

# MC9S08LL16/8

## Fact sheet

### Target Applications

- Battery-operated handheld devices
- Portable health care devices
- Thermostats
- Alarms/clocks
- Exercise equipment
- Personal diagnostics
- Calculators
- Low-end utility metering
- ZigBee® nodes with display
- Scrolling text displays
- Small appliances

### Overview

Freescale introduces the first S08 ultra-low-power MCU with LCD driver. The MC9S08LL16/8 helps you reach your target performance levels while minimizing power consumption in your design, demonstrating extreme energy efficiency for ultra-long operation in battery-powered applications. The S08LL16 (LL16) microcontroller offers two ultra-low-power stop modes, new low-power run and wait modes, six microsecond wake-up time, ultra-low-power external oscillator and clock gating registers to disable clocks to unused peripherals.

The LL family also provides design flexibility with a large segment-based (8 x 24) driver and an integrated charge pump to provide a true system-on-chip.

### Package Options

Part Number	Package	Temp. Range
MC9S08LL16CLH	64 LQFP	-40° C to +85° C
MC9S08LL16CGT	48 QFN	-40° C to +85° C
MC9S08LL16CLF	48 LQFP	-40° C to +85° C
MC9S08LL8CGT	48 QFN	-40° C to +85° C
MC9S08LL8CLF	48 LQFP	-40° C to +85° C

### Features

#### S08 Central Processor Unit (CPU)

- Up to 20 MHz HCS08 CPU from 1.8V to 3.6V and across a temperature range of -40°C to +85°C
- HCS08 instruction set with added BGND instruction

### Benefits

- Offers high performance, even at low voltage levels for battery-operated applications
- Provides bus speed operation of 10 MHz from 1.8V to 3.6V
- Easy to learn and use
- Backward object code compatibility with 68HC08 and 68HC05 for reuse of existing libraries
- Allows for efficient, compact module coding in assembly or C compiler
- BGND allows user to enter background debug mode that takes advantage of the on-chip in-circuit emulator (ICE)

### Power-Saving Features

- Two ultra-low-power stop modes, one of which allows limited use of peripherals
- New low-power run and wait modes
- 6 µs typical wake-up time from stop mode
- Internal clock source (ICS)—module containing a frequency-locked loop (FLL) controlled by internal or external reference
- Ultra-low-power oscillator (OSC)
- Clock gating disables clocks to unused peripherals

- Allows continued application sampling in a reduced power state, which extends battery life
- Allows use of all chip peripherals in a low-power state
- Enables faster execution out of stop modes
- Provides choice of frequencies on the fly
- Reducing frequency saves current
- Accurate timebase in low-power modes
- Provides flexibility to turn off individual modules
- Reduces power consumption

### LCD Driver and Internal Charge Pump

- Integrated LCD driver supports both standard 3V and 5V LCD glass
- Configurable display for 8 x 24 or 4 x 28 segment display
- Low-power blinking mode

- Gives you flexibility when selecting the ideal glass for your application with respect to display quality, cost and power
- Does not require expensive “chip-on-glass” display
- Up to 16 alpha-numeric display (12 segments based), perfect for scrolling text with simple display
- Allows high mix of numbers, text and icons
- Low-power blinking mode does not require CPU intervention. Blinking mode can be activated and CPU can go to sleep, but segments will remain blinking at the pre-set frequency. Plus, an alternate display feature can be activated to display alternate data (i.e., to blink temperature and time).

- Internal charge pump
- Front plane (FP) and black plane (BP) re-assignments
- Capable of running in STOP3 and STOP2 mode
- LCD driver pins are muxed with GPIO and other functions

- Provides option to run off a single supply, a dual supply for sustained contrast or a customized implementation of contrast control
- FP and BP can be software selectable, making layout an easier task and very flexible for design changes
- Enables driving the display while the CPU sleeps, lowering overall system power consumption
- Any LCD pin can be FP (segment) or BP (common), based on software configuration

### On-Chip Memory

- Up to 16 KB flash read/program/erase over full operating voltage and temperature
- 1.8V to 3.6V RAM

- Allows you to take full advantage of operating voltage and temperature in-application reprogrammability benefits in virtually any environment
- Security circuitry prevents unauthorized access to RAM and flash contents, reducing system power consumption

## Cost-Effective Development Tools

### DEMO9S08LL16

\$69\*

Cost-effective demonstration kit includes the serial port and built-in USB-BDM cable for debugging and programming. This tool also has a lab that demonstrates the ultra-low-power benefits and LCD feature.

