

6|17

A power protection magazine
of the ABB Group

power



Seamless power

Keeping up with the growing demand of data centers 06

An interview with Domagoj Talapko

Power protection for the semiconductor industry 10

PCS100 AVC-40 protecting against voltage sags at a leading semiconductor test assembly company in Malaysia

New UPS battery handbook 14







Lara Cortinovis
Global Product Group Manager
Power Protection

Dear all,

Welcome to our final edition of Power magazine for 2017. It is always good to be able to look back at a successful year, and over the past months, the contributions and commitment of our employees, partners and customers have indeed made our business flourish as never before. New products were released, R&D projects started and our service business around the world expanded and reached more and more customers.

In this edition, you can read a interesting interview with Domagoj Talapko, Business Development Manager, ABB's power conditioning team. As many of you will know, the quantity of data in society is growing rapidly – just think of all the information about you that is held by financial institutions, healthcare facilities, security systems, government departments, social media companies and the like. That material is all kept in data centers around the world and has to be stored safely and in a way that makes it rapidly accessible - 24/7, 365 days a year. These requirements mean that data centers must have UPSs that provide a reliable supply of clean power. In his

interview, Domagoj Talapko talks about ABB's power conditioning solutions that meet the new demands of the growing data center industry.

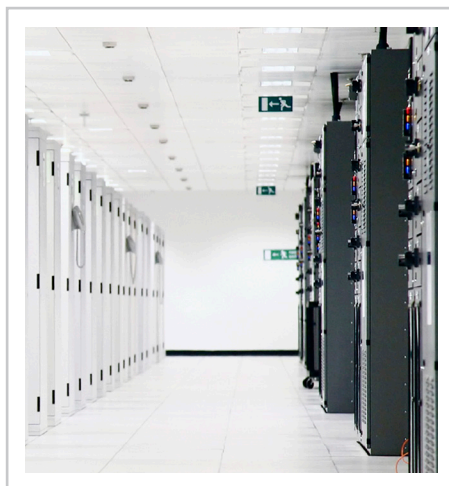
Highlighted in this issue are several outstanding articles that underline the strength of our power conversion and conditioning systems. Foremost is a case study of how ABB technology is ensuring continuous power and operational uptime at a leading semiconductor test company that provides a complete scope of services for the semiconductor market. Learn about how a mega processing facility is achieving a reduction in energy consumption following the installation of ABB's PSC100 reactive power conditioner (RPC) to enhance power quality.

The onward march of renewable energy is unstoppable. Indeed, the rise in installed renewable energy sources in the past few years has exceeded most predictions. One key aspect of renewables is battery technology – a technology that is vital for our power protection solutions too. As battery technology improves, so do our products. We have now completed a comprehensive battery technology handbook that describes every common type of battery - from the trusty lead-acid cell you find in your car to the latest lithium compact cells - and how they are to be used in the field. Some highlights from the handbook are included in this edition of our magazine.

2018 is on our doorstep and we will continue to have exciting product arrivals next year in the areas of industrial UPS, modular UPS, single-phase UPS and power conditioning. More about some of these in the next edition of Power magazine.

In conclusion, I would like to take this opportunity to wish all of you and your families a very happy Christmas and a joyful New Year.

Enjoy this issue of **power**



06

Keeping up with the
growing demand of
data centers



08

Power protection for
the semiconductor
industry



14

Harmonic disruption
eliminated from pasta
plant

Power conditioning

06 Keeping up with the growing demand of data centers

10 Power protection for the semiconductor industry

12 PCS100 AVC-40 - for sag correction 150 kVA - 3600 kVA

14 Harmonic disruption eliminated from pasta plant with power conditioning technology

UPS

16 Our new UPS battery handbook – an overview



16

Our new UPS battery
handbook

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Keeping up with the growing demand of data centers





An interview with Domagoj Talapko, Business Development Manager, Power Conditioning

In today's society, the quantity of data is growing rapidly. For data to be used in many applications it must be stored in a safe and fast manner, but also be retrievable 24/7 365 days a year. Data centers are demanding more and more power.

In this interview, Domagoj Talapko, Business Development Manager MV UPS into data centers, from ABB's power conditioning team talks about ABB's range of products that meet the new demand of this growing industry.





Data Centers require a continuous clean electrical supply for reliable operation. How does ABB's highly innovative products provide a solution for data centers?

Data centers are one of the best representations of critical infrastructure. In today's world, there are numerous challenges within the industry such as constant power increase, the need for flexibility and modularization, high efficiency and high levels of availability.

