Xtra VFI / double conversion mode
Maximizing UPS efficiency under all load conditions

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01 DPA 500 efficiency curve with 10 UPS modules (100 kW) and total avail-able capacity of 1 MW

Xtra VFI operating mode allows ABB UPSs to operate at maximum efficiency – even when underloaded.

When an uninterruptible power supply (UPS) is operating at significantly under capacity, its energy efficiency can be negatively impacted.

With ABB's Xtra VFI operating mode 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 kick in and transfer 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.

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

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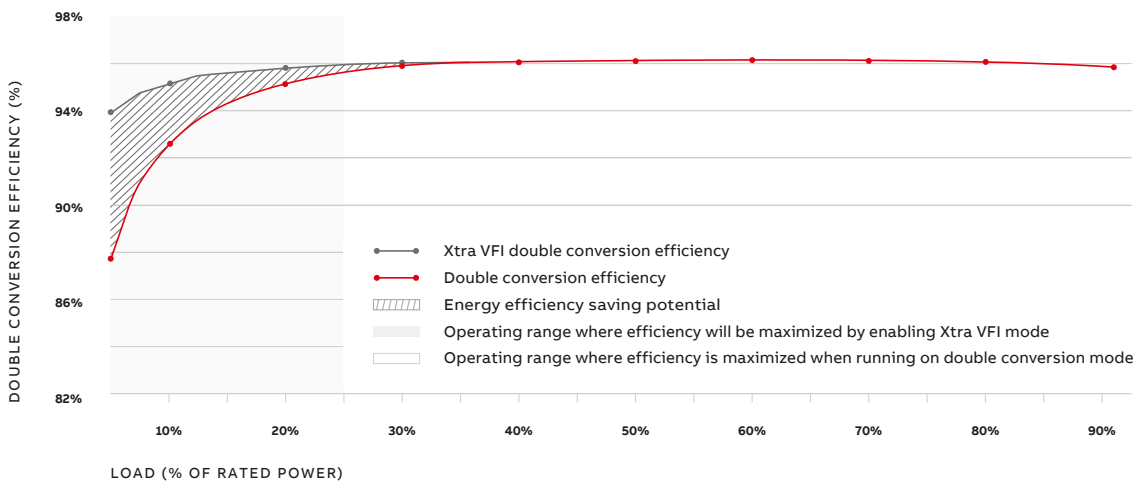

Xtra VFI / double conversion mode
Key features

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01 UPS Standard Modes and UPS Xtra Modes
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02 DPA 500 in parallel configuration

UPS Standard Modes	VFI – Double conversion mode	The default operating mode – efficiency up to 96% (recommended for all critical applications)
	VFD – ECO mode	Alternative operating mode – efficiency up to 99% (for ultimate efficiency savings – double conversion on demand)
	Bypass mode	Load supplied from utility through bypass (Manual selection/automatic transfer in case of e.g. overload)
	Battery mode	Load supplied from batteries when utility is not available (automatic transfer in case of UPS AC input source not available)
UPS Xtra Modes	Xtra VFI – Double conversion mode	Double conversion mode with enhanced efficiency when load is low compared to total capacity Best choice for demanding applications where efficiency is important

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UPS standard modes and Xtra modes
Xtra VFI double conversion mode is a complementary feature to enhance the double conversion efficiency of the UPS when load power is low compared to total UPS system capacity. The figure below demonstrates the various standard and complementary operating modes of the UPS.

Reliability and efficiency without compromise
Enhanced double conversion efficiency
- To maximize efficiency, the UPS active capacity is automatically scaled according to the load power
- The system calculates the optimal load percentage for maximal efficiency, taking into account desired redundancy level selection and other set parameters

Performance adjusted according to application requirements
- The redundancy level for active capacity and highest expected load step can be configured by the user to optimize the performance in a particular application

Fault tolerant and sustainable
- Hysteresis prevents the modules from switching on/off when operating close to the threshold
- In case of mains failure or other abnormal situations, all modules revert to active mode
- The system rotates the modules between active and standby modes at fixed intervals to extend service life and equalize aging

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

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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. Response time for the module to transfer to active mode is in the range of milliseconds.

