

# Guide to professional “UPS” selection

Selecting the correct size ups system is not as hard as you might think. However, it is vitally important because an undersized ups will not function when the power goes out.

Here's how. UPS systems are rated by their Volt Amp (VA) and Watt output capability. For example, a ups may be rated at 3000VA / 2700 Watt.

The difference in VA and Watts is due to an electrical property called a power factor, but if you size the ups using Watts, you don't need to worry about the power factor.

The Watt rating of a ups system is simply measure of how much equipment you can plug into it.

If you get a ups system that has a Watt rating that is too small, it will not provide the battery backup that you are counting on, or it may not work at all. Determining the size requirement for a ups is a pretty straightforward process.

The first thing to determine is the power requirement of your equipment. Most pieces of equipment have a tag on the back that will tell the watts or amps used, and the voltage.

Create a list of what you intend to plug into the ups system along with the watt requirement. The total of this list is your watt requirement.

Another factor to consider is whether you expect to be adding equipment in the future, or if your equipment growth will be pretty static.

Finally, always make sure you have at least 30 % extra capacity to ensure you battery backup will function when you need it. If you need more help configuring a ups system, please contact us.

**The following steps will guide you through the process of specifying and selecting a professional UPS for your organization. For a newcomer to the UPS field it is advised to start with UPS basics article.**

## Decide the required UPS Size

The Power Capacity of the required UPS should be the first thing to decide. In order to evaluate the Power rating of the UPS, you should decide which consumers should be protected. Bear in mind that certain consumer failures may cause power failures in other loads fed from the same UPS. Connection of non-essential hardware should therefore be avoided. The UPS must back up servers, Communication items, preferably Personal Computers, and Emergency lights. Connect monitors only if you need to provide service even if power fails. Avoid connecting printers, copiers, non-critical lights etc, even if the UPS size permits.

Now calculate the total current drawn from the UPS, which is the total sum of the currents of every consumer connected to it. Multiplying this derived total current figure, by the local grid Phase to Neutral voltage, (normally 230V in Kuwait and MEA) provides the required VA Rating. Note the total current of a three-phase system is derived by the sum of all three phases.

The current demand of the consumers can be found in the user's manual or read from the label attached to the instrument. To get the final figure, reserve extra capacity for any expected additional future Loads. The VA figure so derived is in most cases 30% to 50 % above the current, which the equipment consumes. You will have to consult the manufacturer of the equipment or measure the current for a more accurate figure.

The wattage rating is the second figure to consider. It represents the amount of real Power that the load requires. The Watts to VA ratio, called Power Factor, is dictated only by the nature of the load. This ratio can theoretically be any number between zeros to one, but it is normally between 0.6 to 0.9. Unless you have the exact figure, Power Factor 0.7 should be OK for Personal computers and 0.9 for large systems.

A personal computer (or server) including a monitor will normally require no more than 300VA. Multiplying the VA rating by a power factor of 0.7 renders 210Watt. The common presentation is 300VA/210W. Thus, any UPS with a VA rating equal to or above 300VA and Watt rating equal to or above 210W should be sufficient for a single computer.

## Decide the required Autonomy time (Back-up time)

Autonomy time is the time that batteries are able to back-up operation and feed the load upon failure of utility power. Load consumption and size of UPS batteries dictate the back-up time. UPS systems rated below 20-40 KVA come normally with internal batteries. Medium and high power systems (above 3 to 5 KVA) are frequently designed to allow back-up time expansion by adding external batteries.

Statistically, the duration of 90% of utility power outages is less than 5 minutes. The amount of utility grid outages in Kuwait is about 10 to 30 per year. If you are not located in a specific grid troublesome area, you may expect not more than three power failures a year, lasting beyond 5 minutes.

The main reason to purchase a UPS is to protect data and hardware. Main causes of data failures happen due to short time phenomena on the utility grid, such as spikes, sags, dips, and high frequency noise. Uncontrolled, abrupt power failure can harm both software and hardware. Data in process or not stored on

the Hard Disk is totally lost. In some cases, the Hard Disk may also be entirely destroyed. The harm done to it, if power fails during the writing period for instance, is like a scratch made by the needle of a phonograph record should you turn it off while it is playing.