These challenges are tested when you consider data centers operating as microgrids and being implemented into smart grid architectures.

Through new innovations, ABB supports electrification products from grid to chip and services that are applicable in the most challenging environments and infrastructures.

What are the consequences of data center breakdowns? Why chose ABB's power protection as a solution?

Loss of revenue is a serious consequence, which can be severe and can potentially damage the reputation of the data center.

ABB's products allow a holistic approach to the data center electrification, and enable customers to optimize capital and operating costs.

With over 125 years of experience in the field of electrical infrastructure, ABB's constant innovations and adaptations to market requirements are a guarantee for successful implementation and operation.

Please tell us bit about ABB's product range?

ABB's Power Conditioning portfolio is a unique line of low and medium voltage power conversion technology that is part of the product group, power protection.

The product range consists of static frequency converters, UPSs, voltage and power conditioners that demonstrate highly reliable and cost-effective performance.

With this product portfolio, ABB offers efficient power conditioning solutions that are specifically designed to solve power quality problems and stabilize networks.

Current facilities must deal with the need for energy efficient and reliable power to avoid major losses. How does ABB's systems help with this?

ABB has the capability and resources to optimize entire electrical infrastructures and provide state of the art products and components, such as smart power distribution units, transformers and a whole range of protection and power conditioning systems.

Through advanced programs during the design phase, ABB can recommend products and services that will enable the highest levels of efficiency and power quality and simultaneously keeping very high levels of availability.

How does the PCS120 MV UPS offer a flexible solution for higher efficiency and higher reliability in critical power facilities? What are the advantages of the PCS120 MV UPS System?

PCS120 MV UPS is the industry's frontrunner solution for total facility power protection. It operates on medium voltage and by doing so keeps the energy losses minimal.

The PCS120 MV UPS system enables clean power supply to the data center, while in the case of grid connection loss a ride through is enabled by the means of energy storage solutions such as standard VRLA or Li-ion batteries, flywheels, ultracapacitors etc.

Due to the system modularity and advanced monitoring capabilities the PCS120 MV UPS has a very high inherent availability on a system level.

What other products feature in the UPS range? How can they benefit data centers?

In the power protection portfolio, ABB has standard low voltage UPS solutions utilized in data centers and there is also a highly specialized power conditioning product range from which the PCS120 MV UPS derives from.

While the product range covers standard data center configurations, PCS120 MV UPS is utilized for high power data centers (for example >10 MW). Due to the high incremental size (2.25 MW) it reduces the total installed power that is driven by requirement of redundancy, thus it is optimized for the total facility protection (IT and mechanical loads).

What sets ABB's PCS120 MV UPS apart from other products in the market?

It is the possibility of having robust static UPS that incorporates a high level of constant efficiency (>98%).

With fast dynamic performances, enabling high power quality supply towards the load, supporting different energy storage

solutions is achievable through modularity in different electrical architectures, such as hard parallel with N+1, 2N etc. or ring bus structures.

What does Power Conditionings product range mean for the future of data centers?

As data centers become larger and larger in terms of installed power and already have inherent additional energy sources, such as diesel generators, batteries etc. they will play a more important role in enabling overall commercial grid stability.

This is a huge potential for power conditioning products as these devices can achieve the highest standard of power supply to the load (data center) and allow an improved interaction with the grid.

Where can our readers go to find out more?

You can find more information, including technical data, key applications, and a video showcasing the PCS120 MV UPS on ABB's website: [link](#).

To find out more about ABB's power protection solutions:

Email: powerconditioning@abb.com

Web: www.abb.com/ups

Power protection for the semiconductor industry

ABB's PCS100 AVC-40 protecting against voltage sags at a leading semiconductor test assembly company in Malaysia



ABB has installed a 3,000 kVA AVC in a semiconductor facility in Penang, Malaysia, to help protect the power to their micro-chip testing facility. As a global leader, the company provides a complete scope of services for the semiconductor market; driven by superior technologies, breakthrough innovations, and advanced development program.

A high-quality electrical supply is important in many industries, but for a world leader in semiconductor back-end solutions alike, it is a business requirement. The company required a power quality solution to mitigate the power sag issues from the utility supply. They had been experiencing major sags every month, which caused the testing equipment to trip and therefore production had to stop for reprogramming. This

caused material wastage, downtime and man power, which are issues that affect the company's profitability and delivery/production requirements.

