ADLINK TECHNOLOGY INC.

White Paper

Intelligent Systems Advance with 4th Generation Intel® Core™ Processors

ADLINK Technology, Inc.

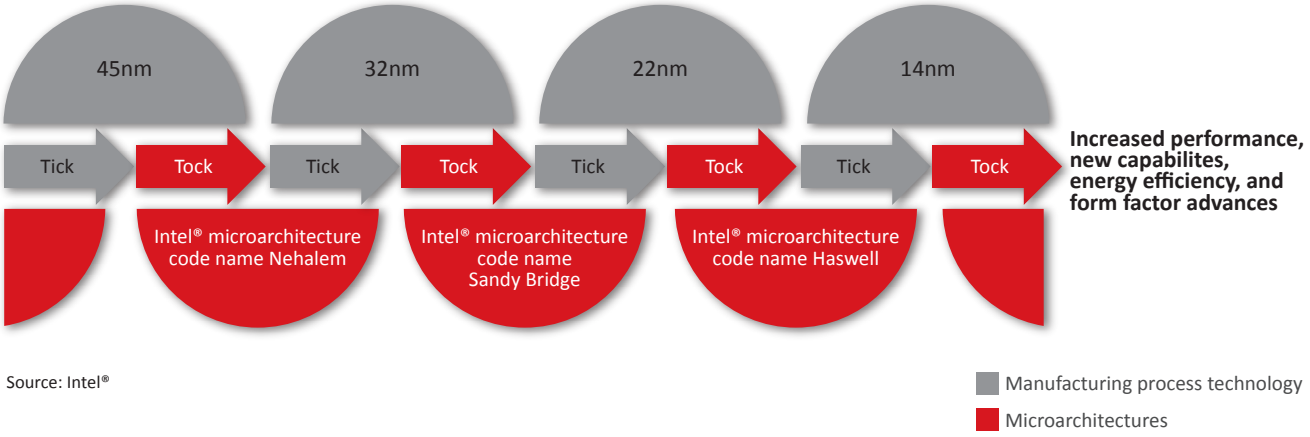
Intelligent Systems Advance with 4th Generation Intel® Core™ Processors

■ ADLINK Extends Performance Capabilities of Platforms for Medical, Defense, Transportation and Industrial Automation

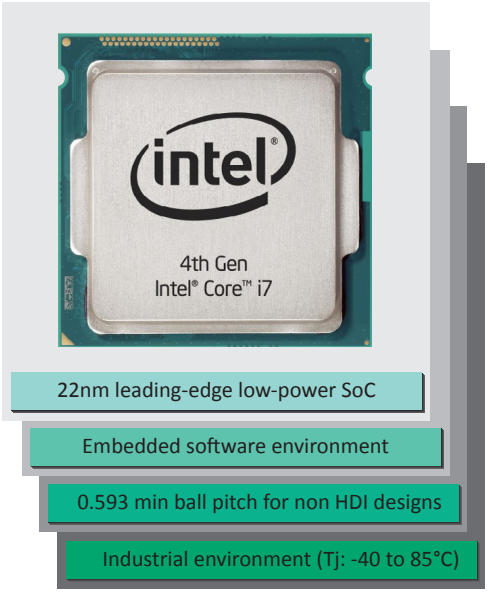
Intel's tick-tock cadence of innovation and processor improvement continually drives embedded advances in performance, power, graphics, security and form factor. Building on the technical achievements of previous processor generations, today's 4th generation Intel® Core™ product family revs up that momentum and enables a dramatic performance advantage for embedded systems developers. This white paper offers a closer look at 4th generation Intel Core features and technology, highlighting advanced CPU, graphics and media performance, along with improved flexibility and enhanced security. Specific application references illustrate the design value of 4th generation processors, supported by selected ADLINK products capitalizing on this powerful new solution.

■ Smarter, Faster, Better – Welcome to 4th Generation Intel® Core™ Processors

4th generation Intel® Core™ processors represent dramatic improvements in the ongoing battle to enable greater computing performance and graphics functionality in embedded design. Breakthrough areas include processing speeds, quality of graphics and media performance, with further improvements in security and manageability, and low power within a reduced footprint. These are essential upgrades for demanding embedded arenas, driving new applications and opportunities for connected, managed and secure intelligent systems.



