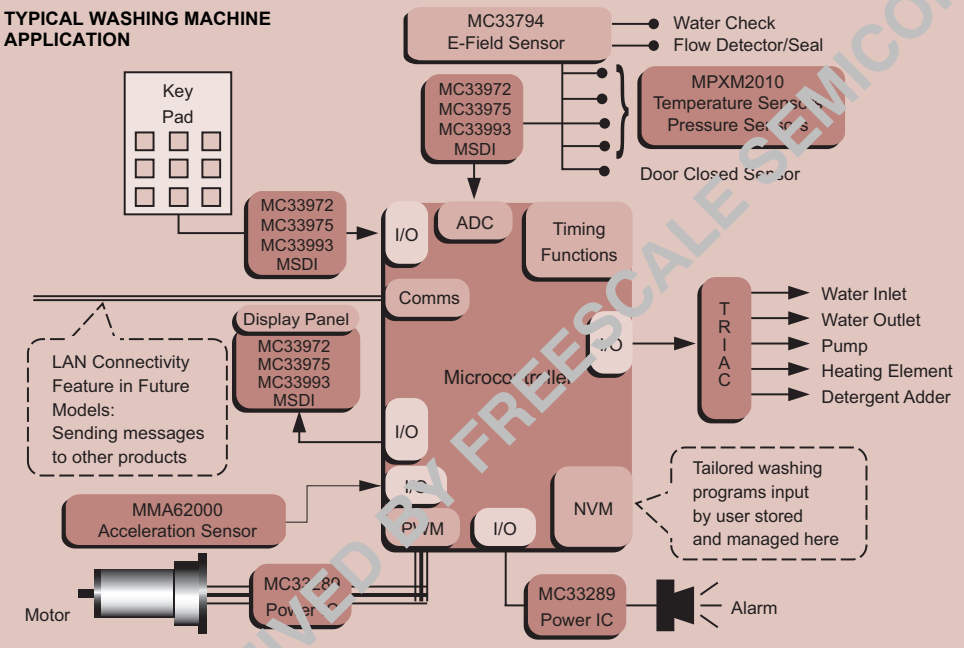
Washing Machines

Overview

Home appliance controls are changing from purely mechanical to fully electronic as microcontrollers, sensors, and analog components are incorporated into the designs. While providing intelligence, microcontrollers, sensors, and analog devices boost reliability, drive down costs, and improve energy efficiency.

Washing machines can use as many as three microcontrollers, three sensors, and three analog devices, which add intelligence for increased functionality and user control. Energy efficiency is realized using microcontrollers, sensors, and analog components for controlling the motor, reducing noise, and minimizing vibration.

TYPICAL WASHING MACHINE APPLICATION



Key Benefits

> Provides environmental-friendly designs that conserve energy and lower cost by adjusting washing time and water usage

> Enables smart features such as rinse cycle foam detection and six-stage spin speed selector

> Incorporates safety features, such as automatic out-of-balance spin protection and leak detection

> Conserves energy by efficiently controlling the heating element

> Enhances informational display functions

> Offers an in-home connection that sends washing machine progress messages to other in-home devices

> E-field sensing for torch panel interface, water detector, and water flow detection

freescale semiconductor

Freescale Ordering Information[Note]

