FIVE APPLICATION CASES OF CONTROLLABLE SOCKETS THAT YOU WOULD HAVE NEVER IMAGINED

Summary

Abstract

Controllable sockets are a powerful feature available on the market and recently introduced in the Liebert® GXT4™ product family. In a separate white paper, "Advantages and efficient use of programmable sockets", we have explained the way they work, their advantages and key parameters as well as the criteria behind their activation. While the first paper provides a solid background about this technology, this document illustrates a series of application cases on how to use it. Some may think that it is just a feature to enable or disable power delivery to the sockets, but after reading this paper you will discover new scenarios that might help you have a better control of your protected load, gain extra runtime or define load priority.

Introduction

For those with no background on this feature, programmable or controllable sockets have the capability to enable or disable power delivery to a selected group of output power sockets on an uninterruptible power supply (UPS). This allows loads to be powered on/off depending on several conditions which can be configured separately. The sockets are controlled through the UPS internal microprocessor and their operation is based on criteria which can be setup locally via software (USB or RS232 connection) or remotely through web access. Greater insight is provided in another white paper on the subject, entitled **"Advantages and efficient use of programmable sockets"**.

Programmable sockets provide an extra level of control and protection over the secure energy supplied to the load, thanks to their capability to enable or disable power at the outputs. Typically, output power sockets are grouped in one or two sets depending on the UPS supplier, and there can also be a third group of sockets that cannot be powered on/off, usually referred to as "always on". These deliver power continuously as far as the UPS is connected to AC mains input, or batteries are not depleted. As reference, Figure 1 shows the rear panel of the Liebert GXT4. In this UPS model there are two groups of controllable sockets plus such group of "always on" sockets that delivers power continuously.

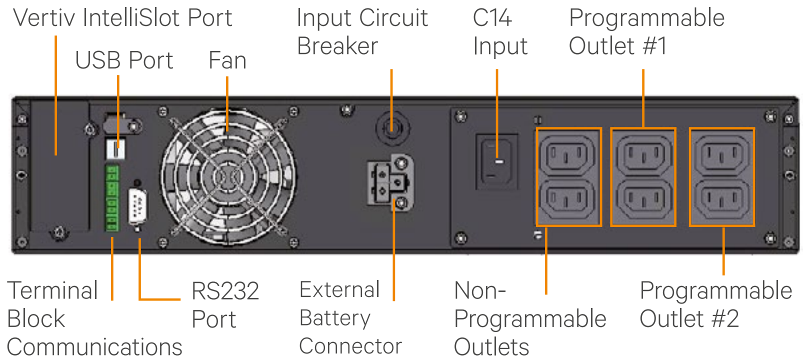


Figure 1. *Output sockets on Liebert GXT4 UPS including programmable groups as well*

Controllable sockets can bring multiple advantages. To simplify, these can be grouped in three major areas and represented along three axes (Figure 2):

- Improved runtime
  - Load prioritization
  - Load progressive disconnection based on specific criteria (time or battery capacity)
  - Batteries and runtime sized for the target load profile on battery mode
- Improved control
  - Remote on/off control of the sockets
  - Overload behaviour management
  - Load reboot capability
  - Program and use of a single IP address
- Improved energy usage
  - Less battery usage because of loads disabled
  - Authorization for load connection

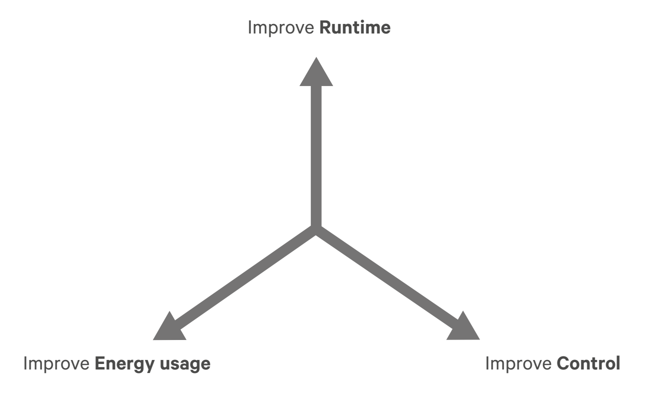


Figure 2. *Three axes for three areas of advantages*

Based on these points, it becomes clear that controllable sockets are not a "simple switch", but revolutionize the way of managing energy and protecting loads. They allow redefining the role of UPS for all applications below 3 kVA ratings, for which the UPS now also becomes an "intelligent power management" device, optimizing energy distribution in a rack and allowing load management and prioritization, remote control, runtime definition, etc. based on specific criteria.

In addition to these general advantages that controllable sockets offer, the next sections will expound five selected application cases. These will further demonstrate how technical features can be translated into actual benefits and bring value for such applications (problem solving).

For each of the five cases, we will first describe the scenario (which may be intentionally simplified for a clearer analysis) together with the challenge that needs to be addressed. Then we will present a solution based on the convenient use of controllable sockets, and the benefits that such solution brings to the user. These examples are not intended to represent the best or unique way of application, but are meant to be representative of what can be achieved in practice. The reader may for sure find also additional application cases.

Application Case 1: Unauthorized Access

Scenario: An airport with distributed power protection and UPS typically in the 1-3 kVA range. These can be used for example to protect computers and ticketing operations (printer, scanner …) devices at the boarding gate, etc.

