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MOTOROLA

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Motorola Announces New Low-Cost, Superscalar 32-bit Processor Core for High-Performance Embedded Applications

Next Generation ColdFire® Core Provides 2.5x Performance Improvement

AUSTIN, Texas -- October 15, 1998 -- Delivering on its roadmap for highly integrated, low-cost solutions for high performance embedded applications, Motorola today announced the latest addition to the ColdFire® processor family. The Version Four (V4) ColdFire core provides 2.5x the performance of the Version 3 core, delivering over 200 MIPS, while still maintaining the low-cost methodology that is the hallmark of the ColdFire architecture.

To achieve this level of performance, V4 employs a Harvard architecture and limited superscalar execution within a single pipeline. V4 provides a significant performance increase, a cost-reduced migration path for higher performance 68K system designs, and a future upgrade path for existing ColdFire system designs. A preliminary model of the V4 core has already been deployed to Hewlett-Packard's Integrated Circuit Business Division.

"With the advent of the Version 4 core, the ColdFire family is continuing on its course of providing low-cost, high-performance solutions for a wide array of embedded applications," says Ray Burgess, corporate vice president and general manager, Motorola. "The ColdFire architecture is designed from the ground up as an ideal solution for core-based designs, with over 200 core deployments to date resulting in over \$2.5 billion of programs in various stages of design today."

Version 4 Performance

At 150 MHz, the Version 4 core achieves 2.1 - 2.5x the performance of the Version 3 core, resulting in greater than 200 Dhrystone 2.1 MIPS, while still

maintaining a small core size (about 4.5 square millimeters when implemented in Version 4 ColdFire Motorola's advanced 0.25 micron CMOS process). By providing high levels of performance and high degrees of customizability, while still maintaining very low system costs, the Version 4 ColdFire architecture continues the family tradition of providing compelling solutions across the 32-bit embedded marketplace.

Most instructions execute in a single clock on Version 4. In addition, V4 uses innovative branch folding and assignment instruction folding techniques, thereby maximizing multiple instruction dispatch within a single pipeline. This limited superscalar methodology approaches dual-issue performance but at a much lower silicon cost. To sustain this high performance, V4 uses a Harvard architecture which doubles the available bandwidth between the core and on-chip local memories, removes instruction and operand conflicts, and provides more flexibility for configuring on-chip memory.

V4 Enhancements

The V4 core maintains complete upward code compatibility with existing ColdFire cores. However, based on inputs from customers and tool developers, new instructions have been added to enhance code density by up to 6% and improve performance by an additional 10%. Also, the MAC unit has been modified to provide added support for signed, fixed-point fractional numbers, resulting in extended precision while maintaining a low hardware cost.

Time-to-Market Advantage

In today's environment of shrinking development cycles, providing solutions which are easy to use and implement is of paramount importance. By leveraging the 68K programming model and instruction set, the ColdFire Family provides a head start to designers familiar with the ubiquitous 68K family. The unique ColdFire debug module also provides an advantage by supporting background debug as well as real-time trace and debug capabilities. Using a standard interface to all ColdFire processors, tools vendors, such as Embedded Support Tools, Inc., can support all standard and custom ColdFire devices using a single debug system. In addition, the ColdFire family is supported by a wide range of compilers, debuggers, and real-time operating systems. Diab Data; Integrated Systems Inc.; Mentor Graphics Company, Microtec Division; Noral Micrologics; and Software Development Systems (SDS) will be supporting the Version 4 core with their leading development tools. Wind River Systems currently supports the existing ColdFire family, and is working with Motorola to finalize plans for the Version 4.

ColdFire Methodology

As with all ColdFire cores, Version 4 is one hundred percent synthesizable and highly configurable. Using this implementation methodology, ColdFire designs are easily ported to new fabrication technologies. In addition, new combinations of cores, compiled memories, peripherals, and custom logic are easily created with fast time-to-market. The first integrated standard microprocessors using V4 are expected to be available in 2Q99, priced in the \$20-25 range. For more information on ColdFire microprocessors, please visit:
<http://www.motorola.com/ColdFire>.

Motorola (NYSE:MOT) Semiconductor Products Sector

As the world's #1 producer of embedded processors, Motorola's Semiconductor Products Sector offers multiple DigitalDNA™ solutions which enable its customers in the consumer, networking and computing, transportation, and wireless communications markets to create new business opportunities. Motorola's semiconductor sales were US\$8.0 billion in 1997.

