

FIRE Emulation Controller

- Universal Emulation Controller
- 16 .. 64 Bit Support
- 160 Channel Trace Analyzer
- 64/512K Trace Depth
- Time-Stamp 10ns
- Statistic Analyzer
- Performance Analyzer
- Trigger System
- VCO 1..150 MHz

The FIRE-EMUCON is the universal emulation system for all FIRE emulation probes.

The system includes the general emulator functions like trigger system and runtime control system.

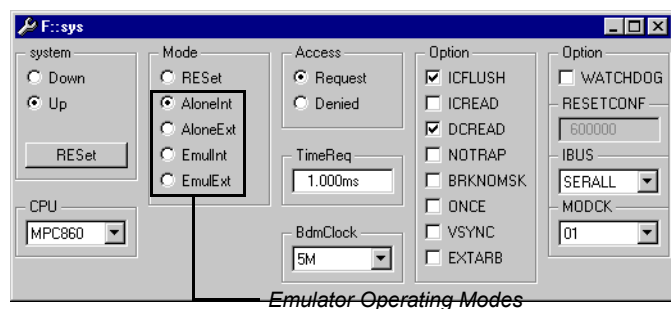
The trigger system enables complex trigger functions on address breakpoints, on events and external signals. An trigger output for external DSOs or logic analyzers is available.

An analyzer system with 160 trace channels, time stamp and performance analyzer capability is included in this module.

In-Circuit Emulator

Most Emulation Functions can be used while the target CPU is running ('on the fly' operation)

Two Emulator Operating Modes



Emulator Operating Modes

Stand Alone Mode

The emulator operates without being connected to the target system. In this mode all emulator capabilities can be used for software debugging.

Active Mode

The emulator operates with the target system (with internal or external clock). This mode provides the ability to test software and hardware using all the functions of TRACE32.

Symbolic Debugging

The screenshot shows the TRACE32 debugger interface with the following components:

- Top Panel:** Menu bar (File, Edit, View, Var, Break, Run, CPU, Devices, Trigger, Analyzer, Perf, Cov, Window, Help) and a toolbar with navigation and control icons.
- Assembly View (E::Data.List):** A table with columns: Step, Step Over, Go Next, Go Return, Go Up, Go, Break, Mode. The main table has columns: addr/line, code, label, mnemonic, comment.

addr/line	code	label	mnemonic	comment
671		for (i = 0 ; i <= SIZE ; i++)		
SP:00000C26	7E00		moveq #0,d7	; #0,i
SP:00000C28	7012		moveq #12,d0	; #18,d0
SP:00000C2A	B087		cmp.l d7,d0	; i,d0
SP:00000C2C	6D30		blt 0C5E	
673		{ if (flags[i])		
SP:00000C2E	207C000086A8		movea.l #86A8,a0	; #flags,a0
- Stack Frame View (E::Var.Frame /locals /caller):** Shows function nesting:


```

end of frame
-002 ___init_main(asm)
-001 main()
      j = 12345678
      p = 0x000C
      while ( TRUE )
      {
-000 sieve()
      i = 19
      Prinz = 0
      k = 0
      anzahl = 0
      sieve();
      }
      
```
- Local Variables View (E::Var.Local):** Shows variables for the current function:


```

sieve()
i = 19
prinz = 0
k = 0
anzahl = 0
      
```
- Source Listing (E::):** Shows the source code in mixed mode, with the current line highlighted.
- Bottom Panel:** Control buttons (emulate, Data, Var, trigger, devices, Analyzer, PERF, Perf, Step) and status information (SP:00000C26 \\diabc\diabc\sieve+22 stopped).

Local variables of the current function

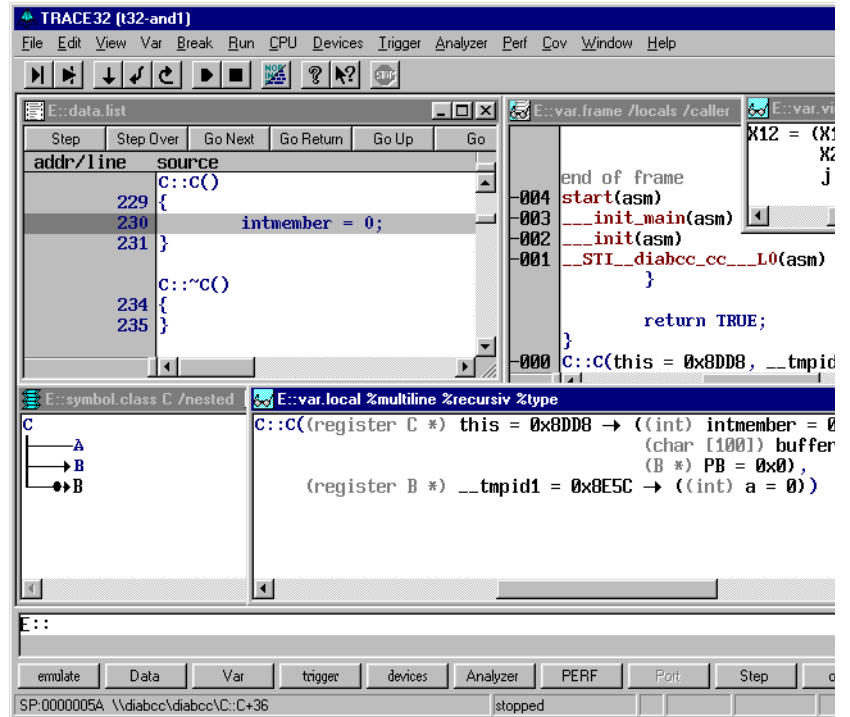
Stack frame to display function nesting

Source listing in mixed mode

A hierarchical symbol database enables structured symbolic debugging. Symbol names can be up to 255 significant characters long and can be used to show single program addresses, module names

and memory classes. The disassembler can use the symbols for labels and/or operands. Demangling for C++ signatures is supported.

High-Level Language Debugging



TRACE32 can directly load the output of all standard compilers for C, C++, Pascal, Modula2, PEARL and ADA from most compiler vendors. Program display and debugging can be done in assembler, high-level or in a mixture of both. It is

possible to construct both assembler and high-level windows on the screen simultaneously. All variable types specific to the high-level language can be displayed and modified. Addresses can be absolute, relative or line number based.

Multitask Debugging

The screenshot displays the TRACE32 multitask debugger interface. The main window shows the command prompt with the command 'pROBE+>qC' and the output of the 'qC' command, which lists system parameters such as ADDR, NC_CPUYPE, NC_MPCT, NC_PROBECT, and NC_PHILECT. Below this, the 'E::TASK.QQ "QMEM"' window shows a table of memory queues with columns for magic, name, id, MQ Len, MQ Limit, and Mqb. The 'E::task.qt' window shows a task queue with columns for magic, name, id, prio, mode, status, susp, and parameters. The 'E::a.stat.tasktree' window shows a task tree with columns for range, tree, time, min, and max. The bottom of the interface shows a command prompt with 'E:: task.' and a toolbar with buttons for QC, QT, QQ, QS, QO, QR, QP, QD, SysCall, and TASKState.

