



## Powering ahead

### **Dairy goodness – 06**

Providing a power protection solution to Fonterra

### **Processing and packaging – 08**

Quality solutions for the food and beverage industry

### **PowerWave 33 Series 3 – 11**

Efficient and reliable power protection for small and medium sized organizations

### **Reliable UPS support – 23**

Power protection for an Indonesian data center

The food and beverage industry is constantly requiring power protection, so resources are not wasted and production output is increased.

ABB is at the forefront to ensure power quality is improved and the value of uncertain energy is eliminated.

Click [here](#) to watch how ABB is helping Fonterra maintain a seamless production output.





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# power



**Kevin Bickerstaffe**  
Product Group Global Sales Manager

For this edition of our magazine, I have the pleasure to say a few words about our business.

I have recently been appointed PG Global Sales Manager. I have been with ABB/Newave since June 2012, when I joined as Regional Sales Manager for the Middle East and Africa, so have seen how our business has taken off in the past two years. Being with the company has been a great experience and I am really excited with my new role.

Once again, we have a packed edition of Power and lots of stories to share. We have a successful few months behind us and we have helped quite a few customers to solve their power quality requirements. In Takanini, in New Zealand, for instance, Fonterra, the world's largest exporter of dairy products, has upgraded their ultra

high temperature (UHT) processing and packing equipment. Peter Williams, New Zealand's Fonterra's Brand Group Automation and Control Manager, told us, "an event like this across seven production lines costs us 28 hours of downtime and around \$50,000 in costs...and can happen up to four times a year."

Our PCS100 Active Voltage Conditioner is able to eliminate these voltage disturbances, saving Fonterra an estimated \$200,000 a year. Happily, the company is now looking to use ABB's products to improve power quality in other locations.

Elsewhere, ABB helped a large Indonesian airline. Each day, thousands of passengers are handled by the airline's online ticketing, check-in, baggage handling and other operations. Clearly, an operation as time-critical as this cannot afford to go off line, for even the shortest time. "But," explained Mr. Tukiman, ABB's representative in Indonesia, "their existing, non-ABB, 300 kVA UPS broke down suddenly and the supplier had no spare parts." ABB replaced the unit with an ABB DPA 250 featuring four 40 kVA modules. This 160 kVA N+1 UPS amply covers the 100 kVA load and leaves capacity spare. Should power requirements increase above 160 kVA, it is a simple matter to add more plug-and-play modules to increase capacity.

In September, ABB's DM division organized an annual conference for ABB's partners in Russia. Top managers from wholesaler and system integration companies

came from all parts of Russia for the one-day event to hear ABB's global 2020 strategy and development priorities for Russia. Every year, ABB gives update on new products and technologies available for Russian customers, and the 2014 conference was the platform for the official launch of ABB UPS business in Russia. The event offered a great opportunity to present the now complete UPS portfolio, starting from commercial retail single-phase UPS, focusing on flagship ABB modular solutions and up to industrial application UPS. With recent development in banking and telecom sectors, and interest in UPS from industrial segment, we believe that existing ABB partners will expand their product portfolio.

As we go into the closing months of the year, we are looking to advance our business further so we can finish 2014 in style and start strong in 2015. This effort will be assisted by creating new offerings and value propositions and by moving into new segments where ABB is not yet present. I would just like to say that I'm glad to be on board as Global Sales Manager and I'm looking forward to working with you all!

Enjoy this issue of Power.



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Helping Fonterra save time and money by minimizing production downtime

## 08 Processing and packaging

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Power protection in food and beverage

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Indonesian airline buys DPA



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The power converters and inverters playlist can now be found on the ABB's YouTube channel.

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# Dairy goodness

ABB's power protection technology is helping Fonterra save time and money by minimizing production downtime.

When leading multinational dairy manufacturer Fonterra needed a power protection solution for its processing and packaging lines at its facility in Takanini, Auckland, ABB was able to provide a solution that would eliminate voltage sags and cut out over four power quality events annually, saving an estimated cost of \$200,000 per year.





ABB successfully installed a PCS100 Active Voltage Conditioner at Fonterra's facility

### Fonterra's Takanini facility

Globally, Fonterra produces over 22 billion liters of milk each year. This requires only the best resources to ensure high quality milk is produced in ways that add real value to Fonterra's customers and consumers around the world. The facility in Auckland produces a number of products including fresh milk, ultra high temperature (UHT) milk and cultured dairy food for some of New Zealand's best-loved brands. The resources needed to produce these products not only derive from New Zealand's natural environment, but also the equipment used at Fonterra's Takanini facility.

More than 90 percent of UHT milk and cream produced at this facility is exported to markets in the Pacific and Asia region, including China, Singapore and the Philippines. Due to the expansion and upgrading of the UHT processing and packaging facilities, to help meet the significant growth occurring in the global UHT market, the facility now draws between 30 to 40 megawatts of power. This is mainly consumed by the large AC drives and motors used in the facility's production lines, which package more than 750,000 liters of fresh milk each day and can produce around 6.4 bottles per second.

### Minimizing production downtime

Most problems are short term voltage sags caused by faults and events in the external electricity utilities network. When this happens there is no guarantee the milk is sterilized for consumer use, so disposal or re processing of the milk is required. Peter Williams, New Zealand's Fonterra's Brand Group Automation and Control Manager, outlines the effect Fonterra's power quality events were causing. "When a glitch occurs in our facility, we need to go through a sterilization process which takes around four hours. An event like this across seven production lines, costs us 28 hours of downtime and around \$50,000 costs to our business. This would typically happen to us two, three or four times a year."

The PCS100 Active Voltage Conditioner, which is part of ABB's power protection portfolio, is able to mitigate voltage disturbances in Fonterra's facility, minimizing unwanted downtime and wasted milk product. "We would be looking to see savings in the amount of \$500,000 a year," says Williams.



The PCS100 Active Voltage Conditioner has been installed to eliminate voltage sags and correct any power quality problems Fonterra encounters

Fonterra decided to implement ABB's PCS100 AVC because of the global relationship with ABB and reliability of its products. "We have experience and a great deal of faith in their products... after some due diligence, we decided to implement it at our facility," adds Williams.

Further benefits of the PCS100 AVC are the lowest total cost of ownership by requiring no energy storage and maintaining an operating efficiency of 99 percent. With a small footprint in design, the PCS100 AVC was able to fit into the small confined area of Fonterra's equipment room, making this an ideal solution for facilities that don't have large amounts of space for their power protection requirements.

Williams indicates in the future Fonterra plan to utilize ABB's products to improve the power quality in other locations. "Over some time we are looking at using this solution at other UHT sites, just to guarantee that supply stability we need. Our mission is to become the world's most trusted source of nutrition and ABB's product is a crucial part of that process."

### About Fonterra

Fonterra the global co-operatively-owned company headquartered in New Zealand's Auckland facility, is the world's largest exporter of dairy products and can be found in over 100 countries.

Click [here](#) to watch the video on YouTube (3.34 minutes)

Click [here](#) to watch the video on ABB library

Download ABB's PCS100 AVC brochure [here](#).

To find out more about ABB power conditioning, visit: [www.abb.com/pcs100-power-converters](http://www.abb.com/pcs100-power-converters).





# Processing and packaging

Power protection in food and beverage.



