Electrical connections in the control cabinet have undergone a remarkable evolution in the past few decades. Highly sophisticated connection technologies and specific functions bear witness to the significance of connection technology for innovative manufacturers and users. Today’s market offers quick and user-friendly connection options for the wiring of large conductors of up to 150 mm$^2$ with high-current spring-cage terminals (Figure 1, lead image).

There are a large number of terminal block solutions ranging from 0.14 to 10 mm$^2$ today: whether connected via screw or spring-cage connection, tool-free, or even wired entirely without cable preparation, the options are immense. Today, terminal blocks are not only used to connect electrical cables, but also for application-specific functions like isolation or fuse protection, universal pluggability, or seating for discrete components.

Recent years have seen a push for the development of a high-connection density. This has resulted in small design widths, multi-level geometries, and high-density contacts, such as switching connectors.
Limited solutions for large cross-sections

The focus tends to be on simple connections when it comes to large conductors of 16 mm² or more. Given the universality in the cross-section spectrum, the screw terminal continues to be the dominant form, followed by the bolt terminal, which is particularly well suited for large cross-sections. The main advantage of the bolt connection is that cable with a ring cable lug can be “hung” frontally on the bolt, making it convenient to tighten the hex nut. On the downside, the assembly of the cable prior to the connection is difficult, and the cable lug has additional costs.

The installer must observe the torque specified by the manufacturer to ensure the proper installation of screw and bolt connection terminals. Due to the modular structure of modern electrical systems, control cabinets and plant parts are often prefabricated and then sold around the world, resulting in decentralized manufacturing. This makes it difficult to guarantee that the end user will observe the torques.

For example, take the installation of combiner boxes in photovoltaics. The engineering, procurement, and construction (EPC) general contractors who install combiner boxes on-site are often spread out all over the globe. Now, more and more PV plants are being set up in Central and South America or Asia. It is not always clear whether qualified specialists are assigned to the construction of plants, or whether lesser-skilled staff may be used due to the price pressure in the industry. However, failure to observe the proper torque represents a potential risk (Figure 2).

Advantages thanks to innovative spring connection

Spring-cage connections for cable cross-sections of up to 35 mm² have been around for many years. Tension-spring technology was the top technology used in terminal blocks for a long time, and even today it is still common around the world. In recent years, push-in connections have been added to spring cage technology. This technology offers a level of wiring convenience not known before – a plastic push button (pusher) provides additional safety with respect to protection against contact and incorrect wiring. This has led to significantly faster installation times. High-density wiring can be realized with a design width of 3.5 mm and a connection cross-section of 1.5 mm². However, spring-cage connections for cross-sections over 35 mm² were not on the horizon for a long time.

High-voltage terminals featuring Power Turn connection technology

A newly developed spring cage connection technology, known as “Power Turn,” entered the market in 2013 – and comes with many advantages. Designed for contacting large cables, Power Turn was initially available with a nominal cross-section of 95 mm². Today, Power Turn now comes in cross sections of 35, 50, and 150 mm².

The Power Turn connection is easy, fast, and safe – any specialist in the world can work with it. The new terminals come with an open clamping area. The cable is placed in the terminal block directly. To close the clamping area, simply move the orange actuator lever. What used to take a lot of effort before is now easy with user-friendly, powerful connection technology.

Massive cables and cables with wire-end ferrules can be plugged in directly without any tools when using the push-in connection terminal with its orange pushbutton. The Power Turn high-current terminal allows for similar direct connection. When the actuator lever is closed, cables of up to 150 mm² can be placed inside the clamping area without any tools. This is particularly useful in small spaces, because Class 1 and Class 2 cables according to DIN EN 60228 (VDE 0295) are used in the larger cross-section segment – round, single-core cables as well as round or sector-shaped multi-core cables.
Flexible verifiability, bridging, and installation

Insertion bridges are available for a nominal cross-section of 50 mm$^2$ or larger. This conveniently allows for the establishment of two- and three-pin connections of adjacent terminal blocks on both sides. Placed in the clamping area before the cable is inserted, the bridges snap into the terminal housing. This prevents them from falling out, and the user has both hands free for wiring. The bridges are equipped with a plastic fin to visually identify them. When the terminals are connected, the red fin sticks out between the cables.

The smallest terminal block with Power Turn technology has a nominal cross-section of 35 mm$^2$. This makes it compatible with universal plug-in bridges from the Clipline Complete accessories program. The bridges can be plugged into the central area of the terminal, as usual, in two rows. Special reducer bridges have proven particularly useful, as the this small power-in terminal block uses them to distribute potential on terminal blocks with nominal cross-sections of 2.5, 4, and 16 mm$^2$ (Figure 3).

Power Turn – the new connection technology

The Power Turn connection technology works with an innovative spring mechanism that consists of a bundle of up to three spring-steel elements that are positioned on top of each other. These press the cable against the current bar with great force at different positions. The current bar has a conic profile, which creates a high-contact surface and a low-contact resistance. The arrangement of the spring elements allows for the direct insertion of the cable when the clamping area is closed (push-in).

The Power Turn connection has by far the greatest cable withdrawal forces in its market segment. Terminal blocks with a spring-cage connection are tested and approved, like screw terminals, according to DIN EN 60947-7-1/2, but because they do not have screws, the terminal blocks are also subjected to an additional aging test.

With 50 mm$^2$ or larger, Power Turn offers three different testing options. The standard variant has openings for test probes with a diameter of 2.3 mm on both sides, near the conductor connection. A so-called tap terminal can be snapped into place on both sides to connect permanent test and measurement devices, but also to attach surge voltage-protection devices. The tap terminal has two additional, full-fledged push-in connections. Cables of up to 16 mm$^2$ can be connected here, and there is also space for two separate 2.3-mm test sockets. If these testing options are not sufficient, then another variant can be used, one that comes with an additional socket in the center of the terminal, for example, for touch-safe measuring lines according to IEC 61010 with a 4-mm lamella-spring contact. As a result, the voltage can be measured conveniently at the front of the terminal.

Figure 3: The PT Power 35 power-in terminal block can distribute potential to smaller cross-sections (2.5 mm$^2$, 4 mm$^2$ and 16 mm$^2$) thanks to new reducer bridges.
Conclusion

Phoenix Contact offers high-current terminals for assembly on the TH 35-15 mounting rail according to DIN EN 60715. There are also additional variants for surface mounting by means of flange mounting. This uses less space in terms of depth and also fixes the terminal optimally in place.

Terminal block variants from the PT Power product program are recommended if a constellation of up to five single terminals is required on a regular basis (Figure 4). Firmly interconnected, they are not only practical to use, but also offer the advantages of a single article when it comes to ordering or storage. These multi-pin terminal blocks are also available in mounting-rail and flange-mounting versions. As a universal terminal, PT Power has all customary approvals – including for shipbuilding and IECEx.

Figure 4: Preassembled terminal blocks reduce assembly and storage costs – the right terminal block is available for every function, for mounting-rail or direct assembly.

ABOUT PHOENIX CONTACT

Phoenix Contact develops and manufactures industrial electrical and electronic technology products that power, protect, connect, and automate systems and equipment for a wide range of industries. Phoenix Contact GmbH & Co. KG, Blomberg, Germany, operates 50 international subsidiaries, including Phoenix Contact USA in Middletown, Pa.

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