The TRACE32 multitask debugger supports all common RTOS. The multitask debugger supports symbolic debugging of complex multi-

task applications and the detailed analysis of the real time behaviour of the system.

Runtime Analyzer

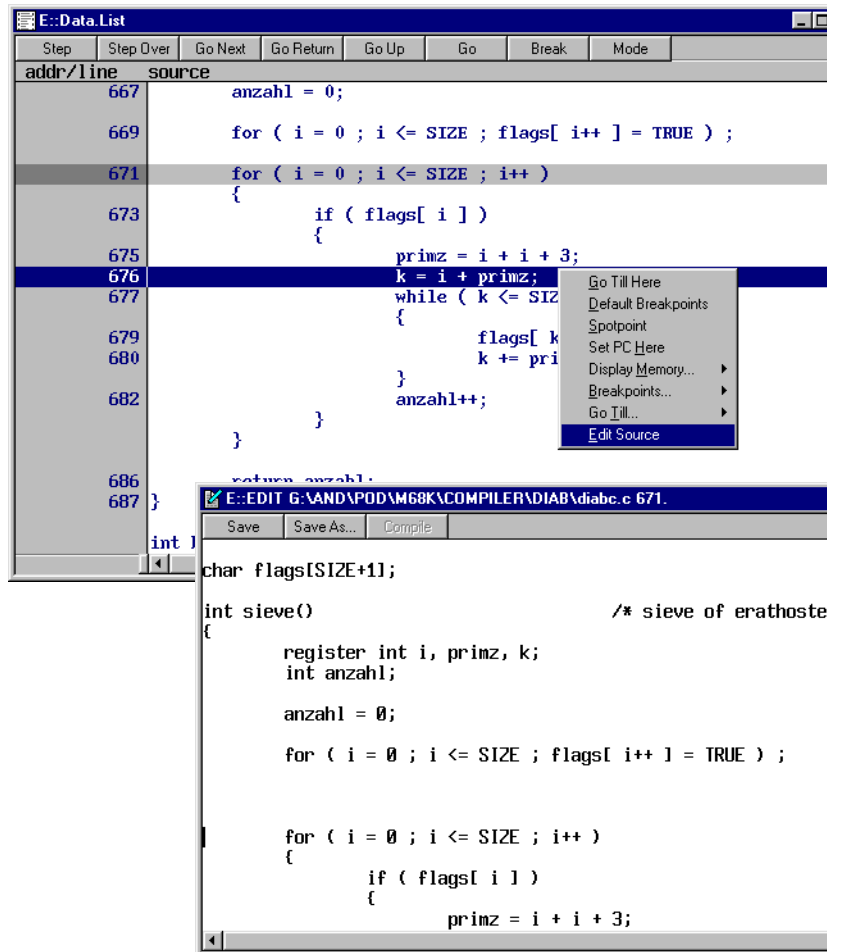
	ref A	ref B	laststart	actual
zero	1.963s	2.931s	3.723s	4.421s
ref A		968.230ms	1.761s	2.459s
ref B			792.455ms	1.490s
laststart				697.996ms

Program runtime is recorded automatically.

Time from initial start - 300ns to 300 days

- Time from the last program stop - 100ns to 300 days
- Time difference between 3 reference points - 300ns to 300 days
- Timers can be checked at any time

Edit/Debug Link



The editor window can be synchronised to the debugging window so that when an error is found, the source text can immediately be shown and if required, edited.

On-Screen Assembler

The on-screen assembler is provided in addition to the more common inline assembler found on

other systems. With the on-screen

assembler, short programs can be written quickly and reliably. It is not a full assembler whose output code is linkable to the main program in the usual way .

Up to 16 MByte Emulation RAM

To store programs in the emulator during the development phase, the emulator provides up to 16 Mbyte

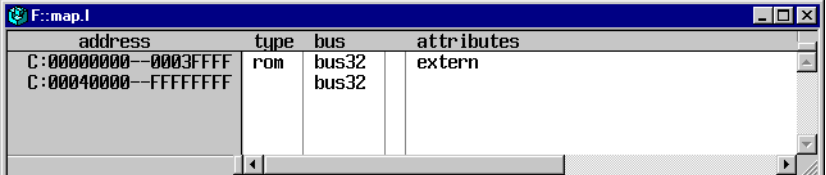
overlay memory . This memory can be static SRAMs with an access time of down 3 ns. (typ 10 ns).

Dual-Ported Access to all Emulation Memory

The whole emulation memory system is dual-ported. This allows the emulator to read or write memory while the target system is running in real-time e.g. to show variables, port contents etc. For low to medium CPU clock frequencies there is no decrease in performance of the target system due to the operation of the dual-port

access mechanism. At higher CPU clock frequencies, the performance may be slightly reduced in accordance with the number of accesses made by the control system. The dual-port access mechanism can be switched off, but if this is done, then memory access by the emulator can only take place when the target program is stopped.

Selective Mapping of Memory Classes

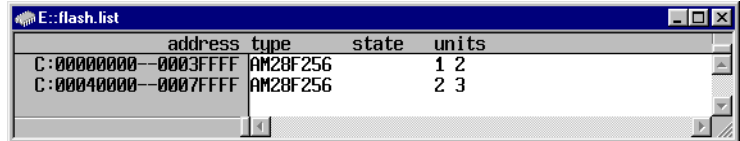


address	type	bus	attributes
C:00000000--0003FFFF	rom	bus32	extern
C:00040000--FFFFFFF		bus32	

The address mapper can segment the memory into 4 segments. By using this segmentation, it is possible for example to split the memory so that a PROGRAM area can be mapped to the emulator RAM while

the DATA area remains mapped as target memory. It is also possible to have totally separate physical memory areas displayed simultaneously.

Flash Programming

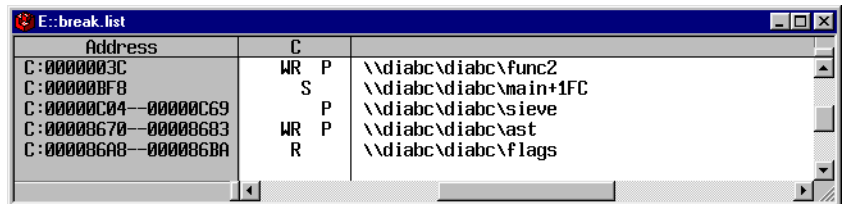


address	type	state	units
C:00000000--0003FFFF	AM28F256		1 2
C:00040000--0007FFFF	AM28F256		2 3

TRACE32 supports the programming of external flash memory as well as the programming of internal flash memory of microcontrollers.

The programming can be controlled by the emulator or by a routine in the target system.

