# 1-A Single Cell Li-Ion Battery Linear Charger with NTC Monitor

## Features

- Single-Chip Charger for 1-cell Li-ion or Polymer Batteries
- 4.55-V to 9.8-V Input Volage Operating Range
- 26.5-V Maximum Input Voltage Rating
- Charging
  - Up to 1000-mA Programmable Charge Current
  - 10% Charge Current Accuracy
  - 4.2-V/4.35-V Charge Float Voltage with 0.5% Accuracy
- Charging Current Monitor and Thermal Foldback
- Battery Temperature Monitor
- Charging Status Detection and Fault Indication
- Soft Start for Inrush Current Limitation
- Trickle Current Battery Charge
- Power Presence Indication
- Automatic Battery Recharge
- No external MOSFET, Current Sensor Required
- Operational Temperature Range: −40°C to +85°C
- Package options: ESOP-8, EMSOP-8

## Applications

- Portable Devices, GPS, ePOS, e-cigarette
- Wireless Devices, Bluetooth Headset
- Personal Electronics, Personal Healthcare
- Wearable Devices

## Description

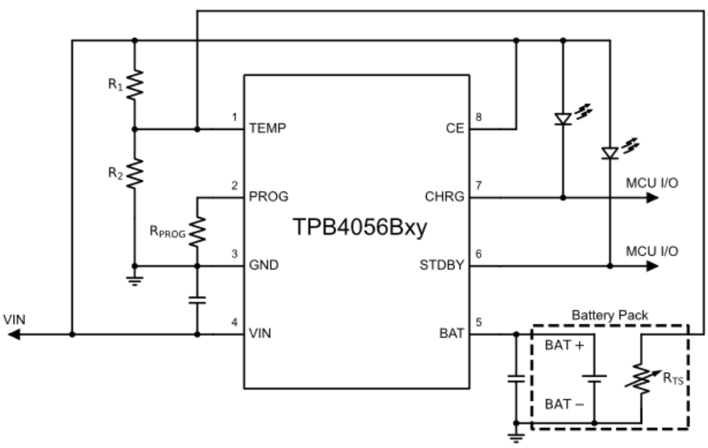
The TPB4056B is a cost-effective, high-integration linear charger for single cell Li-ion or Li-ion polymer batteries. The device supports CC/CV charge from either a USB port or an AC adapter. Low BOM component requirement makes the size of the whole system small. High input voltage range with over-voltage protection supports low-cost unregulated adapters.

The TPB4056B charge current is fully programmable up to 1000 mA with an external resistor. The TPB4056B automatically terminates the charge cycle when the charge current drops below 10% of the set charge current value after the battery voltage reaches the float voltage.

The TPB4056B implements two indication pins, CHRG, and STDBY, allowing connection to microcontroller or LED to show device status. With open-drain structure, CHRG stays low during charging, and STDBY stays low after charging complete, other pins are in the high impedance state.

The TPB4056B features thermal foldback function to limit the charge current and protect the device from over junction temperature fault. The TPB4056B also integrates current monitor, UVLO, OVP function to prevent the device from damage.

## Typical Application Circuit



# Table of Contents

## Product Family Table

| Order Number | Float Voltage (V) | OVP (V) | Trickle Voltage (V) | Package |
|---|---|---|---|---|
| TPB4056B2X-ES1R | 4.200 | 10.5 | 2.9 | ESOP-8 |
| TPB4056B2X-EV1R | 4.200 | 10.5 | 2.9 | EMSOP-8 |
| TPB4056B3X-ES1R (1) | 4.350 | 10.5 | 3.0 | ESOP-8 |
| TPB4056B3X-EV1R (1) | 4.350 | 10.5 | 3.0 | EMSOP-8 |

(1) For future products, contact the 3PEAK factory for more information and samples.

