



Curtiss-Wright Rugged COTS Single Board Computers (SBC) Leverage Intel® Power Management Features to Deploy Complete SBC-based Systems

Introduction

Curtiss-Wright is a leading provider of Intel® architecture-based embedded solutions for the aerospace and defense (A&D) market. A member of the Intel Embedded and Communications Alliance (Intel ECA), Curtiss-Wright's x86-based rugged air- and conduction-cooled SBCs take full advantage of the benefits of Intel's most advanced high performance and low-power processors. Intel supports the A&D market with processors and power management features specifically targeted to meet the stringent demands of system integrators designing solutions for harsh environments. Curtiss-Wright leverages Intel's long life cycle embedded products roadmap to serve the unique program requirements of the rugged deployment market.

Working together, Intel and Curtiss-Wright deliver the most advanced commercial x86 processing technology to the embedded COTS military system market. With Intel's advanced processor technology and Curtiss-Wright's leadership expertise in rugged packaging, system integration, software development and life-cycle management, system integrators are ensured that the space, weight and power (SWaP) constraints uniquely faced by their A&D applications will be addressed and met with the most sophisticated x86 processors and chipsets available.

Intel® Core™ microarchitecture-based processors offer state-of-the-art performance per watt, making them ideal for demanding compute applications in space constrained environments. Intel's recent announcement concerning their next generation of multi-core processors continues their support for the A&D market with the features that system integrators most demand for SWaP, to ensure a supply chain with support for long-lifecycle technology refresh. In addition to their unmatched performance specifications and advanced power management features, Intel architecture x86 processors also provide the industry's broadest operating system environment support, with drivers for Windows®, VxWorks®, LynxOS®, Linux® and Solaris® X. This range of OS support delivers the optimal degree of design flexibility for system integrators.





Intel® Core™ Microarchitecture

Key to Curtiss-Wright's x86 family of products for the embedded A&D market is its use of Intel Core processor family on its entire family of rugged x86-based SBCs. First launched with the Intel Core Duo processor, Intel Core microarchitecture now features Intel Core2 Duo processors, such as the popular Intel Core2 Duo mobile processor family (Intel Core2 Duo processor L7400), which marked the processor family's design improvement from 32-bit to 64-bit. Intel Core microarchitecture memory performance has also been continually improved, with processor memory cache size doubling from 2MB to 4MB in the Intel Core 2 Duo (65nm L7400) and to 6MB with the Intel Core 2 Duo Penryn processor (45nm T9400). The newly announced next generation of Intel Core i7 processors take the Intel Core architecture processor family even further. These processors are able to execute two threads simultaneously, which benefits many highly parallelizable digital signal and image processing workloads. This family of processors also integrate a memory controller into the processor chip itself. Up to two channels of DDR3-1066 memory will be supported per processor. The integrated memory controller results in measurably lower latency and far greater memory bandwidth while the new cache structure also optimizes performance and reduces latency. Each core has its own dedicated Layer 1 and Layer 2 caches, but also has access to a large, shared, third layer (L3) cache. Intel Smart Cache technology enables a core to dynamically utilize "extra" cache if another core is utilizing less. The new family of processors also support PCI Express® (PCIe) Generation 2 interfaces, which effectively doubles I/O bandwidth.



Power Management

Intel's commitment to providing low-power high performance processors and chipsets to the A&D market responds directly to the design constraints faced by embedded military system integrators. Increasingly, A&D customers must confront challenging SWaP constraints that make the need to reduce power dissipation while maximizing processor performance a critical design concern. Intel Core 2 Duo processor and the next generation processor silicon utilize 45nm Hi-k next generation Intel Core microarchitecture with Hafnium dielectrics to greatly reduce leakage current – a major side-effect of operation at high temperatures. Intel Core 2 Duo processor also uses fine-grained "clock gating" logic to turn off switching power to internal processor logic when it is idle. The next generation of Intel Xeon® processors extend this technology by turning off all power (both switching and idle power) to logic within the processor when it isn't being actively used. Power is then switched back to logic gates just before it is needed. Intel's clock and power gating are completely transparent to software—they happen automatically and are an important factor in the large increase in performance per watt ratios seen in Intel Core 2 Duo processor and next generation processors.

Curtiss-Wright's x86 family of SBCs leverage Intel architecture power management features to give system designers more control over processor power consumption. On Curtiss-Wright's 3U CompactPCI® (cPCI) SCP/DCP-1201 and 6U VME SVME/DMV-1901 cards, the ability to enable the user to "park" an unneeded core for significant power savings, or to employ Enhanced Intel Speedstep® Technology to "downshift" a processor's clock rate for additional power savings, are built-into the Curtiss-Wright supplied BIOS. The ability to park a specific core on boot-up by turning off its clock, can save as much as 5W in switching power.

Utilizing Enhanced Intel SpeedStep Technology enables the system integrator to dynamically adjust the processor's voltage and core frequency, to decrease the average power consumption and the average heat production. Combined with existing power saving features, Enhanced Intel SpeedStep Technology can



Figure 1: SCP/DCP-1201
3U cPCI Intel Core2 Duo

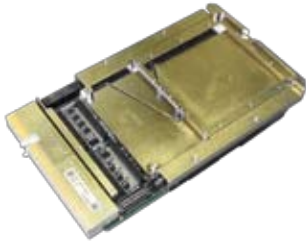


Figure 2: SVME/DMV-1901
6U Intel Core2 Duo

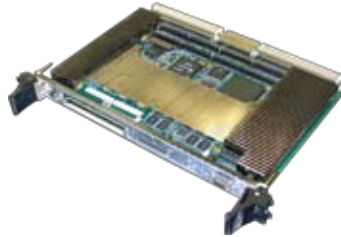
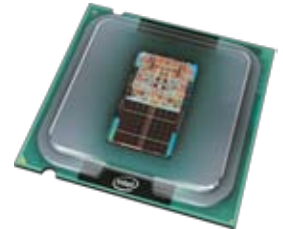


Figure 3: VPX6-1952
6U VPX Intel Core2 Penryn



Figure 4: Intel Core2



provide an excellent balance between providing power when it's needed and conserving it when that is the goal.

