

# Ni-MH

Technical Handbook

Industrial Batteries for Professionals





# INDEX

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# ONE OF THE WORLD'S LARGEST BATTERY MANUFACTURERS



245,546  
EMPLOYEES\*1



62  
BILLION  
SALES\*2



Panasonic Industry Europe  
Headquarters in Ottobrunn  
(near Munich)





## Panasonic Industry Europe



Batteries



Automotive



Factory Solutions



Industry

## 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 up to complete solutions and production equipment for manufacturing lines across a broad range of industries.



Panasonic Industry Europe Office in Hamburg

## 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.



\*1 Employees of Panasonic Corporation

\*2 Refers to the fiscal year ended March 2020

of Panasonic Corporation, based on exchange rate EUR/JPY 121.

# 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!

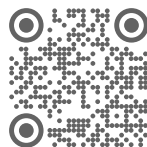
## Mediapool

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:

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- 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
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Get the right product overview

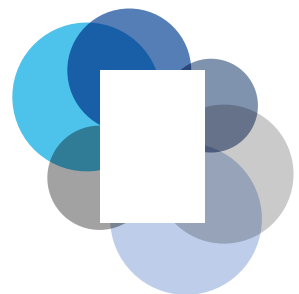
Our range of digital tools to help you in your daily work are complemented by our 'classics' on paper: the Short Form Catalog and the technical handbooks on the various battery product groups. These remain popular with customers as valuable reference aids.



## YouTube Channel

Find the right battery video

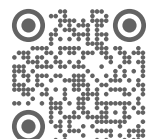
Please find a comprehensive selection of Panasonic battery videos at our YouTube channel. You can discover videos about the inner structure of our different battery chemistries, a couple of application videos and films which explain why batteries sometimes help to save human lives and sharks' lives as 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.



In order to take full advantage of the properties of Ni-MH batteries and also to prevent problems due to improper use, please note the following points during the use and design of battery operated products.

### CHARGING

#### Charging temperature

Charge batteries within an ambient temperature range of 0°C to 45°C. Ambient temperature during charging affects charging efficiency. As charging efficiency is best within a temperature range of 10°C to 30°C, whenever possible place the charger (battery pack) in a location within this temperature range.

At temperatures below 0°C the gas absorption reaction is not adequate, causing gas pressure inside the battery to rise, which can activate the safety vent and lead to leakage of Alkaline gas and deterioration in battery performance.

Charging efficiency drops at temperatures above 40°C. This can disrupt full charging and lead to deterioration in performance and battery leakage.

#### Parallel charging of batteries

Sufficient care must be taken during the design of the charger when charging batteries connected in parallel. Consult Panasonic when parallel charging is required.

#### Reverse charging

Never attempt reverse charging. Charging with polarity reversed can cause a reversal in battery polarity causing gas pressure inside the battery to rise, which can activate the safety vent, lead to Alkaline electrolyte leakage, rapid deterioration in battery performance, battery swelling or battery rupture.

#### Overcharging

Avoid overcharging. Repeated overcharging can lead to deterioration in battery performance. ('Overcharging' means charging a battery when it is already fully charged.)

#### Rapid charging

To charge batteries rapidly, use the specified charger (or charging method recommended by Panasonic) and follow the correct procedures.

#### Trickle charging (continuous charging)

Trickle charging cannot be used with Ni-MH batteries, except specific high temperature batteries (please contact Panasonic to get more information). However, after applying a refresh charge using a rapid charge, use a trickle charge of 0.033It to 0.05It. Also, to avoid overcharging with trickle charge, which could damage the cell characteristics, a timer measuring the total charge time should be used.

#### Note: 'It'

During charging and discharging, 'It' is a value indicating current and expressed as a multiple of nominal capacity. The current are expressed as multiples of It A, where It A = C<sub>5</sub> Ah/1h. For example, for a 1,500mAh battery of 0.033It, this value is equal to 1/30 x 1,500, or roughly 50mA.

### DISCHARGING

#### Discharge temperature

Discharge batteries within an ambient temperature range of -10°C to 60°C.

Discharge current level (i. e. the current at which a battery is discharged) affects discharging efficiency. Discharging efficiency is good within a current range of 0.1It to 2It.

Discharge capacity drops at temperatures below -10°C or above 45°C. Such decreases in discharge capacity can lead to deterioration in battery performance.

#### Overdischarge (deep discharge)

Since overdischarging (deep discharge) damages the battery characteristics, do not forget to turn off the switch when discharging, and do not leave the battery connected to the equipment for long periods of time. Also, avoid shipping the battery installed in the equipment.

#### High-current discharging

As high-current discharging can lead to heat generation and decreased discharging efficiency, consult Panasonic before attempting continuous discharging or pulse discharging at currents larger than 2It.

### STORAGE

#### Storage temperature and humidity (short-term)

Store batteries in a dry location with low humidity, no corrosive gases, and at a temperature range of -20°C to 45°C. Storing batteries in a location where humidity is extremely high or where temperatures fall below -20°C or rise above +45°C can lead to the rusting of metallic parts and battery leakage due to expansion or contraction in parts composed of organic materials.

#### Long-term storage (1 year, -20°C to 35°C)

Because long-term storage can accelerate battery self-discharge and lead to the deactivation of reactants, locations where the temperature ranges between 10°C and 30°C are suitable for long-term storage.

When charging for the first time after long-term storage, deactivation of reactants may lead to increased battery voltage and decreased battery capacity. Restore such batteries to original performance by repeating several cycles of charging and discharging.



## PRECAUTIONS FOR DESIGNING DEVICES WITH Ni-MH BATTERIES

When storing batteries for more than 1 year, charge at least once a year to prevent leakage and deterioration in performance due to self-discharging.

### SERVICE LIFE OF BATTERIES

#### Cycle life

Batteries used under proper conditions of charging and discharging can be used 500 cycles or more. Significantly reduced service time in spite of proper charging means that the life of the battery has been exceeded.

Also, at the end of service life, an increase in internal resistance, or an internal short-circuit failure may occur. Chargers and charging circuits should therefore be designed to ensure safety in the event of heat generated upon battery failure at the end of service life.

#### Service life with long-term use

Because batteries are chemical products involving internal chemical reactions, performance deteriorates not only with use but also during prolonged storage.

Normally, a battery will last 2 years (or 500 cycles) if used under proper conditions and not overcharged or overdischarged. However, failure to satisfy conditions concerning charging, discharging, temperature and other factors during actual use can lead to shortened life (or cycle life) damage to products and deterioration in performance due to leakage and shortened service life.

### DESIGN OF PRODUCTS WHICH USE BATTERIES

#### Connecting batteries and products

Never solder a lead wire and other connecting materials directly to the battery, as doing so will damage the battery's internal safety vent, separator, and other parts made of organic materials. To connect a battery to a product, spot-weld a tab made of Nickel or Nickel-plated steel to the battery's terminal strip, then solder a lead wire to the tab. Perform soldering in as short a time as possible. Use caution in applying pressure to the terminals in cases where the battery pack can be separated from the equipment.

#### Material for terminals in products using the batteries

Because small amounts of Alkaline electrolyte can leak from the battery seal during extended use or when the safety vent is activated during improper use, a highly Alkaline-resistant material should be used for a product's contact terminals in order to avoid problems due to corrosion.

High Alkaline-resistant metals	Low Alkaline-resistant metals
Nickel, stainless steel, Nickel-plated steel, etc.	Tin, Aluminum, Zinc, Copper, Brass, etc.

(Note that stainless steel generally results in higher contact resistance.)

#### Temperature related position of batteries in products

Excessively high temperatures (i.e. higher than 45°C) can cause Alkaline electrolyte to leak from the battery, thus damaging the product and shorten battery life by causing deterioration in the separator or other battery parts. Install batteries far from heat-generating parts of the product. The best battery position is in a battery compartment that is composed of an Alkaline-resistant material which isolates the batteries from the product's circuitry. This prevents damage that may be caused by a slight leakage of Alkaline electrolyte from the battery.

#### Discharge end voltage

The discharge end voltage is determined by the formula given below. Please set the end voltage of each battery at 1.1 volts or less.

Number of batteries arranged serially	
1 to 6	$(\text{Number of batteries} \times 1.0) \text{ V}$
7 to 12	$([\text{Number of batteries} - 1] \times 1.2) \text{ V}$

#### Overdischarge (deep discharge) prevention

Overdischarging (deep discharging) or reverse charging damages the battery characteristics. In order to prevent damage associated with forgetting to turn off the switch or leaving the battery in the equipment for extended periods, preventative options should be incorporated in the equipment. At the same time, it is recommended that leakage current is minimised. Also, the battery should not be shipped inside the equipment.

### PROHIBITED ITEMS REGARDING THE BATTERY HANDLING

Panasonic assumes no responsibility for problems resulting from batteries handled in the following manner.

#### Disassembly

Never disassemble a battery, as the electrolyte inside is strong Alkaline and can damage skin and clothes.

#### Short-circuiting

Never attempt to short-circuit a battery. Doing so can damage the product and generate heat that can cause burns.

### **Throwing batteries into a fire or water**

Disposing of a battery in fire can cause the battery to rupture. Also avoid placing batteries in water, as this causes batteries to cease to function.

### **Soldering**

Never solder anything directly to a battery. This can destroy the safety features of the battery by damaging the safety vent inside the cap.

### **Inserting the batteries with their polarities reversed**

Never insert a battery with the positive and negative poles reversed as this can cause the battery to swell or rupture.

### **Overcharging at high currents and reverse charging**

Never reverse charge or overcharge with high currents (i.e. higher than rated). Doing so causes rapid gas generation and increased gas pressure, thus causing batteries to swell or rupture.

Charging with an unspecified charger or specified charger that has been modified can cause batteries to swell or rupture. Be sure to indicate this safety warning clearly in all operating instructions as a handling restriction for ensuring safety.

### **Installation in equipment (with an airtight battery compartment)**

Always avoid designing airtight battery compartments. In some cases, gases (oxygen, hydrogen) may be given off, and there is a danger of the batteries bursting or rupturing in the presence of a source of ignition (sparks generated by a motor, switch, etc.).

### **Use of batteries for other purposes**

Do not use a battery in an appliance or purpose for which it was not intended. Differences in specifications can damage the battery or appliance.

### **Short-circuiting of battery packs**

Special caution is required to prevent short circuits. Care must be taken during the design of the battery pack shape to ensure batteries cannot be inserted in reverse. Also, caution must be given to certain structures or product terminal shapes which can make short-circuiting more likely.

### **Using old and new batteries together**

Avoid using old and new batteries together. Also avoid using these batteries with ordinary dry-cell batteries, Ni-Cd batteries or with another manufacturer's batteries. Differences in various characteristic values, etc. can cause damage to batteries or the product.

### **OTHER PRECAUTIONS**

Batteries should always be charged prior to use. Be sure to charge correctly.

### **FINAL POINT TO KEEP IN MIND**

In order to ensure safe battery use and to prolong the battery performance, please consult Panasonic regarding charge and discharge conditions for use and product design prior to the release of a battery-operated product.

## STANDARD SECTION

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### FACTORY CERTIFICATIONS

All our production sites are **ISO 9001** and **ISO 14001** certified. Panasonic Energy (Wuxi) Co., Ltd. is also certified according to **OHSAS 18001**.

### PRODUCT CERTIFICATIONS

#### **IEC 62133-1**

Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 1: Nickel systems.

Applicable products in this catalogue: all BK batteries.  
Please contact Panasonic if you require CB Test Certificates.

### TRANSPORT REGULATION

**UN 3496** was brought into the 55th edition of the IATA Dangerous Goods Regulations (DGR) to ensure the list of dangerous goods is "complete" and generally aligned with the UN Model Regulations. This UN Number is only used in sea transport.

#### **Transport by air**

These batteries may be shipped by air transport. The batteries are considered not restricted once the shipper complies with Special Provision A199. This may involve the freight forwarder correctly indicating the required text on the air waybill, when an air waybill is used.

The UN Number "UN 3496" is not a UN Number used in air transport and should not be used in association with the description of the goods.

We understand there is some confusion with the mention of "forbidden" against the limited quantity entry for UN 3496, but the special provision makes clear that the entry is only used in sea transport.

#### **Special provision A199**

The UN number UN 3496 is only applicable in sea transport. Nickel-metal hydride batteries or nickel-metal hydride battery-powered devices, equipment or vehicles having the potential of a dangerous evolution of heat are not subject to these Regulations provided they are prepared for transport so as to prevent: (a) a short circuit (e.g. in the case of batteries, by the effective insulation of exposed terminals; or, in the case of equipment, by disconnection of the battery and protection of exposed terminals); and (b) unintentional activation.

The words "Not Restricted" and the Special Provision number must be included in the description of the substance on the Air Waybill as required by 8.2.6, when an Air Waybill is issued.

### EXPORT CONTROL

Our Ni-MH batteries are not regulated by Wassenaar Agreement / Dual Use. This is only made for Lithium Primary and Lithium-Ion batteries.

# IDEAL FOR LESS COMPLEX AND PROFESSIONAL APPLICATIONS



Suitable for nearly every application

High quality and reliability

Good balance in terms of capacity and lifetime

Excellent discharge characteristics

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# Ni-MH BATTERIES

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## OVERVIEW

More and more electric products with sophisticated functions require extremely compact and light battery solutions delivering a high level of energy density. To meet these needs Panasonic Ni-MH batteries have been developed and manufactured with Nickel hydroxide for the positive electrode and hydrogen absorbing alloys, capable of absorbing and releasing hydrogen at high-density levels, for the negative electrode. The Ni-MH battery technology is the Ni-Cd (Nickel-Cadmium) successor technology for rechargeable and portable devices. All of our Ni-MH batteries are Cadmium-free, in order not to be harmful to human beings and our environment.

## CONSTRUCTION

Ni-MH batteries consist of a positive plate containing Nickel hydroxide as its principal active material, a negative plate mainly composed of hydrogen absorbing alloys, a separator made of fine fibers, an Alkaline electrolyte, a metal case and a sealing plate provided with a self-resealing safety vent. Their basic structure is identical to that of Ni-Cd batteries. With cylindrical Ni-MH batteries, the positive and negative plates are divided by the separator, wound into a coil, inserted into the case, and sealed by the sealing plate through an electrically insulated gasket, see page 14.

Panasonic expands the line of Ni-MH cells that are superior to standard Ni-MH products in applications with low-rate charge at high temperatures. Improvements were made in existing Panasonic Ni-MH cells to the negative plate alloy and

separator fiber density. A different electrolyte composition was achieved to improve performance. Superior long-life characteristics can be achieved when combined with appropriate intermittent charge control circuitry. The intermittent charge consumes 1/30<sup>th</sup> the electricity compared to trickle charge and more than doubles the expected life of the Ni-MH cells compared to Ni-Cd cells that have been trickle charged.

## APPLICATIONS

Ni-MH batteries are suitable for virtually all kinds of application where it matters to reduce complexity and cost. There are seven types of Ni-MH batteries available from Panasonic, all of which deliver a good balance between capacity and battery life, with excellent discharge characteristics. As well as the standard type, Panasonic offers batteries for high ambient temperatures to 75°C (for either high discharge rate or long life), batteries for low temperatures to minus 30°C (designed for automotive application), button-top types, high rate discharge and rapid charge batteries, and infrastructure-type batteries which combine high capacity with efficiency even at low temperatures.

With high performance and reliability throughout, Panasonic Ni-MH batteries are de facto all-rounders, and the applications are correspondingly diverse: Transportation, solar energy technology, medical, household and garden equipment, communications equipment, security equipment and automotive backup are just some of the possible applications powered by Panasonic Ni-MH batteries, see page 23 -27.



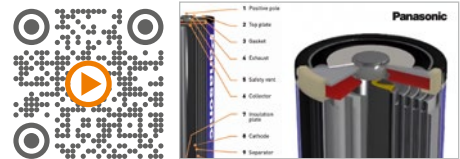
# Ni-MH BATTERIES

## STRUCTURE OF Ni-MH BATTERIES\*1

- 1 Exhaust gas hole
- 2 Safety vent
- 3 Insulation plate
- 4 Tube
- 5 Anode (hydrogen absorbing alloy)
- 6 Separator
- 7 Cathode (Nickel Hydroxide)
- 8 Negative pole (cell can)
- 9 Positive pole
- 10 Top plate
- 11 Gasket
- 12 Collector



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animated video.



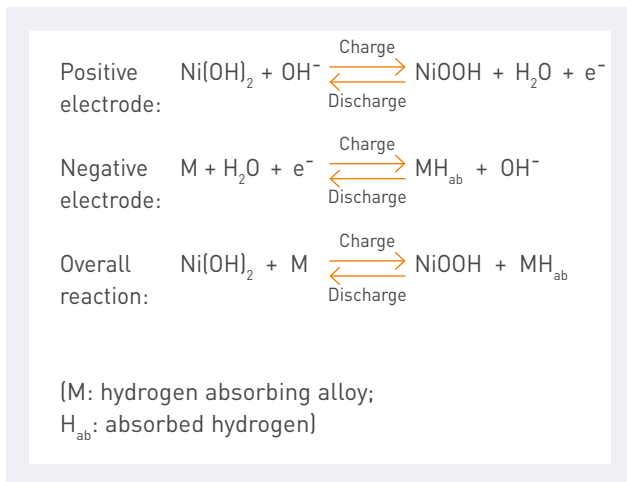
## THE PRINCIPLE OF ELECTROCHEMICAL REACTION INVOLVED IN Ni-MH BATTERIES

### Hydrogen absorbing alloys

Hydrogen absorbing alloys have a comparatively short history which dates back about 40 years to the discovery of NiFe, MgNi and LaNi<sub>5</sub> alloys. They are capable of absorbing hydrogen equivalent to about a thousand times of their own volume, generating metal hydrides and also of releasing the hydrogen that they absorbed. These hydrogen absorbing alloys combine metal (A) whose hydrides generate heat exothermically with metal (B) whose hydrides generate heat endothermically to produce the suitable binding energy so that hydrogen can be absorbed and released at or around normal temperature and pressure levels. Depending on how metals A and B are combined, the alloys are classified into the following types: AB (TiFe, etc.), AB<sub>2</sub> (ZnMn<sub>2</sub>, etc.), AB<sub>5</sub> (LaNi<sub>5</sub>, etc.) and A<sub>2</sub>B (Mg<sub>2</sub>Ni, etc.). From the perspective of charge and discharge efficiency and durability, the field of candidate

metals suited for use as electrodes in storage batteries is now being narrowed down to AB<sub>5</sub> type alloys in which rare-earth metals, especially metals in the Lanthanum group, and Nickel serve as the host metals; and to AB<sub>2</sub> type alloys in which the Titanium and Nickel serve as the host metals.

Principle of electrochemical reaction involved in batteries Ni-MH batteries employ Nickel hydroxide for the positive electrode similar to Ni-Cd batteries. The hydrogen is stored in a hydrogen absorbing alloy for the negative electrode, and an aqueous solution consisting mainly of potassium hydroxide for the electrolyte. Their charge and discharge reactions are shown on the next pages.

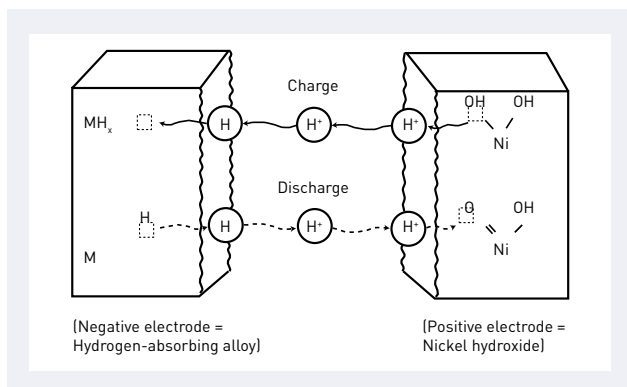


As can be seen by the overall reaction given above, the chief characteristics of the principle behind a Ni-MH battery is that hydrogen moves from the positive to the negative electrode during charge and reverse during discharge, with the electrolyte taking no part in the reaction; which means that there is no accompanying increase or decrease in the electrolyte. A model of this battery's charge and discharge mechanism is shown in the figure on the following pages. These are the useful reactions taking place at the respective boundary faces of the positive and negative electrodes, and to assist one in understanding the principle, the figure shows how the reactions proceed by the transfer of protons (H+).

The hydrogen absorbing alloy negative electrode successfully reduces the gaseous oxygen given off from the positive electrode during overcharge by sufficiently increasing the capacity of the negative electrode which is the same method employed by Ni-Cd batteries.

By keeping the battery's internal pressure constant in this manner, it is possible to seal the battery.

### Schematic discharge of Ni-MH battery\*1



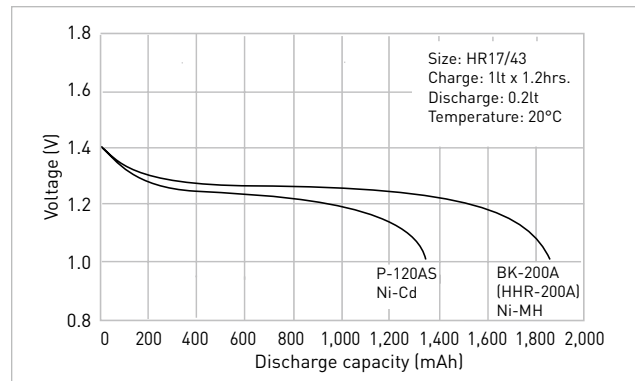
## FEATURES

### Similarity with Ni-Cd batteries

These batteries have similar discharge characteristics to those of Ni-Cd batteries.

### Double the energy density of conventional batteries

Ni-MH batteries have approximately double the capacity compared with Panasonic's standard Ni-Cd batteries.



### Cycle life performance

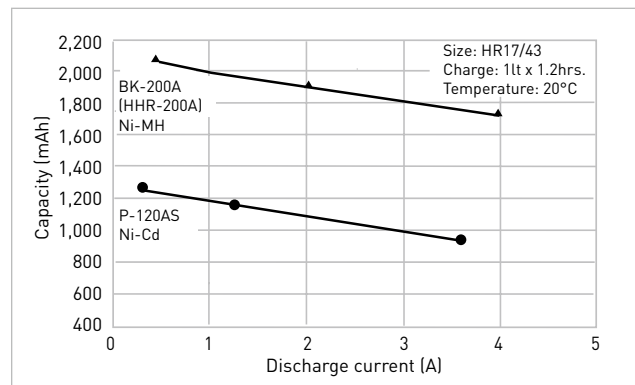
Like Ni-Cd batteries, Ni-MH batteries can be repeatedly charged and discharged for about 500 up to 1,000 cycles. Depending on the battery type even more than 1,200 cycles are available.

### Rapid charge in approx. 1 hour

Ni-MH batteries can be rapidly charged in about an hour using a specially designed charger.

### Excellent discharge characteristics

Since the internal resistance of Ni-MH batteries is low, continuous high-rate discharge is possible.



\*1 The graphic shows only a simplified version of the chemical concept.

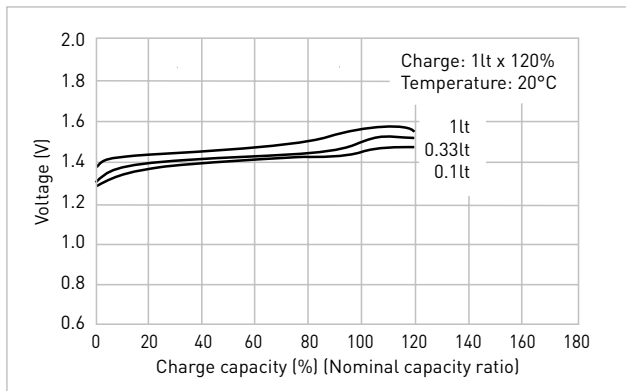
## FIVE MAIN CHARACTERISTICS

As with Ni-Cd batteries, Ni-MH batteries have five main characteristics: charge, discharge, storage life, cycle life, and safety.

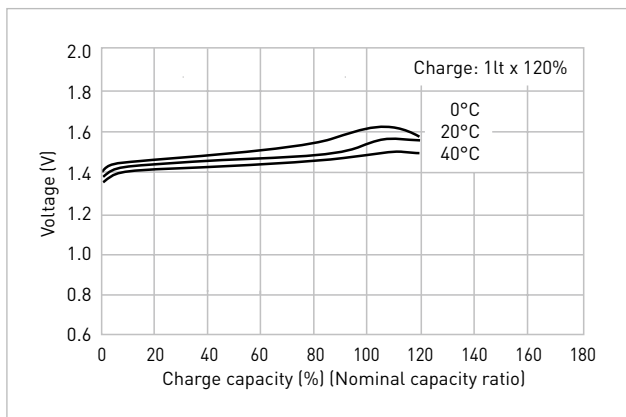
### 1. Charge characteristics

The charge characteristics of Ni-MH batteries are affected by current, time and temperature. The battery voltage rises when the charge current is increased or when the temperature is low. The charge efficiency differs depending on the current, time, temperature and other factors. U type has a wide temperature range. Repeated charge at high or low temperatures causes the battery performance to deteriorate. Furthermore, repeated over-charge should be avoided since it will downgrade the battery performance. Refer to the section on recommended charge methods for details on how to charge the batteries, see page 20 – 21.