## Revision History

| Date | Revision | Notes |
|---|---|---|
| 2022-04-02 | Rev. A.0 | First Release Version. |
| 2023-05-02 | Rev. A.1 | Updated the format. |
| 2023-08-02 | Rev. A.2 | Updated package thermal resistance. |

## Pin Configuration and Functions

TPB4056B
ESOP-8 and EMSOP-8 Packages
Top View

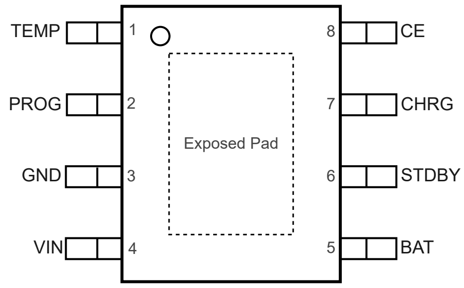



**Table 1. Pin Functions: TPB4056B**

| Pin | | I/O | Description |
|---|---|---|---|
| No | Name | | |
| 1 | TEMP | I | Temperature monitor pin. Connect this pin to battery internal temperature sensor output pin to monitor the battery internal temperature. Connect this pin to GND to disable temperature monitor function. |
| 2 | PROG | I | Constant charge current set pin. Connect an external resistor from PROG pin to GND pin to adjust the charge current. |
| 3 | GND | - | Ground. |
| 4 | VIN | I | Power supply voltage input pin. Bypass VIN to GND with a 1 μF or greater capacitor. |
| 5 | BAT | O | Battery charge output pin. Connect BAT pin to the battery. Baypass BAT to GND with a 1 μF or greater capacitor. |
| 6 | STBY | O | Battery fully charged indication pin. This pin internally pulls low when device enter standby mode after battery charge complete. |
| 7 | CHRG | O | Battery charging indication pin. This pin internally pulls low when battery is under charging. |
| 8 | CE | I | Device enable pin. Drive this pin high to turn on the battery charge function. Drive this pin low to turn off the battery charge function. |
| E | PAD | - | Exposed pad must be connected to PCB ground plance to maximum the thermal performance. |

# Specifications

## Absolute Maximum Ratings

| Parameter | | Min | Max | Unit |
|---|---|---|---|---|
| Input Voltage | VIN | −0.3 | 26.5 | V |
| | PROG | −0.3 | 6 | V |
| | CE | −0.3 | 26.5 | V |
| Output Voltage | CHRG, STDBY | −0.3 | 26.5 | V |
| | BAT | −6 | 6 | V |
| $T_J$ | Maximum Junction Temperature | −40 | 125 | °C |
| $T_A$ | Operating Temperature Range | −40 | 85 | °C |
| $T_{STG}$ | Storage Temperature Range | −65 | 150 | °C |
| $T_L$ | Lead Temperature (Soldering 10 sec) | | 260 | °C |

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
(2) This data was taken with the JEDEC low effective thermal conductivity test board.
(3) This data was taken with the JEDEC standard multilayer test boards.

## ESD, Electrostatic Discharge Protection

| Parameter | | Condition | Minimum Level | Unit |
|---|---|---|---|---|
| HBM | Human Body Model ESD | ANSI/ESDA/JEDEC JS-001 (1) | 2000 | V |
| CDM | Charged Device Model ESD | ANSI/ESDA/JEDEC JS-002 (2) | 1500 | V |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

## Thermal Information

| Package Type | $\theta_{JA}$ | $\theta_{JC}$ | Unit |
|---|---|---|---|
| ESOP-8 | 53 | 40 | °C/W |
| EMSOP-8 | 75 | 42 | °C/W |

## Electrical Characteristics

All test conditions: $V_{IN}$ = 5 V, $T_A$ = +25°C, unless otherwise noted.

