



## S08—The Evolution of 8-bit Automotive Microcontrollers

Unprecedented industry value



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# Welcome to 8-bit Auto

## Freescale is your trusted partner for all 8-bit automotive solutions.

With more than 30 years of automotive leadership, Freescale continues to pioneer microcontroller technology. We are the leading global supplier of semiconductors for the automotive industry with over 1 billion automotive 8-bit MCUs shipped since 2000. Freescale is deeply committed to providing customers with 8-bit solutions that drive industry innovation and make the road to design quick, easy and cost-effective. Our 8-bit automotive portfolio offers an extensive selection of MCUs, which have a variety of peripheral and packaging options. We give you flexibility of choice with a wide range of flash memory options, a common tool and peripheral roadmap and pin compatibility and scalability between many of our families.

Use this brochure to learn more about our S08 families and to help you select the right 8-bit microcontroller for your automotive designs.

## We go beyond traditional silicon.

Freescale goes beyond silicon to ease your design process. We offer a full ecosystem of easy-to-use hardware and software tools, from cost-effective demo boards to advanced, high-performance debuggers, for our entire portfolio of 8-bit MCUs. Our CodeWarrior® Special Edition integrated development environment (IDE) for S08 MCUs can be downloaded at no cost\*, directly from our Web site. In addition, you have direct access to application notes, reference designs, online tutorials, discussion groups, training events and many other useful design assistance programs through our Web site at [www.freescale.com/automotive](http://www.freescale.com/automotive).

## Automotive Quality Standards

Each Freescale automotive microcontroller is tested and certified to withstand extreme automotive environments and stress.

Qualifications include specification conformance over a broad temperature range and automotive test flow adhering to the AEC-Q100 critical stress test qualification. A Production Part Approval Process (PPAP) and automotive quality assurance document is issued with each automotive microcontroller part. As part of our quality manufacturing practices, Freescale has initiated an aggressive Zero Defects initiative. Product testing in a Zero Defects environment

means going beyond the specification limits and eliminating outliers as well as simple test failures. Our advanced outlier methodologies applied to our Zero Defect-focused design and manufacturing processes will enable us to deliver a new level of quality product to our customers.

## Committed to the Environment

Freescale Semiconductor is committed to driving the implementation of environmentally friendly materials for our products. We have implemented lead (Pb)-free and halogen-free initiatives, substituting matte tin for Pb in most of our packaging options and tin/silver/copper materials

for ball-grid arrays. Freescale's environmental programs focus on adherence to the European Union's RoHS and WEEE directives, setting recycling requirements and restrictions on levels of designated substances and mandating recovery of certain electrical/electronic equipment.



\* Subject to license agreement and registration

# 8-bit Automotive Applications

8-bit microcontrollers are everywhere and the design possibilities are limitless. Freescale offers a robust portfolio of 8-bit microcontrollers to give you freedom and flexibility on the road to design. Our 8-bit solutions can be used in almost any automotive application. We give you breadth of choice with exceptional value. Learn all the areas of application and explore our S08 portfolio to choose the right microcontroller for your designs.

## Powertrain

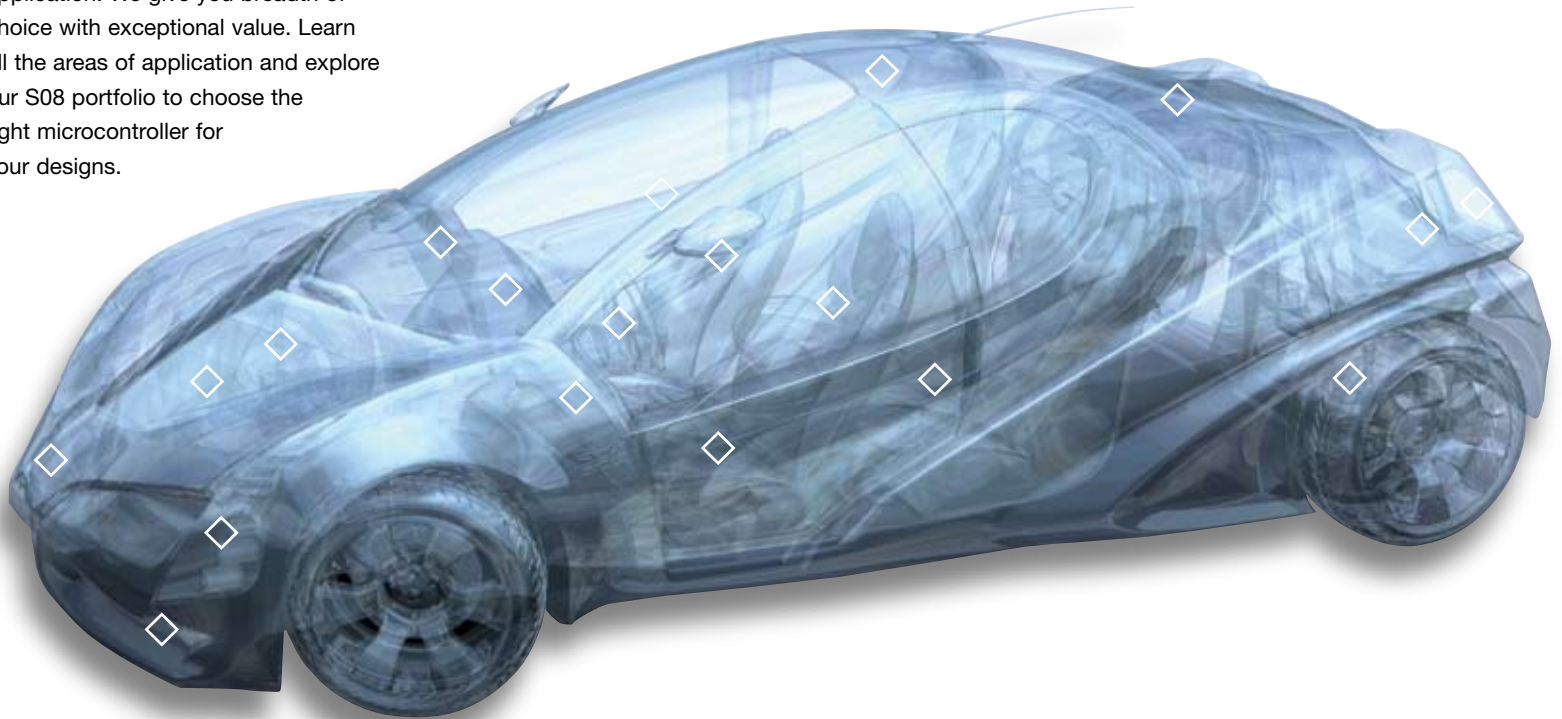
- Engine control watchdog MCU
- Transmission control watchdog MCU
- NOx sensor
- Vacuum leak detection
- Electronic throttle control

