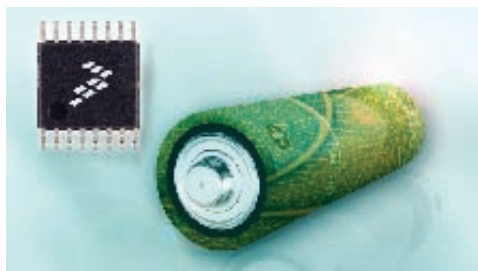


## Ultra-Low-Power Microcontrollers

# MC9S08QE8/4

## Taking the lead in low power



### Target Applications

- Low-power wireless applications
- Security systems
- Personal health care devices
- Cell phone accessories
- Commercial smoke detectors
- Security sensors
- Toys

### Overview

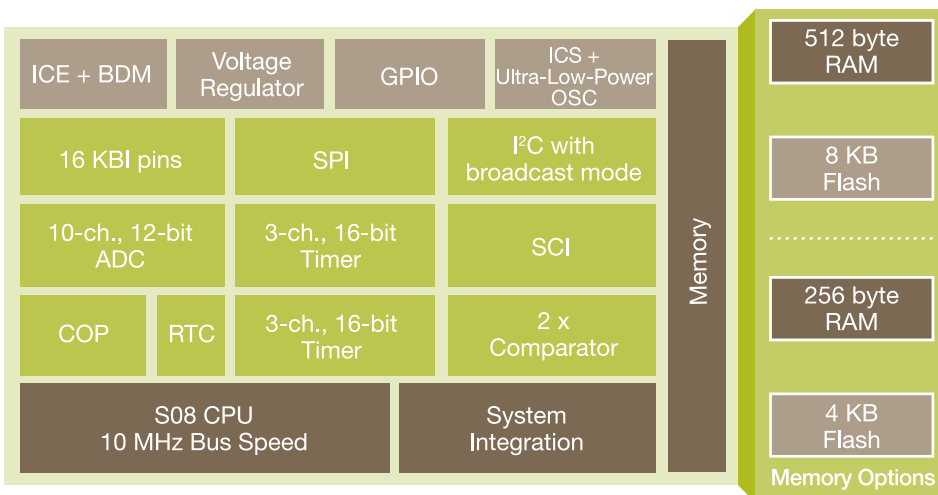
Achieving raw performance is no longer the number one issue—it's now “performance within an energy budget.” Freescale understands this challenge and offers a wide portfolio of S08 devices that help you reach target performance levels while minimizing low power in your design. The QE family demonstrates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

A member of the QE family, the QE8 32-pin-LQFP device is pin compatible with the QE128 S08 and ColdFire® V1 devices. The S08QE8 (QE8) microcontroller offers low-power features such as two ultra-low-power stop modes, new low-power run and wait modes, six  $\mu$ s wake-up time, ultra-low-power external oscillator and clock gating registers to disable clocks to unused peripherals.

The QE8 offers up to 8 KB of flash memory and a 10-channel, 12-bit resolution analog-to-digital converter (ADC). The S08QE8 programs down to 1.8V, a 20 MHz CPU core, two timers, UART, SPI, I<sup>2</sup>C and two analog comparators—perfect for cost-effective portable health care applications.

To test your application with the QE8, take the Battery Calculator challenge, available at [www.freescale.com/lowpower](http://www.freescale.com/lowpower).

### S08QE8/4 Block Diagram



### Features

#### Power-Saving Features

- Two ultra-low-power (ULP) stop modes, one of which allows limited use of peripherals
- New low-power run and wait modes
- 6  $\mu$ s typical wake up time from stop mode
- Internal clock Source (ICS)—module containing a frequency locked-loop (FLL) controlled by internal or external reference
- 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
- Clock gating disables clocks to unused peripherals

### Benefits

- Allows continued application sampling in a reduced power state which extends battery life
- Allows use of all chip peripherals in a low-power state
- Enables faster execution out of stop modes
- Provides choice of frequencies on-the-fly. Reducing frequency saves current.
- Includes ultra-low-power OSC for accurate timebase in low-power modes
- Provides flexibility to turn off individual modules
- 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
- HCS08 instruction set with added BGND instruction
- Offers high performance, even at low voltage levels for battery-operated applications
- Provides bus speed operation of 10 MHz from 1.8V to 3.6V
- Easy to learn and use architecture
- Backward object code compatibility with 68HC08 and 68HC05 for reuse of existing libraries can still be used
- Allows for efficient, compact module coding in assembly or C compiler
- BGND allows user to enter background debug mode that takes advantage of on-chip in-circuit emulator (ICE)

