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File No. : NCR1850-074

Issue Date: 2024/07/05

LITHIUM ION BATTERY SPECIFICATION

BATTERY CLASSIFICATION	LITHIUM ION BATTERY
PRODUCT CODE	BJ-A800038AA
CLIENT	

Client Agreement:

These documents were received without objection.

Signature: _____

Name in Block Letters: _____

Date: _____

*Please return this document with the signature within 30 days after receiving, or reply the requests of modification.

Product Planning Department
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1 Revision History

No	Date	Class	Description		
(a)	2024/07/05	—	Issue	Dft.	E.Yamamoto
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∗ Legend: A for Added, D for Deleted, R for Revised

2 Safety Instructions

The battery contains flammable materials such as organic solvents. Mishandling the battery may cause fire, smoke, or an explosion and the battery's functionality will be seriously damaged. Protection circuitry must be designed into the application device to protect the battery. Additionally, Panasonic Energy highly recommends adding these instructions to the owner's manual. Please read and check the following prohibited actions.

Danger

(1) Immersion

Do not immerse the battery in liquid such as water, beverages, or other fluids.

The battery or the battery pack (including protection circuit) may catch on fire, smoke, explode, or cause heat generation, electrolyte leakage by unexpected electrical load.

(2) High Temperature

Do not use or place the battery near an open flame, heater or high temperature (above 80°C).

Subjecting the battery to high temperature may damage the polyolefin separator and can cause an internal short circuit. This may cause the battery to leak, generate heat, smoke, catch fire, or explode.

(3) Chargers and Charge Conditions

Do not use unauthorized chargers.

Only charge the battery within specified conditions (e.g., temperature range, voltage, and current). Use of an unauthorized charger could cause the battery to leak, generate heat, smoke, catch fire, or explode.

(4) Reverse Polarity

Do not attach or insert battery with polarity reversed.

A battery has polarity. If the battery does not easily fit into the charger or device, check the battery's orientation. Do not force the battery into the battery compartment. If attached to the device with reversed polarity, the battery may generate heat, smoke, catch fire, or explode.

(5) Direct Connection

Do not connect the battery to an AC power supply (ex. AC outlet) or DC power supply (ex. Car cigarett socket).

The battery requires a specific charger. If the battery is connected directly to a power outlet, the battery may leak, generate heat, smoke, catch fire, or explode.

(6) Use in Other Equipment

Do not use the battery in equipment for which it was not intended.

If the battery is used in unapproved applications or systems, the battery may become damaged and leak, generate heat, smoke, catch fire, or explode.

(7) Incineration and Heat

Keep the battery away from heat and / or fire.

Heat will damage the battery and may cause it to leak, generate heat, smoke, catch fire, or explode.

(8) Short-Circuit

Do not apply a short-circuit.

Do not connect the positive (+) and negative (-) terminals with a conductive material. Do not carry or store the battery with any metal objects. If the battery is shorted, the shorting item may overheat and the battery may generate heat, smoke, catch fire, or explode.

(9) Impact

Avoid excessive impact to the battery.

Excessive impact may damage the battery. This may cause the battery to leak, generate heat, smoke, catch fire, or explode.

(10) Penetration

Do not penetrate the battery with a nail or strike with a hammer.

If subjected to a hard strike or penetrated by an object, the battery may be damaged or destroyed, thereby causing an internal short-circuit. This may cause the battery to leak, generate heat, smoke, catch fire, or explode.

(11) Soldering

Do not directly solder to the battery.

Soldering directly to the battery could melt the separator or damage the gas release vent or other safety mechanisms. This may cause the battery to leak, generate heat, smoke, catch fire, or explode.

(12) Disassembly

Do not disassemble the battery cell and battery pack.

Battery cell and/or battery pack may be deformed and damaged by disassembly.
Disassembly or modification of the battery cell and/or battery pack may damage the protection functions. This may cause the battery cell and/or battery pack to leak, generate heat, smoke, catch fire, or explode.

(13) Charge near High Temperatures

Do not charge the battery near high temperature.

If the battery is charged while exposed to high temperature, the battery's protection circuit may activate and prevent charging, or fail and cause the battery to leak, generate heat, smoke, catch fire, or explode.

(14) Damage or Significant Deformation

Do not use the battery with damage or significant deformation.

If the battery has damage or significant deformation, it may cause the battery to leak, generate heat, smoke, catch fire, or explode by unexpected electrical short duraing usage.

Warning

(1) Ingestion

Keep away from small children.

Keep the battery away from small children. If the battery or any of its component parts is swallowed, seek medical attention immediately.

(2) Storage

Do not place the battery in or near a microwave or other cooking appliances.

If subjected to heat or electromagnetic radiation, the battery may leak, generate heat, smoke, catch fire, or explode.

(3) Mixed Use

Do not mix with other batteries.

The battery should not be used with other batteries having a different capacity, chemistry, or manufacturer, and different product code. Doing so could cause the battery to leak, generate heat, smoke, catch fire, or explode.

(4) Discoloration and Deformities

Do not use abnormal batteries.

Immediately stop using the battery if there are noticeable abnormalities, such as smell, heat, discoloration, or deformity. The battery may be defective and could leak, generate heat, smoke, catch fire, or explode with continued use.

(5) Charging Time

Stop charging if the charging process cannot be finished.

If the battery cannot finish the charging process within the specified time, halt the charging process. The battery may leak, generate heat, smoke, catch fire, or explode.

(6) Leakage ①

Do not use a leaking battery near open flame.

If the battery or liquid leaking from the battery has an irritating odor, the battery should be kept away from any open flame. If exposed to an open flame, the battery could ignite and explode.

(7) Leakage ②

Do not touch a leaking battery.

If liquid leaking from the battery gets into your eyes, immediately flush your eyes with clean water and seek medical attention. If left untreated, it will cause significant eye damage.

(8) Transport

Pack the battery securely for transport.

To prevent short-circuit or damage during transport, securely pack the battery in a case or carton.

(9) Exposure to Direct Sunlight

Do not use or leave the battery in a location exposed to excessive heat.

If the battery is used in a location such as in direct sunlight or in a car, it could cause the battery to leak, generate heat, smoke, catch fire, or explode. It may also cause the battery's performance and life to deteriorate.

(10) Recycling

Do not throw away used batteries as home rubbish.