## Safety and Chassis

- Occupant detection
- Airbag watchdog
- Tire pressure monitoring
- Steering column angle sensor
- Rain sensor

## Security/Immobilization

- Remote keyless entry
- Passive entry
- Immobilizer



## Body Electronics

### Lighting

- Headlights
- Indicator
- Indicator repeater (wing/mirror)
- Brake lights
- Tail lights
- High level stop light
- Fog lights (front/rear)
- Reversing lights
- Automatic headlight control
- Automatic headlight levelling
- Headlight washing
- Puddle lamp
- Door open lamp
- Light fault detection
- Passenger cabin lighting
- See-me-home lights

## Comfort and Information

- Rear view mirror display
- Time of day clock
- External temperature sensing
- TPMS
- Information display
- Heated seats
- Power seats (+ memory)
- Climate control
- HVAC
- Audible warning (door open, lights on, seat belt)
- Engine fan control
- Park assist (front/rear)
- Horn
- General purpose user switches
- Compass
- Steering wheel key pads
- Heated/cooled cup holders

## Security and Entry Control

- Vehicle alarm
- Vehicle immobilizer
- Door lock control
- Fuel cap lock
- Trunk lock
- Trunk remote open
- Central locking
- Child locks
- Door lock status (lock/unlock)
- Remote keyless entry
- Passive entry
- Keyless ignition
- Power doors and liftgate (sliding/final close)
- Power boot/trunk

## Windows and Mirrors

- Power windows
- Power windows (one touch)
- Wing mirror control (X,Y)
- Wing mirror heater
- Wing mirror memory
- Wing mirror dimming (electrochromic)
- Rear view mirror dimming
- Sun roof (one touch)
- Power roof
- Rear window heater (timer + switch)
- Front wipe/wash control
- Rear wipe/wash control
- Rain sensor (automatic wiper control)

# Explore the S08 Core

## S08 Core Technology

Optimized for extreme operating economy with a number of low-power options, Freescale's S08 core is particularly attractive for automotive applications. Multiple Stop modes, along with Wait and Standby modes, will help achieve new thresholds in low-power performance under a variety of operating conditions. The S08 core allows efficient, compact, modular coding with full 16-bit stack-pointer and stack-relative addressing, which permit various instruction sizes and enable memory interface in multiple

mechanisms and addressing modes. The object code is also compatible with Freescale's legacy HC05 and HC08 cores.

## S08 Family Benefits

Freescale's S08 families help save cost, reduce board space, increase performance and improve quality by having everything on-chip. No longer are external components required, such as an external crystal, LVI circuit, voltage regulator, I/O mux, watchdog circuit or EEPROM. With on-chip emulation and debug, changes can be

made in application and in real-time, reducing development time. Also, with the S08 CPU running at 40 MHz, MCUs are able to quickly accomplish a task and go back to sleep. Quick execution translates into power savings, which allows customers to add more embedded content while keeping within their power budgets. Learn more about the unique benefits and features that each family provides starting on page 6.

## Core and Feature Differences

Attribute	S08	HC08
CPU Speed	Up to 40 MHz	Up to 16 MHz
Bus Speed	Up to 20 MHz	Up to 8 MHz
Technology	0.25μ	0.50μ
CPU	Additional opcodes for optimal C programming which reduces compiled code size	Additional opcodes not available
Emulation	On-chip, In-Circuit Emulation (ICE); full emulator built into every chip; 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 so no marginal timing is required	FSICE emulation is off-board, resulting in additional expenditures
Debug	On-chip, background debug module (BDM) with single wire communication, no CPU overhead, powerful tool for in field, in target debugging, only uses one MCU pin, same BDM interface pod for HC12, HCS12 and HCS08	On-chip monitor mode, can require up to four pins and interrupts CPU operation
System Protection Features	LVD (low voltage detect) trip point +/- 60 mV, windowed COP (Computing Operating Properly) and independent clock source for COP	LVD trip point +/- 300 mV, no windowed COP and no independent clock
Clock Choices	Multipurpose clock generator (MCG) with phased-lock loop (PLL), frequency-locked loop (FLL), and oscillator on-chip (OSC) on microcontroller	Limited with only PLL clock option
Analog-to-Digital Converter (ADC)	10-bit resolution modes, faster conversion times (up to 2.5 μsec)	10- and 8-bit resolution modes, conversion time (16 to 17 μsec)
I <sup>2</sup> C	Available on most S08 devices	Not available
Timer	Timer PWM module (TPM), providing flexibility, several clock options and various operating modes	Timer module (TIM)
On-Board Regulator	Yes, digital logic kept at constant voltage across VDD range and device operates at full speed across voltage range	No, device runs at 1/2 frequency at low end of the voltage range

Note: For more details on the differences between the S08 and HC08 cores, please refer to application note AN2717 M68HC08 to HCS08 Transition.

The S08 core introduces the next-generation family of easy-to-use microcontrollers equipped with a number of features that provide a higher performance platform over the HC08 core. In addition to higher CPU and bus speeds, the S08 incorporates on-chip in-circuit emulation (ICE)

and a background debug mode as opposed to the HC08's limited on-chip monitor mode. The S08 also offers multiple clock choices, including multipurpose clock generator, frequency-locked loop and oscillator on-chip as well as the phase-lock loop option offered on the HC08.

