



**Power. On Your Terms.**



## **SimpliPhi Power PHI Battery**

### **INTEGRATION GUIDE: VICTRON**

Optimized Energy Storage & Management for Residential & Commercial Applications Utilizing Efficient, Safe, Non-Toxic, Energy Dense Lithium Ferrous Phosphate (LFP) Chemistry

# SimpliPhi Your Energy Security and Independence

**and gain control of your own power.**

SimpliPhi helps you manage your power as a personal resource. Anytime. Anywhere. SimpliPhi energy storage optimizes integration of any power generation source – solar, wind, generator – on or off grid and protects your home and mission-critical business functions from power outages and intermittency. SimpliPhi storage technology eliminates operating temperature constraints, toxic coolants and the risk of thermal runaway and fire. Safe lithium ferrous phosphate. No cobalt. No hazards.

SimpliPhi's battery technology utilizes the industry's most environmentally benign chemistry combined with proprietary architecture and power electronics (BMS) that eliminate the need for cooling or ventilation to create products that provide energy security and resiliency – all with a 98% efficiency rate.

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*SimpliPhi Power offers proprietary, commercially available energy storage and management systems that are safe, non-toxic, reliable, durable, efficient, highly scalable, and economical over the lifetime of the PHI Battery.*

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# 1.0 – Introduction

This integration guide covers the recommended set up and configuration of Victron equipment for optimizing performance with SimpliPhi PHI 3.5 kWh Batteries. More information on SimpliPhi products can be found on our website: <http://simpliphipower.com/>.

If the Victron product you are looking for is not covered in this integration guide, the parameters listed here should be used as a general guide.

The specific Victron product(s) installation and setup covered in this Integration Guide include:

- Victron BMV-7xx Series Battery Monitor

Programming parameters described herein relate to PHI 3.5 Battery general settings requirements as well as to the following Victron Products:

- Victron Inverter / Chargers
  - Phoenix VE.Direct Inverter
  - MultiPlus and Quattro Inverter / Charger
- MPPT Solar Charge Controllers
- ESS
  - General
  - Color Control or Venus GX

Based on tests and evaluations, the following parameters (refer to tables below) have been established. More information on Victron products can be found on their website: <https://www.victronenergy.com/>. More information on the Victron BMV-700 can be found on their website: <https://www.victronenergy.com/battery-monitors/bmv-700>.

# 2.0 – Battery Bank Sizing

A properly sized PHI battery bank should be at least double (2x) the kW rating of the inverter(s) and have a C/2 rating greater than the maximum charge controller rating. Depending on the specifications of the equipment used in the system, sizing the PHI Battery bank based on these two criteria may yield different results. Therefore, the best practice is to calculate the PHI Battery bank based on both criteria and use the greater of the two results as the minimum quantity. We can compare these two calculation methods assuming the nomenclature below:

- Battery rated continuous power =  $Bat_{kWh}$  (typically @ C/2)
- Inverter power full load =  $Inv_{kW}$
- Maximum battery charge current =  $I_{BatChrgMax}$
- PV charge controller maximum =  $I_{PVChrgMax}$
- Recommended minimum number of batteries =  $B\#$

Discharge equation:  $B\#_{Inv} \geq Inv_{kW} / Bat_{kWh}$

Charge equation:  $B\#_{PV} \geq I_{PVChrgMax} / I_{BatChrgMax}$

## 2.1 – Discharge Calculation: Inverter Power Bank Sizing

To optimize the PHI Battery bank and protect against over-discharge (voiding the battery Warranty), the PHI Battery bank should be sized at least double (2x) the kW rating of the inverter.

