Sol-Ark Integration Guide

AmpliPHI 3.8 kWh Batteries

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SimpliPhi Power 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 reduces operating temperature constraints, the risk of thermal runaway and eliminates toxic coolants. Safe lithium ferrous phosphate (LFP). No cobalt. No toxic hazards.

SimpliPhi's battery technology utilizes the industry's most environmentally benign chemistry (LFP) combined with proprietary architecture and power electronics (BMS) to create a portfolio of high performance, scalable and enduring energy storage solutions that provide power security, resilience and daily cycling for savings on your utility bill – 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 Sol-Ark equipment for optimizing performance with SimpliPhi's AmpliPHI batteries.

> ⚠️ **CAUTION: THIS INTEGRATION GUIDE IS RELEVANT TO AMPLIPHI BATTERIES ONLY. REFER TO THE SOL-ARK INTEGRATION GUIDE FOR SIMPLIPHI POWER PHI BATTERIES, LINKED HERE, FOR APPLICATIONS USING CORE POWER PHI BATTERIES THAT DO NOT INCLUDE A NETWORKING COMMUNICATIONS PORT.**

More information on SimpliPhi products can be found on our website at https://simpliphipower.com/. All SimpliPhi Product Documentation can be found at https://simpliphipower.com/product-documentation/. More information regarding Sol-Ark's products can be found at https://www.sol-ark.com.

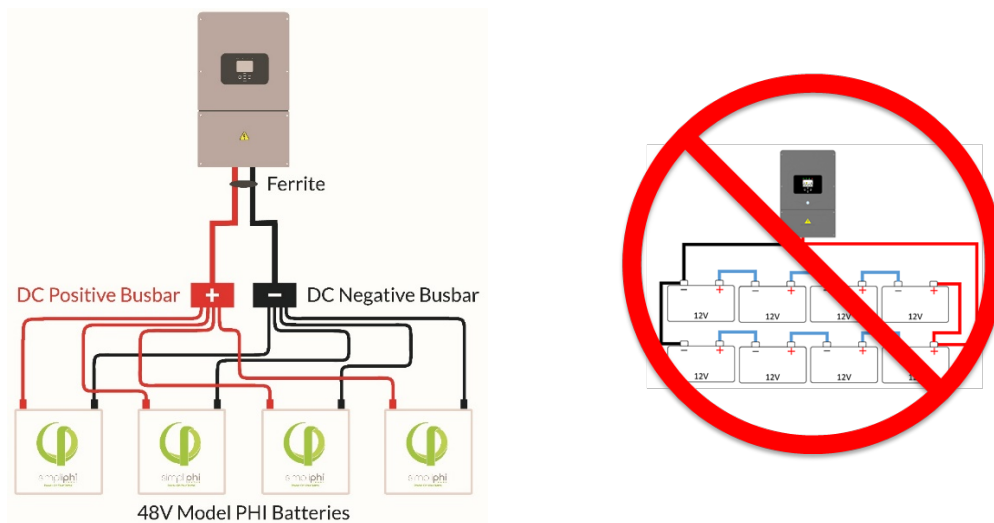The Sol-Ark products covered in this guide are the Sol-Ark-8K and the Sol-Ark-12K-P. Limiter sensors referenced in this Guide are included with a purchase of Sol-Ark equipment. Sol-Ark equipment includes a built-in transfer switch but *not* a critical loads panel.

Contact SimpliPhi Power Technical Support (805-640-6700; techsupport@simpliphipower.com) regarding any compatibility questions for products not listed in this guide.

2.0 – Battery Bank-to-Inverter Connection

Wire the AmpliPHI Battery bank to the Sol-Ark according to the AmpliPHI Battery Installation Manual [https://simpliphipower.com/wp-content/uploads/documentation/ampliphi-series/simpliphi-power-ampliphi-3-8-installation-manual.pdf], **not according to the Sol-Ark Manual**:

Figure 1: Solar-Ark to Battery Connection

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It is acceptable but not required to use the ferrite choke on the positive and negative DC busbar-to-inverter leads (see Figure 1 above).

SimpliPhi and Sol-Ark recommend against using the 100 Ohm resistor included with the Sol-Ark equipment to charge the Sol-Ark's capacitors when connecting the SimpliPhi Batteries for the first time (as described in the Sol-Ark Install Guide Owner's Manual).

Do not install the Battery Temperature Sensor. The SimpliPhi Batteries require no temperature compensation.
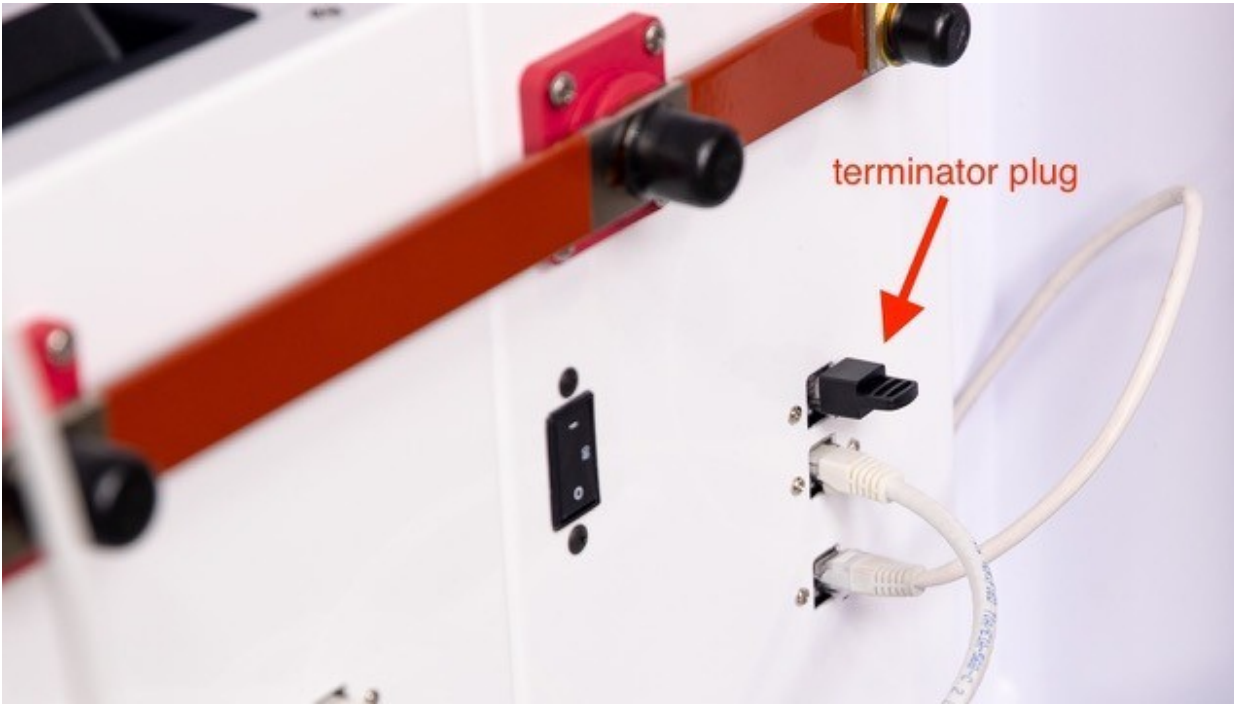
AmpliPHI batteries are networked together in a daisy chain using CAT5 or greater cabling and utilizing the two battery ports that that are in closer proximity to each other (identified in Figure 2 below). The maximum number of AmpliPHI batteries that can be connected in a single system is 40, with a maximum total connected distance of 40m (131 feet) from the first AmpliPHI battery module to the last AmpliPHI battery module in the chain.

