

UPS Knowledge ABC

Edit By www.kemapower.com

What is UPS?

UPS means "Uninterruptible Power Supply", consisting of battery unit, inverter and control circuit. It is a kind of power supply protection and power storage equipment capable of providing uninterrupted AC power during abnormality of electric network (power failure, surge, under-voltage, commercial power sag, radiated interference, etc).

What is the use of UPS?

UPS can be used for:

1. When the electric network works properly, the voltage of commercial power will supply power to the load after undergoing the voltage stabilization of UPS, and at the same time it will charge the built-in battery unit to store back-up energy;
2. During the electric network abnormality (under voltage, over voltage, interference, power failure, etc.), the inverter of UPS will convert the DC energy stored in the battery unit to AC energy in a timely manner, to maintain the normal power supply to the loads;
3. UPS can be automatically switched between electric network power supply and battery feed, to ensure the uninterrupted power supply to the loads. The affordable switching time can be selected according to the equipment precision;
4. When the quality of electric power is poor (electromagnetic interference, radiation, surge, etc.), UPS voltage stabilization and filtration functions may be applied to supply stable and pure sine wave.

Classification of UPS

According to the operation mode of UPS inverter

UPS can be classified into three types: Back-up type (off-line type), on-line type and line interactive type.

According to the output waveform of inverter

It can be classified as sine wave or step wave (or refer to as square wave or class sine wave)

According to its power capacity

They are classified like this as a practice: low power (0.5~3KVA), medium power (3~10KVA), high power (over 10KVA)

According to power supply system

Classified as 1 phase-in 1 phase-out, 3 phase-in 1 phase-out, and 3 phase-in 3 phase-out.

According to battery back-up time

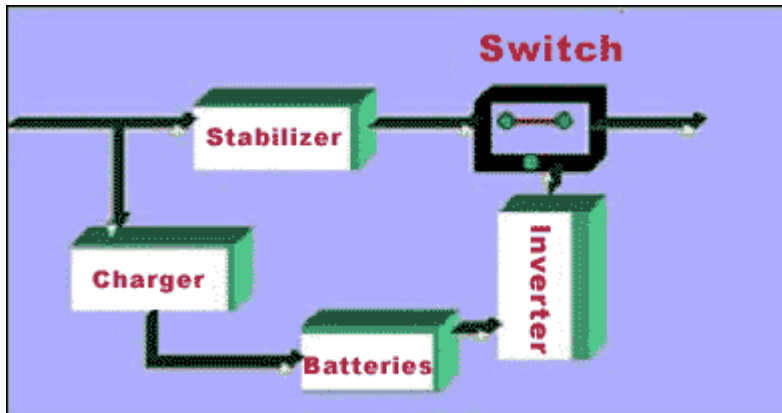
Classified as standard type and long time delay type

Operational Principle of UPS

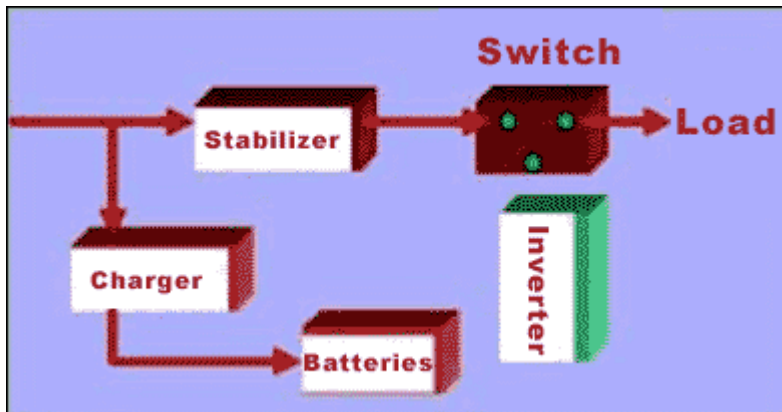
Back-up type UPS

Back-up type: basic structure consists of inverter, battery unit and switch. When the electric network works properly, the inverter will stop AC output, and the electric network will supply AC power to the loads through UPS. During electric network failure (power failure, under voltage, over voltage, etc.), UPS will be switched to inverter output mode. This switching process lasts for 3-10ms

