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| Title: Prismatic Li-ion Rechargeable Battery | Number: PC036067—09C04 |
| Model: <i>PowerCard™</i> 036067 | Date: 2003-09-26 Rev: 1.0 |

SPECIFICATIONS OF POWERCELL LI-ION BATTERY

MODEL: PC 036067

APPLICATION:

Accepted by :

Date:

Korea PowerCell Inc.

Prepared by :

Approved by :

Date:



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1. Preface

This Product Specification describes the requirements of Rechargeable Lithium-ion Battery ("Cell") to be supplied to _____ by **Korea Powercell Inc.**

2. Description and Model

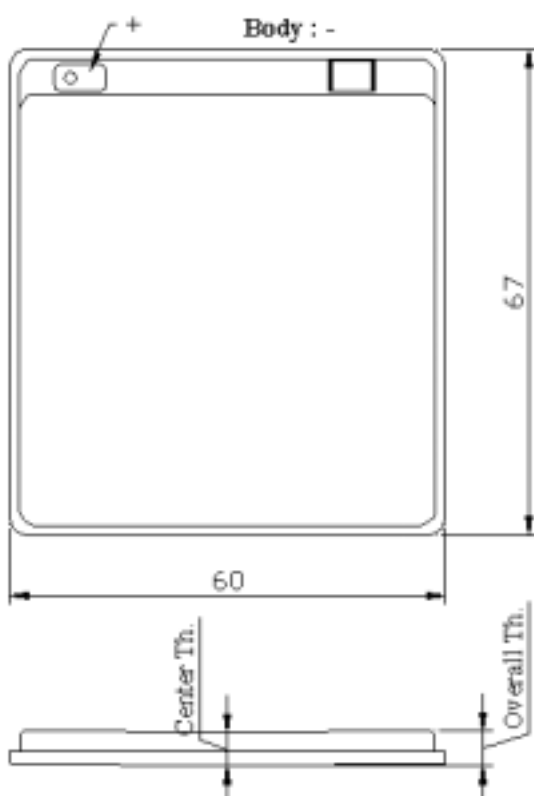
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|------------------|---|
| 2.1 Description | Lithium-ion Rechargeable Battery |
| 2.2 Model (Type) | PC036067 (<i>PowerCard™</i>) |

3. Nominal Specification

| Item | Specification | Remark |
|---------------------------------|-----------------|-------------------------------------|
| 3.1 Nominal Capacity | 1500 mAh(min.) | 0.2C rate, 3.0V cut-off |
| 3.2 Nominal Voltage | 3.7 V | From 4.20 V to 3.00V |
| 3.3 Charging Method | CC/CV | Constant Current / Constant Voltage |
| 3.4 Charging Current (Std.) | 0.5CA (0.75A) | End Current : 40 mA (0 ~ 45) |
| 3.5 Charging Voltage | 4.2 ± 0.03 V | 0 ~ 45 |
| 3.6 Charging Time (Std.) | 4.0 hours | |
| 3.7 Discharge Current (Std.) | 0.5CA (0.75A) | - 20 ~ 60 |
| 3.8 Discharge Current (Max) | 1CA (1.5A) | - 20 ~ 60 |
| 3.9 Discharge Cut-off Voltage | 3.0 V | |
| 3.10 Initial Internal Impedance | Less than 60 m | AC Impedance 1kHz |
| 3.11 Cell Weight | approx. 42g | |
| 3.12 Storage Temperature Range | -20 ~ 35 | |

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4. Dimension Drawing of PC 036067 (unit : mm)



Center thickness: 3.5 ± 0.1 mm

Overall thickness: 3.6 ± 0.2 mm

5. Standard Test Conditions

Unless otherwise specified, all tests stated in this Product Specification are conducted at temperature 25 ± 3 and humidity $65 \pm 20\%$ RH.



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6. Electrical Characteristics

6.1 Standard Charge

The "Standard Charge" means charging the Cell with initial charge current 750mA (0.5C) and with a constant voltage 4.20V (± 0.03 V) at 25 °C for 3.0 hours or with 40mA end-current.

