Panasonic

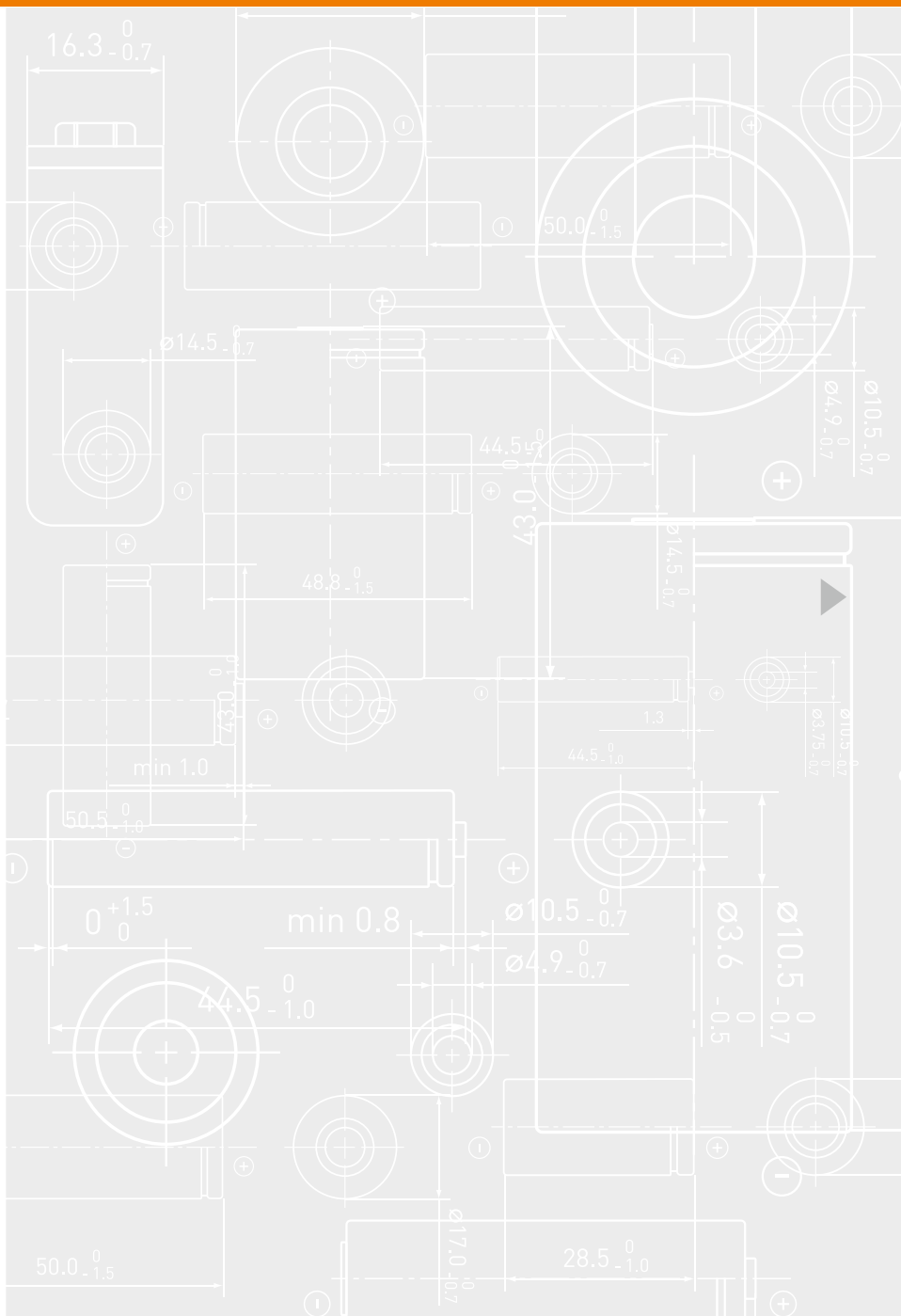
NI-MH HANDBOOK

ENGLISH

INDUSTRIAL BATTERIES

APPLICATIONS

- Garden tool
- Shaver
- Marine device
- Electrical vehicle
- Two way radio
- Power tool
- Handheld scanner
- Vacuum cleaner
- Toothbrush
- Defibrillator
- Ticketing machine
- Energy storage
- Alarm system
- Combined solar application
- Medical device
- POS terminal
- Emergency light, etc.



Panasonic BATTERIES
Quality is our Business.

WORLD'S LARGEST BATTERY MANUFACTURER

PANASONIC ENERGY

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, 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 manufacturer worldwide, with an extensive network of manufacturing companies globally. The company employees are dedicated to research, development and production of batteries for an energised world.

PANASONIC AUTOMOTIVE & INDUSTRIAL SYSTEMS EUROPE GMBH (PAISEU)

Panasonic Corporation, founded in Osaka 1918, is one of the world's largest manufacturers of quality electronic and electrical equipment. Its subsidiary, Panasonic Automotive & Industrial Systems Europe GmbH (PAISEU), markets a diverse portfolio of industrial products throughout Europe. Formed in 2014 to strengthen Panasonic's pan-European industry operations, the company is now active in Automotive, Industry, Factory Solutions and Energy.

In October 2014, Panasonic Automotive & Industrial Systems Europe GmbH (PAISEU), Sanyo Component Europe GmbH (SCE) and Panasonic Industrial Devices Sales Europe GmbH (PIDSEU) merged and now operate as one AIS (Automotive & Industrial Systems) company. In addition, Panasonic Electric Works Europe AG (PEWEU) became a wholly owned subsidiary of PAISEU in October 2014. This new organisation reinforces Panasonic's position in the market, creating a stronger business partner for customers, who benefit from the capabilities and technical solutions of the combined product and service portfolios.

PAISEU organisation

ENERGY

FACTORY SOLUTIONS

PAISEU

PANASONIC AUTOMOTIVE & INDUSTRIAL SYSTEMS EUROPE GMBH

AUTOMOTIVE

INDUSTRY

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.

Our 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, and delivers products that measure up to toughest standards of reliability.

Most of our factories are also certified to OHSAS 18001 (Occupational Health and Safety Assessment Series), an international standard to assess the management system which organisations have in place for occupational safety. This confirms that our factories have been proactive in putting the occupational health and safety of staff at the centre of the company's dealings. In addition our VRLA batteries are for example approved to German VdS standard and the US UL standard.

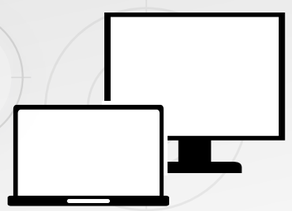
Our batteries therefore offer benefits – power, safety, long life – which guarantee quality in every respect and deliver the best performance for your application. Find out how we can power your business.

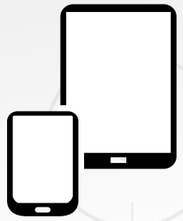
Panasonic quality – certified by authorised agencies.

FIND THE RIGHT BATTERY FOR YOUR APPLICATION

App 2.0
and online version

BATTERY FINDER
app & find





FEATURES

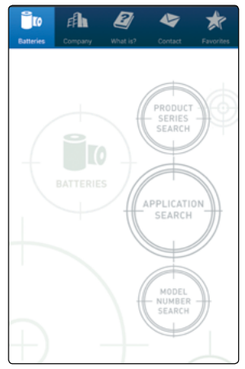
Designed for engineers, electronics specialists and developers who need batteries for their projects, the Battery Finder provides an overview of what's available in the Panasonic range of industrial batteries, and gives a recommendation on the type of battery that's best suited to the user's application. It also offers a wealth of information, diagrams and videos on battery technology.

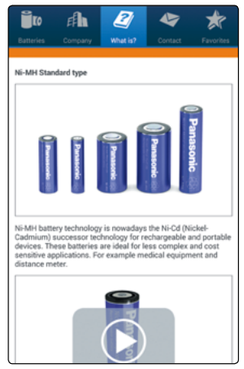
- Search for batteries using three filter criteria:
  - Search by product series (chemistries)
  - Search by application
  - Search by model number
- Current Panasonic range: now 280 batteries (62 new products)
- Automatic update of range
- Pictures and technical drawings of all products
- Product datasheets
- Favorites selection and sending to interested person
- Function for comparing batteries based on technical details (only online application)
- Function for requesting product material in hardcopy or PDF format
- Function for recommendation
- Function for sending an inquiry
- Extensive information on battery technology ('What is' glossary)
- 3D animations showing battery structures
- Information about the company
- Corporate video about Panasonic batteries (eco ideas)
- All contact details for Panasonic Automotive & Industrial Systems Europe GmbH
- Function to save images to smartphone gallery
- Direct link to Panasonic Battery Channel on YouTube
- Optimised usability

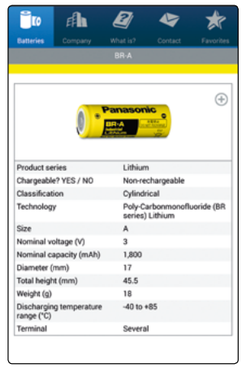
There are two versions of the Battery Finder: a smartphone app for iPhone and Android devices (2.0) and an online application for computers or tablets.

SMARTPHONE APP

App version 2.0







ANDROID APP ON Google play

Download on the App Store

HOME

This is the welcome screen. You can start looking for a battery straight from here, or check out the information on Panasonic and details on battery technologies. Good luck!

BATTERY FINDER

You can search for the batteries in three ways: by product series, by application or by model number.

WHAT IS?

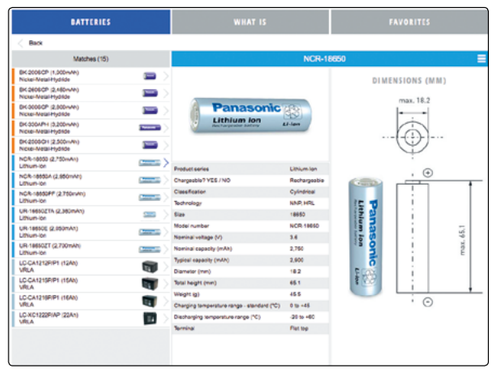
If you're looking for background info, you'll find it here in the app's extensive glossary on battery technology. Find out about our battery types, product series and terminal types.

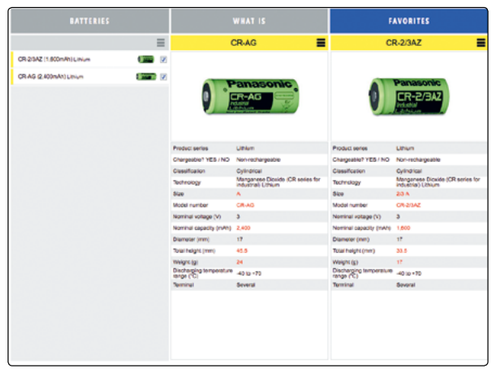
BATTERY INFORMATION

You're shown the selected battery with all the key details. You have also several options for requesting downloads and hardcopies.

HTML APP

Online version





TECHNICAL INFORMATION

If you're looking for background info, you'll find it here – in the app's extensive glossary on battery technology. Find out about our battery types, product series and terminal types.

BATTERY COMPARISON

You have the option to display two batteries simultaneously. The differences between the products are automatically highlighted.

DOWNLOAD THE RIGHT BATTERY IMAGE


ALKALINE


LITHIUM


LITHIUM-ION


NICKEL-METAL-HYDRIDE


VRLA


ZINC-CARBON

GENERAL PICTURES


DISCLAIMER/USAGE

FEATURES

The Panasonic Picturepool is a complete online library of Panasonic battery images, providing you with just the right visuals for illustrating material such as presentations, brochures and user guides. The Picturepool is open to all visitors to the Panasonic website, and offers images for both print and web. The web and print images differ with respect to their resolution (image size) and color space (CMYK or RGB). For each product, there is also a version with a shadow (suitable for use on a white background) and without shadow (suitable for use on a colored or gray background). The library contains images in three formats: JPG, EPS and PNG.

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

- Locate the images you need by product name or by clicking through the categories
- Preview image details – the preview function tells you the full file name of the image, the file size, format and resolution
- Select the files you wish to download. You can take files from multiple folders, or select all the images in particular folder or category in one-click operation – there's no need to select each one individually
- Preview your personal 'download bag' of the files you have selected

The Picturepool zips your images into a downloadable file, which you then download to your computer. You unzip the images to the location of your choice simply by double-clicking the zip file name. The images are then ready for use.

FIND THE RIGHT BATTERY VIDEO

PANASONIC IN MOTION

Please find a comprehensive selection of Panasonic battery videos at our YouTube Channel. You can find videos about the inner structure of our different battery chemistries, a video which gives you a clear insight about 'green' battery applications and last but not least a video which explains the working of our Battery Finder App in detail.

Find out how we can power your business!

PANASONIC GREEN BATTERY APPLICATION

PANASONIC NI-MH PRODUCT VIDEO FOR PROFESSIONALS

PANASONIC ALKALINE PRODUCT VIDEO FOR PROFESSIONALS

PANASONIC BATTERY FINDER UPDATE 2.0 - APP & ONLINE VERSION

INDEX

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 0.033CmA to 0.05CmA. Also, to avoid overcharging with trickle charge, which could damage the cell characteristics, a timer measuring the total charge time should be used.

Note: ‘CmA’

During charging and discharging, ‘CmA’ is a value indicating current and expressed as a multiple of nominal capacity. Substitute ‘C’ with the battery’s nominal capacity when calculating. For example, for a 1500mAh battery of 0.033CmA, this value is equal to 1/30 x 1500, 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 0.1CmA to 2CmA.

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 2CmA.

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.

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	(Number of batteries x 1.0) V
7 to 12	([Number of batteries - 1] x 1.2) 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.

NI-MH BATTERY TRANSPORTATION SITUATION*1

Transport by sea

UN 3496 takes place under IMDG-Code 36-10 with Special Provision 963. Ni-MH batteries are classified as dangerous goods in class 9. Batteries shall be securely packed and protected from short circuit.

When loaded in a cargo transport unit with 100kg gross mass or more, special stowage is requested away from heat source. Furthermore an information on the IMO (International Maritime Organisation) document is required.

Transport by air

UN 3496 takes place under IATA DGR 2015 56th Edition. A806 informs that UN 3496 is only valid for sea freight. This means that there are no restrictions for air freight.

Transport by road

As of today there are no fixed regulations for the worldwide transportation of Ni-MH batteries by road.

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.

*1 The aforementioned information is subject to change without any notice.

PRODUCT SAFETY DATA SHEET*1

Manufacturer

Name of Company:	Panasonic Corporation Energy Company
Address:	1-1, Matsushita-cho, Moriguchi, Osaka 570-8511 Japan
Document number:	PMH-PSDS-100129E
Issued:	Jan, 29th , 2010
Name of product:	Nickel-Metal-Hydride Storage Battery
(Model Name)	The models described as BK-*****

Substance identification

Substance:	Nickel-Metal-Hydride Storage Battery
CAS No.:	Not Specified.
UN Class:	UN Class: UN 3496 (only valid under IMDG for sea freight above 100kg each container)

[Special Provision 304] (UN Recommendations on the TRANSPORT OF DANGEROUS GOODS Model Regulations Volume 1. 18th revised edition revised edition) Battery, dry, containing corrosive electrolyte which will not flow out of the battery if the battery case is cracked are not subject to these Regulations provided the batteries are securely packed and protected against short-circuits. Examples of such batteries are: Alkali-Manganese, Zinc-Carbon, Nickel-Metal-Hydride and Nickel-Cadmium batteries.

Ecological information

Heavy metal quantity for cell:	Hg < 0.5ppm	Measurement Analysis: Atomic Absorption Spectrometer
	Cd < 5.0ppm	Measurement Analysis: Atomic Absorption Spectrometer
	Pb < 40ppm	Measurement Analysis: Atomic Absorption Spectrometer

Transport information

1. During the transportation of a large amount of batteries by ship, trailer or railway, do not leave them in the places of high temperatures and do not allow them to be exposed to dew condensation.
2. Avoid transportation with the possibility of the collapse of cargo piles and the packing damage.
3. Protect the terminals of batteries and prevent them from short circuit so as not to cause dangerous heat generation.

Regulatory information

- IATA Dangerous Goods Regulations 56th Edition effective 1 January - 31 December 2015
- ICAO Technical Instructions for the safe transport of dangerous goods by air
- IATA (A806) for air shipment
- IMDG (Special Provision) for sea shipment under UN3496

Other references

- Ni-Cd, Ni-MH Panasonic Catalogue and technical handbook.
- Recommendations on the TRANSPORT OF DANGEROUS GOODS Model Regulations Volume 1. 18th revised edition.
- IATA Dangerous Goods Regulations 56th Edition effective 1 January - 31 December 2015

*1 The aforementioned PSDS is only an extract. Please contact Panasonic to get the complete version.

VIDEO

Scan QR code to view product series video.

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 15.

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 1/30th 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 60°C (for either high discharge rate or long life), batteries for low temperatures to minus 30°C (designed for outdoor applications), 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 cordless power tools are just some of the possible applications powered by Panasonic Ni-MH batteries, see page 22 – 25.

STRUCTURE OF NI-MH BATTERIES

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

VIDEO

Scan QR code to view 3D 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 30 years to the discovery of NiFe, MgNi and $LaNi_5$ 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_2 ($ZnMn_2$, etc.), AB_5 ($LaNi_5$, etc.) and A_2B (Mg_2Ni, 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_5 type alloys in which rare-earth metals, especially metals in the lanthanum group, and nickel serve as the host metals; and to AB_2 type alloys in which the titanium and nickel serve as the host metals. Panasonic is now focusing its attention on AB_5 type alloys which feature high capacity, excellent charge and discharge efficiency, and excellent cycle life. It has developed, and is now employing its own $MmNi_5$ alloy which uses Mm (misch metal – an alloy consisting of a mixture of rare-earth elements) for metal A.