Discharge Example:  $B_{\#Inv} \geq Inv_{kW} / Bat_{kWh}$

- Inverter is rated at 8 kW
- PHI Battery is rated at 3.5 kWh, therefore the C/2 load rating is 1.75 kW

$$B_{\#Inv} \geq 8 \text{ kW} / 1.75 \text{ kW} = 4.57$$

**So, a properly sized PHI Battery bank based on maximum discharge would have a minimum of 5 PHI Batteries.** This ensures no greater than C/2 battery load. If the PHI Battery bank has fewer batteries than calculated, special care must be taken with the inverter settings to limit the load below the specified rating of the PHI Battery. These settings are described in the following sections of this Integration Guide.

## 2.2 – Charge Calculation: Charge Controller Power Sizing

To optimize solar harvesting, a properly sized PHI Battery bank should be able to accept the maximum PV charge current. To determine the minimum number of PHI Batteries required to optimize PV, divide the output of the charge controller(s) by the “max continuous charge current” per PHI Battery. Be sure to verify the “max continuous charge current” for the PHI Battery model that you’re using, because it may differ from C/2 depending on the model.

Charge Example:  $B_{\#PV} \geq I_{PVChrgMax} / I_{BatChrgMax}$

- Maximum continuous charge current for PHI 3.5 kWh 48V = 34A
- PV charge controller max = 80A

$$B_{\#PV} \geq 80A/34A = 2.35$$

**So, a properly sized PHI Battery bank based on available PV charge would have a minimum of 3 PHI Batteries.** This maximizes the use of available PV while ensuring the PHI Batteries are never stressed by overcharging. If the PHI Battery bank has fewer batteries than calculated, special care must be taken with the inverter settings to limit the charge rate below the specified rating of the PHI Battery. These settings are described in the following sections of this Integration Guide.

**In summary: When comparing the same system using these two calculations for sizing the PHI Battery bank, the minimum number of PHI Batteries should be the greater of the two results (Discharge Calculation & Charge Calculation). In this example, this translates into 5 PHI Batteries in the system.**

## 3.0 – Victron BMV-700 Installation & Setup

The BMV-7xx series products will follow the general installation and settings in this section. The BMV-700 is used as a specific example here. Other products in this series have additional capabilities (i.e., the BMV-702 has the capability to monitor an additional PHI Battery).

The BMV-700 is a precision battery monitor that functions as a ‘fuel gauge’ and indicates time remaining in the PHI Battery bank. The remaining PHI Battery capacity depends on the ampere-hours consumed, discharge current, temperature and the age of the PHI Battery. Ampere hours consumed are calculated by integrating the current flowing in or out of the PHI Battery. Complex software algorithms are utilized to take all these variables into account for an accurate reading. The monitor tracks several parameters regarding the state of charge of the PHI Battery which can be used to evaluate usage patterns and battery health.

## 3.1 – Standard Features

The BMV-700 standard features include:

- Battery voltage, current, power, ampere-hours consumed and state of charge
- Remaining time at the current rate of discharge
- Programmable visual and audible alarm for alerts
- Programmable relay, to turn off non-critical loads or to run a generator when needed
- 500 Amp quick connect shunt and connection kit
- Shunt selection capability up to 10.000 Amps
- VE Direct communication port - Stores a wide range of historical events, which can be used to evaluate usage patterns and battery health
- Wide input voltage range: 9.5 – 95V
- High current measurement resolution: 10 mA (0.01A)
- Low current consumption: 2.9Ah per month (4mA) @12V and 2.2Ah per month (3mA) @ 24V
- Bluetooth Smart dongle monitors your batteries on Apple or Android smartphones, tablets, Macbooks and other devices

## 3.2 – Installation – Connections

Follow the instructions below to setup the BMV-700.



