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# Line-interactive vs. online double conversion UPS for IT applications

Whitepaper

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## Introduction

In a world that has rapidly become data-centric – by 2022 the whole economy will be 60 percent digital - the availability of data is the concern of all. This means that power protection for IT equipment is a challenge that also involves everyone – from the end-user to the data center manager.

Full power outages are the most feared power disturbance events as they can have devastating effects – on businesses of all sizes. And no country can consider itself safe from such interruptions: in 2017, South-East Asia had an average of 25 power outages per month, while even European countries faced an average of 1.5 events per month, each with a typical duration of 3.4 hrs. These outages were estimated to incur a cost to the businesses affected of between 1.6 percent (LAM) to 10.9 percent (ASEAN) of annual sales.

On top of total power outages and blackouts, the voltage may sag or swell over short periods. It may also do so over longer periods – so-called brownouts or overvoltages. And there can be electrical noise on the line, or frequency variation, or harmonics may appear in the voltage. All these phenomena can compromise the availability and performance of mission-critical equipment – the “critical loads.” The continuous operation of such loads is usually either fundamental to the functioning of the business or these loads require a more stable and reliable power source than that generally offered by the utility mains supply in order to guarantee their correct operation.

Product	PowerValue 11LI Up/Pro 600-2000 VA	PowerValue 11T G2 1-10 kVA	PowerValue 11RT 1-10 kVA	PowerValue 11/31T 10-20 kVA	PowerScale 33 10-50 kVA
					
Description	Cost-effective power protection and automatic voltage correction for lower-power operations and entry-level network applications such as server rooms in offices, workstations and point-of-sale.	Cost-effective power protection for entry-level server rooms, lab equipment, ATM and other sensitive electronic devices	Professional single-phase UPS for the most demanding applications, it maintains the power for critical servers, PoS, workstations, clusters and eliminates the incoming power disturbances. The thinnest and fully rack-tower convertible module available in the market (2U only)	The ideal power protection for large IT rooms, networks and critical applications with its high power capability and redundancy	The high-performance three-phase UPS for low-power applications to minimize your total cost of ownership (TCO) providing state-of-art and flexible power uptime

Figure 01: Single-phase product offering

ABB’s product portfolio of high-quality and reliable single-phase transformerless uninterruptible power supplies. All our UPSs are designed for continuous power protection of critical equipment against all power problems: power failure, power sag, power surge, undervoltage, overvoltage, switching transient, line noise, frequency variation and harmonic distortion.

Highly dependable uninterruptible power supplies (UPSs) can eliminate all these power supply issues and ensure a continuous flow of clean power to critical IT equipment.