### CodeWarrior™ Development Studio for Microcontrollers v6.2

Complimentary\*\* Special Edition

CodeWarrior Development Studio for Microcontrollers is a suite of tools that supports software development for Freescale's 8-bit MCUs and 32-bit V1 ColdFire® devices. Designers can further accelerate application development with the help of Processor Expert™, an award-winning rapid application development tool integrated into the CodeWarrior tool suite.

\* Prices indicated are MSRP

\*\* Subject to license agreement

#### 9S08LL16 Block Diagram

S08 Core	LVI	I <sup>2</sup> C
Flash Size 16K	KBI	SCI
	COP	ICS
2K RAM	SPI	TOD
	Comparator	8-ch., 12-bit ADC
ICE + 08BDM	LCD Driver 8 x 24	2 x 2-ch. 16-bit Timer

#### Features, cont.

##### Peripherals

- Analog-to-digital converter (ADC)—8-channel, 12-bit resolution; 2.5 μs conversion time; automatic compare function; internal temperature sensor; internal bandgap reference channel; operation in stop mode
- Timer—two 2-channel (TPM1 and TPM2); selectable input capture, output compare, buffered-edge or center-aligned PWM on each channel
- Serial communications interface (SCI)—module offering asynchronous communications, 13-bit break option, flexible baud rate generator, double buffered transmit and receive and optional HW parity checking and generation
- Analog comparator with selectable interrupt on rising, falling or either edge of comparator output; compare option to fixed internal bandgap reference voltage; outputs can be optionally routed to TPM module; operation in stop3
- Serial peripheral interface (SPI)—one module with full-duplex or single-wire bidirectional; double-buffered transmit and receive; master or slave mode; MSB-first or LSB-first shifting
- I<sup>2</sup>C with up to 100 kbps with maximum bus loading; multi-master operation; programmable slave address; interrupt-driven byte-by-byte data transfer; supports broadcast mode and 10-bit addressing

##### Input/Output

- 38 general purpose input/output (GPIO), two output-only pins
- Eight keyboard interrupt (KBI) pins with selectable polarity

##### System Protection

- Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock
- Low-voltage detection with reset or interrupt; selectable trip points
- Illegal op code and illegal address detection with reset
- Flash block protection

##### Development Support

- Single-wire background debug interface
- Breakpoint capability
- ICE debug module containing three comparators and nine trigger modes. Eight deep FIFO for storing change-of-flow addresses and event-only data—debug module supports both tag and force breakpoints.

#### Benefits, cont.

- Having eight channels allows up to eight analog devices to be sampled at extremely high speeds
- Accuracy and full functionality guaranteed across 1.8V to 3.6V operating voltage of the MCU
- Two TPMs allow for two different time bases, with a total of twelve timer channels
- Provides standard UART communications peripheral
- Allows full-duplex, asynchronous NRZ serial communication between MCU and remote devices
- Edge interrupt can wake up MCU from low-power mode
- Requires only single pin for input signal, freeing additional pins for other use
- Allows other components in system to see result of comparator with minimal delay
- Can be used for single slope ADC and RC time constant measurements
- Allows high-speed (up to 5 Mbps) communications to other MCUs or peripherals, such as MC1319x RF transceivers
- I<sup>2</sup>C port enables increased system memory by using an additional I<sup>2</sup>C EEPROM. This also creates an opportunity to add an additional I<sup>2</sup>C device.

- Results in large number of flexible I/O pins that allow developers to easily interface devices into their own designs

- Can be used for reading input from a keypad or used as general pin interrupts

- Allows device to recognize runaway code (infinite loops) and resets processor to avoid lock-up states

- Warns the developer of voltage drops outside of the typical operating range

- Allows the device to recognize erroneous code and resets the processor to avoid lock-up states

- Prevents unintentional programming of protected flash memory, which greatly reduces the chance of losing vital system code for vendor applications

- Allows developers to use the same hardware cables between S08 and V1 ColdFire platforms

- Allows single breakpoint setting during in-circuit debugging (plus three more breakpoints in on-chip debug module)

- Provides built-in full emulation without expense of traditional emulator

## Learn More:

For current information about Freescale products and documentation, please visit [www.freescale.com/lcd](http://www.freescale.com/lcd).