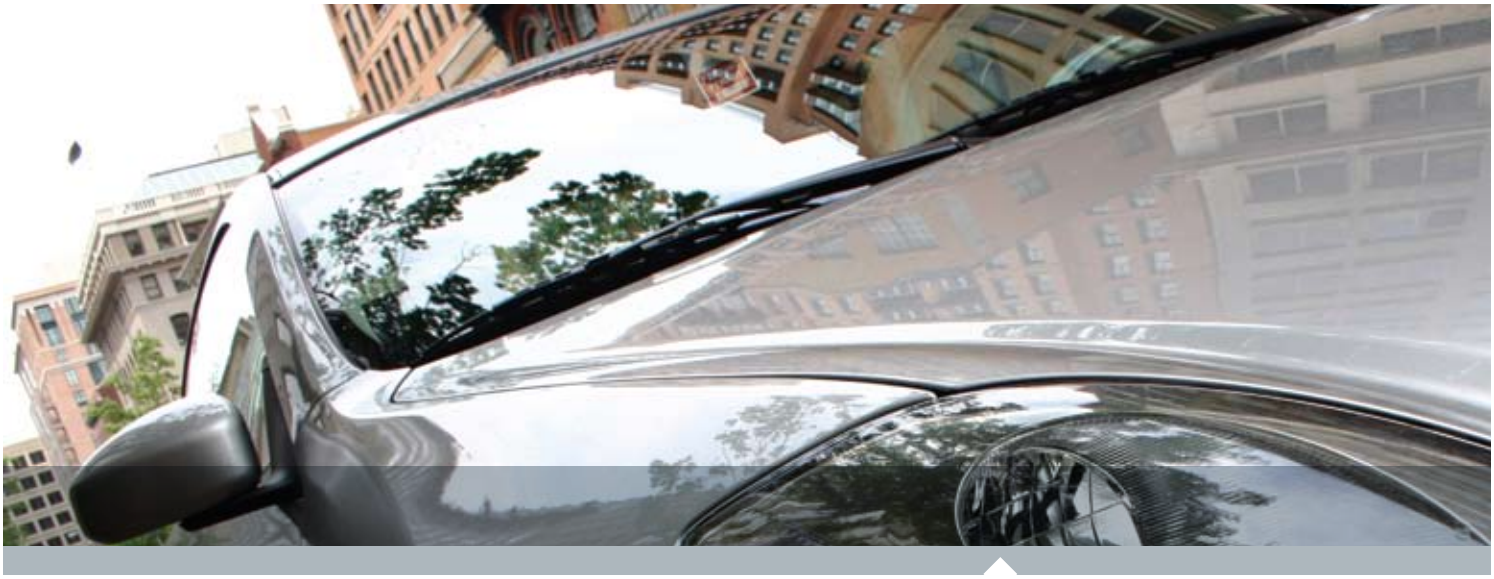

8-bit microcontrollers

S08D Family

DZ, DV, DN 8-bit microcontrollers

Connect with CAN. Drive big ideas with the S08D family of microntrollers.

The S08D family can help save cost, power, board space and development time with embedded controller area network (CAN), EEPROM and on-chip emulation/debug.

Freescale's 8-bit MC9S08D family of microcontrollers (MCUs) is the latest addition to the popular S08 family and the first S08 with embedded MSCAN and EEPROM. The MC9S08D family offers 40 MHz of CPU performance using Freescale's 0.25µ flash to push the boundaries of 8-bit into the range of 16-bit MCU performance.

The 9S08D family, which includes the 9S08DZ128/96/60/48/32/16, 9S08DV128/96/60/48/32/16 and 9S08DN60/48/32/16, offers an upward migration path from Freescale's 68HC05 and 68HC08 architectures for applications that need enhanced peripherals and higher performance at lower costs.

