Mentor Graphics®

The Power To Create™

Microtec Solutions

PROCESSOR INFORMATION

68000 & 68300 Families

Development Environments, Tools & Operating Systems

Supported Microprocessors

- 68000/HC000/HC001/08/10/20/30/40/LC040/IP040/040V/060/LC060
- 68EC000/EC020/EC030/EC040/EC060
- 68302/LC302/PM302/EN302/306/307/307V/322/328/356
- CPU32: 68330/330V/331/332/F333/F335/340/340V/341/341V
- CPU32+: 68349V, 68360

Supported Hosts

Mentor Graphics' Microtec Division provides 68K embedded software development solutions for the following host platforms:

- Sun SPARCstation
- HP 9000/700
- IBM-PC or compatible running Microsoft Windows® 95 or NT®

MOTOROLA EMBEDDED DEVELOPER PROGRAM

The Complete Embedded Software Development Solution

The Microtec® VRTX® Development System provides a complete Integrated Development Environment (IDE) consisting of:

- Microtec C & C++ Compilers
- Microtec Assembler
- Microtec Linker/Librarian
- XRAY® Debugger
- VRTX Real-Time Operating System (RTOS)
- Spectra Backplane tools, including Xpert Profiler, Virtual Target, BSP Builder

These tools are tightly coupled with the XRAY Debugger accelerating the edit-compile-download-debug cycle. The XRAY Debugger supports simulation and cross-development debugging environments. Cross development is supported by the Spectra Backplane that provides target debug connections to both bare machines and multi-tasking operating system-based applications.

Microtec C & C++ Compilers

The Microtec C and C++ Compilers for 68K processors provide support for ANSI C and the latest C++ standards, as well as a variety of older language dialects that assist in migrating legacy code. Supported C & C++ dialects include:

- ANSI C
- K&R C
- C & C++ — Annotated Reference Manual, including templates and exception handling
- C++ — AT&T Cfront 3.0
- C++ — AT&T Cfront 2.1

The Microtec C & C++ Compilers make full use of the powerful 68K instruction set to minimize code size and maximize performance. The compilers have specific switches for most members of the 68000/68300 families and take full advantage of any additional capabilities available for a particular variant.

For all 68000/68300 variants, the compilers support address register-relative and PC-relative code and data, register indirect function calls, and multiple move instructions for saving and restoring contexts.

The 68000/68300 architecture has several instructions designed to improve efficiency. Microtec's compilers take full advantage of these instructions, including:

- DBcc for loop statements
- Scc for if-then-else statements
- Quick instructions (MOVEQ, ADDQ, and SUBQ) for short constant operations
- Bit-field operations

Additional optimizations for the 68020, CPU32, CPU32+, 68030, and 68040 family members include scaled index addressing mode for faster access to arrays and structures, 32-bit multiply and divide, full use of additional bit-field instructions, and faster char-to-long conversions. The compilers also support access to data aligned on odd word boundaries for CPU types that provide this compatibility. In-line code is generated for the 68881/68882 floating-point coprocessor and the 68040's on-chip floating point unit.

For the 68040/60, the compilers employ instruction reordering to avoid unnecessary delays. This ensures optimal use of the on-chip caches. For maximum performance, there are several operations that should be performed differently on a 68040/60 compared to other members of the family, such as using ADDI in place of MOVEQ and ADD for constant addition.

In addition to optimizing for specific variants, the Microtec Compilers support options that eliminate data structure incompatibilities between 68000 core-based devices and devices based on the processor cores of other family members, such as the 68040 or 68360. These incompatibilities arise because 68000 cores align data on 16-bit boundaries, whereas other family members align them on 32-bit boundaries. This causes difficulty when exchanging data between, for example, a 68302-based device and a 68360-based device. To resolve this problem, compiler options allow you to lay out data structures aligned on either 16- or 32-bit boundaries for all 68000/68300 family members.

Pre-Compiled Header Support

Embedded software applications based on powerful processors, such as the 68K processor, can be large. This results in long compile times. One approach that can significantly reduce compile times is pre-compiling header files. In many applications, especially those written in C++, it is common practice to include every header file in each source file. As a result, whenever a module is compiled, considerable time is spent compiling the include files. Microtec's C & C++ Compilers avoid this problem by allowing users to compile the header files in one module and then subsequently refer to this already compiled version when compiling the other modules.

