

## Ultra-Low-Power Microcontrollers

# MC9S08QB8/4: Simplicity with Substance

## Taking the lead in 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

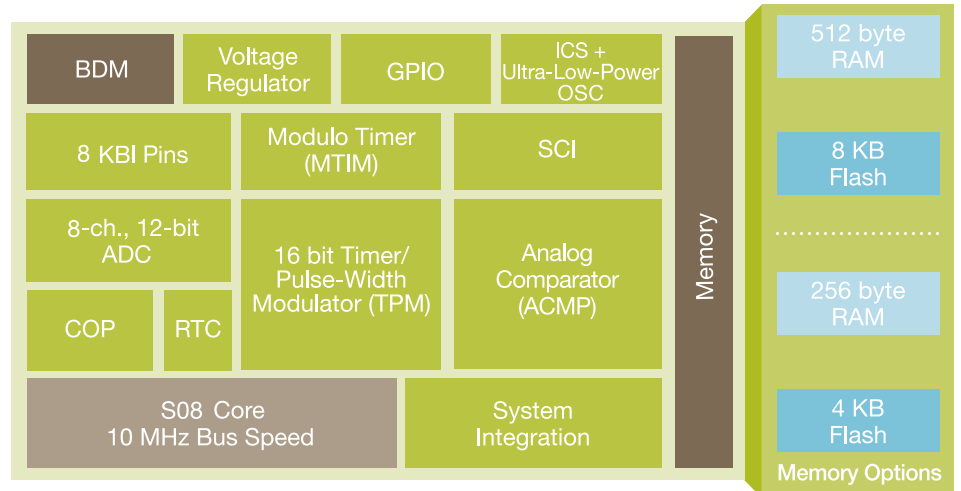
### Overview

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  $\mu$ s 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



■ Debugging/Interface ■ Peripherals ■ Flash/ROM ■ RAM ■ Core plus Feature

Features	Benefits
<b>Power-Saving Features</b>	
<ul style="list-style-type: none"> <li>• Two ultra-low-power stop modes, one of which allows limited use of peripherals</li> <li>• New low-power run and wait modes</li> <li>• 6 <math>\mu</math>s typical wake up time from stop mode</li> </ul>	<ul style="list-style-type: none"> <li>• Allows continued application sampling in a reduced power state which extends battery life</li> <li>• Allows use of all chip peripherals in a low-power state</li> <li>• Enables faster execution out of stop modes</li> </ul>
<ul style="list-style-type: none"> <li>• Internal clock Source (ICS)—module containing a frequency locked-loop (FLL) controlled by internal or external reference</li> <li>• 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</li> </ul>	<ul style="list-style-type: none"> <li>• Provides choice of frequencies on the fly. Reducing frequency saves current.</li> <li>• Includes ultra-low-power OSC for accurate timebase in low-power modes</li> </ul>
<ul style="list-style-type: none"> <li>• Clock gating disables clocks to unused peripherals</li> </ul>	<ul style="list-style-type: none"> <li>• Provides flexibility to turn off individual modules</li> <li>• Reduces power consumption</li> </ul>
<b>8-bit HCS08 Central Processing Unit (CPU)</b>	
<ul style="list-style-type: none"> <li>• Up to 20 MHz HCS08 CPU from 1.8V to 3.6V and across temperature range of -40°C to +85°C</li> </ul>	<ul style="list-style-type: none"> <li>• Offers high performance, even at low voltage levels for battery-operated applications</li> <li>• Provides bus speed operation of 10 MHz from 1.8V to 3.6V</li> </ul>
<ul style="list-style-type: none"> <li>• HCS08 instruction set with added BGND instruction</li> </ul>	<ul style="list-style-type: none"> <li>• Easy to learn and use architecture</li> <li>• Backward object code compatibility with 68HC08 and 68HC05 for reuse of existing libraries can still be used</li> <li>• Allows for efficient, compact module coding in assembly or C compiler</li> </ul>
<b>On-Chip Memory</b>	
<ul style="list-style-type: none"> <li>• Up to 8 KB flash read/program/erase over full operating voltage and temperature</li> </ul>	<ul style="list-style-type: none"> <li>• Allows user to take full advantage of in-application, reprogrammability benefits in virtually any environment</li> </ul>
<ul style="list-style-type: none"> <li>• Up to 512 bytes of random access memory(RAM) with low ram retention voltage and security feature</li> </ul>	<ul style="list-style-type: none"> <li>• RAM can hold content with low voltage supply. This reduces over all power consumption.</li> <li>• Security circuitry prevents unauthorized access to RAM and flash content.</li> </ul>



