

# MC9S08AC60/48/32

## 8-bit microcontroller

### Target Applications

- General industrial applications
  - Motor control
  - Building control
  - HVAC
- Appliance applications
  - Dishwashers
  - Washing machines
  - Dryers
  - Refrigerators

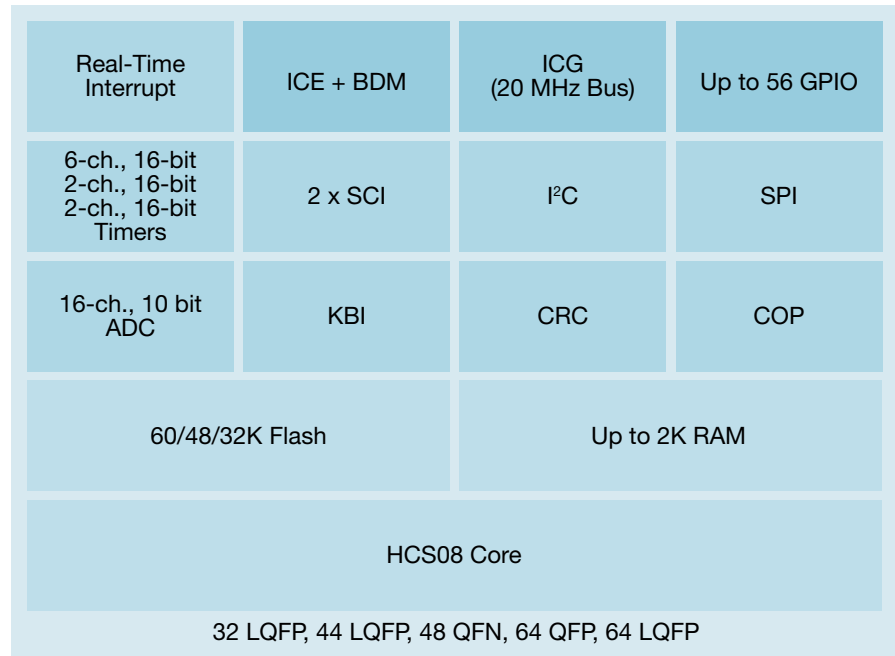
### Overview

Freescall Semiconductor's HCS08AC family of microcontrollers (MCUs) is part of the popular and rapidly growing HCS08 family featuring advanced on-chip development support, enhanced peripherals, increased memory options and improved system security.

Using Freescall's industry-leading 0.25  $\mu$ s flash, the MC9S08AC60 offers an upward migration path from Freescall's MC9S08AW products for applications that need enhanced peripherals, increased performance, additional memory and improved system security. Other features include enhanced low-voltage warning, two serial communications interfaces (SCIs), a serial peripheral interface (SPI), an inter-integrated circuit (I<sup>2</sup>C), 16-ch, 10-bit analog-to-digital converter (ADC) and ten programmable 16-bit timer channels with center-aligned pulse-width modulation (PWM) capability.

The combination of performance and on-chip integration make the MC9S08AC60 a perfect fit for many general embedded industrial control applications, specifically motor control applications.

### AC60 Block Diagram



### Features

#### 8-Bit HCS08 Central Processing Unit (CPU)

- High-performance 40 MHz CPU
  - 50 ns minimum instruction cycle time down to 2.7V @ 20 MHz bus
- C-optimized architecture
- Multiply and divide instructions
- Optional reduced power modes
  - Support for up to 32 interrupt reset sources
- Auto wake-up with internal timer requires only 300 nA additional current

#### Integrated Third-Generation Flash Memory

- In-application programming
- Self-timed fast programming
  - Program 8-bits in 20  $\mu$ s
  - Fast flash page erase, 20 ms
- 10K write erase cycles minimum, 100K typical
- 15 year minimum data retention, 100 years typical
- Internal program/erase voltage generation
- Fine flash granularity—flash erase/flash program
- Flexible block protection and enhanced security
- Read/program/erase over full operation voltage and temperature

### Benefits

- Provides the performance needed in many higher performance 8-bit applications
- Produces extremely compact code with full 16-bit stack pointer and stack relative addressing
- Allows for greater software flexibility and optimizations in addition to saving power

- Ultra-fast programming reduces system cost
- Command program interface eliminates complex programming algorithms
- Flexibility—flash-based systems can be reprogrammed during the development cycle or late in the manufacturing cycle
- Flash is easily used for data EEPROM

## Features

## Benefits

## Internal Clock Generator

- Programmable frequency-locked loop (FLL) generates 8 MHz to 40 MHz
- Provides multiple options for internal and external clock source and in-application clock switching
- Trimmable with temperature and voltage compensation

- Designed to reduce board space and system cost by eliminating the need for external components
- Accuracy across temperature and voltage allows reliable serial communications without external clocks
- The lack of external components decreases noise

