



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

Made BY: Engineering Dept.

APPROVED BY: Hung JB

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FLY POWER INDUSTRIES LIMITED
3rd Building,Zhou Teng Industrial Park,Shang Li Lang,Buji,
Long-gang District,, Shenzhen, Guangdong, 518129,China
Website: <http://www.fly-power.com> E-mail: info@fly-power.com
Tel: (+86-755) 8421 4058 Fax: (+86-755) 2917 9251

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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 ₅ A) | $\geq 12500\text{mAh}$ | 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) | $\geq 12000\text{mAh}$ | Discharged at 1C ₅ A rate after the standard charged cells rest 10min at $20 \pm 5^\circ\text{C}$. Three cycles are permitted. |
| 5 | Temperature Characteristics | Retention Capacity: $60^\circ\text{C} \geq 98\% \text{ * initial capacity}$ $20^\circ\text{C} \geq 100\% \text{ * initial capacity}$ $0^\circ\text{C} \geq 80\% \text{ * initial capacity}$ $-20^\circ\text{C} \geq 60\% \text{ * initial capacity}$ Appearance: No deformation, leakage and ruptures. | Measured the high rate capacity as the initial capacity. Stored the recharged cells for 3 hrs at $60 \pm 2^\circ\text{C}$, $20 \pm 2^\circ\text{C}$, $0 \pm 2^\circ\text{C}$, $-20 \pm 2^\circ\text{C}$, and then quickly discharged at this temperature, but Standard discharged at $-20 \pm 2^\circ\text{C}$ exceptionally. Checked the cells' appearance after rest for 2 hours at room temperature. |
| 6 | Storage Characteristics | Retention Capacity: $\geq 80\% \text{ initial capacity}$ impedance increase: $\leq 70\text{m}\Omega$ Swelling: $\leq 0.5\text{mm}$ Appearance: No leakage | Measured the high rate capacity as the initial capacity. Stored the recharged cells for 7 days at $60 \pm 2^\circ\text{C}$ and then rest for 2 hrs at room temperature, standard discharged after checked the cells' appearance and impedance. |
| | | Retention Capacity: $\geq 90\% \text{ initial capacity}$ Recoverable Capacity: $\geq 95\% \text{ initial capacity}$ impedance: $\leq 280\text{m}\Omega$ Impedance Variation: $\leq \pm 10\text{m}\Omega$ Swelling: $\leq 0.1\text{mm}$ 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: $\geq 80\% \text{ initial capacity}$ Impedance: $\leq 300\text{m}\Omega$ Swelling: $\leq 0.3\text{mm}$ | Carry out 300 cycles (standard charge/ 0.5C discharge) at $20 \pm 5^\circ\text{C}$. |

4. Safety Characteristics

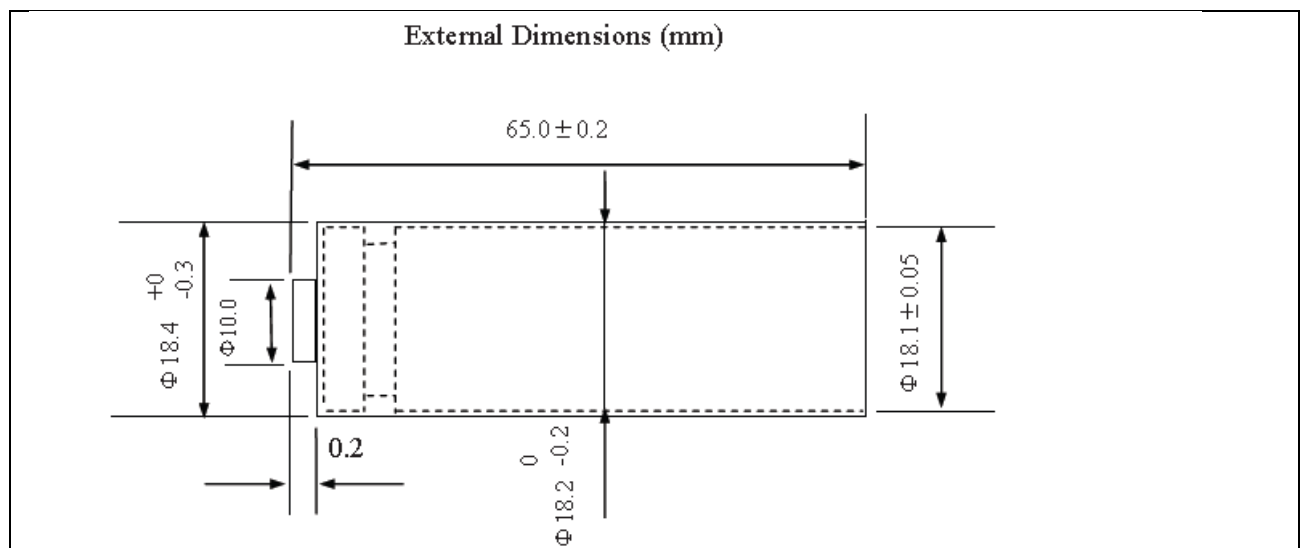
| No. | Items | Criteria | Test Conditions |
|-----|--------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Overcharge Characteristics | The maximum Temperature: $\leq 150^{\circ}\text{C}$ 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: $\leq 150^{\circ}\text{C}$ 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: $\leq 150^{\circ}\text{C}$ 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: $\leq 200^{\circ}\text{C}$ 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

