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A power protection magazine
of the ABB Group

power



Power solutions

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Key power protection featured at the power and automation show

ABB India's first shore-to-ship power supply - 9

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A key factor when specifying a UPS





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Kevin Bickerstaffe
Global Sales Manager

Dear colleagues,

It is with some surprise that we have reached the end of the year already and we are presenting our final edition of Power magazine for 2016. This year has gone by quickly. But thanks to the great contributions and commitment of our employees, partners and customers, our business has made great progress over the past 12 months. We brought out new products, started new developments and built up our service profile around the globe. We continue to grow our market share in the Global Data Centre market as our Products from Quartino and Richmond are increasingly used in this sector and now we start to see interest for our MV solutions from our Napier facility in New Zealand.

I know that some of you reading this will have attended the hugely successful ABB stand at the power and automation show in Ho Chi Minh City, Vietnam. Vietnam's economy is growing fast and the country is working very hard to expand its power infrastructure to keep up with demand. To help this growth, an annual international electric power industry show is held each September. The show is a major event for the region and it helps to enhance intra-regional power trade, promote investment

and foster technology transfer. ABB was a major participant. Not only did we have a very impressive exhibition stand that displayed all our latest power protection solutions, such as the very successful DPA UPScale ST UPS, but we also held a series of seminars over two days in which participants were informed in detail about the problems of power quality and the advantages of ABB solutions in overcoming them.

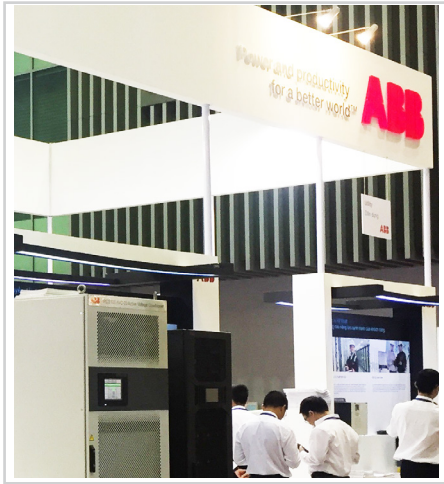
I would also like to inform you that we will hold our Biannual Far East Channel Partner event in Vietnam in March where our colleagues from the manufacturing plants in Napier, Richmond & Quartino will join us.

Diesel emissions have been very much in the news recently and precisely this topic was the subject of a shore-to-ship power supply we delivered in India. ABB is a global leader in shore-to-ship solutions and the significance of this contract is that is the first such installation at a commercial port in India – a country with 12 major ports and over 200 smaller ones. You can read all about the job and the potential for future contracts in this edition.

In this issue, we present an introductory article on power factor. Most of you will realize the great significance of this parameter for our products and the article will provide you with a more detailed insight.

In conclusion, I would like to take this opportunity to wish all of you a very happy Christmas and a joyful New Year. Thank you all again for your efforts and I look forward to working with you in 2017.

Enjoy this issue of **power**.



06 ABB's UPS on show in Vietnam



9 ABB India's first shore-to-ship power supply



13 Power factor and the uninterruptible power supply

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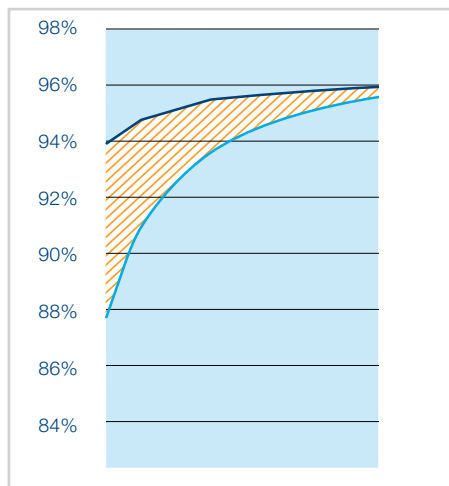
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Maximum UPS
efficiency in all
loading conditions

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ABB's UPS on show in Vietnam

ABB's DPA UPScale ST UPS and PCS 100 featured at the power and automation show in Ho Chi Minh City



Vietnam's expanding economy is driving a growing demand for electricity. Governmental and other agencies are, therefore, striving to ensure that the country's power infrastructure keeps up with the national needs. One important aspect of this effort is the staging of an annual international electric power industry event to enhance intra-regional power trade, promote investment and foster technology transfer. Held in mid-September and co-hosted with the Industrial Automation Vietnam 2016 show, the Electric and Power Vietnam event is now in its sixth year and has established itself as one of the region's major power shows.

