

Dishwashers

Overview

Home appliance controls are changing from purely mechanical to fully electronic as microcontrollers are incorporated into the designs.

The migration in the industry from mechanical to electromechanical control, then to full electronic control has been ongoing for several years.

Today, microcontrollers provide the intelligence for every electronic solution. The primary reasons driving the adoption of electronics are reliability, cost, and improved energy efficiency.

Dishwashers are among the most recent additions to the White Goods product portfolio, with market penetration increasing rapidly over the last ten years. Because of this relatively recent introduction (compared

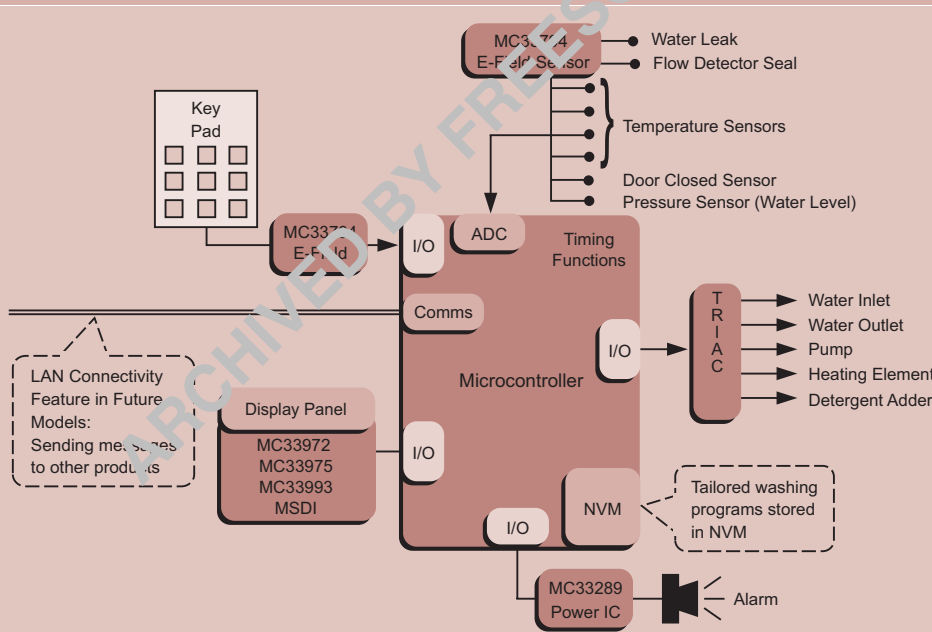
to other appliances), a high percentage of dishwashers use electronic control.

Microcontrollers enable the electronic control that provides a range of dishwasher appliance features.

Freescal's SMARTMOS™ analog portfolio provides power actuation (MC33289), sensing (MC33794), and multiple switch detect (Flexible I/O) family ICs. The MC33794 provides water level sensing. The Flexible I/O family provides a simple system power conservation solution, providing a WAKE output with which the MCU power supply can be enabled when MCU activation is required. It allows optimized switch OPEN/CLOSE status verification of multiple switches with changes immediately reported to the MCU.

Key Benefits

- > Measures water temperature, which allows efficient control of the heating element to conserve energy
- > Enhances informational display functions such as a countdown to completion of the wash
- > Provides an event control alarm
- > Offers an in-home connection that sends dishwasher machine progress messages to other in-home devices
- > Provides automatic machine startup when electricity is least expensive
- > E-Field sensing for touch panel interface, water detector, and water flow detection



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, and 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, and 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, and 1 K Data RAM; MCU-Friendly Instruction Set; OnCE for Debug; On-Chip Relaxation Oscillator; 2 K BootFLASH; Up to 16 GPIO Available in a 100-Pin LQFP	
MC33289	Dual High-Side Switch for Inductive Loads, 2 x 40 mΩ	www.freescale.com/analog
MC33794	Electric Field Imaging Device	
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	
MC56F8122	40 MHz, 40 MIPS, 40 KB Flash and 8KB RAM; 2 SPI, 2 SCI, ADC, COP, PLL, and 2 Quad Timers; MCU-Friendly Instruction Set; Enhanced OnCE for Debug; Industrial (-40°C to 105°C) with Up to 21 GPIOs in a 48-Pin LQFP	www.freescale.com
MC56F8123	40 MHz, 40 MIPS, 48 KB Flash and 8 KB RAM; 2 SPI, 2 SCI, ADC, COP, PLL, and 2 Quad Timers; MCU-Friendly Instruction Set; Enhanced OnCE for Debug; Industrial (-40°C to 105°C) with Up to 27 GPIOs in a 64-Pin LQFP	
MC56F8322	60 MHz, 60 MIPS, 48 KB Flash and 12 KB RAM; 2 SPI, 2 SCI, 2 ADC, PWM, COP, PLL, Decoder, 2 Quad Timers, and <i>FlexCAN</i> [™] ; 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; 2 SPI, 2 SCI, 2 ADC, PWM, COP, PLL, Decoder, 2 Quad Timers, and <i>FlexCAN</i> [™] ; 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 13 KB Flash; 4 KB Unified Data/Program RAM; EEPROM Emulation Capability; Support with LIN, SPI, I ² C, ADC, PWM, GPIO, COP/Watchdog, MCU-Style Software Stack Support, and JTAG/OnCE for Debug	
MC68HC(9)08ABxx	ADC, SCI, SPI, EEPROM	
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	
MC68HC908GT16	ADC, SCI, SPI, ICG	
MC68HC908KXxx	ADC, SCI	
MC68HC908MRxx	ADC, PWM, SCI, SPI	
MC68HC908Qxx	Low pin count, low cost	
MPXM2010	Compensated Pressure Sensor	
MPXV5004	Integrated Pressure Sensor	

