



Modular UPS systems

Uninterruptible power supply systems The modular approach

The modular approach

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

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

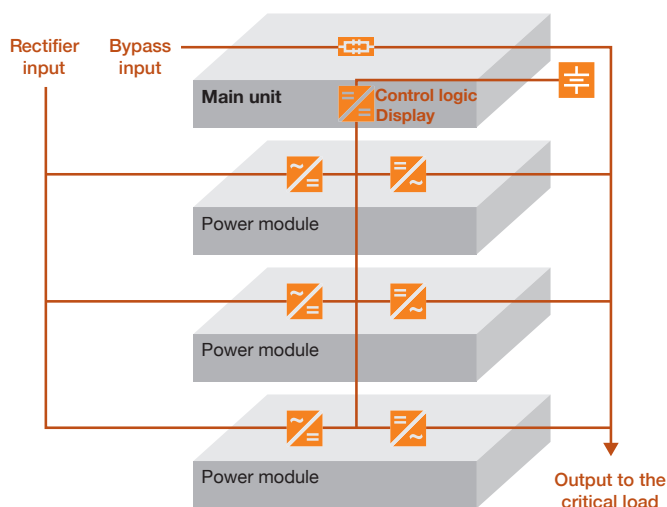
ABB's unique UPS design is based on the concept of true modularity.

Modularity

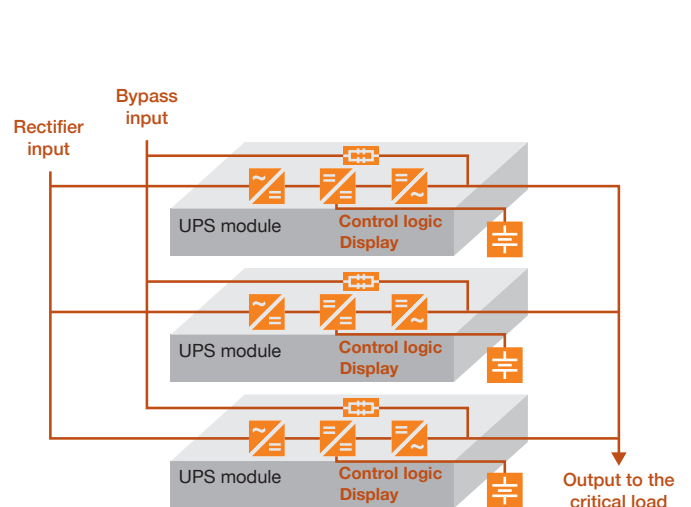
In ABB's range of modular UPSs, each UPS module has all the hardware and software needed for autonomous operation – rectifier, inverter, battery converter, static bypass switch, back-feed protection, control logic, display, and mimic diagram for monitoring and control. With all the critical components distributed between individual units, potential single points of failure are eliminated.

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

Modular UPS with common system components



Modular UPS with no common system components



In centralized systems, failure of one point can bring down the entire system; in DPA, each UPS module has all the hardware and software it needs for autonomous operation – there are no shared critical elements and therefore no single points of failure.



Availability and how to increase it

For all applications, availability is the most crucial UPS parameter. It is a measure of how much time per year a system is up and available. UPS power availability is measured by MTBF and MTTR (see figure to the right).

From the equation, it can be seen that the best ways to increase power availability are to increase the MTBF and decrease the MTTR of the power protection system. The nature of the modular design lends itself very well to achieving this objective.

How to increase availability:

- Add redundancy
- Minimize chance for human error
- Select high quality, reliable equipment
- Minimize downtime
- Standardize service concept

Reliability

Measure of ability of a system to run without failures

Mean time between failures (MTBF)

Serviceability

The ease and speed of maintenance and service

Mean time to repair/recover (MTTR)

Availability

A measure of time a system is operational – “uptime”

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

The best ways to maximize power availability are to increase MTBF and to decrease MTTR of the power protection system.

How a modular UPS increases availability



Add redundancy

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

Minimize chance for human error

ABB's UPS modules can be online-swapped, ie, removed or inserted, without risk to the critical load and without the need to power down or transfer to the mains. This procedure is simple and quick to perform and introduces no risk for system operation. Each module can be individually switched off before removing it from the system. This makes the service safe for the technician and ensures absolutely no disturbance to the system.

As the same modular UPS can be used across different applications and load segments, the service technicians do not need to be educated on several different platforms, but can apply the same practices and procedures on all UPS equipment.

Select high-quality, reliable equipment

In ABB DPA UPSs, the incoming AC is first converted to DC. The output AC is then synthesized from this DC – giving a clean sinusoid. These two conversion steps give the term “double conversion” and isolate the output voltage waveform from any disturbances on the input AC side.

