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Whitepaper – Power Distribution in Data Centres

ENCLOSURES | POWER DISTRIBUTION | CLIMATE CONTROL | IT INFRASTRUCTURE | SOFTWARE & SERVICES

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Introduction

The demands placed on the power supply to a data centre vary according to the particular equipment installations and use. The general supply configuration, however, is common to many data centres: They are provided with a mains power supply, uninterruptible power supply systems (UPS) and a generator.
The situation in the individual IT enclosures, on the other hand, is quite different. It is often the case that a given enclosure accommodates a variety of devices with different connectors. That makes it difficult to select an ideal socket strip for the enclosure. Many manufacturers produce standard socket strips with a fixed number of CEE earth-contact or IEC sockets. Variable socket strips which can be matched precisely to the requirements of an individual application are less commonplace.
A few manufacturers also offer intelligent socket strips with which it is possible to monitor the energy consumption of the connected devices. Furthermore, it is often possible to activate and deactivate single branches via the network.
Such variable and intelligent power distribution systems offer decisive benefits in the data centre when it comes to flexibility, speed of reaction and the monitoring of power distribution and consumption.

Standard socket strips

The user can choose between a number of different socket strips for rack power distribution. The figure below shows commonly used connection cables:

IEC60320 C13/C14
230 V / 10 A
3-pole

IEC60320 C19/C20
230 V / 16 A
3-pole

Earth contact (CEE 7/4)
230 V / 16 A
3-pole

Figure 1: Overview of the typical connectors found in a data centre

Earth-contact sockets (CEE 7/4) are widespread above all in Europe. IEC connectors of type C13/C14 are used primarily for servers and switches, while those of type C19/C20 are often found on particularly powerful equipment, e.g. blade servers.

Figure 2: Standard socket strip with CEE earth-contact sockets

Proper installation is hardly feasible using standard socket strips, as this would require a separate socket strip for each connector type used in the enclosure. In addition, valuable enclosure space would be occupied. And if equipment with country-specific connecting cables is installed, the user must even provide another additional socket strip.
Furthermore, there is a risk that inappropriate cable management could disturb optimum air routing through the enclosure. If the air flow from devices in the server rack is not routed optimally, hot spots may result, with corresponding negative consequences for the equipment.
Modern IT equipment often possesses two power packs to achieve a redundant power supply. That, in turn, means that twice the determined number of socket strips must be installed in the rack. In the case of 600 mm wide and 1000 mm deep racks, such installation is practically impossible. For such applications, the user should better choose a modular socket system.

Intelligent standard socket strips

Many manufacturers offer intelligent socket strips. With these systems, it is possible to switch or manage individual sockets. Some manufacturers already pre-install measuring instruments to measure current, overall consumption, voltage and the specific power consumption of the connected devices. These measured values can be called up and saved locally via a display and the network. Power failures, voltage fluctuation and overloads can be reported via SNMP (Simple Network Management Protocol), by e-mail or by SMS to the building services management system and the administrator.

Modular socket strips

One flexible means to remain prepared for changing demands in the data centre is to make use of modular socket strips. A basis for such a modular system is a support rail which acts as a busbar and is connected directly to the power infeed or the UPS system. Various socket modules can then be mounted on this support rail as required. Modules are available with all typical socket types, including also many country-specific connector sockets.

Figure 3: Modular socket strip

Once the busbar has been installed and connected to the power supply, modules can be added or replaced during the course of later operation, even without specialist electrical knowledge. This provides for a high degree of flexibility. Reaction times are also shortened, as modifications can already be performed during operation by the administrator. If more sockets are needed, an additional module can simply be mounted on the busbar. Combinations of modules with different socket types are similarly possible.

Busbars for modular socket strips

The busbar/support rail consists of a U-profile section which accommodates the entire cabling. This design provides for full shock-hazard protection. The busbar can be mounted vertically on the enclosure frame, and thus occupies no rack units which could otherwise be used for IT equipment. Once the busbar is mounted, the required socket modules can be installed. Busbars are available in different lengths to match different heights of IT rack. The electrical connection can be realised as a 3-phase (e.g. 3 x 16 A) or single-phase (e.g. 1 x 32 A) infeed, depending on the power requirements in the enclosure. Modern busbar systems offer the option of two independent infeed sources. In this way, redundancy can still be achieved with a single busbar.

IEC60309	IEC60309	IEC60309	IEC60309
single-phase 16 A	single-phase 32 A	3-phase 16 A	3-phase 32 A
230V+N+PE	230V+N+PE	400V+N+PE	400V+N+PE

Figure 4: Overview of the typical power infeeds to the busbar

The orientation of the installed modules determines which of the two supplies is used. If a module is removed from the busbar and re-inserted after turning by 180°, it will automatically take its power supply from the other infeed source. This principle is illustrated by the infeeds A and B to be seen in Figure 5 below.

