MC9S08GW64
Single-phase single-chip energy meter

Overview

The MC9S08GW is a low-power 8-bit microcontroller family, based on the proven S08 core, and used in gas or water flow meters, as well as single-phase electric meters. Two independent 16-bit SAR ADCs with a programmable delay block and a pulse counter with automatic sensor decoding for gas and water flow meters make this family ideal for electric metering applications. In addition, the flexible LCD controller enables it to be highly integrated. The MC9S08GW family comes with a full suite of hardware and software tools to make development quick and easy, including a cost-effective Tower module for rapid development.

Feature list of MC9S08GW64

- 8-bit HCS08 central processor unit (CPU)
  - New, low power version of S08 core with same performance as traditional S08
  - Up to 20 MHz CPU at 3.6V to 2.1V and up to 10 MHz CPU at 2.1V to 1.8V, across a temperature range of -40°C to +85°C
  - HC08 instruction set with added BGND instruction
  - Support for up to 48 interrupt/reset sources
- On-chip memory
  - Flash read/program/erase over full operating voltage and temperature
  - Random-access memory (RAM)
  - Security circuitry to prevent unauthorized access to RAM and flash contents
- Clock source options
  - Oscillator (XOSC1): Loop-control Pierce oscillator, crystal or ceramic resonator of 32.768 kHz, dedicated clock source for iRTC and optional for ICS
  - Oscillator (XOSC2): Loop-control Pierce oscillator, crystal or ceramic resonator range of 31.25 kHz to 38.4 kHz or 1 MHz to 16 MHz, optional clock source for ICS

9S08GW 64/32 Block Diagram
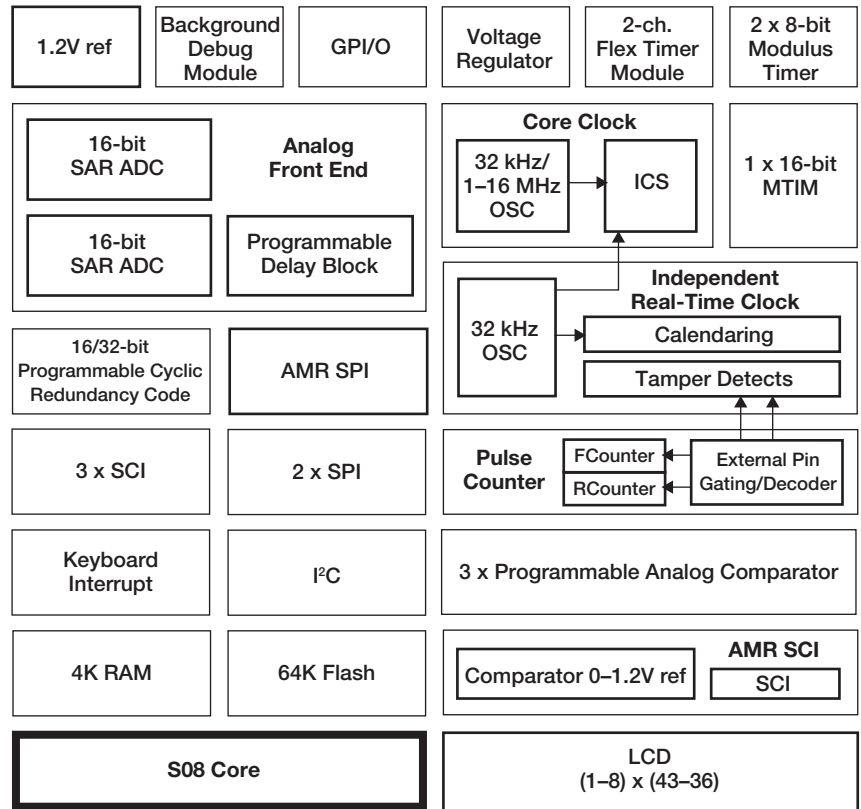
- System protection
  - Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock
  - Low-voltage warning with interrupt
  - Low-voltage detection with reset or interrupt
  - Illegal opcode and illegal address detection with reset
  - Flash block protection
- Peripherals
  - LCD: Up to 4 x 40 or 8 x 36 LCD driver with internal charge pump and option to provide an internally regulated LCD reference that can be trimmed for contrast control

- Two analog-to-digital converters (ADCs): 16-bit resolution, one dedicated differential per ADC, up to 16-ch, up to 2.5 μs conversion time for 12-bit mode, automatic compare function, hardware averaging, calibration registers, temperature sensor, internal band gap reference channel, operation in stop3, fully functional from 3.6V to 1.8V
- Three rail to rail programmable reference analog comparators (PRACMP): Up to eight inputs, on-chip programmable reference generator output, selectable interrupt on rising, falling, or either edge of comparator output, operation in stop3