As part of the facility's expansion project, ABB's local sales manager in Malaysia arranged for a demonstration active voltage conditioner (AVC) to be installed as a trial system for a number of months. Following the successful trial, a PCS100 AVC was installed at the end of 2016 in one of their switch rooms to protect their micro-chip testing facility.

The semiconductor industry is extremely important as semiconductors serve as the core building materials for important electronic products. Semiconductor devices range from the extremely small, lightweight memory chips and microprocessors through to power semiconductors that are highly efficient and reliable. The production of these sensitive chips require extremely high-quality electrical power. Without advanced power protection this is simply not available from the electrical utility. The cost of lost production, down time, quality and ultimately lost profit can be of huge scale for semiconductor manufacturing fabrication plants that are not adequately protected.

The facility manager, said: “ABB is providing a good solution and quality equipment to improve our production activity. Furthermore, the after sales support is satisfactory and is up to our expectation.”

ABB's PCS100 AVC can react within a few milliseconds to provide an efficiency rate exceeding 98 percent, whilst providing continuous online regulation and voltage unbalance correction. ABB's PCS100 AVC has been widely applied in the semiconductor industry for process protection and achieved improved product yield and reduced waste.

Voltage sags have been identified in many international studies as one of the most costly power quality problems for continuous process industry. They are very difficult for the electricity utilities to eliminate from even the most robust power systems even at transmission connection levels. Typically caused by lightning and system faults, sags will propagate quite large distances through the electrical network causing sensitive loads to trip. For some customers this can just be an inconvenience, but for many it results in expensive product loss and downtime.

To find out more about ABB's power protection solutions:

Web: www.abb.com/ups

Email: powerconditioning@abb.com



PCS100 AVC-40

Active Voltage Conditioner for sag correction 150 kVA - 3600 kVA

The PCS100 AVC-40 Active Voltage Conditioner (AVC) is specifically designed for correcting voltage sags in large commercial and industrial applications. With a proven and dependable converter platform, the PCS100 AVC-40 ensures instant surge and voltage sag correction, thereby increasing productivity. The load capacities range from 150 to 3600 kVA, and higher ratings can also be used on request.

The rugged overload capability and industrial design of the PCS100 AVC-40 allows it to withstand conditions that cannot be handled by other systems. In addition, a redundant internal bypass system ensures continuous supply of load from the utility.

The PCS100 AVC-40 achieves higher than 98 percent efficiency and minimal heat rejection, thereby reducing the costs of cooling and electricity. It does not require batteries as the utility supply provides the additional energy to make up the correction voltage.

Key features

The main features of the PCS100 AVC-40 are:

- Small footprint design
- Low cost of ownership
- Can be easily fitted into confined spaces or equipment rooms
- Batteries not required
- Rugged overload capability ensures operation in harsh electrical conditions
- Continuous protection from voltage sags and surges

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. Failsafe worry free operation even in harsh electrical environments. The PCS100 AVC-40 is specifically designed for industrial and large commercial applications. Its 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 with 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 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.



Watch the video: ABB's PCS100 AVC-40 active voltage conditioner for sag correction

To find out more about ABB's power protection solutions:

Web: www.abb.com/ups

Email: powerconditioning@abb.com



PCS100 AVC-40

Superior voltage
conditioning for commercial
and industrial applications

The PCS100 AVC 40 designed for sag correction in large commercial and industrial applications. Available in ratings from 150 kVA to 3600 kVA, the PCS100 AVC-40 offers continuous protection from the most common utility voltage problems found in modern power networks. Failsafe worry free operation even in harsh electrical environments and a faster return on investment due to low operation costs will ensure your business is protected from power quality events. abb.com/ups



Harmonic disruption eliminated from pasta plant with power conditioning technology

A pasta plant based in Jebel Ali, a business hub on the southern outskirts of Dubai, is achieving a reduction in energy consumption following the installation of ABB's PSC100 reactive power conditioner (RPC) to enhance power quality.



ABB's customer's industrial facility for pasta production is one of the largest pasta plants in the Gulf Cooperation Council (GCC). The facility is over 15,000 sq ft. and is split between a processing plant and a storage warehouse. The pasta plant consistently rolls out quality pasta with durum semolina such as spaghetti, penne, fusilli and macaroni for major international fast-moving consumer goods (FMCG) companies across Asia, the Middle East and Africa.

