

Control. Connectivity. Security.

# Expanding ColdFire® Portfolio

Enabling Designs With  
Low-Power and Connectivity



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



# The ColdFire Family of 32-bit Embedded Controllers

## Fact Sheet

### The ColdFire Portfolio Advantage

The ColdFire 32-bit embedded controllers are backed by 25-years of development and support which originates from the 68K architecture. 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.

### ColdFire Key Features

- Ideal for network-connected control applications in consumer and industrial markets
- Variable-length RISC architecture allows 16-, 32- and 48-bit length instructions so code can be packed into memory easily and more efficiently
- Optimized for low-power consumption with advanced operating modes and distributed clocking functions
- Robust and reliable flash memory with security features that protect your IP
- Extensive selection of hardware and software tools from Freescale and industry-leading third-party suppliers

### ColdFire Core Architecture

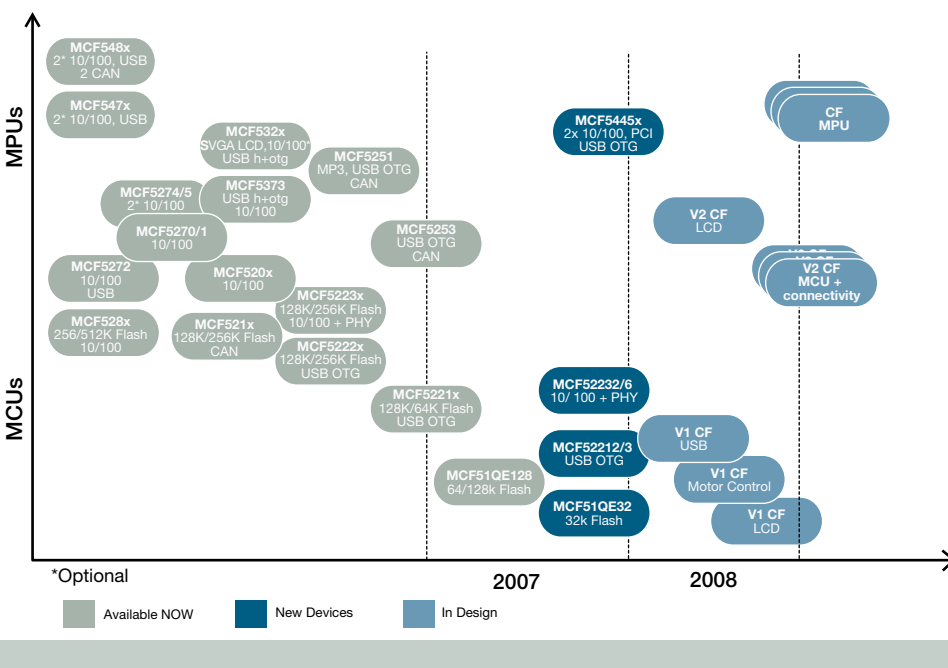
#### V1 ColdFire Core

- Up to 50 MHz-pipelined 32-bit core with 32-bit address bus for improved access to local flash and RAM
- 8-bit data bus can allow 16-bit references to peripherals by decomposing into two 8-bit cycles
- S08 compatible peripherals and single-wire background debug interface with on-chip in-circuit emulation

#### V2 ColdFire Core

- Up to 166 MHz-32-bit address and data buses with integrated debug module
- Enhanced multiply accumulate (eMAC) provides DSP-like performance

### ColdFire® MCU/MPU Solutions



Except for historical information, all of the expectations and assumptions contained in the foregoing are forward-looking statements involving risk and uncertainties. Important factors that could cause actual results to differ materially from such forward-looking statements, include but are not limited to, the competitive environment for our products, changes of rates of all related services and legislation that may affect the industry. For additional information regarding these and other risks associated with the Company's business, refer to the Company's reports with the SEC.

- Cryptography acceleration unit helps protect data

#### V3 ColdFire Core

- Up to 240 MHz-features refined instruction prefetch pipeline, branch prediction capabilities and higher operating frequencies
- Delivers up to 300-percent performance improvement over the V2 ColdFire core
- eMAC and encryption available on many products

#### V4/V4e/V4m ColdFire Cores

- Up to 266 MHz-limited superscalar execution with Harvard memory organization
- Memory management unit (MMU) and floating point unit (FPU) execute engines boost performance

- eMAC and encryption available on many products

#### V5/V5x ColdFire Cores

- Up to 400 MHz-superscalar hardware featuring 64-bit Harvard local memory interfaces
- Dual execution pipeline capable of sustained execution rates of two instructions per machine cycle
- Superscalar eMAC unit capable of four accumulations per cycle with full data trace debug

## Coldfire® On-chip Peripheral Selection

### Connectivity

10/100 FEC (Fast Ethernet Controller)	Performs the full set of IEEE 802.3/Ethernet CSMA/CD media access control and channel interface functions. It requires an external transceiver (PHY) to complete the interface to the media.
EPHY (Ethernet Physical Interface)	IEEE 802.3 compliant 10/100 Ethernet physical transceiver supports both the medium-independent interface (MII) and the MII management interface. When combined with FEC, delivers a single-chip Ethernet solution.
USB (Universal Serial Bus)	USB 2.0 input/output bus protocol incorporates three speeds: High Speed (480 Mbps), Full speed (12 Mbps) and Low speed (1.5 Mbs). The PHY is standard on all modules.
USB Host	The USB host controller is configured for a single port, which can connect to downstream hubs to support connection of up to 127 devices.
USB-OTG (On-The-Go)	The dual-role feature allows device-to-device connectivity without the need for a host PC (e.g., digital camera to photo printer). The OTG module supports high-speed (480 Mbps) operation via an external ULPI transceiver.
CAN (Controller Area Network)	Commonly used as an industrial control serial data bus, meeting the specific requirements of real-time processing, reliable operation in a harsh EMI environment, cost-effectiveness and required bandwidth.
ZigBee® Technology	802.15.4 is an IEEE low data rate WPAN standard in both the 2.4 GHz and 868/915 MHz bands. Freescale is a driver of the IEEE 802.15.4 standard and a promoter of the ZigBee® Alliance. Freescale Semiconductor offers a broad portfolio of RF products serving both the wireless infrastructure and subscriber markets.

### Communication

I2C (Inter-Integrated Circuit)	The C bus provides a method of communication between a number of devices. The interface is designed to operate up to 100 Kbps with maximum loading and timing.
I2S (Inter-Integrated Sound)	2S bus is a serial link especially for digital audio. A three-line serial bus is used consisting of a line for two time-multiplexed data channels, a word select and a clock line.
PCI (Peripheral Communications Interface)	PCI 2.2 compliant bus controller and arbiter. The PCI bus is capable of 66 MHz operation with a 32-bit address/data bus. PCI controller acts as the central resource, bus arbiter, and configuring master on the PCI bus.
PSC (Programmable Serial Controller)	Independently programmable serial controllers that can be configured to operate as UART, IrDA SIR, MIR or FIR; 8-bit, 16-bit or AC97 soft modem. PSCs can also interface to full-function modems or external codecs for soft modem support.
QSPI (Queued Serial Peripheral Interface)	Provides a high-speed synchronous serial peripheral interface with queued transfer capability. It allows up to 16 transfers to be queued at once, eliminating CPU intervention between transfers.
SCI (Serial Communications Interface)	SCI module is used to connect to the RS232 serial I/O port of a computer and other embedded controllers. The SCI receiver employs an advanced data sampling technique that ensures reliable communication and noise detection.
SPI (Serial Peripheral Interface)	The SPI uses a synchronous serial bus to communicate with external peripherals and other MCUs
SSI (Synchronous Serial Interface)	Full-duplex, serial port that allows the chip to communicate with a variety of serial devices, including audio codecs, DSPs and microprocessors that implement the inter-IC sound bus standard (I2S) or Intel AC97 standard.
UART (Universal Asynchronous Receiver Transmitter)	UART modules are used to connect to the RS232 serial I/O port of a computer and other embedded controllers. A flexible 12-bit modulo-based baud rate generator supports a broad range of standard rates beyond 115.2 Kbaud.

### Security

CAU (Cryptography Acceleration Unit)	Incorporates small, fast, dedicated hardware accelerators for random number generation, message digest and hashing, and the DES, 3DES and AES block cipher functions for the implementation of common Internet security protocol cryptography operations.
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### Display Interface

LCD (Liquid Crystal Display) Controller	Supports black-and-white, gray-scale, passive-matrix color (passive color or CSTN), and active-matrix color (active color or TFT) LCD panels. The module also provides a direct interface to Sharp 240x320 HR-TFT panels.
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### The Embedded Technology Leader

Freescale's embedded leadership position—the result of continuous innovative technology—provides customers with the opportunity to build market share in an evolving industry. Freescale's vast technology library completes the ColdFire architecture by enabling a product portfolio that offers a broad mix of performance, price, integration and debugging capabilities. From microcontrollers to integrated processors, with performance

levels ranging from 10 to 400+ MIPS and suggested retail pricing starting below \$5—the ColdFire family has something to meet your needs, whatever your system performance and integration requirements may be.

### A Peripheral Mix That Gets You Connected

How would you like to connect? Ethernet? USB? PCI? CAN? The ColdFire family has you covered. ColdFire embedded controllers

are specifically targeted at network-connected control applications: health care instrumentation devices, POS clients, security systems, building/home automation networks, process control equipment and factory automation applications, all of which require connection with protection. The ColdFire family of 32-bit controllers is uniquely positioned to deliver control, connectivity and security within one piece of silicon.

### Learn More:

For more information about ColdFire family products, please visit [www.freescale.com/coldfire](http://www.freescale.com/coldfire).

