



8-bit microcontroller

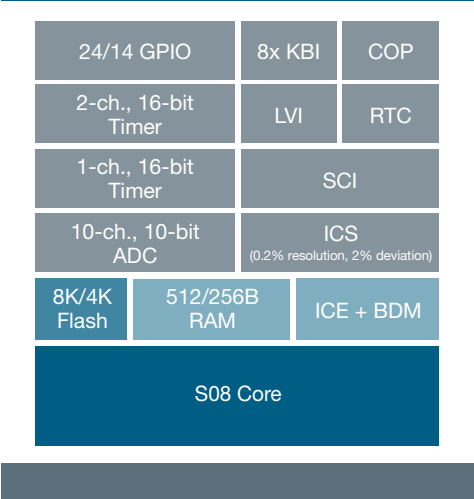
# MC9S08SE8/4

## Do more with less

### Target Applications

- Personal care/handheld devices
- AC-powered consumer goods
- Power tools
- Security systems
- Lawnmowers
- Small appliances
- Treadmills
- Vacuum cleaners
- Industrial appliances/compressors
- DC computer cooling fans
- Power supplies
- AC voltage line monitors

### MC9S08SE8/4 Block Diagram



| Features                                                                                                                                                                                               | Benefits                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>8-bit HCS08 Central Processor Unit (CPU)</b>                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>• Up to 20 MHz HCS08 (10 MHz internal bus frequency)</li> <li>• HC08 instruction set with added BGND instruction</li> </ul>                                     | <ul style="list-style-type: none"> <li>• Offers high performance up to 5V, ideal for industrial applications</li> <li>• Enables backward object-code compatibility with 68HC08 and 68HC05</li> <li>• Allows existing code libraries to be used</li> <li>• Allows for efficient, compact module coding in assembly or C compiler</li> </ul>                          |
| <ul style="list-style-type: none"> <li>• Supports up to 32 interrupt/reset sources</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>• Enables software flexibility and optimization for real-time applications</li> </ul>                                                                                                                                                                                                                                        |
| <b>Integrated Third-Generation Flash Memory and RAM</b>                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>• Embedded flash that is in-application reprogrammable over the full operating voltage and temperature range with a single power supply</li> </ul>              | <ul style="list-style-type: none"> <li>• Provides users a single solution for multiple platforms or a single platform that is field reprogrammable in virtually any environment</li> <li>• Does not require additional pin or power supply for flash programming, thus simplifying the interface for in-line programming and allowing for more GPIO pins</li> </ul> |
| <ul style="list-style-type: none"> <li>• Extremely fast, byte-writable programming; as fast as 20 <math>\mu</math>s (burst mode)</li> </ul>                                                            | <ul style="list-style-type: none"> <li>• Helps reduce production programming costs through ultra-fast programming, as well as lowering system power consumption due to shorter writes</li> </ul>                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>• Up to 100,000 write/erase cycles at typical voltage and temperature (10k minimum write/erase); 100 years typical data retention (15 years minimum)</li> </ul> | <ul style="list-style-type: none"> <li>• Allows electrically erasable programmable read-only memory (EEPROM) emulation, reducing system costs and board real estate</li> </ul>                                                                                                                                                                                      |
| <b>Flexible Clock Options</b>                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>• Internal clock source (ICS) module with a frequency-locked loop (FLL) controlled by internal or external reference</li> </ul>                                 | <ul style="list-style-type: none"> <li>• Eliminates the cost of utilizing external clock components, reducing board space and increasing system reliability</li> </ul>                                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>• Precision trimming of internal reference allows typical 0.2 percent resolution and 2 percent deviation over operating temperature and voltage</li> </ul>      | <ul style="list-style-type: none"> <li>• Provides one of the most accurate and cost-effective internal clock sources in the market</li> </ul>                                                                                                                                                                                                                       |
| <ul style="list-style-type: none"> <li>• Internal reference can be trimmed from 31.25 kHz to 38.4 kHz, allowing for up to 10 MHz FLL output</li> </ul>                                                 | <ul style="list-style-type: none"> <li>• Enables adjustment of bus clocks for optimal serial communication baud rates and/or timer intervals</li> </ul>                                                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>• 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</li> </ul>           | <ul style="list-style-type: none"> <li>• 32 kHz oscillator provides low-power option for systems requiring time-keeping functionality (i.e. time and date) while in low-power modes</li> </ul>                                                                                                                                                                      |
| <b>22 I/O Pins, One Input-Only Pin and One Output-Only Pin</b>                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>• Outputs 10 mA each; 60 mA max for package</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>• High-current I/O allows direct drive of LED and other circuits, virtually eliminating external drivers and reducing system costs</li> </ul>                                                                                                                                                                                |
| <ul style="list-style-type: none"> <li>• Software-selectable pull-ups on ports when used as inputs; internal pull-up on reset and interrupt request (IRQ) pin</li> </ul>                               | <ul style="list-style-type: none"> <li>• Reduces customer's system cost by eliminating the need for external resistors</li> </ul>                                                                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>• Software-selectable slew rate control and drive strength on ports when used as output</li> </ul>                                                              | <ul style="list-style-type: none"> <li>• Allows user to configure ports for slower slew rate and weaker drive to minimize noise emissions from the MCU</li> </ul>                                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>• 8-pin keyboard interrupt module with software-selectable polarity on edge or edge/level modes</li> </ul>                                                      | <ul style="list-style-type: none"> <li>• Keyboard scan with programmable pull-ups/pull-downs virtually eliminates external glue logic when interfacing to simple keypads</li> </ul>                                                                                                                                                                                 |