Formerly codenamed Haswell, 4th generation Intel Core processors are fueled by Intel's tick-tock model of technology development, which alternates advancements in manufacturing process technology and processor microarchitecture. The 4th generation Intel Core processors represent a significant tock in Intel's cycle of innovation by delivering a new microarchitecture using 3D Tri-Gate transistors in the 22nm process. The resulting upgrades notably improve CPU, graphics and media performance, increase flexibility, and enhance security as compared to 3rd generation Intel Core processors known as Ivy Bridge. The 4th generation Intel Core platform includes a range of variants for the embedded market – up to quad core and spanning a broader performance spectrum than previous generations – and is ideal for the design of high-performance, low-power intelligent systems for medical, defense, transportation and industrial automation.

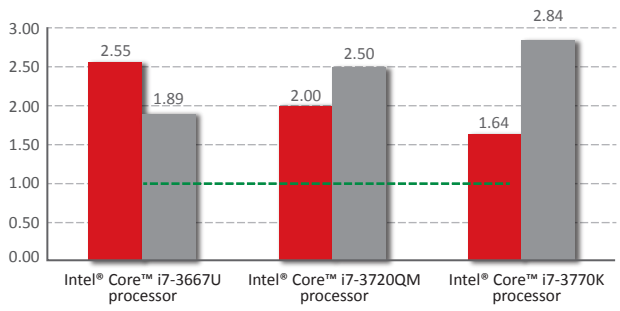


Tangible Performance Leap

For designers of embedded platforms facing a range of markets that are evolving with increased requirements for portable/mobile devices, as well as graphically demanding applications, highly integrated 4th generation Intel® Core™ products are a big win. These processors deliver a CPU performance jump up to 15% greater than 3rd generation processors. SWaP (size, weight and power) is reduced by two to four times, and power consumption at the CPU level is as low as six watts; active power and idle power have been improved by creating new ultra-low power states where the CPU consumes a fraction of the power compared to previous idle states. Applications will recognize approximately a twofold increase in graphics performance, and systems can 'wake up' about eight times faster.

Small form factor platforms are likely to benefit greatly from these improvements in performance, graphics and power consumption; computationally intensive applications such as sensor processing and signal intelligence will also advance due to the 4th generation Intel Core platform's enhancements in performing massively parallel embedded computing with an integrated general-purpose graphics processing engine (GPGPU).

Platform (CPU+GPU) performance advantage over single-device case for the 3 different processors, each bar is geomean over the Sandra/Luxmark test (see prev. setcion)



Source: Intel®

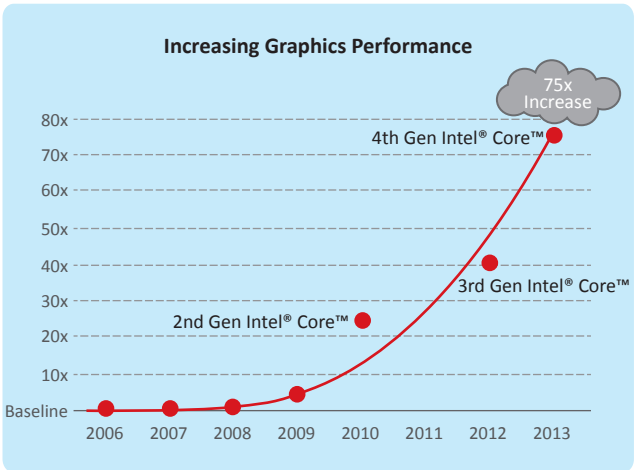
Defining the 4th Generation Intel® Core™ Processor Family

Intel's 22nm production process remains the same as the previous generation Core processor; engineering resources solely focused on architectural modifications and enhancements while retaining and improving key features that differentiate Intel products such as Intel® Hyper-Threading, Intel® Turbo Boost, and the ring interconnect. The goal was a converged core – a single design flexible enough to scale performance from tablet to server and create embedded design value across a large spectrum of end-use applications.

The 4th generation Intel Core design is based on three key elements: performance, modularity and power management – each of which in turn has its own set of goals. The performance goal sought to improve functionality of legacy code and deliver the ability to design for greater parallel operation with fewer complex coding demands on developers. Modularity refers to the 4th generation Intel Core platform's extensive embedded product span, which allows a consistent optimization path for designers. Development resources are maximized when an application can be written to run at different feature or performance levels. Power management is sophisticated and highly adaptable based on the latest generation's various configurations, which include two to four processing cores, three different levels of graphics subsystems, and a range of idle and active power levels, interconnects and platforms. Intel's 4th generation variants include eight CPU SKUs and four chipset SKUs on the embedded roadmap with extended lifecycle support.

