



# TDS Browser

by

Software Verify

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# TDS Browser

## Turbo Debugger Symbols inspector

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*by Software Verify Limited*

*Welcome to the TDS Browser software tool. TDS Browser is a software tool that allows you to inspect the contents of TDS (Turbo Debugger Symbol) files.*

*We hope you will find this document useful.*

# TDS Browser Help

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# Table of Contents

Foreword	1
<b>Part I How to get TDSBrowser</b>	<b>2</b>
<b>Part II What does TDSBrowser do?</b>	<b>4</b>
<b>Part III What is a module?</b>	<b>6</b>
<b>Part IV Menu</b>	<b>8</b>
1 File .....	9
2 Settings .....	9
3 Query .....	9
4 Software Updates .....	10
5 Help .....	13
<b>Part V The user interface</b>	<b>16</b>
<b>Part VI Settings Dialog</b>	<b>22</b>
1 Source Paths .....	23
2 Path Substitutions .....	24
<b>Part VII How to use TDSBrowser</b>	<b>26</b>
1 Decoding an absolute crash address .....	28
2 Decoding a relative crash address .....	30
3 Decoding a symbol relative crash address .....	34
4 Decoding an Event Viewer XML crash log .....	37
5 What is a load address? .....	40
<b>Part VIII Command Line Interface</b>	<b>48</b>
<b>Index</b>	<b>0</b>



**Part**



# 1 How to get TDSBrowser

TDSBrowser is free for commercial use. TDSBrowser can be downloaded for Software Verify's website at <https://www.softwareverify.com/product/tds-browser/>.

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

Windows Help	<a href="https://www.softwareverify.com/documentation/chm/tdsBrowser.chm">https://www.softwareverify.com/documentation/chm/tdsBrowser.chm</a>
PDF	<a href="https://www.softwareverify.com/documentation/pdfs/tdsBrowser.pdf">https://www.softwareverify.com/documentation/pdfs/tdsBrowser.pdf</a>
Online	<a href="https://www.softwareverify.com/documentation/html/tdsBrowser/index.html">https://www.softwareverify.com/documentation/html/tdsBrowser/index.html</a>

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## Contact

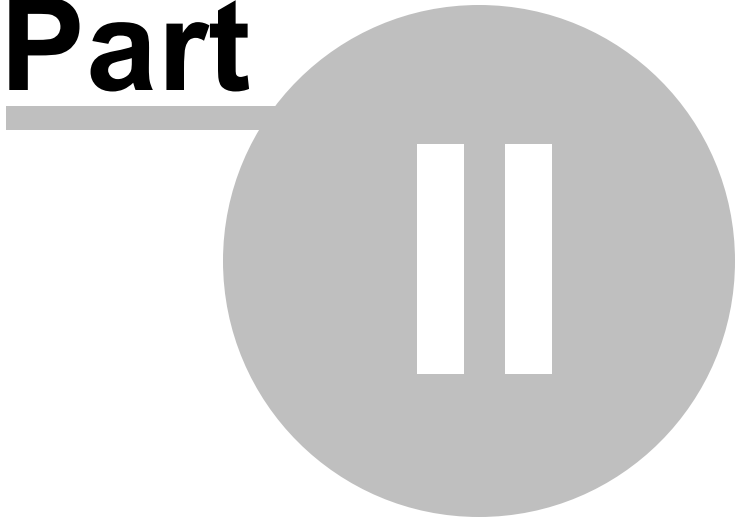
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web <https://www.softwareverify.com>  
blog <https://www.softwareverify.com/blog>  
twitter <http://twitter.com/softwareverify>

Visit our blog to read our articles on debugging techniques and tools.  
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**Part**



## 2 What does TDSBrowser do?

TDSBrowser allows you to inspect the contents of a TDS (Turbo Debugger Symbols) file. This can be TDS data embedded in an executable (or DLL) or TDS symbols in a standalone TDS file.

You can sort the data, filter the data by name or by type of data.

You can also query the data by address which can be useful for identifying what function is at a given address if all you have is a crash address and nothing else.

Query by address is supported three ways:

- Query by absolute address.
- Query by address offset from a DLL load address.
- Query by address offset from a symbol.
- Query using Windows event log XML crash data.

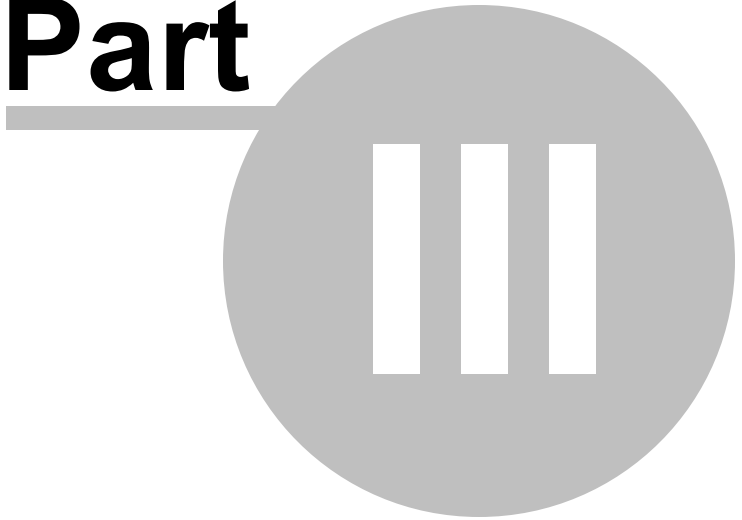
### 32 bit and 64 bit

TDS files created by 32 bit and 64 bit software are supported. On 64 bit Operating systems if a 64 bit TDS file is opened the 64 bit version TDSBrowser is automatically started.

### History

TDSBrowser 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 What is a module?

A module is a contained block of executable code and data. For example, a DLL or EXE.

Some software vendors name their DLLs with different file extensions, for example .BPL, .ARX.

When you call `LoadLibrary` to load a module, you are returned a `HMODULE`, which is an opaque handle to a module. The `HMODULE` is most often the same as the module load address, but not always. The lower few bits of the `HMODULE` can get OR'd with some flags to create a `HMODULE` value that is not the same as the module load address.

You can get the load address of a module from its `HMODULE` by masking out the lower 16 bits of the `HMODULE` value then casting to a `DWORD_PTR`.

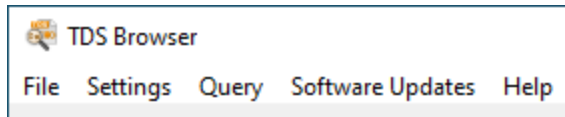
In this documentation when you read EXE or DLL or module, we are effectively referring to the same thing. It's easier to read and write "DLLs" rather than "DLLs or EXE".

**Part**



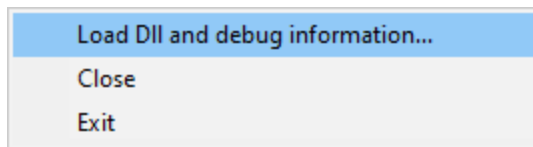
## 4 Menu

The main menu contains five menus, File, Settings, Query, Software Updates and Help.



### 4.1 File

The File menu controls loading of DLLs and debug information, clearing the display and exiting the program.



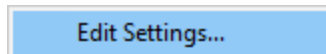
**File** menu > **Load DLL and debug information...** > loads a DLL and the debug information and displays it.

**File** menu > **Close** > clear all results, unloads the DLL and debug information.

**File** menu > **Exit** > closes TDS Browser.

### 4.2 Settings

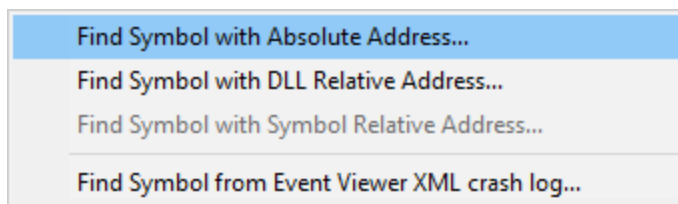
The Settings menu controls editing of the settings controlling Exception Tracer



**Settings** menu > **Edit Settings...** > displays the settings dialog.

### 4.3 Query

The Query menu controls searching for symbols.



**Query menu > Find Symbol with Absolute Address...** > use this option to turn an absolute address in a process into a symbol, filename and line number.

See Decoding an absolute crash address for more details.

**Query menu > Find Symbol with DLL Relative Address...** > use this option to turn a relative address inside a DLL into a symbol, filename and line number.

See Decoding a relative crash address for more details.

**Query menu > Find Symbol with Symbol Relative Address...** > use this option to turn an address that is relative to a symbol inside a DLL into a symbol, filename and line number.

See Decoding a symbol relative crash address for more details.

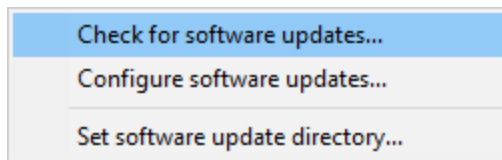
**Query menu > Find Symbol from Event Viewer XML crash log...** > use this option to turn an XML crash log from the Microsoft Event Viewer to a symbol inside a DLL into a symbol, filename and line number.

See Decoding an Event Viewer XML crash log for more details.

## 4.4 Software Updates


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

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

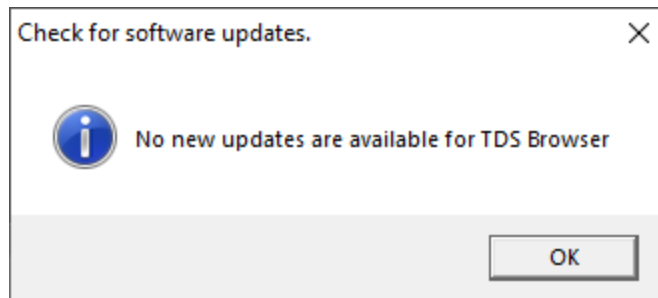


 **Software Updates menu > Check for software updates** > checks for updates and shows the software update dialog if any exist

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

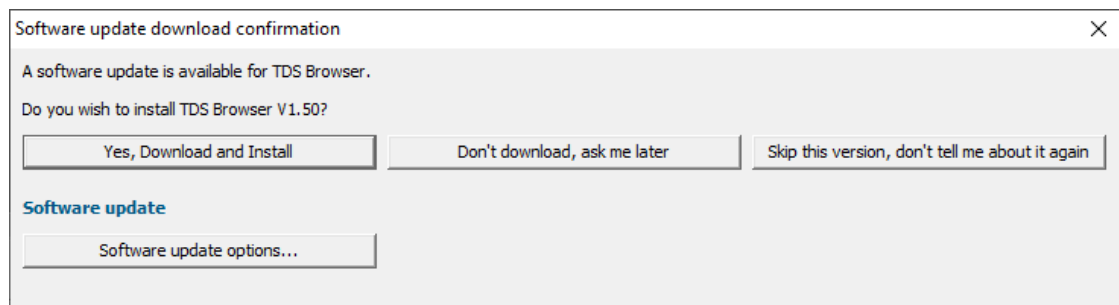
 Before updating the software, close the help manual, and end any active session by closing target programs.

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



## Software Update dialog

If a software update is available for TDS Browser you'll see the software update dialog.



