The Flexibility of Modular Connectors

Technical Article

Positronic

Specifying a new connector is a complicated process. Connectors must work reliably in some of the most demanding environments and applications known to man, which has led to huge variations in connector design. As a result, they can be among the most difficult components for designers to select.

Faced with such a confusing range of options, designers often find it difficult to choose the correct product for their design. Even then, it is possible that the exact combination of options that the customer requires might not be available, even with the entire interconnect industry at their disposal.

The designer must then work with a connector manufacturer to design and create a custom connector. This can be a very costly process, which may force the customer into making a compromised choice.

INTRODUCING MODULAR CONNECTORS

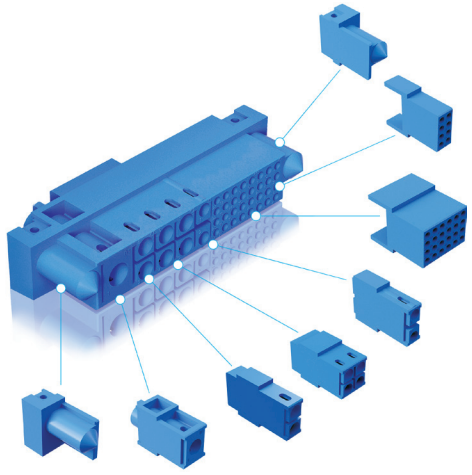
Many major connector manufacturers have identified this as an issue, and so have created several choices in the area of modular connectors. Modular connectors are designed to allow customers to construct a bespoke design from a range of standard options. The components of the modular connector are already designed and ready for manufacture, making it easy for the customer to specify the exact features required. All that the customer need do is choose the options they need to create their perfect connector.

Different manufacturers have taken different paths to create a range of modular connectors. The simplest approach follows a building-block concept. In this case, the manufacturer offers a range of individual modules that perform different functions. The customer must purchase the modules required and arrange them in the order that suits the application. The modules are then secured with a frame to create the final connector.

This concept will be very familiar to anyone who understands LEGO building blocks, and it provides similar advantages - the designer has the ability to build and rebuild their connector to suit future needs.

There are disadvantages to this concept, however. The customer must order each of the individual components which will add to inventory and record-keeping complexity. However, the flexibility provided by this system means that the designer can reconfigure the connector by simply taking it apart and starting again. In addition, as the connector is created from a number of components, they must be assembled correctly to ensure the best possible mechanical strength.

At the other end of the scale of complexity is the approach taken by manufacturer Positronic Industries with the Scorpion family. In this system, it is the mold tool itself that is modular. To create a connector, the customer selects the modules needed as before. Positronic then creates the mold tool from a number of standard dies, arranged according to the customer's design. The plastic connector is then created as a single piece before the contacts are installed, in a process known as monolithic injection molding.



The body of the Scorpion is therefore a one-piece connector that allows the customer to order a single part number. The designer might lose some flexibility as the connectors are not reconfigurable, but nonetheless the Scorpion is essentially a custom connector without the custom price tag.

The advantages of this monolithic process go beyond the creation of a single part number. Unlike a modular connector that is assembled from several components, the one-piece construction of Scorpion makes it very strong. This is of paramount importance in applications that require connectors to perform reliably in harsh environments, including aerospace and defense where systems must withstand extremes of temperature, vibration and shock.

MODULAR CONNECTORS AND ELECTRICAL PERFORMANCE

Modular connectors come into their own in applications that must accommodate a mix of different signal and power circuits in a small amount of space. A perfect example is the printed circuit board connector used in distributed power architecture applications. Here, a single connector needs to handle several AC power inputs, a number of signals for conditioning, and a potentially large number of DC power outputs. As technology continues to evolve, power supplies are being designed to deliver ever-higher performance. The concept of linear current density becomes important to the designer. Linear current density is a method used to describe how much power can be delivered by a printed circuit board connector and is affected by the type of contact that is used in the connector itself.

For decades, most connectors have used stamped and formed contacts. Stamped contacts are easy to manufacture in vast quantities, and have been highly successful in the interconnect world, helping to make mass-produced electronics affordable for consumers. Connectors that are intended to carry high power often use a blade-shaped contact that provides a greater contact surface area and a higher current rating.

For many devices, blade connectors are a good choice. They offer a combination of low cost construction with reasonable electrical characteristics. However, there are applications that require superior performance, both mechanically and electrically, that stamped contacts cannot deliver. In these circumstances, designers turn to the reliability of machined contacts.

MACHINED CONTACTS AND HIGH CONDUCTIVITY TO THE RESCUE

Machined contacts are manufactured on a lathe from a solid piece of metal. When compared with the construction of a stamped and formed contact, this manufacturing process offers a number of advantages. Mechanically, the solid body of a machined contact is stronger, and is more able to withstand repeated mating cycles or vibration. When combined with advanced features such as the Posiband contact system, machined contacts deliver class-leading reliability, making them more suitable for harsh environments.

