Fortress Power

Lithium Energy Storage Systems

Alternative Energy Plus

FORTRESS Power
SECURE YOUR ENERGY

President-Barry Moore

- *15+ years experience in renewable energy*
- *30+ years experience as Financial Executive with serveral large multinational companies*
- *Involved in numerous non-profits supporting renewable energy*
- *Built several successful and profitable businesses in Asia, North America and Europe*
- *Elected township official*

Jing Yu-Managing Director

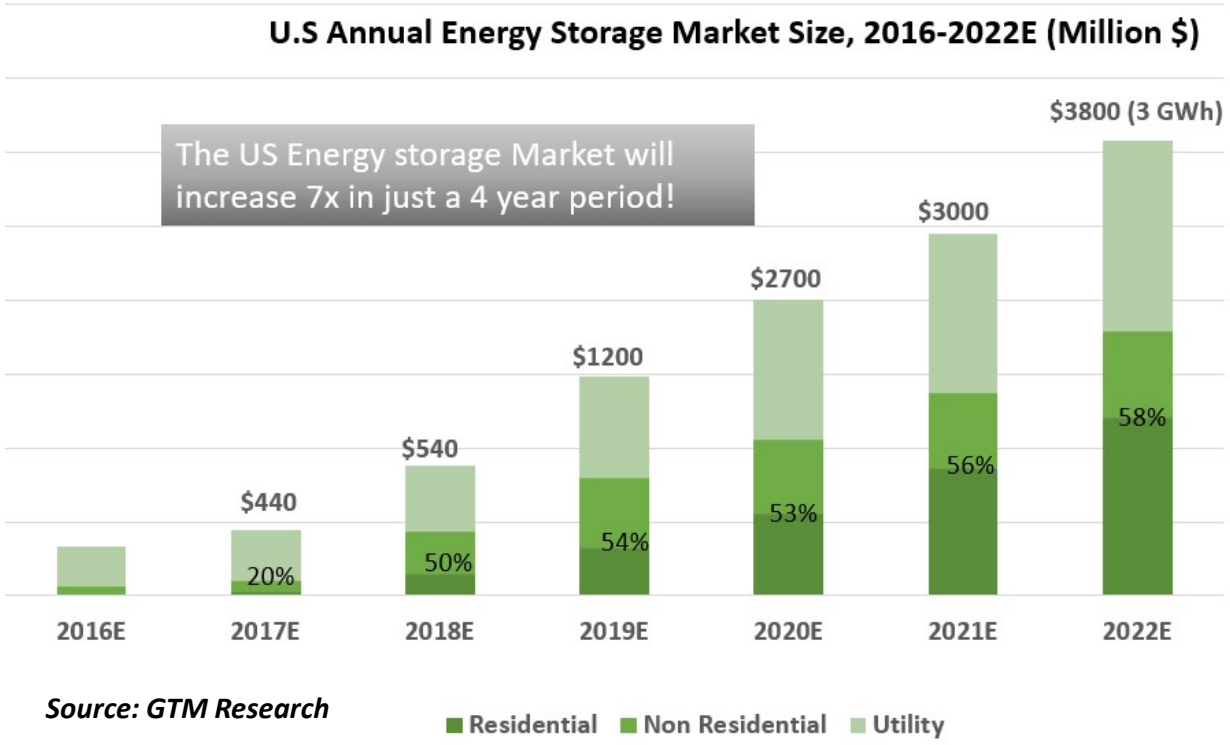
- *Graduated as Electrical Engineer at Hannover University, Germany*
- *Received MBA degree at Würzburg University, Germany*
- *10 + years as Country Manager for a solar module manufacturer*
- *Managing Director at Fortress Power since 2016*

Topic

- Growth Opportunity
- Company Introduction
- Lithium Iron Phosphate Technology
- Battery Technology Comparison
- Compatible Inverter
- Design Guide
- Installation Guide

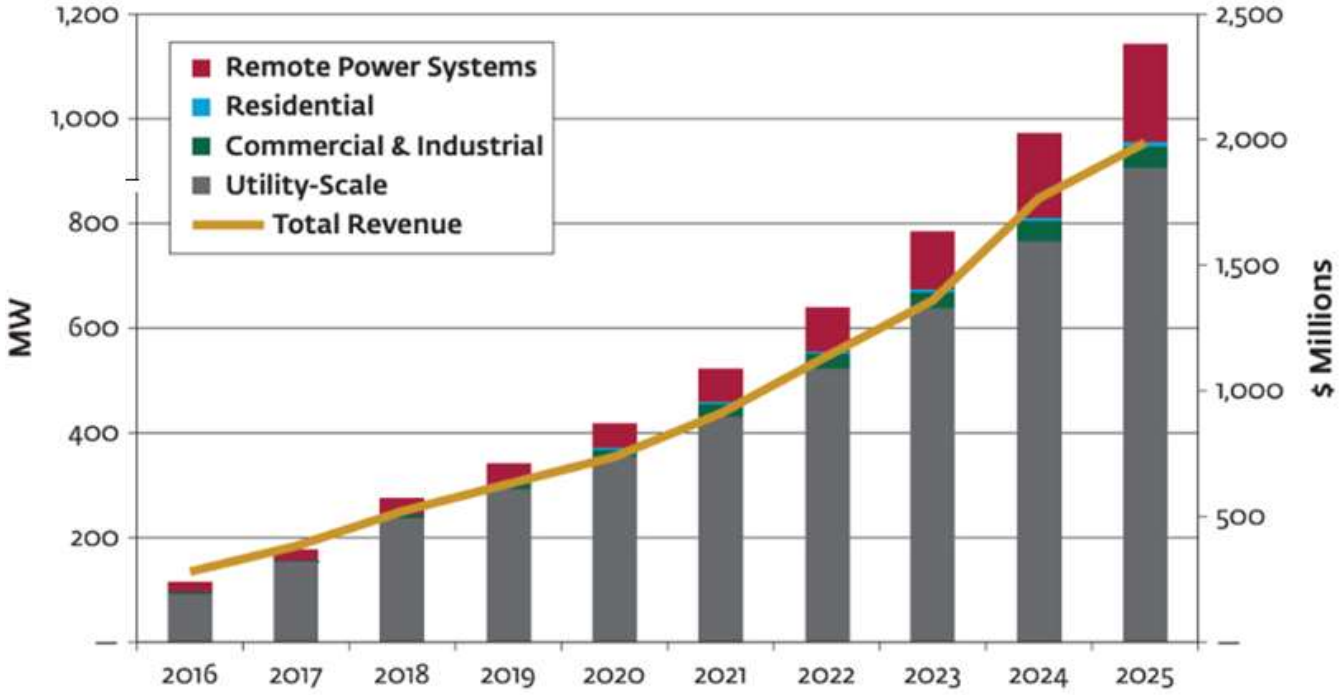
Growth Opportunity

US Energy Storage Market



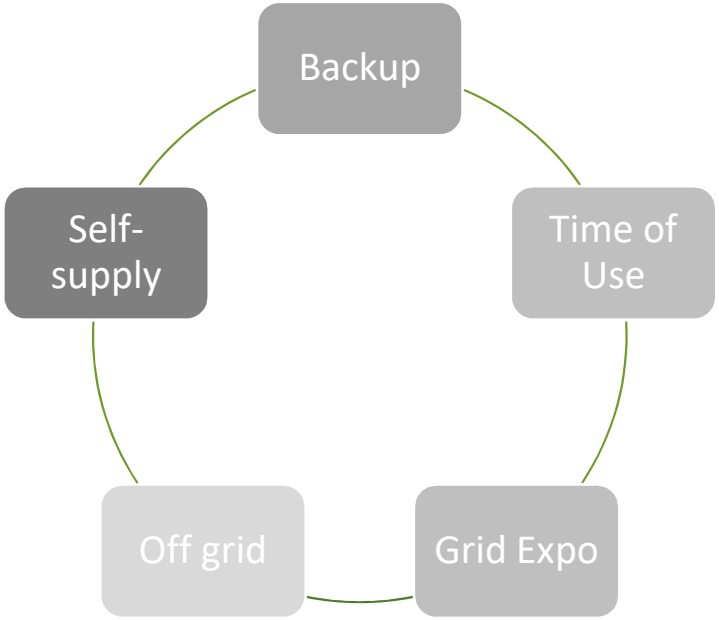
Source: GTM Research

Central & Latin America Energy Storage Market



Annual stationary Energy Storage Deployments by Segments Central & Latin America, (2016-2025); Source IFC ES Report

Energy Storage Benefits



Back Up Your Facility
Power your facility when the grid is off; keep solar panels running during outages.

