LiFePO4 Lithium Ion

green power

(LiFePO4 single cell)

Lithium Iron Phosphate Battery

Type: HP-PW-20AH

Power Type ”24V” 20Ah

These batteries are widely used in electric vehicles, energy storage, marine applications, industry, telecommunications, electric tools, ect.. The single Lithium Ion cells are completely sealed, and the cells can be assembled in serial and parallel connections for a complete battery pack that match customers battery box designs.

For LiFePO4 molecular structure is reliable and has a high degree of electrical conductance. The battery offer high continuously / peak power even when nearing the end of discharge, and the battery do also accept large charging current such as regeneration of power when the EV's are braking or reducing speed. Those features gives electrical vehicles above average performance when starting or accelerating or climbing.

ELECTRICAL CHARACTERISTICS / @ 23°C / 77°F	
Nominal capacity (single cells):	20Ah
Nominal voltage:	24V (25,60V)
Charge voltage:	29,20V
Charge cut-off:	30,80V
Charge mode:	CC / CV (29,20V) (constant current / constant voltage)
Standard charge current:	6,67 (C/3) A
Max. cont. current in CC state:	≤ 20 (1C) A @ 0~90% SOC
Peak charge current:	≤ 40 (2C) A @ 15 sec. @ 0~80% SOC
Balancing time in CV state:	1 ~ 2h
Floating charge voltage:	27,20V
Discharge voltage:	25,60V @ C/2 discharge
Cut-off discharge voltage:	19V
Standard discharge current:	6,67 (C/3) A
Max. cont. discharge current:	60 (3C) A
Peak current / 5 sec.:	≤ 200 (10C) A
Peak current / 15 sec.:	≤ 100 (5C) A
Peak current / 60 sec.:	≤ 100 (5C) A
Self discharge rate:	3% / month
Dimensions (cell), L*W*H mm.:	103x41x168 mm
Weight, cell / 24V battery:	0,83kg / 6,64kg
Poles:	M12
Poles distance:	54 mm
Available capacity:	≥98% @ 1C discharge
	≥95% @ 2C discharge
	≥90% @ 3C discharge
Energy density (C/3):	90,20Wh/L
Specific energy (C/3):	77,10 WH/Kg
Specific power:	386 W/Kg. @ 15 sec. Continuously: 231 W/Kg
Inner resistance / cell:	≤ 2mΩ
Cycle life:	2000 times @ 80% DOD
	1000 times @ 100% DOD
Working temp. / charging:	0~45°C
Working temp. / discharging:	-20~+60°C
Storage temp.:	1 month: -20°C~+60°C
	3 month: -20°C~+45°C
	6 month: -20°C~+25°C
Protection class / cell:	IP67
Atmospheric pressure:	86~106 KPa
Operation humidity:	25~85%, non-condensing

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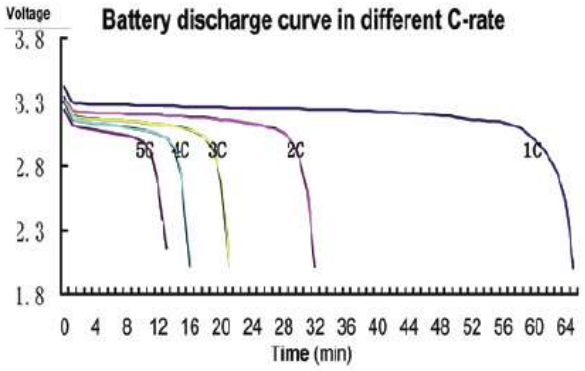
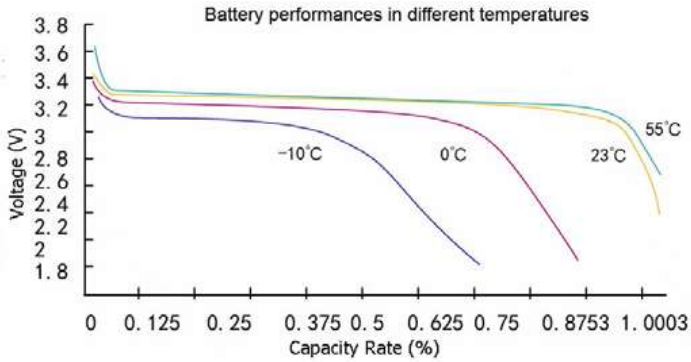
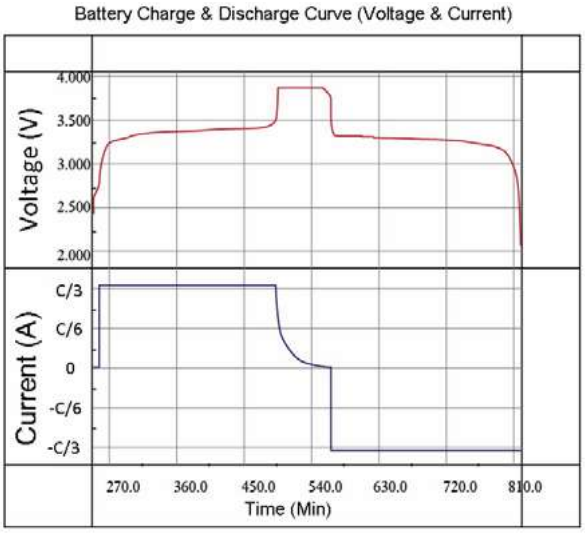
Common advantages

