SPECIFICATION OF PRODUCT

For Lithium-ion Rechargeable Battery

Model：IFR18650E-1500 4S8P 12.8V 12Ah with PCM

Prepared by	Checked by	Approved by

	Signature	Date
Customer Approval		
	Company name:	
	Company Stamp:	

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History of revision

Version	Description	Date
A/0	First issue	2011-12-06

1. Scope

This Product Specification describes the requirements for the rechargeable lithium ion battery ("Battery") to be supplied by Tenergy Corporation

2. Description and Model

2.1. Description	Lithium ion rechargeable battery
2.2. Model	IFR18650E-1500 4S8P 12.8V 12Ah With PCM

Note: IFR*18*650*E*1500*4S8P = LiFePO4--Li-ion Cylindrical*Diameter*Height* Kind* Capacity* Configuration Code

3. Nominal Specifications

Items	Specification	
3.1. Nominal Capacity	12.5Ah (Typ.) 12.0Ah (Min.)	
3.2. Nominal Voltage	12.8V	
3.3. Charging Voltage	14.60 ±0.05 V	
3.4. Charging method （Can float charging）	CC-CV Constant Current with limited Voltage- Constant Voltage with limited Current （or float charging see 7.1）	
3.5. Initial Charging Current	Standard Charge	: 2.4A
	Max. Charge	: 12A
3.6. Max. Discharge Current（Pulse）	70.0A	
3.7. Discharge Method-Standard	2.4A	
3.8. Max. Continuous Discharge	30.0 A	
3.9. Discharge Cut-off Voltage	9.2V	
3.10. Battery Dimension	Length*Width*High (Max)	See Fig.1 Dimension drawing
3.11. Case Dimension	Length*Width*High	150mm x 100mm x 95mm
3.12. Operating Temperature	Charge	5℃ ~ 60℃
	Discharge	-20℃ ~ 60℃
3.13. Storage Temperature	1 month	-25℃ ~ 45℃

	3 month	-25℃ ~ 30℃
3.14.Weight	1.4 ± 0.1Kg	

4. Outline Dimensions

See attached drawing (Fig.1).

5. Appearances

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

6. Reference Standard and Test Conditions

This specification is compiled by referring the Standard UL1642、 IEC61960:2003、 UN38.3 GB/T 18287-2000 and so on.

Unless otherwise specified, all tests stated in this Product Specification are conducted at temperature 25±5℃ and humidity 65±20 %RH. If it is judged that the test results are not affected by such conditions, the tests may be conducted at temperature 15 ~ 30℃and humidity 25 ~85%RH.

7. Electrical Characteristics

<table>
<tr><th>Items</th><th>Test Condition</th><th>Criteria</th></tr>
<tr><td>7.1. Standard Charge</td><td>The "Standard Charge" means charging the Battery with initial charge current 2.4A and with constant voltage 14.60 V ,then constant voltage (14.60V)with floating current taper to 600mA cut-off (Charger for exclusive use lithium ion rechargeable battery, with an accuracy 14.60+/-0.05V) at 25±5℃.(if float charging, not limit the CV current)</td><td></td></tr>
<tr><td>7.2. Nominal Capacity</td><td>The capacity means the discharge capacity of the Battery, which is measured with discharge current 2.4A with 9.2 V cut-off at 25±5℃ within 5 hour after the Standard Charge.</td><td>≥ 12Ah</td></tr>
<tr><td>7.3. Cycle Life</td><td>Each cycle is an interval between the charge (charge current 2.4A) CC 2.4A to 14.60V, CV to 600mA , stop 30min and discharge (discharge current 1.3A) with 9.2V cutoff, stop 30min at 25±5℃.Capacity after 1000 cycles and plus 1 day, measured under the same conditions stated in 7.2.</td><td>≥80% Nominal capacity</td></tr>
<tr><td>7.4. Internal Impedance</td><td>Internal resistance measured at 1KHz after Standard Charge.</td><td>≤300mΩ</td></tr>
<tr><td>7.5. Rated capacity</td><td><table><tr><td>Charge Current</td><td colspan="4">Discharge Current</td></tr><tr><td rowspan="2">2.4A</td><td>2.4A</td><td>6.0A</td><td>12A</td><td>24A</td></tr><tr><td>100%</td><td>≥95%</td><td>≥90%</td><td>≥85%</td></tr></table></td><td></td></tr>
<tr><td>7.6. Charge retention</td><td>Capacity after 28 days storage at 25℃ from Standard Charge, measured under the same conditions stated in 7.2.</td><td>Retention capacity ≥85%</td></tr>
<tr><td>7.7. Battery</td><td>As of shipment</td><td>12.80~ 13.60 (V)</td></tr>
</table>