Maximize Your PV Production
Store excess solar power for later use.

Save Money on your Electric Bill
Charge the batteries at off-peak times; discharge them during peak periods.

Tax and Incentives
30% ITC available if it's powered by solar; enjoy state and utilities rebates

Company Introduction

Mission Statement

"Our mission is to provide clean and affordable energy to millions of homes and businesses."

-Barry Moore, President

Company Introduction

A world-leading manufacturer who brings automotive Lithium Ferro Phosphate batteries to the energy sector

U.S Headquarters, Southampton, PA
(30,000 Sqf)

Manufacturing Facility, Shenzhen China
(since 2008)

Fortress Lithium Battery

Lithium Ferro Phosphate Technology

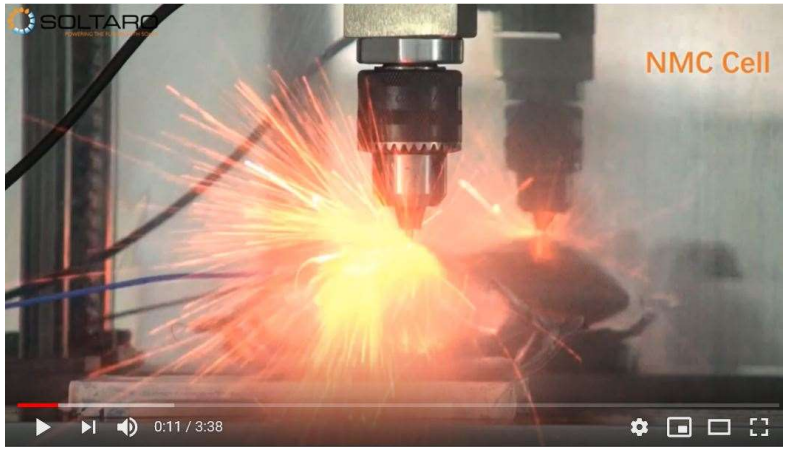
We incorporate the safest technology available into our batteries.

	Fortress Power	**Tesla, LG Chem, Panasonic**
Chemistry	Lithium Ferro Phosphate (LFP)	Lithium Ion or Nickel- Magnesium -Cobalt (NMC)
Safety	✓	X
Eco-friendly	✓	X
Life Cycles	6000	< 3000
Operating Temperature	32– 140 °F	32 – 113 °F
Degradation Rate	LFP < NMC	
Energy density	LFP < NMC	

Search LFP vs. NMC nail test videos on YouTube

Highest Safety Standard

Lithium Iron Phosphate Technology (Fortress Power)



Nickel-Manganese-Cobalt Technology (Tesla)

View LFP vs. NMC nail test video on YouTube

Fortress Lithium Batteries

LFP-10

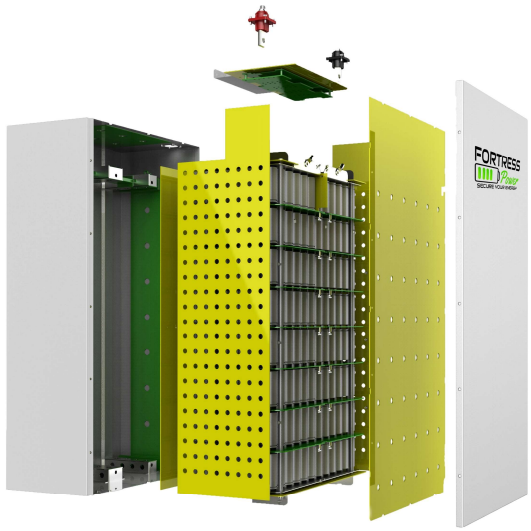
eVault 16.5

- ✓ ***Safe Lithium Chemistry***
- ✓ ***Large Capacity for Easy Installation***
- ✓ ***98% Round Trip Efficiency***
- ✓ ***Long Lasting***
- ✓ ***Competitively Priced***
- ✓ ***Lowest Cost Per Cycle***
- ✓ ***Maintenance-free***

Smart Battery Management System (BMS)

Multilevel Safety Concept for Highest Reliability

- ✓ Overcharge and Deep Discharge Protection
- ✓ Over-heat Protection
- ✓ Over Current Protection
- ✓ Cell Monitoring and Balancing
- ✓ Voltage and Temperature Monitoring



LCD Monitoring of eVault 16.5

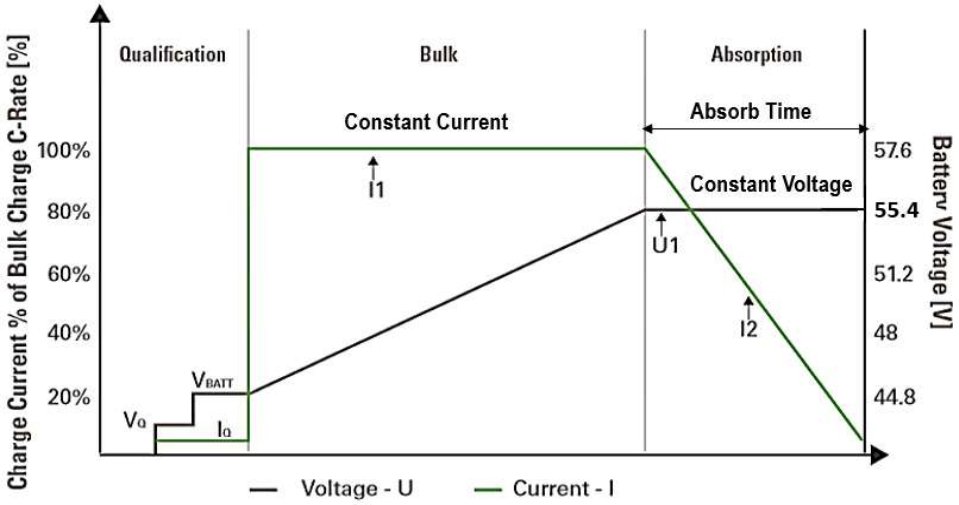
Information on LCD Display:

- ✓ Voltage
- ✓ Current In/Output
- ✓ State of Charge
- ✓ Power In/Output
- ✓ Safety Warning: Over-charging & -discharging; Over Current; Over-Heat