When disposing of the battery, recycle it according to local rules and regulations.
If used batteries are thrown away as home rubbish, there is possibility that batteries catch fire or smoke according to damage in rubbish collection.

Caution

(1) Static Electricity

The battery pack has a protection circuit. Do not use the battery where static electricity in excess of 100V is generated as it may damage the protection circuit. If the protection circuit fails, the battery may leak, generate heat, catch fire, smoke, or explode.

(2) Charging Temperature Range

Only charge the battery at our specified temperature range. Charging outside of this temperature range may cause the battery to leak, generate heat, or result in serious damage. It may also cause the battery's performance and life to deteriorate.

(3) Manual

Read the manual before use. Keep for future reference.

(4) Charging Method

Read the charger's manual before use for proper charging method.

(5) First Time Usage

Please contact the supplier if the battery gives off an unusual odor, generates heat, or shows signs of rust prior to its initial use.

(6) Use by Children

Parents must explain how to safely use the system and the battery. Please check back periodically to ensure children are using the system and the battery correctly.

(7) Flammable Materials

Do not charge or discharge near flammable materials. Doing so could result in fire.

(8) Leakage

If electrolyte leaks from the battery and comes into contact with skin or clothing, immediately flush with water. Otherwise, it may cause skin irritation.

(9) Handling of Exposed Contacts or Conductors

If the battery pack has a system interface consisting of stripped lead wires or exposed contact plates, handle with due care. Temporarily insulate exposed contacts and conductors with an insulator such as polypropylene tape or polyvinylchloride tape. Failure to do so could result in an electrical shock; a short circuit causing the battery to leak, generate heat, smoke, catch fire, or explode; or the combustion of other materials.

3 Scope

This specification applies to the Lithium Ion Battery NCR1850B-H00BA for Light by

Do not use this battery in applications other than described above.
If the battery was used in other applications, it may cause performance degradation and safety deterioration depending on the usage of the battery in the equipment.
Incorrect handling of the battery may cause potential hazards of electrolyte leakage, overheat, smoke, fire, or explosion.
Battery usage other than described above could result in bodily injury or property damage.

This Specification shall not apply to special applications requiring a high degree of quality and reliability where the failure or malfunction of the products may directly jeopardize life or cause threat of personal injury. A non-exhaustive list of such applications includes: weapons, aircraft and aerospace equipment, aircraft electronics equipment, medical equipment (excluding Class 1 equipment), intrinsically safe equipment, electric vehicles, hybrid electric vehicles, and electric motorcycles (excluding electric bicycles).

4 Battery Classification and Product Code

4.1 Battery Classification	Lithium Ion Battery
4.2 Product Code	BJ-A800038AA
4.3 Model Name	NCR1850B-H00BA
4.4 Cell Type	NCR1850B

5 Nominal Specifications

Item		Specifications	Notes
5.1 Rated Capacity	4.20V Charge	2200mAh	0.450A discharge at 20°C
	4.15V Charge*1	2135mAh	
5.2 Capacity (Minimum)	4.20V Charge	2250mAh	0.450A discharge at 25°C
	4.15V Charge*1	2180mAh	
5.3 Capacity (Typical)	4.20V Charge	2350mAh	Reference only
	4.15V Charge*1	2280mAh	
5.4 Nominal Voltage	4.20V Charge	3.6V	0.450A discharge
	4.15V Charge*1		
5.5 Discharging End Voltage		2.50V	
5.6 Charging Current	Low temp.	0.563A or less	0 ~ +10°C
	Std. temp.	1.125A or less	+10 ~ +45°C
5.7 Charging Voltage	4.20V Charge	4.20 ± 0.03 V	
	4.15V Charge*1	4.15 ± 0.03 V	
5.8 Charging Time (Std.)		4.0 hours	
5.9 Continuous Discharge Current (Max.) *2,		4.50 A	0 ~ +40°C
5.10 Internal Resistance		less than 100 mΩ	AC impedance 1 kHz
5.11 Weight		less than 36.5 g	
5.12 Operating Temperature	Charge	0 ~ +45°C	
	Discharge	-20 ~ +60°C	
	Storage	-20 ~ +50°C	
5.13 Storage Conditions (State of Shipment)	less than 1 month	-20 ~ +50°C	Recoverable Capacity: 80%*3
	less than 3 months	-20 ~ +40°C	
	less than 1 year	-20 ~ +20°C	

*1 Regarding Charging Voltage Control, please refer to Item 6 "Charging control for Life End" and Item 11 "Standard Charging Method".

*2 The maximum discharge current is for a single cell use. However after the battery pack assembly, maximum discharge current will be limited by a protection circuit or device.

$$*3\ Recoverable\ Capacity = \frac{Discharge\ Time\ after\ Storage}{Initial\ Discharge\ Time} * 100$$

The discharge time is measured by fully charging the battery at 25°C and then discharging it at a current of 0.450A to 2.50V per cell in series.

6 Charging Control for Life End

Safety and cycle characteristics of Lithium-ion batteries can be improved by reducing the voltage lower than the rated charging voltage.
Therefore, when designing the battery pack using this cell, Panasonic Energy will request to reduce the charging voltage from the beginning.
Or Panasonic Energy will request to add a function to reduce the charging voltage when the deterioration rate reaches a certain level.

6.1 During usage, if charging voltage can NOT be changed.
- The charging voltage should be reduced from the beginning.

6.2 During usage, if charging voltage can be changed.
- The charging voltage should be reduced before SOH (State of Health) reaches 70%.

One of 6.1 or 6.2 above must be the mandatory item.

7 Electrical Characteristics

Items	Conditions	Criteria
7.1 Full Charge	[4.20V charge] The battery is charged at a 1.125A constant current until the voltage reaches 4.20V. The current is then reduced to keep a constant voltage of 4.20V. The total charging time is 4.0 hours at 25°C. [4.15V charge] The battery is charged at a 1.125A constant current until the voltage reaches 4.15V. The current is then reduced to keep a constant voltage of 4.15V. The total charging time is 4.0hours at 25°C.	
7.2 Capacity	(1) Within 1 hour after fully charging at 25°C as per item 7.1, the battery is discharged at 0.450A continuously to 2.50V at 25°C.	[4.20V charge] More than 300 min. [4.15V charge] More than 290.7 min.
	(2) Within 1 hour after fully charging at 25°C as per item 7.1, the battery is discharged at 2.25A continuously to 2.50V at 25°C.	[4.20V charge] More than 54 min. [4.15V charge] More than 52 min.
7.3 Cycle Life	[4.20V charge] After the battery has been subjected to 300 repeated charge and discharge cycles (charged by CC-CV of 1.125A – 4.20V for 4.0hours; discharged by CC of 2.25A to 2.50V at 25°C), the discharge time is measured as per Item 7.2, (2). [4.15V charge] After the battery has been subjected to 300 repeated charge and discharge cycles (charged by CC-CV of 1.125A – 4.15V for 4.0hours; discharged by CC of 2.25A to 2.50V at 25°C), the discharge time is measured as per Item 7.2, (2).	More than 38 min. More than 36 min.