# ABB's power protection products can be applied to any application in the food and beverage industry.

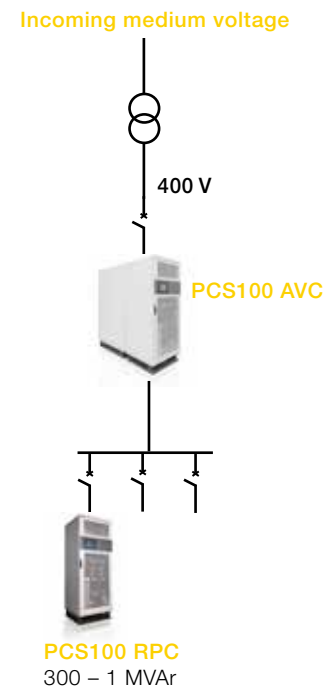


Figure one: A typical incoming power protection installation conditioning the incoming utility voltage and the factory power factor and harmonic draw

The way we process and package our food has undergone a revolution, with high levels of automation, monitoring and information systems. This has been driven by not only productivity improvement, but also by a host of food safety requirements. The control room in a modern food processing plant can often resemble a small version of a NASA launch center. Many of these modern factories are also located in developing countries where the electricity infrastructure presents challenges in terms of power quality.

With these changes, a high quality of electrical power becomes business critical, which means food and beverage companies must carefully consider their approach to power protection. For example, a haphazard approach of placing small UPSs on all digital equipment may not be the way to go as many who have tried this approach can attest. The maintenance cost of regularly checking and replacing small batteries, often installed in far from ideal environments, can be prohibitively high, and if maintenance isn't carried out the system reliability can be worse than having no protection. This is where good policy and practice documents become important.

Good information is key to good decision making. What is the quality of the electrical supply to your plant – do you know? Digital metering is now available which can monitor and record electrical events. Comparing this information with plant performance provides very useful information. For example, you may notice the lights dip at the same time as your Ultra High Temperature (UHT) plant trips off line. Often we hear plant employees referring to a voltage surge, but usually the event is not a surge at all but a sag. With good metering you can see exactly what has happened to the utility power supply and often there are clues as to why. One of

the most common faults of this type we see are single phase voltage sags caused by lightening, trees hitting lines and other common place distribution grid faults. Knowledge of the depth of these problems, and their duration, will also provide good information on the most appropriate power protection solution.

Knowledge of the quality of the electrical supply quality is even more important when constructing a green fields processing plant. Information on the supply quality may be available from the electricity utility, possibly even from other businesses already operating in the area. This can be critical information, especially in developing countries where the quality of supply can be poor. In most developed countries voltage regulation is not an issue, but in developing countries the supply voltage can vary greatly and the level of voltage imbalance can be high. This is very problematic for industrial loads including direct on line connected motors and variable speed motor drives. For direct connected motors, the high voltage can cause damage and saturation, low voltage substantial torque reduction and the imbalance, damaging negative sequence current flow. AC variable speed drives are also badly impacted by imbalance as the input current will be much higher through the rectifier on the higher voltage phases than the phases that are low.

Voltage regulation, as shown in figure one, may be required to stabilize and regulate the incoming supply. Traditionally servo variac regulators have been commonly applied, but now electronic voltage conditioners are available with higher efficiency and much faster performance such as the PCS100 Active Voltage Conditioner.

Most modern food and beverage plants will have a computer room or small data center along with the electrical control

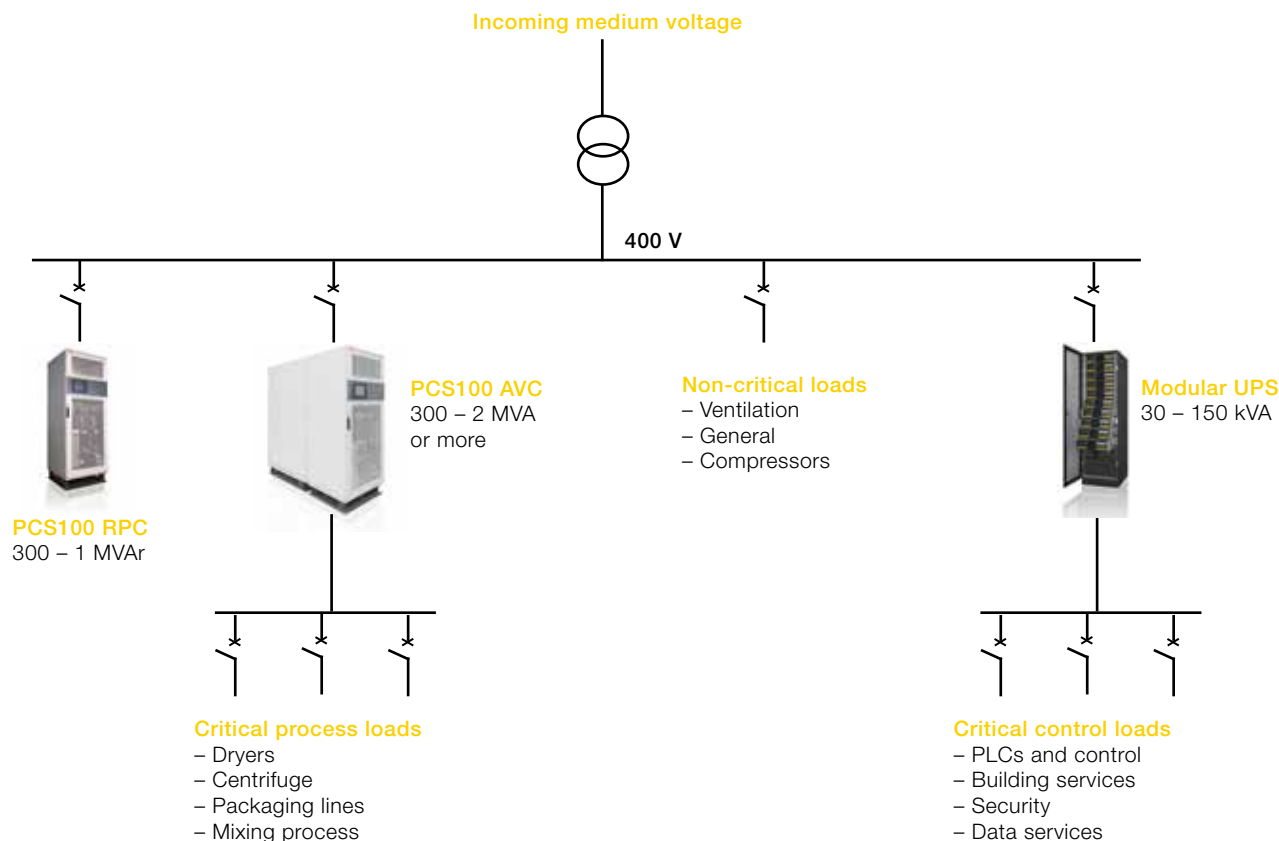


Figure two: A typical separated centralized power protection configuration for a food and beverage facility

room. Here a centralized UPS solution is a good approach. Modern modular UPS solutions allow scaling of the power protection to match with load growth, minimizing the initial upfront investment. They also provide greater system availability as modules can be swapped out in the event of a problem rather than having to be changed on site. Figure two shows a typical centralized power protection configuration.

The main factory loads also have a mix of connected equipment with greatly varying power protection requirements. These are categorized into the following classes of loads and protected separately but in a centralized way as shown in figure two.

