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PHOENIX CONTACT
INSPIRING INNOVATIONS

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DC/DC Converters Supply Rated Voltages of 12, 24, and 48 V DC Even in Extreme Environments

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Executive summary

DC/DC converters are used in a wide range of applications. They compensate voltage drops in long cables, and they increase availability by decoupling circuits or establishing separate input circuits. Also, some versions have protective coatings, so they can withstand challenging environmental conditions.

INSIDE:

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Introduction

In large systems such as bookbinding machines or bottling plants, long distances between individual stations require bridging. Cables with a large cross-section are the ideal choice for centrally supplying loads with 24 V DC. If lines are not sufficiently dimensioned, voltage drops occur that can lead to an outage or cause the connected control systems to reset. In addition, the power loss on the secondary-side supply line increases linearly as the current and line length increase.

As an example, let's assume that a 10 A power load 30 meters away is to be supplied with 10 A. A copper cable with a cross-section of 1.5 square millimeters is used for this purpose. If the power supply output voltage is 24 V DC, the remaining voltage at the load is about 17 V DC. When a voltage drop like this occurs, and it cannot be corrected by adjusting the output voltage, it makes sense to deploy multiple distributed power supplies. These are each located at the main load points (Figure 1). For 230 V AC or 400 V AC supplies, voltage drops along long cables can be disregarded as a result of the lower current.

FIGURE 1: Kolbus GmbH & Co. KG from Rahden (Germany), a market leader in the area of bookbinding machines, deploys multiple distributed power supplies located at the main load points

In some cases, however, it may be necessary to position the central control cabinet away from the system in an air-conditioned room. Other situations may require that the 24 V DC power supply is installed inside a control cabinet, because 230 V AC or 400 V AC supplies are dangerous, and should not be mounted on easily accessible machine parts. In such cases, DC/DC converters boost the voltage at the end of long cables back to the required value. Today's modules correct input voltages to a regulated output voltage of 5 to 18 V DC, 18 to 29.5 V DC, or 30 to 56 V DC.

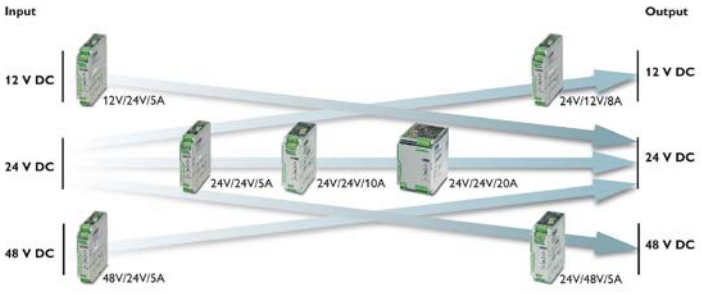

FIGURE 2: The Quint DC/DC converters cover the commonly used rated voltages of 12, 24 and 48 V DC

Reliable protection against voltage fluctuations

In addition to 24 V DC, available input voltages also include 12 V DC and 48 V DC (Figure 2). The devices' rated currents for these vary from 5 to 20 A. The circuits are galvanically isolated from one another so that sensitive loads are protected as a result of the decoupling. For this purpose, the primary switched-mode switching devices have an internal intermediate circuit, which serves as a filter. This makes it possible to separate grounded and ungrounded electrical circuits.

An additional advantage of DC/DC converters is that critical loads can be protected against interfering voltage fluctuations. For instance, when a high inrush current switches on, a brief voltage dip may occur. The same happens when loads with high input capacities are activated. Troubleshooting transient faults such as these often proves difficult and time-consuming.

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DC/DC converters are also suitable for deployment in battery-buffered supply networks or solutions with non-regulated transformers, where sensitive loads need to be supplied with a stable 24 V DC voltage.

Versatile range of deployment possibilities thanks to protective coating

It is critical to avoid failures in any industrial applications where downtimes may result in high costs. The reliability of DC/DC converters plays a decisive role when it comes to supplying controls, as well as sensors and actuators. Electromechanical migration or creepage currents caused by corrosion must in no way diminish the supply of DC voltage loads to consumers. For this reason, many manufacturers use a protective coating on their modules, which allows them to operate dependably even under extreme environmental conditions.

