Product Specification

for LiFePO4 Battery

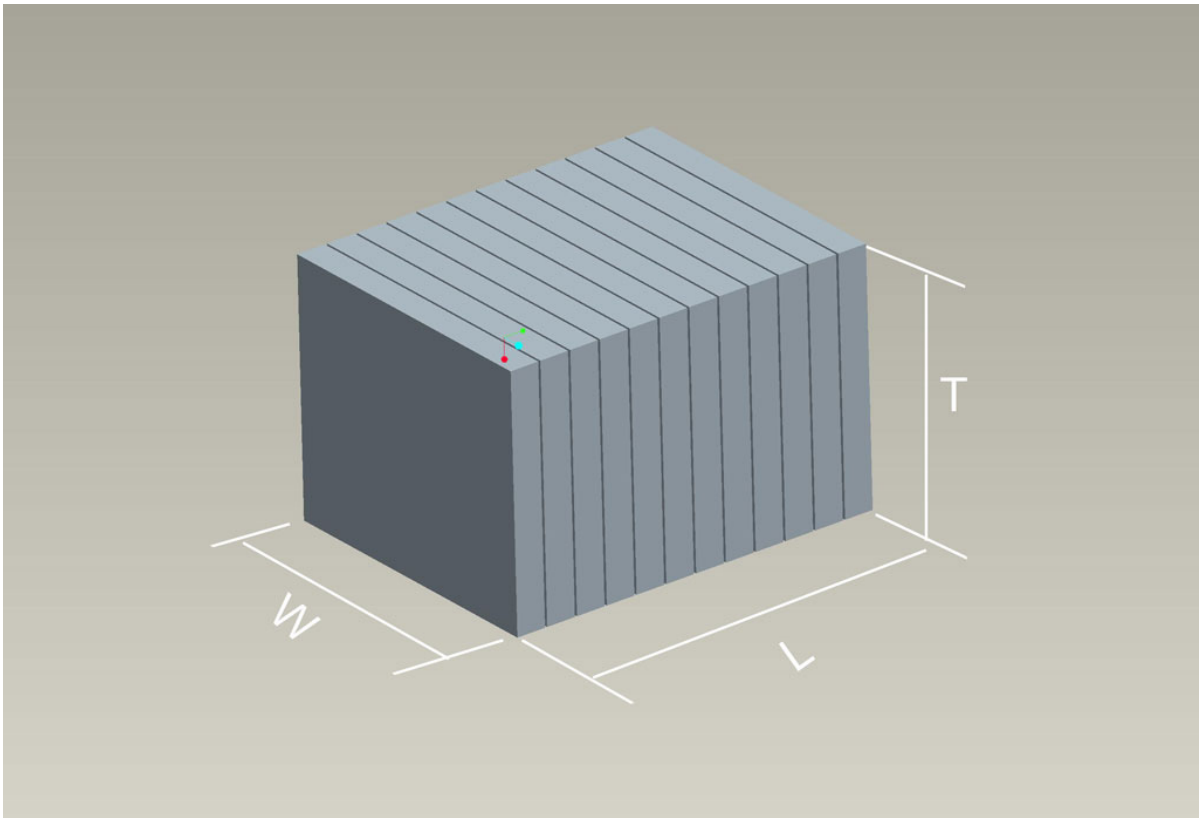
Model Number: GEB10Ah/36V-LPB

This document describes the Product Specification of the Lithium-Ion Power battery supplied by GE Battery Co., Limited.

1. Dimension of battery

Dimension of Battery Packge

(can be customized by client)



Sketch of Battery

The case outside size:

Items	Description	Dimension and Spec/ mm
T	Thickness of package	52.0max
W	Width of packge	150.0max
L	Length of packge	438.0max
U	Length of PCB	<80.0
V	Width of PCB	<90.0

2.Specification

NO.	Items	Specifications
1	Charge voltage	45.6V
2	Number of cell	36 (3 in parallels then 12 in series)
3	Nominal voltage	36V
4	Nominal capacity	10 Ah @ 0.2C Discharge
5	Charge current	Standard Charging:：0.2C Rapid charge： 0.5C
6	Standard Charging method	0.2C CC（constant current）charge to 45.6V,then CV(constant voltage 45.6V)charge till charge current decline to ≤0.02C
7	Charging time	Standard Charging：6.0 hours(Ref.) Rapid charge： 3 hours(Ref.)
8	Max.charge current	1C
9	Max.discharge current	3.0C
10	Discharge cut-off voltage	24.0V
11	Operating temperature	Charging： 0℃~45℃ Discharging： -10℃~45℃
12	Storage temperature	-10℃~ +45℃
13	Battery Weight	Approx：4.7Kg