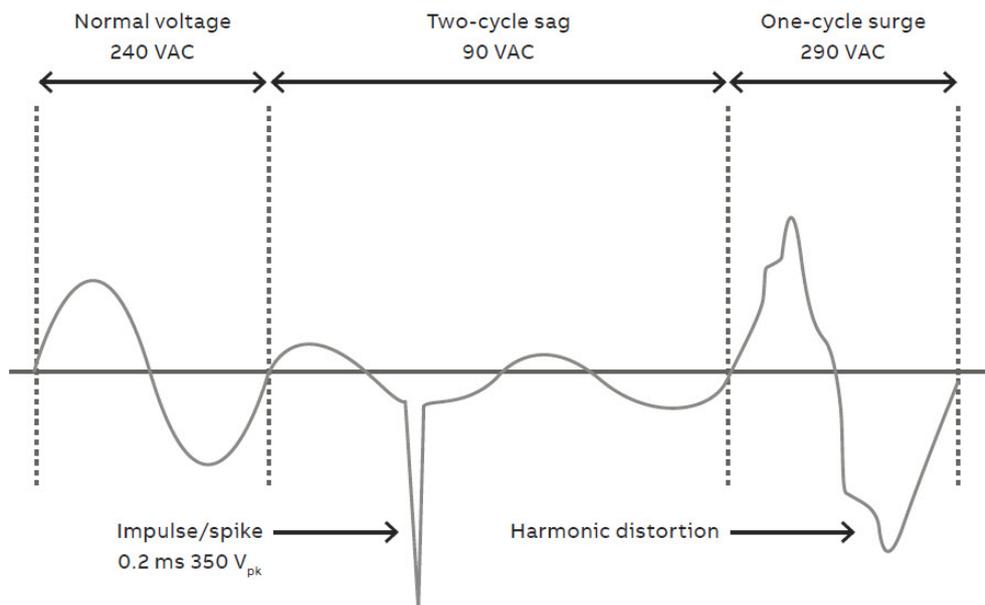


Figure 02: Common power disruptions

ABB has a long engineering experience in the UPS field and offers a wide range of UPS devices that overcome all the power challenges described above. As well as being well known as a pioneer in three-phase modular solutions for large data centers, ABB, with its PowerValue product family, also has a complete product base in the single-phase segment.

As depicted in the picture above, ABB markets both line-interactive and online double conversion single-phase UPSs. Regularly, the question arises as to what parameters and criteria are important when choosing which of these UPS types should be adopted for a particular application. This white paper will help users decide whether a line-interactive or online double conversion UPS best fits the bill.

### Before choosing, know your application

Whereas choosing a three-phase UPS system can involve many factors, specifying a single-phase UPS is somewhat easier. However many aspects still must be considered:

- Type of application
- Application criticality
- Environmental considerations (eg, temperature, site access, relative humidity, etc.)
- Determination of equipment type and its characteristics (especially regarding power supply needs)
- Power sensitivity of the connected equipment
- Expected UPS reliability and availability in relation to the protected equipment and application
- Quality of the UPS output voltage
- Battery runtime demanded by the application
- Expertise needed for installing and operating the UPS
- Maintenance intervals and schedule
- Acceptable acoustic UPS noise levels

When all these aspects have been satisfactorily determined, the correct single-phase UPS for the application can be chosen.

## PowerValue 11LI –The line-interactive UPS

The line-interactive UPS operates similarly to the offline/standby UPS in that it typically supplies the critical load through the bypass line and then transfers it to the inverter in the event of a bypass supply failure. The line-interactive system utilizes the battery, charger and inverter in the same manner as the offline/standby unit, but with added circuit regulators in the bypass line. This regulator transfers the load to the battery-fed in-verter supply less frequently, which makes the line-interactive UPS more efficient in operation costs and battery wear and tear compared to the of-fline/standby UPS system.

