南京拓品微电子有限公司

NanJing Top Power ASIC Corp.

DATASHEET

TP4062

（600mA Electronic Cigarette Linear Lithium-ion Battery Charger）

Description

TP4062 is a complete single cell lithium-ion battery charger suitable for e-cigarette solutions, equipped with positive and negative pole reverse protection, with a larger charging current of 600mA and more stable current consistency. It adopts constant current/constant voltage linear control, SOT packaging, and fewer external components, making TP4062 an ideal choice for portable applications.

Due to the use of an internal PMOSFET architecture and an anti reverse charging circuit, there is no need for external detection resistors and isolation diodes. Thermal feedback can automatically adjust the charging current to limit the chip temperature during high-power operation or high ambient temperature conditions. The full charge voltage is fixed at 4.2V, and the charging current can be externally set through a resistor. When charging enters the constant voltage stage, the charging current will automatically decrease. When the charging current drops to 1/10 of the set value, the indicator light can indicate a fully charged state, but the charging current will be in a float state until the battery is fully charged to 4.2V.

When the input voltage (AC adapter or USB power supply) is removed, TP4062 automatically enters a low current state, and the battery leakage current is below 2uA. Other features of TP4062 include a charging current monitor, undervoltage lockout, and two status pins used to indicate the end of charging and input voltage connection.

characteristic

- Lithium battery reverse connection protection
- Programmable Charge Current 600mA
- Trickle, constant-current and constant-voltage control
- Preset Charge Voltage with 1% Accuracy
- Highest input can be up to 9V
- Automatic Recharge
- Available in 6-Lead SOT-23 Package
- Two Charge Status Output Pins
- C/10 Charge Termination
- For Single Cell titanic acid Lithium-Ion Batteries

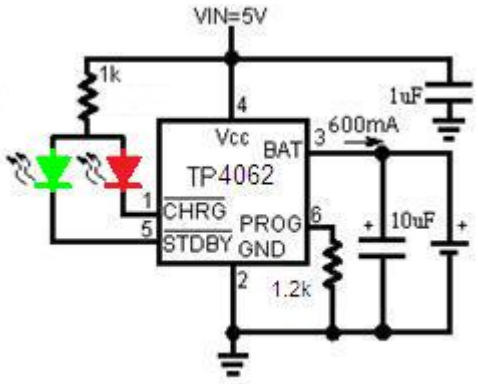
APPLICATIONS

- Miniature lithium battery
- Cellular phone、PAD、MP3 player

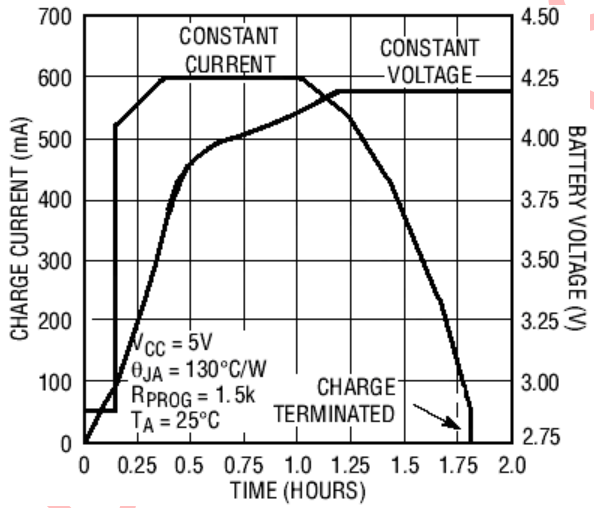
absolute maximum rating

- VCC：-0.3V～9V
- PROG：-0.3V～VCC+0.3V
- BAT：-4.2V～7V
- CHRG：-0.3V～10V
- STDBY：-0.3V～10V
- BAT Pin Current：600mA
- PROG Pin Current：800uA
- Maximum Junction Temperature：145℃
- Operating Ambient Temperature Range：-40℃～85℃
- Storage Temperature Range：-65℃～125℃
- Lead Temperature(Soldering, 10sec)：260℃