Figure 3. *Boarding gate with access control*

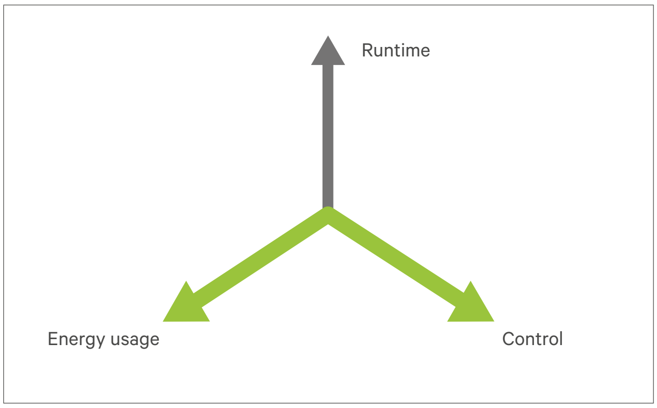
Problem: In an airport, it may happen that even after the system at the boarding gate is set up, more loads can be "unintentionally" added to the UPS. This may result in unexpected runtimes (lower backup time than the system integrator had specified), overloads or even a complete system shutdown at the boarding gate.

From the perspective of a system designer or operation manager, this can be considered as an unauthorized use or connection to the UPS protected power delivery. A UPS without controllable sockets does not allow avoiding or rejecting any extra load that may have been added, which leads to the above listed series of risks.

This case can be found in other applications such as remote unattended ATM, reception service desks, office printing areas in which extra printers may be added, etc.. – basically most of the cases where the UPS is located remotely to the IT or system manager, and there is the need to control which loads are connected and protected by each UPS to avoid misuse.

Solution: In these cases, the best solution is to use the capability of controllable sockets to switch-on or switch-off each group. In this way, the IT manager can disable permanently (or enable if required) one or both groups of sockets. By doing so, no power is delivered by the UPS whether the UPS is operating in line mode or in battery mode.

Benefits: While the benefits of protecting against unauthorized use are clear, controllable sockets also bring an extra level of control to the UPS and the loads protected. For example, the control of the connected loads; the use of unauthorized loads; a better control of runtimes as no "unknown" loads will be connected; and avoiding overloads. Last but not least, the possibility to reboot loads separately.



How to get it done: Control of the sockets can be performed very easily: either locally with the LCD interface screen or with a configuration software tool, or remotely in case the UPS uses a SNMP/webcard and is connected to an IP network.

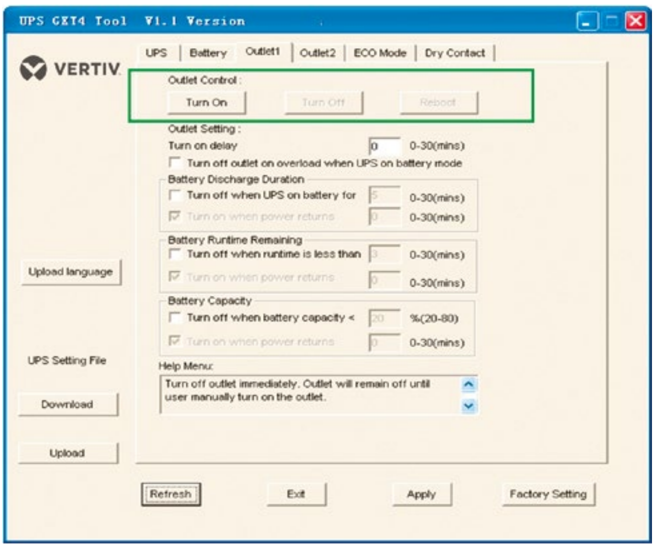


Figure 4. *On/off control for each group of sockets*

For example, each Liebert® GXT4™ UPS has a configuration software tool which can communicate with the UPS through the USB port connection and then apply a specific setup (Figure 4). It can also use the SNMP/webcard, and do so by navigating the web browser and selecting the tab for each group.

Application Case 2: Progressive System Start-up

In this section we will review a case where a complex system (composed of several electronic or smart sub-systems) can be progressively activated to "wake-up" in the right way.

Scenario: This second case refers to laboratory diagnostic equipment used in healthcare applications (hospitals, medical assistance centers, etc.). To simplify, it can be composed of a "smart" computer with data storage and control functionality, and a subsystem in charge for the analysis (with servo motors, reactants, display, etc.). Out of the healthcare field, other similar examples of complex systems can be tooling machines, centralized servers and Point-of-Sale (POS) terminals in retailing, the combination of servers and switches for IP addresses, etc.

Figure 5. *Laboratory equipment for analysis*

In this case we will describe a very practical example. Assuming to use a Liebert GXT4 3 kVA UPS, there is a maximum output power of 2700 Watts. The power of the control computer may be around 200-300 watts, thus leaving more than 2000 watts to protect and manage the loads on the analyzer sub-system (blood analyzer, chemistry, resonance, etc.)

Problem: In this scenario we need a progressive system start-up for proper operation, progressively delivering power to the loads in several steps and with delays between the different systems. In this simulation case, the analyzer sub-system requires that the data and control computer are ready prior to the analyzer. Otherwise the complete system will not work correctly.

While this is a simplified case, the reasons for the need for a progressive start may be multiple – to name a few:

- Correct system synchronization at start up;
- High inrush currents that would determine an overload if all the loads were powered simultaneously;
- Need for a "warming" period in a sub-system;

Controllable sockets allow to easily solving these issues. Integrators or system designers will surely appreciate this flexibility to simplify the design and achieve a better operation that otherwise would require more complex and expensive electronics.

Solution: Using the synchronization of sub-systems, as there are 3 groups of sockets: "always on" which is powered as soon as the UPS is turned on, group 1 which can be programmed with a delay, and group 2 which can also be programmed sequentially with further delay. Thus the loads can be shed or connected progressively in a maximum of 3 steps of power groups, which is usually enough for most applications.

These controllable groups can be configured separately, and with a delay of 30 minutes maximum. Therefore the solution is to program a delay between the moment in which the UPS is connected and turned on, thus delivering power immediately (to the computer in our case, referred to as Load 1 in Figure 6), and the moment in which it powers the chemical analysis module (referred to here as Load 2). In the example the assumption is that a period of 4 minutes is enough to wake-up the computer (load operating system and management application), and then start delivering power to the second sub-system (chemical analyzer). As a result, once the chemical analysis analyzer wakes-up, the control computer will be perfectly ready and operative as an interface.

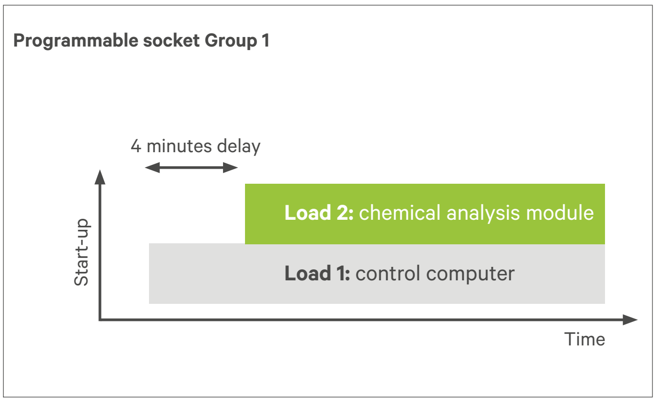
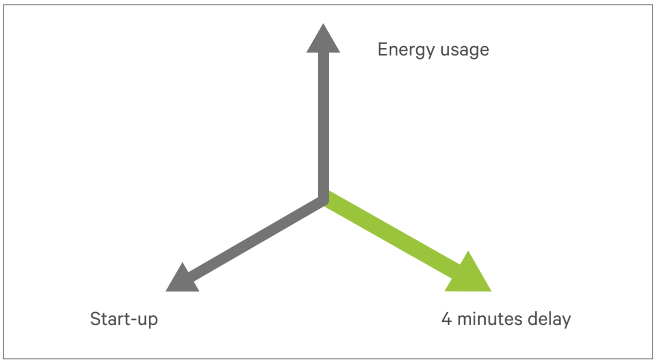


Figure 6. *Progressive system start-up with a delay*

Even in this scenario the UPS goes one step beyond the role of simple power protection and actually works as a kind of "smart power manager", thus managing the energy flow through each sub-system in a smart and controlled way defined by the user.



Benefits: This is a good example of the extra level of control and flexibility that controllable sockets bring to users or system integrators.
The key benefits are related to the flexibility to manage the groups of loads connected, the capability to synchronize the start-up as well as the satisfaction of the requirements for each load (peak currents, warming period, etc.)

How to get it done: There are several ways to set up the Liebert® GXT4™ UPS using this feature, but one of the easiest is using the configuration tool bundled with each UPS. Thus, just connecting their desktop or portable computer through the USB port, the user can set up the parameters for Group 1 and/or Group 2 of sockets.

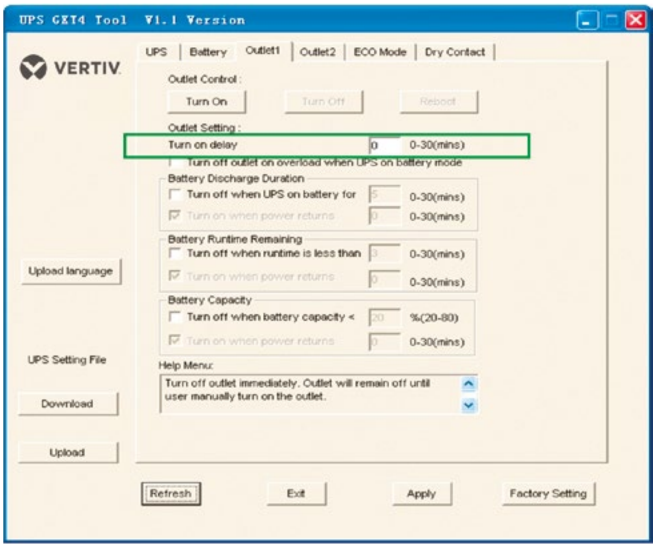


Figure 7. *Liebert GXT4 configuration tool for initial delay setup*

Figure 7 shows a screenshot of the configuration tool to setup the delay for a group of sockets, which is a quite intuitive process.

It is important to highlight the difference between the "initial start-up", intended as the delay when a UPS is connected to the AC mains, or alternatively the delay period when there is a mains failure and the UPS returns from battery to AC mains (either when the batteries are completely depleted and output power delivery is completely stopped, or when there is still energy in the batteries). These two cases are slightly different; however the utmost flexibility of the Liebert® GXT4™ allows a different time set up for both cases (see Figure 7).

Application Case 3: Programmed Load Disconnection

Now we will consider a case in which a pre-defined group of sockets will be configured so as to disconnect the load when the UPS is running on battery mode.

This particular case is probably the one encountered more frequently by users interested in controllable sockets. While the need for an interruption in power delivery is quite plausible, the key point is defining the criteria for such interruption. Should it be after a fixed period of time that the UPS is on battery mode? Should it happen few minutes before the batteries are depleted? Does it affect the way to estimate the battery capacity required? As we will see in the next paragraphs, this case is particularly interesting as it presents several complex aspects to take into consideration.

Scenario: For this application case we will consider retail shops with several POS terminals composed of screen, ticket printer and computer chassis for each. In addition, we will consider security cameras with their control system, such as a recorder. The scenario for this simulation is simplified as a real retail shop may have a number of additional elements such as lighting, hubs, servers, door controls, etc. While more complex cases can be evaluated, for the sake of simplicity

Figure 8. *Retail store*

we will consider the POS as the top priority loads to keep sales and customers flowing, and security cameras as lower priority. More complex scenarios can be evaluated, but as said above, it is just for simplicity.

The same solution can be applied in many other scenarios, like transportation (protection of signalling or information systems, boarding, lighting, etc.), healthcare (customer service areas, small computer rooms, lab equipment etc.), finance, banking, telecom, and so forth.

In the case of our simplified retail shop, we will assume the following:

- A POS terminal system with a power consumption of 200 W each and 5 lines, meaning 1000 W of total power consumption. This load is defined as our top priority load, so it is crucial to keep it operating as long as possible according to the target runtime expected by the UPS.
- A security camera (CCTV) system composed of several cameras plus the control system manager, with a total power consumption of 500 W. This load, as per our set criteria, is defined as lower priority and will be disabled in case of need, according to several criteria that will be explained later on.

In a normal operating condition with AC mains input, the UPS will be protecting the loads against any perturbation that may occur at the input (swells, brownouts, voltage spikes, frequency variations, etc.). In the worst case of complete mains failure, the UPS will be providing backup power to the top priority loads identified to keep business continuity – in this instance, POS terminals so that customers can pay and leave the store with their goods.

Problem: In case of a AC mains failure or out of tolerance, the UPS switches to battery mode. Having controllable sockets available, how can we optimize the battery usage to achieve maximum runtime for the high priority loads? Which are the criteria to disable sockets and power delivery to the other loads? What is the consequence of the application of these criteria? Do we just need to interrupt power delivery or should we also consider the operating system shutdown?

Solution: There are a lot of alternative answers to these questions, thus we will address them one by one.

- The first step is to define which the priority assigned to each load is. Assigning a priority means deciding if that load can be disconnected/disabled while the UPS is working on battery mode, secondly defining which criteria for disconnection is to be used (basically time or battery capacity), and finally grouping the loads in maximum 3 groups.

- Defining the priority is not deciding whether that load is important or not – as connected to the UPS, we can assume all of these are important and require power protection – but to decide the relative criticality for the specific application. The decision is based on how long the loads should remain powered when the UPS is on battery mode.
- In our sample scenario, the CCTV system is defined as lower priority and POS terminals as higher priority.
- Once priorities are defined, then the second step is to decide the criteria for power disabling. This can be set with a fixed time or battery capacity criteria.

Assuming that the UPS batteries are fully recharged (100%), we can consider the typical case of turning off power delivery after several minutes, for example 5-10 minutes after a mains failure (see Figure 9). After this time, it is probable that the interruption of the mains will not be short and we can expect a long interruption. In this case, most of the energy in the batteries should be reserved for the highest priority load. Calculations need to be done for each specific case; however battery capacity should be selected mainly based on the target runtime and power needed for the highest priority load. This option is shown in Figure 9, and it is generally the most appropriate one when there are loads with high priority difference.

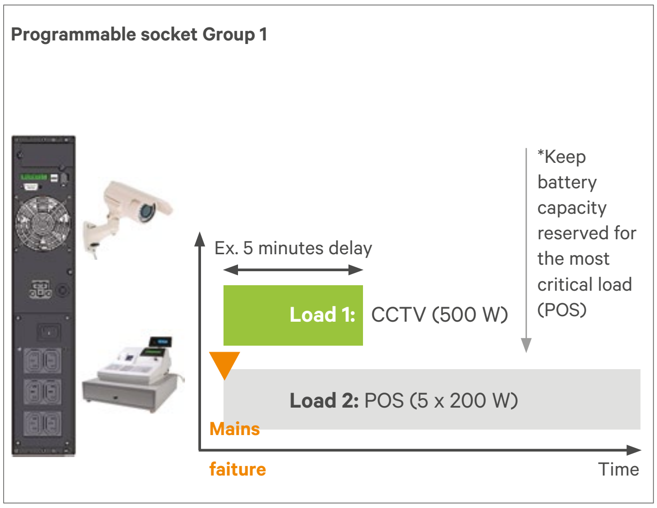


Figure 9. *Immediate disabling of controllable sockets*

A second option is to keep both high and low priority loads powered up as long as possible. For example, assuming a target runtime of 30 minutes, we can decide to keep both loads powered up as long as the batteries have energy stored, with a delay of 5-10 minutes for sequential disconnection. The timing is represented in Figure 10, so that it can be easily compared with the previous alternative.

The key factors to be considered are that battery capacity is calculated based on the runtime for all the loads (adding each nominal power consumption), and the need to select the time delay. This parameter can be selected in a range from 1 to 30 minutes, which is enough for most applications. This setup is a good alternative when there is a small difference between load priorities, so that all of them need to remain powered as long as possible.

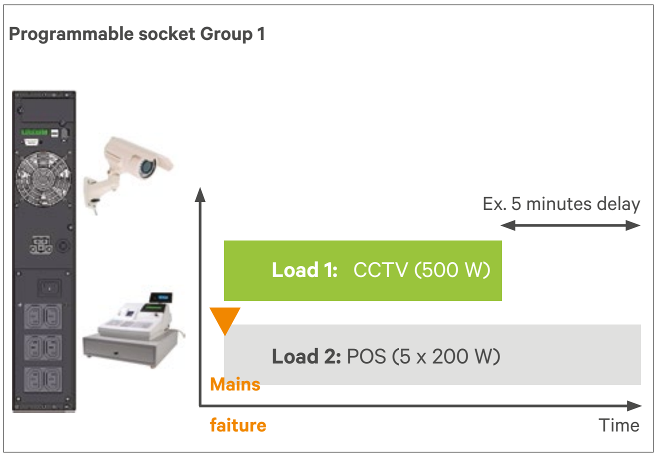


Figure 10. *"Last minute" disabling of controllable sockets*

Furthermore, there is a third option to be considered. In the two former examples, the criterion is based on a fixed time (in the range of minutes), previously defined by the user or system integrator. However, the user may also decide to disable such group of controllable sockets according to the estimation of remaining battery capacity. This means that the exact timing for disconnection is not precisely known beforehand, but the advantage is that the actual battery capacity status is taken into account. For example, in case of a series of mains failures, such that there is no time for the UPS to recharge the batteries to 100% between one failure and the other, the previous configurations may lead to unexpected timings. Using the battery capacity status as a criterion will ensure that whatever the status is, the energy stored in the batteries is allocated in the best way possible.

Battery capacity for controllable socket disconnection can be configured from 20% to 80%. Last but not least, the user can make a combined use of time and battery criteria to better fit the target runtime for each load.

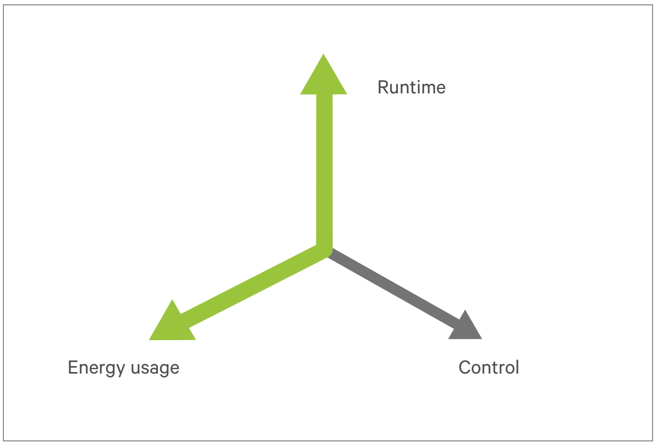
These considerations allow plenty of flexibility in the configuration of the loads.

The third and last step regards synchronization with the operating system (OS) shutdown. Indeed the loads connected may be for instance a screen (thus passive, accepting a break interruption), or a server needing a previous OS shutdown before a stop on power delivery.

When synchronization is required between power delivery stop by the UPS controllable sockets and the OS graceful shutdown, we need to use the shutdown software or the SNMP/webcard to trigger the shutdown. Multiple situations can be considered here (i.e. servers, USB port, IP network, quantity of devices, etc.) which should be analyzed thoroughly to find the appropriate solution. The key take away is the need to achieve the proper synchronization between the UPS (responsible for power delivery) and the shutdown software (responsible for graceful OS shutdown).

Benefits: Utmost flexibility to define load priorities, runtime for each load, the time intervals and the criteria applied.

Reaching optimum runtimes for each group of loads is one of the major advantages. Just consider that battery capacity can be sized according to different requirements without controllable sockets (all the loads powered and target runtime). This allows saving the amount of battery used, or alternatively providing extra runtime for the top priority loads (assuming the same battery capacity).



How to get it done: The UPS can be configured either locally (via display or configuration tool) or remotely (via internet network) depending on how the specific UPS is designed. In the case of the Liebert® GXT4™, all the options explained above can be set up using the UPS configuration tool.

Using a dedicated screen (Figure 11) for each group of controllable sockets, the user can easily check and configure each group separately. Bearing in mind that multiple criteria can be selected, the user needs to make sure that the chosen socket management setup is appropriate for the actual application.

Moreover, it is possible to configure a time delay to turn on specific group of sockets once mains power returns.

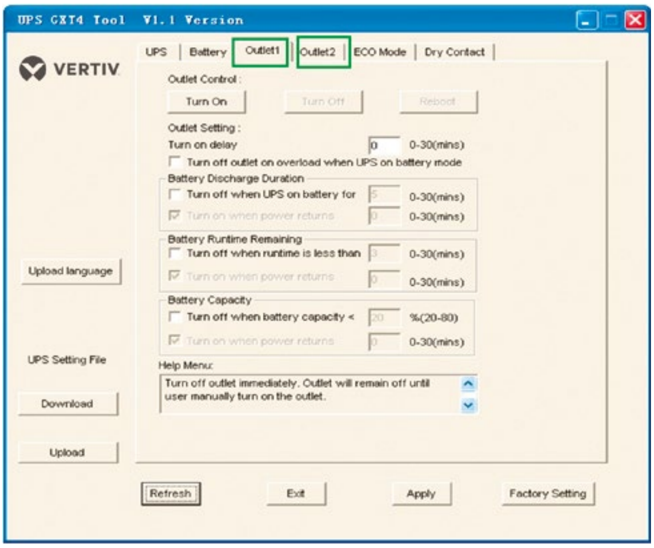


Figure 11. *Time and battery capacity setup page*

Application Case 4: IP Addresses

The previous application cases have shown how controllable sockets bring benefits in terms of control, runtime and load management. Now we can go one step farther and see how these help simplify IT assets management.

Scenario: In this case we will analyze a new scenario in the transportation field, as for instance a railway train station or airport terminal. Travellers typically rely on the information panels showing the arrival and departure times as well as any relevant notice regarding their scheduled travel.

Figure 12. *Information panels at train station or airport*

Each of these information points typically includes 3 or 4 panels (around 75-150 W power each, depending on panel size and technology) plus a switch or small server (200-300 VA) that manages the flow of information to be displayed. In total this means a power demand from 1.5 kVA to 3 kVA depending on the number of panels and complexity of the system. Therefore a UPS close or equal to 3 kVA with six power sockets would be a good solution for power protection and backup of these information points.

Issues may arise if more panels are added, thus requiring additional power sockets or an auxiliary power distribution unit (PDU) connected to the UPS (Figure 13). Besides, the system manager may prefer to control these remotely, turning them on or off through the use of a more advanced, managed PDU.

While this presents no issues from a system design point of view, but with regards to power administration this means using 2 IP addresses. Thus the user will need to access a pre-defined IP address for the SNMP/webcard connected to the UPS to know the status, alarms or settings, and then a second IP address to reach the managed PDU and to execute any power enable/disable action on it.

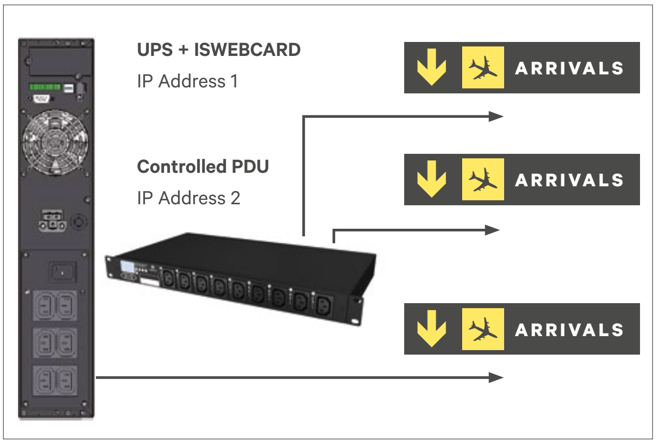


Figure 13. *Power delivery for panels, with a UPS and a controlled PDU (x2 IP addresses)*

This means more complexity in managing the complete system, more IP addresses (while there may be restrictions on the quantity of IP addresses available in the network) and in some cases also the need to integrate status information (i.e. SNMP traps) from multiple vendors.

Problem: This scenario shows the complexity of several devices requiring multiple IP addresses (switch, server, UPS, managed PDU, etc.), making these more difficult to monitor. Even in those cases where the number of socket groups in the PDU is not high, the cost for that PDU will be certainly higher than for a basic PDU without features for control and IP monitoring. Is it possible to simplify the system, lowering the cost and the number of IP addresses required?

Solution: This is an example which combines UPS and PDU and requires a lot of flexibility to manage the loads, especially when many separate loads need to be controlled. Where loads can be clustered in 2-3 groups for powering, a UPS with controllable sockets would be the perfect solution. For example, the Liebert® GXT4™ allows loads to be arranged in 2-3 groups that can be enabled or disabled by the IT systems manager according to the need (see Figure 14). If multiple sockets are required for the connection of the information panels, a PDU can be connected to each of these groups. The difference is that now this PDU will be much simpler (no remote access, no IP address, no switch capability ...).

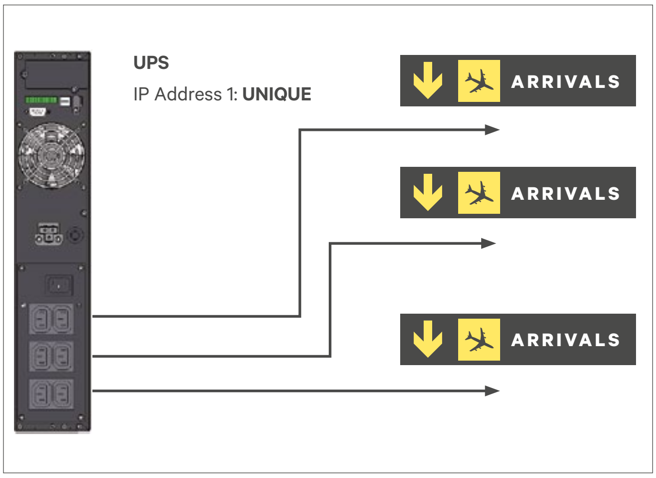


Figure 14. *Power delivery for information panels, with a UPS and a basic PDU (a single IP address)*

Benefits: The benefits are related to the use of one simple device (UPS) for complete power management. Having a single IP address and interface, the UPS will allow easier load management. The advantage is even greater if the total quantity of loads increases, for example, in an airport with 50 information panels and a twofold number of IP addresses and devices between UPS and managed PDU.

For those applications where loads need to be split in more than 3 groups, more complex configurations can be set up using a managed PDU.

How to get it done: Depending on the power consumption, number of loads and groups required for distinct management, the user can identify the best combination of UPS and PDU models. Loads can then be enabled or disabled remotely through the optional SNMP/webcard or monitoring software as shown in Figure 4.

To increase flexibility even more, this solution can be combined with any of the setups explained in the previous cases so as to configure the minimum runtime while UPS is operating in battery mode as well as progressive system start-up.

Application Case 5: Overload Management

This case will assess when controllable sockets can make the difference in case of unexpected situations such as overloads.

Scenario: The UPS has multiple loads connected to its output, with the total power consumption below or equal to the nominal power of the UPS.

Each load typically has a nominal power consumption, defined as the power demand when that device is operating at normal workload or at an average value. There may be however special conditions due to tolerances (i.e. oscillations at input supply voltage), abnormal conditions (i.e. a failure or short-circuit) or other particular conditions (i.e. inrush or peak currents on an electric motor when started).

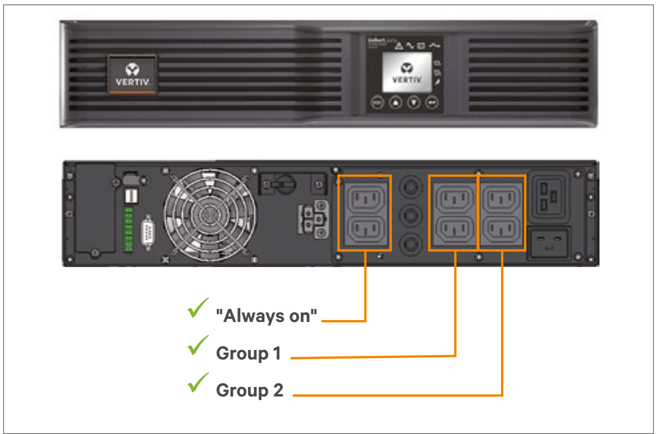


Figure 15. *Liebert® GXT4 3000 VA UPS front and rear panel*

As a consequence, a perturbation or other problem generated at the UPS output by any of the loads may cause it to be "transferred" also to the other loads and determine the drop of the load itself. In this scenario we will concentrate on overloads.

For those who are familiar with electrical installations and the need to manage overloads or short-circuits, this is similar to the "selectively" concept for the isolation of failures.

Clearly in those cases where a UPS protects several loads, it is crucial to be able to react selectively to these occurrences. This is achievable using the breakers (input or output, depending on the UPS model), an electronic control and controllable sockets.
As an example, Figure 15 shows the front and rear panels of the Liebert® GXT4™ 3000 VA UPS. Here we can see the three different groups of controllable sockets ("always on", controllable group 1 and controllable group 2), together with the input breaker and output protection breakers for these groups.