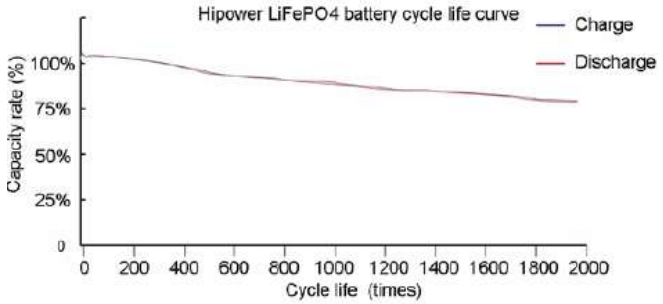
1. **LiFePO4 is environmentally friendly without any heavy metal, rare metal and toxics.**
2. **Completely sealed (IP67) and no gassing. Therefore the batteries can be recharged in same room as living.**
3. **Low weight = 1/3 of lead acid.**
4. **Small dimensions = ~50% of lead acid.**
5. **Long cycle life = ~2.000. Lead acid = ~350 cycles.**
6. **No memory effect.**
7. **Good performance at high & low temperatures.**
8. **Intrinsically safe.**
9. **High C-rate discharge.**
10. **High peak power available under high DOD.**
11. **Can be fast re-charged.**

Examples of LiFePO4 batteries for electric wheelchairs









Remarks:

1. C-rate can be used to distribute current, "C" means capacity rating (Amp-hour), easy for calculating. For example, 50Ah cell, 3C means 3*50=150A, C/5 means 1/5*50=10A, also be called 0,2C
2. Test is according to QC/T743-2006

TECHNICAL REQUIREMENTS TO BATTERY CELLS

Testing Conditions

Standard charge: Under temperature 20±5 °C, charge with $1I_3$ constant current till it reaches (to) charge cut off voltage(3.85V), then starts to Charge with constant voltage, Till charge current<0.01C.

Standard discharge: Under temperature 20±5 °C, discharge with $1I_3$ constant current till(to) discharge cut-off voltage(2.0V).

Standard testing environment:

Temperature:	15-35°C
Relative Humidity:	25%～85%RH;
Atmospheric pressure:	86kPa～106kPa.

Electrical cell performance:

No.	Item	Testing Instructions	Requirement
1	Nominal Capacity	Temperature 20±5 ℃, Measure discharge capacity to 2.0V cut-off within 1h after standard charge.。(One time for the first 5times ,meeting the requirements can do)	20.0Ah
2	high-current discharge performance	Temperature 20±5 ℃, discharge with 1.5C constant current to discharge cut-off voltage within 1hrs after standard charge.。	Discharge time≥ 36 min. The battery shall not be metamorphose, rupture。
3	Low-temperature discharge performance	Keep the battery in the case at -20±2°C for 20hrs after standard charge. Measure the discharge time with constant discharge current $1I_3$ to cut-off voltage. Then, Temperature 20±5°C lay the battery for 2hrs, observe the appearance of the battery.。	Discharge time≥ 126min The battery shall not be metamorphose, rupture。
4	High-temperature discharge performance	Keep the battery in the case at 55±2°C for 5hrs after standard charge. Measure the discharge time with constant discharge current $1I_3$ to cut-off voltage. Then, Temperature 20±5°C lay the battery for 2hrs, Observe the appearance of the battery.	Discharge time≥ 171 min. The battery shall not be metamorphose, rupture。
5	Charge Retention	Temperature 20±5°C after standard charge, keep the battery open circuit for 28 days. Then, Measure the discharge time with constant discharge current $1I_3$ to cut-off voltage.	Discharge time≥ 144min
6	Cycle Life	Temperature 20±2°C, Charge with constant charge current $1I_3$ to charge cut-off voltage, Then charge with constant voltage to the current ≤ 0.01C, Then, stop charge. 10 min later, discharge with discharge current 0.5C to 100% of the capacity DOD. 10 min later, repeat the cycle, till the capacity of lasting 24times ≤ 80% of the Nominal Capacity, Then consider the life of battery end.。	Cycle Life ≥1000 times