In the global marketplace, Motorola also is one of the leading providers of wireless communications, advanced electronic systems, components and services. Major equipment businesses include cellular telephone, two-way radio, paging and data communications, personal communications, automotive, defense and space electronics and computers. Corporate sales in 1997 were US\$29.8 billion.

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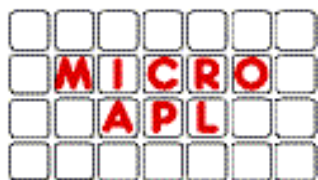
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MicroAPL and Motorola Offer New 68K to ColdFire® Microprocessor Migration Solution

8th October 1998 -- MicroAPL Ltd and Motorola Inc today announced the availability of CF68KLib, a new emulation library to assist in migrating 68K family code to the ColdFire® devices. CF68KLib is available for download free of charge from the internet.

Motorola's ColdFire architecture is derived from the 68K family, but with a simplified set of instructions and addressing modes in order to provide high performance at low cost and low power consumption. CF68KLib allows 680x0, CPU32 and CPU32+ object code to run on ColdFire cores (Version 3 and later), by emulating unimplemented instructions and addressing modes in software. It can be configured to emulate the instructions sets of all the main 680x0 and CPU32 processors, in both user- and supervisor-modes. It thus provides a bridge for Motorola clients with an existing 68K family code base who are evaluating ColdFire devices or migrating their code to the newer architecture.

Under a special agreement between Motorola and MicroAPL, CF68KLib will be distributed free of charge to Motorola's customer base. It is also available for downloading from the MicroAPL web site (<http://www.microapl.co.uk>), or through Motorola's ColdFire web-site (<http://www.motorola.com/ColdFire>). MicroAPL also provides an internet-based support service for the product.

CF68KLib is the second 68K to ColdFire Family migration solution to be developed by MicroAPL in partnership with Motorola. Last year, MicroAPL released PortAsm/68K for ColdFire, an assembler source-code translation tool which largely automates the process of translating 68K assembly-language code to efficient ColdFire code. The two solutions are complementary to each other; CF68KLib assists developers who are evaluating the ColdFire architecture, and shorten development times by allowing legacy code to be run with little or no modification irrespective of the language in which it was originally written.

"The response to last year's launch of PortAsm/68K for ColdFire has been excellent", commented Richard Nabavi, Managing Director of MicroAPL Ltd. "CF68KLib builds on that success by making it even easier to re-target almost any 68K family code to ColdFire."

"Customers who have large investments in 68K code can now immediately re-link their code and have an instant estimate of code performance in a ColdFire processor system", stated Pete Highton, Marketing and System Engineering Manager at Motorola.

MicroAPL Ltd was founded in 1979, and is based in London, England. It specializes in translation tools for moving existing software to the new generation of RISC processors, as well as providing consultancy services in systems development and cross-platform porting. Further information on CF68KLib, PortAsm, and other MicroAPL products and services can be found on the company's web site: <http://www.microapl.co.uk>

* * *

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New Motorola MCF5307 ColdFire® Development Kit Speeds Up Prototype-to-Production Timeline for Embedded Designers

MCF5307 ColdFire Processor Offers Small Price and Big Results

AUSTIN, TX, June 8, 1998 -- Answering the industry's ever-growing need for increased performance, improved time-to-design, and affordable pricing, Motorola (NYSE: MOT) today announced a special promotion to introduce its MCF5307 ColdFire® microprocessor evaluation board. The promotion features a complete evaluation package, which will be offered at a reduced price for a limited time only and provides the comprehensive support that design engineers require for development and evaluation of the MCF5307 ColdFire microprocessor, including evaluation copies of third-party software tools. The MCF5307 integrated microprocessor enables system designers to develop future generations of low-cost business peripherals and advanced consumer electronics.

Providing a total hardware/software solution for application development, the package includes an MCF5307 evaluation board; limited time or limited function copies of multiple third-party development tools including compilers, debuggers, and real-time operating systems; literature on software and hardware support tools; and a complete set of documentation. It has a suggested promotional resale price of \$499 and is available now.

