

Lithium

Primary
Small Rechargeable

Technical Handbook

Industrial Batteries for Professionals



| | PAGE |
|--|---------|
| Index | 3 |
| Company | 4 – 5 |
| Marketing service tools | 6 – 7 |
| Safety warnings and precautions | 8 |
| Introduction | 9 – 10 |
| General features | 11 – 13 |
| Primary vs. rechargeable lithium batteries | 14 |
| Applications | 15 |
| Selecting a battery/model number | 16 – 17 |
| Battery selection chart | 18 – 22 |
| General safety precautions for using, handling and designing | 23 – 26 |
| Design for memory back-up use | 27 |
| Primary lithium batteries – non rechargeable | 28 |
| Poly-carbonmonofluoride lithium batteries (BR series) – cylindrical type | 29 – 32 |
| Manganese dioxide lithium batteries (CR series for consumer) – cylindrical type | 33 – 35 |
| Manganese dioxide lithium batteries (CR series for industrial) – cylindrical type | 36 – 40 |
| Poly-carbonmonofluoride lithium batteries (BR series) – coin type | 41 – 45 |
| High temperature poly-carbonmonofluoride lithium batteries (BR-A series) – coin type | 46 – 49 |
| Manganese dioxide lithium batteries (CR series) – coin type | 50 – 59 |
| High temperature manganese dioxide lithium batteries (CR-A/B series) – coin type | 60 – 63 |
| Poly-carbonmonofluoride lithium batteries (BR series) – pin type | 64 – 65 |
| Secondary lithium batteries – rechargeable | 66 |
| Vanadium rechargeable lithium batteries (VL series) – coin type | 67 – 72 |
| Manganese rechargeable lithium batteries (ML series) – coin type | 73 – 78 |
| Titanium rechargeable lithium batteries (MT series) – coin type | 79 – 82 |
| Lithium-ion rechargeable batteries (CG Series) – pin type | 83 – 86 |
| Lithium battery terminals and soldering | 87 – 93 |
| Standards and regulations | 94 |
| Avoiding hazards | 95 |
| Preventing quality problems | 96 – 98 |
| Contact | 100 |

ONE OF THE WORLD'S LARGEST BATTERY MANUFACTURERS



243,540
EMPLOYEES*¹



54
BILLION
SALES*²



Panasonic Industry Europe
Headquarters in Ottobrunn
(near Munich)



Panasonic Industry Europe



Batteries



Automotive



Industry

Panasonic Batteries

Panasonic offers a wide range of power solutions for portable and stationary applications. Our product range includes high reliability batteries such as Lithium-Ion, Lithium-Ion Pin-type, Lithium, Nickel-Metal Hydride, Nickel-Cadmium, Valve-Regulated-Lead-Acid (VRLA), Alkaline, and Zinc-Carbon. With this breadth and depth to the portfolio, we can power your business in virtually all applications.

Panasonic began manufacturing batteries in 1931 and is today the most diversified global battery producer worldwide, with an extensive network of manufacturing companies. The company employees are dedicated to research, development and production of batteries for an energised world.

Our battery production facilities use leading-edge manufacturing processes that meet the toughest quality standards. All our factories are certified to ISO standards – with ISO 9000 and ISO 14000 being the minimum benchmarks. This means each factory has its own quality and environmental management, delivers products that measure up to toughest standards of reliability.

Certifications

'Quality is our Business' – this is what Panasonic stands for. It is the principle for all our batteries and supporting services. This commitment is confirmed by numerous certifications.



Panasonic Industry Europe

Panasonic Industry Europe GmbH is part of the global Panasonic Group and provides industrial products and services in Europe. As a partner for the industry sector, Panasonic researches, develops, manufactures and supplies technologies that contribute to a better life and a better world. Looking back on over 100 years of engineering knowhow in electronics, Panasonic is the right supplier when it comes to engineering expertise combined with solution competence. The portfolio covers key electronic components such as batteries, devices and modules across a broad range of industries.



Panasonic Industry
Europe Office in
Hamburg

*1 Employees of Panasonic Corporation

*2 Refers to the fiscal year ended March 2021
of Panasonic Corporation, based on exchange rate EUR/JPY 124.

YOUR TOOLS TO FIND

At Panasonic Batteries we offer diverse services intended to make the customer's life easier. Find the right pictures and media files in our Mediapool, gain insight into battery technology in our handbooks and white papers and be entertained by watching amazing videos at our YouTube Channel. Finally, our Battery Finder will help you to find the right battery for your application. Test our services!

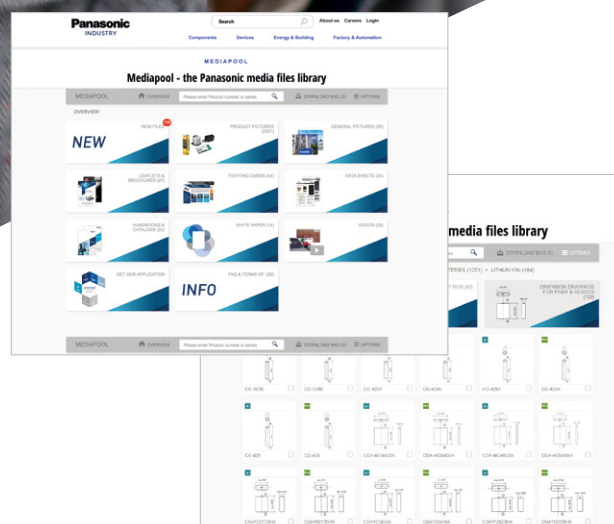
Mediapool

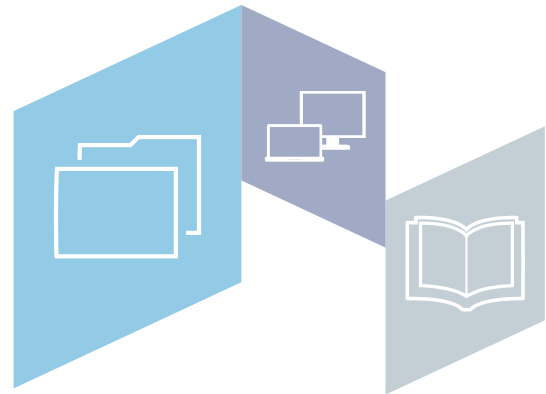
Download the right battery media files

The Panasonic Industry Mediapool is a complete online library of Panasonic battery images, videos, handbooks, press releases, and white papers, providing you with just the right material for all sorts of projects. The Mediapool is open to all visitors to the Panasonic website, and offers material for both print and web. The image files differ with respect to their resolution (image size) and colour space (CMYK or RGB). The library contains files in six formats: TIF, PNG, JPG, AI, PDF, and MP4. New files appear in the folder 'New files' for three months.

You can assemble as many files as you need and download them directly to your computer. Here's an overview of what you can do:

- Locate the material you need by product name or by clicking through the categories
- Preview file details – the preview function tells you the full name of the file, its size, format, and resolution
- Select the files you wish to download. You can take files from multiple folders, or select all the material in a particular folder or category in one-click operation – there's no need to select each one individually
- Preview your personal 'Download bag' of the files you have selected
- The Mediapool zips your data into a file, which you then download to your computer. You unzip the file to the location of your choice simply by double-clicking the file name. The material is then ready for use.

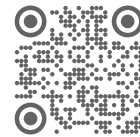




Short Form Catalog and Handbooks

Get the right product overview

Our range of digital tools to help you in your daily work are complemented by our 'classics' on paper: the Short Form Catalog and the technical handbooks on the various battery product groups. These remain popular with customers as valuable reference aids.



YouTube Channel

Find the right battery video

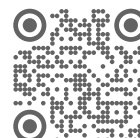
Please find a comprehensive selection of Panasonic battery videos at our YouTube channel. You can discover videos about the inner structure of our different battery chemistries, a couple of application videos and films which explain why batteries sometimes help to save human lives and sharks' lives as well. Are you getting curious? Please follow the QR code to our batteries video world!



White Paper

Find the right technical information

Our white papers give developers and technical professionals the opportunity to leverage the expertise of our specialists for their own projects. We have been manufacturing batteries for a number of decades, and over this time have accumulated considerable knowledge and experience that we wish to share.



Please be sure to observe the following warnings. As batteries contains flammable substances such as lithium or other organic solvents, they may cause heating, rupture or ignition.

CYLINDRICAL TYPE LITHIUM BATTERIES

Warning

1. It may cause rupture or ignite.
 - Do not charge, short (an exception is to pass batteries through dipping solder) disassemble, deform or heat batteries. Do not throw batteries into fire.
 - Do not connect the \oplus and \ominus electrodes to each other with metal or wire. Do not carry or store batteries together with a metallic necklace, etc
 - Avoid inversed connection of \oplus and \ominus terminals to devices.
 - Avoid mixed use of new and old batteries or batteries of other series.
 - Avoid direct soldering to batteries.
2. When discarding batteries, insulate the \oplus and \ominus terminals of batteries with insulating tape, etc. (see fig. 1). When disposed of improperly, lithium batteries may short, causing them to become hot, burst or ignite.
3. Keep batteries out of reach of small children. Should a child swallow a battery, consult a physician immediately.

Caution

Keep batteries away from direct sunlight, high temperature, and high humidity.

COIN TYPE LITHIUM BATTERIES

Warning

1. Do not charge, short (an exception is to pass batteries through dipping solder) disassemble, deform or heat batteries. Do not throw batteries into fire.
2. Keep batteries out of reach of small children. Should a child swallow a battery, consult a physician immediately.
3. When discarding batteries, insulate the \oplus and \ominus terminals of batteries with insulating tape, etc. (see fig. 1). When disposed of improperly, lithium batteries may short, causing them to become hot, burst or ignite.

Caution

1. Be sure to connect the \oplus and \ominus electrodes correctly.
2. Avoid mixed use of batteries, i.e. new, used or different types.
3. Avoid direct soldering to batteries.
4. Keep batteries away from direct sunlight, high temperature, and high humidity.

COIN TYPE RECHARGEABLE LITHIUM BATTERIES

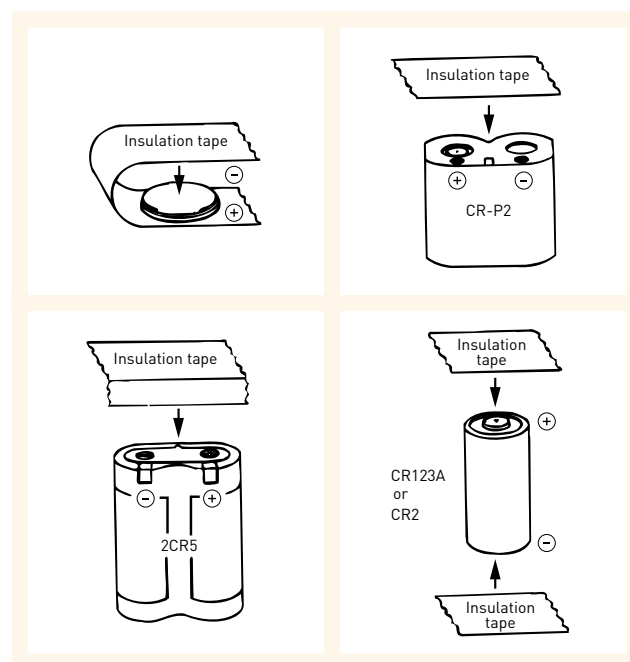
Warning

1. Do not short-circuit (an exception is to pass batteries through dipping solder), disassemble, deform or heat batteries. Do not throw batteries into fire.
2. Do not charge rechargeable batteries with a higher voltage than specified.
3. Keep batteries out of reach of small children. Should a child swallow a battery, consult a physician immediately.
4. When discarding batteries, insulate the \oplus and \ominus terminals of batteries with insulating tape, etc. (see fig. 1). When disposed of improperly, lithium batteries may short, causing them to become hot, burst or ignite.

Caution

1. Be sure to connect the \oplus and \ominus electrodes correctly.
2. Avoid mixed use of batteries, i.e. new, used or different types.
3. Avoid direct soldering to batteries.
4. Keep batteries away from direct sunlight, high temperature, and high humidity.

Fig. 1 When disposing batteries (example of insulating)*¹



LITHIUM & MICRO BATTERIES: TYPES AND FEATURES



Ever since Panasonic became the first company in the world to develop and commence the mass production of lithium batteries for consumer products in 1971, Panasonic has launched a series of lithium batteries in many shapes and sizes including cylindrical types, coin types and pin types. Panasonic has also successfully introduced coin type rechargeable lithium batteries to the market for applications such as memory back-up or watches.

Today, lithium batteries have a proven track record of opening up a host of new fields where conventional batteries cannot be used. Applications range from high-current discharge applications typified by 35 mm cameras to ultra-low current discharge applications in such products as electronic watches or applications as power supplies for IC memory back-up which require long-term reliability.

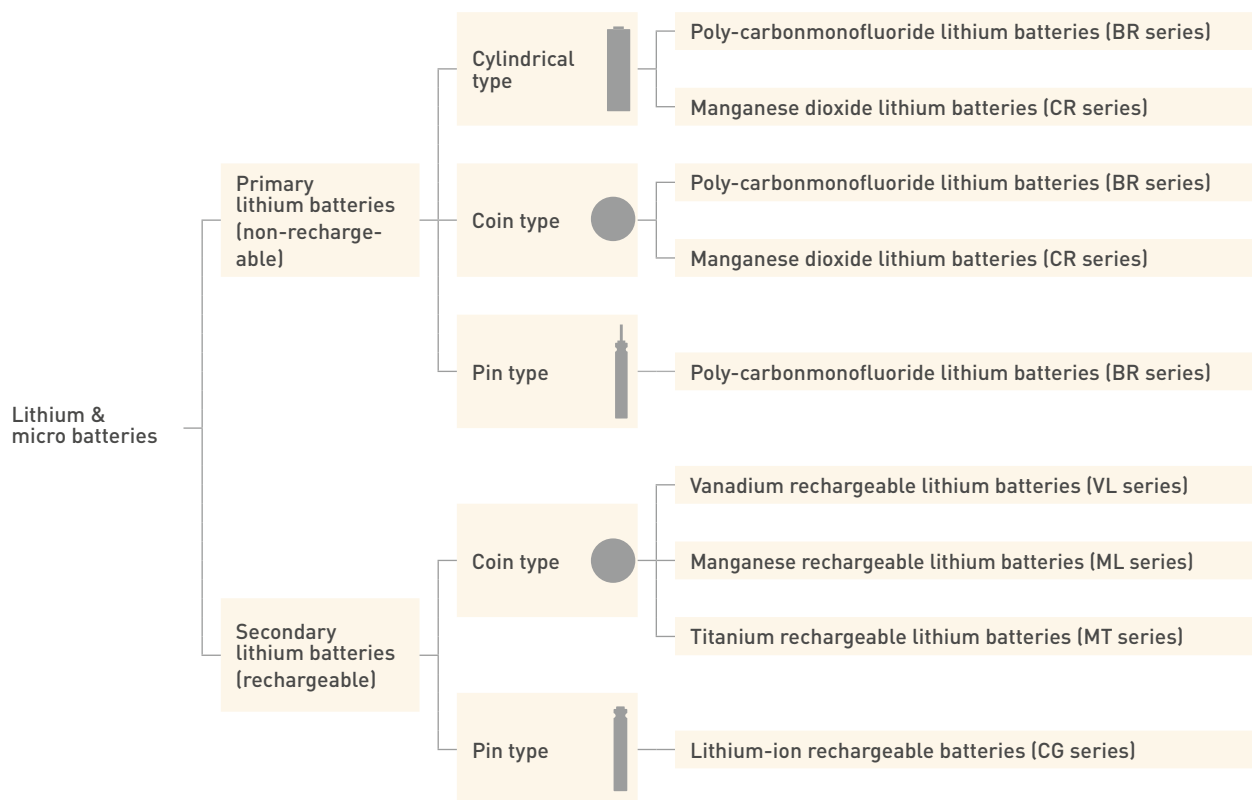
Panasonic has conducted repeated tests on the various safety and performance characteristics, plus the effects of environmental factors such as temperature. We have accumulated a wealth of corroborative data on the performance of our batteries which cannot be pinpointed by short-term accelerated tests. As a result, Panasonic batteries have won approval under the UL safety standards in the United States and wide recognition throughout the world for their high reliability and safety.

COMPARISON OF LITHIUM PRIMARY CHEMISTRY*1

| Chemistry | | | BR | CR | ER |
|-------------|--|--------------|---------------------|---------------------|---------------------|
| Material | Cathode | | CF | MnO ₂ | SOCl ₂ |
| | Anode | | Lithium metal | Lithium metal | Lithium metal |
| | Electrolyte | | Organic electrolyte | Organic electrolyte | Organic electrolyte |
| Performance | Nominal voltage | | 3V | 3V | 3.6V |
| | Discharge capacity | | + | + | + |
| | Voltage during discharge (Initial) | Low current | + | + | ++ |
| | | High current | + | ++ | – |
| | Voltage during discharge (End of capacity) | Low current | ++ | + | ++ |
| | | High current | + | ++ | – |
| | Pulse performance at low temperature | Initial | + | ++ | – |
| | | End of life | ++ | + | – |
| | Storage performance | | ++ | + | ++*2 |
| | Reliability | | ++ | + | –*2 |
| Safety | | ++ | ++ | – | |
| Environment | Eco friendly | | ++ | ++ | –*3 |

++ Very good capability
+ Good capability
- Not good capability

TYPES OF LITHIUM & MICRO BATTERIES



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

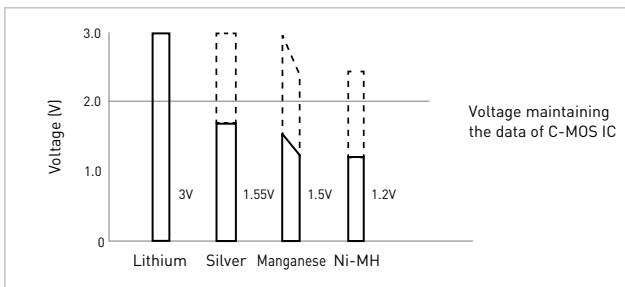
*1 Please contact Panasonic to get more detailed information about this technical comparison overview.

*2 Impedance is increasing due to the passivation phenomena.

*3 Harmful substances included.

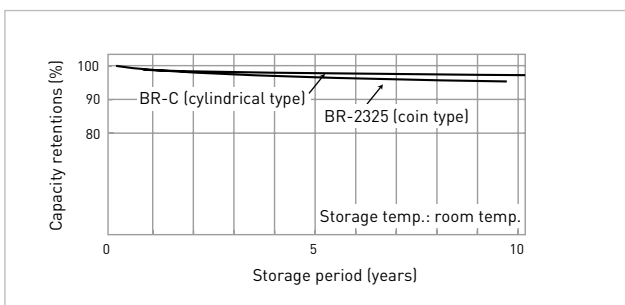
HIGH VOLTAGE

The high energy density of lithium batteries and their high voltage of 3V (there are 1.5V and 3.8V lineups also) make them ideally suited for use in all kinds of products where the trend is to achieve increasing miniaturization. A single lithium battery can replace two, three or more conventional batteries.

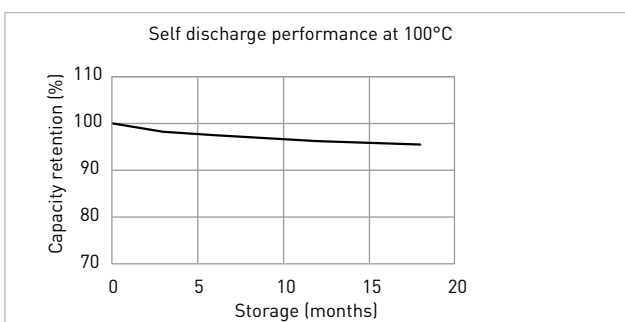


LOW SELF-DISCHARGE RATE AND SUPERIOR STORABILITY

Since the substance that is chemically very stable is used for plus terminal as an active material (BR series: Poly-Carbonmonofluoride, CR series: Manganese Dioxide), if preservation conditions are proper, 90% of capacity remains even after ten years storage.



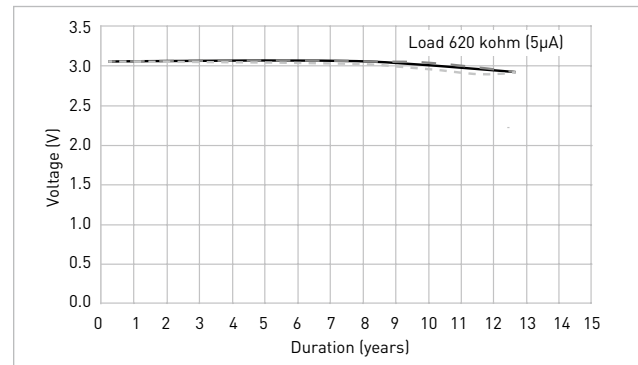
BR-2330A



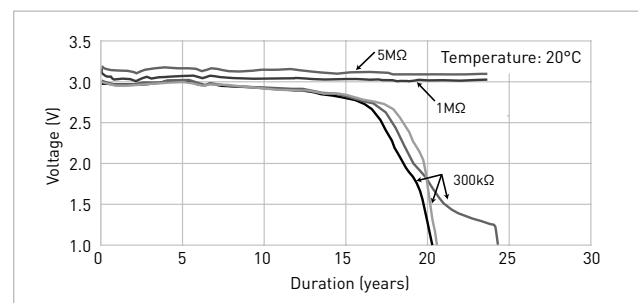
LONG-TERM DISCHARGE

Long-term discharge has been verified at all operating temperatures under low-load discharge conditions.

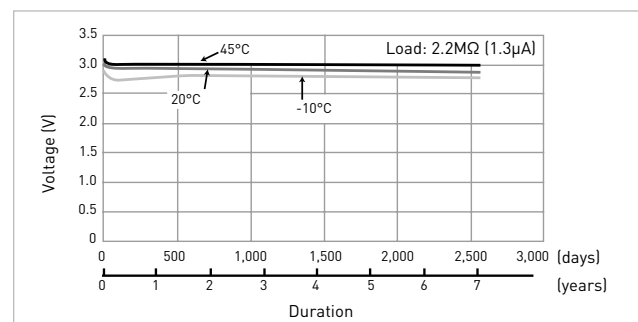
CR-2/3AZ



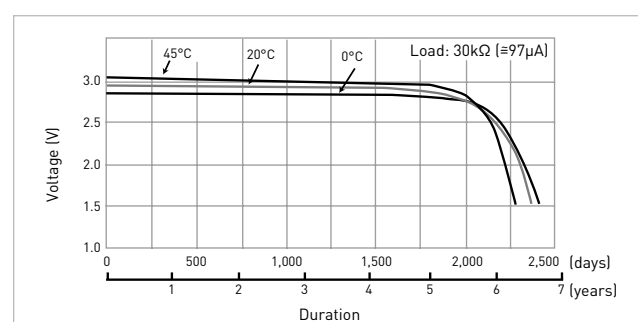
BR-2/3A



BR-2325



BR-C



OUTSTANDING ELECTROLYTE LEAKAGE RESISTANCE

Lithium batteries employ organic electrolytes with minimum creeping so they are vastly superior in terms of leakage resistance under environmental changes compared to other types of batteries that employ aqueous solution electrolytes. The batteries achieve stable characteristics under high temperature and humidity conditions (45°C/90% RH, 60°C/90% RH), and even under heat shock which constitutes the severest challenge for batteries.

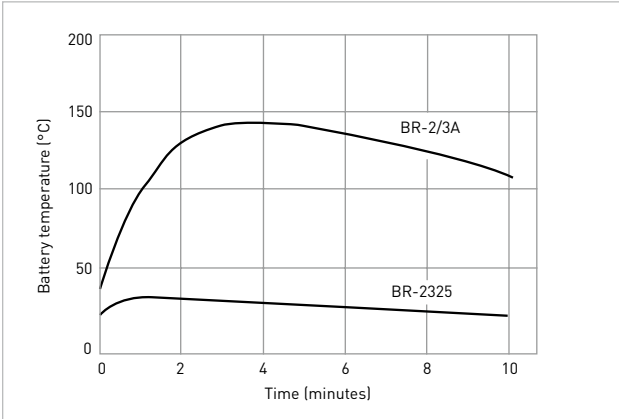
WIDE OPERATING TEMPERATURE RANGE

Due to the use of organic electrolytes with a solidifying point that is much lower than the aqueous solution electrolytes used in other types of batteries, lithium batteries are capable of operation in a wide range of temperatures. Not only do the high operating temperature BR series cells use a special engineering plastic as the material for the gasket and separator instead of the conventional polyolefin resin but its operating temperature range has also been significantly increased by employing an electrolyte with a high boiling point.

SUPERIOR SAFETY

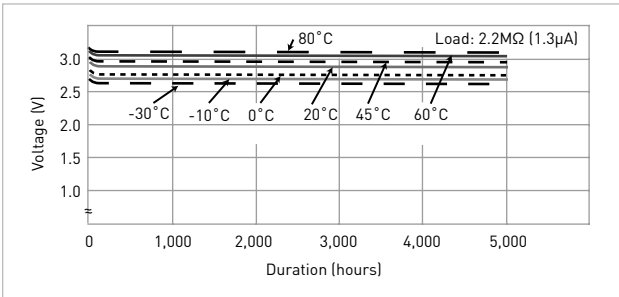
Lithium batteries feature stable substances for the active materials and a structural design that assures safety and, as such, their superior safety has been verified from the results of repeatedly subjecting them to a number of different safety tests. As a result, Panasonic's Lithium batteries have been approved under the safety standard (UL1642) of UL (Underwriters Laboratories Inc.).

Battery surface temperature when short-circuited



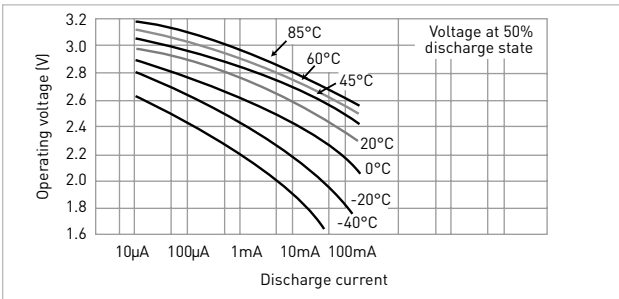
BR-2325

Operating voltage under high-resistance discharge



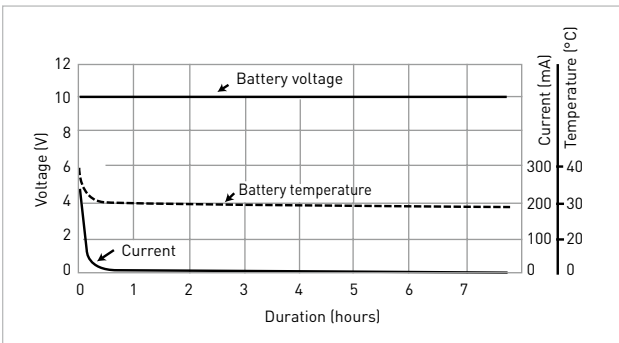
BR-2/3A

Current drain vs. operation voltage



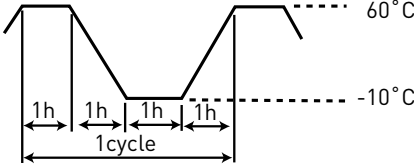
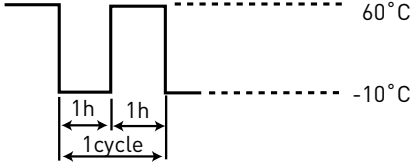
BR-2325

Charge resistance (10V consistent-voltage charge)



LEAKAGE RESISTANCE TEST RESULTS

| Model number | Conditions Storage | 60°C | | 45°C/90% | | 60°C/90% | | Temp. cycle | Heat shock |
|--------------|-----------------------|---------|----------|----------|----------|----------|----------|-------------|------------|
| | | 1 month | 3 months | 1 month | 3 months | 1 month | 3 months | 60 cycles | 120 cycles |
| BR-2325 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| BR-2/3A | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

| Leakage resistance evaluation items | Test conditions |
|-------------------------------------|--|
| High temperature storage | 60°C |
| High temperature | 45°C/90% RH |
| High humidity storage | 60°C/90% RH |
| Temperature cycle |  |
| Heat shock |  |

PRIMARY VS. SECONDARY LITHIUM BATTERIES

COIN TYPE RECHARGEABLE LITHIUM BATTERIES

Rechargeable lithium batteries come with excellent characteristics and high reliability.

- Long-term reliability
- High capacity
- Low self-discharge rate
- Resistance to continuous discharge
- Resistance to over discharge

Comparison table of lithium battery types

| Item | Type | Primary battery | | Secondary battery | | | |
|---|------------------|--|--|---|---|---|--|
| | Model | BR | CR | VL | ML | MT | CG |
| Material | ⊕ electrode | (CF)n | MnO ₂ | V ₂ O ₅ | LiMnO _y | LiO _y | Co |
| | ⊖ electrode | Li | Li | LiAl | LiAl | LiTiO _y | Li |
| Nominal voltage (V) | | 3.0 | 3.0 | 3.0 | 3.0 | 1.5 | 3.8 |
| Operating temperature range (°C) | | Cylindrical: -40 to +85 Coin: -30 to +85 High operating temperature coin: -40 to +125 Pin: -30 to +80 | Cylindrical: -40 to +70 -85 Coin: -30 to +85 High operating temperature coin: -40 to +105 -125 | -20 to +60 | -20 to +60 | -10 to +60 | 0 to +60 (charging) -20 to +60 (discharging) |
| Self-discharge (per year) under standard conditions | Cylindrical type | 0.5% | 1.0% | 2.0% | 2.0% | 2.0% | 1.0% |
| | Coin type | 1.0% | 1.0% | | | | |
| Average discharge voltage (V) | | – | – | 2.85 | 2.5 | 1.2 | 3.7 |
| Charge voltage (V) | | – | – | 3.25 to 3.55 | 2.8 to 3.2 | 1.6 to 2.6 | 4.3 |
| Cut off voltage (V) | | 2.0 | 2.0 | 2.5 | 2.0 | 1.0 | 3.0 |
| Charge-discharge cycles | | – | – | 1,000 charge/discharge partly (charge/discharge for 10% of discharge depth) | 1,000 charge/discharge partly (charge/discharge for 10% of discharge depth) | 500 charge/discharge down to 1V or discharge limit voltage (charge/discharge for 100% of discharge depth) | 500 charge/discharge down to 3.0V (100% discharge depth) |

Comparison between BR and CR

| Model | BR vs. CR |
|-------------|--|
| Performance | Discharge capacity |
| | BR = CR |
| | Voltage during discharging |
| | BR < CR (Higher) |
| | Flatness of discharge voltage |
| Performance | (Flatter) BR > CR |
| | Load characteristics |
| | BR < CR (Superior) |
| Performance | Storage properties (self-discharge) |
| | < 60°C |
| | > 60°C |
| Performance | (Less self-discharge) BR ≥ CR |
| | (Less self-discharge & stable) BR > CR |

Notes: In terms of their characteristics, the CR series provides a slightly higher voltage during discharge than the BR series. BR batteries, compared with CR batteries, show more stable characteristics with less discharge voltage variations. These characteristics should be taken into consideration when selecting a battery for each application.

PRIMARY TYPE

| Industry | Application | Coin type | | | | Cylindrical type | | | Pin type |
|----------------|--|-----------|-------------|-----------|---------------|------------------|------------------------|--------------------------|-----------|
| | | BR series | BR-A series | CR series | CR-A/B series | BR series | CR series for consumer | CR series for industrial | BR series |
| Auto-motive | Electronic Toll Collection (ETC) | | ○ | | ○ | ◎ | | ◎ | |
| | Emergency call (E-Call) | | | | | ○ | ○ | ◎ | |
| | Remote Keyless Entry (RKE) | | | ◎ | | | | | |
| | Tyre Pressure Monitoring System (TPMS) | | ◎ | | ◎ | | | | |
| Communi-cation | Advertising beacon | | | | | | ◎ | | |
| | IoT | ○ | | ◎ | | | ◎ | ◎ | |
| | Personal digital assistant | | | ◎ | | | | | |
| Home appliance | Distance meter | | | | | | ○ | | ○ |
| | Sanitary equipment | | | | | | ◎ | | |
| Marine | Emergency position indicating radio beacon | | | ○ | | ○ | ○ | ◎ | |
| | Life jacket light | | | ○ | | ○ | ○ | ◎ | |
| Medical | Digital thermometer | ○ | | ◎ | ○ | | | | |
| | Scales | | | ◎ | | | | | |
| Metering | Distance meter | | | | | | ○ | | ○ |
| | Electricity meter | ◎ | | ○ | | | | | |
| | Heat cost allocator | | ◎ | | ◎ | ◎ | | | |
| | Water meter | ◎ | | | | ◎ | | ◎ | |
| Security | Door lock system | | | ◎ | | | ◎ | | |
| | Smoke detector | | | | | ○ | | ◎ | |
| | Window monitoring system | | | ◎ | | ○ | ◎ | | |
| Others | Distance meter | | | | | | ○ | | ○ |
| | Fishing equipment | | | | | | | | ◎ |
| | Real Time Clock (RTC) | ◎ | | ○ | | ◎ | | | |
| | Tracking & RFID | ○ | | ◎ | ○ | ○ | | ○ | |
| | Vending machine | | | ◎ | | | | | |
| | Watch | | | ◎ | | | | | |

SECONDARY TYPE

| Industry | Application | Coin type | | | Pin type |
|----------------|----------------------------|-----------|-----------|-----------|-----------|
| | | VL series | ML series | MT series | CG series |
| Auto-motive | Remote Keyless Entry (RKE) | ◎ | ○ | | ○ |
| Communi-cation | IoT | ◎ | ○ | | ◎ |
| Others | Calculator | ○ | ○ | | ○ |
| | Real Time Clock (RTC) | ○ | ◎ | | |
| | Tracking & RFID | ○ | ○ | | ◎ |
| | Vending machine | ○ | ○ | | |
| | Watch | | | ◎ | ○ |

◎ Recommended applications

○ Potential applications

SELECTING A BATTERY/MODEL NUMBER

SELECTING A BATTERY

The steps for selecting the batteries for the power supplies of specific equipment are summarized below.

Preparation of required specifications (draft)

The required specifications (draft) are studied by checking the requirements for the batteries to be used as the power supplies of the specific equipment and their conditions against the battery selection standards. The technical requirements for battery selection are shown in the table below for reference purposes.

Selection of a battery

Select several candidate batteries by referring to the catalogs and data sheets of batteries which are currently manufactured and marketed. From this short list, select the battery which will best meet the ideal level of the requirements. In actual practice, however, the 'perfect' battery is seldom found by this method, instead, the basic procedure followed should be to examine the possibility of finding a compromise or partial compromise with the required specifications (draft) and then make a selection under the revised requirements from the batteries currently manufactured and marketed. Such a procedure enables batteries to be selected more economically. Questions and queries arising at this stage should be directed to our battery engineers. Sometimes, although it may not be shown in the catalogue, the appropriate battery has become available through recent development or improvement. As a rule, the required specifications are finalized at this stage.

Requests for developing or improving batteries

If the battery that meets the essential and specific requirements cannot be found through the selection process described above, a request for battery development or improvement should be made to our technical department. A request like this should be coordinated as early as possible to allow for a sufficient study period. While this period depends on the nature of the request and the difficulties involved, a lead time of at least 6 to 12 months is usually required.

MODEL NUMBER

How to interpret the model numbers generally used for coin type lithium batteries

The model numbers are normally indicated using two upper-case English letters and a figure consisting of three or more digits as shown in the example below. This numbering system is supported by the Japan International Standard Committee of Clocks and Watches and is also an established practice in Japan.

| B | R | 2 | 3 | 2 | 5 | |
|--------------|----------|----------|----------|----------|----------|---|
| Battery type | Round | Diameter | | Height | | ① |
| | | | | | | ② |
| | | | | | | ③ |

- ① Figures to first decimal place with decimal point omitted (ex. 2.5mm)
- ② Integers omitting fractions (ex. 23mm Dia.)
- ③ In accordance with JIS and IEC standards

Examples

BR - 1 / 2 A A

Round
Poly-Carbonmonofluoride Lithium battery
Battery size
Battery diameter

CR - 1 2 3 A

Round
Manganese Dioxide Lithium battery
Battery size
Battery diameter

BR - 2 4 7 7 A

Round
Poly-Carbonmonofluoride Lithium battery
High temperature usage
Divide this by 10 to obtain the battery height in mm
Battery diameter (in mm)

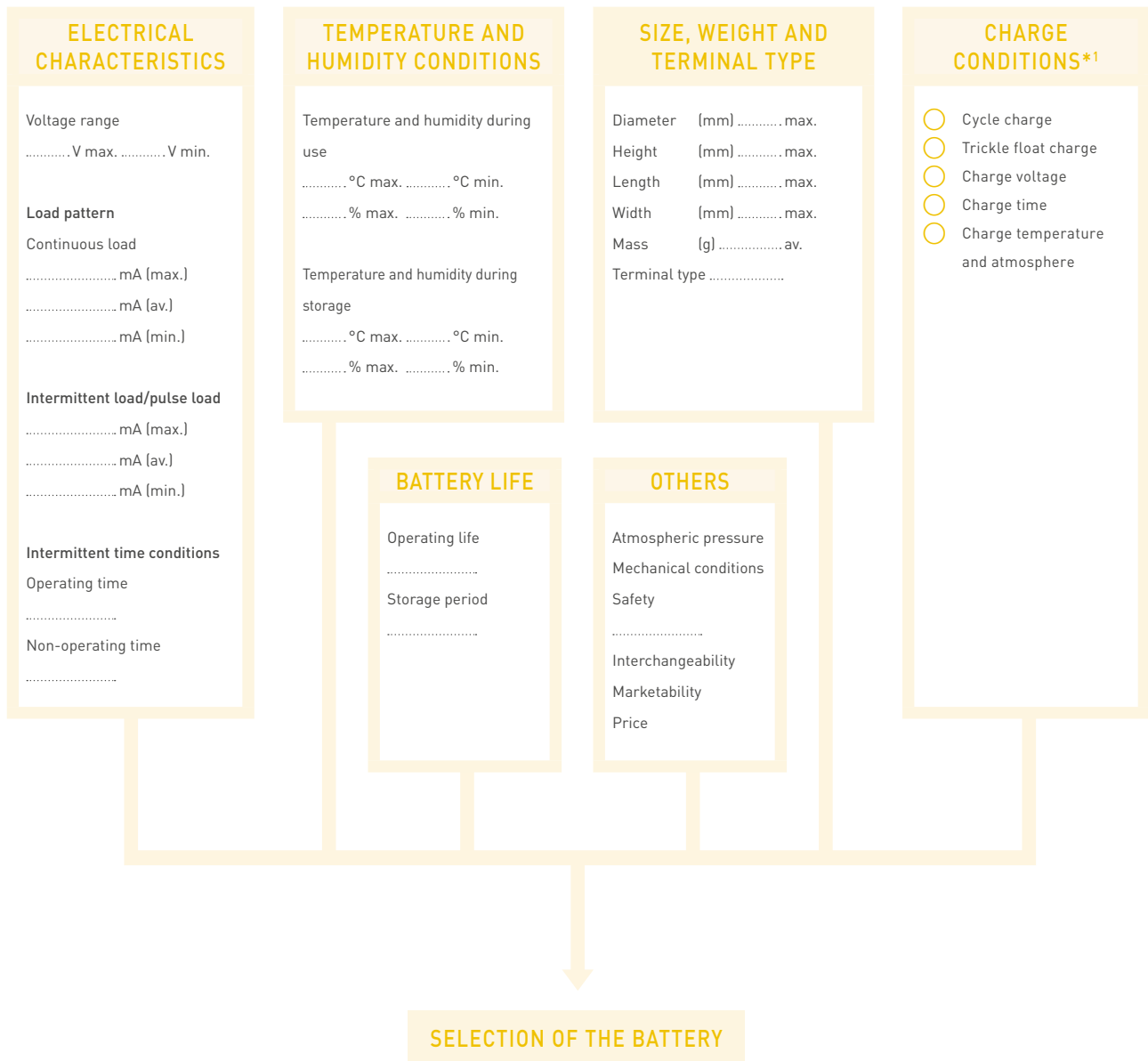
CR - 2 0 3 2

Round
Manganese Dioxide Lithium battery
Divide this by 10 to obtain the battery height in mm
Battery diameter (in mm)

VL - 2 0 2 0

Round
Vanadium Pentoxide Lithium battery
Divide this by 10 to obtain the battery height in mm
Battery diameter (in mm)

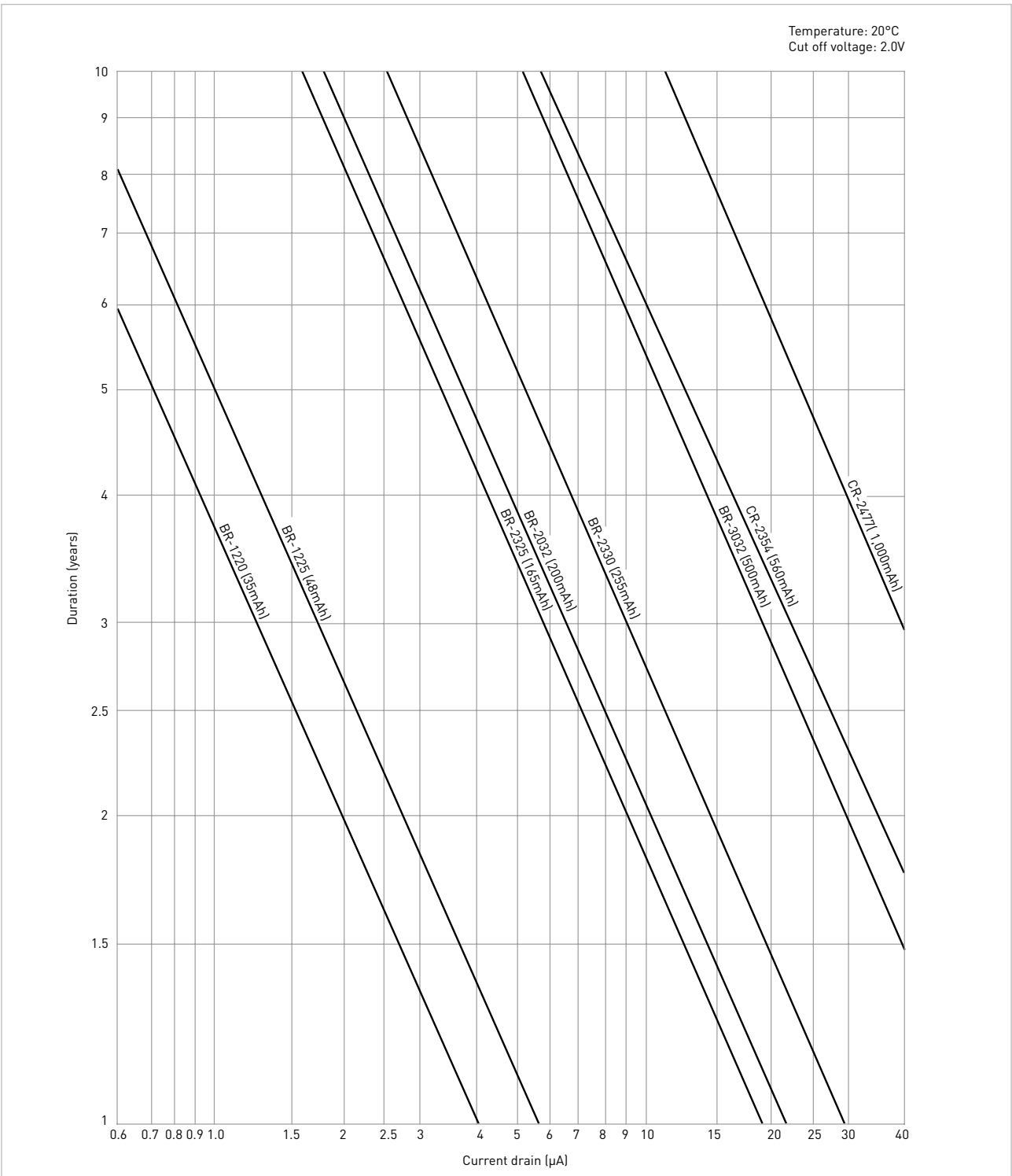
TECHNICAL CONDITIONS FOR SELECTING BATTERIES



BATTERY SELECTION CHART

COIN TYPE PRIMARY LITHIUM BATTERIES (EXAMPLE)

