PowerPC 460EX
Embedded Processor

With speeds of up to 1.0 GHz, support for floating-point operations, USB 2.0, PCI-Express, SATA, Gigabit Ethernet, security, NAND Flash interfaces and low power dissipation, the PowerPC 460EX embedded processor is ideally suited to a wide range of high-performance applications, including imaging, storage (NAS), and networking.

Benefits

- Delivers 600 MHz to 1.0 GHz performance (CPU)
- 32-KB Instruction and Data Caches
- 256-KB L2 Cache with parity protection, may also be used as on-chip SRAM
- 64-KB On Chip Memory
- DDR1/2 memory support
- Single/double-precision floating point unit for math-intensive applications
- Two PCI-Express interfaces
- SATA controller
- 10/100/1000 Mbit/s Ethernet support
- Security (optional)
- NAND Flash support
- Extensive connectivity by means of on-chip Ethernet, USB, UARTs, IIC, SPI and PCI
- Offers low power dissipation and small form factor for high-density and power-conscious applications

The PowerPC 440 Core

To enhance overall throughput, the PowerPC 440 superscalar core incorporates a 7-stage pipeline and executes up to two instructions per cycle. Its large 32-KB data cache and 32-KB instruction cache are 64-way set-associative. Versatile configurations enhance performance tuning while optional parity protection preserves data integrity. For additional system performance, the PowerPC 440 core includes dynamic branch prediction and 24 multiply accumulate instructions (MAC) that can be used for signal processing or other numerical tasks, as well as non-blocking caches that can be managed in either write-through or write-back mode.

High Performance FPU

In addition to its powerful 440 core, the PowerPC 460EX includes a high-performance FPU. This superscalar FPU supports both single and double precision operations, and offers single cycle throughput on most instructions. The result is exceptional performance in imaging and other calculation intensive applications.

Turbo Security (Optional)

The PPC460EX delivers advanced security capabilities with the optional Turbo Security Engine. This security engine attaches directly to the PLB4 bus for the fastest possible throughput between the PPC440 processor, memory, and the security engine itself. The Turbo Security engines supports DES, 3DES, AES, ARC-4 encryption, MD-5, SHA-1 and SHA-256 hashing. The security engine includes a pseudo random number generator as well as header and trailer protocol processor. The header/trailer protocol processor eliminate any need for security processing by the PPC440 processor, freeing it to handle application-based operations, while improving overall security performance. The engine incorporates an on-chip true random number generator and a public key accelerator. The algorithms are compliant with FIPS-140-2 and ANSI X9.17 Annex C.

High-Bandwidth Bus Architecture

The PowerPC 460EX 128-bit processor local bus (PLB) provides a two-way crossbar, with a separate 128-bit read and 128-bit write data bus for each way. The four 128-bit data buses may operate concurrently, providing up to 12.8 GBs/s of peak on-chip bandwidth at 200 MHz. The SDRAM controller attaches to both PLB slave segments to provide optimal access to memory from any other peripheral/core. Lower bandwidth I/O devices are supported by the on-chip peripheral bus (OPB).

Extensive Memory Support

An on-chip double data rate 1/2 (DDR1/2) SDRAM controller provides a 32/64-bit memory interface with optional error checking and correcting (ECC). It supports four memory banks of up to 2 GBs each, for a maximum capacity of 8 GBs. An integrated NAND Flash controller allows up to four banks of Flash memory devices to be connected to the processor's external peripheral bus. The Flash controller supports device densities up to 256 Mbytes. It can also interface to an optional SmartMedia card interface. Theses devices can be accessed much like diskette drives, with available boot capability.

On-Chip Memory

The PowerPC 460EX offers 64 KB of on-chip memory.

PCI Express and PCI Interfaces

The 460EX offers two independent PCI-Express interfaces compliant with PCI-Express base specification 1.1. One interface has four lanes and supports x4 or x1 configurations. The other interface has one lane. Both interfaces can be configured as root or end point ports. In addition, the 460EX offers a 32-bit PCI V2.2 interface and supports frequencies of up to 66 MHz. Multiple read prefetch and write post buffers enhance throughput, while the ability to boot the processor from PCI bus memory increases functionality.

