



# Power Architecture™ Technology

## An Industrial Superpower



### Overview

Power Architecture™ technology surrounds you with high-performance processors that enhance your daily life. Networks and telecommunications systems use these highly integrated devices to transfer countless e-mails, voice conversations and music downloads. Most of the cars parked outside your door use Power Architecture technology to control power trains, safety systems and in-dash equipment. Jumbo jets, airport traffic control and unmanned defense systems use it for reliable operation under the harshest conditions imaginable. Banks trust this technology with your money, and hospitals trust it with your life. Appearing in hundreds of diverse industrial applications ranging from factory automation to commercial robotics, Power Architecture technology is the industrial superpower.

Power Architecture technology was designed from the ground up for scalability and adaptability in a wide range of applications. Its minimal silicon requirements enable high levels of integration, making it possible to pack multiple peripheral functions on a single chip with low power consumption and heat dissipation. Since its launch in 1994, this architecture has matured and advanced into practically every market where efficient, flexible and highly integrated high-performance processors are needed.

Once you design a system using Power Architecture, your software is highly portable to a vast ecosystem of other related products. Visit [www.Power.org](http://www.Power.org) to see how many well-known vendors support this amazing architecture.

This software portability is especially true for Freescale products, with devices ranging from \$5 to \$1000, 500 mW to 50 watt and with high feature integration and performance up to 8400 MIPS in a single device.

These Freescale products are supported by Code Warrior® tools as well as tools from Green Hills, Wind River and other vendors. In addition, Freescale processors built on Power Architecture technology are supported by Linux® and real-time operating systems from Wind River, MontaVista, QNX, TimeSys and many others. Power Architecture products help solve all your industrial challenges with minimal system cost, power and effort.

## Power Architecture Platform

Freescale's portfolio of products, built on Power Architecture technology, ranges from very high-performance processors based on the e600 core, found in high-end general-purpose computing applications, to high-precision microcontrollers for motor control—and everything in between. Power Architecture technology is designed for scalability and software compatibility across generations and sub-families to help simplify customer migration and reduce costs. Multiprotocol support and connectivity to a wide variety of interfaces increases versatility. For example, the MPC5200, built on Power Architecture technology, which was originally designed for applications such as automotive driver information and rear-seat entertainment systems, has become important in several industrial applications because it offers a wide variety of interfaces, including Ethernet, USB, CAN and several serial channels.

Freescale's PowerQUICC™ processors, built on Power Architecture technology, offer several particularly important attributes for industrial applications, including:

- Pin-for-pin compatibility for ease of migration
- Ability to run industrial protocols including ProfitNet, Ethernet/IP, Ethernet Powerlink and IEEE® 1588
- Multiprotocol support
- Floating point precision; up to 1 teraFLOPS of processing power
- Ethernet controllers integrated across the range
- On-chip 10/100/1000 Ethernet controllers—some are programmable
- On-chip interconnect interfaces and memory controllers with ECC protection often eliminate the need for external bridge chips
- Low heat dissipation (some are <1W or <2W) and extended temperature range (-40°C to +105°C) for fanless operation
- Long-term product life cycles
- An extensive third-party ecosystem, including Linux OS support

## MPC500/MPC5200

The MPC500/MPC5200 processors, built on Power Architecture technology, combine low power, high performance and a broad range of input/output (I/O) in a single, cost-effective package.

Based on the 603e core, the 400 MHz MPC5200 processor has the performance needed to handle a number of simultaneous tasks. Originally designed for the mobileGT® platform, the MPC5200 has since proven valuable in industrial applications including instrumentation, industrial control, video detection/analysis and others requiring Ethernet, USB, CAN, PCI, ATA, Serial, I<sup>2</sup>S or I<sup>2</sup>C.

The cost-effective MPC5200 delivers 760 MIPS with a floating point unit (FPU) while consuming fewer than 850 milliwatts of power. It is packed with I/O, designed for fast data throughput and processing and supports double data rate (DDR) memory and an integrated BestComm DMA controller.

