory doesn't have execute privilege (downloaded update can't be run)

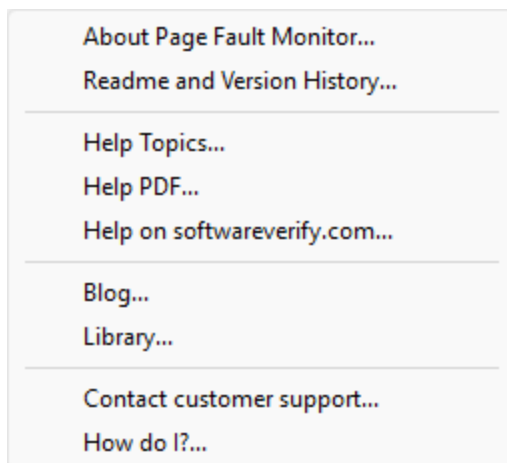
 When modifying the download directory, you should ensure the directory will continue to be valid. Updates may no longer occur if the download location is later invalidated.

- **Reset** > reverts the download location to the user's `TEMP` directory

The default location is `c:\users\[username]\AppData\Local\Temp`

3.5 Help

The Help menu controls displaying this help document and displaying information about Page Fault Monitor.



Help menu > **About Page Fault Monitor...** > displays information about Page Fault Monitor.

Help menu > **Readme and Version History...** > displays the readme and version history.

Help menu > **Help Topics...** > displays this help file.

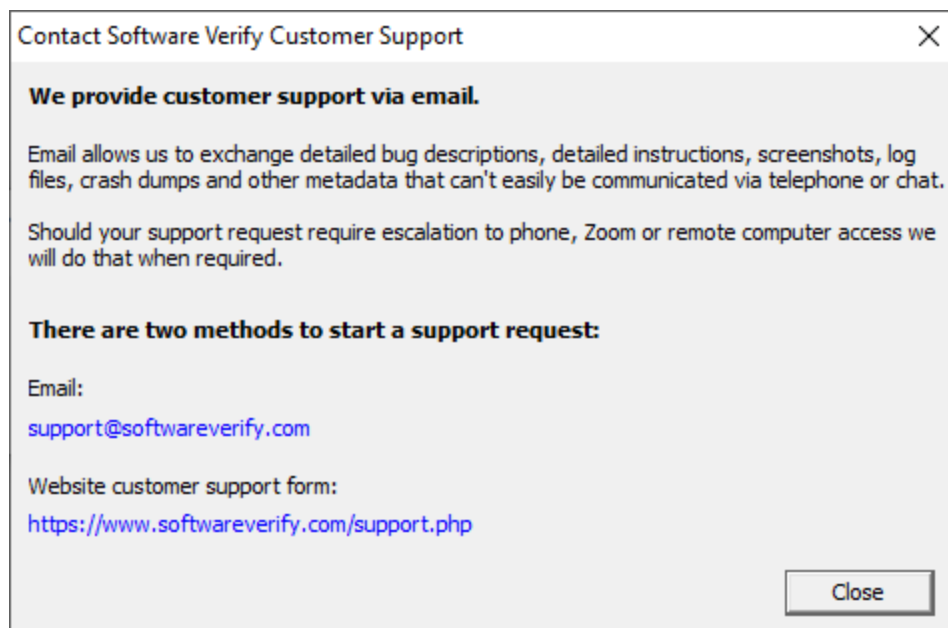
Help menu > **Help PDF...** > displays this help file in PDF format.

Help menu > **Help on softwareverify.com...** > display the Software Verify documentation web page where you can [view online documentation](#) or download compiled HTML Help and PDF help documents.

Help menu > **Blog...** > display the [Software Verify blog](#).

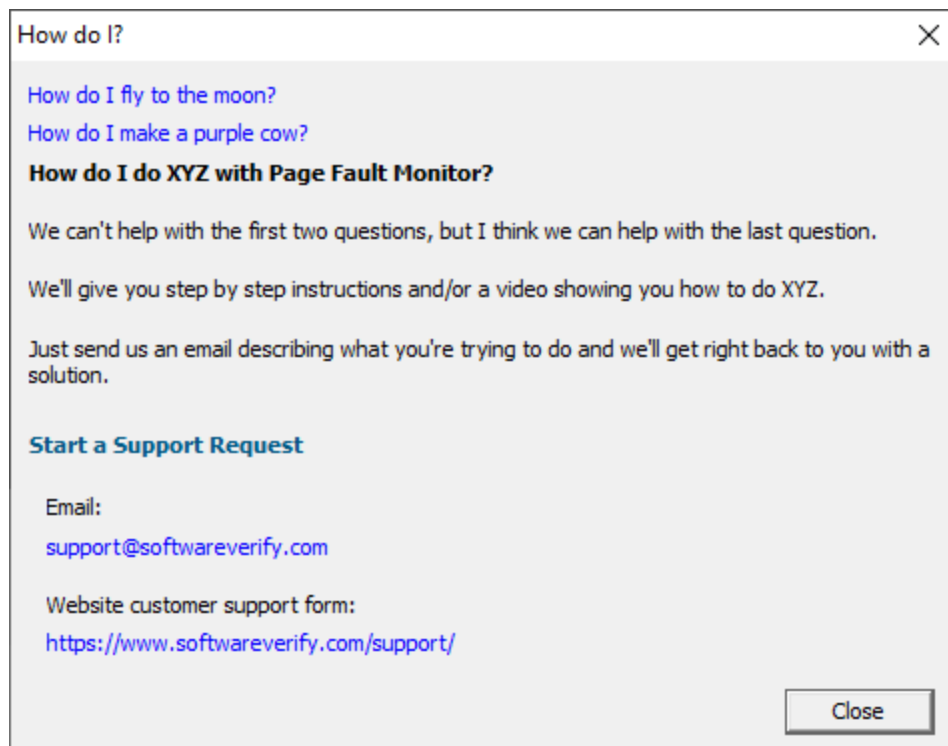
Help menu > **Library...** > display the Software Verify library - [our best blog articles grouped by related topics](#).

Help menu > **Contact customer support...** > displays the options for contacting customer support.



Click a link to [contact customer support](#).

Help menu > **How do I?...** > displays the options for asking us how to do a particular task.

