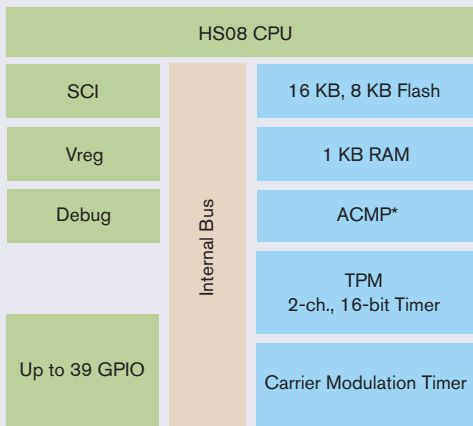# 8-bit Microcontrollers

MC9S08Rx16/8

Target Applications

> Universal remote controls
> Handheld instruments
> Portable consumer devices

Overview

Freescale Semiconductor's HCS08 family of microcontrollers is part of the popular and rapidly growing HC08 Family with advanced technology for long battery life, high performance and additional enhancements such as advanced on-chip development support. Utilizing Freescale's industry-leading 0.25μ Flash, the MC9S08Rx16/8 offers an upward migration path from Freescales's 68HC05 and 68HC08 architectures for applications that need lower power, more peripherals and higher performance. Other features include a carrier modulation timer for infrared remote control communications, a serial communications interface (SCI), an analog comparator and two programmable timer channels.

HS08 CPU		
SCI		16 KB, 8 KB Flash
Vreg	Internal Bus	1 KB RAM
Debug		ACMP*
Up to 39 GPIO		TPM 2-ch., 16-bit Timer
		Carrier Modulation Timer

*ACMP not available in 28-pin packages

	MC9S08RCxx	MC9S08RDxx	MC9S08RExx
ACMP	√		√
SCI		√	√

Features	Benefits

8-bit HCS08 CPU Core

> Low-power technology
  - Multiple power management modes including 100 nA powerdown
  - Optional auto wakeup from stop 2 or stop 3 modes with internal timer that typically requires only 300 nA additional current
  - 1.8V operation
> High performance when needed
  - 125 μs minimum instruction cycle time down to 1.8V at 8 MHz bus
> C-optimized architecture with multiply-and-divide instructions

> Extends battery life with flexible power management
> Designed to provide the higher performance required of many 8-bit applications, while allowing low-power 1.8V operation
> C-optimized architecture produces extremely compact code with full 16-bit stack pointer and stack-relative addressing
> Multiply-and-divide instructions increase performance while reducing code size

On-Chip Debug Interface

> Single-wire background debug module (BDM)
> On-chip trace buffer with nine flexible trigger modes and multiple hardware breakpoints
> Non-intrusive emulation

> Real-time emulation of microcontroller functions at full operating voltage and frequency range with no limitations like traditional emulators
> Real-time in-circuit emulation and debug without expensive and cumbersome box emulators
> Read/write memory and registers while running at full speed
> Bus state analysis without the expense of a traditional emulator

Integrated Third-Generation Flash Memory

> In-application reprogrammable
  - Self-timed, fast programming
  - Fast Flash page erase: 20 μs (512 bytes)
> Can program 8 bits in 20 μs while in burst mode
> 10K write/erase cycles minimum; 100K typical
> 15-year minimum data retention; 100 years typical
> Internal program/erase voltage generation
> Flash granularity: 512 byte Flash erase/ 2 byte Flash program
> Flexible block protection and security

- Ultra-fast programming reduces system cost (up to 100x faster than most embedded Flash)
- Command programming interface virtually eliminates complex programming algorithms
- Flexibility/maximum creativity: Flash-based systems can be reprogrammed many times during the development cycle or late into the manufacturing cycle and can make in-application upgrades in the field
- Flash can easily be used for data EEPROM

Carrier Modulation Timer

> Consists of a carrier generator, modulator and transmitter, which generate infrared pulses

> Remote control communications

Timer With Two Programmable Channels

> Each channel programmable for:
  - Input capture, output compare or buffered pulse-width modulation (PWM)
  - PWM can be edge- or center-aligned

