Figure 1 I 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.

Reliable in extreme environments

DC/DC converter with protective coatings

Dipl.-Ing. Anja Moldehn, Marketing Communication, Phoenix Contact Power Supplies GmbH, Paderborn

DC/DC converters are used in a wide range of applications. They regenerate the voltage at the end of long cables, and they increase availability by decoupling circuits or establishing separate input circuits. The variants with protective coatings furthermore withstand challenging environmental conditions.

In large systems such as bookbinding machines or bottling plants, long distances need to be bridged between the individual stations. 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.

Let us assume, for example, that a 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 such a voltage drop occurs, which can no longer 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.

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 in a control cabinet, as hazardous 230 V AC or 400 V AC supplies should not be mounted on easily accessible machine parts. For requirements such as these, DC/DC converters boost the voltage at the end of long cables back up to the required value. The modules from Phoenix Contact's Quint product range 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.

Reliable protection against voltage fluctuations

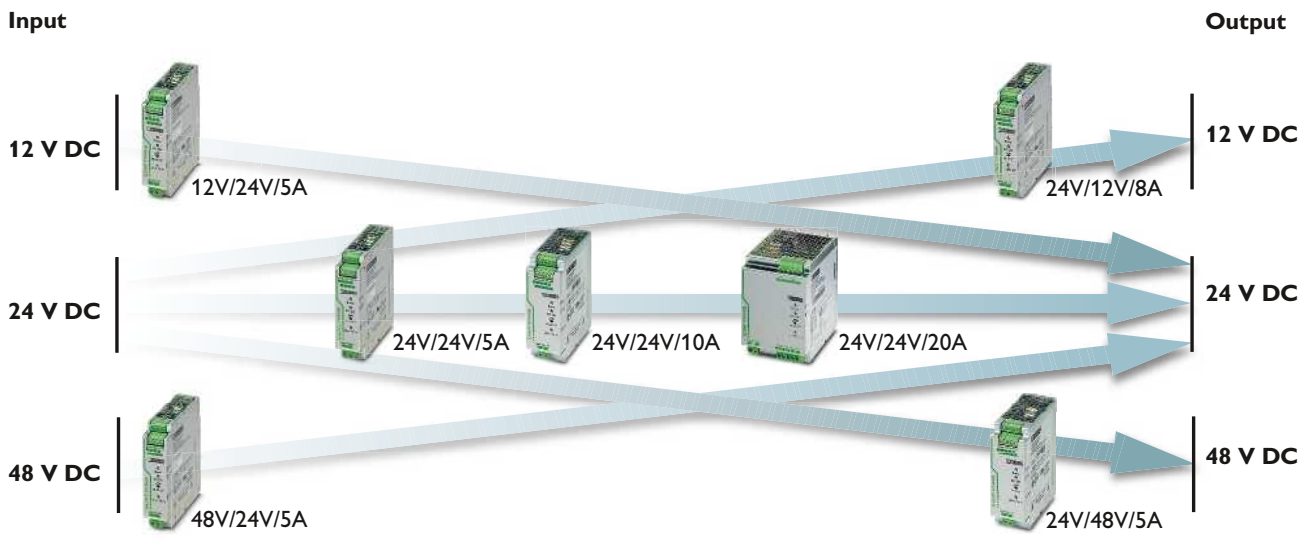
In addition to 24 V DC, the available input voltages also include 12 V DC and 48 V DC (Figure 2). The devices' rated currents for these vary from 5 to 20 A. The circuits are galvanically isolated from one another so that sensitive loads are protected as a result of the decoupling. For this purpose, the primary switched-mode devices have an internal intermediate circuit, which serves as a filter. This makes it possible to separate, for example, 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, a brief voltage dip may occur when a motor with a high inrush current is switched on. The same happens when loads with high input capacities are activated. Troubleshooting transient faults such as these often proves difficult and time consuming. 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 voltage.

