
FLYPOWER Battery Expert

FLYPOWER Li-ion BATTERIES SPECIFICATIONS **APPROVAL SHEET**

TO:

MODEL NO.: 18650 14.8V 13.2Ah (FlyPower Model 4S6P of FLC-18650-2200)

TOTAL PAGES: 12 pages including this cover page

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1. Scope

This specification governs the performance of the following FlyPower Li-ion cylindrical battery pack 18650 11.1V 11Ah.

FlyPower model: 4S6P of FLC-18650-2200.

Cell size: 18650.

The data involving the nominal voltage and the approximate weight of the batteries.

2. Product Specifications

No.	Item	Specification
1	Rated Capacity	13200mAh
2	Minimum Capacity	13000mAh
3	Nominal Voltage	14.8V
4	Charge Limited Voltage	$4.20^{+0.03}_{-0.02}$ V /cell
5	Discharge Cut-off Voltage	The min is 2.75V/cell, and the standard is 3.0V/cell
6	End-of-charge Current	100mA
7	Standard Charge	Constant Current: 0.1C(1320mA) Constant Voltage:4.2V/cell End-of-charge Current:100mA
8	Standard Discharge	Using 0.2C(2640mA) constant current discharge to the Discharge Cut-off Voltage. Quickly discharge current: 0.5C(6600mA)
9	Maximum Continuous Charge Current	0.5C (6600mA)
10	Maximum Continuous Discharge Current	0.5C (6600mA)
11	Operating Temperature Range	Charge: 0 ~ 45℃
		Discharge: -20 ~ 60℃
	Storage Temperature Range	-20 ~ 60℃
12	Operating And Storage Humidity Range	Less than 85%RH
13	Weight	1100.0g or less
14	Battery pack dimensions	70mm*74mm*112mm

3. Performance

No.	Items	Criteria	Test Conditions
1	Open Circuit Voltage	14.8~16.8V	Measure cells at $20 \pm 5^\circ\text{C}$ after received
2	Internal Impedance	$\leq 280\text{m}\Omega$	Measure cells using an alternate current impedance meter at 1kHz at $20 \pm 5^\circ\text{C}$ after received.
3	Rated Capacity(0.2C _{5A})	$\geq 12500\text{mAh}$	Standard discharged after the standard charged cells rest 10min at $20 \pm 5^\circ\text{C}$. Three

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			cycles are permitted.
4	High Rated Capacity(0.5C ₅)	≧ 12000mAh	Discharged at 1C ₅ A rate after the standard charged cells rest 10min at 20 ± 5°C. Three cycles are permitted.
5	Temperature Characteristics	Retention Capacity: 60°C ≧ 98%* initial capacity 20°C ≧ 100%* initial capacity 0°C ≧ 80% *initial capacity -20°C ≧ 60%* initial capacity Appearance: No deformation, leakage and ruptures.	Measured the high rate capacity as the initial capacity. Stored the recharged cells for 3 hrs at 60 ± 2°C, 20 ± 2°C, 0 ± 2°C, -20 ± 2°C, and then quickly discharged at this temperature, but Standard discharged at -20 ± 2°C exceptionally. Checked the cells' appearance after rest for 2 hours at room temperature.
6	Storage Characteristics	Retention Capacity: ≧ 80% initial capacity impedance increase: ≧ 70m Ω Swelling: ≧ 0.5mm Appearance: No leakage	Measured the high rate capacity as the initial capacity. Stored the recharged cells for 7 days at 60 ± 2°C and then rest for 2 hrs at room temperature, standard discharged after checked the cells' appearance and impedance.
		Retention Capacity: ≧ 90% initial capacity Recoverable Capacity: ≧ 95% initial capacity impedance: ≧ 280 m Ω Impedance Variation: ≧ ± 10 m Ω Swelling: ≧ 0.1mm Appearance: No leakage, damage	Measured the high rate capacity as the initial capacity. Stored the recharged cells for 30 days at room temperature. Quickly discharged after checked the cells' appearance and impedance. Measured recoverable quickly discharge capacity and recoverable impedance.
7	Cycle Life (20°C)	Retention Capacity: ≧ 80% initial capacity Impedance: ≧ 300m Ω Swelling: ≧ 0.3mm	Carry out 300 cycles (standard charge/ 0.5C discharge) at 20± 5°C.