### **CAUTION: Connect the Negative Pole of the PHI Battery last!**

1. Locate suitable place for 500A/50mV shunt and secure in place.
2. Remove fuse from PHI Battery supply cable.
3. Connect positive supply cable and appropriately sized PHI Battery positive cable to positive output of PHI Battery bank and to the positive of the load/charger.
4. From the “load and charger” side of the shunt, connect appropriately sized negative cable to the inverter or load/charger.
5. Connect positive supply cable to +B1 on the shunt.
6. Locate suitable place for the Victron meter and secure in place.
7. Connect UTP cable to rear of battery monitor.
8. Connect free end of UTP cable to battery shunt.
9. Connect appropriately sized negative cable between the “battery only” side of the shunt and the negative output of the PHI Battery bank. Replace Fuse in fuse holder ensuring it is fully seated.

Please review Figure 1.0 below for additional detail.

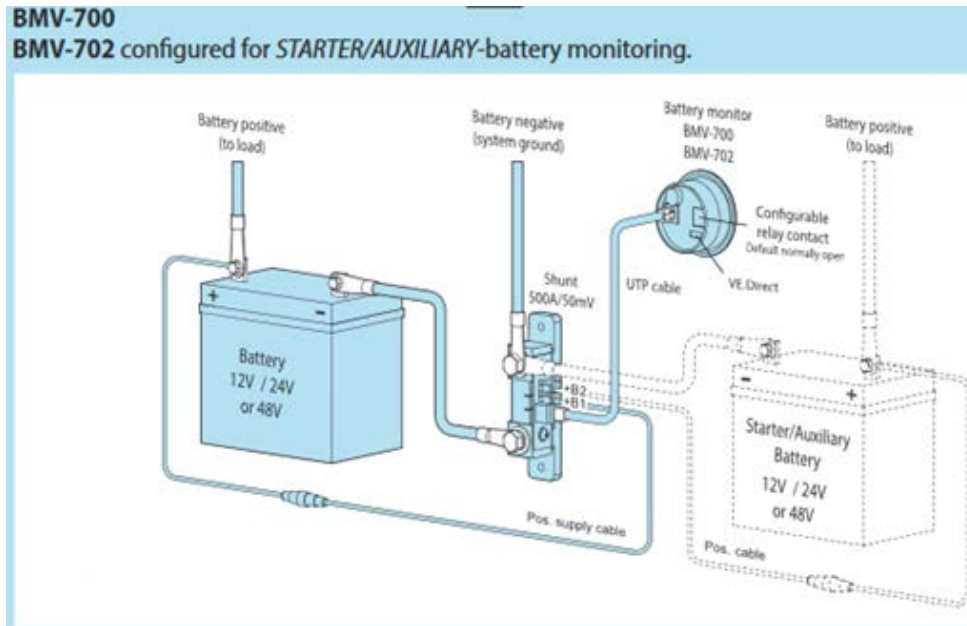


Figure 1.0 - BMV-700 Typical Installation



**CAUTION:** Connect the Negative Pole of the PHI Battery last!

### 3.3 – Installation – Quick Start Guide

After installation / connection, on initial startup, the BMV-700 “Setup Wizard” will automatically start. The following steps should be used to initialize the meter.

1. BMV will automatically start the setup wizard.
  - a. The scrolling text “Battery Capacity” will appear.
    - i. Set the Ah capacity using the +/- buttons.
    - ii. Pressing “select” after each digit is selected.
    - iii. Calculate total bank capacity based on number of PHI Batteries in the bank.
    - iv. Example: 69Ah x 3 Batteries = 207Ah.
  - b. Press “setup” for 2 seconds to enter other parameters of the BMV.
  - c. Press “select” to access the desired parameter.
  - d. Use the +/- buttons to customize the settings.
  - e. For PHI 3.5 kWh Batteries, **set parameters per Table 1.0** below.
  - f. Zero Current calibration: Disconnect the Negative cable between the load and shunt and press “select”.
  - g. Synchronize: press “select”.
  - h. For any other settings, such as relay, temperature, or alarm settings, consult the BMV Manual.
  - i. Press “setup” to end the wizard.

The BMV should be setup for normal use at this time.

If additional assistance is required, contact Victron Energy at: [sales@victronenergy.com](mailto:sales@victronenergy.com) or call Victron at +31 (0)36 5359700.



