

Imaging Diagnostics's Smart Camera's On-Board Blackfin® Enhances Image Processing Power for Machine Vision

Like most embedded systems, machine-vision applications are relentless in their escalating challenge for higher levels of processing intelligence combined with miserly allowances for power consumption and physical size. Precise, high-resolution imaging capabilities packaged into compact and efficient cameras are fundamental to virtually all of today's industrial inspection systems.

Since 2003, [BDR Group](#) has staked out a leading position in the design and manufacture of advanced digital-imaging modules for the most demanding industrial and medical applications. With an eye toward boosting real-time imaging functionality for its customers, BDR is integrating the processing power and connectivity of an [Analog Devices Blackfin BF548](#) into the [BDR Embedded Camera \(BEC\)](#) – the company's newest family of industrial imaging modules.

BEC Cameras

BEC is a family of digital cameras for machine vision applications with fast USB2 connection and embedded digital signal processor capable of performing advanced image processing algorithms in the camera on the fly and capable of storing a buffer of images on the camera without the need to send all images to the PC. The cameras are intended for medical and industrial applications requiring superior image quality high performance and yet attractive pricing.

For this new line of high end USB2 Cameras, BDR's choice to base their design on the Blackfin processor takes BEC-based cameras to a new level of quality for real-time imaging with exceptional on-camera image processing capacity. As the industry's only convergent architecture, equally capable of powerful signal and control processing, Blackfin helps reduce the BEC's part count and bill-of-materials for a complete low-power, low-cost system solution for intelligent industrial cameras. While Blackfin's DSP performance brings true intelligence to BDR's "smart" machine-vision technology, the processor's best-in-class microcontroller capabilities and connectivity (including integrated USB 2.0, optional Ethernet, Bluetooth or cellular) provide seamless support for a wide range of machine vision applications.

Superior Image Processing with Application-Specific Options

The BEC's processor-centric architecture transfers real-time image data from the module's sophisticated on-camera sensor directly to the Blackfin BF548 high performance DSP for processing. 64 Mbytes of system DDR buffer memory stores enough image data to prevent data losses, and Blackfin's high-speed 480 Mb/s USB 2.0 connection streams live (30 FPS at 1.3MPixels) pre-processed video to a host PC. Meanwhile, the Blackfin's system-level 8/16-bit Host DMA Interface speeds data movement through the system.

Incorporating the Blackfin, with its ability to support the required advanced image-processing intelligence into the camera itself, off-loads computational cycles from the host PC, allowing the application to focus on its responsibility for image or streaming data acquisition and analysis. The device's USB connectivity and low power consumption facilitate camera mobility and eco-friendliness by providing standalone independence from external power supplies, using only the power from the USB. The processor's standard serial connections (multiple on-chip SPORT, SPI, UART, TWI, and CAN interfaces) let the BEC make optional glue-less connections to off-chip devices including a full range of application-specific industrial interfaces.

A Convergence of Power and Connectivity In its analysis of processor options, BDR Group concluded the Blackfin BF548 is the ideal low-cost, high-performance engine for a smarter machine-vision camera design. For BDR, the camera needed, in addition to outstanding image-processing performance, seamlessly flexible connectivity to support a wide range of machine-vision applications.

Easy interfaces to a range of image sensors, accessory options and communication options such as USB, Ethernet and Bluetooth were essential to the final design. The resulting industrial-grade BEC module is designed to fulfill a comprehensive range of image-processing and resolution needs. The combined attributes of the Blackfin processor have allowed BDR Group to develop a smarter and smaller embedded camera that consumes less power, helping the company meet its customers' demands for higher levels of industrial image-processing intelligence at reduced cost, power consumption and physical size.

Architecture Description:



Raw data from the sensor is transferred to the Blackfin using the integrated PPI (Parallel Peripheral Interface). Using DMA, the image data is transferred to the BF548 external memory for storage (64Mbytes of external memory) and further processing.

In parallel using high speed DMA, raw data from the external memory such as filters, lookup tables, customize field of views, Bit per pixel reduction, etc. is transferred to the internal memory of the Blackfin for image processing, and then, using a third DMA transfer processed data is sent via the built-in high speed USB2 Interface with practical effective rates of up to 40Mbytes per second (up to 30 FPS in 1.3MP, 8 FPS at 5MP, or much higher rates at VGA).