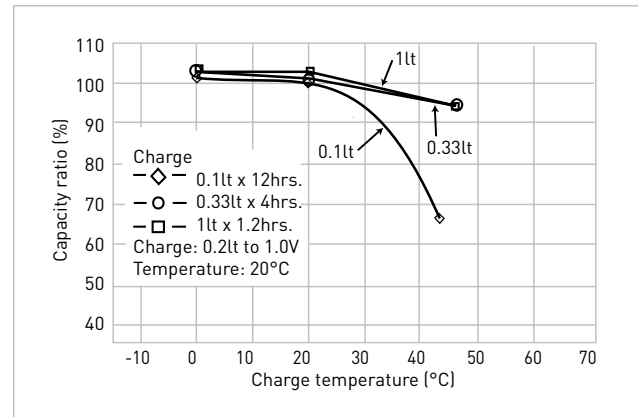
### Charge characteristics



### Charge temperature characteristics at 1It charge



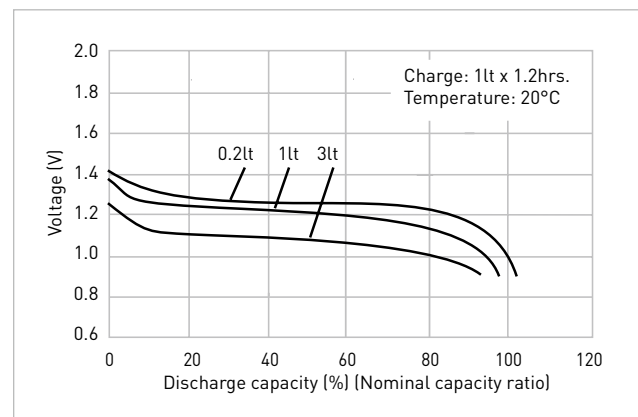
### Charge temperature characteristics at various charge rates



### 2. Discharge characteristics

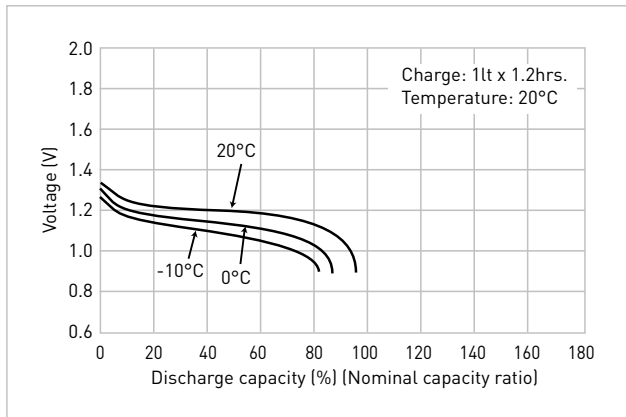
The discharge characteristics of Ni-MH batteries are affected by current, temperature, etc., and the discharge voltage characteristics are flat at 1.2V, which is almost the same as for Ni-Cd batteries. The discharge voltage and discharge efficiency decrease in proportion as the current rises or the temperature drops. As with Ni-Cd batteries, repeated charge and discharge of these batteries under high discharge cut-off voltage conditions (more than 1.1V per cell) causes a drop in the discharge voltage (which is sometimes accompanied by a simultaneous drop in capacity). The discharge characteristics can be restored by charge and discharge to a discharge end voltage of down to 1.0V per cell.

### Discharge characteristics





**Discharge temperature characteristics at 1lt discharge**

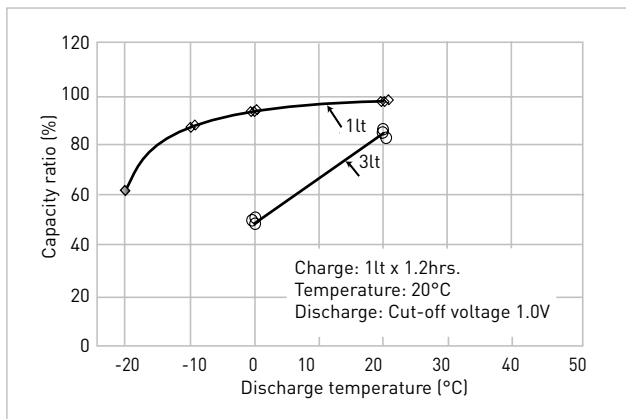


the batteries are left standing and the length of time during which they are left standing. It increases in proportion as the temperature or the shelf-standing time increases. Panasonic's Ni-MH batteries have excellent self-discharge characteristics.

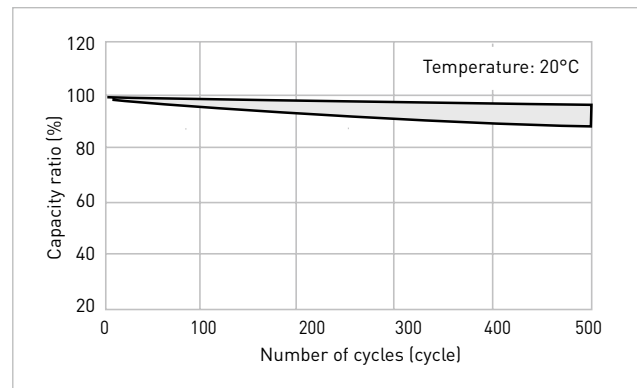
**4. Cycle life characteristics**

The cycle life of these batteries is governed by the conditions under which they are charged and discharged, temperature and other conditions of use. Under proper conditions of use (example: IEC charge and discharge conditions), these batteries can be charged and discharged for more than 2,000 cycles.

**Discharge temperature characteristics**



**Cycle life characteristics**



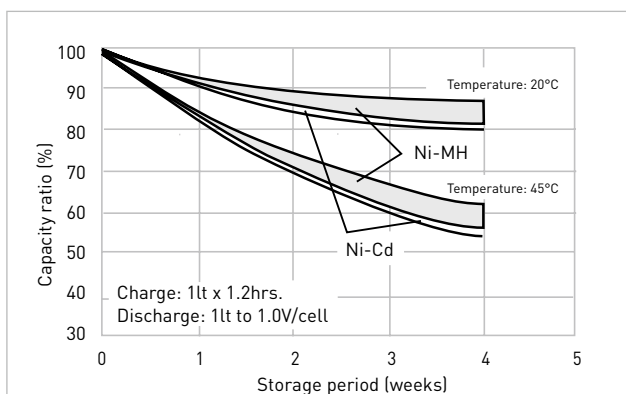
**3. Storage characteristics**

These characteristics include self-discharge characteristics and restoration characteristics after long-term storage. When batteries are left standing, their capacity generally drops due to self-discharge, but this is restored by charge.

**5. Safety**

When the internal pressure of these batteries rises due to overcharge, short-circuiting, reverse charge or other abuse or misuse, the self-sealing safety vent is activated to prevent battery damage.

**Self-discharge characteristics**



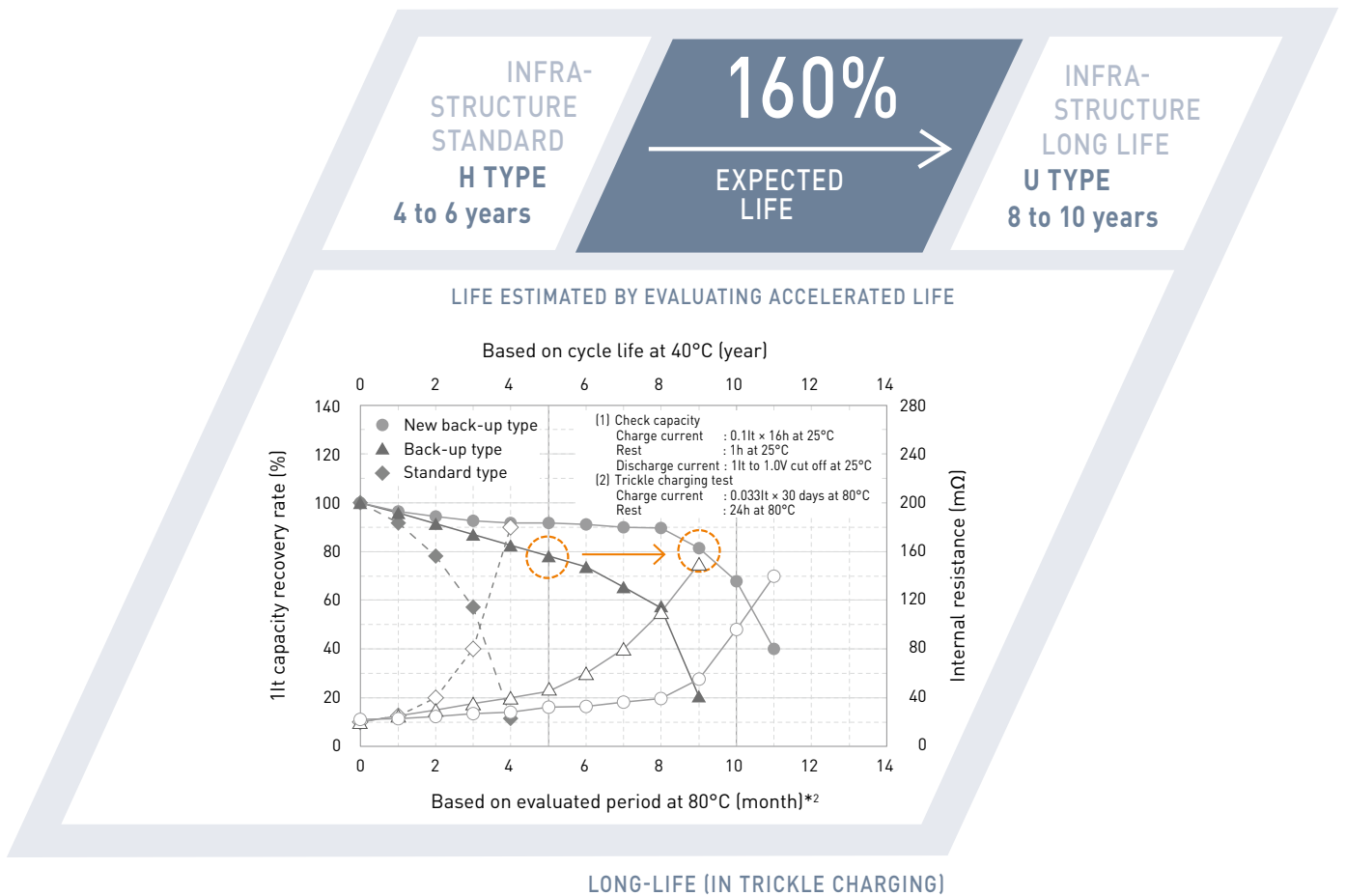
Self-discharge is affected by the temperature at which

Ni-MH TECHNOLOGIES

INFRASTRUCTURE LONG LIFE TYPE (E.G. BK-120AAHU)

New battery type which provides high temperature durability and long-life adapted to the IEC-U standard.

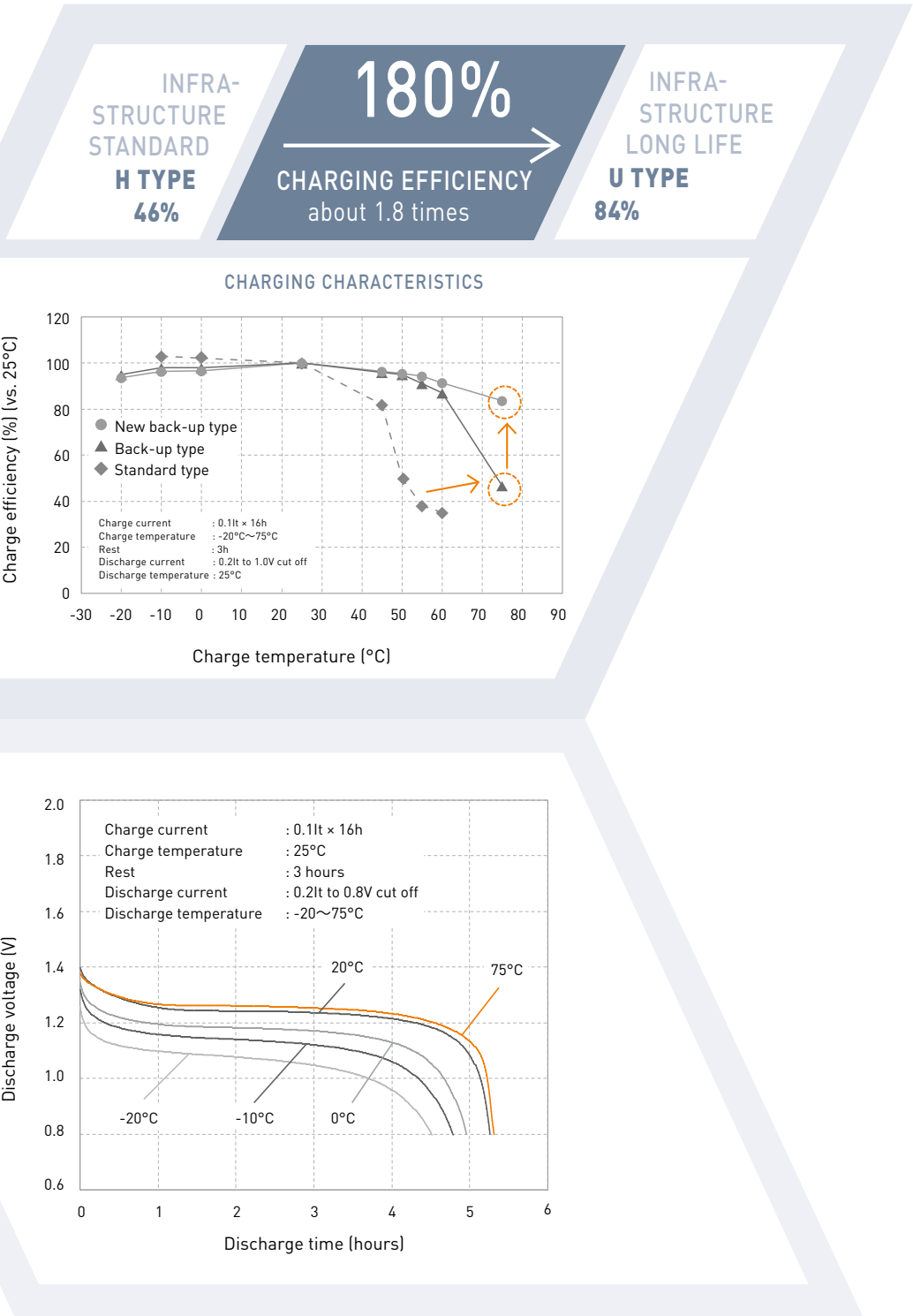
- Excellent charging and discharging performance in wide temperature conditions (-20°C to 75°C)\*1
- Long-life in trickle charging (most suitable for replacing Nickel-Cadmium batteries)
- Fit well for various equipments and applications
- From AAA to F, various size line-up



\*1 Charging temperature BK-60AAAHU -10 to 75°C, BK-1100FHU -20 to 85°C

\*2 It is accelerated evaluation on the condition that trickle charging current is 0.033It at 80°C.

EXCELLENT CHARGING PERFORMANCE AT HIGH TEMPERATURE ENVIRONMENT UP TO 75°C



# CHARGE METHODS FOR Ni-MH BATTERIES

## CHARGE METHODS

Charge is the process of restoring a discharged battery to its original capacity. In order for a battery to be usable for a long period of time, it must be charged via the proper

charge method. Various methods are used to charge rechargeable cells, but Panasonic recommends the charge methods described below to charge its Ni-MH batteries.

Charge system	Cycle (repetitive) use			Standby (backup) use	
	Constant-current charge		Semi-constant-current charging method	Trickle-charging method	Intermittent charging method
	-ΔV cutoff charging method	dT/dt cutoff charging method			
<b>Operation overview</b> VB: Battery voltage I <sub>ch</sub> : Charge current T: Battery surface temperature CV: Constant voltage					
<b>Features</b>	Most common rapid-charging method	Charging-circuit cost is comparatively higher, but can prevent over-charge, extending cycle life in comparison to the -ΔV cutoff charging method	Charging circuit is simple and affordable	Charging circuit is simple and affordable Applicable to devices requiring continuous charging for long periods	Charging cost is comparatively higher, but supports longer service life than trickle-charging
<b>Charge time</b>	1 – 2 hrs	1 – 2 hrs	15 hrs	30 hrs or longer	15 hrs or longer
<b>Charge current</b>	0.5 – 1 lt	0.5 – 1 lt	max. 0.1 lt	—	0.1 – 0.5 lt
<b>Trickle-charge current</b>	1/30 – 1/20 lt	1/30 – 1/20 lt	—	1/30 – 1/20 lt	—
<b>Charge level at charge control</b>	Approx. 100 – 120 %	Approx. 100 – 110 %	—	—	Approx. 120 %
<b>Infrastructure backup type</b>	○	⊙	○	○	⊙
<b>Button-top type</b>	⊙	○	—	—	○
<b>Standard type</b>	⊙	⊙	—	—	○
<b>High rate discharge &amp; rapid type</b>	○	⊙	—	—	○
<b>Automotive backup type</b>	—	—	—	—	○

# BATTERY SELECTION

## THE STEPS FOR SELECTING A TYPE OF BATTERY FOR USE AS THE POWER SUPPLY OF A DEVICE ARE SHOWN BELOW

### Study of the proposed required specifications

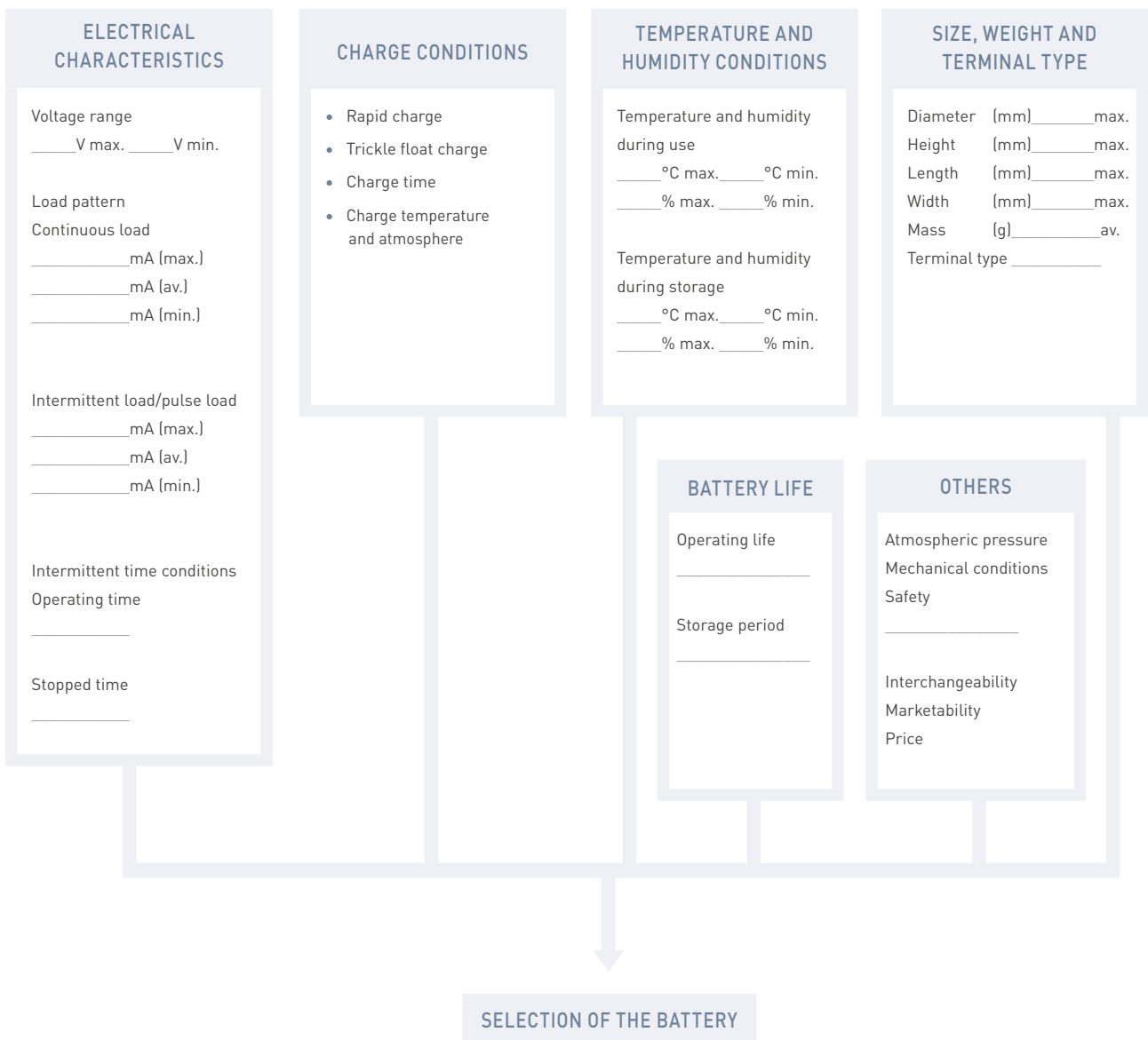
Verify the battery specifications required for the power supply of the device and use those conditions as the standards for battery selection. For reference, the technological factors concerning battery selection are shown below.

### Battery selection


Using the catalogs and data sheets for the batteries currently produced and marketed, narrow down the number of candidates to a few battery types. From those candidates,

select the one battery that most closely satisfies the ideal conditions required. In actual practice, the selection of a battery is rarely completed as easily as this. In most cases it is necessary to consider eliminating or relaxing some of the proposed specifications, and then select the most suitable battery from among those currently available to meet the adjusted conditions. This process makes it possible to select more economical batteries. If you have any doubts at this stage, consult closely with a battery engineer. In some cases, newly improved or newly developed batteries that are not yet listed in the catalog may be available. Normally the required specifications are also finalised at this stage.

## TECHNOLOGICAL FACTORS CONCERNING BATTERY SELECTION



# NICKEL-METAL HYDRIDE LINE-UP

BATTERY TYPE	FEATURES	APPLICATIONS
<b>N TYPE</b>	<p>STANDARD TYPE</p> <ul style="list-style-type: none"> <li>• high energy</li> </ul>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Handheld device</p> </div> <div style="text-align: center;">  <p>Home appliance</p> </div> <div style="text-align: center;">  <p>Medical equipment</p> </div> </div>
<b>B TYPE</b>	<p>BUTTON TOP DRY BATTERY COMPATIBLE</p> <ul style="list-style-type: none"> <li>• low self-discharge</li> <li>• durable for cycle usage</li> </ul>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Home appliance</p> </div> <div style="text-align: center;">  <p>Game</p> </div> <div style="text-align: center;">  <p>Remote controller</p> </div> </div>
<b>H TYPE</b> <b>PH TYPE</b>	<p>INFRASTRUCTURE FOR STANDARD/HIGH RATE DISCHARGE</p> <ul style="list-style-type: none"> <li>• long life and high performance at high temp</li> <li>• available for continuous charging for back up</li> </ul>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Emergency light</p> </div> <div style="text-align: center;">  <p>Security</p> </div> </div>
<b>P TYPE</b>	<p>HIGH RATE DISCHARGE &amp; RAPID CHARGE</p> <ul style="list-style-type: none"> <li>• high Power: 10lt discharge</li> </ul>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Electric equipment</p> </div> <div style="text-align: center;">  <p>Cable less vacuum</p> </div> </div>
<b>U TYPE</b>	<p>INFRASTRUCTURE FOR LONG LIFE</p> <ul style="list-style-type: none"> <li>• Refinement H type more superb performance for backup usage and extended temperature range</li> </ul>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="text-align: center; width: 30%;">  <p>Storage system</p> </div> <div style="text-align: center; width: 30%;">  <p>Backup for lifts</p> </div> <div style="text-align: center; width: 30%;">  <p>Solar system</p> </div> <div style="text-align: center; width: 30%;">  <p>AGV</p> </div> <div style="text-align: center; width: 30%;">  <p>Wind turbine</p> </div> </div>
<b>W TYPE</b>	<p>AUTOMOTIVE BACKUP</p> <ul style="list-style-type: none"> <li>• designed for automotive application back up</li> </ul>	<div style="text-align: center;">  <p>E-call/TCU</p> </div>

STANDARD TYPE

N TYPE

Ni-MH battery technology is nowadays the Ni-Cd (Nickel-Cadmium) successor technology for rechargeable and portable devices. These batteries are ideal for less complex and cost sensitive applications. For example medical equipment and handheld devices.

FEATURES

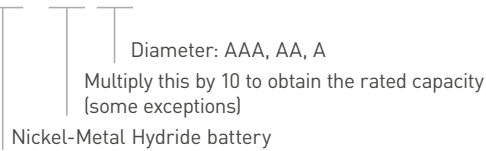
- High versatility for various application
- Good balance in terms of capacity and lifetime
- Various sizes for wide range of applications

APPLICATIONS

- Medical
- Communication
- Shaver
- Toothbrush
- Navigation device
- Torchlight
- Measurement
- Two way radio
- Construction sites signaling
- UPS, etc.

