



PC/104: Right Sizing Your Embedded Application

The [ADLGS45PC](#) is a powerhouse in the PC/104 form factor. With the myriad of “COTS embedded” based products available, it can be difficult to come to a decision as to what type of embedded product is right for your application. Narrowing the field of possibilities can be costly and time consuming. How do you determine which product best fits your application requirements? Which products will give you the most flexibility? What about space constraints and environmental factors like extreme hot and cold temperatures? What kind of airflow or lack thereof will be available for cooling? What is your power budget? These are all very important questions that must be answered in order to make your project a success.

What is your application?

The fact is that most embedded products will provide adequate processing power when appropriately sized for the job at hand. However, I/O bandwidth and product expandability become critical data points when defining your application. Not only the connection of peripherals, but also data storage I/O can bottleneck your system and keep it from performing at an optimal level.

What type of environmental factors will affect the application?

There are many environmental factors that can put your hard work into an early grave when defining an embedded computer system. The top three system killers, in no particular order are temperature, shock and vibration, and power.

As a technical professional in the embedded segment for many years, I consider temperature as the largest threat to life of an embedded design. It is a silent killer. Although you may be operating your system in a relatively benign environment, thermal buildup can shorten the life of your system. Thermal buildup can occur if supplied airflow is impeded when a convective cooling design is used. The most likely cause of this after implementation is dust contamination within the system such as dust buildup on fan blades, heatsinks, components and clogged filters. If the system uses a transmissive - radiative thermal solution, then heat buildup can occur if the thermal junctions within the thermal transmission pathway are not optimal for heat transference. Misalignment when assembling or, an extreme shock or vibration event could cause misalignment if the thermal solution isn't adequately secured.

Extreme heat will not only affect the life of an embedded system but also the performance. For instance, most x86 based embedded board designs include signaling for thermal management. Onboard sensors monitor the processor die temperature as well as the board temperature at various locations. This thermal management may control (usually via BIOS and/or O/S based tool) fan rotation, providing slower fans when system loads are light, and faster fans when system loads begin to create heat. This same technology is used to prevent a runaway overtemp condition within the processor which will dynamically throttle it back to try to keep it from reaching overtemp shutdown. If thermal buildup exists, your system could be perpetually running in a “throttled” condition, giving you less than 100 percent performance. ADL offers many high performance thermal solutions that have been tailored to the thermal profile of each board. ADL can also work with customers to develop custom solutions that will enhance their system reliability.



Input power can cause an array of unforeseen and sometimes unidentifiable problems for a system designer. While most ADL products run on a single +5VDC rail, the quality of power supplied can vary greatly depending on the application. PC/104 boards are often integrated into larger assemblies such as environments where only mobile power is available. Power sources in planes, trains and automobiles vary greatly. Remote or “wearable” applications could use a renewable energy source, or run on batteries, or a gas powered generator. Most ships use power from an onboard power generator to supply the onboard equipment. Most embedded boards simply do not have the necessary PCB real estate to include the power conditioning circuits that are found on desktop boards. Therefore, choosing a quality power supply with a high switching frequency can go a long way to removing design headaches. ADL understands power requirements and has many options available to help customers with their power requirements.

Regardless of where the power comes from, it can pose unique problems that can shorten the life of a board. In all cases, a “brown-out” condition can be the most dangerous because of the severely unstable nature of the power when a brown-out occurs. This condition can send power spikes into connected equipment, often causing catastrophic component failure. Included within failure concerns with regard to power is electrostatic discharge (ESD). ESD is typically referred to in handling of electronic devices, but ESD damage can occur to a board that is installed in a system where transient voltages may exist. An extreme example of ESD is a lightning strike. Transient voltage damage can occur slowly over time, causing latent failure.

Shock and vibration failures are much less subtle than some types of heat or power failures. Vehicles provide excellent examples of both shock and vibration. Provided that the necessary space is available, what are the chances of an ITX, miniITX, COM or even an Epic board surviving a vehicle crash, or extreme airplane turbulence, or the concussion blast of artillery on the battlefield? One thing is for certain, is that it is not as good as PC/104. The mass of the larger boards is enough to cause them to break more readily in a shock environment than the smaller form factors like PC/104 have a higher survivability rate. While COM is a small form factor, it employs a modular approach that adds to the risk of a shock failure because of the added connector interface. Vibration at various frequencies will create resonant frequencies within a PCB and can cause solder failures. Small form factor boards survive a wider range of vibration as they are less affected by lower vibration frequencies than larger form factors.

Is the PC/104 form factor the right choice for my embedded application?

The short answer is, “yes.” PC/104 form factor boards offer the highest level of customization of any of the COTS embedded form factors. There are no baseboards to design and no onboard consumer grade connectors that limit the product implementation. All I/O’s can be custom cabled to meet very specific needs, allowing the board to be deeply embedded within a system. PC/104 form factor uses ISA and PCI bus interfaces similar to the VME style connectors, providing a deep and secure fit to added peripheral boards.

At ADL, PC/104 form factor boards are designed with long life components to promote 5+ years of manufacturability. Boards are available to support slower “legacy” applications that were developed years ago, as well as new technology, supporting PCI Express and SATA300 RAID architectures, such as the ADLGS45PC.

The ADLGS45PC PCI/104-Express is a powerhouse within the PC/104 form factor. It is designed around the Intel® GS45/ICH9M-E chipset and Intel® Celeron M / Core 2 Duo SFF processors up to 2.26GHz. It will support up to 4GB of DDR3/1066MHz SDRAM on an SoDIMM204 module. It offers features like 4 ports of SATA 300 RAID, 8 user USB 2.0 ports, 7.1 high definition audio, onboard dual gigabit Ethernet LAN ports, TPM and much more. With the GS45 chipset LVDS, VGA, DVI, and HDMI are all available video output options onboard or via PCI Express expansion, and it supports dual independent display.



The ADLGS45PC provides near-server grade speed and performance with higher efficiency than anything before it within a PC/104 form factor and it exceeds all others in performance per watt. Power consumption with the SP9300 processor (Core 2 Duo 2.26GHz) and 4GB of 1066MHz DDR3 SDRAM tops out at 33W, with typical consumption around 18W, when tested under 100 percent processor load under Windows XP using SiSandra benchmark utilities. When used with the Celeron M 722 (1.2GHz) the ADLGS45PC draws a maximum of 14W under the same conditions. A typical load will average 12W.

There are many reasons why the PC/104 form factor is the right choice for embedded applications. Whether the application is simple or complex, benign or harsh environment, space constrained or just the need for something compact, ADL PC/104 has the right size solution. With years of thermal solution expertise and ability to customize and ruggedize to customer needs, ADL can provide the right solution.

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