

For converters and inverters

PCB connection technology is becoming more compact

Power electronics – as used in drive technology or photovoltaics – plays a role in many areas of our everyday life. Currently, it is also gaining in importance thanks to the growing demand for energy efficiency. For instance, 40 percent of today's global electrical power consumption goes into electrical drives. Complex power electronics ensures optimal use of electrical power behind the scenes (Figure 1, lead figure).



Figure 1 (Lead Image) - Electrical drive technology plays a role in many areas of everyday life – and energy efficiency is one of its key requirements.

Most manufacturers of frequency converters and inverters are currently engaged in international competition to build a more compact, more powerful, and more economical solution. The development of semiconductors for power electronics enables constantly improving efficiency and more compact converter dimensions. Efficiency of 96 percent and higher can be reached with current devices.

Less space – more power

The increasingly compact design of devices also results in higher demands for connection technology. Converter manufacturers need optimal and fitting PCB and feed-through terminal blocks to stay on top of the game. One challenge is that there is less and less space inside the device itself for connecting and transporting electrical power. However, the conductance of economically feasible conductor materials is physically set and, therefore, limited.

It is very common to use copper with a conductance of

$$\kappa = 56,0 \frac{m}{\Omega \cdot mm^2} \text{ bei } 20^\circ C$$

or even copper alloys.

For weight and economical reasons, the use of aluminum with a conductance of

$$\kappa = 36 \frac{m}{\Omega \cdot mm^2} \text{ bei } 20^\circ C$$

is also possible in some cases. Generally, the use of aluminum is, however, limited to certain externally connected cables, depending on the application.

Therefore, the required cross-section of the conductor materials for external connection as well as for the transport of electrical power within the frequency converter is largely predetermined. Almost in contradiction to this, the connection space should still be large enough to enable comfortable cable connection of suitably large cross-sections. The cable cross-section of copper cables remains unchanged for the same current and cannot be reduced. In order to avoid line losses, even larger cross-sections tend to be used the installation environment. When considering the system from an economic point of view, a right-fit design makes sense in most cases.

Compact connection technology increases cost-effectiveness

The MKDSP 95 PCB terminal block – today's most powerful wave solderable PCB terminal block on the global market – represents a viable solution (Figure 2). The rated current is 232 A according to IEC and 200 A according to UL. Where an expensive copper busbar installation was previously needed, the device manufacturer can now use a simple solderable solution, which no longer requires separate operations during production. A standard PCB with multilayer technology carries the high current. Bolts, nuts, and special busbars are no longer needed.



Figure 2 - With a current-carrying capacity of up to 232 A, the newly developed MKDSP 95 PCB terminal block is the most powerful wave-solderable PCB terminal block on the market.

The lower space requirement is another advantage of this solution. In addition, there are no potential sources of error during installation. Furthermore, the PCB terminal block can be processed using common soldering profiles. The design and geometry of the pinnings enable the necessary energy inputs during the soldering process. The forces required for the cable connection up to 95 mm² with or without ferrule are exceeded by equipping the screws with a Torx drive, among other things. Despite the 1000 V according to IEC and 600 V according to UL, the pitch is a compact 20 mm. Based on the vibration test according to DIN EN 60068-2-6, the user is safe from an electrical and mechanical point of view. The MKDSP 95 is available with 1 to 6 pins.

Manufacturers of frequency converters and inverters can now consistently use PCB terminal blocks from 1.5 mm² to 95 mm². In this way, end users receive an integrated cable connection up to 232 A based on an identical operating philosophy.

An external connection is necessary

The external cable connection of devices should be as easy and self-explanatory as possible. When installing photovoltaic inverters, engineers have little time on site. For this reason, the connection should be simple and robust. One feasible method would be a screw connection. Terminal blocks with screw connection are known by operators and are also internationally accepted. The screw-type terminals of Phoenix Contact are also vibration tested and fitted with self-locking screws. In addition, the screws are integrated in the terminal to prevent their loss; the screw must be tightened with the required torque as a matter of principle.