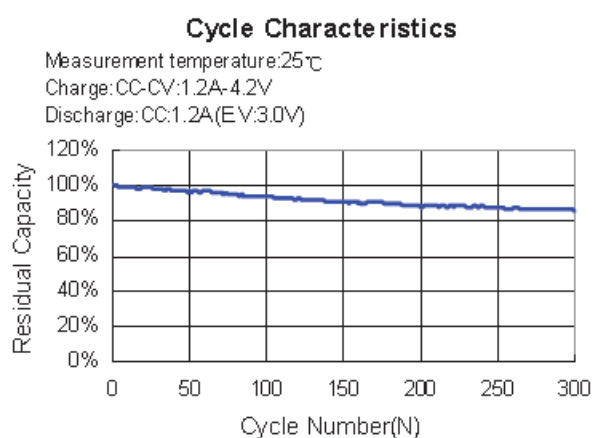
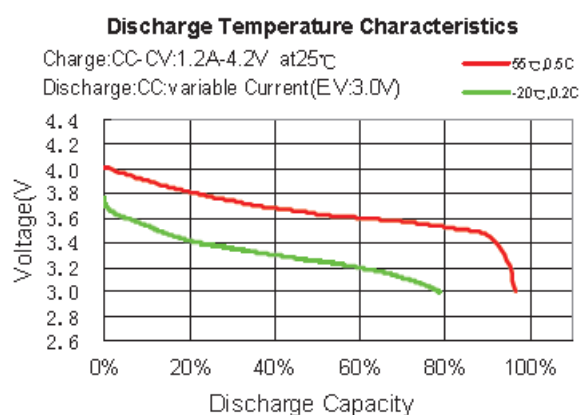
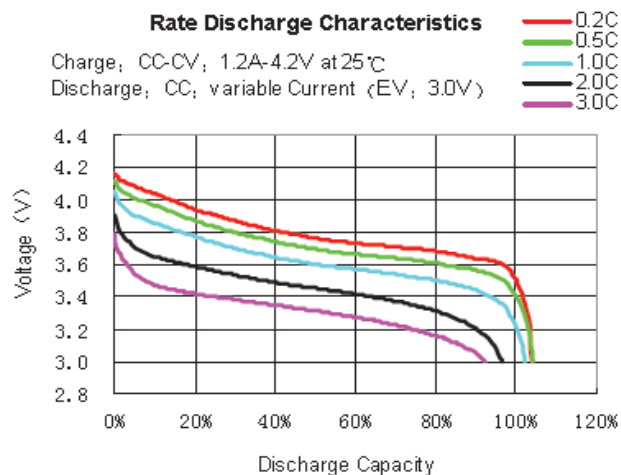
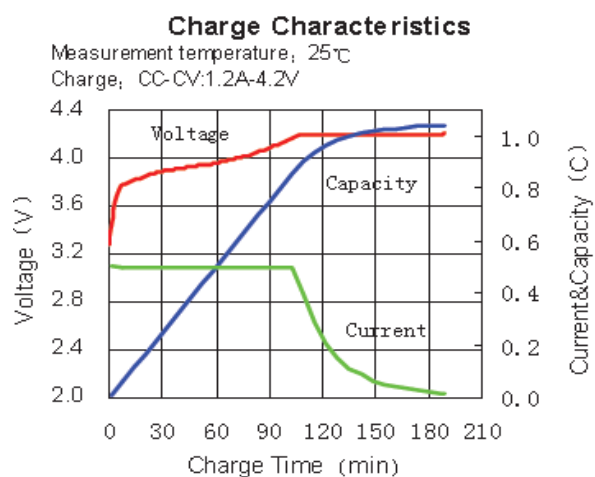
| No. | Items | Criteria | Test Conditions |
|-----|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Static Humidity and Temperature Characteristics | Retention Capacity: $\geq 50\%$ initial capacity Recoverable Capacity: $\geq 80\%$ initial capacity Swelling: $\leq 0.5\text{mm}$ Impedance: $\leq 160 \text{ m } \Omega$ 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: $\leq 0.01\text{V}$ Impedance: $\leq 80 \text{ m } \Omega$ Variation: $\leq 5 \text{ m } \Omega$ 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: $\geq 60\%$ initial capacity Swelling: $\leq 1\text{mm}$ Impedance: $\leq 120 \text{ m } \Omega$ 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: $\geq 95\%$ initial capacity Impedance: $\leq 80 \text{ m } \Omega$ Impedance Variation: $\leq 5 \text{ m } \Omega$ OCV Variation: $\leq 0.01\text{V}$ 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