Unless you provide real time service, or your equipment comprises part of a working industrial process, which can't be interrupted, you might be happy with a system that backs up your loads for 5 minutes, and then turns off your computer in a graceful manner. In most cases, mains outage is shorter than 5 minutes, and UPS turn off won't be needed. Therefore, 7 to 15 minute's back-up time should suffice for most applications. You should however make sure that the UPS is supplied with a software suitable for your computer or network, and that the software exits the system, while storing on computers hard disk all open files before turning down the computers, the way you would do it manually.

You should also take in account that back up time is strongly related to the size of your load. UPS systems sense the battery voltage, emitting audible alarm, including load turn off signal to the computer, to allow orderly shutdown short time before the battery discharges below a preset voltage level, at which the UPS will turn off. Lower load draws less current from the batteries, extending the battery time.

Eaton type 9SX UPS for instance with 8 minutes backup time at full load (0.7 PF), provides 24 minutes back-up time at half load (0.7PF). Thus, over sizing the UPS by 20 to 30%, which good practice requires doing anyway, will enable you to protect your computer network without purchasing a system with bigger battery.

In applications which require continuous operation, even during power absence, other and additional factors should be considered. The battery should be sized according to the required autonomy time. The size of the UPS may have to be increased because small units do not allow battery extensions. You may need to increase UPS size also in order to supply the charging current of an extended external battery, or in order to decrease the charging time required by big battery bank. You might also consider installation of a backup generator, to feed the UPS. Cost, availability of space, and reliability, should all be taken in consideration.

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## Decide the type of the UPS you need

UPS's are roughly divided to three main classes. The Off Line UPS is the simplest and the least expensive, then comes the Line Interactive type, which overcomes the major disadvantages inherent to the off-line unit, finally the Double Conversion On-Line UPS which provides the best power protection.

An off-line UPS, also called Stand-by or Backup, feeds the load continuously from Mains. Upon mains outage, the load connections transferred to the inverter fed from the batteries. Most of the short term spikes surges and high frequency harmonics are decayed by means of special filters. However, various

phenomena of transient nature during mains existence, like over voltages and dips can harm protected data. These units are generally equipped with spike suppressors, aimed to protect the hardware from high voltages on the utility grid.

Off-line systems are used mainly for low power installations, small offices, personal home computers and other less critical application, where eliminating 85% to 90% of computer malfunctions caused by power failure, is satisfactory. In such applications, this low cost solution, is a good value for your money, it decreases tenfold the probability of a harm to data and hardware from utility Grid. The inverter output voltage in this class is usually non-sinusoidal, frequently called semi-sinusoidal. Personal computers will probably work nicely with such waveform. You should however check with your vendor before using other types of loads.

Professional installations generally require better protection, here comes the Line Interactive UPS, called sometimes Interactive UPS, or On Line, Interactive UPS. These systems are also based on stand-by principle, working directly from mains, switching to battery (via the inverter) upon mains disappearance. Here however, additional circuits filter and correct output voltage, keeping it within allowed tolerance band, thus providing conditioned power to the critical load. This UPS will probably have a sinusoidal type inverter, therefore, special precautions as regards to type of load might not be required. Line Interactive UPS units come generally in the range of 350 to 2700 watts, offering a popular solution for servers, personal computers hubs and other loads in this power range. These units are used mainly for short backup times, sufficient to provide an orderly shutdown.

Like the Off-Line unit, also here the stand by behavior, is in most cases the major drawback of the Interactive UPS. Practically, UPS operation is verified upon mains failure which is the most critical moment. Upon mains disappearance, the load is connected to the inverter and batteries. Any dormant malfunction, such as loose internal connection or weak batteries might be revealed at the very moment when it is called to action. Neither off-line nor Interactive UPS systems are able to correct frequency. The output frequency of any stand-by unit is in normal operation the same as the input utility grid. These units should therefore be avoided on sites equipped with small back-up generators, exhibiting generally poor frequency regulation.