Technical Specification

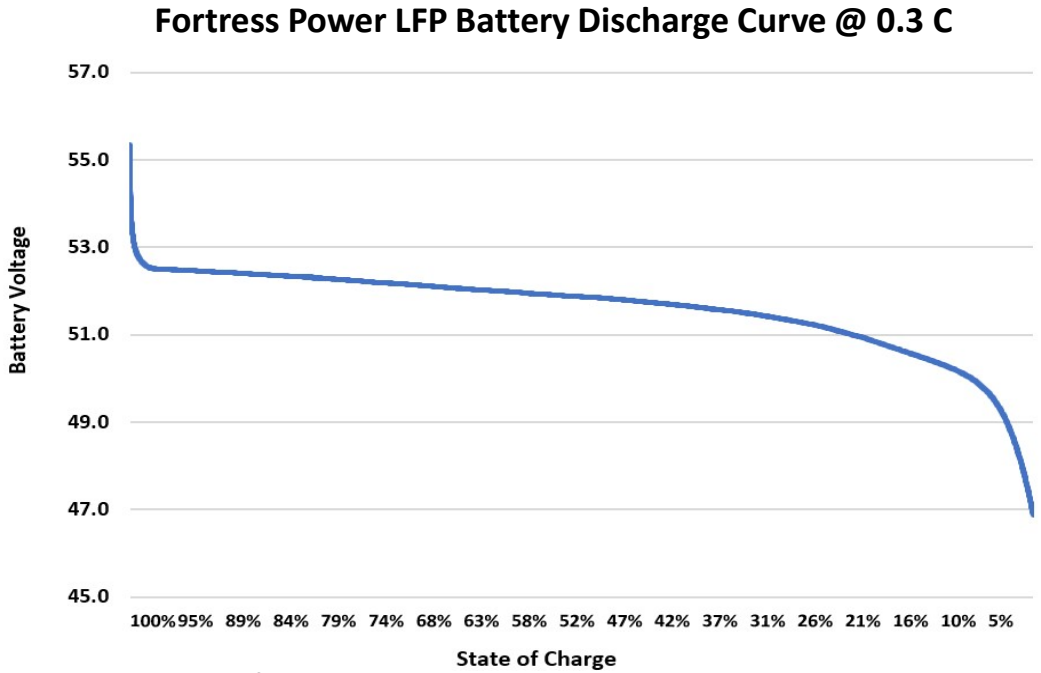
	LFP-10	eVault 16.5
Total Energy [KWH]	10.2	**18.4**
Usable Energy [KWH]	10.2	16.5
Capacity [AH]	200	360
Battery Voltage [V]	48V	
Max. Charge Current (Continuous) [A]	80	150
Max Discharge Power (Continuous) [KW]	5 (100A)	8.2 (160A)
Peak Output [KW]	7.5 (150A)	12 (240A)
Parallel Stacking	2	8
LCD Monitoring	No	Yes
Communication	N/A	CAN/RS485
Breaker	150A	250A
Warranty	5 years; up-to 6,000 cycles	

Fortress LFP Battery Charging Curve



	Lithium Ferro Phosphate (LFP)	Lead Acid
Absorb time	6 min	120min
Float Charge	N/A	✓

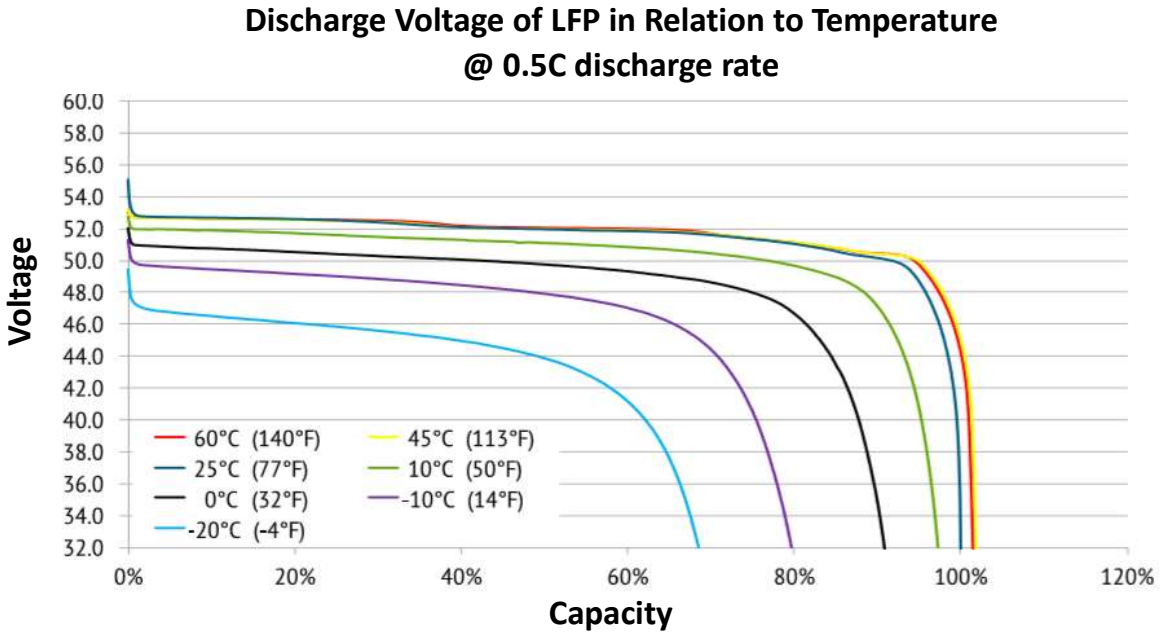
Discharging Curve of LFP Battery



C rate of LFP-10: 200 A; 0.3 C = 60A discharge current

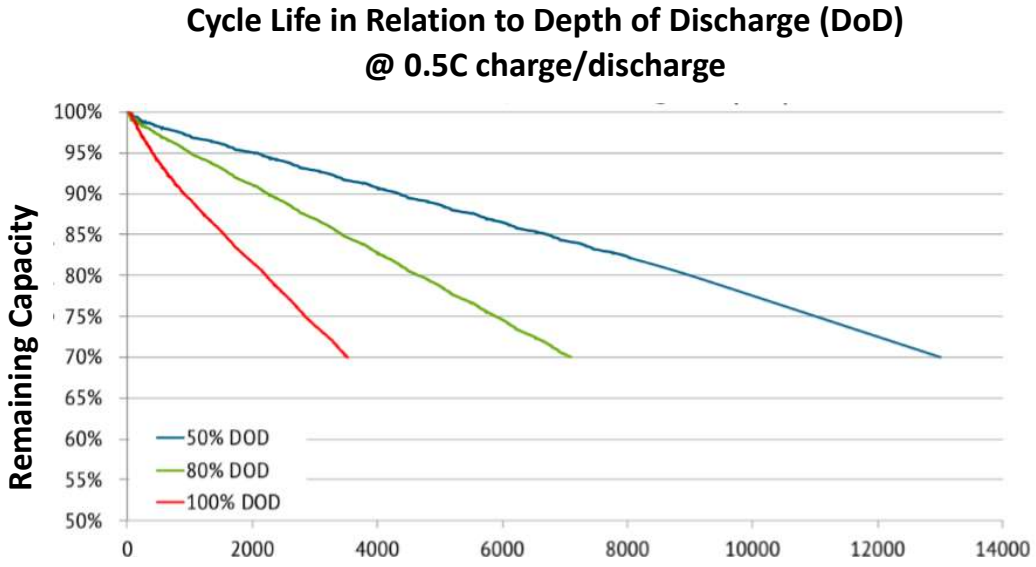
C rate of LFP-15: 300 A; 0.3 C = 90A discharge current

Temperature Impact on Performance



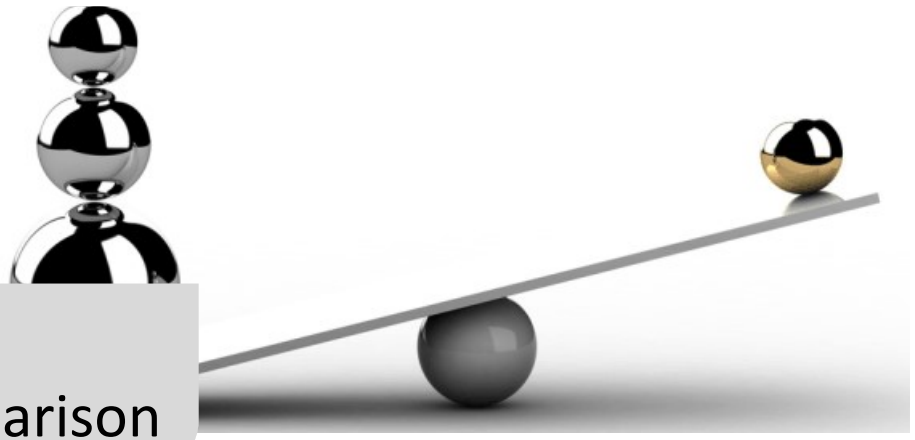
	3000 Cycles	6000 Cycles
Temperature Range	32 F to 130F (0 °C to 49°C)	10 F to 110 F (0°C to 43°C)

