



UPS Practical Guide

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Basics in electricity

• Alternating Current

An Alternating Current (AC) is an electrical current that changes direction cyclically. It is characterized by its voltage, measured in volts (V), and its frequency, measured in hertz (Hz).

In France, the Alternating Current's voltage is 230V, and its frequency 50Hz. However, these characteristics may vary from one geographical area to another. In the United States for instance, the Alternating Current's voltage is 110V / 60Hz.

The Alternating Current is the most frequently used current. It is the one that comes from the power grid to supply your wall sockets and therefore powers all the electrical devices plugged into the mains.

The sinusoidal curve is the shape the most commonly used for the Alternating Current.

☞ *Normal Alternating Current supplied by the national grid:*



• Direct Current

A Direct Current (DC), as opposed to an Alternating Current, is an electrical current that does not change direction. It is characterized solely by voltage, measured in volts (V), usually 12V.

Direct Current can be found in batteries, solar panels and storage cells.

• Electrical Power & UPS

It is easy to change Alternating Current into Direct Current, but it is really difficult to do the contrary. This is where the UPS comes in.

A UPS uses a technology that makes it possible to turn Alternating Current (coming from the national power grid) into Direct Current and vice versa, in a seamless way without disturbances to the power supply. A UPS can therefore revert to "battery mode" in the event of a power cut, giving people enough time to avoid a breakdown of their IT systems.

Disturbances to the power grid



The power grid is constantly subjected to numerous disturbances!

What we know about lightning is limited to statistics since lightning strikes are very different in terms of characteristics (amplitude, duration, number of return strokes, etc.). It has been estimated that 3 out of 4 claps of thunder happen between clouds, but **the number of claps that reach the ground every year amounts to 32 million.**

At any given moment, there are more than 2,000 storms in the world producing between 30 and 100 cloud-ground bolts of lightning every second, in other words about **5 million bolts a day.** The dangers of lightning are both thermoelectric and electromagnetic and cause **major damage to electrical, phone and industrial installations¹.**

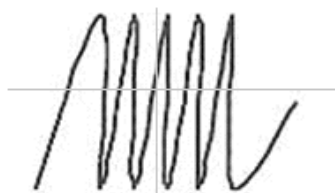
☞ Disturbed power supply: the different types of fluctuations



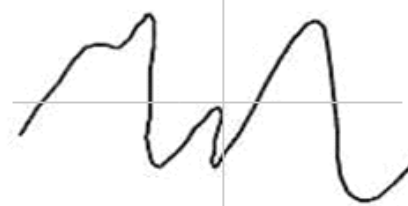
1. Sudden fluctuations in voltage



2. Voltage dips



3. Slow fluctuations in voltage



4. Transient HF disruptions



5. Frequency fluctuations



6. Unbalanced Voltage

¹ Wikipedia : <http://fr.wikipedia.org/wiki/Foudre>

Definition of common electrical disturbances and failures

- **Frequency fluctuations**

Sinusoid periodicity is not stable. These fluctuations, either sudden or slow, are mainly due to variations in generator speed and are quite rare in the state-owned power grids in most developed countries.

- **Voltage brownout**

Voltage dips are due to a decrease in voltage amplitude over several periods. They are mainly due to large electrical loads being started such as engines, lifts, lighting, heating, etc., and lead to system shutdowns and untimely breakdowns.

- **Harmonics**

Non-linear loads connected to the distribution network create harmonic voltages and currents. Harmonic distortion is a kind of power grid interference that may cause problems if the sum of harmonic currents is higher than certain limit values.

- **Power cuts**

The voltage drops to 0 VAC for a long time. This is a “power failure” resulting from a problem on the national power grid.

- **Power blips**

The voltage drops to 0 VAC for a few milliseconds. These are short-circuit related power line disturbances caused by users of a building's power supply.

These disturbances cause many problems in an IT network

- Untimely system shutdowns and breakdowns
- Data processing errors
- Total failure of the system

Consequences

- Loss of several hours of data capture
- Valuable data irretrievable
- Erroneous figures and calculations
- Accelerated wear to hardware
- Partial or total destruction of the hard drive

⇒ A financial burden!