| Parameter | | | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Supply Voltage and Current** | | | | | | | |
| $V_{IN}$ | Operating Supply Voltage | | | 4.55 | | 9.8 | V |
| $I_{CC}$ | VIN Pin Supply Current | | $V_{BAT}$ = 4.4 V, CE = High | | 180 | 250 | μA |
| $I_{SD}$ | Shutdown Current | | CE = Low, $V_{IN}$ > UVLO (1) | | 55 | 110 | μA |
| UVLO | Under Voltage Lockout | | $V_{IN}$ rising | 3.5 | 3.7 | 3.9 | V |
| | Hysteresis | | $V_{IN}$ drop | 120 | 200 | 280 | mV |
| **Charge Voltage and Current** | | | | | | | |
| $V_{PROG}$ | PROG Voltage | | Constant current mode, $R_{PROG}$ = 1.2 kΩ | 0.92 | 1 | 1.08 | V |
| $I_{PROG}$ | PROG Source Current | | $V_{PROG}$ = 5 V | | 2 | | μA |
| $V_{FLOAT}$ | BAT Pin Float Voltage or Battery End of Charge Voltage | TPB4056B2x | | 4.158 | 4.2 | 4.242 | V |
| | | TPB4056B3X | | 4.306 | 4.35 | 4.394 | V |
| $R_{ON}$ | Power FET Turn on Resistance | | | | 650 | | mΩ |
| $I_{BAT}$ | BAT Pin Output Charge Current | | Constant current range | 50 | | 1000 | mA |
| | | | Constant current mode, $R_{PROG}$ = 2.4 kΩ | 450 | 500 | 550 | mA |
| | | | Constant current mode, $R_{PROG}$ = 1.2 kΩ | 930 | 1000 | 1070 | mA |
| | Battery Quiescent Current | | Standby mode, $V_{BAT}$= 4.2V | | −2.5 | −6 | μA |
| | | | Shutdown mode | | −1 | −2 | μA |
| | | | Sleep mode, $V_{IN}$= 0 V | | −1 | −2 | μA |
| $t_{ss}$ | Soft-Start Delay Time | | Charge current from 0 mA to $I_{CC}$ | | 1 | | ms |
| $V_{TCK}$ | Battery Trickle Charge Voltage | | $V_{BAT}$ < $V_{TCK}$, $R_{PROG}$ = 1.2 kΩ | 2.8 | 2.9 | 3 | V |
| | Hysteresis | | $R_{PROG}$ = 1.2 kΩ | 70 | 130 | 200 | mV |
| $I_{TCK}$ | Battery Trickle Charge Current | | $V_{BAT}$ < $V_{TCK}$, $R_{PROG}$ = 1.2 kΩ | 70 | 100 | 140 | mA |
| $V_{BAT.LO}$ | Battery Charge Lockout Threshold, $V_{IN}$ – $V_{BAT}$ | | $V_{IN}$ rising | 70 | 100 | 130 | mV |
| | | | $V_{IN}$ failing | 15 | 30 | 60 | mV |

(1) Only tested at VIN > UVLO

All test conditions: $V_{IN}$ = 5 V, $T_A$ = +25°C, unless otherwise noted.

| Parameter | | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Charge Voltage and Current** | | | | | | |
| $I_{TERM}$ | Termination Current Threshold, 10% of $I_{CC}$ | $R_{PROG}$ = 2.4 kΩ | | 50 | | mA |
| | | $R_{PROG}$ = 1.2 kΩ | | 100 | | mA |
| $t_{TERM}$ | Termination Deglitch Time | | 0.8 | 1.8 | 4 | ms |
| $\Delta V_{RECHG}$ | Recharge Threshold | $V_{FLOAT} – V_{RECHG}$ | 50 | 110 | 200 | mV |
| $t_{RECHG}$ | Recharge Deglitch Time | | 0.8 | 1.8 | 4 | ms |
| **Logic Input and Output** | | | | | | |
| $V_{CE.IH}$ | CE Logic-Input High Level (enable) | | 1.6 | | | V |
| $V_{CE.IL}$ | CE Logic-Input Low Level (disable) | | | | 0.4 | V |
| $I_{CE}$ | CE Pin Leakage Current | $V_{CE}$ = 5 V | | | 1 | μA |
| $V_{CHRG.OL}$ | CHRG Low Level Output Voltage | $I_{CHRG}$ = 5 mA | | 0.25 | 0.6 | V |
| $V_{STDBY.OL}$ | STDBY Low Level Output Voltage | $I_{STDBY}$ = 5 mA | | 0.25 | 0.6 | V |
| $V_{TEMP.IH}$ | TEMP High-Level Threshold | | 3.9 | 4 | 4.1 | V |
| $V_{TEMP.IL}$ | TEMP Low-Level Threshold | | 2.15 | 2.25 | 2.35 | V |
| **Protection** | | | | | | |
| $V_{OVP}$ | Input Over-Voltage Protection | $V_{IN}$ rising | 9.8 | 10.5 | 11.2 | V |
| | Hysteresis | | | 200 | | mV |
| $V_{BAT.SP}$ | Battery Short to Ground Protection Threshold | | | 1.8 | | V |
| $I_{BAT.SP}$ | Battery Short to Ground Protection | BAT short to ground | | 20 | | mA |
| **Junction Temperature Protection** | | | | | | |
| $T_{OTP}$ | Over Temperature Protection Threshold | | | 150 | | ºC |

