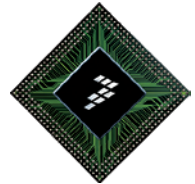




32-bit embedded devices

# ColdFire<sup>®</sup> Embedded Controllers

The Perfect 32-bit Compilation





“

I'm the  
best-connected  
15-year-old in the  
MCU industry.

Find out what  
I can do for you.

”

# Open the Door to 32-bit Control

## Freescale Is the Right Company for Your 32-bit Embedded Processor Needs

Freescale is dedicated to providing semiconductor solutions that build value into your products for your customers. When you purchase from us, you're buying more than a product. You're getting access to a broad ecosystem of technical support services, development tools and training—all designed to make your job easier and your end products better.

Our ColdFire® embedded controller portfolio includes a broad roadmap of cost-effective 32-bit solutions that emphasize control, connectivity and security for a wide range of consumer and industrial applications.

## You Are Never Very Far from Freescale

We have hundreds of salespeople and applications engineers in the field and an extensive network of distributors around the world. Your Freescale representatives are trained to understand your needs and help you find the best solutions for your products.

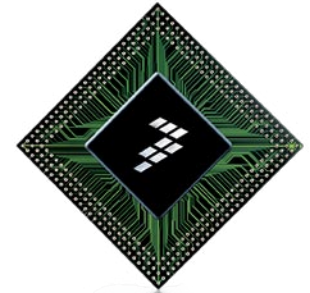
Our FastTrack online support resource is your portal to Freescale training, technical support and product documentation. It gives you the opportunity to contact us directly or access a number of self-help resources from a single web page—[freescale.com/fasttrack](http://freescale.com/fasttrack). FastTrack is also your doorway to DevToolDirect, an e-commerce solution for ordering software and hardware development tools as well as Freescale's Really Simple Syndication (RSS) feeds, which allow you to quickly browse information from a variety of sources.

