power

3|15

A power protection magazine
of the ABB Group

Eliminating voltage sags

Power and productivity
for a better world™

ABB has released the PCS100 AVC-40 Active Voltage Conditioner designed for sag correction in large commercial and industrial applications. Watch the video **here**.

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power

Kevin Bickerstaffe
Product Group Global Sales Manager
Power Protection
Discrete Automation and Motion division

Welcome once again to our magazine. A lot has happened since our last edition and in this issue we have some exciting updates and stories that cover a wide range of our products. And that product range has just increased with the release of our PCS100 AVC-40 and PCS100 AVC-20 Active Voltage Conditioners (AVCs). These products take care of the voltage being supplied to industrial installations – if the voltage level sags or surges, the AVC will instantly correct it. Not only that, but the AVC also provides continuous voltage regulation – so constant, quality power is guaranteed. To see all the great features of these innovative products be sure to watch the video that accompanies the articles on the PCS100 AVC range of products.

You can find out even more in our article on ABB's Cyberex industrial UPS. Have you ever wondered what is involved in specifying a UPS battery bank? Or why fuses are used instead of breakers on UPS distribution panels? Or how a UPS should be sized? To have these, and many other, questions answered have a look at the in-depth Cyberex article.

Our business is global and our UPS products find their way into applications that are many and varied. In Finland, for example, we are supplying UPS capability to Ficolo, one of the big Finnish colocation companies – ie, a company that provides data center capacity for users to rent storage or processing power, as opposed to a data center that is dedicated to one enterprise.

Ficolo's data center is located in three large excavated halls in a network of tunnels originally constructed by the Finnish Defence Forces during the Cold War. Six further halls are available, but have not yet been kitted out. This sort of location is ideal for our modular decentralized parellel architecture (DPA) UPS.

DPA is fully scalable and can be installed module by module as power requirements grow, so as the new halls are brought into service they can be equipped with just the right number of UPS modules – this saves the customer buying a lot of capital equipment up front that may not be used for a few years.

Staying in the data center business, we are looking at cloud computing and the massive change it is catalyzing in the IT landscape. This rapid redefinition of an entire industry offers a unique opportunity to companies who are able to supply the ultra-reliable and flexible uninterruptible power systems needed by the cloud infrastructure. What are the current trends in this area and how are they likely to play out over the next decade? Find out more in the article "Center of attention: The rise of the cloud is radically changing the data center industry".

In conclusion, it just remains for me to thank you all once again for your support and for reading this update.

Enjoy this issue of ***power***.

Feature

UPS

Power conditioning

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Brochure

ABB's modular UPS system ensures the reliability of the data center power supply and perfectly supports the customers need in terms of scalability and flexibility

An underground data center

Ensuring uninterruptible power for Ficolo's 8,500 square meter underground data center in Ulvila.

“Ficolo’s data center is located in Ulvila, in an underground tunnel network covering 8,500 square meters, originally quarried for the Finnish Defence Forces” explains Ficolo’s CEO, Seppo Ihalainen

Finland has an affordable, stable and secure electricity supply, as well as a safe, predictable political climate. Along with favorable legislation, this makes Finland a perfect location for a global data center, making it one of the world's most competitive countries in this sector.

Ficolo is a major Finnish colocation company that recognizes the advantages of its home country. Ficolo’s CEO, Seppo Ihalainen, says “costs in Finland are four to six times lower than the rest of Europe. The data center we have constructed in the Ulvila location is ideal. It is just outside one of the most built-up parts of the country and it brings with it inherent cost savings, energy efficiency and security.”

Technology in deep rock caves

Ficolo’s data center in Ulvila is in an 8,500 square meter underground tunnel network originally excavated by the Finnish Defence Forces. Inside the geological formations there are nine halls, each between 500 and 800 square meters in size. In May 2014, three of the halls were brought up to operational condition.

The halls can be dedicated to specific customers or shared by several customers. Ihalainen observes, “Our investment costs can be optimized with this facility. New halls can be brought online as required, and the caves that lie empty do not incur any costs while they wait to be kitted out. We also have the ability to expand our ABB modular uninterruptible power supply as needed – this scalability is vital to us so we can grow the installed UPS as the power requirements grow. And we don’t have to make a major, upfront speculative investment. The individual data center halls operate entirely independently of one another and our colocation model allows customers to choose between a centralized or distributed data center solution that best fits their needs.”

Electrical security a top priority

Ihalainen continues, “a reliable electricity supply is critical to the data center business and having our supply backed up by ABB UPS systems is ideal. We also use wind-turbine-generated power together with diesel generators as a backup source. This means that customer service continues as normal in the event of a grid power outage.

"ABB was able to provide the UPS technology quickly; we submitted the order on Christmas Eve and by February we were up and running. The ABB installation engineers, Einar Kinnunen and Jani Nissinen, showed exceptional diligence and commitment, enabling this large contract to be fulfilled on schedule. The system is ideal for our business model, both technically and financially."

Energy efficient solution for data centers

ABB offers technologies, technical solutions and professional services for data centers. Energy-efficient, cost-effective solutions are provided for data centers by intelligent design, construction, commissioning, testing and operation as well as allowing for flexibility and scaling.

Various security systems are built in to the Ulvila installation to ensure network, fire and physical safety. Energy efficiency, green and renewable energy, and waste heat recovery are also important aspects of the data center operations. "There is also a project on-going to use recovered waste heat to help power Ulvila city,” says Ihalainen.

There are huge growth prospects, as Ficolo’s is the first data center to bring the colocation business model to Finland. Ficolo pursues an agile approach, in which the customer can choose the depth and breadth of cooperation, outsourcing either all or part of its IT Services. Traditional global hosting duplication is eliminated.

Ihalainen estimates that after five to eight years all nine halls will be sold out due to the continuing growth of enterprise IT systems and business-critical systems. “Large international companies can depend on us as their data volumes continue to grow alongside their need to have guaranteed reliability regardless of what crisis comes up.”

Modularity increases usability

ABB provided Ficolo with a truly modular high-efficiency DPA™ UPS concept which scales to changing needs. System reliability is ensured by the modularity of double conversion

ABB's modular UPS product range

technology and the in-built redundancy. Hot swappable modules keep the system operational and repair times short. DPA module replacement does not require an expert engineer to be on-site and the part can be sent to ABB for service or repair.

Each 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. The other modules take up the load if one module is defective or if it is removed for service or repair. The only common component of the system is at the five-module rack level. Up to six racks can be connected to form one very powerful UPS.

ABB's DPA UPSs operate with an efficiency of up to 96 percent and their scalability minimizes power losses, thereby maximizing energy efficiency.

