



Training Nexus Tracing

TRACE32 Online Help

TRACE32 Directory

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NEXUS Characteristics

NEXUS is a message-based trace protocol. A NEXUS hardware module generates the trace messages. Trace messages can be generated for activities of core(s), eTPU(s), GTM(s), for activities of DMA controller(s), of FlexRay controller(s), of SRAM port sniffers and other units. The **Source Processor Identifier** in the NEXUS messages identifies the trace source.

NEXUS hardware modules are available in two versions:

- **NEXUS Class 2 + Modules** provide the visibility of the instruction flow and task switches.
- **NEXUS Class 3 + Modules** provide the visibility of the instruction flow, load/store operations, task switches and trace information generated by code instrumentation.

Trace messages generated by a NEXUS module:

- can be exported off-chip via a **parallel trace interface**.
- can be exported off-chip via a **serial (Aurora) trace interface**.
- can be stored to an on-chip trace memory (**trace to memory**).

NEXUS hardware modules are compliant to one of the following standards:

- **IEEE-ISTO 5001™-2012**
Serial (Aurora) trace interfaces are always compliant to this standard.
- **IEEE-ISTO 5001™-2008**
- **IEEE-ISTO 5001™-2003**

Before you continue with this training, refer to your processor manual and check:

- Which class is supported by your NEXUS module?
- Are trace messages exported off-chip via a parallel or serial trace interface?
- Are trace messages stored to an on-chip trace memory?
- Which NEXUS standard is supported by your NEXUS module?

Limited Bandwidth

Regardless of the implementation of your NEXUS module (off-chip export or on-chip trace memory) it may happen while testing that more trace messages are generated than the trace interface/memory interface can convey. This may disturb your tests.

For a better understanding of this issue and its counter-measures, a short introduction into the NEXUS protocol is given. The following example configuration is used: MPC5775K with parallel trace interface consisting of 16 pins (MDO) for the export of NEXUS messages. The term *trace beat* is used for the trace information that is transferred per trace clock.

Branch Trace Messages (All NEXUS Classes)

Branch trace messages provide a standard protocol for instruction flow visibility.

Direct Branch Messages

TCODE number = 3 (6 bits)
Source processor identifier (4 bits)
Number of sequential instructions executed since the last taken branch (1 to 8 bits)
Timestamp (optional) (0 to 30 bits)

11 to 48 bits
in 1 to 4 trace beats

Indirect Branch Messages

TCODE number = 4 (6 bits)
Source processor identifier (4 bits)
Address space indicator (1 bit)
Number of sequential instructions executed since the last taken branch (1 to 8 bits)
Branch destination address (1 to 32 bits)
Timestamp (optional) (0 to 30 bits)

13 to 81 bits
in 1 to 6 trace beats

Indirect Branch History Messages (All NEXUS Classes)

Indirect Branch History Messages can be used to save bandwidth, since only indirect branches cause messages. Information on direct branches is stored in the Direct Branch History.

Indirect Branch History Messages are recommended for:

- small trace ports if they have bandwidth problems
- long instruction flow traces
- TRACE32 Trace Mode STREAM
- multi-source traces

Indirect Branch History Messages

TCODE number = 28 (6 bits)
Source processor identifier (4 bits)
Address space indicator (1 bit)
Number of sequential instructions executed since the last taken branch (1 to 8 bits)
Branch destination address (1 to 32 bits)
Direct branch history (1 to 32 bits)
Timestamp (optional) (0 to 30 bits)

14 to 113 bits
in 1 to 8 trace beats

- The caveat of the use of Indirect Branch History Messages is a less accurate timestamp, since less NEXUS messages are generated and timestamped.

B::Trace.List									
Setup... Goto... Find... Chart Profile MIPS More Less									
	run	address	cycle	data	symbol				ti.back
-00339572		blr							
		P:400010E0 ptrace			\\diabc_int\diabc\func40+0x84				0.660us
		lis r8,0x4000		r8,16384					
		addi r8,r8,0x4258		r8,r8,16984					
		slwi r7,r31,0x3		r7,index,3					
		add r8,r8,r7							
		stw r3,0x0(r8)		r3,0(r8)					
		stw r4,0x4(r8)		r4,4(r8)					
		addi r31,r31,0x1		index,index,1					
580		for (x = 0.0 ; x < 62.8 ; x += 0.1)							
		lwz r3,0x8(r1)		r3,x(r1)					
		lwz r4,0x0C(r1)		r4,12(r1)					
		lis r5,0x3FB9		r5,16313					
		ori r5,r5,0x9999		r5,r5,39321					
		lis r6,-0x6667		r6,-26215					
		ori r6,r6,0x999A		r6,r6,39322					
		bl 0x40001828		_d_add					
-00339571		P:40001828 ptrace			\\diabc_int\Global_d_add				4.500us
		mr r11,r1							
		stwu r1,-0x40(r1)		r1,-64(r1)					
		mflr r0							
		bl 0x40003018		_savegpr_21_1					
-00339570		P:40003018 ptrace			\\diabc_int\Global_savegpr_21_1				1.160us
		stw r21,-0x2C(r11)		r21,-44(r11)					
		stw r22,-0x28(r11)		r22,-40(r11)					
		stw r23,-0x24(r11)		r23,-36(r11)					
		stw r24,-0x20(r11)		r24,-32(r11)					
		stw r25,-0x1C(r11)		r25,-28(r11)					
		stw r26,-0x18(r11)		r26,-24(r11)					
		stw r27,-0x14(r11)		r27,-20(r11)					
		stw r28,-0x10(r11)		r28,-16(r11)					
		stw r29,-0x0C(r11)		r29,-12(r11)					
		stw r30,-0x08(r11)		r30,-8(r11)					
		stw r31,-0x04(r11)		r31,-4(r11)					
		stw r0,0x4(r11)		r0,4(r11)					
		blr							
-00339569		P:40001838 ptrace			\\diabc_int\Global_d_add+0x10				2.000us

B::Trace.List									
Setup... Goto... Find... Chart Profile MIPS More Less									
	run	address	cycle	data	symbol				ti.back
-00060834		blr							
		P:400010E0 ptrace			\\diabc_int\diabc\func40+0x84				3.320us
		lis r8,0x4000		r8,16384					
		addi r8,r8,0x4258		r8,r8,16984					
		slwi r7,r31,0x3		r7,index,3					
		add r8,r8,r7							
		stw r3,0x0(r8)		r3,0(r8)					
		stw r4,0x4(r8)		r4,4(r8)					
		addi r31,r31,0x1		index,index,1					
580		for (x = 0.0 ; x < 62.8 ; x += 0.1)							
		lwz r3,0x8(r1)		r3,x(r1)					
		lwz r4,0x0C(r1)		r4,12(r1)					
		lis r5,0x3FB9		r5,16313					
		ori r5,r5,0x9999		r5,r5,39321					
		lis r6,-0x6667		r6,-26215					
		ori r6,r6,0x999A		r6,r6,39322					
		bl 0x40001828		_d_add					
		mr r11,r1							
		stwu r1,-0x40(r1)		r1,-64(r1)					
		mflr r0							
		bl 0x40003018		_savegpr_21_1					
		stw r21,-0x2C(r11)		r21,-44(r11)					
		stw r22,-0x28(r11)		r22,-40(r11)					
		stw r23,-0x24(r11)		r23,-36(r11)					
		stw r24,-0x20(r11)		r24,-32(r11)					
		stw r25,-0x1C(r11)		r25,-28(r11)					
		stw r26,-0x18(r11)		r26,-24(r11)					
		stw r27,-0x14(r11)		r27,-20(r11)					
		stw r28,-0x10(r11)		r28,-16(r11)					
		stw r29,-0x0C(r11)		r29,-12(r11)					
		stw r30,-0x08(r11)		r30,-8(r11)					
		stw r31,-0x04(r11)		r31,-4(r11)					
		stw r0,0x4(r11)		r0,4(r11)					
		blr							
-00060832		P:40001838 ptrace			\\diabc_int\Global_d_add+0x10				8.500us
		mr r24,r3							

Data Trace Messages (NEXUS Class 3 only)

Data trace messages are used to export information on the load/store operations.

Data write messages

TCODE number = 5 (6 bits)
Source processor identifier (4 bits)
Address space Indicator (1 bit)
Data size (4 bits)
Data write address (1 to 32 bits)
Data write value (1 to 64 bits)
Timestamp (optional) (0 to 30 bits)

17 to 141 bits
in 2 to 9 trace beats

Data read messages

TCODE number = 6 (6 bits)
Source processor identifier (4 bits)
Address space Indicator (1 bits)
Data size (4 bits)
Data read address (1 to 32 bits)
Data read value (1 to 64 bits)
Timestamp (optional) (0 to 30 bits)

17 to 141 bits
in 2 to 9 trace beats

Exporting information on load/store operations may easily generate more trace messages than the interface in use can convey. This is most likely to occur when several data accesses are carried out in quick succession.

If information on all load/store operations is exported, each data access can be correlated to its instruction (data cycle assignment).

record	run	address	cycle	data	symbol	ti.back
+00187894		P:400013AC ptrace			\\diabc_int\\diabc\\sieve+0x24	0.320us
		cmpwi r31,0x12		; i,18		
		bgt 0x400013CC		; .L527 (-)		
		lis r12,0x4000		; r12,16384		
		addi r12,r12,0x5620		; r12,r12,22048		
		li r11,0x1		; r11,1		
		stbx r11,r12,r31		; r11,r12,i		
+00187895		D:40005623 wr-byte		01	\\diabc_int\\Global\\flags+0x3	0.500us
		addi r31,r31,0x1		; i,i,1		
		b 0x400013AC		; .L529		
+00187896		P:400013AC ptrace			\\diabc_int\\diabc\\sieve+0x24	0.340us
		cmpwi r31,0x12		; i,18		
		bgt 0x400013CC		; .L527 (-)		
		lis r12,0x4000		; r12,16384		
		addi r12,r12,0x5620		; r12,r12,22048		
		li r11,0x1		; r11,1		
		stbx r11,r12,r31		; r11,r12,i		
+00187897		D:40005624 wr-byte		01	\\diabc_int\\Global\\flags+0x4	0.500us
		addi r31,r31,0x1		; i,i,1		

If a trace filter is used to export only some load/store operations, the correlation to the instruction is not always possible.

record	run	address	cycle	data	symbol	ti.back
697		lis r12,0x4000		; r12,16384	flags[k] = FALSE;	
		addi r12,r12,0x5620		; r12,r12,22048		
		li r11,0x0		; r11,0		
		stbx r11,r12,r29		; r11,r12,k		
698		add r29,r29,r30		; k,k,primz	k += primz;	
		b 0x400013F8		; .L533		
+00081847		D:40005623 wr-byte		00	\\diabc_int\\Global\\flags+0x3	2.500us
+00081848		P:400013F8 ptrace			\\diabc_int\\diabc\\sieve+0x70	0.340us
695		cmpwi r29,0x12		; k,18	while (k <= SIZE)	
		bgt 0x40001418		; .L532 (-)		
697		lis r12,0x4000		; r12,16384	flags[k] = FALSE;	
		addi r12,r12,0x5620		; r12,r12,22048		
		li r11,0x0		; r11,0		

It was not possible to correlate the load/store operation to its instruction. For this reason the data access cycle is printed in red and is displayed preceding the next Branch Trace Message.

Ownership Trace Messages (All NEXUS Modules)

Ownership trace messages are trace messages that are generated when a write access to the Process ID register PID0 (8 bit) occurs.

Ownership trace messages can be used to export OS-related information e.g. task switch information for NEXUS Class 2 Modules.

Ownership Trace Message

TCODE number = 2 (6 bits)
Source processor identifier (4 bits)
Task/Process ID tag (32 bits)

42 bits
in 3 trace beats

Alternative for IEEE-ISTO 5001™-2012

Since 8 bits are often not sufficient to encode OS-related information, the 32-bit NEXUS PID Register (NPIDR) can be used as an alternative. Ownership Trace Messages have also a slightly different format for IEEE-ISTO 5001™-2012.

Ownership Trace Message

TCODE number = 2 (6 bits)
Source processor identifier (4 bits)
Task/Process ID tag (1 to 32 bits)
Timestamp (optional) (0 to 30 bits)

11 to 72 bits
in 1 to 5 trace beats

The Ownership Trace Messages can not clearly be assigned to an instruction. Similar to the filtered Data Trace Messages they are printed in red and displayed preceding the next Branch Trace Message.

record	nexus	run	address	cycle	data	symbol	ti.back
-02662152	TCODE=03 SRC=0 PT=DBG ICNT=000F		rliwim	r6,r7,0x4,0x12,0x17	r8,r7,resetvector,18,23		
			or	r10,r0,r8			
			extrwi	r6,r12,0x6,0x10	; r6,r12,6,16		
			or	r3,r10,r6			
			bl	0x2655C	; osSetRegisterPID24		
			F:0002655C	ptrace	..Global\osSetRegisterPID24		1.720us
			mtpid	r3			
			nop				
			srawi	r3,r3,0x8	; r3,r3,8		
			mtpid	r3			
			nop				
			srawi	r3,r3,0x8	; r3,r3,8		
			mtpid	r3			
			bl				
-02662149	TCODE=02 SRC=0 O1M PROCESS=000000F0				owner 0000000C		1.860us
-02662148	TCODE=04 SRC=0 PT=IBM MAP=0 ICNT=0008 U-ADDR=000001DC		F:0002612C	ptrace	..TimerInterrupt_cat2c+0xD4		0.860us

Watchpoint Trace Messages (All NEXUS Classes)

The Onchip breakpoints of the MPC5xxx/SPC5xxx can be used:

- to stop the program execution at a specific event.
- to generate a pulse on EVTO at a specific event.
 - Not available for AMP systems if synchronous break is activated.
 - Not available for SMP systems.
- to export Watchpoint Hit Messages.

Data Acquisition Messaging (DQM) allows code to be instrumented to export customized trace information.

Data Acquisition Messages are trace messages that are generated when a write access to the Debug Data Acquisition Message register DDAM (32 bit) occurs. DQTAG (8 bit) is sampled from the DEVENT register when a write to DDAM is performed.

The DQTAG field can be used to attribute the information written to DDAM. E.g. the DQTAG field can be interpreted by the trace tool as a channel ID.

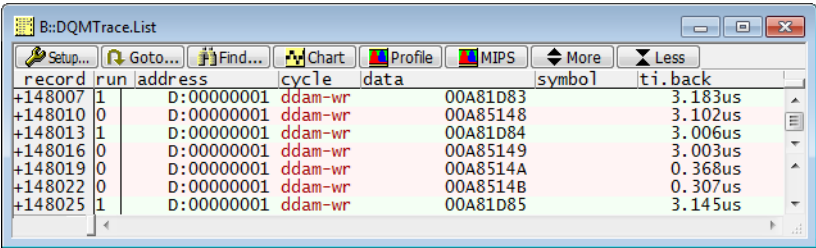
Data acquisition message

TCODE number = 7 (6 bits)
Source processor identifier (4 bits)
Identification tag from DQTAG (8 bits)
Data from DDAM (1 to 32 bits)
Timestamp (optional) (0 to 30 bits)

19 to 80 bits
in 2 to 6 trace beats

The command group **DQMTrace** is used to display and analyze the Data Acquisition Messages.

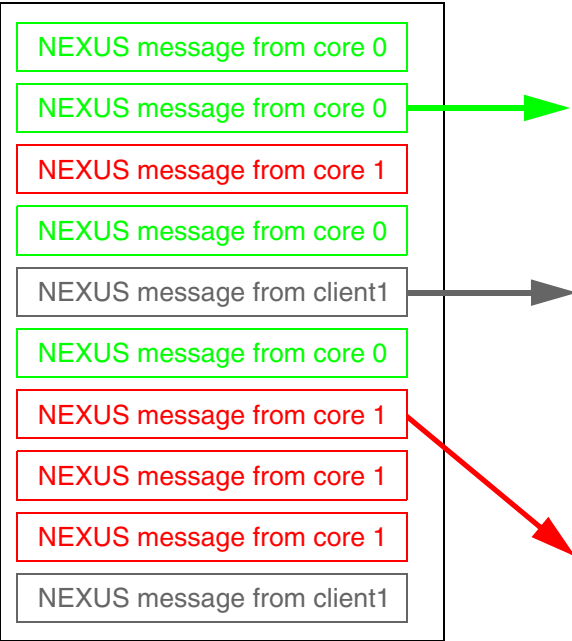
```
DQMTrace.List
```



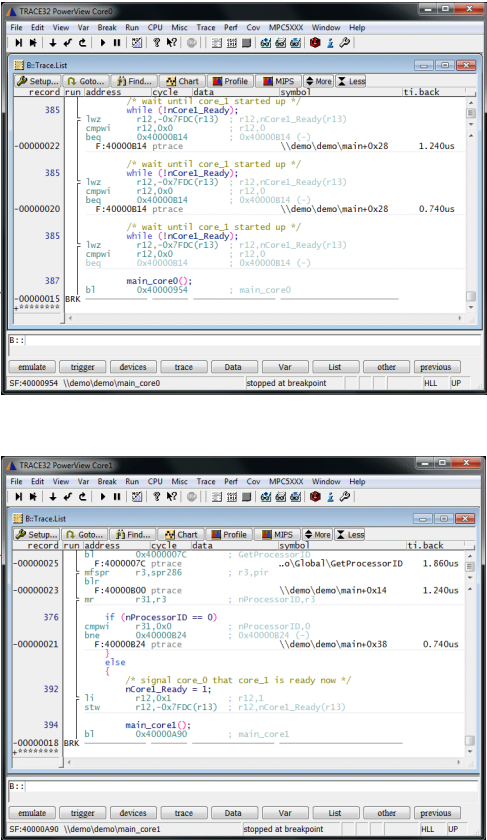
column layout	
address	Identification tag
cycle	Always “write access to DDAM”
data	Exported data
ti.back	Timestamp

AMP Tracing

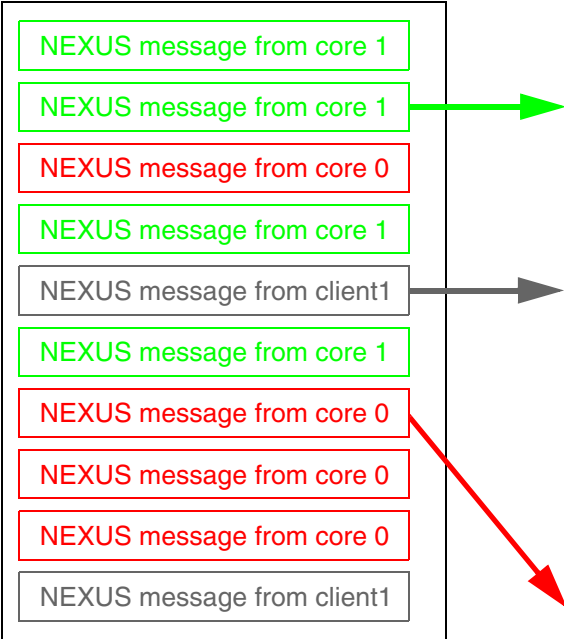
Trace Display	<p>Each TRACE32 instance analyzes and displays the trace information generated by the core(s) it controls.</p> <p>Trace messages generated by clients (DMA, FlexRay etc.) are assigned to the TRACE32 instance that enabled the messaging.</p>
----------------------	--



Trace memory



Trace Display	Trace information from all trace sources in the SMP system is displayed together.
---------------	---



Trace memory

The screenshot shows the 'Bi:TraceList.TASK Default' window. The top toolbar includes buttons for Setup, Goto, Find, Chart, Profile, MIPS, and More/Less. The main window is divided into several panes:

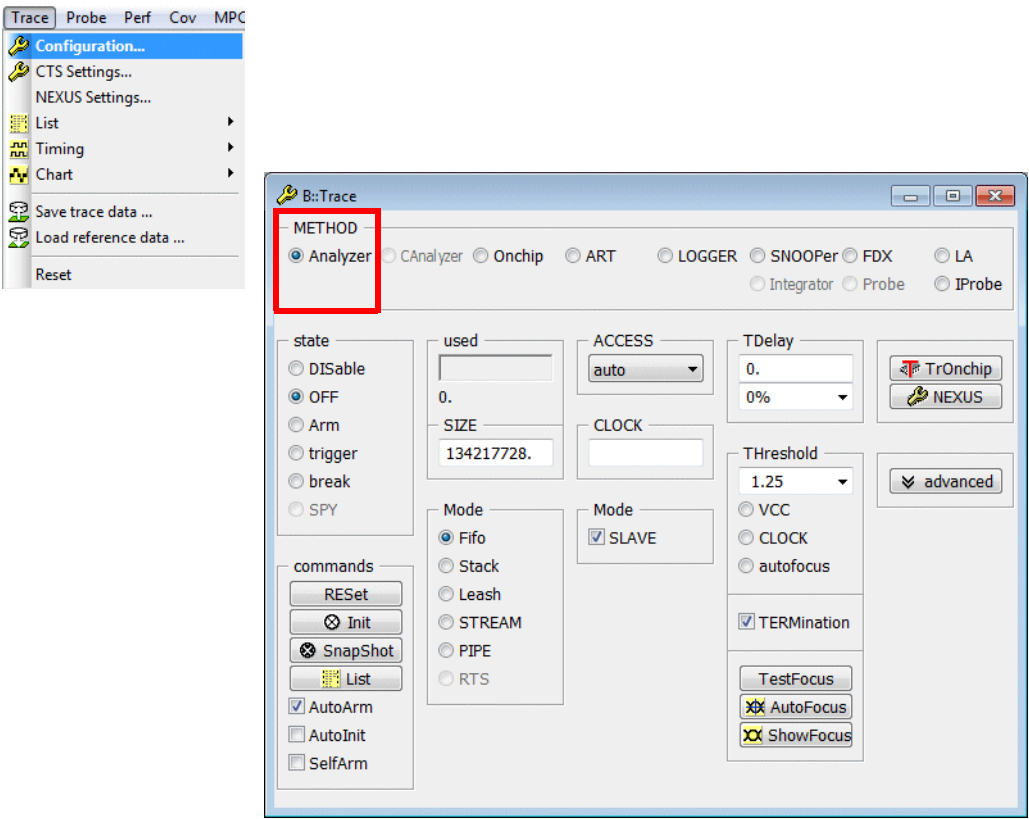
- record**: Shows the sequence of trace records with their run addresses and cycle counts.
- run address**: Displays the memory addresses of the trace data.
- data**: Shows the raw trace data in hexadecimal and decimal.
- symbol**: Maps the trace data to symbolic names.
- ti.back**: A pane for backtrace information.

The trace data is organized into color-coded blocks:

- Green blocks**: Correspond to 'NEXUS message from core 1'. The first entry at address -0000275101 shows a description: 'Description: Wait for the finish remote service'. Below it, assembly code for `void OSWaitRC(volatile OSREMOTEALLCB *rc, CoreIDType remoteCoreId)` is displayed.
- Grey blocks**: Correspond to 'NEXUS message from client1'. The first entry at address -0000275100 shows an interrupt at address 0x9118.
- Red blocks**: Correspond to 'NEXUS message from core 0'. The first entry at address -0000275098 shows assembly code for `while(rc->sstate == OSRC_WAIT)`.

Source for the Recorded Trace Information

If TRACE32 is started when a PowerTrace hardware and a NEXUS ADAPTER / PREPROCESSOR SERIAL is connected, the source for the trace information is the so-called **Analyzer** (**Trace.METHOD Analyzer**).



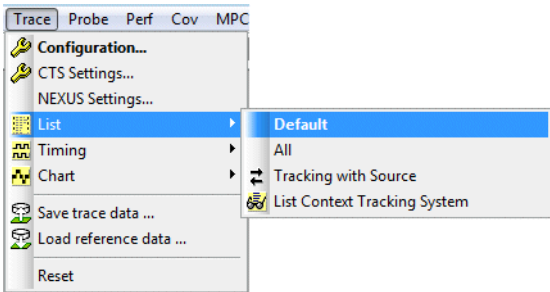
The setting **Trace.METHOD Analyzer** has the following impacts:

1. **Trace** is an alias for **Analyzer**.

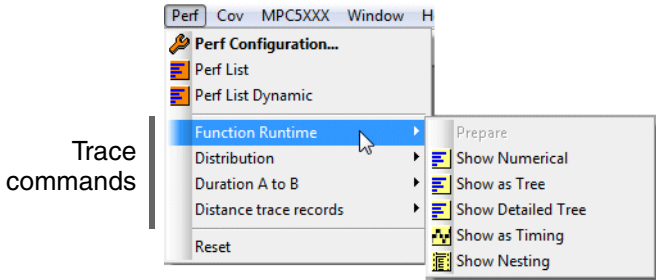
```
Trace.List                                ; Trace.List means
                                           ; Analyzer.List

Trace.Mode Fifo                          ; Trace.Mode Fifo means
                                           ; Analyzer.Mode Fifo
```

2. All commands from the Trace menu apply to the Analyzer.



3. All Trace commands from the Perf menu apply to Analyzer.



4. TRACE32 is advised to use the trace information recorded to the Analyzer as source for the trace evaluations of the following command groups:

CTS. <sub_cmd>	Trace-based debugging
COV erage.<sub_cmd>	Trace-based code coverage
ISTAT. <sub_cmd>	Detailed instruction analysis
MIPS. <sub_cmd>	MIPS analysis
BMC. <sub_cmd>	Synthesize instruction flow with recorded benchmark counter information

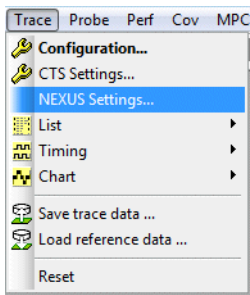
This NEXUS Training uses always the command group **Trace**. If your trace information is stored to an **on-chip trace memory**, just select the trace method Onchip and nearly all features will work as demonstrated for the trace method Analyzer

```
Trace.METHOD Onchip
```

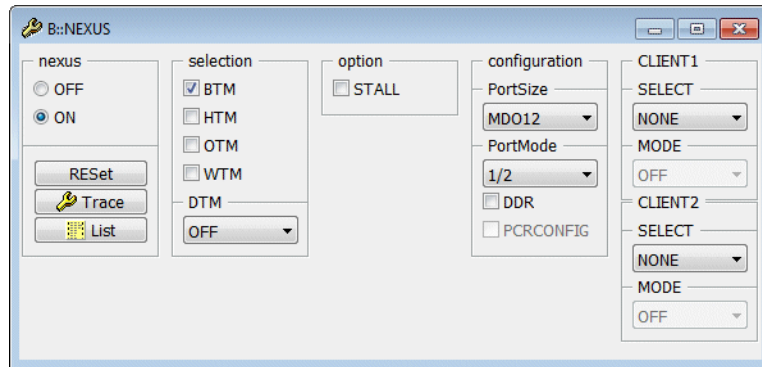
Configuration of the Trace Interface

Parallel Interface

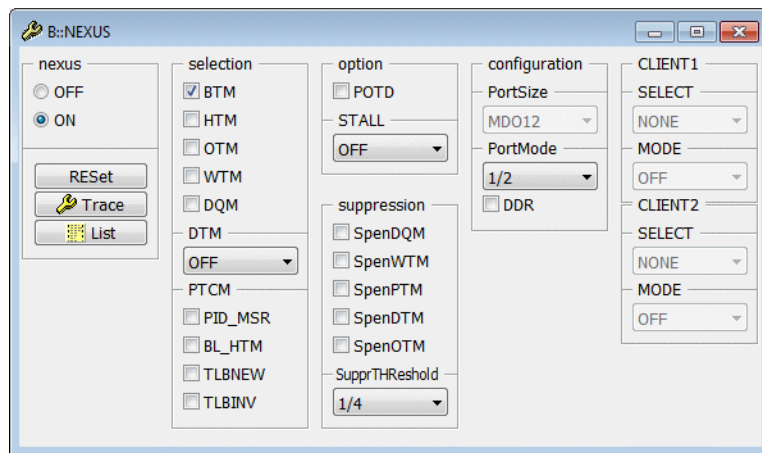
The interface configuration is done via the NEXUS window. The TRACE32 NEXUS window has a different look for IEEE-ISTO 5001TM-2003, IEEE-ISTO 5001TM-2008 and IEEE-ISTO 5001TM-2012.



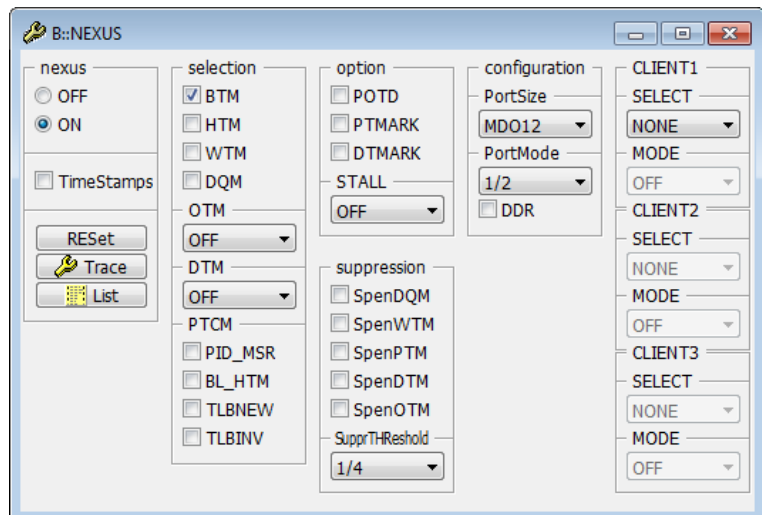
NEXUS window for IEEE-ISTO 5001TM-2003



NEXUS window for IEEE-ISTO 5001TM-2008



NEXUS window for IEEE-ISTO 5001TM-2012



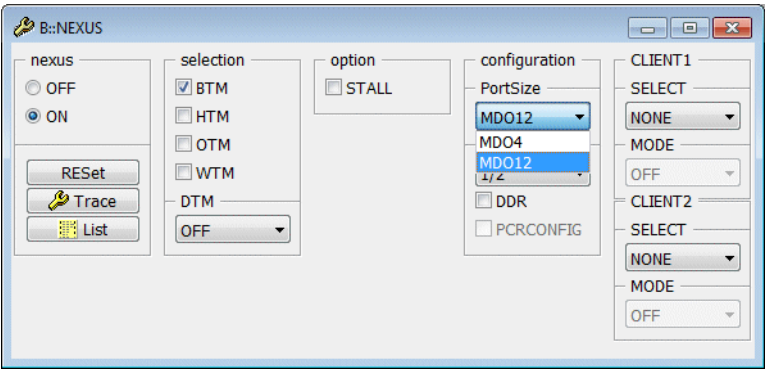
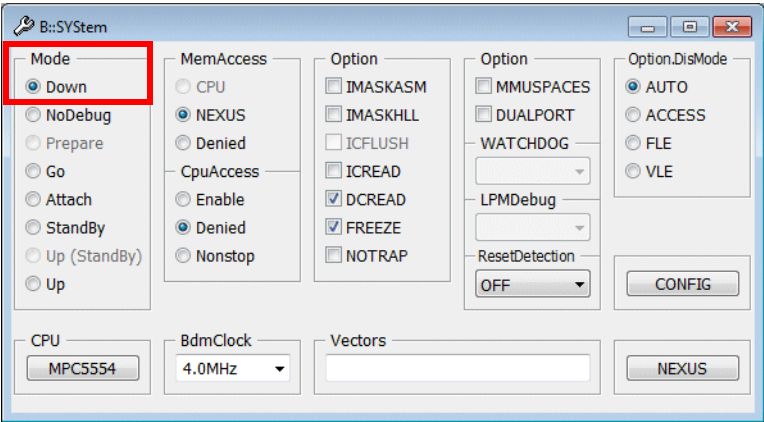
NEXUS.state

; display NEXUS window

The configuration for a parallel NEXUS interface is identical for all compliant standards. This is why only the simpler IEEE-ISTO 5001™-2003 is shown in the configuration examples.

Select NEXUS Port Size

Selecting the NEXUS port size is only possible if **SYSTEM Mode Down** is selected.

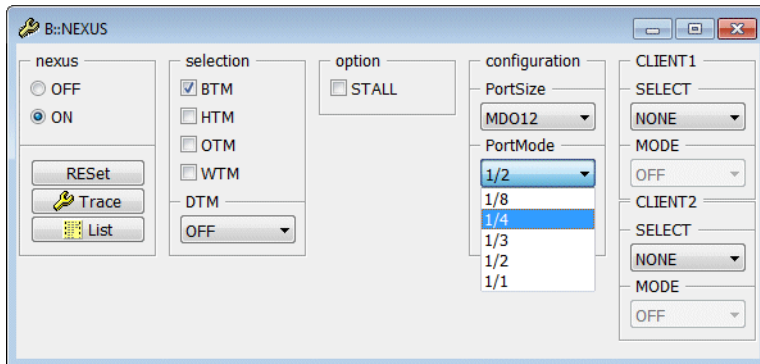


NEXUS port size	
MOD2 MOD4 MDO8 MDO12 MDO16	Specify MDO[f:0] (number of Message Data Out pins available)

```
NEXUS.PortSize MDO12 ; specify a trace port width of ; 12 MDOs
```

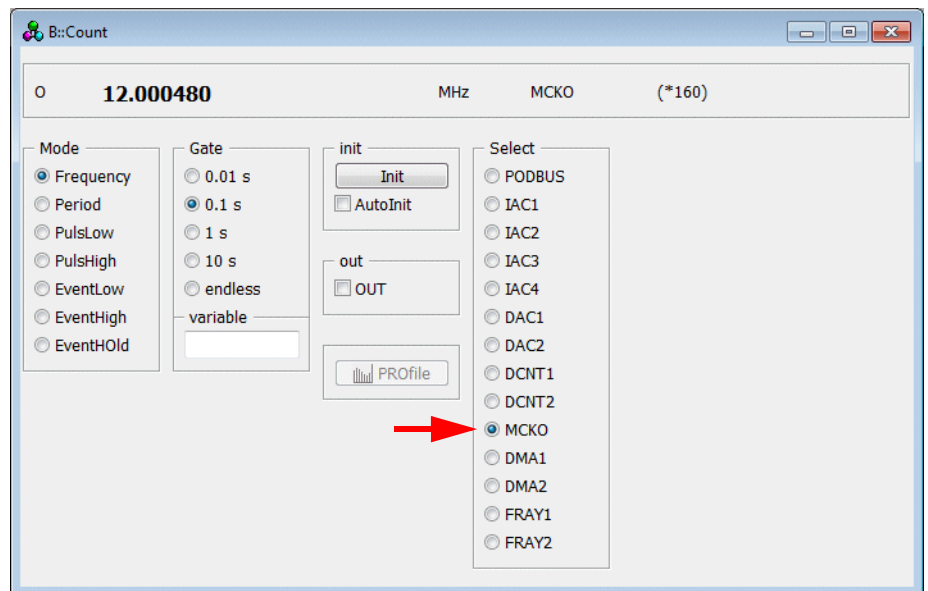
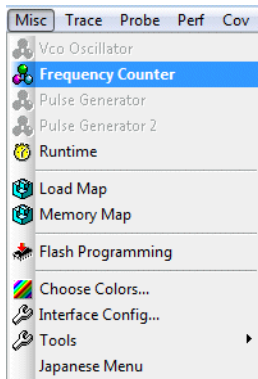
Select the Trace Clock

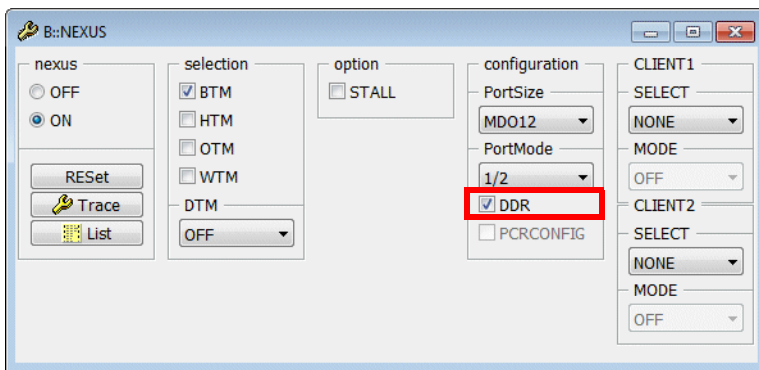
The PortMode determines the frequency of MCKO (Message Clock Out) relative to the system clock (SYS_CLK). Max. MCKO is usually 80 MHz, please refer to the **Nexus characteristics** in the data sheet of your chip for details.



NEXUS.PortMode 1/4

To measure the MCKO frequency with TRACE32 proceed as follows:





Advise the NEXUS module to export trace information on the rising and falling edge of MCKO (not supported by all chips/cores).

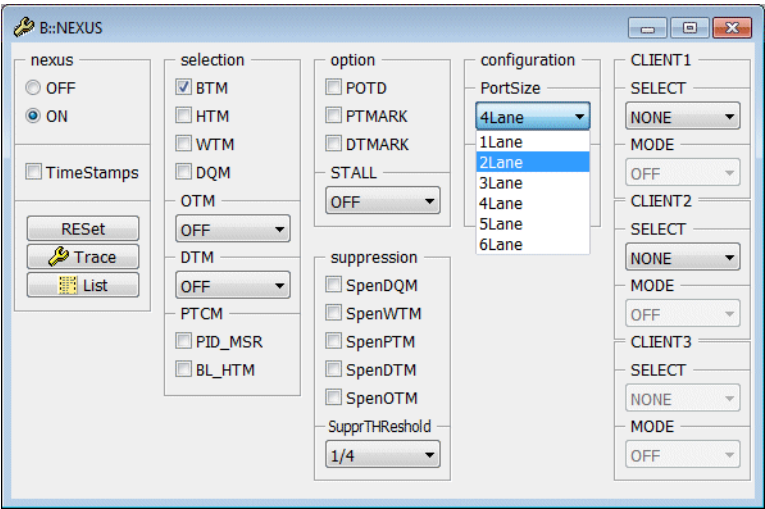
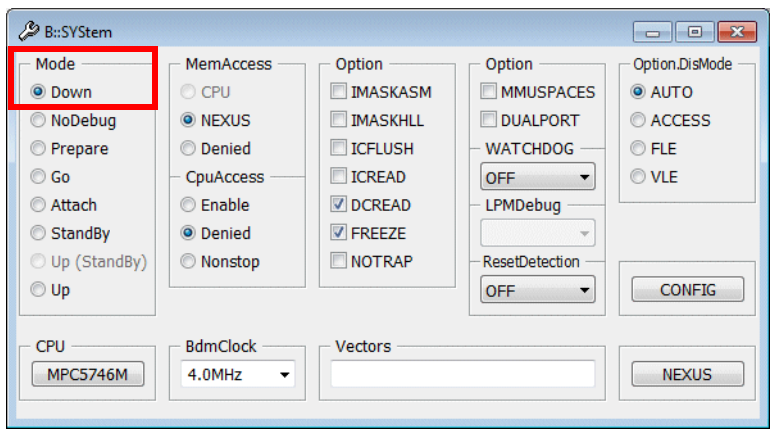
```
NEXUS.DDR ON
```

Serial Interface

Chips with serial interface provide a Nexus module compliant to the IEEE-ISTO 5001™-2012 standard.

Select NEXUS PortSize

Selecting the NEXUS PortSize is only possible if **SYSTEM Mode Down** is selected.

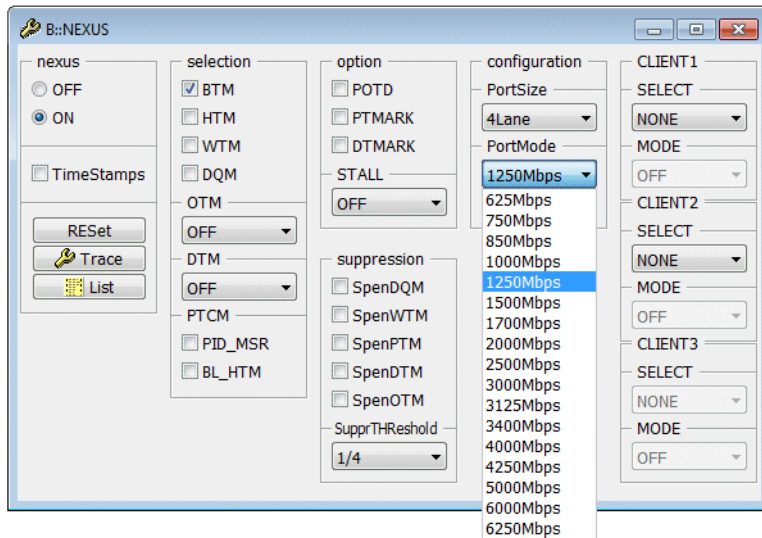


NEXUS port size	
2Lane 4Lane	Specify number of (Aurora) lanes

```
NEXUS.PortSize 2Lane ; specify a trace port with 2 lanes
```

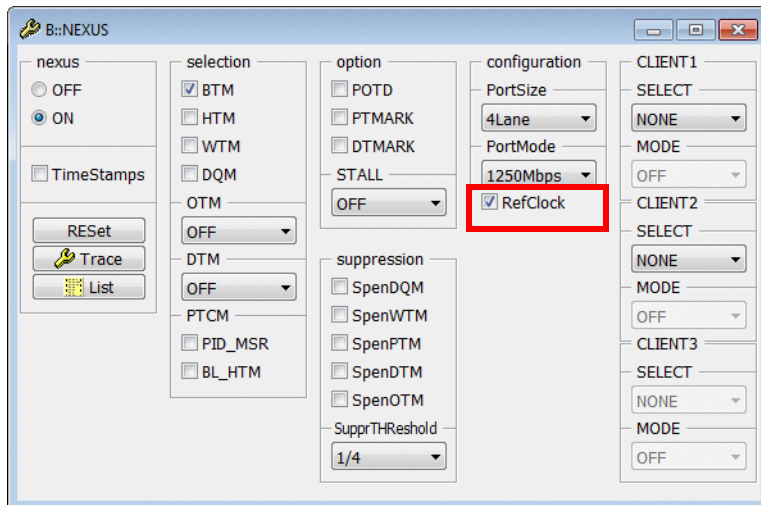
Set Fixed Bit Clock

Set the bit clock according to the processor's data sheet.



NEXUS.PortMode 1250Mbps

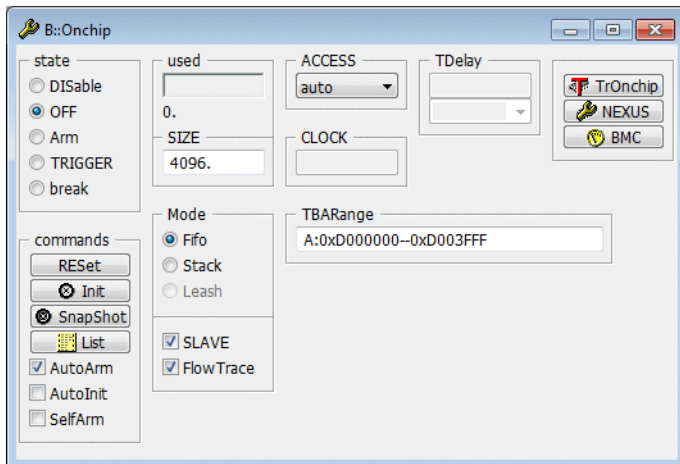
Automotive processors usually need an external reference clock for Aurora operation. Lauterbach's PREPROCESSOR SERIAL can provide this clock signal. It is enabled using **NEXUS.RefClock ON**.



Trace to Memory

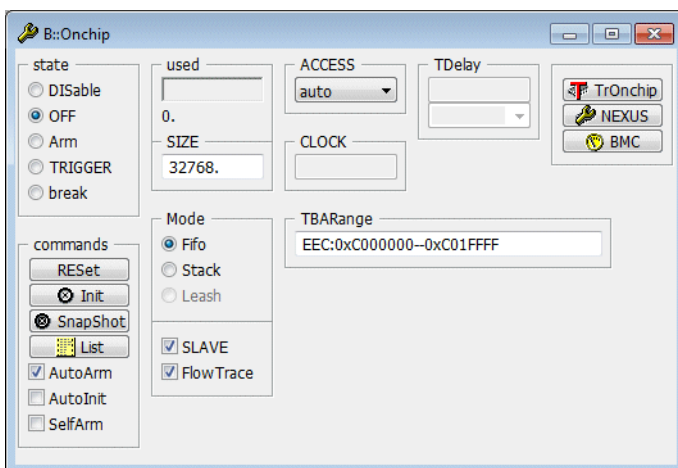
The usage of the onchip trace memory requires that trace memory is allocated.

```
; allocate trace memory for 4K NEXUS packets (packet size = 32 bit)
; A: stands for physical memory
Onchip.TBRange A:0xD000000--0xD003fff
```



Emulation devices may provide more trace memory.

```
; allocate trace memory for 32K NEXUS packets (packet size = 32 bit)
; EEC: stands for emulation device memory
Onchip.TBRange EEC:0xC000000--0xC01FFFF
```



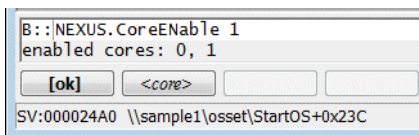
Trace information generated for multiple cores is:

- Exported via a single off-chip trace interface.
- Stored in a joint on-chip trace memory.

SMP Systems

Due to the fact that one TRACE32 instance is used to control multiple cores in an **SMP system** there is only one NEXUS configuration window, and thus no problem to keep the Nexus interface setting consistent.

Since trace messaging from more than one core may easily generate more trace messages than the interface in use can convey, it is possible to enable the message generation only for the cores that are in the focus of the analysis.

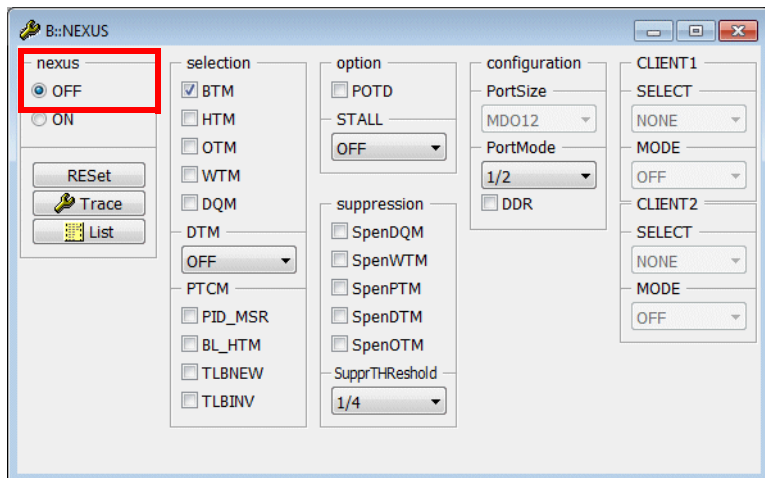


NEXUS.CoreENable {<logical_core>}

Enable core tracing for listed logical cores.

The situation is different for multiple cores in an **AMP system**. Here each core is controlled by its own TRACE32 instance, each with its own NEXUS configuration window. Since the TRACE32 Resource Management does not keep the Nexus interface settings in multiple TRACE32 instances consistent, this is the job of the user.

Since trace messaging from more than one core may easily generate more trace messages than the interface in use can convey, it is recommended to disable the message generation for core(s) that are not in the focus of the analysis.

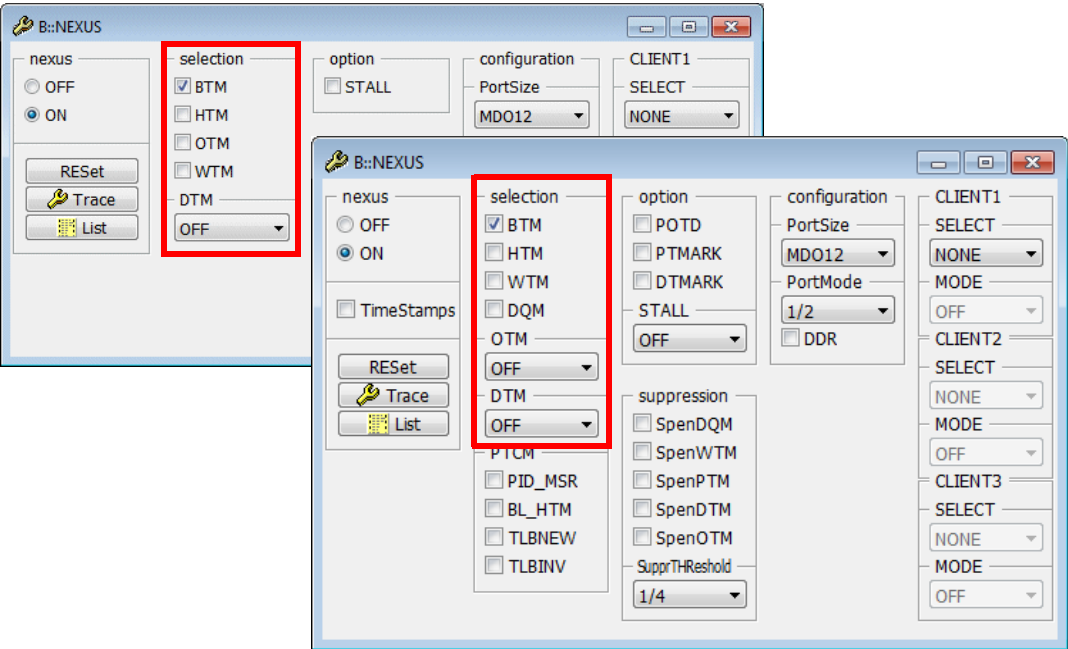


NEXUS.OFF

Configuration of the NEXUS Messages

Basic Messages

NEXUS window for IEEE-ISTO 5001™-2003



NEXUS window for IEEE-ISTO 5001™-2012

Messages	
BTM ON	Enable Branch Trace Messages.
BTM ON + HTM ON	Enable Indirect Branch History Messages.
OTM ON (2003/2008 Standard)	Enable Ownership Trace Messages via 8-bit PID0.
OTM PID0 (2012 Standard)	Enable Ownership Trace Messages via 8-bit PID0.
OTM NPIDR (2012 Standard)	Enable Ownership Trace Messages via 32-bit NPIDR.
WTM ON	Enable Watchpoint Hit Messages. Watchpoint Hit Messages are usually not used by the user. TRACE32 enables them automatically, if they are needed.

DTM Read DTM Write DTM ReadWrite DTM IFETCH	<p>Enable Data Read Messages. Enable Data Write Messages. Enable Data Read and Write Messages. Instruction fetches are exported as Data Read Messages.</p> <p>The basic idea of the Limited settings is to exclude stack read/writes from the message generation and thus avoid bandwidth problems.</p>
DTM ReadLimited (2012 Standard)	<p>Enable Data Read Messages, but exclude read accesses using GPR R1 in effective address computations.</p>
DTM WriteLimited (2012 Standard)	<p>Enable Data Write Messages, but exclude write accesses using GPR R1 in effective address computations.</p>
DTM ReadWriteLimited (2012 Standard)	<p>Enable Data Read and Write Messages, but exclude read/write accesses using GPR R1 in effective address computations.</p>

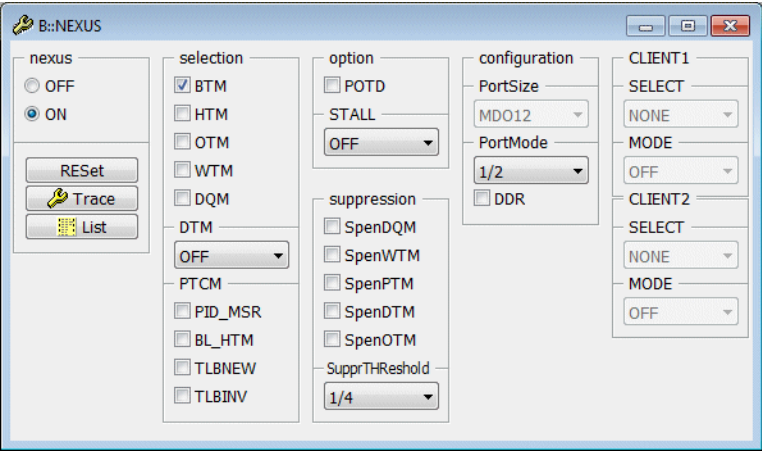
```

NEXUS.BTM ON                                ; enable Branch Trace Messages

NEXUS.DTM ReadWrite                          ; enable Data Trace Messages for
                                              ; both read and write operations

NEXUS.OTM NPIDR                             ; enable Ownership Trace Messages
                                              ; via NPIDR register

```



Data Acquisition Messages

Messages	
DQM ON	Enable Data Acquisition Messages.

Program Trace Correlation Message (PID/NPIDR)

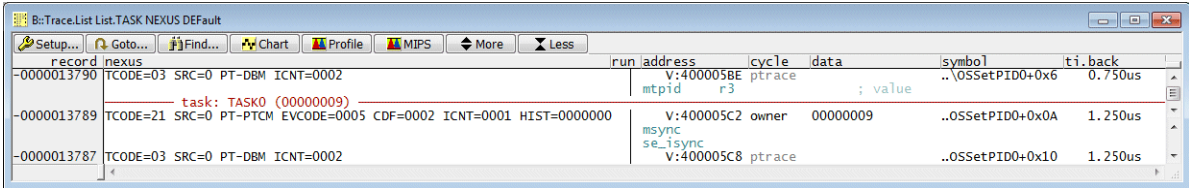
When a write to the PID or NPIDR register occurs, a Program Trace Correlation Message can be generated instead of an Ownership Trace Message.

The Program Trace Correlation Message contains the address of the instruction that wrote the OS-related information to the PID or NPIDR register and the OS-related information itself.

This has the following advantages:

- Trace.List:** the OS-related information can be directly assigned to instruction that wrote to the PID or NPIDR register.
- Trace.STATistic.Func:** the accuracy of all task-aware function run-time measurements is improved.

<div><div>OTM ON PID_MSR ON (2008 Standard)</div><div>or</div><div>OTM PID0 PID_MSR ON (2012 Standard)</div><div>or</div><div>OTM NPIDR PID_MSR ON (2012 Standard)</div></div>	Enable Program Trace Correlation Messages for Ownership tracing.
POTD	<div>Periodic Ownership Trace message Disable.</div> <div>OFF: Periodic Ownership Trace Message is enabled (default).</div> <div>ON: Periodic Ownership Trace Message is disabled.</div> <div>Recommended if PID0 register is used.</div>



```
NEXUS.OTM NPIDR

NEXUS.PID_MSR ON

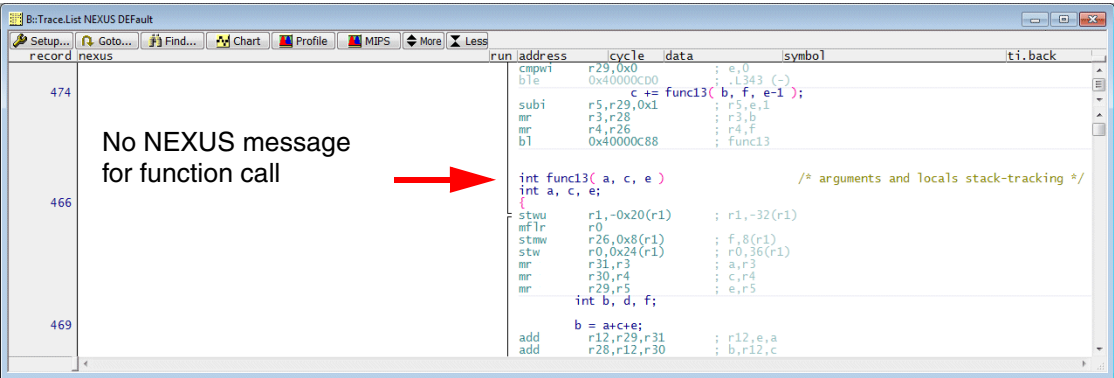
NEXUS.POTD ON
```

Program Trace Correlation Message (Branch and Link Instruction)

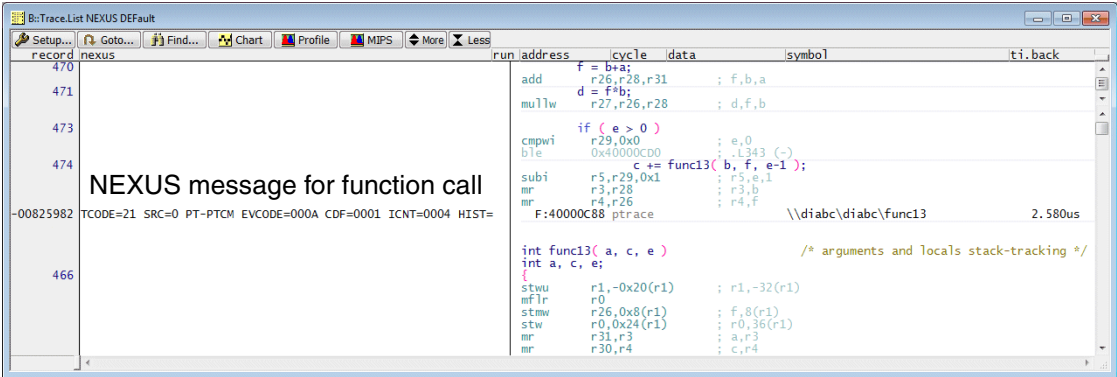
A Program Trace Correlation Message is generated when a direct branch function call (bl/bcl/bla/bcla) occurred while Indirect Branch History messaging is used.

BL_HTM	Program Trace Correlation Message is generated on a direct branch function call (for NEXUS.HTM ON only).
--------	--

NEXUS.BTM ON
NEXUS.HTM ON



NEXUS.PTCM BL_HTM ON



Enabling Program Trace Correlation Messages for direct branch function calls allows the optimum message generation for function run-time measurements. The screenshots below show this for the TRACE32 command **Trace.Chart.Func**.

Legend:

- **I**: Indirect Branch Message generated for function exits (“BLR”), function pointers, interrupts etc.
- **L**: Direct Branch Message generated for function calls (opcode “BL”)
- **C**: Direct Branch Message generated for conditional branches

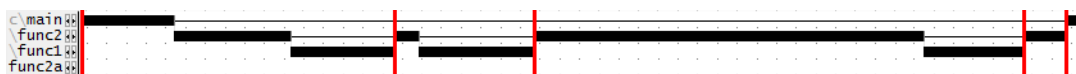
BTM ON

more trace messages are generated than required.



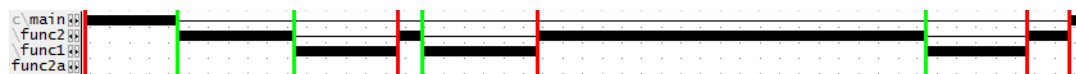
BTM ON + HTM OM

too little trace messages are generated for an accurate run-time measurement.



BTM ON + HTM ON + BL_HTM ON

an optimum number of trace messages is generated for an accurate run-time measurement.

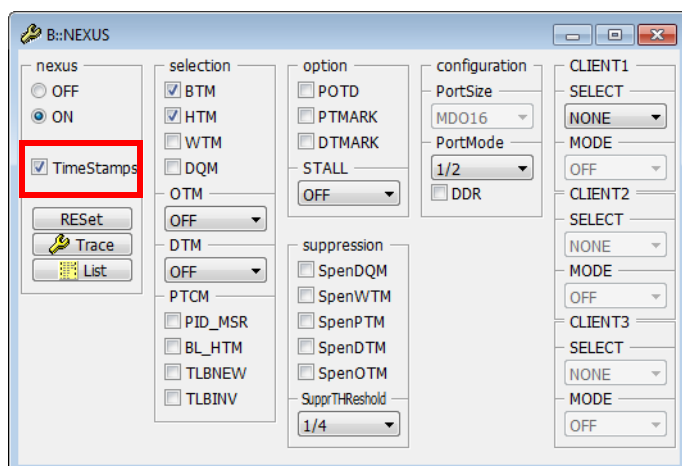


Add Timestamps to NEXUS Messages (MPC57xx/SPC57x only)

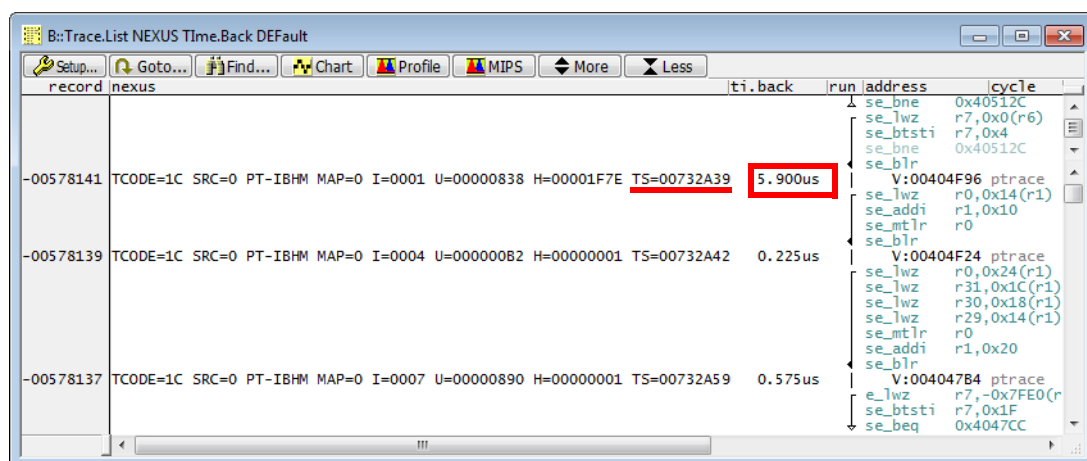
The Nexus Module implemented on the MPC57xx/SPC57x is able to add a timestamp field to the Nexus messages. The timestamp value is applied to the messages as they enter the Nexus message queues.

To use this feature proceed as follows:

1. Check TimeStamps in the NEXUS configuration window.

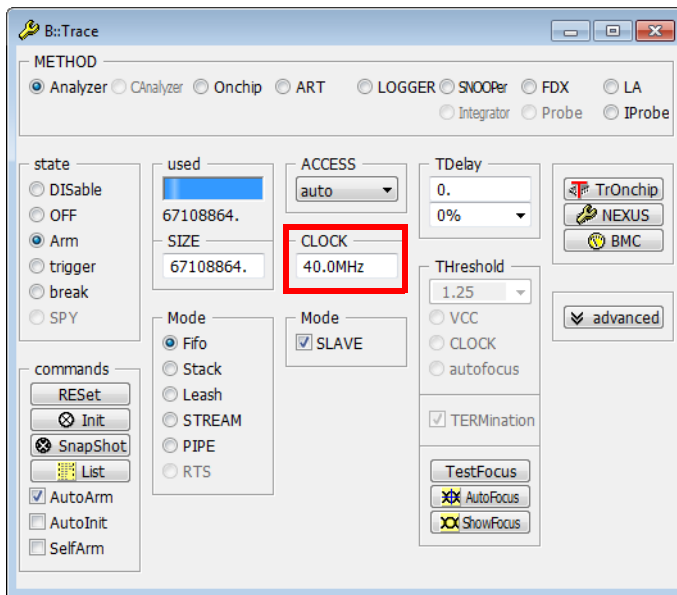


```
NEXUS.TimeStamps ON
```



TRACE32 calculates its trace time information (ti.back) out of the values of the Nexus timestamp field (TS=). To calculate the time information TRACE32 needs to know the core clock frequency.

2. Inform TRACE32 about the core clock frequency.



```
Trace.CLOCK 40.MHz
```

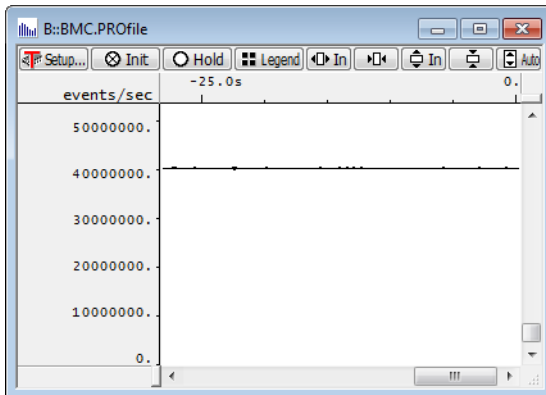
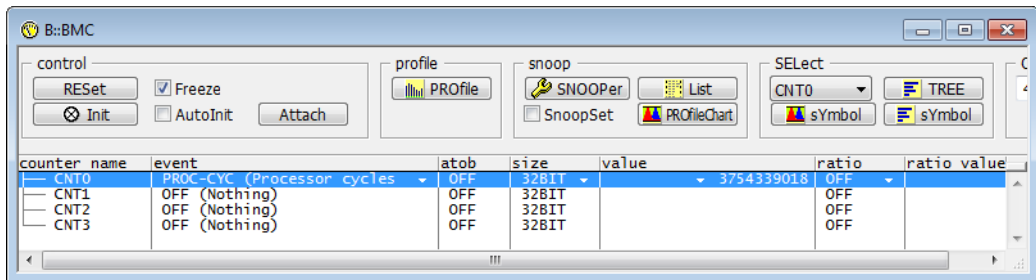
Trace.CLOCK <freq>

Specify core clock frequency.

Trace.CLOCK {<freq>}

The core clock frequency can be set per core in an SMP system.

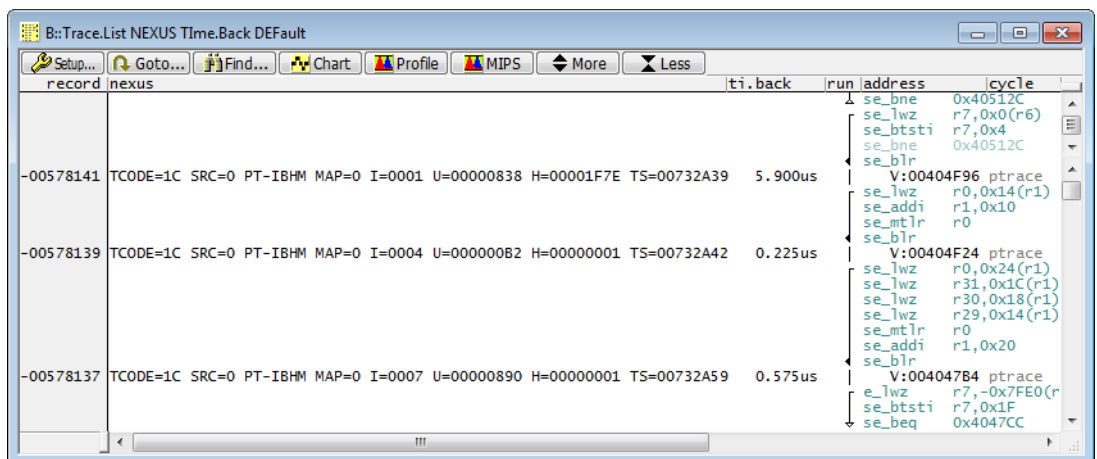
If you do not know your core clock frequency you can measure it as follows:



```
BMC.CNT0.EVENT PROC-CYC          ; configure CNT0 to count processor
                                   ; cycles

BMC.Profile                        ; display the frequency of CNT0
```

3. If all configurations are done start and stop the program execution.
4. Display the result.



Adding timestamp information to Nexus messages has the following advantages:

- The time is more precise, because it is added at the trace source. Parallel execution is clearly visible.
- Nexus timestamps are the only way to get time information for trace-to-memory (onchip trace).
- Nexus timestamps solve some issues of the serial trace recording.

But Nexus timestamps have also disadvantages:

- They need additional bandwidth (approx. 20%).
- The TRACE32 trace decoding becomes slower, since the time information has to be calculated for the complete recording before it can be displayed (Tracking).
- Since TRACE32 uses a fixed core frequency to calculate trace time information out of the Nexus timestamps, this calculation is not possible for variable clock frequencies.

To display only the Nexus timestamp information in the trace display, use the following command:

```
Trace.List Nexus CLOCKS.Back DEFault TIme.Back.OFF
```

- It may happen, that not all cores in a chip provide the ability to generate Nexus timestamps.

If NEXUS TimeStamps is unchecked, the TRACE32 tool timestamp mechanism is used. This means a Nexus message is timestamped after it is completely received and stored into the trace memory of the TRACE32 tool. The TRACE32 tool timestamp has a resolution of 20ns for POWERTRACE/ETHERNET or POWERTRACE PX and 5 ns for POWERTRACE II / POWERTRACE III. The time is less precise, because it is added at the trace sink. The merging of the parallel trace streams to a single serial trace stream and the TRACE32 recording logic are the main reasons that make TRACE32 tool timestamp less precise.

SMP systems: Due to the fact that one TRACE32 instance is used to control all cores of the SMP system, the message setup is identical for all controlled cores.

AMP systems: Due to the fact that one TRACE32 instance is used per core, an individual message setup per core is possible.

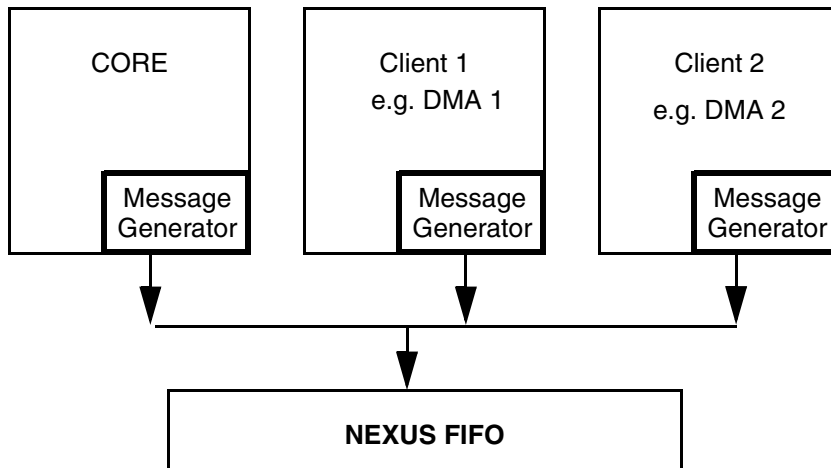
NEXUS Trace Clients

A MPC5xxx/SPC5xxx core can provide several models for the trace clients.

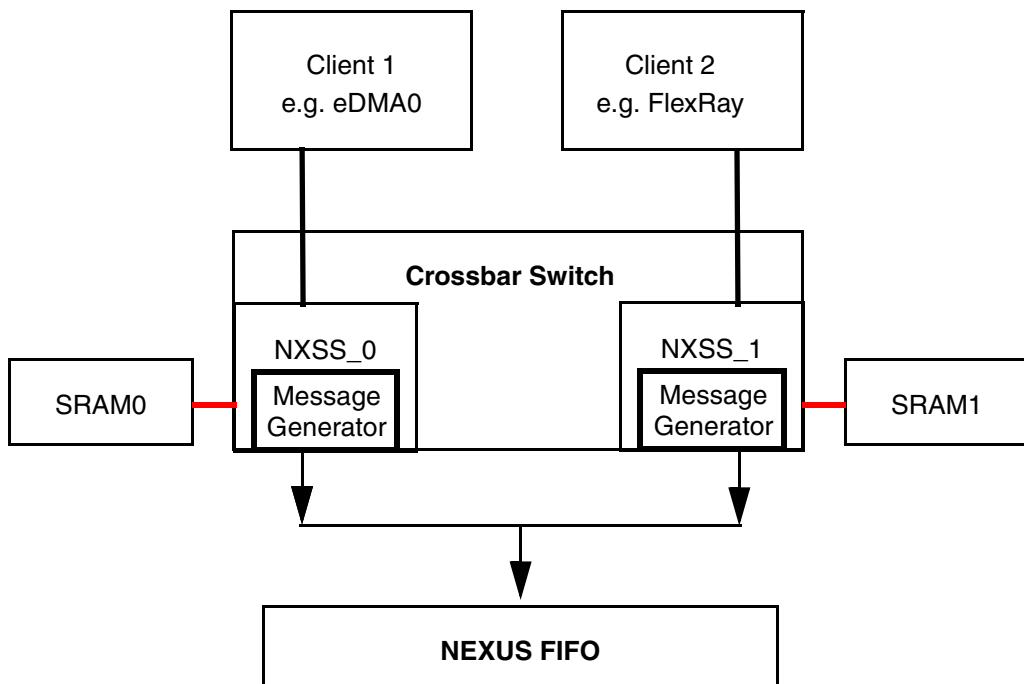
Trace Client Types

Dedicated Trace Clients

Each client that can generate NEXUS messages has its own Message Generator.

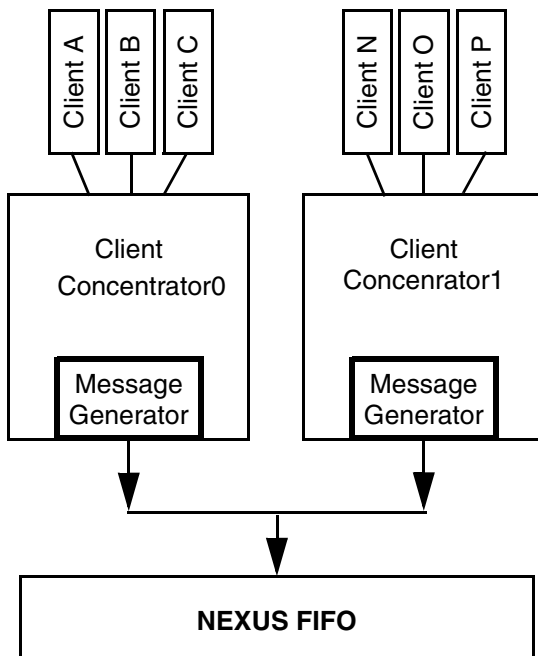


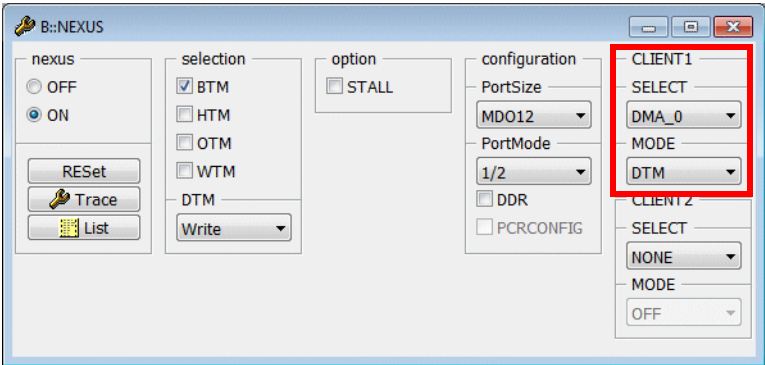
A port sniffers is used to generate the NEXUS messages for the selected clients.



Please be aware, that the NXSS (Nexus Crossbar Slave Port Data Trace Module) can only snoop read/write accesses from the selected trace client to the connected SRAM.

The Message Generator of the Client Concentrator generates NEXUS messages for the connected clients. Clients can be enabled independently.





```
NEXUS.CLIENT1 SELECT DMA           ; specify DMA for CLIENT1

NEXUS.CLIENT1 MODE DTM             ; NEXUS messages are generated
                                   ; according to the DTM settings
                                   ; (here write)
```

Possible clients:

DMA/DMA2	DMA controller
ETHERNET	Ethernet controller
FLEXRAY	FlexRay controller
PDI	Parallel Digital Interface controller
...	

Possible modes:

OFF	No NEXUS messages are generated.
Read	Generate NEXUS messages for all read accesses.
Write	Generate NEXUS messages for all write accesses.
ReadWrite	Generate NEXUS messages for all read and write accesses.
DTM	The client is using the DTM settings.

Target FIFO Overflow

B::Trace.List							
<div> <div>Setup...</div> <div>Goto...</div> <div>Find...</div> <div>Chart</div> <div>Profile</div> <div>MIPS</div> <div>More</div> <div>Less</div> </div>							
record	run	address	cycle	data	symbol	ti.back	
+00000826		<div> <div>blt</div> <div>P:40001DD4</div> <div>ptrace</div> </div>		0x40001DD4 ; 0x40001DD4 (-)	\\diabc_int\Global_d_div+0x2A8	1.340us	
		and	r10,r29,r4				
		and	r9,r28,r3				
		or	r10,r9,r10				
		slwi	r30,r30,0x1	; r30,r30,1			
		inslwi	r30,r31,0x1,0x1F	; r30,r31,1,31			
		slwi	r31,r31,0x1	; r31,r31,1			
		beq	0x40001DA0	; 0x40001DA0 (-)			
		TARGET FIFO OVERFLOW, PROGRAM FLOW LOST					
+00000829		<div> <div>P:40001DB8</div> <div>ptrace</div> </div>			\\diabc_int\Global_d_div+0x28C	4.660us	
		blt	0x40001DD4	; 0x40001DD4 (-)			
		subfc	r31,r27,r31				
		mr	r28,r28				
		ori	r29,r29,0x1	; r29,r29,1			

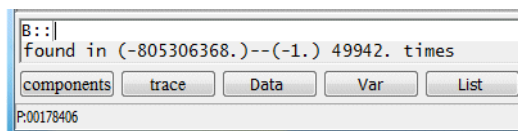
TARGET FIFO OVERFLOW, PROGRAM FLOW LOST occurs, when so much trace information is generated that it can not be buffered in the NEXUS FIFO.

Diagnosis

In order to get an immediate display of the trace contents TRACE32 uploads only the currently displayed section from the physical trace memory to the host. To check if there are FIFOFULLs it is recommended to upload the complete trace contents to the host by the command: **Trace.FLOWPROCESS.**

The number of FIFOFULL is printed to the TRACE32 state line as result of the following command:

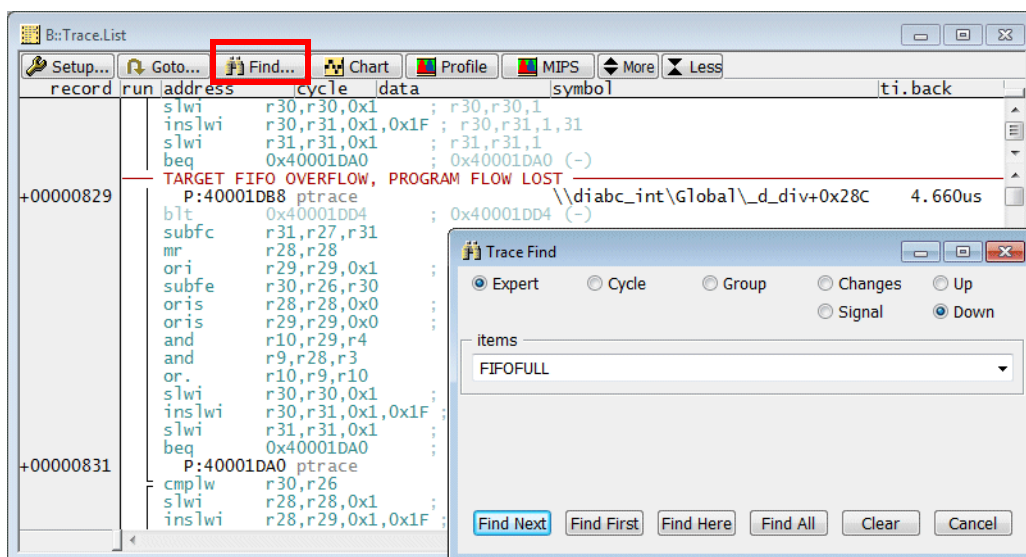
```
Trace.Find FIFOFULL /ALL
```



The following TRACE32 functions allows you to process the result in a script:

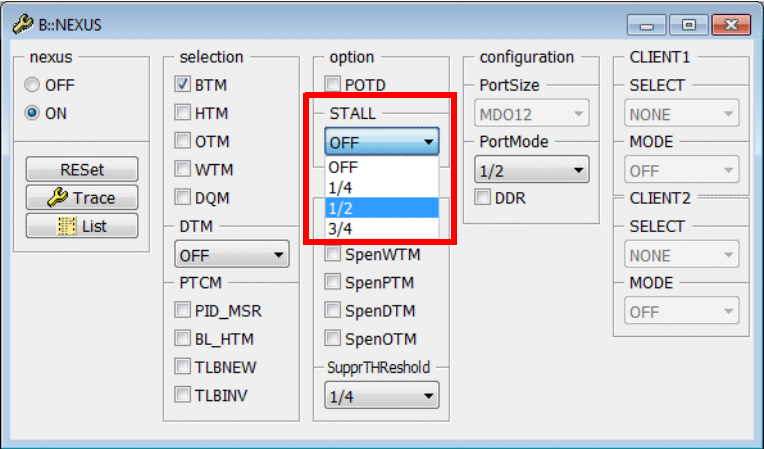
FOUND.COUNT ()

The single FIFOFULLs can be found in the trace:



FIFOFULLs may occur during your tests, they are not errors. But FIFOFULLs may disturb your trace analysis. There are various strategies to avoid FIFOFULLs.

Stall Program Execution on Overflow Threat

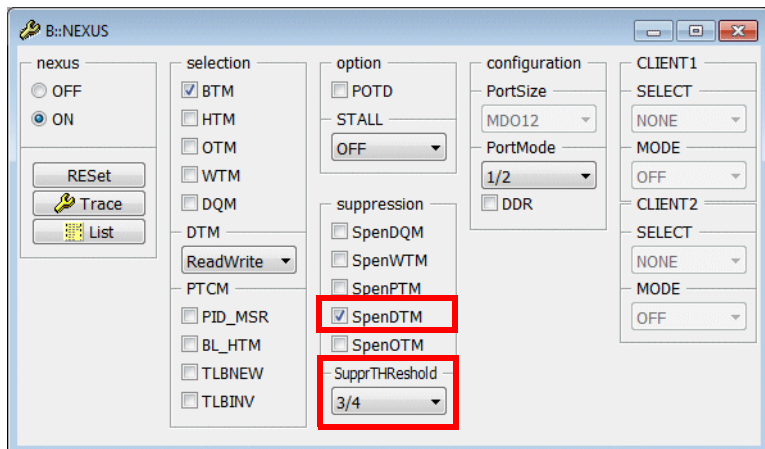


Overrun control	
STALL OFF	Generate overrun message when a new message can not be queued due to the NEXUS FIFO being full. No new message is queued to the NEXUS FIFO until it is completely empty.
STALL ON (2003 Standard)	Stall the program execution whenever the on-chip NEXUS FIFO threatens to overflow.
STALL 1/4 (2008/2012 Standard)	Stall the program execution when 1/4 of the on-chip NEXUS FIFO is filled.
STALL 1/2 (2008/2012 Standard)	Stall the program execution when 1/2 of the on-chip NEXUS FIFO is filled.
STALL 3/4 (2008/2012 Standard)	Stall the program execution when 3/4 of the on-chip NEXUS FIFO is filled.

NEXUS.STALL 3 / 4

Suppress Data Trace Messages on Overflow Threat

Since Data Trace Messages are high-risk for NEXUS FIFOs getting full, it may be helpful to suppress these messages when the NEXUS FIFO reaches a certain fill level.



NEXUS.DTM ReadWrite

NEXUS.SupprTHReshold 3/4 ; Sets the NEXUS FIFO fill level, at which
; messages will be suppressed

NEXUS.SpenDTM ON ; Suppress Data Trace Messages when the
; NEXUS FIFO reaches the specified filling
; level

... ; Start and stop the program execution

Trace.FindAll,Cycle Write ; Search for all write accesses

The image shows the B::Trace.FindAll, Cycle Write window. It displays a table of memory accesses. The columns are: run, address, cycle, data, symbol, and ti.back. The data is as follows:

run	address	cycle	data	symbol	ti.back
3690883					
-0006475828	D:40007F10	wr-long	40007F68	\\diabc\Global__SP_TEST+0x518	3.950us
-0006475825	D:40007F2C	wr-long	00000000	\\diabc\Global__SP_TEST+0x534	1.105us
-0006475824	D:40007F30	wr-long	00000000	\\diabc\Global__SP_TEST+0x538	0.620us
-0006475823	D:40007F34	wr-long	00000000	\\diabc\Global__SP_TEST+0x53C	0.620us
-0006475782	D:400040EC	wr-long	00030003	\\diabc\Global\vbfield+0x4	18.745us
-0006475780	D:400040F0	wr-word	0001	\\diabc\Global\vbfield+0x8	0.865us
-0006475778	D:400040F0	wr-long	0001E000	\\diabc\Global\vbfield+0x8	1.230us
-0006475776	D:400040F0	wr-long	0001A000	\\diabc\Global\vbfield+0x8	1.235us
-0006475775	D:400040E8	wr-long	FC080800	\\diabc\Global\vbfield	0.615us
-0006475771	D:400040E8	wr-long	FFF80800	\\diabc\Global\vbfield	1.730us
-0006475767	D:400040E8	wr-long	FFFFF800	\\diabc\Global\vbfield	1.475us
-0006475763	D:40007F68	wr-long	40007F80	\\diabc\Global__SP_TEST+0x570	1.730us
-0006475761	D:40007F78	wr-long	4000402C	\\diabc\Global__SP_TEST+0x580	0.985us
-0006475759	D:40007F7C	wr-long	0000000B	\\diabc\Global__SP_TEST+0x584	0.740us
-0006475758	D:40007F84	wr-long	400011C8	\\diabc\Global__SP_TEST+0x58C	0.620us

The NEXUS protocol does not indicate the message suppression. But read/write cycles that can not be assigned to its instruction (displayed in red) are a good indicator, the a message suppression occurred.

Further Countermeasures

If you do not want to stall the program execution or suppress messages, just reduce the number of the generated trace messages:

- Enable HTM (**NEXUS.BTM** ON and **NEXUS.HTM** ON)
- Switch DTM to off when possible (**NEXUS.DTM** OFF).
- Disable the NEXUS message generation for cores you are not interested in for you current analysis.
- Filter the DTMs. Refer to [“Filter and Trigger \(Core\) Overview”](#), page 101 for details.

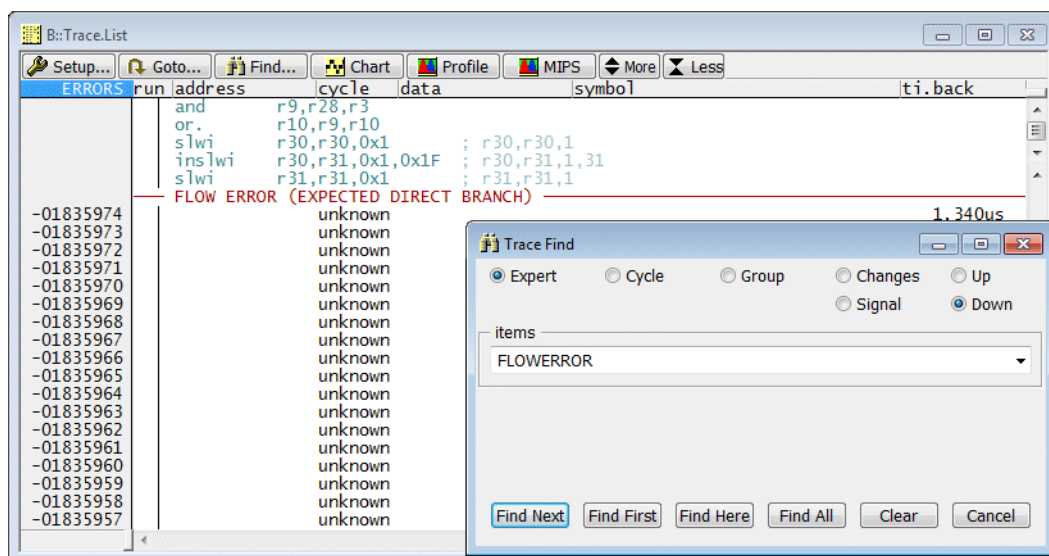
TRACE32 indicates FLOWERRORS:

- If the instruction flow information generated by NEXUS does not match with the code image in the target.
- If invalid NEXUS messages are generated.

The complete number of FLOWERRORS is printed to the TRACE32 state line as result of the following command:

```
Trace.Find FLOWERROR /ALL
```

The single FLOWERROR can be found in the trace:



FLOWERRORs are errors and it is recommended to fix them. Please contact your local Lauterbach support if you need assistance.

Settings in the Trace Configuration Window

The main influencing factor on the trace information is the NEXUS hardware module. It specifies what type of trace information is generated for the user.

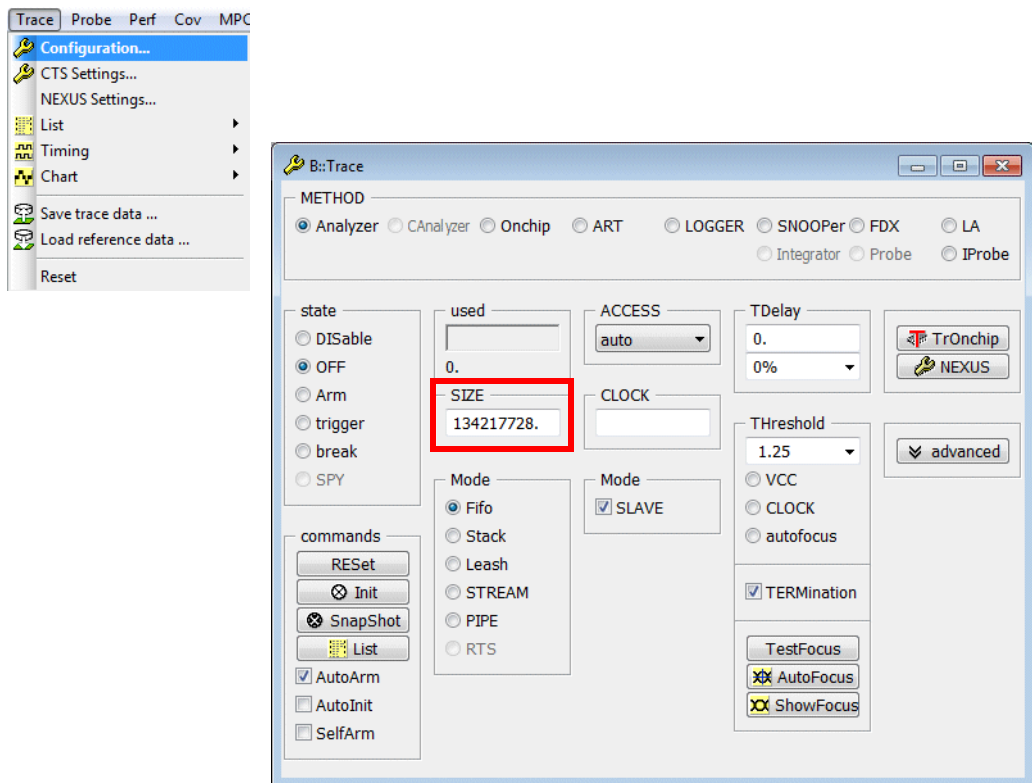
Another important influencing factor are the settings in the TRACE32 Trace Configuration window. They specify how much trace information can be recorded and when the trace recording is stopped.

Recording Modes

The **Mode** settings in the Trace configuration window specify how much trace information can be recorded and when the trace recording is stopped.

The following modes are provided:

- **Fifo, Stack, Leash Mode:** allow to record as much trace records as indicated in the **SIZE** field of the Trace Configuration window.



- **STREAM Mode (PowerTrace II hardware only):** STREAM mode specifies that the trace information is immediately streamed to a file on the host computer. STREAM mode allows a trace memory size of several T Frames.

- PIPE Mode (PowerTrace II hardware only):** PIPE mode specifies that the trace information is immediately streamed to a named pipe on the host computer.
 PIPE mode creates the path to convey trace raw data to an application outside of TRACE32 PowerView. The named pipe has to be created by the receiving application before TRACE32 can connect to it.