Mr. Richard Yue, ABB's local DM division sales manager, played a key role in setting up and running the ABB part of the event. He explains, "The show is one of the major events of its kind in the region, with 7000 m2 of exhibition space, over 150 exhibitors from 22 countries and seven international group pavilions."

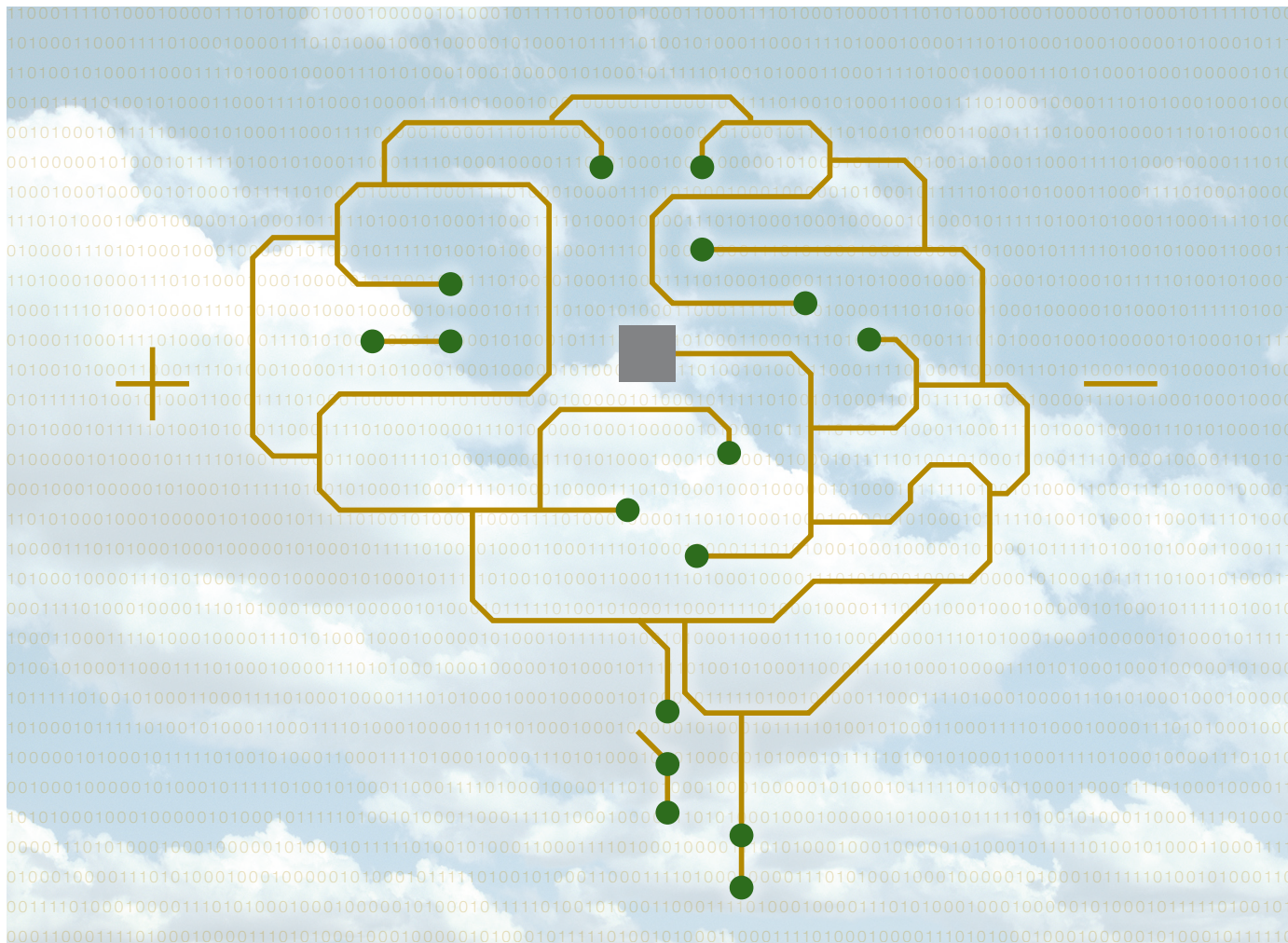
With over 4600 participants and 195 group delegations, the event was extremely well attended – a sign of the vigorous growth of the power business in Vietnam. Derrick Koh, ABB's regional UPS sales manager for Asia was very satisfied with the success of the ABB stand, "I am pleased to say that the

ABB stand was the most crowded and attractive of the whole show, with various products and solutions displayed - including the DPA UPScale ST UPS and the PCS 100, which both attracted a lot of interest."

