Anticipating the impact of high-power system features

The high availability values, often up to a range near 99.999%, for telecommunications applications make even the smallest risk of failure unacceptable, and make it necessary to consider up front, in the design phase, any mechanical ambient conditions that may affect system reliability. It is in this phase that components such as the subrack, the plug-in module handle, EMC (electromagnetic compatibility) shielding or cable guides must be considered. It is here, also, that the impact of features such as redundancy, powerful cooling methods, and efficient cable routing schemes (which are quickly becoming the norm) should be considered. By anticipating the impact of high-power system features and building needed options into the system from the beginning, manufacturers will develop systems that prove more cost-efficient in both the short and long term.

Fiber optic cable in the CompactPCI environment

Optical fiber technology is becoming increasingly important in telecommunications. Designing efficient configurations for fiber optic cables in the subrack system is becoming vital, especially when one considers that these cables are extremely sensitive compared to conventional copper cables. And because the construction of subracks in telecommunication applications should conform to either the ETSI standard or to NEBS requirements, the practice of accommodating telecom fiber at the front of the subrack (via a front panel and/or a special termination panel) has become the popular norm.

In order to maintain the integrity of fiber transmission capabilities, however, optical cables must be routed with a minimum-bending radius of 30 mm. To meet this requirement, special cable guides that enable the user to efficiently route the optical cables without risk of damage are needed. These cable guides normally consist of three components or modules that can be configured as needed to meet the minimum bending requirements. At the same time, these cable guides can be easily fitted to subracks, as they can be simply clipped into perforated cover plates. Vertical modules guide the cables from the front panel to the top of the subrack, keeping the bending radius to an acceptable minimum and often eliminating the requirement for any additional cable attachment schemes. Vertical modules are typically 4HP wide, and additional 1HP spacers can be used to adapt the cable guide as one block to all conceivable configurations and to any front panel width. In special cases, it is also possible to plug the vertical cable guide directly onto a C profile.

Horizontal components attach cables to the top of the subrack. Here again, the cable guides are attached by snapping into the perforated cover plate.

EMC shielding challenges for CompactPCI Systems

With the high clock frequencies of microelectronic components, sensitivity of the modules to electromagnetic interference increases. Many new telecom applications are still working through challenges in terms of EMC because as clock frequencies increase, so do demands for robustness and easy handling. Many different subrack designs are available on the market with EMC provisions, but some involve the use of finger stock, which can be easily damaged. Designs for EMC shielding applications must address not only the longevity of the EMC solution, but also the need to achieve as much shielding as necessary for as little cost as possible.

The number of front panels in a typical system can also be a critical consideration. For example, if there are

- 8 boards
- 2 power supplies
- 2 drives

that makes for a total of 12 front panels which must retain the EMC integrity of the system in spite of the fact that front panels are where modules are fitted and removed, and that these actions must not damage the shielding. The cost can become an issue here as well, because large numbers of front panels may be needed in a subrack. Fortunately, manufacturers such as Pentair are now designing innovative EMC shielding concepts that offer viable solutions.

Unlike conventional contact spring seals of high-grade steel or copper-beryllium, the new shielding is composed of a conductive textile. The shielding attenuation values of this textile seal in the frequency range up to 1 GHz, and are in the same order of magnitude as a contact spring seal. However, in frequencies over 1 GHz, better results can be achieved by 5 to 10 dB, i.e. the shielding attenuation increases by a factor of three to seven.

Another great advantage of the newer seals is the mechanical resistance they offer. Contact springs can take only a limited amount of mechanical stress, but the special textile in the newer seals is almost indestructible and resists all normal stresses without problems. Users can fit and remove the front panel and seal as often as they want, without signs of wear.

The new front panels also allow for simple gasket installation without the use of additional tools. The textile seal is simply glued into a groove on one side of the front panel profile. The gasket seal compensates for the width tolerances of the front panels, while the front panels incorporate the design features of the gasket, including the mechanical tolerances of the extrusion, offering a solution that is both very strong and extremely cost effective.

Users benefit directly from the new U-shaped front panels, because they offer 1 mm more width for components and markings than traditional flat front panels (those with slots for contact springs where instability or lack of rigidity have been known to cause problems). The additional front panel space in the newer design is very important for connector or component mounting. The U-shape guarantees adequate stability even when there are numerous front panel cutouts. The PEN-6004 shown in Figure 1 is a Schroff Front Panel with fabric EMC gasket.