Curtiss-Wright's custom firmware enables the user to simply set a register to enable or disable core parking or to select the clock frequency desired. To simplify and speed time to market, Curtiss-Wright offers three-fixed speed steps from which the user may select the processor to operate upon reboot. After the board is booted, the user has an option during the BIOS set up screen to select the desired clock frequency. Currently, frequencies supported as optional speed steps are 1.5GHz, 1.33GHz and 1GHz.

Newer board designs from Curtiss-Wright, based on the Intel Core 2 Duo processor take this speed step process further, providing additional frequency options with a finer resolution to enable the customer to dial-in exactly how much performance they are willing to exchange in balance with the power management gained. Future board designs may support sleep states enabling processor cores to go idle during operation, as opposed to simply toggled on or off at reboot, which will provide even more power management flexibility. With each boot-up the user has the flexibility to decide which settings to use. Specific settings may be utilized, for example, in the development phase of a system and later modified for the deployed variant of the system. Settings in the BIOS will ensure that the system boots with the appropriate parameters when deployed in the field.

Complete System on a Rugged SBC

The low-power requirements of the Intel Core 2 Duo processor family, enhanced even further by use of power management features, enable the integration of compact high performance rugged systems with a SBC. The integration of high performance graphics within the processor chipset further aids in the design of powerful, small factor board-based systems that outperform alternatives such as rugged laptops in price, flexibility and their ability to withstand harsh shock, vibration and temperature environments.

Graphics support on Curtiss-Wright x86 SBCs ranges from the SVME/DMV-1901's on-board ATI graphics, and the SCP/DCP-1201's support for graphics expansion via a PMC site with Curtiss-Wright's Atlas, PMC-704 or PMC-706 graphics cards to the next generation of high-end graphics controllers being built directly into Intel chipsets. All new Intel architecture SBCs from Curtiss-Wright will take advantage of high-end embedded graphics built into the chipset. For example, the currently shipping VPX6-1952, in addition to support for SATA 3.0, features the mobile Intel GM45 Express chipset with an embedded graphics controller.

Advanced Video and Audio

By integrating the graphics functionality within the processor chipset, Intel saves board vendors vital PWB real-estate. While some competitors may offer 3U cPCI x86 SBCs with older video technology, Curtiss-Wright's SBCs will field the latest high-end Intel Dynamic Video



Memory Technology provided in the mobile Intel GM45 Express chipset as featured on the VPX6-1952 SBC. The high-end video that Intel is delivering in their new chipsets is equivalent to that previously available only on high-end gaming and CAD systems. For the first time, this level of video performance is being offered to system integrators as an integral part of the processor chipset, requiring no additional chips, which lowers power and raises reliability, and not simply as a mezzanine board option.

The availability of high-end video is of great value for numerous applications, such as UAVs, which are rapidly moving to the use of high definition (HD) displays. UAV operators require 1080p progressive scan capability of advanced video controllers. But video isn't the whole story. Increasingly, system designers are turning to high definition audio to enable the use of spatial recognition for radar or UAC operator applications. Curtiss-Wright SBCs featuring the latest chipset will feature built-in HD audio, making it possible for the system operator to receive directional stereophonic audio cues from different areas of their displays, making the Man Machine Interface much more intuitive and powerful.

Far Beyond Rugged Laptops

The addition of embedded graphics to high performance x86 SBCs means that the addition of a hard drive, keyboard, mouse and embedded display deliver a complete workstation from a SBC. The use of SBCs, compared to rugged laptops, delivers significant advantages including ease of upgrade, maintenance and repair while bring high-end video and audio to a truly rugged environment. Another key advantage over rugged laptops is the support for networking inherent in standard open architecture cPCI, VME and VPX chassis. These net-centric architectures enable processors to be combined to increase performance bandwidth far beyond what is possible with laptops.

All of Curtiss-Wright's x86 SBCs are provided in rugged form factors, air- and conduction-cooled, to fit into environments where a rugged laptop would frequently prove too large and cumbersome. For example, consider a vision system in a ground vehicle: a 3U SBC provides a compact, rugged single board



solution with which an entire system can be configured. With the use of DDI fiber optic cables, integrators have access to greater configuration flexibility, enabling graphics displays and spinning media to be located exactly where desired, at much greater distances from the SBC than would be possible with the cords required by a rugged laptop. To further enhance connectivity, the card-based enclosures used by open architecture SBCs may provide expansion slots to add standard data communications such as ARINC 429, 1553 and CANbus, or FPGA type environments, without having to replace a laptop's standard motherboard. The SVME/DMV-1901 also supports SCSI 320.

Spinning Media

Curtiss-Wright's Intel architecture-based SBCs are designed to ease the addition of hard disks or FLASH drives. The SCP/DCP-1201 and SVME/DMV-1901 both support SATA channels. Upcoming Curtiss-Wright SBC designs will provide support for SATA 3.0, which doubles hard drive read/write speeds from 1.5gbits to 3gbits/s. SATA 3.0 also supports additional channels, enabling RAID arrays that are becoming increasingly popular in embedded systems. RAID 0 supports multiple pipes to increase performance throughput, while RAID 1 enables the addition of another hard drive to provide data mirroring.

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