#### Critical loads – UPS protection

**Sensitive process loads** – Active Voltage Conditioning protection or even industrial UPS if outages are present

**Non-critical** – Loads that can trip or fail and then restart without impacting on plant performance do not need protection and can be separated

Another consideration for many plants are regulations and limitations being imposed by utilities on the quality of the electrical power consumed by the plant. The primary focus is commonly power factor and harmonic levels which often have maximum allowable limits. Historically simple capacitor switched power factor correction has been sufficient. Now with large numbers of six pulse variable speed drives installed in many of these plants, high levels of current harmonic draw can cause problems for poorly designed capacitor correction. New products are now available such as the PCS100 Reactive Power Conditioner that can correct both

fundamental frequency reactive power along with 5th and 7th harmonics electronically. This can complement well-designed harmonically blocked capacitor correction and wider band width active harmonic filtering.

With good information on the quality of the external electrical supply, good planning and use of power protection equipment, modern food and beverage facilities, full of sensitive electronics, can operate safely and reliably.

Click [here](#) to watch the video on YouTube (3.43 minutes)

Click [here](#) to watch the video on ABB library

Download ABB's Power Protection brochure [here](#).

For more information visit: [www.abb.com/ups](http://www.abb.com/ups).



# PowerWave 33 Series 3

## Efficient and reliable power protection for small- and medium-sized organizations.

**ABB has introduced its new uninterruptible power supplies (UPS) PowerWave 33 series 3 available in ratings from 60 to 120 kW.**

The PowerWave 33 product range has been continuously upgraded to include the very latest hardware and software innovations. Thanks to the improved features and additional functionalities arising from this new technology update, the double conversion uninterruptible power supplies (UPS) offers the best combination of power availability and power performance in the industry.

The PowerWave 33 S3 has true online double conversion technology that continuously conditions incoming power to eliminate spikes, swells, sags, noise and harmonics, ensuring that the critical load is at no point affected by any utility disturbances. Top-of-market 96 percent efficiency in double conversion mode reduces running costs without compromising reliability. This UPS has a very flat efficiency curve. Therefore, high efficiency is reached at low load levels.

Battery runtime can be optimized to match the exact needs. The UPS supports usage of 42-48 batteries in a single string, which minimizes the total cost of installation, as optimal configuration can be used and so there is no need to oversize the battery.

1.0 rated output power factor means that each and every Watt of power is real power that is available for use. This helps with optimizing the complete electrical infrastructure in terms of switchgears and cabling, both upstream and downstream from the UPS.

Up to 10 units can be configured in parallel to provide over a megawatt of UPS power or redundant backup. This scalability means the UPS system capacity can be sized to match the load requirements, with the possibility to add incremental capacity later, when power needs change. The resulting savings in power usage over the service life of the UPS are substantial.



Space-saving mechanical design results in a footprint of only 0.30 m<sup>2</sup> and front-to-top airflow allows installation directly against a wall.

For more information visit: [www.abb.com/ups](http://www.abb.com/ups).





# Why a modular UPS increases availability and lowers total cost of ownership

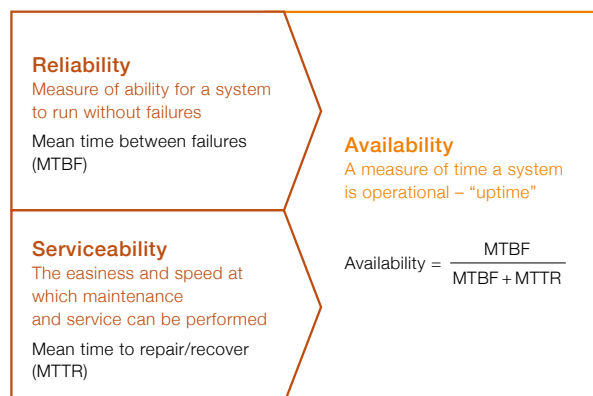
The effect of a power failure in a data center can be disastrous. Therefore great care is taken to make sure that the very best back up power scheme is in place. A reliable and efficient uninterruptible power supply (UPS) is a mainstay of such a scheme. Once the UPS is installed, however, it becomes a focus of reliability – for what use is it if it fails just when it is needed? For this reason, the most critical loads must be protected by the very best UPS design. ABB, one of the leading suppliers of UPS has invested much research and development effort in developing and refining a UPS design that optimizes availability and total cost of ownership.

ABB's unique UPS design is based on the concept of true modularity. In ABB's range of modular UPSs, each UPS module has all the hardware and software needed for autonomous operation – rectifier, inverter, battery converter, static bypass switch, back-feed protection, control logic, display, and mimic diagram for monitoring and control.

If redundancy is provided for, there are more modules than are needed to supply the critical load. In a redundant system, all modules are active and share the load equally. Should one module fail, the remaining modules take over the load smoothly. The system is fault tolerant and there are no single points of failure. ABB calls this modular approach decentralized parallel architecture (DPA). DPA not only provides the best availability, but also the best serviceability, scalability and flexibility. Taken together, these features all deliver a low total cost of ownership (TCO).

## Availability and how to increase it

For all applications, availability is the most crucial UPS parameter. It is a measure of how much time per year a system is up and available. UPS power availability is measured by MTBF and MTTR (see figure below). From the equation, it can be seen that the best ways to increase power availability are to increase the MTBF and decrease the MTTR of the power protection system. The nature of the modular design lends itself very well to achieving this objective.



The best ways to maximize power availability are to increase MTBF (mean time between failures) and to decrease MTTR (mean time to repair) of the power protection system.

## How a modular UPS increases availability

### Add redundancy

The surest way to increase availability of power is to add redundancy to the UPS system and to minimize its maintenance and repair time. One major advantage of modularity is the ease with which redundancy can be accommodated. Usually, adding redundancy merely involves configuring one UPS module more than is necessary to cover the basic load. This is then switched in automatically when required.

### Minimize chance for

ABB's UPS modules can be online-swapped, i.e., removed or inserted, without risk to the critical load and without the need to power down or transfer to the mains. This procedure is simple and fast to perform and introduces no risk for system operation. Each module can be individually switched off before removing it from the system. This makes the service safe to both, the technician and system operation. As the same modular UPS can be used across different applications and load segments, the service technicians do not need to be educated on several different platforms, but can apply the same practices and procedures on all UPS equipment.

### Select high-quality, reliable equipment

In ABB's DPA UPSs, the incoming AC is first converted to DC. The output AC is then synthesized from this DC – giving a clean sinusoid. These two conversion steps give the term "double conversion" and isolate the output voltage waveform from any disturbances on the input AC side. With over 20 years experience in modular UPS, ABB's Swiss-made DPA delivers unrivaled UPS availability and the serviceability, scalability, flexibility and low energy usage made possible by the modular DPA approach deliver a very attractive TCO. There are no better UPS architectures available to those users whose critical electrical loads represent a valuable commercial asset that must be kept powered at all costs.

