Chapter 3

Rechargeable Coin Type Lithium Batteries

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3-1 Vanadium Pentoxide Lithium Coin Type Batteries (VL series)

### Vanadium Pentoxide Lithium Rechargeable Batteries (VL series)

#### Features

These completely new coin-type lithium batteries feature vanadium oxide for the positive pole, lithium alloy for the negative pole and a non-aqueous solvent for the electrolyte.

#### Construction

![Construction Diagram]

- Anode cap
- Anode (Li-Al)
- Separator
- Cell can
- Collector
- Cathode (V₂O₅)
- Gasket

#### Applications

- Memory backup power supplies for office automation equipment (personal computers, fax machines, etc.), audio-video equipment (VTRs, etc.), communications equipment (mobile phones, etc.), etc.
- Hybrid systems with solar batteries (solar remote controllers, etc.)

#### General Specifications

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Electrical characteristics (20°C)</th>
<th>Dimensions (mm)</th>
<th>Weight (g)</th>
<th>JIS</th>
<th>IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal voltage (V)</td>
<td>Nominal capacity (mAh)</td>
<td>Continuous drain (mA)</td>
<td>Diameter</td>
<td>Height</td>
</tr>
<tr>
<td>VL621</td>
<td>3</td>
<td>1.5</td>
<td>0.01</td>
<td>6.8</td>
<td>2.1</td>
</tr>
<tr>
<td>VL1216</td>
<td>3</td>
<td>5.0</td>
<td>0.03</td>
<td>12.5</td>
<td>1.6</td>
</tr>
<tr>
<td>VL1220</td>
<td>3</td>
<td>7.0</td>
<td>0.03</td>
<td>12.5</td>
<td>2.0</td>
</tr>
<tr>
<td>VL2020</td>
<td>3</td>
<td>20.0</td>
<td>0.07</td>
<td>20.0</td>
<td>2.0</td>
</tr>
<tr>
<td>VL2320</td>
<td>3</td>
<td>30.0</td>
<td>0.10</td>
<td>23.0</td>
<td>2.0</td>
</tr>
<tr>
<td>VL2330</td>
<td>3</td>
<td>50.0</td>
<td>0.10</td>
<td>23.0</td>
<td>3.0</td>
</tr>
<tr>
<td>VL3032</td>
<td>3</td>
<td>100.0</td>
<td>0.20</td>
<td>30.0</td>
<td>3.2</td>
</tr>
</tbody>
</table>

* Nominal capacity shown above is based on standard drain and cut off voltage down to 2.5V at 20°C.
Charging circuits

<table>
<thead>
<tr>
<th>Charging/discharge cycle</th>
<th>Approx. 1,000 times at 10% discharge depth to nominal capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging system*</td>
<td>Constant-voltage charging. (Please strictly adhere to the specified charge voltage)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-20 °C ~ +60 °C</td>
</tr>
</tbody>
</table>

* Consult with Panasonic concerning constant-current charging systems.

The charging circuit is crucial in terms of ensuring that full justice will be done to the battery characteristics. Consider it carefully as the wrong charging circuit can cause trouble.

Precautions regarding the charge voltage setting

Under no circumstances should trickle charging, which is used for nickel-cadmium batteries, be used. Ignoring this precaution will cause the battery voltage to rise to about 5V, resulting in a deterioration of performance.

Charge voltage range

If a fixed-charging method is applied, please adhere to the specified charging voltage.

The guaranteed value over an operating temperature range from -20 to +60°C is 3.4V ± 0.15V.

(Actual value: 3.4V ± 0.20V)

* If the charging voltage exceeds the specifications, the internal resistance of the battery will rise and may cause battery deterioration. Also, with a charge voltage around 4V, corrosion of the (+) terminal (case) may occur, causing leakage. ("Influence of the charge voltage on VL batteries" in Chapter 3-59.)

* It is not possible for the battery capacity to recover completely when the charging voltage is below the specification.

Recommended charging circuits

- Basic conditions
  - Charge voltage: 3.4V ± 0.15V
  - Charge current: For a battery voltage of 3V
    - VL621: Approx. 0.2 mA or below
    - VL1216, VL1220: Approx. 0.5 mA or below
    - VL2020: Approx. 1.5 mA or below
    - VL2320, VL2330: Approx. 2.0 mA or below
    - VL3032: Approx. 4.0 mA or below
  (It is permissible for the current to increase beyond the above level when the battery voltage drops below 3V.)

Mixed usage of batteries

Do not use these batteries and lithium primary batteries or other rechargeable batteries together, and do not use new batteries and old batteries together even if they are of the same type.
Reference: Examples of 5-V charging circuits

1. Standard circuits
   For D1, select a diode of small inverse current (I<sub>R</sub> = 1 A below 5 V)
   D1 : MA716 (Diode type code)
   D2 : MA704, MA700

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL621</td>
<td>2.2kΩ</td>
<td>5.6kΩ</td>
</tr>
<tr>
<td>VL1220, VL1216</td>
<td>750Ω</td>
<td>2000Ω</td>
</tr>
<tr>
<td>VL2020</td>
<td>200Ω</td>
<td>510Ω</td>
</tr>
<tr>
<td>VL2320, VL2330</td>
<td>150Ω</td>
<td>390Ω</td>
</tr>
<tr>
<td>VL3032</td>
<td>68Ω</td>
<td>160Ω</td>
</tr>
</tbody>
</table>