At the ABB stand, visitors were made aware of the importance of various power quality issues and how ABB solutions such as the DPA UPScale ST UPS can help resolve them. Over two days, seminars were held to describe in more detail power quality challenges and ABB's solution for them. These seminars were very well received by the over 60 participants, who rated the content at 4.55/5.

Overall, Derrick Koh, Richard Yue and their colleagues in the South Asian sales team organized and hosted an event that was highly successful for ABB, with 570 visitors to the stand interested enough to give their details, in addition to 120 participants in the two ABB seminars.





Intelligence in a UPS?

Absolutely.



Availability is everything in a UPS, making ABB's Conceptpower decentralized parallel architecture (DPA) design the preferred choice, ensuring power is always on when you need it. Each highly reliable standardized module is self-contained and can be online-swapped at any time, ensuring 99.9999 percent availability, making routine maintenance safe and easy. With class-leading efficiency of up to 96 percent, your power consumption and cooling effort are minimized. And, by adding expansion modules only when required, you only pay for the power you need. www.abb.com/datacenters

ABB



Ship docked at VOC Port in Tuticorin

ABB India's first shore-to-ship power supply for Tuticorin port to significantly reduce carbon footprint



The first such installation in a commercial port, it provides a plug and play power solution to help eliminate emissions that would result from burning diesel while ships are berthed

In line with the government of India's Green Ports project, ABB India has commissioned a state-of-the-art solution for shore-to-ship power supply for ships at the V.O.Chidambaranar Port, formerly the Tuticorin Port. This solution expands the scope of the green agenda beyond renewable power to technology, which will enable ships docking at a port to plug for power instead of running on polluting diesel generators and using expensive power.

The Indian grid delivers power at a frequency of 50 Hz. So ships, most of which adhere to 60 Hz, have to depend on on-board diesel generators for power. For an average docking time of 60 hours for a commercial vessel at a port, the diesel generators produce a staggering 360 MT of carbon dioxide. ABB shore-to-ship technology supplies ships that are docked with electricity from shore, so they can turn off the diesel engines that provide electricity for systems like heating, lighting and refrigeration of the vessel, and reduce greenhouse gas and noise emissions in the port. The technology also helps reduce low-frequency noise and vibrations, and allows the crew to maintain diesel engines while the ship is berthed

"ABB is a global leader in shore-to-ship solutions and this is the first such installation at a commercial port in India. I would like to congratulate the V.O. Chidambaranar Port for their vision and focus on clean energy and we are proud to bring this technology to India. Trade volumes and efficiency of ports will play a large role in furthering initiatives such as Make in India and volume increase will be sustainable only when the carbon footprint of berthed ships' power sources reduce significantly," said Sanjeev Sharma, CEO and Managing Director, ABB India Limited. "ABB's deep footprint and technology expertise makes it well positioned to partner the nation in its journey of decoupling growth from carbon emissions."

The existing infrastructure at the port, which entailed usage of generators by the ships, was upgraded with ABB's state-of-the-art shore-to-ship supply system. The scope includes the proven PCS100 based Static Frequency Converter (SFC) with the associated electricals. The PCS100 SFC end-to-end solution is engineered for the demanding port applications with a modular construction, overload capability and power flow control in either direction using the advanced ABB technology.



the country, which will implement various schemes related to the Project Green Port initiative in a time bound manner. Approximately 1350 ships dock at the port, transferring around 33 MT of goods per year. The installation was inaugurated by Rajive Kumar, I.A.S., and Secretary to Government of India, Ministry of Shipping in the presence of S.Anantha Chandra Bose, Chairman, and S.Natarajan, Deputy Chairman, V.O.Chidambaranar Port Trust with N. Chandrasekar, Zone Group Head, Discrete Automation and Motion and S.Muthu Kumaran, Manager, Sales from ABB India.

India's 7,500 km coastline is serviced by 12 major ports, 200 notified minor and intermediate ports handling over 95 percent of the country's trading (by volume). Reducing their carbon footprint through the use of bio-diesel and renewables is central to the government's green port initiative. Switching to shore-to-ship power has the potential of significantly reducing emissions, contributing to the efforts of the Indian government in reconciling economic growth and preserving the environment. An offshore FPSO and India's largest shipbuilding company have already deployed ABB shore-to-ship power solutions to increase efficiencies.