Misuse testing:

No	Item	Testing instruction	Requirement
1	Falling off testing	After standard charge , drop the battery from the height of 1.5m to the hardwood floor 20mm thin , 2 times one direction , 6 times altogether. During the testing ,make note of the changes of voltage and the temperature .	No explosion, no leakage, no fire.
2	Extrusion testing	After standard charge ,lay the battery at 20±5℃ for 1 hour . a) Extrusion direction：press in he vertical direction of the battery polar board. b) Extrusion area：≥20cm2 Extrusion extent：till the rupture of the battery rind and till to be short-circuited inside(voltage be 0V).	No explosion、no fire（distortion and leakage allowed）。
3	Puncture testing	After standard charge ,put the battery at 20±5℃ for 1 hrs .Then puncture the battery in the direction of electrode board with the high temperature-proof steel pin with 3mm diameter .(the pin staying in the battery). The test must be conducted in the protective condition .During the test ,make note of the changes of the voltage and the temperature .	No explosion、no fire（distortion and leakage allowed）。
4	Calefaction testing	Put the battery in the case at constant temperature of 70±2℃ for 120min and observe the appearance of the battery . Meanwhile, make note of the changes of the battery voltage.	No explosion、no fire（distortion and leakage allowed）

Safety cell performance:

NO	Item	Testing Instructions	Requirement
1	Short Circuit performance	After charging the battery standardly put it under the temperature of 20±5℃for 1 hrs and then short-circuit the battery for 10 min ,connecting the positive and negative terminals of it (The resistance of the circuitry ≤5 mΩ). Notice the change of the temperature, battery current and the voltage during the experiment.	No fire ,no explosion
2	Over charge performance	After charging the battery standardly, put it under the temperature of 20±5℃for 1 hrs The battery with thermocouple is to be put into the fume cupboard .Charge it with constant current 0.3C to 4.1 voltage. Observe the appearance of the battery. Notice the change of the temperature, battery current and the voltage during the experiment	No fire ,no explosion

3	Over discharge performance	After standard charge and under the temperature of 0±5°C, discharge the battery（if there is BMS, please disconnect the BMS first）with the current of 1I3 till the voltage of the battery is 0v . Notice the change of the temperature, battery current and the voltage during the experiment .	No explosion , no leakage , no fire .

Storage

The place of preserving the battery must accord with the following requirements: Indoor, The temperature of environment is between 5℃～35℃, The relative humidity is ≤75%, The place must be clean dry and ventilative;

Avoid contacting to the corrosives;
Keep far away from fire and heat;
Keep the battery 50%～60% charge state;
Avoid being over-charged, the battery should be charged once per 3~6 months when preserved.

Battery maintenance

Be sure to charge the new battery fully before using for the first time .The battery will reach its max capacity after 3-5 times of full charging and discharging .

The battery should be used in a ventilated and dry environment. Avoid being near to fire .

The best working temperature range for the battery is 15℃-40℃ .Beyond that , there will be effect on the battery's normal working .

Don't short circuit the battery by connecting the cathode and anode, in case of any danger.

Don't wash the outer shell of the battery with impregnate .In case of fire, please use Carbon Chlorin to put out fire instead of CO2.

If the battery goes wrong, please deliver that to the factory service centre or relevant organization for proper disposal.

Don't dismantle the battery at will and never open the electrolyte-injecting hole .

Notice when using the battery

In case of leakage, heat, fire, performance decrease etc , please use the battery according to the following regulations Factory won't take any responsibility for any mis-operation not according to this specification.

Handle with care.

Don't immerge the battery in the water or other liquid , in case of damp .Especially on rainy days , take care to prevent the water from going into the controller and motor ,in case of short- circuit.

Avoid being short-circuited, connecting the anode and cathode.

Please charge the battery with the special Lith.Ion charger provided by your Lith. Ion battery supplier.

Don't dismantle the battery, as that may cause inner short-circuit and then decomposition of the inner material, fire and even explosion accordingly. In addition , dismantling the battery may cause the leakage of the electrolyte ,which will do bad to the human body. If the electrolyte is spattered onto skin , eye and other part of the body , please wash with clean water immediately and go to the doctor at once.

