



# Rittal White Paper 401: The Benefits of Busbar Power Distribution Systems for US & Global Applications

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## Executive Summary

Busbar power distribution systems are common throughout the world and are rapidly gaining broader acceptance in the US due to their flexibility, safety and ability to reduce overall design and integration costs. In addition to these factors, increasing globalization has led many designers of industrial control systems to move toward design techniques, electrical components and integration methods that are readily accepted worldwide—making busbar systems more attractive than ever before. This paper examines the benefits that a busbar system can provide to designers, integrators and end-users of industrial control panels, especially when compared to “traditional” block-and-cable power distribution solutions found primarily in the US.

## Introduction

In today's global industrial marketplace, even the smallest design and build panel-shops are likely to engineer systems destined to control equipment or machinery that will be used both in the US and abroad. This creates an imperative to use internationally available control components as well as internationally accepted power distribution techniques to provide solutions that are viable and competitive across a wide spectrum of markets.

For the purposes of this paper, a busbar system will be defined as "a set of pre-engineered, solid copper conductors that may be interlocked together to create various system configurations or lengths." Additionally, a busbar system has a standardized way of making power connections to both panel-mounted and bus-mounted components while maintaining a high level of touch-safety. Figure 1 shows a 3-pole busbar system with an example of a typical component adaptor.



Figure 1

A typical busbar system is comprised of the following components:

- Copper busbar and splice connectors
- Busbar supports
- Cover system for contact hazard protection
- Connection accessories such as connection adaptors, cable clamps and plate clamps
- Component adaptors for items that mount to DIN rail
- Circuit breaker adaptors
- Fuse base adaptors

## Design Benefits

Busbar power distribution systems have an innovative quality that traditional wiring methods lack and can provide the most efficient layout and simplified bills of material for control panels. A busbar system essentially takes the place of two major items found within a typical control panel—the power distribution block and the line-side wiring. With the elimination of the power distribution block and the line-side wiring, designers may be able to reduce the overall enclosure size or perhaps even consolidate controls that were previously housed in multiple enclosures

into one. In addition to design cost savings, a smaller overall controls package may become an attractive system selling point.

In regards to bill of material simplification, a busbar system can provide an efficient and repeatable way to distribute power consistently for a wide range of system loads. For example, the full load amperage requirements of one system may be 700 amps and demand the use of 30x10 mm busbar while a similar, but smaller system may require only 350 amps of capacity that a 15x10 mm busbar can provide. The typical busbar system is designed to utilize a variety of different busbar cross-section sizes to provide various current ratings without having to change any other parts of the system, so bill of material revisions are completed quickly by substituting in the appropriate cross-section of busbar. Alternatively, if the full load amperage is unchanged from system to system, the convenience of fully interchangeable connection and component adaptors makes it simple to meet changing component requirements.

It is important to note that a typical busbar system is designed to accommodate a wide array of internationally accepted electrical components so designs may be quickly modified according to the destination country. Certification for the busbar system components such as UL/cUL listing, CE conformity and GL acceptance ensure the appropriate testing has been completed. Items such as *rated current* for specific bar/ambient temperatures and *short circuit current* ratings are provided to assist in the design process and final approval sign-off. More importantly to the bottom line, internationally certified components ensure a streamlined process from design to shipment.