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



Once the update has downloaded, TDS Browser 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 TDS Browser
- **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 TDS Browser as follows:

- Ensure TDS Browser 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

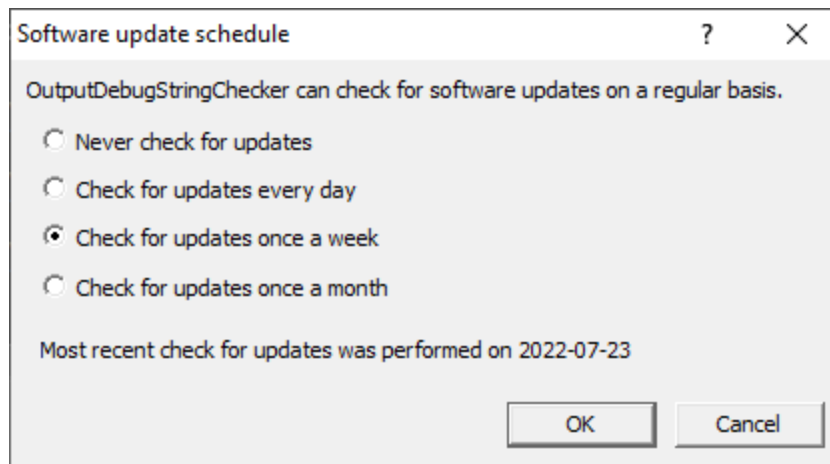
TDS Browser can automatically check to see if a new version of TDS Browser is available for downloading.

 **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.

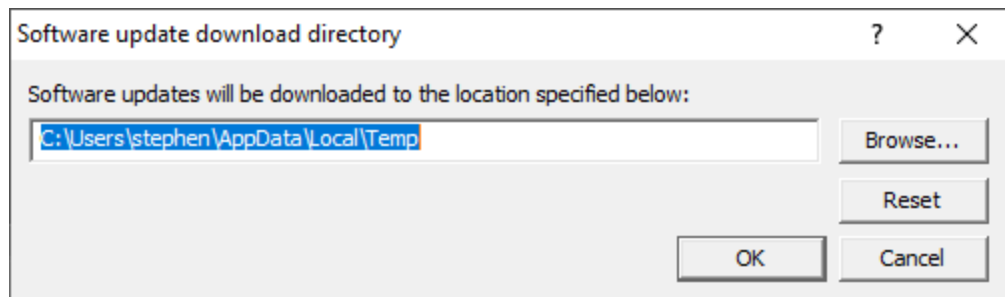


## Software update directory

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)

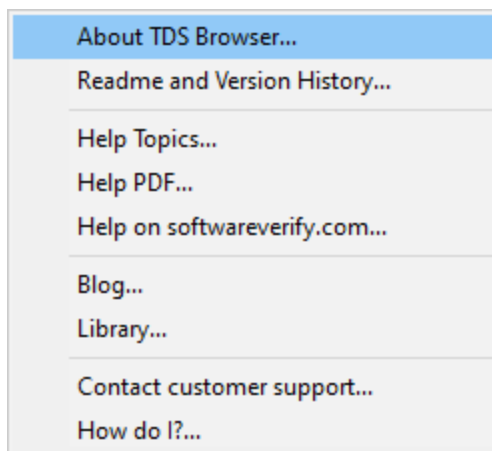
 When modifying the download directory, you should ensure the directory will continue to be valid. Updates may no longer occur if the download location is later invalidated.

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

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

## 4.5 Help

The Help menu controls displaying this help document and displaying information about TDS Browser.



**Help** menu > **About TDS Browser...** > displays information about TDS Browser.

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

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

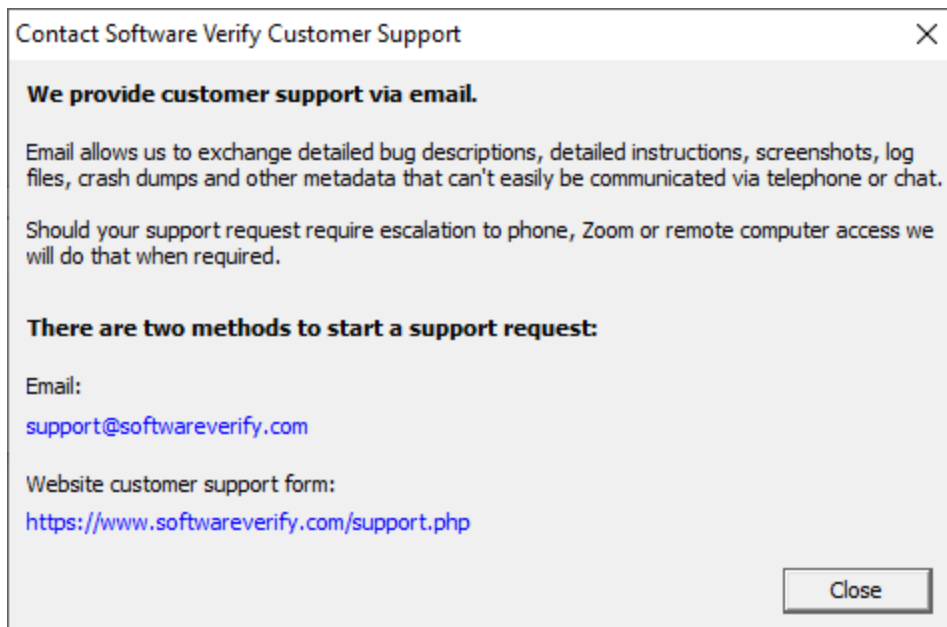
**Help menu** > **Help PDF...** > displays this help file in PDF format.

**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.

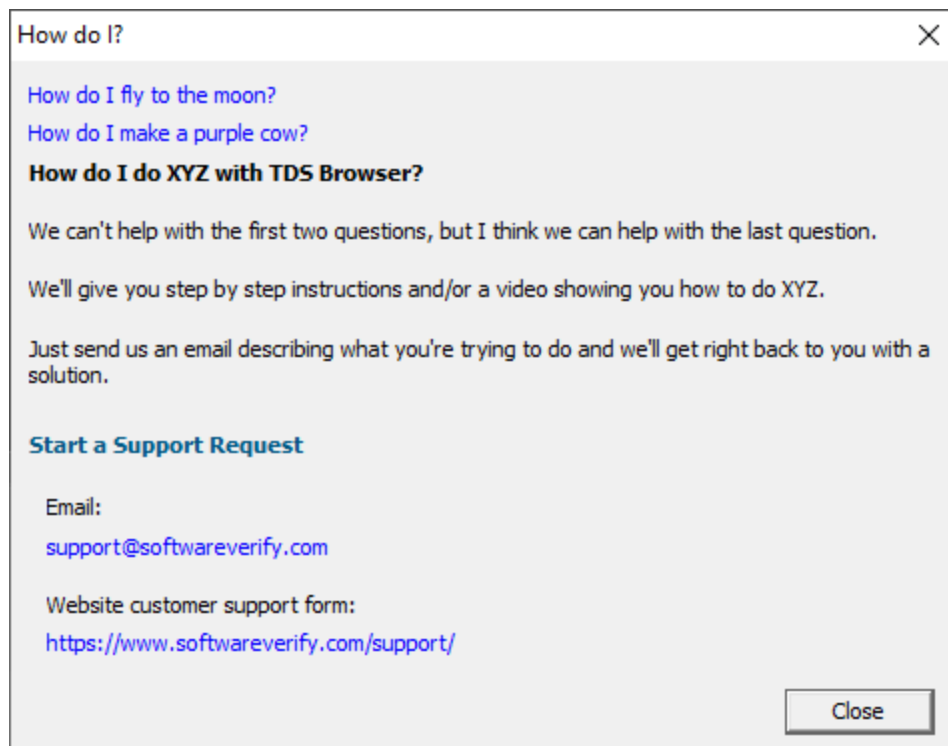
**Help menu** > **Library...** > display the Software Verify library - our best blog articles grouped by related topics.

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

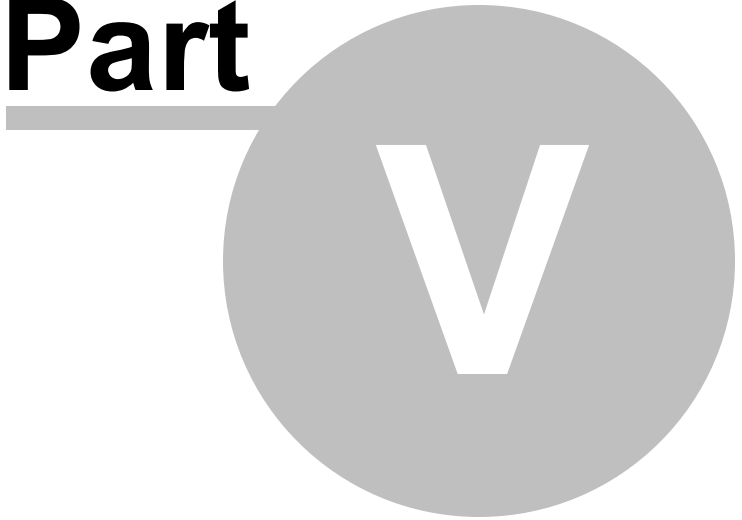


Click a link to contact customer support.

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

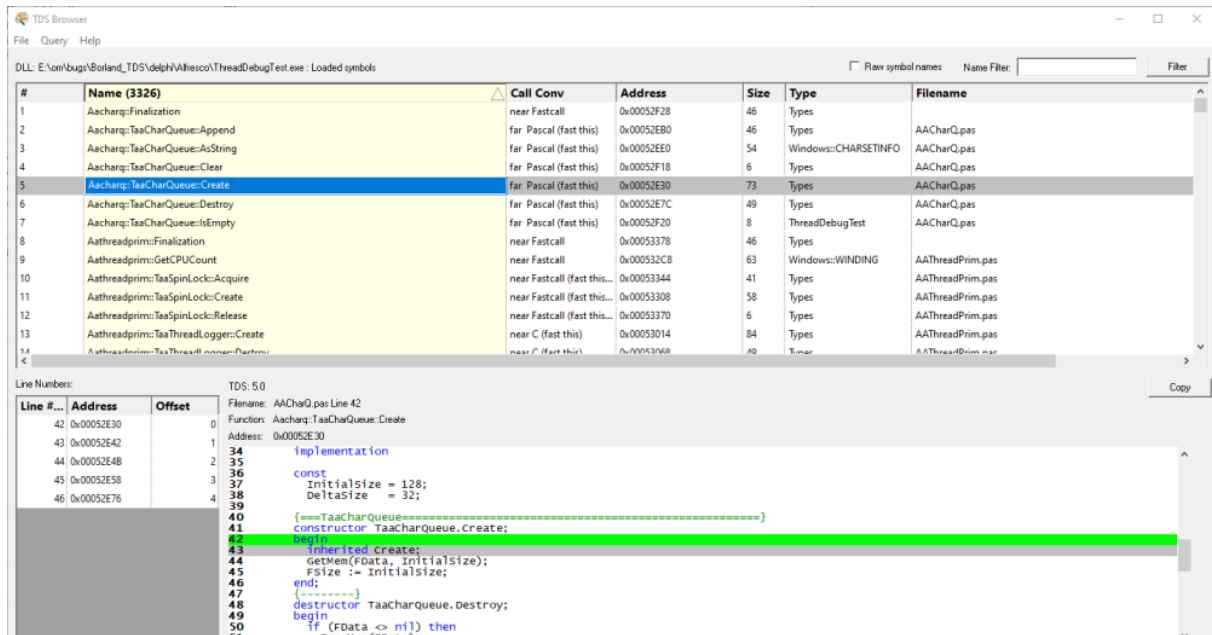


**Part**



## 5 The user interface

The TDSBrowser user interface is shown below.



The user interface consists of a main grid showing all main datatypes and functions in the debug help.

Below is a display for line numbers and a source code display for viewing the source code of any function or variable that is selected.