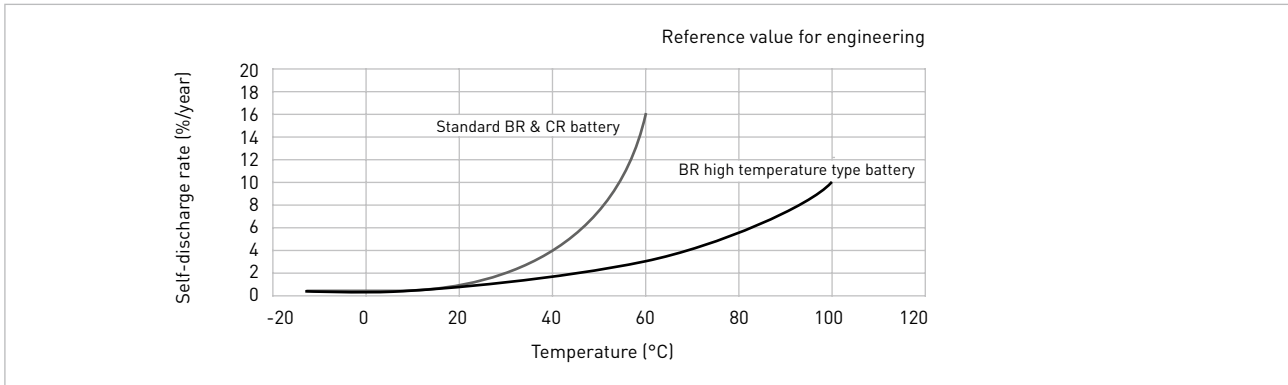
Discharge life as a function of operating current



General formula (rough value with 20°C, standard load)

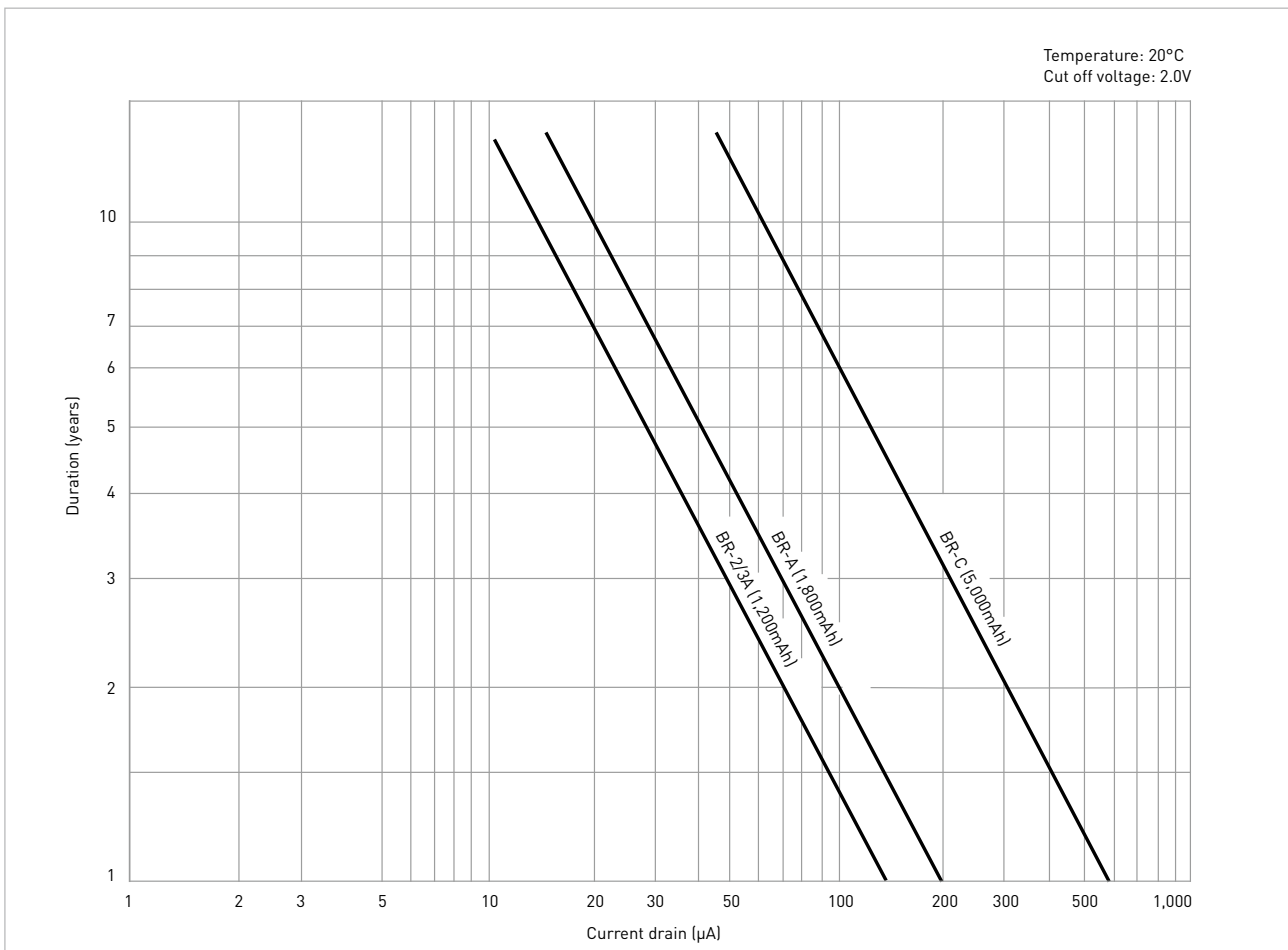
| | |
|-------------|--|
| Calculation | Duration (years) = $\frac{\text{Nominal capacity (mAh)}}{\text{Current drain (mA)} \times 24 \text{ (hours)} \times 365 \text{ (days)}}$ |
|-------------|--|

Self discharge



CYLINDRICAL TYPE PRIMARY LITHIUM BATTERIES (EXAMPLE)

Discharge life as a function of operating current

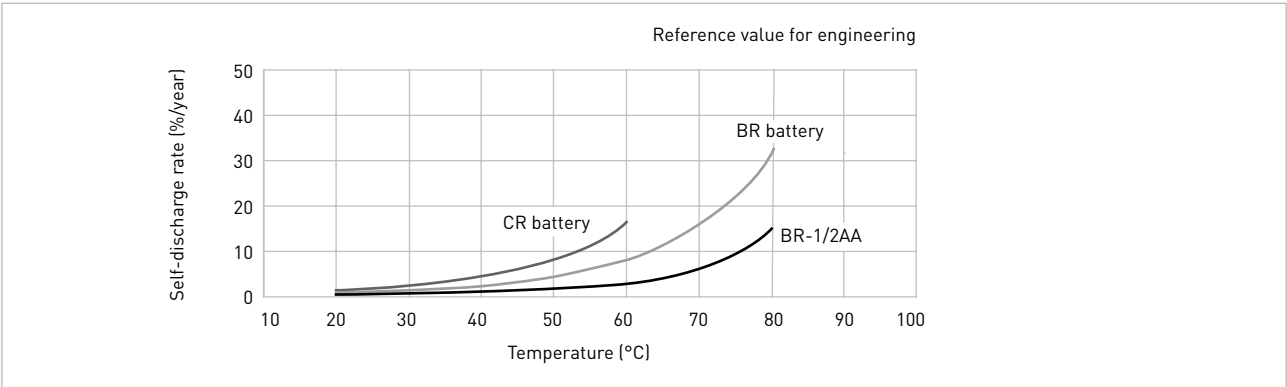


General formula (rough value with 20°C, standard load)

| Calculation | Duration (years) = $\frac{\text{Nominal capacity (mAh)}}{\text{Current drain (mA)} \times 24 \text{ (hours)} \times 365 \text{ (days)}}$ |
|-------------|--|
|-------------|--|

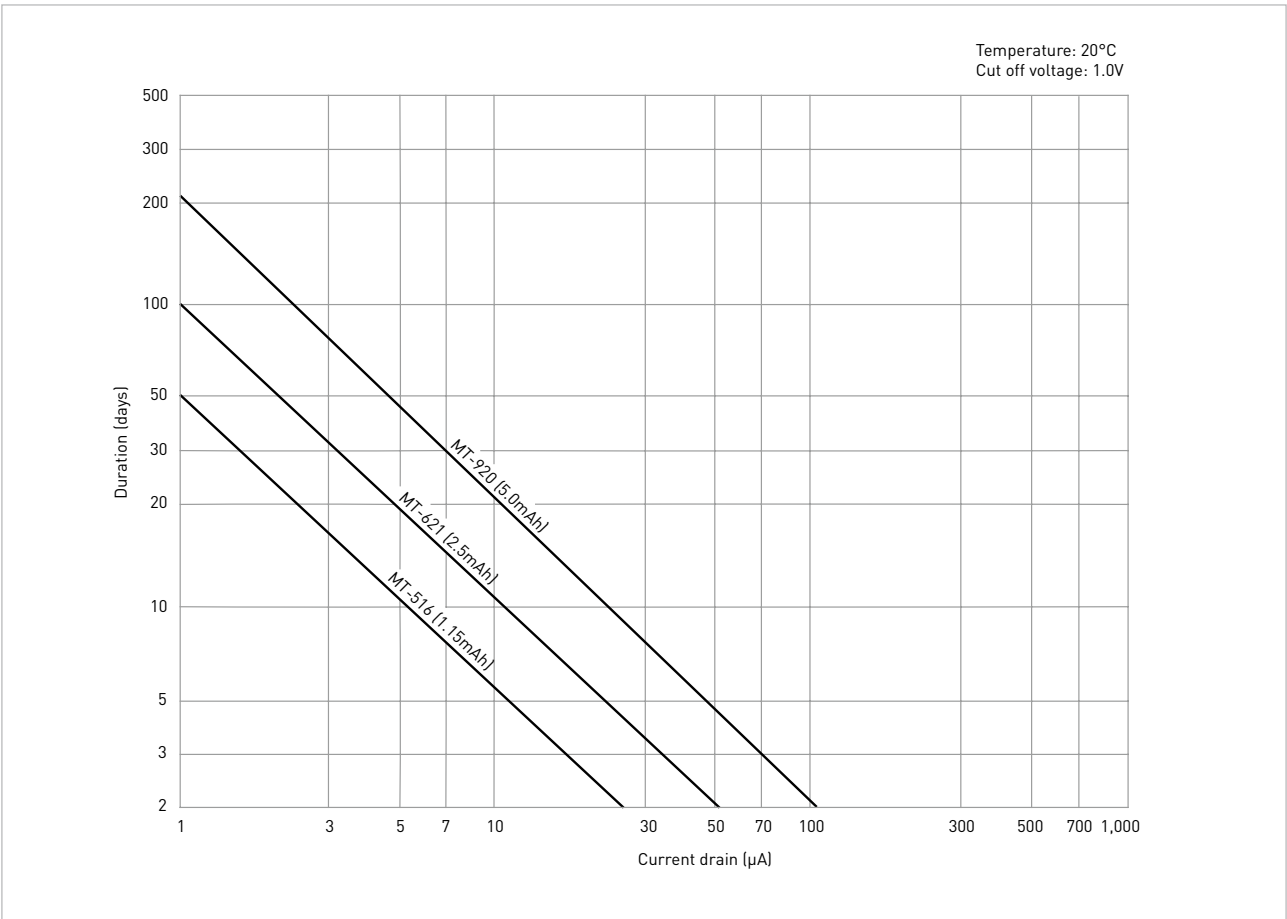
BATTERY SELECTION CHART

Self discharge

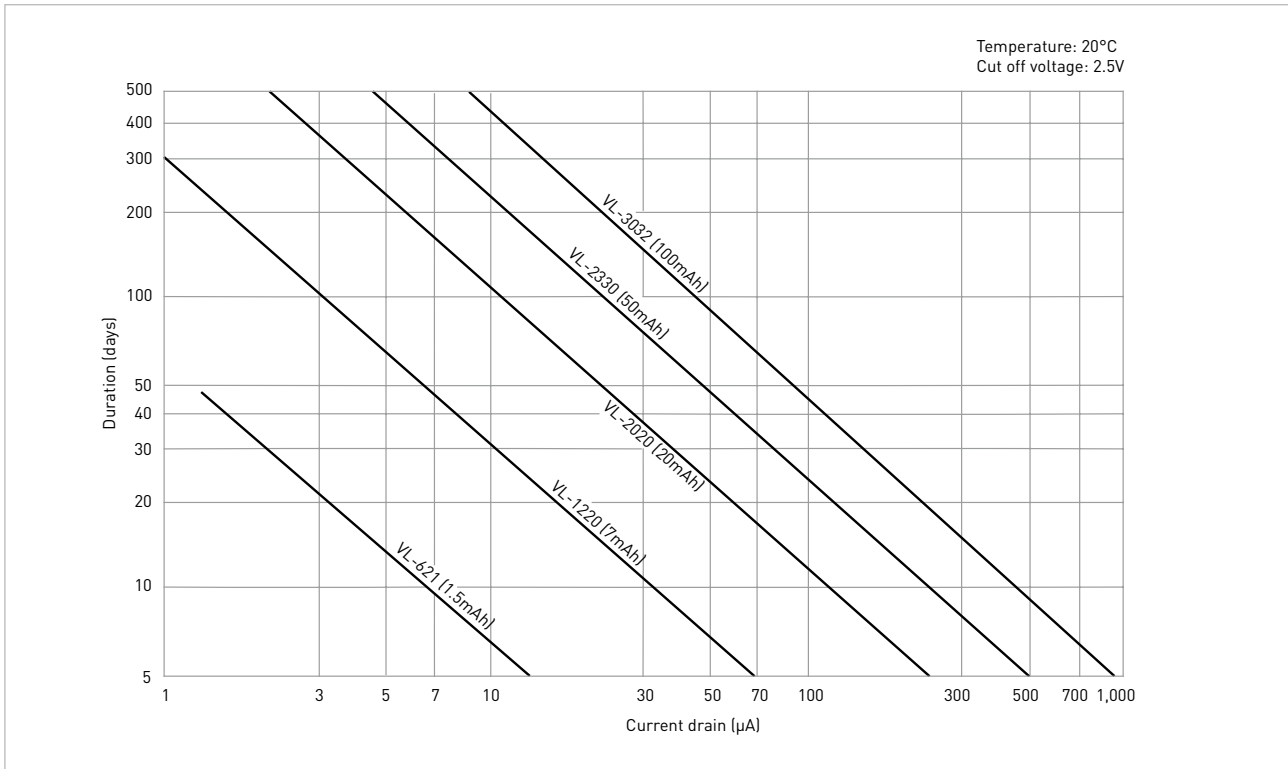


COIN TYPE SECONDARY LITHIUM BATTERIES (EXAMPLE)

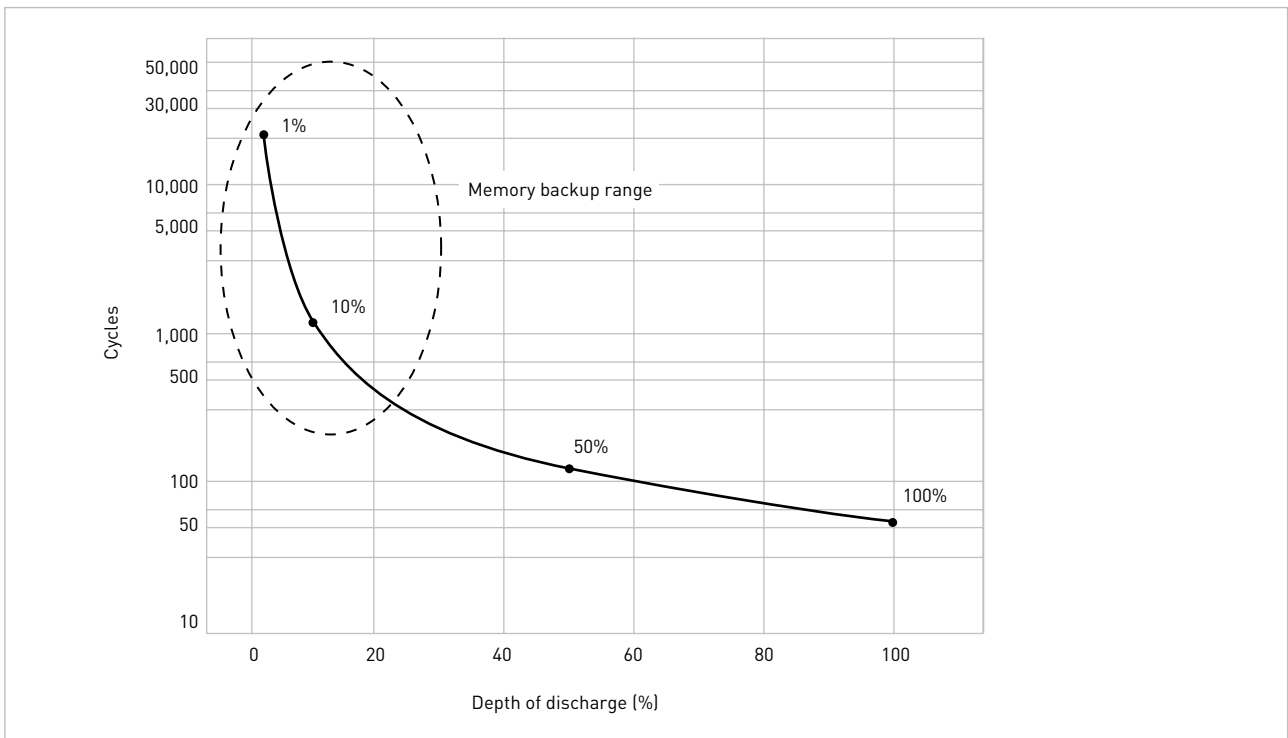
Discharge life as a function of operating current



Discharge life as a function of operating current



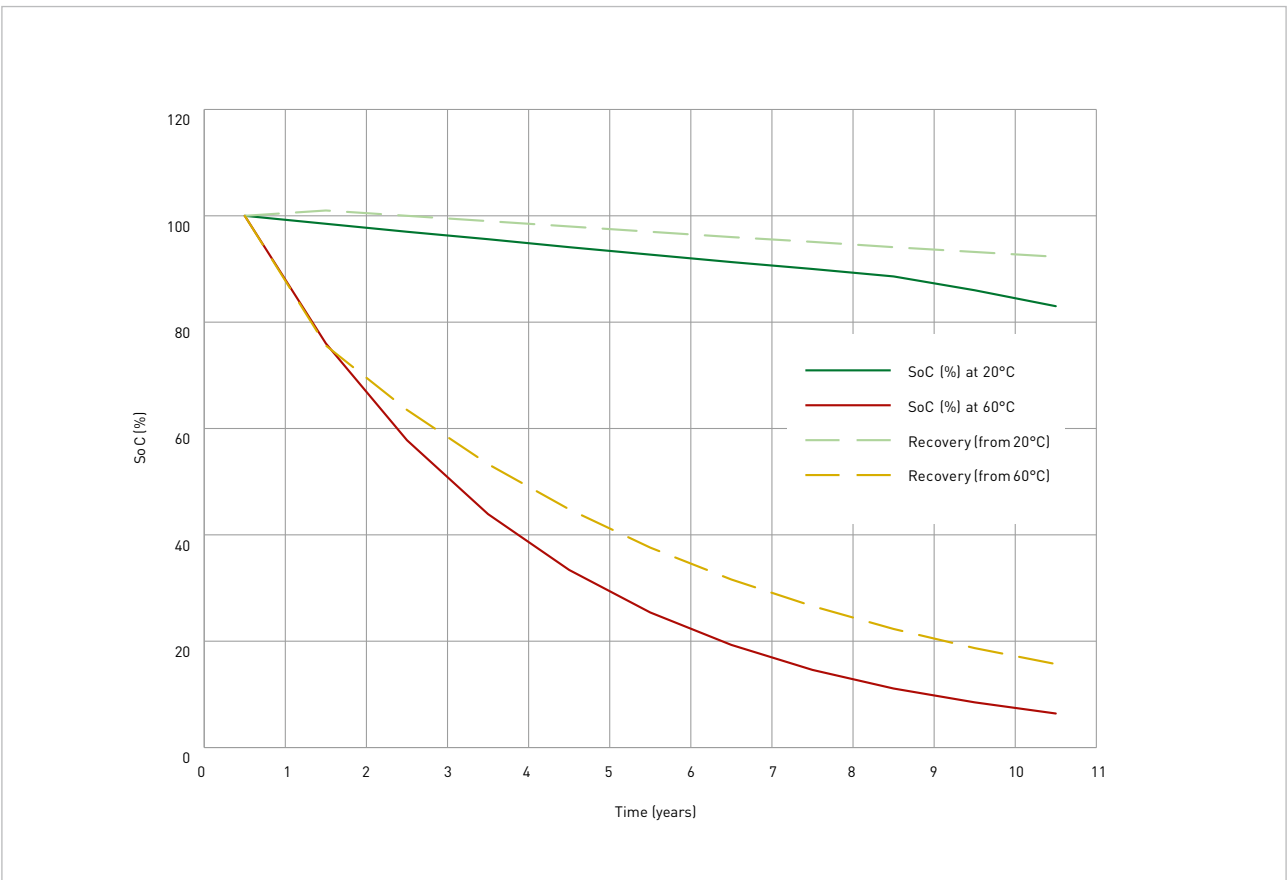
Cycle life



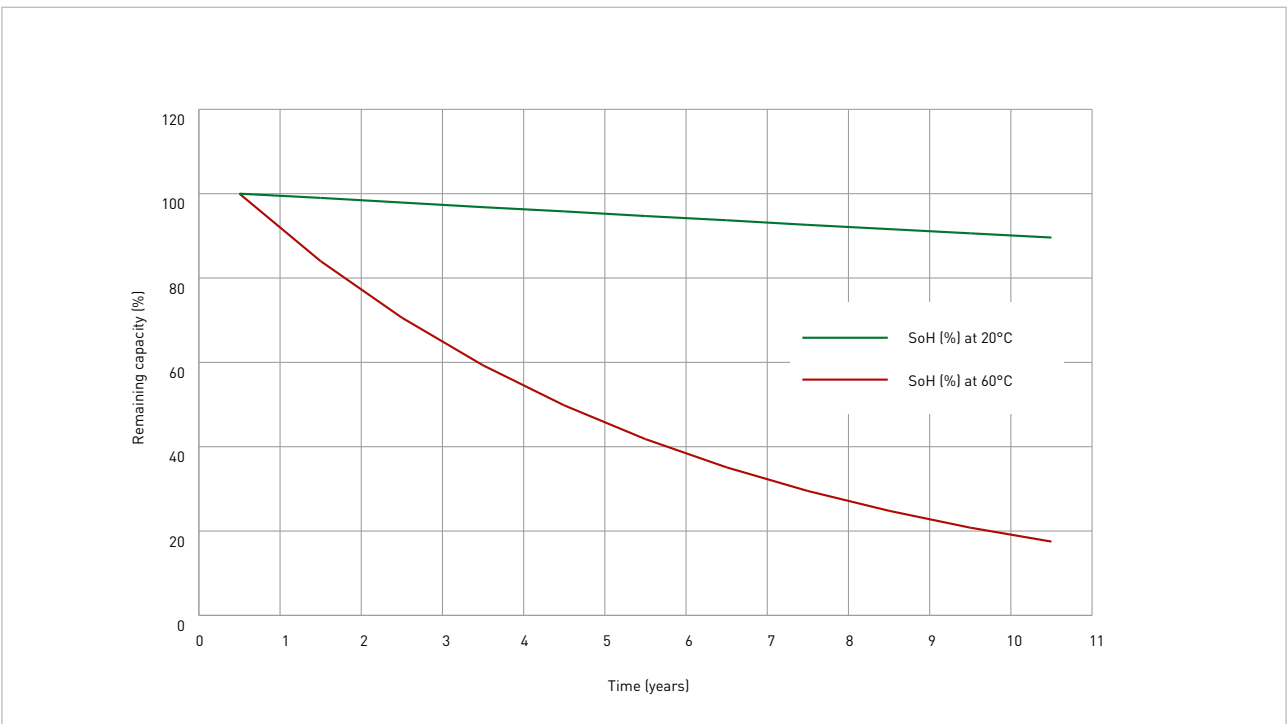
The number of cycles is defined with the batteries' remaining capacity $\leq 50\%$.

CHARGE RETENTION AND TEMPERATURE DEGRADATION DEPENDENCIES

VL/ML residual capacity and recovery



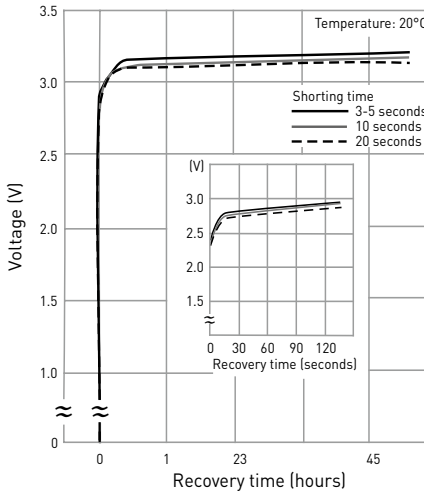
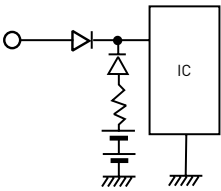
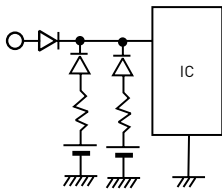
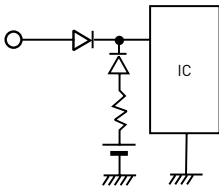
VL/ML capacity degradation under float



APPLICABLE BOTH PRIMARY AND SECONDARY BATTERIES

| Classification | Item | Precaution |
|-----------------------------------|--|---|
| Batteries | Voltage measurement | To measure the battery voltage, use an instrument with an input resistance of 10MΩ or higher. |
| | Internal resistance measurement | To measure the internal resistance, use a 1,000Hz AC instrument. |
| | Electrical characteristics check | Even minimal shorting causes the battery voltage to drop, requiring a period of time for the voltage to recover. Checking the voltage characteristics before the voltage has sufficiently recovered in such a situation may result in a misjudgment of battery voltage. |
| | Cleaning | Prior to installation in the equipment, wipe the batteries and equipment terminals clean using a dry cloth, etc. |
| | Washing and drying | <ul style="list-style-type: none"> ○ Washing: Use of a conductive detergent causes batteries to discharge, the battery voltage to drop and the battery performance to deteriorate in other ways. Be sure to use a non-conductive detergent. ○ Drying: The heat produced when the temperature of the battery units rises above 85°C deforms the gaskets and causes electrolyte leakage and a deterioration in performance. Be sure to dry batteries only for short periods of time at temperatures below 85°C. |
| | Mounting | <ul style="list-style-type: none"> ○ Ensure that dust and other foreign substance will not cause shorting between the poles. ○ When handling batteries, wear finger covers or gloves made of rubber, cotton, etc. to protect the batteries from dirt. |
| | UL | Strictly comply with the conditions outlined on the next page. |
| | Use of multiple batteries | Give sufficient consideration to safety in design when a multiple number of batteries are to be used. Consult with Panasonic concerning packs of multiple batteries. |
| | Simultaneous use of other types of batteries | When other types of batteries are also to be used in the some equipment, design the circuitry in such a way that the current (leakage current) from the other batteries will not flow to the lithium batteries. (This applies to primary batteries.) |
| | Use of batteries in series or in parallel | This requires special circuitry: Please consult with Panasonic. Do not use lithium batteries together with different types of batteries in series or in parallel. |
| Battery compartments in equipment | Storage | Recommended storage conditions: T: +5-35°C, RH: 45-85% (non-condensing) Maximum storage period: 10 years (7 years for CR cylindrical consumer cells) |
| | Battery life | Prior to installation in the equipment, wipe the batteries and equipment terminals clean using a dry cloth, etc. |
| | Design | <ul style="list-style-type: none"> ○ Ensure that the batteries can be replaced easily and that they will not fall out of position. ○ Give consideration to the battery dimensions, tolerances, etc. ○ Give consideration to the shape of ⊕ and ⊖ electrodes of the batteries and their tolerances to prevent installation in reverse. ○ Clearly indicate on the battery compartment the type of batteries to be used and their correct installation direction (polarities). ○ Limit the electrical circuits inside the battery compartment only to the circuits relating to the battery contacts. ○ With the exception of the terminal areas, insulate the battery compartment from the electrical circuits. ○ Take steps to minimize any damage to the equipment resulting from electrolyte leakage from the battery compartment. ○ Batteries should be free from leakage of liquids, which can damage equipment and spoil the contact at terminals, making the operation of equipment unstable. |
| Battery compartments in equipment | Battery layout and construction and materials of compartment | <ul style="list-style-type: none"> ○ Take steps to ensure the batteries are not located heat generating component in the equipment. Installing batteries near a heat source will heat up the batteries, causing thermal deformation of the gasket and resulting in electrolyte leakage and a deterioration in characteristics. ○ Adopt a construction which allows the gases to be vented. ○ Give consideration to the impact and the effect on the environment in selecting the materials to be used. |

GENERAL SAFETY PRECAUTIONS FOR USING, HANDLING AND DESIGNING

| Classification | Item | Precaution |
|-----------------------------------|------------------------------|--|
| Contacts and connection terminals | Contact point materials | Use nickel-plated iron or nickel-plated stainless steel for the contact points. |
| | Contact pressure of contacts | In order to ensure stable contact, use the following levels of contact as a general guideline: 5N to 15N for cylindrical types 2N to 10N for coin types. |
| | Shape of terminals | Use of Y-shaped terminals (2-point contact) for both the \oplus and \ominus electrodes yield stable contact. |
| | Connection terminals | If lead wires and connection terminals such as tab terminals are required for the batteries, consult with Panasonic since we offer a range of external terminals (connectors, etc.). |
| Notes | Circuit design | <p>1. Shorting causes the battery voltage to drop to about 0V before slowly recovering from the open state. It takes time for the initial voltage to be restored. Notice that measuring the open-circuit voltage immediately after shorting may lead to a misjudgment that the battery is abnormal. The figure on the right illustrates how voltage recovers after shorting.</p> <p>2. Reverse current preventing diodes. Since lithium primary batteries are not rechargeable, use of a reverse current preventing diode and a protective resistor in series is required where there is the possibility of charging in the equipment circuit. Use a silicon diode or Schottky diode with a low reverse current as the reverse current preventing diode. To maintain the characteristics of a coin type lithium battery, the total charging amount of the battery during its total usage period must be kept within 3% of the nominal capacity of the battery.</p> <p style="text-align: right;">BR-2/3A Voltage recovery after short-circuited (example)</p>  <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>(A) 2-cell 6V usage</p> </div> <div style="text-align: center;">  <p>(B) Parallel usage</p> </div> <div style="text-align: center;">  <p>(C) UL conditions</p> </div> </div> |

PRIMARY BATTERIES

Since lithium primary batteries are not rechargeable, use a reverse current blocking diode and a protective resistor in series where there is the possibility of charging in the equipment circuit.

Reverse current blocking diode

Diode used

Use a low leak current diode (this current varies with temperature).

Selection standard

The total allowable charging amount of a battery during its total usage period must not be greater than 3% of the nominal capacity of the battery for a coin type battery or 1% for a cylindrical battery.

Example

When a CR-2477 (1,000mAh) coin type battery is to be used for 5 years, a reverse current preventing diode with a reverse current of 0.7μA or less is required.

Calculation method

$$1,000\text{mAh (CR-2477)} \times \leq 3\% \text{ (coin type battery)} = \leq 30\text{mAh}$$

$$30\text{mAh} \div \text{usage period (5 years} \times 365 \text{ days} \times 24 \text{ hours)} = 0.7\mu\text{A}$$

Use of protective resistor in series:

Selection and installation (UL Standard)

A resistor must be installed in series with the battery to limit the charge current which will flow to the battery in case of destruction in continuity of the reverse current preventing diode. The maximum allowable current is specified for each battery size in the table at the right, and the resistance value of the protective resistor is determined as:

$$R > V \div I$$

(where 'I' is the maximum allowable charge current specified by UL).

Conditions for UL Standard

(Contact Panasonic for further details.)

1. Use of protective resistor in series

Selection

Select the protective resistor in such a way that the charge current which will flow to the battery when the diode is destroyed is less than the value given in the table on the next page.

Installation

To protect the battery from being charged in the event of the destruction of the diode, install a protective resistor in series with the battery.

2. Battery replacement

Replacement by qualified engineer

These batteries are intended for use as a part of an electrical circuit in equipment and any battery with an asterisk '*' in the table on the next page should only be replaced by a qualified engineer.

Replacement by user

Those lithium batteries which are not accompanied by an asterisk '*' in the table on the next page and which include the use of up to four of them in series or in parallel may be replaced by users provided that the conditions specified by the UL Standard are met.

Use in series or in parallel

In replacing up to four batteries, the batteries must all be replaced with new ones at the same time. Set the maximum allowable charge current to within the current permitted by the number of batteries in series or in parallel.

SECONDARY BATTERIES

Use of multiple batteries

Consult with Panasonic if two or more Vanadium rechargeable Lithium batteries (VL series) or Manganese rechargeable Lithium batteries (ML series) are to be used in series or in parallel.

Charging

Details on the charge voltage, charge current and charge circuit are given for each type of battery.

Conditions of UL approval

The maximum charge current must be restricted to 300mA when protective components have been subjected to short- or open-circuiting.

GENERAL SAFETY PRECAUTIONS FOR USING, HANDLING AND DESIGNING

PRIMARY AND SECONDARY BATTERIES

UL approval and maximum allowable charge current

| | Shape | Model number | UL approval | Maximum abnormal charging current (mA) |
|-----------------------------|---|------------------------|-------------|--|
| Primary Lithium batteries | Cylindrical type BR series | BR-1/2AA | ● | 5 |
| | | BR-2/3A | ● | 10 |
| | | BR-2/3AG | ● | 10 |
| | | BR-A* ¹ | ● | 15 |
| | | BR-AG* ¹ | ● | 15 |
| | | BR-C* ¹ | ● | 20 |
| | Cylindrical type CR series for consumer | CR-2 | ● | 20 |
| | | CR-123A | ● | 25 |
| | | 2CR-5 | ● | 25 |
| | | CR-P2 | ● | 25 |
| | Cylindrical type CR series for industrial | CR-2U, CR-2Z | ● | 20 |
| | | CR-2/3AU, CR-2/3AZ | ● | 25 |
| | | CR-AAK, CR-AAU | ● | 25 |
| | | CR-AG, CR-AGZ | ● | 25 |
| | Coin type BR series | BR-1220 | ● | 3 |
| | | BR-1225 | ● | 3 |
| | | BR-1632 | ● | 4 |
| | | BR-2032 | ● | 5 |
| | | BR-2325 | ● | 5 |
| | | BR-2330 | ● | 5 |
| | | BR-3032 | ● | 5 |
| | Coin type BR-A series | BR-1225A | ● | 3 |
| | | BR-1632A | ● | 4 |
| | | BR-2330A* ¹ | ● | 5 |
| | | BR-2450A* ¹ | ● | 5 |
| | | BR-2477A* ¹ | ● | 5 |
| | Coin type CR series | CR-1025 | ● | 2 |
| | | CR-1216 | ● | 3 |
| | | CR-1220 | ● | 3 |
| | | CR-1616 | ● | 4 |
| | | CR-1620 | ● | 4 |
| | | CR-1632 | ● | 4 |
| | | CR-2012 | ● | 10 |
| | | CR-2016 | ● | 10 |
| | | CR-2025 | ● | 10 |
| | | CR-2032 | ● | 10 |
| | | CR-2330 | ● | 10 |
| | | CR-2354 | ● | 10 |
| | | CR-2412 | ● | 10 |
| | | CR-2450 | ● | 30 |
| | | CR-2477 | ● | 10 |
| | | CR-3032 | ● | 10 |
| | Coin type CR-A/B series | CR-2032A | ● | 10 |
| | | CR-2032B | ● | 10 |
| | | CR-2050A | ● | 10 |
| | | CR-2050B2 | ● | 10 |
| | | CR-2450A | ● | 30 |
| | Pin type BR series | BR-425 | ● | 0.1 |
| | | BR-435 | ● | 0.2 |
| Secondary Lithium batteries | Coin type VL series | VL-621* ¹ | ● | 300 |
| | | VL-1220 | ● | 300 |
| | | VL-2020 | ● | 300 |
| | | VL-2330 | ● | 300 |
| | | VL-3032 | ● | 300 |
| | Coin type ML series | ML-421 | ● | 300 |
| | | ML-614 | ● | 300 |
| | | ML-621 | ● | 300 |
| | | ML-920 | ● | 300 |
| | | ML-1220 | ● | 300 |
| | | ML-2020* ¹ | ● | 300 |
| | Coin type MT series | MT-516 | ● | 300 |
| | | MT-621 | ● | 300 |
| | | MT-920 | ● | 300 |
| | Pin type CG series | CG-320B | ● | 38 |
| | | CG-420A | ● | 72 |
| | | CG-425A | ● | 99 |

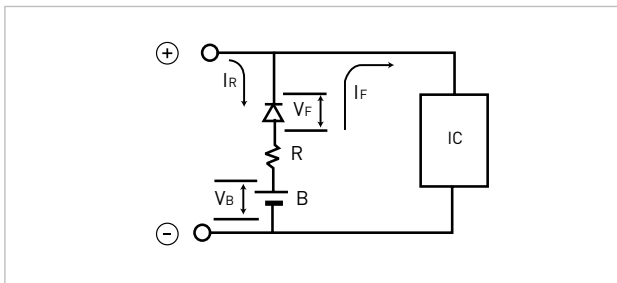
● UL approval

Selecting batteries

When selecting batteries, give consideration to such factors as the current consumption of the equipment in which the batteries are to be used, the expected life of the batteries, and temperature in the operating environment. At low operating environment temperatures, the consumption current of the ICs drops but the discharge voltage of the batteries will also decrease. Also it is important to note that the capacity deterioration of batteries in long-term use becomes significant at high operating environment temperatures.

Memory back-up circuit and holding voltage

The circuit typically used for memory back-up is shown in the figure on the right. The memory holding voltage is expressed as: $V_B - V_F - I_F \times R > \text{memory holding voltage of IC}$.



Reverse current blocking diode

Since lithium primary batteries are not rechargeable, use of a reverse current blocking diode and a protective resistor in series is required where there is the possibility of charging in the equipment circuit. Use a diode with a low leak current as the reverse current blocking diode. To maintain the characteristics of a coin type lithium battery, the total charging amount of the battery during its total usage period must be kept within 3% of the nominal capacity of the battery.

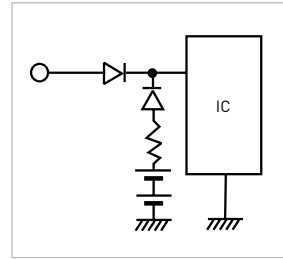
For example, assuming that a CR-2477 (1,000mAh) will be used in a memory back-up power supply for 5 years, charging by the leak current of the reverse current blocking diode should be no greater than 30mAh (= 3% of 1,000mAh), thus: 30mAh ÷ usage period (5 years x 365 days x 24 hours) = 0.7μA. In other words, a leak current blocking diode whose reverse current is not greater than 0.7μA must be selected.

Allowable total charging amount

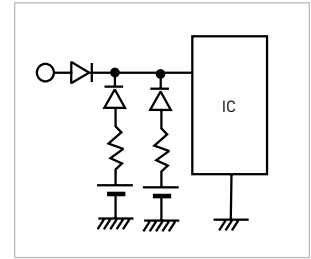
- Within 3% for coin type batteries
- Within 1% for cylindrical type batteries

Note that the leak current of reverse current blocking diodes varies with temperature.

(A) 2-cell 6V usage

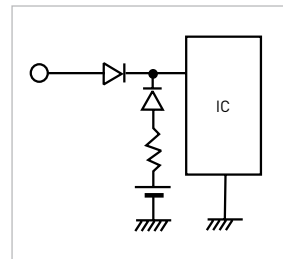


(B) Parallel usage



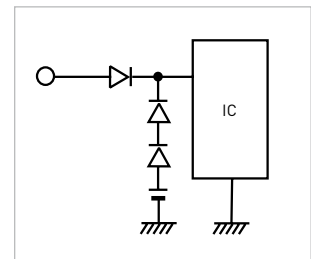
(C) UL conditions

(When a protective resistor has been inserted)

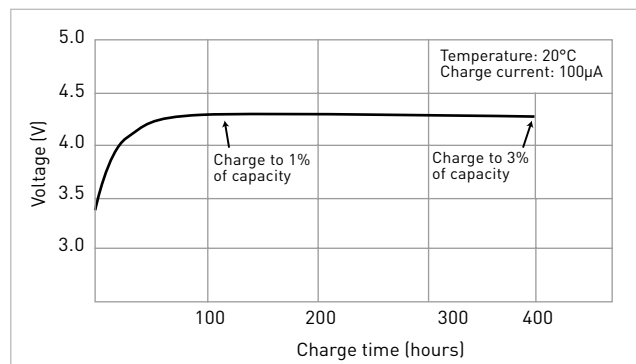


(D) UL conditions

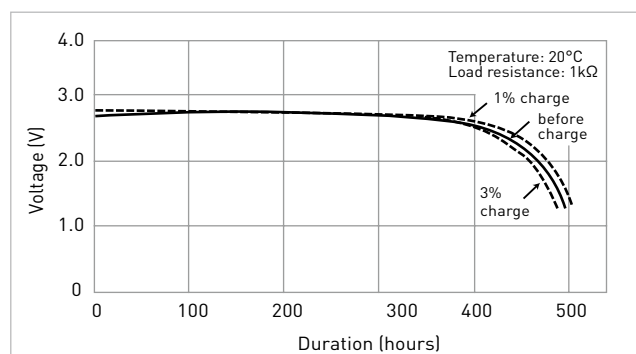
(Protective diode)



Charge test results assuming diode leakage current BR-2/3A (cylindrical type) Charge test



BR-2/3A (cylindrical type) Discharge test after charging



STATE-OF-THE-ART LITHIUM PRIMARY BATTERIES



LOW SELF-DISCHARGE
DECADES OF MASS PRODUCTION EXPERIENCE
SUPERIOR DESIGNED BATTERY RANGES
PROVEN RELIABILITY

Scan QR code
to view product
series video.





POLY-CARBONMONOFLUORIDE LITHIUM BATTERIES (BR SERIES) – CYLINDRICAL TYPE LITHIUM BATTERIES

Our Panasonic Poly-Carbonmonofluoride Lithium batteries (BR series) are ideal for applications such as meters or smoke detectors which demand either long-term power supply reliability or need to handle a wide temperature range.

FEATURES

- Operating temperature range: between -40°C ~ +85°C
- Self-discharge rate at 20°C is just 0.5% per year
- Superior long-term reliability
- 38+ years of experience in production

APPLICATIONS

- Heat cost allocators
- Water & gas meters
- Car alarm
- Smoke detectors
- Tracking & RFID
- Marine devices, etc.

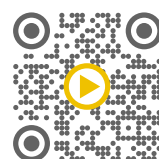
| Model number | Nominal voltage (V) | Nominal capacity (mAh)*1 | Diameter (mm) | Total height (mm) | Weight (g) | IEC |
|--------------|---------------------|--------------------------|---------------|-------------------|------------|---------|
| BR-1/2AA*2,3 | 3 | 1,000 | 14.5 | 25.5 | 8.0 | - |
| BR-2/3A*3 | 3 | 1,200 | 17.0 | 33.5 | 13.0 | BR17335 |
| BR-2/3AG*3 | 3 | 1,450 | 17.0 | 33.5 | 13.0 | BR17335 |
| BR-A*3 | 3 | 1,800 | 17.0 | 45.5 | 18.0 | - |
| BR-AG*3 | 3 | 2,200 | 17.0 | 45.5 | 18.0 | - |
| BR-C*3 | 3 | 5,000 | 26.0 | 50.5 | 41.0 | - |

BATTERY INSIDE*4

- 1 Positive pole
- 2 Gasket
- 3 Separator
- 4 Cathode (Carbonmonofluoride)
- 5 Anode (Lithium)
- 6 Insulator
- 7 Tube
- 8 Positive pole platform
- 9 Cell can
- 10 Collector
- 11 Negative pole



Scan QR code to view 3D animated video.