Figure 2: AmpliPHI's Networking Communications Ports

RJ45 ports used for daisy chaining networking connections *between* AmpliPHI batteries
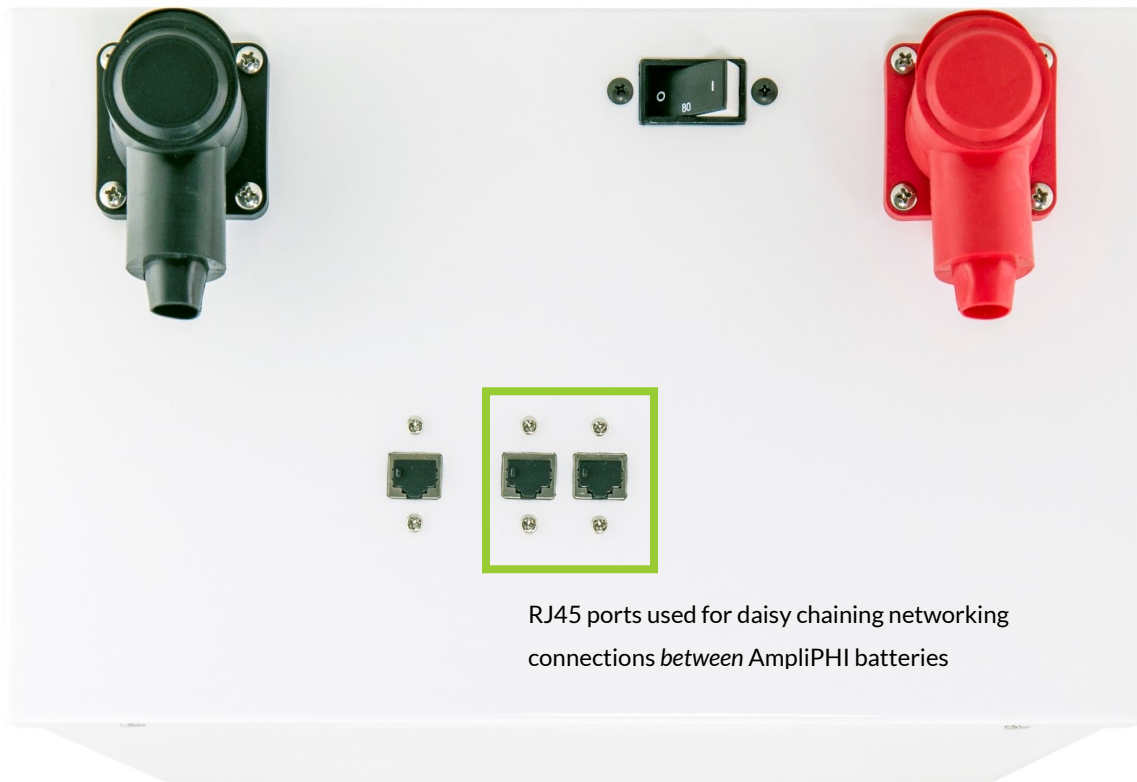
In a string of batteries, the two batteries at the ends of the communication chain will have one of their RJ45 "daisy-chaining" ports (indicated in Figure 2 above) remaining un-utilized. On each of these two batteries, the communication port that is not occupied by a cable will have a 120Ohm terminator plug installed in the open port (see Figures 3 and 5 below).

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Figure 3: AmpliPHI's Terminator Plug

Utilizing the closest battery to the inverter, create the closed loop communications bridge between the AmpliPHI Battery and the Communication Input Port (labeled "CAN") in the Sol-Ark Inverter utilizing CAT5 or greater cable. The cable length from the last AmpliPHI Battery in the chain to the Inverter cannot exceed 40m (131 feet).

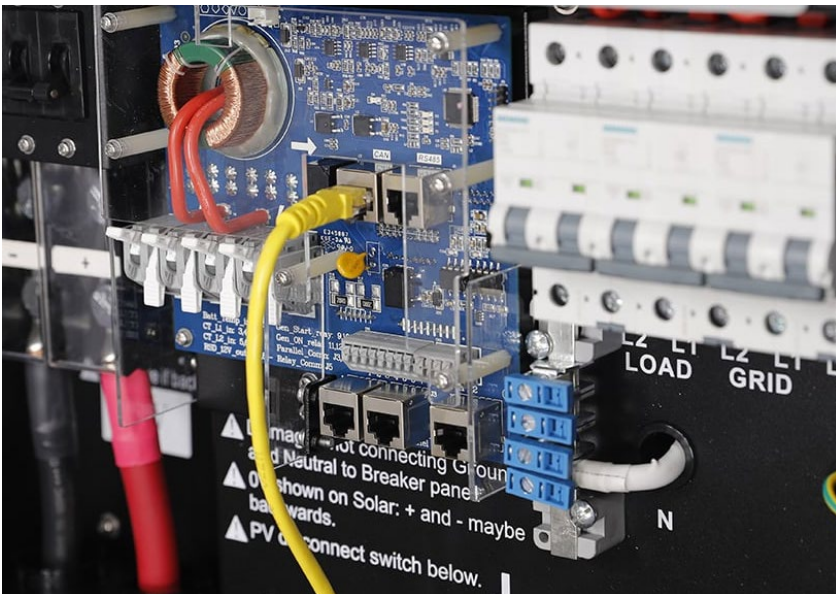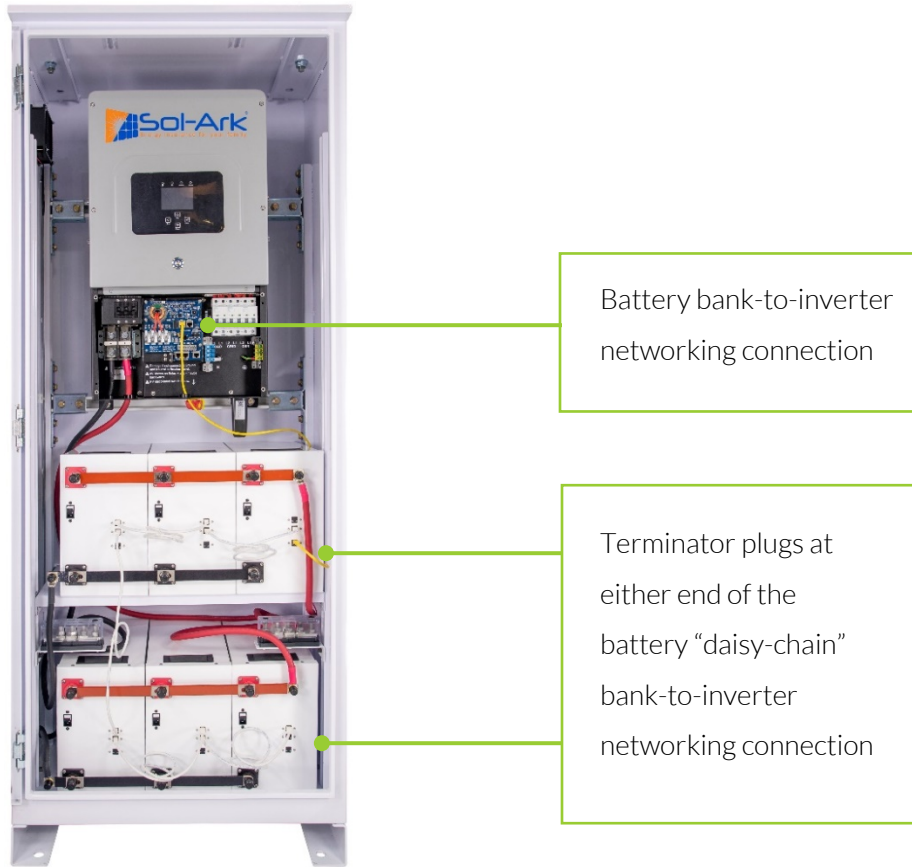Figure 4: Sol-Ark's Battery Networking Connection Port