S08D Family Customer Benefits

Cost and Board Space Savings

- All on-chip components help to cut costs, save board space and improve quality by eliminating the need for external EEPROM, LVI circuit, voltage regulator, input/output (I/O) multiplexing, crystal, watchdog circuit, ADC and development tools.
- Pin compatibility across DZ, DV and DN families and package scalability helps to eliminate the cost of I/O multiplexers and offers future expandability.

Development Time Savings

- On-chip emulation/debug reduces development time since changes can be made onboard and in real time.
- Increased RAM (up to 8 KB) provides C/C++ developers the required memory to create code quickly.
- Commonality and familiarity of tools among S08D families helps to shorten development time.

Power Savings

- S08 0.25µ technology exhibits lower power consumption and increased CPU performance when compared to its HC08 0.50µ technology predecessor. These improvements help to allow for more embedded content while maintaining a power budget.

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Typical Applications for the S08D Family MCUs

An application focus area of the S08D family is network distributed control. The network in many cases is CAN, which is a serial, asynchronous, multi-master communication protocol for connecting electronic control modules in automotive and industrial applications. Operating as a serial bus network for microcontrollers, it connects devices, sensors and actuators in a system or subsystem for control applications. CAN offers data rates up to 1 Mbps and provides error confinement and detection to make it reliable in noise-critical environments.

Areas of CAN Possibilities	Typical Applications
Passenger vehicle and motorcycles	**Body** • Motor control, power door, power sunroof, power lift gate • Door modules, HVAC • Low-end body controller (lighting, network communication) **Safety** • Passenger occupant detection • Electronic parking brake **Powertrain** • Vacuum leak detection • Electronic throttle control • Watchdog **Chassis** • Watchdog • Motor control
Factory automation	Conveyors, production data recording, end-user configurable systems, off-the-shelf plug-and-play capability
Industrial machine control	Textile, printing, injection molding or packaging machines
Building automation	Manage heating, cooling, lighting, air ventilation, doors, alarm system control, sprinkler systems, backstage control systems, studio equipment including audio and video control for railway stations, school buildings, deep-freezers and refrigerators in some supermarkets
Non-industrial equipment	Communicate data between microscopes and other laboratory equipment, use in boilers and solar power systems and measurement systems such as petrol pump stations
Health care equipment and devices	Networking of operating room management, x-ray machines, patient beds, hospital control systems with voltage control, indication and control units, multi-cube power meters, digital I/O and visualization software
Non-industrial control	Vending machines, automatic teller machines (ATMs), gambling machines (e.g. Japanese pachinko machines), bank terminals, copy machines and printers
Lifts and escalators	Networking and control of panels, controllers, doors, drives and light barriers
Trucks and buses	Powertrain applications, communication between truck and trailer
Off-highway and off-road vehicles	Position sensing, add-on subsystems such as harvesters and cranes
Passenger and cargo trains	Linking the door units or brake controllers, passenger information systems connecting inside and outside displays, ticket validation devices, acoustic output devices, passenger counting units and other peripheral subsystems
Maritime electronics	Boats, ships and vessels as embedded network