Memory Oriented Breakpoint System with up to 16 MByte Breakpoint Memory



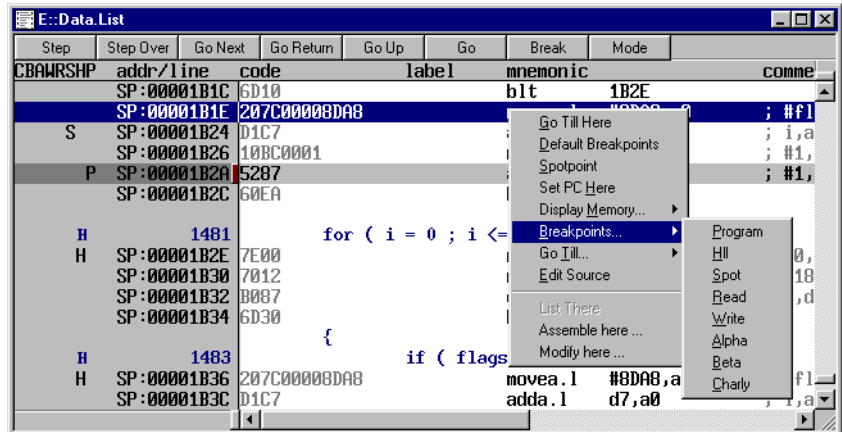
Address	C	
C:0000003C	WR	P \\diabc\diabc\func2
C:00000BF8	S	\\diabc\diabc\main+1FC
C:00000C04--00000C69		P \\diabc\diabc\sieve
C:00000670--000006B3	WR	P \\diabc\diabc\ast
C:000006A8--000006BA	R	\\diabc\diabc\flags

Most currently available emulators use multiple address and data comparators to form the breakpoint system. This technique not only restricts the number of breakpoints available it also means that systems using bank selection are difficult to support. The breakpoint memory on the TRACE32 is basically a byte-wide memory structure that can be mapped in a similar way

like the overlay memory. When any memory location is accessed, the corresponding breakpoint byte is also accessed so that there are effectively 8 kinds of breakpoints for each addressable location.

The break memory is dual-ported, so that breakpoints can be set and displayed while the system is running.

9 Breakpoint Types



- Program Breakpoint
- Spot Breakpoint
- Data Read Breakpoint
- Data Write Breakpoint
- General Purpose Point A..E

In each group there are up to 16 million breakpoints available depending upon the amount of breakpoint ram in the emulator. Breakpoints can be specified as a single address or an address range.

Support for On-Chip Breakpoints

On-Chip breakpoint system are used to generate hardware breakpoints.

Flag System

```

F::d.I /flag /MARK RF
Step Step Over Go Next Go Return Go Up Go Break Mode
addr/line source
int func1( x ) /* multiple returns */
int x;
401 {
402     switch ( x )
403     {
405         case 1:
406             x = x+1;
407             x = x*2;
408             return x*x;
409         case 2:
410             return x+x;
411         case 3:
412             return x-x;
413         case 4:
414             x = x+1;
415             x = x*2;
416             return x*x;
417         case 5:
418             break;
419         case 6:
420             return x+x;
421         default:
422             break;
423     }
}

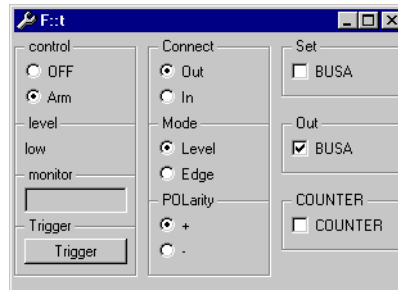
```

Code Coverage

In a special memory, all addresses which are read or written are marked with read or write flags. This memory can therefore supply a lot of important information:

- Systematic program test due to the fact that each executed module will be marked in the flag ram.
- Detection of unused or unexecuted code.
- Systematic system test through visible code coverage analysis.
- Detecting accesses to unused or illegal address locations.

Bus Trigger System



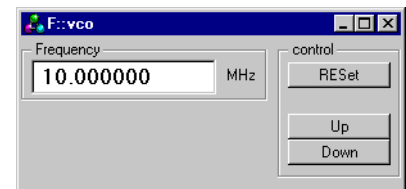
- Trigger interactions with other TRACE32 systems
- Change trigger polarity

Strobe Monitor for Target System

If the strobe period becomes $\gg 10\mu\text{s}$ the system will alert the user. If programmed to do so, the emulator can go into a standby mode if this occurs .

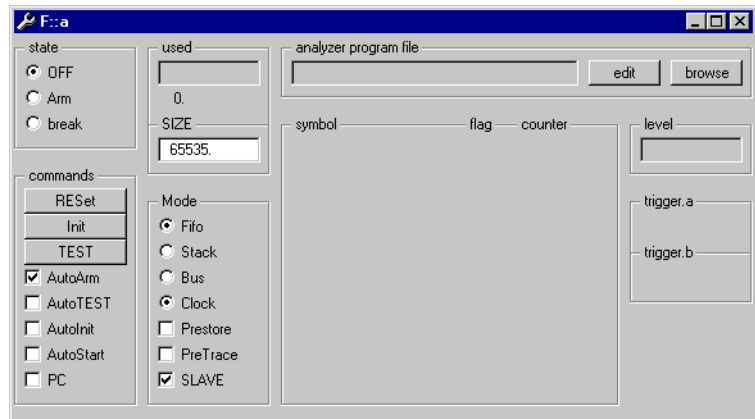
Internal Frequency Generator

- Variable VCO with frequency range from 1 to 150 MHz.
- Emulation CPU clock frequency programming is done via the emulation control unit.



State Analyzer

Operation Modes



- 160 Trace Channels
- Up to 320 Extra Trace Channels on Emulator Module
- High-Speed 10ns Cycle Time
- Clock and Bus Trace
- Large Trace Depth (64K/512KFrames)
- Trace Memory Depth programmable from 0.1 K to 512 K
- Two Operating Modes - FIFO and STACK
- Freely defined Markers can also be recorded to highlight specific Routines
- Time Correlation available with Logic Analyzer and ICD Trace or other Emulators

Internal Expansion Capability

External Trigger Inputs

- 2 external inputs

Free Format Definition of Data Events

Data events can be specified with constants, masks, or

boolean formulae.

Hex and Mnemonic Display of Trace Data

Configurable Display

- Disassembly or HLL
- Special Channels
- Ascii/Hex/Decimal/Bin
- Suppress Prefetching
- Dequeued Disassembly

record	run	address	cycle	d.w	symbol	ti.back	
-000241	f	asl.w r0,#1					
		P:000A66	fetch	0940	\\htc\HTC\sieve+20	0.225us	
-000240	f	mov r4,r0					
		P:000A68	fetch	8943	\\htc\HTC\sieve+22	0.200us	
-000239	f	adds.w r4,#3					
		P:000A6A	fetch	FE21	\\htc\HTC\sieve+24	0.375us	
695		k = i + primz;					
-000238	f	mov r2,r1					
		P:000A6C	fetch	0003	\\htc\HTC\sieve+26		
-000237	f	br 0A72					
		P:000A6E	fetch	20B5	\\htc\HTC\sieve+28		
-000236	f						
		P:000A72	fetch	2409	\\htc\HTC\sieve+2C		
699		k += primz;					
-000235	f	add r2,r4					
		P:000A74	fetch	2499	\\htc\HTC\sieve+2E		
-000234	f						
		P:000A76	fetch	1200	\\htc\HTC\sieve+30		
696		while (k <= SIZE)					
697		}					
-000233	f	cmp.w r2,#12					
		P:000A78	fetch	FAFD	\\htc\HTC\sieve+32	0.150us	