Selecting any item in the grid populates the lower grid and source code display as appropriate.

Querying any value will select the nearest item in the main grid and populate the other displays as appropriate.

Some basic filtering functionality is also provided.

### TDS Information

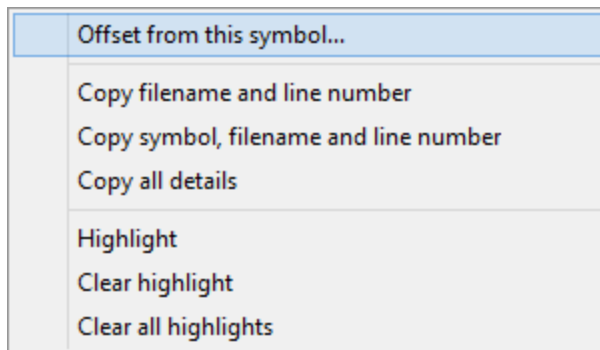
#	Name (3326)	Call Conv	Address	Size	Type	Filename
1	AaCharQ:Finalization	near Fastcall	0x00052F28	46	Types	
2	AaCharQ:TaaCharQueue:Append	far Pascal (fast this)	0x00052E80	46	Types	AACharQ.pas
3	AaCharQ:TaaCharQueue:AsString	far Pascal (fast this)	0x00052EE0	54	Windows::CHARSETINFO	AACharQ.pas
4	AaCharQ:TaaCharQueue:Clear	far Pascal (fast this)	0x00052F18	6	Types	AACharQ.pas
5	AaCharQ:TaaCharQueue:Create	far Pascal (fast this)	0x00052E30	73	Types	AACharQ.pas
6	AaCharQ:TaaCharQueue:Destroy	far Pascal (fast this)	0x00052E7C	49	Types	AACharQ.pas
7	AaCharQ:TaaCharQueue:IsEmpty	far Pascal (fast this)	0x00052F20	8	ThreadDebugTest	AACharQ.pas
8	Aathreadprim:Finalization	near Fastcall	0x00053378	46	Types	
9	Aathreadprim:GetCPUCount	near Fastcall	0x000532C8	63	Windows::WINDING	AAThreadPrim.pas
10	Aathreadprim:TaaSpinLock:Acquire	near Fastcall (fast this)	0x00053344	41	Types	AAThreadPrim.pas
11	Aathreadprim:TaaSpinLock:Create	near Fastcall (fast this)	0x00053308	58	Types	AAThreadPrim.pas
12	Aathreadprim:TaaSpinLock:Release	near Fastcall (fast this)	0x00053370	6	Types	AAThreadPrim.pas
13	Aathreadprim:TaaThreadLogger:Create	near C (fast this)	0x00053014	84	Types	AAThreadPrim.pas
14	Aathreadprim:TaaThreadLogger:Destroy	near C (fast this)	0x00053068	40	Types	AAThreadPrim.pas

The TDS information shows you the symbol name, calling convention, symbol address, symbol size, symbol type, and the filename and line number for the symbol.

You can sort the data by clicking on the column header and clicking again to reverse the direction of the sort.

If you select any item in the grid the lower grids and source code display are populated with data as appropriate.

If you right click any item a context is displayed which will allow you to perform a symbol relative query.



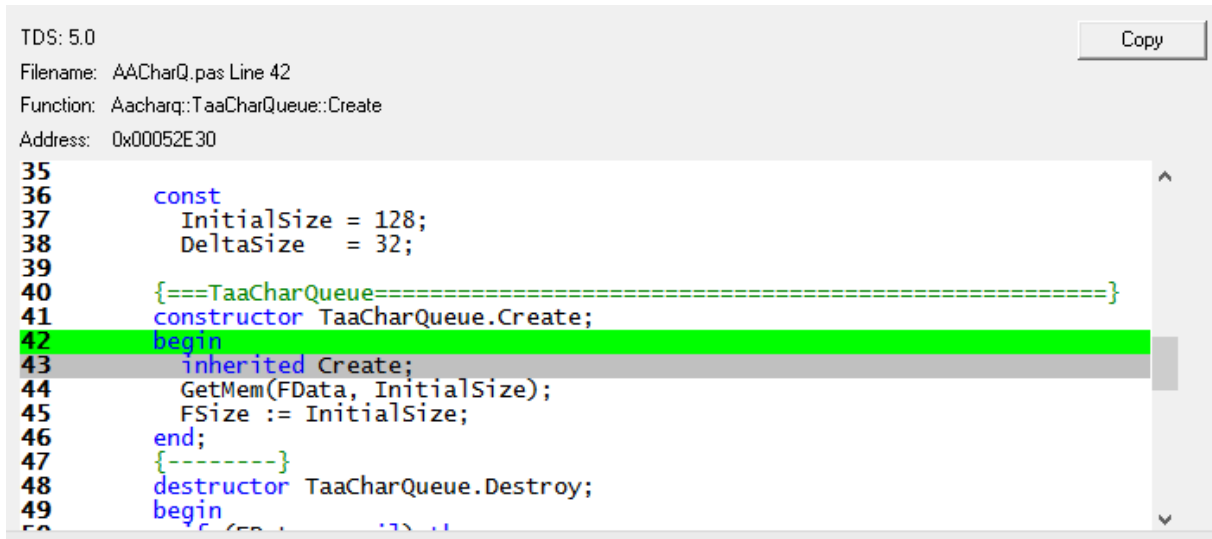
## Line Numbers

Line Numbers:

Line #...	Address	Offset
42	0x00052E30	0
43	0x00052E42	1
44	0x00052E4B	2
45	0x00052E58	3
46	0x00052E76	4

The line numbers section lists each line number, the address of that line and the offset of that line from the start of the owning function. Note that offsets can be negative as well as positive depending on how the compiler did it's work.

## Source Code



```
TDS: 5.0
Filename: ACharQ.pas Line 42
Function: Acharq::TaaCharQueue::Create
Address: 0x00052E30

35
36     const
37         InitialSize = 128;
38         DeltaSize  = 32;
39
40     {===TaaCharQueue=====}
41     constructor TaaCharQueue.Create;
42     begin
43         inherited Create;
44         GetMem(FData, InitialSize);
45         FSize := InitialSize;
46     end;
47     {-----}
48     destructor TaaCharQueue.Destroy;
49     begin
50         FFree(FData);
51     end;
52 end;
```

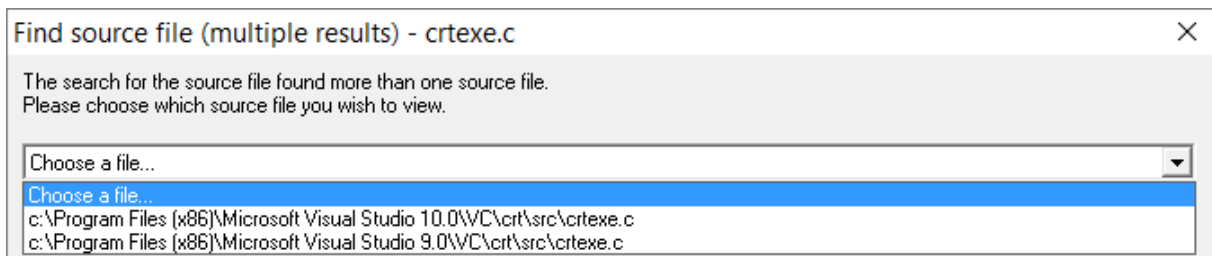
The source code section displays the source code, highlights the selected line and displays information relating to filename, line number, function and address.

## Filters

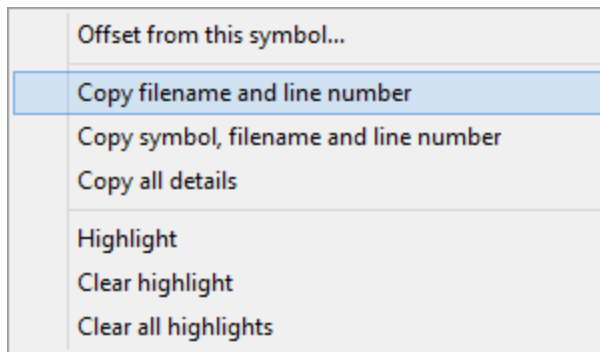


Name Filter:

Filtering by symbol name allows you to easily find a particular symbol. This is very useful when wanting to decode a crash address that has been provided as relative to a symbol (symbol + offset).



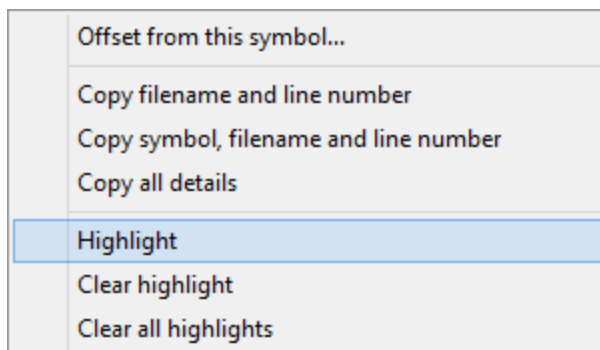
## Clipboard



Options on the context menu to allow you to copy the following information to the clipboard:

- Filename and line number. `ThSort.pas 80`
- Symbol, filename and line number. `Thsort.TThreadSortForm.FormCreate ThSort.pas 80`
- All symbol details. `4 Thsort.TThreadSortForm.FormCreate Unknown14 (fast this) 0x002F6B40 16 System.Types ThSort.pas 80`

## Highlighting



Options on the context menu allow you to highlight multiple symbols, and to remove highlights.

Highlighting can be useful when you want to easily mark a symbol for future reference. Here's an example image showing some symbols that have been highlighted.

Name (3219)	Call Conv	Address	Size	Type	Filename	
Thsort:TThreadSortForm:StartBtnClick	far Fastcall (fast this) ...	0x00050798	140	Types	ThSort.pas	80
Thsort:TThreadSortForm:FormCreate	far Fastcall (fast this) ...	0x00050790	6	Types	ThSort.pas	8
Thsort:TThreadSortForm:QuickSortBoxPaint	far Fastcall (fast this) ...	0x0005077C	19	Types	ThSort.pas	71
Thsort:TThreadSortForm:SelectionSortBoxPaint	far Fastcall (fast this) ...	0x00050768	19	Types	ThSort.pas	7
Thsort:TThreadSortForm:BubbleSortBoxPaint	far Fastcall (fast this) ...	0x00050754	19	Types	ThSort.pas	61
Thsort:TThreadSortForm:PaintArray initialization	far Fastcall (fast this) ...	0x00050704	77	Types	ThSort.pas	51
SortThds:TQuickSort:Sort	near C (fast this) (var ...)	0x00050418	24	Types	SortThds.pas	11
QuickSort	near Fastcall	0x0005036C	171	Types	SortThds.pas	11
SortThds:TSelectionSort:Sort	far Pascal (fast this)	0x000502E4	136	Types	SortThds.pas	11
SortThds:TBubbleSort:Sort	PCode (fast this)	0x00050274	110	Types	SortThds.pas	11
SortThds:TSortThread:Execute	far Pascal (fast this)	0x00050264	15	Types	SortThds.pas	11
SortThds:TSortThread:VisualSwap	far Pascal (fast this)	0x00050240	36	Types	SortThds.pas	91
SortThds:TSortThread:DefineSwap	far Pascal (fast this)	0x000501CC	116	Types	SortThds.pas	71



