

TENTATIVE

File No. UR1865-2981

**SANYO LITHIUM ION
BATTERY SPECIFICATIONS**

BATTERY CLASSIFICATION LITHIUM ION BATTERY

BATTERY TYPE UR18650RX

PURCHASER

【 ACCEPTANCE 】

Accepted by: _____

Name in block letters: _____

Date: _____

*In case of not returning your signed specifications until 30 days from our submission,
it is considered that you agree to this specification.

SANYO Electric Co., Ltd.

Energy Devices Company
Lithium-Ion Battery Division
Battery System Development Management Department
PA · BA Technical Service Department
PA Business Development

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Specification Change History

No.	Date	Class	Main Changed Item	Drw.	Chk.	App.
(0)	2011/12/15	-	Issue(Tentative)	Drw.		Y. Kageyama <i>Y. Kageyama</i>
				Chk.		K. Matsuo <i>K. Matsuo</i>
				App.		M. Seki <i>M. Seki</i>
				Drw.		H. Matsui <i>H. Matsui</i>
				Chk.		
				App.		
				Drw.		
				Chk.		
				App.		
				Drw.		
				Chk.		
				App.		

* : Class A,D and R means added, deleted and revised, respectively.

1. Extent of the Application

This specification is applied to the SANYO Lithium Ion Battery of UR18650RX

2. Battery Classification and Type

2.1 Battery Classification SANYO Lithium Ion Battery
 2.2 Battery Type UR18650RX

3. Nominal Specifications

Item		Specification	Remark
3.1	Nominal Capacity * ¹	1950mAh	0.39A discharge
3.2	Nominal Voltage	3.60V	0.39A discharge
3.3	End Voltage	2.75V	
3.4	Charging Current (Std.)	1.36A	
3.5	Charging Voltage	4.20V	
3.6	Charging Time (Std.)	3.0hours	
3.7	Discharging Current (Std.) * ²	1.95A	
3.8	Continuous Discharging Current (Max.) * ² * ³	20A	
3.9	Internal Resistance	less than 25mΩ	AC Impedance 1kHz
3.10	Weight	less than 46.2g	
3.11	Operating Temperature	Charge	0 ~ +40°C
		Discharge	-20 ~ +60°C
3.12	Surroundings Temperature Range for Shipped Battery	less than 1month	-20 ~ +50°C
		less than 3months	-20 ~ +40°C
		less than 1year	-20 ~ +20°C
			Percentage of recoverable capacity 80% * ⁴

※1 Nominal capacity is measured by the discharge at 0.39A to 2.75V end voltage after fully charged according to specification at approximately 25°C.

※2 Discharged at high rate and high temperature frequently, battery life will be shorten.

※3 Maximum discharge current as a single cell state is as above stated. However after assembling to the battery pack, there is the limitation of maximum discharge current because of protection circuit and protection device.

※4 Percentage of recoverable capacity

= (discharging time after storage/ Initial discharging time) × 100

Discharging time is measured by the discharge at 0.39A to 2.75V end voltage after fully charged according to specification at approximately 25°C.