Don't dispose the battery with fire ,in case of any danger.

If the battery is damaged, distorted or there is leakage of the electrolyte or the taste of electrolyte and some similar

abnormal phenomena ,don't use the battery any more. Please deliver that to the factory service centre or relevant organization for proper disposal . In addition , battery with electrolyte leakage should be far away from fire ,in case of explosion.

Battery replacement:

The battery provider should be responsible for replacing and installing the battery. The consumer may not make any service/dismantle or replace cells or complete battery unit.

Notice during the transportation:

The battery is suitable for being transported by truck , train , plane . During transportation, please avoid direct solar irradiation, drench and serious shake.

The battery pack must be packed with insulated material and marked with logo of frangibility in case of any damage caused by bumping in transit.

Don't upside down the battery. A sticker indicating *'Don't upside down'* is needed.

Handle with care in transit. Can't throw or impact the battery.

Don't place any heavy objects on battery pack.

Don't mix-transport with flammable or explosive consignment, or metal objects with sharp end.

Outer packing should be marked 'Away from moisture, water, and fire'.

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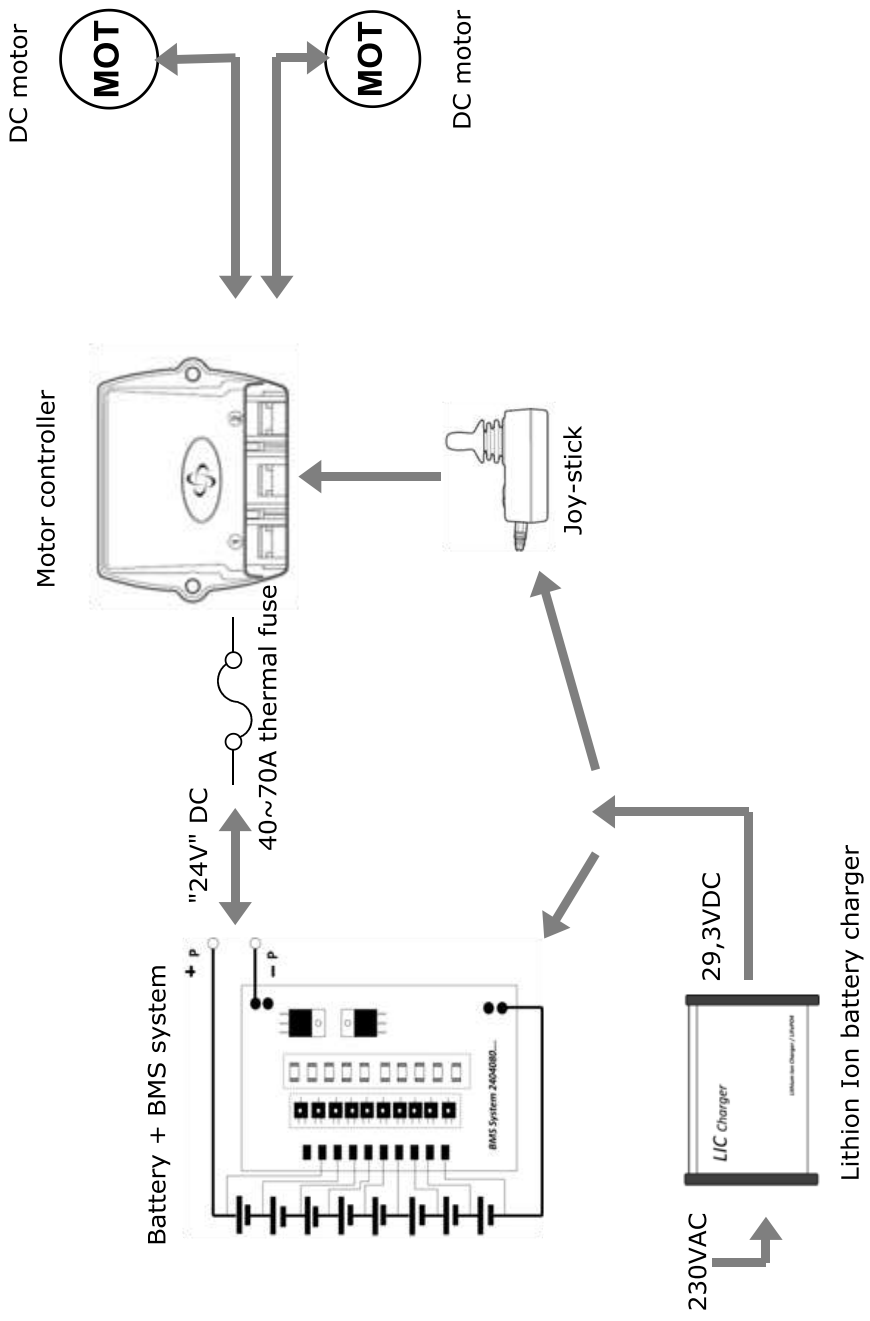
BMS Systems *(battery-management-system)*