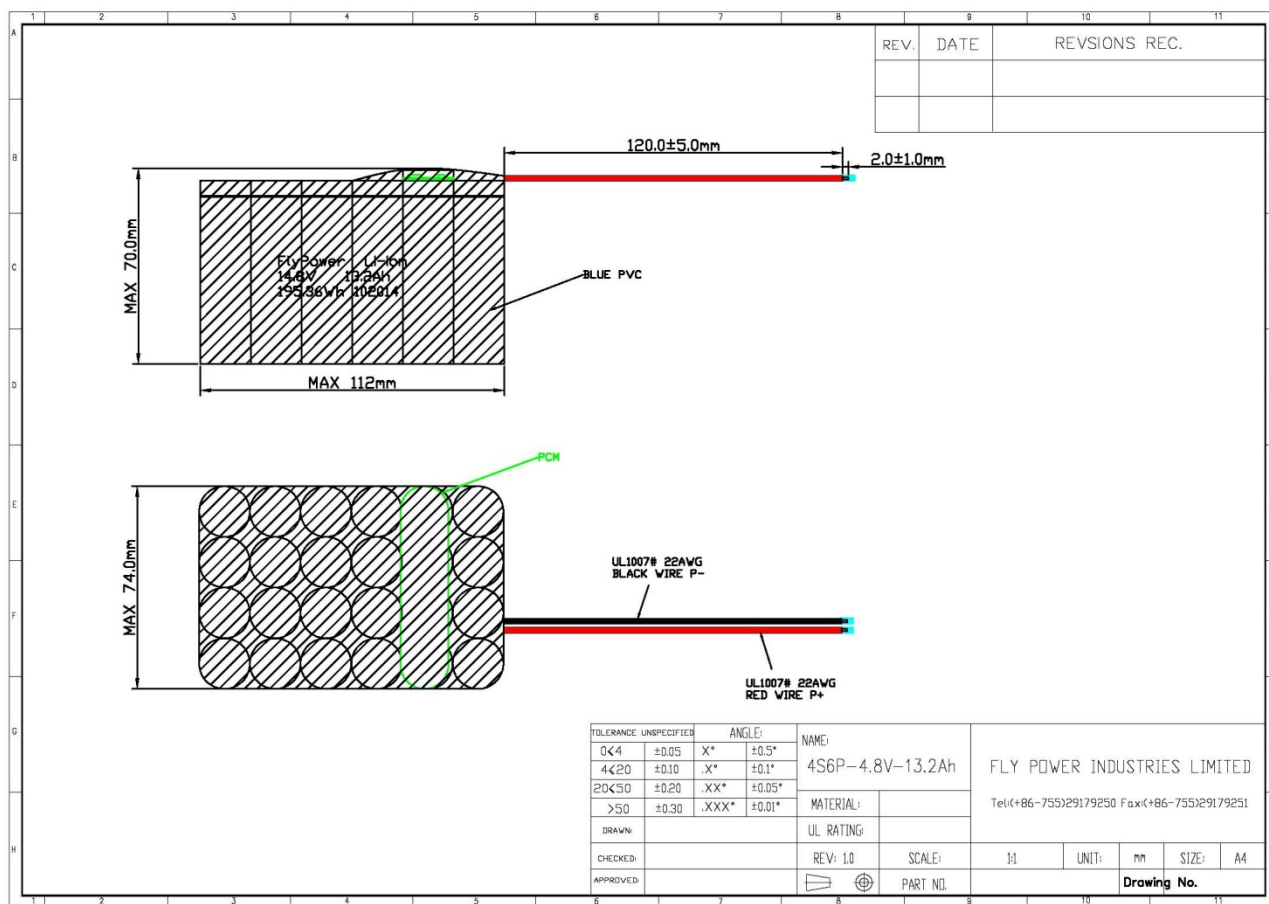
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7. Cell Performance



