A Little 8-bit Goes a Long Way
Freescale Semiconductor is a world leader in 8-bit microcontroller (MCU) technology. Throughout several decades, we have perfected our core processing designs and integration techniques to create a large portfolio of compact, cost-effective solutions with the analog, memory and communications options to meet your specific product design needs.

It’s more than a microcontroller.

We offer a full range of hardware and software tools, from cost-effective demo boards to advanced, high-performance debuggers, for our entire portfolio of 8-bit MCUs. Our CodeWarrior® Special Edition integrated development environment (IDE) for microcontrollers can be downloaded, at no cost†, directly from our website. In addition, you have direct access to application notes, reference designs, online tutorials, discussion groups, training events and many other useful design assistance programs through our website at www.freescale.com/8bit.

S08 Core Software Efficiency
Optimized for extreme operating economy with a number of low-power options, the S08 core is particularly attractive for battery-powered and handheld applications. Multiple Stop modes, along with Wait and Standby modes, will help you achieve new thresholds in low-power performance under a variety of operating conditions.

The S08 core allows efficient, compact, modular coding with full 16-bit stackpointer and stack-relative addressing. It also permits various instruction sizes and enables memory interface in multiple mechanisms and in many addressing modes. The object code is compatible with Freescale’s legacy HC05 and HC08 cores and is upward compatible to other Freescale architectures.

Features include:
• On-Chip ICE
  Permit real-time emulation of MCU functions at full operating voltage and frequency range without the limitations of traditional emulators.
  Includes on-chip trigger and trace capability, effectively replacing expensive emulators with a cost-effective serial real-time emulation and debug cable.
• Includes nine flexible triggers and buffer hardware to replace an emulator’s costly bus analyzer.
• Allows the user to view and change internal registers and memory while running an application.
  Integrated third-generation flash memory and RAM
• Multiple serial communication options
• Highly capable and high-performance analog functionality including 12-bit ADC and analog comparators.

RS08 Core for Ultra-Low-End Applications
The RS08 core is a reduced version of the S08 central processing unit (CPU) that has been specifically designed for small-pin-count devices with under 16 KB memory. 30 percent smaller than the S08 CPU, it’s more efficient and cost-effective for simple electromechanical devices that are migrating to fully solid-state electronic operation or portable devices that have evolved into smaller or even disposable versions. Freescale’s first products utilizing the RS08 core architecture are the MC9RS08KA ultra-low-end microcontrollers.

The HC08 Core
From a basic controller in a tiny 8-pin quad flat non-leaded (QFN) package to feature-rich silicon in a 64-lead quad flat package (QFP), the HC08 MCU is an industry workhorse with an impressive array of peripherals. Here are some examples:
• Electrically erasable programmable read-only memory (EEPROM) or industry-leading in-circuit reprogrammable flash technology
• 8- or 10-bit analog-to-digital converters (ADCs)
• Multichannel timers
• A wide variety of communications protocol support, including universal serial bus (USB), controller area network (CAN), local interconnect network (LIN), J1850 and radio frequency (RF)

Environmentally Preferred Products
Freescale now introduces all new 8-bit products in lead (Pb)-free packaging. As part of our Pb-free packaging initiative, we are in the process of converting our entire product portfolio to more recyclable Pb-free packaging. We will meet or exceed legislative requirements for environmentally friendly packaging, including the European Union’s Reduction of Hazardous Substances (RoHS) and Waste of Electrical and Electronic Equipment (WEEE) directives as well as other Pb-free and Halogen-free initiatives.

Online Sample Program
Need to cut your risks and get your project moving quickly? Order samples directly from our website to test before you buy: www.freescale.com/samples. There’s no charge†† for shipping or handling, and no applicable taxes.