2. Simple economical circuits
   D : MA700 (Very small inverse current)

   Load with 5 V applied
   D, Vf
<table>
<thead>
<tr>
<th></th>
<th>0.2V~0.6V</th>
<th>0~0.2V</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL621</td>
<td>8.2kΩ</td>
<td>2.4kΩ</td>
</tr>
<tr>
<td>VL1220, VL1216</td>
<td>2000Ω</td>
<td>510Ω</td>
</tr>
<tr>
<td>VL2020</td>
<td>1300Ω</td>
<td>330Ω</td>
</tr>
<tr>
<td>VL2320, VL2330</td>
<td>1100Ω</td>
<td>270Ω</td>
</tr>
<tr>
<td>VL3032</td>
<td>510Ω</td>
<td>120Ω</td>
</tr>
</tbody>
</table>

3. For minimizing current leakage due to resistance, etc., as when charging by another battery.

4. Zener control
   ZD : HZ2ALL
   R : 43Ω/2320
   D : MA700 or MA704
   Patent pending

5. LED control
   LED
   R : 51Ω for VL2320
   D : MA700 or MA704

6. Transistor control (for VL2320)
   R : 4.3kΩ
   R1 : 15.0kΩ
   R2 : 680Ω

7. Parallel circuit
Charging characteristics

Influence of the charge voltage on VL batteries

If the charge voltage goes beyond its adequate range, battery performance may deteriorate early. Be sure to observe the guaranteed charge voltage.

The lower the charging voltage becomes, the less the capacity becomes.

Charging completed
**VL621**

- **Dimensions (mm)**

  (VL621 / F9D)

- **Specification**
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 1.5
  - Continuous standard load (mA): 0.01
  - Operating temperature (°C): -20 ~ +60

- **Discharge Temperature Characteristics**

- **Consumption current vs. Duration time**

**VL1216**

- **Dimensions (mm)**

  (VL1216 / 1F5U)

- **Specification**
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 5.0
  - Continuous standard load (mA): 0.03
  - Operating temperature (°C): -20 ~ +60

- **Discharge Temperature Characteristics**

- **Consumption current vs. Duration time**
### Vanadium Pentoxide Lithium Coin Type Batteries (VL series)

#### VL1220

**Dimensions (mm)**

(VL1220 / 1F5U)

<table>
<thead>
<tr>
<th>Specifi cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (V)</td>
<td>3</td>
</tr>
<tr>
<td>Nominal capacity (mAh)</td>
<td>7.0</td>
</tr>
<tr>
<td>Continuous standard load (mA)</td>
<td>0.03</td>
</tr>
<tr>
<td>Operating temperature (°C)</td>
<td>-20 ~ +60</td>
</tr>
</tbody>
</table>

**Discharge Temperature Characteristics**

![Discharge Temperature Characteristics](image)

**Consumption current vs. Duration time**

![Consumption current vs. Duration time](image)

#### VL2020

**Dimensions (mm)**

(VL2020 / 1VC)

<table>
<thead>
<tr>
<th>Specifi cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (V)</td>
<td>3</td>
</tr>
<tr>
<td>Nominal capacity (mAh)</td>
<td>20.0</td>
</tr>
<tr>
<td>Continuous standard load (mA)</td>
<td>0.07</td>
</tr>
<tr>
<td>Operating temperature (°C)</td>
<td>-20 ~ +60</td>
</tr>
</tbody>
</table>

**Discharge Temperature Characteristics**

![Discharge Temperature Characteristics](image)

**Consumption current vs. Duration time**

![Consumption current vs. Duration time](image)
### Chapter 3

**Vanadium Pentoxide Lithium Coin Type Batteries (VL series)**

#### VL2320

- **Dimensions (mm)**
  - (VL2320 / 1VC)

![Dimension Diagram](image)  

<table>
<thead>
<tr>
<th>Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (V)</td>
<td>3</td>
</tr>
<tr>
<td>Nominal capacity (mAh)</td>
<td>30.0</td>
</tr>
<tr>
<td>Continuous standard load (mA)</td>
<td>0.1</td>
</tr>
<tr>
<td>Operating temperature (°C)</td>
<td>-20 ~ +60</td>
</tr>
</tbody>
</table>

**Discharge Temperature Characteristics**

![Temperature Characteristics Diagram](image)

**Consumption current vs. Duration time**

![Current vs. Duration Diagram](image)

#### VL2330

- **Dimensions (mm)**
  - (VL2330 / 1VC)

![Dimension Diagram](image)  

<table>
<thead>
<tr>
<th>Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage (V)</td>
<td>3</td>
</tr>
<tr>
<td>Nominal capacity (mAh)</td>
<td>50.0</td>
</tr>
<tr>
<td>Continuous standard load (mA)</td>
<td>0.1</td>
</tr>
<tr>
<td>Operating temperature (°C)</td>
<td>-20 ~ +60</td>
</tr>
</tbody>
</table>

**Discharge Temperature Characteristics**

![Temperature Characteristics Diagram](image)

**Consumption current vs. Duration time**

![Current vs. Duration Diagram](image)
Vanadium Pentoxide Lithium Coin Type Batteries (VL series)