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4. Electrical Characteristics				
Item	Test Method		Criterion	
4.1 Full Charge	The charger supply 1.36A constant current until battery voltage reaches 4.20V, then be changed at constant voltage of 4.20V while tapering the charge current. Charging time is 3hours in all. Charging temperature is 25°C.			
4.2 Capacity	① Within 1hour after fully charged at 25 °C , discharge at 0.39A continuously down to 2.75V end voltage at 25°C.		300min. or more	
	② Within 1hour after fully charged, discharge at 1.95A continuously down to 2.75V end voltage at 25°C.		54min. or more	
4.3 Cycle Life	The cell shall be repeated 300 charge/ discharge cycles at 25°C, charged at CC-CV (1.36A-4.20V) for 3hours, discharged at 1.95A to 2.75V end voltage. After 300cycles, discharging time is measured as specified in paragraph 4.2.②.		38min. or more	
4.4 Temperature	① Within 1hour after fully charged at 25°C, the cell is stored at 0°C for 3hours. Discharging time is measured as specified in paragraph 4.2.② at 0°C.		30min. or more	
	② Within 1hour after fully charged at 25°C, the cell is stored at 60°C for 3hours. Discharging time is measured as specified in paragraph 4.2.② at 60°C.		50min. or more	
4.5 Full Charged State Storage	① After fully charged at 25°C, stored for 10days at 60°C and rested at 25°C for 3hours. Discharging time is measured as specified in paragraph 4.2.②.		35min. or more	
	Then next discharge time is measured as specified in paragraph 4.2.②.		45min. or more	
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4.6 Full Discharged State Storage	<p>②After fully charged at 25°C, stored for 20days at 60°C and rested at 25°C for 3hours. Discharging time is measured as specified in paragraph 4.2.②.</p> <p>Then next discharge time is measured as specified in paragraph 4.2.②.</p> <p>After fully charged at 25°C and discharged as specified in paragraph 4.2.②, then store for 10days at 60°C and rest at 25°C for 3hours. Discharging time is measured as specified in paragraph 4.2.②.</p>	30min. or more	40min. or more
4.7 Drop	<p>After fully charged at 25°C, the cell is dropped 3 times in random direction from a height of 1m onto a flat surface of concrete.</p>	50min. or more	No rupture, no fire
<p>STANDARD TEST CONDITIONS:</p> <p>The battery used for the test mentioned above should be new one delivered a week before at most. The test shall be performed at $25 \pm 2^\circ\text{C}$ (Standard temperature of second grade adopted in <i>JIS Z 8703</i>(Standard Test Conditions)), $65 \pm 20\%$ (Standard humidity of twentieth grade adopted in <i>JIS Z 8703</i>(Standard Test Conditions)). The grade of voltmeter and ammeter used in the test shall be higher than class 0.5 adopted in <i>JIS C 1102</i>(Electric Indicator)</p> <p>5. Design, Construction</p> <p>The cell shall be of the design, construction and physical dimensions shown in the attached drawing. (Drawing No.AUR18650RX)</p> <p>6. Appearance</p> <p>There shall be no practical damage such as conspicuous liquid electrolyte leakage, flaw electrolyte leakage, flaw, rust, dirt, and deformation. The battery must have marketability.</p> <p>7. Shipment</p> <p>The cell shall be shipped in 40% charged state. It is not specified more than 40% capacity remain at because of self discharge.</p>			
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<p>8. Precautions on Design of Power Tool, Charger and Battery Pack</p> <p>8-1. Precautions on Design of Power Tool and Charger.</p> <p>① Charge</p> <ul style="list-style-type: none"> · A battery must be charged with constant current-constant voltage. · In case of UR18650RX, charge current must be below 3.9A/cell. · Charge voltage must be set 4.20V/cell or less. Concerning charge voltage tolerance of charger, charge voltage is recommended to set below 4.20V/cell. Even if the charge control could be out of order, cell voltage should not be above 4.25V/cell. · Have pre-charge system in charger. In case of a battery voltage is below 3.0V, a battery should be charged with pre-charge that current is below 0.19A. Then a battery voltage reaches over 3.0V, standard charge starts. And if a battery voltage never reaches to 3.0V in specified period (timer), charger stop charging. · Have full charge detection in charger. By timer, current detection and open circuit voltage detection, charger detects full charge. When charger detects full charge, charger stops charging. Do not use the continuous charging (trickle charging) method. · Charger should start charging at temperature range 0~+40°C. <p>② Discharge</p> <ul style="list-style-type: none"> · Discharge current must be below 20A/cell. · Discharge temperature range should be -20~+60°C. (1.95A discharge base) · Discharge end voltage must be over 2.75V/cell. <p>③ Over Discharge</p> <ul style="list-style-type: none"> · Do not over-discharge a battery below 2.0V/cell. <p>④ Battery Position in Power Tool and Charger.</p> <ul style="list-style-type: none"> · To avoid degradation of battery performance by heat, a battery should set the place apart from heat generating electronic parts inside Power Tool and charger. <p>8-2. Precautions on Battery Pack Design.</p> <p>① Battery pack Shape, Mechanism and Material</p> <ul style="list-style-type: none"> · Do not make the shape which easy connect to other chargers exclusive of charger. · Do not make the shape and mechanism which easy use another equipment exclusive of Power Tool and charger. · Do not make the terminal shape which easy cause short circuit by metal object such as necklaces, hairpins, etc. And further, have over current protection function to prevent outer short circuit. · Do not make the terminal shape and mechanism which connect reverse to equipment. · Do not make the shape and mechanism which static electricity and water easy go through the battery pack inside. · Make the shape and mechanism which can inspect protection circuit function (specified paragraph 8-2②) before the battery pack makes completely. 			
