POWERABLE
an Alpine4 Holdings, Inc. Initiative

Modular Thinking
Adaptable Systems
Scalable Performance

POWERABLE battery cells utilize the best of Solid State Lithium technology available. Our battery cell systems are scalable to meet any requirement of a lithium battery.

Look for more POWERABLE products as they come to markets near you.

POWERGEAR

Everyday products that are smaller in scale using 2-30 cells that may charge mobile devices or provide 110V, USB-A or USB-C ports.

POWERMOTION

Rugged water-tight battery products that power vehicles from small Carts to RV's, ATV's to Wheel Chairs that use 20-50 cells.

POWERBUILDS

Stationary power products that produce enough power to operate a home or business utilizing as many battery cells as needed.

POWERCUSTOMS

Our designers and engineers work with you and your specifications to create powerful efficient batteries to over-exceed your needs.

POWERABLE
an Alpine4 company

5935 West 84th Street | Indianapolis, IN 46278 | www.PowerAble.com

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POWERMOTION

ADAPTABLE SOLID STATE POWER CELLS

POWERMOTION

Out on the road - safe and reliable power is a requirement. The POWERMOTION products that utilize POWERABLE power cell technology start and mobilize any vehicle requiring “best in class” features.

POWERMOTION solid state lithium batteries continually innovate, adapt and change the way batteries will perform today and into the distant, fast-paced future.

POWERABLE cell enhancements include:

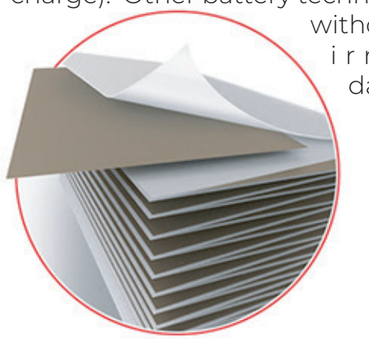
- Solid state electrolyte intelligence.
- 33% higher energy density.
- Higher performance with less weight.
- Discharging temps of -22˚ F to 140˚ F.
- Delivers precise amperage as needed.
- Better power delivery than typical lithium chemstries.
- No flammable liquid electrolytes means reduced thermal runaway.

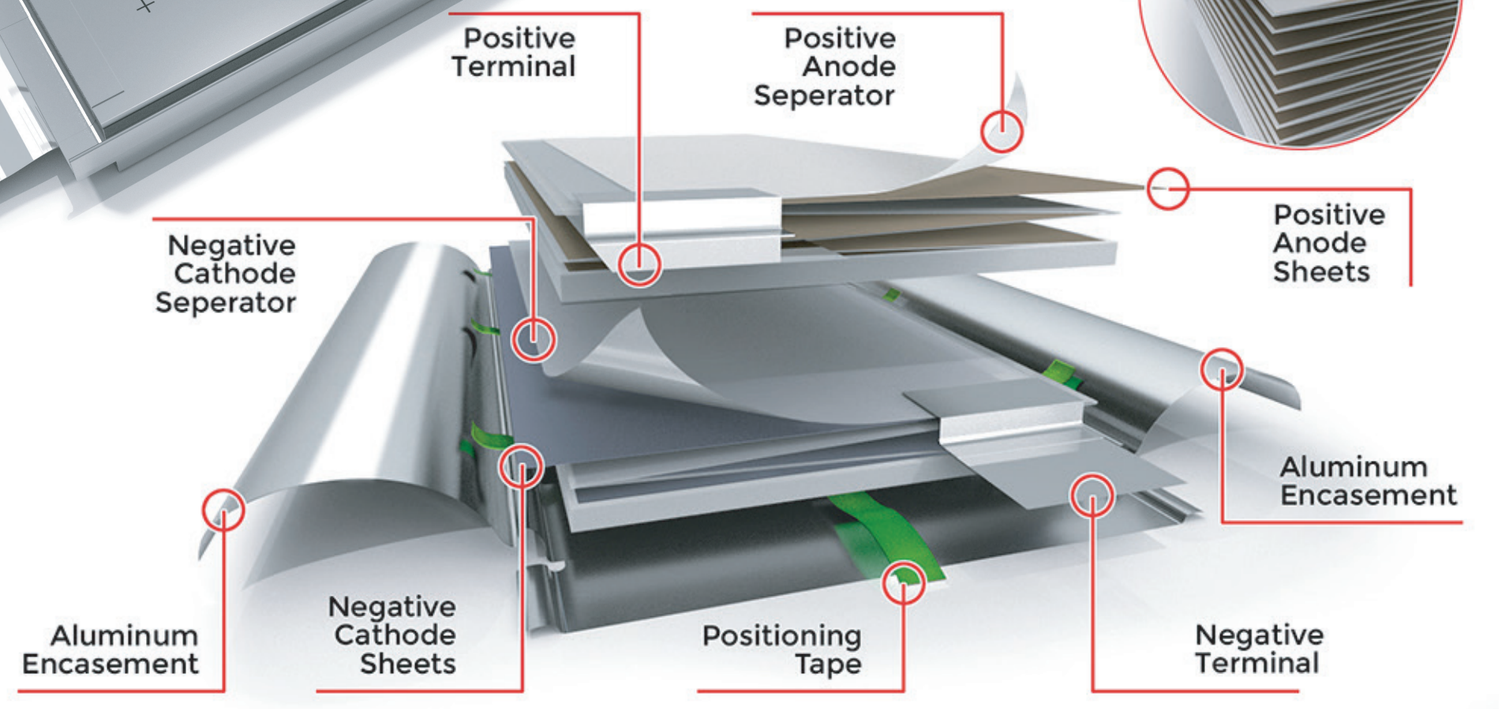
POWERABLE power cells introduce new innovations in Lithium battery technology using a ceramic oxide solid state electrolyte.

