

Delivering Power for Electric Vehicle Applications

Technical Article



Positronic®



Vehicles are at the heart of the modern economy. The last few decades have seen a boom in the electric vehicle market as the rising environmental cost of traditional vehicles grows. Electric cars and trucks have been joined by rail systems, and even electrically-powered aircraft. Providing connectivity for these high-power systems presents challenges, made harder by the tough environments in which these vehicles are expected to work.

Addressing the challenges of harsh environments combined with high power, Positronic has introduced the Panther family (Panther I – the PA series and Panther II – the PB Series) to deliver high performance in all weather. Combining high reliability and high capacity electrical contacts with advanced materials are key factors to solve the latest power problems in the rail, industrial, electric vehicle, and electric aircraft markets.



Designed for Tough Conditions

Connectors destined for harsh environments are created with performance in mind. The shell of the connector needs to be constructed of materials that will withstand exposure to extreme weather, physical impacts and contaminants. The contacts housed within the connector must stay aligned in high vibration conditions to provide reliable connectivity. The rubber seals around the connector body must stay flexible in a wide range of temperatures.

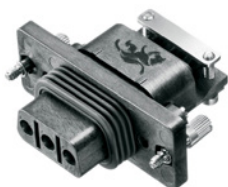
To create this level of reliability, designers must develop a true understanding of the conditions that their equipment will experience. Equipment needs to be able to withstand shock, vibration and ingress from contamination. This could be as simple as rain and spray, but there is also a need to protect against more aggressive substances. The fuel, lubricants and hydraulic fluids that are common in transportation applications can impair the safe functioning of equipment.

The Panther connector series is rated to IP69K. This means that the connector is protected from water, including being subjected to high-pressure spray, making the Panther connector ideal for outdoor use. In addition, the Panther will function in the tough conditions found on vehicle chassis and engine bay situations.



The Right Materials

Selecting the right insulator material is critical for connector design. The insulator of the Panther series connectors is a high-performance polymer material, which combines high temperature stability with mechanical strength, making it ideal for use in demanding environments. Panther I uses Polyetherimide (PEI) which delivers a working temperature of 160° Celsius, while Panther II is manufactured from Liquid Crystal Polymer (LCP), allowing a maximum working temperature of 200° Celsius, considerably higher than many alternative connectors. Both material choices offer good resistance to salt spray and comply with international railway standards on toxicity, smoke and fire safety.



PANTHER I,
Insulator materials:
Polyetherimide (PEI)



PANTHER II,
Insulator materials:
Liquid crystal polymer (LCP)

Both polymer materials enable the Panther to use a one-piece construction for the connector insulator. The trapezoidal design of the insulator provides polarization to prevent incorrect mating, and the one-piece design allows rapid assembly. Both members of the Panther family feature stainless steel fittings to provide a positive lock and deliver a secure connection, even under harsh conditions of vibration and shock.



Contacts at the Heart of Connector Design

The performance and reliability of any connector depends upon sound contact design and an understanding of materials. Positronic specializes in manufacturing machined contacts, which have a profound effect on the performance of connectors. By machining from solid metal, the electrical contact is stronger and longer lasting. A contact with a solid cross section has greater mass, which creates a lower electrical resistance and allows connectors to carry more current while keeping the temperature rise to a minimum.



This can be improved further by manufacturing contacts from high conductivity material. The standard contact material used by Positronic is copper alloy. However, the use of Tellurium Copper increases the conductivity and reduces the temperature rise. Tellurium copper contacts are a standard option across the Panther family, allowing engineers to take advantage of this high-performance material.

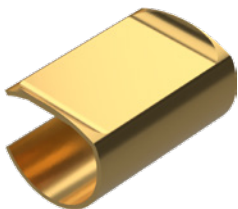
Closed Entry Contacts

The machining process allows the creation of closed entry contacts. Traditional electrical contacts often use an open-entry design, with the mating part of the female contact featuring a split tine or bifurcated contact area. The split tine is vulnerable to mis-mating or foreign object damage, which can deform the contact. This damage has the effect of reducing the normal force that ensures a reliable contact, and can reduce its electrical performance, especially under harsh conditions.



PosiBand closed entry

Machining from solid metal allows closed entry contacts to have an unbroken ring of solid material at the face of the contact. This prevents incorrect mating and damage from other objects, thus improving both the mechanical and electrical reliability of the connector.



Spring Clip

To provide the positive spring force within the contact, Positronic uses a separate spring clip. Due to the design of the contact, this can be manufactured from beryllium copper to take advantage of its elastic properties. The smallest size uses the Positronic patented Posiband, while larger contacts feature either the Large Surface Area (LSA) design or the basket-type Crown Band design. In each case, the spring clip provides a consistent retention force and a large contact surface area to provide the best possible conductivity.



Safety is Paramount



Shifting from technical design elements discussed above, the issue of safety is of primary concern for electric vehicles. Modern vehicles, especially those that use electric power to provide traction, generate circuits with very high current and voltage ratings. Without additional safety features, this high power could easily pose a significant risk to personnel required to conduct maintenance. The largest power contacts used in Panther connectors are designed with safety in mind. Male contacts are fitted with insulating caps, and female contacts are safely recessed within the connector insulator, all to ensure that operators cannot accidentally touch live electrical circuits.

Creating connectors for use in rail and mass transit applications generate an additional set of requirements. While safety should always be a consideration for designers, any situation involving members of the public requires an additional level of safety.

In addition to electrical safety, designers understand the need for products that minimize the dangers caused by fire, smoke and toxicity. Components designed for use in passenger vehicles must meet stringent standards to ensure their suitability for the application.