Designing with 4th Generation Intel® Core™ Processors

Embedded systems are getting smarter, with more sensors collecting more data from more connected devices. High performance I/O must keep pace, moving data quickly to automate operations, speed up business decisions, or improve the end-user experience. This evolution is just beginning – it's the Internet of Things, with machine-to-machine connections anticipated to exceed 365M within three years. Media and graphics performance is integral to this growth, with visual solutions becoming more present and valued in embedded arenas. Digital surveillance in military environments, machine vision in manufacturing settings, and high resolution displays within transportation control solutions or used by medical practitioners – in each of these situations, high-resolution imaging and fast processing improve the application itself.

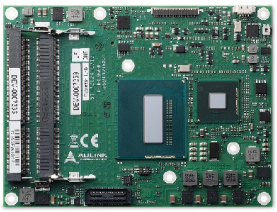


Source: Intel®

For example, today's MRI machines process greater than 500M pixels per second with expectations for continued evolution in performance and image resolution. As a result, diagnosis is faster and more accurate. Applications such as industrial automation and PCs, unmanned systems and robots, PLCs, HMIs, motion drives and more, face a similar path of increasing performance demands, well met by ADLINK solutions incorporating 4th generation Intel Core technology. ADLINK offers a number of embedded platforms that capitalize on these latest Core processors for graphics and media intensive applications, computationally demanding designs, and systems requiring high performance I/O.

● Express-HL and cExpress-HL (COM Express®)

The Express-HL is a COM Express® COM.0 R2.1 Type 6 Basic module supporting the 64-bit 4th generation Intel® Core™ i7/ i5/3 processor with CPU, memory controller, and graphics processor on the same chip. Based on the latest Mobile Intel® QM87 Express chipset, the Express-HL is a long product life solution specifically designed for high-level processing and graphics performance. The Express-HL is designed for customers with high performance graphics processing requirements who want to outsource the custom core logic of their systems for reduced development time. For smaller space requirements, the cExpress-HL provides an even smaller solution via the Compact form factor of the COM Express standard.

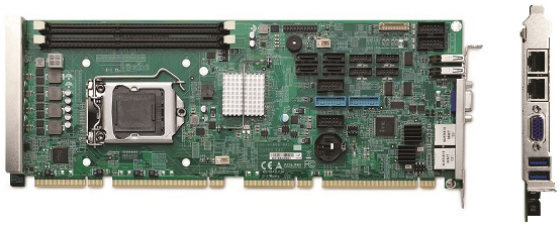


For example, Express-HL is an optimal solution enabling enhanced medical imaging. Used in an ultrasound device, an Express-HL-based system offers the right blend of performance and power, enabling faster computation with more advanced algorithms and faster diagnostics while allowing for long battery run times.

● NuPRO-E42 (PICMG® 1.3)

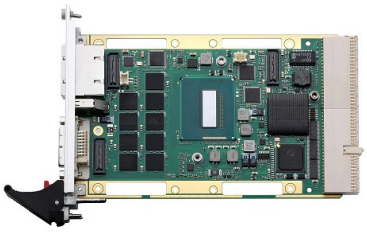
ADLINK NuPRO-E42 is the latest PICMG® 1.3 full-sized System Host Board (SHB), which utilizes the 4th generation Intel® Core™ processor at core speeds up to 3.1GHz combined with the Intel Q87 Express chipset. It provides high-speed data transfer interfaces such as USB 3.0 and SATA 6 Gb/s.

ADLINK's NuPRO-E42 SHB is ideally suited to applications requiring multi-tasking capabilities, high computing power, and high-speed data transfer rates such as industrial control, machine vision and automation. The NuPRO-E42 enables the high network throughput required in complex, non-stop industrial computing environments. As bandwidth for data processing and transmission continues to increase, deployed solutions often deliver complex feature sets that vary dramatically from application to application. The NuPRO-E42 is well-suited to these challenges, with flexible features that maintain performance over a long product life cycle.



● cPCI-3510 (CompactPCI)

The ADLINK cPCI-3510 Series is a 3U CompactPCI® PlusIO compatible processor blade with soldered DDR3L-1600 ECC memory up to 8GB. Featuring an Intel® Core™ i7 processor with Mobile Intel® QM87 Express Chipset, the cPCI-3510 Series is a 3U CompactPCI blade available in single-slot (4HP), dual-slot (8HP) or triple-slot (12HP) width form factors with various daughter boards for a broad range of I/O requirements. Graphics support is integrated on the CPU and allows three independent displays on the front panel.