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 below.

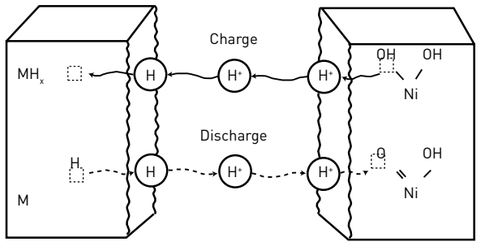
Positive electrode:	$Ni(OH)_2 + OH^- \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftarrows}} NiOOH + H_2O + e^-$
Negative electrode:	$M + H_2O + e^- \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftarrows}} MH_{ab} + OH^-$
Overall reaction:	$Ni(OH)_2 + M \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftarrows}} NiOOH + MH_{ab}$

(M: hydrogen-absorbing alloy; H_{ab}: absorbed hydrogen)

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 page. 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



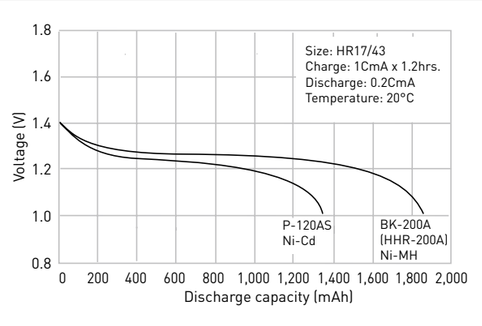
FEATURES

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

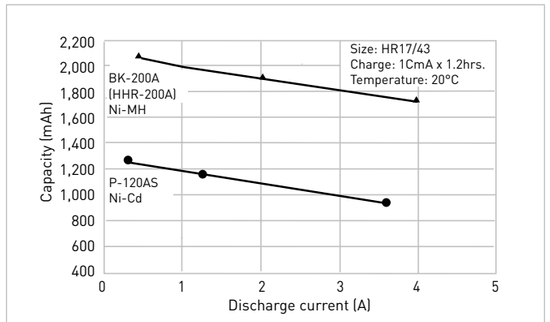
Like Ni-Cd batteries, Ni-MH batteries can be repeatedly charged and discharged for about 500 up to 1000 cycles. Depending on the battery type even more than 1800 cycles are available.

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 up to 3CmA is possible.



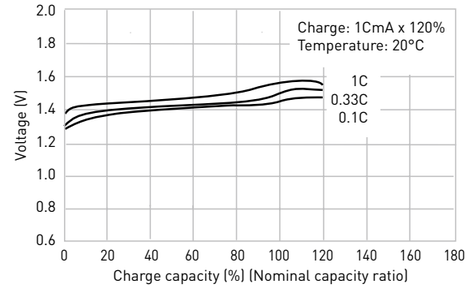
FIVE MAIN CHARACTERISTICS

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

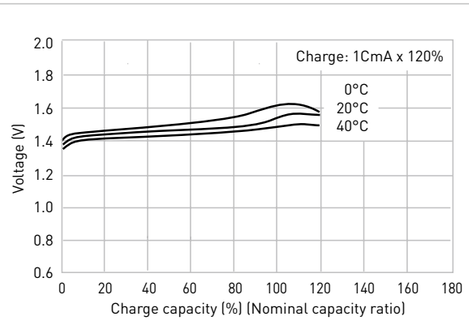
1. Charge characteristics

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. Ni-MH batteries should be charged at a temperature ranging from 0°C to 40°C using a constant current of 1C or less. The charge efficiency is particularly good at a temperature of 10°C to 30°C. Repeated charge at high or low temperatures causes the battery performance to deteriorate. Furthermore, repeated overcharge 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 19 – 20.

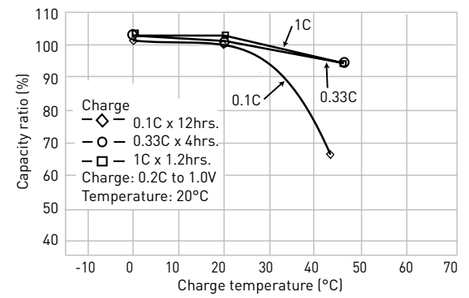
Charge characteristics



Charge temperature characteristics at 1C charge



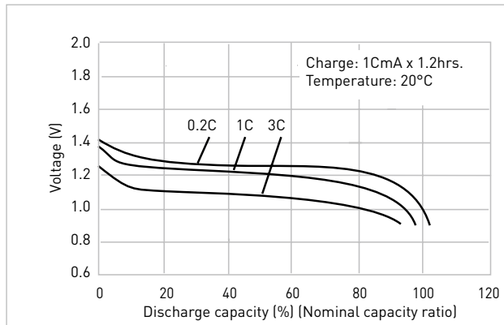
Charge temperature characteristics at various charge rates



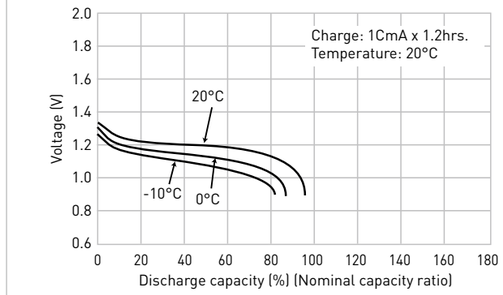
2. Discharge characteristics

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.

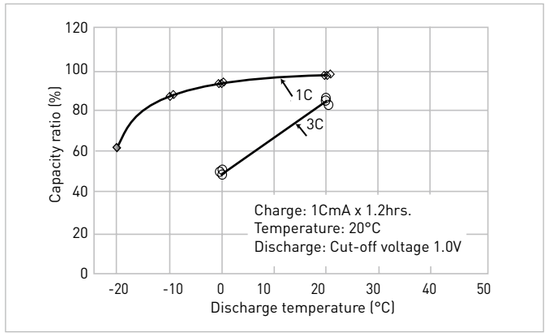
Discharge characteristics



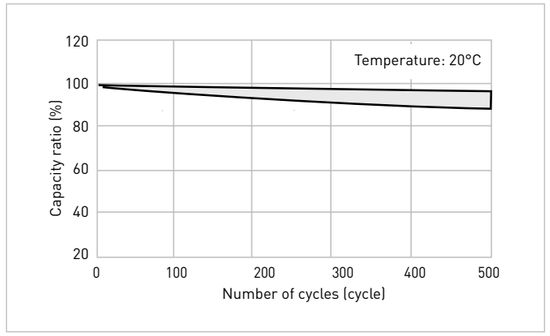
Discharge temperature characteristics at 1C discharge



Discharge temperature characteristics



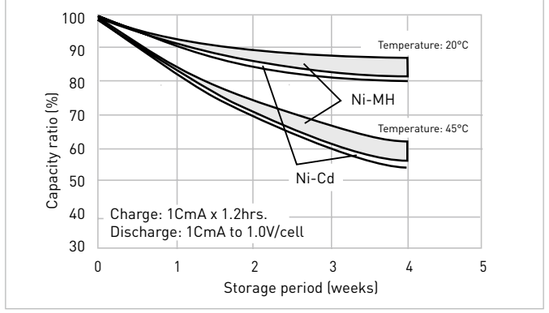
Cycle life characteristics



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.

Self-discharge characteristics



Self-discharge is affected by the temperature at which 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 500 cycles.

5. Safety

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

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.

1. Rapid charge current: 1CmA (rapid charge temperature range: 0°C to 40°C). In order to exercise proper control to stop rapid charge, it is recommended that batteries be charged at over 0.5CmA but less than 1CmA. Charging batteries at a current in excess of 1CmA may cause the safety vent to be activated by a rise in the internal pressure of the batteries, thereby resulting in electrolyte leakage. When the temperature of the batteries is detected by a thermistor or other type of sensor, and their temperature is under 0°C or over 40°C at the commencement of the charge, then trickle charge, rather than rapid charge, must be performed. Rapid charge is stopped when any one of the values among the types of control described in 4., 5., 6., and 11. reaches the prescribed level.

2. Allowing a high current: to flow to excessively discharged or deep-discharged batteries during charge may make it impossible to sufficiently restore the capacity of the batteries. To charge excessively discharged or deep-discharged batteries, first allow a trickle current to flow, and then proceed with the rapid charge current once the battery voltage has risen.

3. Rapid charge start voltage: Approx. 0.8V/cell rapid charge transition voltage restoration current: 0.2 ~ 0.3CmA

4. Upper battery voltage limit control: Approx. 1.8V/cell. The charge method is switched over to trickle if the battery voltage reaches approximately 1.8V/cell due to trouble or malfunctioning of some kind.

5. ΔV value: 5 to 10mV/cell. When the battery voltage drops from its peak to 5 to 10mV/cell during rapid charge, rapid charge is stopped, and the charge method is switched over to trickle charge.

6. dT/dt value: Approx. 1 to 2°C/min. When a rise in the battery temperature per unit time is detected by a thermistor or other type of temperature sensor during rapid charge, and the prescribed temperature rise is sensed, rapid charge is stopped and the charge method is switched over to trickle charge.

7. Temperature cut-off (TCO): 55°C (for A and AA size), 50°C (for AAA size), 60°C (for L-A, LfatA and SC size). The cycle life and other characteristics of batteries are impaired if the batteries are allowed to become too hot during charge. In order to safeguard against this, rapid charge is stopped and the charge method is switched over to trickle charge when the battery temperature has reached the prescribed level.

8. Initial delay timer: to 10min. This prevents the - ΔV detection circuit from being activated for a specific period of time after rapid charge has commenced. However, the dT/dt detection circuit is allowed to be activated during this time. As with Ni-Cd batteries, the charge voltage of Ni-MH batteries may show signs of swinging (pseudo - ΔV) when they have been kept standing for a long time or when they have discharged excessively, etc. The initial delay timer is needed to prevent charge from stopping (to prevent malfunctioning) due to this pseudo - ΔV.

9. Trickle current: 0.033 to 0.05CmA. When the trickle current is set higher, the temperature rise of the batteries is increased, causing the battery characteristics to deteriorate.

10. Rapid charge transfer timer: 60min.

11. Rapid charge timer: 90min. (at 1C charge)

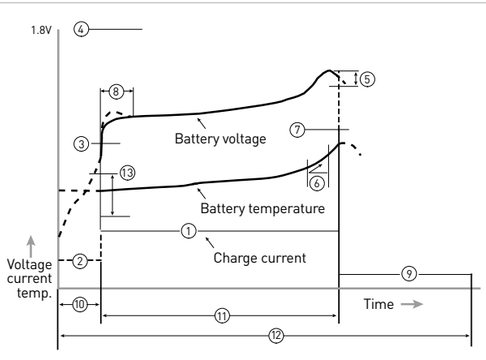
12. Total timer: 10 to 20 hours. The overcharging of Ni-MH batteries, even by trickle charging, causes a deterioration in the characteristics of the batteries. To prevent overcharging by trickle charging or any other charging method, the provision of a timer to regulate the total charging time is recommended.

Note: The temperature and voltage of Ni-MH batteries varies depending on the shape of the battery pack, the number of cells, the arrangement of the cells and other factors. Therefore

Panasonic should be consulted for more detailed information on the referenced charge control values. The charge methods described previously can be applied also when Ni-MH batteries are employed in a product, but Panasonic should be consulted for the control figures and other details.

Recommended Ni-MH battery charge system*1	
1. Rapid charge current	Max. 1CmA to 0.5CmA
2. Rapid charge transition voltage restoration current	0.2 to 0.3CmA
3. Rapid charge start voltage	Approx. 0.8V/cell
4. Charge terminating voltage	1.8V/cell
5. ΔV value	5 to 10mV/cell
6. Battery temperature rising rate dT/dt value	1 to 2°C/min.
7. Maximum battery temperature cut-off (TCO)	60°C (for L-A, L-FatA and SC size) 55°C (for A, AA and D size) 50°C (for AAA)
8. Initial -ΔV detection disabling timer	5 to 10min.
9. Trickle current (after rapid charge)	0.033 to 0.05CmA
10. Rapid charge transfer timer	60min.
11. Rapid charge timer	90min. (at 1CmA charge)
12. Total timer	10 to 20 hours (h)
13. Rapid charge temperature range	0° to 40°C

Example of a rapid charge system



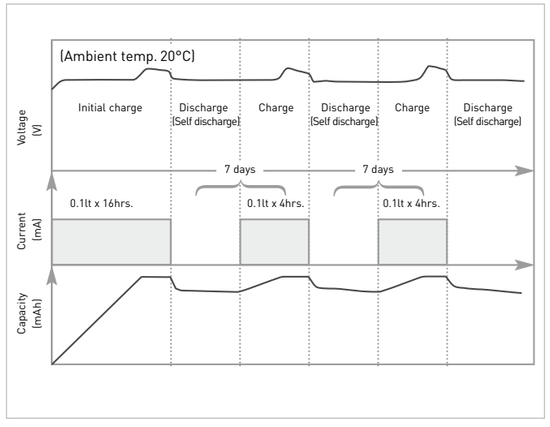
NI-MH HIGH-TEMPERATURE SERIES RECOMMENDED CHARGE FOR BACK-UP APPLICATIONS

The optimal charge system for the Ni-MH back-up or high temperature applications is an intermittent timer charge. An intermittent timer charge improves charge efficiency, extends battery life (-vs- trickle charge) and reduces electricity consumption up to 30% compared to trickle charge*2.

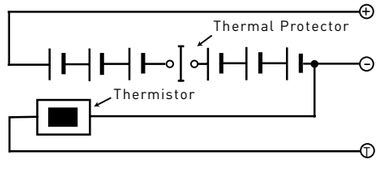
Intermittent timer charge: (See diagram) At the beginning of the charge, an IC timer is started and charging is activated at a current of 0.1lt until the timer stops and the charge is terminated. When the batteries self discharge down to a set point (1.3V), the timer charge is re-activated.

Example of intermittent timer charger system:
Average charge current: 0.1ltA
Re-charge time: 16 hours
Pulse charging can be used

Intermittent charge



Basic pack configuration circuit



*1 Matching test is required because these values vary depending on rapid charge current, number of cells, configuration of battery pack, etc.
*2 Trickle charge is not recommended in general for Ni-MH batteries. Please consult Panasonic on any Ni-MH applications requiring trickle charge.

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

Electrical characteristics

Voltage range
_____V max. _____V min.

Load pattern
Continuous load
_____mA (max.)
_____mA (av.)
_____mA (min.)

Intermittent load/pulse load
_____mA (max.)
_____mA (av.)
_____mA (min.)

Intermittent time conditions
Operating time
_____

Stopped time
_____

Charge conditions

- Rapid charge
- Trickle float charge
- Charge time
- Charge temperature and atmosphere

Temperature and humidity conditions

Temperature and humidity during use
_____°C max._____°C min.
_____% max. _____% min.

Temperature and humidity during storage
_____°C max._____°C min.
_____% max. _____% min.

Size, weight and terminal type

Diameter (mm)_____max.
Height (mm)_____max.
Length (mm)_____max.
Width (mm)_____max.
Mass (g)_____av.
Terminal type _____

Battery life

Operating life
_____

Storage period
_____

Others

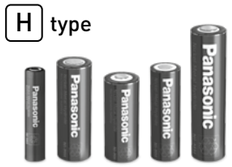
Atmospheric pressure
Mechanical conditions
Safety
_____

Interchangeability
Marketability
Price

Selection of the battery

HIGH TEMPERATURE & LONG LIFE TYPE The expected life of these back-up batteries is about 6 to 10 years and therefore approximately twice the life time compared to standard Ni-MH batteries. In addition they are capable of delivering excellent charge characteristics at high temperature (60°C). Recommended applications are for example emergency light, vending machines and back-up for base station.

H type



Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-60AAAH	HHR-60AAAH	AAA	AAA	1.2	500	550	10.5 +0/-0.7	44.5 +0/-1.5	13	HR11/45	26
BK-70AAH	HHR-70AAH	AA	AA	1.2	700	750	14.5 +0/-0.7	49.0 +0/-1.5	18	HR15/49	27
BK-160AH	-	A	4/5A	1.2	1,600	1,720	17.0 +0/-0.7	43.0 +0/-1.5	29	HR17/43	28
BK-210AH	HHR-210AH	A	A	1.2	1,900	2,050	17.0 +0/-0.7	50.0 +0/-2.0	36	HR17/50	29
BK-370AH	HHR-370AH	A	LFat/A	1.2	3,500	3,700	18.2 +0/-0.7	67.5 +0/-1.5	60	-	30

Applications

- Emergency call (E-Call)
- Medical equipment
- Emergency lighting
- Ticketing machine
- POS system
- Solar window shutter
- Shaver, other

Features

- High charge efficiency at elevated temperatures
- Small size and light weight
- Long lifetime when using intermittent charge

Model number (example)

B K - 6 0 A A A H

- H: High temperature & long life type
- AAA: Diameter: AAA, AA, A
- 60: Multiply this by 10 to obtain the rated capacity (some exceptions)
- BK: Nickel-Metal-Hydride battery

HIGH RATE DISCHARGE & HIGH TEMPERATURE 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.