# MCF51QE128

## 32-bit Fact Sheet



### Target Applications

- HVAC building and control systems
- Health care monitoring and instrumentation
- Fire/security control and monitoring systems
- Factory and automation systems
- Measurement equipment
- Hand-held medical/industrial applications
- Low-power industrial applications

### Overview

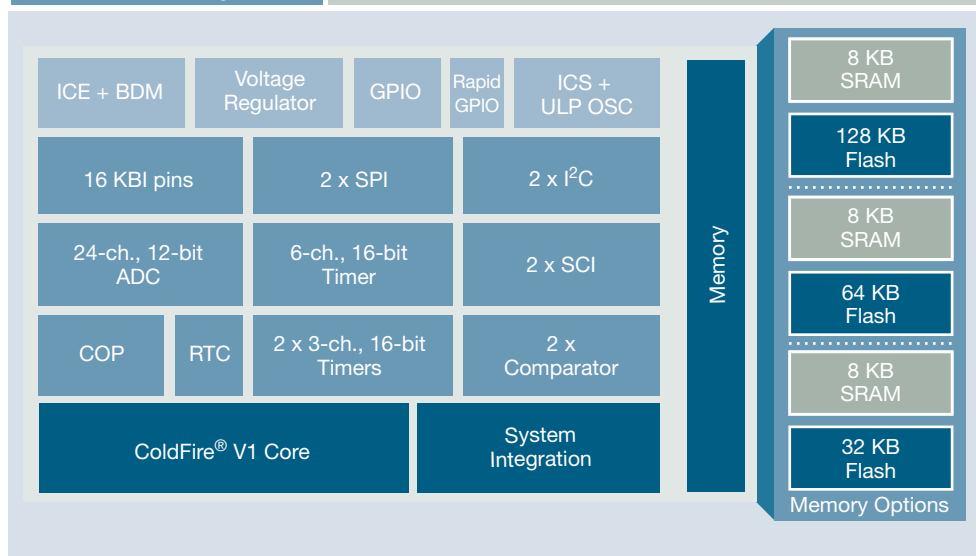
The Flexis™ series of controllers is the connection point on the Freescale Controller Continuum, where 8- and 32-bit compatibility becomes reality. The Flexis series includes complementary families of 8-bit S08 and 32-bit ColdFire® V1 microcontrollers that share a common set of peripherals and development tools to deliver the ultimate in migration flexibility.

The QE family, comprised of a pin-compatible 8-bit and 32-bit device duo, is the first family in the Flexis series.

The 32-bit MCF51QE128 device extends the low end of the ColdFire embedded controller family with up to 128 KB flash memory and a 12-bit analog to digital converter (ADC) with up to 24 channels. The MCF51QE128 includes up to 3.6V supply voltage, a 50 MHz CPU core and three timers for improved motor control—perfect for medical devices such as health care monitoring instrumentation and industrial equipment including networked smoke detectors and security cameras.

The 32-bit MCF51QE128 is pin-, peripheral- and tool-compatible with the 8-bit S08QE128 device, providing unprecedented design freedom across the performance spectrum.

MCF51QE Block Diagram



### Features

#### 32-Bit ColdFire V1 Central Processing Unit (CPU)

- Up to 50 MHz ColdFire V1 core from 2.1V to 3.6V, and 20 MHz CPU at 1.8V to 2.1V across temperature range of -40°C to +85°C

- ColdFire Instruction Set Revision C (ISA\_C)

- Support for up to 256 interrupt/reset sources

#### On-Chip Memory

- Up to 128 KB flash read/program/erase over full operating voltage and temperature
- Up to 8 KB random-access memory (RAM)

#### Power-Saving Modes

- Two ultra-low-power (ULP) stop modes, one of which allows limited use of peripherals
- New ULP power wait mode
- 6 μs typical wake up time from stop3 mode
- Internal clock Source (ICS) Module containing a frequency locked-loop (FLL) controlled by internal or external reference
- Oscillator (OSC) Loop-control Pierce oscillator; crystal or ceramic resonator range of 31.25 kHz to 38.4 kHz or 1 MHz to 16 MHz

### Benefits

- Offers high performance, even at low voltage levels for battery operated applications
- Provides bus speed operation of 25.117 MHz from 2.1V to 3.6V and 10 MHz from 1.8 to 2.1V

- Provides additional instructions for easy handling of 8-bit and 16-bit data

- Allows for software flexibility and optimization for real-time applications

- Security circuitry prevents unauthorized access to RAM and flash contents to reduce system power consumption

- Allows continued application sampling in a reduced power state which extends the battery life

- Eliminates use of an external clock source. This ultimately reduces system costs associated with development

- Includes ultra-low-power OSC for accurate timebase in low-power modes



## Features

## Benefits

### Peripherals

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>Two analog comparators with option to compare to an internal reference—output can be optionally routed to timer/pulse width modulator (PWM) as input capture trigger</li> </ul>  | <ul style="list-style-type: none"> <li>Requires only single pin for input signal, freeing up additional pins for other use</li> <li>Allows other components in system to see result of comparator with minimal delay</li> <li>Can be used for single slope ADC and RC time constant measurements</li> </ul> |
| <ul style="list-style-type: none"> <li>Analog Digital Converter (ADC) up to 24-channel, 12-bit resolution; 2.5 <math>\mu</math>s conversion time; automatic compare function; 1.7 mV/<math>^{\circ}</math>C temperature sensor; internal bandgap reference channel; operation in stop3</li> </ul> | <ul style="list-style-type: none"> <li>Having 24 channels allows up to 24 analog devices to be sampled at extremely high speeds. Provides functionality across operational voltage of the MCU</li> </ul>  |
| <ul style="list-style-type: none"> <li>2x Serial Communications Interface (SCI)—Two modules offering asynchronous communications, 13-bit break option, flexible baud rate generator, double buffered transmit and receive and optional H/W parity checking and generation</li> </ul>              | <ul style="list-style-type: none"> <li>Provides standard UART communications peripheral</li> <li>Allows full-duplex, asynchronous, NRZ serial communication between MCU and remote devices</li> <li>Edge interrupt can wake up MCU from low-power mode</li> </ul>   |
| <ul style="list-style-type: none"> <li>2x SCI (Serial Peripheral Interfaces)—Two modules with full-duplex or single-wire bidirectional; double-buffered transmit and receive; master or slave mode; MSB-first or LSB-first shifting</li> </ul>  | <ul style="list-style-type: none"> <li>Having two SPI provides dedication to two separate devices. An example would be to have one SPI dedicated to a ZigBee<sup>®</sup>-ready transceiver, and the other for MCUs or peripherals</li> </ul>  |
| <ul style="list-style-type: none"> <li>Time pulse-width modulation (TPM) one 6-channel (TMP3) and two 3-channel (TPM1 and TPM2); selectable input capture, output compare, or buffered edge- or center-aligned PWM on each channel</li> </ul>   | <ul style="list-style-type: none"> <li>Three TPMs allow for three different time bases, with a total of twelve timer channels</li> </ul>  |
| <ul style="list-style-type: none"> <li>Two I<sup>2</sup>Cs with; Up to 100 kbps with maximum bus loading; multi-master operation; programmable slave address; interrupt-driven byte-by-byte data transfer; supports broadcast mode and 10-bit addressing</li> </ul>                               | <ul style="list-style-type: none"> <li>Two I<sup>2</sup>C ports enable increased system memory by using an additional I<sup>2</sup>C EEPROM. This also creates an opportunity to add an additional I<sup>2</sup>C device</li> </ul>   |

### Input/Output

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| <ul style="list-style-type: none"> <li>16 bits of Rapid General Purpose Input/Output (RGPIO) connected to the CPU's high-speed local bus with set, clear and toggle functionality</li> <li>70 GPIO (General Purpose Input/Output), one input-only and one output-only pin</li> </ul> | <ul style="list-style-type: none"> <li>Results in large number of flexible I/O pins that allow developers to easily interface device into their own designs</li> </ul> |
| <ul style="list-style-type: none"> <li>16 Keyboard Interrupts (KBI) pins with selectable polarity</li> </ul>   | <ul style="list-style-type: none"> <li>Can be used for reading input from a keypad or used as general pin interrupts</li> </ul>  |

### System Protection

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| <ul style="list-style-type: none"> <li>Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock</li> </ul> | <ul style="list-style-type: none"> <li>Allows device to recognize runaway code (infinite loops) and resets processor to avoid lock-up states</li> </ul>  |
| <ul style="list-style-type: none"> <li>Low-voltage detection with reset or interrupt; selectable trip points</li> </ul>   | <ul style="list-style-type: none"> <li>Alarms the developer of voltage drops outside of the typical operating range</li> </ul>   |
| <ul style="list-style-type: none"> <li>Illegal op code detection with reset</li> </ul>  | <ul style="list-style-type: none"> <li>Allows the device to recognize erroneous code and resets the processor to avoid lock-up states</li> </ul>   |
| <ul style="list-style-type: none"> <li>Flash block protection</li> </ul>  | <ul style="list-style-type: none"> <li>Prevents unintentional programming of protected flash memory, which greatly reduces the chance of losing vital system code for vendor applications</li> </ul> |

### Development Support

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>Classic ColdFire Debug B+ functionality mapped into a single-pin BDM interface</li> </ul> | <ul style="list-style-type: none"> <li>Allows developers to use the same hardware cables between S08 and ColdFire V1 platforms</li> </ul>   |
| <ul style="list-style-type: none"> <li>Real-time debug support</li> </ul>  | <ul style="list-style-type: none"> <li>Six hardware breakpoints which can be configured into a 1- or 2-level trigger with a programmable response (CPU halt or interrupt)</li> </ul>                        |
| <ul style="list-style-type: none"> <li>Program trace support</li> </ul>  | <ul style="list-style-type: none"> <li>Capture of processor status and debug data into on-chip trace buffer provides program trace capabilities and programmable start/stop recording conditions</li> </ul> |

## Package Options

Part Number	Temp. Range	Package
MCF51QE128CLK	-40°C to +85°C	80 LQFP
MCF51QE128CLH	-40°C to +85°C	64 LQFP
MCF51QE64CLH	-40°C to +85°C	64 LQFP
MCF51QE32CLH	-40°C to +85°C	64 LQFP
MCF51QE32LH	0°C to +70°C	64 LQFP

## Cost-Effective Development Tools

### DEMOQE128

\$99\*

Cost-effective demonstration kit, including the S08 and ColdFire<sup>®</sup> V1 daughter cards, as well as a serial port and built-in USB-BDM cable for debugging and programming.