Typical lithium ion and Lithium polymer chemistries integrate a flammable gel or liquid electrolyte. Our solid state ceramic oxide electrolyte composition eliminates the use of these highly unstable liquids, greatly reducing thermal runaway conditions that cause typical lithium batteries to ignite.

Eliminating liquid and capitilizing on a solid also reduces the weight of our cells, which increases our energy density. This means you get 33% more power from the battery using the same weight in materials. Because a solid electrolyte can be much thinner and consistent than a liquid or gel, internal resistances are lowered and power density is greatly improved allowing the cells to deliver the amps from the battery at a much higher speed. This advancement provides the power needed for the most demanding conditions.

POWERABLE low internal resistance makes high charging rates possible (up to 4C / 15M). Solid state properties make charging and discharging temperature ranges much better than the LiFePo and other lithium chemistry batteries. POWERABLE cells can drain down to 0% (100% Depth of Discharge). Other battery technologies can not without causing irreversible damage.

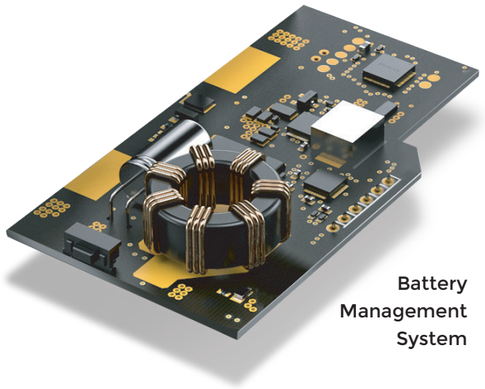




POWERMOTION Batteries Go the Distance and Back.

POWERABLE battery cells have replaced the flammable and heavy liquid electrolyte with a solid state ceramic oxide material. This material is thin and light weight compared to a liquid or gel, which makes our batteries lighter and more compact. Our patented self-healing ceramic oxide technology reduces the possibility of thermal runaway caused by damaging the lithium cell. This makes living with POWERMOTION battery products remarkably safe.

The POWERMOTION battery models incorporate a Battery Management System (BMS) for managing the battery cells. The BMS protects against overcharge, short circuit, overcurrent, ensures charging and that cells are evenly discharging. This system properly manages the battery cells for high performance protection and extended life.



Battery Management System

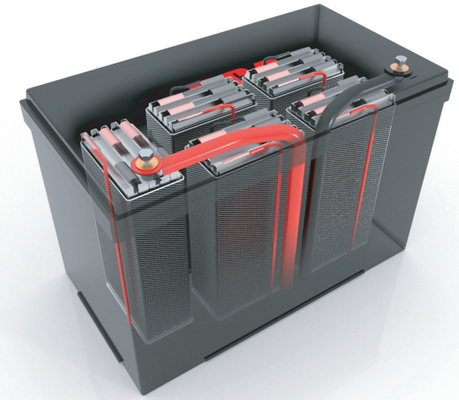
Individual Battery Cell Base Configurations

	Amp Hours	Watt Hours
12 Volt	160	2,000
	192	2,300
	225	2,700
	250	3,075
24 Volt	100	2,300
	128	3,000
	160	3,850
	190	4,600
	225	5,375
	250	6,150

