SAFETY, LONG-LIFE AND POWER!

PANASONIC BATTERIES

We are able to offer you a wide range of individual power solutions for portable and stationary applications. Our product range includes high reliability batteries such as Lithium-Ion, Lithium, Nickel-Metal-Hydride, Valve-Regulated-Lead-Acid (VRLA), Alkaline and Zinc-Carbon. Based on this battery range we can power your business in virtually all applications.

PIE organisation divisions

Panasonic Energy Company (PEC) started its battery production in 1931. Today PEC is the most diversified global battery manufacturer with a network of 16 manufacturing companies in 16 countries. More than 12,600 employees are dedicated to the research & development and in the production of new batteries for a new world.

When it comes to production our facilities employ leading edge manufacturing processes meeting the highest quality standards. Our factories are certified to ISO standards. This means that each factory has its own quality and environmental management. The ISO 9000 and ISO 14000 series are the minimum benchmarks that ensure our excellent product reliability.

Furthermore the majority of our factories is also certified to OHSAS 18001 (Occupational Health and Safety Assessment Series), an international standard for assessing a management system for occupational safety. This confirms that our factories have been proactive in putting the occupational health and safety of its staff at the centre of the company’s dealings. In addition our VRLA batteries are for example approved to German VdS standard and U.S. UL standard.

Panasonic quality – certified by authorised companies.

PANASONIC INDUSTRIAL EUROPE

Panasonic Corporation, founded in Osaka 1918, is one of the world’s largest manufacturers of quality electronic and electrical equipment. Its subsidiary, Panasonic Industrial Europe GmbH (PIE) deals with a wide diversified range of industrial products for all European countries. This company was formed in 1998 to strengthen Panasonic’s Pan-European industry operation, and today is active in such different business fields as Automotive, Audio/Video & Communication, Appliance and Industry & Devices to satisfy its customer’s needs.

PIE Organisation Divisions

Audio/Video & Communication

PMG (Product Marketing Group)

Automotive

Industry & Devices

Appliance

Factory Solutions
Pursuing coexistence with the global environment in its business vision, Panasonic places reduction of the environmental impact in all its business activities as one of the important themes in its mid-term management plan. In its ‘eco ideas’ Strategy, which focuses in particular on rapid implementation of measures to prevent global warming and global promotion of environmental sustainability management, Panasonic is advancing three key initiatives: ‘eco ideas’ for Manufacturing, ‘eco ideas’ for Products, and ‘eco ideas’ for Everybody, Everywhere.

The Panasonic ‘eco ideas’ House

We are approaching a global turning corner and it would not be an exaggeration to call it the Environmental Industrial Revolution. Based on this recognition, Panasonic has built an ‘eco ideas’ House on the premise of our showroom, Panasonic Center Tokyo in April 2009 in order to help create a carbon-free society and reduce CO₂ emissions from a household sector.

The concept of this ‘eco ideas’ House can be described as follows:

1. Virtually zero CO₂ emissions in an entire house envisaged in three to five years into the future
2. Synergy of technology and nature

Aforementioned concepts shows that Panasonic is not only aware of it’s environmental responsibility moreover this Panasonic takes action.

Example

The Wakayama Plant of the Energy Company is strengthening its management structure to cut CO₂ emissions from the main production bases for Lithium-Ion batteries, which are a core component of Panasonic’s energy business. As a result, it has succeeded in roughly halving CO₂ emissions per production unit, as well as sharply curbing an increase in CO₂ emissions even as production has expanded.

Our energy will Drive eco Innovation.

The Panasonic ‘eco ideas’ House
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 40°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.

**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.

**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.

### Discharging

**Discharge temperature**
Discharge batteries within an ambient temperature range of -10°C to +45°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.

**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.

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**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 40°C.
  - Ambient temperature during charging affects charging efficiency.
  - Best within a temperature range of 10°C to 30°C.
  - Place charger (battery pack) in a location within this temperature range.

- **Parallel charging of batteries**
  - Sufficient care must be taken during design.
  - Consult Panasonic when parallel charging required.

- **Reverse charging**
  - Never attempt reverse charging.
  - Charging with polarity reversed causes reversal in battery polarity.
  - Gas pressure inside battery rises.

- **Overdischarge (deep discharge)**
  - Do not leave battery connected to equipment for long periods.
  - Avoid shipping with battery installed.

- **Overcharging**
  - Avoid overcharging.

- **Rapid charging**
  - To charge rapidly, use specified charger.

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**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.**

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- **Charging temperature**
  - Charge batteries within an ambient temperature range of 0°C to 40°C.
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  - Best within a temperature range of 10°C to 30°C.
  - Place charger (battery pack) in a location within this temperature range.

- **Parallel charging of batteries**
  - Sufficient care must be taken during design.
  - Consult Panasonic when parallel charging required.

- **Reverse charging**
  - Never attempt reverse charging.
  - Charging with polarity reversed causes reversal in battery polarity.
  - Can cause gas pressure inside battery to rise.

- **Overdischarge (deep discharge)**
  - Do not leave battery connected to equipment for long periods.
  - Avoid shipping with battery installed.

- **Overcharging**
  - Avoid overcharging.

- **Rapid charging**
  - To charge rapidly, use specified charger.
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 +40°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 discharging can be used 500 cycles or more. Significantly discharging can be used

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 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. 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.

Temperature related the 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.

Overdischarge (deep discharging) 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 minimized. 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.

Number of batteries arranged serially

<table>
<thead>
<tr>
<th>Number of batteries</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 6</td>
<td>1.0 V</td>
</tr>
<tr>
<td>7 to 12</td>
<td>1.1 V</td>
</tr>
</tbody>
</table>

(Please note that stainless steel generally results in high contact resistance.)
PRECAUTIONS FOR DESIGNING DEVICES WITH NI-MH BATTERIES

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
Ni-MH batteries are classified as no dangerous goods under IMDG-Code 34-08 (International Maritime Dangerous Goods Code), valid until 31.12.2011. From 01.01.2012 new UN 3496 takes place under IMDG-Code 35-10 with Special Provision 963. Ni-MH batteries are then 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 Organization) document is required.

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

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.

PRODUCT SAFETY DATA SHEET

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 HHR-*****

Substance identification
Substance: Nickel-Metal-Hydride Storage Battery
CAS No.: Not Specified.
UN Class: Classified as UN3028, but they are exempted from Dangerous Goods pursuant to UN Special Provision as below. Not restricted, as per Special Provision A123

[Especial Provision 304] [UN Recommendations on the TRANSPORT OF DANGEROUS GOODS Model Regulations Volume 1. 15th 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
- ICAO Technical Instructions for the Safe transport of dangerous goods by air
- IATA (A123) for air shipment and IMDG (Special Provision) for sea shipment under UN3028

Others

References
- Ni-Cd, Ni-MH Panasonic Catalogue and technical handbook.
- MSDS of Nickel hydro oxide and potassium hydro oxide and sodium hydro oxide from supplier.
- Recommendations on the TRANSPORT OF DANGEROUS GOODS Model Regulations Volume 1. 15th revised edition.