ADLINK's cPCI-3510 is a high performance solution for transportation, defence, communications and other industrial applications that require superior data transfer capability and advanced computing power. Intelligent, networked systems; secure and rugged transportation applications such as train management and wayside systems, automatic piloting, interlocking and control center systems; and communications segments requiring compact size and high density blade computing such as video surveillance, video analytics, network acceleration and video transcoding are examples of compute-intensive environments fueled by this high availability platform.

● Matrix MXE-5400

The ADLINK Matrix MXE-5400 series of rugged designed quad-core fanless computers features the latest 4th generation Intel® Core™ i7-4700EQ to deliver outstanding processor performance with minimum power consumption. Intel's Quick Sync Technology and Core IPG equip the MXE-5400 with a market leading performance boost in image/video related applications.

ADLINK's Matrix MXE is optimized for high performance machine vision, as well as industrial or factory automation applications characterized by extreme environmental conditions. Matrix offers reliable, rugged performance and delivers the fast, high resolution image processing required by these and other image-intensive applications; examples include digital surveillance for situational awareness, medical imaging, and intelligent transportation systems such as vehicle and system diagnostics.

● VPX6000

The ADLINK VPX6000 is a 6U VPX processor blade featuring the 4th generation Intel® Core™ processor with Mobile Intel® QM87 Express Chipset. The VPX6000 is rugged conduction cooled with conformal coating, making it ideal for mission critical applications such as military and aerospace platforms. As sensor data processing demand increases exponentially across all fronts, the VPX6000 provides a high performance embedded computing (HPEC) solution to address the increasing volumes of data being generated and shared among military forces. System demands continue to grow; for example, sophisticated radar and missile defense applications must not only locate but also discriminate targets to determine effective response and countermeasures. ADLINK's VPX6000 offers secure, enhanced performance in these scenarios – delivering the high throughput required for advanced military systems that must perform with extreme precision.

■ Parallel Processing Improvements Enable Speed

The 4th generation Intel Core platform is fast, incorporating an upgrade to the Intel® Advanced Vector Extensions (Intel® AVX) instruction set that improves integer/matrix-based calculation abilities, including wider vectors, new extensible syntax and rich functionality. By fusing multiply and add functions, AVX 2.0 advances the original AVX instruction set handling single instruction, multiple data (SIMD) parallel processing functions to provide twice the floating point performance for multiply-add workloads, 256-bit integer SIMD operations; this is in contrast to previous 128-bit gather operations and bit manipulation instructions. Gather support integrated into AVX 2.0 simplifies code vectorization, enabling vector elements to load from non-contiguous memory locations.

As a result, the latest Core processing engine is fed very effectively; system tasks that previously required two clock cycles can now be completed in a single clock cycle. This level of performance enhances applications requiring increased vectorization or advanced video processing capabilities such as facial recognition, industrial or medical imaging, high performance embedded computing, or digital security surveillance.

AVX 2.0 also drives better management of data and general purpose industrial applications, optimizing demanding processing environments such 3D modeling, imaging or analysis, audio or video, scientific simulations or financial analytics. For example, faster calculations enable rapid and accurate machine vision on an industrial line, or the speedy collection and interpretation of ultrasound data for timely patient-doctor interaction and diagnosis.

■ Enriched, Embedded Graphics Advance Visual Applications

The 4th generation Intel Core processor's integrated graphics eliminate the need for a discrete GPU – delivering advanced on-board graphics performance, while improving cost and design space. 3D rendering is built in, and one system can deliver HD playback to multiple screens based on platform support for up to three independent displays. Sophisticated HD media playback enables highly visual solutions – a factor becoming more prominent in embedded arenas that include medical, military and industrial.

Intel® Iris and Iris Pro graphics nearly double the performance relative to the previous generation of Intel® HD Graphics, although the graphics subsystem will depend on which

chip variant is used in the design. The latest Core platform introduces a new approach to creating GPU cores with different performance, and includes three graphics core modifications. Designers can choose a model with six cores (GT1), 20 cores (GT2) or 40 cores (GT3) featuring 128 MB embedded memory – each offers varying levels of graphics performance without necessarily increasing power requirements.