Part Number	Product Highlights	Additional Information
DSP56F801	80 MHz, 40 MIPS, SCI, SPI, ADC, PWM, Quad Timer and 8 K Program Flash; 1 K Program RAM; 2 K Data Flash; 1 K Data RAM; MCU-Friendly Instruction Set; OnCE for Debug; On-Chip Relaxation Oscillator; 2 K BootFLASH; Up to 11 GPIO Available in a 48-Pin LQFP	www.freescale.com
DSP56F802	80 MHz, 40 MIPS, SCI, SPI, ADC, PWM, Quad Timer and 8 K Program Flash; 1 K Program RAM; 2 K Data Flash; 1 K Data RAM; MCU-Friendly Instruction Set; OnCE for Debug; On-Chip Relaxation Oscillator; 2 K BootFLASH; Up to 4 GPIO Available in a 32-Pin LQFP	
DSP56F803	80 MHz, 40 MIPS, CAN, SCI, SPI, ADC, PWM, Quad Timer and 8 K Program Flash; 1 K Program RAM; 2 K Data Flash; 1 K Data RAM; MCU-Friendly Instruction Set; OnCE for Debug; On-Chip Relaxation Oscillator; 2K BootFLASH; Up to 16 GPIO Available in a 100-Pin LQFP	
MC56F8322	60 MHz, 60 MIPS, 48 KB Flash and 12 KB RAM with 2 SPI, 2 SCI, 2 ADC, PWM, COP, PLL, Decoder, 2 Quad Timers, *FlexCAN*™; MCU-Friendly Instruction Set; Enhanced OnCE for Debug; On-Chip Relaxation Oscillator; Temperature Sensor; Industrial (-40°C to 105°C) and Extended (-40°C to 125°C) Temperature Ranges with up to 21 GPIOs in a 48-Pin LQFP	
MC56F8323	60 MHz, 60 MIPS, 48 KB Flash and 12 KB RAM with 2 SPI, 2 SCI, 2 ADC, PWM, COP, PLL, Decoder, 2 Quad Timers, *FlexCAN*™; MCU-Friendly Instruction Set; Enhanced OnCE for Debug; On-Chip Relaxation Oscillator; Temperature Sensor; Industrial (-40°C to 105°C) and Extended (-40°C to 125°C) Temperature Ranges with up to 27 GPIOs in a 64-Pin LQFP.	
MC56F801x Family	Up to 32 MHz, 32 MIPS, and up to 16KB Flash, 4 KB Unified Data/Program RAM, EEPROM emulation capability, SCI with LIN, SPI, I^2C, ADC, PWM, GPIO, COP/Watchdog, MCU-style software stack support, JTAG/OnCE for debug	
MC33289	Dual High-Side Switch for Inductive Load 2 x 40 mΩ	www.freescale.com/analog
MC33927	Three-Phase FET Pre-Driver	
MC33972	22 Input Multiple Switch Detection Interface with Suppressed Wake-Up	
MC33975	22 Input Multiple Switch Detection Interface with Higher Wetting Current	
MC33993	22 Input Multiple Switch Detection Interface	
MC68HC(9)08ABxx	ADC, SCI, SPI, EEPROM	www.freescale.com
MC68HC(9)08AZxx	ADC, SCI, SPI, CAN, EEPROM	
MC68HC(9)08GPxx	ADC, SCI, SPI	
MC68HC(9)08JKxx	ADC	
MC68HC(9)08JLxx	ADC	
MC68HC908GRxx	ADC, SCI, SPI	
MC68HC908GTxx	ADC, SCI, SPI, ICG	
MC68HC908KXxx	ADC, SPI	
MC68HC908MRxx	ADC, PWM, SCI, SPI	
MC68HC908Qxx	Low pin count, low cost	
MMA6231Q	10g, 300 Hz XY-Axis Acceleration Sensor	
MMA6233Q	10g, 300 Hz XY-Axis Acceleration Sensor	
MMA6260Q	1.5g, 50 Hz XY-Axis Acceleration Sensor	
MMA6261Q	1.5g, 300 Hz XY-Axis Acceleration Sensor	
MMA6262Q	1.5g, 150 Hz XY-Axis Acceleration Sensor	
MMA6263Q	1.5g, 900 Hz XY-Axis Acceleration Sensor	
MPXM2010	Compensated Pressure Sensor	
MPXV5004	Integrated Pressure Sensor	

Note: Search on the listed part number.

Design Challenges

Today's appliance designers face multiple challenges beyond the appliance's base functionality of:

Cost

The highly competitive, high-volume, and cost-sensitive appliance market can save thousands of dollars by eliminating just a few cents from the solution's cost.

Flexibility

New models are introduced every year and products have a relatively short life cycle. Software problems must be quickly eliminated, which requires professional development tools and faster, more efficient development cycles.

Noise

Minimum levels of noise and vibration are desirable. As consumers become busier, multiple appliances are simultaneously in use, especially at night when electricity rates are lower.

Legislation

Energy regulations combined with consumer demand for efficient appliances consuming less energy, water, and laundry products are forcing manufacturers to design their products to meet these requirements.

Measurement Accuracy

Accurately measuring washing machine water temperatures is essential to enable optimal appliance performance and to minimize energy and water usage.

Freescale Semiconductor Solution

Freescale Semiconductor is the Flash microcontroller industry leader. Flash memory is a non-volatile memory (NVM) technology that provides:

> Reduced time to market with application re-programmability
> Improved write/erase and data retention performance for Flash, which allows the user to define preferred settings
> Faster Flash memory programming and erase times
> Flexible block protection and security
> EEPROM emulation

Embedded Flash brings new design flexibility:

> Provides end-of-line customizing for regional variations in consumer demands
> Provides software-enabled intelligence to satisfy changing legislation
> Supports remote diagnostics and preventative maintenance
> Minimizes programming costs
> Increases code flexibility with production line programming
> Reduces code obsolescence, which saves on scrapped product costs
> Shortens lead times, which improves time to market
> Standardizes platforms, which reduces product variability
> Eliminates sockets and rework with in-system programmable Flash
> Provides for field upgrades and allows remote reprogramming of the microcontroller
> Eliminates the need for external EEPROM with 10,000 write/erase cycles using EEPROM emulation

Development Tools [Note]