S08D Family Features and Benefits

Root Part Number	Family	Core	Flash	RAM	EEPROM	CAN	Analog (ADC)	UART	SPI	I^2C	Timer	Clock	Pin Count	Additional Features	Market Focus
9S08DZ128	DZ	S08	128	8K	2K	1	Up to 24-ch., 12-bit ADC, 2 comparators	2	Up to 2	Up to 2	Up to 8-ch. + 4-ch	MCG (PLL, FLL, OSC)	100, 64, 48	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor	CAN, LIN Master, Gen Mkt
9S08DZ128	DZ	S08	128	8K	2K	1	Up to 24-ch., 12-bit ADC, 2 comparators	2	Up to 2	Up to 2			100, 64, 48		
9S08DZ60	DZ	S08	60 KB	4 KB	Up to 2 KB	1	Up to 24-ch., 12-bit ADC, 2 comparators	2xSCI	1	1	Up to 6-ch. + 2-ch.		64, 48, 32		
9S08DZ48	DZ	S08	48 KB	3 KB	Up to 1.5 KB	1	Up to 24-ch., 12-bit ADC, 2 comparators	2xSCI	1	1			64, 48, 32		
9S08DZ32	DZ	S08	32 KB	2 KB	Up to 1 KB	1	Up to 24-ch., 12-bit ADC, 2 comparators	2xSCI	1	1			64, 48, 32		
9S08DZ16	DZ	S08	16 KB	1 KB	Up to 512B	1	Up to 16-ch., 12-bit ADC, 2 comparators	2xSCI	1	1			48, 32		
9S08DV128	DV	S08	128	6K	0	1	Up to 24-ch., 12-bit ADC, 2 comparators	2	Up to 2	Up to 2	Up to 8-ch. + 4-ch		100, 64, 48		
9S08DV96	DV	S08	96	4K	0	1	Up to 24-ch., 12-bit ADC, 2 comparators	2	Up to 2	Up to 2			100, 64, 48		
9S08DV60	DV	S08	60 KB	3 KB		1	Up to 16-ch., 12-bit ADC, 2 comparators	2xSCI	1	1	Up to 6-ch. + 2-ch.		64, 48, 32		
9S08DV48	DV	S08	48 KB	2 KB		1	Up to 16-ch., 12-bit ADC, 2 comparators	2xSCI	1	1			64, 48, 32		
9S08DV32	DV	S08	32 KB	2 KB		1	Up to 16-ch., 12-bit ADC, 2 comparators	2xSCI	1	1			64, 48, 32		
9S08DV16	DV	S08	16 KB	1 KB		1	Up to 16-ch., 12-bit ADC, 2 comparators	2xSCI	1	1			48, 32		
9S08DN60	DN	S08	60 KB	2 KB	Up to 2 KB		Up to 16-ch., 12-bit ADC, 2 comparators	1xSCI	1	1			64, 48, 32		LIN Master, Gen Mkt.
9S08DN48	DN	S08	48 KB	2 KB	Up to 1.5 KB		Up to 16-ch., 12-bit ADC, 2 comparators	1xSCI	1	1			64, 48, 32		
9S08DN32	DN	S08	32 KB	1 KB	Up to 1 KB		Up to 16-ch., 12-bit ADC, 2 comparators	1xSCI	1	1			64, 48, 32		
9S08DN16	DN	S08	16 KB	1 KB	Up to 512B		Up to 16-ch., 12-bit ADC, 2 comparators	1xSCI	1	1			48, 32		

