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1	Revision History								
No.	Date	Class	Description						
				Dft.		T.Higami			
				Chk	. Y.	Nishimura			
(a)	2015/4/20	_	Issue	Chk		M.Seki			
				Chk	. т	Nishitani			
				Арр	. +	H.Yoneda			
				Dft.					
				Chk					
				Chk					
				Chk					
				Арр					
				Dft.					
				Chk.					
				Chk.					
				App.					
				Dft.					
				Chk.					
				Chk.					
				App.					
				Dft.					
				Chk.	-				
				Chk.					
* Le	egend: A for <i>i</i>	Added, I	D for Deleted, R for Revised	App.					
File	No. NCR18	3650-618	Rechargeable Battery Busin SANYO Electric Co.		vision,				

Т	itle	Lithium Ion E	Battery Specification (Cylindrical Type)	Page	2/13			
2		ty Instructions	nable materiale auch an annanis achuante. Michae	dline the	hetter men			
	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, SANYO highly recommends adding these instructions to the owner's manual. Please read and check the following prohibited actions.							
			Danger					
(1)	Imme	ersion						
	Do no	ot immerse the battery i	in liquid such as water, beverages, or other fluids.					
	-	· ·	nage the battery or the battery pack (including pro rate heat, smoke, catch fire, or explode.	otection c	rcuit). As a			
(2)	High	Temperature						
	Do no	ot use or place the batte	ery near an open flame, heater or high temperature	(above 8	0°C).			
	-		th temperature may damage the polyolefin separate ay cause the battery to generate heat, smoke, catch					
(3)	Char	gers and Charge Co	onditions					
	Do no	ot use unauthorized cha	argers.					
		of an unauthorized cha	nin specified conditions (e.g., temperature range, v arger could cause the battery to generate heat, s	•	,			
(4)	Reve	erse Polarity						
	Do no	ot attach or insert batte	ry 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)	Direc	t Connection						
		-	o an AC outlet or DC automotive plug.					
	batter	y may generate heat, s	cific charger. If the battery is connected directly to smoke, catch fire, or explode.	a powei	outlet, the			
(6)	Use	in Other Equipment						
	Do no	ot use the battery in equ	uipment for which it was not intended.					
		battery is used in unap ate heat, smoke, catch	pproved applications or systems, the battery may be i fire, or explode.	ecome da	maged and			
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				i ayc	5/15		
(7)	Incin	eration and Heat					
	Keep	the battery away from	heat and fire.				
	Heat	will damage the battery	and may cause it to generate heat, smoke, catch fi	re, or exp	olode.		
(8)	Shor	t-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)	Impa	act					
	Avoid	l excessive impact to th	ne battery.				
	Impact beyond specification may damage the battery. This may cause the battery to leak, generate heat, smoke, catch fire, or explode.						
(10)	Pene	etration					
	Do no	ot 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 generate heat, smoke, catch fire, or explode.						
(11)	Sold	ering					
	Do no	ot directly solder to the	battery.				
		• •	tery could melt the separator or damage the gas r ay cause the battery to generate heat, smoke, catch				
(12)	Disa	ssembly					
	Do no	ot disassemble the batt	ery.				
		•	of the battery may damage the protection circuit. oke, catch fire, or explode.	This may	/ cause the		
(13)	Chai	rge near High Temp	eratures				
	Do no	ot charge the battery ne	ear high temperature.				
		ate and prevent chargin	hile exposed to high temperature, the battery's pring, or fail and cause the battery to generate heat, s		-		
(14)	Defo	rmation					
		•	onspicuous damage or deformation. It, smoke, rupture or flame.				
(15)	Reve	rse Charge and Ove	erdischarge				
		ot reverse polarity (and			d -1		
	On charging, the battery is reverse-charged and abnormal chemical reaction occurs. And also, there may be case that unexpected large current flows on discharging. These cause the generating heat, smoke, rupture or flame.						
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Title		Lithium Ion E	Battery Specification (Cylindrical Type)	Page	4/13					
		1		<u> </u>						
	Warning									
(1)	Inge	stion								
	Кеер	away from small childr	en.							
	-	the battery away from medical attention imme	small children. If the battery or any of its compone ediately.	nt parts is	swallowed,					
(2)	Stora	age								
	Do no	ot place the battery in o	r near a microwave or other cooking appliances.							
		jected to heat or electr r explode.	omagnetic radiation, the battery may leak, general	e heat, sr	noke, catch					
(3)	Mixe	d Use								
	Do no	ot mix with other batteri	es.							
		•	used with other batteries having a different ca d cause the battery to generate heat, smoke, catch		•					
(4)	Rust	, Discoloration and I	Deformities							
	Do no	ot use abnormal batteri	es.							
	Immediately stop using the battery if there are noticeable abnormalities, such as smell, heat, discoloration, or deformity. The battery may be defective and could generate heat, smoke, catch fire, or explode with continued use.									
(5)	Char	ging Time								
	Stop	charging if the charging	g process cannot be finished.							
		•	sh the charging process within the specified tim nerate heat, smoke, catch fire, or explode.	e, halt th	ne charging					
(6)	Leak	age ①								
	Do no	ot use a leaking battery	near open flame.							
		• •	g from the battery has an irritating odor, the battery osed to an open flame, the battery could ignite and		e kept away					
(7)	Leak	age 2								
	Do no	ot touch a leaking batte	ry.							
		•	ery gets into your eyes, immediately flush your eyes t untreated, it will cause significant eye damage	with clea	n water and					
(8)	seek medical attention. If left untreated, it will cause significant eye damage. 3) Transport									
(-)	Pack the battery securely for transport.									
			amage during transport, securely pack the battery in	ו a case c	r carton.					
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Ti	itle	Lithium Ion E	Battery Specification (Cylindrical Ty	ype)	Page	5/13			
	Caution								
(1)	(1) Exposure to Direct Sunlight Do not use or leave the battery in a location exposed to excessive heat, such as in direct sunlight or in a car. Doing so could cause the battery to generate heat, smoke, catch fire, or explode. It may also cause the battery's performance and life to deteriorate.								
(2)	The t 100V	• •	ection circuit. Do not use the battery w y damage the protection circuit. If the p e, smoke, or explode.		-				
(3)	Only cause		ween 10°C and 45°C. Charging outsid enerate heat, or result in serious damag		•	• •			
(4)	Man Read		e. Keep for future reference.						
(5)		ging Method the charger's manual l	before use for proper charging method.						
(6)	Pleas	Time Usage se contact the supplier i prior to its initial use.	f the battery gives off an unusual odor, g	generates he	at, or sho	ows signs of			
(7)	Parer	•	to use the system and the battery. P e system and the battery correctly.	lease check	back pe	riodically to			
(8)		mable Materials	near flammable materials. Doing so cou	uld result in fi	re.				
(9)	Leak	age	battery and comes into contact with s			liately flush			
(10)	D) 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 generate heat, smoke, catch fire, or explode; or the combustion of other materials.								
(11)	Recy Wher	•	ry, recycle it according to local rules an	d regulations					
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# 3 Scope