A reliable and flexible UPS is a basic requirement in today's business-critical environment as problems with power generation or supply can cause outages or quality issues such as voltage dips, spikes or frequency variations and harmonics.

The availability, flexibility and reliability of the power supply, and its cost, are critical to data centers, as well as hospitals, media houses, telecom sectors and the process automation industry. UPS systems are essential to protect these critical services and maximizing efficiency keeps energy costs to a minimum.

To find out more about ABB's UPS solutions:
Web: www.abb.com/ups **or** DPA modular page

ABB's UPS website

Cyberex UPS – FAQs

Frequently asked questions about Cyberex UPS, now answered.

What is a UPS?

A UPS is an electrical device that provides continuous, conditioned, uninterrupted power to a critical AC load. It also provides isolation between the input and the output. It consists of a rectifier/battery charger, battery system and inverter. The battery charger converts incoming commercial/utility AC power to DC power. This power is then supplied both to a battery system and an inverter. The inverter then converts this DC power back into AC power which is fed to the critical load(s).

The battery is an emergency DC supply that is connected in parallel with the output of the battery charger, and supplies the DC power to the inverter (without any switching) in the event that the incoming commercial power is lost or outside of specified tolerances.

A true UPS is an on-line system, which means that under normal operating conditions, the power flow is through the battery charger, then through the inverter to the load. This differs from off-line, or stand-by systems, which are designed such that under normal conditions, power for the load is supplied directly from the commercial power source, NOT through the inverter. Depending on the design, and cost, the power may be conditioned by means of a voltage regulating transformer or power conditioner placed in the power path between the commercial power source and the load. In an off-line or standby system, the inverter only supplies power to the load if the utility power fails. The battery then picks up the inverter load for a finite period of time (typically 15 to 20 minutes).

> A UPS is an electrical device that provides continuous, conditioned, uninterrupted power to an AC load

When the battery is depleted, the inverter will turn off, and the load will go down. In order for a power supply to be considered a true UPS, it must accept three sources of power. The first source is the commercial, or utility, power that supplies AC power to the battery charger; the second is the battery, which provides emergency DC power. The third source is a bypass, or alternate, AC source, which provides emergency AC power to the load if the inverter is unable to supply power, either because of an inverter failure, or a fault on the load. Under these conditions, the load would be automatically transferred to the bypass source via a static (electronic) transfer switch.

The bypass source also supplies power in the event that the load is transferred manually from the inverter via a manual maintenance bypass switch. A true on-line UPS is also referred to as a double conversion system. This means, as the name implies, that the power is converted twice. First it is converted from AC to DC at the rectifier; then it is converted back from DC to AC at the inverter. Another common term is reverse transfer. This refers to the fact that the load, under certain conditions as described above (faults, equipment failure or manual operation), is transferred back onto the commercial/utility power source.

Again, this differentiates it from an off-line system where, under normal operation, the load is powered from the utility source.

How do I size batteries for UPS applications?

UPS batteries are sized to provide emergency back-up power to the UPS in the event of a total AC blackout. While it is often a matter of convenience or personal preference, the length of back-up time required is primarily a function of the process being protected. It is also governed by the cost of the battery. Since a UPS is utilized to provide continuous power to a process of one kind or another, the batteries should be sized to carry the load for as long as it takes to either complete the process, perform an orderly shut-down of the process, or bring a generator on-line to power the load. A UPS inverter

Battery type	Typical warranty	Life expectancy	Hydrogen gas evolution	Approx. number of deep charges	Initial cost comparison to lead calcium
Lead calcium wet cell	20 years	20 years	Low to moderate	100	100%
Lead calcium VRLA	10 years	5 years	None	200	3–50%
Lead calcium VRLA	20 years	15 years	None	200	80–120%
Lead antimony wet cell	15–20 years	15 years	High	400	100%
Nickel cadmium wet cell	20–25 years	20–25 years	Low	1000	250–300%

Table 1: Comparison between battery technologies

converts DC power to AC power. The battery must be sized large enough to provide the DC input power (in kilowatts) for a fully loaded inverter for the specified length of time. The DC input power is determined by applying the load power factor, and inverter conversion efficiency to the inverter's AC power rating.

Next, you must determine the DC bus voltage, and the corresponding number of battery cells. Then, you can determine the battery capacity per cell required for the load. (Note that a battery has a nominal voltage of 2 volts per cell. So, on a nominal 120 VDC bus, you will need 60 cells.) Then, using discharge data supplied by a battery manufacturer, you can determine the battery type and size required. Following is a typical battery sizing example: 20kVA UPS (inverter) with a DC to AC conversion efficiency of 87 percent; a load power factor of 0.8, and a nominal 120 VDC bus.

$$\frac{20\text{kVA} \times 0.8}{87\%\ \text{cells}} = \frac{16\ \text{kW}}{87\%\ \text{cells}} = \frac{18.39\ \text{kW}}{60\ \text{cells}} = 0.307\ \text{kW/cell}$$

Using discharge tables supplied by the battery manufacturer(s), select the type of battery that meets the above requirements of 0.307 kilowatts per cell. Please note that complex load duty cycle profiles, commonly called step load profiles, should be referred to your UPS supplier for proper sizing.

What are the advantages/disadvantages of different battery technologies?

There are several different types of batteries available for UPS applications. However, they basically break down into two technologies: Lead Acid and Nickel Cadmium. Lead acid batteries are further divided into two types: Lead Calcium and Lead Antimony. Lead calcium batteries can be broken down into two categories: traditional wet cell (or flooded) and valve regulated lead acid (or VRLA – sometimes mistakenly referred to as maintenance free). The proper battery for a given application is dependent upon a number of factors. (Refer to table 1 for a quick comparison between battery technologies).

1. Ambient temperature

The optimum average ambient temperature for batteries is 25ºC. Ambient temperatures above that will significantly reduce battery life. The rule of thumb is that an increase in ambient temperature of 9.4ºC above 25ºC will reduce the battery life by 50 percent.
Certain battery types are more susceptible to the effects of temperature than others. For example, a VRLA battery with a five or 10 year design life is much more prone to premature failure due to temperature extremes than a wet cell with a 20 or 30 year design life. The least susceptible is the nickel cadmium battery. Although they are affected by temperature extremes, they can withstand slightly higher ambient temperatures than other types. But caution dictates that the same 'rules' be applied to all batteries equally.

