Power. On Your Terms.

SimpliPhi Power PHI Battery

INTEGRATION GUIDE: SCHNEIDER

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 Schneider Electric equipment for optimizing performance with SimpliPhi PHI 3.8 kWh batteries. More information on SimpliPhi products can be found on our website: https://simpliphipower.com/.

Schneider Electric offers many products which are too numerous to be covered here. The specific Schneider products covered in this guide include, but are not limited to:

- Schneider Conext XW+ Inverter/Chargers
  - Conext XW Pro
  - Conext XW+ 6848 NA
  - Conext XW+ 5548 NA
- Schneider Conext MPPT Charge Controllers
  - Conext MPPT 60 150
  - Conext MPPT 80 600
- Schneider Conext Battery Monitor

2.0 – Charge Controller and Inverter Settings

Schneider Electric has performed qualification testing of the PHI 3.8 kWh battery with their equipment. Based on these combined tests and evaluations, the following parameters (refer to table below) have been established. More information on Schneider Electric products can be found on their website: https://solar.schneider-electric.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 – 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 3.8kWh, therefore the C/2 load rating is 1.9 kW

$B_{\#Inv} \geq 6.8\ kW / 1.9\ kW = 3.58$

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 Bank 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 3.8 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 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 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 Schneider Electric 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 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 Schneider Electric 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 is 80% depth of discharge.

4.2 – Inverter/Charger Settings

The Conext XW+ Inverter/Charger has a firmware limitation that creates a potential issue with Lithium-Ion batteries: the Low Battery Cut-Out Voltage (LBCO) setting is limited to 48V maximum. This value is below the recommended LBCO settings to maximize cycle-life of most Lithium-Ion batteries including PHI batteries. Per the Warranty, a 48V LBCO corresponds to 100% DoD and maintains a much more limited cycle life.

Until Schneider Electric releases updated firmware to adjust this setting above 48V, this issue can be largely mitigated by setting the "Recharge Volts" above the desired LBCO thresholds as outlined in Table 1.0 below. Therefore, systems that do not rely solely on renewable energy (i.e. grid tied systems, AGS systems) will typically start charging the batteries once the recharge voltage level is reached, preventing further discharge of the batteries and thus optimizing cycle-life.

Table 1.0 – Settings for SimpliPhi PHI 3.8 kWh 48V Battery w/Schneider Conext XW Pro & XW+ Inverters

Conext XW+ Settings	10K Cycles Warranty	5K Cycles Warranty	3.5K Cycles Warranty
Advanced Settings > Inverter Settings	**80% DoD**	**90% DoD**	**100% DoD**
Low Battery Cut Out Voltage[1]	48 (50.2V Recommended)	48V (49.5V Recommended)	48V
LBCO Hysteresis	2.0V		
LBCO Delay	10 Sec		
High Batt Cut Out	60V		
Search Watts	Default		
Search Delay	Default		
Charger Settings > Custom Settings			
Batt Type	Lithium Ion		
Lithium Ion			
Control	2StgNoFloat		
Bulk Voltage	54.4V	54.4V	56V
MaxBulkCurrent (C/2)[2]	37.5A (per PHI 3.8)		
DisChgImax[2]	60A (per PHI 3.8)		
DisChgImax Timer	300 sec		
Batt Capacity[2]	75Ah (per PHI 3.8)		
Max Charge Rate (C/2)[2,3]	37.5A (per PHI 3.8)		
Default Batt Temp	Warm		
Recharge Volts	50.5V		
Absorb Time	1 Hour		
Chg Block Start	Default		
Chg Block Stop	Default		

Notes:

- 1. Maximum setting of 48V limited by some inverter firmware is below the recommended setting.
- 2. Per PHI 3.8 kWh 48V battery – These settings are calculated by multiplying the nominal value per-battery value times the # of batteries. For other batteries, refer to the Warranty and Specification Sheet for the specific model. Refer to Charge Controller Bank Sizing under the "Battery Bank Sizing" section.
- 3. To calculate Max Bulk Current as a percentage, divide the calculated Max Bulk Current in Amps DC by the equipment's maximum potential charging current:

Bat QTY	PHI 3.8 / 48V (37.5ADC)	1 x XW+ 5548 (110ADC charger)	1 x XW+6848 (140ADC charger)
2	75A	68%	53%
3	112.5A	100%	80%
4	150A	100%	100%

- Levels are typical @ 25ºC and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles the 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 to be reassessed. Failure to do so will void the Warranty.

4.3 – MPPT Charge Controller Settings

Solar charge controllers must be used in DC coupled systems to regulate the power produced by the PV array that is delivered to the batteries. Schneider Electric offers two different MPPT charge controllers, both of which are compatible with PHI batteries:

1. Conext MPPT 80 600
2. Conext MPPT 60 150

The 80 600 model is somewhat unique in that allows for larger strings of PV modules to be easily installed and connected to the PHI battery bank. Charge controller selection depends on the system size and personal preference; The recommended setpoints for either Schneider Electric charge controller are the same.

SimpliPhi Power recommends the 80% DoD settings in Table 2.0 below in order to maximize the Warranty. Additional settings are outlined based on Warranty and desired cycle life.

Table 2.0 - Settings for SimpliPhi PHI 3.8 kWh 24V & 48V Battery w/Schneider XW MPPT60/80

Conext MPPT60 / 80 Settings	10K Cycles Warranty	5K Cycles Warranty	3.5K Cycles Warranty
Advanced Settings > Charger Settings	**80% DoD**	**90% DoD**	**100% DoD**
Batt Type	Custom		
Custom Settings			
Eqlz Supt	Disabled		
Bulk Voltage	27.2V / 54.4V	27.2V / 54.4V	28V / 56V
Absorb Voltage	27.2V / 54.4V	27.2V / 54.4V	28V / 56V
Float Voltage	27V / 54V		
Batt Temp Comp	0mV/C		
Batt Capacity[2]	151Ah (per PHI 3.8 24V) / 75Ah (per PHI 3.8 48V)		
Max Charge Rate (C/2)[2,3]	45A (per PHI 3.8 24V) / 37.5A (per PHI 3.8 48V)		
Charge Cycle	3 Stage		
ReCharge Volts	25.25V / 50.5V		
Absorb Time	1 Hour		
Default Batt Temp	Warm		
Batt Voltage (Auto-detected)	24V / 48V		
Aux Settings	**Not Used**		
…	Default		

Notes:

- 1. Maximum setting of 48V limited by some inverter firmware is below the recommended setting.
- 2. Per PHI 3.8 kWh 48V battery – These settings are calculated by multiplying the nominal value per-battery value times the # of batteries. For other batteries, refer to the Warranty and Specification Sheet for the specific model. Refer to Charge Controller Bank Sizing under the "Battery Bank Sizing" section.
- 3. To calculate Max Charge Rate as a percentage, divide the calculated Max Bulk Current in Amps DC by the equipment's maximum potential charging current:

Bat QTY	PHI 3.8 / 24V (45ADC)	1 x MPPT 80 (80ADC charger)	PHI 3.8 / 48V (37.5ADC)	1 x MPPT 80 (80ADC charger)
2	90A	100%	75A	93%

- Levels are typical @ 25ºC and may need adjusting at temperature extremes.
- When performing rapid deep charge/discharge cycles the 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.

4.4 – Conext Battery Monitor Settings

The Schneider Electric Conext™ Battery Monitor provides a more accurate state of charge (SOCS) reading for the PHI battery bank. The Conext™ Battery Monitor indicates hours of PHI battery-based runtime and determines PHI battery bank state of charge. The Conext Battery Monitor shares key PHI battery bank parameters with Conext XW+ inverter/chargers, improving the overall system performance of the battery bank.