PH type

Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-330APH	HHR-330APH	A	LFat/A	1.2	3,200	3,300	18.2 +0/-0.7	67.5 +0/-1.5	60	-	31
BK-250SCH	HHR-250SCH	SC	SC	1.2	2,500	2,650	23.0 +0/-1.0	43.0 +0/-1.5	55	HR23/43	32
BK-310CH	-	C	C	1.2	3,100	3,300	25.8 +0/-1.0	50.0 +0/-2.0	80	HR26/50	33

Applications

- Medical equipment
- Power tool
- Garden tool
- Robot cleaner
- Electric vehicle, others

Features

- Excellent large current discharge characteristics at 60°C
- Small size and light weight
- Energy saving, long life

Model number (example)

B K - 3 3 0 A PH

- PH: High rate discharge & high temperature type
- AAA: Diameter: AAA, AA, A
- 330: Multiply this by 10 to obtain the rated capacity (some exceptions)
- BK: Nickel-Metal-Hydride battery

BUTTON TOP TYPE The Panasonic button type batteries are compatible with dry batteries such as Alkaline and can be used up to 1800 times based on JIS standards. Besides they provide a high capacity level and a low self-discharge. Last but not least they can power applications which require superior low temperature characteristics.

B type

Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-65AAAB[*1]	-	AAA	AAA	1.2	650	700	10.5 +0/-0.7	44.5 +0/-1.0	12	HR11/45	34
BK-80AAAB[*1]	HHR-80AAAB	AAA	AAA	1.2	750	780	10.5 +0/-0.7	44.5 +0/-1.0	13	HR11/45	35
BK-110AAB[*2]	HHR-110AAB	AA	AA	1.2	1,000	1,050	14.5 +0/-0.7	50.5 +0/-1.0	20	HR15/51	36
BK-200AAB[*2]	-	AA	AA	1.2	1,900	2,000	14.5 +0/-0.7	50.5 +0/-1.0	29	HR15/51	37

Applications

- Flash light
- Personal digital assistant
- Toothbrush
- Shaver
- Remote control, others

Features

- Offers long charge/discharge cycle life, about 1800 times
- High capacity level and low self-discharge (still have 90% capacity after storage for 1 year)
- Provides excellent temperature characteristics especially in low temperature

Model number (example)

B K - 8 0 A A A B

- B: Cap shape: button top type
- AAA: Diameter: AAA, AA, A
- 80: Multiply this by 10 to obtain the rated capacity (some exceptions)
- BK: Nickel-Metal-Hydride battery

STANDARD 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 distance meter.

N type

Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-65AAAK	HHR-65AAAK	AAA	AAA	1.2	650	700	10.5 +0/-0.7	44.5 +0/-1.5	12	HR11/45	38
BK-70AAAJ	HHR-70AAAJ	AAA	AAA	1.2	700	730	10.5 +0/-0.7	44.5 +0/-1.5	12	HR11/45	39
BK-90AAA	-	AAA	L-AAA	1.2	830	880	10.5 +0/-0.7	50.5 +0/-1.5	14	HR11/67	40
BK-120AA	HHR-120AA	AA	4/5AA	1.2	1,150	1,220	14.5 +0/-0.7	43.0 +0/-1.5	23	HR15/43	41
BK-70AA	HHR-70AA	AA	AA	1.2	700	780	14.5 +0/-0.7	49.0 +0/-1.5	18	HR15/49	42
BK-150AA	HHR-150AA	AA	AA	1.2	1,500	1,580	14.5 +0/-0.7	50.5 +0/-1.5	26	HR15/51	43
BK-110AAO	HHR-110AAO	AA	AA	1.2	1,100	1,180	14.5 +0/-0.7	50.5 +0/-1.5	26	HR15/51	44
BK-200A	HHR-200A	A	4/5A	1.2	2,000	2,040	17.0 +0/-0.7	43.0 +0/-1.5	32	HR17/43	45
BK-210A	HHR-210A	A	A	1.2	2,100	2,200	17.0 +0/-0.7	50.0 +0/-2.0	38	HR17/50	46
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	47
BK-450A	HHR-450A	A	LFat/A	1.2	4,200	4,500	18.2 +0/-0.7	67.5 +0/-1.5	60	-	48

Applications

- Medical
- Communication
- Shaver
- Toothbrush
- Navigation device
- Torchlight
- Measurement, others

Features

- High quality and reliability
- Good balance in terms of capacity and lifetime

Model number (example)

B K - 7 0 A A

- AAA: Diameter: AAA, AA, A
- 70: Multiply this by 10 to obtain the rated capacity (some exceptions)
- BK: Nickel-Metal-Hydride battery

[*1] Compatible with consumer AAA size. [*2] Compatible with consumer AA size.

HIGH RATE DISCHARGE & RAPID CHARGE 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 electric vehicles.

P type

Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-200SCP[*1]	HHR-200SCP	SC	4/5SC	1.2	1,900	2,100	23.0 +0/-1.0	34.0 +0/-1.5	42	HR23/34	49
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	50
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	51

Applications

- Power tool
- Medical equipment
- Garden tool
- Robot cleaner
- Electric vehicle, others

Features

- Excellent large current discharge characteristics
- Rapid charge-capable

Model number (example)

B K - 3 0 0 S C P

- P: High rate discharge & rapid charge type
- C: Diameter: 4/5SC, SC, C
- 300: Multiply this by 10 to obtain the rated capacity (some exceptions)
- BK: Nickel-Metal-Hydride battery

LOW TEMPERATURE TYPE This Panasonic battery type is especially designed for low temperature discharge at -30°C. Thus these batteries are ideal to power two way radios and other outdoor applications.

L type

Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-130AA	-	AA	AA	1.2	1,250	1,400	14.5 +0/-0.7	50.5 +0/-1.5	26	HR15/51	52
BK-250A	-	A	A	1.2	2,450	2,600	17.0 +0/-0.7	50.0 +0/-2.0	40	HR17/50	53

Applications

- Two way radio
- UPS
- Construction sites signaling, others

Features

- Designed for applications which require low temperature discharge at -30°C

Model number (example)

B K - 1 3 0 A A

- A: Diameter: AAA, AA, A
- 130: Multiply this by 10 to obtain the rated capacity (some exceptions)
- BK: Nickel-Metal-Hydride battery

[*1] For high power use application such as power tools.

INFRASTRUCTURE TYPE These battery types offer high capacity on the one hand and an outstanding efficiency even at low temperature environments on the other. They are particular designed for power storage and automated guided vehicles (AGV).

Model	Old Model No	Diameter	Size	Nominal voltage (V)	Rated capacity (mAh)	Average capacity (mAh)	Dimensions with tube (mm)		Approx. weight (g)	IEC	Page
							Diameter	Height			
BK-10V1S	-	V	V	1.2	90,000	95,000	62.6 +1.0/-1.0	188.7 +1.0/-1.0	1,700	-	54
BK-10V10T	HHR-10V10T	Pack	Pack	12	90,000	95,000	428 x 159 x 270mm (WxDxH)		23,000	-	55

Applications

- UPS
- Green energy
- Solar window shutter
- Wind turbine
- Energy storage
- Floating machine, others

Features

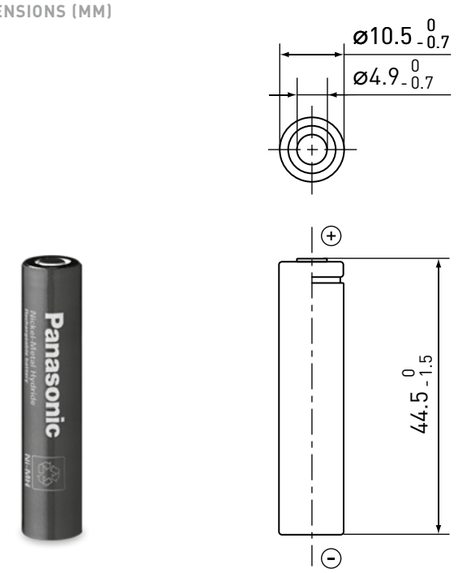
- Realisation of lightweight and space-saving
- Alternative compared to VRLA batteries
- By using Nickel-Metal-Hydride battery, power supply provides high efficiency even at a low temperature

BK-60AAAH
HHR-60AAAH (OLD)

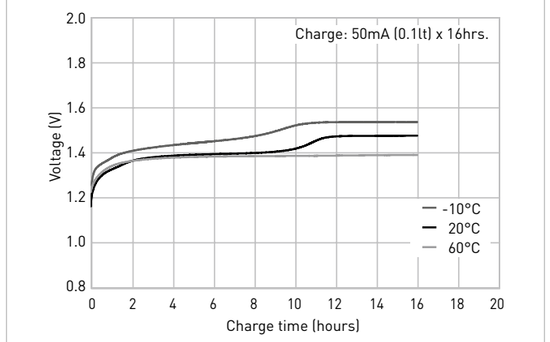
HIGH TEMPERATURE & LONG LIFE TYPE
AAA SIZE (HR11/45)

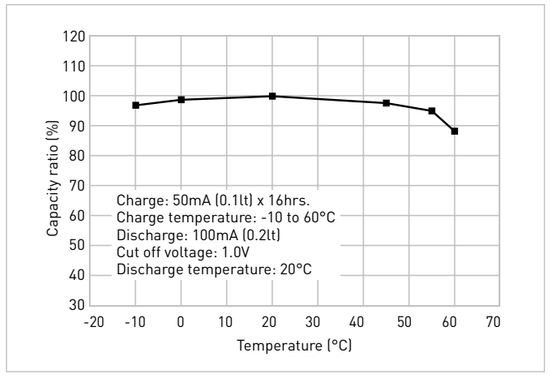
H type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

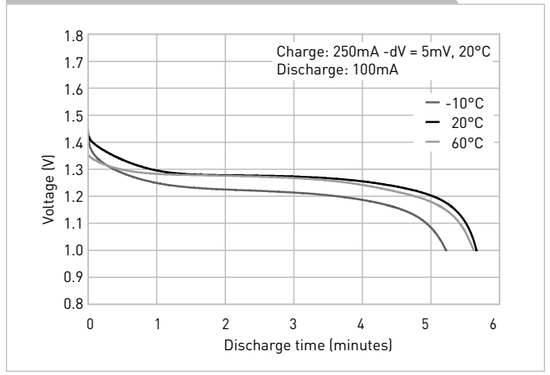




SPECIFICATIONS

Name			BK-60AAAH
Diameter (mm)			10.5 +0/-0.7
Height (mm)			44.5 +0/-1.5
Approximate weight (g)			13
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	550
		Rated/min. (mAh)	500
Approx. internal impedance at 1,000Hz at charged state (mΩ)			35
Charge		Standard (mA x hrs.)	50 x 16
		Rapid*3 (mA x hrs.)	250 x 2.4
		Low rate (mA x hrs.)	25 x 32
			17 x 48
Ambient temperature	Charge	Standard (°C)	-10 to 60
		Rapid (°C)	
		Low rate	-10 to 45
	Discharge (°C)		-10 to 60
	Storage	<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 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

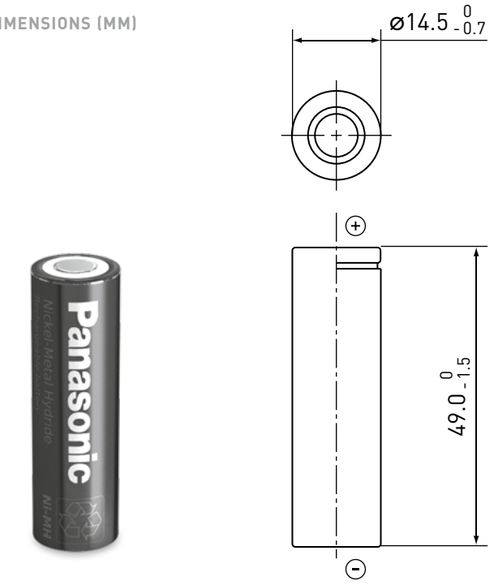
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-70AAH
HHR-70AAH (OLD)

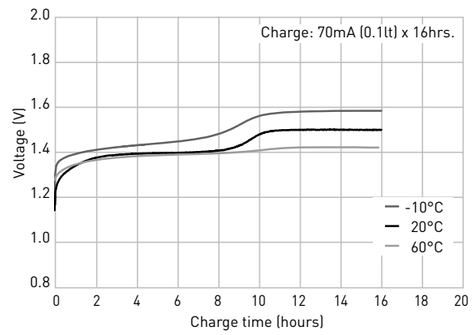
HIGH TEMPERATURE & LONG LIFE TYPE
AA SIZE (HR15/49)

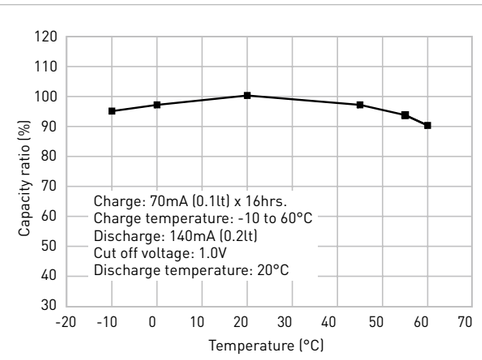
H type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

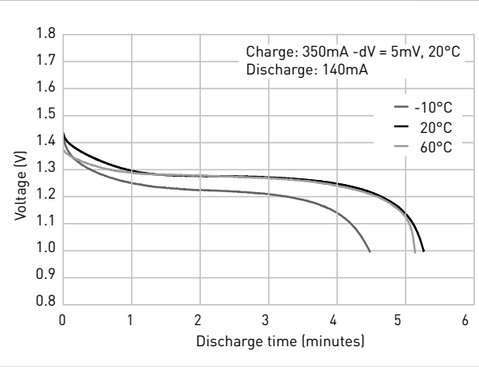




SPECIFICATIONS

Name			BK-70AAH
Diameter (mm)			14.5 +0/-0.7
Height (mm)			49.0 +0/-1.5
Approximate weight (g)			18
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	750
		Rated/min. (mAh)	700
Approx. internal impedance at 1,000Hz at charged state (mΩ)			25
Charge		Standard (mA x hrs.)	70 x 16
		Rapid*3 (mA x hrs.)	350 x 2.4
		Low rate (mA x hrs.)	35 x 32
			23 x 48
Ambient temperature	Charge (°C)	Standard	-10 to +60
		Rapid	
		Low rate	-10 to +45
	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

TYPICAL DISCHARGE CHARACTERISTICS



*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

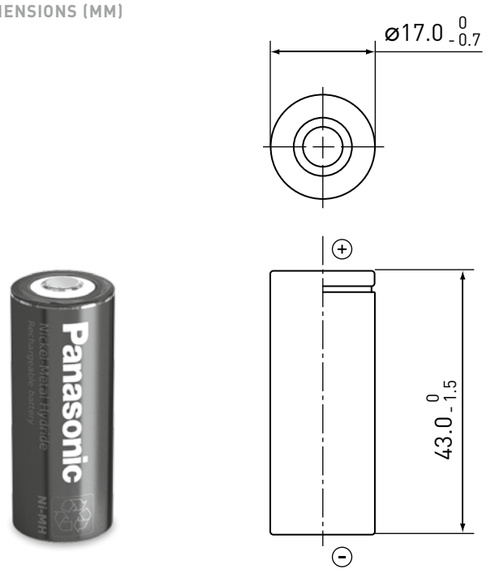
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-160AH

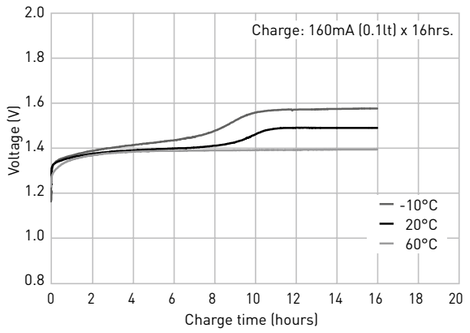
HIGH TEMPERATURE & LONG LIFE TYPE
4/5A SIZE (HR17/43)

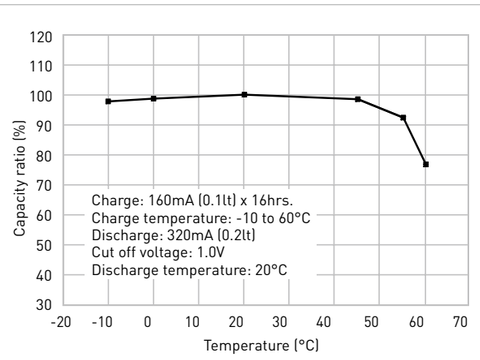
H type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

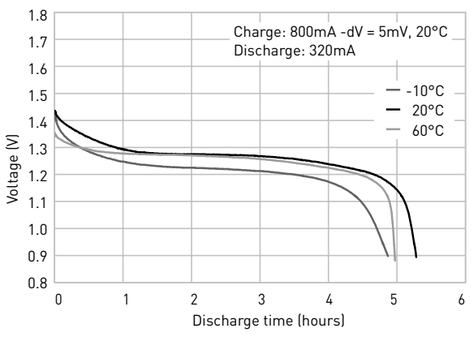




SPECIFICATIONS

Name			BK-160AH
Diameter (mm)			17.0 +0/-0.7
Height (mm)			43.0 +0/-1.5
Approximate weight (g)			29
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	1,720
		Rated/min. (mAh)	1,600
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	160 x 16
		Rapid*3 (mA x hrs.)	800 x 2.4
		Low rate (mA x hrs.)	80 x 32
			53 x 48
Ambient temperature	Charge	Standard (°C)	-10 to 60
		Rapid (°C)	
		Low rate	-10 to 45
	Discharge (°C)		-10 to 60
	Storage	<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 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

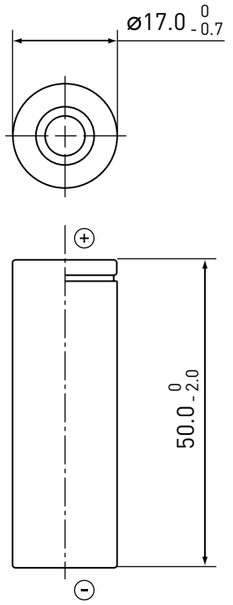
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-210AH
HHR-210AH (OLD)

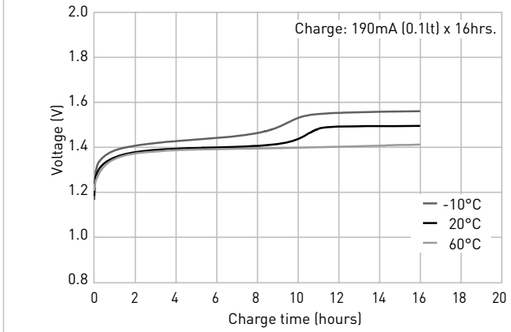
HIGH TEMPERATURE & LONG LIFE TYPE
A SIZE (HR17/50)

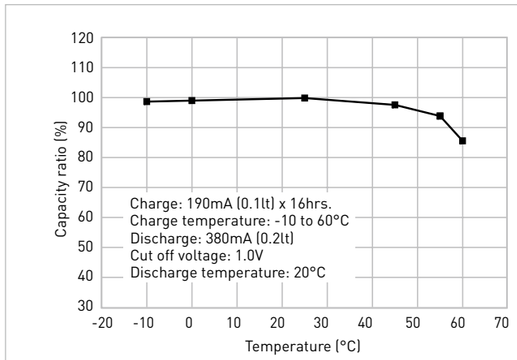
H type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

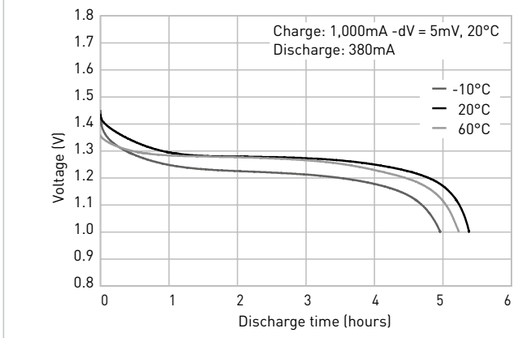




SPECIFICATIONS

Name			BK-210AH
Diameter (mm)			17.0 +0/-0.7
Height (mm)			50.0 +0/-2.0
Approximate weight (g)			36
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,050
		Rated/min. (mAh)	1,900
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	190 x 16
		Rapid*3 (mA x hrs.)	1,000 x 2.3
		Low rate (mA x hrs.)	105 x 32
			70 x 48
Ambient temperature	Charge (°C)	Standard	-10 to +60
		Rapid	
		Low rate	-10 to +45
	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

TYPICAL DISCHARGE CHARACTERISTICS



*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 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.