Note: Search on the listed part number.

Design Challenges

Cost

The appliance market is highly competitive and cost sensitive. Eliminating just a few cents from the cost of a solution can save thousands of dollars in this high-volume market.

Flexibility

A new model can be introduced every year, with products having a shorter life cycle. This means software problems must be eliminated quickly, which requires professional development tools and faster, more efficient development cycles.

Noise

Having a quiet appliance is a major goal of manufacturers. As consumers become busier, more appliances are likely to be operating simultaneously, possibly even during night hours when electricity is least expensive. Therefore, minimum noise and vibration levels are desirable.

Legislation

Energy regulations and consumer demand for energy-efficient appliances are driving manufacturers to redesign their products to meet these expectations. Dishwashers are designed with two efficiency concerns, water and electricity.

Measurement Accuracy

Measuring temperatures in different interior zones of the dishwasher and the amount of water used for maximum efficiency is critical.

Freescale Semiconductor Solution

Freescale Semiconductor is the industry leader in Flash microcontrollers. Flash memory is a nonvolatile memory (NVM) technology that provides access to the following features:

- > Faster programming and erase times of the Flash memory with reprogram capability
 - > In-application programming, which reduces time to market
 - > Improved write/erase and data retention performance for Flash
 - > Flexible block protection and security
 - > Flash emulation of EEPROM
- Embedded Flash brings new flexibility to your designs:
- > Provides end-of-line customization for regional variations in consumer demands
 - > Enables changing legislation to be satisfied with software-enabled intelligence
 - > Supports remote diagnostics and preventative maintenance
- > Minimizes programming costs while increasing code flexibility with production line programming
 - > Reduces code obsolescence, which saves on scrapped product costs
 - > Improves time to market, which reduces lead times
 - > Standardizes platforms, which reduces product variability
 - > Eliminates sockets and rework with in-system programmable Flash
 - > Provides field upgrade capability while allowing remote reprogramming of the microcontroller
 - > Eliminates the need for external EEPROM with 10,000 write/erase cycles because Flash can emulate EEPROM

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	DSP56F801EVM	Freescale Semiconductor	Evaluation Module for 56F801 and 56F802	
Hardware	DSP56F803EVM	Freescale Semiconductor	Evaluation Module for 56F803	
Hardware	MC56F8300DSK	Freescale Semiconductor	56F8300 Developers Start Kit	
Hardware	MC56F8323EVM	Freescale Semiconductor	Evaluation Module for 56F8322 and 56F8323	
Hardware	DEMO56F8013	Freescale Semiconductor	Demonstration Kit for the 56F8013	
Hardware	DEMO56F8014	Freescale Semiconductor	Demonstration Kit for the 56F8014	
Evaluation Kit	KIT3209LWBEVB	Metrowerks	Automotive Dual High-Side Switch	www.metrowerks.com
Evaluation Kit	KIT3303LWBEVM	Metrowerks	Electric Field Sensing Device	
Evaluation Kit	KIT33993DWBEVB	Metrowerks	22 input Multiple Switch Detection Interface	
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	

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	
APDPAK	Analog ICs Integrated Solutions Pitch Pack	
BR68HC08FAMAM	68HC08 Family: High Performance and Flexibility	
CWDEVSTUDFACTHC08	CodeWarrior Development Studio for 68HC08, Special Edition Brochure	
FLYR30	MPXM Series Pressure Sensors	
FLYREMBEDFLASH	Embedded Flash: Changing the Technology World for the Better	
SG1002	Analog Product Selector Guide	
SG1004	Digital Signal Processors Product Selector Guide	
SG1006	Microcontrollers Product Selector Guide	
SG1010	Sensors Product Selector Guide	

Note: Search on the listed document number.

ARCHIVED BY FREESCALE SEMICONDUCTOR INC.

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.