**Part**



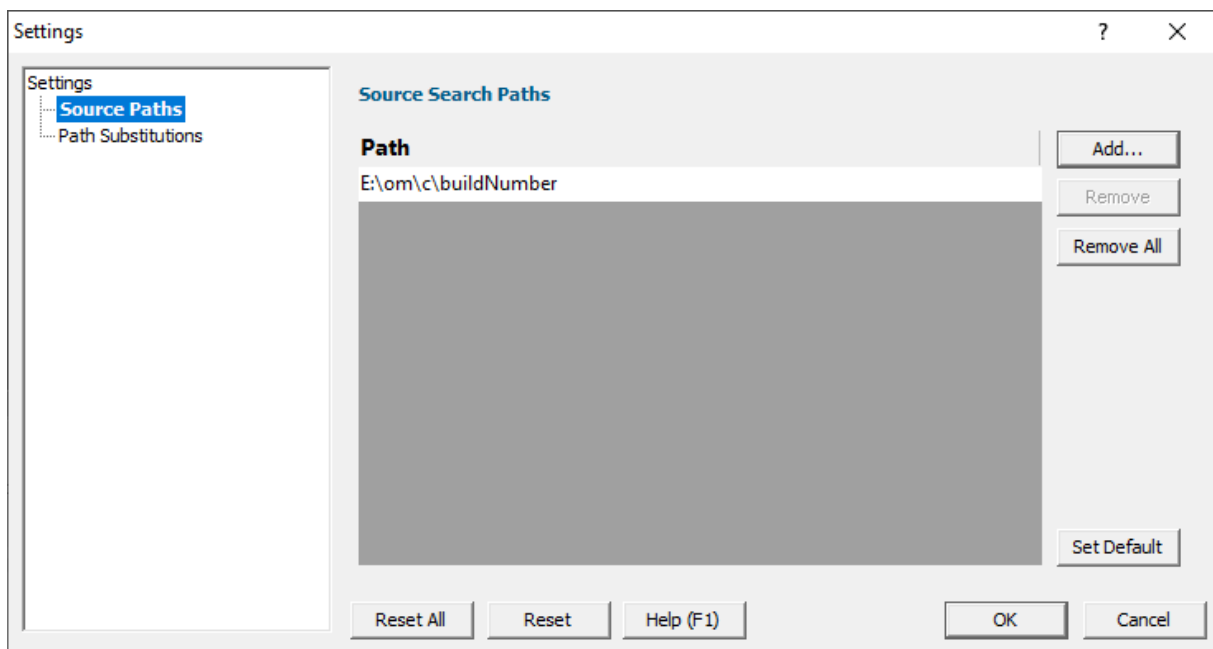
## 6 Settings Dialog

Enter topic text here.

### 6.1 Source Paths

The Source Paths settings allow you to specify where TDS Browser 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

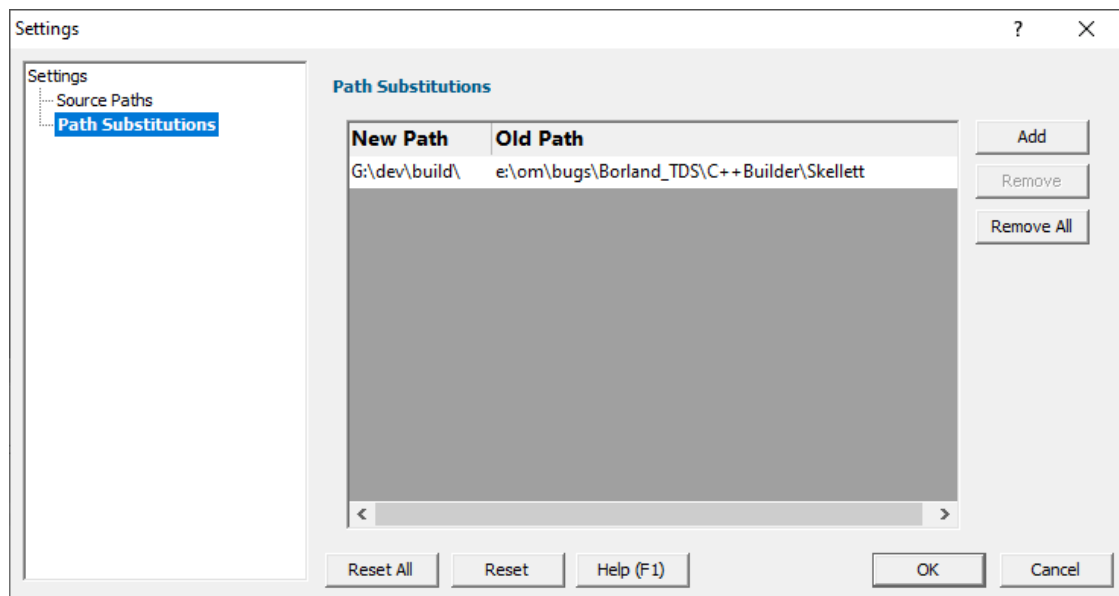
Alternatively, press **Del** to delete selected items, and **Ctrl** + **A** to select all items in the list first.

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

## 6.2 Path Substitutions

The **Path Substitutions** tab allows you to specify file path substitutions to handle copying builds from build machines to development or test machines .

The default settings are shown below:



### Path Substitutions

Some software development schemes have multiple rolling builds of their software, often enabled by using substituted disk drive naming schemes.

When you download the build to your development machine for development and testing, debugging information may reference disk drives that don't exist on your machine, for example, drive X: while your machine only has C:, D:, and E: drives.

Or you may just be copying a build from a drive on a development machine to a subdirectory on a drive on your test machine.

These options let you remap the substitution so that the TDS Browser looks in the correct place for the source code.

- **Add** > adds a row to the **File Paths Substitutions** table > enter the new path that will replace the old path in the **New Path** column > click in the **Old Path** column > enter the path that is being replaced

For example, you might enter `c:\users\stephen\documents` for the new path and `f:\dev\build` for the old path.

You can double click to edit drives and paths in the table, or remove items:

- **Remove** > removes selected substitutions from the list
- **Remove All** > removes all substitutions from the list


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

#### Example: Changed disk drive

Project originally located at	m:\dev\build\testApp
Project copied to	e:\dev\build\testApp
New Path	e:\
Old Path	m:\

#### Example: Project copied to a new location

Project originally located at	f:\dev\build\testApp
Project copied to	C:\Users\Stephen\Documents\testApp
New Path	C:\Users\Stephen\Documents
Old Path	f:\dev\build

 The slashes do not have to match, a forward slash will match a backslash when comparing path fragments. This is deliberate - to improve ease of use with libraries built by different compilers (LLVM and compilers that use it use forward slashes, whereas Visual Studio etc use backslashes).

**Reset All** - Resets **all** global settings, not just those on the current page.

**Reset** - Resets the settings on the current page.

**Part**



## 7 How to use TDSBrowser

### Load TDS information

To load Debug information you need to have the TDS file containing debug information and the DLL that the TDS file relates to. You need to ensure the TDS files corresponds to the very same build as the DLL.

Use the **File > Load DLL and debug information...** option to load the appropriate DLL and it's debug information.

The grid displays various attributes of each debugging item. You can sort the grid by clicking the appropriate column header. Click the same header to reverse the sort order.

Select a symbol to see information about the parameters, locals, line numbers and source code.

### Filtering

If you wish to only view one type of debugging data, select that datatype using the **Tags** combo.

You can also filter by name by typing the name into the **Name Filter** box and clicking the **Filter** button to perform the filtering.

### Viewing function data

As each item in the list is selected the Parameters and Locals grid are populated, the Line Numbers are updated and the source code display updates to show the source code for the function. All lines in the function that contain executable code (as indicated by the debugging information) are coloured grey. The current line for the function is coloured bright green.

### Querying data

You can query data by using the two Query fields below the main grid.

#### Relative query

Type the relative address (also know as address offset) into the Query by Offset field, then click Query. The symbol information is displayed.

The field accepts decimal or hexadecimal values. Hex values must be prefixed with 0x.

#### Absolute query

Type the absolute address into the Query by Address field, type the absolute DLL load address into the Alternate Load Address field, then click Query. The symbol information is displayed.

The fields accept decimal or hexadecimal values. Hex values must be prefixed with 0x.

## 7.1 Decoding an absolute crash address

### Scenario:

A customer has supplied you with a crash report containing a callstack with addresses. The callstack also indicates which module relates to which address.

The customer has also supplied you with a list of module load addresses.

### Example Data:

```
Exception code: C0000005 ACCESS_VIOLATION
Fault address: 0x005f5eec (base 0x00400000) C:\Program Files (x86)\Software Verification\
Exception Parameters:
  0: 0x00000000 [Read Error]
  1: 0x035f0034 [Address]

Registers:
EAX:035F0034
EBX:00000000
ECX:FFFDD000
EDX:00002370
ESI:006F7D58
EDI:035F0034
CS:EIP:0023:005F5EEC
SS:ESP:002B:0018FE14  EBP:0018FE3C
DS:002B  ES:002B  FS:0053  GS:002B
Flags:00010202

StackTrace

C:\Program Files (x86)\Software Verification\C++ Memory Validator\memoryValidator.exe : 0x
C:\Program Files (x86)\Software Verification\C++ Memory Validator\memoryValidator.exe : 0x
C:\Windows\syswow64\msvcrt.dll : 0x75D70000 : 0x75D7C3E4
C:\Windows\syswow64\msvcrt.dll : 0x75D70000 : 0x75D836B6
C:\Program Files (x86)\Software Verification\C++ Memory Validator\memoryValidator.exe : 0x
C:\Windows\syswow64\kernel32.dll : 0x754D0000 : 0x754E3365
C:\Windows\SysWOW64\ntdll.dll : 0x77920000 : 0x77959F6D
C:\Windows\SysWOW64\ntdll.dll : 0x77920000 : 0x77959F40
C:\Windows\SysWOW64\ntdll.dll : 0x77920000 : 0x77959F40
```

This is data from a real crash a few years ago, from C++ Memory Validator 5.80.

### Question:

How do you decode these absolute addresses?

### Answer:

In the above data we can see a callstack containing entries for ntdll.dll, msvcrt.dll, and memoryValidator.exe.

All the modules are Microsoft DLLs except for the EXE, which is part of C++ Memory Validator, one of our tools.

To decode these values, we load memoryValidator.exe into TDSBrowser.exe, then for each symbol we take the following actions.

For our purposes here, we're going to show how to convert one symbol. We're going to use the first symbol from memoryValidator.exe in the example data above.

```
0x005f5eec (base 0x00400000)
```

The address is 0x005f5eec. The DLL loaded at 0x00400000. You'll notice the load address for all MemoryValidator.exe entries is 0x00400000.

From the Query menu choose **Find Symbol with Absolute Address...**



The Query Symbol by Absolute Address dialog is displayed.

Query Symbol by Absolute Address ? X

DLL: memoryValidator.exe

DLL Load Address:

[What's a load address?](#)

Address:

Find Symbol Cancel

Type the DLL load address into the DLL Load Address field. Prefix any hexadecimal addresses with 0x.

Type the symbol address into the Address field. Prefix any hexadecimal addresses with 0x.

Click the **Find Symbol** button.