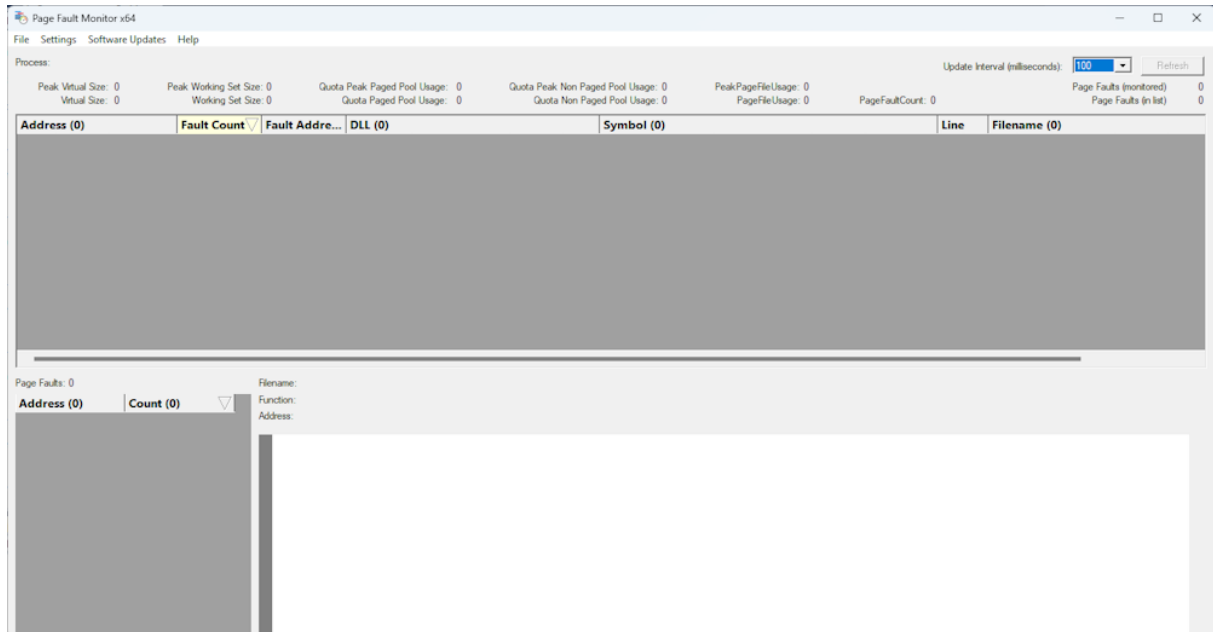


Part



4 The user Interface

The user interface of Page Fault Monitor is shown below.



The top list shows all unique addresses that caused page faults for the monitored process.

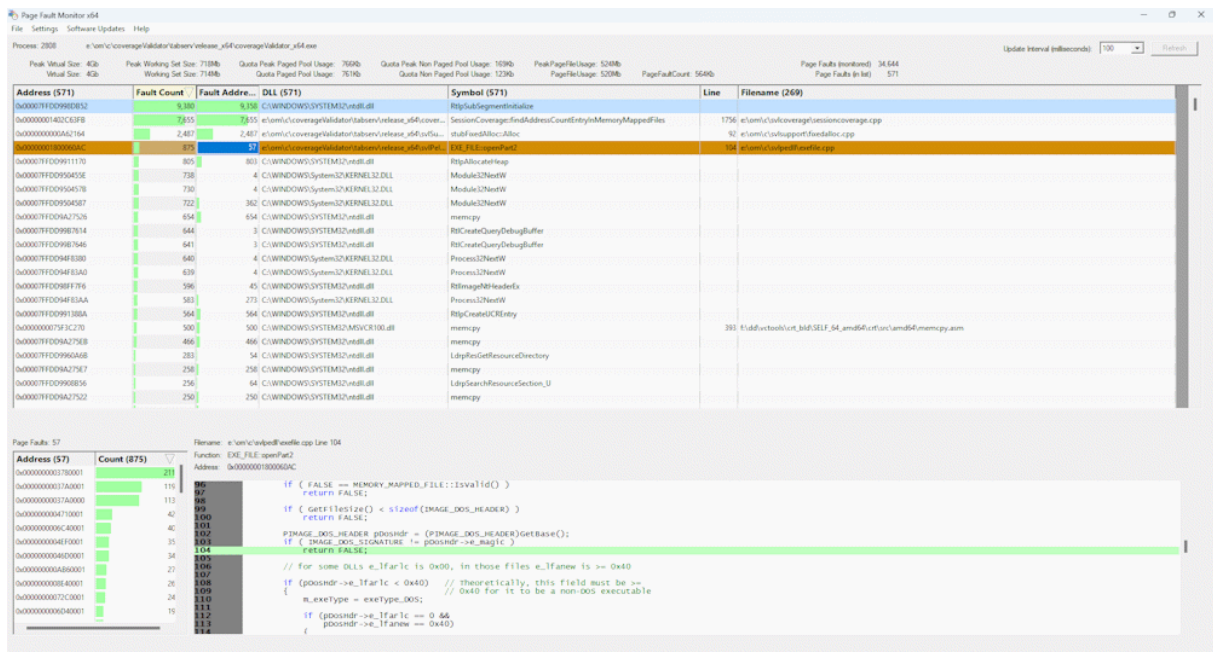
The bottom list shows the page fault information associated with any address in the top list. Select an address in the top list and the related data is shown below.

For any addresses that we can determine the DLL, symbol, filename and line number, we display that information in the source code window at the bottom of the display.

Above the top list various Virtual Memory status values are shown indicating virtual size, working set size, page file usage and various quota values. The total page fault count for the application is also shown, this value will be different from the number of page faults that Page Fault Monitor has information about. The reason the two values are different is that Page Fault Monitor displays the information Windows NT provides about page faults. Windows NT only stores a limited amount of data about page faults. Once this storage is used up, no more data is stored until after Page Fault Monitor has asked for the stored data. If Page Fault Monitor does not ask for the data frequently enough some information will be discarded by Windows NT.

- **Update Interval** ➤ changes how often information about page faults is queried. The shorter the interval, the more accurate the information collected about page faults
- **No Update** ➤ choosing **No Update** in the combo prevents the page fault list from being updated by the timer. When **No Update** is chosen, the **Refresh** button is enabled
- **Refresh** ➤ refreshes the processes list and the page fault list

The picture shown below shows Page Fault monitor monitoring **coverageValidator_x64.exe**.



