Notes for Designers

Select the correct type of battery to match the operating conditions such as load current, etc.

Charge conditions
To get the most out of coin type lithium-ion batteries and use them safely, please use specified charge IC, protection IC and read the following requirements carefully: For different charge IC, protection IC, consult your nearest Maxell dealer or distributor.

<table>
<thead>
<tr>
<th>Charge IC</th>
<th>Specified IC by Maxell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge method</td>
<td>Constant current, constant voltage charge</td>
</tr>
<tr>
<td>Charge voltage</td>
<td>4.20±0.05V / cell</td>
</tr>
<tr>
<td>Standard charge current</td>
<td>0.5A</td>
</tr>
<tr>
<td>Max. charge current</td>
<td>1.0A</td>
</tr>
<tr>
<td>Charge temperature</td>
<td>0 to +45 deg. C</td>
</tr>
</tbody>
</table>

Protection conditions
Protection IC Specified IC by Maxell

Charge control flowchart (sample)
Refer to the following flowchart when designing constant current and constant voltage battery chargers.

Safety Instructions
The battery contains organic solvents and other combustible materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion or fire, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents. The following are general cautions and guidelines only and as such may not include every possible usage scenario. The manufacturer will not be liable for actions taken or accidents caused.

Danger
- Do not dip or wet the battery in water, seawater, or other liquid. Otherwise the battery may be shorted, which may generate heat or cause damage.
- Do not put the battery into a fire. Otherwise, the electrolyte may burn or cause an explosion or fire.
- Do not heat the battery. Otherwise heating the battery could increase the internal pressure, causing leakage, explosion, overheating or fire.
- The battery has a predetermined polarity. If the battery will not connect well to the charger or equipment, do not try to connect the battery forcefully. Check the polarity first. If the battery is connected in reverse, it will be charged in reverse and may cause distortion, leakage, overheating, explosion or fire due to an abnormal chemical reaction during charge or an excessive current during discharge.
- Do not let the battery terminals (+ and –) come into contact with a wire or any metal (like a metal necklace or a hairpin) with which it is carried or stored. In such a case, the battery will be shorted and discharge excessive current, which may result in overheating, explosion, fire or heat generation of the metal necklace or the hairpin.
- Do not apply any heavy impact to the battery, throw or drop it. Do not apply heavy load to the battery causing distortion. Otherwise the battery may be shorted and result in leakage, overheating, explosion or fire.
- Do not drive a nail into, hammer or stamp on the battery. Otherwise the battery may be shorted and result in destruction, distortion, overheating, explosion or fire.
- Do not weld a terminal or weld a wire to the body of the battery directly. The heat of welding or soldering could cause damage to the insulating material or the structure in the battery, leading to distortion, leakage, overheating, explosion, or fire. When soldering the battery directly to equipment, use the battery with tabs or leads and solder only the tips of the tabs or leads. Even then, the temperature of the soldering iron must be below 350 deg. C and the soldering time less than 5 seconds. Do not use a soldering bath, because the circuit board with battery attached could stop moving or the battery could drop into the bath. Moreover do not use excessive solder, because the solder could flow to unwanted portions of the board, leading to a short-circuit or charging of the battery by connecting to power source.
- Do not disassemble or alter the battery. Otherwise the insulating materials or the inside structure could be damaged, leading to distortion, leakage, overheating, explosion or fire.
- After long periods of storage without being used, the battery should be charged before it is used. Charge the battery every 6 months to the level specified by the manufacturer, even if the battery is not used. Otherwise over-discharging the battery may cause an abnormal chemical reaction in the battery and result in the degradation of battery performance, such as a shortening of battery life, distortion, leakage, overheating or fire.
- When charging the battery, always follow the charge conditions specified by the manufacturer. If the battery is charged under other conditions (a high temperature, a high voltage/current or an altered charger) not specified by the manufacturer, the battery may cause distortion, overheating, explosion or fire due to abnormal chemical reactions.