†Subject to license agreement and registration. ††Subject to registration on the Freescale website.
MC9RS08KA

Little doesn’t mean limited—think big

Designed specifically for the ultra-low-end marketplace, the MC9RS08KA family of 8-bit microcontrollers is ideal for product developers transitioning from solid-state relays and switching systems to a full electronic solution. MC9RS08KA highlights include:

- Keeping the overall board design small—packages as small as the 3 mm x 3 mm 6-pin DFN
- Keeping design easy with the tools, code and technical support needed
- Analog control for increased system capabilities
- Suitable flash and RAM to give the software more functionality and the designer more possibility

Key Features

- Up to 2 KB third-generation flash with extremely fast byte-writable programming
- 1.8-volt to 5.5-volt supply
- Integrated clock source (ICS) up to 10 MHz internal bus operation with 2 percent deviation over full temperature and voltage range
- 8-bit modulo timer with 8-bit prescalar
- Real-time interrupt trigger with 3-bit prescalar
- Analog comparator with full rail-to-rail supply operation that can operate in STOP mode
- Four bidirectional input/output (I/O) lines
- Computer operating properly (COP) feature
- 3-/5- channel keyboard interrupt (KBI)
- Low voltage detect (LVD) with Reset, Stop or Wakeup
- Auto Wakeup
- Background debugging system
- 6-pin DFN, 8-pin plastic dual in-line package (PDIP) and 8-pin narrow-body small outline integrated circuit (NB-SOIC) packaging options

Target Applications

- High-brightness LED
- Lighting system control
- Small handheld devices
- Toys
- AC line voltage monitoring
- Simple logic, analog driver and ASIC replacement

Application Notes/Reference Designs

- Implementing the Infrared RC-5 Decoder on MC9RS08KA2-AN3402
- Low-cost digital timer-AN3413
- High brightens LED controller using the MC9RS08KA2-DRM079
- Multi-button IR remote control using ultra low-end MCU and electric-field sensor-DRM085
- Many more!

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### Board highlights include:

- 8-pin PDIP 9RS08KA2 microcontroller
- GPIO header connector 4 x 2-pin
- Built in USB-to-BDM interface
- Two push switches circuitry: one user, one reset
- Four LED circuitry connections: three user, one VDD
- BDM header connector
- Power input selector
- USB up to 500mA
- Power connector 9 VDC typical (7V–18V)

*Manufacturer Suggested Resale Price

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<th>Flash</th>
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*Auto qualification not currently available

www.freescale.com/8bit
MC9S08QG
So highly integrated, it’s redefining low-end

Often it’s not just the individual features but the full feature set that matters. The MC9S08QG family enhances system functionality by integrating embedded modules that frequently are not included in low-end MCUs (see key features). These modules help:

- Reduce overall system size
- Lessen the probability of overall board quality problems and conflicts
- Cut overall system cost
- Reduce overall design time

Key Features

- Powerful, advanced S08 core
- Multiple communications options—SCI, SPI and I^2C
- High-resolution analog—8-ch., 10-bit ADC and analog comparator
- “Extras” included—2-ch., 16-bit timer; internal/external oscillator; LVI; COP; and up to 13 GPIOs
- Multiple memory options—8 KB or 4 KB Freescale flash memory and up to 512B RAM

Target Applications

General purpose use is only the beginning.

- Wireless sensors including SMAC
- Watchdog coprocessors
- Small appliances
- Handheld devices

Security systems
- Control systems

Application Notes/Reference Designs

- AN3325
  - Designing for Migration among 8-pin, 8-bit MCUs
- AN3031
  - Temperature Sensor for the HCS08 Microcontroller Family
- AN2497
  - HCS08/RS08 Background Debug Mode versus HC08 Monitor Mode
- AN2949
  - Using Processor Expert to Develop a Software Real-Time Clock
- AN3048
  - Analog-to-Digital Converter on an I^2C Bus
- AN3041
  - Internal Clock Source (ICS) Module on the HCS08 in Depth
- AN2295
  - Developer’s Serial Bootloader for M68HC08 and HCS08 MCUs
- AN1818
  - Software SCI Routines with the 16-Bit Timer Module

Demo9s08qg8e—MSRP* $50

The demo board integrates the USB-to-BDM interface, providing the capabilities of USB Multilink without the added cost of additional hardware. It allows in-circuit debugging and flash programming without the emulation requirements of serial monitors or other debugging techniques used in the industry.