6.2 Standard Discharge

The "Standard Discharge" means discharging the Cell with initial discharge current 750mA (0.5C) and with 3.0V cut-off voltage at 25 °C.

6.3 Capacity

The capacity is the discharge capacity of the Cell, which is measured with discharge current 300mA (0.2C) with 3.0V cut-off at 25 °C within 1 hour after the Standard Charge.

Nominal Capacity 1500 mAh

6.4 Cycle Life

Each cycle has each phase of charge current 750 mA and discharge 750 mA current with 3.0V cut-off at 25 °C.

Capacity after 300 cycles, measured under the same conditions stated in 6.3.

Capacity 1200 mAh (80%)

6.5 Initial Internal Impedance

Internal resistance measured at 1KHz after Standard Charge.

Initial Internal Impedance 60 m Ω (Typically 50m Ω)



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6.6 Temperature Dependency of Discharge Capacity

Relative capacity at each temperature are shown below, measured as stated in 6.3 with 2.75V cut-off

| Charge Temp. | Discharge Temp. | | | |
|--------------|-----------------|------|-------|-----------------------|
| 25 | -20 | -10 | 25 | 60 |
| | > 50 % | >70% | 100 % | >95%(* ¹) |

Note(*¹) : Generally, more than 100%

6.7 Discharge Characteristics on Load (C-Rate)

Relative capacity at each load, measured with constant discharge current 0.2C, 0.5C, 1.0C, 1.5C with 3.00V cut-off after Standard Charge shown below.

| Charge Current | Discharge Current | | | |
|-----------------|-------------------|--------|---------|---------|
| Standard Charge | 0.2 CA | 0.5 CA | 1 CA | 1.5 CA |
| | 300 mA | 750 mA | 1500 mA | 2250 mA |
| | 100 % | >96 % | > 93 % | > 80% |

7. Safety Test

| Test Item | Test Method | Criteria |
|--|---|-----------------------|
| 7.1 High Temperature | Storing a Cell at 90 for 4 hours after charged at 4.2 V | No leakage |
| 7.2 High Temperature and High Humidity | Storing a Cell at 60 (90 % RH) for 168 hours after charged at 4.2V. | No leakage |
| 7.3 Thermal Shock Test | Storing a fully charged Cell(4.2V) at 60 for 2hour and at -20 for 2hour (1 cycle). Total 10 cycles with the maximum transition time, 5mins. | No leakage |
| 7.4 Overcharge Test | Charging the Cell up to 250% of its Nominal | No explosion, No fire |



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| (with PTC) | capacity(1500mAh) with 1C rate at 25 for 2.5 hours. | |
| 7.5 Hot Box Test | A cell is to be heated in a gravity convection oven. The temperature of the oven is to be raised at a rate of 5 ± 2 per minute to a temperature of 130 ± 2 and maintained for 30 minutes at the temperature before the test is discontinued. | No explosion, No fire |
| 7.6 Impact Test | A test cell is to be placed on a flat surface. The bar of 9.1 kg weight and 15.8 mm diameter is dropped from a height of 610 mm onto the cell. | No explosion, No fire |
| 7.7 Short-Circuit Test | A Cell is to be short-circuited by connecting the positive and negative terminals of the battery with copper wire having a maximum resistance load of 100m . | No fire or no explosion, until it is completely discharged |
| 7.8 Applying Pressure | Giving Pressure on whole surface of a fully charged cell with 7kg _f for 72 hours | No leakage, No weight decrease |

8. Shipment

The Cell shall be shipped in about 25% charged state. (Cell voltage range: 3.7 ~ 3.8 V)
It is not specified more than 25% capacity remain at customer, because of self -discharge.

9. Warranty Period

The Warranty Period of battery is one year from the date of shipment. However, even though the problem occurs within this period, PowerCell won't replace a new battery for free as long as the problem is not due to the failure of PowerCell manufacturing process or is due to customer's abuse or misuse.