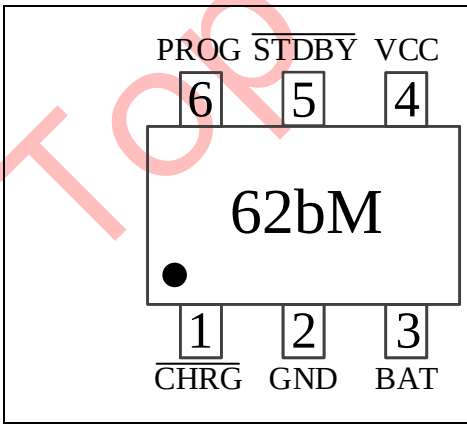
Typical application



600mA Full charging cycle（600mAh）



Package information



ORDER PART NUMBER
TP4062-42-SOT236
PART MARKING
62bM—4.2V

Pin Description

$\overline{\text{CHRG}}$ **(Pin 1) : Charge status indicator of drain open circuit output.**When the charger charges the battery, the pin is pulled to a low level by the internal switch, indicating that the charge is in progress. Otherwise, the pin is in a high resistance state.

GND (pin 2) : Ground

BAT (pin 3) : Charging current output. This pin provides charging current to the battery and adjusts the final floating charging voltage to 4.2V. A precise internal resistance divider of the pin sets the floating charging voltage, which is disconnected in shutdown mode.

VCC (pin 4) : Positive input supply voltage. This pin supplies power to the charger. The VCC varies between 4V and 9V and should be bypassed by at least one 1μF capacitor. When the VCC drops to within 30mV of the BAT pin voltage, the TP4062 enters the shutdown mode, so that the IBAT drops below 2μA.

$\overline{\text{STDBY}}$ **(pin5): Indicating end of battery charging completion.** When the battery is charged, $\overline{\text{STDBY}}$ is pulled to a low level by the internal switch, indicating that the battery is charged. In addition, $\overline{\text{STDBY}}$ pin will be in a high resistance state.

PROG (Pin 6) : Charging current setting, charging current monitoring and stopping pins. The charging current can be set by connecting a resistor RPROG with 1% accuracy between the pin and the ground. When charging in constant current mode, the pin voltage is maintained at 1V.

The PROG pin can also be used to turn off the charger. Disconnect the set resistor from the ground, and an internal 3μA current pulls the PROG pin to high level. When the voltage of this pin reaches the shutdown threshold voltage of 2.7V, the charger enters the shutdown mode, the charging stops and the input power current drops to 50μA. Reconnecting RPROG to ground will restore the charger to normal operation.

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at TA=25℃，VCC=5V，unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{CC}	Input Supply Voltage		●	4.0	5	9.0	V
I_{CC}	Input Supply Current	Charge Mode, R_{PROG} = 10k	●		50		μA
		StandbyMode(Charge	●		60	150	μA
		Terminated)	●		50	160	μA
		Shutdown Mode (RPROG				150	μA
		Not Connected,VCC <					
		VBAT, or VCC < VUV)					
V_{FLOAL}	Regulated Output (Float) Voltage	0℃≤T_A≤85℃，I_{BAT}=40mA		4．158	4．2	4．242	V
I_{BAT}	BAT Pin Current (Except that VBAT=3.9V)	R_{PROG}=10K， Current Mode	●	68	80	92	mA
		R_{PROG}=2K， Current Mode	●	331	390	449	mA
		R_{PROG}=1.6K， Current Mode	●	382	450	518	mA
		R_{PROG}=1.2K， Current Mode	●	510	600	690	mA
		Standby Mode ，V_{BAT}=4.2V			－2.5	－6	μA
		Shutdown Mode (R_{PROG} Not			±1	±2	μA
		Connected)			－1	－2	μA
		Sleep Mode, V_{CC} = 0V					
I_{TRIKL}	Trickle Charge Current	V_{BAT}<V_{TRIKL},R_{PROG}=10K	●	8	10	12	mA
V_{UV}	VCC Undervoltage Lockout Threshold	From VCC Low to High	●	3.4	3.6	3.8	V
I_{TERM}	C/10 Termination Current Threshold	R_{PROG}=10K	●	8	10	12	mA
		R_{PROG}=1.66K	●	30	40	50	mA
V_{PROG}	PROG Pin Voltage	R_{PROG}=10K， Current Mode	●	0.9	1.0	1.1	V
$V_{\overline{CHRG}}$	CHRG Pin Output versr Low Voltage	$I_{\overline{CHRG}}$ =5mA			0.3	0.6	V
ΔV_{RECHRG}	Rechargeable battery threshold voltage	V_{FLOAT}-V_{RECHRG}		100	150	200	mV