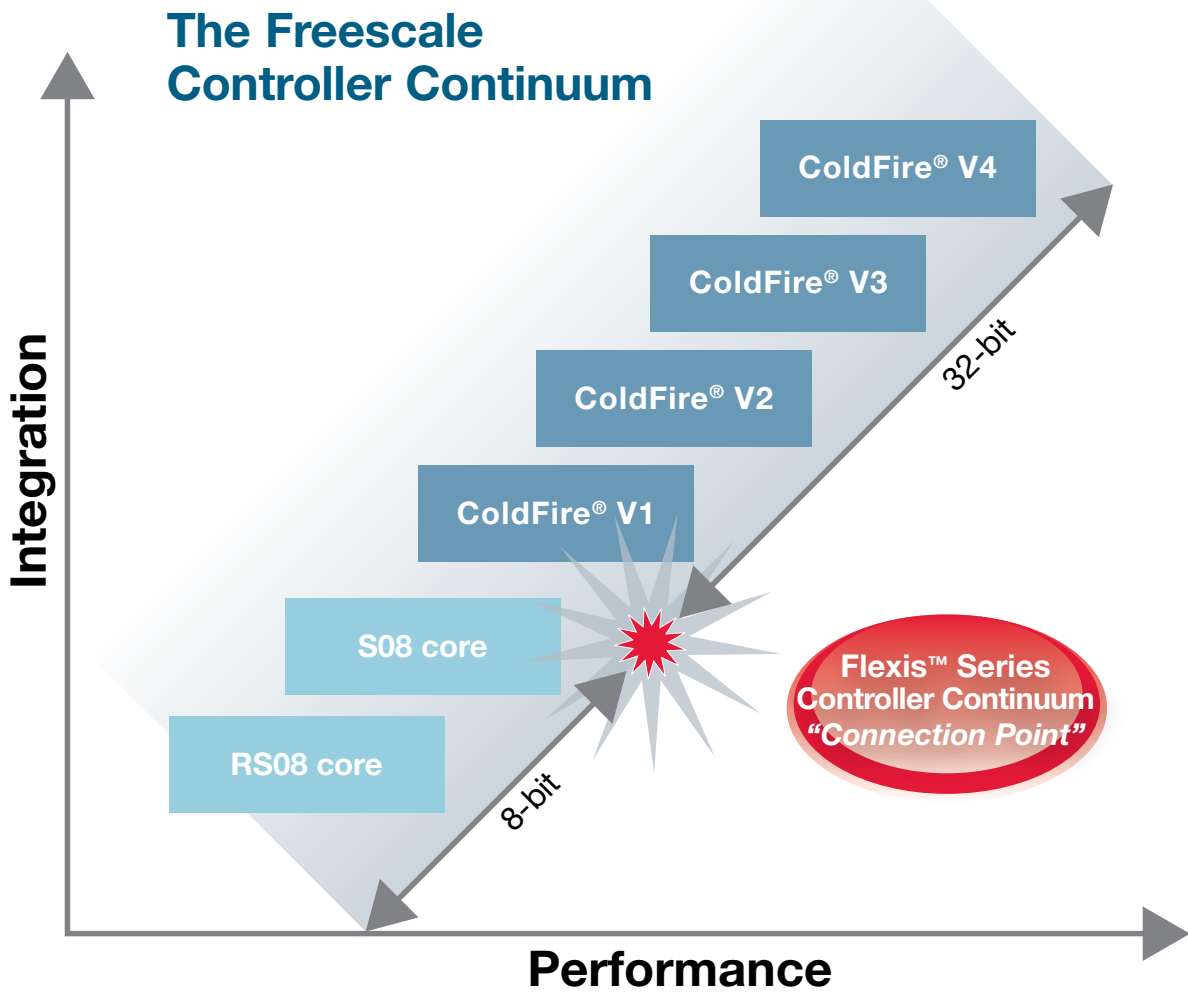
## The ColdFire Portfolio Advantage

ColdFire is unlike any other 32-bit architecture in the industry. With a wide portfolio of 32-bit solutions, an unparalleled range of performance and peripherals and the lowest power 32-bit MCU on the market, ColdFire offers incredible flexibility and choice. Enabled by a vast ecosystem of development tools and design resources, Freescale helps make 32-bit development as easy as it can be.

The ColdFire family of 32-bit embedded controllers is backed by a 25-year legacy of 68K development and support. Because ColdFire devices are code compatible, you can migrate throughout the portfolio according to your applications' specific needs and performance requirements, without investing in entirely new tool sets. An extensive library of peripheral sets and memory sizes gives you the flexibility to custom fit an off-the-shelf embedded controller that suits your needs and benefits your customers. If an off-the-shelf solution is not right for you, Freescale gives you the flexibility to license the ColdFire architecture to create a custom embedded solution. We are continually pushing the envelope for high-performance control and connectivity. We have introduced a number of industry firsts in 32-bit flash-based microcontrollers: the MCF528x family is the first with integrated Ethernet and controller area network (CAN); the MCF5223x devices are the first with integrated Ethernet controller and physical layer (PHY) and the MCF537x family is the first with a USB On-The-Go (OTG) controller and transceiver.

As we continue to lower the cost of entry to 32-bit performance, additional benefits such as scalability and ease-of-migration become more important when planning long term. Our ColdFire families are an integral part of Freescale's roadmap of seamless compatibility. Leveraging a common peripheral library and tool set, the Controller Continuum delivers 32-bit performance with 8-bit ease-of-use.







# The Controller Continuum. Only from Freescale.

It's time to break from tradition. In the past, bit boundaries have defined microcontroller (MCU) price and performance solutions for the consumer and industrial markets—8-bit for low-end, easy-to-use applications and 32-bit for the high-end, performance-driven market. As 8-bit users reach their performance ceiling and need to move to a more powerful architecture, the increased complexities of 32-bit software, peripherals and development tools could significantly hinder new product development and time to market.

No more. Freescale is uniquely positioned to provide a path to performance from the low-end of 8-bit to highly integrated 32-bit MCUs. We created the Controller Continuum—the industry's first and only roadmap for 8- and 32-bit compatible architectures. From the ultra-low-end RS08 and S08 controllers to the full-featured ColdFire® devices, the Controller Continuum is a range of stepwise compatible MCUs sharing tools and peripherals to ease your design process and accelerate your time to market.

## The Flexis™ Series of Microcontrollers

Freescale's revolutionary 8-bit to 32-bit compatibility story comes to life with the Flexis™ series of MCUs. This new series is the 8-bit to 32-bit connection point on the Freescale Controller Continuum, where duos of S08 and ColdFire V1 microcontrollers share a common set of peripherals and development tools to deliver the ultimate in migration flexibility. You can quickly move from an 8-bit design to a 32-bit design in just a handful of clicks, perfect for developing a portfolio of products that span the performance spectrum. The Flexis 32-bit devices, based on the ColdFire V1 core, offer not only seamless compatibility to and from the S08 MCUs, but are also the gateway to other high performing and highly integrated 32-bit ColdFire devices.

