UPGRADING THE AEROSPACE INDUSTRY WITH LIGHTER, SPACE-SAVING CABLE SOLUTIONS IS POSSIBLE

Reducing weight, simplifying wiring harnesses and streamline troubleshooting are just some of the reasons that aircraft manufacturers and avionics box designers are making the switch to Single Pair Ethernet.

Each year, new sensor suites and electronic hardware packages are added to aircraft designs. While each of these enhances the safety, reliability or fuel efficiency of the aircraft, they also add weight and increase the complexity of the design. With more sensors comes large wire bundles and more difficult troubleshooting, all jammed into the valuable real estate in the aircraft

Many techniques have been employed to reduce the overall weight of the aircraft. Steel was replaced with aluminum components, and many aluminum components were replaced with composites. All of this was done to shave off a few pounds from the design. Specialty polymer foams have also been developed for seats, carpet, sound deadening and other such purposes. Aircraft designers recognize the return on investment (ROI) in replacing materials up to a point, but the benefit has its limits.

While changing materials has reduced the overall aircraft weight, new avionics packages are constantly being added. This presents challenges for wire and harness aircraft engineers.

This Single Pair Ethernet (SPE) solution could help solve this problem. SPE is a reliable alternative that not only reduces weight but also reduces the physical footprint of the avionics package while simultaneously boosting reliability, reducing troubleshooting, and cutting installation times. SPE does all this without sacrificing data throughput, reliability or network performance. Compared to standard 1000 BASE-T connections, the number of conductors per connection is cut by 75%.

PIC Wire & Cable, a leader in Ethernet cabling and solutions, is working with both aircraft manufactures and system developers to reduce weight in aircraft design. By making the switch to SPE, wiring harness weight can be reduced by 50%, and occupy less space in the airframe.

Challenges in Aircraft Cabins

As aviation technology improves, new sensors, controllers and feedback loops are added to the systems of the aircraft. While the number of sensors changes every year, the laws of physics do not, and each additional sensor and its cabling adds weight to the aircraft.

Weight Reduction and Reduced Emissions

Weight reduction without compromising safety or system integrity is the main goal of all the aircraft design projects. The more weight that is added, the more energy (and thus fuel) is required to operate the aircraft. With many companies aiming for rigorous environmental, social and governance (ESG) goals, weight reduction is becoming non-negotiable. When the cabling is reduced, so are the weight, fuel consumption and emissions. Lowering the rate of the cable allows for an increase in the amount of payload.

Physical Space

Besides the weight, cabling also uses up valuable widespread aircraft real estate. Physical space is a commodity onboard the aircraft, and the more space that is occupied by cabling, the less space can be used for additional hardware or passenger commodities. The loss of space also makes troubleshooting tasks harder, as cables must be routed past each other in tight spaces. By reducing the cabling, the hardware system's footprint is reduced.

Increasing uptime

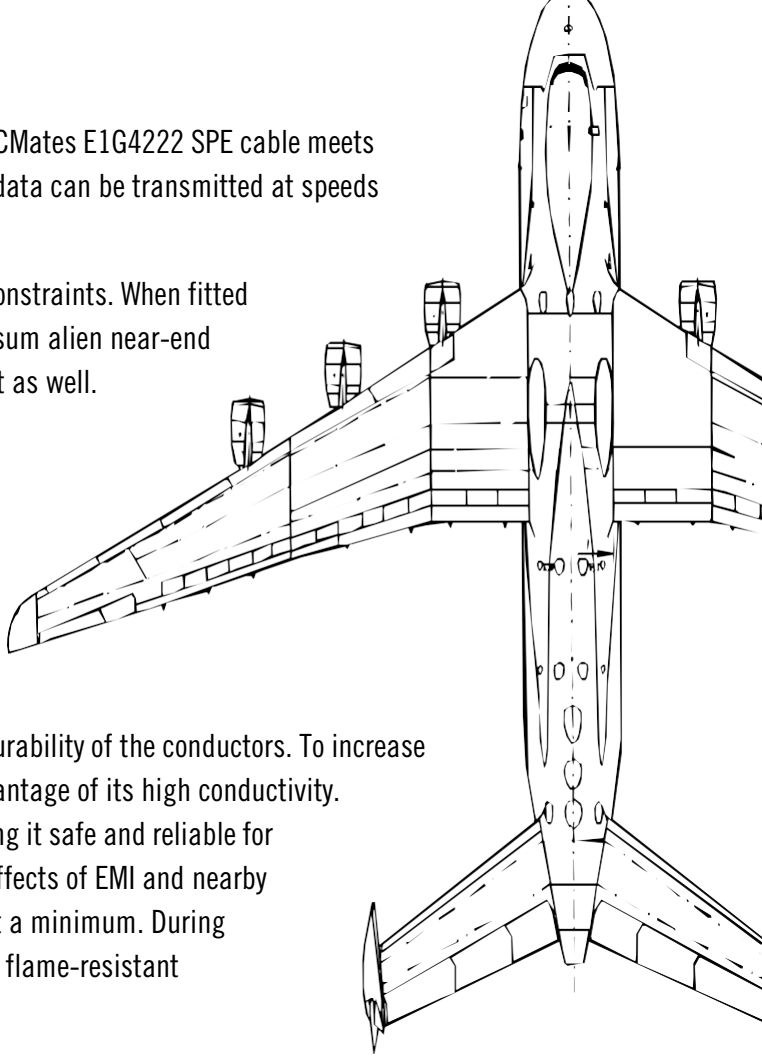
The additional sensors and cabling add complexity to the aircraft. Consequently, there are more systems to fail and more systems to troubleshoot. This often means tracing cables throughout and the more cables there are, the more time technicians must spend working on the aircraft. Ultimately, the more cables that exist, the more downtime there is during both planned and unplanned maintenance tasks. By reducing the cabling complexity, uptime is increased.

