

Miniaturization

Design Considerations to Meet the Urgent Demand for Miniaturization of Electronics in Military Applications

Summary

Military organizations throughout the world are working hard to lighten the load that soldiers carry into battle, and are looking at connector and cabling solutions as one place to make improvements. Selecting the wrong connector can be life-threatening. In this paper, Fischer Connectors' David Magni takes a close look at the miniaturization of military connectors, and addresses issues of size, weight and functionality.



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David Magni focuses on innovation and creating products that make a difference in the lives of users. He has been working closely with Fischer Connectors' customers to deliver new connector technology to the marketplace.

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Introduction

Military organizations worldwide have a great sense of urgency to modernize their operations. According to National Defense Magazine, there is an "innovation gap" that is putting the soldier of today in peril. For troops to have the best shot at surviving and winning wars, they must carry a collection of equipment that includes, among other things, communication devices, weapons, ammunition and batteries. The rugged environment in places like Afghanistan, where troops trek miles up into the thin air of the mountains, has made it more imperative that scientists in government and industry find ways to lighten loads that can reach 100 pounds. The added weight also reduces the amount of food, water and ammunition a soldier can carry. So every ounce of equipment carried must improve communications, agility and lethality for soldier survivability. And contractors must make sure the miniaturization happens now, not years down the road.

About Fischer Connectors

Fischer Connectors has been designing, manufacturing and distributing high performance connectors and cable assembly solutions for almost 60 years. Known for their reliability, precision and resistance to demanding and harsh environments, Fischer Connectors' products are commonly used in fields requiring faultless quality, such as medical equipment, industrial instrumentation, measuring and testing devices, broadcast, telecommunication and military forces worldwide. Primary design and manufacturing facilities are located in Saint-Prex, Switzerland, with subsidiaries and distributors located worldwide.

Many "Future Soldier" programs like the U.S. Department of Defense's Nett Warrior, India's F-Insas, Italy's Soldato Futuro, Poland's Uhlan 21, Finland's Finnish Warrior and Australia's Land 125 have been established to address these very issues. These military organizations pay attention to what they call SWAP – size, weight and power.

Weight is a particularly vital consideration for the dismounted soldier, who typically carries more than 80lbs. The mandate put forth by military organizations is to reduce this weight by 25%. Given that each soldier wears a backpack, body armor, and carries weaponry and ammunition, finding that 20 pounds of overall weight reduction requires rethinking the design and packaging of many types of electronic and communication equipment. For instance, night vision, targeting systems, smart phones, GPS, tactical computers and communications equipment could be integrated into a very functional and reliable subsystem, requiring an array of cables, harnesses and connectors. All of this equipment is necessary, so manufacturers must work with component partners to find ways to lose small amounts of weight in each component so they can achieve this 20-pound weight loss.

The miniaturization of component electronics and connectivity plays a vital role in reaching this goal. Connectors play an important role. They have to be rugged enough to withstand dirt, grime and weather, but should be small, light, and easy to use in tense situations. Connections must be made in fractions of a second, and often, they have to be made when wearing gloves, favoring push-pull connector designs that lock instantly rather than requiring twists. Communications devices must work 100% of the time, whether they are radios to talk with commanders or remote control devices for robots that peek around corners and report back electronically. Therefore, designers for military equipment should consider connectivity holistically with the design of their device. This can help them limit the number and size of connectors, and reduce cabling as well.

When searching for the perfect connector for a military application, several factors should be considered, including weight, size, functionality, sterilization and waterproof ratings.

Weight

Maintaining a lightweight design is extremely important when dealing with portable units. Some connectors provide weight saving of up to 75%, compared to the standard core connectors. For instance, a rugged Fischer MiniMax Series connector without any cable assembly weighs only 13 grams, yet brings 20 signal and four power connections to the device.

Size

As part of efforts to reduce the weight each soldier must carry, militaries and their prime contractors are also striving to shrink the physical size of components as well. Highly functional connectors and cable assemblies can be reduced in size by 40% compared with the older connector solutions, and prevent interference between power and signal. The diameter of a Fischer MiniMax Series connector is 12.9 millimeters, which is significantly lower than any other connector with the same number of contacts. Smaller connectors that maintain functional standards allow designers to shrink the size of their boxes. Even millimeters make a difference to a soldier in the field. **Functionality**
Ruggedness is an extremely important factor in functionality. Connectors that are being used in extreme conditions should be able to withstand an onslaught of sand, water, chemicals and other exterior factors.