"Motorola understands that design engineers are under a lot of pressure to reduce time-to-market while also keeping costs down," says Ray Burgess, Vice President and Assistant General Manager, Motorola's Consumer Systems Group. "The MCF5307 Evaluation Package gives them the tools that they need, at a price they can afford. Through partnering with third-party tool developers, we are able to deliver the tools that enable design engineers to perform efficiently and effectively."

MCF5307 Evaluation Package

The MCF5307 evaluation board provides an excellent vehicle for embarking on a high-performance embedded design. With 8 MBytes of SDRAM, 1 MByte of Flash, ethernet connectivity, two serial ports, available expansion of 512 KBytes SRAM for high-speed critical code or benchmarking, and access to the world-class ColdFire debug module, the M5307PROMO board gives designers the hardware they need to begin developing their systems. To further enhance these capabilities, the kit includes software from Motorola and third parties along with complementary

hardware to fully evaluate the MCF5307. An on-board ROM monitor provides capability to read and write registers and memory, disassemble assembly code, as well as write assembly code using the built-in ColdFire processor in-line assembler. To automate the porting of 68K Family assembly code to ColdFire processors, PortASM/68K is also included. This complete package includes all the components for realizing an MCF5307 design quickly and easily.

The limited function or limited time tools included in the package are

- Accelerated Technology Inc., Real Time Operating System (Nucleus Plus LV)
- Diab Data, C & C++ Compiler Suites
- Embedded System Products, Real Time Embedded Kernel RTX
- P & E Microcomputer Systems, Inc., ColdFire BDM Interface Libraries
- Precise Software Technologies Inc., Real Time Operating System
- Software Development Systems, SingleStep Debugging Suite

In addition to the evaluation board and software, the kit also contains cables and literature. The cables give access to the ROM monitor, which includes an in-line assembler. The literature includes the MCF5307 User's Manual/ Errata, a ColdFire Programmer's Reference Manual, an SBC5307AN User's Manual, an MCF5307 Product Brief, a 68K/ColdFire documentation CD-ROM, and product information sheets on a variety of third-party software and hardware tools.

MCF5307 Overview

The MCF5307 is Motorola's first generation of the Version Three (V3) ColdFire core. The chip's clock-multiplied core boosts CPU performance to 70 MIPS at 90 MHz. The MCF5307 maintains a low-frequency domain for on-chip peripherals and external interfaces that simplifies the integration of on-chip functions as well as lowers the device's power consumption. The chip's multiply-accumulate (MAC) and hardware divider can significantly increase performance of target systems such as printers and mass-storage devices. For example, signal processing algorithms for servo-motor control can be accelerated by as much as 70 percent using the MAC unit, and raster-image processing in printers can be improved by as much as 15 percent with the hardware divider.

The powerful MCF5307 attains much higher operating frequencies than 52xx series parts due to refinements made to the instruction fetch and execution pipelines of the Version 3 ColdFire core. The new core also includes powerful branch-acceleration capabilities to speed up change-of-flow operations in the instruction execution stream. The MCF5307 on-chip peripherals include 8 Kbytes of unified cache; 4 Kbytes of SRAM; a four-channel direct memory access (DMA) controller; a DRAM controller with glueless support for up to 256 Mbytes of synchronous, EDO, or page-mode

DRAMs; dual 16-bit general-purpose multimode timers; serial and parallel communications interfaces; Motorola's M-bus, which is I2C compatible; and power management modes.

Motorola (NYSE: MOT) Semiconductor Products Sector

As the world's #1 producer of embedded processors, Motorola's Semiconductor Products Sector offers multiple DigitalDNA(tm) solutions which enable its customers in the consumer, networking and computing, transportation, and wireless communications markets to create new business opportunities. Motorola's semiconductor sales were US\$8.0 billion in 1997.

In the global marketplace, Motorola also is one of the leading providers of wireless communications, advanced electronic systems, components and services. Major equipment businesses include cellular telephone, two-way radio, paging and data communications, personal communications, automotive, defense and space electronics and computers. Corporate sales in 1997 were US\$29.8 billion.

URL:

<http://www.motorola.com/ColdFire>

Pricing, Availability and Ordering Information:

Suggested list price for Limited Time Only Promotion: US\$499.

Motorola Part Number: M5307PROMO

Contact your local Motorola Sales Office or distributor to order.