- SCI: Four full duplex non-return to zero (NRZ), LIN master extended break generation, LIN slave extended break detection, wakeup on active edge, SCI0 designed for AMR operation, TxD of SCI1 and SCI2 can be modulated with timers and RxD can recieved through PRACMP
- SPI: Three full-duplex or single-wire bi-directional, double-buffered transmit and receive, master or slave mode, MSB-first or LSB-first shifting, SPI0 designed for AMR operation
- I²C: Up to 100 kbps with maximum bus loading, multi-master operation, programmable slave address, interrupt driven byte-by-byte data transfer, supporting broadcast mode and 10-bit addressing, supporting SM BUS functionality, can wake up from STOP3
- FTM: 2-channel FTMs, selectable input capture, output compare, or buffered edge- or center-aligned PWM on each channel
- Independent real-time clock (IRTC): Independent power domain, 32 bytes RAM, 32.768 kHz input clock optional output to ICS, hardware calendar, hardware compensation due to crystal or temperature characteristics, tamper detection and indicator
- 16/32-bit programmable cyclic redundancy check (PCRC): For high-speed CRC calculation
- MTIM: Two 8-bit and one 16-bit timers, configurable clock inputs and interrupt generation on overflow
- Programmable delay block: Optimized for scheduling ADC conversions
- Position counter: Working in stop3 mode without waking CPU, can be used to generate timer waveforms
- Input/output
  - 57 GPIOs including one output-only pin
  - Eight KBI interrupts with selectable polarity
  - Hysteresis and configurable pull up device on all input pins, configurable slew rate and drive strength on all output pins
- Package options
 - 80-pin LQFP, 64-pin LQFP

Overview

This reference design is suitable for energy or electricity meters which measure and display active energy (kWh) and apparent energy (kVAh). It also measures and displays voltage, current, frequency, power factor, active power (kW), reactive power (kVAr), apparent power (kVA), maximum demand in kW as well as time and date. All of the electrical parameters of the meter can be read using the optical port, which is based on the IEC62056. The meter can be calibrated and configured in different modes using the optical interface.

Design Features

- Based on MC9S08GW64
- Supports IEC 62053-21, 62053-22 and IEC 620533-23
- Shunt sensor for single phase, CT for detecting neutral missing tamper

- Box-open tamper feature built in
- Based on capacitive supply, meets 4 VA requirement
- Measures and displays the following:
  - RMS voltage (accuracy ±1% of full scale)
  - RMS currents (accuracy ±1% of full scale)
  - Net active power (accuracy ±1% of full scale)
  - Net apparent power (accuracy ±1% of full scale)
  - Power factor (accuracy ± 0.1 PF or better)
  - Line frequency (accuracy ± 0.5 Hz or better)
  - Tamper count
  - Active energy: Class 1 or better
  - Time and Date
  - Maximum demand
- Operating frequency range of 50 Hz ±3 Hz (230V, 5–30A model)
- Measurement and storage of kWh

MC9S08GW64 Single-Phase Electricity Meter Reference Design Block Diagram
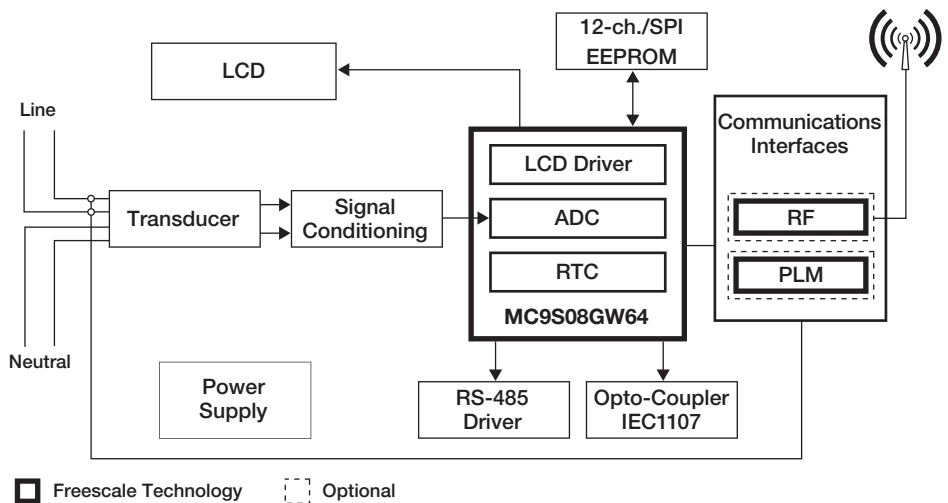
Learn More: For more information, visit **freescale.com.**

freescale™
semiconductor