Iris and Iris Pro GPUs also support next-generation graphics APIs, such as Microsoft DirectX* 11.1, OpenGL* 4.0, and OpenCL* 1.2. Overall visual quality of applications is smooth and seamless, based on multi-codec support and improved ability to decode and transcode simultaneous video streams via Intel® Clear Video HD technology and Intel® Quick Sync Video 2.0. In addition to formats previously supported in 3rd generation processors, 4th generation Intel Core processors now support native MVC short format, MJPEG decode and hardware decode acceleration of SVC (Scalable Video Coding). SVC, for example, is a key enabler of multi-participant video conferencing and streaming media servers, ramping up media performance within embedded designs. The 4th generation Intel Core processor also offers native support for future evolution in large resolution content up to 4Kx2K (for example, outputs up to 4096x2304, 4096x2160 and 3840x2160).

4th Generation Intel® Core™ Processors

Enhanced Graphics



NEW Amazing performance

NEW 3 Screen Collage Display

NEW Faster Intel® Quick Sync Video

NEW Integrated on-package EDRAM Memory

NEW Enhanced 4K x 2K support

NEW Fast JPEG Decode & Faster MPEG Encode

NEW DX11.1, OpenGL 4.0 support

NEW 2x bandwidth with Display Port 1.2

NEW OpenGL 1.2 Support

Source: Intel®

Dynamic Power Management, Core by Core

Power-saving features on the 4th generation Intel Core processors have been refreshed from the ground up, with Intel considering silicon enhancements at logic and process levels; IP block modularity, variable cache and a range of graphics subsystems; and system-level power management including both hardware and software elements. In doing so, Intel has effectively reduced processor power consumption in idle mode, while also substantially improving transition times from idle to active mode. The 4th generation Intel Core processor improves existing C-states and adds new, deeper C-states – further speeding the transition from one to the other by up to 25%. The latest Core processor's newly defined S0xi state is of particular value to embedded applications, reducing idle mode processor power consumption by 20 times compared to earlier processor generations, with no performance drawbacks during transition into active mode.

The 4th generation Intel Core processor architecture further includes Intel® Turbo Boost Technology 2.0, a series of algorithms which consistently manage current, power and temperature to ensure maximum performance and energy efficiency. Active power is reduced, as Turbo Boost automatically enables individual processor cores to run faster than base operating frequencies, as long as they are operating below power, current and temperature specification limits. This dynamic increase in performance of individual cores is an important first in power management and is unique to 4th generation Intel® Core™ processors; the increase is activated when the system's OS requests the highest processor performance state (P0). The amount of time the processor spends in Turbo Boost mode depends simply on the workload and operating environment.

For maximum performance, Intel Turbo Boost Technology 2.0 allows the processor to operate at power levels higher than its rated upper power limit (TDP) for short durations – overclocking as needed in order to complete more processing quickly. Applications run faster through intelligent use of available thermal headroom for the system to run at higher frequencies. Intel® Hyper-Threading Technology works in conjunction with Turbo Boost, delivering two processing threads per physical core, allowing more work done in parallel.

Overall, the 4th generation Intel Core platform is designed for significantly lower power; the on-chip power optimizer enables fine-grained power management control over all aspects of the system and its peripherals, especially during power down and power up sequences. Intel® Intelligent Power Technology is aware of how long these operations take and starts slower devices first, ensuring the entire system is fully started in sync. Automated power management increases energy efficiency, and further enables low-power states to adjust system power based on real-time processor loads.

Low Power Revolution

The 4th generation Intel Core processor family features a one-chip U-series (Ultra Low Power) processor with 15-watt thermal design power (TDP). U-Series products integrate both CPU and platform controller hub (PCH) in a smaller package – bundling higher performance processing into a smaller chip package. In

addition to enabling design of thinner, lighter devices such as portable diagnostic equipment, patient monitors or wearable PCs for civic or military deployment, U-Series products also enable smaller form factors in compute intensive applications. Improved performance in a small footprint supports equipment manufacturers in addressing new industrial environments and reducing space requirements on the factory floor; this advanced platform is also poised to drive development of lower-power, smaller form factor devices suitable for data acquisition in mobile industrial applications. For example, 4th generation Intel Core processors deliver 10-13 days of connected standby compared to 4.5 days of standby power on earlier processor generations; high definition video viewing is available up to 9.1 hours versus six hours previously.

The 4th generation Intel Core processors also incorporate greater scaling of voltage and frequency, which reduces core voltage in proportion to the CPU's clock speed. Lower voltage results in lower current, which in turn ensures dramatically lower power consumption and requirements for heat dissipation. Coupled with gating techniques, where unused cores are switched on and off as needed to handle processing loads, scaled voltage plays a key role in the 4th generation Intel Core processors' proven low power consumption.