With over 20 years experience in modular UPS, ABB's Swiss-made DPA delivers unrivaled UPS availability and the serviceability, scalability, flexibility and low energy usage made possible by the modular DPA approach deliver a very attractive TCO. There are no better UPS architectures available to those users whose critical electrical loads represent a valuable commercial asset that must be kept powered at all costs.

Minimize downtime

Because the UPS modules in a DPA are independent, they can be online-swapped without risk to the critical load and without the need to power down or transfer to raw mains supply. So engineers can work on the UPS without interrupting operations. Swap-out time is only 15–20 minutes and is very safe and you never have to switch off your load.

Online-swappable modules directly address availability requirements, significantly reduce MTTR, reduce inventory levels of specialist spare parts and simplify system upgrades.

Standardize service concept

DPA modules are standardized. This keeps costs low: A straightforward, standardized modular concept simplifies and speeds every step of the deployment process – from planning, through installation and commissioning to final use. High-quality standardized products significantly reduce intervention time during maintenance or in the event of failure – components can be changed quickly and easily and service is simplified.

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

Total Cost of Ownership (TCO)



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

How to minimize Total Cost of Ownership:

- Optimize your investments
- Optimize your battery capacity
- Save valuable floor space
- Reduce installation and maintenance costs
- Save energy costs

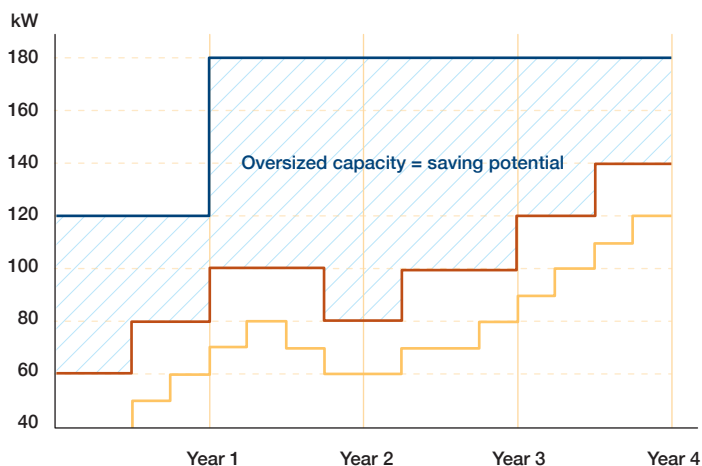
Optimize your investments

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

Optimize your battery capacity

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

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



— Standalone solution:

- 1×60 kW (+60 kW) UPS until year 1
- 2×60 kW (+60 kW) UPS years 1–4

/// Oversized capacity

— Modular solution:

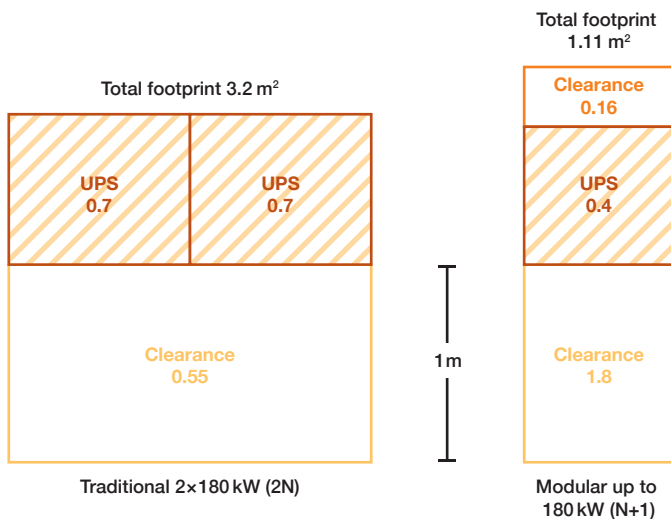
- 20 kW UPS modules can be added or removed at any time.

— Typical 4-year load curve of a medium-sized data center.



Save valuable floor space

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



Modularity minimizes space requirements and maximizes predictability of future space requirements. In the example shown, 2 m² is saved.

Reduce installation and maintenance costs

The modular approach makes installation and commissioning easy. Standardized modules reduce inventory levels of specialist spare parts and simplify system upgrades. This approach pays off too when it comes to serviceability and availability as service personnel do not need special skills and human error is reduced. Spares can be held on-site or at a nearby service center. Not only does this improve availability but it also reduces cost as service engineers spend less time on-site, and any risks of data or production loss are minimized. The only UPS elements common to all modules are contained in the mechanical frame that accommodates the UPS modules – I/O connection, customer interface signaling, maintenance bypass and, in some models, a system display. These elements are standardized in order to minimize maintenance costs.