4. Safety Characteristics

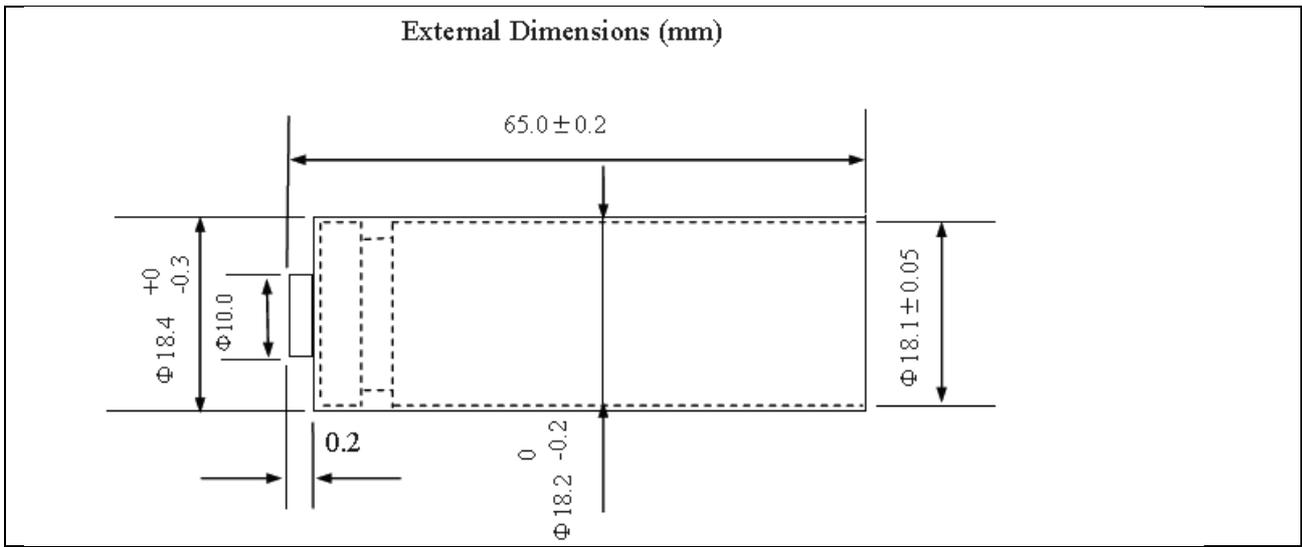
No.	Items	Criteria	Test Conditions
1	Overcharge Characteristics	The maximum Temperature: $\cong 150^{\circ}\text{C}$ Appearance: No rupture, fire, smoke, and leakage.	Charged the quickly discharged cells at 3C (6600mA) current with a voltage limit of 10V. Test can be terminated until constant voltage charge time is more than 8 hrs or charge current tapered less than 20mA.
2	Over-discharge Characteristics	The maximum Temperature: $\cong 150^{\circ}\text{C}$ Appearance: No rupture, fire, smoke, and leakage.	Reverse charged the standard charged cells at 3C (6000mA) current to -10V or until the Cell voltage indicates a positive $-\Delta\text{V}$ or discharge-time is more than 2.5 hrs.
3	Short-circuit Characteristics	The maximum Temperature: $\cong 150^{\circ}\text{C}$ Appearance: No rupture, fire, smoke, and leakage.	Rest cells for 30min at $25 \pm 2^{\circ}\text{C}$ after standard charged. Connect between Cell terminals with 1.5mm^2 copper lead (electric resistance: $50\text{m}\Omega$ or less) and leave for 1 hour..
4	Hot Oven Characteristics	The maximum Temperature: $\cong 200^{\circ}\text{C}$ Appearance: No explode	The standard charged cell is to be heated in a gravity convection or circulating air oven. The temperature of the oven is to be raised at a rate of $5 \pm 2^{\circ}\text{C}/\text{min}$. The oven is to remain for 10 minutes at $150 \pm 2^{\circ}\text{C}$ before the test is discontinued.
5	Impact Test	No fire, explode	After standard charged, the cell is to be placed on a flat surface. A 5/8inch (15.8mm) diameter bar is to be placed across the center of the sample. A 20 pound (9.1kg) weight is to be dropped from a height of 24 ± 1 inch ($610 \pm 25\text{mm}$) onto the sample.
6	Crush Test	No fire, explode	After standard charged, the cell is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram with a 1.25inch (32mm) diameter piston. The crushing is to be continue until a pressure reading of 2500 psig (17.2MPa) is reached on the hydraulic ram, applied force of 3000 pounds(13kN). Once the maximum pressure has been obtained it is to be released.