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Figure 5:   AmpliPHI's Networking Connections to Sol-Ark Equipment

3.0 – Battery Bank Sizing

3.1 – All Systems

AmpliPHI batteries in DC Coupled or AC Coupled systems should be sized according to the connected loads' energy (kWh) and power (kW) requirements. While as few as one AmpliPHI battery may be paired with either Sol-Ark-8K or Sol-Ark-12K equipment without voiding the battery warranty, consider that the AmpliPHI battery is rated according to the specifications in the table below, and that without a backup AC power source, loads that exceed the battery bank's total capacity or power rating will result in the entire system shutting down. Specifically, when operating in off-grid mode, the Sol-Ark shuts down when the current discharged from the battery bank to the loads exceeds 120% of the Sol-Ark's **Max A Discharge** parameter value for 10 seconds.

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For example, one AmpliPHI battery has a maximum continuous discharge rate of 37.5 Amps DC. The AmpliPHI battery communicates this value to the Sol-Ark and auto-populates the Sol-Ark's **Max A Discharge** parameter to this value. When 45 Amps DC (120% of 37.5 ADC) are discharged from the battery to the loads (equivalent to a ~9 Amps at 240 VAC load), then the system will shut down.

AmpliPHI 3.8 Battery	
Rated kWh Capacity per Battery	3.8 kWh DC @ 100% DoD 3.04 kWh DC @ 80% DoD (recommended)
MAX Continuous Discharge Rate	37.5 Amps DC (1.9 kW DC)

Multiply by the number of AmpliPHI batteries in the battery bank for total capacity and power ratings.

Note: In a DC Coupled system, the AmpliPHI battery's maximum charge rate (37.5 Amps DC, or 1.9 kW DC) need not be considered when sizing the AmpliPHI battery bank. DC coupled photovoltaic (PV) connected via the Sol-Ark's charge controllers will limit charging current based on the Sol-Ark's **Max A Charge** setting without issue.

$$\text{Charge Example: } B_{\#PV} \geq \frac{PV_{kW}}{0.8 \times Bat_{kW}}$$

- AC Coupled Solar PV Array is rated at 8 kW
- PHI 3.8 kWh-51.2V$_{nom}$ battery has a maximum continuous charge rate of 1.92 kW$_{DC}$

$$B_{\#PV} \geq \frac{8_{kW}}{0.8 \times 1.92_{kW}} = 5.2$$

A properly sized PHI battery bank based on the maximum charge from the AC Coupled solar PV array has a **minimum of 6 batteries**. This helps ensure that the battery bank receives as much charge as possible from the AC Coupled solar PV.

> ⚠️ CAUTION: USING FEWER THAN THE CALCULATED NUMBER OF PHI BATTERIES IN THIS AC COUPLED CHARGE CALCULATION MAY RESULT IN LIMITEDLY EFFECTIVE CHARGING FROM AC COUPLED PV IN OFF-GRID OR GRID-OUTAGE CONDITIONS. WHEN THE OUTPUT OF THE AC COUPLED SOLAR PV ARRAY EXCEEDS THE MAX A CHARGE PARAMETER, AND FREQUENCY SHIFT IS UNABLE TO MITIGATE THE OUTPUT, THE BATTERY CHARGING WILL BE INTERRUPTED. TO AVOID THIS, PV ARRAY SIZING NEEDS TO BE ADJUSTED TO ACCOMMODATE THE MAX A CHARGE PARAMETER FOR THE OVERALL SYSTEM.

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Homeowners with little to no loads on during the day (while solar power production is at its peak) might consider sizing a larger PHI battery bank to take advantage of the entire solar PV output potential for battery charging. Homeowners that consistently power loads during peak solar power production times may require a smaller sized battery bank.

4.0 – Program Settings for PHI Batteries

The AmpliPHI battery is capable of automatically communicating many of the battery's operating parameters to the Sol-Ark equipment. Parameters that must be manually programmed into the Sol-Ark are **in red** in Table 1 on page 12.

4.1 – Depth of Discharge

To optimize the PHI batteries' and overall system's performance and life, SimpliPhi Power highly recommends programming the equipment settings for an 80% maximum Depth of Discharge (DoD). Maintaining the PHI battery at this DoD ensures the greatest level of SimpliPhi battery health. This affects the "Start %" parameter in the **Charge** menu and the "Shutdown", "Low Batt", and "Restart" parameters in the **Discharge** menu, marked **in red** in Table 1 on page 12.

> ⚠️ CAUTION: IF A FIRMWARE UPDATE IS EXECUTED ON THE SOL-ARK 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 and Charger Settings

Refer to Sol-Ark's **Menus and Programming** online video (https://www.youtube.com/watch?v=mcXXzgfRT90&t=1497s) for guidance on programming the settings outlined in Table 1 below.

Press the gear icon to get to the **Settings** menu (Figure 6), then press **Battery Setup** (Figure 7) to program the parameters in Figure 6 and 7 below.