operating principle

TP4062 is a single lithium-ion battery charger using constant current/constant voltage algorithm. It is capable of providing 600mA charging current (with the help of a thermally well-designed PCB layout) and an internal P-channel power MOSFET and thermal regulation circuit. No isolation diode or external current detection resistor is required; Therefore, the basic charger circuit requires only two external components. Not only that, TP4062 is also able to get working power from a USB power supply.

Normal charging cycle

When the voltage of the Vcc pin rises above the UVLO threshold level and a set resistor with an accuracy of 1% is connected between the PROG pin and ground, and when a battery is connected to the output of the charger, a charging cycle begins. If the BAT pin level is below 2.9V, the charger enters trickle charging mode. In this mode, TP4062 provides approximately 1/10 of the set charging current to raise the current and voltage to a safe level, thereby achieving full current charging.

When the voltage of the BAT pin rises above 2.9V, the charger enters constant current mode, providing a constant charging current to the battery. When the voltage of the BAT pin reaches the final float voltage (4.15V), TP4062 enters a constant voltage mode, and the charging current begins to decrease until the voltage of the BAT pin rises to 4.2V.

Setting of charging current

The charging current is set using a resistor connected between the PROG pin and the ground. The setting resistor and charging current are calculated using the following formula:

The resistor resistance value is determined according to the required charging current，

Formula ： $R_{prog} = \frac{800}{I_{BAT}}$

In applications larger than 0.3A, chip heat is relatively large, temperature protection will reduce the charging current, and the test current in different environments will not be completely consistent with the theoretical value calculated by the formula. In customer applications, RPROG of appropriate size can be selected according to requirements.

R_{PROG} (k)	I_{BAT} (mA)
20k	40
10k	80
5k	155
4k	195
3k	260
2k	380
1.6k	490
1.2k	600

Charge termination

The charging current starts to decrease after the BAT pin voltage reaches the final float charging voltage. As the BAT pin voltage increases, the charging current continues to decrease until the BAT pin voltage reaches 4.2V, and the charging current approaches 0. During this process, if the voltage of the BAT pin drops, the charging current will increase proportionally again until it reaches a constant current.

Battery reverse connection protection function

TP4062 has the reverse connection protection function of lithium battery. The positive and negative terminals of the

lithium battery are reverse connected to the TP4062 current output pin, and the TP4062 will stop and show the fault state without charging current. Both charging indicator pins are in the high resistance state, and both LED lights are off. At this time, the leakage current of the reverse connected lithium battery is less than 5mA. Connect the reverse battery correctly, and TP4062 will automatically start the charging cycle. TP4062 after reverse connection When the battery is removed, because the capacitor potential of the BAT pin at the output end of TP4062 is still negative, the TP4062 indicator light will not immediately turn on normally, and only the correct connection of the battery can automatically activate and charge. Or wait for a long time for the electric quantity with negative potential of the BAT terminal capacitor to emit light. If the BAT terminal potential is greater than zero volt, TP4062 will display the normal battery-free indicator state. In the case of reverse connection, the supply voltage should be about 5V, and should not exceed 8V. If the power supply voltage is too high and the battery voltage is reversed, the chip voltage difference will exceed 10V. Therefore, the power supply voltage should not be too high when the battery voltage is reversed.

