

# MC9S08MP16

## 8-bit MCU for brushless DC motor control

### Target Applications

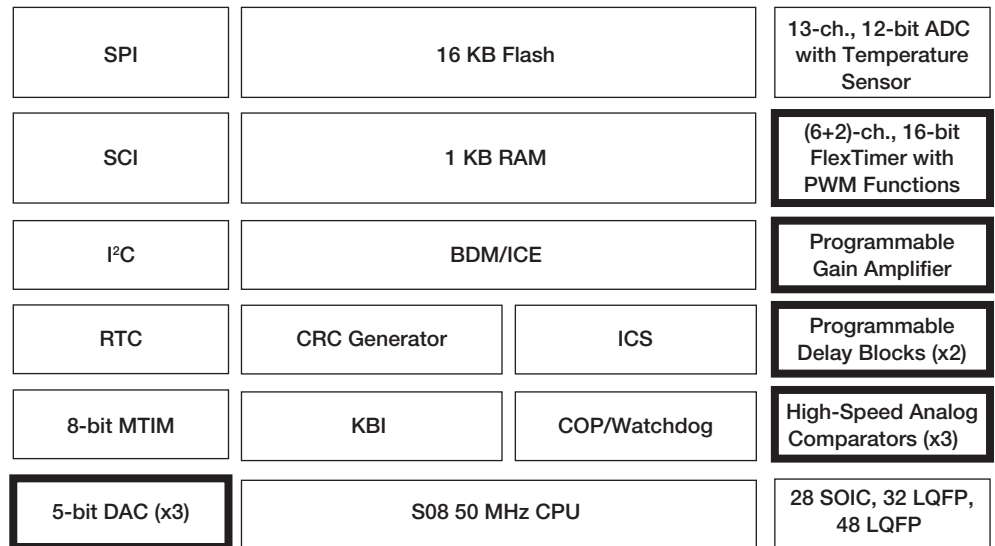
- Industrial drives/fans/pumps
- HVAC systems
- Actuator systems
- Medical equipment (infusion pumps, respirators, analyzers)
- Office equipment
- Small appliance/personal care (food processors, shavers)

### Overview

The MC9S08MP16 is a cost-effective 8-bit MCU that delivers smooth, efficient, sensorless brushless DC motor control across a broad spectrum of industrial applications. Its peripherals are tailored specifically towards sensorless brushless DC motor control environments and include two 16-bit FlexTimers (the first S08 MCU to include), three high-speed analog comparators, a 6-ch., 16-bit PWM module with emergency over-current shutdown protection, a programmable gain amplifier and, and a 12-ch., 12-bit ADC with PWM hardware triggering. Also included are an independently clocked COP and cyclic redundancy check (CRC) engine providing CLK failure protection and memory content validation for safety-critical applications such as IEC60730.

Combined with a 50 MHz CPU, a range of serial communications interfaces and three on-board digital-to-analog converters, the result is small footprint solution that delivers smooth, precise motor control with minimal bill-of-materials costs.

### S08MP16 Block Diagram



### Package Options

Part Number	Temp Ranges (Ta)	Package
MC9S08MP12VWL	-40°C to +105°C	28 SOIC
MC9S08MP16VWL	-40°C to +105°C	28 SOIC
MC9S08MP16VLC	-40°C to +105°C	32 LQFP
MC9S08MP16VLF	-40°C to +105°C	48 LQFP
MC9S08MP16MLF	-40°C to +125°C	48 LQFP

### Development Tools

- DEMO9S08MP16 demo board. \$69
- CodeWarrior™ Development Studio for Microcontrollers V6.2, Complimentary Special Edition: Supports software development for Freescale's 8-bit and 32-bit V1 ColdFire® MCU devices. Full-featured IDE with editor, C compiler, flash programmer, assembler, linker and source-level debugger. Includes Processor Expert™ graphical-based automatic C code generator for rapid application development.