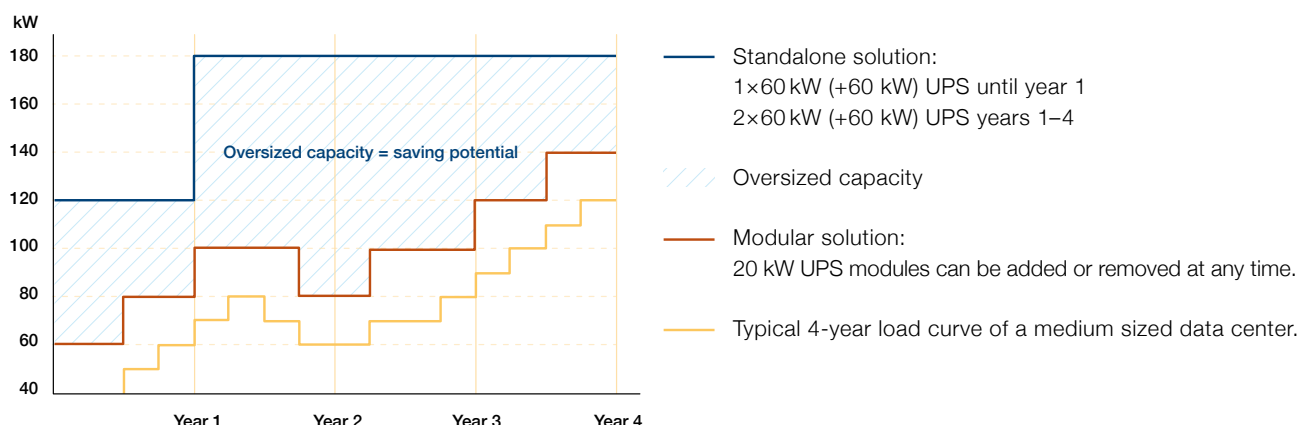
### Minimize downtime

Because the UPS modules in a DPA are independent, they can be online-swapped without risk to the critical load and without the need to power down or transfer to raw mains supply. So engineers can work on the UPS without interrupting operations. Swap-out time is only 15–20 minutes and is very safe and you never have to switch off your load. Online-swappable modules directly address availability requirements, significantly reduce MTTR, reduce inventory levels of specialist spare parts and simplify system upgrades.

### Standardize service concept

DPA modules are standardized. This keeps costs low. A straightforward, standardized modular concept simplifies and speeds every step of the deployment process – from planning, through installation and commissioning to final use.

The UPS capacity can be changed with changing load, reducing the need to oversize. Below: Example of a changing (increasing) load up to 120 kW in 4 years.



High-quality standardized products significantly reduce intervention time during maintenance or in the event of failure, components can be changed quickly and easily and service is simplified.

The better quality that results from the mass production and testing of standardized modules has a direct positive impact on reliability and, thus availability. Modular systems with standardized connections can be pre-wired and field configured at the factory allowing for more thorough testing, and standardized connections and front access reduce the risk of bad connections in the field.

### Total Cost of Ownership (TCO)

TCO is the sum of capital expenditure (CapEx) and operating expenditure (OpEx). The CapEx of a UPS comprises the UPS itself and battery bank, the surrounding infrastructure and the installation and commissioning costs. Energy consumption and maintenance are the two big contributors to OpEx.

### Optimize your investments

As UPS power requirements change – if a data center is expanded, for example – modularity makes it really easy to add modules and increase the power capabilities. You don't have to oversize the initial configuration to cater for future expansion, you just add modules when needed. This means that you only cable, power and cool what you need. Power consumption is a topic of great concern for most operators and the energy savings made by the modular approach over the service life of the UPS are substantial.

### Optimize your battery capacity

Run-time and battery sizing can be exactly fitted to what is required. A separate battery allows the system to be upgraded and autonomy preserved, while not compromising availability. Full redundancy is only achieved with a redundant battery. If a common battery may be required, ABB's modular UPS allow flexible blocks per string.

### Save valuable floor space

Modularity lends itself well to keeping UPS footprint small, too – ideal where real estate is limited and expensive. A modular UPS rack has a small footprint and when extra modules are added, no extra floor space is taken up.

### Reduce installation and maintenance costs

The modular approach makes installation and commissioning easy. Standardized modules reduce inventory levels of specialist spare parts and simplify system upgrades. This approach pays off too when it comes to serviceability and availability, as service personnel do not need special skills and human error is reduced. Spares can be held on-site or at a nearby service center.

Not only does this improve availability, but it also reduces cost as service engineers spend less time on-site, and any risks of data or production loss are minimized. The only UPS elements common to all modules are contained in the mechanical frame that accommodates the UPS modules – I/O connection, customer interface signaling, and maintenance bypass and, in some models, a system display. These elements are standardized in order to minimize maintenance costs.

### Save energy costs

The modularity and scalability described have a major positive impact on achieving a low cost of ownership, but costs are held down too by designs that have best-in-class energy efficiency. ABB's Conceptpower DPA 500, for example, operates with an efficiency of up to 96 percent. Its efficiency curve is very flat so there are significant savings in every working regime. Further, cooling costs can be substantial and, because less power is consumed, high-efficiency modular UPSs require less cooling effort, creating further savings.

### Modularity – the simple answer

ABB's decentralized parallel architecture provides full redundancy and fault tolerance in a way that is unique amongst UPS vendors. UPS modules can be swapped online, which means fast and easy service and no downtime at all. DPA and modularity result in many knock-on advantages that guarantee that ABB's modular UPS has the lowest TCO around while providing the operator with a flexible, reliable, agile and environmentally attractive infrastructure. The overwhelming benefits of modular UPSs speak for themselves.

For more information visit: [www.abb.com/ups](http://www.abb.com/ups).



# How voltage conditioning improves productivity and lowers costs



The fundamentals of manufacturing are quite similar to the time when Henry Ford introduced the production line to his factories at the beginning of the industrial revolution. This model, where production is organized into work stations and the product passes by each station, can be seen in every industry globally today. What has changed, however, is the product being manufactured and with this, the manufacturing tools required to produce that product. Instead of people welding car bodies together, there are robots, and painting is done with the help of electrostatic charges and final testing automated with computers. High quality electrical energy is now a must for modern factories to perform at their peak, and it's not just the control systems that are requiring power protection.

## What are we protecting?

To decide what a customer needs for their power protection we need to understand several aspects;

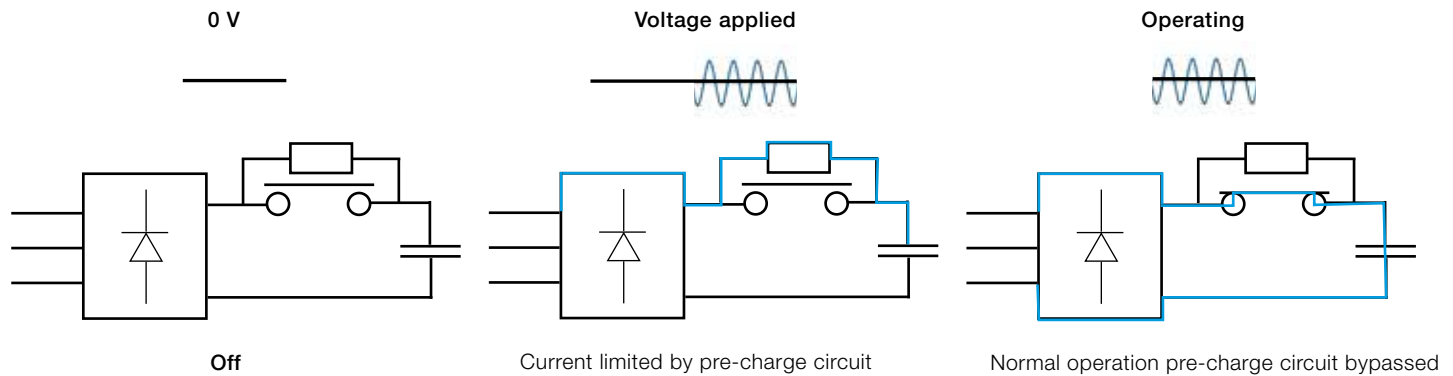
1. What is the quality of the power supplied from the utility?
2. What happens to their process if there is a power interruption or sag?
3. What are the load types in the factory and their electrical requirements?