Items	Conditions	Criteria
7.4 Temperature Characteristics	(1) Within 1 hour after fully charging at 25°C as per item 7.1, the battery is stored at 0°C for 3 hours. The discharge time is then measured as per Item 7.2, (2) at 0°C.	[4.20V charge] More than 30 min. [4.15V charge] More than 29 min.
	(2) Within 1 hour after fully charging at 25°C as per item 7.1, the battery is stored at 60°C for 3 hours. The discharge time is then measured as per Item 7.2, (2) at 60°C.	[4.20V charge] More than 50 min. [4.15V charge] More than 48 min.
7.5 Storage at Fully Charged State	After fully charging at 25°C as per item 7.1, the battery is stored for 20 days at 60°C After storage, the battery is held at 25°C for 3 hours. Then, the discharge time is measured as per Item 7.2, (2). Then, the same battery is fully charged again and discharged a second time and measured as per Item 7.2, (2) at 25°C.	[4.20V charge] More than 30 min. [4.15V charge] More than 29 min. [4.20V charge] More than 40 min. [4.15V charge] More than 38 min.
7.6 Storage at Fully Discharged State	After fully charging at 25°C, the battery is discharged as per Item 7.2, (2). Then, the battery is stored for 20 days at 60°C. After storage, the battery is held at 25°C for 3 hours and is then fully charged as per item 7.1. Then, the discharge time is measured as per Item 7.2, (2) at 25°C.	[4.20V charge] More than 50 min. [4.15V charge] More than 48 min.
7.7 Drop	After fully charging at 25°C, the cell is dropped 3 times in random directions from a height of 1 m onto a flat surface of concrete.	No rupture, no fire

STANDARD TEST CONDITIONS:

All tests shall be conducted with new batteries delivered within the last 7 days. Tests shall be performed at a temperature of 25±2°C and a humidity of 65±20% (the standard temperature tolerance for Class 2 and the standard humidity tolerance for Class 20, respectively, as specified by *JIS Z 8703,* Standard Atmospheric Conditions for Testing). The precision of the voltmeter and ammeter used in the tests shall be higher than Class 0.5 as specified by *JIS C 1102-2,* Special Requirements for Ammeters and Voltmeters.

8 Design and Dimensions

The battery design is shown in the following documents or drawings.

- Drawing No. : NCR1850B01-**

9 Appearance

There shall be no such defects as followings, which may adversely affect commercial value of the cell:

- Scratch
- Rust
- Discoloration
- Dirt
- Deformation

10 State of Charge at Time of Shipment

At time of shipment, the battery's state of charge shall be 30% of its rated capacity or less.

11 Standard Charging Method

The standard charge condition is a constant current – constant voltage method with a current of 1.125A and a maximum voltage of 4.20V. The charging process should be halted when either time, battery voltage, or current reach certain values.

However, the charging voltage should be reduced to 4.15V before SOH (State of Health) reaches 70%. Also, if SOH reaches 50~60%, further charging voltage reduction or alarm function for battery replacement should be installed. (Recommendation).

If the charging voltage cannot be changed during the cycle, the charging voltage should be reduced to 4.15V from the beginning. (Mandatory)

Battery voltage can be decreased by storage and over-discharge protection can be triggered. To charge from this condition, the battery should be charged by a pre-charge function described in the next section.

The pre-charging current should be approximately 0.225A. Once over-discharge protection is released by charging, the charger can resume the standard charging method. The pre-charge function should have a cut-off timer in order to detect a short circuit. If the voltage does not recover to the value of detection voltage within the specified time, charging must be terminated.

The current interrupt device (CID) may activate if the battery is charged continuously after it has reached a fully-charged state or if the battery is charged at a high temperature. Please consult Panasonic Energy for instruction on the charge method.

12 Precautions for Designing the Light, the Charger and the Battery pack

Please comply with the following instructions during every stage of application, charger, battery pack design and assembly processes otherwise the battery may experience a deterioration of functionality, quality, and safety. In the worst case, the battery may generate heat, smoke, catch fire, or explode.

12.1 Precautions for Designing the Light and the Charger

(1) Charge

- The battery is charged by a method of constant current-constant voltage.
- Regarding NCR1850B-H00BA, the charging current should be 1.125A /cell or less.
- The charging voltage is required to be set at 4.20V/cell or less.
- The charging voltage should not exceed 4.23V/cell with considering the accuracy of charger.
- However, when the charging voltage control is necessary, the charging voltage after the charging control is required to be set at less than or equal to 4.15V/cell, and the charging voltage should not exceed 4.18V/cell with considering the accuracy of charger.
  Even if the charger is failed, the total safety shall be secured.
- The charger shall be equipped with a pre-charge system.
- If battery voltage goes down to less than 2.5V/cell, the battery should be charged by pre-charge current of maximum 0.225A. Once, the battery reached more than 2.5V/cell by the pre-charging, the charger can resume the standard charging method. However, if the battery voltage never re-covers more than 2.5V/cell, the charger must be stopped and turned off.
- The charger shall be equipped a full charge detection.
- The charger shall detect the full-charged state by a timer, current detection or open circuit voltage detection. When the charger detects the full-charge, the charger shall stop charging. Do not apply the continuous charging (trickle charging) method.
- The charging temperature should be confined to the range 0°C to +45°C.
- It is recommended that charging should be stopped to avoid continuous charging, when either of the following conditions are met;
  - The charging current reaches approximately 45mA in CV mode.
  - The charging time reaches 4.0hours in case of charging at 1.125A

(2) Discharge

- The discharge current should not exceed 4.50A/cell.
- The discharge temperature should be between -20°C to +60°C.
- The discharge end voltage should be more than 2.50V/cell.
  If cells are to be connected in series, please refer to Item 14.1.