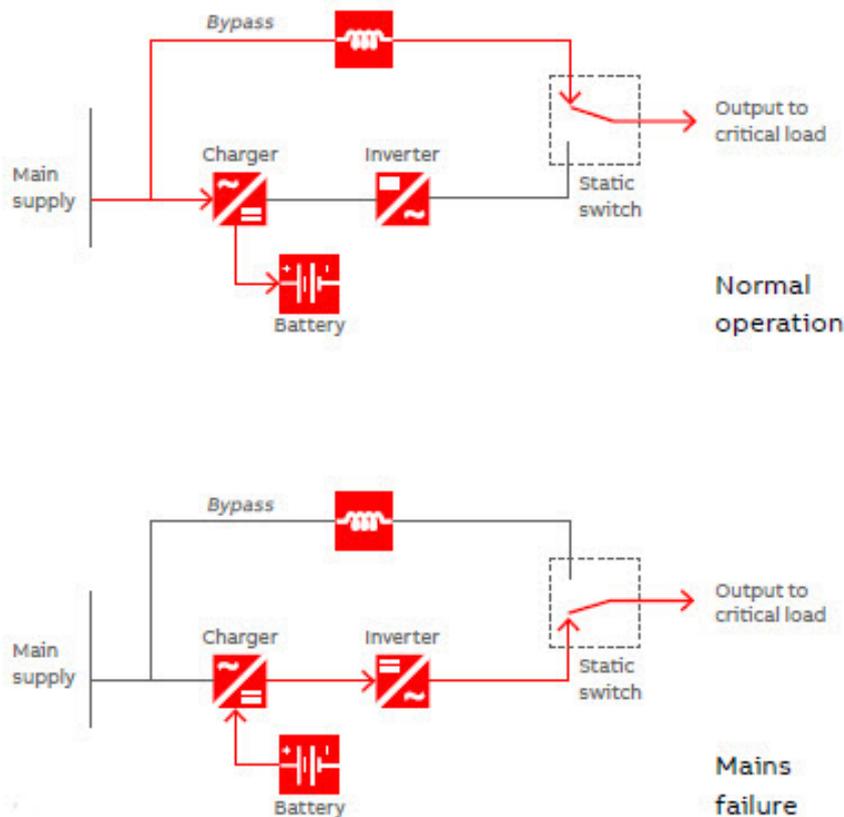


Figure 03: Line-interactive UPS

The figure 03 shows the line-interactive UPS system during normal operation and mains failure. During normal operation, the mains supply powers the electrical load through the bypass line and charges the battery if needed. During mains failure, the battery supplies power to the inverter which provides power to the electrical load.

### What are the typical applications for a PowerValue 11LI?

- SoHo (small office/home office) IT devices
- Entry-level network equipment
  - Small business servers
  - Workstations
  - PoS
  - Network-attached storage (NAS)/other storage devices

Important features of PowerValue 11LI:

- Low heat generation – long lifetime
- Cost-effective power protection solution

- Plug-and-play concept, easy installation and operation
- Generally, no maintenance is required
- Battery replacement (typically after three to five years) is quick and easy
- Compact footprint (average 15 x 30 cm)

Be aware that:

- Voltage regulation is not as tight as with an online double conversion UPS. Nevertheless, the output voltage level is well tolerated by the vast majority of IT devices.
- Switch-to-battery takes place more often than with an online double conversion UPS. Therefore, the battery health should be periodically checked.
- Non-zero transfer time. However, the typical transfer time is shorter than that of the switched mode power supplies of connected IT devices.
- The transfer time is limited as no external battery modules can be connected. However, for typical IT loads, the internal batteries provide an autonomy well beyond typical power outage durations.

### **Online double conversion UPS**

An online UPS offers the most comprehensive solution in uninterruptible power. The online UPS system replaces the battery charger with a rectifier/charger block, which is either two separate units or a combined power block.

The figure below illustrates the online UPS system during normal operation, mains failure and UPS failure on bypass mode. When mains power is present, this power block charges the battery and supplies the inverter with a steady voltage supply. During mains failure, the UPS rectifier drops from the circuit, allowing the batteries to maintain constant and uninterrupted power. When power is restored, the rectifier begins carrying most of the load and recharging the batteries.

The rectifier/charger has a control feature that has an input current limit feature that protects critical equipment that is sensitive to minor power fluctuations from losing power. This type of UPS is perfect for environments containing sensitive electrical equipment that mandates isolation.

This UPS is also known as the double conversion UPS due to its two conversion stages of AC-DC and DC-AC. The double conversion UPS offers the greatest degree of critical power supply integrity.

When the UPS input mains supply is present, the rectifier, charger, and inverter power blocks are all active and the load is connected to the inverter output from the static switch. As the load is powered from the inverter during normal operation circumstances, it is protected from power fluctuations and disturbances since the rectifier and inverter act as a “firewall” between the equipment and mains power voltage fluctuations.

If the mains input supply fluctuates above or below a preset voltage range (typically +10% to -20%) or suffers a total failure, the inverter continues operating from battery power and the event is completely transparent to the electrical load. This is because there is no power transfer operation involved.

When operating from battery power, the inverter supplies steady regulation as when the mains is present. If the mains power is not restored before the battery is depleted, then the inverter shuts down.