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Motorola Raises the Bar: Announces a New Microprocessor for High-Performance, Cost-Sensitive Consumer Applications

"Breakthrough" price/performance point attractive for designers

AUSTIN, TEXAS - May 11, 1998 -- Continuing to enhance its portfolio for high-performance, low-cost, consumer electronics solutions, Motorola has added a new member to its 68K/ ColdFire® processor lineup which offers a very attractive price/performance value for designers - the 32-bit MCF5206e integrated microprocessor. Implemented in 0.35 µm process technology, the MCF5206e is an enhanced version of the highly popular MCF5206, offering nearly three times the performance at a lower price. Operating at 54 Mhz and 3.3 Volts, the MCF5206e delivers 50 dhrystone 2.1 MIPS while maintaining pin compatibility with the MCF5206, which offers 17 MIPS at 33 MHz.

"The MCF5206e achieves a breakthrough price/performance point that is very attractive for designers under pressure to develop their embedded control applications faster and for less cost," said Ray Burgess, vice president and assistant general manager, Consumer Systems Group, Motorola. "The MCF5206e provides an outstanding framework upon which system developers can quickly build high-performance, low-cost business peripherals and advanced consumer electronics products."

MCF5206e Overview

The MCF5206e combines a V2 ColdFire core with the peripheral functions of the MCF5206 such as a DRAM controller, timers, and parallel and serial interfaces. In addition, the MCF5206e also boasts substantially larger cache and memory blocks, a multiply/accumulate unit (MAC), a hardware divider, and two channels of DMA control. The superior performance levels of the MCF5206e are achieved by leveraging single-cycle access to its 4 Kbyte instruction cache and 8 Kbyte SRAM block. By implementing the MCF5206e in advanced 0.35 µm process technology, and retaining the same package used by the MCF5206, the MCF5206e can be offered at a much lower price, resulting in an aggressive new price/performance point for the Version 2 ColdFire core.

ColdFire Processor Technology

The ColdFire architecture is built on a strong foundation of reuse. With the synthesizable and highly configurable ColdFire core, new product implementations can be created very quickly. For example, the MCF5206e was created by a small team split between Munich, Germany and Austin, Texas, U.S.A. in a short time by reusing parts of both the MCF5206 and the higher performance MCF5307. Because each component is synthesizable and designed for reuse, the realization of the MCF5206e was simply a matter of combining the elements, modifying and verifying the functionality, then resynthesizing for the target process.

68K/ColdFire Architectural Continuity

The ColdFire architecture is the evolution of the 68K Family designed specifically for the embedded microprocessor market. With a commanding lead in the 32-bit embedded microprocessor market, the 68K/ColdFire architecture ships nearly twice the volume of its nearest competitor, according to figures from Dataquest. Both the MCF5206 and MCF5206e devices represent ideal upgrades for designs currently using 68K embedded processors. The MCF5206e demonstrates the superior roadmap which the ColdFire architecture makes available for 68k customers by offering up to 6 times the performance of the MC68340 at lower cost with the addition of a DRAM controller, an I2C-compatible interface, and on-board memory. In addition, the MCF5307 offers an excellent upgrade path for both MCF5206 and MCF5206e designs, offering up to 70 MIPS of performance and similar integration.

MCF5206e Pricing and Availability

The 3.3 volt MCF5206e is available for commercial temperature (0 to 70 degrees C) operation at 54 MHz. Also available is a 40 MHz version, designed for commercial or extended temperature (-40 to 85 degrees C). In a 160 QFP package, the commercial temperature parts are available in sample quantities immediately with production quantities planned for the third quarter of 1998. In 25K quantities, the 40 MHz part is direct list priced at \$7.70; the 54 MHz at \$9.55. In 1K quantities, the suggested resale price of the 40 MHz part is \$9.62; the 54 MHz is \$11.93. For more on-line information about ColdFire processors, please visit <http://www.motorola.com/ColdFire/>.

Motorola (NYSE:MOT) Semiconductor Products Sector

Motorola's Semiconductor Products Sector is the number one global producer of embedded processors and develops the essential building blocks to help its customers create new opportunities for a digital world in the consumer, networking and computing, transportation and wireless communications markets. Motorola's worldwide semiconductor sales were \$8.0 billion in 1997.

In the global marketplace, Motorola also is one of the leading providers of wireless communications, advanced electronic systems, components and services. Major equipment businesses include cellular telephone, two-way radio, paging and data communications, personal communications, automotive, defense and space electronics and computers. Corporate sales in 1997 were \$29.8 billion.