(*) Leakage is defined as the unintentional escape of a liquid from a battery.)
**Warnings**

- Do not connect the battery directly to an electric outlet or cigarette lighter socket in a car. Applying a high voltage may generate an excessive current and cause an electric shock. In such a case, the battery may leak electrolyte, overheat, explode or cause fire.
- Do not use or leave the battery near fire, heaters, inside an automobile in hot weather or under strong sunshine. Such conditions of high temperature may damage the separator, and the battery may be shortened and result in overheating, explosion or fire.
- Do not use the battery with any equipment or device other than those specified by the manufacturer. Any such practice may expose your equipment or device to an abnormal current, which may result in distortion, overheating, explosion or fire.

**Caution**

- Use protection circuit in the application or a battery pack in order to prevent over-charge or over-discharge. Excess charge current or charge voltage may cause distortion, leakage, overheating, explosion or fire.
- Do not allow the battery electrodes to come in contact with your skin or fingers. Do not stick the battery on skin with adhesive tape or glue. Otherwise the moisture from your skin could cause a discharge of the battery, which could produce certain chemical substances causing you to receive chemical burns.
- Please be careful when installing the battery not to short-circuit it with metal portions of the equipment. Otherwise this could lead to distortion, leakage, overheating, explosion or fire.
- Keep the contact pressure at more than 2N for stable contact resistance. Otherwise the battery voltage may be lower than intended value due to poor contact condition.
- Do not use or leave the battery in a hot and highly humid place such as under the direct rays of the sun or in a car in hot weather. It may cause distortion, leakage, overheating, explosion or fire.
- Do not leave the battery or battery pack being charged after charge is finished. Otherwise it may cause the degradation of battery performance, such as a shortening of battery life.
- When the battery is expected not to be used for a long time, take the battery out of the equipment or device and store it in a less humid area.
- Do not use the battery in other than the following temperature ranges:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge</td>
<td>0 deg. C to +45 deg. C</td>
</tr>
<tr>
<td>Discharge</td>
<td>-20 deg. C to +60 deg. C</td>
</tr>
<tr>
<td>Storage (less than 30 days)</td>
<td>-20 deg. C to +50 deg. C</td>
</tr>
<tr>
<td>Storage (less than 90 days)</td>
<td>-20 deg. C to +35 deg. C</td>
</tr>
</tbody>
</table>

**Warnings — Disposal**

The battery may be regulated by national or local regulation. Please follow the instructions of proper regulation. As electric capacity is left in a discarded battery and it comes into contact with other metals, it could lead to distortion, leakage, overheating, or explosion, so make sure to cover the (+) and (-) terminals with friction tape or some other insulator before disposal.
Overview

Developed by Maxell, the coin type lithium-ion rechargeable battery has a high-rate discharge characteristic of up to 2Ia, made possible by the battery’s original stacked electrode structure. This compact high-power battery is designed for small portable devices that have communication and charging functions.

Features

- **High power**
  A unique stacked electrode structure enables power of up to 140mA (CLB2032).
- **Discharge capability of CLB2032 is approximately 40 times better**
  * Compared with Maxell’s CR2032 at 60% available capacity
- **Excellent cost performance**
  Superior recharging properties ensure a service life of about 500 charge/discharge cycles under normal usage conditions. The superior cost/performance ratio ensures that lithium-ion batteries are ultimately more economical than primary batteries.
- **High reliability**
  Maxell has concentrated its original technologies, accumulated during the development of crimping and electrode coating technologies, into this highly reliable CLB battery. The stainless steel battery body minimizes battery swelling.
- **Superior safety**
  Separator-wrapped positive electrodes help prevent internal short-circuits. Safety is ensured even when external short-circuits occur.