High levels of automation, monitoring and information systems are used when food is processed and packaged. This means that food processing companies must carefully consider their approach to power protection to avoid huge losses. Power outages, sags or other voltage disturbances can result in tripping or failure of critical equipment causing the cost of lost production, down time, quality and ultimately lost profit.

A professional electrical system audit highlighted issues with total harmonic distortion (THD) within the pasta production facility. Primarily negative sequence harmonics were emphasized, which were effecting the performance and reliability of the processing equipment, reducing load efficiency, and therefore increasing operating costs. The solution proposed was to retro fit the low voltage main distribution panels with a tailor designed active harmonic filter from ABB.

To ensure a continuous flow of clean power in the facility, two of ABB's PCS100 107 kVAr RPCs were installed in December 2016. ABB's technology drastically improved the facility's power quality. The manufacturing cost vs output were reduced and the power factor improved from 0.8 – 0.95.

The PCS100 RPC is rated for applications from 100 kVA to 2,000 kVA. The technology is a hybrid solution that not only provides dynamic reactive power conditioning but also filtering of low order harmonics, all based on ABB's PCS100 inverter technology. Compared with other technologies, the PCS100 RPC has a number of benefits, including imbalance correction, fast dynamic power factor, and active filtering of harmonic currents.

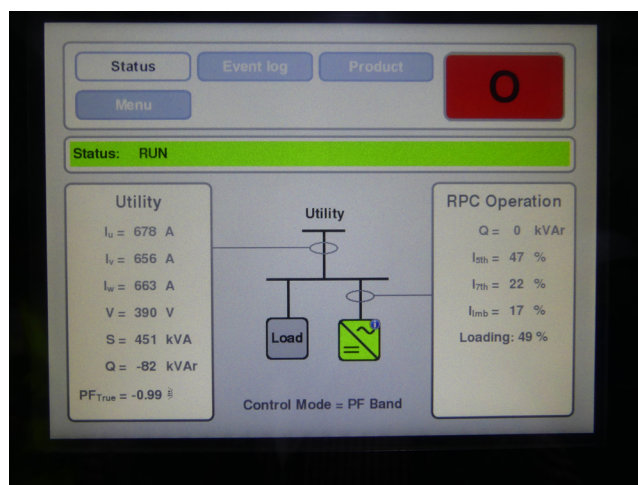
The turnkey project was installed by Energy Savers FZE whose industry qualified engineers provided a one stop point of contact throughout the project. The client chose ABB over its competitors due to the durability of the product and the reliability and performance of ABB solutions.

A spokesperson for the company, explains, "ABB's RPC units were installed at our BMN facility at the end of 2016 and we are seeing a notable reduction in our energy consumption compared with last year. Energy Savers FZE provided a professional and punctual services throughout. Their after sales support and technical ability is an additional benefit".

To find out more about ABB's power protection solutions:

Web: www.abb.com/ups

Email: powerconditioning@abb.com



New UPS battery handbook – an overview





Ever wondered about batteries? What's the difference between lead-acid, lithium-ion and NiCad? How do you choose an appropriate size of battery? Is it better to completely discharge a battery? Can you recycle a battery? Should you pump out a flooded battery? (No!) These and many other battery questions are answered in ABB's brand-new UPS battery handbook. Here, we present some highlights from the handbook.



UPS BATTERY HANDBOOK

The Main Characteristics of UPS Battery Systems

Power protection for critical infrastructure



[Click here to view the UPS battery handbook](#)

A secure supply of energy is the foundation for the success and continuity of many enterprises – be they industrial plants, offices, healthcare facilities, utilities or data centers. For some of these concerns, power outages can be very expensive indeed, with costs sometimes running into the tens of millions of dollars. This is why many businesses install an uninterruptible power supply (UPS).

A critical part of the UPS is the battery bank that provides the energy needed to ensure that a continuous flow of clean power is available to the critical process that the UPS is protecting. Parameters that have to be taken into consideration in properly selecting battery systems are the desired power and autonomy (the length of time the battery has to support the load), inverter efficiency, final voltage level (ie, the voltage once the battery should stop to operate) and the available charging voltage. Our new handbook describes how to pick a battery system based on these, and other, parameters.

Of particular interest are lead-acid (LA) batteries as these are in widespread use in UPSs. In specific instances with special requirements, nickel-cadmium or lithium-ion batteries are sometimes used. Lithium-ion is a rapidly growing battery technology, used where high-energy density and low weight are the primary requirements.

Why are lead-acid batteries so popular?

