

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 Rating to Maximum Current Rating of Battery

 $\sum_{battery \ bank \ cotinuous \ rating} \geq \sum_{inverter \ cotinuous \ rating}$ &

 $\Sigma_{battery \ bank \ surge \ rating} \geq \Sigma_{inverter \ surge \ rating}$

- 3. Match Charge Controller to Battery Bank charge capacity $\Sigma_{battery \ bank \ max \ charge \ current} \geq \Sigma_{cha}$ controller $\max_{a} \ output$
- 4. Calculate the required battery bank capacity based on actual loads

 $\frac{\sum_{total \; energy \; used \; (kwh)}}{\sum_{total \; available \; battery \; capacity \; (kwh)}} x \; 100\% \; \le \; 80\%$

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

- 1 Outback Radian 8048 Inverter utilizing (2) 104A DC Breakers
 - Nameplate Capacity: 8000 Watts continuous / 156A DC
 - Surge Capacity: 12,000 Watts for 5 seconds / 240A DC
- 2 Outback FLEXmax 80 charge controllers
 - Nameplate Capacity: 80A DC / ~4000 Watts DC per Charge Controller
 - Nameplate Capacity for 2 parallel charge controllers: 160A DC

1. Match Overcurrent Protection Device (Breaker Sizes):

- A single Radian 8048 inverter has (2) 104A breakers
- The LFP-5 has a 125A breaker





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

 A single Radian 8048 Inverter has a continuous rating of 156A and a surge capacity of 240A.





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.

1. 2 LFP-5's = 10.24kwh. Therefore, not acceptable.

 $\frac{\sum_{total energy used (kwh)}(9.8kWh)}{\sum_{total available battery capacity (kwh)}(10.24kWh)} x \ 100\% = 97\% \le 80\%$

2. 1 LFP-10 = 10.2kwh. Offering 2 LFP-10's at 20.4 kwh yields approx. 48% DOD. Acceptable, but oversized.

 $\frac{\sum_{total \; energy \; used \; (kwh)}(9.8kWh)}{\sum_{total \; available \; battery \; capacity \; (kwh)}(20.4kWh)} x \; 100\% \; = 48\% \leq \; 80\%$

3. 1 eVault at 18.5kwh however, would be the better option.

 $\frac{\sum_{total energy used (kwh)}(9.8kWh)}{\sum_{total available battery capacity (kwh)}(18.5kWh)} x \ 100\% = 53\% \le 80\%$

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 Radian 8048 is rated at 8kW meaning a minimum battery size of 8kWh would be required. In that case two LFP-5, with an 80% discharge capacity of 8kWh would be enough to meet the minimum battery size by this very basic calculation method.



This guide covers the recommended set up and configuration of Outback equipment for optimizing performance with Fortress LFP batteries. More information on Fortress products can be found on our website: <u>www.fortresspower.com</u>

Integrating with a Radian/FXR

Absorb Voltage and Time54.4, 0.3 hour54.6, 0.3 hourFloat Voltage and Time54.4 Time = 0 = DisableRe-float Voltage52.5Re-Bulk Voltage51.5AC Input ModeGrid Tied (default, adjust as needed)AC Charger Limit in ACLFP-5/LFP-10:17A@240V or 34A@120V per battery eVault: 30A@240V or 60A@120V per batteryLow Battery Cut-Out Voltage50.8LBCO Delay120 secondsLow Battery Cut-in Voltage51.2High Battery Cut-Out Voltage58HBCO Delay10 secondsHigh Battery Cut-in Voltage55.5SellRE (Offset) Voltage53.2Charge Controller54.9, 0.2 hours				
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Charge Controller				
Absorb voltage and Time 54.8, 0.3 nours 56, 0.3 nours				
Float voltage 54				
Rebulk Voltage 51.5				
DC Current Limit ** LFP-5/LFP-10:80 A per battery				
eVault: 150 A per battery				
Absorb End Amps 0				
FLEXnet DC (FN-DC)				
Battery AH LFP-5: 100 per battery				
LFP-10: 200 per battery				
evault: 360 per battery				
Charged Deturn Amno 104				
Charged Return Amps T0A				
Palay Invert Logia				
Relay Invert Logic No				
$\begin{array}{c} \text{Relay voltage} \\ \hline \\ $				
Relay SOC High/Low SOC High = 0% SOC Low = 0%				
Relay DelayHigh = 1, Low = 0				
MATE3/MATE3s				
FLEXnet DC Advanced Low SOC Warning = 15%				
FLEXnet DC Advanced Critical SOC Warning = 10%				

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



Integrating with a SkyBox

The settings below should be programmed into the unit under the Custom choice. Please consult the SkyBox Programming Guide for detailed instructions on how to adjust these settings.

Inverter		
Maximum SOC	100%	
Minimum SOC	20%	
Absorb Charge	Timed	
Absorb Voltage	54.4 Vdc	
Absorb Time	00:20	
Float Charge	Disabled	
Float Voltage	Can be left at default	
Float Time	Can be left at default	
Re-float Voltage	52.5 Vdc	
Re-bulk Voltage	51.5 Vdc	
Equalize Voltage	54.4 Vdc	
Minimum Equalize Time	00:00	
Max Charge Current (Adc)	LFP-5 & LFP-10: 50Adc	
	eVault: 100Adc	
Max Discharge Current	LFP-5 & LFP-10: 90Adc	
(AdC)	eVault: 125Adc	
Grid Charge Limit (kW)	Site specific	
Low Battery Cutout	50.2 Vdc	
LBCO Delay	15 seconds	
Low Battery Cut-in	51.0 Vdc	
High Battery Cutout	56.0 Vdc	
HBCO Delay	10 seconds	
High Battery Cut-in	55.5 Vdc	
Battery Series	Custom	
Battery Model Number	Custom	
Battery Description	Fortress Power	
Battery Total Amp-Hours	LFP-5: 100Ah	
	LFPP-10: 200Ah	
Charge Efficiency Faster	evault: 360 An	
Absorb End Amps	10.0 Aac	

**Ensure the maximum battery charging current is not exceeded after all charge controll ers are taken into consideration (i.e. – 2 FM100 controllers would charge at 200 Adc tot al, a violation of the limit if only one LFP-10 is used).



Best Practice Operation

During testing, it was seen that a commissioning charge was necessary to properly calibrate the SkyBox state of charge monitor. If possible, a full load test should also be performed. Each time the battery reaches the low battery cutout voltage, the SkyBox recalculates a state-of-health (SOH) for the battery. This number is used to more accurately track the SOC.

Should you have any questions, please don't be hesitate to contact us!

Warm regards from Fortress team