

White Paper: Overcome the Challenges of Crafting a Customized Computer

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Whether they're powering a map-sensor payload for a Global Hawk UAV or a man-pack radio system for a soldier on the move, custom computer solutions have to be small and lightweight. Oh, and while you're at it, make them ruggedized, constant in temperature, power efficient, and inexpensive.

Military contractors have been trying to solve this puzzle for years, but in almost every application, they are forced to make some tradeoffs.

The Challenges of Crafting a Customized Computer

When engineers build a 3U or 6U rack-based VME or Compact PCI-based solution, at a minimum they need an array of supporting devices including the rack, CPU, PMC or XMC cards, carrier cards, storage devices, a power supply, and cooling fans.

Tallied together, the cost for a typical assembly can easily reach north of \$20,000, while the size, heat, and power demands pile up as well. Shrink the system into a smaller size to fit in a tight space, and an engineer might need to specify conduction cooling, adding even more cost to the bottom line.

That can present a problem when the computing application has to fit on a UAV aircraft bay or in a soldier's stuffed backpack. These are completely different platforms but they share some of the same constraints: any embedded computing solution built for these locations usually carries sharp limits on its Size, Weight and Power (SWAP) requirements.

The challenge grows even tougher when the computer has to survive and thrive in extreme conditions of heat, cold, shock, and vibration. A computing solution that works for tasks in the medical or telecommunications fields would often simply fall apart if subjected to the harsh treatment of military, industrial, and aerospace jobs.

Clever Solution Speeds Development Time and Reduces Cost

To meet these stringent demands, engineers have created a clever solution – modular embedded computing platforms that allow customers to design their own customized machines.

The latest of these is a compact, integrated computing specification known by the designation COM Express Type 6, as defined by the PCI Industrial Computer Manufacturers Group (PICMG). The system essentially shaves all extra components off a design by using the carrier card to fill the role of the backplane and providing bus extensions in various form factors so that users can add only the hardware they absolutely need for the job.

The foundation of the system is simply a CPU module and a carrier card. Customers treat this system as a blank canvas and use expansion sites in standardized form factors to add specialty items from a broad menu of computing tools. For example, a user might customize the system

by plugging extra memory or MIL-STD-1553 interface cards into the MiniPCIe bus. Other bus extensions on the carrier include PMC and XMC formats, opening the door to installing almost any device imaginable.

Compared to a custom-built rack-based computer system, this result features rugged design, a small footprint in both size and power, and enough I/O expansion to meet many application demands, all for about one-third the cost.

That rare combination of attributes makes the modular embedded computing solution a great fit for Defense and industrial applications that need to operate perfectly in extreme conditions. But any defense contractor will tell you that it's not enough to simply promise perfect performance – you have to deliver the goods.

Customers shopping for a rugged, small form-factor, embedded computing system can choose from a range of products, prices, and providers in this area.

Companies like Acromag, Adlink, and Radisys all provide varieties of related products. Some of their products are fit for commercial and basic industrial applications in the medical, light industrial, or telecommunications fields, while others provide tougher solutions for use in harsh environments on military, aerospace, and heavy industrial platforms.

Upgrade to Acromag

When your embedded computing device has to work perfectly to protect expensive equipment, gather valuable data, or even protect soldiers' lives, engineers know they have to choose the strongest kit in the embedded systems market.

The COM Express product family from Acromag is built from the ground up to meet that demand, with native rugged design, integrated conduction cooling, and made-in-America manufacturing.

To guarantee robust performance in extreme operations such as defense and industrial applications such as a UAV aircraft or Mine-Resistant Ambush Protected (MRAP) vehicle, this rugged computing system bulks up the basic concept of an embedded computing device by using a thicker (more rigid) circuit board, adding extended operating temperature support via conduction cooling, and eliminating internal cabling to provide a more reliable connection.

Acromag rugged solutions also offer superior control over the thermal envelope by including heat sink bars between the CPU and the carrier, and between the carrier and the PMC or XMC bus. Keep control of the temperature and you can save on space, size, cost, and power.

Building on that solid design, users create a customized computer by selecting a processing board powered by the type of high-performance Intel multi-core CPU that best meets their demands for cost, power demand, and processing speed. Finally, customers complete the design by choosing from carrier cards featuring two Mini PCIe and up to two PMC/XMC sites.

Fine-tune Your Custom Computer Solution

Engineers need a full toolbox of options so they can address any challenge when they design a modular embedded computing platform. Here are four ways to use Acromag COM Express platforms to tackle typical challenges in building rugged computing systems for extreme operations.

1. To provide maximum computing power for high-speed imaging, analysis, and control applications, engineers could equip their modular computer with an Intel Core i7 CPU, a quad-core chip that runs at 2.4GHz and consumes 47W of power. For additional processing power, they could add 16GB of removable DDR3L memory, secured for rugged use with the SODIMM lock-down mechanism.
2. If they need to provide a boost in signal processing or to add an FPGA co-processor, engineers could choose a carrier card with two Mini PCIe sites and two XMC/PMC sites to give great flexibility for I/O expansion.
3. A job that calls for the best available power efficiency – such as smaller mobile applications – might call for an Intel i5 processor, primed to deliver plenty of processing punch while generating less heat. This dual core chip runs at 1.6GHz and needs 25W of power. Add as much as 16GB of removable DDR3L memory, lock it down with SODIMM system and the computer will be ready to go.
4. Some jobs call for advanced I/O or FPGA signal processing in a very small footprint. If that's your goal, pick a carrier card with two Mini PCIe sites and one XMC/PMC site, add the appropriate CPU module, and you're ready for testing for that rugged field deployment.

Users can create dozens more specialized applications with Acromag's COM Express embedded systems, such as:

- a small carrier that is capable of interfacing a wide variety of peripheral I/O signals from your field devices to the processor module, via a single, high-speed connector
- a solution using simplified #38999 cylindrical connectors for military-grade defense and aerospace deployments
- a special board for use during the prototyping and testing stages, that routes signals from the carrier card's high-density connector to individual peripheral connectors, simplifying system development
- carrier cards designed to fit in the smallest footprints possible, using Type 2 or Type 3 COM Express modules.

Acromag in the Field

Customers have already created strong solutions from this great array of parts. Acromag computing solutions currently running in the field include a mapping application that rides on the Global Hawk UAV and ties cameras, GPS positioning, fast CPUs, and data storage together in one tight package.

Another Acromag computer is wired in to a C-5 Galaxy transport plane, enabling it to extend a trailing arm from the cargo bay and place a package at any pinpoint location.

An Acromag kit also powers a lightweight, man-pack radio system providing crucial communication for soldiers. Yet another design acts as the brains of a rugged, industrial tablet computer used to control a drilling rig for heavy industrial use in nasty conditions of snow and rain.

About Acromag

Acromag has designed and manufactured measurement and control products for more than 50 years. They are an AS9100 and ISO 9001-certified international corporation with a world headquarters near Detroit, Michigan and a global network of sales representatives and distributors. Acromag offers a complete line of [embedded computing](#), [COM Express](#), and [embedded I/O](#) products including bus boards, mezzanine modules, wiring accessories, and software. Industries served include military, aerospace, manufacturing, transportation, utilities, and scientific research laboratories.

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