## Typical Performance Characteristics

All test conditions: $V_{IN}$ = 5 V, $T_A$ = + 25°C, unless otherwise noted.

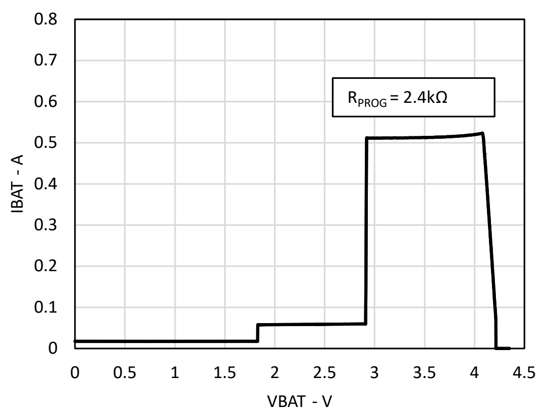



**Figure 1. Charging Current IBAT vs VBAT Voltage**

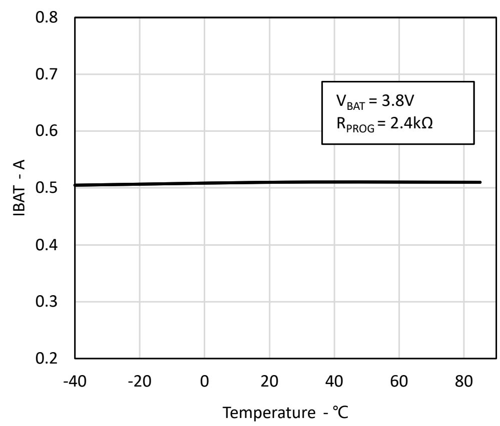



**Figure 2. Charging Current IBAT vs Temperature**

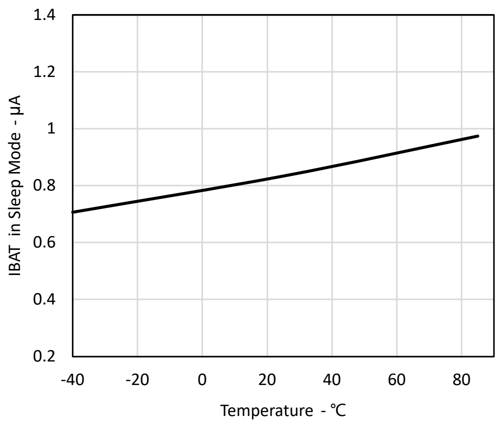



**Figure 3. IBAT in Sleep Mode vs Temperature**

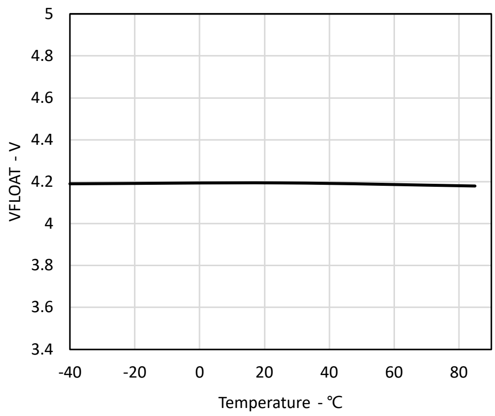



**Figure 4. VFLOAT Voltage vs Temperature**

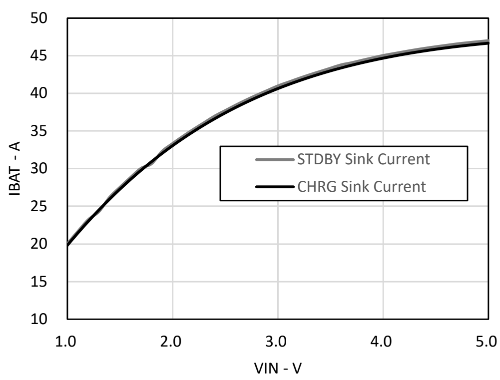



**Figure 5. Sink Current of STDBY or CHRG vs VIN**

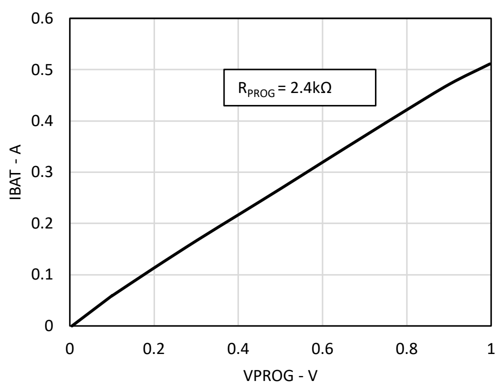



**Figure 6. Charging Current IBAT vs PROG Voltage**

# Detailed Description

## Overview

The TPB4056B device is a cost-effective, high-integration linear charger for single cell Li-ion or polymer batteries. The device supports CC/CV charge from either a USB or an AC adapter. Low BOM components requirement makes the size of the whole system small. High input voltage range with over-voltage protection supports low-cost unregulated adapters. The TPB4056B device charge current is fully programmable from 50 mA to 1000 mA with an external resistor. The device can automatically terminate the charge cycle when the charge current drops below 10% of the set charge current value after the battery voltage reaches float voltage.

## Feature Description

### Enable (CE)

The TPB4056B device is in shutdown mode when the chip enable pin (CE) is low. Connect this pin to GPIO of an external processor or digital logic control circuit to enable or disable the device. Or connect this pin to the $V_{CC}$ pin for self-bias applications.

### Under-Voltage Lockout (UVLO)

The TPB4056B device uses an under-voltage lockout circuit to keep the device in shutdown mode until the supply voltage is higher than the UVLO threshold.