## The e300 Core and the PowerQUICC II Pro

The e300 core is the foundation of Freescale's PowerQUICC II Pro communications processor family. It scales from 266 MHz to 667 MHz. As an enhanced version of the 603e core used in previous-generation PowerQUICC II processors, it is fully software-compatible with products based on the 603e core. Enhancements include twice as much L1 cache (32 KB data cache and a 32 KB instruction cache), integrated parity-checking and other performance-oriented features.

The PowerQUICC II Pro MPC8349E processors are the first PowerQUICC II chips built with a system-on-chip (SoC) architecture for increased design versatility. In addition to the e300 core, these chips include advanced features such as DDR memory, dual Gigabit Ethernet, dual PCI and high-speed USB controllers.

The MPC8349E PowerQUICC II Pro family is designed to provide a cost-effective, highly integrated control processing solution. Among its target applications are network storage, industrial control equipment, copiers,

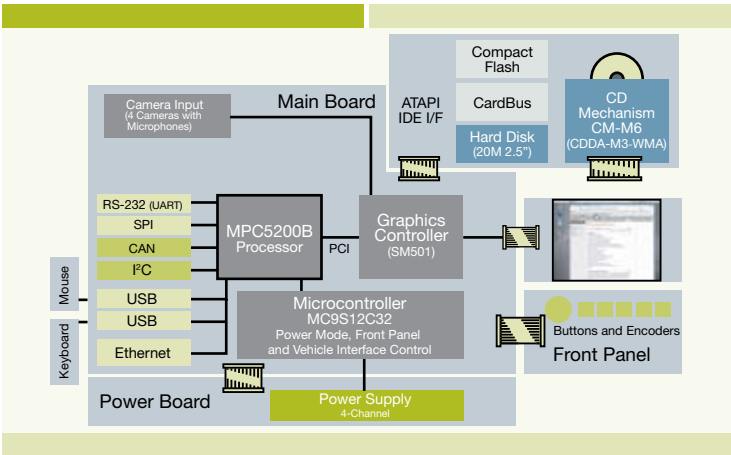
printers and other imaging systems. The e500 core and PowerQUICC III communications processors are based on 90 nm silicon-on-insulator (SOI) copper interconnect process technology, and the e500 core and e500 platform power Freescale's award-winning PowerQUICC III communications processors. Freescale currently offers the e500 at up to 1 GHz and plans to offer e500-based products that exceed 1.5 GHz. The e500 core delivers flexibility for application-specific optimizations and uses application processing units (APUs) for instruction set extensions. It is designed to be highly configurable and meet the specific needs of the embedded market, enabling SoC solutions with an optimal balance of performance, features and power consumption.

A member of the PowerQUICC III family, the MPC8543E general-purpose control processor features a 256 KB L2 cache, 64-bit DDR1/2 scaling up to a 400 MHz data rate, 32-bit PCI, 4-bit Serial RapidIO® interconnect technology or 4-bit PCI Express® and two Gigabit Ethernet interfaces. With clock frequencies scaling from 800 MHz to 1 GHz, this cost-effective device is ideally suited for a

wide range of general-purpose embedded control applications such as robotics, discrete manufacturing and process manufacturing control.