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Figure 6: Sol-Ark Home Screen (Touchscreen), from the Sol-Ark Installation Manual
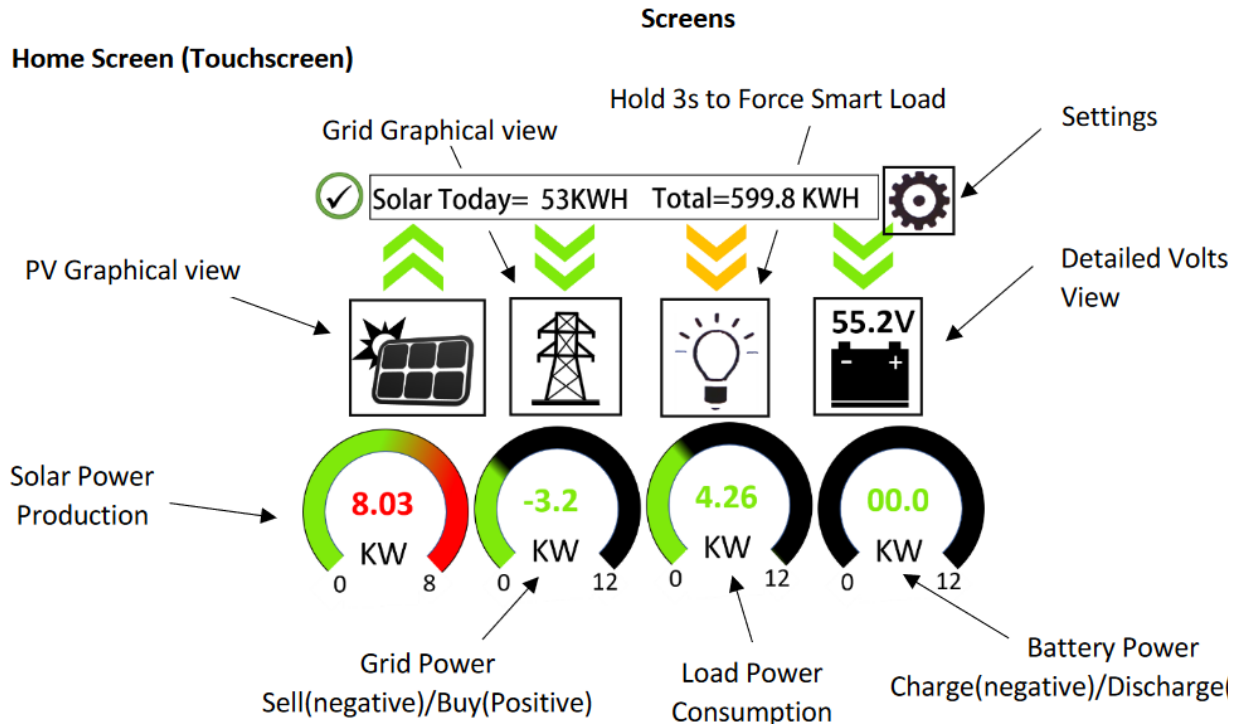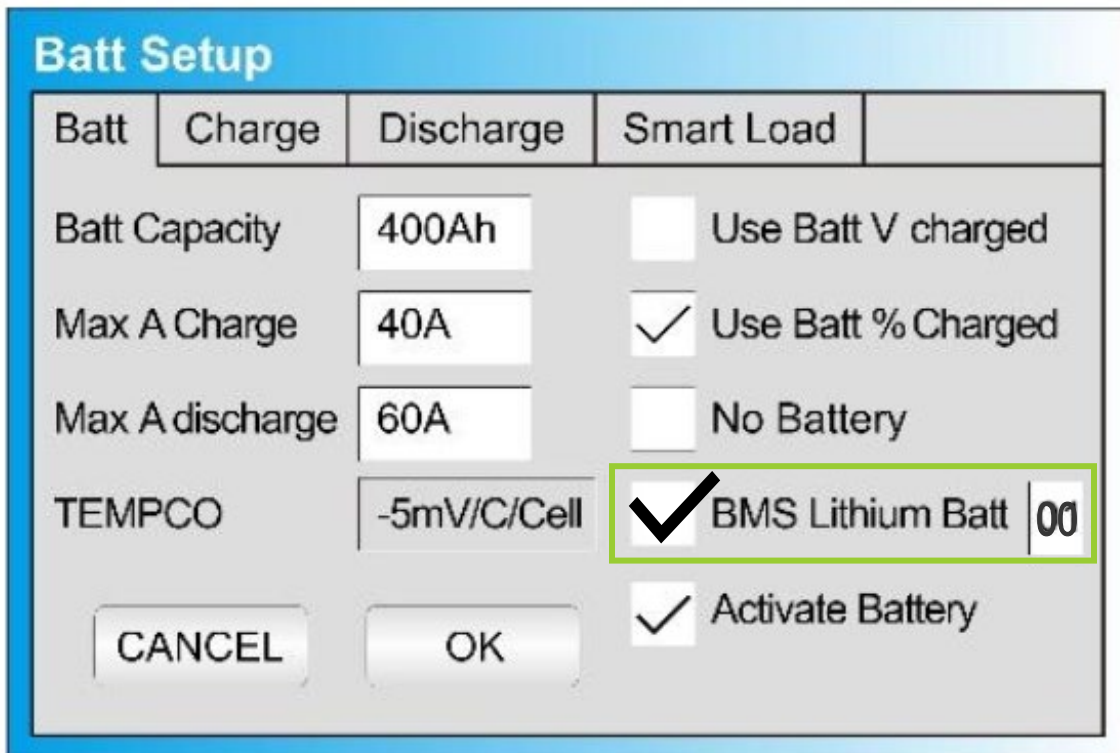
Figure 7: Sol-Ark System Setup Screen, from the Sol-Ark Installation Manual

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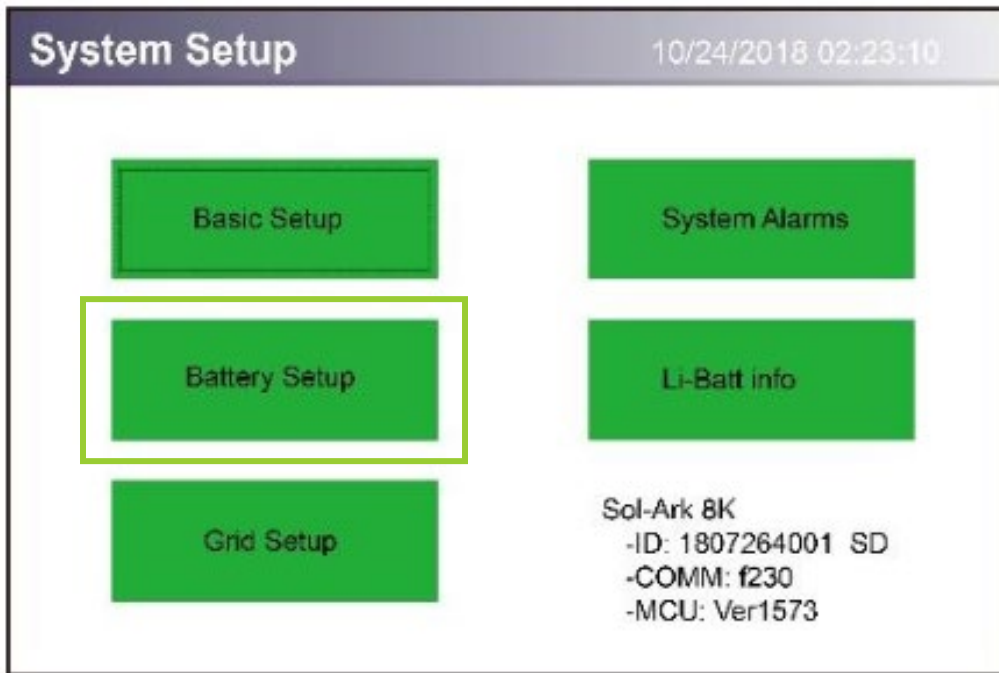
Checking the **BMS Lithium Batt** box in the Batt Setup menu's "Batt" tab _first_ will auto-populate all values communicated from the AmpliPHI batteries to the Sol-Ark (see Figure 8 below). These auto-populated parameters will include:

- Batt Capacity (Battery Setup → Batt menu)
- Max A Charge (Battery Setup → Batt menu)
- Max A Discharge (Battery Setup → Batt menu)
- TEMPCO (Battery Setup → Batt menu)
- A (referring to Gen/Grid Charge Amps in the Battery Setup → Charge menu)
- Float V (Battery Setup → Charge menu)
- Absorption V (Battery Setup → Charge menu)
- Equalization V / days / hours (Battery Setup → Charge menu)