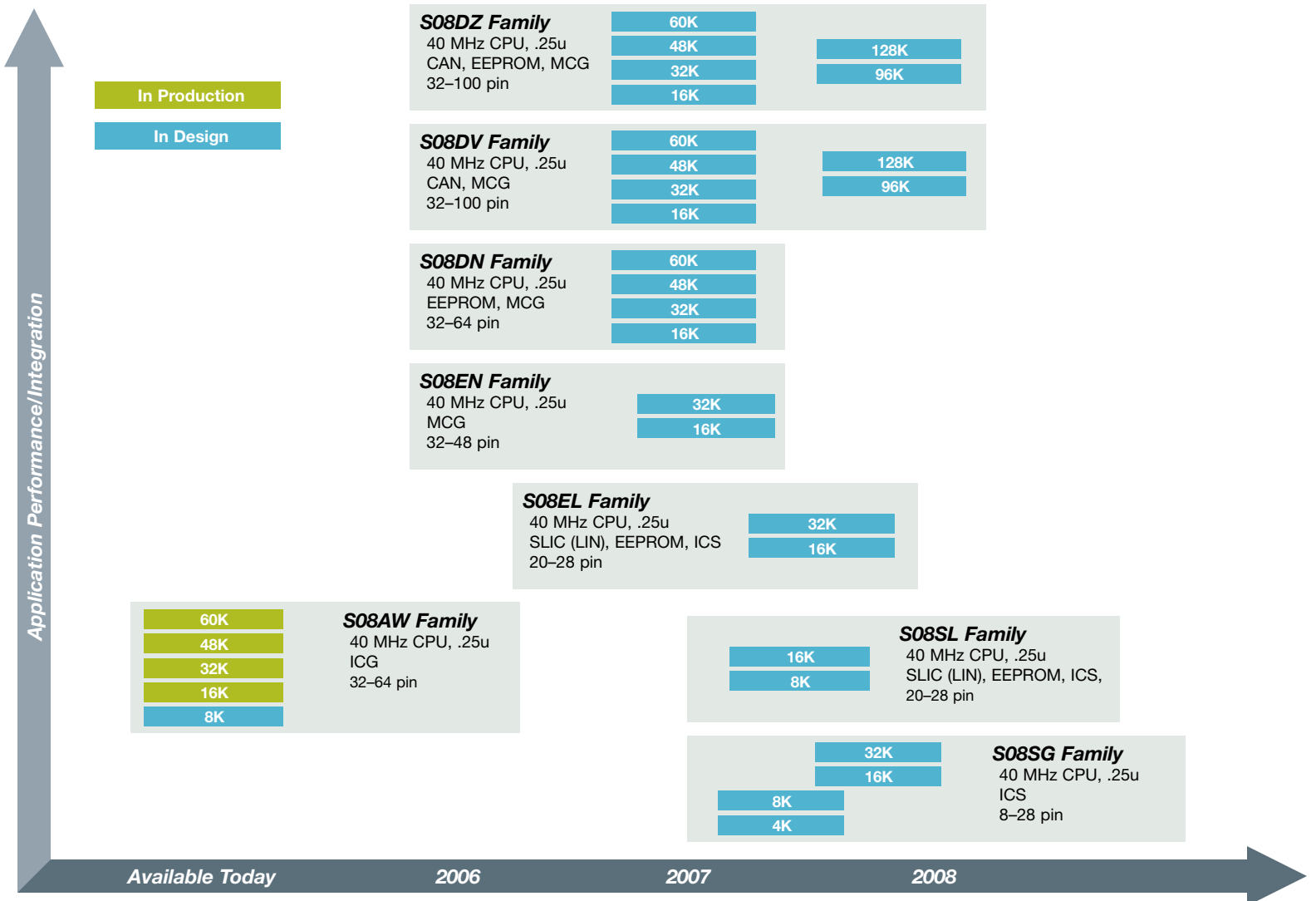
The table above outlines the primary differences between the S08 and HC08 microcontroller cores.

# Evolution of 8-bit: The Automotive S08 Roadmap

Freescale is committed to integrating more functionality with the S08 core while still providing an extremely cost-effective solution. Our roadmap outlines additional advanced features, such as

CAN, LIN, multipurpose clock generator and internal clock source module along with greater memory options. The S08 architecture does not sacrifice performance to offer you low-power

operation. With a wealth of feature sets at your disposal, the entire portfolio continues to give you the flexibility to choose the solution that is ideal for your automotive application.



**CAN** Controller Area Network

**EEPROM** Electrically Erasable Programmable Read-Only Memory

**SLIC** Slave LIN Interface Controller

**LIN** Local Interconnect Network

**MCG** Multipurpose Clock Generator

**ICS** Internal Clock Source

**ICG** Internal Clock Generator

This document contains forward-looking statements based on current expectations, forecast and assumptions of Freescale that involves risk and uncertainties. Forward looking statements are subject to risk and uncertainties associated with Freescale business that could cause actual results to vary materially from those stated or implied by such forward-looking statements.

# Choose Your S08 Family

The product map illustrates the wide range of capabilities across the S08 families. This table provides a quick and easy reference tool to help

you determine the appropriate family based on your market focus, memory and peripheral needs.

	Family	Market Focus	Application Examples	Flash	ROM Available	RAM	EEPROM	CAN	Analog (ADC)	UART	SPI	I <sup>2</sup> C	SLIC	Timer	Clock	Pin Count	Additional Features
High End	DZ	CAN, LIN Master, General Market	Wireless Control, Rx Low End, HVAC Door Modules, Watchdog Ctrl, Power Lift Gate	16 KB–128 KB		1 KB–8 KB	512B–2KB	1	Up to 24-ch., 10-bit ADC, two comparators	2 x SCI	Up to 2	Up to 2		Up to 10-ch. +2-ch.	MCG (PLL, FLL, OSC)	100, 64, 48, 32	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
	DV	CAN, LIN Master, General Market		16 KB–128 KB	✓	1 KB–6 KB		1	Up to 24-ch., 10-bit ADC, two comparators	2 x SCI	Up to 2	Up to 2		Up to 10-ch. +2-ch.	MCG (PLL, FLL, OSC)	100, 64, 48, 32	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
	DN	LIN Master, General Market		16 KB–60 KB		1 KB–2 KB	512B–2 KB		Up to 16-ch., 10-bit ADC, two comparators	1 x SCI	1	1		Up to 6-ch. +2-ch.	MCG (PLL, FLL, OSC)	64, 48, 32	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
Mid Range	EN	General Market	Trip Computer Seats, Rain Sensors, Compass, Mirror	16 KB–32 KB	✓	512B–1 KB			Up to 12-ch., 10-bit ADC, one comparator	1 x SCI	1			4-ch.	MCG (PLL, FLL, OSC)	48, 32	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
	EL	LIN Slave, General Market		16 KB–32 KB		1 KB	Up to 512B		Up to 16-ch., 10-bit ADC, two comparators	1 x SCI	1	1	1	4-ch. +2-ch.	ICS	28, 20	LIN Auto-Baud/Synch, 40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
	AW	LIN Slave, High I/O	Trip Computer Seats, Rain Sensors, Compass, Mirror	8 KB–60 KB	✓	768B–2 KB			Up to 16-ch., 10-bit ADC	Up to 2 x SCI	1	1		Up to 6-ch. +2-ch.	ICG	64, 48, 44, 32	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
Low End	SL	LIN Slave, General Market	LIN Sub-Bus, Watchdog Ctrl, Airbag, General Powertrain	8 KB–16 KB		512B	Up to 256B		Up to 16-ch., 10-bit ADC, one comparator	1 x SCI	1	1	1	2-ch. +2-ch.	ICS	28, 20	LIN Auto-Baud/Synch, 40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
	SG	LIN Slave, General Market		4 KB–32 KB	✓	256B–1 KB			Up to 16-ch., 10-bit ADC, one comparator	1 x SCI	1	1		Up to 2-ch. +2-ch.	ICS	28, 20, 16, 8	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

