

Opportunity load management (relays) for ESS installations

Intro notes (Author Lucas Huber)

In my particular case running an Easy Solar with I have at the end 3 different opportunity loads which I want to control via relays. But I have a solution in my mind that should be flexible enough to handle the whole spectrum of opportunity loads. So I try to outline a basic specification of what I think could fit for most different use cases, eventually also those which doesn't run ESS.

Basic Specifications of a Load Management System (LMS)

The solution should fit for Off and On-grid system but is written with a system on Grid-System that runs with ESS.

First lets define possible opportunity loads that might be controlled via a Load Management System (LMS).

- Electric (resistance) hot water storage, 2 - 3kW
- Electric (resistance) heating(s), 1 - 10kW
- Electric vehicle charger, 3 – 7kW single phase
- Heat pump (only partially an opportunity load), 2 – 6kW
- Air condition/Air Heating (only partially an opportunity load), 2 - 6kW

Application assumptions:

Of course the goal is to dump as many as possible energy surplus from the PV system to the battery and if the battery is full to unmet opportunity loads. And if we assume that a typical size of the PV installation is about 3-6kW for a single phase ESS system we need to ensure that only one opportunity load is active at the same time to avoid discharging the battery again.

In a system with only one or two opportunity loads this can be provided with a relative simple solution, similar to the Genset control function in the Venus (CCGX). But I'm not sure how technically challenging it is to control the K1/K2 relays from the multi via the CCGX? Those relays are normally managed by a Multi assistant.

Possible configurable parameters (set-points):

General Parameter	Unity	As in Genset	Advanced
Start LMS when battery SOC is higher than	95%	x	
Stop LMS when battery SOC is lower than	90%	x	
Start LMS when potential solar yield* is higher than	1800W		
Stop LMS when potential solar yield is lower than	1000W		
Use Active time	Y/N	X Quiet h.	
Start time (Active time)	hh:mm		
Stop time (Active time)	hh:mm		

* Potential solar yield (PV excess power) is not an available parameter in a non feed into the Grid system. But in that case (if the battery is full and no other heavy loads are active) it could be calculated by switching a resistance load on for a short time. Or eventually that are more sophisticated solutions available or necessary to accomplish this as some are discussed in this interesting thread¹.

1 Link to Forum: <https://community.victronenergy.com/questions/7170/calculating-and-controlling-excess-pv-power.html>

Those parameter should be available for each load (relay) separate.

Parameter per load	Unity	As in Genset	Advanced
Name of the load	TEXT		
Resistance load	Y/N		
Discharge load	Y/N		x
Typical load power	2300W		x
Peak load power	3000W		x
Priority	1-10		
Typical runtime	1-5 hours		
Minimal runtime	30 min		
Minimal frequency in days*	1		x
Used relays	K1/2		

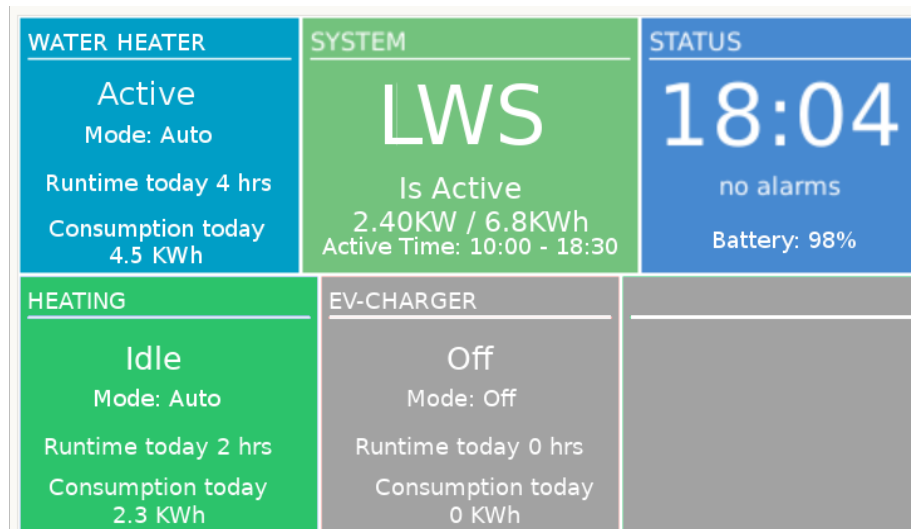
* For instance, if ones has a sufficient big water heater it didn't need to get charged daily when the weather is cloudy. Then this parameter can set to 2 days for the water heater to use the provided PV excess power for other loads. The same might be for a EV vehicle charger.

Advanced LMS specification:

If ones needs to control more than two opportunity loads, or wants to have a more sophisticated control system a viable solution could look as follow. One major challenge with many opportunity loads is that the LMS doesn't really know which of the loads are in need of energy at the moment. Of course this can be mitigated by the daily **Typical runtime** parameter, but this is not quite accurate and will certainly lead to situation when the LMS is switching on loads which are not capable to consume energy right now.

For instance the LMS can't know if a car is wired to the wallbox or heater does really needs energy. A sophisticated solution, at least for resistance loads, could be to implement an intelligent poling function. If the LMS would use the typical load power for a particular load it could regularly switch on and off the load to check if an equivalent change in the inverter output current is happening or not. If there is no significant change in inverter output current the load seems to not in need of energy and the LMS can switch to feed the next load.

Another important feature of an advanced solution would be an easy way to control the LMS from a CGGX device. Each load should be easy switched on and off or set to manual/automatic mode. Of course some statistical values would be nice to see there. A viable way to do this would be to add a new main screen to CGGX as the one for the Generator Start/Stop.



Of course the shown screen is only a mockup, but important would be to allow for each configured load a Manual Start button/Field, plus eventually to change the mode there.

Discharge load

Another advanced option could be to manage loads that can be discharged if the power is going up in the system for too long. This could avoid throttling due to high temperatures. Another use case exists in countries which have current limits in the base contract with the utility. So in France where the minimal base contract is for 3 KW which is less costly than a 6 or 9 KW contract. Switching to a low power contract could be much more secure, if a function for discharge some loads, in the case of sucking to much power from the Grid, exists.

Technical implementation:

As I'm not very experienced in how the different Victron devices are communicating and how they can manage shared data, this is merely a basic idea how it could be done.

I suppose it would be necessary and useful to manage the basic configuration (parameter) data with VictronConnect in the Multi and not in the CGGX. I assume this is at least mandatory for the functions of the relays. It must be specified somewhere if a relay is managed through an Assistant or the LMS. If other relay directed parameters should be specified there I don't know, eventually the parameter for the type of load (Resistance load or not) or invers relays functionality could make sense.

All the params which needs to be adapted and improved during the daily use, needs to be set on the CGGX.

(Note, Fronius has a Load Manager² since quite a while. Eventually their solutions could be inspiring too.)

2 Link to Fronius Data manager Whitepaper: https://www.fronius.com/~/downloads/Solar%20Energy/Whitepaper/SE_WP_Energy_flow_management_using_the_four_digital_outputs_EN.pdf

Optional output card/device:

In cases with multiple loads that needs to be managed an external Modbus device with digital outputs would be required. This should be as easy to install as an external Energy Meter (as ET112) and integrated into the LMS. This could also reduce cabling efforts of the relays and keeps the relays free for other purposes.