5. Cell Reliability Characteristics

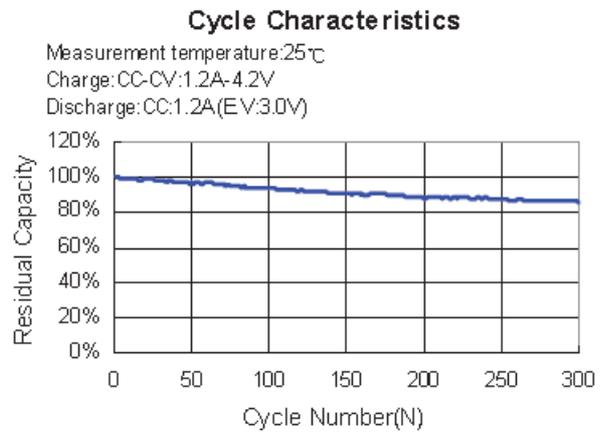
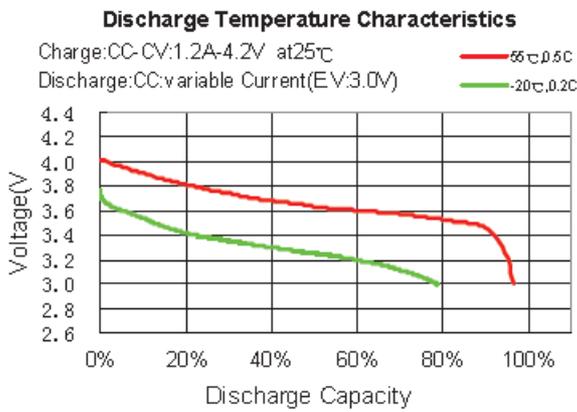
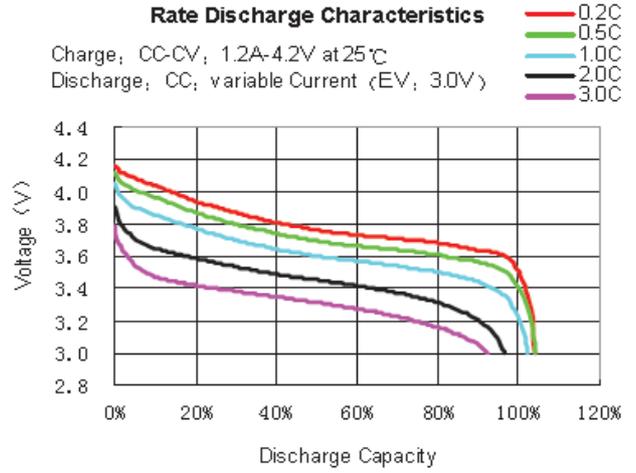
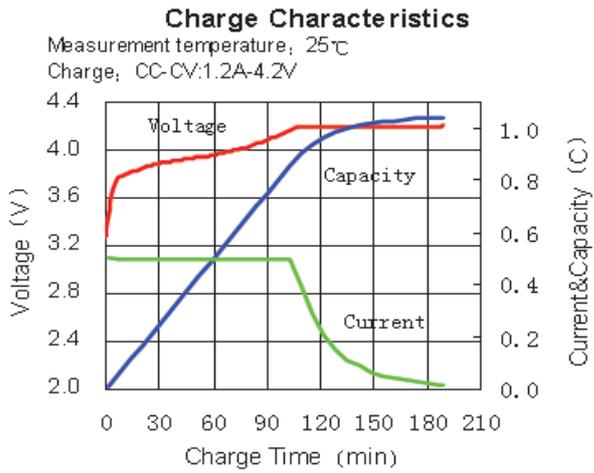
No.	Items	Criteria	Test Conditions
1	Static Humidity and Temperature Characteristics	Retention Capacity: $\cong 50\%$ initial capacity Recoverable Capacity: $\cong 80\%$ initial capacity Swelling: $\cong 0.5\text{mm}$ Impedance: $\cong 160\text{ m}\Omega$ Appearance: No leakage, damage	Measured the high rate capacity as the initial capacity. Stored the recharged cells for 7 days at $60 \pm 2^\circ\text{C}$ and 95%RH, then rest for 4 hrs at room temperature. Quickly discharged after checked the cells' appearance and impedance. Measured recoverable quickly discharge capacity and recoverable impedance.
2	Vibration Characteristics	OCV Variation: $\cong 0.01\text{V}$ Impedance: $\cong 80\text{ m}\Omega$ Variation: $\cong 5\text{ m}\Omega$ Appearance: No deformation, leakage	Measured the initial OCV and impedance after standard charged at $20 \pm 5^\circ\text{C}$. Vibrate the cells for 30minutes on each direction at room temperature in 10min. Amplitude: 1.6mm, (p-p) Vibration: 10-60Hz (sweep 1 oct/min) Direction: X, Y Then measure OCV and impedance.
3	70°C Storage Characteristics	Recoverable Capacity: $\cong 60\%$ initial capacity Swelling: $\cong 1\text{mm}$ Impedance: $\cong 120\text{ m}\Omega$ Appearance: No leakage, damage	Measured the high rate capacity as the initial capacity. Stored the recharged cells for 48 hrs at $70 \pm 2^\circ\text{C}$, then rest for 2 hrs at room temperature. Quickly discharged after checked the cells' appearance and impedance. Measured recoverable quickly discharge capacity and recoverable impedance.
4	Drop Test	Retention Capacity: $\cong 95\%$ initial capacity Impedance: $\cong 80\text{ m}\Omega$ Impedance Variation: $\cong 5\text{ m}\Omega$ OCV Variation: $\cong 0.01\text{V}$ Appearance: No leakage, damage	Measured the high rate capacity as the initial capacity. Measured the initial OCV and impedance after standard charged. Drop the cells from 1.9m above onto concrete floor every plane at room temperature, then measured OCV and impedance. Repeat this drop cycle 6 times. Then measured retention capacity.