### Over Voltage Protection (OVP)

The TPB4056B device uses an over-voltage protection circuit to prevent the device from damage when the supply voltage is higher than the OVP threshold. The internal power FET, if previously on, turns off after a deglitch period. After the supply voltage falls below the normal voltage range, the device recovers to the normal operating mode after another deglitch period.

### Battery Charge Current Value Setting

The TPB4056B device provides fully programmable charge current from 50 mA to 1000 mA under normal charge conditions. A single current-programming resistor connected from the PROG pin to GND determines the constant battery charge current value at the BAT pin, and no additional block diode or sensing resistor is required. Use Equation 1 to calculate the resistor value.

$$I_{CC} = \frac{1200}{R_{PROG}} \text{ (mA)} \quad (1)$$

Where,

$I_{CC}$ is the desired constant charge current, $R_{PROG}$ is the external current setting resistor of which the unit is kΩ.

The TPB4056B device implements the PROG pin short protection function, when PROG is short to ground, the battery charge current is limited to 1.5 A.

When the TPB4056B is powered up, the whole battery charging process can be divided into five sections below:

1. **Trickle Current Battery Charge**
   The TPB4056B device operates in the trickle charge mode when the battery voltage is detected below the trickle charge threshold, $V_{TCK}$. In trickle charge mode, battery charge current is limited to a small current range, $I_{TCK}$, to protect the battery.
2. **Constant Current Battery Charge**

The TPB4056B device enters constant current (CC) battery charge mode when the battery voltage ramps higher than the trickle charge threshold $V_{TCK}$. In this mode, constant current, determined by the resistor from PROG to GND, flows out from the BAT pin to the battery.