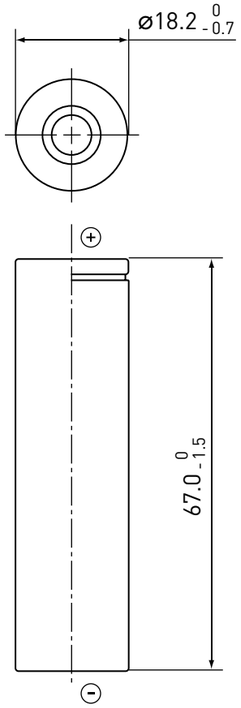
BK-370AH

HHR-370AH (OLD)

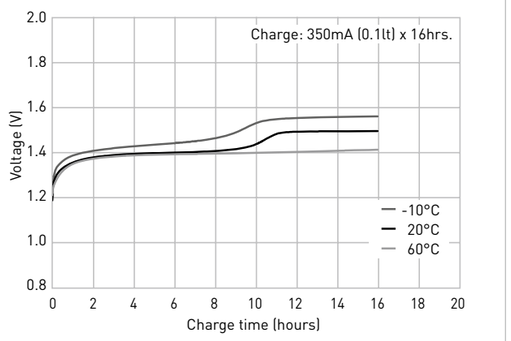
HIGH TEMPERATURE & LONG LIFE TYPE
LFAT/A SIZE

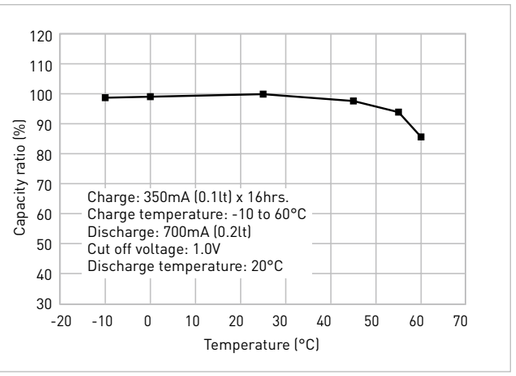
H type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

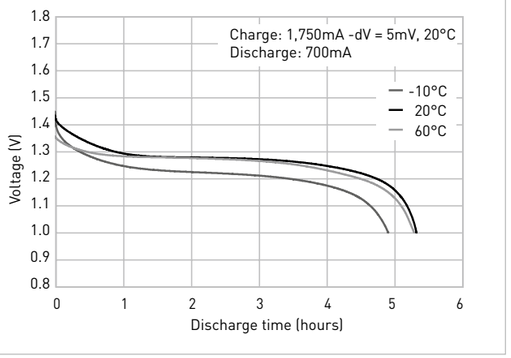




SPECIFICATIONS

Name			BK-370AH
Diameter (mm)			18.2 +0/-0.7
Height (mm)			67.0 +0/-1.5
Approximate weight (g)			60
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	3,700
		Rated/min. (mAh)	3,500
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	350 x 16
		Rapid*3 (mA x hrs.)	3,000 x 1.4
		Low rate (mA x hrs.)	185 x 32
			123 x 48
Ambient temperature	Charge (°C)	Standard	-10 to +60
		Rapid	
		Low rate	-10 to +45
	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

TYPICAL DISCHARGE CHARACTERISTICS



*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 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.

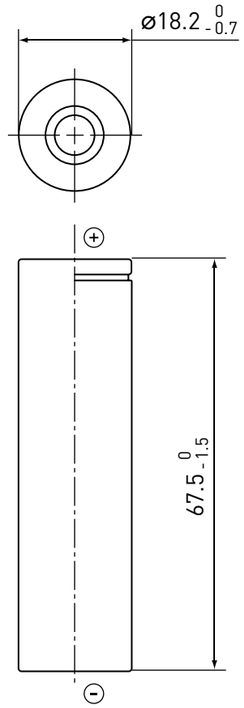
BK-330APH

HHR-330APH (OLD)

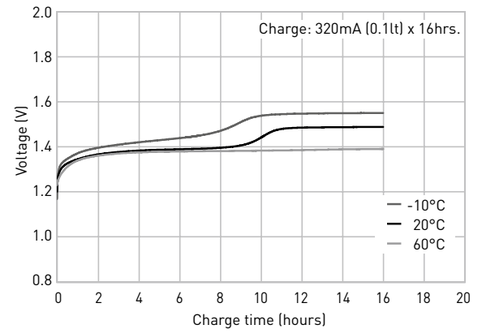
HIGH RATE DISCHARGE & HIGH TEMPERATURE TYPE
LFAT/A SIZE

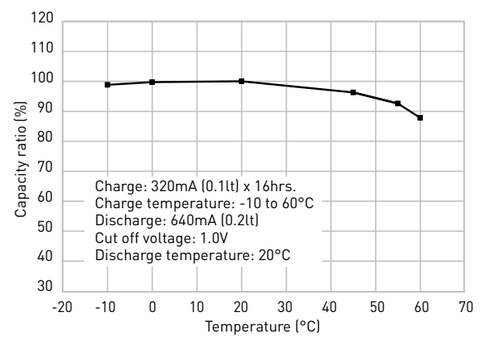
PH type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

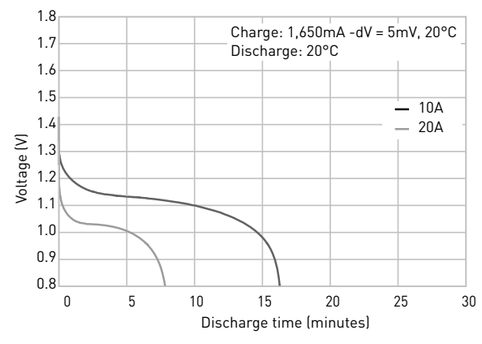




SPECIFICATIONS

Name			BK-330APH
Diameter (mm)			18.2 +0/-0.7
Height (mm)			67.5 +0/-1.5
Approximate weight (g)			60
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	3,300
		Rated/min. (mAh)	3,200
Approx. internal impedance at 1,000Hz at charged state (mΩ)			5.5
Charge		Standard (mA x hrs.)	320 x 16
		Rapid*3 (mA x hrs.)	1,650 x 2.4
		Low rate (mA x hrs.)	165 x 32
			110 x 48
Ambient temperature	Charge (°C)	Standard	-10 to +60
		Rapid	
		Low rate	-10 to +45
	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

TYPICAL DISCHARGE CHARACTERISTICS



*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 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.

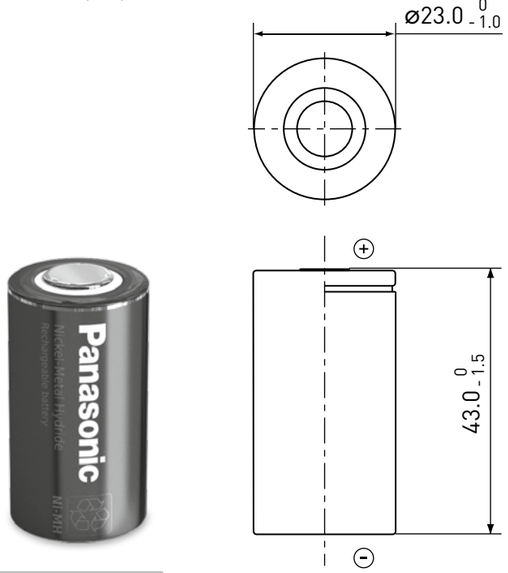
BK-250SCH

HHR-250SCH (OLD)

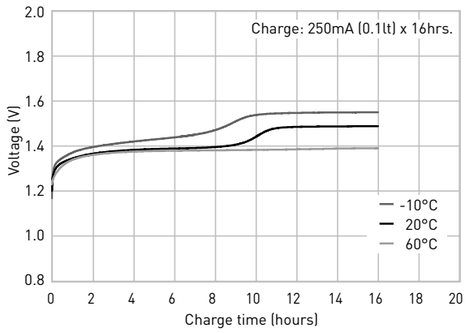
HIGH RATE DISCHARGE & HIGH TEMPERATURE TYPE
SC SIZE (HR23/43)

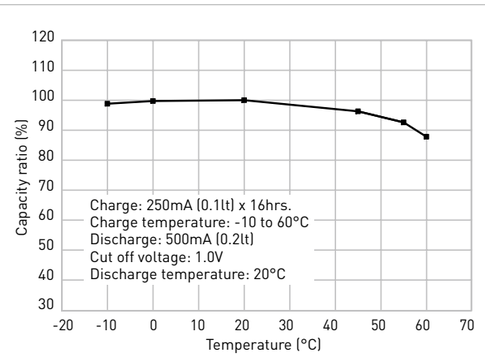
PH type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

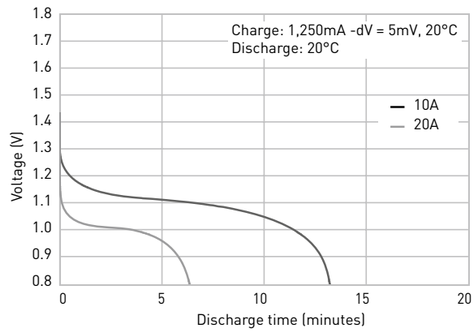




SPECIFICATIONS

Name			BK-250SCH
Diameter (mm)			23.0 +0/-1.0
Height (mm)			43.0 +0/-1.5
Approximate weight (g)			55
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,650
		Rated/min. (mAh)	2,500
Approx. internal impedance at 1,000Hz at charged state (mΩ)			5
Charge		Standard (mA x hrs.)	250 x 16
		Rapid*3 (mA x hrs.)	1,250 x 2.4
		Low rate (mA x hrs.)	125 x 32
			83 x 48
Ambient temperature	Charge (°C)	Standard	-10 to +60
		Rapid	
		Low rate	-10 to +45
	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

TYPICAL DISCHARGE CHARACTERISTICS



*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

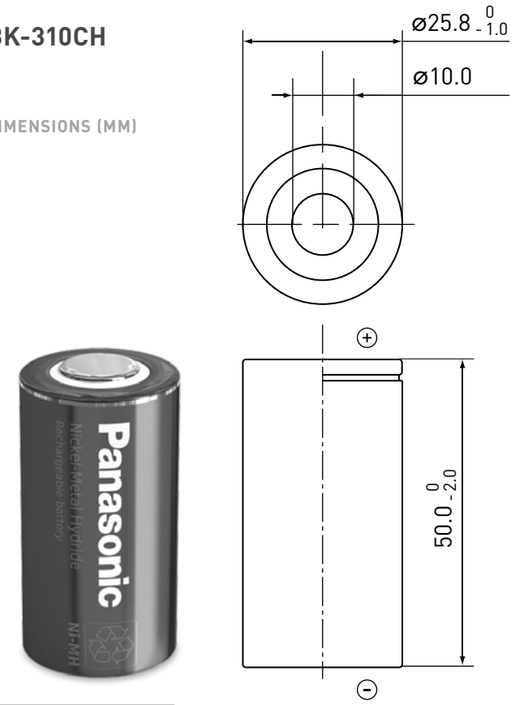
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-310CH

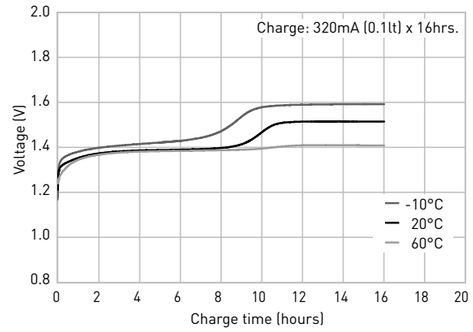
HIGH RATE DISCHARGE & HIGH TEMPERATURE TYPE
C SIZE (HR26/50)

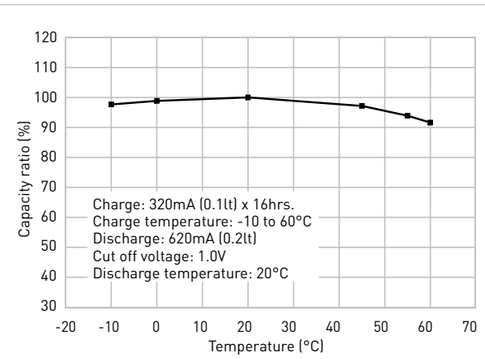
PH type

DIMENSIONS (MM)



TYPICAL CHARGE CHARACTERISTICS

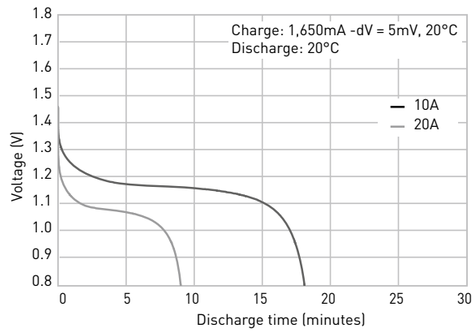




SPECIFICATIONS

Name			BK-310CH
Diameter (mm)			25.8 +0/-1.0
Height (mm)			50.0 +0/-2.0
Approximate weight (g)			80
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	3,300
		Rated/min. (mAh)	3,100
Approx. internal impedance at 1,000Hz at charged state (mΩ)			5
Charge		Standard (mA x hrs.)	310 x 16
		Rapid*3 (mA x hrs.)	1,550 x 2.4
		Low rate (mA x hrs.)	150 x 32
			100 x 48
Ambient temperature	Charge (°C)	Standard	-10 to +60
		Rapid	
		Low rate	-10 to +45
	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

TYPICAL DISCHARGE CHARACTERISTICS



*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

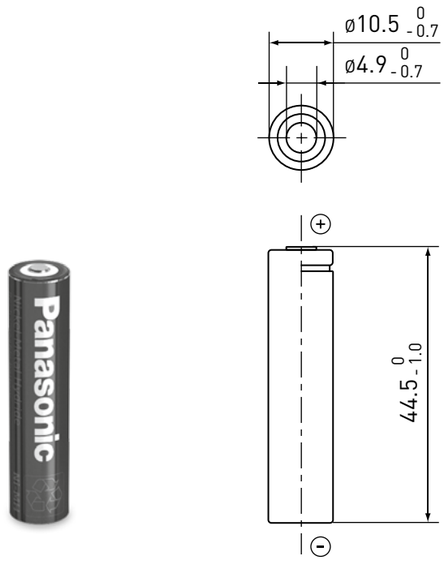
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-65AAAB

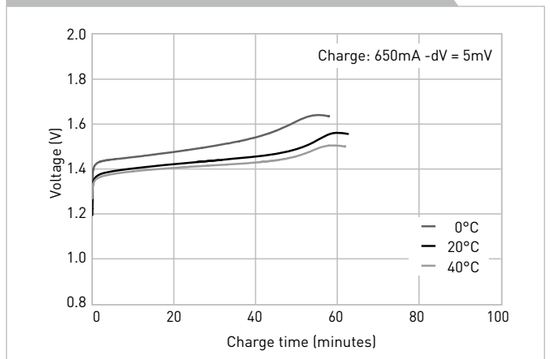
BUTTON TOP TYPE
AAA SIZE (HR11/45)