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

** The aforementioned PSDS is only an extract. Please contact Panasonic to get the complete version.
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 nowadays 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 13. 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 charged.

APPLICATIONS

Panasonic Ni-MH batteries can either be used for standard applications with a moderate ambient temperature or for applications which requires high temperature resistance.

Standard ambient temperature

E-Bikes, Pedelecs, Scooters, Golf-Trolleys, Power tools, Grape Cutters, Multimeters, Voting Machine, Barcode Readers, Handheld Scanners, Labelprinters, Vacuum Cleaners, Muscle Electro-Stimulations, Toothbrushes, etc.

High temperature resistance (for back-up use)

Combined Solar Applications, Portable Medical Devices, POS Terminals, Emergency Light for buildings and trains, Elevator Safety Systems, etc.

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 20 years to the discovery of NiFe, MgNi and LaNi5 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.], ABxZnMnx, etc., ABx[LaNix, etc.] and A:B [Mg:Ni, etc.]. From the perspective of charge and discharge efficiency and durability, the field of candidate metals suited for use as electrodes in storage batteries is now being narrowed down to ABx type alloys in which rare-earth metals, especially metals in the lanthanum group, and nickel serve as the host metals; and to ABx type alloys in which the titanium and nickel serve as the host metals. Panasonic is now focusing its attention on ABx type alloys which feature high capacity, excellent charge and discharge efficiency, and excellent cycle life. It has developed, and is now employing its own MnNi5 alloy which uses Mn (misch metal – an alloy consisting of a mixture of rare-earth elements) for metal A.

 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.

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 17-18.

Charge characteristics

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

Charge temperature characteristics at 1C charge

Discharge temperature characteristics at 1C discharge

Cycle life equivalent to 500 charge and discharge cycles

Like Ni-Cd batteries, Ni-MH batteries can be repeatedly charged and discharged for about 500 cycles. (example: IEC charge and discharge conditions)

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.

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Discharge characteristics

Charge temperature characteristics at 1C charge

Discharge temperature characteristics at 1C discharge
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.

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 and other conditions of use. These characteristics and restoration characteristics after long-term storage.

5. Safety

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

6. 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 prolonged 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 prevent malfunctioning, 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 8°C or over 60°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. ∆V 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. ∆t/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), 58°C (forAAA 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 10 min. This prevents the - ∆V detection circuit from being activated for a specific period of time after rapid charge has commenced. However, the ∆t/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 - ∆V) when they have been left 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 - ∆V.

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: 60 min.

11. Rapid charge timer: 90 min. (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.
CHARGE METHODS FOR NI-MH BATTERIES

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.

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

The optimal charge system for the Ni-MH “H” Series for back-up power applications is an intermittent timer charge. An intermittent timer charge improves charge efficiency, extends battery life (i.e. trickle charge) and reduces electricity consumption up to 30% compared to trickle charge.¹⁴

#### Interimmitent timer charge:

- [See diagram] At the beginning of the charge, an IC timer is started and charging is activated at a current of 0.1ltA 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

1. Rapid charge current
   - Max. 1CmA to 0.5CmA
2. Rapid charge transition voltage
   - 0.2 to 0.3CmA
3. Rapid charge start voltage
   - Approx. 0.8V/cell
4. Charge terminating voltage
   - 1.8V/cell
5. dT/dt value
   - 5 to 2°C/min
6. Battery temperature rising rate
   - dT/dt value
7. Maximum battery temperature
   - TCO 60°C (for L-A, L-fatA and SC size)
8. Battery temperature rising rate
   - 1 to 2°C/min
9. Trickle current (after rapid charge)
   - 0.033 to 0.05CmA
10. Initial -∆V detection disabling timer
    - 5 to 10 min
11. Rapid charge timer
    - 90 min (at 1CmA charge)
12. Total timer
    - 10 to 20 hours
13. Rapid charge temperature range
    - 0° to 40°C

### Recommended Ni-MH battery charge system

<table>
<thead>
<tr>
<th>No.</th>
<th>Charge item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rapid charge current</td>
<td>Max. 1CmA to 0.5CmA</td>
</tr>
<tr>
<td>2</td>
<td>Rapid charge transition voltage</td>
<td>0.2 to 0.3CmA</td>
</tr>
<tr>
<td>3</td>
<td>Rapid charge start voltage</td>
<td>Approx. 0.8V/cell</td>
</tr>
<tr>
<td>4</td>
<td>Charge terminating voltage</td>
<td>1.8V/cell</td>
</tr>
<tr>
<td>5</td>
<td>dT/dt value</td>
<td>5 to 2°C/min</td>
</tr>
<tr>
<td>6</td>
<td>Battery temperature rising rate</td>
<td>dT/dt value</td>
</tr>
<tr>
<td>7</td>
<td>Maximum battery temperature</td>
<td>TCO 60°C (for L-A, L-fatA and SC size)</td>
</tr>
<tr>
<td>8</td>
<td>Battery temperature rising rate</td>
<td>1 to 2°C/min</td>
</tr>
<tr>
<td>9</td>
<td>Trickle current (after rapid charge)</td>
<td>0.033 to 0.05CmA</td>
</tr>
<tr>
<td>10</td>
<td>Initial -∆V detection disabling timer</td>
<td>5 to 10 min</td>
</tr>
<tr>
<td>11</td>
<td>Rapid charge timer</td>
<td>90 min (at 1CmA charge)</td>
</tr>
<tr>
<td>12</td>
<td>Total timer</td>
<td>10 to 20 hours</td>
</tr>
<tr>
<td>13</td>
<td>Rapid charge temperature range</td>
<td>0° to 40°C</td>
</tr>
</tbody>
</table>

### Example of a rapid charge system

- [Diagram showing charge current, voltage, and temperature over time]

### Basic pack configuration circuit

- [Diagram showing battery, thermal protector, and temperature sensor]

### Battery Selection

#### The Steps for Selecting a Type of Battery for Use as the Power Supply of a Device Are Shown Below:

Study of the proposed required specifications

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

Battery selection

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

#### Technological Factors Concerning Battery Selection

<table>
<thead>
<tr>
<th>Electrical characteristics</th>
<th>Charge conditions</th>
<th>Temperature and humidity conditions</th>
<th>Size, weight and terminal type</th>
<th>Battery life</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>Rapid charge</td>
<td>Temperature and humidity during use</td>
<td>Diameter [mm] max.</td>
<td>Operating life</td>
<td>Atmosphere pressure</td>
</tr>
<tr>
<td>V max. _______ V min.</td>
<td>trickle float charge</td>
<td>_____________ °C max. _____________ °C min.</td>
<td>Height [mm] max.</td>
<td>Storage period</td>
<td>Mechanical conditions</td>
</tr>
<tr>
<td>Load pattern</td>
<td>Charge time</td>
<td>_____________ % max. _____________ % min.</td>
<td>Length [mm] max.</td>
<td>_____________</td>
<td>Safety</td>
</tr>
<tr>
<td>Continuous load</td>
<td>Charge temperature and atmosphere</td>
<td>_____________ % max. _____________ % min.</td>
<td>Width [mm] max.</td>
<td>_____________</td>
<td>Interchangability</td>
</tr>
<tr>
<td>_____________ mA (max.)</td>
<td>_____________ °C max. _____________ °C min.</td>
<td>_____________</td>
<td>Max. _____________</td>
<td>Moisture resistance</td>
<td></td>
</tr>
<tr>
<td>_____________ mA (min.)</td>
<td>_____________ % max. _____________ % min.</td>
<td>_____________</td>
<td>_____________</td>
<td>Price</td>
<td></td>
</tr>
<tr>
<td>_____________ mA (av.)</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>_____________ mA (max.)</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>_____________ mA (min.)</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>Intermitent load/pulse load</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>_____________ mA (max.)</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
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<td>_____________</td>
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<tr>
<td>_____________ mA (min.)</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>_____________ mA (av.)</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>Current pattern</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>_____________ V max.</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
<tr>
<td>_____________ V min.</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
<td>_____________</td>
</tr>
</tbody>
</table>

¹ Matching test is required because these values vary depending on rapid charge current, number of cells, configuration of battery pack, etc.