Trace.Mode PIPE		
Trace.PipeWRITE	<i><pipe_name></i>	Connect to named pipe
Trace.PipeWRITE	\\.\pipe\ <i><pipe_name></i>	Connect to named pipe (Windows)
Trace.PipeWRITE		Disconnect from named pipe

```


...

Trace.Mode PIPE                                ; switch trace to PIPE mode

Trace.PipeWRITE \\.\pipe\pproto00              ; connect to named pipe
                                              ; (Windows)

...

Trace.PipeWRITE                                ; disconnect from named pipe
  
```

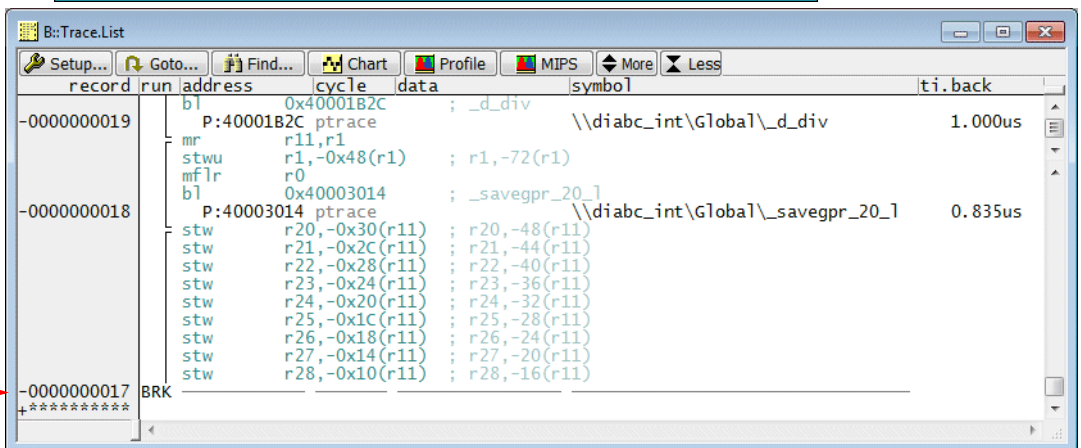
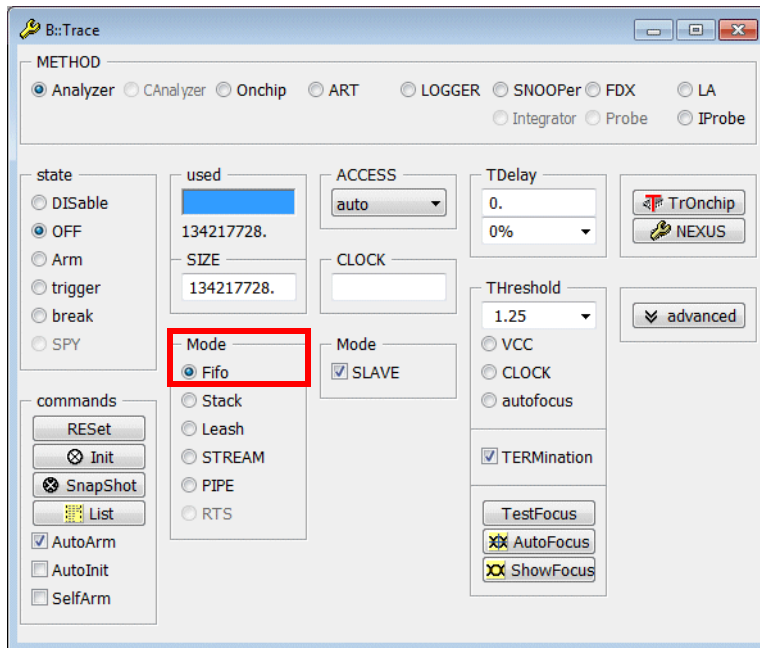
	NEXUS packets (no tool timestamp) are conveyed in PIPE mode.
--	--

- RTS Mode (PowerTrace II hardware only):** RTS mode enables the processing while the trace data are recorded. The main use case for **RTS** is a live display of the code coverage results.

```
Trace.Mode Fifo ; default mode

; when the trace memory is full
; the newest trace information will
; overwrite the oldest one

; the trace memory contains all
; information generated until the
; program execution stopped
```

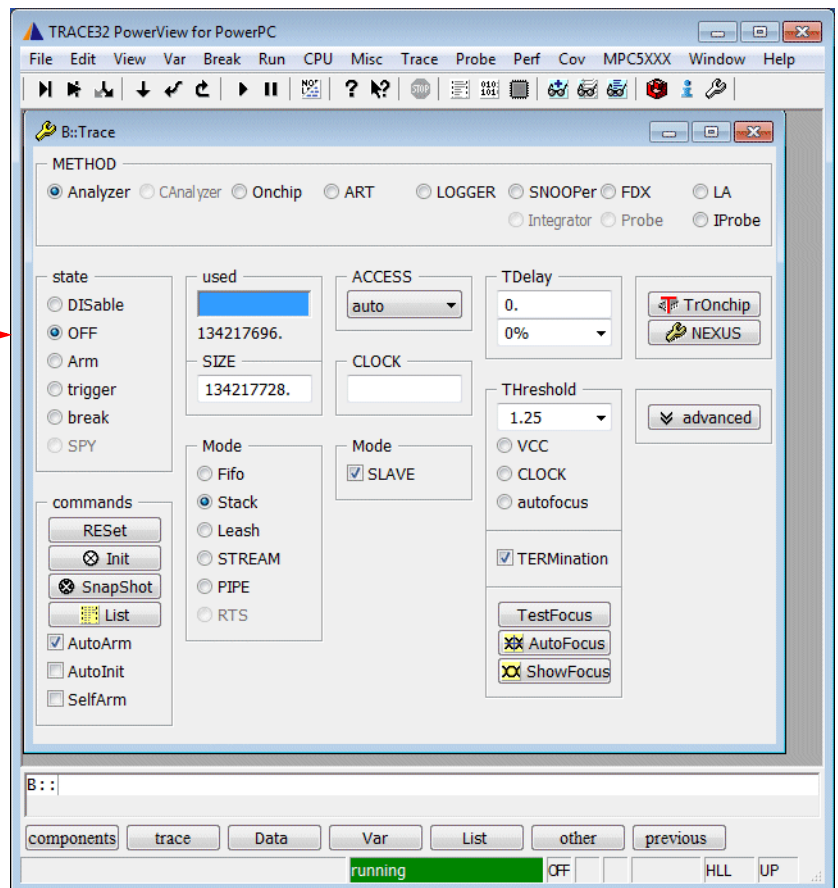


In **Fifo** mode negative record numbers are used. The last record gets the smallest negative number.

```
Trace.Mode Stack ; when the trace memory is full
                  ; the trace recording is stopped

                  ; the trace memory contains all
                  ; information generated directly
                  ; after the start of the program
                  ; execution
```

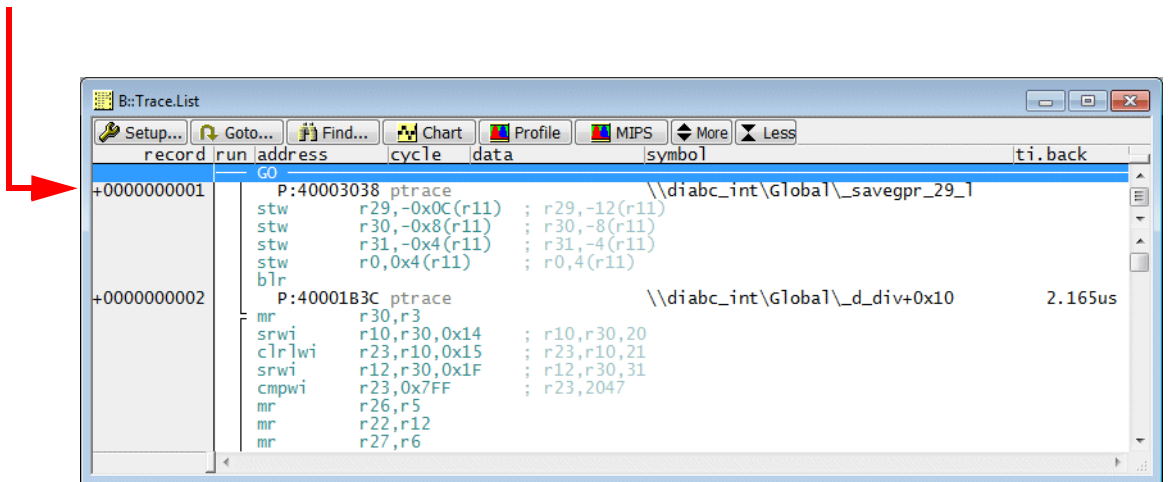
The trace recording is stopped as soon as the trace memory is full (OFF state)



Green **running** in the Debug State Field indicates that program execution is running

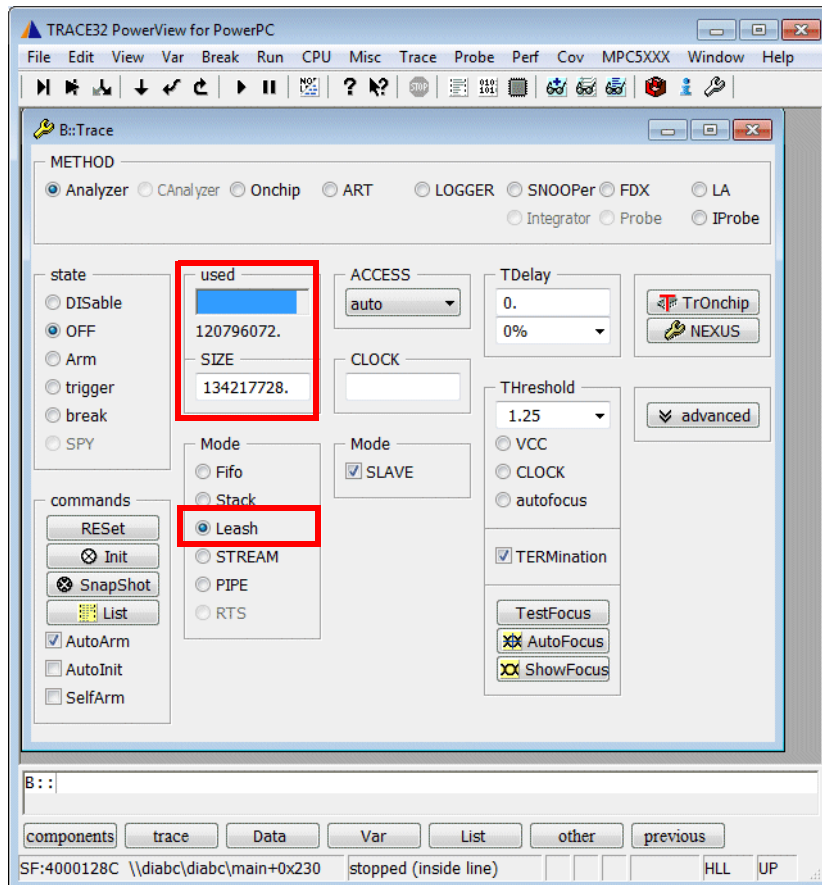
OFF in the Trace State Field indicates that the trace recording is switched off

Since the trace recording starts with the program execution and stops when the trace memory is full, positive record numbers are used in **Stack** mode. The first record in the trace gets the smallest positive number.



```
Trace.Mode Leash ; when the trace memory is nearly
                  ; full the program execution is
                  ; stopped

                  ; Leash mode uses the same record
                  ; numbering scheme as Stack mode
```



The program execution is **stopped** as soon as the trace buffer is nearly full.

Since stopping the program execution when the trace buffer is nearly full requires some logic/time, **used** is smaller than the maximum **SIZE**.

```
NEXUS.HTM ON                                ; enable Indirect Branch History
                                              ; Messaging to get compact raw
                                              ; trace data

Trace.Mode STREAM                           ; STREAM the recorded trace
                                              ; information to a file on the host
                                              ; computer

                                              ; STREAM mode uses the same record
                                              ; numbering scheme as Stack mode
```

The trace information is immediately streamed to a file on the host computer after it was placed into the trace memory. This procedure extends the size of the trace memory to several T Frames.

- STREAM mode requires a TRACE32 trace hardware that allows streaming the trace information while recording. This is currently supported by PowerTrace II.
- STREAM mode required a 64-bit host computer and a 64-bit TRACE32 executable to handle the large trace record numbers.

By default the streaming file is placed into the TRACE32 temporary directory ([OS.PresentTemporaryDirectory\(\)](#)).

The command [Trace.STREAMFILE](#) *<file>* allows to specific a different name and location for the streaming file.

```
Trace.STREAMFILE d:\temp\mystream.t32      ; specify the location for
                                              ; your streaming file
```

TRACE32 stops the streaming when less then the 1 GByte free memory left on the drive by default.

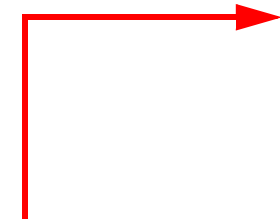
The command [Trace.STREAMFileLimit](#) *<+/- limit in bytes>* allows a user-defined free memory limitation.

```
Trace.STREAMFileLimit 5000000000.          ; streaming file is limited to
                                              ; 5 GByte

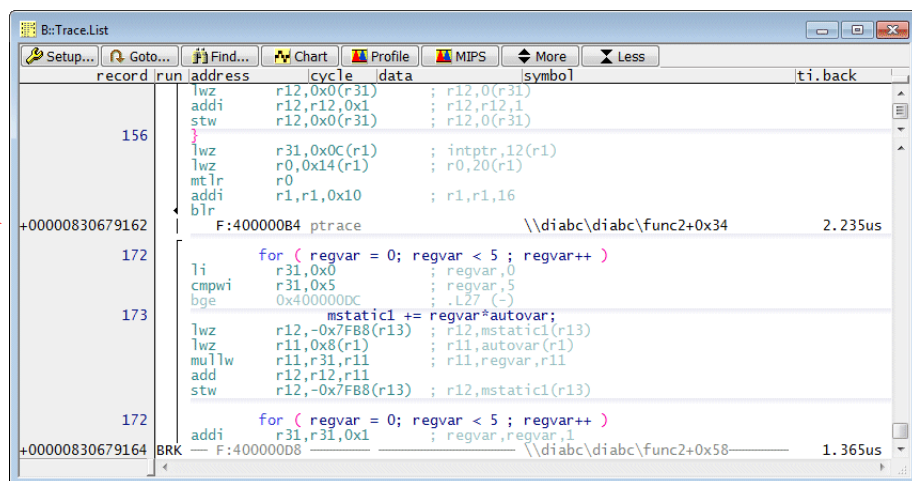
Trace.STREAMFileLimit -5000000000.         ; streaming is stopped when less
                                              ; the 5 GByte free memory is left
                                              ; on the drive
```

Please be aware that the streaming file is deleted as soon as you de-select the STREAM mode or when you exit TRACE32.

Downloaded from <https://www.cambridge.org/core>. University of Cambridge, on 02 Jun 2020 at 10:00:00, subject to the Cambridge Core terms of use, available at <https://www.cambridge.org/core/terms>. <https://doi.org/10.1017/S0022216X20000509>



STREAM mode can generate very large record numbers

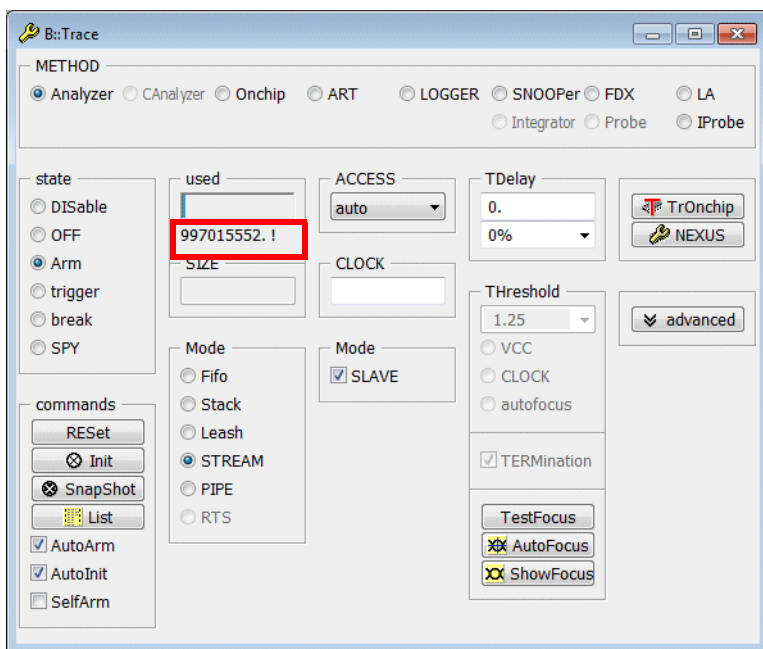


STREAM mode can only be used if the average data rate at the trace port does not exceed the maximum transmission rate of the host interface in use. Peak loads at the trace port are intercepted by the trace memory, which can be considered to be operating as a large FIFO.

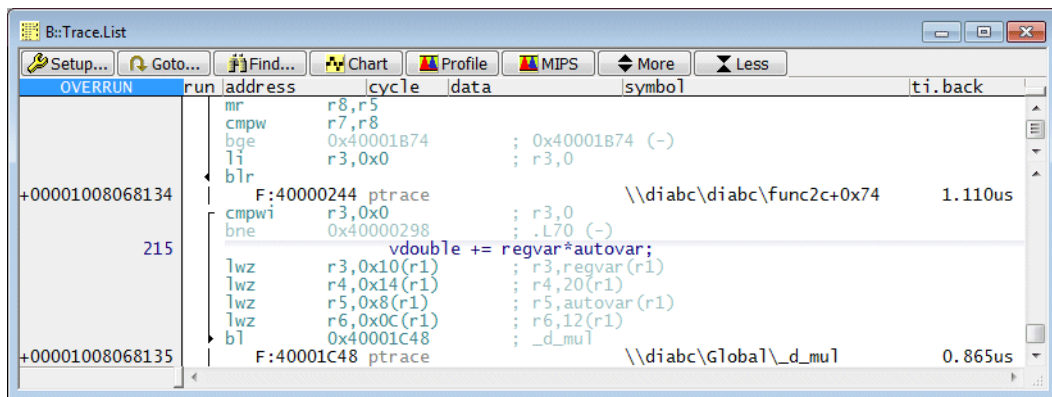
If the average data rate at the trace port exceeds the maximum transmission rate of the host interface in use, a **PowerTrace FIFO Overrun** occurs. TRACE32 stops streaming and empties the PowerTrace FIFO. Streaming is re-started after the PowerTrace FIFO is empty.

A **PowerTrace FIFO Overrun** is indicated as follows:

1. A **!** in the **used** area of the Trace configuration window indicates an overrun of the PowerTrace FIFO.

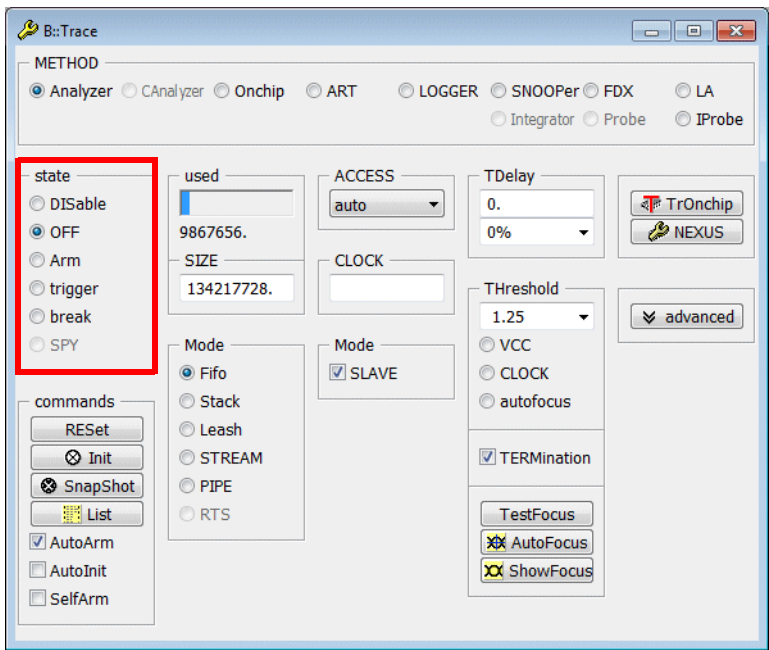


2. The **OVERRUN** is indicated in all trace display windows.



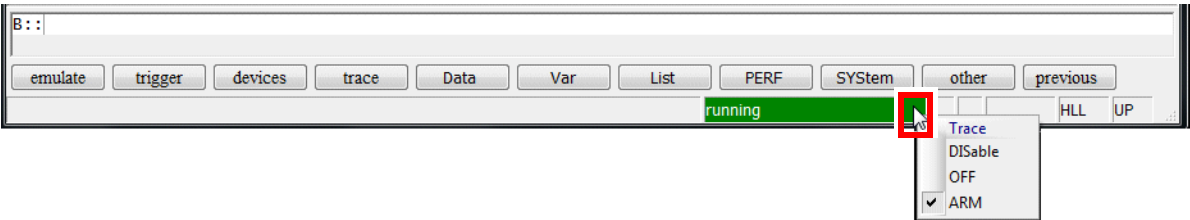
States of the Trace

The trace buffer can either sample or allows the read-out for information display.



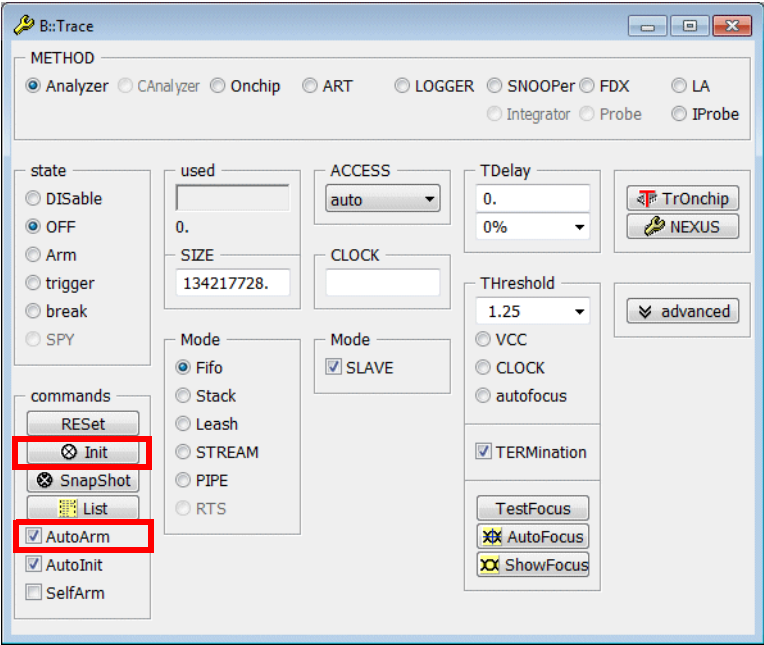
States of the Trace	
DISable	The trace is disabled.
OFF	The trace is not sampling. The trace contents can be red-out and displayed.
Arm	The trace is sampling. The trace contents can not be red.

The current state of the trace is always indicated in the **Trace State** field of the TRACE32 state line.



The Trace states **trigger** and **break** are introduced in detail later in this training.

The Autolnit Command



Init Button	Clear the trace memory. All other settings in the Trace configuration window remain valid.
Autolnit CheckBox	ON: The trace memory is cleared whenever the program execution is started (Go, Step).

The focus of the Trace configuration window is:

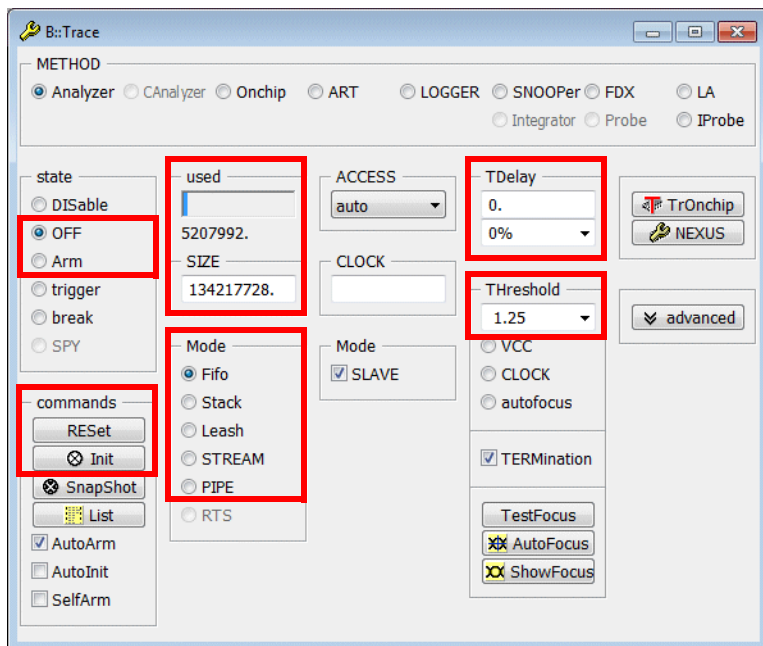
- Setup and maintenance of the TRACE32 trace tool (METHOD Analyzer).
- Setup and maintenance of the onchip trace (METHOD Onchip).

SMP systems: Due to the fact that one TRACE32 instance is used to control all cores, setups and states are identical for all controlled cores.

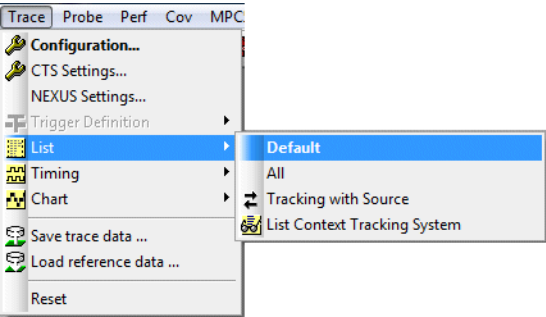
AMP systems: Due to the fact that the setups and states are maintained by multiple TRACE32 instances, the TRACE32 Resource Management maintains consistency for all joint settings and joint states.

Consistency maintenance means: status changes in one TRACE32 instance affect all other TRACE32 instances.

Joint Settings and States

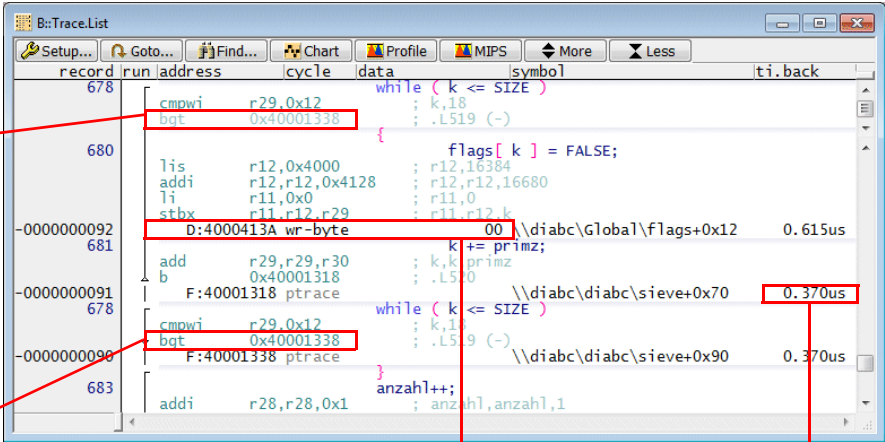


Default Listing



Conditional branch not executed (pastel printed)

Conditional branch executed



Data access

Timing information

Trace.List Default trace display.

The trace information for all cores is displayed by default in the **Trace.List** window if you are working with an **SMP** system. The column run and the coloring of the trace information are used for core indication.

B::Trace.List List.TASK Default						
<div> <div>Setup...</div> <div>Goto...</div> <div>Find...</div> <div>Chart</div> <div>Profile</div> <div>MIPS</div> <div>More</div> <div>Less</div> </div>						
record	run	address	cycle	data	symbol	ti.back
1	1	e_cmpi	0x0,r12,0x1	; 0,r12,1		
1	1	se_li	r29,0x0	; r29,0		
1	1	se_bne	0x80D6	; ..lin.d.3A.5COSEK.5Csrc.5Cautosar.5Csrc.5Cosmpc564xB		
	1	{				
	1	/* Wait for reply from remote core */				
191	1	while(rc->state == OSRC_WAIT)				
	1	{				
193	1	if(!OSStartedOnCore(remoteCoreId))				
	1	se_cmpi	r28,0x1	; remoteCoreId,1		
	1	se_bne	0x80B6			
-0000275100	0	V:00001040 ptrace		\\sample1\Global\VTABLE+0x40		
	0	interrupt				
	0	e_b	0x9118	; ..eof.d.3A.5COSEK.5Csrc.5Cautosar.5Csrc.5Cosmpc564xB		
-0000275098	0	V:00009118 ptrace		..5Cstandard.5Csc1..4F8D2BCC..0 0.515us		
	0	e_stwu	r1,-0x50(r1)	; r1,-80(r1)		
	0	e_stmvgprw	0x0C(r1)	; 12(r1)		
	0	e_stmvsprw	0x38(r1)	; 56(r1)		
	0	e_stmvsrrw	0x48(r1)	; 72(r1)		
	0	e_bl	0x77DE	; OSInterruptDispatcher1		
-0000275097	0	V:000077DE ptrace		..osisr\OSInterruptDispatcher1 2.195us		

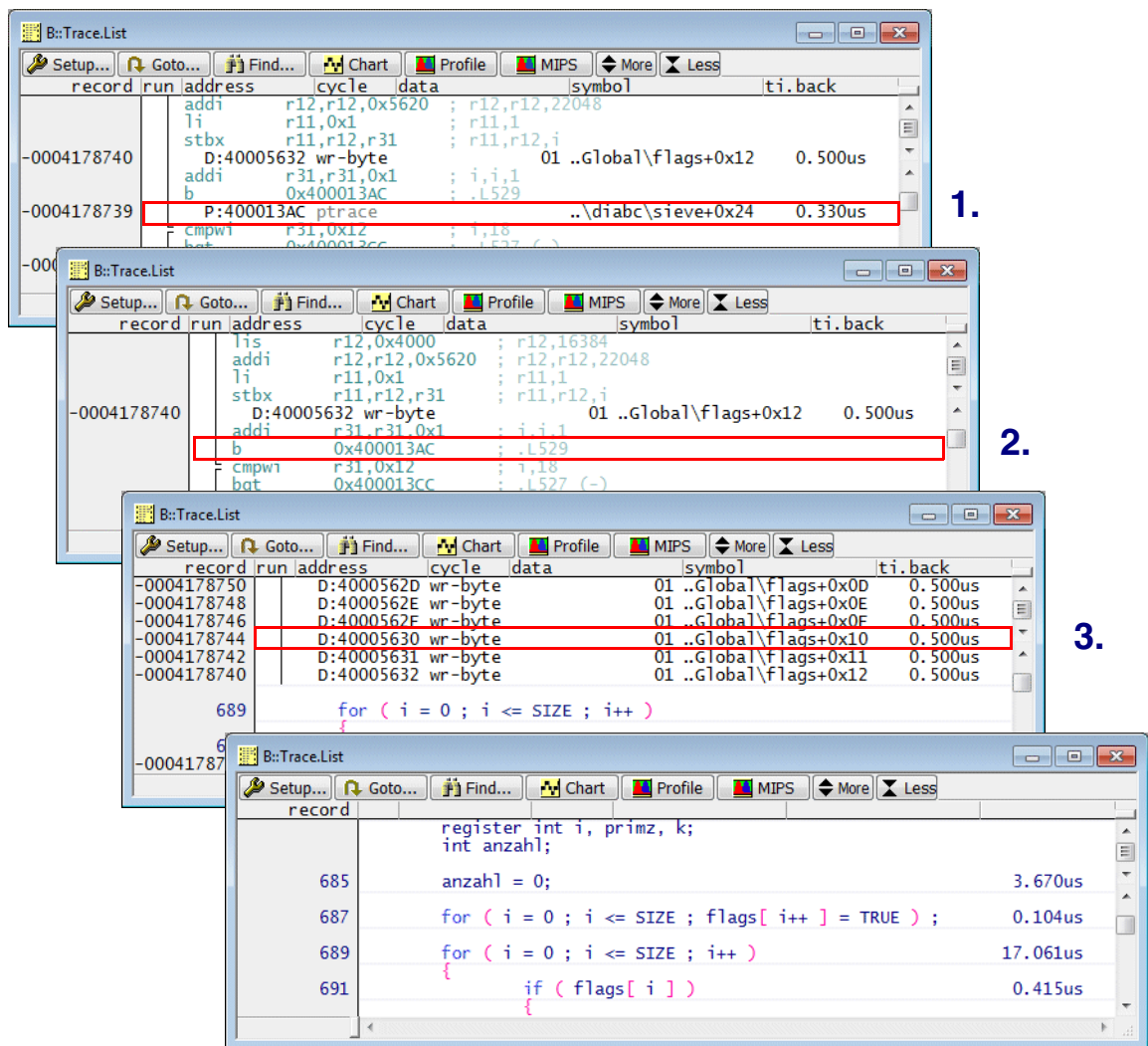
Trace.List /CORE <n>

The option CORE allows a per core display.

B::Trace.List /CORE 1

Setup... Goto... Find... Chart Profile MIPS More Less

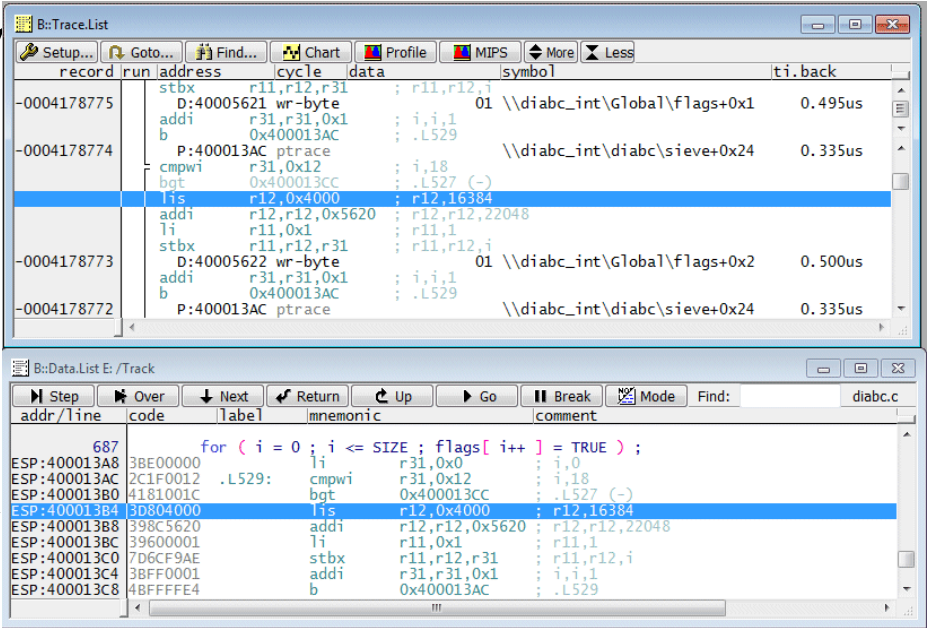
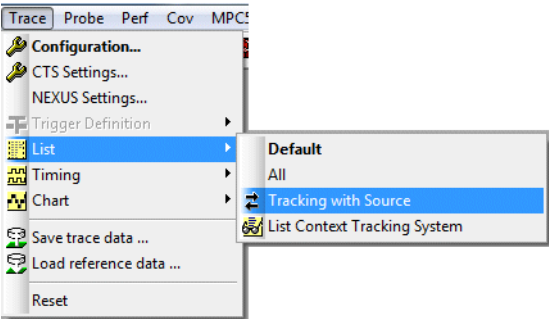
record	run	address	cycle	data	symbol	ti.back	
		e_lwz	r0,0x44(r1)	; r0,68(r1)			
		se_mtlr	r0				
		e_addi	r1,r1,0x40	; r1,r1,64			
		se_blr					
-0000001083		V:0000912C ptrace				..andard.5Csc1..4F8D2BCC..0+0x14	7.605us
		e_lmvssrrw	0x48(r1)	; 72(r1)			
		e_lmvsprrw	0x38(r1)	; 56(r1)			
		e_lmvgsrrw	0x0C(r1)	; 12(r1)			
		e_addi	r1,r1,0x50	; r1,r1,80			
		se_rfi					
-0000001077		V:000024A0 ptrace				\\sample1\osset\StartOS+0x23C	5.545us
		se_b	0x249C				
-0000001073		V:0000249C ptrace				\\sample1\osset\StartOS+0x238	1.155us
		wait					
-0000001066		V:000024A0 ptrace				\\sample1\osset\StartOS+0x23C	2.840us



1. time Less	Suppress the display of the program trace package information (ptrace).
2. time Less	Suppress the display of the assembly code.
3. time Less	Suppress the data access information (e.g. wr-byte cycles).

The **More** button works vice versa.

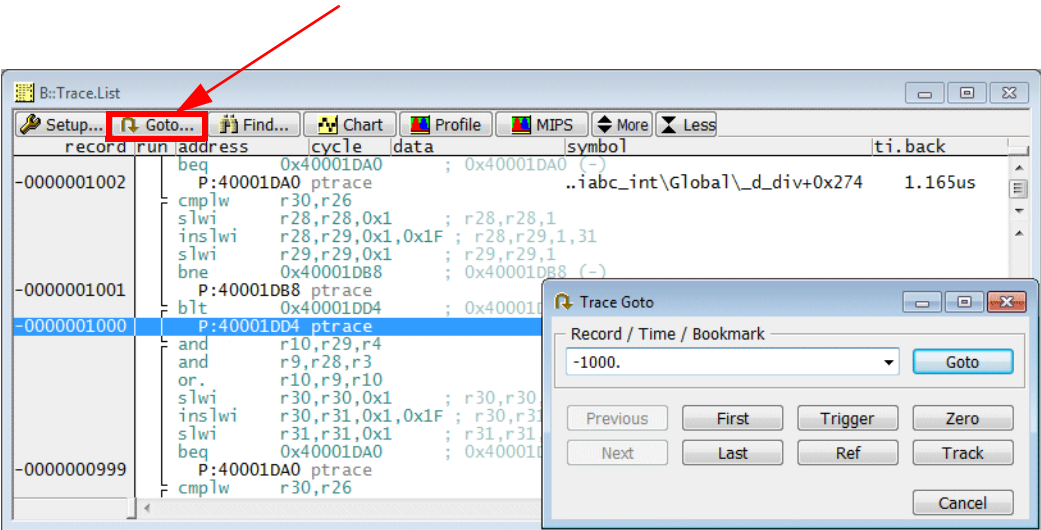
Correlating the Trace Listing with the Source Listing



Active Window

All windows opened with the */Track* option follow the cursor movements in the active window

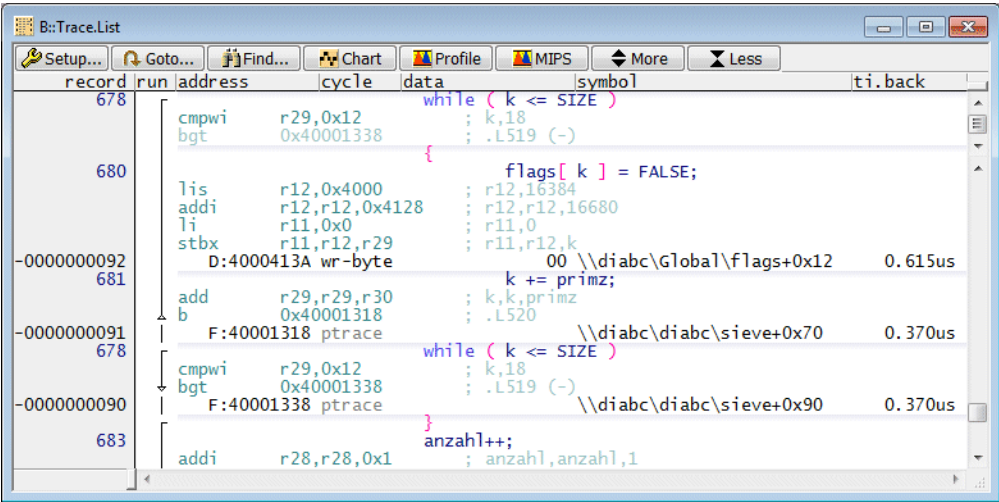
Browsing through the Trace Buffer



Pg ↑	Scroll page up.
Pg ↓	Scroll page down.
Ctrl - Pg ↑	Go to the first record sampled in the trace buffer.
Ctrl - Pg ↓	Go to the last record sampled in the trace buffer.

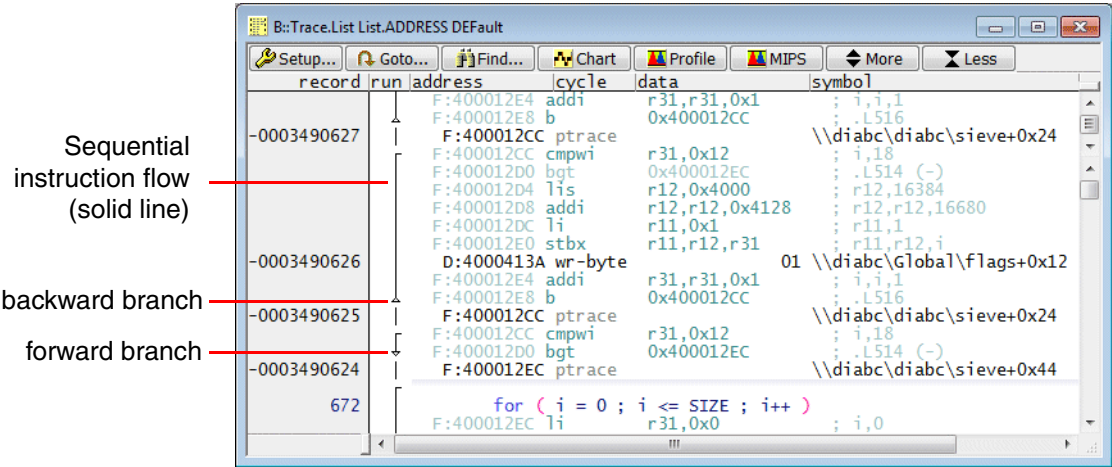
Display Items

Default Display Items



- **Column *record***
Displays the record numbers
- **Column *run***
The column run displays some graphic element to provide a quick overview on the instruction flow.

Trace.List List.ADDRESS Default



The column run also indicates interrupts and TRAPS.

record	run	address	cycle	data	symbol	ti.back
-0000010061	e_rlwim	r6,r3,0x3,0x0,0x1C		r6,sint,3,0,28		
	se_sraw	r7,r6				
	e_lis	r5,0xFFF50000		r5,4294246400		
	e_stw	r7,-0x7FE0(r5)		r7,-32736(r5)		
	se_blr					
	V:40005408	ptrace			\\im02_bf1x\im02\FuncTASK3+0x38	1.250us
	e_lbz	r7,0x0(r31)		r7,0(r31)		
-0000010060	interrupt					
	V:40000040	ptrace			\\im02_bf1x\Global\VTABLE+0x40	1.250us
-0000010059	e_b	0x40004FEE			OSInterruptDispatcher	
	V:40004FEE	ptrace			..x\Global\OSInterruptDispatcher	0.750us
	e_stwu	r1,-0x50(r1)		r1,-80(r1)		
	e_stmvgprw	0x0C(r1)		12(r1)		
	e_stmvsprw	0x38(r1)		56(r1)		
	e_stmvsrrw	0x48(r1)		72(r1)		
-0000010058	e_bl	0x40003D50			OSInterruptDispatcher1	
	V:40003D50	ptrace			..x\osisir\OSInterruptDispatcher1	0.750us

• Column cycle

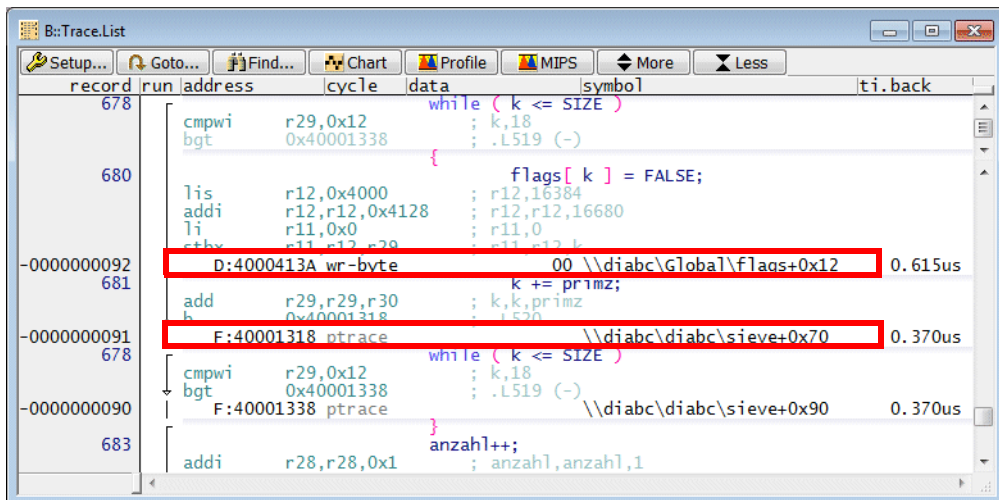
The main cycle types are:

- ptrace (program trace information)
- rd-byte, rd-word, rd-long (read access)
- wr-byte, wr-word, wr-long (write access)
- owner (ownership trace messages)
- unknown (Branch Trace Messages that can not be decoded)

B::Trace.List NEXUS Default							
record	nexus	run	address	cycle	data	symbol	ti.back
-0000999813	TCODE=03 SRC=0 PT-DBM ICNT=0007			unknown			1.110us
-0000999812	TCODE=03 SRC=0 PT-DBM ICNT=0002			unknown			0.370us
-0000999811	TCODE=03 SRC=0 PT-DBM ICNT=000C			unknown			1.480us
-0000999810	TCODE=03 SRC=0 PT-DBM ICNT=0003			unknown			0.495us
-0000999809	TCODE=03 SRC=0 PT-DBM ICNT=000C			unknown			1.355us
-0000999808	TCODE=0B SRC=0 PT-DBSM ICNT=0003	F-ADDR=400012F0		F:400012F0	ptrace	..sieve+0x48	0.740us
				cmpwi	r31,0x12	i,18	
				bgt	0x40001344	.L517 (-)	
					{		
					if (flags[i])		
				lis	r12,0x4000	r12,16384	
				addi	r12,r12,0x4128	r12,r12,16680	
				lbzx	r12,r12,r31	r12,r12,i	
				cmpwi	r12,0x0	r12,0	
				beq	0x4000133C	.L521 (-)	
-0000999806	TCODE=03 SRC=0 PT-DBM ICNT=0007		F:4000133C	ptrace		..sieve+0x94	0.860us

The decoding of the Branch Trace Messages can start, as soon as a full address (F-ADDR) is exported. Branch Trace Messages that can not be decoded are marked as **unknown**.

- **Column address/symbol**



The **address column** shows the following information:

<access class>:<logical_address>

Access Classes	
F	Program address, disassembly shows standard PowerPC instructions
V	Program address, disassembly shows VLE encoded instructions
D	Data address

The **symbol column** shows the corresponding symbolic address.

- **Column *ti.back***

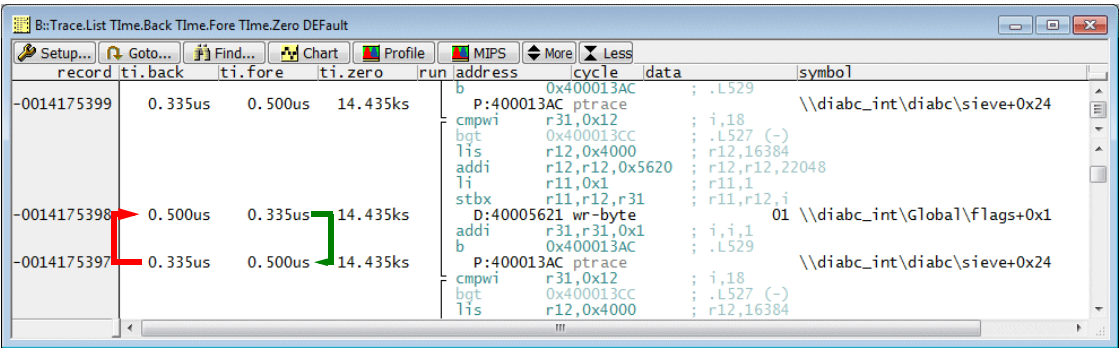
record	run	address	cycle	data	symbol	ti.back
678				while (k <= SIZE)		
		cmpwi	r29,0x12	; k,18		
		bgt	0x40001338	; .L519 (-)		
680				{ flags[k] = FALSE;		
		lis	r12,0x4000	; r12,16384		
		addi	r12,r12,0x4128	; r12,r12,16680		
		li	r11,0x0	; r11,0		
		stbx	r11,r12,r29	; r11,r12,k		
-0000000092		D:4000413A	wr-byte	00 \\diabc\\Global\\flags+0x12		0.615us
681				k += primz;		
		add	r29,r29,r30	; k,k,primz		
		b	0x40001318	; .L520		
-0000000091		F:40001318	ptrace	\\diabc\\diabc\\sieve+0x70		0.370us
678				while (k <= SIZE)		
		cmpwi	r29,0x12	; k,18		
		bgt	0x40001338	; .L519 (-)		
-0000000090		F:40001338	ptrace	\\diabc\\diabc\\sieve+0x90		0.370us
683				} anzahl++;		
		addi	r28,r28,0x1	; anzahl,anzahl,1		

The **ti.back** column shows the time distance to the previous record.

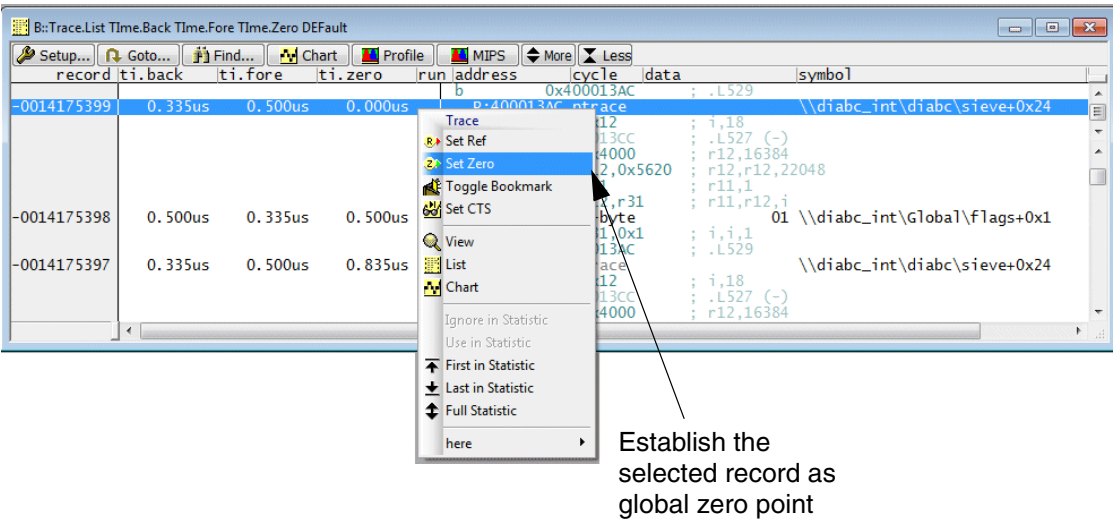
Time Information

Time.Back	Time relative to the previous record (red)
Time.Fore	Time relative to the next record (green).
Time.Zero	Time relative to the global zero point.

Trace.List Time.Back Time.Fore Time.Zero Default



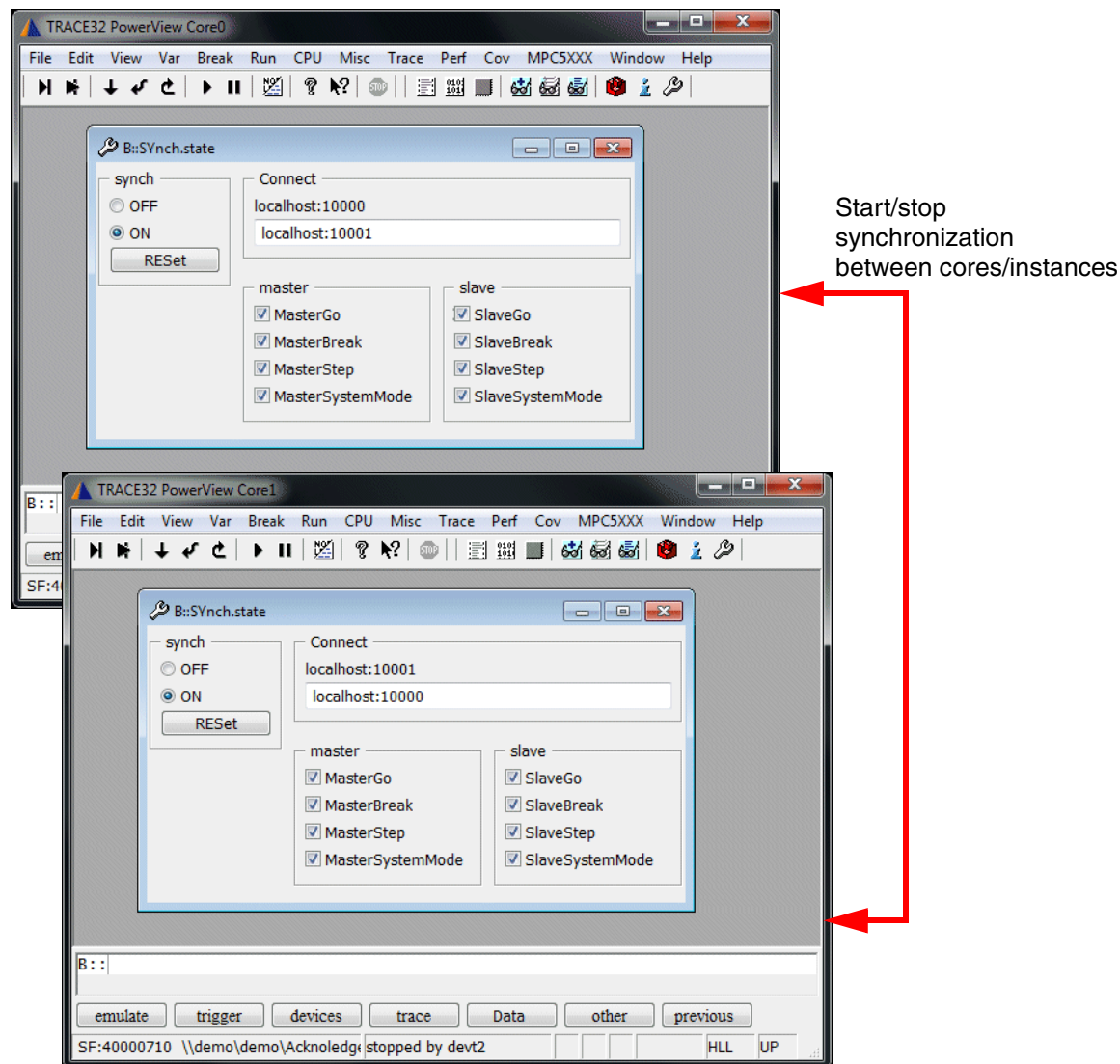
Set the Global Zero Point (tool timestamp only)



Time Synchronization between TRACE32 Instances (AMP)

Setup

If a AMP multi-core debugging session is set up, start/stop synchronization for the cores is established.

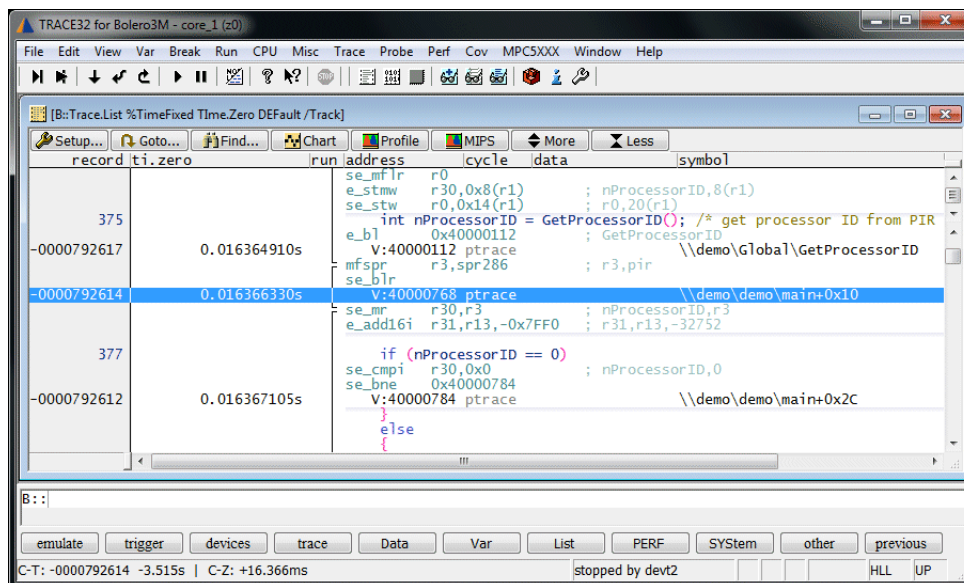


For trace synchronization the following commands have to be executed:

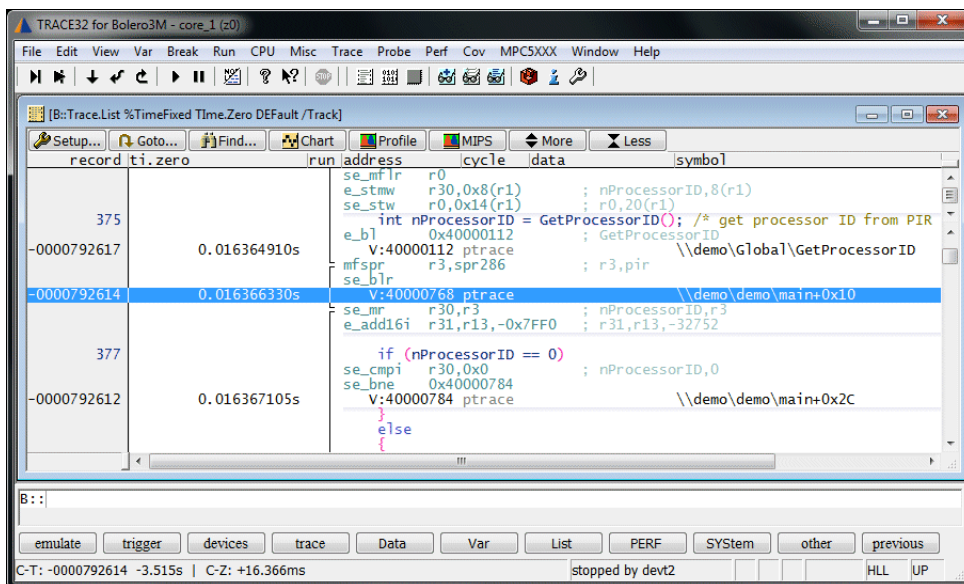
```
SYnch.XTrack localhost:10001 ; in TRACE32 instance for core0
SYnch.XTrack localhost:10000 ; in TRACE32 instance for core1
```

The base for the trace synchronization is the tool timestamp or if enabled the Nexus timestamps.

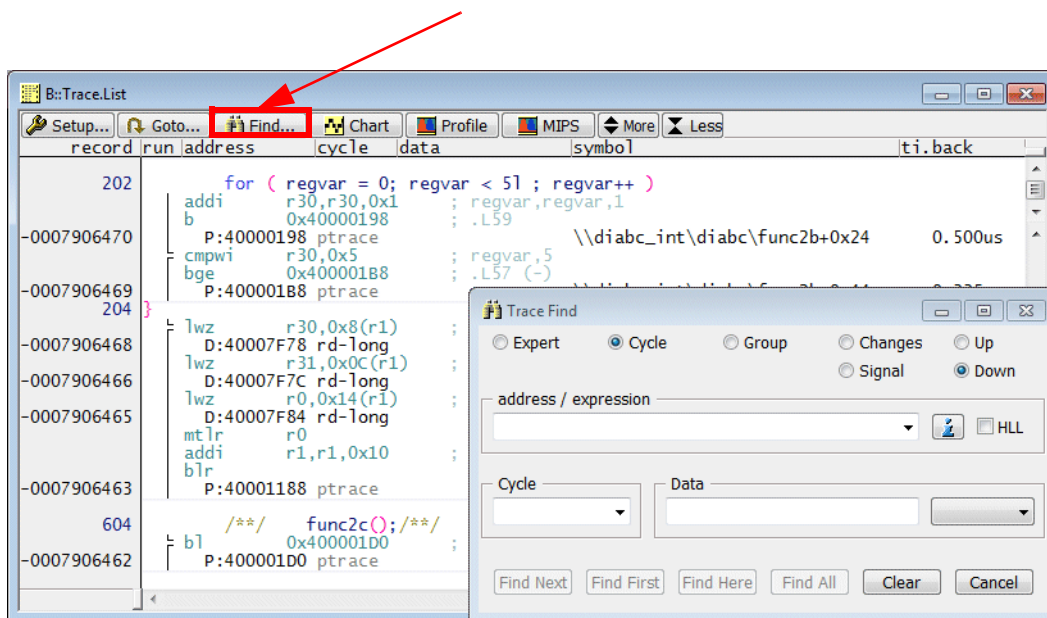
```
Trace.List Time.Zero DEFault /Track ; /Track enables here the
                                     ; time synchronisation to
                                     ; trace display windows in
                                     ; other TRACE32 instance
```



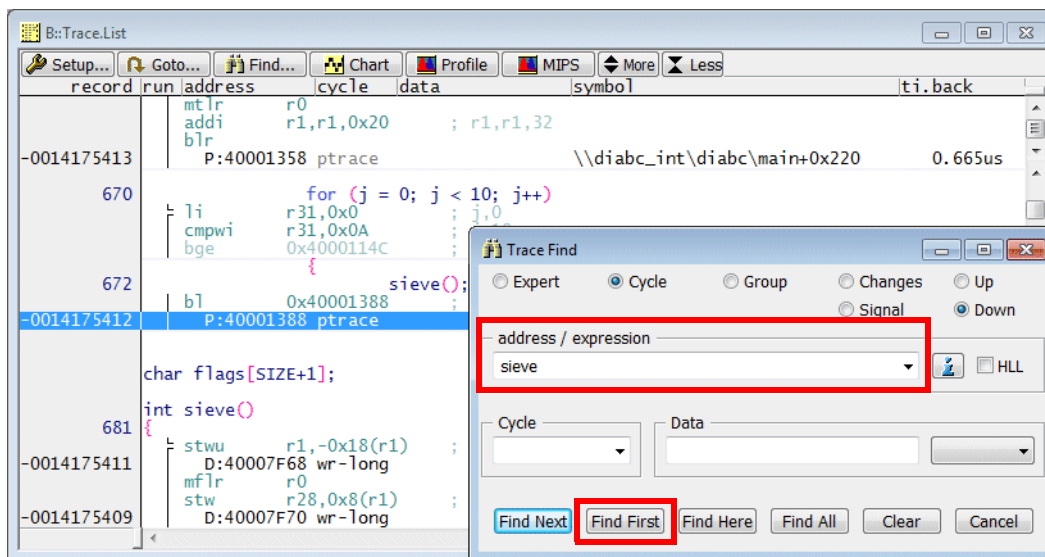
Time
synchronization
between
TRACE32
instances



Find a Specific Record



Example: Find a specific symbol address.



A more detailed description on how to find specific events in the trace is given in [“Application Note for Trace.Find”](#) (app_trace_find.pdf).

Belated Trace Analysis

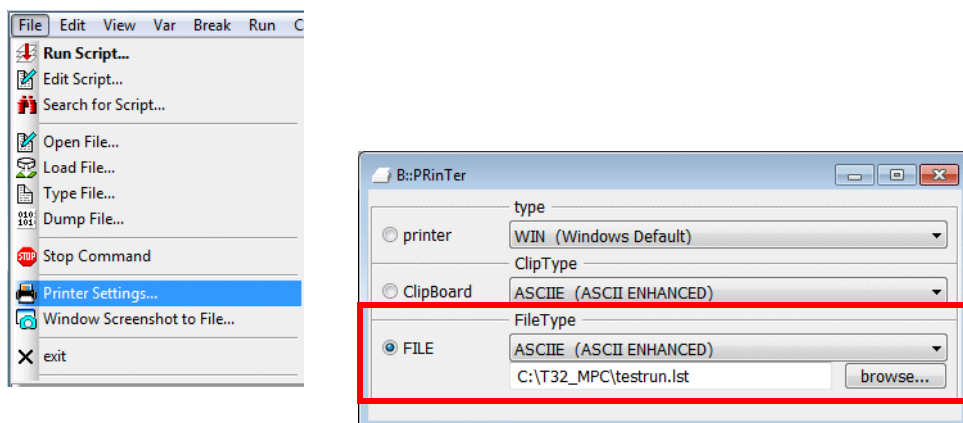
There are several ways for a belated trace analysis:

1. Save a part of the trace contents into an ASCII file and analyze this trace contents by reading.
2. Save the trace contents in a compact format into a file. Load the trace contents at a subsequent date into a TRACE32 Instruction Set Simulator and analyze it there.

Save the Trace Information to an ASCII File

Saving a part of the trace contents to an ASCII file requires the following steps:

1. Select **Print** in the **File** menu to specify the file name and the output format.



```
PRinTer.FileType ASCIIIE           ; specify output format
                                   ; here enhanced ASCII

PRinTer.FILE testrun.lst           ; specify the file name
```

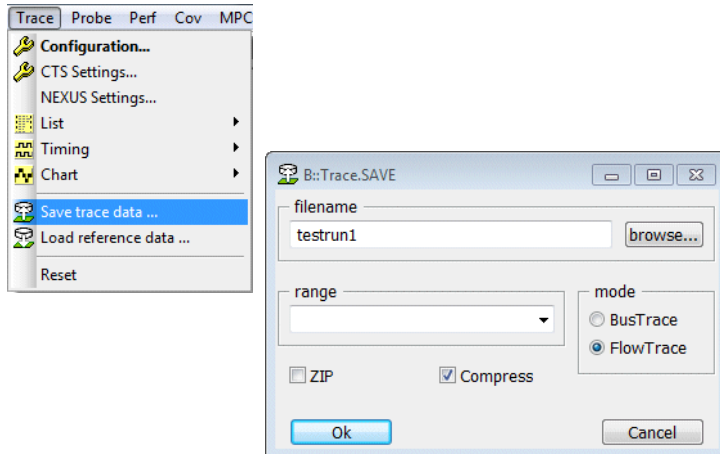
2. It only makes sense to save a part of the trace contents into an ASCII-file. Use the record numbers to specify the trace part you are interested in.

TRACE32 provides the command prefix **WinPrint.** to redirect the result of a display command into a file.

```
; save the trace record range (-8976.)--(-2418.) into the
; specified file
WinPrint.Trace.List (-8976.)--(-2418.)
```

3. Use an ASCII editor to display the result.

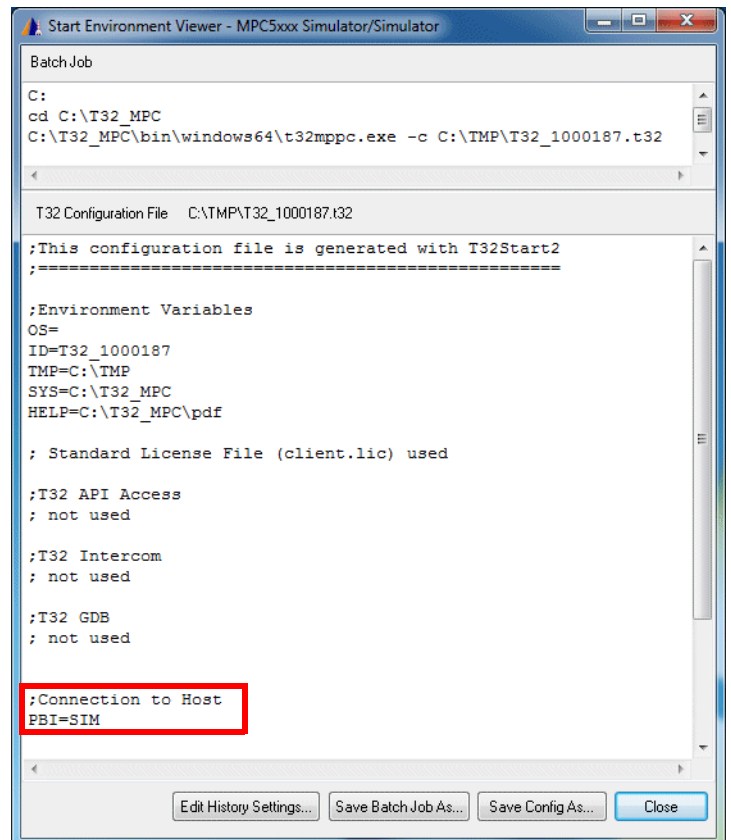
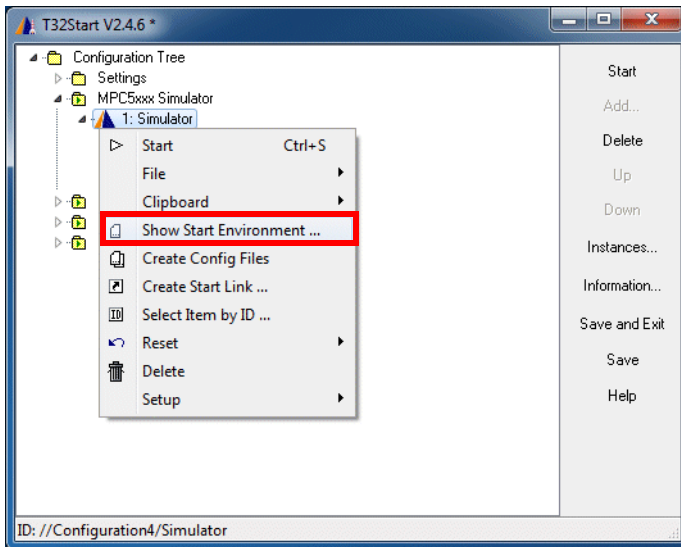
1. Save the contents of the trace memory into a file.



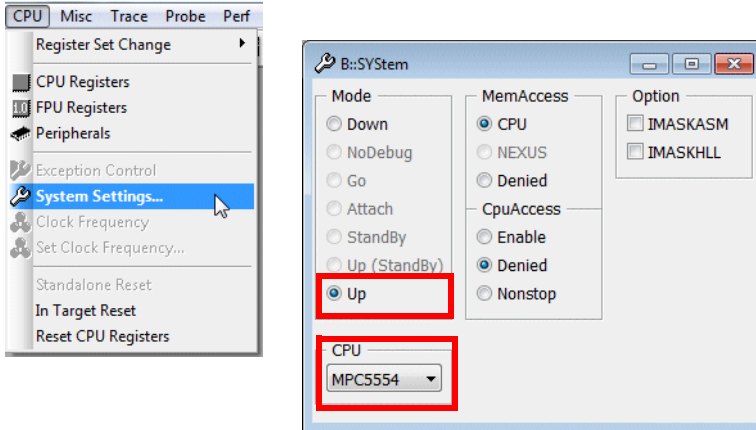
The default extension for the trace file is **.ad**.

```
Trace.SAVE testrun1
```

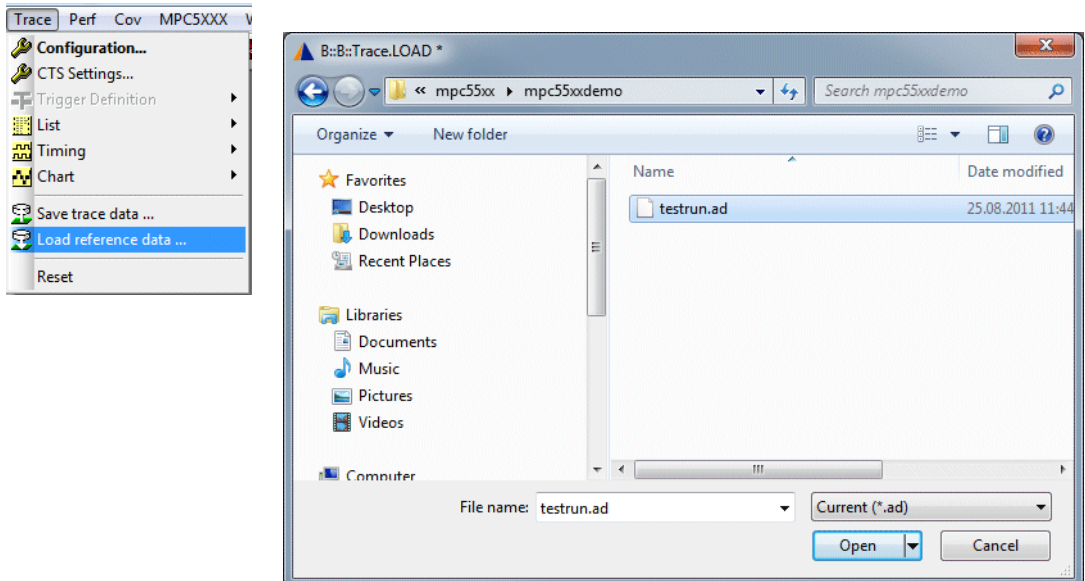
2. Start a TRACE32 Instruction Set Simulator (PBI=SIM).



3. Select your target CPU within the simulator. Then establish the communication between TRACE32 and the simulator.

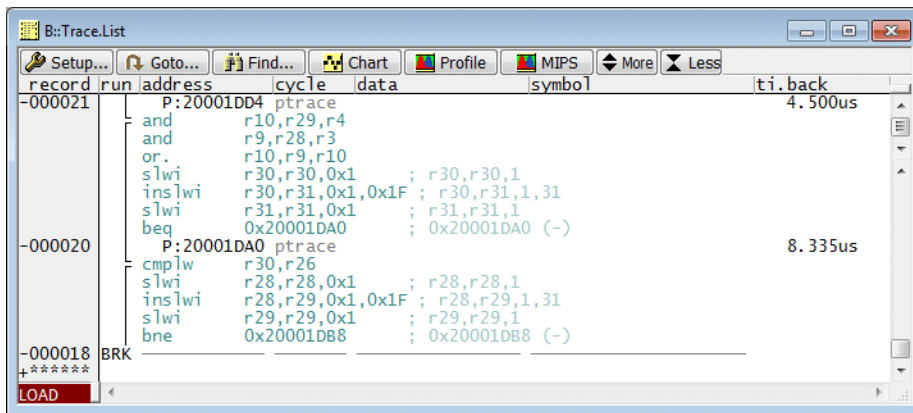


4. Load the trace file.



```
Trace.LOAD testrun
```

5. Display the trace contents.



LOAD indicates that the source for the trace information is the loaded file.

6. Load symbol and debug information if you need it.

```
Data.LOAD.Elf diabc_ext.x /NoCODE
```

The TRACE32 Instruction Set Simulator provides the same trace display and analysis commands as the TRACE32 debugger.

Trace-based Debugging (CTS)

Trace-based debugging allows to re-run the recorded program section within TRACE32 PowerView.

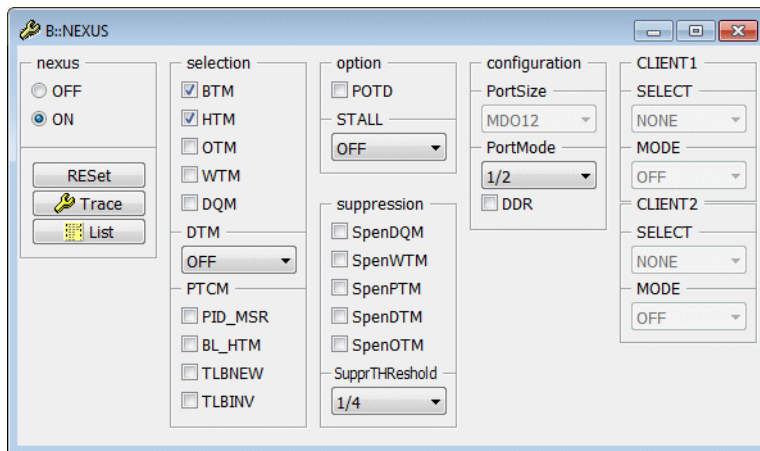
If Data Trace Messages were enabled for ReadWrite, it is also possible to watch memory, variable and register changes while re-running the recorded program section.

Re-Run the Program

Setup

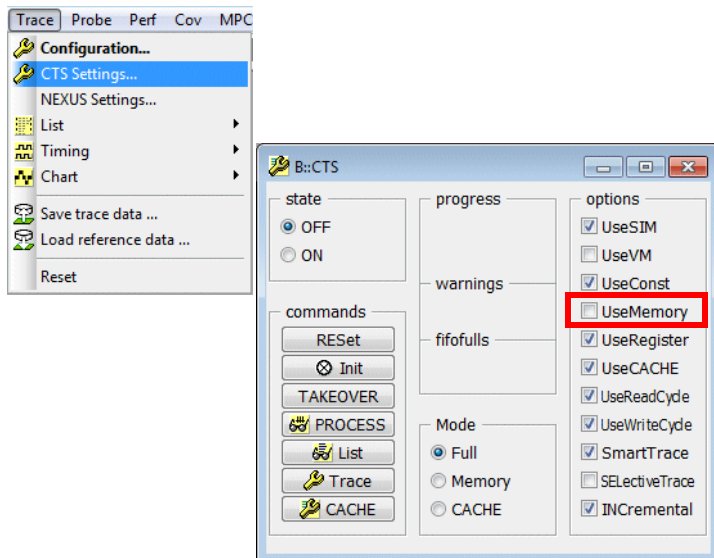
In order to re-run the program, it is sufficient to only enable Branch Trace Messaging. One of the following configurations is suitable:

- BTM ON
- BTM ON + HTM ON
- BTM ON + HTM ON + BL_HTM ON



If you use an OS, it is recommended to also record the task switch information. See [“OS-Aware Tracing \(ORTI File\)”](#) in Training Nexus Tracing, page 193 (training_nexus.pdf).

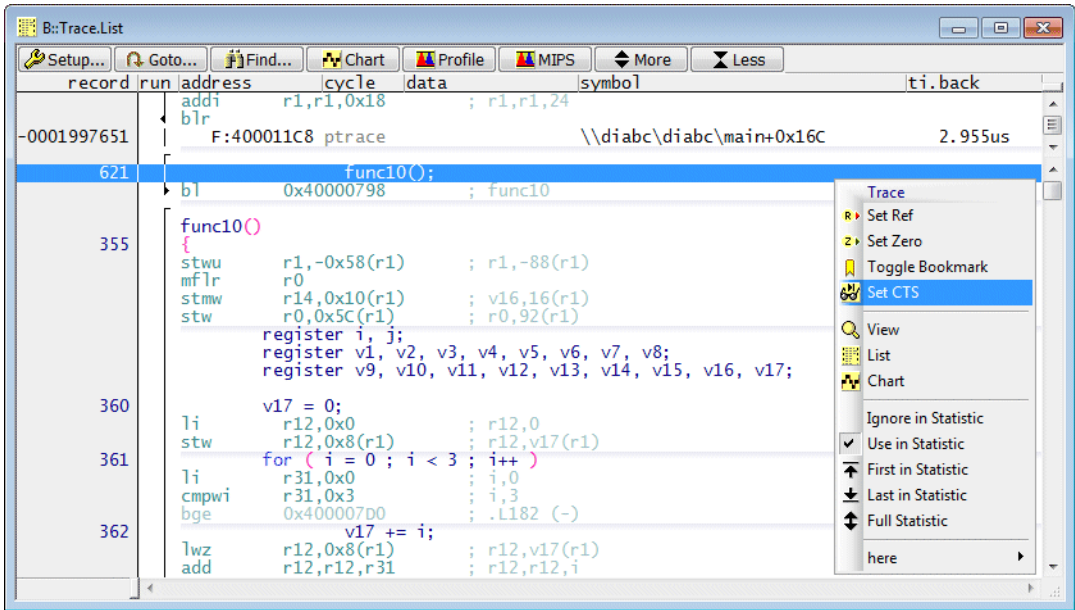
Un-check **UseFinalMemory** in the CTS configuration window. A full explanation on this is given later in the chapter “**CTS Technique**”, page 99



CTS.state

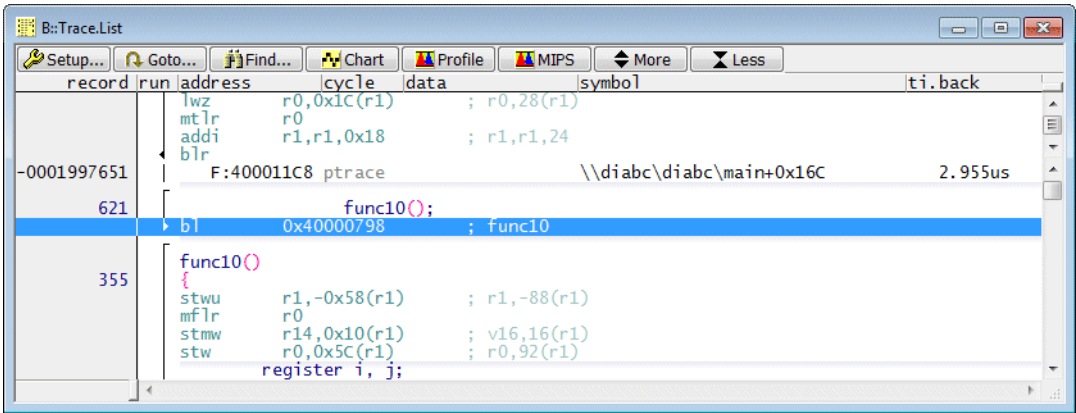
CTS.UseFinalMemory OFF

Specify the starting point for the trace re-run by selecting **Set CTS** from the Trace pull-down menu. The starting point in the example below is the entry to the function **func10**.



Selecting **Set CTS** has the following effect:

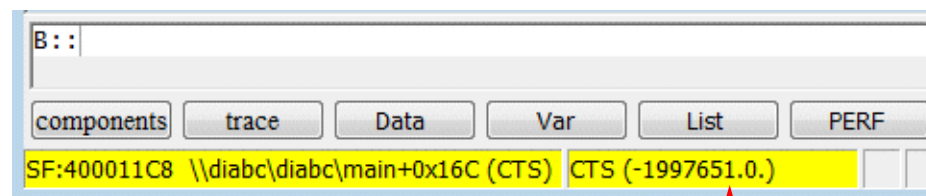
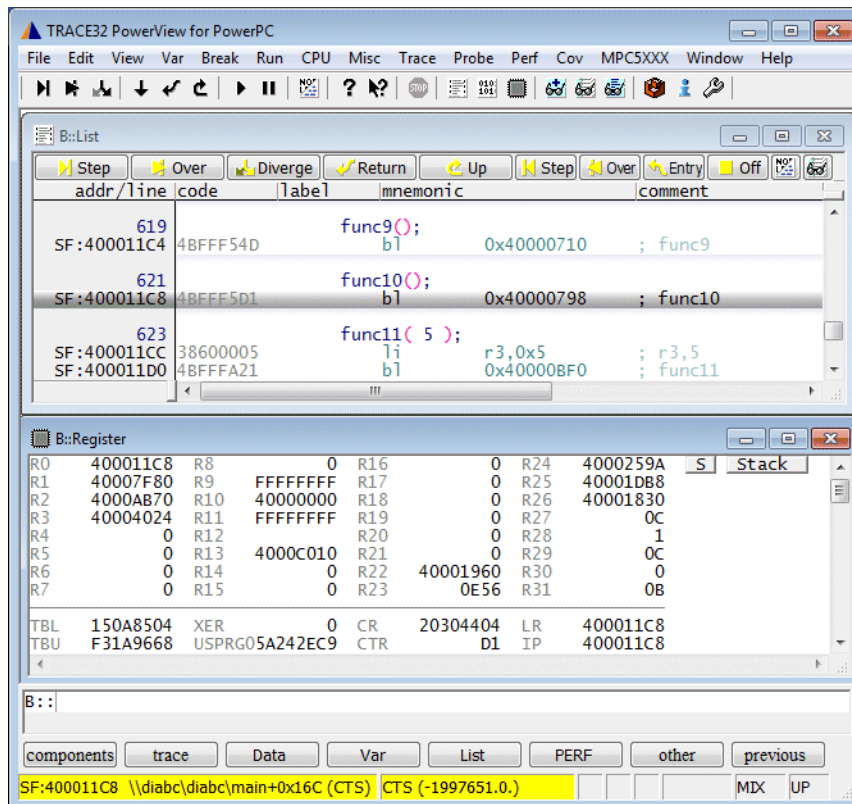
- TRACE32 PowerView will use the preceding trace packet as starting point for the trace re-run.



- The TRACE32 PowerView GUI does no longer show the current state of the target system, but it shows the target state as it was, when the starting point instruction was executed. This display mode is called CTS View.

CTS View means:

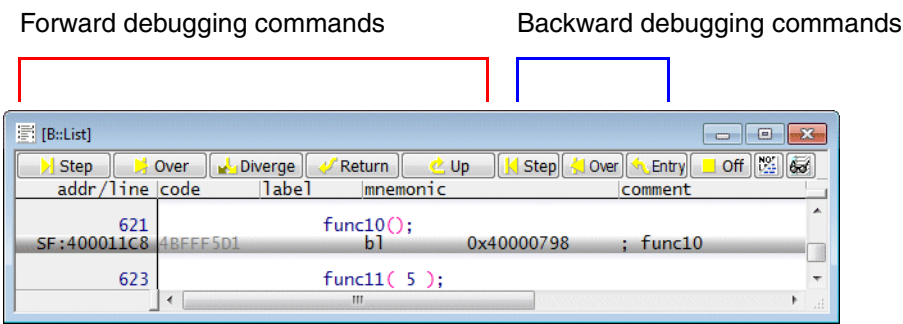
- The instruction pointer is set to the values it had when the starting point instruction was executed. This is done for all cores if an SMP system is under test.
- The content of the core registers is reconstructed (as far as possible) to the values they had when the starting point instruction was executed. This is done for all cores if an SMP system is under test. If TRACE32 can not reconstruct the content of a register it is displayed as empty.
- TRACE32 PowerView uses a yellow look-and-feel to indicate CTS View.
- The **Off** button in the Source Listing can be used to switch off the CTS View.



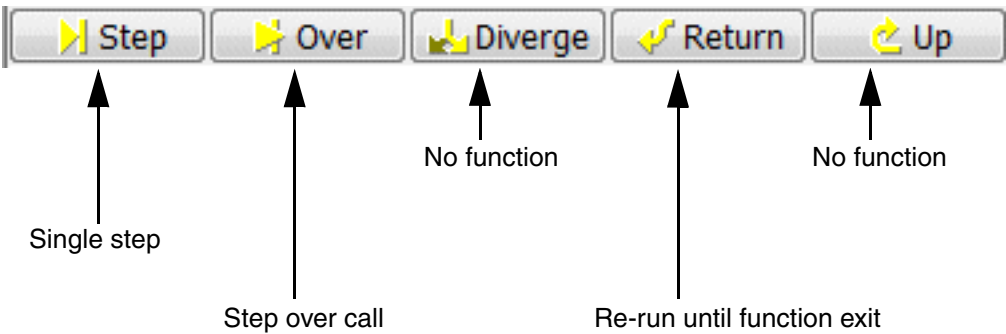
TRACE32 PowerView displays the state of the target as it was when the instruction of the trace record -1997651.0 was executed

Forward and Backward Debugging

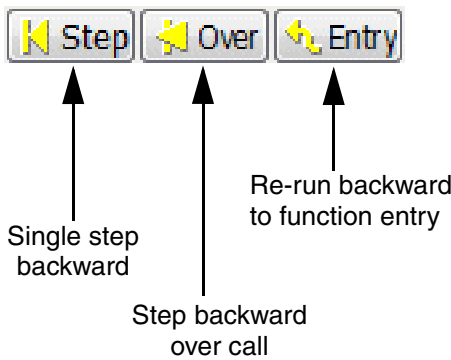
Now you can start to re-run the recorded program section within TRACE32 PowerView by forward or backward debugging.



Forward Debugging



Backward Debugging

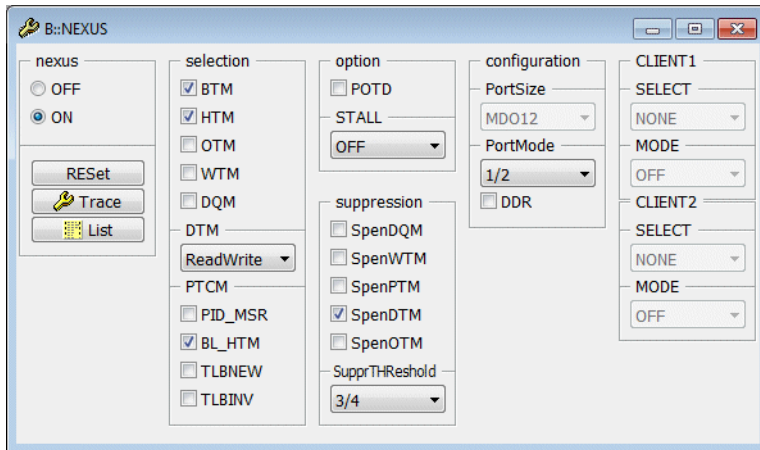


Re-Run the Program and Watch the Variables

This feature only makes sense for the IEEE-ISTO 5001-2008 and the IEEE-ISTO 5001-2012 standard.

Setup

In order to re-run the program and watch the variables, the following Nexus setups are recommended:



- Enable Branch Trace Messaging (BTM ON / BTM ON + HTM ON / BTM ON + HTM ON + BL_HTM ON)
- Enable Data Trace Messages for read/write accesses, but suppress Data Trace Messages on overflow threat.

; Configuration example

NEXUS.BTM ON

NEXUS.HTM ON

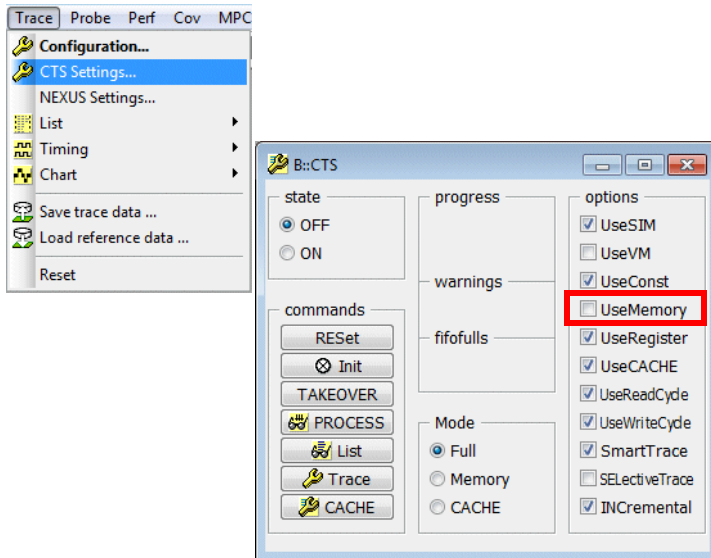
NEXUS.BL_HTM ON

NEXUS.DTM ReadWrite

NEXUS.SupprTHReshold 3/4 ; Advise Nexus to suppress specified
; messages when Nexus FIFO is 3/4 filled

NEXUS.SpenDTM ON ; Advise Nexus to suppress Data Trace
; Messages when the specified filling
; level is reached

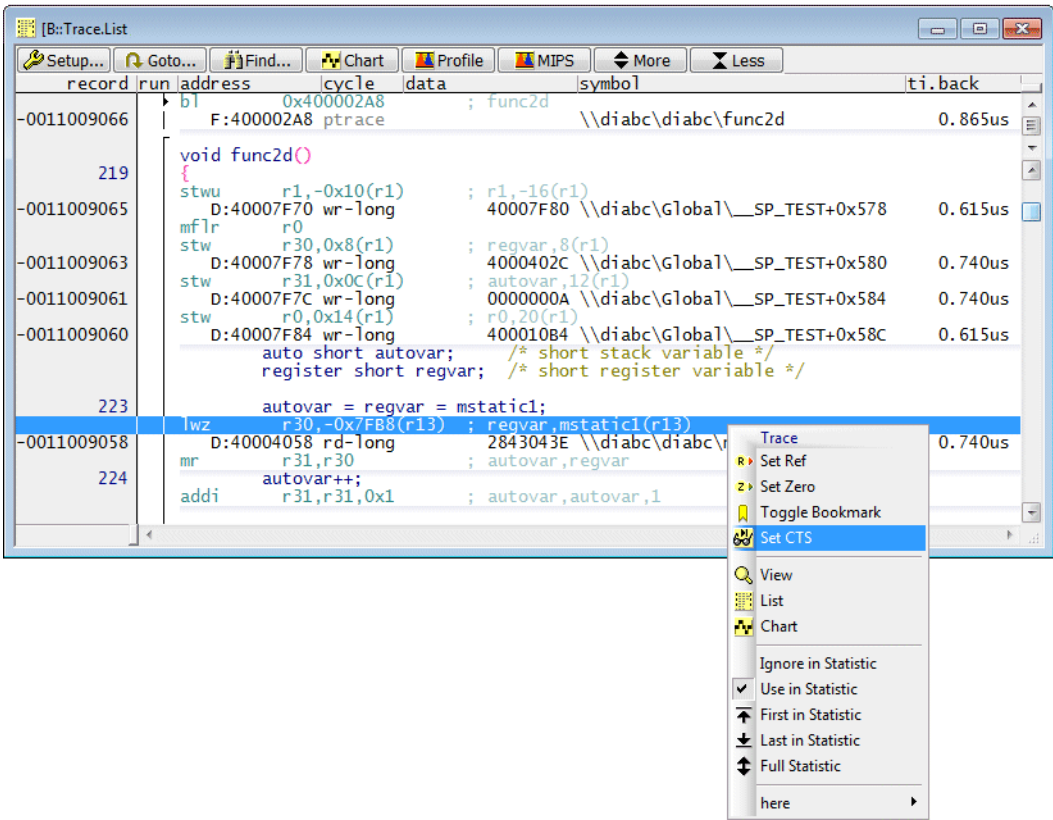
Un-check **UseMemory** in the CTS configuration window. A full explanation on this is given later in the chapter “**CTS Technique**”, page 99.