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<ul style="list-style-type: none"> · Fix cells with mold case by rib, tape, glue etc., but do not make damage cells (especially sealing part) by rib or sharp part of mold case. In case of the battery pack is struck by hard shock or vibration, the battery pack has possibility to cause leakage, smoke, explosion. · Weld mold case by glue. Not weld mold case by ultra sonic welding. If the ultra sonic is used for welding of mold cases, SANYO will not accept any responsibility for any defects. · Make the structure where the end user cannot remove the pack easily. <p>② Protection Circuit</p> <p>Have protection circuit function which is described below inside battery pack, to insure safety of battery in case of misuse.</p> <ul style="list-style-type: none"> · Overcharge Protection The overcharge protection should work when the cell voltage or the voltage of cell block will be over 4.25V. However, in case that the charge system can control the cell voltage or the voltage of cell block within 4.25V, the overcharge protection can be controlled near 4.25V. · Over Discharge Protection At the voltage range 2.20~2.40V/cell, over discharge protection should work. Then discharge current shall be shut down and consumption current is below 1μA. · Over Discharge Current Protection When discharge current exceed about 20A, over discharge current protection should work. Then over discharge current shall be shut down. <p>③ Electric Circuit</p> <ul style="list-style-type: none"> · To avoid to discharge during storage, design the low consumption current electronic circuit (e.g. Protection circuit, fuel gauge, etc) inside battery pack. <p>④ Battery Connection</p> <ul style="list-style-type: none"> · Do not solder onto a cell in order to avoid a damage on the cell. Weld spot welding lead plate onto cell, and solder lead wire or lead plate. <p>⑤ Precautions on Label</p> <ul style="list-style-type: none"> · Write information and precautions on label. Precautions are based on chapter 14. Write the precaution manual based on chapter 14. <p>9. Storage Condition</p> <p>9-1 Storage Temperature and Humidity (less than 3 months)</p> <ul style="list-style-type: none"> · Store the cell at temperature range -20~+35$^{\circ}$C, low humidity (less than 70%RH) and no corrosive gas atmosphere. · No condensation on the cell. 				
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<p>9-2 Long Period Storage</p> <ul style="list-style-type: none"> · In case of long period storage, store the cell at temperature range -20~+20°C, low humidity (less than 70%RH), no corrosive gas atmosphere. And in this case, charge condition of the cell is SANYO shipment charge state or discharge state. · No condensation on the cell. <p>10. Precautions on Handling Lithium Ion Cells</p> <p>In term of shipping and assembling the battery pack, this chapter describes precautions on handling SANYO lithium ion cells, which are assembled for Power Tool's battery packs by This battery pack consists of UR18650RX.</p> <p>10-1 Expiration Date</p> <ul style="list-style-type: none"> · Assemble single cell(s) into battery pack within 1 month after delivery. <p>10-2 Precautions on Series Connection of Cell</p> <ul style="list-style-type: none"> · When the cells are connected in series, use same rank cells, use same lot number cells and use same charging date cells. These date show label for carton on the master carton. Further, the cell's voltage has to be checked and confirm the voltage to be within 25mV voltage difference. * Lot number on carton label. <p>10-3 Inspection Before Shipment of The Battery Pack</p> <ul style="list-style-type: none"> · About all battery pack, inspect voltage, internal impedance and function of protection circuit before shipment. <p>10-4 Packing and Shipping Cells</p> <ul style="list-style-type: none"> · When cells are re-shipped to assembling factory, make enough attention the packing to avoid stress by shipping. SANYO recommends the same package shipped from SANYO when re-shipping. Even if after open package, when re-shipping, use the same parts and materials from SANYO for re-packing. <p>10-5 Abnormal Cell</p> <ul style="list-style-type: none"> · Do not use abnormal cell which has damages by shipping stress, drop, short or something else, and which gives off electrolyte odor. <p>11. Exemption from Warrantee</p> <ul style="list-style-type: none"> · SANYO will not be responsible for trouble occurred by handling outside of the precautions in this specification. · SANYO will not be responsible for trouble occurred by matching electric circuit, battery pack, Power Tool and charger. · SANYO will be exempt from warrantee any defect cells during assembling after acceptance. 				
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<p>12. Other Remarks</p> <ul style="list-style-type: none"> · If there are problems in this specification, SANYO can consider to change specification after discussion. · About the things not covered by this specification, SANYO will have discussion. · Do not use this cell for other models or equipment. <p>13. Standard Charging Method</p> <p>(1) If the cell voltage drops to 0V as a result of storage and the cell is charged at this condition, the FET on the protection circuit may generate heat. The charger must have the pre-charge system.</p> <p>(2) Pre-charge current of charger should be approximately 0.19A. When the cell voltage becomes 3.0V/cell, standard charge should be started. When the cell voltage is less than 3.0V/cell even after the set period of timer, charging should be stopped.</p> <p>(3) Rapid charge is 3.9A/cell -4.20V/cell (Constant current-constant voltage). Charging should be suspended when the time, OCV or current is certain value.</p> <p>(4) The maximum current of the cell is 3.9A. Charging current of charger must not exceed 3.9A/cell.</p> <p>(5) The cell could be worked the current interrupt device by continuous charging, especially under the high temperature atmosphere. Therefore, do not use the continuous charging (trickle charging) method or the short term re-charging (supplementary charging) method. Please consult SANYO regarding the detail for charging method.</p> <p>14. Safety Instruction</p> <p>Prohibition Points on Handle</p> <p>The cell includes the flammable objects such as the organic solvent. If the handling is missed there will be possibility that the cell rupture flames or hot, or it will cause the deterioration or damage of cell. Please observe the following prohibitive matters. And also, add the protection device the equipment for fear that the trouble would affect the battery by the abnormality of equipment. In addition, mention the following matters as "Prohibition Points on Handle" in the instruction manual of the equipment.</p>				
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! D a n g e r

