Battery Bank Sizing

Please make sure to go through these steps to make sure you have properly sized your system to avoid damaging your battery. There are 4 ways of properly calculating the battery bank size for a given system as outlined below:

1. **Match Overcurrent Protection Device (OPD) Ratings**
   $\sum_{battery\ bank\ breakers} \geq \sum_{inverter\ breakers}$
2. **Match Inverter Surge Rating to Maximum Current Rating of Battery**
   $\sum_{battery\ bank\ cotinuous\ rating} \geq \sum_{inverter\ cotinuous\ rating}$
   &
   $\sum_{battery\ bank\ surge\ rating} \geq \sum_{inverter\ surge\ rating}$
3. **Match Charge Controller to Battery Bank charge capacity**
   $\sum_{battery\ bank} \max charge\ current \geq \sum_{charge\ controller} \max output$
4. **Calculate the required battery bank capacity based on actual loads**
   $$\frac{\sum_{total\ energy\ used\ (kwh)}}{\sum_{total\ available\ battery\ capacity\ (kwh)}} x\ 100\% \leq 80\%$$

For the following battery bank size calculations, the below system assumptions apply:

- 1 Schneider XW+6848 Inverter utilizing the supplied 250A DC Breaker
  - Nameplate Capacity: 6,800 Watts continuous / 136A DC
  - Surge Capacity: 12,000 Watts for 60 seconds / 240A DC
- 2 Schneider MPPT-60-150 charge controllers
  - Nameplate Capacity: 60A DC / ~3000 Watts DC per Charge Controller
  - Nameplate Capacity for 2 parallel charge controllers: 120A DC

- The LFP-5 has a 125A breaker

$$\sum_{(2)\ LFP-5\ battery\ breakers} (125A + 125A) \geq \sum_{inverter\ breakers} (250A)$$

- The LFP-10 has a 150A breaker

$$\sum_{(2)\ LFP-\ battery\ breakers} (150A + 150A) \geq \sum_{inverter\ breakers} (250A)$$

- A single eVault 18.5 has a 250A breaker

$$\sum_{eVault\ battery\ breakers} (250A) \geq \sum_{inverter\ breakers} (250A)$$

2. Match Inverter Surge Rating to Maximum Current Rating of Battery:

- A single XW+6848 Inverter has a continuous rating of 136A and a surge capacity of 240A.
- The continuous rating of LFP-5: 80A; The surge capacity of LFP-5: 180A; The continuous rating of LFP-10: 100A; The surge capacity of LFP-10: 180A;

$$\sum_{(2)\ LFP-5\ battery\ continuous\ rating} (80A + 80A) \geq \sum_{inverter\ continuous\ rating} (136A)$$

$$\sum_{(2)\ LFP-\ battery\ continuous\ rating} (180A + 180A) \geq \sum_{inverter\ continuous\ rating} (136A)$$

$$\sum_{(2)\ LFP-\ surge\ rating} (125A + 125A) \geq \sum_{inverter\ surge\ rating} (240A)$$

$$\sum_{(2)\ LFP-\ surge\ rating} (180A + 180A) \geq \sum_{inverter\ surge\ rating} (240A)$$

- The eVault 18.5 has a continuous rating at 180A and surge capacity at 240A, but ONLY for 5 sec, while the inverter can surge for 60 sec. You will need 2 of eVault to handle inverter's 60 sec surge.

$$\sum_{(1)\ eVault\ \ battery\ continuous\ rating} (180A) \geq \sum_{inverter\ continuous\ rating} (136A)$$

$$\sum_{(2)\ eVault\ \ surge\ rating} (240 + 240A) \geq \sum_{inverter\ surge\ rating} (240A)$$

3. Match Charge Controller to Battery Bank charge capacity.

- Each MPPT-60-150 charge controller has a maximum output current of 60A. Two parallel MPPT-60-150 charge controllers can put out 120A.
- The Technical Specifications for the LFP-5 & LFP-10 batteries have a maximum charge current of 80A.

$$\sum_{(2)\ LFP-5\ battery\ \max char\ \ rating} (80A + 80A) \geq \sum_{inverter\ \max ch\ \ rating} (120A)$$

$$\sum_{(2)\ LFP-10\ battery\ \max cha\ \ rating} (80A + 80A) \geq \sum_{inverter\ \max char\ \ rating} (120A)$$

- The eVault has a maximum charge current of 170A.

$$\sum_{(1)\ eVault\ battery} \max charge\ rating\ (170A) \geq \sum_{inverter} \max charge\ rating\ (120A)$$