3. **Constant Voltage Battery Charge**
   The TPB4056B device enters constant voltage (CV) battery charge mode when the battery voltage reaches the floating voltage $V_{FLOAT}$. In this mode, battery charge current decreases from the constant current value, and the BAT pin voltage keeps constant at $V_{FLOAT}$.
4. **Battery Charge Termination**
   When the charge current falls below 1/10 of the constant current value, the TPB4056B device terminates the battery charge cycle after a deglitch period, and the TPB4056B device enters the battery charge standby mode.
5. **Battery Recharge**
   In battery charge standby mode, the TPB4056B monitors the battery voltage continuously. When the battery voltage falls below the battery recharge voltage threshold $V_{RECHG}$, the TPB4056B starts a new charge cycle after a deglitch period. Figure 7 shows the typical behavior during one battery charging cycle.

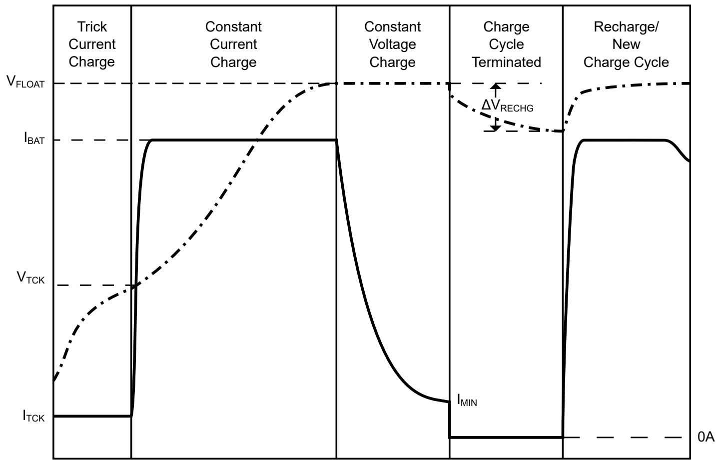



**Figure 7. Current and Voltage During One Charging Cycle**

### Soft-Start

The TPB4056B device integrates a soft-start circuit to reduce the inrush current after new charge cycle starts. When one new charge cycle starts, the ramp-up period of the battery charge current is within 20 μs from 0 to the set value.

### Battery Short Circuit and Reverse Polarity Protection

The TPB4056B features the BAT output short to ground protection. When the TPB4056B device detects the BAT output voltage below the short to ground protection threshold, the BAT output short to ground protection works after a deglitch period, and the BAT output current is limited to 20 mA.

The TPB4056B implements battery reverse polarity protection, when the TPB4056B device detects the BAT output voltage below −0.1 V, battery reverse protection works after a deglitch period, and the leakage current of the BAT pin is limited to 100 μA.

### Battery Temperature Monitor

The TPB4056B device implements temperature monitor circuit to protect battery from damage due to over or under temperature range. By measuring the TEMP pin voltage whether it maintains in the normal operating voltage range or not, the TPB4056B device calculates the internal temperature of the battery and turns on or off the output charge FET. The normal operating temperature range is determined by a resistor divider and the internal temperature sense resistor of the battery.

Use Equation 2 and Equation 3 to calculate the resistors divider for battery high temperature threshold $T_{BAT,H}$ and low temperature threshold $T_{BAT,L}$.

$$V_{TEMP,H} = \frac{R_2//R_{TS,H}}{R_1 + R_2//R_{TS,H}} \times V_{IN} \quad (2)$$

$$V_{TEMP,L} = \frac{R_2//R_{TS,L}}{R_1 + R_2//R_{TS,L}} \times V_{IN} \quad (3)$$

Where,

- $V_{TEMP,H}$ is the TEMP pin high level threshold.
- $V_{TEMP,L}$ is the TEMP pin low level threshold.
- $R_{TS,H}$ is the temperature sense resistance at high temperature $T_{BAT,H}$.
- $R_{TS,L}$ is the temperature sense resistance at low temperature $T_{BAT,H}$.

If only single temperature protection is under consideration, e.g. over temperature protection, $R_2$ can be removed and then calculation is simplified, vice versa. If the battery temperature monitor function is not used, connect the TEMP pin to ground directly.