**ADC** Analog-to-Digital Converter

**ROM** Read-Only Memory

**RAM** Random Access Memory

**EEPROM** Electrically Erasable Programmable Read-Only Memory

**CAN** Controller Area Network

**LIN** Local Interconnect Network

**ICG** Internal Clock Generator

**ICS** Internal Clock Source

**UART** Universal Asynchronous Receiver Transmitter

**SPI** Serial Peripheral Interface

**I<sup>2</sup>C** Inter-Integrated Circuit

**SLIC** Slave LIN Interface Controller

**MCG** Multipurpose Clock Generator

**PLL** Phase-Locked Loop

**FLL** Frequency-Locked Loop

**OSC** Oscillator on-Chip

**COP** Computer Operating Properly

**LVI** Low Voltage Inhibit

**ICE** In-Circuit Emulation

**BDM** Background Debug Mode

**POR** Power-on-Reset

**KBI** Keyboard Interrupt Module

# DZ Family

## Benefits

- Save cost, save board space and improve quality with on-chip EEPROM by eliminating the need for external EEPROM
- Save cost with pin compatibility and scalability across DZ, DV, DN and EN families by mitigating future expandability expenses
- Save cost with high pin count devices (32-pin and above) by eliminating the need for I/O expanders
- Save cost with wide flash range (16K–128K), which allows customer to expand application within the same family and avoid unnecessary development costs

- Provides flexibility with several timing options via an MCG (PLL, FLL, OSC)

## Key Features

- 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
- EEPROM in-circuit programmable memory; flexible 8-byte single-page or 4-byte dual-page erase sector; Program and Erase while executing flash; Erase abort
- EEPROM block protect

- MCG—PLL and FLL modes; internal reference clock with trim adjustment; external reference with oscillator/resonator options

## Market Focus

- CAN
- LIN Master
- General Market

40 MHz S08 CPU (20 MHz Bus)	Up to 128K Flash			Up to 2K EEPROM
Up to 8K RAM	Up to 2 x SPI	Up to 2 x I <sup>2</sup> C	WDT	RTC
	Multiclock Generator (PLL, FLL, OSC)	Up to 2 x SCI	LVI + LVW	Up to 12-ch., 16-bit Timer
MSCAN	Up to Two Comparators	Up to 24-ch., 10-bit ADC	On-Chip ICE On-Chip BDM	Up to 88 GPIO

Indicates a differentiating feature

Root Part Number	Flash	RAM	EEPROM	CAN	UART	SPI	I <sup>2</sup> C	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08DZ128	128 KB	8 KB	Up to 2KB	1	2 x SCI	2	2	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch. +4-ch.+ 2-ch.	MCG (PLL, FLL, OSC)	100-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DZ96	96 KB	6 KB	Up to 2KB	1	2 x SCI	2	2	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch. +4-ch.+ 2-ch.	MCG (PLL, FLL, OSC)	100-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DZ60	60 KB	4 KB	Up to 2 KB	1	2 x SCI	1	1	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DZ48	48 KB	3 KB	Up to 1.5 KB	1	2 x SCI	1	1	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DZ32	32 KB	2 KB	Up to 1 KB	1	2 x SCI	1	1	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DZ16	16 KB	1 KB	Up to 512B	1	2 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.



# DV Family

## Benefits

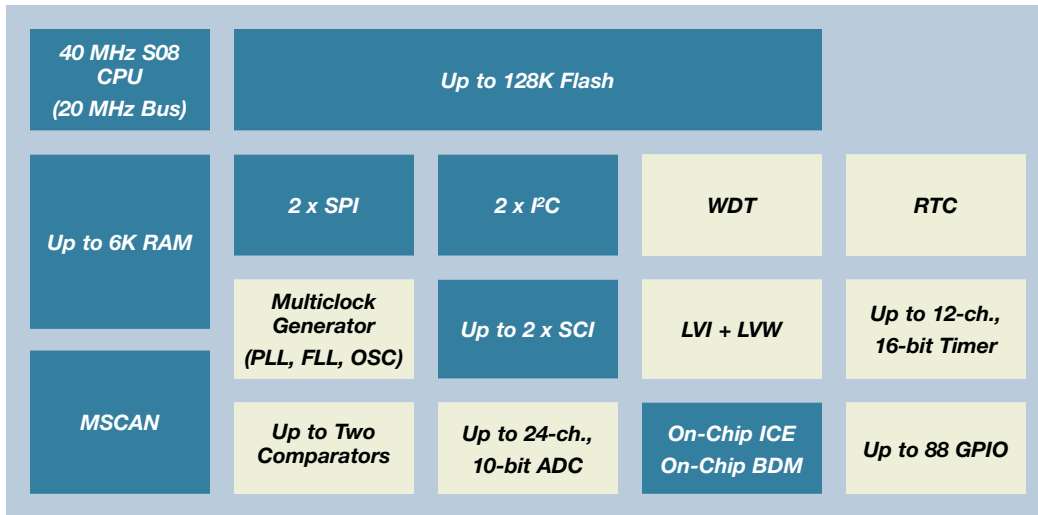
- Save cost with pin compatibility and scalability across DZ, DV, DN and EN families by mitigating future expandability expenses
- Save cost with high pin count devices (32-pin and above) by eliminating the need for I/O expanders
- Save cost with wide flash range (16K–128K), which allows customer to expand application within the same family and avoid unnecessary development costs
- Provides flexibility with several timing options via an MCG (PLL, FLL, OSC)

## Key Features

- 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
- MCG—PLL and FLL modes; internal reference clock with trim adjustment; external reference with oscillator/resonator options

## Market Focus

- CAN
- LIN Master
- General Market



Indicates a differentiating feature

Root Part Number	Flash	ROM available	RAM	CAN	UART	SPI	I <sup>2</sup> C	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08DV128	128 KB	✓	6 KB	1	2 x SCI	2	2	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch. +4-ch.+2-ch.	MCG (PLL, FLL, OSC)	100-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DV96	96 KB	✓	4 KB	1	2 x SCI	2	2	Up to 24-ch., 10-bit ADC, two comparators	Up to 6-ch. +4-ch.+2-ch.	MCG (PLL, FLL, OSC)	100-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DV60	60 KB	✓	3 KB	1	2 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DV48	48 KB	✓	2 KB	1	2 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DV32	32 KB	✓	2 KB	1	2 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DV16	16 KB	✓	1 KB	1	2 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

# DN Family

## Benefits

- Save cost, save board space and improve quality with on-chip EEPROM by eliminating the need for external EEPROM
- Save cost with pin compatibility and scalability across DZ, DV, DN and EN families by mitigating future expandability expenses
- Save cost with high pin count devices (48-pin and above) by eliminating the need for I/O expanders

- Save cost with wide flash range (16K–60K), which allows customer to expand application within the same family and avoid unnecessary development costs
- Provides flexibility with several timing options via an MCG (PLL, FLL, OSC)