The Interactive UPS is a professional solution for business application where the main concern is to provide software protection from about 90% to 95% of utility grid disturbances. These units may be utilized in relatively small networks, comprising 10-12 computers. They are applied in such locations as lawyer offices, accountants, sales agencies, engineering offices etc. Some prefer to back up with Interactive UPS less critical equipment in the company, such as personal computers connected to LAN network, whereas the servers are backed up by an ON - LINE UPS.

An On-Line UPS, also called Double Conversion UPS, or True On-Line UPS, is the ultimate solution for all applications from one, or two kilowatts up to Megawatt sized consumers. Here, the load is constantly fed from the Inverter, providing conditioned, stabilized sinusoidal voltage. The utility line in these systems forms a backup source in case of UPS malfunction. The Transfer switch will automatically transfer the load to mains in case of overload or UPS failure.

The On-Line unit comprises two converting stages. The first stage converts the incoming ac power to DC, thus creating a dc-buss, which is fed either from mains or from storage battery. A second stage converts the DC power back to conditioned ac in order to feed the critical load. Filters on the DC buss and fast regulating circuits in the converters practically isolate the load from any abnormal utility behavior.

In normal operation, load energy comes from mains, via the Rectifier and the Inverter. Upon mains outage the battery supplies the energy, which the load requires (by the dc/ac Inverter). Should the mains voltage return before the battery was fully discharged, the Rectifier will feed the load through the Inverter and start a battery recharge regime to compensate for the lost charge.

Otherwise, the UPS will turn off when battery becomes fully discharged. The UPS will resume automatically normal operation upon mains restoration. Also here, the Rectifier will feed the load via the Inverter, recharging the battery. The Output voltage of an On-Line UPS is generally stabilized within one percent tolerance. Output frequency is locked to input if it is within preset tolerance band, otherwise a free running crystal controlled clock will dictate the output.

The merits of Double Conversion ON -Line system make it the preferred choice for business and industrial applications. It is the best solution in spite of the added system and electricity costs.

- It offers the best power protection, covering all types of mains disturbances.
- There is no size limit. Standard On-Line UPS's are available to backup any installation.
- With the right system, no practical limit exists on the available back-up time.
- Many systems allow power extension to satisfy the needs of a growing enterprise.
- Units can be connected in redundant configuration to increase reliability or in parallel to enhance output power.
- In addition, this is the best choice, considering such issues as modularity, ability to work from generator, input power factor correction, hot swapping, maintenance, fault clearing, supervising, and communicating.

## Estimate the required Reliability

You can rely on the UPS to back-up your system and protect it from most power grid problems. You should however consider Reliability issues if you provide real time service. Unfortunately, though the calculations are very simple, some basic mathematical knowledge might be required, if you want to make the calculations yourself.

Reliability and Availability are the basic functions for measuring UPS non-failure probability. You should be acquainted also with some additional interrelated terms, which describe different Reliability aspects.

MTBF (Mean Time between Failures), represents the average time (generally in hours) between expected failures. The UPS manufacturer should supply the MTBF Figure (Either by means of UPS data sheet or when requested.)

Failure Rate ( $\lambda$  = Reciprocal of MTBF) represents the average number of failures during a particular interval. Reliability ( $R(t) = e^{-\lambda t}$ ) is defined as the probability of no failure before time  $t$ . For comparison purposes " $t$ " refers normally to one year (8760 hours).

Suppose the MTBF of a UPS is 100,000 hours. The Reliability figure becomes  $0.9161(e^{-8760/100,000})$ . We can therefore expect that in a one year interval 91.6% of the time (totaling 334 days) the UPS will operate satisfactory and feed the load with conditioned power, but during 8.4% of the time (totaling 31 days) the UPS will be down. In case of On-Line system the load will be fed during the down time from, the utility grid.

