

High-Performance 16-bit Microcontrollers

HCS12X



Target Applications

- > Climate control
- > Body control module
- > Dashboard cluster
- > Security
- > Chassis control
- > Industrial control gateways
- > Factory automation
- > Building control
- > Gateway
- > Door/seat

- > Improved 32-bit calculations and semaphore handling
- > Access to large data segments independent of PPAGE
- > Up to 40 MHz bus operation
- > Opcode compatible with the 68HC11, 68HC12 and HCS12
- > Industry-leading EMC performance
- > 3V to 5.5V operation
- > Wide range of high-performance peripherals

16-bit Enhanced S12 CPU Core

- > C-optimized CISC architecture produces extremely compact code

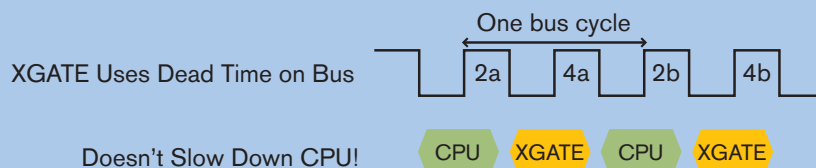
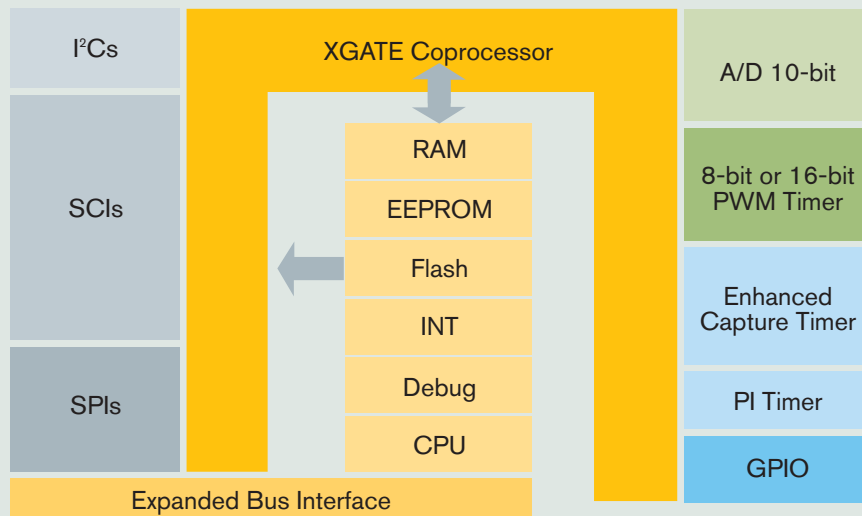
Overview

Freescale Semiconductor's HCS12X family of microcontrollers (MCUs) is based on an enhanced S12 core and uses Freescale's industry-leading, full automotive spec SG-Flash. The HCS12X MCUs deliver 32-bit performance with the advantages and efficiencies of a 16-bit MCU, including cost efficiency, power-consumption, EMC and code-size efficiency advantages currently enjoyed by users of Freescale's existing HCS12 Family.

With the HCS12X Family, Freescale introduces the performance-boosting XGATE coprocessor module. Using enhanced direct memory access functionality, this parallel processing module offloads the CPU by providing high-speed data processing and transfer between peripheral modules, RAM and I/O ports. Running at up to 80 MHz in parallel to the CPU, the XGATE can handle 112 triggers and is fully user programmable in C language. All S12X Family members are LIN- and J2602-compliant.

The HCS12X Family initially ranges from 128 KB to 1 MB of Flash memory with additional integrated EEPROM.

HCS12X FAMILY PRODUCT EXAMPLE



XGATE Coprocessor

- > Peripheral coprocessor performing complex DMA and data preprocessing features
- > Easily programmable in C
- > Up to 80 MHz operation
- > Dramatically reduces the interrupt loading on the main CPU
- > Transfers data to or from all peripherals, RAM and Flash without CPU intervention or CPU wait states
- > Able to perform operations on data (logical, shifts, arithmetic, bit operations)

Memory

- > Proven automotive Flash technology
- 10K W/E cycles at 125°C
- Ability to execute from one Flash block while programming/erasing another
- No external high voltage or charge pump required
- > 1 KB, 2 KB or 4 KB EEPROM
- Minimum of 100K W/E cycles
- > 4 KB, 8 KB, 12 KB, 16 KB, 20 KB or 32 KB RAM
- > Security: option of locking BDM access to Flash and EEPROM
- > Flash array usable for EE extension (virtual EEPROM implementation)

5V A/D Converter Inputs and 5V I/O

Non-Multiplexed External Bus

- > 23-bit address/16-bit data wide

System Integration Modules, Including Enhanced Interrupt Controller

- > Windowed COP watchdog and clock monitor
- > Seven levels of nested interrupt

Up to Five MXCAN Modules with Full CAN Capability

- > CAN 2.0 A, B compliant
- > Flexible identifier filters
- > Wake-up function in Stop mode

Up to Six Serial Communications Interfaces with Hardware LIN Support

Up to Three Serial Peripheral Interfaces

Up to Two Inter-Integrated Circuit (I²C) Interfaces

10-bit Analog-to-Digital Converter

- > One 8-channel and one 16-channel
- > External/internal conversion trigger capability
- > 7 μs, 10-bit single conversion time

Real-Time Interrupt

Enhanced Capture Timer

- > Improved 1–256 prescaler
- > Eight programmable 16-bit input capture or output compare channels
- > Four 8-bit or two 16-bit pulse accumulators
- > Four buffered input capture channels
- > 16-bit modulus down-counter