B type

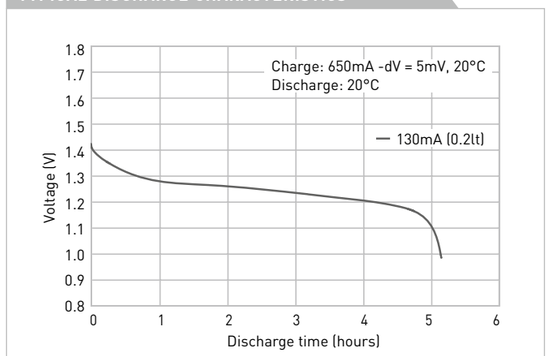
DIMENSIONS (MM)

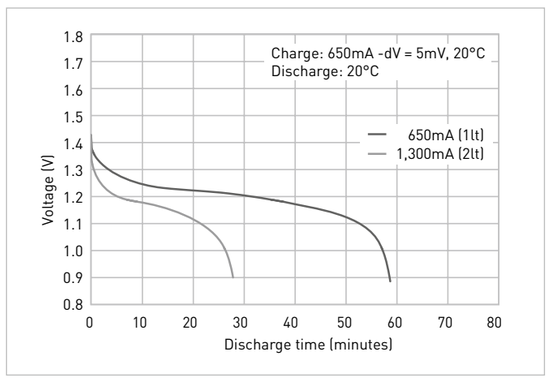


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-65AAAB
Diameter (mm)			10.5 +0/-0.7
Height (mm)			44.5 +0/-1.0
Approximate weight (g)			12
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	700
		Rated/min. (mAh)	650
Approx. internal impedance at 1,000Hz at charged state (mΩ)			30
Charge		Standard (mA x hrs.)	65 x 16
		Rapid*3 (mA x hrs.)	650 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

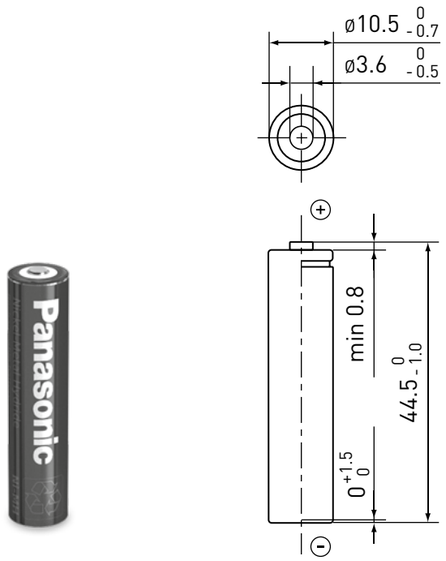
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-80AAAB
HHR-80AAAB (OLD)

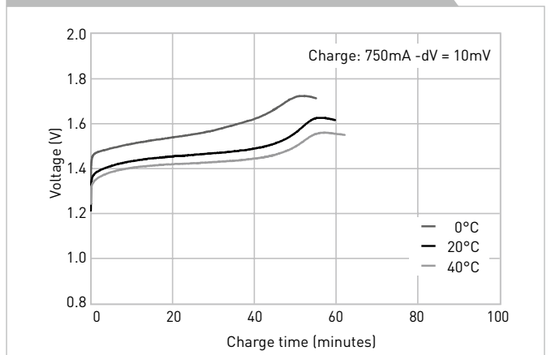
BUTTON TOP TYPE
AAA SIZE (HR11/45)

B type

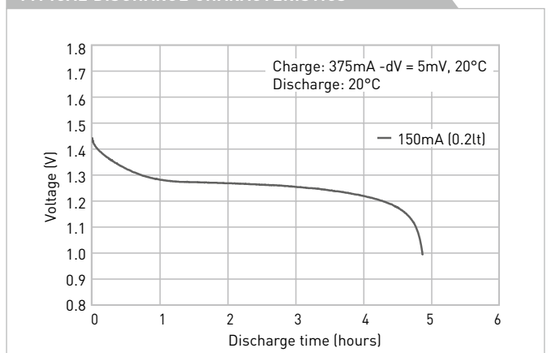
DIMENSIONS (MM)

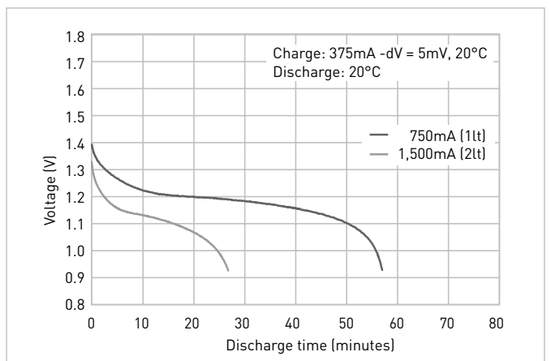


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-80AAAB
Diameter (mm)			10.5 +0 / -0.7
Height (mm)			44.5 +0 / -1.0
Approximate weight (g)			13
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	780
		Rated/min. (mAh)	750
Approx. internal impedance at 1,000Hz at charged state (mΩ)			30
Charge		Standard (mA x hrs.)	75 x 16
		Rapid*3 (mA x hrs.)	750 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

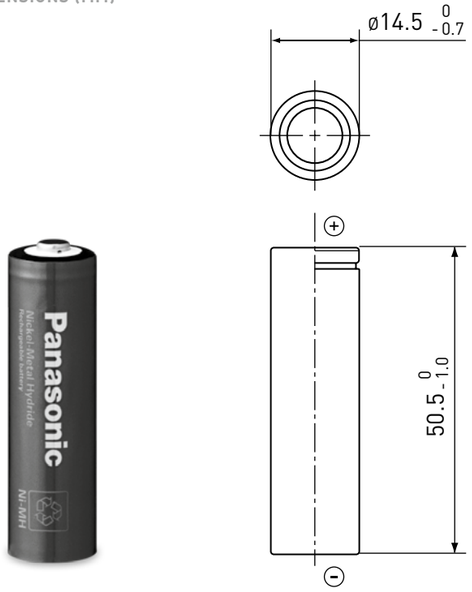
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-110AAB
HHR-110AAB (OLD)

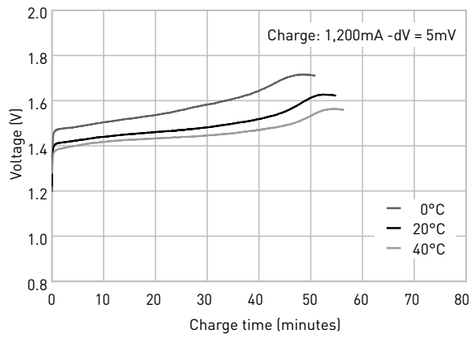
BUTTON TOP TYPE
AA SIZE (HR15/51)

B type

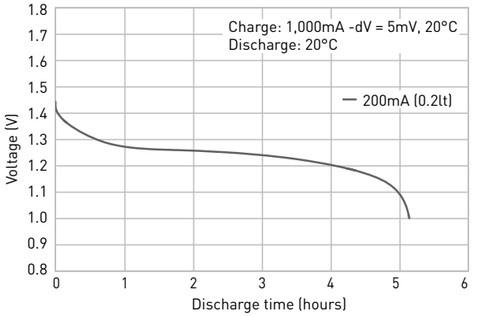
DIMENSIONS (MM)

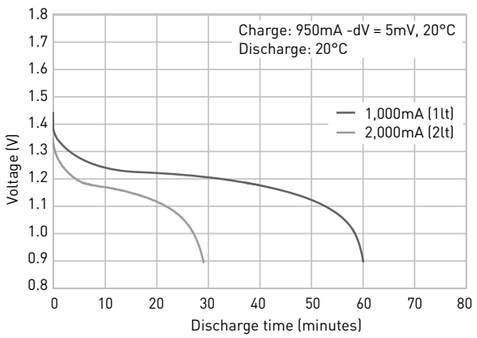


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-110AAB
Diameter (mm)			14.5 +0/-0.7
Height (mm)			50.5 +0/-1.0
Approximate weight (g)			20
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	1,050
		Rated/min. (mAh)	1,000
Approx. internal impedance at 1,000Hz at charged state (mΩ)			30
Charge		Standard (mA x hrs.)	100 x 16
		Rapid*3 (mA x hrs.)	1,200 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

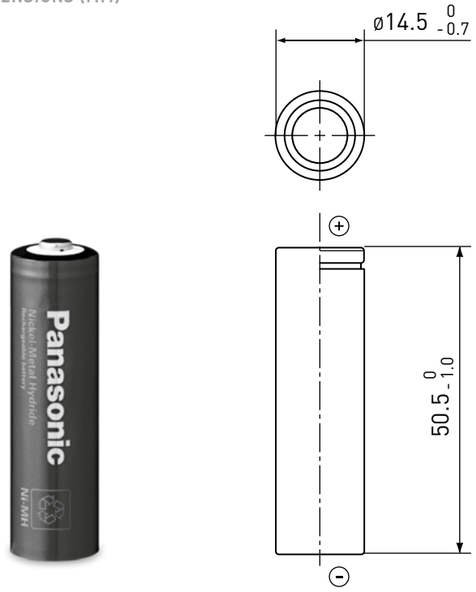
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-200AAB
HHR-200AAB (OLD)

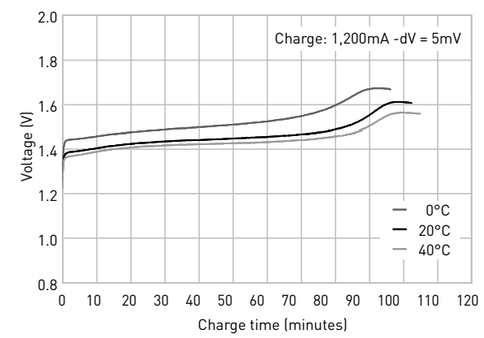
BUTTON TOP TYPE
AA SIZE (HR15/51)

B type

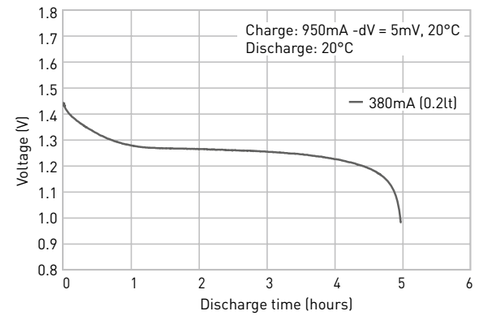
DIMENSIONS (MM)

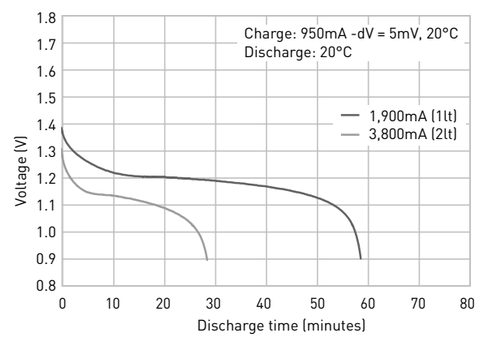


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-200AAB
Diameter (mm)			14.5 +0 / -0.7
Height (mm)			50.5 +0 / -1.0
Approximate weight (g)			29
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,000
		Rated/min. (mAh)	1,900
Approx. internal impedance at 1,000Hz at charged state (mΩ)			25
Charge		Standard (mA x hrs.)	190 x 16
		Rapid*3 (mA x hrs.)	1,200 x 2.0
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

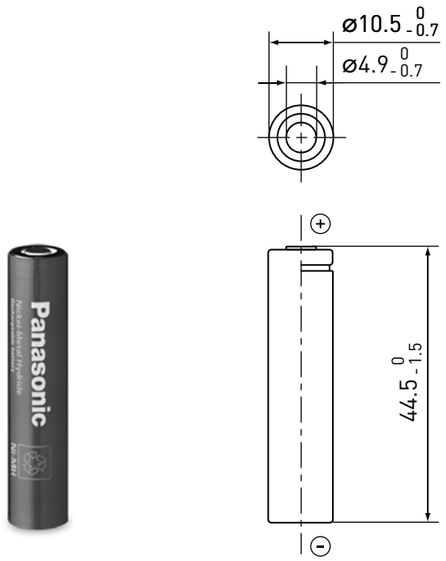
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-65AAAK
HHR-65AAAK (OLD)

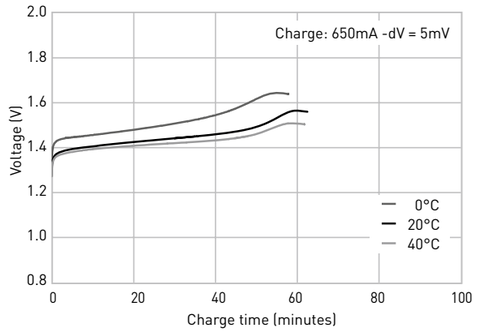
STANDARD TYPE
AAA SIZE (HR11/45)

N type

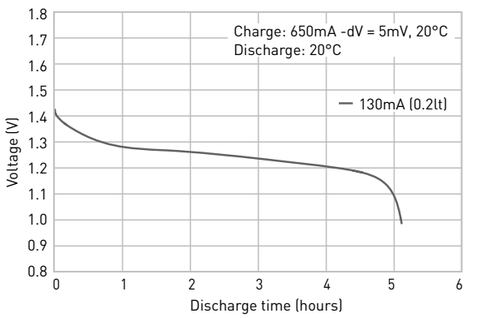
DIMENSIONS (MM)

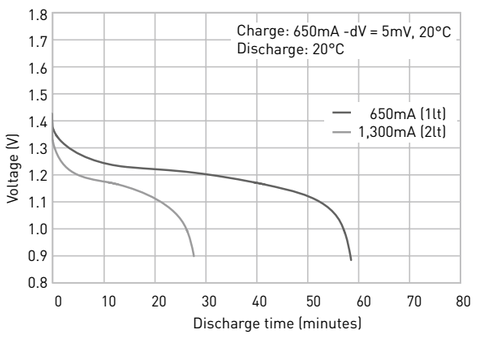


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-65AAAK
Diameter (mm)			10.5 +0/-0.7
Height (mm)			44.5 +0/-1.5
Approximate weight (g)			12
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	700
		Rated/min. (mAh)	650
Approx. internal impedance at 1,000Hz at charged state (mΩ)			30
Charge		Standard (mA x hrs.)	65 x 16
		Rapid*3 (mA x hrs.)	650 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<1 year	-20 to +35
		<6 months	-20 to +45
		<1 month	-20 to +55
		<1 week	-20 to +65

*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

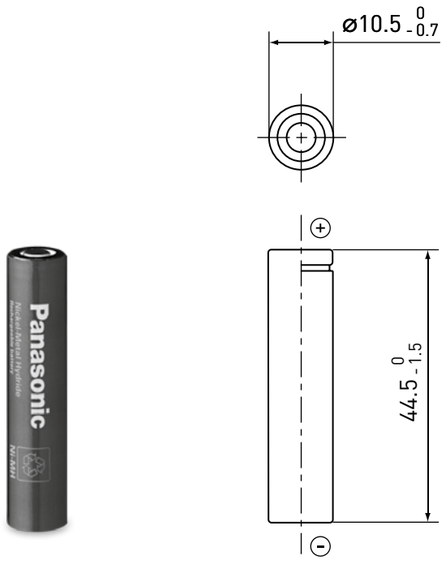
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-70AAAJ
HHR-70AAAJ (OLD)

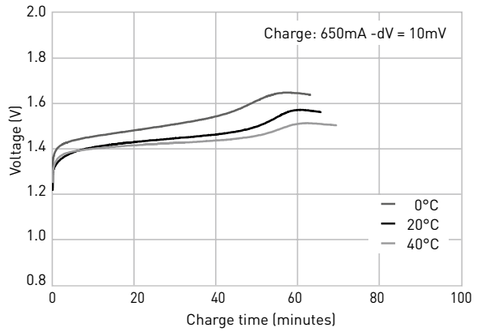
STANDARD TYPE
AAA SIZE (HR11/45)

N type

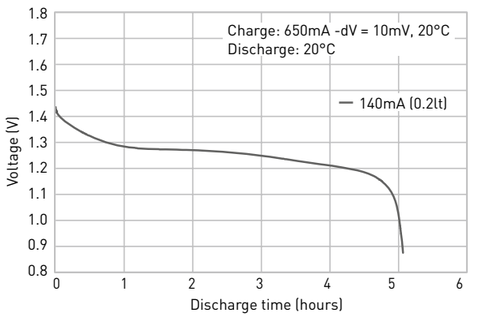
DIMENSIONS (MM)

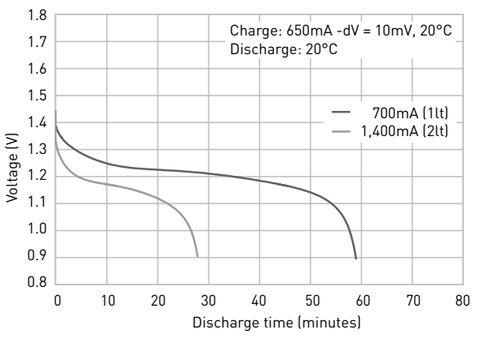


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

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

*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

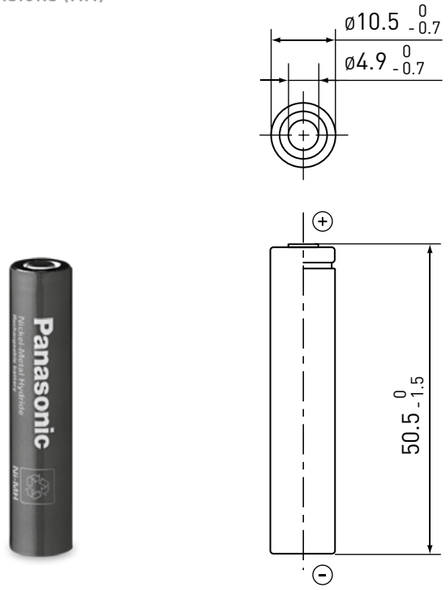
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-90AAA