¹⁴ Trickle charge is not recommended in general for Ni-MH batteries. Please consult Panasonic on any Ni-MH applications requiring trickle charge.
### CYLINDRICAL TABLE

<table>
<thead>
<tr>
<th>Model</th>
<th>Diameter</th>
<th>Size</th>
<th>Nominal voltage (V)</th>
<th>Discharge capacity** (mAh)</th>
<th>Dimensions with tube (mm)</th>
<th>Approx. weight (g)</th>
<th>IEC</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHR-70AAA/FT</td>
<td>AAA</td>
<td>AAA</td>
<td>1.2</td>
<td>700</td>
<td>700</td>
<td>10.6 ±0.7</td>
<td>144 ±0.1 ±1.0</td>
<td>12</td>
</tr>
<tr>
<td>HHR-78AAA/HT**</td>
<td>AAA</td>
<td>AAA</td>
<td>1.2</td>
<td>700</td>
<td>700</td>
<td>10.6 ±0.7</td>
<td>144 ±0.1 ±1.0</td>
<td>12</td>
</tr>
<tr>
<td>HHR-35AAA/FT</td>
<td>A</td>
<td>1/2AAA</td>
<td>1.2</td>
<td>350</td>
<td>14.6 ±0.7</td>
<td>26.5 ±1.0</td>
<td>10.5</td>
<td>21</td>
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<td>HHR-120AAA/FT</td>
<td>A</td>
<td>1/6AAA</td>
<td>1.2</td>
<td>1,150</td>
<td>14.6 ±0.7</td>
<td>43.0 ±1.0</td>
<td>23</td>
<td>HHR15/43 25</td>
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<tr>
<td>HHR-70AA/FT</td>
<td>AA</td>
<td>AA</td>
<td>1.2</td>
<td>700</td>
<td>14.6 ±0.7</td>
<td>48.8 ±1.5</td>
<td>21</td>
<td>HHR15/43 26</td>
</tr>
<tr>
<td>HHR-70AAA/HT**</td>
<td>AA</td>
<td>AA</td>
<td>1.2</td>
<td>700</td>
<td>14.6 ±0.7</td>
<td>56.5 ±1.5</td>
<td>21</td>
<td>HHR15/43 27</td>
</tr>
<tr>
<td>HHR-110AA/FT</td>
<td>AA</td>
<td>AA</td>
<td>1.2</td>
<td>1,100</td>
<td>14.6 ±0.7</td>
<td>56.0 ±1.0</td>
<td>24</td>
<td>HHR15/51 28</td>
</tr>
<tr>
<td>HHR-159AA/FT</td>
<td>AA</td>
<td>AA</td>
<td>1.2</td>
<td>1,500</td>
<td>14.6 ±0.7</td>
<td>56.0 ±1.0</td>
<td>24</td>
<td>HHR15/51 29</td>
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<tr>
<td>HHR-70AAA/HT**</td>
<td>AA</td>
<td>AA</td>
<td>1.2</td>
<td>2,100</td>
<td>14.6 ±0.7</td>
<td>56.0 ±1.0</td>
<td>29</td>
<td>HHR15/51 30</td>
</tr>
<tr>
<td>HHR-200AA/FT</td>
<td>A</td>
<td>L-ZA</td>
<td>1.2</td>
<td>2,000</td>
<td>17.0 ±0.7</td>
<td>61.0 ±1.5</td>
<td>32</td>
<td>HHR17/42 31</td>
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<tr>
<td>HHR-210AA/FT</td>
<td>A</td>
<td>A</td>
<td>1.2</td>
<td>2,200</td>
<td>17.0 ±0.7</td>
<td>50.0 ±1.5</td>
<td>38</td>
<td>HHR17/50 32</td>
</tr>
<tr>
<td>HHR-380AA/FT</td>
<td>A</td>
<td>L-A</td>
<td>1.2</td>
<td>3,700</td>
<td>17.0 ±0.7</td>
<td>67.0 ±1.5</td>
<td>53</td>
<td>HHR17/47 33</td>
</tr>
<tr>
<td>HHR-450AA/FT</td>
<td>A</td>
<td>L-FCA</td>
<td>1.2</td>
<td>4,500</td>
<td>17.0 ±0.7</td>
<td>70.0 ±1.5</td>
<td>65</td>
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<tr>
<td>HHR-200SCP/FT*</td>
<td>SC</td>
<td>L-ZC</td>
<td>1.2</td>
<td>2,100</td>
<td>21.0 ±1.0</td>
<td>40.0 ±1.5</td>
<td>63</td>
<td>-</td>
</tr>
<tr>
<td>HHR-210SCP/FT*</td>
<td>SC</td>
<td>SC</td>
<td>1.2</td>
<td>2,600</td>
<td>21.0 ±1.0</td>
<td>41.0 ±1.5</td>
<td>55</td>
<td>HHR23/43 36</td>
</tr>
<tr>
<td>HHR-300SCP/FT*</td>
<td>SC</td>
<td>SC</td>
<td>1.2</td>
<td>3,000</td>
<td>21.0 ±1.0</td>
<td>43.0 ±1.5</td>
<td>57</td>
<td>HHR23/42 37</td>
</tr>
</tbody>
</table>