Features	Benefits
S08 CPU	
40 MHz core speed, 20 MHz bus speed on S08 CPU	Delivers higher performance for systems needing more bandwidth
HC08 instruction set with added BGND instruction	Offers code re-use and backward compatibility to HC08 (object and source code)
On-Chip Memory	
Up to 128 KB flash read/program/erase over full operating voltage and temperature	Shortens development time by enabling in-circuit programming, field reprogrammability and fast programming and erase times
Up to 2 KB EEPROM in-circuit programmable memory; 8-byte single-page or 4-byte dual-page erase sector; program and erase while executing flash; erase abort	Provides board space savings with on-chip EEPROM and reduces development time by allowing ability to manipulate diagnostic data at byte level, which provides finer granularity with smaller sector sizes than flash
Up to 8 KB RAM (16:1 flash/RAM, ratio better than competition)	Reduces development time by providing more RAM for C/C++ programming
Power Saving Modes	
Two very low-power stop modes	Minimizes power draw so there is power left over for other functions; offers power control and flexibility where multiple modules can run, while others are powered down
Very low-power, real-time interrupt for use in run, wait and stop modes	Improved battery life using on-chip functionality
Clock Source Options	
Oscillator (XOSC)—Loop-control Pierce oscillator; crystal or ceramic resonator range of 31.25 kHz–38.4 kHz or 1 MHz–16 MHz	Optimizes power consumption and provides user flexibility
Multi-purpose clock generator (MCG)–PLL and FLL modes; internal reference clock with trim adjustment; external reference with oscillator/resonator options	MCG provides flexibility for improved system performance and accuracy using various clock sources
System Protection	
Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock	Provides system protection using backup oscillator by resetting the MCU to a known state
Low-voltage detection with reset or interrupt; selectable trip points	Built-in system protection to secure data and warn of possible voltage loss conditions
Illegal opcode detection with reset	Resets the MCU to a known state due to inadvertent execution of illegal opcodes
Illegal address detection with reset	Resets the MCU to a known state due to inadvertent access to unimplemented or reserved address space
Flash block protect	Provides security by protecting code from unauthorized reading and guards against unintentional write/erase of user-code/data
EEPROM block protect	Provides security by protecting code from unauthorized reading and guards against unintentional write/erase of user-code/data
Peripherals	
ACMPx—Analog comparators with selectable interrupt on rising, falling or either edge of comparator output; compare option to fixed internal bandgap reference voltage	Fast and efficient response to analog signals
MSCAN—CAN protocol—Version 2.0 A, B; standard and extended data frames; support for remote frames; five receive buffers with FIFO storage scheme; flexible identifier acceptance filters programmable as: 2 x 32-bit, 4 x 16-bit, or 8 x 8-bit	Enales higher performance by improving CAN message processing efficiency; reuses CAN module from 16-bit that has a large installed base; meets auto industry CAN standards
SCIx—SCI(s) with LIN 2.0 Protocol and SAE J2602 compliance; master extended break generation; slave extended break detection; LIN slave supplement on SCI1; automatic baud rate correction; message time-out detection	Enables standard or LIN UART-based communication; offers additional support for lower power using wake from stop feature
SPI—Full-duplex or single-wire bi-directional; double-buffered transmit and receive; master or slave mode; MSB-first or LSB-first shifting	Delivers fast communication between peripheral devices
I^2C—Up to 100 kbps with maximum bus loading; multi-master operation; programmable slave address; interrupt-driven, byte-by-byte data transfer; broadcast mode enabled	Delivers fast communication between peripheral devices
TPMx—One 6-channel (TMP1) and one 2-channel (TPM2); selectable input capture, output compare or buffered edge-aligned PWM on each channel	Multiple time bases and additional channels provide flexibility for controlling systems
RTC (Real-time counter)—8-bit modulus counter with binary or decimal-based prescaler; external clock source for precise time base, time-of-day calendar or task scheduling functions; free running, on-chip, low-power oscilator (1 kHz) for cyclic wake-up without external components	Improved task scheduling for applications requiring time-of-day calendar functions frees up timers for other activities
Development Support	
Single-wire background debug (BDM) interface	Powerful tool for in-field, in-target debugging; only uses one MCU pin; same BDM interface pod for HC12, HCS12 and S08
On-chip, in-circuit emulation (ICE) with real-time bus capture	Reduces development time as emulation can be done real time and on chip; can be used in the target application at full speed with all the target components being utilized; eliminates expensive external emulator box and interconnect; eliminates timing, loading and drive issues; capture buffer and logic are the same as the target MCU—requiring no marginal timing
Input/Output	
87 general-purpose I/O pins and one input-only pin	Large number of I/O enhances flexibility of circuit interfacing
32 interrupt pins with selectable polarity on each pin	Offers flexibility by interfacing to a large number of pins that are capable of generating interrupts
Hysteresis and configurable pull-up device on all input pins	Saves board space and component cost by eliminating the need for external pull up/pull down resistors and improves system noise immunity
Configurable slew rate and device strength on all output pins	Minimizes emissions by controlling rate outputs change state, thereby increasing performance
Package Options	
100 LQFP 14 x 14 mm	High pin count for high I/O applications
64-pin low-profile quad flat pack (LQFP)—10 x 10 mm	Small 64-pin footprint for applications
48-pin LQFP—7 x 7 mm	Small 48-pin footprint for applications
32-pin LQFP—7 x 7 mm	Small 32-pin footprint for applications
Miscellaneous	
EMC performance	Low EMC radiated emissions and susceptibility performance
Wide operating voltage range: 2.7V–5.5V	Reduces component cost by eliminating need for external voltage regulator

