Welcome to the Controller Continuum
Only from Freescale

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The Freescale Advantage
Freescale is a world leader in embedded control. We pioneered MCU technology and have been a major technology innovator, developing the first flash memory-based MCUs. The Controller Continuum provides easy access to our market-leading products. We also make your development process quick and easy. With an entire ecosystem of tools, training and support, including common development tools, reference designs, application notes and webcasts, Freescale gets you on the design fast track.

- **RS08 MCUs**—A reduced version of the S08 core, which is even more efficient and cost effective for applications such as simple electro-mechanical devices that are migrating to solid-state embedded control.
- **S08 MCUs**—An evolutionary step from our popular HC08 family of MCUs. With higher bus speeds and lower operating voltages than its predecessor, the S08 family is better suited for battery operated applications.
- **ColdFire embedded controllers**—Compatible, highly integrated and cost-effective 32-bit architectures (V1, V2, V3 and V4) that emphasize control, connectivity and security over a wide range of consumer and industrial applications.
- **Common tools**—With the CodeWarrior® Development Studio for Microcontrollers V6.1, we offer you a single tool suite for 8- and 32-bit microcontrollers. Learn more on page 8 about common software and hardware tools available to you.

www.freescale.com/continuum

Welcome to the Controller Continuum
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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 entry-level, 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—a full spectrum of price and performance options and unprecedented compatibility between them.

What is the Controller Continuum?
Freescale's Controller Continuum is the industry's first roadmap for 8- and 32-bit compatible architectures. From the entry-level 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. Stepwise compatibility means that you can move from one device on the Continuum to the next compatible device on any point of the spectrum, from the low end to the high end. For example, you can move from an MC9S08AC128 (AC128) and migrate to an MCF51AC256 (AC256), and from there, migrate to the MCF5222x MCUs with minimal time and effort.

When optimizing for performance, price and functionality, your requirements may change from 8- to 32-bit, or vice versa. It's as easy as swapping controllers on the same board and recompiling code. This connection point between 8- and 32-bit at the center of the Controller Continuum is our Flexis™ series of MCUs.

Flexis Series of Microcontrollers—AC family
Freescale's revolutionary 8-bit to 32-bit compatibility story comes to life with the Flexis series of MCUs. Freescale is adding to the series with the introduction of the Flexis AC family, great for consumer and industrial control type applications.

The 8-bit AC128 and the 32-bit AC256 form the 8- to 32-bit connection point on the Controller Continuum where S08 and ColdFire V1 microcontroller duos 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 next few pages will show you how the unique features of these devices can expand range of design possibilities.
The Freescale Controller Continuum

The Freescale Controller Continuum provides stepwise compatibility up and down the performance spectrum. You can choose to enter the Controller Continuum at the entry-level RS08 family of MCUs, the more sophisticated S08 devices or the top-of-the-line ColdFire embedded controllers—each step has family members that share packaging, peripherals or pin-outs with the Controller Continuum. Add common software and hardware tools, and you have true stepwise compatibility—even across the 8- to 32-bit boundary.

Freescale developed the Controller Continuum to help give you options for the best combination of performance, economy and functionality—and the flexibility to later upgrade your choice at negligible cost and with minimal effect on your time to market.

The Roadmap for Compatibility

Freescale’s AC devices are the third members of the Flexis series of MCUs, creating a portfolio of S08 and ColdFire V1 MCUs that open the door to expanding application capabilities while driving down total system costs.
Introducing the Flexis AC Family

Freescale’s AC128 and AC256 MCUs strike the ideal balance between EMC/EMI performance, cost and energy efficiency. This innovative duo continues to break new ground in 8- to 32-bit compatibility. The S08AC128 (8-bit S08 microcontroller) and MCF51AC256 (32-bit ColdFire embedded controller) feature the basic building blocks for controller compatibility.

Ideal for Industrial and Appliance

Advanced system protection features allow for the design of more robust and reliable systems making the Flexis AC family ideal for industrial applications.

- Industry leading EMC/EMI performance giving you piece of mind when designing products for operation in noisy environments.
- A watchdog timer (COP module) with an independent clock and cyclic redundancy check (CRC) add additional system security in noisy environments.
- Features such as active power-on reset, low voltage detection and low voltage warning protect against system failure due to brownouts.
- Hardware and software safety features help you comply with the IEC 60730 legislation on the safe and reliable operation of electronic controls in household appliances.