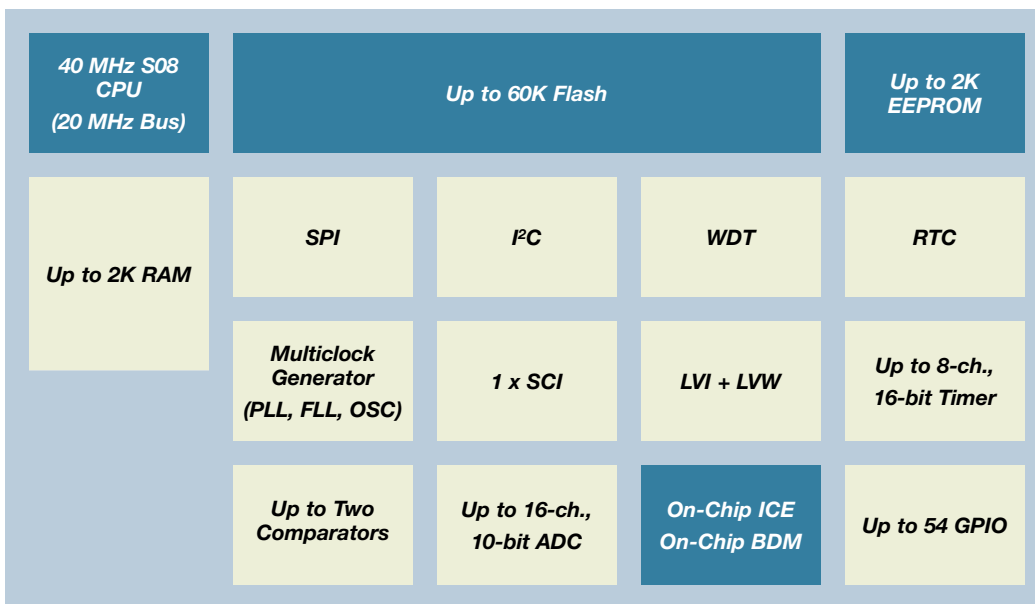
## Key Features

- EEPROM in-circuit programmable memory; 8-byte single-page or 4-byte dual-page erase sector; Program and Erase while executing flash; Erase abort
- EEPROM block protect

- MCG—PLL and FLL modes; internal reference clock with trim adjustment; external reference with oscillator/resonator options

## Market Focus

- LIN Master
- General Market



Indicates a differentiating feature

Root Part Number	Flash	RAM	EEPROM	UART	SPI	I <sup>2</sup> C	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08DN60	60 KB	2 KB	Up to 2 KB	1 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DN48	48 KB	2 KB	Up to 1.5 KB	1 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DN32	32 KB	1.5 KB	Up to 1 KB	1 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP 64-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08DN16	16 KB	1 KB	Up to 512B	1 x SCI	1	1	Up to 16-ch., 10-bit ADC, two comparators	Up to 6-ch.+2-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

# EN Family

## Benefits

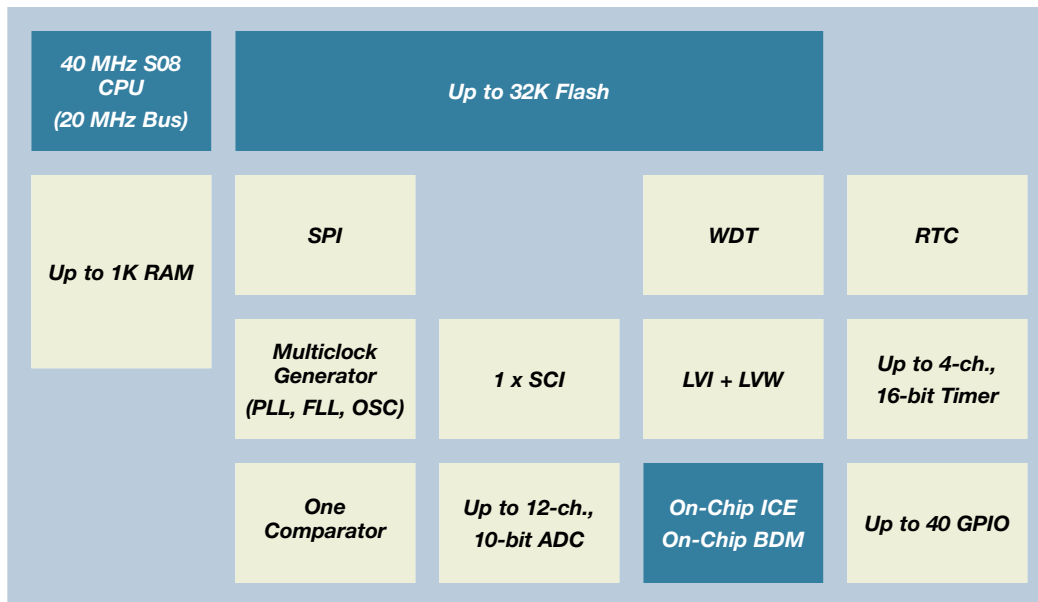
- Save cost with pin compatibility and scalability across DZ, DV, DN and EN families by mitigating future expandability expenses
- Save cost with high pin count devices (32-pin and above) by eliminating the need for I/O expanders
- Provides flexibility with several timing options via an MCG (PLL, FLL, OSC)

## Key Features

- MCG—PLL and FLL modes; internal reference clock with trim adjustment; external reference with oscillator/resonator options

## Market Focus

- LIN Slave Nodes
- General Market



Indicates a differentiating feature

Root Part Number	Flash	ROM Available	RAM	UART	SPI	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08EN32	32 KB	✓	1 KB	1 x SCI	1	Up to 12-ch., 10-bit ADC, one comparator	4-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08EN16	16 KB	✓	512B	1 x SCI	1	Up to 12-ch., 10-bit ADC, one comparator	4-ch.	MCG (PLL, FLL, OSC)	32-pin LQFP 48-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

# EL Family

## Benefits

- Save cost, save board space and improve quality with on-chip EEPROM by eliminating the need for external EEPROM
- Pin compatibility and scalability across EL, SL and SG families offers customers future expandability
- ICS module provides a low-power internal oscillator capable of 1.5 percent accuracy across temperature and voltage

## SLIC module increases performance

- True auto synchronization and auto bauding find LIN frames and adjust baud rate without CPU intervention
- Number of interrupts reduced by up to 83 percent over UART solutions—only two interrupts for any LIN message

- Remaining interrupts are serviced much more efficiently due to patented interrupt handling technology
- Superior LIN bus noise suppression to UART
- SLIC blocks noise instead of passing it on
- Can use SYNCH data from LIN messages to trim oscillator
- SLIC eliminates many steps normally required by UART solutions (trim oscillator, detect break, measure sync signal, adjust baud rate, calculate and verify checksum, handle individual data bytes detect LIN errors)

## SLIC helps shorten development time

- By eliminating message processing steps, SLIC minimizes and simplifies driver code
- SLIC driver code as small as 120 bytes possible (refer to AN2633)

- Simpler driver code means shortened debug and development time—use your engineering time to debug the application, not LIN communication

