![Vertiv logo]

ADVANTAGES AND EFFICIENT USE OF PROGRAMMABLE SOCKETS

Miguel Rascon
AC Power
Senior Product Manager

Abstract

Vertiv™'s most recent products feature programmable sockets embedded in the UPS to provide the user with an extra level of control of the application. This will grant advantages such as a more efficient energy usage, as well as opening a wide scope of possibilities for load management: namely load priority, progressive server shutdown, load disconnection, etc.

Introduction

UPS in the 0-3 kVA range are connected to the load and mains through sockets, which are normally type IEC320. In several markets, they are replaced by connectors adapted to the local needs (Schuko, NEMA, etc.), however, IEC320 C13 or C14 are more frequently used because of their international scope.

Pluggable UPS have a distinctive feature in the use of these sockets versus hardwired UPS. In the most recent generation of new products, these pluggable UPS include programmable sockets (also referred to in technical literature as "load segments", "programmable receptacles", "controlled outlets", etc.). These sockets can be enabled/disabled separately so that the loads connected to them are powered on/off depending on various conditions.

This feature of programmable sockets provides an extra level of control and protection over the secure energy supplied to the load. In addition, there is an extra value in terms of efficiency and energy optimization (especially when used in combination with Advanced ECO mode).

This paper provides some information about the technical points to be taken into consideration (since not every UPS product in the market has the same performance), as well as several application examples about this powerful feature.

Several Points Make the Difference

The addition of programmable sockets in the 0-3 kVA UPS opens many possibilities for better control and load monitoring. The ability to switch the output power supplied by a specific group of sockets on/off is an improvement that gives the following advantages:

- Better energy management - as the loads may be disconnected when several conditions occur - both in "line mode" and in "battery mode".

- In battery mode, the energy stored in the batteries can be used for the most critical loads. Less battery usage (cycles and depth of discharge), or alternatively, longer autonomy can be achieved for the most critical loads. Fig.1 shows how the autonomy time for the priority loads connected to several sockets is augmented as soon as low priority loads are disconnected (only Group 1 switched-off in this image). In Fig. 2, a second case is represented, where both "Group 1" and "Group 2" are sequentially disconnected to gain extra runtime for the group of sockets that are "always-on".
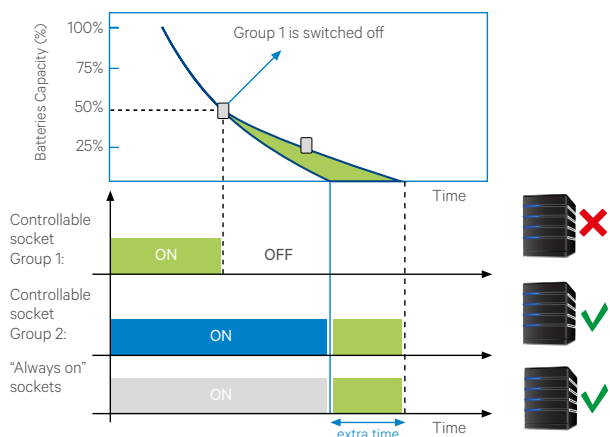

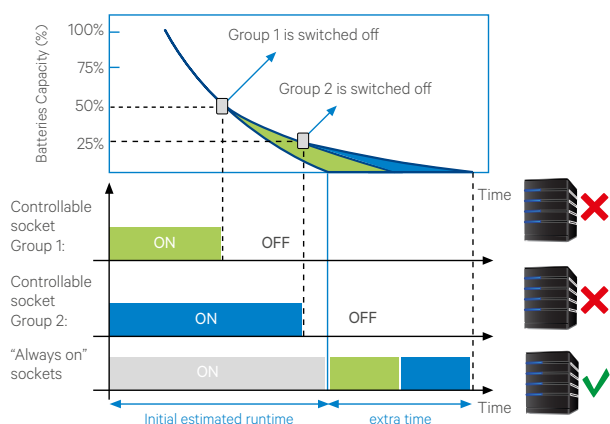*Figure 1:* Operation of programmable sockets.