Charge status indicator

（$\overline{CHRG}$ $\overline{STDBY}$）

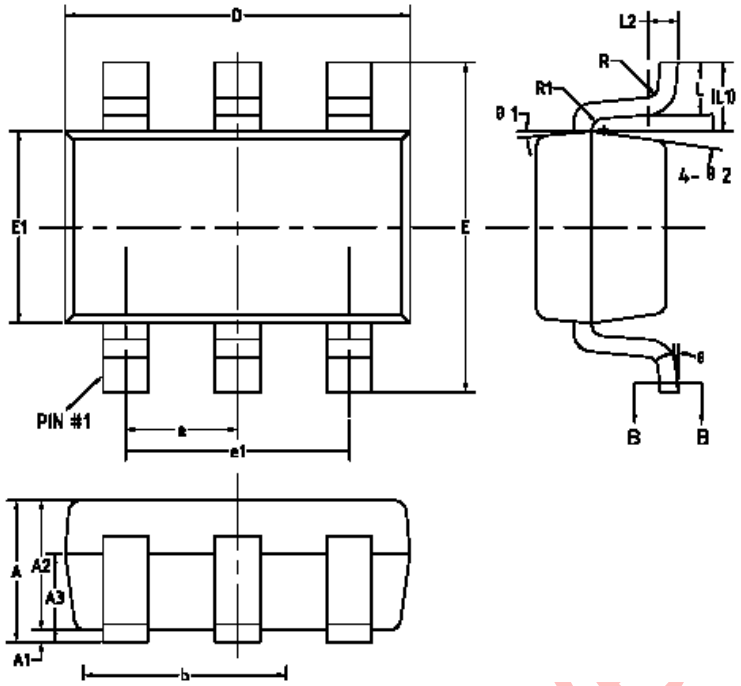
TP4062 has two open drain status indicator output terminals $\overline{CHRG}$ and $\overline{STDBY}$. When the charger is in charge state, $\overline{CHRG}$ is pulled to the low level and in the other state, $\overline{CHRG}$ is in the high resistance state. When the battery is not connected to the charger, the $\overline{CHRG}$ output pulse signal indicates that the battery is not installed.

During charging, the transient load on the BAT pin will cause the voltage of the PROG pin to briefly drop below 100mV when the DC charging current drops to 1/10 of the set value. 100ms filtering time on internal filtering comparator Ensure that transient loads of this nature do not cause premature switching of the charging indicator light. Once the average charging current drops below 1/10 of the set value, it will indicate a fully charged state without cutting off the charging current. The charging current will continue to float until the battery is fully charged.

In full mode, TP4062 continuously monitors the voltage of the BAT pin. If the voltage of the pin drops below the recharge threshold of 4.1V, $\overline{CHRG}$ will be pulled back to the low level and $\overline{STDBY}$ switch to the high resistance state.