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 Capacity based on standard drain and cut off voltage down to 2.0V at 20°C.

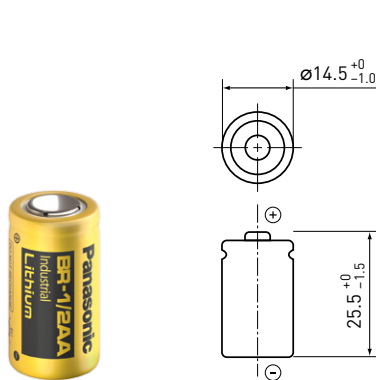
*2 Operating temperature range is from -40°C ~ +100°C.

*3 Cells are supplied with tabs or lead-wires only. For available configurations please consult the Panasonic homepage or your sales contact.

*4 The illustration shows only one example of Lithium battery structure.

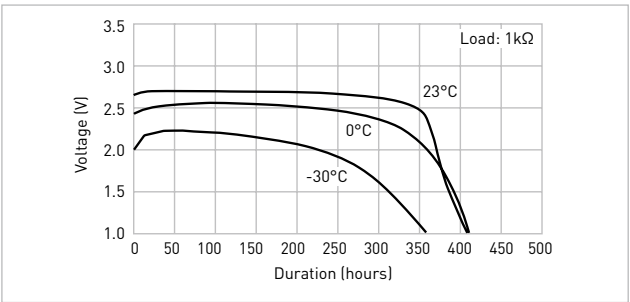
BR-1/2AA

DIMENSIONS (MM)

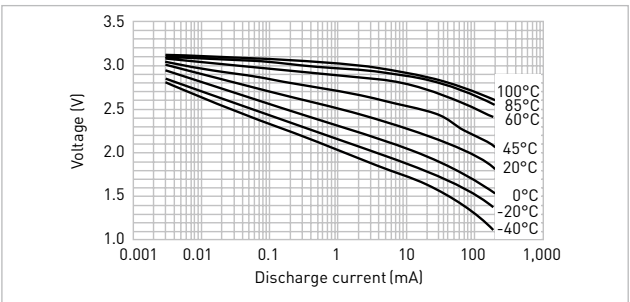


| Specifications | BR-1/2AA |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,000 |
| Diameter (mm) | 14.5 |
| Total height (mm) | 25.5 |
| Discharging temperature range (°C) | -40 to +100 |
| Weight (g) | 8.0 |

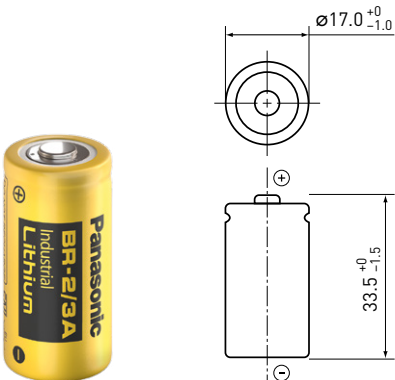
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

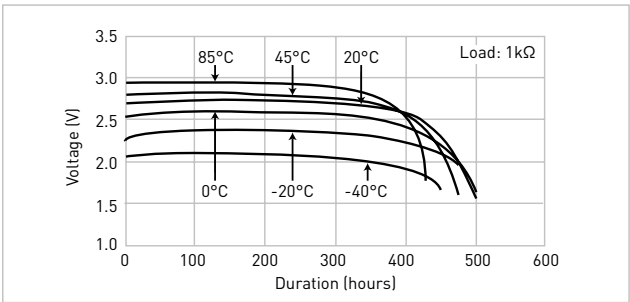


BR-2/3A

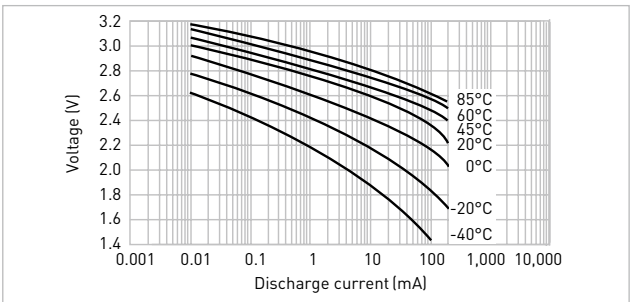


| Specifications | BR-2/3A |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,200 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 33.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 13.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS

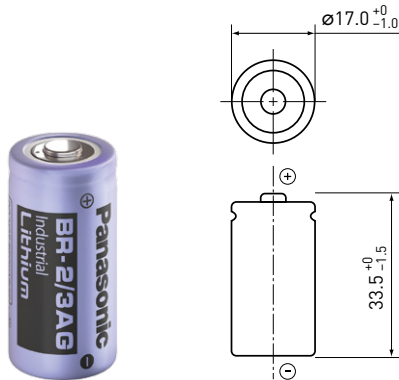


OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



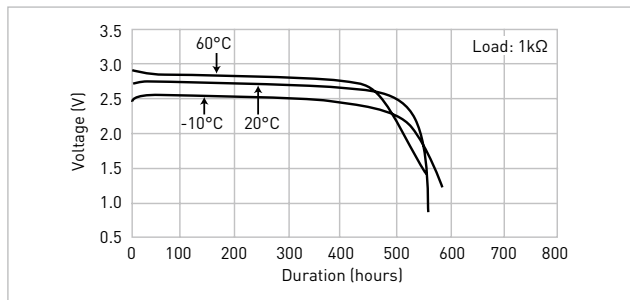
BR-2/3AG

DIMENSIONS (MM)

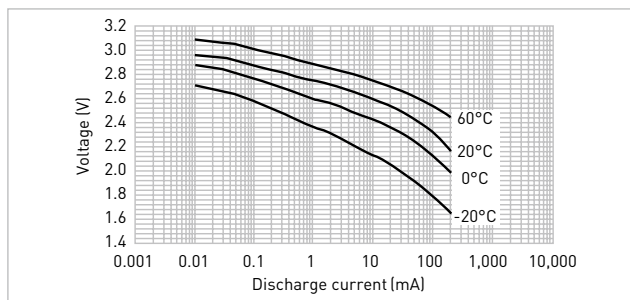


| Specifications | BR-2/3AG |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,450 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 33.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 13.0 |

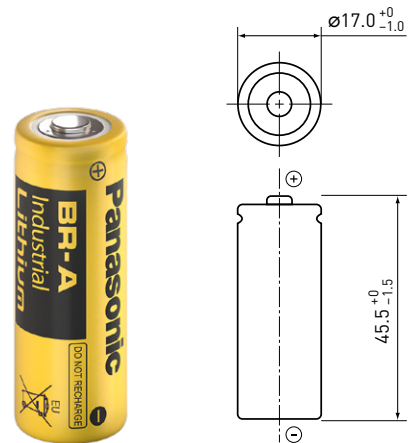
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

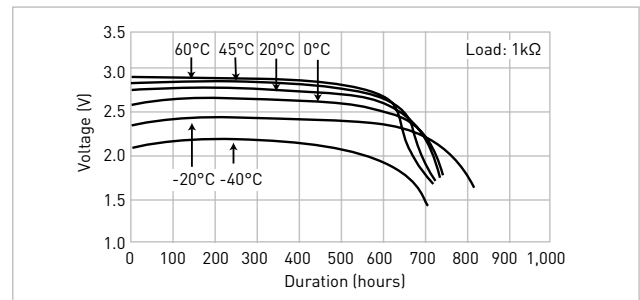


BR-A

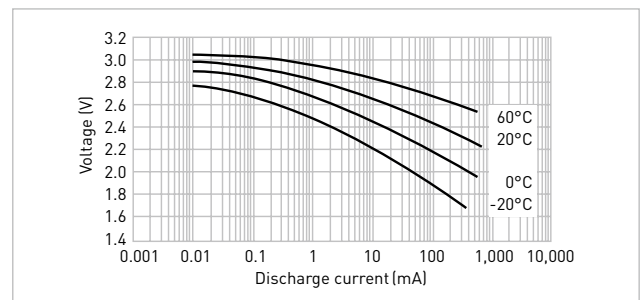


| Specifications | BR-A |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,800 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 45.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 18.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS

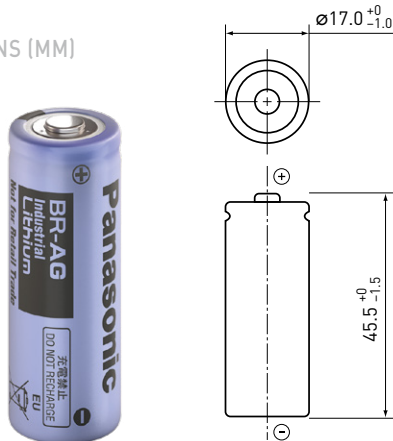


OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



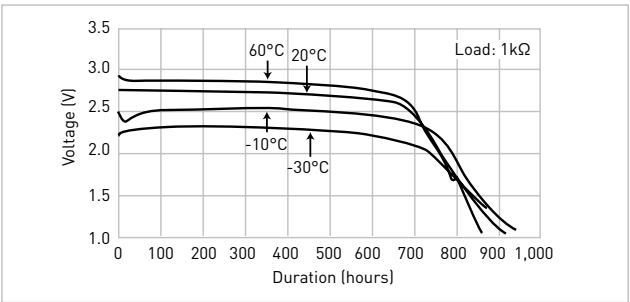
BR-AG

DIMENSIONS (MM)

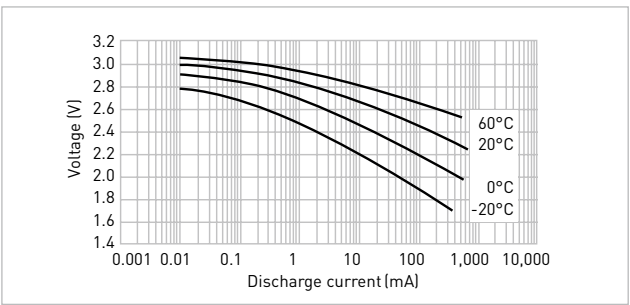


| Specifications | BR-AG |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 2,200 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 45.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 18.0 |

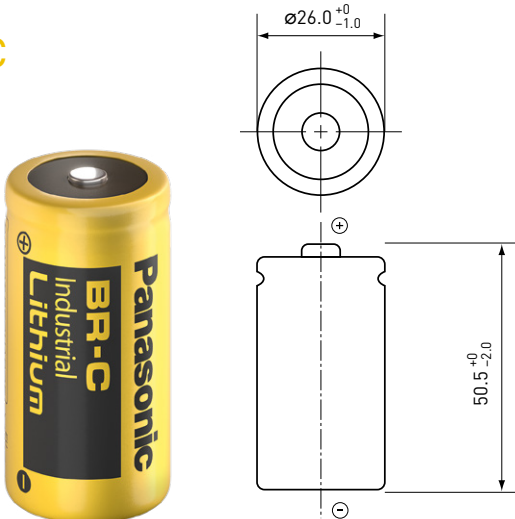
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

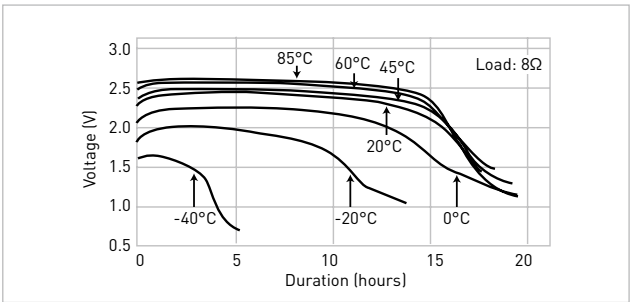


BR-C

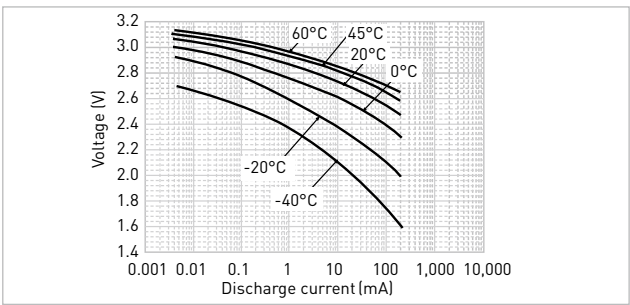


| Specifications | BR-C |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 5,000 |
| Diameter (mm) | 26.0 |
| Total height (mm) | 50.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 41.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1





MANGANESE DIOXIDE LITHIUM BATTERIES (CR SERIES FOR CONSUMER) – CYLINDRICAL TYPE LITHIUM BATTERIES

Panasonic Lithium CR type cylindrical batteries come as either single cells or dual cell packs. All cylindrical type Manganese Dioxide (CR series) Lithium batteries feature a spiral structure. With the enlarged electrode surface areas, they permit a current as high as several amperes to be drawn. In addition these batteries are convenient for equipments which are considered to replace the battery at the field.

FEATURES

- Operating temperature range: between -40°C ~ +70°C
- Good pulse discharge capability
- Stable operation voltage
- Self-discharge rate at 20°C just 1% per year

APPLICATIONS

- Medical equipment
- Door lock systems
- Marine devices
- Cameras
- High energy flashlights
- Sanitary equipment, etc.

| Model number | Nominal voltage (V) | Nominal capacity (mAh)* ¹ | Diameter (mm) | Total height (mm) | Weight (g) | IEC |
|-----------------------|---------------------|--------------------------------------|---------------|-------------------|------------|----------|
| CR-2* ² | 3 | 850 | 15.6 | 27.0 | 11.0 | CR15H270 |
| CR-123A* ² | 3 | 1,550 | 17.0 | 34.5 | 16.0 | CR17345 |
| 2CR-5* ² | 6 | 1,550 | 34.0 x 17.0 | 45.0 | 38.0 | 2CR5 |
| CR-P2* ² | 6 | 1,550 | 35.0 x 19.5 | 36.0 | 37.0 | CRP2 |

BATTERY INSIDE*³

- 1 Positive pole
- 2 Vent diaphragm
- 3 Gasket
- 4 Separator
- 5 Anode (Lithium)
- 6 Cathode (Manganese Dioxide)
- 7 Tube
- 8 Insulator
- 9 PTC (Positive Temperature Coefficient Device)
- 10 Collector
- 11 Cell can
- 12 Negative pole



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

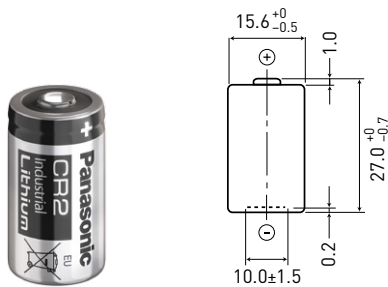
*¹ Capacity based on standard drain and cut off voltage down to 2.0V or 4.0V at 20°C.

*² Please consult your Panasonic sales representative when anticipating usage in operation temperature is between -40°C to -20°C, or +60°C to 70°C.

*³ The illustration shows only one example of Lithium battery structure.

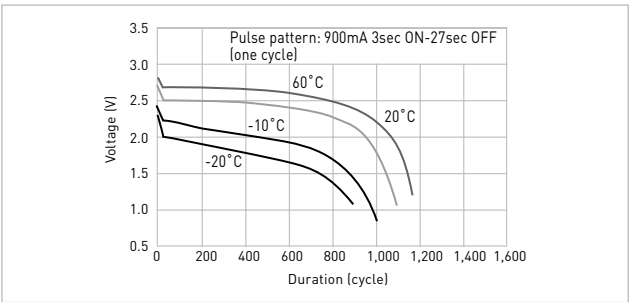
CR-2

DIMENSIONS (MM)

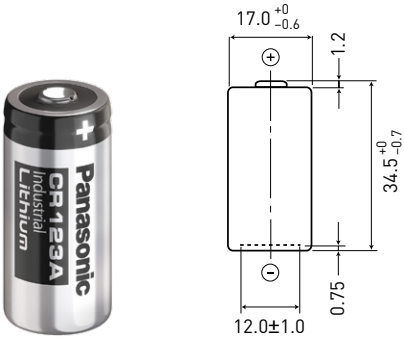


| Specifications | CR-2 |
|------------------------------------|--------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 850 |
| Diameter (mm) | 15.6 |
| Total height (mm) | 27.0 |
| Discharging temperature range (°C) | -40 to +70*1 |
| Weight (g) | 11.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS

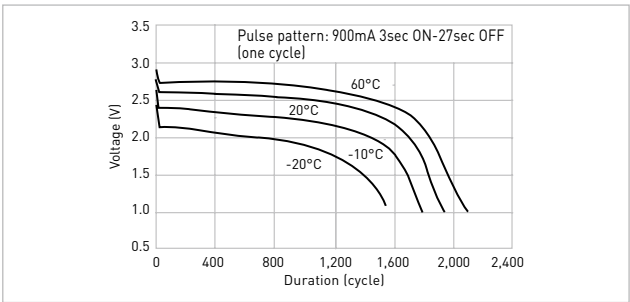


CR-123A



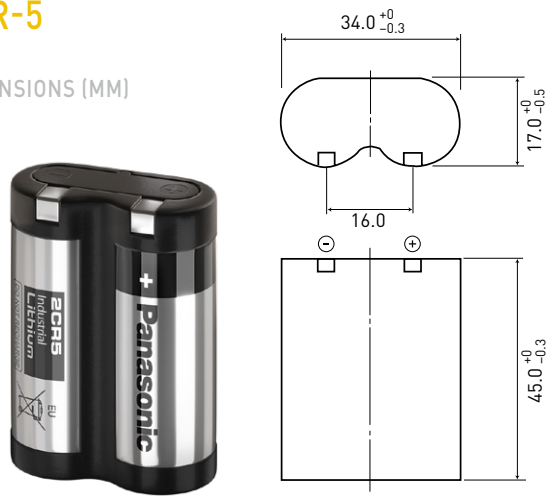
| Specifications | CR-123A |
|------------------------------------|--------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,550 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 34.5 |
| Discharging temperature range (°C) | -40 to +70*1 |
| Weight (g) | 16.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS



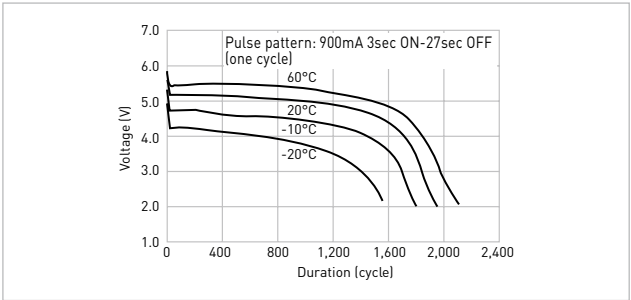
2CR-5

DIMENSIONS (MM)

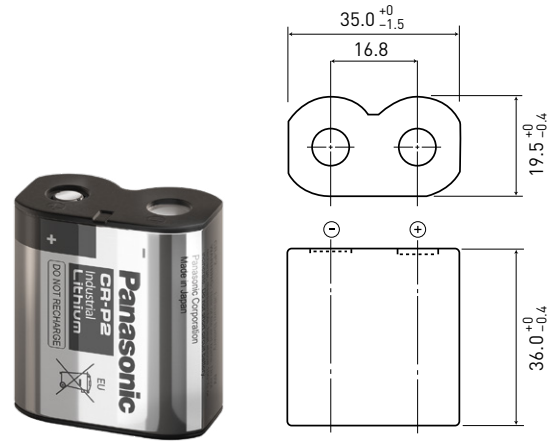


| Specifications | 2CR-5 |
|------------------------------------|--------------|
| Nominal voltage (V) | 6 |
| Nominal capacity (mAh) | 1,550 |
| Diameter (mm) | 34.0 x 17.0 |
| Total height (mm) | 45.0 |
| Discharging temperature range (°C) | -40 to +70*1 |
| Weight (g) | 38.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS

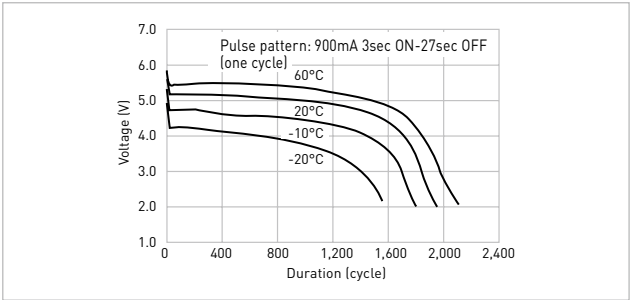


CR-P2



| Specifications | CR-P2 |
|------------------------------------|--------------|
| Nominal voltage (V) | 6 |
| Nominal capacity (mAh) | 1,550 |
| Diameter (mm) | 35.0 x 19.5 |
| Total height (mm) | 36.0 |
| Discharging temperature range (°C) | -40 to +70*1 |
| Weight (g) | 37.0 |

DISCHARGE TEMPERATURE CHARACTERISTICS



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 Please consult Panasonic for use below and above -20°C to +60°C.



MANGANESE DIOXIDE LITHIUM BATTERIES (CR SERIES FOR INDUSTRIAL) – CYLINDRICAL TYPE LITHIUM BATTERIES

Ideal for industrial equipment, this series offers both excellent high-rate discharge performance and a service life of 15 years or more.

FEATURES

- Stable impedance throughout battery life
- Operating temperature range: between -40°C ~ +85°C*1
- High current discharge performance
- Long-term reliability
- Self-discharge rate at 20°C is just 1% per year

APPLICATIONS

- Medical equipment
- Automotive
- Smoke detectors
- Security devices and systems
- Marine devices
- Smart meter, etc.

| | Model number | Nominal voltage (V) | Nominal capacity (mAh)*2 | Diameter (mm) | Total height (mm) | Weight (g) |
|-----|--------------|---------------------|--------------------------|---------------|-------------------|------------|
| NEW | CR-AAK*3 | 3 | 1,650 | 14.5 | 50.5 | 18.0 |
| NEW | CR-AAU*3 | 3 | 1,800 | 14.5 | 50.5 | 18.0 |
| | CR-2Z*3 | 3 | 1,000 | 15.6 | 27.0 | 11.0 |
| NEW | CR-2U*3 | 3 | 1,000 | 15.6 | 27.0 | 11.0 |
| NEW | CR-2/3AU*3 | 3 | 1,600 | 17.0 | 33.5 | 16.0 |
| | CR-2/3AZ*3 | 3 | 1,600 | 17.0 | 33.5 | 16.0 |
| NEW | CR-AG*3 | 3 | 2,400 | 17.0 | 45.5 | 24.0 |
| | CR-AGZ*3 | 3 | 2,700 | 17.0 | 45.5 | 23.0 |

BATTERY INSIDE*4

- 1 Positive pole
- 2 Vent diaphragm
- 3 Tube
- 4 Anode (Lithium)
- 5 Separator
- 6 Cathode (Manganese Dioxide)
- 7 Insulator
- 8 PTC (Positive Temperature Coefficient Device)
- 9 Collector
- 10 Cell can
- 11 Negative pole



Scan QR code to view 3D animated video.



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 Please contact Panasonic when anticipating usage in operation temperature 70°C or above.

*2 Capacity based on standard drain and cut off voltage down to 2.0V at 20°C.

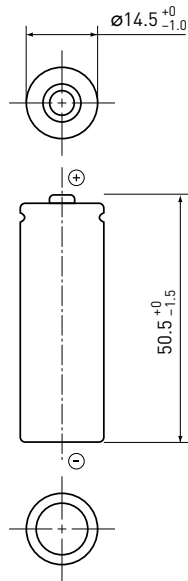
*3 Cells are supplied with tabs or lead-wires only. For available configurations please consult the Panasonic homepage or your sales contact.

*4 The illustration shows only one example of Lithium battery structure.

MANGANESE DIOXIDE LITHIUM BATTERIES (CR SERIES FOR INDUSTRIAL)

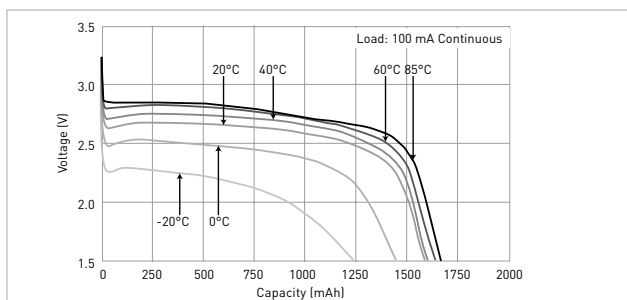
CR-AAK

DIMENSIONS (MM)

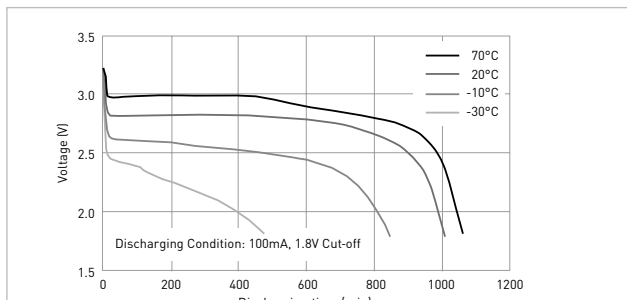


| Specifications | CR-AAK |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,650 |
| Diameter (mm) | 14.5 |
| Total height (mm) | 50.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 18.0 |

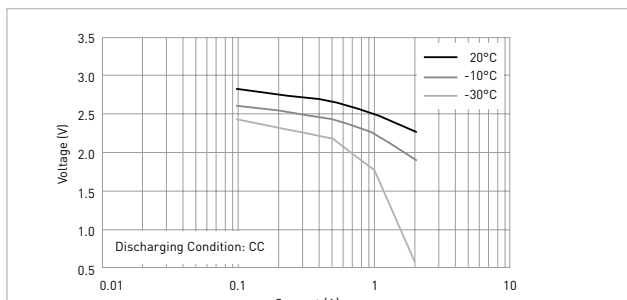
DISCHARGING CHARACTERISTICS



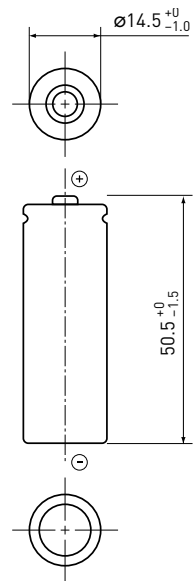
DISCHARGING CHARACTERISTICS BY TEMPERATURE



CONTINUOUS DISCHARGING CHARACTERISTICS

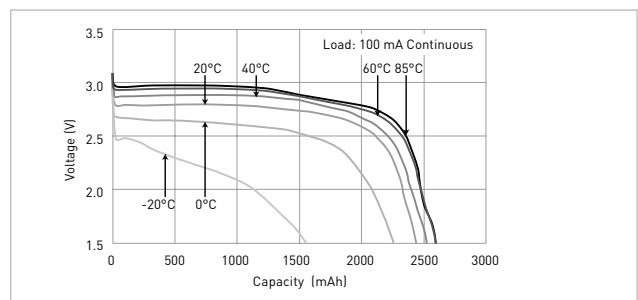


CR-AAU

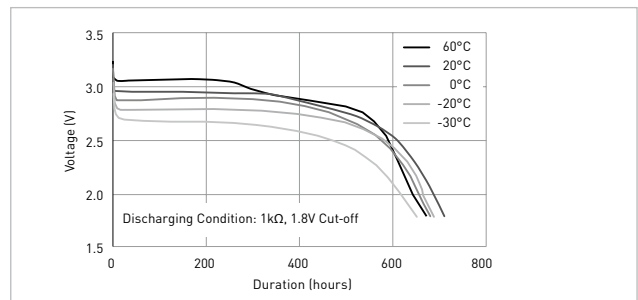


| Specifications | CR-AAU |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,800 |
| Diameter (mm) | 14.5 |
| Total height (mm) | 50.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 18.0 |

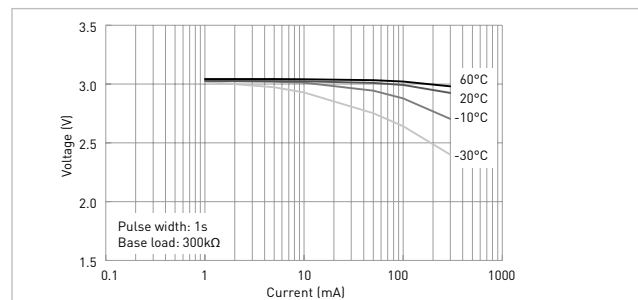
DISCHARGING CHARACTERISTICS



DISCHARGING CHARACTERISTICS BY TEMPERATURE

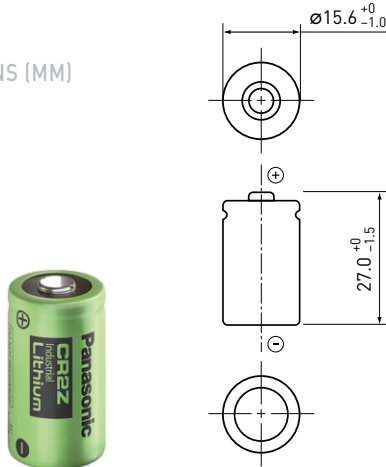


OPERATING VOLTAGE VS. DISCHARGE CURRENT



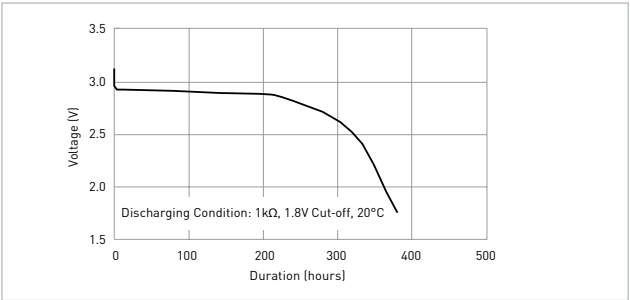
CR-2Z

DIMENSIONS (MM)

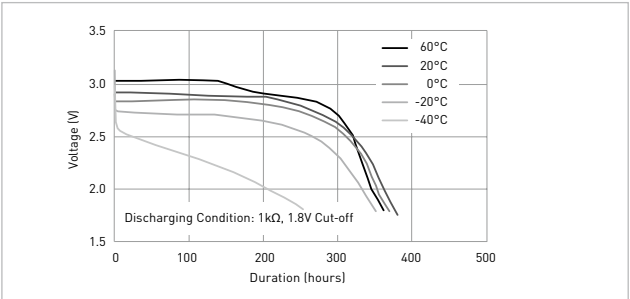


| Specifications | CR-2Z |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,000 |
| Diameter (mm) | 15.6 |
| Total height (mm) | 27.0 |
| Discharging temperature range (°C) | -40 to +75 |
| Weight (g) | 11.0 |

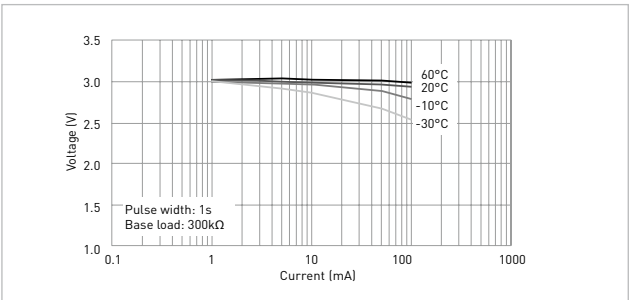
DISCHARGING CHARACTERISTICS



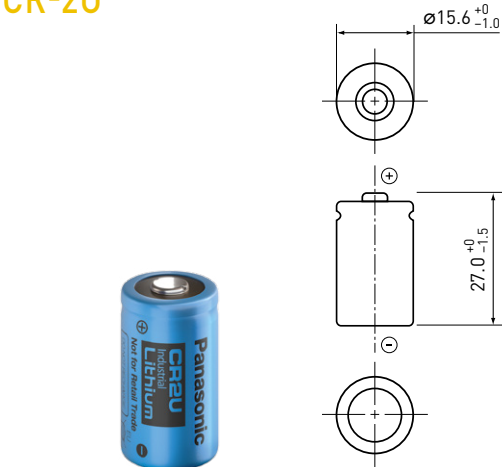
DISCHARGING CHARACTERISTICS BY TEMPERATURE



PULSE DISCHARGING CHARACTERISTICS*1

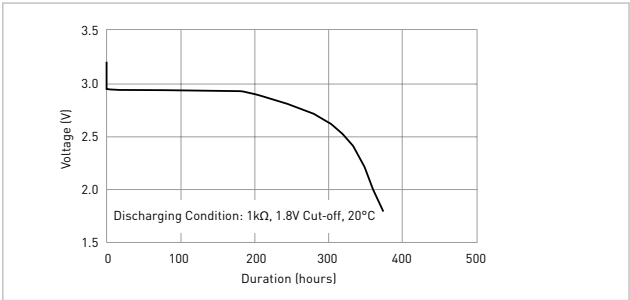


CR-2U

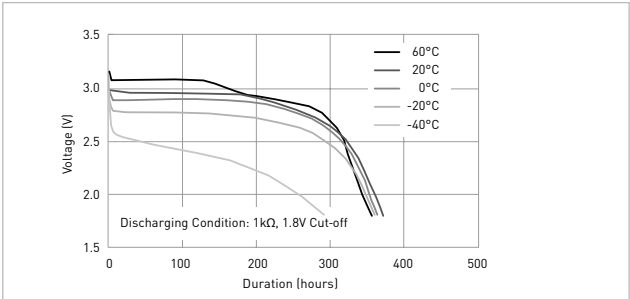


| Specifications | CR-2U |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,000 |
| Diameter (mm) | 15.6 |
| Total height (mm) | 27.0 |
| Discharging temperature range (°C) | -40 to +70 |
| Weight (g) | 11.0 |

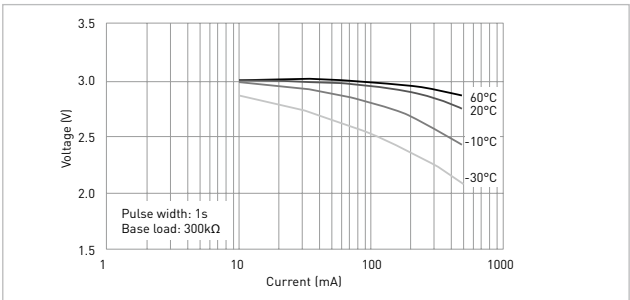
DISCHARGING CHARACTERISTICS



DISCHARGING CHARACTERISTICS BY TEMPERATURE

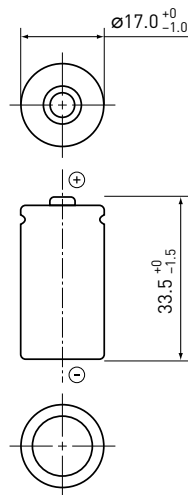


PULSE DISCHARGING CHARACTERISTICS*1



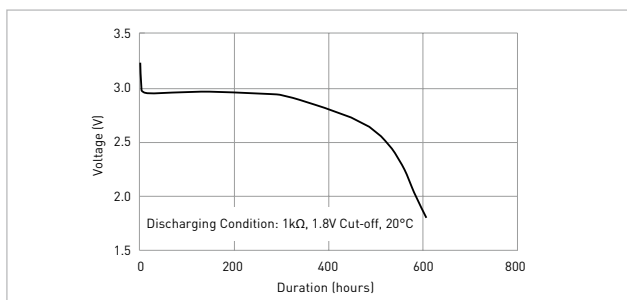
CR-2/3AU

DIMENSIONS (MM)

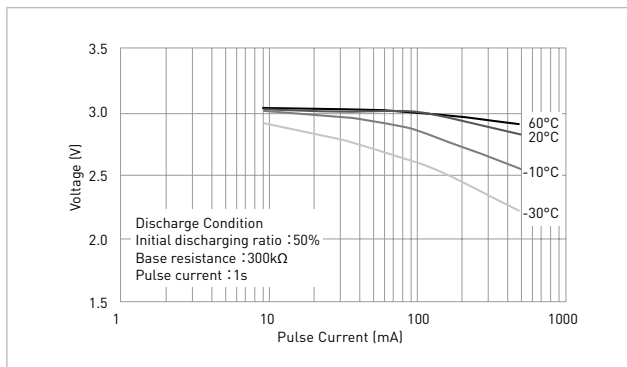


| Specifications | CR-2/3AU |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,600 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 33.5 |
| Discharging temperature range (°C) | -40 to +85 |
| Weight (g) | 16.0 |

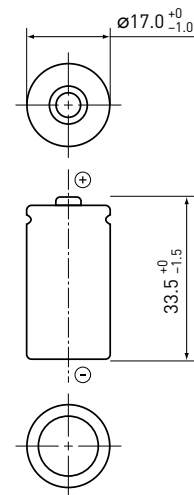
DISCHARGING CHARACTERISTICS



PULSE DISCHARGING CHARACTERISTICS

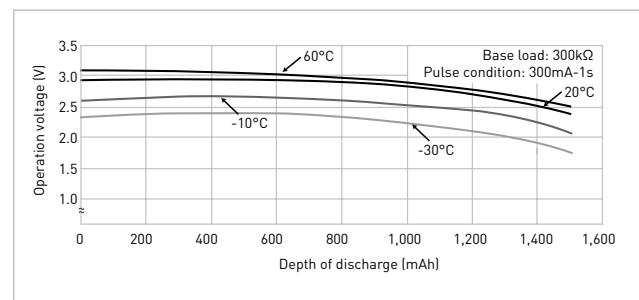


CR-2/3AZ

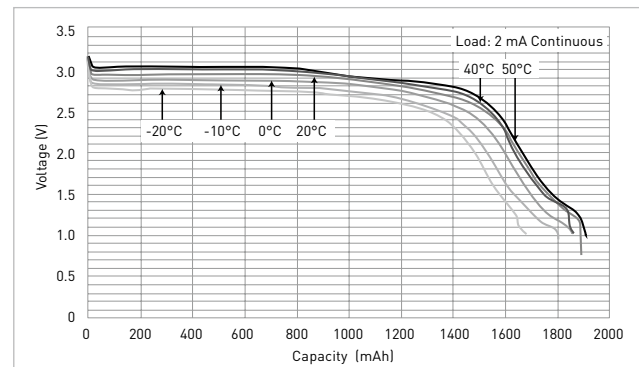


| Specifications | CR-2/3AZ |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,600 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 33.5 |
| Discharging temperature range (°C) | -40 to +70 |
| Weight (g) | 16.0 |

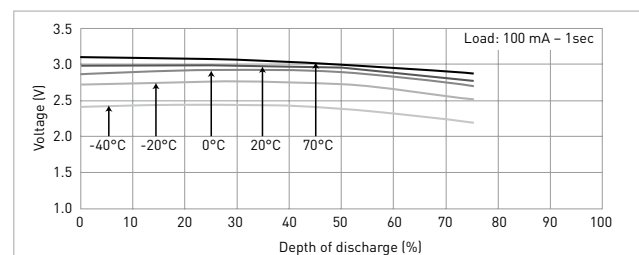
PULSE DISCHARGE PERFORMANCE



DISCHARGE TEMPERATURE CHARACTERISTICS



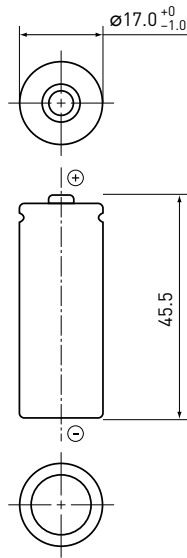
PULSE DISCHARGE CHARACTERISTICS



MANGANESE DIOXIDE LITHIUM BATTERIES (CR SERIES FOR INDUSTRIAL)

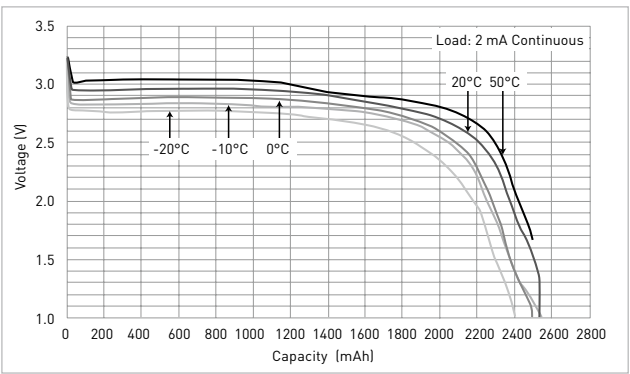
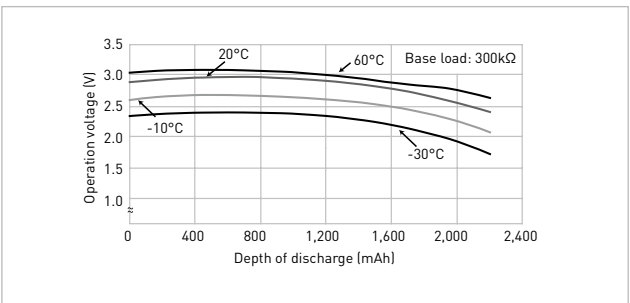
CR-AG

DIMENSIONS (MM)

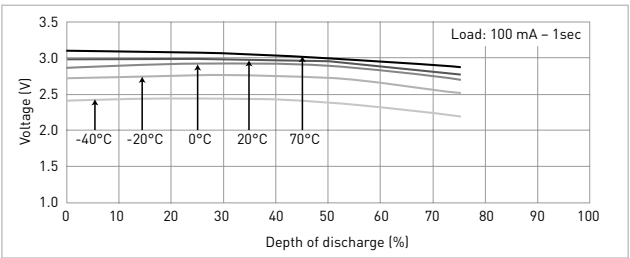


| Specifications | CR-AG |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 2,400 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 45.5 |
| Discharging temperature range (°C) | -40 to +70 |
| Weight (g) | 24.0 |

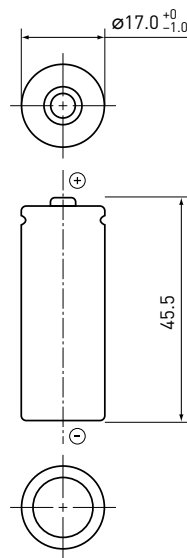
DISCHARGE TEMPERATURE CHARACTERISTICS



PULSE DISCHARGE CHARACTERISTICS

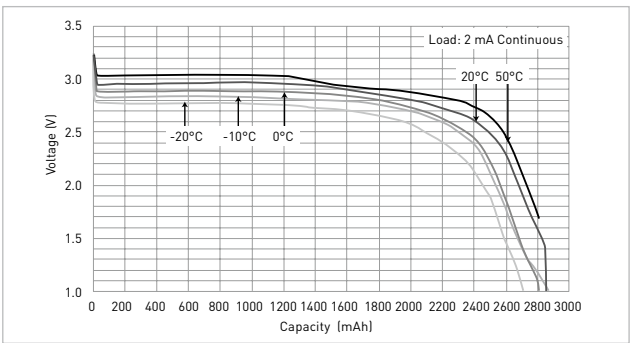


CR-AGZ

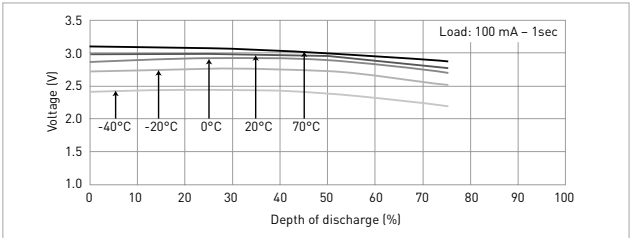


| Specifications | CR-AGZ |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 2,700 |
| Diameter (mm) | 17.0 |
| Total height (mm) | 45.5 |
| Discharging temperature range (°C) | -40 to +70 |
| Weight (g) | 23.0 |

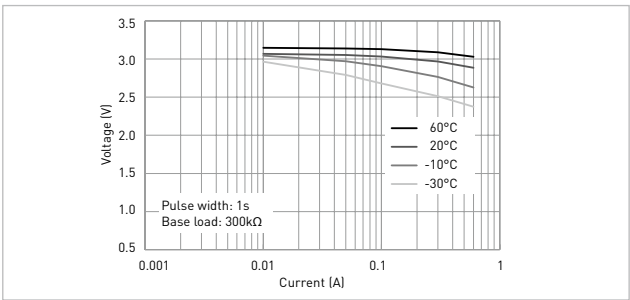
DISCHARGE TEMPERATURE CHARACTERISTICS



PULSE DISCHARGE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1





POLY-CARBONMONOFLUORIDE LITHIUM BATTERIES (BR SERIES) – COIN TYPE LITHIUM BATTERIES

Panasonic Lithium BR coin type batteries feature high energy density, and were developed and commercialized using Panasonic's extensive experience in battery technology. They exhibit stable performance under high ambient temperatures.