Clock Generation Module

- > Phase-Lock Loop (PLL) clock frequency multiplier/divider
- > Clock monitor
- > Low-power Pierce oscillator using a 0.5 MHz to 16 MHz crystal or full-drive Pierce 0.5 MHz to 40 MHz crystal oscillator reference clock

Periodic Interrupt Timer

- > Four 16-bit internal counters
- > Two independent 8-bit prescalers

Eight Pulse Width Modulation (PWM) Channels

- > Independent period and duty cycle center-aligned outputs for motor control
- > 8-bit, 8-channel; or 16-bit, 4-channel

Operating Frequency for Ambient Temperatures -40°C to 125°C

- > 40 MHz for CPU; 80 MHz for XGATE

144-pin LQFP, 112-pin LQFP or 80-pin QFP Package

- > 112-pin and 80-pin packages compatible with popular HCS12D-Family and B-Family members

Up to 119 Input/Output (I/O) Lines

- > Programmable pull-ups/pull-downs
- > Dual drive capability for EMC-optimized design

Development Support/ On-Chip Debug Interface

- > Single-wire background debug mode (BDM) for debugging both S12X CPU and XGATE simultaneously while running at full speed
- > On-chip hardware breakpoints with no limitation on memory address
- > Read/write memory and registers while running at full speed

Flash	RAM	E2	Device	XGATE	Speed	CAN	SCI	SPI	I ² C	A/D (10-bit)	PWM (8-bit)	Enhanced Capture Timer (16-bit)	Periodic Interrupt Timer (24-bit)	I/O	Package	Temp.
512 KB	32 KB	4 KB	MC9S12XDP512	Yes	40 MHz	5	4	3	1	2 x 8 ch.	8 ch.	1 x 8 ch.	4	91	112 LQFP (PV)	C/V/M
	32 KB	4 KB	MC9S12XDP512	Yes	40 MHz	5	6	3	2	1 x 8 ch., 1 x 16 ch.	8 ch.	1 x 8 ch.	4	119	144 LQFP (FV)	C/V/M
	20 KB	4 KB	MC9S12XDT512	Yes	40 MHz	3	2	2	1	1 x 8 ch.	7 ch.	1 x 8 ch.	4	59	80 QFP (FU)	C/V/M
	20 KB	4 KB	MC9S12XDT512	Yes	40 MHz	3	4	3	1	2 x 8 ch.	8 ch.	1 x 8 ch.	4	91	112 LQFP (PV)	C/V/M
	20 KB	4 KB	MC9S12XDT512	Yes	40 MHz	3	6	3	1	1 x 8 ch., 1 x 16 ch.	8 ch.	1 x 8 ch.	4	119	144 LQFP (FV)	C/V/M
	32 KB	4 KB	MC9S12XA512	Yes	40 MHz	-	2	2	1	1 x 8 ch.	7 ch.	1 x 8 ch.	4	59	80 QFP (FU)	C/V
	32 KB	4 KB	MC9S12XA512	Yes	40 MHz	-	4	3	1	2 x 8 ch.	8 ch.	1 x 8 ch.	4	91	112 LQFP (PV)	C/V
256 KB	32 KB	4 KB	MC9S12XA512	Yes	40 MHz	-	6	3	1	1 x 8 ch., 1 x 16 ch.	8 ch.	1 x 8 ch.	4	119	144 LQFP (FV)	C/V
	16 KB	4 KB	MC9S12XDT256	Yes	40 MHz	3	2	2	1	1 x 8 ch.	7 ch.	1 x 8 ch.	4	59	80 QFP (FU)	C/V/M
	16 KB	4 KB	MC9S12XDT256	Yes	40 MHz	3	4	3	1	2 x 8 ch.	8 ch.	1 x 8 ch.	4	91	112 LQFP (PV)	C/V/M
	16 KB	4 KB	MC9S12XDT256	Yes	40 MHz	3	4	3	1	1 x 8 ch., 1 x 16 ch.	8 ch.	1 x 8 ch.	4	119	144 LQFP (FV)	C/V/M
	14 KB	4 KB	MC9S12XD256	Yes	40 MHz	1	2	2	1	1 x 8 ch.	7 ch.	1 x 8 ch.	4	59	80 QFP (FU)	C/V/M
	14 KB	4 KB	MC9S12XD256	Yes	40 MHz	1	4	2	1	2 x 8 ch.	8 ch.	1 x 8 ch.	4	91	112 LQFP (PV)	C/V/M
	14 KB	4 KB	MC9S12XD256	Yes	40 MHz	1	4	2	1	1 x 8 ch., 1 x 16 ch.	8 ch.	1 x 8 ch.	4	119	144 LQFP (FV)	C/V/M
	16 KB	4 KB	MC9S12XA256	Yes	40 MHz	-	2	2	1	1 x 8 ch.	7 ch.	1 x 8 ch.	4	59	80 QFP (FU)	C/V
	16 KB	4 KB	MC9S12XA256	Yes	40 MHz	-	4	3	1	2 x 8 ch.	8 ch.	1 x 8 ch.	4	91	112 LQFP (PV)	C/V
16 KB	4 KB	MC9S12XA256	Yes	40 MHz	-	4	3	1	1 x 8 ch., 1 x 16 ch.	8 ch.	1 x 8 ch.	4	119	144 LQFP (FV)	C/V	

C -40° to +85°C

V -40° to +105°C

M -40° to +125°C

Learn More: For more information about Freescale's HCS12X Family, please visit www.freescale.com/S12X.