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VL3032

Specifications:
- Nominal voltage (V): 3
- Nominal capacity (mAh): 100.0
- Continuous standard load (mA): 0.2
- Operating temperature (°C): -20 ~ +60

Discharge Temperature Characteristics:

Consumption current vs. Duration time:

Diagram 1: Voltage vs. Duration

Diagram 2: Consumption current vs. Duration time

Diagram 3: Temperature vs. Voltage

Diagram 4: Load vs. Duration

Diagram 5: Temperature vs. Consumption current
Chapter 3

Manganese Lithium Coin Type Batteries (ML series)

3-2 Manganese Lithium Coin Type Batteries (ML series)

Manganese Lithium Rechargeable Batteries (ML series)

Features

These super compact lithium rechargeable batteries feature a manganese compound oxide for the positive electrode, a lithium/aluminum alloy for the negative electrode and a special non-aqueous solvent for the electrolyte. They can easily be incorporated into circuits where 3V ICs are used to save space.

Applications

- Memory backup power supplies for mobile phones, memory cards, pagers and other compact communications equipment, data terminals and office automation equipment

General Specifications

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Electrical characteristics (20°C)</th>
<th>Dimensions(mm)</th>
<th>Weight(g)</th>
<th>JIS</th>
<th>IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal voltage(V)</td>
<td>Nominal capacity(mAh)</td>
<td>Continuous drain(mA)</td>
<td>Diameter</td>
<td>Height</td>
</tr>
<tr>
<td>ML612S</td>
<td>3</td>
<td>2.6</td>
<td>0.01</td>
<td>6.8</td>
<td>1.2</td>
</tr>
<tr>
<td>ML614S</td>
<td>3</td>
<td>3.4</td>
<td>0.01</td>
<td>6.8</td>
<td>1.4</td>
</tr>
<tr>
<td>ML616S</td>
<td>3</td>
<td>2.9</td>
<td>0.01</td>
<td>6.8</td>
<td>1.6</td>
</tr>
<tr>
<td>ML621S</td>
<td>3</td>
<td>5.0</td>
<td>0.01</td>
<td>6.8</td>
<td>2.1</td>
</tr>
<tr>
<td>ML920S</td>
<td>3</td>
<td>11.0</td>
<td>0.03</td>
<td>9.5</td>
<td>2.0</td>
</tr>
<tr>
<td>ML1220</td>
<td>3</td>
<td>17.0</td>
<td>0.03</td>
<td>12.5</td>
<td>2.0</td>
</tr>
<tr>
<td>ML2020</td>
<td>3</td>
<td>45.0</td>
<td>0.10</td>
<td>20.0</td>
<td>2.0</td>
</tr>
<tr>
<td>ML2430(Under development)</td>
<td>3</td>
<td>120.0</td>
<td>0.30</td>
<td>24.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Nominal capacity shown above is based on standard drain and cut off voltage down to 2.0V at 20°C.
Charging circuits

<table>
<thead>
<tr>
<th>Charging/discharging cycle</th>
<th>Approx. 1,000 times at 10% discharge depth to nominal capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging system*</td>
<td>Constant-voltage charging.(Please strictly adhere to the specified charge voltage)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-20 °C ~ + 60 °C</td>
</tr>
</tbody>
</table>

* Consult with Panasonic concerning constant-current charging systems.
The charging circuit is crucial in terms of ensuring that full justice will be done to the battery characteristics. Consider it carefully as the wrong charging circuit can cause trouble.

Precautions regarding the charge voltage setting

Under no circumstances should trickle charging, which is used for nickel-cadmium batteries, be used. Ignoring this precaution will cause the battery voltage to rise to about 5V, resulting in a deterioration of performance.

Charge voltage range

If a fixed-charging method is applied, please adhere to the specified charging voltage.
Guaranteed voltage is 2.8V ~ 3.2V at the temperature of -20°C~60°C.
* If the charging voltage exceeds the specifications, the internal resistance of the battery will rise and may cause battery deterioration. Also, with a charge voltage around 4V, corrosion of the (+)terminal (case) may occur, causing leakage. (*Influence of the charge voltage on ML batteries* on the back.)
* It is not possible for the battery capacity to recover completely when the charging voltage is below the specification.

Recommended charging circuits

- Basic conditions
  Fixed-voltage charge
  Charge voltage: 2.8~3.2V (Standard voltage: 3.1V)
  Charge current: For a battery voltage of 2.5V
  ML612S,ML614S,ML616S Approx. 0.3 mA or below
  ML621S Approx. 0.6 mA or below
  ML920S Approx. 1.2 mA or below
  ML1220 Approx. 1.2 mA or below
  ML2020 Approx. 3.0 mA or below

Mixed usage of batteries

Do not use these batteries and lithium primary batteries or other rechargeable batteries together, and do not use new batteries and old batteries together even if they are of the same type.
Charging

Reference: Examples of 5-V charging circuits

When charging using another battery

<table>
<thead>
<tr>
<th>REG</th>
<th>D</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2V</td>
<td>MA700</td>
<td>1.5kΩ</td>
</tr>
<tr>
<td>3.1V</td>
<td>MA700</td>
<td>1.5kΩ</td>
</tr>
<tr>
<td>ML621S</td>
<td>D</td>
<td>R</td>
</tr>
<tr>
<td>3.2V</td>
<td>MA700</td>
<td>910Ω</td>
</tr>
<tr>
<td>3.1V</td>
<td>MA700</td>
<td>750Ω</td>
</tr>
<tr>
<td>ML3000</td>
<td>REG</td>
<td>D</td>
</tr>
<tr>
<td>3.2V</td>
<td>MA700</td>
<td>1.8kΩ</td>
</tr>
<tr>
<td>3.1V</td>
<td>MA700</td>
<td>1.5kΩ</td>
</tr>
</tbody>
</table>

Standard circuits

For D⇧, select a diode of small inverse current

<table>
<thead>
<tr>
<th>REG</th>
<th>D</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML612S, ML614S, ML616S</td>
<td>2.7kΩ</td>
<td>5.1kΩ</td>
</tr>
<tr>
<td>ML621S</td>
<td>1.3kΩ</td>
<td>2.0kΩ</td>
</tr>
<tr>
<td>ML3000</td>
<td>180Ω</td>
<td>330Ω</td>
</tr>
</tbody>
</table>

Simple economical circuits

Load ≤ 100μA below

<table>
<thead>
<tr>
<th>REG</th>
<th>D</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML612S, ML614S, ML616S</td>
<td>2.7kΩ</td>
<td>5.1kΩ</td>
</tr>
<tr>
<td>ML621S</td>
<td>1.3kΩ</td>
<td>2.0kΩ</td>
</tr>
<tr>
<td>ML3000</td>
<td>180Ω</td>
<td>330Ω</td>
</tr>
</tbody>
</table>

VF of D will be different from the value given above if a current in excess of 100μA flows to the load during operation. Compensation must be provided by the resistors in such cases.

Influence of the charge voltage on ML batteries

If the charge voltage goes beyond its adequate range, battery performance may deteriorate early. Be sure to observe the guaranteed charge voltage.

Prohibited operating range

Operational range

Adequate charge voltage range (guaranteed specified value)

Early battery deterioration region

60°C withstand voltage limit

The lower charging voltage becomes, the less capacity becomes.

Inadequate range

Charge voltage (V)

- 3.5
- 3.0
- 2.5

Pat No. JP284170
Manganese Lithium Coin Type Batteries (ML series)

**ML612S**

- **Dimensions (mm)**
  - $\phi 6.8\pm 0.15$
  - $h = 3.6\pm 0.15$
  - Weight: 0.15g

- **Specification**
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 2.6
  - Continuous standard load (mA): 0.01
  - Operating temperature (°C): -20 ~ +60

- **Discharge characteristics**

- **Consumption current vs. Duration time**

**ML614S**

- **Dimensions (mm)**
  - $\phi 5.0\pm 0.3$
  - $h = 1.45\pm 0.15$
  - Weight: 0.17g

- **Specification**
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 3.4
  - Continuous standard load (mA): 0.01
  - Operating temperature (°C): -20 ~ +60

- **Discharge characteristics**

- **Consumption current vs. Duration time**
Chapter 3
Manganese Lithium Coin Type Batteries (ML series)

ML616S

- Dimensions (mm)

- Specification
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 2.9
  - Continuous standard load (mA): 0.01
  - Operating temperature (°C): -20 ~ +60

- Discharge characteristics

- Consumption current vs. Duration time

---

Lithium Battery Holders for ML616S

These battery holders are designed for sure and easy loading/removal of Panasonic coin type lithium batteries in/from equipment enabling the batteries to fully exploit their capabilities as the backup power supply in C-MOS RAM memory and microcomputer memory. All of the battery holders are designed to prevent inverted insertion of the battery.

---

Precaution for washing battery holders

The battery holders can be adversely affected by some detergents used in the circuit board washing process and may result in cracks forming in the holder. Please test the holders in your washing process before use.
ML621S

- Dimensions (mm)
  - Diameter: 6.8 ± 0.15
  - Thickness: 5.2 (max), 0.05 (min), 2.15 ± 0.22
  - Weight: 0.30g

- Specification
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 5
  - Continuous standard load (mA): 0.01
  - Operating temperature (°C): -20 ~ +60

- Discharge characteristics
  - Voltage (V) vs. Discharge capacity (mAh)
  - Load: 200Ω

ML920S

- Dimensions (mm)
  - Diameter: 9.5 max
  - Height: 12.8 ± 0.5, 2.0 ± 0.5, 0.15 (max)

- Specification
  - Nominal voltage (V): 3
  - Nominal capacity (mAh): 11.0
  - Continuous standard load (mA): 0.03
  - Operating temperature (°C): -20 ~ +60

- Discharge characteristics
  - Voltage (V) vs. Discharge capacity (mAh)
  - Temp: 20°C
  - Load: 754Ω (32mA)

- Charge / discharge characteristics
  - Voltage (V) vs. Current (mA)
  - Load: 3.1V, 1kΩ

- Consumption current vs. Duration time
  - Duration (hour) vs. Consumption current (μA)
### ML1220 Specifications

- **Nominal voltage (V):** 3
- **Nominal capacity (mAh):** 17.0
- **Continuous standard load (mA):** 0.03
- **Operating temperature (°C):** -20 ~ +60

### ML2020 Specifications

- **Nominal voltage (V):** 3
- **Nominal capacity (mAh):** 45
- **Continuous standard load (mA):** 0.1
- **Operating temperature (°C):** -20 ~ +60
ML2430 (Under development)

- **Dimensions (mm)**
  - Under development

- **Weight**: 4.0g

- **Specification**
  | Nominal voltage (V) | 3 |
  | Nominal capacity (mAh) | 120 |
  | Continuous standard load (mA) | 0.3 |
  | Operating temperature (°C) | -20 ~ +60 |

- **Discharge characteristics**

- **Consumption current vs. Duration time**
3-3 Niobium-Lithium Coin Type Batteries (NBL series)

Niobium-Lithium Rechargeable Batteries (NBL series)

Features

The NBL series eliminates the need for a voltage boosting circuit since they can be charged at a low voltage. They help to simplify charging circuits.

Applications

- Memory backup power supplies for mobile phones using ICs which reduce the voltage to lower levels and which are driven at 2.5V or so.

General Specifications

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Electrical characteristics (20°C)</th>
<th>Dimensions (mm)</th>
<th>Weight (g)</th>
<th>JIS</th>
<th>IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal voltage (V)</td>
<td>Nominal capacity (mAh)</td>
<td>Continuous drain (mA)</td>
<td>Diameter</td>
<td>Height</td>
</tr>
<tr>
<td>NBL621</td>
<td>2</td>
<td>4</td>
<td>0.01</td>
<td>6.8</td>
<td>2.1</td>
</tr>
</tbody>
</table>

*Nominal capacity shown above is based on standard drain and cut off voltage down to 1.0V at 20°C.

Charging

Consult Panasonic for charging conditions.
NBL621

- Dimensions (mm)

- Specification

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage(V)</td>
<td>2</td>
</tr>
<tr>
<td>Nominal capacity(mAh)</td>
<td>4</td>
</tr>
<tr>
<td>Continuous standard load(mA)</td>
<td>0.01</td>
</tr>
<tr>
<td>Operating temperature(°C)</td>
<td>-20 ~ +60</td>
</tr>
</tbody>
</table>

- Discharge characteristics

- Recovered capacity (According to charge voltage)
3-4 Manganese Titanium Lithium Coin Type Batteries (MT series)

Manganese Titanium Lithium Rechargeable Batteries (MT series)

Features

These coin-type manganese titanium lithium coin batteries use a lithium-manganese complex oxide for the positive pole and a special lithium-titanium complex oxide for the negative pole. They provide a capacity which is more than 10 times that of capacitors of the same size.

Applications

- Main power supplies in compact products such as rechargeable watches
- Memory backup power supply for pagers, timers, etc.

General Specifications

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Electrical characteristics (20°C)</th>
<th>Dimensions(mm)</th>
<th>Weight(g)</th>
<th>JIS</th>
<th>IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal voltage(V)</td>
<td>Nominal capacity(mAh)</td>
<td>Continuous drain(mA)</td>
<td>Diameter</td>
<td>Height</td>
</tr>
<tr>
<td>MT516</td>
<td>1.5</td>
<td>0.9</td>
<td>0.05</td>
<td>5.8</td>
<td>1.6</td>
</tr>
<tr>
<td>MT616</td>
<td>1.5</td>
<td>1.05</td>
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<td>1.6</td>
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<td>11.0</td>
<td>0.50</td>
<td>16.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Nominal capacity shown above is based on standard drain and cut off voltage down to 1.0V at 20°C.

Charging

Consult Panasonic for charging conditions.
**MT516**

- **Dimensions (mm)**
  - Diameter: 5.8 ± 0.15
  - Height: 2.5
  - Thickness: 1.65 ± 0.2
  - Weight: 0.15g

- **Specification**
  - Nominal voltage (V): 1.5
  - Nominal capacity (mAh): 0.9
  - Continuous standard load (mA): 0.05
  - Operating temperature (°C): -20 ~ +60

- **Charge / discharge characteristics**

- **Consumption current vs. Duration time**

---

**MT616**

- **Dimensions (mm)**
  - Diameter: 6.8 ± 0.15
  - Height: 3.2
  - Thickness: 1.65 ± 0.2
  - Weight: 0.20g

- **Specification**
  - Nominal voltage (V): 1.5
  - Nominal capacity (mAh): 1.05
  - Continuous standard load (mA): 0.05
  - Operating temperature (°C): -20 ~ +60

- **Charge / discharge characteristics**

- **Consumption current vs. Duration time**

---

**Manganese Titanium Lithium Coin Type Batteries (MT series)**
**MT621**

- **Dimensions (mm)**
  - Weight: 0.25g

- **Specification**
  - Nominal voltage (V): 1.5
  - Nominal capacity (mAh): 2.5
  - Continuous standard load (mA): 0.05
  - Operating temperature (°C): -20 ~ +60

- **Charge / discharge characteristics**

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<th>Discharge capacity (mAh)</th>
<th>0.0</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage (V)</td>
<td>0.0</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
<td>4.0</td>
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<td>6.0</td>
<td>7.0</td>
<td>8.0</td>
<td>9.0</td>
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- **Consumption current vs. Duration time**

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<tr>
<th>Consumption current (μA)</th>
<th>1000</th>
<th>500</th>
<th>300</th>
<th>200</th>
<th>100</th>
<th>50</th>
<th>10</th>
<th>5</th>
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<td>200</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td>5</td>
<td>1</td>
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**MT920**

- **Dimensions (mm)**
  - Weight: 0.45g

- **Specification**
  - Nominal voltage (V): 1.5
  - Nominal capacity (mAh): 4.0
  - Continuous standard load (mA): 0.10
  - Operating temperature (°C): -20 ~ +60

- **Charge / discharge characteristics**

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<th>Discharge capacity (mAh)</th>
<th>0.0</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage (V)</td>
<td>0.0</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
<td>4.0</td>
<td>5.0</td>
<td>6.0</td>
<td>7.0</td>
<td>8.0</td>
<td>9.0</td>
<td>1.0</td>
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</table>

- **Consumption current vs. Duration time**

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<thead>
<tr>
<th>Consumption current (μA)</th>
<th>1000</th>
<th>500</th>
<th>300</th>
<th>200</th>
<th>100</th>
<th>50</th>
<th>10</th>
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<tr>
<td>Duration (h)</td>
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<td>500</td>
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<td>200</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td>5</td>
<td>1</td>
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**Discharge characteristics**

- Voltage (V) vs. Discharge capacity (mAh)

- Temperature: -10°C, 20°C, 60°C

- Load: 10xΩ
MT1620

Dimensions (mm)

Weight: 1.25g

Specification

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<thead>
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<th>Nominal voltage (V)</th>
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<tbody>
<tr>
<td>Nominal capacity (mAh)</td>
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<tr>
<td>Continuous standard load (mA)</td>
<td>0.50</td>
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<tr>
<td>Operating temperature (°C)</td>
<td>-20 to +60</td>
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Charge / discharge characteristics

Consumption current vs. Duration time

Temp.: 20°C
Cut off voltage: 1.0V
### Batteries with Terminals and Soldering Lithium Batteries

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<table>
<thead>
<tr>
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<th>Soldering</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.......................... 80</td>
</tr>
</tbody>
</table>
Batteries with Terminals

Highly Reliable Terminal Welding

(1) Using a laser to weld terminals
Panasonic uses a laser welding method to weld the terminals onto the batteries so they can be mounted onto PC boards by soldering. This method has the effect of boosting the tensile strength accompanying a welding strength to approximately 100N (approx. 10kgf) compared with 20N to 50N (approx. 2 to 5 kgf) yielded by the conventional resistance welding method. The method also more or less cuts in half the individual variations occurring in the welding. Furthermore, it enables terminals to be welded onto thin batteries, such as those with a thickness of 1.6 mm, and it improves compatibility with many other uses. This highly reliable terminal soldering method can be used in a wide range of applications, obviating eliminating the need for reinforcement or other such means.

(2) Execution of pre-soldering
The tips of the terminals are pre-soldered in order to enhance the reliability of the soldering.

Complete Line-up
Panasonic offers a full range of batteries with terminals for PCB mounting. Since the terminals come in a variety of types, please contact Panasonic for further details. A more limited selection of simple battery holders to support the batteries is also available.

Soldering

(1) Using a soldering iron
Do not allow the soldering iron to make direct contact with the bodies of the batteries. Proceed with the soldering quickly within 5 seconds while maintaining the iron tip temperature at about 350°C, and do not allow the temperature of the battery bodies to exceed 85°C.

(2) Automatic dip-soldering bath
Soldering with a dip-soldering bath can be used but do not allow the temperature of the battery bodies to exceed 85°C. It is important to note, depending on the temperature conditions inside the dipping device, that the battery body temperature may rise after dipping due to the residual heat retained. When a post-dipping temperature rise is observed, review the temperature conditions and consider a dipping time reduction or a way of forcibly cooling the batteries after dipping.

<table>
<thead>
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<th>Basic conditions</th>
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<td>Dip-soldering bath</td>
<td>260°C or less</td>
</tr>
<tr>
<td>time</td>
<td>Within 5 sec.</td>
</tr>
<tr>
<td>Number of dips</td>
<td>Not more than 2</td>
</tr>
</tbody>
</table>

Never Use Reflow Soldering

Never use reflow soldering since doing so directly heats the battery surface to high temperatures, causing electrolyte leakage, deterioration of battery characteristics and risking bursting or ignition.

\[\text{Cautions} \]

Example where the terminals were soldered straight onto a coin-type lithium battery, the terminals were connected to a PC board or other electronic components, and the heat generated by the soldering adversely affected the battery, resulting in a deterioration of the battery characteristics:

- The heat generated when terminals are mounted using solder causes lithium to melt.
- The separator melts and becomes perforated.
- The positive and negative poles are welded together, causing "internal shorting."
- In terms of the battery characteristics, the open-circuit voltage and electrical capacity are both reduced.
- The battery loses its functions or it bursts in rare cases.

Soldering

\[\text{Terminal} \]

- Solder
- Welding
- Cathode cap
- Lithium\(^{(\text{note 1})}\)
- Separator\(^{(\text{note 2})}\)
- Cathode

\(\text{(note 1)}\) Metal whose melting point is about 180°C
\(\text{(note 2)}\) Non woven cloth of polypropylene whose melting point is about 165°C
Chapter 5

Standards and Regulations

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The Lithium & Micro Battery Division has acquired certification under ISO9001, the international standard for quality assurance, for its cylindrical type lithium batteries and coin-type lithium batteries. In addition, we have acquired certification under QS-9000, the quality standard for the automobile manufacturing industry, for its coin-type lithium primary batteries.