## Integration Benefits

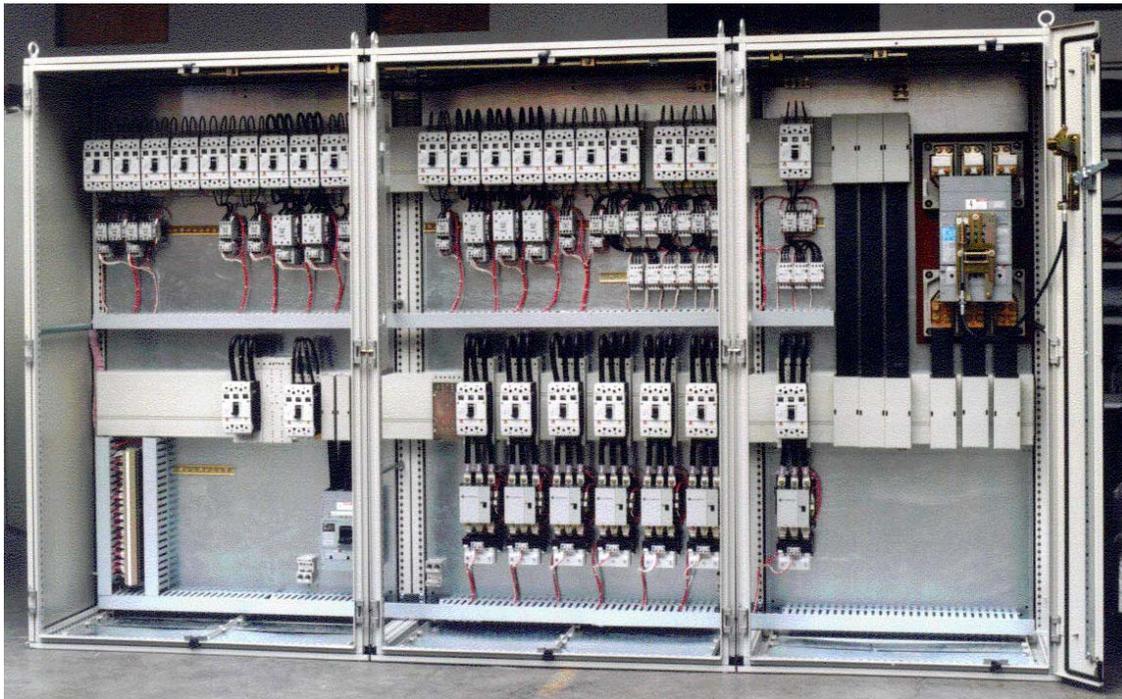
Today's increased emphasis on lean manufacturing demands that no aspect of project fulfillment efficiency be overlooked, making it more important than ever to examine how a control panel is integrated. Looking for ways that waste within that process can be eliminated should be a part of any effort to improve overall operational efficiency.

Traditionally, in the United States, power distribution is done by connecting the main disconnect device to a power distribution block with large parallel cables (referred to as "block-and-cable" throughout this paper). In turn, the power distribution block individually feeds each component on the panel. This process not only consumes a significant amount of panel space, but also takes a great deal of time when the measuring, cutting, labeling, stripping and routing of the cable/wire are all taken into consideration. As previously mentioned, a busbar system replaces the power distribution block and line-side wiring which drastically reduces the time it takes to fully integrate a control panel. When distributing power to larger, panel-mounted components such as drives or circuit breakers, a bus system with connection adaptors can be utilized to take the place of what would normally be large, difficult, parallel cable runs from the main distribution block out to devices in adjacent enclosures.

Physically mounting the bus directly to the enclosure or mounting panel could also save a considerable amount of integration time depending upon the control and/or protection components used. For example, a system that utilizes ten circuit breakers and five fuse blocks in a block-and-cable system would normally require that at least two mounting holes be located, drilled and tapped on the mounting panel for each device. For fifteen components, that would translate to thirty holes, which isn't an unreasonable task for a CNC machine, but if being done manually, the mounting panel preparation alone could be extremely time consuming. With the same fifteen components mentioned above mounted on a busbar system, it is realistic to estimate that as few as eight holes may be required to mount the appropriate number of busbar supports to the mounting panel, thus greatly reducing the amount of time it takes to mount all of the required components.

Another important integration benefit provided by busbar systems is quick mounting and termination to the electrical components. Connection adaptors provide a means to terminate cables or flexible busbar without having to drill and tap the busbar—saving time and also reducing costs by eliminating the need for ring terminals or cable lugs. Component adaptors provide a quick way to mount both DIN-mountable devices such as starters, contactors or miniature circuit breakers as well as panel-mounted devices such as circuit breakers and fuse blocks. Typically, component adaptors are pre-wired for quick termination to electrical components—eliminating the need to measure, cut and strip wire leads. In some cases, the main disconnect circuit breaker may even be bus-mounted to free up additional panel space and simplify the distribution to downstream devices. For control systems that are repeatable, electrical components may be mounted and terminated on the adaptor and kitted prior to final integration on the mounting panel, reducing the integration time even further.

