

# MC68HC908GR16

## Target Applications

- > Sensors
- > Industrial and consumer communications
- > Home appliances
- > Security systems

## Overview

Freescale Semiconductor's MC68HC908GR16 microcontroller (MCU) uses integrated second-generation Flash and is enhanced with embedded, on-chip functions that eliminate the need for external serial components. The 32 kHz Phase-Lock Loop (PLL) provides cost savings by replacing the need for expensive, high-speed crystals or noisy oscillators. The on-chip timebase module (TBM) further reduces costs by eliminating the need for external real-time clock and wake-up circuitry. Other features of the MC68HC908GR16 are an analog-to-digital converter (ADC), a serial communications interface (SCI), a serial peripheral interface (SPI), low-voltage inhibit (LVI) and a watchdog timer.

HC08 CPU	KBI
16 KB Flash	8-ch., 10-bit ADC
1 KB RAM	ESCI
PLL	SPI
COP	2-ch., 16-bit Timer
LVI	Up to 37 GPIO

### Features

### Benefits

#### High-Performance 68HC08 CPU Core

- > 8 MHz bus operation at 5V operation for 125 ns minimum instruction cycle time
- > 4 MHz bus operation at 3V for 250 ns minimum instruction cycle time
- > Efficient instruction set, including multiply and divide
- > 16 flexible addressing modes, including stack relative with 16-bit stack pointer
- > Fully static, low-voltage, low-power design with wait and stop modes

- > Object code compatible with the 68HC05
- > Easy to learn and use architecture
- > C-optimized architecture provides compact code

#### Integrated Second-Generation Flash Memory

- > In-application reprogrammable
- > Extremely fast programming, encoding 64B in as fast as 2 ms
- > Flash programming across the 68HC08's full operating supply voltage with no extra programming voltage
- > 10K write/erase cycles minimum over temperature
- > 100K write/erase cycles typical
- > Flexible block protection and security

- > Cost-effective programming changes and field software upgrades via in-application programmability and reprogrammability
- > Reduces production programming costs through ultra-fast programming
- > Allows reprogrammable battery-powered applications
- > Byte-writable for data as well as program memory
- > Protects code from unauthorized reading and guards against unintentional writing/erasing of user-programmable segments of code

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

- > 8 channels
- > Single conversion in 17  $\mu$ s

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

#### Clock Generation Module with Phase-Lock Loop (PLL)

- > Programmable clock frequency in integer multiples of external crystal reference
- > Crystal reference of 32 kHz to 100 kHz
- > External clock option with or without PLL

- > Provides high-performance using low-cost, low-frequency reference crystals
- > Reduces generated noise while still providing high-performance (up to 32 MHz internal clock)

#### Four Programmable 16-bit Timer Channels

- > 125 ns resolution at 8 MHz bus
- > Free-running counter or modulo up-counter

- > Each channel independently programmable for input capture, output compare or unbuffered pulse-width modulation (PWM)
- > Pairing timer channels provides a buffered PWM function

## Features

## Benefits

### Timebase Module

- > Eight user-selectable periodic real-time interrupts
- > Optionally operate in low-power stop mode

- > Provides autowake-up from low-power stop mode to maintain real-time clock or check external device status such as sensors

### Enhanced Serial Communications Interface

- > UART asynchronous communications system
- > Flexible baud rate generator
- > Double-buffered transmit and receive
- > Optional hardware parity checking and generation

- > Enables high-speed asynchronous communication

### Serial Peripheral Interface

- > Full-duplex, three-wire synchronous transfers
- > Maximum master bit rate of 4 MHz for 8 MHz system clock

- > High-speed synchronous communication between multiple MCUs or between MCU and serial peripherals
- > Cost-effective serial peripheral expansion to applications including EEPROM, high-precision analog-to-digital and digital-to-analog converters, and real-time clocks

### Computer Operating Properly Watchdog Timer

- > Issues reset in the event of runaway code

### Selectable Trip Point Low-Voltage Inhibit

- > Improves reliability by resetting the MCU when voltage drops below trip point
- > Two trip points allow optimum operation in both 5V and 3V nominal systems
- > Integration reduces system cost

### Up to 37 Bidirectional Input/Output (I/O) Lines

- > 10 mA sink/source capability on all I/O pins
- > 15 mA sink capability on two I/O pins
- > Keyboard scan with selectable interrupts on four I/O pins
- > Software programmable pull-ups on 13 I/O pins

- > High-current I/O allows direct drive of LED and other circuits to eliminate external drivers and reduce system costs
- > Keyboard scan with programmable pull-ups eliminates external glue logic when interfacing to simple keypads

## Application Notes

- AN1050 Designing for Electromagnetic Compatibility (EMC) with HCMOS Microcontrollers
- AN1218 HC05 to HC08 Optimization
- AN1219 M68HC08 Integer Math Routines
- AN1259 System Design and Layout Techniques for Noise Reduction in MCU-Based Systems
- AN1263 Designing for Electromagnetic Compatibility with Single-Chip Microcontrollers
- AN1705 Noise Reduction Techniques for Microcontroller-Based Systems
- AN1752 Data Structures for 8-bit MCUs
- AN1831 Using MC68HC908 On-Chip Programming Routines
- AN1837 Non-Volatile Memory Technology Overview
- AN2093 Creating Efficient C Code for the MC68HC08
- EB368 In-Circuit Programming of 68HC908GR8 Flash Memory

**Learn More:** For more information about Freescale's products, please visit [www.freescale.com](http://www.freescale.com).

## Cost-Effective Development Tools

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

**DEMO908GZ60**  
\$49

Cost-effective demonstration board in a small form factor with a serial port, switches, LEDs, MON08 header, input/output (I/O) header, photocell and potentiometer

**FSICEKITGRGZ**  
\$2,195

Complete FSICE high-performance emulator kit; includes emulator module, cables, head adapters and programming adapters

**M68EML08GZ**  
\$495

Emulation module for FSICE system

**M68CYCLONEPRO**  
\$499

HC08/HCS08/HC12/HCS12 stand-alone Flash programmer or in-circuit emulator, debugger, Flash programmer; USB, serial or Ethernet interface options

**USBMULTILINK08**  
\$99

Universal HC08 in-circuit debugger and Flash programmer; USB PC interface

**M68CPA08QF324448**  
\$199

Programming adapter for MON08 cables and single MCU: 32-pin 0.8 mm QFP packages, 44-pin 0.8 mm QFP packages and 48-pin 0.5 mm QFP packages

**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

## Package Options

Part Number	Package	Temp. Range
MC68HC908GR16CFJ	32 QFP	-40°C to +85°C
MC68HC908GR16VFJ	32 QFP	-40°C to +105°C
MC68HC908GR16MFJ	32 QFP	-40°C to +125°C
MC68HC908GR16CFA	48 QFP	-40°C to +85°C
MC68HC908GR16VFA	48 QFP	-40°C to +105°C
MC68HC908GR16MFA	48 QFP	-40°C to +125°C

32-Lead QFP



48-Lead QFP

