HCS12X

High-performance 16-bit Microcontrollers

Target Applications

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

16-bit Enhanced S12 CPU Core

- C-optimized CISC architecture produces extremely compact code
- 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
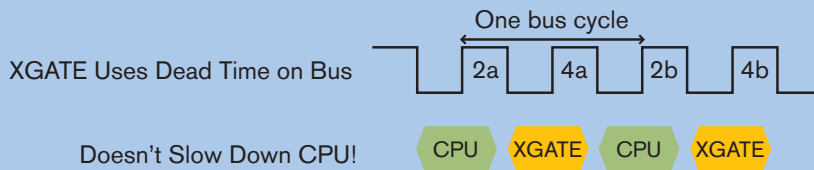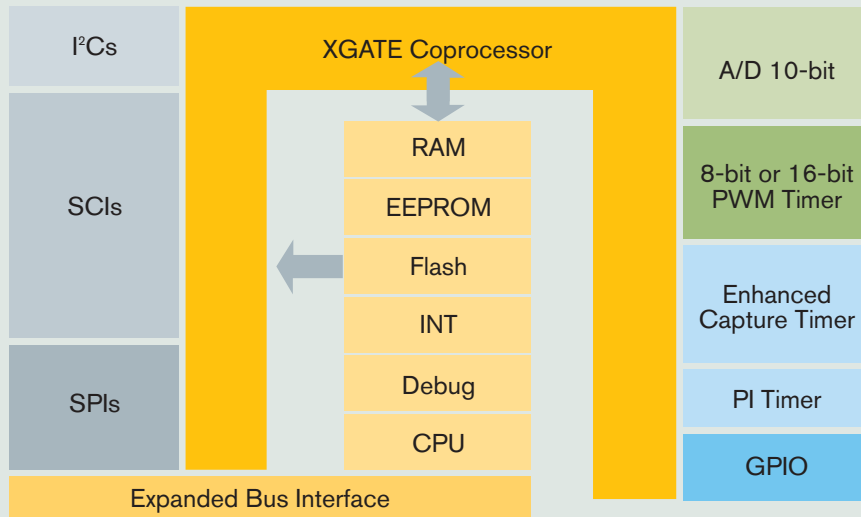- Wide range of high-performance peripherals

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 Uses Dead Time on Bus

Doesn't Slow Down CPU!

One bus cycle

2a 4a 2b 4b

CPU XGATE CPU XGATE

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	I²C	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
	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
256 KB	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., 1x 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., 1x 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**.

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