



# Embedded Processors for Industrial Applications

## Key Features

### Blackfin Processors:

- Combined control and signal processing capabilities enable new product features
- Dynamic power management (DPM) enables the ability to specifically tailor device power consumption to the end system requirements
- Easy to use mixed 16-/32-bit instruction set architecture and development tool suite minimizes development time
- Applications-tuned peripherals provide glueless connectivity to general-purpose converters in data-acquisition applications
- Code security and data integrity enabled with Lockbox Secure Technology
- On-chip flash memory with up to 1 MB of storage

### SHARC Processors:

- Provide 32-/40-bit IEEE floating-point math 32-bit fixed-point multipliers with 64-bit product and 80-bit accumulation
- 32 address pointers support 32 circular buffers
- Six nested levels of zero-overhead looping in hardware
- Rich, algebraic assembly language syntax instruction set supports conditional arithmetic, bit manipulation, divide and square root, bit field deposit, and extract



## Signal Processing Performance for Industrial Control and Instrumentation

During the past decade, industrial control and instrumentation applications have seen a steady increase in the adoption of analog and digital technologies, a trend that doesn't seem to be slowing. What is clear is that in order to keep pace with the market's package and application level demands, highly efficient technologies are needed to support the continuing evolution of industrial control and instrumentation designs.

Analog Devices Blackfin® and SHARC® processors offer best-in-class performance for the given power and cost, allowing developers to create intelligently aware systems that communicate via wireless or wired connections and are not limited to a specific package or standard.

SHARC Processors provide the industry's best 32-bit floating point performance for applications where dynamic range is a key consideration—analysis equipment, server drives, and signal generators—while Blackfin Processors enable industrial control processing as well as network processing to be carried out by the same processor, delivering a key functionality required by these increasingly sophisticated industrial applications, video surveillance, robotics, and power control.

Supported by a robust ecosystem that helps developers reduce time to market by bringing them nearer to the capabilities of their end products, Analog Devices provides industry-leading tools such as VisualDSP++®, emulators, and EZ-KIT Lite® in addition to starter kits, GNU GCC toolchain and  $\mu$ Clinix™ support, and a rich third-party network to enable customers to design for more intelligent and efficient solutions in a wide variety of markets.



## Industrial Power Control

- Communication, control, and intelligent sensing
- PLCs (analog and digital)
- UPS/Power supplies
- Motion/motor control/drives

## Test and Measurement

- Science and lab test equipment
- Handheld/battery-powered systems
- Flow and energy
- High speed signal processing enhancements



## Blackfin Processors in Industrial

The feature-rich Blackfin Processor family is ideally suited for a wide range of industrial applications, from low power metering to high end networked power control systems. With models spanning from low cost to the highest performance with pin- and code-compatible models, designers can choose a device that has been optimized for their industrial application. Code leveragability and Lockbox™ Secure Technology reduce time to market, add flexibility, and safeguard your code. The powerful, scalable, software-programmable 16-/32-bit embedded architecture blends microcontroller unit (MCU) and digital signal processing (DSP) capabilities onto a single chip, eliminating the need for a multiprocessor approach. With applications-tuned peripherals including CAN 2.0B, PWM outputs, TWIs, 10/100 Ethernet, SPORTs, UARTs, PPIs, and GPIOs, designers have all the flexibility they need.

Blackfin Processors provide the ideal single-processor solution for products where a convergence of capabilities is necessary, such as:

- Control processing
- Multiformat video and audio
- Multimode communication and packet processing

Blackfin Processors offer performance up to 750 MHz/1512 MMACS in single-core products. New symmetric, multiprocessor members of the Blackfin family extend this to over 3000 MMACS. The family offers the lowest power consumption—as low as 0.15 mW/MMAC at 0.8 V. The combination of high performance and low power is essential in meeting the needs of signal processing applications today and in the future—including broadband wireless, audio/video-capable Internet appliances, and mobile communications. All Blackfin Processors offer fundamental benefits to the system designer, including:

- High performance signal processing and efficient control processing capability
- Dynamic power management (DPM), enabling the system designer to tailor device power consumption to the end-system requirements
- Easy to use instruction set architecture and development tools suite that saves development time

The Blackfin Processor family offers the industry's highest performance and power efficiency for applications where a convergence of capabilities—multiformat audio, video, voice, and image processing; multimode baseband and packet processing; and real-time security and control processing—are critical.

## SHARC Processors in Industrial



SHARC Processors dominate the floating-point digital signal processing market, delivering exceptional core and memory performance complemented by outstanding I/O throughput. Starting at 319 MFLOPS per dollar, the industry-standard SHARC Processor family makes floating-point processing economical for applications where dynamic range is a key consideration, such as home and car audio, medical, industrial, and instrumentation products. SHARC Processors are available in commercial, industrial, and automotive temperature grade packages. They are used in a wide variety of signal processing applications, providing up to 400 MHz performance in a Single-Instruction, Multiple-Data (SIMD) architecture.