Bus Cycle

Assembler

High-Level

Execution Time

Go Till Here

Default Breakpoints

Spotpoint

Set PC Here

Display Memory... List

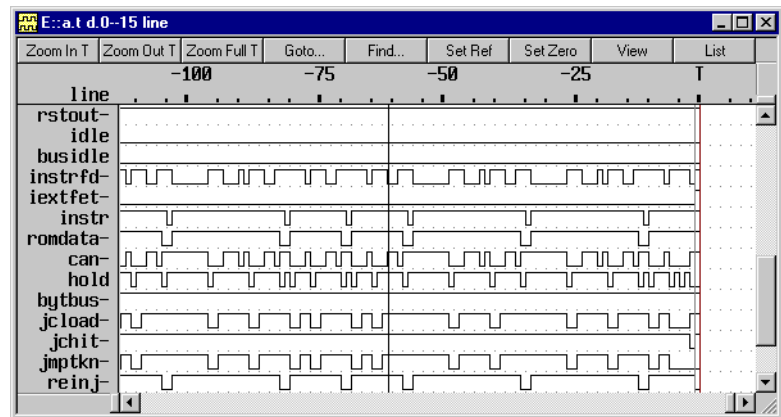
Breakpoints... View Detailed

Go Till... Dump

Edit Source Indirect List

Ignore in Statistic Indirect View

Use in Statistic Indirect Dump



Cursor

Ref. Cursor

Trigger

record	run	address	cycle	d.w	symbol	ti.back
-000241	f	asl.w r0,#1				
		P:000A66	fetch	A940	\\htc\HTC\sieve+20	0.225us
-000240	f	mov r4,r0				
		P:000A68	fetch	8943	\\htc\HTC\sieve+22	0.200us
-000239	f	adds.w r4,#3				
		P:000A6A	fetch	FE21	\\htc\HTC\sieve+24	0.375us
695					k = i + primz;	
-000238	f	mov r2,r1				
		P:000A6C	fetch	0003	\\htc\HTC\sieve+26	
		br 0A72				
-000237	f	P:000A6E	fetch	20B5	\\htc\HTC\sieve+28	
-000236	f	P:000A72	fetch	2409	\\htc\HTC\sieve+2C	
699					k += primz;	
-000235	f	add r2,r4				
		P:000A74	fetch	2499	\\htc\HTC\sieve+2E	
-000234	f	P:000A76	fetch	1200	\\htc\HTC\sieve+30	
696					while (k <= SIZE)	
697					}	
-000233	f	cmp.w r2,#12				
		P:000A78	fetch	FAFD	\\htc\HTC\sieve+32	0.150us

- Go Till Here
- Default Breakpoints
- Spotpoint
- Set PC Here
- Display Memory...
 - List
 - View Detailed
 - Dump
 - Indirect List
 - Indirect View
 - Indirect Dump
- Breakpoints...
- Go Till...
- Edit Source
- Ignore in Statistic
- Use in Statistic

