TENTATIVE

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SANYO LITHIUM ION BATTERY SPECIFICATIONS

BATTERY CLASSIFICATION LITHIUM ION BATTERY

BATTERY TYPE NCR18650B-H00BA

SANYO CODE BJ-A300024AA

CLIENT BATTERIEN-MONTAGE-ZENTRUM GmbH

【 The client's agreement 】

Signature:_____

Name in block letters:_____

Date:_____

*"If there is no reply within 30 days after the delivery, This document shall be presumed valid.

Energy Company of Panasonic Group

Energy Company, SANYO Electric Co., Ltd.

Lithium-Ion Battery Business Unit

Battery System Management Department

PA/BA Technical Service Group

BA Business Development Team

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Contents

	Page
1. Publication Record	1
2. Safety Instructions	2-5
3. Extent of the Application	6
4. Battery Classification and Type	6
5. Nominal Specifications	6
6. Electrical Characteristics	7-8
7. Design and Dimensions	8
8. Appearance	8
9. Shipping Charge	8
10. Precautions on Designing of Data Terminal, the Charger and the Battery Pack	9-10
11. Storing Conditions	11
12. Handing Precautions for Lithium Ion Cells	11
13. Warranty Exemptions	12
14. Other Remarks	12
15. Standard Charging Method	12
16. Battery Warranty Period	13
17. Battery Safety Requirements	13
18. Document Terms (Only Tentative Specification)	13

Title	Specifications of Lithium Ion battery (Cylindrical Type)	page	1/13

1. Publication Record

No.	Date	Class	Items		
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＊Key to Class abbreviations : A for Added, D for Deleted, R for Revised

File No.	NCR18650-068	Energy Company, SANYO Electric Co., Ltd. Lithium-Ion Battery Business Unit Battery System Management Department

2. Safety Instructions

Prohibited Actions

The cell contains flammable objects such as organic solvents. If the battery is mishandled, it may cause fire, smoke or an explosion and the battery's functionality will be seriously damaged. Please read and check the following prohibited actions. Also, please equip a protection in the application so the application troubles don't affect the battery. Additionally, SANYO highly recommends embedding these instructions into the owner's manual.

! Danger

(1) Immersion

"Do not immerse the battery with liquid such as water, *sea water or soda."*

If the protection circuit in the battery is broken with liquid, the battery cannot be protected and may catch a fire, smoke, heat generation or cause an explosion by unexpected electrical load.

(2) High Temperature

"Do not use or place the battery near fire, a heater or a high temperatures (more than 80℃)."

The battery's polyolefin separator may get damaged from the heat and could cause an internal short circuit. This may cause the battery to catch on fire, smoke, explode, or cause heat generation.

(3) Charger and Charge Condition

"Do not use unauthorized chargers."

If the battery is charged under unacceptable conditions (For example: usage in restricted temperature ranges, over voltage, or over current with unauthorized chargers) the battery may catch on fire, smoke, explode, or cause heat generation.

(4) Reverse Polarity

"Do not force a reverse-charge or a reverse-connection."

The battery has correct polarity. If the battery doesn't fit, please check the battery's orientation and do not force into the battery mount. If the battery is forced to set with a different polarity, the battery may catch on fire, smoke, explode, or cause heat generation.

(5) Direct Connection

"Do not connect the battery with AC plug (outlet) or car plugs."

The battery requires a specific charger. If the battery connects with the outlet directly, the battery may catch on fire, smoke, explode, or cause heat generation.

(6) Inappropriate Use with Other Equipment

"Do not adapt the battery to unspecified applications. "

If the battery is used for unspecified applications or systems, the battery may get damaged or catch fire, smoke, heat generation or explode.

(7) Incineration and Heat

"Please keep the battery away from heat and fire"

The battery materials will get damaged and may catch fire, smoke or explode.

(8) Short-Circuit

"Do not make a *short-circuit. "*

Do not connect the + and - terminals with conductive material. Do not carry or store the battery with metal objects (such as wire, necklace or hairpins). If the battery is in a short-circuit, excessive large current will occur and may catch fire, smoke, heat generation or explode.

(9) Impact

" Avoid unnecessary impact to the battery"

Unnecessary impact may cause the battery to leak, heat generation, smoke, fire or explode. Also, the protection circuit may break and that will lose the function of the battery's protection system.