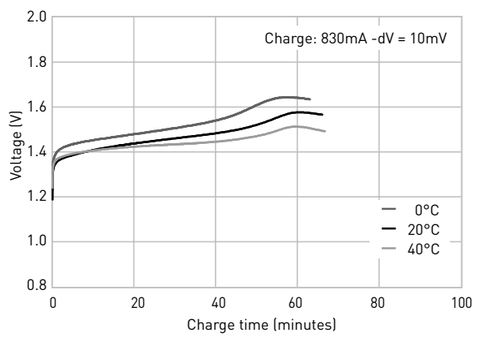
STANDARD TYPE
L-AAA SIZE (HR11/67)

N type

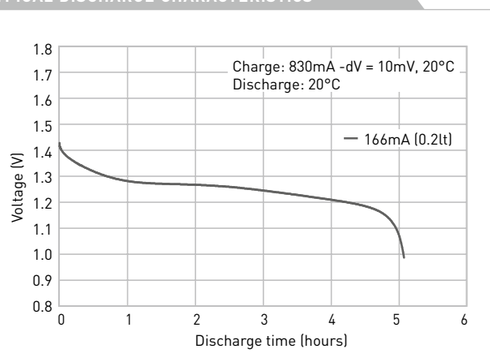
DIMENSIONS (MM)

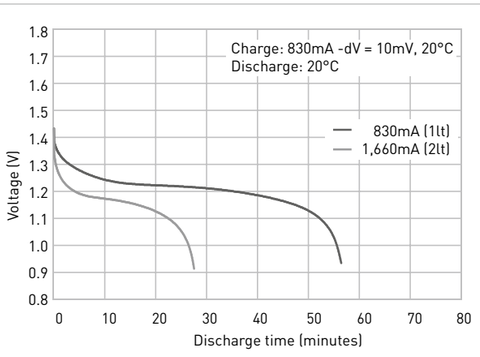


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-90AAA
Diameter (mm)			10.5 +0/-0.7
Height (mm)			50.5 +0/-1.5
Approximate weight (g)			14
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	880
		Rated/min. (mAh)	830
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	83 x 16
		Rapid*3 (mA x hrs.)	830 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

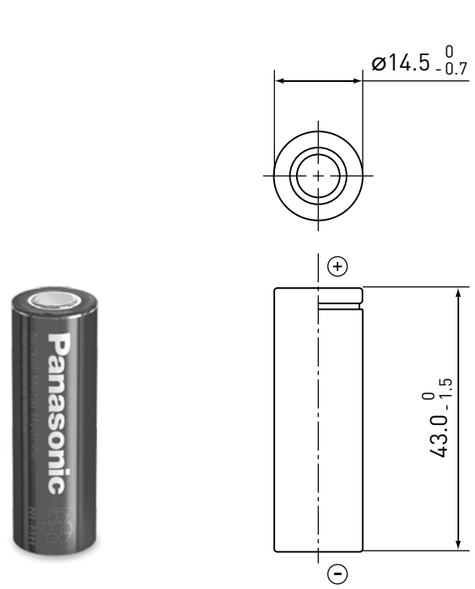
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-120AA
HHR-120AA (OLD)

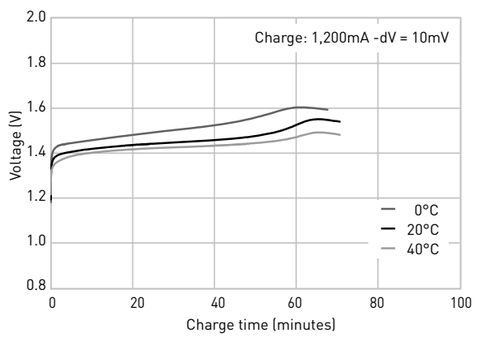
STANDARD TYPE
4/5AA SIZE (HR15/43)

N type

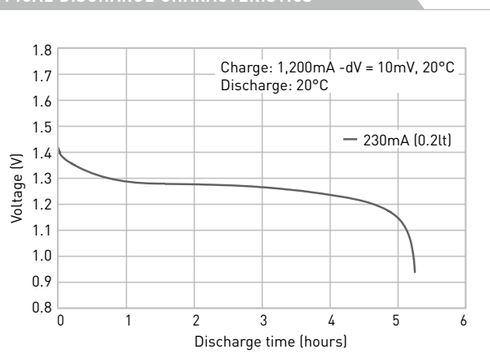
DIMENSIONS (MM)

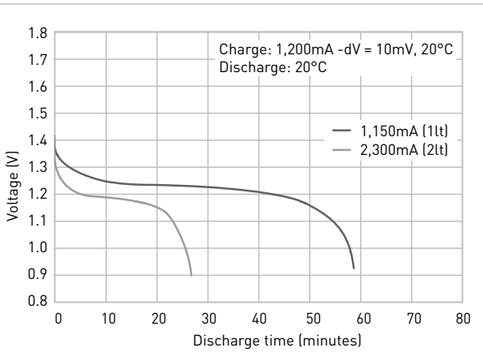


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-120AA
Diameter (mm)			14.5 +0 / -0.7
Height (mm)			43.0 +0 / -1.5
Approximate weight (g)			23
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	1,220
		Rated/min. (mAh)	1,150
Approx. internal impedance at 1,000Hz at charged state (mΩ)			19
Charge		Standard (mA x hrs.)	115 x 16
		Rapid*3 (mA x hrs.)	1,200 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

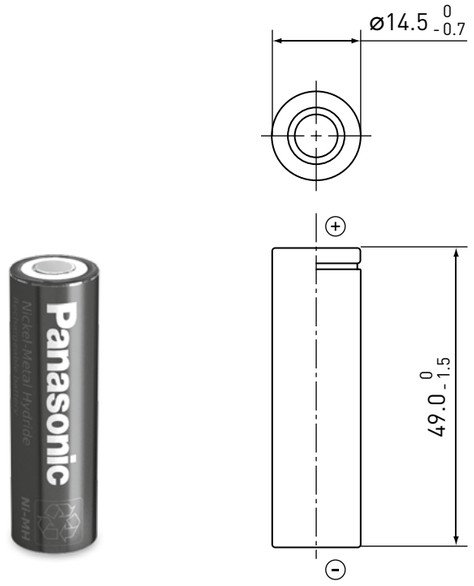
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-70AA
HHR-70AA (OLD)

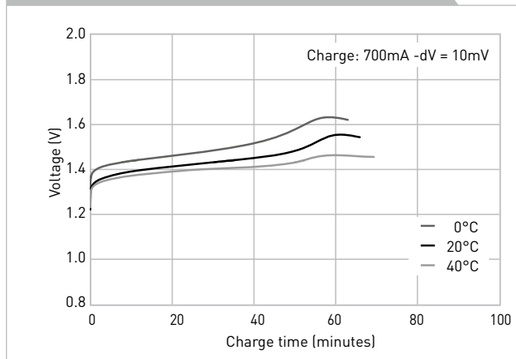
STANDARD TYPE
AA SIZE (HR15/49)

N type

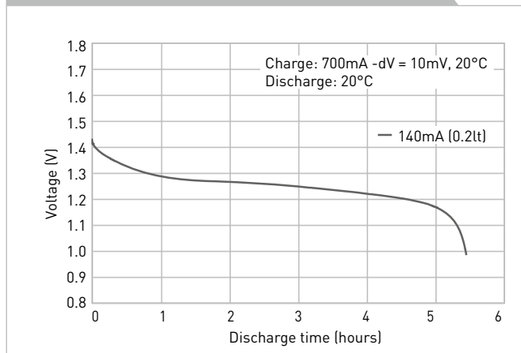
DIMENSIONS (MM)

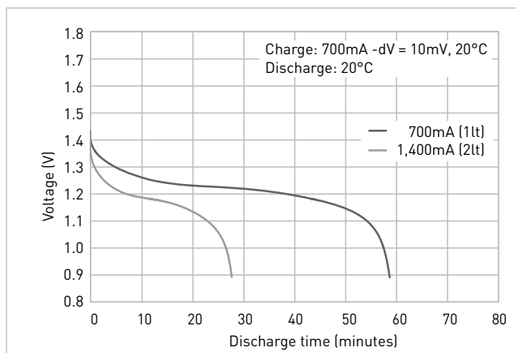


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-70AA
Diameter (mm)			14.5 +0/-0.7
Height (mm)			49.0 +0/-1.5
Approximate weight (g)			18
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	780
		Rated/min. (mAh)	700
Approx. internal impedance at 1,000Hz at charged state (mΩ)			25
Charge		Standard (mA x hrs.)	70 x 16
		Rapid*3 (mA x hrs.)	700 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

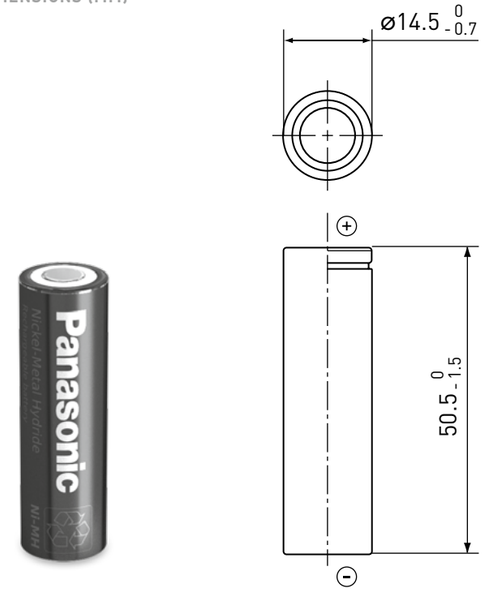
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-150AA
HHR-150AA (OLD)

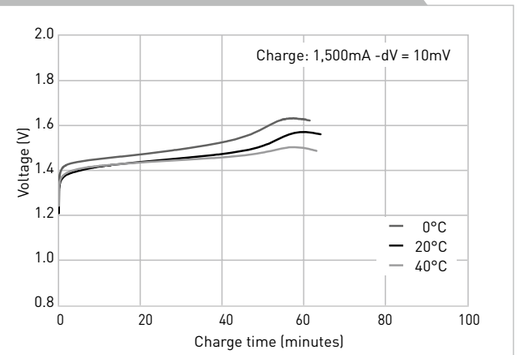
STANDARD TYPE
AA SIZE (HR15/51)

N type

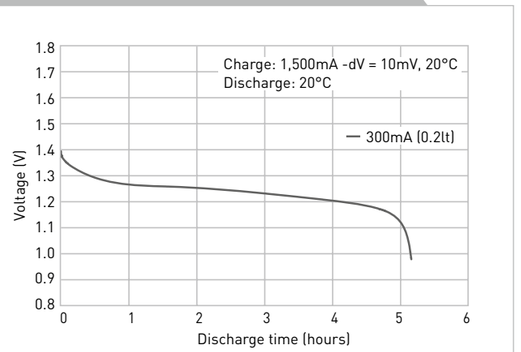
DIMENSIONS (MM)

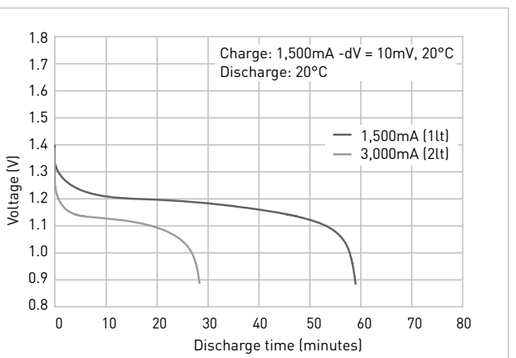


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-150AA
Diameter (mm)			14.5 +0 / -0.7
Height (mm)			50.5 +0 / -1.5
Approximate weight (g)			26
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	1,580
		Rated/min. (mAh)	1,500
Approx. internal impedance at 1,000Hz at charged state (mΩ)			23
Charge		Standard (mA x hrs.)	150 x 16
		Rapid*3 (mA x hrs.)	1,500 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 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.

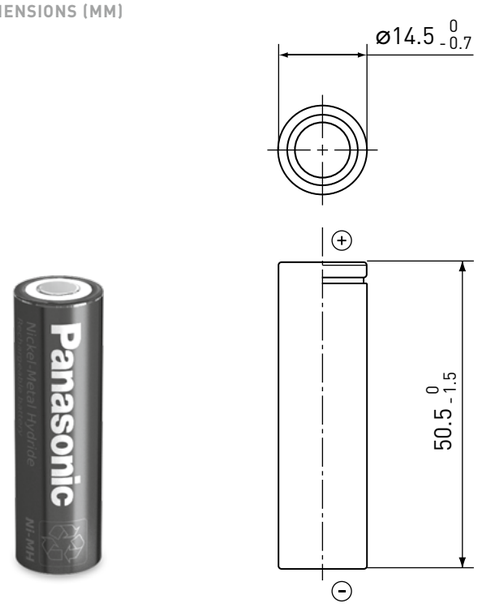
BK-110AA0

HHR-110AA0 (OLD)

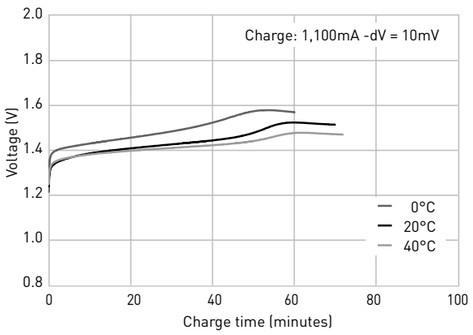
STANDARD TYPE
AA SIZE (HR15/51)

N type

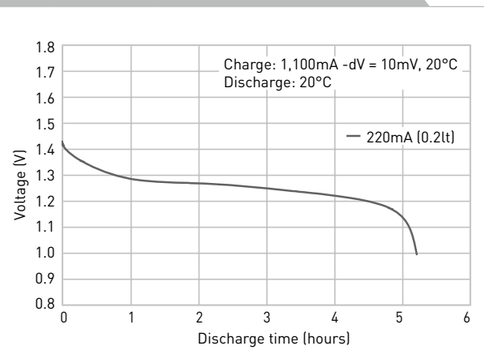
DIMENSIONS (MM)

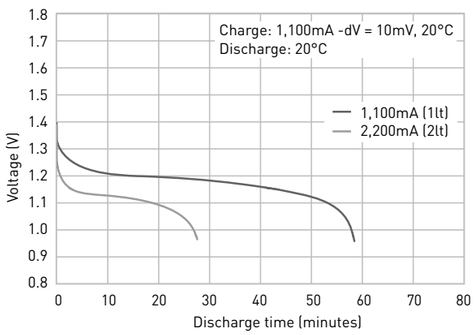


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-110AA0
Diameter (mm)			14.5 +0/-0.7
Height (mm)			50.5 +0/-1.5
Approximate weight (g)			26
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	1,180
		Rated/min. (mAh)	1,100
Approx. internal impedance at 1,000Hz at charged state (mΩ)			16
Charge		Standard (mA x hrs.)	110 x 16
		Rapid*3 (mA x hrs.)	1,100 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 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.

