### Overview
Freescale Semiconductor’s HCS12 family of microcontrollers (MCUs) is the next generation of the highly successful 68HC12 architecture. Using Freescale's industry-leading 0.25 µs Flash, the MC9S12DT256 is part of a pin-compatible family that scales from 32 KB to 512 KB of Flash memory. The DT256 provides an upward migration path from Freescale’s 68HC08, 68HC11 and 68HC12 architectures for applications that need larger memory, more peripherals and higher performance. Also, with the increasing number of CAN-based electronic control units (ECUs), its multiple network modules support this environment by enabling highly efficient communications between different network buses.

### Target Applications
- Automotive applications
- Industrial control

### Features

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| **High-Performance 16-bit HCS12 CPU Core** | > Opcode compatible with the 68HC11 and 68HC12  
> C-optimized architecture produces extremely compact code |
| **On-Chip Debug Interface** | > Dedicated serial debug interface  
> On-chip breakpoints  
> Real-time in-circuit emulation and debug without expensive and cumbersome box emulators  
> Read/write memory and registers while running at full speed |
| **Network Modules** | > Ability to link modules for higher buffer count  
> Programmable bit rate up to 1 Mbps  
> FIFO receive approach superior for event-driven networks |
| **Integrated Third-Generation Flash Memory** | > Flexibility to change code in the field  
> Efficient end-of-line programming  
> Total program time for 256 KB code is less than 10 seconds  
> Reduces production programming cost through ultra-fast programming  
> No external high voltage or charge pump required  
> Virtual EEPROM implementation, Flash array usable for EE extension  
> Can erase one array while executing code from another |
| **4 KB Integrated EEPROM** | > Can erase 4 bytes at a time and program 2 bytes at a time for calibration, security, personality and diagnostic information |
| **10-bit Analog-to-Digital Converter (ADC)** | > Fast, easy conversion from analog inputs like temperature, pressure and fluid levels to digital values for CPU processing  
> Can effectively have 3.5 µs conversion time by sampling same signal with both ADCs |

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Cost-Effective Development Tools

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

**Features**

- **Clock Generation Module with Phase-Lock Loop (PLL)**
  - Clock monitor with self clock mode in case of no external clock
  - Programmable clock frequency with 1024 options ranging from divide by 16 to multiply by 64 from base oscillator
  - Real-time interrupt
  - Watchdog
  - > 256 clock-rate options
  - 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
  - > 8-channel, 8-bit or 4-channel, 16-bit PWM
  - PWM supports center-aligned operation

- **8-bit or 16-bit Pulse-Width Modulation (PWM)**
  - > 8-channel, 8-bit or 4-channel, 16-bit PWM
  - PWM supports center-aligned operation
  - > 8-channel, 8-bit with input capture, output compare and pulse accumulator
  - > 16-bit modulus down counter

- **Two Serial Communications Interfaces**
  - > 8192 prescaler options
  - Asynchronous communication between the MCU and a terminal, computer or a network of MCUs
  - Exact baud rate matching

- **Three Serial Peripheral Interfaces**
  - > Up to 6.25 Mbps
  - High-speed synchronous communication between multiple MCUs or between MCU and serial peripherals

- **Inter-IC (I²C) Bus**
  - > 256 clock-rate options
  - 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
  - > Programmable pull-ups/pull-downs
  - Dual drive capability
  - > Up to 6.25 Mbps
  - > High-speed synchronous communication between multiple MCUs or between MCU and serial peripherals

**Benefits**

- Reliable, robust operation
- Provides high performance using low-cost reference crystals
- Reduces generated noise
- Reduces power consumption
- Easily able to implement real-time clock
- Flexible, programmable timer system
- Asynchronous communication between the MCU and a terminal, computer or a network of MCUs
- Exact baud rate matching

**Application Notes and Engineering Bulletins**

- AN2206 Security and Protection on the HCS12 Family
- AN2213 Using Cosmic Software’s M68HC12 Compiler for MC9S12DP256
- AN2216 MC9S12DP256 Software Development Using Metrowerks CodeWarrior™
- AN2250 Audio Reproduction on HCS12 Microcontrollers
- EB376 A comparison of the MC9S12DP256 (mask set 0K36N) versus the HC12
- EB377 EB377Change Summary of the MC9S12DP256 mask set 0K79X versus 0K36N Engineering Brief
- EB386 HCS12 D-Family Compatibility

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

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**Cost-Effective Development Tools**

- **M68KIT912DP256** Evaluation kit for development and evaluation of HCS12 application code that includes the M68EVB912DP256 and USBMULTILINKBDM
- **M68CYCLONEPRO** HC08/HCS08/HCS12 in-circuit emulator, debugger, Flash programmer; USB, serial or Ethernet interface options
- **USBMULTILINKBDM** Universal HC08/HCS08/HCS12 in-circuit emulator, debugger, and Flash programmer; USB PC interface
- **CWX-H12-SE** CodeWarrior™ Special Edition for Free HCS12 MCUs; includes integrated development environment (IDE), linker, debugger, unlimited assembler, Processor Expert™ auto-code generator, full-chip simulation and limited C compiler

**Data Sheets**

- 9S12DP256BDGV2 MC9S12DP256 Device Guide
- S12DP256PMV2 MC9S12DP256 Port Integration Module Block Guide
- S12BDMV4 HCS12 Background Debug (BDM) Block Guide
- S12BKVD1 HCS12 Breakpoint (BKP) Block Guide
- S12CPU2V HCS12 CPU Reference Manual
- S12MSCANV2 HCS12 Motorola Scalable Controller Area Network Block Guide
- S12ATD10B8CV2 HCS12 10-bit 8-channel Analog to Digital Block Guide
- S12CRGV3 HCS12 Clock Reset Generator Block Guide
- S12ECT16B8CV1 HCS12 16-bit 8-channel Enhanced Capture Timer Block Guide
- S12EETS4KV2 HCS12 4K EEPROM Block Guide
- S12FTS256KV2 HCS12 256K Flash Block Guide
- S12ICV2 HCS12 I²C Block Guide
- S12INTV1 HCS12 Interrupt (INT) Block Guide
- S12MEBIV3 HCS12 Multiplexed External Bus Interface (MEBI) Block Guide
- S12MMCV4 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
- S12SPIV2 HCS12 Serial Peripheral Interface Block Guide
- S12VREGV1 HCS12 Voltage Regulator Block Guide

**Package Options**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Temp. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC9S12DT256BCPV</td>
<td>112 LFQFP</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>MC9S12DT256BVPV</td>
<td>112 LFQFP</td>
<td>-40°C to +105°C</td>
</tr>
<tr>
<td>MC9S12DT256BMPV</td>
<td>112 LFQFP</td>
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