

# MC9S08AC128/96

## 8-bit microcontroller

### Target Applications

- General Industrial Applications
  - Motor Control
  - Building Control
  - HVAC
- Appliance Applications
  - Dishwashers
  - Washing Machines
  - Dryers
  - Refrigerators

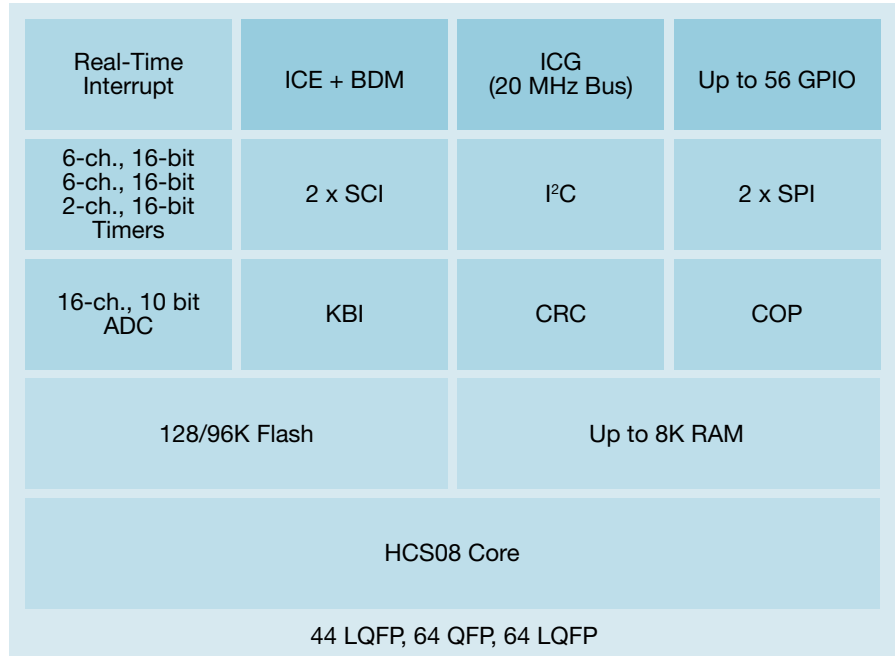
### Overview

The MC9S08AC128 is part of the Flexis series of microcontrollers, the connection point on the Freescale Controller Continuum where 8-bit and 32-bit compatibility becomes a reality. The Flexis series of products include complimentary families of S08 8-bit and V1 ColdFire® 32-bit microcontrollers that have a common set of peripherals and development tools to deliver the ultimate in migration flexibility.

The MC9S08AC128 expands Freescale's microcontroller roadmap upward by offering industry leading EMC/EMI performance, more advanced peripherals, and larger memory options, up to 8 KB RAM and 128 KB flash. The standard peripheral set includes two serial communications interfaces (SCIs), two serial peripheral interfaces (SPI), an Inter-Integrated Circuit (I<sup>2</sup>C), 16-ch, 10-bit analog-to-digital converter (ADC), fourteen programmable 16-bit timer channels with center-aligned pulse-width modulation (PWM) capability, a cyclic redundancy check (CRC) and a watchdog timer (COP). The combination of performance and on-chip integration make the MC9S08AC128 a perfect fit for home appliance and embedded industrial control applications.

The MC9S08AC128 products are pin, software and peripheral compatible with the MC9S08AC60 and the MCF51AC256 providing the flexibility to add or remove functionality quickly and easily, reducing development time and cost.

MC9S08AC128/96 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
- Memory management unit
- Linear address pointer
- Optional reduced power modes
  - Support for up to 32 interrupt reset sources
  - Auto wake-up with internal timer requires only 300 nA additional current

### Benefits

- Provides the performance needed in many higher performance 8-bit applications
- Allows the support of paged memory and direct page data accesses of the entire memory map
- 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

- Ultra-fast programming reduces system cost
- Command program interface eliminates complex programming algorithms
- Flexible, 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 clock source and in-application clock switching
  - 32 KHz to 16 MHz reference external crystal
  - External clock
- Trimmable with temperature and voltage compensation

### 10-bit Analog-to-Digital Converter

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

### Timer with Ten Programmable Channels

- One 2-channel, 16-bit timer systems
- Two 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
  - Active edge on receive pin detection
  - Selectable receiver input polarity
  - LIN compatible
- Inter IC-bus (I<sup>2</sup>C)
  - Up to 100 Kbps
  - Supports broadcasting Mode and 10-bit addressing
- Dual Synchronous SPI
  - Multimaster operation
  - 256 clock options

### System Protection

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

### Input/Output

- Up to 70 GPIO pins
  - Programmable pull-ups
  - High-current drivers
  - Eight keyboard interrupts
  - Controlled rise/fall times minimize noise

### On-Chip Debug Interface

- Single-wire background debug mode
- On-chip trace buffer with 9 flexible trigger modes and multiple hardware breakpoints
- Non-intrusive emulation
- 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 baud rate matching
- SCI interrupts and flags can be set when an active edge occurs on Rx pin
- SCI can correctly receive data whose polarity was inverted during transmission
- 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

- Protect against system failure due to brownouts
- Allows fast cyclic redundancy checks on system 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

## Package Options

Part Number	Temp. Range	Package
MC9S08AC128CLKE	-40°C to +85°C	80-pin LQFP
MC9S08AC128CFUE	-40°C to +85°C	64-pin QFP
MC9S08AC128CFGE	-40°C to +85°C	44-pin LQFP
MC9S08AC96CLKE	-40°C to +85°C	80-pin LQFP
MC9S08AC96CFUE	-40°C to +85°C	64-pin QFP
MC9S08AC96CFGE	-40°C to +85°C	44-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

### DEMOACKIT

\$99\*

Flexible and cost-effective demonstration kit for the Flexis AC device family. The DEMOACKIT contains daughter cards for both the MC9S08AC128CLKE (S08) and the MCF51AC256CLKE (V1 ColdFire) processor. It 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.

### DEMOACEX

\$30\*

An expansion board that plugs into the DEMOACKIT and provides additional functionality such as large prototype area that allow for the surface mount of SOICs and TSSOPs, a CAN Phy, and 12 additional LEDs. The DEMOACEX also contains Freescale touch sensing technology with one rotary sensor and seven button sensors.

### CodeWarrior® Development Studio for Microcontrollers 6.2

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/flexis](http://www.freescale.com/flexis).