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01 Example DPA 500 in Xtra VFI operating mode (2× 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

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02 Display showing UPS-settings and measures in Xtra VFI operating mode (number of modules in active mode and on standby)

Control and metering via graphical interface
Xtra VFI has an interface that allows the user to set up operating parameters to suit the particular application.

Customer-configurable parameters include:
- How many redundant modules should be active at any time
- The highest expected load step (in kW or %). This allows the system to further optimize the UPS performance and efficiency

The system calculates and displays Xtra VFI energy savings, etc. compared to normal operation:
- Instantaneous power (kW) currently being saved by the Xtra VFI mode
- The cumulative energy (kWh) saved from the day Xtra VFI mode was first enabled
- The number of modules in active mode and on standby
- A Xtra VFI preview in the display menu can be used to simulate how much power would be saved with different Xtra VFI setups

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ABB’s modular UPS design

Ensuring high availability and low total cost of ownership

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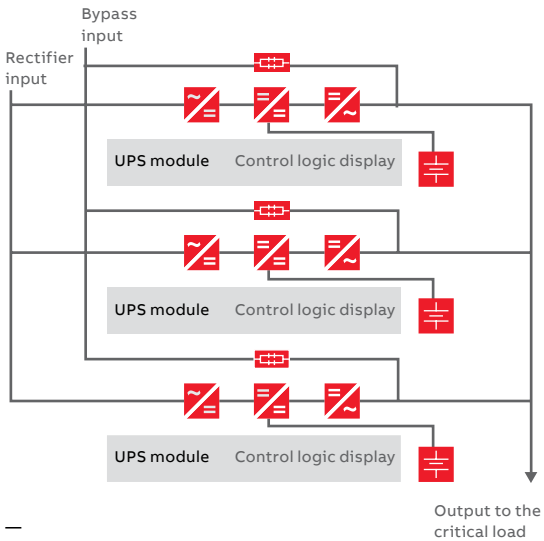
01 In DPA, each UPS module has all the hardware and software it needs for autonomous operation.

DPA architecture
ABB’s decentralized parallel architecture (DPA) is the most advanced approach to modularized UPS available. With DPA, each module has all the hardware and software needed for autonomous operation. DPA is ideal forN + 1 redundancy, ie, when one more module is installed in addition to the minimum number required to supply the critical load. If one module fails, the others take up the load. Modules are standardized – this keeps costs low as modular systems with standardized connections can be pre-wired, tested and configured at the factory. DPA makes for a very robust UPS with an extremely low failure rate.



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Online-swapping and serviceability
ABB’s DPA modules can be removed or inserted without risk to the critical load and without the need to power down or transfer to raw mains supply. This unique aspect of modularity directly addresses continuous uptime requirements, significantly reduces MTTR (mean time to repair), reduces inventory levels of specialist spare parts and simplifies system upgrades.

Energy costs and scalability
ABB’s DPA UPSs have excellent energy efficiency and a very flat efficiency curve – so there are significant savings in most operating working regimes. As UPS power requirements grow, the modular nature of DPA makes it very easy to add modules and increase the power capabilities. So, the initial configuration does not have to be oversized to cater for future expansion and the user only cables, powers and cools what is currently needed.

Maximized efficiency under all load conditions
A common issue is that even though excellent efficiency is maintained at 25–80 percent of nominal load, operation at very low load levels, eg, below 25 percent, can result in excessive power consumption.

The power loss in a UPS built using IGBTs (insulated-gate bipolar transistors) consists largely of the sum of conductive losses generated by the current flow and switching losses generated by the IGBTs as they rapidly switch on and off to produce a perfect, disturbance-free sine wave for the load.

By reducing the number of active modules used to support the load, losses can be reduced and less energy consumed.

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