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Still #1 in Embedded Processors

Motorola Ships 79 Million 68K/ColdFire® Processor Units in 1997

AUSTIN, Texas, February 19, 1998 - Continuing to dominate the 32-bit embedded processing market, Motorola today announced that 79 million 68K/ColdFire® microprocessor devices were shipped worldwide during 1997.

"Shipment volumes for our 68K/ColdFire line grew by 14 million units last year, and the number of new design-ins continues to expand at an unprecedented rate," said Carlos Genardini, senior vice president and general manager, Consumer Systems Group, Motorola. "System designers choose 68K/ColdFire products for their designs because of the product family leadership in the areas of price/performance, debug capability, and integration level, as well as their familiarity with and investment in the architecture."

Tom Starnes, director and principal analyst for Dataquest, commented, "In the marketplace for microprocessors in embedded applications, Motorola has better than twice the business of any competitor. Industrywide, the expanded 68K/ColdFire architecture pulls in almost 40 percent of the total revenue. In this arena, there's no doubt that Motorola is king."

Starnes added, "The largest embedded microprocessor space is best served by high integration and low cost solutions like Motorola provides. The ColdFire core is the ultimate, streamlined 68K processor for the embedded marketplace and promises to continue the successful legacy of the 68000 for many years."

Increasingly, designers are selecting Motorola's 68K/ColdFire processors to support the new breed of low-cost, high-volume digital consumer electronics products and business peripherals. 68K/ColdFire products are key to applications such as satellite receivers, video games, multi-function office peripherals, the highly successful 3Com PalmPilot™ - connected organizer, and low-end laser and inkjet printers. 68K/ColdFire processors are used throughout the embedded market in a diverse array of other applications, such as automotive, industrial control, telecommunications, and wireless communications.

The success of the 68K/ColdFire family can be attributed to a variety of factors including the lowest-cost entry point to 32-bit embedded processing, the vast number of designers familiar with the architecture, the abundance of third-party tools support for the family, the wide variety of available products with performance ranging from 1 to over 100 MIPS and covering the spectrum of integrated features, and a roadmap to 300 MIPS in the year 2001. Because Motorola offers products from those with little or no integration all the way to devices with specialized processors on board, designers can find a device which suits their application.

In addition, Motorola provides customers with the option to create their own integrated devices. "A significant portion - over 25 percent - of our 68K/ColdFire volume in 1997 was contributed by integrated customer-specific ASICs," Genardini said. "The ColdFire architecture was designed from the ground up to be quickly and efficiently integrated into customer designs - and customers are telling us we are on the right track."

The ColdFire architecture makes use of several innovations to accomplish this ease of use. The cores are 100 percent synthesizable, enabling rapid deployment into the lowest cost technology. The architecture includes a hierarchical structure that allows efficient integration of memories, peripherals, and customer logic. The cores are highly configurable, allowing addition of execution units (such as a MAC), as well as compiled memories and caches. The ColdFire debug unit is unique in the industry and allows the use of standard third-party hardware development tools for customer-specific designs, reducing customer investment and time to market. In addition, the innovative test methodology employed by the ColdFire architecture enables very low test costs. As a result, this ease of use means the ColdFire architecture is attractive to existing and potential licensees.

The 68K/ColdFire product line is one part of Motorola's strong portfolio of 32-bit processors. It is complemented by the PowerPC™ line, which offers customers high-performance solutions, and the M•CORE™ architecture, which provides low power consumption.

Motorola (NYSE:MOT) Semiconductor Products Sector

With 1997 worldwide sales of \$8.0 billion, Motorola's Semiconductor Products Sector develops the essential building blocks to help its customers create new opportunities in the consumer, networking and computing, transportation and wireless communications markets.

In the global marketplace, Motorola also is one of the leading providers of wireless communications, advanced electronic systems, components, and services. Major equipment businesses include cellular telephone, two-way radio, paging and data communications, personal communications, automotive, defense and space electronics and computers. Corporate sales in 1997 were \$29.8 billion.