## SLIC helps reduce cost

- SLIC can handle any LIN speed on any LIN bus with only one software driver required, which allows for:
  - Code reuse for many applications, regardless of LIN bus speed—no reprogramming required to change bus speeds means fewer part numbers to track and stock
  - High-speed (up to 120 kbps), end-of-line programming through LIN allows faster module manufacturing times and field re-programmability
  - Smaller driver code means less flash required for given application—use flash for your application, not LIN communication
- SLIC does not require oscillator trimming, unlike UART or bit-banged LIN solutions, eliminating a manufacturing step

## Key Features

- EEPROM in-circuit programmable memory; 8-byte single-page or 4-byte dual-page erase sector; Program and Erase while executing flash; Erase abort
- ICS—FLL mode; internal reference clock with trim adjustment; external reference with oscillator/resonator options

## Market Focus

- LIN Slave Nodes
- General Market
- Space-Constrained Applications

<b>40 MHz S08 CPU (20 MHz Bus)</b>	<b>Up to 32K Flash</b>				<b>Up to 512 B EEPROM</b>
<b>Up to 1K RAM</b>	<b>SPI</b>	<b>I<sup>2</sup>C</b>	<b>WDT</b>	<b>RTC</b>	
	<b>ICS Clock</b>	<b>1 x SCI</b>	<b>LVI + LVW</b>	<b>Up to 6-ch., 16-bit Timer</b>	
<b>SLIC</b>	<b>Up to Two Comparators</b>	<b>Up to 16-ch., 10-bit ADC</b>	<b>On-Chip ICE On-Chip BDM</b>	<b>Up to 22 GPIO</b>	

Indicates a differentiating feature

Root Part Number	Flash	RAM	EEPROM	UART	SPI	I <sup>2</sup> C	SLIC	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08EL32	32 KB	1 KB	Up to 512B	1 x SCI	1	1	1	Up to 16-ch., 10-bit ADC, two comparators	4-ch.+2-ch.	ICS	28-pin TSSOP 20-pin TSSOP	2.7 to 5.5	LIN Auto-Baud/Synch, 40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08EL16	16 KB	1 KB	Up to 512B	1 x SCI	1	1	1	Up to 16-ch., 10-bit ADC, two comparators	4-ch.+2-ch.	ICS	28-pin TSSOP 20-pin TSSOP	2.7 to 5.5	LIN Auto-Baud/Synch, 40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

# AW Family

## Benefits

- Save cost with high pin count devices (32-pin and above) by eliminating the need for I/O expanders
- Save cost with wide flash range (8K–60K), which allows customer to expand application within same family and avoid unnecessary development costs

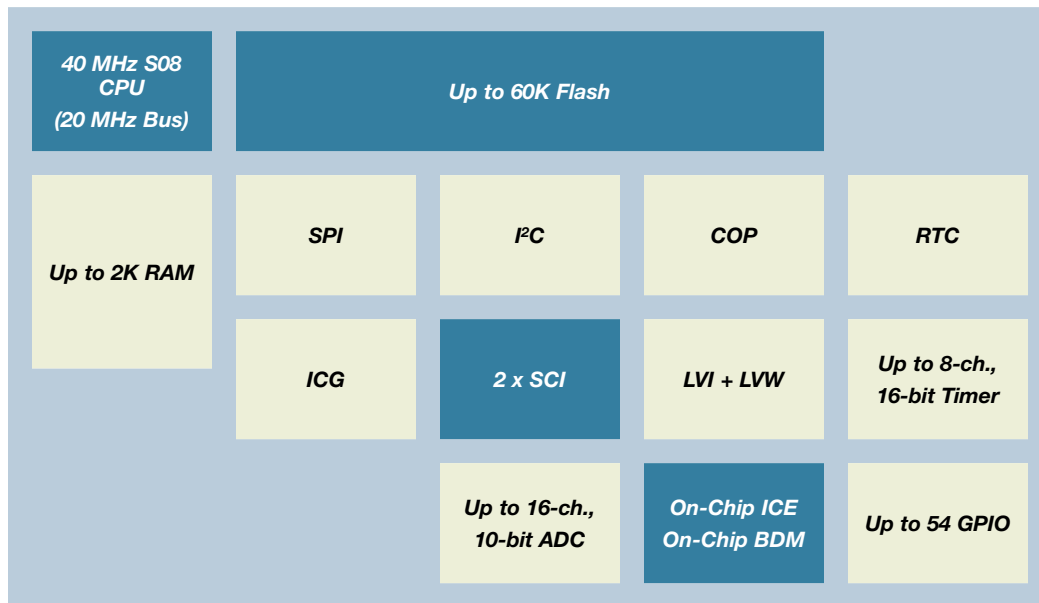
- Save cost with entry-level devices for applications requiring less features and performance
- ICG—Provides accurate on-chip clock source and saves cost by eliminating the need for external components

## Key Features

- ICG—programmable FLL; post-FLL divider; trimmable with temperature and voltage compensation, multiple options for clock sources and in-application clock switching

## Market Focus

- LIN Slave Nodes
- General Market



Indicates a differentiating feature

Root Part Number	Flash	ROM Available	RAM	UART	SPI	I <sup>2</sup> C	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08AW60	60 KB	✓	2 KB	2 x SCI	1	1	Up to 16-ch., 10-bit ADC	Up to 6-ch.+2-ch.	ICG	64-pin QFP 64-pin LQFP 48-pin QFN 44-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08AW48	48 KB	✓	2 KB	2 x SCI	1	1	Up to 16-ch., 10-bit ADC	Up to 6-ch.+2-ch.	ICG	64-pin QFP 64-pin LQFP 48-pin QFN 44-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08AW32	32 KB	✓	2 KB	2 x SCI	1	1	Up to 16-ch., 10-bit ADC	Up to 6-ch.+2-ch.	ICG	64-pin QFP 64-pin LQFP 48-pin QFN 44-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08AW16	16 KB	✓	1 KB	2 x SCI	1	1	Up to 16-ch., 10-bit ADC	Up to 4-ch.+2-ch.	ICG	48-pin QFN 44-pin LQFP 32-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08AW8	8 KB	✓	768B	2 x SCI	1	1	Up to 8-ch., 10-bit ADC	Up to 4-ch.+2-ch.	ICG	48-pin QFN 44-pin LQFP 32-pin LQFP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

# SL Family

## Benefits

- Save cost, save board space and improve quality with on-chip EEPROM by eliminating the need for external EEPROM
- Pin compatibility and scalability across EL, SL and SG families offers customers future expandability
- ICS module provides a low-power internal oscillator capable of 1.5 percent accuracy across temperature and voltage

## SLIC module increases performance

- True auto synchronization and auto bauding find LIN frames and adjust baud rate without CPU intervention
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- Remaining interrupts are serviced much more efficiently due to patented interrupt handling technology
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## SLIC helps shorten development time

- By eliminating message processing steps, SLIC minimizes and simplifies driver code
- SLIC driver code as small as 120 bytes possible (refer to AN2633)