There is one way to offset these risks:

UPS - Uninterruptible Power Supply

What is a UPS?

A UPS is not only designed to overcome power cuts. It also aims to stabilize the power supply and eradicate interference.

The UPS is a very important link in the IT system security. Its main purpose is to take over in the event of power cuts, giving users time to save the work in progress.

Power cuts are not the only incidents that a UPS has to deal with. Voltage filtering and regulation are also a major part of its functions.

A good UPS should supply the connected equipment with continuous quality power.

A UPS consists of 3 parts:

- The **rectifier** that turns Alternating Current into a Direct Current intended to charge batteries and supply power to the UPS
- The **batteries** that store energy
- The **UPS** that turns the Direct Current provided by the rectifier or batteries into an Alternating Voltage of 230V at 50Hz (identical to the mains)

Some so called "communicating" UPS, those with USB or RS 232 ports, also come with an automatic shutdown software: when a power failure occurs, this software (installed in a PC connected to the UPS) will automatically shut down all the programs after having done the required back ups.

How to choose your UPS?

Step 1: Calculate the power required for your setup

In order to work, each device needs:

- a Voltage (U), measured in Volts and always equal to 230V in France
- an Intensity (I), measured in Amperes and that varies depending on the device's needs



- 1- Take note of the Ampere, Watt and VA consumption of every device you want to protect
- 2- Make a sum of all these values (using the same units)
- 3- Choose a UPS whose power is higher than the sum of the connected loads

NOTE: TO CALCULATE THE POWER OF THE CONNECTED DEVICES

If the values are calculated in Amperes:

Voltage (in Volts) x Intensity (in Amperes) = Apparent Power in VA (Volts Amperes)
(in France, voltage = 230V)

Example: $230V \times 7.5A = 1,725VA$

*
* *

If the values are calculated in Watts, divide them by the Power Factor ($\cos \varphi$) in order to obtain power in VA:

Effective Power in W (Watts) / $\cos \varphi$ = Apparent Power in VA (Volts Amperes)
($\cos \varphi$ has an approximate value of 0.70)

Example: $1,207.5W / 0.70 = 1,725VA$

It is important to make sure that the supplied load does not exceed the UPS capacity.

Step 2: Choose the technology that suits your setup

OFF LINE TECHNOLOGY

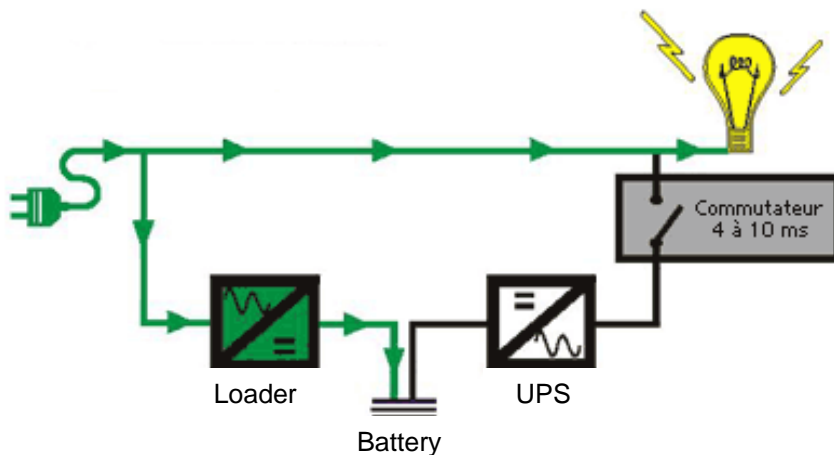
The mains power normally provides the equipment with electricity. The UPS only takes over when there is a power cut or an excessive drop in mains power.

This off-line technology keeps the devices it protects energised long enough to save their data and/or switch them off correctly.