Features		Benefits		Package Options		
<b>Peripherals</b>				<b>Part Number</b>	<b>Temp. Range</b>	<b>Package</b>
<ul style="list-style-type: none"> <li>ADC—8-channel, 12-bit resolution for 28-pin and 24-pin packages, 10-bit resolution for 16-pin package; 2.5 <math>\mu</math>s 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</li> </ul>	<ul style="list-style-type: none"> <li>Allows up to 8 external ADC channels to be sampled at extremely high speeds</li> <li>Accuracy and full functionality guaranteed across 1.8V to 3.6V operating voltage of the MCU</li> </ul>	<ul style="list-style-type: none"> <li>MC9S08QB8CWL -40°C to +85°C 28-pin SOIC</li> <li>MC9S08QB8CGK -40°C to +85°C 24-pin QFN</li> <li>MC9S08QB8CTG -40°C to +85°C 16-pin TSSOP</li> <li>MC9S08QB4CWL -40°C to +85°C 28-pin SOIC</li> <li>MC9S08QB4CGK -40°C to +85°C 24-pin QFN</li> <li>MC9S08QB4CTG -40°C to +85°C 16-pin TSSOP</li> </ul>				
<ul style="list-style-type: none"> <li>Timer/pulse-width modulator (TPM)—one channel with 16-bit counter, selectable input capture, output compare, or buffered edge- or center-aligned PWM</li> <li>The TPM channel is located at PTA0 by default but it can also be selected by software to relocate at PTB5 port</li> </ul>	<ul style="list-style-type: none"> <li>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</li> <li>TPM channel reposition at different I/O port allows flexibility to apply TPM functions at different pin out as application desire</li> </ul>					
<ul style="list-style-type: none"> <li>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</li> </ul>	<ul style="list-style-type: none"> <li>Provides standard UART communications peripheral</li> <li>Allows full-duplex, asynchronous, NRZ serial communication between MCU and remote devices</li> <li>Edge interrupt can wake up MCU from low-power mode</li> </ul>					
<ul style="list-style-type: none"> <li>Analog comparator (ACMP) with option to compare to an internal reference voltage. Output can be optionally routed to TPM as input capture trigger</li> </ul>	<ul style="list-style-type: none"> <li>Requires only single pin for input signal, freeing additional pins for other use</li> <li>Allows other components in system to see result of comparator with minimal delay</li> <li>Can be used for single slope ADC and RC time constant measurements</li> </ul>					
<ul style="list-style-type: none"> <li>8-bit module timer module with 8-bit prescaler (MTIM)</li> </ul>	<ul style="list-style-type: none"> <li>A timer overflow interrupt can be enabled to generate periodic interrupts for time-based software loops</li> </ul>					
<b>Input/Output</b>				<b>Cost-Effective Development Tools</b>		
<ul style="list-style-type: none"> <li>Up to 22 general purpose input/output (GPIO), one input-only and one output-only pin</li> </ul>	<ul style="list-style-type: none"> <li>Results in large number of flexible I/O pins that allow developers to easily interface device into their own designs</li> </ul>	<b>DEMO9S08QB8</b>				
<ul style="list-style-type: none"> <li>8 keyboard interrupts (KBI) pins with selectable polarity</li> </ul>	<ul style="list-style-type: none"> <li>Can be used for reading input from a keypad or used as general pin interrupts</li> </ul>	<b>\$69*</b>				
<b>System Protection</b>				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.		
<ul style="list-style-type: none"> <li>Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock</li> </ul>	<ul style="list-style-type: none"> <li>Allows device to recognize runaway code (infinite loops) and resets processor to avoid lock-up states</li> </ul>	<b>DC9S08QB8</b>				
<ul style="list-style-type: none"> <li>Low-voltage detection with reset or interrupt; selectable trip points</li> </ul>	<ul style="list-style-type: none"> <li>Alarms the developer of voltage drops outside of the typical operating range</li> </ul>	<b>\$10*</b>				
<ul style="list-style-type: none"> <li>Illegal op code and illegal address detection with reset</li> </ul>	<ul style="list-style-type: none"> <li>Allows the device to recognize erroneous code and resets the processor to avoid lock-up states</li> </ul>	Daughter card of QB8 to use on your DEMOQE base board.				
<ul style="list-style-type: none"> <li>Flash block protection</li> </ul>	<ul style="list-style-type: none"> <li>Prevents unintentional programming of protected flash memory, which greatly reduces the chance of losing vital system code for vendor applications</li> </ul>	<b>CodeWarrior™ Development Studio for Microcontrollers 6.2</b>				
<b>Development Support</b>				Complimentary** Special Edition		
<ul style="list-style-type: none"> <li>Breakpoint capability</li> </ul>	<ul style="list-style-type: none"> <li>Allows single breakpoint setting during in-circuit debugging (plus three more breakpoints in on-chip debug module)</li> </ul>	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](http://www.freescale.com/lowpower).