Intelligent Peripheral Mix

The Flexis AC peripheral set was designed to help improve performance in motor control applications and, at the same time, reduce external component count and overall costs.

- True 5.5V to 2.7V operation allows you to create cost-effective systems by reducing component cost and decreasing the overall time to market.
- On-chip timers and an analog-to-digital converter (ADC) make Flexis AC ideal for basic motor control techniques. The ability to synchronize the ADC and the FlexTimer on the AC256 gives you even more advanced motor control capabilities.
- The AC256 also features a CAN bus for network connectivity. A Cycle Redundancy Check (CRC) engine adds additional security to this protocol allowing for faster testing of flash memory.

Easy to Migrate

We’ve significantly reduced the learning curves normally associated with migrating between 8- and 32-bit technologies. With a new version of CodeWarrior and a wide selection of software and hardware development tools, you can get on the design fast track and simplify your development cycle. We also offer extensive training and documentation to make the process even easier.

To learn more about the tools and training available to you, see page 8 of this brochure or visit www.freescale.com/flexis.
The Flexis 8-bit **AC128**

### MC9S08AC128:
- 48 MHz HCS08 core
- 24 MHz bus frequency
- 2.7–5.5V operating range
- 80-pin LQFP, 64-pin LQFP, 64-pin QFP, 44-pin LQFP package options

### MC9S08AC128 Block Diagram

<table>
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<tr>
<th>Real-Time Interrupt</th>
<th>ICE + BDM</th>
<th>ICG (20 MHz Bus)</th>
<th>Up to 56 GPIO</th>
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<tr>
<td>6-ch., 16-bit</td>
<td>2x SCI</td>
<td>I²C</td>
<td>2x SPI</td>
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<td>6-ch., 16-bit</td>
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<td>2-ch., 16-bit</td>
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<tr>
<td>Timers</td>
<td>16-ch., 10 bit</td>
<td></td>
<td>COP</td>
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<tr>
<td>ADC</td>
<td>KBI</td>
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<tr>
<td>128/96KB Flash</td>
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<td>Up to 8K RAM</td>
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<tr>
<td>HCS08 Core</td>
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<tr>
<td>44 LQFP, 64 QFP, 64 LQFP</td>
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</table>

### Features Shared with the AC256 ColdFire Embedded Controller
- 16-bit timer/pulse-width modulator (PWM)
- 2x SCI, 2x SPI, I²C
- Watchdog Timer with independent clock (COP)
- Cyclic Redundancy Check (CRC)
- Multi-purpose clock generation
- Pin compatibility in 80- and 64-pin LQFP packages
- Common development tools, including CodeWarrior for Microcontrollers V6.2

### Features Unique to the S08 AC MCUs
- 16-channel, 10-bit Analog-to-Digital Converter (ADC)
- (2) additional 16-bit timer/pulse-width modulators (PWM)
- Up to 128 KB flash memory
- Up to 8 KB RAM
- Up to 70 general-purpose input/output ports (GPIO)
- -40°C to +125°C temperature range

### Use Cases
You can use one or both AC MCUs in your designs, depending on your product requirements.

Use any of the Flexis AC products when:
- EMC/EMI is a primary design concern
- You are interested in generating a cost-effective and low-overhead link to future 32-bit designs
- The application requires a path to higher or lower flash densities

Use the AC128 when:
- Lower-pin-count options are desired
- There are no requirements for higher performance calculations or peripherals
- Cost sensitivity is a primary design concern
The Flexis 32-bit AC256

MCF51AC256:
- 50.33 MHz V1 ColdFire core
- 25.17 MHz bus frequency
- 2.7–5.5V operating range
- 80-pin LQFP, 64-pin LQFP, 64-pin QFP, 44-pin LQFP package options

Features Shared with the AC128 HCS08 Embedded Controller
- 16-bit timer/pulse-width modulator (PWM)
- 2x SCI, 2x SPI, I²C
- Watchdog Timer with independent clock (COP)
- Cyclic Redundancy Check (CRC)
- Multi-purpose clock generation
- Pin compatibility in 80- and 64-pin LQFP packages
- Common development tools, including CodeWarrior for Microcontrollers V6.2

Features Unique to the V1 ColdFire AC MCUs
- 2x Analog Comparators
- 24-channel Analog-to-Digital Converter (ADC)
- 2.5 µs conversion time
- Integrated CAN module
- Complimentary CAN stack created by Freescale
- CAN open support available through 3rd party suppliers
- 12-channel 16-bit Flexible timer/pulse-width modulator (FTM)
- Synchronization with the ADC and dead-time insertion allows for precise motor control.
- Timers can be daisy chained together providing higher resolution.
- Provides the ability of run off the core clock with high speed and high resolution.