Microtec Assembler/Linker

The Microtec Assembler supports the Motorola™ syntax, including the macro language. The assembler has switch selections for most members of the 68000/68300 family to enable the user to utilize the full instruction set of any particular variant.

The Microtec Linker supports unique optimizations that dramatically reduce the code and data size of C++ applications. These optimizations work by eliminating duplicate copies of template functions, in-line functions, and virtual function tables. The linker can produce a wide variety of output formats for compatibility with other common embedded development tools such as emulators and PROM burners. IEEE-695 and S-Records are supported directly, and a.out and b.out are supported using a converter.

XRAY Debugger

The XRAY Debugger, a complete development and debugging environment, provides a range of debugging support for the 68K family, including:

Host Based Simulation: XRAY Simulator provides instruction-set simulation on UNIX and PC hosts.

Target Resident Monitor: XRAY Monitor cross-debugger communicates to the target system via Ethernet, serial, a Background-Debug™ Mode (BDM) connector, or ROM emulator.

Emulator Support: XRAY HP ICE provides comprehensive debugging support for HP 64700 emulators.

Hardware Assist: The XRAY Debugger includes support for hardware assist solutions such as the HP Probe.

Advanced Multitasking Debug: In conjunction with the VRTX RTOS, XRAY for Spectra Backplane provides:

- Simultaneous multiple processor debug
- Powerful editor-centric IDE
- Integrated build utility
- Window-per-task

The XRAY Debugger supports C++, C, and assembly language source-level debugging, including interleaved displays of C & C++ and assembly language. Unique C++ debugging support includes templates and exception handling, as well as many other advanced object-oriented programming features.

For 68K targets, XRAY Debugger supports debug information from IEEE-695 or a.out object files, enabling the user to employ a wide range of compilers.

Background Debug Mode

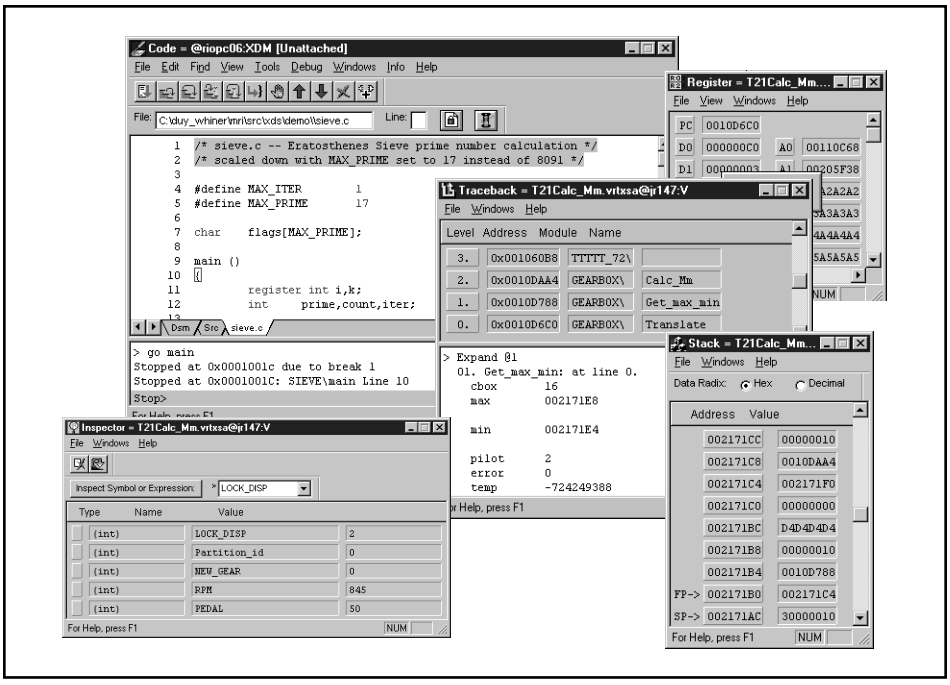
Motorola microprocessors based on CPU32 or CPU32+ cores, such as the 68360 and 68332, provide a built-in debug monitor support known as Background Debug Mode (BDM). BDM allows you to set breakpoints and read and write memory and registers without requiring an I/O port on the target or a software monitor resident in the target. PC-hosted versions of XRAY Monitor can utilize BDM by using a low-cost parallel cable that connects to the BDM pins on the target processor.