CTS.state

CTS.UseMemory OFF

Specify the starting point for the trace re-run by selecting **Set CTS** from the Trace pull-down menu. The starting point in the example below is the read access to the variable **mstatic1** in function **func2d**.



- TRACE32 PowerView will use the preceding trace packet as starting point for the trace re-run.

- The TRACE32 PowerView GUI does no longer show the current state of the target system, but it shows the target state as it was, when the starting point instruction was executed. This display mode is called CTS View.

CTS View means:

- The instruction pointer is set to the values it had when the starting point instruction was executed. This is done for all cores if an SMP system is under test.
- The content of the core registers is reconstructed (as far as possible) to the values they had when the starting point instruction was executed. This is done for all cores if an SMP system is under test. If TRACE32 can not reconstruct the content of a register it is displayed as empty.
- The contents of the variables changed by the recorded program section are reconstructed (as far as possible) to the values they had when the starting point instruction was executed. If TRACE32 can not reconstruct the content of a variable ??? are displayed.
- TRACE32 PowerView uses a yellow look-and-feel to indicate CTS View.
- The **Off** button in the Source Listing can be used to switch off the CTS View.

TRACE32 PowerView for PowerPC

File Edit View Var Break Run CPU Misc Trace Probe Perf Cov MPC5XXX Window Help

Step Over Diverge Return Up Step Over Entry Off Find:

addr/line code label mnemonic comment

SF:400002B8 90010014 stw r0,0x14(r1) ; r0,20(r1)

auto short autovar; /* short stack variable */

register short regvar; /* short register variable */

223 autovar = regvar = mstatic1;

SF:400002BC 83CD8048 lwz r30,-0x7FB8(r13) ; regvar,mstatic1(r13)

SF:400002C0 7FDFF378 mr r31,r30 ; autovar,regvar

224 autovar++;

SF:400002C4 3BF00001 addi r31,r31,0x1 ; autovar,autovar,1

226 for (regvar = 0; regvar < 51; regvar++)

SF:400002C8 3BC00000 li r30,0x0 ; regvar,0

SF:400002CC 7FCC0734 .L85: extsh r12,r30 ; r12,regvar

SF:400002D0 2C0C0005 cmpwi r12,0x5 ; r12,5

SF:400002D4 40800024 bge 0x400002F8 ; .L83 (-)

227 vlong += regvar*autovar;

SF:400002D8 818D8060 lwz r12,-0x7FA0(r13) ; r12,vlong(r13)

SF:400002DC 7FCB0734 extsh r11,r30 ; r11,regvar

!!!

B::Register

R0	400010B4	R8	40140000	R16		R24	14	S	Stack
R1	40007F70	R9	40100000	R17	0	R25	400009A0		
R2	4000AB70	R10	0	R18	0	R26	40000A00		
R3	1	R11	0	R19	0	R27	FFF48008		
R4	0	R12	0	R20	0	R28	400009E8		
R5	40140000	R13	4000C010	R21	0	R29	0		
R6	0	R14		R22	0	R30	4000402C		
R7	40140000	R15		R23	0	R31	0A		

B::Var.Watch mstatic1 fstatic vlong vfield

Watch View

mstatic1 = 675480638

fstatic = -332437825

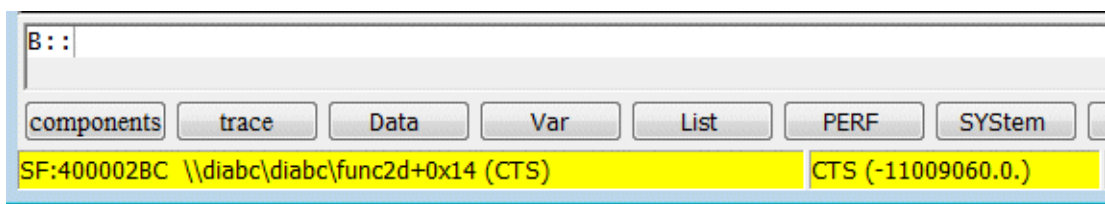
vlong = 1902502262

vfield = (a = ???, b = ???, c = ???, d = ???, e = ???, f = ???, g = ???, h = ???, i = ???,

B:::

components trace Data Var List PERF SYSTEM other previous

SF:400002BC \\diabc\\diabc\\func2d+0x14 (CTS) CTS (-11009060.0.) MIX UP



TRACE32 PowerView displays the state of the target as it was when the instruction of the trace record -11009060.0 was executed

Forward and Backward Debugging

Now you can start to re-run the recorded program section within TRACE32 PowerView by forward or backward debugging.

Forward debugging commands

Backward debugging commands

The screenshot shows the TRACE32 PowerView debugger window. The top toolbar contains various debugging commands. Below the toolbar, a list of assembly instructions is displayed with columns for address/line, code, label, mnemonic, and comment. The instructions include:

- SF:400002B8 90010014 stw r0,0x14(r1) ; r0,20(r1)
- auto short autovar; /* short stack variable */
- register short regvar; /* short register variable */
- 223 autovar = regvar = mstatic1;
- SF:400002BC 83CD8048 lwz r30,-0x7FB8(r13) ; regvar,mstatic1(r13)
- SF:400002C0 7FDFF378 mr r31,r30 ; autovar,regvar
- 224 autovar++;
- SF:400002C4 3BFF0001 addi r31,r31,0x1 ; autovar,autovar,1

Forward Debugging

Diagram illustrating forward debugging commands:

- Step**: Single step
- Over**: Step over call
- Diverge**: No function
- Return**: Re-run until function exit
- Up**: No function

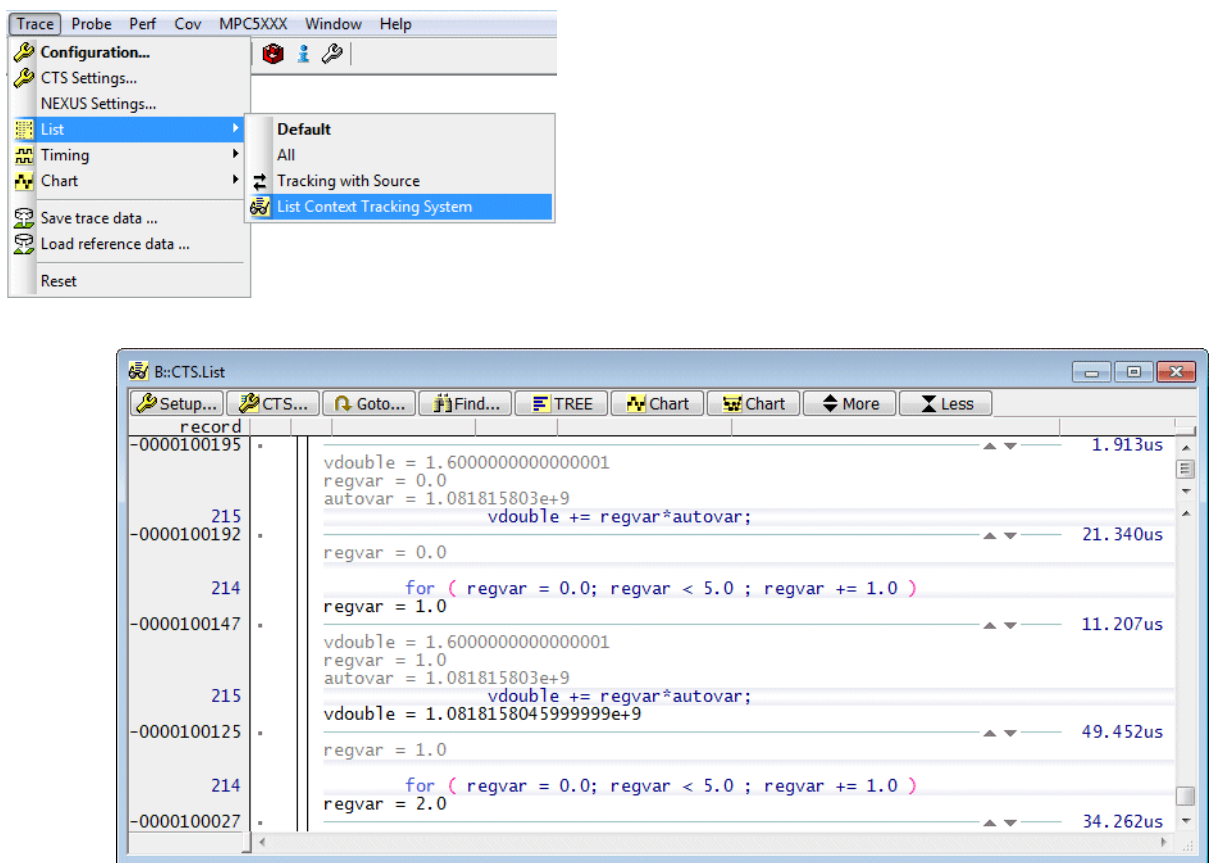
Backward Debugging

Diagram illustrating backward debugging commands:

- Step**: Single step backward
- Over**: Step backward over call
- Entry**: Re-run backward to function entry

Details on HLL Instructions

The technology used for Trace-Based Debugging allows additionally to display a full HLL trace.

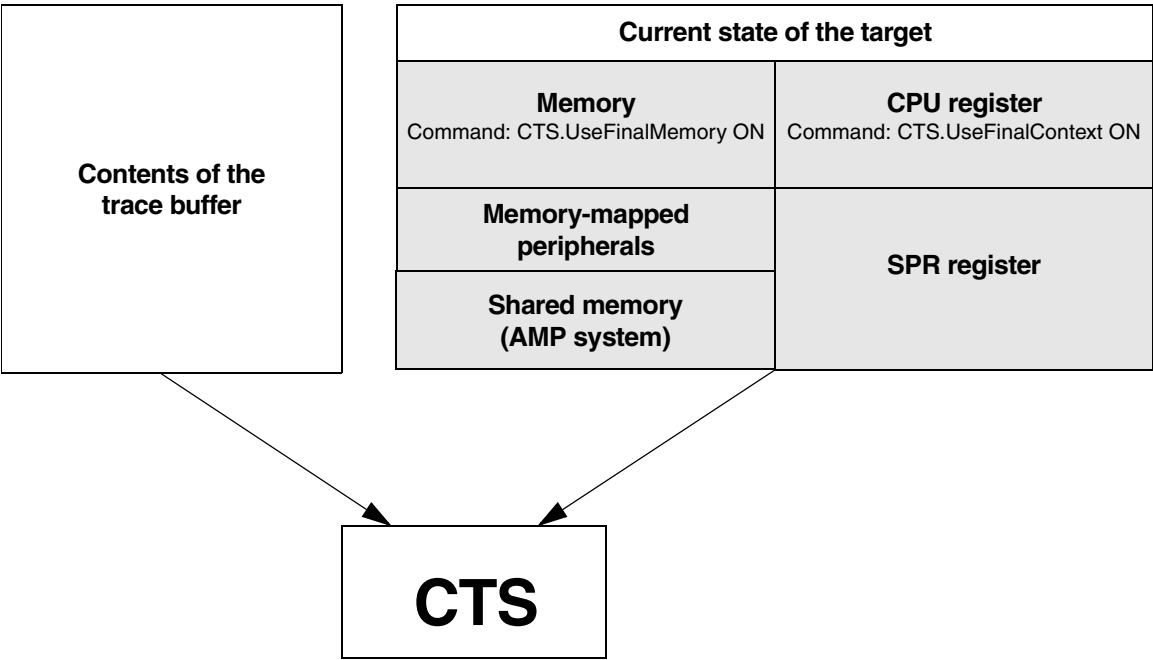


For each HLL step the following information is displayed:

- The values of the local and global variables used in the HLL step
- The result of the HLL step
- The time needed for the HLL step

CTS.List

List pure HLL trace.



CTS reads and evaluates the current state of the target together with the information recorded to the trace memory by default.

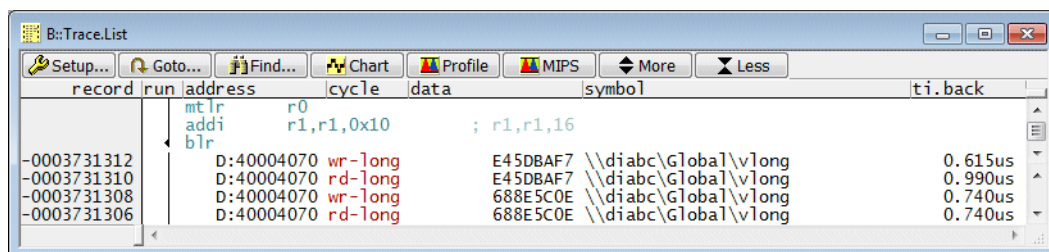
The following commands are used to configure CTS properly:

CTS.UseFinalMemory ON Default setting within TRACE32

If **CTS.UseFinalMemory** is ON and TRACE32 detects that a memory address was not changed by the recorded program section, TRACE32 PowerView displays the current content of this memory in CTS display mode.

- If Data Trace Messaging is disabled (NEXUS.DTM OFF), TRACE32 can not detect which memory content was changed. This is the reason why **CTS.UseFinalMemory** has to be set to OFF.
- If Data Trace Messaging is enabled (NEXUS.DTM ReadWrite) it is not guaranteed, that all read/write accesses are recorded. This is the reason why **CTS.UseFinalMemory** has to be set to OFF.

Please be aware, that CTS ignores all read/write cycles that can not be assigned to its instruction (displayed in red).



MAP.VOLATILE <range> Declare specified address range as volatile.

CTS supposes by default that memory is only written by the core(s) for which trace information is recorded into the trace memory. But other bus master such as the DMA controller or other, not recorded cores, can change memory too. And external interfaces can change memory mapped peripheral registers.

All memory ranges, that are not only changed by the core(s) for which trace information is recorded, have to be excluded from the CTS memory/variable reconstruction.

```
MAP.VOLATILE 0xF0000000-0xFFFFFFFF ; exclude peripheral register
                                           ; address space from the CTS
                                           ; reconstruction

MAP.VOLATILE 0x40018000--0x4001BFFF ; exclude memory that is
                                           ; changed not only by the
                                           ; recorded core(s)
                                           ; from the CTS reconstruction
```

If Data Trace Messaging is disabled (NEXUS.DTM OFF) and **CTS.UseFinalMemory** is switch OFF, but your target memory contains constants, you can configure TRACE32 to use these constants for the CTS reconstruction by the following commands:

MAP.CONST <address_range>

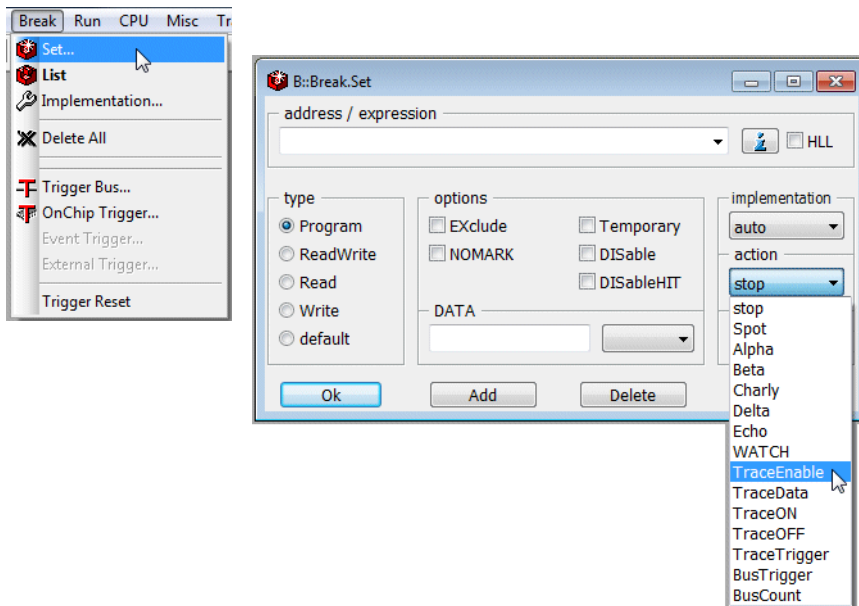
CTS.UseConst ON

CTS.UseFinalContext ON Default setting within TRACE32

If **CTS.UseFinalContext** is ON and TRACE32 detects that a register was not changed by the recorded program section, TRACE32 PowerView displays the current content of this register in CTS View mode.

CTS.UseFinalContext has to be set to OFF, if you used **Stack** mode for tracing recording.

Filter and Trigger (Core) Overview



TraceEnable, TraceData, TraceON and TraceOFF are so-called filters. **Filters** can be used advise the NEXUS module to generate trace information only for events of interest.

TraceEnable: Advise the NEXUS module to generate trace messages only for the specified instruction(s) or read/write accesses.

TraceData: Advise the NEXUS module to generate trace messages for all executed instructions and for the specified read/write accesses.

TraceON: Advise the NEXUS module to start the generation of trace messages at the specified event.

TraceOFF: Advise the NEXUS module to stop the generation of trace messages at the specified event.

TraceTrigger, BusTrigger and BusCount are so-called triggers. **Triggers** can be used to advise the NEXUS module to signal the occurrence of an event. TRACE32 can react on this occurrence by stopping the trace recording, by counting the event

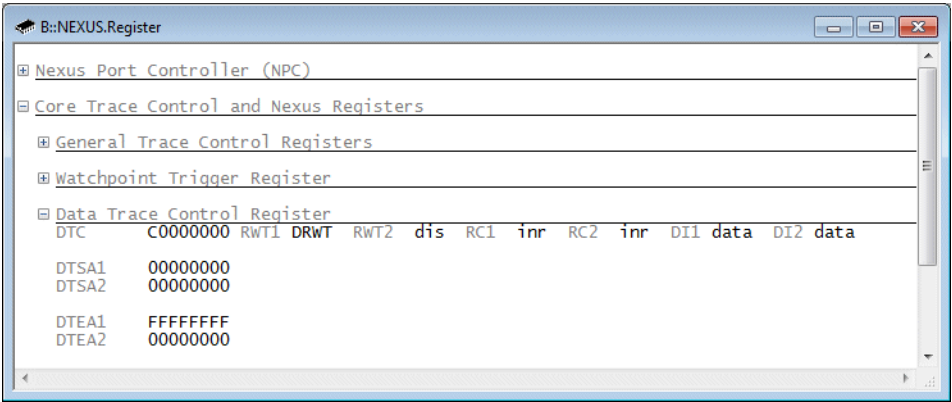
TraceTrigger: Stop the trace recording at the specified event.

BusTrigger: Generate a pulse on the trigger bus at the specified event.

BusCount: Count the specified event.

The MPC5xxx provides the following resources for filter and trigger:

- Data Trace Control Register (DTC): to filter Data Trace Messages (2-4 address ranges)



NEXUS.Register

- Watchpoint Trigger Register: to activate a trace action on a specified event. The source for the specified event are the Watchpoints that are also used for the on-chip breakpoints.

Core type:	On-chip Breakpoints	Instruction Address Breakpoints	Data Address Breakpoints	Data Value Breakpoints
e200z0 e200z0h	4 instruction 2 read/write no counters	4 single breakpoints -- or -- 2 breakpoint ranges	2 single breakpoints -- or -- 1 breakpoint range	none
e200z0Hn3	4 instruction 2 read/write 2 data value no counters	4 single breakpoints -- or -- 2 breakpoint ranges	2 single breakpoints -- or -- 1 breakpoint range	2 single breakpoints (associated with data address BPs)
e200z1 e200z3 e200z6 e200z650 e200z750	4 instruction 2 read/write 2 counters	4 single breakpoints -- or -- 2 breakpoint ranges	2 single breakpoints -- or -- 1 breakpoint range	none

Core type:	On-chip Breakpoints	Instruction Address Breakpoints	Data Address Breakpoints	Data Value Breakpoints
e200z335	4 instruction 2 read/write 2 data value 2 counters	4 single breakpoints -- or -- 2 breakpoint ranges	2 single breakpoints -- or -- 1 breakpoint range	2 single breakpoints (associated with data address BPs)
e200z446 e200z4d e200z760	8 instruction 2 read/write 2 data value 2 counters	8 single breakpoints -- or -- 2 breakpoint ranges and 4 single breakpoints	2 single breakpoints -- or -- 1 breakpoint range	2 single breakpoints (associated with data address BPs)
e200z210 e200z215 e200z225 e200z420 e200z425 e200z720 e200z4201 e200z4203 e200z4204 e200z4251 e200z7260	8 instruction 4 read/write 2 data value no counters	8 single breakpoints -- or -- 4 breakpoint ranges	4 single breakpoints -- or -- 2 breakpoint ranges	2 single breakpoints (associated with data address BPs)

- The **MPC57xx** provides also means to control Program Trace Messaging and Data Trace Messaging from the application.

Nexus Development Control Register:

PTMARK Bit 1	Program Trace Messaging when PMM bit is set
DTMARK Bit 1	Data Trace Messaging when PMM bit is set

Machine Status Register:

PMM Bit	<p>Performance monitor mark bit.</p> <p>PMM Bit 1, PTMARK Bit 1 -> Program Trace Messaging is enabled</p> <p>PMM Bit 1, DTMARK Bit 1 -> Data Trace Messaging is enabled</p>
----------------	---

The table below summarizes the influence of the filter/ trigger on the messaging.

	WTM Watchpoint Trace Messages	BTM Branch Trace Messages	DTM Data Trace Messages	OTM Ownership Trace Messages	DQM Data Acquisition Messages
TraceEnable on single instruction	Watchpoint Hit Message for instruction	Disabled	Unaffected	Unaffected	Unaffected
TraceEnable on instruction range	Unused	Filter applies	Filter applies	Unaffected	Unaffected
TraceEnable on read/write access	Unused	BTM disabled	DTM enabled Filter applies	Unaffected	Unaffected
TraceData	Unused	Unaffected	DTM enabled Filter applies	Unaffected	Unaffected
Global TraceON/ TraceOFF	Unused	Filter applies	Filter applies	Unaffected	Unaffected
Program TraceON/ TraceOFF	Unused	BTM enabled Filter applies	Unaffected	Unaffected	Unaffected
Data TraceON/ TraceOFF	Unused	Unaffected	Filter applies	Unaffected	Unaffected
TraceTrigger BusTrigger BusCount	WHM for instruction or data address/data value	Unaffected	Unaffected	Unaffected	Unaffected

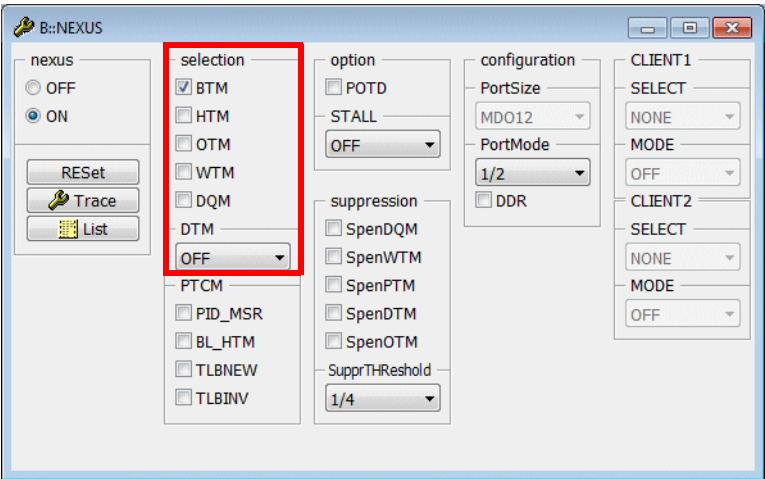
Examples for TraceEnable on Instructions

Resource: Watchpoints

Controlled message types

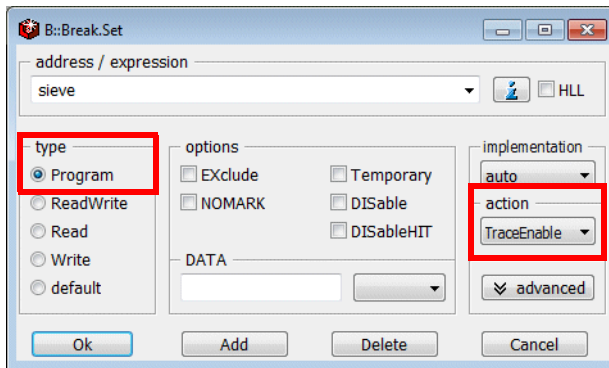
WTM Watchpoint Trace Messages	BTM Branch Trace Messages	DTM Data Trace Messages	OTM Ownership Trace Messages	DQM Data Acquisition Messages
Watchpoint Hit Message(s) is generated for the specified instruction(s)	Disabled	Unaffected	Unaffected	Unaffected

Disable message types, that are unaffected by the filter and not required for your analysis.

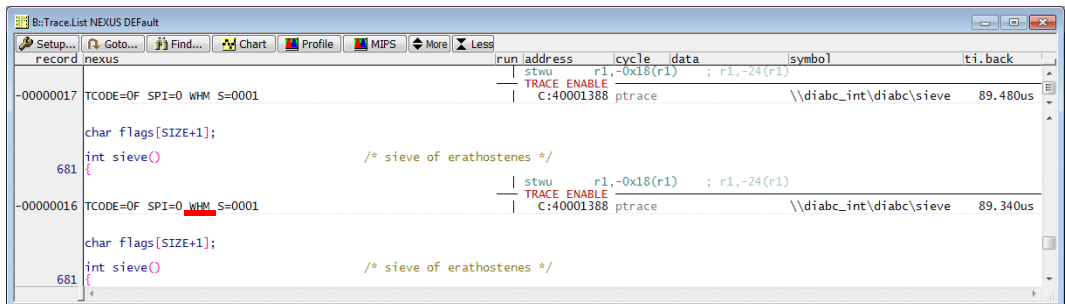


Example 1: Advise the NEXUS module to generate only trace information for the entries to the function sieve.

1. Set a Program breakpoint to the start address of the function sieve and select the action TraceEnable.

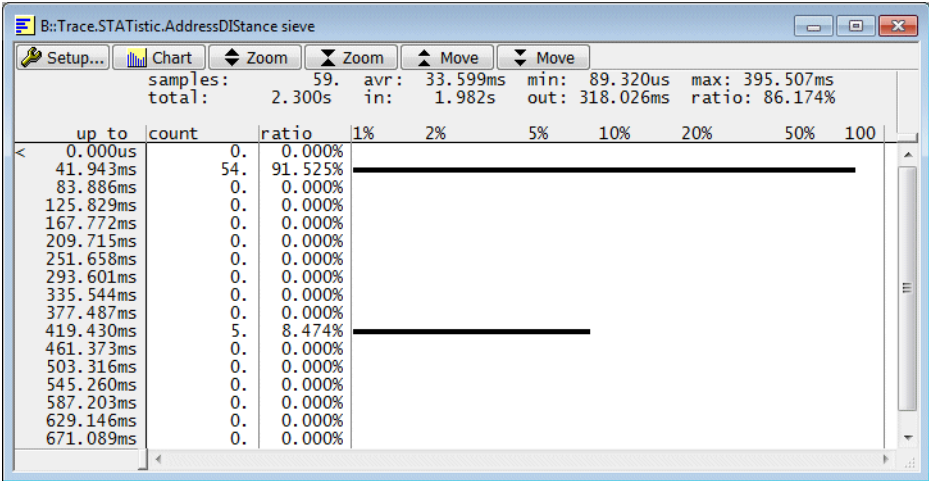


2. Start the program execution and stop it.
3. Display the result.



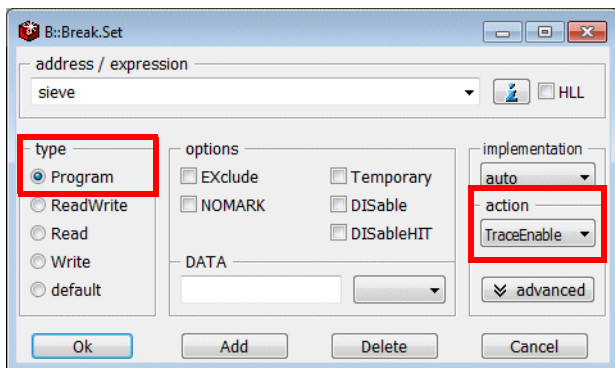
The following **Trace.STATistic** command calculates the time intervals for a program address event. The program address event is here the entry to the function sieve:

```
Trace.STATistic.AddressDIStance sieve
```

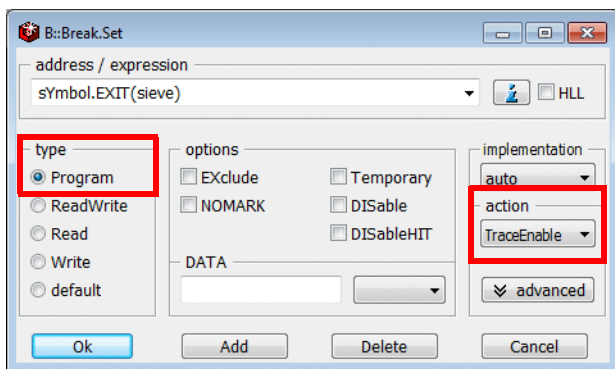


Example 2: Advise the NEXUS module to generate trace information for the entries to the function sieve and for the exits of the function sieve.

1. Set a Program breakpoint to the start address of the function sieve and select the action TraceEnable.



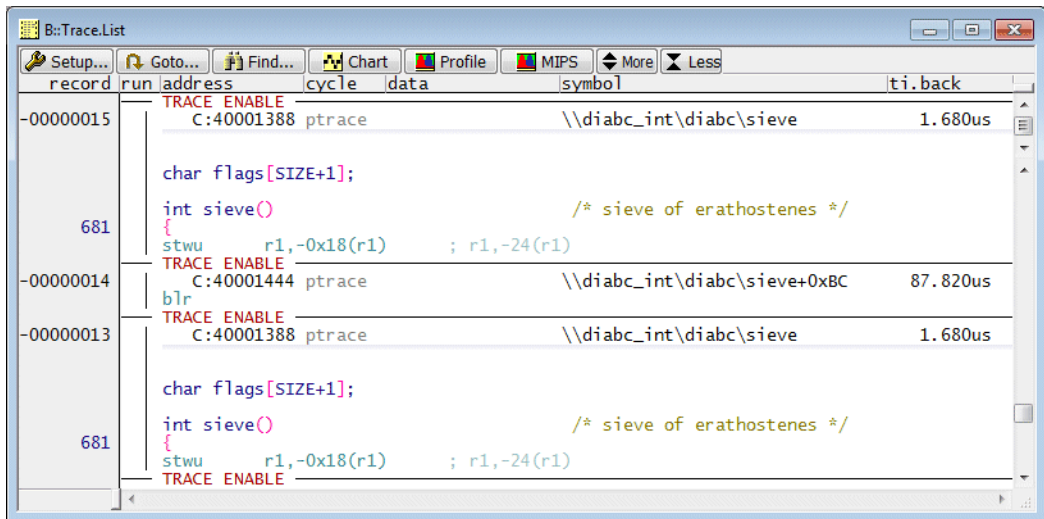
2. Set a Program breakpoint to the exit address of the function sieve and select the action TraceEnable.



sYmbol.EXIT(<symbol>) Returns the exit address of the specified function

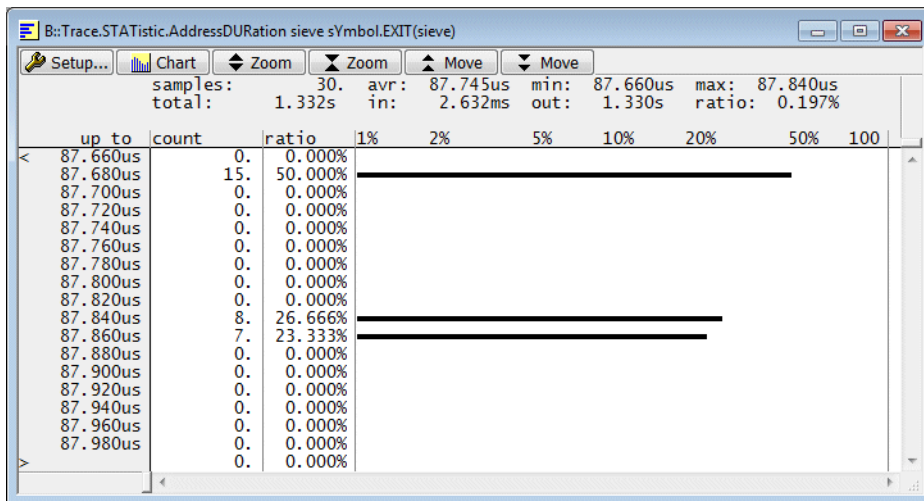
3. Start the program execution and stop it.

4. Display the result.



The following **Trace.STATistic** command calculates the time intervals between two program address events A and B. The entry to the function sieve is A in this example, the exit from the function is B.

```
Trace.STATistic.AddressDuration sieve sYmbol.EXIT(sieve)
```



Example for TraceEnable on Instruction Range

Resource: Watchpoints, limited to one instruction address range

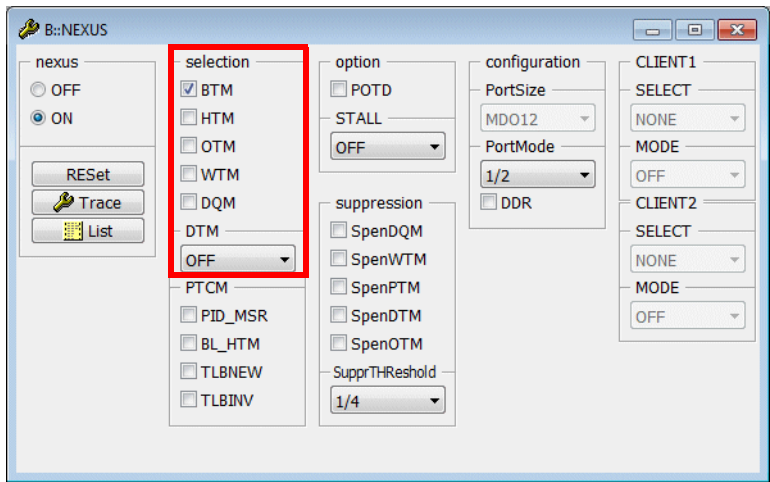
Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	Filter applies if BTM is enabled	Filter applies if DTM is enabled	Unaffected	Unaffected

Enable BTM. This filter requires that Branch History messaging is disabled.

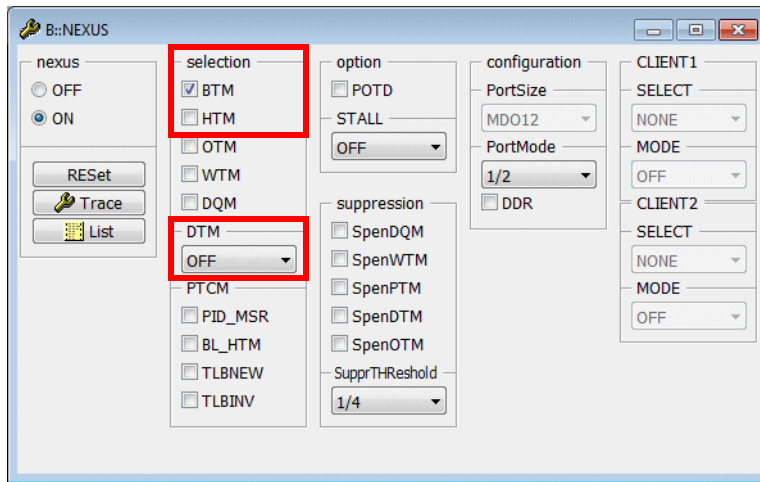
Enable DTM if you are interested in the read/write accesses performed by the specified instruction address range.

Disable message types, that are unaffected by the filter and not required for your analysis.

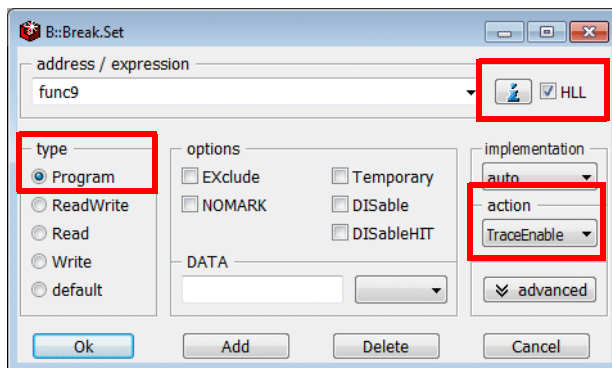


Example: Advise the NEXUS module to generate trace information for all taken branches within the function func9.

1. Enable Branch Trace messaging, but don't enable Indirect Branch History messaging.
Disable Data Trace messaging.



2. Set a Program breakpoint to the complete address range of the function func9 (HLL check box ON) and select the action TraceEnable.



3. Start the program execution and stop it.

4. Display the result.

B::Trace.List									
Setup... Goto... Find... Chart Profile MIPS More Less									
record		run address		cycle data		symbol		ti.back	
		static void func1(intptr) /* static function */							
		int * intptr;							
154	{	stwu r1,-0x10(r1) ; r1,-16(r1)							
-00000059		TRACE ENABLE		P:4000004C ptrace				\\diabc_int\\diabc\\func1 3.680us	
		static void func1(intptr) /* static function */							
		int * intptr;							
154	{	stwu r1,-0x10(r1) ; r1,-16(r1)							
-00000057		TRACE ENABLE		P:40000744 ptrace				\\diabc_int\\diabc\\func9+0x34 3.820us	
		cmpw		r30,r31 ; reg2,reg1					
		bge		0x40000774 ; .L155 (-)					
-00000056		P:40000774 ptrace		\\diabc_int\\diabc\\func9+0x64				0.680us	
334		for (reg1 = 0 ; reg1 < 2 ; reg1++)							
		addi		r31,r31,0x1 ; reg1,reg1,1					
		b		0x40000730 ; .L158					
-00000055		P:40000730 ptrace		\\diabc_int\\diabc\\func9+0x20				0.500us	
		cmpwi		r31,0x2 ; reg1,2					
		bge		0x4000077C ; .L152 (-)					

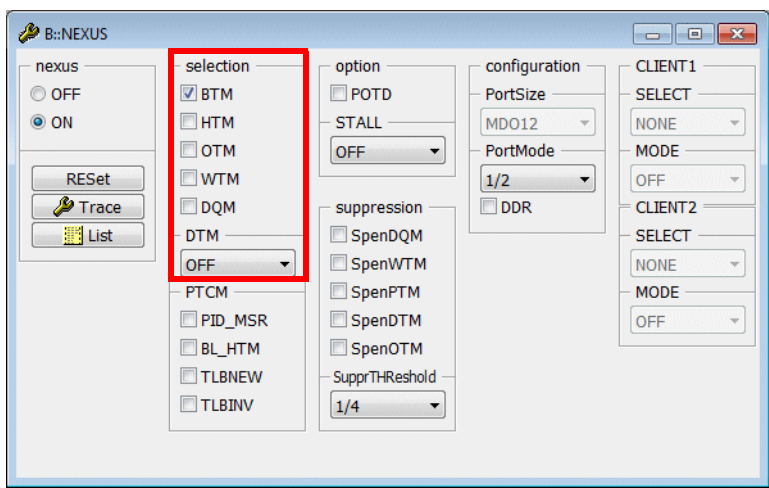
Examples for TraceEnable on Read/Write Accesses

Resource: DTC Register

Controlled message types

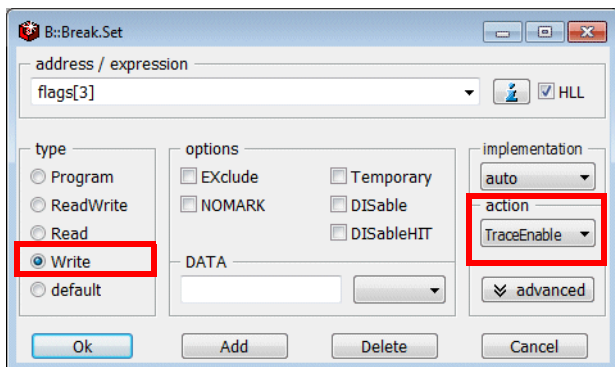
WTM	BTM	DTM	OTM	DQM
Unused	BTM is disabled by filter	DTM is enabled by filter Filter applies	Unaffected	Unaffected

Disable message types, that are unaffected by the filter and not required for your analysis.



Example: Disable Branch Trace messaging and advise the NEXUS module to only generate trace information for the write accesses to the variable flags[3].

1. Set a Write breakpoint to the variable flags[3] and select the action TraceEnable



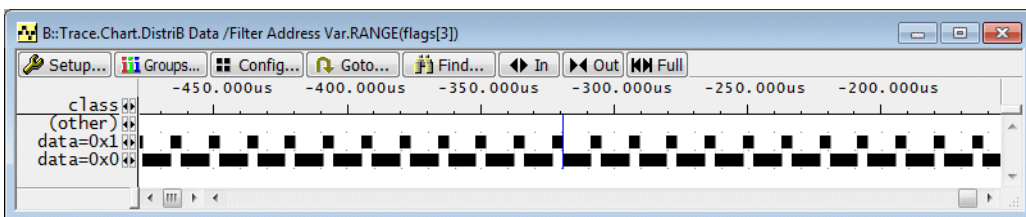
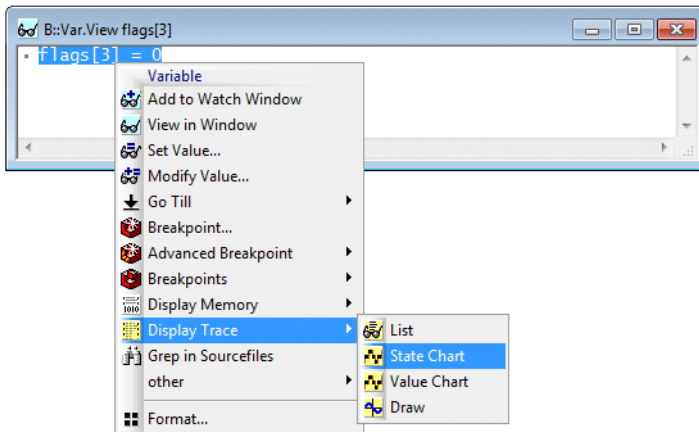
- no data value possible (limitation of DTC Register)
- accessing instruction not possible (limitation of DTC Register)

2. Start the program execution and stop it.
3. Display the result.

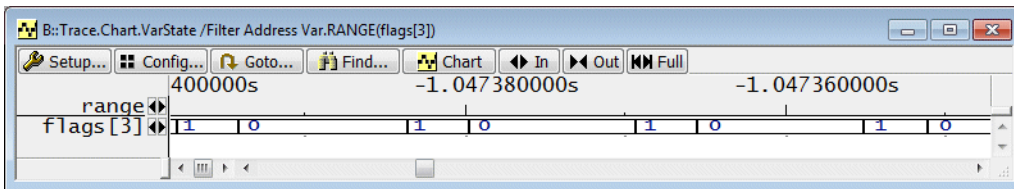
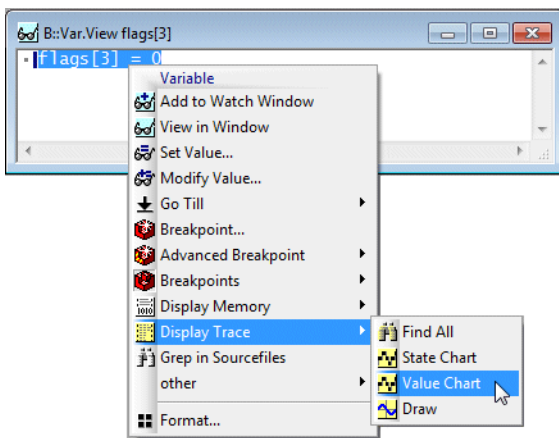
record	nexus	var	run	address	cycle	data	symbol	ti.back
-00000027	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000001	Flags[3] = 1	0	0:40005623	wr-byte	01	\\diabc_int\Global\Flags+0x3	67.500us
-00000026	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000000	Flags[3] = 0	0	0:40005623	wr-byte	00	\\diabc_int\Global\Flags+0x3	22.000us
-00000025	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000001	Flags[3] = 1	0	0:40005623	wr-byte	01	\\diabc_int\Global\Flags+0x3	67.500us
-00000024	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000000	Flags[3] = 0	0	0:40005623	wr-byte	00	\\diabc_int\Global\Flags+0x3	21.820us
-00000023	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000001	Flags[3] = 1	0	0:40005623	wr-byte	01	\\diabc_int\Global\Flags+0x3	67.500us
-00000022	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000000	Flags[3] = 0	0	0:40005623	wr-byte	00	\\diabc_int\Global\Flags+0x3	22.000us
-00000021	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000001	Flags[3] = 1	0	0:40005623	wr-byte	01	\\diabc_int\Global\Flags+0x3	67.500us
-00000020	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000000	Flags[3] = 0	0	0:40005623	wr-byte	00	\\diabc_int\Global\Flags+0x3	21.840us
-00000019	TCODE=05 SPI=0 DT=DWM S=0000 A=00000000 V=00000000000000000001	Flags[3] = 1	0	0:40005623	wr-byte	01	\\diabc_int\Global\Flags+0x3	67.500us

The Variable pull-down provides various way to analyze the variable contents over the time.

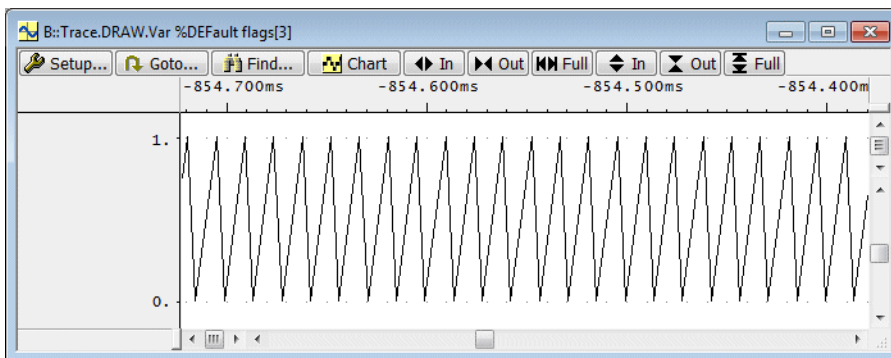
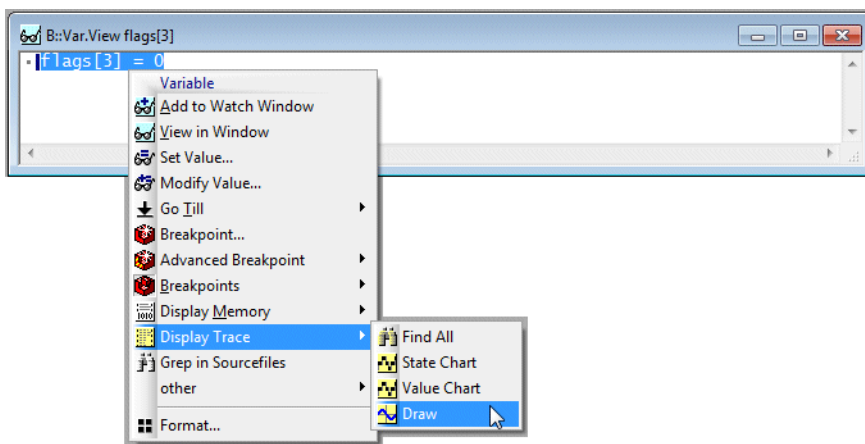
```
; open a window to display the variable  
Var.View flags[3]
```



Display the value changes of a variable graphically
Trace.Chart.DistriB Data /Filter Address Var.RANGE(<var>)



Display variable contents over the time numerically
Trace.Chart.VarState



Display variable contents over the time graphically

Trace.DRAW.Var %DEFAULT <var>

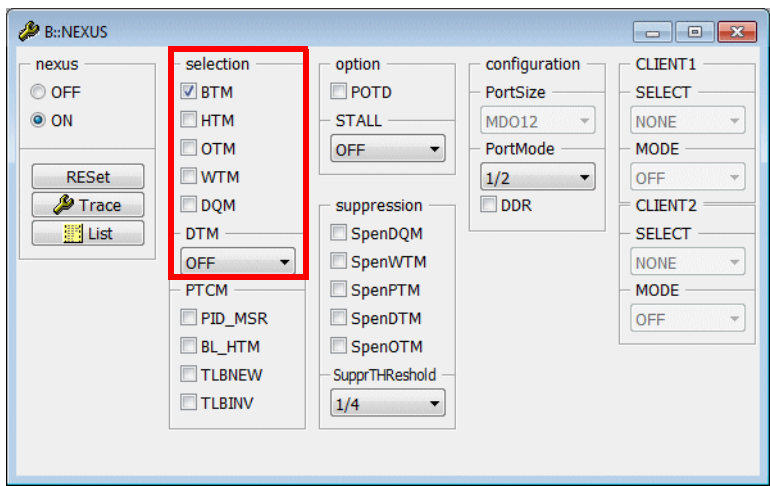
Example for TraceData

Resource: DTC Register

Controlled message types

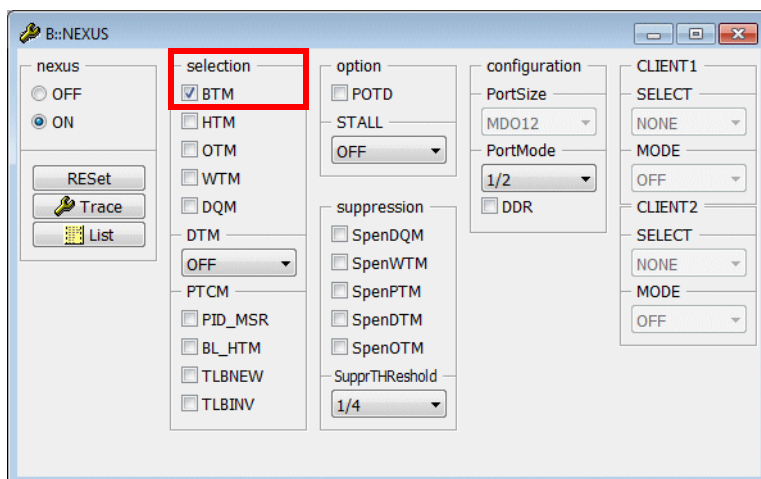
WTM	BTM	DTM	OTM	DQM
Unused	Unaffected	DTM is enabled by filter Filter applies	Unaffected	Unaffected

Disable message types that are unaffected by the filter and not required for the analysis.

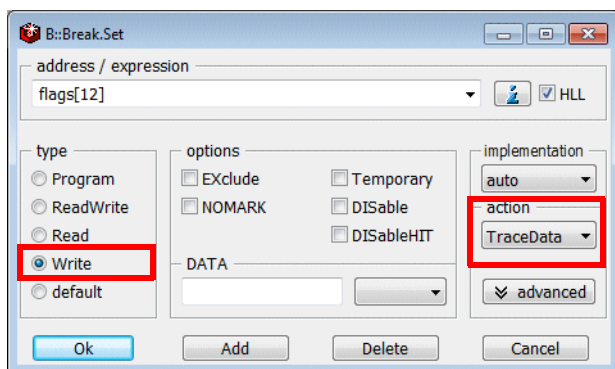


Example: Advise the NEXUS module to generate trace information for the write accesses to flags[12] and to generate trace information for all executed instructions.

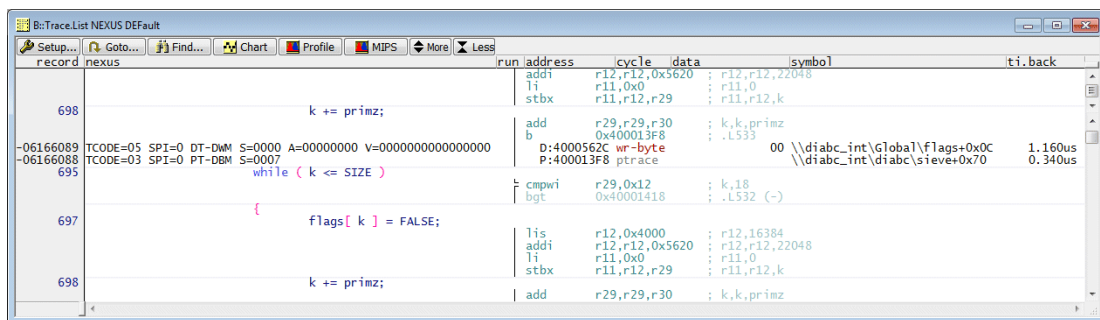
1. Enable Branch Trace messaging.



2. Set a Write breakpoint to the variable flags[12] and select the action TraceData.



3. Start the program execution and stop it.
4. Display the result.



Please be aware that in the case of a TraceData filter a correlation of the data access and the instruction is in most cases not possible.

Global TraceON/Trace OFF

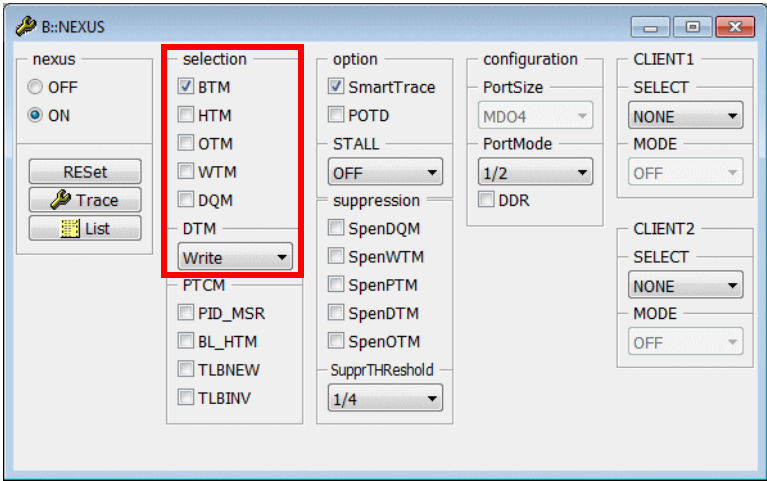
Resource: Watchpoints

Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	Filter applies	Filter applies	Unaffected	Unaffected

Enable Branch Trace Messaging and Data Trace Messaging if this information is required for your analysis.

Disable messages types that are unaffected and not required for the analysis.

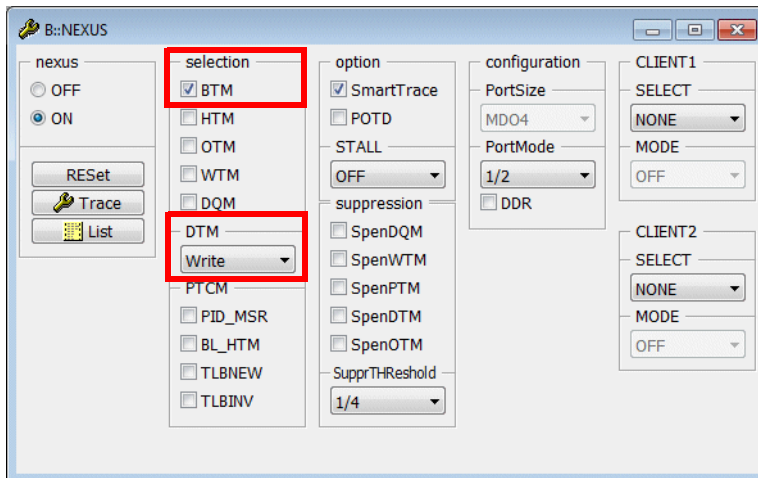


Example:

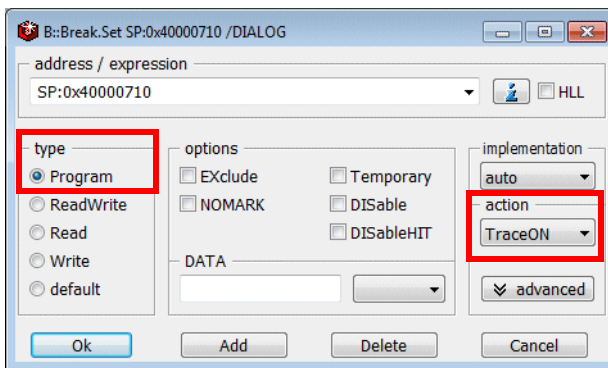
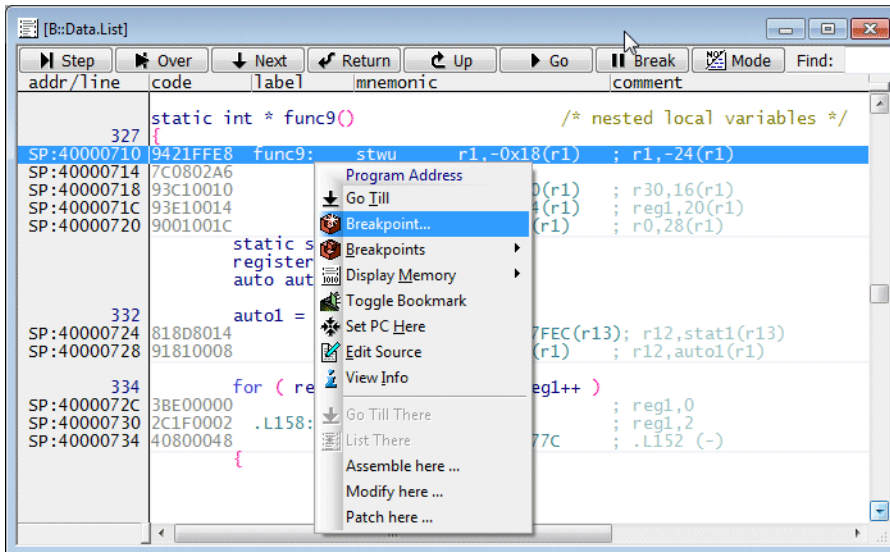
Advise the NEXUS module to start Branch Trace messaging and Data Write Messages at the entry to the function func9.

Advise the NEXUS module to stop Branch Trace messaging and Data Write Messages at the exit of the function func9.

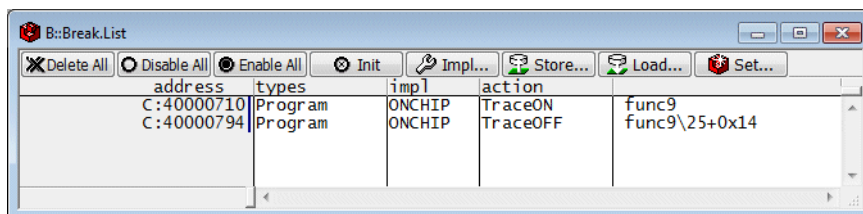
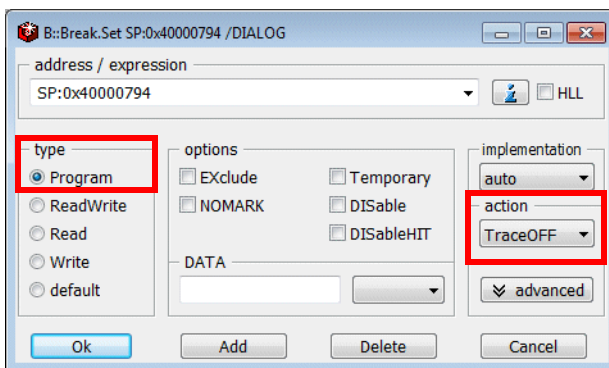
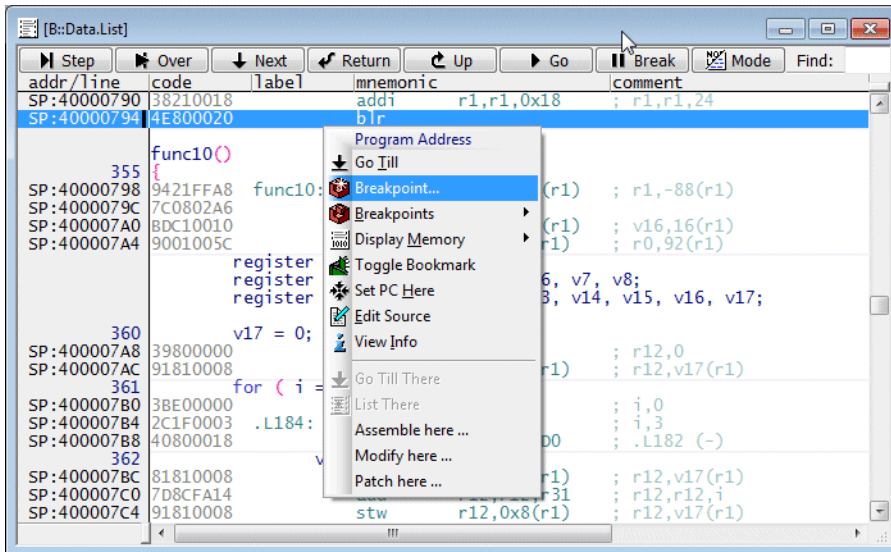
1. Enable Branch Trace Messages and Data Write Messages.



2. Set a Program breakpoint to the entry of the function func9 and select the action TraceON.



3. Set a Program breakpoint to the exit of the function func9 and select the action TraceOFF.



4. Start the program execution and stop it.

5. Display the result.

B::Trace.List												
<div> <div>Setup...</div> <div>Goto...</div> <div>Find...</div> <div>Chart</div> <div>Profile</div> <div>MIPS</div> <div>More</div> <div>Less</div> </div>												
record	run	address	cycle	data	symbol	ti.back						
-00129868		bge 0x4000077C ; .L152 (-)			\\diabc\\diabc\\func9+0x6C	0.360us						
		F:4000077C ptrace										
		}										
351		return &stat1;										
		subi r3,r13,0x7FEC ; r3,r13,32748										
-00129866		TRACE ENABLE										
-00129866		D:40007F78 wr-long	4000402C	\\diabc\\Global__SP_TEST+0x580	1.883ms							
-00129864		D:40007F7C wr-long	0000000B	\\diabc\\Global__SP_TEST+0x584	1.720us							
-00129863		D:40007F84 wr-long	400011C8	\\diabc\\Global__SP_TEST+0x58C	1.480us							
-00129861		D:40007F70 wr-long	48003BD8	\\diabc\\Global__SP_TEST+0x578	1.740us							
-00129859		D:40007F74 wr-long	48003ACB	\\diabc\\Global__SP_TEST+0x57C	1.720us							
-00129857		F:40000774 ptrace		\\diabc\\diabc\\func9+0x64	1.620us							
334		for (reg1 = 0 ; reg1 < 2 ; reg1++)										
		addi r31,r31,0x1 ; reg1,reg1,1										
		b 0x40000730 ; .L158										
-00129856		F:40000730 ptrace			\\diabc\\diabc\\func9+0x20	0.360us						
		cmpwi r31,0x2 ; reg1,2										
		bge 0x4000077C ; .L152 (-)										
		{										
		static stat2 = 0;										
		register reg2;										
		auto auto2;										
340		auto2 = stat2;										
		lwz r12,-0x7FE8(r13) ; r12,stat2(r13)										
		stw r12,0x0C(r1) ; r12,auto2(r1)										
-00129855		D:40007F74 wr-long	48003ACB	\\diabc\\Global__SP_TEST+0x57C	1.480us							

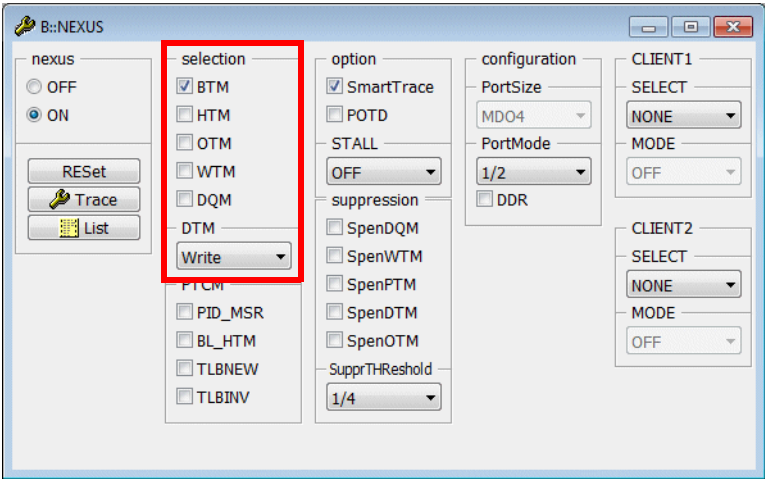
The event that switched the trace generation on is not visible in the trace.

Resource: Watchpoints

Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	BTM is enabled by filter Filter applies	Unaffected	Unaffected	Unaffected

Disable messages types that are unaffected and not required for the analysis.



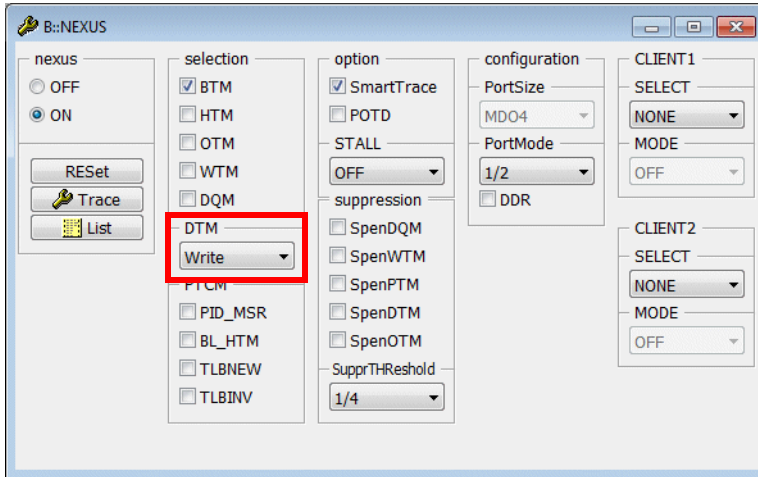
Example:

Advise the NEXUS module to generate trace information for all write accesses.

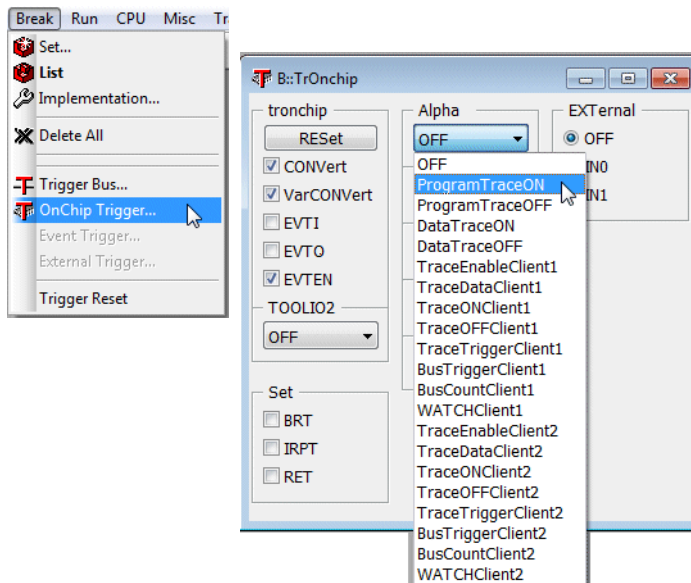
Advise the NEXUS module to start the Branch Trace messaging at the entry to the function func9.

Advise the NEXUS module to stop Branch Trace messaging at the exit of the function func9.

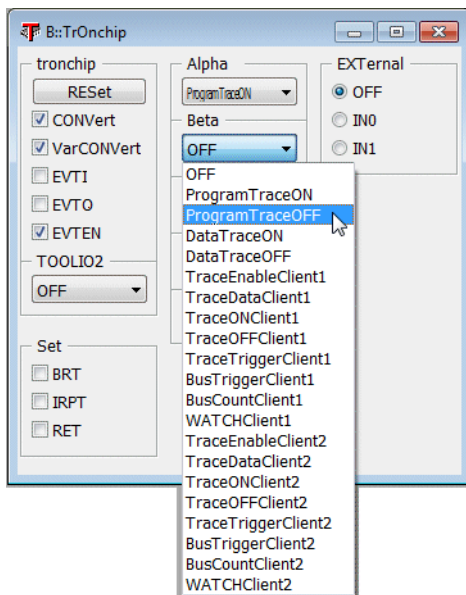
1. Enable Data Trace messaging for write accesses.



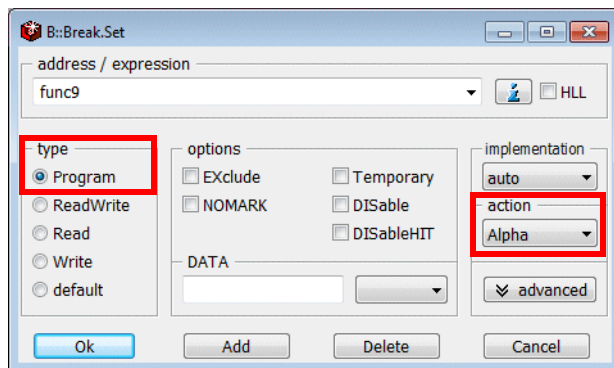
2. Open the TrOnchip window and select ProgramTraceON for Alpha.



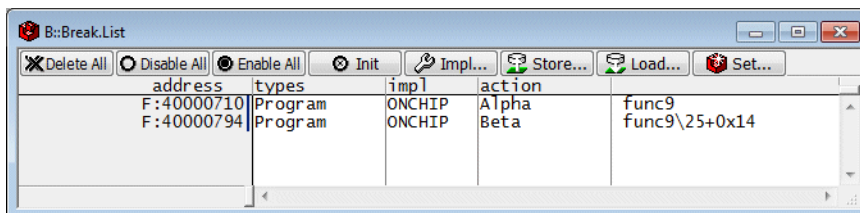
3. Select ProgramTraceOFF for Beta.



4. Set a Program breakpoint to the entry of the function func9 and select Alpha.



5. Set a Program breakpoint to the exit of the function func9 and select Beta.



6. Start and stop the program execution.

7. Display the result.

record	run	address	cycle	data	symbol	ti.back
-02647066		D:40007F7C	wr-long	0000000B	\\diabc\Global__SP_TEST+0x584	0.860us
-02647065		D:40007F84	wr-long	400011C8	\\diabc\Global__SP_TEST+0x58C	1.480us
-02647063		D:40007F70	wr-long	48006BD1	\\diabc\Global__SP_TEST+0x578	1.740us
-02647061		D:40007F74	wr-long	48006AC4	\\diabc\Global__SP_TEST+0x57C	1.720us
-02647059		F:40000774	ptrace		\\diabc\diabc\func9+0x64	1.620us
334		for (reg1 = 0 ; reg1 < 2 ; reg1++)				
		addi r31,r31,0x1			; reg1,reg1,1	
		b 0x40000730			; .L158	
-02647058		F:40000730	ptrace		\\diabc\diabc\func9+0x20	0.360us
		cmpwi r31,0x2			; reg1,2	
		bge 0x4000077C			; .L152 (-)	
		{				
		static stat2 = 0;				
		register reg2;				
		auto auto2;				
340		auto2 = stat2;				
		lwz r12,-0x7FE8(r13)			; r12,stat2(r13)	
		stw r12,0x0C(r1)			; r12,auto2(r1)	
-02647057		D:40007F74	wr-long	48006AC4	\\diabc\Global__SP_TEST+0x57C	1.480us

Command line example

```

; establish a default start situation
Break.Delete /ALL
TrOnchip.RESet

; messaging setup
NEXUS.BTM ON
NEXUS.DTM Write

; filter settings
TrOnchip.Alpha ProgramTraceON
TrOnchip.Beta ProgramTraceOFF
Break.Set func9 /Program /Alpha
Break.Set sYmbol.EXIT(func9) /Program /Beta

Go

...

Break

; display result
Trace.List

```

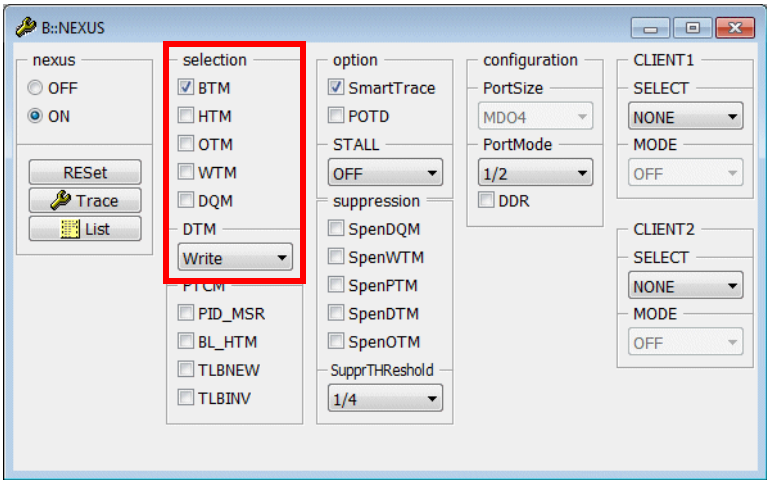
Resource: Watchpoints

Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	Unaffected	Filter applies	Unaffected	Unaffected

Enable Data Trace messaging as required for the analysis.

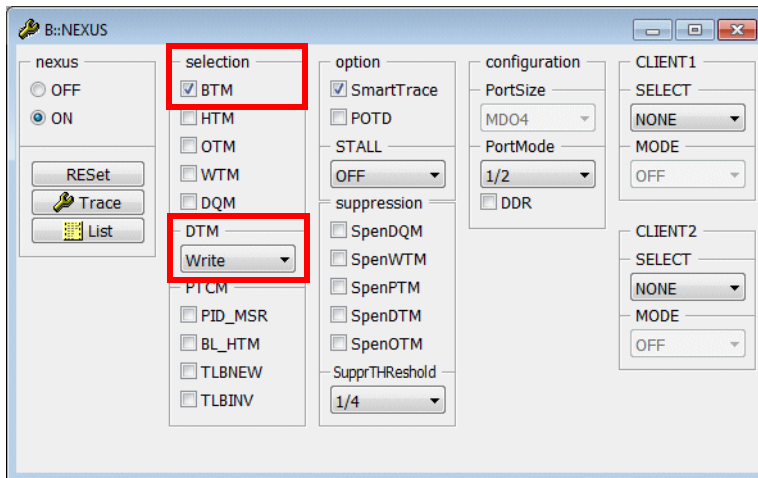
Disable messages types that are unaffected and not required for the analysis.



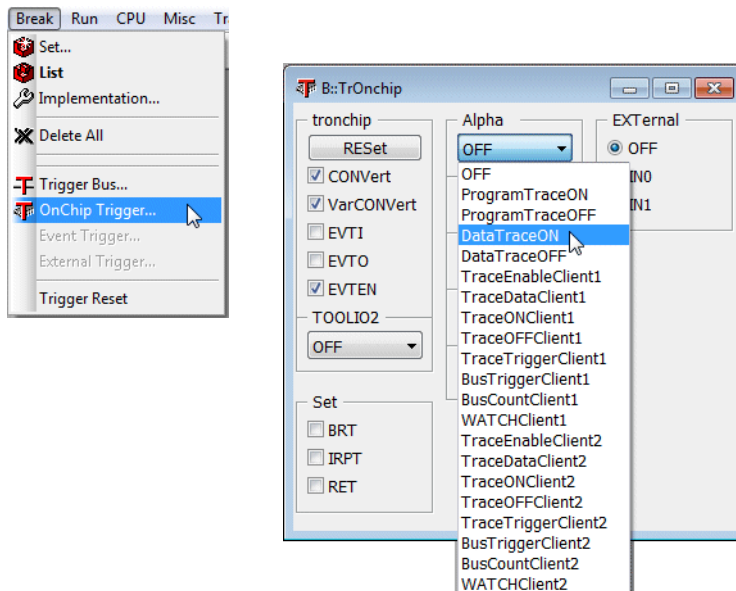
Example:

Enable Branch Trace messaging. Advise the NEXUS module to start the generation of Data Write Messages at the entry to the function func9. Advise the NEXUS module to stop the generation of Data Write Messages at the exit of the function func9.

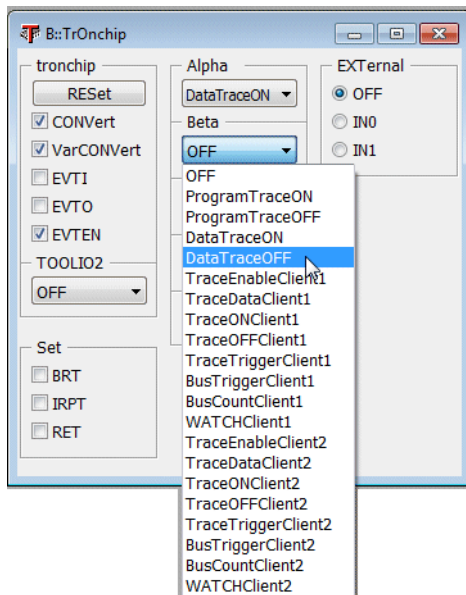
1. Enable Branch Trace messaging and Data Trace messaging for write accesses.



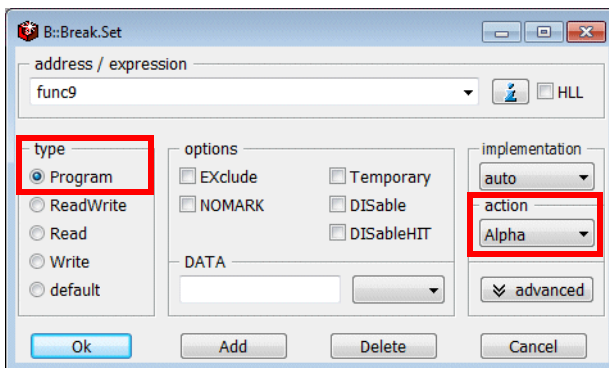
2. Open the TrOnchip window and select DataTraceON for Alpha.



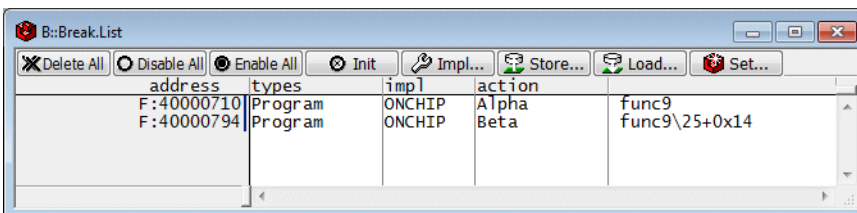
3. Select DataTraceOFF for Beta.



4. Set a Program breakpoint to the entry of the function func9 and select Alpha.



5. Set a Program breakpoint to the exit of the function func9 and select Beta.



6. Start and stop the program execution.

7. Display the result.

B::Trace.List					
Setup... Goto... Find... Chart Profile MIPS More Less					
record	run	address	cycle	data	symbol
					ti.back
		lis	r12,0x4000	; r12,16384	
		li	r11,-0x1	; r11,-1	
		lwz	r0,0x40F0(r12)	; r0,16624(r12)	
		insrwi	r0,r11,0x2,0x11	; r0,r11,2,17	
		stw	r0,0x40F0(r12)	; r0,16624(r12)	
323		vbfield.m = -1;			
		lis	r10,0x4000	; r10,16384	
		li	r9,-0x1	; r9,-1	
324		sth	r9,0x40F4(r10)	; r9,16628(r10)	
		}			
		lwz	r0,0x0C(r1)	; r0,12(r1)	
		mtlrr	r0		
		addi	r1,r1,0x8	; r1,r1,8	
		blr			
-04040169		F:400011C4 ptrace \\diabc\diabc\main+0x168			
					16.420us
619		func9();			
		blr	0x40000710	; func9	
-04040168		F:40000710 ptrace \\diabc\diabc\func9			
					0.380us
327		static int * func9() /* nested local variables */			
		{			
-04040167		stwu	r1,-0x18(r1)	; r1,-24(r1)	
		D:40007F78 wr-long	4000402C	\\diabc\Global__SP_TEST+0x580	1.600us
		mflr	r0		
-04040165		stw	r30,0x10(r1)	; r30,16(r1)	
		D:40007F7C wr-long	0000000B	\\diabc\Global__SP_TEST+0x584	1.740us
-04040164		stw	r31,0x14(r1)	; regl,20(r1)	
		D:40007F84 wr-long	400011C8	\\diabc\Global__SP_TEST+0x58C	1.480us
-04040162		stw	r0,0x1C(r1)	; r0,28(r1)	
		D:40007F70 wr-long	48008022	\\diabc\Global__SP_TEST+0x578	1.720us
		static stat1 = 0;			

Example for TraceTrigger

Resource: Watchpoints and logic in NEXUS Adapter (parallel trace only)

Controlled message types

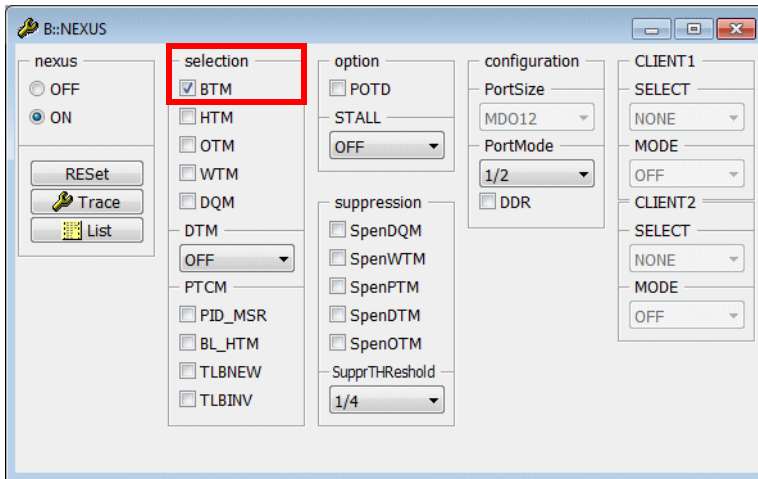
WTM	BTM	DTM	OTM	DQM
Watchpoint Hit Message(s) is generated for the specified instruction(s) or data address+data value	Unaffected	Unaffected	Unaffected	Unaffected

Disable messages types that are unaffected and not required for the analysis.

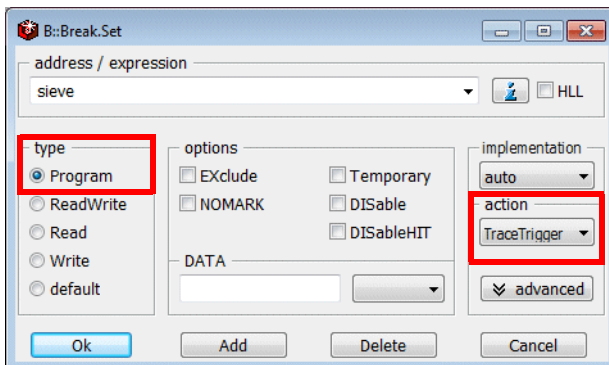
Example:

Enable Branch Trace messaging. Advise the NEXUS module to generate a trigger for the trace if the function sieve is entered. Use this trigger to stop the trace recording.

1. Enable Branch Trace messaging.

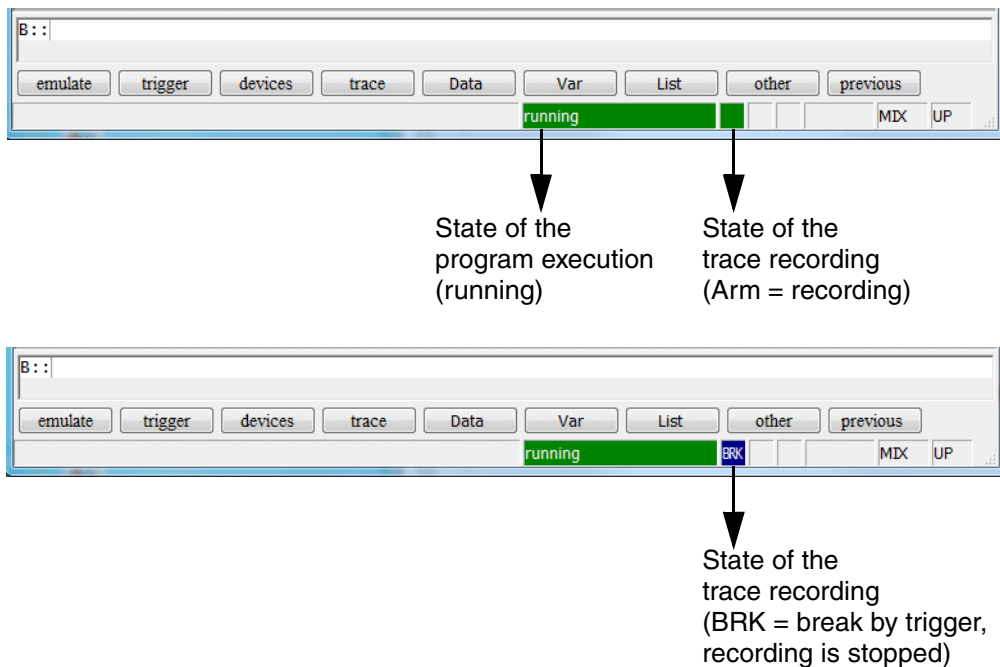


2. Set a Program breakpoint to the start address of the function sieve and select the action TraceTrigger.

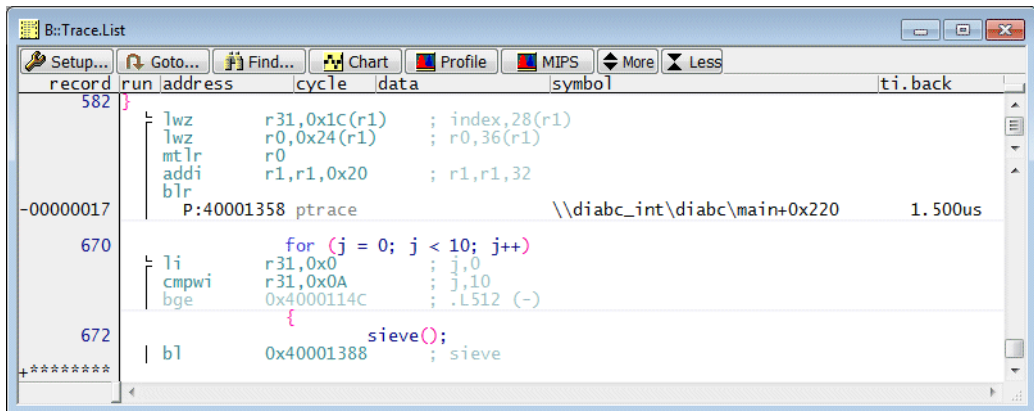


3. Start the program execution

The state of the trace changes from Arm to BRK when the trigger occurs.



4. Display the result.

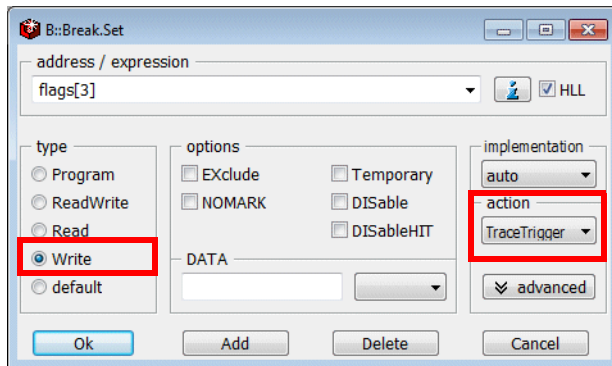


The trace generation is usually stopped before trace information is generated for the event that caused the trigger.

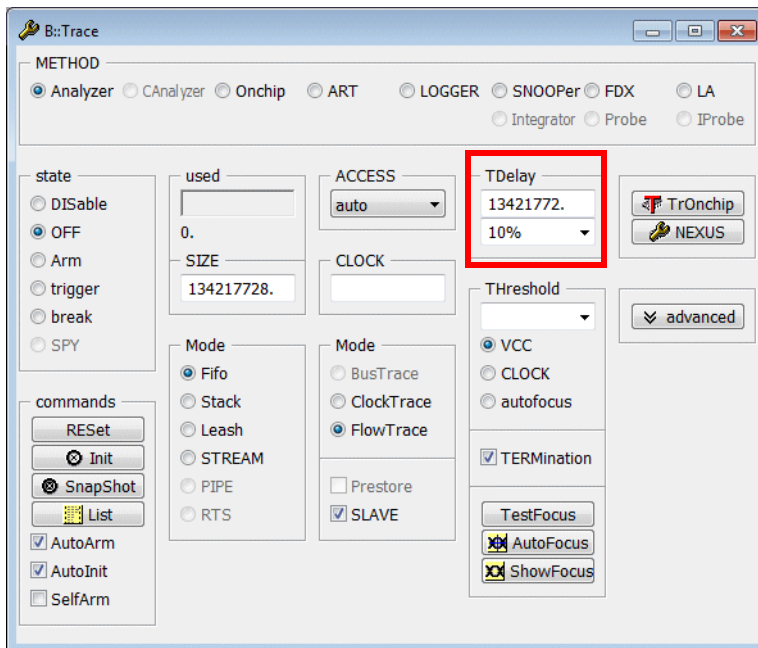
Example for TraceTrigger with a Trigger Delay

Example: Advise the NEXUS module to generate a trigger for the trace if a write access occurs to the variable flags[3]. Advise TRACE32 to fill another 10% of the trace memory before the trace recording is stopped.

1. Set a Write breakpoint to the variable flags[3] and select the action TraceTrigger.



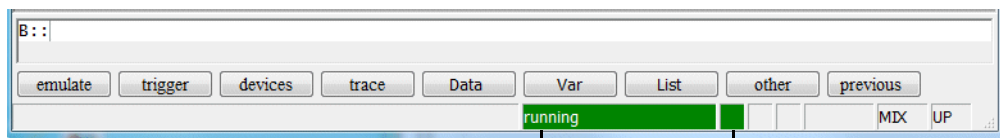
2. Define the trigger delay in the **Trace Configuration** Window.



3. Start the program execution.

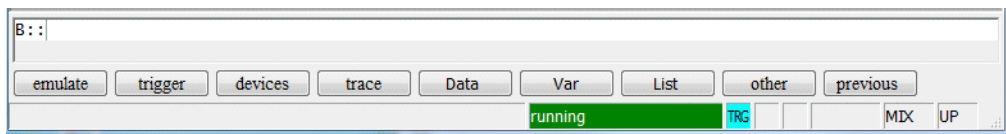
The state of the trace changes from Arm to TRG when the trigger occurs.

The state of the trace changes from TRG to BRK when the delay counter elapses.

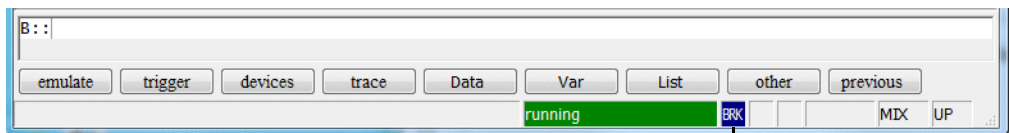


State of the
program execution
(running)

State of the
trace recording
(Arm = recording)

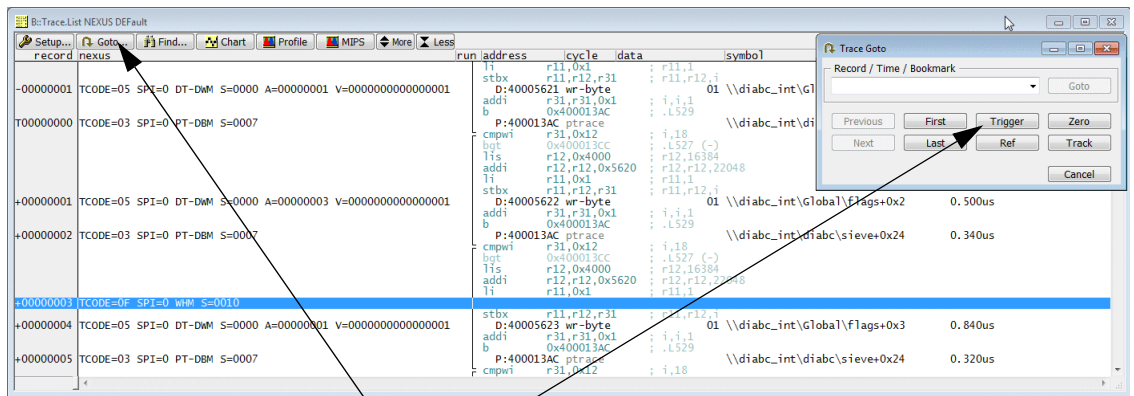


State of the
trace recording
(TRG = trigger occurred,
delay counter started)



State of the
trace recording
(BRK = delay counter elapsed,
recording is stopped)

4. Display the result.



Push the **Trigger** button in the **Trace Goto** window to find the record, where TraceTrigger was detected by the trace (WHM message). Here the sign of the record numbers has changed. The TraceTrigger event is usually shortly after this point.