Query Symbol by Absolute Address ? X

DLL: memoryValidator.exe

DLL Load Address:

[What's a load address?](#)

Address:

Find Symbol Cancel

The appropriate location in the code is found and displayed.

```

DbgHelp.dll
Filename: E:\om\c\memory32\tabserv\MemorySettingData.cpp Line 5374 + 5 bytes
Function: MemorySettingData::saveSoftwareUpdateInformation
Address: 0x06255EEC
5367
5368 void MemorySettingData::saveCoverageFilters(CArchive &a
5369 {
5370 #if _DO_NEW_COVERAGE_DATA
5371     DWORD i, n;
5372     DWORD schemaVersion;
5373
5374     schemaVersion = MEMORYSETTINGDATA_SCHEMA;
5375     ar << schemaVersion;
5376
5377     n = coverageFilters.getNumItems();
5378     ar << n;
5379
5380     for(i = 0; i < n; i++)
5381     {
5382         memoryCoverageFilter *mf;

```

**Results:**

Repeating the process for the data shown above resulted in this information.

```

0x005f5eec (base 0x00400000) C:\Program Files (x86)\Software Verification\C++ Memory Valid
C:\Program Files (x86)\Software Verification\C++ Memory Validator\memoryValidator.exe : 0x
C:\Program Files (x86)\Software Verification\C++ Memory Validator\memoryValidator.exe : 0x
C:\Windows\syswow64\msvcrt.dll : 0x75D70000 : 0x75D7C3E4
C:\Windows\syswow64\msvcrt.dll : 0x75D70000 : 0x75D836B6
C:\Program Files (x86)\Software Verification\C++ Memory Validator\memoryValidator.exe : 0x
C:\Windows\syswow64\kernel32.dll : 0x754D0000 : 0x754E3365
C:\Windows\SysWOW64\ntdll.dll : 0x77920000 : 0x77959F6D
C:\Windows\SysWOW64\ntdll.dll : 0x77920000 : 0x77959F40
C:\Windows\SysWOW64\ntdll.dll : 0x77920000 : 0x77959F40

```

**Help! I have a crash address but I don't know what the load address is? What do I do?**

You need to read about load addresses.

## 7.2 Decoding a relative crash address

**Scenario:**

A customer has supplied you with a crash report containing a callstack with relative offsets from DLLs. The callstack also indicates which module relates to which address.

**Example Data:**

```
Exception code: C0000005 ACCESS_VIOLATION
Fault offset: 0x00036FA3 C:\WINDOWS\system32\MSVCRT.dll
Exception Parameters:
  0: 0x00000000 [Read Error]
  1: 0x5f8f2000 [Address]
```

```
Registers:
EAX:B3BEB6D4
EBX:5F8CB6C8
ECX:150BE5B5
EDX:00000000
ESI:5F8F2000
EDI:01B98DEC
CS:EIP:001B:77C46FA3
SS:ESP:0023:0012F158 EBP:0012F160
DS:0023 ES:0023 FS:003B GS:0000
Flags:00010212
```

#### StackTrace

```
C:\WINDOWS\system32\MFC42u.DLL : 0x0000270a
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x000db989
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x000db1f8
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00121a83
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00121b7e
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00174ec5
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00175094
C:\WINDOWS\system32\MFC42u.DLL : 0x00013724
C:\WINDOWS\system32\MFC42u.DLL : 0x00014245
C:\WINDOWS\system32\MFC42u.DLL : 0x00001b31
C:\WINDOWS\system32\MFC42u.DLL : 0x0008cba7
```

This is data from a real crash many years ago.

#### Question:

There are no DLL load addresses and the addresses aren't addresses, but offsets from the start of a DLL. How do you decode these relative offsets?

#### Answer:

In the above data we can see a callstack containing entries for mfc42u.dll, and memoryValidator.exe.

All the modules are Microsoft DLLs except for the EXE, which is part of C++ Memory Validator, one of our tools.

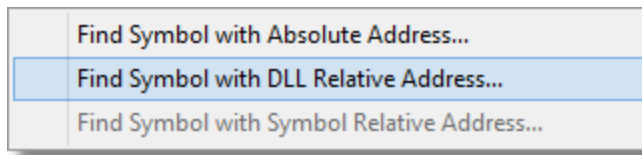
To decode these values, we load memoryValidator.exe into TDSBrowser.exe, then for each symbol we take the following actions.

For our purposes here, we're going to show how to convert one symbol. We're going to use the first symbol from memoryValidator.exe in the example data above.

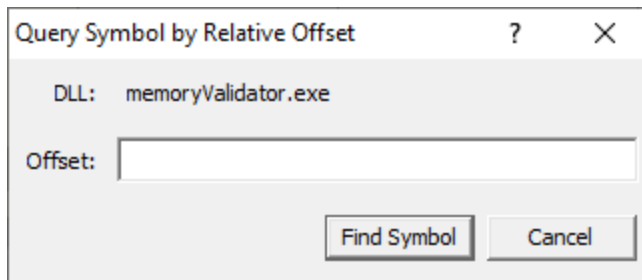
```
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x000db989
```

The relative address (or offset) is 0x000db989. We don't know the DLL load address.

From the Query menu choose **Find Symbol with DLL Relative Address...**

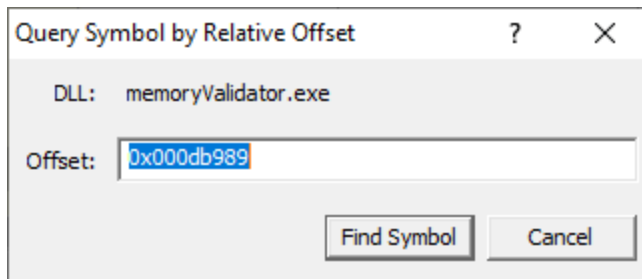


The Query Symbol by Absolute Address dialog is displayed.

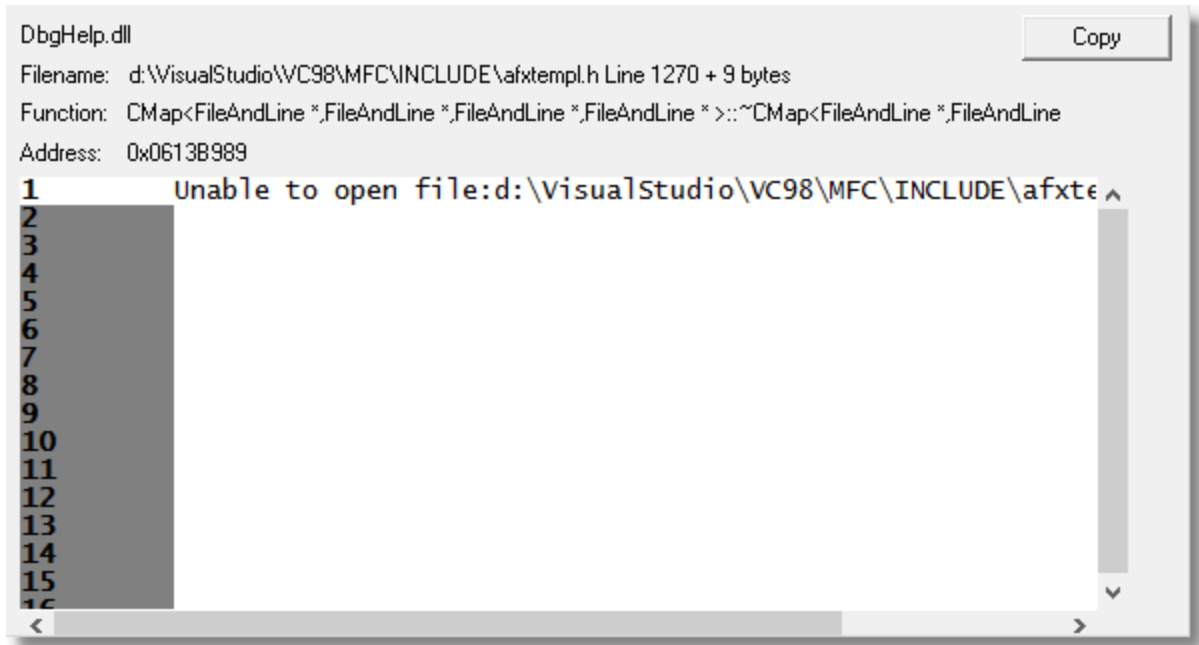


Type the relative address into the Offset field. Prefix any hexadecimal addresses with 0x.

Click the **Find Symbol** button.



The appropriate location in the code is found and displayed. In this example TDSBrowser could not locate the source code (as the file location is not valid on this machine)



The screenshot shows a debugger window titled "DbgHelp.dll" with a "Copy" button in the top right corner. The window displays the following information:

```
Filename: d:\VisualStudio\VC98\MFC\INCLUDE\afxtempl.h Line 1270 + 9 bytes
Function: CMap<FileAndLine *,FileAndLine *,FileAndLine *,FileAndLine * >::~CMap<FileAndLine *,FileAndLine
Address: 0x0613B989
```

The main content of the window is a list of line numbers from 1 to 16 on the left side. Line 1 is highlighted in blue and contains the text: "Unable to open file:d:\VisualStudio\VC98\MFC\INCLUDE\afxt".

**Results:**

Repeating the process for the data shown above resulted in this information.

```
Exception code: C0000005 ACCESS_VIOLATION
Fault offset: 0x00036FA3 C:\WINDOWS\system32\MSVCRT.dll
Exception Parameters:
  0: 0x00000000 [Read Error]
  1: 0x5f8f2000 [Address]
```

```
Registers:
EAX:B3BEB6D4
EBX:5F8CB6C8
ECX:150BE5B5
EDX:00000000
ESI:5F8F2000
EDI:01B98DEC
CS:EIP:001B:77C46FA3
SS:ESP:0023:0012F158 EBP:0012F160
DS:0023 ES:0023 FS:003B GS:0000
Flags:00010212
```

#### StackTrace

```
C:\WINDOWS\system32\MFC42u.DLL : 0x0000270a
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x000db989
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x000db1f8
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00121a83
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00121b7e
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00174ec5
C:\Program Files\Software Verification\Memory Validator\memoryValidator.exe : 0x00175094
C:\WINDOWS\system32\MFC42u.DLL : 0x00013724
C:\WINDOWS\system32\MFC42u.DLL : 0x00014245
C:\WINDOWS\system32\MFC42u.DLL : 0x00001b31
C:\WINDOWS\system32\MFC42u.DLL : 0x0008cba7
```

## 7.3 Decoding a symbol relative crash address

### Scenario:

A customer has supplied you with a crash report containing a callstack with symbol relative offsets from DLLs. The callstack also indicates which module relates to which address.

### Example Data:

```
ntoskrnl.exe!KeSynchronizeExecution+0x2246
ntoskrnl.exe!KeWaitForMultipleObjects+0x135e
ntoskrnl.exe!KeWaitForMultipleObjects+0xdd9
ntoskrnl.exe!KeWaitForSingleObject+0x373
ntoskrnl.exe!KeStallWhileFrozen+0x1977
ntoskrnl.exe!_misaligned_access+0x13f9
ntoskrnl.exe!KeWaitForMultipleObjects+0x152f
ntoskrnl.exe!KeWaitForMultipleObjects+0xdd9
ntoskrnl.exe!KeWaitForSingleObject+0x373
ntoskrnl.exe!NtWaitForSingleObject+0xb2
ntoskrnl.exe!setjmpex+0x34a3
ntdll.dll!ZwWaitForSingleObject+0xa
KERNELBASE.dll!WaitForSingleObjectEx+0x98
svlcoveragevalidatorstub_x64.dll!sendCommandLineAndStartTimeToGUI+0x2868
svlcoveragevalidatorstub_x64.dll!setValidatorFeedbackHookingComplete+0x1fa6
svlcoveragevalidatorstub_x64.dll!svl_sendMessageRawToUserInterface+0x21837
svlcoveragevalidatorstub_x64.dll!svl_sendMessageRawToUserInterface+0x218cb
KERNEL32.DLL!BaseThreadInitThunk+0x22
ntdll.dll!RtlUserThreadStart+0x34
```

This is real data from a bug at Software Verify Ltd. This is one thread from many in a dump relating to a deadlock bug we were investigating.