1. Immersion

"Do not immerse the battery in water or sea water, or get it wet"

If the protection circuit included in the battery is broken, the battery will be charged at extreme current or voltage and the abnormal chemical reaction occurs in it. And then it causes the generating heat, smoke, rupture or flame.

2. Use Nearby Heated Place

"Do not use or leave battery nearby fire, stove or heated place (more than 80°C)"

In case that separator made of polymer is melted by high temperature, the internal short-circuit occurs in individual cells and then it causes the generating heat, smoke, rupture or flame. In addition, do not use the battery under the heated place (more than 80°C) for same reason.

3. Charger and Charge Condition

"Do use the specified charger and observe charging requirement"

If the battery is charged with unspecified condition (under high temperature over the regulated value, excessive high voltage or current over regulated value, or remodeled charger), there are cases that it will be overcharged or the abnormal chemical reaction will occur in cells. It causes the generating heat, smoke, rupture or flame.

4. Reversed Polarity Use

"Do not reverse-charge or reverse-connect"

The battery has polarity. In case the battery is not connected with charger or equipment smoothly, do not force them to connect and do check polarity of battery. If the battery is connected to opposite polarity with charger, it will be reverse-charged and abnormal chemical reaction will occur. It causes the generating heat, smoke, rupture or flame.

5. Connect Battery to the Plug

"Do not connect battery to the plug socket or car-cigarette-plug"

Added high voltage to the battery, the excessive current will flow in it and then it will cause the generating heat, smoke, rupture or flame.

6. Inappropriate Use for Other Equipment

"Do not use battery for other equipment"

If the battery is used for unspecified equipment, it will deteriorate its performance and cycle-life. At worst, abnormal current will flow or battery may generate heat, smoke, rupture or flame.

7. Incineration and Heating

"Do not incinerate or heat the battery"

These occur the melting of insulator, damage of gas release vent or safety function, or ignition on electrolyte.

Above mentioned matters cause the generating heat, smoke, rupture or flame.

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<p>8. Short-Circuit <i>"Do not short-circuit battery"</i> Do not connect the + and - terminals with metals (such as wire). Do not carry or store the battery with metal objects (such as wire, necklace or hairpins). If the battery is short-circuited, excessive large current will flow and then the generating heat, smoke, rupture or flame will occur. And also, it causes generating heat at metals.</p> <p>9. Impact <i>"Do not give battery impact or throw it"</i> The impact might cause leakage, heat, smoke, rupture, and/ or fire of cell in the battery. And also if the protection circuit in the battery is broken, the battery will be charged at abnormal voltage or current, and abnormal chemical reaction might occur. It might cause leakage, heat, smoke, rupture, and/ or fire.</p> <p>10. Penetration <i>"Do not drive a nail into the battery, strike it by hammer, or tread it"</i> As the battery might be broken or deformed and then it will be short-circuited, it causes the generating heat, smoke, rupture or flame.</p> <p>11. Soldering <i>"Do not make the direct soldering on battery"</i> As the insulator is melted by heat or the gas release vent (or safety function) is broken, it causes the generating heat, smoke, rupture or flame.</p> <p>12. Disassemble and Reconstruction <i>"Do not disassemble or reconstruct battery"</i> The battery pack has safety function and protection circuit to avoid the danger. If they have serious damage, it will cause the generating heat, smoke, rupture or flame.</p> <p>13. Charge Nearby Heated Place <i>"Do not charge battery nearby the fire or under the blazing sun"</i> If the protection circuit to avoid the danger works under high temperature or it is broken, the battery will be charged at abnormal current (or voltage) and abnormal chemical reaction will occur. It causes the generating heat, smoke, rupture or flame.</p> <p>14. Deformation <i>"Do not use the battery with conspicuous damage or deformation"</i> It causes the generating heat, smoke, rupture or flame.</p> <p>15. Reverse Charge and Overdischarge <i>"Do not reverse polarity (and terminals) "</i> 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.</p>				
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! W a r n i n g