Example for BusTrigger

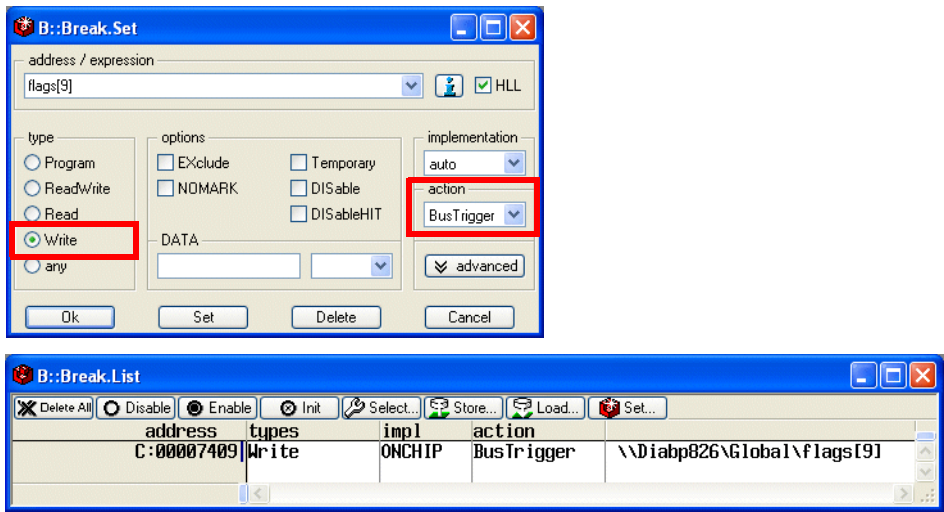
Resource: Watchpoints and logic in NEXUS Adapter (parallel trace only)

Controlled message types

WTM	BTM	DTM	OTM	DQM
Watchpoint Hit Message(s) is generated for the specified instruction(s) or data address+data value	Unaffected	Unaffected	Unaffected	Unaffected

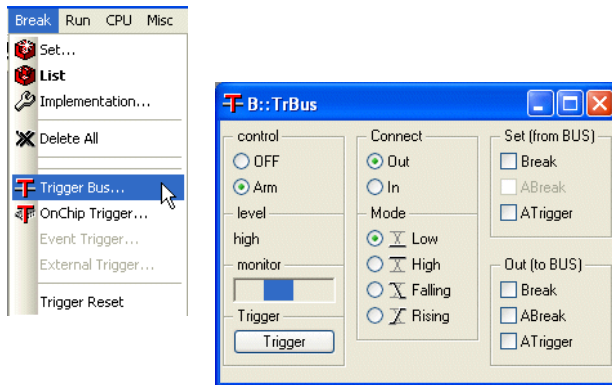
Example: Generate a 100 ns high pulse on the trigger connector of POWERTRACE/ETHERNET or POWER DEBUG II when a write access to flags[9] occurs.

1. Set a write breakpoint to the variable flags[9] and select the action BusTrigger.



2. Start the program execution.

3. Open the **TrBus** window to watch the trigger.



Example for BusCount (Watchpoint)

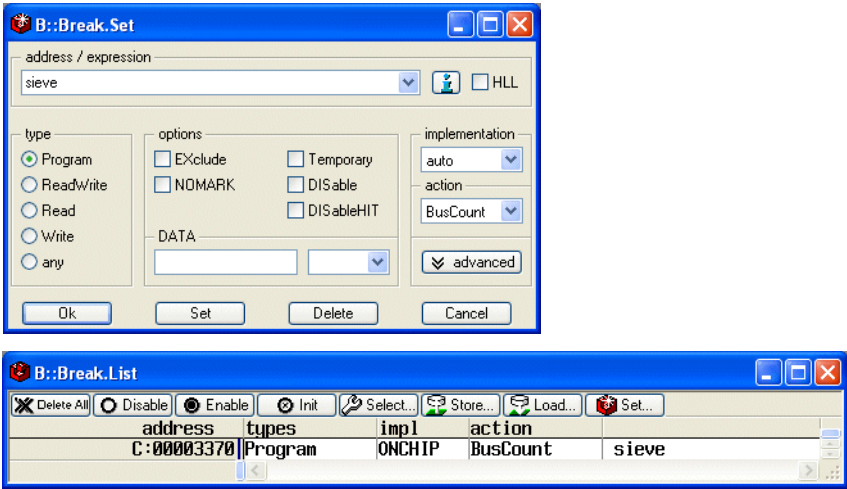
Resource: Watchpoints and logic in NEXUS Adapter (parallel trace only). Only one event possible.

Controlled message types

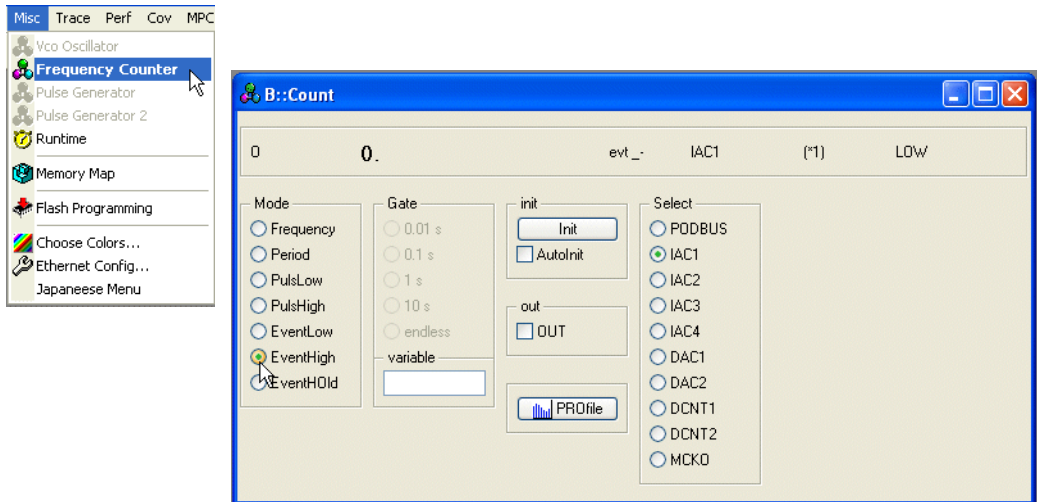
WTM	BTM	DTM	OTM	DQM
Watchpoint Hit Message(s) is generated for the specified instruction(s) or data address+data value	Unaffected	Unaffected	Unaffected	Unaffected

Example 1: Count how often the function sieve is called.

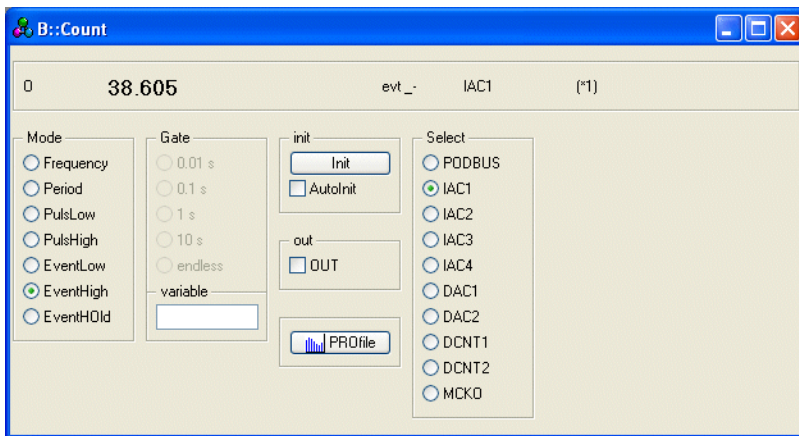
1. Set a Program breakpoint to the start address of the function sieve and select the action BusCount.



2. Open the TRACE32 counter window and select EventHigh.

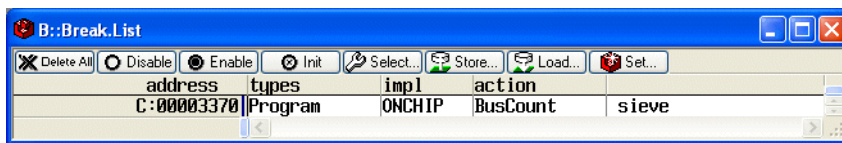
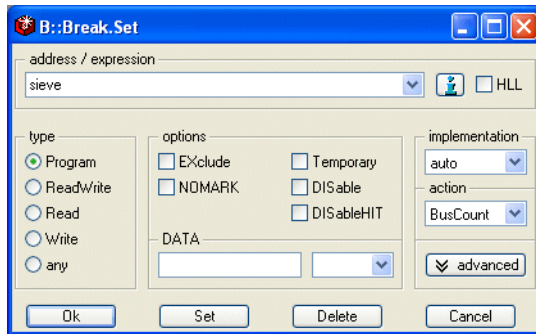


3. Start the program execution and display the result.

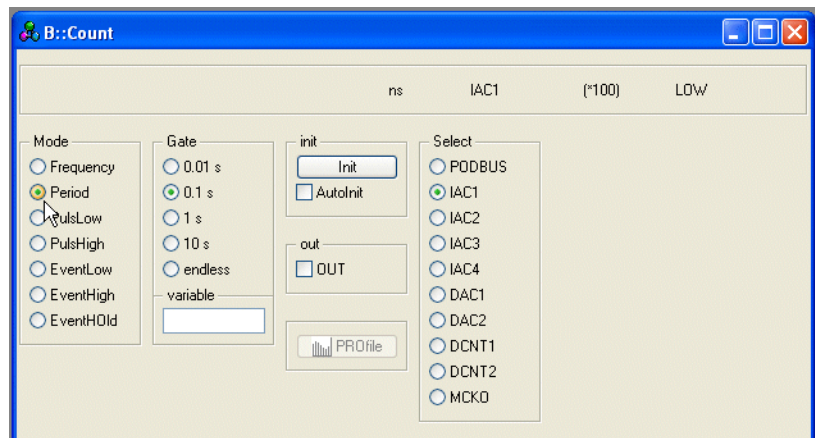


Example 2: Measure the averaged time distance in which the function sieve is called.

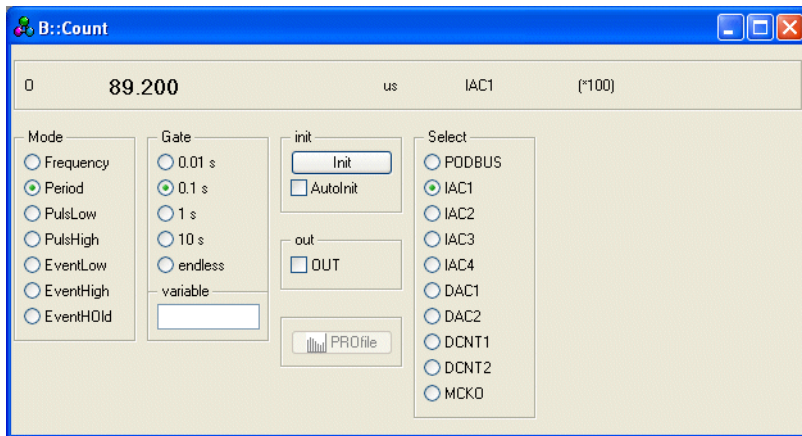
1. Set a Program breakpoint to the start address of the function sieve and select the action BusCount.



2. Open the TRACE32 counter window and select Period.



3. Start the program execution and display the result.



Filter and Trigger (Core) - SMP Debugging

Filters and Triggers are programmed to all cores that are controlled by the TRACE32 instance.

The fact that TRACE32 does not know on which core of the SMP system a program section is running has the consequence that the same filters/triggers are programmed to all cores. So, from the perspective of TRACE32, you can say the resources for filters/triggers are shared by all cores.

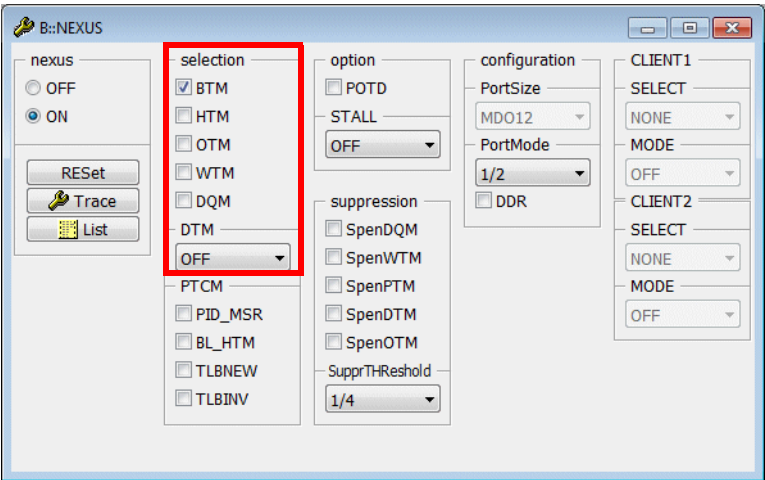
Examples for TraceEnable on Single Instruction

Resource: Watchpoints

Controlled message types

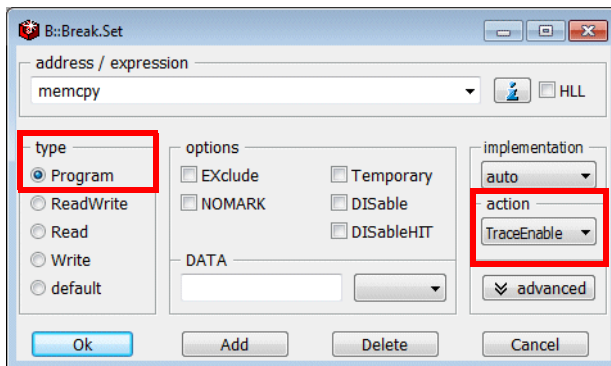
WTM Watchpoint Trace Messages	BTM Branch Trace Messages	DTM Data Trace Messages	OTM Ownership Trace Messages	DQM Data Acquisition Messages
Watchpoint Hit Message(s) is generated for the specified instruction(s)	Disabled	Unaffected	Unaffected	Unaffected

Disable message types, that are unaffected by the filter and not required for your analysis.

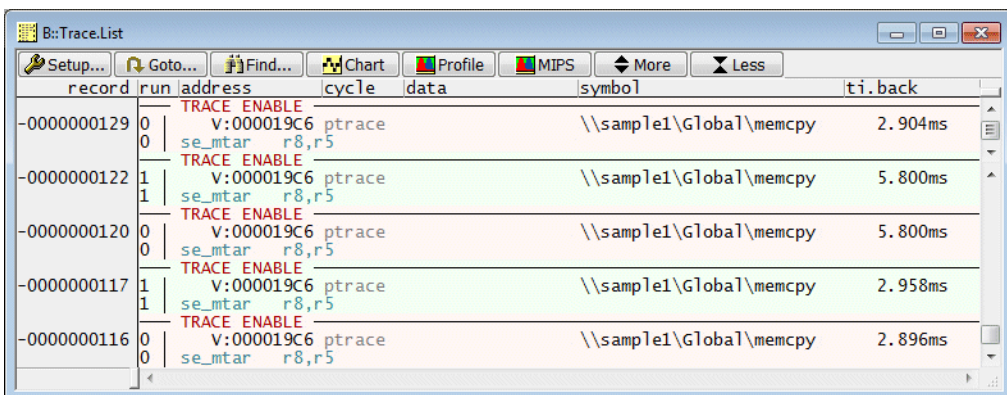


Example 1: Advise the NEXUS module to generate only trace information for the entries to the function memcpy.

1. Set a Program breakpoint to the start address of the function memcpy and select the action TraceEnable.



2. Start the program execution and stop it.
3. Display the result.



```

Break.Delete /ALL ; delete all breakpoints

Break.Set memcpy /Program /TraceEnable ; program filter

Go ; start program execution

...

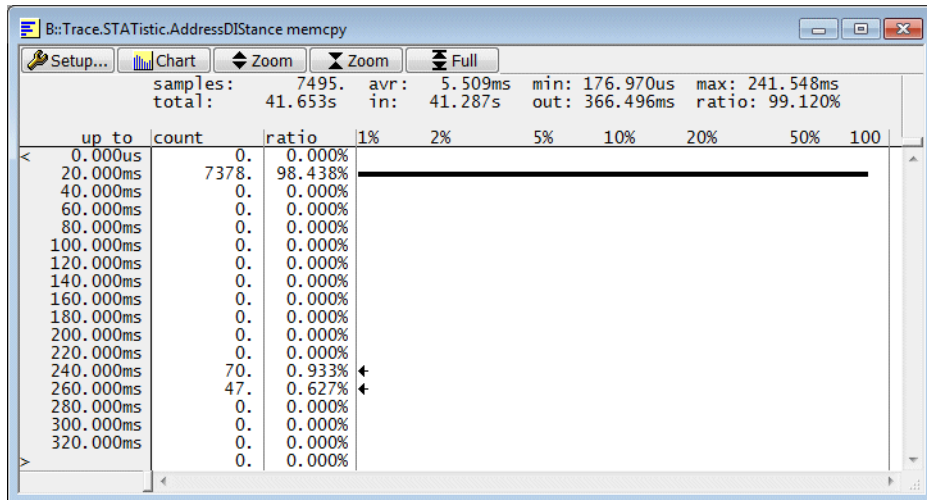
Break ; stop program execution

Trace.List ; display result

```

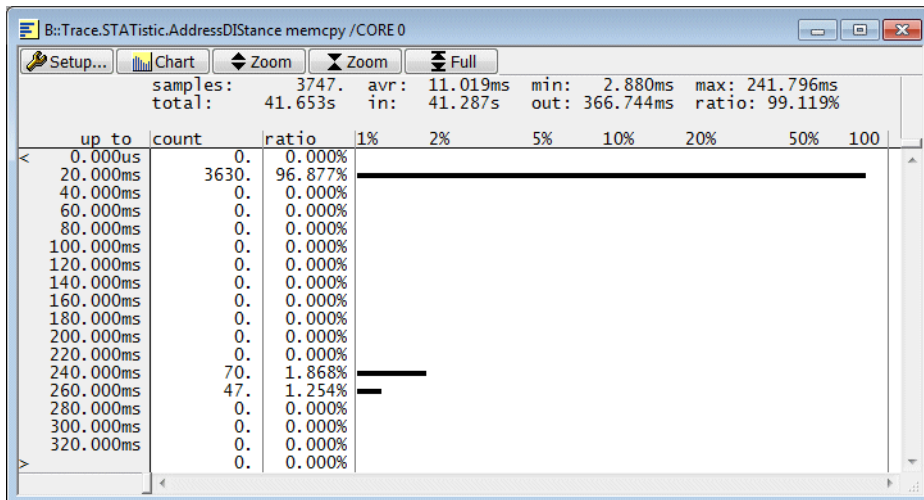
The following **Trace.STATistic** command calculates the time intervals for a program address event. The program address event is here the entry to the function memcpy. The core information is discarded for this calculation.

```
Trace.STATistic.AddressDIStance memcpy
```



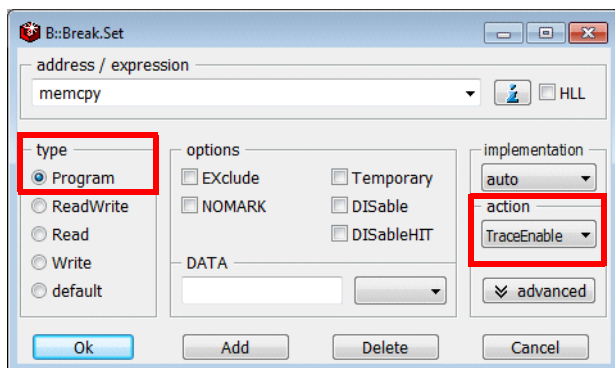
If you need the result per core, use the following command:

```
Trace.STATistic.AddressDIStance memcpy /CORE 0
```

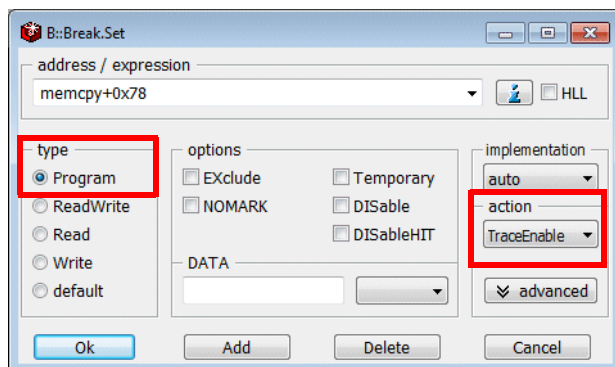


Example 2: Advise the NEXUS module to generate trace information for the entries to the function memcpy and for the exits of the function memcpy.

1. Set a Program breakpoint to the start address of the function memcpy and select the action TraceEnable.



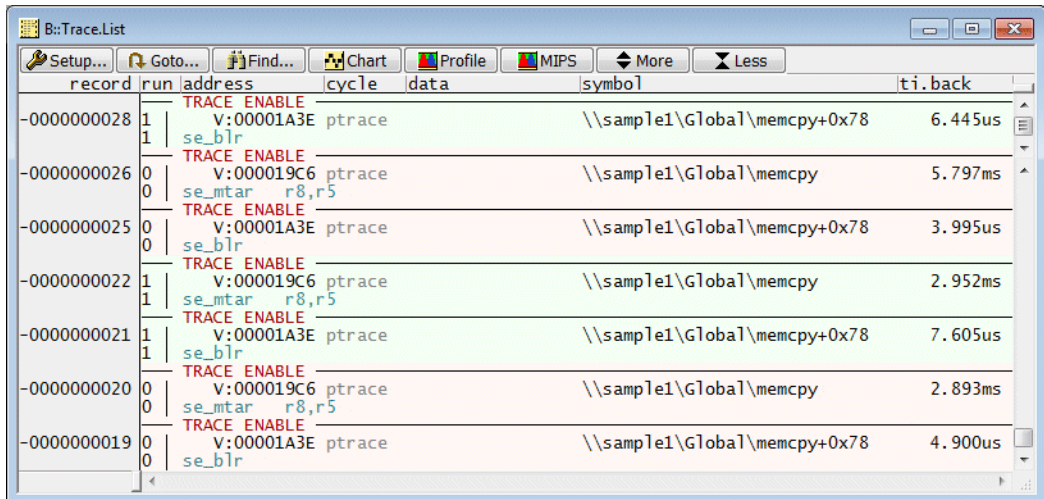
2. Set a Program breakpoint to the exit address of the function memcpy and select the action TraceEnable.



symbol.EXIT(<symbol>) Returns the exit address of the specified function

3. Start the program execution and stop it.

4. Display the result.

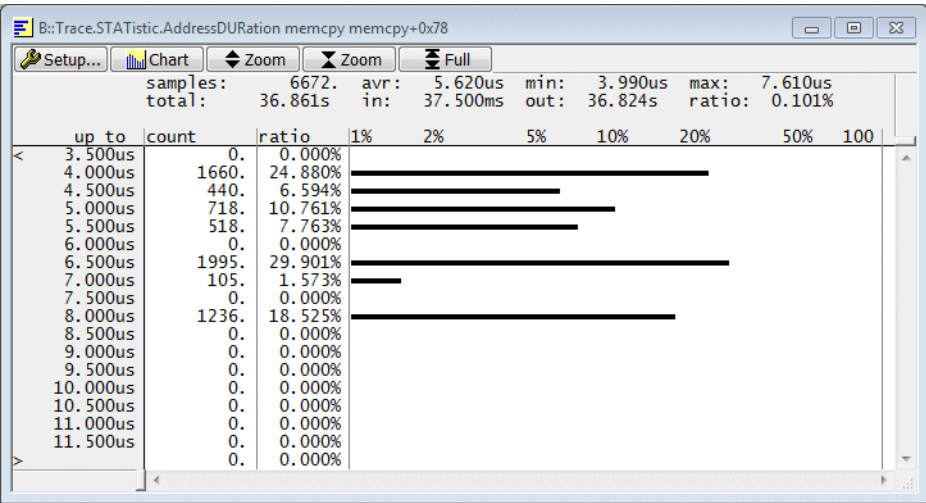


The screenshot shows a window titled "B::Trace.List" with a toolbar containing buttons for Setup..., Goto..., Find..., Chart, Profile, MIPS, More, and Less. Below the toolbar is a table with the following columns: record, run, address, cycle, data, symbol, and ti.back. The table contains several rows of trace data, alternating between green and pink background colors. Each row is preceded by a negative record number in the left margin.

record	run	address	cycle	data	symbol	ti.back
-0000000028	1	TRACE ENABLE				
	1	V:00001A3E ptrace			\\sample1\Global\memcpy+0x78	6.445us
		se_blr				
-0000000026	0	TRACE ENABLE				
	0	V:000019C6 ptrace			\\sample1\Global\memcpy	5.797ms
	0	se_mtar r8,r5				
-0000000025	0	TRACE ENABLE				
	0	V:00001A3E ptrace			\\sample1\Global\memcpy+0x78	3.995us
		se_blr				
-0000000022	1	TRACE ENABLE				
	1	V:000019C6 ptrace			\\sample1\Global\memcpy	2.952ms
		se_mtar r8,r5				
-0000000021	1	TRACE ENABLE				
	1	V:00001A3E ptrace			\\sample1\Global\memcpy+0x78	7.605us
		se_blr				
-0000000020	0	TRACE ENABLE				
	0	V:000019C6 ptrace			\\sample1\Global\memcpy	2.893ms
	0	se_mtar r8,r5				
-0000000019	0	TRACE ENABLE				
	0	V:00001A3E ptrace			\\sample1\Global\memcpy+0x78	4.900us
		se_blr				

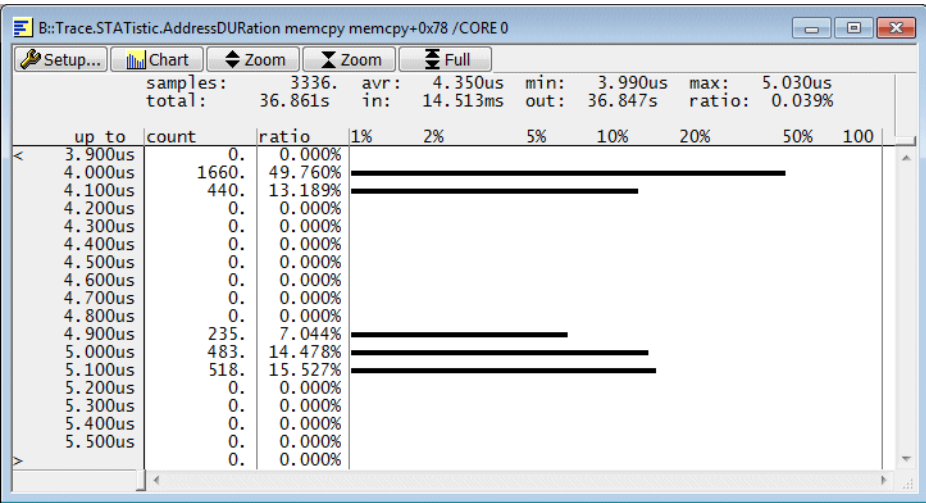
The following **Trace.STATistic** command calculates the time intervals between two program address events A and B. The entry to the function memcpy is A in this example, the exit from the function is B. The core information is discarded for this calculation.

```
Trace.STATistic.AddressDURation memcpy memcpy+0x78
```



If you need the result per core, use the following command:

```
Trace.STATistic.AddressDURation memcpy memcpy+0x78 /CORE 0
```



Examples for TraceEnable on Instruction Range

Resource: Limited to one instruction address range

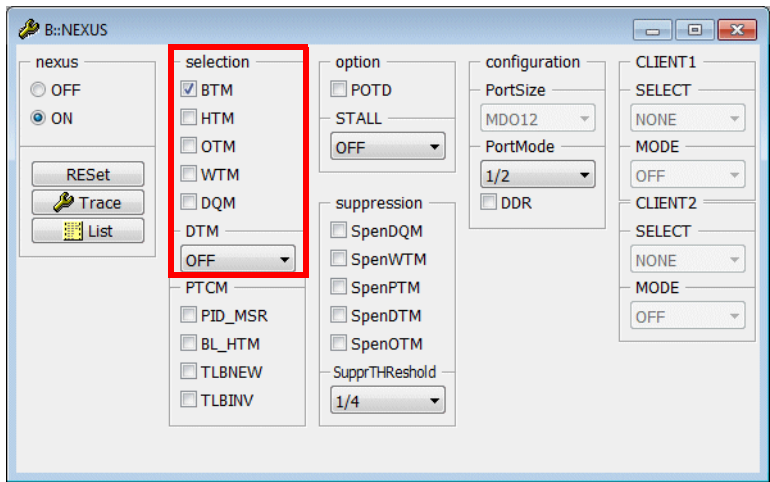
Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	Filter applies if BTM is enabled	Filter applies if DTM is enabled	Unaffected	Unaffected

Enable BTM. This filter requires that Branch History messaging is disabled.

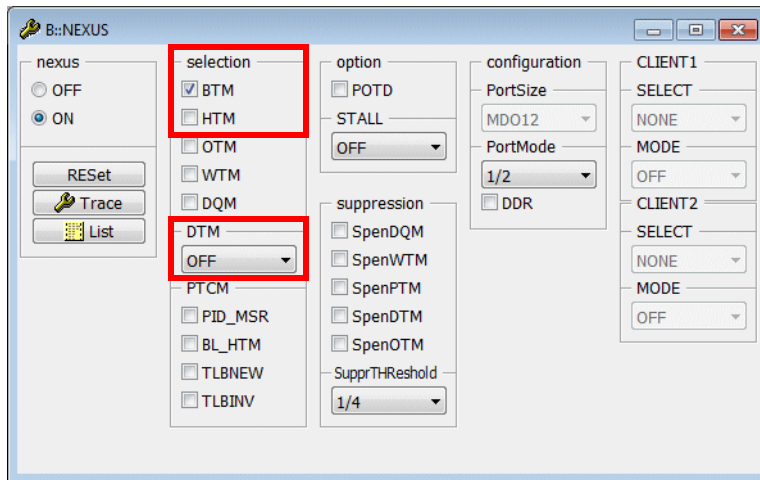
Enable DTM if you are interested in the read/write accesses performed by the specified instruction address range.

Disable message types, that are unaffected by the filter and not required for your analysis.

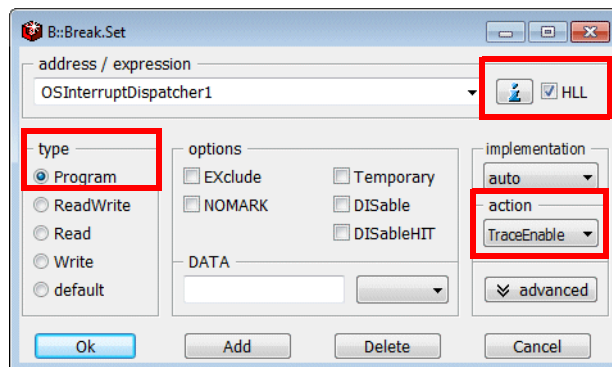


Example: Advise the NEXUS module to generate trace information for all taken branches within the function OSInterruptDispatcher1.

1. Enable Branch Trace messaging, but don't enable Indirect Branch History messaging.
Disable Data Trace messaging.



2. Set a Program breakpoint to the complete address range of the function OSInterruptDispatcher1 (HLL check box ON) and select the action TraceEnable.



3. Start the program execution and stop it.
4. Display the result.

[B:\TraceList\t]					
Setup... Goto... Find... Chart Profile MIPS More Less					
record	run	address	cycle	data	symbol
-0000019167	0	V:00007C04	pttrace	\\sample1\os\sr\OSInterruptDispatcher1+0x426	
	0	msync			ti.back 3.095us
	0	lwzx	r8,r27,r25		
	0	stbx	r22,r21,r31	; curApp,r21,coreId	
	0	stwx	r26,r8,r28	; oldPri,r8,r28	
	0	e_lmw	r19,0x0C(r1)	; r19,12(r1)	
	0	e_lwz	r0,0x44(r1)	; r0,68(r1)	
	0	se_mtlr	r0		
	0	e_addi	r1,r1,0x40	; r1,r1,64	
	0	se_blr			
-0000019166	0	V:0000912C	pttrace	\\sample1\Global_ghs_eofn_OS_StartNonAutosarCore+0x14	
	0	e_lmvsrrw	0x48(r1)	; 72(r1)	2.835us
TRACE ENABLE					
-0000019163	1	V:00007850	pttrace	\\sample1\os\sr\OSInterruptDispatcher1+0x72	
	1	e_addi6i	r24,r13,-0x7FE0	; r24,r13,-32736	
	1	lwzx	r5,r24,r25		
	1	e_addi6i	r12,r13,-0x7FB0	; r12,r13,-32688	
	1	lwzx	r0,r12,r25		
	1	e_addi6i	r21,r13,-0x7F6C	; r21,r13,-32620	
	1	lbzx	r22,r21,r31	; curApp,r21,coreId	
	1	e_andi	r11,r5,0x1F	; r11,r5,31	
	1	e_rlwinm	r5,r5,0x2,0x19,0x1D	; r5,r5,2,25,29	
	1	stwx	r30,r5,r0	; isrPtr,r5,r0	
	1	se_bne	0x7882		
	1	e_bl	0x4032	; OSCheckStack	
-0000019162	1	V:00004032	pttrace	\\sample1\ostsk\OSCheckStack	
					3.740us

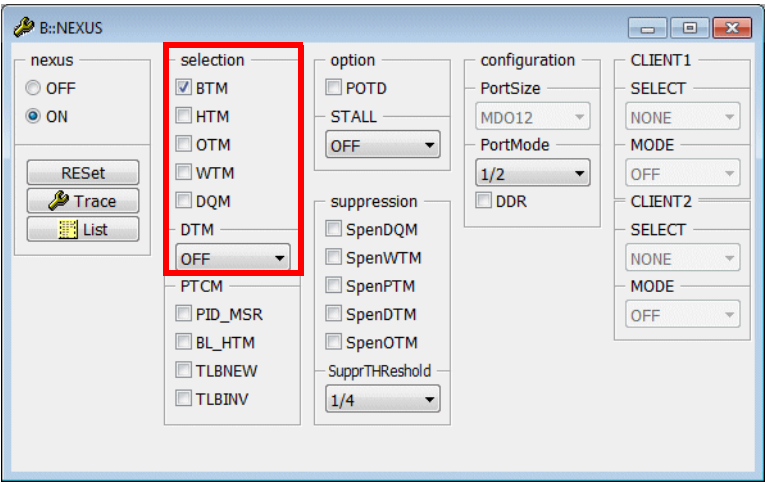
Examples for TraceEnable on Read/Write Accesses

Resource: DTC Register

Controlled message types

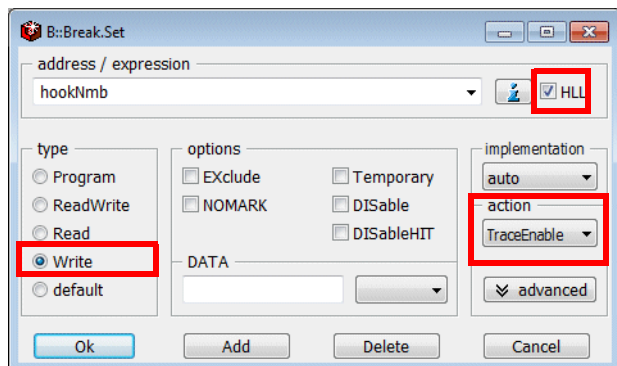
WTM	BTM	DTM	OTM	DQM
Unused	BTM is disabled by filter	DTM is enabled by filter Filter applies	Unaffected	Unaffected

Disable message types, that are unaffected by the filter and not required for your analysis.



Example: Disable Branch Trace Messaging and advise the NEXUS module to generate trace information for the write accesses to the variable hookNmb.

1. Set a Write breakpoint to the variable hookNmb and select the action TraceEnable



- no data value possible (limitation of DTC Register)
- accessing instruction not possible (limitation of DTC Register)

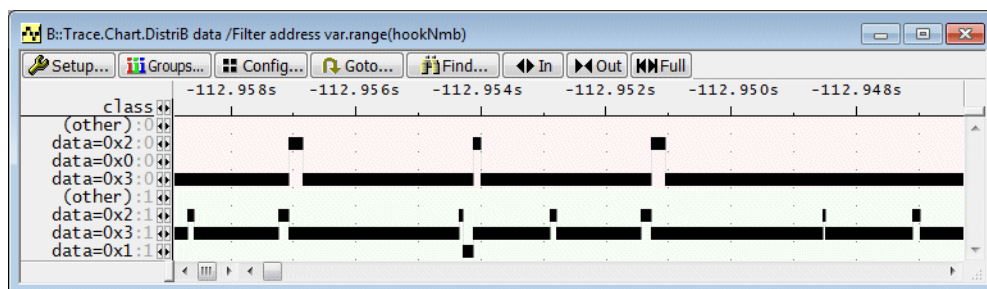
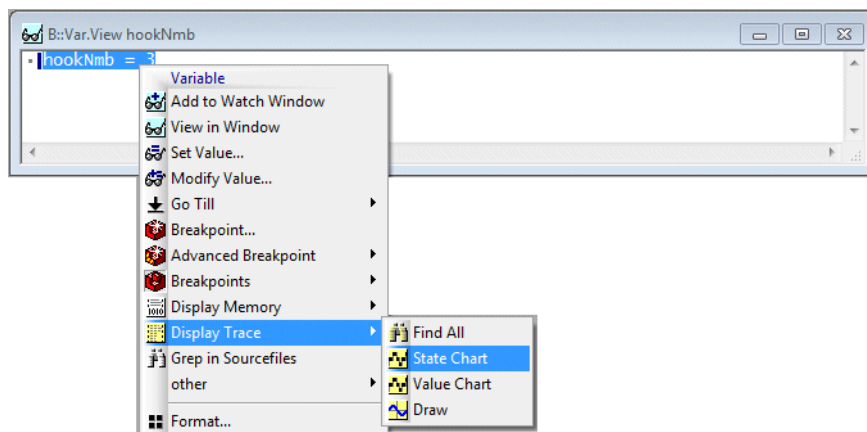
2. Start the program execution and stop it.
3. Display the result.

The screenshot shows the 'B::Trace.List' window with a table of trace records. The table has columns: record, run, address, cycle, data, symbol, and ti.back. The records show write operations to the variable 'hookNmb' at address 'D:40000A58'.

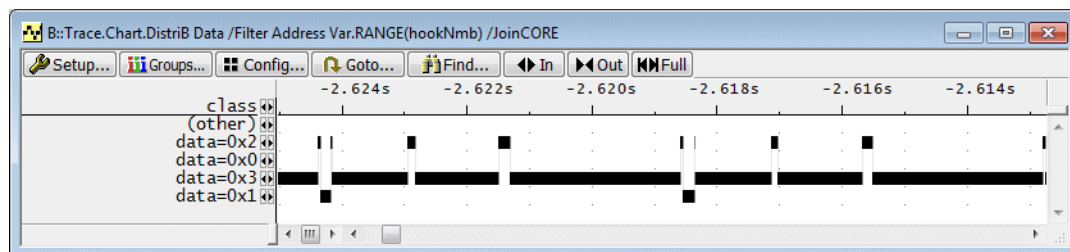
record	run	address	cycle	data	symbol	ti.back
-0000000031	0	D:40000A58	wr-long	00000002	\\sample1\Global\hookNmb	149.110us
-0000000030	1	D:40000A58	wr-long	00000003	\\sample1\Global\hookNmb	180.555us
-0000000028	0	D:40000A58	wr-long	00000003	\\sample1\Global\hookNmb	226.955us
-0000000025	1	D:40000A58	wr-long	00000002	\\sample1\Global\hookNmb	2.710ms
-0000000023	1	D:40000A58	wr-long	00000001	\\sample1\Global\hookNmb	52.840us
-0000000022	0	D:40000A58	wr-long	00000002	\\sample1\Global\hookNmb	2.707ms
-0000000020	1	D:40000A58	wr-long	00000003	\\sample1\Global\hookNmb	174.130us
-0000000018	0	D:40000A58	wr-long	00000003	\\sample1\Global\hookNmb	116.780us

The Variable pull-down provides various ways to analyze the variable contents over the time.

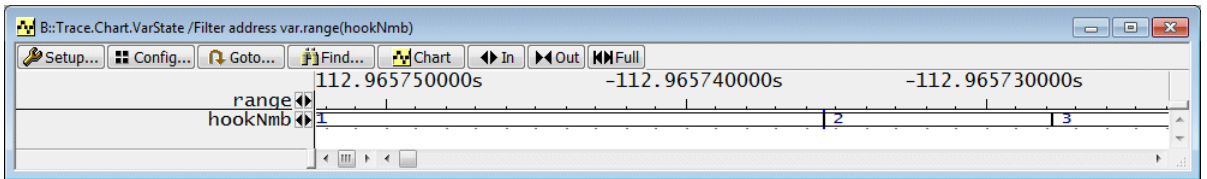
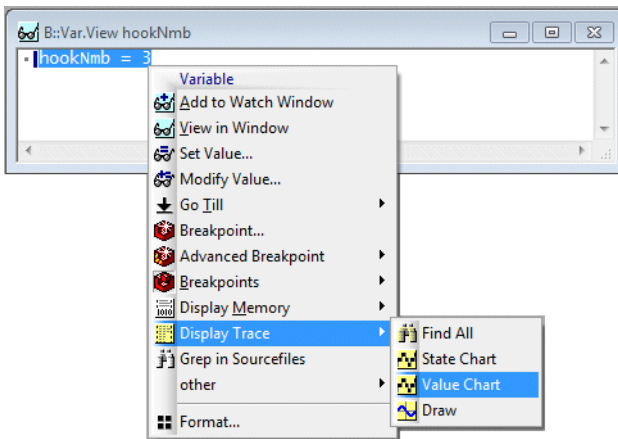
```
; open a window to display the variable  
Var.View hookNmb
```



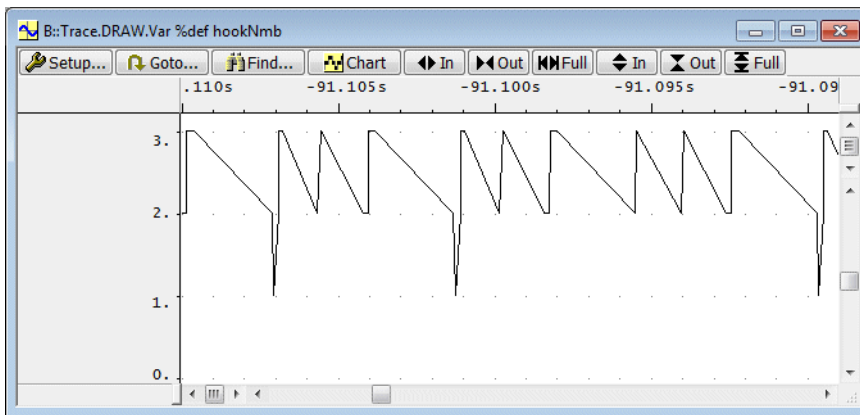
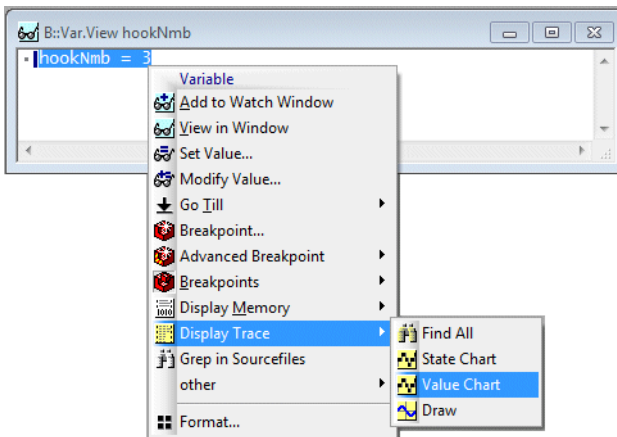
Display the value changes of a variable graphically - value changes per core
Trace.Chart.DistriB Data /Filter Address Var.RANGE(<var>) [/SplitCORE]



Display the value changes of a variable graphically - value changes of all cores
Trace.Chart.DistriB Data /Filter Address Var.RANGE(<var>) /JoinCORE



Display variable contents over the time (numerically) - the core information is discarded
Trace.Chart.VarState



Display variable contents over the time (graphically) - the core information is discarded
Trace.DRAW.Var %Default <var>

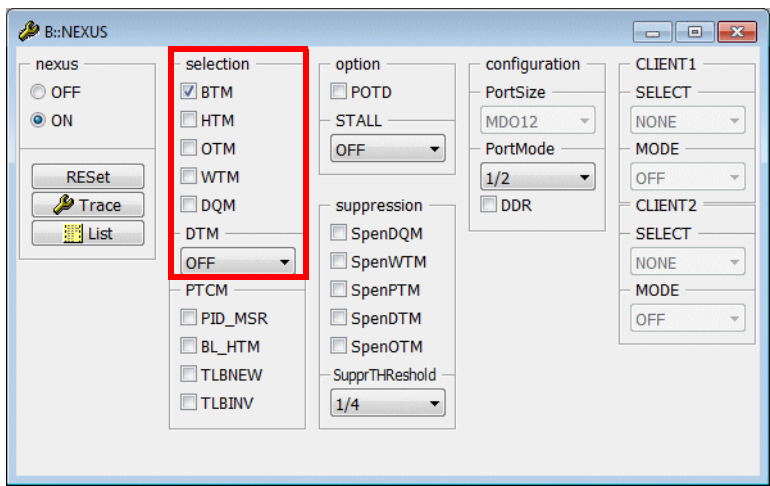
Example for TraceData

Resource: DTC Register

Controlled message types

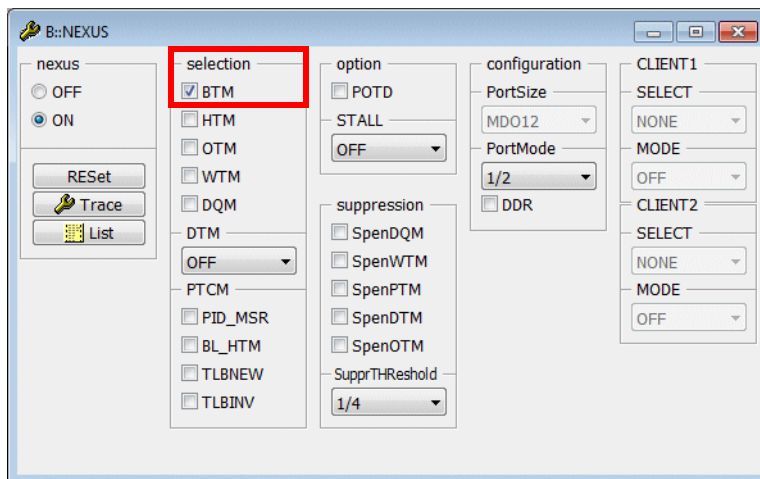
WTM	BTM	DTM	OTM	DQM
Unused	Unaffected	DTM is enabled by filter Filter applies	Unaffected	Unaffected

Disable message types that are unaffected by the filter and not required for the analysis.

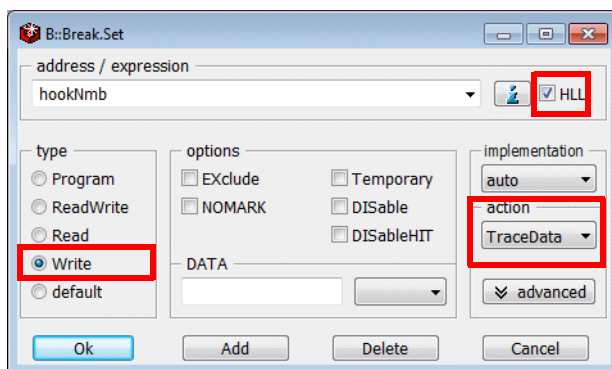


Example: Advise the NEXUS module to generate Data Trace Messages for all write accesses to the variable hookNmb and to generate trace information for all executed instructions.

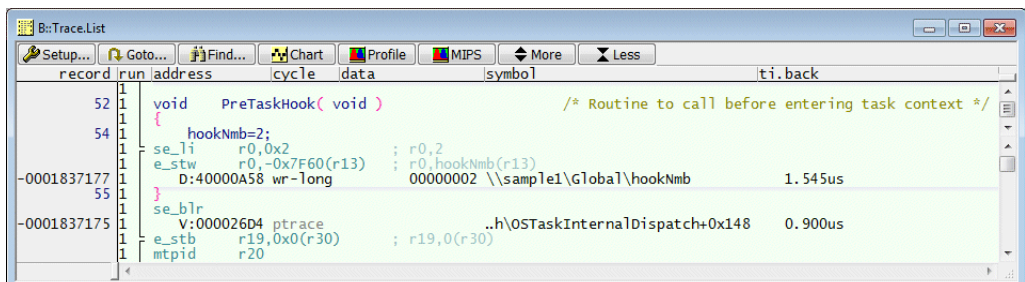
1. Enable Branch Trace messaging.



2. Set a Write breakpoint to the variable hookNmb and select the action TraceData.



3. Start the program execution and stop it.
4. Display the result.



Please be aware that in the case of a TraceData filter a correlation of the data access and the instruction is in most cases not possible.

Examples for TraceON/TraceOFF

Resource: Watchpoints

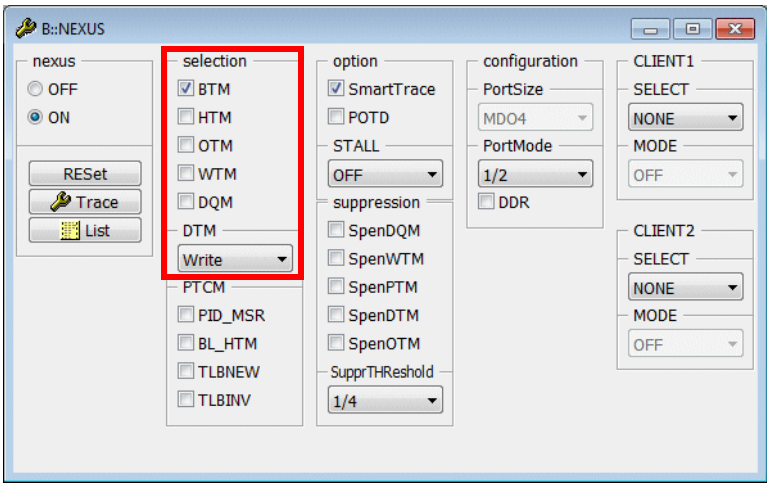
Global TraceON/Trace OFF

Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	Filter applies	Filter applies	Unaffected	Unaffected

Enable Branch Trace Messaging and Data Trace Messaging if this information is required for your analysis.

Diabale messages types that are unaffected and not required for the analysis.

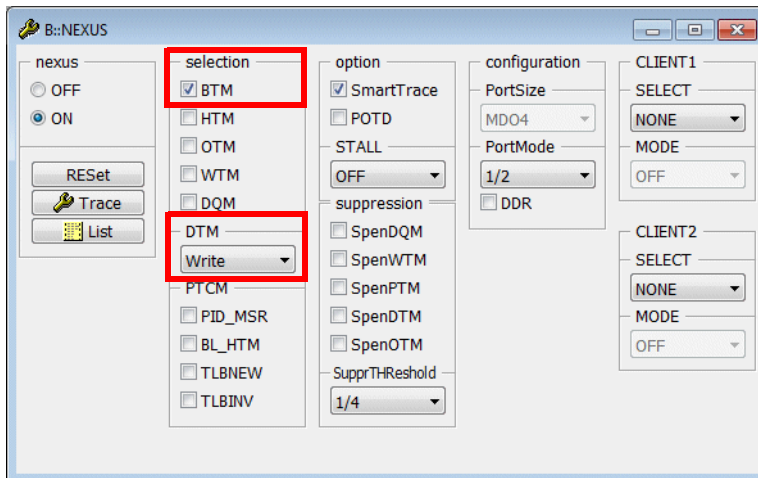


Example:

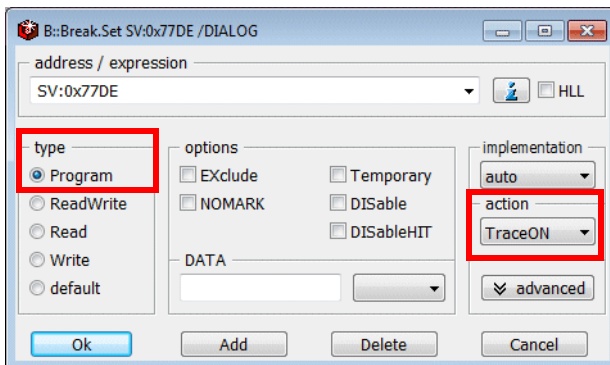
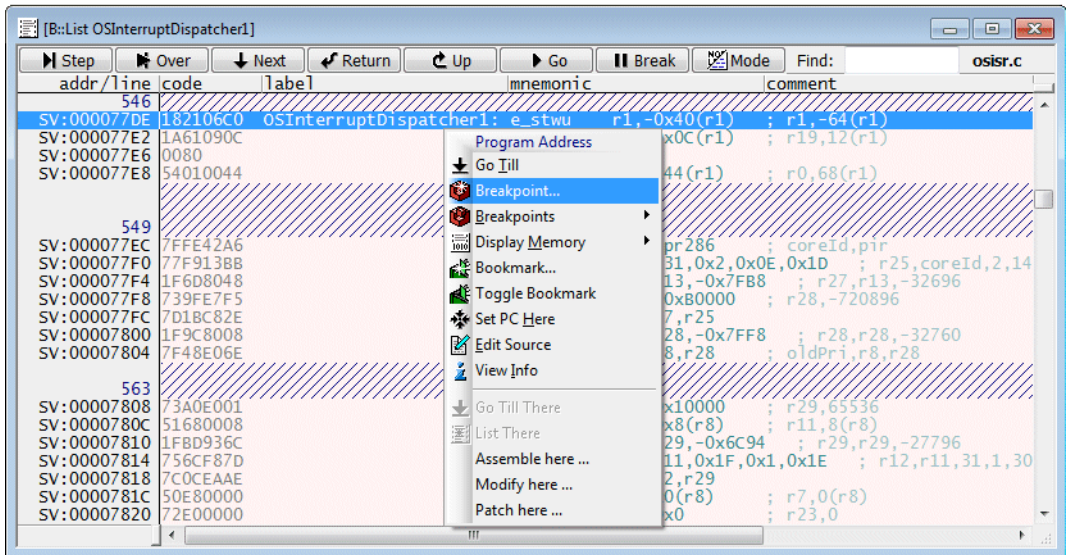
Advise the NEXUS module to start Branch Trace messaging and Data Write Messages at the entry to the function OSInterruptDispatcher1.

Advise the NEXUS module to stop Branch Trace messaging and Data Write Messages at the exit of the function OSInterruptDispatcher1.

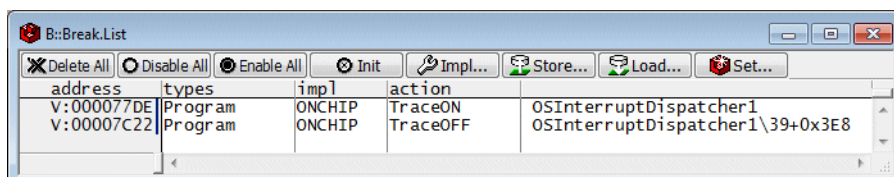
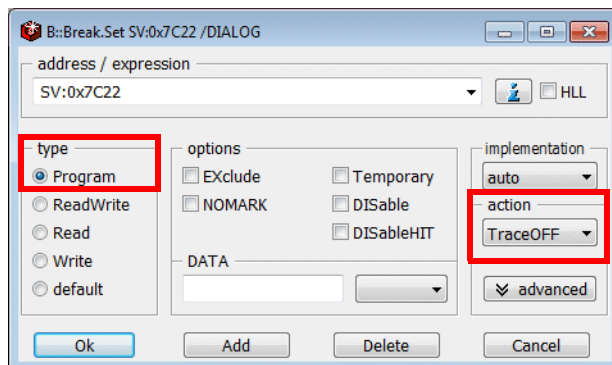
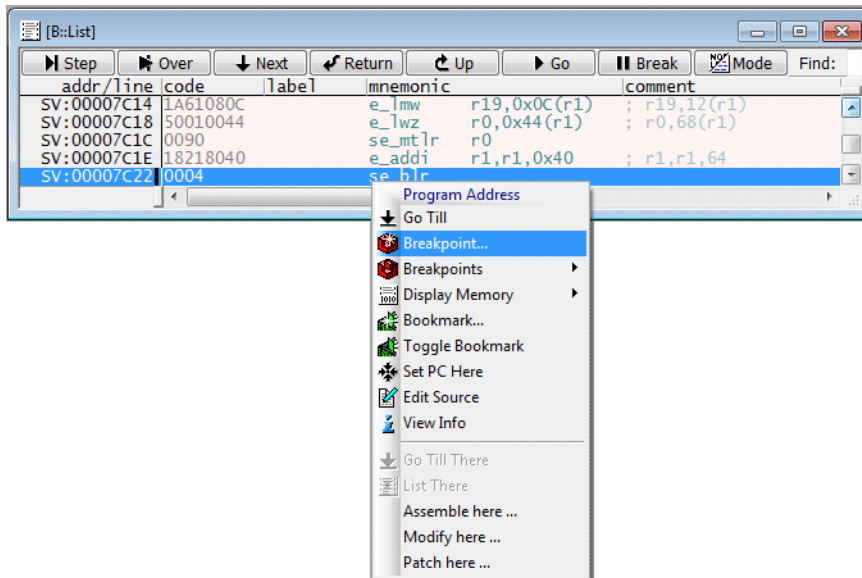
1. Enable Branch Trace Messages and Data Write Messages.



2. Set a Program breakpoint to the entry of the function `OSInterruptDispatcher1` and select the action `TraceON`.



3. Set a Program breakpoint to the exit of the function `OSInterruptDispatcher1` and select the action `TraceOFF`.



4. Start the program execution and stop it.

5. Display the result.

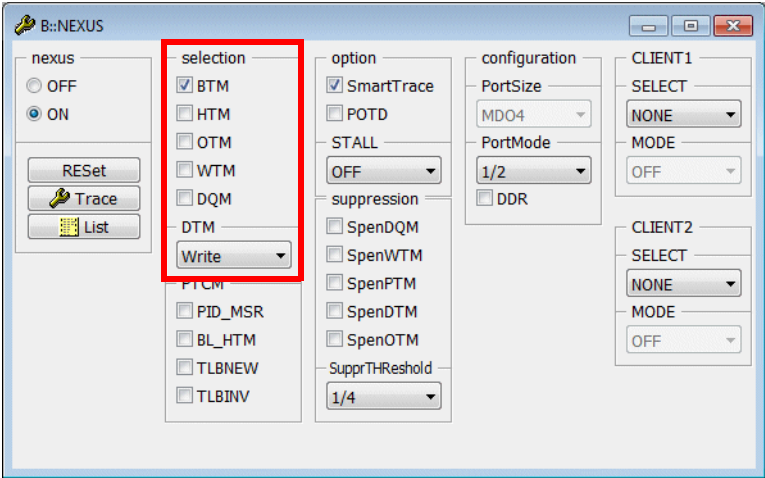
record	run	address	cycle	data	symbol	ti.back
-0003380107	0	V:00007C04	ptrace		\\sample1\osisir\OSInterruptDispatcher1+0x426	3.095us
	0	msync				
	0	lwzx	r8,r27,r25			
	0	stbx	r22,r21,r31	; curApp,r21,coreId		
-0003380106	0	D:40000A4C	wr-byte	03	\\sample1\Global\OsAppID_	1.160us
	0	stwx	r26,r8,r28	; oldPr1,r8,r28		
-0003380105	0	D:FFF48008	wr-long	00000000		0.645us
	0	e_lmw	r19,0x0C(r1)	; r19,12(r1)		
	0	e_lwz	r0,0x44(r1)	; r0,68(r1)		
	0	se_mtlr	r0			
	0	se_addi	r1,r1,0x40	; r1,r1,64		
	0	seblr				
-0003380103	0	V:0000912C	ptrace		\\sample1\Global__ghs_eofn_OS_StartNonAutosarCore+0x14	1.030us
	0	TRACE ENABLE				
-0003380100	0	D:40001EF4	wr-long	00000000	\\sample1\Global_OsOrtiStackStart+0xEB4	1.882ms
-0003380098	0	D:40001EF8	wr-quad	0000000000000000	\\sample1\Global_OsOrtiStackStart+0xEB8	0.900us
-0003380097	0	D:40001F00	wr-quad	0000000000000000	\\sample1\Global_OsOrtiStackStart+0xEC0	0.645us
-0003380096	0	D:40001F08	wr-quad	00000014400009A0	\\sample1\Global_OsOrtiStackStart+0xEC8	0.645us
-0003380094	0	D:40001F10	wr-quad	40000A00FFF48008	\\sample1\Global_OsOrtiStackStart+0xED0	0.905us
-0003380092	0	D:40001F18	wr-quad	400009E800000000	\\sample1\Global_OsOrtiStackStart+0xED8	1.160us
-0003380090	0	D:40001F20	wr-quad	0000000000000000	\\sample1\Global_OsOrtiStackStart+0xEE0	1.160us
-0003380089	0	D:40001F2C	wr-long	0000912C	\\sample1\Global_OsOrtiStackStart+0xEEC	0.645us
-0003380088	0	V:00007850	ptrace		\\sample1\osisir\OSInterruptDispatcher1+0x72	0.645us
	0	e_add16i	r24,r13,-0x7FE0	; r24,r13,-32736		
	0	lwzx	r5,r24,r25			
	0	e_add16i	r12,r13,-0x7FB0	; r12,r13,-32688		
	0	lwzx	r0,r12,r25			
	0	e_add16i	r21,r13,-0x7F6C	; r21,r13,-32620		
	0	lbzx	r22,r21,r31	; curApp,r21,coreId		
	0	e_andi	r11,r5,0x1F	; r11,r5,31		
	0	e_rlwinm	r5,r5,0x2,0x19,0x1D	; r5,r5,2,25,29		
	0	stwx	r30,r5,r0	; isrPtr,r5,r0		
-0003380087	0	D:40000E44	wr-long	40000CDC	\\sample1\Global\OsIsrArrayCore0	0.640us
	0	se_bne	0x7882			
	0	e_bl	0x4032	; OSCheckStack		
-0003380085	0	V:00004032	ptrace		\\sample1\ostsk\OSCheckStack	0.645us

The event that switched the trace generation on is not visible in the trace.

Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	BTM is enabled by filter Filter applies	Unaffected	Unaffected	Unaffected

Diable messages types that are unaffected and not required for the analysis.



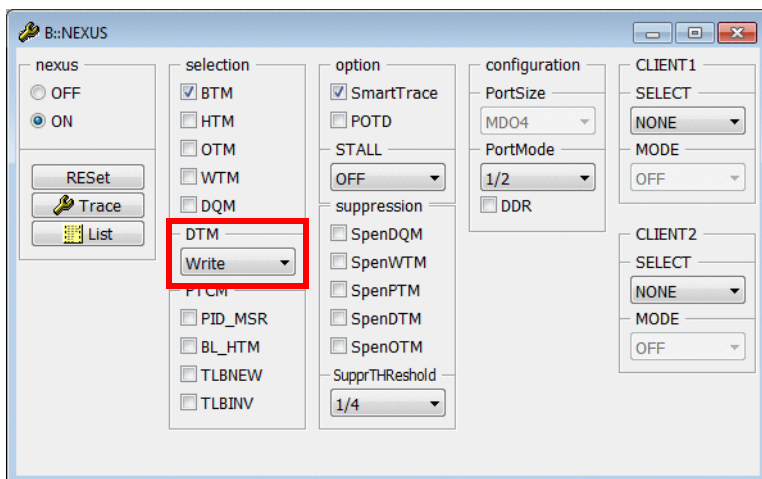
Example:

Advise the NEXUS module to generate trace information on all write accesses.

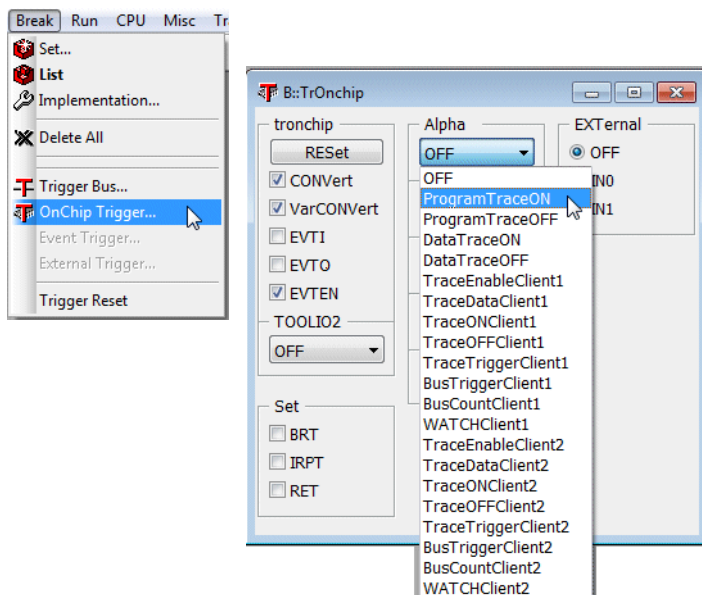
Advise the NEXUS module to start the Branch Trace messaging at the entry to the function mempcy.

Advise the NEXUS module to stop Branch Trace messaging at the exit of the function mempcy.

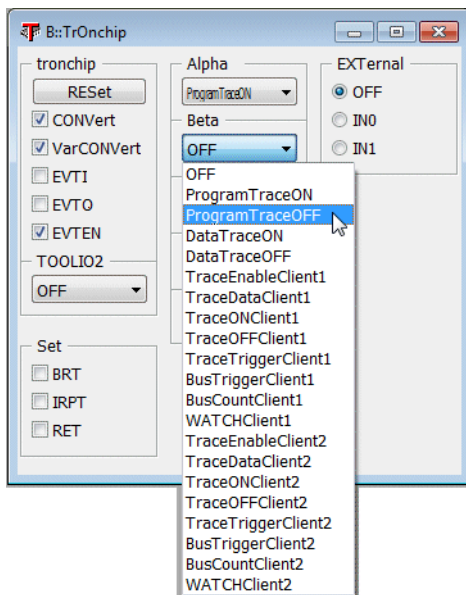
1. Enable Data Trace messaging for write accesses.



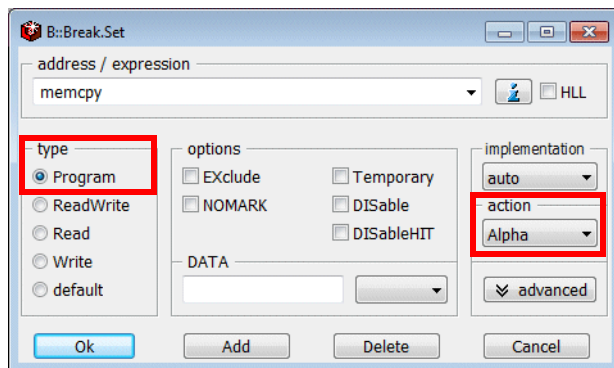
2. Open the TrOnchip window and select ProgramTraceON for Alpha.



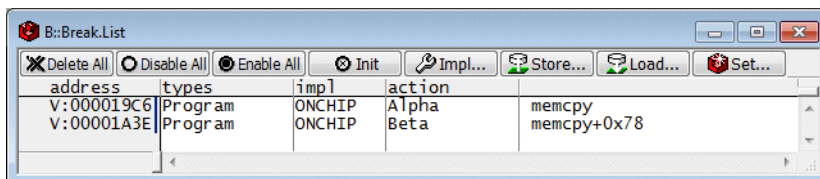
3. Select ProgramTraceOFF for Beta.



4. Set a Program breakpoint to the entry of the function memcpy and select the action Alpha.



5. Set a Program breakpoint to the exit of the function at memcpy and select the action Beta.



6. Start and stop the program execution.

7. Display the result.

B::Trace.List							
Setup... Goto... Find... Chart Profile MIPS More Less							
record	run	address	cycle	data	symbol	ti.back	
-0000322899	0	D:FFF48008	wr-long	00000006		4.255us	
-0000322897	0	D:FFF2400E	wr-byte	01		0.905us	
-0000322895	0	V:00001A22	ptrace		\\sample1\Global\memcpy+0x5C	2.835us	
	0	e_cmpli	0x0,r8,0x0		; 0,r8,0		
	0	se_addi	r7,0x4		; r7,RCHW2		
	0	se_addi	r4,0x4		; r4,RCHW2		
	0	se_beq	0x1A3E				
	0	se_mfar	r5,r8				
	0	se_mtctr	r5				
	0	se_subi	r5,0x1		; r5,1		
	0	lbzx	r6,r5,r4				
	0	stbx	r6,r5,r7				
-0000322894	0	D:40000985	wr-byte	6C	\\sample1\Global\OsStacks+0x185	2.065us	
	0	e_bdnz	0x1A30				
-0000322892	0	V:00001A30	ptrace		\\sample1\Global\memcpy+0x6A	0.640us	
	0	se_subi	r5,0x1		; r5,1		
	0	lbzx	r6,r5,r4				
	0	stbx	r6,r5,r7				
-0000322891	0	D:40000984	wr-byte	07	\\sample1\Global\OsStacks+0x184	0.645us	
	0	e_bdnz	0x1A30				
	0	se_blr					
-0000322890	0	V:00003D4E	ptrace		\\sample1\os\ioc\OS_OSIocReadAcross+0xD4	0.645us	
	0	TRACE ENABLE					

```
; default start situation
Break.Delete /ALL
TrOnchip.RESet

; messaging setup
NEXUS.BTM ON
NEXUS.DTM Write

; filter settings
TrOnchip.Alpha ProgramTraceON
TrOnchip.Beta ProgramTraceOFF
Break.Set memcpy /Program /Alpha
Break.Set memcpy+0x78 /Program /Beta

Go

...

Break

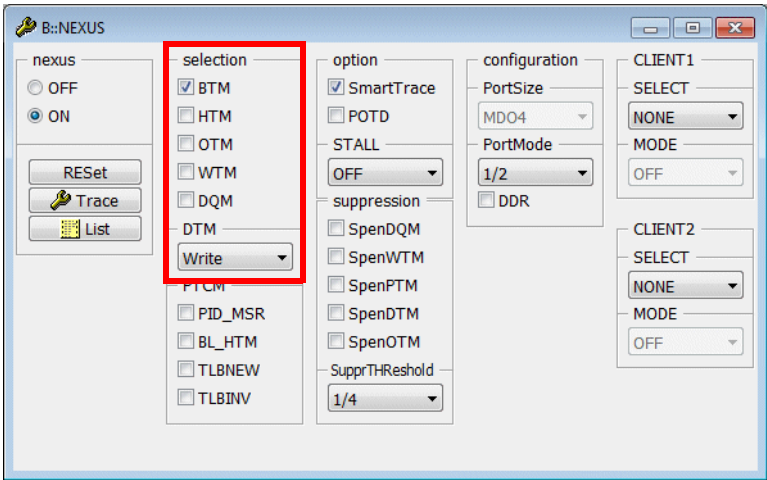
; display result
Trace.List
```

Controlled message types

WTM	BTM	DTM	OTM	DQM
Unused	Unaffected	Filter applies	Unaffected	Unaffected

Enable the Data Trace Messaging as required for the analysis.

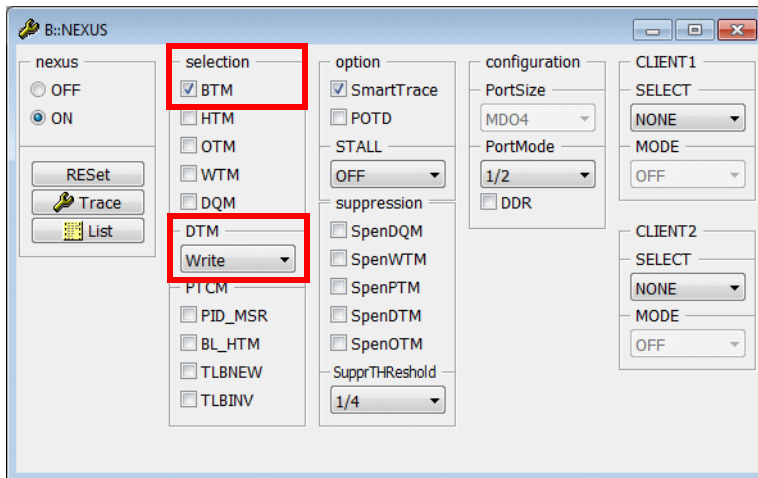
Disable messages types that are unaffected and not required for the analysis.



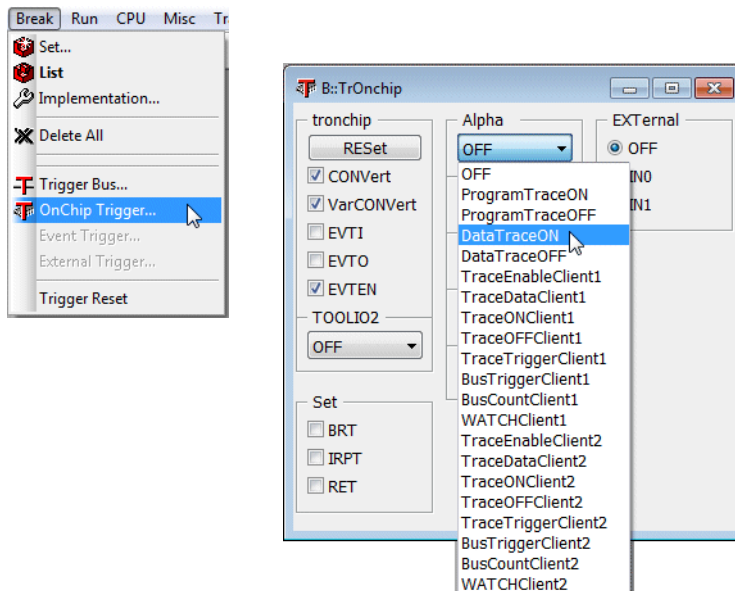
Example:

Enable Branch Trace messaging. Advise the NEXUS module to start the generation of Data Write Messages at the entry to the function OSInterruptDispatcher1. Advise the NEXUS module to stop the generation of Data Write Messages at the exit of the function OSInterruptDispatcher1.

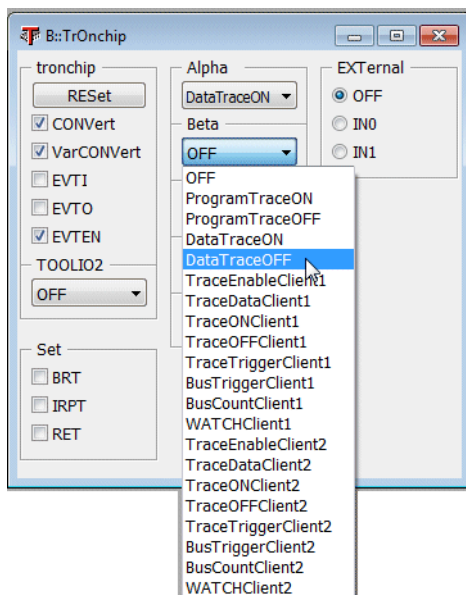
1. Enable Branch Trace messaging and Data Trace messaging for write accesses.



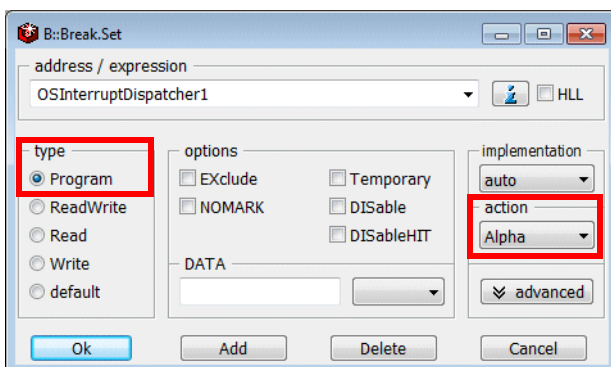
2. Open the TrOnchip window and select DataTraceON for Alpha.



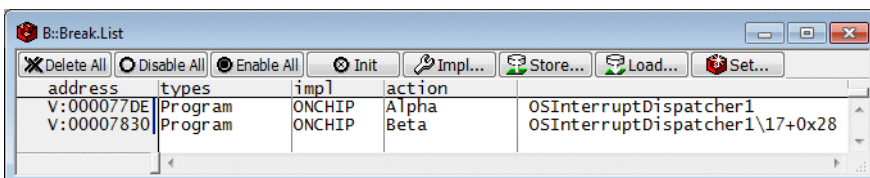
3. Select DataTraceOFF for Beta.



4. Set a Program breakpoint to the entry of the function OSInterruptDispatcher1 and select the action Alpha.



5. Set a Program breakpoint to the exit of the function OSInterruptDispatcher1 and select the action Beta.



6. Start and stop the program execution.

7. Display the result.

The screenshot displays the B::Trace.List application window. The top menu bar includes options like Setup..., Goto..., Find..., Chart, Profile, MIPS, More, and Less. The main window is divided into two panes. The upper pane shows assembly code with columns for record, run, address, cycle, data, and symbol. The code is for a function named OSInterruptDispatcher1, which includes logic for getting the core ID, setting up the interrupt priority, and restoring the interrupt level. The lower pane shows a timeline of events with columns for time, address, data, and symbol. The timeline shows various events occurring between 1.675us and 0.390us, including stack starts and interrupt dispatcher calls.

record	run	address	cycle	data	symbol
546	0	void OSInterruptDispatcher1(void)			ti.back
0	0	e_stwu r1,-0x40(r1)		r1,-64(r1)	
0	0	e_stmw r19,0x0C(r1)		r19,12(r1)	
0	0	se_mflr r0			
0	0	e_stw r0,0x44(r1)		r0,68(r1)	
0	0	{			
0	0	#if (OSNISR > 0)			
549	0	OSGETCOREID		/* get core Id */	
0	0	mfspr r31,spr286		coreId,pir	
0	0	e_rlwinm r25,r31,0x2,0x0E,0xD		r25,coreId,2,14,29	
0	0	e_addl6i r27,r13,-0x7FB8		r27,r13,-32696	
0	0	e_lis r28,-0x80000		r28,-720896	
0	0	lwzx r8,r27,r25			
0	0	e_addl6i r28,r28,-0x7FF8		r28,r28,-32760	
0	0	lwzx r26,r8,r28		oldPri,r8,r28	
0	0	#endif			
563	0	isrPtr = &(OsIsrTable[OsIsr[OSINTC_IACKR >> 2]]);			
0	0	e_lis r29,0x10000		r29,65536	
0	0	e_lwz r11,0x8(r8)		r11,8(r8)	
0	0	e_addl6i r29,r29,-0x6C94		r29,r29,-27796	
0	0	e_rlwinm r12,r11,0x1F,0x1,0x1E		r12,r11,31,1,30	
0	0	lhax r0,r12,r29			
0	0	e_lwz r7,0x0(r8)		r7,0(r8)	
0	0	e_li r23,0x0		r23,0	
0	0	e_lis r30,0x40000000		isrPtr,OsTASKRCV1Stack	
0	0	e_lwi r6,r0,0x2		r6,r0,2	
0	0	e_addl6i r30,r30,0xCC8		isrPtr,3272	
0	0	se_add r0,r6			
0	0	se_extzh r31		coreId	
0	0	...			
0	0	#endif			
0	0	#if defined(OSAPPLICATION)			
0	0	#if defined(OSISRENTREYEXIT)			
0	0	OSAPPLICATIONTYPE curApp;			
0	0	#endif			
0	0	#endif			
0	0	#if defined(OSUSEISRLEVEL)			
561	0	oldPri = OSISRGetPrio();		/* get the previous IPL (before reading IACKR) */	
0	0	se_slwi r0,0x2		r0,2	
0	0	se_cmpi r26,r7		oldPri,r7	
0	0	se_add r30,r0		isrPtr,r0	
0	0	...			
0	0	#endif /* defined(OSCHECKCONTEXT) */			
0	0	OSEOIR();		/* restore IPL */	
0	0	return;			
0	0	#endif /* !defined(OSNOISR1) */			
0	0	#if defined(OSUSEISRLEVEL)			
585	0	if(oldPri >= OSISRGetPrio())			
0	0	se_blt 0x7850			
-0021791622	0	D:40001EF4 wr-long	00000000	00000000	\\sample1\\Global_OsOrtiStackStart+0xEB4 1.675us
-0021791620	0	D:40001EF8 wr-quad	0000000000000000	0000000000000000	\\sample1\\Global_OsOrtiStackStart+0xEB8 0.905us
-0021791619	0	D:40001F00 wr-quad	0000000000000000	0000000000000000	\\sample1\\Global_OsOrtiStackStart+0xEC0 0.645us
-0021791618	0	D:40001F08 wr-quad	000000014400009A0	000000014400009A0	\\sample1\\Global_OsOrtiStackStart+0xEC8 0.645us
-0021791616	0	D:40001F10 wr-quad	40000A00FF48008	40000A00FF48008	\\sample1\\Global_OsOrtiStackStart+0xED0 0.900us
-0021791614	0	D:40001F18 wr-quad	400009E800000000	400009E800000000	\\sample1\\Global_OsOrtiStackStart+0xED8 1.160us
-0021791612	0	D:40001F20 wr-quad	0000000000000000	0000000000000000	\\sample1\\Global_OsOrtiStackStart+0xEE0 1.160us
-0021791611	0	D:40001F2C wr-long	0000912C	0000912C	\\sample1\\Global_OsOrtiStackStart+0xEEC 0.645us
-0021791610	0	V:00007850 ptrace			\\sample1\\osISR\\OSInterruptDispatcher1+0x72 0.390us
0	0	e_addl6i r24,r13,-0x7FE0		r24,r13,-32736	
0	0	lwzx r5,r24,r25			
0	0	e_addl6i r12,r13,-0x7FB0		r12,r13,-32688	

Example for TraceTrigger

Resource: Watchpoints and logic in NEXUS Adapter (parallel trace only)

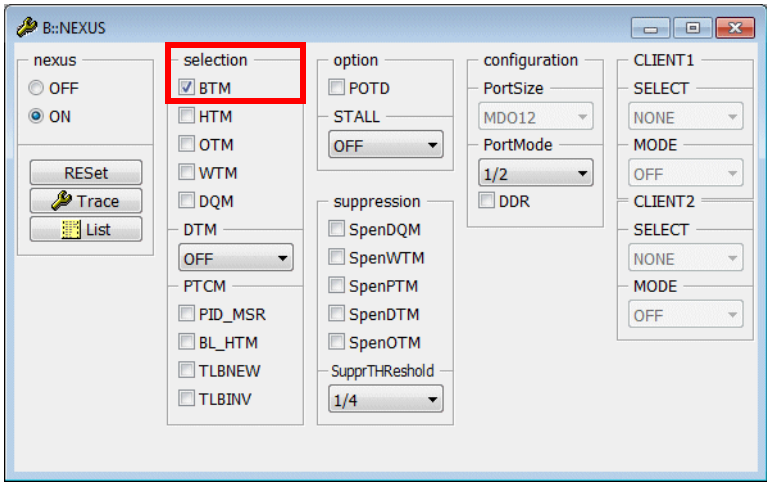
Controlled message types

WTM	BTM	DTM	OTM	DQM
Watchpoint Hit Message(s) is generated for the specified instruction(s) or data address+data value	Unaffected	Unaffected	Unaffected	Unaffected

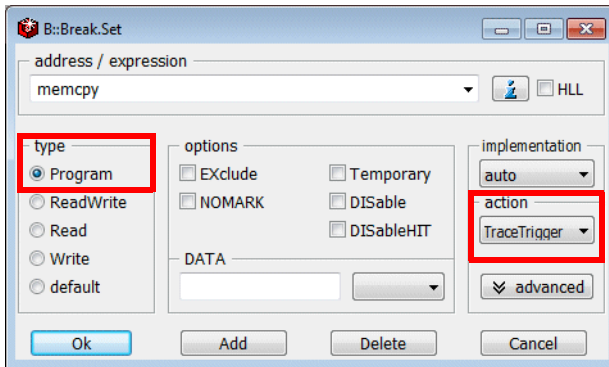
Disable messages types that are unaffected and not required for the analysis.

Example: Enable Branch Trace messaging. Advise the NEXUS module to generate a trigger for the trace if the function memcpy is entered. Use this trigger to stops the trace recording.

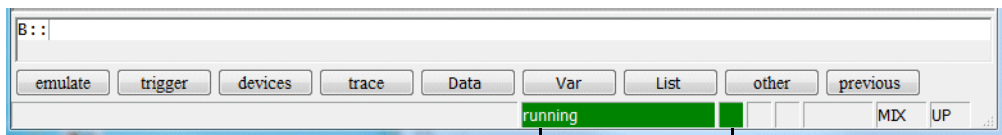
- 1. Enable Branch Trace messaging.



2. Set a Program breakpoint to the start address of the function memcpy and select the action TraceTrigger.

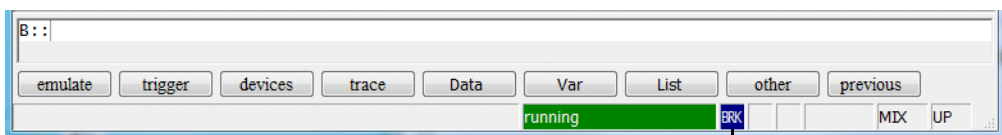


3. Start the program execution.



State of the
program execution
(running)

State of the
trace recording
(Arm = recording)



State of the
trace recording
(BRK = break by trigger,
recording is stopped)

4. Display the result.

record	run	address	cycle	data	symbol	ti.back
-0000000014	0	V:0000287C	ptrace		\\sample1\ossch\OSTaskForceDispatch+0x8E	0.385us
0	0	lwzx	r0,r29,r31			
0	0	se_bclri	r0,0x8	; r0,8		
0	0	stwx	r0,r29,r31			
0	0	e_add16i	r11,r13,-0x7FD0	; r11,r13,-32720		
0	0	lwzx	r0,r11,r31			
0	0	e_add16i	r6,r13,-0x7FA0	; r6,r13,-32672		
0	0	lwzx	r7,r6,r31			
0	0	cntlzw	r10,r0			
0	0	e_slwi	r10,r10,0x2	; r10,r10,2		
0	0	lwzx	r5,r10,r7			
0	0	e_addi	r3,r1,0x8	; r3,r1,8		
0	0	se_stw	r3,0x18(r28)	; r3,24(r28)		
0	0	stwx	r5,r27,r31			
0	0	e_b1	0x913E	; OSSetJmp		
-0000000013	1	V:00003BEE	ptrace		\\sample1\osioc\OS_OSiocWriteAcrossRef+0xBA	8.640us
1	1	se_lwz	r3,0x0(r31)	; commId,0(r31)		
1	1	se_lhz	r5,0x4(r31)	; r5,4(r31)		
1	1	e_b1	0x19C6	; memcpy		

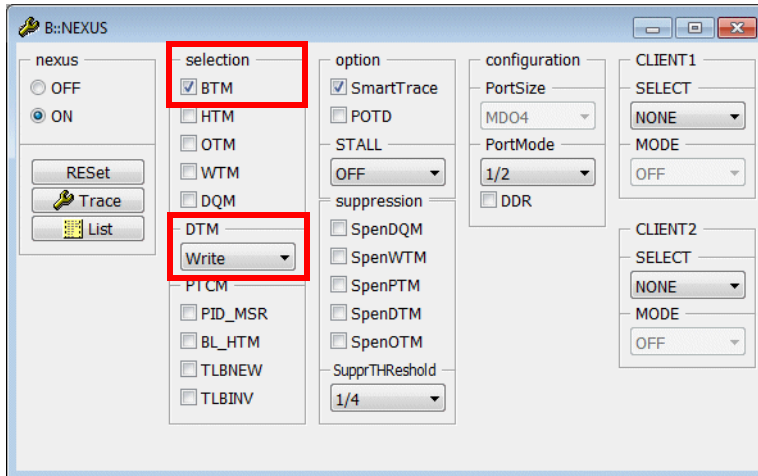
The trace generation is usually stopped before the trace information for the event that caused the trigger is exported.

Example for TraceTrigger with a Trigger Delay

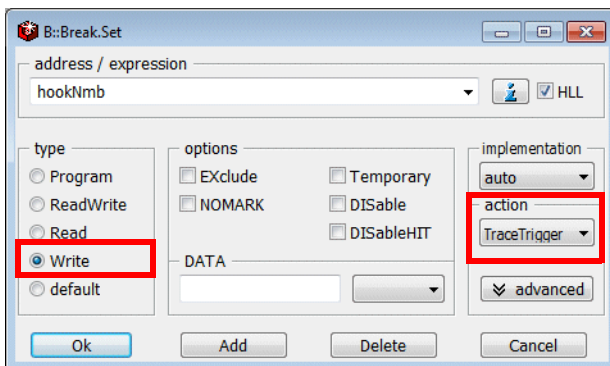
Example:

Advise the NEXUS module to generate a trigger if a write access to the variable hookNmb occurs. Advise TRACE32 to fill another 10% of the trace memory before the trace recording is stopped.

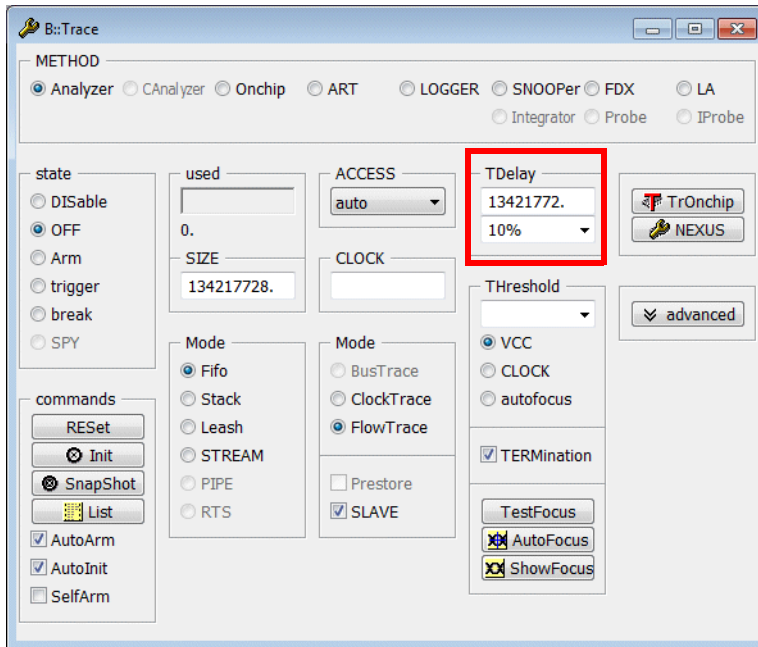
1. Enable Branch Trace messaging and Data Trace messaging for write accesses.



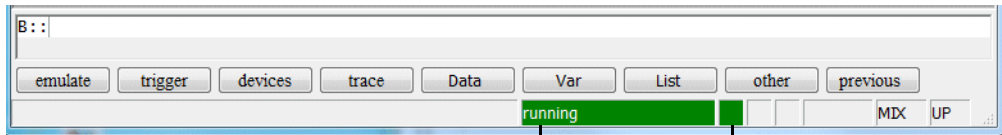
2. Set a Write breakpoint to the variable hookNmb and select the action TraceTrigger.



3. Define the trigger delay in the **Trace Configuration** Window.

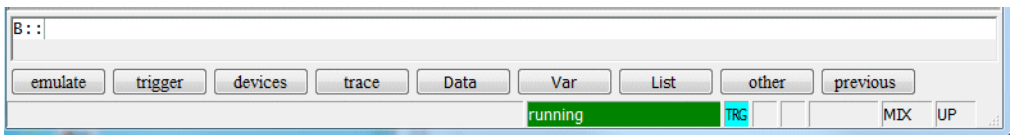


4. Start the program execution.

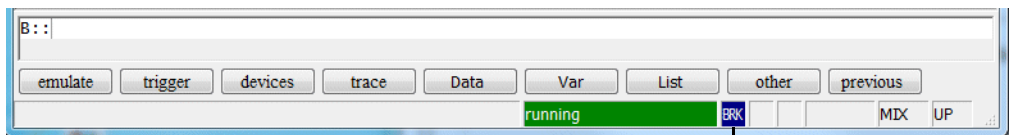


State of the
program execution
(running)

State of the
trace recording
(Arm = recording)

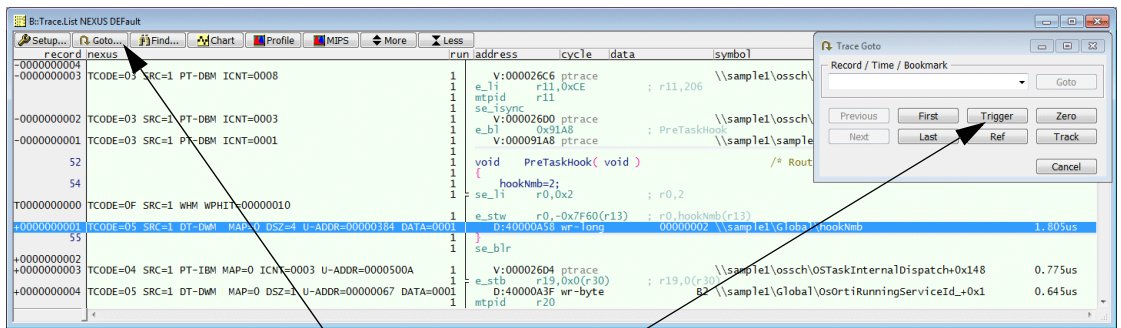


State of the
trace recording
(TRG = trigger occurred,
delay counter started)



State of the
trace recording
(BRK = delay counter elapsed,
recording is stopped)

5. Display the result.



Push the **Trigger** button in the **Trace Goto** window to find the record, where the trigger occurred (WHM message). Here the sign of the record numbers changed. The specified event is usually exported shortly after this point.

