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NXP Semiconductors MC9S08QE4CLC

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**Distributor of NXP Semiconductors: Excellent Integrated System Limited** Datasheet of MC9S08QE4CLC - IC MCU 8BIT 4KB FLASH 32LQFP Contact us: sales@integrated-circuit.com Website: www.integrated-circuit.com

**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<sup>®</sup> 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 µs 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,  $I^2C$  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.

## S08QE8/4 Block Diagram



#### **Features Benefits Power-Saving Features** Two ultra-low-power (ULP) stop modes, one of Allows continued application sampling in a reduced which allows limited use of peripherals power state which extends battery life New low-power run and wait modes Allows use of all chip peripherals in a low-power state Enables faster execution out of stop modes • 6 µs typical wake up time from stop mode ٠ Internal clock Source (ICS) - module containing a frequency locked-loop (FLL) controlled by internal Provides choice of frequencies on-the-fly. Reducing frequency saves current. or external reference Oscillator (OSC)-loop-control Pierce oscillator; Includes ultra-low-power OSC for accurate crystal or ceramic resonator range of 31.25 kHz to 38.4 kHz or 1 MHz to 16 MHz timebase in low-power modes · Provides flexibility to turn off individual modules · Clock gating disables clocks to unused peripherals • Reduces power consumption 8-bit HCS08 Central Processing Unit (CPU) Up to 20 MHZ HCS08 CPU from 1.8V to 3.6V and Offers high performance, even at low voltage levels across temperature range of -40°C to +85°C for battery-operated applications 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 ٠ 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 Allows user to take full advantage of operating voltage and temperature in-application, reprogrammability benefits in virtually any environment Up to range of 1.8V to 3.6V random-access memory (RAM) Security circuitry prevents unauthorized access to RAM and flash contents to reduce system power consumption



## 8-bit Fact Sheet





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Peripherals	
•	Analog-to-digital converter (ADC) – 10-channel, 12-bit resolution; 2.5 µs conversion time; automatic compare function; internal temperature sensor; internal bandgap reference channel; operation in stop mode
•	Timer-two 3-channel (TPM1 and TPM2); selectable input capture, output compare, or buffered edge- or center-aligned PWM on each channel

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

- 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
- 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

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

#### Input/Output

 27 General Purpose Input/Output (GPIO), one input-only and one output-only pin own designs 8 Keyboard Interrupts (KBI) pins with selectable polarity System Protection Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz lock-up states internal clock source or bus clock Low-voltage detection with reset or interrupt; selectable trip points Illegal op code and illegal address detection with reset Flash block protection

#### **Development Support**

Breakpoint capability

· Single-wire background debug interface

ICE debug module containing three comparators and nine trigger modes. Eight deep FIFO for storing change-of-flow addresses and event-only -debug module supports both tag and dataforce breakpoints.

Having 10 channels allows up to 10 analog devices to be sampled at extremely high speeds Accuracy and full functionality guaranteed across 1.8V to 3.6V operating voltage of the MCU Two TPMs allow for two different time bases,

**Benefits** 

- with a total of twelve timer channels
- Provides standard UART communications peripheral
- Allows full-duplex, asynchronous, NRZ serial
- communication between MCU and remote devices Edge interrupt can wake up MCU from low-power mode
- Requires only single pin for input signal, freeing additional pins for other use
- Allows other components in system to see result of comparator with minimal delay
- Can be used for single slope ADC and RC time • constant measurements
- Allows high speed (up to 5 Mbps) communications to other MCUs or peripherals such as MC1319x RF transceivers
- I<sup>2</sup>C port enables increased system memory by using an additional I<sup>2</sup>C EEPROM. This also creates ٠ an opportunity to add an additional I2C device.
- Results in large number of flexible I/O pins that allow developers to easily interface device into their
- Can be used for reading input from a keypad or used as general pin interrupts
- Allows device to recognize runaway code (infinite loops) and resets processor to avoid
- Alarms the developer of voltage drops outside of the typical operating range
- Allows the device to recognize erroneous code and resets the processor to avoid lock-up states Prevents unintentional programming of protected
- flash memory, which greatly reduces the chance of losing vital system code for vendor applications
- Allows developers to use the same hardware cables between S08 and V1 ColdFire® platforms
- Allows single breakpoint setting during in-circuit debugging (plus three more breakpoints in on-chip debug module)
  - Provides built-in full emulation without expense of traditional emulator

#### **Package Options** Part Number Package Temp. Range 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 MC9S080F4CLC -40°C to +85°C 32-pin LOEP 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<sup>®</sup> 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.

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