## Overview

The MC9S08SE8/4 strengthens Freescale's entry level 8-bit microcontroller portfolio by extending the advantages of the HCS08 core and peripherals to 5V. The highly integrated SE controllers give you the choice of cost-effective higher-pin-count devices, with 20 MHz CPU, for entry-level products. Functionality is enhanced with rich analog capabilities, a complete set of serial modules, a temperature sensor and robust memory options, which are ideal for general-purpose consumer and industrial applications in the 2.7V to 5.5V range.

### Cost-Effective Development Tools

| Part Number              | Description                                                                                                                                                                                                                              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DEMO9S08SE8<br>\$75*     | Cost-effective demonstration board with potentiometer, LEDs, serial port and built-in USB-BDM cable for debugging and programming                                                                                                        |
| M68CYCLONEPRO<br>\$499*  | HC08/HCS08/HC12/HCS12 stand-alone flash programmer or in-circuit emulator, debugger, flash programmer; USB, serial or Ethernet interface options                                                                                         |
| USBMULTILINKBDM<br>\$99* | Universal HCS08 in-circuit debugger and flash programmer; USB PC interface                                                                                                                                                               |
| CWX-HXX-SE<br>Free**     | CodeWarrior™ Special Edition for Microcontrollers; includes integrated development environment (IDE), linker, debugger, unlimited assembler, Processor Expert™ auto-code generator, full-chip simulation and 32 KB C compiler limitation |

\*Prices indicated are MSRP.