**CAUTION:** If a firmware update is executed on Victron equipment, ALL the settings must be reverified.

## 3.4 – Victron – Available Interfaces

The following interfaces are available from Victron to allow easy monitoring of the PHI Battery status / performance.

- PC software BMV- Reader. Downloadable from Victron website in the support and downloads section. Uses the VE.direct to USB interface.
- Color Control GX display featuring a 4.3-in color display can be connected to the BMV using VE.direct to USB interface.

If additional assistance is required, contact Victron Energy at: [sales@victronenergy.com](mailto:sales@victronenergy.com) or call Victron at +31 (0)36 5359700.

## 4.0 – Program Settings for PHI Batteries

In order to maintain the Warranty, it is critical to ensure that the appropriate settings for the desired Warranty are programmed in all the system components. This section will cover the basic concepts and settings for the PHI 3.5 Batteries as well as settings specific to Victron products.

### 4.1 – Depth of Discharge

In order to optimize performance and the life of your system and PHI batteries, SimpliPhi Power recommends programming the equipment settings for 80% Depth of Discharge (DoD). This qualifies for the SimpliPhi 10-year / 10,000 cycle Warranty on the PHI Batteries. Greater DoD is possible, but will result in reduced cycle life. Refer to the PHI 3.5 kWh Battery Warranty to compare DoD settings and the associated Warranty.



## 4.2 – PHI 3.5 General Settings with Victron

The general program settings for the PHI 3.5 Batteries with Victron products are outlined below.

**Table 1.0 - Settings for SimpliPhi PHI 3.5 kWh 24V / 48V Battery w/Victron**

General	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
Battery Curve	Fixed		
Capacity <sup>1</sup> (Ah)	138Ah per PHI3.5 24V; (276Ah for 2, 414Ah for 3) 69Ah per PHI3.5 48V; (138Ah for 2, 207Ah for 3)		
Absorb Voltage (V)	28 / 56	28.8 / 57.6	28.8 / 57.6
Absorb Time	6 Minutes		
Float Voltage (V)	27 / 54 (typically Disable)		
Discharge Voltage "LBCO" (V)	25.1 / 50.2	24.8 / 49.6	24 / 48
Re-Charge (V)	25.3 / 50.6		
Max Discharge/Charge Current (C/2) <sup>1</sup>	45A per PHI3.5 24V; (90A for 2, 135A for 3) 34A per PHI3.5 48V; (68A for 2, 102A for 3)		
Peukert Expo	1.05		
Charge Efficiency	95%		
SoC when Bulk Finished	95%		

Notes:

- 1. Per PHI 3.5 Battery – These settings are calculated by multiplying the nominal per battery value times the # of batteries.
- Levels are typical @ 25°C and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles, the PHI Battery should be allowed to "rest" 15 minutes in between.
- Always refer to the SimpliPhi Power Manual and Warranty for the specific PHI Battery model.

## 4.3 – Victron BMV-700 Programming Settings

**Table 2.0 - Settings for SimpliPhi PHI 3.5 kWh 48V Battery w/Victron BMV-700 Battery Monitor**

Victron BMV-700 Settings	PHI 3.5 kWh 24V / 48V
<b>Quick Start</b>	
Battery Capacity <sup>1</sup> (Ah)	138Ah per PHI3.5 24V; (276Ah for 2, 414Ah for 3) 69Ah per PHI3.5 48V; (138Ah for 2, 207Ah for 3)
Charged Voltage (V)	26.5 / 53.2
Tail Current (%)	4
Charge Detection Time (minutes)	1
Peukert Exponent	1.05
Charge Efficiency Factor (%)	98
Current Threshold (A)	0.1
Time to go Averaging Period (minutes)	3

Notes:

- 1. Per PHI 3.5 Battery – These settings are calculated by multiplying the nominal per battery value times the # of PHI Batteries.
- Levels are typical @ 25°C and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles, the PHI Battery should be allowed to "rest" 15 minutes in between.
- Always refer to the SimpliPhi Power Manual and Warranty for the specific PHI battery model.