Often a factory manager will know details of point 2 and 3 but sometimes the power quality data from the utility is unknown. This may be because it is simply not measured by the utility, or it may be measured at the substation which may not accurately reflect the voltage at the customer's facility. They should however be able to answer the following question: *What most frequently causes problems for your facility power quality events or outages?*

More often than not the answer is power quality events (unless the utility grid is very poor, outages are much less frequent). They may mention the momentary dip in the lights, after which under-voltage relays and variable speed drives have tripped. This is the clue that voltage conditioning is going to benefit this customer. Of course if its outages, ABB has a product offering of UPSs too.



## Start-up



## Voltage sag

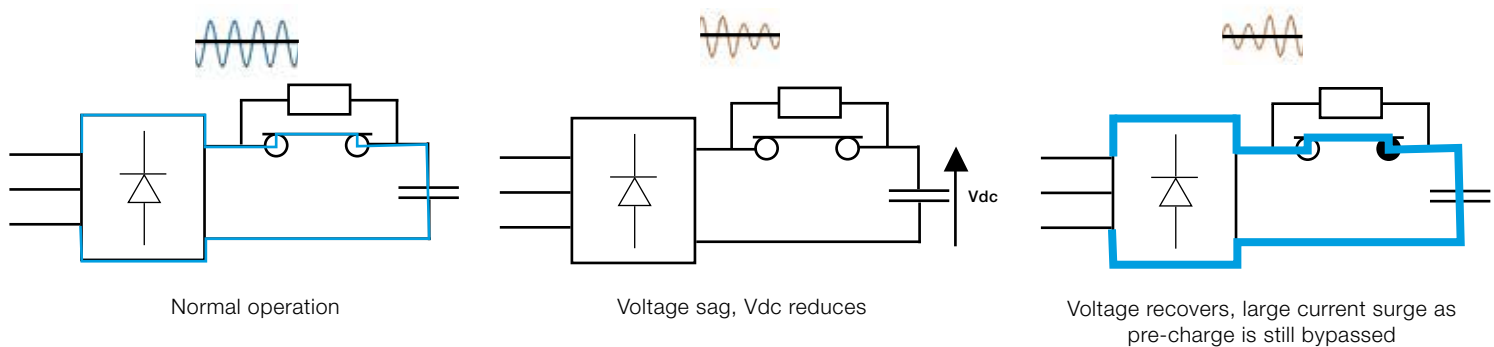


Figure one: **Top** normal controlled startup process. **Bottom** Inrush currents following a voltage sag

The next important piece of the puzzle is what happens to the manufacturing process, during one of these power quality events, and the impact to the customer. This helps build an understanding of the business case for the customer.

Typically the more complicated the process the more chance of not being able to recover the product from the manufacturing line, resulting in scrap costs. There could also be considerable time needed to reset (clean or recalibrate) the production line which also costs, but as well introduces delays, meaning the customer may not meet their delivery schedules. In the worst case there could also be damage to equipment or product, not from the voltage sag itself, but often when the voltage recovers there can be a potentially damaging surge of current back into the equipment.

The graphic in figure one illustrates this problem. A typical front end rectifier for a power supply or variable speed drive is shown. During a voltage sag event there are two options for the behavior of this load.

1. Trip offline and perform a controlled restart. This may require operator intervention and will take some time.

2. Ride through the sag (if there is enough energy in the DC link capacitors). However when the voltage recovers this is where the problem lies and large surge currents can potentially damage equipment.

## The smart utility grid, more or less reliable?

The utility grid is undergoing one of the biggest changes in structure ever seen. Buzzwords such as smart grid and distributed generation are ever present in the media. Many have questioned the impact of distributed generation, in particular on grid reliability, and the consensus is the grid is becoming less reliable as a result. The issue is not so much outages, but voltage regulation due to generation at the distribution level, which was not designed this way decades ago. Coupled to this is the fact that this generation is intermittent, photovoltaic and wind, which presents a real challenge for utilities to maintain grid stability. While distributed generation is not helping, weather events are still the predominant cause of power quality events on the grid.

The graph in figure two is a plot of the input and output voltages over one year from a PCS100 AVC installed in the Philippines.

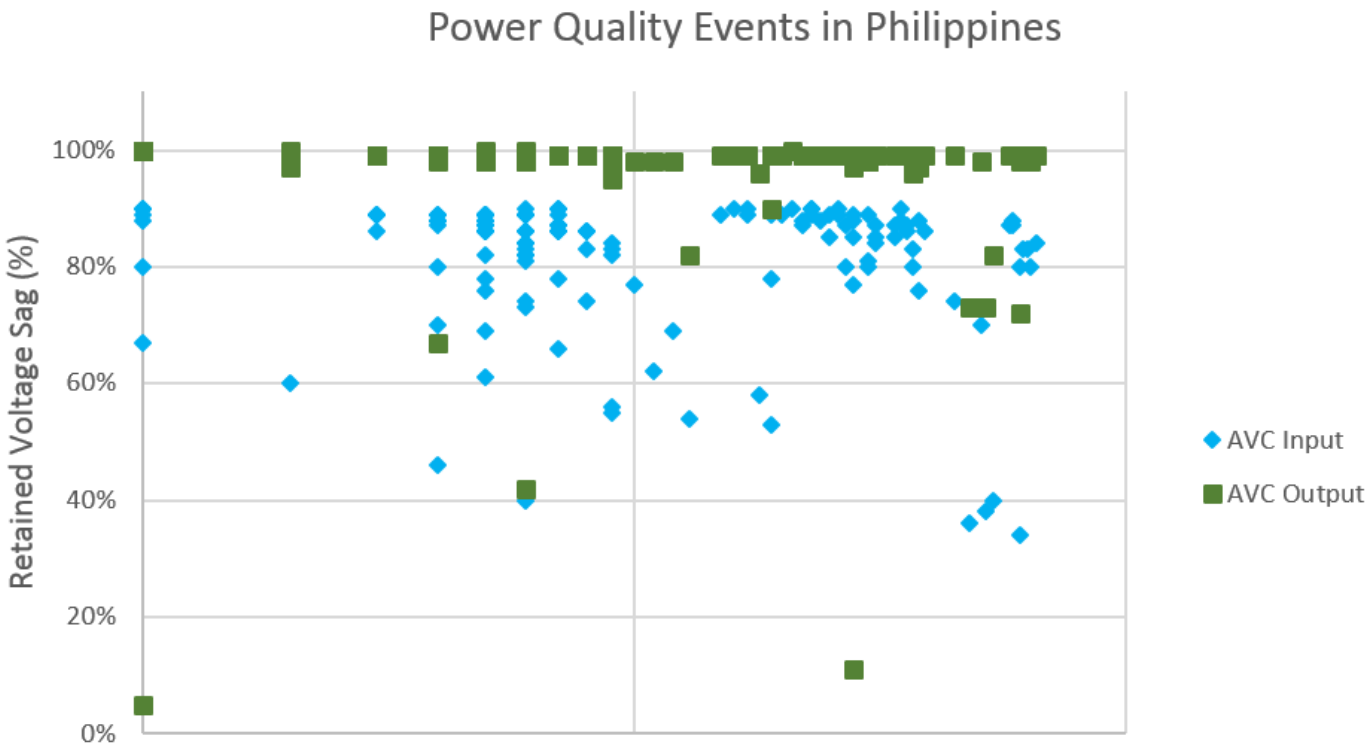


Figure two: Recording of PCS100 AVC performance

This region is frequently battered by storms which causes havoc with the utility grid. During the storm season, voltage sags are extremely common, with 129 events recorded at the below site over 12 months. With the PCS100 AVC the vast majority of events are corrected back to nominal voltage.