The PLW 16 lever clamp from Phoenix Contact makes this task even easier. The correct contact force is enabled automatically and continuously through the spring. Furthermore, the user has visual control via the lever position – and the lever operation, too, is self-explanatory.

It's simply faster

The requirements for external device connections go in the direction of easy operation and highly compact design. On the other hand, device-internal PCB connections often take place in industrial large-scale production under controlled conditions. In addition, wiring and installation is performed by trained personnel.

Prefabricated cables with ferrule are often used, enabling high-speed installation. The desired level of economic efficiency is easier to reach when valuable time is saved during production. The use of fast connection technology also has decisive advantages.

In the case of fast connection technology based on the push-in principle, the prefabricated cable is merely pushed into the clamping area, and contact is made permanently and securely. Only a few seconds are needed for this operation. Until now, PCB terminal blocks with push-in connection were available from Phoenix Contact up to a cross-section of 16 mm². With the new SPT 35 PCB terminal block, device manufacturers can now benefit from fast connection up to a cross-section of 35 mm² (Figure 3). This means that 125 A and 1000 V according to IEC can be connected in a matter of seconds.

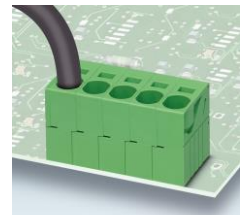


Figure 3 - 35 mm² connected in a matter of seconds – the SPT series enables simple contacting as the prefabricated cable is inserted via push-in technology.

Reflow solderable without insulation housing

A cost-efficient device design is possible today thanks to compact and flexible connection technology, as well as through the avoidance of different manufacturing processes. The

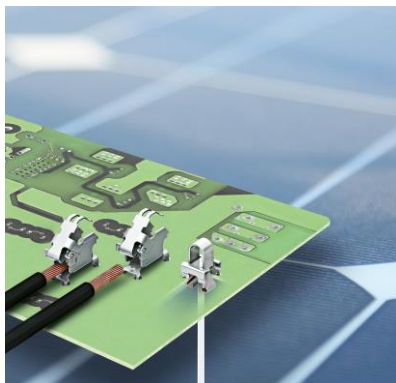


Figure 4 - Horizontal and vertical cable connection – the reflow solderable PCB terminal blocks have a current-carrying capacity of up to 41 A.

PT-SPL 6 and PT-SG 1 PCB terminal blocks are the first reflow solderable PCB terminal blocks for up to 41 A (Figure 4). Therefore, the terminal blocks can be processed with the other components in *one* soldering process. A compact spring connector without insulation housing was developed for this purpose. The developer can set the reachable voltage level by means of trace spacing on the PCB. The PT-SPL 6 PCB terminal block allows for horizontal cable connection and is available with open or closed spring connector. The closed version can be populated with the pick-and-place method via a vacuum pipette. The PT-SG 1 PCB terminal block even supports a vertical flat conductor connection.

Conclusion

The demands placed on power electronics devices are constantly increasing. An innovative connection technology offers device manufacturers the desired level of compact design and economy without forcing them to make compromises with regard to quality. The main demands of device manufacturers usually refer to the following aspects:

- Connection technology
- Angle of cable entry
- Operating direction
- Manufacturing process
- External shape/dimensions

In addition, in large-scale production there is often the desire to match the colour of external connectors to a superordinate or corporate design. Marketable PCB terminal blocks must fulfil all of these manufacturer demands.

For further information visit:
www.phoenixcontact.co.uk

If you are interested in publishing this article, please contact Becky Smith: marketing@phoenixcontact.co.uk or telephone 0845 881 2222.

PCB terminal blocks from Phoenix Contact

- The MKDSP 95 PCB terminal block reaches high levels of cost-effectiveness through fast processing as well as by forgoing additional parts, such as bolts, nuts, and busbars.
- The SPT 35 PCB terminal block facilitates extremely fast cable connection.
- The PTSPL 6 and PT-SG 1 PCB terminal blocks are reflow solderable and very compact.
- High-quality conductor materials with a sufficient cross-sectional area ensure high quality.
- Device manufacturers get highly safe components because regulatory demands are exceeded.