(3) Over discharge

- Do not discharge the battery less than 2.0V/cell.

(4) Design of Lights and chargers

- The cells should be kept away from heat generating electronic parts in order to avoid deterioration of battery performance.

(5) Strength of the battery pack enclosure

- The battery pack enclosure must be designed to have sufficient strength to resist damage from specified or typical expected mechanical stresses such as bending, twisting, and impact due to drop of application.

12.2 Precautions for Battery Pack Design

(1) Shape, mechanism and material of battery packs

- The battery pack should be designed so it cannot connect to unauthorized chargers.
- The battery pack should be designed so it cannot connect with unauthorized equipment and/or devices.
- The terminal shape should be designed to avoid short circuit issues. In addition, the battery pack should be equipped with an over current protection function in order to prevent from external short circuit issues.
- The terminal shape and structure should be designed so that it cannot connect in backwards.
- The battery pack should be designed to prevent static electricity, electrolyte, or water ingress issues.
- The battery pack should be designed so the protection circuit functions can be inspected during the assembly process.
- The battery pack should be designed so electrolyte cannot reach to the protection circuit board even if electrolyte leak out of the cells.
- The cells should be fixed by tape or glue in the case. If the battery pack is dropped, the cells should be protected against dents, deformations, and other mechanical stresses.
- Plastic cases should be closed with glue. If an ultrasonic welding method is applied to the case sealing, Panasonic Energy will not accept any responsibilities for any defects.
- The pack shall be designed so end users cannot remove or disassemble the cells.
- Improper usage may damage the gas release vent on the cell, which generates flammable gas. If the flammable gas is generated, the battery could ignite and explode. Therefore, the battery pack should be designed that the flammable gas doesn't stay inside the pack.
- The battery pack or module shall be designed for the functions of anti-thermal propagation and flame containment in all usage. For Shanghai PYTES Energy Co.,Ltd.'s reference, the battery design items are shown as follows.
  - Gas management structure not to remain heated-gases.
  - Prevention of large current flow from other cells.
  - Prevention of heat transfer to neighbor cells.

(2) Protection circuit

The following protection circuit should be equipped in the battery pack:

- **Overcharge protection**

  We recommend the overcharge protection engages when cell voltage reaches more than 4.25V/cell then, the current shall be shut down. However, when the charging control for life end is necessary, the operation voltage of overcharge protection after the charging control is recommended to 4.20V/cell.
- **Over discharge protection**

  If cell voltage reaches approximately 2.2V/cell, we recommend that the over discharge protection circuit shuts down the discharge current and the circuit consumption current is set to less than 1μA.
- **Over current protection**

  If discharge current exceeds approximately 4.50A/cell, the over current protection will shut down the current.

(3) Electric circuit

- To avoid over discharge mode during long storage times, the consumption current of the battery pack's protection circuit should be set as low as possible.

(4) Cell connection

- The cells should not be connected using a soldering process. In order to avoid any damages, cells should be connected to lead plates by a spot welding method.

(5) Precautions on label

- The rating label should indicate required information and precautions.
- The precautions should be based on the information in section 2.

13 Storing Conditions

13.1 Storage Temperature and Humidity (Within 3 months)

- Cells should be stored in a stable environment characterized by low-humidity (less than 70%RH), free of corrosive gasses, and an ambient temperature between -20°C and +40°C.
- To prevent rust, avoid conditions that can create condensation such as rapid fluctuations in the ambient.

13.2 Long Duration Storage

- When long duration storage cells should be stored in a stable environment characterized by low-humidity (less than 70%RH), free of corrosive gasses, and an ambient temperature between -20°C and +20°C.
- To prevent rust, avoid conditions that can create condensation such as rapid fluctuations in the ambient.
- For long term storage, a discharged or partial charged state of charge per section 10 is recommended.

14 Handling Precautions for Lithium Ion Cells

- This section describes handling precautions for lithium ion cells which will be assembled as battery packs with pack consists of NCR1850B.

14.1 Series Connections Precautions

- When cells are connected in series, make sure that shipping charge date and capacity rank match. Please do not mix cells with different shipping charge dates or capacity ranks. The voltage variability between cells should be within 20mV.
- The shipping charge date and the capacity rank are indicated on the shipping carton label..
- If cells are connected in series, the discharge end voltage is recommended to set more than 2.75V/cell.

14.2 Inspection of the Battery Pack before Shipping

All battery packs shall be inspected for:

- Voltage
- Internal impedance
- Function of protection circuit
- Thermistor resistance
- Thermal fuse

14.3 Precautions on Pack Assembly

- Do not use potentially abnormal cells which have been dropped, shorted, or deformed during handling or assembly even if no damage is readily apparent. Do not use cells giving off the odor of electrolyte.
- Do not bring battery near or into contact with heat sources such as soldering irons.
- Do not allow any metal to come into direct contact with cells inside the battery pack compartment.
- Do not lift the core pack by holding the lead wires or the printed circuited board. Do not unnecessarily twist or bend the lead wires or the printed circuited board.
- Do not re-work the battery.

14.4 Precautions on Cell of pack

- Do not use different product code cell for one battery pack.

15 Remark of Safety Design

- Panasonic Energy has been addressing to enhance the quality and the reliability of battery cell, but we also require our customers to introduce the safety design into the battery pack for avoiding unsafety situation.
- The event such as abnormal heat generation, smoke, fire and explosion might happen due to the failure of battery cell and the use out of the specification.
  to the product manufacturer about having the safety design such as redundant design, the prevention design against the spread of the fire, and so on, in order to prevent the accident of injury, death, fire, social harm as the result of battery cell failure.
- Panasonic Energy will not be liable for any damage due to slack safety design.

16 Other Remarks

- If there are problems in this specification, Panasonic Energy will take them into consideration.
- Panasonic Energy can discuss specification or precautions that are not described in this specification.
- Do not use the provided cells for other applications.

17 Battery Warranty

Unless specifically agreed otherwise between and Seller (defined in Appendix 2) in written agreement(s) signed by authorized representatives of and Seller, Appendix 2 shall control the warranty terms of the battery. Notwithstanding the foregoing, Appendix 2 shall not apply to the battery sold under the laws of the Federal Republic of Germany or Switzerland.