### CYLINDRICAL FOR BACK-UP USE (HIGH TEMPERATURE TYPE)

<table>
<thead>
<tr>
<th>Model</th>
<th>Diameter</th>
<th>Size</th>
<th>Nominal voltage (V)</th>
<th>Discharge capacity** (mAh)</th>
<th>Dimensions with tube (mm)</th>
<th>Approx. weight (g)</th>
<th>IEC</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHR-70AAA/FT</td>
<td>AAA</td>
<td>AAA</td>
<td>1.2</td>
<td>700</td>
<td>700</td>
<td>10.6 ±0.7</td>
<td>144 ±0.1 ±1.0</td>
<td>18</td>
</tr>
<tr>
<td>HHR-70AA/FT</td>
<td>AA</td>
<td>AA</td>
<td>1.2</td>
<td>700</td>
<td>700</td>
<td>10.6 ±0.7</td>
<td>144 ±0.1 ±1.0</td>
<td>18</td>
</tr>
<tr>
<td>HHR-210AA/FT</td>
<td>A</td>
<td>A</td>
<td>1.2</td>
<td>1,900</td>
<td>17.0 ±0.7</td>
<td>56.0 ±1.5</td>
<td>36</td>
<td>HHR17/50 40</td>
</tr>
<tr>
<td>HHR-330AAH/FT**</td>
<td>A</td>
<td>L-FCA</td>
<td>1.2</td>
<td>3,200</td>
<td>18.2 ±0.7</td>
<td>67.0 ±1.5</td>
<td>65</td>
<td>-</td>
</tr>
<tr>
<td>HHR-370AAH/FT**</td>
<td>A</td>
<td>L-FCA</td>
<td>1.2</td>
<td>3,700</td>
<td>18.2 ±0.7</td>
<td>67.0 ±1.5</td>
<td>65</td>
<td>-</td>
</tr>
<tr>
<td>HHR-250CH/FT**</td>
<td>SC</td>
<td>SC</td>
<td>1.2</td>
<td>2,600</td>
<td>21.0 ±1.0</td>
<td>41.0 ±1.5</td>
<td>55</td>
<td>HHR23/43 43</td>
</tr>
<tr>
<td>HHR-300CH/FT**</td>
<td>C</td>
<td>C</td>
<td>1.2</td>
<td>3,000</td>
<td>21.0 ±1.0</td>
<td>43.0 ±1.5</td>
<td>57</td>
<td>HHR23/42 44</td>
</tr>
</tbody>
</table>

### E-BLOCK TABLE

<table>
<thead>
<tr>
<th>Model</th>
<th>Diameter</th>
<th>Nominal voltage (V)</th>
<th>Discharge capacity** (mAh)</th>
<th>Dimensions with tube (mm)</th>
<th>Approx. weight (g)</th>
<th>IEC</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHR-159SC/BA</td>
<td>E-Block</td>
<td>8.4</td>
<td>175</td>
<td>170</td>
<td>26.0</td>
<td>45.5</td>
<td>16.3</td>
</tr>
</tbody>
</table>

Model number (example)

HHR-60AAA/HT/F
- 6: Nominal charge current: 60mA
- 0: Non-chargeable
- AAA: Type AAA
- F: For 1V model only

### HHR-70AAA/FT CYLINDRICAL AAA SIZE (HR11/45)

#### DIMENSIONS (mm)

- **Diameter:** 10.5 mm
- **Height:** 45.0 mm

#### TYPICAL CHARGE CHARACTERISTICS

- **Nominal Voltage:** 1.2 V
- **Discharge Capacity:** 730 mAh

#### TYPICAL DISCHARGE CHARACTERISTICS

- **Nominal Voltage:** 1.2 V
- **Discharge Current:** 1,000 mA
- **Temperature:** 20°C

#### SPECIFICATIONS

- **Name:** HHR-70AAA/FT
- **Diameter (mm):** 10.5 ±0.7
- **Height (mm):** 44.5 ±1.0
- **Approximate weight (g):** 12
- **Nominal Voltage (V):** 1.2
- **Discharge Capacity:** Average** (mAh) 730
- **Rated (min) (mAh):** 700
- **Approx. Internal Impedance:** 1,000Hz at charged state (mΩ)
- **Charge:** Standard (mA x hrs.) 70 x 14
- **Charge:** Standard (°C) 0 to +5
- **Discharge (°C):** Rapid (°C) 0 to +40
- **Discharge (°C):** Rapid (°C) -10 to +65
- **Storage:** <6 months 20°C
- **Storage:** <6 months -20°C

* After charging at 0.1It for 16 hours, discharging at 0.2CmA.
* For reference only.
* 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 maximize 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.
HHR-75AAA/HT  CYLINDRICAL AAA SIZE (HR11/45)

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-75AAA/HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>10.5 ±0.7</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>44.5 ±0.6</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity</td>
<td>730</td>
</tr>
<tr>
<td>Rated/min. (mAh)</td>
<td>7000</td>
</tr>
<tr>
<td>Approx. internal impedancel at charged state (mΩ)</td>
<td>35</td>
</tr>
<tr>
<td>Charge (°C)</td>
<td>-10 to +65</td>
</tr>
<tr>
<td>Discharge (°C)</td>
<td>-20 to +35</td>
</tr>
<tr>
<td>Storage (°C)</td>
<td>-20 to +35</td>
</tr>
</tbody>
</table>

**TYPICAL CHARGE CHARACTERISTICS**

Charge: 450mA(0.64 It) ≤ 1.9Vn.
Discharge temperature: 20°C

**TYPICAL DISCHARGE CHARACTERISTICS**

Discharge: 0.2lt A to 1.0V

---

HHR-80AAA/HT  CYLINDRICAL AAA SIZE (HR11/45)

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-80AAA/HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>10.5 ±0.7</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>44.5 ±0.6</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity</td>
<td>780</td>
</tr>
<tr>
<td>Rated/min. (mAh)</td>
<td>7000</td>
</tr>
<tr>
<td>Approx. internal impedancel at charged state (mΩ)</td>
<td>65</td>
</tr>
<tr>
<td>Charge (°C)</td>
<td>-10 to +65</td>
</tr>
<tr>
<td>Discharge (°C)</td>
<td>-20 to +35</td>
</tr>
<tr>
<td>Storage (°C)</td>
<td>-20 to +35</td>
</tr>
</tbody>
</table>

**TYPICAL CHARGE CHARACTERISTICS**

Charge: 1.0 lt-5mV ≤ 1.0Vn.
Discharge temperature: 0, 20, 45°C

**TYPICAL DISCHARGE CHARACTERISTICS**

Discharge: 0.2lt A to 1.0V

---

**Note:**
- After charging at 1.0 It for 16 hours, discharging at 0.2 It.
- For reference only.
- 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 maximize 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.

---

HHR-75AAA/HT  CYLINDRICAL AAA SIZE (HR11/45)

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-75AAA/HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>10.5 ±0.7</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>44.5 ±0.6</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>1.2</td>
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<tr>
<td>Discharge capacity</td>
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<td>Rated/min. (mAh)</td>
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<tr>
<td>Approx. internal impedancel at charged state (mΩ)</td>
<td>35</td>
</tr>
<tr>
<td>Charge (°C)</td>
<td>-10 to +65</td>
</tr>
<tr>
<td>Discharge (°C)</td>
<td>-20 to +35</td>
</tr>
<tr>
<td>Storage (°C)</td>
<td>-20 to +35</td>
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</table>

**TYPICAL CHARGE CHARACTERISTICS**

Charge: 450mA(0.64 It) ≤ 1.9Vn.
Discharge temperature: 20°C

**TYPICAL DISCHARGE CHARACTERISTICS**

Discharge: 0.2lt A to 1.0V

---

HHR-80AAA/HT  CYLINDRICAL AAA SIZE (HR11/45)

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-80AAA/HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>10.5 ±0.7</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>44.5 ±0.6</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity</td>
<td>780</td>
</tr>
<tr>
<td>Rated/min. (mAh)</td>
<td>7000</td>
</tr>
<tr>
<td>Approx. internal impedancel at charged state (mΩ)</td>
<td>65</td>
</tr>
<tr>
<td>Charge (°C)</td>
<td>-10 to +65</td>
</tr>
<tr>
<td>Discharge (°C)</td>
<td>-20 to +35</td>
</tr>
<tr>
<td>Storage (°C)</td>
<td>-20 to +35</td>
</tr>
</tbody>
</table>

**TYPICAL CHARGE CHARACTERISTICS**

Charge: 1.0 lt-5mV ≤ 1.0Vn.
Discharge temperature: 0, 20, 45°C

**TYPICAL DISCHARGE CHARACTERISTICS**

Discharge: 0.2lt A to 1.0V

---

**Note:**
- After charging at 1.0 It for 16 hours, discharging at 0.2 It.
- For reference only.
- Need specially designed control system. Please contact Panasonic for details.