3.Battery Performance Criteria

3.1 Electrochemical characteristics

NO.	Items	Test Method and Condition	Criteria
1	Standard Charge	Charging the battery initially with constant current at 0.2C and then with constant voltage at 45.6V till charge current declines to 0.02C	
2	Initial Capacity	The capacity means the discharge capacity of the battery, which is measured with discharge current of 0.2C with 24.0Vcut-off voltage after standard charge.	≥10Ah
3	Cycle Life	Test condition: Charge:0.2C CC/CV to 45.6V, current declines to 0.02C Discharge:0.2C to 24.0V 80% or more of 1st cycle capacity at 0.2C discharge of Operation	≥1000
4	High temperature -Storge performance	Battery is to be storaged at 60℃ with 100% charge for 7days, then measured the ratio of thickness , capacity retention ratio and the capacity recovery ratio(battery is to be charged/discharged in 0.2C, at 25℃).	Ratio of thickness≤5% capacity retention≥90% capacity recovery≥95%
5	Capacity-retention ratio after 30 days	After the standard charging, storied the battery under the condition as Appendix No. 4. 0 for 30 days, then measured the capacity with 0.2C till 24.0V. Then charged according to item 3.1.1,at 23±5℃, at last, measured the capacity with 0.2C till 24.0V	Residual capacity≥90% Recovery capacity≥95%
6	Initial impedance	Internal resistance measured at AC 1KHz after 50% charge	≤200mΩ
7	Battery Voltage	As of shipment.	40-41V
8	Temperature Characteristics	1. According to item 3.1.1, at 23±5℃. 2. Capacity comparison at each temperature, measured with constant discharge current 0.2C with 24.0V cut-off. Percentage as an index of the capacity compared with 100% at 23℃	-10℃: Capacity≥60% 0℃: Capacity.≥80% 23℃: Capacity=100% 55℃: Capacity ≥95%

Figure 1. Rated discharge of cell (for reference)