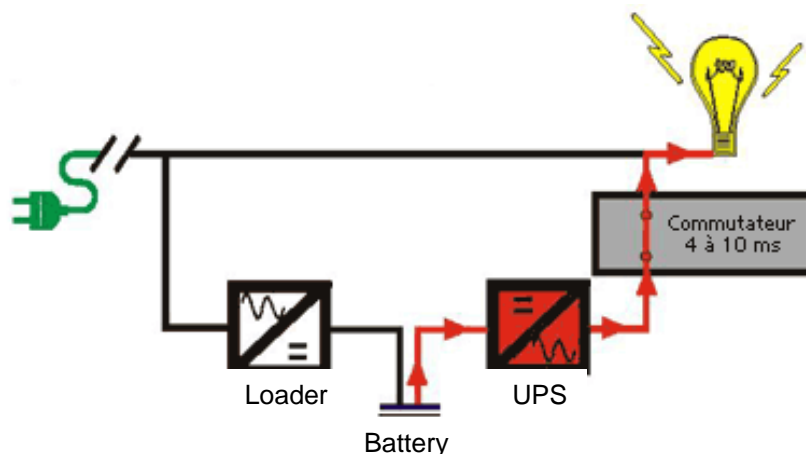
This switch over to battery power takes a certain time (in general, transfer $> 4\text{ms}$), which computers with a cutting feed are able to ride out, but it could cause a problem for more sensitive equipment (measuring devices).

Off-line UPS are the most economical. They are recommended for **single office system workstations** or **PCs** and **small servers** in urban areas with little electrical disturbance.

MAINS ON:



MAINS OFF:



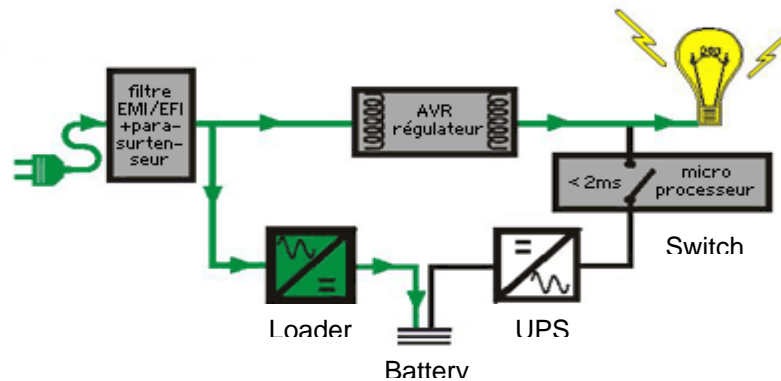
LINE INTERACTIVE or IN LINE TECHNOLOGY

The Line Interactive or In Line Technology uses improved Off Line technology since the input voltage is monitored and filtered by the UPS before being delivered to the equipment.

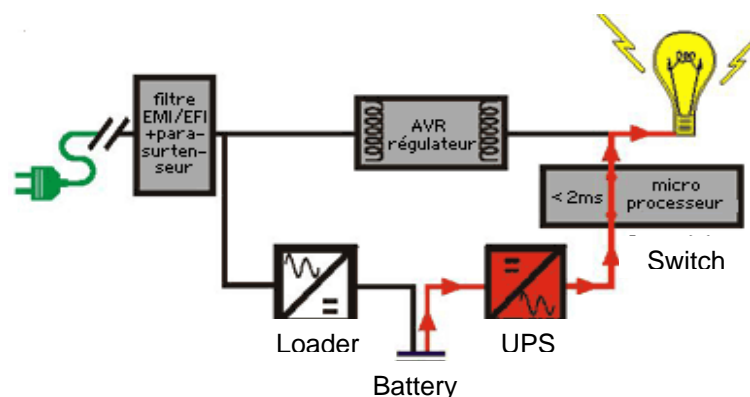
As a result, the quality of the supplied power is better. A voltage stabilizer maintains good power quality during major voltage fluctuations without using the batteries whose useful life depends on the number of charge cycles. A filter and a surge protector increase the security even more.