## The High-end of the Continuum

At the top of the Controller Continuum are the ColdFire devices—a series of compatible, highly-integrated and cost-effective 32-bit microcontrollers that emphasize control, connectivity and security over a wide range of consumer and industrial applications. All ColdFire cores (V1, V2, V3, V4 and V5) share the same architecture and instruction set. These product families are downward and upward code compatible, so drivers require minimal rewrite. Software tools, including IDE, initialization tool, debugger and compiler, have a similar look-and-feel to ease your transition as you move between cores.



# High-Performance Integration

## Meeting Your Demands for Increased Performance, Lower Power and Lower Costs

The ColdFire family of embedded controllers is built upon the legacy of the popular 68K family. Freescale's portfolio of ColdFire products offers a wide range of performance, price and integration options.

- The portfolio is targeted at network-connected control applications in the commercial and industrial markets. Various family members support Fast Ethernet, USB, Peripheral Component Interconnect (PCI) bus, CAN and other industry-standard serial interfaces.
- Variable-length RISC architecture means instructions can be 16, 32 or 48 bits long. Code can be packed into memory more efficiently, reducing overall memory requirements and system costs without complicating development efforts.
- The ColdFire portfolio is optimized for low-power product designs. Some devices include advanced features such as distributed clocking for module-by-module clock enable/disable in all operating modes; low-power stop modes with programmable options for clock activity; phase-lock loop (PLL) bypass mode for low-speed operation and a low-power divider used for PLL bypass clock generation.

- Robust, reliable flash memory is capable of up to 100,000 write/erase cycles. Flash security features allow enhanced protection of your valuable software IP from piracy. Single cycle average through interleaving allows fast access.
- Unique and innovative options include an enhanced programmable I/O state machine, dual-port SRAM capability that enables concurrency, 12-bit ADC, vectored interrupts that enable effective prioritization and real-time control capability, background debug mode (BDM) trace capability, 32-bit timers, a flexible bus configuration and much more.

## ColdFire Core Architecture

All ColdFire cores are based on a memory-configurable hierarchical architecture that is 100 percent synthesizable, designed for reuse and ease of integration into custom designs. The cores share a common, variable-length RISC instruction set optimized for code density which results in lower overall system cost.

- V1 ColdFire core up to 50 MHz—pipelined 32-bit core with 32-bit address bus for improved access performance to the local flash and RAM. The 8-bit data bus can allow 16-bit references to the peripherals by “decomposing” the accesses into two 8-bit cycles. It features S08-compatible peripherals and single-wire background debug interface with on-chip in-circuit emulator (ICE) debug module. The core also implements a processor status trace buffer to support real-time trace capabilities mapped into a BDM-readable resource.
- V2 ColdFire core up to 166 MHz—32-bit address and data buses and an integrated debug module. Pipelined (instructions) multiple on-chip data paths and a multiply accumulate (MAC) or an enhanced multiply accumulate (eMAC) unit provide a high level of performance. An optional cryptography acceleration unit is available on many products.
- V3 ColdFire core up to 240 MHz—adds refined instruction prefetch pipeline, branch prediction capabilities and higher operating frequencies. Provides up to 300 percent performance improvement over the V2 ColdFire core. An eMAC unit provides a high level of DSP functionality, and an optional cryptography acceleration unit is available on many products.
- V4/V4e ColdFire cores up to 266 MHz—Harvard memory organization and limited superscalar execution through the use of instruction folding. The V4e core includes memory management unit (MMU) and floating point unit (FPU) execute engines. An eMAC unit provides a high level of DSP functionality, and an optional cryptography acceleration unit is available on many products.
- V5/V5e ColdFire cores up to 300 MHz—featuring 64-bit Harvard local memory interfaces and a dual execution pipeline capable of sustained execution rates of two instructions per machine cycle for maximum performance. A superscalar eMAC unit capable of four accumulations per cycle is included along with full data trace debug functionality. The V5e core includes the MMU and FPU engines.



# Rich Ecosystem

## Start with Your Ideas

Use Freescale's Interactive Development Ecosystem to design a development process that meets your specific needs. Begin with CodeWarrior® Development Studio with Processor Expert™, and take advantage of the ecosystem's interoperability to meet contingencies and get your products to market on time and on budget.