Single Pair Ethernet

One method to reduce the weight and complexity of the cabling is to reduce the number of conductors needed to perform the necessary communication. SPE offers this advantage by requiring 25% as many conductors as standard Ethernet cabling. This means for every wiring harness, the switch to SPE can reduce weight by 50%. For example, CAT5e cable can weigh up to 22.6 kg per 305 m (50 lbs per 1000 ft).

SPE makes this possible without sacrificing data throughput. The PICMates E1G4222 SPE cable meets IEEE 802.3-2022bp 1000BASE-T1 Type B standards. On this cable, data can be transmitted at speeds of 1 Gbps, at lengths of up to 42.6m (139 ft).

It passes all relevant tests for insertion loss, return loss and delay constraints. When fitted with proper IEC connections, it passes coupling attenuation, power sum alien near-end crosstalk and power sum attenuation to crosstalk ration far-end test as well.



Cable Construction

The cable itself consists of two conductors for data transmission, dual layers of shielding to reduce the effects of electromagnetic interface (EMI) and a laser markable jacket. The 22 AWG twisted-pair conductors are made from stranded silver-plated copper.
This is done for mechanical reasons to increase the flexibility and durability of the conductors. To increase electrical performance, the conductors are silver coated to take advantage of its high conductivity. The dielectric material has a high breakdown voltage (0.9 kV), making it safe and reliable for use in aircraft networks. The dual shield construction protects the effects of EMI and nearby devices, ensuring alien cross talk and corrupted data packets are at a minimum. During routing, the jacket physically protects the cabling with its wear- and flame-resistant properties and has a low friction coefficient which aids in routing.

Why Make the Switch?

There are numerous ways to transmit data, such as standard four-pair 1000 BASE-T ethernet cables and fiber optics. While fiber optics are still developing in aerospace, SPE is unique in several ways and has distinct advantages over the other solutions. In order to understand these advantages, it is worth looking at several application instances and comparing the technologies.

Consider the in-flight entertainment (IFE) on a business class jet. Wired into a seat that can move, cabling must be fast, reliable and capable of withstanding things like passenger use, continuous wear and tear, high levels of interaction and high amounts of traffic. While Ethernet, SPE and fiber optic cable can have high transmission rates, some of these are not suitable for the job.

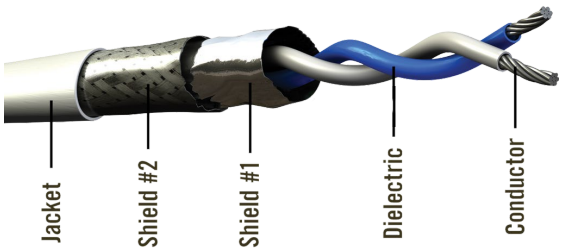
With the repeated motions and potential for bending and twisting of the cabling, fiber optics will have a higher chance of failing near the connectors. Because fiber optics are difficult to install, this will result in extra out of service time for the aircraft to make the repair. Four-paired Ethernet cabling will work, but the SPE occupies less space, is lighter and is easier to troubleshoot. Furthermore, the reduced diameter SPE cable can be bent at a tighter radius (23.37 mm or 0.92 inches), meaning it can get into hard-to-reach areas without damaging the cable.

SPE is 50% lighter and occupies 50% less space in wiring bundles than four-pair Ethernet cabling. Why not switch to a cable that weighs less and takes up less space?

The PIC Advantage

PIC Wire & Cable is a well-known, well-respected name in the aerospace-grade cabling industry. They are ISO9001 and AS9100 certified, a testament to their high-quality control standards in the aerospace industry. These cables are also RoHS compliant, making them suitable for the worldwide aircraft industry.

All of PIC's cabling has already been tested and verified to meet all relevant FAA standards. One such standard is 14 CFR Part 25 - Airworthiness Standards, which says cables must self-extinguish. These "burn and smoke" tests have been verified through third-party lab, ensuring their safety. Their tough cable jackets are resistant to abrasion, chafing, fretting and other wear due to vibration and they have a long mean time between failure (MTBF). The jacket material is also suitable for a wide range of temperatures -55°C to 200°C (-67°F to 392°F) without brittle failure from the low temperatures. For aircraft at altitude, temperature resilience is extremely important.



PIC Wire & Cable also has some of the shortest lead times in the industry. Their cables are designed to be "plug and play" and can be manufactured to custom lengths

The Bottom Line

Reducing weight, simplifying wiring harnesses and simplifying troubleshooting are just some of the reasons that aircraft manufacturers and avionics box designers are making the switch to SPE.

PIC's long-standing expertise in designing ruggedized cabling solutions for aircraft industry makes them a good choice for a partner in their switch to SPE. Reach out to their sales engineering team to guide through the transition into SPE for any avionics packaging needs.

PIC WIRE & CABLE
W220 N1051 Springdale Rd.
Waukesha, WI 53186
Tel: (262) 246-0500
www.PICWire.com
sales@theangeluscorp.com

ABOUT PIC WIRE & CABLE

PIC Wire & Cable is your premier aerospace and defense connectivity expert, delivering comprehensive, innovative interconnect solutions engineered to enhance the performance of mission-critical avionics systems. For over 50 years, we've worked side-by-side with clients to solve challenging problems and integrate those engineered solutions into aircraft worldwide. This is what we do—we're here to make our customers' jobs easier. We are committed to providing high-quality service, premium products and superior solutions to the aerospace and defense industries. Make PIC your go-to for aerospace cabling solutions and you'll see why we've been trusted with some of the toughest jobs in the industry.

PIC® WIRE & CABLE