6. Cell External Dimension

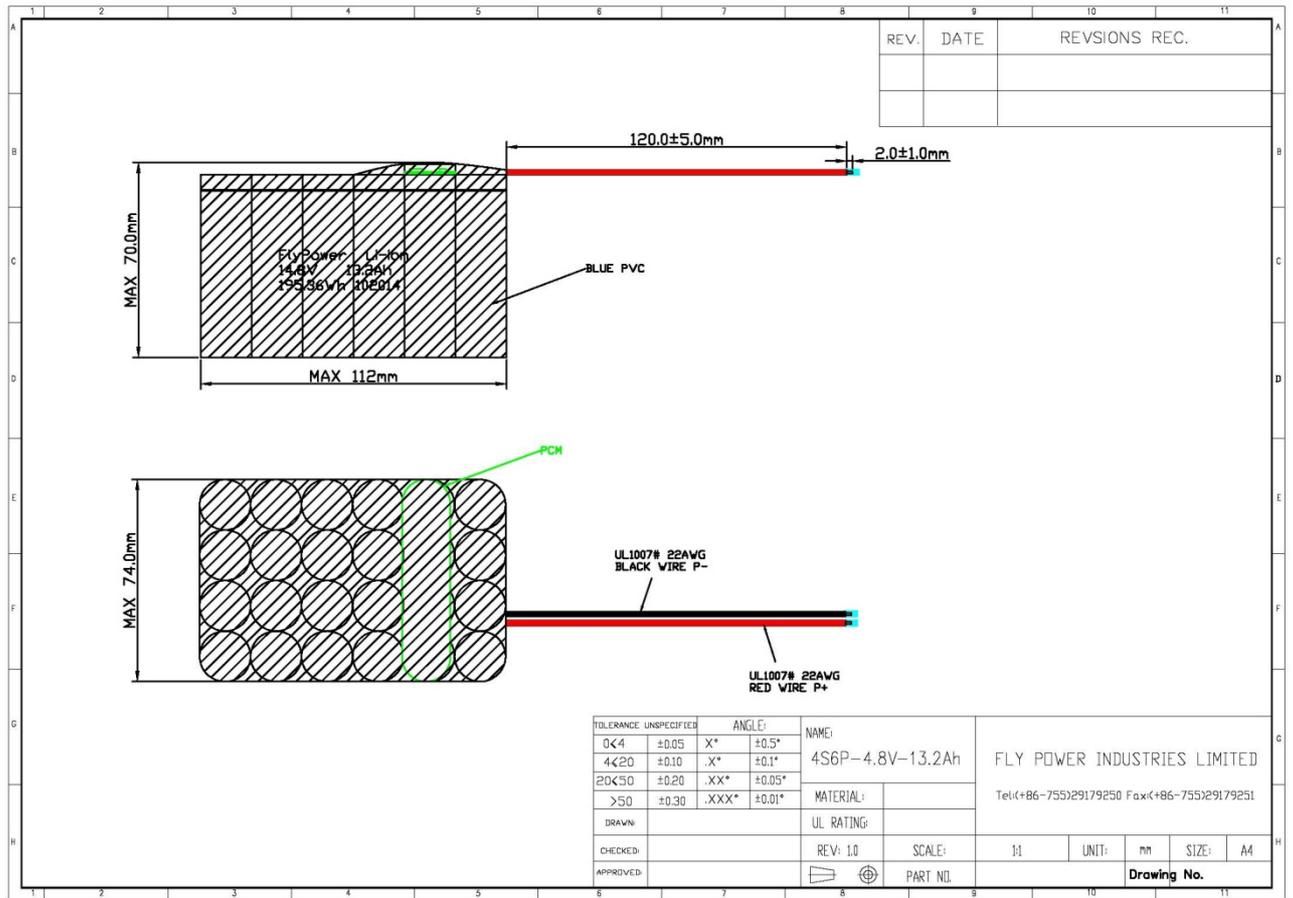
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7. Cell Performance