Back to business

Installing power protection is only undertaken where there is a positive cost / benefit ratio for the customer. The benefit side is well known by the customer, this is their products and factory so they can calculate the benefit of fewer production interruptions and equipment failures. Obviously there is cost involved, however the PCS100 AVC offers an extremely competitive total cost of ownership, especially for higher power loads, where power protection costs may have been prohibitive in the past. The following table outlines costs and the features of the PCS100 AVC that minimize these.

Customers cost	PCS100 AVC features
Capital costs	Competitive especially for larger loads where power protection costs may have been prohibitive in the past.
Installation	Small footprint. 3 phase AC in and 3 phase AC out are the only connections needed.
Operating costs - energy	Very high energy efficiency minimizing energy consumption and ventilation requirements.

Operating costs - maintenance	Minimal maintenance required. No batteries to maintain or replace, 20 year design lifetime with maintenance at 10 years (cooling fans only at 5 years).
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Summary

The right power protection scheme for a customer is not always black and white. Understanding of the customer's process, utility quality and consequence when affected by events are all important. If there is a case for voltage conditioning then the customer can be assured that with over 685 MVA of PCS100 AVCs installed worldwide, they are joining a growing list of customers maximizing their productivity.

Click [here](#) to watch the PCS100 AVC video on YouTube (4.35 minutes)

Download ABB's PCS100 AVC brochure [here](#).

To find out more about ABB's power conditioning, visit: [www.abb.com/pcs100-power-converters](http://www.abb.com/pcs100-power-converters).



# Dynamic Inrush Restraint (DIR)

## Why is it needed?

Today's data center designers often use static transfer switches (STS) in their power system designs. The STS allows for flexible maintenance, adds to system reliability, and overall uptime. The typical system design incorporates two separate uninterruptible power supplies (UPS), feeding the primary and alternate sources of the STS. The most common and cost effective design is to do the switching at 480 volts. This only requires one downstream PDU transformer from the STS. The alternative design would be to switch at 208 volts. This design would require each source to have its own fully rated transformer.

Typically, UPS A and B are fed from the same utility grid. Both UPS inverters will synchronize to their utility inputs. During this normal condition, the phase angle between UPS A and B is minimal. However, during battery operation, each UPS goes on its own internal clock. Over time, the phase angle can drift apart. The problem can be made worse if each UPS has its own dedicated emergency generator. In either case, the phase angle between sources can be problematic to the critical power system. When a 480 volt STS needs to conduct an emergency transfer during an out of phase condition, the open transfer time of the STS is less than a ¼ cycle. With this quick out of phase transfer, the transformer's magnetic field does not have enough time to collapse. This results in large inrush currents drawn from downstream PDU transformers.

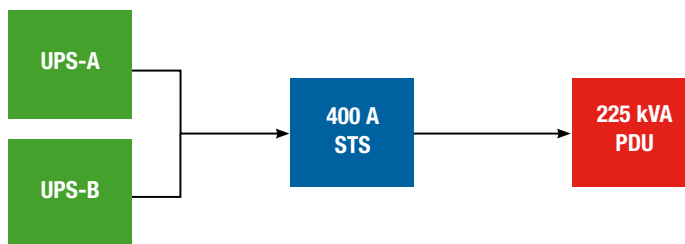


Figure one

Let's look at a scenario (Figure one) with a 480 volt STS, rated at 400 amps, feeding one 225 kVA PDU transformer. The 225 kVA transformer will draw 625 amps at full load. With a phase angle difference of 120 degrees, an inrush current could be up to 6100 amps during an emergency transfer as illustrated in figure two. The bases of the peak value of the first cycle inrush current can be obtained using following equation:



$$I_{\text{peak}} = \frac{\sqrt{2} V_m}{\sqrt{(\omega \cdot L)^2 + R^2}} \frac{(2 \cdot B_n + B_r - B_s)}{(B_n)}$$

$V_m$  = Max applied voltage

$L$  = Inductance of the transformer

$R$  = Total resistance of the transformer

$B_n$  = Normal flux density of the core

$B_r$  = Remanent flux density of the core

$B_s$  = Saturation flux density of the core



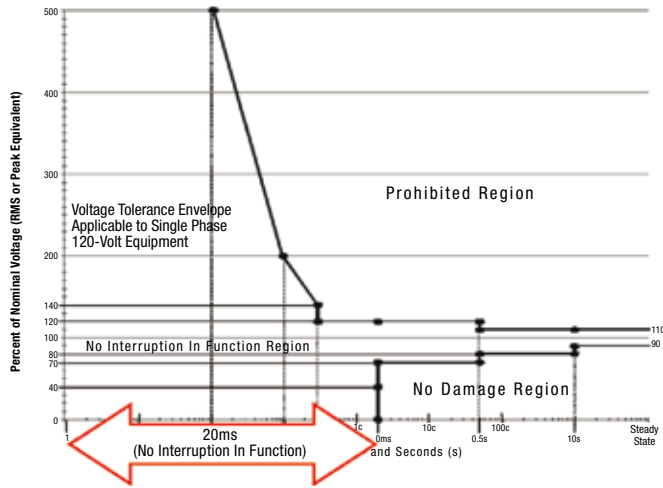


Figure two

The STS is designed to handle this short term overload situation. However, there are some significant problems elsewhere threatening data center reliability and availability.

- There are usually multiple PDU transformers all drawing high inrush currents.
- Breakers may open up depending on the magnitude of the inrush and circuit breaker set points.
- Inverters cannot handle the high currents and transfers to bypass.
- If the bypass source is an emergency generator, its voltage will dip with the large block load.
- These high currents stress all upstream infrastructure.

### Initial solutions

At first there were two solutions to this problem. The first was a topology decision where an additional transformer was added to switch at 208 volts, instead of 480 volts. With this approach, each PDU transformer was always energized. Without the presence of downstream transformers, there would not be a resulting high inrush current during an out of phase transfer. This solution took up more space and was more costly with the additional transformer.

UPS manufacturers then worked on a solution involving the UPS inverter controls. Each of them called it something different, but they all roughly performed the same function. Regardless of the situation, the UPS inverters would maintain a minimal phase angle difference between multiple UPS sources. A centralized control circuit would force all inverters to the same phase reference, regardless of the current mode of UPS operation.

### Best Practice–Dynamic Inrush Restraint

The 208 volt solution remains an effective approach, but does cost more. The UPS inverter synch design also costs more and adds another complex system to maintain. Therefore, UPS manufacturers were asked to look at solutions in the STS. The investigation into a new solution started with the ITIC curve (Figure two). This characteristic curve states that IT equipment power supplies can ride through 20 ms without voltage. Without the ¼ cycle (4.17 ms) constraint, STS designers were free to explore other alternatives. Here is where ‘Dynamic Inrush Restraint’ was born.