FEATURES

- Self-discharge rate at 20°C is just 1.0% per year
- Wide operating temperature range: between -30°C ~ +85°C
- Superior long-term reliability
- 42+ years of experience in production

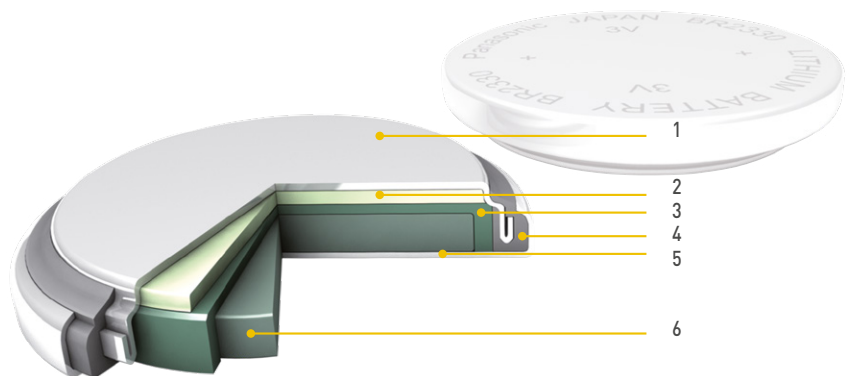
APPLICATIONS

- Tracking & RFID
- Memory back-up
- Real Time Clock (RTC)
- Meters, etc.

| Model number | Nominal voltage (V) | Nominal capacity (mAh)*1 | Diameter (mm) | Total height (mm) | Weight (g) | IEC |
|--------------|---------------------|--------------------------|---------------|-------------------|------------|--------|
| BR-1220 | 3 | 35 | 12.5 | 2.0 | 0.7 | - |
| BR-1225 | 3 | 48 | 12.5 | 2.5 | 0.8 | BR1225 |
| BR-1632 | 3 | 120 | 16.0 | 3.2 | 1.5 | - |
| BR-2032 | 3 | 200 | 20.0 | 3.2 | 2.6 | - |
| BR-2325 | 3 | 165 | 23.0 | 2.5 | 3.0 | BR2325 |
| BR-2330 | 3 | 255 | 23.0 | 3.0 | 3.2 | - |
| BR-3032 | 3 | 500 | 30.0 | 3.2 | 5.7 | BR3032 |

BATTERY INSIDE*2

- 1 Negative pole
- 2 Anode (Lithium)
- 3 Separator
- 4 Gasket
- 5 Positive pole (cell can)
- 6 Cathode (Poly-Carbonmonofluoride)



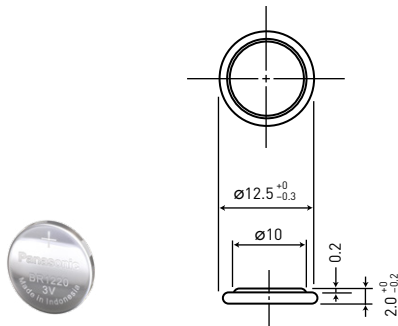
The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 Based on standard drain and cut off voltage down to 2.0V at 20°C.

*2 The illustration shows only one example of lithium battery structure.

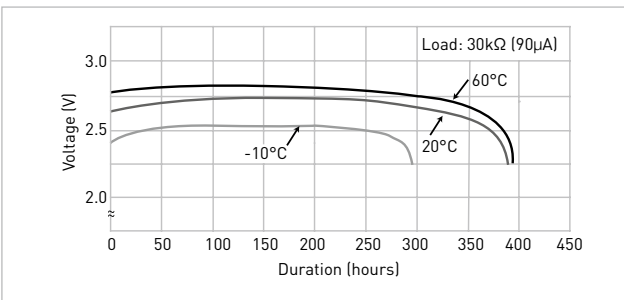
BR-1220

DIMENSIONS (MM)

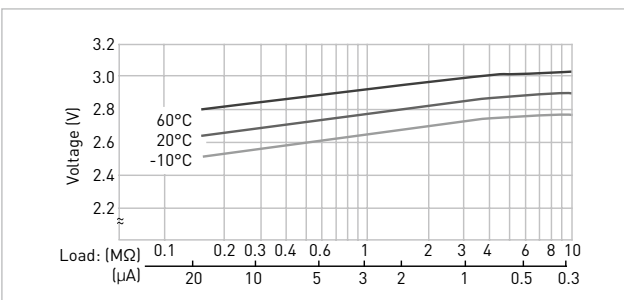


| Specifications | BR-1220 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 35 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 0.7 |

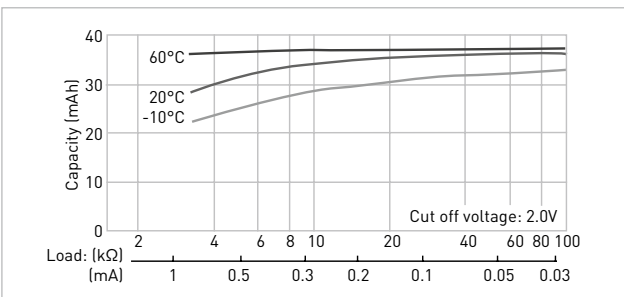
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

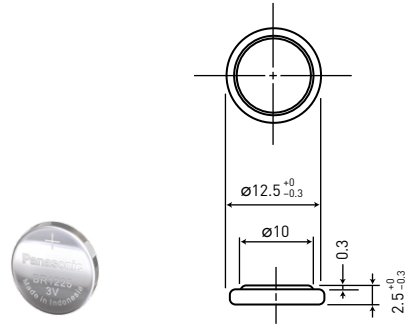


CAPACITY VS. LOAD RESISTANCE



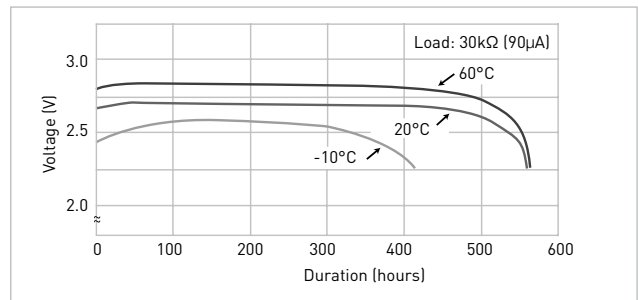
BR-1225

DIMENSIONS (MM)

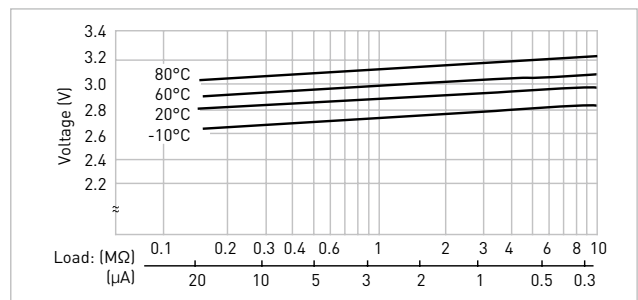


| Specifications | BR-1225 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 48 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 2.5 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 0.8 |

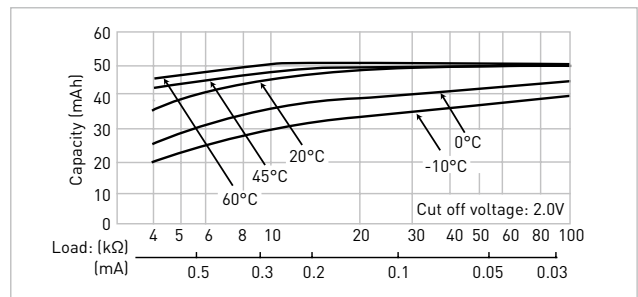
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

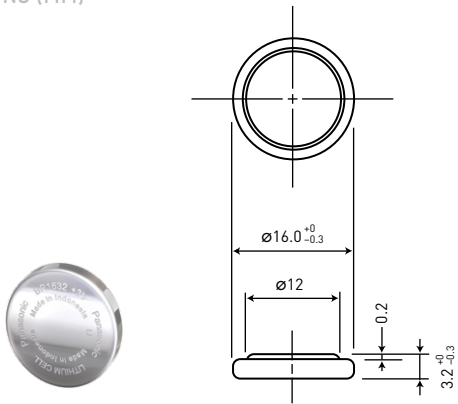


CAPACITY VS. LOAD RESISTANCE



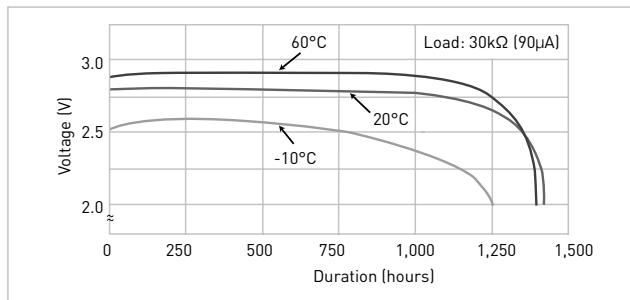
BR-1632

DIMENSIONS (MM)

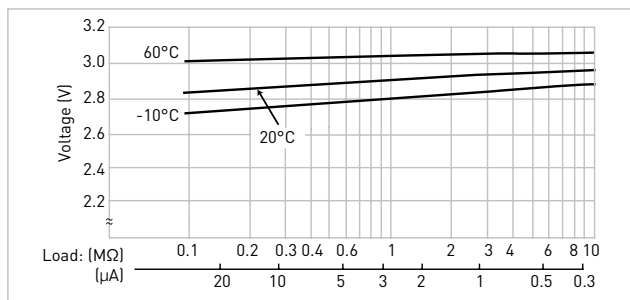


| Specifications | BR-1632 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 120 |
| Diameter (mm) | 16.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 1.5 |

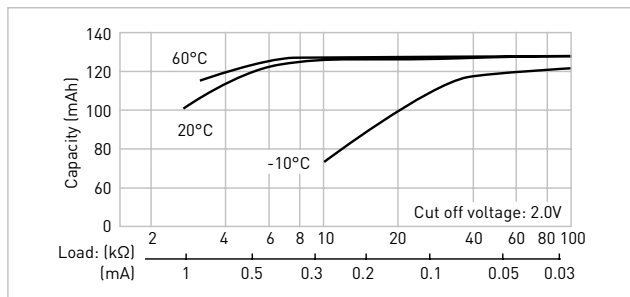
DISCHARGE TEMPERATURE CHARACTERISTICS



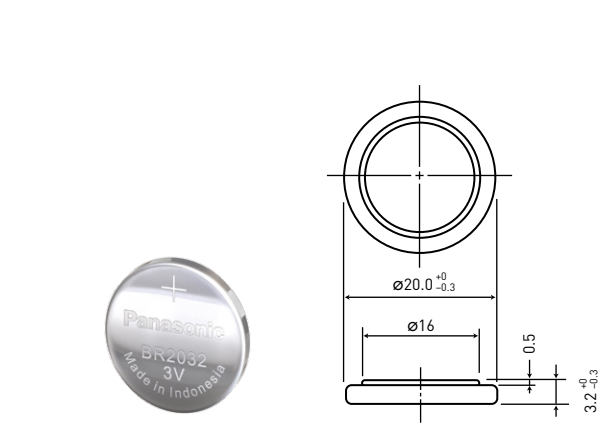
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

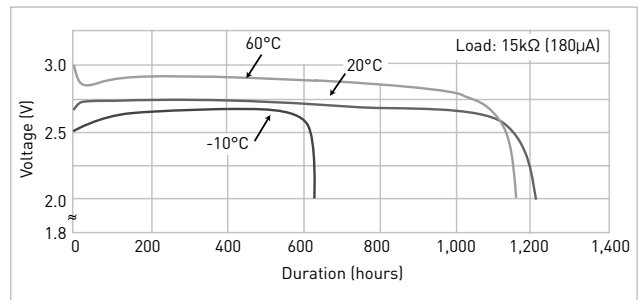


BR-2032

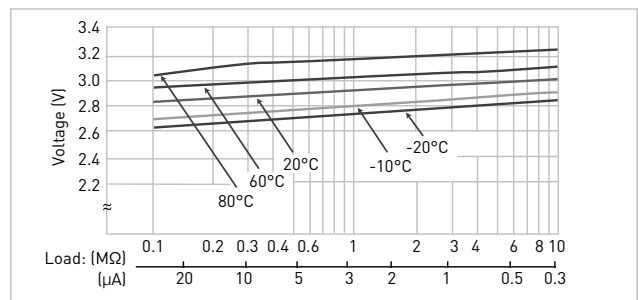


| Specifications | BR-2032 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 200 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 2.6 |

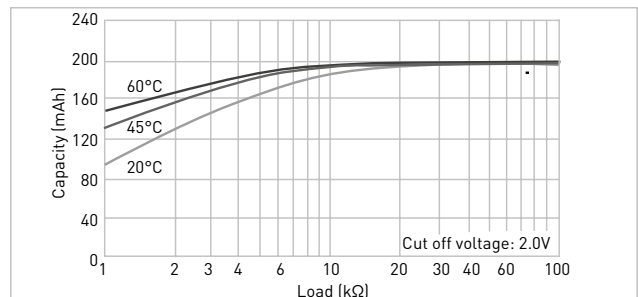
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

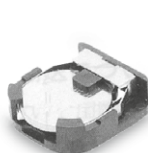
*1 at 50% depth-of-discharge [DoD]

Lithium battery holders for BR-2032

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 back-up power supply in C-MOS RAM memory and microcomputer memory. All of the battery holders are designed to prevent inverted insertion of the battery.



BCR20H4

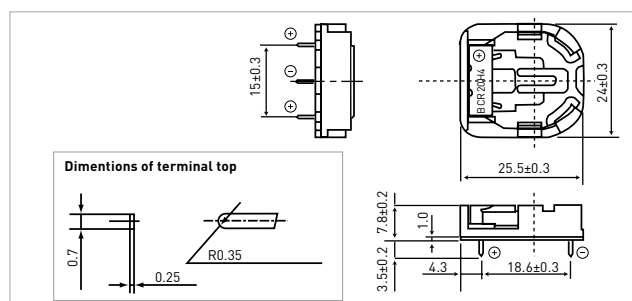


BCR20H5

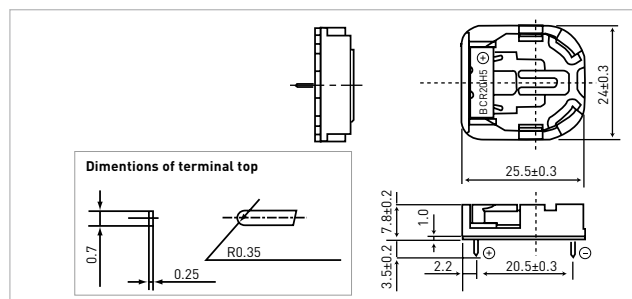


BCR20V4

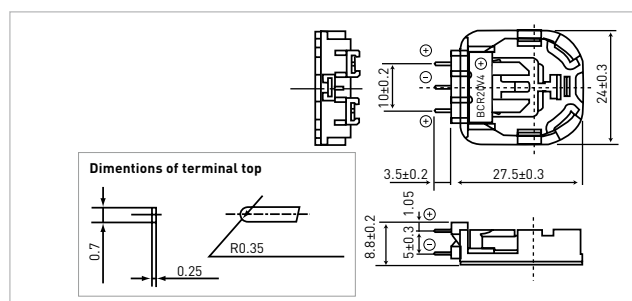
BCR20H4 (3 terminals)



BCR20H5 (2 terminals)



BCR20V4 (3 terminals)

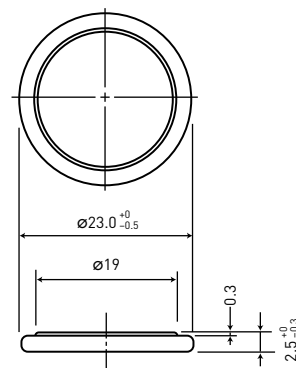


Precaution for washing battery holders

The battery holders can be adversely affected by some detergents use 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.

BR-2325

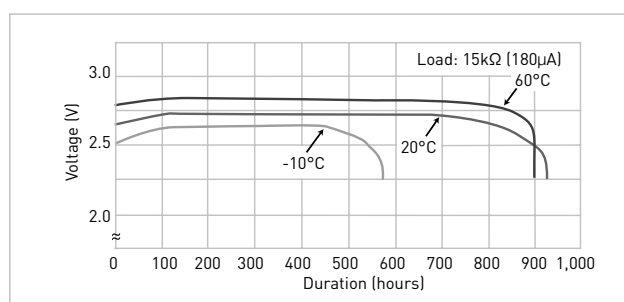
DIMENSIONS (MM)



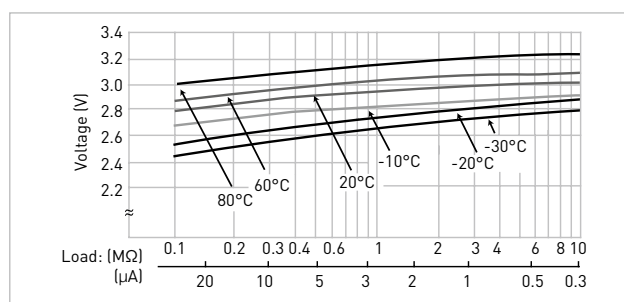
Specifications

| Specifications | BR-2325 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 165 |
| Diameter (mm) | 23.0 |
| Total height (mm) | 2.5 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 3.0 |

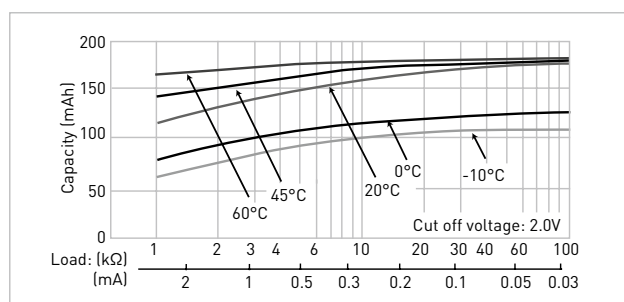
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

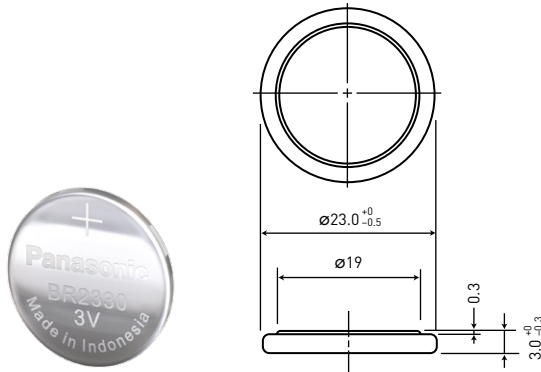


CAPACITY VS. LOAD RESISTANCE



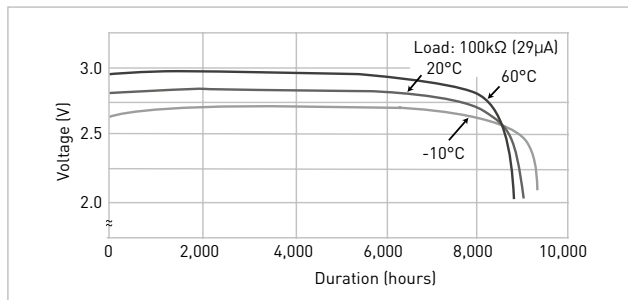
BR-2330

DIMENSIONS (MM)

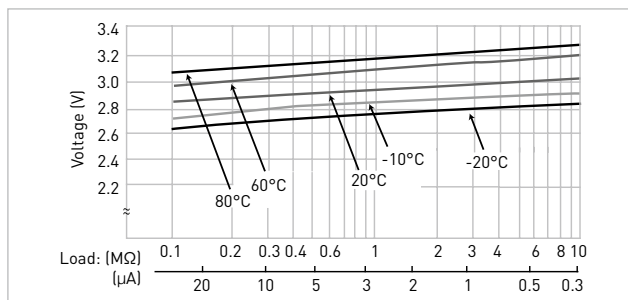


| Specifications | BR-2330 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 255 |
| Diameter (mm) | 23.0 |
| Total height (mm) | 3.0 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 3.2 |

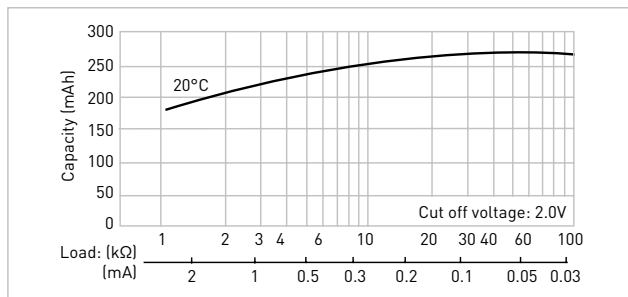
DISCHARGE TEMPERATURE CHARACTERISTICS



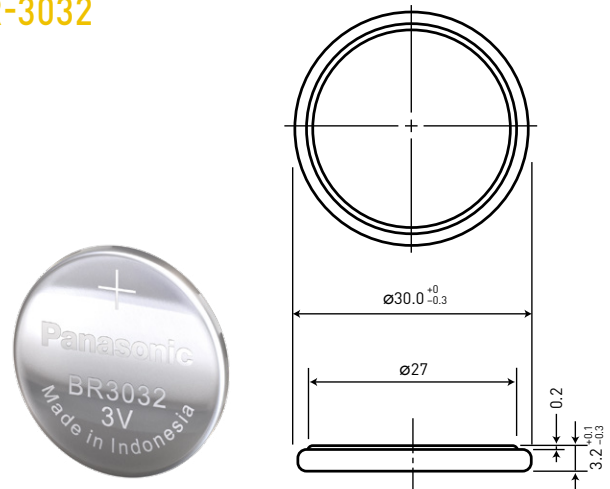
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

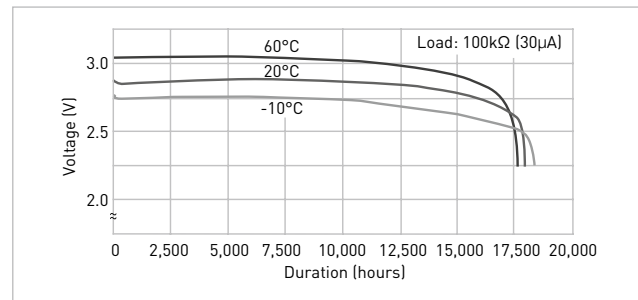


BR-3032

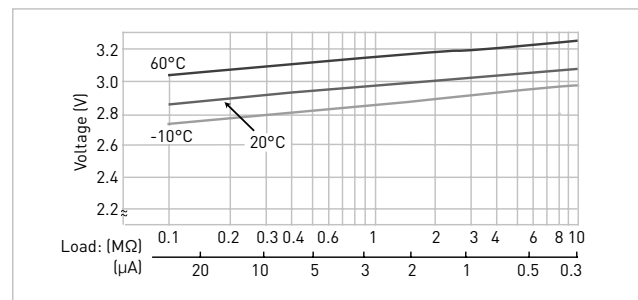


| Specifications | BR-3032 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 500 |
| Diameter (mm) | 30.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 5.7 |

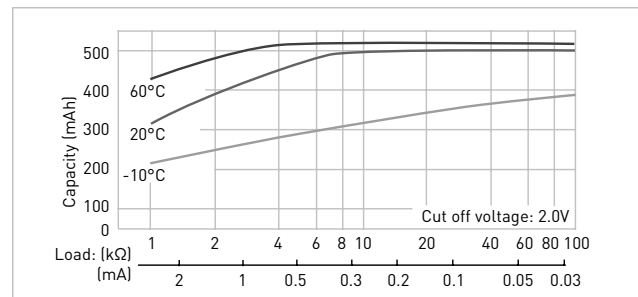
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 at 50% depth-of-discharge (DoD)



HIGH OPERATING TEMPERATURE POLY-CARBONMONOFLUORIDE LITHIUM BATTERIES (BR-A SERIES) – COIN TYPE LITHIUM BATTERIES

The high energy density and the special material for gasket and separator make this battery series the ideal power supply in high ambient temperature applications.

FEATURES

- Superior design for high temperature applications -40°C ~ +125°C
- Outstanding long-term reliability
- 22+ years of experience in production
- Self-discharge rate at 20°C is just 0.5% per year

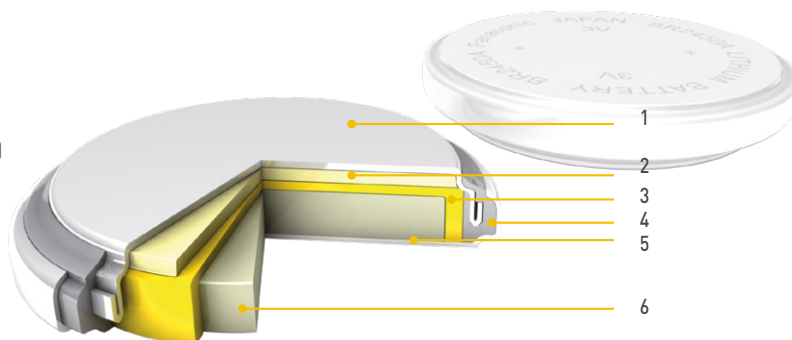
APPLICATIONS

- Tire Pressure Monitoring Systems (TPMS)
- Electric Toll Collection (ETC)
- Heat cost allocators, etc.

| Model number | Nominal voltage (V) | Nominal capacity (mAh)* ¹ | Diameter (mm) | Total height (mm) | Weight (g) |
|------------------------|---------------------|--------------------------------------|---------------|-------------------|------------|
| BR-1225A | 3 | 48 | 12.5 | 2.5 | 0.8 |
| BR-1632A* ² | 3 | 120 | 16.0 | 3.2 | 1.5 |
| BR-2330A* ² | 3 | 255 | 23.0 | 3.0 | 3.2 |
| BR-2450A* ² | 3 | 550 | 24.5 | 5.0 | 4.9 |
| BR-2477A* ² | 3 | 1,000 | 24.5 | 7.7 | 7.9 |

BATTERY INSIDE*³

- 1 Negative pole
- 2 Anode (Lithium)
- 3 Separator
- 4 Gasket
- 5 Positive pole (cell can)
- 6 Cathode (Poly-Carbonmonofluoride)



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

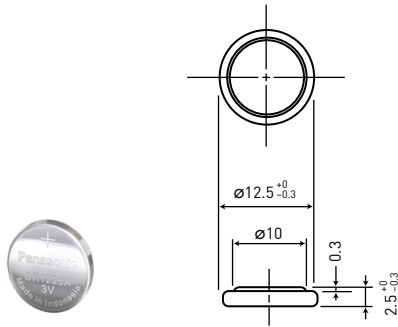
*¹ Based on standard drain and cut off voltage down to 2.0V at 20°C.

*² Cells are supplied with tabs or lead-wires only. For available configurations please consult the Panasonic homepage or your sales contact.

*³ The illustration shows only one example of lithium battery structure.

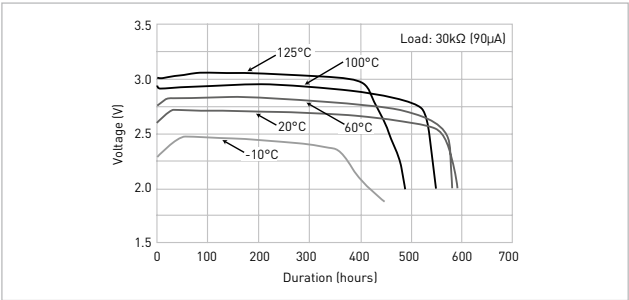
BR-1225A

DIMENSIONS (MM)

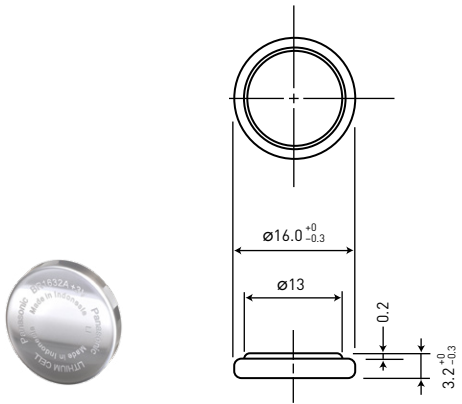


| Specifications | BR-1225A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 48 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 2.5 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 0.8 |

DISCHARGE TEMPERATURE CHARACTERISTICS

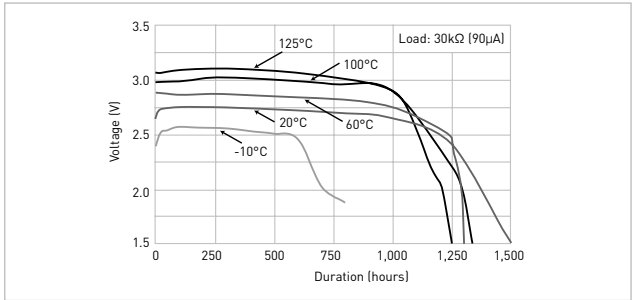


BR-1632A



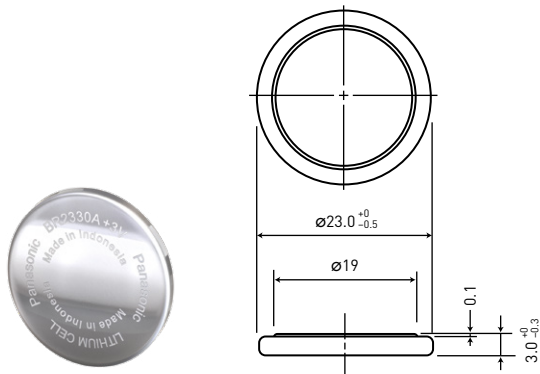
| Specifications | BR-1632A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 120 |
| Diameter (mm) | 16.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 1.5 |

DISCHARGE TEMPERATURE CHARACTERISTICS



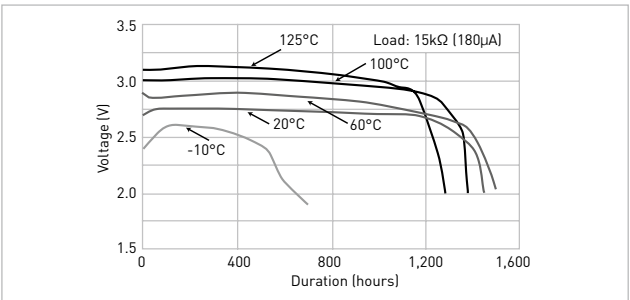
BR-2330A

DIMENSIONS (MM)

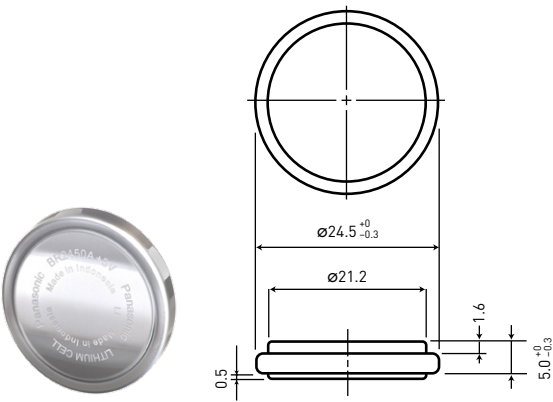


| Specifications | BR-2330A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 255 |
| Diameter (mm) | 23.0 |
| Total height (mm) | 3.0 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 3.2 |

DISCHARGE TEMPERATURE CHARACTERISTICS

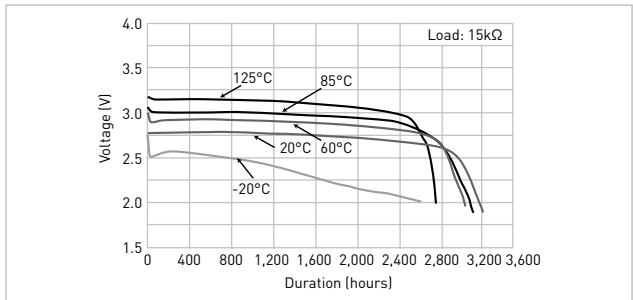


BR-2450A



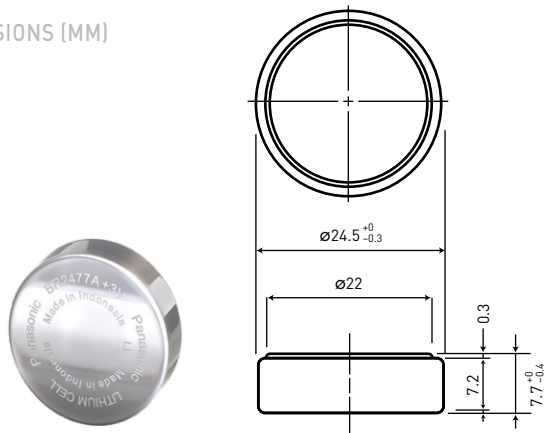
| Specifications | BR-2450A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 550 |
| Diameter (mm) | 24.5 |
| Total height (mm) | 5.0 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 4.9 |

DISCHARGE TEMPERATURE CHARACTERISTICS



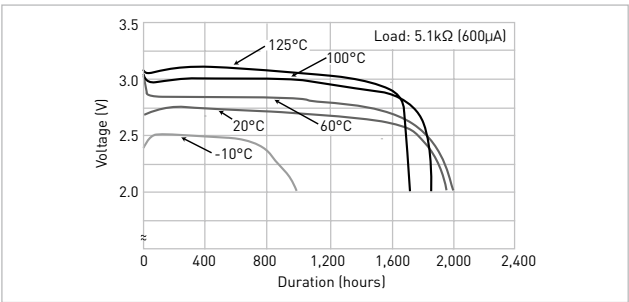
BR-2477A

DIMENSIONS (MM)



| Specifications | BR-2477A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,000 |
| Diameter (mm) | 24.5 |
| Total height (mm) | 7.7 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 7.9 |

DISCHARGE TEMPERATURE CHARACTERISTICS





MANGANESE DIOXIDE LITHIUM BATTERIES (CR SERIES) – COIN TYPE LITHIUM BATTERIES

These batteries have a proven track record of excellence in equipment requiring high currents. Additionally Panasonic has many years of manufacturing experience with this battery technology.

FEATURES

- Good pulse capability
- Stable voltage level during discharge
- Long-term reliability
- Self-discharge rate at 20°C is just 1.0% per year
- Temperature range -30°C ~ +85°C²

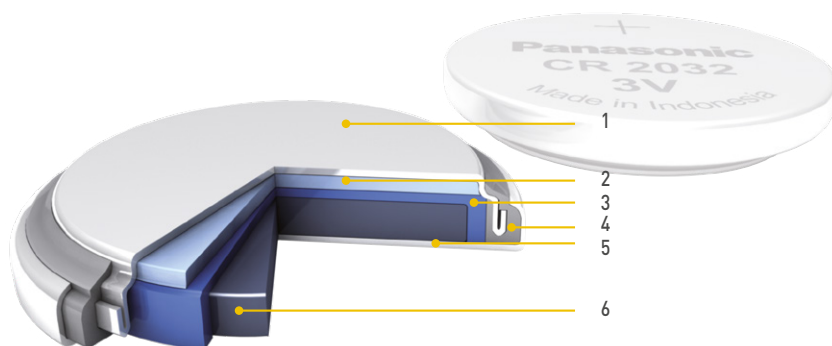
APPLICATIONS

- Remote Keyless Entry (RKE)
- Electricity meters
- Medical equipment
- Tracking & RFID
- Vending machines
- Price tags, etc.

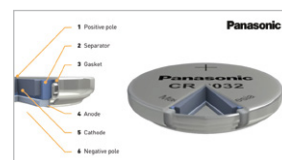
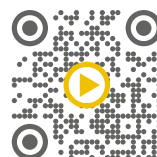
| Model number | Nominal voltage (V) | Nominal capacity (mAh)* ¹ | Diameter (mm) | Total height (mm) | Weight (g) | IEC |
|--------------|---------------------|--------------------------------------|---------------|-------------------|------------|--------|
| CR-1025 | 3 | 30 | 10.0 | 2.5 | 0.6 | CR1025 |
| CR-1216 | 3 | 25 | 12.5 | 1.6 | 0.7 | CR1216 |
| CR-1220 | 3 | 35 | 12.5 | 2.0 | 0.9 | CR1220 |
| CR-1616 | 3 | 55 | 16.0 | 1.6 | 1.0 | CR1616 |
| CR-1620 | 3 | 75 | 16.0 | 2.0 | 1.3 | CR1620 |
| CR-1632 | 3 | 140 | 16.0 | 3.2 | 1.9 | - |
| CR-2012 | 3 | 55 | 20.0 | 1.2 | 1.4 | CR2012 |
| CR-2016 | 3 | 90 | 20.0 | 1.6 | 1.6 | CR2016 |
| CR-2025 | 3 | 165 | 20.0 | 2.5 | 2.3 | CR2025 |
| CR-2032 | 3 | 225 | 20.0 | 3.2 | 2.8 | CR2032 |
| CR-2330 | 3 | 265 | 23.0 | 3.0 | 3.7 | CR2330 |
| CR-2354 | 3 | 560 | 23.0 | 5.4 | 5.7 | CR2354 |
| CR-2412 | 3 | 100 | 24.5 | 1.2 | 2.0 | - |
| CR-2450 | 3 | 620 | 24.5 | 5.0 | 6.2 | CR2450 |
| CR-2477 | 3 | 1,000 | 24.5 | 7.7 | 10.5 | - |
| CR-3032 | 3 | 500 | 30.0 | 3.2 | 6.9 | CR3032 |

BATTERY INSIDE*³

- 1 Negative pole
- 2 Anode (Lithium)
- 3 Separator
- 4 Gasket
- 5 Positive pole (cell can)
- 6 Cathode (Manganese Dioxide)



Scan QR code to view 3D animated video.



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

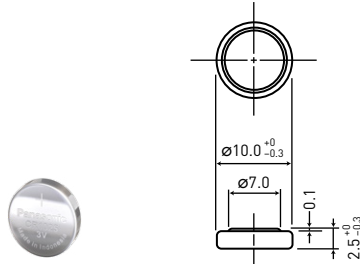
*¹ Based on standard drain and cut off voltage down to 2.0V at 20°C.

*² Please contact Panasonic when anticipating usage in operation temperature 70°C or above.

*³ The illustration shows only one example of lithium battery structure.

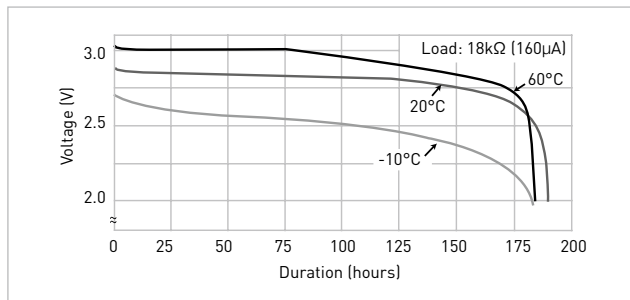
CR-1025

DIMENSIONS (MM)

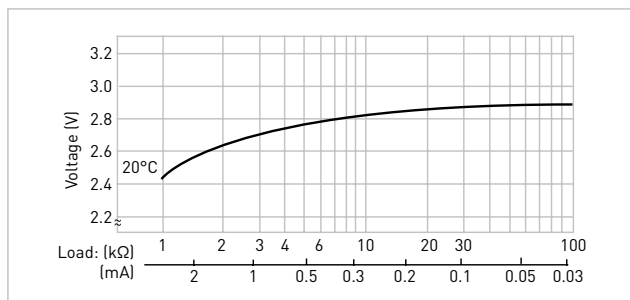


| Specifications | CR-1025 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 30 |
| Diameter (mm) | 10.0 |
| Total height (mm) | 2.5 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 0.6 |

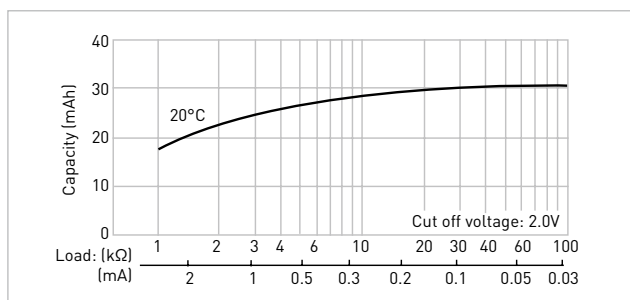
DISCHARGE TEMPERATURE CHARACTERISTICS



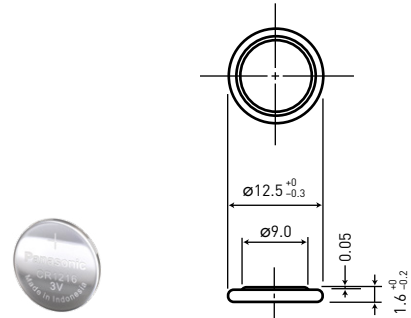
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

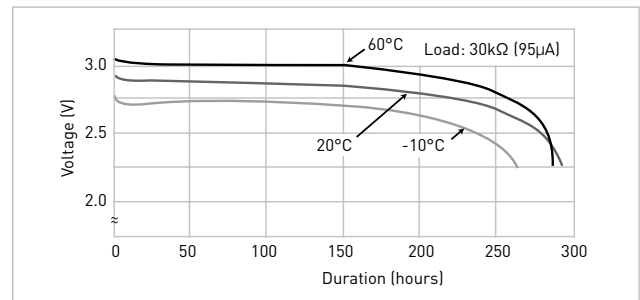


CR-1216

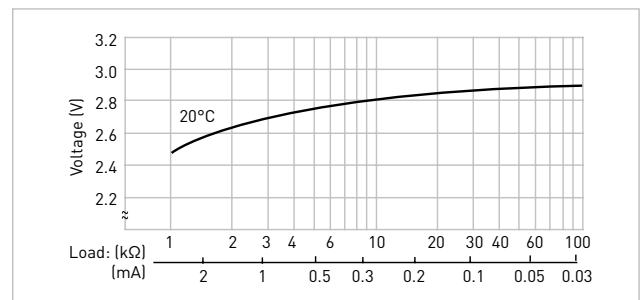


| Specifications | CR-1216 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 25 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 1.6 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 0.7 |

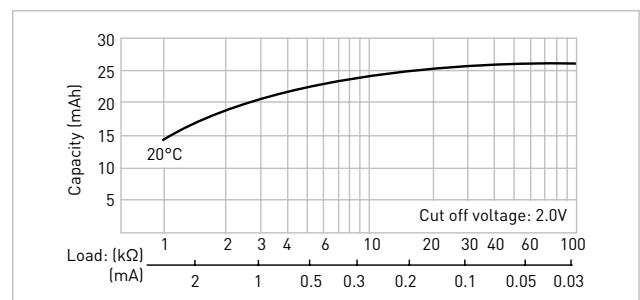
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

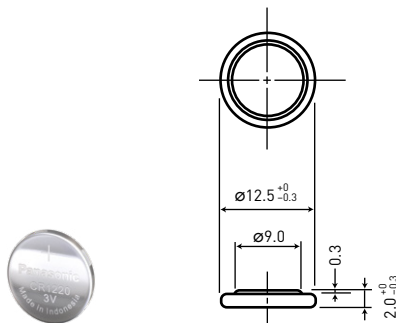


The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 at 50% depth-of-discharge [DoD]

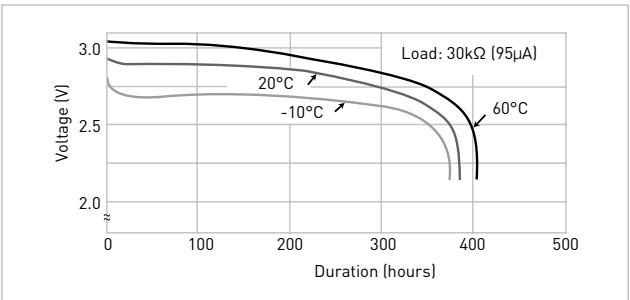
CR-1220

DIMENSIONS (MM)

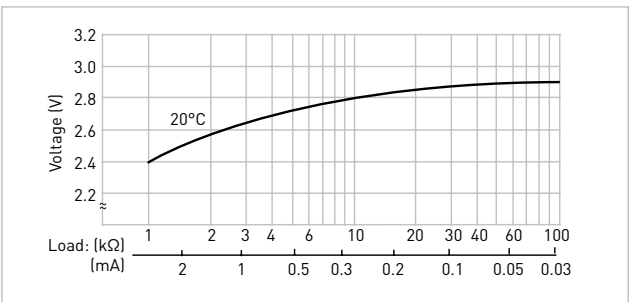


| Specifications | CR-1220 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 35 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 0.9 |

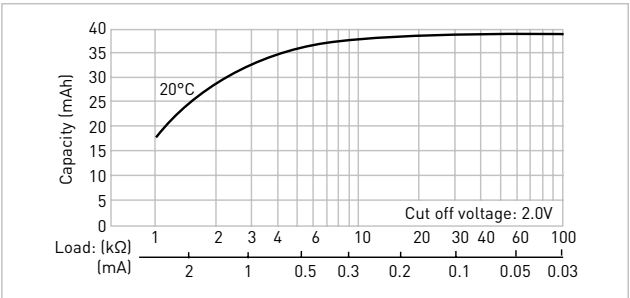
DISCHARGE TEMPERATURE CHARACTERISTICS



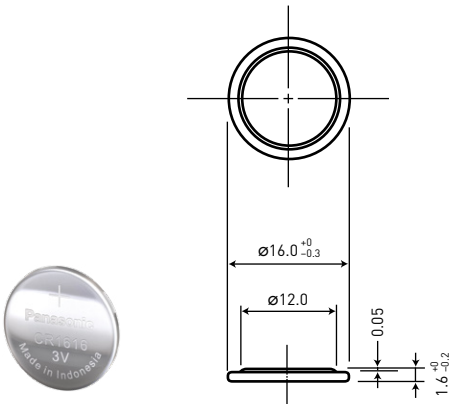
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

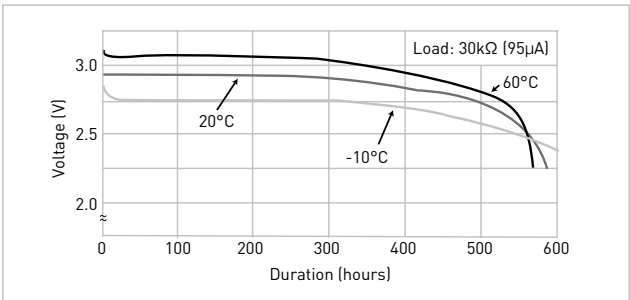


CR-1616

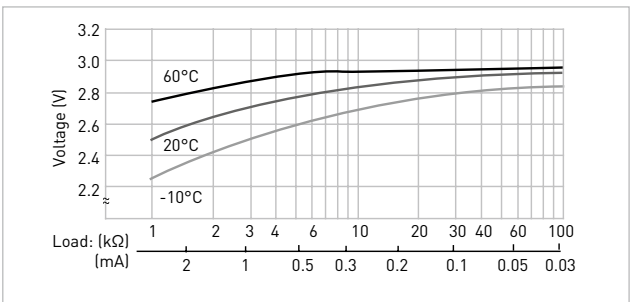


| Specifications | CR-1616 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 55 |
| Diameter (mm) | 16.0 |
| Total height (mm) | 1.6 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 1.0 |

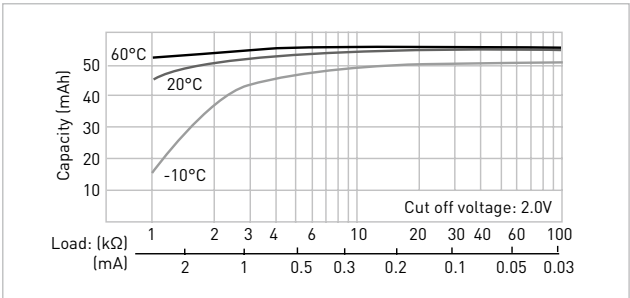
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

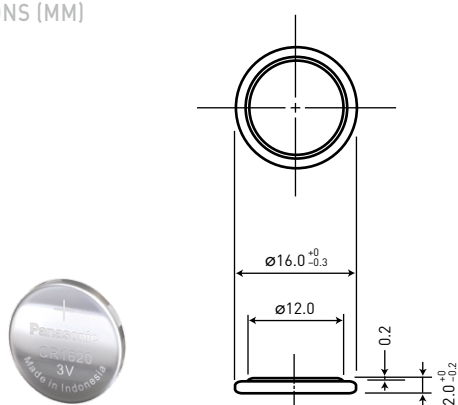


CAPACITY VS. LOAD RESISTANCE



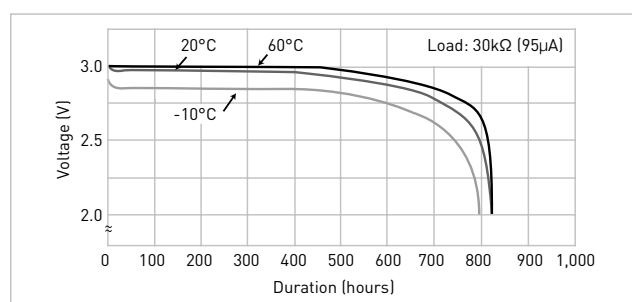
CR-1620

DIMENSIONS (MM)

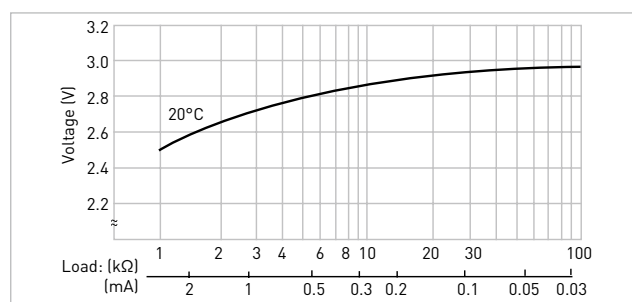


| Specifications | CR-1620 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 75 |
| Diameter (mm) | 16.0 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 1.3 |

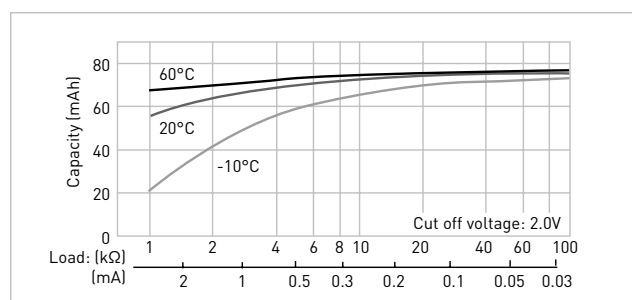
DISCHARGE TEMPERATURE CHARACTERISTICS



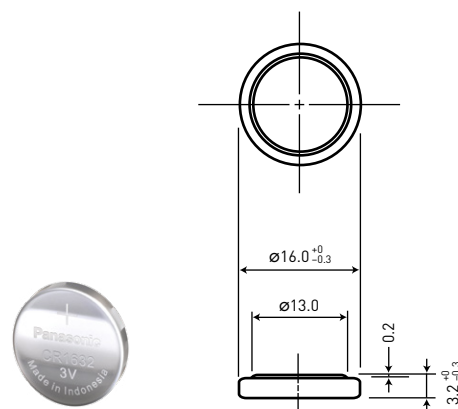
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

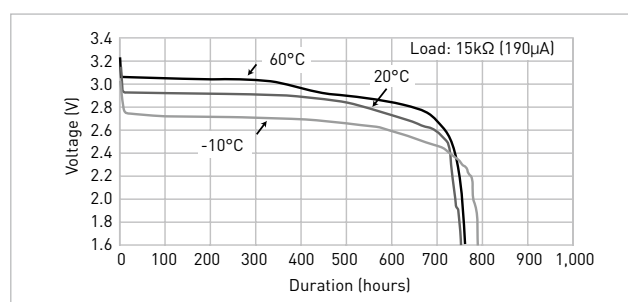


CR-1632

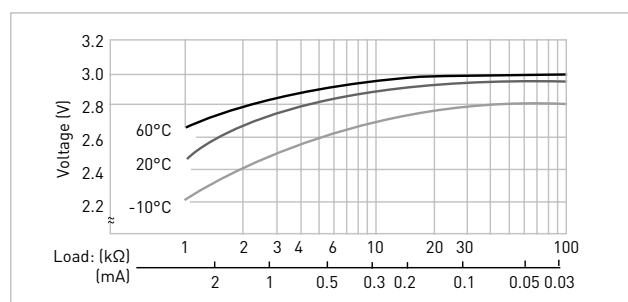


| Specifications | CR-1632 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 140 |
| Diameter (mm) | 16.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 1.9 |

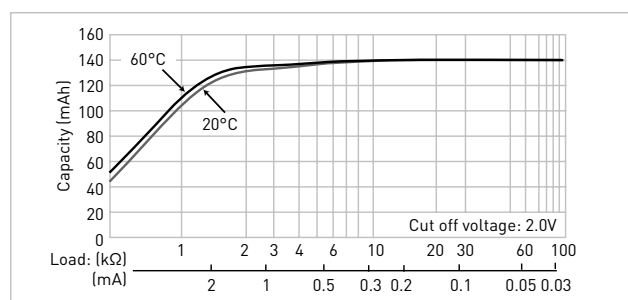
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

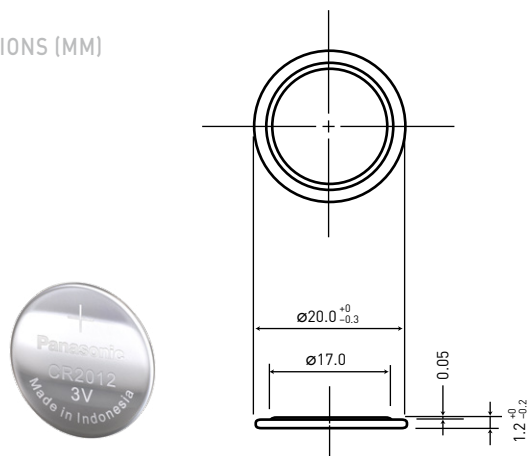


CAPACITY VS. LOAD RESISTANCE



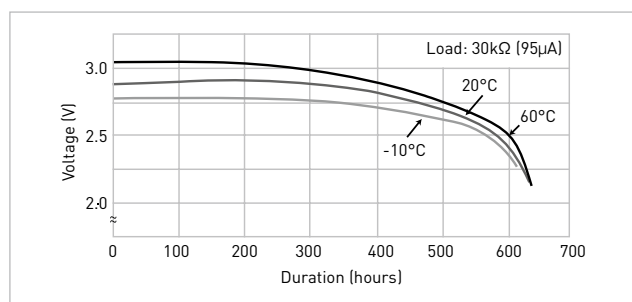
CR-2012

DIMENSIONS (MM)

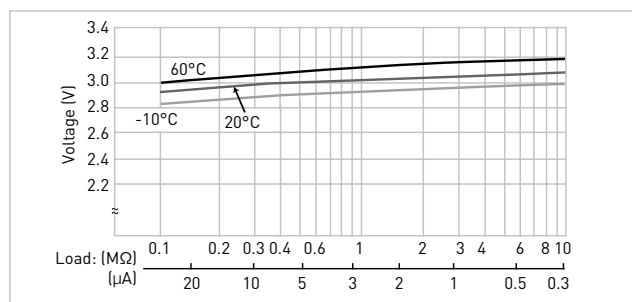


| Specifications | CR-2012 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 55 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 1.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 1.4 |

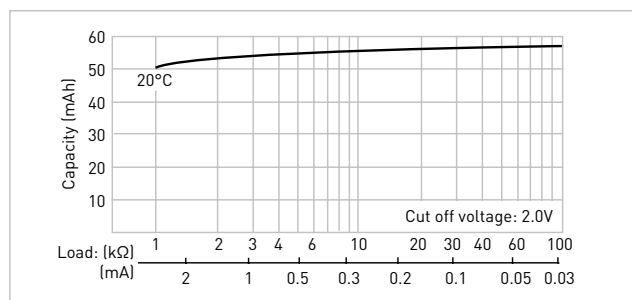
DISCHARGE TEMPERATURE CHARACTERISTICS



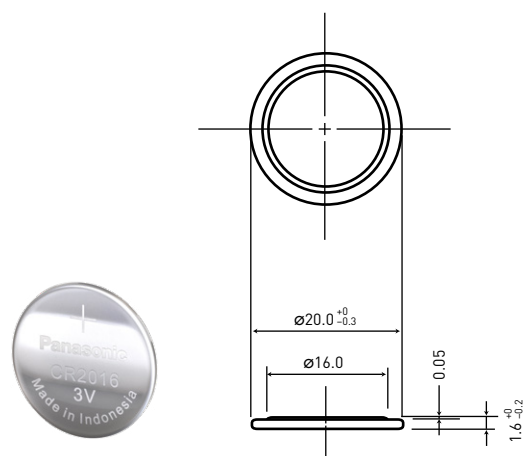
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

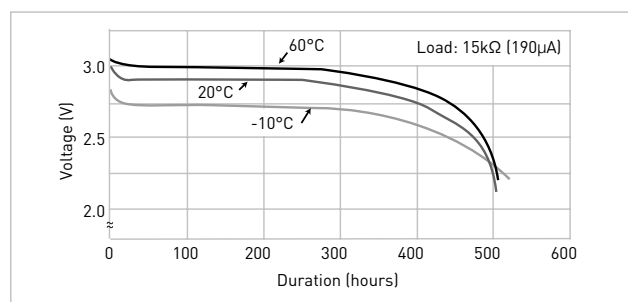


CR-2016

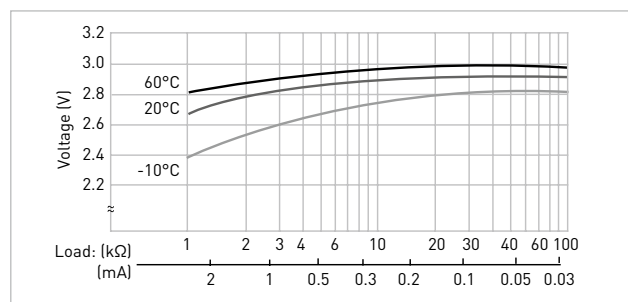


| Specifications | CR-2016 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 90 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 1.6 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 1.6 |

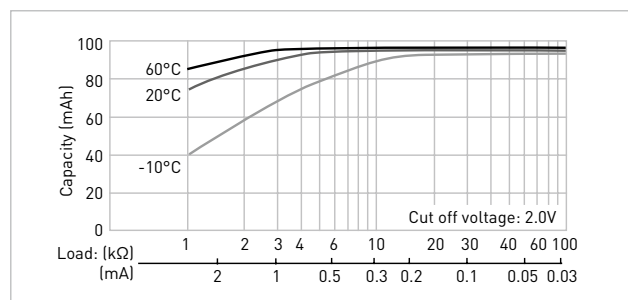
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

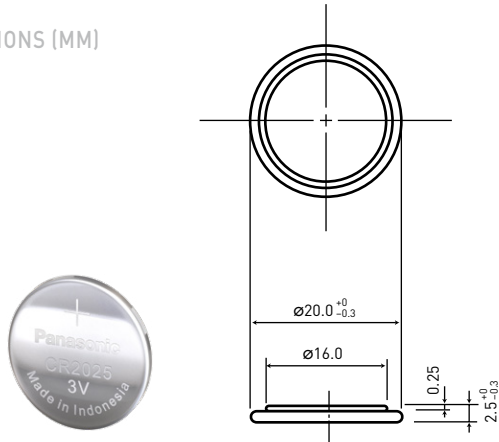


CAPACITY VS. LOAD RESISTANCE



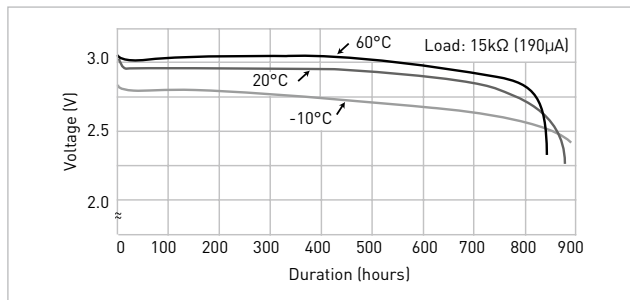
CR-2025

DIMENSIONS (MM)

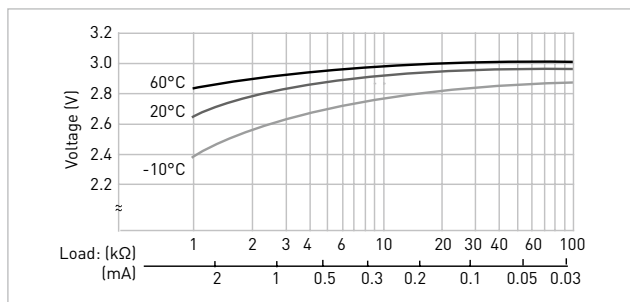


| Specifications | CR-2025 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 165 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 2.5 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 2.3 |

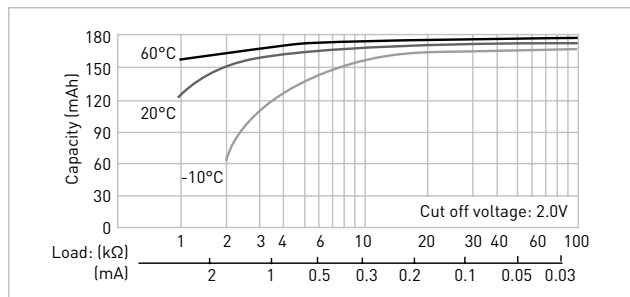
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

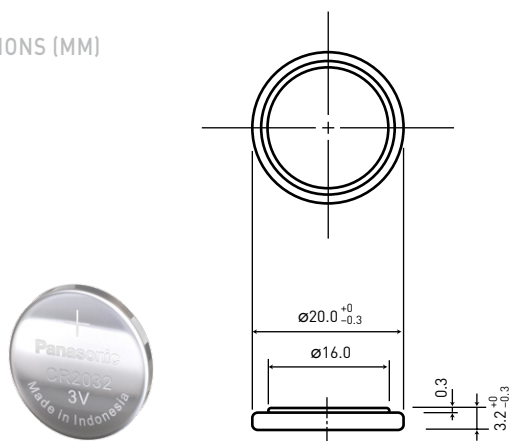


The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 at 50% depth-of-discharge (DoD)

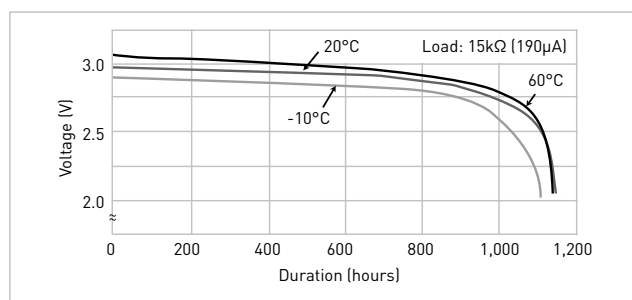
CR-2032

DIMENSIONS (MM)

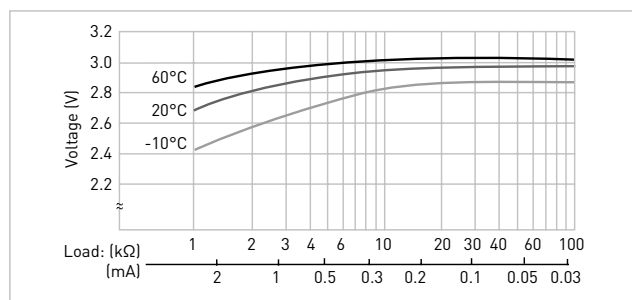


| Specifications | CR-2032 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 225 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 2.8 |

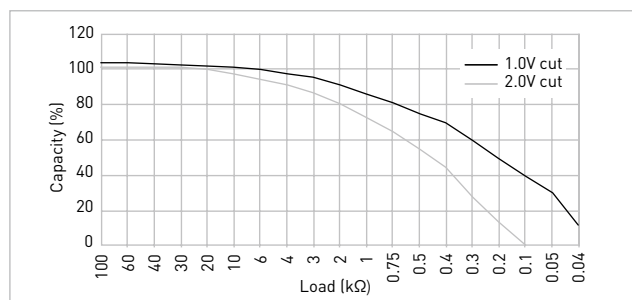
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

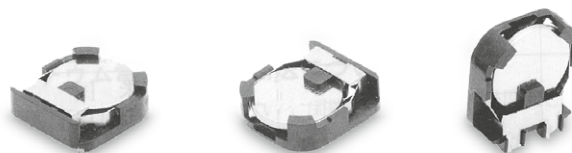


CAPACITY VS. LOAD RESISTANCE AT RT



Lithium battery holders for CR-2032

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 back-up power supply in C-MOS RAM memory and microcomputer memory. All of the battery holders are designed to prevent inverted insertion of the battery.

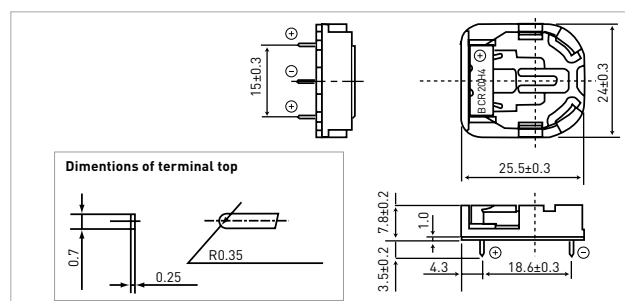


BCR20H4

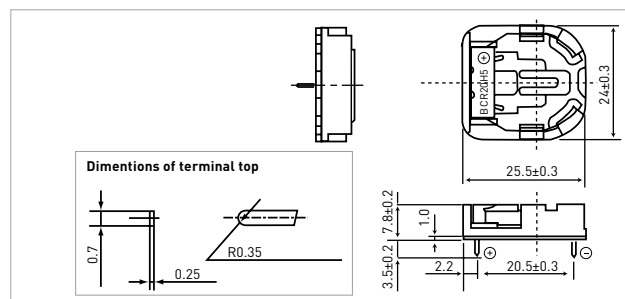
BCR20H5

BCR20V4

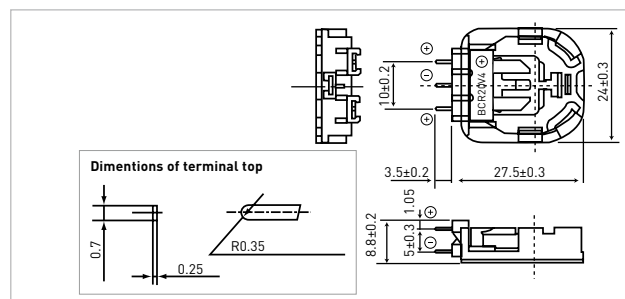
BCR20H4 (3 terminals)



BCR20H5 (2 terminals)



BCR20V4 (3 terminals)

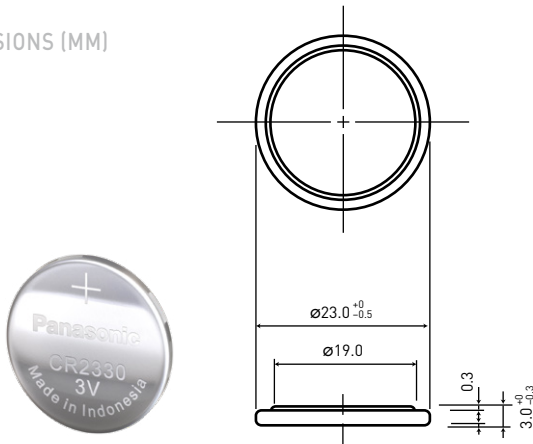


Precaution for washing battery holders

The battery holders can be adversely affected by some detergents use 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.

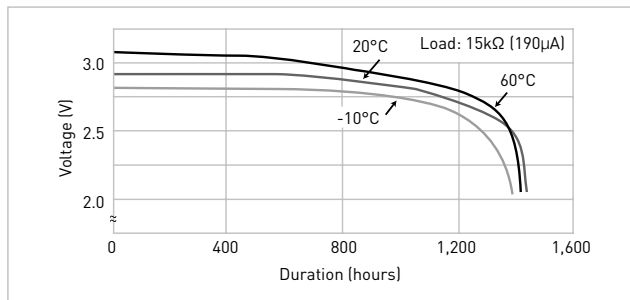
CR-2330

DIMENSIONS (MM)

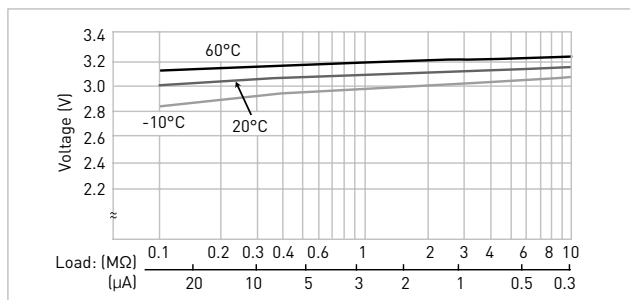


| Specifications | CR-2330 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 265 |
| Diameter (mm) | 23.0 |
| Total height (mm) | 3.0 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 3.7 |

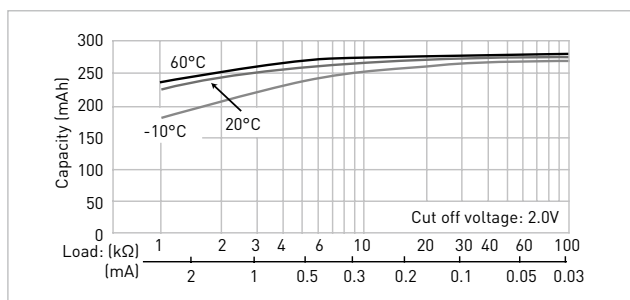
DISCHARGE TEMPERATURE CHARACTERISTICS



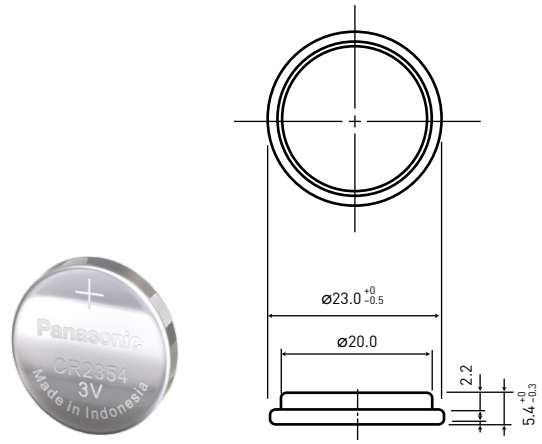
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

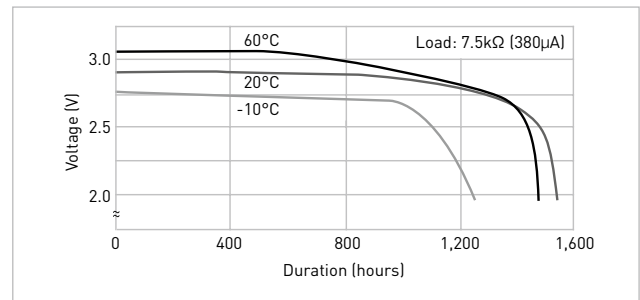


CR-2354

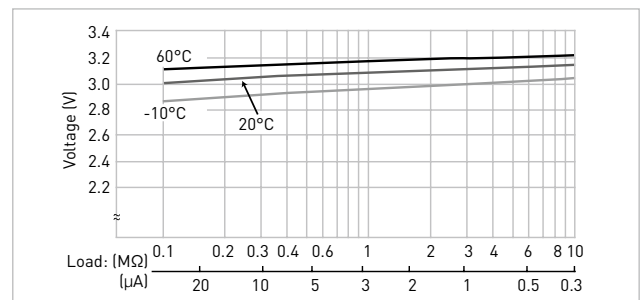


| Specifications | CR-2354 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 560 |
| Diameter (mm) | 23.0 |
| Total height (mm) | 5.4 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 5.7 |

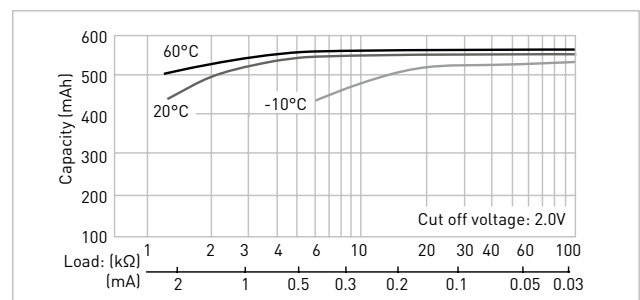
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

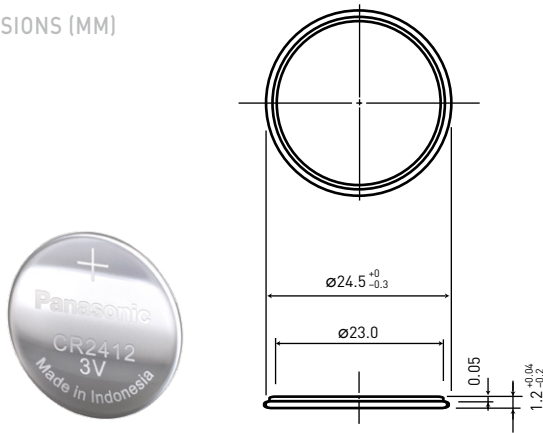


The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 at 50% depth-of-discharge (DoD)

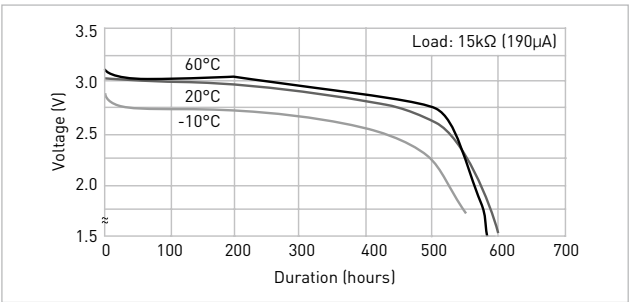
CR-2412

DIMENSIONS (MM)

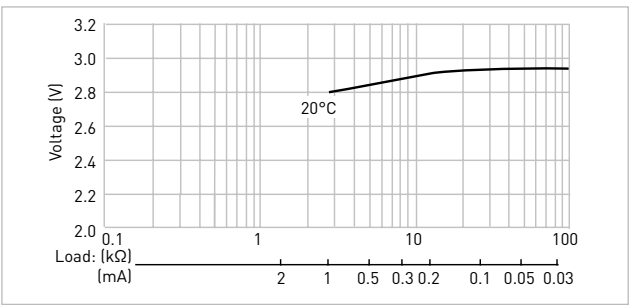


| Specifications | CR-2412 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 100 |
| Diameter (mm) | 24.5 |
| Total height (mm) | 1.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 2.0 |

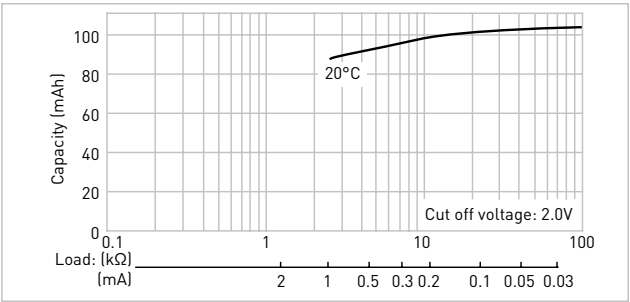
DISCHARGE TEMPERATURE CHARACTERISTICS



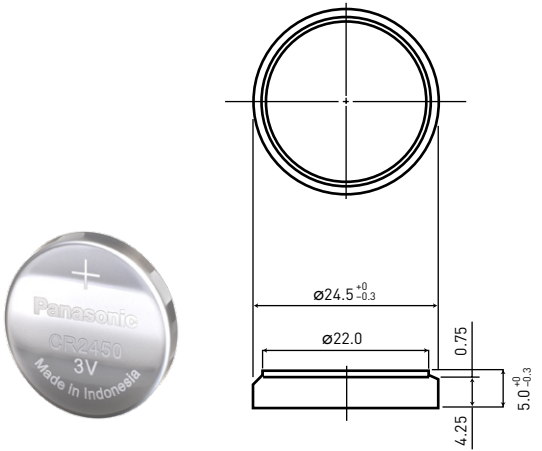
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

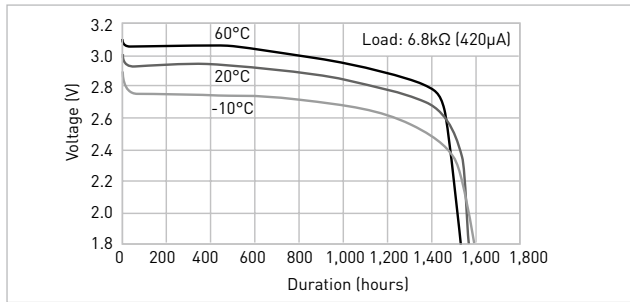


CR-2450

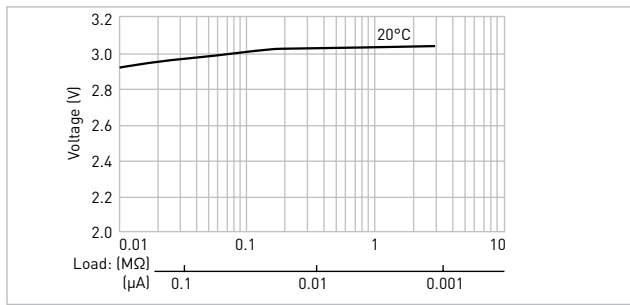


| Specifications | CR-2450 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 620 |
| Diameter (mm) | 24.5 |
| Total height (mm) | 5.0 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 6.2 |

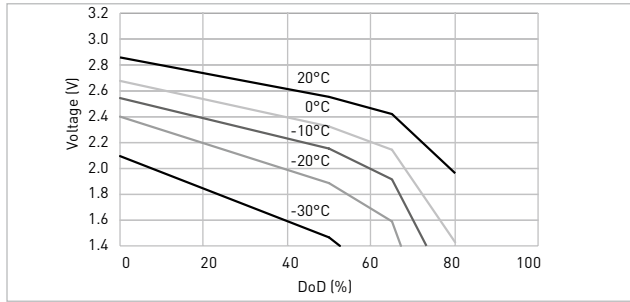
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1

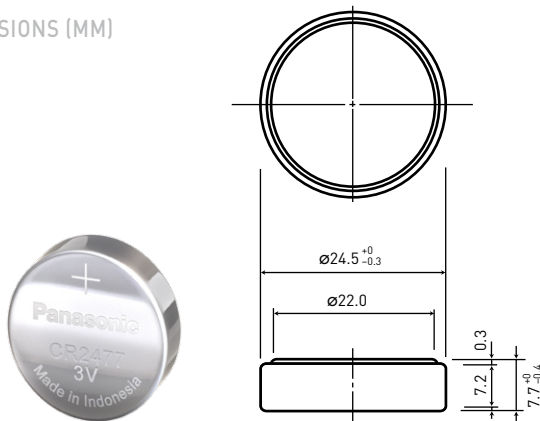


OPERATING VOLTAGE UNDER 30mA/50MS LOAD



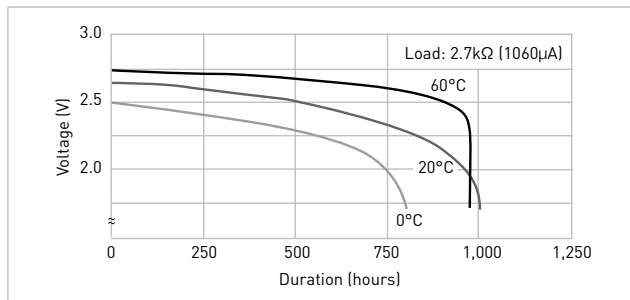
CR-2477

DIMENSIONS (MM)

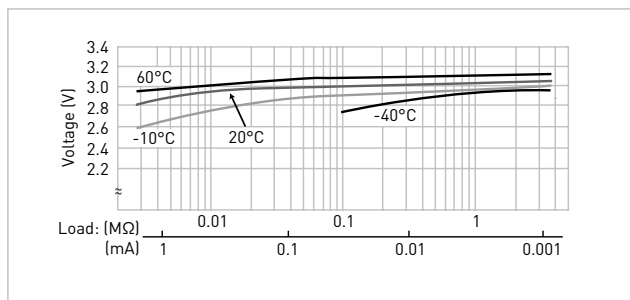


| Specifications | CR-2477 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1,000 |
| Diameter (mm) | 24.5 |
| Total height (mm) | 7.7 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 10.5 |

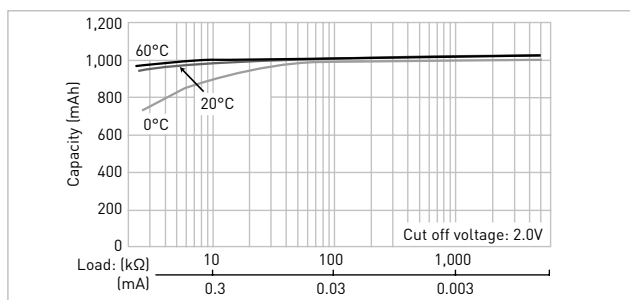
DISCHARGE TEMPERATURE CHARACTERISTICS



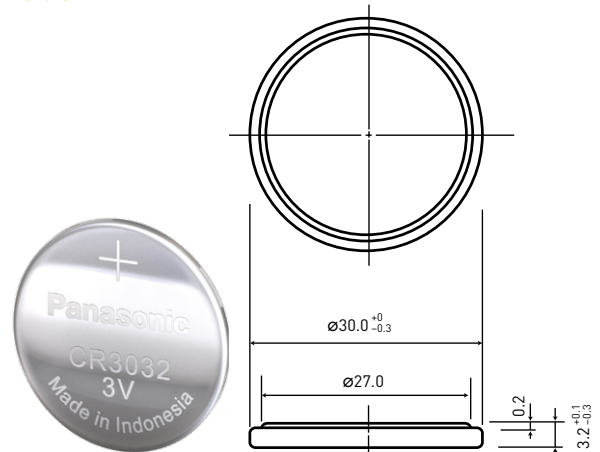
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

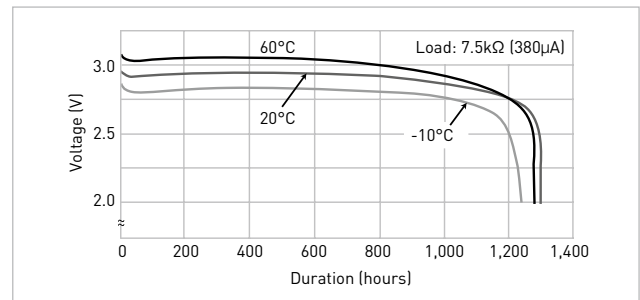


CR-3032

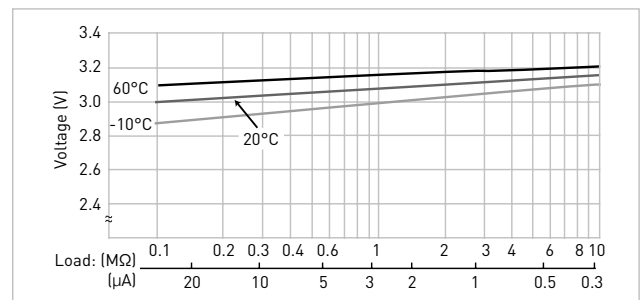


| Specifications | CR-3032 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 500 |
| Diameter (mm) | 30.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -30 to +85 |
| Weight (g) | 6.9 |

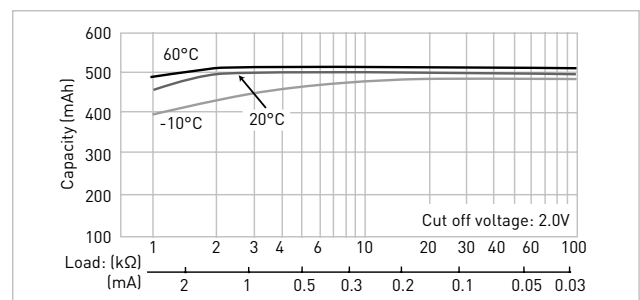
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 at 50% depth-of-discharge (DoD)



HIGH TEMPERATURE MANGANESE DIOXIDE LITHIUM BATTERIES (CR-A/B SERIES) - COIN TYPE LITHIUM BATTERIES

Comprising key design elements of the BR-A high temperature series in combination with the benefits of the conventional CR coin series, these batteries offer the best of both worlds in a cost effective manner.

FEATURES

- Excellent durability in high temperature (up to 125°C*1) allows various devices such as automotive electrical components and outdoor devices to be used under severe environments
- Superior pulse discharging characteristics even at low temperatures and can be used in a wide operating temperature
- Excellent long-term reliability enables safe and long-term use

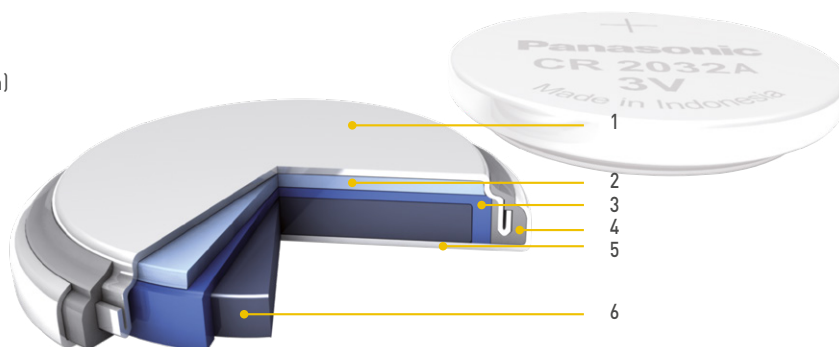
APPLICATIONS

- Tire Pressure Monitoring Systems (TPMS)
- Electronic Toll Collection (ETC)
- Connected meters, etc.

| Model number | Nominal voltage (V) | Nominal capacity (mAh)*2 | Diameter (mm) | Total height (mm) | Weight (g) |
|--------------|---------------------|--------------------------|---------------|-------------------|------------|
| CR-2032A*3 | 3 | 210 | 20.0 | 3.2 | 3.0 |
| CR-2032B*3 | 3 | 210 | 20.0 | 3.2 | 3.0 |
| CR-2050A*3 | 3 | 345 | 20.0 | 5.0 | 4.1 |
| CR-2050B2*3 | 3 | 345 | 20.0 | 5.0 | 4.1 |
| CR-2450B*3 | 3 | 560 | 24.5 | 5.0 | 6.2 |

BATTERY INSIDE*4

- 1 Negative pole
- 2 Anode (Lithium)
- 3 Separator
- 4 Gasket
- 5 Positive pole (cell can)
- 6 Cathode (Manganese dioxide)



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 Max. operating temperature +120°C for „B” and +125°C for „A” type models (dia 20mm), +105°C for CR-2450A.

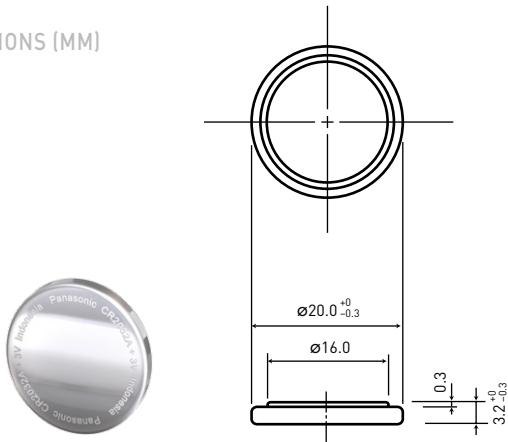
*2 Based on standard drain and cut off voltage down to 2.0V at 20°C.

*3 Cells are supplied with tabs or lead-wires only. For available configurations please consult the Panasonic homepage or your sales contact.

*4 The illustration shows only one example of Lithium battery structure.

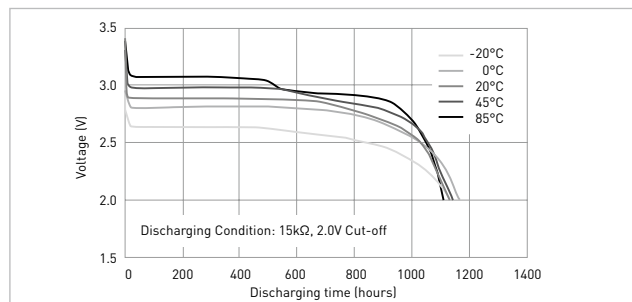
CR-2032A

DIMENSIONS (MM)

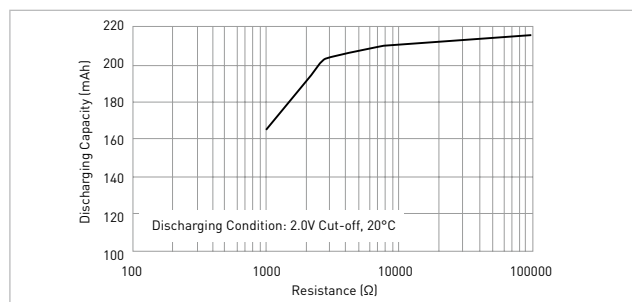


| Specifications | CR-2032A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 210 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 3.0 |

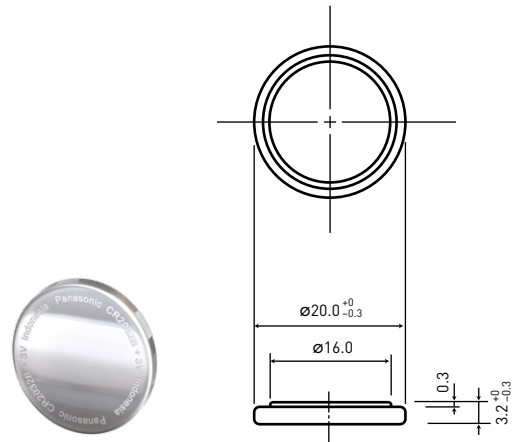
CONTINUOUS DISCHARGING CHARACTERISTICS



CAPACITY VS. LOAD RESISTANCE

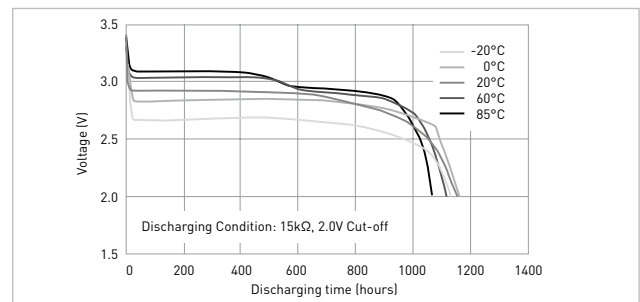


CR-2032B

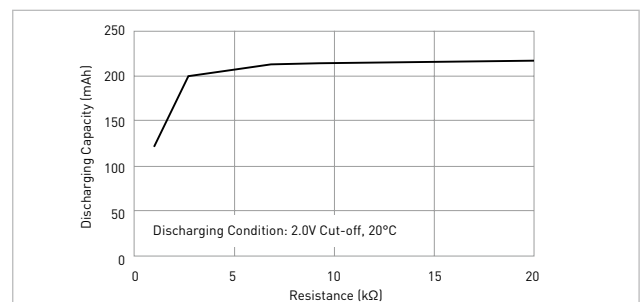


| Specifications | CR-2032B |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 210 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -40 to +120 |
| Weight (g) | 3.0 |

CONTINUOUS DISCHARGING CHARACTERISTICS

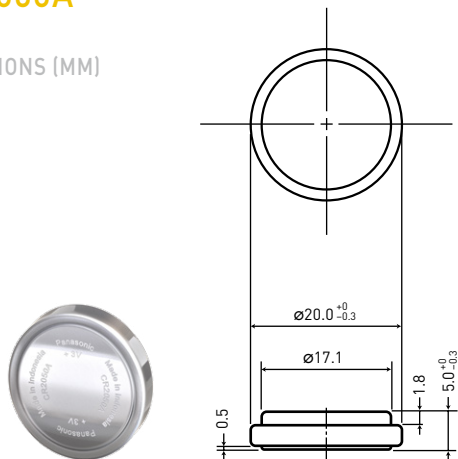


CAPACITY VS. LOAD RESISTANCE



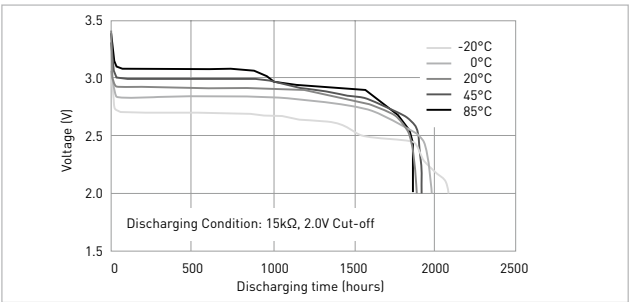
CR-2050A

DIMENSIONS (MM)

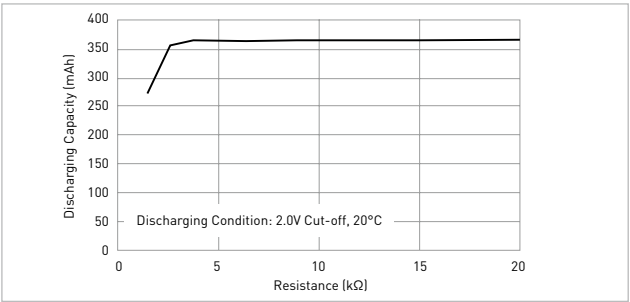


| Specifications | CR-2050A |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 345 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 5.0 |
| Discharging temperature range (°C) | -40 to +125 |
| Weight (g) | 4.1 |

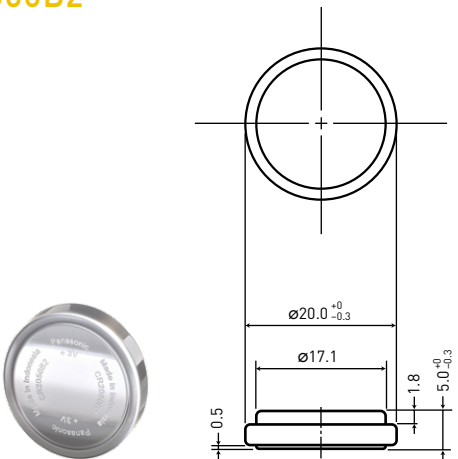
CONTINUOUS DISCHARGING CHARACTERISTICS



CAPACITY VS. LOAD RESISTANCE

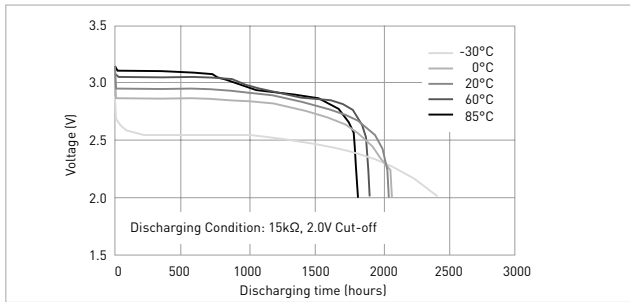


CR-2050B2

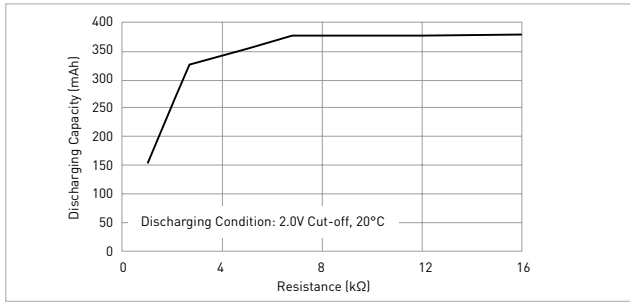


| Specifications | CR-2050B2 |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 345 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 5.0 |
| Discharging temperature range (°C) | -40 to +120 |
| Weight (g) | 4.1 |

CONTINUOUS DISCHARGING CHARACTERISTICS

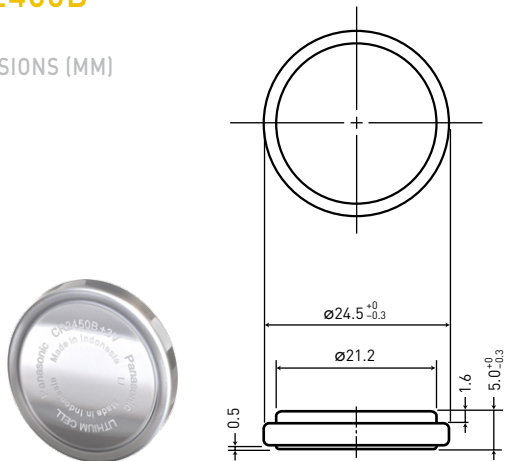


CAPACITY VS. LOAD RESISTANCE



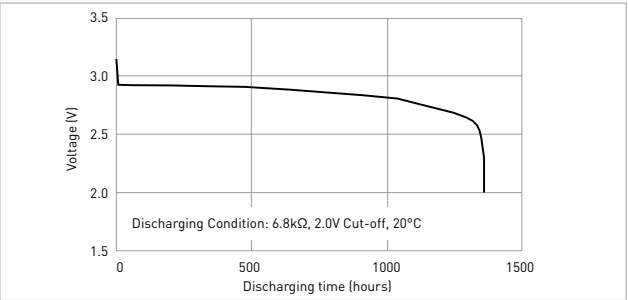
CR-2450B

DIMENSIONS (MM)

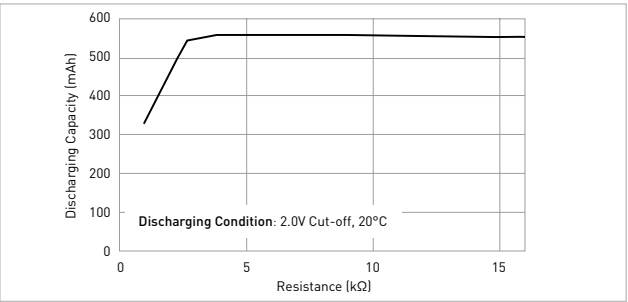


| Specifications | CR-2450B |
|------------------------------------|-------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 560 |
| Diameter (mm) | 24.5 |
| Total height (mm) | 5.0 |
| Discharging temperature range (°C) | -40 to +105 |
| Weight (g) | 6.2 |

DISCHARGING CHARACTERISTICS



CAPACITY VS. LOAD RESISTANCE





POLY-CARBONMONOFLUORIDE LITHIUM BATTERIES
(BR SERIES) – PIN TYPE LITHIUM BATTERIES

Panasonic offers a unique pin shape and space-saving design to meet the requirements of small-scale applications.

FEATURES

- Superior design for high temperature applications -30°C ~ +80°C
- Outstanding long-term reliability
- 43+ years of experience in production
- Self-discharge rate at 20°C is just 0.5% per year

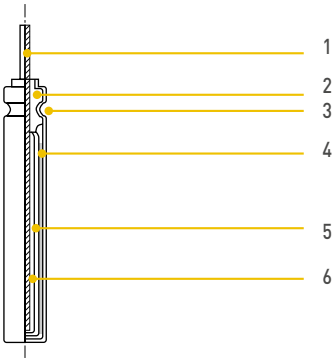
APPLICATIONS

- LED-type night fishing floats
- Various illumination products
- Fishing pole tip lights
- Toys, etc.

| Model number | Nominal voltage (V) | Nominal capacity (mAh)*1 | Diameter (mm) | Total height (mm) | Weight (g) |
|--------------|---------------------|--------------------------|---------------|-------------------|------------|
| BR-425 | 3 | 25 | 4.2 | 25.9 | 0.6 |
| BR-435 | 3 | 50 | 4.2 | 35.9 | 0.9 |

BATTERY INSIDE*2

- 1 Anode pin
- 2 Gasket
- 3 Cathode case
- 4 Cathode
(Poly-Carbonmonofluoride)
- 5 Separator
- 6 Anode (Lithium)



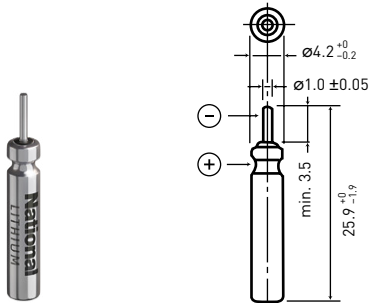
The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*1 Based on standard drain and cut off voltage down to 2.0V at 20°C.

*2 The illustration shows only one example of lithium battery structure.

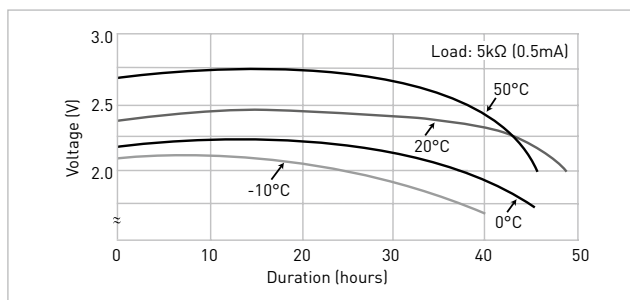
BR-425

DIMENSIONS (MM)

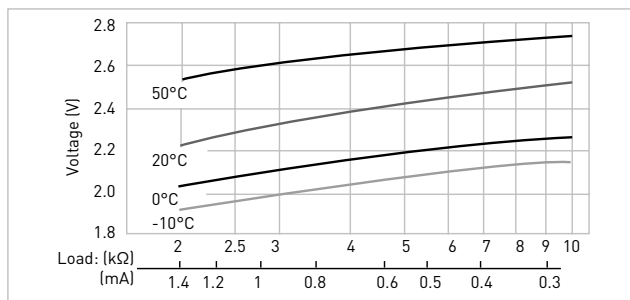


| Specifications | BR-425 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 25 |
| Diameter (mm) | 4.2 |
| Total height (mm) | 25.9 |
| Discharging temperature range (°C) | -30 to +80 |
| Weight (g) | 0.6 |

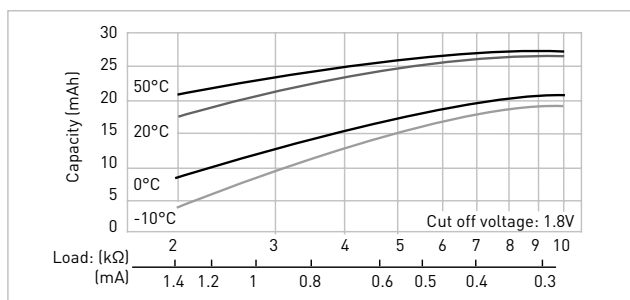
DISCHARGE TEMPERATURE CHARACTERISTICS



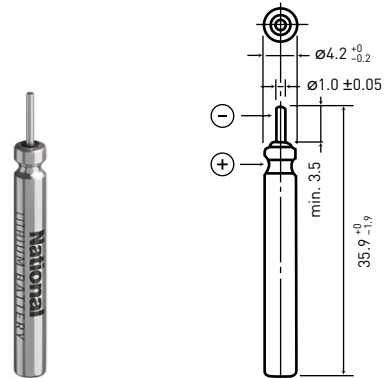
OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE

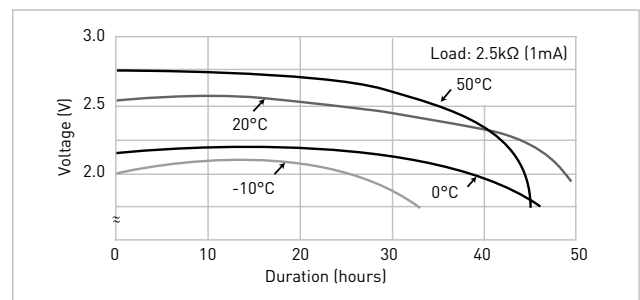


BR-435

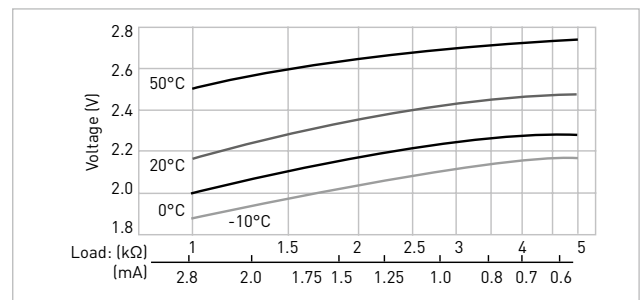


| Specifications | BR-435 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 50 |
| Diameter (mm) | 4.2 |
| Total height (mm) | 35.9 |
| Discharging temperature range (°C) | -30 to +80 |
| Weight (g) | 0.9 |

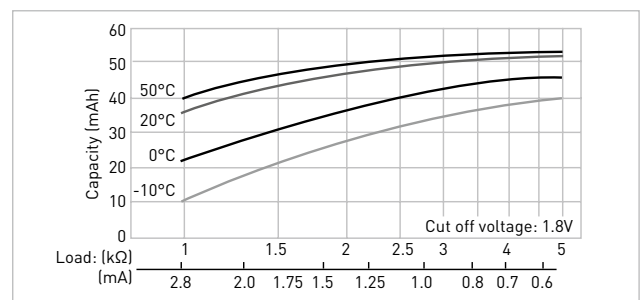
DISCHARGE TEMPERATURE CHARACTERISTICS



OPERATING VOLTAGE VS. DISCHARGE CURRENT*1



CAPACITY VS. LOAD RESISTANCE



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

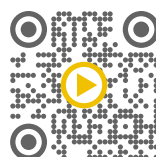
*1 at 50% depth-of-discharge [DoD]

RECHARGEABLE LITHIUM COIN AND PIN TYPE BATTERIES WITH REMARKABLE CHARACTERISTICS



LOW SELF-DISCHARGE
DECADES OF MASS PRODUCTION EXPERIENCE
SUPERIOR DESIGNED BATTERY RANGES
PROVEN RELIABILITY

Scan QR code
to view product
series video.





VANADIUM RECHARGEABLE LITHIUM BATTERIES (VL SERIES) – COIN TYPE RECHARGEABLE LITHIUM BATTERIES

These high quality lithium coin batteries feature vanadium oxide for the positive pole, lithium alloy for the negative pole and non-aqueous solvent for the electrolyte.

FEATURES

- Rechargeable lithium technology
- Self-discharge rate at 20°C is only 2.0% per year
- 1,000 charge-discharge cycles at 10% depth of discharge (DoD)
- Superior long-term reliability
- 30+ years of experience in production

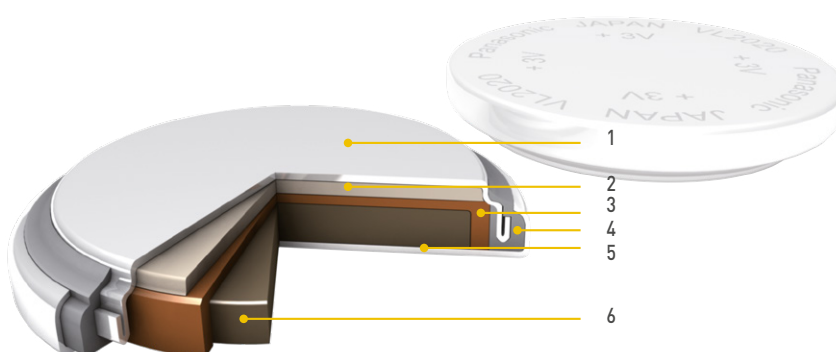
APPLICATIONS

- Real Time Clock (RTC)
- Tracking & RFID
- Remote Keyless Entry (RKE)
- IoT
- Remote control
- Mobile phones, etc.

| Model number | Nominal voltage (V) | Nominal capacity (mAh)* ¹ | Diameter (mm) | Total height (mm) | Weight (g) | Max. discharge current when short circuited (mA) |
|-----------------------|---------------------|--------------------------------------|---------------|-------------------|------------|--|
| VL-621* ² | 3 | 1.5 | 6.8 | 2.1 | 0.2 | 20 |
| VL-1220* ² | 3 | 7.0 | 12.5 | 2.0 | 0.8 | 75 |
| VL-2020* ² | 3 | 20.0 | 20.0 | 2.0 | 2.1 | 200 |
| VL-2330* ² | 3 | 50.0 | 23.0 | 3.0 | 3.5 | 200 |
| VL-3032* ² | 3 | 100.0 | 30.0 | 3.2 | 6.3 | 240 |

BATTERY INSIDE*³

- 1 Negative pole
- 2 Anode (Lithium Aluminium alloy)
- 3 Separator
- 4 Gasket
- 5 Positive pole (cell can)
- 6 Cathode (Vanadium Pentoxide)



The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*¹ Based on standard drain and cut off voltage down to 2.0V at 20°C. State-of-Charge ex-factory: ~70%.

*² Cells are supplied with tabs or lead-wires only. For available configurations please consult the Panasonic homepage or your sales contact.

*³ The illustration shows only one example of lithium battery structure.

CHARGING

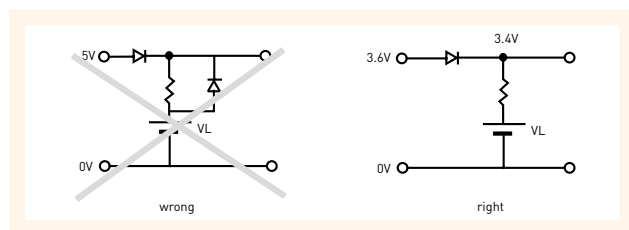
Charging circuits

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.

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

Precautions regarding the charge voltage setting

Under no circumstances should constant current 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°C 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.
- 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

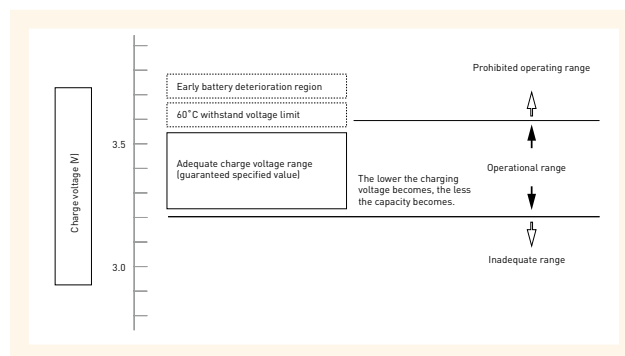
| | |
|-----------------|-----------------------------|
| Charge voltage: | 3.4V \pm 0.15V |
| Charge current: | For a battery voltage of 3V |
| VL-621 | Approx. 0.2mA or below |
| VL-1220 | Approx. 0.5mA or below |
| VL-2020 | Approx. 1.5mA or below |
| VL-2330 | Approx. 2.0mA or below |
| VL-3032 | Approx. 4.0mA 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

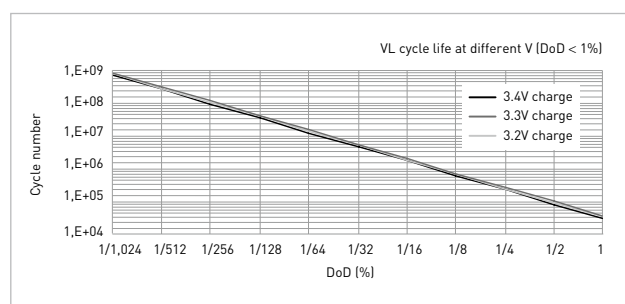
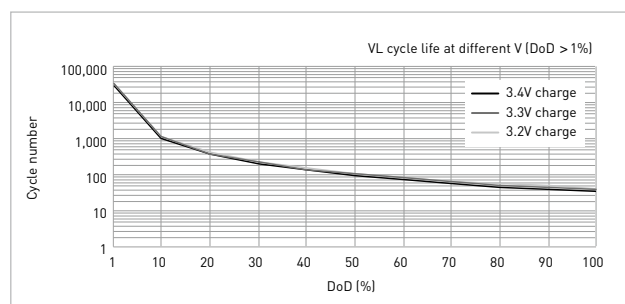
Do not use these batteries and lithium primary batteries or other rechargeable batteries together, and do not use new batteries and old batteries together even if they are of the same type.

Influence of the charge voltage on VL batteries

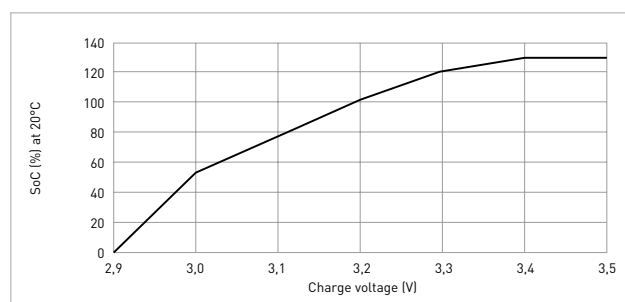


If the charge voltage goes beyond its adequate range, battery performance may deteriorate early. Be sure to observe the guaranteed charge voltage.

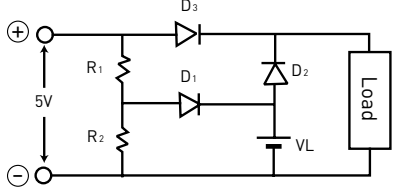
VL cycle life



VL charging



Reference: Examples of charging circuits

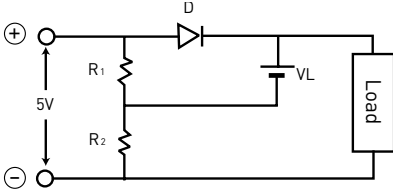


Patent acquired

Standard circuits

D₂: select a diode of small inverse current ($I_R=1\mu A$ below/5V)
D₁, D₂: MA3X716 (Diode type code)
D₃: MA3X704, MA2J728

| | R ₁ | R ₂ | Charge current (max.) |
|---------|----------------|----------------|-----------------------|
| VL-621 | 2.2kΩ | 5.6kΩ | 0.2mA |
| VL-1220 | 750Ω | 1.8kΩ | 0.5mA |
| VL-2020 | 200Ω | 510Ω | 1.5mA |
| VL-2330 | 150Ω | 390Ω | 2.0mA |
| VL-3032 | 68Ω | 180Ω | 4.0mA |



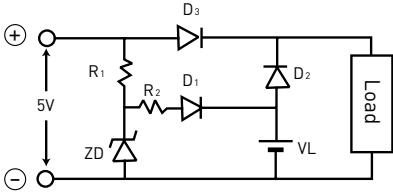
Patent acquired

Simple economical circuits

D: MA2J728 (Very small reverse current)

| Load with 5V applied | 1mA below | |
|----------------------|----------------|----------------|
| D, Vf | 0~0.30V | |
| | R ₁ | R ₂ |
| VL-621 | 6.2kΩ | 2.4kΩ |
| VL-1220 | 1.5kΩ | 560Ω |
| VL-2020 | 470Ω | 180Ω |
| VL-2330 | 390Ω | 150Ω |
| VL-3032 | 180Ω | 68Ω |

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.

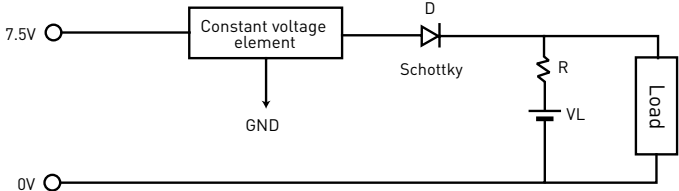


| | ZD | D ₁ | R ₁ | |
|---|-----------|----------------|----------------|---------------------|
| A | MAZ30360L | MA3X704 | 300Ω | Common to all types |
| B | MAZ30360H | MA2J728 | 270Ω | |

| Type | VL-3032 | VL-2330 | VL-2020 | VL-1220 | VL-621 |
|----------------|---------|--------------|---------|---------|--------|
| R ₂ | A | Not required | | 470Ω | 1.5kΩ |
| | B | Not required | | 560Ω | 1.6kΩ |

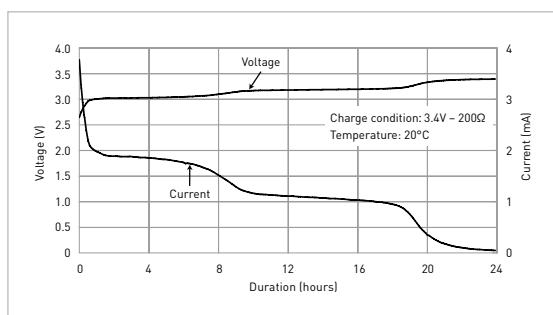
D₂: select a diode of small inverse current ($I_R=1\mu A$ below/5V)

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



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

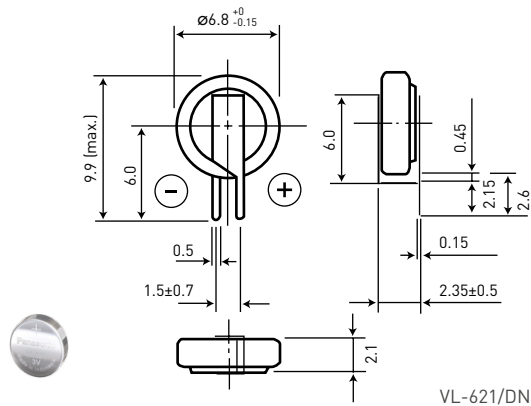
For details, refer to the constant voltage element specifications.



VANADIUM RECHARGEABLE LITHIUM BATTERIES (VL SERIES)

VL-621

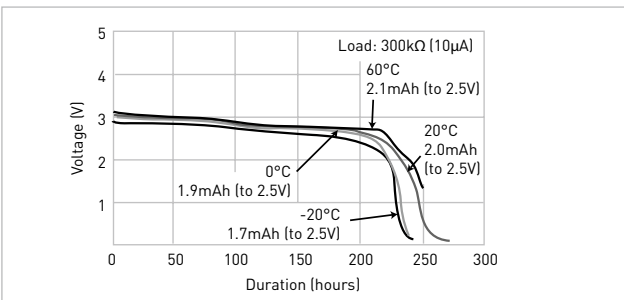
DIMENSIONS (MM)



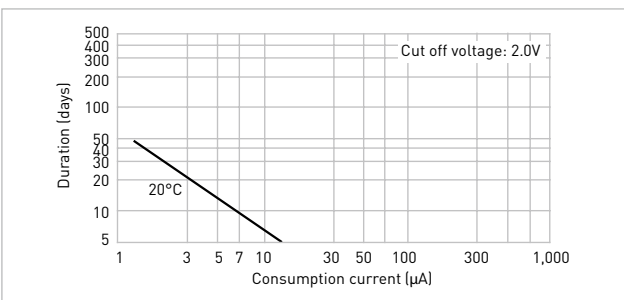
VL-621/DN

| Specifications | VL-621 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 1.5 |
| Diameter (mm) | 6.8 |
| Total height (mm) | 2.1 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.2 |

DISCHARGE TEMPERATURE CHARACTERISTICS

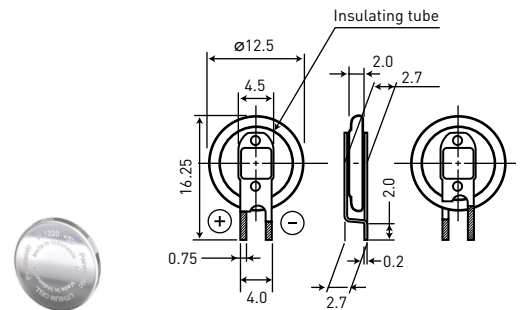


CONSUMPTION CURRENT VS. DURATION TIME



VL-1220

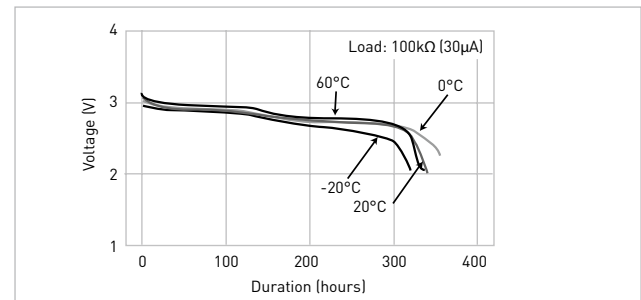
DIMENSIONS (MM)



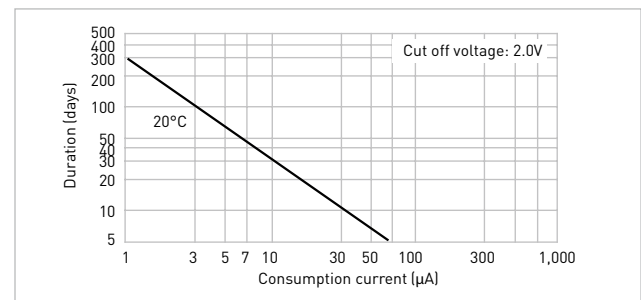
VL-1220/FCN

| Specifications | VL-1220 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 7.0 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.8 |

DISCHARGE TEMPERATURE CHARACTERISTICS

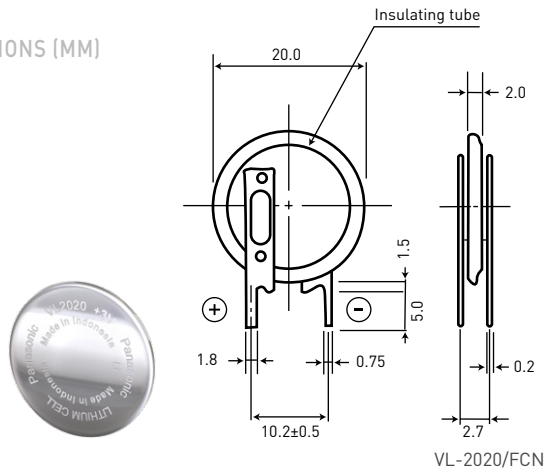


CONSUMPTION CURRENT VS. DURATION TIME



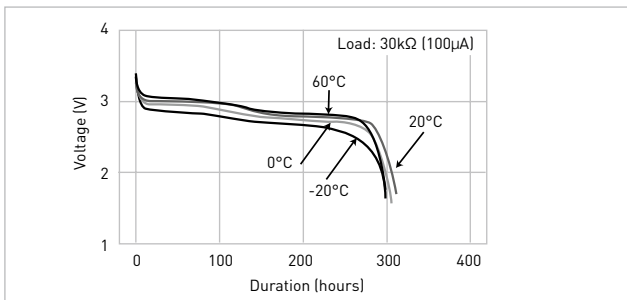
VL-2020

DIMENSIONS (MM)

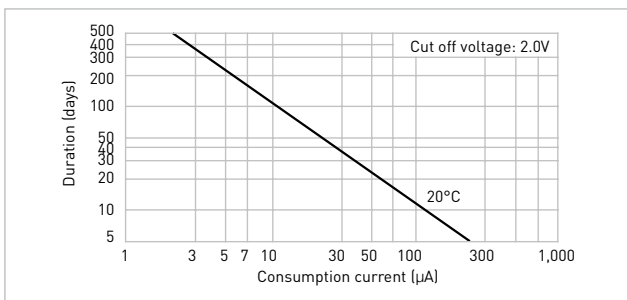


| Specifications | VL-2020 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 20.0 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 2.1 |

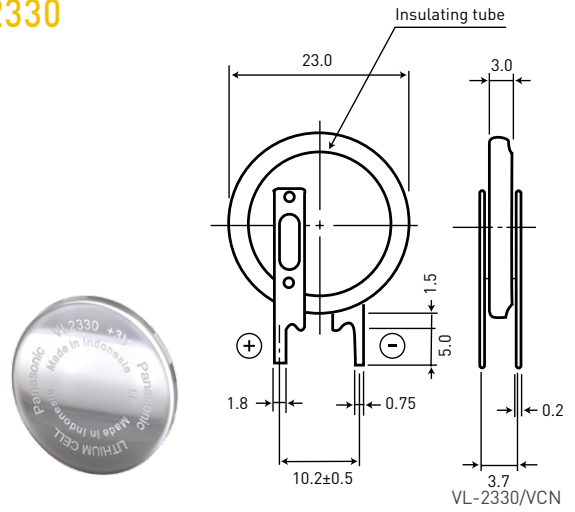
DISCHARGE TEMPERATURE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME

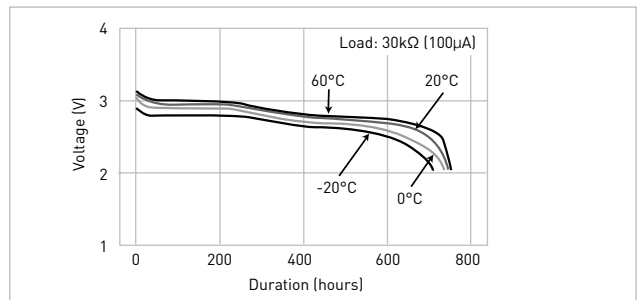


VL-2330

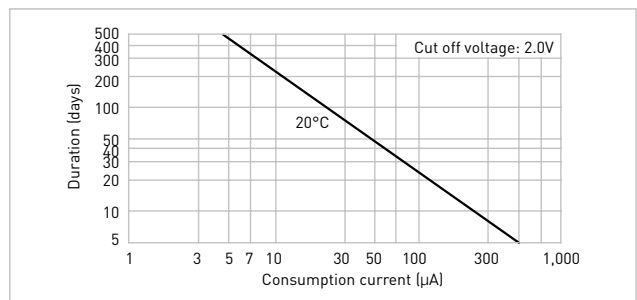


| Specifications | VL-2330 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 50.0 |
| Diameter (mm) | 23.0 |
| Total height (mm) | 3.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 3.5 |

DISCHARGE TEMPERATURE CHARACTERISTICS



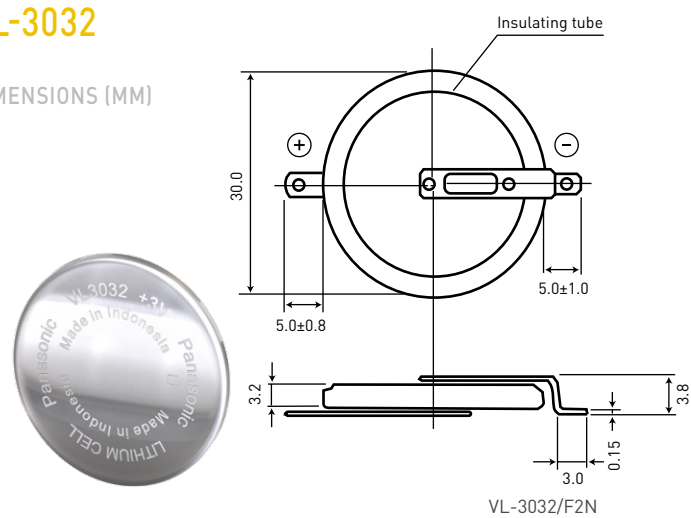
CONSUMPTION CURRENT VS. DURATION TIME



VANADIUM RECHARGEABLE LITHIUM BATTERIES (VL SERIES)

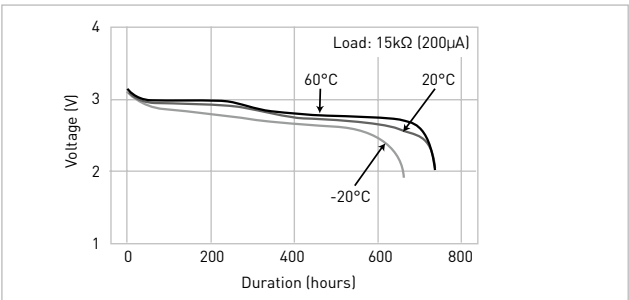
VL-3032

DIMENSIONS (MM)

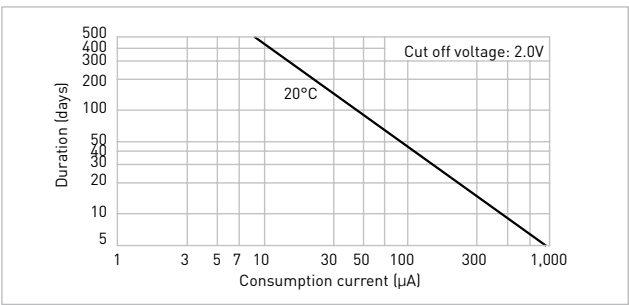


| Specifications | VL-3032 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 100.0 |
| Diameter (mm) | 30.0 |
| Total height (mm) | 3.2 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 6.3 |

DISCHARGE TEMPERATURE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME





MANGANESE RECHARGEABLE LITHIUM BATTERIES (ML SERIES) – COIN TYPE RECHARGEABLE LITHIUM BATTERIES

These super compact rechargeable lithium 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.

FEATURES

- Rechargeable lithium technology
- Self discharge rate at 20°C is only 2.0% per year
- 1,000 charge-discharge cycles at 10% depth of discharge (DoD)
- Superior long-term reliability
- 23+ years of experience in production

APPLICATIONS

- Memory back-up power supplies for mobile phones
- Tracking & RFID
- Pagers and other compact communications equipment
- Real Time Clock (RTC), etc.

| Model number | Electrical characteristics at 20°C | | Dimensions with tube (mm) | | Approx. weight (g) | Max. discharge current when short circuited (mA) |
|--------------|------------------------------------|--------------------------|---------------------------|--------------|--------------------|--|
| | Nominal voltage (V) | Nominal capacity (mAh)*1 | Diameter | Total height | | |
| ML-421 | 3 | 2.3 | 4.8 | 2.1 | 0.1 | 12 |
| ML-614 | 3 | 3.4 | 6.8 | 1.4 | 0.2 | 20 |
| ML-621 | 3 | 5.0 | 6.8 | 2.1 | 0.2 | 20 |
| ML-920 | 3 | 11.0 | 9.5 | 2.0 | 0.4 | 60 |
| ML-1220 | 3 | 17.0 | 12.5 | 2.0 | 0.8 | 75 |
| ML-2020 | 3 | 45.0 | 20.0 | 2.0 | 2.2 | 200 |

CHARGING

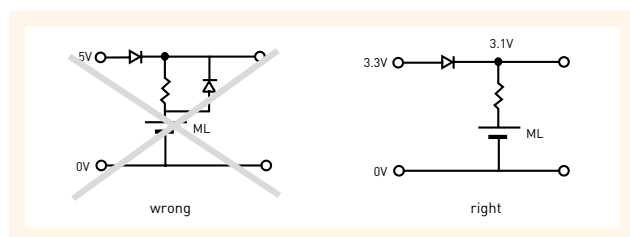
Charging circuits

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.

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

Precautions regarding the charge voltage setting

Under no circumstances should constant current 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 to 3.2V at the temperature of -20°C to +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 \oplus terminal (case) may occur, causing leakage.
- It is not possible for the battery capacity to recover completely when the charging voltage is below the specification.

Recommended charging circuits - basic conditions

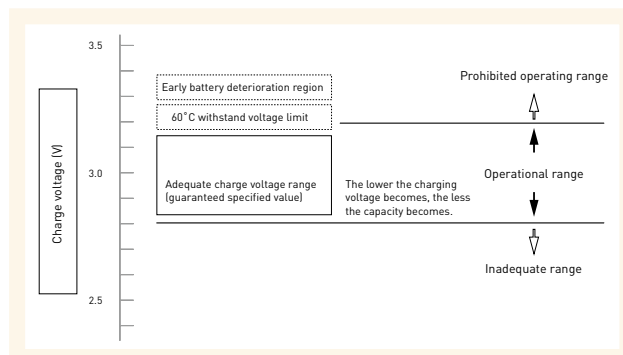
Fixed-voltage charge

| | |
|-----------------|--------------------------------------|
| Charge voltage: | 2.8 to 3.2V (Standard voltage: 3.1V) |
| Charge current: | For a battery voltage of 2.5V |
| ML-421 | Approx. 0.15mA or below |
| ML-614 | Approx. 0.3mA or below |
| ML-621 | Approx. 0.6mA or below |
| ML-920, ML-1220 | Approx. 1.2mA or below |
| ML-2020 | Approx. 3.0mA or below |

Mixed usage of batteries

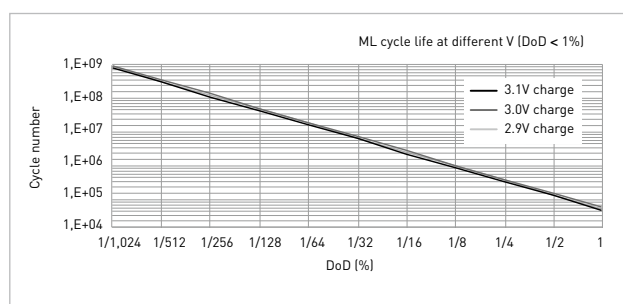
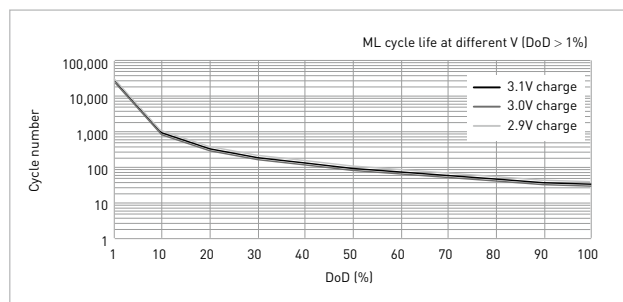
Do not use these batteries and lithium primary batteries or other rechargeable batteries together, and do not use new batteries and old batteries together even if they are of the same type.

Influence of the charge voltage on ML batteries

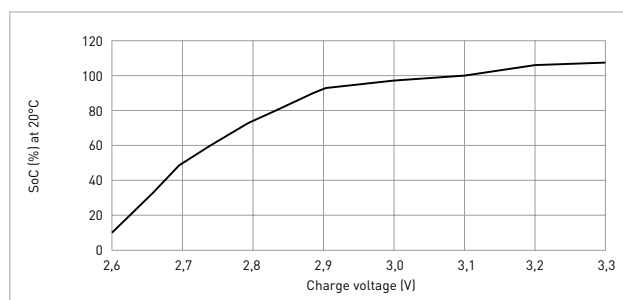


If the charge voltage goes beyond its adequate range, battery performance may deteriorate early. Be sure to observe the guaranteed charge voltage.

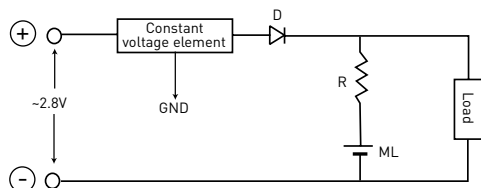
ML cycle life



ML charging



Reference: Examples of charging circuits



When charging using another battery

ML-421

| REG | D | R |
|------|---------|-------|
| 3.2V | MA2J728 | 6.2kΩ |
| 3.1V | MA2J728 | 5.1kΩ |

ML-614

| REG | D | R |
|------|---------|-------|
| 3.2V | MA2J728 | 1.8kΩ |
| 3.1V | MA2J728 | 1.5kΩ |

ML-621

| REG | D | R |
|------|---------|------|
| 3.2V | MA2J728 | 910Ω |
| 3.1V | MA2J728 | 750Ω |

ML-920

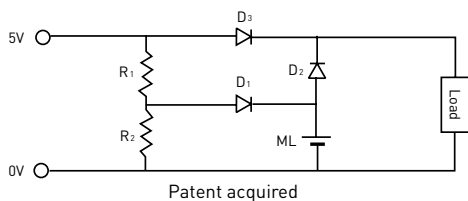
| REG | D | R |
|------|---------|------|
| 3.2V | MA2J728 | 470Ω |
| 3.1V | MA2J728 | 390Ω |

ML-1220

| REG | D | R |
|------|---------|------|
| 3.2V | MA2J728 | 470Ω |
| 3.1V | MA2J728 | 390Ω |

ML-2020

| REG | D | R |
|------|---------|------|
| 3.2V | MA2J728 | 180Ω |
| 3.1V | MA2J728 | 150Ω |



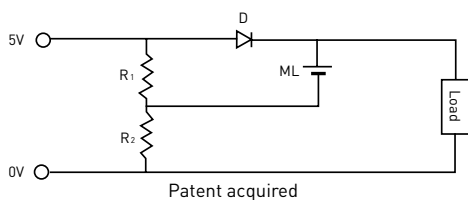
Standard circuits

For D₂, select a diode of small inverse current (I_r=1μA/5V)

D₁, D₂: MA3X716 (Diode type code)

D₃: MA3X704, MA2J728

| | R ₁ | R ₂ |
|---------|----------------|----------------|
| ML-421 | 5.1kΩ | 9.1kΩ |
| ML-614 | 2.7kΩ | 5.1kΩ |
| ML-621 | 1.1kΩ | 2.0kΩ |
| ML-920 | 680Ω | 1.3kΩ |
| ML-1220 | 680Ω | 1.3kΩ |
| ML-2020 | 180Ω | 330Ω |

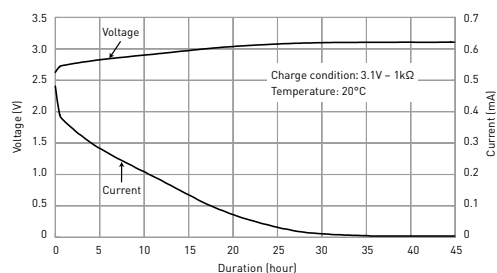


Simple economical circuits

Load 100μA below

| D, Vf | 0~0.2V | |
|---------|----------------|----------------|
| | R ₁ | R ₂ |
| ML-421 | 10kΩ | 5.1kΩ |
| ML-614 | 5.1kΩ | 2.7kΩ |
| ML-621 | 2.4kΩ | 1.3kΩ |
| ML-920 | 1kΩ | 510Ω |
| ML-1220 | 1kΩ | 510Ω |
| ML-2020 | 330Ω | 180Ω |

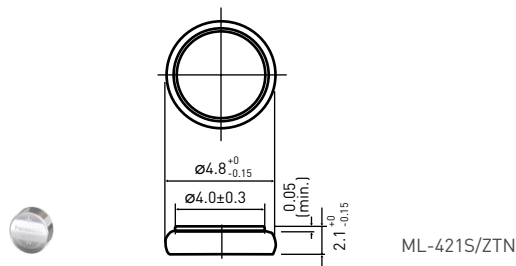
V_F of D will be different from the value given above if a current in excess of 10μA flows to the load during operation. Compensation must be provided by the resistors in such cases.



ML 621 Charging curve

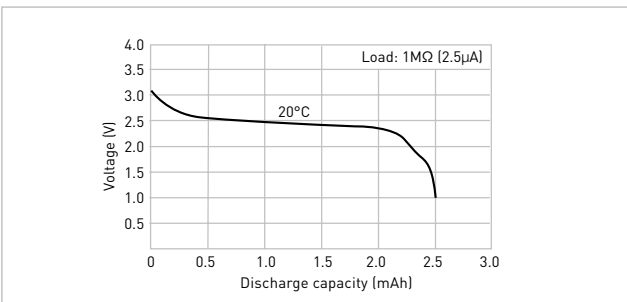
ML-421

DIMENSIONS (MM)

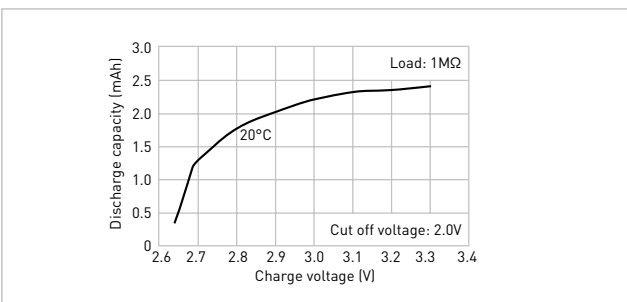


| Specifications | ML-421 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 2.3 |
| Diameter (mm) | 4.8 |
| Total height (mm) | 2.1 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.1 |

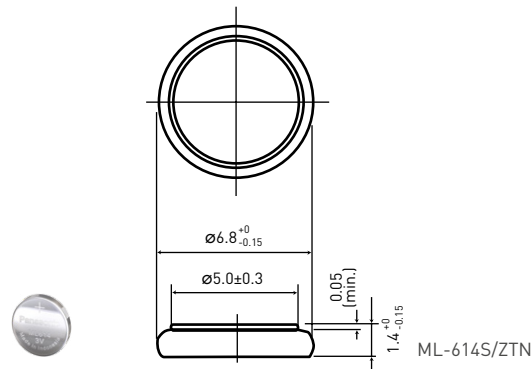
DISCHARGE TEMPERATURE CHARACTERISTICS



CHARGE VOLTAGE VS. DISCHARGE CAPACITY

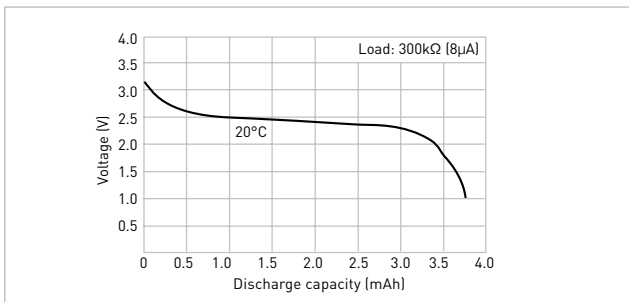


ML-614

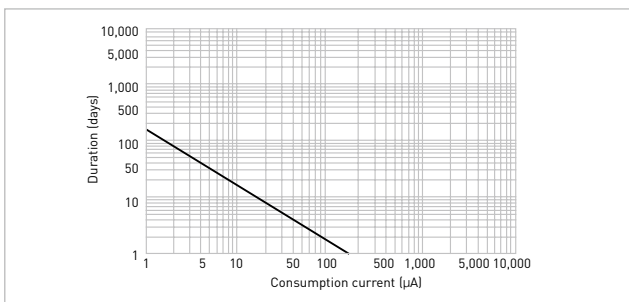


| Specifications | ML-614 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 3.4 |
| Diameter (mm) | 6.8 |
| Total height (mm) | 1.4 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.2 |

DISCHARGE TEMPERATURE CHARACTERISTICS

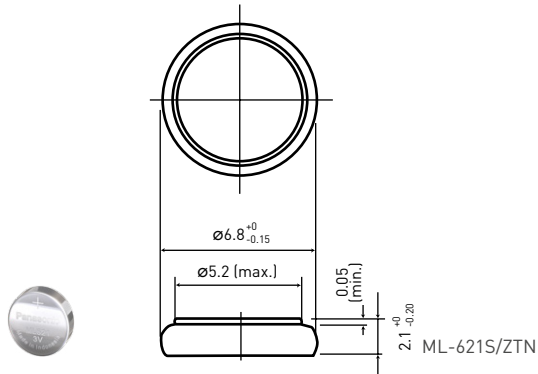


CONSUMPTION CURRENT VS. DURATION TIME



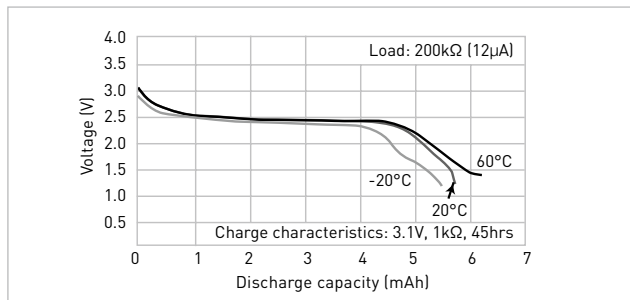
ML-621

DIMENSIONS (MM)

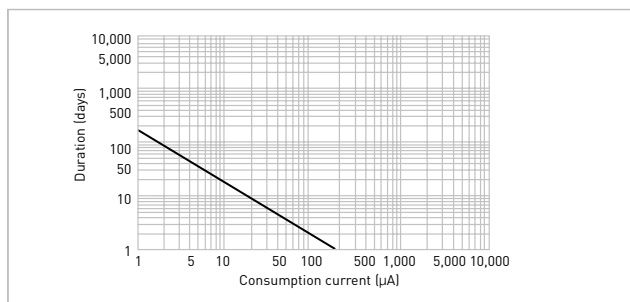


| Specifications | ML-621 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 5.0 |
| Diameter (mm) | 6.8 |
| Total height (mm) | 2.1 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.2 |

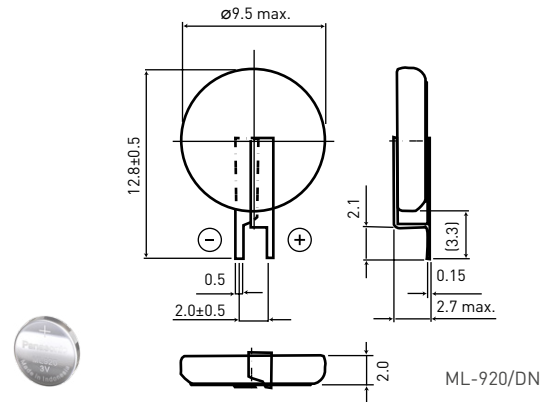
DISCHARGE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME

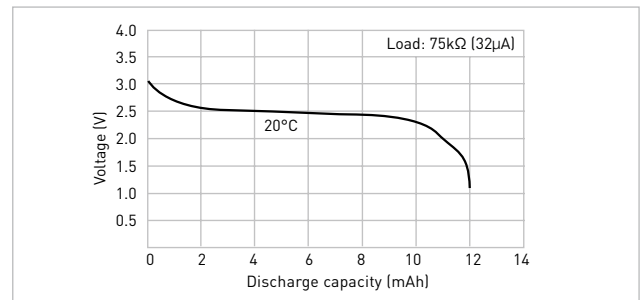


ML-920

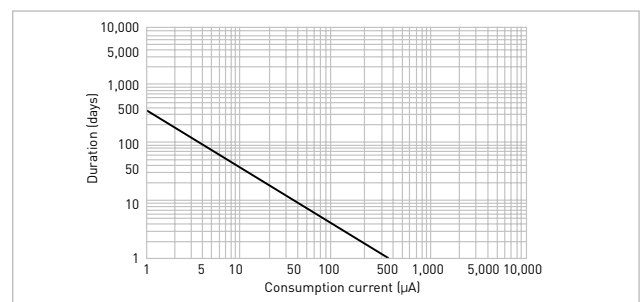


| Specifications | ML-920 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 11.0 |
| Diameter (mm) | 9.5 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.4 |

DISCHARGE CHARACTERISTICS

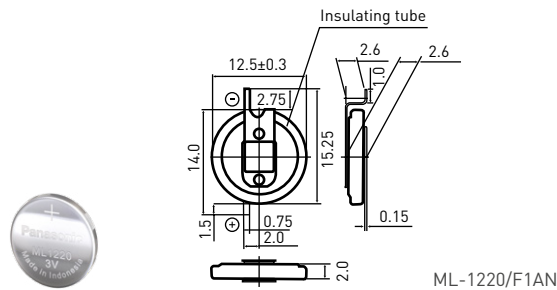


CONSUMPTION CURRENT VS. DURATION TIME



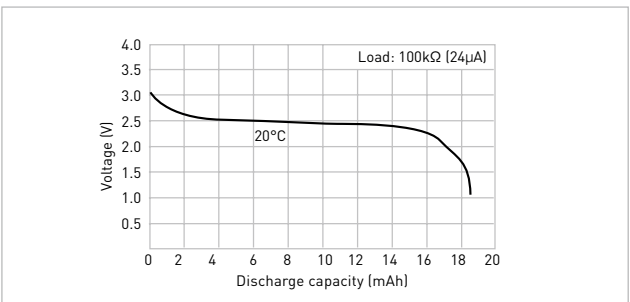
ML-1220

DIMENSIONS (MM)

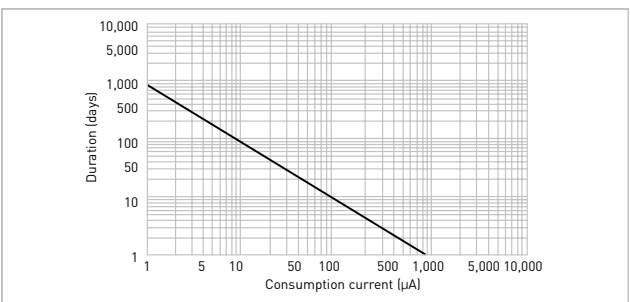


| Specifications | ML-1220 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 17.0 |
| Diameter (mm) | 12.5 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 0.8 |

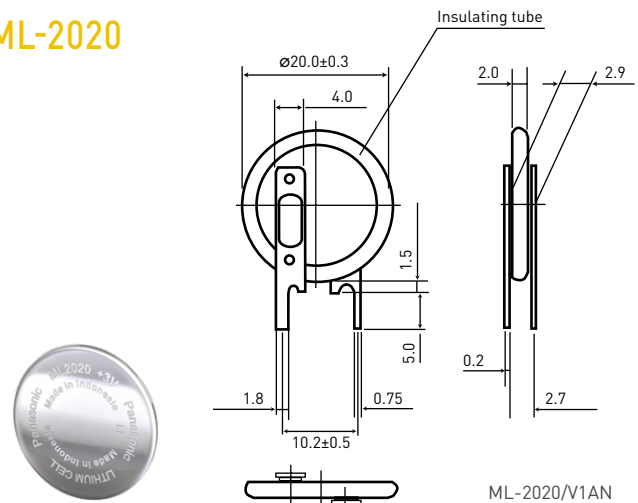
DISCHARGE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME

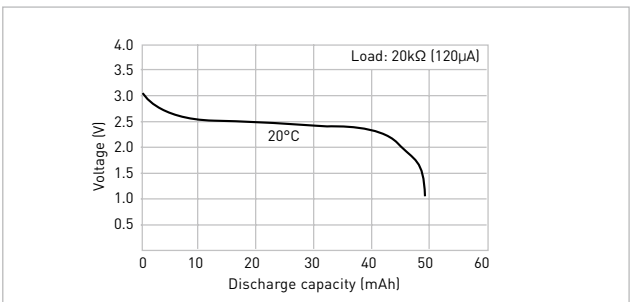


ML-2020

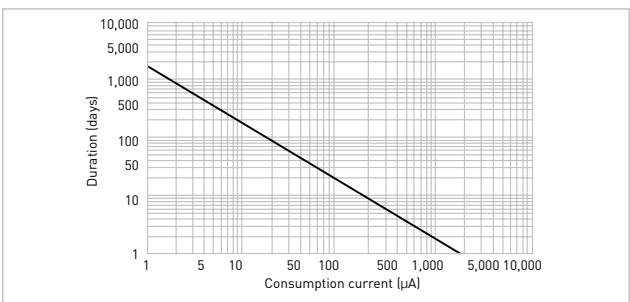


| Specifications | ML-2020 |
|------------------------------------|------------|
| Nominal voltage (V) | 3 |
| Nominal capacity (mAh) | 45.0 |
| Diameter (mm) | 20.0 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Weight (g) | 2.2 |

DISCHARGE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME





TITANIUM RECHARGEABLE LITHIUM BATTERIES (MT SERIES) – COIN TYPE RECHARGEABLE LITHIUM BATTERIES

These coin type manganese titanium rechargeable 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.

FEATURES

- Rechargeable lithium technology
- Superior long-term reliability
- 25+ years of experience in production
- 500 charge-discharge cycles up to 1V or discharge limit voltage (at 100% depth of discharge (DoD))

APPLICATIONS

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

| Model number | Electrical characteristics at 20°C | | Dimensions with tube (mm) | | Approx. weight (g) |
|--------------|------------------------------------|--------------------------------------|---------------------------|--------------|--------------------|
| | Nominal voltage (V) | Nominal capacity (mAh)* ¹ | Diameter | Total height | |
| MT-516 | 1.5 | 1.8 | 5.8 | 1.6 | 0.1 |
| MT-621 | 1.5 | 2.5 | 6.8 | 2.1 | 0.2 |
| MT-920 | 1.5 | 5.0 | 9.5 | 2.0 | 0.4 |

TITANIUM RECHARGEABLE LITHIUM BATTERIES (MT SERIES)

CHARGING

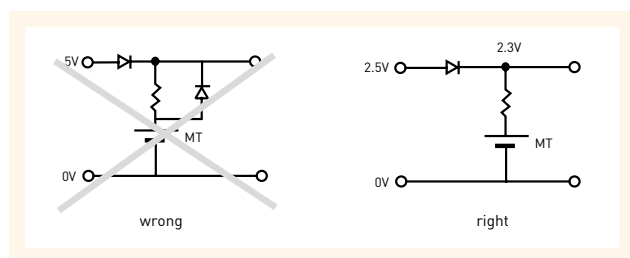
Charging circuits

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.

| | |
|-------------------------------------|--|
| Charging/discharging cycle | Approx. 500 times at 100% discharge depth to nominal capacity |
| Charging system*¹ | Constant-voltage charging. (Please strictly adhere to the specified charge voltage) |
| Operating temperature | -10°C to +60°C |

Precautions regarding the charge voltage setting

Under no circumstances should constant current 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 1.8V to 2.6V at the temperature of -10°C to +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 3V, corrosion of the \oplus terminal (case) may occur, causing leakage.
- It is not possible for the battery capacity to recover completely when the charging voltage is below the specification.

Recommended charging circuits - basic conditions

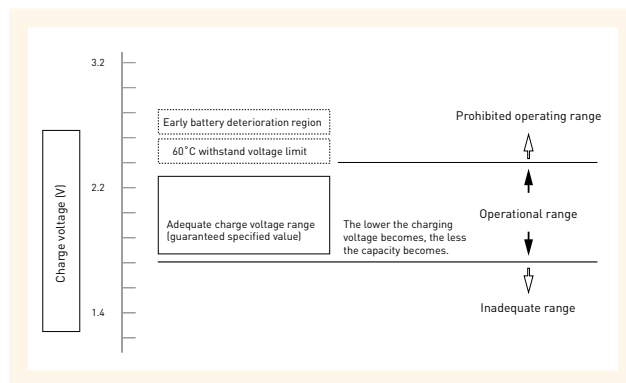
Fixed-voltage charge

| | |
|-----------------|--------------------------------------|
| Charge voltage: | 1.8 to 2.6V (Standard voltage: 2.2V) |
| Charge current: | For a battery voltage of 2.3V |
| MT-516 | Approx. 0.36mA or below |
| MT-621 | Approx. 0.33mA or below |
| MT-920 | Approx. 1.0mA 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.

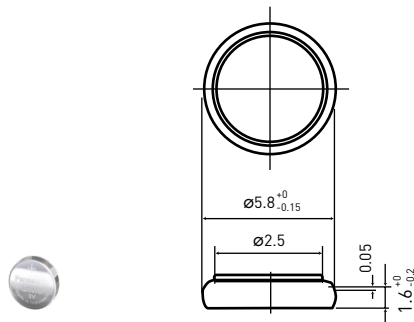
Influence of the charge voltage on MT batteries



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

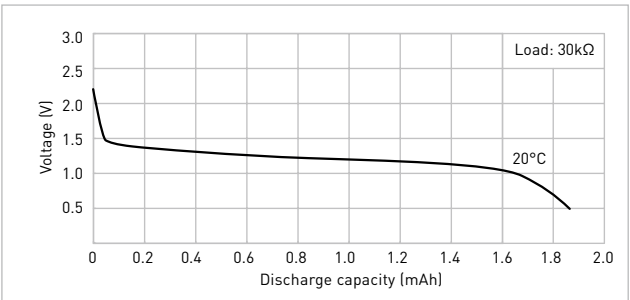
MT-516

DIMENSIONS (MM)

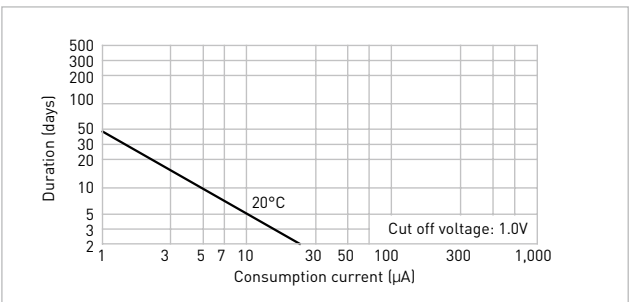


| Specifications | MT-516 |
|------------------------------------|------------|
| Nominal voltage (V) | 1.5 |
| Nominal capacity (mAh) | 1.8 |
| Diameter (mm) | 5.8 |
| Total height (mm) | 1.6 |
| Discharging temperature range (°C) | -10 to +60 |
| Weight (g) | 0.1 |

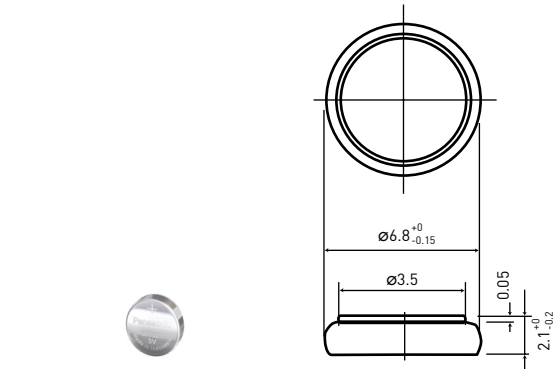
DISCHARGE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME

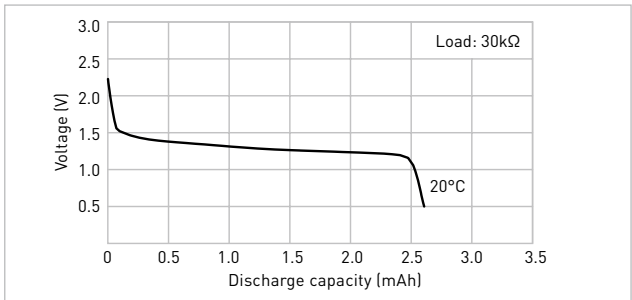


MT-621

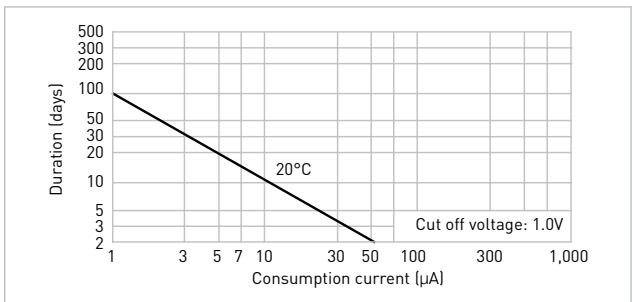


| Specifications | MT-621 |
|------------------------------------|------------|
| Nominal voltage (V) | 1.5 |
| Nominal capacity (mAh) | 2.5 |
| Diameter (mm) | 6.8 |
| Total height (mm) | 2.1 |
| Discharging temperature range (°C) | -10 to +60 |
| Weight (g) | 0.2 |

DISCHARGE CHARACTERISTICS



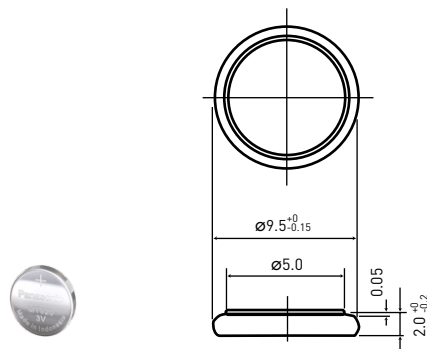
CONSUMPTION CURRENT VS. DURATION TIME



TITANIUM RECHARGEABLE LITHIUM BATTERIES (MT SERIES)

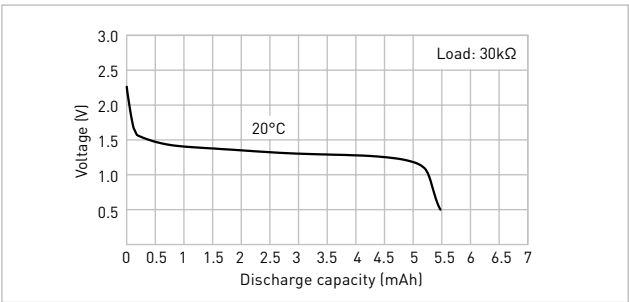
MT-920

DIMENSIONS (MM)

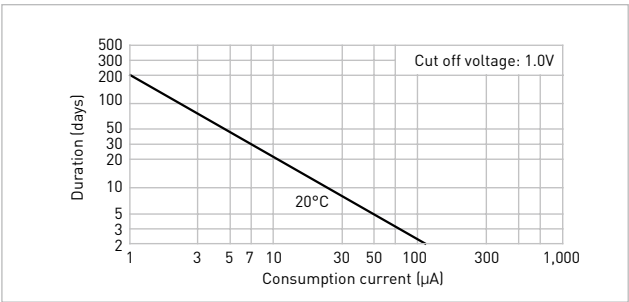


| Specifications | MT-920 |
|------------------------------------|------------|
| Nominal voltage (V) | 1.5 |
| Nominal capacity (mAh) | 5.0 |
| Diameter (mm) | 9.5 |
| Total height (mm) | 2.0 |
| Discharging temperature range (°C) | -10 to +60 |
| Weight (g) | 0.4 |

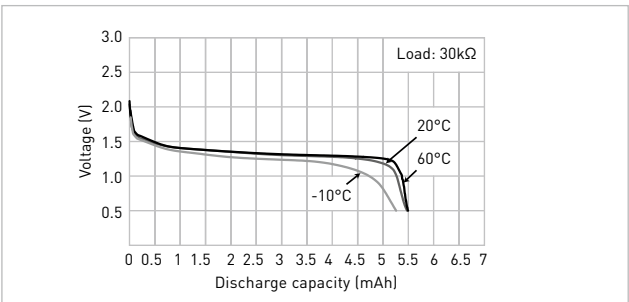
DISCHARGE CHARACTERISTICS



CONSUMPTION CURRENT VS. DURATION TIME



DISCHARGE TEMPERATURE CHARACTERISTICS





LITHIUM-ION RECHARGEABLE BATTERIES (CG-SERIES) – PIN TYPE

The industry's smallest-diameter cylindrical rechargeable battery has been developed using extremely fine components and materials compared to standard lithium-ion batteries. Its outstanding technical design makes this battery ideal for wearable devices with heavy power demands. Panasonic intends to expand this new battery line-up successively to meet the requirements of next-generation mobile communication devices.

FEATURES

- Small diameter pin-shaped lithium-ion battery which expands design options for micro devices
- Rechargeable battery that can be used repeatedly and has the output capability required for near field communications
- High-strength metal exterior provides excellent reliability

APPLICATIONS

- Electric pen
- Wearables
- Hearing aid
- Wristband devices
- Smart glasses
- Industrial IoT applications
- Fitness trackers, etc.

| Model number | Technology | Nominal voltage (V) | Typical capacity (mAh)*2 | Diameter (mm) | Total height (mm) | Weight (g) |
|--------------|----------------|---------------------|--------------------------|---------------|-------------------|------------|
| CG-320B*1 | Lithium Cobalt | 3.8 | 16 | 3.65 | 20.0 | 0.5 |
| CG-420A*1 | Lithium Cobalt | 3.8 | 23 | 4.7 | 20.0 | 0.8 |
| CG-425A*1 | Lithium Cobalt | 3.8 | 32 | 4.7 | 25.0 | 1.0 |

The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

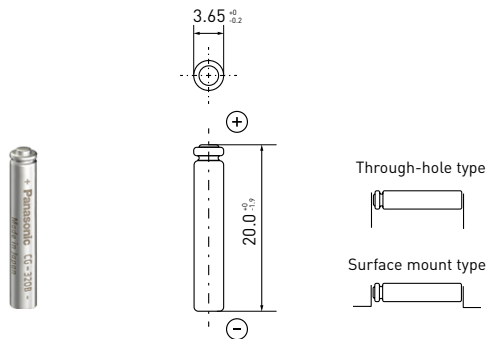
*1 This battery is supplied with tabs only.

*2 Based on standard drain and cut off voltage down to 3.0V at 20°C. State-of-charge ex-factory: ~30%.

LITHIUM-ION RECHARGEABLE BATTERIES (CG-SERIES) - PIN TYPE

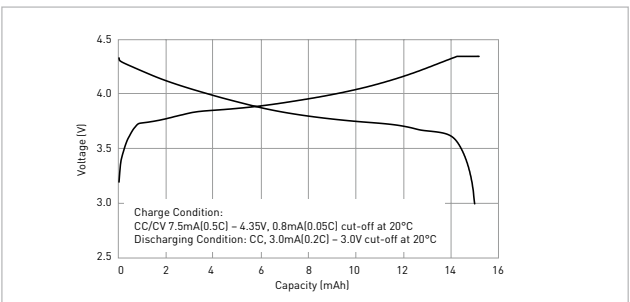
CG-320B

DIMENSIONS (MM)

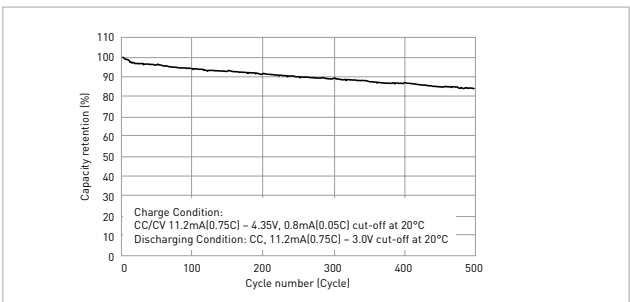


| Specifications | CG-320B |
|------------------------------------|------------|
| Nominal voltage (V) | 3.8 |
| Typical capacity (mAh) | 16.0 |
| Diameter (mm) | 3.65 |
| Total height (mm) | 20.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Charging temperature range (°C) | 0 to +60 |
| Weight (g) | 0.5 |

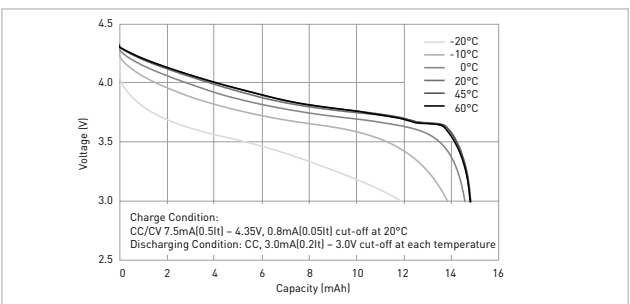
CHARGE AND DISCHARGE CHARACTERISTICS



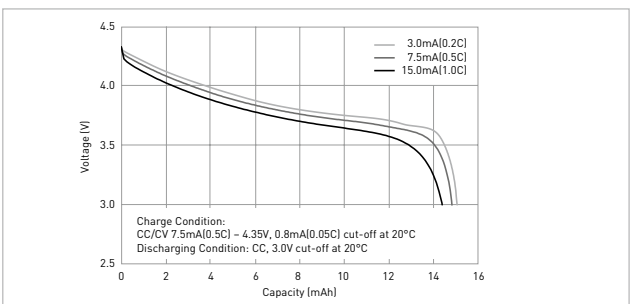
CYCLE LIFE CHARACTERISTICS



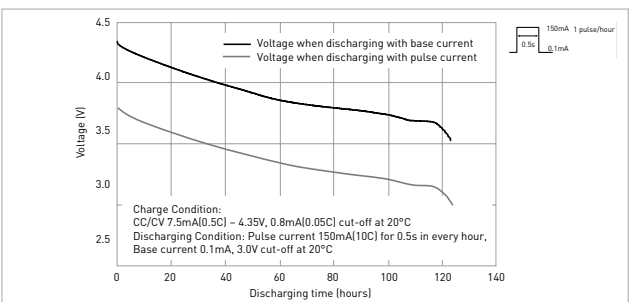
DISCHARGE CHARACTERISTICS BY TEMPERATURE



DISCHARGE CHARACTERISTICS BY RATE OF DISCHARGE

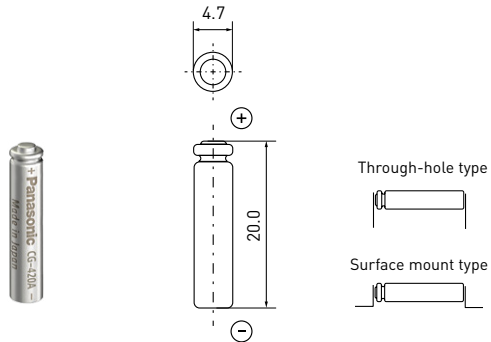


PULSE DISCHARGING CHARACTERISTICS



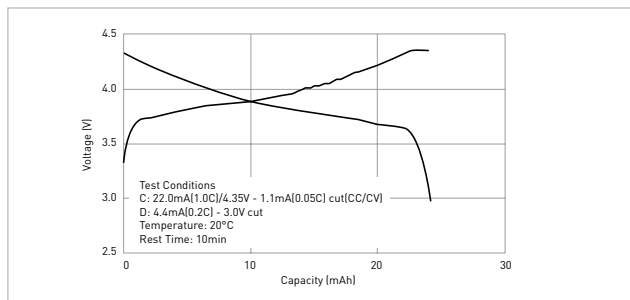
CG-420A

DIMENSIONS (MM)

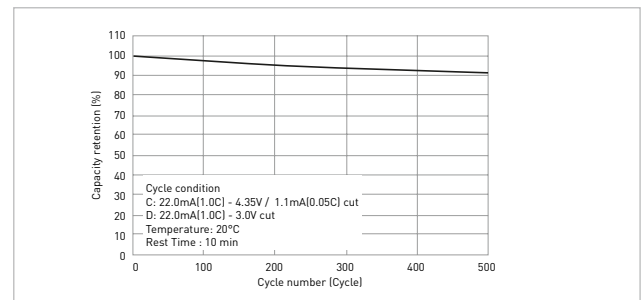


| Specifications | CG-420A |
|------------------------------------|------------|
| Nominal voltage (V) | 3.8 |
| Typical capacity (mAh) | 23.0 |
| Diameter (mm) | 4.7 |
| Total height (mm) | 20.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Charging temperature range (°C) | 0 to +60 |
| Weight (g) | 0.8 |

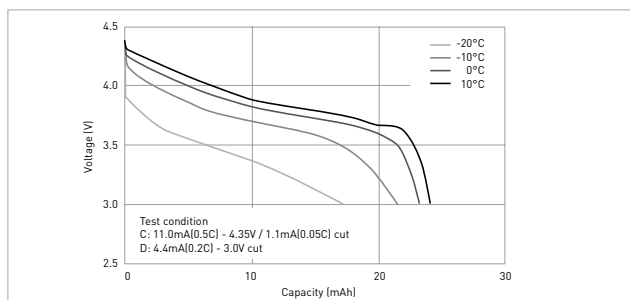
CHARGE AND DISCHARGE CHARACTERISTICS



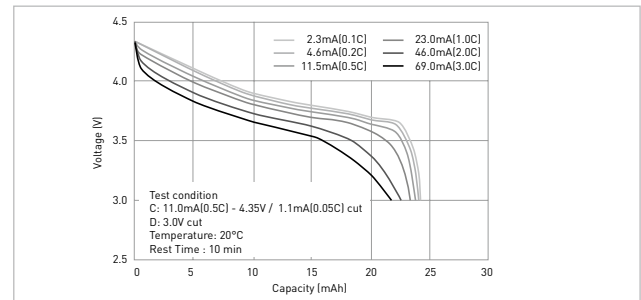
CYCLE LIFE CHARACTERISTICS



DISCHARGE CHARACTERISTICS BY TEMPERATURE

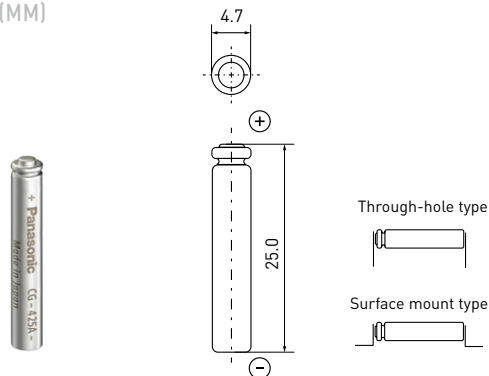


DISCHARGE CHARACTERISTICS BY RATE OF DISCHARGE



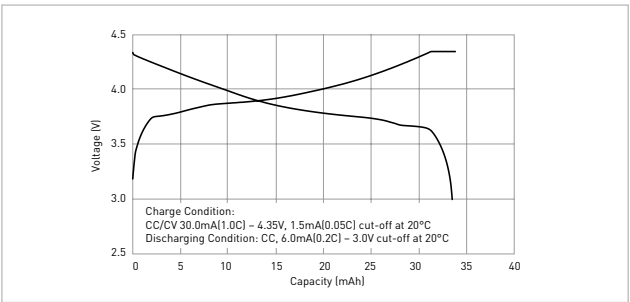
CG-425A

DIMENSIONS (MM)

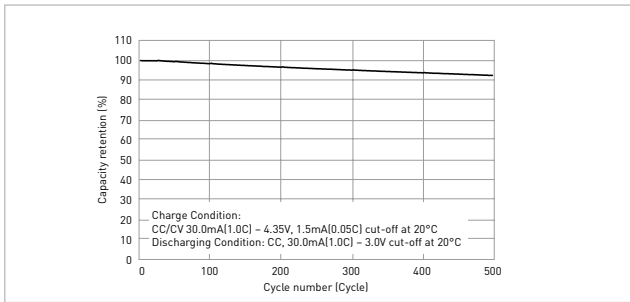


| Specifications | CG-425A |
|------------------------------------|------------|
| Nominal voltage (V) | 3.8 |
| Typical capacity (mAh) | 32.0 |
| Diameter (mm) | 4.7 |
| Total height (mm) | 25.0 |
| Discharging temperature range (°C) | -20 to +60 |
| Charging temperature range (°C) | 0 to +60 |
| Weight (g) | 1.0 |

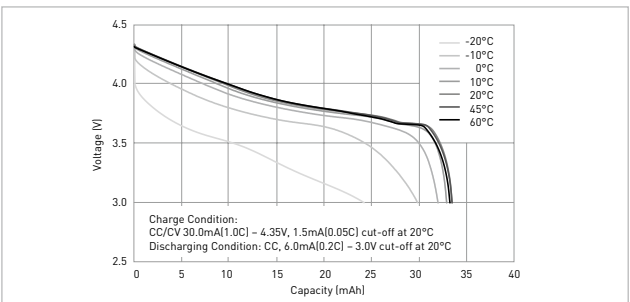
CHARGE AND DISCHARGE CHARACTERISTICS



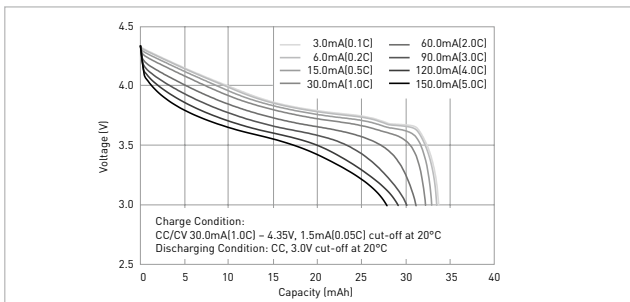
CYCLE LIFE CHARACTERISTICS



DISCHARGE CHARACTERISTICS BY TEMPERATURE



DISCHARGE CHARACTERISTICS BY RATE OF DISCHARGE



LONG-STANDING EXPERIENCE IN HIGH QUALITY WELDING AND SOLDERING METHODS



Due to Panasonic's long experience in quality welding and soldering methods, our customers can always expect the best terminal solution for their application. Our comprehensive line-up of different terminal types covers nearly every requirement – and custom-made solutions are possible as well.

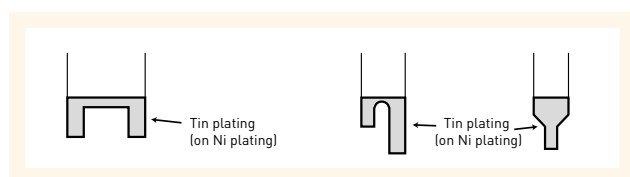
BATTERY TERMINALS

Terminal welding

For terminal welding on the battery, it is quite important to establish the best welding method and its best conditions in order to keep the strong weld strength without any damages on the battery performances. Panasonic mainly use the Laser welding method which is applicable to attach terminals on even quite small batteries that the spot welding hardly to do for. Therefore, our products can correspond exactly and flexibly to various applications. Also, we have established our own high reliable welding capability with a lot of amount of testing data to search the best weld condition for each various combinations of various battery sizes and terminal shapes, which can be provided for widespread equipments and devices.

Soldering on PCB

On the edge of all terminal, tin plating is applied for increasing the reliability of soldering instead of the solder plate in order to consider influences on environments.



Complete Line-up

Panasonic offers a full range of batteries with terminals for various PCB mounting. Since the terminals come in a variety types, please contact Panasonic for further details. On the other hand, we also provide battery holders for some limited sizes.

SOLDERING LITHIUM BATTERIES

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 (heat resistance BR type is 125°C).

Automatic dip-soldering bath

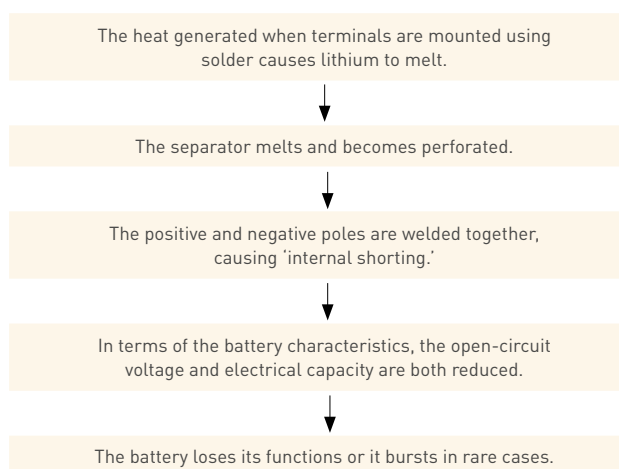
Soldering with a dip-soldering bath can be used by condition but do not allow the temperature of the battery bodies exceed 85°C. It is important to note, depending on the temperature conditions inside the dipping device, that the battery body temperature may rise after dipping due to the residual heat 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.

Basic conditions

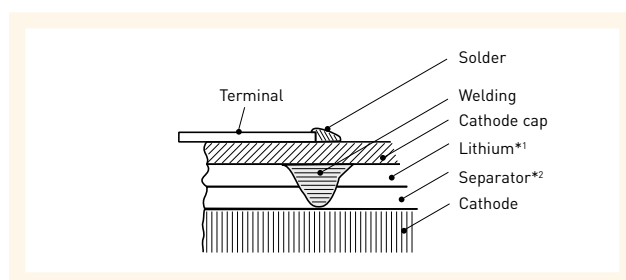
| | |
|---------------------------------|------------------|
| Solder dipping bath temperature | Not exceed 260°C |
| Dipping duration | Within 5 sec. |
| Number of dipping | Within 2 times |

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:



Soldering

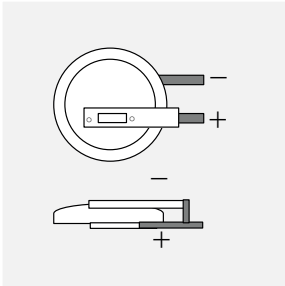


TERMINAL TYPES

Panasonic offers a broad range of different tabs for our Lithium batteries in order to meet all customer needs. In addition tailor-made solutions are possible as well.

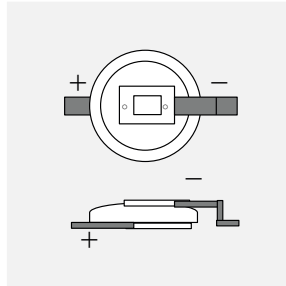
F TYPE

Surface mount
(short distance)



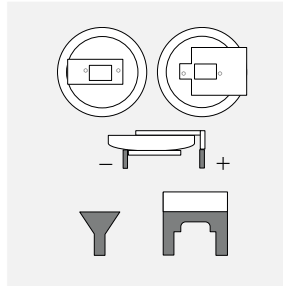
F TYPE

Surface mount
(wide distance)



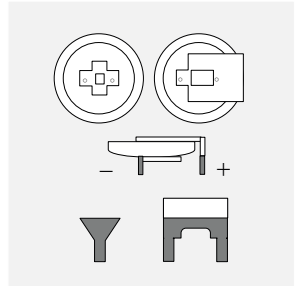
G TYPE

Through hole horizontal
mount (normal distance)



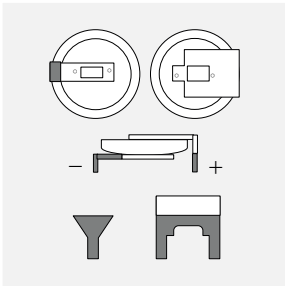
G TYPE

Through hole horizontal
mount (short distance)



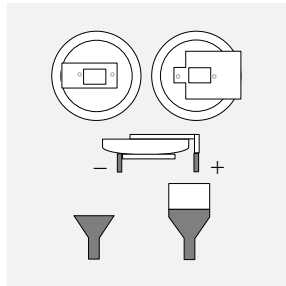
G TYPE

Through hole horizontal
mount (wide distance)



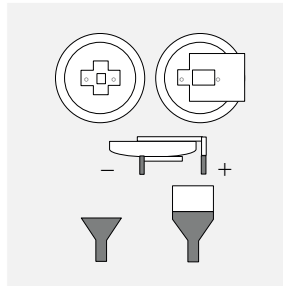
H TYPE

Through hole horizontal
mount (normal distance)



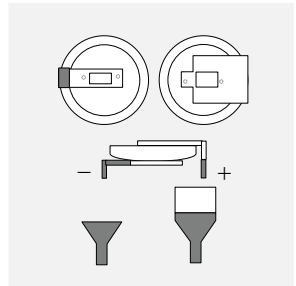
H TYPE

Through hole horizontal
mount (short distance)



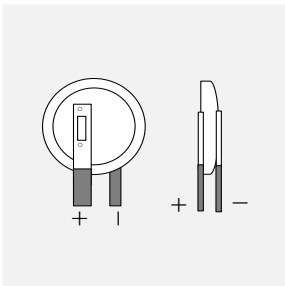
H TYPE

Through hole horizontal
mount (wide distance)



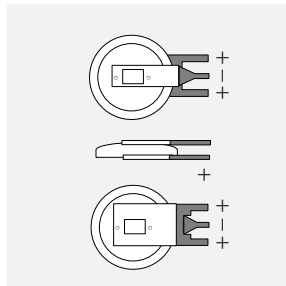
V TYPE

Through hole vertical
mount (two pins)



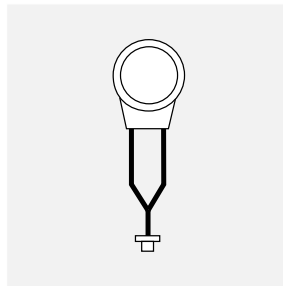
W TYPE

Through hole vertical
mount (three pins)



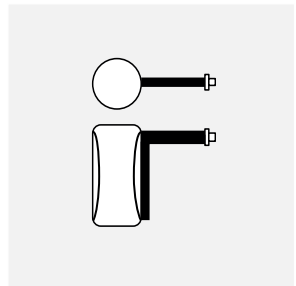
LEAD WIRE TYPE

Coin cell



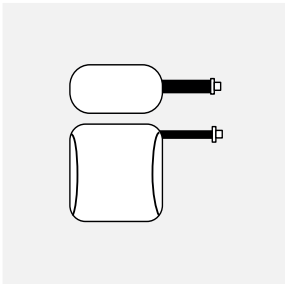
LEAD WIRE TYPE

Single cylindrical cell



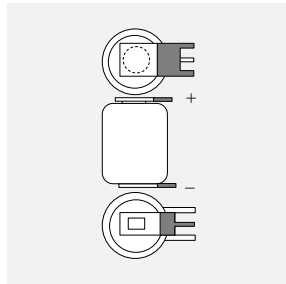
LEAD WIRE TYPE

2 to 6 cells of cylindrical bat-
teries in parallel or in series



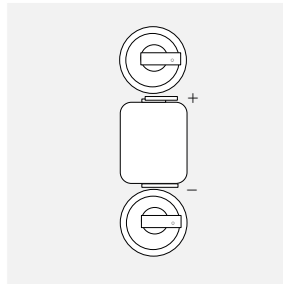
TAB TERMINAL

Cylindrical batteries for
through hole mounting



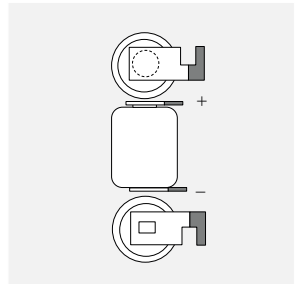
TAB TERMINAL

Cylindrical batteries for
lead wire attaching

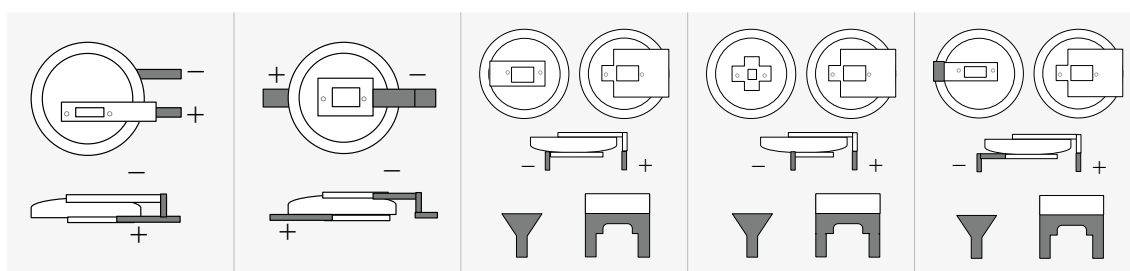


TAB TERMINAL

Cylindrical batteries for
hanging on PCB (hook type)



LITHIUM BATTERY TERMINALS AND SOLDERING



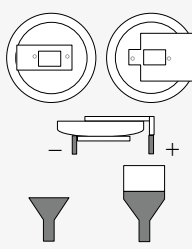
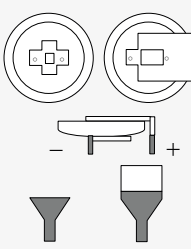
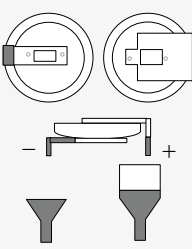
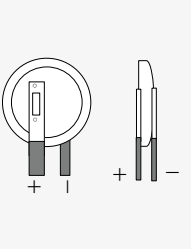
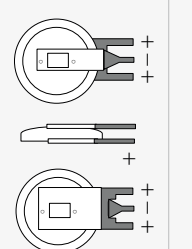
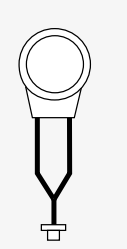
| BATTERY | F TYPE Surface mount (short distance) | F TYPE Surface mount (wide distance) | G TYPE Through hole horizontal mount (normal distance) | G TYPE Through hole horizontal mount (short distance) | G TYPE Through hole horizontal mount (wide distance) |
|----------|---|--|--|---|--|
| CR1025 | N/A | N/A | N/A | N/A | N/A |
| CR1216 | N/A | N/A | N/A | N/A | N/A |
| CR1220 | CR-1220/FCN | N/A | N/A | N/A | N/A |
| CR1616 | N/A | N/A | N/A | N/A | N/A |
| CR1620 | N/A | CR-1620/F9AN | N/A | N/A | N/A |
| CR1632 | N/A | CR-1632/F2N | CR-1632/G1AN | N/A | N/A |
| CR2012 | N/A | N/A | N/A | N/A | N/A |
| CR2016 | N/A | N/A | N/A | N/A | N/A |
| CR2025 | N/A | N/A | N/A | N/A | N/A |
| CR2032 | CR-2032/F4N | CR-2032/F2N | CR-2032/GUFN | N/A | N/A |
| CR2330 | N/A | CR-2330/F3N | N/A | CR-2330/GUFN | N/A |
| CR2354 | N/A | CR-2354/F2N | N/A | CR-2354/GUFN | N/A |
| CR2412 | N/A | N/A | N/A | N/A | N/A |
| CR2450 | N/A | N/A | N/A | CR-2450/G1AN | N/A |
| CR2477 | N/A | CR-2477/F2N | N/A | N/A | CR-2477/G1AN |
| CR3032 | N/A | CR-3032/F2N | N/A | N/A | N/A |
| CR2032A | N/A | N/A | N/A | N/A | N/A |
| CR2032B | CR-2032B/FCN | N/A | N/A | N/A | N/A |
| CR2050A | N/A | N/A | N/A | N/A | N/A |
| CR2050B2 | CR-2050B2/FAN | N/A | N/A | N/A | N/A |
| CR2450A | CR-2450A/FKN | N/A | N/A | CR-2450A/GBN | N/A |
| BR1220 | BR-1220/FCN | N/A | N/A | N/A | N/A |
| BR1225 | BR-1225/F1AN | N/A | N/A | N/A | N/A |
| BR1632 | N/A | BR-1632/F2N | N/A | N/A | N/A |
| BR2032 | BR-2032/F4N | BR-2032/F2N | BR-2032/GUFN | N/A | N/A |
| BR2325 | N/A | N/A | BR-2325/HGN | N/A | N/A |
| BR2330 | N/A | BR-2330/F3N | N/A | BR-2330/GUFN | N/A |
| BR3032 | N/A | BR-3032/F2N | N/A | Please contact us. | N/A |
| BR1225A | BR-1225A/FAN | N/A | N/A | N/A | N/A |
| BR1632A | N/A | BR-1632A/FAN | BR-1632A/GBN | N/A | N/A |
| BR2330A | N/A | BR-2330A/FAN | N/A | Please contact us. | N/A |
| BR2450A | BR-2450A/FJN | N/A | N/A | BR-2450A/GBN | N/A |
| BR2477A | N/A | BR-2477A/FBN | N/A | N/A | BR-2477A/GAN |

The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

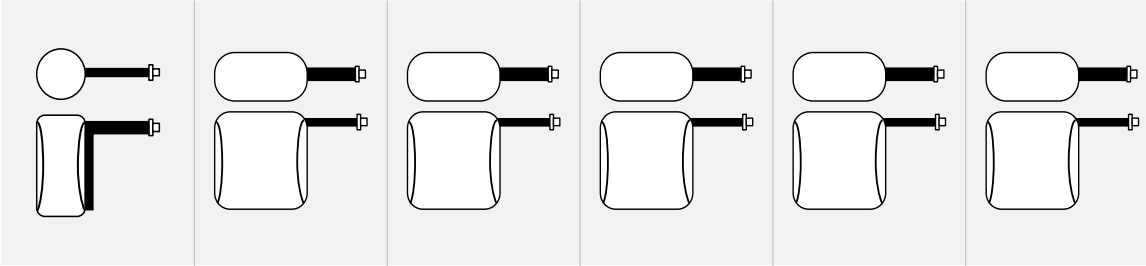
*¹ Metal which melting point is about 180°C.

*² Non woven cloth of polypropylene which melting point is about 165°C.

LITHIUM BATTERY TERMINALS AND SOLDERING

|  |  |  |  |  |  | |
|---|---|---|---|--|---|-----------------|
| H TYPE Through hole horizontal mount (normal distance) | H TYPE Through hole horizontal mount (short distance) | H TYPE Through hole horizontal mount (wide distance) | V TYPE Through hole vertical mount (two pins) | W TYPE Through hole vertical mount (three pins) | LEAD WIRE TYPE Coin cell | BATTERY |
| CR-1025/H9AN | N/A | N/A | Please contact us. | N/A | N/A | CR1025 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR1216 |
| N/A | CR-1220/HFN | N/A | CR-1220/VCN | N/A | N/A | CR1220 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR1616 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR1620 |
| CR-1632/HFN | N/A | N/A | CR-1632/V1AN | N/A | Please contact us. | CR1632 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR2012 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR2016 |
| N/A | N/A | CR-2025/HFN | Please contact us. | N/A | N/A | CR2025 |
| N/A | N/A | CR-2032/HFN | CR-2032/VS1N | CR-2032/GVFN | N/A | CR2032 |
| N/A | N/A | N/A | N/A | CR-2330/GVFN | N/A | CR2330 |
| N/A | CR-2354/HFN | N/A | CR-2354/VCN | N/A | N/A | CR2354 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR2412 |
| N/A | CR-2450/H1AN | N/A | CR-2450/VAN | CR-2450/G3N | N/A | CR2450 |
| N/A | CR-2477/HFN | N/A | CR-2477/VCN | CR-2477/GVFN | N/A | CR2477 |
| N/A | N/A | N/A | CR-3032/VCN | N/A | N/A | CR3032 |
| N/A | N/A | CR-2032A/HAN | N/A | N/A | N/A | CR2032A |
| N/A | N/A | N/A | N/A | N/A | N/A | CR2032B |
| CR-2050A/HCN | N/A | N/A | N/A | N/A | N/A | CR2050A |
| N/A | N/A | CR-2050B2HCN | N/A | N/A | N/A | CR2050B2 |
| N/A | N/A | N/A | N/A | N/A | N/A | CR2450A |
| N/A | BR-1220/HFN | N/A | BR-1220/VCN | N/A | N/A | BR1220 |
| N/A | BR-1225/H1AN | N/A | BR-1225/VCN | N/A | N/A | BR1225 |
| BR-1632/HFN | N/A | N/A | BR-1632/V1AN | N/A | N/A | BR1632 |
| N/A | N/A | BR-2032/HFN | Please contact us. | BR-2032/GVFN | N/A | BR2032 |
| BR-2325/HCN | N/A | N/A | BR-2325/VCN | N/A | N/A | BR2325 |
| BR-2330/HFN | N/A | N/A | Please contact us. | BR-2330/GVFN | N/A | BR2330 |
| N/A | N/A | Please contact us. | BR-3032/VCN | N/A | N/A | BR3032 |
| N/A | BR-1225A/HBN | N/A | BR-1225A/VAN | N/A | N/A | BR1225A |
| BR-1632A/HAN | N/A | N/A | BR-1632A/VAN | N/A | N/A | BR1632A |
| BR-2330A/HDN | N/A | N/A | BR-2330A/VAN | BR-2330A/GDN | N/A | BR2330A |
| N/A | BR-2450A/HAN | N/A | N/A | N/A | N/A | BR2450A |
| N/A | BR-2477A/HBN | N/A | BR-2477A/VAN | N/A | N/A | BR2477A |

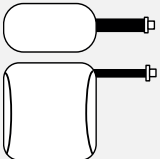
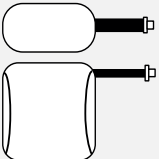
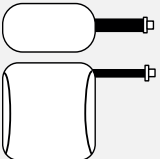
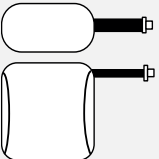
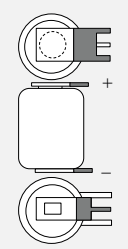


LITHIUM BATTERY TERMINALS AND SOLDERING

| BATTERY |  | | | | | |
|----------|--|---------------------------------------|---------------------------------------|---------------------------------------|--|---------------------------------------|
| | LEAD WIRE TYPE 1 cell | LEAD WIRE TYPE 2 cells in parallel | LEAD WIRE TYPE 3 cells in parallel | LEAD WIRE TYPE 4 cells in parallel | LEAD WIRE TYPE 5 cells in parallel with protection device | LEAD WIRE TYPE 5 cells in parallel |
| CR2 | N/A | N/A | N/A | N/A | N/A | N/A |
| CR123A | N/A | N/A | N/A | N/A | N/A | N/A |
| 2CR5 | N/A | N/A | N/A | N/A | N/A | N/A |
| CR-P2 | N/A | N/A | N/A | N/A | N/A | N/A |
| CR-AGZ | CR-AGZC22N | Please contact us. | Please contact us. | Please contact us. | Please contact us. | Please contact us. |
| CR-AG | CR-AGC22N | CR-AGDCF2TN | Please contact us. | Please contact us. | Please contact us. | Please contact us. |
| CR-2/3AZ | CR-2/3AZC22N | Please contact us. | Please contact us. | Please contact us. | Please contact us. | Please contact us. |
| CR2Z | Please contact us. | Please contact us. | Please contact us. | N/A | N/A | N/A |
| CR2U | Please contact us. | Please contact us. | Please contact us. | N/A | N/A | N/A |
| CR-AAU | CR-AAUC3N | Please contact us. | Please contact us. | Please contact us. | Please contact us. | Please contact us. |
| CR-AAK | N/A | N/A | N/A | N/A | N/A | N/A |
| BR-1/2AA | BR-1/2AAC2P | N/A | N/A | N/A | N/A | N/A |
| BR-2/3A | N/A | N/A | N/A | N/A | N/A | N/A |
| BR-2/3AG | N/A | N/A | N/A | N/A | N/A | N/A |
| BR-A | N/A | N/A | N/A | N/A | N/A | N/A |
| BR-AG | N/A | N/A | N/A | N/A | N/A | N/A |
| BR-C | N/A | N/A | N/A | N/A | N/A | N/A |

The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

*¹ Metal which melting point is about 180°C.

*² Non woven cloth of polypropylene which melting point is about 165°C.

|  |  |  |  |  |  |  | |
|---|---|---|---|---|--|---|----------|
| LEAD WIRE TYPE 5 cells in parallel with protection device | LEAD WIRE TYPE 6 cells in parallel | LEAD WIRE TYPE 2 cells in series | LEAD WIRE TYPE 3 cells in series | TAB TERMINAL Cylindrical batteries for through hole mounting | TAB TERMINAL Cylindrical bat- teries for lead wire attaching | TAB TERMINAL Cylindrical batteries for hanging on PCB (hook type) | BATTERY |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | CR2 |
| N/A | N/A | N/A | Please contact us. | N/A | N/A | N/A | CR123A |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2CR5 |
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | CR-P2 |
| Please contact us. | Please contact us. | Please contact us. | Please contact us. | CR-AGZE2N | N/A | N/A | CR-AGZ |
| Please contact us. | Please contact us. | Please contact us. | Please contact us. | CR-AGE2N | N/A | CR-AGDE27N | CR-AG |
| Please contact us. | Please contact us. | Please contact us. | Please contact us. | CR-2/3AZE2PN | N/A | CR-2/3AZE27N | CR-2/3AZ |
| N/A | N/A | Please contact us. | Please contact us. | CR-2ZLE2N | N/A | N/A | CR2Z |
| N/A | N/A | Please contact us. | Please contact us. | N/A | N/A | N/A | CR2U |
| Please contact us. | Please contact us. | Please contact us. | Please contact us. | CR-AAUE2N | N/A | N/A | CR-AAU |
| N/A | N/A | N/A | Please contact us. | N/A | N/A | N/A | CR-AAK |
| N/A | N/A | N/A | N/A | BR-1/2AAE2PN | N/A | N/A | BR-1/2AA |
| N/A | N/A | N/A | N/A | BR-2/3AE2PN | N/A | N/A | BR-2/3A |
| N/A | N/A | N/A | N/A | BR-2/3AGE2PN | N/A | N/A | BR-2/3AG |
| N/A | N/A | N/A | N/A | BR-AE2SPE | N/A | N/A | BR-A |
| N/A | N/A | N/A | N/A | BR-AGE2PE | N/A | N/A | BR-AG |
| N/A | N/A | N/A | N/A | N/A | BR-CT2SP | N/A | BR-C |

PRODUCT CERTIFICATIONS

UL approved batteries

All our Lithium batteries are in compliance with UL 1642 (primary and secondary lithium batteries) - file number MH 12210. These requirements cover lithium batteries intended for use in technician-replaceable or user-replaceable applications.

FACTORY CERTIFICATIONS

All our production sites are ISO 9001 und ISO 14001 certified. Moriguchi, Japan and Jakarta, Indonesia sites are additionally certified towards IATF 16949. Moriguchi, Japan is also certified according to OHSAS 18001.

APPLICABLE STANDARDS

IEC 60086-1

Standardization of primary batteries with respect to their electrochemical system, dimensions, nomenclature, terminal configurations, markings, test methods, typical performance, safety and environmental aspects.

Applicable products in this catalogue:

BR-2/3A (BR17335), BR-2/3AG (BR17335), CR-2 (CR15H270), CR-123A (CR17345), 2CR-5 (2CR5), CR-P2 (CRP2), BR-1225 (BR1225), BR-2325 (BR2325), CR-1025 (CR1025), CR-1216 (CR1216), CR-1220 (CR1220), CR-1616 (CR-1616), CR-1620 (CR1620), CR-2012 (CR2012), CR-2016 (CR2016), CR-2025 (CR2025), CR-2032 (CR2032), CR-2330 (CR2330), CR-2354 (CR2354), CR-2450 (CR2450), CR-3032 (CR3032)

IEC 60086-2

Complements the general information and requirements of IEC 60086-1.

IEC 60086-3

Specifies dimensions, designation, methods of tests and requirements for primary batteries for watches.

Applicable products in this catalogue:

BR-1225 (BR1225), BR-2325 (BR2325), CR-1025 (CR1025), CR-1216 (CR1216), CR-1220 (CR1220), CR-1616 (CR-1616), CR-1620 (CR1620), CR-2012 (CR2012), CR-2016 (CR2016), CR-2025 (CR2025), CR-2032 (CR2032), CR-2330 (CR2330), CR-2354 (CR2354), CR-2450 (CR2450)

IEC 60086-4

Requirements for primary lithium batteries to ensure their safe operation under intended use and reasonably foreseeable misuse.

Applicable products in this catalogue: BR, CR

Although not mandatory, Panasonic is progressing third party test certification aka CB-scheme according to this standard.

For several battery types in this catalogue, such a report is available on request.

IEC 62133-2

Requirements and tests for the safe operation of portable sealed secondary lithium cells and batteries containing non-acid electrolyte, under intended use and reasonably foreseeable misuse.

Applicable products in this catalogue: CG

LITHIUM BATTERY TRANSPORTATION

The transportation of lithium batteries is regulated by the International Air Transport Association (IATA), the International Civil Aviation Organization (ICAO) and Accord européen relatif au transport international des marchandises Dangereuses par Route (ADR).

All batteries are approved in accordance to UN Spezial Provision SP 188 Manual of Tests & Criteria Part III Subsection 38.3.

Transport test related to UN 38.3 reports are available on request.

Transport by road/rail

UN 3090 takes place under ADR/RID 2019

Transport by sea

UN 3090 takes place under IMDG Code 2019

Transport by air

UN 3090 takes place under IATA DGR 2020 61st Edition

SECURITY EXPORT CONTROL

'Security export control' entails observing the legislation provided to maintain international peace and safety by preventing the proliferation of weapons of massive 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. Later, as part of a new export control regime, Russia and Eastern European countries joined with the previously affiliated nations of COCOM (Japan, America and Europe) and established the Wassenaar Arrangement for dual-use goods & technologies related to conventional weapons. According to the Export Trade Control Order revised by the Japanese Ministry of Economy, Trade & Industry in May 2008, batteries listed in this catalogue are classified as 'batteries' not 'cells', and will therefore not be controlled by (7) in annex table 1 to the order. The above notwithstanding, these batteries may be subject to the regulations depending on their ultimate destination, application and other conditions. When a certificate of classification is required for exportation, etc. or if you have any queries, contact a Panasonic sales representative.

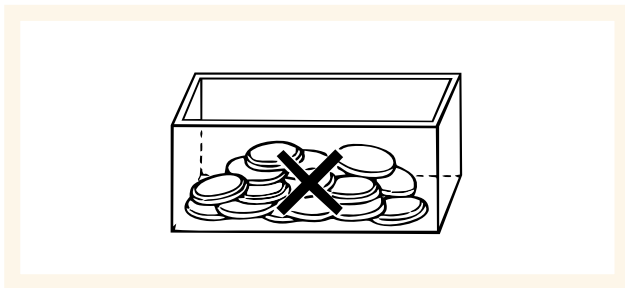
Case Study and Explanation

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.

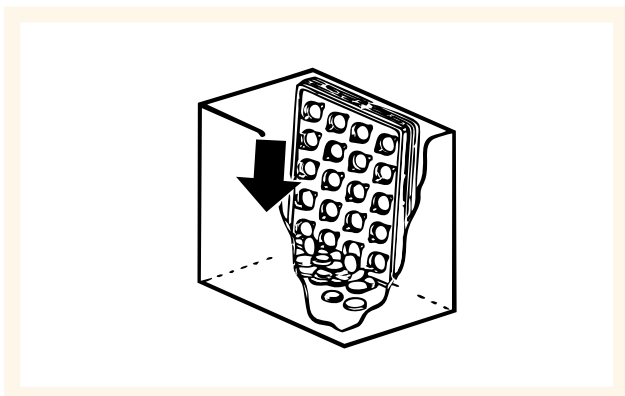
Case study: Ignition of batteries stacked together



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.

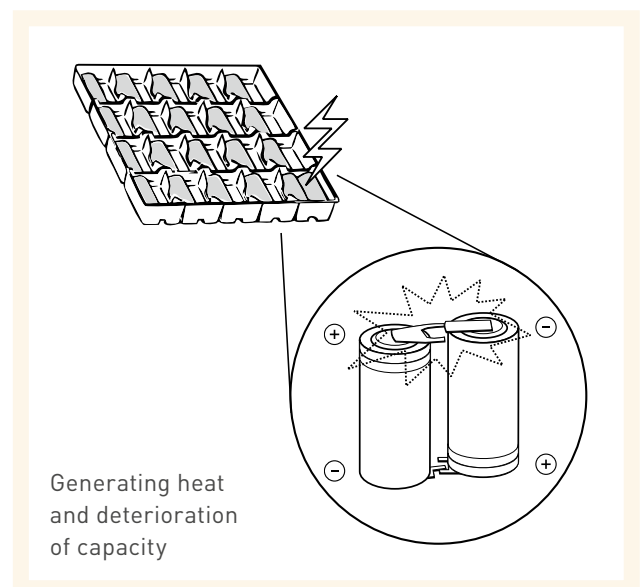
Case study: Bursting of batteries stacked on top of one another



Generating Heat

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. 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 tubes to burst.

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



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.

REDUCTION OF BATTERY VOLTAGE AND DETERIORATION OF CAPACITY

Reduction of battery voltage and deterioration of capacity through contact with antistatic conductive materials

Incidents have been reported where terminal-mounted batteries for memory back-up 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 $10^6 \Omega/\text{cm}$, for instance. This means that if the \oplus and \ominus 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 \oplus and \ominus terminals of the batteries or PC boards, etc. on which batteries are mounted do not touch these protective materials directly.

Fig. 1 A terminal-mounted battery was inserted into a conductive mat. The battery charge was exhausted in several days.

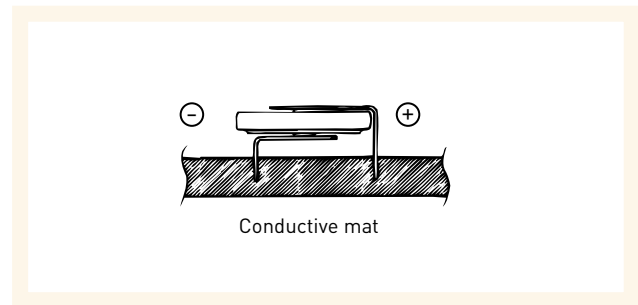


Fig. 2 Battery-mounted PC boards were inadvertently brought into contact with spacers and a conductive rubber sheet. The battery charge was exhausted.

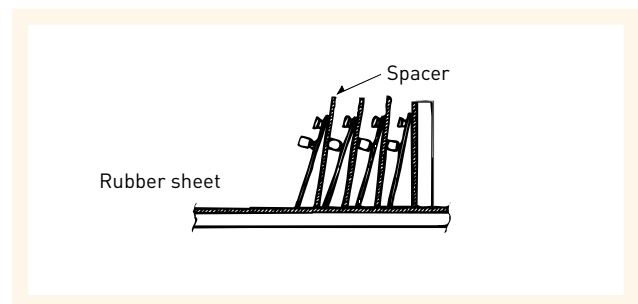


Fig. 3 A battery-mounted PC board was inadvertently brought into contact with a conductive resin case. The battery charge was exhausted.

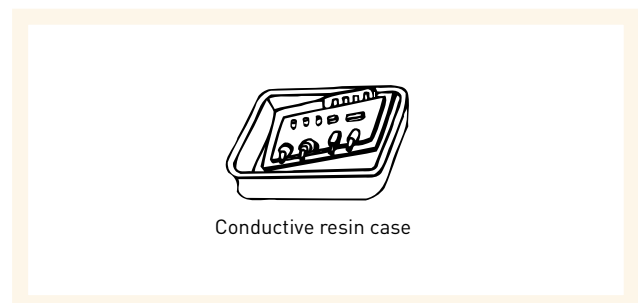
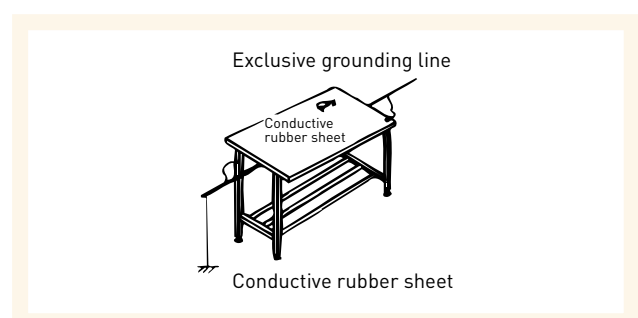


Fig. 4 A battery was placed directly on a rubber sheet spread over a worktable. The \oplus and \ominus terminals were in contact with the sheet and the battery charge was exhausted.

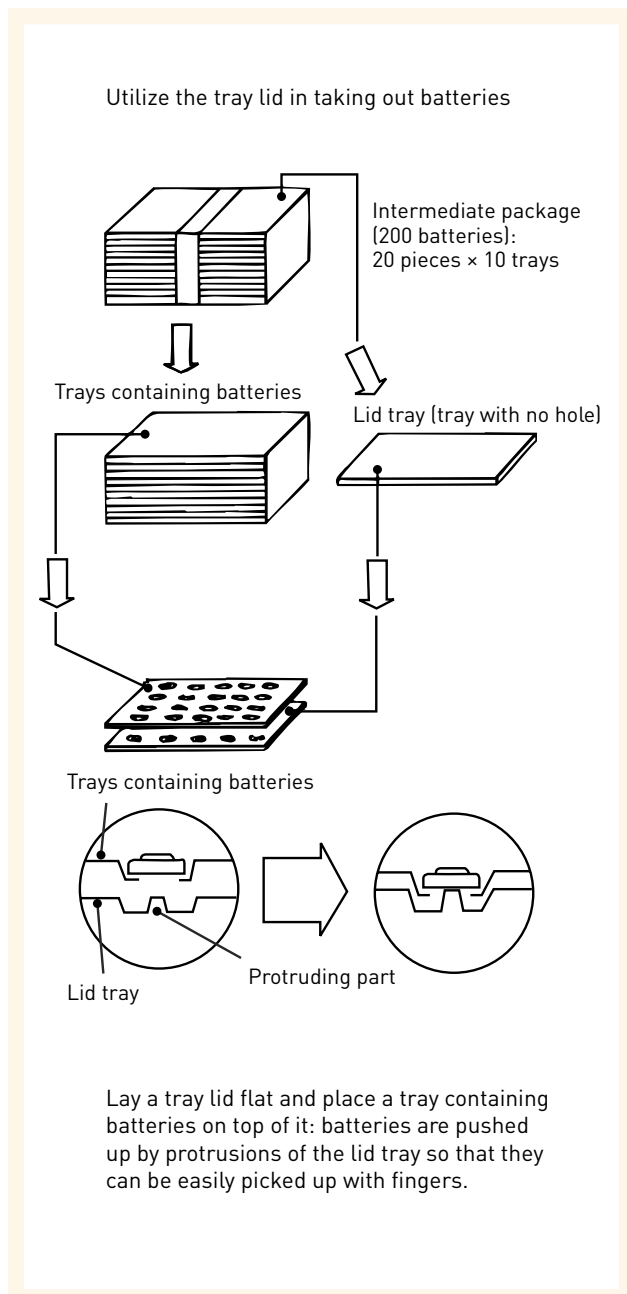


Reduction of battery voltage and deterioration of capacity through contact between batteries

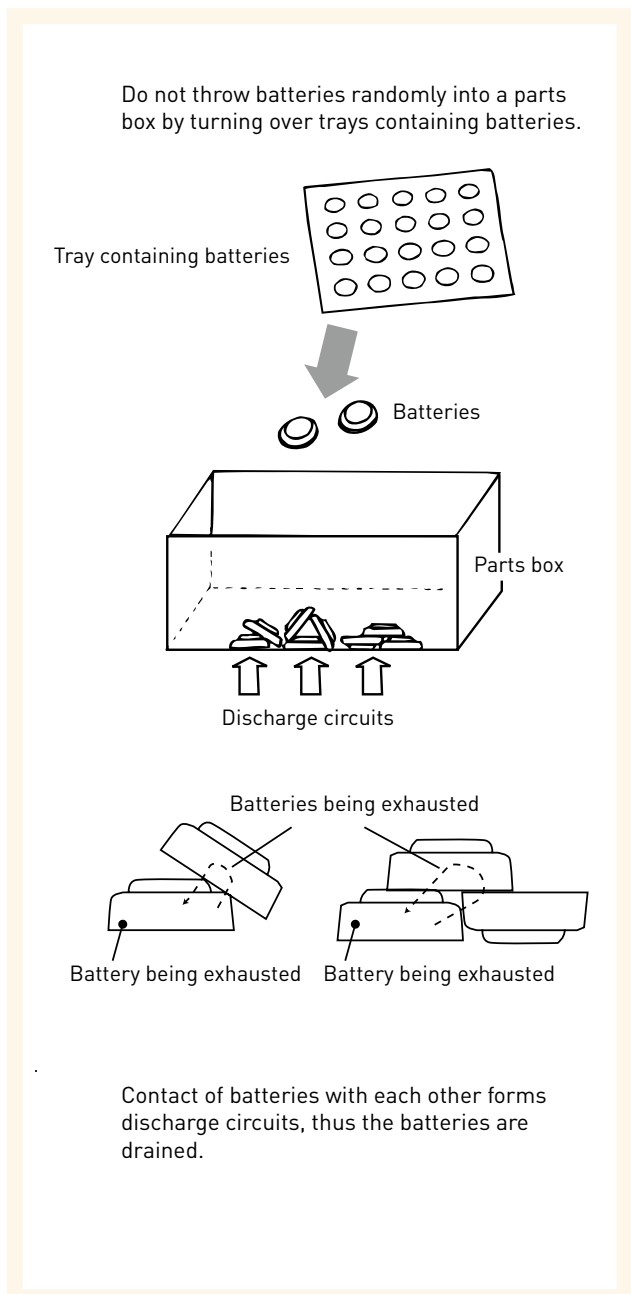
Incidents have been reported where terminal-mounted batteries for memory back-up or coin type lithium batteries have come into contact each other, thus forming discharge circuits (shorted state) and leading to voltage drops or capacity deterioration. Observe the following precautions.

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



✗ Prohibited procedures



Memory Erasure Problems

Coin type lithium batteries are often used as the power supplies for memory back-up 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 CR-2032 and BR-2032, see fig. 2) are available for use.
 - 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 CR-2032 and BR-2032, 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 1,000gf). (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 samples see Fig. 1-6

Fig. 1 Soldering

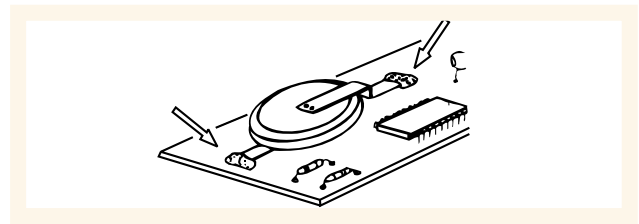


Fig. 2

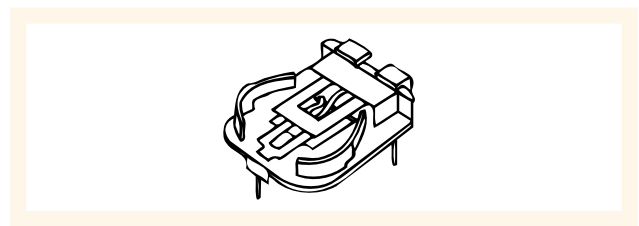


Fig. 3

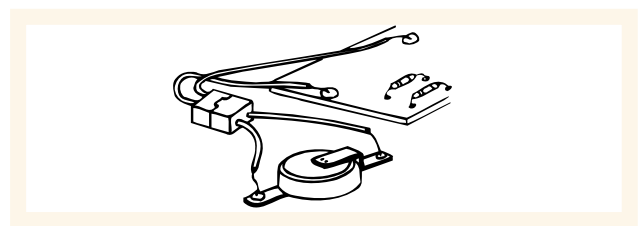


Fig. 4

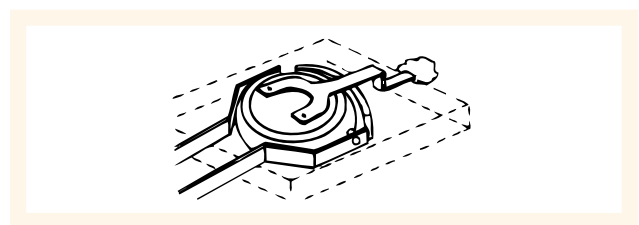


Fig. 5 Excessive load

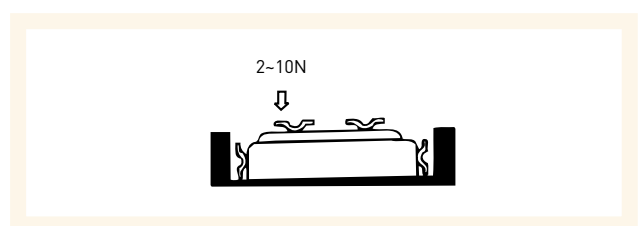
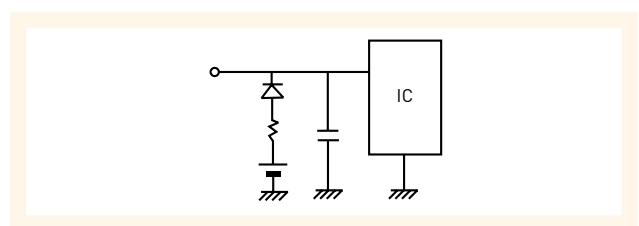


Fig. 6



FIND THE RIGHT CONTACT



YouTube Channel

Please find a comprehensive selection of Panasonic battery videos at our YouTube Channel.

<https://www.youtube.com/user/panasonicbatteries>



E-mail and website for all European countries

battery-solutions@eu.panasonic.com

<http://industry.panasonic.eu>

Notice to Readers

It is the responsibility of each user to ensure that every battery application is adequately designed safe and compatible with all conditions encountered during use, and in conformance with existing standards and requirements. This literature contains information concerning cells and batteries manufactured by Panasonic Corporation. This information is descriptive only and is not intended to make or imply any representation, guarantee or warranty with respect to any cells and batteries. Cell and battery designs are subject to modification without notice.

Panasonic®

Panasonic is a registered trademark of Panasonic Corporation. Printed in Germany 2021

© Panasonic Corporation

For more details please contact:

United Kingdom/Ireland

Panasonic Industry Europe GmbH

Maxis 2, Western Road

Bracknell Berkshire

RG12 1RT, England

Phone: +44 1344 853260

Italy

Panasonic Industry Italy (PIIT)

Viale dell'Innovazione 3

20126 Milano, Italy

Phone: +39 02 6788-1

Spain/Portugal

Panasonic Industry Europe GmbH

Sucursal en España

Parque Empresarial @ Sant Cugat,

Via Augusta 15-25

Edificio B2 Planta 4 Oficina 17

08174 Sant Cugat del Valles

Barcelona, Spain

Phone: +34 93 5043010

France

Panasonic Industry Europe GmbH

10, rue des petits ruisseaux

91370 Verrières-le-Buisson, France

Phone: +33 1 60135762

Germany (all other European countries)

Panasonic Industry Europe GmbH

Winsbergring 15

22525 Hamburg, Germany

Phone: +49 40 8549-6373