Figure 8:   BMS Lithium Batt Box to be Checked First

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Table 1 – Sol-Ark Battery Settings for AmpliPHI Battery Models

System Setup > Battery Setup	for your reference	AmpliPHI
> Batt Tab		
BMS Lithium Batt	Manually check this box	
Batt Capacity	75 Ah per AmpliPHI 3.8 battery	BMS handles SOC determination.
		No manual programming needed
Max A Charge[1,2]	≤37.5 ADC per PHI 3.8 battery (Lower charge rates improve battery life)	BMS auto-populates Max A Charge.
		No manual programming needed.
Max A Discharge[1]	≤37.5 ADC per PHI 3.8 battery	BMS auto-populates Max A Discharge. No manual programming needed.
TEMPCO	0 mv/C/Cell (disabled)	BMS auto-populates TEMPCO.
		No manual programming needed.
Use Batt V Charged	not checked	
Use Batt % Charged	Manually check this box	
No Battery	not checked	
Activate Battery	do not check this box	
> Charge Tab		
Start V	Use Start % instead of Start V when using	
	Batt % Charged instead of Batt V Charged (in the Batt tab)	
Start %[3]	80% DoD – 21%	
	90% DoD – 11%	
	100% DoD – 1%	
A[1,4]	≤37.5 ADC per AmpliPHI 3.8 battery	BMS auto-populates Charge A.
		Lower charge rates improve battery life, which can be manually set)
Gen Charge / Grid Charge[5]	Check the Gen Charge box when a generator is connected to the Gen Input breaker.	
	Check the Grid Charge box when a generator is connected to the Grid Input breaker,	
	or when a grid connection is utilized to charge the batteries.	
Float V	54 V	BMS auto-populates this setting.
		No manual programming is needed.
Absorption V[6]	56 V	BMS auto-populates this setting.
		No manual programming is needed.
Equalization V[7]	56 V	BMS auto-populates this setting.
	30 days	No manual programming is needed.
	2 hours	
> Discharge Tab		
Shutdown	80% DoD – 20% (50.2 V)	80% DoD – 20%
	90% DoD – 10% (49.5 V)	90% DoD – 10%
	100% DoD – 0% (48 V)	100% DoD – 0%
Low Batt	80% DoD – 30% (50.5 V)	80% DoD – 30 %
	90% DoD – 20% (50.2 V)	90% DoD – 20%
	100% DoD – 10% (49.5 V)	100% DoD – 10%
Restart	>1% Greater than the programmed Low Batt Value	
Batt Resistance	Resistance mOhms = 24 ÷ (PHI 3.8 battery quantity)	

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Batt Charge Efficiency	99%	BMS handles SOC determination
> Smart Load Tab		
Use Gen input as load output	*check this box if the Smart Load feature applies (refer to Section 5 of this Guide)*	
Smart Load OFF Batt[8]	95% (51.7 V)	
Smart Load ON Batt[9]	100% (52.5 V)	
	Wattage value is used in grid-connected systems only. This value represents the minimum power required of the solar array before the Smart Loads are powered.	
For Micro inverter input	*check this box for AC coupled systems*	
Smart Load OFF Batt[10]	100% (52.5 V)	
Smart Load ON Batt[11]	30 – 95%	

Notes:

1. These settings are calculated by multiplying the per-battery value by the number of batteries in the connected battery bank.
2. **Max A Charge** refers to the maximum charge rate from the solar PV array. Programming this value to the maximum value versus the reduced-stress value does not impact the AmpliPHI Battery Warranty.
3. If the Auto Generator Start is utilized, the AGS is triggered when the batteries reach this set State of Charge (SoC) percentage. Once triggered, the generator charges the batteries until they reach approximately 95% SoC, at which point the generator turns off. This 95% SoC parameter is not programmable.
4. **A** refers to the maximum charge rate from the grid or the generator. If the Sol-Ark is connected to both the grid and a standby generator, the Sol-Ark prioritizes the grid as the batteries' charging source. Programming the **A** value to the maximum value versus the reduced-stress value does not impact the AmpliPHI Battery Warranty.
5. By default, battery charging from the solar PV array is prioritized over generator or grid charging.
6. When the battery has reached the Absorption voltage setpoint, the Sol-Ark utilizes constant-voltage regulation to maintain the battery at the programmed Absorption voltage. The Absorption phase lasts until the batteries charge at 2% of the programmed Ah size. For example, one AmpliPHI 3.8 battery (rated at 75 Ah), will remain in the Absorption charging phase until the number of Amps used to charge the battery decreases to 1.5 Amps DC (2% of 75Ah).
7. While the AmpliPHI Battery does not require an Equalization charge, programming Equalization to the voltage, frequency and duration outlined in the table above ensures that the Sol-Ark's internal SoC meter re-sets to 100% SoC every 30 days.
8. Smart Loads are no longer powered via solar and/or batteries when the batteries' SoC level drops below this programmed **Smart Load OFF Batt** value.
9. Smart Loads are powered via solar and/or batteries when the batteries' SoC level exceeds this programmed **Smart Load ON Batt** value.
10. The Sol-Ark stops charging the batteries and powering the loads from the AC Coupled solar PV array once the batteries' SoC level reaches the **Smart Load OFF Batt** value.
11. The Sol-Ark triggers the AC Coupled solar PV array to produce power (powering the loads and charging the batteries) when the batteries' SoC level exceeds this programmed **Smart Load ON Batt** value.

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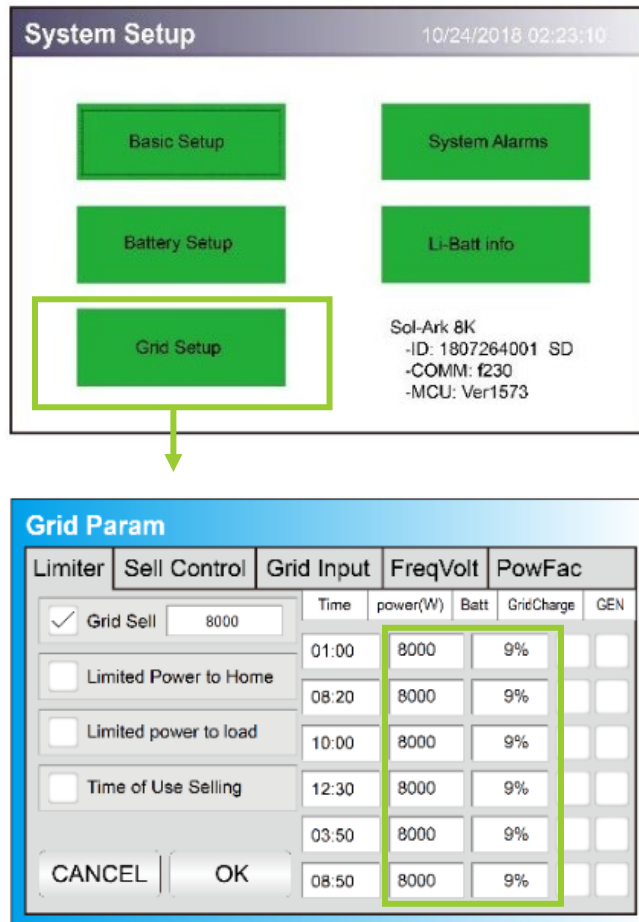
⚠️	CAUTION: WHILE SOL-ARK SETTINGS MUST BE ADJUSTED WITH ANY CHANGE IN THE PAIRED QUANTITY OF STANDARD (NON-COMMUNICATIONS) PHI BATTERIES, AN INCREASE OR DECREASE IN THE NUMBER OF AMPLIPHI BATTERIES IN A BANK RESULTS IN AUTOMATICALLY ADJUSTED CAPACITY AND CHARGE/DISCHARGE CURRENT SETTINGS IN THE SOL-ARK EQUIPMENT. SIMPLIPHI ASKS THAT YOU CHECK THE ADJUSTED PARAMETERS' VALUES HAVE AUTOMATICALLY UPDATED CORRECTLY.

