MC9S08AC60/48/32
8-bit microcontroller

Target Applications

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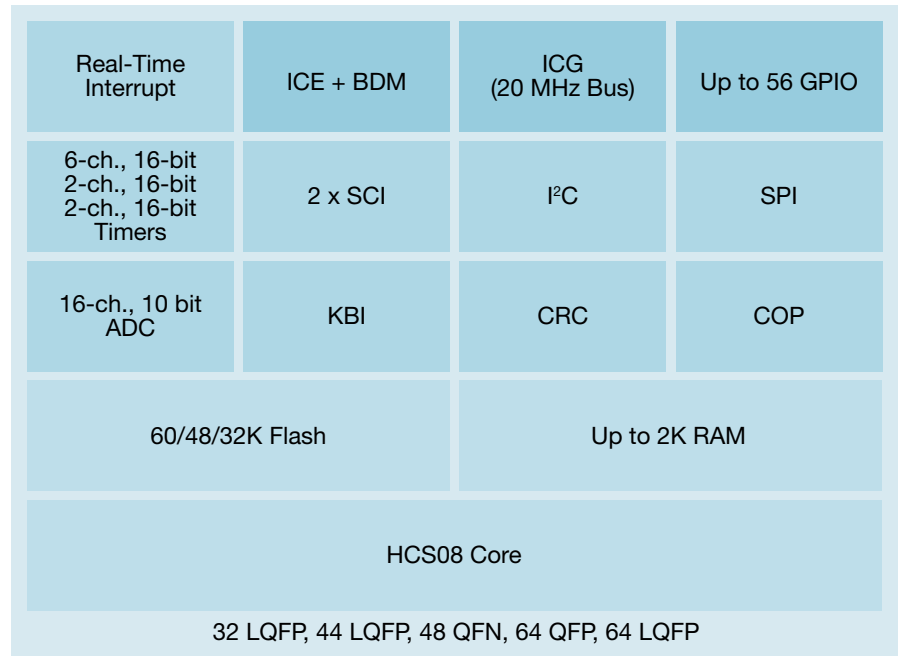 - Dryers
  - Refrigerators

Overview

Freescale 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 Freescale's industry-leading 0.25 μs flash, the MC9S08AC60 offers an upward migration path from Freescale'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 (I²C), 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

Real-Time Interrupt	ICE + BDM	ICG (20 MHz Bus)	Up to 56 GPIO
6-ch., 16-bit 2-ch., 16-bit 2-ch., 16-bit Timers	2 x SCI	I²C	SPI
16-ch., 10 bit ADC	KBI	CRC	COP
60/48/32K Flash		Up to 2K RAM	
HCS08 Core			
32 LQFP, 44 LQFP, 48 QFN, 64 QFP, 64 LQFP			

Features	Benefits
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
	- 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

Integrated Third-Generation Flash Memory	

- In-application programming
- Self-timed fast programming
  - Program 8-bits in 20 μs
  - 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
	- 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

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

10-bit Analog-to-Digital Converter

- 16-channel ADC
- 2.5 μs, 10-bit single conversion time

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

Extensive Serial Communications

- Dual asynchronous SCIs
  - Flexible 13-bit module-based baud rate generators
  - LIN compatible
- Inter-integrated circuit (I²C)
  - Up to 100 Kbps
  - Supports broadcasting mode and 10-bit addressing
- Synchronous SPI
  - Multi-master operation

System Protection

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

Input/Output

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

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

Benefits

- 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

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

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

- Asynchronous communication between the MCU and a terminal, computer, or a network with accurate buad 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

- 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

- 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

- 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**.

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