#### On-Chip Memory

- Up to 8 KB flash read/program/erase over full operating voltage and temperature
- Up to range of 1.8V to 3.6V random-access memory (RAM)
- Allows user to take full advantage of in-application, reprogrammability benefits in virtually any environment
- Security circuitry prevents unauthorized access to RAM and flash contents to reduce system power consumption

Features	Benefits
<b>Peripherals</b>	
<ul style="list-style-type: none"> <li>Analog-to-digital converter (ADC)—10-channel, 12-bit resolution; 2.5 <math>\mu</math>s conversion time; automatic compare function; internal temperature sensor; internal bandgap reference channel; operation in stop mode</li> </ul>	<ul style="list-style-type: none"> <li>Having 10 channels allows up to 10 analog devices 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>Timer—two 3-channel (TPM1 and TPM2); selectable input capture, output compare, or buffered edge- or center-aligned PWM on each channel</li> </ul>	<ul style="list-style-type: none"> <li>Two TPMs allow for two different time bases, with a total of twelve timer channels</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>Two analog comparators with option to compare to an internal reference—output can be optionally routed to timer/pulse width modulator (PWM) 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>Serial Peripheral Interface (SPI)—one module with full-duplex or single-wire bidirectional; double-buffered transmit and receive; master or slave mode; MSB-first or LSB-first shifting</li> </ul>	<ul style="list-style-type: none"> <li>Allows high speed (up to 5 Mbps) communications to other MCUs or peripherals such as MC1319x RF transceivers</li> </ul>
<ul style="list-style-type: none"> <li>I<sup>2</sup>C with up to 100 kbps with maximum bus loading; multi-master operation; programmable slave address; interrupt-driven byte-by-byte data transfer; supports broadcast mode and 10-bit addressing</li> </ul>	<ul style="list-style-type: none"> <li>I<sup>2</sup>C port enables increased system memory by using an additional I<sup>2</sup>C EEPROM. This also creates an opportunity to add an additional I<sup>2</sup>C device.</li> </ul>
<b>Input/Output</b>	
<ul style="list-style-type: none"> <li>27 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>
<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>System Protection</b>	
<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>
<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>
<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>
<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>Development Support</b>	
<ul style="list-style-type: none"> <li>Single-wire background debug interface</li> </ul>	<ul style="list-style-type: none"> <li>Allows developers to use the same hardware cables between S08 and V1 ColdFire® platforms</li> </ul>
<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>
<ul style="list-style-type: none"> <li>ICE debug module containing three comparators and nine trigger modes. Eight deep FIFO for storing change-of-flow addresses and event-only data—debug module supports both tag and force breakpoints.</li> </ul>	<ul style="list-style-type: none"> <li>Provides built-in full emulation without expense of traditional emulator</li> </ul>

Package Options		
Part Number	Temp. Range	Package
MC9S08QE4CPG	-40°C to +85°C	16-pin PDIP
MC9S08QE4CTG	-40°C to +85°C	16-pin TSSOP
MC9S08QE4CWJ	-40°C to +85°C	20-pin SOIC
MC9S08QE4CWL	-40°C to +85°C	28-pin SOIC
MC9S08QE4CLC	-40°C to +85°C	32-pin LQFP
MC9S08QE8CPG	-40°C to +85°C	16-pin PDIP
MC9S08QE8CTG	-40°C to +85°C	16-pin TSSOP
MC9S08QE8CWJ	-40°C to +85°C	20-pin SOIC
MC9S08QE8CWL	-40°C to +85°C	28-pin SOIC
MC9S08QE8CLC	-40°C to +85°C	32-pin LQFP

### Cost-Effective Development Tools

#### DEMO9S08QE8

\$69\*

Cost-effective demonstration kit including the QE8 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.

#### DC9S08QE8

\$10\*

Daughter card of QE8 to use on your DEMOQE128 demonstration kit.

### CodeWarrior® Development Studio for Microcontrollers 6.1

#### 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 Flexis QE family, please visit [www.freescale.com/lowpower](http://www.freescale.com/lowpower).