Refrigerators and Freezers

Overview

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

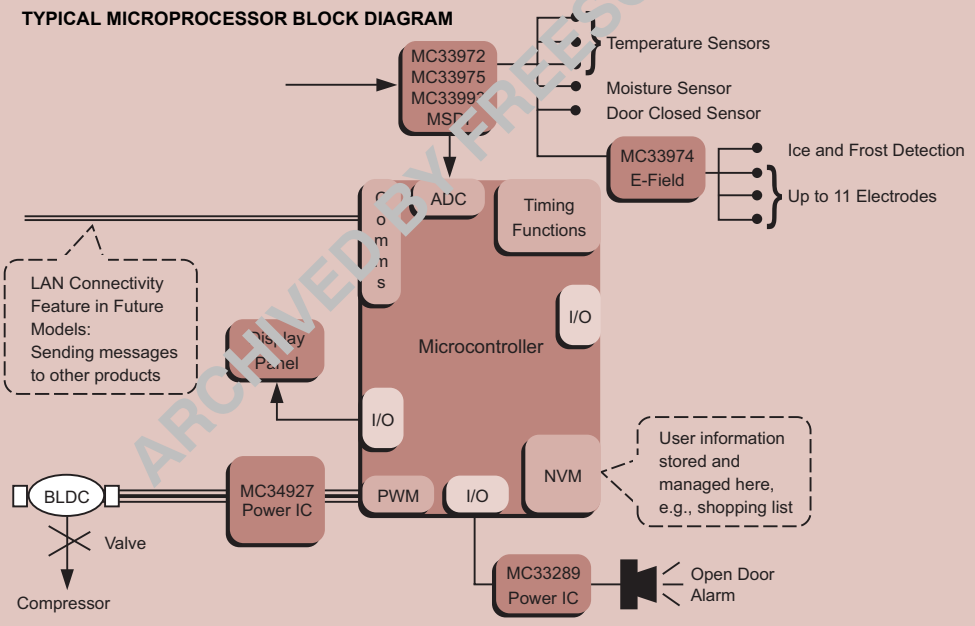
The migration in the industry from mechanical to electromechanical control, then to full electronic control has been ongoing for several years.

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

Continually operating, refrigerators account for much of the energy consumed in an average household. Any energy efficiency refinement of refrigerators can result in real savings to the consumer. Microcontrollers are crucial in maximizing appliance efficiency while supporting a variety of features.

Freescale'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.

TYPICAL MICROPROCESSOR BLOCK DIAGRAM



Key Benefits

> Provides quieter operation with improved power efficiency in refrigerators and freezers

> Improves compressor control and brushless DC motor control while improving energy

> Monitors moisture levels inside the appliance cavity

> Monitor ice and frost formation with E-Field sensing

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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	
MC34927	Three Phase FET Pre-Driver	
MC56F8122	40 MHz, 40 MIPS, 40 KB Flash, and 8 KB RAM with 2 SPI, 2 SCI, ADC, COP, PLL, 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 with 2 SPI, 2 SCI, ADC, COP, PLL, 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 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 32 KB 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	
MC68HC(9)08AZxx	ADC, SCI, SPI, CAN, EE/FROM	
MC68HC908MRxx	ADC, PWM, SCI, SPI	
MC68HC(9)08ABxx	ADC, SCI, SPI, EEPROM	
MC68HC(9)08GPxx	ADC, SCI, SPI	
MC68HC(9)08GTxx	ADC, SCI, SPI, ICG	
MC68HC908GRxx	ADC, SCI, SPI	
MC68HC(9)08JLxx	ADC	
MC68HC(9)08JKxx	ADC	
MC68HC908KXxx	ADC, SCI	
MC68HC908Qxx	Low Pin Count, Low Cost	

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 while recent products are displayed. This means software problems must be eliminated quickly, which requires professional development tools and faster, more efficient development cycles.

Legislation
Energy efficiency regulations are driving manufacturers to redesign their products to meet global legislative demands.

Measurement Accuracy
Measuring temperatures in different interior zones of the refrigerator and freezer is critical to its performance. For example, the vegetable drawer should be a different temperature than the dairy shelf.

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
- Emulation of EEPROM by Flash

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 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	DEMO56F8013	Freescale Semiconductor	Demonstration Kit for the 56F8013	
Hardware	DEMO56F8014	Freescale Semiconductor	Demonstration Kit for the 56F8014	
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	
Evaluation Kit	KIT33289DWEVB	Metrowerks	Automotive Dual High-Side Switch	www.metrowerks.com
Evaluation Kit	KIT33794DWEVM	Metrowerks	Electric Field Sensing Device	
Evaluation Kit	KIT33994DWLEVB	Metrowerks	22 Input Multiple Switch Detection Interface	
Development	In-Circuit Simulator (ICS) Kits	Freescale Semiconductor	Low-Cost Tools for Developing and Debugging Target Systems Incorporating 68HC08 MCUs	www.freescale.com
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	
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.	
Development	MON08 Multilink	Freescale Semiconductor	Low-Cost Development Tool for 68HC08 Flash 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
APDPAK	Analog ICs Integrated Solutions Pitch Pack	
BR68HC08FAMAM	68HC08 Family: High Performance and Flexibility	
CWDEVSTUDFACTHC08	CodeWarrior Development Studio for 68HC08, Special Edition Brochure	
FLYREMBEDFLASH	Embedded Flash: Changing the Technology World for the Better	
SG1002	Analog 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**.

SG2038
REV 4
6/2005

June2005