MODEL NUMBER (EXAMPLE)

**B K - 7 0 A A**



Model number	Old model number	Diameter	Size	Nominal voltage (V)	Nominal capacity (mAh)	Typical capacity (mAh)	Diameter (mm)	Total height (mm)	Weight (g)	IEC	Page
BK-70AAAJ	HHR-70AAAJ	AAA	AAA	1.2	700	730	10.5 +0/-0.7	44.5 +0/-1.5	12	HR11/45	24
BK-70AA	HHR-70AA	AA	AA	1.2	700	780	14.5 +0/-0.7	49.0 +0/-1.5	18	HR15/49	25
BK-110AA0	HHR-110AA0	AA	AA	1.2	1,100	1,180	14.5 +0/-0.7	50.5 +0/-1.5	24	HR15/51	26
BK-150AA	HHR-150AA	AA	AA	1.2	1,500	1,580	14.5 +0/-0.7	50.5 +0/-1.5	25	HR15/51	27
BK-200AAP	-	AA	AA	1.2	1,900	2,000	14.5 +0/-0.7	50.5 +0/-1.5	28	HR15/51	28
BK-200A	HHR-200A	AA	4/5A	1.2	2,000	2,040	17.0 +0/-0.7	43.0 +0/-1.5	32	HR17/43	29
BK-210A	HHR-210A	A	A	1.2	2,100	2,200	17.0 +0/-0.7	50.0 +0/-2.0	36	HR17/50	30
BK-250A	-	A	A	1.2	2,450	2,600	17.0 +0/-0.7	50.0 +0/-2.0	37	HR17/50	31
BK-380A	HHR-380A	A	L-A	1.2	3,700	3,800	17.0 +0/-0.7	67.0 +0/-2.0	53	HR17/67	32
BK-450A	HHR-450A	LFat/A	LFat/A	1.2	4,200	4,500	18.2 +0/-0.7	67.5 +0/-1.5	61	-	33



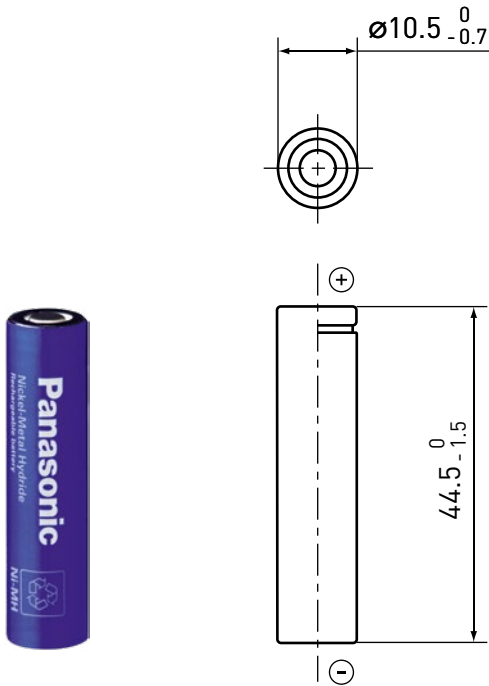
**BK-70AAAJ**

HHR-70AAAJ (OLD)

STANDARD TYPE  
AAA SIZE (HR11/45)

**N TYPE**

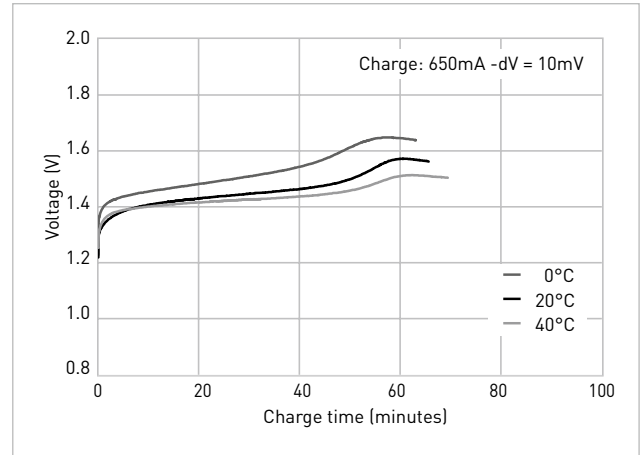
DIMENSIONS (MM)



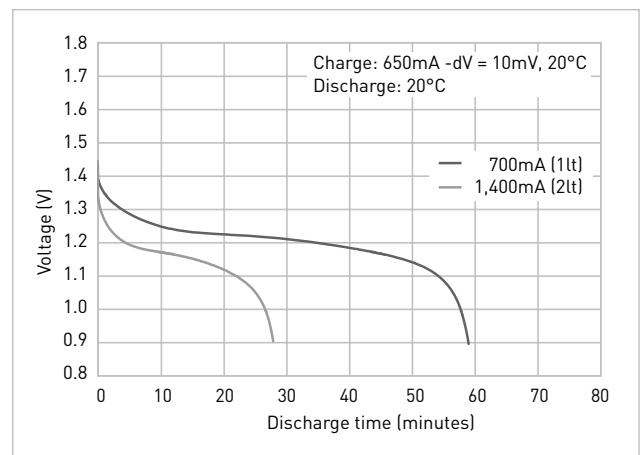
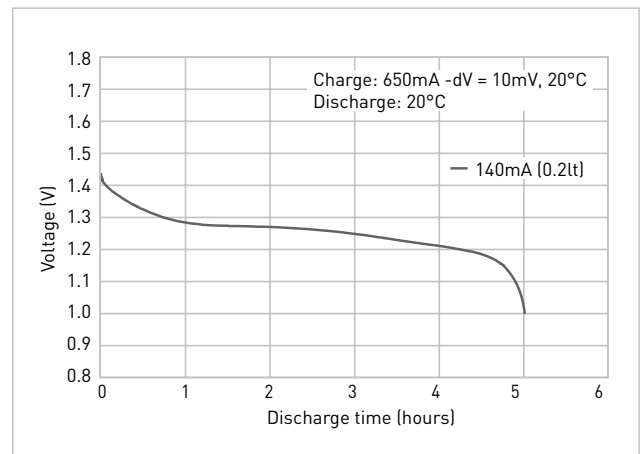
Specifications		BK-70AAAJ	
Diameter (mm)		10.5 +0/-0.7	
Total height (mm)		44.5 +0/-1.5	
Approximate weight (g)		12	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	730	
	Nominal capacity*3 (mAh)	700	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		35	
Charge	Standard (mA x hrs.)	70 x 16	
	Rapid*4 (mA x hrs.)	650 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





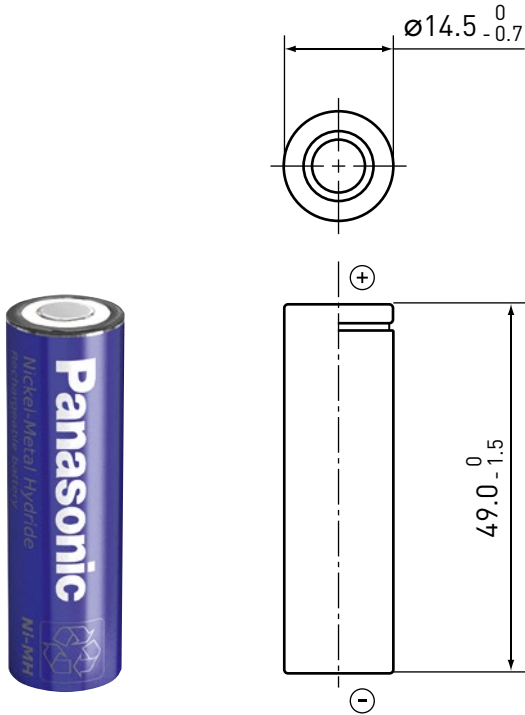
**BK-70AA**

HHR-70AA(OLD)

STANDARD TYPE  
AA SIZE (HR15/49)

**N TYPE**

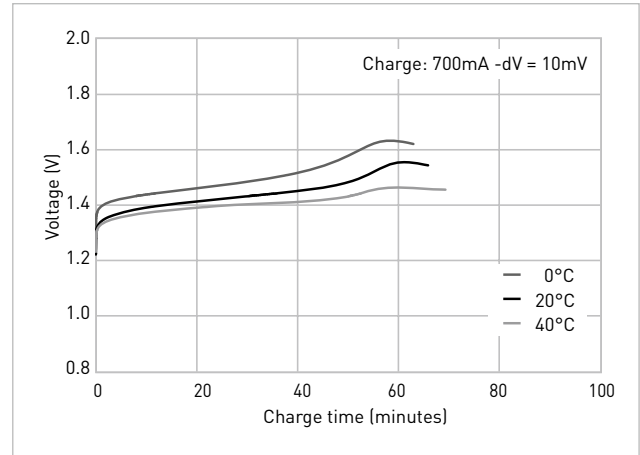
DIMENSIONS (MM)



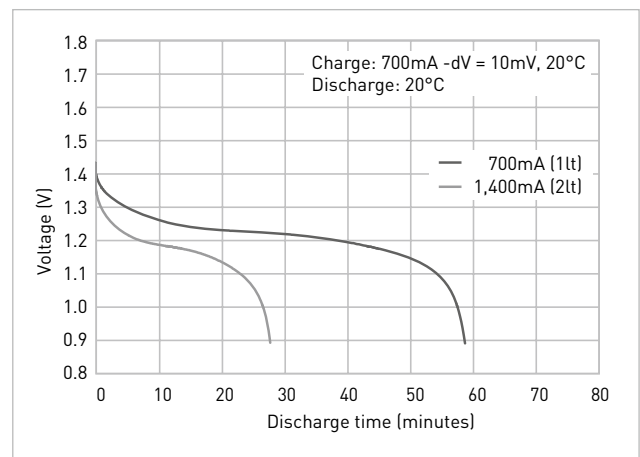
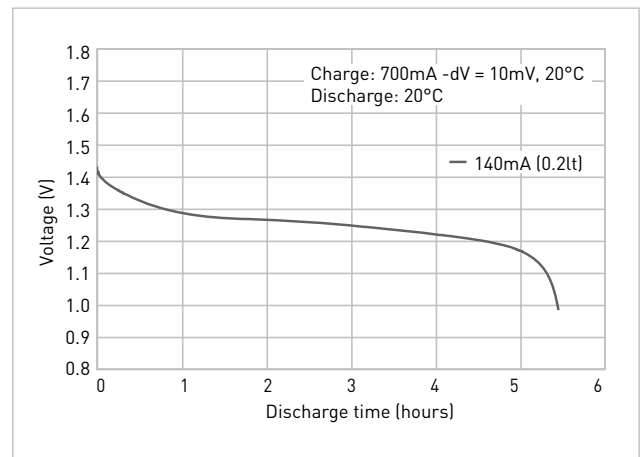
Specifications		BK-70AA	
Diameter (mm)		14.5 +0/-0.7	
Total height (mm)		49.0 +0/-1.5	
Approximate weight (g)		18	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	780	
	Nominal capacity*3 (mAh)	700	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		25	
Charge	Standard (mA x hrs.)	70 x 16	
	Rapid*4 (mA x hrs.)	700 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

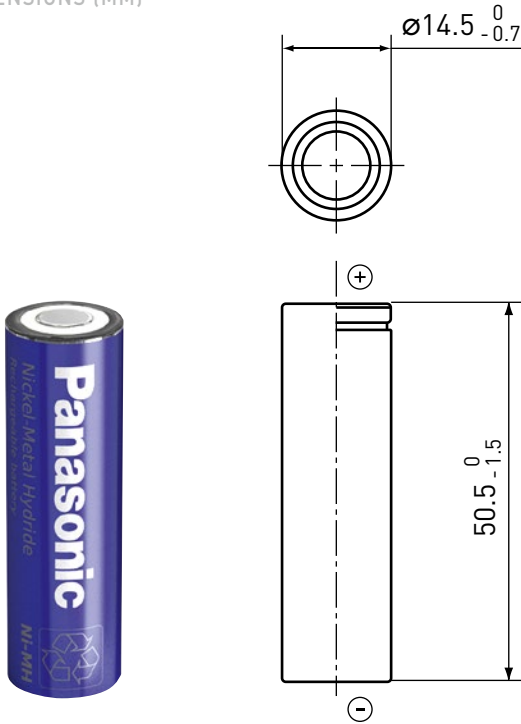


**BK-110AAO**  
HHR-110AAO (OLD)

STANDARD TYPE  
AA SIZE (HR15/51)

**N TYPE**

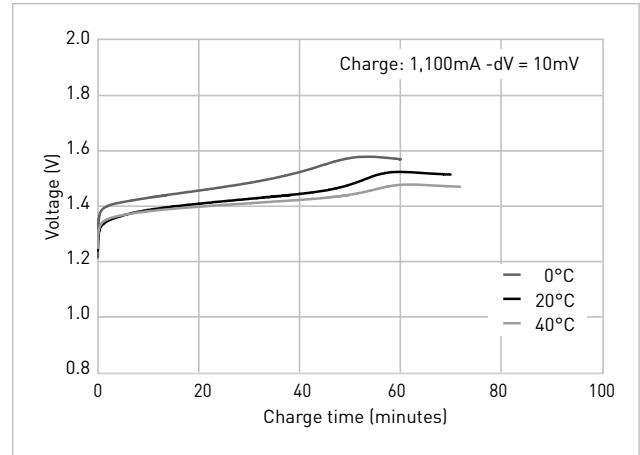
DIMENSIONS (MM)



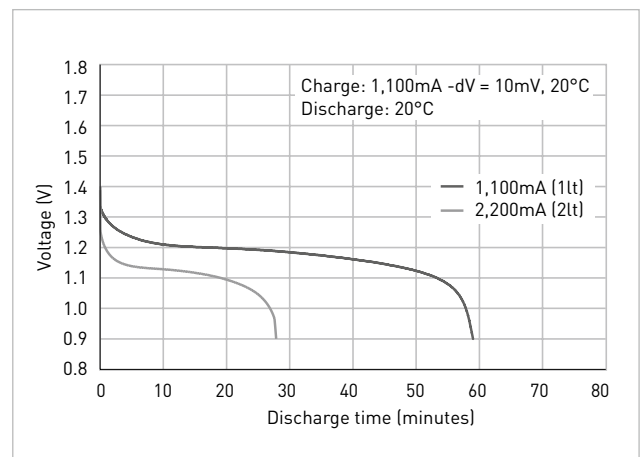
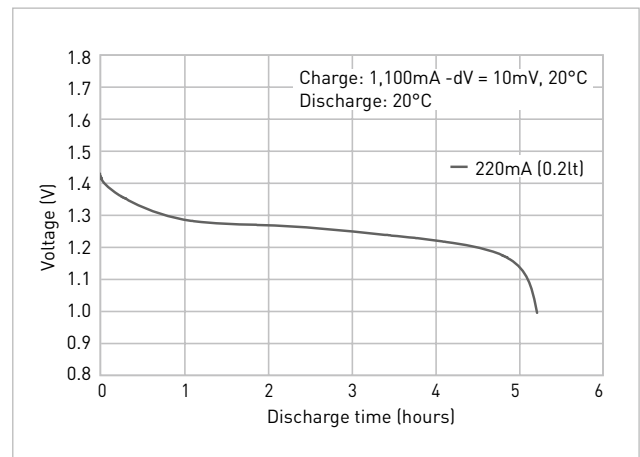
Specifications		BK-110AAO
Diameter (mm)		14.5 +0/-0.7
Total height (mm)		50.5 +0/-1.5
Approximate weight (g)		24
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	1,180
	Nominal capacity*3 (mAh)	1,100
Approx. internal impedance at 1,000Hz at charged state (mΩ)		16
Charge	Standard (mA x hrs.)	110 x 16
	Rapid*4 (mA x hrs.)	1,100 x 1.2
Charge (°C)	Standard	0 to 45
	Rapid	0 to 40
Discharge (°C)		-10 to 65
Ambient temperature	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

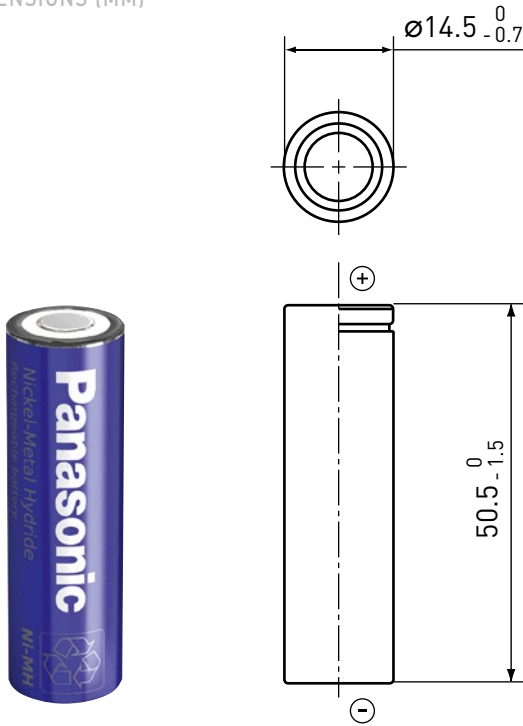


**BK-150AA**  
HHR-150AA (OLD)

STANDARD TYPE  
AA SIZE (HR15/51)

**N TYPE**

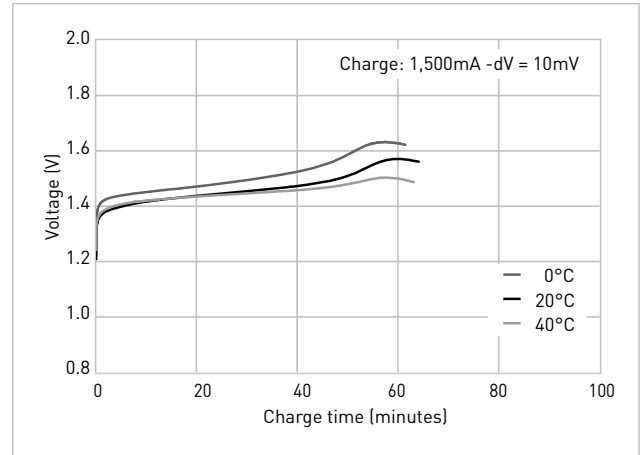
DIMENSIONS (MM)



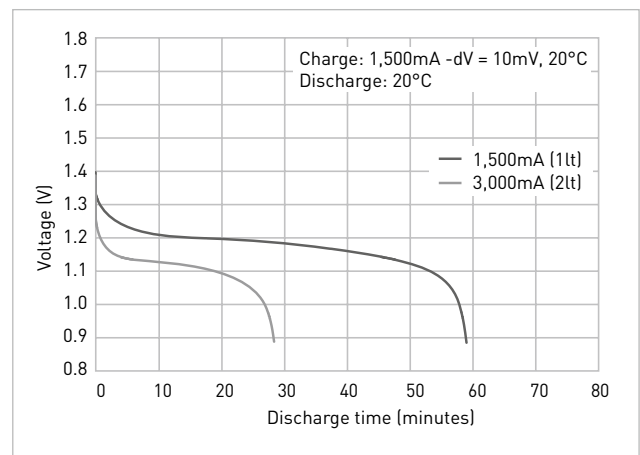
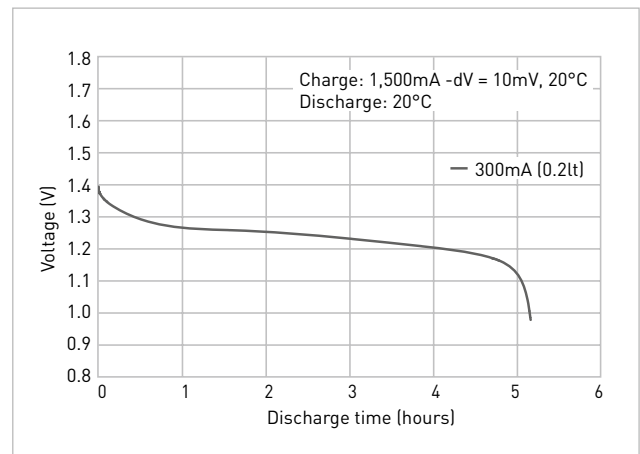
Specifications		BK-150AA	
Diameter (mm)		14.5 +0/-0.7	
Total height (mm)		50.5 +0/-1.5	
Approximate weight (g)		25	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	1,580	
	Nominal capacity*3 (mAh)	1,500	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		23	
Charge	Standard (mA x hrs.)	150 x 16	
	Rapid*4 (mA x hrs.)	1,500 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

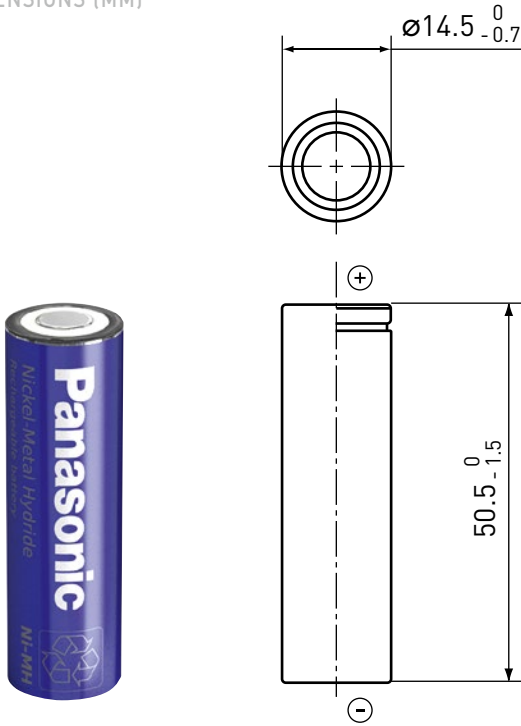


# BK-200AAP

STANDARD TYPE  
AA SIZE (HR15/51)

N TYPE

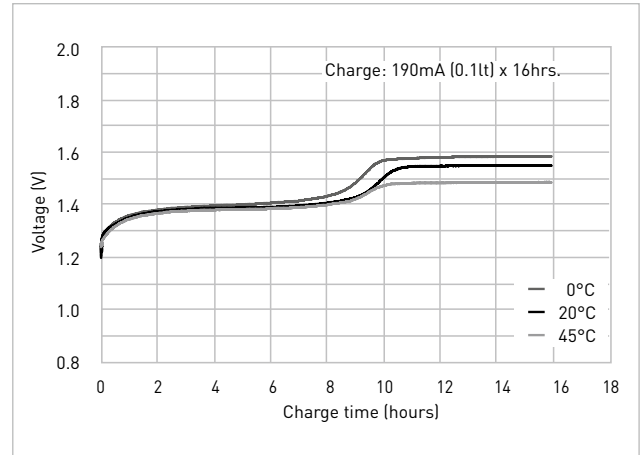
DIMENSIONS (MM)



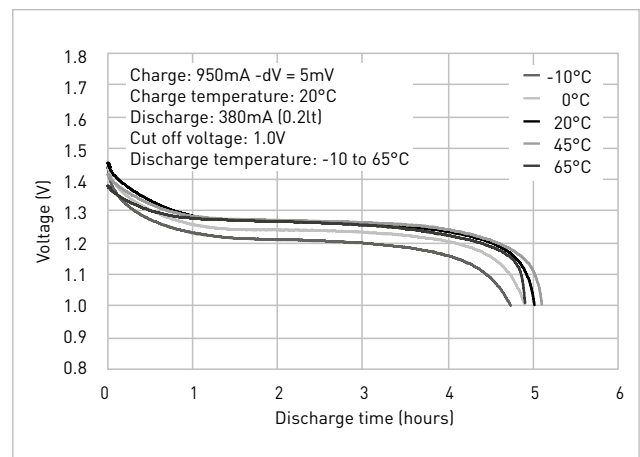
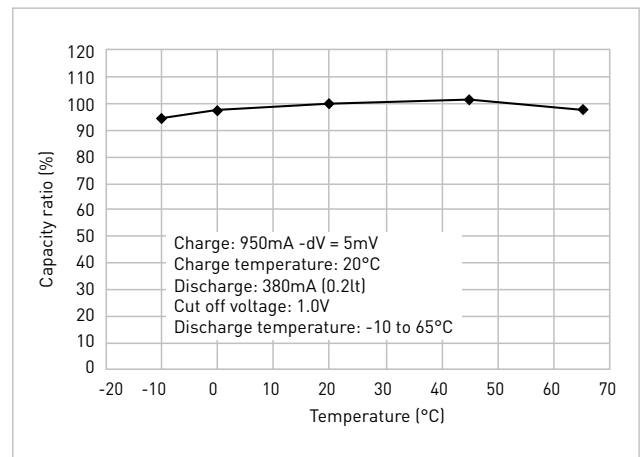
Specifications		BK-200AAP
Diameter (mm)		14.5 +0/-0.7
Total height (mm)		50.5 +0/-1.5
Approximate weight (g)		28
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	1,980
	Nominal capacity*3 (mAh)	1,900
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20
Charge	Standard (mA x hrs.)	190 x 16
	Rapid*4 (mA x hrs.)	1,900 x 1.2
Ambient temperature	Charge (°C)	Standard: 0 to 45 Rapid: 0 to 40
	Discharge (°C)	-10 to 65
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



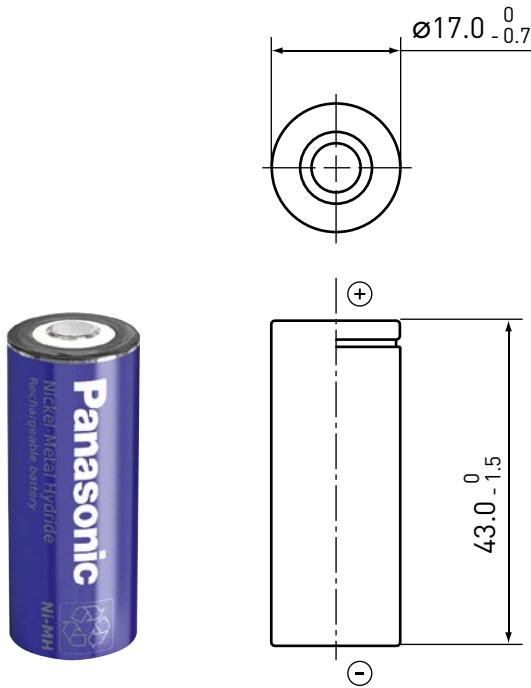
**BK-200A**

HHR-200A (OLD)