UL (Underwriters Laboratories Inc.) Recognized Components (Technician Replaceable)

Recognized model: CLB3032, CLB2032, CLB2016  
Certification Number: MH12568

Applications

- Biological information monitoring systems
- Wearable data devices
- Medical sensor networks
- Environment monitoring systems
- Logistics management systems
- Remote keyless entry systems (RKE)

Products

<table>
<thead>
<tr>
<th>Model</th>
<th>CLB3032</th>
<th>CLB2032</th>
<th>CLB2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)*1</td>
<td>30</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Initial dimensions</td>
<td>Height</td>
<td>Weight (g)*1</td>
<td>7.5</td>
</tr>
<tr>
<td>Charge (CC)</td>
<td>Max. voltage (V)</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Standard current (mA)</td>
<td>100</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>Temperature (deg. C)</td>
<td>0 to +45</td>
<td>0 to +45</td>
<td>0 to +45</td>
</tr>
<tr>
<td>Discharge (CC)</td>
<td>End voltage (V)</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Max. current (mA)</td>
<td>400</td>
<td>140</td>
<td>60</td>
</tr>
<tr>
<td>Temperature (deg. C)</td>
<td>–20 to +60</td>
<td>–20 to +60</td>
<td>–20 to +60</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Nominal capacity (mAh)*2</td>
<td>200</td>
<td>70</td>
<td>30</td>
</tr>
</tbody>
</table>

*1 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

*2 Nominal capacity is according to the following conditions: Charge: 0.5A/4.2V (CCCV)/End current 0.03mA, Discharge: 0.2A/E.V. = 3.0V, Temperature 20 deg. C

Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Visit our website for more information
Go to: Products > Rechargeable Batteries > CLB (Coin Type Lithium-ion Rechargeable Battery)
Maxell has developed a CLB2032 battery unit that includes battery control functions. This battery unit facilitates circuit design and can be installed quickly.

**Small CLB2032 battery unit that includes battery control functions**
With a diameter of 20mm* and a height of 5mm, this small battery unit includes a charge control, protection function and voltage regulator.

**Facilitates circuit design**
This CLB2032 battery unit has essential control circuits, enables easy circuit design and can be installed quickly.

**Charge control function**
The charging process is controlled automatically.

**Protection function**
Under-voltage, over-voltage and other limitations are controlled automatically.

**Voltage regulation (optional)**
The CLB2032 battery unit includes a DC/DC converter, which enables the device to have constant voltage supply and detect low power when charging is necessary. This supports easier circuit design from a primary battery to a rechargeable battery by using existing circuit designs.

* Diameter excludes projection.

---

### External Dimensions with Terminals and Wire Connectors (unit : mm)

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions (mm)</th>
<th>Diameter</th>
<th>Height</th>
<th>Weight (g)</th>
<th>Charge (CV) Input voltage (V)</th>
<th>Temperature (deg. C)</th>
<th>End voltage (V)</th>
<th>Discharge (CC) Max. current (mA)</th>
<th>Temperature (deg. C)</th>
<th>Nominal voltage (V)</th>
<th>Nominal capacity (mAh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLB2032 BU PB</td>
<td>Diameter*2</td>
<td>20</td>
<td>5.0</td>
<td>3.8</td>
<td>Input voltage (V)</td>
<td>5.0</td>
<td>0 to +45</td>
<td>End voltage (V)</td>
<td>3.0 (2.7)*</td>
<td>140</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Weight (g)*1</td>
<td></td>
<td></td>
<td></td>
<td>Temperature (deg. C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Dimensions and weight are for the product itself, but may vary depending on terminal specifications and other factors.
*2 Diameter excludes projection.
*3 Nominal capacity is according to the following conditions: Charge: 0.5I / 4.2V (CCCV) / End current 2mA, Discharge: 0.2I / E.V. = 3.0V, Temperature 20 deg. C without DC/DC converter
*4 2.7V means the under-voltage limit by the protection circuit
*5 The DC/DC converter enables voltages of between 3.7V and 0.8V. 3.0V is an example.

- Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

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Visit our website for more information
Go to: Products > Rechargeable Batteries > CLB2032 Battery Unit
Some transportation regulations have been recently revised and will come into effect after Jan. 1, 2015. The summary is shown in the following table. Please use updated Dangerous Goods Regulations listed in Normative Reference to confirm details.