For more information please contact:
Corporate Communications, ABB India Ltd

The V.O Chidambaranar Port is one of the 12 major ports in



Mr Rajive Kumar, Secretary, Govt of India, Ministry of Shipping congratulating local ABB staff member



Eliminating emissions and saving costs with
shore-to-ship power.



By choosing from ABB's shore-to-ship solutions, you are selecting from a unique line up of advanced technologies and expertise. ABB's grid interconnection products allow direct connection of ships to a harbor's electric grid, at the same time eliminating port noise and emissions. Thanks to a complementary product portfolio, ABB is able to offer adequate static frequency converter solutions ranging from 120 kVA up to 120 MVA.

www.abb.com/converters-inverters (Converters for Grid interconnection)







Power factor and the uninterruptible power supply

Power factor has to be taken into account when specifying a UPS

When specifying a new UPS, its power rating must be well matched to the job in hand or else it could fail just when it is needed. However, picking the correct power rating is not as straightforward as it may seem as, for most applications, the aspect of power factor and load profile will have to be taken into consideration

Power factor

When power flows into a simple resistive load the power usage is easy to calculate – it is merely the product of the voltage applied and the current flowing into the load. However, when reactive components – such as inductive or capacitive elements – are present in the load, things become a bit more complicated.

Inductive and capacitive elements in a load will store energy for a short time – in magnetic fields (inductive) or in electric fields (capacitive). This energy is then released later in the 50 or 60 Hz cycle. Thus, the energy supplied to the load is used to power the load itself (the “real” or “active” power, expressed in Watts), but also feed these reactive elements (the “reactive” power, expressed in VAR). In this way, a power larger than what is actually consumed by the load to do work, may flow out of the UPS and into the load. This power that the load is apparently using is called the apparent power (expressed in VA).

The ratio of the active power and the apparent power is called the power factor. For loads with a lot of reactive elements, this ratio is a small number over a larger one. For loads with low reactive power, the ratio is closer to one (unity), typically 0.95 – 1.0.

However, when specifying a UPS, several different aspects of the power factor have to be taken into account.

UPS input power factor – not a problem in a modern UPS

The UPS rectifier has reactive and capacitive components, so it will also have a power factor and this will have to be accounted for when making the upstream electrical connection. The UPS input power factor is a characteristic of the design and is usually declared by the manufacturer in the technical specification. With modern IGBT (insulated-gate bipolar transistor) front-end rectifier technology, the input power factor is typically close to unity, 0.99, at 100% nominal load. The actual metered input power factor may, however, be slightly different as, for example, highly nonlinear loads can cause the input power factor to decrease slightly. Typically, though, a UPS input power factor will still be in the range of 0.97 – 0.99 and not of great concern. With older technology, using six- or 12-pulse rectifiers, the THDI (total harmonic distortion of current) and power factor require more attention.

UPS rated output power factor is a UPS design factor

The rated output power factor describes the maximum active and apparent load the UPS can tolerate by design. For example, a 100 kVA UPS with a rated output power factor of 1.0 can handle loads up to 100 kW active power and 100 kVA apparent power. If the power factor is 0.8, these loads become 80 kW and 100 kVA, respectively. To correctly select and size the UPS, the total active and apparent power of the load must be known. As an example a UPS with a rated power factor of 0.8 can handle loads of higher power factor as well – and vice versa.

A UPS will be called upon to support different types of load equipment and these may have nonlinear input stages. The compatibility of the UPS output stage (ie, the inverter) with different types of nonlinear load equipment is usually stated in the product documentation. If not, it must be checked with the manufacturer directly. Note that:

- In cases with high inrush currents or peak currents - eg, motor loads - even the stated range of UPS output power factor does not provide enough detail to determine if the UPS can support the load.
- With static loads, the UPS specification can be used to determine compliance.

The rated output power factor of UPS is not an indication of the quality of a UPS or represent anything of its performance capability – it is merely used to state the ratio of the maximum active power versus maximum apparent power. Understanding the critical load profile and load input power factor is the key to making a decision on how to specify the UPS power.

UPS metered output power factor is dominated by load characteristics

Once the UPS has been installed and commissioned, the UPS real output apparent and active power can be checked

by measuring them. The real output power factor can then be determined (it may differ from the calculated value, so it is best to check). This metered output power factor of the UPS is a characteristic of the load (not the UPS) and is determined by the design of the load input stages.