\*\*Subject to license agreement and registration

| Features                                                                                                                                                                                                                                       | Benefits                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ganged Output Option for PTB (5:2) and PTC (3:0)</b>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Allows single write to change state of multiple pins</li> <li>Provides option to tie multiple pins from different ports to same control registers</li> </ul>                                            | <ul style="list-style-type: none"> <li>Safely drives multiple outputs</li> </ul>                                                                                                                                                                                                                                                                                                   |
| <b>Multiple Serial Communication Options</b>                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Serial communication interface module with option for 13-bit break capabilities and double-buffered transmit and receive</li> </ul>                                                                     | <ul style="list-style-type: none"> <li>All serial peripherals available for use in parallel on 16-pin devices</li> </ul>                                                                                                                                                                                                                                                           |
| <b>10-channel, 10-bit Analog-to-Digital Converter (ADC)</b>                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Automatic compare function, software programmable for greater than, equal to or less than conditions</li> </ul>                                                                                         | <ul style="list-style-type: none"> <li>Easy interface to analog inputs, such as sensors</li> <li>Used to set conversion complete and generate interrupt only when result matches condition</li> </ul>                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>Asynchronous clock source</li> </ul>                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Can be used to run the ADC when MCU clocks are off, such as in STOP3 low-power mode</li> </ul>                                                                                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>Temperature sensor</li> </ul>                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Calculates temperature without any external components and saves an ADC input channel for other use</li> </ul>                                                                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>Hardware triggerable using the RTC counter</li> </ul>                                                                                                                                                   | <ul style="list-style-type: none"> <li>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</li> </ul>                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>Low-power and high-speed options</li> </ul>                                                                                                                                                             | <ul style="list-style-type: none"> <li>Flexible configuration to meet high-performance and low-power requirements</li> </ul>                                                                                                                                                                                                                                                       |
| <b>Real-Time Counter (RTC)</b>                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>8-bit modulus counter with binary or decimal-based prescaler</li> <li>Three software selectable clock sources: 1 kHz internal low-power oscillator, external clock and 32 kHz internal clock</li> </ul> | <ul style="list-style-type: none"> <li>Serve as a cyclic wakeup from low-power modes without the need of external components</li> <li>Provides precise time base for time-of-day, calendar or task scheduling functions</li> </ul>                                                                                                                                                 |
| <b>Three Timer Modules</b>                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Programmable 16-bit timer/PWM modules (TPM1 and TPM2)</li> </ul>                                                                                                                                        | <ul style="list-style-type: none"> <li>Each channel is independently programmable for input capture, output compare, buffered edge-aligned pulse width modulation (PWM) or buffered center-aligned PWM</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> <li>Low-voltage detection with reset or interrupt</li> </ul>           | <ul style="list-style-type: none"> <li>Resets device in instance of runaway or corrupted code</li> <li>Independent clock source provides additional protection in case of loss of clock</li> <li>Allows system to write/save important variables before voltage drops too low</li> <li>Can hold device in reset until reliable voltage levels are reapplied to the part</li> </ul> |
| <ul style="list-style-type: none"> <li>Illegal opcode detection with reset</li> <li>Security feature for flash and RAM</li> </ul>                                                                                                              | <ul style="list-style-type: none"> <li>Resets device in instance of runaway or corrupted code</li> <li>Prevents unauthorized access to memory to protect a customer's valuable software IP</li> </ul>                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>Always-on power-on reset (POR) circuitry</li> </ul>                                                                                                                                                     | <ul style="list-style-type: none"> <li>Significantly reduces risk of code runaway due to brownout situations</li> </ul>                                                                                                                                                                                                                                                            |
| <b>Development Support</b>                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Background debugging system</li> <li>On-chip in-circuit emulation (ICE) with real-time bus capture</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li>Provides single-wire debugging and emulation interface; eliminates the need for expensive emulation tools</li> <li>Provides circuit emulation without the need for additional, expensive development hardware</li> </ul>                                                                                                                    |

### Package Options

| Part Number  | Package | Temp. Range     |
|--------------|---------|-----------------|
| MC9S08SE8CWL | SOIC28  | -40°C to +85°C  |
| MC9S08SE4CWL | SOIC28  | -40°C to +85°C  |
| MC9S08SE8VWL | SOIC28  | -40°C to +105°C |
| MC9S08SE4VWL | SOIC28  | -40°C to +105°C |
| MC9S08SE8MWL | SOIC28  | -40°C to +125°C |
| MC9S08SE4MWL | SOIC28  | -40°C to +125°C |
| MC9S08SE8CTG | TSSOP16 | -40°C to +85°C  |
| MC9S08SE4CTG | TSSOP16 | -40°C to +85°C  |
| MC9S08SE8VTG | TSSOP16 | -40°C to +105°C |

### Package Options

| Part Number  | Package | Temp. Range     |
|--------------|---------|-----------------|
| MC9S08SE4VTG | TSSOP16 | -40°C to +105°C |
| MC9S08SE8MTG | TSSOP16 | -40°C to +125°C |
| MC9S08SE4MTG | TSSOP16 | -40°C to +125°C |
| MC9S08SE8CRL | PDIP28  | -40°C to +85°C  |
| MC9S08SE4CRL | PDIP28  | -40°C to +85°C  |
| MC9S08SE8VRL | PDIP28  | -40°C to +105°C |
| MC9S08SE4VRL | PDIP28  | -40°C to +105°C |
| MC9S08SE8MRL | PDIP28  | -40°C to +125°C |
| MC9S08SE4MRL | PDIP28  | -40°C to +125°C |

## Learn More:

For current information about Freescale products and documentation, please visit [www.freescale.com/8bit](http://www.freescale.com/8bit).