8. Battery Pack Dimension Drawing



9. PCB

9.1 PCB specifications

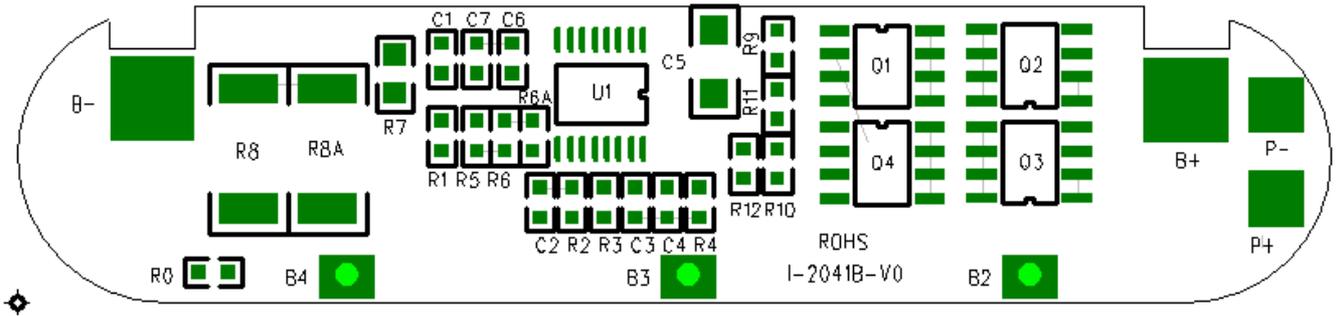
No	Item	Condition	Specification
1	输入电压/input Voltage	B+/B-间输入电压/input Voltage B+ to B-	-0.3~+26V
2	过充电 Overcharge	保护电压/Detection voltage	4.250±0.050V
3		恢复电压/ Release voltage	4.150±0.050V
4		保护延迟时间/ Detection delay time	1.0±0.5S
5	过放电 Over discharge	保护电压/Detection voltage	2.50±0.08V
6		恢复电压/ Release voltage	3.00±0.10V
7		保护延迟时间/ Detection delay time	100±50mS
8	放电过流 Over discharge current	放电过流保护电流/Over current	3.500~10.00 A
9		放电过流保护延时/delay time	10.0±5.0mS
10	短路保护	短路保护延时/ Short detection delay time	100~600uS
11		恢复条件/Release Conditions	断开负载/Cut off load

12	自耗电 Normal current consumption	工作状态自耗电 Normal current consumption of PCM	Max50.00uA
13	OV 充电/0V charger	是否允许 0V 充电/allowed 0V change	YES
14	建议工作条件 Suggest working conditions	建议最大持续充/放电电流 max continuous charge/discharge current	2.500A
15		建议工作温度/suggest working temperature	-20℃~60℃
16	内阻/IR resistance	PCM 内阻/ IR of PCM	≤65.00 mΩ
17	PCM 尺寸 The size of final PCM	长度/ The length of final PCM	70.40±0.15mm
18		宽度/ The width of final PCM	16.0±0.10mm
19		厚度/ The thickness of final PCM	MAX:3.20mm
20	外观 Appearance	1) 没有元器件的破损/Nothing part deflection 2) 所有焊点良好/The status of solder is all right 3) PCM 没有翘曲/ PCM will not crook	