18 Battery Safety and Reliability Requirements

In order to ensure the safety and reliability of the battery, please contact Panasonic Energy to discuss design of the application from a mechanical and electrical perspective. Also, if there are special usage conditions (for example: a large current load, a quick charge method, or a special usage pattern), please consult Panasonic Energy before finalizing the product specification.

19 Battery Operation Region

- The charging voltage and current should be designed to be lower than following maximum charging voltage and charging current in performance operation region and must not exceed safety operation region. Please design and evaluate the system so that charging voltage and current in per cell does not exceed the operation region.
- Repeated peak discharge current can cause overheat and/or over discharge condition. Please design and evaluate the system so that battery is used within the nominal spec.

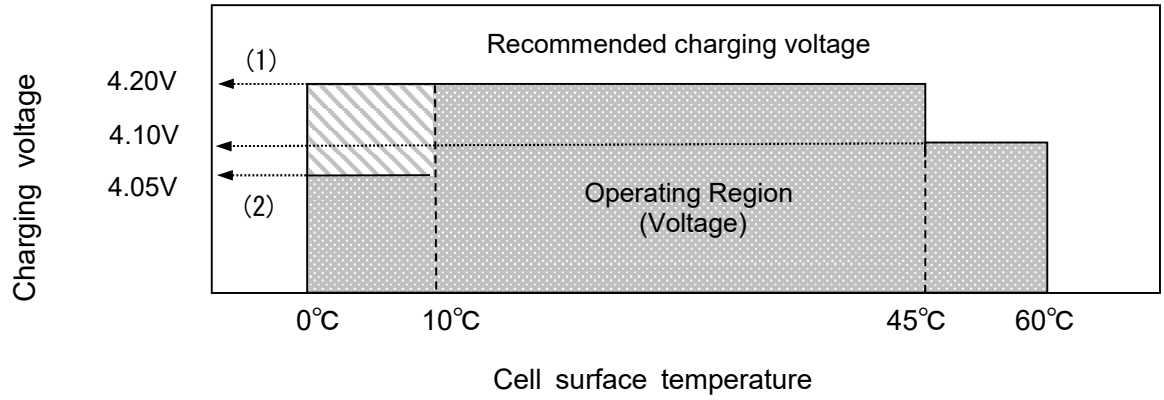
19-1 Performance operation region

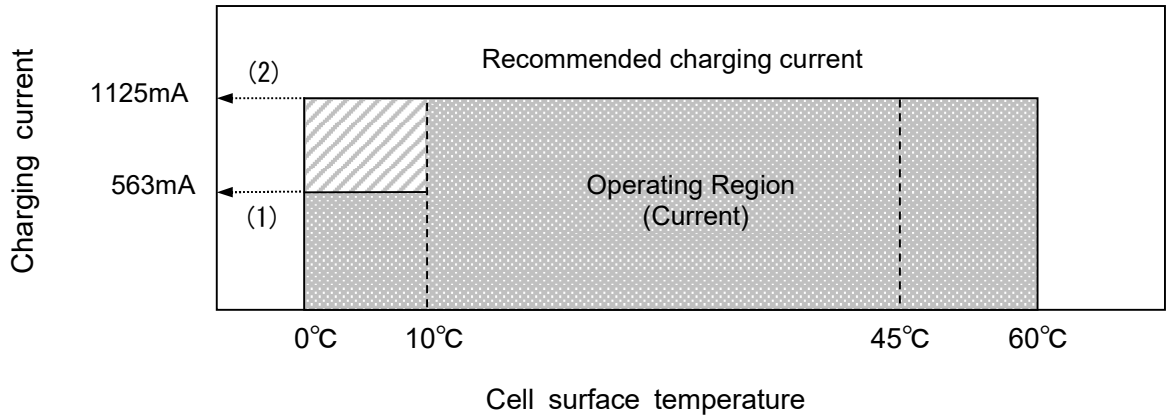
Performance operation region is the upper value (not including tolerance) considering life end for ordinary usage condition.
Regarding operating region for performance, please follow the below condition.
The charging voltage and current should be lower than following recommended charging voltage and recommended maximum charging current in Table.1 for suppression of deterioration.

Model: NCR1850B-H00BA

Table.1 Operating region (Cell surface temperature, voltage, current)

Temperature		/Recommended charging voltage	/Recommended maximum charging current
0℃~10℃	(1)	4.20V	563mA
	(2)	4.05V	1125mA
10℃~45℃		4.20V	1125mA
45℃~60℃		4.10V	1125mA





