

Enclosure mission: To serve and protect



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Without exception, finished or ready-to-work computer-based hardware solutions, including the circuit boards and software together with any necessary interface connectors, need secure mounting and appropriate protection from environmental conditions. Enclosure selection, the material, and applied finish can determine a project's success or failure. Packaging or enclosure choices dictate how the device is mounted and how physical protection facilitates its proper operation and life cycle serviceability. This article will explain the benefits of proper packaging and enclosure design and application.

The standard desktop computer case has evolved little since the onslaught of the personal computer. This case is a metal box surrounding the power supply, motherboard, and various internally mounted devices. Power feeds into this box, and I/Os such as keyboards and monitors connect to it. The ubiquitous tower serves extremely well in its role of protecting the electronics, given the average conditions of a clean and comfortable office. However, taking this same computer and installing it in an even slightly less hospitable work space often leads to early system failure.

When the environment is harsh, embedded systems such as industrial computers, *black boxes*, or Commercial-Off-the-Shelf (COTS) products must address a very wide range of real-world conditions. This is especially true when reliability, uptime, data value, or mission-critical operation holds prime importance, or when any

combination of these takes precedence. In these situations, overall project success can hinge on selection of an appropriate enclosure to mount, house, and protect the hardware. Yet the enclosure is often underappreciated and given the least thought, which can, and often does, lead directly to early in-service failures, higher cost of ownership, and shorter life cycles.

Meeting rugged requirements with PC/104

A wide range of environments uses PC/104 solutions. These environments include those encompassing the day-to-day data collectors found on the shop floor, to the much more challenging, if not downright hostile conditions, found in remote installations and in airborne, seagoing, and land mobility portable or semi-portable applications.

An enclosure must fit in the space available for device installation, and must protect the device from external conditions. The enclosure's ability to meet the following requirements should be considered:

- Fit within the available space allowing for cabling and mounting
- Effectively mount and restrain the internal electronics payload
- Dissipate the energy/heat generated by the embedded electronics and by the effects of cabling on air movement within the box, by convection or fan
- Protect the payload from external thermal conditions and operational and storage temperature fluctuations, which could range from -40°C to +100°C
- Protect against environmental elements such as rain, snow, wind, lightning, dust, insects, rodents, sand, and atmospheric

pressure, and adhere to any applicable fixed standards, such as the National Electrical Manufacturers Association (NEMA) ratings

- Minimize electromagnetic interference (EMI) emitted from or received by the device when mounted in an RF hostile location
- Accommodate for improper or rough handling by the operator and/or intentional vandalism or theft
- Manage the physical load placed on both enclosure and payload, such as tension, compression, and deflection. This loading may occur on all three axes as a result of g-force(s)/shock, vibration, and natural harmonics

Application example

One product that addresses the above requirements is the Cisco Systems Series 3200 Mobile Access Router. Using industry-standard PC/104-Plus architecture, which meets the 3200's space, power, and motion requirements, this router typifies a successful embedded solution using an enclosure that meets most of the challenges listed above. The Cisco 3200 Mobile Access Router provides an always-on, seamless IP communications infrastructure. It allows connection over any wireless network that law enforcement, fire, or emergency medical personnel use to coordinate activity during a crisis. The router's compact size and rugged design make it easy to deploy in public safety vehicles, where it can withstand the harsh demands of the mobile environment. These black boxes

support any combination of data, voice, and video applications over a single IP connection to the headquarters network. It is optimized for mobile vehicular applications and offers a pathway to a paradigm shift in the way organizations communicate and share information across wireless networks to networks in motion. Such networks in motion include people who are moving, walking with a cell phone, for example, and vehicles such as airplanes, ships, tanks, and trains. The high-speed x86 processor and PCI communications bus, along with high-capacity memory, enable the Cisco 3200 Series to support advanced IP applications. The 3200 Black Box router extends the edge of the public-safety IP network into the field, where it provides critical, real-time information to those who need it most.



Figure 1

Figure 1 shows the Cisco 3200 enclosure using the off-the-shelf Tri-M Engineering CanTainer™ System. This enclosure incorporates a combination of anodized black extruded aluminum and a unique dual, internal vibration and external shock extruded rubber mounting protection system.

Figure 2 shows part of a wide endcap assortment, allowing for many different I/O connectors to meet the particular needs of Cisco's clients. Open holes ventilate the thermal energy that the electronic payload generates.