**Question:**

How do you decode these symbol relative offsets?

**Answer:**

In the above data we can see a callstack containing entries for ntoskrnl.exe, ntdll.dll, kernelbase.dll, kernel32.dll and svlcoveragevalidatorstub\_x64.dll.

All the modules are Microsoft DLLs except for one DLL, which is part of C++ Coverage Validator, one of our tools.

To decode these values, we load svlCoverageValidatorStub\_x64.dll into TDSBrowser.exe (64 bit), then for each symbol we take the following actions.

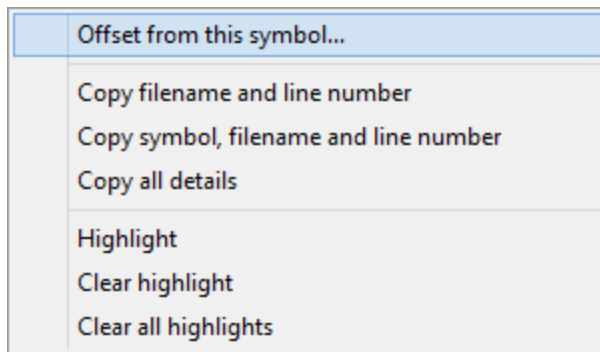
For our purposes here, we're going to show how to convert one symbol. We're going to use the first symbol from svlCoverageValidatorStub\_x64.dll in the example data above.

```
svlcoveragevalidatorstub_x64.dll!sendCommandLineAndStartTimeToGUI+0x2868
```

Type the symbol name into the **Name Filter** field, then click **Filter**. This makes it easy to find the symbol we want.

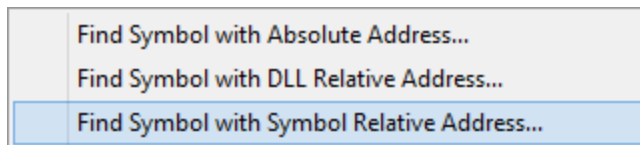


Once we have found the symbol, right click on the symbol to display the context menu and choose **Offset from this symbol...**



An alternate method is to click on the symbol to select it, then from the Query menu choose **Find Symbol with Symbol Relative Address...**

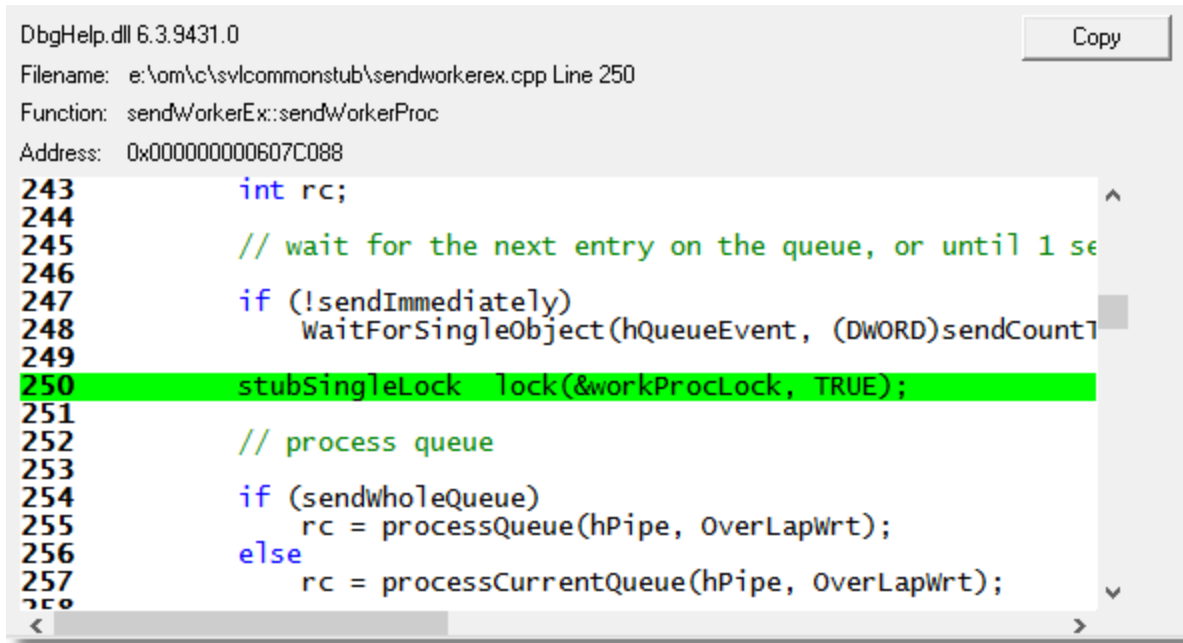
Or, from the Query menu choose **Find Symbol with Symbol Relative Address...** then choose the symbol you want from the combo box.



Type the offset into the dialog (hex values must be prefixed with 0x) and click OK.



The appropriate location in the code is found and displayed.



```
DbgHelp.dll 6.3.9431.0
Filename: e:\om\c\svlcommonstub\sendworkerex.cpp Line 250
Function: sendWorkerEx::sendWorkerProc
Address: 0x000000000607C088
243     int rc;
244
245     // wait for the next entry on the queue, or until 1 se
246
247     if (!sendImmediately)
248         WaitForSingleObject(hQueueEvent, (DWORD)sendCountT
249
250     stubSingleLock lock(&workProcLock, TRUE);
251
252     // process queue
253
254     if (sendWholeQueue)
255         rc = processQueue(hPipe, OverLapWrt);
256     else
257         rc = processCurrentQueue(hPipe, OverLapWrt);
258
259
```

**Results:**

Repeating the process for the data shown above resulted in this information.

```
svlcoveragevalidatorstub_x64.dll!sendCommandLineAndStartTimeToGUI+0x2868
svlcoveragevalidatorstub_x64.dll!setValidatorFeedbackHookingComplete+0x1fa6
svlcoveragevalidatorstub_x64.dll!svl_sendMessageRawToUserInterface+0x21837
svlcoveragevalidatorstub_x64.dll!svl_sendMessageRawToUserInterface+0x218cb
```

```
sendWork
stubSend
memcpy
wscopy
```

## 7.4 Decoding an Event Viewer XML crash log

**Scenario:**

A customer has supplied you with data from Windows Event Viewer about a crash. The log contains XML and you don't know which values are relevant.

The event log data will have a provider name of "Windows Error Reporting" or "Application Error".

The XML data is found on the "Details" tab with the XML View radio box selected.

**Example Data:**

```

<Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event">
  <System>
    <Provider Name="Windows Error Reporting" />
    <EventID Qualifiers="0">1001</EventID>
    <Level>4</Level>
    <Task>0</Task>
    <Keywords>0x8000000000000000</Keywords>
    <TimeCreated SystemTime="2020-02-10T17:39:08.000000000Z" />
    <EventRecordID>260219</EventRecordID>
    <Channel>Application</Channel>
    <Computer>hydra</Computer>
    <Security />
  </System>
  <EventData>
    <Data>2023787729086567941</Data>
    <Data>1</Data>
    <Data>APPCRASH</Data>
    <Data>Not available</Data>
    <Data>0</Data>
    <Data>testDeliberateCrash.exe</Data>
    <Data>1.0.0.1</Data>
    <Data>5e419525</Data>
    <Data>testDeliberateCrash.exe</Data>
    <Data>1.0.0.1</Data>
    <Data>5e419525</Data>
    <Data>c0000005</Data>
    <Data>000017b2</Data>
    <Data />
    <Data />
    <Data>C:\Users\stephen\AppData\Local\Temp\WERA14E.tmp.WERInternalMetadata.xml</Data>
    <Data>C:\Users\stephen\AppData\Local\Microsoft\Windows\WER\ReportArchive\AppCrash_testDelibera
    <Data />
    <Data>0</Data>
    <Data>3cc45263-4c2c-11ea-83d3-001e4fdb3956</Data>
    <Data>0</Data>
    <Data>54756af49aec84f97c15f03794ffd605</Data>
  </EventData>
</Event>

```

This is data from a test program that is designed to crash.

#### Question:

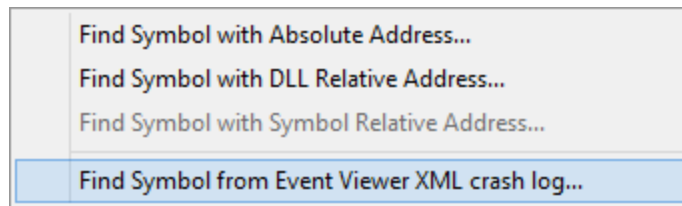
There the event log indicates a DLL, but no load address, two different addresses, an exception code and an offset from the start of the DLL. How do you decode this relative offset?

#### Answer:

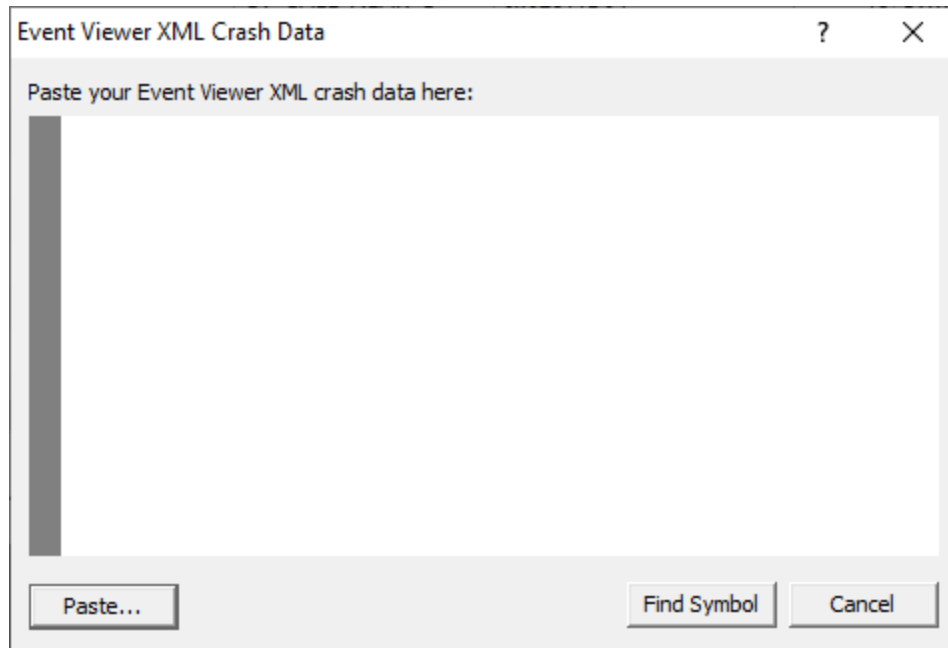
TDSBrowser has an option specifically for this occasion.

The XML data indicates the crash happened in **testDeliberateCrash.exe**. Load this into TDSBrowser being sure to load the correct build version and that the TDS file can be found so that symbols get loaded.