4.3 – Grid Setup

The Sol-Ark's Grid Setup menu includes many advanced features (refer to Section 5 of this Guide). Regardless of the features used, the AmpliPHI battery bank should never discharge more than its maximum continuous discharge rate. Furthermore, to maintain the AmpliPHI batteries' optimal (10,000-cycle level) life, also do not discharge the battery bank to a State of Charge (SoC) level less than 20%. These details are controlled in the Grid Setup menu's Limiter tab. (Figure 9)

Figure 9: Limiter Tab in Grid Setup menu

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The **power (W)** column in Figure 4 above dictates the maximum amount of power pulled from the batteries and should be set to the AmpliPHI battery bank's maximum discharge rate <u>in AC Watts</u>. To calculate the connected AmpliPHI battery bank's maximum discharge Watts (AC):

1. Multiply the number of batteries in the bank by the maximum discharge rate (ADC) per battery
   a. AmpliPHI 3.8 battery max. discharge rate = 37.5 ADC per battery
2. Convert the battery bank's DC discharge current to DC discharge watts.
3. Apply the discharge efficiency.

The following Tables 2 and 3 describe the continuous power output limitations of the AmpliPHI 3.8 model batteries. Populate the power (W) column according to these tables.

Populate the Batt column to the right of the power (W) column according to the degree to which you wish to discharge the battery bank. Again, to maintain the AmpliPHI batteries at the 10,000-cycle life level, do not populate the Batt column with any value less than 20%.

Table 2 – Conversion from DC to AC Discharge Limit for 1 to 6 AmpliPHI 3.8 Batteries

A	B	C	D	E
# of Parallel Batteries	DC Current Limit	ADC X VDC (48)	WDC X Discharge Efficiency (95%)	MAX Battery Output (WAC)
1	37.5 Amps DC	1,800 Watts DC	1,710 Watts AC	1,710 Watts AC
2	75 ADC	3,600 WDC	3,420 WAC	3,420 WAC
3	112.5 ADC	5,400 WDC	5,130 WAC	5,130 WAC
4	150 ADC	7,200 WDC	6,840 WAC	6,840 WAC
5	187.5 ADC	9,000 WDC	8,550 WAC	8,550 WAC*
6	225 ADC	10,800 WDC	10,260 WAC	10,260 WAC*

Note: Sol-Ark's Manual shows these power (W) parameters programmed to 1,000 Watts × PHI Battery Quantity. While there is no harm in using this approximation, the greater values outlined in the tables above may be used.

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5.0 – Use Cases & Application Notes

Sol-Ark equipment includes many advanced programming features and a variety of modes (more than one mode can be used simultaneously). This section of the Guide will outline the system programming and setup basics for common use cases. However, refer also to the Sol-Ark Manual for all installation requirements relevant to the application at hand.

Table 3 – Sol-Ark Grid Settings

System Setup > Grid Setup	80% DoD (10k cycle warranty)	90% DoD (5k cycle warranty)	100% DoD (3.5k cycle warranty)
> Limiter Tab			
Grid Sell	check this box when exporting solar PV power to the grid		
	(Net Energy Metering agreement required)		
	set the numerical value to the maximum number of exporting Watts		
Limited Power to Home	check this box when powering both the critical loads sub-panel and		
	the main house breaker panel using solar and/or battery,		
	without exporting energy to the grid (limiter sensors required)		
Limited power to load	check this box when powering the critical loads sub-panel using solar and/or battery		
Time of Use Selling	check this box when discharging the batteries during set times		
	(either the Grid Sell or Limited Power to Home box must also be checked)		
Time	sets the time at which the batteries discharge to power both the critical loads sub-panel and the main house breaker panel (limiter sensors required)		
power (W)	sets the maximum amount of power discharged from the batteries during the set time		
	do not exceed the Wattage values listed in Tables 2 or 3 above		
Batt	the percentage SoC to which the batteries discharge during the set time		
	20%	10%	0%
Grid Charge	check this box to allow for grid-to-battery charging during the set time		
GEN	check this box to allow for gen-to-battery charging during the set time		
> Sell Control Tab	80% DoD	90% DoD	100% DoD
General Standard	check this box when a generator is wired to the Grid Input		
	or to use the Protect Param settings listed in the Grid Input tab		
UL 1741 & IEEE 1547	check this box for grid sell compliant functionality (default)		
CA Rule 21	check this box for compliance with CA Rule 21		
UL 1741SA	check this box for compliance with HECO Rule 14H and/or PREPA		
GEN connect to Grid input	check this box when a generator is wired to the Grid Input		
> Grid Input Tab			
Grid Frequency	select 50 Hz or 60 Hz		
Grid Type	select 120/240V split phase (North America),		
	or contact SimpliPhi to special-order 220V single phase or 120/208V 3 phase		
Protect Param	leave as default values when UL 1741 & IEEE 1547 are enabled		
	frequency values may change when a generator is wired to the Grid Input		
> FreqVolt tab	refer to the Sol-Ark Manual for Puerto Rico or Kauai-specific settings		

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5.1 – AC Coupled

In an AC Coupled system setup, the grid-tie inverter(s) output – string or micro-inverters – is wired to the Sol-Ark's Generator Input (40A double-pole breaker) and the **For Micro inverter input** box in the **Smart Load** tab of the **Battery Setup** menu must be checked:

Figure 10: Smart Load Tab in Batt Setup menu
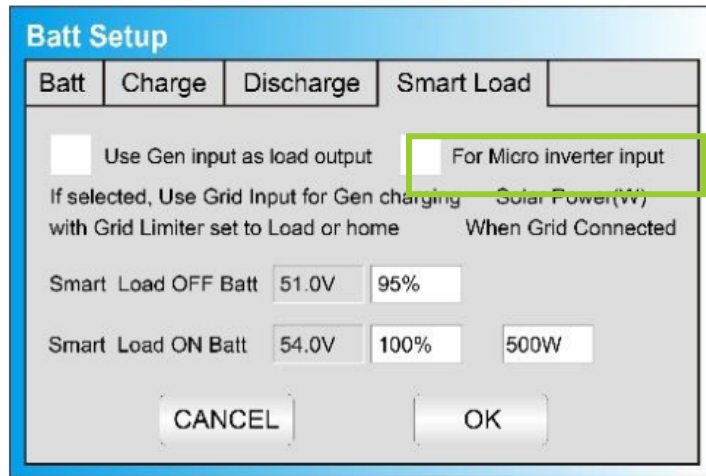
The Sol-Ark-8K is limited to a maximum of 7 kW of AC Coupled solar PV, and the Sol-Ark-12K is limited to 7.6 kW of AC Coupled solar. AC Coupled systems can operate in Grid Sell / Grid-Tied with Battery Backup, Limited to Home, Limited to Load, or Time of Use Selling modes.