Use of the breakers is not to be confused with the controllable sockets. Breakers manage electrical protection in case of overcurrent that may damage the device or create a risk, being these breakers permanently connected. In contrast, controllable sockets can be used to stop power delivery but are not intended for electrical protection, and may be used as either an optional or a permanent feature at the discretion of the user.

In case an overload occurs while the UPS is working in on-line mode, the UPS can switch to bypass mode, thus having an alternative path for power delivery that exceeds the nominal inverter power capability. Alternatively, if the overload is severe, the input or output breakers may trip. But what happens if the UPS is working in battery mode and there is no chance to use the bypass line? Would it be acceptable to drop all loads? Or would it be best to selectively disable any of these loads to keep the others up and running? Controllable sockets can help in these critical situations.

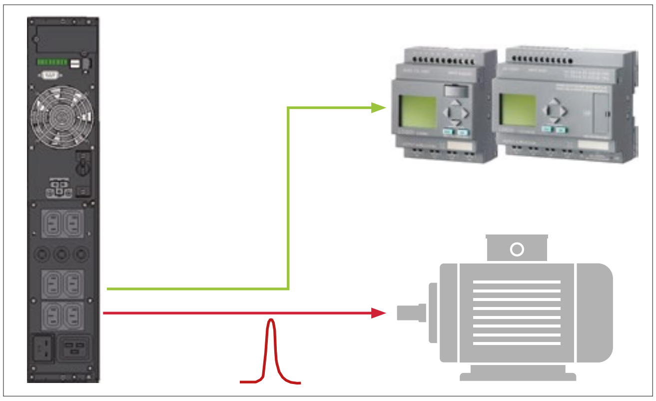


Figure 16. *UPS with two loads connected and a peak current*

For our application case, we will consider an industrial manufacturing process, or driving a small electric motor for the access barrier. This is composed of a small programmable logic controller (PLC) computer plus a small single phase electric motor regulating the process. Electric motors generally require a higher starting current that exceeds the nominal current consumption. This surge current may exceed in a variable amount of time depending on the motor type and design, or in other cases it may be due to an abnormal situation if for instance the electric motor gets blocked. The UPS needs to be sized to manage such inrush currents correctly, but this is just to show that in several cases the UPS needs to manage currents exceeding the nominal value for short periods. These over currents or overload conditions may turn off the UPS and consequently drop all the loads connected. Is it possible to manage these overloads and keep the most critical loads powered?

Problem: The key point is that in most cases the UPS rating is selected based on the maximum power of the load (thus with a conservative approach), but in many other situations the power demanded by the load is evaluated in nominal conditions only.

In this scenario it is crucial to be able to separately manage each load in case of an overload condition, and disable a group of loads in case of overload conditions while keeping breakers for electrical protection. Controllable sockets, combined together with breakers where available, can help manage these conditions.

Solution: A UPS with an overload management feature grants that even if on battery mode, a group of sockets can be turned off in case of an overload on the nominal power of the UPS.

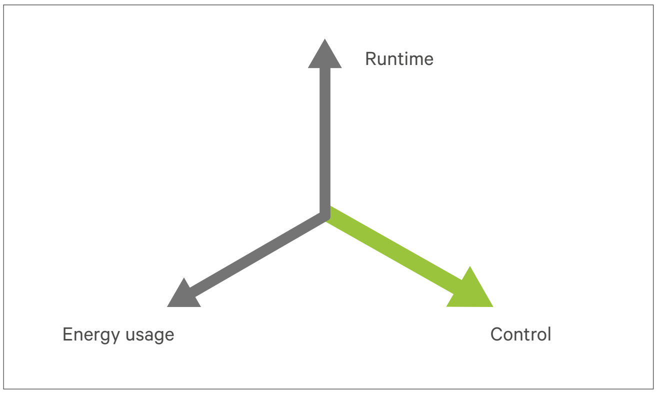
Thus, each group of controllable sockets (group 1 or 2) can be configured so that in case of overload condition for the UPS (not referred for that group of sockets), those sockets will be automatically disconnected. In this scenario with the PLC computer and the electric motor, the decision would be to keep the PLC powered and protected as priority load, and disable the power delivery to the electric motor. The PLC computer will remain active and continue to provide alarming and signalling, so that the corrective actions are implemented.

The overload condition is defined based on the nominal UPS power, not for that group of sockets. Moreover, in case the UPS has protection breakers for that group, they may operate alternatively if the tripping conditions are achieved.

Again, breakers are intended for electrical protection and should not be confused with controllable sockets, being an optional feature for load management and not safety protection.

Benefits: The possibility to keep several loads powered even in overload conditions can be vital. Indeed, in those UPS where this feature is not implemented, the UPS will completely turn off once the overload conditions are achieved for a certain period of time, which is defined in the user manual or technical specs.

Moreover, in this example the user has 3 groups, so that "always on" will remain powered even in case of disconnection of groups 1 and 2. This means a more flexible approach versus other UPS designs where there may be only 1 or 2 groups managing the loads.



How to get it done: The disconnection of a group of sockets in case of UPS overload can be set up through the display or configuration tool depending on the UPS. With Liebert® GXT4™ this can be easily done with the configuration software, flexibly allowing the user to disable a specific group or even both.

The advantage of having the "always on" sockets is that the most critical priority loads connected to these sockets will remain powered even after programmable group disconnection. Only in the case of longer overload conditions or in case that overload remains even after groups 1 and 2 disconnection, then the UPS will be completely shut down. It is recommended to assess the overload conditions as described in the UPS user manual to understand the thresholds.