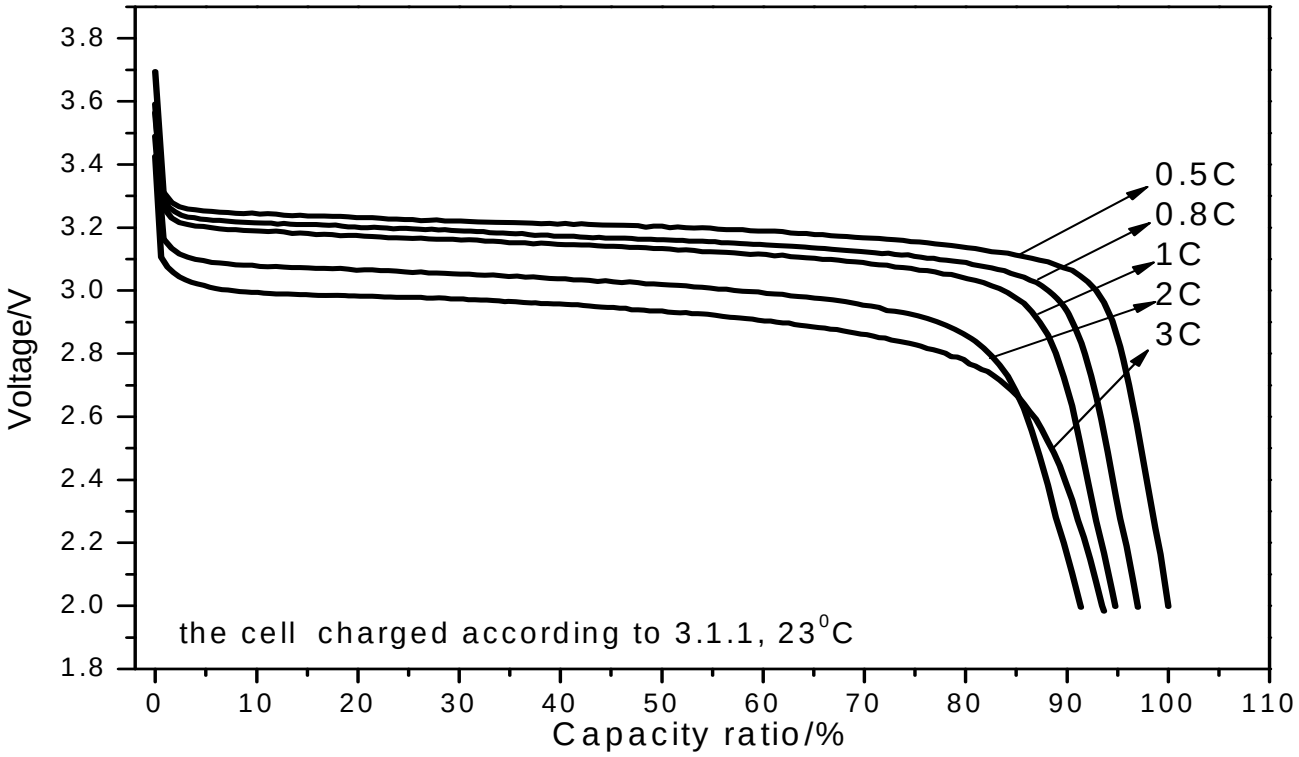
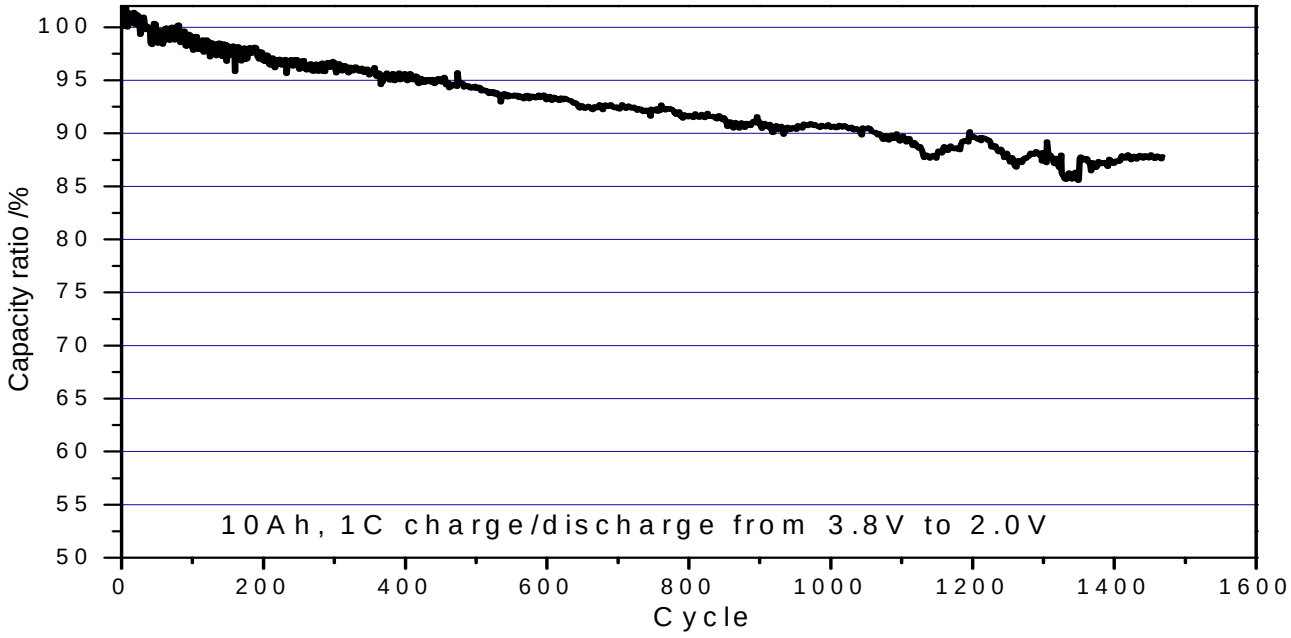


Figure 2. Cycle life of cell (for reference)