5.2 – Grid Sell / Grid-Tied with Battery Backup

A net energy metering agreement with the utility company is required in order to sell energy from the solar PV array to the grid. In this mode, the Sol-Ark prioritizes powering all loads (on both the critical loads sub-panel and the main house breaker panel) from solar PV first (if available), then (2) grid, (3) generator, and (4) batteries. In the event of a grid failure, the batteries will power the critical loads sub-panel only. Take care to size the battery bank accordingly; in a grid failure scenario, the Sol-Ark does not limit the batteries' maximum current output. The maximum power draw (kW) on the critical loads sub-panel should not exceed the maximum continuous discharge rate of the AmpliPHI battery bank. Refer to the Discharge Calculation in Section 3 of this Guide:

$$B_{\#Inv} \geq \frac{Inv_{kW} \div Inv_{eff}}{Bat_{kW}}$$

Discharge Example:

- Circuits on the critical loads sub-panel amount to a maximum potential power draw of 30 Amps at 240 VAC, or 7.2 Kw_{AC}
- Sol-Ark-8K inverter DC-to-AC efficiency is 95.5%
- AmpliPHI 3.8 battery has a maximum continuous discharge rate of 1.92 kW_{DC}

$$B_{\#Inv} \geq \frac{7.2_{kW} \div 0.955_{eff}}{1.92_{kW}} = 3.9$$

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A properly sized AmpliPHI battery bank based on the maximum draw of the critical loads sub-panel has a **minimum of 4 batteries**, even in this Grid-Tied with Battery Backup application. Note also that during a grid failure, the critical loads' maximum energy draw (kWh) is also limited by the battery bank's capacity.

5.3 – Limited to Home

Checking the **Limited power to Home** box in the **Limiter** tab of the Sol-Ark's **Grid Setup / Grid Param** menu allows for all loads* (on both the critical loads sub-panel and the main house breaker panel) to be powered using the connected solar PV and/or batteries. The Sol-Ark prioritizes powering these loads from solar PV first (if available), then (2) grid, (3) generator, and (4) batteries. To prioritize the batteries' use over the grid or generator during specific set times, also use the **Time of Use Selling** mode.

*While the **Limited to Home** mode *allows* for all loads to be powered using solar PV and/or batteries, the Sol-Ark prioritizes powering loads on the critical loads sub-panel first, and loads on the main house breaker panel are offset by solar (and/or batteries, during Time of Use Selling mode times) *as much as possible*. If the loads' draw exceeds the available power from the solar PV array and (with **Time of Use Selling** mode also in play) the batteries have also discharged to their minimum programmed SoC percentage level, the Sol-Ark will then resort to powering loads using grid power.
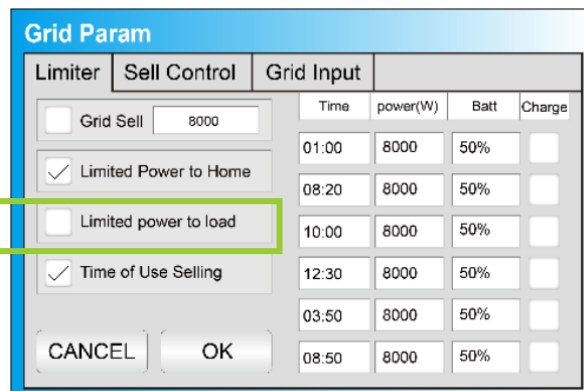
> ⚠️ **CAUTION: IN LIMITED TO HOME MODE, LIMITER SENSORS ARE REQUIRED TO ENSURE THAT THE HOME'S MAIN BREAKER PANEL CIRCUITS ARE POWERED WITHOUT EXPORTING ENERGY TO THE GRID.**

5.4 – Limited to Load

Checking the **Limited power to load** box in the **Limiter** tab of the Sol-Ark's **Grid Setup / Grid Param** menu discharges the battery to power the critical loads sub-panel's loads. The **Limited to Load** mode does not allow for any solar or battery energy to power the main house breaker panel and it does not allow for any solar or battery energy to be exported to the grid.

Figure 11: Limiter Tab in Grid Setup Menu

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5.5 – Time of Use Selling / Energy Arbitrage

Discharge batteries to power circuits during specific set times. Program these times to coincide with the utility company's peak pricing times to avoid high energy charges from the utility.

Homeowners who have a net energy metering agreement with the utility company can use both **Grid Sell** and **Time of Use Selling** modes to sell solar PV and battery energy (until the minimum programmed SoC percentage level) back to the grid during peak sun-hour times and then discharge the batteries during programmed times, usually in the afternoon and evening. Depending on whether **Limited power to load** or **Limited Power to Home** is enabled, the batteries will power either the critical loads sub-panel only (**Limited to Load**) or the critical loads sub-panel and the main house breaker panel (**Limited to Home**) during the **Time of Use Selling** time period. Make sure to size the battery accordingly. (Refer to the Discharge Example in the **Grid Sell / Grid-Tied with Battery Backup** section of this Guide for battery bank sizing when batteries power the critical loads sub-panel only. Refer to the Discharge Example in Section 3 of this Guide for battery bank sizing when the batteries power both the critical loads sub-panel and the main house breaker panel.)

Homeowners who do not have a net energy metering agreement use both **Limited Power to Home** and **Time of Use Selling** modes to prioritize powering all loads (circuits both on the critical loads sub-panel and the main house breaker panel) from the solar and/or batteries during programmed times. Refer to the Discharge Example in Section 3 of this Guide for battery bank sizing when the batteries power both the critical loads sub-panel and the main house breaker panel.
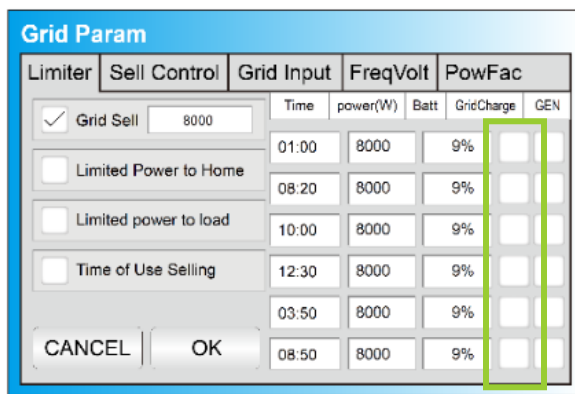
> ⚠️ **CAUTION: EITHER THE GRID SELL OR THE LIMITED POWER TO HOME MODE (CHECK THE APPROPRIATE BOX IN THE GRID SETUP / GRID PARAM MENU) MUST BE USED IN CONJUNCTION WITH TIME OF USE SELLING.**

During **Time of Use Selling** times, loads are powered from solar first (if available), batteries second, and the grid third (if batteries have discharged to their programmed minimum SoC percentage level).

Make sure the **GridCharge** box is <u>unchecked </u>during peak pricing times so that the batteries do not charge when energy from the utility company is most expensive (see Figure 12).

Figure 12 – Limiter Tab in Grid Setup menu

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5.6 – Off-Grid

The Sol-Ark automatically operates in **Off-Grid** mode when it does not detect a grid connection.
In an Off-Grid system setup, all the home's loads are connected to the Sol-Ark's Load Output (50A double-pole breaker).