2. Number of discharge cycles

Batteries are rated in two general duty, or service, categories: 'float' service or 'cycling' service. Batteries considered to be in float service are only rarely called upon to carry a load. Cycling batteries (such as those designed for UPS applications), on the other hand, experience many discharge cycles over their useful life, with the depth of discharge ranging anywhere from several seconds, to a 100 percent discharge. Lead antimony and nickel cadmium batteries typically offer the 'best' cycling service. That is, they are designed to provide two to five times the number of discharges of other battery types, such as flooded or 20 year VRLA. A Five or 10 year VRLA, as you would expect, will accommodate the least number of discharges.

3. Maintenance

One of the trade-offs to using lead antimony batteries is that they expel greater amounts of hydrogen into the atmosphere when discharging. This requires more frequent maintenance, such as the addition of water. By far, the least amount of maintenance is required on the 10 and 20 year valve regulated

batteries, since they do not expel hydrogen gas under normal operation. Lead calcium wet cell batteries do require some maintenance, and fall somewhere in the middle. Another aspect of maintenance for flooded batteries is the periodic measuring of specific gravity to insure the batteries are fully charged. All battery types require periodic tightening of battery terminals and connections.

4. Physical Size

Valve regulated batteries are designed for maximum power density. That is, they deliver a large amount of power per cubic inch. Nickel cadmium batteries also have a high power density. Typically, if battery room space is at a premium, a valve regulated or nickel cadmium battery may be the best choice, because you get “more bang for your buck” in a limited space.

5. Expected life/warranty

A five or 10 year valve regulated battery can be expected to last two to five years, depending on the number of discharges it experiences, the ambient temperature and other factors. A 20 year wet cell or valve regulated battery will generally last 15 to 20 years, if properly maintained. A nickel cadmium battery may last 25 to 30 years. Battery warranties are typically one year full, with the balance pro-rated. In other words, a 20 year battery will carry a 12 month full warranty, with the remaining 19 years prorated against the manufacturer’s list price. Extended warranties are often available.

One unfortunate thing about batteries is that, no matter how much you pay for them, they are essentially a consumable part, and need to be replaced periodically. Of course, there are many factors that affect how frequently this needs to happen, but eventually, even under ideal service conditions, they will need to be replaced. The real downside to this is that it is not always possible to predict exactly when the batteries are near their end of life although in this instance wet cell batteries have a distinct advantage over valve regulated types. There are several ways to determine the status of wet cell batteries. 1) You can measure the specific gravity of a cell, and make determinations as to electrolyte levels; 2) you can measure cell temperature (which actually should be done in conjunction with specific gravity readings); 3) you can perform a visual inspection of the battery jar to determine the amount of sediment in the bottom; 4) you can perform a discharge test on the battery.

One advantage of the Cyberex Industrial UPS is it's small footprint, meaning it can be retrofitted into sites where there is limited space

Typically, if battery room space is at a premium, a valve regulated or nickel cadmium battery may be the best choice, because you get “more bang for your buck” in a limited space

With VRLA batteries, because the jars are sealed, the best way to get an accurate indication of battery life and capacity is to perform a periodic discharge test. There are also several types of battery monitoring systems on the market, but the results of using those have been somewhat mixed.

The CBEMA curve defines the voltage tolerance levels and duration that computers and other electrical control devices can safely operate within without corruption of data

6. Cost

With batteries, it is generally true that “you get what you pay for.” Nickel cadmium batteries offer the best overall performance – less susceptible to temperature extremes; greater number of cycles; greater power density; low maintenance; and greater life expectancy. However, the trade-off is that the initial cost can be two to three times that of a 20 year wet cell lead calcium battery. A 20 year valve regulated battery is comparably priced (usually within 10–20 percent) with a 20 year wet cell battery. As you might expect, a five or 10 year battery is priced accordingly.

Why fuses instead of breakers for UPS distribution panels?

The goal of any well designed UPS system is to maintain power to the load at all times. However, since the output of the UPS is generally fed through a distribution panel board to the load, there may be times when an overload or fault occurs on one or more branch circuits that have the potential for dropping the load(s) on that branch. This condition needs to be limited to only that branch, and not affect any other loads, or upstream electrical equipment. Therefore, it is imperative that the fault condition be cleared as quickly as possible. Most molded case breakers, used as branch breakers in panel boards, take two to three cycles (50 milliseconds) before they will open under short circuit or fault conditions. Fast-acting fuses, such as the Gould Shawmut A25X™, however, have much faster clearing characteristics, typically 1/4 cycle (4 milliseconds).

Many UPS systems (inverters) will not provide enough fault clearing current for the two to three cycles required to clear those types of breakers. Fuse clearing energy of a power source can be expressed in terms of its I2-T capability. For example, a Cyberex inverter is able to deliver 150 percent of its rated output for 15 minutes without transferring to the bypass. A fault or short circuit of sufficient magnitude that is sustained for long enough could eventually cause damage or cascaded failures to other loads under what is referred to as panel pull-down.

Other types of inverters, which are not designed with the energy storage capability of Cyberex inverters, will only supply approximately 10 to 15 percent of the fault clearing energy of inverters. This severely limits their ability to clear faults without transferring to an alternate source.