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**HHR-35AA/FT** CYLINDRICAL 2/3AA SIZE

**DIMENSIONS (MM)**

- Diameter: 14.5 ± 0.7
- Height: 28.5 ± 1.0
- Approximate weight: 18.5 g

**SPECIFICATIONS**

- **Name**: HHR-35AA/FT
- **Nominal voltage**: 1.2 V
- **Diameter**: 14.5 ± 0.7 mm
- **Height**: 28.5 ± 1.0 mm
- **Approximate weight**: 18.5 g
- **Discharge capacity**
  - Average*: 390 mAh
  - Rated/min. (mAh): 390 mAh
- **Approx. internal impedance**: 30 mΩ
- **Charge**
  - Standard: 35 ± 14 mA (mA x hrs.)
  - Rapid*: 390 ± 1.2 mA (mA x hrs.)
  - Charge (°C)
    - Standard: -10 to +65°C
    - Rapid: 0 to +60°C
- **Discharge**
  - Temperature: 20°C
  - Storage (°C)
    - <1 year: -20 to +35°C
    - <6 months: -20 to +65°C
- **Charge time**
  - Standard: 1.2 hrs.
  - Rapid*: 1.2 hrs.
- **Discharge time**
  - Standard: 1.2 hrs.
  - Rapid*: 1.2 hrs.

* After charging at 0.1I for 16 hours, discharging at 0.2I.

**HHR-120AA/FT** CYLINDRICAL 4/5AA SIZE (HHR15/43)

**DIMENSIONS (MM)**

- Diameter: 14.5 ± 0.7
- Height: 42.0 ± 0.6
- Approximate weight: 43.0 ± 0.7 g

**SPECIFICATIONS**

- **Name**: HHR-120AA/FT
- **Nominal voltage**: 1.2 V
- **Diameter**: 14.5 ± 0.7 mm
- **Height**: 42.0 ± 0.6 mm
- **Approximate weight**: 43.0 ± 0.7 g
- **Discharge capacity**
  - Average*: 1,220 mAh
  - Rated/min. (mAh): 1,150 mAh
- **Approx. internal impedance**: 30 mΩ
- **Charge**
  - Standard: 120 ± 14 mA (mA x hrs.)
  - Rapid*: 1,200 ± 1.2 mA (mA x hrs.)
  - Charge (°C)
    - Standard: 0 to +65°C
    - Rapid: 0 to +60°C
- **Discharge**
  - Temperature: 20°C
  - Storage (°C)
    - <1 year: -20 to +35°C
    - <6 months: -20 to +65°C
- **Charge time**
  - Standard: 1.2 hrs.
  - Rapid*: 1.2 hrs.
- **Discharge time**
  - Standard: 1.2 hrs.
  - Rapid*: 1.2 hrs.

* After charging at 0.1I for 16 hours, discharging at 0.2I.
**HHR-70AA/FT**  CYLINDRICAL AA SIZE (HR15/49)

### Dimensions [mm]

**ø14.5, 0.7**

Height (mm): 50.5 +0/-1.5

### Specifications

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-70AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>14.5 +0/-0.7</td>
</tr>
<tr>
<td>Approximate weight (g)</td>
<td>26</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity**</td>
<td>Average** (mAh) 780</td>
</tr>
<tr>
<td></td>
<td>Rated/min. (mAh) 700</td>
</tr>
<tr>
<td>Approx. internal impedanc**</td>
<td>1,000kHz at charged state (mΩ) 25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Charge</th>
<th>Standard (mA x hrs.) 700 x 1.2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge (°C)</td>
<td>Rapid 0 to +65</td>
</tr>
<tr>
<td>Discharge (°C)</td>
<td>&lt;1 year -20 to +35</td>
</tr>
<tr>
<td>Storage (°C)</td>
<td>&lt;6 months -20 to +65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discharge</th>
<th>Standard (mA x hrs.) 700 x 1.2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge time (minutes)</td>
<td>60</td>
</tr>
<tr>
<td>Discharge temperature: 20°C</td>
<td></td>
</tr>
</tbody>
</table>

*3 Need specially designed control system. Please contact Panasonic for details.

*2 For reference only.

*1 After charging at 0.1It for 16 hours, discharging at 0.2It.

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---

**HHR-70AA/HT**  CYLINDRICAL AA SIZE (HR15/49)

### Dimensions [mm]

**ø14.5, 0.7**

Height (mm): 50.5 +0/-1.5

### Specifications

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-70AA/HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>14.5 +0/-0.7</td>
</tr>
<tr>
<td>Approximate weight (g)</td>
<td>26</td>
</tr>
<tr>
<td>Nominal voltage (V)</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity**</td>
<td>Average** (mAh) 780</td>
</tr>
<tr>
<td></td>
<td>Rated/min. (mAh) 700</td>
</tr>
<tr>
<td>Approx. internal impedanc**</td>
<td>1,000kHz at charged state (mΩ) 25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Charge</th>
<th>Standard (mA x hrs.) 700 x 1.2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge (°C)</td>
<td>Rapid 0 to +65</td>
</tr>
<tr>
<td>Discharge (°C)</td>
<td>&lt;1 year -20 to +35</td>
</tr>
<tr>
<td>Storage (°C)</td>
<td>&lt;6 months -20 to +65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discharge</th>
<th>Standard (mA x hrs.) 700 x 1.2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge time (minutes)</td>
<td>60</td>
</tr>
<tr>
<td>Discharge temperature: 20°C</td>
<td></td>
</tr>
</tbody>
</table>

*3 Need specially designed control system. Please contact Panasonic for details.

*2 For reference only.

*1 After charging at 0.1It for 16 hours, discharging at 0.2It.