**QS-9000**

The QS-9000 standard was established by the "Big Three" U.S. automakers (Daimler-Chrysler, Ford and GM) on the basis of the ISO9001 international standard governing quality assurance but with additional requirements of their own. A company which has been certified under this standard can supply highly reliable products by incorporating into its quality system proven "predictive management" techniques which are substantiated by numerical data from a customer satisfaction survey, failure mode and effects analysis (FMEA), process capability analysis, measurement systems analysis, etc. which are required under the standard.
### Transporting Lithium Batteries

**Regulations for transporting lithium batteries (only batteries which have a solid cathode electrode are listed)**

(as of March / 2000)

<table>
<thead>
<tr>
<th>Name of regulations</th>
<th>ICAO</th>
<th>IATA</th>
<th>IMDG</th>
<th>Highway, Railway</th>
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<tbody>
<tr>
<td><strong>Means of transportation</strong></td>
<td>airplane</td>
<td>air cargo</td>
<td>ship</td>
<td>DOT</td>
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<td><strong>Application range</strong></td>
<td>international</td>
<td>international</td>
<td>United States</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td><strong>Total weight of lithium battery</strong></td>
<td>1g or less</td>
<td>1g or less</td>
<td>1g or less</td>
</tr>
<tr>
<td></td>
<td><strong>Total weight of lithium battery pack</strong></td>
<td>2g or less</td>
<td>2g or less</td>
<td>2g or less</td>
</tr>
<tr>
<td>B</td>
<td><strong>Total weight of lithium battery</strong></td>
<td>5g or less</td>
<td>5g or less</td>
<td>5g or less</td>
</tr>
<tr>
<td></td>
<td><strong>Total weight of lithium battery pack</strong></td>
<td>25g or less</td>
<td>25g or less</td>
<td>25g or less</td>
</tr>
<tr>
<td>C</td>
<td><strong>Total weight of lithium battery</strong></td>
<td>12g or less</td>
<td>12g or less</td>
<td>12g or less</td>
</tr>
<tr>
<td></td>
<td><strong>Total weight of lithium battery pack</strong></td>
<td>500g or less</td>
<td>500g or less</td>
<td>500g or less</td>
</tr>
<tr>
<td></td>
<td><strong>Total weight of a carton</strong></td>
<td>Up to 5kg of batteries can be carried if they are packed in a container which is approved 2nd class by UN.</td>
<td>Up to 25kg of batteries can be carried if they are packed in a container which is approved 2nd class by UN.</td>
<td>DOT:49CFR173.185</td>
</tr>
</tbody>
</table>

A: The batteries listed above are not subject to these restrictions provided that they satisfy the A45 conditions, IATA.

B: The batteries listed above are not subject to these restrictions provided that they have been certified as satisfying the test standards specified in the U.N. recommendation and as not falling under the classification of hazardous items.

C: The batteries listed above can be transported provided that they satisfy the conditions stipulated by the laws and regulations listed below and that they meet the packaging standards.

The regulation above is an extract of the latest version. See the original for details.

**UN** (United Nations)

**ICAO** (International Civil Aviation Organization)

**IATA** (International Air Transport Association)

**IMO** (International Marin Organization)

**DOT** (Department Of Transportation)

This section of the catalog is quoted by transportation hazards issued by the organizations shown above.

---

### Security Export Control

"Security export control" entails observing the legislation provided to maintain international peace and safety by preventing the proliferation of weapons of mass destructions (nuclear weapons, chemical warfare weapons, biological weapons and missiles) and the excessive buildup of conventional weapons. COCOM, the committee that imposed controls on exports to the Communist bloc, was disbanded on March 31, 1994. However, the items, etc. which were restricted by COCOM are still the target of the restrictions but they are now also subject to some amendments which were made in September 1996.

Lithium batteries are on the list of items subject to the Export and Trade Control Regulation (Item 7 in annex Table 1) but all the products mentioned in this catalog are exempt from these regulations.

The above notwithstanding, these batteries may be subject to the regulations depending on their ultimate destination, application and other conditions. When a non-exemption/exemption certificate is required for exportation, etc. or if you have any queries, contact a Panasonic sales representative.
Chapter 6

Avoiding Hazards and Preventing Quality Problems

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Avoiding Hazards

Chapter 6 Avoiding Hazards and Preventing Quality Problems

Case Study and Explanation

To store batteries, place each of the batteries in the sections provided on the designated tray in such a way that they will not make contact with one another.

**Ignition**

2,000 new batteries were taken out from the 20-piece tray containers and thrown randomly into a cardboard box where they were stacked on top of one another. About 30 minutes later, smoke was seen emanating from the batteries followed by ignition several minutes after that.

Case study: Ignition of batteries stacked together

**Generating Heat**

21 cylindrical type lithium batteries with tab terminals were placed in a 20 piece tray--one battery more than the capacity of the 20-piece tray shown in the figure--two of the batteries were placed together with their poles reversed. As a result, the tab terminals came into contact with each other, causing external shorting, and the temperature of the two batteries rose dramatically, generating heat and causing the halon tubes to burst.

