Selecting the right Data Transmission Modules to achieve industry compliance and high performance

Environmental and Electromagnetic Challenges in Ethernet Networks

The need for Gigabit data transmission with lower latency is growing in industrial, military and aerospace applications. While all users ask for reliable Ethernet solutions, the applications also require reduced crosstalk for high reliability, operate in harsh environmental conditions with high vibration, mechanical shock and hundred thousand mating cycles. The requirements of these differ in terms of protocols, environmental conditions, certifications and standards.

Standards organisations recognised a need to address the harsh environment that can cause intermittent network. Standards like ANSI/TIA-1105-A and ISO 11801:3 refer to 'MICE' where M is mechanical (flex, vibration), I is ingress (moisture), C is climatic (temperature) and E is electromagnetic (noise).

Poor connection can lead to intermittent packet loss: Ethernet connection is sensitive to delays caused by dropped or damaged data frames (packets) as connectors experience flexing from cables, vibration, tempertaure changes leading to contraction and expansion. These problems are intermittent and a result not picked up by continuity test because such a test find open connections and not poor connections.

Electromagnetic Interference (EMI) can cause intermittent packet loss: even if one bit of ethernet packet is damaged by the MI, a frame error will be created that causes the entire packet to be rejected by their device. If several packets are damaged in a row, their machine could not function.

Background and description of Cat 5e and Cat 6A data transmission modules

Cat 5e (Category 5 Enhanced) and Cat 6A (Category 6 Augmented) data transmission modules are integral components in modern Ethernet networks, each serving distinct performance needs. Cat 5e modules, an enhancement over the original Cat 5, support up to 1 Gbps data rates and are designed to reduce crosstalk, making them suitable for most general networking applications. They usually operate at a frequency of up to 100 MHz and are widely used in residential and small business environments. On the other hand, Cat 6A modules offer significantly higher performance, supporting data rates up to 10 Gbps and operating at frequencies up to 500 MHz. These modules are designed to handle more demanding applications, such as high-speed data centers and enterprise networks, where reduced latency and higher bandwidth are critical. Cat 6A

also provides better protection against crosstalk and electromagnetic interference (EMI), making it ideal for environments with high levels of electronic noise. Available modules in the marketplace can on average operate at temperatures from -40° to +90° and withstand up to 10,000 mating cycles.

Smiths Interconnect Cat 5e and Cat 6A data transmission modules

Smiths Interconnect Cat 5e and Cat 6A data transmission modules offer robust performance in terms of electric requirement, and EMC shielding to external sources for protection and minimization crosstalk.

The electrical performance of these modules is optimized through low insertion loss, controlled impedance, and high return loss characteristics. These factors contribute to efficient signal transmission with minimal attenuation and reflection, reducing data errors and ensuring high-speed communication. Additionally, the use of high-quality conductors and advanced shielding techniques enhances resistance to electromagnetic interference (EMI), further stabilizing data transmission.

They use compliant materials who satisfy Railway standards (EN 45545-2 HL3 R22-R22), such as the polycarbonate family, to ensure high-quality insulator materials for test and measurements applications. This thermoplastic polymer offers excellent electrical and thermal insulation properties, is lightweight, can support heavy loads, and is resistant to abrasion, steam, and weather, all contributing to the safety and reliability of our products.

The high-quality insulator material plays a crucial role in maintaining dielectric properties, reducing signal degradation, and ensuring minimal crosstalk between conductors. By offering a high insulation resistance and low dielectric constant, the material supports consistent signal propagation and prevents unwanted capacitance effects. Moreover, its thermal and mechanical stability ensures long-term reliability, even in demanding environmental conditions.

Compared to existing commercial solutions, Smiths Interconnect Cat 5e and Cat 6A data transmission modules surpass various limitations, particularly in terms of operating temperature range and durability over multiple mating cycles.

They are designed to withstand higher +125°C and lower temperature -55°C extremes, ensuring reliable performance in harsh environments where standard commercial solutions may fail due to material degradation, signal instability, or mechanical stress. This makes them ideal for applications in aerospace, defense, industrial automation, and other demanding sectors requiring consistent performance under varying environmental conditions.

Additionally, they are engineered for an extended number of mating cycles (up to 100,000), utilizing high-quality contact materials and advanced surface treatments that resist wear, oxidation, and contact degradation. This enhanced durability ensures stable electrical performance over repeated connections and disconnections, reducing maintenance requirements and improving the overall lifespan of the product.

These configurations of Cat 5e and Cat 6A modules used for standard cable categories enable data transmission to satisfy specific technical requirements in ethernet protocol applications.

Data Transmission Module Cat 5e offers electrical performance with a bandwidth of 100 MHz, that satisfies the ANSI TIA 568 C.2 standard, which uses UTP and STP cables for data transmission up to 1 Gbps appropriate for IEEE 802.3 standard.

Data Transmission Module Cat 6A offer electrical performance with a bandwidth of 500 MHz, this satisfied the ANSI TIA 568 C.2 standard, which uses STP, S/STP and S/FTP cables for data transmission up to 10 Gbps appropriate for IEEE 802.3 standard.

As a result, Smiths Interconnect Cat 5e and Cat 6A modules offer significantly greater robustness and longevity compared to competitive solutions, providing a reliable, cost-effective, and future-proof data transmission solution.