Table 3.0 - Settings for SimpliPhi PHI 3.8 kWh 48V Battery w/Schneider Conext Battery Monitor

Conext Battery Monitor Settings	
Setting	**Value**
Capacity[2]	75Ah (per PHI 3.8)
Discharge Rate	20 Hrs
Nominal Temp	67F
Shunt Amps	500
Shunt mV	50
Self Disch	<1%/Month
Discharge Floor	20%
Float Voltage	53.32
Float Amps	2%
Auto Sync Time	240 Sec
Temp Unit	Celsius
Back Light Timer	30 Sec
Peukert Expo	1.05
Charge Eff Mode	Automatic
Temp Coeff	0.5Ah/degC
Default Temp	76 Deg F
Sync Sensitivity	5
Time Rem Filter	Faster

CAUTION: When PHI battery quantities change, the capacity & charge/discharge current settings must be reassessed. Failure to do so will void the Warranty.

4.4 – Conext Auto Generator Start (AGS) Settings

The Schneider Electric Conext™ Auto Generator Start (AGS) device allows for a connected generator to automatically start and stop according to battery voltage. Check with your generator manufacturer regarding the compatibility of your generator with this AGS device.

Table 4.0 – Settings for SimpliPhi PHI 3.8 kWh 48V Battery w/Schneider Conext AGS

Conext AGS Settings	10K Cycles Warranty	5K Cycles Warranty	3.5K Cycles Warranty
Advanced Settings > Cfg Trigger	**80% DoD**	**90% DoD**	**100% DoD**
Start DCV 30 sec	50.4V	49.8V	48.2V
Start DCV 15 min	Disabled		
Start DCV 2 hr	Disabled		
Start DCV 24 hr	Disabled		
Stop Float	**Enabled**		
Stop Absorb	Disabled		
Stop V	Disabled		
Temp1	Disabled		
Temp2	Disabled		
Load	**Enabled** if necessary[1]		
Strt Load	See Table 5.0		
Stop Load	(Start Load Value) – 1A		
Load Start Delay	0 s		
Start Soc	20%		
Stop Soc	90%		

- 1. **Enable** the **Load** trigger if the battery bank does not meet the Power Bank Sizing requirements outlined in Section 3.1.

The **Start Load** trigger enables the generator to start at a specified AC load (current draw) on the inverter. The current draw must be present for 5 minutes before the generator will start. The generator will assist the inverter with powering the AC load.
If the inverter(s') power rating exceeds the battery bank's maximum instantaneous discharge rating (i.e. does not adhere to the sizing requirements outlined in Section 3.1 above), enable the **Load** start trigger to prevent the battery bank from over-discharging through the inverter to the loads.

1. First convert DC discharge current to DC watts. (AC and DC watts are the same)
2. Then apply the inverter efficiency.
3. Then convert AC watts to AC current.

Table 5.0 – Conversion from DC to AC Limit for 1 to 5 PHI 3.8 kWh 48V Batteries (37.5A DC limit per PHI battery)

A	B	C	D	E	F
# of Parallel Batteries	**DC Current Limit**	**ADC x VDC (48)**	**WDC ÷ Inverter Efficiency (90% = .9)**	**Column D ÷ Inverter Voltage (120 or 240 VAC, dep. on inverter; 240 VAC used below)**	**Round down (only whole #s can be used as input)**
1	37.5A	1,800 WDC	2,000 WAC	8.33 AAC	**
2	75A	3,600 WDC	4,000 WAC	16.67 AAC	**16 AAC**
3	112.5A	5,400 WDC	6,000 WAC	25 AAC	**25 AAC**
4	150A	7,200 WDC	8,000 WAC	33.33 AAC	**33 AAC**
5	187.5A	9,000 WDC	10,000 WAC	41.67 AAC	**41 AAC**

**10A is the minimum programmable value

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.