- Up to 256 KB flash memory
- Up to 32 KB random access memory (RAM)
- Up to 70 general-purpose GPIO
- Single wire background debug module
- -40C° to +105C° temperature range

Use Cases
You can use one or both AC MCUs in your designs, depending on your product requirements.

Use any of the Flexis AC products when:
- EMC/EMI is a primary design concern
- You are interested in generating a cost-effective and low-overhead link to future 32-bit designs
- The application requires a path to higher flash densities (>128 KB)

Use specifically the MCF51AC256 when:
- CAN network connectivity is required
- More precise and flexible timing is required
- System flash memory requirements exceed 128K
- Advanced algorithms require a 32-bit processor
Freescale’s Controller Continuum with the AC MCUs gives you unprecedented opportunities to expand into new markets without heavily investing in new product development resources. If you enter a market with a low-end product, you can scale the same application, using the tools you already have, to reach new markets with high performance requirements.

8- and 32-bit Applications

<table>
<thead>
<tr>
<th>Common Applications</th>
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<tbody>
<tr>
<td>The products in the Controller Continuum provide the unique flexibility to greatly simplify your new product development, whether you’re upgrading to a higher performing S08 solution or transitioning to the 32-bit performance of the ColdFire family of embedded controllers. The Controller Continuum gives you the ability to quickly exploit business opportunities and speed your time to market in an almost unlimited variety of consumer and industrial applications, including:</td>
</tr>
<tr>
<td>- HVAC building and control systems</td>
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<td>- Lighting control systems</td>
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<tr>
<td>- Test and measurement equipment</td>
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<td>- Environmental and building automation</td>
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<td>- Home appliances</td>
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<tr>
<td>- Security and access control panels</td>
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<td>- Stationary barcode scanners and barcode printers</td>
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<tr>
<td>- PC peripherals and I/O modules</td>
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<tr>
<td>- Patient monitoring systems</td>
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<tr>
<td>- Laboratory equipment</td>
</tr>
<tr>
<td>- Industrial networking products</td>
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<tr>
<td>- Hospital beds and electric wheel chairs</td>
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</tbody>
</table>

Discover the Range of Possibilities

Industrial Automation

Patient Monitoring Devies

White Goods

Building Control Systems

HVAC Systems
The Full Breadth of the Controller Continuum

In addition to the Flexis series of controllers, the Controller Continuum in its entirety is a range of stepwise-compatible 8- and 32-bit devices that share a common set of tools. Read below to learn about the product families of the Freescale Controller Continuum.

RS08 Core Products
A reduced version of the S08 CPU, the RS08 core has been crafted to be more efficient and cost-effective for small memory size microcontrollers. Popular RS08 MCU products include:

- **MC9RS08 KA family**—the lowest entry point into the Controller Continuum, ideal for emerging applications, such as simple electro-mechanical devices that are migrating to fully solid-state electronic operation or portable devices that have evolved into smaller or even disposable versions.

S08 Core Products
Optimized for extreme operating economy with a number of low-power options, the S08 core features:

- On-chip in-circuit emulation (ICE), which permits real-time emulation of MCU functions at full operating voltage and frequency range without the limitations of traditional emulators
- Integrated third-generation flash memory and RAM
- Multiple serial communications options
- Highly capable and high-performance analog functionality, including 10-bit ADC

Popular S08 MCU products include:

- **MC9S08JM family**—a cost-effective, general-purpose 8-bit microcontroller featuring the added benefit of USB connectivity for easy upload and download of data.
- **MC9S08QE family**—the industry’s most power-efficient 8-bit offerings, with stop current of less than 300 nA and run current as low as 7 uA. Ideal for battery powered and handheld applications.
- **MC9S08QA family**—cost-effective, general-purpose 8-bit microcontroller with advanced capabilities to improve the performance of battery-powered applications.

ColdFire Embedded Controllers
Targeted at network-connected control applications in the commercial and industrial markets, various ColdFire family members support Ethernet, USB, Peripheral Component Interconnect (PCI), Controller Area Network (CAN) and Secured Internet Protocol (IPsec).