Since two batteries were placed in a space (indicated by ) allocated to one battery, their terminals made contact with each other, and external shorting resulted.

**Rupture**

This particular case involves batteries which were packed in trays and destined for OEMs. The batteries were packed in an intermediate package consisting of 10 trays with each tray containing 20 (or 40) batteries, and the trays were stacked on top of each other. The intermediate package (of the 10 trays) was opened at the distribution stage of our operations, and five of the trays were delivered to one customer. Since the trays were stored at an angle inside the box, the batteries fell out of their positions on the trays and became stacked up on the bottom inside the small box. As a result, some of the batteries burst.

Case study: Bursting of batteries stacked on top of one another

**Generating heat and deterioration of capacity**

To store batteries, place each of the batteries in the sections provided on the designated tray in such a way that they will not make contact with one another.
Batteries should be used near protective materials and take every possible care to ensure that the (+) and (-) terminals of the batteries or PC boards, etc. on which batteries are mounted do not touch these protective materials directly.

Incidents have been reported where terminal-mounted batteries for memory backup or coin-type lithium batteries have come into contact with antistatic conductive materials, thus forming external discharge circuits and leading to voltage drops or capacity deterioration.

In manufacturing plants using ICs, LSI and other semiconductor components, thoroughgoing antistatic measures are taken. Various protective materials are used to prevent static: most of them have special compounds of carbon, aluminum foil and other metals and are therefore conductive. These protective materials are used, for example, in the form of packaging bags, trays, mats, sheets, films, corrugated boards and resin cases.

A protective material may have a resistance ranging from $10^3$ to $10^6 \, \Omega/cm$, for instance. This means that if the (+) and (-) terminals of a battery come into contact with this material, a current ranging from several milliamperes to several microamperes will flow and the battery will discharge, causing voltage drop and capacity deterioration.

When batteries are to be used near protective materials, take every possible care to ensure that the (+) and (-) terminals of the batteries or PC boards, etc. on which batteries are mounted do not touch these protective materials directly.
(2) Reduction of battery voltage and deterioration of capacity through contact between batteries

Incidents have been reported where terminal-mounted batteries for memory backup or coin-type lithium batteries have come into contact each other, thus forming discharge circuits (shorted state) and leading to voltage drops or capacity deterioration. Observe the following precautions.

1. Remove the batteries from the tray one at a time.
   If the tray is turned upside down, the batteries will come into contact with each other, forming discharge circuits.
2. Do not place batteries randomly in a parts box or other container.
   Discharge circuits will be formed by multiple batteries coming into contact numbers of the batteries, causing the batteries to discharge and drain.

---

**Recommended procedures**

*Utilize the tray lid in taking out batteries*

- **Intermediate package (200 batteries):**
  - 20 pieces × 10 trays

```
Trays containing batteries
```

```
Lid tray (tray with no hole)
```

```
Lid tray protruding part
```

```
Recommended procedures
```

**Prohibited procedures**

*Do not throw batteries randomly into a parts box by turning over trays containing batteries.*

```
Tray containing batteries
```

```
Parts box
```

```
Discharge circuits
```

```
Batteries being exhausted
```

```
Contact of batteries with each other forms discharge circuits, thus the batteries are drained.
```

*Lay a tray lid flat and place a tray containing batteries on top of it: batteries are pushed up by protrusions of the lid tray so that they can be easily picked up with fingers.*
Memory Erasure Problems

Coin-type lithium batteries are often used as the power supplies for memory backup in various equipment. However, problems with the erasure of valuable data in the memory due to improper contact between the batteries and equipment have been reported.

1. When batteries are to be used continuously for a prolonged period.
   - Select tab terminal-mounted batteries, and solder the tabs to the battery connection terminals of the equipment. (See Fig. 1)
   - When batteries need to be replaced, use a battery holder (see Fig. 2) or battery with lead wire connectors (see Fig. 3). Battery holders made by Panasonic (exclusively for the CR2032 and BR2032, see Fig. 2) are available for use.

2. When batteries need to be replaced in the short term, select batteries with no terminals or lead wire connectors.
   - Use of Y-shaped terminals (2-point contact) for both the (+) and (-) poles as the shape of the connection terminals in the equipment helps to achieve a more stable contact. (See Fig. 4)
   - The contact pressure of the contacts should be no less than 2 to 10N (approx. 200 to 1000 gf). (See Fig. 5)
   - To prevent momentary contact failure of several milliseconds in the circuit, the use of a tantalum capacitor, etc. with a capacitance of several microfarads is effective. (See Fig. 6)
   - For the connection terminals of the equipment, use iron or stainless steel with nickel plating at the very least. Gold-plating is more suitable when the contact resistance must be reduced.

Note: Do not touch batteries with bare hands because perspiration (salt), body oil etc. will increase the surface resistance which may lead to defective contact.

<Reference Sample>
For Literature and General Product Information:

<table>
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<th>Country</th>
<th>Address</th>
<th>Tel</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom/Ireland</td>
<td>Panasonic Industrial Europe GmbH</td>
<td>+44 1344-853262</td>
<td>+44 1344-853724</td>
</tr>
<tr>
<td></td>
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<td>Panasonic Industrial Europe GmbH</td>
<td>+33 1-49 46 44 10</td>
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