STANDARD TYPE  
4/5A SIZE (HR17/43)

**N TYPE**

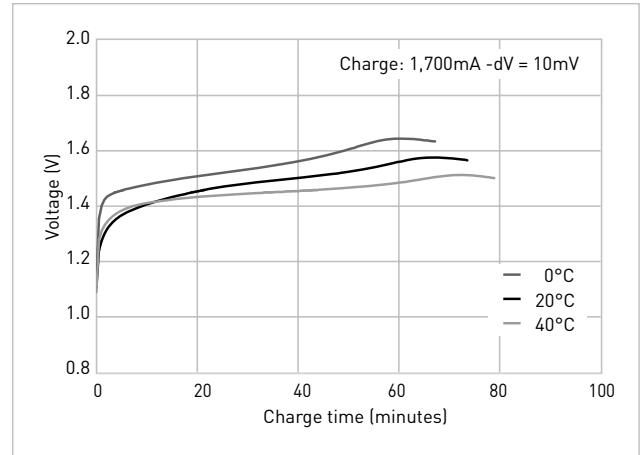
DIMENSIONS (MM)



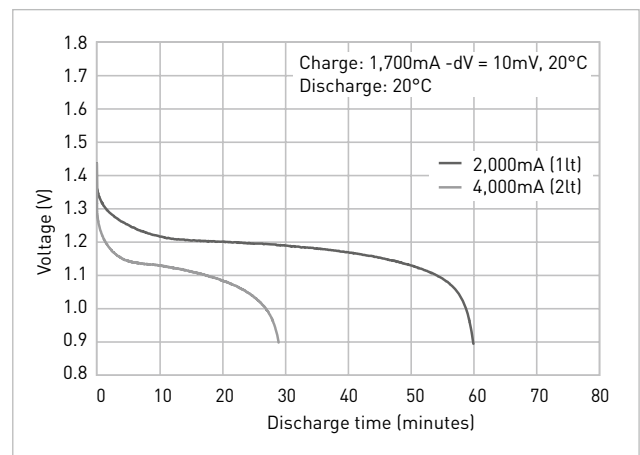
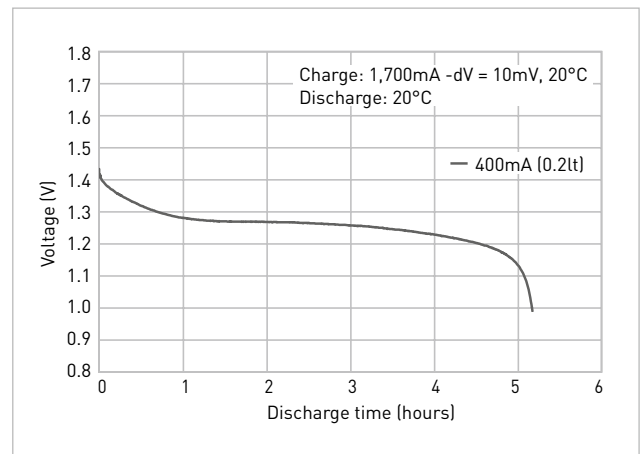
Specifications		BK-200A	
Diameter (mm)		17.0 +0/-0.7	
Total height (mm)		43.0 +0/-1.5	
Approximate weight (g)		32	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	2,040	
	Nominal capacity*3 (mAh)	2,000	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20	
Charge	Standard (mA x hrs.)	200 x 16	
	Rapid*4 (mA x hrs.)	1,700 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

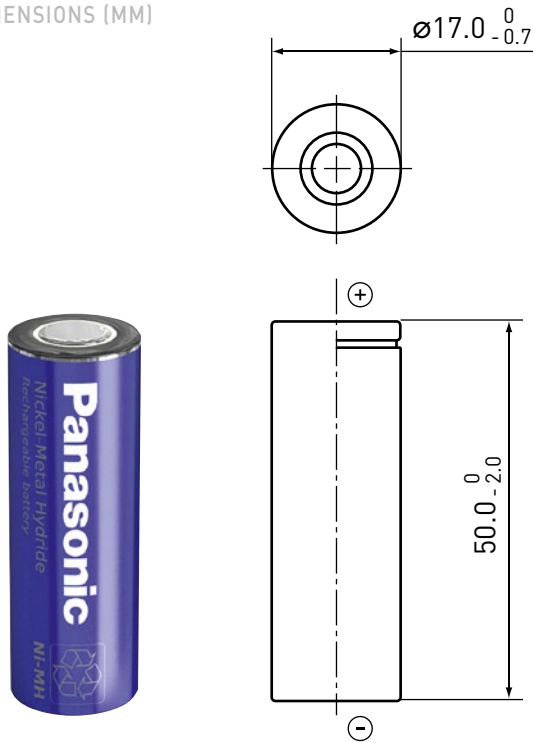


**BK-210A**  
HHR-210A (OLD)

STANDARD TYPE  
A SIZE (HR17/50)

**N TYPE**

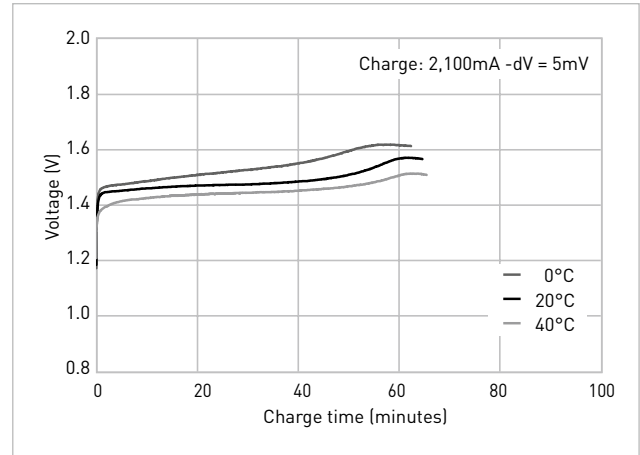
DIMENSIONS (MM)



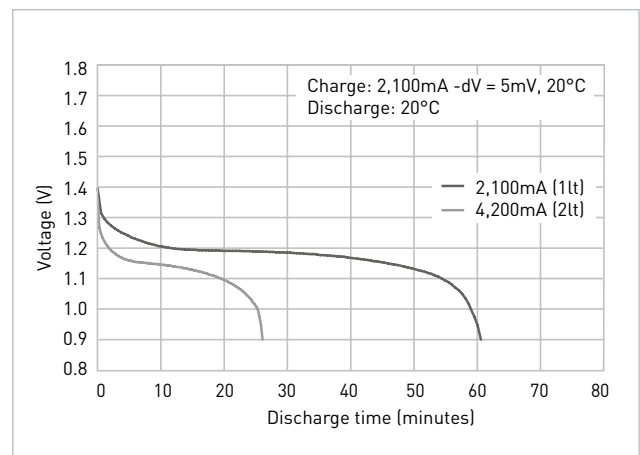
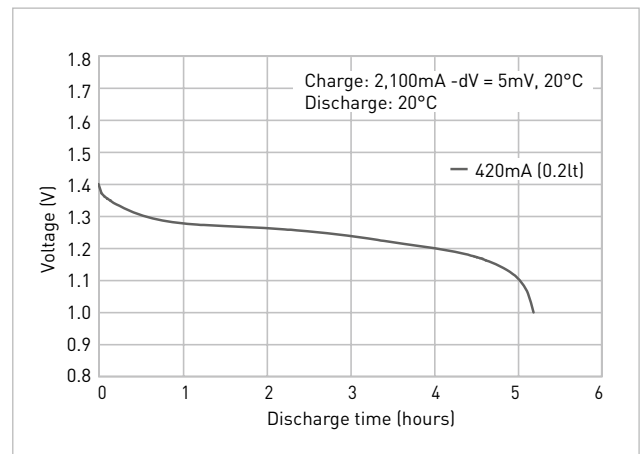
Specifications		BK-210A	
Diameter (mm)		17.0 +0/-0.7	
Total height (mm)		50.0 +0/-2.0	
Approximate weight (g)		36	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	2,200	
	Nominal capacity*3 (mAh)	2,100	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20	
Charge	Standard (mA x hrs.)	210 x 16	
	Rapid*4 (mA x hrs.)	2,100 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

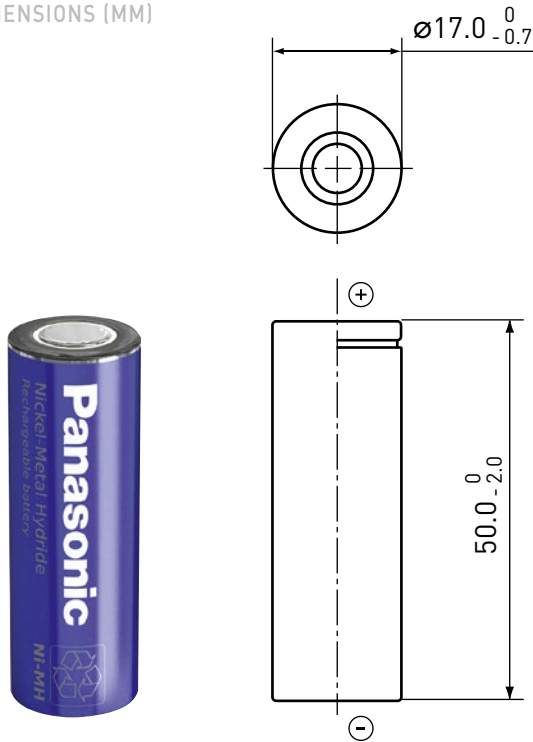


# BK-250A

LOW TEMPERATURE TYPE  
A SIZE (HR17/50)

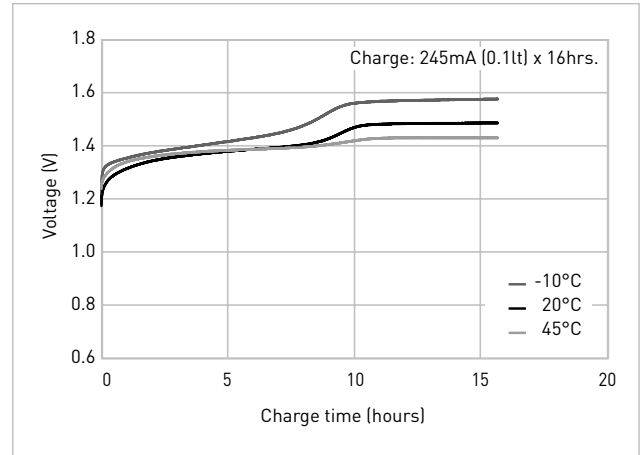
N TYPE

DIMENSIONS (MM)

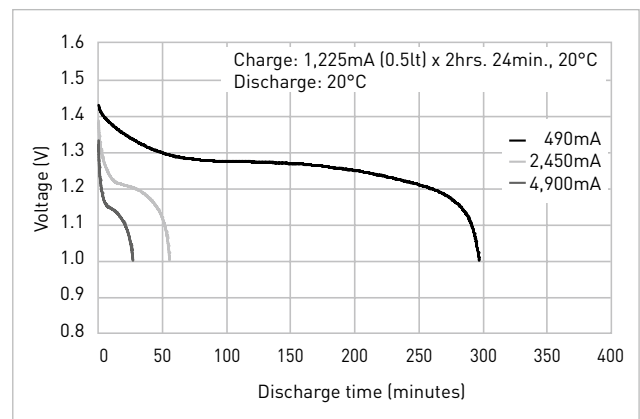
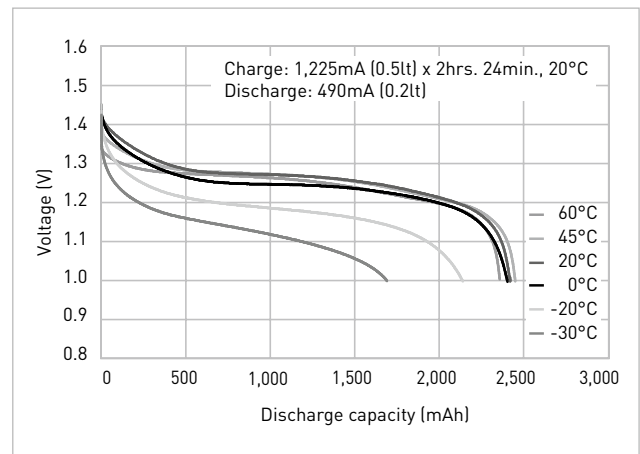


Specifications		BK-250A
Diameter (mm)		17.0 +0/-0.7
Total height (mm)		50.0 +0/-2.0
Approximate weight (g)		37
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	2,600
	Nominal capacity*3 (mAh)	2,450
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20
Charge	Standard (mA x hrs.)	245 x 16
	Rapid*4 (mA x hrs.)	2,450 x 1.2
Ambient temperature	Charge (°C)	Standard: 0 to 45 Rapid: 0 to 40
	Discharge (°C)	-30 to 65
Storage (°C)	<1 year	-30 to 35
	<6 months	-30 to 45
	<1 month	-30 to 55

TYPICAL CHARGE CHARACTERISTICS



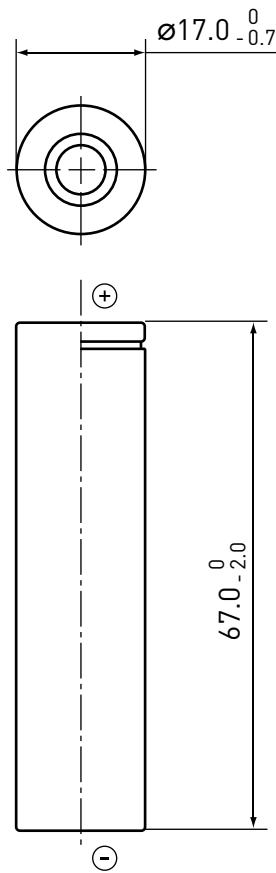
TYPICAL DISCHARGE CHARACTERISTICS



\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

**BK-380A**  
HHR-380A (OLD)

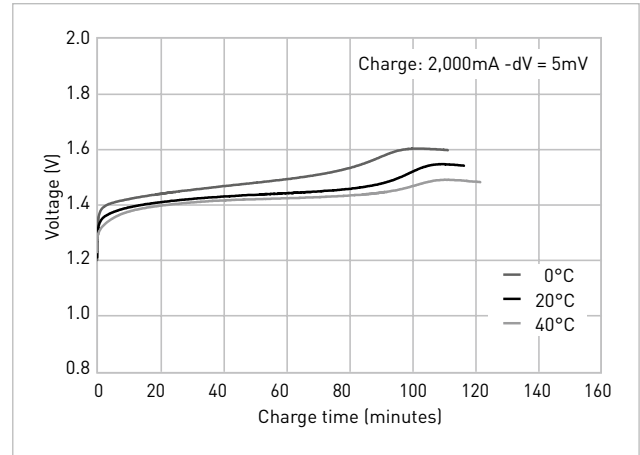
DIMENSIONS (MM)



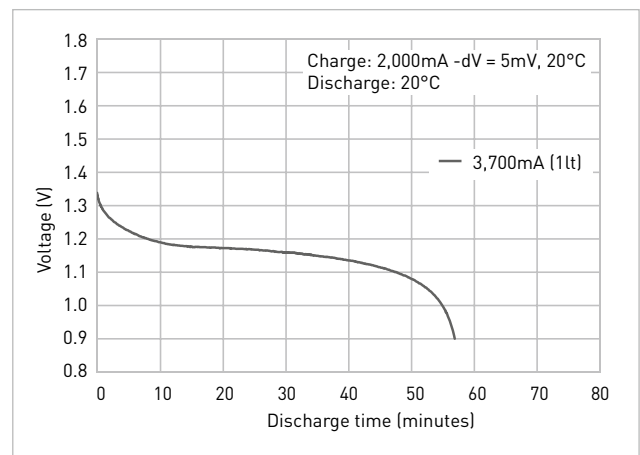
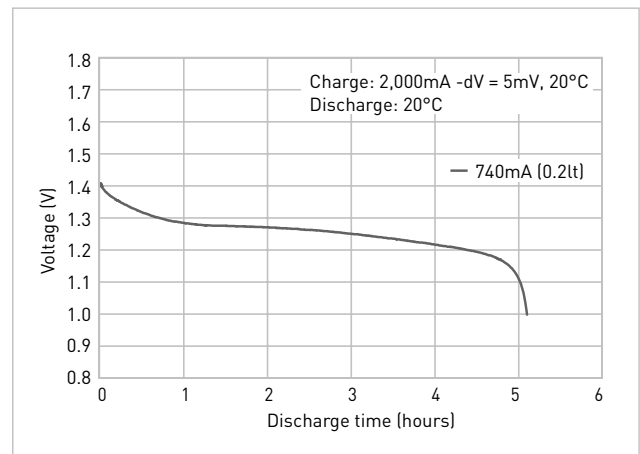
STANDARD TYPE  
L-A SIZE (HR17/67)

**N TYPE**

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



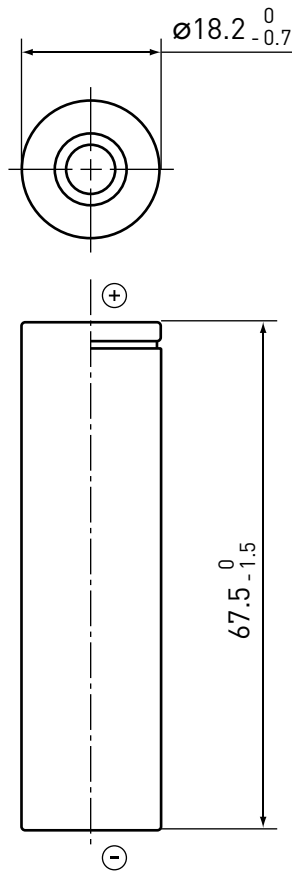
Specifications		BK-380A
Diameter (mm)		17.0 +0/-0.7
Total height (mm)		67.0 +0/-2.0
Approximate weight (g)		53
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	3,800
	Nominal capacity*3 (mAh)	3,700
Approx. internal impedance at 1,000Hz at charged state (mΩ)		25
Charge	Standard (mA x hrs.)	370 x 16
	Rapid*4 (mA x hrs.)	2,000 x 1.2
Charge (°C)	Standard	0 to 45
	Rapid	0 to 40
Discharge (°C)		-10 to 65
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.



**BK-450A**  
HHR-450A (OLD)

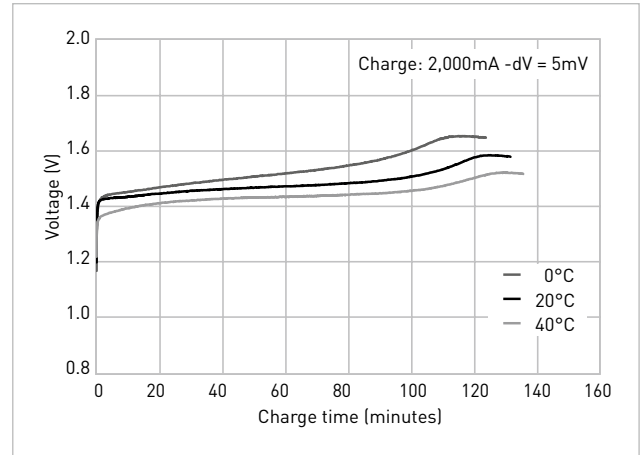
DIMENSIONS (MM)



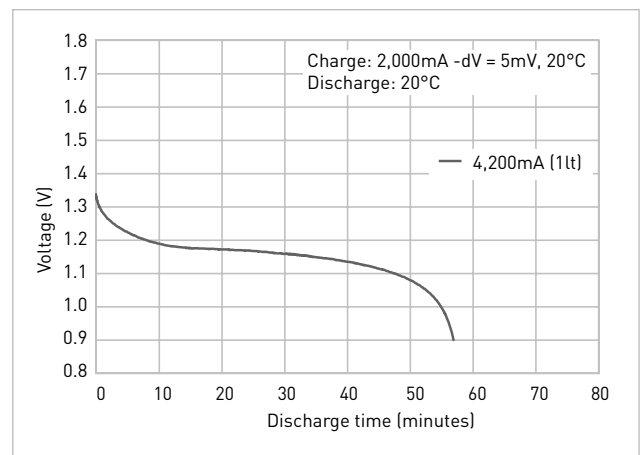
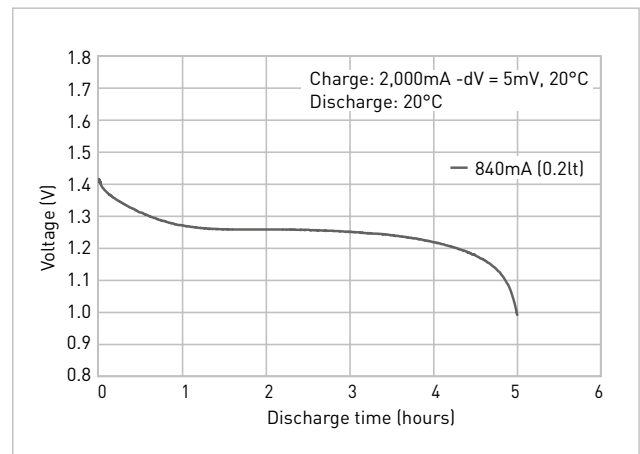
STANDARD TYPE  
LFAT/A SIZE

N TYPE

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



Specifications		BK-450A	
Diameter (mm)		18.2 +0/-0.7	
Total height (mm)		67.5 +0/-1.5	
Approximate weight (g)		61	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	4,500	
	Nominal capacity*3 (mAh)	4,200	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		25	
Charge	Standard (mA x hrs.)	420 x 16	
	Rapid*4 (mA x hrs.)	2,000 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.



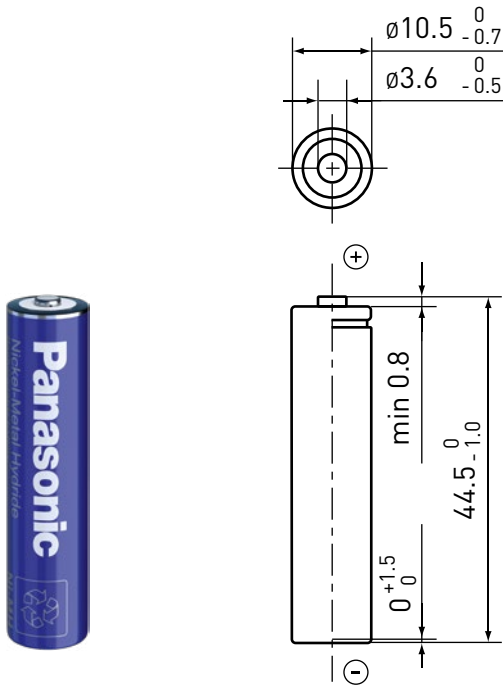
**BK-80AAAB**

HHR-80AAAB (OLD)

BUTTON TOP TYPE  
AAA SIZE (HR11/45)

**B TYPE**

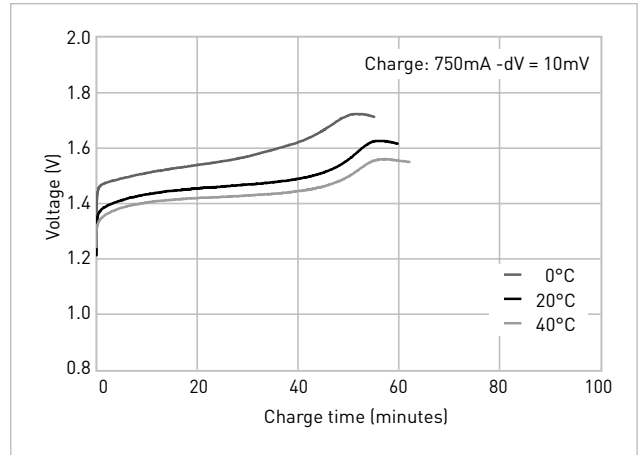
DIMENSIONS (MM)



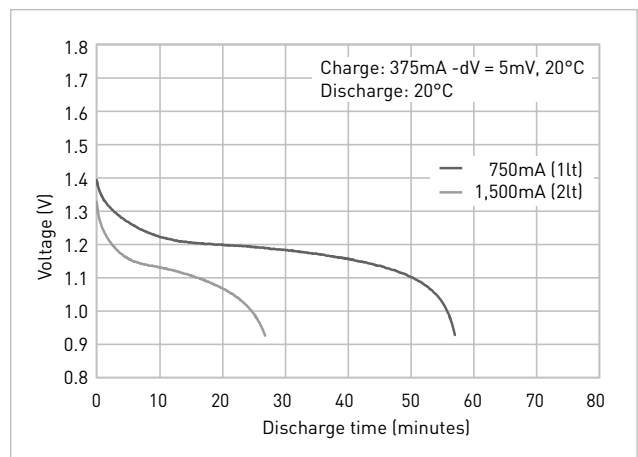
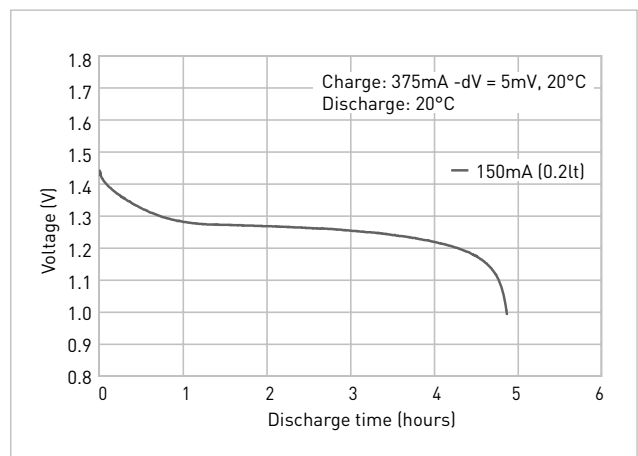
Specifications		BK-80AAAB	
Diameter (mm)		10.5 +0/-0.7	
Total height (mm)		44.5 +0/-1.0	
Approximate weight (g)		12	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	780	
	Nominal capacity*3 (mAh)	750	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		30	
Charge	Standard (mA x hrs.)	75 x 16	
	Rapid*4 (mA x hrs.)	750 x 1.2	
Charge (°C)	Standard	0 to 45	
	Rapid	0 to 40	
Discharge (°C)		-10 to 65	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

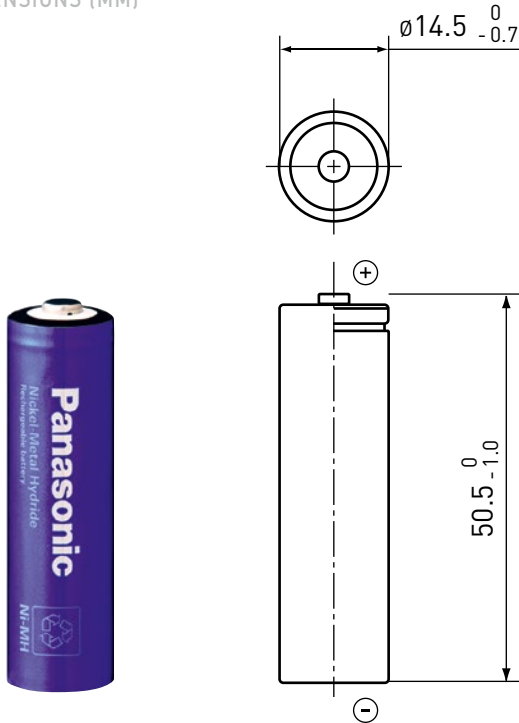


# BK-200AAB

BUTTON TOP TYPE  
AA SIZE (HR15/51)

B TYPE

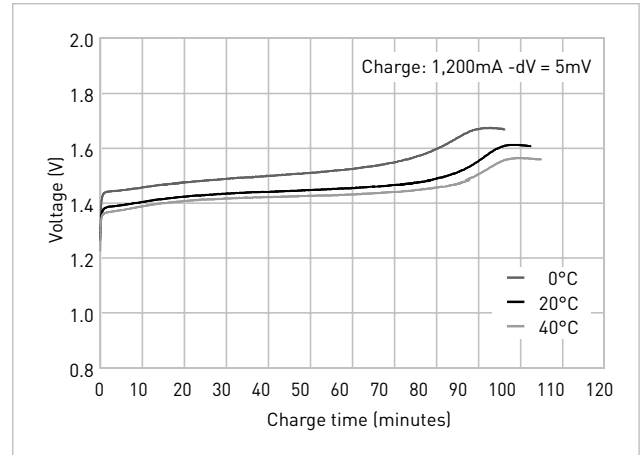
DIMENSIONS (MM)



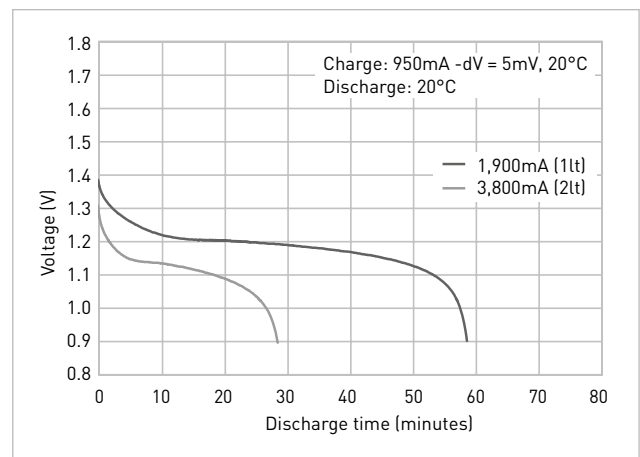
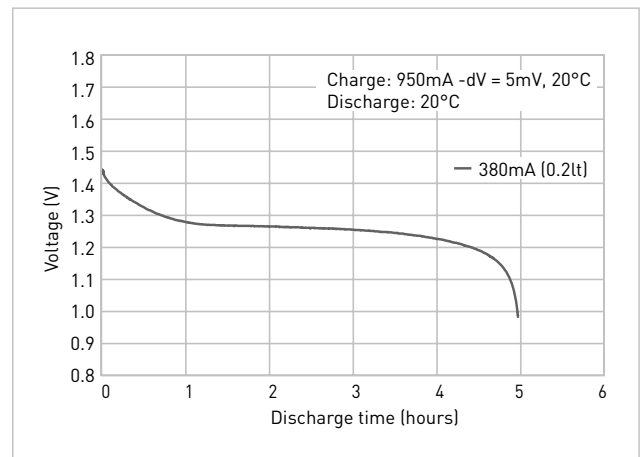
Specifications		BK-200AAB
Diameter (mm)		14.5 +0/-0.7
Total height (mm)		50.5 +0/-1.0
Approximate weight (g)		28
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	2,000
	Nominal capacity*3 (mAh)	1,900
Approx. internal impedance at 1,000Hz at charged state (mΩ)		25
Charge	Standard (mA x hrs.)	190 x 16
	Rapid*4 (mA x hrs.)	1,200 x 1.2
Charge (°C)	Standard	0 to 45
	Rapid	0 to 40
Discharge (°C)		-10 to 65
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



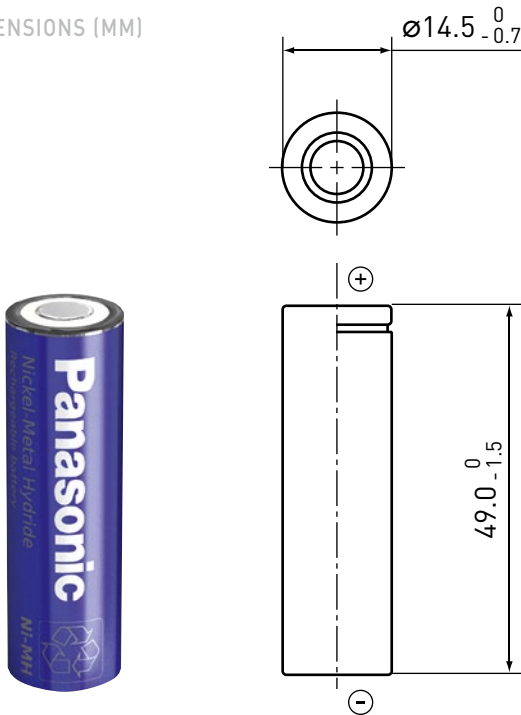


**BK-70AAH**  
HHR-70AAH (OLD)

INFRASTRUCTURE FOR STANDARD  
AA SIZE (HR15/49)

**H TYPE**

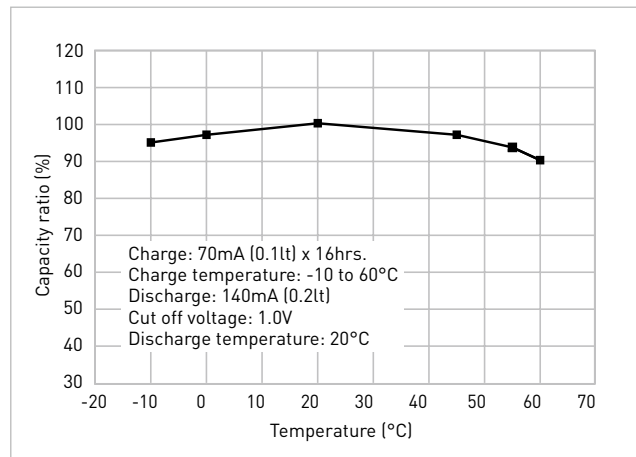
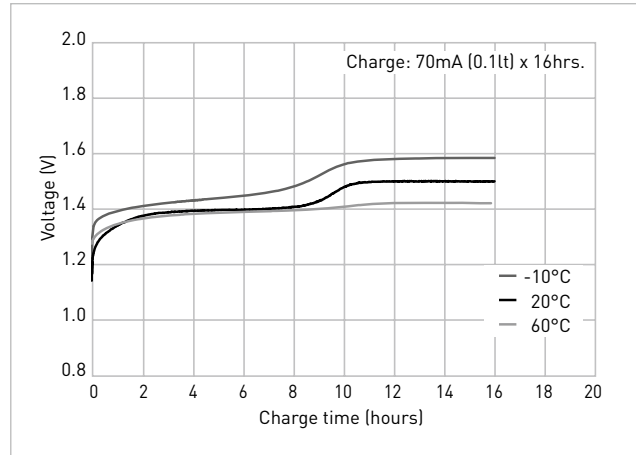
DIMENSIONS (MM)



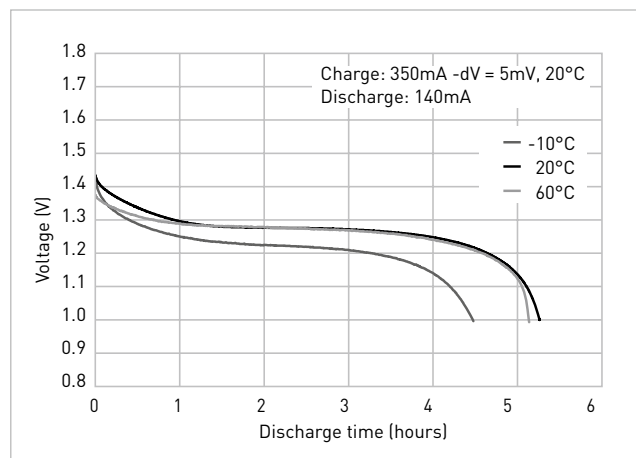
Specifications		BK-70AAH
Diameter (mm)		14.5 +0/-0.7
Total height (mm)		49.0 +0/-1.5
Approximate weight (g)		18
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	750
	Nominal capacity*3 (mAh)	700
Approx. internal impedance at 1,000Hz at charged state (mΩ)		25
Charge	Standard (mA x hrs.)	70 x 16
	Rapid*4 (mA x hrs.)	350 x 2.4
	Low rate (mA x hrs.)	35 x 32
Charge (°C)	Standard	-10 to 60
	Low rate	-10 to 60
	Rapid	-10 to 45
Discharge (°C)		-10 to 60
		-10 to 60
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



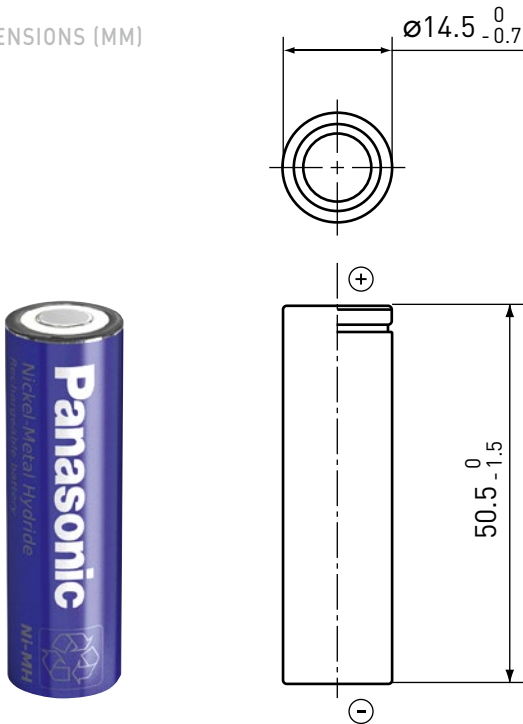
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

# BK-110AAH

INFRASTRUCTURE FOR STANDARD AA SIZE (HR15/51)

H TYPE

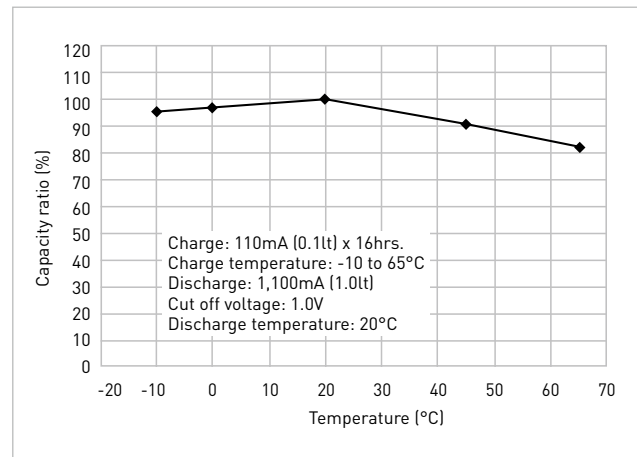
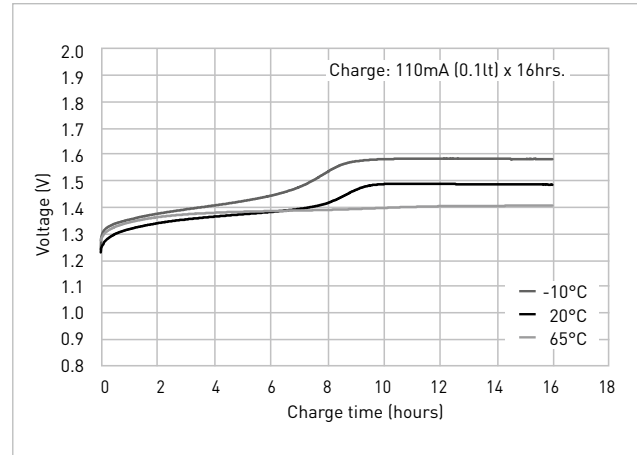
DIMENSIONS (MM)



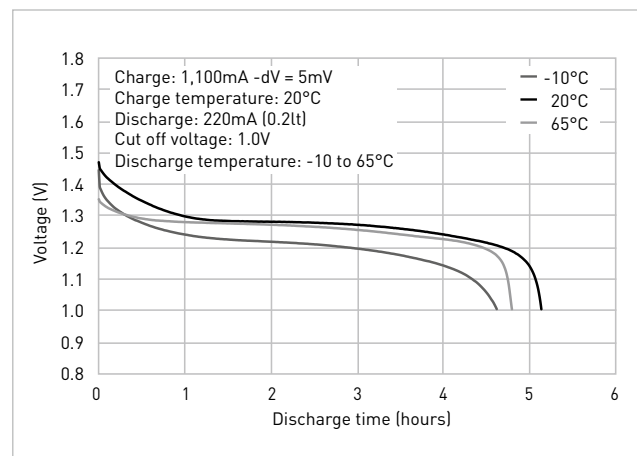
Specifications		BK-110AAH	
Diameter (mm)		14.5 +0/-0.7	
Total height (mm)		50.5 +0/-1.5	
Approximate weight (g)		24	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	1,180	
	Nominal capacity*3 (mAh)	1,100	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		17	
Charge	Standard (mA x hrs.)	110 x 16	
	Rapid*4 (mA x hrs.)	1,100 x 2.4	
	Low rate (mA x hrs.)	55 x 32	
Charge (°C)	Low rate	-10 to 60	
	Standard	-10 to 60	
	Rapid	-10 to 45	
Ambient temperature	Discharge (°C)	-10 to 60	
	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
		<1 month	-20 to 55
<1 week		-20 to 65	

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

## TYPICAL CHARGE CHARACTERISTICS



## TYPICAL DISCHARGE CHARACTERISTICS



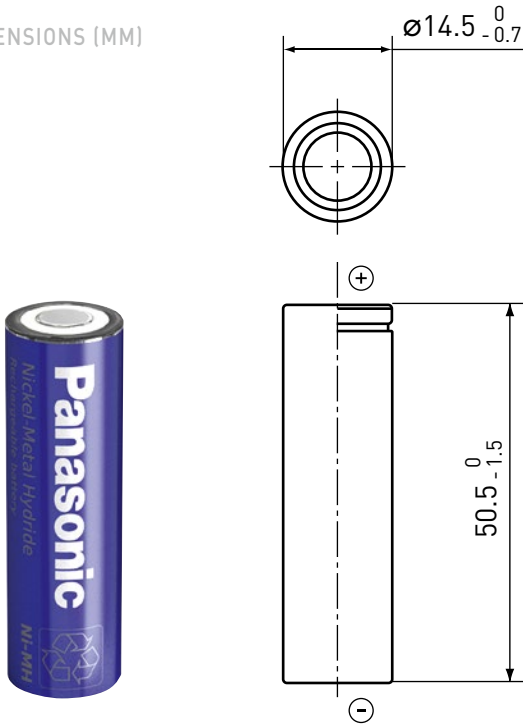
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# BK-150AAH

INFRASTRUCTURE FOR STANDARD AA SIZE (HR15/51)

H TYPE

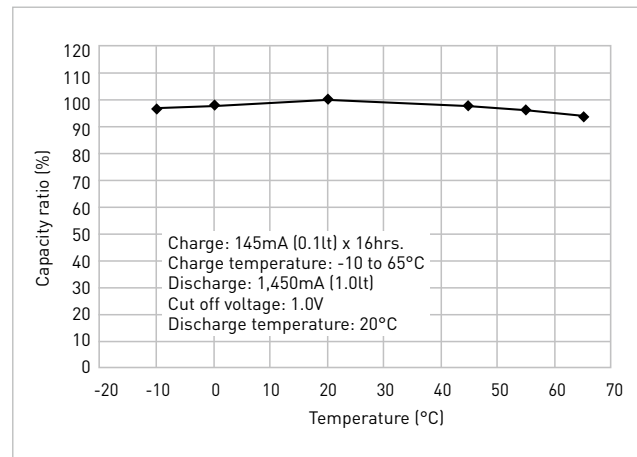
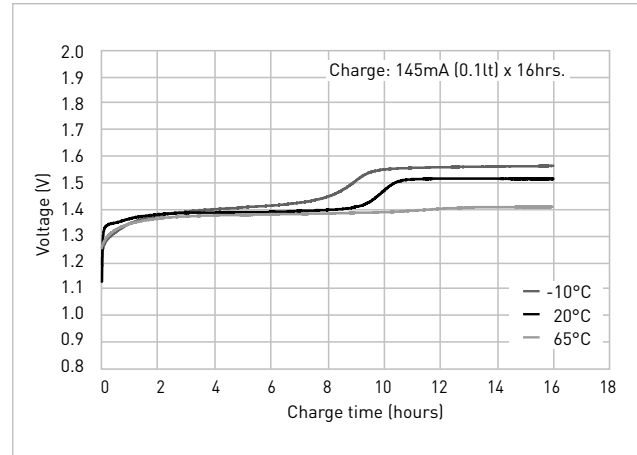
DIMENSIONS (MM)



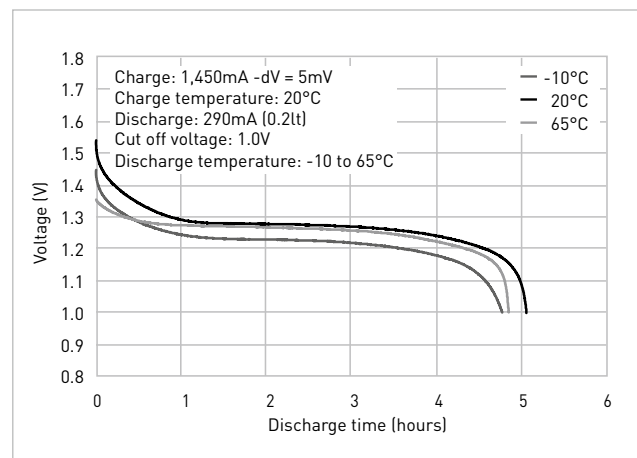
Specifications		BK-150AAH	
Diameter (mm)		14.5 +0/-0.7	
Total height (mm)		50.5 +0/-1.5	
Approximate weight (g)		25	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	1,530	
	Nominal capacity*3 (mAh)	1,450	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		17	
Charge	Standard (mA x hrs.)	145 x 16	
	Rapid*4 (mA x hrs.)	1,450 x 1.2	
	Low rate (mA x hrs.)	73 x 32	
Ambient temperature	Charge (°C)	-10 to 60	
	Discharge (°C)	Standard	-10 to 60
		Rapid	-10 to 45
Storage (°C)	<1 year	-20 to 35	
	<6 months	-20 to 45	
	<1 month	-20 to 55	
	<1 week	-20 to 65	

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

## TYPICAL CHARGE CHARACTERISTICS



## TYPICAL DISCHARGE CHARACTERISTICS



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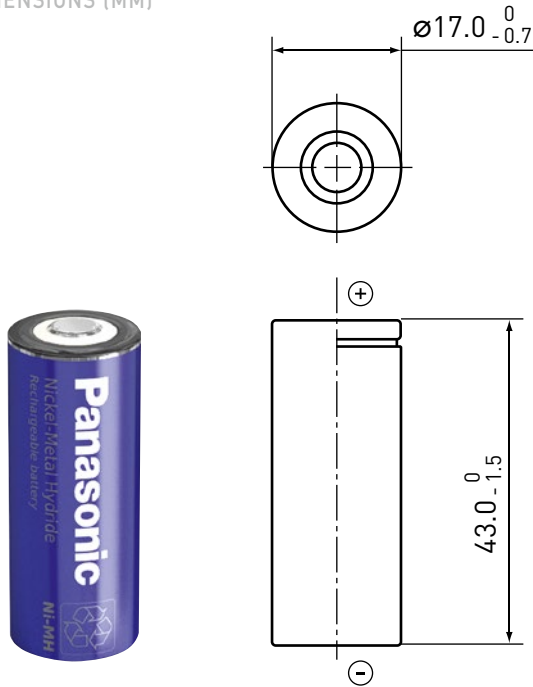


**BK-160AH**

INFRASTRUCTURE FOR STANDARD  
4/5A SIZE (HR17/43)

**H TYPE**

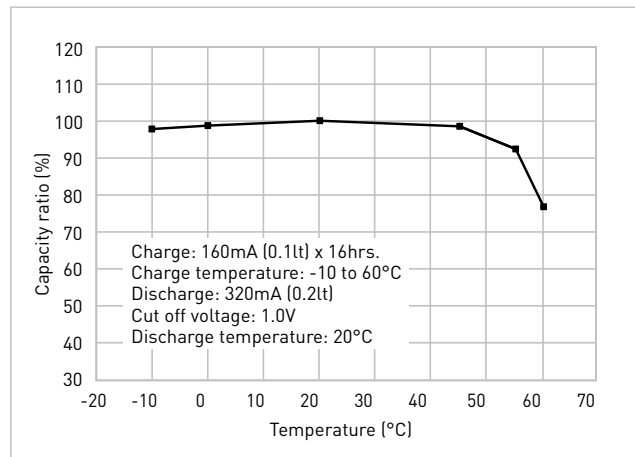
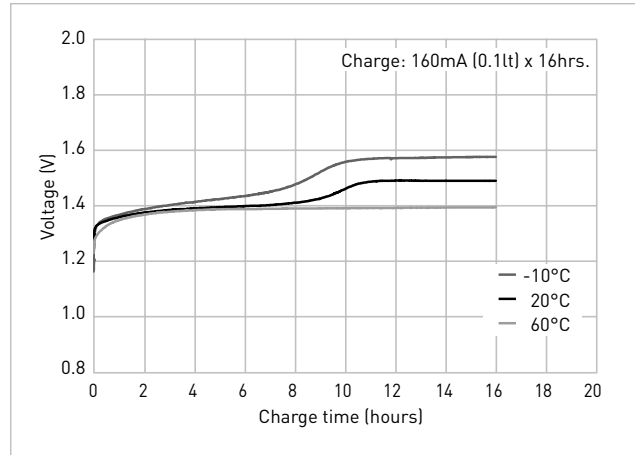
DIMENSIONS (MM)



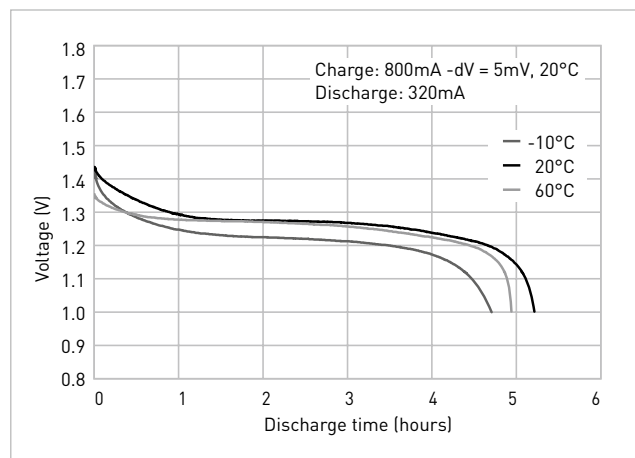
Specifications		BK-160AH	
Diameter (mm)		17.0 +0/-0.7	
Total height (mm)		43.0 +0/-1.5	
Approximate weight (g)		29	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	1,720	
	Nominal capacity*3 (mAh)	1,600	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20	
Charge	Standard (mA x hrs.)	160 x 16	
	Rapid*4 (mA x hrs.)	800 x 2.4	
	Low rate (mA x hrs.)	80 x 32	
Charge (°C)	Standard	-10 to 60	
	Low rate	-10 to 60	
	Rapid	-10 to 45	
Ambient temperature	Discharge (°C)	-10 to 60	
	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
		<1 month	-20 to 55
<1 week		-20 to 65	

