

CAST

BA20

PipelineZero 32-bit Embedded Processor

Implements a small, ultra-low-power, and very processing-efficient 32-bit processor, ideal for energy-sensitive deeply embedded applications such as wearable electronics, Internet of Things (IoT) sensors, wireless communication, and other mixed-signal ICs.

Thanks to its PipelineZero™ architecture, the BA20 core delivers a surprisingly high processing efficiency with a tiny silicon footprint. True single-cycle instruction execution of the BA2 ISA, zero-delay branches, no pipeline-stalling overheads, and an optional hardware multiply unit enable the BA20 to operate with efficiency as high as 3.41 CoreMarks/MHz. With no pipeline stages in the instruction execution path the BA20 uses a minimal number of flip-flops and a simplified CPU control, so its processing efficiency comes without a silicon area penalty. For example, in a 40G technology the BA20 occupies about 10,000 gates, or approximately 0.01mm².

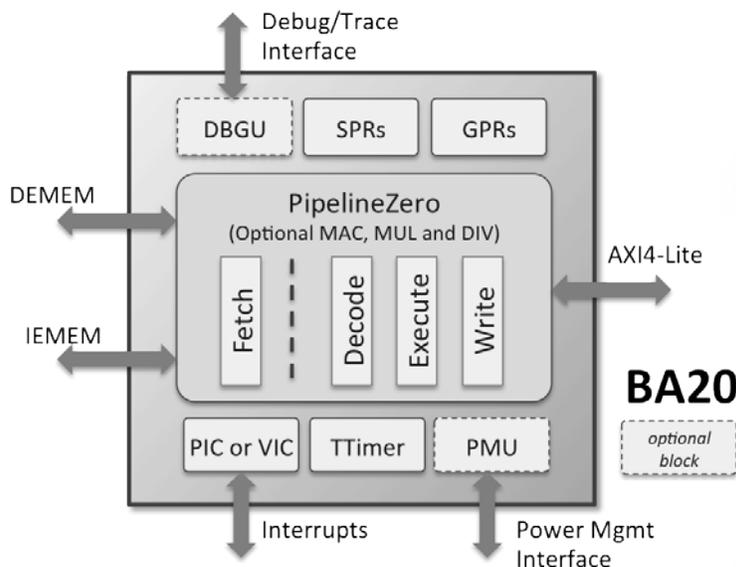
These advantages plus advanced power management features and the extreme code density of the BA2 instruction set make the BA20 the most energy-efficient 32-bit processor currently available, consuming just 2uW/MHz on a 40G technology.

The BA20's capabilities can be enhanced with options including a hardware multiplier/divider, multiply-accumulate block, and IEEE 754 compliant floating-point units. A vectored interrupt controller facilitates timely responses to interrupts, and an optional memory protection unit protects application code and/or data from corruption.

The core's system interface uses a 32-bit wide AMBA® AXI4-lite bus. Two tightly-coupled embedded memory (EMEM) buses allow fast access for time-critical code and data, and can be used for inter-core communication in a multi-core architecture. Software development is facilitated with the included C/C++ tool chain, BeyondStudio™ Eclipse-based IDE, architectural simulator, ported C libraries, RTOSs and OSs, debug capabilities, and hardware reference designs.

Additional microcontroller peripherals may be ordered for pre-integration and delivery with the core, individually or in a complete platform.

Block Diagram



Features

Ultra-Low Power

- PipelineZero™ architecture for high performance efficiency with tiny silicon footprint
 - 3.04 DMIPs/MHz
 - 3.41 Coremarks/MHz
 - 2uW/MHz and 10K gates (0.01mm²) in 9-track 40G
- BA2™ ISA Extreme Code Density for less instruction fetching energy usage
- Advanced power management
 - Dynamic clock gating and power shut-off of unused units
 - Software- and hardware-controlled clock frequency
 - Wake-up on tick timer or external interrupt

Optional Processor Units

- Programmable Vectored Interrupt Controller Unit
- Memory Protection Unit
- Timer Unit
- Debug Unit
 - MDB support
 - Trace port support
- ROM Patching Unit
- Floating Point Unit
- Hardware Multiplier/Divider

Pre-Integrated Platforms

- Available microcontroller peripherals include GPIO, UART, Real-Time Clock, Timers, I2C, and SPI
- Memory controllers, interconnects, and more from the CAST IP line

Easy Software Development

- Non-intrusive JTAG or Serial debug/trace for both CPU and system
- Complex chained watchpoint and breakpoint conditions
- BeyondStudio™ complete IDE for Windows or Linux under Eclipse
- Ported libraries and operating systems

The BA2 Instruction Set

The BA2 instruction set provides extreme code density without compromising performance, ease of use, or scalability. It features:

- A linear, 32-bit address space
- Variable length instructions: 16-, 24-, 32-, or 48-bits
- Simple memory addressing modes
- 12 to 32 general purpose registers
- Efficient flow-control, arithmetic, and load/store instructions
- Floating point and DSP extensions

Customizable Platforms

The BA20 processor can be delivered pre-integrated with typical microcontroller peripherals such as UARTs, timers and serial communication cores, or with memory controllers and interconnect IP cores. Contact CAST Sales for details

Support and Services

The core as delivered is warranted against defects for 90 days from purchase. Thirty days of phone and email technical support are included, starting with the first interaction. Additional maintenance and support options are available. IP Integration Services are also available to help minimize time to market for BA22-based systems.

Deliverables

The core is available for ASICs in synthesizable Verilog source code or FPGAs in optimized netlists, and includes everything required for successful implementation. The core is delivered with software development tools for Windows and Linux, with an Eclipse IDE interface.

The BA2x Family of Processors

The BA2™ Processor Family includes a set of royalty-free, pre-configured products intended for different applications:

- **BA21** 32-bit Low-Power Deeply Embedded Processor, a dual-pipeline 32-bit low-power processor that delivers better performance than most processors its size.
- **BA22-DE** 32-bit Deeply Embedded Processor, a 4- or 5-stage pipelined processor for deeply embedded applications that use on-chip instruction and data memories.
- **BA22-CE** 32-bit Cache-Enabled Embedded Processor, a 4- or 5-stage pipelined processor, with instruction and data caches for deeply embedded applications.
- **BA22-AP** Basic Application Processor, a 5-stage pipelined, cache, and MMU-enabled processor.
- **BA25:** Advanced Application Processor, a 7/12-stage pipelined, out of order, cache- and MMU-enabled processor.