USES OF ROBOTS IS INCREASING IN THE THE MILITARY TO PROTECT TROOPS FROM THE MOST HAZARDOUS OPERATIONS AND THE CONNECTORS HAVE A VITAL ROLE TO PLAY.

OMNETICS
CONNECTOR CORPORATION

How Rugged Miniature Connectors are Helping **Revolutionize the Battlefield**

In the ever-evolving world of modern warfare, electronic systems are more important than ever. Not only on a wider scale, but for individual soldiers on the ground, leading to a constant demand for devices that are compact and lightweight, yet still capable of high-speed performance and rugged enough to withstand an array of extreme environments.

Operational efficiency is key to survival in the field, for both mounted and dismounted soldiers, and so the technology used by them has to be at the forefront of design and innovation. Such innovation when it comes to devices is often well-documented, and comes with much fanfare. But a vital element of the electronic systems used by soldiers in the field is the interconnect technology within those systems – without which, they would not function, at least not effectively. Consequently, ruggedized connectors – including miniature, micro-miniature and nano-miniature - are often overlooked, yet are pivotal in ensuring the integrity and reliability of portable electronic systems on the battlefield, providing soldiers with invaluable real-time data yet doing so with more flexibility and security than ever before.

As a market leader with decades of experience innovating and producing world-class miniature connector design, Omnetics combines engineering expertise and collaboration with military stakeholders to continually advance connector technology to ensure it shapes the efficacy and versatility of those using it. Ruggedized miniature connectors remain a critical component of modern warfare technology and by addressing key challenges, innovating constantly, and proving its technology in real-life settings, Omnetics plans to remain at the forefront of the industry, producing ruggedized miniature connectors that are key to the most advanced electronic systems in the world.

Integration, Customization and Collaboration

The battlefield is an increasingly digital setting. But electronic systems need to be a careful balance of being portable but high-performing. From power hubs to cabling, and other devices worn in the field, soldiers require systems that are lightweight and miniature, yet capable of high-speed digital performance, while also being rugged enough to stand up to the harsh environments that they are deployed into. All of these requirements apply not only to the devices themselves – but to the units that connect them. Ruggedized connectors need to maintain consistent signal quality in a vast range of extreme environments, handling everything from shock and vibration to extreme temperatures, while also being protected against possible contaminants. Such requirements – all while being as small and easy to use and carry as possible - mean sophisticated engineering, innovation and integration are vital in ensuring these components guarantee unrivalled performance within the challenging environment of field operations. While technological advancements are key, so is practicality.

Such specific and challenging requirements often mean that custom connector designs are necessary. The soldier of 2023 has varying roles, in varying environments, and (sometimes, occasionally or often) needs application specific equipment for those tasks, roles and backdrops. The creation of customized connector solutions is a process that needs to be carefully undertaken, but also efficiently to answer requirements that can emerge at relatively short notice. Such a process is necessarily collaborative, bringing connector designers and system engineers together to ensure interconnects are modified and optimized for specific operational requirements.
The creation of custom connectors and systems often involves utilizing tried-and-tested components from certified and military-tested connectors to guarantee reliability, alongside the development of new formats quickly and efficiently with speed and efficiency for field testing. This quick, effective evolution and innovation of electronic soldier systems – and the connectors within them - is only possible thanks to collaboration and synergy between connector manufacturers and military technologists.

Signal Integrity, Stealth and Shielding

The modern battlefield is a busy place - electronically and physically. As technology continues to advance, and more and more electronic elements are involved, maintaining signal integrity in field operations is paramount. While electronic systems are more complex than ever, requiring high-speed data processing for everything from vision systems to biosensors, and more, the challenging conditions of the battlefield remain. This means developing devices and connectors that can cater for large amounts of data, ensuring it is transmitted and received with minimal signal loss. Reliable performance is absolutely vital to battlefield communications and operations, so the development of specialized cable and connector systems – including those capable of Gigabit signal transmission, receipt and processing - and which can match the impedance requirements of sophisticated electronic circuits, are vital to the systems used on the ground. As connectors become smaller and smaller, the risk of crosstalk and electromagnetic interference (EMI) issues are higher, which can prove problematic in extreme environments. Omnetics' signal integrity engineers not only focus on designing connectors as small as possible, but do so with the need to maintain electrical signal performance in mind - ensuring signal integrity remains market-leading and reliable for those using it in active operations.

The evolution of the battlefield into an increasingly digital space brings its own challenges and threats - with electronic and cyber threats a new enemy for those designing the systems used on the ground. Such threats mean electronic invisibility is a new must-have element for survival. This requires the development of advanced shielding techniques in both cable and connector systems. Such shielding, which include fully-shielded cables, and full-metal back shells to ensure stealth, help safeguard electronic signals from EMI interference and cyber threats. Such measures ensure that electronic systems not only operate efficiently and effectively, but do so undetected in hostile environments, ensuring soldiers can rely on their systems without fear of unwanted detection or enemy interference.

Innovating for Unmanned Systems

While the focus on miniature ruggedized connectors is often on dismounted soldiers, the technology and innovation behind them is compatible - and often as vital - for autonomous systems. Unmanned aerial vehicles (UAVs) and other autonomous systems have the same requirements for lightweight, rugged connectors that can withstand extreme environments and challenges while also guaranteeing reliable signal and data processing. With such requirements in mind, the developments within connectors for dismounted soldiers also apply - with connector interfaces that can minimize crosstalk and interference, ensuring signal quality is paramount. As UAVs play an increasing role in combat and conflict, the amount of vital data they collect and transmit is increasing exponentially, leading to a demand for high data rates yet smaller, lighter systems - all requirements that can benefit from the advances made in connector technology for dismounted soldiers and the innovation that has addressed similar challenges.

Connector technology remains an often-overlooked element of electronic systems within the theatre of war - both for dismounted soldiers but also for autonomous vehicles. Yet it is a vital element in ensuring information - the keystone of successful military operations - is transmitted reliably and efficiently in the harshest of environments. The developments undertaken to ensure miniature connectors are ahead of the game in data transmission, signal integrity and ability to withstand extreme environments and settings, as well as being capable of operating undetected, shielded from cyber threats and able to withstand potential compromise, are what make them a vital component in the electronic systems of modern warfare. And with innovation key to the long-term plan for Omnetics and its rivals, that role is here to stay.

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