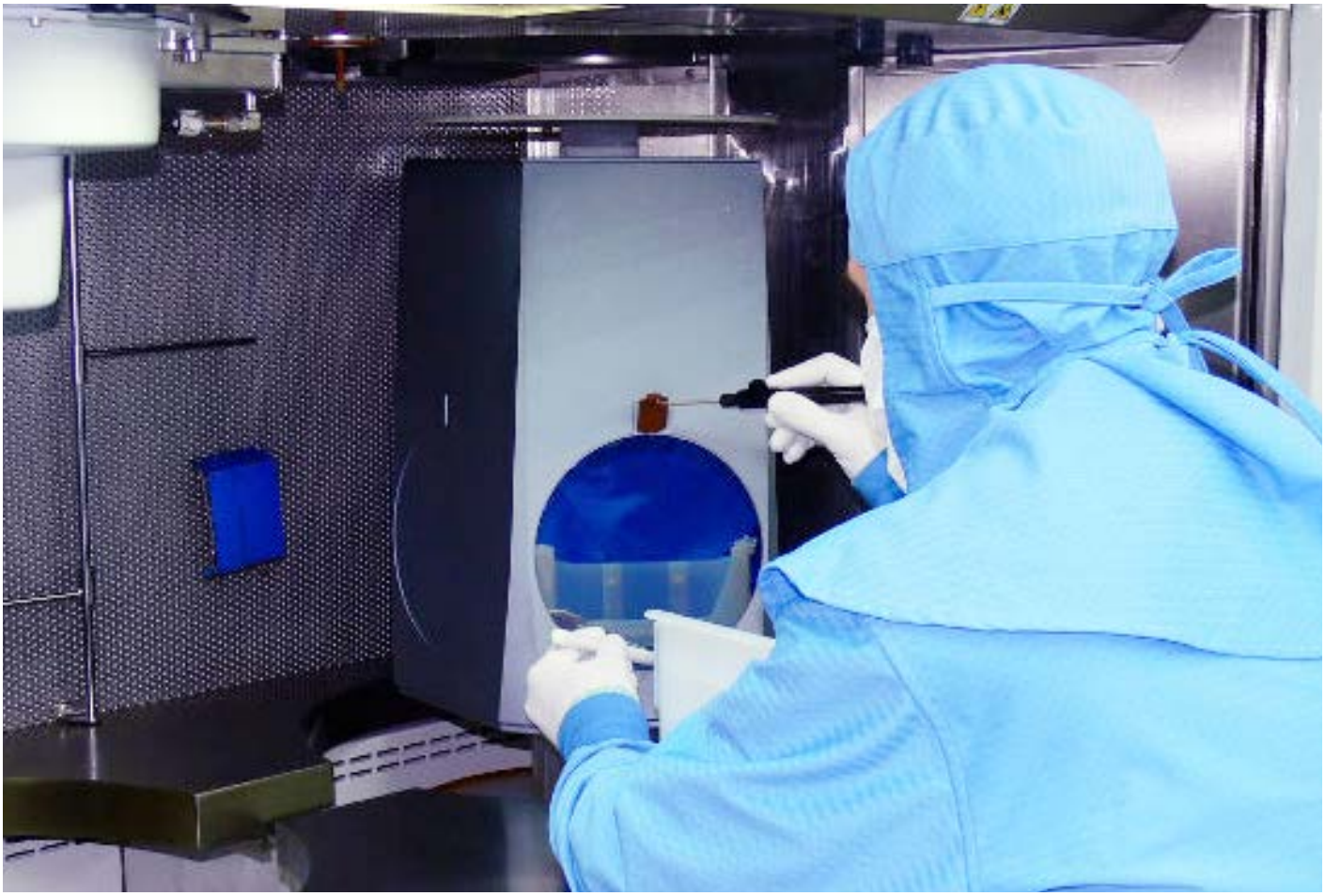
What is pulse-width-modulation (PWM)?

A PWM inverter employs high speed switching power devices to generate a series of “pulses” in the inverter bridge to simulate a sine wave. This signal is then filtered and fed to the load through a linear transformer. Due to the advanced technology behind the industrialized standard of using PWM inverters, it has a very tight voltage regulation during step loading and unloading (be it 0 to 100 percent, 100 to 0 percent, 0 to 50 percent, 50 to 0 percent, etc) of between two to five percent of nominal under any operating condition. Loads are not compromised due to step loading or unloading. Other technical benefits are higher efficiencies, smaller footprint, advanced metering/monitoring, and lower audible noise.

What is the CBEMA curve and what does it mean?

CBEMA stands for Computer Business Equipment Manufacturer’s Association. The CBEMA curve defines the voltage tolerance levels and duration that computers and other electrical control devices, such as Programmable Logic Controllers (PLCs) can safely operate within without corruption of data. The curve shows that voltage transients of certain magnitudes, say 250 percent, are acceptable for short periods of time – 100 microseconds. That same transient with a duration of say 1/2 cycle (8.33 milliseconds) would cause disruption of data.

The curve also shows that voltage levels below nominal are also acceptable, provided they do not exceed the magnitude



Computers and other extremely sensitive equipment are affected by even very short term power fluctuations

and duration defined by the curve. For example, a voltage deviation of up to -30 percent held for that same 1/2 cycle, would not cause a disruption of data. Indeed, the curve shows that voltage levels of even zero can be tolerated for a very brief period of time – say four milliseconds (1/4 cycle). That same zero voltage level sustained for longer than 1/4 cycle could wreak havoc on data.

Losing voltage for only a little more than 1/4 cycle (8.33 milliseconds) seems insignificant, but for a computer, or other extremely sensitive equipment, it can be a lifetime.
The significance of the CBEMA curve in UPS applications is important when considering a UPS (or inverter) with an electronic (static) transfer switch. This switch is critical to the overall reliability and up time of the UPS (and its load) because it is able to transfer the load from the inverter to an alternate AC power source to clear downstream faults when necessary, or in the event of an inverter failure. The ability to do this quickly and seamlessly is vital to the load. This seamless transfer must take place in both directions. Most static switches are designed to retransfer the load back onto the inverter after the fault or overload has been cleared. This retransfer should also cause no disruption of power. But, inevitably, there is a voltage deviation of some magnitude and duration when making this transfer. Therefore, it is extremely important to understand the implications of these voltage deviations. As has been pointed out, a voltage deviation of up to 30 percent, for example, can be tolerated for up to 1/2 cycle or more. Much has been made in the past of inverters that display a “lower” voltage deviation (commonly referred to as transient response) than some other types of inverters.

However, the CBEMA curve shows that electronic devices don’t care whether the level is higher or lower, just as long as it is within acceptable limits. A PWM inverter will always stay within the CBEMA curve and the acceptable limits of load power supplies.

How do I size my UPS?

A UPS is designed and sized to provide continuous power to an AC load. The term continuous is a key word because many AC loads, such as motors, require a great deal more power (current) during start-up, than the actual “running” current. A typical rule of thumb is that start-up current for a motor, commonly referred to as “locked rotor current” is eight to 12 times the actual running or steady-state current; otherwise you could end up with a UPS that is eight to 12 times larger than what your load actually requires. It will be shown below how to avoid this problem when sizing your UPS.

The current measurement used to determine the load is the RMS value, rather than the peak value. (Note: If only the peak value is known, the RMS value can be determined by multiplying the peak value times 0.707). Once the load current is determined, the capacity of the UPS can be determined simply by multiplying the RMS current by RMS voltage. This result is the Volt Ampere (VA) capacity required of the UPS. On 3-phase systems, multiply the result by $3\sqrt{(1.732)}$.

A phenomenon associated with today's electronic loads, such as computer and control devices, is the introduction of switch-mode power supplies. These power supplies are non-linear in nature, and exhibit what is known as a crest factor. The crest factor is the ratio of the peak value of current to its corresponding RMS value. These crest factors can be anywhere from 1.414 (the ratio of peak to RMS current for a perfect sine wave), to 3 or 4, depending on the non-linearity of the load. However, for all practical situations, the crest factor is typically seen as 2 to 2.5.

Most UPS systems utilize a static (or electronic) transfer switch to transfer the load to an alternate AC source in the event that a fault or overload occurs that is beyond the overload rating of the inverter (typically 120 percent). In addition, most of these static switches have in-built crest factor logic that differentiates between a true overload and a crest factor that often results from a switching power supply. This prevents the static switch from making "nuisance" transfers back and forth from the inverter to the alternate source. Therefore, although some manufacturers of DCS and other controls systems recommend that the UPS be sized to accommodate the crest factor, it is not necessary to do so. As stated previously, the UPS need only be sized for the RMS current.