Users may be reluctant to set up a configuration for each separate UPS, which may be tedious when managing distributed systems with many UPS. Liebert GXT4 can make

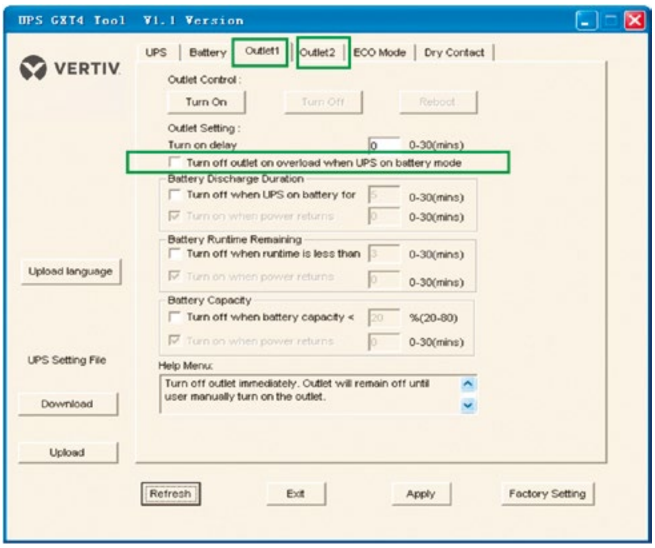


Figure 17. *How to setup overload operation*

the difference thanks to its capability to upload/download its configuration locally via the USB port. Thus, once the pre-defined setup is identified as the most convenient, it can be easily "replicated" or "copied & pasted" via the USB port on multiple Liebert® GXT4™ of the same rating.

Figure 18. *Liebert GXT4*

Load Prioritization: A New Concept

As explained at the beginning of this paper, the feature of controllable sockets is not only "a switch" to enable or disable power delivery to a load segment, but a new approach to load management.

This means that users can decide when to disable power delivery while the UPS is on battery mode, based on time delay or battery capacity, but also setup a progressive system start-up, or define how to react in case of an overload. The ultimate goal is to keep the top priority loads powered as long as possible or as configured by the user. Depending on the characteristics selected, this configuration can be done locally with a configuration tool (USB) or LCD display.

As described in the various application cases and assuming the UPS is on battery mode, the criteria to define the load priority or grouping can be done through:

- Desired time for load operation
- Battery capacity
- Operation in overload conditions
- Progressive turn-on delay
- Need for separate reboot

Defining this prioritization of the loads brings advantages in terms of a longer runtime for the higher priority loads, extra flexibility, advanced load control, and a more intelligent battery management that optimizes battery life and runtime.

Conclusions

This paper has examined a series of practical application cases of controllable sockets, a powerful feature recently introduced in new generation UPS. Through a "hands on" approach simulating several scenarios, we have defined the problem, identified a solution and indicated the relevant benefits achieved. Application cases cover examples in retail, transportation or healthcare to demonstrate the flexibility in various fields.

This demonstrates that controllable sockets are not only capable of enabling or disabling power, allowing new ways to configure and prioritize your protected loads. Taking full advantage of the controllable sockets, these can bring a series of benefits in terms of longer runtimes for prioritized loads, extra control over these loads and a more efficient usage for the batteries.

Thanks to advanced capabilities, innovative UPS systems go beyond the role of simple power protection and actually work as a kind of "intelligent power manager" or "power hub" for your applications. Figure 19 shows a smart way to configure a rack system where the UPS is its "power hub" for energy distribution, powering and protecting each load and managing a series of conditions, such as load disconnection, reboot, remote control, and so on.

Perhaps readers are keen to learn more about potential application cases and are wondering – is the series to be continued? The answer is both yes and no – after reading this paper, we invite you to follow the outlined approach so as to define your actual scenario, evaluate load priority, define the best setup, implement it by configuring the controllable sockets and ultimately benefit of the advantages of improving your power protection system.

- **Watch the Liebert GXT4 video at:**
  https://www.youtube.com/watch?v=YphLv2XEJbQ
- **Learn more about Liebert GXT4 controllable sockets white paper at:**
  http://vertiv.es

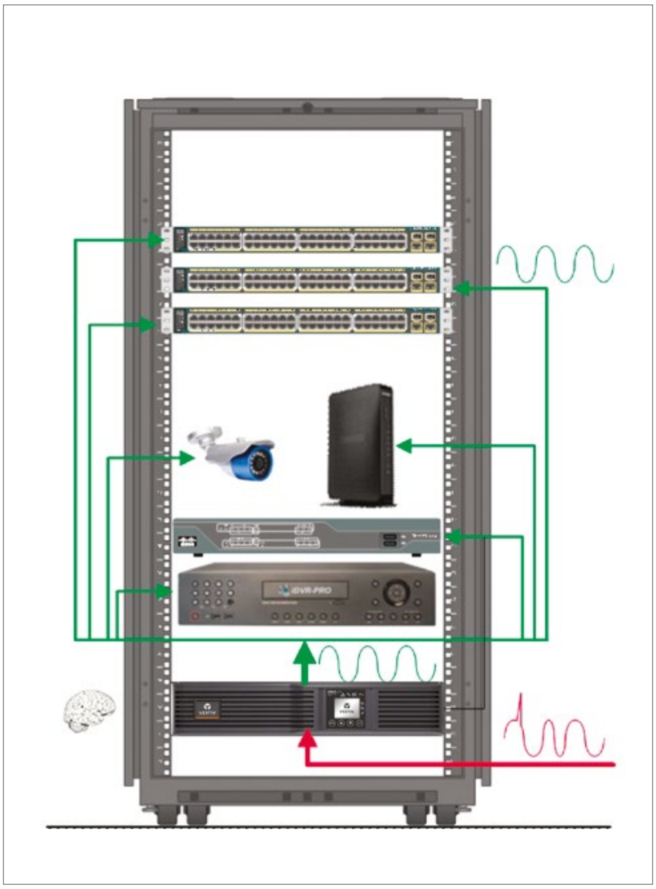


Figure 19. Liebert GXT4 intelligent power management