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- PowerCell will not be responsible for trouble occurred by handling outside of the precautions in this specification.
- PowerCell will not be responsible for trouble occurred by matching electric circuit, battery pack and charger.
- PowerCell will be exempt from guaranteeing any defect cells during assembling after acceptance.

10. Precautions and Safety Instructions

Lithium-Ion rechargeable batteries subject to abusive conditions can cause damage to the battery and/or personal injury. Please read and observe the standard battery precautions below before using.

Note 1. The customer is required to contact PowerCell in advance, if and when the customer needs other applications or operating conditions than those described in this document.

Note 2. PowerCell will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

10.1 Standard Battery Precaution:

- a. Do not expose the battery to extreme heat or flame.
- b. Do not short circuit, over-charge or over-discharge the battery.
- c. Do not subject the battery to strong mechanical shocks.
- d. Do not immerse the battery in water or sea water, or get it wet..
- e. Do not reverse the polarity of the battery for any reason.
- f. Do not disassemble or modify the battery.
- g. Do not remove charge/discharge protection circuitry.
- h. Do not handle or store with metallic like necklaces, coins or hairpins, etc.
- i. Do not use the battery with conspicuous damage or deformation.
- j. Do not connect battery to the plug socket or car-cigarette-plug.
- k. Do not make the direct soldering onto a battery. Weld spot welding lead plate onto a battery.



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- l. Do not touch a leaked battery directly.
- m. Do not use for other equipment.
- n. Do not use Lithium-ion battery in mixture.
- o. Do not use or leave the battery under the blazing sun (or in heated car by sunshine).
- p. Keep battery away from children.
- q. Do use the specified charger and observe charging requirement.
- r. Do not drive a nail into the battery, strike it by hammer or tread it.
- s. Do not give battery impact or fling it.

10.2 Battery Operation Instruction:

A. Charging

- a. Charge the battery in a temperature range of 0°C to + 45°C.
- b. Charge the battery at a constant current of 0.5C until 4.20±0.03V per cell is attained. Charge rates greater than 1C are NOT recommended. (C : Rated Capacity of Battery)
- c. Maintain charge voltage at 4.20V per cell until current diminishes to 40mA (recommended for maximum capacity).

** Use a constant voltage, constant current (CV/CC) lithium-ion (Li+) battery charge controller.*

** Do not continue to charge battery over specified time.*

B. Discharging

- a. Recommended cut-off voltage to 3.0V. Recommended maximum discharge rate is 1C at constant current.
- b. For maximum performance, discharge the battery in a temperature range of –20°C to + 45°C.

C. Protection Circuit

A protection circuit is provided for protecting the battery against damage and/or performance deterioration. The circuit must include :

a. Overcharge Protection (to stop charging)

- A maximum voltage threshold of 4.25V (±0.025V).



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- If the maximum charging voltage is surpassed, the protection circuit interrupts or stops charging.
- b. **Over-discharge Protection (to stop discharging)**
 - Voltage threshold of 2.5V or less is NOT recommended.
 - If the battery is discharged below the cut-off voltage, the protection circuit stops discharging.
- c. **Over-current Protection (to protect terminals against possible short circuiting)**
 - If current exceeding the battery rating or recommendations flows during charging or discharging, the charge or discharge process stops.

D. Storage Recommendations

- a. Storage Temperature and Humidity
 - Storage the battery at temperature range $-20 \sim +35^{\circ}\text{C}$, low humidity and no corrosive gas atmosphere.
 - No condensation on the battery
- b. Long Period Storage
 - In case of long period storage (more than 3 months), storage the battery at temperature range $-10 \sim +20^{\circ}\text{C}$, low humidity, no corrosive gas atmosphere.
 - No condensation on the battery

11. Consultation

As to the obscurity, contact the following.

PowerCell Korea Inc. Sales & Marketing Division

sales@powercellkorea.com

Tel : +82-42-864-0255

Fax : +82-42-864-4342

12. Requirement for Safety Assurance

For the sake of safety assurance, please discuss the equipment design, its system and protection circuit of Lithium-ion battery with PowerCell in advance.

And consult about the high rate current, rapid charge and special applications in the same way.