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Motorola Unveils 32-bit Embedded Processor Designed To Enable Low-Cost, High-Performance Consumer and Business Electronics

First Progeny of Version Three ColdFire® Processor Architecture Announced

AUSTIN, Texas, January 26, 1998 -- Motorola today disclosed details of the MCF5307 integrated microprocessor, which will enable system designers to develop future generations of low-cost business peripherals and advanced consumer electronics. Making a potent bid for new embedded designs, as well as providing an ideal upgrade for designs using previous 68K or ColdFire® products, the MCF5307 is Motorola's newest member of its compact variable-length RISC ColdFire product family and the first incarnation of the recently announced Version Three (V3) core.

"The 5307 adds valuable features to an already successful ColdFire lineup. The new chip combines better mathematical performance, advanced fabrication technology, and basic DSP functions with enough built-in peripherals to make a single-chip system," says Jim Turley, Senior Editor of Microprocessor Report.

Premium Performance

The chip's clock-multiplied core boosts CPU performance to 70 MIPS at 90 Mhz. This performance level is 2.5x to 3.0x higher than the MCF5202, out of the same external memory system; as well as almost a 2.0x improvement over the MC68EC040. The MCF5307 maintains a low-frequency domain for on-chip peripherals and external interfaces that simplifies the integration of on-chip functions as well as lowers the device's power consumption. The chip's multiply-accumulate (MAC) and hardware divider can significantly increase performance of target systems such as printers and mass-storage devices. For example, signal processing algorithms for servo-motor control can be accelerated up to 70% using the MAC unit, and raster-image processing in printers can be improved by up to 15% with the hardware divider.

The powerful MCF5307 attains much higher operating frequencies than 52xx series parts due to refinements made to the instruction fetch and execution pipelines of the Version 3 ColdFire core. The new core also includes powerful branch-acceleration capabilities to speed up change-of-flow operations in the instruction execution stream.

The MCF5307 on-chip peripherals include:

- 8 Kbytes of unified cache
- 4 Kbytes of SRAM
- a four-channel direct memory access (DMA) controller
- a DRAM controller with glueless support for up to 256 Mbytes of synchronous, EDO or page-mode DRAMs
- dual 16-bit general-purpose multimode timers
- serial and parallel communications interfaces
- Motorola's M-bus, which is I2C compatible, and
- power management modes

Potent Peripherals

The MCF5307 programmable DMA controller provides four fully independent DMA channels -- two of which include external request pins that initiate transfers internally or externally. The DMA controller supports single- and dual-address transfer operations; 8-, 16- and 32-bit transfer sizes with independent widths for source and destination; 128-bit bursting block transfers; and dedicated UART service.

The MCF5307 sophisticated bus interface provides a glueless interface to external 8-, 16-, and 32-bit memory and I/O devices. The on-board DRAM controller supports asynchronous, synchronous, or ECO DRAMs for write and read burst accesses as fast as 2:1:1:1 for synchronous DRAMs and can be directed via chip selects to support different wait-state configurations.

The MCF5307 sophisticated debug module supports background debug, real-time trace, and real-time debug, to simplify and speed up test and verification of new products. The debug module provides a common interface for consistent emulator support across the entire ColdFire processor family.

Compatibility and Upgrade Path

The MCF5307 is 100% upward instruction code compatible with the 52xx products. Because of its compatible feature set and similar bus interface, the new core is an excellent upgrade for existing MCF5206-based designs, currently one of the most popular members of the ColdFire processor family.

Migrating 68K-based designs to ColdFire products represents a natural transition for system designers -- the ColdFire architecture has its roots in the 68K architecture. The MCF5307 is especially suited to upgrading legacy designs based on Motorola's 68340 or 68EC040 parts. Compared to these devices, the MCF5307 provides up to two to nine times significantly more on-chip functionality, plus the addition of real-time debug and trace capabilities. The recently announced, free-of-charge PostASM assembly code translation tool developed by MicroAPL, Ltd. provides an automated method to convert and optimize 68K code to run on the ColdFire architecture (licensing agreement applies).

Deployment, Pricing, and Availability

Fabricated in Motorola's 0.35 micron triple-level metal, CMOS technology, the 3.3 volt MCF5307 is initially offered for commercial temperature (0 to 70 degrees C) operation at 90 MHz with bus programmability of 22.5, 30 and 45 MHz. Also available is a 66 MHz version, designed for commercial or extended temperature (-40 to 85 degrees C) ranges, that features bus speeds of 16.5, 22 and 33 MHz. In a 208 QFP package, the parts are available in sample quantities immediately -- production is planned for the second quarter of 1998. In 10K quantities, the 66 MHz part is direct list priced at \$14.33; the 90MHz at \$17.21. For more information about ColdFire processors, please visit <http://www.mot.com/ColdFire>.