Board highlights include:

- Socketed MC9S08QG8 16-pin DIP
- Integrated USB-to-BDM cable
- 32-pin I/O header
- Power LED
- User I/O features:
  - Reset push button
  - Two push buttons
  - Two LEDs
  - Potentiometer
  - Light sensor
  - Jumpers to disable the user I/O functions
  - RS-232 transceiver circuit, 9-pin D-shell connector
- Onboard 12-volt to 5-volt voltage regulator with 3.3-volt output to MCU
- Barrel-style power connector
- Optional BDM connector (6-pin header)
- Optional external oscillator circuit
- CodeWarrior\textsuperscript{\textregistered} Development Studio for Microcontrollers included with the demo board

* Manufacturer Suggested Resale Price
**MC908QC**

*Highest on-chip integration in the HC08 Q Family*

The MC908QC family is a feature-rich HC08 designed to bring the benefits of a versatile yet cost-effective platform to applications requiring additional input/output (I/O). Family highlights include:

- Three-phase motion control with multiple independent timer modules
- Software-enabled LIN
- Scalable to other low-end products in the HC08Q family

**Key Features**

- HC08 core—3-volt to 5-volt standard operation
- Multiple communications options—ESCI and SPI
- Analog included—10-ch., 10-bit ADC
- Multiple memory options—8 KB to 16 KB
- Freescale robust flash memory and up to 512B RAM
- 4-ch. and 2-ch., 16-bit timers
- Up to 26 general purpose input/output (GPIO) pins

**Target Applications**

- Watchdog coprocessors
- Security systems
- Control systems
- Analog control replacement
- Motion control
- Toys
- Small appliances
- Automotive
- Local interconnect network (LIN)

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**Application Notes**

- AN2767
  - LIN 2.0 Connectivity on Freescale 8/16-bit Using Volcano LTP
- AN2295
  - Developer’s Serial Bootloader for M68HC08 and HCS08 MCUs
- AN2396
  - Servo Motor Control Application on a Local Area Interconnect Network (LIN)

**DEMO908QC16—MSRP* $75**

The demo board integrates USBMULTILINK08E (Universal Serial Bus [USB] in-circuit debug and flash programming cable) into the demo board. No additional hardware is needed for MC908QC development, and the board can be powered from the USB, eliminating the need for an external power supply.

User components for application development include:

- Reset push button
- Two input push buttons
- Light sensor and potentiometer for analog-to-digital input
- Two output LEDs
- LIN communication interface
- I/O header for external circuit development

* Manufacturer Suggested Resale Price

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**Device** | **Flash** | **RAM** | **ADC Channels** | **ESCI** | **SPI** | **16-bit Timer Channels** | **Clock Type** | **Package** | **Applications/Additional Features**
--- | --- | --- | --- | --- | --- | --- | --- | --- | ---
MC908QC16CDZE | 16 KB | 512B | 10 | √ | √ | 4+2-ch. | OSC | SOIC28 | Extra timers and pins
MC908QC16CDYE | 16 KB | 512B | 10 | √ | √ | 4+2-ch. | OSC | SOIC20 | Extra timers and pins
MC908QC16CDXE | 16 KB | 512B | 10 | √ | √ | 4+2-ch. | OSC | TSSOP24 | Extra timers and pins
MC908QC16CDRE | 16 KB | 512B | 10 | √ | √ | 4+2-ch. | OSC | TSSOP20 | Extra timers and pins
MC908QC16CDSE | 16 KB | 512B | 10 | √ | √ | 4+2-ch. | OSC | TSSOP16 | Extra timers and pins
MC908QC16CDTE | 16 KB | 512B | 10 | √ | √ | 4+2-ch. | OSC | TSSOP16 | Extra timers and pins
MC908QC16CDEZE | 8 KB | 384B | 10 | √ | √ | 4+2-ch. | OSC | SOIC28 | Extra timers and pins
MC908QC16CDYE | 8 KB | 384B | 10 | √ | √ | 4+2-ch. | OSC | SOIC20 | Extra timers and pins
MC908QC16CDEX | 8 KB | 384B | 10 | √ | √ | 4+2-ch. | OSC | SOIC16 | Extra timers and pins
MC908QC16CDE | 8 KB | 384B | 10 | √ | √ | 4+2-ch. | OSC | TSSOP28 | Extra timers and pins

*Auto qualification planned.*
The MC9S08QD4/2 provides design flexibility and integrated functionality for small appliances and DC fans. The QD includes up to 5.5V supply voltage, a 10-bit analog to-digital converter (ADC) and two timers for improved motor control. The MC9S08QD extends the advantages of the low-end S08 core as a low-pin-count, small-package 8-bit MCU. With pin and tool compatibility with MC9RS08KA and MC9S08QG8, the QD allows designers to move up and down the performance spectrum quickly and easily.