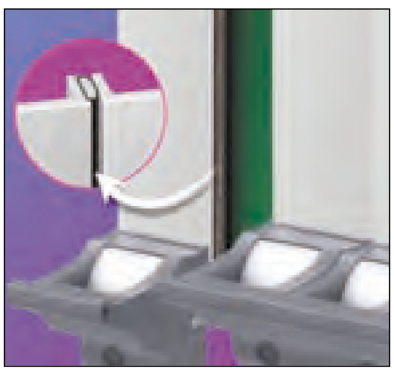

Figure 1

These new extruded front panels are typically available in 4, 8, and 12HP versions. In standard form, the front is anodized and the back is etched. The anodized front provides a surface free from the fingerprints common on alodined surfaces. In addition, the anodized surface provides a better finish for silk screening. The etched rear surface is also valuable, as it provides a conductive surface for components such as connectors. The user thus obtains a scratch-resistant, visually acceptable surface at the front, with highly conductive side and back surfaces that ensure low-resistance bonding to the seal and housing or subrack.

The importance of injector/ejector handles

The high-density connectors normally found on CompactPCI boards and backplanes require that the system be able to resist high levels of insertion and extraction forces. In the case of 6U CompactPCI boards, for example, up to 500 Newtons of force may need to be accommodated during board installation. To ensure problem-free operation, the mechanical environment must resist these forces reliably, both in terms of the front panel handle (which plays a critical role in resisting insertion and extraction forces) and the subrack and/or backplane.

When a board is installed into a CompactPCI subrack or backplane, the insertion handle latches to the front rail as shown in Figure 2. Both the hooks of material on the handle and mating rail surface are designed to handle the forces as defined by CompactPCI requirements. Centering pins are used to affix the printed circuit board horizontally in the slot before it is screwed securely into the horizontal rail. To center the board, both the CompactPCI guide rail and a perforated strip located in front of the threaded insert are used.

Figure 2

Injector/ejector handles are also the ideal solution for hot-swap systems where modules must be replaced during operation. In hot swap applications, the insertion and extraction function must be clearly decoupled from the locking and switching function. Before the board is actually removed, a micro-switch must signal to the system that the extraction process has begun. The system needs this time delay to prepare for the removal of the active board and to configure its software and hardware accordingly.

Today, many injector/ejector handles incorporate a locking switch mechanism that can be used with or without a microswitch. For hot swap applications, the switch is used to interface with the active board. Using the embedded button on the handle, the user can unlock the front panel, thus warning the system that a board is about to be removed. The front panel button design also ensures that users do not activate the unlocking function unintentionally, e.g. by inadvertently pressing an adjacent button. The Model PEN-6003 shows the button in Figure 3.

Figure 3

Injector/ejector handles were developed specifically for telecom applications where a shortage of space at the front occurs because of the space needed for cabling in the rear. In the locked state, the injector handle lies flat on the front of the panel, and is only 14 mm deep. The Model PEN-6020 Low Profile Handle is shown in Figure 4. While conformity to standards such as IEEE 1101.10 should be maintained, manufacturers should also look to providing cost effective designs that address the application-specific requirements of different markets. Figure 5 displays a variety of injector/ejector handle designs.

CompactPCI subrack solutions

In order to design the most cost-effective subrack solution, designers must have a wide range of subracks from which to choose. From the most strenu-

Figure 4

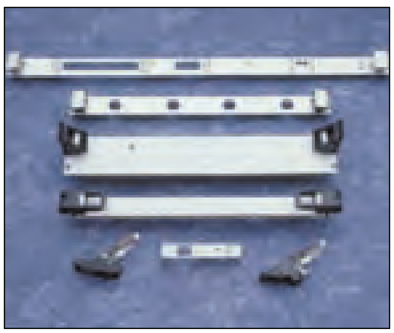

Figure 5

ous demands of high availability systems, to cost sensitive data acquisition applications, packaging engineers need flexibility in subrack platform designs. For telecom applications, designers are especially concerned with stability/rigidity, particularly in NEBS compliant applications where earthquake issues must be considered. Hence, a growing number of manufacturers have developed subrack products that address a broad range of application requirements.

There are basically three different options for prototyping and medium volume subrack applications:

- lightweight
- flexible
- heavy-duty

Customized versions that add a high volume option and are tailored for projects involving large numbers of units (often where cost is more important than modularity) are also available from some manufacturers, and represent alternatives for applications with the highest demands for stability, shielding, and price.

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