Cycle Life vs Depth of Discharge



	3000 Cycles	6000 Cycles
Depth of Discharge	90%	80%

Battery Technology Comparison

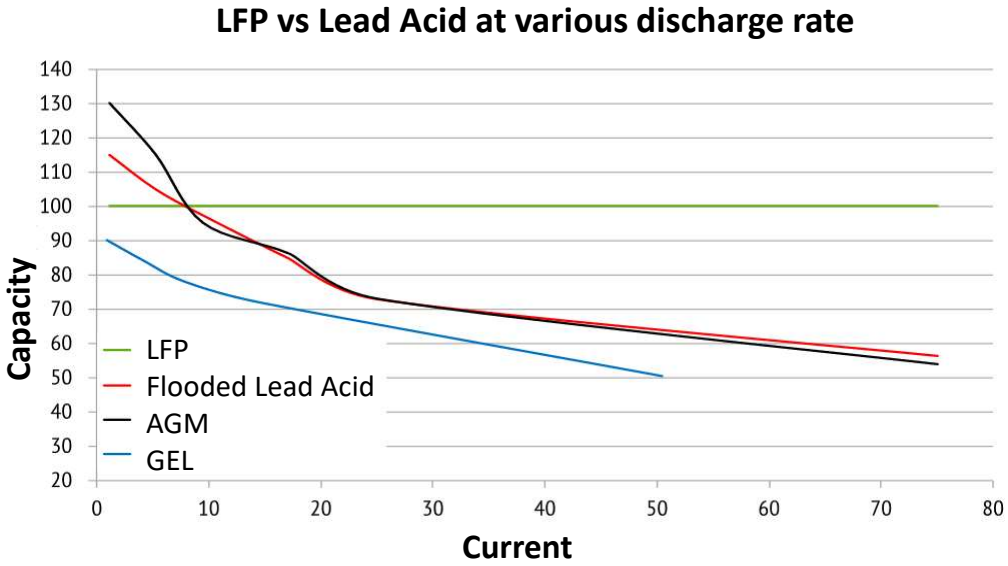


Comparison of different Battery Technologies

	Fortress LFP	Lithium Ion	Li-Polymer	Flooded LA*	AGM*	Nickel Iron*
Round trip efficiency	98%	95%	95%	80%	88%	65%
Cost of 10 kWh Usable Power (MSRP)	6,900	6,999	4,500	2,800	3,600	18,000
Cycle Life	6,000	2,500	1,500	600	750	8,000
Off Grid Years	16.4	6.8	4	2.7	2	21.9
Cost per Cycle per kWH	0.11	0.28	0.30	0.46	0.48	0.23
Safety	Yes	No	No	No	No	Yes
Free Maintenance	Yes	Yes	Yes	No	Yes	No

*** Lead Acid, AGM, Carbon AGM and Nickel Iron can only be discharged to 50%; additional battery rack is required!**

Performance Comparison



Disadvantages of Lead Acid:

- *Capacity drops significantly when output current increases*
- *6 times more space*
- *Higher cable cost and longer installation time*

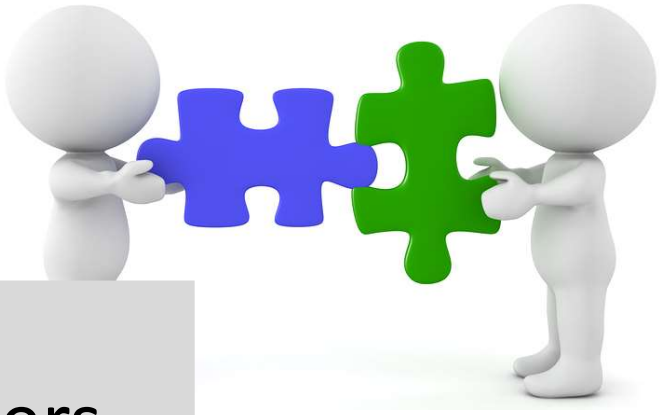
Performance Comparison

Comparison Chart of Various Lithium Batteries

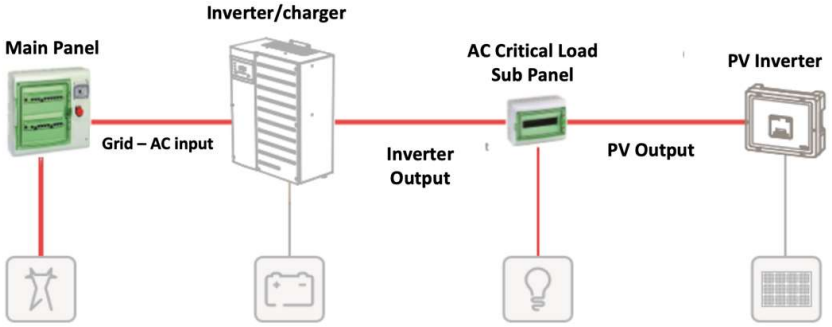
	Fortress Power	Simpliphi	Discover	LG Chem	Panasonic
Battery Chemistry	LFP	LFP	LFP	NMC	NMC
Safety	Y	Y	Y	N	N
Usable Power	10/15/16.5 kWh	2.5/3.5 kWh	6.6 kWh	9.3 kWh	2 kWh
Roundtrip efficiency	98%	98%	98%	94.5%	96.5%
LCD Display	Yes	No	No	No	No
Guaranteed Battery Cycles	6,000	10,000	5,000	2,500	2,800
Off-Grid years	16	27 **	13.6	6.8	7.7
Price per kWh	Low	High	High	Low	Low
Installation time	Low	High	High	Low	High
Cost per Cycle	Lowest	Mid	Mid	High	High

** Simpliphi uses low-cost MOSFET based BMS, which only lasts 10-15 years.

Compatible Inverters



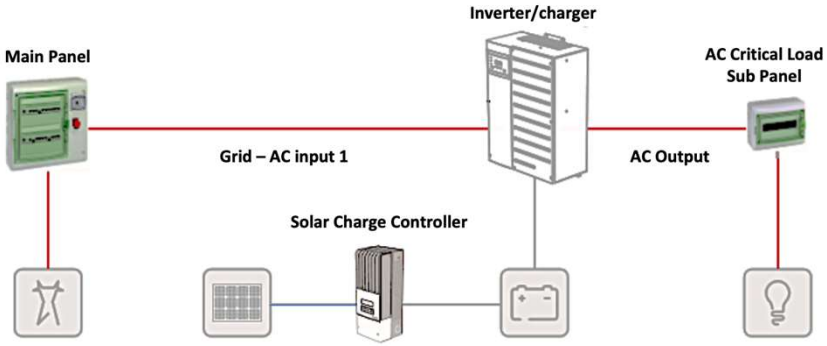
AC vs DC Coupled Solution



AC-Coupled System Diagram

Application for AC coupled solutions

- *When retrofitting to existing PV systems*
- *For new installations that require module level rapid shutdown*



DC-Coupled System Diagram

Application for DC coupled solutions

- *For new installation*
- *No additional PV inverter*
- *More efficient*

Compatible Inverters

COMPATIBLE WITH MOST 48V CHARGERS AND HYBRID INVERTERS!