**Key Features**
- 8-bit HCS08 central processor unit (CPU)
- Integrated third-generation flash memory and RAM
- General purpose input/output (GPIO) lines
- Integrated analog peripherals
- Flexible clock options
- Two timer modules
- System protection

**Target Applications**
- DC cooling fan applications
  - Computers
  - Low-power supplies
  - Battery chargers
- Digital capacitive discharge ignition (CDI) for motorcycles
- Industrial compressors
- Camera zoom control
- Walkie-talkies
- Vacuum cleaners
- Small and large appliances
  - Toasters
  - Low-end microwaves
- Industrial control
- Watchdog coprocessors
- Security systems
- Fan control
- AC voltage line monitors

**Application Notes/Reference Designs**
- AN3414
  - Toaster Oven Control System
    - Using MC9S08QD2
- AN3381
  - Using SMAC with the HCS08QD4 MCU
- AN3235
  - Designing for Migration among 8-pin, 8-bit MCUs
- AN2717
  - M68HC08 to HCS08 Transition
- AN2497
  - HC08/RS08 Background Debug Mode versus HC08 Monitor Mode
- AN2111
  - A Coding Standard for HCS08 Assembly Language

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*Auto qualification not currently available*
MC908QT/QY
The foundation of the HC08 Q Family—cost-effective and general-purpose

MC908QT/QY are versatile, cost-effective, small-packaged HC08 devices designed for a variety of applications. Family derivatives provide a wide range of choices, and all devices support the DEMO908QB8E demo board for product development.

- QY devices are 16-pin packages—extra GPIOs
- QT devices are 8-pin packages—smaller form factor

Key Features
- HC08 core—3-volt to 5-volt standard operation
- High-resolution analog available—up to 10-ch., 10-bit ADC
- Multiple memory options—1.5 KB to 8 KB Freescale flash memory and up to 256B RAM

Target Applications
- Discrete replacement
- Appliances
- Control systems
- Battery chargers
- Home and industrial security
- Toys
- Automotive body control

Application Notes/Reference Designs

- AN2503
  - Slave LIN Driver for the MC68HC908QT/QY Family
- AN2509
  - I2C Slave on the HC908QT/QY Family MCU
- AN2679
  - Smart NiCd/NiMH Battery Charger Using MC68HC908QY4
- AN2475
  - Generating a PWM Signal Modulated by an Analog Input Using the MC68HC908QY4 Microcontroller
- AN2305
  - User Mode Monitor Access for MC68HC908QY/QT Series MCUs

MC908QY8

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* Manufacturer Suggested Resale Price

Auto qualification available. Contact Freescale Sales or Marketing for appropriate orderable part numbers.

MC908QY8CDTE—MSRP $75

Demo board fuses USBMULTIINK08E (USB in-circuit debug and flash programming cable) into the board design. Development for the MC908QT/QY can be achieved without additional hardware.

Board can be powered from the USB, eliminating an external power-supply requirement.

User components for application development include:
- Reset push button
- Two input push buttons
- Light sensor and potentiometer for ATD input
- Two output LEDs
- Local Interconnect Network (LIN) communication interface
- I/O header for external circuit development

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The MC908JL/JK family provides pin compatibility across different flash sizes and a clear migration path to packages with larger I/O counts.