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---

**HHR-110AA/FT CYLINDRICAL AA SIZE (HR15/51)**

**DIMENSIONS [MM]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-110AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter [mm]</td>
<td>14.5 ±0.7</td>
</tr>
<tr>
<td>Height [mm]</td>
<td>50.5 ±0.5</td>
</tr>
<tr>
<td>Approximate weight [g]</td>
<td>26</td>
</tr>
</tbody>
</table>

**Nominal voltage [V]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-110AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td></td>
</tr>
</tbody>
</table>

**Discharge capacity [Ah]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-110AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1,100</td>
</tr>
<tr>
<td>Rate/min.</td>
<td>1,100</td>
</tr>
</tbody>
</table>

**Approx. internal impedance 1,000Hz at charged state [mΩ]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-110AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**Charge**

<table>
<thead>
<tr>
<th>Standard (mA x hrs.)</th>
<th>110 x 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid (mA x hrs.)</td>
<td>1,100 x 1.2</td>
</tr>
</tbody>
</table>

**Charge temperature**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-110AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0 to +45</td>
</tr>
<tr>
<td>Rapid</td>
<td>0 to +45</td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>-10 to +65</td>
</tr>
<tr>
<td>&lt;5 months</td>
<td>-20 to +35</td>
</tr>
<tr>
<td>&lt;1 month</td>
<td>-20 to +35</td>
</tr>
</tbody>
</table>

**TYPICAL CHARGE CHARACTERISTICS**

Charge: 1,100mA(1 It) x 1.2hrs. 20°C

Discharge temperature: 20°C

**TYPICAL DISCHARGE CHARACTERISTICS**

Charge: 1,100mA(1 It) x 1.2hrs. 20°C

Discharge temperature: 20°C

---

**HHR-150AA/FT CYLINDRICAL AA SIZE (HR15/51)**

**DIMENSIONS [MM]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-150AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter [mm]</td>
<td>14.5 ±0.7</td>
</tr>
<tr>
<td>Height [mm]</td>
<td>60.5 ±0.5</td>
</tr>
<tr>
<td>Approximate weight [g]</td>
<td>26</td>
</tr>
</tbody>
</table>

**Nominal voltage [V]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-150AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td></td>
</tr>
</tbody>
</table>

**Discharge capacity [Ah]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-150AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>3,300</td>
</tr>
<tr>
<td>Rate/min.</td>
<td>3,300</td>
</tr>
</tbody>
</table>

**Approx. internal impedance 1,000Hz at charged state [mΩ]**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-150AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

**Charge**

<table>
<thead>
<tr>
<th>Standard (mA x hrs.)</th>
<th>150 x 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid (mA x hrs.)</td>
<td>1,500 x 1.2</td>
</tr>
</tbody>
</table>

**Charge temperature**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-150AA/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0 to +45</td>
</tr>
<tr>
<td>Rapid</td>
<td>0 to +45</td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>-10 to +65</td>
</tr>
<tr>
<td>&lt;5 months</td>
<td>-20 to +35</td>
</tr>
<tr>
<td>&lt;1 month</td>
<td>-20 to +35</td>
</tr>
</tbody>
</table>

**TYPICAL CHARGE CHARACTERISTICS**

Charge: 1,500mA(1 It) x 1.2hrs. 20°C

Discharge temperature: 20°C

**TYPICAL DISCHARGE CHARACTERISTICS**

Charge: 1,500mA(1 It) x 1.2hrs. 20°C

Discharge temperature: 20°C

---

* After charging at 1.1It for 14 hours, discharging at 2.2It.
* For reference only.
* Need specially designed control system. Please contact Panasonic for details.
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**HHR-210AA/HT**  CYLINDRICAL AA SIZE (HR15/51)

### Dimensions [mm]
- Diameter: 14.5 ±0/-0.7
- Height: 50.5 ±0/-1.0
- Approximate weight: 29

### Specifications
- **Name**: HHR-210AA/HT
- **Nominal Voltage (V)**: 1.2
- **Discharge Capacity**: Average (mAh)
  - Standard: 2,000
  - Rapid: 2,080
- **Rated/Min. (mAh)**: 2,000
- **Approx. Internal Impedance @ 1,000Hz at Charged state (mΩ)**: 20

### Typical Charge Characteristics
- **Charge**: 1200mA x 2hrs. @ 20°C
- **Charge temperature**: 20°C

### Typical Discharge Characteristics
- **Discharge**: 1200mA x 2hrs. @ 20°C
- **Discharge temperature**: 20°C

**Note:**
- *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.

**HHR-200A/FT**  CYLINDRICAL 4/5A SIZE (HR17/43)

### Dimensions [mm]
- Diameter: 17.0 ±0/-0.7
- Height: 43.0 ±0/-1.5
- Approximate weight: 32

### Specifications
- **Name**: HHR-200A/FT
- **Nominal Voltage (V)**: 1.2
- **Discharge Capacity**: Average (mAh)
  - Standard: 2,000
  - Rapid: 2,080
- **Rated/Min. (mAh)**: 2,000
- **Approx. Internal Impedance @ 1,000Hz at Charged state (mΩ)**: 20

### Typical Charge Characteristics
- **Charge**: 1700mA (0.85It) x 1.4hrs. @ 20°C
- **Charge temperature**: 20°C

### Typical Discharge Characteristics
- **Discharge**: 1700mA (0.85It) x 1.4hrs. @ 20°C
- **Discharge temperature**: 20°C

**Note:**
- *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.
**INDIVIDUAL DATA SHEETS**

### HHR-210A/FT CYLINDRICAL A SIZE (HR17/50)

**DIMENSIONS (MM)**

![Dimensions Diagram](image)

**TYPICAL CHARGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>0.8</th>
<th>1.0</th>
<th>1.1</th>
<th>1.3</th>
<th>1.3</th>
<th>1.5</th>
<th>1.4</th>
<th>1.6</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge time (minutes)</td>
<td>2100</td>
<td>1600</td>
<td>1200</td>
<td>900</td>
<td>800</td>
<td>720</td>
<td>600</td>
<td>450</td>
<td>360</td>
</tr>
<tr>
<td>Discharge temperature</td>
<td>20°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TYPICAL DISCHARGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>0.8</th>
<th>0.9</th>
<th>1.1</th>
<th>1.3</th>
<th>1.3</th>
<th>1.5</th>
<th>1.4</th>
<th>1.6</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge time (minutes)</td>
<td>2100</td>
<td>1600</td>
<td>1200</td>
<td>900</td>
<td>800</td>
<td>720</td>
<td>600</td>
<td>450</td>
<td>360</td>
</tr>
<tr>
<td>Discharge temperature</td>
<td>20°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

- **Name**: HHR-210A/FT
- **Diameter (mm)**: 17.0 ± 0.7
- **Height (mm)**: 50.0 ± 1.5
- **Approximate weight (g)**: 33
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**:
  - Average (mAh): 2200
  - Rated/min. (mAh): 2100
- **Approx. internal impedance at 1000Hz at charged state (mΩ)**: 20

**Notes**:

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

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### HHR-380A/FT CYLINDRICAL L-A SIZE (HR17/67)

**DIMENSIONS (MM)**

![Dimensions Diagram](image)