48 Volt configurations are available on request. Contact factory for viable options.

SPECIFICATIONS:

- Solid state lithium ceramic oxide battery
- Integrated Battery Mnagement System (BMS)
- POWERABLE AX1 cell used
- 33% lighter than LiFePo batteries
- Better power delivery than other LI chemistries
- No flamable liquid electrolytes

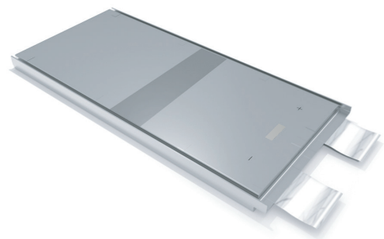


ALL 12V			**ALL 24V**		
Charge Voltage Range	13.9 - 14.5	Volts	**Charge Voltage Range**	27.8 -29.0	Volts
Max Charge Voltage	14.7	Volts	**Max Charge Voltage**	29.4	Volts
Charge Temperature Range	14~140°F	°F	**Charge Temperature Range**	14~140°F	°F
Discharge Temperature Range	-22~140°F	°F	**Discharge Temperature Range**	-22~140°F	°F
Discharge Current			**Discharge Current**		
160 Amp Hr.	160.00	Amps	100 Amp Hr.	140.00	Amps
192 Amp Hr.	160.00	Amps	128 Amp Hr.	140.00	Amps
225 Amp Hr.	180.00	Amps	160 Amp Hr.	140.00	Amps
250 Amp Hr.	200.00	Amps	190 Amp Hr.	160.00	Amps
			225 Amp Hr.	180.00	Amps
			250 Amp Hr.	220.00	Amps
Max Cont. Charge Current			**Max Cont. Charge Current**		
160 Amp Hr.	110.00	Amps	100 Amp Hr.	100.00	Amps
192 Amp Hr.	120.00	Amps	128 Amp Hr.	120.00	Amps
225 Amp Hr.	130.00	Amps	160 Amp Hr.	130.00	Amps
250 Amp Hr.	150.00	Amps	190 Amp Hr.	140.00	Amps
			225 Amp Hr.	150.00	Amps
			250 Amp Hr.	150.00	Amps
Max Pulse Amps <10 sec.			**Max Pulse Amps <10 sec.**		
160 Amp Hr.	250.00	Amps	100 Amp Hr.	250.00	Amps
192 Amp Hr.	300.00	Amps	128 Amp Hr.	250.00	Amps
225 Amp Hr.	350.00	Amps	160 Amp Hr.	300.00	Amps
250 Amp Hr.	350.00	Amps	190 Amp Hr.	300.00	Amps
			225 Amp Hr.	350.00	Amps
			250 Amp Hr.	350.00	Amps
Recommended Charge			**Recommended Charge**		
160 Amp Hr.	90.00	Amps	100 Amp Hr.	90.00	Amps
192 Amp Hr.	100.00	Amps	128 Amp Hr.	90.00	Amps
225 Amp Hr.	110.00	Amps	160 Amp Hr.	100.00	Amps
250 Amp Hr.	120.00	Amps	190 Amp Hr.	110.00	Amps
			225 Amp Hr.	110.00	Amps
			250 Amp Hr.	120.00	Amps
Cycle times 80% DOD (Typical usage)					
0.5C Charge / 0.5C Discharge	2400	cycles	0.5C Charge / 0.5C Discharge	2400	cycles
0.3C Charge / 0.3C Discharge	3500	cycles	0.3C Charge / 0.3C Discharge	3500	cycles
Cycle times 100% DOD (Complete discharge, caused by long term storage)					
0.3C Charge / 0.3C Discharge	1200	cycles	0.3C Charge / 0.3C Discharge	1200	cycles
Dimensions (in.)	12.9L x 6.8W x 8.5		Dimensions (in.)	20.1L x 9W x 8.58	
Weight (approx)	28	lbs	Weight (approx)	38	lbs