The LA battery represents the most economical choice for larger power applications where weight is of little or no concern. Most UPS systems use LA batteries because they provide excellent performance, high power efficiency with low internal impedance, high tolerance to improper treatment and an attractive price. LA batteries use an electrolyte that consists of water and sulfuric acid, and plates made of sponge lead (negative electrode) and lead oxide (positive). The two main LA battery types are:

- VRLA (valve-regulated lead-acid), also known as “sealed” or “maintenance-free”
- Flooded, also called “vented” or “open”

VRLA batteries are sealed so the electrolyte cannot leak and they can be mounted in any orientation. The battery case is equipped with a valve that vents any buildup of gas (a rare event, which may occur, for example, when the battery is subject to a high charging rate or rapid discharge). VRLA batteries normally require no direct maintenance: they do not need to be topped up with water, as any hydrogen released during charging is recombined internally with oxygen to form water. There are two main VRLA types, distinguished by their electrolyte composition:

- Absorbed glass material (AGM) type, where the electrolyte is held within a highly porous microfiber glass separator.
- Gel type, which has an electrolyte gel made from a mixture of sulfuric acid and silica.

UPS applications normally work with the VRLA AGM type because of its lower internal resistance, high specific power and efficiency, low self-discharge and lower price. AGM batteries also charge faster and can deliver a high current of short duration.



The lifeblood of financial institutions is a reliable source of quality electrical power. This is why businesses install a UPS. The battery in a UPS is the most vulnerable part of the system.

What other batteries are used in UPS systems?

As well as VRLA, several other technologies are used in UPS battery banks:

Flooded batteries

Flooded LA batteries, as the name suggests, have plates that are immersed in an acid electrolyte. Since they are not sealed, the hydrogen generated during operation escapes directly into the environment – so make sure you have good ventilation! Flooded batteries must be kept and operated upright so they don't spill and their water levels must be topped up manually. They provide a longer lifespan and higher reliability than sealed LA batteries.

Nickel-cadmium batteries

Nickel-cadmium (NiCd) battery electrodes are made of nickel hydroxide (positive plate) and cadmium hydroxide (negative plate). The electrolyte is an aqueous solution of alkaline potassium hydroxide. NiCd batteries provide a very long calendar life (up to 20 years) and can cope with temperature extremes (-20 to +40 °C). They also offer a high cycle life, have good tolerance to deep discharges and can be charged quickly. The storage time of NiCd batteries is very long, especially if fully discharged. However, NiCd batteries cost much more than traditional VRLA equivalents and have to be topped up with water.

Lithium-ion batteries

In a lithium-ion battery (LIB), the "cathode" is usually made of a metal oxide, while the anode is usually porous carbon graphite. Both are immersed in a liquid electrolyte made of a lithium salt and an organic solvent. Various LIB chemistries exist:

- Lithium cobalt oxide (LCO)
- Lithium manganese oxide (LMO)
- Lithium-nickel manganese cobalt oxide (NMC)
- Lithium iron phosphate (LFP)
- Nickel cobalt alumina (NCA)
- Lithium titanium oxide (LTO)

The chemistries mostly used for UPS applications are LMO-NMC and LFP because of their long calendar life, high safety and high power density. ABB's first choice for battery technology is an LIB cabinet solution with a special combination of lithium manganese oxide and nickel manganese cobalt capable of providing over 200 kW of continuous power for several minutes.

Battery sizing – is it the same as choosing an AA or AAA?

Choosing a UPS battery is rather more complicated than choosing a battery for your TV remote control! One normally begins with two major requirements: power and autonomy. The power value to consider is the one delivered by the batteries, so the calculation should start with the load power and subtract power factor and inverter efficiency effects as these will "consume" some of the battery energy. Major aspects of battery selection are:

- Battery life
- Performance at beginning or end of life (BOL or EOL)
- Operating temperature
- Depth of discharge
- Cutoff voltage
- Charging time



Lithium-ion batteries

Battery life

All major battery manufacturers' products are categorized by lifespan, which depends on various factors. Real service life may differ significantly from the original design life specified by the manufacturer - eg, where the temperature is higher than nominal, it can be 50 to 70 percent less.

Beginning- and end-of-life performance

Customer specifications may require a specific level of performance (eg, power and autonomy) from batteries at their beginning of life (BOL) or end of life (EOL). Battery sizing must include an oversizing factor (typically 125 percent) to account for aging in the case of an EOL requirement.