Densification of pins is also important, as this allows a single miniature connector to do the job of two, three or more larger, less compact connectors. The ideal connector can have up to 24 pins and perform several functions – transmission of power, ethernet, HDMI, etc. – without interference. Manufacturers have recently made strides toward creating connectors with a large number of pins that function optimally without interference. Fischer Connectors used new techniques to achieve miniaturization, as the standard techniques limited efforts to make the connectors smaller.

Connectors should be easy to mate or unmate even when using gloves and durable enough to be functional through up to 5,000 mating cycles. This ensures that after 5,000 mating cycles, the electrical performance is still the same. Anything less and a soldier risks finding a failure in their equipment, which could be a matter of life and death.

Sterilization

In the harsh, extreme battlefield environment, it is crucial that connectors be sealed, whether mated or unmated, in order to keep out sand, dirt, water and chemicals. Just as important is the ability to clean and often sterilize (ABC principle: radioActivity, Bacterial, Chemical) these connectors without damaging them. All connectors can be sterilized, but not through all methods. For example, some can be washed, some can be steam-sterilized, and others can be placed in an autoclave machine.

Waterproof Ratings

Most connector manufacturers self-test their products. This means that while the rating “IP68,” for example, might be placed on a connector, the test that the manufacturer used to obtain such a rating might be different than the test used by another manufacturer. Such tests include immersing the connector in different levels of water for different amounts of time. When researching connectors, it is important to question the testing methods, as one brand’s “IP68” rating may have been obtained differently than another brand’s.

Military connectors should also be IP rated both mated and unmated, reducing the need for protective caps. An IP68 rating for an unmated connector is a distinct advantage to the soldier.

Conclusion

Today’s militaries continue to invest in the latest technologies, and are turning to prime contractors and off-the-shelf suppliers to bring that technology to them. The companies which bring smaller, lighter equipment to the table will be given additional opportunities to prove their devices will work in the battlefield. Paying attention to the connection solution and the latest trends in rugged connector miniaturization will help companies meet military demands and make it into the field.

MiniMax™ for the military's ruggedized devices

Fischer Connectors has created the MiniMax™ series to keep up with contemporary military standards. MiniMax™ increases the performance of ruggedized devices, handling more mixed signal and power connections, while saving space, weight and costs. MiniMax™ is designed for handheld or body-worn applications. With 20 signal pins and four power pins, MiniMax™ gives you three times more contacts and is three times more compact.

As a complete interconnect solution, MiniMax™ saves you time and money by including pre-cabled plugs and pre-wired receptacles, overmolding and protection caps.

How MiniMax™ works for the military

Fischer MiniMax is the only rugged connector of its size that brings 20 signal and 4 power connections to your device. Made with communications, robotics, and military equipment in mind, the Fischer MiniMax is designed for 5,000 mating cycles, and is easy to handle even with gloves. For the contractors building military devices and equipment, it means less weight, smaller size and building for today's military needs.

Money

Save money by using connectors that pack more functionality into smaller devices. MiniMax™ provides a cost-effective solution, containing more signal power in a smaller connector, decreasing the number needed.

Size

By miniaturizing the connector, Fischer has designed a product that takes up 40% less space, compared to the Core Series SS/DBPLU, and prevents interference.

Weight

Save more than 75% in weight, compared to the Core Series SS/DBPLU, and improve portability of your devices.

Reliable connections: MiniMax™ underwent a series of stringent tests, such as extreme temperature analysis, to produce a fully rugged product. MiniMax™ can be submerged to depths of 120 meters without experiencing disruption in operation, and is resistant to salt-water spray corrosion for 1,000 hours. This is due to the quality seal design, which provides protection to the connector whether mated or unmated.

MiniMax's mechanical and visual coding improve end-user safety. Reliable for use in the toughest environments and most demanding applications, MiniMax™ can withstand more than 4Nm of torque, 10kg of pull force and 500 mating cycles.

Expertise in sealing performance: MiniMax™ is perfectly adapted for underwater applications. Connectors are waterproof to 2 meters and safe for 24-hour submersion. Sealing is reliable even when unmated and even in case of accidental disconnection.

Complete solution

Pre-cabled plug and pre-wired receptacle termination means fast and easy connector integration. Straight and right-angle ergonomic overmolding gives you a durable and reliable solution, and sealing caps protect your connectors in the field. Measuring the width of a push pin, Fischer Connectors' miniaturized connector is available in a choice of three latching systems, push-pull, breakaway and screw lock, depending on the individual application. MiniMax's ergonomic design and compactness make these connectors easy to handle, even with gloves.

Fischer MiniMax™ Series