<table>
<tr><td>voltage</td><td></td><td></td></tr>
<tr><td>7.8. Discharge Character</td><td>
<table>
<tr><td>Discharge current</td><td colspan="4">Discharge Degree</td></tr>
<tr><td rowspan="2">2.4A</td><td>-20℃</td><td>0℃</td><td>25℃</td><td>60℃</td></tr>
<tr><td>≥60%</td><td>≥80%</td><td>100%</td><td>≥100%</td></tr>
</table>
</td><td>No leakage, No appearance defect</td></tr>
</table>

8. Safety Characteristics（single cell）

Items	Test Condition	Criteria
8.1. Impact	A 15.8 mm diameter bar is inlayed into the bottom of a 9.1kg weight. And the weight is to be dropped from a height of 610mm onto a sample cell and then the bar will be across the center of the sample.	No explosion, No fire
8.2. Short Circuit	To short-circuit the Cell charged 3.65 V by connecting positive and negative terminal by 50milli-ohm wire for 1 hour.	No explosion, No fire
8.3. Over Charge	Cells are charge at constant current of $3C_5$mA and constant voltage of 5V for 2 hour.	No explosion, No fire
8.4. Over discharge	After standard charge .Cells are discharged at constant Current of $0.2C_5$mA to 2.0V, and the positive and negative terminal is connected by a 30Ω wire for 24 hour.	No explosion, No fire
8.5. Nail test	A Steel needle (diameter: 2.5mm-5mm) is Penetrated vertically through the center of a fully charged cell	No explosion, No fire
8.6. Heating test	After standard charge ,Cells are heated in a circulating air Oven at a rate of 5℃ per minute to 150℃ and keeping the state for 30 minutes	No explosion, No fire
8.7. Crush	Crush between two flat plates. Applied force is about 13kN(1.72Mpa) for 30min	No explosion, No fire

9. Protection： When Li-ion rechargeable battery is used over the permitted voltage or current, electrolyte may disassemble, and this case will affect safety performance of Li-ion rechargeable battery.

10. Specifications of PCM:

No.	Test item		Criterion
1	Voltage	Charging voltage	DC:14.6V
2	Current	Low current consumption for single cell	≤20μA
		Maximal continuous discharging current	30A
3	Over charge Protection（single cell）	Over charge detection voltage	3.90±0.025V
		Over charge detection delay time	1.0±0.5S
		Over charge release voltage	3.80±0.05V
4	Over discharge protection（single cell）	Over discharge detection voltage	2.00±0.08V
		Over discharge detection delay time	144mS±50mS
		Over discharge release voltage	2.30±0.1V
5	Over current protection	Over current detection voltage	0.15±0.025V
		Over current detection current	80±5A
		Detection delay time	12ms

		Release condition	Automatic Recovery
6	Short protection	Detection condition	Exterior short circuit
		Detection delay time	200-500us
		Release condition	Automatic Recovery
7	Resistance	Protection circuitry （MOSFET）	≤60mΩ
8	Cell balance	Balance Start Point voltage	3.60±0.025V
		Balance Current	100±10mA
9	Temperature	Operating Temperature Range	-10～+65℃
		Storage Temperature Range	-40～+85℃

11. Product Liability

The Safety should be sure to confer previously with between the both parties.
The results of the conference must be recorded and the range of the liability or the burden should be cleared.
The indications of a warning are established by conference with between the both parties.