SATA

The 460EX offers an on-chip one port SATA controller. Fully compliant with Serial ATA II specifications, the SATA controller supports both 1.5 Gb/s and 3.0 Gb/s.

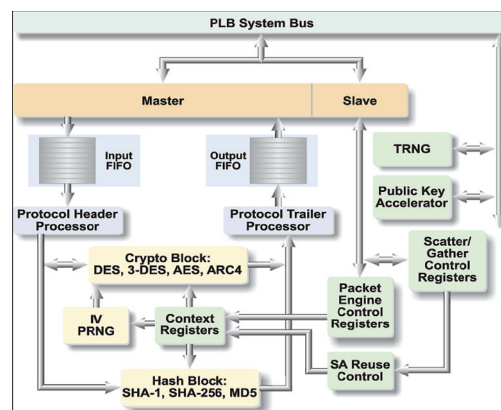## Dual Ethernets with QoS and TCP/IP Acceleration Hardware

For extensive connectivity options, the 460EX offers two integrated 10/100/1000 Ethernet ports with TCP/IP Acceleration Hardware, QoS and Jumbo Frame support. Supports GMII/MII, RGMII, and SGMII interfaces.

USB Interface

The 460EX includes USB 2.0 host and OTG controllers able to operate at 1.5, 12, and 480 Mbps.

External Bus Interface

To accommodate connectivity with other devices, the PowerPC 460EX offers a 32-bit bus supporting up to six ROM, RAM or slave peripheral I/O devices and speeds up to 100 MHz. The 4-Channel DMA is also supported.

Turbo Security Engine Block Diagram

BUILT ON Power

PowerPC 460EX

Standard Peripherals

The PowerPC 460EX offers support for up to 64 general-purpose I/O (GPIO) and two IIC controllers. A serial peripheral interface (SPI), also referred to as a serial communications port (SCP), allows full-duplex, synchronous data exchanges with other serial devices. The 460EX also supports up to four UARTs in a variety of configurations. A JTAG interface is provided for debugging purposes.

PowerPC Partners Ecosystem

AMCC's embedded PowerPC processors are supported by an extensive ecosystem of products and services from a wide range of leading suppliers. AMCC's PowerPC Partners program includes industry standard providers of:
- Embedded operating systems
- Hardware and software development tools
- Embedded software products and services
- Board-level products
- System design services
- Technical training.

For full details of the products and services available through the PowerPC Partners program, or to browse support available for a specific processor, visit: **http://www.amcc.com/Embedded/Partners**
AMCC also provides an evaluation kit for this PowerPC processor, including an optimized evaluation board as well as sample applications and other software.

