

32-bit Microcontrollers

## ColdFire MCF51AG128

Meeting the performance needs of large appliance and industrial applications

### Overview

The MCF51AG128 expands the 32-bit ColdFire microcontroller portfolio by offering products with DMA and iEvent modules to handle data transaction and interrupt management, thereby off-loading CPU overhead and increasing overall performance.

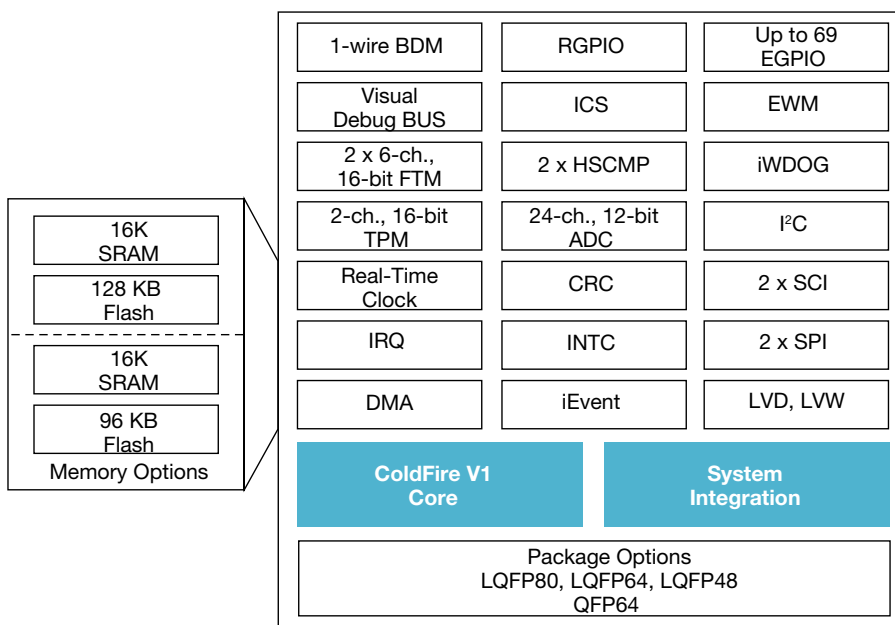
The peripheral set is aligned to the needs of 3-phase motor control applications, including two 16-bit FlexTimers, high-speed analog comparators, a 2-ch., 16-bit PWM timer, a programmable delay block and a 24-ch., 12-bit ADC with PWM hardware triggering.

Also included is functionality important for system safety and integrity, such as an advanced independently clocked COP, external watchdog monitor and a cyclic redundancy check (CRC) engine providing CLK failure protection and memory content validation for applications covered by regulations such as IEC60730.

### Target Applications

- Room air conditioner
- Washing machine
- Dishwasher
- Refrigeration
- Microwave ovens
- Industrial drives/pumps
- Fans/compressors

### MCF51AG128 Block Diagram



Freescale Technology

**freescale**  
semiconductor  
**ColdFire**

## Development Tools Hardware

TWR-MCF51AG

TWR-MCF51AG-KIT

The MCF51AG128 evaluation and demonstration board can be purchased individually or as part of a complete kit for quick and easy development.

- TWR-MCF51AG features the MCF51AG128 MCU in an 80-pin LQFP package
- TWR-MCF51AG-KIT, which includes the TWR-MCF51AG development board and TWR-PROTO, TWR-ELEV elevator boards that connect the MCU and prototype board boards. It also contains interactive DVD complete with tools, software, lab supplements and other helpful resources.

## Software

CodeWarrior Development Studio for Microcontrollers V6.3, Complimentary Special Edition supports software development for Freescale's 8-bit and 32-bit ColdFire V1 MCU devices. Full-featured IDE with editor, C compiler, flash programmer, assembler, linker and source-level debugger. Includes Processor Expert graphical-based automatic C code generator for rapid application development.

Innovative solutions for advanced human-machine interface (HMI) functionality enabled by Xtrinsic touch-sensing software and eGUI software ideal for low-end graphical user interfaces.

## Freescale's MQX™ Software Solution (complimentary)

Leveraging 15 years in the market, Freescale MQX has been providing powerful real-time performance within a small, configurable footprint in over a million Freescale-enabled products. Freescale MQX,

a component-based architecture, provides scalability and reduces overhead by allowing developers to choose only those components required for their applications. MQX ported to AG128 with priority drivers for the BSP supporting DMA, iEvent and DMA enabled.

