TP4066 1A Standalone Linear Li-Ion Battery Charger with Thermal Regulation in ESOP8 / DFN2*2-8

DESCRIPTION

The TP4066 is a complete constant-current/constant-voltage linear charger for single cell lithium-ion batteries, with battery reverse connect protection. Its ESOP8/DFN2*2-8 package and low external component count make the TP4066 ideally suited for portable applications. Furthermore, the TP4066 can work within USB and wall adapter.

No blocking diode is required due to the internal PMOSFET architecture and have prevent to negative Charge Current Circuit. Thermal feedback regulates the charge current to limit the die temperature during high power operation or high ambient temperature. Full voltage can be divided into three files: 4.35V, 4.2V, 3.7V. and the charge current can be programmed externally with a single resistor. The TP4066 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached.

When the input voltage (AC adapter or USB power supply) is removed, TP4066 automatically enters a low current state, reducing the battery leakage current to below 1uA. TP4066 Other features include supply voltage self adaptive, current monitor, under voltage lockout, automatic recharge and two status pin to indicate charge termination and the presence of an input voltage.

FEATURES

- •Lithium-ion batteries Reverse battery protection
- •Power adaptive
- •Programmable Charge Current Up to 1000mA
- •For Single Cell Lithium-Ion Batteries
- •Constant-Current/Constant-Voltage
- •Preset Charge Voltage with 1% Accuracy
- •Automatic Recharge
- •two Charge Status Output Pins
- •C/10 Charge Termination
- •When there is no power supply, the battery leakage is less than 1uA
- •2.9V Trickle Charge Threshold
- •Soft-Start Limits Inrush Current
- •Maximize Charge Rate Without Risk of Overheating
- •Available in 8-pin ESOP/DFN2*2 package

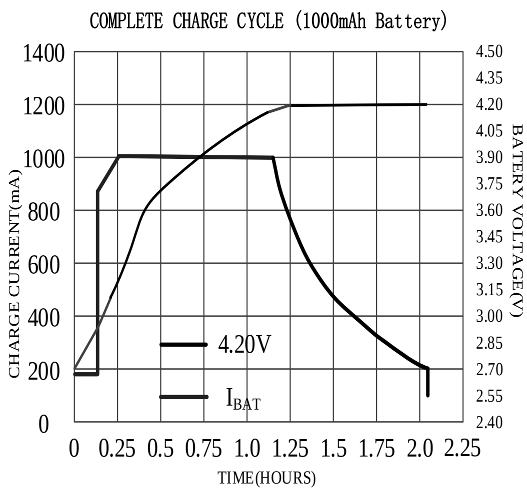
APPLICATIONS

- •Energy storage, Fast charge equipment
- •Medical aesthetics and medical care
- •Mobile payment terminal
- •Smart wear, various chargers

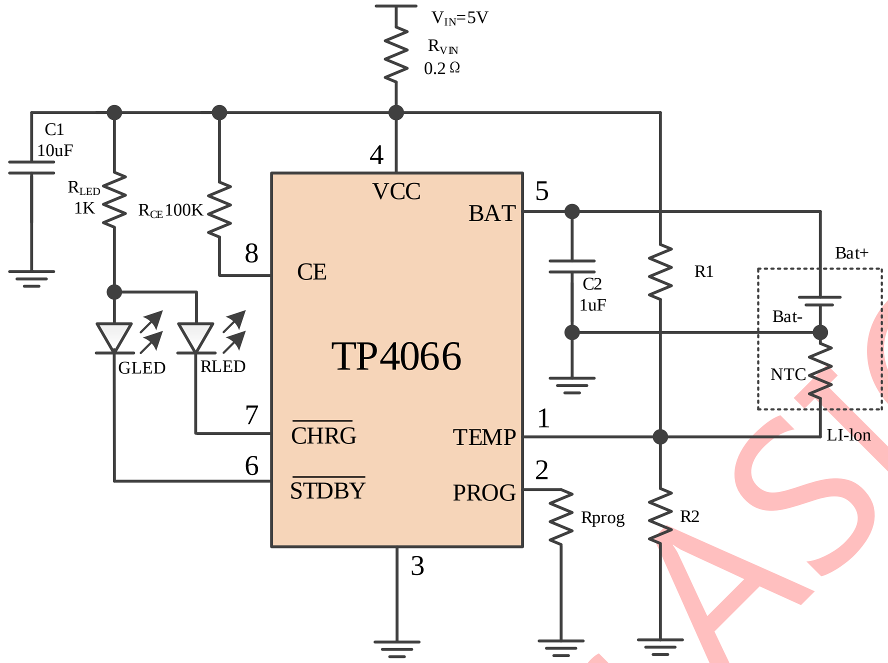
ABSOLUTE MAXIMUM RATINGS

- •Input Supply Voltage(VCC)：-0.3V～8V
- •PROG：-0.3V～VCC+0.3V
- •BAT：-4.2V～7V
- •CHRG：-0.3V～8V
- •STDBY:-0.3V~8V
- •TEMP：-0.3V～8V
- •CE：-0.3V～8V
- •BAT Short-Circuit Duration：Continuous
- •BAT Pin Current：1100mA
- •PROG Pin Current：1000uA
- •Maximum Junction Temperature：145℃
- •Operating Ambient Temperature Range：-40℃～85℃
- •Storage Temperature Range：-65℃～125℃
- •Lead Temp.(Soldering, 10sec)：260℃

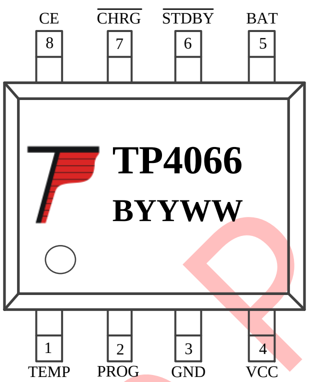
COMPLETE CHARGE CYCLE (1000mAh Battery)



TYPICAL APPLICATIONS

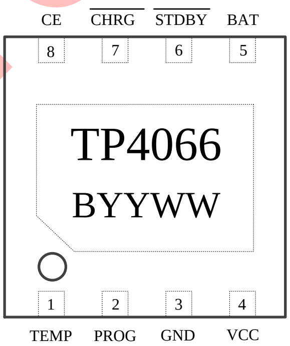


PACKAGE/ORDER INFORMATION



ESOP8

ORDER PART NUMBER
TP4066-4.35V-ESOP8 TP4066-4.2V-ESOP8 TP4066-3.7V-ESOP8
PART MARKING: **AYYWW**→4.35V **BYYWW**→4.2V **CYYWW**→3.7V
BYYWW（B is variable and represents different preset voltages. YYWW is the production lot number, variable.）



DFN2*2-8

ORDER PART NUMBER
TP4066-4.2V-DFN228
PART MARKING: **AYYWW**→4.35V **BYYWW**→4.2V **CYYWW**→3.7V
BYYWW（B is variable and represents different preset voltages. YYWW is the production lot number, variable.）

ELECTRICAL CHARACTERISTICS

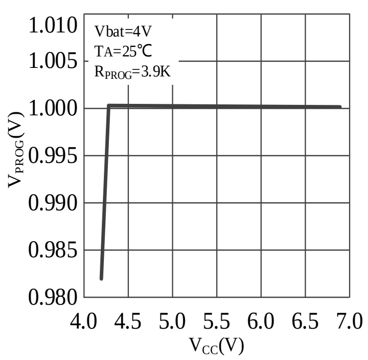
The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at **T_A=25°C, V_{CC}=5V**, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{CC}	Input Supply Voltage		●	4.35	5	8.0	V
V_{OVP}	Overvoltage protection point		●	6.5	7	7.5	V
I_{CC}	Input Supply Current	Charge Mode, R_{PROG} = 0.7K Standby Mode (Charge Terminated), Shutdown Mode (R_{PROG} Not Connected, V_{CC} < V_{BAT}, or V_{CC} < V_{UV})	● ● ●		120 90 90	200 200 200	µA µA µA
V_{FLOAT}	Regulated Output (Float) Voltage	0°C≤T_A≤85°C		4.306 4.158 3.663	4.35 4.2 3.7	4.394 4.242 3.737	V V V
I_{BAT}	BAT Pin Current (Test condition: VBAT=4.0V)	R_{PROG}=1.2K, Current Mode R_{PROG}=0.7K, Current Mode Standby Mode, V_{BAT} = 4.2V Shutdown Mode((R_{PROG} Not Connected) Sleep Mode, V_{CC} =0V	● ● ●	470 900 0	520 1000 -2.0 ±1 -1	570 1100 -6 ±2 -2	mA mA µA µA µA
I_{TRIKL}	Trickle Charge Current	V_{BAT}<V_{TRIKL}, R_{PROG}=0.7K	●	90	130	170	mA
V_{TRIKL}	Trickle Charge Threshold Voltage	R_{PROG}=0.7K, V_{BAT} Rising		2.8	2.9	3.0	V
V_{TRHYS}	Trickle Charge Hysteresis Voltage	R_{PROG}=0.7K		60	80	100	mV
V_{UV}	V_{CC} UVLO Voltage	V_{CC} from low to high	●	3.5	3.7	3.9	V
V_{UVHYS}	V_{CC} UVLO Hysteresis		●	150	200	300	mV
V_{ASD}	V_{CC}-V_{BAT} lockout threshold voltage	V_{CC} from low to high V_{CC} from high to low		130 30	160 50	190 70	mV mV
I_{TERM}	C/10 termination current threshold	R_{PROG}=1.2K R_{PROG}=0.7K	● ●	40 100	50 150	60 200	mA mA
V_{PROG}	PROG pin voltage	RPROG=0.7K， current mode	●	0.9	1.0	1.1	V
$V_{\overline{CHRG}}$	$V_{\overline{CHRG}}$ Pin output low voltage	$I_{\overline{CHRG}}$ =4.8mA			0.2	0.6	V
$V_{\overline{STDBY}}$	$V_{\overline{STDBY}}$ Pin output low voltage	$I_{\overline{STDBY}}$ =4.8mA			0.2	0.6	V
V_{TEMP-H}	TEMP upper trip threshold				80	82	%Vcc
V_{TEMP-L}	TEMP lower trip threshold			43	45		%Vcc
ΔV_{RECHRG}	Recharge battery threshold voltage (V_{FLOAL}= 4.2V)	V_{FLOAT}-V_{RECHRG}		90	110	130	mV
T_{LIM}	Junction Temperature in Constant Temperature Mode				145		℃
R_{ON}	The resistance of power FET ON (between VCC and BAT)				400		mΩ

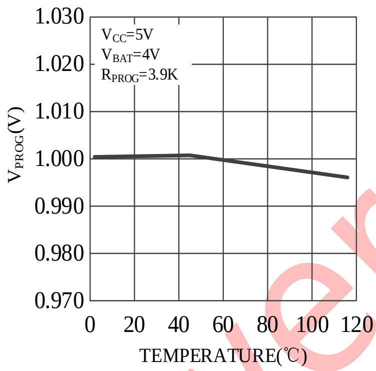
t_{SS}	Soft-start time	I_{BAT}=0 to I_{BAT}=1100V/R_{PROG}			20		us
$t_{RECHARGE}$	Recharge comparator filter time	V_{BAT} from high to low		0.8	1.8	4	ms
t_{TERM}	Rermination comparator filter time	I_{BAT} drops below I_{CHG}/10		0.8	1.8	4	ms
I_{PROG}	PROG pin pull-up current				2.0		µA
V_{ADPT}	Vcc adaptive starting voltage	Rprog=0.7K，Vcc from high to low		4.1	4.3	4.5	V
I_{BAT}	BAT reverse leakage current	BAT reverse, VIN =5V			25	30	mA

TYPICAL PERFORMANCE CHARACTERISTICS

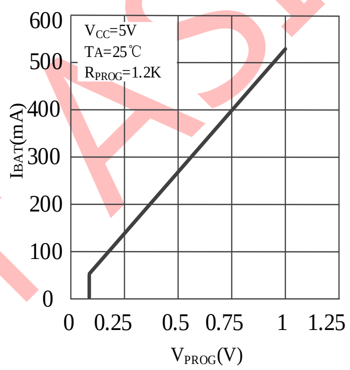
PROG Pin Voltage vs Supply Voltage (Constant Current Mode)



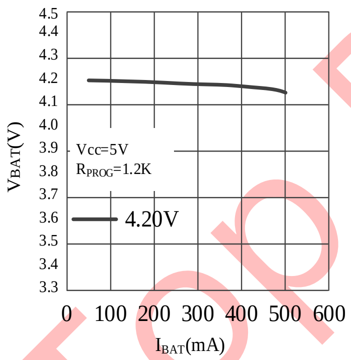
PROG Pin Voltage vs Temperature



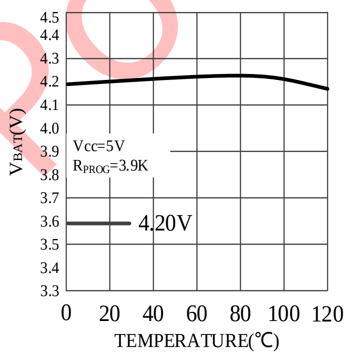
Charge Current vs PROG Pin Voltage



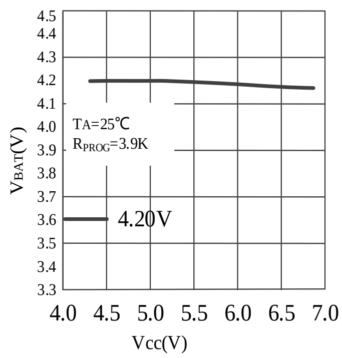
Regulated Output (Float) Voltage vs Charge Current



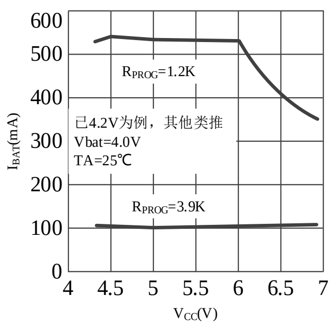
Regulated Output (Float) Voltage vs Temperature



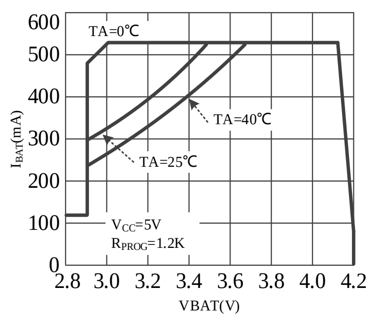
Regulated Output (Float) Voltage vs Supply Voltage



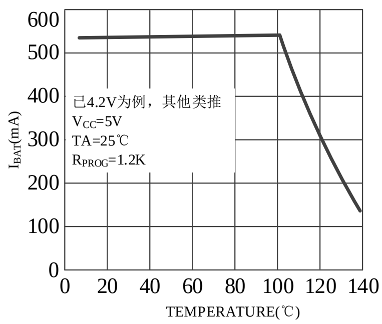
4.2V Charge Current vs Supply Voltage



4.2V Charge Current vs Battery Voltage



4.2V Charge Current vs Temperature



Pin Description

▪**TEMP(Pin 1) :Temperature Sense Input** Connecting TEMP pin to NTC thermistor's output in Lithium ion battery pack. If TEMP pin's voltage is below 45% or above 80% of supply voltage VIN, this means that battery's temperature is too high or too low, charging is suspended. The temperature sense function can be disabled by grounding the TEMP pin.

▪**PROG(Pin 2): Constant Charge Current Setting and Charge Current Monitor Pin** charge current is set by connecting a resistor RISET from this pin to GND. When in precharge mode, the ISET pin's voltage is regulated to 0.2V. When in constant charge current mode, the ISET pin's voltage is regulated to 1V.

▪**GND(Pin3): Ground Terminal**

▪**VCC(Pin 4): Positive Input Supply Voltage** VIN is the power supply to the internal circuit. When VIN drops to within 50mV of the BAT pin voltage, TP4066 enters low power sleep mode, dropping BAT pin's current to less than 1uA.

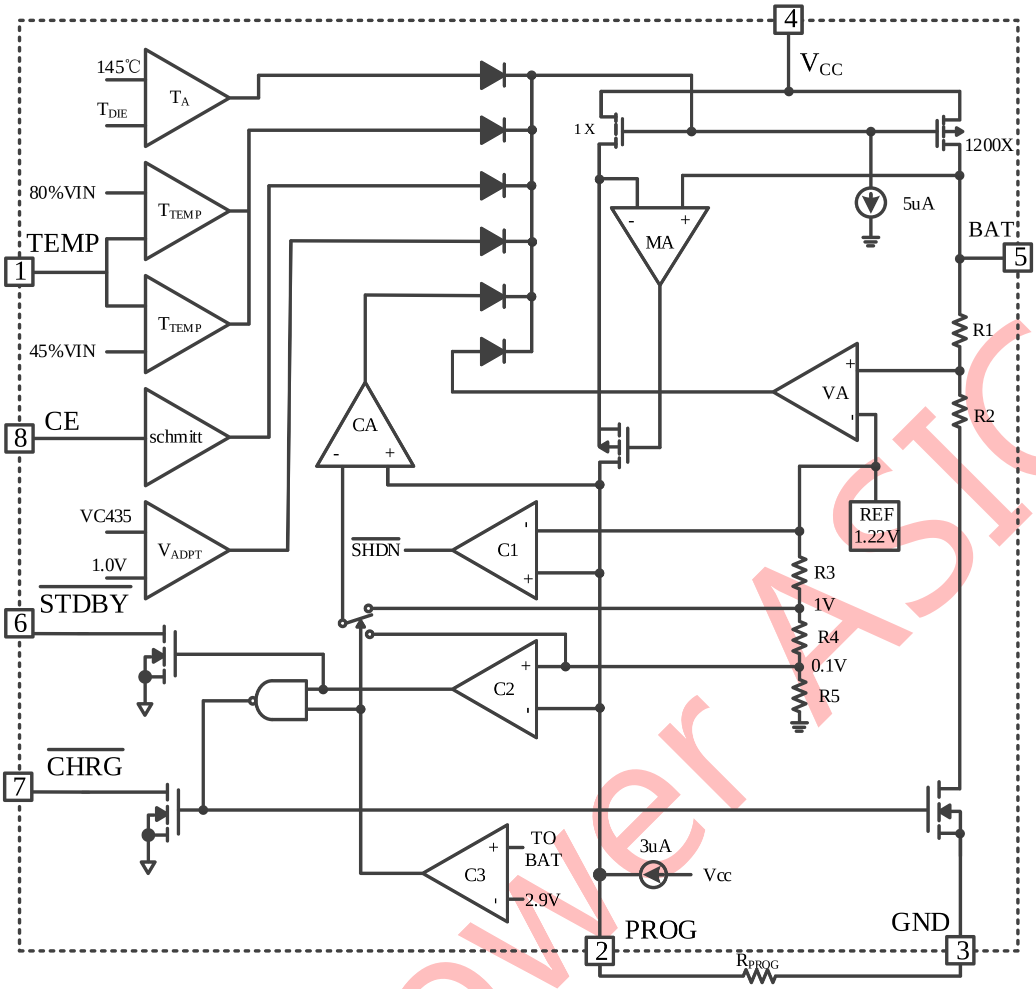
▪**BAT(Pin5): Battery Connection Pin.** Connect the positive terminal of the battery to BAT pin. BAT pin draws less than 1uA current in chip disable mode or in sleep mode. BAT pin provides charge current to the battery and provides regulation voltage of 4.2V.

▪$\overline{STDBY}$ **(Pin6): Open Drain Charge Status Output** When the battery Charge Termination, the $\overline{STDBY}$ pin is pulled low by an internal switch, otherwise $\overline{STDBY}$ pin is in high impedance state.

▪$\overline{CHRG}$ **(Pin7): Open Drain Charge Status Output** When the battery is being charged, the $\overline{CHRG}$ pin is pulled low by an internal switch, otherwise $\overline{CHRG}$ pin is in high impedance state.

▪**CE(Pin8): Chip Enable Input.** A high input will put the device in the normal operating mode. Pulling the CE pin to low level will put the TP4066 into disable mode. The CE pin can be driven by TTL or CMOS logic level.

DIAGRAM



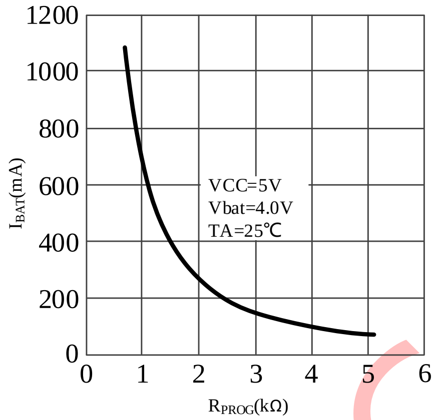
OPERATION

TP4066 is a linear charger circuit specifically designed for a lithium-ion or lithium-polymer battery, using the power transistor inside the chip to charge the battery at constant current and constant voltage. The charging current can be programmed with an external resistor, and the maximum continuous charging current is up to 1A. The TP4066 consists of two state indicator outputs with open drain outputs, a charge state indicator and a battery fault state indicator output. The power management circuit inside the chip automatically reduces the charging current when the junction temperature of the chip exceeds 145 ° C. This function allows users to maximize the power processing capacity of the chip without worrying about the chip overheating and damaging the chip or external components. In this way, the user can design the charging current without considering the worst case, and just design according to the typical case, because in the worst case, the TP4066 will automatically reduce the charging current When the input voltage is greater than the low voltage detection threshold of the power supply and the chip enables the input end to connect to high power, TP4066 starts to charge the battery, and the CHRG pin output is low, indicating that charging is in progress. If the battery voltage is below 2.9V, the TP4066 uses a trickle stream to pre-charge the battery. When the battery voltage exceeds 2.9V, the charger uses constant current mode to charge the battery, and the charging current is determined by the resistance RPROG between the PROG pin and GND. When the battery voltage approaches 4.2V voltage, the charging current gradually decreases, and TP4066 enters the constant voltage charging mode. When the charging current decreases to the charging end threshold, the charging cycle ends, the $\overline{CHRG}$ pin end outputs high resistance state, and the $\overline{STDBY}$ pin end outputs low potential.

The charging end threshold is 10% of the constant current charging current.The charge cycle can also be automatically restarted if the BAT pin voltage falls below the recharge threshold. The on-chip reference voltage, error amplifier and the resistor divider network provide regulation voltage with 1% accuracy, which can meet the requirement of lithium-ion and lithium polymer batteries. When the input voltage is not present, or input voltage is below VBAT, the charger enters a sleep mode, dropping battery drain current to less than 1 μ A. This greatly reduces the current drain on the battery and increases the standby time. The charger can be shut down by forcing the CE pin to GND.

Programming Charge Current

The charge current is programmed using a single resistor from the PROG pin to ground. The resistor and charging current can be calculated based on the relationship curve between RPROG and charging current: the resistor resistance value can be determined according to the required charging current, with an error of ± 10%



In applications, one can refer to the following chart showing the relation between R_{PROG} and charge current:

R_{PROG} (K)	I_{BAT} (mA)
5.1	70
3.9	100
2.7	170
2	260
1.5	390
1.2	520
1.0	660
0.85	800
0.77	900
0.7	1000

Charge Termination

A charge cycle terminates when the charge current falls to 1/10th the programmed value after the final float voltage is reached. This condition is detected by using an internal filtered comparator to monitor the PROG pin. When the PROG pin voltage falls below 100mV for longer than t_{TEMP} (typically 1.8ms), charging is terminated. The charge current is latched off and the TP4066 enters standby mode, where the input supply current drops to 90 μA.

(Note: C/10 termination is disabled in trickle charging and thermal limiting modes).

When charging, transient loads on the BAT pin can cause the PROG pin to fall below 100mV for short periods of time before the

DC charge current has dropped to 1/10th the programmed value. The 1.8ms filter time (t_{TEMP}) on the termination comparator ensures that transient loads of this nature do not result in premature charge cycle termination. Once the average charge current drops below 1/10th the programmed value, the TP4066 terminates the charge cycle and ceases to provide any current through the BAT pin. In this state all loads on the BAT pin must be supplied by the battery.

The TP4066 constantly monitors the BAT pin voltage in standby mode. If this voltage drops below the 4.09V recharge threshold (V_{RECHRG}), another charge cycle begins and charge current is once again supplied to the battery.

Figure 1 shows the state diagram of a typical charge cycle.

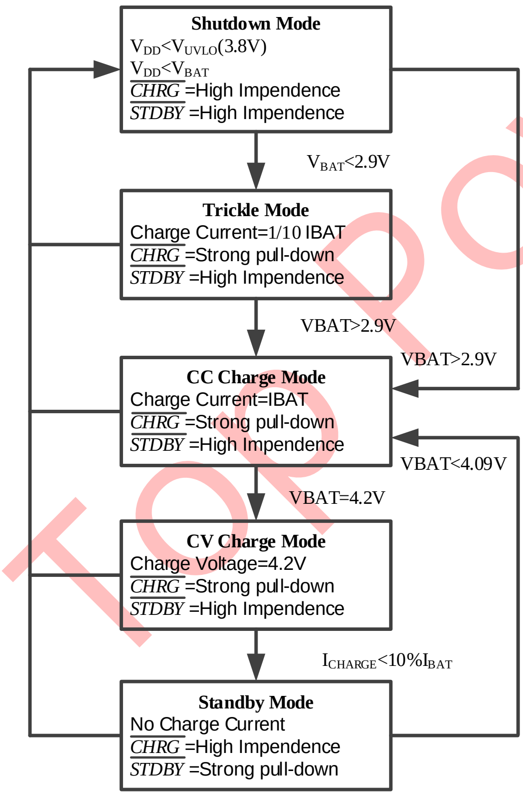


Fig.1 State diagram of a typical charge cycle

Charge status indicator

TP4066 has two open-drain status indicator: CHRG and STDBY . CHRG is pull-down when the TP4066 is in a charge cycle, and CHRG becomes high impedance for other states. Both CHRG and STDBY will be high impedance when the battery is operating out of the normal temperature. When TEMP pin is connected, and battery is not connected to charger: both red LED and green LED are OFF to indicate a failure mode. When TEMP is grounded, the battery temperature sense function is disabled. If battery is not connected to charger, CHRG pin outputs a PWM level to indicate no battery failure mode. If BAT pin connects to a 10 μF capacitor, the frequency of CHRG flicking will be with T=1-4s.

If not using a status indicator, the pins should be connected to GND.

Charger's Status	Red LED CHRG	Green LED STDBY
Charging	ON	OFF
Charging Completes	OFF	ON
Under-voltage, battery's temperature is too high or too low, or not connect to battery (TEMP pin in use)	OFF	OFF
BAT reverse connection status	Micro-lig ht	ON
BAT pin is connected to 10uF capacitor, and not connect to battery (TEMP connects to GND)	Green LED ON, Red LED flickering with T=1-4s	

Thermal limiting

An internal thermal feedback loop reduces the programmed charge current if the die temperature attempts to rise above a preset value of approximately 130 °C, and current will be reduced to zero if die temperature reaches beyond 145 °C. This feature protects the TP4066 from excessive temperature and allows the user to push the limits of the power handling capability of a given circuit board without risk of damaging the TP4066. The charge current can be set according to typical (not worst-case) ambient temperature with the assurance that the charger will automatically reduce the current in worst-case conditions.

Battery temperature monitoring

To prevent the damage caused by the very high or very low temperature done to the battery pack, the TP4066 continuously senses battery pack temperature by measuring the voltage at TEMP pin determined by the internal voltage divider circuit and the battery's internal NTC thermistor as shown in the typical application legend.

The TP4066 compares the voltage at TEMP pin (V_{TEMP}) against its internal V_{TEMP_L} and V_{TEMP_H} thresholds to determine if charging is allowed. V_{TEMP_L} is fixed at (45%×Vcc), while V_{TEMP_H} is fixed at (80%×Vcc). If $V_{TEMP}<V_{TEMP\_L}$ or $V_{TEMP}>V_{TEMP\_H}$, it indicates that the battery temperature is too high or too low and the charge cycle is suspended. When V_{TEMP} is in between V_{TEMP_L} and V_{TEMP_H} , charging cycle resumes. The battery temperature sense function can be disabled by connecting TEMP pin to GND.

Selecting R1 and R2

The values of R1 and R2 in the application circuit can be determined according to the assumed temperature monitor range and thermistor's values. See following example as a reference:

Assume temperature monitor range is TL～TH，(TL＜TH)；the thermistor in battery has negative temperature coefficient (NTC). RTL is thermistor's resistance at TL， RTH is the resistance at TH，so RTL＞RTH. Then at temperature T_L, the voltage at TEMP pin is:

$$V_{TEMPL}=\frac{R2\|R_{TL}}{R1+R2\|R_{TL}}\times VIN$$

At temperature T_H, the voltage at TEMP pin is:

$$V_{TEMPH}=\frac{R2\|R_{TH}}{R1+R2\|R_{TH}}\times VIN$$

We know

V_{TEMPL} = V_{HIGH} = K2×Vcc (K2=0.8)；

V_{TEMPH} = V_{LOW} = K1×Vcc (K1=0.45)

Then we can have：

$$R1=\frac{R_{TL}R_{TH}(K_2-K_1)}{(R_{TL}-R_{TH})K_1K_2}$$

$$R2=\frac{R_{TL}R_{TH}(K_2-K_1)}{R_{TL}(K_1-K_1K_2)-R_{TH}(K_2-K_1K_2)}$$

Likewise, for positive temperature coefficient thermistor in battery, we have

$R_{TH}>R_{TL}$ and we can calculate:

$$R1=\frac{R_{TL}R_{TH}(K_2-K_1)}{(R_{TH}-R_{TL})K_1K_2}$$

$$R2=\frac{R_{TL}R_{TH}(K_2-K_1)}{R_{TH}(K_1-K_1K_2)-R_{TL}(K_2-K_1K_2)}$$

We can conclude that temperature monitor range is independent of power supply voltage V_{CC} and it only depends on R1, R2, R_{TL} and R_{TH}. The values of R_{TH} and R_{TL} can be found in the related battery handbook or deduced from testing data. In actual application, if considering only one terminal temperature (normally protecting from overheating), there is no need to use R2.

Under Voltage Lockout (UVLO)

An internal undervoltage blocking circuit monitors the input voltage and keeps the charger in shutdown mode before Vcc rises above the undervoltage blocking threshold. The UVLO circuit will keep the charger in shutdown mode. If the UVLO comparator jumps, the charger will not exit shutdown mode until Vcc rises to 160mV higher than the battery voltage.

Manual Shutdown

The TP4066 can be put into shutdown mode at any time during the charge cycle by setting the CE end to low potential or removing the RPROG (thus making the PROG pin float). This reduces the battery leakage current to less than 1μA and the supply current to less than 90μA. Resetting the CE end to high potential or connecting the setting resistor initiates a new charging cycle.

If the TP4066 is in undervoltage latching mode, $\overline{CHRG}$ and $\overline{STDBY}$ in a high impedance state with the pin: either the VCC is less than 160mV above the BAT pin voltage, or the voltage applied to the VCC pin is insufficient.

Automatic Recharge

Once the charge cycle is terminated, the TP4066 immediately employs a comparator with a 1.8ms filter time ($t_{RECHARGE}$) to continuously monitor the voltage on the BAT pin. When the battery voltage drops below 4.09V, the charging cycle starts again. This ensures that the battery is maintained at (or near) a full charge state and eliminates the need for a periodic charge cycle to start. During the recharge cycle, the pin output enters a strong pull-down state.

Stability Considerations

In constant current mode, the PROG pin is located in the feedback loop, not the battery. The stability of the constant current mode is affected by the PROG pin impedance. When no additional capacitance is attached to the PROG pin, the maximum allowable resistance of the set resistor is reduced. The pole frequency on the PROG pin should remain at C_{PROG}, then the maximum resistance value of R_{PROG} can be calculated using the following formula:

$$R_{PROG} \le \frac{1}{2\pi \bullet 10^5 \bullet C_{PROG}}$$

For the user, they may be more interested in the charging current rather than the transient current. For example, if a switching power supply operating in low current mode is in parallel with the battery, the average current coming out of the BAT pin is usually more important than the transient current pulse. In this case, a simple RC filter can be used on the PROG pin to measure the average battery current (as shown in Figure 2). A 10K resistor is added between the PROG pin and the filter capacitor to ensure stability.

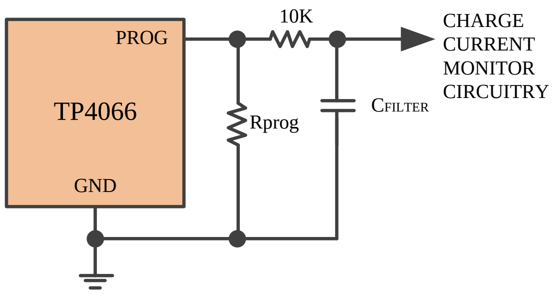


Figure 2: Isolation of capacitive load and filter circuit on PROG pin

Thermal Considerations

Due to the small form factor of the ESOP8/DFN2*2-8 package, it was important to have a thermally designed PC board layout to maximize the available charging current. The heat dissipation path used to dissipate the heat generated by the

IC runs from the chip to the lead frame and reaches the copper surface of the PC board through the heat sink at the bottom. The copper surface of the PC board is a heat sink. The copper foil area connected to the heat sink should be as wide as possible and extend outwards to a larger copper area in order to disperse heat to the surrounding environment. The through-hole to the inner or back copper circuit layer is also useful in improving the overall thermal performance of the charger. When designing the PC board layout, other heat sources unrelated to the charger on the circuit board must also be considered, because they will have an impact on the overall temperature rise and maximum charging current.

VCC Bypass Capacitor

The input bypass can use many types of capacitors. However, caution must be exercised when using multilayer ceramic capacitors. Because some types of ceramic capacitors have self-resonance and high Q values, it is possible to generate high voltage transient signals under certain starting conditions (such as connecting the charger input to a working power supply). High quality ceramic capacitors or tantalum capacitors are recommended.

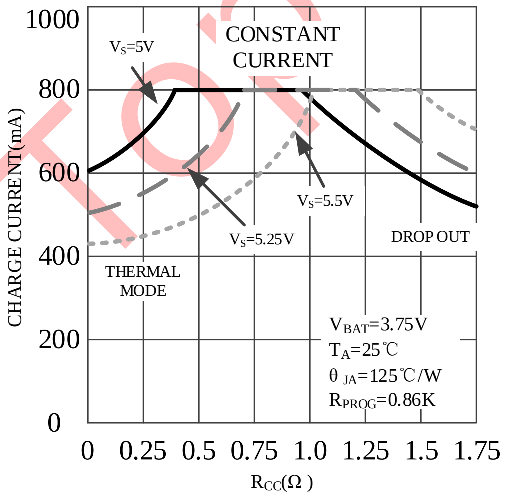


Figure 4: Relationship curve between charging current and RCC

Soft Start Of Charging Current

TP4066 includes a soft start circuit for minimizing inrush current at the beginning of the charging cycle. When a charging cycle is initiated, the charging current will rise from 0 to the full-scale value in about 20us. During the startup process, this can minimize the transient current load on the power supply.

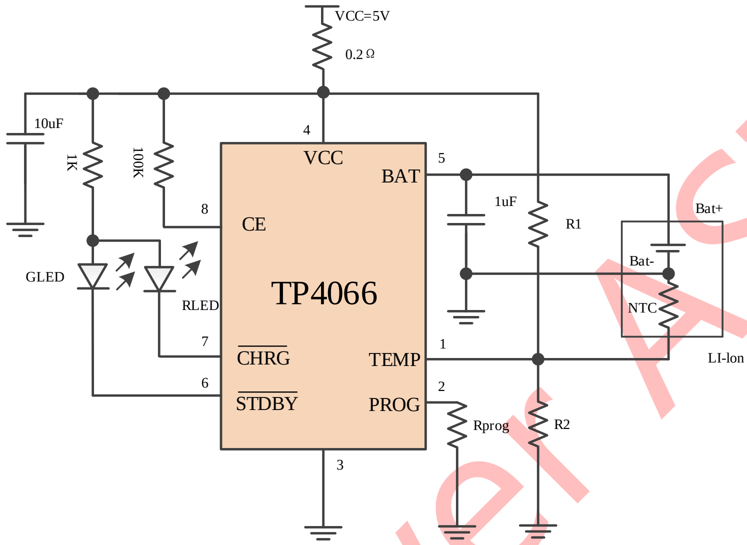
Power adaptation

When the Supply Voltage drops to V_{ADPT}, the adaptive circuit starts; Automatically reduce the output current until the Supply Voltage no longer decreases. This function can use a USB or low-power power adapter or solar cell as the power source for the high current charging system, avoiding power reset or restart.

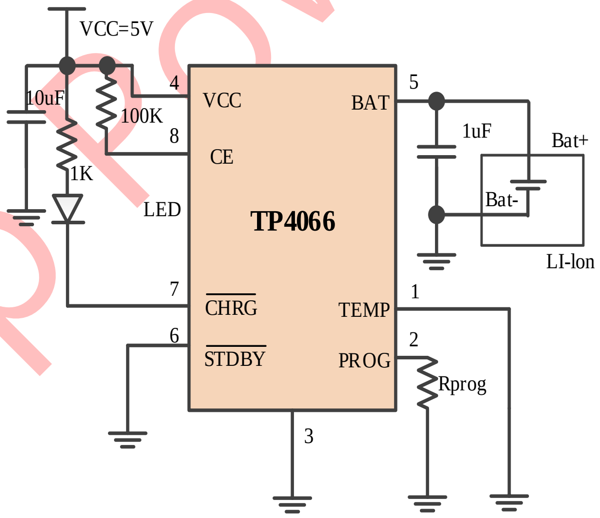
Battery reverse connection protection function

TP4066 has the function of lithium battery reverse connection protection. When the positive and negative batteries are inversely connected to the TP4066 current output BAT pin, TP4066 will stop and display fault status without charging current. Charge indicator pin RLED is slightly bright, GLED bright, at this time the reverse leakage current of the battery is less than 30mA. When the reverse battery is connected correctly, the TP4066 automatically starts the charging cycle. After the battery is removed, because the capacitance potential of the BAT pin at the output end of the TP4066 is still negative, the TP4066 indicator light will not be on normally immediately, and only the correctly connected battery can automatically activate the charging. Or wait for a long time for the negative capacitor potential of the BAT end to emit light, the BAT end potential is greater than zero volts, TP4066 will display a normal battery-free indicator state. In the case of reverse connection, the power supply voltage should be about 5V standard voltage and should not exceed 6.5V. In the case of reverse battery voltage, the pressure difference of the chip will exceed the ultimate withstand voltage.

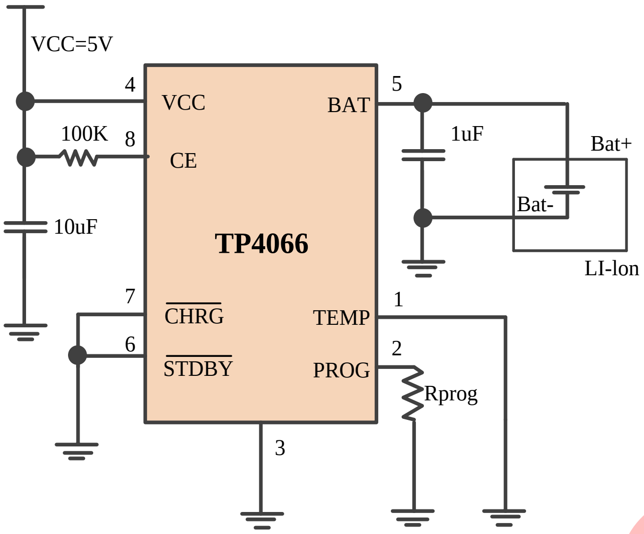
Other typical application circuits



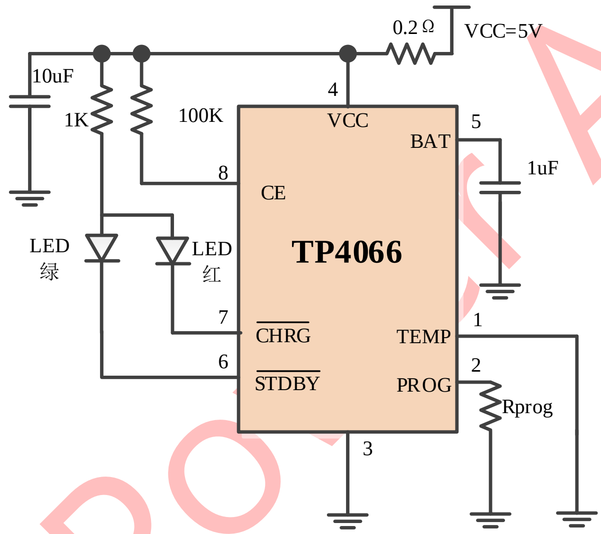
Suitable for applications requiring battery temperature detection, battery temperature anomaly indication and charging status indication.



Suitable for applications that require charging status indication and do not require battery temperature monitoring.