1. Ingestion

"Keep the battery away from babies"

Keep the little battery out of the reach of babies in order to avoid troubles by Swallowing. In case of swallowing the battery, see a doctor immediately.

2. Store

"Do not get into a microwave or a high pressure container"

It causes the generating heat, smoke, rupture or flame because of a sudden heat or damage of sealing condition of battery.

3. Mixed Use

"Do not use Lithium ion battery in mixture"

Do not use Lithium ion battery with the primary batteries or secondary batteries whose capacity or kinds or maker is different. If do that, the battery will be discharged or charged excessively in use. And it may cause the generating heat, smoke, rupture or flame because of the abnormal chemical reaction in cells.

4. Rust, Changing Color and Deformation

"Do not use an abnormal battery"

In case the battery has bad smell or is generated its changing color or deformation or causes something wrong in using (includes charging and storage), let it take out from equipment or charger and do not use it. If an abnormal battery is used, it will generate heat, smoke, rupture or flame.

5. Charging Time

"Do not continue to charge battery over specified time"

If the battery is not finished charging over regulated time, let it stop charging. There is possibility that the battery might generate heat, smoke, rupture or flame.

6. Leakage

"Do not use a leaked battery nearby fire"

If the liquid leaks from the battery (or the battery gives out bad smell), let the battery leave from flammable objects immediately. Unless do that, the electrolyte leaked from battery will catch fire and it will cause the smoke, flame or rupture of it.

7. Leakage

"Do not touch a leaked battery directly"

In case the leaked electrolyte gets into eyes, wash them with fresh water as soon as possible without rubbing eyes. And then, see a doctor immediately.

If leave damaged eyes undone, it will cause eye-trouble.

8. Transport

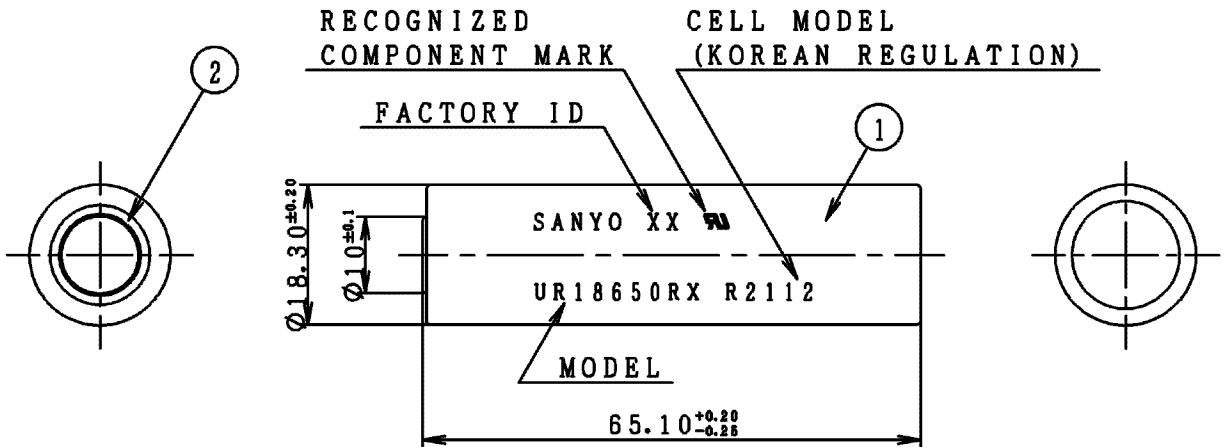
"Do not pack battery unstable"

Please fix the battery stable and pack in case, if the battery is transported. It will cause the deterioration, damage or short of the battery.