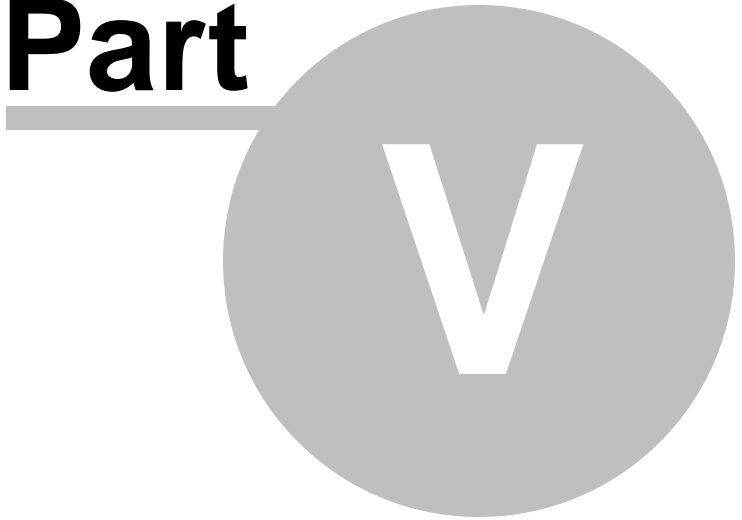
This picture shows process 2808 (coverageValidator_x64.exe) is being monitored for page faults. Page Fault Monitor has collected information about 572 page faults caused by coverageValidator_x64.exe. The top list shows information about the page faults. The list displays the addresses of all instructions that have caused page faults. The **Fault Count** column indicates how many times this address has caused a page fault. The **Fault Addresses** column indicates how many different fault addresses are associated with page faults at this instruction address.

When displaying information about instructions, Page Fault Monitor will try to display DLL name, symbol, filename and line number, with the latter being taken from debug information.

Selecting an address in the top list causes information about the page faults at that address to be shown in the bottom list. The source code and symbol information (if known) is also displayed.

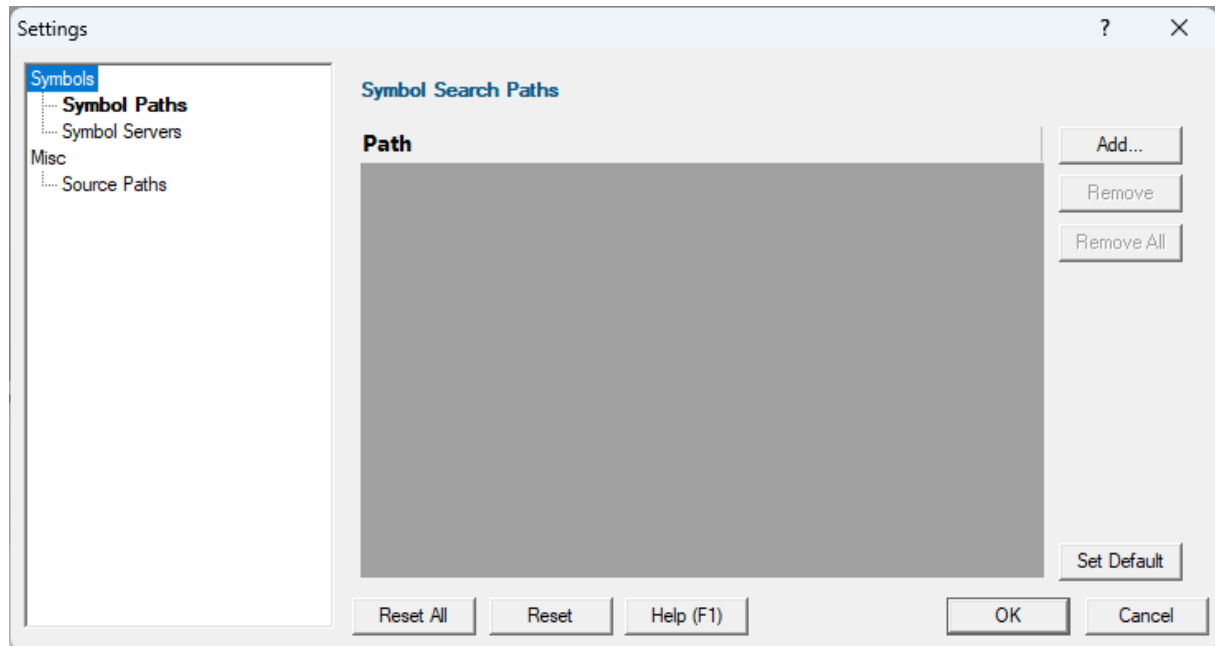
Note that the Page Fault count of 564,000 is higher than the numbers monitored by Page Fault Validator because memoryValidator_x64.exe in this example has been running for a very long time, whereas Page Fault Monitor has been running for a few minutes.

Part



5 Settings dialog

The settings dialog allows you to configure how Page Fault Monitor gets symbol information.



Symbol Search Paths

We use debug information found in PDB files to turn addresses into human readable symbols, filenames and lines.

By default there is one path in the symbol search paths: `c:\windows\symbols\dll`.

If you wish to add more paths to symbols you can add or remove them using the **Add...**, **Remove** and **Remove All** buttons.

You can restore the default symbol paths using the **Set Default** button.

Symbol Server

If the symbol server is enabled (**Use Symbol Server**) Page Fault Monitor will download symbols using a symbol server.

Symbols are downloaded to a **Symbol Directory**. This directory must be valid for the symbol server to work. You can type the directory name or click **Browse...** to use the Microsoft folder browser to select the directory.

Microsoft DLLs

For Microsoft DLLs that are found in the Windows System32 directory we download symbols from Microsoft's symbol server:

<http://msdl.microsoft.com/download/symbols>

None Microsoft DLLs

For none Microsoft DLLs we download symbols from the symbol server specified on the settings dialog in the **Symbol Server** field.

You can set the symbol server to it's default value using the **Set Default** button.

Please note that if you have symbol servers enabled there may be a delay in providing symbol information the first symbols for a specific DLL are downloaded from the symbol server.