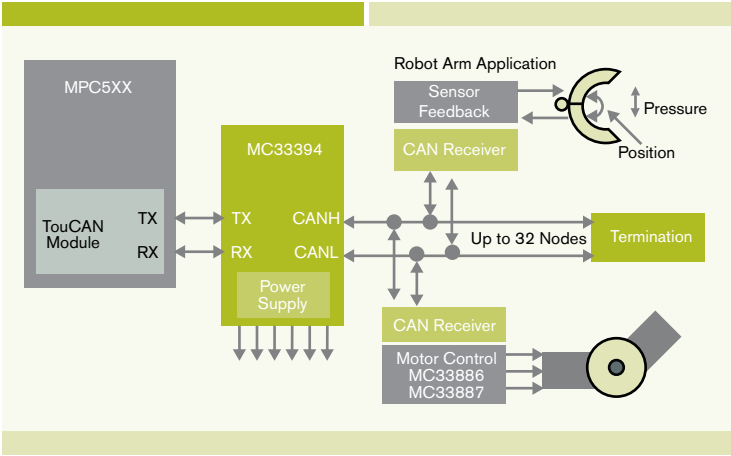
## At the High End: the e600 Core

The superscalar e600 core issues four instructions per clock cycle (three instructions plus one branch) into 11 independent execution units, and includes a full 128-bit implementation and the advanced AltiVec™ single instruction multiple data (SIMD) vector processing technology, which is used for high-performance image and signal processing. The flexible MPC7448 processor, built on the e600 core, is designed to offer extensive compute efficiency combined with world-class power management, speeds from 600 MHz to 1.7 GHz and a system bus that runs up to 200 MHz. It operates at less than 10 watts—highly advantageous for systems that require fanless operation. The MPC7448 power management features also include nap and sleep modes and introduces dynamic frequency switching that permits software to reduce power “on the fly.”



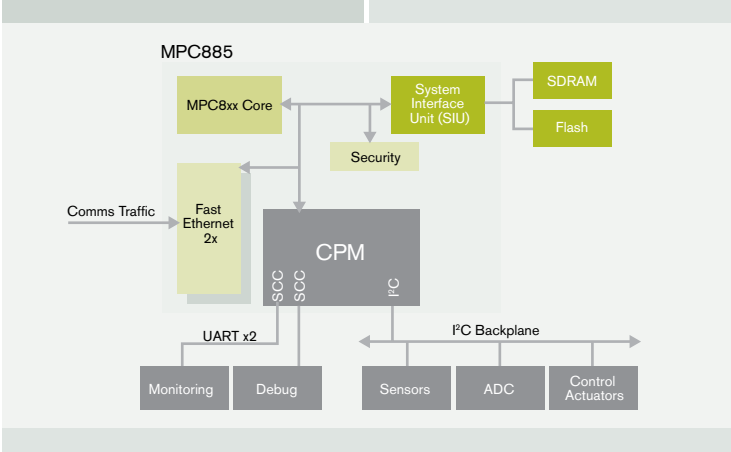
### General Industrial Control System

This block diagram shows a typical industrial control system using the MPC5200 as the central control processor. It can enable a complete multimedia industrial system with graphics and audio control. There are a variety of serial interfaces (UART for RS-232, CAN, USB for keyboard/ mouse input, Ethernet, SPI) and an on-board ATA controller to provide connectivity to a CD-ROM/hard-disk drive.



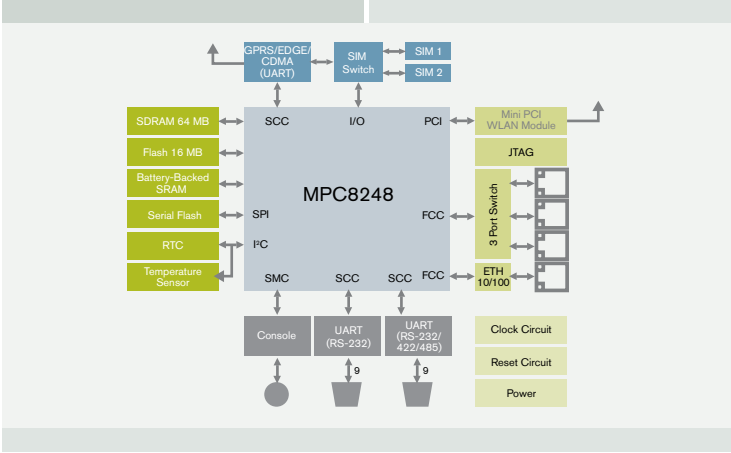
### Robotic Arm/MPC500 Processor

Design challenges for the robotics industry include boundary control, strength of movement and interaction between dual robotic arms. Boundary control and strength control can be assisted by queued analog-to-digital converter (QADC) modules. Interaction between dual robotic arms can be assisted by the timer processor unit (TPU) modules. TouCAN modules assist in timely communication between controls. MPC500 devices are available with two or three TouCAN modules to send control signals to CAN drivers (one for each TouCAN module). A CAN 2.0B protocol is used for communication between two lines. Each CAN driver can drive up to 32 nodes. The nodes independently deliver control commands to motors or actuators or send and receive sensor information about the robot or the surrounding environment.