12. Shipping

The capacity of delivery battery is approximately at 50% of charging. During transportation, keep the battery from acutely vibration, impacting, solarization, drenching.

13. Warranty

As long as the Battery is treated in accordance with this Product Specification and / or Handling Precautions and Prohibitions, Supplier warrants that the Battery should be free from any defect for a period of 6 month (25℃ or less) from the date of shipment or for 1000 cycles (see 7.3), whichever comes earlier.
The warranty set forth above or described in Handling Precautions and Prohibitions for Lithium Ion Rechargeable Batteries excludes a defect, which is not related to manufacturing of the Battery.

14. Others

14.1.Storage for a long time If Battery is preserved for a long time (more than 3 months); the Battery should be preserved at the dry and low temperature.
14.2.Other Any matters that this specification does not cover should be conferred between the both parties.

! Note

- When charging the battery, use dedicated chargers and follow the specified conditions.
- Use the battery only in the specified equipment.
- Do not connect battery directly to an electric outlet or cigarette lighter charger.
- Do not heat or throw battery into a fire.
- Do not use, leave battery close to fire or inside of a car where temperature may be above 60℃. Also do not charge / discharge in such conditions.
- Do not immerse, throw, and wet battery in water/ seawater.
- Do not put batteries in your pockets or a bag together with metal objects such as necklaces.

Hairpins, coins, or screws. Do not store batteries with such objects.
- Do not short circuit the (+) and (-) terminals with other metals.
- Do not place battery in a device with the (+) and (-) in the wrong way around.
- Do not pierce battery with a sharp object such as a needle.
- Do not hit with a hammer, step on or throw or drop to cause strong shock.
- Do not disassemble or modify the battery.
- Do not solder a battery directly.
- Do not use a battery with serious scar or deformation.
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! Warning
- Do not put battery into a microware oven, dryer, or high-pressure container.
- Do not use battery with dry batteries and other primary batteries, or batteries of a different package, type, or brand.
- Stop charging the battery if charging is not completed within the specified time.
- Stop using the battery if abnormal heat, odor, discoloration, deformation or abnormal condition is detected

During use. Charge. Storage.
- Keep away from fire immediately when leakage or foul odor is detected.
- If liquid leaks onto your skin or clothes, wash well with fresh water immediately.
  If liquid leaking from the battery gets into your eyes, do not rub your eyes. Wash them well with clean water and go to see a doctor immediately.

! Caution
- Store batteries out of reach of children so that they are not accidentally swallowed.
- If younger children use the battery, their guardians should explain the proper handling.
- Before using the battery, be sure to read the user's manual and cautions on handling thoroughly.
- Thoroughly read the user's manual for the charger before charging the battery.
- For information on installing and removing from equipment, thoroughly read the user's manual for the specific equipment.
- Batteries have life cycles. If the time that the battery powers equipment becomes much shorter than usual, the battery life is at an end. Replace the battery with a new same one.
- Remove a battery whose life cycle has expired from equipment immediately.
- When the battery is thrown away, be sure it is non-conducting by applying vinyl tape to the (+) and (-) terminals.
- When not using battery for an extended period, remove it from the equipment and store in a place with low humidity and low temperature.
- While the battery pack is charged, used and stored, keep it away from objects or materials with static electric charges.
- If the terminals of the battery become dirty, wipe with a dry clothe before using the battery.
- The battery can be used within the following temperature ranges. Do not exceed these ranges.
  Charge temperature range: 5℃ to 60℃
  Discharge temperature range: -20℃ to 60℃
  (When using equipment)

Fig.1 Dimension drawing IFR18650E-1500 4S8P 12.8V 12Ah with PCM

Case dimension（±1㎜): L151mm*W98mm*H95mm (excluding terminal)