Overview
Freescale Semiconductor’s MC9S12A128 Flash microcontroller (MCU) is the next generation of the highly successful 68HC12 architecture. Using Freescale’s industry-leading 0.25 µs Flash, the A128 is part of a pin-compatible family that scales from 32 KB to 512 KB of Flash memory. The MC9S12A128 provides an upward migration path from Freescale’s 68HC08, 68HC11 and 68HC12 architectures for applications that need larger memory, more peripherals and higher performance.

Target Applications
> Instrumentation
> Energy management
> Industrial control
> Robotics
> Safety equipment
> Security

Features

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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<tr>
<td>High-Performance 16-bit HCS12 CPU Core</td>
<td>Opcode compatible with the 68HC11 and 68HC12</td>
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<td>&gt; 25 MHz bus operation at 5V for 40 ns minimum instruction cycle time</td>
<td>&gt; C-optimized architecture produces extremely compact code</td>
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<td>On-Chip Debug Interface</td>
<td>&gt; Real-time in-circuit emulation and debug without expensive and cumbersome box emulators</td>
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<td>&gt; Dedicated serial debug interface</td>
<td>&gt; Read/write memory and registers while running at full speed</td>
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<td>&gt; On-chip breakpoints</td>
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<td>Integrated Third-Generation Flash Memory</td>
<td>&gt; Flexibility to change code in the field</td>
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<td>&gt; In-application reprogrammable</td>
<td>&gt; Efficient end-of-line programming</td>
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<td>&gt; Self-timed, fast programming</td>
<td>&gt; Total program time for 128 KB code is less than five seconds</td>
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<td>&gt; Fast Flash page erase—20 ms (512 bytes)</td>
<td>&gt; Reduces production programming cost through ultra-fast programming</td>
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<td>&gt; Can program 16 bits in 20 µs while in burst mode</td>
<td>&gt; No external high voltage or charge pump required</td>
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<td>&gt; 5V Flash program/erase/read</td>
<td>&gt; Virtual EEPROM implementation, Flash array usable for EE extension</td>
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<td>&gt; Flash granularity—512 byte Flash erase/2 byte Flash program</td>
<td>&gt; Can erase one array while executing code from another</td>
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<td>&gt; Two independently programmable Flash arrays</td>
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<td>&gt; Flexible block protection and security</td>
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<td>2 KB Integrated EEPROM</td>
<td>&gt; Can erase 4 bytes at a time and program 2 bytes at a time for calibration, security, personality and diagnostic information</td>
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<td>&gt; Flexible protection scheme for protection against accidental program or erase</td>
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<td>&gt; EEPROM can be programmed in 46 µs</td>
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<tr>
<td>10-bit Analog-to-Digital Converter (ADC)</td>
<td>&gt; Fast, easy conversion from analog inputs like position sensors, analog meters and photovoltaic cells to digital values for CPU processing</td>
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<td>&gt; Two, 8-channel ADCs</td>
<td>&gt; Can effectively have 3.5 µs conversion time by sampling same signal with both ADCs</td>
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<td>&gt; 7 µs, 10-bit single conversion time, scan mode available</td>
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**Features**

**Clock Generation Module with Phase-Lock Loop (PLL)**
- Clock monitor with limp home mode in case of no external clock
- Programmable clock frequency with 1024 options ranging from divide by 16 to multiply by 64
- Real-time interrupt
- Watchdog
  - Reliable, robust operation
  - Provides high performance using low-cost reference crystals
  - Reduces generated noise
  - Reduces power consumption
  - Easily able to implement real-time clock

**Enhanced Capture Timer**
- 8-channel, 16-bit with input capture, output compare and pulse accumulator
- 16-bit modulus down counter
  - Flexible, programmable timer system

**8-bit or 16-bit Pulse-Wide Modulation (PWM)**
- 8-channel, 8-bit or 4-channel, 16-bit PWM
- PWM supports center-aligned operation
  - Efficiently implement motor control, battery charging or digital-to-analog (DAC) functions

**Two Serial Communications Interfaces**
- 8192 prescaler option
  - Asynchronous communication between the MCU and a terminal, computer or a network of MCUs

**Two Serial Peripheral Interfaces**
- 256 clock rate options
  - High-speed synchronous communication between multiple MCUs or between MCU and serial peripherals

**Inter IC (I2C) Bus**
- Provides a simple, efficient method of data exchange between devices
- Minimizes the need for large numbers of connections between devices and eliminates the need for an address decoder

**Up to 91 Input/Output (I/O) Lines**
- Programmable pull-ups/pull-downs
- Dual drive capability
  - Reduce system cost
  - Able to tailor application for minimum EMC or high current loads

**Application Notes and Engineering Bulletins**
- AN2206 Security and Protection on the HCS12 Family
- AN2213 Using Cosmic Software’s M68HC12 Compiler for MC9S12DP256 Software Development
- AN2216 MC9S12DP256 Software Development Using Metrowerks CodeWarrior™
- AN2250 Audio Reproduction on HCS12 Microcontrollers
- EB386 HCS12 D-Family Compatibility

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

**Data Sheets**
- S12D712BDGV2 MC9S12A128 Device Guide
- S12D712BPMV1 MC9S12A128 Port Integration Module Block Guide
- S12ATD10BBV2 HCS12 10-bit 8-channel Analog to Digital Block Guide
- S12BDMV4 HCS12 Background Debug (BDM) Block Guide
- S12BKVDD HCS12 Breakpoint (BKP) Block Guide
- S12CPUV2 HCS12 CPU Reference Manual
- S12CRG3V HCS12 Clock Reset Generator Block Guide
- S12EEVTS2KV1 HCS12 2K EEPROM Block Guide
- S12FTS128KV1 HCS12 128K Flash Block Guide
- S12ICV2 HCS12 I2C Block Guide
- S12INTV1 HCS12 Interrupt (INT) Block Guide
- S12MEBNV3 HCS12 Multilayered External Bus Interface (MEBI) Block Guide
- S12MMC4V HCS12 Module Mapping Control (MMC) Block Guide
- S12PWM8B8CV1 HCS12 8-bit 8-channel Pulse-Width Modulator Block Guide
- S12SCIV2 HCS12 Serial Communications Interface Block Guide
- S12SPV2 HCS12 Serial Peripheral Interface Block Guide
- S12TIM16B8CV1 HCS12 16-bit 8-channel Timer Block Guide
- S12VREGV1 HCS12 Voltage Regulator Block Guide

**Cost-Effective Development Tools**
For more information on development tools, please refer to the Freescale Development Tool Selector Guide (SG1011).
- M68KIT912DP256 $495
  - Evaluation kit for development and evaluation of HCS12 application code that includes the M68EBVB912DP256 and USBMULTILINKBDM
- M68CYCLONEPRO $499
  - HCS08/HCS09/HC12/HCS12 stand-alone Flash programmer or in-circuit emulator, debugger, Flash programmer; USB, serial or Ethernet interface options
- USBMULTILINKBDM $99
  - Universal HCS08/HCS12 in-circuit emulator, debugger, and Flash programmer; USB PC interface
- CWX-H12-SE Free
  - CodeWarrior™ Special Edition for HCS12 MCUs; includes integrated development environment (IDE), linker, debugger, unlimited assembler, Processor Expert™ auto-code generator, full-chip simulation and limited C compiler

**Package Options**
- Part Number | Package | Temp. Range
- MC9S12A128CFU | 80 QFP | -40°C to +85°C
- MC9S12A128CPV | 112 LQFP | -40°C to +85°C

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