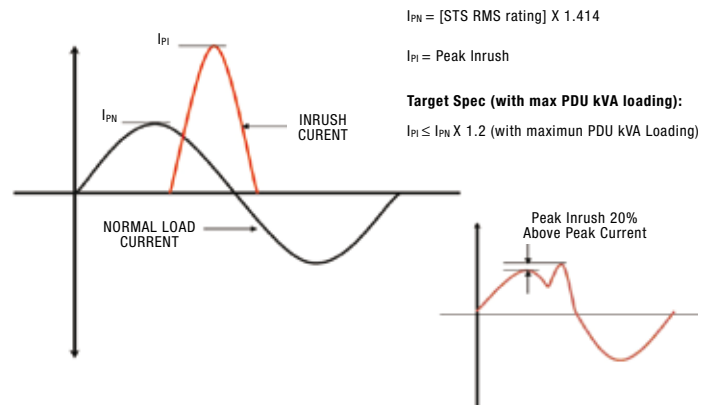


Figure three: Target specifications for DIR are illustrated

### How does it work?

The STS constantly looks at the power quality of both input sources. The Digital Signal Processor (DSP) of each source is sensing voltage, current, frequency, and phase angle differential. The user selects their power quality tolerance settings for the STS. These settings are usually dictated by the facility’s design engineer and validated during commissioning of the critical power system. Most customers use the recommended setting of “DIR Sometimes.” This means the STS will auto select when, and if, the DIR function is needed.

There are various methods of performing this delayed style transfer. Some manufacturers merely add a time constant delay on top of the original ¼ cycle transfer. This type of transfer will produce various inrush current results, depending on the phase angle and the point on the waveform that the transfer is initiated. Another manufacturer pulses the SCR’s to create a quick low inrush transfer. This approach uses complex circuitry and creates a chopped up voltage waveform.

The optimal solution is to intelligently select the transfer time based on real-time power-quality sensing and perform a non-pulsed clean transfer with less than 2x.

Let’s return to the same scenario with the 480 volt, 400 amp STS feeding our 225 kVA PDU transformer. This time, the STS is set up with a plus/minus 15 degree phase window tolerance. The DIR function is set to “DIR Sometimes.” An emergency out of phase transfer of 120 degrees is performed, resulting in a reduced 1,125 amps (1.8x) inrush current. The transfer time was 10 ms, or half of the allotted time according to the ITIC curve. The DSP selects the best time to initiate its transfer. This algorithm results in a typical transfer time of 8 to 14 ms with an inrush below 2x. The actual test result is illustrated in figure four.

### Dynamic Inrush Restraint

The DSP technology is used to dynamically compute switching delay based on volt seconds at transformer input, phase difference between sources and phase angle of source oncoming, if the phase angle differential is recognized inside the users preset window. The DSP will intelligently pick the optimum time to initiate the transfer, if the phase angle falls outside the preset window.

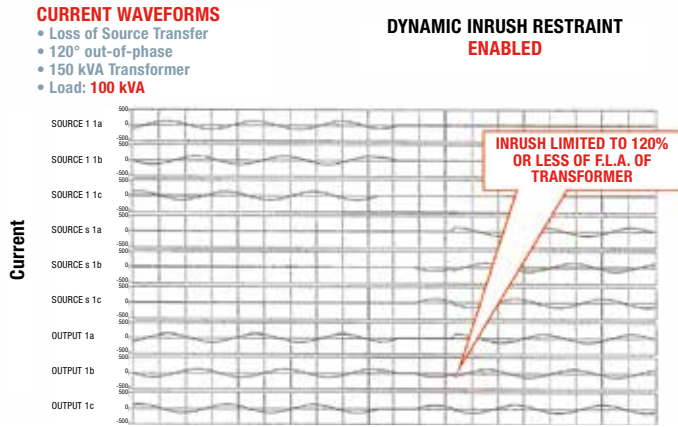


Figure four

The DSP takes into consideration the volt-second integration of both input sources. Then, based on known magnetic flux properties of downstream transformers, the DSP selects the best time to initiate the transfer.

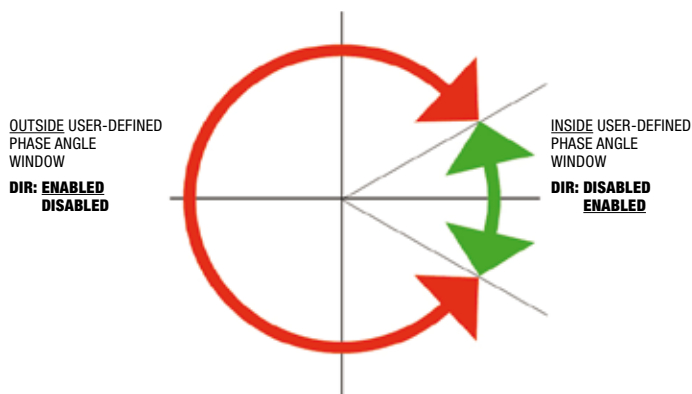


Figure five

Cyberex's patented simultaneous transfer (Figure five) is not an answer to the traditional sequential transfer in the static transfer switch. The simultaneous algorithm produces a faster, smoother transfer - especially under ideal, in phase transfer conditions.

The total transfer time (4ms or 1/4 cycle) = sense time (1–1.5ms) + transfer time (2–2.5ms). Load type and condition of transfer may result in different total transfer time not to exceed 16ms. Let us review the anatomy of the simultaneous transfer:

1. Sensing
2. Source 1 gated off – wait for source 1 current to decay
3. Source 2 gated on
4. Transfer complete

### DIR is the best choice for multiple reasons

- Initiated on demand
- Allows for smaller equipment footprint (one PDU transformer)
- Eliminates the need for complex inverter control schemes
- Maintains true independence between UPS systems (higher reliability)

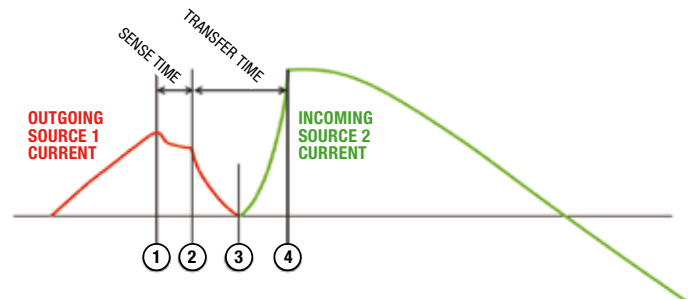


Figure six

- Keeps inrush currents below 2x
- Completes emergency transfer safely within 20 ms ITIC curve
- Reduces cost of installation (smaller STS, one transformer)
- Better PUE, no load losses eliminated from 2nd PDU transformer
- Protects expensive critical electrical infrastructure (UPS, breakers, stand by generators, and cables)

### Summary

Dynamic Inrush Restraint (DIR) has been installed in thousands of installations and has proven to be the most cost effective and reliable solution to the inrush current problem. This approach conducts out of phase transfers only when needed. These transfers are in compliance with ITIC guidelines. The magnitude of the inrush currents are minimized to safe operating levels.

For more information visit:

[www.tnbpowersolutions.com/digital\\_static\\_transfer\\_switches](http://www.tnbpowersolutions.com/digital_static_transfer_switches)





Photo courtesy of Fisher & Paykel

# Any frequency, anywhere

Quality conversion for Fisher & Paykel.

# ABB's frequency conversion technology is helping Fisher & Paykel cross international borders seamlessly and cost effectively.

## Background

Fisher & Paykel (F&P) are a New Zealand whiteware manufacturer who export their products to many countries around the world. With development facilities in NZ (50 Hz) F&P also need to test at 60 Hz to ensure quality control is upheld. F&P therefore needed a solution to convert the voltage in their factory to a different voltage to match the power requirement in other countries to carry out this testing. Due to F&P expanding their operations at their Whiteware Product Development site, the existing inverters did not have the capacity to supply the extra load of the new labs and workshops. To ensure their products are tested to simulate the end-users premises, the existing inverters needed to be replaced with a larger 120 V + 120 V 60 Hz PCS100 SFC. Because the PCS100 SFC was able to convert F&P's voltage (50 Hz) to match the requirement of the country's load (60 Hz in the U.S. specifically), F&P could carry out their testing without any inconsistencies in voltage. This resulted in reduced operating and maintenance costs with high reliability, providing maximum power availability. The PCS100 SFCs small footprint in design, enabled it to be installed into a confined space, saving further on costs.

