**Target Applications**

- Wireless sensor applications including simple media access controller (SMAC)
- Watchdog coprocessors
- Small appliances
- Handheld devices
- Secure boot coprocessors
- Security systems

**Overview**

The MC9S08QG8/4 extends the advantages of Freescale’s HCS08 core to low pin count, small-package, 8-bit microcontrollers. QG devices are low voltage with on-chip in-circuit flash memory programmable down to 1.8V, and afford the standard features of all HCS08 MCUs including wait mode and multiple stop modes. The functionality is completed with strong analog capabilities, a complete set of serial modules, a temperature sensor and robust memory options.

**Data Sheets**

MC9S08QG8 Data Sheet for QG8/QG4

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### Features

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-bit HCS08 Central Processor Unit (CPU)</td>
<td></td>
</tr>
<tr>
<td>- Up to 20 MHz HCS08 CPU (10 MHz bus frequency) for 100 ns minimum instruction time</td>
<td>- Offering high performance, even at low voltage levels for battery-operated applications</td>
</tr>
<tr>
<td>- HC08 instruction set with added BGND instruction</td>
<td>- Backward object-code compatibility with 68HC08 and 68HC05 so existing code libraries can still be used</td>
</tr>
<tr>
<td>- Support for up to 32 interrupt/reset sources</td>
<td>- Allows for efficient, compact module coding in assembly or C compiler</td>
</tr>
</tbody>
</table>

### Integrated Third-Generation Flash Memory and RAM

- Embedded flash that is in-application reprogrammable over the full operating voltage and temperature range with a single power supply
- Provides users a single solution for multiple platforms or a single platform that is field reprogrammable in virtually any environment
- Does not require additional pin or power supply for flash programming, simplifying the interface for in-line programming and allowing for more GPIO pins
- Extremely fast, byte-writable programming; as fast as 20 us/byte
- Helps reduce production programming costs through ultra-fast programming, as well as lowering system power consumption due to shorter writes
- Up to 100,000 write/erase cycles at typical voltage and temperature (10k minimum write/erase); 100 years typical data retention (15 years minimum)
- Allows electrically erasable programmable read-only memory (EEPROM) emulation, reducing system costs and board real estate

### Flexible Clock Options

- Internal clock source (ICS) module containing a frequency-locked loop (FLL) controlled by internal or external reference
- Precision trimming of internal reference allows typical 0.1 percent resolution and +0.5 percent to -1 percent deviation over operating temperature and voltage
- Internal reference can be trimmed from 31.25 kHz to 39.065 kHz, allowing for 8 MHz to 10 MHz FLL output
- Provides one of the most accurate internal clock sources on the market for the money
- Low-power oscillator module (XOSC) with software selectable crystal or ceramic resonator range, 31.25 kHz to 38.4 kHz or 1MHz to 16 MHz, and supports external clock source input up to 20 MHz
- 32 kHz oscillator provides low-power option for systems requiring time-keeping functionality (i.e., time and date) while in low-power modes

### 12 Bidirectional Input/Output (I/O) Lines; One Input Only and One Output Only Line

- Outputs 10 mA each; 60 mA max for package
- High-current I/O allows direct drive of LED and other circuits to virtually eliminate external drivers and reduce system costs
- Software selectable pull-ups on ports when used as input; internal pull-up on reset and interrupt request (IRQ) pin
- Reduces customer system cost by eliminating need for external resistors
- Software selectable slew rate control and drive strength on ports when used as output
- Can configure ports for slower slew rate and weaker drive to minimize noise emissions from the MCU
- 8-pin keyboard interrupt module with software selectable polarity on edge or edge/level modes
- Keyboard scan with programmable pull-ups/pull-downs virtually eliminate external glue logic when interfacing to simple keypads
### Features

#### Integrated Analog Peripherals
- 8-ch., 10-bit analog-to-digital converter (ADC)
- Automatic compare function, software programmable for greater than/equal to or less than conditions
- Asynchronous clock source
- Temperature sensor
- Internal bandgap reference channel
- Hardware triggerable using the RTI counter
- Low-power and high-speed options

#### Two Timer Modules
- Programmable 16-bit timer/PWM module (TPM)
- 8-bit modulo timer module (MTIM) with 8-bit prescaler

#### System Protection
- Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock
- Low-voltage detection with reset or interrupt
- Illegal opcode detection with reset
- Flexible block protection
- Security feature for flash and RAM
- Always-on power-on reset (POR) circuitry

#### Background Debugging System and On-Chip In-Circuit Emulation (ICE) with Real-Time Bus Capture
- On-chip ICE

#### Multiple Serial Communication Options
- Serial communications interface module with option for 13-bit break capabilities and double-buffered transmit and receive
- Serial peripheral interface module
- PC bus module

### Benefits
- Easy interface to analog inputs, such as sensors
- Used to set conversion complete and generate interrupt only when result matches condition
- Can be used to run ADC when MCU clocks are off, such as in STOP3 low-power mode
- Calculates temperature without any external components and saves an ADC input channel for other use
- Takes periodic measurements without CPU involvement; can be used in STOP3 with compare function to take measurement and wake MCU from STOP3 only when compare level is reached
- Flexible configuration to meet high-performance and low-power requirements
- One of the most flexible timer modules for the money; each channel can be independently programmable for input capture, output compare, buffered edge-aligned pulse width modulation (PWM) or buffered center-aligned PWM
- Timer overflow interrupt can be enabled to generate periodic interrupts for time-based software loops
- Resets device in instance of runaway or corrupted code, and independent clock source provides additional protection in case of loss of clock
- Allows system to write/save important variables before voltage drops too low
- Can hold device in reset until reliable voltage levels are reapplied to the part
- Secures code sections so that it cannot be accidentally corrupted by runaway code
- Option to protect various block sizes
- Option to put bootloader code in protected space and clear corrupted by runaway code
- Can hold device in reset until reliable voltage levels are reapplied to the part
- Prevents unauthorized access to memory to protect a customer’s valuable software IP
- Significantly reduces risk of code runaway due to brownout situations
- Provides single-wire debugging and emulation interface; eliminates need for expensive emulation tools
- Provides circuit emulation without the need for additional, expensive development hardware
- All serial peripherals available for use in parallel on 16-pin devices

### Cost-Effective Development Tools

**DEMO9S08QG8** $50*  
Cost-effective demonstration board with potentiometer, LEDs, serial port and built-in USB-BDM cable for debugging and programming

**M68CYCLONEPRO** $499*  
HC08/HCS08/HCS12 stand-alone flash programmer or in-circuit emulator, debugger, flash programmer; USB, serial or Ethernet interface options

**USBMULTILINKBDM** $99*  
Universal HC08 in-circuit debugger and flash programmer; USB PC interface

**CWX-H08-SE** Free**  
CodeWarrior® Special Edition for HC(S)08 MCUs; includes integrated development environment (IDE), linker, debugger, unlimited assembler, Processor Expert™ auto-code generator, full-chip simulation and 16 KB C compiler

*Prices indicated are MSRP.  
**Subject to license agreement and registration.

### Package Options

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<tr>
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<th>Package</th>
<th>Temp. Range</th>
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<tbody>
<tr>
<td>MC9S08QG4CPAE</td>
<td>8-pin DIP</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>MC9S08QG4CDNE</td>
<td>8-pin SOIC-NB</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>MC9S08QG4CFQE</td>
<td>8-pin DFN</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>MC9S08QG4CTDE</td>
<td>16-pin TSSOP</td>
<td>-40°C to +85°C</td>
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<tr>
<td>MC9S08QG4CFEE</td>
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### Learn More:
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