From the Query menu choose **Find Symbol from Event Viewer XML crash log...**

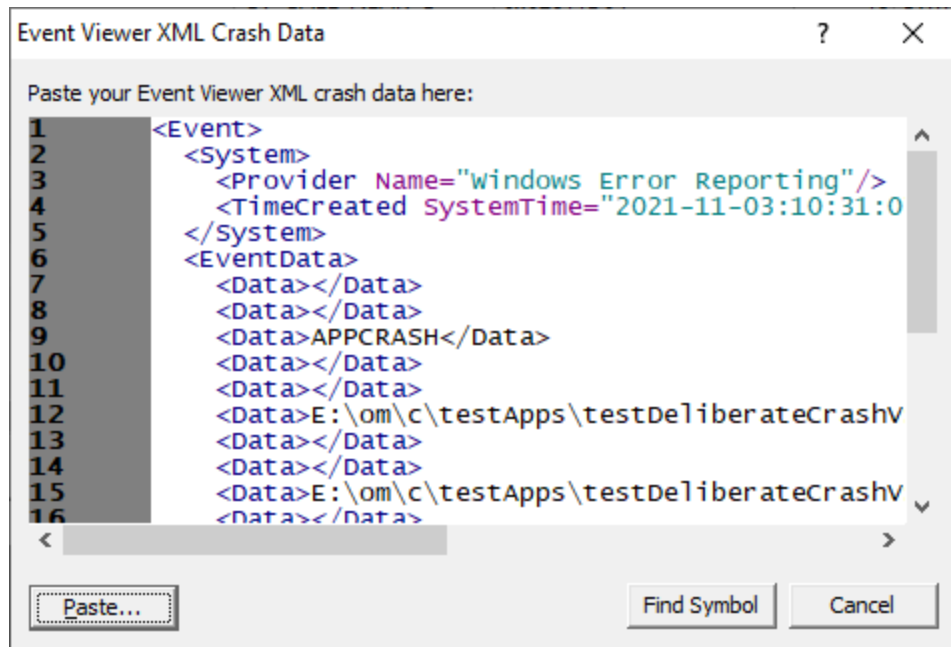


The Query Symbol by Absolute Address dialog is displayed.

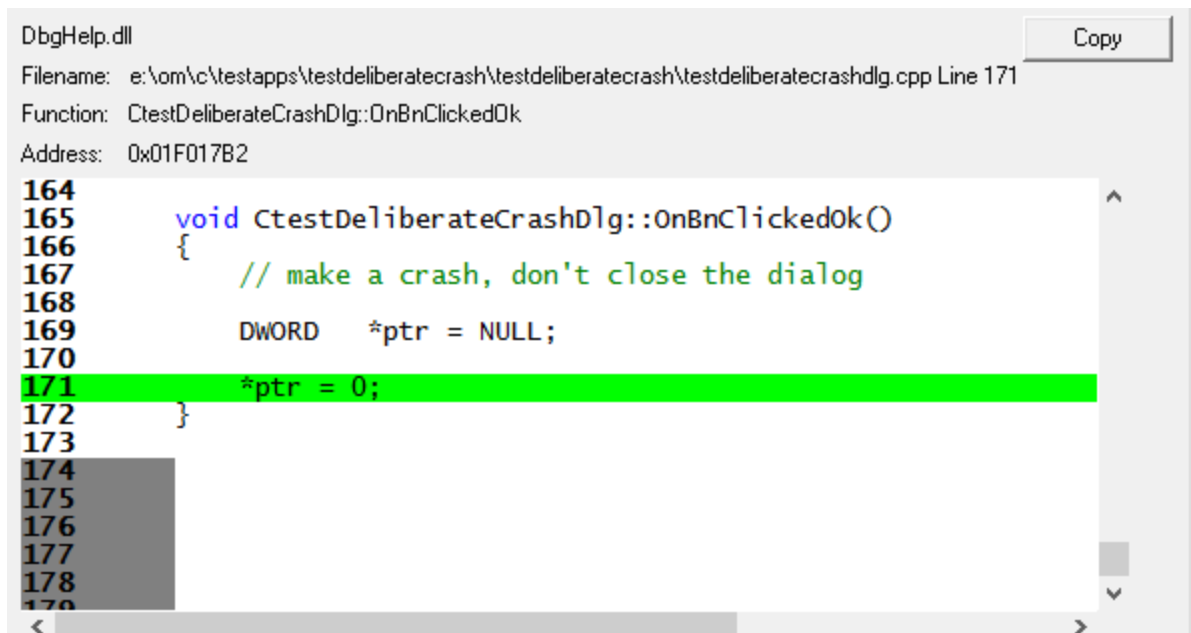


Paste the XML data from the Event Viewer into the text field.

Click the **Find Symbol** button.



The appropriate location in the code is found and displayed.



## 7.5 What is a load address?

A load address is the address at which a DLL loads.

All versions of Microsoft Windows load modules (.dll, .exe) into address space that is reserved using a call to VirtualAlloc().

The allocation of VirtualAlloc() can be queried by calling Win32 API GetSystemInfo() and examining the value returned in **dwAllocationGranularity**. For all versions of Microsoft Windows this has been 64KB.

### **Why is the load address important?**

The load address is important because without it we can't calculate the offset inside the DLL so that we can obtain a symbol.

That's why a crash address with no DLL Load Address isn't very useful - we don't know which DLL the crash is in, nor do we know where the DLL was loaded.

### **But I don't have a load address. What can I do?**

Depending upon how your module (DLL/EXE) was built we may be able to guess the correct load address.

If the OS you are using is Windows XP or earlier, we can guess the address.

### **First a brief chat about Address Space Layout Randomisation...**

If the OS you are using is Windows Vista or later, we may not be able to guess the load address. The reason this is not precise is because something known as Address Space Layout Randomisation (ASLR) was introduced with Microsoft Vista to improve security against many malicious computer attacks. Any program built with ASLR enabled when run on Vista (or later) will have the load address for all modules (including the .exe) randomised, making guessing the load address a waste of time.

ASLR is enabled by the /DYNAMICBASE in the linker settings of Visual Studio.

If you are using Visual Studio 2005 or earlier this setting is not available, your program is not affected by ASLR.

If you are using Visual Studio 2008 or later you will need to check to see if this option is present. If it is not present, your program is not affected by ASLR.

If you are not using Visual Studio to build your program then you may not be affected by this option, consult your compiler/linker documentation.

### **If your program is not affected by ASLR...**

We can try to guess the load address of your DLL/EXE. We can do this regardless of which compiler/linker you used to build your program. All the programs I mention here are free to download at the time of writing this help file.

### **VM Validator**

<https://www.softwareverify.com/cpp-virtual-memory.php>

This works for 32 bit and 64 bit programs.

#### Method 1

- Start your program using VM Validator or attach to your running program with VM Validator.
- On the Summary tab, inspect the DLLs sub tab in the lower half of the display.
- Find the DLL name in the DLL column.
- The load address is the value in the Address column.

DLLs		Page Faults					
DLL (133)	Fault Count	Address	Size	Commit	Reserve	CPU	
E:\om\c\dbgHelpBrowser\Release\x86\dbgHelpBrowser.exe	0	0x00400000	1176.00 KB	1176.00 KB	0.00 KB	x86	
E:\om\c\testApps\testDeliberateCrash\Release\testDeliberateCrash.exe		0x00640000	100.00 KB	100.00 KB	0.00 KB	x86	
E:\om\c\dbgHelpBrowser\Release\x86\svlPEInfo.dll	0	0x006C0000	172.00 KB	172.00 KB	0.00 KB	x86	

#### Method 2

- Start your program using VM Validator or attach to your running program with VM Validator.
- Go to the Paragraphs tab.
- Find any purple entry, check the DLL name in the Description field.
- The load address is the value in the Address column.

Summary		Virtual		Pages		Paragraphs	
Address	Size	Type	Protect	Working Set	Shared	Swap	Description
0x002C0000	64 KB	Private	Read, Write	Read/write.			Committed, Reserved
0x002D0000	152 KB	Private					Reserved, Committed, Reserved
0x00300000	1,024 KB	Private					Reserved
0x00400000	1,176 KB	Image	Read Only	Read-only. Executable and read-only.	Shared: 98		e:\om\c\dbghelpbrowser\release\x86\dbghelpbrowser.exe
0x00530000	796 KB	Mapped	Read Only	Read-only.	Shared: 49		Committed, Free

In the example above, for dbgHelpBrowser.exe, the load address is 0x00400000.