This specification applies to the Lithium Ion Battery NCR18650G-H0ANA .

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-A300230AA
4.3	Model Name	NCR18650G-H0ANA
4.4	Cell Type	NCR18650GA

### 5 Nominal Specifications

	Item			Specifications	Notes
5.1	Rated Capacity			3300mAh	0.67A discharge at 20°C
5.2	Capacity (Minimum) *	۰1		3350mAh	0.67A discharge at 25°C
5.3	Capacity (Typical)			3450mAh	Reference only
5.4	Nominal Voltage			3.6V	0.67A discharge
5.5	Discharging End Volt	age		2.5V	
5.6	Charging Current (Sto	d.)		1.675A	
5.7	Charging Voltage			4.20 ± 0.03V	
5.8	Charging Time (Std.)			4.0hours	
5.9	Continuous Discharge	e Curr	ent (Max.) * <sup>2,3</sup>	10A	0 ~ +40°C
5.10	Internal Resistance			less than $38m\Omega$	AC impedance 1 kHz
5.11	Weight			less than 49.5g	
5.12	Operating Temperatu	re	Charge	10 ~ +45°C	
			Discharge	-20 ~ +60°C	
5.13	Storage Conditions	less	than 1 month	-20 ~ +50°C	
		less	than 3 months	-20 ~ + 40°C	Recoverable Capacity: 80%* <sup>4</sup>
			s than 1 year	-20 ~ + 20°C	

\*1 Capacity is measured by the discharge at 0.67A until end voltage of 2.5V after fully charged at 25°C as described in the specification.

\*2 Discharge at high rate or high temperature environment will accelerate the degradation of the battery capacity.

\*3 The maximum discharge current for a single cell use. However after the battery pack assembly , maximum discharge current will be limied by a protection circuit or device.