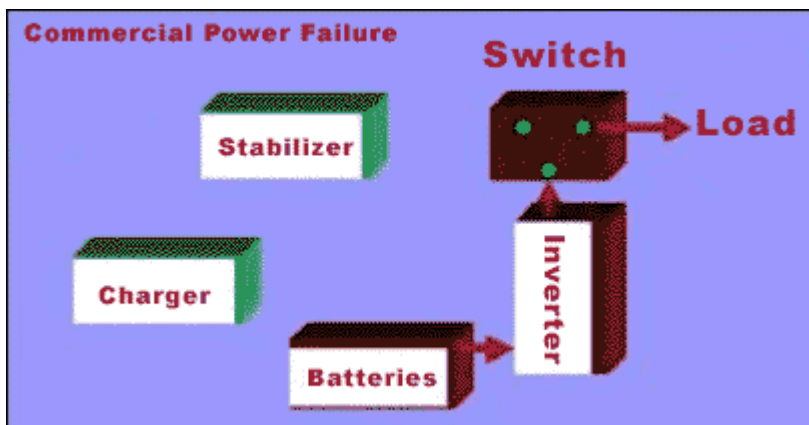
Functional Block Diagram



UPS operating mode when commercial power works properly



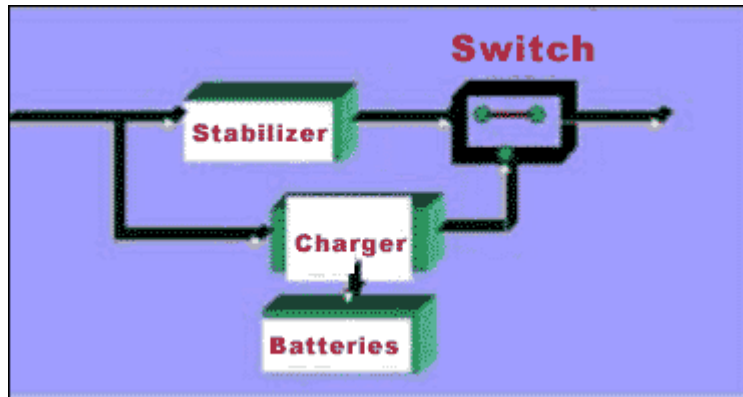
UPS operating mode during power fail



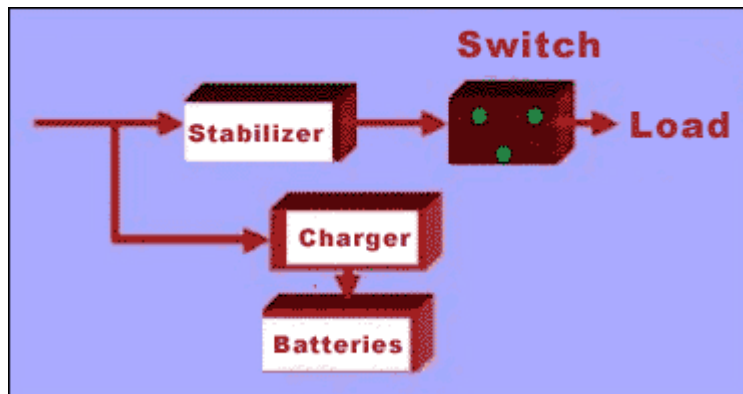
UPS of Line Interactive Type

Line interactive type: basic structure consists of bilateral inverter, battery unit and switch. During electric network failure, inverter will supply power to the loads, and when the electric network works properly, the inverter switches to charge the battery. UPS of interactive type has comparatively strong charging function, yet with problem in output time.