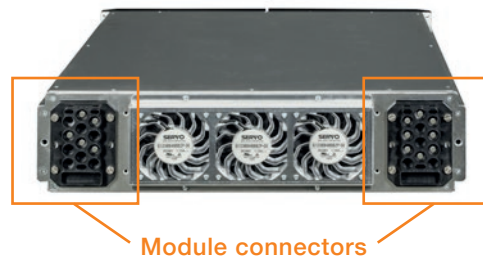
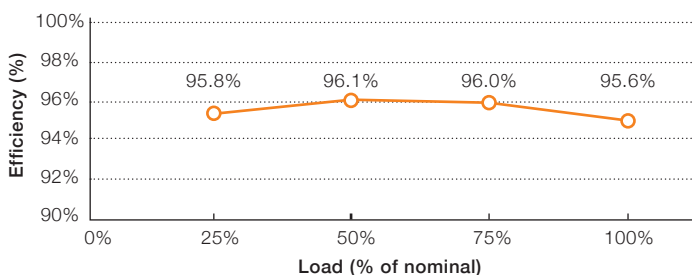


ABB design simplifies service: The ABB design for module connectors makes swapping modules very easy and safe.

Double conversion efficiency

Conceptpower DPA 500



Save energy costs

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

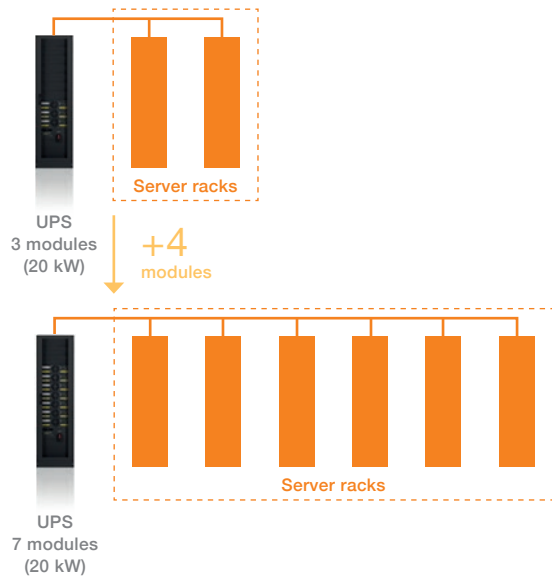
Modular UPS applications

The modular concept permits a range of different power protection solutions for all types of IT applications. The UPS function can be located centrally or located beside each row of servers ("end of rack row"). A centralized power protection

concept is appropriate, in most cases, for large data centers. A distributed power protection concept may be applicable in small data centers or large data centers with decentralized power protection demands.