Example for BusTrigger

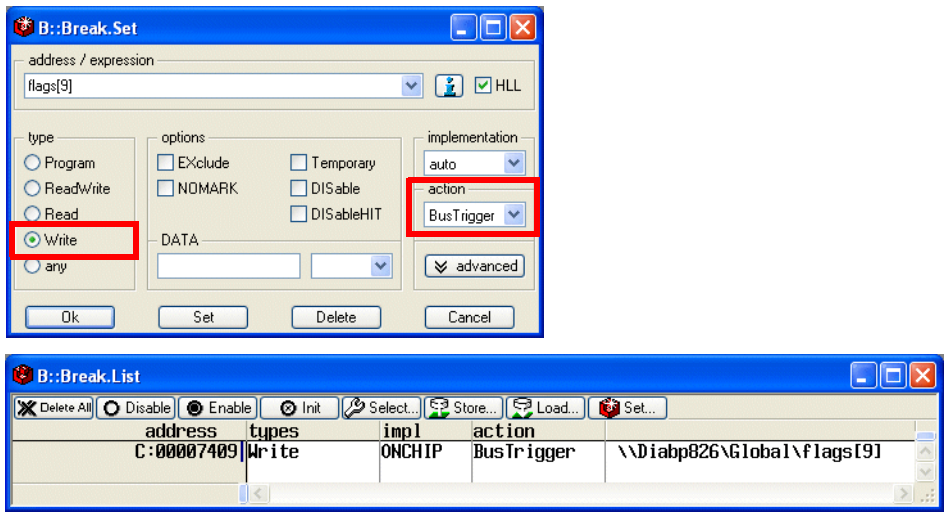
Resource: Watchpoints and logic in NEXUS Adapter (parallel trace only)

Controlled message types

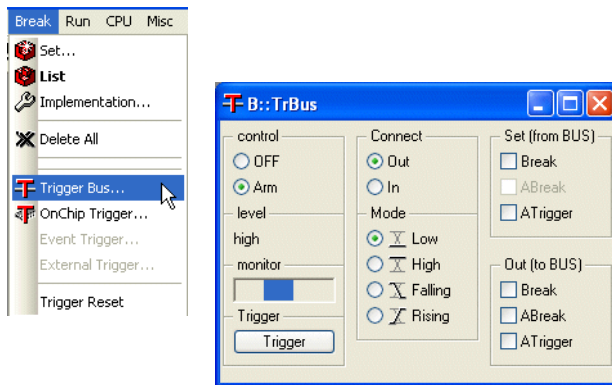
WTM	BTM	DTM	OTM	DQM
Watchpoint Hit Message(s) is generated for the specified instruction(s) or data address+data value	Unaffected	Unaffected	Unaffected	Unaffected

Example: Generate a 100 ns high pulse on the trigger connector of the POWER TRACE / ETHERNET or POWER DEBUG II when 3 is writes to hookNmb.

1. Set a write breakpoint to the variable flags[9] and select the action BusTrigger.



2. Start the program execution.
3. Open the **TrBus** window to watch the trigger.



Example for BusCount (Watchpoint)

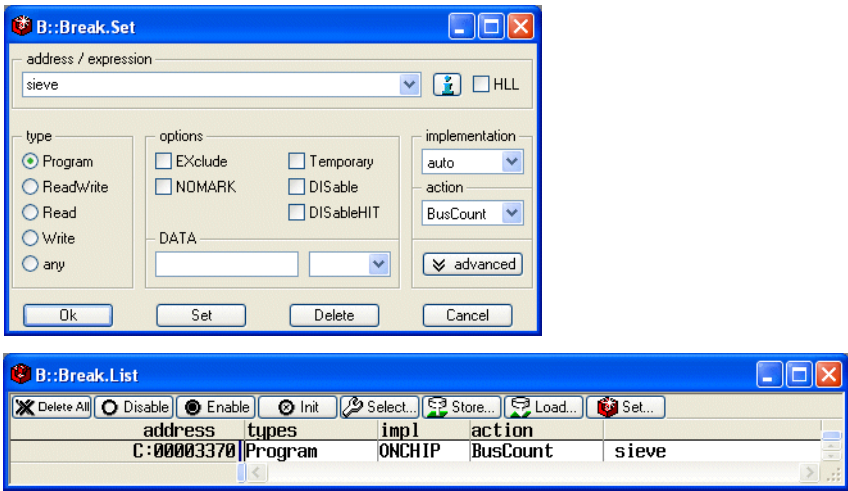
Resource: Watchpoints and logic in NEXUS Adapter (parallel trace only). Only one event possible.

Controlled message types

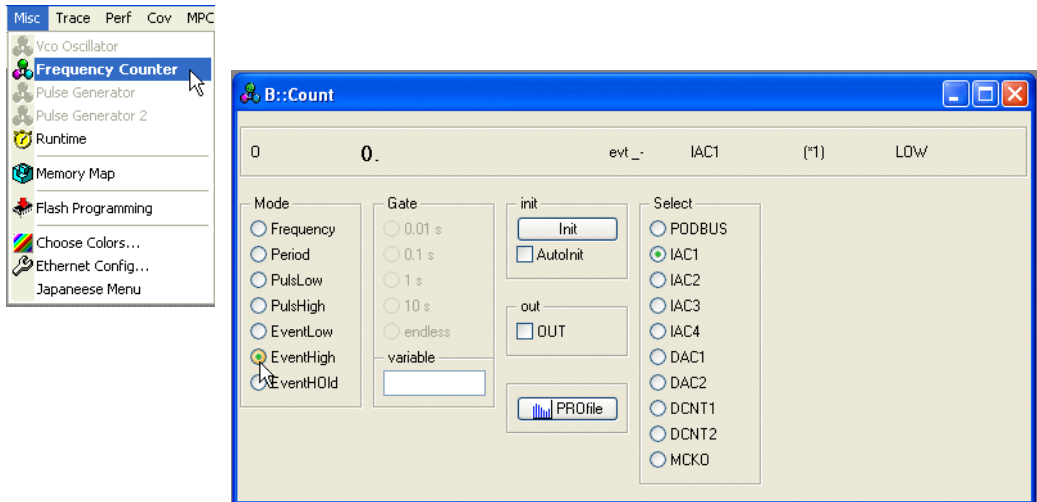
WTM	BTM	DTM	OTM	DQM
Watchpoint Hit Message(s) is generated for the specified instruction(s) or data address+data value	Unaffected	Unaffected	Unaffected	Unaffected

Example 1: Count how often the function sieve is called.

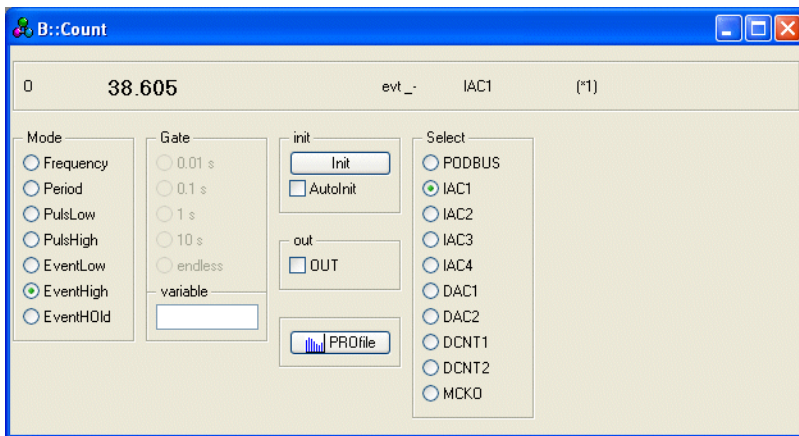
1. Set a program breakpoint to the start address of the function sieve and select the action BusCount.



2. Open the TRACE32 counter window and select EventHigh.

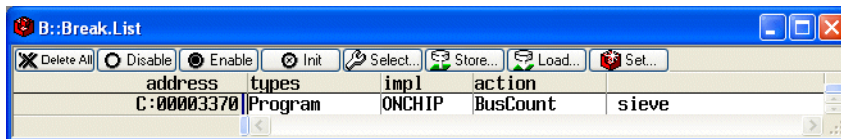
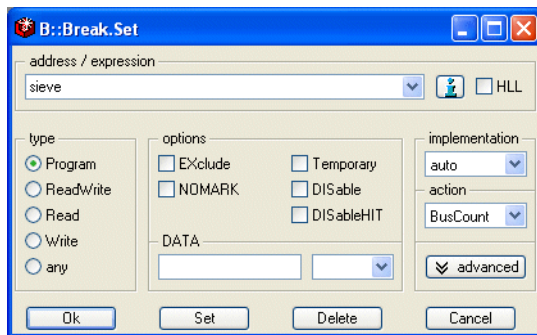


3. Start the program execution and display the result.

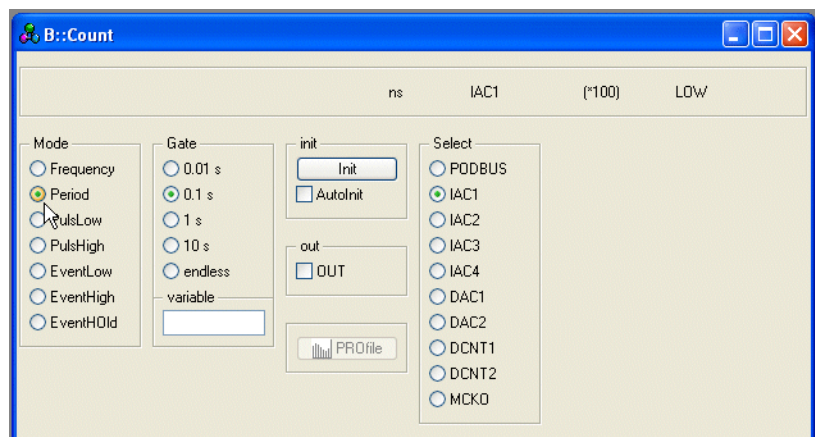
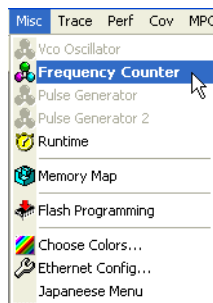


Example 2: Measure the period in which the function sieve is called.

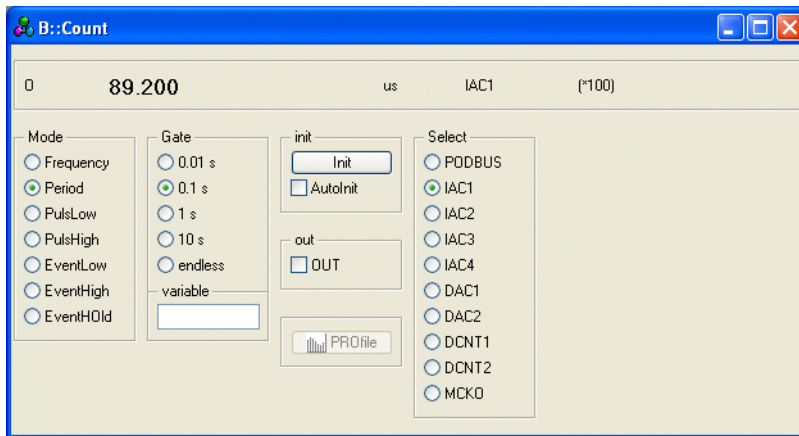
1. Set a program breakpoint to the function sieve and select the action BusCount.



2. Open the TRACE32 counter window and select Period.

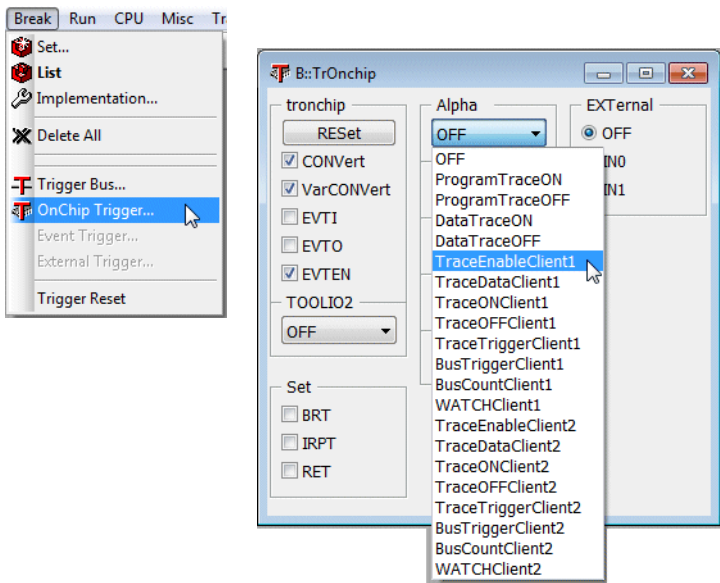


3. Start the program execution and display the result.

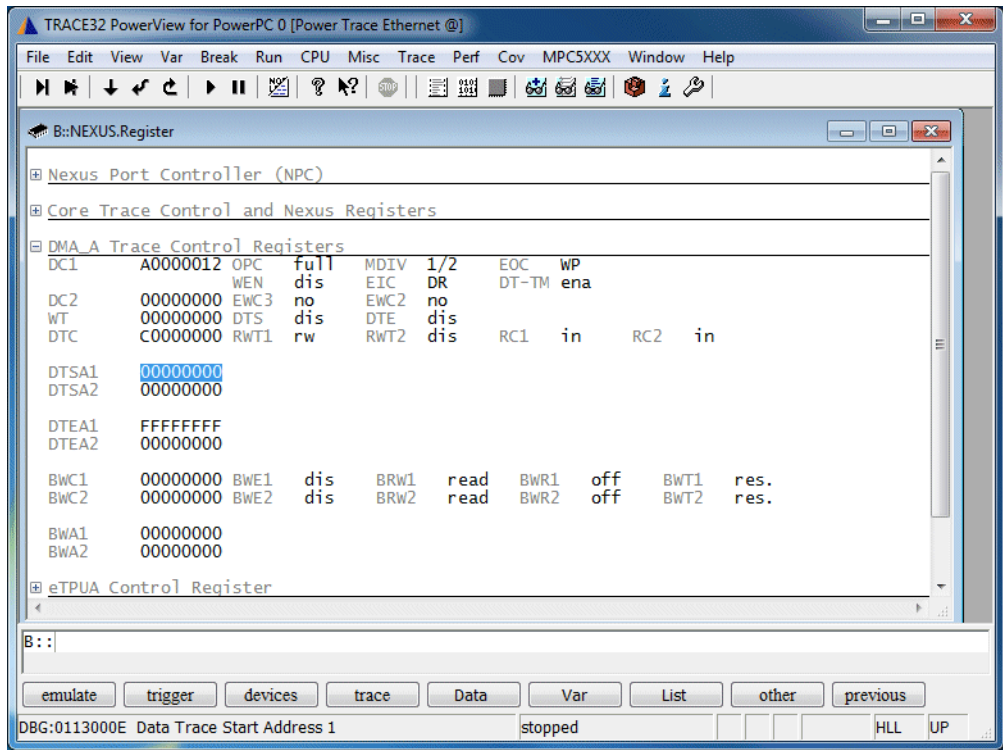


Filter and Trigger (Trace Clients)

The filter and trigger feature for the Trace Clients are provided via the *TrOnchip* window.



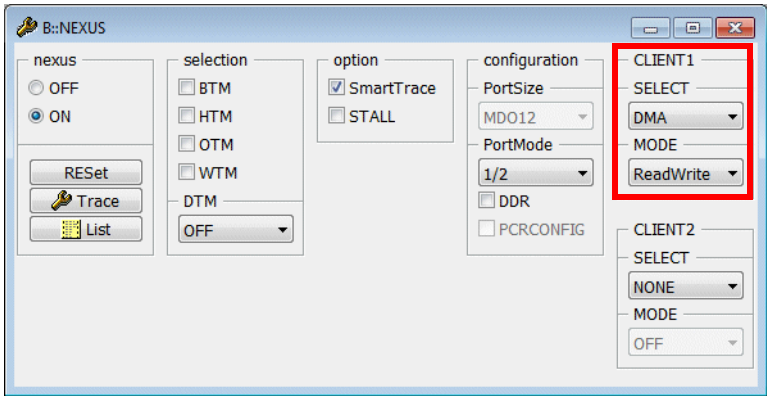
Trace Clients have their own resources in the NEXUS module. E.g. DMA client on MPC5554.



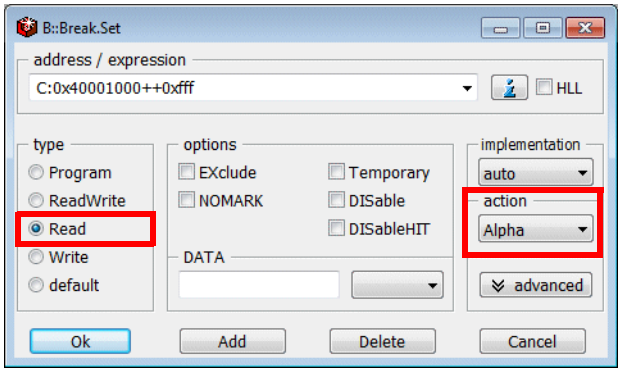
Example for TraceEnableClient1

Example MPC5554: Sample only DMA reads from address 0x40001000++0FFF.

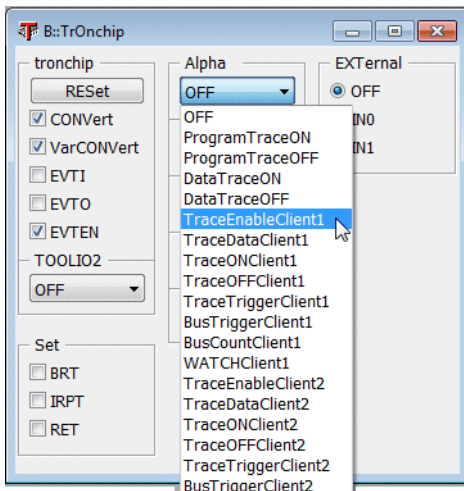
- 1. Select DMA a Trace Client1



- 2. Set a Read breakpoint to the address range 0x40001000++0FFF and select Alpha as breakpoint action.



3. Select `TraceEnableClient1` for Alpha in the **TrOnchip** window.



4. Start and stop the program.
5. Display the result.

The screenshot shows the B::Trace.List window with a table of trace data. The table has columns for record, run, address, cycle, data, symbol, and ti.back. The data shows a sequence of memory accesses at addresses D:400010C8 through D:400010E4, all with a cycle value of 02102900 and a time interval of 5.000us.

record	run	address	cycle	data	symbol	ti.back
-00000042		D:400010C8	rd-dma	02102900		5.000us
-00000040		D:400010CC	rd-dma	02102900		5.000us
-00000038		D:400010D0	rd-dma	02102900		5.000us
-00000036		D:400010D4	rd-dma	02102900		5.000us
-00000034		D:400010D8	rd-dma	02102900		5.000us
-00000032		D:400010DC	rd-dma	02102900		5.000us
-00000030		D:400010E0	rd-dma	02102900		5.000us
-00000028		D:400010E4	rd-dma	02102900		5.000us

Activate the TRACE32 OS Awareness

TRACE32 includes a configurable target-OS debugger to provide symbolic debugging of operating systems.

Since most users use an AUTOSAR operating system, this is taken as an example here.

In order to provide AUTOSAR-aware tracing an ORTI file is required. The ORTI file is created by the AUTOSAR System Builder. It describes the structure and the memory mapping of the operating system objects.

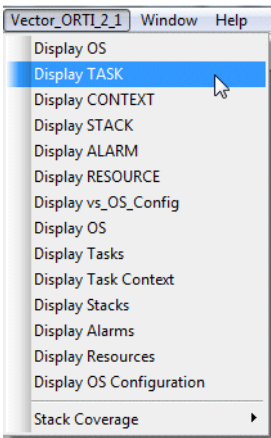
Setup command:

TASK.ORTI <ORTI_file>

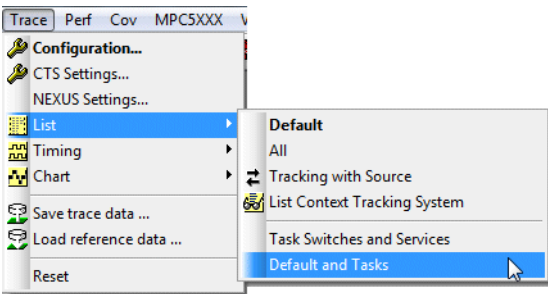
Load the ORTI file into TRACE32

Loading the ORTI file results in the following:

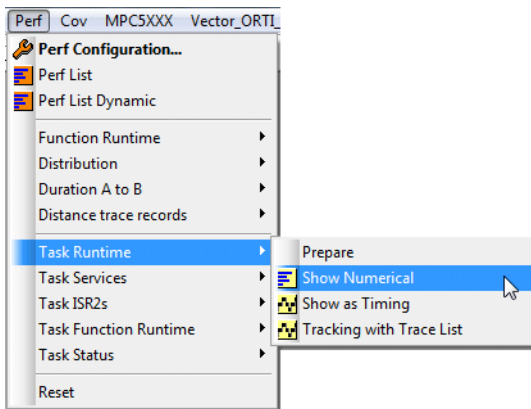
- Symbolic debugging of the OSEK OS is possible. Debug commands are provided via an ORTI menu.



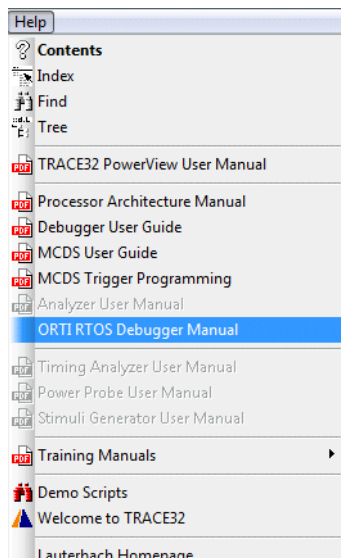
- The **Trace** menu is extended for OS-aware trace display.



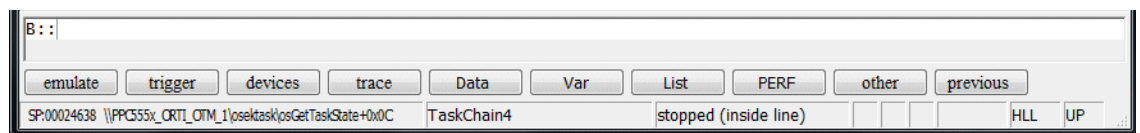
- The **Perf** menu is extended for OS-aware profiling.



- The manual of the OS Awareness for OSEK/**ORTI** is added to the **Help** menu.



- The name of the current task is displayed in the **Task** field of the TRACE32 state line.



Task field

Exporting Task Information (Overview)

There are two methods how task information can be generated by the NEXUS hardware module:

- **By generating an Ownership Trace Messages**

This method should be used if supported by the OSEK operating system. It is the only method for NEXUS Class 2 Modules.

- **By generating trace information for a specific write access**

This method requires a NEXUS Class 3 Module. It should be used, if the OSEK operating system does not support Ownership Trace Messages.

Exporting all Types of Task Information (OTM)

Ownership Trace Messages are generated when the OS updates

- the 8-bit Process ID register (PID0) - all compliant standards
- NEXUS PID Register (NPIDR) - IEEE-ISTO 5001-2012 compliant NEXUS module

PID0/NPIDR are updated by the OS on

- task switches
- entries and exits to service routines
- starts of ISR2 interrupt service routines and NO_ISR information

AUTOSAR OSs perform this update since 10/2010.

If you are using a IEEE-ISTO 5001-2003/2008 compliant NEXUS module and your task ID is longer the 8-bit, the PID0 register has to be updated in several steps. This requires special support from your OS. If your OS does not provide this special support, Lauterbach can provide you patch information. Please contact **support@lauterbach.com** for details.

The generation of Ownership Trace Messages has to be enabled within TRACE32.

```
NEXUS.OTM ON           ; enable the generation of Ownership Trace
                        ; Messages
```

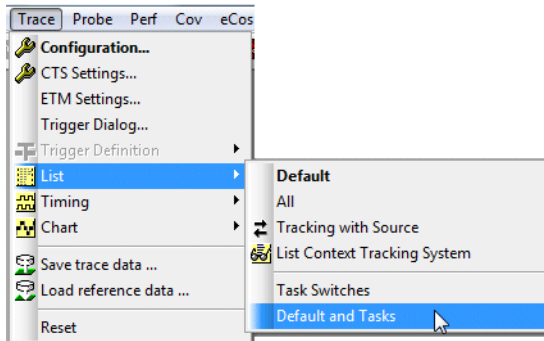
Example:

1. Advise the NEXUS hardware module to generate only Ownership Trace Messages.

```
NEXUS.BTM OFF ; disable the Branch Trace
                  ; Messages

NEXUS.OTM ON ; enable the Ownership Trace
                ; Messages
```

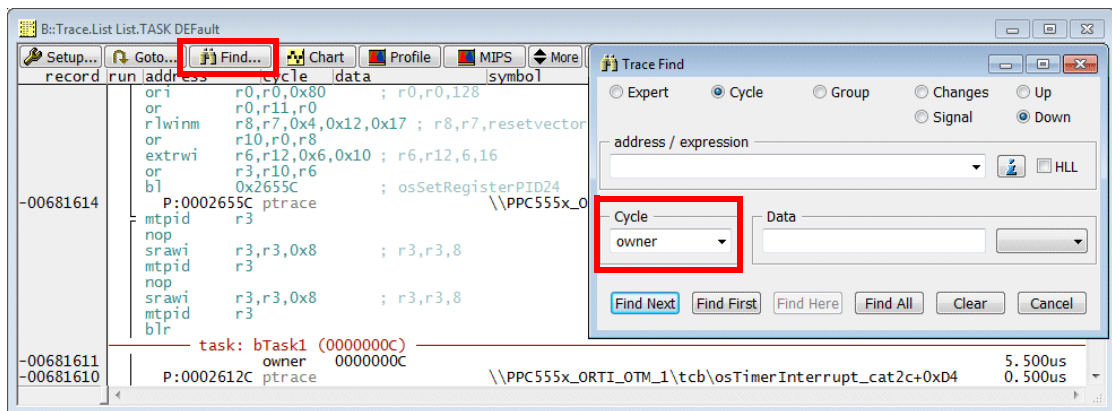
2. Start and stop the program execution to fill the trace buffer.
3. Display the result.



record	run	address	cycle	data	symbol	ti.back
-0000000064	---	ISR2 = ISR2	---	intr 00000003		50.000us
-0000000062	---	ISR2 = NO_ISR	---	intr 00000005		35.500us
-0000000060	---	SERVICE = OServiceId_ResumeAllInterrupts	exit ---	service 00000030		13.005us
-0000000058	---	SERVICE = OServiceId_ChainTask	entry ---	service 00000025		11.250us
-0000000056	---	SERVICE = OServiceId_PostTaskHook	entry ---	service 000000B5		19.250us
-0000000054	---	SERVICE = OServiceId_GetTaskID	entry ---	service 00000029		7.000us
-0000000052	---	SERVICE = OServiceId_GetTaskID	exit ---	service 00000028		7.750us
-0000000050	---	SERVICE = OServiceId_PostTaskHook	exit ---	service 000000B4		11.250us
-0000000048	---	task: TASK1 (00000008)	---	owner 00000008		19.000us
-0000000046	---	SERVICE = OServiceId_ChainTask	exit ---	service 00000024		14.000us

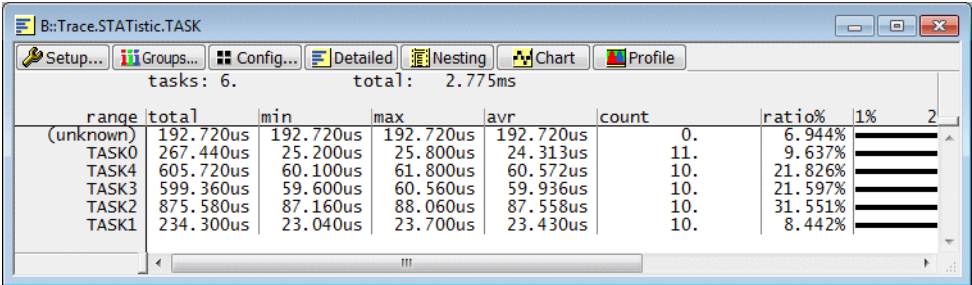
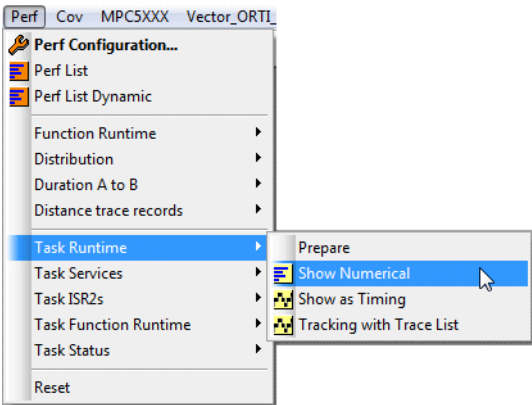
<i>cycle types</i>	
owner	Ownership trace message for task switches
service	Ownership trace message for entries and exits to OSEK service routines
intr	Ownership trace message for start of OSEK interrupt service routine and NO_ISR information

TRACE32 allows to search for all available cycle types e.g. owner:

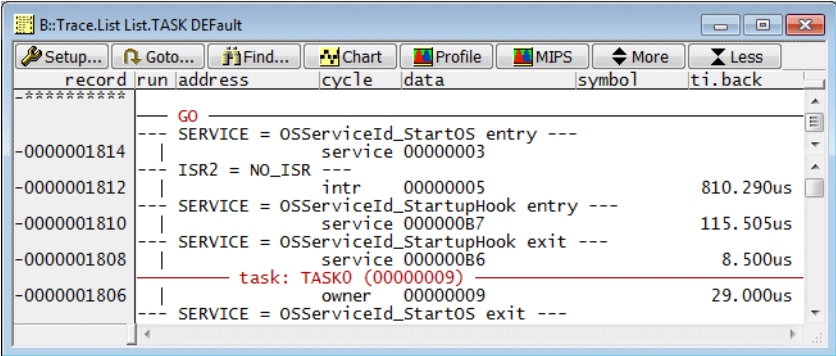


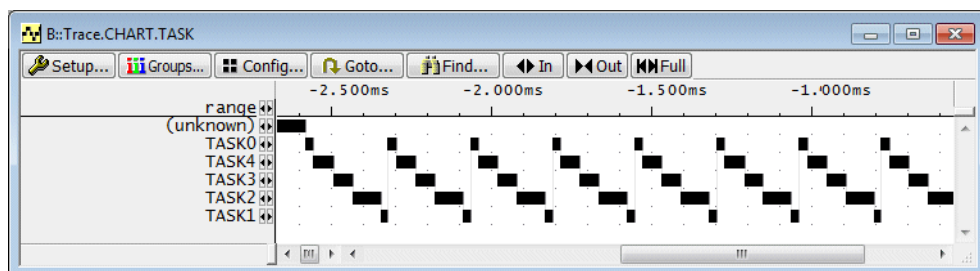
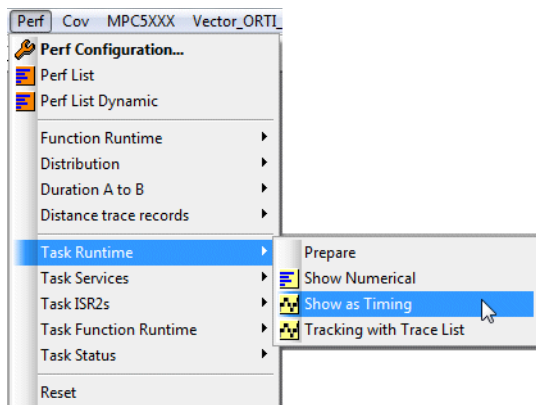
Statistic Analysis of Task Switches

The following two commands perform a statistical analysis of the task switches:



TRACE32 assigns all trace information generated before the first **task** information to the **(unknown)** task.

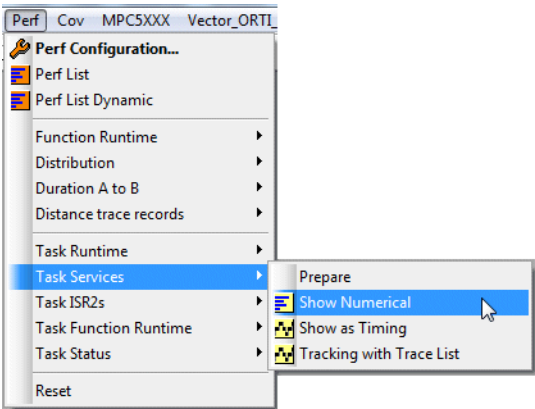




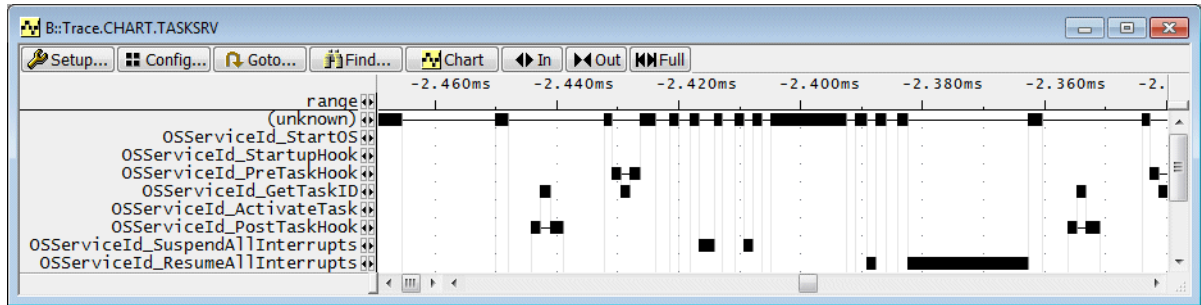
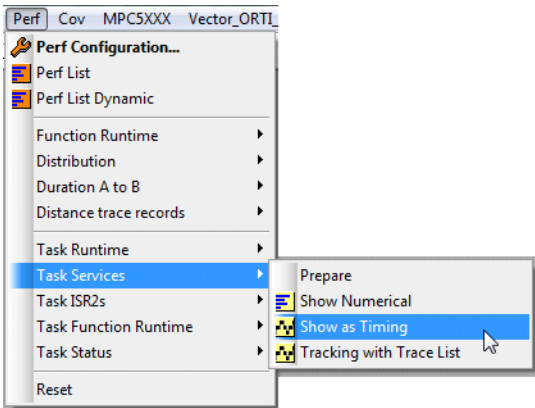
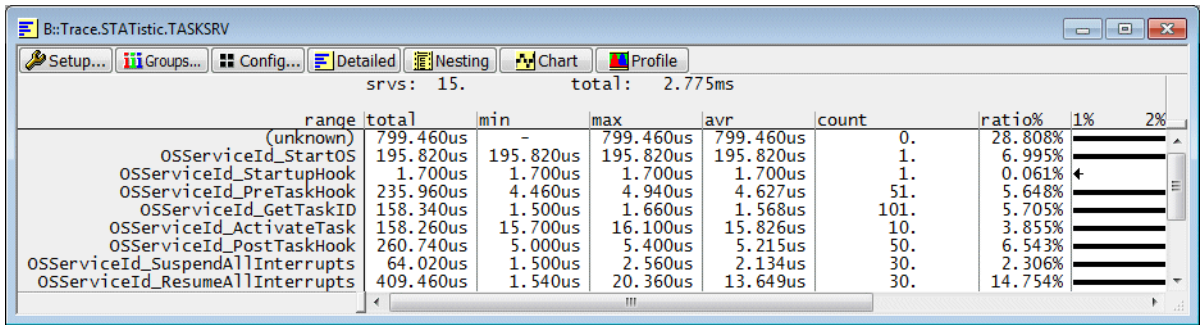
Trace.STATistic.TASK	Task runtime statistic
Trace.Chart.TASK	Task runtime time chart

Statistic Analysis of OSEK Service Routines

The following two commands perform a statistical analysis of the OSEK service routines:



(unknown) represents the time in which the processor/core is not in an OSEK service routine



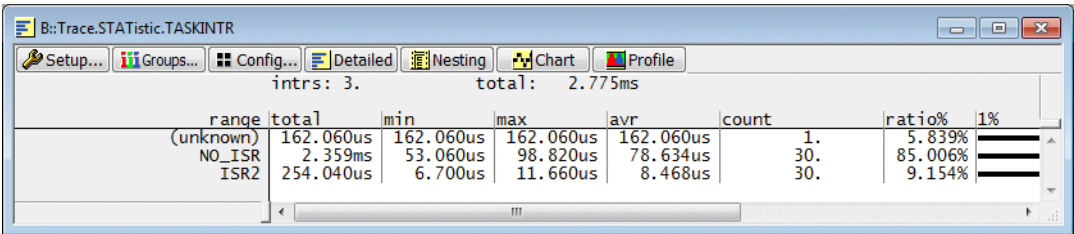
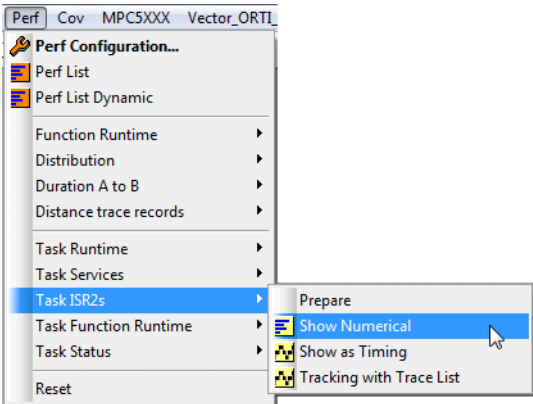
Trace.STATistic.TASKSRV

Statistic on service routines

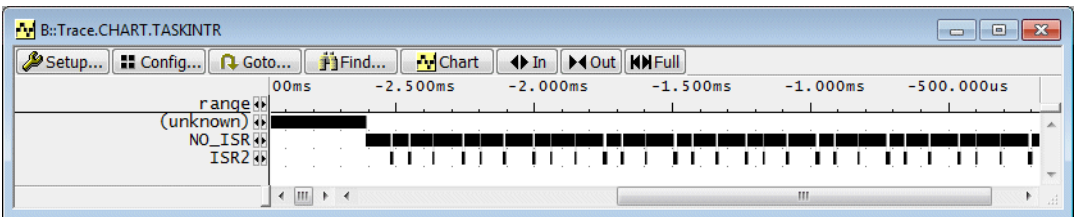
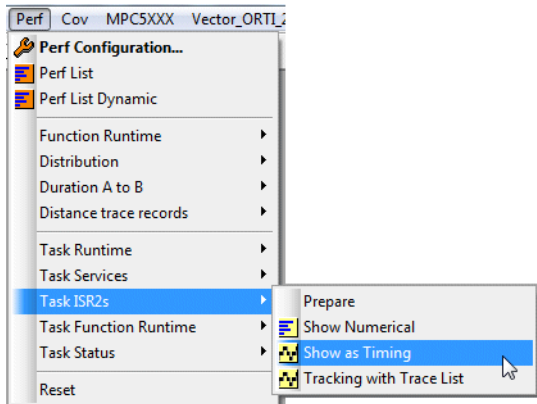
Trace.Chart.TASKSRV

Time chart on service routines

The following two commands perform a statistical analysis of the OSEK interrupt service routines:



TRACE32 assigns all trace information generated before the first **intr** information to **(unknown)**.

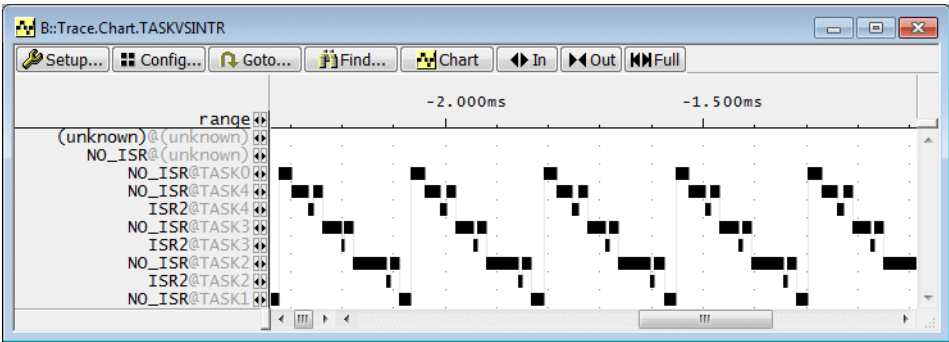
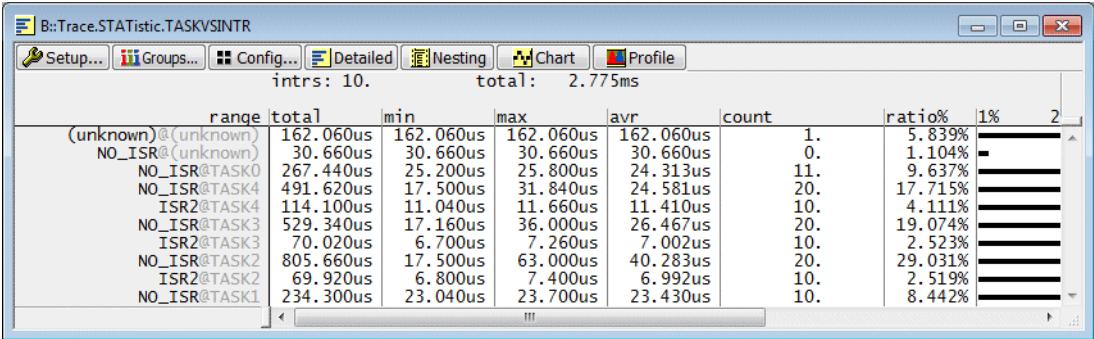


Trace.STATistic.TASKINTR	Statistic on interrupt service routines
Trace.Chart.TASKINTR	Time chart on interrupt service routines

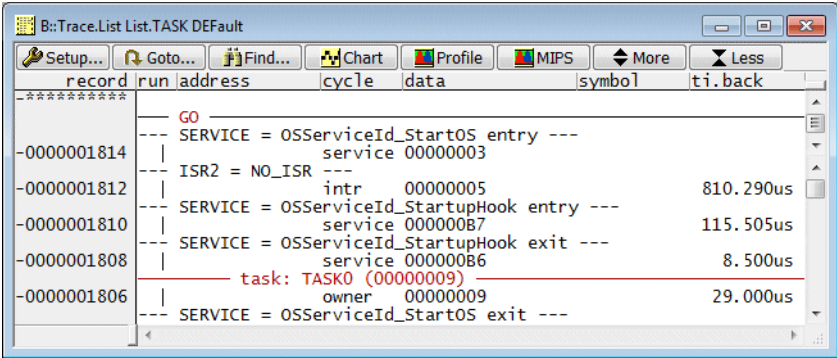
Statistic Analysis of Task-related OSEK ISR2s

The following command allows to perform a statistical analysis of the OSEK interrupt service routines related to the active tasks.

Trace.STATistic.TASKVSINTR	Task-related statistic on interrupt service routines
Trace.Chart.TASKVSINTR	Time-chart for task related interrupt service routines



intr information that was generated before the first task information is assigned to the @(unknown) task.



Exporting all Types of Task Information and all Instructions (OTM)

General setup:

```
NEXUS.BTM ON ; enable the Branch Trace
; Messages

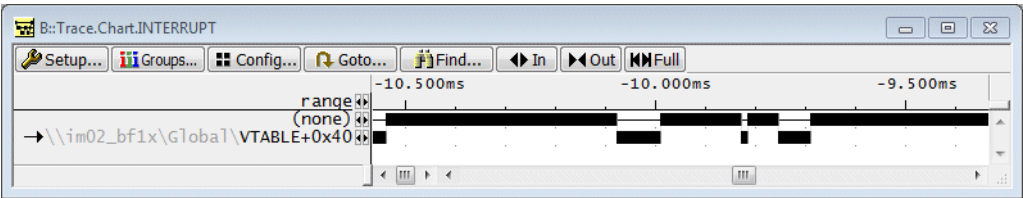
NEXUS.OTM ON ; enable the Ownership Trace
; Messages

Trace.STATistic.InterruptIsFunction ON ; advise TRACE32 to regard the
; time between interrupt entry
; and exit as function
```

Statistic Analysis of Interrupts

Trace.Chart.INTERRUPT

Interrupt time chart



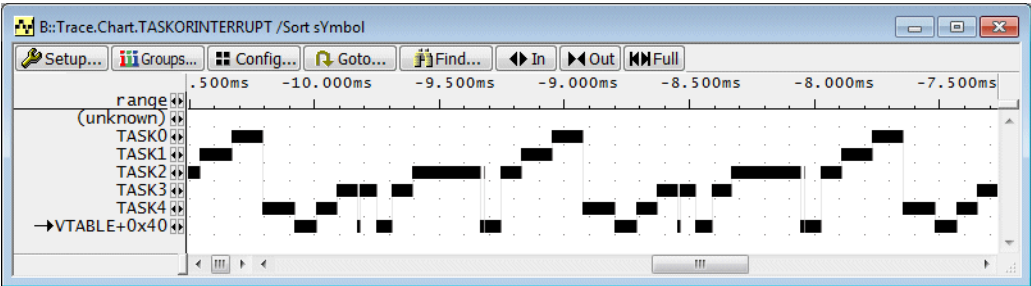
Trace.STATistic.INTERRUPT

Interrupt statistic

B::Trace.STATistic.INTERRUPT									
funcs: 2. total: 22.625ms intr: 2.460ms									
range	total	min	max	avr	count	intern%	1%	2%	
(none)	20.164ms	-	20.164ms	-	-	89.125%			
->\\im02_bf1x\\Global\\VTABLE+0x40	2.250ms	11.250us	71.005us	41.006us	60.	10.874%			

Trace.Chart.TASKORINTERRUPT

Time chart of interrupts and tasks



Trace.STATistic.TASKORINTERRUPT

Statistic of interrupts and tasks

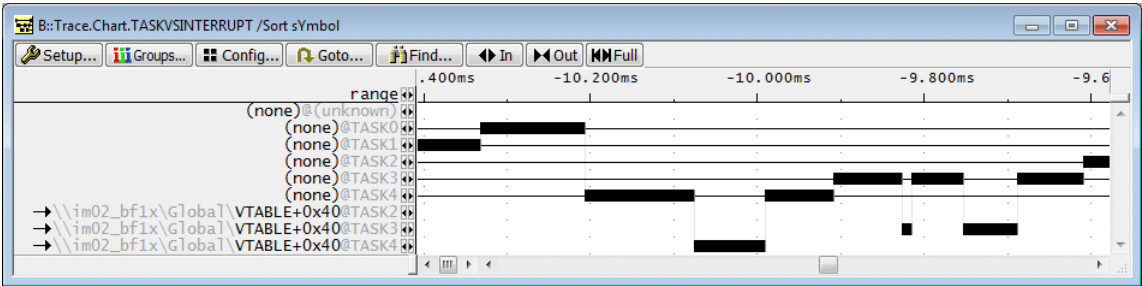
The screenshot shows a statistical summary window titled "B::Trace.STATistic.TASKORINTERRUPT /Sort sYmbol". The window displays a table with the following data:

range	total	min	max	avr	count	ratio%	1%	2%
(unknown)	9.705ms	9.705ms	9.705ms	9.705ms	0.	-		
TASK0	1.319ms	124.005us	129.005us	119.882us	11.	5.829%		
TASK1	1.228ms	121.505us	124.255us	122.806us	10.	5.428%		
TASK2	3.606ms	1.746us	278.010us	120.187us	30.	15.938%		
TASK3	2.227ms	61.500us	82.005us	74.243us	30.	9.845%		
TASK4	2.110ms	80.405us	130.755us	105.510us	20.	9.328%		
->VTABLE+0x40	2.426ms	11.000us	66.605us	40.436us	60.	10.725%		

Summary statistics: tasks: 7. total: 22.621ms

Trace.Chart.TASKVSINTERRUPT

Time chart interrupts, task-related



Trace.STATistic.TASKVSINTERRUPT

Statistic of interrupts, task-related

The screenshot shows a table titled "B:\Trace.STATistic.TASKVSINTERRUPT /Sort sYmbol". The table displays statistics for tasks TASK0 through TASK4. The columns are: range, total, min, max, avr, count, intern%, and 1%. The data is as follows:

range	total	min	max	avr	count	intern%	1%
(none)@(unknown)	0.000us	-	-	0.000us	0. (1/0)	-	-
(none)@TASK0	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK1	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK2	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK3	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK4	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
→ im02_bf1x\Global\VTABLE+0x40@TASK2	792.800us	13.250us	67.005us	39.640us	20.	3.504%	=====
→ im02_bf1x\Global\VTABLE+0x40@TASK3	779.805us	11.500us	66.755us	38.990us	20.	3.447%	=====
→ im02_bf1x\Global\VTABLE+0x40@TASK4	678.035us	20.750us	70.750us	44.465us	20.	3.931%	=====

Exporting Task Information (Write Access)

Task Switches

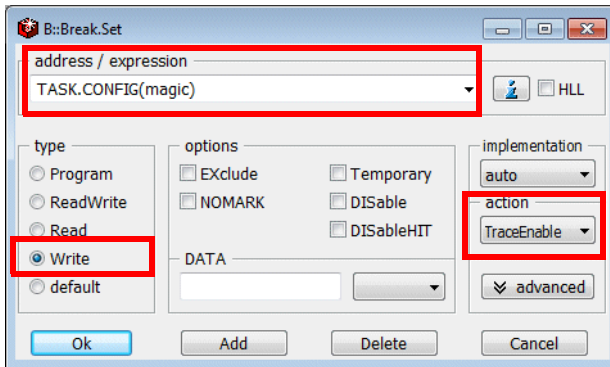
Each operating system has a variable that contains the information which task is currently running. One way to export task switch information is to advise the NEXUS hardware module to generate trace information when a write access to this variable occurs.

The address of this variable is provided by the TRACE32 function **TASK.CONFIG(magic)**.

```
PRINT TASK.CONFIG(magic)           ; print the address of the variable  
                                   ; that holds the task identifier
```

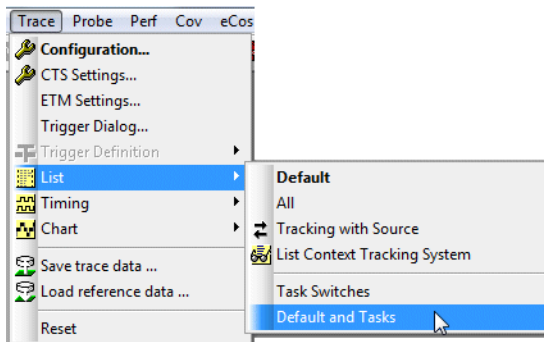
Example: Advise the NEXUS hardware module to generate only trace information on task switches.

1. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic) and select the trace action TraceEnable.



```
Break.Set TASK.CONFIG(magic) /Write /TraceEnable
```

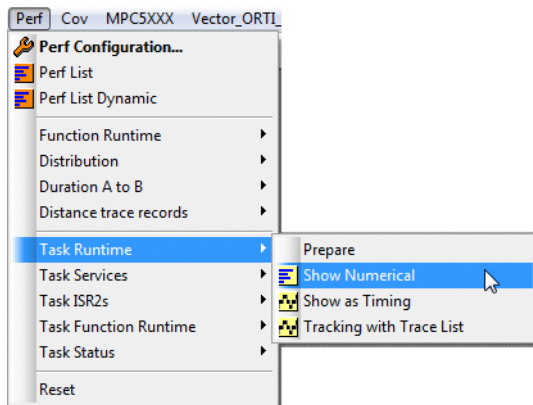
2. Start and stop the program execution to fill the trace buffer
3. Display the result.



The screenshot shows the 'Trace.List' window with the title 'B::Trace.List List.TASK Default'. The window displays a table of trace data with columns: record, run, address, cycle, data, symbol, and ti.back. The data shows several task switch events, including 'TASK = NO_TASK' and 'TASK = TaskChain4', with corresponding addresses and symbols.

record	run	address	cycle	data	symbol	ti.back
-00000021		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	111.160us
		TASK = NO_TASK	---	FFFF	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	697.320us
-00000020		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	110.980us
		TASK = TaskChain4	---	FFFF	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	697.320us
-00000019		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	111.160us
		TASK = NO_TASK	---	FFFF	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	697.320us
-00000018		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	111.160us
		TASK = TaskChain4	---	FFFF	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	697.300us
-00000017		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	111.000us
		TASK = TaskChain4	---	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	
-00000016		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	
-00000015		D:400008A0	wr-word	0008	\\PPC555x_ORTI_OTM_1\\Global\\osCtrlVars	
-00000014		BRK				

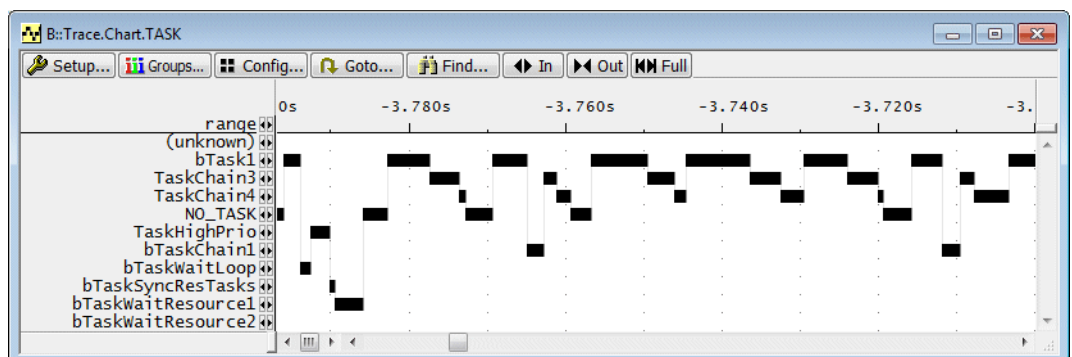
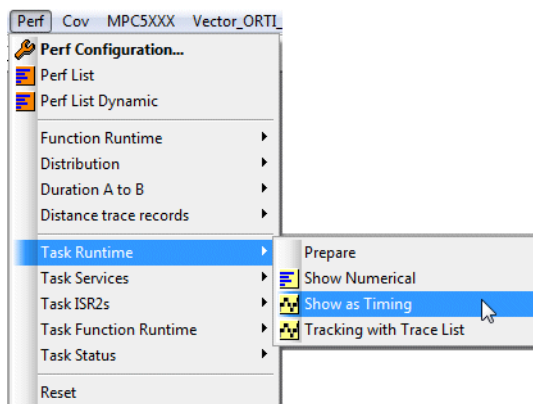
The following two commands perform a statistical analysis of the task switches:



B::Trace.STATISTIC.TASK

tasks: 13. total: 7.029s

range	total	min	max	avr	count	ratio%	1%	2%
(unknown)	0.000us	0.000us	-	0.000us	0.	0.000%		
NO_TASK	561.324ms	103.660us	1.242ms	155.319us	3614.	7.985%		
bTask1	3.050s	559.320us	7.394ms	5.427ms	562.	43.390%		
bTaskChain1	342.671ms	317.140us	1.430ms	641.707us	534.	4.875%		
TaskChain3	1.446s	337.160us	2.301ms	1.197ms	1208.	20.565%		
TaskChain4	1.458s	242.660us	1.686ms	823.314us	1771.	20.743%		
bTaskWaitLoop	36.029ms	1.402ms	2.396ms	1.638ms	22.	0.512%	←	
TaskHighPrio	95.511ms	688.800us	1.020ms	782.880us	122.	1.358%		
bTaskSyncResTasks	16.849ms	623.640us	2.172ms	1.532ms	11.	0.239%	←	
bTaskWaitResource2	10.035ms	293.000us	1.487ms	771.912us	13.	0.142%	←	
bTaskWaitResource1	11.011ms	806.120us	1.301ms	1.001ms	11.	0.156%	←	
TaskSec	1.655ms	728.120us	927.120us	827.620us	2.	0.023%	←	
bTaskChain2	416.980us	416.980us	416.980us	416.980us	1.	0.005%	←	



Trace.STATistic.TASK	Task runtime statistic
Trace.Chart.TASK	Task runtime time chart

OSEK Service Routines

The time spent in OSEK service routines can be evaluated.

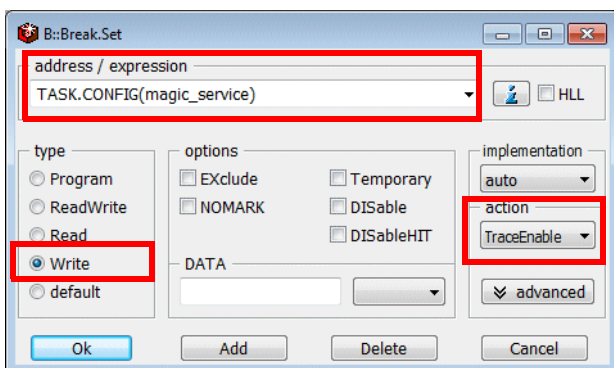
OSEK writes information on the entries and exits to OSEK service routines to a defined variable. One way to export information on OSEK service routines is to advise the NEXUS hardware module to generate trace information when a write access to this variable occurs.

The address of this variable is provided by the TRACE32 function **TASK.CONFIG(magic_service)**.

```
PRINT TASK.CONFIG(magic_service)      ; print the address of the variable
                                       ; that holds the service
                                       ; information
```

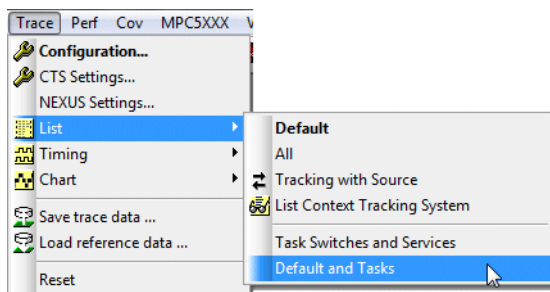
Example: Advise the NEXUS hardware module to generate only trace information for entries and exits to OSEK service routines.

1. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic_service) and select the trace action TraceEnable.



```
Break.Set TASK.CONFIG(magic_service) /Write /TraceEnable
```

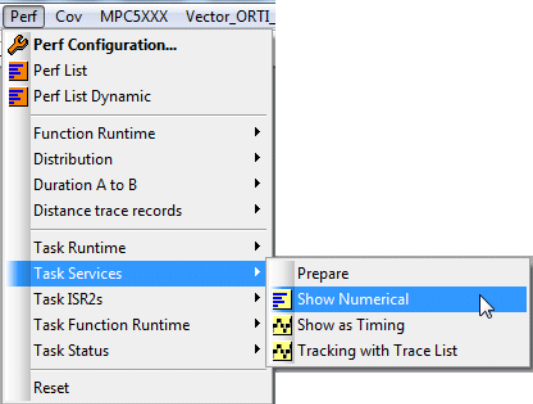
2. Start and stop the program execution to fill the trace buffer
3. Display the result.



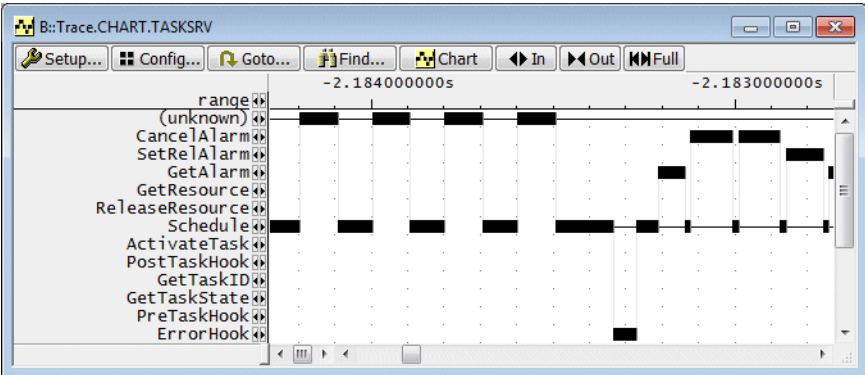
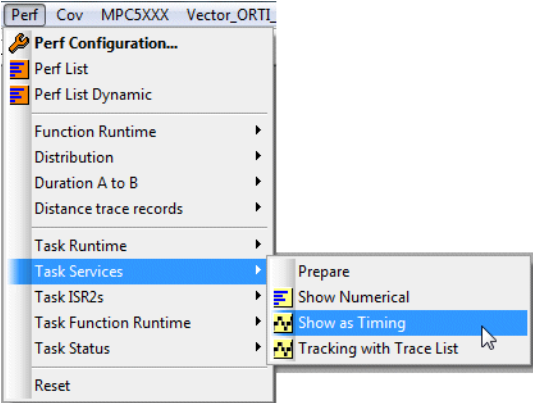
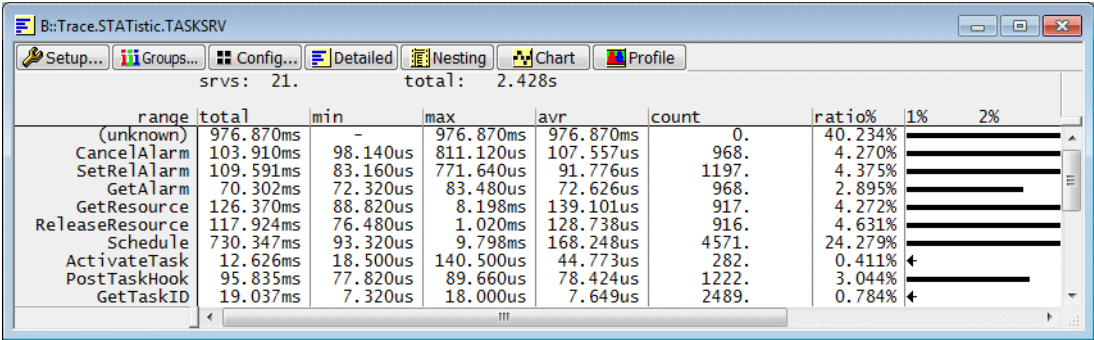
The screenshot shows the 'Trace.List.TASK DEFAULT' window. It displays a list of trace records with columns for record, run, address, cycle, data, symbol, and ti.back.

record	run	address	cycle	data	symbol	ti.back
---		SERVICE = SetRelAlarm entry ---				
-00000028		D:400008E0 wr-byte			31 \\PPC555x_ORTI_OTM_1\\Global\\osORTICurrentServiceId	51.500us
---		SERVICE = SetRelAlarm exit ---				
-00000027		D:400008E0 wr-byte			30 \\PPC555x_ORTI_OTM_1\\Global\\osORTICurrentServiceId	88.160us
---		SERVICE = ReleaseResource entry ---				
-00000026		D:400008E0 wr-byte			23 \\PPC555x_ORTI_OTM_1\\Global\\osORTICurrentServiceId	44.000us
---		SERVICE = ReleaseResource exit ---				
-00000025		D:400008E0 wr-byte			22 \\PPC555x_ORTI_OTM_1\\Global\\osORTICurrentServiceId	120.160us

The following two commands perform a statistical analysis of the OSEK service routines:



(unknown) represents the time in which the processor/core is not in an OSEK service routine



OSEK ISR2s

The time spent in OSEK interrupt service routine can be evaluated.

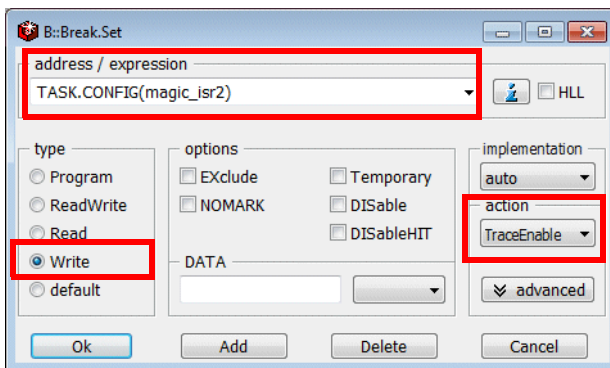
OSEK writes information on the start of an interrupt service routine to a defined variable as well as the information NO_ISR. One way to export information on OSEK interrupt service routine is to advise the NEXUS hardware module to generate trace information when a write access to this variable occurs.

The address of this variable is provided by the TRACE32 function **TASK.CONFIG(magic_isr2)**.

```
PRINT TASK.CONFIG(magic_isr2)           ; print the address of the variable
                                         ; that holds the interrupt service
                                         ; information
```

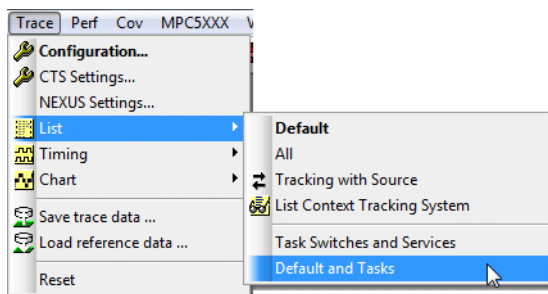
Example: Advise the NEXUS hardware module to generate only trace information on the start of an interrupt service routine as well as on the information NO_ISR.

1. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic_isr2) and select the trace action TraceEnable.



```
Break.Set TASK.CONFIG(magic_isr2) /Write /TraceEnable
```

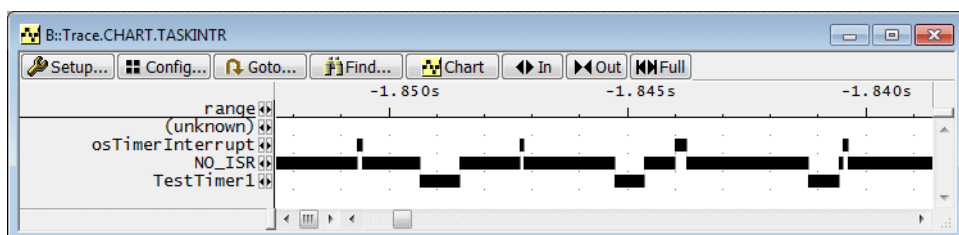
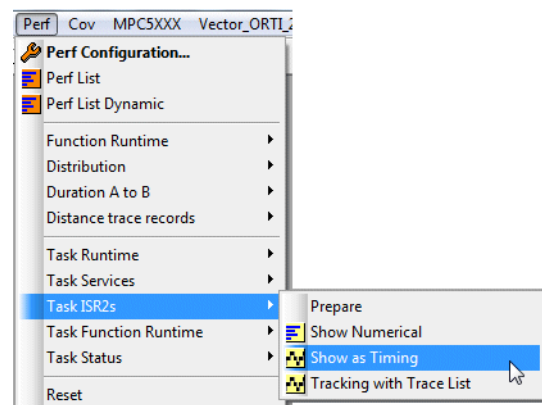
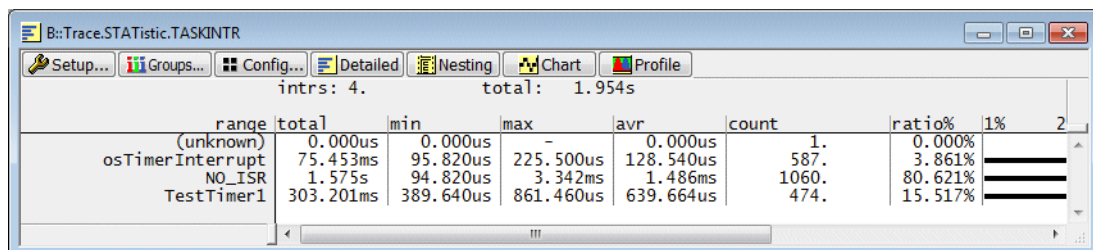
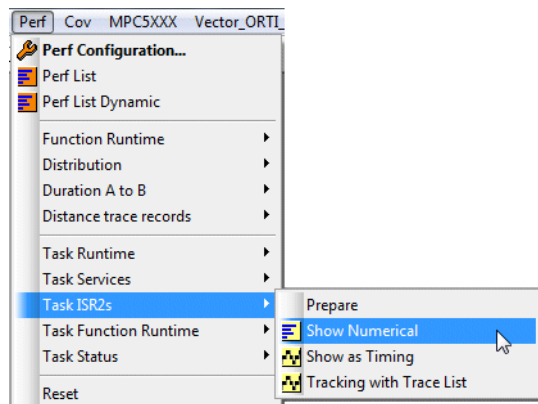
2. Start and stop the program execution to fill the trace buffer
3. Display the result.



The screenshot shows the 'B:Trace.List List.TASK DEFAULT' window. It displays a list of trace records with columns for record, run, address, cycle, data, symbol, and ti.back.

record	run	address	cycle	data	symbol	ti.back
-00000017		ISR2 = NO_ISR				
		D:400008D4	wr-word		FDFD \\PPC555x_ORTI_OTM_1\Global\osActiveISRID	224.500us
-00000016		ISR2 = TestTimer1			0000 \\PPC555x_ORTI_OTM_1\Global\osActiveISRID	1.243ms
		D:400008D4	wr-word			
-00000015		ISR2 = NO_ISR			FDFD \\PPC555x_ORTI_OTM_1\Global\osActiveISRID	598.320us
		D:400008D4	wr-word			
-00000014		ISR2 = osTimerInterrupt			0001 \\PPC555x_ORTI_OTM_1\Global\osActiveISRID	1.335ms
		D:400008D4	wr-word			
-00000013		ISR2 = NO_ISR			FDFD \\PPC555x_ORTI_OTM_1\Global\osActiveISRID	96.000us
		D:400008D4	wr-word			

The following two commands perform a statistical analysis of the OSEK interrupt service routines:



Trace.STATistic.TASKINTR Statistic on interrupt service routines

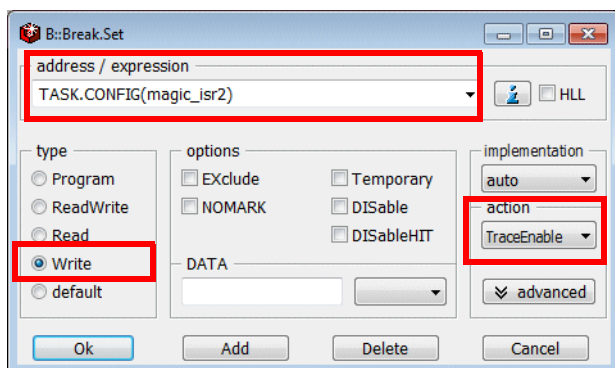
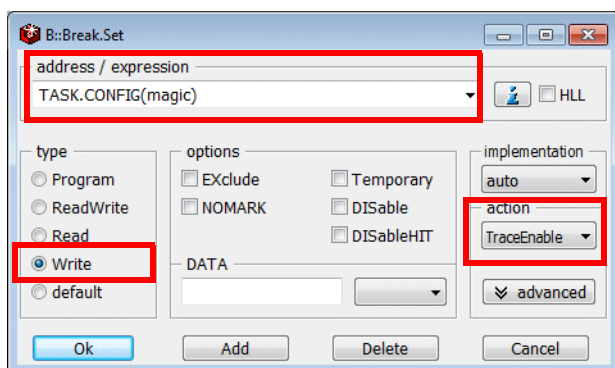
Trace.Chart.TASKINTR Time chart on interrupt service routines

OSEK interrupt service routines that occur in multiple tasks can be displayed per task, if the following information is available:

- Task switch information
- ISR2 start and NO_ISR information

Example:

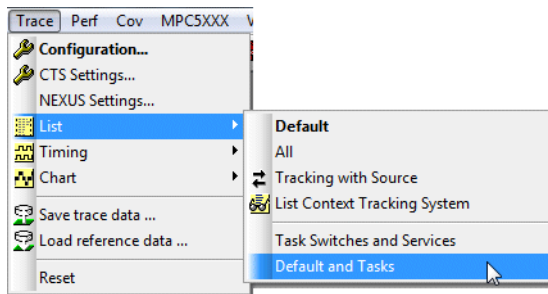
1. Advise the NEXUS hardware module to generate only trace information
 - on task switches
 - on the start of an interrupt service routine as well as on the information NO_ISR



```
Break.Set TASK.CONFIG(magic) /Write /TraceEnable  
Break.Set TASK.CONFIG(magic_isr2) /Write /TraceEnable
```

2. Start and stop the program execution to fill the trace buffer.

3. Display the result.



The screenshot shows the 'B:\Trace.List.TASK DEFAULT' window. The window has a menu bar with 'Setup...', 'Goto...', 'Find...', 'Chart', 'Profile', 'MIPS', 'More', and 'Less'. Below the menu bar is a table with columns: 'record', 'run', 'address', 'cycle', 'data', 'symbol', and 'ti.back'. The table contains several rows of trace data, including ISR2 = NO_ISR, TASK = NO_TASK, TASK = TaskChain4, and ISR2 = osTimerInterrupt.

record	run	address	cycle	data	symbol	ti.back
-00000025		ISR2 = NO_ISR ---				
		D:400008D4 wr-word		FFFF	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	561.480us
-00000024		TASK = NO_TASK ---				
		D:400008A0 wr-word		FFFF	\\PPC555x_ORTI_OTM_1\Global\osCtrVars	554.300us
-00000023		TASK = TaskChain4 ---				
		D:400008A0 wr-word		0008	\\PPC555x_ORTI_OTM_1\Global\osCtrVars	111.180us
-00000022		TASK = NO_TASK ---				
		D:400008A0 wr-word		FFFF	\\PPC555x_ORTI_OTM_1\Global\osCtrVars	680.460us
-00000021		TASK = TaskChain4 ---				
		D:400008A0 wr-word		0008	\\PPC555x_ORTI_OTM_1\Global\osCtrVars	111.320us
-00000020		ISR2 = osTimerInterrupt ---				
		D:400008D4 wr-word		0001	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	233.660us
-00000019		ISR2 = NO_ISR ---				
		D:400008D4 wr-word		FFFF	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	96.160us

The following command allows to perform a statistical analysis of the OSEK interrupt service routines related to the active tasks.

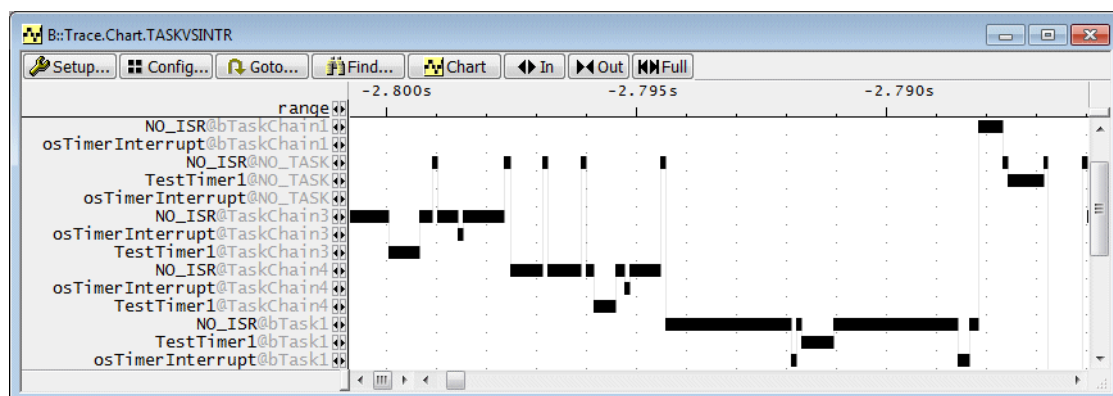
Trace.STATistic.TASKVSINTR

Task-related statistic on interrupt service routines

Trace.Chart.TASKVSINTR

Time-chart on task related interrupt service routines

range	total	min	max	avr	count	ratio%	1%	2%
(unknown)@(unknown)	0.000us	0.000us	-	0.000us	1.	0.000%		
TestTimer1@(unknown)	616.800us	616.800us	616.800us	616.800us	1.	0.031%	+	
NO_ISR@(unknown)	932.800us	198.320us	734.480us	932.800us	1.	0.048%	+	
osTimerInterrupt@TaskChain1	95.980us	95.980us	95.980us	95.980us	1.	0.004%	+	
NO_ISR@NO_TASK	99.336ms	75.000us	114.480us	108.801us	913.	5.120%		
NO_ISR@TaskChain3	393.778ms	94.980us	1.340ms	748.628us	526.	20.300%		
TestTimer1@TaskChain3	73.057ms	393.980us	830.460us	603.780us	121.	3.766%		
NO_ISR@TaskChain4	274.230ms	94.820us	781.140us	497.695us	551.	14.137%		
osTimerInterrupt@TaskChain4	11.723ms	95.980us	96.320us	96.087us	122.	0.604%	+	
NO_ISR@Task1	670.648ms	94.820us	3.238ms	1.040ms	645.	34.573%		
TestTimer1@Task1	141.549ms	402.660us	860.960us	711.300us	199.	7.297%		
osTimerInterrupt@Task1	45.908ms	95.820us	348.480us	162.219us	283.	2.366%		
NO_ISR@TaskChain1	79.392ms	159.480us	544.820us	441.066us	180.	4.092%		
osTimerInterrupt@TaskChain3	11.241ms	95.980us	96.320us	96.074us	117.	0.579%	+	
NO_ISR@TaskHighPrio	24.776ms	153.320us	698.800us	527.146us	47.	1.277%		



ISR2 information that was generated before the first TASK information is assigned to the **@(unknown)** task.

record	run	address	cycle	data	symbol	ti.back
---	GO					
---	ISR2 = TestTimer1 ---					
-00003975		D:400008D4	wr-word	0000	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	
---	ISR2 = NO_ISR ---					
-00003973		D:400008D4	wr-word	FFFF	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	616.800us
---	ISR2 = osTimerInterrupt ---					
-00003972		D:400008D4	wr-word	0001	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	734.480us
---	ISR2 = NO_ISR ---					
-00003971		D:400008D4	wr-word	FFFF	\\PPC555x_ORTI_OTM_1\Global\osActiveISRID	95.980us
---	TASK = NO_TASK ---					
-00003970		D:400008A0	wr-word	FFFF	\\PPC555x_ORTI_OTM_1\Global\osCtrlVars	198.320us

Exporting Task Switches and all Instructions (Write Access)

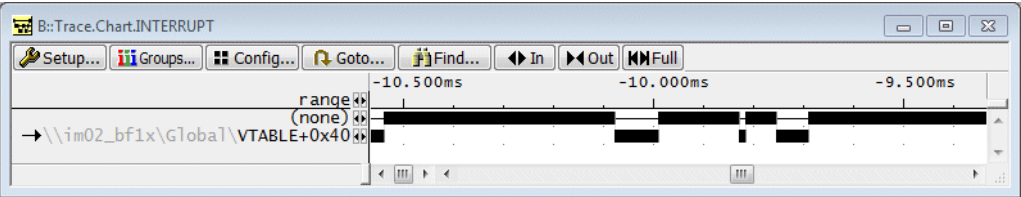
General setup:

```
Break.Set TASK.CONFIG(magic) /Write /TraceData

; advise TRACE32 to regard the time between interrupt entry
; and exit as function
Trace.STATistic.InterruptIsFunction ON
```

Statistic Analysis of Interrupts

Trace.Chart.INTERRUPT Interrupt time chart

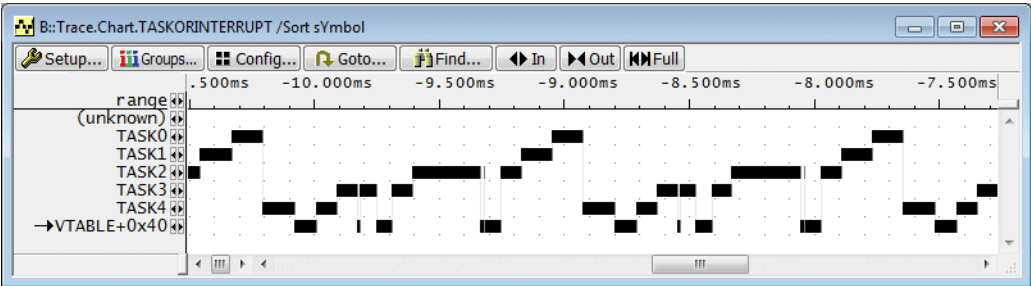


Trace.STATistic.INTERRUPT Interrupt statistic

range	total	min	max	avr	count	intern%	1%	2%
(none)	20.164ms	-	20.164ms	-	-	89.125%		
→\im02_bf1x\Global\VTABLE+0x40	2.250ms	11.250us	71.005us	41.006us	60.	10.874%		

Trace.Chart.TASKORINTERRUPT

Time chart of interrupts and tasks



Trace.STATistic.TASKORINTERRUPT

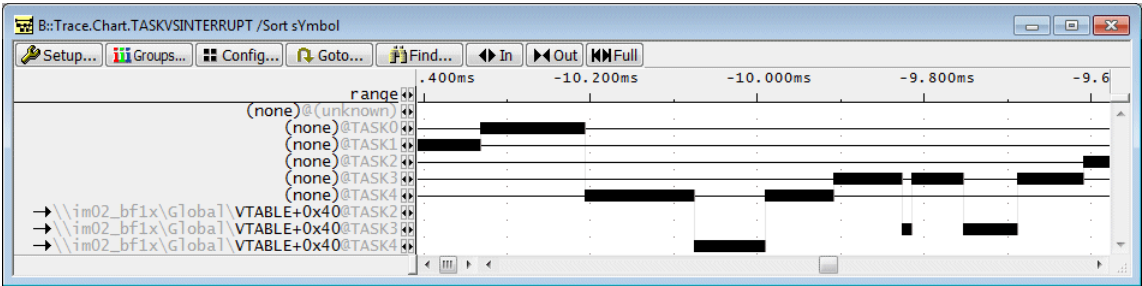
Statistic of interrupts and tasks

The screenshot shows a statistics window titled "B::Trace.STATistic.TASKORINTERRUPT /Sort sYmbol". It displays a table of statistics for tasks and interrupts. The table has columns for range, total, min, max, avr, count, ratio%, 1%, and 2%. The tasks listed are (unknown), TASK0, TASK1, TASK2, TASK3, TASK4, and →VTABLE+0x40. The total time for all tasks is 22.621ms.

range	total	min	max	avr	count	ratio%	1%	2%
(unknown)	9.705ms	9.705ms	9.705ms	9.705ms	0.	-		
TASK0	1.319ms	124.005us	129.005us	119.882us	11.	5.829%		
TASK1	1.228ms	121.505us	124.255us	122.806us	10.	5.428%		
TASK2	3.606ms	1.746us	278.010us	120.187us	30.	15.938%		
TASK3	2.227ms	61.500us	82.005us	74.243us	30.	9.845%		
TASK4	2.110ms	80.405us	130.755us	105.510us	20.	9.328%		
→VTABLE+0x40	2.426ms	11.000us	66.605us	40.436us	60.	10.725%		

Trace.Chart.TASKVSINTERRUPT

Time chart interrupts, task-related



Trace.STATistic.TASKVSINTERRUPT

Statistic of interrupts, task-related

The screenshot shows a table titled "B:\Trace.STATistic.TASKVSINTERRUPT /Sort sYmbol". The table displays statistics for tasks TASK0 through TASK4. The columns are: range, total, min, max, avr, count, intern%, and 1%. The data is as follows:

range	total	min	max	avr	count	intern%	1%
(none)@(unknown)	0.000us	-	-	0.000us	0. (1/0)	-	-
(none)@TASK0	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK1	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK2	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK3	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
(none)@TASK4	0.000us	-	-	0.000us	0. (1/0)	0.000%	-
→ im02_bf1x\Global\VTABLE+0x40@TASK2	792.800us	13.250us	67.005us	39.640us	20.	3.504%	=====
→ im02_bf1x\Global\VTABLE+0x40@TASK3	779.805us	11.500us	66.755us	38.990us	20.	3.447%	=====
→ im02_bf1x\Global\VTABLE+0x40@TASK4	678.035us	20.750us	70.750us	44.465us	20.	3.931%	=====

Belated Trace Analysis (OS)

The TRACE32 Instruction Set Simulator can be used for a belated OS-aware trace evaluation. To set up the TRACE32 Instruction Set Simulator for belated OS-aware trace evaluation proceed as follows:

1. Save the trace information for the belated evaluation to a file.

```
Trace.SAVE belated__orti.ad
```

2. Set up the TRACE32 Instruction Set Simulator for a belated OS-aware trace evaluation (here OSEK on a MPC5553):

```
SYStem.CPU MPC5553                ; select the target CPU

SYStem.Up                        ; establish the
                                ; communication between
                                ; TRACE32 and the TRACE32
                                ; Instruction Set
                                ; Simulator

Trace.LOAD belated_orti.ad        ; load the trace file

Data.Load.ELF my_app.out /NoCODE /GHS ; load the symbol and
                                ; debug information

TASK.ORTI my_orti.ort             ; load the ORTI file

Trace.List List.TASK DEFault      ; display the trace
                                ; listing
```

Exporting all Types of Task Information (OTM)

Ownership Trace Messages are generated when the OS updates

- the 8-bit Process ID register (PID0) - IEEE-ISTO 5001-2003 compliant NEXUS module
- NEXUS PID Register (NPIDR) - IEEE-ISTO 5001-2008 compliant NEXUS module and subsequent standards

PID0 respectively NPIDR is updated on

- task switches
- entries and exits to OSEK service routines
- start of OSEK interrupt service routines and start of NO_ISR code

The ORTI standard support task-aware tracing via OTMs since October/2010.

If you are using a IEEE-ISTO 5001-2003 compliant NEXUS Class 2 module and your task ID is longer the 8-bit, the PID0 register has to be updated in several steps. This requires special support from your OSEK system. If your OSEK system does not provide this special support, Lauterbach can provide you patch information. Please contact support@lauterbach.com for details.

The generation of Ownership Trace Messages has to be enabled within TRACE32.

```
NEXUS.OTM ON           ; enable the generation of Ownership Trace
                        ; Messages
```

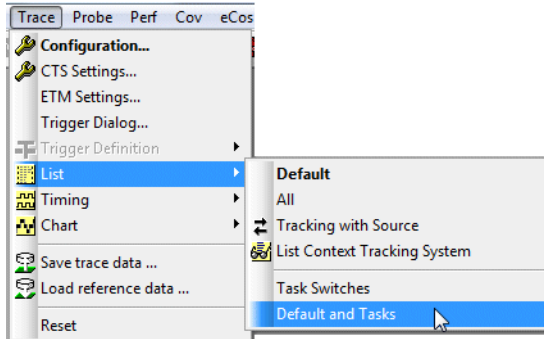
Example:

1. Advise the NEXUS hardware module to generate only Ownership Trace Messages.

```
NEXUS.BTM OFF ; disable the Branch Trace
                ; messaging

NEXUS.OTM ON    ; enable the Ownership Trace
                ; Messages
```

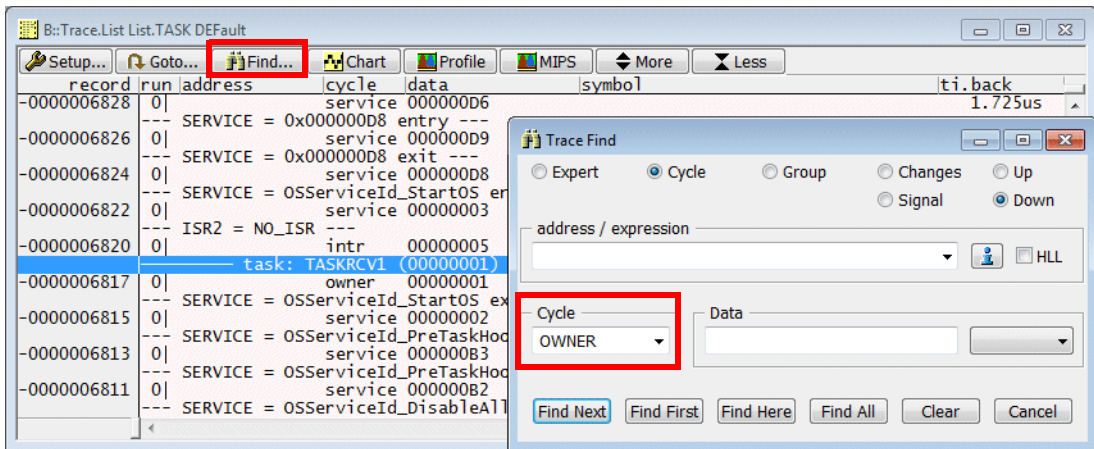
2. Start and stop the program execution to fill the trace buffer.
3. Display the result.