Reset

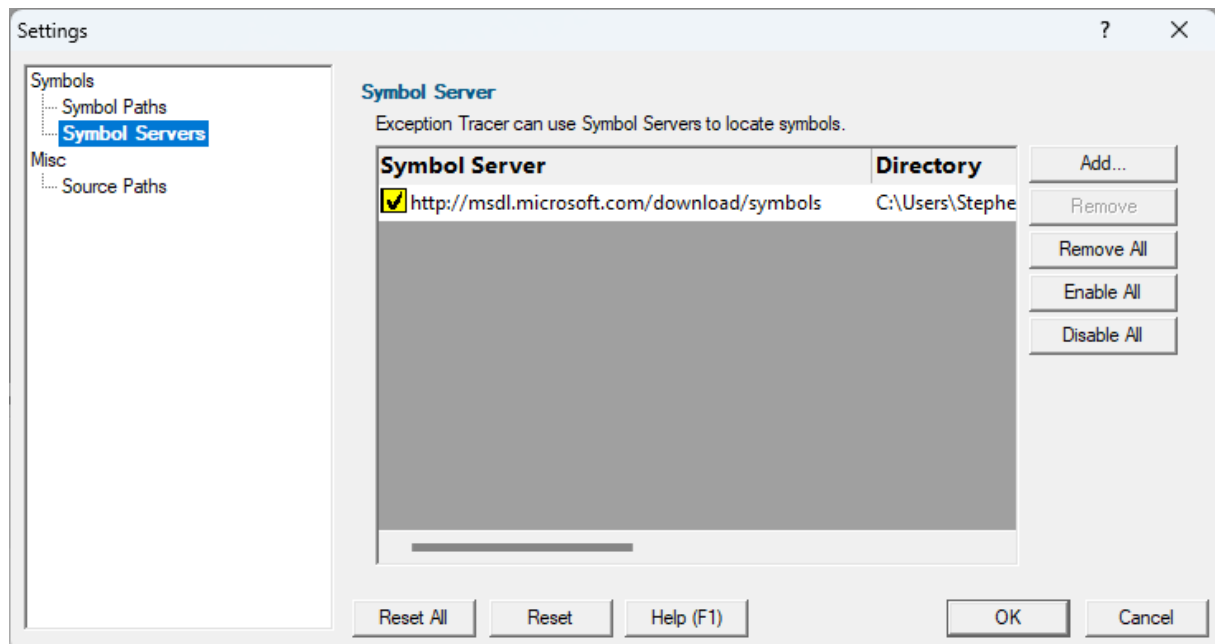
You can reset the settings to their default state at any time by clicking **Reset**.

5.1 Symbols

5.1.1 Symbol Servers

The Symbol Server settings allow you to specify what symbol servers to use.

 **You do not need to specify a symbol server** if you do not wish to. Page Fault Monitor will work correctly without a symbol server.



Symbol server

The symbol server is entirely optional, but is useful for obtaining symbols from a centralized company resource or for obtaining operating symbols from Microsoft.

The default symbol server is the Microsoft symbol server used for acquiring symbols about Microsoft's operating system DLLs. You may also wish to add some symbol servers for any software builds in your organisation.

A symbol server is defined by at least the following:

- the symbol server dll to be used to handle the symbol server interaction
- a directory location where symbol definitions are saved
- the server location - a url

The symbol server can be enabled or disabled allowing you to keep multiple symbol server configurations available without constantly editing their definitions.

Symbol Server Errors

Any symbol server entry shown in red indicates there is a problem with parts of the definition of that symbol server.

In the image shown above the symbol server at <http://127.0.0.42:8000> cannot be reached. It is either offline or does not exist.

Managing symbol servers

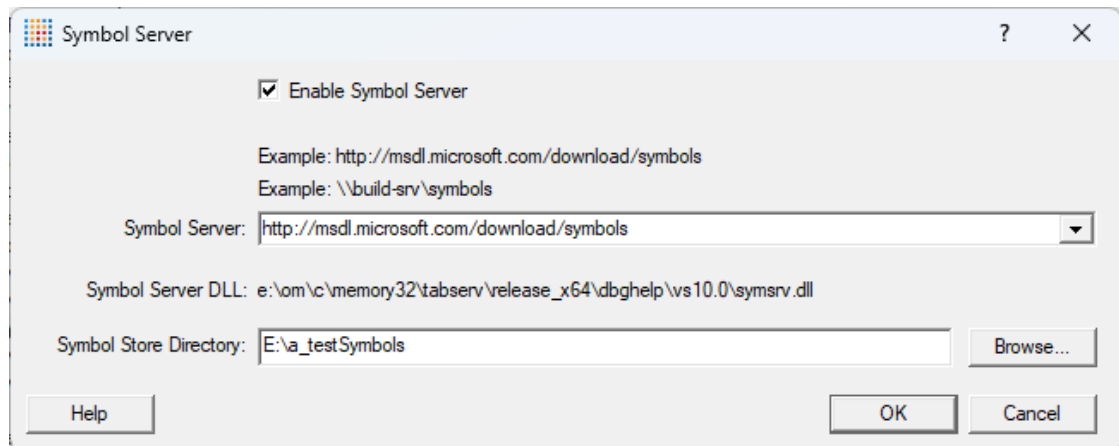
- **Add...** > displays the [symbol server dialog](#) described below
- **Remove** > remove selected symbol server(s) in the list
- **Remove All** > remove all symbol servers
- **Enable All** > enables all symbol servers in the list
- **Disable All** > disables all symbol servers

You can also enable or disable an item in the list via the yellow check box at the left of each row.

To edit the details for a symbol server, just double click the entry in the list to show the symbol server dialog again.


Symbol server dialog

The dialog initially appears pre-populated with some default values and allows you to set up or edit the definition of a symbol server. Some of the default values can be changed.



- **Enable Symbol Server** > enable or disable this server

The following three entries must be set to enable the **OK** button and define the symbol server.

 **OK button not enabled?** The OK button will only be enabled when the following entries have a valid value: - Symbol Server DLL names a dll present in the Memory Validator install directory. - Symbol Store Directory has been specified and exists. - Symbol Server URL has been specified (this value will not be checked for correctness).