Brand	Inverter/Charger Mode	Configuration
Schneider	Conext XW MPPT charge controller; Conext XW+ series; Conext SW;	AC or DC coupled
Outback	Skybox, FLEX max charge controller (48V), FLEXpower series (48V); Radian series (48V); FXR(A) and FXR (E) series (48V); GVFX and GVFX series (48V);	AC or DC coupled
Magnum	MS 4448PAE; MS 4048-20B	AC or DC coupled
SMA**	SUNNY ISLAND 4548-US/6048-US; SUNNY ISLAND 3.0M/4.4M/6.0H/8.0H	AC coupled
Sol-Ark**	8 KW Inverter	AC or DC coupled
Victron	Phoenix VE.Direct Inverter; MultiPlus and Quatro Inverter/Charger; Skylla-TG Charger; General; Color Control or Venus GX	DC coupled
Morning Star	TriStar MPPT 600V; TriStar MPPT; Tristar PWM	DC coupled
Midnite Solar	Solar Classic 150, 200 & 250; Solar Classic 150, 200 & 250-SL	DC coupled

** we're establishing communication with those inverters!

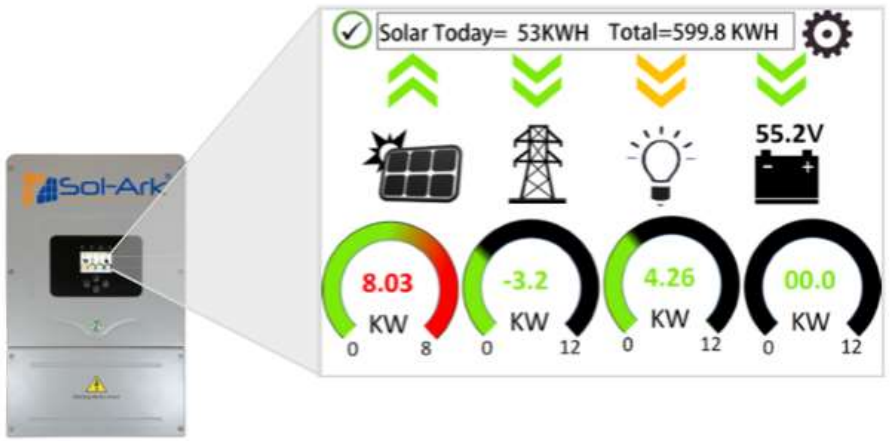
Integration Guide-Inverters/Charger Setting

Charger/Inverter configuration recommendation for best performance:

Schneider/Outback/SMA/Sol-Ark	3000 Cycles	6000 Cycles
Equalized Support	Off	Off
Capacity Limit	eVault 16.5: 360 AH	
Equalized Voltage	Off	Off
Recharge Voltage	51V	52V
Bulk Voltage	54.6V	54.4V
Absorb Voltage	54.6V	54.4V
Low Battery Cut Out Voltage	48.4V	50.7V
High Battery Cut Out Voltage	61V	61V
Float Voltage	OFF/unless use as back up 54.4V	
Max Charge Current	150A per battery	100A per battery
Max Discharge Current	160A per battery	160A per battery

The Battery Parameter Setting Guides with Schneider, Outback and SMA inverters are available to download on www.fortresspower.com/Resource

FORTRESS + SOL-ARK 8KW (AC & DC Coupling)



Available in our stock!

Key features:

- *All in one unit (Off-Grid; Time-of-Use; Self-Supply; Back-up; Grid export)*
- *Extreme Compact & Easy Installation*
- *DC Coupled & Transform-less*
- *The best Roundtrip efficiency: 93%*
- *High Surge Power: 20KW*
- *Auto-Gen Start included*
- *Allows to use Gen Output to AC couple to an existing PV array*

Color Touch Display

On/Off Button

48V Battery

4 PV inputs

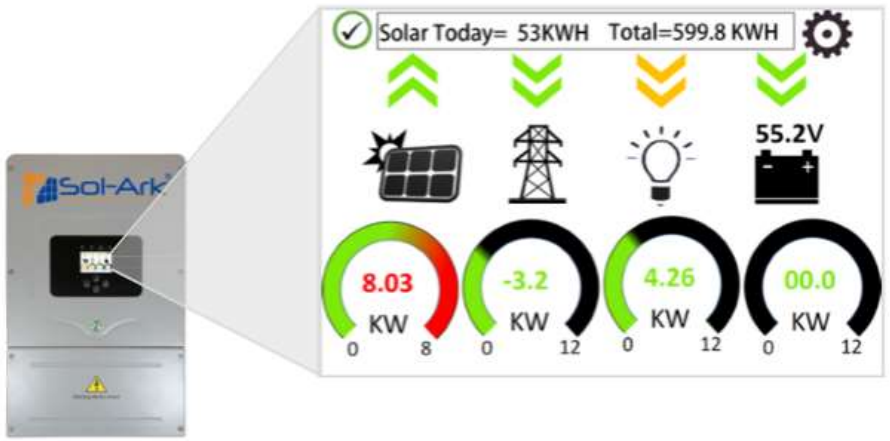
PV Shut-off

120/240V 50A Breakers

- AC In/Out
- AC Load Out
- AC Gen In/Smart Load Out

- Battery Temp sensor
- Auto-Generator Start
- PV Rapid Shut Down

FORTRESS + SOL-ARK 8KW (AC & DC Coupling)



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- *Auto-Gen Start included*
- *Allows to use Gen Output to AC couple to an existing PV array*

Technical Specification

	Output to the Critical Load		**Output to the Grid**
	On Solar or Battery (Back-up)	With Grid or Generator Present	Pass-through
AC Output Power	8 KW	12 KW	12 KW
Surge power	20 kW (5 Sec)		
AC Output Voltage	120/240V & 120/208V		
UPS Grid Failure Transfer time	12 kW auto-transfer relay at 2ms		
PV Array in DC Coupling	Up-to 11 KW		
PV Array in AC Coupling	Up-to 7 KW		
PV Array in AC & DC Coupling combined	Total max 13 KW		
Module-level rapid shutdown Compliance	Adding Tigo Optimizers		
Storage capacity	10/16.5 KWH per unit; scalable to 132 KWH		

Fortress + Schneider XW+ (AC & DC Coupling)

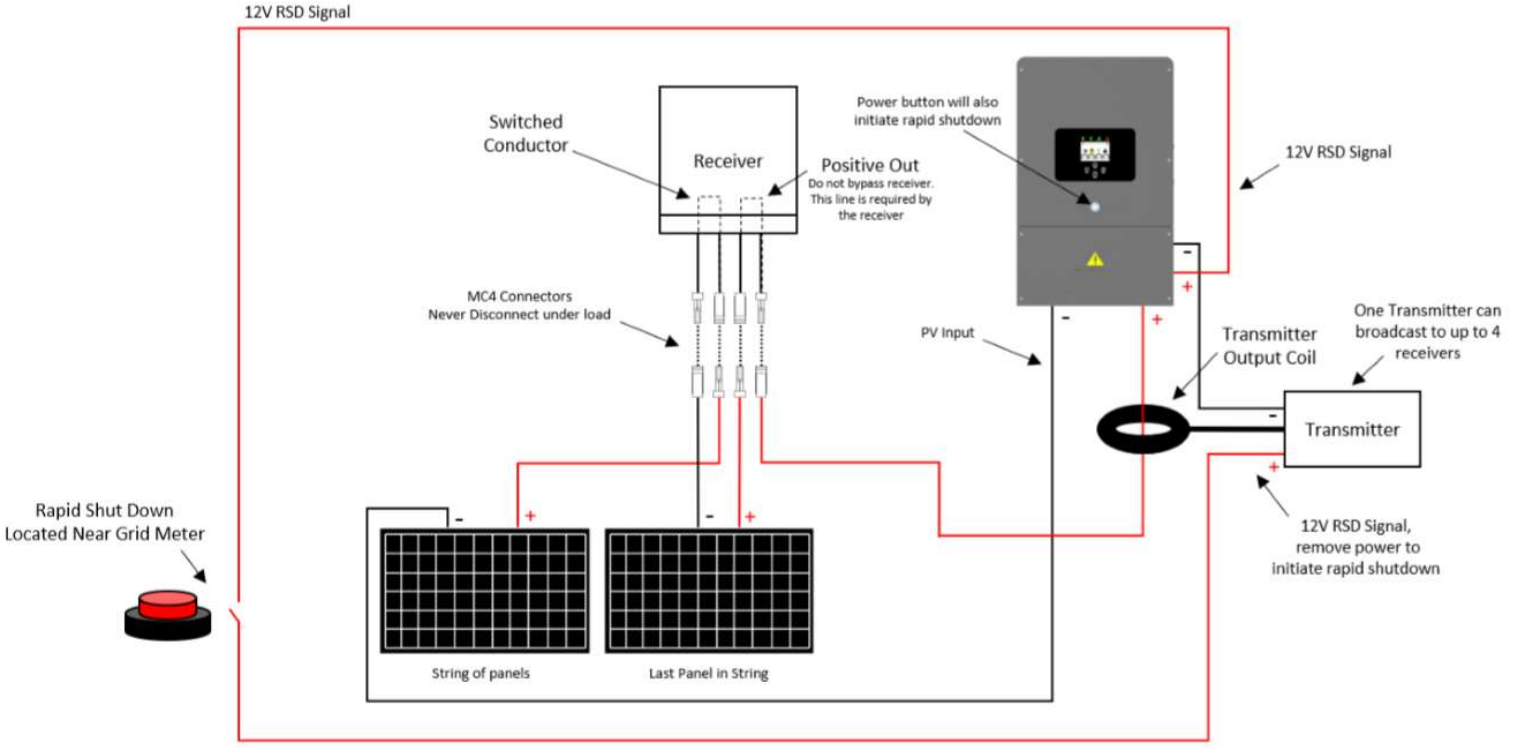
Key features:

- *Over 10 years in operation*
- *All in one unit (Off-Grid; Time-of-Use; Load shifting; Back-up; Grid export)*
- *Allows DC & AC coupling*
- *Single or three phase systems from 7 kW to 62 kW*
- *Performs in hot environments up to 70°C*
- *Auto-Gen Start optional*

Technical Specification

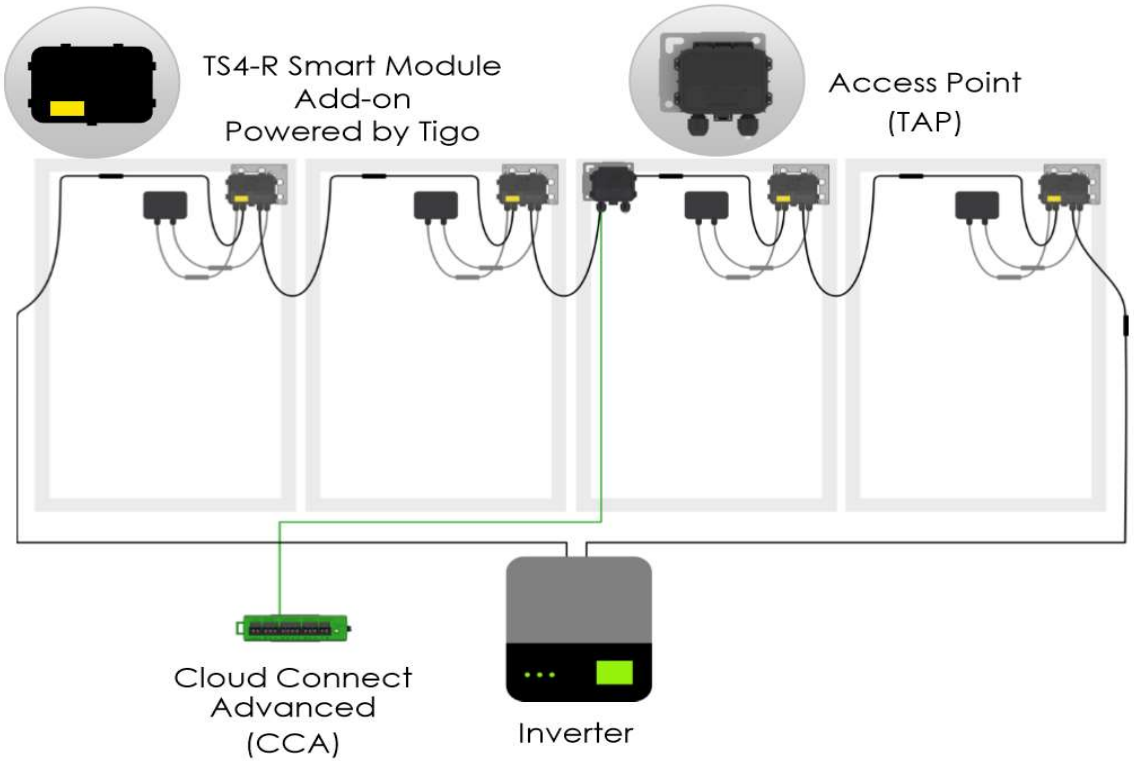
	Technical Specification	
Inverter AC output	5.5 KW	6.8 KW
Surge power at backup	7/9.5 kW (30 min/60 sec)	8.5/12 kW (30 min/60 sec)
Storage capacity	10/16.5 KWH per unit; scalable to 132 KWH	
UPS Grid Failure Transfer time	Built-in 60A auto-transfer relay at 8ms	
Compatible PV Inverters	AC-coupled to Enphase, AC modules, Solaredge, SMA, Fronius 10 kW+, etc.	
Stack-ability	▪ Max. 4 in 1-Ph (120/240V) ▪ Max. 9 in 3-Ph (120/208V): 3 units per phase	