Line-interactive technology is recommended in areas where the mains undergoes average disturbance (commercial and rural areas) and is also chosen to protect **servers**, **CADD applications** and **minor accounting systems**.

MAIN ON:



MAIN OFF:



The following INFOSEC products have Line Interactive Technology:
X2, X3, XP Pro RM.

ON LINE DOUBLE CONVERSION TECHNOLOGY

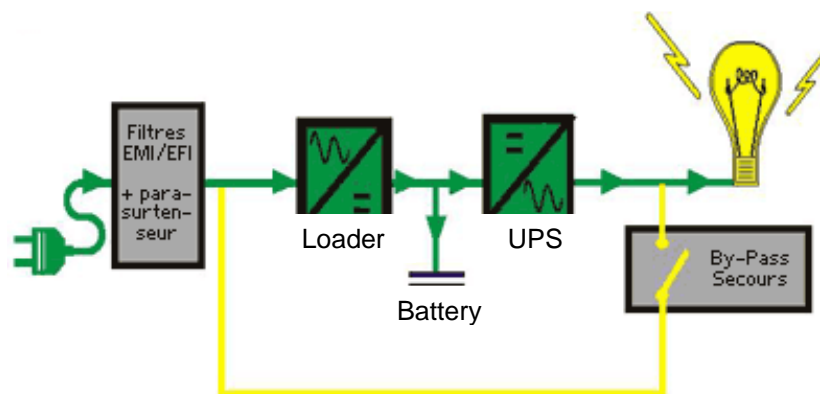
Power is permanently provided by the UPS, which consequently ensures stability & no interference. The protected equipment is therefore totally disconnected from the mains. As a result, there is no switching time which avoids any power blips.

During a power cut, communication software automatically closes all programmes after having carried out the required back up.

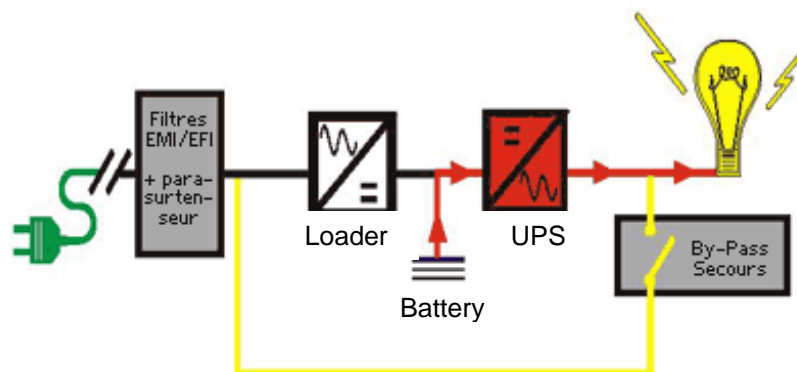
These On Line UPS offer the most stable output voltage and the best immunity to interference. From 5kVA, every INFOSEC UPS System product has the On Line Double Conversion technology.

This technology is mainly recommended for **industrial applications**, but also for applications where the least data loss is unacceptable such as **calculators, PLCs, cash registers, major IT systems**, and in a general way **any strategic applications, sensitive electronic systems** and **medical devices**.

MAINS ON:



MAINS OFF:



The following INFOSEC products have On-Line Technology:
E4 LCD, E6 LCD RT, M2X, M3Tc, M3T.

Step 3: Understand the product's main characteristics

HIGH FREQUENCY TECHNOLOGY

High-Frequency Technology is an independent technology that can apply to the three technologies described above.

A UPS without High-Frequency Technology has a filtering transformer that enables it to regulate power so as to make input and output power identical, but this filtering transformer also increases the power generated by the battery (up to 230V) in case of failure.

In a UPS with the High-Frequency Technology, filtering is done automatically, without going through a transformer, which enables the UPS to be more efficient (better output power and lower breakdown rate), lighter, smaller (space-saving), more resistant (sturdier components, longer product lifecycle) and energy-saving.