### EVBQE128

\$325\*

Full-featured evaluation system for the QE128 device family. This evaluation system enables full evaluation of both the MC9S08QE128 and MCF51QE128 devices.

## CodeWarrior<sup>®</sup> Development Studio for Microcontrollers 6.0

Complimentary\*\* Special Edition

CodeWarrior Development Studio for Microcontrollers is a single tool suite that supports software development for Freescale's 8-bit and 32-bit ColdFire V1 microcontrollers. Designers can further accelerate application development with the help of Processor Expert, an award-winning rapid application development tool integrated into the CodeWarrior tool suite.

\* Prices indicated are MSRP

\*\* Subject to license agreement

## Learn More:

For more information about the Flexis QE family, please visit [www.freescale.com/flexis](http://www.freescale.com/flexis).

## ColdFire® Embedded Controllers

# MCF5221x

## Fact Sheet

### Overview

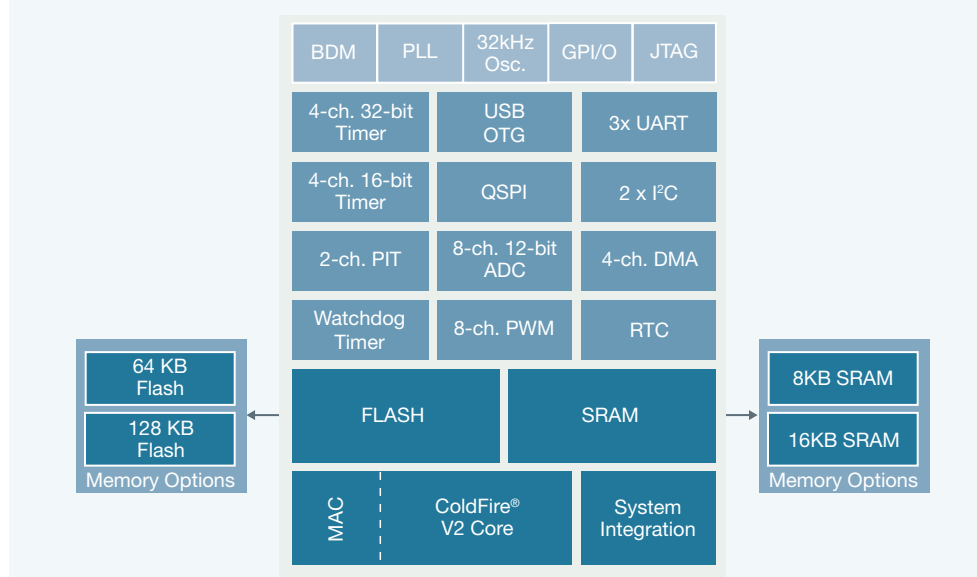
Freescale Semiconductor continues to expand the broad portfolio of ColdFire® embedded controllers with the low cost, low power MCF5221x product family. The MCF5221x represents a family of highly-integrated 32-bit microcontrollers based on the popular Version 2 ColdFire core with a multiply-accumulate unit (MAC) and divider providing 76 Dhrystone 2.1 MIPS at a frequency up to 80 MHz out of flash memory. An integrated USB On-The-Go (OTG) controller makes it ideal for applications requiring device or host connectivity functionality.

The MCF5221x gives product designers a cost-effective, full-featured solution that allows them to create next-generation systems quickly and efficiently. In addition to the USB-OTG, the MCF5221x features 16 Kbytes of internal static random access memory (SRAM) and up to 128 Kbytes of flash memory, 8-channel, 12-bit analog-to-digital converter (ADC), four 32-bit timers with DMA request capability and a 4-channel DMA controller.

The communications peripherals enable easy connection to other systems. Three universal asynchronous receiver/transmitters (UARTs) provide medium to long distance communication to other control systems or computers. Two inter-integrated circuit (I<sup>2</sup>C) modules and a queued serial peripheral interface (QSPI) allow in-system communication to connected peripherals.

The MCF5221x family is ideal for embedded control applications needing USB connectivity such as general industrial control, factory and home automation, electronic point-of-sale terminals, medical devices, electronic test equipment and consumer applications.

MCF5221x Block Diagram



Features	Benefits
<b>32-Bit ColdFire V2 Central Processing Unit (CPU)</b>	
Up to 80-MHz/3.3V CPU	Offers high performance at low voltage levels for battery-operated 32-bit applications
Temperature range of -40°C to 85°C and 0°C to 70°C	Allows for application development in the industrial market or consumer market
Support for up to 127 interrupt sources with priority and level encoding	Allows for exceptional software flexibility and optimization for real-time applications
Multiply-Accumulate (MAC) unit with 32-bit accumulator to support 16x16 or 32x32 operations.	Provides hardware acceleration of multiply and divide instructions improving overall system performance
<b>On-Chip Memory</b>	
Up to 128 Kbytes of interleaved flash memory supporting 2-1-1 accesses	Allows user to take full advantage of in-application, re-programmability benefits in virtually any environment
Up to 16-Kbyte dual-ported SRAM on CPU internal bus, supporting core and DMA access with standby power supply support	Allows write access from the DMA and CPU simultaneously, freeing the CPU resource quickly
<b>Power Management</b>	
Reduced power wait mode	Allows for analog sampling in a reduced power state
Internal relaxation oscillator—internal clock source	Eliminates the use of an external clock source which ultimately reduces the system costs
Oscillator (OSC)—Loop-control Pierce oscillator; Fundamental mode Crystal or ceramic resonator	Improves communications peripheral timing accuracy

Features Cont.	Benefits Cont.
<b>Peripherals</b>	
Universal Serial Bus On-The-Go (USB OTG) dual-mode host and device controller	Allows development of a fully compliant peripheral device that can also dynamically assume the role of a USB host
Battery backed Real Time Clock (RTC) with 32 KHz oscillator	Adds time of day and calendar functionality to system even while main power is removed from MCU.
Fast Analog to Digital Converter (ADC) 12-bit resolution; 1.125 $\mu$ s conversion time; automatic compare function and offset correction	Eight channels allows up to eight analog devices to be sampled at extremely high speeds with quick conversion times. Dual converters allow differential measuring and increase conversion speed
Serial communications interface (UART) modules offering asynchronous communications, 13-bit break option, flexible baud rate generator, double buffered transmit and receive and optional H/W parity checking and generation	Provides full duplex asynchronous/synchronous receiver and transmitter deriving an operating frequency from the internal bus clock or external clock using the timer pin
Serial peripheral interfaces (QSPI) with full-duplex or single-wire bidirectional; double-buffered transmit and receive; master or slave mode; MSB-first or LSB-first shifting	Allows full-duplex, asynchronous, NRZ serial communication between MCU and remote devices. Queued SPI provides messaging automation and buffering of messages
Two I <sup>2</sup> C modules with up to 400 kbps with maximum bus loading; multi-master operation; programmable slave address; interrupt driven byte-by-byte data transfer; supports broadcast mode and 10-bit addressing	Two I <sup>2</sup> C ports enable use of the external OTG interface, while having an additional expansion channel available that can be used by an LCD controller or IIC EEPROM, for example. This provides high bandwidth and ease of connectivity
Timer (TIM)—One 4-channel; Selectable input capture, output compare on each channel	Generates output waveforms and timer software delays. These functions allow simultaneous input waveform measurements and output waveform generation.
Pulse-Width Modulation (PWM)—8 channel module with PCM control	New PCM function eases external filter requirements
Two Programmable Interrupt Timer Modules (PIT)	Allows two programmable periodic interrupts to system. The second timer allows system application to have their own timer while scheduler or OS has its own
DMA controller with 4 fully programmable channels	Enables fast transfers of data with minimal processor interaction
<b>Input/Output</b>	
Up to 56 general purpose input/output (GPIO)s and one input-only and one output only pin	Results in a large number of flexible I/O pins that allow vendors to easily interface the device into their own designs
<b>System Protection</b>	
Secondary Watchdog Timer (SWT) Module	Allows the device to recognize run-away code and resets the processor to avoid lock-up states
Low-voltage detection with reset or interrupt	Alarms the system of voltage drops outside of the typical operating range
Flash block protection	Helps to prevent unauthorized access to flash RAM which greatly reduces the chance of losing vital system code
<b>Development Support</b>	
Real-time Trace Support	A fundamental debug function that defines the dynamic execution path
Background Debug Module (BDM)	Single wire interface for both programming and debugging that allows developers to use the same interface for multiple platforms
Breakpoint capability	Allows six breakpoints (4 PC, 1 address, and 1 data) that can be configured into one or two level trigger

## Target Applications

- HVAC building and control systems
- Medical instrumentation and monitors
- Fire/security control and monitoring systems
- Factory and automation systems
- Measurement equipment
- Hand-held medical/industrial applications
- Lighting control
- Industrial instrumentation
- Consumer electronics
- Low power industrial applications

## Cost Effective Development Tools

### M52211EVB

### US\$299 MSRP

Full-featured evaluation system for both the MCF5221x and the MCF521xx device families.

## CodeWarrior® Development Studio for Microcontrollers 6.4 Complimentary

CodeWarrior Development Studio for Microcontrollers is a single tool suite that supports software development for Freescale's ColdFire 32-bit microcontrollers and microprocessors.

## ColdFire USB Software Stack by CMX Complimentary

Freescale and CMX have collaborated to provide a complimentary USB stack for ColdFire Microcontrollers. This complimentary software package provides both USB host and USB device stacks for General HID, Joystick HID, Keyboard HID and Mouse HID.

## Package Options

Part Number	Temp. Range	Package
MCF52210CAE66	-40°C to 85°C	64 LQFP
MCF52210CEP66	-40°C to 85°C	64 QFN
MCF52210CVM66	-40°C to 85°C	81 MAPBGA
MCF52210CVM80	-40°C to 85°C	81 MAPBGA
MCF52211CAE66	-40°C to 85°C	64 LQFP
MCF52211CEP66	-40°C to 85°C	64 QFN
MCF52211CVM66	-40°C to 85°C	81 MAPBGA
MCF52211CVM80	-40°C to 85°C	81 MAPBGA
MCF52211CAF80	-40°C to 85°C	100 LQFP
MCF52212CAE50	-40°C to 85°C	64 LQFP
MCF52212AE50	0°C to 70°C	64 LQFP
MCF52213CAE50	-40°C to 85°C	64 LQFP
MCF52213AE50	0°C to 70°C	64 LQFP

## Learn More:

For more information about ColdFire family products, please visit [www.freescale.com/coldfire](http://www.freescale.com/coldfire).

# MCF5223x Family

## Fact Sheet

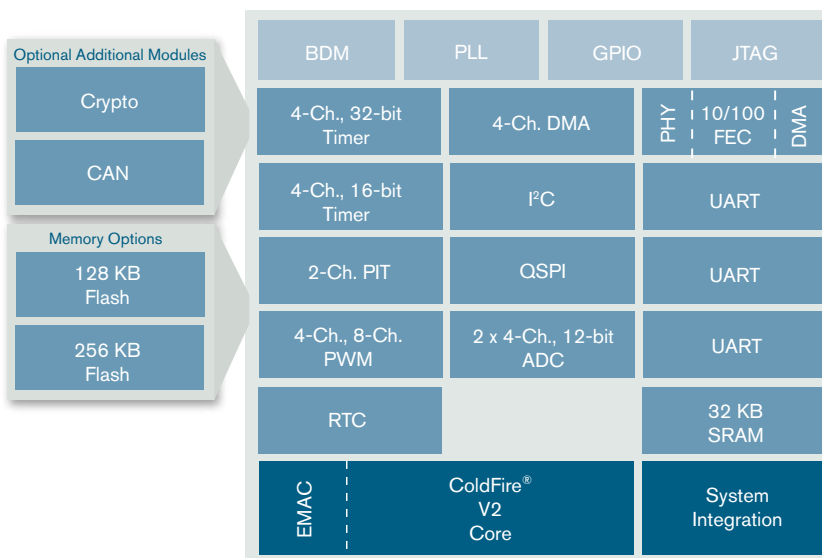
### Overview

Connecting 32-bit controlled applications in the industrial, commercial and consumer markets is fast becoming a necessity rather than an option. Many new applications, such as remote data collection, home automation and networked appliances, require secure, high-performance connectivity at an economical price. Freescale Semiconductor gives design engineers the flexibility to choose the right 32-bit microcontroller from a broad portfolio of ColdFire® embedded controllers.

To help ensure secure connectivity, the MCF5223x family of ColdFire devices are single-chip solutions that provide 32-bit control with an Ethernet interface. It combines a 10/100 Fast Ethernet controller (FEC), Ethernet Physical Layer (EPHY), CAN 2.0B and a Cryptographic Acceleration Unit (CAU) for secure hardware encryption with the Version 2 ColdFire core to provide exceptional performance at a reasonable cost. The MCF5223x embedded controller family provides designers with the right set of peripherals and memory sizes for a compact Ethernet-enabled platform that cuts development time and cost to help your products get to market quicker.

The MCF5223x family integrates standard ColdFire peripherals, including three universal asynchronous receiver/transmitters (UARTs) for medium and long distance connections, an inter-integrated circuit (I<sup>2</sup>C) and a queued serial peripheral interface (QSPI) for in-system communications to connected peripherals.

### MCF5223x Family Block Diagram



### Delivering Cost-Effective ColdFire Solutions

The MCF5223x family expands the entry-level to 32-bit performance and supports standard protocols for applications that need connectivity options with security encryption. Industrial and commercial applications typically have long lifetimes, and Freescale has demonstrated a commitment to long-term support.

A natural migration for current MCF521x customers looking to integrate Ethernet into their applications, the MCF5223x family delivers cost-effective, feature-rich microcontrollers with industry-standard

connectivity. These devices widen the migration bridge for existing 8- and 16-bit users who need a low-cost, entry-level 32-bit solution that incorporates 32-bit performance, Fast Ethernet features and comprehensive tools support. The Freescale ColdFire roadmap to high-end 32-bit performance and connectivity will allow customers to migrate their applications easily and quickly.



## ColdFire® Selector Guide

Part Number	Memory Flash/SRAM	Key Features	Package	Speed
MCF52230	128 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, DMA	80/112 LQFP	60 MHz
MCF52231	128 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, DMA, CAN	80/112 LQFP	60 MHz
MCF52232	128 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, DMA	80 LQFP	50 MHz
MCF52233	256 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, DMA	80/112 LQFP	60 MHz
MCF52234	256 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, DMA, CAN	112 LQFP 121 MAPBGA	60 MHz
MCF52235	256 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, CAN, DMA, Crypto	112 LQFP 121 MAPBGA	60 MHz
MCF52236	256 KB/32 KB	FEC, EPHY, 3 UARTs, I <sup>2</sup> C, QSPI, A/D, 16-bit/32-bit/PWM timers, DMA	80 LQFP	50 MHz
M52235EVB		Development Kit \$299*		
M52233DEMO		Cost-Effective Board \$99*		

\*Manufacturer Suggested Resale Price

### Developing with the MCF5223x Family

The easy to use and fully functional M52235EVB development kit simplifies MCF5223x product development, which helps customers reach their markets quickly with a new generation of products. Each kit includes open source software and CodeWarrior™ Development Studio for ColdFire Architectures, Special Edition. Further development assistance is available through Freescale's web-based Fast Track™ support resources, including online training and tech support. In addition, the MCF5223x family of embedded controllers benefits from the support of a number of world-class third-party tool vendors.

#### MCF52230/1/2 Features

- 128 KB of embedded flash memory
- 32 KB of SRAM
- 80 LQFP
- 112 LQFP (MCF52230 and MCF52231 only)

#### MCF52233/6 Features

- 256 KB of embedded flash memory
- 32 KB of SRAM
- 80 LQFP
- 112 LQFP (MCF52233 only)

#### MCF52234/5 Features

- 256 KB of embedded flash memory
- 32 KB of SRAM
- 112 LQFP
- 121 MAPBGA

### Integration

- Up to 32 KB SRAM
- Up to 256 KB flash: 100 KB W/E cycles, 10 years data retention
- 10/100 Fast Ethernet controller (FEC) with PHY
- Ethernet media access controller (EMAC) module
- Cryptographic accelerator unit with random number generator
- CAN 2.0B controller
- Three UARTs
- Queued serial peripheral interface (QSPI)
- Inter-integrated circuit (I<sup>2</sup>C) bus interface
- Four 32-bit timer channels with DMA capability
- 4-channel, 16-bit timer for capture, compare and pulse width modulation (PWM)
- 2-channel periodic interrupt timer
- 4-channel, 16-bit or 8-channel, 8-bit PWM generator
- Two 4-channel, 12-bit analog-to-digital (ADC) converters
- 4-channel DMA controller
- Up to 73 general-purpose I/Os
- System integration (PLL, SW watchdog)
- Single 3.3-volt supply

### MCF5223x Specifications

- 10/100 Fast Ethernet controller (FEC)
- Ethernet Physical Layer (EPHY)
- Up to 57 Dhrystone 2.1 MIPS @ 60 MHz
- EMAC module and HW divide
- Optional CAN 2.0
- Optional Crypto
- Real-time clock

### Learn More:

For more information about ColdFire family products, please visit [www.freescale.com/coldfire](http://www.freescale.com/coldfire).

# MCF5445x Family

## ColdFire® embedded controllers

### Target Applications

- Network attached storage
- Point-of-sale terminals
- HVAC building and control systems
- Medical instrumentation and monitors
- Embedded VoIP
- Fire/security control and monitoring systems
- Factory and automation systems
- Test and measurement equipment

### Overview

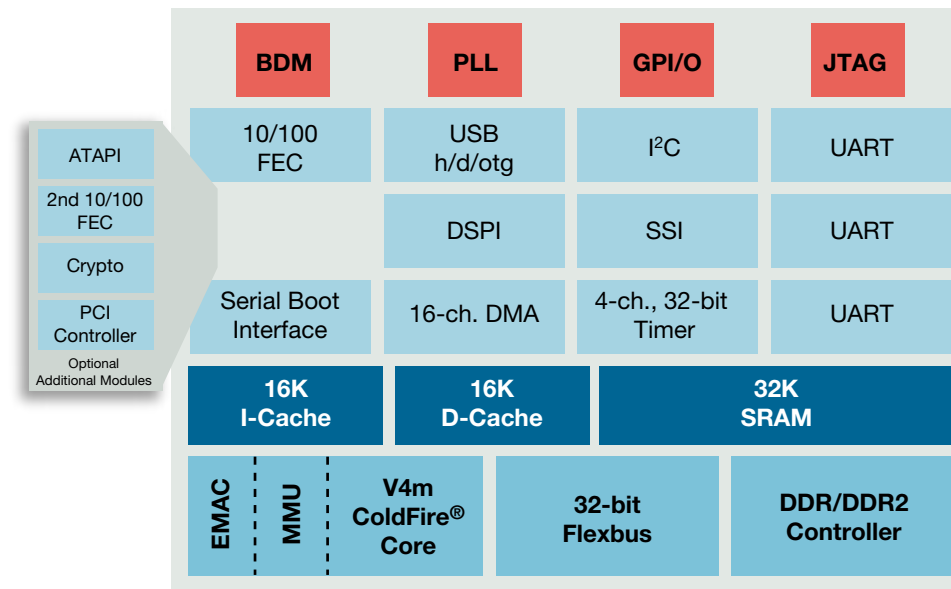
Freescale Semiconductor continues to expand the Controller Continuum by introducing an advanced high performance, highly integrated product family, the MCF5445x family. The ColdFire MCF5445x microprocessors are designed for power-conscious developers needing a high performance 32-bit microprocessor plus a rich set of on-chip connectivity peripherals including Ethernet, USB

On-The-Go (OTG) and Peripheral Component Interconnect (PCI). These highly integrated microprocessors open the door to expanding application capabilities while driving down the total system cost and power requirements.

The MCF5445x products are based on the V4m ColdFire microarchitecture featuring an enhanced multiply-accumulate unit (eMAC), hardware divide and a memory management unit (MMU), allowing designers to run protected mode OS, such as Linux® OS as well as other third party RTOSs. In addition, the MCF5445x family features 32 Kbytes of internal SRAM and 16Kbytes of both I-Cache and D-Cache and a DDR2/DDR memory controller that allows the use of DDR1, DDR2 and Mobile DDR memory. The MCF5445x also contain four 32-bit timers with DMA request capability, a 16-channel DMA controller, an I²C module, 3 UARTs, a DMA SPI, a hardware encryption module, an SSI module, a serial boot facility and an ATAPI hard drive controller.

The combination of performance and on-chip integrations make the MCF5445x family an ideal solution for consumer applications such as network attached storage and Ethernet gateways. This product also fits well in embedded control applications such as industrial control, embedded VoIP, factory automation, point-of-sale, medical and testing equipment.

MCF5445x Family Block Diagram



### Package Options

Part Number	Temp. Range	Features	Package	Speeds*	10k Resale Pricing**
MCF54455	0° to 70°, -40° to +85°	USB 2.0 OTG with Transceiver, 2xFEC, PCI, DDR2, ATA, Crypto	360 PBGA	266 MHz, 200 MHz	\$18.95
MCF54454	0° to 70°, -40° to +85°	USB 2.0 OTG with Transceiver, 2xFEC, PCI, DDR2, ATA	360 PBGA	266 MHz, 200 MHz	\$16.95
MCF54453	0° to 70°, -40° to +85°	USB 2.0 OTG with Transceiver, 2xFEC, PCI, DDR2, Crypto	360 PBGA	266 MHz, 200 MHz	\$15.95
MCF54452	0° to 70°, -40° to +85°	USB 2.0 OTG with Transceiver, 2xFEC, PCI, DDR2	360 PBGA	266 MHz, 200 MHz	\$13.95
MCF54451	0° to 70°, -40° to +85°	USB 2.0 OTG with Transceiver, FEC, DDR2, Crypto	256 MAPBGA	240 MHz, 180 MHz	\$11.95
MCF54450	0° to 70°, -40° to +85°	USB 2.0 OTG with Transceiver, FEC, DDR2	256 MAPBGA	240 MHz, 180 MHz	\$9.95

\* Indicated speeds are targets for the devices

\*\* Suggested Resale Pricing

**Features****Benefits****32-Bit ColdFire V4 Central Processing Unit (CPU)**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• 410 MIPS at 266-MHz</li> <li>• 3.3V I/O, 1.5V core</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Delivers high performance and functionality for improved system performance</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Memory Management Unit (MMU)</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Allows for use of a protected memory OS</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Cryptography Acceleration Unit (CAU)</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Helps to protect sensitive data using DES and AES block cipher engines and MD5, SHA-1 and HMAC hash accelerators</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Enhanced Multiply-Accumulate (eMAC) unit with four 48-bit accumulators to support 16x16 or 32x32 operations</li> </ul> | <ul style="list-style-type: none"> <li>◦ Provides hardware acceleration of multiply instructions improving overall system performance</li> <li>◦ Allows for use in typical DSP type applications</li> </ul> |

**On-Chip Memory**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Independent 16Kbyte data and instruction caches</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Increases system performance</li> </ul>  |
| <ul style="list-style-type: none"> <li>• 32-Kbyte dual-ported SRAM on CPU internal bus, supporting core and DMA access with standby power supply support</li> </ul> | <ul style="list-style-type: none"> <li>◦ Security circuitry to prevent unauthorized access to RAM contents and increase system performance for critical code, fast stack operations and Ethernet buffers</li> </ul> |

**Power Management**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Peripheral power management register</li> </ul>      | <ul style="list-style-type: none"> <li>◦ Allows the enable/disable of the clocks to most peripherals, lowering power consumption</li> </ul> |
| <ul style="list-style-type: none"> <li>• Processor sleep and whole chip stop modes</li> </ul> | <ul style="list-style-type: none"> <li>◦ Minimizes power consumption for use in "green" products</li> </ul>                                 |

**Peripherals**

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• DDR1/DDR2/Mobile DDR SDRAM Controller</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Popular, economical and fast memory access which allows for a scalable solution to meet power and performance needs</li> </ul>   |
| <ul style="list-style-type: none"> <li>• ATA Controller</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Enables control of an external hard disk</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Peripheral Component Interconnect (PCI) Bus</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Enables fast integration of any PCI-based peripheral (ex. Firewire, Bluetooth, WiFi, Graphics and DAQ systems, etc.)</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Universal Serial Bus (USB) 2.0 On-The-Go (OTG) Controller with full-speed transceiver</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Configurable as Full-Speed device, host or OTG</li> <li>◦ High-Speed capable with off-chip ULPI PHY</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Two Fast Ethernet Media Access Controllers (FEC MAC)</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Enables remote access, remote management, redundant networking or gateway functions</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Serial communications interface (UART) modules offering asynchronous communications, 13-bit break option, flexible baud rate generator, double buffered transmit and receive and optional H/W parity checking and generation</li> </ul> | <ul style="list-style-type: none"> <li>◦ Provides full duplex asynchronous/synchronous receiver and transmitter deriving an operating frequency from the internal bus clock or external clock using the timer pin</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Synchronous Serial Interface (SSI)</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Audio CODEC interface using I<sup>2</sup>S mode within SSI module</li> </ul>   |
| <ul style="list-style-type: none"> <li>• DMA Serial Peripheral Interfaces (DSPI) with full-duplex, three-wire synchronous transfer with up to 16 pre-programmed transfers</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Allows full-duplex, asynchronous, NRZ serial communication between MPU and remote devices</li> <li>◦ DMA SPI provides messaging automation and the scheduling of messages</li> <li>◦ Also used for Serial Boot to SPI-based flash devices</li> </ul> |
| <ul style="list-style-type: none"> <li>• Master or slave configurable</li> </ul>   |   |
| <ul style="list-style-type: none"> <li>• I<sup>2</sup>Cs Module; Up to 400 kbps with maximum bus loading; Multi-master operation; Programmable slave address</li> </ul>  | <ul style="list-style-type: none"> <li>◦ I<sup>2</sup>C ports enable external interfaces to an LCD display, EEPROM, A/D controller, etc. I<sup>2</sup>C provides high bandwidth and ease of connectivity</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Real Time Clock (RTC) with separate power pins</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Adds time of day and calendar functionality to system even while main power is removed from MPU</li> </ul>   |
| <ul style="list-style-type: none"> <li>• DMA Timers</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Four 32-bit timers used independently or for generating DMA transactions</li> </ul>  |
| <ul style="list-style-type: none"> <li>• DMA Controller with 16 fully programmable channels.</li> </ul>  | <ul style="list-style-type: none"> <li>◦ Enables fast transfers of data with minimal processor interaction</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Programmable Interrupt Timer Modules (PIT)</li> </ul>   | <ul style="list-style-type: none"> <li>◦ Allows four programmable periodic interrupts to system, enabling system applications to have their own timer while scheduler or OS has its own</li> </ul>  |

**Input/Output**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Up to 132 GPIO pins</li> </ul> | <ul style="list-style-type: none"> <li>◦ Results in a large number of flexible I/O pins that allow vendors to easily interface the device into their own designs as every peripheral pin is GPIO capable</li> </ul> |
|---|---|

**Development Support**

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Real-time Trace Support</li> </ul>          | <ul style="list-style-type: none"> <li>◦ A fundamental debug functionality that defines the dynamic instruction execution path</li> </ul>                |
| <ul style="list-style-type: none"> <li>• Background Debug Interface (BDM)</li> </ul> | <ul style="list-style-type: none"> <li>◦ This allows the developers to use the same interface for multiple platforms</li> </ul>                          |
| <ul style="list-style-type: none"> <li>• Breakpoint capability</li> </ul>            | <ul style="list-style-type: none"> <li>◦ Allows six breakpoints (4 PC, 1 address and 1 data) that can be configured into 1 or 2 level trigger</li> </ul> |

## Cost-Effective Development Tools

### M54455EVB—Suggested retail price - \$850 (USD)



Full-featured evaluation system for the MCF5445x

device family. The M54455EVB is powered by the MCF54455VM266 processor and features an ATA interface, USB Host, USB Device, dual-10/100 Ethernet, four PCI slots, DDR2 SDRAM, and much more. This evaluation system comes packaged in a low-profile ATX case with all the necessary components to get up and running quickly and easily.

**Linux BSP—Complimentary**

Linux Board Support Packages (BSPs) for Freescale silicon are tested, certified and frozen, ensuring a fully operational tool chain, kernel and board specific modules that are ready to use together within a fixed configuration for specific hardware reference platforms. These BSPs provide the foundation you need to begin your project quickly.

## CodeWarrior® Development Studio for ColdFire Architectures, v7.0—Complimentary

CodeWarrior Development Studio for ColdFire architectures is a single tool suite that supports software development for Freescale's ColdFire Family of 32-bit products. Support for all Freescale ColdFire devices coupled with the cross-platform capabilities of the award winning CodeWarrior Integrated Development Environment (IDE) simplifies code migration and re-use for faster product development. CodeWarrior Development Studio for ColdFire Architectures, version 7 is a comprehensive integrated development environment for ColdFire hardware bring-up through embedded applications.

**3rd Party Tools—Trial Version Included**

The ColdFire embedded controller family is supported by world-class development tool suites offered through leading third-party tools developers. Selected third parties tools have provided trial editions for initial evaluation.

**Learn More:**

For more information about ColdFire family products, please visit [www.freescale.com/coldfire](http://www.freescale.com/coldfire).

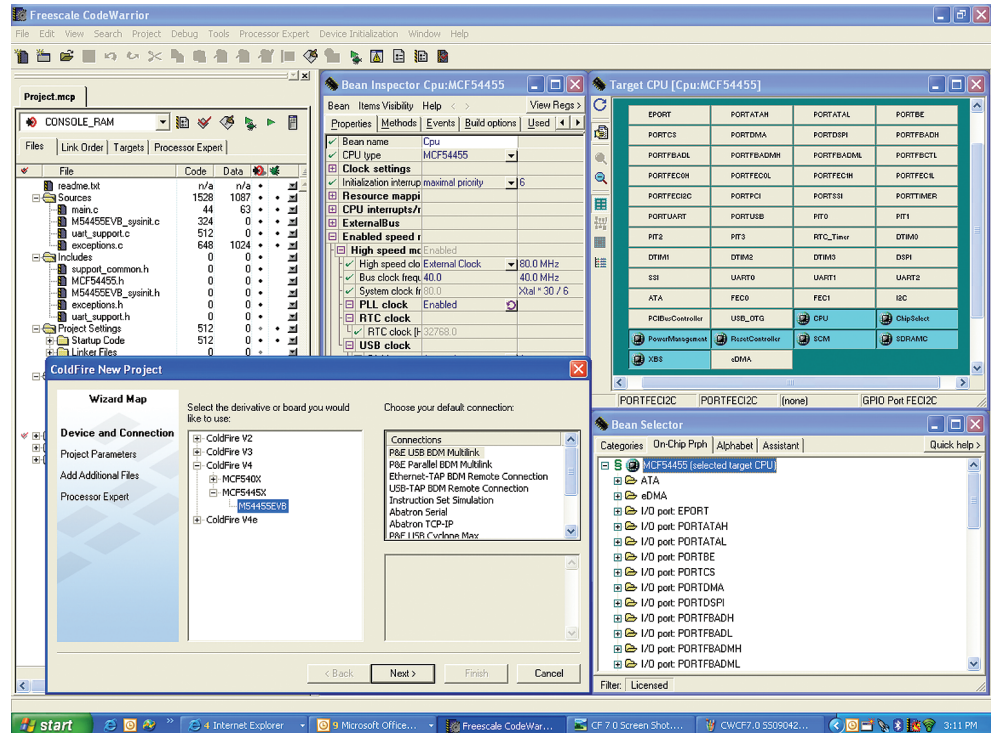
# CodeWarrior® Development Studio for ColdFire® Architectures v7.0

## Tools to Maximize Time to Market

When building network connected industrial control devices, comprehensive development tools that enhance developer productivity are a crucial component of project success. As a part of Freescale, we have unique access to the silicon design teams, which is leveraged to create complementary supporting products and solutions. Support for Freescale ColdFire devices coupled with the cross-platform capabilities of the award-winning CodeWarrior integrated development environment (IDE) simplifies code migration and reuse for faster product development.\* CodeWarrior Development Studio for ColdFire Architectures, version 7.0 is a single integrated tool suite environment for ColdFire hardware bring-up through embedded applications.

## Start Your Projects Quickly and Easily

A quick start guide eases installation and helps create a first example project. Additional example projects are also available to assist in your design efforts. New to CodeWarrior Development Studio for ColdFire is an intuitive Project Wizard, that enables you to create a working project (C or C++) in as few as seven mouse clicks.



Skip the endless debug cycles at the end of a project and the frantic search through the silicon documentation to find the single bit that is set incorrectly causing your application to crash. Just define the functionality you need for your application and Processor Expert™, which is a rapid application development tool integrated into the CodeWarrior tool suite, generates

tested, optimized C code tuned for your application and the particular ColdFire derivative you have chosen. If you prefer a more hands-on approach to development, use the Device Initialization tool. Just select the CPU peripheral settings required for your application and then generate the initialization code tuned to your application needs.



## UNIS Processor Expert\*

Processor Expert is a rapid application design tool that combines easy-to-use component-based application creation with an expert knowledge system. CPU, on-chip peripherals, external peripherals and software functionality are encapsulated into components called Embedded Beans™. You can tailor each component's functionality to fit your application requirements by modifying the component's properties, methods and events. When you build the project, Processor Expert automatically generates highly optimized C code and places the files into your project. Endless troubleshooting cycles are a thing of the past! Processor Expert's knowledge base only provides valid choices and immediately flags potential resource conflicts, allowing you to resolve the problems during the initial design phase. Processor Expert also makes porting a breeze. Simply select the new MCU and Processor Expert maps the software and peripheral components that describe your application's functionality to the resources available on the new MCU. All you have to do is resolve any problems flagged by Processor Expert and you're finished.

\*Available December 2007

## UNIS Device Initialization

Device Initialization provides a fast and easy way to configure and generate initialization code for ColdFire microcontrollers. The Device Initialization tool contains only one set of beans: Peripheral Initialization Beans. The initialization code can be generated in either assembly or C code. During the Code Generation process the Device Initialization tool generates a function named MCU\_Init with the initialization code for the CPU peripherals you selected—configured to your specifications. To use the MCU\_Init function, just insert the function call at the start of your application code.

You control how the generated code is added to your project. The Device Initialization tool can add the code directly to your project or it can create a separate text file—it's your choice. If you decide to create a separate text file, you can easily add the code to your project by cutting and pasting the code to an existing file in your project or adding the text file to your project.

## Build Systems

The CodeWarrior build system helps you develop applications with the smallest code size and fastest execution time. Industry-leading CodeWarrior C/C++ Compiler Suite includes ANSI C and ISO C++ compatible standard library.

- Standard or compact C libraries available for embedded development
- Global optimizations for C/C++
- Support for ColdFire native data alignment yielding increased performance
- Easily configurable warning levels
- Flexible compiler/linker settings through graphical control
- Enhanced sets of standard libraries for better memory footprint

## Project Manager

CodeWarrior IDE holds source files and libraries, manages dependencies and stores compiler, linker and other preferences using projects in a graphical user interface.

- Dependency management eliminates the need for complicated make-files
- Keeps constant track of code size, file link order and debugging options
- Easily configurable warning levels

## Source-Level Debugger

A high-performance graphical source-level debugger is equipped with the latest features to shorten hardware bring-up and application development time.

- Edit/write code while debugging for faster results with source code browsing
- Pop-up windows to display/edit variable values and registers
- Source, assembly and mixed debugging support
- Debug With Arbitrary Records Format (DWARF2) support
- Debugging and analysis support for industry-leading real-time operating systems (RTOS): ARC™ MQX™, ThreadX, Quadros RTXC™ and others.

## Editor and Code Navigation System

Enables the creation and manipulation of source code and other text files.

- Set breakpoints in the editor
- Supports Assembly language coloring
- Edit compile-time errors from inside the build system
- Pop-up menus enable quick navigation to project functions and headers
- Drag-and-drop editing in IDE for source code
- Click on compile-time error links to view the source of the error

## Search Engine

Locates a specific text string; provides file comparison and file-differencing functionality.

- Differences can easily be viewed with color-coded, line-by-line comparisons
- Compare files and selectively apply differences with a single mouse click

Note: Please see product release notes for details on 7.0

CodeWarrior Development Studio provides the capabilities required by every engineer in the development cycle, from board bring-up to firmware development to final application development.

Segmented ColdFire Development Tools Editions Features and Benefits				
Feature	Benefit	Special Edition	Standard Edition	Professional Edition
<b>IDE</b>				
Project Wizard	Allows for easy project set-up	Yes	Yes	Yes
Program Manager Projects/Sub Projects	Eliminates confusing and often complex make-files with visual preference panels	Unlimited/ Unlimited	Unlimited/ Unlimited	Unlimited/ Unlimited
<b>Build Tools</b>				
Assembler for ColdFire V2, V3 and V4e MCUs	For specific optimization only you can provide	Unlimited	Unlimited	Unlimited
Optimizing Compiler for ColdFire V2, V3 and V4e MCUs	Reduces code size and maximizes the capabilities of the microcontroller to achieve top performance	C-128K	C-Unlimited	C-Unlimited C++ Unlimited
Libmaker	Allows reuse and maintenance of Code through libraries	Yes	Yes	Yes
<b>Debug Tools</b>				
Source-Level Debugger	Speeds debug cycles by view the source code as it executes	ASM-Unlimited C-128K	ASM-Unlimited C-Unlimited	ASM-Unlimited C-Unlimited C++-Unlimited
Flash Programming	Fully Integrated flash programming improves the build-debug cycle because it automates your downloads	Yes	Yes	Yes
Flash Algorithm Tool	Adds capability to generate flash Algorithm for external memory devices	Yes	Yes	Yes
Simulator V2 and V4e	Reduces costs and eliminates possible hardware issues during development	No	Yes	Yes
Data Visualization	Allows designers to see how a program effects peripherals	Yes	Yes	Yes
RTOS Awareness	Ready to work with RTOS-aware debug capabilities	No	No	Yes
Debug Hardware Support	Allows for stop mode debug and on-chip debugging	USB connections	USB connections	USB/Ethernet connections
<b>Advanced Tools</b>				
Device Initialization for ColdFire V2, V3 and V4e MCUs	Allows you to graphically set up the CPU peripheral registers and generate initialization code (ASM or C) tailored to your application	Yes	Yes	Yes
Processor Expert for ColdFire V2, V3 and V4e MCUs	Abstracts the hardware layer and generates optimized, microcontroller-specific code tailored to your application, so you can concentrate on design			
• Basic Beans		Yes	Yes	Yes
• Advanced Beans		No	No	Yes
Bean Wizard	Allows you to create reuseable software components, which can be easily retargeted to any Freescale ColdFire, DSC, HC(S)08 or HC(S)12 microcontroller	No	No	Yes
Profile Analysis and Code Coverage	Gives you visibility into running a program to allow fine tuning and better quality and style guidelines	No	No	Yes

## Processors Supported

MCF52xxx V2 Core	MC53xx V3 Core	MCF54xx V4 Core	MCF547x V4e Core	MCF548x V4e Core	MCF5445x V4m
5206	5307	5407	5470	5480	54450
5208	5327		5471	5481	54451
5213	5328		5472	5482	54452
5214	5329		5473	5483	54453
523x	5373		5474	5484	54454
5253			5475	5485	54455
5249					
5272, 527x					
5282, 528x					
5221x, 5222x, 5223x					

## Features

- New Project Wizard
- New optimized ColdFire compiler and embedded libraries to increase code density and performance
- Assembler for ColdFire V2, V3 and V4 MCUs
- Graphical, source-level debugger
- Flash programming support
- Flash Tool Kit—Enables the creation of new flash programming algorithms for external memory devices
- Updated ColdFire Flash Programmer
- Instruction set simulation for V2 and V4e MCUs
- Data visualization
- Simple Profiler
- UNIS Device Initialization tool to generate ColdFire V2, V3 and V4 CPU and peripheral initialization code
- UNIS Processor Expert™ with Bean Wizard™ and components for ColdFire V2, V3 and V4 CPUs, on-chip peripherals (Available December 2007)

- Multiple example projects to use as templates for your next project
- CodeWarrior for ColdFire v6.4 to v7.0 Porting Guide
- CodeWarrior IDE5.9
  - Support to set a limit on the number of stack frames the debugger retrieves/displays
  - Support to set the type of watchpoint to set in a debug session
  - Support to automatically set the default breakpoint template at the offset of a debug launch

## Specifications

- IDE version: 5.9
- Host platforms: Microsoft® Windows XP/2000/Vista
- Language support: Assembly, C/C ++
- Build tools output formats: ELF/DWARF 2.0, Freescale S Record, Intel® hex, binary

- Host target interfaces:
  - CodeWarrior® USB TAP
  - CodeWarrior® Ethernet TAP
  - Open Source BDM connections (ColdFire TBLCF)
  - Cyclone Max, USB BDM Multilink, Parallel, Lightning (P&E Microsystems)
  - Abatron BDI1000 and 2000

## System Requirements

- 1.0 GHz Pentium®-compatible processor or better
- Microsoft Windows 2000/XP/Vista
- 512 MB RAM (1 GB recommended)
- At least 600 MB hard disk space
- CD-ROM drive for installation
- USB port for communications with target hardware
- (optional) Ethernet port for communications with target hardware

## Support Policy

- Online help and documentation
- Includes 12-month technical support
- Free 30-day evaluation license available

Contact your local Freescale representative for more information.

## Products

## Part Number

CodeWarrior for ColdFire, Standard Edition	CWS-MCF-STDED-CX
CodeWarrior for ColdFire, Professional Edition	CWS-MCF-PROED-CX
<b>Support</b>	
CodeWarrior for ColdFire, Standard Edition	CWT-MCF-STDED-TX
CodeWarrior for ColdFire, Professional Edition	CWT-MCF-PROED-TX

Contact your local Freescale representative for information

\*The Flexis™ series of products is supported by CodeWarrior Development Studio for Microcontrollers v6.0.

## Learn More:

For more information about Freescale products, please visit [www.freescale.com/codewarrior](http://www.freescale.com/codewarrior).

# ColdFire Development Tools

## Fact Sheet

### Overview

Freescale Semiconductor's ColdFire® family of 32-bit embedded controllers is backed by an unbeatable selection of development tools, both from Freescale and the industry's leading third-party vendors. These tools help you get the most out of Freescale processors in all phases of the design process.

### Evaluation Boards and Development Kits

Freescale Semiconductor	<a href="http://www.freescale.com">www.freescale.com</a>
Axiom	<a href="http://www.axman.com">www.axman.com</a>
FSI Systems	<a href="http://www.fsisys.com">www.fsisys.com</a>
Logic Product Development	<a href="http://www.logicpd.com">www.logicpd.com</a>
NetBurner	<a href="http://www.netburner.com">www.netburner.com</a>
Intec Automation	<a href="http://www.steroidmicros.com">www.steroidmicros.com</a>
P&E Microcomputer Systems	<a href="http://www.pemicro.com">www.pemicro.com</a>
SofTec	<a href="http://www.softecmicro.com">www.softecmicro.com</a>

### Real-Time Operating Systems (RTOSes)

Accelerated Technology/Mentor Graphics	<a href="http://www.acceleratedtechnology.com">www.acceleratedtechnology.com</a>
eCosCentric	<a href="http://www.ecoscentric.com">www.ecoscentric.com</a>
CMX Systems	<a href="http://www.cmx.com">www.cmx.com</a>
ExpressLogic	<a href="http://www.rtos.com">www.rtos.com</a>
Green Hills Software, Inc.	<a href="http://www.ghs.com">www.ghs.com</a>
InterNiche Technologies	<a href="http://www.iniche.com">www.iniche.com</a>
Linux	<a href="http://www.freescale.com/linux">www.freescale.com/linux</a>
Micrium	<a href="http://www.micrium.com">www.micrium.com</a>
MicroDigital	<a href="http://www.smx-rtos.com">www.smx-rtos.com</a>
MQX Embedded	<a href="http://www.mqxembedded.com">www.mqxembedded.com</a>
NetBurner	<a href="http://www.netburner.com">www.netburner.com</a>
Quadros Systems, Inc.	<a href="http://www.quadros.com">www.quadros.com</a>
Wind River Systems Inc.	<a href="http://www.windriver.com">www.windriver.com</a>
µClinux	<a href="http://www.freescale.com/linux">www.freescale.com/linux</a>

### Compilers, Simulators, Debuggers

Accelerated Technology/Mentor Graphics	<a href="http://www.acceleratedtechnology.com">www.acceleratedtechnology.com</a>
CodeSourcery	<a href="http://www.codesourcery.com/">www.codesourcery.com/</a>
CodeWarrior™ tools	<a href="http://www.codewarrior.com">www.codewarrior.com</a>
GNU	<a href="http://www.gnu.org">www.gnu.org</a>
Green Hills Software, Inc.	<a href="http://www.ghs.com">www.ghs.com</a>
IAR	<a href="http://www.iar.com">www.iar.com</a>
P&E Microcomputer Systems	<a href="http://www.pemicro.com">www.pemicro.com</a>
NetBurner	<a href="http://www.netburner.com">www.netburner.com</a>
Wind River Systems Inc.	<a href="http://www.windriver.com">www.windriver.com</a>

### Stacks, Drivers, Translators

Accelerated Technology/Mentor Graphics	<a href="http://www.acceleratedtechnology.com">www.acceleratedtechnology.com</a>
CMX Systems	<a href="http://www.cmx.com">www.cmx.com</a>
Embedded Access	<a href="http://www.embedded-access.com">www.embedded-access.com</a>
ExpressLogic	<a href="http://www.rtos.com">www.rtos.com</a>
Freescale	<a href="http://www.freescale.com">www.freescale.com</a>
Green Hills Software, Inc.	<a href="http://www.ghs.com">www.ghs.com</a>
InterNiche Technologies	<a href="http://www.iniche.com">www.iniche.com</a>
Ixxat	<a href="http://www.ixxat.com">www.ixxat.com</a>
Micrium	<a href="http://www.micrium.com">www.micrium.com</a>
Micro APL	<a href="http://www.microapl.com">www.microapl.com</a>
Mocana Corporation	<a href="http://www.mocana.com">www.mocana.com</a>
NetBurner	<a href="http://www.netburner.com">www.netburner.com</a>
OpenTCP	<a href="http://www.opentcp.org">www.opentcp.org</a>
Quadros Systems, Inc.	<a href="http://www.quadros.com">www.quadros.com</a>
Treck	<a href="http://www.treck.com">www.treck.com</a>
Wind River Systems Inc.	<a href="http://www.windriver.com">www.windriver.com</a>

### Specialized Tools

Arcturus (VoIP)	<a href="http://www.arcturus.com">www.arcturus.com</a>
ASH WARE Inc. (eTPU)	<a href="http://www.ashware.com">www.ashware.com</a>
Byte Craft Limited (eTPU)	<a href="http://www.bytecraft.com">www.bytecraft.com</a>
Freescale (eTPU)	<a href="http://www.freescale.com">www.freescale.com</a>
Nano-X (LCD)	<a href="http://www.microwindows.org">www.microwindows.org</a>
Swell Software (LCD)	<a href="http://www.swellsoftware.com">www.swellsoftware.com</a>



## ColdFire Evaluation/Development Boards and Systems

- **EVBE128**  
Evaluation System for the Flexis™ QE Family
- **M5208EVB**  
Evaluation System for the MCF5207 and MCF5208
- **M5213EVB**  
Evaluation System for the MCF5211, MCF5212 and MCF5213
- **M52211EVB**  
Evaluation system for the MCF521xx and the MCF5221x Families
- **M52223EVB**  
Evaluation System for the MCF5222x Family
- **M52235EVB**  
Evaluation System for the MCF5223x Family
- **M523xEVB**  
Evaluation System for the MCF523x Family
- **M5253EVB**  
Evaluation system for the MCF5253
- **M5271EVB**  
Evaluation System for the MCF5270 and MCF5271
- **M5275EVB**  
Evaluation System for the MCF5274/L and MCF5275/L
- **M5282EVB**  
Evaluation Board for the MCF5214/16 and MCF5280/81/82
- **M5329EVB**  
Evaluation System for the MCF532x Family
- **M5373EVB**  
Evaluation System for the MCF537x Family
- **M54455EVB**  
Evaluation System for the MCF5445x Family
- **M5475EVB**  
Evaluation System for the MCF547x Family
- **M5485EVB**  
Evaluation System for the MCF548x Family

## ColdFire Low-Cost Development Systems

- **DEMOQE128**  
Low-cost development kit for the Flexis™ QE Family
- **M5211DEMO**  
Low-Cost Kit for the MCF5211
- **M52210DEMO**  
Low-Cost Board for the MCF52210
- **M52221DEMO**  
Low-Cost Board for the MCF52221
- **M52233DEMO**  
Low-Cost Board for the MCF52233
- **M5235BCC**  
Low-Cost Board—Business Card Computer—for the MCF5235
- **M5235BCCkit**  
Low-Cost Development Kit for the MCF5235
- **M5270PROMO**  
Lite Low-Cost Kit for the MCF5270
- **M5282LITE**  
Low-Cost Board for the MCF5282
- **M5282LITEKIT**  
Low-Cost Development Kit for the MCF5282
- **M5474LITEkit**  
Low-Cost Board for the MCF547x Family
- **M5484LITEkit**  
Low-Cost Board for the MCF548x Family
- **NB5270PRO**  
Full Low-Cost Kit for the MCF5270

## Production-Ready Modules

Fire Engine Part Number	DDR Memory (MB)	NOR Flash (MB)	Boot Flash	Graphics Controller	USB Host	Freescall Processor
M5329AFE	32	0	X	X	X	MCF5329CVM240
M5329BFE	32	16	X	X	X	MCF5329CVM240
M5475CFEE	64	16	X	X	X	MCF5475ZP266
M5484GFEE	64	0	X	-	X	MCF5484CZP200
M5485AFEE	64	0	X	-	-	MCF5485CZP200
M5485BFEE	64	16	X	-	-	MCF5485CZP200
M5485HFEE	64	16	X	X	X	MCF5485CZP200

**MOD5270:** MCF5270 processor, 10/100 Ethernet RJ-45, 2 MB SDRAM/512 KB Flash, three UARTs, address/data bus, QSPI, I<sup>2</sup>C, CS, GPIO

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

# RTOS and Development Tools

## ColdFire® MCF5445x Family



### Target Applications

- Network attached storage
- Point-of-sale terminals
- HVAC building and control systems
- Medical instrumentation and monitors
- Embedded VoIP
- Fire/security control and monitoring systems
- Factory and automation systems
- Test and measurement equipment

### Overview

Green Hills Software expands its ColdFire offering to the new Freescale MCF5445x family with its unique royalty-free end-to-end solution encompassing RTOS, silicon optimized software and hardware development tools.

The new MCF5445x microprocessor family is designed for power-conscious developers needing a high-performance 32-bit microprocessor plus a rich set of on-chip connectivity peripherals. Green Hills enables the developer to unlock these silicon strengths:

- Royalty-free for lower system cost
- MULTI and TimeMachine development tools that drastically decrease the time and cost of debugging code, while building in higher quality
- One consistent and scalable RTOS family, software tools and BDM Probes across the ColdFire portfolio
- Compilers and RTOSes optimized for the MCF5445x family yield greater security, higher performance, smaller code size

### Scalable Processors and Scalable RTOS

The MCF5445x family joins the existing Freescale Controller Continuum offering solutions for the low to high end of customer applications. Developers benefit from the family's options for price, peripherals and performance.

Because one RTOS does not fit all applications and customer needs, Green Hills offers three upward-compatible RTOSes for the MCF5445x: INTEGRITY, velOSity and u-velOSity, all royalty-free. To help retain your software investment, middleware and connectivity stacks such as TCP/IP, file systems and graphics rendering are compatible across the family. To further enable application portability, INTEGRITY's system services are certified to the newest POSIX standard.

### Develop Code Quicker with Higher Quality

While software is the most time-consuming and highest-risk aspect of electronic product development, it also holds the greatest potential to enhance a product's profit. MULTI and TimeMachine were created specifically for the embedded developer to:

- Efficiently develop code
- Dramatically reduce debugging time
- Optimize for fast performance and small size
- Analyze and check code quality and reliability

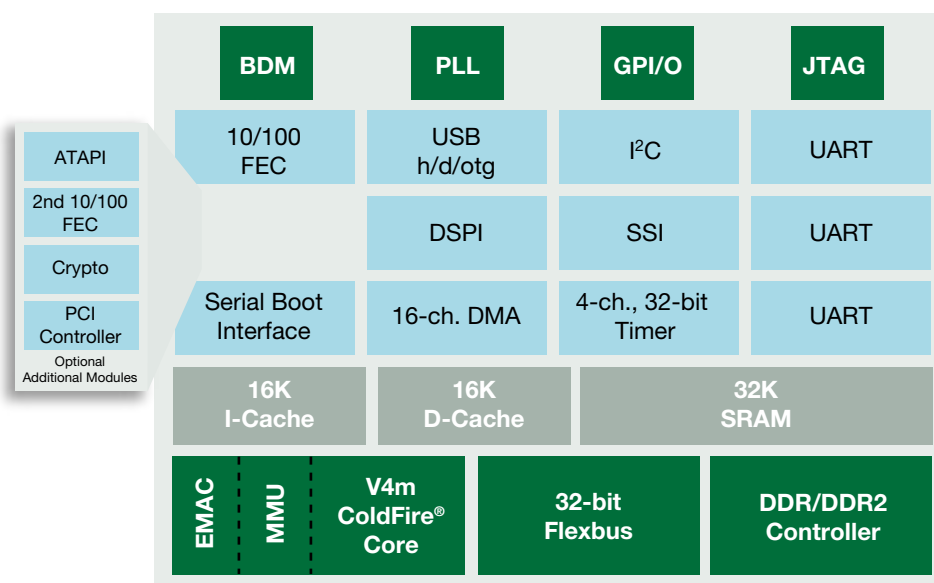
### Processor and Software Optimizations

What good are hardware features if the RTOS and software tools don't take advantage of them? Green Hills Software's reputation for highly optimized compilers and RTOSes continues for the MCF5445x family.



Software Development	<ul style="list-style-type: none"> <li>• MULTI IDE</li> <li>• Compilers</li> <li>• TimeMachine</li> </ul>
Real-Time Operation Systems	<ul style="list-style-type: none"> <li>• INTEGRITY</li> <li>• velOSity</li> <li>• u-velOSity</li> </ul>
BDM and Trace Probes	<ul style="list-style-type: none"> <li>• Green Hills Probe</li> <li>• SuperTrace Probe</li> </ul>

### MCF5445x Family Block Diagram



MCF5445x Family Feature	RTOS Family (INTEGRITY, velOSity, u-velOSity)	MULTI & Time-Machine®	Green Hills Probes	Description and Benefits
V4m CPU	√	√	√	MULTI C/C++ compilers for ColdFire support many C/C++ dialects. Over 100 optimizations for ColdFire's instruction set and particular pipeline yield high performance and small code size. For example, built-in floating point instructions replace slower library calls and Small Data Area and PID/PIC (position independent data & code) reduce code size. A MISRA C feature helps you catch costly software flaws early.
Enhanced Multiply-Accumulate (eMAC)		√		MULTI C/C++ compilers supports the eMAC to accelerate 16x16 or 32x32 operations
Hardware floating point divide		√		MULTI C/C++ compilers support this floating point acceleration feature
Memory Management Unit (MMU)	√			INTEGRITY's protection starts with the MMU and goes far beyond other commercial RTOSes. Its partitioned memory architecture, guaranteed CPU and memory availability and virtual device drivers enable the highest reliability and security
Integrated controllers for serial, interrupts, ATA hard disk, PCI bus, USB 2.0 OTG, 2 fast Ethernet MACs, I2C	√			INTEGRITY, velOSity and u-velOSity support a wide range of connectivity and communication options. In addition, INTEGRITY enables device drivers to be run in a protected, virtual address space for added security
Cryptography Acceleration Unit	√			Secure networking stacks (IPSec, SSH, SSL).
Real-time Trace Support		√	√	TimeMachine and PathAnalyzer enable debugging and profiling backward in time with no MCF5445x processor overhead and with no recompilation. Imagine running backward and setting reverse breakpoints until you find the origin of a difficult bug!
BDM (Background Debug Interface) and multiple breakpoint capability			√	The Green Hills Probe offers fast, reliable debug, test, and board bring-up power over BDM. Windows, Linux, Solaris hosts connect to the Probe with Ethernet or USB. Manage the probe through a web interface. Easily reflash the firmware for updates or for other ColdFire processors

**Learn More:** For more about our products for ColdFire and the entire Freescale 32-bit family of microprocessors, please visit [www.ghs.com](http://www.ghs.com), 805-965-6044.

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