



## SimpliPhi Power PHI Battery

### INTEGRATION GUIDE: MORNINGSTAR

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 is intended to supplement the PHI Battery and Morningstar Installation Manuals. It covers the recommended set up and configuration of Morningstar Charge Controller equipment for optimizing performance with SimpliPhi PHI 2.7 kWh and 3.5 kWh batteries. More information on SimpliPhi products can be found on our website: <http://simpliphipower.com/>.

SimpliPhi Power offers solutions for a range of Morningstar products covering 24V to 48V PHI battery applications, which are too numerous to be covered here. If the Morningstar 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 Morningstar products covered in this guide include, but are not limited to:

- Morningstar charge controllers
  - Morningstar TriStar MPPT 600V
  - Morningstar TriStar MPPT
  - Morningstar ProStar MPPT
  - Morningstar SunSaver MPPT

## 2.0 – Charge Controller Settings

Based on tests and evaluations of the PHI 3.5 kWh battery with Morningstar's equipment, the following parameters (refer to table below) have been established. More information on Morningstar series charge controller products can be found on their website: <http://support.morningstarcorp.com/>.

## 3.0 – 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:  $B_{\#PV} \geq I_{PVChrgMax} / I_{BatChrgMax}$

## 3.1 – 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 model.

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

- Max 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 batteries.** This maximizes the use of available PV while ensuring the 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 batteries should be the greater of the two results (Discharge Calculation & Charge Calculation). In this example, this translates into 4 PHI batteries in the system.**

# 4.0 – Program Settings for PHI 2.7 and 3.5 Batteries

In order to maintain the Warranty, it is critical to ensure that the appropriate settings for the desired Warranty are programmed in all of the system components. This section will cover the basic concepts and settings for Morningstar equipment.

## 4.1 – Depth of Discharge

In order to optimize performance and the life of your system and PHI batteries, SimpliPhi 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 – Charge Controller Settings

Please review Table 2.0 below for Morningstar charge controller(s) program settings.

**Table 2.0 - Settings for SimpliPhi PHI 2.7 & 3.5 kWh Batteries w/ Morningstar Charge Controller**

CHARGE CONTROLLER	PHI 2.7 kWh & 3.5 kWh; 24V / 48V		
Setting	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
<b>Charging Source</b>			
Source	24 / 48		
Battery Voltage (V)	Custom		
<b>Charge</b>	<b>Battery Charge Setpoints</b>		
<b>Volts</b>			
EQ (V)	Off	Off	Off
Absorb (V)	28 / 56	28.4 / 57.2	28.4 / 57.2
Float (V)	27 / 54	27 / 54	27 / 54
<b>ChgTime</b>			
Absorb Minimum (Mins)	10		
EQ Time (Mins)	0		
EQ Time (Days)	0		
Float Timeout	Please See Note		
<b>Limits</b>			
Output Amps <sup>1,2</sup>	45A per PHI2.7 24V; 26A per PHI2.7 48V 45A per PHI3.5 24V; 34A per PHI3.5 48V		
Input Amps <sup>1</sup>	Size based on input charging source		

Notes:

- 1. Per PHI battery – Refer to Section 3.0 herein for charge controller PHI battery bank sizing.
- 2. Per PHI battery – These settings are calculated by multiplying the nominal value per each PHI battery times the # of PHI batteries. For other batteries, refer to the Warranty and Specification Sheet for the specific model.
- 3. Float Timeout setting can be used in place of a ReBulk setting. Adjust this setting to the desired time you would like the battery to remain below the float voltage before entering into a its bulk stage charging cycle. 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 PHI battery quantities change, the capacity & charge/discharge current settings must be reassessed. Failure to do so will void the Warranty.**

## 5.0 – Specifications & Warranty

For your reference:

- See PHI 3.5 kWh 48V Specifications sheet.
- See PHI 3.5 kWh 48V 10-Year Warranty.
- See PHI 2.7 kWh 48V Specifications sheet.
- See PHI 2.7 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 2.7 kWh Battery, 3.5 kWh Battery, or other SimpliPhi Power products, please contact us directly at:

805.640.1874

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