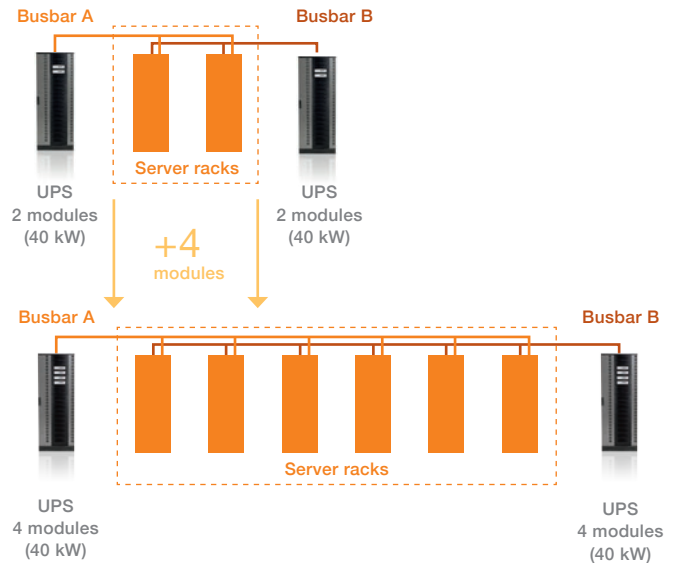
Distributed power protection solutions

Servers with single power supply



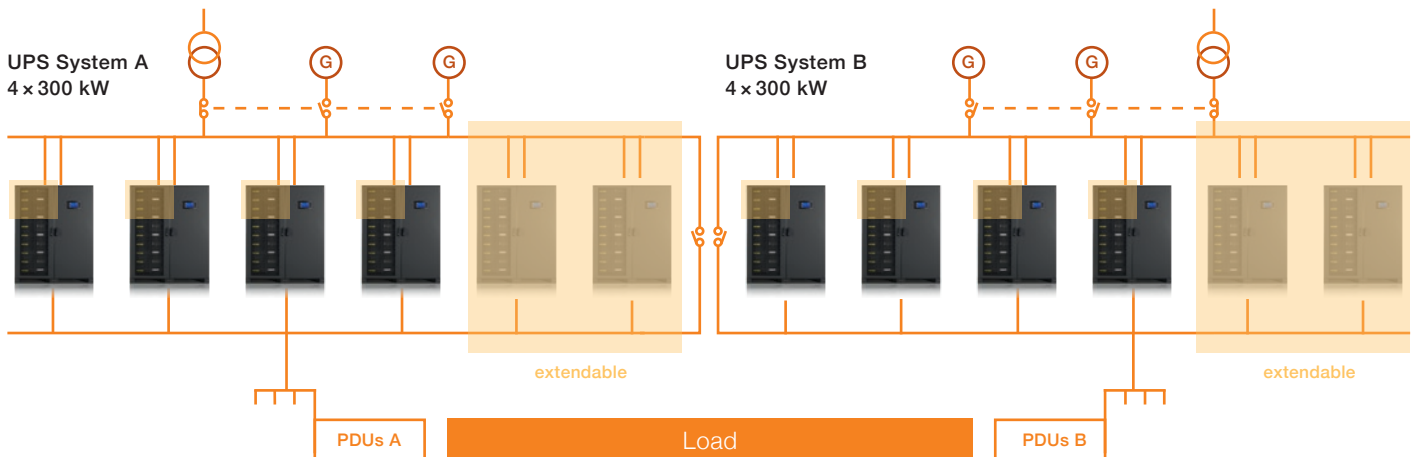
In this distributed power protection concept, the power demand grows from 40 kW (N+1) to 120 kW (N+1). The UPS can be easily adapted to meet the power demands of the growing infrastructure by adding four 20 kW modules.

Servers with dual power supply



The power demand in the sample configuration increases from 40 kW (N+1) to 120 kW (N+1). The UPS is perfectly capable of adapting to this increase in power demand.

Centralized power protection solutions



The sample reference scenario, 1,200 kW Tier 4, illustrates one example of how ABB's modular UPS can be used to create a high performance infrastructure. The system flexibility allows power capacity to be upgraded to 3 MW.

Critical applications are best served by using modular UPS technology with an N+1 configuration.

Modular UPS product overview

Modularity – the simple answer

ABB's decentralized parallel architecture provides full redundancy and fault tolerance in a way that is unique amongst UPS vendors. UPS modules can be swapped online, which means fast and easy service and no downtime at all. DPA and modularity result in many knock-on advantages that guarantee that ABB's modular UPS has the lowest TCO

around while providing the operator with a flexible, reliable, agile and environmentally attractive infrastructure. The overwhelming benefits of modular UPSs speak for themselves. ABB Newwave were pioneers in UPS technology and see standardization and modularity as key elements in UPS design for the foreseeable future.



	DPA UPScale RI	DPA UPScale ST	Conceptpower DPA	Conceptpower DPA 500
GENERAL DATA				
UPS frame rated power	10 / 20 / 40 / 80 kW	60 / 80 / 120 / 200 kW	50 / 150 / 250 kVA	500 kW
UPS module rated power	10 / 20 kW	10 / 20 kW	30 / 40 / 50 kVA	100 kW
UPS output rated PF	1.0	1.0	0.8	1.0
Max. no of parallel frames	1 subrack	1 frame	up to 6 frames	up to 6 frames
Max no of parallel modules across frames	4 modules	10 modules	30 modules	30 modules
Max system power	80 kW	200 kW	1500 kVA	3000 kW
Wiring	3ph + N + PE	3ph + N + PE	3ph + N + PE	3ph + N + PE
UPS type	Modular (DPA)	Modular (DPA)	Modular (DPA)	Modular (DPA)
Topology	True online double conversion	True online double conversion	True online double conversion	True online double conversion
EFFICIENCY				
Double conversion	Up to 96%	Up to 96%	Up to 96%	Up to 96%
Eco-mode	98%	98%	99%	99%
COMMUNICATIONS				
User Interface	Module level LCD + mimic diagram Remote system display optional	Module level LCD + mimic diagram Remote system display optional	Module level LCD + mimic diagram	Module level LCD + mimic diagram System graphical touch screen (one per system)
Communication ports	USB, RS-232, SNMP slot, potential-free contacts	USB, RS-232, SNMP slot, potential-free contacts	USB, RS-232, SNMP slot, potential-free contacts	USB, RS-232, SNMP slot, potential-free contacts
Software	monitoring and shutdown software available as option			

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