DESCRIPTION

The TP4056 is a single lithium-ion battery constant current / constant voltage linear charger，adopt ESOP8 package with heat sink at the bottom and simple external application circuit，very suitable for portable device applications, USB power supply and adapter power supply work，internal use of anti-reverse charging circuit，no external isolation diode is required.The thermal feedback can automatically adjust the charging current, in order to operate at high power or high ambient temperature conditions to limit the chip temperature.

The TP4056 charging cut-off voltage is 4.2v, and the charging current can be set through external resistance.When the charging current drops to 1/10 of the set value, TP4056 will automatically end the charging process.When the input voltage is removed, TP4056 will automatically enter the state of ultra-low power consumption standby, and the standby current will be reduced to below 1uA.TP4056 can also be put into shutdown mode when there is an input power supply, thus reducing the working current to 40uA.

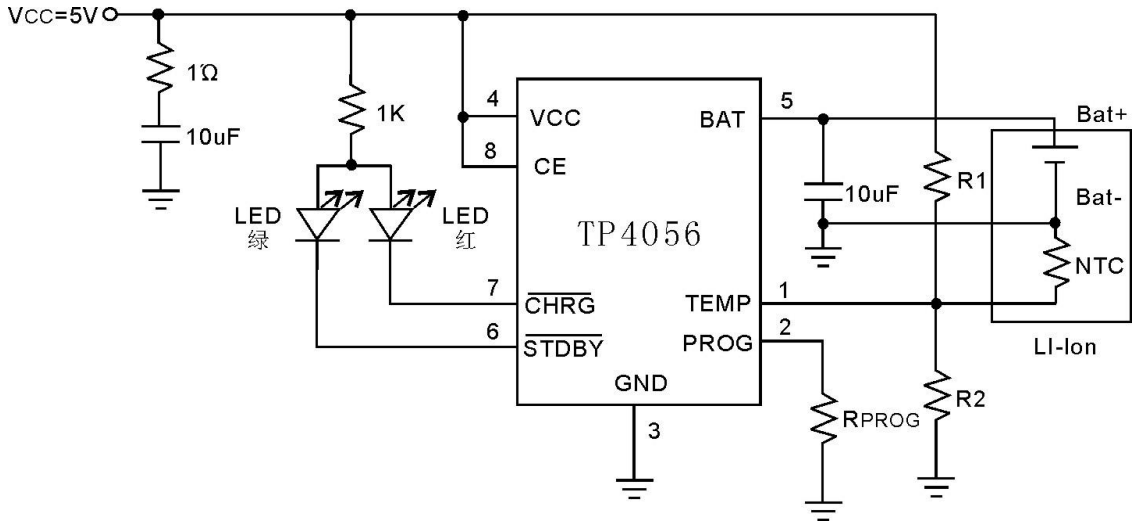
KEY FEATURES

- Up to 1A Charging Current
- No MOSFET or Blocking diode Required
- Intelligent Thermal Regulation
- Intelligent Recharging Function
- Preset Charge Voltage：4.2V
- C/10 Charge Termination
- 2.9V Trickle Charge Threshold
- Package：ESOP8

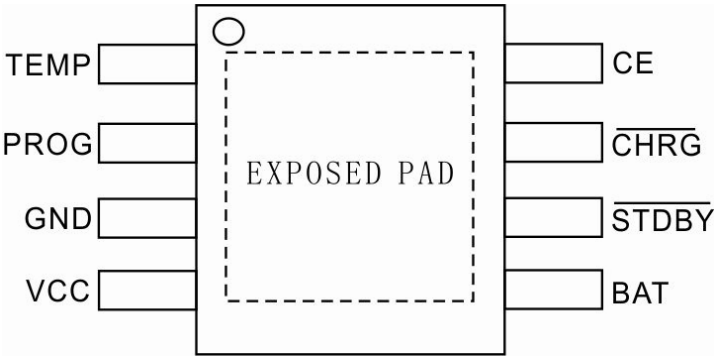
APPLICATIONS

- Mobile Phone、PDA、MP3/MP4
- Bluetooth headset、GPS、Electronic dictionary
- Power bank
- Mini audio and other portable equipment

TYPICAL APPLICATION



PIN CONFIGURATION



SOP8-PP

ORDER INFORMATION

Package	Order model	Packaging form	Marking
SOP8-PP	TP4056	Tape and Reel	TP4056

ABSOLUTE MAXIMUM RATINGS (NOTE1)

SYM	PARAMETER	Range	Units
VCC	Input Supply Voltage	-0.3~7	V
PROG	PROG Pin Voltage	-0.3~0.3	V
BAT	BAT Pin Voltage	-0.3~7	V
CHRG	CHRG Pin Voltage	-0.3~7	V
STDBY	STDBY Pin Voltage	-0.3~7	V
TEMP	TEMP Pin Voltage	-0.3~7	V
CE	CE Pin Voltage	-0.3~7	V
T_{BAT_SHT}	BAT Short Circuit Duration	Continuous	-
I_{BAT}	BAT Pin Current	1200	mA
I_{PROG}	PROG Pin Current	1200	uA
T_{OP}	Operating Ambient Temperature	-40~85	℃
T_{STG}	Storage Temperature	-65~125	℃
ESD	HBM	2000	V
	MM	200	V

Note 1: the maximum limit value means that the chip may be damaged beyond the working range.

ELECTRICAL CHARACTERISTICS（NOTE 2,3）

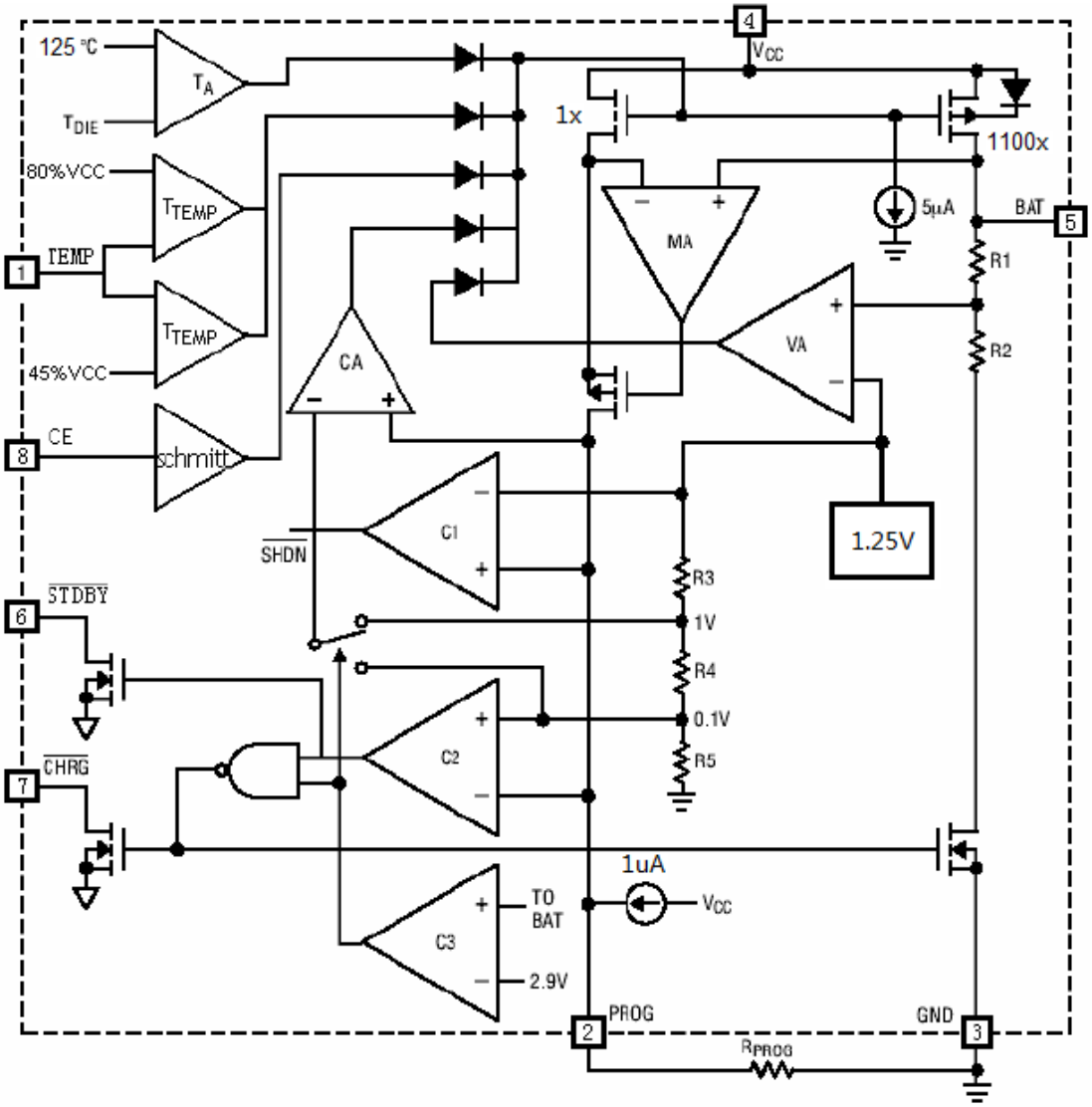
Unless otherwise specified,VIN=5V，Ta=25℃

SYM	PARAMETER	Test Condition	Min.	Typ.	Max.	Unit.
V_{CC}	Input Supply Voltage		4.5	5	5.5	V
I_{CC}	Input Supply Current	Charge Mode，R_{PROG}=1.2K		130	300	uA
		StandbyMode (Charge Terminated)		50	100	uA
		Shut Down Mode:(R_{PROG} Not Connected , V_{CC}＜V_{BAT},V_{CC}＜ V_{UV},V_{CE}=0V)		40	100	uA
V_{FLOAT}	Regulated Output (Float) Voltage	0℃≤T_A≤85℃		4.2		V
I_{BAT}	BAT Pin Current	R_{PROG}=2K，Current Mode	500	550	600	mA
		R_{PROG}=1 K，Current Mode	1000	1100	1200	mA
		Standby Mode (V_{CC}=5V,V_{BAT}=4.2V)	0	2	4	μA
		Shutdown Mode（R_{PROG} Not Connected , Or V_{CE}=0V）		0	2	μA
		Sleep Mode，V_{CC}=0		0	2	μA
I_{TRIKL}	Trickle Charge Current	V_{BAT}＜V_{TRIKL},R_{PROG}=1.2K	100	120	150	mA
V_{TRIKL}	Trickle Charge Threshold Voltage	R_{PROG}=1K，VBAT Rising	2.8	2.9	3.0	V
V_{TRHYS}	Trickle Charge Hysteresis Voltage	R_{PROG}=1K	60	80	100	mV
V_{UV}	V_{CC} Undervoltage Lockout Threshold	V_{CC} Rising	3.5	3.7	3.9	V
V_{UVHYS}	V_{CC} Undervoltage Lockout Hysteresis	V_{CC} Falling	0.15	0.2	0.3	V
V_{ASD}	V_{CC}-V_{BAT} Lockout Threshold Voltage	V_{CC} Rising	60	100	140	mV
		V_{CC} Falling	5	30	50	mV
I_{TERM}	C/10 Termination Current Threshold	R_{PROG}=2K	50	60	80	mA
		R_{PROG}=1K	100	120	150	mA
V_{PROG}	PROG Pin Voltage	R_{PROG}=1K，Current Mode	0.9	1.0	1.1	V
V_{CHRG}	CHRG Pin Output Low Voltage	I_{CHRG}=5mA		0.3	0.6	V
V_{STDBY}	STDBY Pin Output Low Voltage	I_{STDBY}=5mA		0.3	0.6	V
ΔV_{RECHRG}	Recharge Battery Threshold Voltage	V_{FLOAT}-V_{RECHRG}	70	100	150	mV
V_{TEMP-H}	TEMP Pin high flip voltage			80	82	%V_{CC}
V_{TEMP-L}	TEMP Pin low flip voltage		43	45		%V_{CC}
T_{LIM}	Junction Temperature in Constant Temperature Mode			125		℃
R_{ON}	Power FET “ON” Resistance(Between VCC and BAT)			500		mΩ
T_{SS}	Soft-Start time	I_{BAT}=0 to I_{BAT}=1200V/R_{PROG}		20		uS
T_{RECHRG}	Recharge Comparator Filter Time	V_{BAT} Falling	1	2	3	mS

T_{TERM}	Termination Comparator Filter Time	I_{BAT}falling below C/10	1	2	3	mS
I_{PROG}	PROG pin pull-up current			1		uA
V_{CE-H}	CE logic enables high level voltage			0.9		V

Note 2: the typical parameter values under the condition of 25 ℃ measured standard parameter values.
Note 3 the minimum and maximum specification range of the specification is guaranteed by test, and the typical value is guaranteed by design, test or statistical analysis.

SIMPLIFIED BLOCK DIAGRAM



OPERATION DESCRIPTION

TP4056 is a linear charger specially designed for a Li-ion battery or lithium polymer battery,Chip integrated power MOSFET，charging current can be set with external resistance，maximum continuous charge current up to 1A，no additional isolation diodes and current detection resistors are required。TP4056 contains two open-drain output status indicating terminals, charging status indicating output CHRG and charging completion indicating output STDBY。When charging, the pin CHRG output low level indicates that the charging is in progress.If the battery voltage is lower than 2.9v, TP4056 precharges the battery with a small current.When the battery voltage exceeds 2.9v, the battery is charged in constant current mode, and the charging current is determined by the resistance R_{PROG} between PROG pin and GND.When the battery voltage is close to 4.2v, the charging current gradually decreases, and TP4056 enters the mode of constant voltage charging.When the charging current decreases to the threshold value at the end of charging, the charging cycle ends, the CHRG terminal outputs a high-impedance state, and the STDBY terminal outputs a low potential. The charging end threshold is 10% of the constant current charging current. When the battery voltage drops below the recharging threshold of 4.1v, TP4056 will automatically start a new charging cycle. The high-precision voltage reference source, error amplifier and resistance voltage divider network inside the chip ensure that the precision of modulating voltage at the battery end is within 1%, meeting the requirements of Li-ion battery and lithium polymer battery.When the input voltage is lower than the under-voltage lock threshold voltage or the input voltage is lower than the battery voltage, the charger enters a low-power sleep mode, and the current consumed at the battery end is less than 2uA.

TP4056 within the intelligent temperature control circuit automatically when chip junction temperature over 125℃ lower charging current, this feature enables users to maximize the use of chip power handling capacity, don't have to worry about because of overheating and damage the chip or external components.In this way, users can design the charging current without considering the worst case, but only according to the typical case, because in the worst case, TP4056 will automatically reduce the charging current.If the power input CE is connected to a low level, the charger will stop charging.

Pin function

TEMP(PIN1): Battery temperature detection input terminal

Connect TEMP pins to the output of the battery's NTC sensor.If the TEMP pin voltage is less than 45% of the input voltage or greater than 80% of the input voltage, indicating that the battery temperature is too low or too high, the charging is terminated.If the battery temperature detection function is not required, TEMP can be directly connected to GND. The battery temperature detection function is invalid, but other charging functions are normal.

PROG(PIN2): Constant current charging current setting terminal

Charging current can be set by connecting a resistor from PROG pin to GND.The setting resistor and charging current are calculated using the following formula: $R_{PROG}=1100V/I_{BAT}$

The resistance value of the resistor R_{PROG} is determined according to the required charging current I_{BAT}.In the trickle charging stage, the voltage of this pin is modulated at 0.1v, and in the constant charging stage, the voltage of this pin is fixed at 1V.

GND(PIN3):Power ground

V_{CC}(PIN4): Input voltage positive terminal

The voltage of this pin is the working power of the internal circuit.Charging will only start when the VCC input voltage must be greater than the undervoltage locking threshold and also greater than BAT voltage 100mV.When the VCC input voltage is lower than the under-voltage locking threshold or the voltage difference between VCC and BAT pin is less than 30mV, TP4056 will enter the low-power shutdown mode, and the consumption current of BAT pin is less than 2uA.

BAT(PIN5):Battery positive terminal

Connect the positive of the battery to this pin.The chip is prohibited from working or sleeping

In sleeping mode, the leakage current of BAT pins is less than 2uA, and BAT pins provide charging current and 4.2v limiting voltage to the battery.

STDBY(PIN6):Charging completion indicating end

When the battery charging is completed,STDBY is pulled to the low level by the internal switch, indicating that the charging is completed.In addition, the STDBY pins will be in a high impedance state.

CHRG(PIN7): Charging status indicating terminal

When the charger charges the battery, the CHRG pin is

pulled to a low level by an internal switch, indicating that the charging is in progress.Otherwise, the CHRG pin is in a high impedance state.

CE(PIN8):Chip enable input terminal

When high power is input, TP4056 is in normal working state;When low power is input,TP4056 is in the forbidden charging state.The CE pin can be driven by TTL level or CMOS level.

APPLICATION INFORMATION

Charge termination

When the charging current drops to 1/10 of the set value after reaching the final floating charging voltage, the charging process ends.This condition is detected by monitoring the PROG pin with an internal filter comparator. When the PROG pin voltage drops below 100mV for more than 2ms, the charging stops and TP4056 enters standby mode, at which time the input power current drops to 50uA.

Intelligent recharging

In standby mode, TP4056 to monitor BAT pin voltage, only when the BAT pin voltage is lower than the recharge threshold voltage of 4.1 V (corresponding to the battery capacity 80% ~ 90%), charging will begin a new cycle, to charge the battery again, this avoids unnecessary repeated charging the battery, prolong the service life of batteries.

Charge status indicator

TP4056 has two open-drain state indicating the output end, CHRG and STDBY. When the charger is in the charging state, CHRG is pulled to the low level. After charging, CHRG is in the high-resistance state and STDBY is pulled to the low level.If the state indicating function is not used, the unused state indicating output terminal is grounded.The following is a summary of the installation indicating functions:

Charging Status	Red (CHRG)	Green (STDBY)
Charging	On	Off
Charge End	Off	On
BAT is connected to 10uF capacitor	Flick （T≈1-4S）	On

Intelligent temperature control

TP4056 internal integrates the function of intelligent temperature control, when the chip temperature higher than 125 ℃, automatically reduce the charging current.This feature allows the user to increase the upper limit of the power handling capability of a given circuit board without the risk of damaging the TP4056. On the premise that the charger will automatically reduce the current in the worst case, the charging current can be set according to the typical (but not the worst case) ambient temperature.

Battery temperature monitoring

In order to prevent damage to the battery caused by too high or too low temperature, TP4056 has integrated battery temperature monitoring circuit. Battery temperature monitoring is achieved by monitoring the voltage of TEMP pins, which is realized by the NTC thermistor and a resistance voltage distribution network within the battery, as shown in typical application circuits.TP4056 compares the voltage of the TEMP pin with the two thresholds V_{TEMP-H} and V_{TEMP-L} inside the chip to confirm whether the battery temperature is beyond the normal range.

V_{TEMP-L} = 45%×V_{CC}, V_{TEMP-H}= 80%×$V_{CC.}$

If the voltage of TEMP pin is V_{TEMP}<V_{TEMP-L} or V_{TEMP}>V_{TEMP-H}, the battery temperature is too high or too low, and the charging process will be terminated.If battery temperature monitoring is not required, connect the TEMP pin to the ground.

Increase the thermal regulation resistance

Reducing the voltage drop at both ends of IC VCC and BAT can significantly reduce the power consumption in IC.In thermal regulation, this has the effect of increasing the charging current. Implementation can be between input power and the VCC series a 0.3 Ω power resistor or are diode to the pressure drop is less than 0.5 V, which will be part of the power consumption.

Soft start of charging current

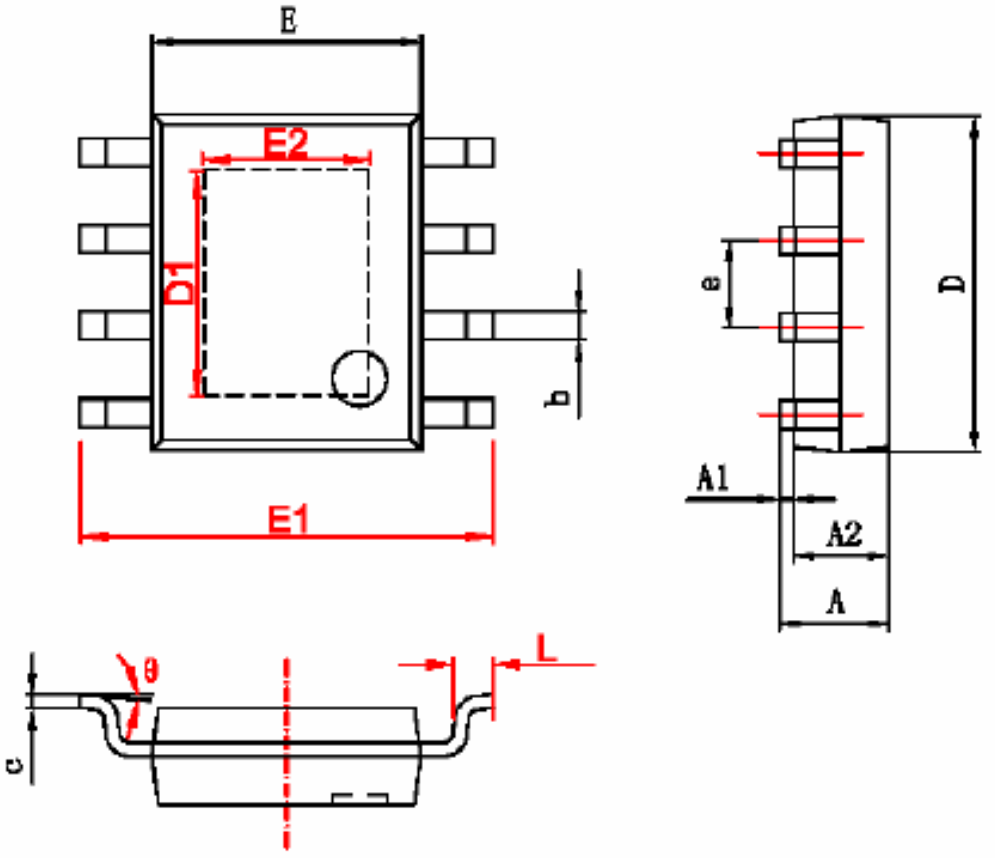
TP4056 has a soft start path built in.When a charging cycle is started, the charging current will gradually rise from zero to constant current in 20uS time.

Stop mode

If the CE terminal is set as low potential or the PROG pin is made to float empty, TP4056 will be placed in the stop mode.The battery leakage current will drop below 1uA and the supply current will drop below 40uA.

PACKAGE DIMENSION

SOP8-PP



字符	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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