**TYPICAL CHARGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>0.8</th>
<th>0.9</th>
<th>1.1</th>
<th>1.3</th>
<th>1.3</th>
<th>1.5</th>
<th>1.4</th>
<th>1.6</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge time (minutes)</td>
<td>2000</td>
<td>1600</td>
<td>1200</td>
<td>900</td>
<td>800</td>
<td>720</td>
<td>600</td>
<td>450</td>
<td>360</td>
</tr>
<tr>
<td>Discharge temperature</td>
<td>20°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TYPICAL DISCHARGE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>0.8</th>
<th>0.9</th>
<th>1.1</th>
<th>1.3</th>
<th>1.3</th>
<th>1.5</th>
<th>1.4</th>
<th>1.6</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge time (minutes)</td>
<td>2000</td>
<td>1600</td>
<td>1200</td>
<td>900</td>
<td>800</td>
<td>720</td>
<td>600</td>
<td>450</td>
<td>360</td>
</tr>
<tr>
<td>Discharge temperature</td>
<td>20°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

- **Name**: HHR-380A/FT
- **Diameter (mm)**: 17.0 ± 0.7
- **Height (mm)**: 67.0 ± 1.5
- **Approximate weight (g)**: 53
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**:
  - Average (mAh): 3800
  - Rated/min. (mAh): 3700
- **Approx. internal impedance at 1000Hz at charged state (mΩ)**: 25

**Notes**:

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

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## HHR-450A/FT

**Cylindrical LFAT/A Size**

### Dimensions (mm)
- Diameter: 18.2 ± 0.7
- Height: 67.0 ± 1.5

### Specifications
- **Name**: HHR-450A/FT
- **Diameter (mm)**: 18.2 ± 0.7
- **Height (mm)**: 67.0 ± 1.5
- **Approximate weight (g)**: 43
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**
  - Average*: 4,500 mAh
  - Rated/min. (mAh): 2,000 mAh
- **Approx. Internal impedance at 1,000Hz at charged state (mΩ)**: 25
- **Charge**
  - Standard (mAh x hrs.): 630 x 16
  - Rapid* (mAh x hrs.): 2,000 x 1.2
  - Standard: 0 to +45
  - Rapid: 0 to +40
  - Discharge (°C): -10 to +65
  - Storage (°C):<br>  - <1 year: -20 to +35<br>  - <3 months: -20 to +35<br>  - <1 month: -20 to +35
- **Average*2 (mAh)**: 1,200
- **Rated/min. (mAh)**: 1,900
- **Approx. Internal impedance at 1,000Hz at charged state (mΩ)**: 5
- **Charge**
  - Standard (mAh x hrs.): 200 x 16
  - Rapid* (mAh x hrs.): 2,000 x 1.2
  - Standard: 0 to +45
  - Rapid: 0 to +40
  - Discharge (°C): -10 to +65
  - Storage (°C):<br>  - <1 year: -20 to +35<br>  - <3 months: -20 to +35<br>  - <1 month: -20 to +35

---

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

### Typical Charge Characteristics

![HHR-450A/FT Charge Characteristics](image1)

### Typical Discharge Characteristics

![HHR-450A/FT Discharge Characteristics](image2)

## HHR-200SCP/FT

**Cylindrical 4/5 SC Size**

### Dimensions (mm)
- Diameter: 23.0 ± 0.10
- Height: 74.0 ± 1.0

### Specifications
- **Name**: HHR-200SCP/FT
- **Diameter (mm)**: 23.0 ± 0.10
- **Height (mm)**: 74.0 ± 1.0
- **Approximate weight (g)**: 43
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**
  - Average*: 2,100 mAh
  - Rated/min. (mAh): 1,900 mAh
- **Approx. Internal impedance at 1,000Hz at charged state (mΩ)**: 5
- **Charge**
  - Standard (mAh x hrs.): 200 x 16
  - Rapid* (mAh x hrs.): 2,000 x 1.2
  - Standard: 0 to +45
  - Rapid: 0 to +40
  - Discharge (°C): -10 to +65
  - Storage (°C):<br>  - <1 year: -20 to +35<br>  - <3 months: -20 to +35<br>  - <1 month: -20 to +35

---

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

### Typical Charge Characteristics

![HHR-200SCP/FT Charge Characteristics](image3)

### Typical Discharge Characteristics

![HHR-200SCP/FT Discharge Characteristics](image4)
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HHR-260SCP/FT CYLINDRICAL SC SIZE (HR23/43)

**DIMENSIONS (MM)**

- **Diameter (mm)**: 23.0 ± 0.1
- **Height (mm)**: 43.0 ± 0.15
- **Approximate weight (g)**: 5.0

**SPECIFICATIONS**

- **Name**: HHR-260SCP/FT
- **Diameter (mm)**: 23.0 ± 0.1
- **Height (mm)**: 43.0 ± 0.15
- **Approximate weight (g)**: 5.0
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**: Average\*1 (mAh): 2,600, Rated/min. (mAh): 2,450
- **Approx. internal impedance at 1,000Hz at charged state (mΩ)**: 15
- **Charge**: Standard (mA x hrs.) x 1.2hrs. 20°C
- **Discharge**: 2,600mA, 0°C, 20°C, 40°C
- **Adaptation temperature**: 0°C to +45°C
- **Storage temperature**: <1 year, -20°C to +35°C
- **Storage**: <3 months, -20°C to +35°C

\*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.

**TYPICAL CHARGE CHARACTERISTICS**

- **Charge time (minutes)**: 260 x 16
- **Discharge time (minutes)**: 2,450

**TYPICAL DISCHARGE CHARACTERISTICS**

- **Voltage (V)**: 1.2
- **Discharge capacity**: 1.4
- **Discharge time (minutes)**: 1.6

HHR-300SCP/FT CYLINDRICAL SC SIZE (HR23/43)

**DIMENSIONS (MM)**

- **Diameter (mm)**: 23.0 ± 0.1
- **Height (mm)**: 43.0 ± 0.15
- **Approximate weight (g)**: 5.0

**SPECIFICATIONS**

- **Name**: HHR-300SCP/FT
- **Diameter (mm)**: 23.0 ± 0.1
- **Height (mm)**: 43.0 ± 0.15
- **Approximate weight (g)**: 5.0
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**: Average\*1 (mAh): 3,000, Rated/min. (mAh): 2,800
- **Approx. internal impedance at 1,000Hz at charged state (mΩ)**: 4
- **Charge**: Standard (mA x hrs.) x 1.2hrs. 20°C
- **Discharge**: 3,000mA, 0°C, 20°C, 40°C
- **Adaptation temperature**: 0°C to +45°C
- **Storage temperature**: <1 year, -20°C to +35°C
- **Storage**: <3 months, -20°C to +35°C

\*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.