Figure 2: Operation of programmable sockets

- Loads can be shut down progressively in a sequence through previously defined settings. The sequence in which power is turned on/off for each socket can be configured by the user. Sequencing also allows users to predetermine which piece of equipment is turned on/off first so that other equipment that is dependent on that unit will function properly. This is interesting in applications where each server runs a different application software (i.e. Outlook Exchange, ERP system, VoIP, etc.) and is connected to a different group of programmable sockets

- Enhanced remote power management to reboot servers and network gear individually or as a selected group in case of a malfunction

- Similarly, loads can be powered on progressively when starting the system and building up these applications sequentially (in the same way as described in the paragraph above of Outlook, VoIP, etc), reducing peak currents at UPS input. This helps avoid in-rushes at start-up, which can cause overloaded circuits and dropped loads, permitting a smooth and controlled system "wake-up

- A priority for protection can be fixed for each load

- Better management of the output power. For example, in case of overloads in a group of sockets, programmable sockets can be switched off without interrupting other priority loads

- Lower costs, as external switched PDUs are not required. In addition, remote operation through SNMP is simplified in a single device (UPS), instead of having multiple networks or IP addresses

- Finally, this feature also allows the prevention of unauthorized equipment from being plugged into the UPS (a group of sockets is permanently disabled until somebody activates it again).

Vertiv™ can offer this advanced technology of programmable sockets in the Liebert®GXT4™ Micro range.

Figure 3: Liebert GXT4 Micro

However, the introduction of this technology in a UPS is not easy, and several technical points should be considered for correct implementation, thus making the difference as it will become clear in the following paragraphs.

1. Design and powering strategy:

- "Always on" socket availability. Vertiv™ UPS with programmable sockets also include "always on" sockets, which cannot be switched off. This is done so as to ensure that the most critical loads are not mistakenly switched off. Other UPS suppliers do not include these "always on" sockets, thus requiring a connection to the programmable groups of sockets, with the risk of disconnection due to an error

- Quantity of groups: several suppliers either only add 1 programmable group, or make every socket programmable. However, Liebert® GXT4™ includes 2 separate groups of programmable sockets, which offer an extra level of flexibility and control, and intentionally remain "always on" sockets without the capability of control (in order to avoid the wrong disconnection of the most critical loads).
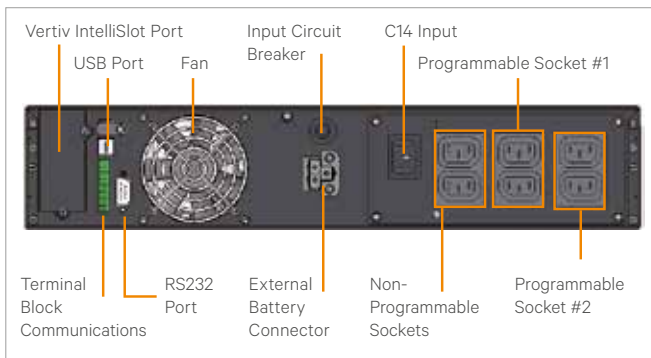

Figure 4: Programmable sockets on Liebert GXT4 UPS.

2. Signalling and user information:

- Programmable sockets should provide information when the loads are connected. This is done in Liebert GXT4 using specific text labels on the rear panels (shown in Fig.4) and silk screens on each socket relative to its particular feature - avoiding the risks of wrong connections

- The status of each group should be reported on the front panel. Liebert GXT4 UPS includes 2 separate LED indicators to specifically illustrate the status of each group of programmable sockets (Fig. 5) to the user