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



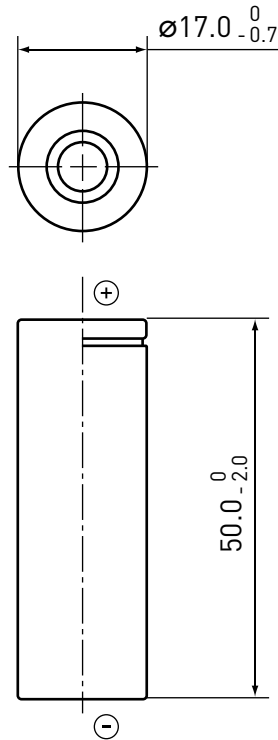
TYPICAL DISCHARGE CHARACTERISTICS



Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

**BK-210AH**  
HHR-210AH (OLD)

DIMENSIONS (MM)



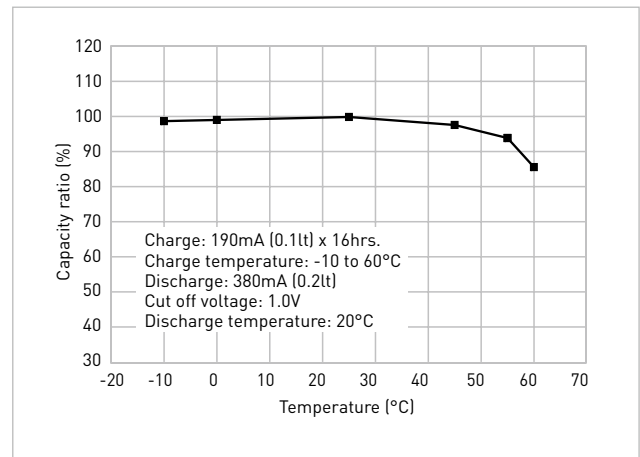
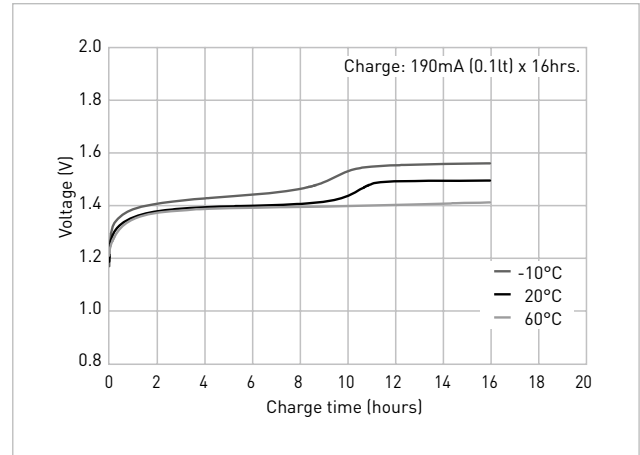
Specifications		BK-210AH	
Diameter (mm)		17.0 +0/-0.7	
Total height (mm)		50.0 +0/-2.0	
Approximate weight (g)		35	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	2,050	
	Nominal capacity*3 (mAh)	1,900	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20	
Charge	Standard (mA x hrs.)	190 x 16	
	Rapid*4 (mA x hrs.)	1,000 x 2.3	
	Low rate (mA x hrs.)		105 x 32
			70 x 48
Charge (°C)	Standard	-10 to 60	
	Low rate	-10 to 60	
	Rapid	-10 to 45	
Discharge (°C)		-10 to 60	
Ambient temperature	Storage (°C)	<1 year	-20 to 35
		<6 months	-20 to 45
	Storage (°C)	<1 month	-20 to 55
		<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

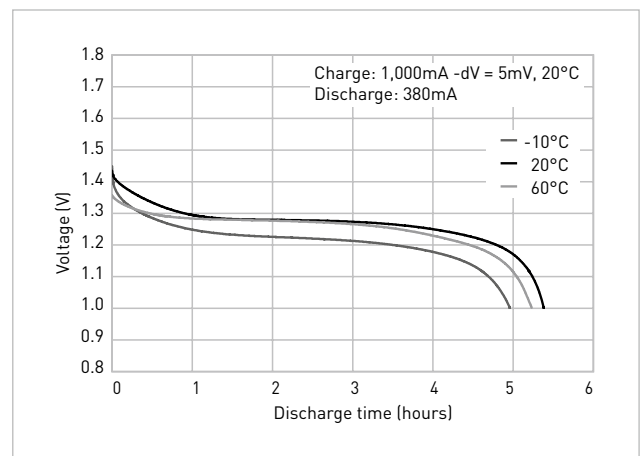
INFRASTRUCTURE FOR STANDARD  
A SIZE (HR17/50)

H TYPE

TYPICAL CHARGE CHARACTERISTICS



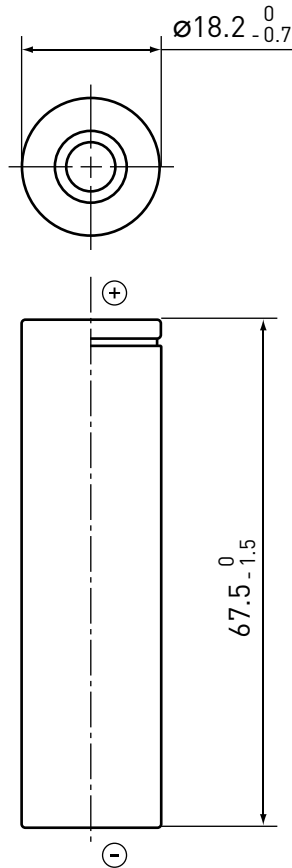
TYPICAL DISCHARGE CHARACTERISTICS



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**BK-370AH**  
HHR-370AH (OLD)

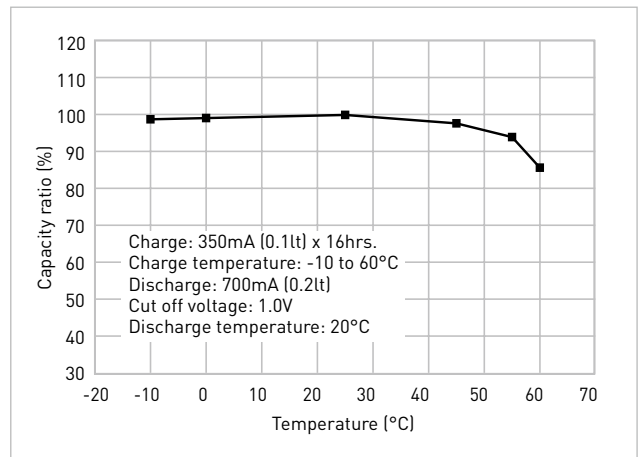
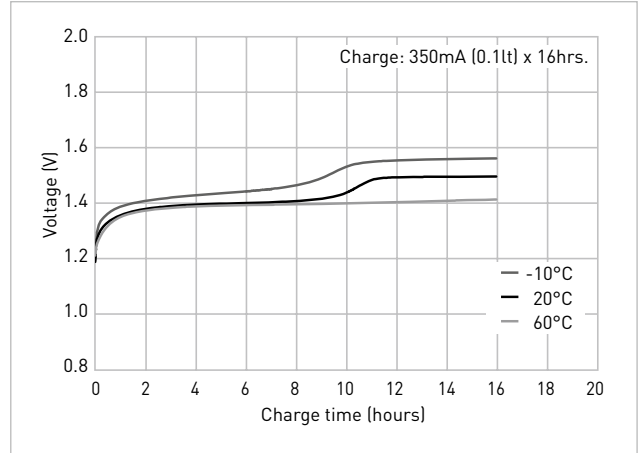
DIMENSIONS (MM)



INFRASTRUCTURE FOR STANDARD LFAT/A SIZE

**H TYPE**

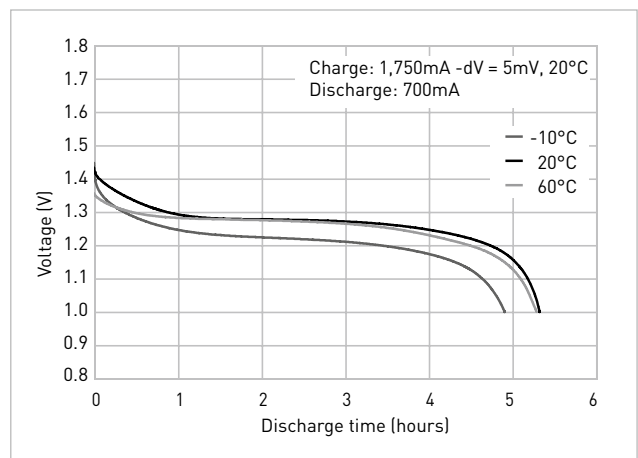
TYPICAL CHARGE CHARACTERISTICS



Specifications		BK-370AH
Diameter (mm)		18.2 +0/-0.7
Total height (mm)		67.5 +0/-1.5
Approximate weight (g)		60
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	3,700
	Nominal capacity*3 (mAh)	3,500
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20
Charge	Standard (mA x hrs.)	350 x 16
	Rapid*4 (mA x hrs.)	3,000 x 1.4
	Low rate (mA x hrs.)	185 x 32
Charge (°C)	Standard	-10 to 60
	Low rate	-10 to 60
	Rapid	-10 to 45
Discharge (°C)		-10 to 60
		-10 to 60
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL DISCHARGE CHARACTERISTICS



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## HIGH RATE DISCHARGE & HIGH TEMPERATURE TYPE

**PH TYPE**

These state-of-the-art back-up batteries deliver excellent current discharge characteristics at high temperature (60°C). They are able to power applications such as back-up for UPS, POS systems and solar window shutter.

### FEATURES

- Long 4-6 years operational life
- High rate discharge (5lt discharge@20°C) available

### APPLICATIONS

- Medical equipment
- Garden tool
- Robot cleaner
- Electric vehicle

### MODEL NUMBER (EXAMPLE)

#### **B K - 3 3 0 A P H**

				Infrastructure for high rate discharge
				Diameter: A, SC, C
				Multiply this by 10 to obtain the rated capacity (some exceptions)
				Nickel-Metal Hydride battery

Model number	Old model number	Diameter	Size	Nominal voltage (V)	Nominal capacity (mAh)	Typical capacity (mAh)	Diameter (mm)	Total height (mm)	Weight (g)	IEC	Page
<b>BK-330APH</b>	HHR-330APH	LFat/A	LFat/A	1.2	3,200	3,300	18.2 +0/-0.7	67.5 +0/-1.5	59	-	45
<b>BK-250SCH</b>	HHR-250SCH	SC	SC	1.2	2,500	2,650	23.0 +0/-1.0	43.0 +0/-1.5	53	HR23/43	46

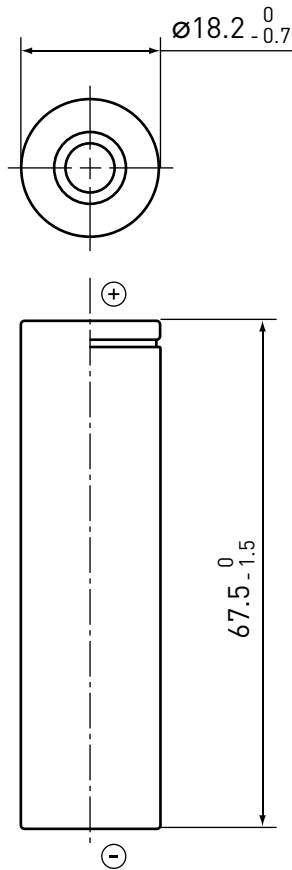


PH

**BK-330APH**

HHR-330APH (OLD)

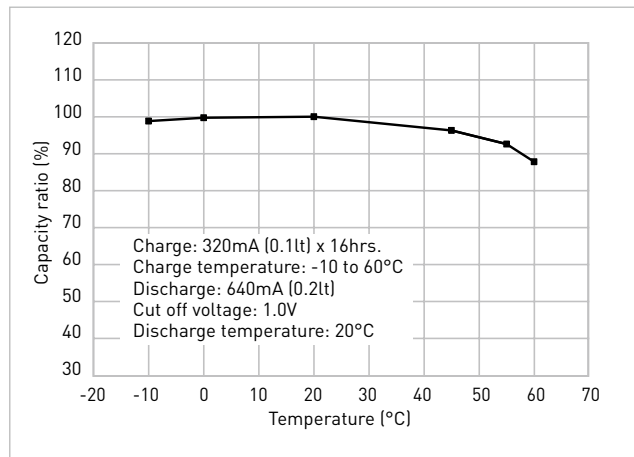
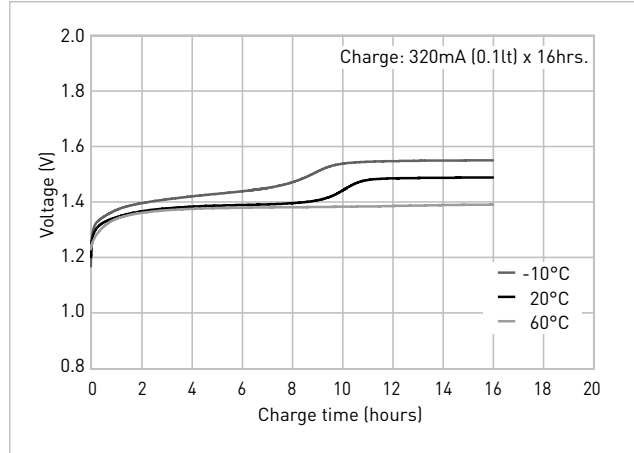
DIMENSIONS (MM)



INFRASTRUCTURE FOR HIGH RATE DISCHARGE  
LFAT/A SIZE

**PH TYPE**

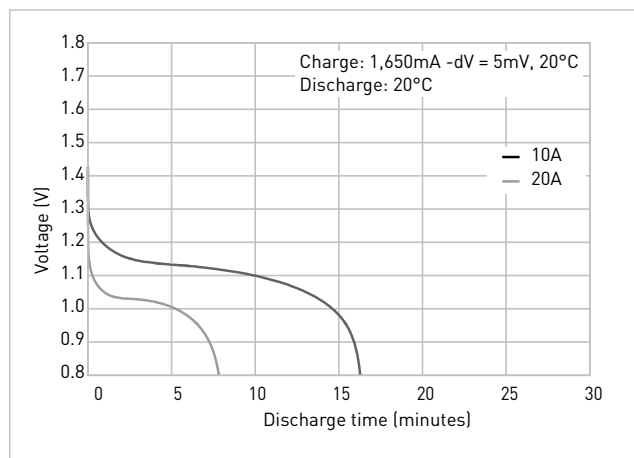
TYPICAL CHARGE CHARACTERISTICS



Specifications		BK-330APH	
Diameter (mm)		18.2 +0/-0.7	
Total height (mm)		67.5 +0/-1.5	
Approximate weight (g)		59	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	3,300	
	Nominal capacity*3 (mAh)	3,200	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		5.5	
Charge	Standard (mA x hrs.)	320 x 16	
	Rapid*4 (mA x hrs.)	1,650 x 2.4	
	Low rate (mA x hrs.)		165 x 32
			110 x 48
Charge (°C)	Standard	-10 to 60	
	Low rate	-10 to 60	
	Rapid	-10 to 45	
Ambient temperature	Discharge (°C)	-10 to 60	
Storage (°C)	<1 year	-20 to 35	
	<6 months	-20 to 45	
	<1 month	-20 to 55	
	<1 week	-20 to 65	

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL DISCHARGE CHARACTERISTICS

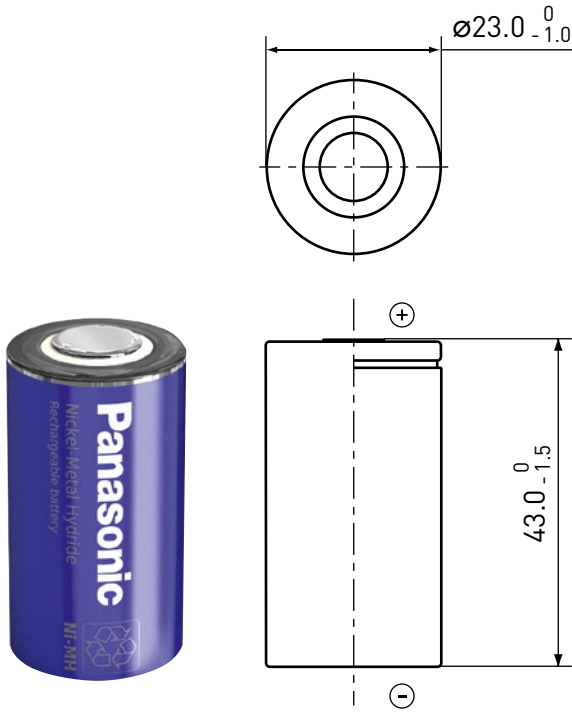


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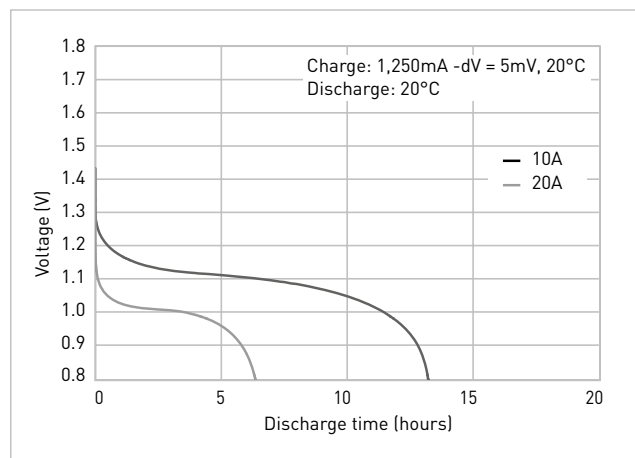
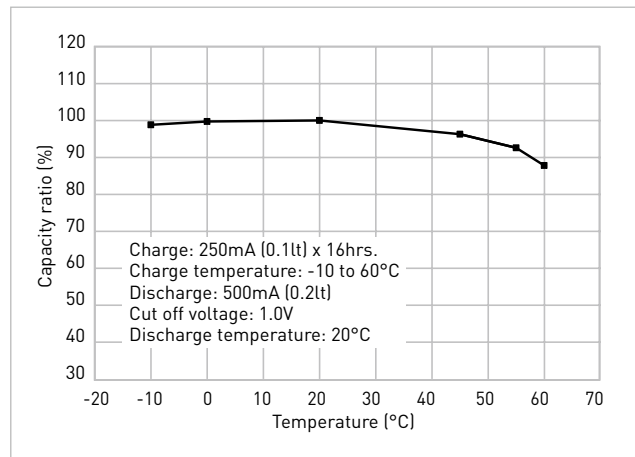
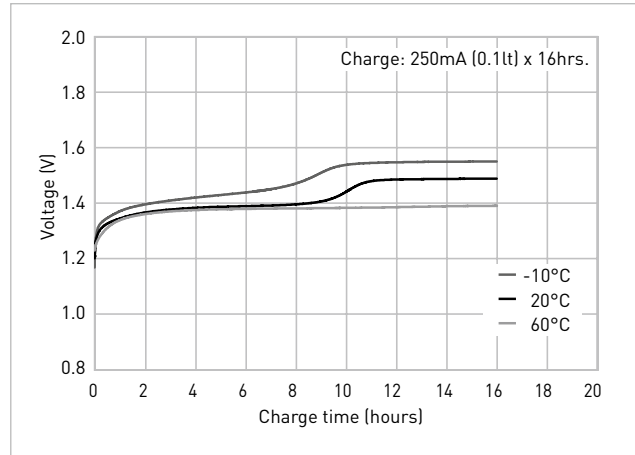
**BK-250SCH**  
HHR-250SCH (OLD)

INFRASTRUCTURE FOR HIGH RATE DISCHARGE  
SC SIZE (HR23/43)

**PH TYPE**



Specifications		BK-250SCH	
Diameter (mm)		23.0 +0/-1.0	
Total height (mm)		43.0 +0/-1.5	
Approximate weight (g)		53	
Nominal voltage (V)		1.2	
Discharge capacity*1	Typical capacity*2 (mAh)	2,650	
	Nominal capacity*3 (mAh)	2,500	
Approx. internal impedance at 1,000Hz at charged state (mΩ)		5	
Charge	Standard (mA x hrs.)	250 x 16	
	Rapid** (mA x hrs.)	1,250 x 2.4	
	Low rate (mA x hrs.)		125 x 32
			83 x 48
Charge (°C)	Standard	-10 to 60	
	Low rate	-10 to 60	
	Rapid	-10 to 45	
Discharge (°C)		-10 to 60	
Ambient temperature	Storage (°C)	<1 year	
		<6 months	
		<1 month	
		<1 week	



PH

## HIGH RATE DISCHARGE & RAPID CHARGE TYPE

P TYPE

These battery types provide excellent current discharge characteristics and are designed for rapid charging. They are most suitable for power tools, robot cleaners and high power high cycle applications.

### FEATURES

- Excellent large current discharge characteristics
- Rapid charge-capable

### APPLICATIONS

- Medical equipment
- Power tool
- Garden tool
- Robot cleaner
- Electric vehicle, etc.

### MODEL NUMBER (EXAMPLE)

#### BK - 300 S C P

				High rate discharge & rapid charge type
				Diameter: SC
				Multiply this by 10 to obtain the rated capacity (some exceptions)
				Nickel-Metal Hydride battery

Model number	Old model number	Diameter	Size	Nominal voltage (V)	Nominal capacity (mAh)	Typical capacity (mAh)	Diameter (mm)	Total height (mm)	Weight (g)	IEC	Page
BK-260SCP*1	HHR-260SCP	SC	SC	1.2	2,450	2,700	23.0 +0/-1.0	43.0 +0/-1.5	55	HR23/43	48
BK-300SCP*1	HHR-300SCP	SC	SC	1.2	2,800	3,050	23.0 +0/-1.0	43.0 +0/-1.5	57	HR23/43	49



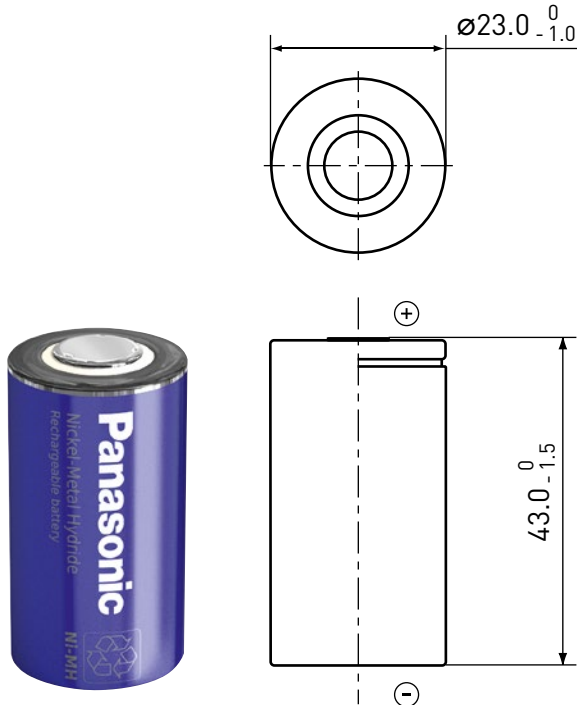
\*1 For high power use application such as power tools.