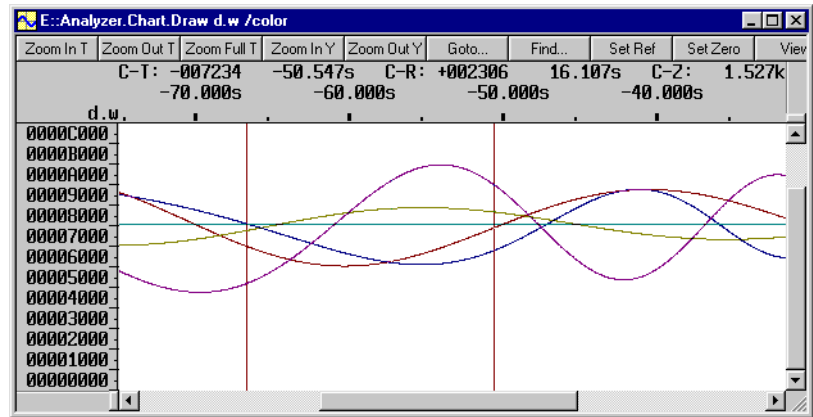
Bus Cycle

Assembler

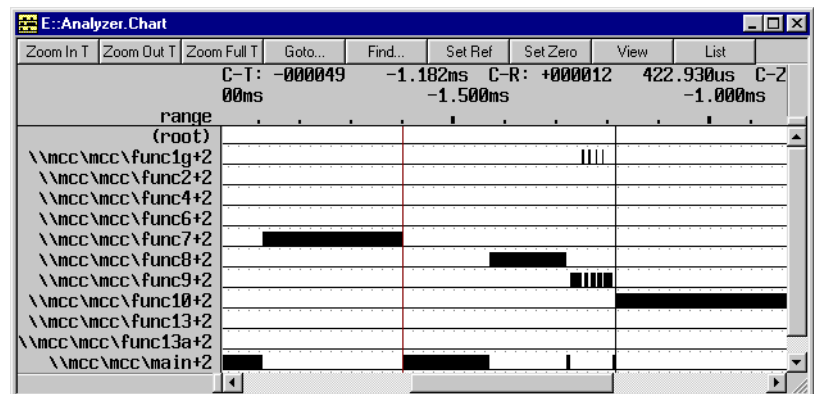
High-Level

Execution Time

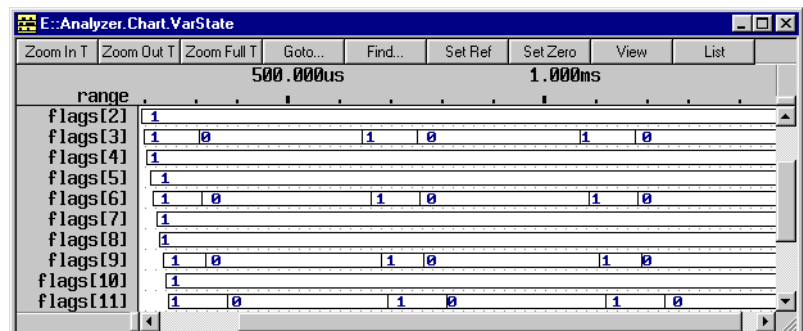
Graphic Display



Graphical Display



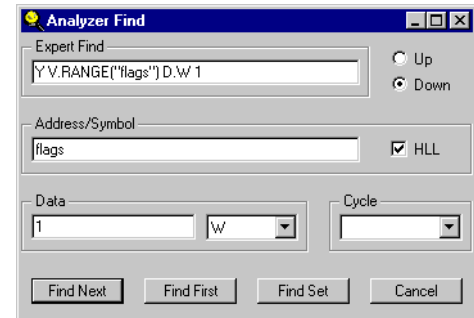
Execution Time Chart



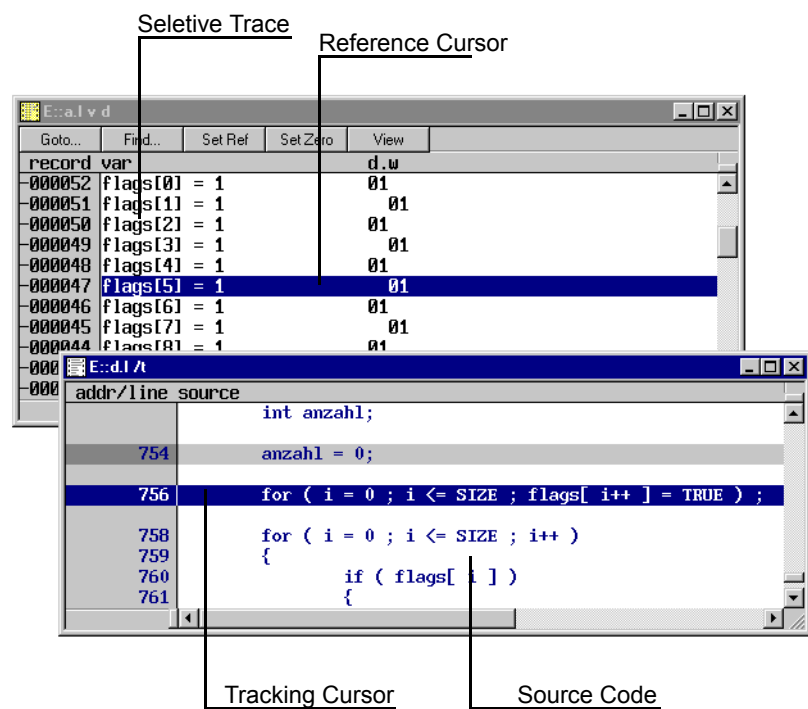
Variable Time Chart

Powerful Trace Memory Manager

- Save memory
- Load memory
- Print memory
- Compare memory
- Find specific entry
- Goto record
- Time and record number evaluation.
- Referenz pointer



Tracking to List Windows



Graphical Data Display

- Show A/D Conversion
- Visualize Program Flow

Complex Search and Compare Functions

Save and Reload of Trace Data

PC Display on Real-Time Emulation

Trigger Unit

Main Trigger Unit with 4 Levels

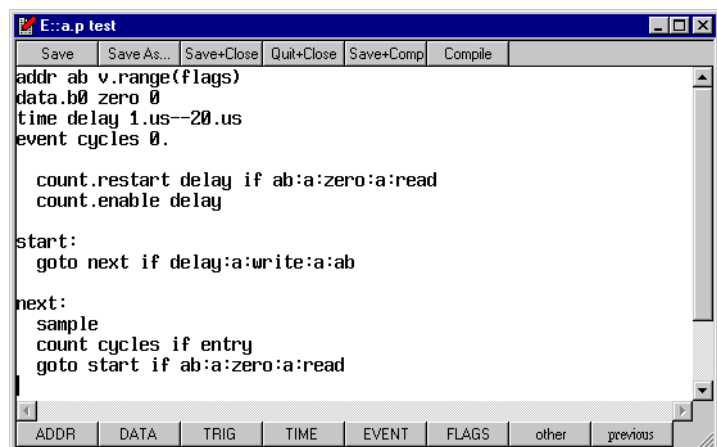
The level structure of the trigger unit allows very flexible trigger combinations and sequences in consecutive and nonconsecutive order. Each level has the same priority and the same

capabilities. A trigger program defines, under which circumstances a level can be reached or left, and therefore which trigger conditions or operations are the current or the next.

Analyzer Programming via a special Window

The programming of this complex trigger unit is done in an assembler like language for maximum flexibility. Using this language, the programming of very

complex trigger sequences or operations can be defined. For simple demands, a pull down menu improves the programming for beginners.



```
E::a.p test
Save Save As... Save+Close Quit+Close Save+Comp Compile
addr ab v.range(flags)
data.b0 zero 0
time delay 1.us--20.us
event cycles 0.

count.restart delay if ab:a:zero:a:read
count.enable delay

start:
goto next if delay:a:write:a:ab

next:
sample
count cycles if entry
goto start if ab:a:zero:a:read

ADDR DATA TRIG TIME EVENT FLAGS other previous
```

Fast Programming by Menu

Symbolic Operations for Analyzer Programming

All output operators and input variables can be entered in symbolic form. The target program symbols can also be used.

Trigger Sources

- 4 hardware breakpoints
- 1 data events (mask, range, ASCII, hex, binary)
- 2 external trigger events
- CPU state (MEM READ, IO WRITE, INTA, ...)
- Counter outputs

External Trigger Inputs

- 2 inputs lines
- 2 trigger qualifiers for each trigger level
- Static levels of the trigger inputs can be read at any time
- Free format definition of external trigger events

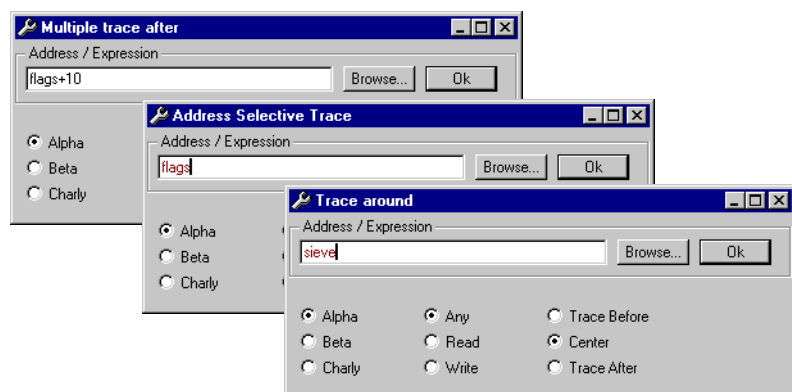
Trigger Output Operations

- | | |
|---|---|
| <input type="checkbox"/> Count.Restart | <input type="checkbox"/> Break Analyzer |
| <input type="checkbox"/> Count.Enable | <input type="checkbox"/> Bus.Trigger |
| <input type="checkbox"/> Sample.Enable | <input type="checkbox"/> Spot |
| <input type="checkbox"/> Break Program | <input type="checkbox"/> GOTO level |
| <input type="checkbox"/> Trigger.Exception | <input type="checkbox"/> Mark record |
| <input type="checkbox"/> Out (Target Stimulation) | |

Free Format Definition of Data, Address and Trigger Events

- | | |
|--|---|
| <input type="checkbox"/> Hex and hex masks | <input type="checkbox"/> ASCII character and string |
| <input type="checkbox"/> Binary and binary masks | |

Wizards for Standard Trigger Problems



Time and Event Measurements with up to 3 Counters

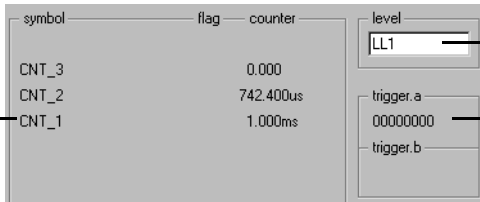
There are 2 28-bit counters and 2 28-bit Timers available for event measurement or event triggering. All counters are re-triggerable and can be evaluated as a part of an expression in the trigger sequences. Each counter can be programmed as a timer for timing measurements or an event counter.

- Retriggerable

- Selective release
- Trigger event when counter is zero
- Definition of time and event windows
- All Counters can be read 'on the fly'

Trigger Monitor

A display of the counter values, the trigger values, the trigger levels and the trigger flags is available in the trigger monitor window.