UPS systems are available in a variety of voltage configurations

Likewise, when looking at motor applications, or other loads that require a large amount of inrush current, the static switch allows the load to be started on the alternate source rather than the inverter. Once the load is stabilized, the static switch can then transfer the load onto the UPS inverter. That way, you can avoid the need for oversizing the UPS and incurring unnecessary costs.

Why single phase instead of three phase?

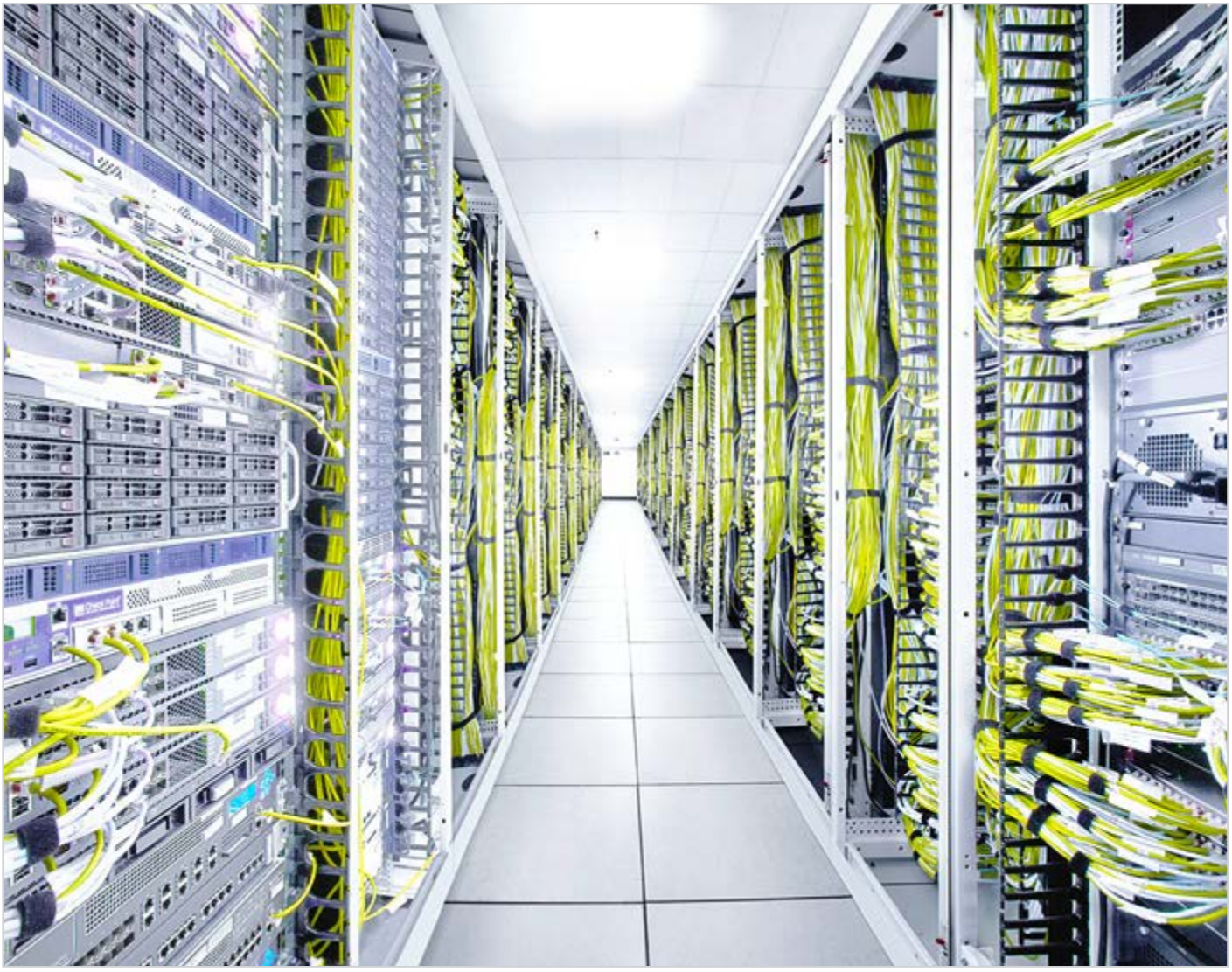
UPS systems are available in a variety of single phase, three phase, and so-called split phase voltage configurations. However, many loads in the industrial market are single phase only – particularly DCS, SCADA, and PLC applications. In years past, the EDP market – especially large main frame computer applications – gave rise to a need for three phase UPS systems. There are, obviously, some three phase industrial loads, notably large motors, but by and large most industrial situations require single phase. This is actually good news, because a single phase UPS offers some advantages over three phase systems. First, the fault clearing capability of a single phase inverter is approximately three times greater than a three phase unit. Downstream fault protection coordination is also easier to accomplish with single phase.

Second, there are no loads to balance. When using a three phase inverter to drive single phase loads, care must be taken that loads are balanced within a few percent of each other. Load imbalance can lead to voltage regulation that is out of spec, as well as increased harmonics, which can lead to distortion in the output waveform and/or overheating.

Single phase distribution panel boards and switchboards are less expensive, smaller, and easier to work with than three phase units. Again, since industrial control systems for the most part consist of single phase loads, it probably doesn't make a lot of sense to install three phase panels and inverters in the distribution system. This is likewise true for so-called split phase distribution systems. Many panel boards are rated for 120/240 volt operation. Therefore, many electricians think that they need to provide an inverter (UPS system) with a 120/240 volt output, rather than a straight 120 volt output, even though the actual loads are only 120 volts. In reality, a 120 volt unit is what they need – all they need to do is split the loads at the panel board. Many panel board manufacturers will make a straight 120 volt panel if requested to do so, usually at no extra cost.

To find out more about ABB's Cyberex UPS solutions:
Web: www.abb.com/ups

ABB Cyberex website



Center of attention

The rise of the cloud is radically changing the data center industry.

Amazon, Adobe, Microsoft and Google are ramping up their cloud use

The cloud is catalyzing massive change in the IT landscape. This rapid redefinition of an entire industry offers a unique opportunity to companies who are able to supply the ultra-reliable and flexible uninterruptible power systems needed by the cloud infrastructure - in particular, by the data centers that actually physically house the cloud's content. What are the current trends in this area and how are they likely to play out over the next decade?