The total ColdFire experience is designed to get you started quickly, speed you through the development process and get your products to market ahead of your competition. A key to speedy execution is shortening your learning curve—that's why we make ease of use a priority.

## Code Compatibility

Given the complexity of today's embedded processors, software development often represents the most time-consuming and costly portion of system development. Reusing code from previous projects can help simplify the development process and preserve more resources for new application programming. Freescale has maintained code compatibility across the ColdFire embedded controller portfolio, so each core is 100-percent upward compatible.

In addition, the ColdFire instruction set architecture (ISA) is based on a subset of the 68000 instruction set. Even though we have expanded the ISA beyond the original 68K definition, creating a "superset of the subset," software code from existing 68K-based systems can still be easily ported to any of the ColdFire cores.

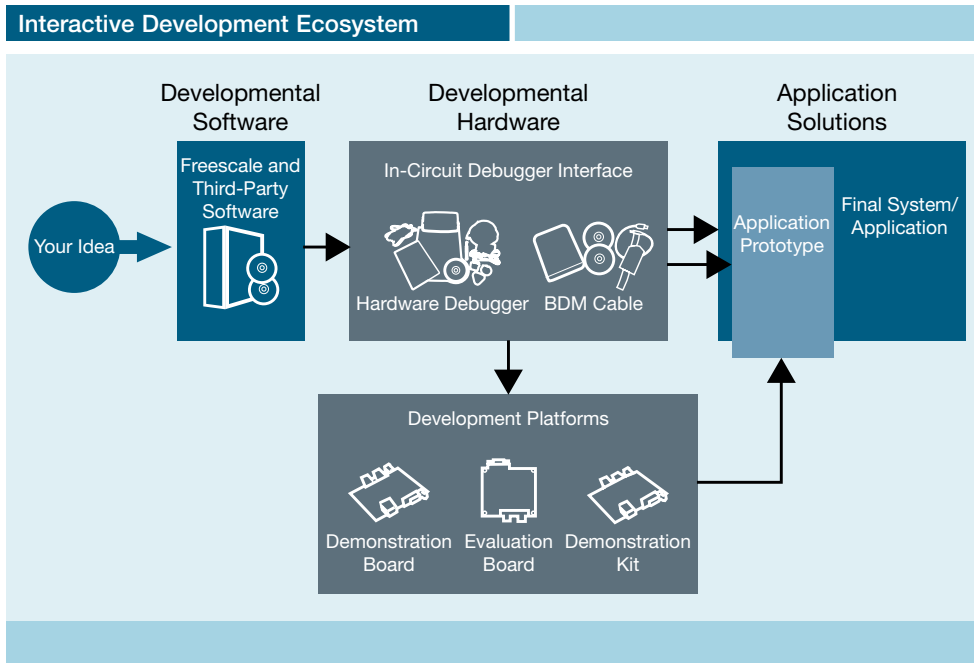
## Evaluation Boards and Other Tools

The ColdFire family of embedded controllers is backed by an extensive selection of hardware and software tools from Freescale and third-party vendors. These tools include evaluation boards (EVBs) and development kits, compilers, debuggers, simulators, drivers, translators, protocol stacks and real-time operating systems. In addition, Freescale provides complimentary and royalty-free TCP-IP and USB stacks with supporting demonstrating code. All of these tools are available to ensure your project gets done on time and within budget.

Each device family has a dedicated evaluation system, and some are complemented by an increasing number of cost-optimized development kits and reference designs. Selected families also offer production-ready modules that go beyond the development phase to provide you an ideal foundation for use, in volume, in your final embedded control products.

Each tool is available at DevToolDirect, part of the Freescale Buy Direct Program—[freescale.com/buydirect](http://freescale.com/buydirect). CodeWarrior Development Studio for ColdFire Architectures, Standard and Professional Editions are available for download from DevToolDirect. Complimentary\* downloads include CodeWarrior Special Edition and additional plug-ins, such as TCP/IP stack and ColdFire\_Init initialization tool. You can also download updates and patches for CodeWarrior software development tools from DevToolDirect.

\* Subject to licensing agreement and registration



Start with your idea. Then use Freescale's Interactive Development Ecosystem to design a development process that fulfills your specific needs. Begin with CodeWarrior Development Studio software tools, and add only the hardware tools you need to complete your design. You can even choose tools as you go along, taking advantage of the ecosystem's interoperability to meet contingencies and get your products to market on time and on budget.

