



Power. On Your Terms.



SimpliPhi Power PHI Battery

INTEGRATION GUIDE: SELECTRONIC

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 Selectronic equipment for optimizing performance with SimpliPhi PHI 3.8 kWh 48V Batteries. More information on SimpliPhi products can be found on our website: <https://simpliphipower.com/>.

Selectronic offers many products which are too numerous to be covered here. SimpliPhi Power offers solutions for a wide range of Selectronic products covering 24V to 60V battery applications. The 48V products are covered in this Integration Guide. If the Selectronic 48V product you are looking for is not covered in this Integration Guide, the parameters listed herein should be used as a general guide. The specific Selectronic products covered in this guide include, but are not limited to:

- Selectronic SP PRO AU (48V)
 - SPMC481-AU
 - SPMC482-AU

2.0 – Charge Controller and Inverter Settings

Based on combined tests and evaluations, the following parameters (refer to table below) have been established. More information on Selectronic SP PRO AU series inverter products can be found on their website: <http://www.selectronic.com.au/sppro/models.htm>.

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 size 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 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 PHI 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 7.5 kW
- Battery is rated at 3.8 kWh, therefore the C/2 load rating is 1.9 kW

$B_{\#Inv} \geq 7.5 \text{ kW} / 1.9 \text{ kW} = 3.95$

A properly sized PHI Battery bank based on maximum discharge would have a minimum of 4 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.

3.2 – Charge Calculation: Charge Controller Power Bank Sizing

Selectronic does not manufacture a charge controller device, and the SP PRO does not have its own built-in charge controller (aka “solar controller”). According to Selectronic, when setting up a DC coupled system, you can use “any type of Solar Controller you wish” with the SP PRO. However, “a current shunt must be installed in the DC negative of the controller. The current shunt allows the SP PRO to read the DC current and accurately calculate State of Charge of the batteries.”

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

- Max. continuous charge current for PHI 3.5 kWh 48V = 37.5A
- PV charge controller max = 80A

$$B_{\#PV} \geq 80A/37.5A = 2.13$$

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 4 PHI Batteries in the system.

3.3 – Selectronic Inverter/Charger Battery Bank Sizing Examples

The two examples below apply to the two Selectronic inverters identified. Calculations are for the minimum recommended number of PHI 3.8 kWh 48V Batteries. More PHI Batteries should be added to increase PHI Battery bank capacity.

3.3.1 - SPMC481-AU BATTERY BANK SIZING

5.0 kW / 104A

Discharge Method

- Inverter is rated at 5 kW
- Battery is rated at 3.8 kWh, therefore the C/2 load rating is 1.9 kW

$$B_{\#Inv} \geq 5 \text{ kW}/1.9 \text{ kW} = 2.6 \quad \text{Use } \geq 3 \text{ PHI } 3.8 \text{ kWh } 48\text{V Batteries.}$$

Charge Method

- PV charge controller max = 104A
- Max continuous charge current for PHI 3.8 kWh 48V = 37.5A

$$B_{\#PV} \geq 104A/37.5A = 2.8 \quad \text{Use } \geq 3 \text{ PHI } 3.8 \text{ kWh } 48\text{V Batteries.}$$

Battery Bank Sizing

The minimum recommended PHI Battery bank size is 3 PHI 3.8 kWh 48V batteries (the greater of the two calculation methods, although in this specific instance both equations yield the same result). More PHI Batteries should be added to increase PHI Battery bank capacity.

3.3.2 - SPMC482-AU BATTERY BANK SIZING

7.5 kW / 156A

Discharge Method

- Inverter is rated at 7.5 kW
- Battery is rated at 3.8 kWh, therefore the C/2 load rating is 1.9 kW

$B_{\#Inv} \geq 7.5 \text{ kW} / 1.9 \text{ kW} = 3.9$ Use ≥ 4 PHI 3.8 kWh 48V Batteries.

Charge Method

- PV charge controller max = 156A
- Max continuous charge current for PHI 3.8 kWh 48V = 37.5A

$B_{\#PV} \geq 156A / 37.5A = 4.2$ Use ≥ 5 PHI 3.8 kWh 48V Batteries.

Battery Bank Sizing

The minimum recommended PHI Battery bank size is 5 PHI 3.8 kWh 48V Batteries (the greater of the two calculation methods). More PHI Batteries should be added to increase PHI Battery bank capacity.

4.0 – Program Settings for PHI Batteries

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 Selectronic equipment.

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 3.8 kWh Battery Warranty to compare DoD settings and the associated Warranty.



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

4.2 – Inverter/Charger Settings

Table 1.0 - Settings for SimpliPhi PHI 3.8 kWh 48V Battery
w/Selectronic SP PRO AU Inverter/Charger