High-Frequency Technology UPS are generally recommended in environments that frequently experience short and relatively major voltage drops. They are often used to protect computer hardware.

The following UPS use this technology :

Zenergy Station I & II, Z4 Business Box, E3, E4 LCD, E6 LCD RT, M2X, M3Tc, M3T.

POWER FACTOR OR "COS ϕ "

The Power Factor parameter takes into account the efficiency of a load to consume power when a current passes through it.

Power Factor = 1: maximum value

Power Factor = 0.7: intermediate value

Power Factor = 0.2: low value

UPS are manufactured according to the loads (load power) that will be connected to them.

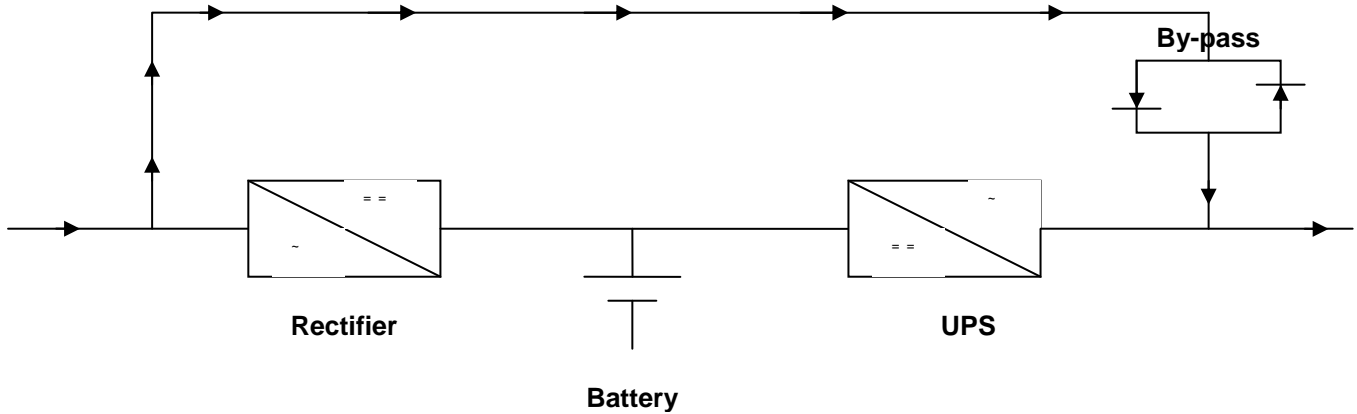
For every device, when the Power Factor equals to 1, it means that the connected power is used as much as possible (no turbulence on the electric circuit, which gives a perfectly sinusoidal curve). An incandescent lamp, for instance, has a Power Factor of 1.

But a computer does not use all the power to which it is connected and its Power Factor is often around 0.7. There is therefore a little turbulence on the electrical circuit used by a computer and this circuit is represented by a square symbol (cutting supply).

It is useless to have a UPS with a Power Factor of 1 connected to a device that does not use the electric circuit to the full! Don't hesitate to consult our Sales Team to find the solution that best meets your expectations!

BY-PASS

INFOSEC On Line Double Conversion UPS come with a "By-Pass" or "shunt" system that can be either static or automatic.



In the event of breakdown or overload at start-up, the electric charge from the devices connected to the UPS is directly transferred to the by-pass system, which enables the equipment to always be powered, even in the event of a power failure or defect.

SINGLE OR THREE-PHASE ELECTRICAL POWER

There are two ways of distributing Alternating Current power: in single-phase or three-phase mode.

- **Single-phase electrical power**

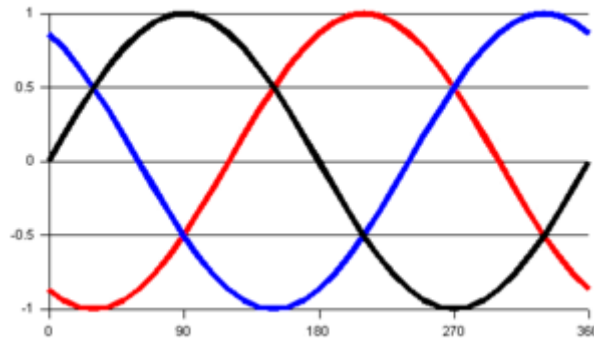
Single-phase electrical power uses two cables: the phase (230V) and neutral cable. It is a system of electrical energy distribution in which the voltage is represented on a line with 2 wires.