SHARC Processors provide the industry's best floating-point performance for applications where dynamic range is a key consideration:

- SIMD—32-/40-bit fixed or floating point
- Powerful balance of memory and performance
- Advanced audio processing and control

The SHARC Processor portfolio currently consists of three generations of products providing code-compatible solutions ranging from entry level to high performance products offering fixed- and floating-point computational power. All SHARC Processors provide a common set of features and functionality usable across many signal processing markets and applications, allowing designers an easy transition to the newest products with the latest features and the highest performance.

First-generation SHARC Processors offer performance to 66 MHz/198 MFLOPS. Their easy to use instruction set architecture supports both 32-bit fixed-point and 32-/40-bit floating-point data formats, combined with large memory arrays, and sophisticated communications ports make them suitable for a wide array of parallel processing applications, including consumer audio, medical imaging, military, industrial, and instrumentation.

Second-generation SHARC Processors double the level of signal processing performance (100 MHz/600 MFLOPS) by utilizing a SIMD architecture. This hardware extension doubles the number of computational resources available to the system programmer. Second-generation products contain dual multipliers, ALUs, shifters, and data register files—significantly increasing overall system performance. This capability is especially relevant in consumer, automotive, and professional audio applications where the algorithms related to multichannel processing can effectively utilize the SIMD architecture.

Third-generation SHARC Processors are based on an enhanced SIMD architecture, which extends core performance to an industry-leading 400 MHz/2.4 GFLOPS. Third-generation SHARC audio processors feature the highest level of integrated on-chip peripherals, such as multichannel audio surround sound decoders and post-processing algorithms, S/PDIF transmitter/receiver, high performance asynchronous sample-rate conversion, PWM channels, code security, and DTCP cipher for protection of digital data in automobiles. All SHARC Processors are code compatible with previous generations of SHARC Processors, so legacy code is easily ported to the newer products. In addition, a number of third-generation processors are also pin compatible for use with a single hardware platform.



### Third-Party Developers for Industrial Applications

The ADI network of third-party developers includes companies from all over the world that provide hardware products, software products, algorithms, and design services that let you explore, evaluate, and design with our Blackfin and SHARC processor families.

**BLUE TECHNIX** Bluetech offers a set of sophisticated technology products for the most demanding applications in a space and power constrained environment. A set of tiny Core Modules and outstanding development boards for rapid prototyping help developers and system integrators to quickly design their products. Intended for prototypes and small- and medium-volume products, Bluetech Tinyboards save development costs and risks significantly, and enable incredible performance on a tiny space. For more information, visit [www.bluetech.com](http://www.bluetech.com).

**connectBlue** connectBlue is a leading provider of wireless solutions for demanding applications in segments like industrial automation, medical, instrumentation, diagnostics, logistics/transportation, vehicles, and point of sale. Based on Bluetooth® technology, WLAN, and 802.15.4, connectBlue provides ready-to-use products and modules as well as custom design solutions in both hardware and software. For more information, visit [www.connectblue.se](http://www.connectblue.se).

**NATIONAL INSTRUMENTS** The NI LabVIEW™ Embedded Module for ADI Blackfin Processors provides a comprehensive graphical development approach for embedded design. This new module, jointly developed by ADI and NI, seamlessly integrates NI LabVIEW embedded technology and ADI VisualDSP++ to provide out-of-the-box embedded programming. The module helps you take designs from concept to production in a single, integrated development environment by including all the tools you need to create your application quickly in LabVIEW and ultimately target custom-developed hardware. The module includes hundreds of optimized math and signal processing functions, integrated drivers for several ADCs and DACs, real-time debugging capabilities, and a simple interface for including legacy code. For more information, visit [www.ni.com/blackfin](http://www.ni.com/blackfin).

**PHYTEC** PHYTEC offers Single Board Computer (SBC) modules to support the embedded engineer in every stage of embedded design: from evaluation, through development and prototyping, to OEM deployment. Implementation of an insert-ready, OEM-able SBC subassembly as the “core” of your embedded design

allows you to focus on hardware peripherals and firmware without expending resources to “reinvent” microcontroller circuitry. Take advantage of PHYTEC products to shorten time to market, reduce development costs, and avoid substantial design issues and risks. For more information, visit [www.phytec.com](http://www.phytec.com).

**Schmid Engineering AG** Schmid Elektronik AG develops and manufactures top-quality electronic devices at the heart of industrial systems. Flexibility for small and medium-sized series is their strength. The latest security technologies and electronic devices profit from this know-how worldwide. Schmid Engineering AG offers solutions for mechatronic applications and embedded systems. The company is a globally active system integrator in industrial automation, safety technology, and rail technology. For more information, visit [www.schmid-elektronik.ch](http://www.schmid-elektronik.ch).

**3S-Software Solutions GmbH** is one of the leading software manufacturers in the automation industry. CoDeSys is the leading hardware-independent IEC 61131-3 programming system under Windows® for creating controller applications. The integrated compilers in CoDeSys that translate the controller application into machine code guarantee optimal performance on the processors in use. CoDeSys contains an extensive range of such native code generators for 8-/16-/32-bit CPUs commonly used in automation devices with controller functionality. For more information, visit [www.3s-software.com](http://www.3s-software.com).