- Simpler driver code means shortened debug and development time—use your engineering time to debug the application, not LIN communication

## SLIC helps reduce cost

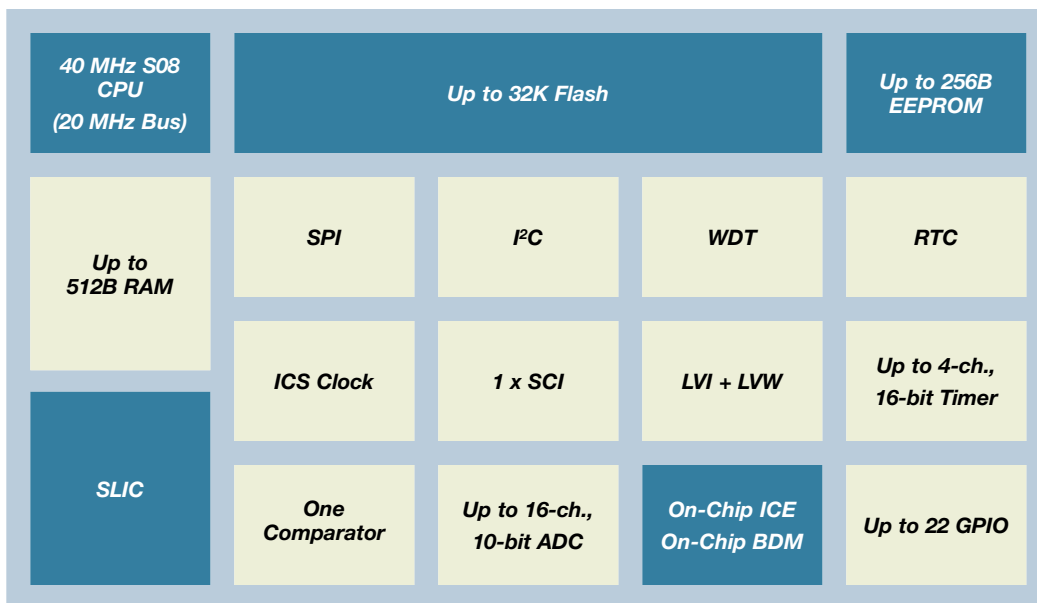
- SLIC can handle any LIN speed on any LIN bus with only one software driver required, which allows for:
  - Code reuse for many applications, regardless of LIN bus speed—no reprogramming required to change bus speeds means fewer part numbers to track and stock
  - High-speed (up to 120 kbps), end-of-line programming through LIN allows faster module manufacturing times and field re-programmability
  - Smaller driver code means less flash required for given application—use flash for your application, not LIN communication
- SLIC does not require oscillator trimming, unlike UART or bit-banged LIN solutions, eliminating a manufacturing step

## Key Features

- EEPROM in-circuit programmable memory; 8-byte single-page or 4-byte dual-page erase sector; Program and Erase while executing flash; Erase abort
- ICS—FLL mode; internal reference clock with trim adjustment; external reference with oscillator/resonator options

## Market Focus

- LIN Slave Nodes
- General Market
- Space-Constrained Applications



Indicates a differentiating feature

Root Part Number	Flash	RAM	EEPROM	UART	SPI	I <sup>2</sup> C	SLIC	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08SL16	16 KB	512B	Up to 256B	1 x SCI	1	1	1	Up to 16-ch., 10-bit ADC, one comparator	2-ch.+2-ch.	ICS	28-pin TSSOP 20-pin TSSOP	2.7 to 5.5	LIN Auto-Baud/Synch, 40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08SL8	8 KB	512B	Up to 256B	1 x SCI	1	1	1	Up to 16-ch., 10-bit ADC, one comparator	2-ch.+2-ch.	ICS	28-pin TSSOP 20-pin TSSOP	2.7 to 5.5	LIN Auto-Baud/Synch, 40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

# SG Family

## Market Focus

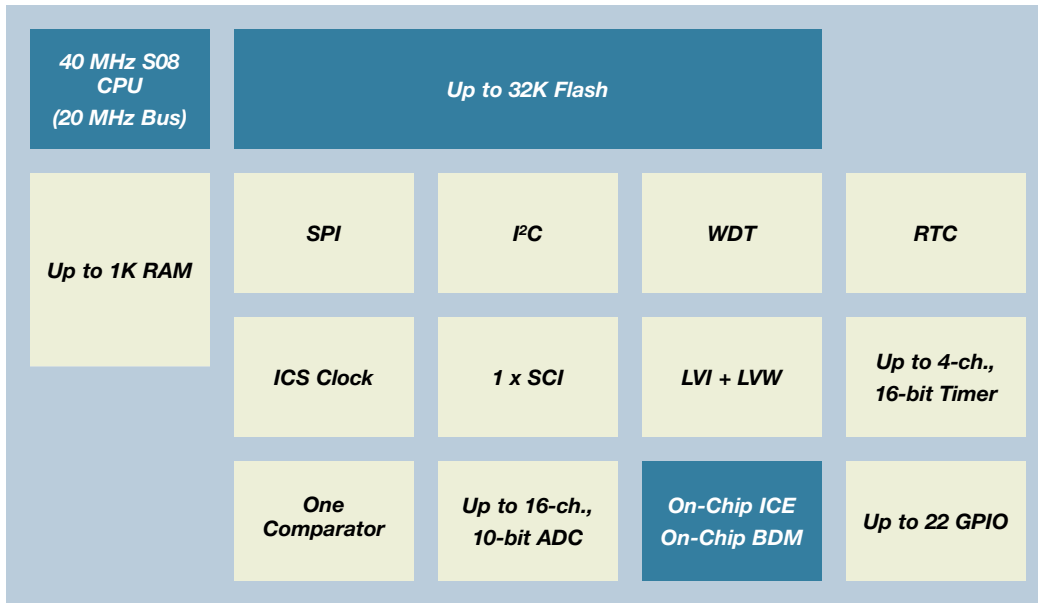
- LIN Slave Nodes
- General Market
- Space-Constrained Applications

## Benefits

- Save cost with pin compatibility and scalability across EL, SL and SG families by mitigating future expandability expenses
- Save cost with entry-level devices for applications requiring less features and performance
- ICS module provides a low-power internal oscillator capable of 1.5 percent accuracy across temperature and voltage

## Key Features

- ICS—FLL mode; internal reference clock with trim adjustment; external reference with oscillator/resonator options
- Real-time interrupt (RTI)—mechanism is useful for generating a periodic interrupt after a programmable amount of time. This can be useful for executing diagnostics, maintenance routines and polling I/O or events.