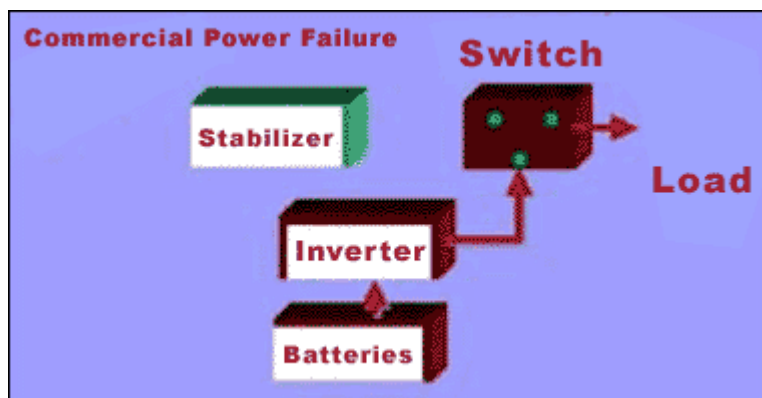
Functional Block Diagram



UPS operating mode when commercial power works properly



UPS operating mode during power fail

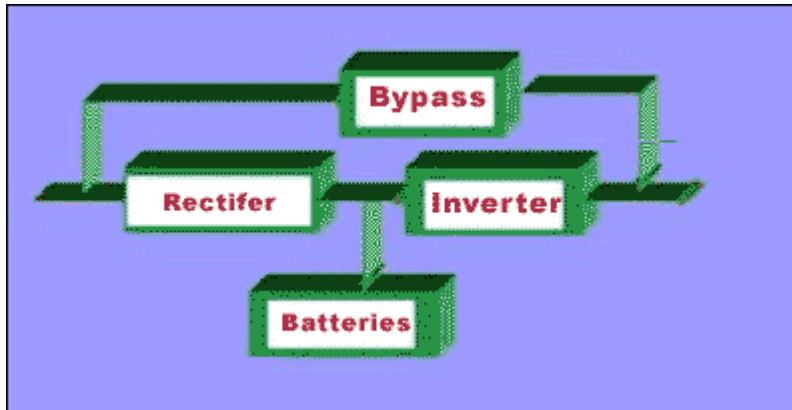


UPS of On-line Type

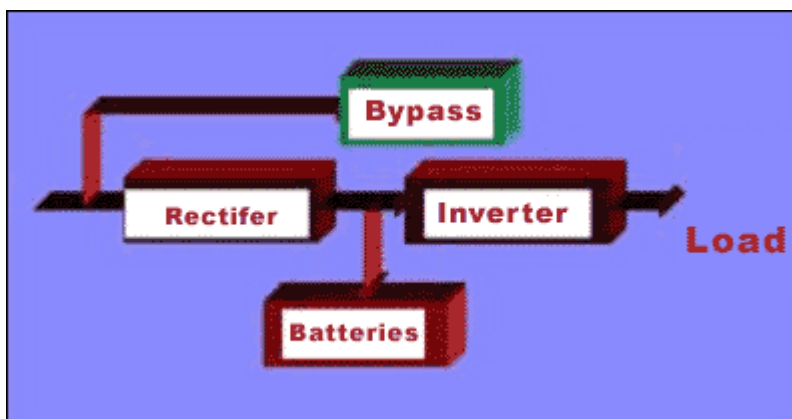
On-line type: basic structure consists of rectifier (AC/DC), battery unit, inverter (DC/AC) and by-pass switch. No matter whether the electric network is working properly, inverter will always supply stable AC

current to the loads. For this kind of UPS, there will be no switching time when switching between commercial power/battery operation mode.