3.2 Safty performance of cell

Short circuit	1. Charging according to item 3.1.1, at 23±5℃. 2.The battery will be short-circuited by connecting the positive and negative terminals with a metal wire having a maximum resistance load of 50 mΩ, the battery is to be discharged until its case temperature has returned to near ambient temperature.	No explosion，No fire
Over charge	1. Charging according to item 3.1.1, at 23±5℃. 2. battery charged in 1C to 5.0V and kept the voltage constant until the current reduced to 0.02C and the battery case temperature has returned to near ambient temperature.	No explosion，No fire
Nail test	1. Charging according to item 3.1.1, at 23±5℃. 2.using a steel nail with 3mm diameter and resistance load less than 50mΩ to puncture through the battery in the vertical direction to the max surface. Measured the temperature of battery until it return to ambient temperature.	No explosion，No fire
Oven test	1. Charging according to item 3.1.1, at 23±5℃. 2. Battery is to be placed in a air oven and the temperature is be raised in a rate of 5℃±2℃ per minute to a temperature of 130℃±2℃ and remain for 30 min until it returned to ambient temperature	No explosion，No fire

3.3 Mechanical characteristics

NO.	Items	Test Method and Condition	Criteria
1	Vibration Test	After standard charging, fixed the cell to vibration table and subjected to vibration cycling that the frequency is to be varied at the rate of 1Hz per minute between 10Hz an 55Hz,the excursion of the vibration is 1.6mm.The cell shall be vibrated for 30 minutes per axis of XYZ axes.	No fire no leakage
2	Drop Test	The cell is to be dropped from a height of meter twice onto concrete ground.	No fire no leakage

3.4 Visual inspection

There shall be no such defect as scratch, flaw, crack, and leakage, which may adversely affect commercial value of the cell.

3.5 Standard environmental test condition

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

Temperature：23±5℃

Humidity: 65±20%RH

4.Storage and Others

a) Long Time Storage

If the battery is stored for a long time, the battery's storage should be 40-41V and the battery is to be stored in a condition as No.4.4。

b) Others

Any matters that this specification does not cover should be conferred between the customer and GEB.

Appendix

Handling Precautions and Guideline For Lithium-Ion Power Batteries

Preface

This document of' Handling Precautions and Guideline shall be applied to the lithium-ion power battery manufactured by GEB

Note(1):

The customer is requested to contact GEB in advance, if and when the customer needs other applications or operating conditions than those described in this document. Additional experimentation may be required to verify performance and safety under such conditions.

Note(2):

GEB will take no responsibility for any accident when the battery is used under other conditions than those described in this Document.

Note(3):

GEB will inform, in a written form, the customer of improvement(s) regarding proper use and handing of the battery, if it is deemed necessary.

1. Charging

1.1 Charging current:

Charging current should be less than maximum charge current specified in the Product Specification. Charging with higher current than recommended value may cause damage to battery electrical, mechanical and safety performance and could lead to heat generation or leakage.

1.2 Charging voltage:

Charging shall be done by voltage less than that specified in the Product Specification (45.6V/battery). Charging beyond 47.0V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply with this condition.

It is very dangerous that charging with higher voltage than maximum voltage may cause damage to the battery electrical, mechanical safety performance and could lead to heat generation or leakage.

1.3 Charging temperature:

The battery shall be charged within 0℃~45℃ range in the Product Specification.

1.4 Prohibition of reverse charging:

Reverse charging is prohibited. The battery shall be connected correctly. The polarity has to be confirmed before wiring, In case of the battery is connected improperly, the battery cannot be charged. Simultaneously, the reverse charging may cause damaging to the battery which may lead to degradation of battery performance and damage the battery safety, and could cause heat generation or leakage.

2. Discharging

2.1 Discharging current

The battery shall be discharged at less than the maximum discharge current specified in the Product Specification. High discharging current may reduce the discharging capacity significantly or cause over-heat.

2.2 Discharging temperature

The battery shall be discharged within -20℃~60℃ range specified in the Product Specification.

2.3 Over-discharging:

It should be noted that the battery would be at over-discharged state by its self-discharge characteristics in case the battery is not used for long time. In order to prevent over-discharging, the battery shall be charged periodically to maintain between 40 and 41V.

Over-discharging may causes loss of battery performance, characteristics, or battery functions.

