# DESCRIPTION

The TP4054 is a single lithium-ion battery constant current/constant voltage linear charger. The IC features simple external application circuits, ideal for portable devices, and supports power supply via USB or AC-DC adapters. An internal anti-reverse charging circuit eliminates the need for an external isolation diode. Thermal feedback automatically adjusts the charging current to limit the IC temperature under high-power operation or high ambient temperature conditions.

The TP4054 has a fixed charge termination voltage of 4.2V, and the charging current can be programmed via an external resistor. When the charging current drops to 1/10 of the set value, the TP4054 automatically terminates the charging cycle. Once the input supply voltage is removed, the TP4054 automatically enters a low-current standby state, reducing the standby current to 3uA.

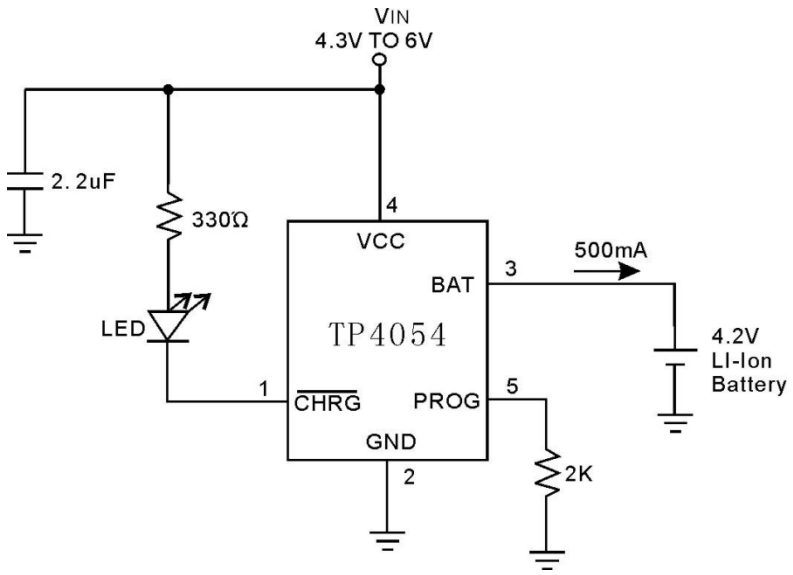
# KEY FEATURES

- Up to 600mA Charging Current
- LED flashes for poor battery contact indication
- 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 : SOT23-5

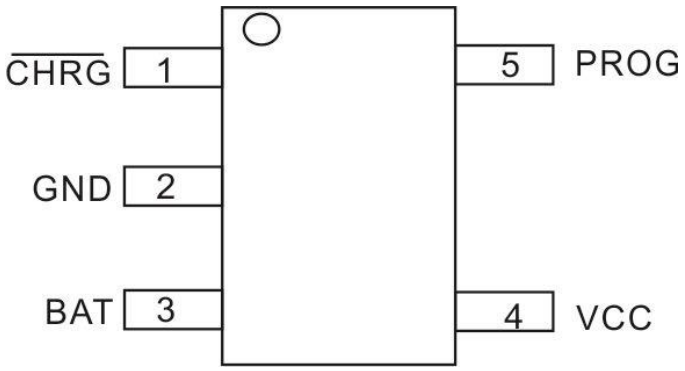
# APPLICATION

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

# TYPICAL APPLICATION



# PIN CONFIGURATION




SOT23-5

# ORDER INFORMATION

| Package | Order model | Packaging form | Marking |
|---|---|---|---|
| SOT23-5L | TP4054ST25P | Tape and Reel | 54XX |

# 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 |
| TBAT_SHT | BAT Short Circuit Duration | Continuous | - |
| IBAT | BAT Pin Current | 1200 | mA |
| IPROG | PROG Pin Current | 1200 | μA |
| TOP | Operating Ambient Temperature | -40~85 | ℃ |
| TSTG | 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