### The major revisions for air transport of lithium cells and batteries

1. Lithium metal cells and batteries transported as cargo will be restricted to cargo aircraft only. Note. The prohibition does not apply to lithium metal batteries packed with equipment (PI 969) or contained in equipment (PI 970).
2. Gross mass will change to net quantity for both lithium ion cells and batteries (PI 965 Section IB) and lithium metal cells and batteries (PI 968 Section IB)

#### Technical instructions for lithium metal batteries (PI 968)

<table>
<thead>
<tr>
<th>Section</th>
<th>Section II</th>
<th>Section IB</th>
<th>Section IA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium Metal Content</td>
<td>Cell: ≤ 0.3 g Battery: ≤ 0.3 g</td>
<td>Cell: ≤ 1.0 g Battery: ≤ 2.0 g</td>
<td>Cell: ≤ 1.0 g Battery: ≤ 2.0 g</td>
</tr>
<tr>
<td>Package Limits</td>
<td>N/A</td>
<td>≤ 2 batteries or ≤ 8 cells</td>
<td>&gt; 2 batteries or &gt; 8 cells</td>
</tr>
<tr>
<td>Net Weight</td>
<td>Cargo aircraft only 2.5 kg</td>
<td>Cargo aircraft only N/A</td>
<td>Cargo aircraft only 2.5 kg</td>
</tr>
<tr>
<td>Classification</td>
<td>Exempted</td>
<td>Class 9</td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td>Strong outer packaging 1.2 M drop test</td>
<td>UN performance packaging</td>
<td></td>
</tr>
<tr>
<td>Labels</td>
<td>![Note 1)](Note 2): Cargo aircraft only label (necessary for lithium metal cells and batteries) ![Note 3): Class 9 hazardous label</td>
<td>![Note 1): Handling label](Note 2): Cargo aircraft only label (necessary for lithium metal cells and batteries) ![Note 3): Class 9 hazardous label</td>
<td></td>
</tr>
<tr>
<td>Documents</td>
<td>Invoice (air waybill)* Additional documents**</td>
<td>Declaration for DG Air waybill** Additional documents**</td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>Adequate instructions</td>
<td>DG training</td>
<td></td>
</tr>
</tbody>
</table>

* The words "lithium metal batteries, in compliance with Section II of PI 968" and "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when an air waybill is used. This description should appear in the "Nature and Quantity of Goods" box.
** The words "Dangerous Goods as per attached Shipper's Declaration" and "Cargo Aircraft Only" or "CAO" must appear in the air waybill's "Handling Information" column.
*** Additional documents must indicate:
- The package contains lithium metal cells or batteries;
- The package must be handled with care and that a flammability hazard exists if the package is damaged;
- Special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

Note 1): Handling label Note 2): Cargo aircraft only label (necessary for lithium metal cells and batteries) Note 3): Class 9 hazardous label

This information can be written in the Declaration for DG's "Additional Handling Information" column or on the air waybill.
## Technical instructions for lithium-ion batteries (PI 965)

<table>
<thead>
<tr>
<th>Section</th>
<th>Section II</th>
<th>Section III</th>
<th>Section IA</th>
</tr>
</thead>
</table>
| Watt hour| Cell: ≤ 2.7 Wh  
Battery: ≤ 2.7 Wh | Cell: ≤ 20 Wh  
Battery: ≤ 100 Wh | Cell: > 20 Wh  
Battery: > 100 Wh |
| Package limits | Quantity | ≤ 2 batteries or ≤ 8 cells | > 2 batteries or > 8 cells | N/A |
|              | Net Weight | 2.5 kg | N/A | 10 kg  
Passenger and cargo aircraft |
| Classification | Exempted | Class 9 |
| Packaging | Strong outer packaging  
1.2 M drop test | UN performance packaging |
| Labels | | |
| Documents | Invoice (air waybill)*  
Additional documents*** | Declaration for DG  
Air waybill**  
Additional documents*** | Declaration for DG  
Air waybill** |
| Training | Adequate instructions | DG training |

* The words "Lithium ion batteries in compliance with section II of PI 965" must appear in the air waybill’s "Nature and Quantity of Goods" box, when an air waybill is used. The words "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when transported by cargo.