(10) Penetration

" Do not penetrate with a nail or strike with a hammer"

The battery cell may get destroyed or damaged. And the battery's protection circuit may get damaged and case an internal short-circuit. Additionally, the battery may catch fire, smoke, heat generation or explode.

(11) Soldering

"Do not directly solder the battery"

The insulator could melt or the gas release vent might get damaged from the heat. Additionally, the battery may catch fire, smoke, heat generation or explode.

(12) Disassemble and Reconstruction

"Do not disassemble the battery"

If the protection circuit gets damaged, the battery will not be protected. Then, the battery may catch fire, smoke, heat generation or explode.

(13) Charge near High Temperatures

"Do not charge the battery near high temperatures"

If the battery is charged near high temperatures, the battery may not be able to charge due to the activation of the protection circuit. In these conditions, the protection circuit may break and the battery may catch fire, smoke, heat generation or explode.

! Warning

(1) Ingestion

"Keep away from infants"

The battery should be kept away from infants. In case of swallowing the battery, see a doctor immediately.

(2) Storing

"Do not put the battery in the microwave or other cooking appliances"

The battery may catch fire, smoke, heat generation or explode due to heat or the electrical impact from the microwave.

(3) Mixed Use

"Do not mix the battery with other batteries."

The battery should not be used with other batteries with different capacity, chemistry or manufacturer. Do not connect with other batteries or mix with other batteries. The battery may catch fire, smoke, heat generation or explode.

(4) Rust, Changing Color and Deformities

"Do not use abnormal batteries."

Please stop using the battery if the there are noticeable abnormalities such as abnormal smell, heat, deformities, or discoloration. The battery may have a defect and may catch fire, smoke, heat generation or explode if used continuously.

(5) Charging Time

" Stop charging if the charging process cannot be finished."

If the battery can not finish the charging process within the specified time, please stop the charging process. The battery may catch fire, smoke, heat generation or explode.

(6) Leakage①

"Do not use a leaking battery near flames"

If the battery or liquid leaking from the battery has a pungent odor, the battery should keep away from flames. The battery may ignite and explode.

(7) Leakage②

"Do not touch a leaking battery"

If the liquid leaking from the battery gets into eyes, it will cause significant damage. If the leaking liquid gets into your eyes, please flush eyes immediately with pure water. Please consult a physician immediately. If the liquid remains in the eyes it will cause significant damage.

(8) Transport

" Pack the battery tightly during transport"

To prevent short-circuit or damages, please tightly pack the battery into a case or a carton box.

! Caution

(1) Use under Direct Sunlight

Do not use or leave the battery in excessive heat such as in a car in direct sunlight.
The battery may catch fire, smoke, heat generation or explode. Also, it might cause a deterioration of battery's characteristics and battery life.

(2) Static Electricity

The battery pack has a protection circuit. Do not use the battery where it generates static electricity (more than 100V) that might damage the protection circuit. If the protection circuit is broken, the battery may catch fire, smoke, heat generation or explode.

(3) Charging Temperature Range

Charging temperature range is regulated between 0℃ and 40℃. Do not charge the battery out of the specified temperature range. Otherwise, it may cause heat generation, leakage or a serious damage. Also, it might cause deterioration of the battery's characteristics and battery life.

(4) Manual

Please read the manual before usage. Please save the manual for future reference.

(5) Charging Method

Please read the charger’s manual for the charging method.

(6) First Time Use

Please contact the supplier If the battery has unusual odor, heat generation or rusts during the first usage.

(7) Use by Children

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

(8) Inflammable Materials

Please keep away from flammable materials during the charge and the discharge. It may catch fire, explode, smoke, or cause heat generation.

(9) Leakage

If electrolyte leak from the battery and adhere to the skin or clothes, immediately flush it with water. Otherwise, it may cause skin irritation.

(10) Insulation

If lead wires or metal objects come out from the battery, please seal and insulate them completely. Otherwise, the battery may cause a short circuit and catch fire, explode, smoke, or cause heat generation.

(11) Recycle

Please recycle the battery according to local rules or regulations after use.

3. Extent of the Application

This specification is applied to SANYO Lithium Ion Battery of NCR18650B-H00BA for Data Terminal with BATTERIEN-MONTAGE-ZENTRUM GmbH.