A screenshot of the 'B::Trace.List List.TASK Default' window. The window displays a table of trace records. The columns are: record, run, address, cycle, data, symbol, and ti.back. The records show various system events and their durations. A red line highlights a specific record: 'task: TASKRCV1 (00000001)'.

record	run	address	cycle	data	symbol	ti.back
-0000006824	0			service 000000D8		6.780us
---				SERVICE = OServiceId_StartOS entry ---		
-0000006822	0			service 00000003		5.425us
---				ISR2 = NO_ISR ---		
-0000006820	0			intr 00000005		2.044ms
---				task: TASKRCV1 (00000001)		
-0000006817	0			owner 00000001		365.180us
---				SERVICE = OServiceId_StartOS exit ---		
-0000006815	0			service 00000002		6.535us
---				SERVICE = OServiceId_PreTaskHook entry ---		
-0000006813	0			service 000000B3		2.340us
---				SERVICE = OServiceId_PreTaskHook exit ---		
-0000006811	0			service 000000B2		3.080us

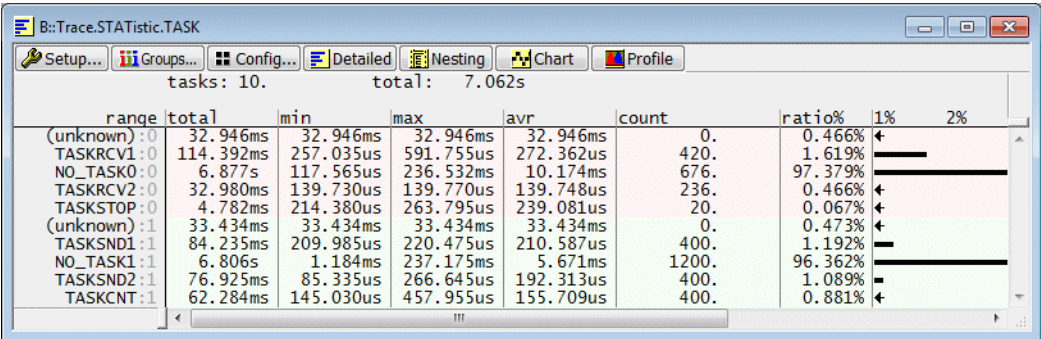
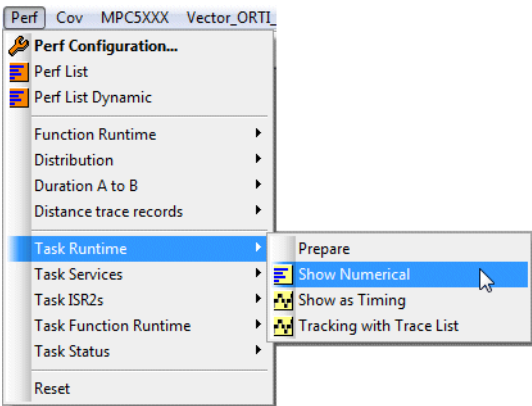
cycle types	
owner	Ownership trace message for task switches
service	Ownership trace message for entries and exits to OSEK service routines
intr	Ownership trace message for start of OSEK interrupt service routine and start of NO_ISR code

TRACE32 allows to search for all available cycle types e.g. owner:

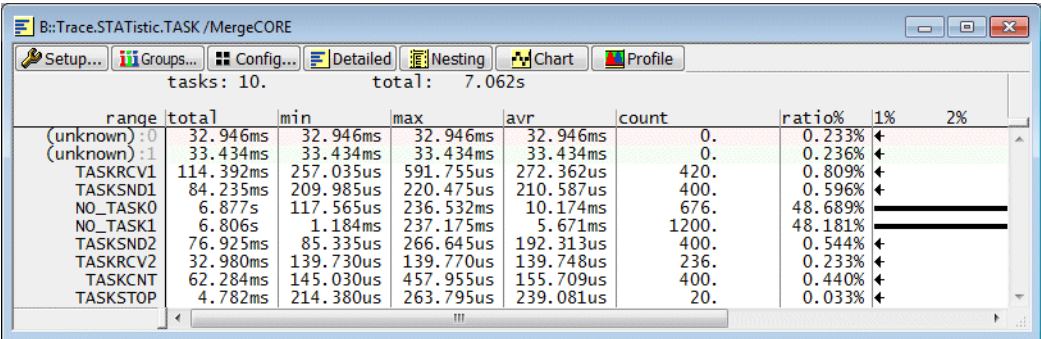


Statistic Analysis of Task Switches

The following commands perform a statistical analysis of the task switches:



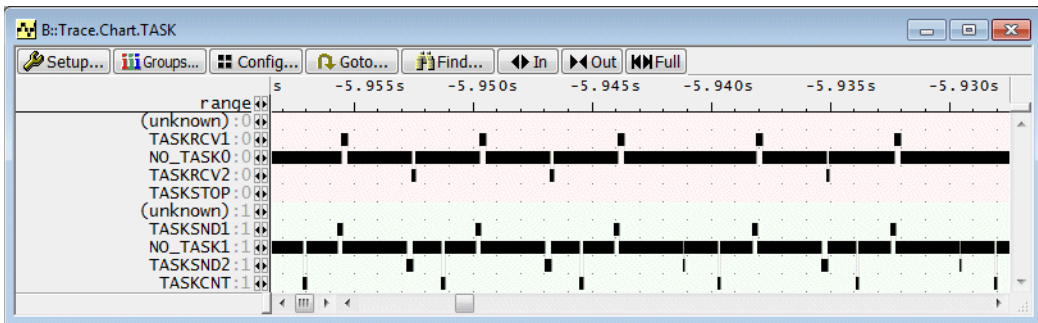
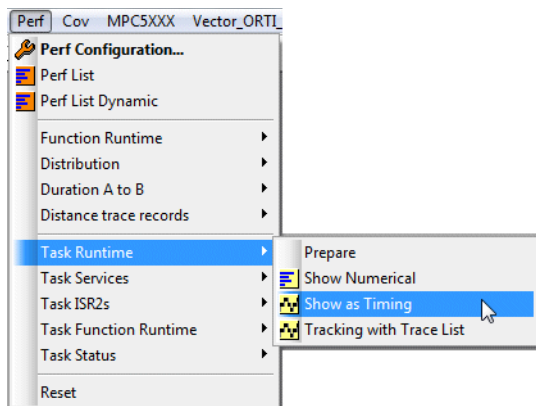
Trace.STATistic.TASK [/SplitCORE] Task runtime statistic, result per core



Trace.STATistic.TASK /MergeCORE Task runtime statistic, results of all cores merged

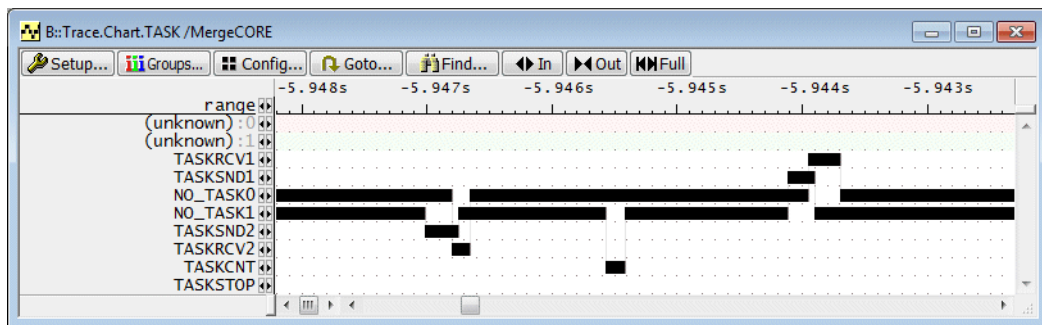
TRACE32 assigns all trace information generated before the first **task** information to the **(unknown)** tasks. The **(unknown)** tasks are always displayed per core.

The following commands display a time-chart of the task run-times:



Trace.Chart.TASK [/SplitCORE]

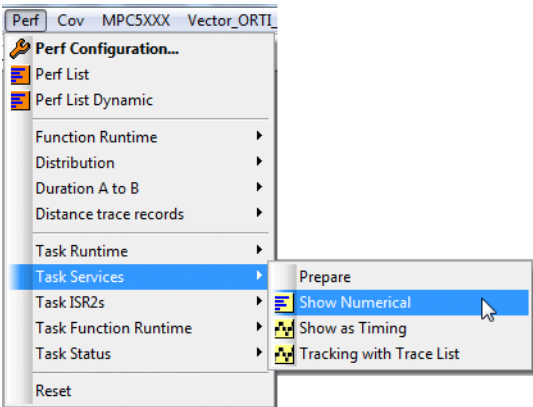
Task runtime time chart, result per core



Trace.Chart.TASK /MergeCORE

Task runtime time chart, results of all cores merged

The following commands perform a statistical analysis of the OSEK service routines:

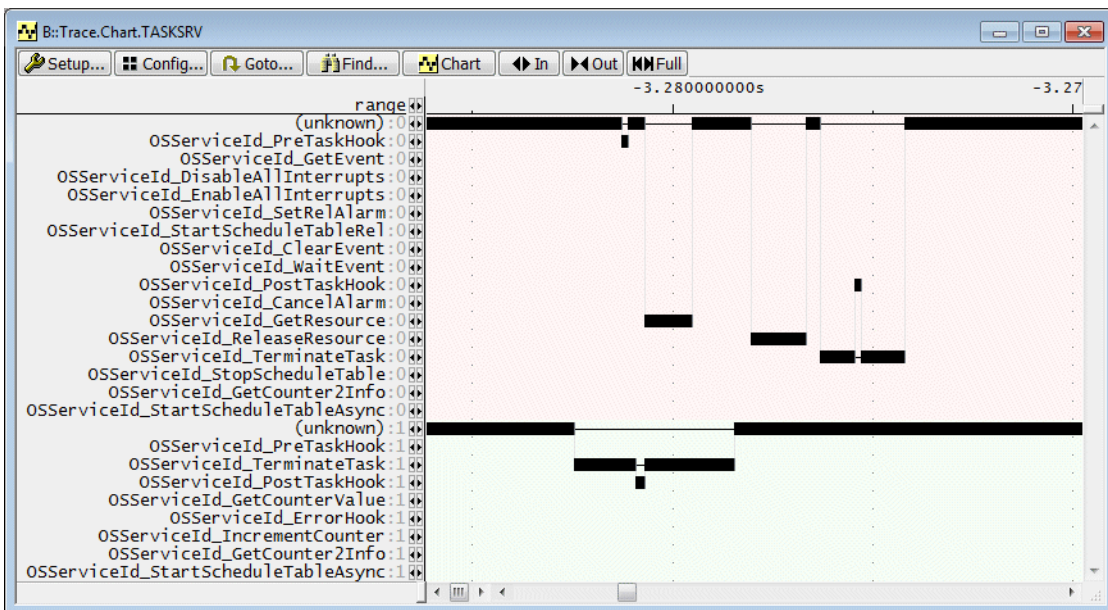
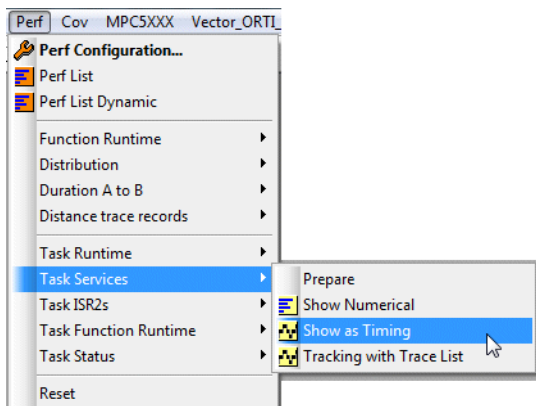


(unknown) represents the time in which the processor/core is not in an OSEK service routine

The screenshot shows a window titled 'B::Trace.STATistic.TASKSRV'. It contains a table with columns: range, total, min, lmax, avr, count, ratio%, 1%, and 2%. The table lists various OSEK service routines and their execution statistics. The first row is for '(unknown):0' with a total of 4.005s and a ratio of 98.377%. Subsequent rows list specific routines like 'OSServiceId_PreTaskHook:0', 'OSServiceId_GetEvent:0', etc., with their respective statistics. The last row is for '(unknown):1' with a total of 3.992s and a ratio of 98.070%.

range	total	min	lmax	avr	count	ratio%	1%	2%
(unknown):0	4.005s	-	4.005s	4.005s	0.	98.377%		
OSServiceId_PreTaskHook:0	1.698ms	3.350us	4.645us	4.191us	405.	0.041%		
OSServiceId_GetEvent:0	3.137ms	11.340us	12.505us	12.447us	252.	0.077%		
OSServiceId_DisableAllInterrupts:0	124.240us	5.025us	5.415us	5.177us	24.	0.003%		
OSServiceId_EnableAllInterrupts:0	110.575us	4.380us	5.030us	4.607us	24.	0.002%		
OSServiceId_SetRelAlarm:0	9.736ms	32.345us	127.740us	36.880us	264.	0.239%		
OSServiceId_StartScheduleTableRel:0	2.795ms	232.880us	232.920us	232.898us	12.	0.068%		
OSServiceId_ClearEvent:0	2.198ms	8.630us	9.410us	8.723us	252.	0.053%		
OSServiceId_WaitEvent:0	12.579ms	49.615us	54.780us	49.919us	252.	0.290%		
OSServiceId_PostTaskHook:0	1.255ms	2.960us	3.480us	3.098us	405.	0.030%		
OSServiceId_CancelAlarm:0	6.402ms	26.545us	26.685us	26.674us	240.	0.157%		
OSServiceId_GetResource:0	8.688ms	22.035us	24.105us	22.804us	381.	0.213%		
OSServiceId_ReleaseResource:0	10.158ms	26.160us	27.590us	26.661us	381.	0.249%		
OSServiceId_TerminateTask:0	6.433ms	41.755us	45.245us	42.043us	153.	0.146%		
OSServiceId_StopScheduleTable:0	1.885ms	132.620us	181.620us	157.113us	12.	0.046%		
OSServiceId_GetCounter2Info:0	54.135us	18.045us	18.045us	18.045us	3.	0.001%		
OSServiceId_StartScheduleTableAsync:0	48.330us	16.110us	16.110us	16.110us	3.	0.001%		
(unknown):1	3.992s	-	3.992s	3.992s	0.	98.070%		
OSServiceId_PreTaskHook:1	3.345ms	4.635us	5.030us	4.646us	720.	0.082%		
OSServiceId_TerminateTask:1	55.611ms	74.745us	81.470us	77.238us	720.	1.282%		
OSServiceId_PostTaskHook:1	3.415ms	4.635us	4.900us	4.743us	720.	0.083%		
OSServiceId_GetCounterValue:1	6.724ms	47.680us	47.700us	47.691us	141.	0.150%		
OSServiceId_ErrorHook:1	617.895us	4.380us	4.385us	4.382us	141.	0.015%		
OSServiceId_IncrementCounter:1	11.648ms	43.820us	127.745us	48.531us	240.	0.286%		
OSServiceId_GetCounter2Info:1	186.240us	30.800us	31.320us	31.040us	6.	0.004%		
OSServiceId_StartScheduleTableAsync:1	1.042ms	173.605us	173.745us	173.695us	6.	0.025%		

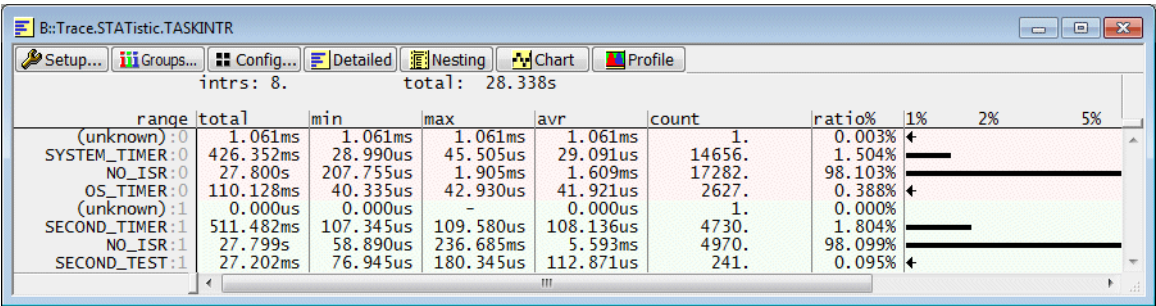
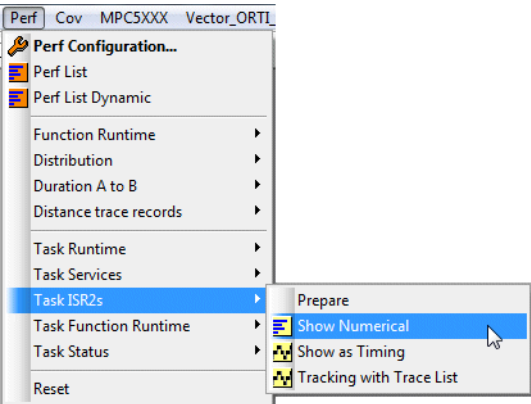
Trace.STATistic.TASKSRV [/SplitCORE] Statistic on service routines, result per core



Trace.Chart.TASKSRV [/SplitCORE]

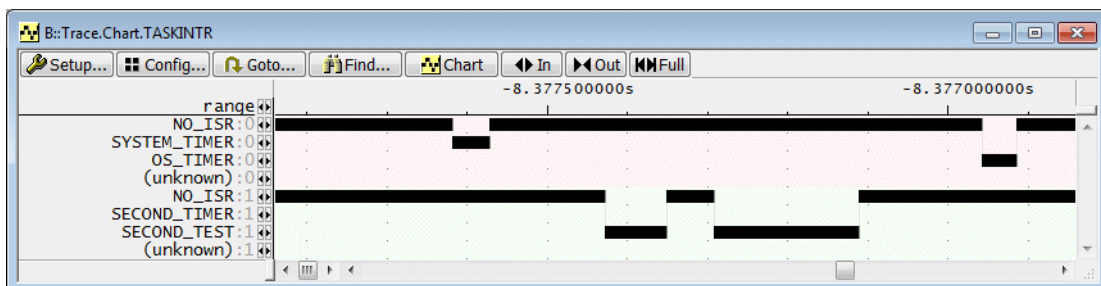
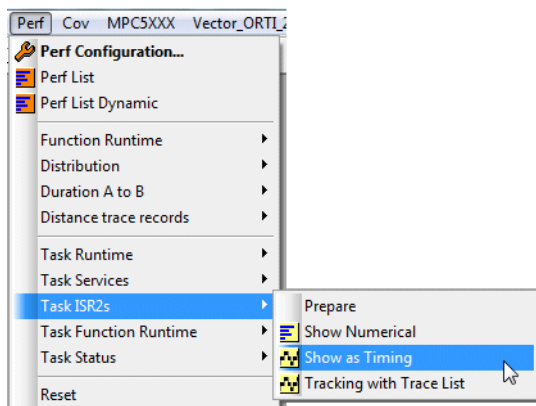
Time chart on service routines, result per core

The following commands perform a statistical analysis of the OSEK interrupt service routines:



Trace.STATistic.TASKINTR [/SplitCORE] Statistic on interrupt service routines, result per core

TRACE32 assigns all trace information generated before the first **intr** information to **(unknown)**.



Trace.Chart.TASKINTR [/SplitCORE]

Time chart on interrupt service routines, result per core

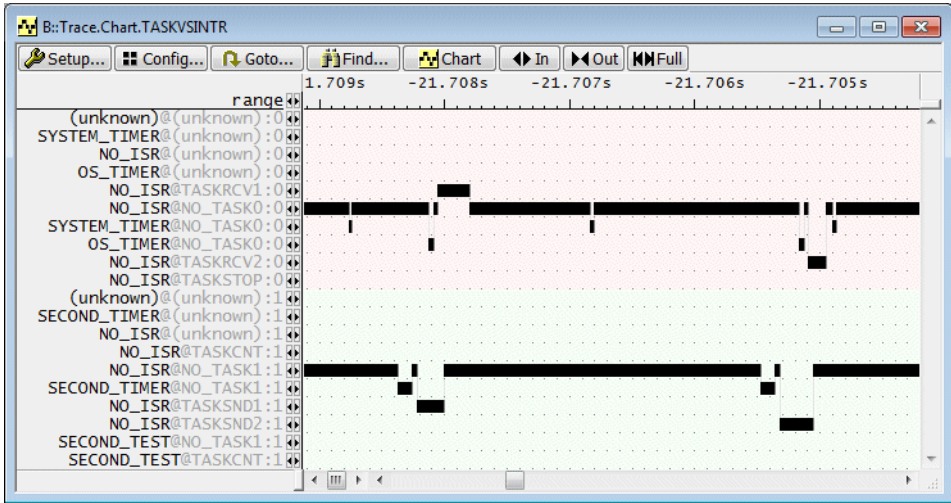
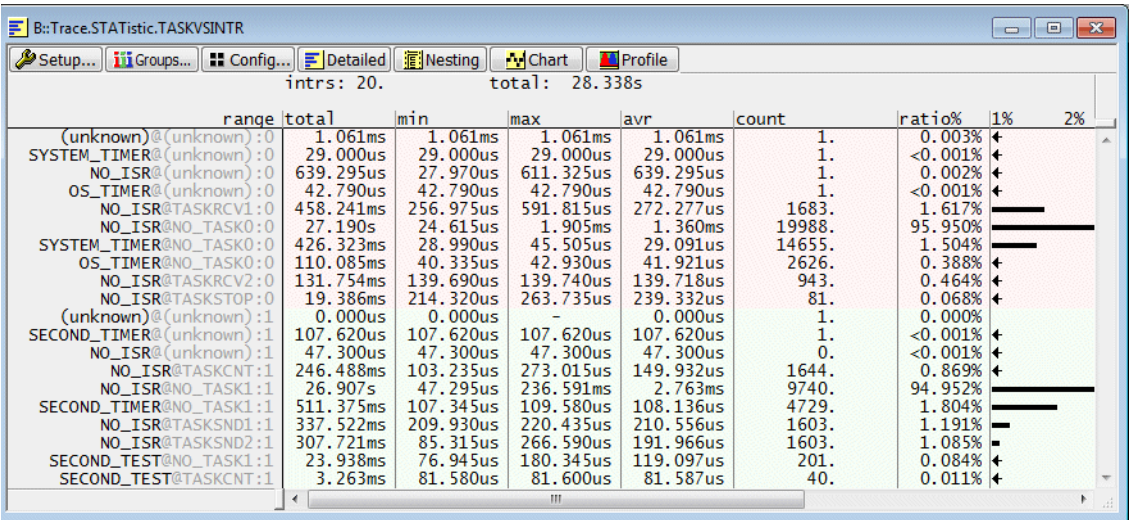
The following commands allow to perform a statistical analysis of the OSEK interrupt service routines related to the active tasks.

Trace.STATistic.TASKVSINTR [/SplitCORE]

Task-related statistic on interrupt service routines, result per core

Trace.Chart.TASKVSINTR [/SplitCORE]

Time-chart for task related interrupt service routines, result per core



intr information that was generated before the first **task** information is assigned to the **@(unknown)** task.

BTrace.List List.Task Default

Setup... Goto... Find... Chart Profile MIPS More Less

record	run	address	cycle	data	symbol	ti.back

		GO				
		GO				
-0000294748	1			intr	00000002	
-0000294746	1			intr	00000005	107.620us
task: TASKCNT (00000004)						
-0000294744	1			owner	00000004	47.300us
-0000294742	1			service	000000B3	11.080us
-0000294740	1			service	000000B2	4.645us
-0000294738	1			service	00000093	15.205us
-0000294736	1			service	00000092	44.340us
-0000294734	1			service	00000023	15.205us
-0000294732	1			service	000000B5	28.230us
-0000294730	1			service	000000B4	4.635us
task: NO_TASK1 (00000007)						
-0000294728	1			owner	00000007	22.300us
-0000294726	1			service	00000022	19.720us
-0000294723	0			intr	00000001	
-0000294721	0			intr	00000005	29.000us
-0000294718	1			intr	00000002	1.130ms
-0000294716	1			intr	00000005	109.555us
task: TASKSND1 (00000000)						
-0000294714	1			owner	00000000	47.300us
-0000294712	1			service	000000B3	11.085us
-0000294710	1			service	000000B2	4.640us
-0000294708	0			intr	00000003	611.325us
-0000294706	0			intr	00000005	42.790us
-0000294704	1			service	00000023	136.110us
task: TASKRCV1 (00000001)						
-0000294702	0			owner	00000001	27.970us

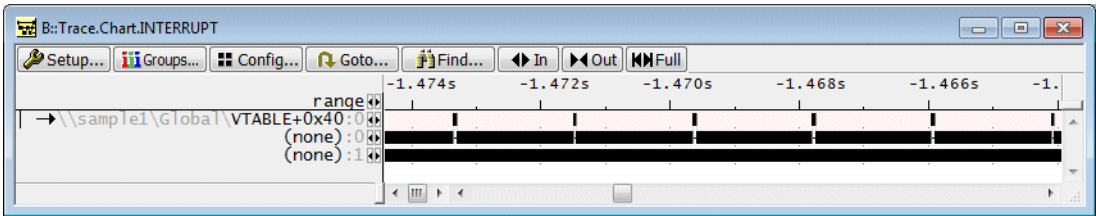
Exporting all Types of Task Information and all Instructions (OTM)

General setup:

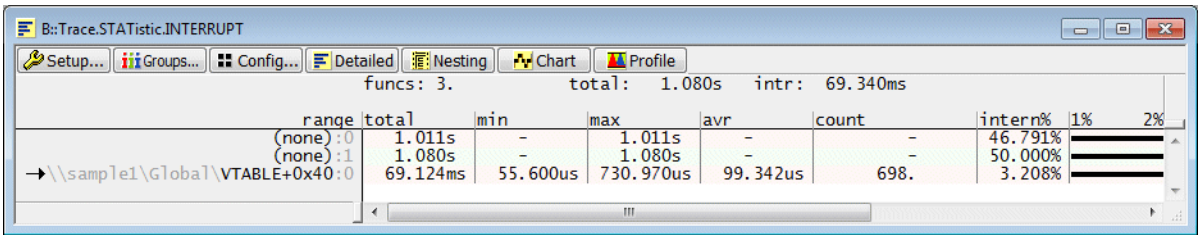
NEXUS.BTM ON	; enable the Branch Trace ; Messages
NEXUS.OTM ON	; enable the Ownership Trace ; Messages
Trace.STATistic.InterruptIsFunction ON	; advise TRACE32 to regard the ; time between interrupt entry ; and exit as function

Statistic Analysis of Interrupts

Trace.Chart.INTERRUPT [/SplitCORE]	Interrupt time chart (default), results split up per core
Trace.Chart.INTERRUPT /CORE <n>	Interrupt time chart for specified core



Trace.STATistic.INTERRUPT [/SplitCORE]	Interrupt statistic (default), results split up per core
Trace.STATistic.INTERRUPT /CORE <n>	Interrupt statistic for specified core

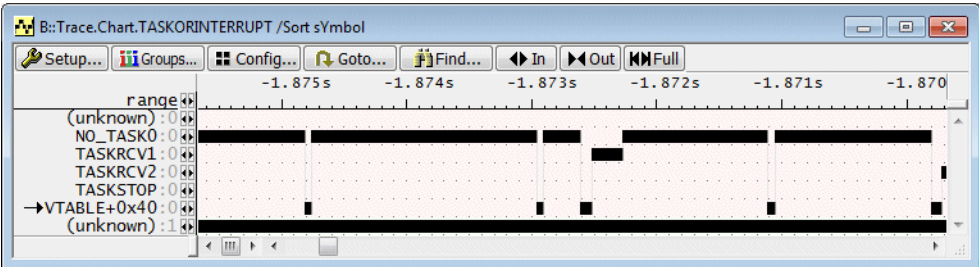


Trace.Chart.TASKORINTERRUPT [/SplitCORE]

Time chart for interrupts and tasks (default), results split up per core

Trace.Chart.TASKORINTERRUPT /CORE <n>

Time chart for interrupts and tasks for specified core



Trace.STATistic.TASKORINTERRUPT [/SplitCORE]

Statistic for interrupts and tasks (default), results split up per core

Trace.STATistic.TASKORINTERRUPT /CORE <n>

Statistic for interrupts and tasks for specified core

The screenshot shows the 'Trace.STATistic.TASKORINTERRUPT /Sort sYmbol' window. It features a toolbar with buttons for Setup, Groups, Config, Detailed, Nesting, Chart, and Profile. Below the toolbar, it displays 'tasks: 7.' and 'total: 1.978s'. The main area contains a table with the following data:

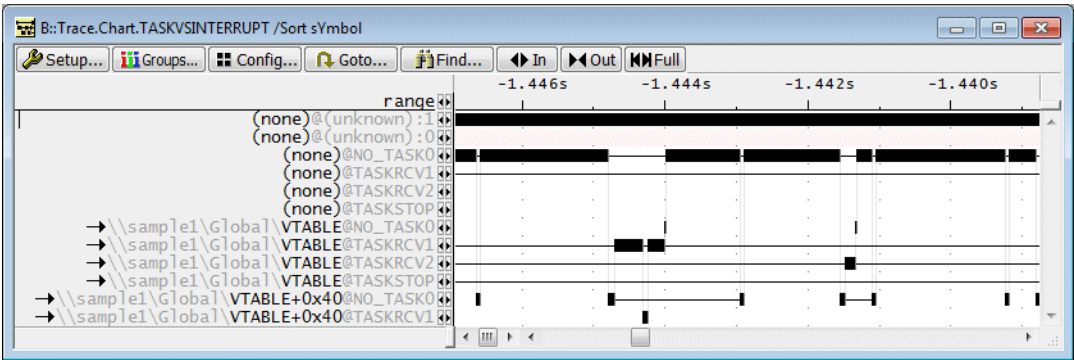
range	total	min	max	avr	count	ratio%	1%
(unknown):0	5.544ms	5.544ms	5.544ms	5.544ms	0.	-	←
NO_TASK0:0	1.854s	203.605us	1.795ms	1.475ms	1257.	93.759%	←
TASKRCV1:0	30.321ms	234.958us	434.675us	250.584us	121.	1.533%	←
TASKRCV2:0	9.016ms	128.725us	128.900us	128.797us	70.	0.455%	←
TASKSTOP:0	1.131ms	169.810us	207.215us	188.511us	6.	0.057%	←
->VTABLE+0x40:0	77.415ms	55.181us	307.750us	61.343us	1262.	3.914%	←
(unknown):1	1.978s	-	1.978s	1.978s	0.	-	←

Trace.Chart.TASKVSINTERRUPT [/SplitCORE]

Interrupt time chart, task-related (default), results split up per core

Trace.Chart.TASKVSINTERRUPT /CORE <n>

Interrupt time chart task-related, for specified core



Trace.STATistic.TASKVSINTERRUPT [/SplitCORE]

Interrupt statistic, task-related (default), results split up per core

Trace.STATistic.TASKVSINTERRUPT /CORE <n>

Interrupt statistic, task-related, for specified core

The screenshot shows the Trace.STATistic.TASKVSINTERRUPT window. The title bar indicates the path 'B::Trace.STATistic.TASKVSINTERRUPT /Sort sYmbol'. The window contains a toolbar with buttons for Setup..., Groups..., Config..., Detailed, Nesting, Chart, and Profile. Below the toolbar, it shows 'funcs: 12.' and 'total: 1.787s'. The main area displays a table with columns: range, total, min, max, avr, count, intern%, and 1%. The table lists statistics for various tasks.

range	total	min	max	avr	count	intern%	1%
(none)@(unknown):0	0.000us	-	-	0.000us	0. (1/0)	-	←
(none)@(unknown):1	0.000us	-	-	0.000us	0. (1/0)	-	←
(none)@NO_TASK0	0.000us	-	-	0.000us	0. (1/0)	0.000%	
(none)@TASKRCV1	0.000us	-	-	0.000us	0. (1/0)	0.000%	
(none)@TASKRCV2	0.000us	-	-	0.000us	0. (1/0)	0.000%	
(none)@TASKSTOP	0.000us	-	-	0.000us	0. (1/0)	0.000%	
1\Global\VTABLE@NO_TASK0	60.841ms	234.720us	775.965us	318.539us	191.	1.702%	
1\Global\VTABLE@TASKRCV1	0.000us	-	-	0.000us	0.	0.000%	
1\Global\VTABLE@TASKRCV2	0.000us	-	-	0.000us	0.	0.000%	
1\Global\VTABLE@TASKSTOP	0.000us	-	-	0.000us	0.	0.000%	
1\Global\VTABLE+0x40@NO_TASK0	53.271ms	55.590us	55.625us	55.607us	958.	1.490%	
1\Global\VTABLE+0x40@TASKRCV1	432.895us	71.750us	72.260us	72.149us	6.	0.012%	←

Exporting Task Information (Write Access)

Task Switches

An SMP operating system has **one variable per core** that contains the information which task is currently running. One way to export task switch information is to advise the NEXUS hardware module to generate trace information when a write access to one of these variables occurs.

The address of these variables is provided by the TRACE32 functions **TASK.CONFIG(magic[<core>])**.

```
PRINT TASK.CONFIG(magic[0])      ; print the address of the variable
                                ; that holds the task identifier
                                ; for core 0

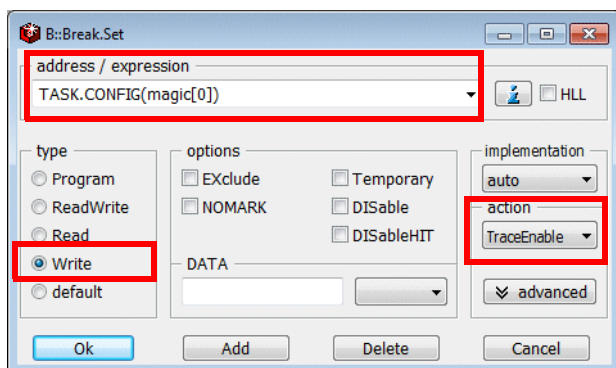
PRINT TASK.CONFIG(magic[1])      ; print the address of the variable
                                ; that holds the task identifier
                                ; for core 1

...

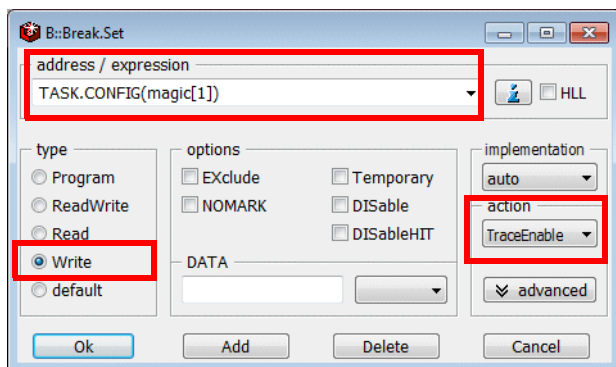
PRINT TASK.CONFIG(magic[n])      ; print the address of the variable
                                ; that holds the task identifier
                                ; for core n
```

Example: Advise the NEXUS hardware module to generate only trace information on task switches for a dual-core chip.

1. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic[0]) and select the trace action TraceEnable.



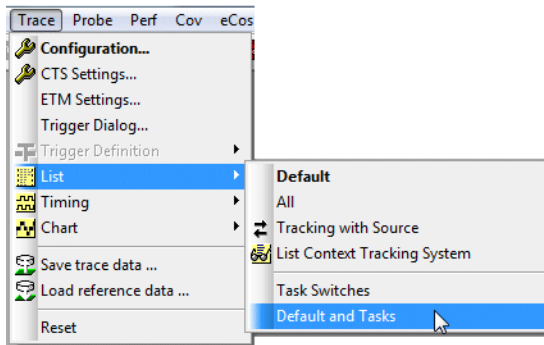
2. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic[1]) and select the trace action TraceEnable.



```
Break.Set TASK.CONFIG(magic[0]) /Write /TraceEnable  
Break.Set TASK.CONFIG(magic[1]) /Write /TraceEnable
```

3. Start and stop the program execution to fill the trace buffer

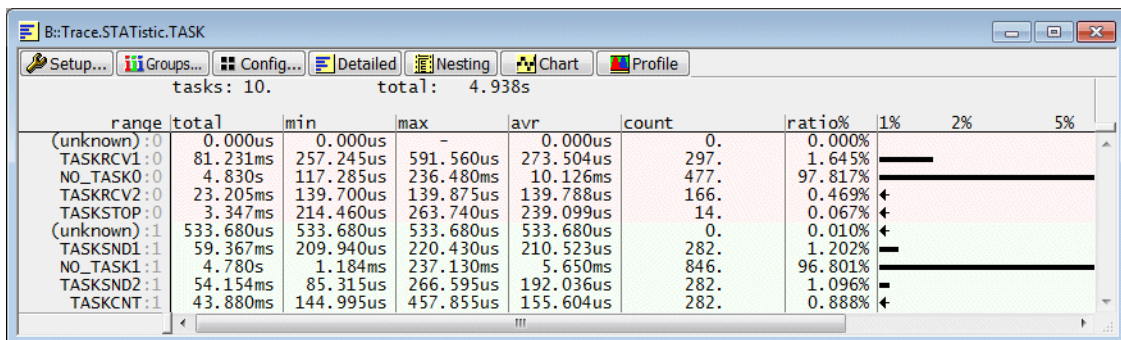
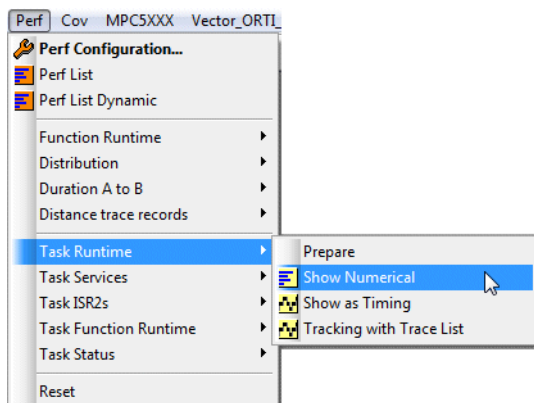
4. Display the result.



B::Trace.List List.TASK Default

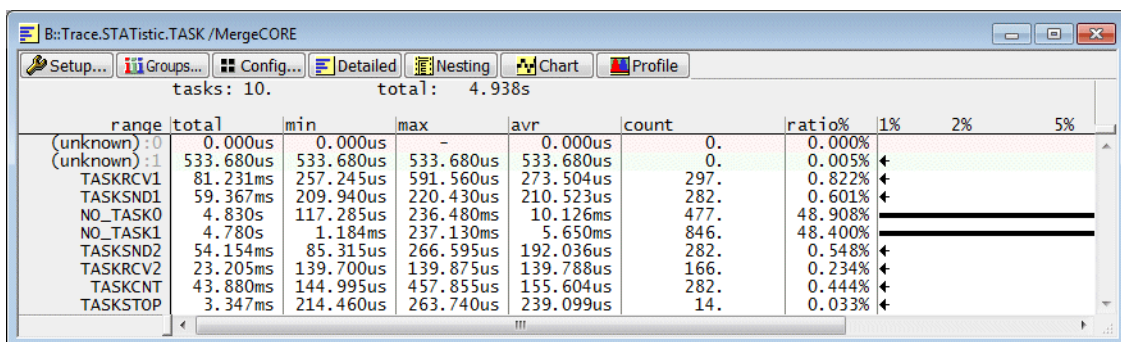
record	run	address	cycle	data	symbol	ti.back
-0000000037	1	TASK = NO_TASK1 --- D:40000A45 wr-byte	07	\\sample1\Global\OsOrtiRunning_+0x1	145.660us	
-0000000034	1	TASK = TASKSND1 --- D:40000A45 wr-byte	00	\\sample1\Global\OsOrtiRunning_+0x1	1.307ms	
-0000000032	0	TASK = TASKRCV1 --- D:40000A44 wr-byte	01	\\sample1\Global\OsOrtiRunning_	2.704ms	
-0000000030	1	TASK = NO_TASK1 --- D:40000A45 wr-byte	07	\\sample1\Global\OsOrtiRunning_+0x1	209.975us	
-0000000028	0	TASK = NO_TASK0 --- D:40000A44 wr-byte	06	\\sample1\Global\OsOrtiRunning_	258.440us	
-0000000025	1	TASK = TASKSND2 --- D:40000A45 wr-byte	02	\\sample1\Global\OsOrtiRunning_+0x1	2.688ms	
-0000000023	1	TASK = NO_TASK1 --- D:40000A45 wr-byte	07	\\sample1\Global\OsOrtiRunning_+0x1	85.325us	
-0000000020	1	TASK = TASKCNT --- D:40000A45 wr-byte	04	\\sample1\Global\OsOrtiRunning_+0x1	1.365ms	

The following commands perform a statistical analysis of the task switches:



Trace.STATistic.TASK [/SplitCORE]

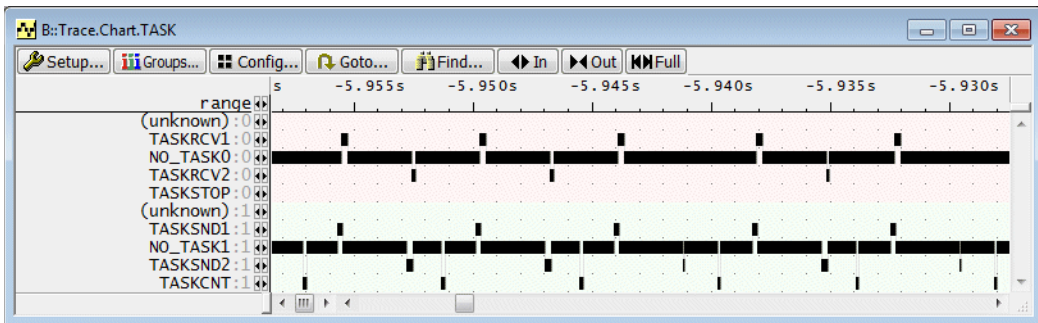
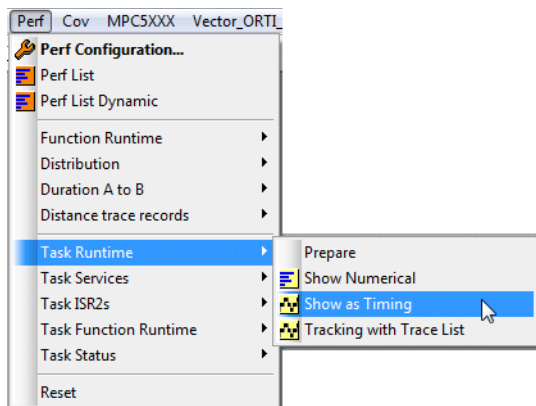
Task runtime statistic, result per core



Trace.STATistic.TASK /MergeCORE

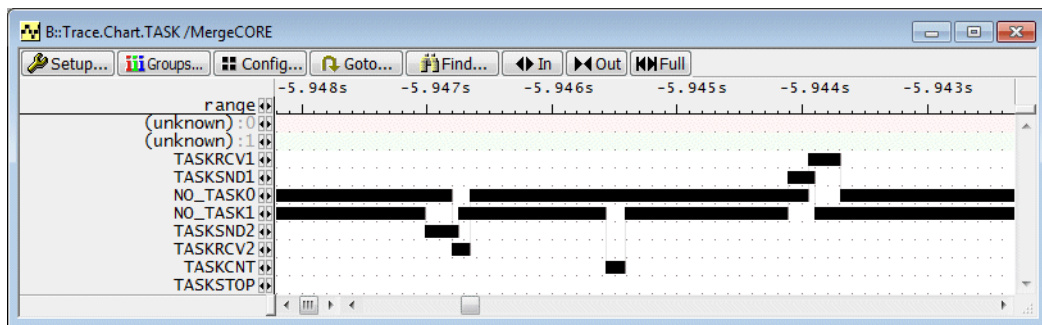
Task runtime statistic, results of all cores merged

The following commands display a time-chart of the task run-times:



Trace.Chart.TASK [/SplitCORE]

Task runtime time chart, result per core



Trace.Chart.TASK /MergeCORE

Task runtime time chart, results of all cores merged

The time spent in OSEK service routines can be evaluated.

OSEK writes information on the entries and exits to OSEK service routines to a defined variable per core. One way to export information on OSEK service routines is to advise the NEXUS hardware module to generate trace information when a write access to one of these variables occurs.

The address of these variables is provided by the TRACE32 functions

TASK.CONFIG(magic_service[<core>]).

```
PRINT TASK.CONFIG(magic_service[0])      ; print the address of the
                                           ; variable that holds the
                                           ; service information for core 0

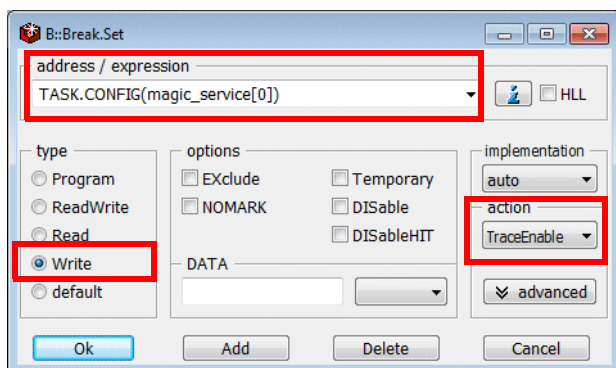
PRINT TASK.CONFIG(magic_service[1])      ; print the address of the
                                           ; variable that holds the
                                           ; service information for core 1

...

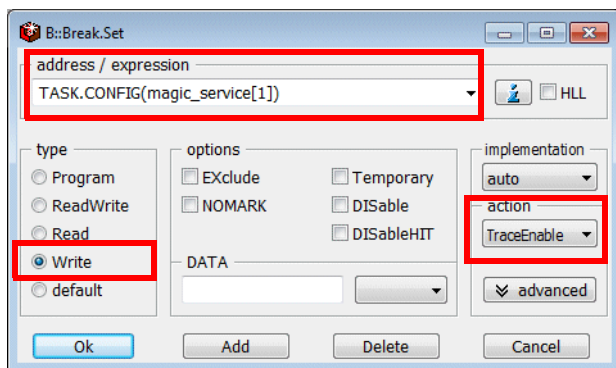
PRINT TASK.CONFIG(magic_service[n])      ; print the address of the
                                           ; variable that holds the
                                           ; service information for core n
```

Example: Advise the NEXUS hardware module to generate only trace information for entries and exits to OSEK service routines for a dual-core chip.

1. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic_service[0]) and select the trace action TraceEnable.



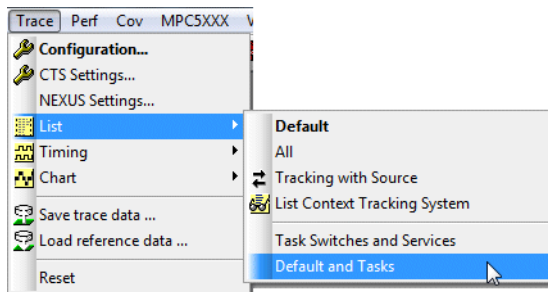
2. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic_service[1]) and select the trace action TraceEnable.



```
Break.Set TASK.CONFIG(magic_service[0]) /Write /TraceEnable  
Break.Set TASK.CONFIG(magic_service[1]) /Write /TraceEnable
```

3. Start and stop the program execution to fill the trace buffer

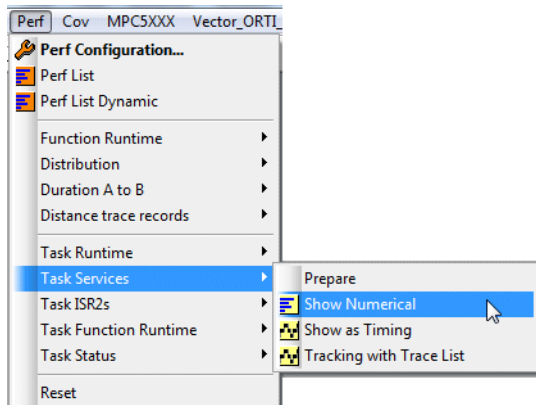
4. Display the result.



B::Trace.List List.TASK Default

record	run	address	cycle	data	symbol	ti.back
-0000000128	0	D:40000A3E	wr-byte	SERVICE = OSServiceId_PostTaskHook entry	B5 \\sample1\Global\OsOrtiRunningServiceId_	17.015us
-0000000127	0	D:40000A3E	wr-byte	SERVICE = OSServiceId_PostTaskHook exit	B4 \\sample1\Global\OsOrtiRunningServiceId_	3.735us
-0000000126	1	D:40000A3F	wr-byte	SERVICE = OSServiceId_StartScheduleTableAsync exit	D4 ..sample1\Global\OsOrtiRunningServiceId+0x1	176.465us
-0000000125	0	D:40000A3E	wr-byte	SERVICE = OSServiceId_TerminateTask exit	22 \\sample1\Global\OsOrtiRunningServiceId_	22.945us
-0000000124	1	D:40000A3F	wr-byte	SERVICE = OSServiceId_TerminateTask entry	23 ..sample1\Global\OsOrtiRunningServiceId+0x1	8.250us
-0000000122	1	D:40000A3F	wr-byte	SERVICE = OSServiceId_PostTaskHook entry	B5 ..sample1\Global\OsOrtiRunningServiceId+0x1	27.070us
-0000000121	1	D:40000A3F	wr-byte	SERVICE = OSServiceId_PostTaskHook exit	B4 ..sample1\Global\OsOrtiRunningServiceId+0x1	5.545us
-0000000120	1	D:40000A3F	wr-byte	SERVICE = OSServiceId_TerminateTask exit	22 ..sample1\Global\OsOrtiRunningServiceId+0x1	40.605us

The following two commands perform a statistical analysis of the OSEK service routines:



(unknown) represents the time in which the processor/core is not in an OSEK service routine

B:\Trace.STATIC.TASKSRV

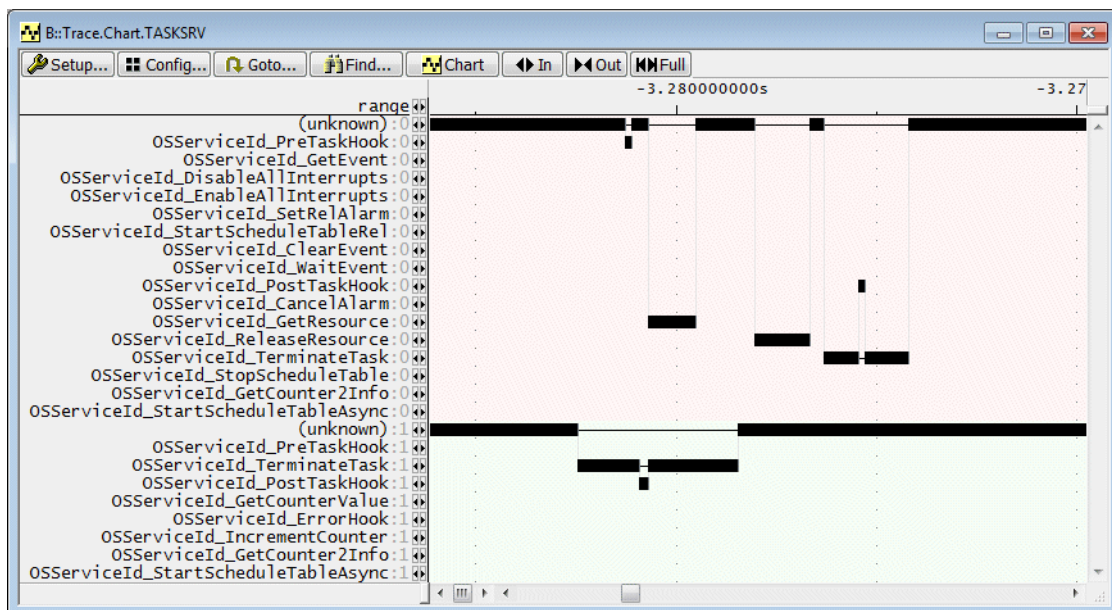
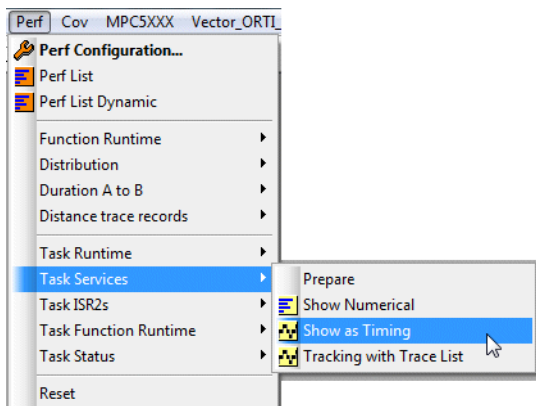
Setup...Groups...Config...DetailedNestingChartProfile

srvs: 26. total: 4.071s

	range	total	min	max	avr	count	ratio%	1%	2%
(unknown)	4.005s	-	4.005s	4.005s	4.005s	0.	98.377%		
OSServiceId_PreTaskHook	1.698ms	3.350us	4.645us	4.191us	405.	0.041%			
OSServiceId_GetEvent	3.137ms	11.340us	12.505us	12.447us	252.	0.077%			
OSServiceId_DisableAllInterrupts	124.240us	5.025us	5.415us	5.177us	24.	0.003%			
OSServiceId_EnableAllInterrupts	110.575us	4.380us	5.030us	4.607us	24.	0.002%			
OSServiceId_SetRelAlarm	9.736ms	32.345us	127.740us	36.880us	264.	0.239%			
OSServiceId_StartScheduleTableRel	2.795ms	232.880us	232.920us	232.898us	12.	0.068%			
OSServiceId_ClearEvent	2.198ms	8.630us	9.410us	8.723us	252.	0.053%			
OSServiceId_WaitEvent	12.579ms	49.615us	54.780us	49.919us	252.	0.290%			
OSServiceId_PostTaskHook	1.255ms	2.960us	3.480us	3.098us	405.	0.030%			
OSServiceId_CancelAlarm	6.402ms	26.545us	26.685us	26.674us	240.	0.157%			
OSServiceId_GetResource	8.688ms	22.035us	24.105us	22.804us	381.	0.213%			
OSServiceId_ReleaseResource	10.158ms	26.160us	27.590us	26.661us	381.	0.249%			
OSServiceId_TerminateTask	6.433ms	41.755us	45.245us	42.043us	153.	0.146%			
OSServiceId_StopScheduleTable	1.885ms	132.620us	181.620us	157.113us	12.	0.046%			
OSServiceId_GetCounter2Info	54.135us	18.045us	18.045us	18.045us	3.	0.001%			
OSServiceId_StartScheduleTableAsync	48.330us	16.110us	16.110us	16.110us	3.	0.001%			
(unknown)	3.992s	-	3.992s	3.992s	0.	98.070%			
OSServiceId_PreTaskHook	3.345ms	4.635us	5.030us	4.646us	720.	0.082%			
OSServiceId_TerminateTask	55.611ms	74.745us	81.470us	77.238us	720.	1.282%			
OSServiceId_PostTaskHook	3.415ms	4.635us	4.900us	4.743us	720.	0.083%			
OSServiceId_GetCounterValue	6.724ms	47.680us	47.700us	47.691us	141.	0.150%			
OSServiceId_ErrorHook	617.895us	4.380us	4.385us	4.382us	141.	0.015%			
OSServiceId_IncrementCounter	11.648ms	43.820us	127.745us	48.531us	240.	0.286%			
OSServiceId_GetCounter2Info	186.240us	30.800us	31.320us	31.040us	6.	0.004%			
OSServiceId_StartScheduleTableAsync	1.042ms	173.605us	173.745us	173.695us	6.	0.025%			

Trace.STATistic.TASKSRV [/SplitCORE]

Statistic on service routines, result per core



Trace.Chart.TASKSRV [/SplitCORE]

Time chart on service routines, result per core

The time spent in OSEK interrupt service routines can be evaluated.

OSEK writes information on the start of an interrupt service routine to a defined variable per core as well as the information NO_ISR. One way to export information on OSEK interrupt service routines is to advise the NEXUS hardware module to generate trace information when a write access to these variables occurs.

The address of these variables is provided by the TRACE32 functions

TASK.CONFIG(magic_isr2[<core>]).

```
PRINT TASK.CONFIG(magic_isr2[0])      ; print the address of the variable
                                       ; that holds the interrupt service
                                       ; information for core 0

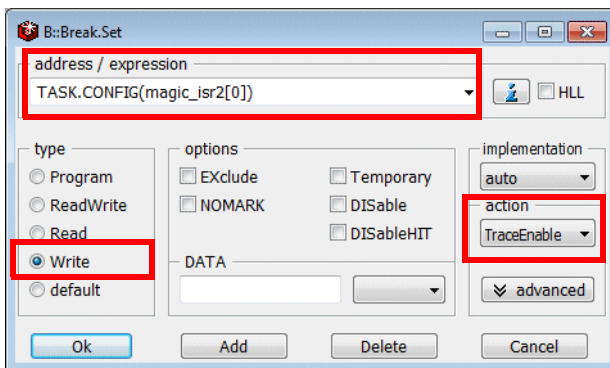
PRINT TASK.CONFIG(magic_isr2[1])      ; print the address of the variable
                                       ; that holds the interrupt service
                                       ; information for core 1

...

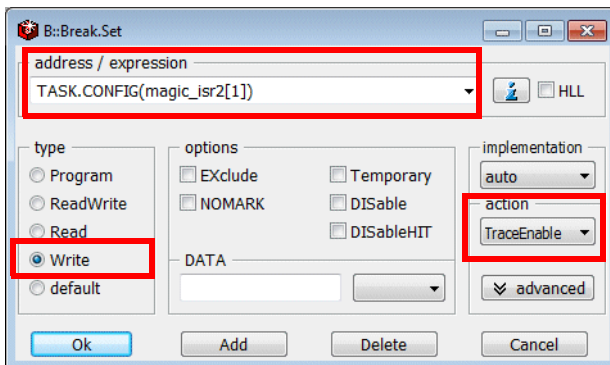
PRINT TASK.CONFIG(magic_isr2[n])      ; print the address of the variable
                                       ; that holds the interrupt service
                                       ; information for core n
```

Example: Advise the NEXUS hardware module to generate only trace information on the start of an interrupt service routine as well as on the information NO_ISR for a dual-core chip.

1. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic_isr2[0]) and select the trace action TraceEnable.



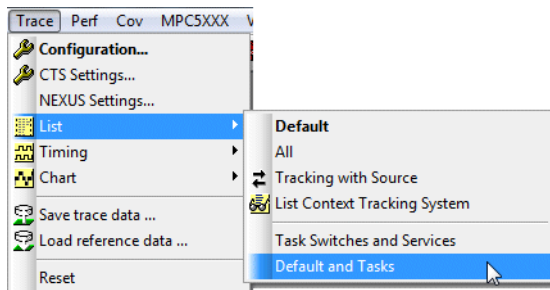
2. Set a Write breakpoint to the address indicated by TASK.CONFIG(magic_isr2[1]) and select the trace action TraceEnable.



```
Break.Set TASK.CONFIG(magic_isr2[0]) /Write /TraceEnable  
Break.Set TASK.CONFIG(magic_isr2[1]) /Write /TraceEnable
```

3. Start and stop the program execution to fill the trace buffer

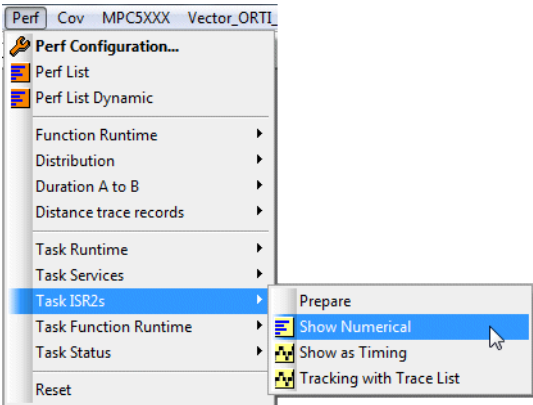
4. Display the result.



B::Trace.List List.TASK DEFAULT

record	run	address	cycle	data	symbol	ti.back
-0000038840	1	ISR2 = SECOND_TIMER --- D:40000A36 wr-word	---	0002	\\sample1\\Global\\OSISRId_+0x2	1.342ms
-0000038838	1	ISR2 = NO_ISR --- D:40000A36 wr-word	---	0005	\\sample1\\Global\\OSISRId_+0x2	108.155us
-0000038836	0	ISR2 = SYSTEM_TIMER --- D:40000A34 wr-word	---	0001	\\sample1\\Global\\OSISRId_	1.904ms
-0000038834	0	ISR2 = NO_ISR --- D:40000A34 wr-word	---	0005	\\sample1\\Global\\OSISRId_	29.520us
-0000038832	1	ISR2 = SECOND_TIMER --- D:40000A36 wr-word	---	0002	\\sample1\\Global\\OSISRId_+0x2	1.342ms
-0000038830	1	ISR2 = NO_ISR --- D:40000A36 wr-word	---	0005	\\sample1\\Global\\OSISRId_+0x2	110.215us
-0000038829	0	ISR2 = OS_TIMER --- D:40000A34 wr-word	---	0003	\\sample1\\Global\\OSISRId_	658.865us

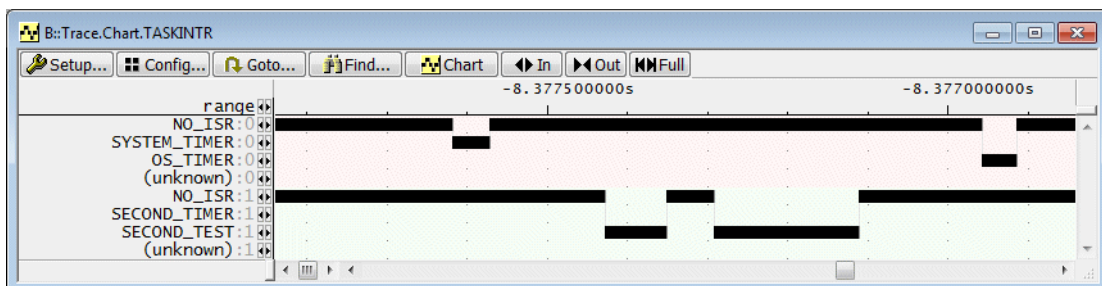
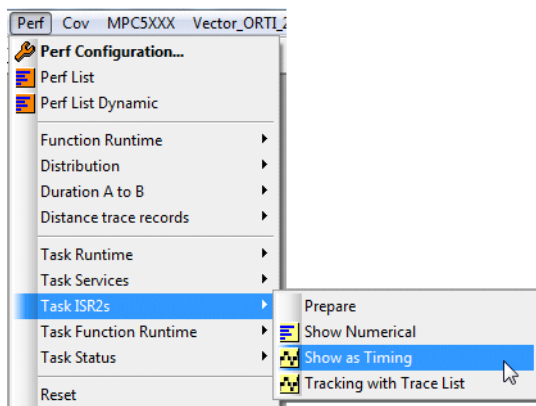
The following commands perform a statistical analysis of the OSEK interrupt service routines:



The screenshot shows the 'B::Trace.STATistic.TASKINTR' window. The table displays statistics for various interrupt service routines. The 'range' column shows the range of the routine, the 'total' column shows the total time, the 'min' column shows the minimum time, the 'max' column shows the maximum time, the 'avr' column shows the average time, the 'count' column shows the number of occurrences, the 'ratio%' column shows the percentage of total time, and the '1%' and '2%' columns show the 1% and 2% quantiles.

range	total	min	max	avr	count	ratio%	1%	2%
(unknown):0	0.000us	0.000us	-	0.000us	1.	0.000%		
SYSTEM_TIMER:0	193.169ms	29.510us	46.025us	29.609us	6524.	1.531%		
NO_ISR:0	12.370s	207.380us	1.904ms	1.606ms	7703.	98.072%		
OS_TIMER:0	49.992ms	40.725us	43.315us	42.366us	1180.	0.396%		
(unknown):1	42.774ms	42.774ms	42.774ms	42.774ms	1.	0.339%		
SECOND_TEST:1	12.277ms	77.720us	180.995us	113.674us	108.	0.097%		
NO_ISR:1	12.327s	58.385us	236.699ms	5.525ms	2231.	97.732%		
SECOND_TIMER:1	230.917ms	107.875us	110.230us	108.718us	2124.	1.830%		

Trace.STATistic.TASKINTR [/SplitCORE] Statistic on interrupt service routines, result per core



Trace.Chart.TASKINTR [/SplitCORE]

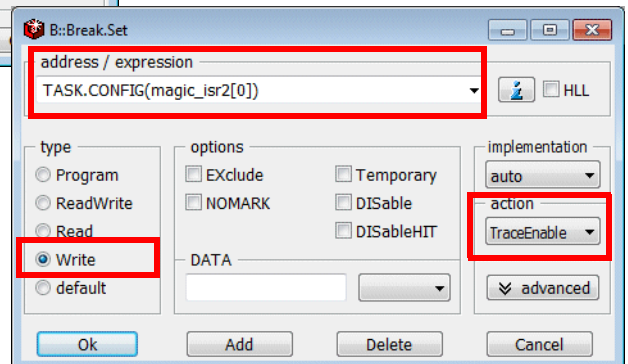
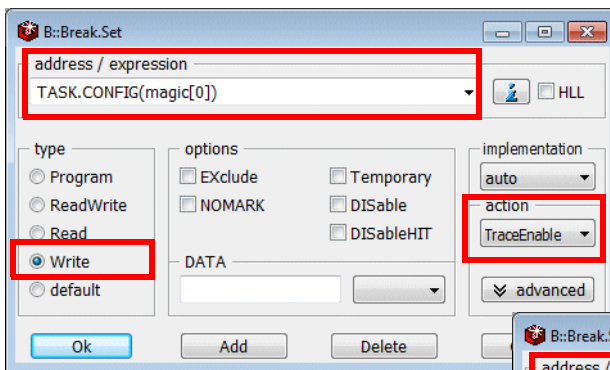
Time chart on interrupt service routines, result per core

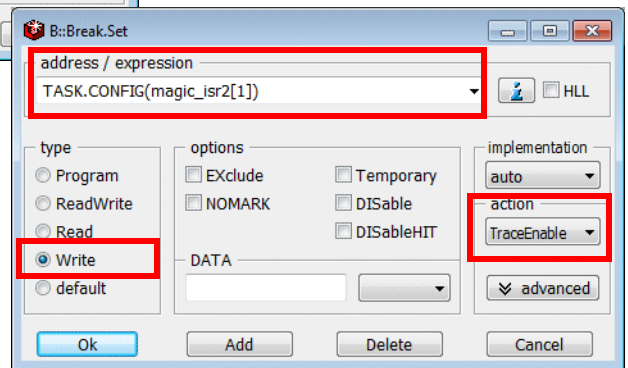
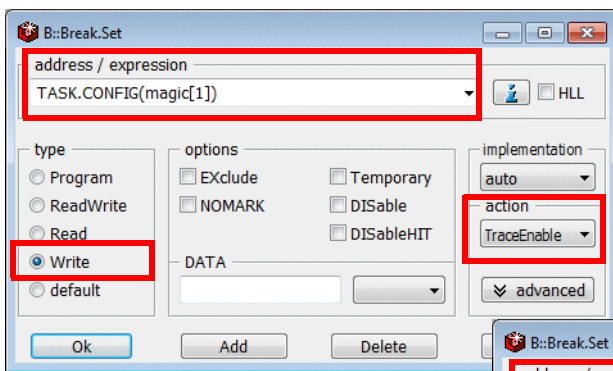
OSEK interrupt service routines that occur in multiple tasks can be displayed per task, if the following information is available:

- Task switch information per core
- ISR2 start and NO_ISR information per core

Example:

1. Advise the NEXUS hardware module to generate the following trace information for a dual-core chip:
 - task switches per core
 - start of an interrupt service routine as well as on the information NO_ISR per core.

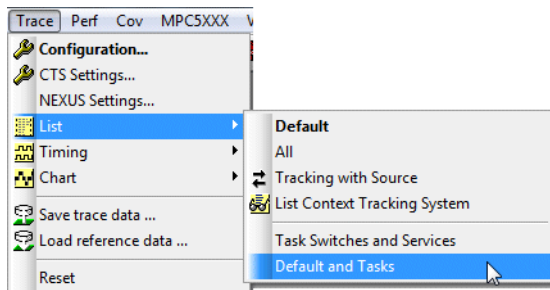




```
Break.Set TASK.CONFIG(magic[0]) /Write /TraceEnable
Break.Set TASK.CONFIG(magic_isr2[0]) /Write /TraceEnable
Break.Set TASK.CONFIG(magic[1]) /Write /TraceEnable
Break.Set TASK.CONFIG(magic_isr2[1]) /Write /TraceEnable
```

2. Start and stop the program execution to fill the trace buffer.

3. Display the result.



B::Trace.List List.TASK Default

record	run	address	cycle	data	symbol	ti.back
-0000044868	1	ISR2 = NO_ISR				
		D:40000A36 wr-word		0005	\\sample1\Global\OSISRId_+0x2	108.140us
-0000044866	0	ISR2 = SYSTEM_TIMER				
		D:40000A34 wr-word		0001	\\sample1\Global\OSISRId_	1.904ms
-0000044864	0	ISR2 = NO_ISR				
		D:40000A34 wr-word		0005	\\sample1\Global\OSISRId_	29.515us
-0000044862	1	ISR2 = SECOND_TIMER				
		D:40000A36 wr-word		0002	\\sample1\Global\OSISRId_+0x2	1.342ms
-0000044860	1	ISR2 = NO_ISR				
		D:40000A36 wr-word		0005	\\sample1\Global\OSISRId_+0x2	110.070us
-0000044859	0	ISR2 = OS_TIMER				
		D:40000A34 wr-word		0003	\\sample1\Global\OSISRId_	612.740us
-0000044857	0	ISR2 = NO_ISR				
		D:40000A34 wr-word		0005	\\sample1\Global\OSISRId_	43.300us
		TASK = TASKRCV1				

The following commands allow to perform a statistical analysis of the OSEK interrupt service routines related to the active tasks.

Trace.STATistic.TASKVSINTR [/SplitCORE]

Task-related statistic on interrupt service routines, result per core

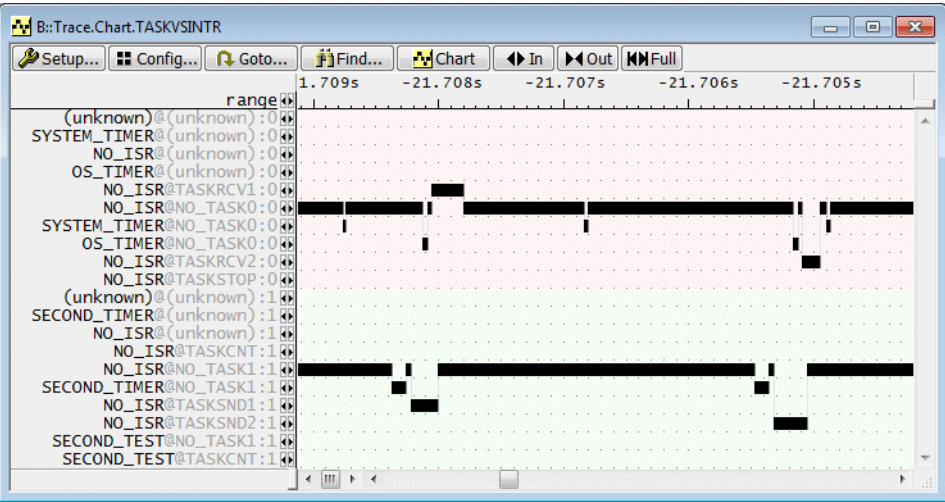
Trace.Chart.TASKVSINTR [/SplitCORE]

Time-chart for task related interrupt service routines, result per core

B::Trace.STATistic.TASKVSINTR

intrs: 20. total: 28.338s

	range	total	min	max	avr	count	ratio%	1%	2%
(unknown)@(unknown):0		1.061ms	1.061ms	1.061ms	1.061ms	1.	0.003%		
SYSTEM_TIMER@(unknown):0		29.000us	29.000us	29.000us	29.000us	1.	<0.001%		
NO_ISR@(unknown):0		639.295us	27.970us	611.325us	639.295us	1.	0.002%		
OS_TIMER@(unknown):0		42.790us	42.790us	42.790us	42.790us	1.	<0.001%		
NO_ISR@TASKRCV1:0		458.241ms	256.975us	591.815us	272.277us	1683.	1.617%		
NO_ISR@NO_TASK0:0		27.190s	24.615us	1.905ms	1.360ms	19988.	95.950%		
SYSTEM_TIMER@NO_TASK0:0		426.323ms	28.990us	45.505us	29.091us	14655.	1.504%		
OS_TIMER@NO_TASK0:0		110.085ms	40.335us	42.930us	41.921us	2626.	0.388%		
NO_ISR@TASKRCV2:0		131.754ms	139.690us	139.740us	139.718us	943.	0.464%		
NO_ISR@TASKSTOP:0		19.386ms	214.320us	263.735us	239.332us	81.	0.068%		
(unknown)@(unknown):1		0.000us	0.000us	-	0.000us	1.	0.000%		
SECOND_TIMER@(unknown):1		107.620us	107.620us	107.620us	107.620us	1.	<0.001%		
NO_ISR@(unknown):1		47.300us	47.300us	47.300us	47.300us	0.	<0.001%		
NO_ISR@TASKCNT:1		246.488ms	103.235us	273.015us	149.932us	1644.	0.869%		
NO_ISR@NO_TASK1:1		26.907s	47.295us	236.591ms	2.763ms	9740.	94.952%		
SECOND_TIMER@NO_TASK1:1		511.375ms	107.345us	109.580us	108.136us	4729.	1.804%		
NO_ISR@TASKSND1:1		337.522ms	209.930us	220.435us	210.556us	1603.	1.191%		
NO_ISR@TASKSND2:1		307.721ms	85.315us	266.590us	191.966us	1603.	1.085%		
SECOND_TEST@NO_TASK1:1		23.938ms	76.945us	180.345us	119.097us	201.	0.084%		
SECOND_TEST@TASKCNT:1		3.263ms	81.580us	81.600us	81.587us	40.	0.011%		



intr information that was generated before the first **task** information is assigned to the **@(unknown)** task.

Exporting Task Switches and all Instructions (Write Access)

General setup:

```
Break.Set TASK.CONFIG(magic[0]) /Write /TraceData

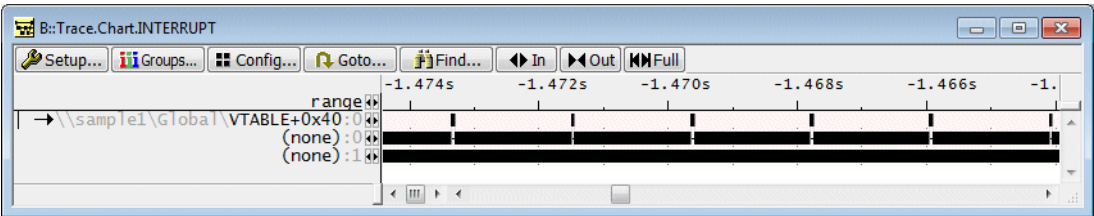
Break.Set TASK.CONFIG(magic[1]) /Write /TraceData

...

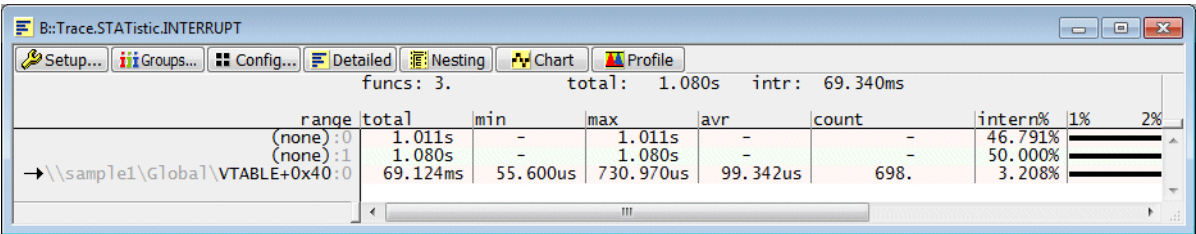
; advise TRACE32 to regard the time between interrupt entry
; and exit as function
Trace.STATistic.InterruptIsFunction ON
```

Statistic Analysis of Interrupts

- Trace.Chart.INTERRUPT [/SplitCORE]**
Trace.Chart.INTERRUPT /CORE <n>
- Interrupt time chart (default), results split up per core
Interrupt time chart for specified core



- Trace.STATistic.INTERRUPT [/SplitCORE]**
Trace.STATistic.INTERRUPT /CORE <n>
- Interrupt statistic (default), results split up per core
Interrupt statistic for specified core

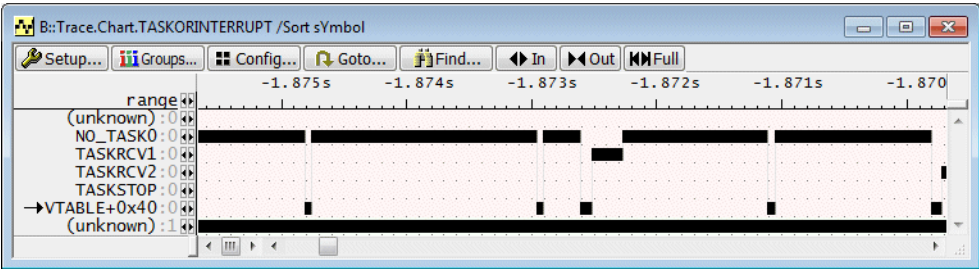


Trace.Chart.TASKORINTERRUPT [/SplitCORE]

Time chart for interrupts and tasks (default), results split up per core

Trace.Chart.TASKORINTERRUPT /CORE <n>

Time chart for interrupts and tasks for specified core



Trace.STATistic.TASKORINTERRUPT [/SplitCORE]

Statistic for interrupts and tasks (default), results split up per core

Trace.STATistic.TASKORINTERRUPT /CORE <n>

Statistic for interrupts and tasks for specified core

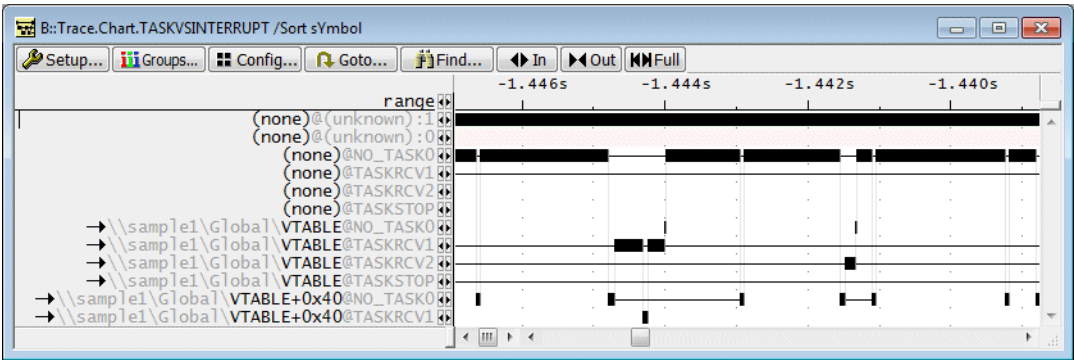
The screenshot shows the 'Trace.STATistic.TASKORINTERRUPT /Sort sYmbol' window. It features a toolbar with buttons for Setup, Groups, Config, Detailed, Nesting, Chart, and Profile. The main area displays a table of statistics for interrupts and tasks, split up per core. The table has the following columns: range, total, min, max, avr, count, ratio%, and 1%. The data is as follows:

range	total	min	max	avr	count	ratio%	1%
(unknown):0	5.544ms	5.544ms	5.544ms	5.544ms	0.	-	←
NO_TASK0:0	1.854s	203.605us	1.795ms	1.475ms	1257.	93.759%	←
TASKRCV1:0	30.321ms	234.958us	434.675us	250.584us	121.	1.533%	←
TASKRCV2:0	9.016ms	128.725us	128.900us	128.797us	70.	0.455%	←
TASKSTOP:0	1.131ms	169.810us	207.215us	188.511us	6.	0.057%	←
->VTABLE+0x40:0	77.415ms	55.181us	307.750us	61.343us	1262.	3.914%	←
(unknown):1	1.978s	-	1.978s	1.978s	0.	-	←

- Trace.Chart.TASKVSINTERRUPT [/SplitCORE]**

Interrupt time chart, task-related (default), results split up per core
- Trace.Chart.TASKVSINTERRUPT /CORE <n>**

Interrupt time chart task-related, for specified core



- Trace.STATistic.TASKVSINTERRUPT [/SplitCORE]**

Interrupt statistic, task-related (default), results split up per core
- Trace.STATistic.TASKVSINTERRUPT /CORE <n>**

Interrupt statistic, task-related, for specified core

The screenshot shows the Trace.STATistic.TASKVSINTERRUPT window. The title bar indicates the path 'B::Trace.STATistic.TASKVSINTERRUPT /Sort sYmbol'. The window contains a toolbar with buttons for Setup..., Groups..., Config..., Detailed, Nesting, Chart, and Profile. Below the toolbar, it shows 'funcs: 12.' and 'total: 1.787s'. The main area displays a table of interrupt statistics for various tasks and cores. The table has columns for range, total, min, max, avr, count, intern%, and 1%.

range	total	min	max	avr	count	intern%	1%
(none)@(unknown):0	0.000us	-	-	0.000us	0. (1/0)	-	←
(none)@(unknown):1	0.000us	-	-	0.000us	0. (1/0)	-	←
(none)@NO_TASK0	0.000us	-	-	0.000us	0. (1/0)	0.000%	
(none)@TASKRCV1	0.000us	-	-	0.000us	0. (1/0)	0.000%	
(none)@TASKRCV2	0.000us	-	-	0.000us	0. (1/0)	0.000%	
(none)@TASKSTOP	0.000us	-	-	0.000us	0. (1/0)	0.000%	
1\Global\VTABLE@NO_TASK0	60.841ms	234.720us	775.965us	318.539us	191.	1.702%	
1\Global\VTABLE@TASKRCV1	0.000us	-	-	0.000us	0.	0.000%	
1\Global\VTABLE@TASKRCV2	0.000us	-	-	0.000us	0.	0.000%	
1\Global\VTABLE@TASKSTOP	0.000us	-	-	0.000us	0.	0.000%	
bal\VTABLE+0x40@NO_TASK0	53.271ms	55.590us	55.625us	55.607us	958.	1.490%	
bal\VTABLE+0x40@TASKRCV1	432.895us	71.750us	72.260us	72.149us	6.	0.012%	←

Belated Trace Analysis (OS)

The TRACE32 Instruction Set Simulator can be used for a belated OS-aware trace evaluation. To set up the TRACE32 Instruction Set Simulator for belated OS-aware trace evaluation proceed as follows:

1. Save the trace information for the belated evaluation to a file.

```
Trace.SAVE belated__orti.ad
```

2. Set up the TRACE32 Instruction Set Simulator for a belated OS-aware trace evaluation (here OSEK on a MPC5553):

```
SYStem.CPU MPC5553                ; select the target CPU

SYStem.Up                        ; establish the
                                ; communication between
                                ; TRACE32 and the TRACE32
                                ; Instruction Set
                                ; Simulator

Trace.LOAD belated_orti.ad        ; load the trace file

Data.Load.ELF my_app.out /NoCODE /GHS ; load the symbol and
                                ; debug information

TASK.ORTI my_orti.ort             ; load the ORTI file

Trace.List List.TASK DEFault      ; display the trace
                                ; listing
```

Function Run-Times Analysis (Overview)

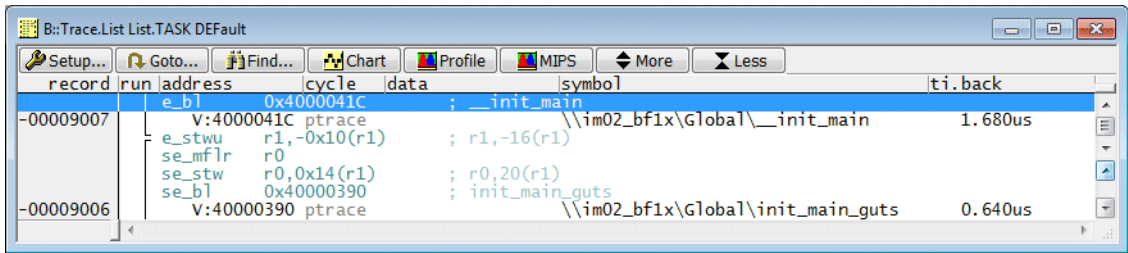
All commands for the function run-time analysis introduced in this chapter use the **contents of the trace buffer** as base for their analysis.

If you use Branch History Tracing it is recommended to enable Program Trace Correlation Messages for `bl <func>` and `e_bl <func>` instructions (saves return address in link register, then jumps to `<func>`) (IEEE-ISTO 5001-2008 and subsequent standards only).

As a result function entries are timestamped in the trace.

```
NEXUS.HTM ON

NEXUS.PTCM BL_HTM ON                                ; generate Program Trace
                                                       ; Correlation message when a
                                                       ; "Branch and Link" instruction
                                                       ; executes
```



Software under Analysis (no OS or OS)

For the use of the function run-time analysis it is helpful to differentiate between two types of application software:

1. Software without operating system (abbreviation: **no OS**)
2. Software with an operating system (abbreviation: **OS**)

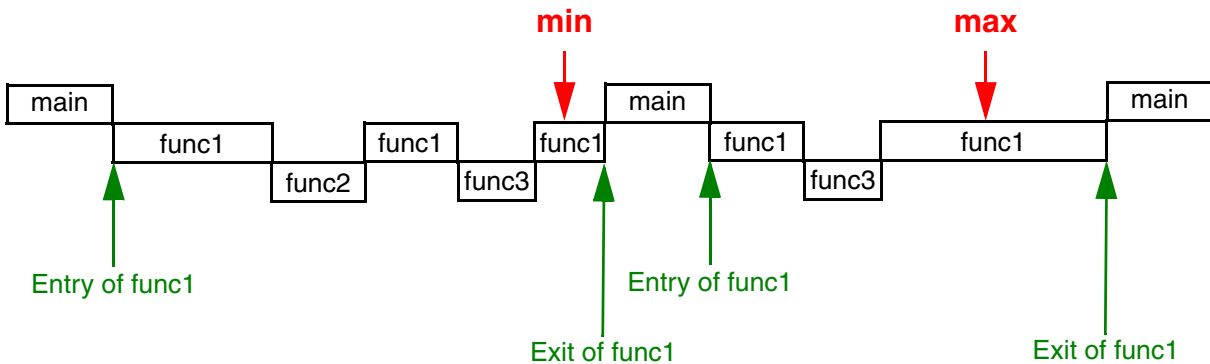
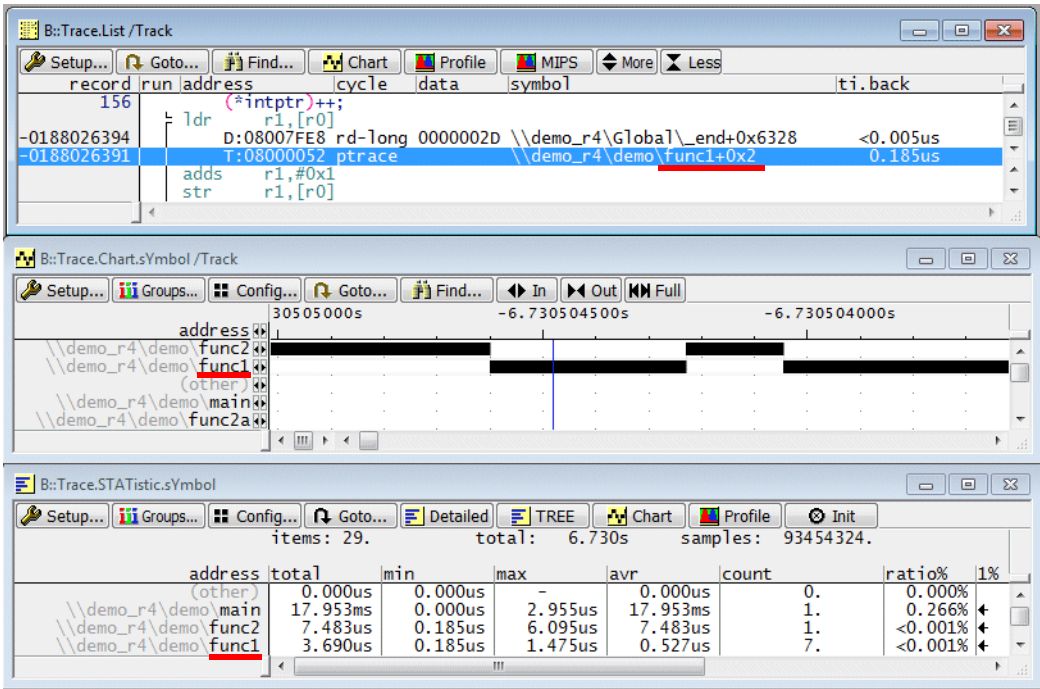
Flat vs. Nesting Analysis

TRACE32 provides two methods to analyze function run-times:

- Flat analysis
- Nesting analysis

Basic Knowledge about Flat Analysis

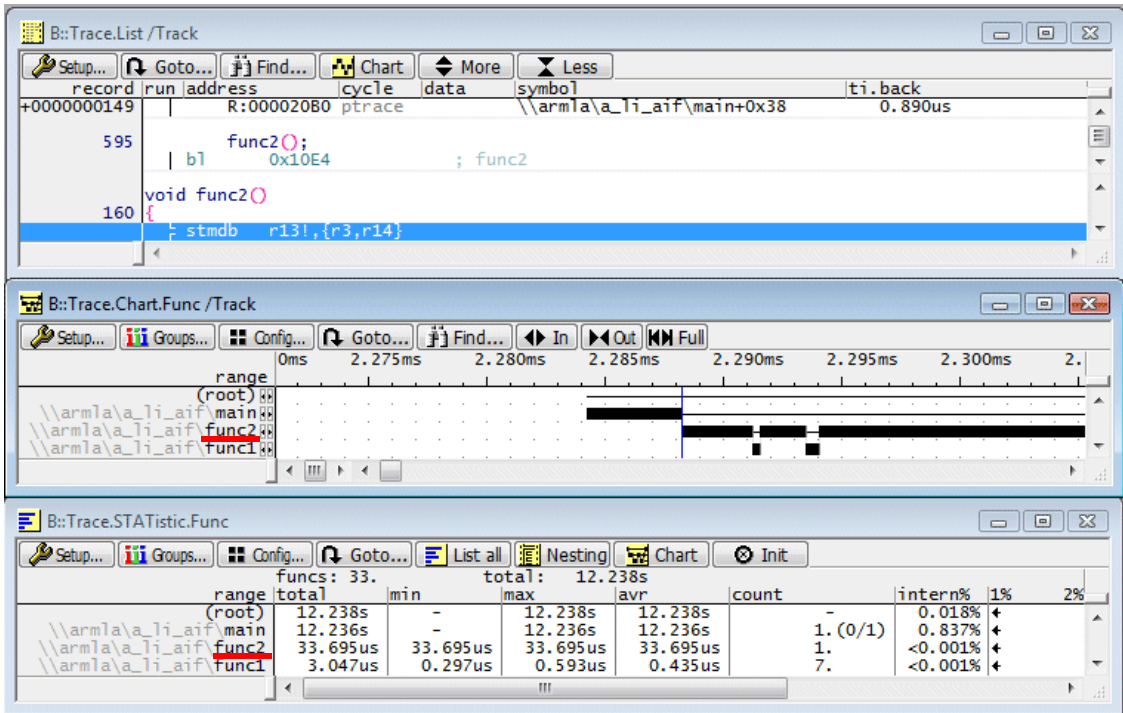
The flat function run-time analysis bases on the symbolic instruction addresses of the trace entries. The time spent by an instruction is assigned to the corresponding function/symbol region.

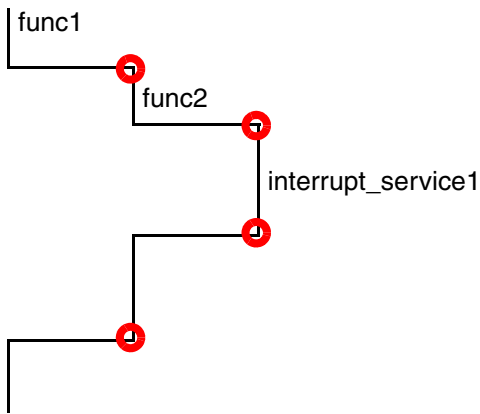


min	shortest time continuously in the address range of the function/symbol region
max	longest time continuously in the address range of the function/symbol region

Basic Knowledge about Nesting Analysis

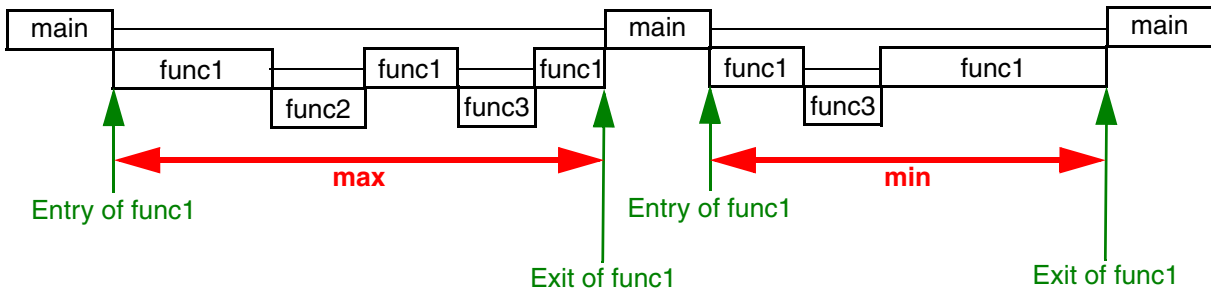
The function nesting analysis analyses only high-level language functions.





In order to display a nesting function run-time analysis TRACE32 analyzes the structure of the program execution by processing the trace information. The focus is put on the transition between functions (see picture above). The following events are of interest:

1. **Function entries**
2. **Function exits**
3. **Entries to interrupt service routines**
4. **Exits of interrupt service routines**
5. **Entries to TRAP handlers** (not implemented yet)
6. **Exits of TRAP handlers** (not implemented yet)



min	shortest time within the function including all subfunctions and traps
max	longest time within the function including all subfunctions and traps

Summary

The nesting analysis provides more details on the structure and the timing of the program run, but it is much more sensitive than the flat analysis. Missing or tricky function exits for example result in a worthless nesting analysis.

Function Run-Times Analysis - Single

This chapter applies for single-core TRACE32 instances.

Flat Analysis

It is recommended to reduce the trace information generated by NEXUS to the required minimum.

- To avoid an overload of the NEXUS port.
- To make best use of the available trace memory.
- To get a more accurate timestamp.