**CAUTION: When battery quantities change, the capacity current settings must to be reassessed.**

## 4.4 – Inverter / Charger Settings

The program settings for the PHI 3.5 Batteries with Victron Inverter / Charger products are outlined below.

**Table 3.0 - Settings for SimpliPhi PHI 3.5 kWh 48V Battery w/Victron Inverter / Charger**

Program Settings for SimpliPhi Model 3.5 - 48V with Victron Inverters / Chargers			
Phoenix VE.Direct Inverters	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
<b>Victron Connect</b>			
<b>Static Low Voltage Cutoff</b>			
Output Voltage	230V		
Output Frequency	50Hz		
Dynamic Cutoff	OFF		
Low Battery Shutdown	50.2	49.6V	48V
Low Battery Restart & Alarm	50.5V		
Charge Detect	54V		
ECO Mode Wake-up Minimum Power	15W		
ECO Mode Search Interval	2.5S		
<b>Victron Connect</b>			
<b>Dynamic Low Voltage Cutoff</b>			
Enable Dynamic Cutoff	ON		
Battery Type	Custom		
Battery Capacity <sup>1</sup>	34A per PHI3.5; (68A for 2, 102A for 3)		
Voltage for Discharge 0A	50.2	49.6V	48V
Voltage for Discharge 8A	50.2	49.6V	48V
Voltage for Discharge 23A	50.2	49.6V	48V
<i>Voltage for Discharge 66A<sup>2</sup></i>	<i>50</i>	<i>49.1V</i>	<i>47.5V</i>
MultiPlus & Quattro Inverter Chargers	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
<b>VE Configure</b>			
<b>General Tab</b>			
SoC when Bulk Finished	95%		
Total Battery Capacity <sup>1</sup>	69Ah per PHI3.5; (138Ah for 2, 207Ah for 3)		
Charge Efficiency	95%		
<b>VE Configure</b>			
<b>Inverter Tab</b>			
DC Input Low Shut-Down	50.2	49.6V	48V
DC Input Low Restart	50.5V		
DC Input Low Pre-Alarm	51V		
<b>VE Configure</b>			
<b>Charger Tab</b>			
Battery Type	Lithium		
Lithium > Yes	Lithium Iron Phosphate		
Absorb Voltage	56V	57.6V	57.6V
Float Voltage	54V		
Charge Current (C/2) <sup>1</sup>	34A per PHI3.5; (68A for 2, 102A for 3)		
Repeated Absorb Time	1.00 Hr		
Repeated Absorb Interval	7 Days		
Absorb Time	0.10 Hour (6 Minutes)		

Notes:

- 1. Per PHI 3.5 Battery – These settings are calculated by multiplying the nominal per battery value times the # of batteries.
- 2. These levels exceed the warranted recommended operating conditions.
- Levels are typical @ 25°C and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles, the PHI Battery should be allowed to "rest" 15 minutes in between.
- Always refer to the SimpliPhi Power Manual and Warranty for the specific PHI Battery model.

## 4.5 – MPPT Settings

The program settings for the PHI 3.5 Batteries with Victron MPPT products are outlined below.

**Table 4.0 - Settings for SimpliPhi PHI 3.5 kWh 48V Battery w/Victron MPPT**

MPPT Solar Charge Controllers	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
Battery Voltage	48V		
Max Charge Current (C/2) <sup>1</sup>	34A per PHI3.5; (68A for 2, 102A for 3)		
Default Charge Settings	OFF		
Absorb Voltage	56V	57.6V	57.6V
Absorb Time	6 Minutes		
Float Voltage	54V		
Equalization Voltage	54V		
Auto Equalization	OFF		
Temperature Compensation	OFF		

Notes:

- 1. Per PHI 3.5 Battery – These settings are calculated by multiplying the nominal per battery value times the # of batteries.
- Levels are typical @ 25°C and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles, the PHI Battery should be allowed to "rest" 15 minutes in between.
- Always refer to the SimpliPhi Power Manual and Warranty for the specific PHI Battery model.