Machined contacts also deliver superior electrical performance. Machined contacts are solid which means that the cross-sectional area (CSA) of the contact body is considerably greater when compared to a similarly sized stamped contact. This larger CSA translates into a much lower contact resistance, which in turn increases the current rating.

To improve the electrical performance even further, the Scorpion family can also make use of high conductivity materials. These contacts are manufactured from an alloy that contains a higher proportion of copper, which reduces the contact resistance even further.

When designers start to think about the linear current density of the connectors for their design, the advantages of solid machined contacts become very apparent. In the example below, a connector fitted with machined contacts made from high conductivity alloy has been compared with a traditional power connector featuring blade power contacts.

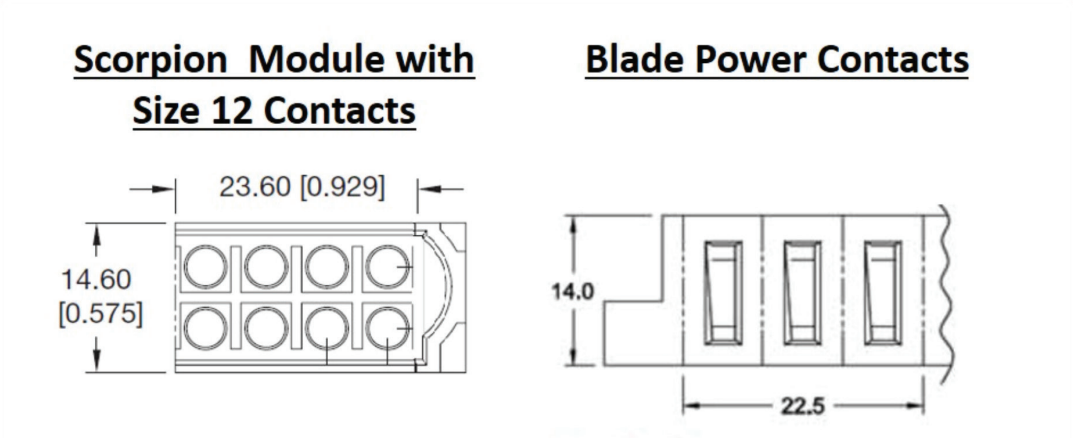


Figure 1

Contact Type	Length	Breadth	Area	Current Rating with 30° C Temp Rise	Number of Contacts	Total Current (Amps)	Linear Current Density
Size 12 Solid	23.6 mm	14.6 mm	345 mm²	27.5A	8	220 Amps	236.8 Amps/Inch
Blade Power	22.5 mm	14.0 mm	315 mm²	30A	3	90 Amps	101.6 Amps/Inch

Figure 2

You will see that, although the individual machined contacts are smaller than the blade contacts, the ability to fit more of them into the same size of connector delivers more than double the total power capacity. The linear current density for the machined contacts is nearly 237 Amps per inch, compared with 101 Amps per inch for the blade contacts.

The other feature that should be clear is that the machined contacts are much smaller than the blade contacts. When machined contacts such as these are combined with the flexibility of Scorpion and its modular construction, the designer has much greater control over the size and shape of the connector. The example shown below shows a connector designed for a distributed power system and combines different contact sizes to perform specific roles.

By allowing the designer to choose exactly the contact arrangement they require, there is no wasted space or unused contacts. The connector can be specified to deliver precisely the linear current density that is needed for the application.

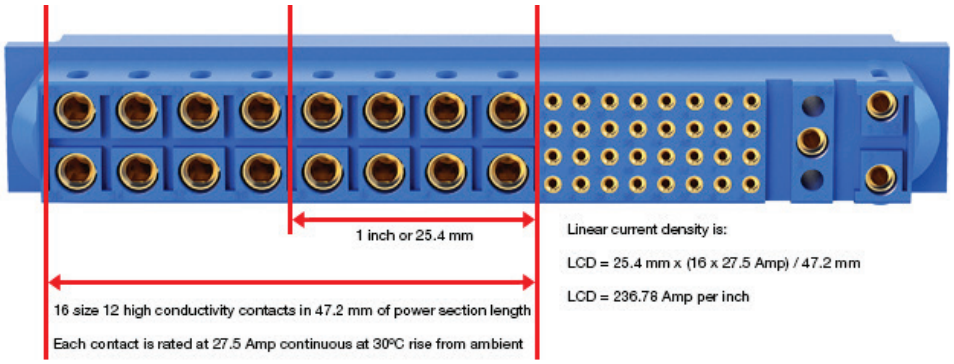


Figure 3

CONCLUSION

By combining superior electrical performance with high conductivity contacts and an innovative monolithic molding technique, Positronic has created the Scorpion family of modular connectors. However, the advantages of Scorpion go beyond the simple convenience of creating a custom connector and have addressed the challenge of increasing power demands in tough environments. The Scorpion concept allows the designer to create a custom connector that will perform exactly the role for which it is intended without compromising form or reliability.