Increased Security and Manageability Drives New Embedded Applications

Fourth generation Intel Core processor-based designs benefit from security algorithms enabling hardware acceleration for data encryption and decryption. By incorporating Intel® Advanced Encryption Standard New Instruction (Intel® AES-NI), 4th generation Intel Core processors rely on new encryption instructions to enable faster data encryption and decryption, securing data running over a broad range of industrial applications and online transactions. AES-NI encrypts up to four times faster than earlier generations, without affecting a user's productivity. Hardware is also integrated with McAfee software, and uniquely executes security processes in the hardware itself – a notable advancement over earlier generation processors. For embedded designers, this is a more strategic approach that acknowledges the evolving need for greater security; threats do exist and must be met head-on. Performance also improves with encryption and decryption executed in hardware, contrasted to using software algorithms which are costly in terms of cycles and power consumption.

This higher level of data security is an essential advance in the growth of connected, embedded devices. With systems handling anything from highly secure financial data to automating factory processes to transmitting medical records, embedded designers must capitalize on a greater ability to protect the extensive data gathered, stored and shared via M2M applications.

Paired with the Intel® Q87 Chipset, 4th generation Intel Core processors deliver a comprehensive set of security, manageability, and productivity-enhancing capabilities. Powered by Intel® vPro™ technology, which combines a range of hardware-based features, 4th generation Intel Core processors build in an added layer of security below the operating system, ideal for intelligent systems. Key features such as Intel® Trusted Execution Technology, Intel® Virtualization Technology and Intel® Active Management Technology come together to create powerful and flexible security protocols behind the firewall – centralizing image management and administration, secure network storage, and out-of-band protection.

Embedded designers can deploy these options to optimize threat management and protect against difficult-to-detect, penetrating rootkits and malware that threaten users working in cloud or virtual environments. Identities, website access and confidential data are protected with built-in lines of defense that out-secure traditional forms of authentication via embedded one-time password, public key infrastructure technology (PKI) and protected transaction display. Remote management features can lock down a missing computer (regardless of the system's power state or OS condition), repair workstations or prevent unauthorized software from starting up. Because vPro is embedded in hardware, its broad capabilities are available in a pre-boot environment, accessed and administered separately from the hard drive, OS and software applications. Time and costs are reduced through this type of centralized IT administration; operating systems can be shut down remotely, allowing users to more easily activate, deploy and securely manage unattended systems.

Intelligent Systems Coming on Strong

As the number of connected, intelligent devices increases globally, designers face a new set of demands on platforms and designs. From machine vision and industrial PCs to person-wearable systems and portable medical imaging, fast and reliable connectivity demands attention to securing, managing and analyzing data. Non-stop performance is essential; as a result, lower power platforms are optimal for physically and thermally intensive computing environments. At the same time, users demand rich and instantaneous visual experiences – these applications must deliver seamless performance that capitalizes on sophisticated processing technology. By integrating 4th generation Intel Core processors into its platforms, ADLINK is delivering on this promise with breakthrough CPU, graphics and media performance, supported by low power and flexible, integrated security and management functionality. For questions or to speak with ADLINK regarding 4th generation Intel Core processor-based embedded solutions, visit www.adlinktech.com.

About ADLINK Technology

ADLINK Technology provides a wide range of embedded computing products and services to the test & measurement, automation & process control, gaming, communications, medical, network security, and transportation industries. ADLINK products include PCI Express-based data acquisition and I/O; vision and motion control; and AdvancedTCA, CompactPCI, and computer-on-modules (COMs) for industrial computing. With the acquisition of Ampro Computers, Inc. and LiPPERT Embedded Computers GmbH, ADLINK also provides a wide range of rugged by design Extreme Rugged™ and Rugged product lines including single board computers, COMs and systems.

ADLINK strives to minimize the total cost of ownership (TCO) of its customers by providing customization and system integration services, maintaining low manufacturing costs, and extending the lifecycle of its products. ADLINK is a global company with headquarters and manufacturing in Taiwan; R&D and integration in Taiwan, China, the US, and Germany; and an extensive network of worldwide sales and support offices.

ADLINK is ISO-9001, ISO-14001, ISO-13485 and TL9000 certified, is an Associate Member of the Intel® Intelligent System Alliance, an Executive Member of PICMG, a Sponsor Member of the PXI Systems Alliance, an Executive Member of PC/104 Consortium, and a Strategic Member of the AXIe Consortium, a member of VMEbus International Trade Association (VITA). ADLINK is a publicly traded company listed on the TAIEX Taiwan Stock Exchange (stock code: 6166).

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