Operating temperature

Operating temperature has a strong impact on battery life and performance. Higher temperature values increase battery performance but decrease battery lifespan. Battery life is halved for each 10 °C increase above the 20–25 °C range.

Depth of discharge (DOD)

Batteries can be discharged completely or partially. The less (state of charge) a battery discharges per cycle, the lower the number of cycles that the battery will provide during its entire life. The number of cycles is normally not so pertinent for UPS systems since they normally utilize the batteries just a few times a year.

Cutoff voltage

The lower the cutoff voltage is, the more power a battery can deliver. If batteries ever discharge below their minimum cutoff voltage, they are considered to be over-discharged. In such a case, internal resistance increases due to plate sulfation (see below), and both capacity and life decrease dramatically.

Charging time

Charging time depends on the maximum power that a battery can accept without jeopardizing its lifespan. In some cases where long autonomies are required, it is also very important to verify that the UPS charging power is sufficient to ensure proper battery charging within the required time.

Why do batteries eventually fail?

Battery failure is the cause of 50 to 70 percent of UPS outages. Other than short circuits, there are three main mechanisms that reduce VRLA battery life and performance:

Plate corrosion

Plate corrosion is usually the result of oxygenation of the positive plate. It reduces the amount of active material that can participate in chemical reactions, reducing battery performance and life. This factor is unavoidable. Limiting the depth of discharge, reducing the cycle count, operating at moderate temperatures and controlling overcharge are preventive measures that keep plate corrosion under control.

Dry-out

“Dry-out” means a decrease in electrolyte quantity, which strongly impacts battery life and performance. The main reasons for battery dry-out are excessive temperatures and overcharging. With a higher charging voltage or current, the

internal rate of gas recombination is not enough to compensate for the large amount of hydrogen and oxygen generated. This leads to an internal overpressure, which causes the relief valve to open. In a VRLA, the electrolyte lost to the environment cannot be recovered, strongly affecting battery performance and life. In the worst case, it may result in thermal runaway, or even in a fire or explosion.

Sulfation

In normal chemical reactions when a VRLA discharges, lead sulfate crystals are deposited on the plates. In charge mode, they are converted back to active materials. If batteries remain empty or only partially charged for a certain period, these lead sulfate crystals harden, and it is not possible to convert them back to lead or lead oxide during charging. This strongly impacts battery performance, life and capacity, so it is important to fully charge batteries after each discharge.

How should LA batteries be stored?

VRLA batteries discharge themselves, so their available capacity decreases even when they are not operating. VRLA batteries must be stored fully charged and in a dry, clean and well-ventilated environment. After a certain period has elapsed since a battery's production date or most recent charging, the battery needs to be recharged according to the manufacturer's instructions. Higher ambient temperatures decrease the interval allowed between charges.

Is it possible to recycle LA batteries?

Nearly 100 percent of LA batteries are recycled. There are two main reasons for this: Recycling lead is cheaper than obtaining new raw material and all the parts of the battery can be completely recycled: Polypropylene is recycled into new battery cases, sulfuric acid is resold as commodity acid, and lead is smelted and reused in batteries or other products. The LA recycling system is ecologically almost a closed loop and it is highly regulated.

And there you have it, an overview of battery technology! If you would like to find out more, have a look at the full version of the handbook, which you can find at this [link](#).

For further information, please contact:

Federico Resmini
Product Manager - Energy Storage and Battery Monitoring
Power Protection SA



Making power availability available

Conceptpower DPA 500

Availability is everything when it comes to a UPS, so ABB's modular UPS architecture is designed to make sure that power is always available when you need it. Each high-reliability, standardized module is self-contained and can be online-swapped at any time, so nothing has to be ever switched off – making routine maintenance safe and easy. And if one module gets into trouble, the others take over the load and keep the show on the road. Availability available now **at abb.com/ups**



Efficient power



06. Data Center Forum 2017

ABB is sponsoring the Data Center forum 2017, which is being held on 13th September in Moscow

10. Successful shore-to-ship power link in China

Static frequency converter (SFC) providing reliable power infrastructure for a greener and more efficient port

18. Continuous power flow for the Central Bank of Malta

Customized DPA UPScale ST UPS systems installed in the Central Bank data center

Active power



06. Product launch for critical power facilities

10. ABB Technology helps semiconductor manufacturer improve productivity

PCS100 AVC-40 power protection system supports production increases

15. Elastic data center infrastructure

Maximizing energy efficiency across all operating conditions with no uptime compromise. The Xtra VFI case.