Electromechanical migration can cause a film of moisture to form on the PCB, depending on the prevalent temperature and air humidity. This film reduces the surface resistance and, therefore, the insulating capability. This can cause PCB tracks and solder materials to lose their contact properties and conductivity, resulting in device failure. Copper contacts may experience corrosion-related creepage currents or even interruptions. This is especially likely in atmospheres containing sulfur with a relative air humidity of more than 60 percent – not an unusual condition in industrial plants and systems.

These two examples are just some of the many scenarios that can lead to the failure of electronic components. However, one thing is quite clear: high humidity is the cause of most problems.

Coating modules with a protective layer of paint can prevent these types of faults. Yet, comprehensive protection only occurs if the coating is applied carefully. A protective coating must be thorough, leaving no area exposed. To ensure comprehensive coating, an ideal method of coating is to create a thin film by dipping the module. This type of coating even covers areas difficult to access, achieving a complete and seamless protective film. The coating also perfectly adapts itself to the contours of the electronic components. This protects these devices from the adverse effects of high air humidity levels.

Certification for the Ex range

Ensuring that devices have the proper certifications – including compliance with UL standard ANSI/ISA 12.12.01, and with Class I, Division 2, Groups A, B, C, and D (Hazardous Locations) in addition to other typical industrial approvals – is an important criteria. These approvals make them fully suitable for the U.S. market. Protective-coated modules can comply with the ATEX guideline EN 60079-15. This allows installation in hazardous zones where Category 3G equipment is necessary. In addition, they can also be used according to the conditions laid down in the railway directive EN 50155.

Selective shut-off of faulty current paths

Phoenix Contact has now integrated Selective Fuse Breaking technology (SFB), used in the company's Quint Power series, into its DC/DC converters. SFB's dynamic power reserve reliably trips standard circuit breakers within just a few milliseconds. For this, the devices supply six times the rated current for a period of twelve milliseconds. The SFB technology selectively turns off the faulty current paths and localizes the fault, so that important system components remain operational.

The primary and secondary SFB pulses are similar. This means that the DC/DC converters can also be exposed to six times the rated current for a period of twelve milliseconds. That makes it possible to deactivate the SFB technology (Figure 3). This can be necessary in cases where the upstream source cannot provide the required power in the event of a short circuit. This may occur when the input is being

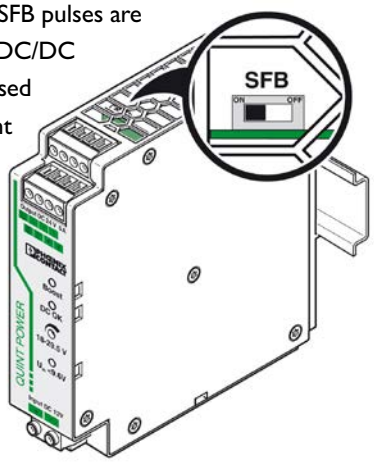

FIGURE 3: In combination with the Quint Power supply units, the SFB technology remains active, allowing the power supply to provide the required power

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supplied from a low-capacity battery or from a power supply without SFB technology.

When the SFB pulse is disabled, the DC/DC converter will not accept any high currents from the mains supply. With SFB technology activated, the DC/DC converter provides up to six times the rated current for 12 milliseconds at its output to trigger any standard circuit breakers. This means that the supply source must provide a relatively high current. The SFB switch, located on the upper side of the device, can be activated using a screwdriver.

A project planning matrix is available for designing the secondary side. This specifies the maximum wire length based on the device power class, the cable cross-section, and the MCB. The matrix can be downloaded from the Phoenix Contact website. On the primary side, the largest possible cable cross-sections and shortest possible cable lengths should be accommodated to keep the line impedances as low as possible.

Conclusion

As described, the DC/DC converters from the Quint product range significantly increase the availability of plants and systems. A high degree of functionality and quality ensure that connected loads are reliably supplied. Protective-coated devices also allow these advantages to be enjoyed in applications with extreme environmental conditions.

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.

For more information about Phoenix Contact or its products, visit **www.phoenixcontact.com,** call technical service at **800-322-3225,** or e-mail **info@phoenixcon.com.**

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