## 10-bit Analog-to-Digital Converter

- 16-channel ADC
- 2.5  $\mu$ s, 10-bit single conversion time

- Fast, easy conversion from analog inputs such as temperature, pressure and fluid levels, to digital values

## Timer with Ten Programmable Channels

- Two 2-channel 16-bit timer systems
- One 6-channel 16-bit timer systems
- Programmable for input, capture, output compare or buffered pulse-width modulator (PWM)
  - PWM can be edge or center aligned

- Flexible, programmable timer system
- Center aligned PWMs are designed to allow noise minimization by distributing the edges of the PWM

## Extensive Serial Communications

- Dual asynchronous SCIs
  - Flexible 13-bit module-based baud rate generators
  - LIN compatible
- Inter-integrated circuit (I<sup>2</sup>C)
  - Up to 100 Kbps
  - Supports broadcasting mode and 10-bit addressing
- Synchronous SPI
  - Multi-master operation

- Asynchronous communication between the MCU and a terminal, computer, or a network with accurate baud rate matching
- High-speed synchronous communication between multiple MCUs or between MCU and serial peripherals
- Provides a simple, efficient method of data exchange between devices
- Serial peripherals are available for use in parallel

## System Protection

- Selectable low-voltage detect/reset
- COP watchdog timer
  - Option to run COP off independent clock source or bus
- Cyclic redundancy check (CRC)

- Provides additional system reliability
- The addition of a 1 kHz independent oscillator provides two additional timeout options
- Adds security to network protocols like CAN allowing fast testing of flash memory
- Prevents runaway code caused by noise spikes, EMC and/or voltage drops

## Input/Output

- Up to 56 GPIO pins
  - Programmable pull-ups
  - High-current drivers
  - Controlled rise/fall times minimize noise

- Results in a large number of flexible I/O pins that allow vendors to easily interface the device into their own designs as every peripheral pin is GPIO capable

## On-Chip Debug Interface

- Single-wire background debug mode
- Non-intrusive emulation
- On-chip in-circuit emulator (ICE) debug module containing two comparators and nine trigger modes
- View and change internal registers and memory while running an application

- Real-time emulation of MCU functions at full operating voltage and frequency range with no limitations
- On-chip trigger and buffer hardware replaces and emulator's expensive bus state analyzer
- Non-intrusive debugging through a single dedicated pin helps eliminate the need and cost emulator cables
- Reduces debugging time and field returns

## Product Selector Guide

Part Number	Temp. Range	Package
MC9S08AC60CPUE	-40°C to +85°C	64-pin LQFP
MC9S08AC60CFUE	-40°C to +85°C	64-pin QFP
MC9S08AC60CFDE	-40°C to +85°C	48-pin QFN
MC9S08AC60CFGE	-40°C to +85°C	44-pin LQFP
MC9S08AC60CFJE	-40°C to +85°C	32-pin LQFP
MC9S08AC48CPUE	-40°C to +85°C	64-pin LQFP
MC9S08AC48CFUE	-40°C to +85°C	64-pin QFP
MC9S08AC48CFDE	-40°C to +85°C	48-pin QFN
MC9S08AC48CFGE	-40°C to +85°C	44-pin LQFP
MC9S08AC48CFJE	-40°C to +85°C	32-pin LQFP
MC9S08AC32CPUE	-40°C to +85°C	64-pin LQFP
MC9S08AC32CFUE	-40°C to +85°C	64-pin QFP
MC9S08AC32CFDE	-40°C to +85°C	48-pin QFN
MC9S08AC32CFGE	-40°C to +85°C	44-pin LQFP
MC9S08AC32CFJE	-40°C to +85°C	32-pin LQFP

\*All parts are available in tape & reel packages. They are also available in extended temperature ranges. See datasheet for details.

## Cost Effective Development Tools

## DEMO9S08AC60

\$85\*

Full-featured evaluation system for the AC60/48/32 device family. The DEMO9S08AC60 is powered by the MC9S08AC60CFGE processor and features a ZIF socket, a built-in USB BDM, LEDs, a serial port, an acceleration sensor and an I/O header. This kit comes complete with everything you need to get your board up and running quickly and easily.

## USBMULTILINKBDM

\$99\*

A universal in-circuit emulator and debugger, capable of flash programming that can also be used on HCS08 and HCS12 products. Comes standard with USB-PC interface.

## CodeWarrior® Development Studio for Microcontrollers, V6.1

Complimentary\*\*

CodeWarrior Development Studio for Microcontrollers is an integrated tool suite that supports software development for Freescale's 8-bit or 32-bit microcontrollers. Designers can further accelerate applications development with the help of the Processor Expert™ tool, which is an award-winning rapid application development tool in the CodeWarrior tool suite.

For more information, please refer to the Freescale Development Tool Selector Guide (SG1011).

\* Prices indicated are MSRP

\*\* Subject to license agreement

## Learn More:

For more information about the AC family, please visit [www.freescale.com/8-bit](http://www.freescale.com/8-bit).