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

freescale™
semiconductor

Features	Benefits
One Serial Communications Interface	
> 8192 prescalar option	> Asynchronous communication between the microcontroller and a terminal, computer or a network of microcontrollers > Exact baud rate matching
Analog Comparator	
> Full rail-to-rail supply operation > Selectable interrupt on rising edge, falling edge, or either rising or falling edge of comparator output	> Option to compare unknown input to a fixed internal bandgap reference voltage or external user-supplied reference > Designed to help reduce overall system costs
System Protection	
> Selectable low-voltage detect/reset at nominal 1.8V > Low-battery warning > Computer operating properly (COP) watchdog timer	> Designed to help reduce overall system costs > Designed to provide a simple, efficient method of data exchange between devices
Up to 39 Input/Output (I/O) Lines	
> Programmable pull-ups > High-current drivers > Eight keyboard interrupts	> Designed to help reduce overall system costs > Designed to allow direct drive of LED and other circuits to eliminate external drivers and reduce system costs

Application Notes

AN2616	Getting Started with HCS08 and CodeWarrior Using C
AN2596	Using the HCS08 Family On-Chip Debug System
AN2497	HCS08 Background Debug Mode Versus HC08 Monitor Mode
AN2688	Implementing a 10-bit Sigma-Delta Converter Using the HC9SO8Rx MCU Family Analog Comparator

Package Options

Part Number	Package	Temp. Range
MC9S08RD8CDWE	28 SOIC	-40°C to +85°C
MC9S08RD16CDWE	28 SOIC	-40°C to +85°C
MC9S08RD8CPE	28 PDIP	-40°C to +85°C
MC9S08RD16CPE	28 PDIP	-40°C to +85°C
MC9S08RC8CFJ	32 LQFP	-40°C to +85°C
MC9S08RC16CFJ	32 LQFP	-40°C to +85°C
MC9S08RD8CFJ	32 LQFP	-40°C to +85°C
MC9S08RD16CFJ	32 LQFP	-40°C to +85°C
MC9S08RE8CFJ	32 LQFP	-40°C to +85°C
MC9S08RE16CFJ	32 LQFP	-40°C to +85°C
MC9S08RC8CFG	44 LQFP	-40°C to +85°C
MC9S08RC16CFG	44 LQFP	-40°C to +85°C
MC9S08RD8CFG	44 LQFP	-40°C to +85°C
MC9S08RD16CFG	44 LQFP	-40°C to +85°C
MC9S08RE8CFG	44 LQFP	-40°C to +85°C
MC9S08RE16CFG	44 LQFP	-40°C to +85°C

28-Pin DIP   P

32-Lead QFP   FJ

28-Lead SOIC   DW

44-Lead QFP   FG

Cost-Effective Development Tools

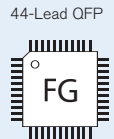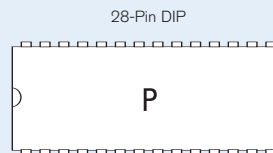For more information on development tools, please refer to the Freescale Development Tool Selector Guide (SG1011).

DEMO9S08RG60 *$49*	Cost-effective demonstration board in a small form factor with a serial port, switches, LEDs, BDM header, and I/O header
USBMULTILINKBDM *$99*	Universal HCS08/HCS12 in-circuit emulator, debugger, and Flash programmer; USB PC interface
M68CYCLONEPRO *$499*	HC08/HCS08/HC12/HCS12 stand-alone Flash programmer or in-circuit emulator, debugger, Flash programmer; USB, serial or Ethernet interface options
CWX-H08-SE *Free*	CodeWarrior™ Special Edition for HC(S)08 MCUs; includes integrated development environment (IDE), linker, debugger, unlimited assembler, Processor Expert™ auto-code generator, full-chip simulation and 16 KB C compiler.

Learn More: For more information about Freescale's products, please visit **www.freescale.com**.

Document Number: MC9S08RX16FS
REV 1

freescale™
semiconductor