

## Consolidating Three Phase Power Conversion

### *The Power to Reclaim Rack Space*

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Managing the conversion of three phase AC power to DC is something of a balancing act – both in terms of levelling the load across all phases, and in producing more power in less space. For years, in large industrial and manufacturing operations, power distribution designers simply converted each of the three AC power phases with three corresponding AC-DC rectifiers.

Yet today, with three phase power used across high-demand, high-reliability and high-quality power settings such as data centers and high-bandwidth communications operations, converting each phase of the AC power coming into the facility into usable DC power presents phase balancing challenges. In a data center, for example, each phase may be powering a different set of servers. If one row of server cabinets is pulling more power than another row of cabinets, then the power distribution system is unbalanced. The data center power design, which splits each phase to feed a row of server racks, must ensure that each phase is evenly loaded.

To manage this three-phase load balancing challenge, traditional power conversion topologies use three separate AC-DC rectifiers, connected with an additional power distribution unit (PDU). But this comes at a cost of both power efficiency and additional server cabinet space – space that can be used for server capacity. For example, a typical server cabinet has 42 vertical rack units or about 74 inches of usable vertical space for server blades. Yet typical power conversion consumes about four or five of these rack units. That’s about nine inches of vertical rack space unavailable for server computing or networking capacity.

The challenge is to reduce the size of the power conversion footprint to free up server cabinet computing space.



## A Three-to-One Savings

In the case of true three phase AC-to-DC rectifiers, new products can replace the three conversion units for each phase, with one unit that balances all three phases. These units employ sophisticated load balancing algorithms and technologies, so data center operators don't have to manage load balancing issues.

For example, two [GP100](#) six kilowatt rectifiers can deliver the same amount of power in half the rack space of previous generation three phase power solutions, while consuming the same amount of space as competing single phase power supplies. That means data center power engineers can put 12 kilowatts of three-phase power in a single rack unit of space, eliminating the need for a separate power distribution unit to split the phases, and connecting all three phases directly to the single power supply.

Critical server bay space is therefore freed up inside the rack for extra computing capacity. Multiply that space savings times the hundreds of server cabinets in a typical data center and data center operators can save significant capital and operating expenses in infrastructure and facility costs.

## Putting Power Conversion in its Place

In addition to consolidating three phase power conversion into a single unit, space savings for increased processing capacity can be realized by locating power units in the typically unused areas along the interior sides of the server cabinet. Using the few extra inches between the 19-inch interior width for equipment and the total 24-inch interior cabinet width, power designers are locating both the PDU and single integrated three phase rectifiers in that unused space. Applying this unused space for power frees up the full 74 inches of vertical equipment space for data center equipment, improving power density and computing capacity.

In one real-world application, an Edge Cabinet PDU connects up to five rectifiers outside of the server rack. Each rectifier converts 380-480 volt three-phase AC power to the servers required DC distribution bus. This creates the same phase-balanced power conversion capabilities, but in half of the footprint of conventional single phase rectifiers, enabling users to create a more



efficient power system. Once converted at the rectifier, the bus power is then delivered to servers via pairs of proven “bullet-style” power terminals. This configuration significantly reduces the distribution distance minimizing loss and maximizing efficiency.

Using this unused corner on the side of the server cabinet also facilitates both the ease and safety of installing the rectifiers, the power distribution unit and cabling.

When we look at the challenge of three phase power conversion as an opportunity to rethink both load balancing and space issues, we can free up valuable server and rack real estate to improve capacity, provide higher power density and lower operating expenses maximizing total cost of ownership.

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Author Bio: Jim Montgomery, a senior product manager at ABB, *works with telecommunications and data center customers to provide advanced power solutions that support massive communications, network and computing capacity. Go to ABB’s [GP100 Three Phase Rectifier](#) to learn more.*