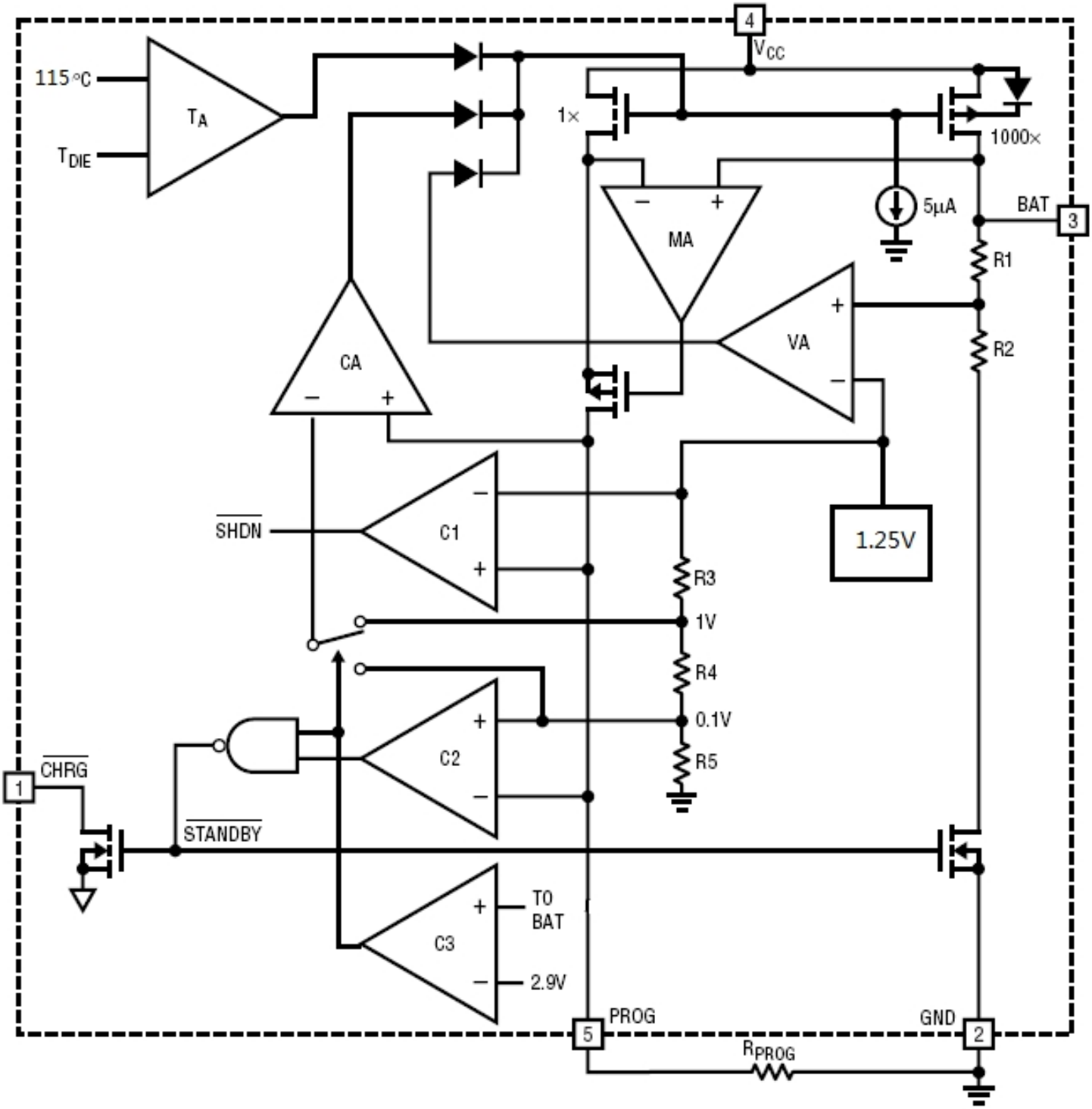
# ELECTRICAL CHARACTERISTICS (NOTE 2,3）

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

| SYM | PARAMETER | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **VCC** | Input Supply Voltage | | 4.5 | 5 | 5.5 | V |
| **VFLOAT** | Regulated Output (Float) Voltage | 0℃≤TA≤85℃ | | 4.2 | | V |
| **IC** | Constant Charging Current | | 450 | 500 | 600 | mA |
| **ITRIKL** | Trickle Charge Current | VBAT<VTRIKL, RPROG=1.2K | 40 | 60 | 80 | mA |
| **IBAT** | BAT Pin Current | Standby Mode (Vcc=0V, VBAT(Vcc=4.2V) | | 3 | 5 | μA |
| | | Shutdown Mode (Vcc = 0 V) | | 3 | 5 | μA |
| **VTRIKL** | Trickle Charge Threshold Voltage | RPROG=2K, VBAT Rising | 2.8 | 2.9 | 3 | V |
| **VTRHYS** | Trickle Charge Hysteresis Voltage | RPROG=2K | 60 | 80 | 100 | mV |
| **VUV** | VCC Undervoltage Lockout Threshold | VCC Rising | 3.5 | 3.7 | 3.9 | V |
| **VUVHYS** | VCC Undervoltage Lockout Hysteresis | VCC Falling | | 0.1 | | V |
| **VASD** | VCC-VBATm Lockout Threshold Voltage | VCC Rising | 60 | 100 | 140 | mV |
| | | VCC Falling | 5 | 30 | 50 | mV |
| | | RPROG=2K | 40 | 60 | 80 | mA |
| **VPROG** | PROG Pin Voltage | RPROG=2K, Current Mode | 0.9 | 1 | 1.1 | V |
| **VCHRG** | CHRG Pin Output Low Voltage | ICHRG=5mA | | 0.3 | 0.6 | V |
| **ΔVRECHRG** | Recharge Battery Threshold Voltage | VFLOAT-VRECHRG | 70 | 100 | 150 | mV |
| **TLIM** | Junction Temperature in Constant Temperature Mode | | | 100 | | ℃ |
| **RON** | Power FET “ON” Resistance (Between VCC and BAT) | | | 800 | | mΩ |
| **TRECHRG** | Recharge Comparator Filter Time | VBAT Falling | 1 | 2 | 3 | mS |
| **TERM** | Termination Comparator Filter Time | IBAT falling below C/10 | 1 | 2 | 3 | mS |

Note 2: the typical parameter values under the condition of 25 ℃ are 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.