**TYPICAL CHARGE CHARACTERISTICS**

- **Charge time (minutes)**: 300 x 16
- **Discharge time (minutes)**: 3,000 x 1.2

**TYPICAL DISCHARGE CHARACTERISTICS**

- **Voltage (V)**: 1.2
- **Discharge capacity**: 1.4
- **Discharge time (minutes)**: 1.6

**INDIVIDUAL DATA SHEETS**
**HHR-60AAH/FT**  CYLINDRICAL AAA SIZE (HR11/45) FOR BACK-UP USE

### Dimensions (mm)
- **Diameter**: ø10.5 ±0.07
- **Height**: ø4.9 ±0.07

### Specifications
- **Name**: HHR-60AAH/FT
- **Diameter (mm)**: 10.5 ±0.07
- **Height (mm)**: 44.5 ±0.5
- **Approximate weight (g)**: 13
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**: Average 530 mAh; Rated/Min. 530 mAh
- **Approx. internal impedance at 1,000Hz at charged state (mΩ)**: 35
- **Nominal charge current**: Standard: 50mA x 16hrs.
- **High rate**: 17mA x 32hrs.
- **Low rate**: 12.5mA x 16hrs.
- **Charge (°C)**: -10 to 60
- **Discharge (°C)**: -10 to 60
- **Storage (°C)**: 1 year: -10 to +60; < 6 months: -10 to +60

### Typical Charge Characteristics
- **Internal resistance at 1 kHz at charged state**: 1.0mΩ
- **Charge temperature**: -10°C to 60°C
- **Discharge temperature**: 25°C

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### HHR-70AAH/FT  CYLINDRICAL AA SIZE (HR15/4F) FOR BACK-UP USE

### Dimensions (mm)
- **Diameter**: ø14.5 ±0.07
- **Height**: 48.3 ±0.0

### Specifications
- **Name**: HHR-70AAH/FT
- **Diameter (mm)**: 14.5 ±0.07
- **Height (mm)**: 68.3 ±0.5
- **Approximate weight (g)**: 18
- **Nominal voltage (V)**: 1.2
- **Discharge capacity**: Average 790 mAh; Rated/Min. 790 mAh
- **Approx. internal impedance at 1,000Hz at charged state (mΩ)**: 25
- **Nominal charge current**: Standard: 70mA x 16hrs.
- **High rate**: 17mA x 32hrs.
- **Low rate**: 12.5mA x 16hrs.
- **Charge (°C)**: -10°C to 60°C
- **Discharge (°C)**: -10°C to 60°C
- **Storage (°C)**: 1 year: -10°C to +60°C; < 6 months: -10°C to +60°C

### Typical Charge Characteristics
- **Internal resistance at 1 kHz at charged state**: 1.0mΩ
- **Charge temperature**: -10°C to 60°C
- **Discharge temperature**: 25°C

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**HHR-370AH/FT**

**Cylindrical Lf/A Size for Back-up Use**

**Dimensions (mm)**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>HHR-370AH/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>18.2 ø±0.7</td>
</tr>
<tr>
<td>Height</td>
<td>67.0 ø±1.5</td>
</tr>
</tbody>
</table>

**Specifications**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-370AH/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>18.2 ø±0.7</td>
</tr>
<tr>
<td>Height</td>
<td>67.0 ø±1.5</td>
</tr>
<tr>
<td>Approximate weight</td>
<td>60</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity</td>
<td>Average (mAh) 3,700</td>
</tr>
<tr>
<td>Approx. internal impedance 1,000Hz at charged state</td>
<td>20</td>
</tr>
</tbody>
</table>

**Typical Charge Characteristics**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Charge: 250mA x 16hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

**Typical Discharge Characteristics**

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Charge: 250mA x 16hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
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<tr>
<td>1.2</td>
<td></td>
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<tr>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

**HHR-250SCH/FT**

**Cylindrical SC Size (HR23/43) for Back-up Use**

**Dimensions (mm)**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>HHR-250SCH/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>23.0 ø±1.0</td>
</tr>
<tr>
<td>Height</td>
<td>63.0 ø±1.5</td>
</tr>
</tbody>
</table>

**Specifications**

<table>
<thead>
<tr>
<th>Name</th>
<th>HHR-250SCH/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>23.0 ø±1.0</td>
</tr>
<tr>
<td>Height</td>
<td>63.0 ø±1.5</td>
</tr>
<tr>
<td>Approximate weight</td>
<td>55</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>1.2</td>
</tr>
<tr>
<td>Discharge capacity</td>
<td>Average (mAh) 2,600</td>
</tr>
<tr>
<td>Approx. internal impedance 1,000Hz at charged state</td>
<td>5</td>
</tr>
</tbody>
</table>

**Typical Charge Characteristics**

<table>
<thead>
<tr>
<th>Charge (°C)</th>
<th>Standard (mA x hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 to 60</td>
<td>250 x 16</td>
</tr>
<tr>
<td>-10 to +60</td>
<td>1,250 x 2.4</td>
</tr>
<tr>
<td>-10 to +65</td>
<td>83 x 48</td>
</tr>
</tbody>
</table>

**Typical Discharge Characteristics**

<table>
<thead>
<tr>
<th>Discharge temperature</th>
<th>Standard (mA x hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10A, 20A, 25°C</td>
<td>250 x 16</td>
</tr>
<tr>
<td>10A, 20A, 25°C</td>
<td>1,250 x 2.4</td>
</tr>
<tr>
<td>10A, 20A, 25°C</td>
<td>83 x 48</td>
</tr>
</tbody>
</table>

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INDIVIDUAL DATA SHEETS

HHR-300CH/FT

DIMENSIONS (MM)

SPECIFICATIONS

Name

HHR-300CH/FT

Diameter (mm)

26.0 ±0.1

Height (mm)

10.0

50.0 ±0.2

Approximate weight (g)

80

Nominal voltage (V)

1.2

Discharge capacity**

Average*1 (mAh)

3,300

Rated/Min (mAh)

3,100

Approx. internal impedance 1,000Hz at charged state (mΩ)

5

Charge

Standard (mA x hrs.)

300 x 16

Rapid** (mA x hrs.)

1,500 x 2.4

Low rate (mA x hrs.)

190 x 32

100 x 68

Charge (°C)

Rapid

-10 to +60

Low rate

-10 to +60

Discharge (°C)

<1 year

-20 to +35

<6 months

-20 to +65

<1 month

-20 to +65

<1 week

-20 to +65

Storage (°C)

-20 to +65

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BATTERY PACKS

Purpose of packs

For the most part, Ni-MH batteries are used in battery packs when installed in products. When these batteries are used, the type of battery, number of cells, shape of the pack, constituent parts of the pack, etc., are determined by the specifications (voltage, load current) of the product. In addition, the charge specifications, space available in the battery compartment, operating conditions, etc., must also be considered. At Panasonic, we are working on the promotion of battery packs which emphasize the safety and reliability of the batteries. We customize packs in the shapes that satisfy the unique requirements of each of our customers. Do not hesitate to contact us regarding your specific needs.

Shapes of battery packs (Typical & Standard Types)

F Type

The required number of single cells are arranged side by side along their diameter connected by nickel plates and packed together with heat-shrinkable tubing.

Composite F Type

Single cells connected in the F type configuration are further connected in two to five rows and packed together by heat-shrinkable tubing.

L Type

The required number of single cells are arranged in a line in the axis of the batteries connected by connecting plates and packed together by heat-shrinkable tubing.

Composite L Type

Single cells connected in the L type configuration are further connected in two to five rows and packed together by heat-shrinkable tubing.
**Structural-related Items**

**Active Material**
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.

**Electrode**
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. AB₅ type alloy 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 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.

**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 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 1500mAh:

0.1CmA = 0.1 x 1500 = 150mA
0.2CmA = 0.2 x 1500 = 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.

**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.

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

**OTHER TERMS**

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

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

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