- Remote information through the SNMP card (if installed) and web browser.
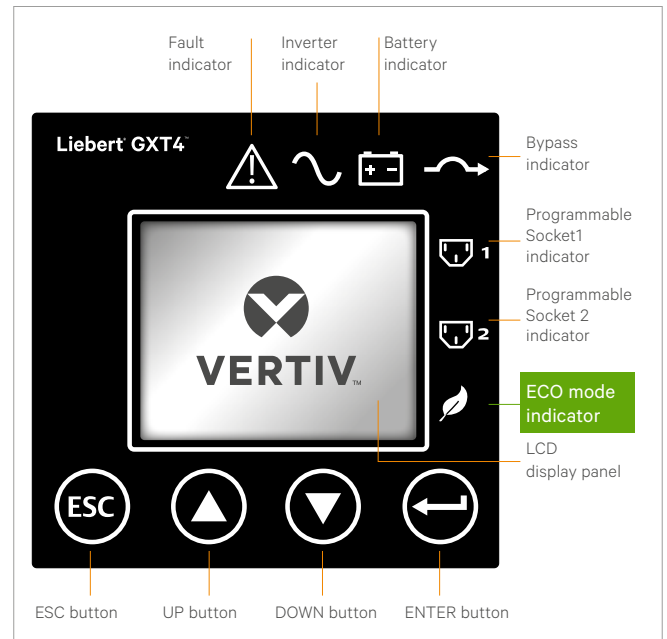

Figure 5: LED indicators on front panel display socket status.

3. Control of programmable socket groups:

- Groups can be enabled/disabled manually through the front panel, as well as remotely with the SNMP card (saving valuable time for IT administrators)

- Several criteria for automatic socket activation must be included so that the administrator can define them based on several criteria: time on battery mode, remaining battery capacity, delayed/immediate deactivation, etc

- An additional variable for control is the possibility to use shutdown agents in combination with the programmable sockets. In this way multiple servers can be shut down and then auxiliary loads (displays, etc.) switched off.

These points show that the implementation of programmable sockets in a UPS is not something immediate and obvious. Not all UPS suppliers can provide the same scope of powering, control and signalling: always-on sockets not available, fewer programmable groups, a simpler control, etc. Vertiv provides a complete set of features that can be used in combination with its connectivity suite, thus lending itself to being the right partner for any IT administrator or facility manager.

Applications of Programmable Sockets

To better understand programmable sockets' functionality and benefits, a few practical examples are illustrated below.

The first example is the campus network with multiple terminals distributed remotely. These terminals (ATMs, points of sale, etc.) may include several small computers or LCD screens to integrate into the entire system.

In case of failure or malfunction of a subsystem, such as a web server or a printer server, the system administrator can proceed to shutdown and reboot the computer remotely. However, it may occur that the computer crashes, and there is no chance to switch it off remotely. This situation would require transportation to the assistance area and the support of a technician, thus meaning cost and time. The other option is to remotely remove power only from this load. Without the assistance of a programmable socket, this operation would require a shutdown of the entire system. Programmable sockets help minimize costly downtime and avoid restoration time. Thanks to this feature, the specific crashed load can be reset with a minor interruption to the complete system. In any case, the feature helps arrive at a proactive fault isolation and management.

A second example of advantageous application of the programmable sockets can be found in energy optimization.

In several applications, loads comply with ENERGY STAR® requirements for minimum energy usage while in stand-by or no-load status. In spite of the reduced power consumption, an extra level of energy optimization may be achieved with dedicated software if the loads, such as a printer or a non-critical device, are disconnected during periods of low transactions or during the night (and automatically powered during periods of full transaction). Critical loads remain powered and securely protected through the always-on sockets.

Moreover, in case of an AC mains fault, the energy stored in the batteries can be "assigned" to the protection of priority loads. If the interruption only lasts a few seconds, the entire system operation is guaranteed, but if the failure lasts longer, priority loads will have maximum autonomy time.

Finally, please do not forget that programmable sockets make a good contribution to energy saving, as they result in reduced battery usage and energy for priority loads, especially when used together with the ECO mode in the UPS.

Conclusions

Design and implementation of programmable sockets in the UPS is not obvious, and there are many technical points to consider in order to match the requirements of servers, networking and IT systems.

Figure 6: Technician during a sub-system reset.