Single-phase voltage is used for lighting and heating for example, and more generally, whenever high power is not needed.

- **Three-phase electrical power**

Three-phase electrical power uses four cables: three phases and one neutral cable (400VA between phase cables and 230VA between phase and neutral cables).



Sinusoidal Alternating Current on a balanced three-phase network. Each colour refers to a phase (Wikipedia)

High voltage is required in order to transfer energy, and devices using three-phase power are more suited to providing high power.



- **Three-phase/ Three-phase – Single-phase/ Single-phase – Three-phase / Single-phase UPS**



Deciding on a three-phase/ three-phase – single-phase/ single-phase or three-phase/ single-phase UPS is above all a technological and physical choice that depends on consumers’ needs. Don’t hesitate to consult our Sales Team to find the solution that best meets your expectations!

UNINTERRUPTIBLE AND PROTECTED OUTLETS

Uninterruptible outlets	Surge suppressors with a battery capacity that make it possible to store electric current during the time necessary for users to save their data.
Protected outlets	“Standard” surge suppressors, with no battery capacity but with protection against overvoltage...

INPUT AND OUTPUT CONNECTORS

<p>SNMP Protocol (Simple Network Management Control)</p>	<p>A protocol that enables network administrators to manage network equipment and to diagnose network problems. The network management system is based on two main parts: supervisor and agents.</p>
<p>SNMP Agent</p>	<p>SNMP Agents are located on each interface connecting the managed equipment to the network and make it possible to gather information on different objects. These manageable objects may be material information, configuration parameters, performance statistics or other objects that are directly linked to the current behaviour of the equipment involved.</p>
<p>AS 400 Agent</p>	<p>A card that uses dry contacts to indicate UPS status remotely (see below)</p>
<p>Connection box</p>	<p>Connector with screws into which an electric cable can be plugged</p>
<p>Dry Contacts</p>	<p>In electricity, this is a power-free contact. It is used for a detector or relay output where there is no power (synonym: potential free).</p>
<p>DB 9</p>	<p>See RS 232</p>
<p>EPO</p>  <p>EPO Switch for M3T – INFOSEC</p>	<p>Emergency Power Off</p>
<p>USB communication port (Universal Serial Bus)</p>  <p>X3-1200 USB port</p>	<p>The USB port is, as its name suggests, based on a serial-type architecture. Nevertheless, it is a much faster input-output interface than standard serial ports. The standard USB port, invented in 1995, is designed to connect a wide range of peripheral devices.</p>

<p>RJ 11</p>	<p>A RJ11 connector, also called Registered Jack 11, is an international standard used by fixed telephones. It is also used in the field of local networks.</p>
<p>RJ 45</p>  <p>RJ-45 Connector</p>	<p>A RJ45 connector is a physical interface often used at the end of twisted pair type cables. It is made of 8 pins of electric connexions. A very common use for RJ45 connectors is the Ethernet connexion that usually uses 4 pins (2 pairs). Other applications are for instance office phones and IT network connectors.</p>
<p>RS 232</p>  <p>RS-232 DB-9 connector</p>	<p>Protocol that standardizes a serial-type communication port. Available on almost every PC, it is commonly called "serial port". This port can be presented as a 9 or 25-pin connector (this is why it is called either DB-9 or DB-25 depending on the number of pins). Although this communication port tends to be replaced by the USB port on PCs, it is still very often used in industry due to its sturdiness and simplicity</p>
<p>RS 485</p>	<p>The RS 485 communication port works in the same way as the RS 232 but is much longer (40 metres of wire instead of 5 for the RS 232)</p>