Optimum NEXUS Configuration (No OS)

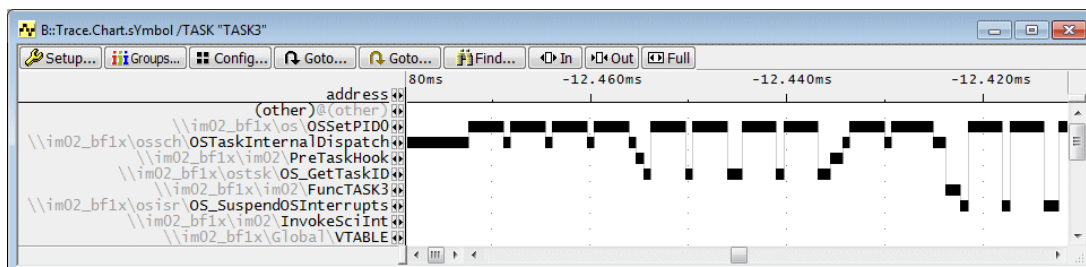
Flat function run-time analysis does **not** require any **data information** if no OS is used. That's why it is recommended to switch Data Trace Messaging off.

```
NEXUS.DTM OFF
```

Optimum NEXUS Configuration (OS)

Your function time chart **can** include task information if you advise NEXUS to export the instruction flow and task switches. For details refer to the chapter [“OS-Aware Tracing \(ORTI File\)”](#), page 193.

```
Trace.Chart.Symbol /TASK "TASK3 "
```



Optimum Configuration 1 (if OSEK generated OTMs):

```
NEXUS.OTM ON
```

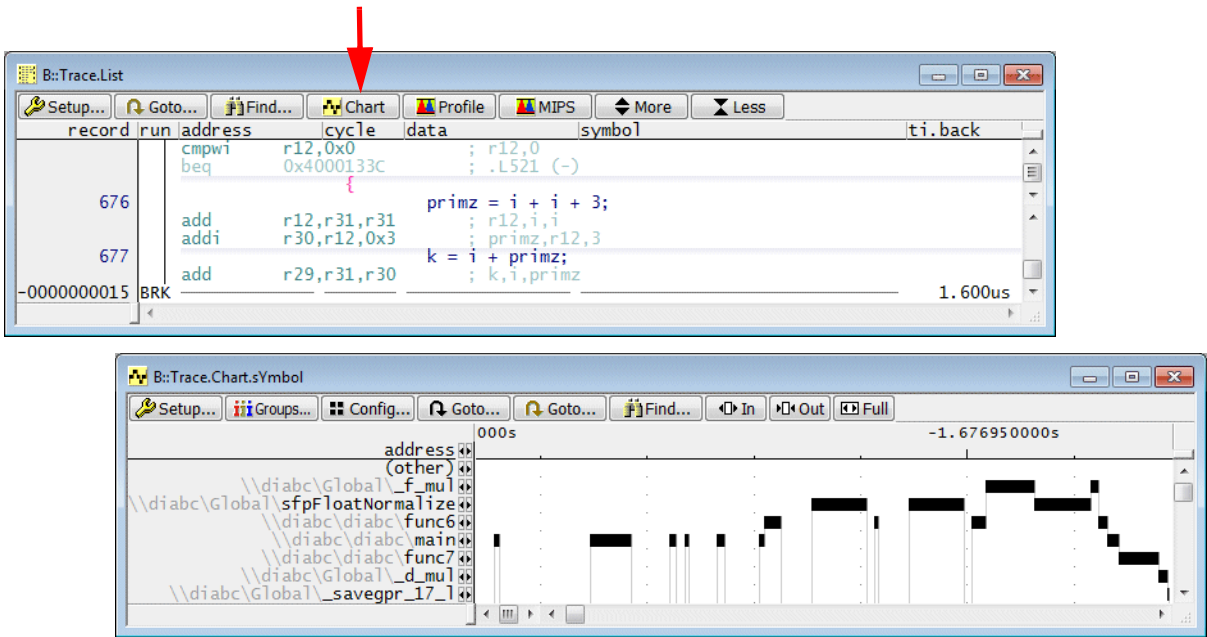
Optimum Configuration 2 (if OSEK does not support OTMs, NEXUS class 3 only):

```
Break.Set TASK.CONFIG(magic) /Write /TraceData
```

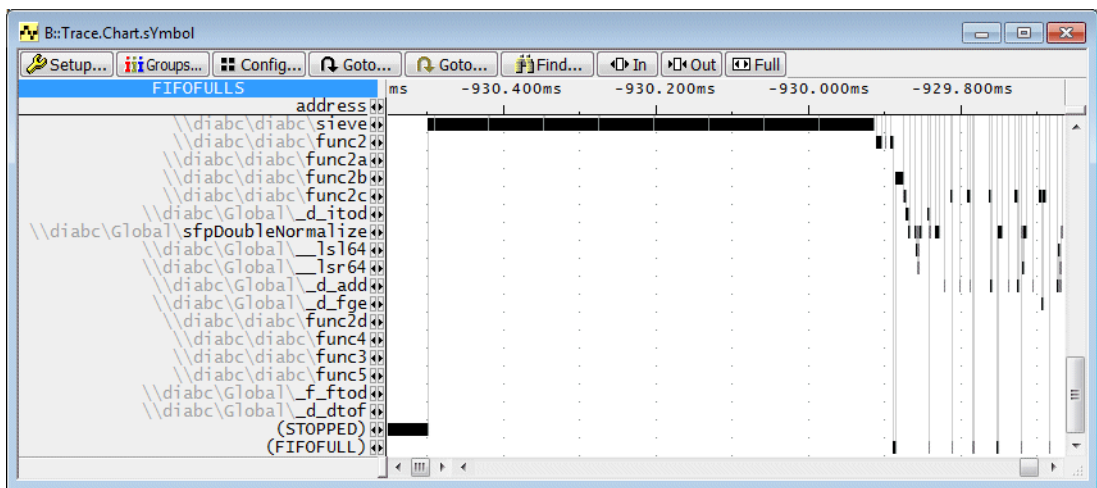
Function Time Chart

TRACE32 PowerView provides a time chart which shows when the program counter was in which function/symbol range.

Pushing the **Chart** button in the **Trace.List** window opens a **Trace.Chart.sYmbol** window

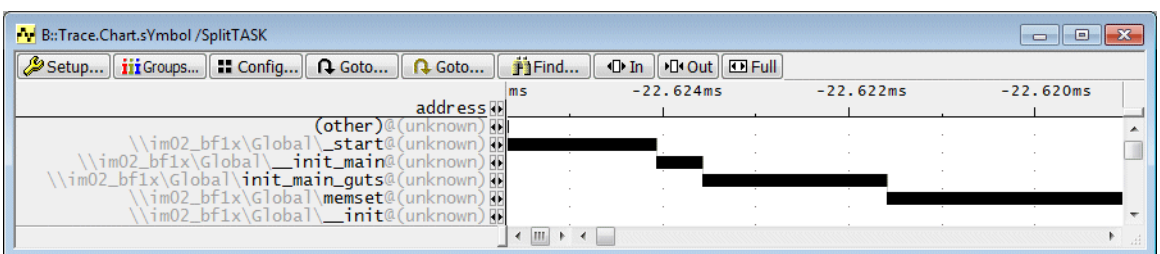
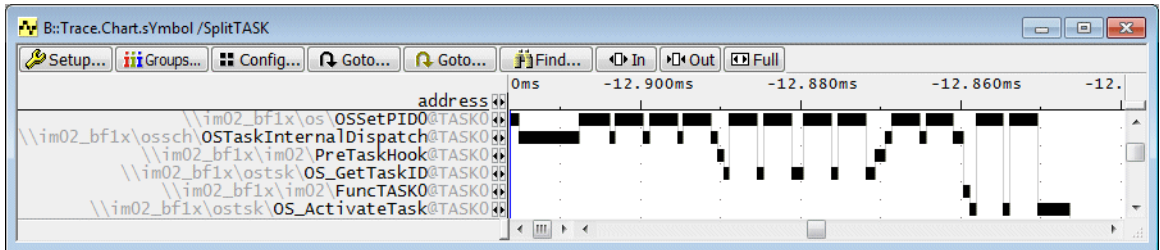


Trace.Chart.sYmbol	Display function time chart (no OS)
Trace.Chart.sYmbol [/MergeTASK]	Display function time chart (OS but task information is not of interest)



(STOPPED): If the trace recording contains time periods in which the program execution was stopped, these time periods are assigned to (STOPPED).

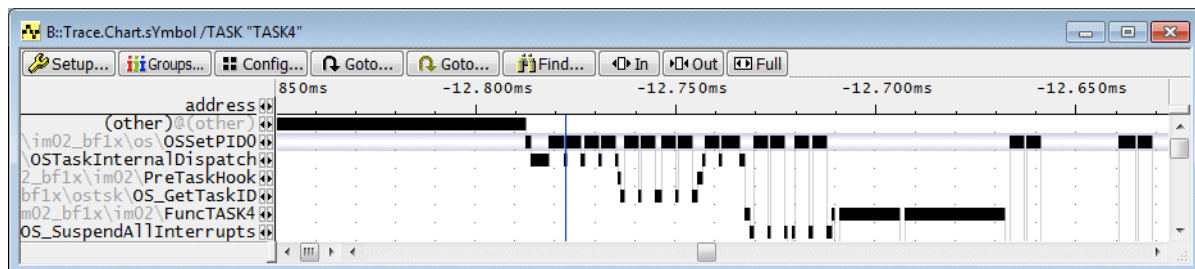
(FIFOFULL): If the trace recording contains time periods in which FIFO overflow was indicated, these time periods are assigned to (FIFOFULL).



@ <task_name>	Task name information
@(unknown)	<ul style="list-style-type: none"> Function was running before the OS was started Function was recorded before first task switch information was recorded
(UNKNOWN)@	Message decoding not possible.
(other)@(unknown)	No trace information available.

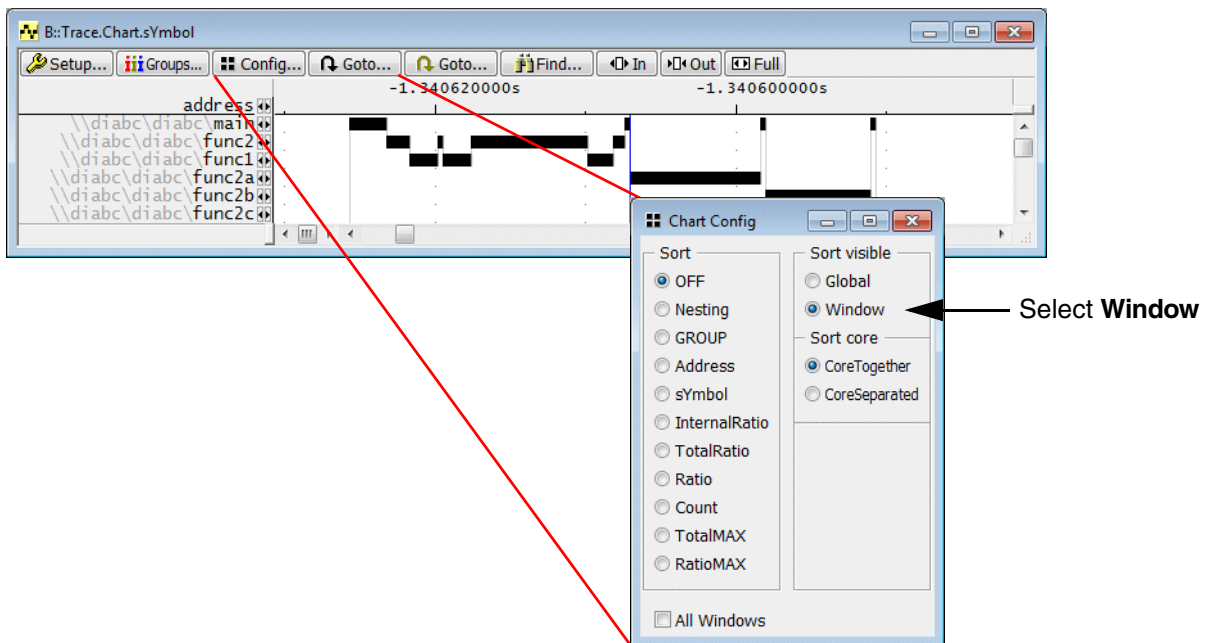
Trace.Chart.sYmbol /TASK <task_name>

Display function time chart for specified task
(OS only)



(other)@(other)

All other trace information

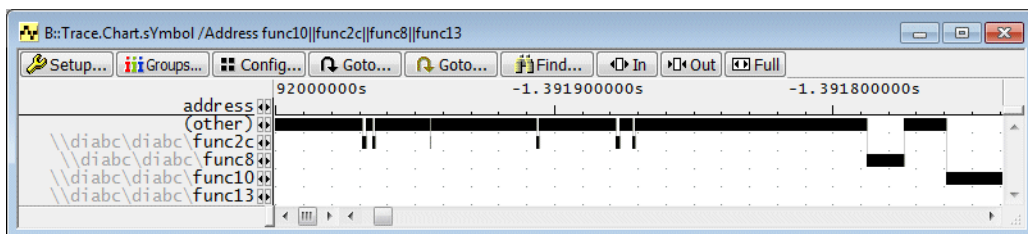


If **Window** is selected in the **Chart Config** window, the functions that are active at the selected point of time are visualized in the scope of the **Trace.Chart.sYmbol** window. This is helpful especially if you scroll horizontally.

For a detailed description of all options provided by the **Chart Config** window refer to the command description of [Trace.STATistic.Sort](#).

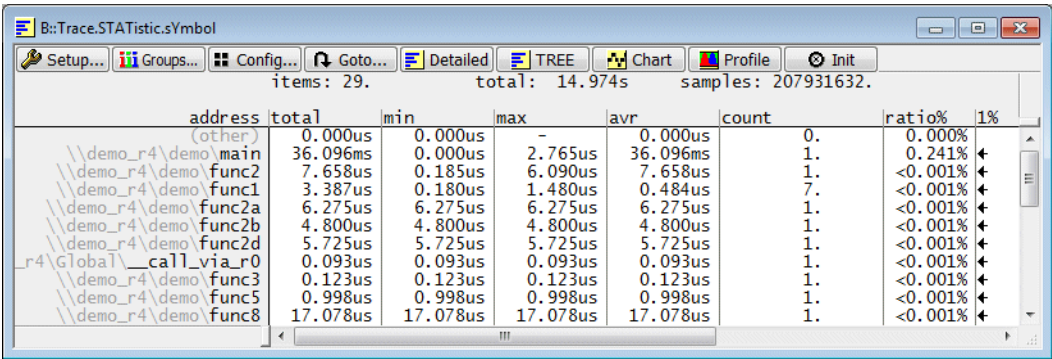
If you want to get the time chart only for a few functions, you can use the **/Address** option to list them.

Trace.Chart.sYmbol /Address <func1>||<func2>||...



More features to structure your trace analysis are introduced in [“Structure the Trace Evaluation”](#), page 335.

Analog to the timing diagram also a numerical analysis is provided.

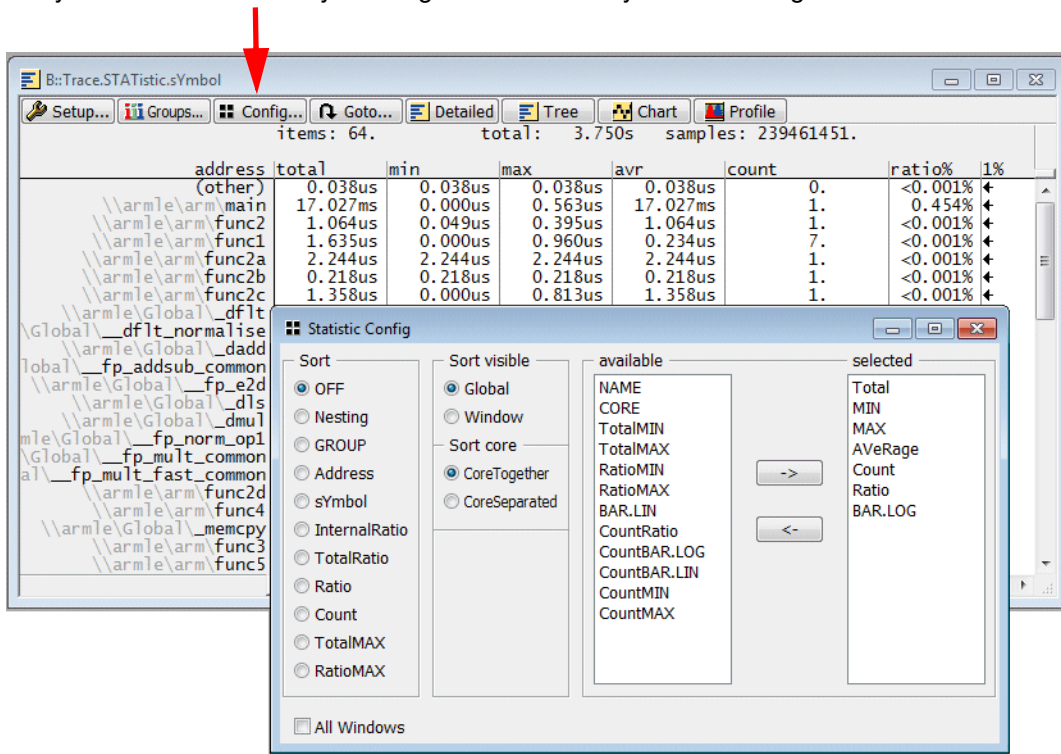


survey	
item	number of recorded functions/symbol regions
total	time period recorded by the trace
samples	total number of recorded changes of functions/symbol regions (instruction flow continuously in the address range of a function/symbol region)

Only the grey rows provide useful information about the run-time of a function/symbol range.

<i>function details</i>	
address	function/symbol region name (other) program sections that can not be assigned to a function/symbol region
total	time period in the function/symbol region during the recorded time period
min	shortest time continuously in the address range of the function/symbol region
max	longest time continuously in the address range of the function/symbol region
avr	average time continuously in the address range of the function/symbol region (calculated as total/count)
count	number of new entries (start address executed) into the address range of the function/symbol region
ratio	ratio of time in the function/symbol region with regards to the total time period recorded

Pushing the **Config** button provides the possibility to specify a different sorting criterion for the address column or a different column layout. By default the functions/symbol regions are sorted by their recording order.



Trace.STATistic.sYmbol

Flat function run-time analysis (no OS)
- numerical display

Trace.STATistic.sYmbol [/MergeTASK]

Flat function run-time analysis (OS)
- numerical display
- no task information

Trace.STATistic.sYmbol /SplitTASK

Flat function run-time analysis (OS)
- numerical display including task information

Trace.STATistic.sYmbol /TASK <task_name>

Flat function run-time analysis (OS)
- numerical display for specified task

Nesting Analysis

Restrictions

1. The nesting analysis analyses only high-level language functions.
2. The nested function run-time analysis expects common ways to enter/exit functions.
3. The nesting analysis is sensitive with regards to FIFOFULLs.

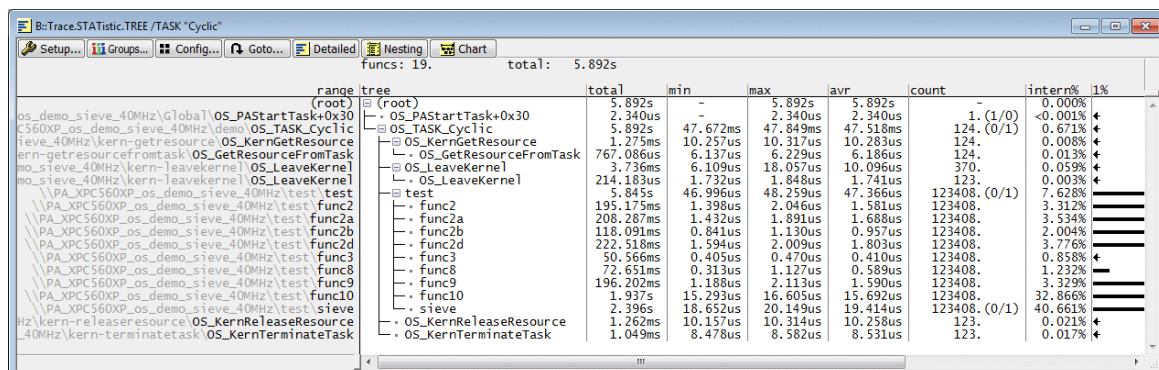
Optimum NEXUS Configuration (No OS)

The nesting function run-time analysis doesn't require any data information if no OS is used. That's why it is recommended to switch the export of data information off.

```
NEXUS.DTM OFF
```

TRACE32 PowerView builds up a separate call tree for each task.

```
Trace.STATistic.TREE /TASK "Cyclic"
```



In order to hook a function entry/exit into the correct call tree, TRACE32 PowerView needs to know which task was running when the entry/exit occurred.

The standard way to get information on the current task is to advise the NEXUS to export the instruction flow and task switches. For details refer to the chapter **“OS-Aware Tracing (ORTI File)”**, page 193.

Optimum Configuration 1 (if OSEK generated OTMs):

```
NEXUS.OTM ON

; default setting since 2015-01
Trace.STATistic.InterruptIsFunction ON
```

Optimum Configuration 2 (if OSEK does not support OTMs, NEXUS class 3 only):

```
Break.Set TASK.CONFIG(magic) /Write /TraceData

; default setting since 2015-01
Trace.STATistic.InterruptIsFunction ON
```

In order to prepare the results for the nesting analysis TRACE32 post-processes the instruction flow to find:

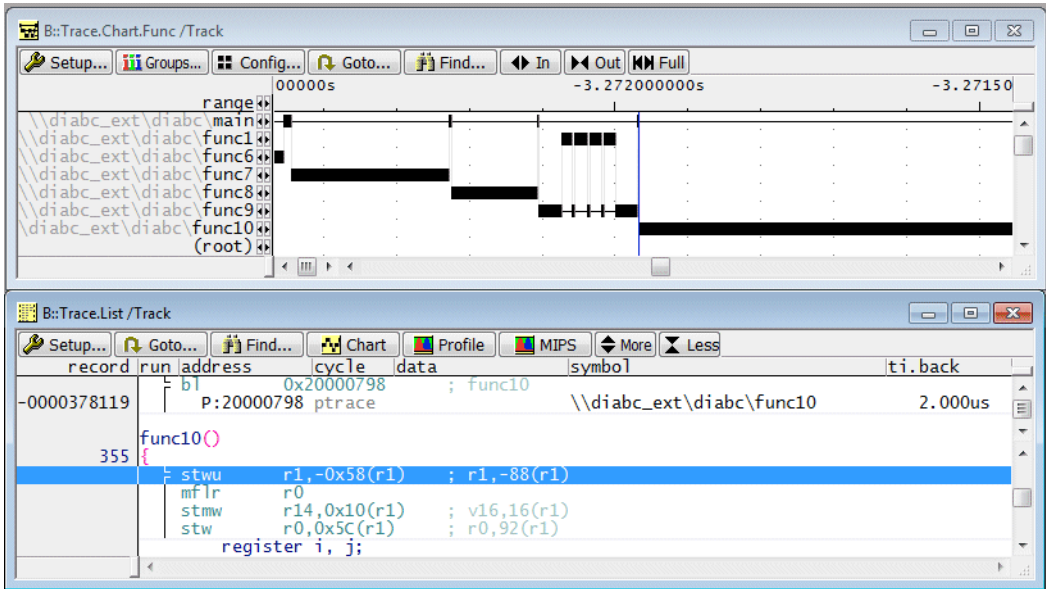
- **Function entries**

The execution of the first instruction of an HLL function is regarded as function entry.

Additional identifications for function entries are implemented depending on the processor architecture and the used compiler.

```
Trace.Chart.Func                                ; function func10 as
                                                ; example

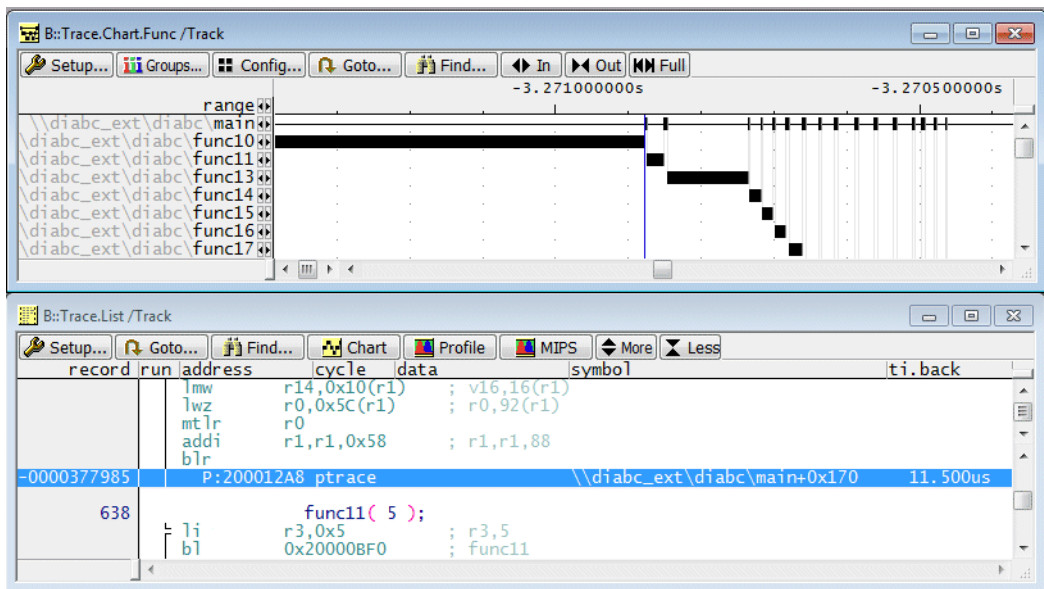
Trace.List /Track
```



- **Function exits**

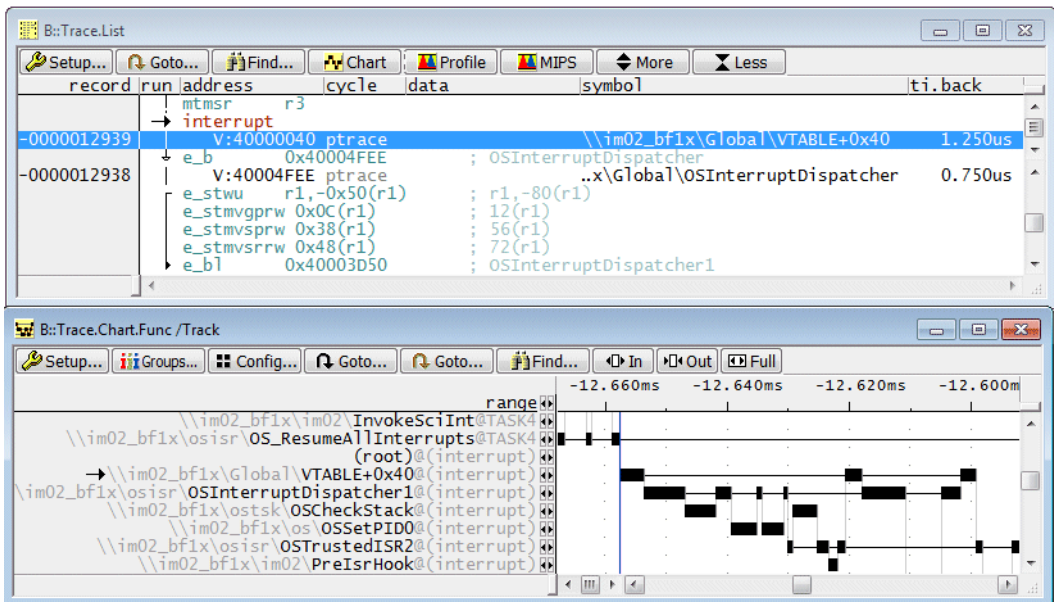
A RETURN instruction within an HLL function is regarded as function exit.

Additional identifications for function exits are implemented depending on the processor architecture and the used compiler.



- **Entries to interrupt service routines (asynchronous)**

If an indirect branch to the Interrupt Vector Table occurs, an interrupt entry is detected. The interrupt function gets the name `VTABLE+<offset>` if no symbol is specified.



- **Exits of interrupt service routines**

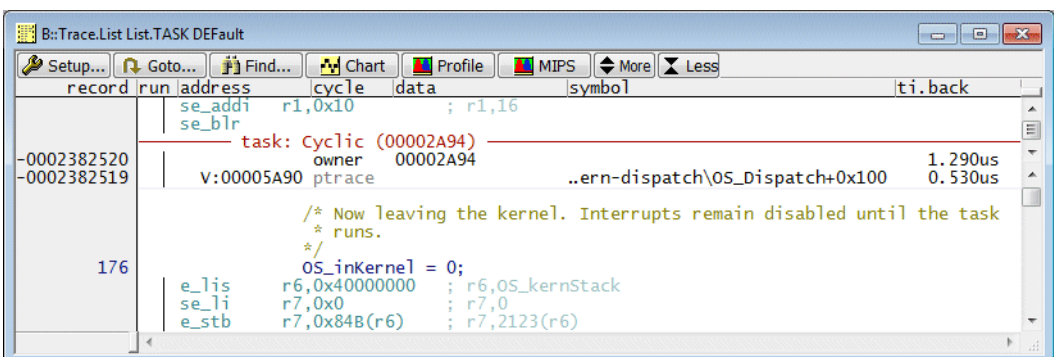
RETURN FROM INTERRUPT is regarded as exit of the interrupt function.

- **Entries to TRAP handlers** (not implemented yet)

- **Exits of TRAP handlers** (not implemented yet)

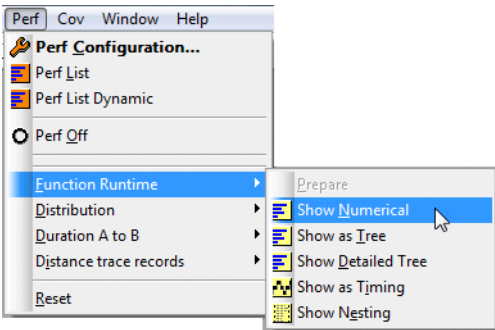
- **Task switches**

Task switches are needed to build correct call trees if a target operating system is used.



Trace.STATistic.Func

Nested function run-time analysis
- numeric display

A screenshot of the 'B::Trace.STATistic.FUNC' window. It displays a table with columns: range, total, min, max, avr, count, interr%, and 1%. The table lists various functions like 'main', 'func1', 'func2a', etc., along with their respective run-time statistics. The window also has tabs for 'Setup...', 'Groups...', 'Config...', 'Goto...', 'Detailed', 'Nesting', and 'Chart'.

funcs: 103. total: 22.618ms intr: 2.574ms 10 workarounds

survey	
funcs: <number>	number of functions in the trace
total: <time>	total measurement time
intr: <time>	total time in interrupt service routines

survey (issue indication)	
stopped: <i><time></i>	The analyzed trace recording contains program stops. <i><time></i> indicates the total time the program execution was stopped.
<i><number></i> problems	The nested analysis contains problems. Please contact support@lauterbach.com .
<i><number></i> workarounds	The nested analysis contains issues, but TRACE32 found solutions for them. It is recommended to perform a sanity check on the proposed solutions.
stack overflow at <i><record></i>	The nested analysis exceeds the nesting level 200. It is highly likely that the function exit for an often called function is missing. The command Trace.STATistic.TREE can help you to identify the function. If you need further help please contact support@lauterbach.com .
stack underflow at <i><record></i>	The nested analysis exceeds the nesting level 200. It is highly likely that the function entry for an often executed function is missing. The command Trace.STATistic.TREE can help you to identify the function. If you need further help please contact support@lauterbach.com .

The main reasons for all the issues are code optimizations.

columns	
range (NAME)	function name, sorted by their recording order as default

- **HLL function**
`\\diabc_ext\\diabc\\func6`
- **(root)**
`(root)`
The function nesting is regarded as tree, (root) is the root of the function nesting.
- **Interrupt service routine**
`→\\PA_XPC560XP_os_demo_sieve_40MHz\\Global\\OS_InterruptTable+0x78`
- **HLL trap handler** (not implemented yet)

The screenshot shows a window titled "B::Trace.STATistic.FUNC" with a menu bar (Setup..., Groups..., Config..., Goto..., Detailed, Nesting, Chart) and a toolbar. Below the menu bar, it says "funcs: 33." and "total: 22.760s". The main area contains a table with the following columns: range, total, min, max, avr, count, intern%, and 1%. The table lists statistics for various functions, including (root), diabc_ext\diabc\main, and several func2, func1, func2a, func2b, func2c, func2d, func4, func3, func5, func6, func7, func8, func9, func10, func11, func13, and func14. The values are in units of ms or us.

range	total	min	max	avr	count	intern%	1%
(root)	22.760s	-	22.760s	22.760s	-	0.000%	
\\diabc_ext\\diabc\\main	22.760s	-	22.760s	22.760s	1. (0/1)	0.009%	
\\diabc_ext\\diabc\\func2	1.062ms	132.495us	132.830us	132.786us	8.	0.003%	
\\diabc_ext\\diabc\\func1	846.290us	13.330us	16.005us	15.112us	56.	0.003%	
\\diabc_ext\\diabc\\func2a	563.975us	70.495us	70.500us	70.497us	8.	0.002%	
\\diabc_ext\\diabc\\func2b	557.305us	69.660us	69.665us	69.663us	8.	0.002%	
\\diabc_ext\\diabc\\func2c	33.832ms	4.114ms	4.303ms	4.229ms	8.	0.148%	
\\diabc_ext\\diabc\\func2d	654.630us	81.825us	81.830us	81.829us	8.	0.002%	
\\diabc_ext\\diabc\\func4	241.320us	30.160us	30.170us	30.165us	8.	0.001%	
\\diabc_ext\\diabc\\func3	67.995us	8.495us	8.505us	8.499us	8.	<0.001%	
\\diabc_ext\\diabc\\func5	170.830us	21.330us	21.495us	21.354us	8.	<0.001%	
\\diabc_ext\\diabc\\func6	2.483ms	310.315us	310.320us	310.319us	8.	0.010%	
\\diabc_ext\\diabc\\func7	1.733ms	216.655us	216.660us	216.657us	8.	0.007%	
\\diabc_ext\\diabc\\func8	933.295us	116.660us	116.665us	116.662us	8.	0.004%	
\\diabc_ext\\diabc\\func9	1.077ms	134.660us	134.660us	134.660us	8.	0.002%	
\\diabc_ext\\diabc\\func10	8.732ms	1.091ms	1.092ms	1.092ms	8.	0.038%	
\\diabc_ext\\diabc\\func11	195.985us	24.495us	24.500us	24.498us	8.	<0.001%	
\\diabc_ext\\diabc\\func13	883.955us	25.995us	110.495us	68.163us	32.	0.003%	
\\diabc_ext\\diabc\\func14	115.990us	14.495us	14.500us	14.499us	8.	<0.001%	

columns (cont.)

total	total time within the function
min	<p>shortest time between function entry and exit, time spent in interrupt service routines is excluded</p> <p>No min time is displayed if a function exit was never executed.</p>
max	longest time between function entry and exit, time spent in interrupt service routines is excluded
avr	average time between function entry and exit, time spent in interrupt service routines is excluded

B:\Trace.STATistic.FUNC

Setup... Groups... Config... Goto... Detailed Nesting Chart

funcs: 33. total: 22.760s

	range	total	min	max	avr	count	intern%	1%
(root)		22.760s	-	22.760s	22.760s	-	0.000%	
\\diabc_ext\\diabc\\main		22.760s	-	22.760s	22.760s	1. (0/1)	0.009%	
\\diabc_ext\\diabc\\func2		1.062ms	132.495us	132.830us	132.786us	8.	0.003%	
\\diabc_ext\\diabc\\func1		846.290us	13.330us	16.005us	15.112us	56.	0.003%	
\\diabc_ext\\diabc\\func2a		563.975us	70.495us	70.500us	70.497us	8.	0.002%	
\\diabc_ext\\diabc\\func2b		557.305us	69.660us	69.665us	69.663us	8.	0.002%	
\\diabc_ext\\diabc\\func2c		33.832ms	4.114ms	4.303ms	4.229ms	8.	0.148%	
\\diabc_ext\\diabc\\func2d		654.630us	81.825us	81.830us	81.829us	8.	0.002%	
\\diabc_ext\\diabc\\func4		241.320us	30.160us	30.170us	30.165us	8.	0.001%	
\\diabc_ext\\diabc\\func3		67.995us	8.495us	8.505us	8.499us	8.	<0.001%	
\\diabc_ext\\diabc\\func5		170.830us	21.330us	21.495us	21.354us	8.	<0.001%	
\\diabc_ext\\diabc\\func6		2.483ms	310.315us	310.320us	310.319us	8.	0.010%	
\\diabc_ext\\diabc\\func7		1.733ms	216.655us	216.660us	216.657us	8.	0.007%	
\\diabc_ext\\diabc\\func8		933.295us	116.660us	116.665us	116.662us	8.	0.004%	
\\diabc_ext\\diabc\\func9		1.077ms	134.660us	134.660us	134.660us	8.	0.002%	
\\diabc_ext\\diabc\\func10		8.732ms	1.091ms	1.092ms	1.092ms	8.	0.038%	
\\diabc_ext\\diabc\\func11		195.985us	24.495us	24.500us	24.498us	8.	<0.001%	
\\diabc_ext\\diabc\\func13		883.955us	25.995us	110.495us	68.163us	32.	0.003%	
\\diabc_ext\\diabc\\func14		115.990us	14.495us	14.500us	14.499us	8.	<0.001%	

columns (cont.)

count

number of times within the function

If function entries or exits are missing, this is displayed in the following format:

<times within the function >. (<number of missing function entries>/<number of missing function exits>).

count

2. (2/0)

Interpretation examples:

2. (2/0): 2 times within the function, 2 function entries missing
4. (0/3): 4 times within the function, 3 function exits missing
11. (1/1): 11 times within the function, 1 function entry and 1 function exit is missing.



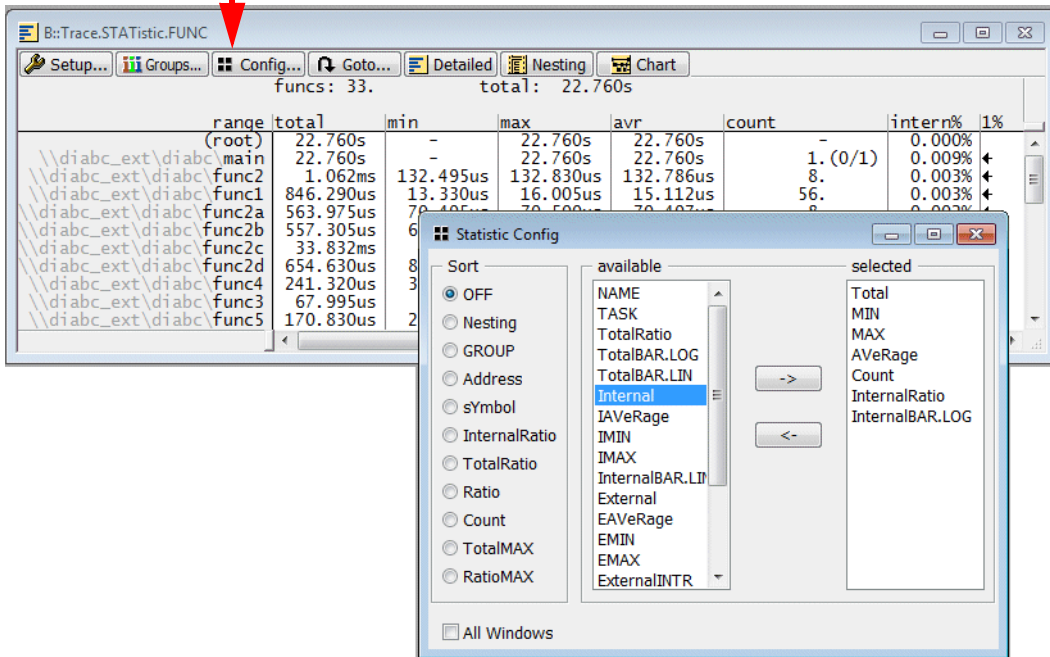
If the number of missing function entries or exits is higher the 1 the analysis performed by the command **Trace.STATistic.Func** might fail due to nesting problems. A detailed view to the trace contents is recommended.

columns (cont.)

intern% (InternalRatio, InternalBAR.LOG)

ratio of time within the function without subfunctions, TRAP handlers, interrupts

Pushing the **Config...** button allows to display additional columns



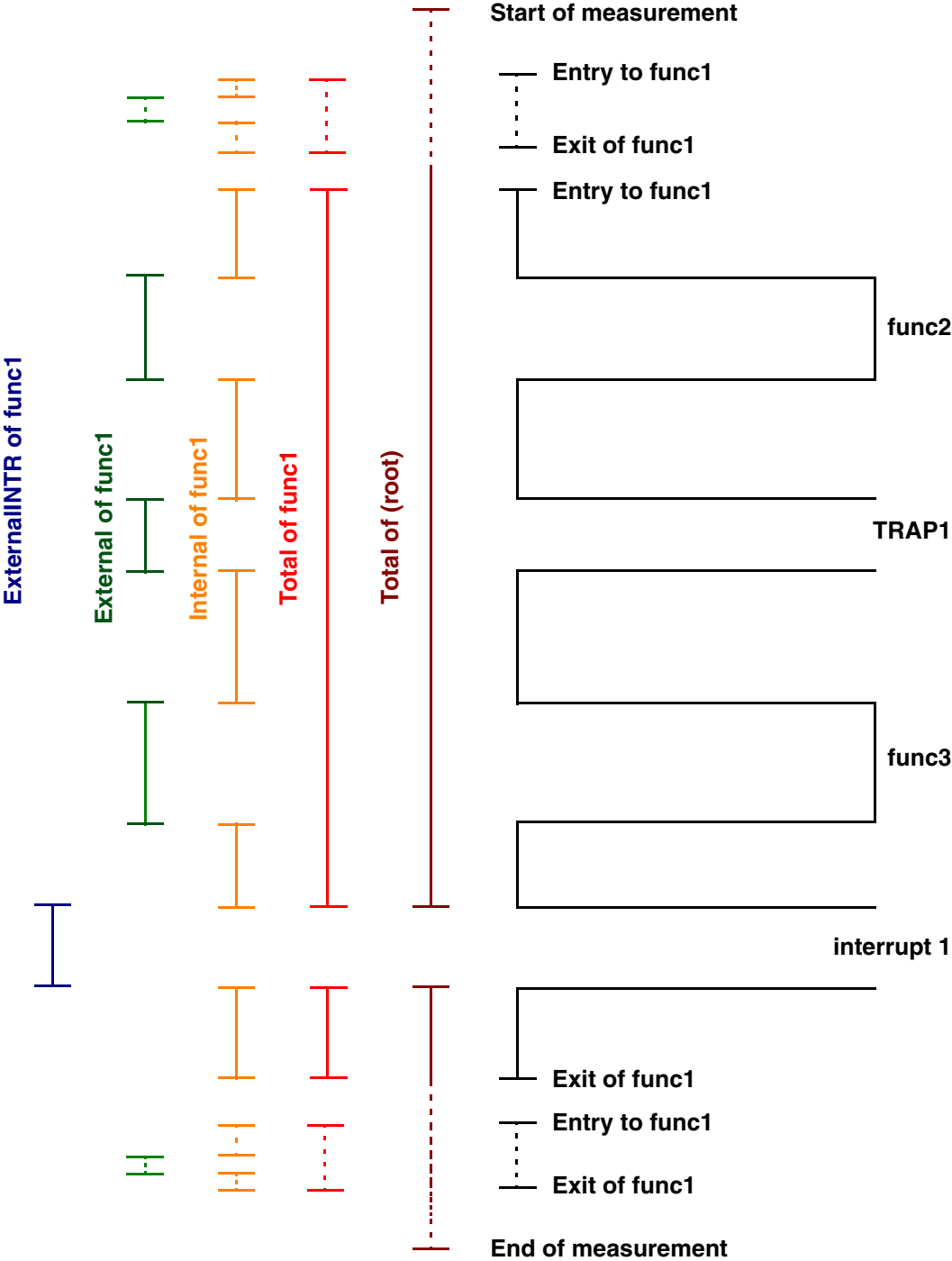
columns (cont.) - times only in function

Internal	total time between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
IAVeRage	average time between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
IMIN	shortest time between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
IMAX	longest time spent in the function between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
InternalRatio	$\langle \text{Internal time of function} \rangle / \langle \text{Total measurement time} \rangle$ as a numeric value.
InternalBAR	$\langle \text{Internal time of function} \rangle / \langle \text{Total measurement time} \rangle$ graphically.

<i>columns (cont.) - times in sub-functions and TRAP handlers</i>	
External	total time spent within called sub-functions/TRAP handlers
EAVeRage	average time spent within called sub-functions/TRAP handlers
EMIN	shortest time spent within called sub-functions/TRAP handlers
EMAX	longest time spent within called sub-functions/TRAP handlers

<i>columns (cont.) - interrupt times</i>	
ExternalINTR	total time the function was interrupted
ExternalINTRMAX	max. time one function pass was interrupted
INTRCount	number of interrupts that occurred during the function run-time

The following graphic give an overview how times are calculated:



func8@Cyclic

	range	total	min	max	avr	count	intern%	1%	2%
\\PA_XPC560XP_os_demo_sieve_40MHz\test\func8@Cyclic	72.651ms	0.313us	1.127us	0.589us	123408.	1.045%			
\\PA_XPC560XP_os_demo_sieve_40MHz\test\func9@Cyclic	196.202ms	1.188us	2.113us	1.590us	123408.	2.822%			
\\PA_XPC560XP_os_demo_sieve_40MHz\test\func10@Cyclic	1.937s	15.293us	16.605us	15.692us	123408.	27.861%			
\\PA_XPC560XP_os_demo_sieve_40MHz\test\sieve@Cyclic	2.396s	18.652us	20.149us	19.414us	123408. (0/1)	34.469%			
z\kern-releaseresource\OS_KernReleaseResource@Cyclic	1.262ms	10.157us	10.314us	10.258us	123.	0.018%			
40MHz\kern-terminatetask\OS_KernTerminateTask@Cyclic	1.049ms	8.478us	8.582us	8.531us	123.	0.015%			
demo_sieve_40MHz\Global\OS_PASartTask+0x30@Task_St1	2.400us	-	2.400us	2.400us	1. (1/0)	<0.001%			
P_os_demo_sieve_40MHz\demo\OS_TASK_Task_St1@Task_St1	1.127ms	-	1.127ms	1.127ms	-	0.000%			
\\PA_XPC560XP_os_demo_sieve_40MHz\test\test@Task_St1	711.729us	47.355us	47.570us	47.449us	15. (0/1)	<0.001%			

HLL function

\\PA_XPC560XP_os_demo_sieve_40MHz\test\func2@Cyclic

HLL function “func2” running in task “Cyclic”

Root of call tree for task “Cyclic”

(root)@Cyclic

BTrace.STATistic.FUNC

Setup... Groups... Config... Goto... Detailed Nesting Chart

funcs: 113. total: 6.951s intr: 192.665ms

	range	total	min	max	avr	count	intern%
(root)@(unknown)		160.813us	-	160.813us	160.813us	-	0.000%
\\PA_XPC560XP_os_demo_sieve_40MHz\demo\main@(unknown)		160.813us	-	160.813us	160.813us	1. (0/1)	<0.001%
\\PA_XPC560XP_os_demo_sieve_40MHz\demo_arch\ArchInitHardware@(unknown)		0.000us	0.000us	-	0.000us	1.	0.000%
\\PA_XPC560XP_os_demo_sieve_40MHz\kern-startos\OS_KernStartOs@(unknown)		146.413us	146.413us	146.413us	146.413us	1.	<0.001%

Unknown task

\\PA_XPC560XP_os_demo_sieve_40MHz\demo\main@(unknown)

Before the first task switch is found in the trace, the task is unknown

Root of unknown task

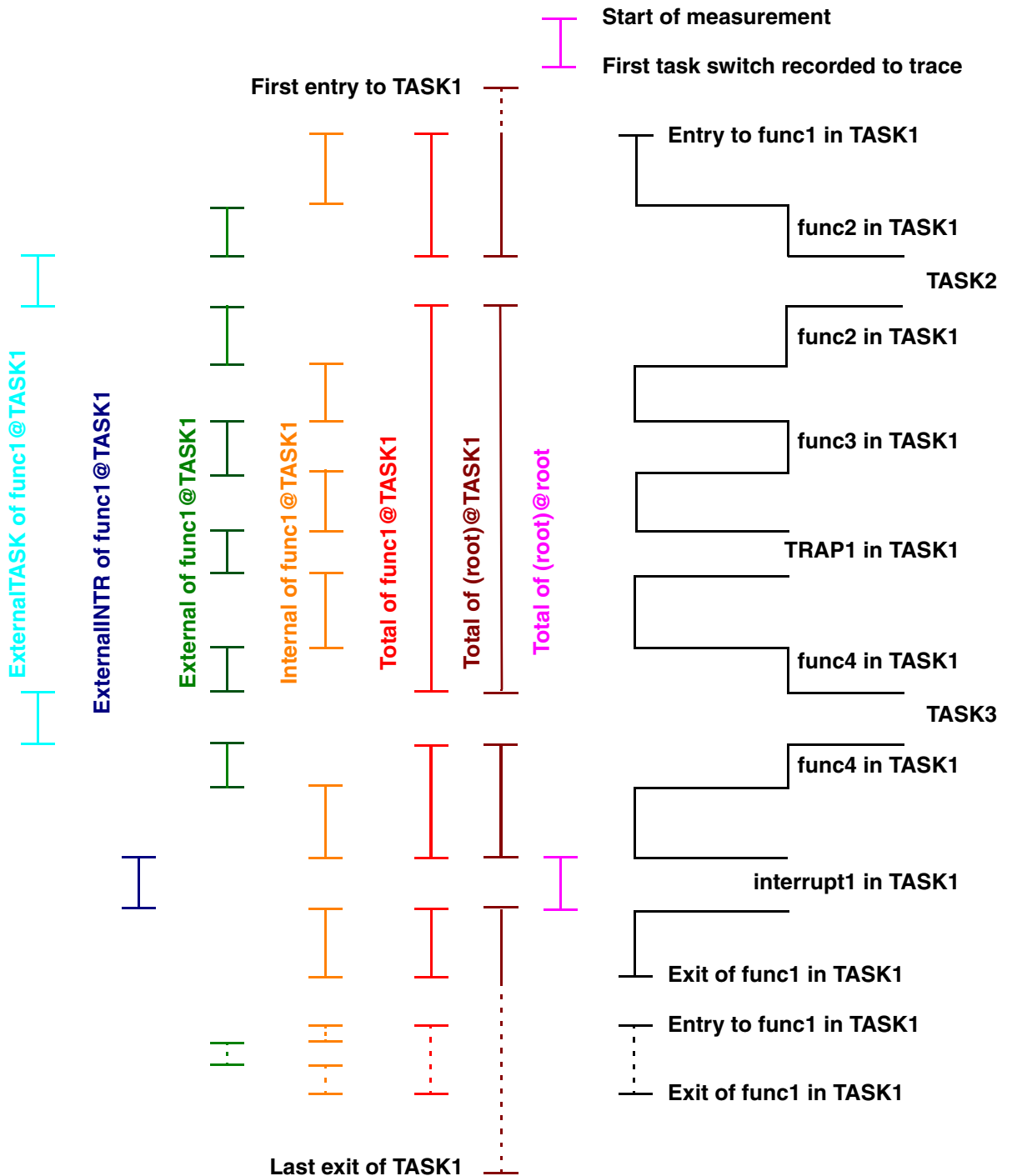
(root)@(unknown)

B:\Trace.STATistic.FUNC
 Setup... Groups... Config... Goto... Detailed Nesting Chart
 funcs: 113. total: 6.951s intr: 192.665ms

range	total	taskcount	etask	etaskmax	min	max	avr	count	intern%	1%
\OS_PASartTask+0x30@Loop (root)@Loop	2.285us	1.	0.000us	0.000us	-	2.285us	2.285us	1. (1/0)	<0.001%	+
Hz\demo\OS_TASK_Loop@Loop	863.762ms	125.	6.058s	6.058s	-	863.762ms	863.762ms	-	0.000%	+
\EndlessLoopInternal@Loop	863.759ms	124.	6.058s	6.058s	-	863.760ms	863.760ms	1. (0/1)	<0.001%	+
ieve_40MHz\test\test@Loop	858.284ms	124.	6.058s	49.268ms	46.924us	863.759ms	863.759ms	1. (0/1)	0.078%	+
ieve_40MHz\test\func2@Loop	27.401ms	-	-	-	1.330us	48.063us	47.268us	18158. (0/1)	0.943%	+
ieve_40MHz\test\func2a@Loop	30.654ms	5.	245.764ms	49.246ms	1.544us	1.904us	1.509us	18158.	0.394%	+
ieve_40MHz\test\func2b@Loop	17.380ms	-	-	-	0.731us	2.176us	1.688us	18158.	0.441%	+
ieve_40MHz\test\func2d@Loop	32.744ms	4.	196.311ms	49.207ms	1.599us	1.409us	0.957us	18158.	0.250%	+
ieve_40MHz\test\func3@Loop	7.442ms	-	-	-	0.405us	2.410us	1.803us	18158.	0.471%	+
						0.470us	0.410us	18158.	0.107%	+

columns - task/thread related information

TASKCount	number of tasks that interrupt the function
ExternalTASK	total time in other tasks
ExternalTASKMAX	max. time 1 function pass was interrupted by a task



Timing Improvements for OS

The standard NEXUS settings do often not allow to locate exactly the instructions that are already executed by a newly activated task. This is especially true is Branch History Messaging is used. This might disturb the task-aware function run-time measurement.

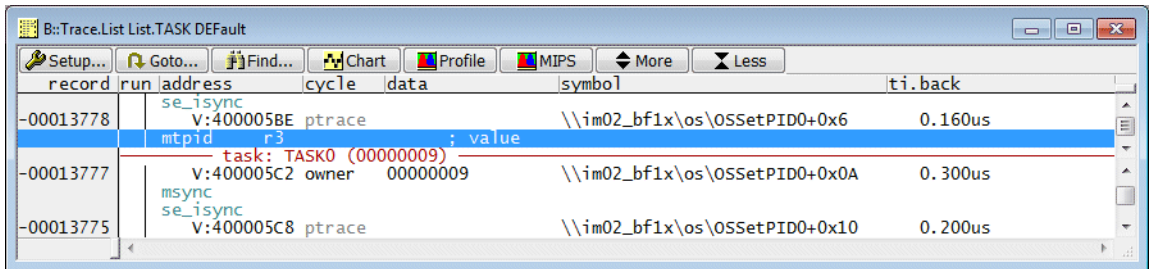
An instruction-accurate assignment of the task switches may improve the results.

IEEE-ISTO 5001-2008 and Subsequent Standards

The Ownership Trace Messages (task switches) can be exactly assigned to an instruction, if the following setting is done.

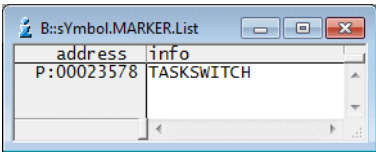
```
NEXUS.PTCM PID_MSR ON ; enable Program Trace Correlation
                        ; Messages for PID0/NPIDR accesses

NEXUS.POTD ON          ; disable Periodic Ownership Trace
                        ; Messages
```



Alternative

```
; mark instruction that performs the task switch for the task-aware
; function run-time analysis
sYmbol.MARKER.Create TASKSWITCH osDispatcher+0x100
```



TRACE32 analyzes the structure of the program execution by processing the trace information in order to provide the nesting statistic. The objective is to construct a complete call tree. When a OS is used, it is more likely the TRACE32 has issues while construction the call tree. There are two types of issues:

• **PROBLEMS**

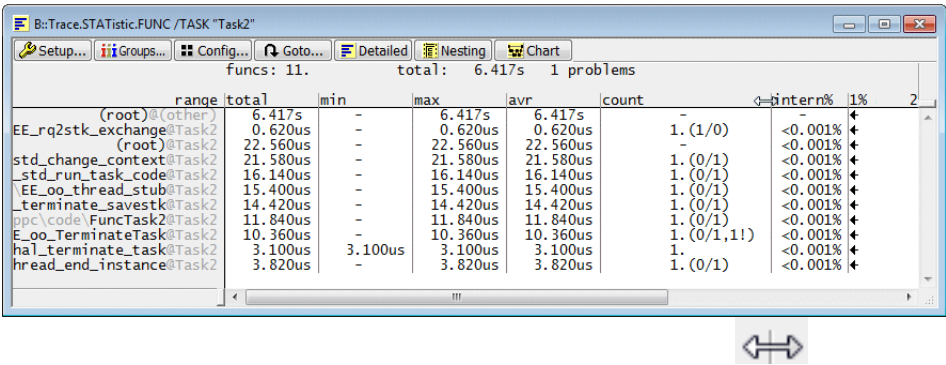
A PROBLEM is a point it the trace recording that TRACE32 can not integrate into the current nesting. TRACE32 does not discard this point for the call tree, it integrates this point by assigning a meaningful interpretation.

TRACE32 marks functions that include a PROBLEM with ! in the count column.

• **WORKAROUNDS**

A WORKAROUND is a point it the trace recording that TRACE32 can not integrate into the current nesting. But TRACE32 integrates this point into the function nesting, by supplementing information based on previous scenarios in the nesting. TRACE32 marks functions that include a WORKAROUND with ? in the count column.

It is recommended to drag the count column wider to see all details.



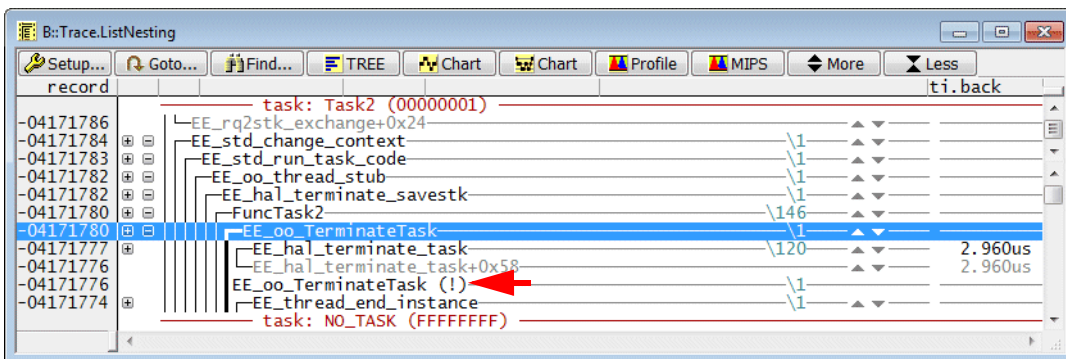
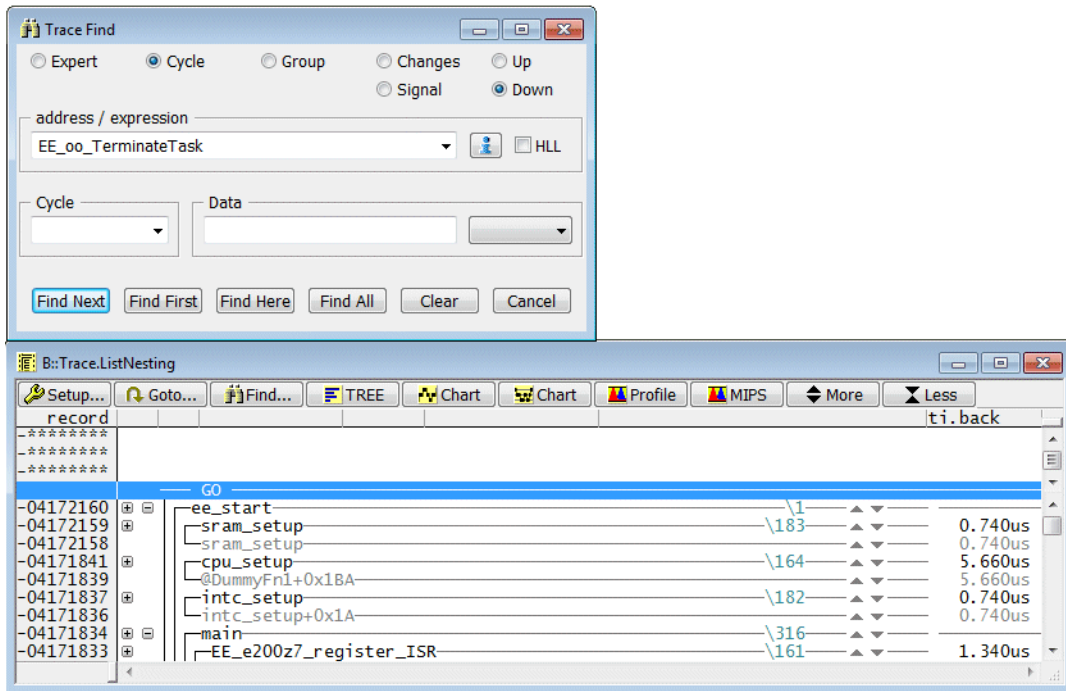
The following two TRACE32 windows are recommended if you want to inspect the issues:

```
Trace.ListNesting

Trace.List List.TASK List.ADDRESS List.sYmbol DEFault /Track
```

Example 1: We inspect the problem with the function EE_oo_TerminateTask.

We start to search for the entry to the function EE_oo_TerminateTask in the task Task2 in the **Trace.ListNesting** window.



In the screenshot above we can see that the exit from the function EE_oo_TerminateTask is marked as a problem. Why is that?

Let's examine the function EE_oo_TerminateTask by looking to the trace listing.

[B::Trace.List List.TASK List.ADDRESS List.sYmbol DEFault /Track]						
	record	run	address	cycle	data	symbol
			V:400010D0	se_beq	0x400010EC	ti.back
			EE_oo_TerminateTask+0x6C:			
			V:400010EC	mfmsr	r8	; np_flags
			V:400010F0	wrtteei	0x0	; 0
			V:400010F4	e_lis	r8,0x40000000	; np_flags,1073741824
106			...			
103			V:400010F8	se_li	r0,0x4	; r0,4
			...			
			V:400010FA	e_add16i	r8,r8,0x2364	; np_flags,np_flags,9060
			V:400010FE	se_bmaski	r5,0x0	; r5,0
			V:40001100	stwx	r5,r8,r6	; r5,np_flags,r6
			V:40001104	se_stb	r0,0x0(r4)	; r0,0(r4)
			V:40001106	e_bl	0x40000AC0	; EE_hal_terminate_task
-04171778			D:400023CC	rd-long	00000001	\\ppc\Global\EE_stkfirst 2.840us
-04171777			V:40000AC0	ptrace		\\ppc\ee_oo_asm\EE_hal_terminate_task 1.840us
148			...			
			EE_hal_terminate_task:			
			V:40000AC0	e_rlwinm	r4,r3,0x2,0x0,0x1D	; r4,r3,2,0,29
149				addis	r5, 0, EE_terminate_data@ha	
			V:40000AC4	e_lis	r5,0x40000000	; r5,1073741824

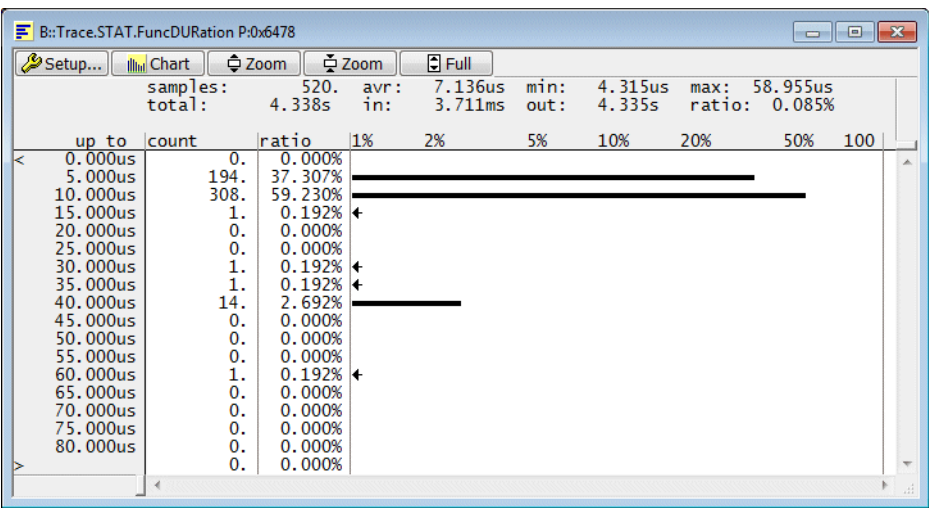
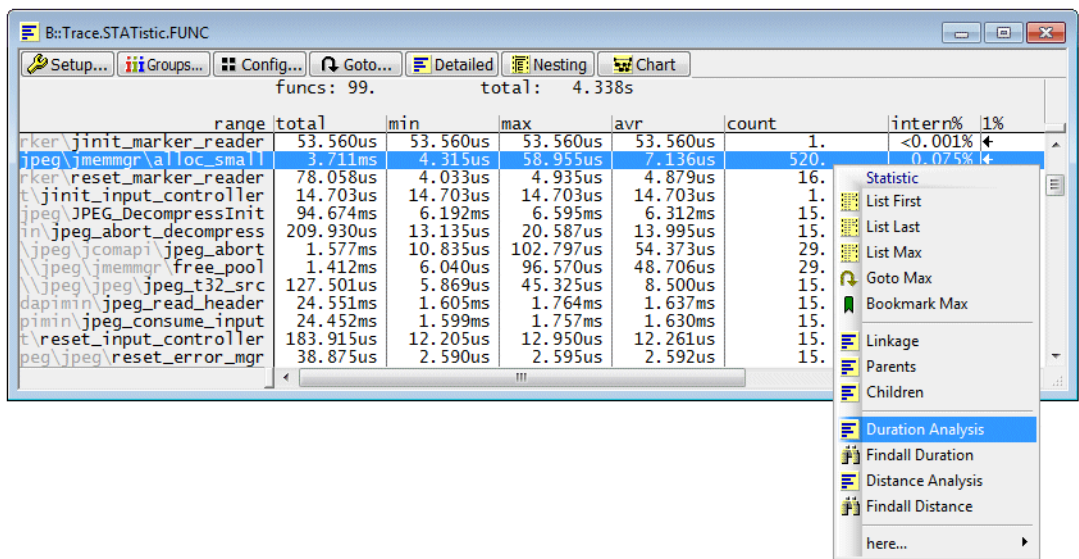
In its execution the function EE_oo_TerminateTask calls the function EE_hal_terminate_task.

[B::Trace.List List.TASK List.ADDRESS List.sYmbol DEFault /Track]						
	record	run	address	cycle	data	symbol
			V:40000AC0	ptrace		\\ppc\ee_oo_asm\EE_hal_terminate_task 1.840us
148			...			
			EE_hal_terminate_task:			
			V:40000AC0	e_rlwinm	r4,r3,0x2,0x0,0x1D	; r4,r3,2,0,29
149				addis	r5, 0, EE_terminate_data@ha	
			V:40000AC4	e_lis	r5,0x40000000	; r5,1073741824
execution of the function EE_hal_terminate_task						
			V:40000B14	e_add16i	r1,r1,0x60	; r1,r1,96
179				blr		
			V:40000B18	se_blr		
-04171776			V:40000C20	ptrace		\\ppc\ee_context\EE_std_run_task_code+0x10 2.960us
			EE_std_run_task_code+0x10:			
			V:40000C20	wrtteei	0x0	; 0
57			...			
			V:40000C24	e_bl	0x40001120	; EE_thread_end_instance
-04171774			V:40001120	ptrace		\\ppc\ee_thendin\EE_thread_end_instance 0.740us
81			...			
			EE_thread_end_instance:			

Now one would expect the function EE_hal_terminate_task returns with the se_blr instruction to the calling function (which was EE_oo_TerminateTask). But if we look at the trace listing, we see that the program execution continued in the middle of the function EE_std_run_task_code.

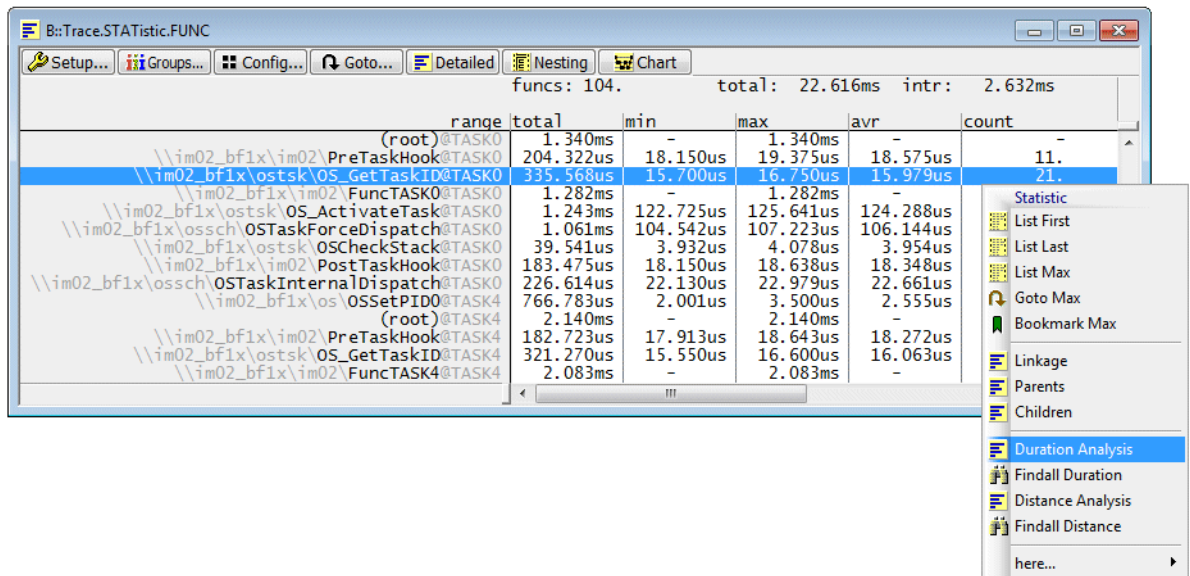
Look and Feel (No OS)

Trace.STATistic.FuncDURation <function> Detailed analysis of a single function, time between function entry and exit, time spent in interrupt service routines is excluded.



Detailed analysis of a single function, time between function entry and exit, time spent in interrupt service routines and other tasks is excluded.

Trace.STATistic.FuncDURation <function> [/TASK "<task_name>"]



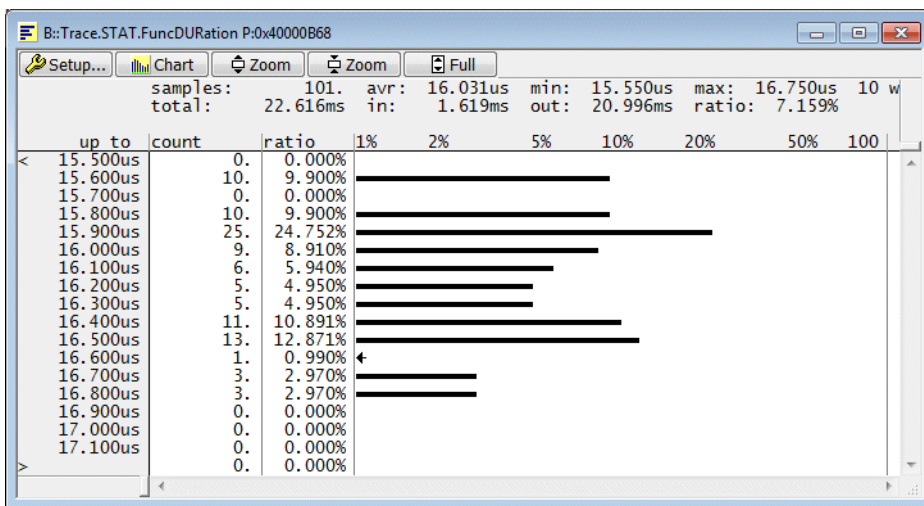
B::Trace.STATistic.FUNC

funcs: 104. total: 22.616ms intr: 2.632ms

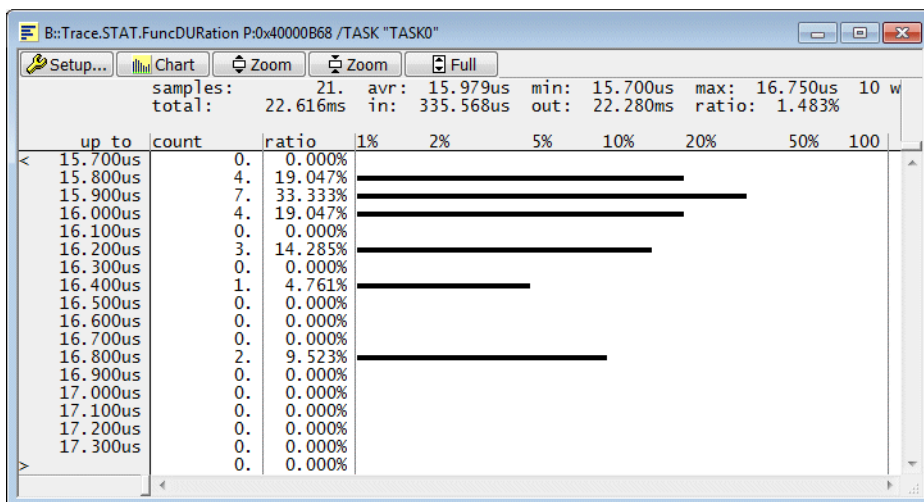
range	total	min	max	avr	count
(root)@TASK0	1.340ms	-	1.340ms	-	-
\\im02_bf1x\im02\PreTaskHook@TASK0	204.322us	18.150us	19.375us	18.575us	11.
\\im02_bf1x\ostsk\OS_GetTaskID@TASK0	335.568us	15.700us	16.750us	15.979us	21.
\\im02_bf1x\im02\FuncTASK0@TASK0	1.282ms	-	1.282ms	-	-
\\im02_bf1x\ostsk\OS_ActivateTask@TASK0	1.243ms	122.725us	125.641us	124.288us	-
\\im02_bf1x\ostsch\OSTaskForceDispatch@TASK0	1.061ms	104.542us	107.223us	106.144us	-
\\im02_bf1x\ostsk\OSCheckStack@TASK0	39.541us	3.932us	4.078us	3.954us	-
\\im02_bf1x\im02\PostTaskHook@TASK0	183.475us	18.150us	18.638us	18.348us	-
\\im02_bf1x\ostsch\OSTaskInternalDispatch@TASK0	226.614us	22.130us	22.979us	22.661us	-
\\im02_bf1x\os\OSSetPID0@TASK4	766.783us	2.001us	3.500us	2.555us	-
(root)@TASK4	2.140ms	-	2.140ms	-	-
\\im02_bf1x\im02\PreTaskHook@TASK4	182.723us	17.913us	18.643us	18.272us	-
\\im02_bf1x\ostsk\OS_GetTaskID@TASK4	321.270us	15.550us	16.600us	16.063us	-
\\im02_bf1x\im02\FuncTASK4@TASK4	2.083ms	-	2.083ms	-	-

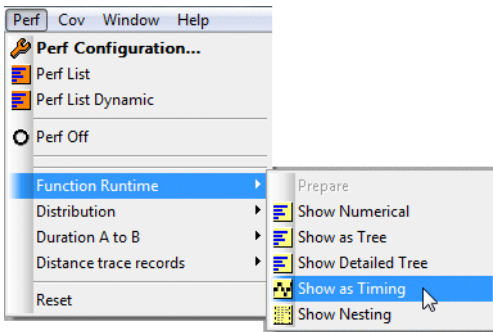
Statistic

- List First
- List Last
- List Max
- Goto Max
- Bookmark Max
- Linkage
- Parents
- Children
- Duration Analysis
- Findall Duration
- Distance Analysis
- Findall Distance
- here...

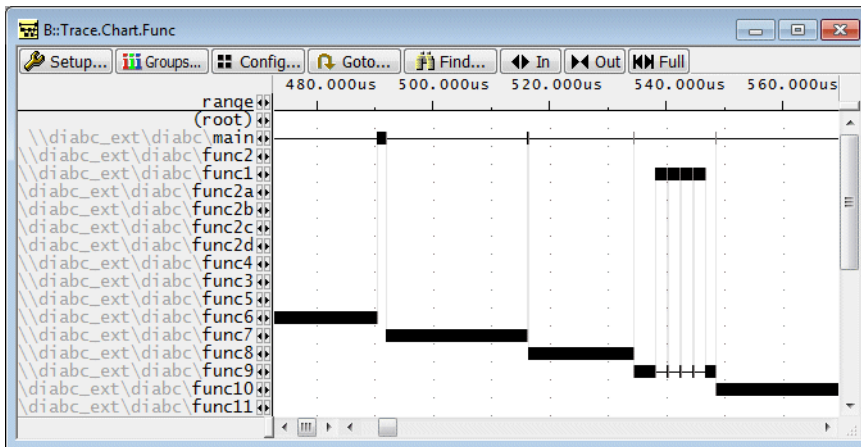


Please be aware, that details are shown for all function runs. If you are interested in a task-specific analysis, you have to use the **/TASK** "<task_name>" option.

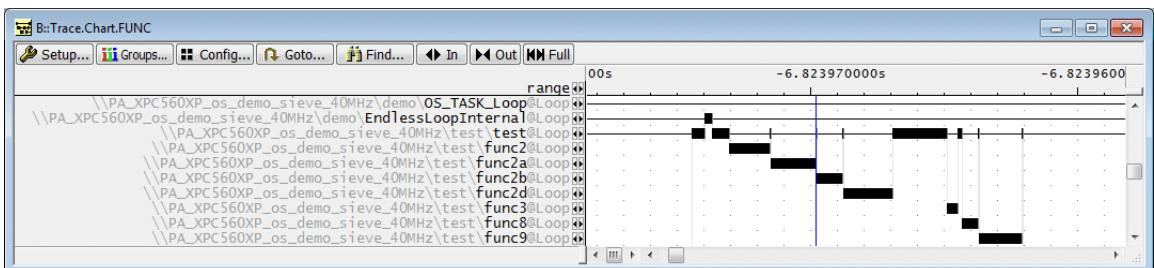


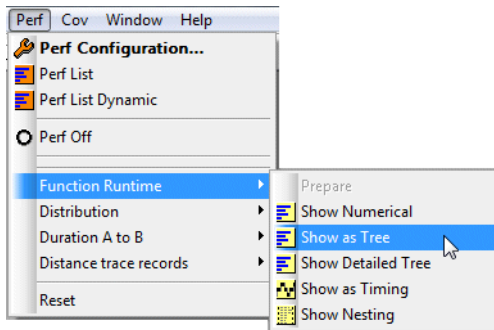


Look and Feel (No OS)



Look and Feel (OS)



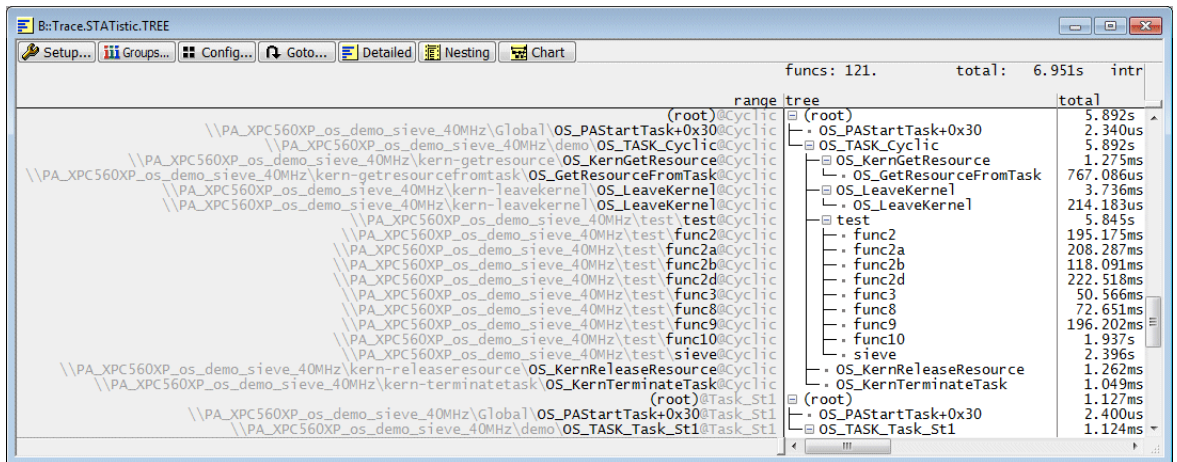


Look and Feel (No OS)

The screenshot shows the 'B:\Trace.STATistic.TREE' application window. It features a toolbar with buttons for 'Setup...', 'Groups...', 'Config...', 'Goto...', 'Detailed', 'Nesting', and 'Chart'. Below the toolbar, it displays 'funcs: 37.' and 'total: 3.488s'. The main area contains a table with columns: 'range', 'tree', 'total', 'min', 'max', 'avr', and 'count'. The table lists various functions and their sub-functions, such as 'main', 'func2', 'func2a', 'func2b', 'func2c', 'func2d', 'func3', 'func4', 'func5', 'func6', 'func7', 'func8', 'func9', 'func10', 'func11', 'func13', and 'func13' (repeated). The 'tree' column shows a hierarchical structure with expandable/collapsible icons. The 'total', 'min', 'max', and 'avr' columns show time values in seconds (s) and microseconds (us). The 'count' column shows the number of occurrences for each function.

range	tree	total	min	max	avr	count
(root)	(root)	3.488s	-	3.488s	3.488s	-
\\diabc_ext\\diabc\\main	main	3.488s	-	3.488s	3.488s	1. (0/1)
\\diabc_ext\\diabc\\func2	func2	265.315us	132.490us	132.825us	132.658us	2.
\\diabc_ext\\diabc\\func1	func1	86.500us	13.500us	16.170us	14.417us	6.
\\diabc_ext\\diabc\\func2a	func2a	141.330us	70.665us	70.665us	70.665us	2.
\\diabc_ext\\diabc\\func2b	func2b	139.660us	69.830us	69.830us	69.830us	2.
\\diabc_ext\\diabc\\func2c	func2c	8.450ms	4.147ms	4.303ms	4.225ms	2.
\\diabc_ext\\diabc\\func2d	func2d	163.990us	81.995us	81.995us	81.995us	2.
\\diabc_ext\\diabc\\func4	func4	60.325us	30.160us	30.165us	30.163us	2.
\\diabc_ext\\diabc\\func3	func3	17.000us	8.500us	8.500us	8.500us	2.
\\diabc_ext\\diabc\\func5	func5	43.165us	21.500us	21.665us	21.583us	2.
\\diabc_ext\\diabc\\func6	func6	620.640us	310.320us	310.320us	310.320us	2.
\\diabc_ext\\diabc\\func7	func7	433.645us	216.820us	216.825us	216.823us	2.
\\diabc_ext\\diabc\\func8	func8	233.320us	116.660us	116.660us	116.660us	2.
\\diabc_ext\\diabc\\func9	func9	269.650us	134.825us	134.825us	134.825us	2.
\\diabc_ext\\diabc\\func1	func1	126.995us	15.000us	16.170us	15.874us	8.
\\diabc_ext\\diabc\\func10	func10	2.183ms	1.092ms	1.092ms	1.092ms	2.
\\diabc_ext\\diabc\\func11	func11	48.995us	24.495us	24.500us	24.498us	2.
\\diabc_ext\\diabc\\func13	func13	220.990us	110.495us	110.495us	110.495us	2.
\\diabc_ext\\diabc\\func13	func13	164.655us	82.325us	82.330us	82.328us	2.
\\diabc_ext\\diabc\\func13	func13	108.330us	54.160us	54.170us	54.165us	2.
\\diabc_ext\\diabc\\func13	func13	52.330us	26.165us	26.165us	26.165us	2.

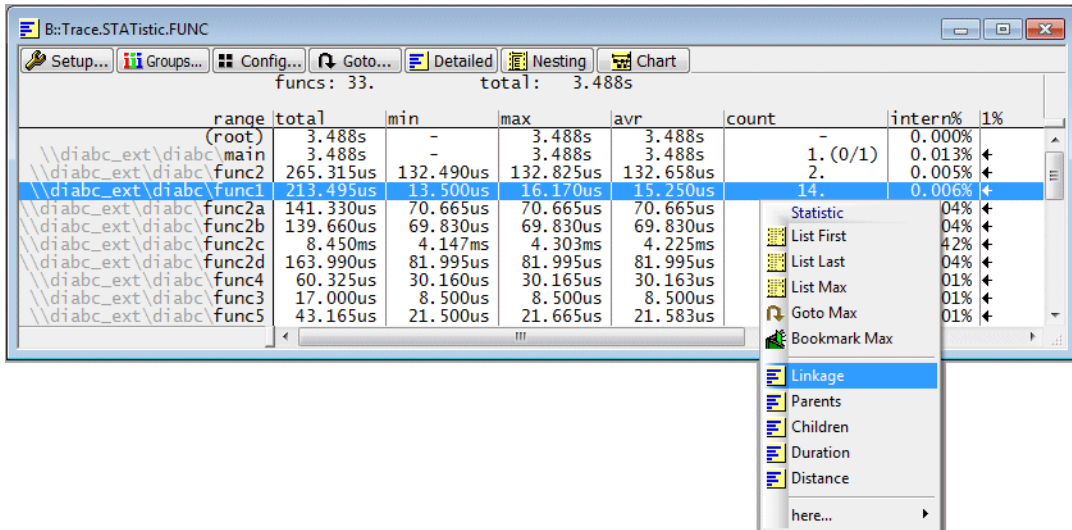
Look and Feel (OS)



It is also possible to get a task-specific tree.

```
Trace.STATistic.TREE /TASK "Cyclic"
```

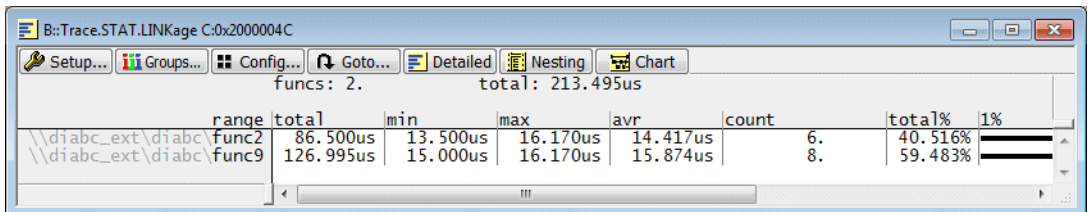
Look and Feel (No OS)



funcs: 33. total: 3.488s

range	total	min	max	avr	count	intern%	1%
(root)	3.488s	-	3.488s	3.488s	-	0.000%	
\\diabc_ext\\diabc\\main	3.488s	-	3.488s	3.488s	1. (0/1)	0.013%	
\\diabc_ext\\diabc\\func2	265.315us	132.490us	132.825us	132.658us	2.	0.005%	
\\diabc_ext\\diabc\\func1	213.495us	13.500us	16.170us	15.250us	14.	0.006%	
\\diabc_ext\\diabc\\func2a	141.330us	70.665us	70.665us	70.665us		04%	
\\diabc_ext\\diabc\\func2b	139.660us	69.830us	69.830us	69.830us		04%	
\\diabc_ext\\diabc\\func2c	8.450ms	4.147ms	4.303ms	4.225ms		42%	
\\diabc_ext\\diabc\\func2d	163.990us	81.995us	81.995us	81.995us		04%	
\\diabc_ext\\diabc\\func4	60.325us	30.160us	30.165us	30.163us		01%	
\\diabc_ext\\diabc\\func3	17.000us	8.500us	8.500us	8.500us		01%	
\\diabc_ext\\diabc\\func5	43.165us	21.500us	21.665us	21.583us		01%	

Linkage
Parents
Children
Duration
Distance
here...



funcs: 2. total: 213.495us

range	total	min	max	avr	count	total%	1%
\\diabc_ext\\diabc\\func2	86.500us	13.500us	16.170us	14.417us	6.	40.516%	
\\diabc_ext\\diabc\\func9	126.995us	15.000us	16.170us	15.874us	8.	59.483%	

Look and Feel (OS)

B::Trace.STATistic.FUNC

funcs: 113. total: 6.951s intr: 192.665ms

range	total	min	max	avr	count
mo_sieve_40MHz\test\func2d@Cyclic	222.518ms	1.594us	2.009us	1.803us	123408.
emo_sieve_40MHz\test\func3@Cyclic	50.566ms	0.405us	0.470us	0.410us	123408.
emo_sieve_40MHz\test\func8@Cyclic	72.651ms	0.313us	1.127us	0.589us	123408.
emo_sieve_40MHz\test\func9@Cyclic	196.202ms	1.188us	2.113us	1.590us	1
mo_sieve_40MHz\test\func10@Cyclic	1.937s	15.293us	16.605us	15.692us	1
emo_sieve_40MHz\test\sieve@Cyclic	2.396s	18.652us	20.149us	19.414us	1
rce\OS_KernReleaseResource@Cyclic	1.262ms	10.157us	10.314us	10.258us	
etask\OS_KernTerminateTask@Cyclic	1.049ms	8.478us	8.582us	8.531us	
obal\OS_PASartTask+0x30@Task_St1	2.400us	-	2.400us	2.400us	
(root)@Task_St1	1.127ms	-	1.127ms	1.127ms	
H\demo\OS_TASK_Task_St1@Task_St1	1.124ms	74.985us	75.265us	74.943us	
mo_sieve_40MHz\test\test@Task_St1	711.729us	47.355us	47.570us	47.449us	
o_sieve_40MHz\test\func2@Task_St1	23.984us	1.597us	1.603us	1.599us	
_sieve_40MHz\test\func2a@Task_St1	26.025us	1.715us	1.774us	1.735us	
_sieve_40MHz\test\func2b@Task_St1	14.352us	0.952us	0.962us	0.957us	

- Statistic
- List First
- List Last
- List Max
- Goto Max
- Bookmark Max
- Linkage
- Parents
- Children
- Duration
- Distance
- here...

B::Trace.STAT.LINKage C:0x2498

funcs: 1. total: 225.103ms

range	total	min	max	avr	count
\\PA_XPC560XP_os_demo_sieve_40MHz\test\test	225.103ms	1.188us	2.113us	1.590us	141588.

Third-party Timing Tools

TRACE32 also provides an interface to third-party timing tools. For details refer to [“Trace Export for Third-Party Timing Tools”](#) (app_timing_tools.pdf).

Function Run-Times Analysis - SMP Instance

This chapter applies for SMP TRACE32 instances.

Flat Analysis

It is recommended to reduce the trace information generated by NEXUS to the required minimum.

- To avoid an overload of the NEXUS port.
- To make best use of the available trace memory.
- To get a more accurate timestamp.

Optimum NEXUS Configuration (No OS)

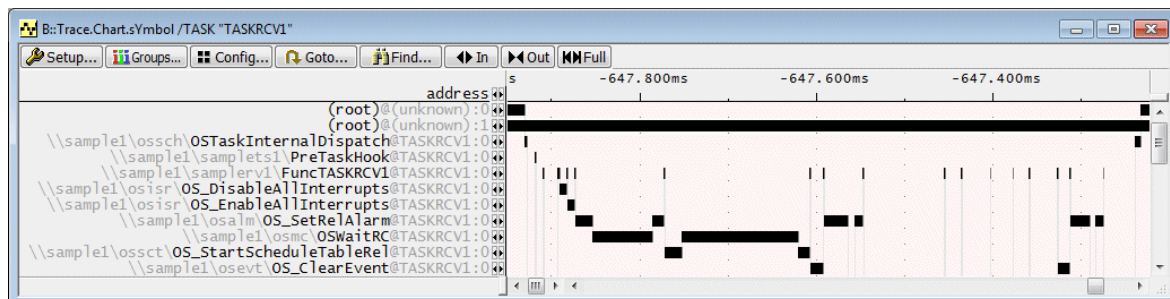
Flat function run-time analysis does **not** require any **data information** if no OS is used. That's why it is recommended to switch the broadcasting of data information off.

```
NEXUS.DTM OFF
```

Optimum NEXUS Configuration (OS)

Your function time chart **can** include task information if you advise NEXUS to export the instruction flow and task switches. For details refer to the chapter [OS-Aware Tracing](#) of this training.

```
Trace.Chart.Symbol /TASK "TASKRCV1"
```



Optimum Configuration 1 (if OSEK generated OTMs):

```
NEXUS.OTM ON
```

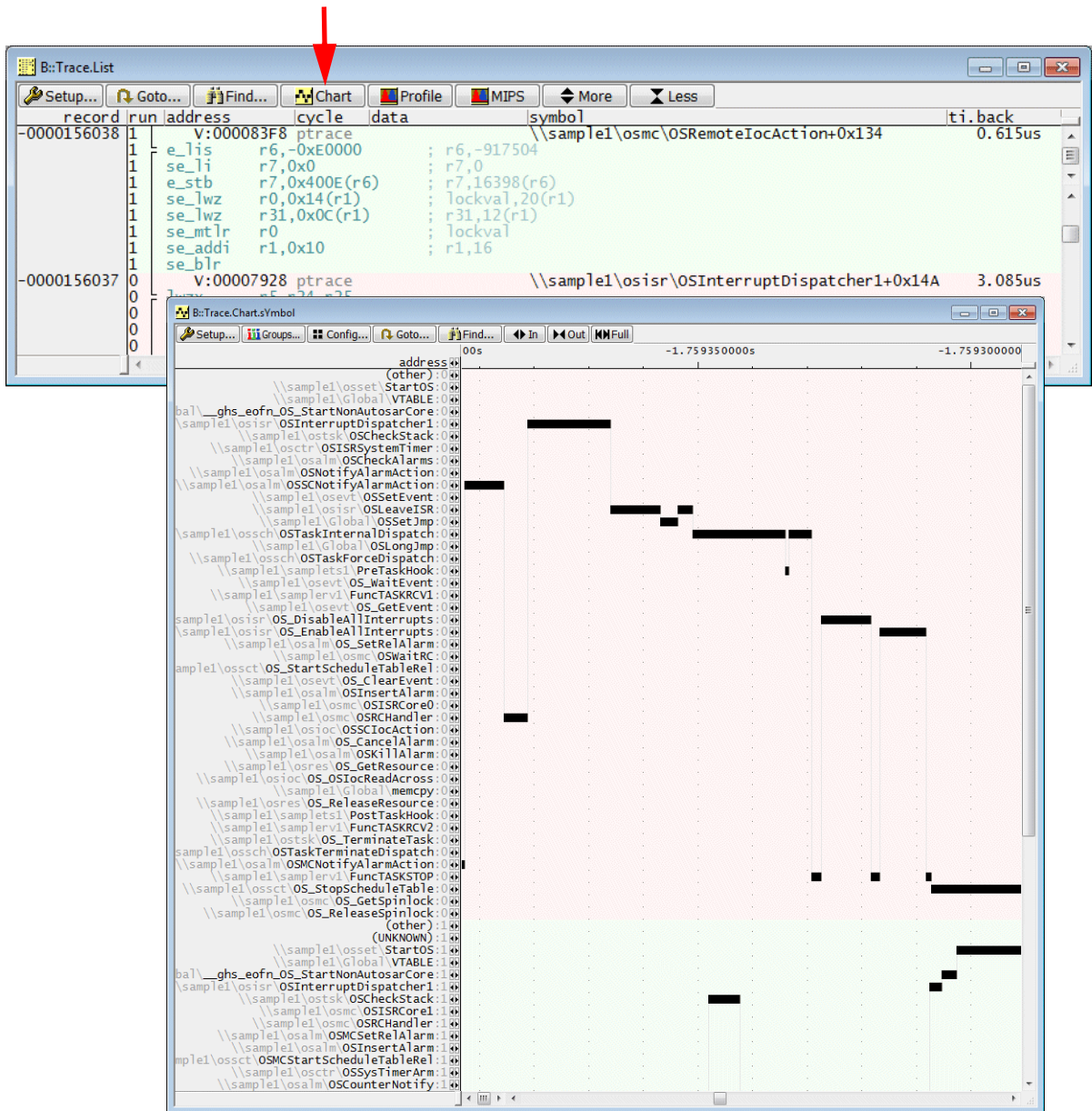
Optimum Configuration 2 (if OSEK does not support OTMs, NEXUS class 3 only):

```
Break.Set TASK.CONFIG(magic[0]) /Write /TraceData
Break.Set TASK.CONFIG(magic[1]) /Write /TraceData
...
```

Function Timing Diagram

TRACE32 PowerView provides a timing diagram which shows when the program counter was in which function/symbol range.

