simpliphi POWER

Power. On Your Terms.™

SimpliPhi Power PHI Battery

INTEGRATION GUIDE: SMA

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.

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 SMA equipment for optimizing performance with SimpliPhi PHI 3.5 kWh 48V batteries. More information on SimpliPhi products can be found on our website: http://simpliphipower.com/.

SMA offers many products which are too numerous to be covered here. SimpliPhi Power offers energy storage battery solutions for SMA Inverters / Chargers. If the SMA 48V 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 SMA products covered in this guide include, but are not limited to:

- SMA Sunny Island
  - SI 4548-US; 6048-US

2.0 – Inverter Settings

Based on tests and evaluations of the PHI 3.5 kWh battery with SMA's equipment, the following parameters (refer to tables below) have been established. More information on SMA Sunny Island series inverter products can be found on their website: https://www.sma-america.com/products/overview.html.

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 – 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 6.8 kW
- PHI battery is rated at 3.5 kWh, therefore the C/2 load rating is 1.75 kW

$B_{\#Inv} \geq 6.8\ kW / 1.75\ kW = 3.88$

So, a properly sized PHI battery bank based on maximum discharge of the inverter would have a minimum of 4 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.

3.2 – 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 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 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 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.

3.3 – SMA Inverter/Charger Battery Bank Sizing Examples

The two examples below apply to the two SMA inverters identified below. Calculations are for the minimum recommended number of PHI 3.5 kWh 48V batteries. More batteries should be added to increase PHI battery bank capacity.

3.3.1 – SI 4548-US Battery Bank Sizing

The SI 4548-US is rated for 5000W @ 25°C or 4000W @ 40°C. For purposes of this example, we will use the 40°C rating to ensure operation over a wide temperature range. This inverter is rated at 4 kW and the PV charge controller max is 56A.

Discharge Method

- Inverter is rated at 4 kW
- Battery is rated at 3.5 kWh, therefore the C/2 load rating is 1.75 kW

$B_{\#Inv} \geq 4$ kW/1.75kW = 2.3 Use ≥ 3 PHI 3.5 kWh 48V batteries

Charge Method

- PV charge controller max = 56A
- Max continuous charge current for PHI 3.5 kWh 48V = 34A

$B_{\#PV} \geq 56A/34A = 1.6$ Use ≥ 2 PHI 3.5 kWh 48V batteries

Battery Bank Sizing

The minimum recommended PHI battery bank size is 3 PHI 3.5 kWh 48V batteries (the greater of the two calculation methods). More PHI batteries should be added to increase PHI battery bank capacity.

3.3.2 – SI 6048-US Battery Bank Sizing

The SI 6048-US is rated for 6000W @ 25°C or 5000W @ 40°C. For purposes of this example, we will use the 40°C rating to ensure operation over a wide temperature range. This inverter is rated at 5 kW and the PV charge controller max is 56A.

Discharge Method

- Inverter is rated at 5 kW
- Battery is rated at 3.5 kWh, therefore the C/2 load rating is 1.75 kW

$B_{\#Inv} \geq 5kW/1.75kW = 2.9$ Use ≥ 3 PHI 3.5 kWh 48V batteries

Charge Method

- PV charge controller max = 56A
- Max continuous charge current for PHI 3.5 kWh 48V = 34A

$B_{\#PV} \geq 56A/34A = 1.6$ Use ≥ 2 PHI 3.5 kWh 48V batteries

Battery Bank Sizing

The minimum recommended battery bank size is 3 PHI 3.5 kWh 48V batteries (the greater of the two calculation methods). More batteries should be added to increase PHI battery bank capacity.

4.0 – Program Settings for PHI 3.5 Battery

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 SMA 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.

CAUTION: If a firmware update is executed on SMA equipment, ALL the settings must be reverified. The programmed settings shown in the following table must be applied based on desired Warranty/cycle life. The recommended is 80% Depth of Discharge.

4.2 – Inverter/Charger Settings

Table 1.0 - Settings for SimpliPhi PHI 3.5 kWh 48V Battery w/ SMA Sunny Island 48V Inverter/Charger

SUNNY ISLAND	10k Cycles (80% DoD)	5k Cycles (90% DoD)	3.5k Cycles (100% DoD)
Setting > Battery > Property			
221.01 BatTyp	VRLA		
221.02 BatCpyNom (Ah)[1]	69		
221.03 BatVtgNom	VRLA 48 V		
221.04 BatTmpMax (°C)	49 (Requires coms)		
Setting > Battery > Charge	**80% DoD**	**90% DoD**	**100% DoD**
222.01 BatChrgCurMax (A)[1]	34		
222.02 AptTmBoost (Minutes)	6 (1Hr if using new SI)		
222.03 AptTmFul (Minutes)	6 (1Hr if using new SI)		
222.04 AptTmEqu (Minutes)	6 (1Hr if using new SI)		
222.05 CycTmFul (Days)	30		
222.06 CycTmEqu (Minutes)	0 (Disable)		
222.07 ChrgVtgBoost (V)	2.33	2.40	2.40
222.08 ChrgVtgFul (V)	2.33	2.40	2.40
222.09 ChrgVtgEqu (V)	2.25		
222.10 ChrgVtgFlo	2.25		
222.11 BatTmpCps (mV)	0		
222.12 AutoEquChrgEna	Disable		
Setting > Battery > Preservation			
223.05 BatPro1Soc	35%		
223.06 BatPro2Soc	30%		
223.07 BatPro3Soc	20%		

Notes:

- 1. Per PHI 3.5 kWh 48V 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. Refer to Section 3.0 herein for PHI battery bank sizing.
- 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; 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