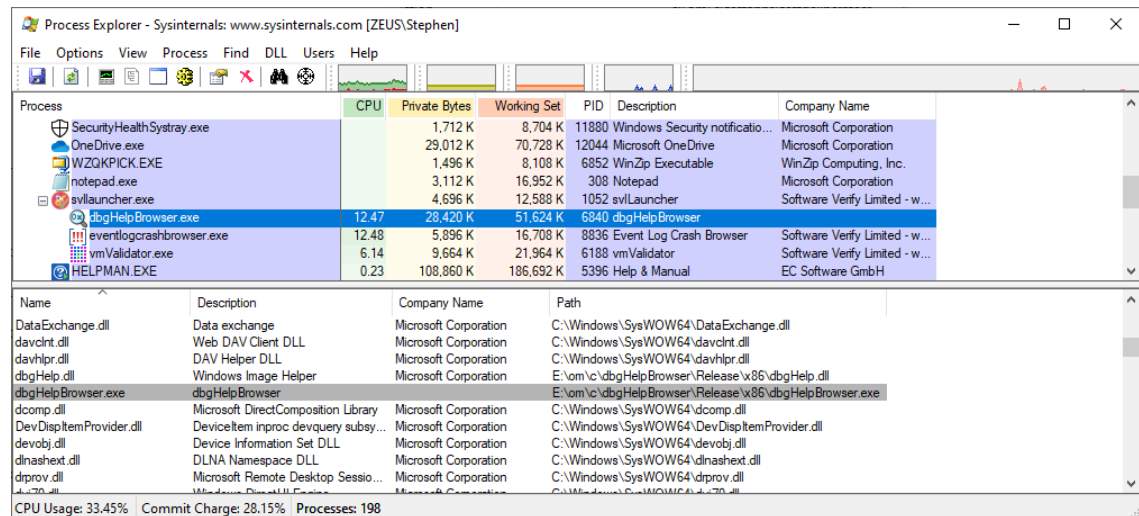
### Process Explorer

<https://technet.microsoft.com/en-us/sysinternals/processexplorer.aspx>

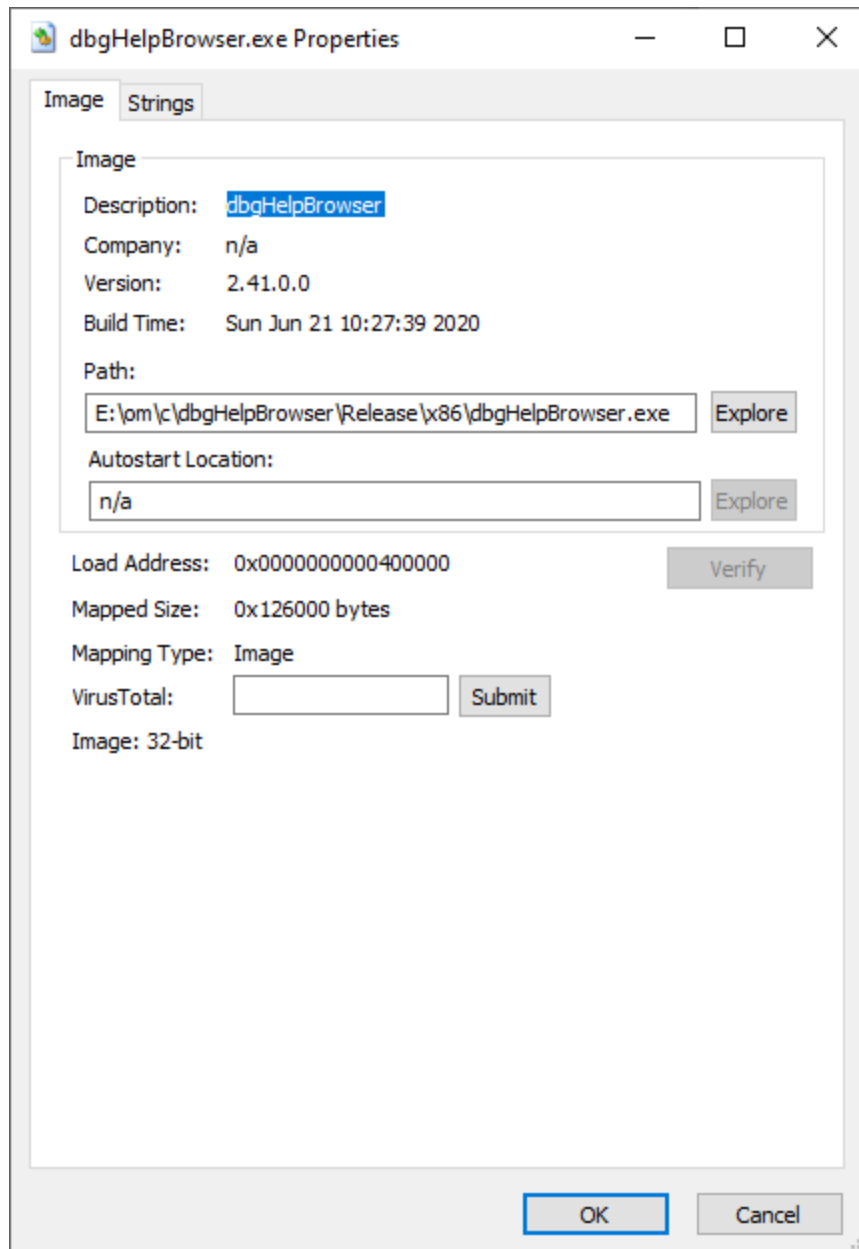
This works for 32 bit and 64 bit programs.

- Start your program
- Start Process Explorer. *If your program is a service or runs as administrator you'll need to start Process Explorer as administrator.*
- In Process Explorer, enable View -> Show Lower Pane. Then for View -> Lower Pane Window, choose DLLs.

- Select your program in the top window.
- Find your DLL in the bottom window. Right click. Choose Properties from the Context menu.



- In the Properties dialog, read the load address.

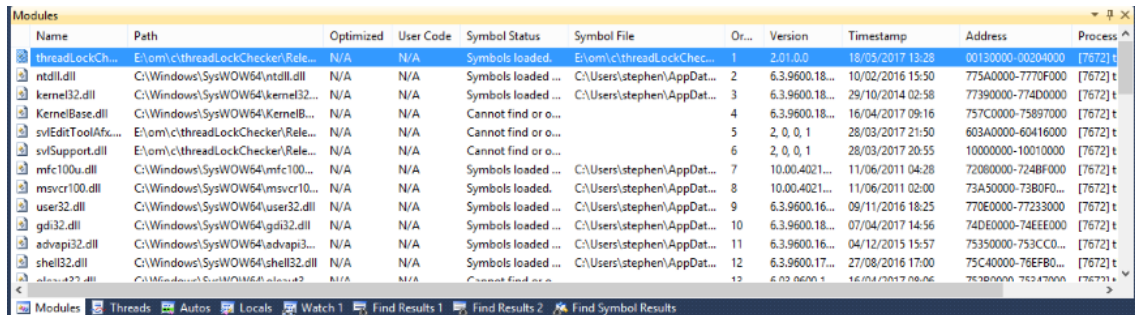


In the example above, for dbgHelpBrowser.exe, the load address is 0x00400000.

**Visual Studio** (any version)  
<https://www.visualstudio.com/>

- Start Visual Studio.
- From the Project menu, choose File -> Open -> Solution. Choose your executable.
- From the Debug menu, choose Start Debugging.
- From the Debug menu, choose Windows -> Modules.

- In the Modules window, find your DLL, then read the Address column.



Name	Path	Optimized	User Code	Symbol Status	Symbol File	Or...	Version	Timestamp	Address	Process
threadLockCh...	E:\om\c\threadLockChecker\Rele...	N/A	N/A	Symbols loaded...	E:\om\c\threadLockChec...	1	2.01.00	18/05/2017 13:28	00130000-00204000	[7672] t
ntdll.dll	C:\Windows\SysWOW64\ntdll.dll	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	2	6.3.9600.18...	10/02/2016 15:50	775A0000-7770F000	[7672] t
kernel32.dll	C:\Windows\SysWOW64\kernel32...	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	3	6.3.9600.18...	29/10/2014 02:58	77390000-774D0000	[7672] t
KernelBase.dll	C:\Windows\SysWOW64\KernelB...	N/A	N/A	Cannot find or o...		4	6.3.9600.18...	16/04/2017 09:16	757C0000-75897000	[7672] t
svlEditToolAfx...	E:\om\c\threadLockChecker\Rele...	N/A	N/A	Cannot find or o...		5	2, 0, 0, 1	28/03/2017 21:50	603A0000-60416000	[7672] t
svlSupport.dll	E:\om\c\threadLockChecker\Rele...	N/A	N/A	Cannot find or o...		6	2, 0, 0, 1	28/03/2017 20:55	10000000-10010000	[7672] t
mfc100u.dll	C:\Windows\SysWOW64\mfc100...	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	7	10.00.4021...	11/06/2011 04:28	72080000-724BF000	[7672] t
msvcr100.dll	C:\Windows\SysWOW64\msvcr10...	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	8	10.00.4021...	11/06/2011 02:00	73A50000-73B0F0...	[7672] t
user32.dll	C:\Windows\SysWOW64\user32.dll	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	9	6.3.9600.16...	09/11/2016 18:25	770E0000-77233000	[7672] t
gdi32.dll	C:\Windows\SysWOW64\gdi32.dll	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	10	6.3.9600.18...	07/04/2017 14:56	74DE0000-74EEE000	[7672] t
advapi32.dll	C:\Windows\SysWOW64\advapi3...	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	11	6.3.9600.16...	04/12/2015 15:57	75350000-753CC0...	[7672] t
shell32.dll	C:\Windows\SysWOW64\shell32.dll	N/A	N/A	Symbols loaded...	C:\Users\stephen\AppData...	12	6.3.9600.17...	27/08/2016 17:00	75C40000-76EFB0...	[7672] t
ole32.dll	C:\Windows\SysWOW64\ole32...	N/A	N/A	Cannot find or o...		13	6.3.9600.17...	16/04/2017 09:06	76380000-763A7000	[7672] t

In the example above, for threadLockChecker.exe, the load address is 0x00130000.

## WinDbg

[https://msdn.microsoft.com/en-gb/library/windows/hardware/ff551063\(v=vs.85\).aspx](https://msdn.microsoft.com/en-gb/library/windows/hardware/ff551063(v=vs.85).aspx)

- Start WinDbg
- From the File menu, choose Open Executable. Choose your executable.
- Type lm, then press return.
- All modules are listed. Find your module. The start address is the load address.

```

E:\om\c\dbgHelpBrowser\Release\x86\dbgHelpBrowser.exe - WinDbg:10.0.19041.1 X86
File Edit View Debug Window Help
Command
eip=770aeaa2 esp=0019fa20 ebp=0019fa4c iopl=0         nv up ei pl zr na pe nc
cs=0023  ss=002b  ds=002b  es=002b  fs=0053  gs=002b             efl=00000246
ntdll!LdrpDoDebuggerBreak+0x2b:
770aeaa2 cc          int     3
0:000> lm
start      end          module_name
001d0000 001fb000    svlPeInfo   (deferred)
00400000 00526000    dbgHelpBrowser (deferred)
10000000 1000f000    svlSupport   (deferred)
73400000 73569000    gdiplus     (deferred)
73650000 736b9000    MSVCP100    (deferred)
737a0000 7382d000    COMCTL32    (deferred)
73830000 73836000    MSIMG32     (deferred)
73ee0000 7431f000    mfc100u     (deferred)
74350000 7440f000    MSVCR100    (deferred)
74420000 74428000    VERSION    (deferred)
747c0000 747ca000    CRYPTBASE   (deferred)
747d0000 747f0000    SspiCli     (deferred)
747f0000 74866000    sechost     (deferred)
74870000 74967000    ole32       (deferred)
74ae0000 74b9b000    RPCRT4      (deferred)
74ba0000 74baf000    kernel_appcore (deferred)
74bb0000 74c29000    ADVAPI32    (deferred)
74c40000 74c9f000    bcryptPrimitives (deferred)
74d00000 74d17000    win32u     (deferred)
74d20000 752e6000    windows_storage (deferred)
752f0000 752f6000    PSAPI       (deferred)
754e0000 75524000    SHLWAPI     (deferred)
75640000 757d7000    USER32     (deferred)
757e0000 758c0000    KERNEL32    (deferred)
75dd0000 75e8f000    msvcrt     (deferred)
75e90000 76409000    SHELL32    (deferred)
76480000 76504000    shcore     (deferred)
76510000 76531000    GDI32      (deferred)
76540000 7655b000    profapi     (deferred)
76570000 766cb000    gdi32full   (deferred)
766d0000 767ef000    ucrtbase   (deferred)
767f0000 767fd000    UMPDC      (deferred)
76800000 76813000    cryptsp     (deferred)
76930000 769ac000    msvcp_win  (deferred)
769e0000 76c55000    combase    (deferred)
76c60000 76cf2000    OLEAUT32   (deferred)
76d00000 76d43000    powrprof   (deferred)
76d50000 76d8b000    cfqmgr32   (deferred)
76d90000 76f8e000    KERNELBASE (deferred)
77000000 7719a000    ntdll      (pdb symbols)  C:\ProgramData\dbg\sym\wntdl
7b330000 7b451000    dbghelp    (deferred)
7ba00000 7ba7a000    svlEditToolAfx (deferred)
0:000>
Ln 0, Col 0 Sys 0:<Local> Proc 000:1bf0 Thrd 000:18dc ASM OVR CAPS NUM

```

In the example above, for threadLockChecker.exe, the load address is 0x00130000.

### Final Comments

OK, you should now know how to find the load address of a DLL or an EXE (or any module type). Remember that a load address obtained this way is only valid for symbol decoding if the executable doesn't have ASLR applied to it.

---

If your crash reporting code only grabs crash addresses and not DLL load addresses, you need to update your code so that you grab DLL load addresses at the time of the crash. That way you know for sure what the load addresses were and you won't have to guess the load addresses in future.

**Part**

**VIII**

## 8 Command Line Interface

TDS Browser can be used from the command line as well as with the GUI.

The command line options allow you to view TDS debug information that is embedded in an executable file, and optionally highlight a symbol at a specified offset.

### **/fileName**

Specifies the module to load. This is typically a .exe or a .dll.

/fileName path-to-executable

Example: /fileName e:\om\c\test\release\test.exe

### **/offset**

Specifies an offset inside the executable. TDS Browser will highlight the symbol that occupies this location.

Typically this offset will be calculated from a crash location.

For example:

If a DLL is loaded at 0x00400000 and a crash happens at 0x00420192, the offset is calculated by subtracting the DLL load address from the crash address.

That is: 0x00420192 - 0x00400000, which gives 0x00020192.

The offset is 0x00020192.

The offset must be specified in hexadecimal with a leading 0x.

/offset value

Example: /offset 0x00020192

### **Example Command Line**

```
tdsBrowser.exe /fileName e:\test\release\test.exe /offset 0x00020192
```