Versatile range of deployment possibilities thanks to protective coating

It is imperative that failures are avoided in any industrial applications where downtimes may result in high costs. The reliability of DC/DC

Figure 2 I The Quint DC/DC converters cover the commonly used rated voltages of 12, 24 and 48 V 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, electronic modules are covered in a protective coating that 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. PCB tracks and solder materials are affected in such a way that they lose their contact properties and conductivity, resulting in device failure. Copper contacts may experience corrosion-related creepage currents or even interruptions. This especially occurs 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 – namely that high humidity is the cause of most problems.

Coating modules with a protective layer of paint provides protection against these types of faults. Yet, comprehensive protection is only achieved if the coating is applied with great care. A protective coating thus only makes sense if it is absolutely seamless and leaves no area exposed. In light of this, the protective coating for modules from the Quint product range is applied in the form of a thin film. This type of coating even covers areas difficult to access, therefore 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

The devices of the Quint product range are certified in compliance with UL standard ANSI/ISA 12.12.01, and with Class I, Division 2, Groups A, B, C and D (Hazardous Locations) on top of bearing all the typical industrial approvals. This makes them fully suitable for the U.S. market. The protective-coated modules of the range furthermore comply with the ATEX guideline EN 60079-15. As a consequence, they can be installed in hazardous zones where Category 3G equipment is necessary (Figure 3). In addition, they can also be used according to the conditions laid down in the railway directive EN 50155.

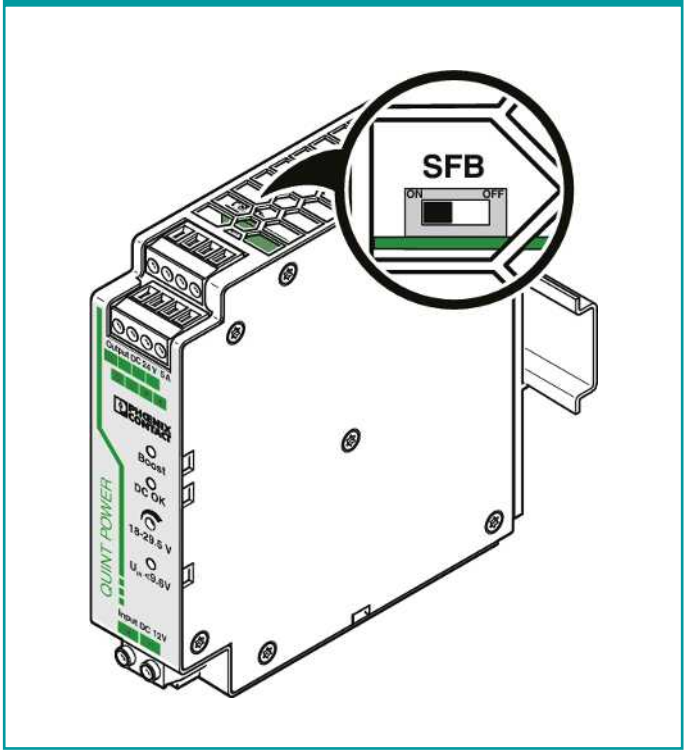
Figure 3 I The protective-coated DC/DC converters with Ex certification are also suitable for deployment in the area of process technology.

Selective shut-off of faulty current paths

Selective Fuse Breaking technology (SFB), as is used in the Quint Power series, has now also been integrated into the 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. Faulty current paths are selectively turned off, the fault is localized, and important system components remain operational. The primary and secondary SFB pulses are largely similar. This means that the DC/DC converters are also exposed to six times the rated current for a period of twelve milliseconds. That is why it is also possible to deactivate the SFB technology (Figure 4). This is necessary, for example, 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 supplied from a low-capacity battery or from a power supply without SFB technology.

Figure 4 I In combination with the Quint Power supply units, the SFB technology remains active, allowing the power supply to provide the required power.



When the SFB pulse is disabled, the DC/DC converter will not accept any high currents from the mains supply. With SFB technology activated, on the other hand, the DC/DC converter provides up to six times the rated current for twelve milliseconds at its output in order to trigger any standard circuit breakers. This means that the supply source needs to be able to provide a relatively high current. The SFB switch is located on the upper side of the device and 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 so as to keep the line impedances as low as possible.

Summary

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.