Integrating Midnight for String Level Rapid Shutdown

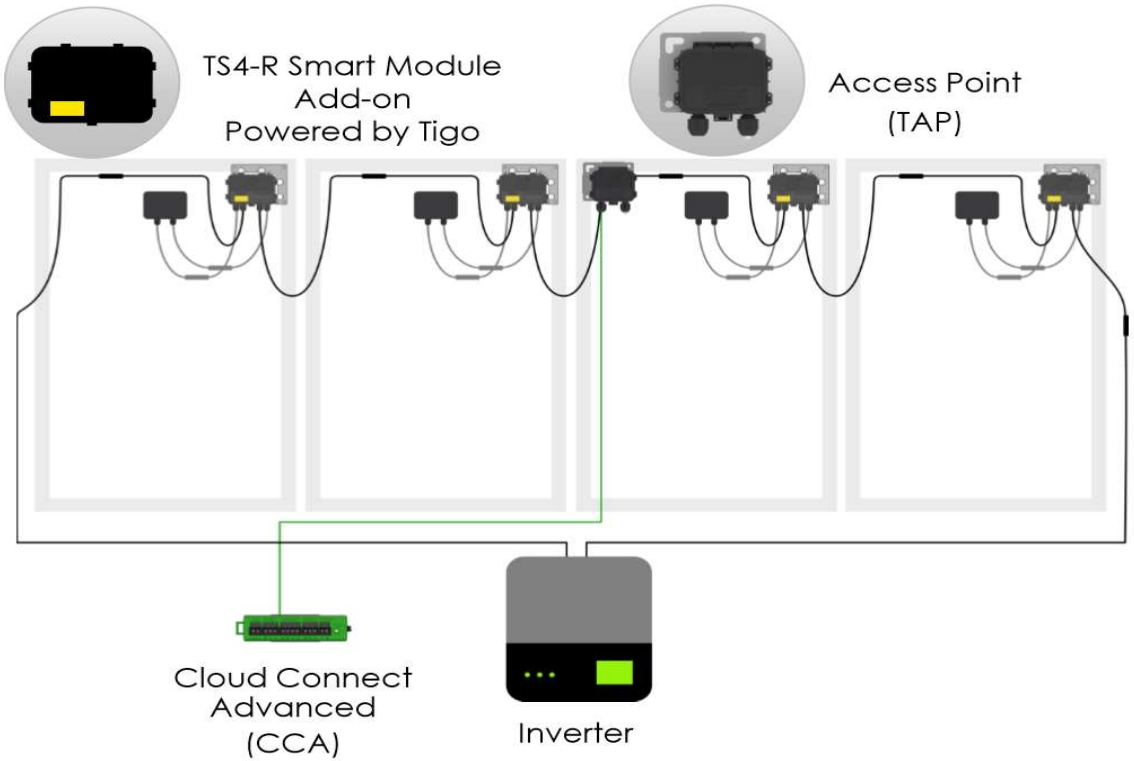


Repeat this setup for each string of panels

Integrating Tigo for Module Level Rapid Shutdown



Integrating Tigo for Module Level Rapid Shutdown



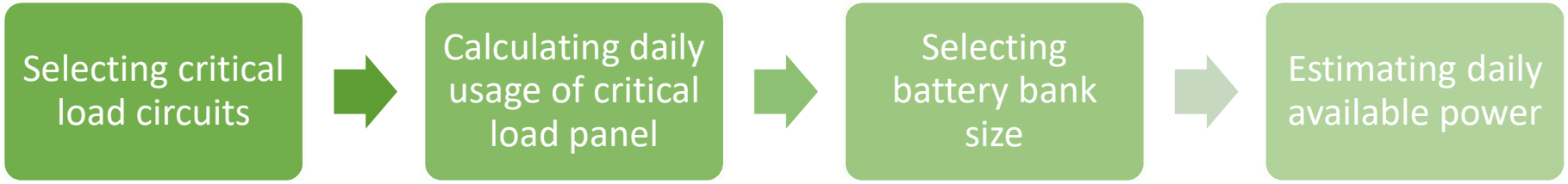
Integration Guide with Schneider XW+

Fortress Battery Integration Guide with Schneider XW+ Inverter - Rev A.pdf

Design Guide

Fortress Energy Storage Sizing Tool

4 Steps to Size Up Energy Storage for Backup



Available to our authorized installers

Select Critical Load Panel

	Category	Item	Quantity	Starting Watts	Running Watts	Hours/Day	Watthours/Day
1	Essential	Refrigerator/Freezer-Energy Star	1	1200	200	8	1600
2	Essential	Incandescent Light Bulb-60 Watt	6	360	360	4	8640
3	Essential	Incandescent Light Bulb-60 Watt	4	240	240	4	3840
4	Essential	Sump Pump-1/3 HP	1	1300	800	0	0
5	Essential	Water Well Pump-1/3 HP	1	1400	750	3	2250
6	Kitchen	Electric Range-8" Element	1	2100	2100	1	2100
7	Kitchen	Microwave Oven-650 Watts	1	1000	1000	0.1	100
8	Personal Electronics	Cell Phone Charger	2	50	50	2	200
9	Personal Electronics	TV-Flat Screen-46"	1	190	190	4	760
10	Personal Electronics	Computer-Laptop	1	250	250	2	500
	STANDBY POWER	**Schneider XW+6848NA**	**1**	8	8	**24**	**192**
			Totals	**8098**	**5940**		**20182**

Inverter Type	Quantity**	Watthours/Day	Surge Power	Running Watts
Schneider XW+6848NA	1	**20182 Watts**	3902 Watts Available	860 Watts Available

Sizing Battery Bank for Best Performance-DC Coupling

a) *Battery Max Charge* **>** *Charge Controller Max Charge* **+** *Inverter Max Charge*

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

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

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

Inverter Max Charge = 40A (28%)

b) Battery max discharge power > Inverter full load power

Example: 1 Schneider XW+ 6848
Each LFP-10 has max 100A discharge current, equal to 5KW; select 2 battery banks

Sizing Battery Bank for AC Coupling

a) PV Watts ≤ Inverter full load power

b) I *Battery Max Charge* **> PV array Size / 48V**

Example: using 1 Schneider XW+ 6848 to AC couple SMA Sunny Boy 7.0
1) PV array must be less than 6.8 KW
2) If the PV array is 6.5 KW, the battery max charging current must be greater than 135A (6.5 KW/48V = 135 A)

6.8 kW/30 kWh ESS

Select Battery Bank Size

Critical Load Consumption Report

Load Consumption Report

Item	Watthours/Day
Refrigerator/Freezer-Energy Star	1600
Incandescent Light Bulb-60 Watt	8640
Incandescent Light Bulb-60 Watt	3840
Sump Pump-1/3 HP	0
Water Well Pump-1/3 HP	2250
Electric Range-8" Element	2100
Microwave Oven-650 Watts	100
Cell Phone Charger	200
TV-Flat Screen-46"	760
Computer-Laptop	500
Inverter Standby Power	192
TOTAL	**20182 Wh/Day**

Select Battery Bank Size

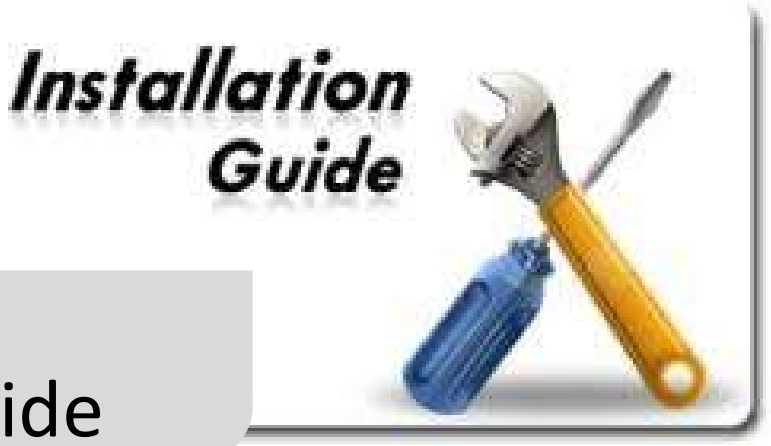
Fortress Power Battery	**LFP -10**
System Size:	10,240 Wh
Battery Quantity	2
Depth of Discharge:	90%
Available Power:	18,432 Wh

Estimate Average Daily PV Production

	Solar Radiation	AC Energy	Energy Per Day (watthours)	Full charge on battery	avail. Energy after battery charged
January	3.8	751	**24,226**	(18,432)	**5,794**
February	4.28	746	**26,643**	(18,432)	**8,211**
March	5.23	986	**31,806**	(18,432)	**13,374**
April	5.91	1,039	**34,633**	(18,432)	**16,201**
May	6.32	1,132	**36,516**	(18,432)	**18,084**
June	6.74	1,106	**36,867**	(18,432)	**18,435**
July	6.36	1,090	**35,161**	(18,432)	**16,729**
August	5.78	1,004	**32,387**	(18,432)	**13,955**
September	5.19	886	**29,533**	(18,432)	**11,101**
October	5.08	926	**29,871**	(18,432)	**11,439**
November	4.14	749	**24,967**	(18,432)	**6,535**
December	3.38	646	**20,839**	(18,432)	**2,407**

WHAT TO EXPECT

Available power in Battery at 90% DoD	18,432 Wh	0.9 Days
Lowest average daily available PV Power:	20,800 Wh	
Highest average daily available PV Power:	36,800 Wh	



Installation Guide

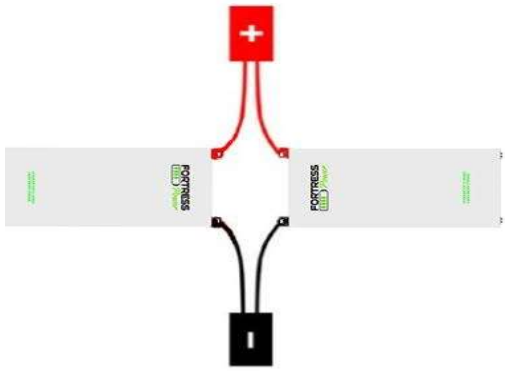
How to Select Cables

Maximum Ampacties for Wire and Cable				
Wire Size (AWG)	Copper Conductor Temp. Rating		Aluminum Conductor Temp. Rating	
14*	20A	25A		
12*	25A	30A	20A	25A
10*	35A	40A	30A	35A
8	50A	55A	40A	45A
6	65A	75A	50A	60A
4	85A	95A	65A	75A
2	115A	130A	90A	100A
1	130A	150A	100A	115A
1/0	150A	170A	120A	135A
2/0	175A	195A	135A	150A
3/0	200A	225A	155A	175A
4/0	230A	260A	180A	205A