- JL devices have up to 32-pin packages—extra GPIOs
- JK devices are in 20-pin packages—smaller form factor

Key Features

- HC08 core—3-volt to 5-volt standard operation
- Multiple communications options—SCI and I2C
- Analog included—up to 13-ch., 8-bit ADC
- Multiple memory options—1.5 KB to 16 KB Freescale flash memory and up to 512B RAM

Target Applications

- Industrial compressor (HVAC)
- Instrument control panels
- Control systems
- Sensors and flow measurement
- Home appliances
- Home and industrial security

Application Notes/Reference Designs

- AN2158 Designing with the MC68HC908JL/JK Microcontroller Family
- AN2321 Designing for Board Level Electromagnetic Compatibility
- AN2295 Developer’s Serial Bootloader for M68HC08 and HCS08 MCUs

ADC Channels

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*Auto qualification not currently available.
### HC(S)08/RS08 Development Tools

**Everything you need. Just add your imagination**

### NEW! Low-cost USB Debug Tool

To aid fast and easy development for embedded systems engineers working on our low-end microcontrollers, Freescale has developed the low-cost, high-performance USB debug tool—the USBSPYDER08. With the USBSPYDER08 you can:

- **SPY** into your application software
- **DEBUG** 8-leg (8-bit) microcontrollers before you have your application board
- **KILL** bugs in your application software. This complete package delivers a low cost, yet powerful, way to develop your products and speed time to market.

The USBSPYDER08 works with any of our existing 8-bit, 8-pin families, including the MC9S08KA, MC9S08QD and MC9S08QG families.


**Not needed for HCS08 and RS08 microcontrollers. HCS08 has integrated in-circuit emulation (ICE). RS08 has an on-chip background debugging system for single-wire debugging and emulation interface.*

### In-Circuit Emulators (FSICE)**

A high-performance emulator system for HC08-based products that, in addition to traditional debugging capabilities, incorporates advanced features, for in-circuit flash programming and remote debugging, and a real-time bus analyzer.

### USBMULTILINK08E*

Provides in-circuit debugging and programming for HC08 products through the standard MON08 serial debug/breakpoint interface.

### Cyclone Pro (M68CYCLONEPROE)*

Cyclone Pro provides all the capabilities of the USBMULTILINKBDME and USBMULTILINK08E plus USB/Ethernet serial interfaces.

### Evaluation Boards (EVB)*

Evaluation boards allow users to program and debug advanced application code with expanded I/O functions and peripherals.

### BDM Multilink (USBMULTILINKBDME)*

A cost-effective development tool for HCS12X/HCS08/RS08 products that provides real-time, in-circuit flash programming, emulation and debugging through the BDM interface.

### Demonstration Boards (DEMO)*

Demonstration boards are cost-effective and time-saving development tools that allow users to program and debug application code with basic I/O functions and peripherals.

### New! CodeWarrior® Development Studio for Microcontrollers 6.0

A single, integrated tool suite designed to get you on the design fast track with RS08, HCS08 and ColdFire V1 members of the Freescale Controller Continuum. The award-winning CodeWarrior IDE goes well beyond basic code generation and debugging—it provides built-in features and utilities, so you can deliver better quality products to market faster.

More than 100 example projects are available to assist in your design efforts. Or by using the New Project Wizard you can create a working project in as few as seven mouse clicks. And when 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. Choose the microcontroller and the default connection. The IDE automatically reconfigures your project with the correct build tools (compiler, assembler, linker) and the appropriate support files (header, libraries, linker). For projects switching between 8- and 32-bit Flexis series microcontrollers this is the extent of the porting effort.

Designers who use Processor Expert—a rapid application design tool integrated into the CodeWarrior tool suite—will also find migration between other Freescale microcontrollers a very easy process. To set up a project using Processor Expert you define the functionality you need for your application and Processor Expert generates tested, optimized C-code tuned for your application and the particular microcontroller you have chosen. 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.

[www.freescale.com/8bit](http://www.freescale.com/8bit)
# Development Tools Summary

Hardware and software building blocks for your next MCU design

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<thead>
<tr>
<th>Family</th>
<th>Part Numbers</th>
<th>Demo Board</th>
<th>Debug Interface Cable</th>
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*CodeWarrior® Development Studio for Microcontrollers Special Edition is available at no additional cost† and is supplied with all Freescale Microcontrollers development tools.

**CodeWarrior Development Studio for Microcontrollers Standard (CWS-HC08-STD-CX) and Professional (CWS-HC08-PRO-CX) Editions are also available.

†Subject to license agreement and registration.