The screenshot shows a window titled 'Trigger Monitor' with a table of counter values and trigger levels. The table has columns for 'symbol', 'flag', and 'counter'. The counter values are 0.000 for CNT_3, 742.400us for CNT_2, and 1.000ms for CNT_1. To the right of the table, there are two sections: 'level' with a dropdown menu showing 'LL1', and 'trigger.a' with a value of '00000000'. Below 'trigger.a' is 'trigger.b'. Labels with arrows point to 'LL1' as 'Trigger level' and '00000000' as 'Input level'. A label 'State of counters or flags' points to the table.

symbol	flag	counter
CNT_3		0.000
CNT_2		742.400us
CNT_1		1.000ms

level: LL1

trigger.a: 00000000

trigger.b:

Statistic Analyzer

Time Stamp

The Time Stamp Unit tags each trace record with a time value. These values are absolute and synchronized with all the other time values within the TRACE32 system.

Recording depth max. 64/512K

48 time stamp recording channels

Resolution 20ns

Maximum measuring time 1.3 days

Function Analysis

Min. and max. time

Include and exclude time

Passes

Link Analysis

Callers

Calls

Min. and max. times

The screenshot shows a window titled "F::Analyzer.STATistic.TREE tree time count avr". It displays a tree structure of function calls with columns for "time", "count", and "avr".

	time	count	avr
total:	2.886ms		
tree			
(root)	2.886ms	1. (-2)	2.886ms
└─main+2	2.885ms	1. (-1)	2.885ms
└─func2+2	211.750us	1.	211.750us
└─func1g+2	7.000us	2.	3.500us
└─func4+2	64.000us	1.	64.000us
└─func6+2	386.000us	1.	386.000us
└─func7+2	281.750us	1.	281.750us
└─func8+2	152.500us	1.	152.500us
└─func9+2	85.250us	1.	85.250us
└─func1g+2	14.000us	4.	3.500us
└─func10+2	456.250us	1.	456.250us
└─func13+2	227.250us	1.	227.250us
└─func13+2	166.250us	1.	166.250us
└─func13+2	104.750us	1.	104.750us
└─func13+2	43.500us	1.	43.500us
└─func13a+2	455.250us	1.	455.250us

Duration

Execution time

- Response time

up to	count	ratio	1%	2%	5%	10%	20%	50
< 20.000us	20.	76.923%						
40.000us	0.	0.000%						
60.000us	1.	3.846%						
80.000us	1.	3.846%						
100.000us	0.	0.000%						
120.000us	0.	0.000%						
140.000us	0.	0.000%						
160.000us	1.	3.846%						
180.000us	0.	0.000%						
200.000us	0.	0.000%						
220.000us	0.	0.000%						
240.000us	0.	0.000%						
260.000us	0.	0.000%						
280.000us	0.	0.000%						
300.000us	1.	3.846%						
320.000us	0.	0.000%						
340.000us	0.	0.000%						
>	2.	7.692%						

Distance

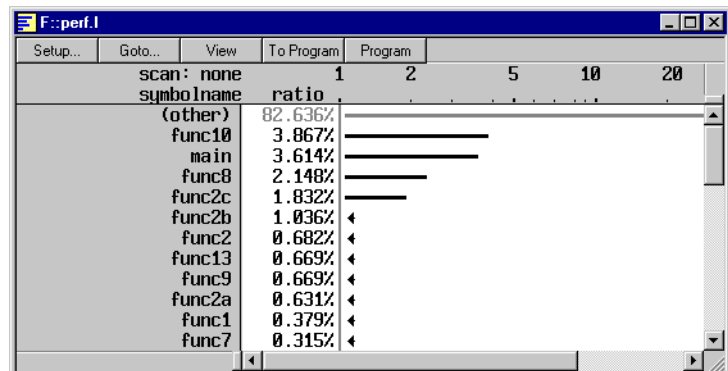
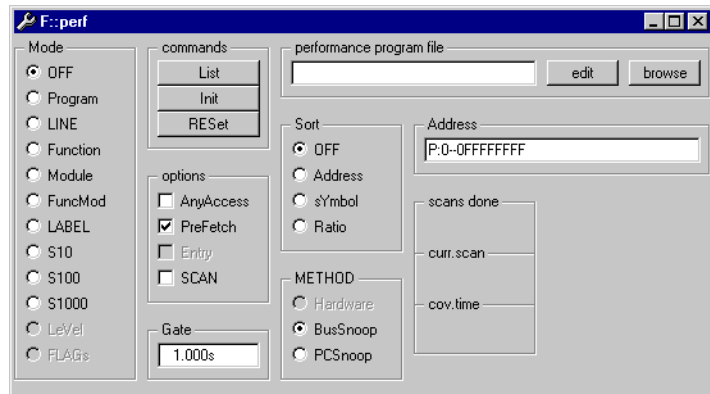
- Time between samples

Distribution

class	time	avr	count	0%	10%	20%	30%	40%	50
total: 2.886ms									
d.b0=0	1.581ms	121.635us	13.						
d.b0=4	70.000us	3.500us	20.						
d.b0=30	3.000us	3.000us	1.						
d.b0=38	152.500us	152.500us	1.						
d.b0=56	0.500us	0.500us	1.						
d.b0=75	1.037ms	29.636us	35.						
d.b0=0F8	23.250us	23.250us	1.						
d.b0=0FC	17.750us	17.750us	1.						

Performance Analyzer

- Resolution
 - 100 us
 - Statistic Reatime Measurement
- Performance Address Ranges
 - Modules
 - Functions
 - Address ranges



Order Information

Module Description

Detailed Order Information

Contact

International Representative

Argentina

Anacom Eletronica Ltda.
Mr. Rafael Sorice
Rua Nazareth, 807, Barcelona
BR-09551-200 São Caetano do Sul, SP
Phone: +55 11 3422 4200
FAX: +55 11 3422 4242
EMAIL: rsorice@anacom.com.br

Australia

Embedded Logic Solutions P/L
Mr. Ramzi Kaffan
Suite 2, Level 3
144 Marsden Street
Parramatta NSW 2150
Phone: +61 2 9687 1880
FAX: +61 2 9687 1881
EMAIL: sales@emlogic.com.au

Austria

Lauterbach GmbH
Alltaufstr. 40
D-85635 Höhenkirchen-Siegertsbrunn
Phone: +49 8102 9876 0
FAX: +49 8102 9876 999
EMAIL: info@lauterbach.com

Belgium

Tritec Benelux B.V.
Mr. Robbert de Voogt
Stationspark 550
NL-3364 DA Slidrecht
Phone: +31 184 41 41 31
FAX: +31 184 42 36 11
EMAIL: software@tritec.nl

Brazil

Anacom Eletronica Ltda.
Mr. Rafael Sorice
Rua Nazareth, 807, Barcelona
BR-09551-200 São Caetano do Sul, SP
Phone: +55 11 3422 4200
FAX: +55 11 3422 4242
EMAIL: rsorice@anacom.com.br

Canada

Lauterbach Inc.
Mr. Udo Zoettler
4 Mount Royal Ave.
USA-Marlborough, MA 01752
Phone: +1 508 303 6812
FAX: +1 508 303 6813
EMAIL: info_us@lauterbach.com

