Ultra-Low-Power Microcontrollers

# MC9S08QB8/4: Simplicity with Substance

## Taking the lead in low power

Energy Efficient Solutions optimized for low power

### Target Applications

- Battery-powered applications
- Residential/commercial garage door openers
- Smoke detectors
- Remote window shutters
- Remote control applications
- Battery-operated toys and games

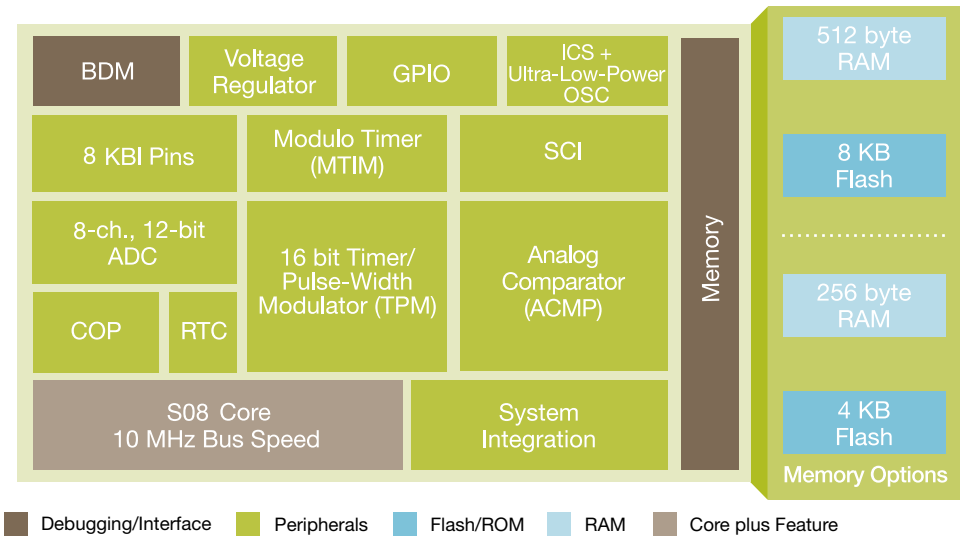
### Overview

Achieving raw performance is no longer the number one issue—it's now "performance within an energy budget." Freescale understands this challenge and offers a wide portfolio of S08 devices that help you reach target performance levels while minimizing low power in your design. The QB family demonstrates extreme energy efficiency for ultra-long operating life in battery-powered applications.

As a subset of QE family, the QB8 16-pin TSSOP and 28-pin SOIC are pin compatible with the QE8 device. The S08QB8 (QB8) microcontroller offers low-power features such as two ultra-low-power stop modes, new low-power run and wait modes, 6 µs wake-up time, ultra-low-power external oscillator and clock gating registers to disable clocks to unused peripherals.

The QB8 offers up to 8 KB of flash memory and an 8-channel, 12-bit resolution analog-to-digital converter (ADC). The S08QB8 can be powered down to 1.8V and still able to operate at maximum 20 MHz CPU speed. QB8 consists of a 8-bit modulo timer, a 16-bit timer/pulse width modulator, UART, real time counter, analog comparator, 8-channel keyboard interrupt module—perfect for cost-effective, battery sensitive, portable, low-power applications.

### S08QB8/4 Block Diagram




| Features | Benefits |
|---|---|
| **Power-Saving Features** | |
| • Two ultra-low-power stop modes, one of which allows limited use of peripherals | • Allows continued application sampling in a reduced power state which extends battery life |
| • New low-power run and wait modes | • Allows use of all chip peripherals in a low-power state |
| • 6 µs typical wake up time from stop mode | • Enables faster execution out of stop modes |
| • Internal clock Source (ICS)—module containing a frequency locked-loop (FLL) controlled by internal or external reference | • Provides choice of frequencies on the fly. Reducing frequency saves current. |
| • 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 | • Includes ultra-low-power OSC for accurate timebase in low-power modes |
| • Clock gating disables clocks to unused peripherals | • Provides flexibility to turn off individual modules<br>• Reduces power consumption |
| **8-bit HCS08 Central Processing Unit (CPU)** | |
| • Up to 20 MHZ HCS08 CPU from 1.8V to 3.6V and across temperature range of -40°C to +85°C | • Offers high performance, even at low voltage levels for battery-operated applications<br>• Provides bus speed operation of 10 MHz from 1.8V to 3.6V |
| • HCS08 instruction set with added BGND instruction | • Easy to learn and use architecture<br>• Backward object code compatibility with 68HC08 and 68HC05 for reuse of existing libraries can still be used<br>• Allows for efficient, compact module coding in assembly or C compiler |
| **On-Chip Memory** | |
| • Up to 8 KB flash read/program/erase over full operating voltage and temperature | • Allows user to take full advantage of in-application, reprogrammability benefits in virtually any environment |
| • Up to 512 bytes of random access memory(RAM) with low ram retention voltage and security feature | • RAM can hold content with low voltage supply. This reduces over all power consumption.<br>• Security circuitry prevents unauthorized access to RAM and flash content. |