Since the charge controllers can put out 120A DC and the inverter can put out 136A DC, the sum of the two charging sources (solar and grid) equals 256A, which exceeds the 200A charge capacity of the battery bank. Since we do not want to limit the solar PV source, the only option is to limit the charge current of the inverter. **In this case the inverter's internal charger must be limited to a maximum of 80A. (58% of the inverter's 136A charger capacity) In the settings menu for the inverter charger, the charge capacity should be set to a lower setting that 58%, for instance ~50% (68A).**

4. Calculate the required battery bank capacity based on actual loads.

Every load on the Back-Up Panel will need to be analyzed (load power and duration). All total energy is calculated by summing the individual energies for each load. Assume the following loads and a customer who wants to run 24 hours off batteries only:

1	Appliance	Running wattage	Operating hours/day	Daily Consumption
2	Refrigerator	250 W	12 hrs/day	3 kWh
3	Lights:	100 W	6 hrs/day	0.6 kWh
4	Well Pump	3000 W	1 hr/day	3.0 kWh
5	Internet and continuous Phantom Loads	100 W	24 hrs/day	2.4 kWh
6	TV	200 W	4 hrs/day	0.8 kWh
			Sum	**9.8 kWh**

REMINDER! Always try to maintain the recommended Depth of Discharge (%DOD) of 80%, for healthy battery life and performance.

- 2 LFP-5's = 10.24kwh. Compared to the required hypothetical sum, this roughly yields a 97% DOD. Therefore, not acceptable.
- 1 LFP-10 = 10.2kwh. Offering 2 LFP-10's at 20.4 kwh yields approx. 48% DOD. Acceptable, but oversized.
- 1 eVault at 18.5kwh however, would be the best option.

$$\frac{\sum_{total\ energy\ used\ (kwh)}(9.8kWh)}{\sum_{total\ available\ battery\ capacity\ (kwh)}(18.5kWh)} x\ 100\% = 53\%$$

If the customer cannot supply the load information, or assumptions cannot be made, the rule of thumb as an absolute minimum battery size is to match the power rating of the inverter in kW to the energy rating of the battery in kWh. A single Schneider inverter is rated at 6.8 kW meaning a minimum battery size of 6.8 kWh would be required. In

that case an LFP-10, with an 80% discharge capacity of 8 kWh would be enough to meet the minimum battery size by this very basic calculation method.

Setting up a Fortress Power Lithium Battery using Schneider Equipment

Inverter/Charger Settings

Parameter Setting for Fortress Battery with Schneider Conext XW+ Inverter

Advanced Setting > Inverter Settings		
	80% DoD, 6000 cycles	90% DoD, 3000 cycles
Low Battery Cut Out Voltage	48V	48 V
LBCO Hysteresis	2.0 V	
LBCO Delay	10 Sec	
High Battery Cut Out Voltage	LFP-5, LFP-10 & LFP-15: 63 V eVault: 61 V	
Search Watts	Default	
Search Delay	Default	
Charger Setting > Custom Setting		
Battery Type	Custom	
Charge Cycle	2StgNoFloat	
Bulk Voltage	54.4 V	54.6 V
MaxBulkCurrent	LFP-5 & LFP-10: 50A per battery eVault: 100A per battery	LFP-5 & LFP-10: 80A per battery eVault: 150A per battery
Max Discharge Current	LFP-5 & LFP-10: 90A per battery eVault: 180A per battery	
Battery Capacity	LFP-5: 100 Ah per battery LFP-10: 200Ah per battery eVault: 360Ah per battery	
Max Charge Rate*	LFP-5 & LFP-10: 50A per battery eVault: 100A per battery	LFP-5 & LFP-10: 80A per battery eVault: 160A per battery
Default Battery Temperature	Warm	
Recharge Volts	51.5 V	
Grid Support Volts **	53.6 V	
Absorb Volts	54.5 V	
Absorb Time	2 Minutes	
Charge Block Start	Default	
Charge Block Stop	Default	

⚠ **Please reassess capacity and charge/discharge current settings, when Fortress battery quantities change.**

How to calculate the max Charge Rate % for Inverter(s) and Charge Controller(s):

$$* \; \boldsymbol{Max\ Charge\ Rate}\ \% = \frac{\boldsymbol{Battery\ Max\ Charge\ Current}}{\boldsymbol{Inverter\ Maximum\ Output\ Charge\ Current}} \times \mathbf{100}$$