China Beijing

Lauterbach Technologies Co., Ltd
Mr. Linglin He
Beijing Office
A3, South Lishi Road, XiCheng District
Beijing 100037, P.R. China
Phone: +86 10 68023502
FAX: +86 10 68023523
EMAIL: linglin.he@lauterbach.com

China Shenzhen

Lauterbach Technologies Co., Ltd
1406/E Xihaimingzhu Building
No.1 Taoyuan Road, Nanshan District
Shenzhen 518052, P.R. China
Phone: +86 755 8621 0671
FAX: +86 755 8621 0675
EMAIL: emily.zhang@lauterbach.com

China Suzhou

Lauterbach Technologies Co., Ltd
Mr. Linglin He
Hengyu Square, Rm 709
No. 188, Xing Hai Street
Suzhou, 215021 P.R. of China
Phone: +86 512 6265 8030
FAX: +86 512 6265 8032
EMAIL: info_cn@lauterbach.com

Czech Republic

Lauterbach GmbH
Alltaufstr. 40
D-85635 Höhenkirchen-Siegertsbrunn
Phone: +49 8102 9876 0
FAX: +49 8102 9876 999
EMAIL: info@lauterbach.com

Denmark

Nohau Danmark A/S
Mr. Flemming Jensen
Klausdalsbrovej 493
DK-2730 Herlev
Phone: +45 44 52 16 50
FAX: +45 44 52 26 55
EMAIL: info@nohau.dk

Egypt

Wantech Egypt
Mr. Wagih A. Nawara
5 Shafik Ghalie St., Suite 2
Off Pyramids Road, Giza
Cairo 12111
Phone: +20 100 1251955
FAX: +20 100 1250349
EMAIL: sales@wantechnet.com

Finland

Nohau Solutions Finland
Mr. Martti Viljainen
Teknobulevardi 3-5
FI-01531 Vantaa
Phone: +358 40 546 1469
FAX: +358 9 2517 8101
EMAIL: sales@nohau.fi

France

Lauterbach S.A.R.L.
Mr. Jean-Pierre Paradiso
Europarc - Le Hameau B
135 Chemin Des Bassins
F-94035 Créteil Cedex
Phone: +33 1 49 56 20 30
FAX: +33 1 49 56 20 39
EMAIL: info_fr@lauterbach.com

Germany

Lauterbach GmbH
Alltaufstr. 40
D-85635 Höhenkirchen-Siegertsbrunn
Phone: +49 8102 9876 0
FAX: +49 8102 9876 999
EMAIL: info@lauterbach.com

Germany North

Lauterbach GmbH
Mr. Klaus Hommann
Leonhardring 5
D-31319 Sehnde
Phone: +49 8102 9876 174
FAX: +49 5138 6185 3
EMAIL: klaus.hommann@lauterbach.com

Germany South

Lauterbach GmbH
 Andreas Grimm
 Altlaufstr. 40
 D-85635 Höhenkirchen-Siegertsbrunn
 Phone: +49 8102 9876 190
 FAX: +49 8102 9876 187
 EMAIL: andreas.grimm@lauterbach.com

Greece

Lauterbach GmbH
 Altlaufstr. 40
 D-85635 Höhenkirchen-Siegertsbrunn
 Phone: +49 8102 9876 0
 FAX: +49 8102 9876 999
 EMAIL: info@lauterbach.com

Hungary

Lauterbach GmbH
 Altlaufstr. 40
 D-85635 Höhenkirchen-Siegertsbrunn
 Phone: +49 8102 9876 0
 FAX: +49 8102 9876 999
 EMAIL: info@lauterbach.com

India-Bangalore

Electro Systems Associates Pvt. Ltd.
 Mr. G. V. Gurunatham
 S-606, World Trade Center
 Malleswaram West, No.26/1, Dr. Rajkumar
 Road
 India - Bangalore 560055
 Phone: +91 80 67648888
 FAX: +91 80 23475615
 EMAIL: Trace32sales@esaindia.com

India-Chennai

Electro Systems Associates Pvt. Ltd.
 Mr. D. Kannan
 No.109/59A, Ground Floor
 IV Avenue, Ashok Nagar
 India - Chennai - 600 083 Tamilnadu
 Phone: +91 044-24715750
 FAX: +91 44 24715750
 EMAIL: chennai@esaindia.com

India-Delhi

Electro Systems Associates Pvt. Ltd.
 Mr. R.K. Bhandari
 No. 705, 7th Floor, Laxmi Deep
 Shivajinagar
 India - Delhi - 110 092
 Phone: +91 11-22549351
 FAX:
 EMAIL: delhi@esaindia.com

India-Hyderabad

Electro Systems Associates Pvt. Ltd.
 Mr. C.V.M. Sri Ram Murthy
 Shop No. 14, "Global Enclave"
 Bhagyannagar Colony, Kukat pally
 India - Hyderabad 500 072
 Phone: +91 40-23063346
 FAX: +91 40-23063346
 EMAIL: hyderabad@esaindia.com

India-Pune

Electro Systems Associates Pvt. Ltd.
 Mr. R K Bhandari
 Shriram Complex, 1126/1, Model Colony
 Shivajinagar
 India - Pune - 411 016
 Phone: +91 20 - 30462035 / 25663
 FAX: +91 20-25677202
 EMAIL: pune@esaindia.com

Ireland

Lauterbach Ltd.
 Mr. Barry Lock
 11 Basepoint Enterprise Centre
 Stroudley Road
 Basingstoke, Hants RG24 8UP
 Phone: +44-1256-333-690
 FAX: +44-1256-336-661
 EMAIL: info_uk@lauterbach.com

Israel

Itec Ltd.
 Mr. Mauri Gottlieb
 P.O. Box 10002
 IL-Tel Aviv 61100
 Phone: +972 3 6491202
 FAX: +972 3 6497661
 EMAIL: general@itec.co.il

Italy

Lauterbach Srl
 Mr. Maurizio Menegotto
 Via Enzo Ferrieri 12
 I-20153 Milano
 Phone: +39 02 45490282
 FAX: +39 02 45490428
 EMAIL: info_it@lauterbach.com

Japan

Lauterbach Japan, Ltd.
 Mr. Kenji Furukawa
 3-8-8 Shinyokohama
 Kouhoku-ku, Nisso 16th Building
 Yokohama-shi, Japan 222-0033
 Phone: +81 45 477 4511
 FAX: +81 45 477 4519
 EMAIL: info@lauterbach.co.jp

Luxembourg

Tritec Benelux B.V.
 Mr. Robbert de Voogt
 Stationspark 550
 NL-3364 DA Sliedrecht
 Phone: +31 184 41 41 31
 FAX: +31 184 42 36 11
 EMAIL: software@tritec.nl

Malaysia

Flash Technology
 Mr. Teo Kian Hock
 No 61, # 04-15 Kaki Bukit Av 1
 Shun Li Industrial Park
 SGP-Singapore 417943
 Phone: +65 6749 6168
 FAX: +65 6749 6138
 EMAIL: teokh@flashtech.com.sg