For high mission requirements, this Reliability figure is generally unacceptable. An additional, Redundant, UPS can be connected to work in parallel with the first unit. Thus, normally both units share the load. Should one unit fail the second will continue to feed the load. As long as one of the UPS's works correctly, the load is supplied with conditioned voltage. Evaluating the proper formula shows that the Reliability figure will increase to 0.993.

Thus 99.3% of the time it will be fed from the UPS. And only 0.7% of the time (2.5 days per annum) it will depend on the reliability of the utility power. Adding additional redundant units increases the Reliability to any desired value.

In practice however, no UPS is left incorrect during 31 days. Two Additional Figures are used to describe the real situation:

MTTR – Mean Time to Repair, expresses in Hours, the total time, which takes to restore the UPS to normal operation, starting from the moment of its failure until the service personnel complete their work.

Availability =  $MTBF / (MTBF + MTTR)$ , represents the degree to which the system is operational when required.

Assuming that the stand alone UPS in our example will be repaired on average within 24 Hours (MTTR=24), the Availability becomes  $0.99976 (100000 / (100000+24))$ . Meaning that 99.976% of the time the unit will supply conditioned power. The down time now decreases to 2.1 hours per annum. We can further proceed to improve this figure by adding additional redundant units.

Parallel connection of UPS systems is possible only if units operate at the same frequency, same voltage are synchronized and have an ability to isolate a faulty UPS disconnecting it from the common output buss.

## Refine the deal

At these stage you should already know the KVA rating of the UPS you intend to buy, the type of the UPS (Standby/Line Interactive/On-Line) the autonomy time needed, and the configuration (Stand alone or Redundant).

Now you can contact a us, or try choosing UPS system by yourself or by selecting a suitable unit on our Web.

## Here are some tips to help you while concluding your Power UPS deal:

- Increase UPS capacity to allow for future expansion
- Don't buy back up time that you don't need. Longer autonomy time does not mean better equipment.
- In case of Online units make sure you can add external batteries in future, and that you can increase power by adding parallel units if expected.
- If you do not see a clear advantage for your application, don't pay more. Higher price does not necessary mean a better or more reliable unit.
- Don't buy any extras if you are not sure that they are needed for your application. Most can be added in the future whenever required.
- Some manufacturers provide 6-figure guarantee to cover damage to your equipment. The enormous sums are seldom meaningful, you won't generally be paid above the value of your backed up hardware. The main items, such as loss of data, or discontinuity of service to your clients are in most cases not covered.
- Make sure that the UPS comes with software which shuts down gracefully and automatically all backed up computers.
- Make sure that the UPS includes surge protectors on input and on its communication lines. Replaced.
- Make sure that the UPS performs automatic battery tests, warning whenever the batteries should be otherwise you will discover that your computer goes down when the lights turn off. Don't be tempted to buy manually initiated test. Nobody remembers to keep the routine.
- Avoid falling into a trap of misleading terms. Eaton UPS should regulate output Semi-sinusoidal output is not sinusoidal. On -Line must be double conversion and be able to regulate output frequency. Note that "Automatic self-test" does not always mean battery test as well.
- Backup time has no meaning if you don't consider the amount of UPS loading. Partial load increases dramatically the time the battery backs-up the equipment.
- Prefer hot swap-able Batteries. The batteries of some systems are not accessible by the operator and should be replaced by qualified technician.
- When purchasing the UPS, make sure that after sales service is in good hands. Check who provides the service, how fast is it, and whether it is provided in your premises.
- Check Guarantee. Duration, Where and When. It is not uncommon to get several years guarantee, 7 days per week at your premises.
- Check the make of the UPS you are going to buy. Check that manufacturing company is at least ten years in the UPS business. Get recommendation if the company is unknown.

## Purchase the UPS

Numerous manufacturers are probably able to meet your requirements. Most provide well designed and reliable systems.

To start you will need only one Right lead. [www.Komax.com.kw](http://www.Komax.com.kw) is a Rating Site which enables you to find a proper product.