## DC solar system with MultiPlus inverter/charger

In a DC solar system batteries are used to store energy. An inverter can be installed if alternating current (AC) is needed.

If AC is also available from the grid / mains, the system becomes more complicated. The DC solar system can then be used as a back up in case the mains supply fails. During a mains failure the AC consumers will be supplied through the inverter. Once the mains is restored, the inverter shuts down and the batteries are recharged with the solar panels. But what to do with the electricity from the solar panels after the batteries have been fully charged? Answer: interface DC and AC with a Phoenix MultiPlus inverter/charger

Description of the DC solar system with MultiPlus inverter/charger (see fig. 1)



Fig. 1: DC solar energy system with MultiPlus inverter/charger

Loads that cannot be handled by the Multi are connected directly connected to the mains supply. (If needed, several Multi's can be paralleled to handle higher loads)

The other loads are connected to the Multi. The Multi, together with the batteries and solar panels, functions as a no break power supply for the connected loads.

The trick to make optimum use of the solar panels is to program the 'virtual switch' in the Multi in such a way that the inverter function of the Multi is switched on when the battery voltage has increased to a certain value (indicating the batteries are charged). Simultaneously the back feed protection relay in the Multi is opened, this to prevent power to be fed back into the mains.

The Multi can be programmed to switch back to mains supply when the battery voltage has decreased to a preset voltage. The Multi remains off until the solar panels have recharged the batteries (unless the mains fails in the mean time of course), and the cycle starts again.

## **Programming the Virtual Switch**

Needed to program the Virtual Switch:

- VEConfigure II software (can be downloaded free of charge from our website)
- White paper 'A guide to VEConfigure' (can be downloaded free of charge from our website)
  Laptop or PC
- Victron Interface MK2 (RS485 to RS 232 interface, Victron Energy part number ASS030120200)

Once VEConfigure is up and running, go to the window 'Virtual Switch'

alle.	VE Configure II (virtual VICTRON device)			
<u>File Port selection Target D</u> efaults <u>H</u> elp				
G	eneral Inverter Charger Virtual switch			
ſ	Usage A: Set VS ON B: Set VS OFF VS options	UMains V IMains A		
	Explanation A	UOut V IOut A		
	Virtual Switch	Udc V Udc ripple V		
	The Virtual Switch (VS) is an imaginary on/off switch in the software. The VS is "switched" by the software when certain conditions are met. The conditions which will cause the VS to switch on and off can be configured by the user. This can be done on the extra tab pages which will become visible when a usage is specified below. The conditions on the A tab have priority over the conditions on the B tab. So switching the VS on has priority over switching it off when the VS is not inverted. This means that as long as a switch on condition is true the switch will be on, regardless of the switch off conditions! A condition can be disabled by setting its corresponding time to -1.	Print settings		
	When the switch switches from off to on all the off conditions are reset meaning that delays are measured from this point. Example: We specify that when VS access of a start URdra10.00 for 5 accessed and that the VS access off 50			
	Specify virtual switch usage :  C Do not use VS			
	Use VS to control multifunctional relay: VS on=close; VS off=open     Use VS to ignore AC input: VS on=do not ignore; VS off=ignore			

Select the window 'Usage'

Select the option 'Use VS to ignore AC input' Now the AC input will be ignored when the VS is off, so the next step is to switch off the VS when the DC voltage has decreased a certain level.

Select window 'A: Set VS ON'

We VE Configure II (virtual VICTRON device)					
<u>File Port selection Target Defaults Help</u>					
General Inverter Charger Virtual switch					
Usage A: Set VS ON B: Set VS OFF VS options	UMains V IMains A				
when load higher than 2001 W for -1 seconds	UOut V IOut A				
when Udc lower than 12.00 V for 10 seconds	Udc ···· V				
when Udc higher than 16.00 V for -1 seconds	Udc ripple V				
when not charging for 1 seconds	ldc A				
when fan on for -1 seconds					
when bulk protection is activated (charger stopped after 10Hr bulk)					
when general system failure occurs					
	<u>P</u> rint settings				
when the following LED alarms are active: Temperature alarm  for -1 seconds					
Low-battery alarm 🔽 for -1 seconds					
Overload alarm 💽 for -1 seconds					
Udc ripple alarm 💽 for -1 seconds	* ************************************				

Select 'when Udc lower than'

Type the required voltage and delay time.

The inverter will switch off at this voltage. Depending on how deep the batteries should be discharged, the voltage should typically be between 11V and 12V for a 12V system. To avoid spurious switching, the delay should at least 10 seconds.

If direct mains supply is also required at high load (to prevent fast discharge of the battery or overload of the inverter), a load limit and delay (minimum 1 second) can be added at 'when load higher than'

Note: a Battery Monitor can also be used to switch the Multi on and off. The advantage of using a Battery Monitor is that the Multi can be switched based on the state of charge of the battery, measured in Ah. This method is more accurate than switching based on DC voltage, and is recommended for large systems.

Now select window 'B: Set VS OFF'

Seconfigure II (virtual VICTRON device)	
<u>File Port selection Target Defaults Help</u>	
General Inverter Charger Virtual switch	
Usage A: Set VS ON B: Set VS OFF VS options	UMains V IMains A
when load lower than 499 W for -1 seconds	UOut V IOut A
when Udc lower than 11.75 V for -1 seconds	
when Udc higher than 14.00 V for 30 seconds	Udc ripple V
when charging for -1 seconds	Idc A
when fan off for -1 seconds	
when bulk charge finished for -1 minutes	
when no VS ON condition for 1 minutes	
when no AC input for -1 seconds	Print settings
when the following LED alarms are IN-active:	
Temperature alarm for -1 seconds	
Low-battery alarm ror -1 seconds	
Overload alarm for -1 seconds	
Udc ripple alarm for -1 seconds	•

Select 'when Udc higher than'

Type the required voltage and delay time.

The inverter will switch on at this voltage. The switch voltage should always be lower than the (absorption-) charge voltage level of the solar panel regulator. Otherwise the inverter will never switch on. The voltage should typically be set between 14V and 15V for a 12V system. The delay should be at least 10 seconds.

To avoid low DC to AC conversion efficiency at low load, a minimum load could be set at 'when load lower than'.

The configuration of the VS is now complete: send the settings to the Multi.