Mexico

Lauterbach Inc.
 Mr. Udo Zoettler
 4 Mount Royal Ave.
 USA-Marlborough, MA 01752
 Phone: +1 508 303 6812
 FAX: +1 508 303 6813
 EMAIL: info_us@lauterbach.com

Netherlands

Tritec Benelux B.V.
 Mr. Robbert de Voogt
 Stationspark 550
 NL-3364 DA Sliedrecht
 Phone: +31 184 41 41 31
 FAX: +31 184 42 36 11
 EMAIL: software@tritec.nl

New Zealand

Embedded Logic Solutions P/L
 Mr. Ramzi Kattan
 Suite 2, Level 3
 144 Marsden Street
 Parramatta NSW 2150
 Phone: +61 2 9687 1880
 FAX: +61 2 9687 1881
 EMAIL: sales@emlogic.com.au

Norway

Nohau Solutions AB
 Mr. Jörgen Nilsson
 Derbyvägen 4
 SE-21235 Malmö
 Phone: +46 40 592 206
 FAX: +46 40 592 229
 EMAIL: sales@nohau.se

Poland

QUANTUM Sp. z o.o.
 Mr. Aleksander Bil
 ul. Jeleniogorska 6
 54-056 Wrocław
 Phone: +48 71 362 6356
 FAX: +48 71 362 6357
 EMAIL: info@quantum.com.pl

Portugal

Captura Electronica, SCCL
Mr. Juan Martinez
c/Duero, 40
E-08031 Barcelona
Phone: +34 93 429 5730
FAX: +34 93 407 0778
EMAIL: info@captura-el.com

Romania

Lauterbach GmbH
Altlaufstr. 40
D-85635 Höhenkirchen-Siegersbrunn
Phone: +49 8102 9876 0
FAX: +49 8102 9876 999
EMAIL: info@lauterbach.com

Russia

RTSoft
Mr. Alexey Isaev
Nikitinskaya 3
RUS-105037 Moscow
Phone: +7 495 742 6828
FAX: +7 495 742 6829
EMAIL: sales@rtsoft.msk.ru

Singapore

Flash Technology
Mr. Teo Kian Hock
No 61, # 04-15 Kaki Bukit Av 1
Shun Li Industrial Park
SGP-Singapore 417943
Phone: +65 6749 6168
FAX: +65 6749 6138
EMAIL: teokh@flashtech.com.sg

South Korea, Pangyo

MDS Technology Co., Ltd.
Mr. Sangheon Lee
3FL, Hancom Tower
49, Daewangpangyo-ro 644, Bundang-gu
Seongnam-si, Gyeonggi-do, 463-400, ROK
Phone: +82-31-627-3000
FAX: +82-31-627-3100
EMAIL: trace32@mdstec.com

Spain

Captura Electronica, SCCL
Mr. Juan Martinez
c/Duero, 40
E-08031 Barcelona
Phone: +34 93 429 5730
FAX: +34 93 407 0778
EMAIL: info@captura-el.com

Sweden

Nohau Solutions AB
Mr. Jörgen Nilsson
Derbyvägen 4
SE-21235 Malmö
Phone: +46 40 592 206
FAX: +46 40 592 229
EMAIL: sales@nohau.se

Switzerland

JDT Jberg DatenTechnik
Mr. Andreas Jberg
Zimmereistrasse 2
CH-5734 Reinach AG
Phone: +41 62 7710 886
FAX:
EMAIL: Andreas.Jberg@jdt.ch

Taiwan

Superlink Technology Corp.
Mr. Sulin Huang
3F-8, No. 77, Sec. 1, Xintaiwu Rd., Xizhi District,
New Taipei City 22101, Taiwan, R.O.C.
Phone: +886 2 26983456
FAX: +886 2 26983535
EMAIL: info.stc@superlink.com.tw

Tunisia

Lauterbach Consulting S.A.R.L.
Mr. Khaled Jmal
Route El Ain Km 3.5
TN-3062 Sfax
Phone: +216-74611730
FAX: +216-74611723
EMAIL: info_tn@lauterbach.com

Turkey-1

Tektronik Muh. ve Tic. A.S.
Mr. Hakan Yavuz
CyberPlaza B-Blok, 702B
Bilkent
06800 Ankara
Phone: +90 312 437 3000
FAX: +90 312 437 1616
EMAIL: info@tektronik.com.tr

Turkey-2

G3TEK Embedded Technologies Ltd.
Mr. Celal Aygun
Ilkyerlesim Mah. 445.
Sok. No: 48
06370 Batikent/Ankara
Phone: +90 312 3324769
FAX: +90 312 3324769
EMAIL: info@g3tek.com

UK

Lauterbach Ltd.
Mr. Barry Lock
11 Basepoint Enterprise Centre
Stroudley Rd
Basingstoke, Hants RG24 8UP
Phone: +44 1256 333 690
FAX: +44 1256 350 301
EMAIL: info_uk@lauterbach.com

USA East

Lauterbach Inc.
Mr. Udo Zoettler
4 Mount Royal Ave.
USA-Marlborough, MA 01752
Phone: +1 508 303 6812
FAX: +1 508 303 6813
EMAIL: info_us@lauterbach.com

USA West

Lauterbach Inc.
Mr. Bob Kupyn
1111 Main Street, Suite 620
USA-Vancouver, WA, 98660
Phone: +1 503 524 2222
FAX: +1 503 524 2223
EMAIL: bob.kupyn@lauterbach.com

Additional Information

<http://www.lauterbach.com>

Lauterbach GmbH

Altlaufstr. 40
D-85635 Höhenkirchen-Siegertsbrunn
Tel. ++49 8102 9876-0 FAX -999
info@lauterbach.com
http://www.lauterbach.de

Lauterbach Inc.

4 Mount Royal Ave.
Marlboro MA 01752
Phone (508) 303 6812 FAX (508) 303 6813
info_us@lauterbach.com
http://www.us.lauterbach.com

Lauterbach Ltd.

11 Basepoint Enterprise Ctre Stroudley Road
Basingstoke, Hants RG24 8UP
Phone ++44-1256-333-690 FAX -661
info_uk@lauterbach.com
http://www.lauterbach.co.uk

Lauterbach S.A.R.L.

135 Chemin Des Bassins
F-94035 Créteil Cedex
Phone ++33-149-562-030
FAX ++33-149-562-039
info_fr@lauterbach.com
http://www.lauterbach.fr

Lauterbach Japan, Ltd.

3-9-5 Shinyokohama Kouhoku-ku
Yokohama-shi Japan 222-0033
Phone ++81-45-477-4511 FAX -4519
info_j@lauterbach.com
http://www.lauterbach.co.jp

Lauterbach s.r.l.

Lauterbach s.r.l.
Via Enzo Ferrieri 12
I-20153 Milano
Phone ++39 02 45490282
FAX ++39 02 45490428
info_it@lauterbach.it
http://www.lauterbach.it

Suzhou Lauterbach Consulting Co.,Ltd.

Room 1605, Xing Hai International Square
No.200, Xing Hai Street
Suzhou, 215021 PR of China
Phone: 0086-512 6265 8030
FAX: 0086-512 6265 8032
info_cn@lauterbach.cn
http://www.lauterbach.cn

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