Figure 3 shows a cut-away view of this enclosure and how the dual custom DMP80 rubber extrusion interlocks with the extruded aluminum. The

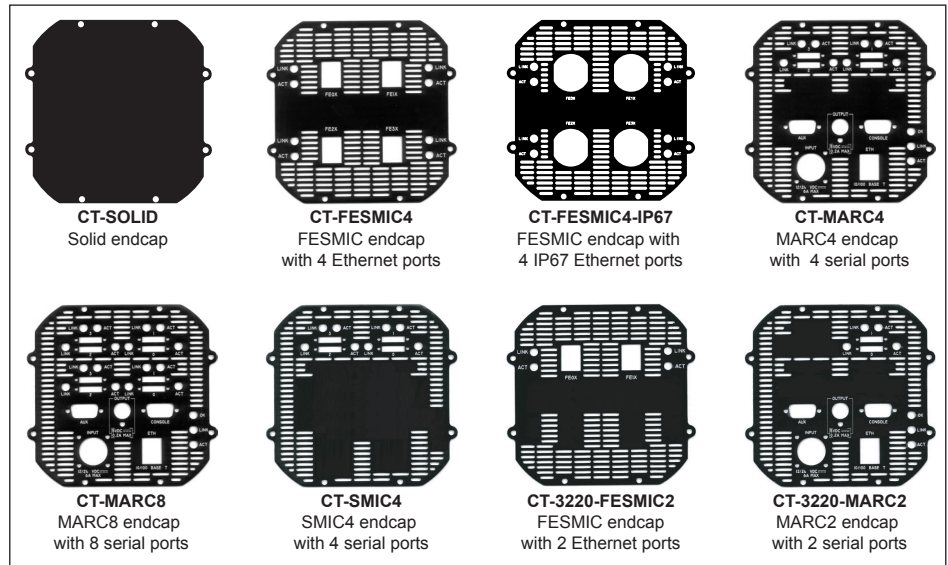


Figure 2

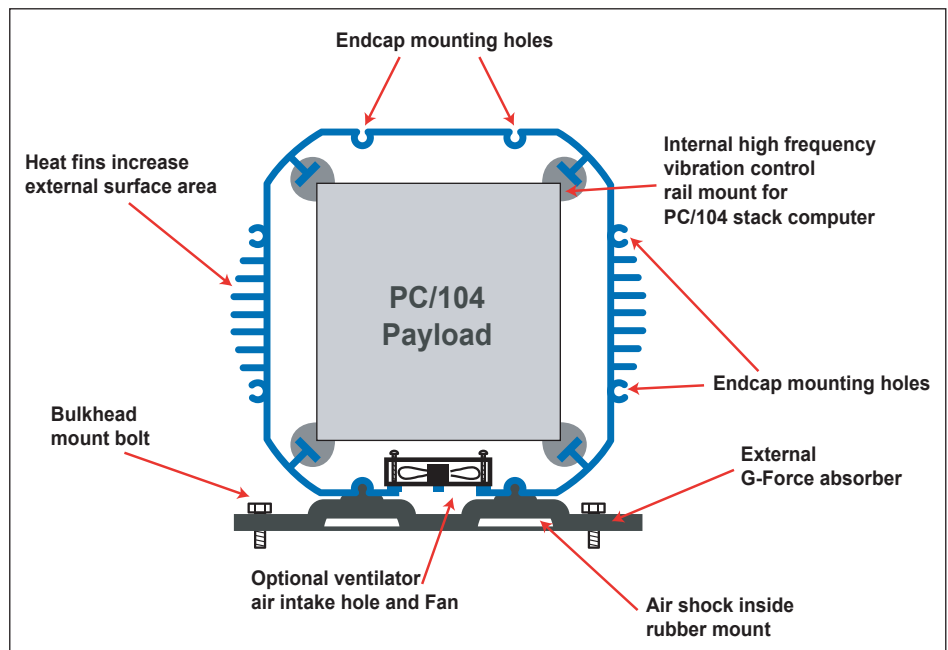


Figure 3

internal rubber rails provide a secure mounting for the PC/104 stack and enable electrical isolation and vibration protection. The external, rubber mounting rail integrates an air-shock absorber and a means to bolt the device to a bulkhead. (This is where the rubber meets the road.)

Summary

Reliable embedded solutions design takes into consideration all factors that affect

performance. Packaging solutions vary widely for PC/104 and other embedded electronics. Serious consideration is warranted in providing appropriate, efficient, and effective mounting and protection for the circuit boards in the environments where embedded devices live and work. Serving and protecting, 24/7, is critical value added.