*4 R	ecoverable Capacity = -	Discharge Time after Storage	* 100		
		<i>Initial Discharge Time</i> ed by fully charging the battery	at 25°C and then discharging it at a current of 0.67A		
	5V per cell in series. num cell surface tempera	ture :The cell temperature mus	t not exceed 70°C.		
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Т	ītle	Lith	nium Ion E	Battery Specification (Cylindrical Type)	Page	7/13
6	Elec	trical Cha	racterist	ics		
	lte	em		Conditions	C	Criteria
6.1	Full (	Charge	voltage re	ery is charged at a 1.675A constant current until the eaches 4.20V. The current is then reduced to keep a voltage of 4.20V. The total charging time is 4.0 hours		
6.2	Сара	ıcity	. ,	n 1 hour after fully charging at 25°C as per item 6.1, attery is discharged at 0.67A continuously to 2.5V at	More than 300 min.	
			. ,	n 1 hour after fully charging at 25°C as per item 6.1, attery is discharged at 3.35A continuously to 2.5V at	More than 54 min.	
6.3	6.3 Cycle Life		After the battery has been subjected to 300 repeated charge and discharge cycles (charged by CC-CV of 1.675A-4.20V for 4.0 hours; discharged by CC of 3.35A to 2.5V at 25°C), the discharge time is measured as per Item 6.2, (2).		More t	nan 38 min.
6.4	6.4 Temperature Characteristics		(1) Within 1 hour after fully charging at 25°C as per item 6.1, the battery is stored at 0°C for 3 hours. The discharge time is then measured as per Item 6.2, (2) at 0°C.		More t	nan 30 min.
			(2) Within 1 hour after fully charging at 25°C as per item 6.1, the battery is stored at 60°C for 3 hours. The discharge time is then measured as per Item 6.2, (2) at 60°C.			nan 50 min.
6.5	6.5 Storage at Fully Charged State		After fully charging at 25°C per item 6.1, 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 6.2, (2).		More t	nan 30 min.
			Then, the same battery is fully charged again and discharged a second time and measured as per Item 6.2, (2) at 25°C.		nan 40 min.	
6.6 Storage at Full Discharged State		Item 6.2, After stor	charging at 25°C, the battery is discharged as per (2). Then, the battery is stored for 20 days at 60°C. age, the battery is held at 25°C for 3 hours. Then, the time is measured as per Item 6.2, (2) at 25°C.	More th	an 50 min.	
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	•						
lt	em		Conditions	С	Criteria		
6.7 Drop		-	irections from a height of 1 m onto a flat surface of	No ruptu	re, 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 <i>JIS Z 8703, Standard</i> <i>Atmospheric Conditions for Testing</i> ). The precision of the voltmeter and ammeter used in the tests shall be higher than Class 0.5 as specified by <i>JIS C 1102-2, Special Requirements for Ammeters and</i> <i>Voltmeters</i>							
The	<ul> <li>7 Design and Dimensions</li> <li>The battery design is shown in the following documents or drawings.</li> <li>Drawing number [NCR18650G-H0ANA01,AUR18650-SIYOUZ2-20]</li> </ul>						
Ther the c	<ul> <li>There shall be no such defects as followings, which may adversely affect commercial value of the cell:</li> <li>Scratch</li> <li>Rust</li> <li>Discoloration</li> <li>Dirt</li> <li>Deformation</li> </ul>						
<ul> <li>9 State of Charge at Time of Shipment         The battery is shipped out with a state of charge that is approximately 48%*.         * The 48% capacity is the state of charge at the time that SANYO ships the battery. It is not the state         of charge when BATTERIEN-MONTAGE-ZENTRUM GMBH receives the battery.     </li> </ul>							
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# 10 Precautions for Designing of the Pedelecs, the Chargers and the Battery packs.

# 10.1 Precautions for Designing of Pedelec and the Charger.

- (1) Charge
  - The battery is charged by a method of constant current-constant voltage.
  - Regarding NCR18650G-H0ANA, the charging current should not exceed 3.35A/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 2.5V/cell, the battery should be charged by pre-charge current of maximum 0.33A. 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 recovers 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 10°C to +45°C.
- (2) Discharge
  - The discharge current should not exceed 10A/cell.
  - The discharge temperature should be between  $-20^{\circ}$ C to  $+60^{\circ}$ C.
  - 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 Pedelecs and chargers.

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

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### 10.2 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 ultra sonic welding method is applied to the case sealing, SANYO will not accept 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

For safety reason and in order not to shorten the cycle life, max overcharge protection voltage of each block should be under 4.25V/cell including tolerance.

### 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  $1\mu$ A.

### Over current protection

If discharge current exceeds approximately 10A/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.

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### **11 Storing Condition**

### 11.1 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.

### 11.2 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 9 is recommended.

### 12 Handling Precautions for Lithium Ion Cells

 This section describes handling precautions for lithium ion cells which will be assembled as battery packs with BATTERIEN-MONTAGE-ZENTRUM GMBH. This battery pack consists of NCR18650GA.

### **12.1 Series Connections Precautions**

• When the cells are connected in series, use the same rank cells. This information is described in the label on the carton. In addition, the cell voltage should be checked and the voltage should be within 20mV.

\* Lot number on carton label.

### 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 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 pouch 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 batter

# 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, Pedelecs, or chargers.
- SANYO will not accept return of any abnormal cells that were damaged 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 specification or precautions that are not described in this specification.
- Do not use the provided cells for other applications.

### 15 Standard Charging Method

The standard charge condition is a constant current – constant voltage method with a current of 1.675A and a maximum voltage of 4.20V. The charging process should be halted when either time, battery voltage, or current reach certain values.

When the battery is in a state of over-discharge (the battery voltage is less than 2.0 V per cell), the battery should be charged by a pre-charge circuit to prevent heat generation in the charge FETs.

The pre-charging current should be approximately 0.33A. Once, the battery voltage reaches more than 2.5V per cell, 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 over 2.5V per cell 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 SANYO for instruction on the charge method.

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# **16 Battery Warranty Period**

Unless otherwise stated in the contract, the warranty period is limited to one year from date of shipment. Panasonic will replace batteries if it is clear that there was a defect in Panasonic's manufacturing process and that the battery hasnot been misused.

# 17 Battery Safety Requirements

In order to ensure the safety of the battery, please contact SANYO 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 SANYO before finalizing the product specification.

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