

# MC9S08QG8/4

### 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 Semiconductor'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.

#### HCS08 CPU

4/8 KB Flash	On-Chip ICE (DBG)
256/512B RAM	BDC
LVI	8-ch., 10-bit ADC
COP	SCI
IIC	SPI
Int/Ext Osc.	2-ch., 16-bit Timer
Internal Clock Source w/FLL	8-bit Modulo Timer w/Prescaler
Temperature Sensor	Up to 13 GPIO
	Analog Comparator

#### Features

##### 8-bit HCS08 Central Processor Unit (CPU)

- > Up to 20 MHz HCS08 CPU (10 MHz bus frequency) for 100 ns minimum instruction time
- > HC08 instruction set with added BGND instruction
- > Support for up to 32 interrupt/reset sources

#### Benefits

- > Offering high performance, even at low voltage levels for battery-operated applications
- > Backward object-code compatibility with 68HC08 and 68HC05 so existing code libraries can still be used
- > Allows for efficient, compact module coding in assembly or C compiler
- > Allows for software flexibility and optimization for real-time applications

##### 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
- > Extremely fast, byte-writable programming; as fast as 20 us/byte
- > Up to 100,000 write/erase cycles at typical voltage and temperature (10K minimum write/erase); 100 years typical data retention (15 years minimum)

- > 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 general purpose input output (GPIO) pins
- > Helps reduce production programming costs through ultra-fast programming, as well as lowering system power consumption due to shorter writes
- > 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
- > Low-power oscillator module (XOSC) with software selectable crystal or ceramic resonator range, 31.25 kHz to 38.4 kHz or 1 MHz to 16 MHz, and supports external clock source input up to 20 MHz

- > Can eliminate the cost of all external clock components, reduce board space and increase system reliability
- > Provides one of the most accurate internal clock sources on the market for the money
- > Can use trimming to adjust bus clocks for optimal serial communication baud rates and/or timer intervals
- > 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
- > Software selectable pull-ups on ports when used as input; internal pull-up on reset and interrupt request (IRQ) pin
- > Software selectable slew rate control and drive strength on ports when used as output
- > 8-pin keyboard interrupt module with software selectable polarity on edge or edge/level modes

- > High-current I/O allows direct drive of LED and other circuits to virtually eliminate external drivers and reduce system costs
- > Reduces customer system cost by eliminating need for external resistors
- > Can configure ports for slower slew rate and weaker drive to minimize noise emissions from the MCU
- > Keyboard scan with programmable pull-ups/pull-downs virtually eliminates external glue logic when interfacing to simple keypads

## Data Sheets

MC9S08QG8 Data Sheet for QG8/QG4

### Cost-Effective Development Tools

For more information on development tools, please refer to the Freescale Development Tool Selector Guide (SG1011).

#### 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/HC12/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

Part Number	Package	Temp. Range
MC9S08QG4CPAE	8-pin DIP	-40°C to +85°C
MC9S08QG4CDNE	8-pin SOIC-NB	-40°C to +85°C
MC9S08QG4CFQE	8-pin DFN	-40°C to +85°C
MC9S08QG4CDTE	16-pin TSSOP	-40°C to +85°C
MC9S08QG4CFFE	16-pin QFN	-40°C to +85°C
MC9S08QG8CDNE	8-pin SOIC-NB	-40°C to +85°C
MC9S08QG8CFQE	8-pin DFN	-40°C to +85°C
MC9S08QG8CPBE	16-pin DIP	-40°C to +85°C
MC9S08QG8CFFE	16-pin QFN	-40°C to +85°C
MC9S08QG8CDTE	16-pin TSSOP	-40°C to +85°C

MC9S08QG Family available at -40°C to +125°C in 2H, 2006

## Features

## Benefits

### Integrated Analog Peripherals

- > 8-channel, 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 real-time interrupt (RTI) counter
    - Low-power and high-speed options
  - > Analog comparator module (ACMP)
    - Option to compare to internal reference
    - Option to route comparator output directly to pin
    - Output can be optionally routed to timer/PWM (TPM) module as input capture trigger
- > 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
  - > Constant voltage source for calibrating ADC results requires no external components
  - > 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
  - > Requires only single pin for input signal
  - > Allows other components in system to see results of comparator with minimal delay
  - > Can be used for single slope ADC and resistance-capacitance (RC) time constant measurements

### Two Timer Modules

- > Programmable 16-bit TPM module
  - > One of the most flexible timer modules for the money; each channel can be independently programmable for input capture, output compare or buffered edge-aligned pulse-width modulation (PWM) or buffered center-aligned PWM
- > 8-bit modulo timer module (MTIM) with 8-bit prescaler
  - > Timer overflow interrupt can be enabled to generate periodic interrupts for time-based software loops

### System Protection

- > Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock
  - > Resets device in instance of runaway or corrupted code, and independent clock source provides additional protection in case of loss of clock
- > Low voltage detection with reset or interrupt
  - > Allows system to write/save important variables before voltage drops to low
  - > Can hold device in reset until reliable voltage levels are reapplied to the part
- > Illegal opcode detection with reset
  - > Resets device in instance of runaway or corrupted code
- > Flexible block protection
  - > 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 Flash for reprogramming
- > Security feature for Flash and RAM
  - > Prevents unauthorized access to memory to protect a customer's valuable software IP
- > Always-on power-on reset (POR) circuitry
  - > Significantly reduces risk of code runaway due to brownout situations

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

- > On-chip ICE
  - > Provides single wire debugging and emulation interface; eliminates need for expensive emulation tools
  - > Provides circuit emulation without the need for additional, expensive development hardware

### Multiple Serial Communication Options

- > SCI—serial communications interface module with option for 13-bit break capabilities and double-buffered transmit and receive
  - > All serial peripherals available for use in parallel on 16-pin devices
- > SPI—serial peripheral interface module
- > I<sup>2</sup>C—inter-integrated circuit bus module

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

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