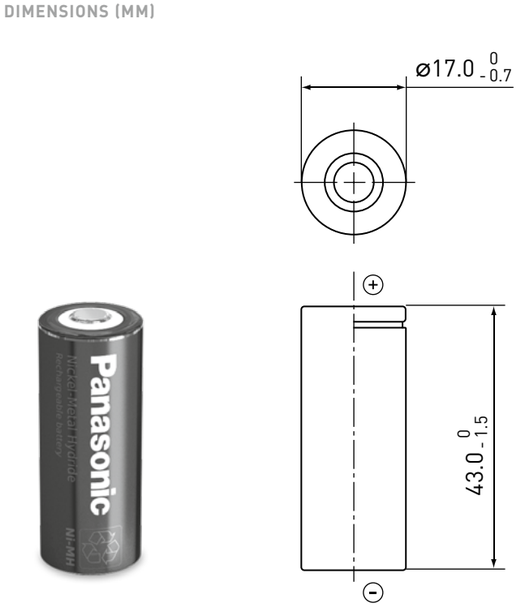
BK-200A

HHR-200A (OLD)

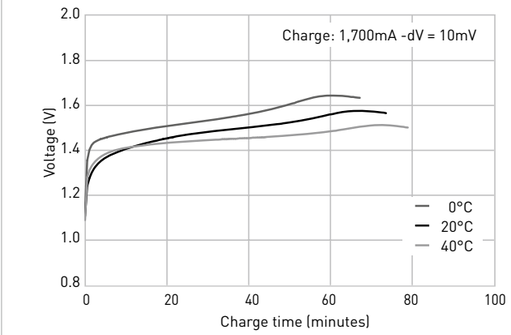
STANDARD TYPE
4/5A SIZE (HR17/43)

N type

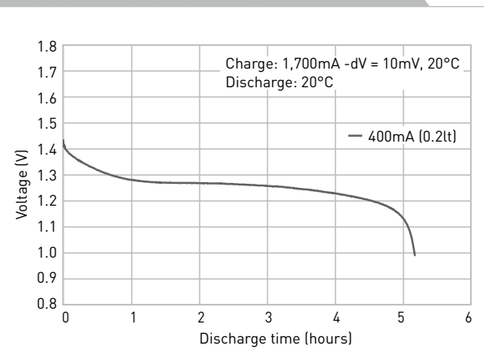
DIMENSIONS (MM)

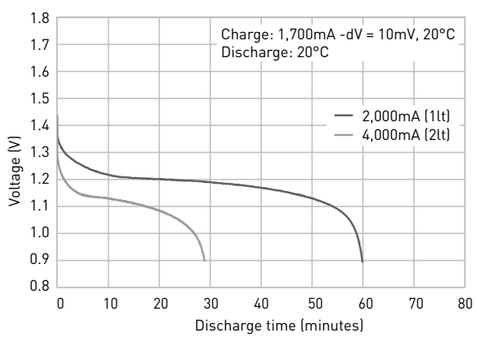


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-200A
Diameter (mm)			17.0 +0 / -0.7
Height (mm)			43.0 +0 / -1.5
Approximate weight (g)			32
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,040
		Rated/min. (mAh)	2,000
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	200 x 16
		Rapid*3 (mA x hrs.)	1,700 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

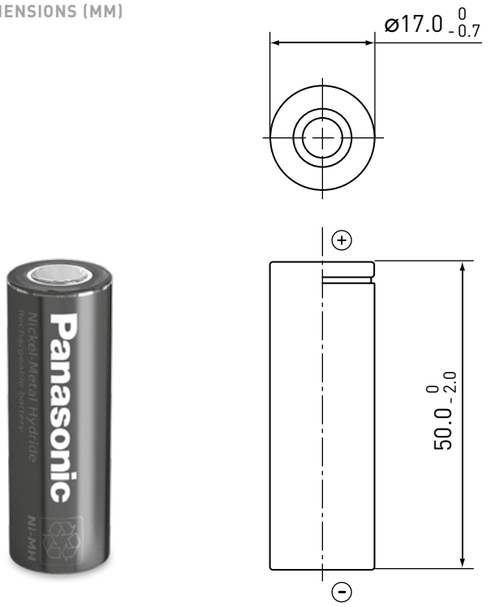
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-210A
HHR-210A (OLD)

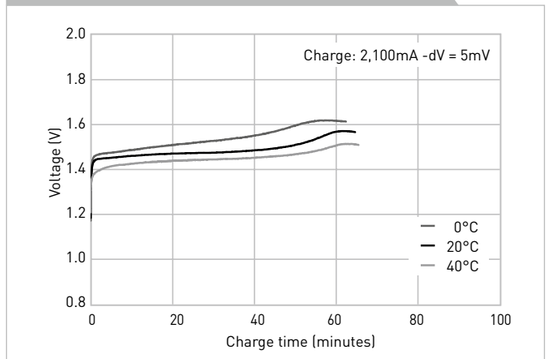
STANDARD TYPE
A SIZE (HR17/50)

N type

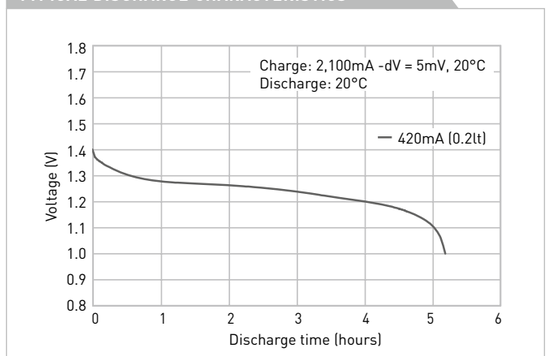
DIMENSIONS (MM)

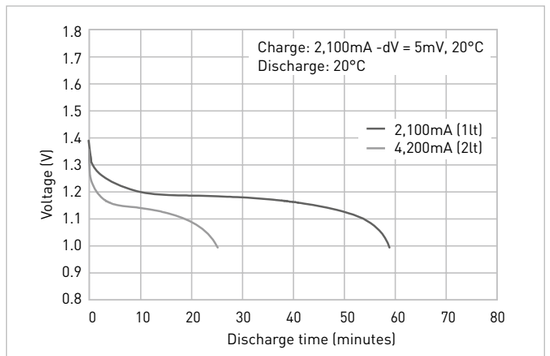


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-210A
Diameter (mm)			17.0 +0/-0.7
Height (mm)			50.0 +0/-2.0
Approximate weight (g)			38
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,200
		Rated/min. (mAh)	2,100
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	210 x 16
		Rapid*3 (mA x hrs.)	2,100 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

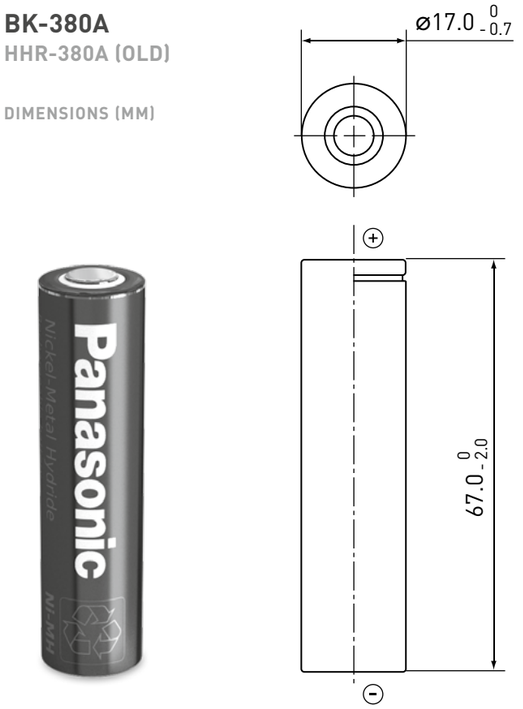
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-380A
HHR-380A (OLD)

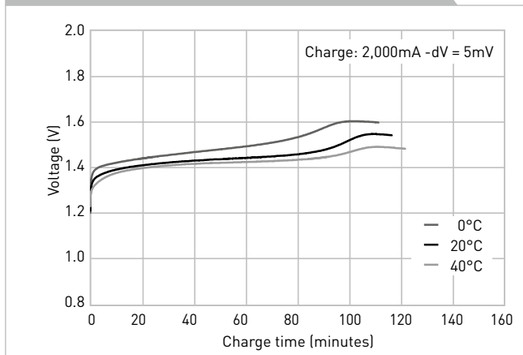
STANDARD TYPE
L-A SIZE (HR17/67)

N type

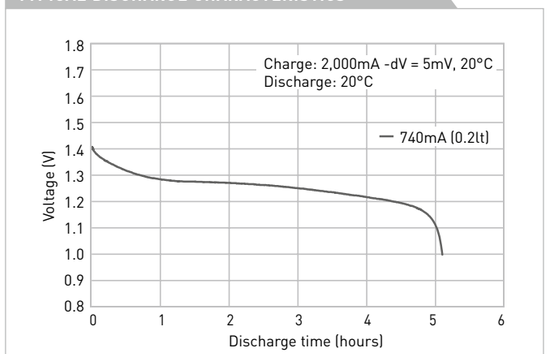
DIMENSIONS (MM)

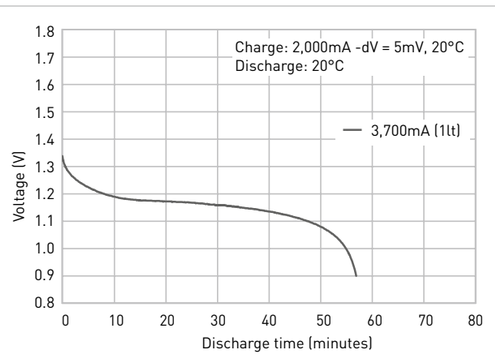


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-380A
Diameter (mm)			17.0 +0 / -0.7
Height (mm)			67.0 +0 / -2.0
Approximate weight (g)			53
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	3,800
		Rated/min. (mAh)	3,700
Approx. internal impedance at 1,000Hz at charged state (mΩ)			25
Charge		Standard (mA x hrs.)	370 x 16
		Rapid*3 (mA x hrs.)	2,000 x 2.3
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

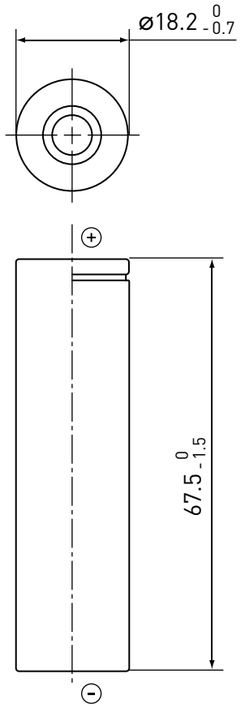
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-450A
HHR-450A (OLD)

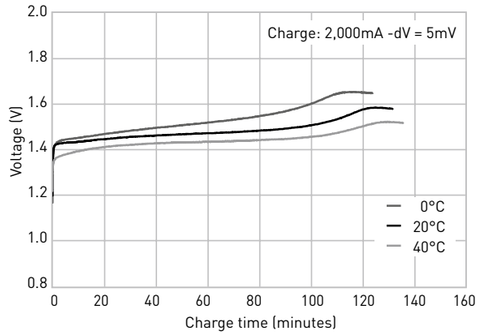
STANDARD TYPE
LFAT/A SIZE

N type

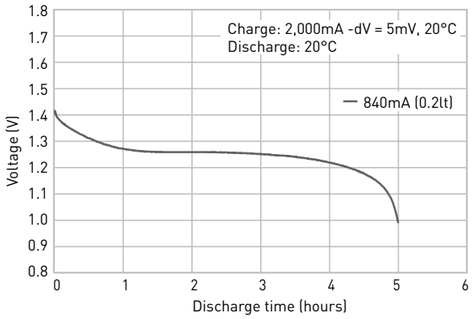
DIMENSIONS (MM)

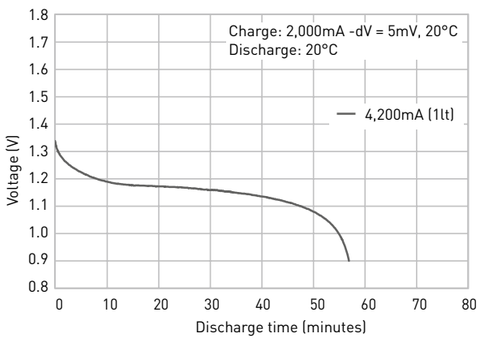


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-450A
Diameter (mm)			18.2 +0/-0.7
Height (mm)			67.5 +0/-1.5
Approximate weight (g)			60
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	4,500
		Rated/min. (mAh)	4,200
Approx. internal impedance at 1,000Hz at charged state (mΩ)			25
Charge		Standard (mA x hrs.)	420 x 16
		Rapid*3 (mA x hrs.)	2,000 x 2.7
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

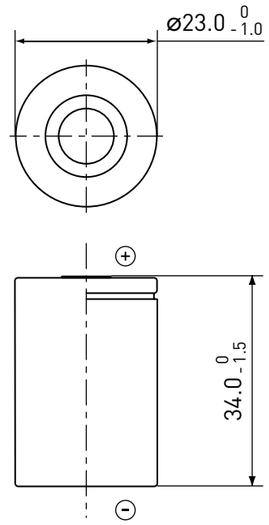
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-200SCP
HHR-200SCP (OLD)

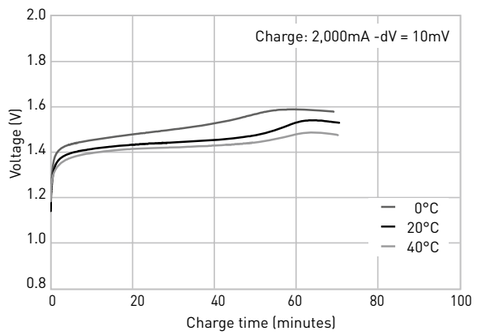
HIGH RATE DISCHARGE & RAPID CHARGE TYPE
4/5SC SIZE (HR23/34)

P type

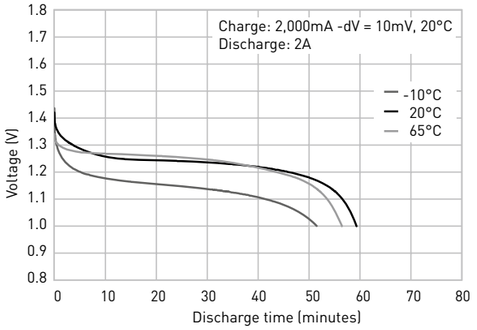
DIMENSIONS (MM)

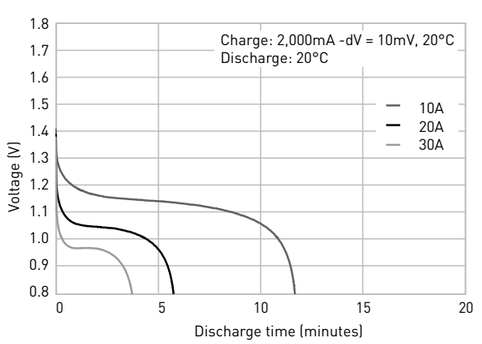


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-200SCP
Diameter (mm)			23.0 +0 / -1.0
Height (mm)			34.0 +0 / -1.5
Approximate weight (g)			42
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,100
		Rated/min. (mAh)	1,900
Approx. internal impedance at 1,000Hz at charged state (mΩ)			5
Charge		Standard (mA x hrs.)	190 x 16
		Rapid*3 (mA x hrs.)	2,000 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

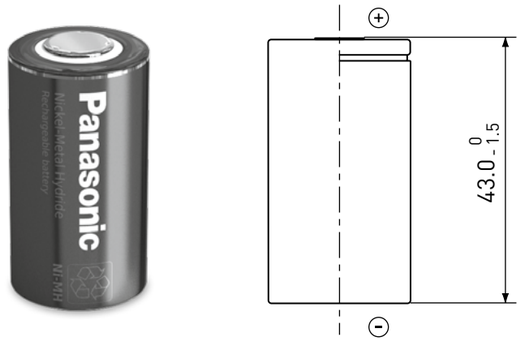
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-260SCP
HHR-260SCP (OLD)

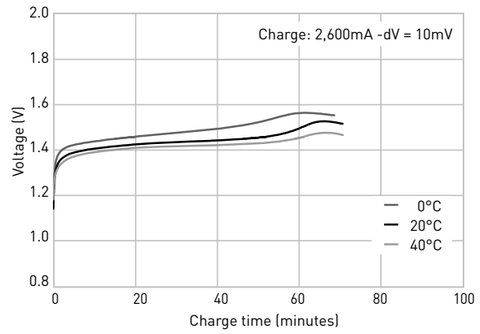
HIGH RATE DISCHARGE & RAPID CHARGE TYPE
SC SIZE (HR23/43)

P type

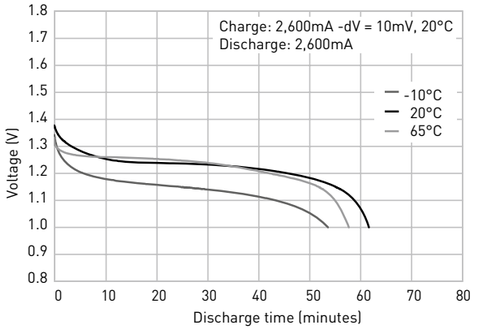
DIMENSIONS (MM)

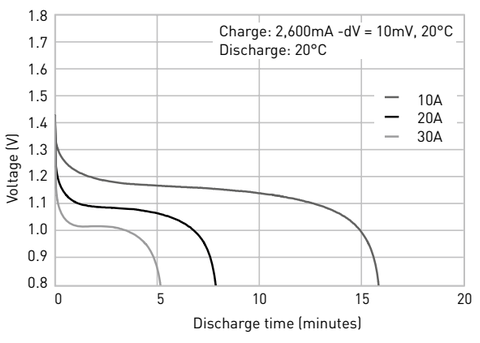


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-260SCP
Diameter (mm)			23.0 +0 / -1.0
Height (mm)			43.0 +0 / -1.5
Approximate weight (g)			55
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,700
		Rated/min. (mAh)	2,450
Approx. internal impedance at 1,000Hz at charged state (mΩ)			4
Charge		Standard (mA x hrs.)	245 x 16
		Rapid*3 (mA x hrs.)	2,600 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

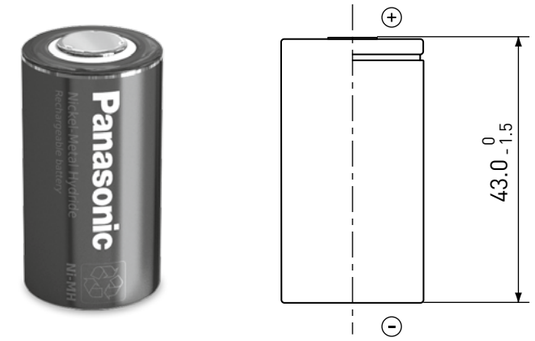
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-300SCP
HHR-300SCP (OLD)

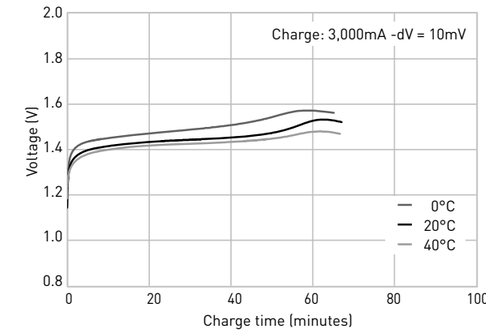
HIGH RATE DISCHARGE & RAPID CHARGE TYPE
SC SIZE (HR23/43)

P type

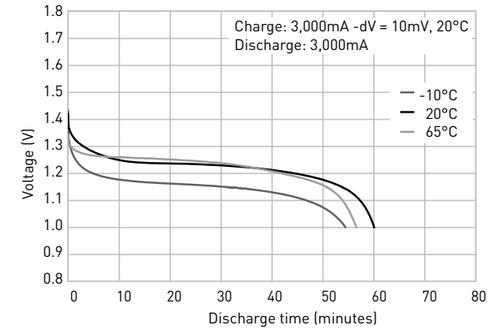
DIMENSIONS (MM)

