M23 hybrid plug-in connectors for power, signals, and data

Three boons in a single package

Devices and equipment used in industrial applications frequently have several electrical connections – for power, signalling, and data. Hybrid plug-in connectors make the installation and maintenance effort much more manageable. The new M23 hybrid plug-in connectors from Phoenix Contact transmit power, signals, and data using just one device, thus creating a new level of quality in industrial cabling (Figure 1).

In the eighties, a start was made to replace conventional parallel wiring of binary and analogue signals with digital transmission technology. Instead of cables with large numbers of conductors, fewer conductors were used for transferring data and supplying the electronics with power. A new phase of decentralisation was reached with the control electronics being shifted and integrated into motors and sensors.

Addressing new applications

Conventionally supplying these devices through their own power, signal, and data cables is time consuming and costly, which is why there is a growing interest in using hybrid plug-in connectors for the supply. Hybrid plug-in connectors offer many advantages for increasingly complex applications and the growing amount of data being transferred. Typical applications include sophisticated open-loop control tasks and archiving process data. Conventional power and signal connectors quickly reach their limits in this regard. Industrial users nowadays demand shorter mounting, installation, commissioning, and maintenance times – but also safer and more reliable operation of these devices and equipment. Phoenix Contact developed its M23 hybrid plug-in connector to specifically address these requirements.
Daisy chain principle

Up until now, serial cabling for field devices was almost only known in conjunction with bus systems. A star distribution topology from the control cabinet to the motor is still the usual approach for variable-frequency drive solutions. Depending on the power and topology of the machine, using suitable hybrid servo cables, it is now possible to serially supply and control devices with power, signals, and data. To achieve this, every node has two device plug-in connectors, one as a male connector and one as a female connector (Figure 2).

The advantages of this serial connection are quite clear. It allows for rapid connection of a motor in two quick steps using the Speedcon quick locking system from Phoenix Contact. As a consequence, not only can a smaller control cabinet be used, but machine and plant cabling also becomes more structured. And shorter cable paths also reduce installation costs. The effort associated with erecting and dismantling plants and systems also needs to be accounted for. After successful completion of the tests and pre-commissioning in the manufacturer’s factory, the plants and systems must be dismantled and shipped quickly, safely, and reliably and then commissioned at the user’s facility.

Coninvers in Herrenberg, Germany – a subsidiary of Phoenix Contact – developed a hybrid plug-in connector based on the M23 connector to address these challenges. The advantages of commonly used plug-in connectors for power, signals and data were combined to pack a high degree of functionality into a small space (Figure 3). Whether the application involves a simple three-phase supply with L1-L3, N, PE, signals and data at 630 VAC or a DC link supply of up to 850 VDC for distributed servo drives, power infeed solutions most commonly use conductor cross-sections of up to 4 mm². Circular M23 hybrid plug-in connectors offer significant space advantages when compared to square plug-in connectors generally available in the market.

100 Mbit reliably transferred with Cat5

A special feature of the new M23 hybrid plug-in connector is a Cat5 element that facilitates wiring of most common bus systems as well as customer-specific data interfaces. The integrated data connector is implemented in a star-quad (also known as twisted-quad) configuration with 0.8-mm contacts. When compared to 0.6-mm contacts, they are not only significantly more rugged, but they also support simple and reliable assembly. Especially for small connector components, the design engineers placed considerable emphasis on reducing part variety and using components that can be uniquely identified. This reduces the risk of interchanging similar components, therefore making incorrect assembly less likely.

Four 1-mm signal contacts are available to address a wide range of applications. With currents up to 8 A and conductor cross-sections up to 1 mm², the connector can be used to supply control electronics or shut down hardware and equipment, for example. Depending on the outer conductor diameter, crimp connections can also be realised up to 1.5 mm².
For 630-VAC and 850-VDC applications, a current of 30 A can be safely transmitted via four touch-protected 2-mm power contacts. To achieve this, crimp contacts are available with a connection cross-section of up to 4 mm².

If no shielded data interface is required, the data element can be replaced by a 4-pole unshielded signal element. The resulting plug-in connector has the same features as the power contacts but offers eight 1-mm signal contacts.

**Suitable design for each and every application**

There are different housing designs, both for cables and devices (Figure 4). Customised cable-connector assemblies up to complete system cabling can also be realised at any time. Users enjoy many advantages:

- Completely tested cables
- Expensive test equipment is not required
- High-quality cables for optimum data transmission
- Coninvers has extensive stock for short delivery times

The hybrid connectors are additionally available as moulded plastic cable and coupler plugs. The rotatable moulded plastic angled plug is quite unique. It combines the advantages of a tested and rugged moulded plastic assembly with the flexibility of subsequently selecting the cable outlet direction to address applications where space is restricted.

**From customer project to standard product**

The M23 hybrid plug-in connector was developed in response to requests from many customers – not just from servo motor manufacturers (Figure 5). Transmitting power, signals and data in one cable and via one electrical plug-in connector between the control cabinet and field devices is also a viable design option in many other application scenarios:

- Tablet IPCs for robot control systems
- Automatic assembly machines with data archiving
- Distributed frequency converters
- Applications in packaging systems and the foodstuff industry

Through its global sales network and large number of regional offices, Phoenix Contact is close to its customers in almost every country. This ensures the reliable supply of individual connectors and components.

The M23 hybrid plug-in connector is seamlessly integrated in the existing series of circular plug-in connectors, both from a functional as well as a design perspective.
M23 hybrid plug-in connectors
Technical specifications

Connector layout: 4+4+4+PE and 8+4+PE

Operating temperature: –40 to +130 °C

Shielding: 360° outer shield as well as independent shielding of the Cat5 data element

Locking: Standard or quick locking

Vibration resistance: up to 25 g

Protection categories: IP66, IP67, and IP68

Accessories: Metal and plastic protective caps, coloured rings for marking

Approvals: UL/CSA

2 x 2 data: 30 VAC/50 VDC, 3.6 A, 0.5 mm²

4 x signal: 30 VAC/50 VDC, 8 A, 1.0 mm²

4 x power+PE: 630 VAC/850 VDC, 30 Amp, 4.0 mm²

Always available through the e-shop

With its e-shop, Phoenix Contact has taken an important step in ensuring that its products are available around the globe. This means that developers can always access the actual product data online at any time. Customers can quickly find the article they are looking for based on faceted search. A filter can be applied using general keywords – for example ‘M23’, ‘Power’, or ‘Hybrid’ – as well as technical criteria. The 3D data saved in the system provide developers with the CAD data for design adjustments on their side.

Using well-established logistics processes, customers around the world can quickly obtain the ordered product samples and components. Individualised variants allow customers to order according to their particular requirements. The e-shop also provides direct access to all relevant information, even the delivery time.