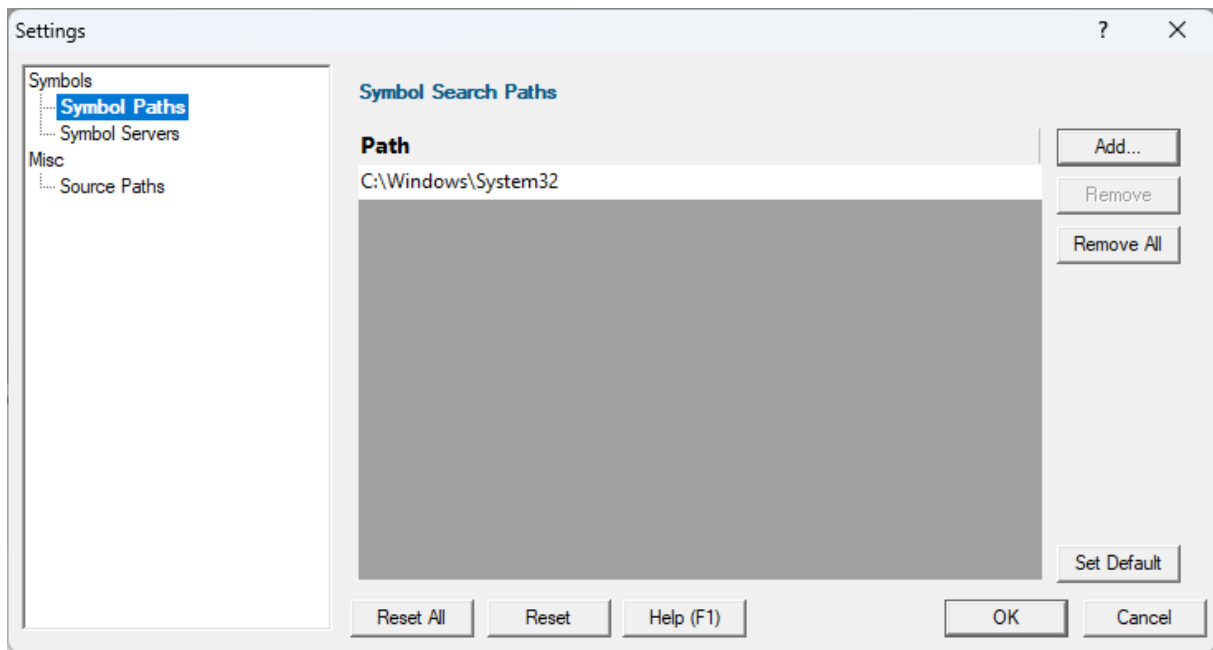
- **Symbol Server** > select a predefined public symbol server or enter the URL of the symbol server you wish to use - the Microsoft server is initially set as the default
- **Symbol Store Directory** > enter or **Browse** to set the directory that will contain local copies of the downloaded symbols

The **Symbol Server DLL** is set automatically.

Reset - Resets **all** global settings, not just those on the current page. This includes removing any symbol servers added.

5.1.2 Symbol Paths

The Symbols settings allow you to specify where Page Fault Monitor looks for symbols.



Manually adding path type directories

The Path list shows all the paths that will be searched for debug information in PDB files.

You can modify the list of files for each path type in the following ways:

- **Add** > appends a row to the directory list > enter the directory path

Edit a directory path by double clicking the entry. The usual controls apply for removing list items:

- **Remove** > removes selected items from the list
- **Remove All** > clears the list
- **Set Default** > adds all valid directories found in the `_NT_SYMBOL_PATH` environment variable, plus the Windows symbols directory

Alternatively, press **Del** to delete selected items, and **Ctrl** + **A** to select all items in the list first.

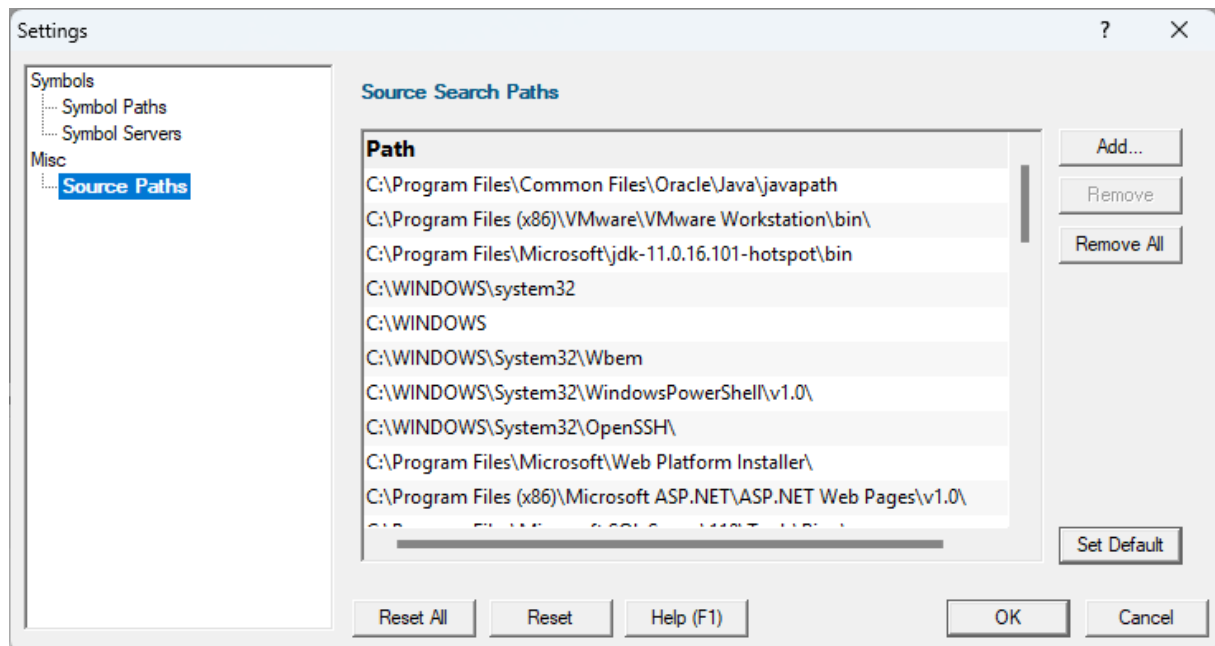
Reset - Resets **all** global settings, not just those on the current page. This includes removing any symbol servers added.

5.2 Misc

5.2.1 Source Paths

The Source Paths settings allow you to specify where Page Fault Monitor looks for source code files.

The source code paths are used when a filename is incomplete - a filename without a path, a filename with a partial path, or a filename that isn't valid on this machine.