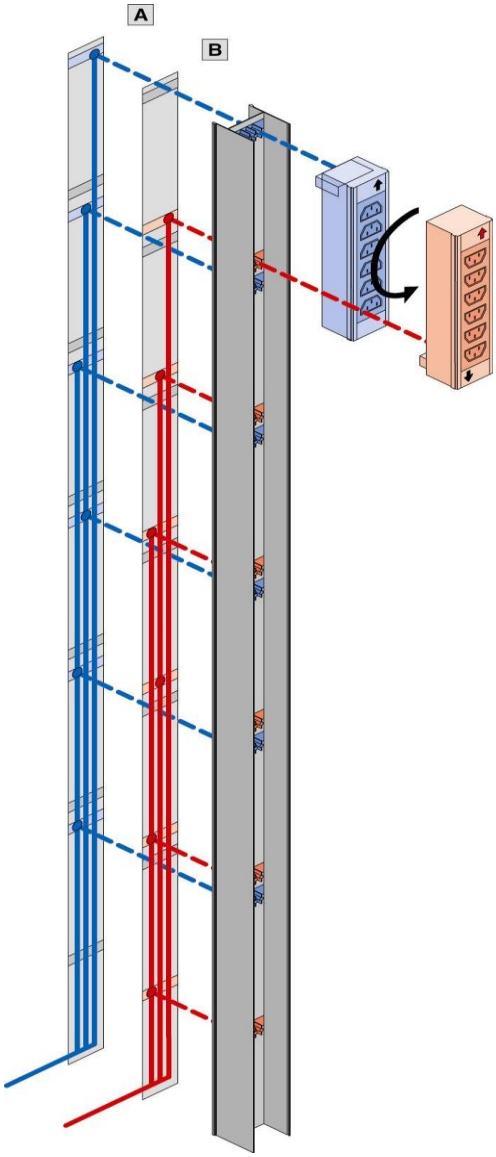

Figure 5: Principle of a redundant power supply

Socket modules

The socket modules are themselves closed systems. In the same way as the busbars, their design provides for full shock-hazard protection. As a result, it remains permissible for persons without specialist electrical knowledge to work with the modules. The simple plug-and-play system for the modules, furthermore, not only reduces assembly time, but also saves costs.
Modules are available for all typical connector variants.
Most modules possess integrated overload protection, i.e. only the fuse of the module affected is tripped in case of overload. If a module is found to be defective, it can be replaced

with a new module in next to no time. The time between failure of the old module and operational readiness of the new module – MTTR (mean time to repair) – is reduced to a minimum. The latest socket modules possess integrated 3-colour LEDs, which provide information on the current load status of the module. An example of a module in the “green” state can be seen in Figure 6.

Figure 6: Socket module with LEDs

Intelligent power distribution systems

In modern data centres, it is especially important to retain an overview of the current power consumption both for individual pieces of equipment and for the data centre as a whole. The possibility of remote monitoring is gaining in significance. The reason: Increasing operating costs. SNMP-capable busbars and socket modules offer this and many other features. The use of such systems greatly simplifies monitoring and control in the data centre, and at the same provides for more intensive monitoring.

Network-capable busbars

One possibility for monitoring is to use network-capable busbars with integrated measuring systems to monitor and record all relevant parameters of the busbar system. These measuring systems can be monitored and configured via the network. It is possible to define limit values for the current, voltage and power per phase of the infeed. If any of these values is exceeded, the system generates an alarm and sends out corresponding messages by e-mail or SMS. The busbars also incorporate an LC display for local visualisation of the data. In addition, this display permits local modification of the relevant settings. Alarms are indicated by a flashing LC display.

Figure 7: LC display on network-capable busbar with measuring system

Intelligent socket modules

Network-capable socket modules with integrated intelligence are similarly a possibility to prepare a data centre for remote monitoring and control. With these systems, the intelligence is independent of the busbars used. It is thus also possible to combine intelligent or active modules with passive socket modules on a standard busbar, for example when only a subset of the installed equipment is to be monitored and controlled. The sockets on these active modules are all switchable, i.e. the connected devices can be controlled individually. As in the case of network-capable busbars, active socket modules also permit the definition of limit values and provide for alarm messages to be issued via e-mail or SMS. The actual current values for the modules are presented locally by way of LED displays. A few manufacturers also offer these modules in 1 U versions for 19" rack installation. This is an interesting option above all where no further space is available to the side of the 19" rack. If several active modules are used in a single enclosure, they can also be cascaded.

Accessories for modular power distribution systems

In addition to the actual socket modules, a broad spectrum of accessories can be added to the modular systems.
One such retrofit option is overvoltage protection, which can be installed ahead of the busbar. Another module enables measuring functions to be added to a busbar without integrated measuring system. This measurement module is connected on the infeed side of the busbar and installed in the enclosure. Further practical accessories include equipment connection cables. To avoid excessive lengths of cable and potential impairment of the air flows within the enclosure, these cables are available in various lengths from 50 cm. This serves to minimise the risk of enclosure hot spots, which could have a negative effect on the performance and service life of the installed equipment. The overall range of accessory products enables a modular system to be tailored precisely to the requirements of an individual enclosure.

Summary

Power distribution systems are present in every data centre. As energy costs and power densities increase, these systems will continue to gain in importance in the future. Standard socket strips very soon reach their limits given the wide diversity of connectors to be found on IT equipment and the growing demands for remote monitoring functionality. The use of modular and network-capable power distribution systems achieves significantly greater flexibility and scalability. Busbars with integrated measuring systems permit the monitoring of energy consumption. Intelligent socket modules offer comprehensive possibilities for remote monitoring and control. With the aid of intelligent, modular power distribution systems, power distribution can be adapted to the specific circumstances, while at the same time reducing energy consumption. This contributes to lowering of the operating costs for a data centre. Thanks to the possibility to realise two independent infeeds with a single busbar, it is no longer necessary to install two distribution systems in each enclosure to achieve a redundant power supply. That reduces the investment outlay for IT enclosures.
All these points are benefits which permit significant cost savings for the data centre of tomorrow.

List of abbreviations

IP	–	Internet Protocol
IT	–	Information technology
LED	–	Light-emitting diode
MTTR	–	Mean time to repair
SMS	–	Short Message Service
SNMP	–	Simple Network Management Protocol
U	–	Rack unit (height 44.45mm)
UPS	–	Uninterruptible power supply

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