## Technology driven

For this project, the PCS100 SFC allows connection of 60 Hz powered equipment to a 50 Hz supply network. Alternatively, the PCS100 SFC allows connection of 50 Hz powered equipment to a 60 Hz supply network. The system functions by converting the input AC power through a sine-wave rectifier to a DC link, and then through an AC sine-wave inverter to produce a clean, full sine-wave output at the new frequency and voltage. One unique feature critical to the reliability of the converted output supply is the built-in redundancy capability which is an intrinsic part of the modular system design. In an unlikely event where either a single rectifier or inverter module encounters a fault and stops functioning, the master controller that oversees the power modules will provide a warning notification - while allowing the system to continue to operate.

ABB has a history of selling power conversion equipment to F&P, having sold around 10 units spanning back to 2000. Maurice Cleland F&P's Electronics Technician commented on ABB's technology, "We have been very impressed with our previous inverters, and believed that ABB would continue to develop and improve on the existing technology."

## Fisher & Paykel

Fisher & Paykel has been designing products since 1934 and has grown into a global company operating in 50 countries and manufacturing in Mexico, Italy, Thailand and New Zealand.



ABB's PCS100 Static Frequency Converter

Fisher & Paykel products are available in more than 80 countries worldwide. The company's trademarked appliances include Active Smart refrigerators, AeroTech ovens, DishDrawer dishwashers, Smart Drive washing machines and Smartload top loading dryers. The company also manufactures gas and electric cooktops.

Download ABB's PCS100 SFC brochure [here](#).

To find out more about ABB's frequency conversion solutions, visit: [www.abb.com/pcs100-power-converters](http://www.abb.com/pcs100-power-converters).





# Indonesian airline buys DPA



With the increasing demand for air travel services, the airline of Indonesia continues to expand its network, reaching fast growing economic cities and new tourist destinations in the Western and Eastern region of Indonesia. Each day, many thousands of passengers are handled through their online ticketing, check-in, baggage handling and other operations. Clearly, an operation as time-critical as this cannot afford to go off line, for even the shortest time. "The airport's operation simply must not go down," explains Mr. Tukiman, ABB's representative in Indonesia. "However, their existing 300 kVA UPS broke down suddenly and the supplier had no spare parts."

ABB replaced the unit with an ABB Conceptpower DPA 250 featuring four 40 kVA modules. This 160 kVA N+1 UPS amply covers the 100 kVA load and leaves capacity spare. Should power requirements increase above 160 kVA, it is a simple matter to add more plug-and-play modules to increase capacity. Reliability and availability are ensured by the Conceptpower DPA proven Decentralized Parallel Architecture.

Each module contains all the hardware and software required for full system operation. They share no common components. Each UPS module has its own independent static bypass, rectifier, inverter, logic control, control panel, battery charger and batteries.

With all the critical components duplicated and distributed between individual units, potential single points of failure are eliminated. The Conceptpower DPA UPSs are highly efficient and the airline will now make substantial energy savings over the lifetime of the unit. The modular design makes repair and maintenance simple too, so it can be carried out by non-expert staff and without powering the unit down.

For more information visit: [www.abb.com/ups](http://www.abb.com/ups).



# Reliable UPS support

## Conceptpower DPA in Indonesian data center.



Cyberindo Aditama (CBN) is an Indonesian company supplying voice and data solutions for clients. As such, they are very reliant on reliable data storage – so they need a good UPS for their data center. They already had UPSs from a different company, but were quite dissatisfied with the support they were receiving for repair and unit replacement. Not only was the quality of service not up to their expectations, but repairs took some time to accomplish. This was not an acceptable situation for CBN's clients.

ABB has now supplied two Conceptpower DPA 250 comprising four 50 kVA modules. The modular approach taken by the DPA 250 suits CBN's needs perfectly. The units are very reliable, but if anything should happen, a module can be hot swapped without powering down. While the module is out, the remaining modules take over and the load sees no change. In addition, if the power load should increase in the future, the DPA 250 can be expanded by simply adding more modules. Further, the UPSs in the DPA range are highly efficient, so the customer will also benefit from lower energy costs.

The local partner is Vektordaya Mekatronika, who run a 24/7 hotline, so the client is assured full peace of mind.

For more information visit: [www.abb.com/ups](http://www.abb.com/ups).





# Driving technology

New technology and products for Russia.

In September, top managers from wholesaler and system integration companies came from all parts of Russia for a one day event to hear ABB's global 2020 strategy and development priorities for Russia.

Every year ABB gives update on new products and technologies available for Russian customers. The 2014 conference was a platform for the official launch of ABB's UPS business in Russia.





1



2



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6

Amina Hamidi, Product Group Manager for Power Protection presented the full UPS portfolio, starting from commercial retail single-phase UPS, focusing on modular solutions up to industrial UPS applications.

For more information on ABB's power protection technology visit:  
[www.abb.com/ups](http://www.abb.com/ups).

1. L-R: Dmitry Leonenko – Head of Marketing, TESLI (ABB UPS official distributor in Russia), Anatoly N. Popov – President, ABB Russia, Amina Hamidi – Product Group Manager, ABB Power Protection, Oleg Volkov – Country Marketing Manager, ABB Russia
2. Anatoly N. Popov – President ABB Russia
3. Sergey Finogenov – Distribution Channel Manager, ABB Russia
4. L-R: Dmitry Kitaev – Sales Director, North-West region, ABB Russia, Anatoly N. Popov – President, ABB Russia
5. L-R: Enver Shulgin – Head of Discrete Automation and Motion Division, ABB Russia, Andrey Sofronov – Head of Service, ABB Russia, Sergey Klyuev – Sales Director, South region, ABB Russia
6. L-R: Anatoly N. Popov – President, ABB Russia, Alexander Prudnikov – Head of Low Voltage Products division, ABB Russia, Oleg Volkov – Country Marketing Manager, ABB Russia



# Complete power



## New products

### 06. PCS100 Medium Voltage UPS

For complete power protection

### 11. PowerValue 31/11

A single-phase UPS with scalable runtime

### 12. Cyberex® PowerBuilt™

System reliability and critical load protection

## Power protection

### 22. Semiconductor protection

ABB provides power protection to HHGrace in China

### 24. Product excellence for Munich Re

Product excellence and lowest total cost of ownership

# Protected



## Power protection

### 08. Industrial power protection

Single conversion UPS for industrial protection

### 10. High density power distribution

Deploying effective power protection in data centers

### 15. Power health

ABB DPA UPScale ST 200 UPS for medical laboratory in Switzerland

### 16. Sensing perfection

Protecting the most sensitive equipment for high-end technology



Maximizing productivity and saving costs?

Certainly.



By choosing from ABB's PCS100 Active Voltage Conditioner, you are selecting from a unique line up of advanced technologies and expertise. This low voltage power protection product provides maximized productivity by providing continuous voltage regulation. The PCS100 AVC ensures high efficiency and requires no energy storage, allowing for a small footprint. Providing protection in many industrial and commercial applications with a rating from 150 kVA to 2.4 MVA, the PCS100 AVC is a sound investment to protect against the most common power quality events. Visit [www.abb.com/ups](http://www.abb.com/ups)

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for a better world™