RULE: I *Battery Max Charge* > I *Charge Controller Max Charge* + I *Inverter Max Charge*

Example: 2 Schneider MPPT 60/150; 1 XW+ 6848; 2 LFP-10

Recommend setting: **I** *Battery Max Charge = 80A per Battery; Total:* ***160A***

I *Charge Controller Max Charge =60A (100%) per Charge Controller; Total 120A*

I *Inverter Max Charge must be less than or = 40A (Charger set to 28% of max.*

****The Parameter Setting for Grid-tie Sell Mode:**

In a DC coupled system, the **Grid Support or Enhanced Grid Support** mode with XW+ (including XW) automatically supplies PV power to the loads and any surplus power can be sold back to the grid. This mode of operation assures the batteries are kept as completely charged as possible.

The **Enhanced Grid Support** is suitable for Conext Systems with only Conext MPPT Solar Controller(s) networked to Conext XW+ units through Xanbus.

Grid Support Mode is used for the systems with DC Sources not communication over Xanbus.

Advanced Setting > Inverter Settings	
Enhanced Grid Support	59.0 V (Schneider Charge Controller)
Grid Support	53.0V (non-Schneider Charge Controller)
Recharge Volts	51 V
Max Sell Amps	**Total PV array/240V/inverter No.
Advanced Setting > Charger Setting	
Recharge Volts	52 V

*** For example, if the system has a 10 KW PV array and 2 of XW+ 5848 inverters, the Max Sell Amps per inverter will be 10,000W/240V/2 = 21A*

MPPT Charge Controller Settings

In a DC coupled system, solar controller(s) must be used to regulate the PV power and charge the batteries. Schneider offers two different MPPT Charge controller that are compatible with Fortress Lithium batteries.

Parameter Setting for Fortress Batteries with Schneider XW+ MPPT 60/80

Advanced Setting > Charger Setting		
Battery Type	Custom	
Custom Setting		
	80% DoD, 6000 cycles	90% DoD, 3000 cycles
Eqlz Support	Disable	
Bulk Voltage	54.4 V	54.6 V
Absorb Voltage	54.4 V	54.6 V

Float Voltage	54.4 V	
Battery Temperature Compensation	0mV/C	
Battery Capacity	LFP-5: 100 Ah per battery LFP-10: 200Ah per battery LFP-15: 300Ah per battery eVault: 360Ah per battery	
Max Charge Rate *	LFP-5, LFP-10 & LFP-15: 50A per battery eVault: 100A per battery	LFP-5, LFP-10 & LFP-15: 80A per battery eVault: 160A per battery
Charge Cycle	Warm	
Recharge Volts	52.0 V	
Absorb Time	2 Minutes	
Default Battery Temperature	Warm	
Battery Voltage (Auto-detected)	48V	
Aux Settings		
…	Default	

Please reassess capacity and charge/discharge current settings, when Fortress battery quantities change.

$$* \boldsymbol{Max\ Charge\ Rate}\ \% = \frac{\boldsymbol{Battery\ Max\ Charge\ Current}}{\boldsymbol{Inverter\ Maximum\ Output\ Charge\ Current}} \times \mathbf{100}$$

Conext Battery Monitoring Settings

The Conext Battery Monitoring is designed for Lead Acid and not recommended for Lithium Batteries.

Please reassess capacity and charge/discharge current settings, when Fortress battery quantities change.

Setting up a Fortress Power Lithium Battery using Schneider Equipment

(Single XW+6848 inverter and XW+ MPPT60-150 Charge Controller with a System Control Panel; The Following Setup Assumes a Grid-Interactive/Battery Back-Up system that is DC Coupled (uses a DC Charge Controller) to the PV Array).

1. **Summary Installation:** If familiar with Schneider Programming with a System Control Panel, a summary of the settings follows:
    a. Multi-Unit Configuration: Set Inverter and Charge Controller Device Numbers to [01] (or any other unique number).
    b. Set the Inverter for:
        i. Charger Enabled
        ii. Grid Support Enabled, and Grid Support Volts to 59V (enhanced mode). If non-Xanbus/3rd Party Charge Controller then 54.0V
        iii. Sell Mode Enabled
    c. Set Charger Menu in both Inverter and Charge Controller:
        i. Custom Battery
        ii. Equalization: OFF/Disabled
        iii. Set Battery Capacity to: 200Ah (LFP-10) or 300Ah (LFP-15) or 360Ah(eVault)
        iv. Absorb and Bulk V: 54.4V for 80% DoD (or 54.6V for 90% DOD)
        v. Float V: 54.4V
        vi. Absorb Time: 2 min.
        vii. Temp Compensation: 0mV/C
        viii. Set ReCharge V to 50V.
        ix. Charge Mode: Inverter to 2-Stage, CC to 3-Stage
        x. Max. Charge Rate: Inverter 70%, CC to 100%
        xi. For Inverter: LBCO to 48V, Delay to 30s.
        xii. For Inverter: HBCO to 61V for eVault or 63V for LFP-10 and LFP-15

