WHITE PAPER

MINIATURIZATION

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fischer® CONNECTORS

REIMAGINING CONNECTIVITY TOGETHER

MINIATURIZATION

DESIGN CONSIDERATIONS TO MEET THE URGENT DEMAND FOR MINIATURIZATION OF ELECTRONICS IN MILITARY APPLICATIONS

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' Product Manager Wim Vanheertum takes a close look at the miniaturization of military connectors, and addresses issues of size, weight and functionality.

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Wim Vanheertum 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.

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 80 lbs. 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, data speed, 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 14 grams, yet brings 20 signal and 4 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 45% compared with the older connector solutions, and prevent interference between power and signal. The diameter of a Fischer MiniMax™ Series receptacle is 12 or 10 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.

Even so, engineers must be careful about reducing size. Going too small could lead to problems for soldier usability. Many commercially available connectors are too fragile for use by soldiers who are often in critical situations, and others are simply too small to be handled with gloves. The key to selecting the right sized connector may come down to looking closely at the density of the pins and the way the connector protects from interference in the smallest, lightest ways. This pin density allows the connector to be smaller, reducing both size and weight of the device and just as importantly – the cable solution required.

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. They also need to withstand rough use over time. It is important that well-used connectors be able to withstand over 4 Nm of torque, and overmolded assemblies should withstand 40 kg of pull (break-away) force.

Increasing the density 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.

Connectors should be easy to mate or unmate even when using gloves and durable enough to be functional through a high number of mating cycles. This ensures that after a high number of mating cycles, the electronical 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.

DATA TRANSFER

With increasing demands for both power and secure data transfer, military considerations for miniaturization include the ability to move data quickly and without interference. Data transfer speed is impacted by the connector, the cable selected, and the assembly itself. It becomes more important than ever to give yourself enough time to test connector/cable combinations to ensure that you achieve the data speed you are looking for. As connectors get smaller, cable selection gets trickier due to size and assembly restrictions. Suppliers should be able provide evidence of achieving certain data speeds and supporting protocols such as USB, Ethernet or HDMI, and suggest appropriate cable designs, or provide fully assembled connector/cable solutions.

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: Atomic, Bacterial, Chemical) these connectors without damaging them. All connectors can be sterilized, but not necessarily with sterilization methods. For example, some can be washed, some can be gamma-sterilized, and others can be placed in an autoclave. If you know that a connector needs sterilization, make sure you know the exact method of sterilization is acceptable for the miniature solution you select.

WATERPROOF IP 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 IP68 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.

FISCHER MINIMAX™ SERIES FOR THE MILITARY'S RUGGEDIZED DEVICES

Fischer Connectors has created the Fischer 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 4 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 PCB receptacles, overmolding and protection caps.

FISCHER **MINIMAX™** SERIES

HIGH DENSITY - SIGNAL & POWER - MINIATURIZATION

How MiniMax works for the military

The Fischer MiniMax™ Series is the only rugged connector of its size that brings up to 20 signal and 4 power connections to your device. Made with communications, robotics, and military equipment in mind, 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 Connectors has designed a product that takes up 45% less space, compared to the Fischer Core Series SS/DBPLU, and prevents interference.

Weight

Save more than 75% in weight, compared to the Fischer 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 high depths 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, 10 kg of pull force and 5,000 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

Receptacle with solder or PCB termination means fast and easy connector integration. Plugs can also come pre-cabled with straight or 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, quick-release and screw lock, and comes in two sizes (06 and 08) with contact configurations ranging from 4 to 24. MiniMax's ergonomic design and compactness make these connectors easy to handle, even with gloves.

ABOUT FISCHER CONNECTORS

Fischer Connectors has been designing, manufacturing and distributing high-performance connectors and cable assembly solutions for more than 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.

Fischer® CONNECTORS

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