The forecasts vary depending on their source and scope, but all estimates of the cloud market put it in the hundreds of billion dollars by 2020. It is clear there is a major shift happening in the IT landscape. Multinational technology companies such as IBM are spending billions acquiring cloud technology companies as well as developing their own products and services. The data center itself is becoming less important for these global players as they move to provide cloud-based data center services for customers on a global scale. The focus of IBM Global Technology Services for example will be on network, mobility, IT systems and the critical aspect of resilience. The business of data centers themselves will decrease in significance to become the concern of special-interest parties, such as banks. IBM will continue to build data centers, but for themselves to provide their cloud services.

Software as a service

Among those ramping up their cloud use are Amazon, Adobe, Microsoft and Google, as well as prominent new entrants to the market, such as Ericsson, to name but a few. The software as a service (SaaS) that is increasingly being offered by these companies is just one operation that is driving cloud expansion. Abobe and Microsoft, for example, have made a major shift to SaaS in recent years with their introduction of subscription-based software services - gone are the days of paying a large sum of money upfront, obtaining and installing a program from a DVD and then keeping an eye out for updates as time went on. Subscription services allow the user to download the installation components needed, pay on a monthly basis, be kept up-to-date with the latest version and store all their data on the cloud. Applications can even be run on the cloud server instead of locally. This trend toward thin clients is gathering pace.

IoT, off-site data storage and processing

Another driver – one that is as important or even more important point than SaaS - is off-site data storage and processing. In practice, this can deliver remote monitoring and the possibility to control almost any equipment that is connected to the virtual world. It means most new devices will, by default, not only have their physical form, but also their virtual profile – one that will be stored in the cloud. For security reasons, the devices will most likely be the ones to initiate connection and send data periodically describing their status and condition. This will generate a huge amount of data that needs to be filtered, stored, analyzed, processed and distributed to the person who needs it - via multiple user interfaces/applications, each dedicated to a specific mission.

This type of technological development would be unthinkable without a cloud-based solution. To attempt a local set-up that tried to mimic the immense number-crunching and data storage abilities of the cloud would be futile as well as wasteful. One good example of this is big data analytics, which is being seized upon by companies eager to increase their margin or improve their business model. This results in huge data quantities, as Computer Weekly notes, "one sensor on a GE gas turbine blade generates 520 GB of data per day – and you have 20 of them," [1]. The Internet of Things (IoT), will see a massive increase in storage and processing requirements in the cloud as data pours in from personal health sensors, RFID tags, building automation systems, industrial machine health monitoring, smart sensors in public infrastructure and transportation, phone apps, smart cars, smart cities – the list is open-ended. The IoT comes into its own when this data is gathered and then analyzed and leveraged. The cloud is essential for such large scale and far-reaching collection, analysis and actioning. PaaS (platform as a service) will provide companies with pre-configured tools to store and analyze data

Leasing server space and processing power in a remote data center is now as easy as hiring a car

with the possibility to build value-adding, software solutions on top for different dedicated purposes.

Off-site but not out-of-sight

Off-site data storage and processing is welcomed too by many companies for whom the cost of maintaining in-house IT resources has become onerous. Cloud facilitators make it easy to hire just whatever IT muscle is required – provision and deprovision can be done effortlessly. The key here is simplicity: leasing server space and processing power in a remote data center is now as easy as hiring a car – without the difficult collision damage waiver decisions. The user sees no difference between in-house and cloud provision of services and is unaffected. It is in the interest of cloud facilitators to make the process as simple as possible and ABB provides many of the tools to do this - of which more, later.

Outsourcing in this manner removes a whole host of unknowns from a business operation and allows company capex and opex to be much more predictable. The allure of the low cost of ultra-efficient data centers will become irresistible and, over the next decade, operating an in-house, fully private data center infrastructure will be an activity for a few niche enterprises - such as those in finance and banking, where the very best security and utter reliability trump the benefits of the cloud - and most companies will look back in wonder at the investment and manpower they used to invest in a facility that they now get for a fraction of the cost.

Every day, around 1.8 billion photos are uploaded to various sites

Data center evolution driven by the cloud

Big is beautiful - Hyperscale

All this cloud growth directly drives the expansion and evolution of data centers. Several such evolutional trends are clear today. For example, data centers are getting bigger ('hyperscale') and multi-tenant facilities are emerging. This makes sense as sharing infrastructure – especially power and cooling – reduces cost for the entire operation.

The Great Divide

In data centers, segmentation is becoming more common. This is where service provision depends on the customer's cost, security and speed concerns – banks and other critical users, for example, are hosted on servers that are not only conceptually separate from the rest of the data center, but are also physically fenced off. As data center infrastructure management (DCIM) tools become more sophisticated over the next decade, this sort of differentiation will become more refined. In addition, the criticality level of a particular application will define the design of the data center infrastructure in which it is hosted.

A perfect data world

A third example of how cloud growth is driving data center evolution is the move toward perfection of data center infrastructure. Here, in a world of critical factors, power protection is the most critical factor – without power, data becomes unavailable and many applications - and irate users and end customers - are left high and dry. Availability is everything, so enterprises turn to the uninterruptible power supply (UPS) to ensure that critical loads have a continuous source of clean power. An appropriate UPS is the most important part of the power protection concept and it can ensure security of power supply, zero downtime, availability and low cost of ownership for a modern data center. However, the UPS must be considered in the context of the application, criticality and other data center infrastructure. Simple UPSs have been around for decades, but only recently have they been adapted and developed for use in data centers. The field is in its infancy, so what is driving UPS development and how will this play out over the coming years?

Protect and survive - UPS

For the data center operator - and user – availability is key. And the ultimate guarantor of availability is power protection. This puts the UPS, the chief mainstay of power protection, into center stage.

Apart from availability, costs and margins are also of primary importance. For the data center operator, running costs need to be stable and predictable, power usage effectiveness (PUE) has to be under control and optimized, and maintenance costs known and scheduled. As far as capex is concerned, flexibility is key: upfront investments should be minimized, but infrastructure should be scalable so that future expansion can be easily accommodated. Due to the segmentation described above, equipment must be able to be deployed in sections, segments or individual modules. So-called core and pod

Decentralized parallel architecture offers unique scalability, online hot-swapping and energy saving characteristics

architectures are already gaining traction. Here, the best gear configuration for a particular customer is contained in a pod and connected to the network core that distributes data and network traffic to customers.

Currently, the best UPS design that satisfies not only these opex and capex criteria, but also availability and total cost of ownership challenges, is decentralized parallel architecture (DPA) and in a future article, ABB will describe how the modular approach of DPA delivers all these via its unique scalability, online hot-swapping and energy saving characteristics.