S08D Family Package Options

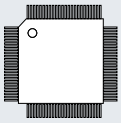
Part Number	Package	Temp. Range
MC9S08DZ128MLL	100 LQFP	-40°C to +125°C
MC9S08DZ128MLH	64 LQFP	-40°C to +125°C
MC9S08DZ128MLF	48 LQFP	-40°C to +125°C
MC9S08DZ96MLL	100 LQFP	-40°C to +125°C
MC9S08DZ96MLH	64 LQFP	-40°C to +125°C
MC9S08DZ96MLF	48 LQFP	-40°C to +125°C
MC9S08DZ60MLH	64 LQFP	-40°C to +125°C
MC9S08DZ60MLF	48 LQFP	-40°C to +125°C
MC9S08DZ60MLC	32 LQFP	-40°C to +125°C
MC9S08DZ48MLH	64 LQFP	-40°C to +125°C
MC9S08DZ48MLF	48 LQFP	-40°C to +125°C
MC9S08DZ48MLC	32 LQFP	-40°C to +125°C
MC9S08DZ32MLH	64 LQFP	-40°C to +125°C
MC9S08DZ32MLF	48 LQFP	-40°C to +125°C
MC9S08DZ32MLC	32 LQFP	-40°C to +125°C
MC9S08DZ16MLF	48 LQFP	-40°C to +125°C
MC9S08DZ16MLC	32 LQFP	-40°C to +125°C
MC9S08DV128MLL	100 LQFP	-40°C to +125°C
MC9S08DV128MLH	64 LQFP	-40°C to +125°C
MC9S08DV128MLF	48 LQFP	-40°C to +125°C
MC9S08DV96MLL	100 LQFP	-40°C to +125°C
MC9S08DV96MLH	64 LQFP	-40°C to +125°C
MC9S08DV96MLF	48 LQFP	-40°C to +125°C
MC9S08DV60MLH	64 LQFP	-40°C to +125°C
MC9S08DV60MLF	48 LQFP	-40°C to +125°C
MC9S08DV60MLC	32 LQFP	-40°C to +125°C
MC9S08DV48MLH	64 LQFP	-40°C to +125°C
MC9S08DV48MLF	48 LQFP	-40°C to +125°C
MC9S08DV48MLC	32 LQFP	-40°C to +125°C
MC9S08DV32MLH	64 LQFP	-40°C to +125°C
MC9S08DV32MLF	48 LQFP	-40°C to +125°C
MC9S08DV32MLC	32 LQFP	-40°C to +125°C
MC9S08DV16MLF	48 LQFP	-40°C to +125°C
MC9S08DV16MLC	32 LQFP	-40°C to +125°C
MC9S08DN60MLH	64 LQFP	-40°C to +125°C
MC9S08DN60MLF	48 LQFP	-40°C to +125°C
MC9S08DN60MLC	32 LQFP	-40°C to +125°C
MC9S08DN48MLH	64 LQFP	-40°C to +125°C
MC9S08DN48MLF	48 LQFP	-40°C to +125°C
MC9S08DN48MLC	32 LQFP	-40°C to +125°C
MC9S08DN32MLH	64 LQFP	-40°C to +125°C
MC9S08DN32MLF	48 LQFP	-40°C to +125°C
MC9S08DN32MLC	32 LQFP	-40°C to +125°C
MC9S08DN16MLF	48 LQFP	-40°C to +125°C
MC9S08DN16MLC	32 LQFP	-40°C to +125°C

Note: Products available in C (-40°C to +85°C), V (-40°C to +105°C) or M (-40°C to +125°C) temperatures. Substitute C, V or M into part number suffix. Customers wanting automotive qualified parts should request a part number starting with S rather than MC.