# BLOCK DIAGRAM



# OPERATION DESCRIPTION

TP4054 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 600mA, no additional isolation diodes and current detection resistors are required. TP4054 contains one open-drain output status indicating terminal for indication of charging in progress or charge completion. During charging, the CHRG pin outputs a low logic level to signal active charging. Once charging is fully completed, the CHRG pin enters high-impedance state.

If the battery voltage is lower than 2.9V, TP4054 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 $P_{ROG}$ pin and GND. When the battery voltage is close to 4.2V, the charging current gradually decreases, and TP4054 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, TP4054 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 the 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 3 μA.

TP4054 within the intelligent temperature control circuit automatically when the chip junction temperature is over 115 ℃ lower charging current, this feature enables users to maximize the use of chip power handling capacity, don't have to worry about overheating and damage to 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, TP4054 will automatically reduce the charging current.

# PIN FUNCTION

## *CHRG(PIN1): Charge Status Indicator Pin*

When the charger charges the battery, the internal switch pulls the CHRG pin low to indicate charging in progress. After charging is completed, the CHRG pin is in high-impedance state. If the charger is connected without a battery attached, the indicator LED flashes to warn of a missing battery or poor battery contact.

## *GND (PIN2): Power ground*

## *BAT (PIN3): Battery positive terminal*

Connect the positive terminal of the battery to this pin. When the VCC supply is removed or the battery is fully charged and enters standby mode, the leakage current of the BAT pin is less than 3 μA. The BAT pin supplies charging current and a full-charge voltage of 4.2V to the battery. If no battery is connected, the floating voltage of the BAT pin is approximately 4.6V.

## *VCC (PIN4): Input voltage positive*

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 the BAT voltage of 100mV. When the VCC input voltage is lower than the under-voltage locking threshold or the voltage difference between VCC and the BAT pin is less than 30mV, TP4054 will enter the low-power shutdown mode, and the consumption current of the BAT pin is less than 3uA.

## *PROG (PIN5): Constant current charging current setting terminal*

Charging current can be set by connecting a resistor from the PROG pin to GND. The setting resistor and charging current are calculated using the following formula: RPROG = 1100 V/IBAT. The resistance value of the resistor RPROG is determined according to the required charging current IBAT. In the trickle charging stage, the voltage of this pin is modulated at 0.1 V, and in the constant charging stage, the voltage of this pin is fixed at 1 V.

# 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 2 ms, the charging stops and TP4054 enters standby mode.

## *Intelligent recharging*

In standby mode, the TP4054 to monitor BAT pin voltage; only when the BAT pin voltage is lower than the recharge threshold voltage of 4.1V (corresponding to the battery capacity 80% ~ 90%), charging will begin a new cycle to charge the battery again. This avoids unnecessary repeated charging of the battery, prolonging the service life of batteries.

## *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 0.3Ω power resistor or diode to the pressure drop is less than 0.5V, which will be part of the power consumption.

## *Soft start of charging current*

TP4054 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 20 uS time.

## *Charge status indicator*

TP4054 has one 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:

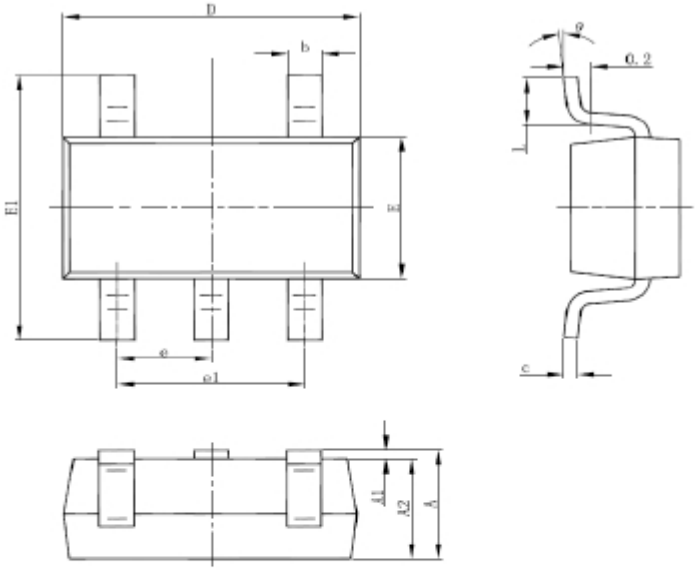
## *Intelligent temperature control*

TP4054 internal integrates the function of intelligent temperature control, when the chip temperature is higher than 115℃, it automatically reduces 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 TP4054. 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.

# PACKAGE DIMENSION

## *SOT-23-5L*

SOT-23-5L PACKAGE OUTLINE DIMENSIONS




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950(BSC) | | 0.037(BSC) | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

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