Do not use the Sol-Ark's **Grid Sell** and **Limited to Home** modes in an off-grid system setup.
Check the **Limited power to load** box in the **Limiter** tab of the Sol-Ark's **Grid Setup / Grid Param** menu to allow for the batteries' power to discharge to the connected loads.

5.7 – Generators

The Sol-Ark's built-in Auto Generator Start functions as a 2-wire automatic switch.
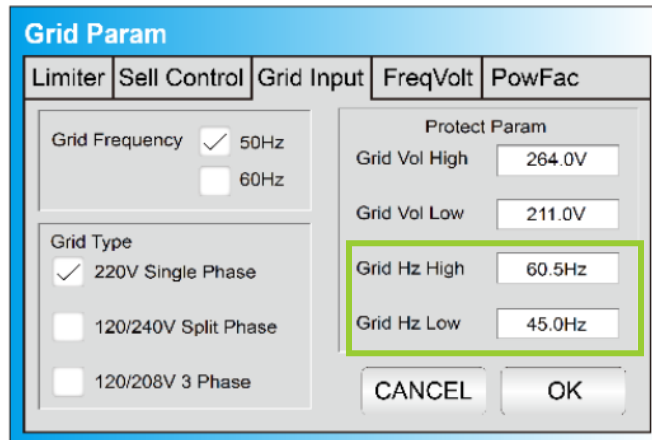
The Sol-Ark's Grid Input breaker can be used as the generator's input breaker. In this scenario, check the **General Standard** box and the **GEN connect to Grid input** box in the **Grid Param** menu's **Sell Control** tab:

Figure 13 – Sell Control Tab in Grid Setup menu
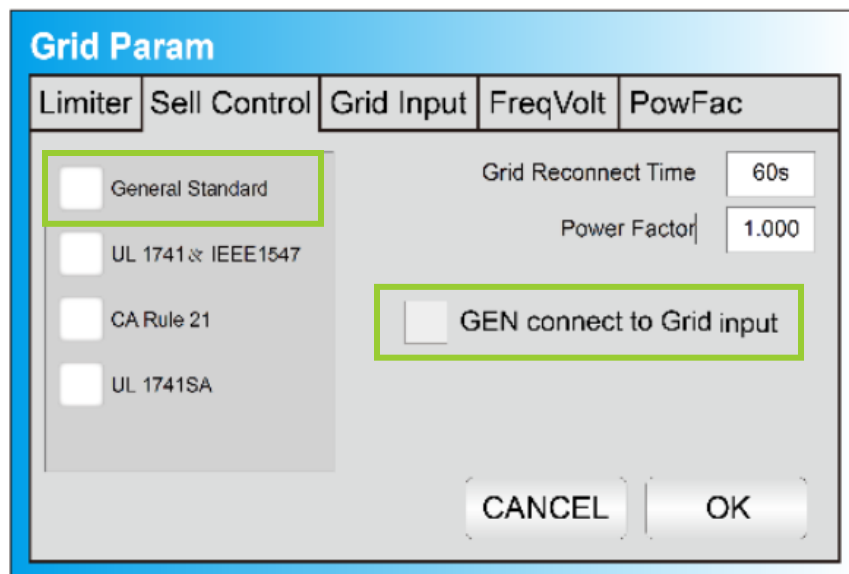
Due to the fact that many generators' output frequency is usually less precise than the grid's, the frequency parameters in the **Grid Param** menu's **Grid Input** tab may also need adjustment to accommodate a wider frequency range:

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Figure 14 – Grid Input Tab in Grid Setup menu

Homeowners who wish to include a grid connection, generator, and Smart Load functionality can install a transfer switch allowing for either grid or generator to connect to the Sol-Ark's Grid Input. This frees up the Sol-Ark's Generator Input to be used as an output for Smart Loads (see the following Smart Loads section for more details).

In an AC Coupled system setup that includes a generator, using a transfer switch for a grid-or-generator connection to the Sol-Ark's Grid Input also frees up the Sol-Ark Generator Input for connection to the AC Coupled solar PV array.

If the system includes both a generator and a grid connection, limiter sensors are required. While smaller generators (less than 10 kW) can be wired to the Sol-Ark's Generator Input, Sol-Ark recommends wiring larger generators to a whole home transfer switch instead of using the inverter's Generator Input.

5.6 – Smart Load

The Smart Load feature allows the homeowner to run higher power non-essential appliances (hot water, dehumidifier, heat pump, irrigation pump, etc.) on solar when excess solar power is available. This setup involves connecting these higher power non-essential loads to the Sol-Ark's Generator Input. To partially protect the batteries against over-discharge, set the **Smart Load Off Batt** and **Smart Load ON Batt** parameters to the batteries' acceptable SoC percentage range while in this mode. However, note that no programmable parameter exists to regulate the batteries' over-discharge from a *current* perspective.

For example, an off-grid system with home loads totaling a maximum instantaneous power draw of 8 kW might include 5 AmpliPHI 3.8 batteries, with a maximum combined continuous power output of 9.6 kW$_{DC}$ / 9.168 kW$_{AC}$. With both the **Smart Load** and **Limited to Load** modes enabled and the **Smart Load ON Batt** parameter set to 100% SoC, the Sol-Ark will begin powering the Smart Loads (in addition to all the home loads) when the batteries are at 100% SoC. If the Smart Load power draw exceeds 9.168 kW$_{AC}$, (38.2 Amps at 240VAC), the batteries will then be operating beyond their maximum continuous power output capabilities. While the batteries have a maximum surge discharge capability of 60 Amps DC per battery (15.36 kW$_{DC}$ / 14.669 kW$_{AC}$ for the 5-battery bank), the batteries cannot surge at this power level for more than 10 minutes. A Smart Load drawing more than 9.168 kW$_{AC}$ for more than 10 minutes will very likely result in the batteries' SoC level reaching the **Smart Load OFF Batt** parameter, if it is set to 95%. However, feel free to reach out SimpliPhi

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Power Technical Support (TechSupport@SimpliPhiPower.com) if the Smart Load feature will be used and battery bank sizing clarification according to Smart Load-specific loads needs to be clarified.

Note that in a grid-connected system that utilizes the **Smart Load** feature, the Wattage value to the right of the **Smart Load ON Batt** parameter in the **Smart Load** menu tab (see Figure 5) represents the minimum power required of the solar PV array before the Smart Loads are powered. Therefore, that Solar PV Wattage value can be added to the battery bank's maximum output power rating when comparing maximum available solar and battery power available, against the Smart Load power draw:

$$Smart\ Load\ Draw\ (kW) \leq Solar\ PV\ (kW) + Batttery\ Bank\ MAX\ Output\ Power\ (kW)$$

> ⚠️ CAUTION: SMART LOADS' MAXIMUM POWER DRAW CANNOT EXCEED THE GENERATOR INPUT BREAKER'S 40 AMP / 240VAC RATING.

6.0 – Specifications & Warranty

For your reference:

- See AmpliPHI 3.8 Specifications Sheet.
- See [PHI Battery 10 Year Limited Warranty](#)

  Failure to adhere to installation protocol will void the Warranty.

7.0 – SimpliPhi Power Technical Support

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

805.640.6700

techsupport@simpliphipower.com