Packaging description

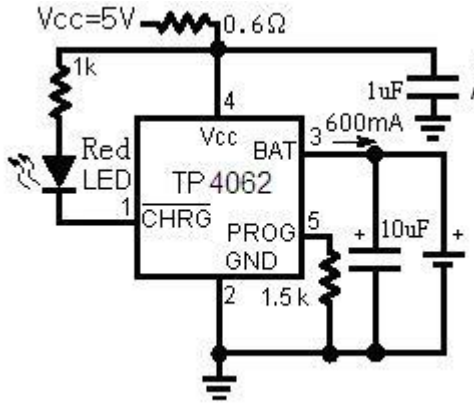
6-pin plastic SOT-23-6 package



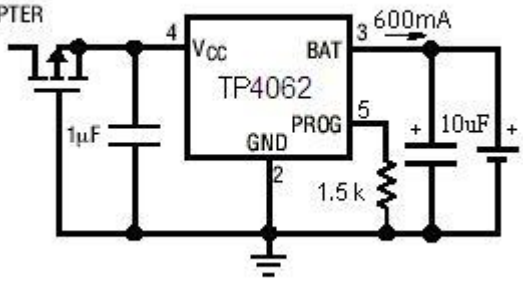
COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	–	–	1.25
A1	0	–	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	–	0.50
b1	0.36	0.38	0.45
c	0.14	–	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.80	2.80	3.00
E1	1.526	1.626	1.726
e	0.95BSC		
e1	1.90BSC		
L	0.35	0.45	0.60
L1	0.59REF		
L2	0.25BSC		
R	0.10	–	–
R1	0.10	–	0.20
θ	0°	–	8°
θ1	3°	5°	7°
θ2	6°	8°	10°

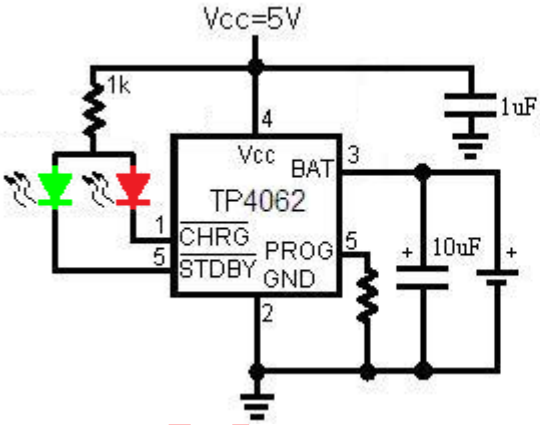
Other Typical Applications



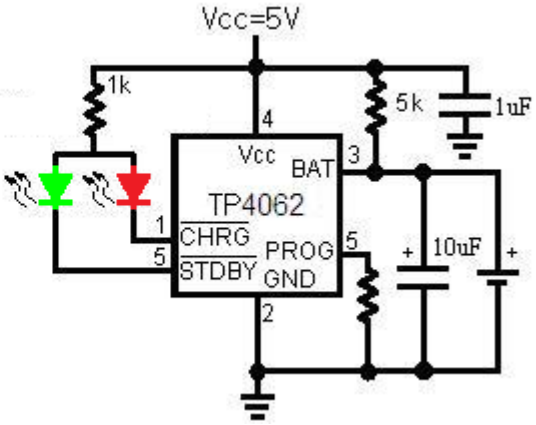
Full function single section lithium battery charger (connected to dissipation resistor)



Charger with input reverse polarity protection



No battery, no flashing light, single lithium batterycharger



Battery free dual light off single lithium battery charger

Precautions for TP4062 test use

1. In the TP4062 charging current test, the BAT end (pin 3) of the chip should be directly connected to the positive electrode of the battery, and an ammeter should not be connected in series. The ammeter can be connected to the Vcc end of the chip.
2. To ensure reliable use in various situations and prevent chip damage caused by spike and burr voltages, it is recommended to connect 1uF and 10uF capacitors respectively to the Vcc and BAT terminals in TP4062 applications. If possible, an additional 0.1u ceramic capacitor can be connected to each end. All capacitor positions should be close to the chip pins and not too far.
3. Using SOT23 packaging, poor heat dissipation in high current applications (above 400mA) may cause a decrease in charging current due to temperature protection. Customers can choose not to connect a dissipation resistor. If the current cannot meet the requirements, please design a thermal dissipation resistor based on the actual power supply voltage. The optimal input voltage for the Vcc end of the chip is 4.6V, which can obtain a larger charging current. Generally, the thermal dissipation resistor is 0.5 to 1 ohm. A similarly good PCB layout can effectively reduce the impact of temperature on current for customers in high current charging applications.