M8 Terminal Ring
(diameter:8mm or 5/16 inches)

knockouts
3/4, 1& 1 ¼ inch

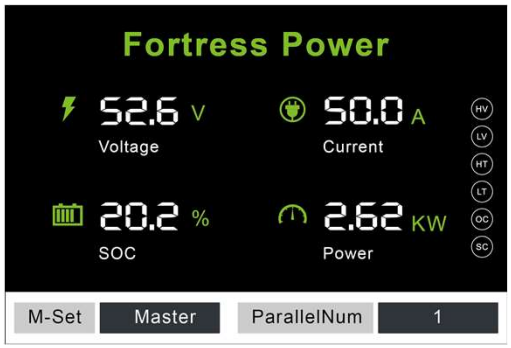
How to Parallel Fortress Batteries



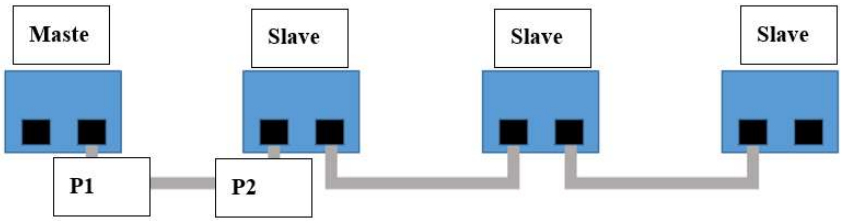
Bus Bar

- Negative and positive Bus Bars are recommend!
- Please do not cross the positive and negative terminals
- Use a volt meter to check polarity before connecting terminals.
- Measure voltage and make sure difference is less than 0.5V before turn on
- During installation breaker on “OFF” position

How to Parallel eVault 16.5



RJ 45 cable

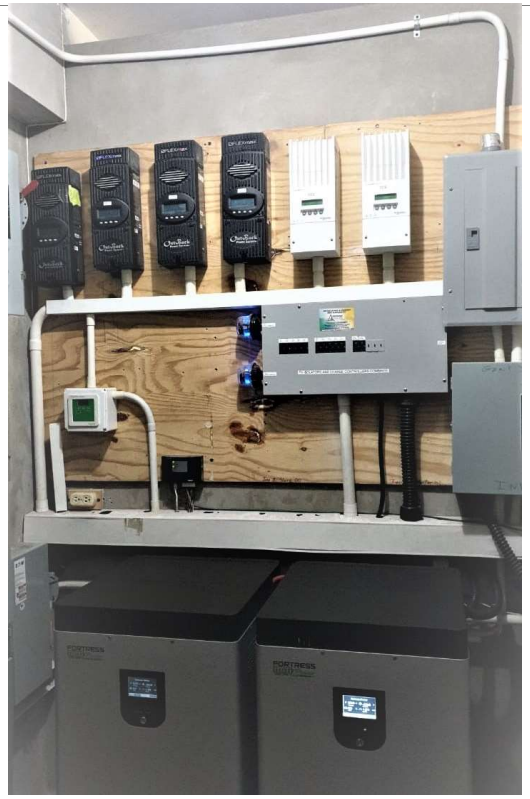


1. Check the voltage of the units
2. Configure each battery to “slave” through touch screen and leave ParalleNum “1”.
3. Wire batteries and connect to inverter(s)
4. Use the RJ45 cables to connect the batteries, as illustrated in the chart below.
5. Switch air breaker to “ON” position
6. Set up “Master” battery and ParallelNum via Touch Screen

Our Product Advantages

- ✓ **Safe**
- ✓ **Competitively priced**
- ✓ **Lowest cost per cycle**
- ✓ **Long lasting**
- ✓ **Best round-trip efficiency**
- ✓ **Easy installation**
- ✓ **Maintenance-free**

Project-Self Supply



- AC & DC Coupling in one system
- Inverter/Charger: 3 x Schneider XW+ 6848
- Storage: 2x Fortress eVault 16.5 (33 kWh)
- Application: Self-supply
- Location: Montego Bay, Jamaica

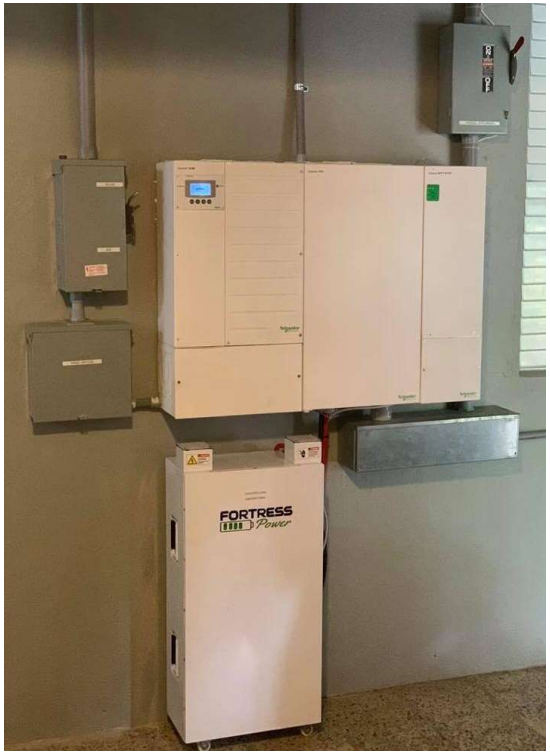
Project-Self Supply

- PV system: 10kW
- Inverter/Charger: 2 x Schneider XW+ 6848
- Storage: 2x Fortress LFP-15 (30 kWh)
- Application: Self-supply
- Location: Jamaica

Project-Off Grid

- Inverter/Charger: Outback
- Storage: 2x Fortress eVault 16.5 (33kWh)
- Application: Off-grid
- Location: Conover, NC

Project-Back-up

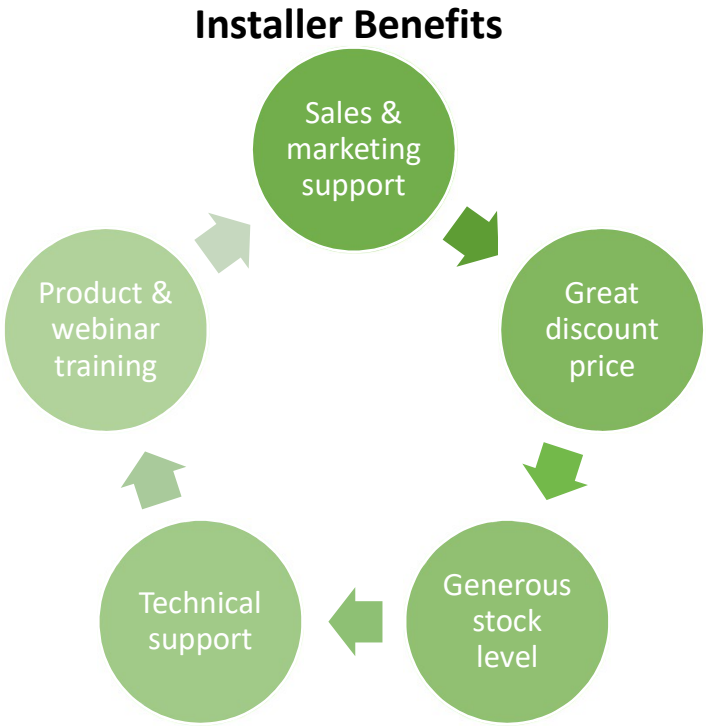


- Inverter/Charger: 1 x Schneider XW+ 6848
- Charge controller: 1 x Conext 80-600
- Storage: 1x Fortress LFP-10 (10 kWh)
- Application: Grid -tie for Back up
- Location: Puerto Rico

Project-Time of Use

- Inverter/Charger: Sol-Ark 8K
- Storage: 2x Fortress LFP-10 (20kWH)
- Application: Time of Use
- Location: California

Authorized Installer Benefits



Thank You & Contact Us

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