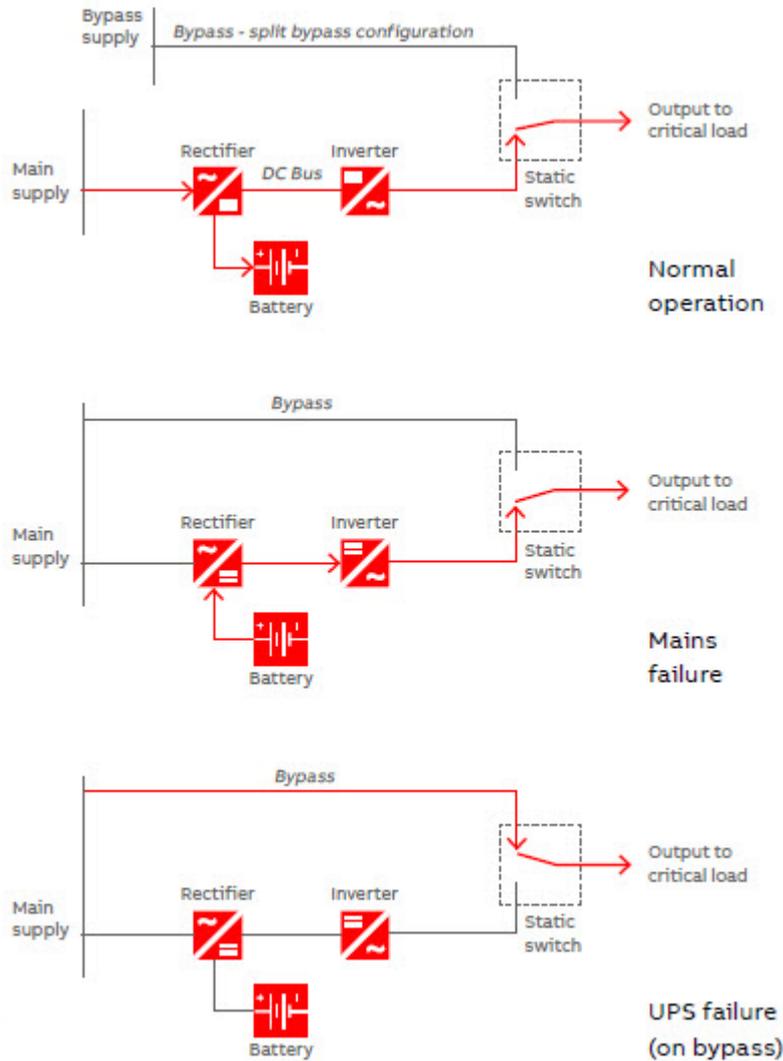


Figure 04: Online/double conversion UPS

What are the typical applications for an online double conversion UPS?

- Low power IT and buildings
- Small offices power protection
- Small- to medium-sized server rooms
- Edge data centres
- ATMs
- Vending machines
- CCTV
- Baffle gates
- LV/MV substations
- Lab equipment
- Advertising displays
- Transportation signaling systems

Important features of an online double conversion UPS

- Tight voltage regulation
- Internal battery runtime can be extended by means of external battery modules
- Zero transfer time when switching to battery mode
- Switch-to-battery occurs less frequently than with a line-interactive UPS

- Advanced features, such as full connectivity and options range
- Higher power range/power density than with a line-interactive UPS
- Presence of a static bypass – the load can be fed (but not protected) during UPS maintenance
- Hot-swap batteries

Be aware that:

- Higher cost is involved
- Installation and operations require a certain expertise (above 10 kVA, qualified engineers are required)
- Internal components heat up – only quality UPSs with top-rated internal components should be chosen
- Regular maintenance is strongly recommended

### **Final recommendations**

Choosing the most appropriate UPS for your single-phase application is not as easy as it might appear as many criteria have to be taken into consideration. Starting from an accurate analysis of the application and the equipment to be protected, the advantages and disadvantages of each technology should be weighed up.

With its long design lifetime and the ease of operation, an ABB line-interactive UPS might represent the ideal trade-off between budget and performance. However, a line-interactive UPS is not recommended for mission-critical applications where tightly regulated voltage has to be provided to the load or where extended runtime should be available.

An ABB online double conversion single-phase UPS offers best-in-class power protection with superior performance, reliability and quality. However, the UPS cost is higher and certain skills are needed for installation, operations and maintenance.