**BK-260SCP**  
HHR-260SCP (OLD)

HIGH RATE DISCHARGE & RAPID CHARGE TYPE  
SC SIZE (HR23/43)

**P TYPE**

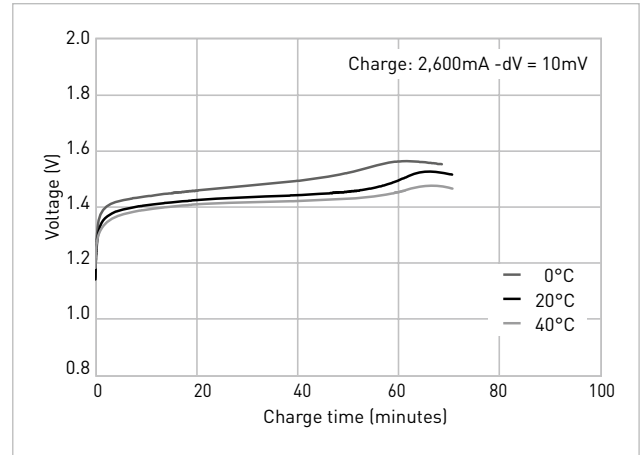
DIMENSIONS (MM)



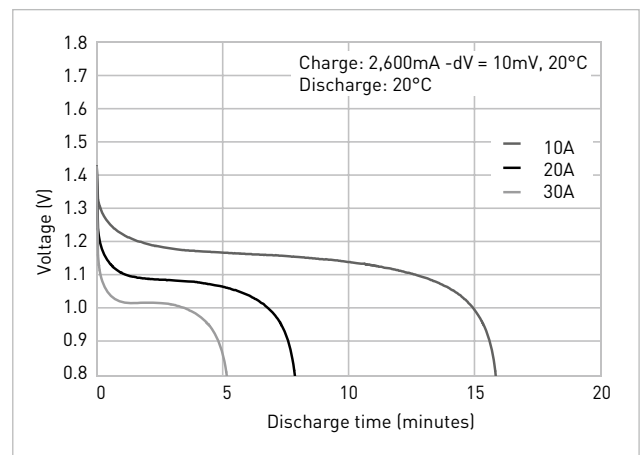
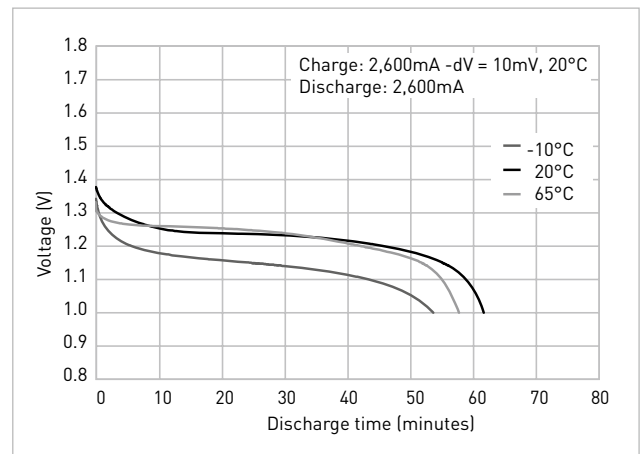
Specifications		BK-260SCP
Diameter (mm)		23.0 +0/-1.0
Total height (mm)		43.0 +0/-1.5
Approximate weight (g)		55
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	2,700
	Nominal capacity*3 (mAh)	2,450
Approx. internal impedance at 1,000Hz at charged state (mΩ)		4
Charge	Standard (mA x hrs.)	245 x 16
	Rapid*4 (mA x hrs.)	2,600 x 1.2
Charge (°C)	Standard	0 to 45
	Rapid	0 to 40
Discharge (°C)		-10 to 65
Ambient temperature	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



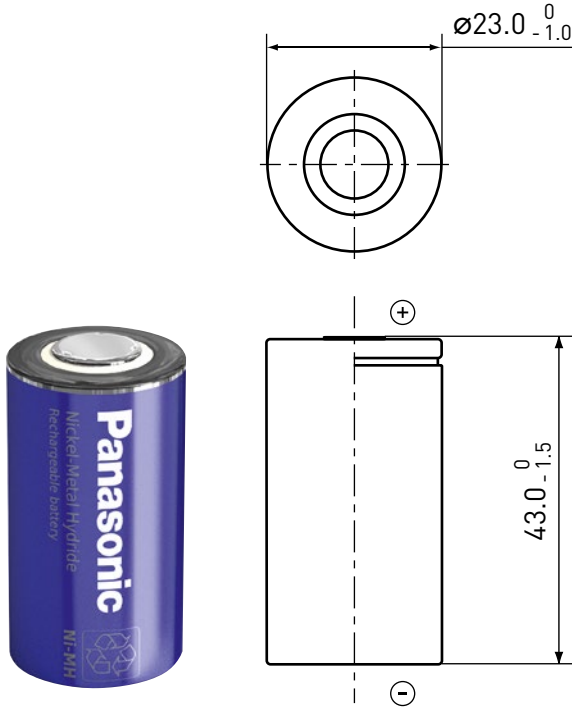


**BK-300SCP**  
HHR-300SCP (OLD)

HIGH RATE DISCHARGE & RAPID CHARGE TYPE  
SC SIZE (HR23/43)

**P TYPE**

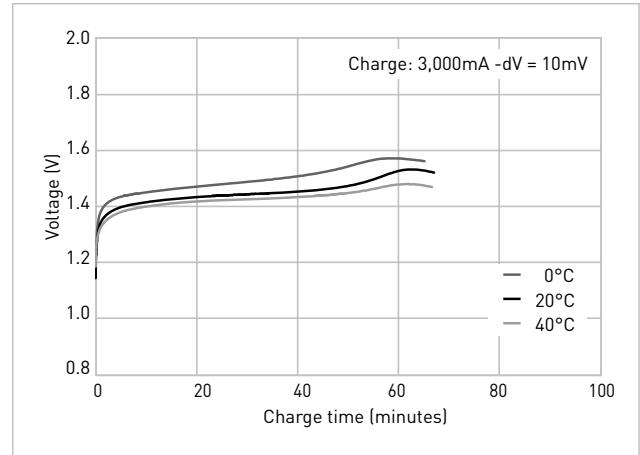
DIMENSIONS (MM)



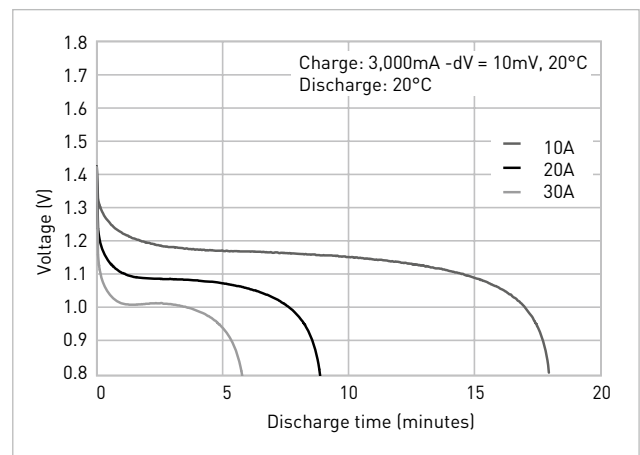
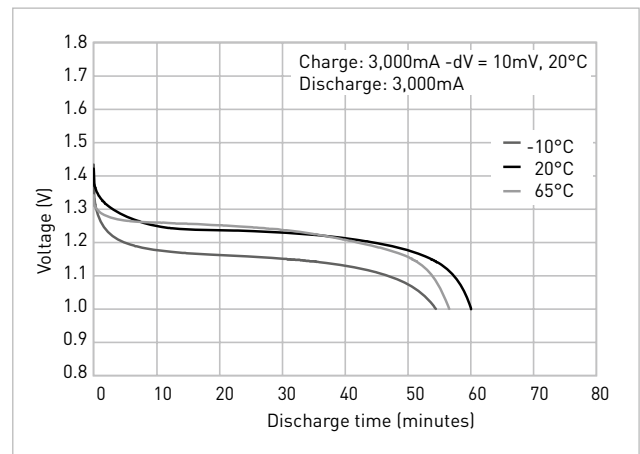
Specifications		BK-300SCP
Diameter (mm)		23.0 +0/-1.0
Total height (mm)		43.0 +0/-1.5
Approximate weight (g)		57
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	3,050
	Nominal capacity*3 (mAh)	2,800
Approx. internal impedance at 1,000Hz at charged state (mΩ)		4
Charge	Standard (mA x hrs.)	280 x 16
	Rapid*4 (mA x hrs.)	3,000 x 1.2
Charge (°C)	Standard	0 to 45
	Rapid	0 to 40
Discharge (°C)		-10 to 65
Ambient temperature	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



## INFRASTRUCTURE FOR LONG LIFE TYPE

U TYPE

These very tough Ni-MH batteries offer a very long service life when using intermittent charging at high ambient temperature conditions. Moreover, these batteries are ideal as a replacement for standard Ni-Cd batteries. They are recommended for use in applications such as emergency lighting, servers, elevators, automated teller machines (ATM), solar powered devices and as a back-up for base stations.

### FEATURES

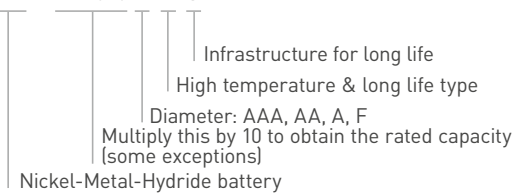
- Expected lifetime is about 8 to 10 years
- Superior charge efficiency under high temperature conditions
- Available in various sizes
- Very long service life when using intermittent charging at high ambient temperature conditions
- Excellent low self discharge characteristics

### APPLICATIONS

- Solar powered application
- Server
- UPS system
- Elevator
- Emergency light, etc.

### MODEL NUMBER (EXAMPLE)

**BK - 1100FHU**



Model number	Old model number	Diameter	Size	Nominal voltage (V)	Nominal capacity (mAh)	Typical capacity (mAh)	Diameter (mm)	Total height (mm)	Weight (g)	IEC	Page
BK-60AAAHU	-	AAA	AAA	1.2	500	550	10.5 +0/-0.7	44.5 +0/-1.5	12	HR11/45	51
BK-120AAAHU	-	AA	AA	1.2	1,200	1,280	14.5 +0/-0.7	50.5 +0/-1.5	24	HR15/51	52
BK-220SCHU	-	SC	SC	1.2	2,200	2,300	23.0 +0/-1.0	43.0 +0/-1.5	52	HR23/43	53
BK-310CHU	-	C	C	1.2	3,100	3,300	25.8 +0/-1.0	50.0 +0/-2.0	78	HR26/50	54
BK-1100FHU	-	F	F	1.2	11,000	12,000	33.0 +0/-1.0	91.0 +0/-2.5	245	HR33/91	55

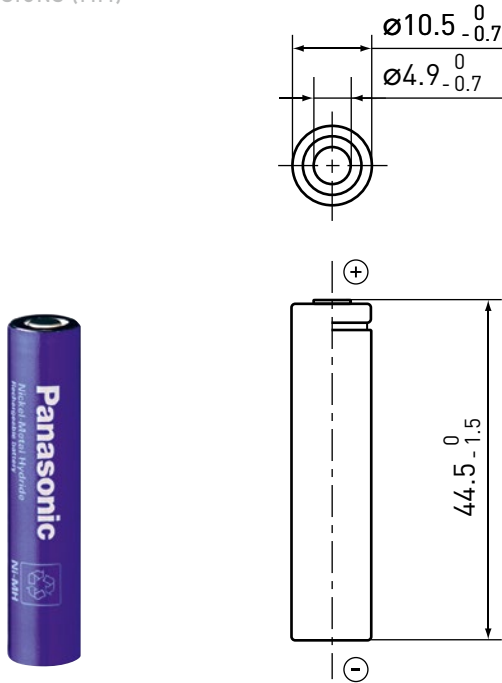


# BK-60AAAHU

INFRASTRUCTURE FOR LONG LIFE  
AAA SIZE (HR11/45)

**U TYPE**

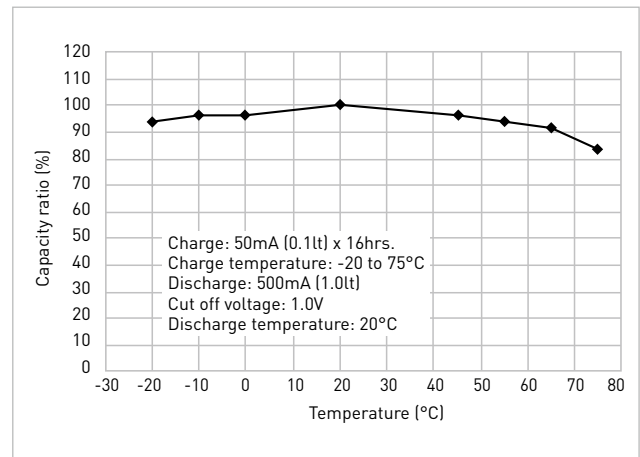
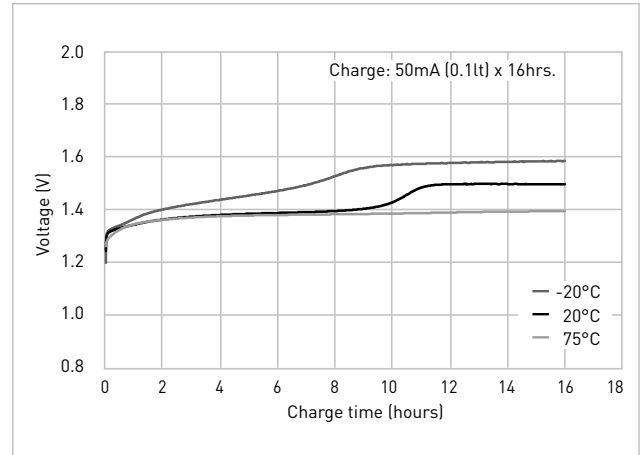
DIMENSIONS (MM)



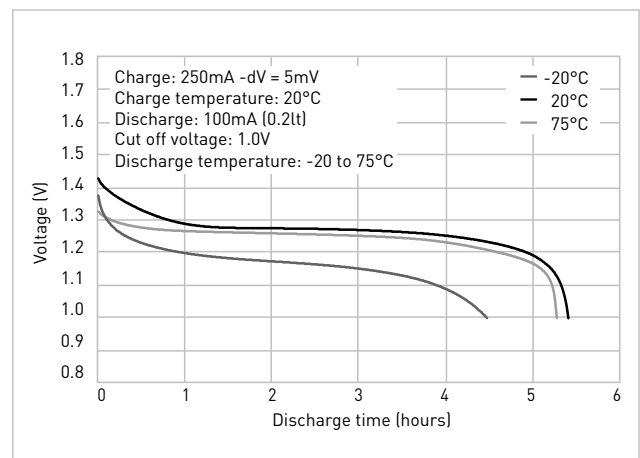
Specifications		BK-60AAAHU
Diameter (mm)		10.5 +0/-0.7
Total height (mm)		44.5 +0/-1.0
Approximate weight (g)		12
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	550
	Nominal capacity*3 (mAh)	500
Approx. internal impedance at 1,000Hz at charged state (mΩ)		35
Charge	Standard (mA x hrs.)	50 x 16
	Rapid*4 (mA x hrs.)	250 x 2.4
	Low rate (mA x hrs.)	25 x 32
Charge (°C)	Low rate	-10 to 75
	Standard	-10 to 60
	Rapid	-10 to 75
Discharge (°C)	Low rate	-20 to 75
	Standard	-20 to 35
	Rapid	-20 to 45
Storage (°C)	<1 year	-20 to 55
	<6 months	-20 to 45
	<1 month	-20 to 35
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



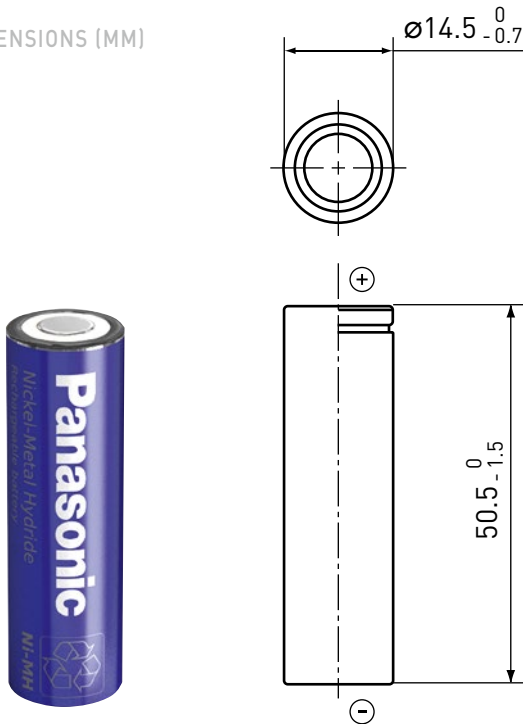
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# BK-120AAHU

INFRASTRUCTURE FOR LONG LIFE  
AA SIZE (HR15/51)

U TYPE

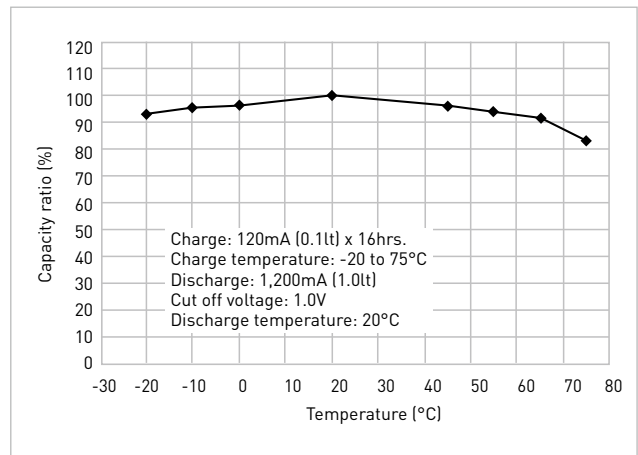
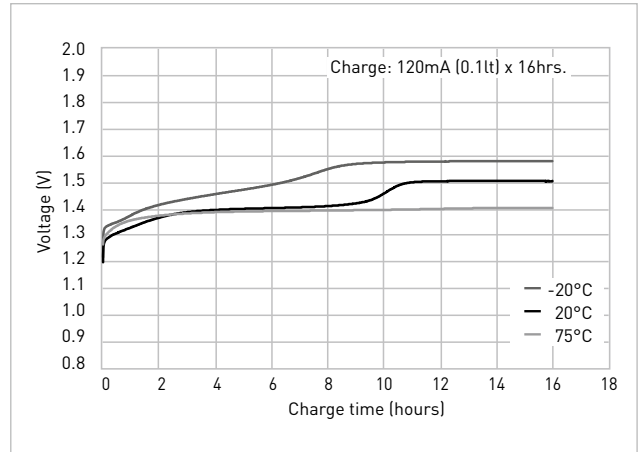
DIMENSIONS (MM)



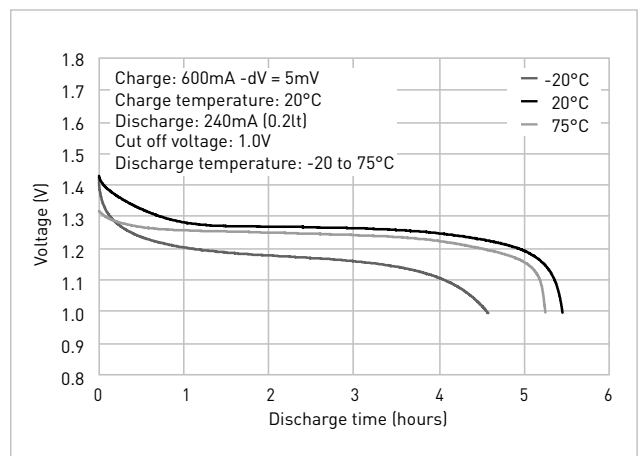
Specifications		BK-120AAHU
Diameter (mm)		14.5 +0/-0.7
Total height (mm)		50.5 +0/-1.5
Approximate weight (g)		24
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	1,280
	Nominal capacity*3 (mAh)	1,200
Approx. internal impedance at 1,000Hz at charged state (mΩ)		17
Charge	Standard (mA x hrs.)	120 x 16
	Rapid*4 (mA x hrs.)	600 x 2.4
	Low rate (mA x hrs.)	60 x 32
Charge (°C)	Low rate	40 x 48
	Standard	-20 to 75
	Rapid	-20 to 60
Discharge (°C)	Low rate	-20 to 75
	Standard	-20 to 75
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

## TYPICAL CHARGE CHARACTERISTICS



## TYPICAL DISCHARGE CHARACTERISTICS

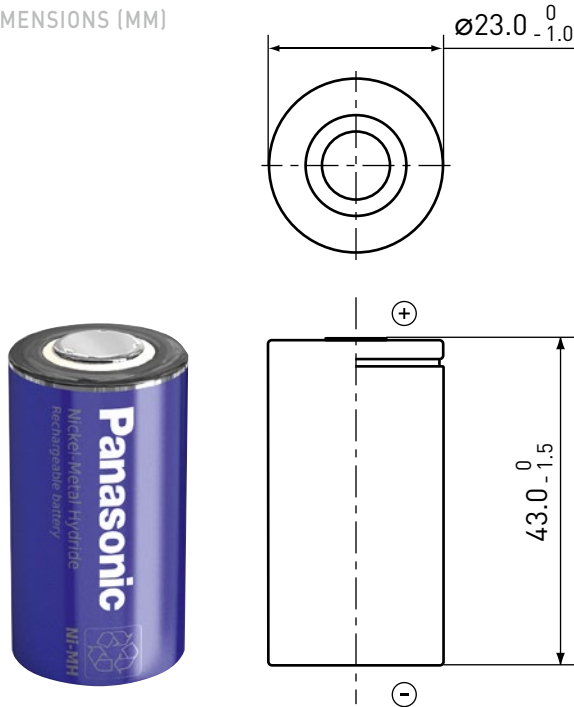


# BK-220SCHU

INFRASTRUCTURE FOR LONG LIFE  
SC SIZE (HR23/43)

**U TYPE**

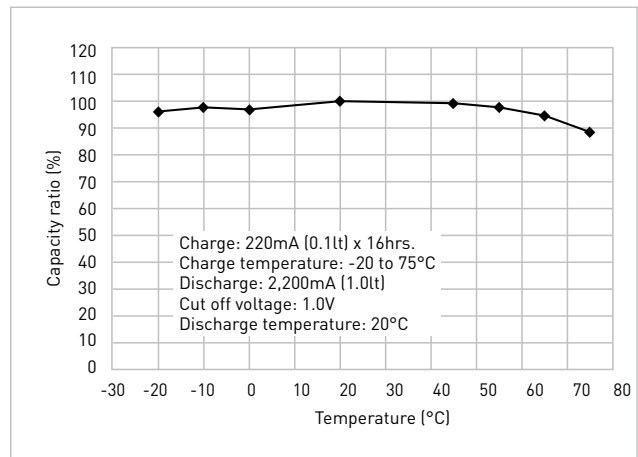
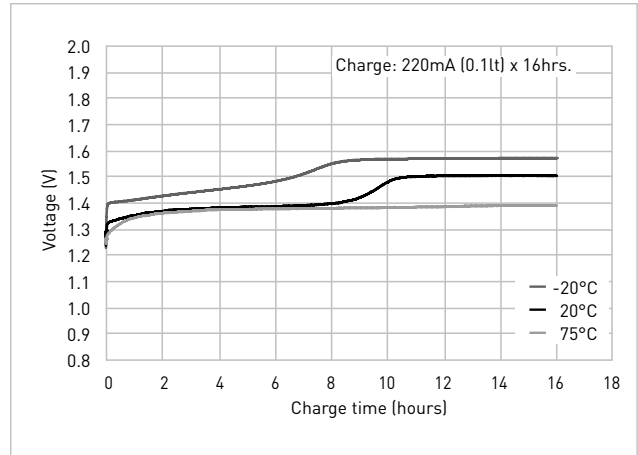
DIMENSIONS (MM)



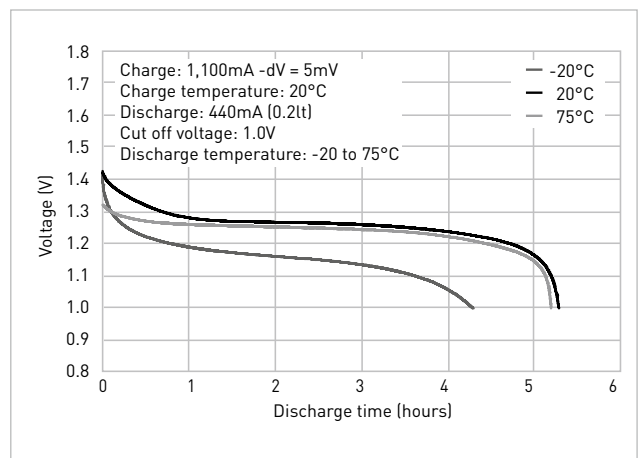
Specifications		BK-220SCHU
Diameter (mm)		23.0 +0/-1.0
Total height (mm)		43.0 +0/-1.5
Approximate weight (g)		52
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	2,300
	Nominal capacity*3 (mAh)	2,200
Approx. internal impedance at 1,000Hz at charged state (mΩ)		5
Charge	Standard (mA x hrs.)	220 x 16
	Rapid**4 (mA x hrs.)	1,100 x 2.4
	Low rate (mA x hrs.)	110 x 32
Charge (°C)	Low rate	73 x 48
	Standard	-20 to 75
	Rapid	-20 to 60
Discharge (°C)	Standard	-20 to 75
	Rapid	-20 to 60
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

TYPICAL CHARGE CHARACTERISTICS



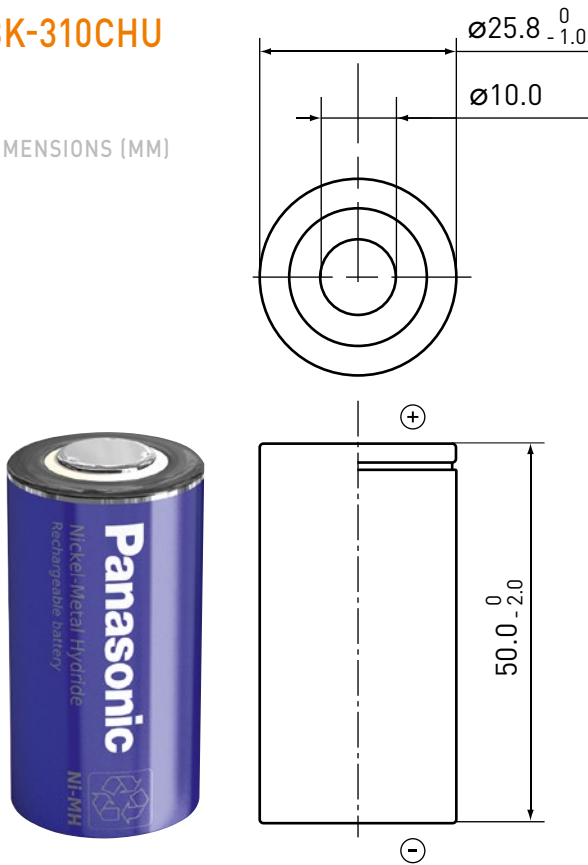
TYPICAL DISCHARGE CHARACTERISTICS



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# BK-310CHU

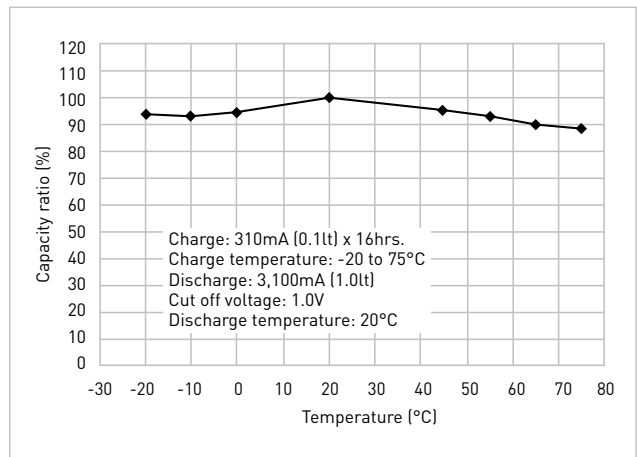
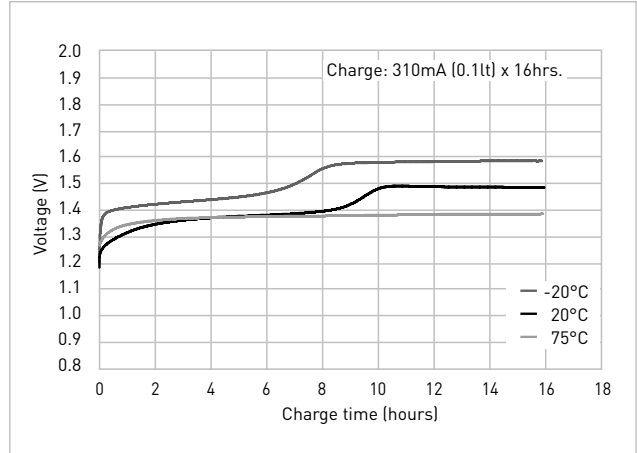
DIMENSIONS (MM)



INFRASTRUCTURE FOR LONG LIFE  
C SIZE (HR26/50)

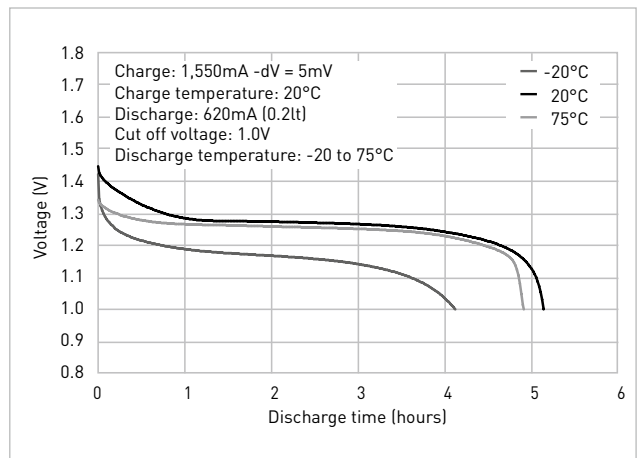
U TYPE

## TYPICAL CHARGE CHARACTERISTICS



Specifications		BK-310CHU
Diameter (mm)		25.8 +0/-1.0
Total height (mm)		50.0 +0/-2.0
Approximate weight (g)		78
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	3,300
	Nominal capacity*3 (mAh)	3,100
Approx. internal impedance at 1,000Hz at charged state (mΩ)		5
Charge	Standard (mA x hrs.)	310 x 16
	Rapid*4 (mA x hrs.)	1,550 x 2.4
	Low rate (mA x hrs.)	155 x 32
Charge (°C)	Low rate	103 x 48
	Standard	-20 to 75
	Rapid	-20 to 60
Discharge (°C)	Standard	-20 to 75
	Rapid	-20 to 60
	Low rate	-20 to 75
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

## TYPICAL DISCHARGE CHARACTERISTICS

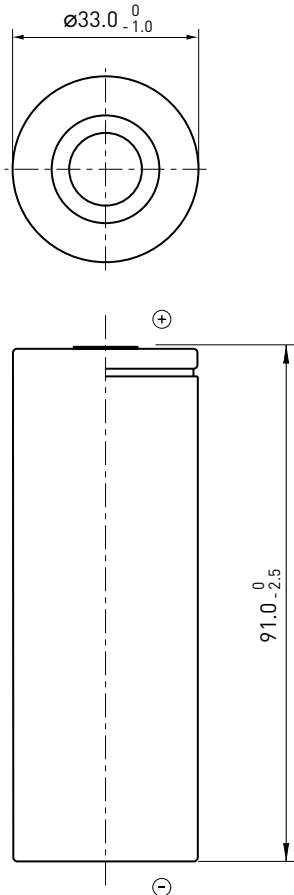


\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

# BK-1100FHU

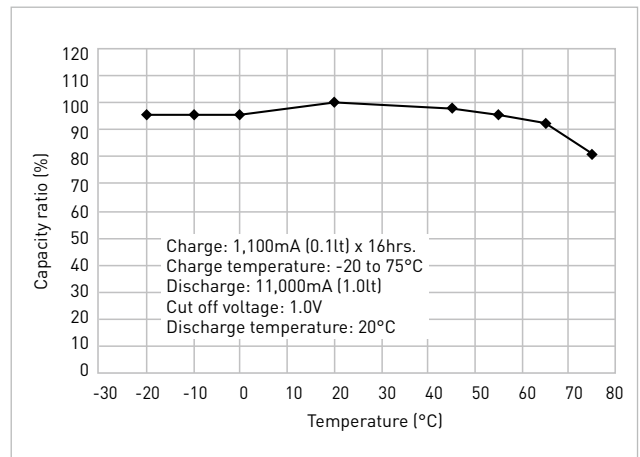
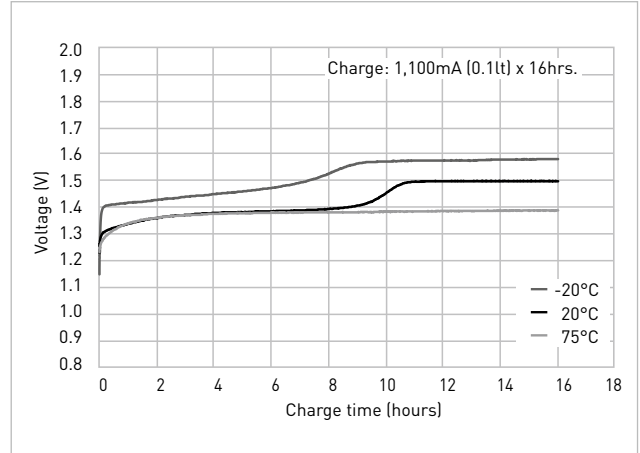
DIMENSIONS (MM)



INFRASTRUCTURE FOR LONG LIFE  
F SIZE

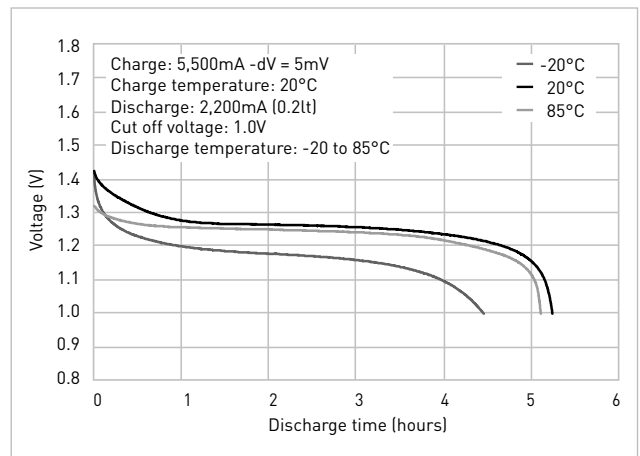
U TYPE

## TYPICAL CHARGE CHARACTERISTICS



Specifications		BK-1100FHU
Diameter (mm)		33.0 +0/-1.0
Total height (mm)		91.0 +0/-2.5
Approximate weight (g)		250
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	12,000
	Nominal capacity*3 (mAh)	11,000
Approx. internal impedance at 1,000Hz at charged state (mΩ)		5
Charge	Standard (mA x hrs.)	1,100 x 16
	Rapid** (mA x hrs.)	5,500 x 2.4
	Low rate (mA x hrs.)	550 x 32
Charge (°C)	Low rate	367 x 48
	Standard	-20 to 75
	Rapid	-20 to 65
Discharge (°C)*5	Low rate	-20 to 85
	Standard	-20 to 85
Storage (°C)	<1 year	-20 to 35
	<6 months	-20 to 45
	<1 month	-20 to 55
	<1 week	-20 to 65

## TYPICAL DISCHARGE CHARACTERISTICS



\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Rated capacity (mAh).  
 \*4 Need specially designed control system. Please contact Panasonic for details.

Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to make or imply any guarantee or warranty.

## AUTOMOTIVE BACKUP TYPE

This new Panasonic Ni-MH battery series is particularly designed for e-call systems. The long life reliability and the high discharge capability make these batteries ideal for these demanding applications. On the top our new batteries are eco-friendly designed and non-flammable.

### FEATURES

- Excellent low temperature discharge performance
- Provides high safety battery pack
- Complies with automotive standard production (IATF, VDA6.3)

### APPLICATIONS

- E-call
- ADAS back-up
- Low temperature data logger

### MODEL NUMBER (EXAMPLE)

#### BK - 60AAAWS

BK	60	AAA	WS
			Automotive backup type
			Diameter: AAA, AA
			Multiply this by 10 to obtain the rated capacity (some exceptions)
			Nickel-Metal Hydride battery

Model number	Old model number	Diameter	Size	Nominal voltage (V)	Nominal capacity (mAh)	Typical capacity (mAh)	Diameter (mm)	Total height (mm)	Weight (g)	IEC	Page
BK-60AAAWS	-	AAA	AAA	1.2	500	550	10.5 +0/-0.7	44.5 +0/-1.5	11	HR11/45	57
BK-120AAWS	-	AA	AA	1.2	1,100	1,180	14.5 +0/-0.7	50.5 +0/-1.5	24	HR15/51	58



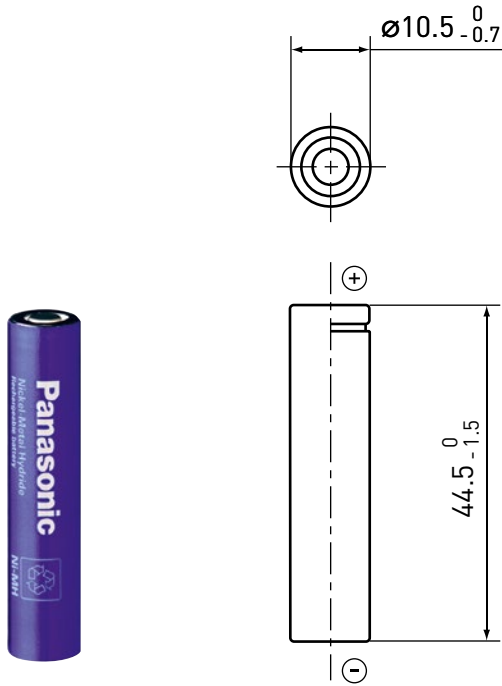


**NEW** BK-60AAAWS

WIDE TEMPERATURE TYPE  
AAA SIZE (HR11/45)

**W TYPE**

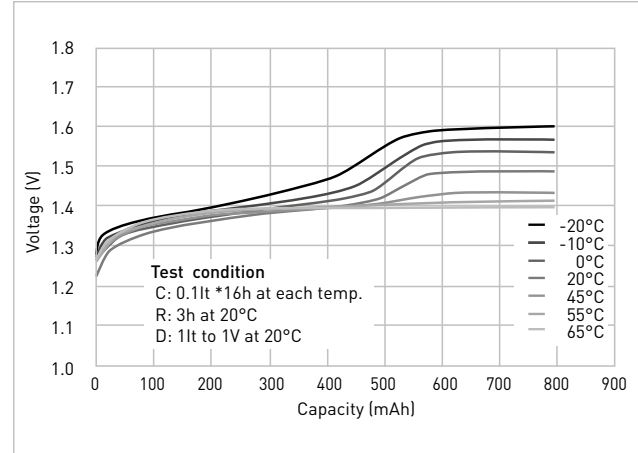
DIMENSIONS (MM)



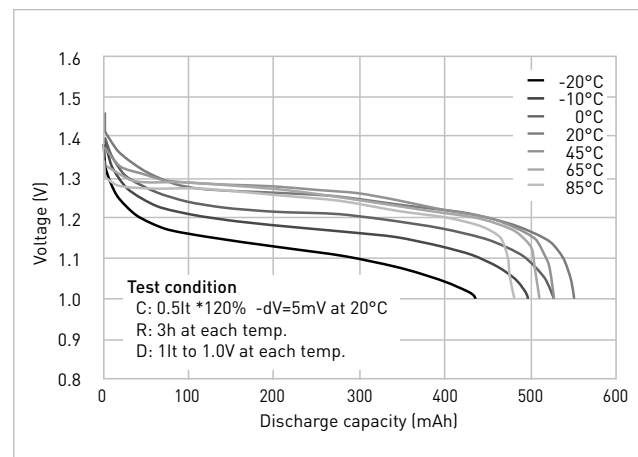
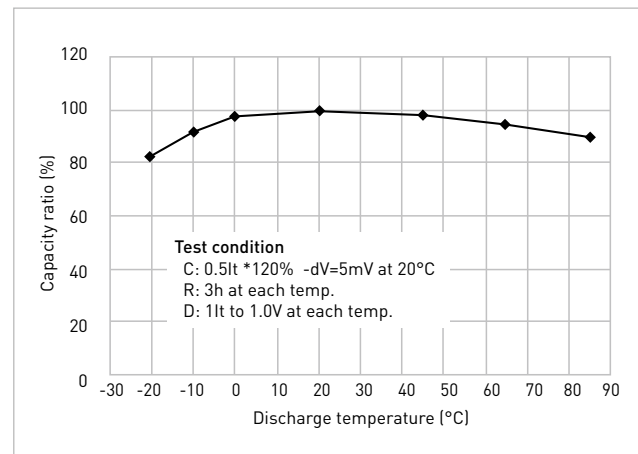
Specifications		BK-60AAAWS
Diameter (mm)		10.5 +0/-0.7
Total height (mm)		44.5 +0/-1.5
Approximate weight (g)		11
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	550
	Nominal capacity*3 (mAh)	500
Approx. internal impedance at 1,000Hz at charged state (mΩ)		25
Charge	Standard (mA x hrs.)	50 x 16
	Rapid*3 (mA x hrs.)	250 x 2.4
Charge (°C)	Standard	-20 to 60
	Rapid	-20 to 45
Discharge (°C)	Recommended	-20 to 60
	Possible*4	-30 to 85
Ambient temperature	<1 year	-40 to 35
	<6 months	-40 to 45
	<1 month	-40 to 55
	<1 week	-40 to 85

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Need specially designed control system. Please contact Panasonic for details.  
 \*4 It depends on usage conditions. Please contact Panasonic.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS

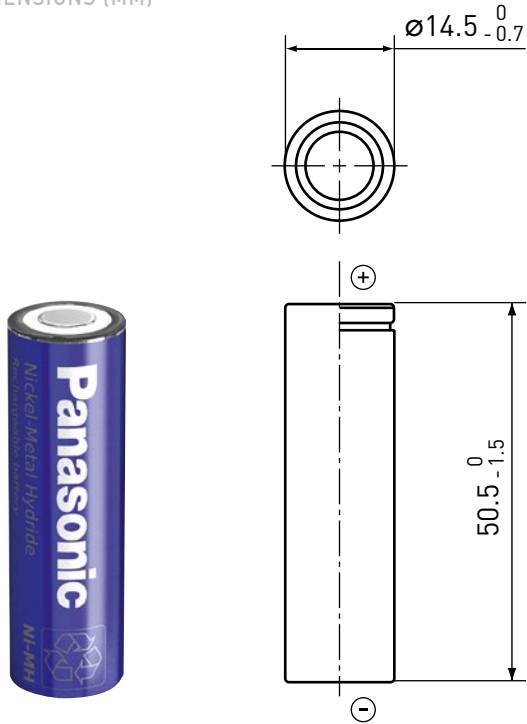


**NEW** BK-120AWS

AA SIZE (HR15/51)

**W TYPE**

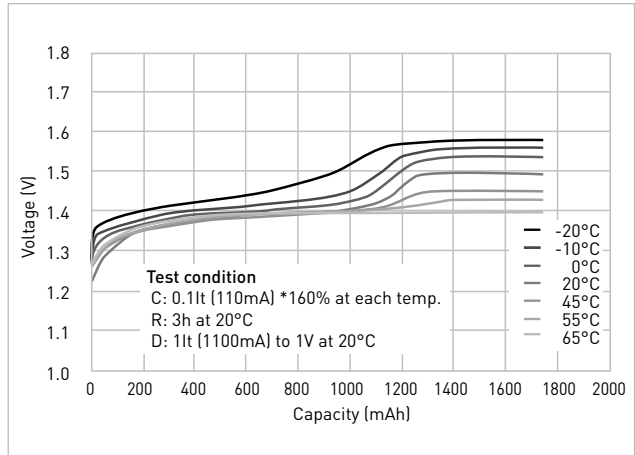
DIMENSIONS (MM)



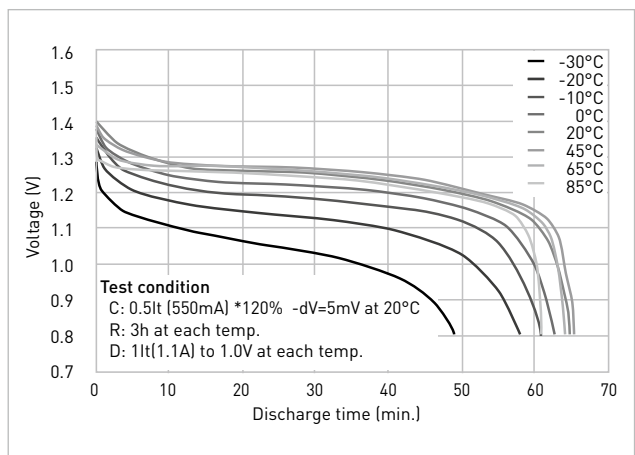
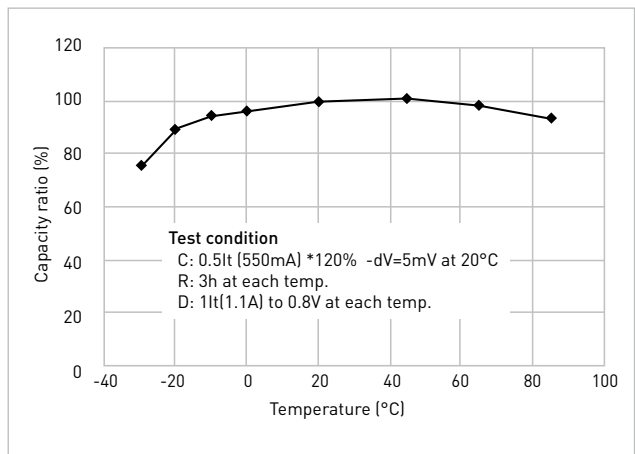
Specifications		BK-120AWS
Diameter (mm)		14.5 +0/-0.7
Total height (mm)		50.5 +0/-1.5
Approximate weight (g)		24
Nominal voltage (V)		1.2
Discharge capacity*1	Typical capacity*2 (mAh)	1,180
	Nominal capacity (min.)	1,100
Approx. internal impedance at 1,000Hz at charged state (mΩ)		20
Charge	Standard (mA x hrs.)	110 x 16
	Rapid*3 (mA x hrs.)	550 x 2.4
Charge (°C)	Standard	-20 to 60
	Rapid	-20 to 45
Discharge (°C)	Recommended	-30 to 60
	Possible*4	-40 to 85
Ambient temperature	<1 year	-40 to 35
	<6 months	-40 to 45
	<1 month	-40 to 55
	<1 week	-40 to 85

\*1 After charging at 0.1It for 16 hours, discharging at 0.2It.  
 \*2 Average capacity (mAh). For reference only.  
 \*3 Need specially designed control system. Please contact Panasonic for details.  
 \*4 It depends on usage conditions. Please contact Panasonic.

TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



### STRUCTURAL-RELATED ITEMS

#### Active material

The electro-chemical materials of the electrodes. In rechargeable Ni-MH battery, Nickel-hydroxide is the active material of the positive electrode and hydrogen absorbing alloy is the active material of the negative electrode.

#### Cell

Each of the individual batteries which comprise a rechargeable battery.

#### Electrolyte

The medium through which ions are conducted during the electro-chemical reaction inside a rechargeable battery. In rechargeable Ni-MH battery, a potassium hydroxide water solution is generally used as the electrolyte.

#### Hydrogen absorbing alloy

Alloy which can absorb/release hydrogen reversibly. AB<sub>5</sub> or AB<sub>2</sub> type alloy is used for batteries. (MmNi<sub>5</sub>) AB<sub>5</sub> type is employed in Panasonic's products.

#### Negative electrode

The electrode that has a lower electrical potential than the positive electrode to which electrical current flows from the external circuit during the discharge of a storage battery.

#### Nickel Oxyhydroxide

Expressed in chemical notation as NiOOH, this indicates that the positive electrode material of the Ni-MH battery is in a charged state. When in the discharged state, the positive electrode material becomes Nickel hydroxide, or Ni(OH)<sub>2</sub>.

#### Pasted type electrode plate

An electrode plate made by applying the active material (hydrogen absorbing compound) in a paste form onto a Nickel-plated steel porous plate. Used as the negative electrode.

#### Positive electrode

The positive electrode that has a higher electrical potential than the negative electrode from which electrical current flows to the external circuit during the discharge of a rechargeable battery.

#### Safety vent

Functions to release the gas when the internal pressure exceeds a predetermined level. In addition to preventing the absorption of external air into the rechargeable battery, this vent also prevents the rupture of the rechargeable battery that would result from the increase in the internal pressure caused by the generation of gas during charge or at other times.

#### Separator

A porous or micro-porous thin plate, cloth, bar or frame which is inserted as a spacer between the positive and negative electrode plates for the purpose of preventing short-circuits. The separator must be non-oxidizing, resistant to chemicals, and be an electrical insulator, and it must not obstruct in any way the ionic conduction or diffusion of the electrolyte. The separator also functions to retain the electrolyte.

### ELECTRICAL-RELATED ITEMS

#### Capacity

The electrical capacity of a rechargeable battery. Normally used to mean the capacity as measured in ampere-hours. Indicated in units of Ah (ampere-hours) or C (coulombs).

#### Charge efficiency

A general term meaning either ampere-hour efficiency or watt-hour efficiency. More commonly used to mean ampere-hour efficiency.

#### Charge level

The amount of electricity used for charge. For constant current charge, it is the product of multiplying the current value by the charge time. Measured in units of ampere-hours (Ah).

#### C (Coulomb)

Used to express the amount of the charge or discharge current. Expressed by attaching the current units to a numerical multiple that represents the rated capacity of the battery. The charge and discharge current are generally expressed using a C multiple. For example, for a battery having a rated capacity of 1,500mAh:

$$0.1\text{ItmA} = 0.1 \times 1,500 = 150\text{mA}$$

$$0.2\text{ItmA} = 0.2 \times 1,500 = 300\text{mA}$$

#### Cut-off discharge voltage

The voltage that indicates the limit at which discharge is completed. In practical use, this voltage is the limit to which the battery can be used.

#### Electrolyte leakage

The penetration of the electrolyte to the outside of the battery.

#### Energy density

The amount of energy that can be obtained per unit weight or per unit volume of a rechargeable battery. Unit: wh/kg, wh/l.

**Excessive discharge**

The discharge of a rechargeable battery to lower than the specified cut-off discharge voltage may cause negative impact.

**High rate discharge**

Discharge at a relatively large current with respect to the battery capacity. Also called high efficiency discharge and high-current discharge.

**Nominal voltage**

The voltage used to indicate the battery voltage. Generally a value slightly lower than the electromotive force is used. For example, the nominal voltage of rechargeable Ni-MH batteries is 1.2V per cell.

**Open circuit voltage**

The voltage of a battery when that battery is electrically cut-off from the external circuit.

**Overcharge current**

Charge after the fully charged state has been reached. In a rechargeable battery that requires water replenishment, the electrolysis of the water causes a sharp decrease in the amount of electrolyte. Generally, the overcharge of a rechargeable battery will shorten the battery's cycle life.

**Rapid charge**

Charge quickly using a large current.

**Rated capacity**

The standard value for the amount of electricity which can be obtained from the battery in a fully charged state at the specified temperature, discharge current, and cut-off discharge voltage. Measured in units of ampere-hours (Ah). Note that CN is used as a symbol to express the rated capacity at a rate of N hours.

**Reverse charge**

Charge with the polarities reversed. If the polarities are reversed, all of the electrical energy will be used to generate gas.

**Self-discharge**

A decrease in the capacity of a rechargeable battery without any discharge of current to the external circuit.

**OTHER TERMS****Alkaline storage battery**

A storage battery that uses an Alkaline water solution as its electrolyte. Generally refers to Ni-MH batteries.

**Cycle use**

A method of use in which charge and discharge are repeated over and over again.

**IEC standards**

The standards established by the International Electrotechnical Commission (IEC).

**Our Panasonic batteries are in compliance with the following standards: IEC61951-2, IEC45014, IEC62133**

Please contact Panasonic in order to get more details.



# 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>



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## Notice to Readers

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