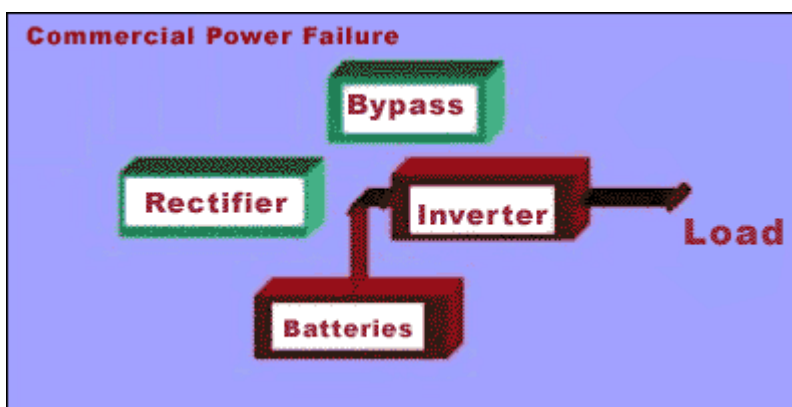
Functional Block Diagram



UPS operating mode when commercial power works properly



UPS operating mode during power fail



What are the common problems for electrical power supply?

According to the tests conducted by the electric power specialist, the following conditions frequently occur in the electric network and have caused interference or damage to the computers and precision instrument:

1. Power surges: means the output voltage effective value exceeds 110% of the rated value, and the duration of which reaches one or several cycles. Basically, surge is the high voltage generated due to sudden off-loading of the electric network when the heavy-duty electrical equipment connected to the electric network is shut down, for example, the shutdown of common household air conditioner. We all have such experience: during the time frame from 6:00pm to 9:00pm, which is the peak hours for power utilization, the voltage of commercial power is generally lower than usual and the illumination light in the houses is relatively dark; after the peak hours, for instance, around 10:00pm, you will find that the lights in the house suddenly flashes up and lights up a lot. This is a sort of surge that we frequently experience in our daily life.

2. High voltage spikes: means the voltage with peak value reaching 6000v, and the duration of which varies from 0.0001 second to 0.5 cycle (10ms). It mainly arises from lightning stroke, arc discharge, static discharge, or the on-off operation of heavy-duty electrical equipment.

3. Switching transients: means the pulse voltage with peak voltage reaching as high as 20000V, and the duration from microsecond to 0.0001 second. The main causes and possible damages are similar to those of high-voltage spike pulse, only different in the solutions.

4. Power sags: means the low voltage state with effective value of commercial power voltage between 80% and 85% of the rated value, and the duration of which reaches one to several cycles. Starting up of major equipment and heavy duty motor or the connection of heavy-duty power transformer may cause such problem.

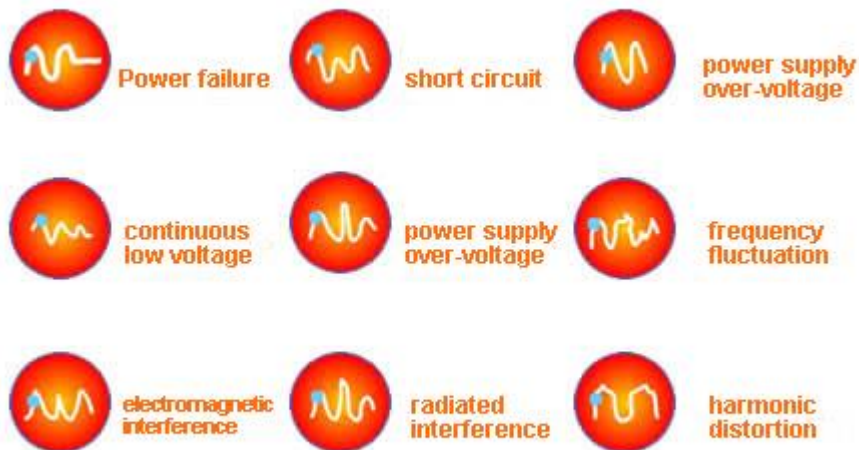
5. Electrical line noise: means radio-frequency interference (RFI) and electromagnetic frequency interference (EFI) as well as other high-frequency interferences. Running of motor, operation of relay, working of motor controller, broadcast transmission, microwave radiation as well as electrical storm will all cause electrical line noise interference.

6. Frequency variation: means the variation of power frequency exceeding 3Hz. This is mainly caused by the unstable running of emergency generator or the power supply with unstable frequency.

7. Brownout: means the effective value of commercial power voltage is lower than the rated value, with relatively long duration. The causes include: the start-up and utilization of major equipment, main power line switching, starting heavy duty motor, line overload (this problem exists in many areas of our country).

8. Power fail: means the power failure that we usually encounter. Causes include: breaker trip on the circuit, commercial power supply failure, and electric network failure

What are the protective functions of UPS for electrical power supply?



Electro-magnetic Compatibility (EMC) of UPS

EMC means electromagnetic compatibility, which means the characteristic of the impact to and from the surrounding electromagnetic environment when the device system is running under specific environment.

Large numbers of electronic components, electronic circuit and MCU micro-control technology are used in the UPS, where a lot of converting devices for energy, voltage and waveform are equipped. UPS is not only a source of EMI that generates considerable electromagnetic interference, but also sensitive to outside electromagnetic interference. Therefore, the EMC of UPS is one of the important indexes for the UPS reliability, which should be improved as much as possible during the design and manufacturing of UPS. KEMAPOWER Company invested money to set up UPS EMC Detection Center of international level in the industry. Through the EMC detection to the UPS, the electromagnetic interference generated by UPS itself can be effectively inhibited and reduced, so as to improve the UPS resistance capability against the outside electromagnetic interference, thus ensuring the reliability of UPS performance and the safety of utilization.

What are the precautions for using UPS?

- 1) The use of UPS requires a clean environment with good ventilation.
- 2) The output socket of the UPS should be clearly marked. Do not apply unrelated loads or cause short circuit.
- 3) Do not use inductive load, such as money-counting machine, daylight lamp and air conditioner to avoid damage.
- 4) Make sure the generator's output power is two times more than the UPS rated power, if the user uses the generator during the power fail. UPS must be connected after the generator is operating stably.
- 5) When turning on the UPS loads, start from the heaviest in duty, and then the ones in the order of duty.

6) The UPS output load should be controlled at about 60%, where the reliability will be the best.

How to conduct UPS maintenance and servicing?

Favorable maintenance and servicing may greatly prolong the UPS life. Storage battery is one of important components of UPS system, its performance will directly affect the reliability of the entire UPS system. However, the storage battery is the unit with the shortest mean time between failures (MTBF) in the whole UPS system. Therefore, the maintenance and servicing of the UPS is actually the maintenance and servicing to the storage battery inside UPS.

Storage battery normally include lead-acid battery, lead-acid, maintenance free battery and nickel-cadmium battery, etc., whose respective features are as follows:

Type/Description/Advantages and Disadvantages

Lead-acid battery/general type battery, is also known as battery for vehicle use, maintenance by adding water is required. The expected life is 1~3 years, with hydrogen gas generated during charging and discharging. The place with battery installed should be equipped with exhaust duct to avoid danger; the electrolytic solution has acidity which may corrode metal; and the price is quite low.

Lead-acid maintenance-free battery/battery of new type/water adding not required, the expected life is normally 5~7 years. For sealed type battery, charging will not produce any harmful gas; easy arrangement without the need to consider the ventilation of the installation site, free of servicing and maintenance; with high discharging rate, stable characteristics and relatively high price.

Nickel-cadmium battery/advanced battery, applicable to special occasion and special equipment/water adding required, and the expected life is 20~40 years. Water is used as media, and the charging and discharging will not produce harmful gas; with low water loss rate yet adding water and performing servicing at fixed time is required; with optimal discharge characteristics; can be placed under any harsh environment; with very high price.

Factors affecting battery life include: UPS operating environment, ambient temperature, charging and discharging current, charging voltage, discharging depth, etc., among which, attention should be paid to:

1. UPS Operating Environment

UPS should be installed at the places that are clean, cool, well-ventilated and dry, thus reducing the corrosion against UPS internal wiring caused by harmful dust; also, avoid the impact to UPS as caused by sunlight, heater (such as heating apparatus used in wintertime) or other radiant heat sources. UPS should be placed upright; inclination is not allowed.

2. Ambient temperature

Ambient temperature has relatively great impact to the UPS battery. When the ambient temperature is too high, the battery will be overcharged to produce gas, or if the ambient temperature is too low, battery will be undercharged. Both will affect battery life. It is ideal to keep the ambient temperature at about 25°C, which will also be appropriate for computer main unit and monitor.

3. Charging and discharging current

The charging and discharging current of UPS battery is normally indicated by C, whose actual value is associated to battery capacity. For instance, for 100AH battery, C=100A. Too large or too small charging current will affect the battery life. Normally, discharging current is required to be 0.05~3C. Under regular service, UPS can meet such requirement. However, actions should be taken to prevent accidents such as battery short-circuit from happening.

4. Charging voltage

UPS battery adopts back-up operating mode. Under normal power condition, the battery is at charging status, and will only discharge during power failure. Too high charging voltage will cause battery overcharge, while too low charging voltage will cause battery undercharge.

5. Discharge depth

Discharge depth has quite a large impact to the UPS battery life. The deeper the battery discharge depth, the fewer the cycle times. Therefore, deep discharge should be avoided during battery use. Although UPS is provided with battery low potential protection function, when a normal single battery discharges to about 10.5V, the UPS will automatically shut down. However, if UPS discharges with light load (i.e., without input of commercial power, capacity of the load connected to UPS is far less than its maximum output load capacity, and the UPS is at on status) or UPS discharges with empty load (i.e., without input of commercial power and any load connected, and the UPS is at on status). Both will cause deep discharge of battery.

◦ Besides the above, UPS should undergo regular check after using for a certain time period. For instance, observe if there is any abnormality in appearance, or any smell of odor. If yes, immediately stop using the UPS and contact the maintenance station as designated by UPS manufacturer for repair. Do not disassemble UPS without authorization or give to non-professional personnel for repair to avoid accidents; if the UPS operates uninterruptedly for a long time period, UPS battery will be always at charging status, and this will weaken battery activity. So, even if there is no power failure, discharging test should still be conducted on a regular basis to maintain battery activity. Normally, discharging test may be performed once every three months using the following procedure: connect load to UPS -- preferably above 50%, then disconnect commercial power to keep the UPS at battery discharging status. The discharge duration should depend on battery capacity, normally from several minutes to ten more minutes. After discharging, restore commercial power supply to continue battery charging.

Product Learning

1, The definition of UPS

A: An Uninterruptible Power Supply is a device that sits between a power supply and your computer and other valuable electronic equipment to prevent undesired features of the power source from adversely affecting the performance of your devices. Those undesired features include blackouts, power sags and power surges, etc. Your equipment can maintain optimum performance and lifetime with UPS protection.

UPS can provide continuous, optimal power supplying in the event of a power down instead of utility line. The power supply can resume within 4 to 8 milliseconds, or even 0 milliseconds, which depends on different types.

2. What are the problems usually happen to the power supply?

Blackout, power slump, power surge, continuous under voltage, continuous over voltage, frequency fluctuation, interference of computers, switching transient, harmonic distortion, etc.

3. The functions of UPS?

An UPS can perform

- 1, Power down protection
1. Under-voltage and over-voltage protection
2. Waveform distortion correction
4. Frequency stabilization
5. Voltage regulation
6. Normal mode noise rejection
7. Common mode noise rejection
8. Surge protection
9. Transient response protection
10. Power supply monitoring

4. What are the main categories of UPS?

There are basically three different types of devices by topology, which are offline, line interactive and on-line ones.

