

Innovative Insights

AEROSPACE AND DEFENSE

FIBER-OPTIC INTERCONNECTS ARE A PRIME CHOICE FOR MILITARY APPLICATIONS ➤

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Downtime and poor performance in military systems are unacceptable. But finding fiber optic components that not only hold up under harsh conditions yet also consistently deliver superior throughput has proved challenging in the past—especially in recent years as the military becomes more dependent on data and video transmissions that require larger communication pipes to drive radar, avionics and surveillance systems to name a few.

Based on the ability to withstand the harsh conditions that military equipment operates in, copper interconnects have been king for many years; copper simply stood up better when subjected to extreme vibrations, heat, moisture and dirt.

But a new competitor is emerging as interconnect manufacturers have begun introducing fiber optic interconnect solutions that feature enhanced ruggedness suitable for military-grade systems. Fiber optic interconnects are also generating a lot of interest for their ability to perform better than copper in the critical SWaP (size, weight and power) areas:

- **Size**—fiber interconnects and cable assemblies can typically be smaller in size dimensionally to a comparable copper-based product that has equal or less information throughput. As boxes become smaller in size with increased bandwidth, output requirements become a key design factor.
- **Weight**—less weight is always a key benefit for military air and land vehicles since weight impacts payload capacity and related fuel usage; less weight also benefits personnel that lug communication and other computing systems long distances by foot.
- **Power**—fiber optics provide greater bandwidth for transmitting more information over longer distances, particularly crucial for the military when it comes to maintaining high-level signal integrity during the uploading/downloading of video and data files or in critical sensor applications.

An added benefit of fiber optics is immunity to EMI/RFI. Fiber is a non-conductor, so signals transmitted over the medium are not affected by the electronics/electrical environment around them; this creates an added security benefit as well.

As shown by the benefits above, fiber optic interconnects have vastly improved. They now withstand higher shock levels while also sealing out moisture and dirt. With manufacturers applying new advancements every year, fiber connectors and cabling can now be considered for an expanding set of harsh environment scenarios.

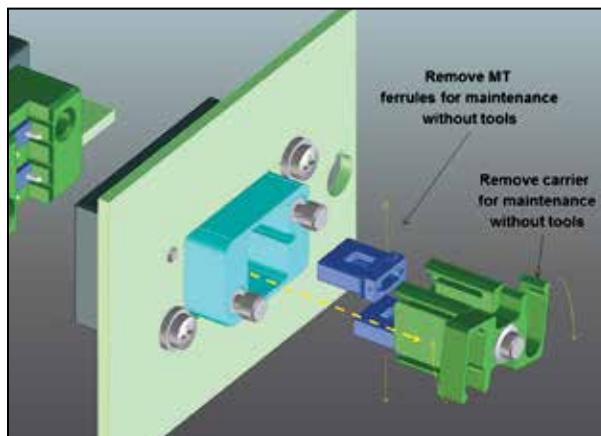


Figure 1. The leading ruggedized fiber optic interconnects are user-friendly for military applications as they enable easier installation and maintenance.

Increased fiber durability

Another key aspect that enables fiber optic cable assemblies to stand up to harsh conditions is the change from molded plastic parts to a metal shell with sealing capability. Metal provides a more robust housing than plastic and also contributes to helping the cable stand up to extreme temperatures and vibrations.

By adopting metal shells, many fiber optic interconnects can now achieve Ingress Protection (IP) ratings up to IP68, and some manufacturers now offer hermetically sealed fiber interconnects, which means they are totally dust tight and protect against the prolonged effects of immersion under pressure.

Streamlined maintenance

When choosing a fiber optic connector solution, designers should also consider how easily the interconnect can be maintained in the field. Debris such as dirt, dust, mud, moisture and oil can all foul up traditional optical interconnects in harsh environments—leading to system failures that typically have required maintenance by trained technicians, who in the past had to use special tools, solvents and cleaning materials to return the interconnects to a state where they can achieve optimal performance.

It's one thing to work on a system back at a base depot or hangar, but it's quite another to work on devices in the field or on the tarmac. There's not a lot of room to work within the tight, confined spaces

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of military vehicles, and the technicians are usually working under adverse conditions.

But interconnect assemblies that do not require specialized tools alleviate this situation. The design of such interconnects streamlines installation and maintenance—especially in densely populated systems with small chassis.

A good example of this is the ruggedized VITA 66.1 backplane solution that some connector manufacturers offer. Some versions do not require special tools to install or maintain connectors, which can be a real cost advantage in assembling a card or backplane and to personnel in the field that don't always have the best or required special tools for servicing.

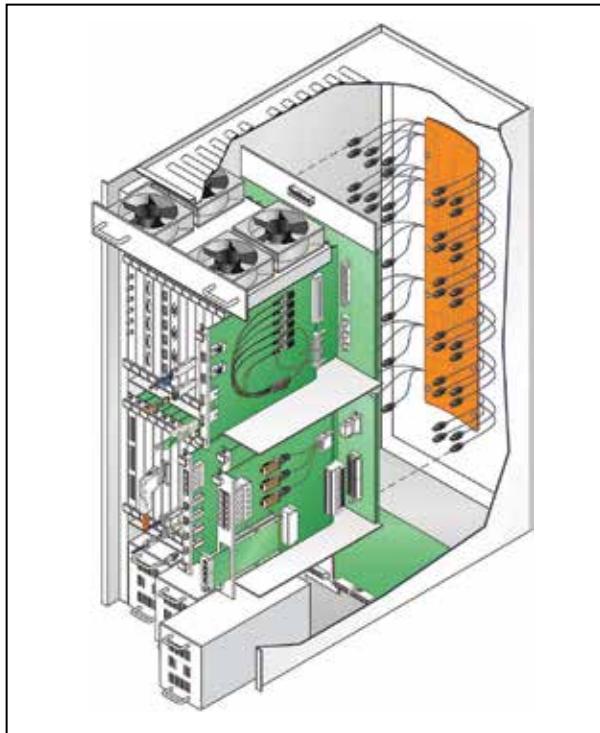


Figure 2. For fiber optic interconnects within military grade servers such as the one shown above, manufacturers now produce ruggedized high-density fiber optic interconnect and cable solutions for backplane as well as panel mount applications.

Another connector solution gaining favor is one that relies on expanded beam technology. The connectors work by utilizing fixed lenses that expand and collimate the light emitting from optical fibers across a sealed connector interface. There is an air-gap between the two aligned fibers rather than the traditional physical butt-mate. The light beam has an active area much larger than the original optical fiber core, making it less sensitive to data-transmission interruption due to dirt and debris particles.

These lenses also enable easier cleaning by technicians or personnel in the field who can clean the lens rather than touch the actual fibers, significantly reducing the potential of fiber core damage. Expanded beam connectors can also withstand thousands of mating cycles.

Suitable for a wide range of electronic military devices

As all military branches are upgrading their electronic devices to process more data as well as advanced video files, the time for deploying ruggedized fiber optic interconnects has arrived. Copper cabling, with limited transmission distance capabilities, simply can't provide the necessary SWaP characteristics paramount for modern military applications.

With fiber optics transmission, distance is considerably enhanced. And when combined with the lower weight characteristics, the technology is very suitable for devices such as backplanes in line replaceable units on aircraft, command center servers, and communication boxes on Humvees and tanks as well as land, sea and airborne-based radar systems.

The key variables for designers to search for when selecting which interconnects to work with for their application are the ability to stand up to harsh conditions, the cost of installation and ease-of-maintenance when in the field. By partnering with a leading interconnect manufacturer, designers can ensure their backplanes deliver robust as well as cost-effective performance features across the board.

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