Tool Type	Product Name	Vendor	Description	Additional Information
Software	CW568X	Freescale Semiconductor	CodeWarrior™ Development Studio for 56800/E Controllers with Processor Expert (Metrowerks)	www.freescale.com
Software	CWHC08	Metrowerks	CodeWarrior Full Package for HC08	www.metrowerks.com
Software	CWHC08ASM	Metrowerks	CodeWarrior ASM Tools for HC08	
Software	CWHC08CC	Metrowerks	Stand-Alone C/C++/cC++/EC++ Compiler for HC08	
Software	CWHC08MIG	Metrowerks	CodeWarrior Full Package for HC08 Migration	
Hardware	56F800DEMO	Freescale Semiconductor	56F800 Demonstration Kit	www.freescale.com
Hardware	68HC08 Emulators, Cables, and Adapters	Freescale Semiconductor	Emulation Modules, Flex Cables, and Target Head Adapters in Support of 68HC08 MCUs	
Hardware	68HC08 Programmers	Freescale Semiconductor	Programmer Boards in Support of 68HC08 MCUs	
Hardware	DEMO56F8013	Freescale Semiconductor	Demonstration Kit for the 56F8013	
Hardware	DEMO56F8014	Freescale Semiconductor	Demonstration Kit for the 56F8014	
Hardware	DSP56F801EVM	Freescale Semiconductor	Evaluation Kit for 56F801	
Hardware	DSP56F803EVM	Freescale Semiconductor	Evaluation Kit for 56F803	
Hardware	MC56F8300DSK	Freescale Semiconductor	56F8300 Developers Start Kit	
Hardware	MC56F8323EVM	Freescale Semiconductor	Evaluation Kit for MC56F8322 and MC56F8323	

Note: Search on the listed product name.

Development Tools (continued)[Note]

Tool Type	Product Name	Vendor	Description	Additional Information
Development	MON08 Cyclone	Freescale Semiconductor	Provides all the capabilities of the MON08 Multilink plus the ability to function as a stand-alone programmer with push buttons and LED user interface.	www.freescale.com
Development	MON08 Multilink	Freescale Semiconductor	Low-Cost Development Tool for 68HC08 Flash MCUs	
Development	In-Circuit Simulator (ICS) Kits	Freescale Semiconductor	Low-Cost Tools for Developing and Debugging Target Systems Incorporating 68HC08 MCUs	
Development	Modular Evaluation System (MMEVS) Kits	Freescale Semiconductor	Economical, Two-Board Emulator for the 68HC(9)08 MCUs	
Development	Modular Development System (MMDS) Kits	Freescale Semiconductor	Full-Featured Emulator System for Developing Embedded Systems Using 68HC(9)08 MCUs	
Reference Design	RD1950MPXM2010GS	Freescale Semiconductor	Water Level Reference Design	
Reference Design	RD1986MMA6260Q	Freescale Semiconductor	Three-Axis Acceleration Sensing Reference Design	
Evaluation Kit	KIT1925MMA6231Q	Freescale Semiconductor	10g, 300 Hz XY-Axis Evaluation Board	
Evaluation Kit	KIT1925MMA6233Q	Freescale Semiconductor	10g, 900 Hz XY-Axis Evaluation Board	
Evaluation Kit	KIT1925MMA6260Q	Freescale Semiconductor	1.5g, 50 Hz XY-Axis Evaluation Board	
Evaluation Kit	KIT1925MMA6261Q	Freescale Semiconductor	1.5g, 300 Hz XY-Axis Evaluation Board	
Evaluation Kit	KIT1925MMA6262Q	Freescale Semiconductor	1.5g, 150Hz XY-Axis Evaluation Board	
Evaluation Kit	KIT1925MMA6263Q	Freescale Semiconductor	1.5g, 900 Hz XY-Axis Evaluation Board	
Evaluation Kit	KIT33289DWEVB	Metrowerks	Automotive Dual High-Side Switch	www.metrowerks.com
Evaluation Kit	KIT33993DWBEVB	Metrowerks	22 Input Multiple Switch Detection Interface	

Note: Search on the listed product name.

Related Documentation[Note]

Document Number	Description	Additional Information
816PITCHPAK03	MCU 8- and 16-Bit Sales Binder	www.freescale.com
AN1516	Liquid Level Control Using a Freescale Semiconductor Pressure Sensor	
AN1950	Water Level Monitoring	
AN1986	Using the TRIAX Evaluation Board	
AN1988	±1.5g Dual Axis Micromachined Accelerometer Power Supply Rejection Ration (PSRR) Suggestions	
APDPAK	Analog ICs Integrated Solutions Pitch Pack	
BR68HC08FAMAM	68HC08 Family: High Performance and Flexibility	
CWDEVSTUDFACTHC08	CodeWarrior Development Studio for 68HC08, Special Edition Brochure	
FLYR30	MPX Series Pressure Sensors	
FLYREMBEDFLASH	Embedded Flash: Changing the Technology World for the Better	
SG1002	Analog Product Selector Guide	
SG1010	Sensors Product Selector Guide	

Note: Search on the listed document number.

Learn More: Contact the Technical Information Center at +1-800-521-6274 or +1-480-768-2130.
For more information about Freescale products, please visit **www.freescale.com**.

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