### Family Overview

Feature	MC9S08MP16			MC9S08MP12
Package	48 LQFP	32 LQFP	28 SOIC	28 SOIC
Flash (Bytes)	16,384			12288
RAM (Bytes)	1024			512
CRC	yes			
ADC channels	13	12	8	
DAC	3			
FTM1 channels	2			
FTM2 channels	6			
MTIM	yes			
HSCMP	3			
PDB	2			
PGA	yes			-
SCI	yes			
SPI	yes			
I <sup>2</sup> C	yes			-
ICS	yes			
RTC	yes			
XOSC	yes			
KBI Pins	24	15	14	
I/O	40	25	22	

## Features

## Benefits

### S08 Central Processor Unit (CPU)

- Up to 50 MHz HCS08 CPU @ 2.7–5.5V across a temperature range of -40°C to +105°C
- HCS08 instruction set with added BGND instruction

- BGND allows user to enter background debug mode that takes advantage of the on-chip in-circuit emulator (ICE)

### On-Chip Memory

- Up to 16 KB flash read/program/erase over full operating voltage and temperature range
- Up to 1 KB RAM
- Security circuitry to prevent unauthorized access to RAM and flash contents

- Allows you to take full advantage of operating voltage and temperature in-application reprogrammability benefits in virtually any environment

### Power Saving Modes

- Two low-power Stop modes and reduced power Wait mode
- Peripheral clock gating can disable clocks to unused modules

- Allows full functionality at reduced frequency for lower power operation
- Reduces overall run and wait mode current by disabling clocks to inactive peripherals

### Peripherals

- Analog-to-digital converter (ADC): 13-ch., 12-bit resolution, 2.5  $\mu$ s conversion time, automatic compare function, 1.7 mV/°C temperature sensor, internal bandgap reference channel, operation in stop 3 mode
- 1 x 2-ch. FlexTimer + 1 x 6-ch. FlexTimer supports up to 51.34 MHz operation, selectable input capture, output compare, edge- or center-aligned PWM, dead time insertion, fault inputs
- MTIM: simple 8-bit timer with four software-selectable clock sources and a programmable interrupt
- 3 x high-speed analog comparators (HSACMP): +ve and -ve inputs, separately selectable interrupt on rising and falling comparator output, filtering, windowing, HSCMP1 and HSCMP2 outputs can be optionally routed to FTM1 module, runs in stop3
- Programmable gain amplifier (PGA): Differential programmable gain amplifier with programmable gain (x1, x2, x4, x8, x16 or x32)
- 2 x programmable delay blocks (PDB): PDB1 synchronizes PWM with samples of ADC, PDB2 synchronizes PWM with comparing window of analog comparators
- Independently clocked COP and cyclic redundancy check generator

- Hardware trigger from PWM or PDB allowing high-resolution conversions at any point in the PWM cycle with no additional CPU overhead
- Increased precision and reduced system cost. 16-bit PWM with emergency over-current shutdown protection
- High PWM frequency reduces size/cost of external components in SMPS and PF correction applications (e.g. passive filters)
- 8-bit counter within MTIM can operate as a free-running counter or a modulo counter. A timer overflow interrupt can be enabled to generate periodic interrupts for time-based software loops.
- Work with timers to capture back EMF zero crossing events to provide accurate rotor position timing. Enables motor to run smoothly across a wide speed range with no speed jittering in turn increasing efficiency, and reducing noise and mechanical wear.
- Amplifies low amplitude signals (such as motor current readings from a low resistance shunt), eliminating the need for external op-amps in multiple applications which reduces system cost.
- Enable efficient and accurate timing of ADC measurements providing low-cost current reconstruction in PWM applications with reduced CPU loading. Can also function as an independent timer to enable digital power factor correction for industrial applications (HID light ballast and motor control).
- Clock failure protection and memory content validation
- System integrity for safety-critical applications implementing IEC60730 safety standards

### Development Support

- Single-wire background debug interface
- Breakpoint capability
- ICE debug module containing three comparators and nine trigger modes. Eight deep FIFO for storing change-of-flow addresses and event-only data—debug module supports both tag and force breakpoints.

- Allows developers to use the same hardware cables between S08 and V1 ColdFire® platforms
- Allows single breakpoint setting during in-circuit debugging (plus three more breakpoints in on-chip debug module)
- Provides built-in full emulation without expense of traditional emulator

**Learn More:** For more information, visit [www.freescale.com](http://www.freescale.com).