2. **Detailed System Commissioning:** (For Single XW+ Inverter with a Power Distribution Panel and MPPT-60-150 Charge Controller in a DC Coupled System with a System Control Panel connected via Xanbus network):
    a. Recommended: Qualified Personnel familiar with Solar PV/Battery Back-Up and Schneider Equipment.
    b. The following assumes all Equipment installed per manufacturer's installation manuals and Xanbus network connected to Inverter, Charge Controller, and System Control Panel (SCP).
    c. In Power Distribution Panel Make Sure Grid AC Breaker (AC1 60A 2-pole) is off, and Load Breaker (60A 2-pole) is OFF (or ON if Load Panel is already energized). Bypass Breaker in Bypass. All DC Breakers OFF.
    d. Turn on 250A DC breaker in Power Distribution Panel to power up Inverter (and Xanbus Network). Both the Inverter should power up and the System Control Panel should power up. A fault may occur such as New Device Found. Press the Exit button SCP several times to get to main screen.
    e. Use the Arrow Keys on the SCP to highlight the XW+6848 Device and press Enter (to reach the main System Status screen, press the Exit button several times from any screen which will keep backing out of the menu system until

reaching the main System Status Screen. When in System Status screen, use the down arrow key to choose the XW+6848 device, press Enter). The XW+6848 Setup menu appears.

f. To enter the “Advanced Settings” menu press simultaneously the Enter + up arrow + down arrow keys, then release all keys. The “Advanced Settings” option appears in the Setup menu. Use the arrow keys to highlight Advanced Settings and press Enter.
g. Use the Arrow Keys to highlight “Multi-Unit Configuration” press Enter.
    i. Use the arrow keys to highlight “Dev Number”. Press Enter.
    ii. The cursor should be on the Device Number [00]. Use the Arrow keys to set device to [01]. Press Enter to save setting.
    iii. Press Exit to get back to “Advanced Settings” screen.
h. Use the arrow keys to highlight “Charger Settings” and press Enter.
    i. Use Arrow Keys to highlight “Batt Type” and Press Enter. Use Arrow Keys to change battery type to [Custom]. Press Enter.
    ii. The Charger menu will now display “Custom Settings” as an option, use Arrow Keys to highlight “Custom Settings” and press Enter.
    iii. In Custom Settings, the general procedure is to use the arrow keys to highlight the desired menu option, then Enter. The highlight shifts to the menu setting where the arrow keys are used to change the menu setting to the desired one. After the desired setting appears, press Enter to save the setting.
        1. With the above procedure set Eqlz Support to Disable
        2. Set Bulk Voltage to 54.4 for 80% DoD (54.6 for 90%DoD – 3000 cycles)
        3. Set Absorb Voltage to 54.4 for 80% DoD (54.6 for 90%DoD)
        4. Set Float Voltage to 54.4
        5. Set Batt Temp Comp to 0mV/C
    iv. Press Exit to get back to Charger Settings Screen
        1. Set Battery Capacity to 200Ah (LFP-10) or 300Ah (LFP-15) or 360Ah (eVault)
        2. Set Max Chg Rate to 50%
        3. Set Charge Cycle to 2-Stage
        4. Set Default Batt Temp to Warm
        5. Set ReCharge Volts to 51
        6. Set Absorb Time to 2 min
        7. Press Exit to return to “Advanced Settings” Menu
i. Press Exit until XW+6848 01 Setup menu is displayed
    i. From the Setup Menu, set the following:
        1. Inverter – Enabled
        2. Search Mode – Disabled
        3. Grid Support – Enabled
        4. Charger – Enabled
        5. Force Chg – None
        6. Equalize – Disabled (if it appears on the menu)
        7. Mode – Operating
j. From the Setup Screen highlight Advanced Settings and press Enter

