



**OMNETICS**  
CONNECTOR CORPORATION

# SWAP IT OUT

**Size, Weight and Power: a driving force behind interconnect design.**

**T**oday's design engineers have a strong directive when it comes to designing new connectors and cables in a mission critical environment, and aside from the sheer reliability necessary, the next shoe to drop relates to SWaP.

SWaP which equates to: Size, Weight, and Power, is a major driving force behind the development of modern electrical and computer equipment. Whether the computing device is physically worn by a soldier on the battlefield or flying 1,200 miles above Earth in Low Earth Orbit, the physical size, weight and power of the device is critical for determining its effectiveness in any scenario.

Space Exploration is a prime example of this unfolding in real-time, and while this market (often referred to as the "New Wild West"), features design engineers navigating their way through problems, no engineer has ever faced prior. In some cases, yesterday's solutions, although proven, are just that...yesterday's solution. This too is true with cables and connectors; as designers have found their proverbial real estate shrinking down from the size of a school bus, to a refrigerator, down to a fraction of a shoe box and

while reliability will continue to be "King", it is safe to say, weight would be the proverbial "Queen" as it is estimated that each gram involved within a space application equates to \$1,000 USD.

While the price to play is a steep one as it relates to Space Exploration, demands too continue to increase with reduced processor and memory sizes, and this carries onto the battlefields as well as soldiers themselves are now carrying more computer processing power on their bodies than what would've once filled an entire building and today's digital designs require less voltage and current, thus enabling the use of smaller wires, and therefore, smaller connectors. The end result is a smaller, lighter, and more functional piece of equipment, but the toughest part for a designer is how do we get there and what do we lose?

## How do we get there?

The main challenge when designing SWaP optimized electronics is finding the delicate balance between size, weight, and power consumption without physically compromising the devices overall performance, durability, and reliability. Omnetics Connector Corp. has served the market with variations of their standard Micro-miniature and Nano-miniature products lines.

By offering design engineers the ability to quickly and painlessly combine elements of past design successes with new technology, enables designers to save both size and weight by over 50% without jeopardizing performance expectations in a singular footprint vs. multiple interconnect solution. This approach allows designers to take the confidence previously instilled by traditional MILSpec style contacts such as M38999 & M24308's and package them in a Micro-D form-factor or smaller. This has allowed engineers to uncork a whole new approach when assessing their own interconnect conundrum.



METAL BRAIDED SHIELDS CAN BE USED EFFECTIVELY TO KEEP THE SIZE AND WEIGHT DOWN AND INCREASE FLEXIBILITY.

## hy-brid: A thing made by combining two different elements

A Hybrid connector solution offers designers power contacts suitable to handle up to 10 Amps per contact, while allowing customizable data-transmission through the same high quality mil spec contacts. These contacts, rated at 3 amps per contact, can withstand over 2,000 mating cycles and while the sheer shape and number of power/signal contacts may be specified to provide the greatest flexibility in circuit design, the connector focus is always kept to the absolute minimum necessary in terms of size. This hybrid combination eliminates the need to have a larger bulk-head style d-sub type or other higher power connector present, making it easier for the operator who now only needs to mate single connector vs. multiple arrays. These hybrid connectors are available in wired or thru hole pcb mount termination types and can be packaged in the conventional screw together type Micro-D/Nano-D shells or the quick latching form factor. Hybrid circulars are also available in a standard, threaded, ratcheting, twist lock and quick disconnect breakaway shell type.

## What do we lose?

Putting aside the size and weight challenge, one additional wild card remains the overall environment. Taking an even deeper dive brings us to; environmental protection.

This is a major challenge for today's engineer invested in utilizing miniature connectors, as the majority of cables designed previously for transmission of electrical power or high voltage signals are relatively unaffected by EMI.

Electromagnetic interference also known as the ugly acronym EMI, is unwanted noise or interference in an electrical path and/or circuit caused by an outside source. Why is this such a big deal? Well, EMI is also known for causing electronics to operate poorly, malfunction and in some cases, stop working completely and which designer has the time for this?

Micro and Nano sized cables on their own are rarely designed in with the intentions of transmitting high power, but rather LVDS (low voltage differential signals), so if precautionary measures are not taken into consideration during the design phase, these cables can have disastrous results for an engineering team. This issue in particular is requiring many military and space programs to specifically require EMP or Electromagnetic Pulse Protection. Designing against EMP is basically the same as designing against EMI and that generally starts with the physical cable used vs. the connector selected. The first line of defense is generally twisted pairs. Twisted pair cable is good for transferring balanced differential signals and the process itself dates back to the early days of telegraph and radio. However, if twisted pairs aren't cutting it, the next step is physically shielding your wire bundle. Yesterday's technology may have had us believe the best cable shields for EMI were solid materials such as conduit, however, where lightweight connectors are being considered, metal braided shields can be used effectively to keep the size and weight down and increase flexibility. In fact, with cabling carrying more low voltage data signals than ever before, proper shielding is of prime importance if the integrity of the transmitted data is to be maintained and therefore consistent. While new issues will continue to place many demands on connector performance as well as constraints on connector design, in the end; reliability trumps all in mission critical applications and markets like space exploration to geophysical explorations continue to operate within some of the harshest environments known to humankind as it relates electrical components survivability. From launch vibration, to the overall operating temperature cycling. These are all challenges mission critical connectors must overcome. Make sure you pick the right one.

*This article was written and submitted by Omnetics Connector Corp., a global miniature connector design and manufacturing company.*  
<https://www.omnetics.com/>