8. Battery Pack Dimension Drawing



9. PCB

9.1 PCB specifications

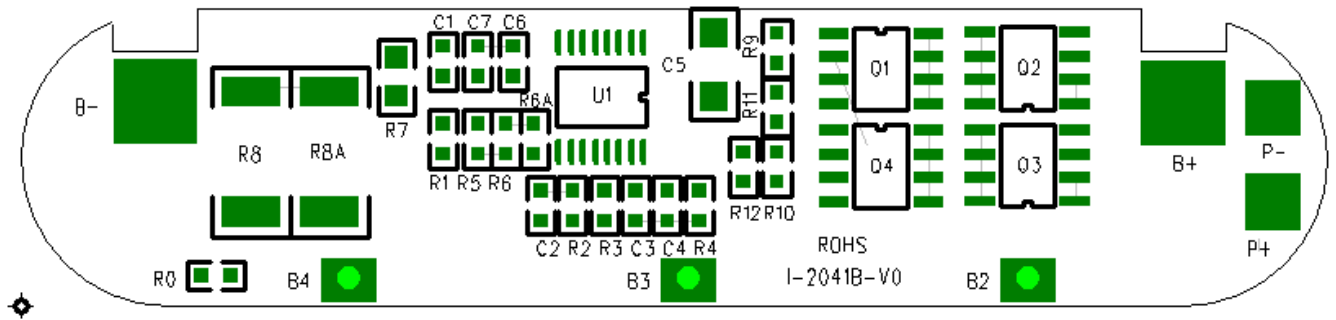
| No | Item | Condition | Specification |
|----|--------------------------------|------------------------------------|-------------------|
| 1 | 输入电压/input Voltage | B+/B-间输入电压/input Voltage B+ to B- | -0.3~+26V |
| 2 | 过充电 Overcharge | 保护电压/Detection voltage | 4.250±0.050V |
| 3 | | 恢复电压/ Release voltage | 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/OV 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 | |

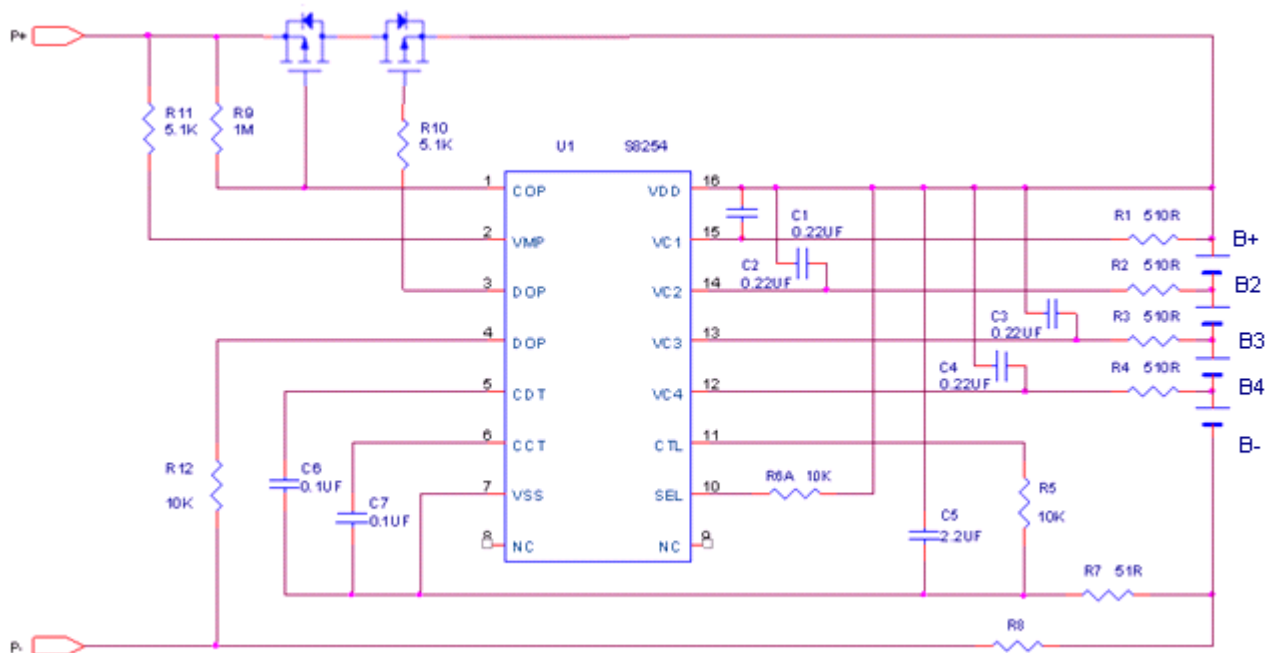
9.2 Part List

| 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.