Fig. 1



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PRINCIP DIAGRAM / ELEC. WHEELCHAIR

"24V" BATTERY SYSTEM / LITHIUM ION - LiFePO4

Fig. 1 shows a typical schematic diagram for a battery implemented into an electric wheelchair. The Lithium Ion battery is connected to a BMS system, which control the safety for single cells and the complete battery pack.

NOTE: A Lithium Ion battery may never be connected to a load or a battery charger without a BMS system connected.

The BMS system will secure that the single battery cells always are being recharged optimal and when the battery is being discharged, the BMS system will secure that no cells are being discharged below their minimum voltage level. This will keep the battery cells in a good condition and optimize the cycle life for the complete battery pack.

Should a short circuit occur in the connected load, DC wires or sockets, the BMS unit will shut down very rapidly for protecting the battery cells.

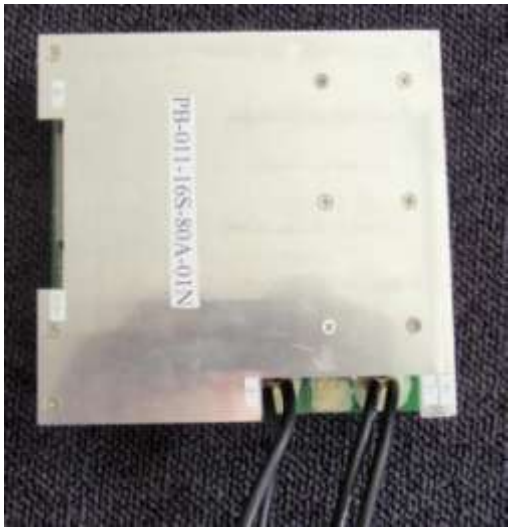

Fig.2

Fig.3

Above is showed 2 different BMS systems, which are developed exact to the vehicle application for charge / discharge performance and the physical size so it can fit into the battery box with battery cells.

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BMS Systems for electric wheelchairs

No	Item	Parameter	Parameter	Parameter
1	BMS version	**8S-40A-100A**	**8S-60A-100A**	**8S-80A-120A**
2	Charging voltage	29,1 ~ 29,3V	29,1 ~ 29,3V	29,1 ~ 29,3V
3	Charging current	40A	60	80
4	Continues discharge current	40A	60	80
5	Max. discharge current	100A / ≥15 sec.	100A / ≥15 sec.	120A / ≥15 sec.
6	Over current protection (100A load)	180A	400A	400A
7	Cell-self-consuming current (3,65V)	90~130μA	≤20μA	≤20μA
8	Cell balancing current (3,60±0,025V)	100mA	100mA	100mA
9	Cell balancing voltage	3,60±0,025V	3,60±0,025V	3,60±0,025V
10	Cell over charge VPOC	3,90±0,025V	3,90±0,025V	3,90±0,025V
11	Overcharge recovery voltage	3,80±0,05V	3,80±0,05V	3,80±0,05V
12	Over charge detection time-delay	0,96 - 1,40 sec.	0,96 - 1,40 sec.	0,96 - 1,40 sec.
13	Cell over discharge VPOC	2,00±0,05V	2,00±0,05V	2,00±0,05V
14	Over discharge recovery voltage	2,30±0,05V	2,30±0,05V	2,30±0,05V
15	Over discharge detection time-delay	115 – 173mS	115 – 173mS	115 – 173mS
16	Short-circuit protection	Self-recovery	Self-recovery	Self-recovery
17	Impedance	3~8mΩ	<10mΩ	<10mΩ
18	Working temperature range	-40°C - +85°C	-40°C - +85°C	-40°C - +85°C
19	Dimensions	112 x 74 x 12 mm	135 x 96 x 12 mm	160 x 153 x 30 mm
20	Weight	150G	220G	800G

NOTE: Other versions of BMS systems can be developed, according to customers requirements !