** The words "Dangerous Goods as per attached Shipper’s Declaration" must appear in the air waybill’s "Handling Information" column. The words "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when transported by cargo.

*** Additional documents must indicate:
- The package contains lithium ion cells or batteries;
- The package must be handled with care and that a flammability hazard exists if the package is damaged;
- Special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

This information can be written in the Declaration for DG’s "Additional Handling Information" column or on the air waybill.
The major revisions for UN Model Regulations 18th Revised Edition

(1) Damaged or defective cells or batteries shall be transported as "Class 9" hazardous goods according to Special Provision 376 and Packing Instruction P908 or LP904.

(2) Cells and batteries transported for disposal or recycling shall be transported as "Class 9" hazardous goods according to Special Provision 377 and Packing Instruction P909.

The IMDG Code 2014 edition will contain the descriptions of these UN recommendations. The voluntary compliance date is Jan. 1, 2015. Compliance becomes mandatory on Jan. 1, 2016. Although these revisions will be reflected in each country’s regulations, some districts, countries or airlines may establish their own special requirements. Therefore the shipper shall confirm with the forwarder in advance.

Reference

Except for air transportation, the necessary requirements to transport lithium metal batteries or lithium-ion batteries as exempted from regulation (non-restricted goods) are as follows;

1. The minimum requirements to transport lithium metal batteries as non-restricted goods are as follows;
   a) Cells and batteries shall be manufactured under a quality management program.
   b) For a lithium metal or a lithium alloy cell, the lithium content must not be more than 1 g.
      For a lithium metal or lithium alloy battery, the aggregate lithium content must not be more than 2 g.
   c) Each cell or battery must be of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
   d) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
   e) Each consignment must be accompanied by a document for transport with an indication that:
      • the package contains lithium metal cells or batteries;
      • the package must be handled with care and that a flammability hazard exists if the package is damaged;
      • special procedures should be followed in the event the package is damaged, to include inspection and repackaging if necessary; and
      • a telephone number for additional information.
   f) Each package must be capable of withstanding a 1.2 m drop test.
   g) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

2. The minimum requirements to transport lithium-ion batteries as non-restricted goods are as follows;
   a) Cells and batteries shall be manufactured under a quality management program.
   b) For lithium-ion cells, the Watt-hour rating is not more than 20 Wh. For lithium-ion batteries, the Watt-hour rating is not more than 100 Wh. The Watt-hour rating must be marked on the outside of the battery case except for those manufactured before Jan. 1, 2009.
   c) Each cell or battery is of the type proven to meet the requirement of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
   d) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
   e) Each consignment must be accompanied by a document for transport with an indication that:
      • the package contains lithium-ion cells or batteries;
      • the package must be handled with care and that a flammability hazard exists if the package is damaged;
      • special procedures should be followed in the event the package is damaged, to include inspection and repackaging if necessary; and
      • a telephone number for additional information.
   f) Each package must be capable of withstanding a 1.2 m drop test.
   g) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

Maxell will provide certificates for b) and c) as the need arises. Documentation for d) and e) needs to be prepared by the customer. If our package is used for transport, Maxell will provide the certificate for f) as the need arises. However, if the customer’s package is used, the customer must confirm the package can withstand a 1.2 m drop test. Furthermore, even if our package is used for transport, the telephone number printed on the label must be changed to that of the sender (customer).

Major Normative Reference

UN (United Nations) Recommendations (Air, Marine, Overland transportation)
• UN (United Nations) Recommendations on the Transport of Dangerous Goods: Model Regulations 18th revised edition

Air Transportation
• International Air Transport Association (IATA): Dangerous Goods Regulations, 56th edition 2015

Marine Transportation
• International Maritime Organization (IMO): International Maritime Dangerous Goods (IMDG) Code, 2012 edition (This is applicable until Dec. 31, 2015)
• International Maritime Organization (IMO): International Maritime Dangerous Goods (IMDG) Code, 2014 edition (This is applicable on and after Jan. 1, 2015 and will be mandatory on and after Jan. 1, 2016)
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Maxell is accredited with international quality management standard ISO 9001 and international environmental management standard ISO 14001 certifications.