Popular ColdFire devices include:

- **MCF5221x family**—V2 ColdFire core-based device featuring an integrated USB OTG and a wide variety of serial interface offerings, which makes the MCUs ideal for adding USB functionality to industrial applications quickly and easily.
- **MCF5223x family**—V2 ColdFire core-based device that features a 10/100 Fast Ethernet Controller (FEC), an Ethernet physical layer (EPHY) and flash memory in a single-chip solution. In addition, it includes CAN 2.0 and a cryptographic acceleration unit (CAU) for enhanced security.
- **MCF532x family**—V3 ColdFire core-based device that features USB host and On-The-Go peripherals plus an integrated super video graphic array (SVGA) LCD controller for applications with a graphical user interface (GUI).
- **MCF5445x**—V4 ColdFire core-based device families that feature a high level of integration, a broad range of communication peripherals and a memory management unit (MMU) that enables process isolation for a high level of reliability.
Development Tools

CodeWarrior Development Studio for Microcontrollers V6.2

Freescale's CodeWarrior Development Studio for Microcontrollers V6.2 is a single, integrated tool suite designed to get you on the design fast track with RS08, HC(S)08 and V1 ColdFire members of the Freescale Controller Continuum. Whether your design is an 8-bit, entry-level application (e.g. smoke detector) or a 32-bit, high-end application (e.g. fire alarm control panel), CodeWarrior Development Studio for Microcontrollers provides optimized tools to take full advantage of the Freescale microcontroller you selected for your design.

Re-Target Your Application in Four Mouse Clicks

The award-winning CodeWarrior tool suite goes well beyond basic code generation and debugging—if market requirements change mid-project, the MCU Change Wizard allows you to re-target the project to a new microcontroller in as few as four mouse clicks. You simply select a new microcontroller (from the same or a different architecture: RS08, HC08, HCS08 or V1 ColdFire), select the default connection and the CodeWarrior tool suite automatically reconfigures your project for the new microcontroller with the correct build tools (compiler, assembler, linker), and the appropriate support files (header files, libraries and linker files). For projects switching between 8-bit and 32-bit Flexis series microcontrollers, this is the extent of the porting effort.

Porting Assistance at Your Fingertips

To move other 8-bit applications to V1 ColdFire, a porting guide is provided which details the differences between the architectures and the impact these differences have on software design. The V1 ColdFire compiler also flags code that needs to be manually inspected and ported (assembly code, interrupt service routines).

Easy Migration with Processor Expert™

If you use Processor Expert—a rapid application design tool integrated into the CodeWarrior tool suite—migrating between Freescale microcontrollers is a breeze. Just define the functionality you need for your application and Processor Expert generates tested, optimized C-code tuned for your application and the selected microcontroller. When you change the microcontroller with the MCU Change Wizard, Processor Expert maps the software and peripheral components that describe your application’s functionality to the resources available on the new microcontroller. All you have to do is resolve any resource issues flagged by Processor Expert and you’re finished.

DEMOACKIT

A flexible and cost-effective evaluation system for the Flexis AC device family. The DEMOACKIT contains daughter cards for both the MC9S08AC128CLKE (S08) and the MCF51AC256CLEE (ColdFire V1) processor. It features a ZIF Socket, a built-in USB BDM, LED’s, a serial port, an acceleration sensor and an I/O header. This kit comes complete with everything you need to get your board up and running quickly and easily.

DEMOACEX

An expansion board that plugs into the DEMOACKIT and provides additional functionality such as large prototype area that allow for the surface mount of SOICs and TSSOPs, a CAN Phy and 12 additional LEDs. The DEMOACEX also contains Freescale touch sensing technology with 1 rotary sensor and 7 button sensors.

Get Started—Get on the Fast Track

Easy, fast, accessible—that’s what our tools and support environment is all about. Starting with your ideas, we help you speed your development process with easy-to-use tools that help you design with the Controller Continuum portfolio of devices. We also have self-support resources that give you:

• Access to a huge knowledge base of information
• Online training options
• Freescale-supported discussion forums

Our sophisticated search engine with a newly integrated parametric attribute tool extends your search across entire product families, which provides you with product comparison details so you can make well-informed feature trade-off decisions. Search, compare, explore or talk to us online or by phone—Freescale is there for you at every point of the design process.