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<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>! C a u t i o n</p> </div> <ol style="list-style-type: none"> <li data-bbox="108 344 1482 495"> <p>1. Use Under Strong Sunshine Do not use or leave the battery under the blazing sun (or in heated car by sunshine). The battery may generate heat, smoke or flame. And also, it might cause the deterioration of battery's characteristics or cycle life.</p> <li data-bbox="108 521 1482 703"> <p>2. Static Electricity The battery pack has the protection circuit to avoid the danger. Do not use nearby the place where generates static electricity (more than 100V) which gives damage to the protection circuit. If the protection circuit were broken, the battery would generate smoke, rupture or flame.</p> <li data-bbox="108 730 1482 920"> <p>3. Charging Temperature Range Charging temperature range is regulated between 0°C and 40°C. Do not charge the battery out of recommended temperature range. Charging out of recommended range might cause the generating heat or serious damage of battery. And also, it might cause the deterioration of battery's characteristics and cycle life.</p> <li data-bbox="108 947 1482 1061"> <p>4. Manual Please read the manual before using the battery and let it keep after reading. And also, please reread if necessary.</p> <li data-bbox="108 1088 1482 1160"> <p>5. Charging Method Please read the manual of specified charger about charging method.</p> <li data-bbox="108 1187 1482 1301"> <p>6. First Time Use When the battery has rust, bad smell or something abnormal at first-time-using, do not use the equipment and go to bring the battery to the shop which it was bought.</p> <li data-bbox="108 1328 1482 1476"> <p>7. Used by Children In case younger children use the battery, their parents teach how to use batteries according to the manual with care. And also, when children are using the batteries, pay attention to use it according to that or not.</p> <li data-bbox="108 1503 1482 1617"> <p>8. Inflammable Materials Do not cover with or put on inflammable materials for charge/ discharge battery. It may cause the generating heat, rupture and flame.</p> <li data-bbox="108 1644 1482 1758"> <p>9. Leakage If the skin or cloth is smeared with liquid from the battery, wash with fresh water. It may cause the skin inflammation.</p> <li data-bbox="108 1785 1482 1899"> <p>10. Insulation Please insulate exposed lead wire and metal terminals by vinyl tape and so on. It may cause the generating heat, rupture and flame because of battery short.</p> 				
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<p>15. Warranty Period of Battery</p> <p>The warranty period of a cell is for one year after shipment. However, if a cell causes unusual operation within this period, SANYO will replace by a new cell for free as long as it is clear that the cause of the failure is in the cell manufacturing process and the cell has not been used in the abnormal condition.</p> <p>16. Requirement for Safety Assurance</p> <p>For the sake of safety assurance, please discuss the equipment design, its system and protection circuit of Lithium ion battery with SANYO in advance. And also, consult SANYO about the high rate current, rapid charge and special application such as extreme condition and / or environment.</p> <p>17. Effectiveness of This Specification</p> <p>① This specification has effectiveness for 6 months.</p> <p>② In case of _____ receives permanent specification, please abrogate or send back this specification to SANYO.</p> <p>③ The standardized figure stated in this specification is tentative value.</p>				
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NO.	PART NAME	APPLICATION PART CODE	QTY.	MATERIAL SPECIFICATION	NOTE
	BATTERY		1	UR18650RX	SHIPPING WITH CHARGE
1	TUBE		1	PET	PET TUBE RED
2	INSULATION RING		1	PAPER 0.25t	BLUE GREEN



NOTE.

$\overline{\text{XXX}}$
 ↑ CHANGED CAREER (A, B, C, Z)
 ↑ WEEK (01, 02, . . . 48, 49, . . . 53)
 ↑ YEAR ('96=A, '97=B, . . '11=P, '12=Q, . . .)
 EX.) DEC. 16. 2011 P51A

DRAWING NOT TO SCALE

DATE	REMARK	SYMBOL	DATE	DESCRIPTION
DEC. 16. 2011				
DR K. Yoshimoto				
CHK	MODEL: UR18650RX		材料・規格	
CHK	CUSTOMER CODE:		MATERIAL	
CHK	TOLERANCE	WEIGHT	処理・加工	
ENG	250 < L	± 5	FINISH	
APP M. Kagoshima	< L ≤	±	部品名	完成電池
	50 < L ≤ 250	± 4	PART NAME	BATTERY PACK (finish goods)
	1 < L ≤ 50	± 3	PART CODE	
	L ≤ 18	± 2	DRAWING NO	AUR18650RX
		QTY	SCALE	Rev.
		1	1/1	