Figure 2 (below) is an example of how a busbar system can drastically simplify power distribution by eliminating the labor associated with panel-mounting an exorbitant number of components, routing large parallel cables and wiring across multiple enclosures as required if using a block-and-cable solution.



**Figure 2 – Example of a Busbar System**

## **End-user Benefits**

It's easy to see how benefits to a design engineer or to an integrator lead to a more cost effective system for the end-user, but there are several other important benefits that busbar systems can deliver including system certification, safety and organization.

To realize greater economic benefits or to meet marketplace requirements, it's common in our global economy for a single company to have multiple manufacturing facilities scattered throughout the world. And because power distribution practices and electrical system codes can vary widely from country to country, it makes sense to use a power distribution system that conforms

to all major international standards such as CE, UL, CSA and GL. The international certifications that a busbar system can provide allow companies (end-users) to deploy the same system anywhere in the world with little concern that the installation or use of that system will be delayed and/or complicated due to lack of certification.

Busbar systems do not compromise the safety of those working with or around them. In fact, several of the standards governing the use of busbar in control systems demand an extremely high level of contact hazard protection. With accessories such as bottom, side and top covers, the chance of stray fasteners, dropped tools or body parts coming into contact with a busbar system is drastically reduced. Connections to components such as circuit breakers or fuses are made under locking covers or shrouds, in many cases making busbar systems even more touch-safe than equivalent block-and-cable systems. Figures 3 and 4 show how a cover system provides a high level of contact hazard protection.



**Figure 3 – Busbar System Showing Bottom, Top and Side Covers**



**Figure 4 – Class J Fuse Base Adaptor Showing Touch-Safe Housing**

Busbar systems neatly organize complex power distribution configurations, essentially simplifying them through superior organization. This level of organization provides enhanced flexibility, which leads to easier system expansion, trouble-shooting and maintenance. From the time a specification is written for a power distribution system to the time it is commissioned, it is quite common for the scope of that system to be expanded. Future expansion can be simplified for the end-user on site by creating initial designs with room for future growth in mind—including unpopulated portions on the bus that are intended specifically for later expansion. Without any additional wiring, new components may be snapped onto a component adaptor, terminated and quickly clamped onto the unpopulated bus system.

Maintenance and trouble-shooting are also easier and more efficient with busbar systems than block-and-cable systems because there is no need to trace line-side wiring, and because of the ability to quickly replace components on the component adaptor. Perhaps even more important to an end-user than the ease of changing the components in a busbar system is the ready availability of replacement parts. Busbar systems that are manufactured by global companies can offer timely replacement of components anywhere in the world.

## Conclusions

Busbar power distribution systems offer a number of significant benefits for designers, integrators and end-users of industrial control panels in the United States and abroad. Busbar systems provide a highly organized, economical way to distribute power that can reduce the overall costs associated with the design and integration of control panels. These systems are widely used throughout the world and comply with a number of international certifications—simplifying the process of deployment into various worldwide markets and creating a competitive advantage in the global marketplace. No matter where they are used in the world, busbar systems are safe, flexible and easily adaptable to changing specifications and requirements. In the US, where more “traditional” block-and-cable power distribution solutions remain prevalent, busbar systems continue to gain wider acceptance as misconceptions dissipate, news of successful system installations spreads and increasing globalization demands that more control panel designs transcend national borders.

To determine if a busbar system is a viable option for a specific application, a detailed cost-benefit analysis can often be quickly completed with application engineering assistance from a reputable busbar system manufacturer. In addition to finding an appropriate power distribution solution for the application, the resulting analysis might also reveal other ways to make the design, integration or operation of the control panel more efficient.

## About the Author

**Jerred Davis** is an Assistant Product Line Manager and has been with Rittal Corporation since 2001. He holds a Bachelor of Science degree in Electrical Engineering and provides product management and customer-specific applications support relating to Rittal power distribution and industrial enclosure solutions.