**ZP Engineering** ZP Engineering offers advanced design services for embedded and signal processing systems; they also provide OEM solutions for DSP-based loudspeaker management systems and for IEEE 1394 audio connectivity. The various design wins completed over these years belong to three main application sectors: the audio field (pro-audio and consumer, both digital and analog), the industrial field (embedded networking, domotics, data acquisition, remote control), and the design of custom development systems, mainly for SoC ASICs. For more information, visit [www.zpeng.com](http://www.zpeng.com).

### Analog Devices' Development Tools, Hardware Evaluation Kits, and Software Support Modules Aid System Development

Today's developers can reduce their time to market and aid systems development by choosing a robust ecosystem that brings them nearer to the capabilities of their end products. Analog Devices provides industry-leading tools, starter kits, and support, including the familiar ADI CROSSCORE® software and hardware tools that support the Blackfin and SHARC processor families.

These development tools provide easier and more robust methods for engineers to develop and optimize DSP systems and shorten product development cycles for industrial and control applications. These development tool offerings include:

- VisualDSP++ development environment
- EZ-KIT Lite evaluation kits
- EZ-Extender® daughter boards
- Emulators
- Real-time operating systems
- Software development kits
- Starter kits

#### VisualDSP++

VisualDSP++ delivers efficient project management, enabling programmers to move easily between editing, building, and debugging within a single interface. Key features include an optimizing C/C++ compiler, advanced plotting tools, embedded OS support (VDK), award-winning statistical profiling, TCP/IP and USB support, free software upgrades, and technical support.

#### EZ-KIT Lite Evaluation Kit

This system consists of a standalone evaluation board and an evaluation suite of VisualDSP++ to facilitate architecture evaluations via a PC-hosted tool set. Users can evaluate ADI's processors and learn about digital signal processing applications, as well as simulate, debug, and prototype applications.



### EZ-Extender

EZ-Extender daughter boards enable developers to access and connect various peripherals from Analog Devices and third parties via the expansion interface of the EZ-KIT Lite evaluation kits.

### USB-Based Emulators

Analog Devices' cost-effective Universal Serial Bus (USB)-based emulator and high performance (HP) USB-based emulator each provide an easy, portable, nonintrusive, target-based debugging solution for Analog Devices JTAG processors and DSPs. These powerful USB-based emulators perform a wide range of emulation functions, including single-step and full speed execution with predefined breakpoints, and viewing and/or altering of register and memory contents.

### Real-Time Operating Systems

RTOS offerings from leading industrial partners like Green Hills® Software, Quadros™, Express Logic, Micriμm, open-source μClinux and ADI's VisualDSP++ Kernel (VDK).

### Software Development Kit (SDK)

The SDK contains example software, source code, device drivers, algorithms, utilities information, and application notes that allow users to develop processor applications. The software can be used as a framework, or as examples of how to use certain aspects and peripherals, in conjunction with an ADI processor. The SDK is included in the starter kits and is also available for free download, provided users have the required hardware, at [www.analog.com/SDK/downloads](http://www.analog.com/SDK/downloads).

### Starter Kits

Starter Kits provide everything needed to get started on an application. They contain a Blackfin EZ-KIT Lite, EZ-Extender daughter board(s), and the software development kit (SDK), which contains sample code, "how to" documents, and various encoders/decoders that make getting started on an application easy and shorten the learning curve.

### ADSP-BF548 EZ-KIT Lite Evaluation Kit for Blackfin Processors

The ADSP-BF548 EZ-KIT Lite provides developers with a cost-effective method for initial evaluation of the ADSP-BF54x Blackfin Processors via a USB-based, PC-hosted tool set. With this EZ-KIT Lite, users can learn more about the Analog Devices ADSP-BF548 hardware and software development, and quickly prototype a wide range of applications. The EZ-KIT Lite includes an ADSP-BF548 Blackfin Processor desktop evaluation board along with an evaluation suite of the VisualDSP++ development and debugging environment, including the C/C++ compiler, assembler, and linker.



ADSP-BF548 EZ-KIT Lite Evaluation Kit for Blackfin Processors.

### ADSP-21369 EZ-KIT Lite Evaluation Kit for SHARC Processors

The ADSP-21369 EZ-KIT Lite provides developers with a cost-effective method for initial evaluation of the ADSP-21367, ADSP-21368, and/or ADSP-21369 SHARC Processor architecture via a USB-based, PC-hosted tool set. With this EZ-KIT Lite, users can learn more about Analog Devices' ADSP-21369 hardware and software development and quickly prototype a wide range of applications.

The EZ-KIT Lite includes an ADSP-21369 SHARC Processor desktop evaluation board along with an evaluation suite of the VisualDSP++ development and debugging environment, including the C/C++ compiler, assembler, and linker. The evaluation suite of VisualDSP++ is designed to be used with the EZ-KIT Lite only.



ADSP-21369 EZ-KIT Lite Evaluation Kit for SHARC Processors.

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