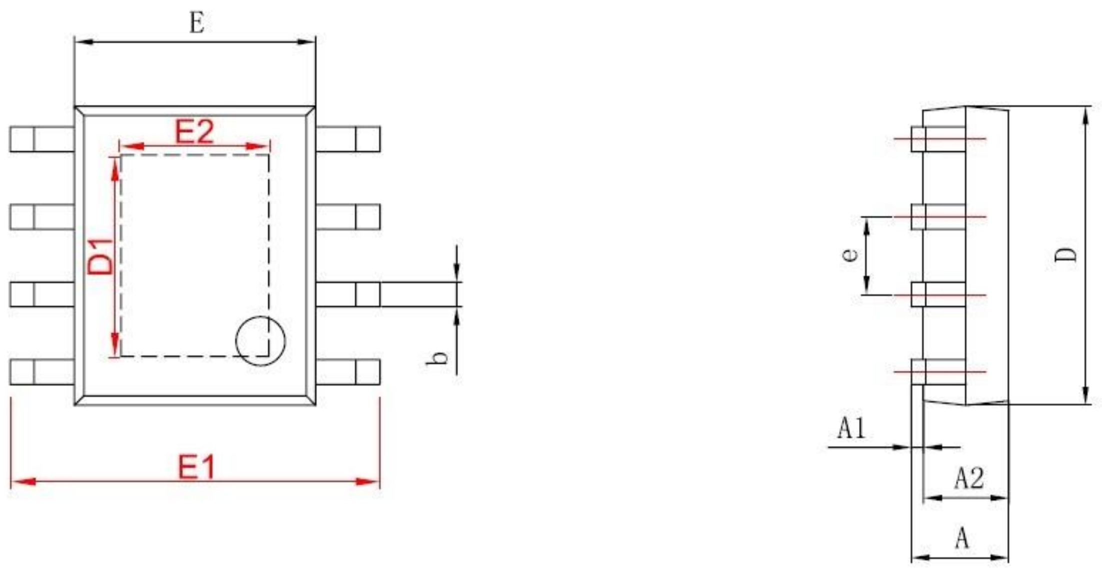
Suitable for applications that require neither charge status indication nor battery temperature monitoring.

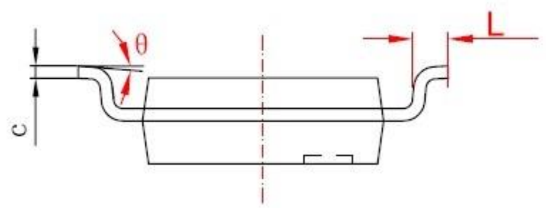


The charging state is indicated by a red LED, and the charging end state is indicated by a green LED to increase the heat dissipation power resistance.

Package Description

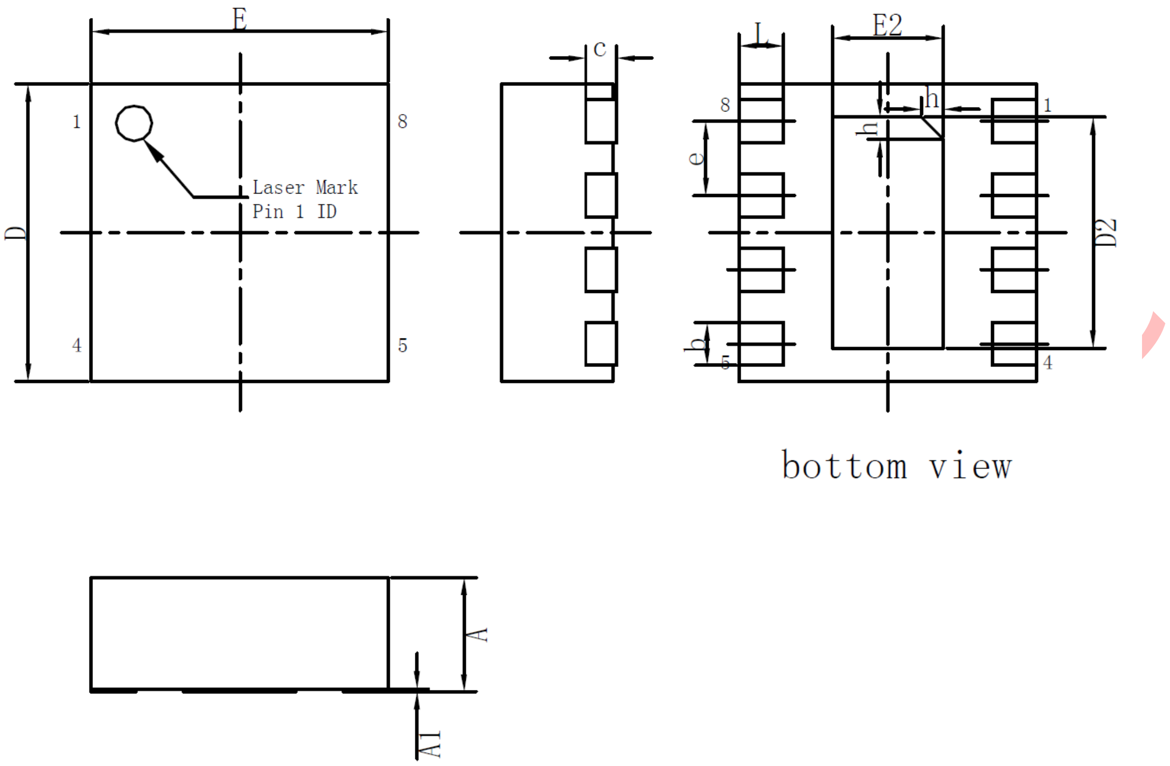
ESOP8（Unit:mm）





	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°

DFN2*2（Unit:mm）



	Min	Standard	Max		Min	Standard	Max
A	0.70	0.75	0.80	e	0.50BSC		
A1	0.00	0.02	0.05	E	1.95	2.00	2.05
b	0.18	0.29	0.30	E2	0.70	0.75	0.80
c	0.20REF			L	0.25	0.30	0.35
D	1.95	2.00	2.05	h	0.10	0.15	0.20
D2	1.50	1.55	1.60		L/F载体尺寸（mm):1.00*1.80		