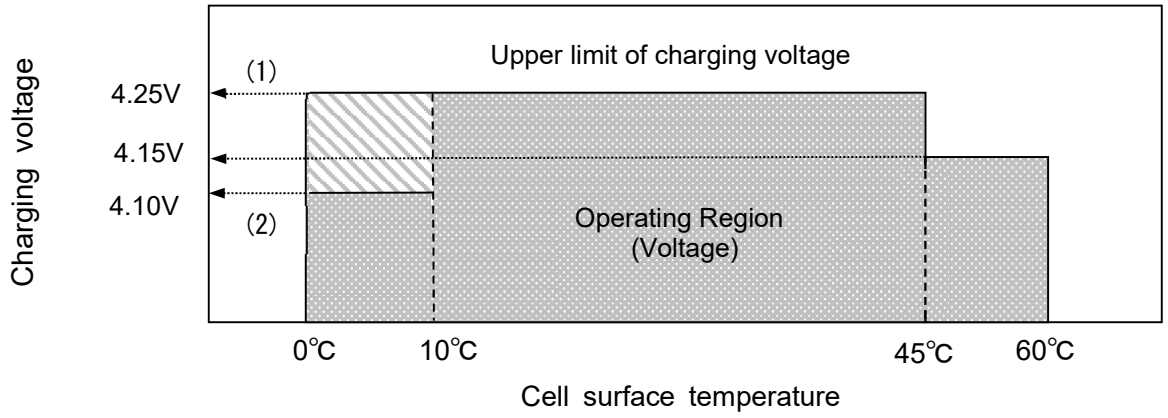
19-2 Safety operation region

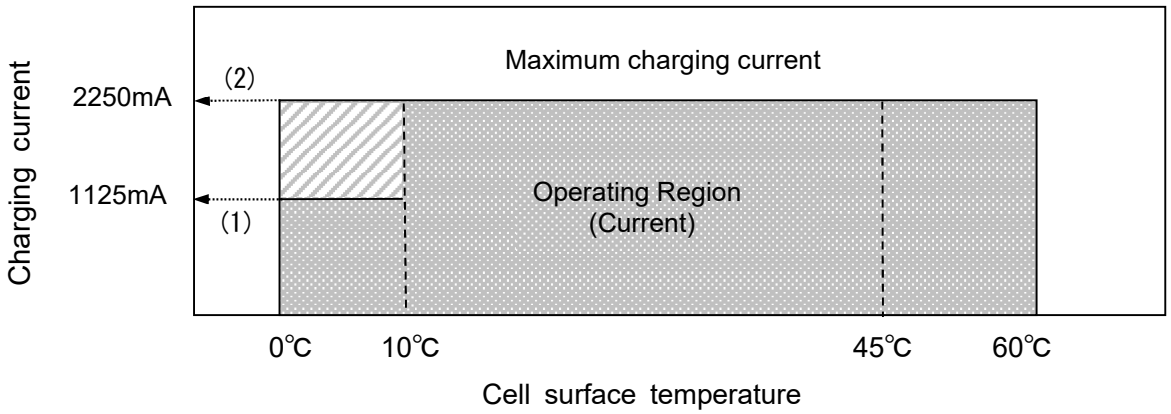
Safety operation region is the upper limit value (including tolerance) considering safety. It cannot use beyond this condition.
Regarding operating region for safety, please follow the below condition.
The charging voltage and current shall not exceed following upper limit of charging voltage and maximum charging current in Table.2 for safe use.

Model: NCR1850B-H00BA

Table.2 Operating region (Cell surface temperature, voltage, current)

Temperature		Upper limit of charging voltage	Maximum charging current
0℃~10℃	(1)	4.25V	1125mA
	(2)	4.10V	2250mA
10℃~45℃		4.25V	2250mA
45℃~60℃		4.15V	2250mA





Appendix 1 < Safety risk of lithium ion batteries >

Depending on the usage condition and environment, lithium ion batteries may become unstable and may cause serious risks such as heat generation, smoke, ignition or rupture.
Please ensure the safety of the battery packs for use in various usage conditions and environments, in consideration of multiple risk factors.

<Safety risks>

(a) Cell electrolyte leakage from battery cells
Electrolyte leakage may cause short-circuit internally or externally of the battery packs, causing the battery cells to generate heat, smoke, fire or rupture.
・Please ensure the battery packs are designed so that the battery packs will not easily short-circuit even if electrolyte leaks from the battery cell.

(b) High temp/flammable gas release from battery cells
High temperature gas from battery cells may cause the battery cells to generate heat, smoke, fire or rupture. Additionally, ignition of flammable gas may cause explosion of the battery cells.
・Please ensure the battery packs are designed with a gas release route so that the gas will not accumulate within the battery packs.

(c) Deterioration of insulation and short-circuit due to vibration, drop and impact
Vibration, fall and shock causing damage (impact, deformation) to the battery cells may result in short-circuit of the battery cells, which may lead to a risk of tab break, leakage, heat generation, fire or rupture.
・Please ensure the battery packs are designed so that (i) short-circuit will not occur even if the battery is dropped or damaged in consideration of the actual usage condition, (ii) the battery cells will not deform in case of a drop.
・Please ensure the battery packs are designed to be safe even if the battery is repeatedly dropped or impacted by all potential misuse.

(d) Abnormal heat generation of battery cell by usage outside the specification temperature
Use of the battery packs outside the temperature range as set forth in the Specification may cause the battery cells to leak, generate heat, smoke, fire or rupture.
・In order to use the battery cells within the specification temperature range, please monitor the cell temperature in appropriate position/method and appropriately control charge/discharge.
・Temperature distribution in the battery pack will greatly affect the safety when charging, so please ensure the battery packs are designed so that battery cell temperature within the battery pack is even.

(e) Safety risk by continuous usage of degraded batteries
If the aged battery cells and packs are continuously used under degraded condition near battery life end, aging degradation may cause a risk of functional failure such as CID and electrolyte leakage or safety events by short, heat generation, etc.
・ Please take care to avoid the degraded battery packs continuously used.

※Note that safety risks may increase when more than one of factors (a)~(e) is combined.
Battery packs must be designed in consideration of safety risk associated with multiple factors such as (a)~(e).

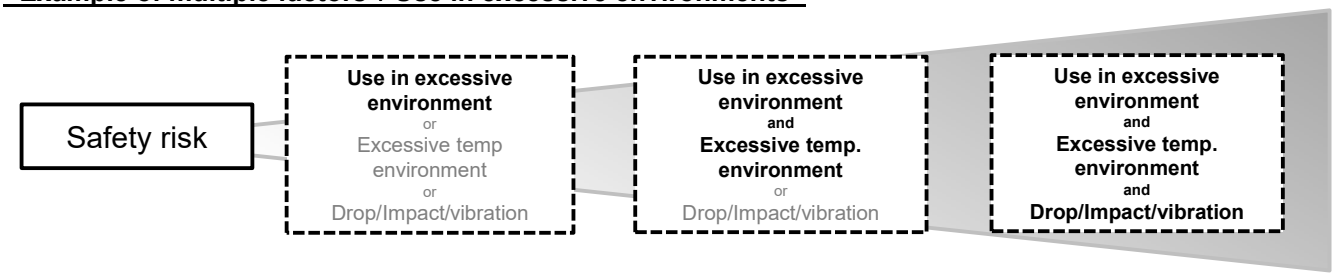
<Danger of electric shock>

In the case of high voltage battery pack, there may be a risk of life-threating electric shock.
・Please ensure the battery packs are designed with insulation measures, which does not directly touch (+) and (-) polar.
・Please ensure the battery packs are designed so that electric shock will not occur even if the battery pack is damaged by drop and impact, or is submerged.

Safety risk associated with multiple factors

To reduce the safety risk associated with multiple factors, please ensure the safety of the battery packs by conducting severe and marginal tests.

<Example of multiple factors：Use in excessive environments>



・As multiple factors increase, safety risk will also increase

・Suggested action for

1) Confirmation the safety risk associated with multiple factors:
   Please make sure you to conduct severe and marginal test, based on actual and all foreseeable usage conditions.
   (i.e. Safety test after excessive temperature environment test, extension of test as in time and number for drop/impact/vibration)
2) Instructions to end users:
   Please make sure you warn your customers against inappropriate usage of the battery packs in the user's manual.