### MPC885 Processing Plant System

MPC885 forms the controller in a small rack of remote-based equipment. Communications comes via Ethernet and uses an encryption block because the communications data needs to be secure. A number of cards, each based on a cost-effective MCU, provide sensors, A to Ds and control actuators. These cards are linked via an I2C backplane running back to the MPC885. Additionally, the MPC885 provides UART terminals for monitoring and debugging. The MPC885 also has boot flash and SDRAM connected to it.



### Industrial Ethernet and Wireless Networking

Industrial networking is rapidly taking advantage of Ethernet cost benefits. This requires bridging between Ethernet and older serial communication protocols. The PowerQUICC II family of communications processors provides an outstanding integrated solution to meet this requirement at a very attractive cost. For example, this block diagram shows the MPC8248 providing connectivity between mature industrial networks and more modern wireless networks. The MPC8248 processor is able to connect to Ethernet, WLAN, GSM/GPRS as well as slower serial communications such as RS-232 and RS-485. These tasks are distributed within the architecture between the communications processor module (CPM) and the processor core to provide high performance with lower clock frequencies, resulting in less power dissipation.



### Consistency, Compatibility, Simplicity

Even after enormous leaps in technology, performance and capabilities, processors built on Power Architecture technology remain compatible and well-defined from generation to generation. The architecture has been consistent from the first PowerQUICC communications processors to the latest PowerQUICC III processors. This continuity offers tremendous advantages to PowerQUICC processor customers, as they can rest assured that their investments in PowerQUICC processors are backward- and forward-compatible with minimal development investment.

### A Comprehensive and Thriving Ecosystem

When it comes to developing solutions for our customers, Freescale often joins forces with other industry leaders. Over the years, a large and thriving product development ecosystem has evolved to support the application needs of Freescale's customers. Power Architecture technology has broad software application support, and Freescale's strong alliances with leading software vendors help ensure that software is available when the processor is available. Linux OS offerings for Freescale products built on Power Architecture span a full range of technologies from symmetric multiprocessing and enterprise through high availability, including Carrier Grade Linux, combined with tools, such as CodeWarrior development tools from Freescale. Most Freescale processors are supported by well-known embedded Linux OS providers such as MontaVista, TimeSys and Wind River. In addition, Freescale cooperates with Linux developers from the open source community to enable support for additional platforms that are built on Power Architecture technology.

Many protocol vendors, such as IXXAT and IndusRad, test their latest versions of industrial protocols, such as IEEE® 1588, on the latest Freescale processors to ensure they run on PowerQUICC and other devices out-of-the-box. Free protocol software downloads are often available to allow customers to observe performance and processor utilization to help them select the optimal combination of processor and protocol software. To streamline development tool selection, Freescale offers options in its tools library and on product summary pages. Key solutions from chosen partners appear for resale through the Buy Direct online development tools program. To learn more about the Buy Direct online program, please visit [www.freescale.com/buydirect](http://www.freescale.com/buydirect).

### Commercially Available Computer Boards

There is a strong and consistent trend in the electronics industry for standardization and modularization of designs. Ever-decreasing design cycle times and limited skills resources force equipment manufacturers to find better and faster routes to bring their new products to market. Standard, commercially available processor boards are an answer for many such design headaches. Freescale is addressing this challenge with processor boards that apply to a wide range of application areas, ranging from ruggedized boards designed for extreme aerospace, automotive, industrial and military environments, as well as providing massive computing power for health care applications. These boards come in a variety of form factors that scale from the well-established VME to the latest Advanced Mezzanine Card and computer-on-module. Freescale is also participating in the Power.org™ community, which drives open specifications and standards that address many levels of system design.

#### Industrial

- Factory automation
- Machine vision for inspection
- Industrial networking
- Test and measurement
- Power system management and protection

#### Aerospace and Defense

- Automated vehicle control
- Terrain awareness system
- Tracking system and radar control
- Video and radar processing
- Graphical heads-up and cockpit display

#### Imaging

- Video conferencing
- Graphics acceleration
- Image processing
- Bar code recognition

#### Printing

- Multifunction printer
- High-end digital copier
- Large format printer

#### Health Care

- CAT/MRI scanning
- Patient monitors
- Diagnostics and monitoring

### Learn More:

For current information about Freescale products and documentation, please visit [www.freescale.com](http://www.freescale.com).



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