Manually adding path type directories

The Path list shows all the paths that will be searched for source code files.

You can modify the list of files for each path type in the following ways:

- **Add** > appends a row to the directory list > enter the directory path

Edit a directory path by double clicking the entry. The usual controls apply for removing list items:

- **Remove** > removes selected items from the list
- **Remove All** > clears the list
- **Set Default** > adds all valid directories found in the PATH environment variable

Alternatively, press **Del** to delete selected items, and **Ctrl** + **A** to select all items in the list first.

Reset - Resets **all** global settings, not just those on the current page. This includes removing any symbol servers added.

Part



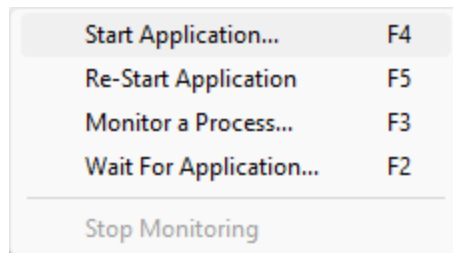
VI

6 Starting your target program

Enter topic text here.

6.1 Launching the program

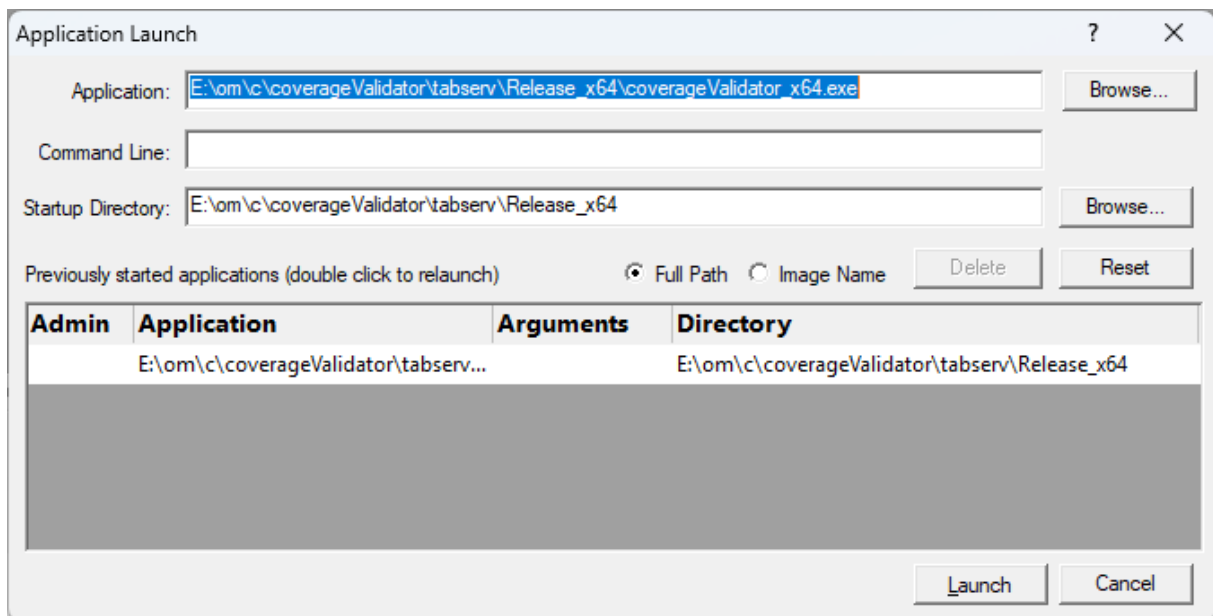
To start your program choose **Start Application...** on the **Launch** menu,



Keyboard shortcuts:



The launch program dialog will be displayed.



The picture shows some already launched programs shown in the scrollable list. You can relaunch these programs by double clicking their entry in the list. Depending on what you want to do with your program you have a choice of launching the program.

Detailed program start (1)

- 1) Type in the program name in the **Application** field, or click the **Browse...** button to use a file browser to choose the program to launch.
- 2) Type in the program arguments in the **Arguments** field.
- 3) Type in the program directory in the **Startup Directory** field, or click the **Browse...** button to use a directory browser to choose the directory.
- 4) Click on the **Launch** button to launch the program.

Page Fault Monitor will start the program and monitor the program for page faults.

Detailed program start (2)

- 1) Click on the program shown in the scrolled list that you want to start. The details for the program will appear in the **Application**, **Arguments** and **Startup Directory** fields.
- 2) Modify any of the **Application**, **Arguments** and **Startup Directory** fields as appropriate.
- 3) Click on the **Launch** button to launch the program.

Page Fault Monitor will start the program and monitor the program for page faults.

Repeat program start

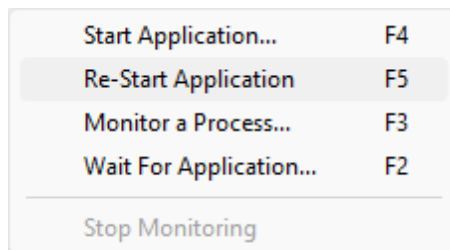
Double click on the program shown in the scrolled list. The program will be launched automatically.

Page Fault Monitor will start the program and monitor the program for page faults.

If at any point you would like the fields reset, click on the **Reset** button.

6.2 Re-Launching the program

To re-start your program choose **Re-Start Application...** on the **Launch** menu,



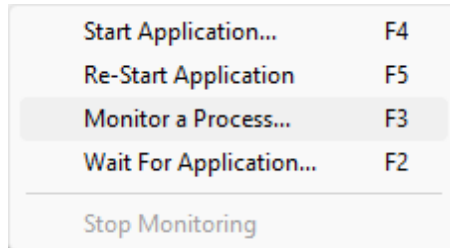
Keyboard shortcuts:



The application that was most recently launched is started.