Features
- CPU Speed (frequency): 600 MHz to 1.0 GHz
- Performance: 2.0 DMIPS/MHz (2,000 DMIPS @ 1.0 GHz peak)
- 32-KB-I/32-KB-D L1 caches, and 256-KB L2/SRAM with parity protection
- 64KB On Chip Memory
- On-chip double data rate 1/2 (DDR1/2) SDRAM controller with 32/64-bit interface
  – Support for four banks of DDR SDRAM memory of up to 2 GB each, maximum capacity of 8 GBs with CAS latencies of 2, 3, 4, 5, 6, and 7
- Two PCI-Express interfaces, one with four lanes and one with one lane; 2.5-Gbit/s full duplex per lane; compliant with PCI-Express base specification 1.1; configurable as root or end point
- 32-bit PCI V2.2, 3.3-V interface supporting frequencies of up to 66 MHz
- One port SATA controller operating at up to 3.0Gb/s. Compliant with Serial ATA II specifications
- 5-stage FPU with 2.0 MFLOPS/MHz (SP/DP); hardware support for IEEE 754; single-precision and double-precision operation with thirty-two 64-bit floating-point registers
- On-chip IPSec/SSL acceleration (optional)
- NAND Flash controller. Supports one to four banks of NAND Flash memory devices; direct interfacing to discrete NAND Flash devices (up to four devices) and Smart-Media Card socket (22-pins); 4-Mbyte - 256-Mbyte devices sizes supported; 512-byte +16-byte or 2-KB + 64-byte device page sizes supported; DMA support allows direct, no processor-intervention block copy from NAND Flash out to SDRAM; boot-from-NAND supported
- 4-channel DMA - available for internal and external use
  – Support for memory-to-memory, peripheral-to-memory, and memory-to-peripheral transfers
  – Scatter/gather capability
- 1-channel high performance DMA for internal use
- USB 2.0 OTG controller and USB 2.0 Host controller operating at 1.5 Mbps, 12 Mbps, and 480 Mbps
- (2) Ethernet 10/100/1000-Mbit/s, full-duplex MACs with TCP/IP Acceleration Hardware, QoS, and Jumbo Frame support, supporting GMII/MII, RGMII, and SGMII interfaces. Memory access layer (MAL) provides DMA capability to both Ethernet channels
- Up to 100 MHz, 27-bit address bus, 32-bit data bus external bus control (EBC) interface
  – Support for up to 6 ROM, RAM, or slave peripheral I/O devices
- Up to four UARTs (1x 8-pin, or 2x 4-pin, or 4x 2-pin, or 1x4-pin and 2x 2-pin)
- Two IIC (with one integrated boot strap controller)
- One SPI serial interface
- Programmable interrupt controller with 16 external inputs, 48 internal inputs
- Programmable timers
- General-purpose I/O (64)
- Support for JTAG board testing, JTAG debuggers, and 4xx instruction trace interface
- RoHS compliant (lead-free) version available

For more information, please visit **http://www.amcc.com.**

Specifications

Technology
- 90nm CMOS

Performance (estimated)
- 1,200 Dhrystone 2.1 MIPS @ 600 MHz
- 2,000 Dhrystone 2.1 MIPS @ 1.0 GHz

Frequency
- CPU: 600 MHz to 1.0 GHz
- DDR1/2 Memory: 32/64 bit width
- PCI: 32-bit, 33 MHz to 66 MHz
- PCI Express
  – One 4-lane @ 2.5 Gbit/s per lane/direction
  – One 1-lane @ 2.5 Gbit/s per lane/direction
- SATA Controller
  – One port @ 1.5 or 3.0 Gb/s

Typical Power Dissipation
- <5 W @ 1 GHz (typical)
- Core/FPU <2.5 W @ 600 MHz

Case Temperature Range
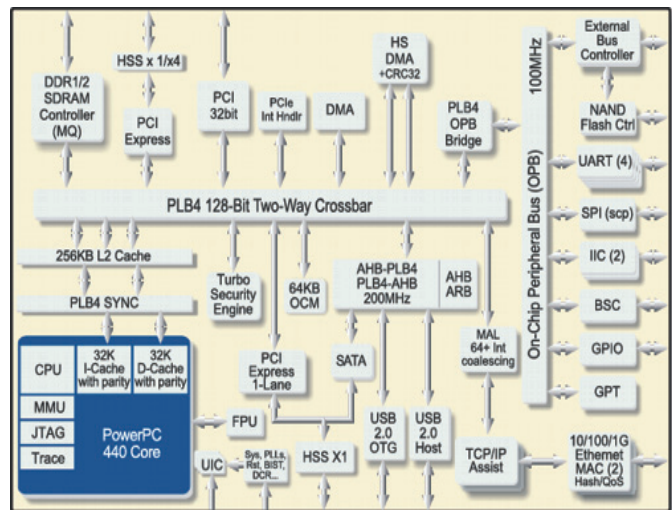- -40 ° to +85 ° C

Power Supply
- 1.25 V (logic), 1.8 V (DDR2), 2.5 V (DDR1, Ethernet, USB), 3.3 V (PCI, other I/O)

Signal I/Os
- 429

Packaging
- 728-TE-EPBGA, 35 mm x 35 mm (1-mm ball pitch)

AMCC

215 Moffett Park Drive
Sunnyvale, CA 94089
P 408 542 8600
F 408 542 8601
www.amcc.com