Motorola (NYSE: MOT) Semiconductor Products Sector

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Next Generation 32-bit RISC Architecture Delivers An Optimized, Integratable Solution for Advanced Storage, Imaging, and Multimedia Products

Motorola Introduces Version Three ColdFire® Core

AUSTIN, Texas - November 4, 1997 -- Motorola today unveiled its 70 MIPS ColdFire® microprocessor core that provides its customers and partners with solutions that enable them to quickly create highly integrated designs. The Version 3 (V3) ColdFire core has already been deployed to key customers who are currently using the Version 2 ColdFire core. Following the roadmap of the low-cost embedded ColdFire architecture, the V3 core is optimized for a whole new generation of advanced consumer electronics and business peripherals.

V3 core products have already been licensed and designed into a wide variety of applications, including laser, inkjet, and impact printers, telecommunications, industrial control, and measurement equipment. Version V3 delivers a significant performance increase (up to three times faster than the V2 ColdFire series) at minimal cost, and the new processor core also offers a well-defined performance-migration path for all 68K and ColdFire system designs that allows designers to leverage existing software code and mature development tools.

"Motorola's V3 ColdFire core has seen significant customer acceptance, owing this success to a roadmap of continuing performance and technology enhancements, a synthesizable/modular approach, and tool enhancements that benefit customers in terms of system cost, upward code compatibility (for the huge 68K base), and design support," said Joyce Putscher, senior analyst at In-Stat, Inc.

The V3 Core Advantage

Utilizing ColdFire's variable-length instruction set, the V3 core maintains 100% upward code compatibility with the V2 core and maximizes code density while minimizing system memory requirements. The V3 core reaches much higher frequencies due to sophisticated refinements to the instruction fetch and execution pipelines plus powerful new branch prediction capabilities.

Application-specific performance improvement is achieved with two additional execution engines - a dedicated multiply-accumulate unit (MAC) and a hardware divide module - making it very efficient for applications, such as servo control, that require some digital signal processing (DSP) and enhanced imaging applications, like desktop printers. Benchmarks have shown that the ColdFire MAC unit can speed up typical disk storage applications by as much as 50 to 70 percent. This powerful module, as well as the new hardware divider, can easily be synthesized into previous generations of ColdFire cores. The hardware-divide function has shown that it can speed up the printing of graphic-based pages by as much as 15 percent.

With an industry-unique debug module, ColdFire processors continue to provide a sophisticated interface to speed up and simplify the task of system-level debug in integrated designs.

As with all ColdFire products, the highly customizable core is 100 percent synthesizable and easily portable to other fabrication technologies and supports a variety of cache and on-chip memory sizes, plus a wide array of pre-defined peripheral functions. Its fully static operation and small chip size (about three square millimeters when implemented in Motorola's advanced 0.35 micron CMOS process) minimize overall power requirements.

Architecture

The architectural enhancements made to the third-generation ColdFire core include additional pipeline stages to support operation at much higher frequencies and powerful branch-acceleration capabilities.

The pipeline of the V3 core consists of two independent and decoupled pipelines: a four-stage instruction fetch pipeline, and a two-stage operand execution pipeline. Two stages were added in the instruction fetch pipeline to yield a well balanced architecture, allowing it to operate at higher frequencies and provide improved performance.

Branch acceleration speeds up the processor's execution time for change-of-flow instructions in the application, such as jumps or subroutine calls. In the V3 core, this acceleration is implemented by monitoring the stream of prefetched instructions for these opcodes, then immediately calculating the target address and initiating prefetches to that target. As a result, in the V3 ColdFire core, most change-of-flow instructions appear with single processor clock execution times in the operand execution pipeline.

Clock Multiplied Core

The V3 ColdFire processor complex can run at speeds up to 90 MHz, while the rest of the device, including peripherals, custom logic, and the external bus, runs at a slower integer derivative of this frequency.

The V3 core employs two distinct clock domains for increased performance, design simplicity, and power savings. A low-frequency clock drives the external bus and on-chip peripherals, while the high-speed clock allows the processor core and on-chip cache and memory to execute at much faster speeds. Performance can exceed 70 MIPS with the processor complex running at 90 MHz.