POWERABLE

CERAMIC OXIDE - SOLID STATE BATTERIES

Battery Cell Model



	AX-01	AX-02	AX-02.5	AX-03 (*Under Development*)	LiFePo
Key Cell Characteristics	Solid state electrolyte dramatically reduces thermal runaway caused by abuse. - Fast Charging (2C) - High Energy Density	Solid state electrolyte. - Super Fast Charging (4C) - High Power Density	Solid state electrolyte within a smaller body. - Super Fast Charging (4C) - High Power Density	Solid state electrolyte dramatically reduces thermal runaway caused by abuse. - High Capacity / Super Fast Charging (4C) - High Energy and High Power Density	Solid state electrolyte within a smaller body. - Fast Charging (2C)
Nominal Capacity	31Ah (0.5C)	31Ah (0.5C)	16Ah (0.5C)	40Ah (0.5C)	3980mAh
Nominal Voltage	3.6V	3.7V	3.7V	3.6V	3.8V
Charging Voltage	4.2V	4.2V	4.2V	4.2V	4.43V
Voltage Termination	2.5V	2.5V	2.5V	2.5V	3V
Charging Specifications					
Super Fast Charging	2C (62A), 95%	4C (124A), 95%	4C (124A), 95%	4C (120A), 95%	2C (8A), 80%
Fast Charging	1C (31A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	2C (62A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	2C (62A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	2C (62A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	1C (4A), 80%
Standard Charging	0.5C (15.5A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	1C (31A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	1C (31A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	1C (40A) constant current (CC) charges to 4.2v, then constant voltage (CV) charging until the charging current is less than 0.02C (0.6A)	0.2C CC chargeto 4.43V then CV charge until current decline to 0.025Cmin
Discharging Specifications					
Pulse Discharging	3C (durations < 10S)	10C (durations < 10S)	10C (durations < 10S)	3C (durations < 10S)	
Continous High Rate Discharging (Max)	2C	7C	7C	2C	1C
Standard Discharging	1C	1C-3C	1C-3C	1C	0.2C
Cycle Life	0.5C/0.5C 2400 times 100% DOD with 80%SoH 1C/1C 1200 times 100% DOD with 80%SoH 1C/2C 900 times 100% DOD with 80%SoH 2C/2C 600 times 100% DOD with 80%SoH	1C/1C 2400 times 100% DOD with 80%SoH 1C/3C 1600 times 100% DOD with 80%SoH 2C/5C 1000 times 100% DOD with 80%SoH	1C/1C 2400 times 100% DOD with 80%SoH 1C/3C 1600 times 100% DOD with 80%SoH 2C/5C 1000 times 100% DOD with 80%SoH	1C/1C 2400 times 100% DOD with 80%SoH 1C/2C 1600 times 100% DOD with 80%SoH 2C/2C 1000 times 100% DOD with 80%SoH	
Operating Temperature					
Charging Temperature	-10°C to 0°C / 14°F to 32°F (0.1C Charging) 0°C to 60°C / 32°F to 140°F (1C Charging)	0°C to 60°C / 32°F to 140°F (1C Charging)	0°C to 60°C / 32°F to 140°F (1C Charging)	-10°C to 0°C / 14°F to 32°F (0.1C Charging) 0°C to 60°C / 32°F to 140°F (1C Charging) 10°C to 45°C / 50°F to 113°F (2C Charging)	0°C to 5°C / 32°F to 41°F (0.1C Charging) 5°C to 15°C / 41°F to 59°F (0.3C Charging) 10°C to 45°C / 50°F to 113°F (2C Charging)
Discharging Temperature	-30°C to 60°C / -22°F to 140°F	-30°C to 60°C / -22°F to 140°F	-30°C to 60°C / -22°F to 140°F	-30°C to 60°C / -22°F to 140°F	0°C to 60°C / 32°F to 140°F (1C Charging)
Internal Resistance	1.3+/-0.5mΩ	1.3+/-0.5mΩ	1.3+/-0.5mΩ	1.1+/-0.5mΩ	
Weight	405g +/- 15g / ~0.89 lb	395g / ~0.87 lb	55g / ~0.12 lb	400g +/-15g / ~0.88 lb	55g / ~0.12 lb
Energy Density	> 270Wh/kg	> 284Wh/kg (0.5C/0.5C)	> 284Wh/kg (0.5C/0.5C)	> 360Wh/kg (0.5C/0.5C)	
Volume Density	> 600Wh/L	> 644Wh/L	> 644Wh/L	> 700Wh/L	
Dimensions	10.8 x 87 x 187mm / 0.43 x 3.43 x 7.36 in	10.8 x 87 x 187mm / 0.43 x 3.43 x 7.36 in	4.5 x 64 x 80mm / 0.18 x 2.25 x 3.15 in	10.8 x 87 x 187mm / 0.43 x 3.43 x 7.36 in	4.5 x 64 x 80mm / 0.18 x 2.25 x 3.15 in