TP4100/TP4101/TP4102

（1000mA/600mA/1000mA） Linear lithium battery charging and discharging protection chip

DESCRIPTION

TP4100/TP4101/TP4102 is a chip that it has complete single-cell lithium-ion battery charging management and discharging protection. It is the first 5V power supply positive and negative reverse connection protection, with battery positive and negative reverse connection protection, compatible with the size of 3mA-1000mA charging current. It features constant current/constant voltage linear control, and the thin DFN and TSOT packages with fewer external components make it ideal for portable applications.

The chip is equipped with a power supply voltage power adaptive function that can be powered directly from USB or solar power. Thermal feedback automatically adjusts the charge current to limit chip temperature during high power operation or high ambient temperature conditions. The full voltage is fixed at 4.2V, and the charging current can be externally set by a resistor. When the battery reaches 4.2V, the charging current drops to 1/10 of the set value, and the TP4100 will automatically terminate charging.

The TP4100's discharge management includes undervoltage protection, overcharge protection, output short circuit protection, output overcurrent protection, chip overtemperature protection, and various post-delay self-activation recovery. Other features include charge current monitor and undervoltage lockout, automatic recharge and two pins for indicating the charge status (the TP4101 has a charge indication status pin). The TP4100 is available in an 8-pin DFN3*3 package with a charge current range of 3mA to 1000mA. The TP4101 is available in a 6-pin TSOT23 package with a charge current range of 3mA to 600mA. The TP4102 is available in an 8-pin DFN2*2 package with a charge current range of 3-1000mA.

FEATURES

- The first 5V power supply reverse connection protection（0.3Ω）;
- Compatible with programmable charge currents from 3mA to 1000mA;
- Lithium battery reverse polarity protection;
- turbulent flow - constant current - constant voltage three-stage charging;
- Charging mode power supply adaptive;
- 4.2V preset charging voltage with an accuracy of ±1%;
- The maximum input can reach 8V;
- 20% constant current pre-charging;
- C/10 charging is terminated;
- The power supply current in charging standby mode is 80uA,
- BAT standby current 4uA in discharge mode;

- Battery 2.6V undervoltage protection shutdown, charging self-recovery;
- Overcharge protection, output short circuit protection, output overcurrent protection;
- After protection, self-recovery after 8 seconds;
- Multiple packages DFN3*3-8 /TSOT23-6/DFN2*2-8.

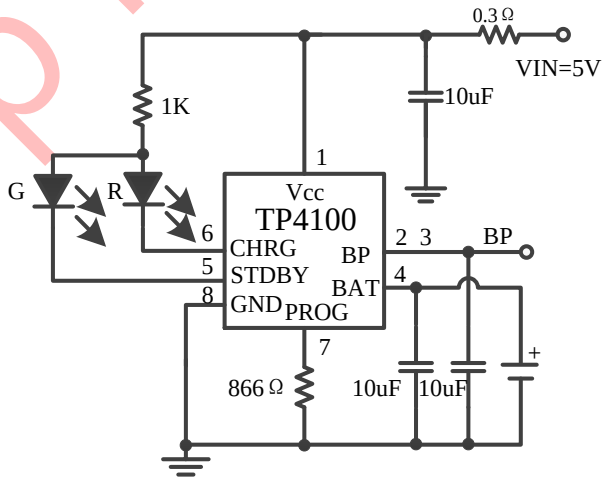
ABSOLUTE MAXIMUM RATINGS

- Input power supply voltage (V_{CC}): -5V~ 8V
- PROG: -0.3V ~ V_{CC}+0.3V
- BAT: -4.2V ~ 8V
- CHRG: -0.3V ~ 8V
- BAT short circuit duration: continuous
- BAT pin current: 1200mA
- PROG pin current: 1500uA
- Maximum junction temperature: 145 °C
- Working environment temperature range: -40 °C ~ 85 °C
- Storage temperature range: -65 °C ~ 125 °C
- Pin temperature (welding time 10 seconds): 260 °C