32-pin LQFP
.65 mm pitch
7 mm x 7 mm body

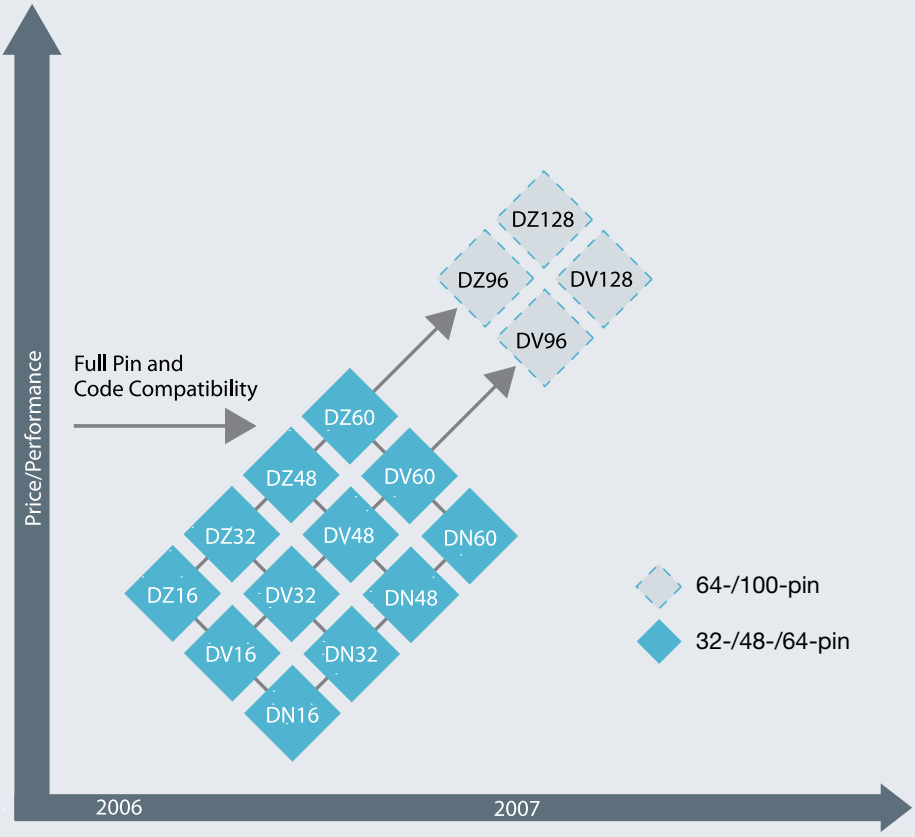
48-pin LQFP
.5 mm pitch
7 mm x 7 mm body

64-pin LQFP
.5 mm pitch
10 mm x 10 mm body



100-pin LQFP
.5 mm pitch
14 mm x 14 mm body

S08D Family Road Map



Development Tools

Evaluation Board
(EVB9S08DZ60)
MSRP Starting at $250

Demonstration Board
(DEMO9S08DZ60)
MSRP $85

Programming Adaptor
(PAS08QF5264—64LQFP;
PAS08QF324448—32/48 LQFP)
MSRP $199

BDM Multilink
(USBMULTILINKBDME)
MSRP $99

Cyclone Pro
(M68CYCLONEPROE):
MSRP $499

CodeWarrior™
(Standard Edition: CWS-H08-STDED-CX,
Professional Edition: CWS-H08-PROED-CX,
Special Edition: CWX-HXX-SE)

Emulation Support (ICE)
(Built-in support on-chip)
(Available at no charge*)

*Subject to license and registration

Learn More: For current information about Freescale's S08D family, please visit **www.freescale.com/S08D**.

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