Indicates a differentiating feature

Root Part Number	Flash	ROM available	RAM	UART	SPI	I <sup>2</sup> C	Analog (ADC)	Timer	Clock	Package Options	Operating Voltage (V)	Additional Features
9S08SG32	32 KB	✓	1 KB	1 x SCI	1	1	Up to 16-ch., 10-bit ADC, one comparator	2-ch.+2-ch.	ICS	28-pin TSSOP 20-pin TSSOP 16-pin TSSOP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08SG16	16 KB	✓	1 KB	1 x SCI	1	1	Up to 16-ch., 10-bit ADC, one comparator	2-ch.+2-ch.	ICS	28-pin TSSOP 20-pin TSSOP 16-pin TSSOP	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08SG8	8 KB	✓	512B	1 x SCI	1	1	Up to 12-ch., 10-bit ADC, one comparator	Up to 2-ch.+2-ch.	ICS	20-pin TSSOP 16-pin TSSOP 8-pin SOIC	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor
9S08SG4	4 KB	✓	256B	1 x SCI	1	1	Up to 12-ch., 10-bit ADC, one comparator	Up to 2-ch.+2-ch.	ICS	20-pin TSSOP 16-pin TSSOP 8-pin SOIC	2.7 to 5.5	40 MHz CPU, Watchdog OSC/Timer, COP, LVI, ICE, BDM, POR, KBI, Temp Sensor

Note: All 8-bit flash MCUs use SuperFlash® technology licensed from SST.

Everything you need. Just add your imagination.

# Development Tools Overview



## Demonstration Boards (DEMO)\*

Demonstration boards are cost-effective and time-saving development tools that allow users to program and debug application code with basic I/O functions and peripherals.



## Evaluation Boards (EVB)\*

Evaluation boards allow users to program and debug advanced application code with expanded I/O functions and peripherals.



## BDM Multilink (USBMULTILINKBDME)\*

A cost-effective development tool for S08 products that provides real-time, in-circuit flash programming, emulation and debugging through the BDM interface.



## Cyclone Pro (CYCLONEPROE)\*

Cyclone Pro provides all the capabilities of the USBMULTILINKBDME and USBMULTILINK08E plus USB/Ethernet serial interfaces.

## CodeWarrior® Development Studio for S08 v5.1



Even small applications can benefit from sophisticated software tools that save you time and money. CodeWarrior Development Studio for S08 v5.1, part of the Freescale Fast Track™ suite of tools, has been reengineered to enhance the user experience.

This latest version of CodeWarrior Development Studio includes built-in features and utilities that improve ease of use, speed and accessibility over previous versions. Using CodeWarrior Development Studio, product developers can get innovative, higher quality products to market faster and more economically.

- **Easy**—A quick start guide eases installation and helps create a first example project. An overview tutorial for introductory users is accessible at any time during a project. Example projects for every supported Freescale microcontroller are available to jump-start your design efforts.
- **Fast**—The project wizard can be used to create a working project (Assembly or C) in as few as seven mouse clicks. An assist knowledge base aids device initialization, enabling users to make smarter design decisions. Users can change target microcontrollers and the debug/flash programming connection in an open project without having to recreate the project.

- **Accessible**—CodeWarrior Development Studio for S08 v5.1 is available for download at [www.freescale.com/8bit](http://www.freescale.com/8bit). To simplify software updates, an updater utility enables Web access to the latest features and service packs.

The CodeWarrior ANSI C/C++ and compact C++ compilers take full advantage of the S08 architecture, with more than 60 advanced optimization strategies specifically designed to boost performance and reduce code size. CodeWarrior Development Studio has all the additional tools you need, but you can also “plug-in” your favorite third-party editors, compilers and debuggers, if you prefer.

## CodeWarrior Package Options

- CodeWarrior Development Studio for HC(S)08/RS08 v5.1, **Special Edition**—a simplified yet fully functional version can be downloaded free\*\* of charge at [www.freescale.com/cw5](http://www.freescale.com/cw5). It allows development of unlimited assembly programs and C programs up to 16 KB.
- CodeWarrior Development Studio for HC(S)08/RS08 v5.1, **Standard Edition**—allows development of unlimited assembly and C programs. In addition, the data visualization tool provided with the Standard Edition allows you to see changes in your data more readily, so you can speed up your development cycle. The Standard Edition can be purchased online at [www.freescale.com/buydirect](http://www.freescale.com/buydirect) or from any Freescale distributor.
- CodeWarrior Development Studio for HC(S)08/RS08 v5.1, **Professional Edition**—allows development of unlimited assembly, C and C++ programs. With the performance analysis, code coverage and data visualization tools provided with the Professional Edition you can fine tune your application’s performance. Bean Wizard, which is also included, allows you to build a software library that can be retargeted to any HC(S)08 or HC(S)12 silicon. The Professional Edition can be purchased online at [www.freescale.com/buydirect](http://www.freescale.com/buydirect) or from any Freescale distributor.

\* Includes CodeWarrior Development Studio for S08, Special Edition, at no additional cost\*\*.

\*\* Subject to license agreement and registration.



# Additional Information

## Development Tools Ordering Information

		Cost-Effective Development Tools and Hardware			Additional Development Tools and Hardware			
Family	Part Number	Demo Board	Demo Board Availability	Software	Evaluation Board	Evaluation Board Availability	Debug Interface Cable	Software
AW	MC9S08AW8/16/32/48/60	DEM09S08AW60E	Available Today	Special Edition: CWX-HXX-SE*	—	—	USBMULTILINKBDME	Standard Edition: CWS-HC08-STDED-CX  Professional Edition: CWS-H08-PROED-CX
DZ	MC9S08DZ16/32/48/60	DEM09S08DZ60	Available Today		EVB9S08DZ60	Available Today		
DV	MC9S08DV16/32/48/60							
DN	MC9S08DN16/32/48/60							
EN	MC9S08EN16/32							
EL	MC9S08EL16/32	DEM09S08EL32	Q3 '07		—	Q1'07		
SL	MC9S08SL8/16							
SG	MC9S08SG16/32	DEM09S08SG32						
SG	MC9S08SG4/8	DEM09S08SG8			—			

\*CodeWarrior Special Edition can be downloaded free of charge at [www.freescale.com/cw5](http://www.freescale.com/cw5). It allows development of unlimited assembly programs and C programs up to 16 KB.

## Package Information

Pin Number	Package Type	Package Size (mm)	Pitch (mm)
64	LQFP	10 x 10 x 1.4	0.5
64	QFP	14 x 14 x 2.2	0.8
48	LQFP	7 x 7 x 1.4	0.5
48	QFN	7 x 7 x 1	0.5
44	LQFP	10 x 10 x 1.4	0.8
32	LQFP	7 x 7 x 1.4	0.8
28	TSSOP	9.7 x 4.4 x 1	0.65
20	TSSOP	6.5 x 4.4 x 1	0.65
16	TSSOP	5 x 4.4 x 1	0.65
8	Narrow Body SOIC	4.9 x 3.9 x 1.55	1.27

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