| Equipment Setting | PHI 3.8kWh 48V | | |
|--|--|------------------------|---------------------------|
| | 10k Cycles (80% DoD) | 5k Cycles (90% DoD) | 3.5k Cycles (100% DoD) |
| Quick Start | | | |
| Battery Type | LFP | | |
| Battery Capacity ¹ (Ah) | 75Ah per PHI 3.8; (150Ah for 2, 225Ah for 3) | | |
| DC Shutdown 0% Load (V) | 50.6 | | |
| DC Shutdown 100% Load (V) (LBCO) | 50.2 | 49.6 | 48 |
| Recovery Voltage (V) | 52 | | |
| SoC Shutdown | Disabled | | |
| Battery Settings | | | |
| Max Voltage Limit (V) | 54.4 | 54.4 | 56 |
| High Battery Alert (V) (HBCO) | 60 | | |
| High Battery Alert Clear (V) | 57.6 | | |
| Periodic Equalize | Disabled | | |
| Periodic Recharge | 3 to 7 Days | | |
| Mid-Point Monitoring | Disabled | | |
| Max Charge Current ¹ (Ah) (C/2) | 37.5A per PHI 3.8; (75A for 2, 112.5A for 3) | | |
| Initial Return (V) | 52.9 | | |
| Limit Charge Above (A) | 44 | | |
| Limit Rate (A) | 20 | | |
| Initial Stage (V) | 54.4V, C/2, 1 Hour | | |
| Bulk Stage (V) | 54.4V, C/2, 1 Hour | | |
| Absorb Stage (V); C/2; 1 Hour | 54.4 | 54.4 | 56 |
| Float Stage (V) | 54 | | |
| Long Term Voltage (V) | 54 | | |
| Equalize Stage (Disable Setpoints) | 53V; 1%; 1 Hour | | |
| Min Temp Comp (°C) | 0 | | |
| Max Temp Comp (°C) | 49 | | |
| Ref A Temp Co | 0.0 | | |
| Ref B Temp Co | 0.0 | | |

Notes:

- 1. Per PHI 3.8 kWh 48V Battery – These settings are calculated by multiplying the nominal value per each PHI Battery times the # of PHI Batteries. For other PHI Batteries, refer to the Warranty and Specification Sheet for the specific model. Refer to Charge Controller Bank Sizing under the “Battery Bank Sizing” section.
- Levels are typical @ 25°C and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles the PH Battery should be allowed to "rest" 15 minutes in between.
- Always refer to the SimpliPhi Power Installation 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.

4.3 – AC Coupled Settings

Please review this section for installations with AC coupled solar and periods of no loads or small loads during sunshine hours.

4.3.1 - SELECTRONIC SP PRO AU 48V INVERTER/CHARGER

During sunshine hours when there is no load to absorb any power spikes on the AC bus, high voltage DC spikes may cause the SP PRO to go into fault mode. This may not be an issue where there are loads during the day. A solution is to lower the instant trip voltage from the AC coupled inverter and make it trip instantly to reduce the chance of spikes. Increasing the Trip Delay up to 2.0 Sec may assist, if needed.

The settings to accomplish this are:

AC Coupled Trip (V)

AC Coupled Trip is the battery voltage at which the SP PRO will trip any Managed AC coupled solar to zero output. This is a legacy setting and is not used in firmware versions greater than 9.09. This is replaced by the Over Target Charge Voltage Trip setting. This setting should not exceed **High Battery Alert (V)** from Table 1.0 above. This is PHI Battery HBCO (the point at which the battery BMS will shut down).

Over Target Charge Voltage Trip (V)

Over Target Charge Voltage Trip is the percentage over the battery charge target voltage at which the SP PRO will trip any Managed AC coupled Solar to zero output. This setting is used for lithium batteries or similar technologies that have an absolute maximum battery charge voltage. Since this is a percentage, this setting needs to be calculated from the **Max Voltage Limit** in Table 1.0 above. The calculation should not exceed **High Battery Alert** from Table 1.0 above. This is the PHI Battery HBCO (the point at which the battery BMS will shut down).

Example:

- If the recommended settings for 80% DoD are used, the **Max Voltage Limit** is 54.4V. So, using a 5% Over Target Charge Voltage Trip would be 57.12V, which is less than the 60V HBCO.
- Using that same 5% for the 100% DoD settings (56V + 5%) would be 58.8V, less than the 60V HBCO.

Over Target Charge Current Trip (A)

Over Target Charge Current Trip is the percentage over the battery charge target current at which the SP PRO will trip any Managed AC coupled solar to zero output. This setting is used for lithium batteries or similar technologies that have an absolute maximum battery charge current.

Trip Delay (Sec)

When the charge voltage or the charge current exceeds the Over Target Charge Voltage Trip, or Over Target Charge Current Trip, respectively, for this time, then any Managed AC coupled solar will trip to zero output. These settings are used for lithium batteries or similar technologies that have an absolute maximum battery charge voltage or current.

Example:

**Table 2.0 – AC Coupled Settings for SimpliPhi PHI 3.8 kWh 48V Battery
w/Selectronic SP PRO (for no load PV trip conditions)**

| Equipment Setting | PHI 3.8 kWh 48V |
|-------------------------------------|---|
| SELECTRONIC SP PRO INVERTER | |
| AC Coupled Settings | To avoid SP-PRO fault when no-load during PV hours |
| AC Coupled Trip (V) | 60 |
| Over Target Charge Voltage Trip (V) | 4 |
| Over Target Charge Current Trip (A) | 10 |
| Trip Delay (Sec) | 2 |

Notes:

- 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 Installation Manual and Warranty for the specific PHI Battery model.

5.0 – Specifications & Warranty

For your reference:

- See PHI 3.8 kWh 48V Specifications Sheet.
- See PHI 3.8 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 3.8 kWh 48V Battery (or other SimpliPhi Power products), please contact us directly at:

805.640.6700

techsupport@simpliphipower.com