Important safety items about battery pack

・Please design the battery packs to ensure safety in case of any leakage of the battery cells.

・Please design the battery packs and systems to ensure safety of equipment and users in case the current is cut off.

・Please design the battery packs considering any impact, drop, shock, vibration, or electric shock in case of deterioration of battery pack components.

* **Please consult with the final product manufacturer with respect to the assumed deterioration period, assumed drop, shock or vibration of the final products.**

Safety risk of cells	Influence on battery pack	Check items
<Non operation>		
Dis-connection	■ Battery malfunction	・Safe design considering redundancy
<Unsafe operation>		
Leakage	■ External / internal short circuit ■ Degradation of battery parts by corrosion	・Safe design against leakage
High Temp./flammable gas release	■ Cause of burning(High Temp. gas) ■ Explosion by fire(Flammable gas)	・Anti-fire propagation / flame containment design ・Securing the gas release route
Internal / external short circuit	■ Deterioration of insulation ■ Battery pack malfunction ■ Abnormal heat generation, fire	・Charge control at the end of life ・Anti-fire propagation / flame containment design ・Safe design considering deterioration
Heat generation	■ Reduction of resistant ■ Abnormal heat generation, fire	・Confirmation of usage temp. range ・Safe design considering deterioration
< Consideration of shape change / lowering strength / use environment of battery pack >		
	■ Reduced tolerance (impact, drop, shock, electric shock) ■ External / internal short circuit ■ Electric shock or external short circuit caused by water immersion, dust, condensation.	・conducting safety tests considering the degraded conditions of battery cells and packs ・Safe design against water immersion, dust and condensation.

Appendix 2 < Battery Warranty >

For clarification, in this Appendix, "Company" means [illegible] . means a company of Panasonic Group selling Battery Cells to Company, the "Battery Cells" means the Lithium Ion Battery Cells **"NCR1850B",** the "Battery Packs" means Lithium Ion battery packs manufactured by or for Company incorporating the Battery Cells, and the "Specification" means this specification for the Battery Cells.

1. Seller warrants to Company:

(a) Upon delivery of the Battery Cells: The Battery Cells shall conform only to the section titled "Battery Classification and Product Code", "Nominal Specifications", "Characteristics", "Design and Dimensions" and "Appearance" of this Specification.

*The incoming inspection shall be conducted promptly after the arrival of Battery Cells on Company's premises or any other place designated in writing by Company and in any event no later than seven (7) days after the arrival of Battery Cells at Company's premises or any other place designated in writing by Company ("Incoming Inspection Period"). If Seller does not receive a written report of a claim within the Incoming Inspection Period, such Battery Cells shall be deemed to have passed the incoming inspection and be accepted by Company, and Company shall be deemed to have waived any claim therefor.

(b) Following one (1) year after the shipment of the Battery Cells ("Warranty Period"):

(1) Before incorporation into Battery Packs

The Battery Cells shall be charged and discharged during storage, so long as the Battery Cells are stored in accordance with the "Storage Temperature and Humidity" of the "Storage Condition" as set forth in this Specification.

(2) After incorporation into Battery Packs (including use by customers of Company and by final users)

The Battery Cells shall be charged under the standard charge conditions and discharged under the standard discharge conditions as set forth in this Specification, so long as the Battery Cells are used in accordance with this Specification.

For the avoidance of doubt, Seller makes no warranty for any period after the Warranty Period.

*In the event that Company provides Seller with reasonable evidence and/or data supporting the return, including but not limited to specifying the location of Battery Cell in the Returned Battery Packs within seven (7) days after the receipt of the Returned Battery Packs by Company, Battery shall be responsible for the non-conforming Battery Cells only if, as a result of the investigation of all relevant information and data, the re-inspection of such Battery Cells and Returned Battery Packs by Seller, Seller concludes the cause of return is a product failure due to failure or defect in the Battery Cells supplied by Seller.

2. The warranty set forth above shall not apply to:

(a) any failure by Company to comply with the handling instructions or advice Seller provides for the Battery Cells, which shall include, without limitation, any use of the Battery Cells not in compliance with this Specification;

(b) normal wear-and-tear arising from operation of the Battery Cells;

(c) any non-compliance to the extent arising out of Seller's compliance with Company's specifications;

(d) any defects relating to the design, assembly or manufacture of the Battery Packs, and any defects directly or indirectly influenced by or in connection with the installed condition of the Battery Packs and/or the circumstances under which the Battery Packs are used.

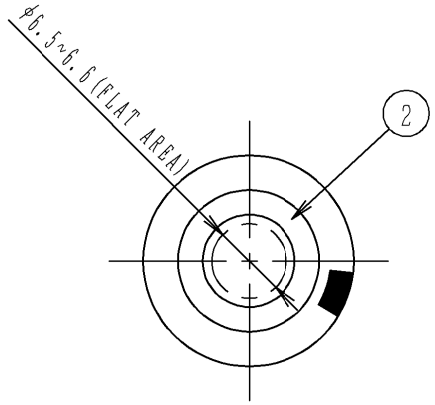
(e) any defects in the Battery Cells caused by (i) Company's shipment or storage of the Battery Cells, (ii) articles not supplied by Seller, including the Battery Packs, (iii) cell propagation, (iv) wet conditions, an impact force of shock, or any other conditions (v) accident, misuse, neglect, abuse, mishandling, misapplication, modification, alteration, acts of God or improper installation, service or maintenance, (vi) any failure due to an external natural phenomena or an animal, bird or insect, or (vii) excessive dust, chemicals, oils, salt water and sun light; or

(f) any instance in which the Battery Packs are resold or transferred and used for other applications or models than the agreed application.

3. Seller shall be responsible for the non-conforming Battery Cells only if, as a result of the investigation of all relevant information and data submitted by Company, Seller concludes the cause of return is a product failure due to failure or defect in the Battery Cells. In such case, Company will be entitled to request Seller, upon the mutual agreement of the parties, to (1) refund the amount Seller received from Company for the non-conforming Battery Cells in the same currency that Seller received from Company in its original payment or (2) provide Company with substitute Battery Cells. The parties agree that such refund or replacement shall constitute Company's sole remedy against Seller with respect to the subject non-conforming Battery Cells. Seller's responsibility is strictly limited to the Battery Cell itself in which Seller concludes the cause of return is a product failure due to failure or defect, and in no event shall Seller be responsible for the Battery Packs. EXCEPT THE WARRANTIES EXPRESSLY PROVIDED IN SECTION 1 (a) AND (b) ABOVE, SELLER DISCLAIMS ALL TYPES OF WARRANTIES EXPRESS OR IMPLIED WITH REGARD TO THE BATTERY CELLS.