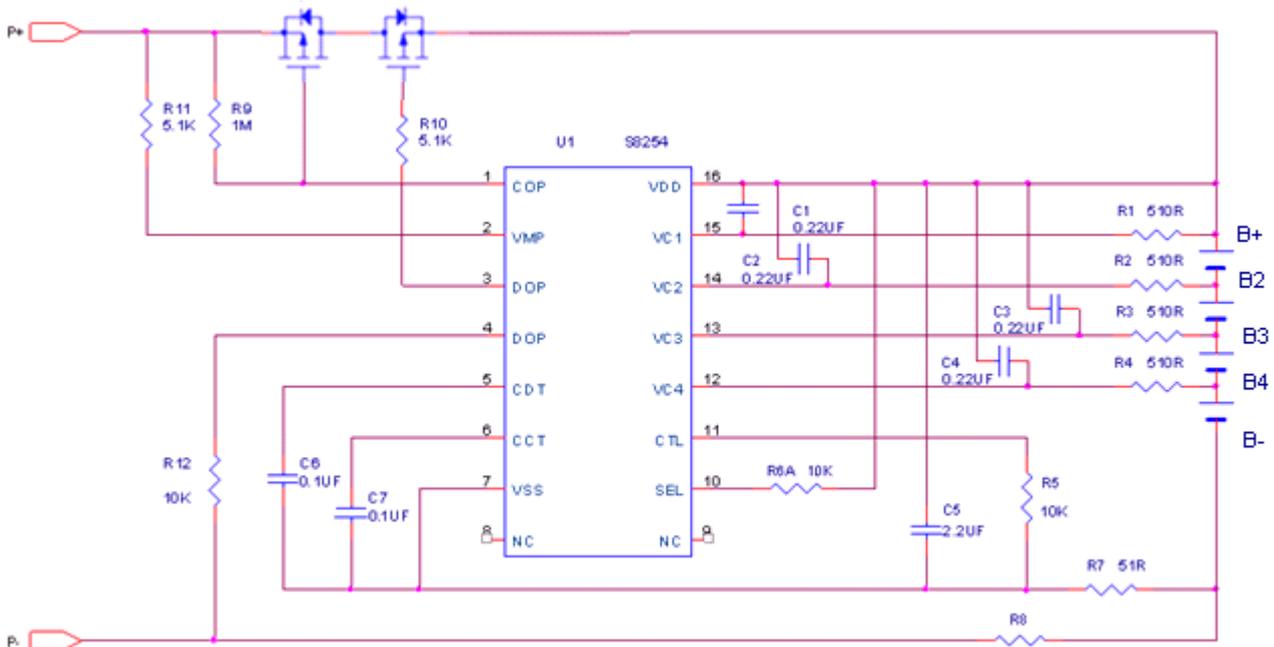
9.2 Part List

器件编号 Location	描述 Description	规格/part No. Specification	尺寸/封装 Size	数量 Qty	供应商 Vendor	环境 ROHS	备注 Remark
U1	贴片保护 IC Protection IC	S-8254AANFT-TB-S	TSSOP-16	1	SEIKO	ROHS	
Q1,Q2	贴片 MSOFET SMD MOSFET	AO4407A	SO-8	2	AOS	ROHS	
R1,R2,R3,R4	贴片电阻 SMD Resistance	510Ω, ±5%, 1/10W	0603	4	YAGEO	ROHS	
R5,R6A,R12	贴片电阻 SMD Resistance	10KΩ, ±5%, 1/10W	0603	3	YAGEO	ROHS	
R7	贴片电阻 SMD Resistance	51Ω, ±5%, 1/8W	0805	1	YAGEO	ROHS	
R8	贴片合金电阻	15mΩ,±1%,1W	2512	1	PDC/GCT	ROHS	
R9	贴片电阻 SMD Resistance	1MΩ, ±5%, 1/10W	0603	1	YAGEO	ROHS	
R10,R11	贴片电阻 SMD Resistance	5.1KΩ, ±5%, 1/10W	0603	2	YAGEO	ROHS	
C1,C2,C3,C4	贴片电容 SMD Capacitance	0.22uF, -20% +80%, 50V	0603	4	YAGEO	ROHS	
C5	贴片电容 SMD Capacitance	2.2uF, -20% +80%, 50V	1206	1	YAGEO	ROHS	
C6,C7	贴片电容 SMD Capacitance	0.1uF, ±10%, 25V	0603	2	YAGEO	ROHS	
PCB	PCB	I-2041B-V0	70.4*16*1.2mm	1	/	ROHS	2-LAYER