68300 Control Register Support

XRAY Debugger fully supports debugging at the 68000/68300 assembly language level. In addition to full mnemonic and 68000 CPU and 68881/68882/68040 FPU register displays, XRAY Debugger allows easy display of the peripheral control registers present in many 68000/68300 derivatives, including the 68302, 68360, 68332, and 68306/7.

Without special help from the debugger, displaying these registers is awkward because the memory locations to which they are mapped is unknown. XRAY Debugger resolves this problem by allowing the user to simply type the register name in the Inspector window.

For further details about Microtec Compilers, assemblers, linkers, and debuggers, please visit the Microtec web site at www.mentorg.com/microtec.



The XRAY Debugger provides an easy-to-use, graphical environment for developing and debugging embedded and real-time applications.

VRTX Real-Time Operating System

The VRTX Real-Time Operating System (RTOS) for 68K processors is optimized to meet the performance requirements and memory constraints found in embedded systems.

In order to build applications that work reliably every time, software developers must be able to predict the performance of time-critical aspects of their system. VRTX features a state-of-the-art design to ensure real-time responsiveness in the application. In addition to such features as priority inheritance and kernel preemptibility, VRTX provides both outstanding throughput and the deterministic kernel operations necessary to stand up to worst-case operating conditions. Microtec performs a rigorous qualification on the VRTX kernels and networking modules to provide you with accurate performance data. For many time-critical kernel services, multiple measurements are given to clearly illustrate how VRTX will perform in a given situation.

VRTX for the 68000/68300 processor families includes the following:

- VRTX kernels: VRTXsa, VRTX32, or VRTXmc
- SNX STREAMS-based TCP/IP networking
- SNMP (Simple Network Management Protocol)
- IFX I/O and file executive
- RTL multitasking run-time library
- OORTL C++ object-oriented run-time library
- ESH embedded shell
- A cache control library
- A variety of board support packages

VRTX includes five optimized versions of the CPU library along with VRTXsa and VRTX32 kernels to support all variants of the 68000 and 68300 families. Two custom-built versions of VRTXmc are available supporting the 68000/68302/68306/307/322/356 and CPU32 processors.

VRTX includes many features that are specifically designed to take advantage of advanced 68000- and 683xx-specific capabilities. For example:

- **Interrupt Stack Switching:** VRTXsa allows usage of a single dedicated interrupt stack to handle all interrupts. This saves a significant amount of RAM because the user no longer needs to allow for worst-case interrupt nesting when allocating each task's stack space. The 68020, 68030, and 68040 processors implement interrupt stack switching in hardware, and VRTX takes advantage of this feature. For the 68000, 68010, and CPU32 processors, which do not implement interrupt stack switching in hardware, VRTX provides optional software interrupt stack switching.
- **Synchronous and Asynchronous Context Switch:** VRTX distinguishes between asynchronous and synchronous context switches. If a task creates a synchronous context switch (for example by suspending itself), VRTX can reduce the context switch time because it does not need to save all the registers.
- **Bit-Field Instructions:** VRTXsa and VRTX32 take advantage of bit-field instructions on the 68020, 68030, and 68040 to optimize context switch times for higher performance.
- **MMU and Cache Support:** Since the 68000/68300 families utilize memory-mapped I/O, it is important to make sure that addresses used for I/O are not cached. VRTX allows the user to specify caching on a per-page basis. VRTX supports on-chip MMUs on the 68030, 68040, 68LC040, and 68060. On-chip instruction caches are supported on the 68020, 68EC020, 68030, 68EC030, 68040, 68LC040, 68EC040, and 68060. On-chip data caches are supported on the 68030, 68040, 68LC040, and 68060.
- **SNX TCP/IP Networking:** SNX provides a modern, high-performance TCP/IP protocol stack. Standard networking Application Programming Interfaces (APIs) are provided, greatly facilitating the development or porting of networking applications. These APIs include: sockets, TLI, STREAMS, and RPC. SNX utilizes

standard internet drivers included with Microtec's Board Support Packages.

