

## ■ Charging circuits

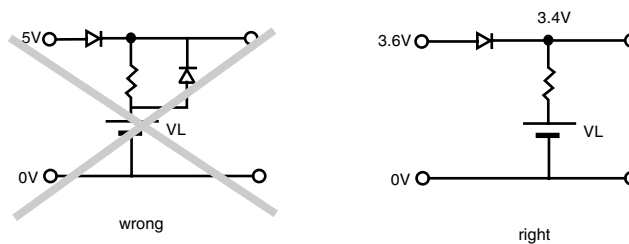
|                            |   |
|----------------------------|---|
| Charging/discharging cycle | Approx. 1,000 times at 10% discharge depth to nominal capacity                      |
| Charging system*           | Constant-voltage charging. (Please strictly adhere to the specified charge voltage) |
| Operating temperature      | -20°C to +60°C  |

\* 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  $3.4V \pm 0.15V$ . (Actual value:  $3.4V \pm 0.20V$ )

\* 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  $\oplus$  terminal (case) may occur, causing leakage. ("Influence of the charge voltage on VL batteries" in Chapter 3-55.)

\* 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:  $3.4V \pm 0.15V$

Charge current: For a battery voltage of 3V

VL621                      Approx. 0.2 mA or below

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.

# Charging

## ● Reference: Examples of charging circuits

①

Standard circuits  
For D<sub>2</sub>, select a diode of small inverse current ( $I_R=1\mu\text{A}$  below / 5V)  
D<sub>1</sub>, D<sub>2</sub>: MA3X716(Diode type code)  
D<sub>3</sub>: MA3X704, MA2J728

|                | R <sub>1</sub> | R <sub>2</sub> |
|----------------|----------------|----------------|
| VL621          | 2.2k $\Omega$  | 5.6k $\Omega$  |
| VL1220         | 750 $\Omega$   | 1.8k $\Omega$  |
| VL2020         | 200 $\Omega$   | 510 $\Omega$   |
| VL2320, VL2330 | 150 $\Omega$   | 390 $\Omega$   |
| VL3032         | 68 $\Omega$    | 180 $\Omega$   |

Patent acquired

| Load with 5V applied | 1mA below      |                |
|----------------------|----------------|----------------|
| D, Vf                | 0~0.30V        |                |
|                      | R <sub>1</sub> | R <sub>2</sub> |
| VL621                | 6.2k $\Omega$  | 2.4k $\Omega$  |
| VL1220               | 1500 $\Omega$  | 560 $\Omega$   |
| VL2020               | 470 $\Omega$   | 180 $\Omega$   |
| VL2320, VL2330       | 390 $\Omega$   | 150 $\Omega$   |
| VL3032               | 180 $\Omega$   | 68 $\Omega$    |

\*Vf of D will be different from the value given above if a current in excess of 1mA flows to the load during operation. Compensation must be provided by the resistors in such cases.

②

Simple economical circuits  
D: MA2J728 (Very small reverse current)

|   | ZD        | D <sub>1</sub> | R <sub>1</sub> | Common to all types |  |  |
|---|-----------|----------------|----------------|---------------------|--|--|
| A | MAZ30360L | MA3X704        | 300 $\Omega$   |                     |  |  |
| B | MAZ30360H | MA2J728        | 270 $\Omega$   |                     |  |  |

| Type           | VL3032 | VL2330       | VL2320 | VL2020 | VL1220       | VL621         |
|----------------|--------|--------------|--------|--------|--------------|---------------|
| R <sub>2</sub> | A      | Not required |        |        | 470 $\Omega$ | 1.5k $\Omega$ |
|                | B      | Not required |        |        | 560 $\Omega$ | 1.6k $\Omega$ |

For D<sub>2</sub>, select a diode of small inverse current ( $I_R=1\mu\text{A}$  below / 5V)

Patent acquired

④ For minimizing current leakage due to resistance, etc., as when charging by another battery.

| REG  | D       |
|------|---------|
| 3.7V | MA2J728 |

For details, refer to the constant voltage element specifications

⑤ Zener control

ZD: HZ2ALL  
R: 43 $\Omega$ /VL2320  
68 $\Omega$ /VL2020  
\*D: MA2J728 or MA3X704

Select a diode having an inverse current as small as possible. ( $I_R=1\mu\text{A}$  below / 5V)

⑥ LED control

LED  
R=51 $\Omega$  for VL2320  
\*D: MA2J728 or MA3X704

⑦ Transistor control(for VL2320)  
R<sub>1</sub>: 4.3k $\Omega$  R<sub>2</sub>: 15.0k $\Omega$  R<sub>3</sub>: 680 $\Omega$

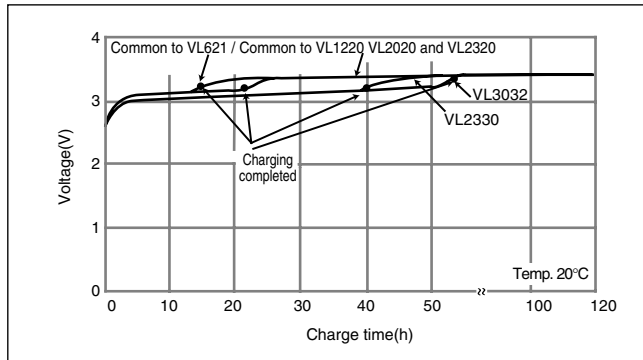
⑧ Parallel circuit

Chapter 3  
Vanadium Rechargeable Lithium Batteries (VL series)

Chapter 3 - 54  
Panasonic 2006

# Charging

## ● 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.