9.2 贴片图/SMT drawing



9.3 PCM Circuit



10. Protection Function

If a cylindrical Li-ion Battery is subjected to a voltage higher than the allowable voltage or is charged with an excessive current, the electrolyte may decompose, resulting possibly in degassing or compromising cell safety. If cell voltage decreases below 1.0V approx., cell performance may deteriorate. Therefore, must be equipped with “Thermal fuse” and protection circuit that can prevent overcharge, over-discharge, and over-current. Thermal fuse should be connected in series with a cell and it should be contacted to the Cell wall, as close as possible.

11. Warranty

One year limited warranty against workmanship and material defect.

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12. Product Responsibility Agreement

Using cells must be observed Product Specification and remarks of Fly Power Industries Ltd., because misuse may cause cell heat, fire or explosive. Future power will not be responsible for any accident occurred by handling outside of the precautions in this specification.

13. Precaution Before Charging

Any information will be notified to consumer with data of quality and reliability while specification, materials, product process or control system will be changed.

14. Handling precautions on Lithium ion secondary cell

To assure product safety, describe the following precautions in the instruction manual of the equipment.

15. Danger

1. When charging the Cell, use dedicated chargers and follow the specified conditions.
2. Use the Cell only in the specified equipment.
3. Do not connect Cell directly to an electric outlet or cigarette lighter charger.
4. Do not heat or throw Cell into a fire.
5. Do not use, leave Cell close to fire or inside of a car where temperature may be above 60°C. Also do not charge / discharge in such conditions.
6. Do not immerse, throw, and wet Cell in water/ seawater.
7. Do not put batteries in your pockets or a bag together with metal objects such as necklaces. Hairpins coins, or screws. Do not store batteries with such objects.
8. Do not short circuit the (+) and (-) terminals with other metals.
9. Do not place Cell in a device with the (+) and (-) in the wrong way around.
10. Do not pierce Cell with a sharp object such as a needle.
11. Do not hit with a hammer, step on or throw or drop to cause strong shock.
12. Do not disassemble or modify the Cell.
13. Do not solder a Cell directly.
14. Do not use a Cell with serious scar or deformation.
15. Thoroughly read the user's manual before use, inaccurate handling of lithium ion rechargeable Cell may cause leakage, heat, smoke, an explosion, or fire
16. Do not put Cell into a microwave oven, dryer, or high-pressure container.
17. Do not use Cell with dry cells and other primary batteries, or batteries of a different package, type, or brand.
18. Stop charging the Cell if charging is not completed within the specified time.
19. Stop using the Cell if abnormal heat, odor, discoloration, deformation or abnormal condition is detected during use, charge, or storage.
20. Keep away from fire immediately when leakage or foul odor is detected.
21. If liquid leaks onto your skin or clothes, wash well with fresh water immediately.
22. If liquid leaking from the Cell gets into your eyes, do not rub your eyes. Wash them well with clean water and go to see a doctor immediately.

16. Caution

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1. Store batteries out of reach of children so that they are not accidentally swallowed.
 2. If younger children use the Cell, their guardians should explain the proper handling.
 3. Before using the Cell, be sure to read the user's manual and cautions on handling thoroughly.
 4. Thoroughly read the user's manual for the charger before charging the Cell.
 5. For information on installing and removing from equipment, thoroughly read the user's manual for the specific equipment.
 6. Batteries have life cycles. If the time that the Cell powers equipment becomes much shorter than usual, the Cell life is at an end. Replace the Cell with a new same one.
 7. Remove a Cell whose life cycle has expired from equipment immediately.
 8. When not using Cell for an extended period, remove it from the equipment and store in a place with low humidity and low temperature.
 9. While the Cell pack is charged, used and stored, keep it away from objects or materials with static electric charges.
 10. If the terminals of the Cell become dirty, wipe with a dry cloth before using the Cell.
 11. The Cell can be used within the following temperature ranges. Do not exceed these ranges.
Charge temperature range : 0°C to 45°C Discharge temperature range : -20°C to 60°C.