The charger shall be equipped with a device to prevent further discharging exceeding a cut-off voltage specified in the Product Specification. Also the charger shall be equipped with a device to control the recharging procedures as follows:

The cell battery pack shall start with a low current (0.01C) for 15-30 minutes, i.e.-charging, before rapid charging starts. The rapid charging shall be started after the (individual) cell voltage has been reached above 3.0Vwithin 15-30 minutes that can be determined with the use of an appropriate timer for pre-charging. In case the (individual) cell voltage does not rise to 3.0Vwithin the pre-charging time, then the charger shall have functions to stop further charging and display the cell/pack is at abnormal state.

3. Protection Circuit Module(PCM)

The cell/battery pack shall be with a PCM that can protect cell/battery pack properly.

PCM shall have functions of (1) overcharging prevention, (2) over-discharging prevention, and (3) over current prevention to maintain safety and prevent significant deterioration of cell performance.

The over current can occur by external short circuit

3.1 Overcharging prohibition:

Overcharging prevention function shall stop charging if any one of the cells of the battery pack reaches 3.8V.

3.2 Over-discharge prohibition:

Over-discharging prevention function shall work to avoid further drop in cell voltage of 2.0V or less per cell in any cell of the battery pack. It is recommended that the dissipation current of PCM shall be minimized to 0.5uA or less with the over-discharge prevention.

The protection function shall monitor each bank of the battery pack and control the current all the time.

4. Storage

The battery shall be storied within -10℃~45℃ range environmental condition.

If the battery has to be storied for a long time (Over 1 months),the environmental condition should be:

Temperature: 23±5℃

Humidity: 65±20%RH

The voltage for a long time storage shall be 40~41V range.

5. Handling of Cells

Since the battery is packed in soft package, to ensure its better performance, it's very important to carefully handle the battery

5.1 Soft Aluminum foil

The soft aluminum packing foil is very easily damaged by sharp edge parts such as Ni-tabs, pins and needles.

- Don't strike battery with any sharp edge parts
- Trim your nail or wear glove before taking battery
- Clean worktable to make sure no any sharp particle

5.2 Sealed edge

Sealing edge is very flimsy.

- Don't bend or fold sealing edge

5.3 Folding edge

The folding edge is form in battery process and passed all hermetic test

- Don't open or deform folding edge

5.4 Tabs

The battery tabs are not so stubborn especially for aluminum tab.

- Don't bend tab.

5.5 Mechanical shock

- Don't Fall, hit, bend battery body

5.6 Short

Short terminals of battery is strictly prohibited, it may damage battery.

6. Notice Designing Battery Pack

6.1 Pack design

- Battery pack should have sufficient strength and battery should be protected from mechanical shock
- No Sharp edge components should be inside the pack containing the battery.

6.2 PCM design

- The overcharge threshold voltage should not be exceed 3.8V
- The over-discharge threshold voltage should not be lower than 2.0V
- The PCM should have short protection function built inside

7. Notice for Assembling Battery Pack

7.1 Tab connection

- Ultrasonic welding or spot welding is recommended to connect battery with PCM or other parts.
- If apply manual solder method to connect tab with PCM, below notice is very important to ensure battery performance.

a) The solder iron should be temperature controlled and ESD safe

b) Soldering temperature should not exceed 350℃

c) Soldering time should not be longer than 3s

d) Soldering time should not exceed 5 times Keep battery tab cold down before next time soldering.

e) Directly heat cell body is strictly prohibited, Battery may be damaged by heat above approx.100℃

7.2 Cell fixing

- The battery should be fixed to the battery pack by its large surface area.
- No cell movement in the battery pack should be allowed.

8. Others

8.1 Prevention of short circuit within a battery pack

Enough insulation layers between wiring and the cells shall be used to maintain extra safety protection.

8.2 Prohibition of disassembly

1）Never disassemble the cells.

The disassembling may generate internal short circuit in the cell, which may cause gassing, firing, or other problems.

2）Electrolyte is harmful

LIP battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

8.3 Prohibition of dumping of cells into fire

Never incinerate nor dispose the cells in fire. These may cause firing of the cells, which is very dangerous and is prohibited.

8.4 Prohibition of cells immersion into liquid such as water

The cells shall never be soaked with liquids such as water, seawater drinks such as soft drinks, juices coffee or others.

8.5 Battery cells replacement

The battery replacement shall be done only by either cells supplier or device supplier and never be done by the user.

8.6 Prohibition of use of damaged cells

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of electrolyte, electrolyte leakage and others, the cells shall never be used any more.

The cells with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing.