Description

PJ4057 is a complete single lithium ion battery with constant current/constant voltage linear charger. Its SOT package and small number of external components make the PJ4057 ideal for portable applications. PJ4057 can be suitable for USB power and adapter power supply work.

Due to the internal PMOSFET architecture, plus the anti-inverted charging circuit, there is no need for external detection resistor and isolation diode. Thermal feedback adjusts the charging current to limit chip temperature at high power operation or ambient temperature conditions. The charging voltage is fixed at 4.2V, and the charging current can be set externally through a resistor. When the charging current reaches the final floating charging voltage and drops to the set value of 1/10,PJ4057 will automatically terminate the charging cycle.

When the input voltage (ac adapter or USB power supply) is removed, PJ4057 automatically enters a low current state, reducing the battery leakage current below 2uA.PJ4057 can also be placed in stop mode to reduce the power supply current to 25uA.Other features of the PJ4057 include a charging current monitor, undervoltage latching, automatic recharging, and a status pin to indicate the end of charging and input voltage access. Dual light indicator for chip integrated charging status, which can be configured to light the red light when charging, and the green light after charging.
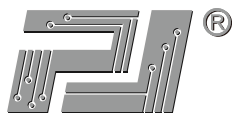
Features

- 500mA programmable charging current;
- No MOSFET, test resistor or isolation diode required;
- A complete linear charger with SOT-23-6 package for single lithium ion battery;
- Constant current/voltage operation, with thermal regulation function;
- Charge single lithium ion battery directly from USB port;
- 4.2V charging voltage is preset;
- Output of charging current monitor for battery quantity detection;
- 1/10 Charge termination, automatic recharging;
- Power supply current in standby mode is 25uA;
- Soft boot limits the surge current;
- 2.9V trickle charge device version
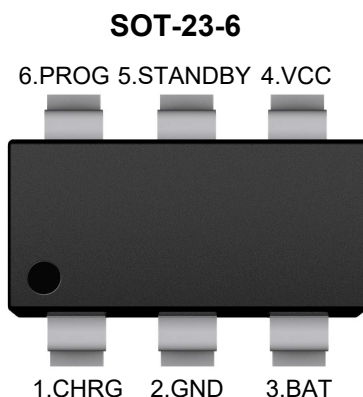
Applications
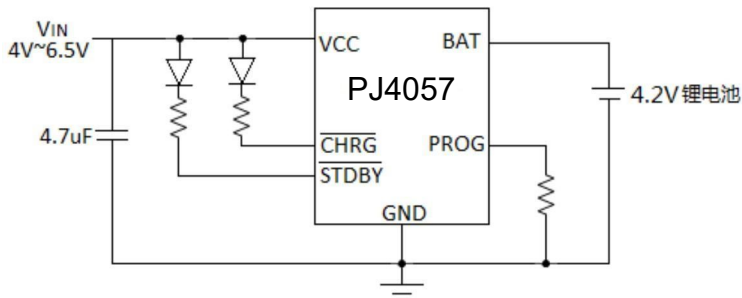
Rprog resistance and charging current Ibat corresponding table

Rprog	Ibat
$I_{bat}=1000/R_{prog}$	
10K	100mA
5K	200mA
3.3K	300mA
2.5K	400mA
2K	500mA
1.65K	600mA

Pin Distribution

SOT-23-6

6.PROG 5.STANDBY 4.VCC

1.CHRG   2.GND   3.BAT

Pin Function

CHRG（Pin1）	Output of open drain charging state. The CHRG pin is pulled to low level by an internal N-channel MOSFET during battery charging. When the charging cycle ends or PJ4057 detects an under voltage blocking condition, the CHRG pin is forced to a high impedance state.When the capacitor at the BAT pin and the ground is 1 µF, the indicator of whether the battery is connected can be completed. When there is no battery, the LED light will flash quickly
GND（Pin2）	GND
BAT(Pin3)	Charging current output.The pin provides charging current to the battery and adjusts the final floating charging voltage to 4.2V. When the battery is connected in reverse, the internal protection circuit protects the ESD diode of VBAT from being burnt out, and a current of about 0.7mA is formed between GND and BAT.
VCC（Pin4）	Positive input power voltage.This pin supplies power to the charger.VCC shall vary from 4.2V to 6.5V and shall be bypassed by at least one 1uF capacitor.When the VCC drops to less than 30mV of BAT pin voltage,PJ4057 enters the stop mode, and the Ibat falls below 2uA.
STANDBY（Pin5）	The charging status indicates that when the battery is charged, STANDBY is pulled to a low level by an internal switch to indicate the end of charging. In other states, STANDBY pins are in a high impedance state
PROG（Pin6）	Charging current setting, charging current monitoring and stop pin.The charging current can be set by connecting a 1% precision resistor Prog between the pin and the ground.When charging in constant current mode, the voltage of this pin is maintained at 1V. In all modes, the voltage on this pin can be used to calculate the charging current. The formula is Ibat=(Vprog/Rprog)*1000.Short connect the set resistor to the ground, and an internal 2uA current pulls the PROG pin to a high level.When the voltage of this pin reaches the stop threshold voltage of 1.21V, the charger enters the stop mode, the charging stops and the input power current drops to 25uA.The clamping voltage of this port is about 2.4V.Supply this port with a voltage in excess of the clipping voltage and a high current of 1.5 mA will be obtained,Reconnecting the Rprog to the ground will restore the charger to normal operation.

Absolute Maximum Rating

Input Voltage	VSS-0.3V～VSS+7V
PROG	VSS-0.3V～VSS+0.3V
BAT	VSS-0.3V～VSS+7V
CHRG	VSS-0.3V～VSS+10V
BAT short-circuit period	Continue
BAT Pin Current	500mA
PROG Pin Current	800uA
Operating Temperature Range	-40℃～85℃
Storage Temperature	-65℃～125℃
Pin temperature (welding time: 10s)	260℃

Block Diagram
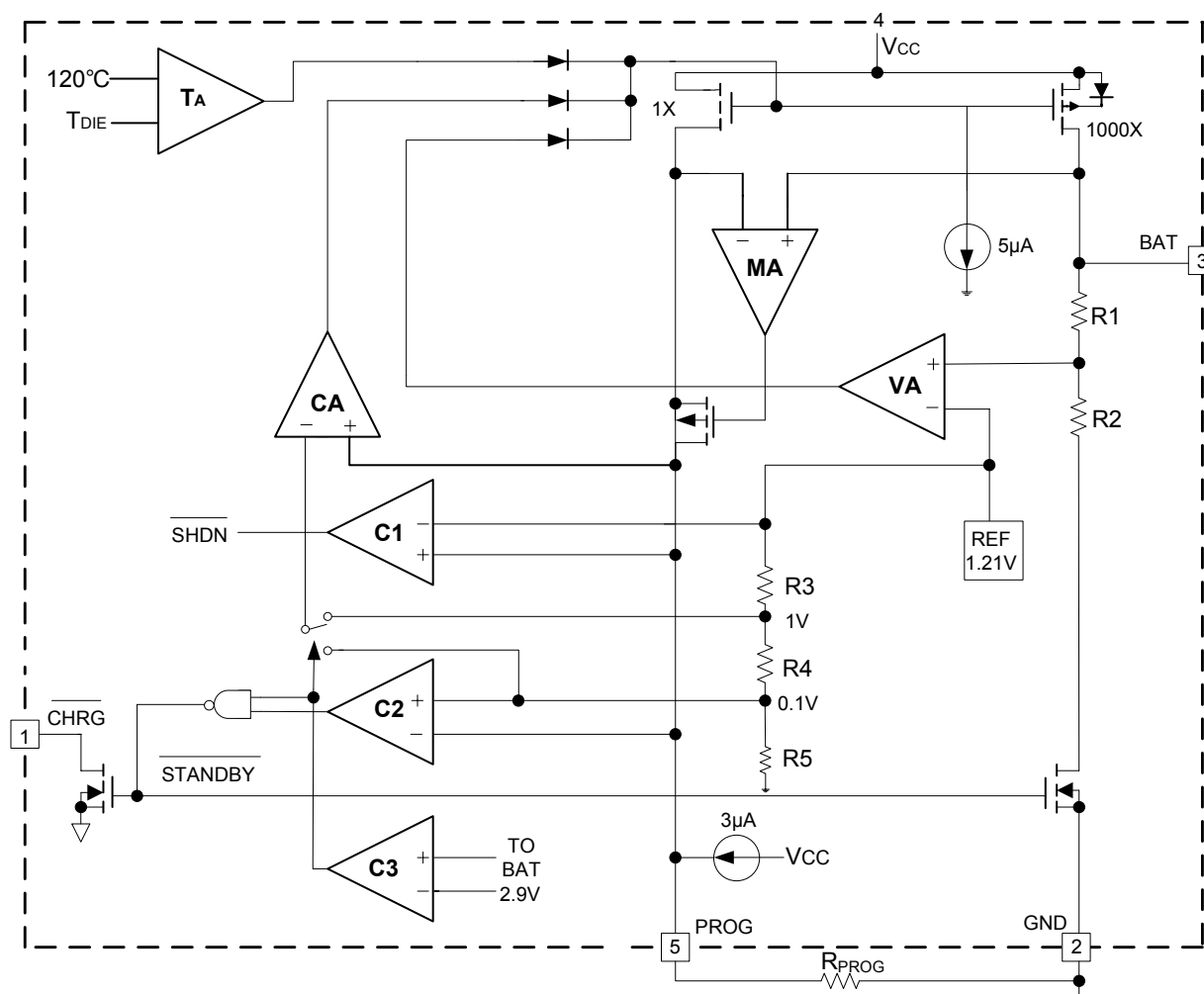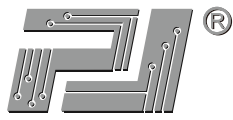
Electrical Characteristics

(T$_A$ =25℃ unless otherwise specified.)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input Voltage	VCC		4.2	5	6.5	V
Input Current	ICC	charging mode，Rprog=10K		300	500	uA
		standby mode（Charge termination）		50	150	
		stop mode（RPROG ununited） VCC<Bbat o r VCC<Vuv		25	50	
Stable Output Voltage	VFLOAT	0℃≤TA≤85℃，Ibat=40mA	4.158	4.2	4.242	V
BAT Pin Current	IBAT	RPROG=10K, current mode	90	100	110	mA
		RPROG=2K, current mode	450	500	550	
		standby mode，Vbat=4.2V	0	-2.5	-6	uA
		stop mode（RPROG ununited）		1	1.5	
		Battery reverse mode VBAT= - 4V		0.7		mA
		sleep mode，VCC=0			1	uA
Trickle Charging Current	ITRIKL	VBAT<VTRIKL，Rprog=2K	40	50	60	mA
Trickle Charging Threshold Voltage	VTRIKL	RPROG=10K，Vbat up	2.8	2.9	3	V
Trickle Charging Hysteresis Voltage	VTRHYS	RPROG=10K,Vbat Down	60	80	100	mV
VCC Undervoltage Locking Threshold	VUV	VCC from low to high	3.7	3.8	4	V
VCC Undervoltage Atresia Hysteresis	VUVHYS	VCC from high to Low	150	200	300	mV
Manual Shutdown Threshold Voltage	VMSD	PROG pin level up	1.15	1.21	1.3	V
		PROG pin level down	0.9	1	1.1	
Blocking Threshold Voltage	VASD	VCC pin from low to high	70	100	140	mV
		VCC pin from high to low	5	30	50	
C/10 Termination Current Threshold	ITERM	RPROG=10K	0.085	0.1	0.115	mA
		RPROG=2K	0.085	0.1	0.115	
PROG Pin Voltage	VPROG	RPROG=10K，current mode	0.93	1	1.07	V
Pin Output Low Voltage	VCHRG	ICHRG=5mA		0.35	0.6	V
Recharging Battery Threshold Voltage	ΔVRECHRG	VFLOAT~VRECHRG		100	200	mV
Recharging Comparator Filter Time	tRECHARGE	VBAT from high to low	0.8	1.8	4	ms
Stop Comparator Filter Time	tTERM	IBAT below Ichg/10	0.63	1.4	3	ms
PROG Pin Pull Current	IPROG			2		uA

The working principle

When the input voltage is greater than the UVLO threshold detection and chip can make the input high electricity at ordinary times, PJ4057 began to the battery. If the battery voltage is lower than 2.9 V, charging for small current for battery charging. When battery voltage is greater than 2.9 V, the constant flow pattern on the charger the battery, the charging current is determined by the resistance between TPROG and GND end. When the battery voltage close to 4.2 V, the charging current decreases, PJ4057 into constant-voltage charging mode. When the charging current to charge over threshold, the end of the charging cycle. Charge over 1/10 of the threshold is constant current charging current. When the battery voltage to recharge threshold, automatically start charging cycle. Chips of high accuracy of the internal voltage reference source, the error amplifier and network to ensure that the BAT end resistance pressure modulation voltage precision is within 1%, meet the requirements of lithium ion and lithium polymer battery. When the input voltage power or the input voltage is lower than the battery voltage, the charger into standby mode, the battery end of current consumption is less than 2 µA, thus increase the standby time.

$V_{BAT}>2.9V$ $V_{BAT}<4.1V$

| **Shutoff mode**
VDD<3.6V
VDD<VBAT
The battery
reverse connect
CHRG=high resistance | **Precharge mode**
charge current=1/10I_{BAT}
CHRG = Strong
pull-down resistance | **Constant voltage charging mode**
charge current=I_{BAT}
CHRG = Strong
pull-down resistance | **Constant voltage charging mode**
Charge Voltage=4.2V
CHRG = Strong
pull-up resistance | **Charge end**
No charge current
CHRG=high resistance |

$V_{BAT}<2.9V$ $V_{BAT}>2.9V$ $V_{BAT}=4.1V$ ITRIKL<1/10I_{BAT}

Normal charging cycles

The battery voltage to float charging voltage, charge cycle is terminated after PJ4057 immediately to monitor voltage of the BAT. When the voltage of the BAT is lower than 4.1 V, charging cycle start again, make sure the battery is maintained in a state of full charge, at the same time periodically from the needs of the charging cycle start.

The charging current settings

Charging current is to use a connection between the PROG pin and ground resistor to set the battery charging current is PROG pin output current of 1000 times, set the resistor and the charging current is calculated using the following formula:

$$RPROG=1000V / ICHG ; \quad ICHG=1000V / RPROG$$

Output 1 foot from BAT charging current can be determined by monitoring PROG pin voltage at any time, formula is as follows:

$$IBAT= VPROG / RPROG *1000$$

PROG relationship with the charging current to determine reference to the table below :

Rprog	Ibat
$I_{bat}=1000/R_{prog}$	
10K	100mA
5K	200mA
3.3K	300mA
2.5K	400mA
2K	500mA
1.65K	600mA

The battery reverse connect protection function

PJ4057 have lithium battery reverse connect protection function, when the lithium battery is the reverse in PJ4057 pin output current, PJ4057 displays the downtime fault state, without charging current, the reverse case, power supply voltage should be in the standard about 5 V, should not exceed 8V, the power of the high voltage in the battery voltage case, chip differential pressure will be more than 10V, so in the reverse case, power supply voltage is unfavorable and exorbitant.

Charging status indicator

PJ4057 has two drain open status indicates output CHRG and STANDBY, when the charger is in charging status, CHRG was pulled down low level, in the other state CHRG as the high impedance state; When the battery is complete, STANDBY was pulled down low level, in the other state STANDBY as the high impedance state, when not received battery charger, twinkle CHRG said no battery installed

The Charging state	CHRG	STANDBY
Be charging	light on	light off
Charging completed	light off	light on
The BAT end is connected with a 1uF capacitor, without battery	Twinkle(≈20Hz)	light on

Charging status

indicatorIf the chip temperature to rise to about 120°C above the preset value, is an internal heat feedback loop will reduce the charging current setting. This function can prevent PJ4057 overheating, and allow users to improve the ability of handling the given circuit board power limit without the risk of damage PJ4057, in ensuring the charger in the worst case conditions under the premise of reducing current automatically, can set the charging current according to the typical environment temperature

Under-voltage lockout

PJ4057 has an internal under-voltage lockout circuit to monitor the input voltage, before the VCC to under-voltage lockout threshold voltage keep the chips in stop working mode. When the VCC voltage rise to 3.8V, chip UVLO, began to work properly. VCC falls UVLO hysteresis voltage of 200 mV
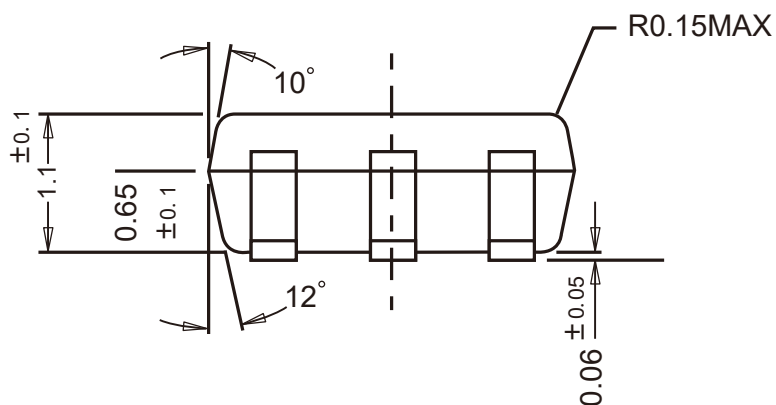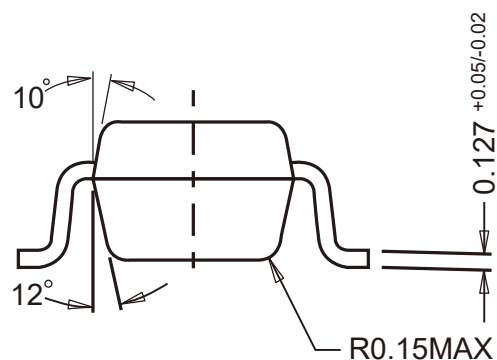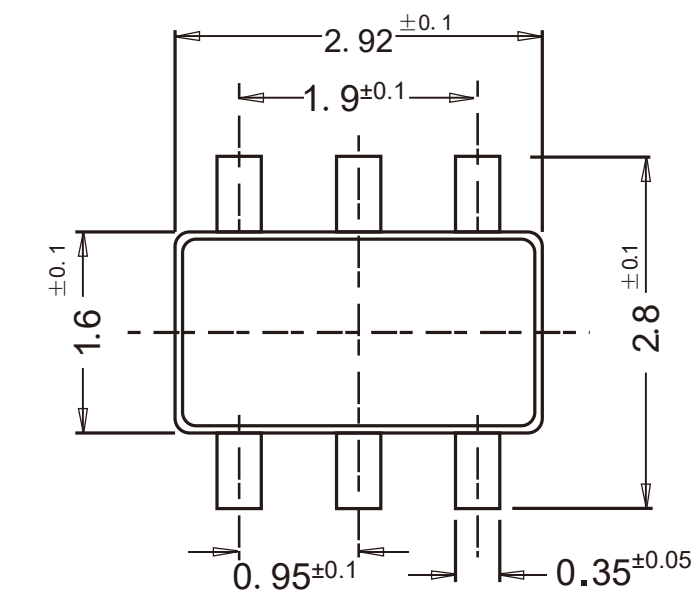
Package Outline

SOT-23-6

Dimensions in mm

Ordering Information

Device	Package	Shipping
PJ4057	SOT-23-6	3,000PCS/Reel&7inches