6.3 Monitoring a process

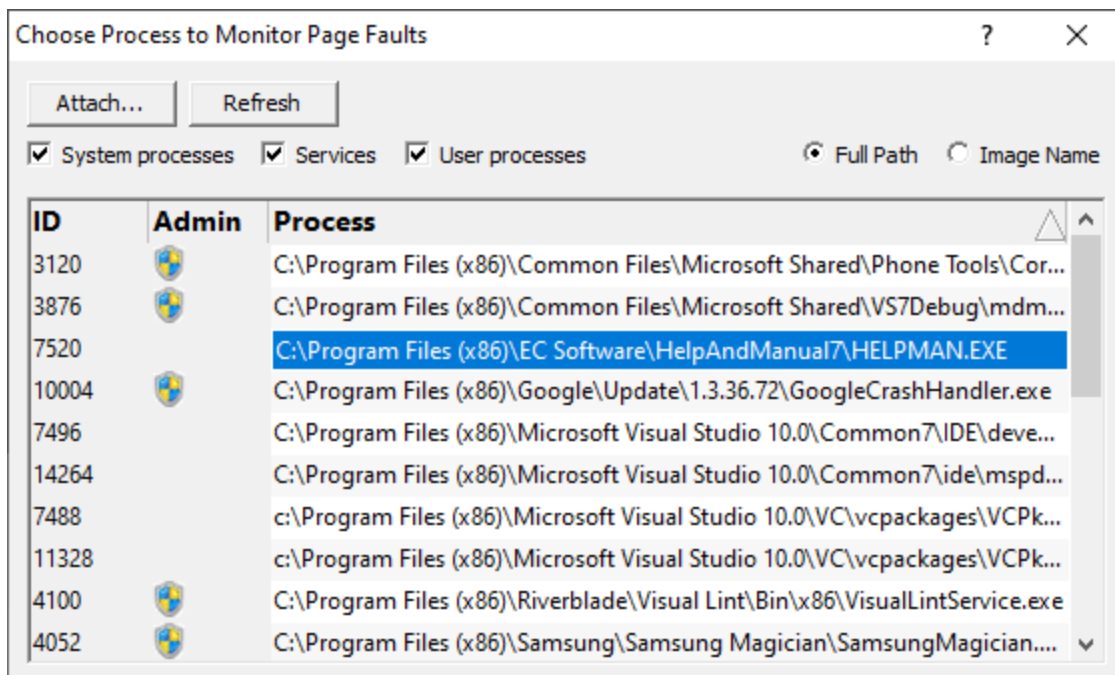
To monitor an already running program for page faults choose **Monitor a Process...** on the **Launch** menu,



Keyboard shortcuts:



The inject program dialog will be displayed.



- **System processes / Services / User processes** > show either of system or services or user processes in the list, or both
- **Full path** > shows the full path to the process executable in the list
- **Image Name** > shows the short program name without path

- **Refresh** > update the list with currently running processes
- **Attach** > start monitoring page faults in the selected process

Administrator Mode

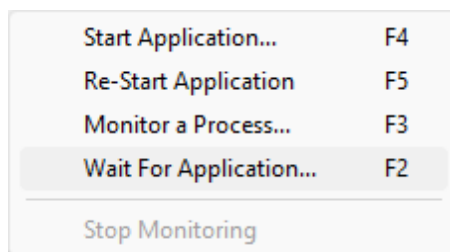
It is not possible to monitor some applications for page faults unless Page Fault Monitor is running in Administrator Mode.

Applications needing Administrator Mode to be monitored as denoted by a shield icon displayed in the Admin column of the grid.

If you try to monitor an application needing Administrator Mode you will be prompted to relaunch Page Fault Monitor in Administrator Mode.

6.4 Waiting for a program

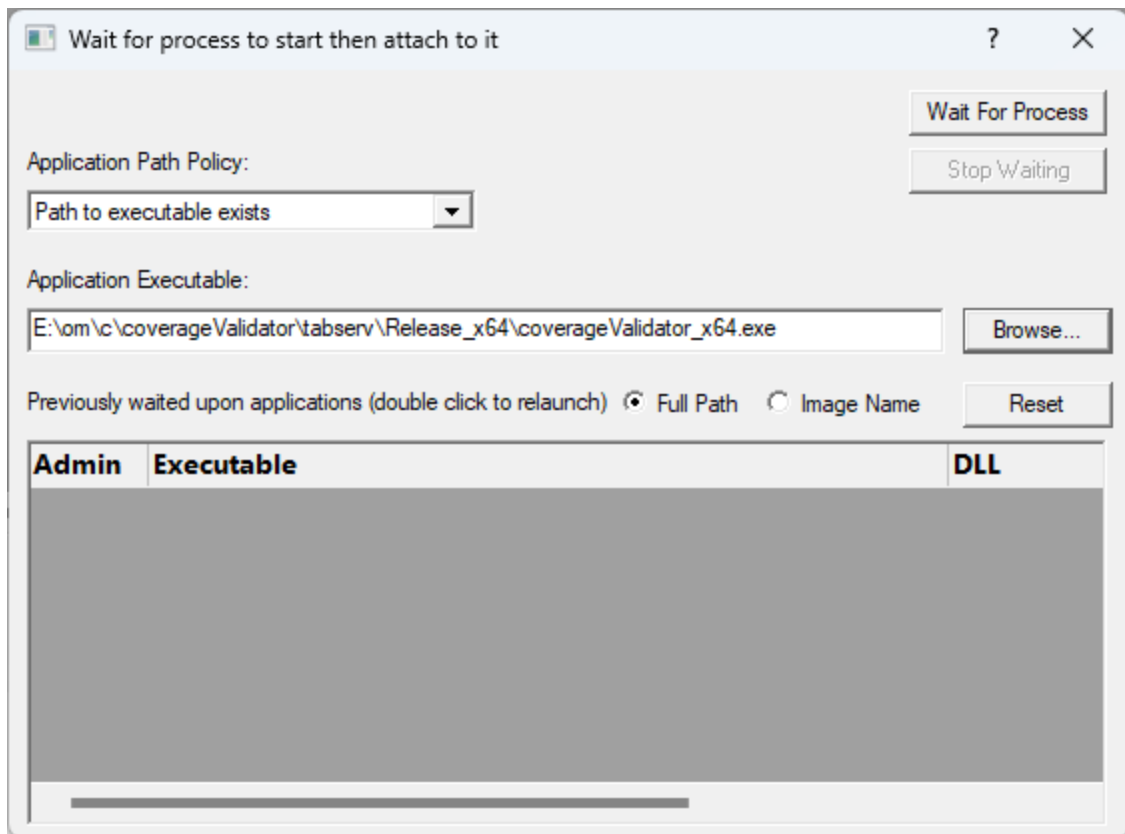
To monitor a program that hasn't started yet choose **Wait For Application...** on the **Launch** menu,



Keyboard shortcuts:

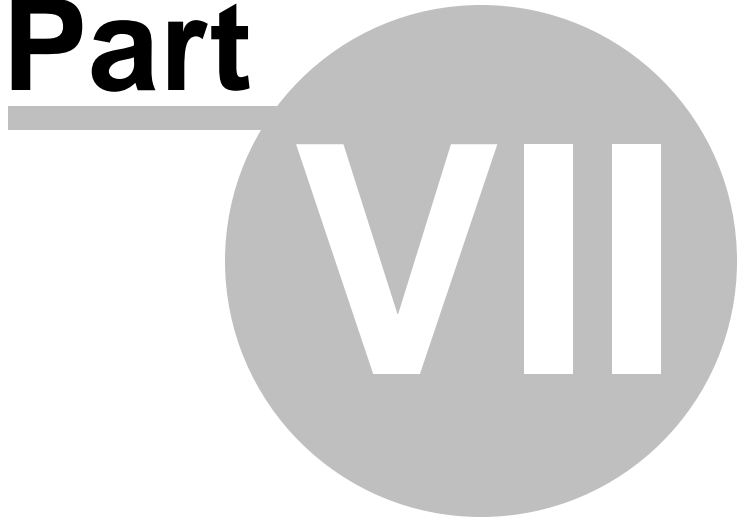


The Wait for process dialog allows you to specify a process that when it starts, Page Fault Monitor will attach to and start collecting debug events.



- **Application Path Policy** > specify if the application you're going to wait for exists on a specific path or it's going to be created dynamically (and the path will therefore be unknown)
- **Application Executable** > type or **Browse** to set the application name to wait for
- **Full path** > shows the full path to the process executable in the list
- **Image Name** > shows the short program name without path
- **Reset** > clears the list
- **Wait for Process** > start waiting for the process to start. When the process starts Page Fault Monitor will attach to it and start collecting debug events.
- **Stop Waiting** > stops waiting for the process to start

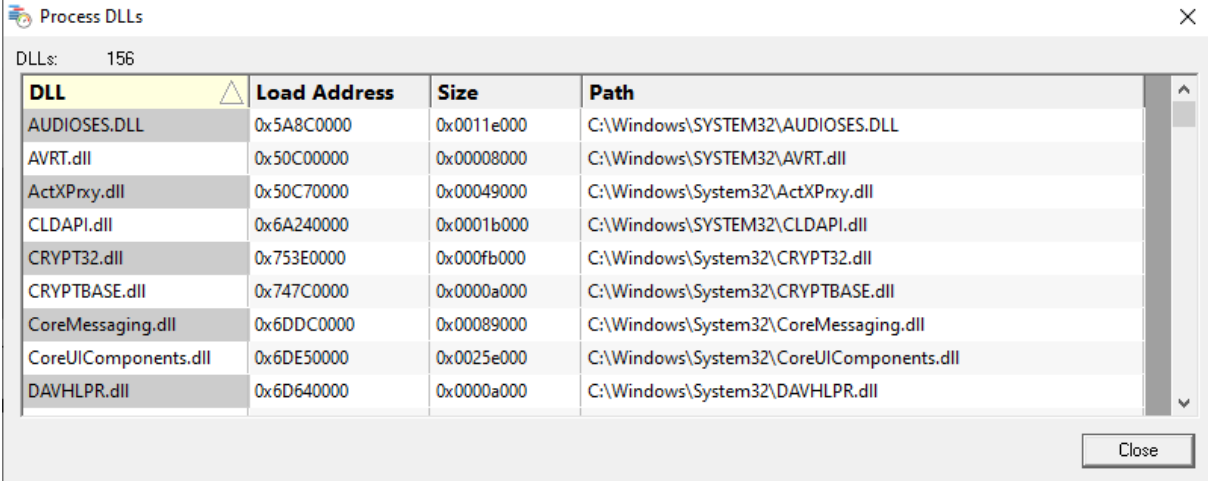
Part



VII

7 Viewing the list of DLLs

The Process DLLs dialog allows you to view the list of DLLs in the process being monitored.



The screenshot shows a window titled "Process DLLs" with a close button in the top right corner. Below the title bar, it says "DLLs: 156". The main area contains a table with four columns: "DLL", "Load Address", "Size", and "Path". The table lists several DLLs, including AUDIOSES.DLL, AVRT.dll, ActXPrxy.dll, CLDAPI.dll, CRYPT32.dll, CRYPTBASE.dll, CoreMessaging.dll, CoreUIComponents.dll, and DAVHLPR.dll. A "Close" button is located at the bottom right of the dialog.

DLL	Load Address	Size	Path
AUDIOSES.DLL	0x5A8C0000	0x0011e000	C:\Windows\SYSTEM32\AUDIOSES.DLL
AVRT.dll	0x50C00000	0x00008000	C:\Windows\SYSTEM32\AVRT.dll
ActXPrxy.dll	0x50C70000	0x00049000	C:\Windows\System32\ActXPrxy.dll
CLDAPI.dll	0x6A240000	0x0001b000	C:\Windows\SYSTEM32\CLDAPI.dll
CRYPT32.dll	0x753E0000	0x000fb000	C:\Windows\System32\CRYPT32.dll
CRYPTBASE.dll	0x747C0000	0x0000a000	C:\Windows\System32\CRYPTBASE.dll
CoreMessaging.dll	0x6DDC0000	0x00089000	C:\Windows\System32\CoreMessaging.dll
CoreUIComponents.dll	0x6DE50000	0x0025e000	C:\Windows\System32\CoreUIComponents.dll
DAVHLPR.dll	0x6D640000	0x0000a000	C:\Windows\System32\DAVHLPR.dll

The display consists of a list of DLL information, with information for each DLL displayed on one line.

The information displayed is DLL name, load address, DLL size and the full path to the DLL.

The display can be sorted by each column. Click the column header to choose which column to sort the data. Click the same column again to reverse the sort direction.

Part

VIII

8 How to use Page Fault Monitor

Select a process to monitor

Use the **File > Monitor a Process...** option to choose a process to monitor

The grid displays page fault data as page faults are detected.

Page fault addresses are converted to symbols according to the [settings](#).

Select a symbol to see information about the line numbers and source code and pages that were faulted at this address.

Please note that if you have symbol servers enabled there may be a delay in providing symbol information the first symbols for a specific DLL are downloaded from the symbol server.