4. Interpretation of this Specification: In no event shall each and all descriptions of Battery Cells' functions, performances, characteristics and/or specifications written in the main body and/or other Appendixes of this Specification be construed as a warranty or any other commitment made by Seller. A Battery Cell shall be construed to fully conform to this Specification if the Battery Cell conforms to the warranties set forth in Section 1 (a) and (b) of this Appendix 2.

NO.	PART NAME	APPLICATION・PART CODE	QTY.	MATERIAL・SPECIFICATION	NOTE
	素電池 BATTERY		1	NCR1850B	充電出荷 SHIPPING WITH CHARGE
1	チューブ TUBE		1	PET	赤色 RED
2	絶縁リング INSULATION RING		1	紙 0.2t PAPER 0.2t	白色 WHITE



注）.
1. 2Dコードは外装缶上に捺印されていること。
・セル上に印字される2Dコードは、SR-1000（KEYENCE製）で読み取れること.
・2Dコード仕様：データマトリックスコード（ECC200），16桁の英数字
2. 出荷ロット印、及びランクはチューブ上に捺印すること。（出荷ロットは充電日とする。）

XXXXXXX
- 出荷充電量（1：30%）
- 日（1日=01，2日=02，・・30日=30，31日=31）
- 月（1月=01，2月=02，・・10月=10，11月=11，12月=12）
- 年（'24=24，'25=25・・）

例.）2024年4月26日・・・・・2404261

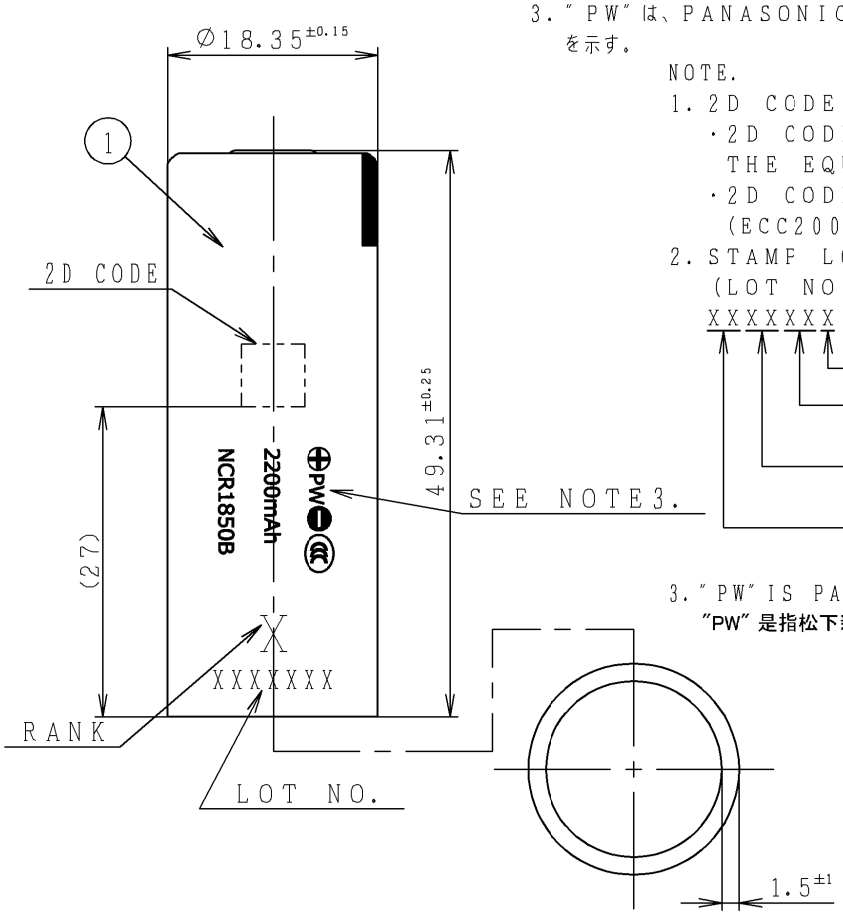
3."PW"は、PANASONIC ENERGY (WUXI) CO., LTD.を示す。

NOTE.
1. 2D CODE TO BE PRINTED ON THE CAN.
・2D CODE ON CELL CAN BE READ BY THE EQUIPMENT SR-1000(KEYENCE).
・2D CODE TYPE:DATA MATRIX CODE (ECC200),16 DIGIT CHARACTER INSIDE.
2. STAMP LOT NO. & RANK ON THE TUBE. (LOT NO IS CHARGING DATE)

XXXXXXX
- SHIPMENT CHARGING RATE(1:30%)
- DAY (1ST=01,2ND=02,・・30TH=30,31TH=31)
- MONTH(JAN=01,FEB=02,・・,OCT=10,NOV=11,DEC=12)
- YEAR ('24=24,'25=25,・・)

EX.) APR.26.2024・・・・・2404261

3."PW" IS PANASONIC ENERGY (WUXI) CO., LTD.
"PW" 是指松下新能源(无锡)有限公司



DRAWING NOT TO SCALE

DATE	REMARK	SYM	DATE	DESCRIPTION
APR. 26. 2024		1	APR. 26. 2024	全面書き換え出図/ALL CHANGED DRAWING
	IEC NAME:INR19/50	0	MAR. 27. 2023	初回出図/1st DRAWING (K. Yoshimoto)
D R I. Shimojyou	MODEL:NCR1850B		材料・規格 MATERIAL	日本リサイクルマーク表示：Li-ion(20) JAPAN RECYCLE MARK:Li-ion(20)
CHK	CUSTOMER CODE:.		処理・加工 FINISH	
CHK	TOLERANCE: 6<L ±0.3; 3<L≦6 ±0.3; 6<L≦30 ±0.2; 3<L≦6 ±0.1; L≦3 ±0.1		部品名 PART NAME	完成電池 BATTERY PACK(finish goods)
ENG	WEIGHT Approx. g	UNIT mm	PART CODE	Rev.
APP K. Yoshimoto	QTY 1	SCALE 3/2	DRAWING NO	NCR1850B01 10

Panasonic Energy Co., Ltd.

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