## 4.6 – ESS Settings

The program settings for the PHI 3.5 Batteries with Victron ESS products are outlined below.

**Table 5.0 - Settings for SimpliPhi PHI 3.5 kWh 48V Battery w/Victron ESS**

General	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
<b>VE Configure</b>	<b>General</b>		
SoC when Bulk Finished	95%		
Total Battery Capacity <sup>1</sup>	69Ah per PHI3.5; (138Ah for 2, 207Ah for 3)		
Charge Efficiency	95%		
<b>VE Configure</b>	<b>Grid Tab</b>		
N/A	No battery specific settings		
<b>VE Configure</b>	<b>Inverter Tab</b>		
N/A	Settings have NO EFFECT once ESS assistant is loaded		
<b>VE Configure</b>	<b>Charger Tab</b>		
N/A	Settings have NO EFFECT once ESS assistant is loaded		
<b>VE Configure</b>	<b>Virtual Switch Tab</b>		
N/A	Do NOT use VS		
<b>VE Configure</b>	<b>Assistants Tab</b>		
Battery System	System uses LiFePo4 with other type BMS		
VE Configure Battery Type Selection	Change battery type as suggested		
Sustain Voltage	50.2V		
Dynamic Cut-Off	Discharge Rate Dependent		
0.005C	50.2	49.6V	48V
0.25C	50.2	49.6V	48V
<i>0.7C<sup>2</sup></i>	<i>50.1</i>	<i>49.5V</i>	<i>48V</i>
<i>2C<sup>2</sup></i>	<i>49.7</i>	<i>49.1V</i>	<i>48V</i>
Restart Offset	1.2V		
Victron Default Absorption Voltage	56V		
<b>FOR BACKUP ONLY SYSTEM</b>			
<b>Color Control GX/Venus GX Settings</b>	<b>Keep Batteries Charged</b>		
Mode	Optimized (with BatteryLife)		
Control Without Grid Meter	OFF		
Inverter AC Output in use	ON		
Feed-in Excess Solar charger Power	ON		
Phase Compensation	ON		
Minimum Discharge SoC <sup>3</sup>	90%		
Actual State of Charge Limit	95%		
BatteryLife State	Self-consumption		
Limit Charger Power	OFF		
Limit Inverter Power	OFF		
Fronius Zero feed-in	OFF		
Fronius Zero feed-in active	No battery specific settings		
Grid setpoint	50W		

Notes:

- 1. Per PHI 3.5 Battery – These settings are calculated by multiplying the nominal per battery value times the # of PHI Batteries.
- 2. These levels exceed the warranted recommended operating conditions.
- 3. For BACKUP ONLY applications, set to desired backup level. This is the level batteries cycle to normally before recharge. If the grid fails, cut-off is determined by the Dynamic Cut-Off values.
- Levels are typical @ 25°C and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles, the PHI Battery should be allowed to "rest" 15 minutes in between.
- Always refer to the SimpliPhi Power Manual and Warranty for the specific PHI Battery model.

## 5.0 – Specifications & Warranty

For your reference:

- See PHI 3.5 kWh 48V Specifications sheet.
- See PHI 3.5 kWh 48V 10-Year Warranty. Failure to adhere to installation protocol will void Warranty.

## 6.0 – SimpliPhi Technical Support

For technical support related to your PHI 3.5 kWh Battery (or other SimpliPhi Power products), please contact us directly at:

**805.640.1874**

**[techsupport@simpliphipower.com](mailto:techsupport@simpliphipower.com)**