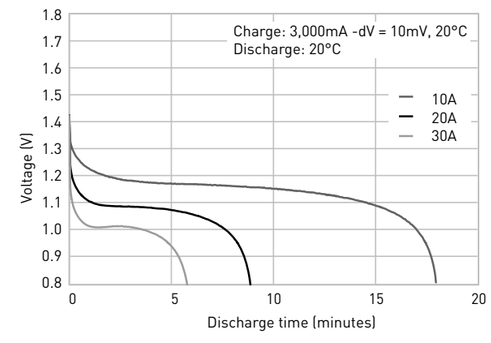


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-300SCP
Diameter (mm)			23.0 +0 / -1.0
Height (mm)			43.0 +0 / -1.5
Approximate weight (g)			57
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	3,050
		Rated/min. (mAh)	2,800
Approx. internal impedance at 1,000Hz at charged state (mΩ)			4
Charge		Standard (mA x hrs.)	280 x 16
		Rapid*3 (mA x hrs.)	3,000 x 1.2
Ambient temperature	Charge	Standard (°C)	0 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-10 to +65
	Storage	<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 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

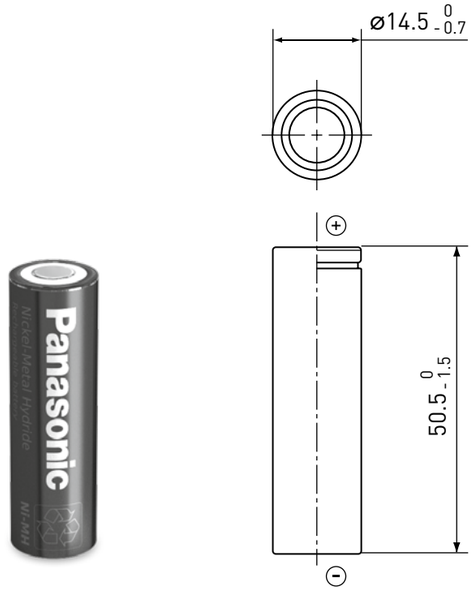
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-130AA

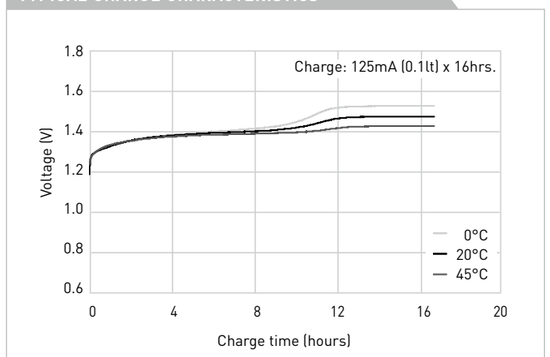
LOW TEMPERATURE TYPE
AA SIZE (HR15/51)

L type

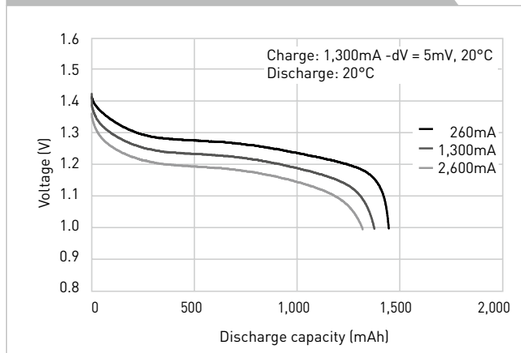
DIMENSIONS (MM)

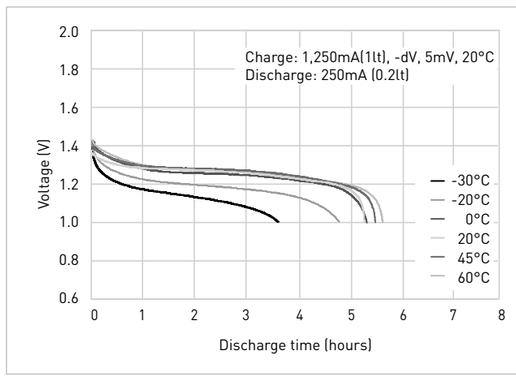


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

Name			BK-130AA
Diameter (mm)			14.5 +0 / -0.7
Height (mm)			50.5 +0 / -1.5
Approximate weight (g)			26
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	1,400
		Rated/min. (mAh)	1,250
Approx. internal impedance at 1,000Hz at charged state (mΩ)			23
Charge		Standard (mA x hrs.)	125 x 16
		Rapid*3 (mA x hrs.)	1,250 x 1.2
Ambient temperature	Charge	Standard (°C)	-10 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-30 to +65
	Storage	<1 year	-30 to +35
		<6 months	-30 to +45
		<1 month	-30 to +55

*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

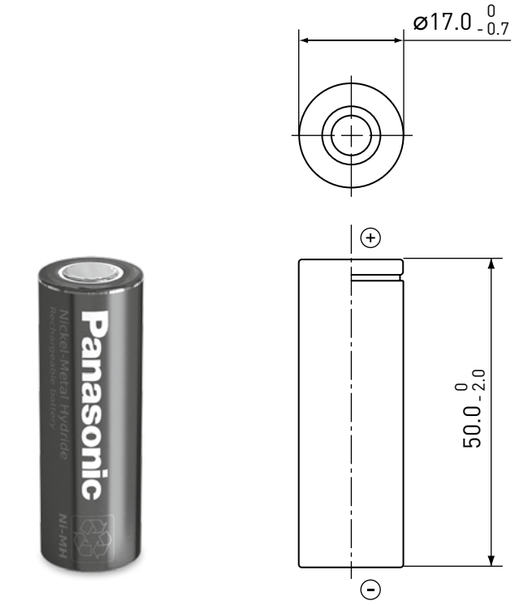
Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-250A

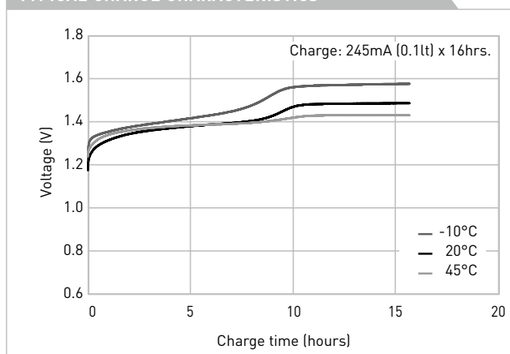
LOW TEMPERATURE TYPE
A SIZE (HR17/50)

L type

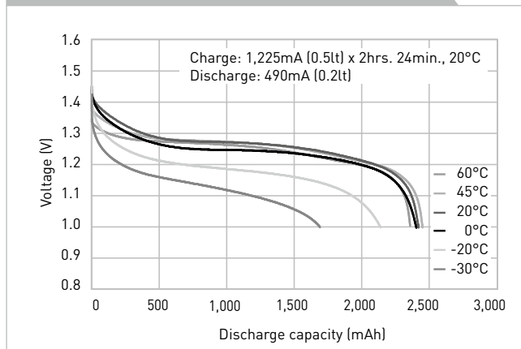
DIMENSIONS (MM)

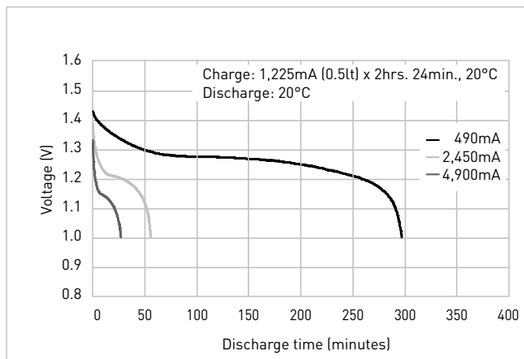


TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS





SPECIFICATIONS

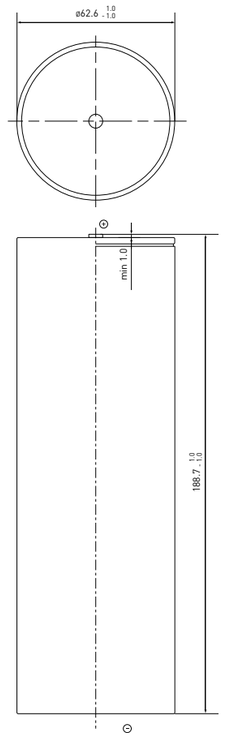
Name			BK-250A
Diameter (mm)			17.0 +0 / -0.7
Height (mm)			50.0 +0 / -2.0
Approximate weight (g)			40
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (mAh)	2,600
		Rated/min. (mAh)	2,450
Approx. internal impedance at 1,000Hz at charged state (mΩ)			20
Charge		Standard (mA x hrs.)	245 x 16
		Rapid*3 (mA x hrs.)	2,450 x 1.2
Ambient temperature	Charge	Standard (°C)	-10 to +45
		Rapid (°C)	0 to +40
	Discharge (°C)		-30 to +65
	Storage	<1 year	-30 to +35
		<6 months	-30 to +45
		<1 month	-30 to +55

*1 After charging at 0.1lt for 16 hours, discharging at 0.2lt.
*2 For reference only.
*3 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-10V1S

DIMENSIONS (MM)



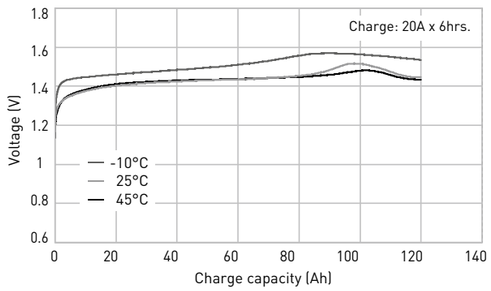
SPECIFICATIONS

Name			BK-10V1S
Diameter (mm)			62.6 +1.0 / -1.0
Height (mm)			188.7 +1.0 / -1.0
Approximate weight (g)			1,700
Nominal voltage (V)			1.2
Discharge capacity*1		Average*2 (Ah)	95
		Rated/min. (Ah)	90
Approx. internal impedance at 1,000Hz at charged state (mΩ)			1.6
Charge		Standard (A x hrs.)	10 x 12
		Rapid*3 (A x hrs.)	20 x 5
Ambient temperature	Charge	Standard (°C)	-20 to +55
		Rapid (°C)	
	Discharge (°C)		-20 to +60
	Storage	<1 year	-20 to +35
		<6 months	-20 to +45
		<1 month	-20 to +55

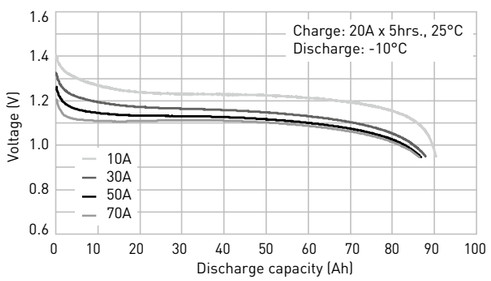
*1 After charging at 0.1It for 16 hours, discharging at 0.2It.
*2 For reference only.
*3 Need specially designed control system. Please contact Panasonic for details.

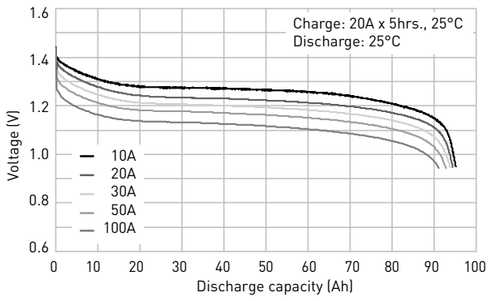
INFRASTRUCTURE TYPE
V SIZE

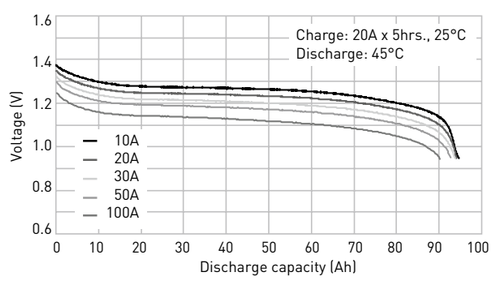
TYPICAL CHARGE CHARACTERISTICS



TYPICAL DISCHARGE CHARACTERISTICS



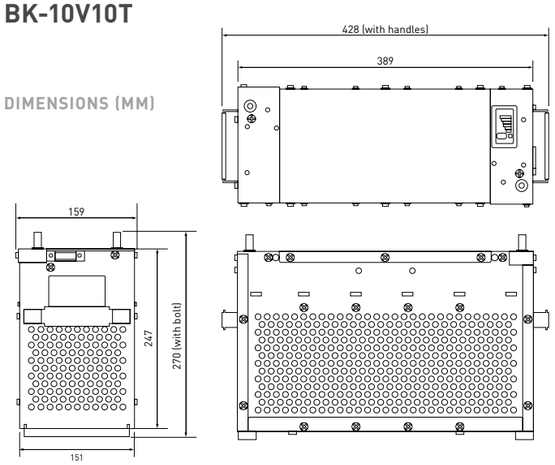




Battery performance and cycle life are strongly affected by how they are used. In order to maximise battery safety, please consult Panasonic when determining charge/discharge specs, warning label contents and design. The data in this document are for descriptive purposes only and are not intended to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

BK-10V10T

DIMENSIONS (MM)

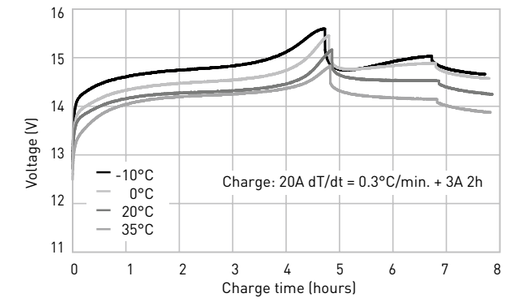


SPECIFICATIONS

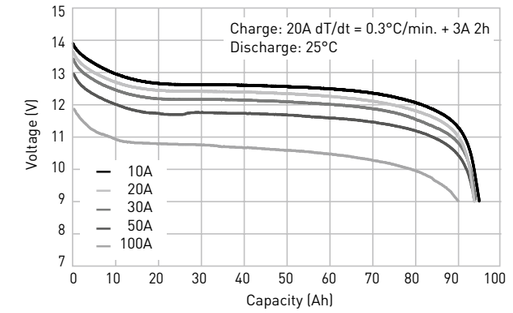
Name		BK-10V10T
Dimensions (mm)	Width (mm)	428
	Depth (mm)	159
	Height (mm)	270
Volume (l)		18.4
Approximate weight (g)		23,000
Nominal voltage (V)		12
Discharge current (A)		100
Battery cell		10 x BK-10V1S
Rated (battery pack)		12V/90Ah
Operating temperature range (°C)		-20 to +60
Display function		Remaining capacity

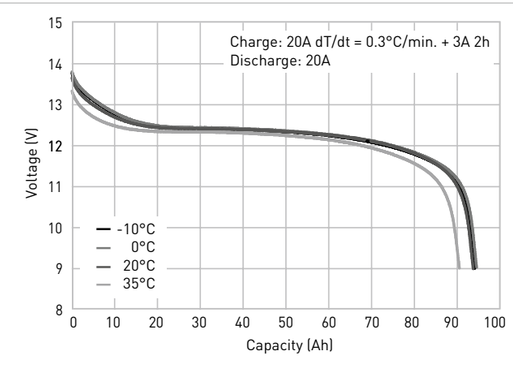
INFRASTRUCTURE TYPE
PACK SIZE

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.

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_5 or AB_2 type alloy is used for batteries. ($MmNi_5$) AB_5 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 $Ni(OH)_2$.

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:

0.1ltmA = 0.1 x 1,500 = 150mA
0.2ltmA = 0.2 x 1,500 = 300mA

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 Electro-technical 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.

NOTES

CONTACT

United Kingdom/Ireland
Panasonic Automotive & Industrial
Systems Europe GmbH (PAISEU)
Willoughby Road
Bracknell Berkshire
RG12 8FP
England
Phone: +44 1344 - 85 32 60
Fax: +44 1344 - 85 33 13

Panasonic Italia
Branch Office of
Panasonic Marketing Europe GmbH
Viale dell'Innovazione 3
20126 Milano
Italy
Phone: +39 02 - 6788 - 232
Fax: +39 02 - 6788 - 207

Spain/Portugal
Panasonic Automotive & Industrial
Systems Europe GmbH (PAISEU)
Sucursal en España
Parque Empresarial @ Sant Cugat,
Via Augusta 15-25
Edificio B2 Planta 4 Oficina 17
08174 Sant Cugat del Valles
Barcelona
Spain
Phone: +34 93 - 504 30 10
Fax: +34 93 - 675 58 92

France
Panasonic Automotive & Industrial
Systems Europe GmbH (PAISEU)
10, rue des petits ruisseaux
91370 Verrières-le-Buisson
France
Phone: +33 1 - 60 13 57 62
Fax: +33 1 - 60 13 57 72

Germany
(all other European countries)
Panasonic Automotive & Industrial
Systems Europe GmbH (PAISEU)
Winsbergring 15
22525 Hamburg
Germany
Phone: +49 40 - 85 386 - 373
Fax: +49 40 - 85 386 - 238

E-mail and website for all countries
battery-solutions@eu.panasonic.com
http://eu.industrial.panasonic.com/

Website for Panasonic Battery Finder
Get more information on Panasonic Battery Finder website.
http://eu.industrial.panasonic.com/battery-finder

App Stores for Panasonic Battery Finder
The Panasonic Battery Finder is available for Android and iOS (iPhone) devices and can be downloaded free of charge in app stores. Scan QR code to go to app store and download app.

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

This catalog has been produced using unchlorinated paper.

For more details please contact:

Panasonic®

Panasonic is a registered trademark of Panasonic Corporation.
Printed in Germany 2015
© Panasonic Corporation