Features	Benefits
<ul style="list-style-type: none"> <li>• CPU—32-bit ColdFire V1 CPU               <ul style="list-style-type: none"> <li>○ High-performance 50 MHz CPU</li> <li>○ 5.5V to 2.7V operating range</li> <li>○ -40°C to +105°C temperature range</li> </ul> </li> <li>• DMA—Four independent DMA channels, each with selectable peripheral source requests and each channel can be used to initiate another channel transfer</li> <li>• iEvent Module—Provides a mechanism to manage CPU interrupts or DMA transfers or triggers to other peripherals</li> </ul>	<ul style="list-style-type: none"> <li>• Provides high performance across a wide range of operating voltages and temperatures</li> <li>• DMA and iEvent module combine to handle data transaction and interrupt management, thereby off-loading CPU overhead and increasing overall performance.</li> </ul>
<b>On-Chip Memory</b> <ul style="list-style-type: none"> <li>• Up to 128 KB flash, read/program/erase over full operating voltage and temperature.</li> <li>• Up to 16 KB RAM</li> </ul>	<ul style="list-style-type: none"> <li>• Allows the user to take full advantage of in-application re-programmability benefits in any environment</li> <li>• Excellent flash to RAM ratio</li> <li>• Security circuitry to prevent unauthorized access to RAM and flash contents</li> </ul>
<ul style="list-style-type: none"> <li>• Analog to Digital Converter—24 analog inputs with 12-bit resolution</li> <li>• Programmable Delay Block—16-bit resolution with prescaler</li> <li>• HSCMP—Two analog comparators with selectable interrupt, programmable voltage reference from two internal DACs</li> </ul>	<ul style="list-style-type: none"> <li>• Fast, easy conversion from analog inputs, such as temperature, pressure and fluid levels, to digital values. Hardware trigger from PWM or PDB, allowing high-resolution conversions at any point in the PWM cycle with no additional CPU overhead.</li> <li>• Work with timers to capture back EMF zero crossing events to provide accurate rotor position timing. Enables motor to run smoothly across a wide speed range with no speed jittering, increasing efficiency and reducing noise and mechanical wear.</li> </ul>
<ul style="list-style-type: none"> <li>• Two 6-ch., 16-bit flexible timer/PWM modules with DMA request option, dead time insertion is available for each complementary channel pair, channels operate as pairs with equal outputs, pairs with complementary outputs or independent channels (with independent outputs)</li> <li>• TPM—16-bit timer with two channels (input capture, output compare or edge-aligned PWM)</li> </ul>	<ul style="list-style-type: none"> <li>• Increased precision and reduced system cost. 16-bit PWM with emergency over-current shutdown protection. High PWM frequency reduces size/cost of external components in SMPS and PF correction applications (e.g. passive filters).</li> </ul>
<ul style="list-style-type: none"> <li>• Serial Communications—Two serial communications interface modules, two serial peripheral interfaces and one I<sup>2</sup>C module</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple communication interfaces for simple and efficient data exchange</li> </ul>
<ul style="list-style-type: none"> <li>• System Safety and Integrity Functionality—Advanced independently clocked COP, external watchdog monitor and cyclic redundancy Check generator</li> </ul>	<ul style="list-style-type: none"> <li>• Clock failure protection and memory content validation</li> <li>• System integrity for safety-critical applications implementing IEC60730 safety standards</li> </ul>

Part Number	DMA	iEvent	Flash	RAM	CRC	ADC	HSCMP	DAC	PDB	Flex Timer	Timer	Watchdog	EWM	I <sup>2</sup> C	SPI	SCI	ICS	XOSC	RTC	GPIO	RGPIO	Package	Temp
MCF51AG128CLK	4-ch.	Yes	128k	16k	Yes	24-ch., 12-bit	2	2	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	Yes	2	2	Yes	Yes	Yes	69	16	80 LQFP (14x14)	-40°C to +85°C
MCF51AG128CLH	4-ch.	Yes	128k	16k	Yes	19-ch., 12-bit	2	2	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	Yes	1	2	Yes	Yes	Yes	53	16	64 LQFP (10x10)	-40°C to +85°C
MCF51AG128CQH	4-ch.	Yes	128k	16k	Yes	19-ch., 12-bit	2	2	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	Yes	1	2	Yes	Yes	Yes	53	16	64 QFP (14x14)	-40°C to +85°C
MCF51AG128CLF	4-ch.	Yes	128k	16k	Yes	12-ch., 12-bit	1	1	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	No	1	2	Yes	Yes	Yes	39	15	48 LQFP (7x7)	-40°C to +85°C
MCF51AG96CLK	4-ch.	Yes	96k	16k	Yes	24-ch., 12-bit	2	2	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	Yes	2	2	Yes	Yes	Yes	69	16	80 LQFP (12x12)	-40°C to +85°C
MCF51AG96CLH	4-ch.	Yes	96k	16k	Yes	19-ch., 12-bit	2	2	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	Yes	1	2	Yes	Yes	Yes	53	16	64 LQFP (10x10)	-40°C to +85°C
MCF51AG96CQH	4-ch.	Yes	96k	16k	Yes	19-ch., 12-bit	2	2	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	Yes	1	2	Yes	Yes	Yes	53	16	64 QFP (14x14)	-40°C to +85°C
MCF51AG96CLF	4-ch.	Yes	96k	16k	Yes	12-ch., 12-bit	1	1	Yes	2 x 6-ch., 16-bit	1 x 2-ch., 16-bit	Yes	Yes	No	1	2	Yes	Yes	Yes	39	15	48 LQFP (7x7)	-40°C to +85°C

\* Note: V temp part numbers also available, supporting temp range of -40°C to +105°C

**Learn More:** To learn more about the MCF51AG128, the Tower System and other Freescale appliance products, please visit [freescale.com/MCF51AG](http://freescale.com/MCF51AG), [freescale.com/Tower](http://freescale.com/Tower) or [freescale.com/appliance](http://freescale.com/appliance).