i. Highlight the Inverter Settings Option and Press Enter
    1. From the Inverter Menu set Low Batt Cut Out to 48V
    2. Set LBCO Delay to 30s
    3. Set High Batt Cut Out to 61V for eVault or 63V for LFP-10 and LFP-15
ii. Use the Exit Button to get back to the Advanced Settings Menu, highlight Grid Support and press Enter.
    1. From Grid Support Menu set Grid supp Volts to 59V (enhanced mode with Schneider Charge Controllers on Xanbus Network). For non-Xanbus/3rd Party Charge Controllers set to 54.0V
    2. Set Sell to Enabled
    3. Set Max Sell Amps to 27A
    4. Set Load Shave to Disabled

k. Hit the Exit Button several times to get back to System Status screen.
    i. At this point the AC 1 Grid Breakers can be turned on. The inverter will start-up and begin a charge cycle. The charging amps can be viewed on the SCP or on the Inverter display.
    ii. Once the Inverter gets AC power from the grid, the load breaker can be turned on and bypass breakers put into normal mode (Bypass off, load breaker on).
    iii. The inverter is now operating.

l. With both the PV Input and Battery Breakers to the MPPT60-150 charge controller in the off position, the next step is to program the charge controller.
    i. Turn the Charge Controller Main Battery Breaker (100A) on. The charge controller display should turn on and the SCP should register a new device (could show a fault).
    ii. Highlight the new device (MPPT60) and Press Enter (Alternatively from the SCP System Status Menu press Enter, use the Arrow Keys to highlight MPPT60 and press Enter).
    iii. From the MPPT60 Setup Menu, enter the Advanced Settings Menu by Simultaneously pressing Enter + arrow up + arrow down. Release buttons and “Advanced Settings” menu option should appear.
    iv. Use Arrow Keys to highlight Advanced Settings and Press Enter.
    v. Use the Arrow Keys to highlight Multi Unit Config and press Enter.
        1. From the Multi Menu use arrow keys to highlight Dev Number, press Enter
        2. Use Arrow Keys to set Dev Number to [01], press Enter
        3. Press Exit to get back to Advanced Settings Menu
    vi. From the Advanced Settings Menu highlight Charger Settings and Press Enter.
        1. Use Arrow Keys to highlight “Batt Type” and Press Enter. Use Arrow Keys to change battery type to [Custom]. Press Enter.
        2. The Charger menu will now display “Custom Settings” as an option, use Arrow Keys to highlight “Custom Settings” and press Enter.
        3. In Custom Settings, the general procedure is to use the arrow keys to highlight the desired menu option, then Enter. The

highlight shifts to the menu setting where the arrow keys are used to change the menu setting to the desired one. After the desired setting appears, press Enter to save the setting.

a. With the above procedure set Eqlz Support to Off
b. Set Equalize Voltage to 54.4V
c. Set Bulk Voltage to 54.4 (54.6 for 90%DoD – 3000 cycles)
d. Set Absorb Voltage to 54.4 (54.6 for 90%DoD)
e. Set Float Voltage to 54.4
f. Set Batt Temp Comp to 0mV/C

4. Press Exit to get back to Chrg Menu. From the Chrg Menu Set the Following:
    a. Set Batt Capacity to 200Ah (LFP-10) or 300Ah (LFP-15) or 360Ah (eVault)
    b. Set Max Chg Rate to 100%
    c. Set Charge cycle to 3-Stage
    d. Set ReCharge Volts to 51V
    e. Set Absorb time to 2 min
    f. Set Default Batt Temp to Warm
    g. Set Batt Voltage to 48.0V
    h. Press Exit Several times to get to System Status menu

m. Turn on PV Breaker to Charge Controller. The Charge Controller should wake-up in several seconds. Confirm CC is producing power by checking the charge controller display screen (Battery Volts, PV Watts, and PV Amps should be displayed.
n. After the charge cycle ends (2 minutes after charger enters absorb mode, use the SCP to check that the system is producing PV power and if the DC power is more than the load power, the inverter should be selling excess power to the grid (green kw led is blinking on inverter display).

3. System Check:

a. Turn off 60A AC breaker (Grid) in Power Distribution Panel (this shuts off AC power to inverter). Inverter should begin to immediately “invert” and continue supplying load panel with 120V/240V 60Hz.
b. Shut off PV Disconnect, PV to charge controller breaker (now inverter is inverting only from batteries). Confirm 120V/240V 60Hz at Load Panel
c. Turn on PV Disconnect
d. Turn on 60A AC Breaker.
e. Confirm battery reaches full charge and system begins selling AC back to AC1 panel once again. This could take up to 5 minutes after an AC1 failure).