The difference between the metered output load and UPS rated load described in the specification, it tells us how much additional load can be connected before full capacity is utilized. For example, a UPS rated at 100 kVA with a power factor of 0.8 can handle 80 kW of active power. If the UPS output metered load shows 50 kVA apparent power and 45 kW active power then the total metered load power factor is 0.9 (=45/50). A further 50 kVA apparent power/35 kW active power can be connected to the UPS output before full capacity is reached. It is important to note that neither the UPS rated active power nor rated apparent power should be exceeded.

Choosing a rating

A UPS with a rated power factor of 1.0 means that you get equal amounts of kVA and kW out of the unit. With modern equipment this is a good match as usually the load consumption of kVA and kW are similar. However, if the load power factor differs from unity, the dominating limit is the kVA rating, not the kW rating. For example, for a load with a rated power of 80 kW / 100 kVA (power factor of $80/100 = 0.8$):

- If the UPS rated output power factor is 1.0, then the UPS rated power needs to be a minimum of 100 kW/ 100 kVA ($100 = 80 / 0.8$).
- If the UPS rated output power factor is 0.8, then the UPS rated power needs to be a minimum of 80 kW/ 100 kVA ($100 = 80 / 0.8$).

Power factor is a major consideration when selecting a UPS. It is very important to understand that if the UPS cannot handle the real power and the reactive power is consumed by the load, an overload situation will quickly develop, which could lead to the UPS being damaged or if an outage occurred the critical load would become unprotected.

Author:
Elina Hermunen,
Product Manager, Power Protection



Superior voltage conditioning for commercial and industrial applications?

Certainly.



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. Visit www.abb.com/ups

Maximum UPS efficiency in all loading conditions

When an uninterruptible power supply (UPS) is operating significantly under capacity, its energy efficiency can be negatively impacted. ABB's Xtra VFI/double conversion mode delivers maximum efficiency by dynamically adjusting the DPA 500 UPS configuration to match the load.

ABB has announced a significant new energy-saving feature for its DPA 500 UPS. In Xtra VFI/double conversion mode, the UPS automatically configures the number of modules that are active to match the load power requirements. Modules that are not needed are switched to standby, ready to transfer to active mode if the load increases. The efficiency improvements achieved by this mode of operation are especially significant in low-load conditions.

When a UPS is operating significantly under capacity, its energy efficiency can be negatively impacted. With ABB's Xtra VFI operating mode – currently available for the DPA 500 UPS

only – this problem is solved. Xtra VFI mode is a smart way to minimize losses and improve efficiency safely when running in double conversion mode.

When Xtra VFI mode is enabled, the UPS automatically adjusts the number of active modules according to the load power requirements. Modules that are not needed are switched to a standby state of readiness, primed to transfer back to active mode if the load increases. The efficiency improvements achieved by this mode of operation are especially significant when the load is less than 25 percent of full UPS system capacity – an operating condition in which traditional UPS systems fare poorly.

The figure below shows how the Xtra VFI operating mode can enhance efficiency when running at a low load level for a Conceptpower DPA 500 modular UPS system with 10 UPS modules (100 kW) and total available capacity of 1 MW.