- SNMP Network Management: The Simple Network Management Protocol (SNMP) allows networked embedded systems to be remotely monitored and controlled. The Microtec SNMP product supports version 1 or 2, MIB-II, and private enterprise management information bases.

For further details about VRTX and its subsystems, please visit the Microtec web site at www.mentorg.com/microtec.

VRTX Library Sizes

Module	Code Size (Kbytes)
VRTXsa*	25–50K
SNX	250–350K
IFX	50–70K
RTL	1–30K
ESH	5–20K

**Includes default initialization software.*

Microtec C Compiler Benchmarks

Version 5.0F Benchmark	Speed (msec)	Version 4.5T Benchmark	Speed (msec)
Ackerman	2384.16	Ackerman	2636.46
Benche	479.18	Benche	459.18
Bezier	677.75	Bezier	736.55
Bubble1	204.59	Bubble 1	224.44
Bubble2	326.08	Bubble 2	325.68
Dhrystone 2.1	49903.00	Dhrystone 2.1	49605.90
Fft	3085.63	Fit	3140.20
Fibonacci	760.39	Fibonacci	760.39
Hanoi	558.37	Hanoi	955.55
Matrix	391.27	Matrix	405.69
Permutation	435.20	Permutation	425.42
Puzzle2	303.96	Puzzle2	312.77
Q8	675.50	Q8	651.55
Qsort 1	320.11	Qsort1	414.96
Sieve	895.88	Sieve	913.50
Stanford fixed	2406.12	Stanford fixed	2576.52
Stanford float	4178.39	Stanford float	4100.81
Tree	422.89	Tree	402.57
Whetstone double	1148.42	Whetstone double	1434.74
Whetstone single	1132.25	Whetstone single	1416.71

All measurements were performed using the Microtec C Compiler version 5.0F on a Motorola MVME165 board with a MC68040 at 25MHz with cache enabled. The compiler options used were –O –Ot –Oe –Ob –p68040.

All measurements were performed using the Microtec C Compiler version 4.5T on a Motorola MVME165 board with a MC68040 at 25MHz with cache enabled. The compiler options used were –O –Ot –Oe –Ob –p68040.

All measurements are in milliseconds except Dhrystone, which is in Dhrystone/second.

Device Drivers and Board Support Packages

Manufacturer	Board	CPU	Serial	Ethernet	Timer	SCSI
Motorola	Mot 302ADS	68302	mo68681s	—	mo68681t	—
Motorola	Mot 302euf	68302	mo68681	mo302en	mo6868lt	—
Motorola	Mot EVK332	68332	mo332 SCI	—	mo332pit	—
Motorola	Mot 360QUADS	68360	mo360scc	moen360	mo3xxpit	—
Motorola	MVME147	68030	zi8530	am7990	mopcc147	147Bug
Motorola	MVME162	68040	zi8530	in82596a	moasctmr	ncr53C710
Motorola	MVME167	68040	cl2401	in82596a	mopcc167	ncr53C710
Motorola	MVME172	68060	zi8530	in82596a	moasctmr	—
Motorola	MVME177	68060	cl2401	in82596a	mopcc177	ncr53C710
Heurikon	Nitro 40	68040	hksio	in82596h	hkpig	—
Force	SYS IDC-II	68360	mo360scc	moen360	mo3xxpit	—

Please contact your local Microtec sales representative for a current list of board support packages.

Availability

The VRTX RTOS, XRAY Debugger and Microtec C & C++ Compilers are available on a wide range of hosts and targets. Contact your local sales representative or visit our web site (www.mentorg.com/microtec) for information about availability for specific hosts and targets.

Partner With the Best

Microtec's Embedded Solutions Partners program includes industry leaders in many fields of embedded systems technology, including emulators, logic analyzers, networking protocols, and real-time operating systems. This ensures that Microtec products are compatible with many third-party products, providing a broad range of tools to select from.

Support and Services

Microtec's Services organization provides applications support, consulting, educational services and systems engineering. This breadth of services provides support from early product development through project completion. Microtec's services complement the skills of software development project teams, enabling resources to be focused on what differentiates the product—the application software.

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