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| Features | Benefits |
|---|---|
| **Peripherals** | |
| • ADC—8-channel, 12-bit resolution for 28-pin and 24-pin packages, 10-bit resolution for 16-pin package; 2.5 µs conversion time for both 10-bit and 12-bit resolution; automatic compare function; internal temperature sensor; internal bandgap reference channel; operation in low-power stop mode | • Allows up to 8 external ADC channels to be sampled at extremely high speeds<br>• Accuracy and full functionality guaranteed across 1.8V to 3.6V operating voltage of the MCU |
| • Timer/pulse-width modulator (TPM)—one channel with 16-bit counter, selectable input capture, output compare, or buffered edge- or center-aligned PWM<br>• The TPM channel is located at PTA0 by default but it can also be selected by software to relocate at PTB5 port | • 16-bit base free running counter allow higher resolution for input capture results and longer TPM period comparing to the conventional 8-bit base counter<br>• TPM channel reposition at different I/O port allows flexibility to apply TPM functions at different pin out as application desire |
| • Serial communications interface (SCI)—module 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 standard UART communications peripheral<br>• Allows full-duplex, asynchronous, NRZ serial communication between MCU and remote devices<br>• Edge interrupt can wake up MCU from low-power mode |
| • Analog comparator (ACMP) with option to compare to an internal reference voltage. Output can be optionally routed to TPM as input capture trigger | • Requires only single pin for input signal, freeing additional pins for other use<br>• Allows other components in system to see result of comparator with minimal delay<br>• Can be used for single slope ADC and RC time constant measurements |
| • 8-bit module timer module with 8-bit prescaler (MTIM) | • A timer overflow interrupt can be enabled to generate periodic interrupts for time-based software loops |
| **Input/Output** | |
| • Up to 22 general purpose input/output (GPIO), one input-only and one output-only pin | • Results in large number of flexible I/O pins that allow developers to easily interface device into their own designs |
| • 8 keyboard interrupts (KBI) pins with selectable polarity | • Can be used for reading input from a keypad or used as general pin interrupts |
| **System Protection** | |
| • Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock | • Allows device to recognize runaway code (infinite loops) and resets processor to avoid lock-up states |
| • Low-voltage detection with reset or interrupt; selectable trip points | • Alarms the developer of voltage drops outside of the typical operating range |
| • Illegal op code and illegal address detection with reset | • Allows the device to recognize erroneous code and resets the processor to avoid lock-up states |
| • Flash block protection | • Prevents unintentional programming of protected flash memory, which greatly reduces the chance of losing vital system code for vendor applications |
| **Development Support** | |
| • Breakpoint capability | • Allows single breakpoint setting during in-circuit debugging (plus three more breakpoints in on-chip debug module) |

## Package Options

| Part Number | Temp. Range | Package |
|---|---|---|
| MC9S08QB8CWL | -40°C to +85°C | 28-pin SOIC |
| MC9S08QB8CGK | -40°C to +85°C | 24-pin QFN |
| MC9S08QB8CTG | -40°C to +85°C | 16-pin TSSOP |
| MC9S08QB4CWL | -40°C to +85°C | 28-pin SOIC |
| MC9S08QB4CGK | -40°C to +85°C | 24-pin QFN |
| MC9S08QB4CTG | -40°C to +85°C | 16-pin TSSOP |

## Cost-Effective Development Tools

### DEMO9S08QB8

**$69***

Cost-effective demonstration kit including QE family base board being reused by QB family and the QB8 daughter card, as well as serial port and built-in USB-BDM cable for debugging and programming. This tool includes a lab that demonstrates the ultra-low-power benefits.

### DC9S08QB8

**$10***

Daughter card of QB8 to use on your DEMOQE base board.

### CodeWarrior™ Development Studio for Microcontrollers 6.2

**Complimentary** Special Edition**

CodeWarrior Development Studio for Microcontrollers is a single tool suite that supports software development for Freescale's 8- and 32-bit V1 ColdFire® 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 QB Family, please visit **www.freescale.com/lowpower.**



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