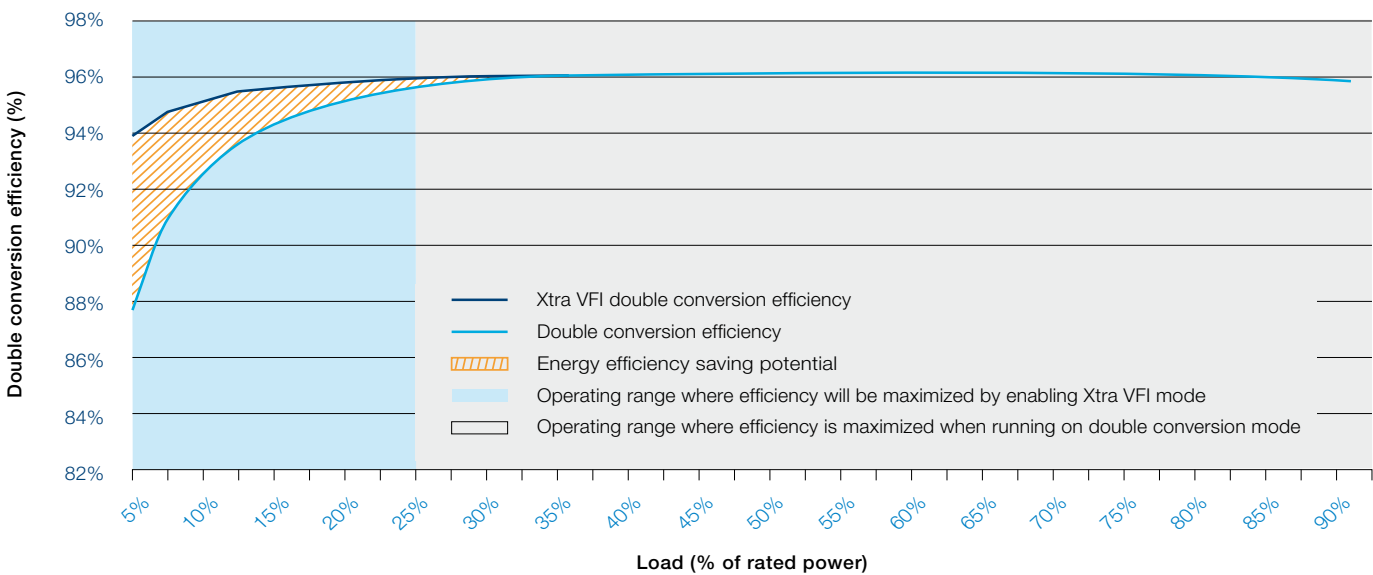


Figure 1: Conceptpower DPA 500 efficiency curve with 10 UPS modules (100 kW) and total available capacity of 1 MW

The DPA 500 calculates the optimal loading for each of its modules, taking into account the desired redundancy level selection and other set parameters. To ensure smooth operation in each application, the highest expected load step can be set by the user, as can the number of redundant modules that should be active at any time. Hysteresis prevents the modules from switching on or off when close to the threshold. To increase reliability, extend service life and equalize ageing, the system rotates the modules between active and standby mode at fixed intervals.

Should there be a mains failure or other abnormal situation, all modules revert to active mode within milliseconds.

Since its recent introduction to the market, the DPA 500 UPS has proven very popular: ABB's decentralized parallel architecture (DPA) is the most advanced approach to modu-

larized UPS available. With DPA, each standardized module has all the hardware and software needed for autonomous operation. Modules can be swapped without powering off. Systems can be scaled up by simply adding more modules. Because of its very flat efficiency curve, the DPA 500 is very efficient in most operating working regimes and Xtra VFI mode increases this capability even further.

The Xtra VFI feature will be of special interest for large and colocation data center users where energy efficiency is a topic of great interest. A pilot installation of the Xtra VFI mode has been running smoothly and effectively for some time in a large data center in Germany.

Conceptpower DPA 500 in Xtra VFI operating mode

The sample reference scenario illustrates one possible example of Conceptpower DPA 500 in Xtra VFI operating mode.



Figure 4: Example Conceptpower DPA 500 in Xtra VFI operating mode (2x 500 kW frames)

System total capacity:	1000 kW
Specified redundancy:	N + 2
Load power:	200 kW
No of active modules:	4 pcs
UPS active capacity:	400 kW

Active

The UPS module is operating in double conversion mode and supplying the load with other active modules. Loading of the module is equal to full load divided by number of active modules.

Standby

The UPS module is on standby mode, ready to kick in and transfer to active double conversion mode in case needed. Res-

Flexible Power Configuration



- 06. PowerLine DPA launches at Hanover Trade Fair**
- 10. Conceptpower DPA UPS installed in Gotthard Base Tunnel**
ABB provides power protection to the world's longest tunnel
- 14. Protecting a leading data centre service provider**
PRONIX selects ABB's DPA UPS for the Czech Republic's TTC TELEPORT data center
- 18. Powering the Pharmaceutical industry**
ABB's power conditioning solutions for the pharmaceutical manufacturing industry

Continuous Power



- 09. First Active Voltage Conditioner commissioned in Nigeria**
PCS100 AVC-40 installed in Abuja, Nigeria
- 14. Ready to toast**
UPS systems by ABB protect Krombacher's production, filling and logistics center
- 17. Powering the railways**
Reliable UPS's for railway applications



Highest energy efficiency?

Certainly.



The PCS100 MV UPS is a medium voltage UPS that offers complete power protection for your business. With power ratings up to 6 MVA, allows you to choose the solution that best suits your application. A wide range in retrofit possibilities, means you can custom design the PCS100 MV UPS for any high powered industry. With an efficiency well in excess of 99 percent and a wide range of energy storage options, the PCS100 MV UPS is the ideal solution for your power protection needs. Visit www.abb.com/ups

