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

Features Benefits

• 8-bit HCS08 Central Processor Unit (CPU)
  • Up to 20 MHz HCS08 (10 MHz internal bus frequency)
  • Offers high performance up to 5V, ideal for industrial applications
  • HC08 instruction set with added BGND instruction
  • Enables backward object-code compatibility with 68HC08 and 68HC05
  • Allows existing code libraries to be used
  • Allows for efficient, compact module coding in assembly or C compiler

• Integrated Third-Generation Flash Memory and RAM
  • Embedded flash that is in-application reprogrammable over the full operating voltage and temperature range with a single power supply
  • Provides users a single solution for multiple platforms or a single platform that is field reprogrammable in virtually any environment
  • 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
  • Extremely fast, byte-writable programming; as fast as 20 µs (burst mode)
  • Helps reduce production programming costs through ultra-fast programming, as well as lowering system power consumption due to shorter writes
  • Up to 100,000 write/erase cycles at typical voltage and temperature (10k minimum write/erase); 100 years typical data retention (15 years minimum)
  • Allows electrically erasable programmable read-only memory (EEPROM) emulation, reducing system costs and board real estate

• Flexible Clock Options
  • Internal clock source (ICS) module with a frequency-locked loop (FLL) controlled by internal or external reference
  • Eliminates the cost of utilizing external clock components, reducing board space and increasing system reliability
  • Precision trimming of internal reference allows typical 0.2 percent resolution and 2 percent deviation over operating temperature and voltage
  • Provides one of the most accurate and cost-effective internal clock sources in the market
  • Internal reference can be trimmed from 31.25 kHz to 38.4 kHz, allowing for up to 10 MHz FLL output
  • Enables adjustment of bus clocks for optimal serial communication baud rates and/or timer intervals
  • 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
  • 32 kHz oscillator provides low-power option for systems requiring time-keeping functionality (i.e. time and date) while in low-power modes

• 22 I/O Pins, One Input-Only Pin and One Output-Only Pin
  • Outputs 10 mA each; 60 mA max for package
  • High-current I/O allows direct drive of LED and other circuits, virtually eliminating external drivers and reducing system costs
  • Software-selectable pull-ups on ports when used as inputs; internal pull-up on reset and interrupt request (IRQ) pin
  • Reduces customer’s system cost by eliminating the need for external resistors
  • Software-selectable slew rate control and drive strength on ports when used as output
  • Allows user to configure ports for slower slew rate and weaker drive to minimize noise emissions from the MCU
  • 8-pin keyboard interrupt module with software-selectable polarity on edge or edge/level modes
  • Keyboard scan with programmable pull-ups/pull-downs virtually eliminates external glue logic when interfacing to simple keypads
## 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

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMO9S08SE8</td>
<td>Cost-effective demonstration board with potentiometer, LEDs, serial port and built-in USB-BDM cable for debugging and programming</td>
</tr>
<tr>
<td>$75*</td>
<td></td>
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<tr>
<td>M68CYCLONEPRO</td>
<td>HC08/HCS08/HC12/ HCS12 stand-alone flash programmer or in-circuit emulator, debugger, flash programmer; USB, serial or Ethernet interface options</td>
</tr>
<tr>
<td>$499*</td>
<td></td>
</tr>
<tr>
<td>USBMULTILINKBDM</td>
<td>Universal HCS08 in-circuit debugger and flash programmer; USB PC interface</td>
</tr>
<tr>
<td>$99*</td>
<td></td>
</tr>
<tr>
<td>CWX-HXX-SE Free*</td>
<td>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</td>
</tr>
</tbody>
</table>

*Prices indicated are MSRP. **Subject to license agreement and registration

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## Features

**Ganged Output Option for PTB (5:2) and PTC (3:0)**  
- Allows single write to change state of multiple pins  
- Provides option to tie multiple pins from different ports to same control registers  
- Safety drives multiple outputs

### Multiple Serial Communication Options

- Serial communication interface module with option for 13-bit break capabilities and double-buffered transmit and receive  
- Safety drives multiple outputs  
- All serial peripherals available for use in parallel on 16-pin devices

### 10-channel, 10-bit Analog-to-Digital Converter (ADC)

- Automatic compare function, software programmable for greater than, equal to or less than conditions  
- Easy interface to analog inputs, such as sensors  
- Used to set conversion complete and generate interrupt only when result matches condition

### Temperature Sensor

- Asynchronous clock source  
- Can be used to run the ADC when MCU clocks are off, such as in STOP3 low-power mode

### Hardware Triggerable using the RTC Counter

- Temperature sensor  
- Calculates temperature without any external components and saves an ADC input channel for other use

### Low-power and High-speed Options

- Hardware triggerable using the RTC counter  
- 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

### Real-Time Counter (RTC)

- 8-bit modulus counter with binary or decimal-based prescaler  
- Serve as a cyclic wakeup from low-power modes without the need of external components

### Three Timer Modules

- Programmable 16-bit timer/PWM modules (TPM1 and TPM2)  
- Each channel is independently programmable for input capture, output compare, buffered edge-aligned pulse with modulation (PWM) or buffered center-aligned PWM

### System Protection

- Background debugging system  
- On-chip in-circuit emulation (ICE) with real-time bus capture  
- Provides single-wire debugging and emulation interface; eliminates the need for expensive emulation tools

### Development Support

- Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock  
- Resets device in instance of runaway or corrupted code  
- Independent clock source provides additional protection in case of loss of clock

- Low-voltage detection with reset or interrupt  
- Allows system to write/save important variables before voltage drops too low  
- Can hold device in reset until reliable voltage levels are reapplied to the part

- Illegal opcode detection with reset  
- Resets device in instance of runaway or corrupted code

- Security feature for flash and RAM  
- Prevents unauthorized access to memory to protect a customer’s valuable software IP

- Always-on power-on reset (POR) circuitry  
- Significantly reduces risk of code runaway due to brownout situations

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## Package Options

### Part Number | Package | Temp. Range  
---|---|---  
MC9S08SE8CWL | S0C28 | -40°C to +85°C  
MC9S08SE4CWL | S0C28 | -40°C to +85°C  
MC9S08SE8WL | S0C28 | -40°C to +105°C  
MC9S08SE4WL | S0C28 | -40°C to +105°C  
MC9S08SE8CTG | TSSOP16 | -40°C to +125°C  
MC9S08SE4CTG | TSSOP16 | -40°C to +125°C  
MC9S08SE8VTG | TSSOP16 | -40°C to +105°C  
MC9S08SE4VTG | TSSOP16 | -40°C to +105°C  
MC9S08SE8MTG | TSSOP16 | -40°C to +125°C  
MC9S08SE4MTG | TSSOP16 | -40°C to +125°C  
MC9S08SE8MRL | PDIP28 | -40°C to +105°C  
MC9S08SE4MRL | PDIP28 | -40°C to +105°C  
MC9S08SE8MRL | PDIP28 | -40°C to +105°C  
MC9S08SE4MRL | PDIP28 | -40°C to +105°C  
MC9S08SE8VRL | SOIC28 | -40°C to +125°C  
MC9S08SE4VRL | SOIC28 | -40°C to +125°C  
MC9S08SE8VWL | SOIC28 | -40°C to +105°C  
MC9S08SE4VWL | SOIC28 | -40°C to +105°C  
MC9S08SE8VRL | TSSOP16 | -40°C to +125°C  
MC9S08SE4VRL | TSSOP16 | -40°C to +125°C  
MC9S08SE8VWL | TSSOP16 | -40°C to +105°C  
MC9S08SE4VWL | TSSOP16 | -40°C to +105°C

## Learn More:

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