For special applications in which quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or cause threat of personal injury such as for weapon, aircraft and aerospace equipment, aircraft electronics equipment, medical equipment (a part of class 2 equipment, class 3 or more equipment), or cause large-scale system troubles, explosion-proof equipment, electric vehicle, hybrid electric vehicle, and electric motor cycle (except electric power-assisted bicycle), this specification shall not be applied.

4. Battery Classification and Type

4.1 Battery Classification — SANYO Lithium Ion Battery

4.2 Battery Type — NCR18650B-H00BA

5. Nominal Specifications

Items		Specifications	Notes
5.1 Rated Capacity (Minimum)		3200mAh	0.65A discharge at 20℃
5.2 Nominal Capacity (Minimum)		3250mAh	0.65A discharge at 25℃
5.3 Nominal Capacity (Typical)		3350mAh	Reference only
5.4 Nominal Voltage		3.6V	0.65A discharge
5.5 Discharging End Voltage		2.5V	
5.6 Charging Current (Std.)		1.625A	
5.7 Charging Voltage		4.20 ± 0.03V	
5.8 Charging Time (Std.)		4.0 hours	
5.9 Continuous Discharging Current (Max.)※1		4.875A	0 ~ +40℃
5.10 Internal Resistance		less than 100mΩ	AC Impedance 1 kHz
5.11 Weight		less than 48.5g	
5.12 Operating Temperature	Charge	0 ~ +40℃	
	Discharge	-20 ~ +60℃	
5.13 Storing Conditions	less than 1 month	-20 ~ +50℃	Percentage of recoverable capacity 80%※2
	less than 3 months	-20 ~ + 40℃	
	less than 1 year	-20 ~ + 20℃	

※1 The maximum discharge current for a single cell use. However after the battery pack assembly , there will be a limitation of maximum discharge current due to a protection circuit or a protection device.

※2 Percentage of recoverable capacity
= (Discharging time after storage / Initial discharging time) ×100
The discharging time is measured by the discharge current of 0.65A until 2.5V of end voltage after the battery is fully charged at 25℃.

6. Electrical Characteristics

Items	Conditions	Criteria
6.1 Full Charge	The battery is charged with 1.625A constant current until the voltage reaches 4.20V. Then, the current is reduced in order to keep the constant voltage of 4.20V. The total charging time is 4.0 hours at 25 ℃.	
6.2 Capacity	①Within 1 hour, after fully charged at 25℃, the battery is discharged with 0.65A continuously until 2.5V of end voltage at 25℃.	More than 300min.
	②Within 1 hour, after fully charged at 25℃, the battery is discharged with 3.25A continuously until 2.5V of end voltage at 25℃.	More than 54min.
6.3 Cycle Life	The battery is repeated 300 times of Charge and Discharge cycles, (Charged by CC-CV of 1.625A-4.20V for 4.0 hours, Discharged by CC of 3.25A to 2.5V (E.V.)) at 25℃. After the 300 cycles, the discharge time is measured by the Item 6.2.②.	More than 38min.
6.4 Temperature Characteristics	①Within 1 hour, after fully charged at 25℃, the battery is stored at 0 ℃ for 3 hours. After that, the discharge time is measured Item 6.2.② at 0 ℃.	More than 30min.
	②Within 1 hour, after fully charged at 25℃, the battery is stored at 60 ℃ for 3 hours. After that, the discharge time is measured Item 6.2.② at 60 ℃.	More than 50min.
6.5 Storage at Fully Charged State	After fully charged at 25℃, the battery is stored for 20 days at 60 ℃. After the storage, the battery is set in 25℃ for 3 hours. Then, the discharge time is measured Item 6.2.②.	More than 30min.
	Then, the same battery is fully charged again and checked the second discharge time by the Item 6.2 ② at 25 ℃.	More than 40min

6.6 Storage at Full Discharged State	After fully charged at 25℃, the battery is discharged by the Item 6.2.②. Then, the battery is stored for 20 days at 60 ℃. After the storage, the battery is set in 25℃ for 3 hours. Then, the discharge time is measured by Item 6.2.② at 25℃.	More than 50min.
6.7 Drop	After fully charged at 25℃, the cell is dropped 3 times in random direction from a height of 1 m onto a flat surface of concrete.	No rupture, no fire

STANDARD TEST CONDITIONS:

The testes shall be implemented with new batteries that were delivered within the last 7 days. The tests shall be performed at 25±2 ℃ (The standard temperature of second grade is specified by *JIS Z 8703* (Standard Test Conditions)), 65±20 % (The standard humidity of twentieth grade is specified by *JIS Z 8703* (Standard Test Conditions)). The grade of voltmeter and ammeter in the tests shall be higher than Class 0.5 which is specified by *JIS C 1102* (Electric Indicator).