The weather forecast

Predicting the path of technology is difficult at the best of times - and is doubly difficult for an area moving as fast as the cloud, especially as there are many unconventional and oblique drivers. The “cloud” can be defined as any computing power delivered through IP. It really covers everything and talking about “the cloud” without reference to a specific area of discussion can easily make things foggy.

The concept of the cloud is not particularly new. However, what is new is the extreme rapidity in the growth of the services that can be provided through the cloud and their sophistication. The technological development that allows better, faster and more reliable delivery of software, computing power and all the related services that can be run on a cloud platform is revolutionary.

This evolution of individual data centers into a global organic network ties in nicely with other trends – for example, that of shifting data around the world to take advantage of low, off-peak electricity prices in other continents, or moving data around based on weather patterns to reduce loads on centers in hot climates.

The cloud is having a major impact on the data center business, so future data centers must become more efficient, more agile and capable of achieving higher levels of availability at lower cost. ABB is using its experience in industrial automation and control solutions for the continual development of comprehensive management systems that include the types of business planning, costing, energy management, and converged physical/virtual data center management technologies that are needed for this.

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To find out more about ABB’s UPS solutions:
Web: www.abb.com/ups

ABB's UPS website

ABB release the PCS100 AVC-40 Active Voltage Conditioner for sag correction

Leading the industry in innovation and technology, ABB has released the PCS100 AVC-40 Active Voltage Conditioner designed for sag correction in large commercial and industrial applications. Providing fast, accurate voltage sag and surge correction as well as continuous voltage regulation, the PCS100 AVC-40 has been optimally designed to provide equipment immunity from power quality events on the supply network.

The PCS100 AVC-40 is able to provide continuous protection from the most common utility voltage problems found in modern power networks. Even the most modern power networks are not perfect and voltage sags are the most common cause of equipment malfunction in today's automated industry. The PCS100 AVC-40, built on a proven and dependable converter platform, provides instant voltage sag and surge correction, ensuring maximum productivity.

The PCS100 AVC-40's fail-safe worry free operation (even in harsh electrical environments) means it is specifically designed for large commercial and industrial applications. It's industrial design and rugged overload capability means it can handle conditions that other voltage conditioners cannot. Furthermore, it contains a redundant internal bypass system that ensures that the load continues to be supplied from the utility. The PCS100 AVC-40 has a faster return on investment due to low operation costs thanks to its leading efficiency exceeding 98 percent, and minimal heat rejection ensures minimal costs for electricity and cooling.

The PCS100 AVC-40 requires no batteries, as it draws the additional energy required to make up the correction voltage from the utility supply. With no ongoing maintenance costs typically associated with batteries, the cost of ownership for a PCS100 AVC-40 system is very low. As the system has a small footprint, it can be easily fitted into equipment rooms or confined spaces, eliminating the need to design and build added floor space.

The PCS100 AVC-40 feature a large LCD touch screen, through which the device can be operated and detailed event logs accessed. An integrated web server allows remote access and emails can be sent to those concerned when a power quality event occurs, allowing information that can be easily accessed, anytime, anywhere.

To find out more about ABB's PCS100 AVC-40 solutions:
Web: www.abb.com/ups
Email: powerconditioning@abb.com

ABB's PCS100 AVC-40 for sag correction

PCS100 AVC-40 now online

The PCS100 AVC-40 video highlights the benefits of installing a PCS100 AVC-40 for your business in commercial or industrial applications

Watch ABB's PCS100 AVC-40 video on YouTube.

ABB's PCS100 AVC-40 video features animations of the product's technology including a new feature, receiving email notifications when a power quality event occurs. Further features include a proven and dependable converter platform with sophisticated control software, industrial design with rugged overload capability, no battery energy storage required and class leading efficiency of over 98 percent.

Industries in developed countries with modern power networks are not immune to voltage problems. Although utilities endeavor to supply reliable, high-quality power, voltage sags and surges will continue to be a fact of life.

The PCS100 AVC-40 is an active voltage conditioner designed to solve these problems. It is a high performance power electronic system, designed for industrial and large commercial applications. It responds instantly to power quality events, providing continuous regulation of voltage.

Watch the PCS100 AVC-40 video here on YouTube.
Watch the PCS100 AVC-40 video here on ABB.

To find out more about ABB's PCS100 AVC-40 marketing material, please click here.

ABB PCS100 AVC-40 website

PCS100 AVC-40

For sag correction – 150 kVA to 3600 kVA

Designed for large commercial and industrial applications, ABB's PCS100 AVC-40 is the solution for any facility that suffers from power quality events. Power ratings ranging from 150 kVA to 3600 kVA allow customers to choose the solution that best suits their applications.

Key benefits

+ Continuous protection from the most common utility voltage problems found in modern power networks

Even the most modern power networks are not perfect and voltage sags are the most common cause of equipment malfunction in today's automated industry. The PCS100 AVC-40, built on a proven and dependable converter platform, provides instant voltage sag and surge correction, ensuring maximum productivity.

+ Fail-safe, worry free operation even in harsh electrical environments

The PCS100 AVC-40 is specifically designed for industrial and large commercial applications. It's industrial design and rugged overload capability means it can handle conditions that others cannot. Furthermore, it contains a redundant internal bypass system that ensures that the load continues to be supplied from the utility.

+ Faster return on investment due to low operation costs

With industry leading efficiency exceeding 98 percent the PCS100 AVC-40 has minimal heat rejection, resulting in minimal costs for electricity and cooling. The PCS100 AVC-40 requires no batteries, as it draws the additional energy required to make up the correction voltage from the utility supply. With no ongoing maintenance costs typically associated with batteries the cost of ownership for a PCS100 AVC-40 systems is very low.

As the system is has a small footprint, it can be easily fitted into equipment rooms or confined spaces, eliminating the need to design and build added floor space.

Steady as a rock

The PCS100 Active Voltage Conditioner range delivers rock-solid voltage.

Even developed countries equipped with modern power networks are not immune to voltage problems. While outages may be rare, the voltage problems caused by weather, network faults or "digger-through-the-power-cable" type events are ever-present. With modern industry employing more and more automation, the sensitivity of processes to such power quality events is increasing. Even an event lasting less than one second can cause processes to unexpectedly stop - potentially resulting in product damage, wastage and production shortages. In developing countries, or regions with a weak power supply, the main problem is poorly regulated voltage. Without the correct voltage, reliable process operation may not be possible. If the voltage is low or imbalanced then the overheating of motors is a particular concern. ABB's PCS100 AVC products are designed to protect industry from voltage events, allowing companies to get on with what they do best.