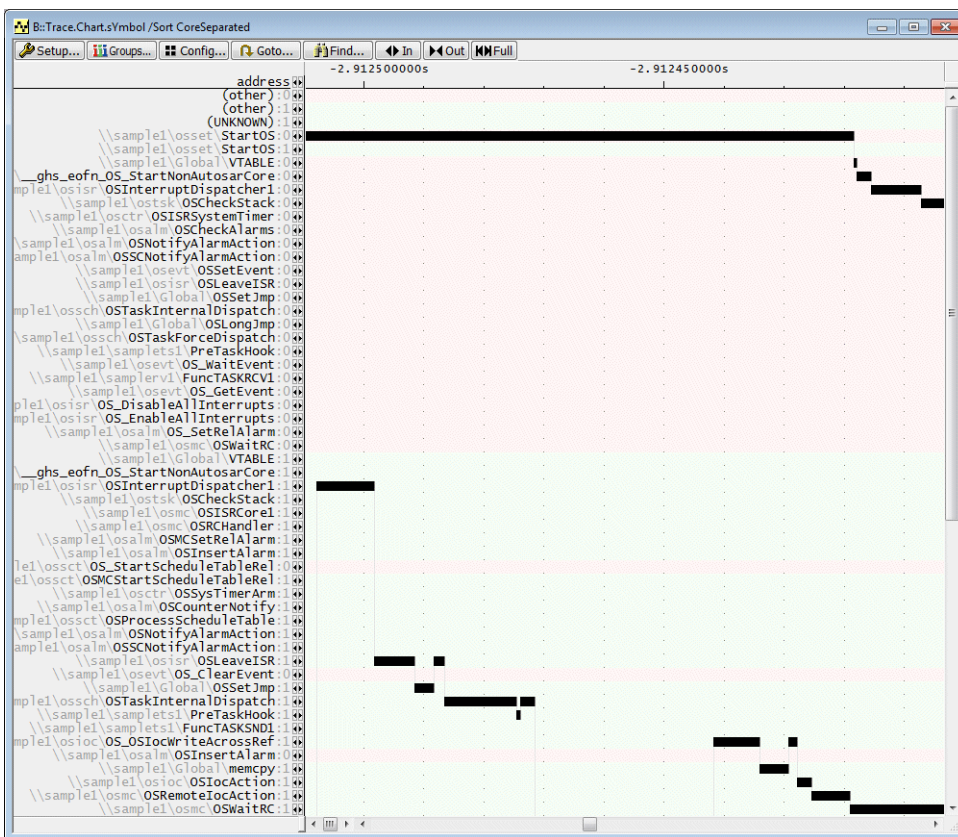
Pushing the **Chart** button in the **Trace.List** window opens a **Trace.Chart.sYmbol** window



Trace.Chart.sYmbol [/SplitCore /Sort CoreTogether]

Flat function run-time analysis

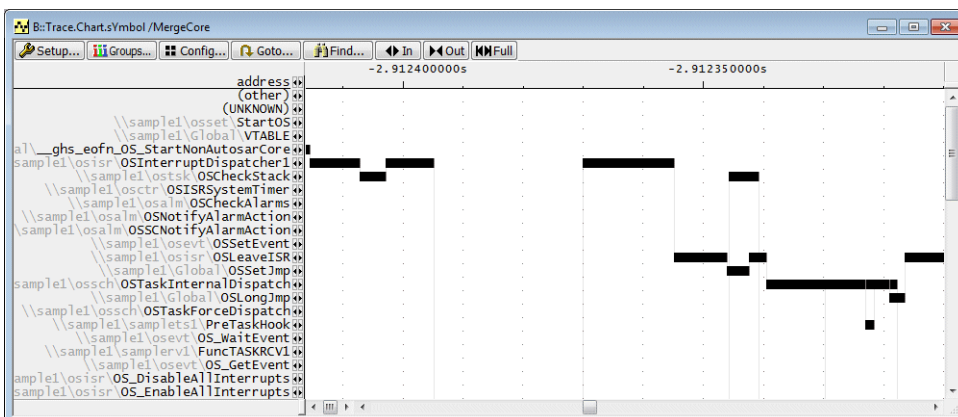
- graphical display
- split the result per core
- sort results per core and then per recording order



Trace.Chart.sYmbol [/SplitCore] /Sort CoreSeparated

Flat function run-time analysis

- graphical display
- split the result per core
- sort the results per recording order



Trace.Chart.sYmbol /MergeCore

Flat function run-time analysis

- graphical display
- merge the results of all cores

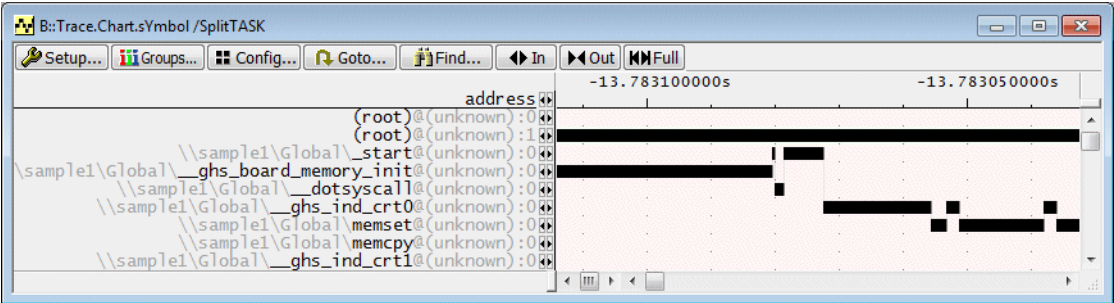
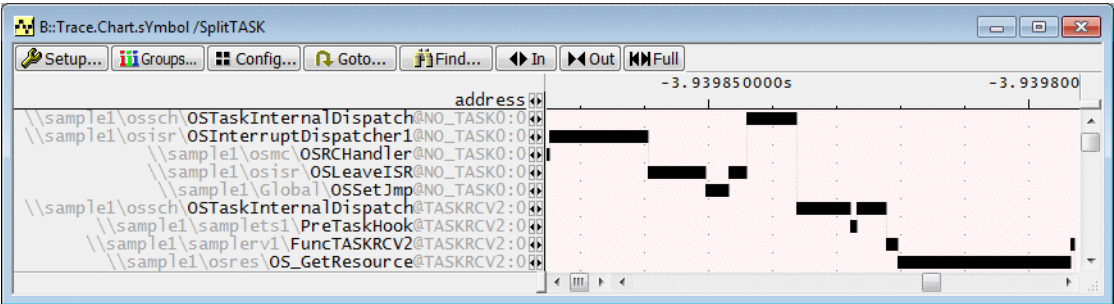
Function Timing Diagram (Including Task Information)

Default setting

Trace.Chart.sYmbol [/MergeTASK] [/SplitCore /Sort CoreTogether]

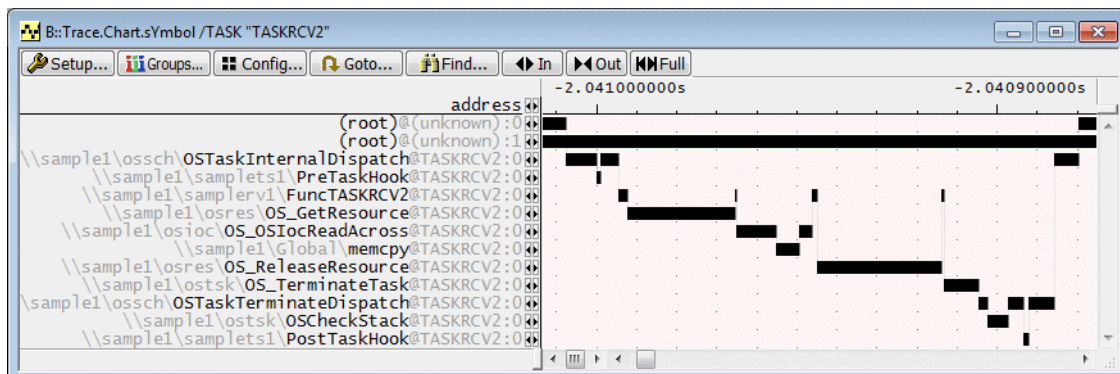
Display function time chart with task information

Trace.Chart.sYmbol /SplitTASK [/SplitCore /Sort CoreTogether]

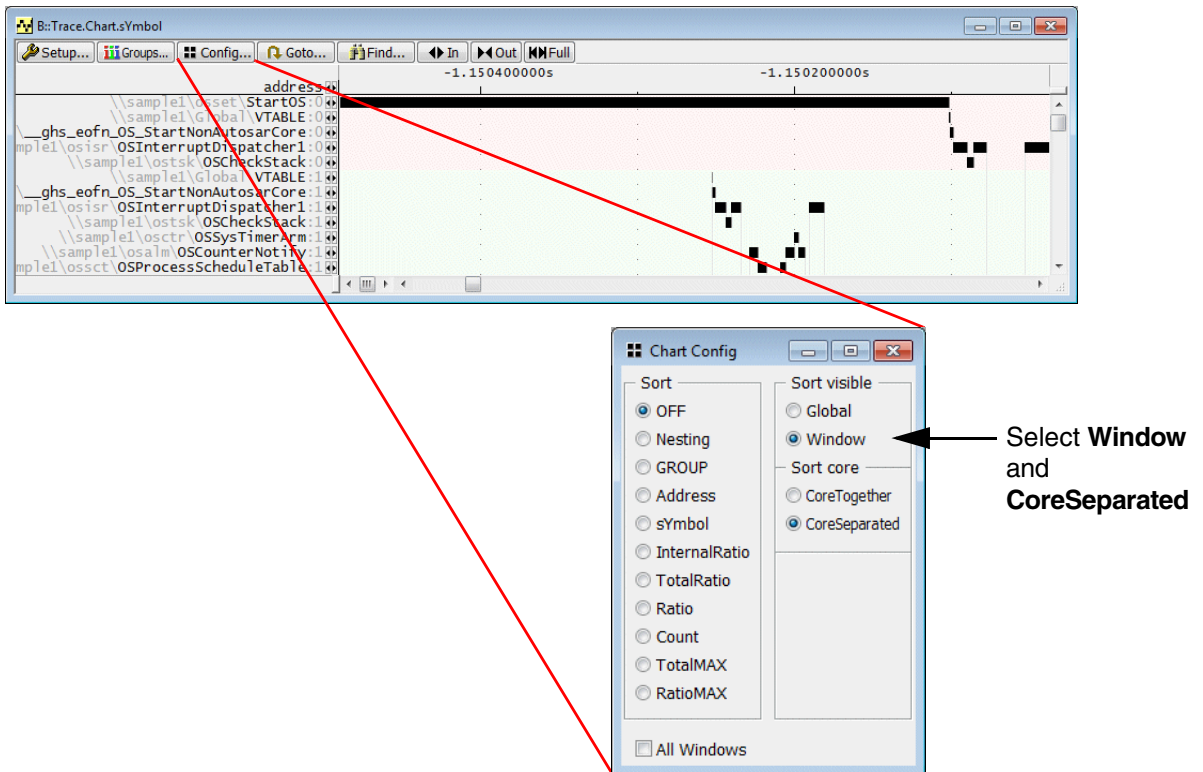


@ <task_name>	Task name information
@(unknown)	<ul style="list-style-type: none">Function was running before the OS was startedFunction was recorded before first task switch information was recorded
(root)@(unknown)	No trace information available

Display function time chart for the specified task
Trace.Chart.sYmbol /TASK <task_name> [/SplitCore /Sort CoreTogether]



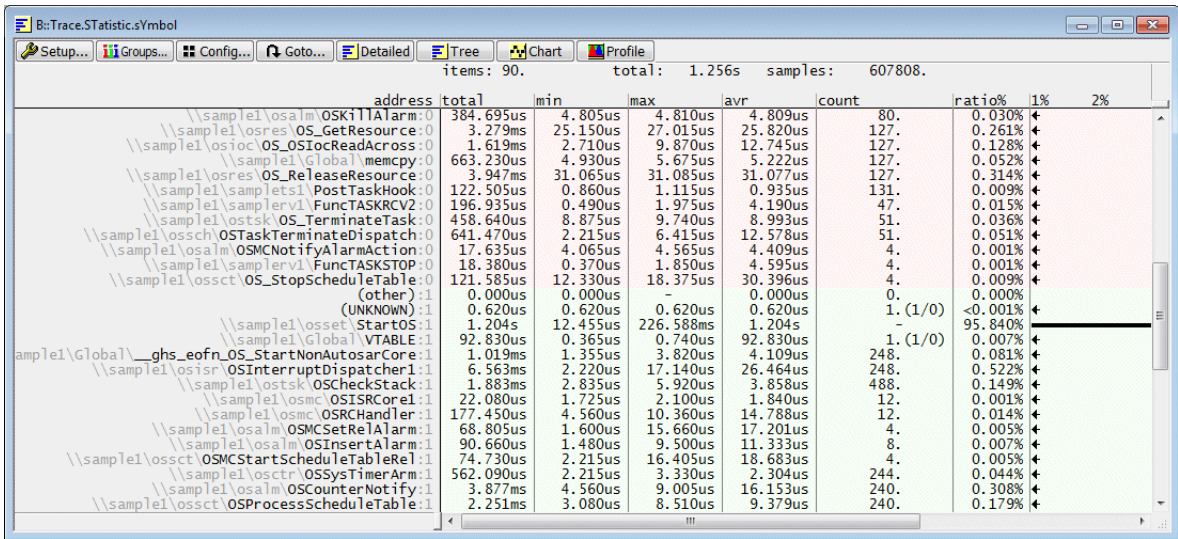
@ <task_name>	Functions running while the specified task was running
(root)@(unknown)	All other trace information



If **Window** and **CoreSeparated** is selected in the **Chart Config** window, the functions that are active at the selected point of time are visualized in the scope of the **Trace.Chart.sSymbol** window. This is helpful especially if you scroll horizontally.

For a detailed description of all **Sort** options provided by the **Chart Config** window refer to the command description of [Trace.STATistic.Sort](#).

Analog to the timing diagram also a numerical analysis is provided.



survey	
item	number of recorded functions/symbol regions
total	time period recorded by the trace
samples	total number of recorded changes of functions/symbol regions (instruction flow continuously in the address range of a function/symbol region)

B:\TraceStatistics.Symbol

items: 90. total: 1.256s samples: 607808.

	address	total	min	max	avr	count	ratio%	1%	2%
\\sample1\osal\OSKillAlarm:0		384.695us	4.805us	4.810us	4.809us	80.	0.030%	+	
\\sample1\osres_OS_GetResource:0		3.279ms	25.150us	27.015us	25.820us	127.	0.261%	+	
\\sample1\osioc_OS_OsIoReadAcross:0		1.619ms	2.710us	9.870us	12.745us	127.	0.128%	+	
\\sample1\Global\memcpy:0		663.230us	4.930us	5.675us	5.222us	127.	0.052%	+	
\\sample1\osres_OS_ReleaseResource:0		3.947ms	31.065us	31.085us	31.077us	127.	0.314%	+	
\\sample1\samplets1_PostTaskHook:0		122.505us	0.860us	1.115us	0.935us	131.	0.009%	+	
\\sample1\samplev1_FuncTASKRCV2:0		196.935us	0.490us	1.975us	4.190us	47.	0.015%	+	
\\sample1\ostsk_OS_TerminateTask:0		458.640us	8.875us	9.740us	8.993us	51.	0.036%	+	
\\sample1\ossch_OSTaskTerminateDispatch:0		641.470us	2.215us	6.415us	12.578us	51.	0.051%	+	
\\sample1\osal\OSMCNotifyAlarmAction:0		17.635us	4.065us	4.565us	4.409us	4.	0.001%	+	
\\sample1\samplev1_FuncTASKSTOP:0		18.380us	0.370us	1.850us	4.595us	4.	0.001%	+	
\\sample1\ossct_OS_StopScheduleTable:0		121.585us	12.330us	18.375us	30.396us	4.	0.009%	+	
(other):1		0.000us	0.000us	-	0.000us	0.	0.000%	+	
(UNKNOWN):1		0.620us	0.620us	0.620us	0.620us	1. (1/0)	<0.001%	+	
\\sample1\osset_StartOS:1		1.204s	12.455us	226.588ms	1.204s	-	95.840%	+	
\\sample1\Global\VTABLE:1		92.830us	0.365us	0.740us	92.830us	1. (1/0)	0.007%	+	
sample1\Global_ghs_eofn_OS_StartNonAutosarCore:1		1.019ms	1.355us	3.820us	4.109us	248.	0.081%	+	
\\sample1\osir_OSInterruptDispatcher:1:1		6.563ms	2.220us	17.140us	26.464us	248.	0.522%	+	
\\sample1\ostsk_OSCheckStack:1		1.883ms	2.835us	5.920us	3.858us	488.	0.149%	+	
\\sample1\osmc_OSISRCorrel:1		22.080us	1.725us	2.100us	1.840us	12.	0.001%	+	
\\sample1\osmc_OSISRCorrel:1		177.450us	4.560us	10.360us	14.788us	12.	0.014%	+	
\\sample1\osal\OSMCSetRelAlarm:1		68.805us	1.600us	15.660us	17.201us	4.	0.005%	+	
\\sample1\osal\OSMCSetRelAlarm:1		90.660us	1.480us	9.500us	11.333us	8.	0.007%	+	
\\sample1\ossct_OSMCStartScheduleTableRel:1		74.730us	2.215us	16.405us	18.683us	4.	0.005%	+	
\\sample1\osctr_OSSysTimerArm:1		562.090us	2.215us	3.330us	2.304us	244.	0.044%	+	
\\sample1\osal\OSCounterNotify:1		3.877ms	4.560us	9.005us	16.153us	240.	0.308%	+	
\\sample1\ossct_OSProcessScheduleTable:1		2.251ms	3.080us	8.510us	9.379us	240.	0.179%	+	

function details	
address	function/symbol region name (other) program sections that can not be assigned to a function/symbol region (UNKNOWN) program sections that can not be decoded
total	time period in the function/symbol region during the recorded time period
min	shortest time continuously in the address range of the function/symbol region
max	longest time continuously in the address range of the function/symbol region
avr	average time continuously in the address range of the function/symbol region (calculated as total/count)
count	number of new entries (start address executed) into the address range of the function/symbol region
ratio	ratio of time in the function/symbol region with regards to the total time period recorded

Trace.STATistic.sYmbol /MergeCORE

Flat function run-time analysis
- numerical display
- merge the results of all cores

Trace.STATistic.sYmbol /Sort CoreSeparated

Flat function run-time analysis
- numerical display
- split the result per core
- sort the results per recording order

Trace.STATistic.sYmbol [/MergeTASK]

Flat function run-time analysis (OS)
- numerical display
- no task information

Trace.STATistic.sYmbol /SplitTASK

Flat function run-time analysis (OS)
- numerical display including task information

Trace.STATistic.sYmbol /TASK <task_name>

Flat function run-time analysis (OS)
- numerical display for specified task

Nesting Analysis

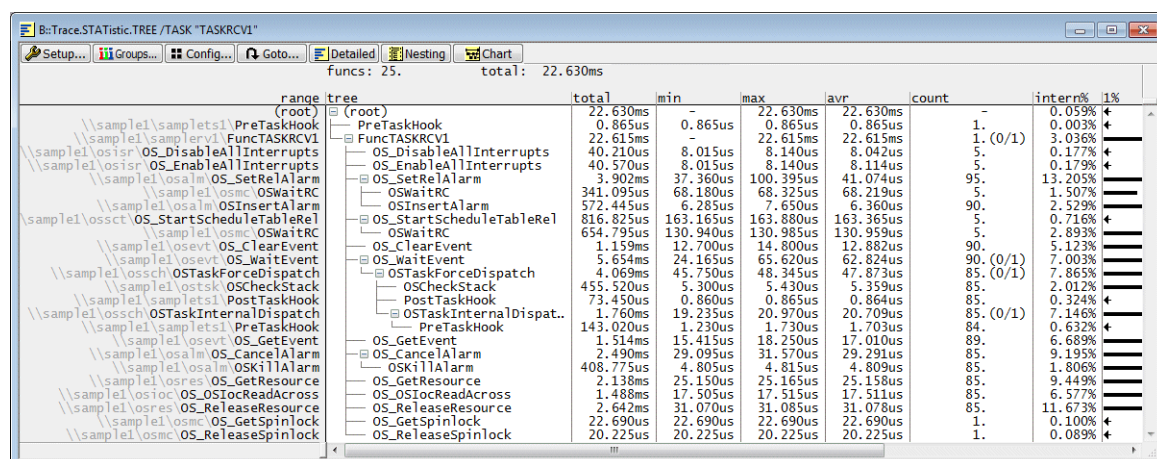
Restrictions

1. The nesting analysis analyses only high-level language functions.
2. The nested function run-time analysis expects common ways to enter/exit functions.
3. The nesting analysis is sensitive with regards to FIFOFULLs.

Optimum NEXUS Configuration (OS)

TRACE32 PowerView builds up a separate call tree for each task.

Trace.STATistic.TREE /TASK "TASKRCV1"



In order to hook a function entry/exit into the correct call tree, TRACE32 PowerView needs to know which task was running when the entry/exit occurred.

The standard way to get information on the current task is to advise the NEXUS to export the instruction flow and task switches. For details refer to the chapter **OS-Aware Tracing** of this training.

Optimum Configuration 1 (if OSEK generated OTMs):

NEXUS.OTM ON

Trace.STATistic.InterruptIsFunction ON

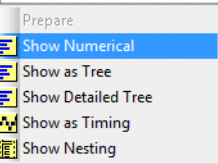
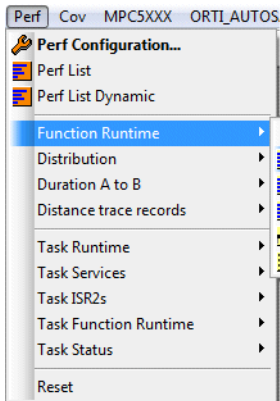
Optimum Configuration 2 (if OSEK does not support OTMs, NEXUS class 3 only):

```
Break.Set TASK.CONFIG(magic[0]) /Write /TraceData
Break.Set TASK.CONFIG(magic[1]) /Write /TraceData
...

Trace.STATistic.InterruptIsFunction ON
```

Trace.STATistic.Func

Nested function run-time analysis
- numeric display



B::Trace.STATistic.FUNC

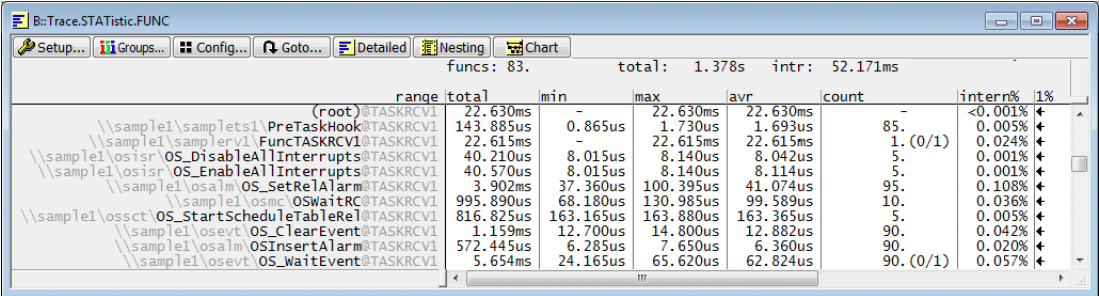
funcs: 83. total: 1.378s intr: 52.171ms

	range	total	min	max	avr	count	intern%	1%
(root)@(unknown):0		5.542ms	-	5.542ms	5.542ms	-	0.112%	
(root)@(unknown):1		1.378s	-	1.378s	1.378s	-	50.000%	
\\sample1\\sample1\\main@:(unknown):0		2.436ms	-	2.436ms	2.436ms	1. (0/1)	<0.001%	
\\sample1\\osmc\\StartCore@:(unknown):0		9.865us	9.865us	9.865us	9.865us	1.	<0.001%	
\\sample1\\osset\\StartOS@:(unknown):0		2.414ms	-	2.414ms	2.414ms	1. (0/1)	0.007%	
\\sample1\\osset\\OSInitApplications@:(unknown):0		28.980us	28.980us	28.980us	28.980us	1.	0.001%	
\\sample1\\osistr\\OSInitializeISR@:(unknown):0		2.014ms	2.014ms	2.014ms	2.014ms	1.	0.073%	
\\sample1\\osctr\\OSInitSystemTimer@:(unknown):0		3.575us	3.575us	3.575us	3.575us	1.	<0.001%	
\\sample1\\osmc\\OSWaitCoreSynch@:(unknown):0		10.235us	3.945us	6.290us	5.118us	2.	<0.001%	
\\sample1\\ostsk\\OSInitTasks@:(unknown):0		68.200us	68.200us	68.200us	68.200us	1.	0.002%	
\\sample1\\osres\\OSInitResources@:(unknown):0		20.840us	20.840us	20.840us	20.840us	1.	<0.001%	
\\sample1\\osctr\\OSInitCounters@:(unknown):0		10.605us	10.605us	10.605us	10.605us	1.	<0.001%	
\\sample1\\osaln\\OSInitAlarms@:(unknown):0		11.100us	11.100us	11.100us	11.100us	1.	<0.001%	
\\sample1\\osmc\\OSInitScheduleTables@:(unknown):0		3.580us	3.580us	3.580us	3.580us	1.	<0.001%	
\\sample1\\osmc\\OSInitSpinLock@:(unknown):0		2.590us	2.590us	2.590us	2.590us	1.	<0.001%	
\\sample1\\osioc\\OSInitIOC@:(unknown):0		11.350us	11.350us	11.350us	11.350us	1.	<0.001%	
\\sample1\\sample1_cfg\\OSIOC_Init@:(unknown):0		0.865us	0.865us	0.865us	0.865us	1.	<0.001%	
\\sample1\\osctr\\OSStartSystemTimer@:(unknown):0		3.085us	3.085us	3.085us	3.085us	1.	<0.001%	
\\sample1\\osctr\\OSTaskForceDispatch@:(unknown):0		21.830us	-	21.830us	21.830us	1. (0/1)	<0.001%	
\\sample1\\ostsk\\OSCheckStack@:(unknown):0		3.575us	3.575us	3.575us	3.575us	1.	<0.001%	
\\sample1\\ostsk\\OSTaskInternalDispatch@:(unknown):0		6.170us	-	6.170us	6.170us	1. (0/1)	<0.001%	
(root)@TASKRCV1		22.630ms	-	22.630ms	22.630ms	-	<0.001%	
\\sample1\\sample1s1\\PreTaskHook@TASKRCV1		143.885us	0.865us	1.730us	1.693us	85.	0.005%	
\\sample1\\sample1s1\\FuncTASKRCV1@TASKRCV1		22.615ms	-	22.615ms	22.615ms	1. (0/1)	0.024%	
\\sample1\\osistr\\OS_DisableAllInterrupts@TASKRCV1		40.210us	8.015us	8.140us	8.042us	5.	0.001%	
\\sample1\\osistr\\OS_EnableAllInterrupts@TASKRCV1		40.570us	8.015us	8.140us	8.114us	5.	0.001%	
\\sample1\\osaln\\OS_SetRelAlarm@TASKRCV1		3.902ms	37.360us	100.395us	41.074us	95.	0.108%	
\\sample1\\osmc\\OSWaitRC@TASKRCV1		995.890us	68.180us	130.985us	99.589us	10.	0.036%	
\\sample1\\ossct\\OS_StartScheduleTableRel@TASKRCV1		816.825us	163.165us	163.880us	163.365us	5.	0.005%	
\\sample1\\osevt\\OS_ClearEvent@TASKRCV1		1.159ms	12.700us	14.800us	12.882us	90.	0.042%	
\\sample1\\osaln\\OSInsertAlarm@TASKRCV1		572.445us	6.285us	7.650us	6.360us	90.	0.020%	
\\sample1\\osevt\\OS_WaitEvent@TASKRCV1		5.654ms	24.165us	65.620us	62.824us	90. (0/1)	0.057%	
(root)@(interrupt):0		0.000us	-	0.000us	0.000us	-	0.000%	
\\sample1\\osistr\\OSInterruptDispatcher1@:(interrupt):0		52.171ms	51.040us	105.080us	59.285us	880. (0/1)	0.964%	
\\sample1\\ostsk\\OSCheckStack@:(interrupt):0		3.422ms	3.695us	6.170us	3.888us	880.	0.124%	
\\sample1\\osmc\\OSISRCore0@:(interrupt):0		3.690ms	24.535us	28.490us	26.544us	139.	0.010%	
\\sample1\\osmc\\OSRCHandler@:(interrupt):0		3.407ms	22.440us	26.635us	24.508us	139.	0.075%	
\\sample1\\osioc\\OSSCIocAction@:(interrupt):0		1.294ms	7.890us	10.730us	9.586us	135.	0.029%	
\\sample1\\osevt\\OSSetEvent@:(interrupt):0		496.865us	3.210us	5.800us	5.583us	89.	0.018%	
\\sample1\\osevt\\OS_GetEvent@TASKRCV1		1.514ms	15.415us	18.250us	17.010us	89.	0.054%	

- Task-specific function run-time analysis, core information is discarded.
- Functions that can not be assigned to a task are assigned to the (@unknown) task, per core display.
- Interrupt service routines are assigned to (@interrupt) task, per core display.

funcs: 83. total: 1.378s intr: 52.171ms

survey	
func	number of functions in the trace
total	total measurement time
intr	total time in interrupt service routines



The screenshot shows a window titled "BTrace.STATistic.FUNC" with a menu bar (Setup..., Groups..., Config..., Goto..., Detailed, Nesting, Chart) and a toolbar. The main area displays a table of function statistics. The table has columns: range, total, min, max, avr, count, intern%, and 1%. The data is sorted by total time. The first row is (root)@TASKRCV1 with a total of 22.630ms. Other functions include sample1\sample1\PreTaskHook@TASKRCV1, sample1\sample1\FuncTASKRCV1@TASKRCV1, sample1\osir\OS_DisableAllInterrupts@TASKRCV1, sample1\osir\OS_EnableAllInterrupts@TASKRCV1, sample1\osalm\OS_SetRelAlarm@TASKRCV1, sample1\osalm\OSWaitRC@TASKRCV1, sample1\osmc\OSWaitRC@TASKRCV1, sample1\ossc\OS_StartScheduleTableRel@TASKRCV1, sample1\osevt\OS_ClearEvent@TASKRCV1, sample1\osalm\OSInsertAlarm@TASKRCV1, and sample1\osevt\OS_WaitEvent@TASKRCV1. The total time for all functions is 1.378s and the interrupt time is 52.171ms.

range	total	min	max	avr	count	intern%	1%
(root)@TASKRCV1	22.630ms	-	22.630ms	22.630ms	-	<0.001%	+
sample1\sample1\PreTaskHook@TASKRCV1	143.885us	0.865us	1.730us	1.693us	85.	0.005%	+
sample1\sample1\FuncTASKRCV1@TASKRCV1	22.615ms	-	22.615ms	22.615ms	1. (0/1)	0.024%	+
sample1\osir\OS_DisableAllInterrupts@TASKRCV1	40.210us	8.015us	8.140us	8.042us	5.	0.001%	+
sample1\osir\OS_EnableAllInterrupts@TASKRCV1	40.570us	8.015us	8.140us	8.114us	5.	0.001%	+
sample1\osalm\OS_SetRelAlarm@TASKRCV1	3.902ms	37.360us	100.395us	41.074us	95.	0.108%	+
sample1\osmc\OSWaitRC@TASKRCV1	995.890us	68.180us	130.985us	99.589us	10.	0.036%	+
sample1\ossc\OS_StartScheduleTableRel@TASKRCV1	816.825us	163.165us	163.880us	163.365us	5.	0.005%	+
sample1\osevt\OS_ClearEvent@TASKRCV1	1.159ms	12.700us	14.800us	12.882us	90.	0.042%	+
sample1\osalm\OSInsertAlarm@TASKRCV1	572.445us	6.285us	7.650us	6.360us	90.	0.020%	+
sample1\osevt\OS_WaitEvent@TASKRCV1	5.654ms	24.165us	65.620us	62.824us	90. (0/1)	0.057%	+

columns	
range (NAME)	function name, sorted by their recording order as default

- **HLL function, task specific**
`sample1\osmc\OSWaitRC@TASKRCV1`
HLL function “OSWaitRC” running in task “TASKRCV1”
- **Root of task-specific call tree**
`(root)@TASKRCV1`
(root) of call tree for task TASKRCV1

range	total	min	max	avr	count	intern%	1%
(root)@(interrupt):0	0.000us	-	-	0.000us	-	0.000%	-
→\\sample1\Global\VTABLE+0x40@(interrupt):0	56.229ms	55.595us	109.885us	63.897us	880. (0/1)	0.147%	←
\\sample1\osir\OSInterruptDispatcher1@(interrupt):0	52.163ms	51.035us	105.070us	59.276us	880. (0/1)	0.964%	←
\\sample1\ostsk\OSCheckStack@(interrupt):0	3.421ms	3.695us	6.165us	3.887us	880.	0.124%	←
\\sample1\osmc\OSISRCore0@(interrupt):0	3.689ms	24.530us	28.490us	26.540us	139.	0.010%	←
\\sample1\osmc\OSRCHandler@(interrupt):0	3.406ms	22.435us	26.640us	24.505us	139.	0.075%	←
\\sample1\osioc\OSSCioAction@(interrupt):0	1.294ms	7.890us	10.730us	9.585us	135.	0.029%	←
\\sample1\osevt\OSSEvent@(interrupt):0	496.780us	3.205us	5.800us	5.582us	89.	0.018%	←

- Indirect branch into interrupt vector table

→\\sample1\Global\VTABLE+0x40@(interrupt):0

- Interrupt service function

\\sample1\osevt\OSSEvent@(interrupt):0

- Root of @(interrupt)

(root)@(interrupt):0

range	total	min	max	avr	count	intern%	1%	2%	5%	10%
(root)@(unknown):0	197.879ms	-	197.879ms	197.879ms	-	10.664%				
(root)@(unknown):1	204.222ms	-	204.222ms	204.222ms	-	11.006%				
(root)@(interrupt):0	0.000us	-	-	0.000us	-	0.000%				

TRACE32 assigns all trace information generated before the first task switch to the @(unknown) task.

range	total	min	max	avr	count	interr%	1%
(root)@TASKRCV1	22.630ms	-	22.630ms	22.630ms	-	<0.001%	+
\\sample1\samplets1\PreTaskHook@TASKRCV1	143.885us	0.865us	1.730us	1.693us	85.	0.005%	+
\\sample1\samplelrv1\FuncTaskHook@TASKRCV1	22.615ms	-	22.615ms	22.615ms	1. (0/1)	0.024%	+
\\sample1\osivr\OS_DisableAllInterrupts@TASKRCV1	40.210us	8.015us	8.140us	8.042us	5.	0.001%	+
\\sample1\osivr\OS_EnableAllInterrupts@TASKRCV1	40.570us	8.015us	8.140us	8.114us	5.	0.001%	+
\\sample1\osalm\OS_SetRelAlarm@TASKRCV1	3.902ms	37.360us	100.395us	41.074us	95.	0.108%	+
\\sample1\osmc\OSWaitRC@TASKRCV1	995.890us	68.180us	130.985us	99.589us	10.	0.036%	+
\\sample1\ossct\OS_startScheduleTableRel@TASKRCV1	816.825us	163.165us	163.880us	163.365us	5.	0.005%	+
\\sample1\osevt\OS_ClearEvent@TASKRCV1	1.159ms	12.700us	14.800us	12.882us	90.	0.042%	+
\\sample1\osalm\OSInsertAlarm@TASKRCV1	572.445us	6.285us	7.650us	6.360us	90.	0.020%	+
\\sample1\osevt\OS_WaitEvent@TASKRCV1	5.654ms	24.165us	65.620us	62.824us	90. (0/1)	0.057%	+

columns (cont.)	
total	total time within the function
min	<p>shortest time between function entry and exit, time spent in interrupt service routines is excluded</p> <p>No min time is displayed if a function exit was never executed.</p>
max	longest time between function entry and exit, time spent in interrupt service routines is excluded
avr	average time between function entry and exit, time spent in interrupt service routines is excluded

B:\Trace.STATistic.FUNC

Setup...

Groups...

Config...

Goto...

Detailed

Nesting

Chart

funcs: 83.

total: 1.378s

intr: 52.171ms

	range	total	min	max	avr	count	intern%	1%
(root)@TASKRCV1	22.630ms	-	22.630ms	22.630ms	-	-	<0.001%	
\\sample1\\samplets1\\PreTaskHook@TASKRCV1	143.885us	0.865us	1.730us	1.693us	85.		0.005%	
\\sample1\\samplets1\\FuncTASKRCV1@TASKRCV1	22.615ms	-	22.615ms	22.615ms	1. (0/1)		0.024%	
\\sample1\\osISR\\OS_DisableAllInterrupts@TASKRCV1	40.210us	8.015us	8.140us	8.042us	5.		0.001%	
\\sample1\\osISR\\OS_EnableAllInterrupts@TASKRCV1	40.570us	8.015us	8.140us	8.114us	5.		0.001%	
\\sample1\\osalm\\OS_SetRelAlarm@TASKRCV1	3.902ms	37.360us	100.395us	41.074us	95.		0.108%	
\\sample1\\osmc\\OSWaitRC@TASKRCV1	995.890us	68.180us	130.985us	99.589us	10.		0.036%	
\\sample1\\osscct\\OS_StartScheduleTableRel@TASKRCV1	816.825us	163.165us	163.880us	163.365us	5.		0.005%	
\\sample1\\osevt\\OS_ClearEvent@TASKRCV1	1.159ms	12.700us	14.800us	12.882us	90.		0.042%	
\\sample1\\osalm\\OSInsertAlarm@TASKRCV1	572.445us	6.285us	7.650us	6.360us	90.		0.020%	
\\sample1\\osevt\\OS_WaitEvent@TASKRCV1	5.654ms	24.165us	65.620us	62.824us	90. (0/1)		0.057%	

columns (cont.)

count	number of times within the function
-------	-------------------------------------

If function entries or exits are missing, this is displayed in the following format:

<times within the function >. (<number of missing function entries>|<number of missing function exits>).

count
2. (2/0)

Interpretation examples:

2. (2/0): 2 times within the function, 2 function entries missing
4. (0/3): 4 times within the function, 3 function exits missing
11. (1/1): 11 times within the function, 1 function entry and 1 function exit is missing.

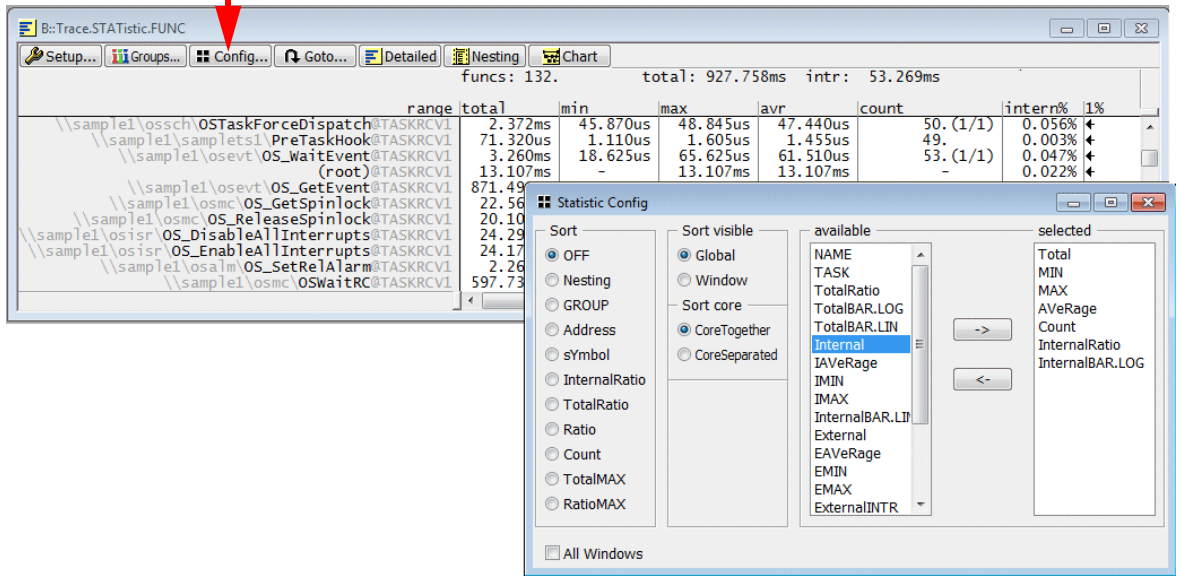


If the number of missing function entries or exits is higher the 1 the analysis performed by the command **Trace.STATistic.Func** might fail due to nesting problems. A detailed view to the trace contents is recommended.

columns (cont.)

intern% (InternalRatio, InternalBAR.LOG)	ratio of time within the function without subfunctions and interrupts
--	---

Pushing the **Config...** button allows to display additional columns



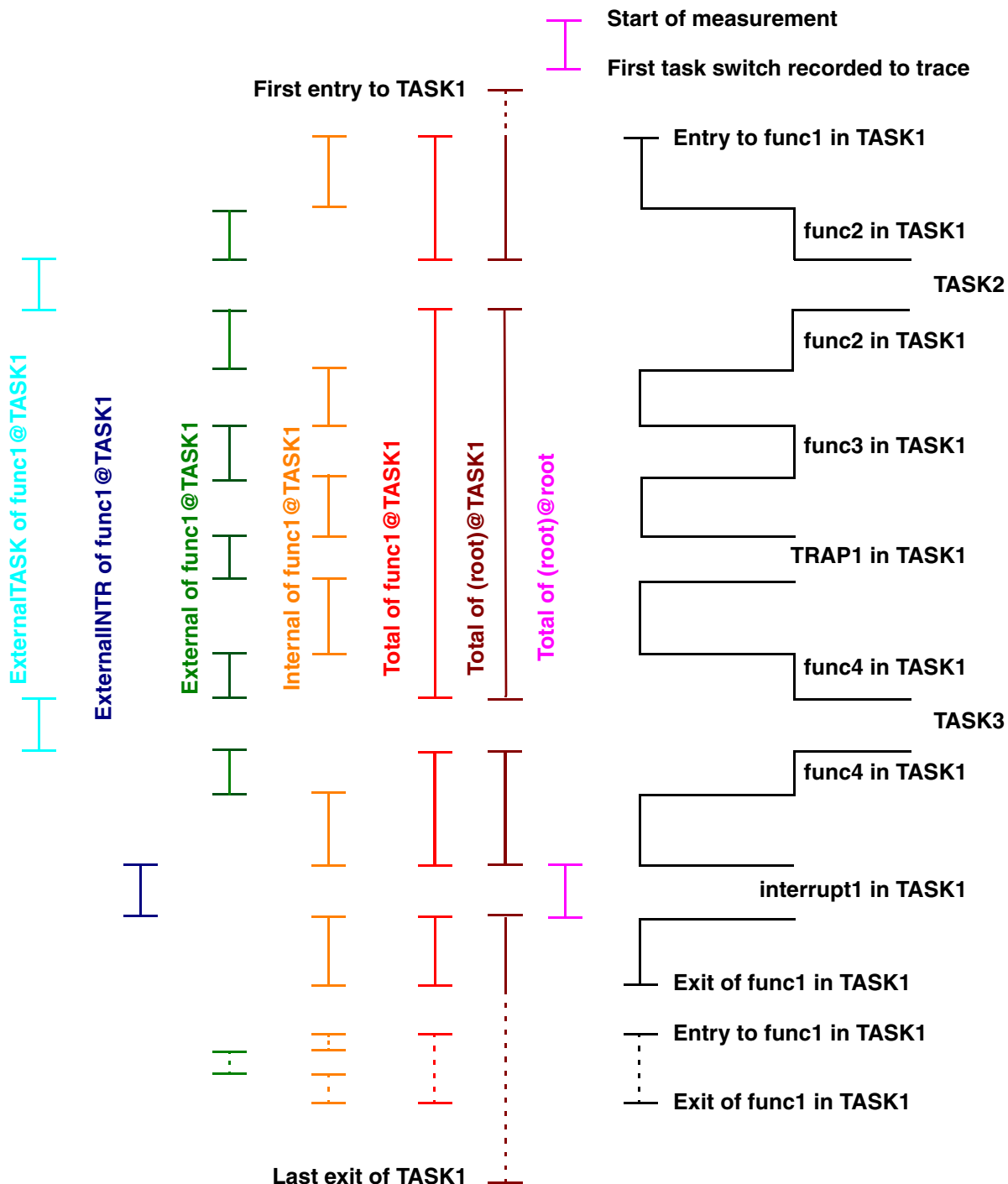
columns (cont.) - times only in function

Internal	total time between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
IAVeRage	average time between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
IMIN	shortest time between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
IMAX	longest time spent in the function between function entry and exit without called sub-functions, TRAP handlers, interrupt service routines
InternalRatio	<i><Internal time of function>/<Total measurement time></i> as a numeric value.
InternalBAR	<i><Internal time of function>/<Total measurement time></i> graphically.

<i>columns (cont.) - times in sub-functions and TRAP handlers</i>	
External	total time spent within called sub-functions/TRAP handlers
EAVeRage	average time spent within called sub-functions/TRAP handlers
EMIN	shortest time spent within called sub-functions/TRAP handlers
EMAX	longest time spent within called sub-functions/TRAP handlers

<i>columns (cont.) - interrupt times</i>	
ExternalINTR	total time the function was interrupted
ExternalINTRMAX	max. time one function pass was interrupted
INTRCount	number of interrupts that occurred during the function run-time

<i>columns - task/thread related information</i>	
TASKCount	number of tasks that interrupt the function
ExternalTASK	total time in other tasks
ExternalTASKMAX	max. time 1 function pass was interrupted by a task



Timing Improvements for OS

The standard NEXUS settings do often not allow to locate exactly the instructions that are already executed by a newly activated task. This is especially true is Branch History Messaging is used. This might disturb the task-aware function run-time measurement.

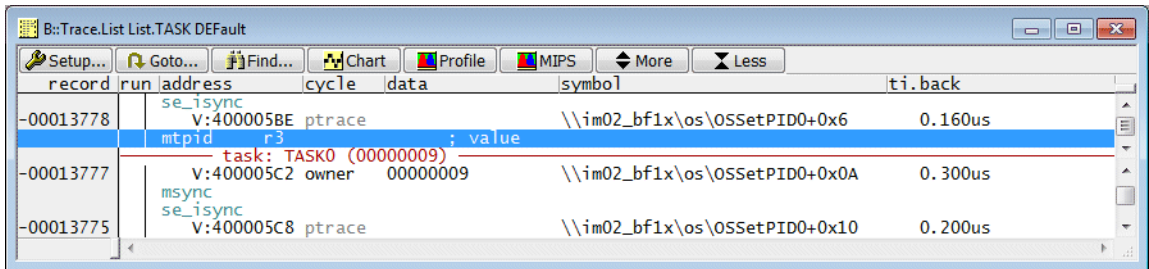
An instruction-accurate assignment of the task switches may improve the results.

IEEE-ISTO 5001-2008 and Subsequent Standards

The Ownership Trace Messages (task switches) can be exactly assigned to an instruction, if the following setting is done.

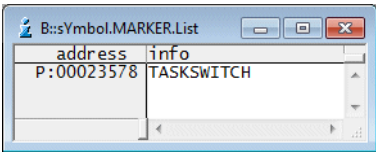
```
NEXUS.PTCM PID_MSR ON ; enable Program Trace Correlation
                        ; Messages for PID0/NPIDR accesses

NEXUS.POTD ON          ; disable Periodic Ownership Trace
                        ; Messages
```



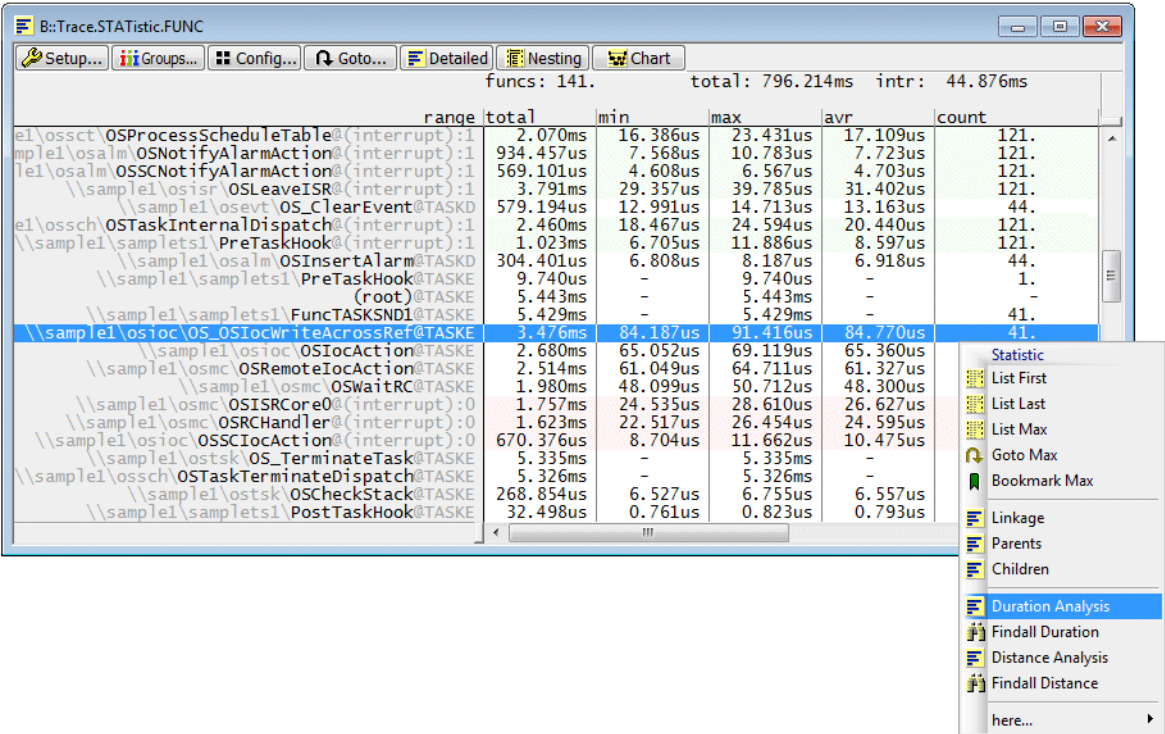
Alternative

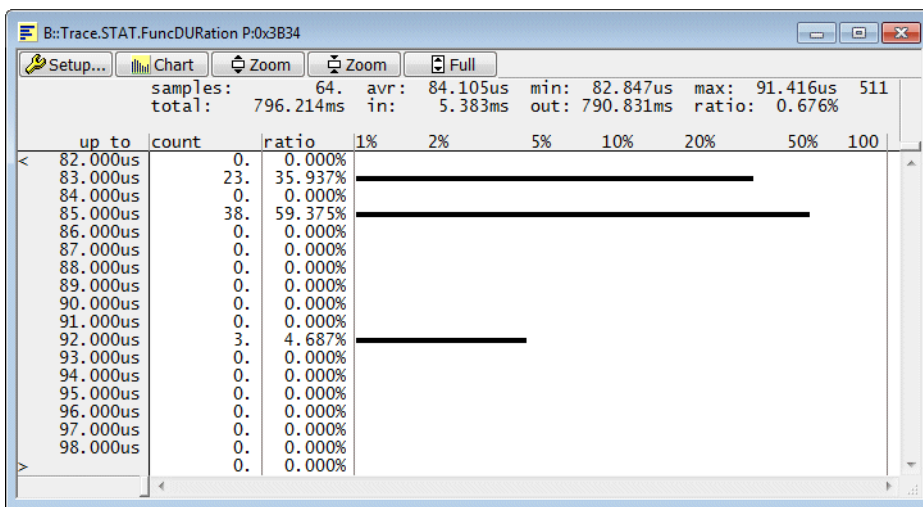
```
; mark instruction that performs the task switch for the task-aware
; function run-time analysis
sYmbol.MARKER.Create TASKSWITCH osDispatcher+0x100
```



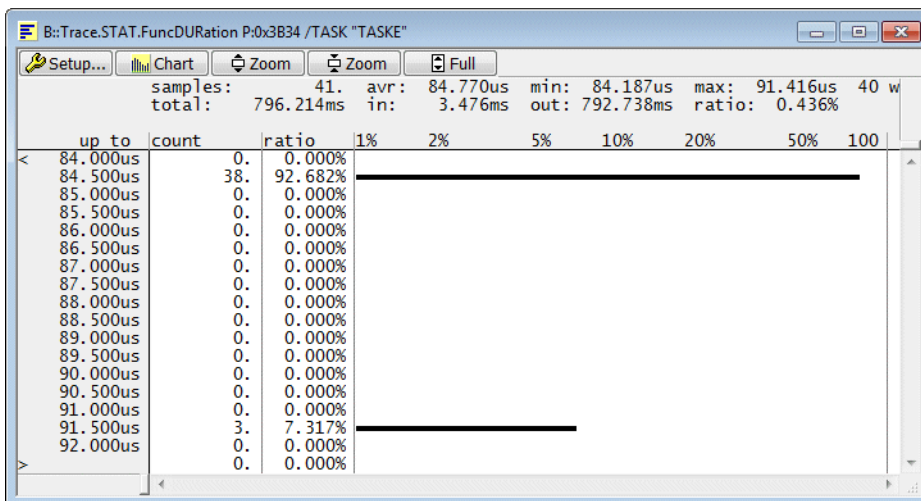
Detailed analysis of a single function, time between function entry and exit, time spent in interrupt service routines and other tasks is excluded.

Trace.STATistic.FuncDURation <function> [/TASK "<task_name>"] [/FilterCORE "<core_number>"]

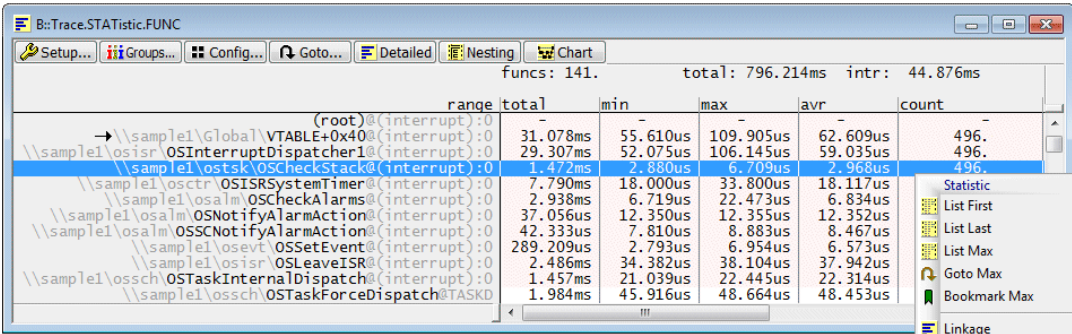




Please be aware, that details are shown for all function runs. If you are interested in a task-specific analysis you have to use the **/TASK "<task_name>"** option.



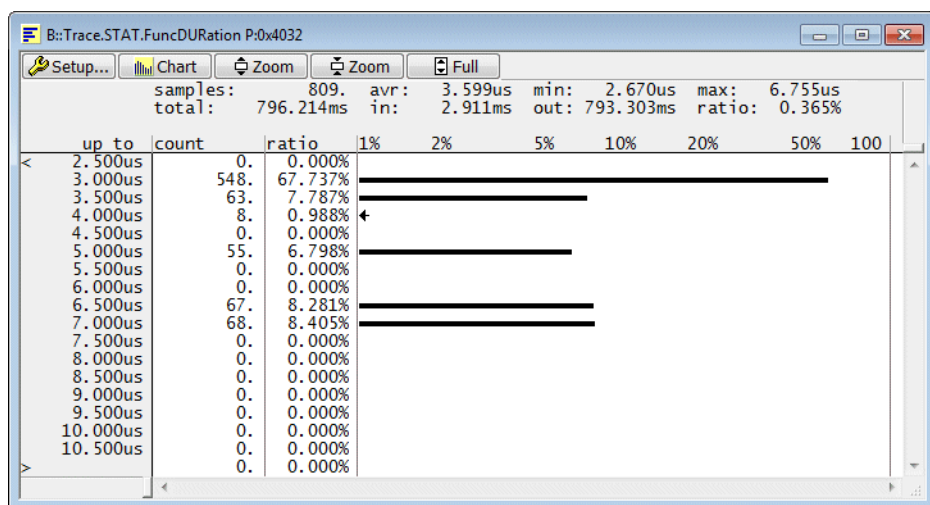
The @ (interrupt) and the @ (unknown) task are split up per core.



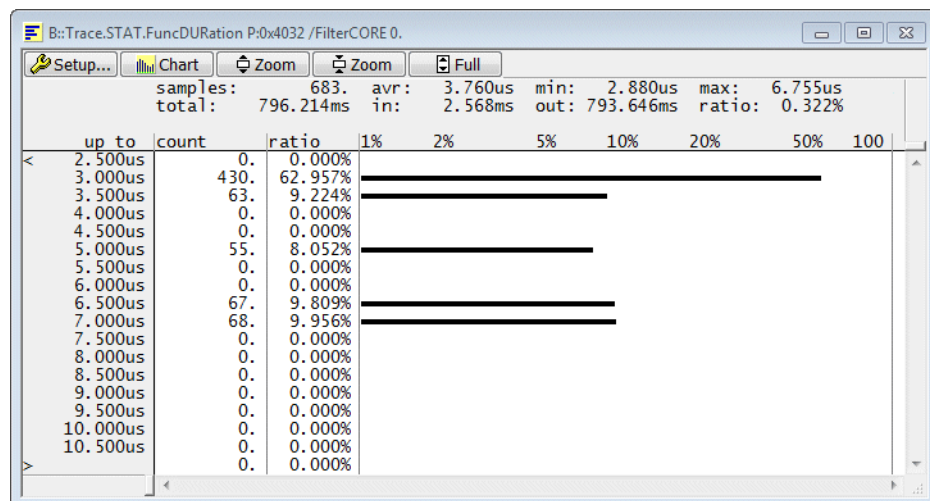
funcs: 141. total: 796.214ms intr: 44.876ms

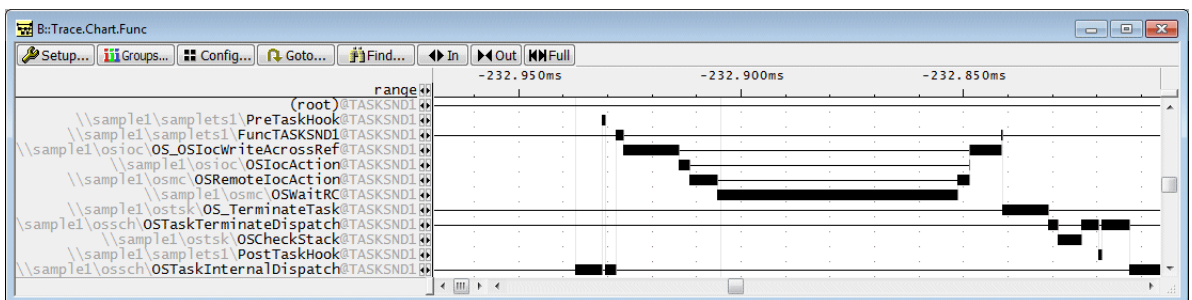
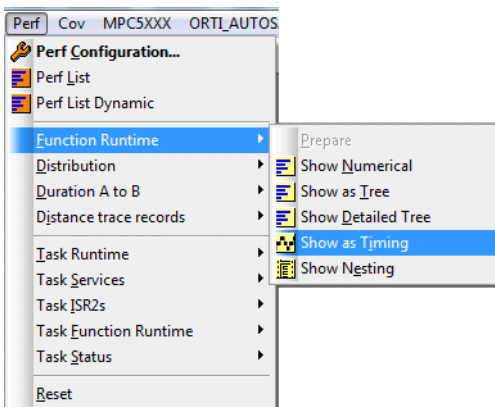
range	total	min	max	avr	count
(root)@(interrupt):0	31.078ms	55.610us	109.905us	62.609us	496.
\\sample1\\osir\\OSInterruptDispatcher1@(interrupt):0	29.307ms	52.075us	106.145us	59.035us	496.
\\sample1\\ostsk\\OSCheckStack@(interrupt):0	1.472ms	2.880us	6.709us	2.968us	496.
\\sample1\\osctr\\OSISRSystemTimer@(interrupt):0	7.790ms	18.000us	33.800us	18.117us	
\\sample1\\osal\\OSCheckAlarms@(interrupt):0	2.938ms	6.719us	22.473us	6.834us	
\\sample1\\osal\\OSNotifyAlarmAction@(interrupt):0	37.056us	12.350us	12.355us	12.352us	
\\sample1\\osal\\OSSCNotifyAlarmAction@(interrupt):0	42.333us	7.810us	8.883us	8.467us	
\\sample1\\osevt\\OSSetEvent@(interrupt):0	289.209us	2.793us	6.954us	6.573us	
\\sample1\\osir\\OSLeaveISR@(interrupt):0	2.486ms	34.382us	38.104us	37.942us	
\\sample1\\osch\\OSTaskInternalDispatch@(interrupt):0	1.457ms	21.039us	22.445us	22.314us	
\\sample1\\osch\\OSTaskForceDispatch@TASKD	1.984ms	45.916us	48.664us	48.453us	

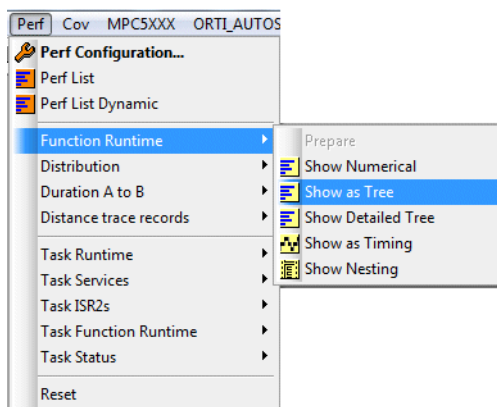
- Statistic
- List First
- List Last
- List Max
- Goto Max
- Bookmark Max
- Linkage
- Parents
- Children
- Duration Analysis
- Findall Duration
- Distance Analysis
- Findall Distance
- here...



Please be aware, that details are shown for all function runs. If you are interested in a core-specific analysis you have to use the **/FilterCORE <core_number>** option.







B:\Trace.STATistic.TREE /TASK "TASKRCV1"

Setup... Groups... Config... Goto... Detailed Nesting Chart

funcs: 25. total: 22.630ms

range	tree	total	min	max	avr	count	intern%	1%
(root)	(root)	22.630ms	-	22.630ms	22.630ms	-	0.059%	+
\\sample1\\samplets1\\PreTaskHook	PreTaskHook	0.865us	0.865us	0.865us	0.865us	1.	0.003%	+
\\sample1\\samplets1\\FuncTASKRCV1	FuncTASKRCV1	22.615ms	-	22.615ms	22.615ms	1. (0/1)	3.036%	+
\\sample1\\osISR\\OS_DisableAllInterrupts	OS_DisableAllInterrupts	40.210us	8.015us	8.140us	8.042us	5.	0.177%	+
\\sample1\\osISR\\OS_EnableAllInterrupts	OS_EnableAllInterrupts	40.570us	8.015us	8.140us	8.114us	5.	0.179%	+
\\sample1\\osAlrm\\OS_SetRelAlarm	OS_SetRelAlarm	3.902ms	37.360us	100.395us	41.074us	95.	13.205%	+
\\sample1\\osAlrm\\OSWaitRC	OSWaitRC	341.095us	68.180us	68.325us	68.219us	5.	1.507%	+
\\sample1\\osAlrm\\OSInsertAlarm	OSInsertAlarm	572.445us	6.285us	7.650us	6.360us	90.	2.529%	+
\\sample1\\osSct\\OS_StartScheduleTableRel	OS_StartScheduleTableRel	816.825us	163.165us	163.880us	163.365us	5.	0.716%	+
\\sample1\\osmc\\OSWaitRC	OSWaitRC	654.795us	130.940us	130.985us	130.959us	5.	2.893%	+
\\sample1\\osevt\\OS_ClearEvent	OS_ClearEvent	1.159ms	12.700us	14.800us	12.882us	90.	5.123%	+
\\sample1\\osevt\\OS_WaitEvent	OS_WaitEvent	5.654ms	24.165us	65.620us	62.824us	90. (0/1)	7.003%	+
\\sample1\\osSch\\OSTaskForceDispatch	OSTaskForceDispatch	4.069ms	45.750us	48.345us	47.873us	85. (0/1)	7.865%	+
\\sample1\\osSch\\OSCheckStack	OSCheckStack	455.520us	5.300us	5.430us	5.359us	85.	2.012%	+
\\sample1\\samplets1\\PostTaskHook	PostTaskHook	73.450us	0.860us	0.865us	0.864us	85.	0.324%	+
\\sample1\\osSch\\OSTaskInternalDispatch	OSTaskInternalDispat..	1.760ms	19.235us	20.970us	20.709us	85. (0/1)	7.146%	+
\\sample1\\samplets1\\PreTaskHook	PreTaskHook	143.020us	1.230us	1.730us	1.703us	84.	0.632%	+
\\sample1\\osevt\\OS_GetEvent	OS_GetEvent	1.514ms	15.415us	18.250us	17.010us	89.	6.689%	+
\\sample1\\osAlrm\\OS_CancelAlarm	OS_CancelAlarm	2.490ms	29.095us	31.570us	29.291us	85.	9.195%	+
\\sample1\\osAlrm\\OSKillAlarm	OSKillAlarm	408.775us	4.805us	4.815us	4.809us	85.	1.806%	+
\\sample1\\osRes\\OS_GetResource	OS_GetResource	2.138ms	25.150us	25.165us	25.158us	85.	9.449%	+
\\sample1\\osIoc\\OS_OStocReadAcross	OS_OStocReadAcross	1.488ms	17.505us	17.515us	17.511us	85.	6.577%	+
\\sample1\\osRes\\OS_ReleaseResource	OS_ReleaseResource	2.642ms	31.070us	31.085us	31.078us	85.	11.673%	+
\\sample1\\osmc\\OS_GetSpinlock	OS_GetSpinlock	22.690us	22.690us	22.690us	22.690us	1.	0.100%	+
\\sample1\\osmc\\OS_ReleaseSpinlock	OS_ReleaseSpinlock	20.225us	20.225us	20.225us	20.225us	1.	0.089%	+

It is also possible to get a task-specific tree.

```
Trace.STATistic.TREE /TASK "TASKRCV1"
```

B:\Trace.STATistic.FUNC

funcs: 132. total: 674.476ms intr: 41.031ms

range	total	min	max	avr	count	intern%	1%
\\sample1\\osmc\\OS_ReleaseSpinlock@TASKCNT	20.720us	20.720us	20.720us	20.720us	1.	0.001%	
\\sample1\\osalm\\OSNotifyAlarmAction@TASKCNT	130.970us	65.485us	65.485us	65.485us	2.	<0.001%	
\\sample1\\osmc\\OSRemoteNotifyAlarmAction@TASKCNT	126.530us	63.265us	63.265us	63.265us	2.	0.001%	
\\sample1\\osmc\\OSWaitRC@TASKCNT	109.260us	54.625us	54.635us	54.630us	2.	0.008%	
\\sample1\\samplets1\\PreTaskHook@TASKCNT	24.650us	0.615us	0.620us	0.616us	40.	0.001%	
\\sample1\\samplets1\\FuncTASKCNT@TASKCNT	2.844ms	-	2.844ms	1.438ms	40.	0.008%	
\\sample1\\osctr\\OS_IncrementCounter@TASKCNT	1.236ms	27.135us	99.645us	30.898us	40.	0.064%	
\\sample1\\osalm\\OSCheckAlarms@TASKCNT	359.155us	5.425us	74.485us	8.979us	40.		
\\sample1\\ostsk\\OS_TerminateTask@TASKCNT	2.813ms	-	2.813ms	1.403ms	40.		
\\sample1\\ossch\\OSTaskTerminateDispatch@TASKCNT	2.807ms	-	2.807ms	1.396ms	40.		

B:\Trace.STAT.LINKage C:\0x4A10

funcs: 2. total: 2.687ms

range	total	min	max	avr	count	total%	1%
\\sample1\\osctr\\OSISRSysSystemTimer	2.327ms	6.285us	22.075us	6.377us	365.	86.631%	
\\sample1\\osctr\\OS_IncrementCounter	359.155us	5.425us	74.485us	8.979us	40.	13.368%	

Third-party Timing Tools

TRACE32 also provides an interface to third-party timing tools. For details refer to [“Trace Export for Third-Party Timing Tools”](#) (app_timing_tools.pdf).

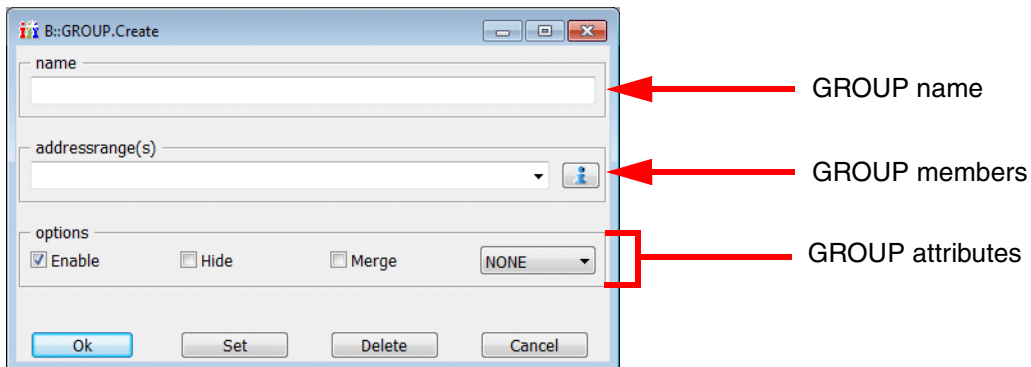
Structure the Trace Evaluation

The command group GROUP allows to structure the software for the trace evaluation. This is especially useful if the software consists of a huge number of functions/modules.

GROUP Creation

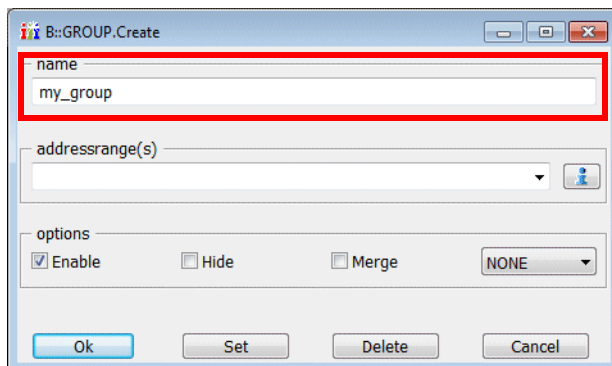
GROUP.Create

If the command **GROUP.Create** is entered without parameters, the **Group.Create** dialog is opened.



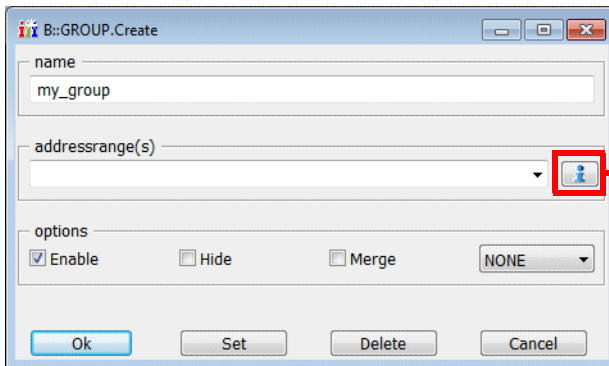
The basic setup for a GROUP includes the following steps:

1. Specify the GROUP name.



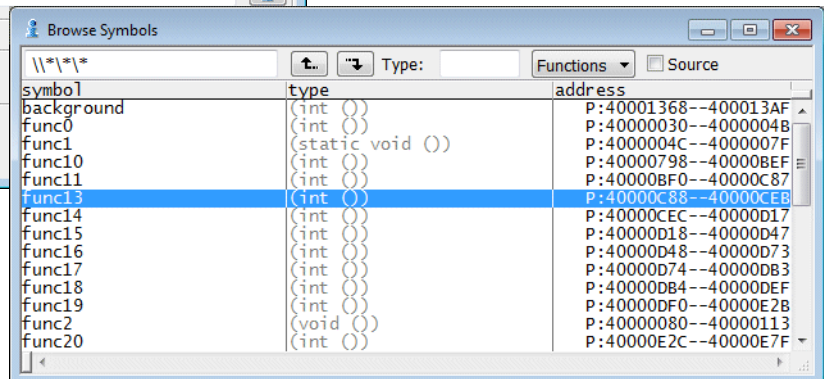
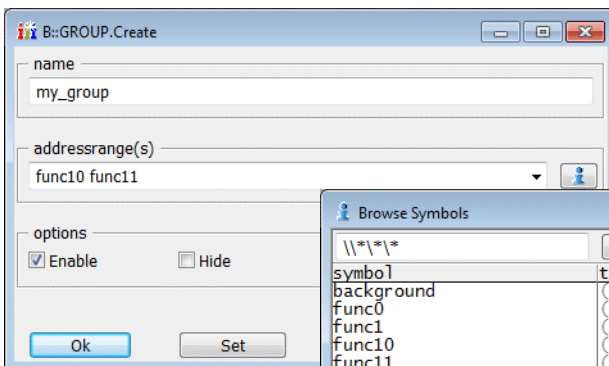
2. Specify the GROUP members.

GROUPS are address ranges, so you can use functions, modules, or programs to specify the group members.



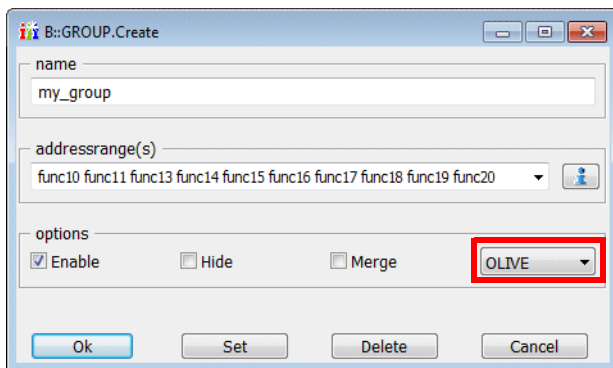
Open the symbol data base to select the group members

A new group member is selected by a double-click.

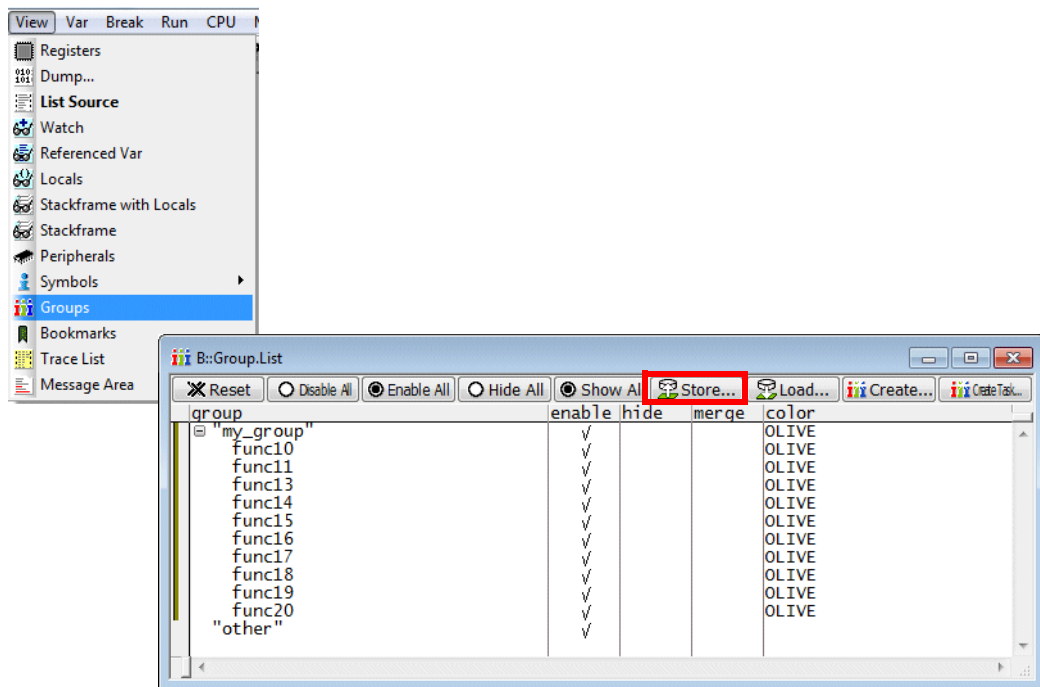


3. Specify the GROUP color and close the dialog with Ok.

The GROUP color is used to mark the GROUP members in the trace analysis windows.



4. Display the GROUP information.



5. Push the Store... button, if you want to generate a script that allows you to re-set the specified groups at any time.

```
; script group_settings.cmm  
B::
```

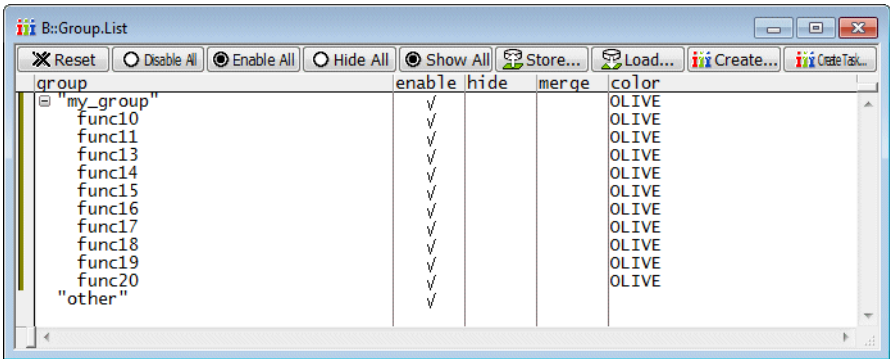
```
GROUP.RESET  
GROUP.CREATE "my_group" \\diabc\diabc\func10 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func11 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func13 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func14 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func15 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func16 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func17 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func18 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func19 /OLIVE  
GROUP.CREATE "my_group" \\diabc\diabc\func20 /OLIVE  
  
ENDDO
```

Working with GROUPs

The GROUP status determines the appearance of a GROUP in the trace display and analysis windows. The following three statuses are available:

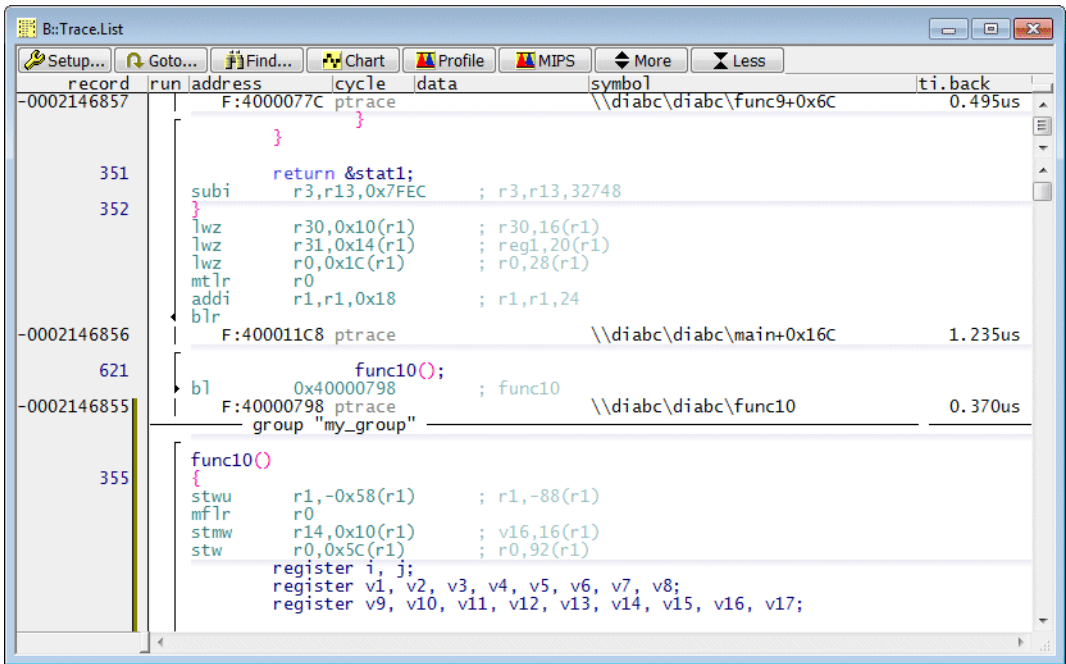
- ENable
- ENable + Merge
- ENable + HIDE

GROUP Status ENable



TRACE32 provide the following features if a GROUP has the status ENable:

1. **GROUP members are marked in the Trace Listing by their group color.**



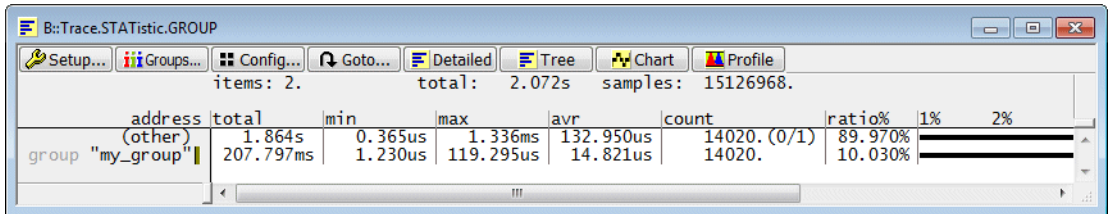
2. Special statistic commands are provide for the GROUPS.

Trace.STATistic.GROUP

Group-based run-time analysis.

Trace.Chart.GROUP

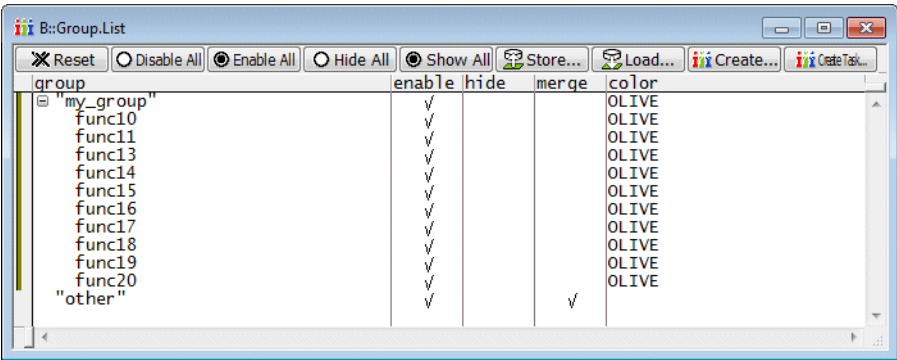
Group-based time chart.



The screenshot shows the 'B::Trace.STATistic.GROUP' window. It has a menu bar with 'Setup...', 'Groups...', 'Config...', 'Goto...', 'Detailed', 'Tree', 'Chart', and 'Profile'. Below the menu bar, it displays 'items: 2.', 'total: 2.072s', and 'samples: 15126968.'. The main area contains a table with the following data:

address	total	min	max	avr	count	ratio%	1%	2%
(other)	1.864s	0.365us	1.336ms	132.950us	14020. (0/1)	89.970%		
group "my_group"	207.797ms	1.230us	119.295us	14.821us	14020.	10.030%		

GROUP Status ENable + Merge

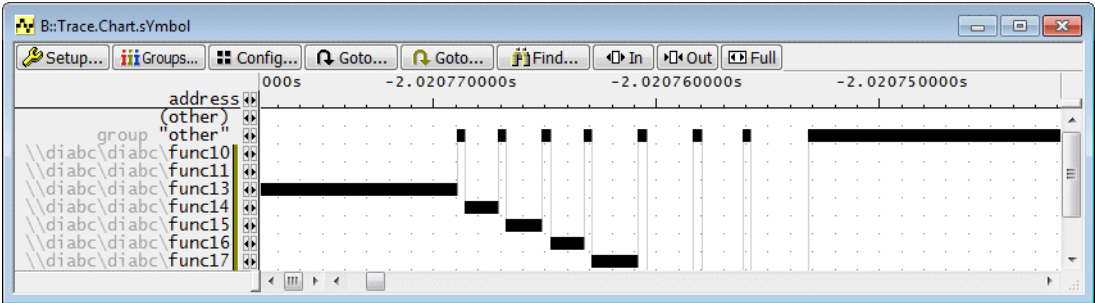


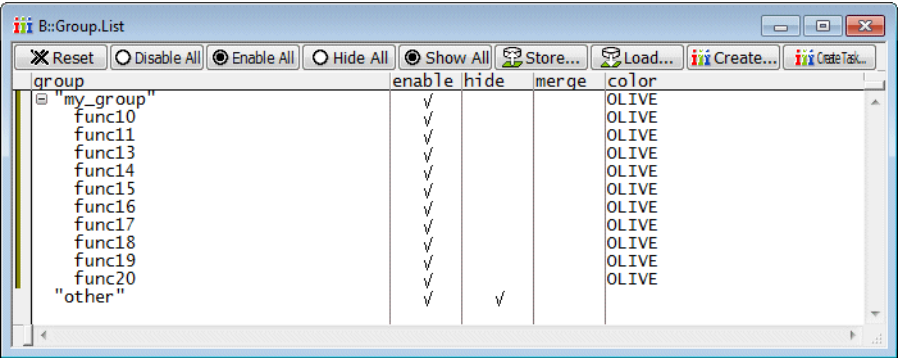
The screenshot shows a window titled "B::Group.List" with a toolbar containing buttons: Reset, Disable All, Enable All, Hide All, Show All, Store..., Load..., Create..., and Create Task... The main area is a table with columns: group, enable, hide, merge, and color.

group	enable	hide	merge	color
"my_group"	✓			OLIVE
func10	✓			OLIVE
func11	✓			OLIVE
func13	✓			OLIVE
func14	✓			OLIVE
func15	✓			OLIVE
func16	✓			OLIVE
func17	✓			OLIVE
func18	✓			OLIVE
func19	✓			OLIVE
func20	✓			OLIVE
"other"	✓		✓	OLIVE

TRACE32 provide the following feature if a GROUP has the status ENable and Merge:

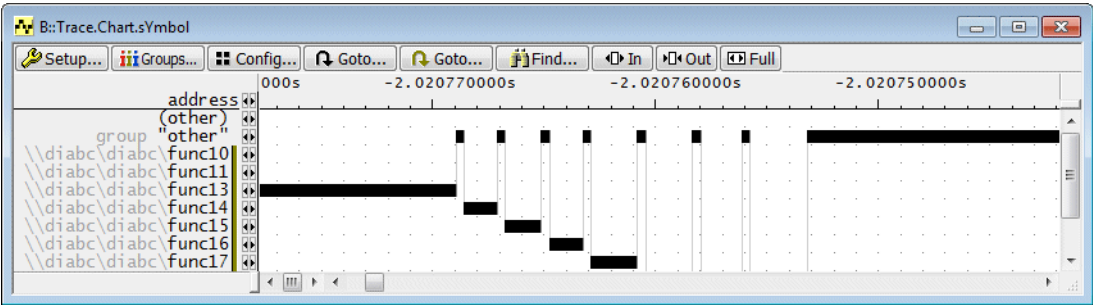
The GROUP represents its members in all trace analysis window. No details about the GROUP members are displayed.



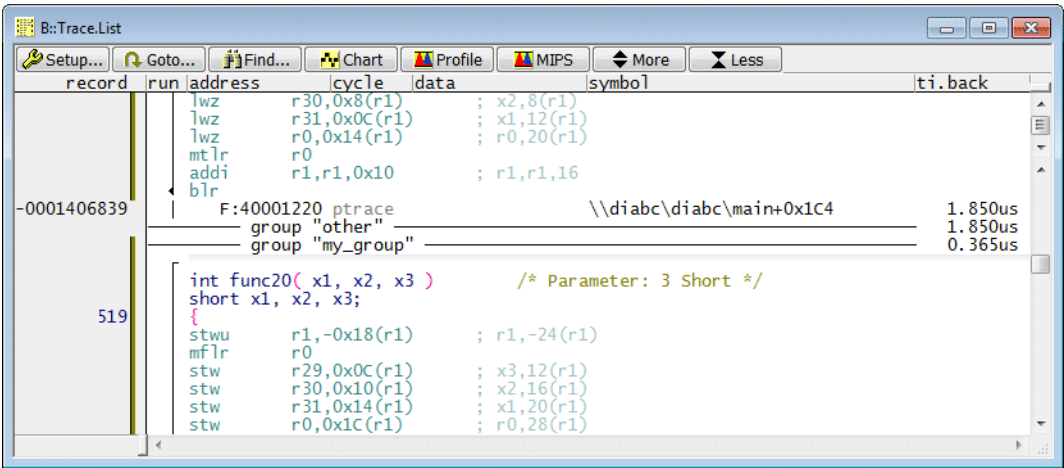


TRACE32 provide the following feature if a GROUP has the status ENable and HIDE:

- 1. The GROUP represents its members in all trace analysis window. No details about the GROUP members are displayed.



- 2. The trace information recorded for the GROUP members is hidden in the Trace Listing.

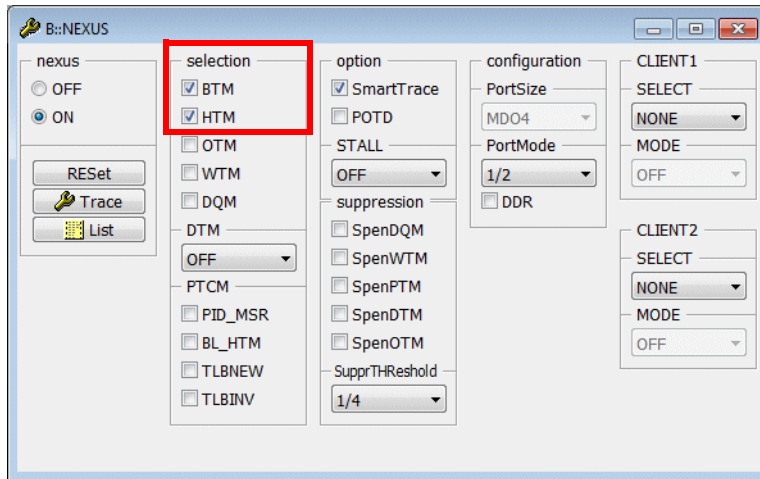


Trace-based Code Coverage

The manual “[Application Note for Trace-Based Code Coverage](#)” (app_code_coverage.pdf) gives a detailed introduction to the trace-based code coverage.

Since the core information is discarded for trace-based code coverage, there is no difference between single-core and SMP TRACE32 instances with regard to this feature.

It is recommended to enable Branch History Messaging for Code Coverage. This advises the Nexus module to generate the trace messages in a compact way.



```
NEXUS.BTM ON
```

```
NEXUS.HTM ON
```

Incremental Code Coverage has to be used in the following situations:

- POWERTRACE/ETHERNET as universal debug and trace hardware
- POWER TRACE PX as universal trace hardware
- On-chip trace memory
- High-bandwidth trace interfaces