7. Design and Dimensions

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

8. Appearance

The battery should not have the following appearance issues at delivery:

- ・Scratch
- ・Rust
- ・Discoloration
- ・Dirt
- ・Deformation
- ・Leakage

The battery should be in good condition.

9. Shipping Charge

The battery is shipped out with the approximately 40%* charged state.

*The 40% capacity is the condition in which SANYO ships the battery but it's not the condition when Fey Elektronik GmbH receives the battery.

10. Precautions for Designing of Data Terminals, the Chargers and the Battery Packs

10-1. Precautions for Designing of Data Terminal and the Charger.

(1) Charge

- The battery is charged by a method of constant current-constant voltage.
- Regarding NCR18650B, the charging current should not exceed 1.625A /cell.
- The charging voltage should not exceed 4.20V /cell.
  The charging voltage is required to be set to less than 4.23V/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 3.0V/cell, the battery should be charged by pre-charge current of maximum 0.32A. Once, the battery reached more than 3.0V/cell by the pre-charging, the charger can resume the standard charging method. However, if the battery voltage never recovers more than 3.0V/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 range should be set between 0 ℃ to +40 ℃.

(2) Discharge

- The discharge current should not exceed 4.875A/cell.
- The discharge temperature should be between -20℃ to ＋60 ℃.
- The discharge end voltage should be more than 2.5V/cell.

(3) Over discharge

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

(4) Design of Data Terminals and chargers.

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

10-2. Precautions for Battery Pack Design.

(1) Shape, mechanism and material of battery packs

- The battery pack should be designed so it does not connect with 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 it does not 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 a tape or a 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 ultra sonic welding method is applied to the case sealing, SANYO will not take any responsibilities for any defects.
- The pack shall be designed so end users cannot remove or disassemble the cells.

(2) Protection Circuit

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

- Overcharge protection

  We recommend the overcharge protection works when cell voltage reaches more than 4.23V. Then, the current shall be shut down.
- Over discharge protection

  If cell voltage reaches approximately 2.2V, we recommend the over discharge protection will shut down the discharge current and the circuit consumption current will be set to less than 1μA.
- Over current protection

  If discharge current exceeds approximately 4.875A, 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.

11. Storing Condition

11-1 Storage Temperature and Humidity (Within 3 months)

- Cells should be stored between -20℃ to +40℃ in a low humidity condition (less than 70 %RH) without any corrosive gases.
- No condensation on the cell

11-2 Long Duration Storage

- Cells should be stored between -20℃ to +20℃ in a low humidity condition (less than 70%RH) without any corrosive gases. We recommend the discharged state or partially charged state SANYO shipped out for the long duration storage.
- No condensation on cells.

12. Handling Precautions for Lithium Ion Cells

- This section describes handling precautions for SANYO lithium ion cells which will be assembled as Data Terminal's battery packs with BATTERIEN-MONTAGE-ZENTRUM GmbH. This battery pack consists of NCR18650B.

12-1 Series Connections Precautions

- When cells are connected in series, make sure the lot number, the shipping charge date, and capacity rank match. Please do not mix cells with different lot numbers, shipping charge date, and capacity rank. Also, the voltage variability should be within 20mV.
- The lot number, 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 should be set more than 2.75V/cell.

12-2 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

12-3 Abnormal Cells

- Do not use damaged cells by dropping, and/or short circuit and cells with electrolyte smell and any other damaged cells.

13. Warranty Exemptions

- SANYO will not be liable for any damages that are caused by violations of the precautions in this specification.
- SANYO will not be liable for any problems caused by design defects of the battery packs, Data Terminal and/or chargers.
- SANYO will not accept any abnormal cells that were caused due to any incorrect assembly process.

14. Other Remarks

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

15. Standard Charging Method

(1) The standard charge condition is 1.625A/cell - 4.20V/cell (Constant current-constant voltage).The charging process should be discontinued when either time, the, OCV or current, reach certain values.