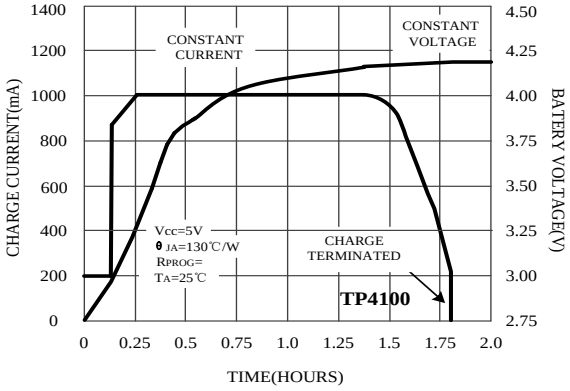
APPLICATIONS

- Micro lithium battery equipment
- Wearable, highly integrated lithium battery device
- Lithium battery portable devices, etc

TYPICAL APPLICATION

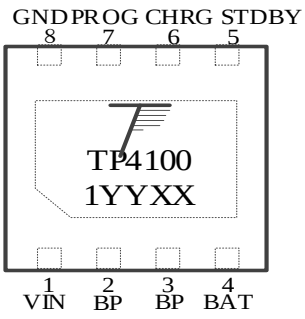


TP4100 single-cell lithium-ion battery 1A charging circuit



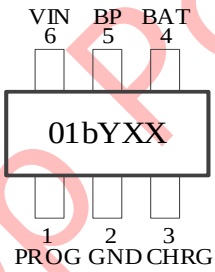
1A current complete charging cycle (1000mAh)

PACKAGE DESCRIPTION



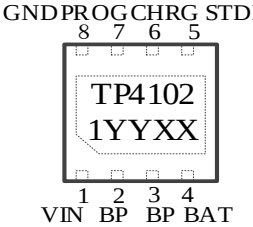
Thin DFN3*3-8 package

Order model
TP4100-42-DFN338
Device Marking
First Logo Second TP4100 Third YY：year；XX：week



Thin TSOT-23-6 package

Order model
TP4101-42-TSOT236
Device Marking
01bYXX (Y:year;XX：week)



Thin DFN2*2-8 package

Order model
TP4102-42-DFN228
Device Marking
First TP4102 Second YY：year；XX：week

Pin function

VCC: Positive input supply voltage. This pin supplies power to the charger. VCC varies from 4.35V to 8V and should be bypassed by at least one 1μF capacitor. When VCC drops below the BAT pin voltage by 30mV, the TP4100/TP4101/TP4102 enters the stop charging mode and the battery changes to the discharge mode.

GND: Ground.

BAT: Charging current output. Connect the positive terminal of the lithium battery. This pin supplies the battery with charging current and adjusts the final float voltage to 4.2V. A precision internal resistor divider on this pin sets the float voltage. In the shutdown mode, the internal resistor divider is turned off.

BP: Battery output pin. The lithium battery supplies power to the load through this pin, and immediately stops the lithium battery output when there is an unexpected situation that needs to protect the battery.

CHRG: The charge status indicator of the open-drain output. When the charger is charging the battery, the CHRG pin is pulled low by the internal switch, indicating that charging is in progress; otherwise the CHRG pin is in a high impedance state.

STDBY: Battery charging completion indicator. When the battery is fully charged, STDBY is pulled low by the internal switch, indicating that charging is complete. In addition, the STDBY pin will be in a high impedance state.

PROG: Charge current setting, charge current monitoring, and shutdown pin. Connect a resistor with a precision of 1% R_{PROG} between this pin and ground to set the charging current. When charging in constant current mode, the voltage at the pin is maintained at 1V.

The PROG pin can also be used to turn off the charger. Disconnect the set resistor from ground and a 0.1μA current source internally pulls the PROG pin high. When the voltage at this pin reaches the shutdown threshold voltage of 2.7V, the charger enters shutdown mode, charging stops and the input supply current drops to 80μA. Reconnecting RPROG to ground will return the charger to normal operation.

ELECTRICAL CHARACTERISTICS

The TP4100 is used as a test electrical characteristic circuit.

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at T_A=25℃， V_{CC}=5V， unless otherwise noted.

Symbol	Parameter	Condition		Min	Typ	Max	Units
V_{CC}	Input Supply Voltage		●	4.35	5	8.0	V
I_{CC}	Input Supply Current	Charge Mode， R_{PROG}=6k Standby Mode(Charge Terminated) Shutdown Mode (R_{PROG} Not Connected, V_{CC} < V_{BAT}, or V_{CC} < V_{UV})	● ● ●		80 80 60	120 120 100	μA μA μA
V_{FLOAT}	Regulated Output (Float) Voltage	0℃≤T_A≤85℃，I_{BAT}=40mA		4.158	4.2	4.242	V

I_{BAT}	BAT Pin Current (unless Vbat=4.0v)	R_{PROG}=100K，Current Mode R_{PROG}=6K，Current Mode R_{PROG}=866，Current Mode Shutdown Mode，V_{BAT}=4.2V	● ● ● ●	2.5 90 900	3 100 1000 -4	3.3 110 1100 -6	mA mA mA μA
I_{BAT}	BAT Pin Current	Normal voltage battery standby mode Battery undervoltage shutdown mode		3	4 -0.01	6 -0.1	μA μA
I_{TRIKL}	Trickle Charge Current	V_{BAT}<V_{TRIKL},R_{PROG}=6K	●	15	20	25	mA
V_{TRIKL}	Trickle charge threshold voltage	R_{PROG}=6k,V_{BAT} rise		2.8	2.9	3.0	V
V_{TRHYS}	Trickle charging hysteresis voltage	R_{PROG}=6k		60	80	100	mV
V_{UV}	VCC undervoltage lockout threshold	VCC From Low to High	●	3.4	3.6	3.8	V
V_{UVHYS}	VCC undervoltage lockout hysteresis		●	150	200	300	mV
V_{MSD}	Manual shutdown threshold voltage	PROG pin level rise PROG pin level drops	● ●	3.40 1.90	3.50 2.00	3.60 2.10	V V
V_{ASD}	VCC-VBAT blocking threshold voltage	VCC From Low to High VCC From High to Low		60 15	80 30	100 45	mV mV
I_{TERM}	C/10 termination current threshold	R_{PROG}=6k R_{PROG}=866	● ●	8 100	9.5 110	11 130	mA mA
V_{PROG}	PROG pin voltage	R_{PROG}=6k，Current Mode	●	0.9	1.0	1.1	V
I_{CHRG}	CHRG pin leakage current	V_{CHRG}=5V（standby mode）			0	1	μA
V_{CHRG}	CHRG pin output low voltage	I_{CHRG}=5mA			0.3	0.6	V
I_{STDBY}	STDBY pin leakage current	V_{STDBY}=5V（standby mode）			0	1	μA
V_{STDBY}	STDBY pin output low level	I_{STDBY}=5mA			0.3	0.6	V
ΔV_{RECHRG}	Recharge battery threshold voltage	V_{FLOAT}-V_{RECHRG}		70	100	130	mV
T_{LIM}	Junction temperature in limited temperature mode				145		℃
R_{ON}	Power FET "on" resistor (between VCC and BAT)				400		mΩ
t_{ss}	Soft start time	I_{BAT}=0 to I_{BAT}=1000V/R_{PROG}			50		us
$t_{RECHARGE}$	Recharge comparator filter time	V_{BAT} From High to Low		0.8	2	4	ms

t_{TERM}	Terminate comparator filter time	I_{BAT} falls below $I_{CHG}/10$		0.8	2	4	ms
I_{PROG}	Pull-up current on the PROG pin				2		μA
I_{BAT}	Battery reverse leakage current	Battery 4.2V reverse connection		1.5	2.5	4.5	mA
R_{BP}	Power FET "on" resistor (between BP and BAT)				100		mΩ
V_{OD}	Battery over-discharge shutdown voltage			2.6	2.7	2.8	V
V_{OC}	Overcharge protection voltage			V_{FLOAT} +100	V_{FLOAT} +120	V_{FLOAT} +140	mV
V_{OV}	BP overvoltage in non-charged state	BP is greater than BAT voltage		5	10	15	mV
I_{OCP}	Discharge output overcurrent protection	V_{BAT}=3V V_{BAT}=3.7V V_{BAT}=4.2V			1.3 1.55 1.7		A
T_{BP}	Discharge overheat protection temperature			150	160	170	℃
T_{CLK}	Protection self-recovery time			4	8	10	S
T_{CLKP}	Protection establishment delay time			80	120	160	mS

Charging current setting

Formula: $R_{PROG} = \frac{650}{I_{BAT}}$ (I_{BAT}＜0.4A)

Formula: $R_{PROG} = \frac{850}{I_{BAT}}$ (I_{BAT}≥0.4A)

RPROG and charging current

R_{PROG} (Ω)	I_{BAT} (mA)
100K	3
12K	45
6K	100
3.5K	200
2K	400
1.35K	600
1.05K	800
866	1000