The dual-clock approach provides a number of benefits. It minimizes power dissipation in noncritical circuitry and can also simplify the design effort, such as integrating the core with custom logic or required peripherals. The overall reliability of the design is improved due to an internal clock boundary which makes the task of distributing clock signals much easier (a significant issue in high-frequency designs). The increased observability of internal signals afforded at the clock boundary also helps speed up system debug.

Due to its highly optimized architecture and mature development environment, the new V3 ColdFire core represents an ideal integrated solution for applications such as mass storage, imaging, and multimedia – products that require high performance, yet are extremely cost conscious.

For more information about ColdFire variable-length RISC processors, please visit <http://www.mot.com/ColdFire/>.

Motorola SPS

With 1996 worldwide sales of \$7.9 billion, Motorola's Semiconductor Products Sector is the largest U.S.-based broad-line supplier of semiconductor solutions. Motorola is one of the world's leading providers of wireless communications, semiconductors, and advanced electronic systems, components, and services. Major equipment businesses include cellular telephone, two-way radio, paging and data communications, personal communications, automotive, defense and space electronics, and computers. Motorola semiconductors power communication devices, computers, and millions of other products. Motorola's 1996 sales were \$28 billion.

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New Hardware and Software Tools Greatly Simplify Migration of 68K Designs to the Innovative ColdFire® Architecture

Motorola Presents ColdFire Gateway Solution

AUSTIN, Texas, September 29, 1997 -- Continuing its efforts to enable customer success, Motorola today unveiled a valuable new set of tools that will help maximize reuse of intellectual property by smoothing the way for the development of new products from existing microprocessor-based designs. These development tools assist in porting system software code from embedded systems based on the highly successful Motorola 68000 (68K) architecture to the company's ColdFire® architecture, the next generation of the 68K.

The just-released Motorola ColdFire Gateway Solution for the MC68EC000 provides a hardware bridge between a target system's MC68EC000 microprocessor socket and the MCF5202 VL-RISC (variable-length reduced instruction set computing) ColdFire to ColdFire automated assembler conversion tool. The Gateway Solutions serve as a cost-effective mechanism for demonstrating and evaluating the potential advantages of migrating existing 68EC000-based designs to the ColdFire architecture. Existing 68K users can easily evaluate effects of system enhancements such as on-chip debug and cache.

The PortASM/68K, a 68K to ColdFire processor automated assembler source-code conversion tool developed by MicroAPL Limited, will assist in the migration of assembler source code from 68000, 68020, 68030, 68040, 68060, CPU32, and CPU32+ processors to the ColdFire architecture. The new MicroAPL tools will support all available versions of the ColdFire cores and includes support for MAC and hardware divide instructions. PortASM/68K supports GNU and Diab Data assembly formats and will be available on DOS, Windows 95™, and SUN hosts.

According to Wendell Smith, manager, systems engineering and tools programs for Motorola's Semiconductor Product Sector, "The development of software has become extremely costly and time consuming for today's embedded system designs. In addition to its obvious use as a vehicle for demonstrating the features of the ColdFire architecture, the new 68K/ColdFire Gateway Solutions allow many 68K users to leverage their existing software and hardware investments."

The hardware interface of the ColdFire Gateway board looks like that of an MC68EC000. The board can be plugged into an existing MC68EC000 based system using a 68-pin socket compatible with the 68EC000 PLCC FN package. The ColdFire Gateway board package includes a short-term sixty day full function license of the Diab Data ColdFire and 68K D-CC compilers, the MicroAPL PortASM/68K tool to migrate the 68K assembler code (available 11/97), and a short-term evaluation license of the Software Development Systems' (SDS) SingleStep™ Debugger.

The ColdFire Gateway board can operate in 8- or 16-bit data mode, supports external or internal interrupt handling, and provides bus arbitration control logic for alternate bus masters. The board also provides access to the standard ColdFire background debug mode (BDM) interface for powerful software debugging capabilities such as real-time trace, real-time debug, and background debug.

The Motorola Gateway Board for the MC68EC000, part number M5202GW is available immediately and is list priced at \$99. The MicroAPL PortASM/68K, part number CDAPL/D will be available in November at no cost and can either be downloaded from the web at www.motorola.com/isd or ordered in a CD format. To order call your local Motorola distributor or you may order on the web at www.motorola.com/isd or by calling 1-800-758-7030 or 408-995-3040.

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