For offline UPS, power is usually derived directly from the power line, until power fails. After power failure, a battery powered inverter turns on to continue supplying power. Batteries are charged, as necessary, when line power is available. This type of supply is sometimes called an "backup" UPS.

The quality and effectiveness of this class of devices varies considerably; however, they are generally quite a bit cheaper than online UPS. The time required for the inverter to come on line, typically called the transfer time, varies by unit.

Since appliances connected to the supply are basically connected directly from the power line, offline UPS provide relatively poor protection from line noise, frequency fluctuation, line spikes, and brownouts.

Online UPS

What we call as "true" UPS systems, those power supplies that continuously operate from an inverter. Obviously, there is no transfer time, and these supplies generally provide the best isolation from power line problems. The disadvantages to these devices are increased cost, increased power consumption, and increased heat generation.

line-interactive UPS

The line-interactive UPS uses a totally different design than any type of offline UPS. In this type of unit, the separate battery charger, inverter and source selection switch have all been replaced by a combination inverter/converter, which both charges the battery and converts

its energy to AC for the output as required. AC line power is still the primary power source, and the battery is the secondary. When the line power is operating, the inverter/converter charges the battery; when the power fails, it operates in reverse.

The main advantage of this design is that the inverter/converter unit is always connected to the output, powering the equipment. This design allows for faster response to a power failure than a offline UPS. The inverter/converter is also normally fitted with circuitry to filter out noise and spikes, and to regulate the power output, providing additional power during brownouts and curtailing output during surges.

5. What are the benefits of a UPS?

A UPS has internal batteries to guarantee that continuous power is provided to the equipment even if the power supply stops providing power.

Advantages:

1. Computer jobs don't stop in case of the power failure.
2. Users do not inconvenienced when computer is out of power.
3. Equipment does not incur the stress of another (hard) power cycle.
4. Data isn't lost because a machine shut down without doing a "sync" or equivalent to flush cached or real time data.

6. How long can equipment on a UPS keep running after the power goes off?

It depends on how big a UPS do you have and what kind of equipment it protects? For most typical computer workstations, one might have a UPS that was rated to keep the machine alive through a 15-minute power loss. If you need a machine to survive hours without power, you should probably look at a more robust power backup solution. Even if a UPS has a very small load, it must still operate it's DC (battery) to AC converter, which costs power.

7: How are the "sizes" of UPSs determined?

Typically, a UPS has a VA rating. The VA rating is the maximum number of Volts * Amps it can deliver. The VA rating is not the same as the power drain (in Watts) of the equipment. Computers are notoriously non-resistive. A typical PF (power factor: Watts/VA) for workstations may be as low as 0.6, which means that if you record a drain of 100 Watts, you need a UPS with a VA rating of 167. Some literature suggests that 0.7 may be a good conversion factor, but this will depend heavily on the machine.

8. The main specs of UPS

The main specs for hardware are:

Operation model: offline, line interactive, online

Input voltage range

Input frequency range

Input power factor
 Load power factor
 Over load capacity
 Transfer time
 The stability of output voltage
 The distortion of output voltage
 Crest ratio
 Ability of taking 100% unbalanced load
 Cold start function
 Bypass function
 Compatible with generators
 Battery management level
 UPS efficiency

9 、 The capabilities of different topologies to utility line problems:

The problems of utility lines	back up UPS	line interactive UPS	online UPS
Power surges	No solution	limited solution	complete solution
High voltage spikes	No solution	limited solution	complete solution
Waveform slump	limited solution	limited solution	complete solution
Electronic interference	limited solution	limited solution	complete solution
Frequency fluctuation	no solution	no solution	Track and lock phase within certain range
Continuous high voltage or low voltage	limited solution	limited solution	complete solution
High voltage transient	no solution	limited solution	complete solution
Power down	complete solution	complete solution	complete solution