(2) In case of the over discharge state(For example: Battery voltage is less than 2V), the battery should be charged by a pre-charge system in order to prevent FET's heat generation in a circuit.

(3) The pre-charging current should be approximately 0.32A. Once the battery voltage reaches more than 3V/cell with, the charger can resume the standard charging method. The pre-charging should have a cut-off timer and if the voltage doesn't recover over 3V/cell in the set time, the charging should be stopped.

(4) The current interrupt device (CID) may work if the battery is charged continuously after fully-charged and/or is charged at high temperature.
Please consult SANYO for charging method instructions.

16. Battery Warranty Period

The warranty period is limited to one year from date of shipment. SANYO will replace batteries if it is clear that there was a defect in SANYO's manufacturing process and that the battery was not misused.

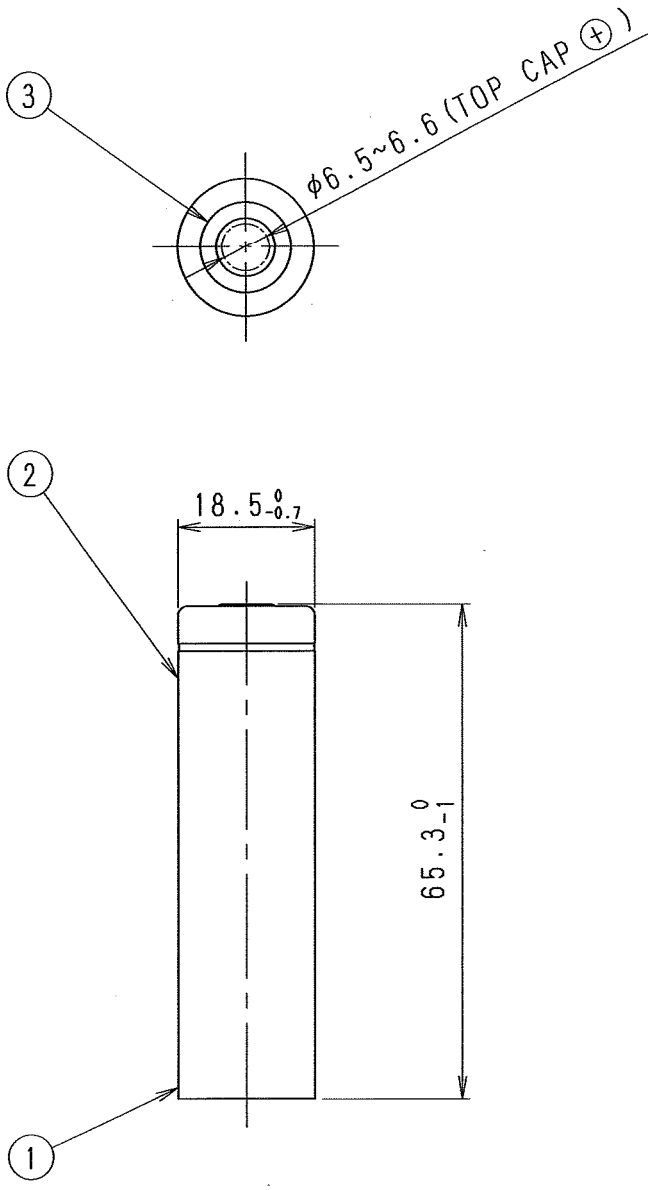
17. Battery Safety Requirements

In order to ensure the safety of the battery, please contact SANYO to discuss the application design from a mechanical or a electrical viewpoint. Also, if there are special conditions (For example: lager current load, a quick charge method or an unique usage pattern), please contact SANYO to check the conditions before the product specification is fixed.

18. Document Terms (Only Tentative Specification)

(1) The expiration period for this document is 6 months.
(2) If a new document is released, please return or dispose the old one.
(3) This document is still preliminary. The contents are not fixed completely.

Symbol	Date	Revision	Signe	Checked



Unit:mm

③	INSULATOR		PAPER			1		
②	OUTER JACKET		SHRINK TUBE			1		
①	CELL		NCR18650B			1		
Symbole	Name		Material			qt.	Process	Remark
Scale	Designed	Drawn	Checked	Checked	Approved	Model No.	NCR18650B	
1:1	Sugimoto	Sugimoto				Name	DIMENSION SKETCH	
	11 Jun 09	11 Jun 09						

Panasonic Corporation Energy Company Unit:mm