\*Check SG1011 and Web for third-party solutions.



# Control, Connectivity and Security

## Making the ColdFire Portfolio Work for You

Our Controller Continuum provides you a complete portfolio of high-performance, highly integrated devices that can meet the product challenges you face now and in the future. ColdFire embedded controllers offer:

- **Control**

Five generations of ColdFire cores provide a wide range of performance options, from a V1 core-based entry-level 32-bit controller to a V5 core-based embedded controller designed to provide hardware support for on-chip multiprocessing for systems requiring intensive numeric processing capabilities.

- **Connectivity**

The ColdFire portfolio of embedded controllers includes families that feature CAN, Ethernet and USB-OTG connectivity options.

- **Security**

Optional on-chip hardware encryption modules, such as the cryptographic acceleration unit (CAU), accelerate functions critical to increasing cryptographic algorithm performance.

Freescale offers ColdFire solutions with interface circuitry for IEEE® 802.11 Wi-Fi® and ZigBee® wireless modules, with a ColdFire embedded processor, plus ZigBee reference design to help you set up a simple network quickly and efficiently. ColdFire embedded controllers deliver control, connectivity and security to a growing number of industrial and commercial applications, and low system costs give you a competitive edge. Long ColdFire product life cycles ensure products are available for the lifetime of industrial applications.

## Health-Care Instrumentation

ColdFire solutions help you meet the growing demand for network connectivity, remote monitoring and support for higher resolution displays in the health-care industry.

## Point-of-Sale (POS) Terminals

ColdFire solutions offer Ethernet and USB connectivity, hardware cryptography support for secure communications and an integrated super video graphics array (SVGA) LCD for easy-to-use human interface systems.

## Factory Automation

ColdFire solutions offer integrated connectivity, such as USB host, device and OTG modules, Ethernet controller, hardware encryption modules for secure networking, universal asynchronous receiver/transmitters (UARTs), I<sup>2</sup>C, CAN and synchronous serial interface (SSI). In addition to communications support, the CPU processing power and timer and analog peripherals support real-time control applications.

## Fire and Security

ColdFire solutions are designed to provide reliable, high-speed communications at an economical price, fulfilling the demand for fire detection systems, closed-circuit television with associated cameras and advanced digital security and surveillance technologies.

## Voice-over-Internet Protocol (VoIP)

ColdFire solutions help you meet the requirements for accurate signal processing and conversion, as well as secure data transmission. The eMAC unit processes voice compression and decompression without the need for a separate DSP.

## Remote Monitoring/Data Collection

ColdFire solutions address the increased demand for instant system diagnostics and secure data transmission. Integrated Ethernet and PHY enable support for data transmission, and the optional hardware encryption module enables secure data transmission without compromising performance.

# Helpful Freescale Links

## Freescale ColdFire:

[www.freescale.com/coldfire](http://www.freescale.com/coldfire)

## Controller Continuum:

[www.freescale.com/continuum](http://www.freescale.com/continuum)

## Buy Direct:

[www.freescale.com/buydirect](http://www.freescale.com/buydirect)

## Freescale Forums:

[www.freescale.com/forums](http://www.freescale.com/forums)

## CodeWarrior Development Tools:

[www.freescale.com/codewarrior](http://www.freescale.com/codewarrior)

## Online Support Services:

[www.freescale.com/fasttrack](http://www.freescale.com/fasttrack)

## Order Samples:

[www.freescale.com/samples](http://www.freescale.com/samples)

## Online Courses and Presentations:

[www.freescale.com/  
embeddedlearningcenter](http://www.freescale.com/embeddedlearningcenter)

## Documentation Library:

[www.freescale.com/documentation](http://www.freescale.com/documentation)

## Technical Support:

[www.freescale.com/techsupport](http://www.freescale.com/techsupport)

## Contact Freescale:

[www.freescale.com/contactus](http://www.freescale.com/contactus)

**Learn More:** For additional information about ColdFire products  
please visit [www.freescale.com/coldfire](http://www.freescale.com/coldfire)

Freescale and the Freescale logo are trademarks or registered trademarks of  
Freescale Semiconductor, Inc. in the U.S. and other countries. All other product or  
service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2008

Document Number: BRCOLDFIREOVRV / Rev 2