Often, industrial sites are located close together - for example, in an industrial park or in a particular area of a city. If one user in this cluster disrupts the utility voltage – by starting a large motor, for example - the others can be affected by voltage sag or fluctuation. Weather events or faults in other parts of the utility network can also cause the voltage to sag well below its nominal value and stay there for several seconds.

Such voltage variations can cause sensitive production equipment to stop. If a production line stops, it has to be restarted and this can be a complicated and very expensive exercise. Equipment damage caused by power quality events can be even more costly. Further, equipment can be very dependent on a stable power supply to deliver a good-quality end product.

It is best, then, for companies exposed to the risk of uncertain power supply to invest in equipment that ensures a constant supply of clean, high-quality power. ABB's PCS100 Active Voltage Conditioner (AVC) product does exactly this.

The PCS100 AVC product

ABB has a variety of power protection products and the PCS100 AVC is unique among these. Specifically designed for industrial and large commercial applications, the PCS100 AVC is able to respond instantly to voltage sags and surges, correct for voltage imbalances and remove voltage flicker. The PCS100 AVC consists of two converters that are not on the current path between the load and the utility. Instead, the corrective voltage injection is achieved by means of a transformer winding placed between the utility and the sensitive load. This configuration delivers a very efficient and effective way to provide voltage correction.

The PCS100 AVC does not require battery storage as it draws the additional current required to make up the correction voltage from the utility supply. Without the ongoing maintenance costs typically associated with batteries, the cost of ownership of PCS100 AVC systems is very low.

Furthermore, the PCS100 AVC contains a redundant bypass system that, in the event of a fault with the PCS100 AVC, ensures that the load continues to be supplied from the utility.

The PCS100 AVC is available with ratings from 150 kVA to 3600 kVA and is realized in a low-voltage switchgear cabinet. It offers online voltage control precise to within a couple of milliseconds, high scalability in terms of voltage and power level, a proven and dependable converter platform, sophisticated control software and an efficiency of over 98 percent. The PCS100 AVC product portfolio has been split into two models, with different ratings:

– The PCS100 AVC-40 – designed for customers who have a stable network, but which one may be susceptible to voltage sags caused by external factors such as weather, etc.
– The PCS100 AVC-20 for continuous voltage regulation. This product is ideal for customers whose network is weak and unstable.

Each product is specifically engineered to fix different types of common utility power supply problems.

PCS100 AVC-40 for sag correction

The PCS100 AVC-40 responds to voltage sags or swells within several milliseconds and can inject a voltage correction of up to 40 percent. For example, if a facility was faced with a voltage that sagged to 60 percent of its nominal value, the PCS100 AVC-40 would boost the voltage back to 100 percent. No lights would dim and no equipment would trip – business would go on as usual. This example applies to three-phase power; performance is even better for single-phase sags (the most common type): voltage sags down to 45 percent of the nominal voltage are fully corrected.

For deeper voltage sags, the PCS100 AVC-40 undertakes a partial correction, which will often prevent the load

Modern factories with sophisticated equipment face continuous threats from power utility network events such as sags and surges

from tripping. In addition, the PCS100 AVC-40 is able to continuously correct voltage fluctuations of ±10 percent in the mains voltage and even remove imbalances from the supply voltage.

The product is rated from 150 kVA to 3600 kVA and is available for 220 V, 400 V and 480 V. Special voltages and powers up to several MVA are available as customized designs.

PCS100 AVC-20 for continuous voltage regulation

Rated at up to 3 MVA, the PCS100 AVC-20 ensures continuous voltage regulation to 100 percent for voltage fluctuations of ±20 percent of the mains voltage. The PCS100 AVC-20 also removes any imbalances from the supply voltage.

If the voltage fluctuations are even higher, the PCS100 AVC-20 will undertake a partial correction, with a voltage injection of up to 20 percent. For example, with mains voltage drops of 30 percent, it corrects to 90 percent of the nominal voltage – keeping voltage levels inside standard specifications of most electrical equipment.

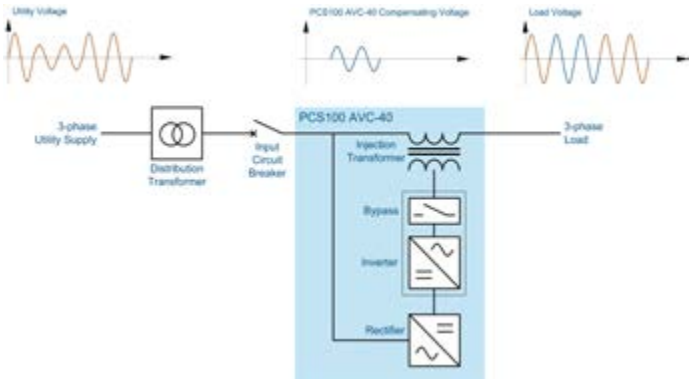
Common features

The PCS100 AVC has several advantages over competitors' devices:

- **Small dimensions:** Space is often an issue in industrial environments and the compact dimensions of the PCS100 AVC allow it to be installed in small spaces.
- **High reliability:** An integrated bypass, and industrial-grade overload and fault capacity contribute to the high reliability.
- **Lowest total cost of ownership:** The absence of energy storage (batteries), low maintenance and high efficiency mean running costs are low.

The PCS100 AVC-40 and AVC-20 products both feature a large LCD touch screen, through which the device can be operated and detailed event logs accessed. An integrated web server allows remote access and emails can be sent to those concerned when a power quality event occurs.

Modern factories with sophisticated equipment face continuous threats from power utility network events such as sags and surges. By installing ABB's PCS100 AVC they are equipping themselves with a sophisticated layer of protection that improves their bottom line by dramatically reducing downtime, scrap material, poor product quality and wasted man-hours.



ABB's PCS100 AVC-40 responds instantly to power quality events, providing continuous regulation of voltage

To find out more about ABB's PCS100 AVC solutions:
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Power 01|15

Outlook for power protection

06. What's in store for power protection
Product releases and modifications in 2015

15. Speedy return on Fonterra's new protection system
Protecting against five power quality events since installation

16. Big data equals big power
Medium voltage UPS is the new "black" amongst large power users

18. Investor protection
Protecting a stock exchange data center from power disruptions

Power 02|15

Addressing voltage issues

06. Tackling voltage problems
What they are and how to fix them

14. Medium voltage UPS goes from strength to strength
LCD company in Japan secures two PCS100 Medium Voltage UPSs

16. A new phase for Samsung
Samsung uses ABB technology to protect its mega investment in China

19. Commercial UPS market in the UAE
ABB signs third party channel agreement with SiteTechnology LLC

26. Patient care
PCS100 AVC technology protecting Toshiba's CT Scanner

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