### Battery Charge Status Indication

The TPB4056B device has two pins to indicate the battery charge status: CHRG and STDBY. Connect these two pins to the GPIO of a microcontroller to read the TPB4056B device working status or connect with LEDs pull-up circuit as the status indicators. Pull down these two pins to ground directly when the status indication function is not used.

**Table 2. Battery Charge Status indication**

| Conditions | Battery temperature monitor | CHRG Pin/LED | STDBY Pin/LED |
|---|---|---|---|
| Battery charging | Yes | Low/On | High-Z/Off |
| Battery fully charged | Yes | High-Z/Off | Low/On |
| Shutdown mode (CE = Low, or PROG float, $V_{IN}$< UVLO, or $V_{IN}$< $V_{BAT}$) | Yes | High-Z/Off | High-Z/Off |
| $V_{IN}$ over voltage (OVP) | | | |
| No battery connected | | | |
| Battery out of operating temperature range | | | |
| No battery connected | No (TEMP = GND) | Pulse/Flicker every 0.5~4s when $C_{BAT}$ = 10 µF | Low/On |

### Over Temperature Protection (OTP)

The TPB4056B device integrates foldback circuit and over-temperature protection to prevent device over-heated. When the junction temperature is higher than $T_{OTP}$, 145°C, a current thermal foldback circuit starts to work and decrease the device output charge current gradually with $T_J$ rise. If $T_J$ still rises and reaches 150°C, the device will shut down.

# Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

## Application Information

The TPB4056B device is a cost-effective, high-integration linear charger for single cell Li-ion or polymer batteries. The device supports CC/CV charge from either USB or AC adapter. Low BOM components requirement makes the size of the whole system small. The following sections show a typical application of the TPB4056B.

## Typical Application

Figure 8 shows the typical application schematic of the TPB4056B.

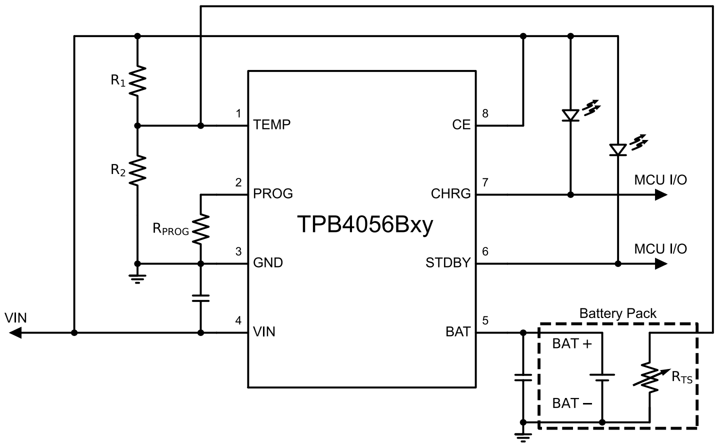



**Figure 8. Typical Application Circuit**

#### VIN Input Capacitor and BAT Output Capacitor

3PEAK recommends adding a 1-μF to 10-μF capacitor with a 0.1-μF bypass capacitor in parallel at $V_{IN}$ to keep the input voltage stable. The voltage rating must be greater than the maximum power supply voltage.

3PEAK recommends selecting an X5R- or X7R-type 1-μF to 10-μF high-frequency decoupling ceramic capacitor at the BAT output.

Both input capacitors and output capacitors must be placed as close to the device pins as possible.

#### Power Dissipation and Thermal Consideration

During normal operation, junction temperature limitation is 145°C. When junction temperature exceeds 145°C, the charge current decreases with the temperature value. Using Equation 4 and Equation 5 to calculate the power dissipation and estimate the junction temperature.

The maximum power dissipation can be calculated using Equation 4.

$$P_D = (V_{IN} - V_{BAT}) \times I_{BAT} = \frac{T_{J,max} - T_A}{\theta_{JA}} \quad (4)$$

Where,

$T_{J,max}$ is the junction temperature limitation, 145°C,

$T_A$ is the ambient temperature,

$\theta_{JA}$ is the junction-to-ambient thermal resistance (See Section Thermal Information).

Solve Equation 4, the constant charge current value is calculated in Equation 5.

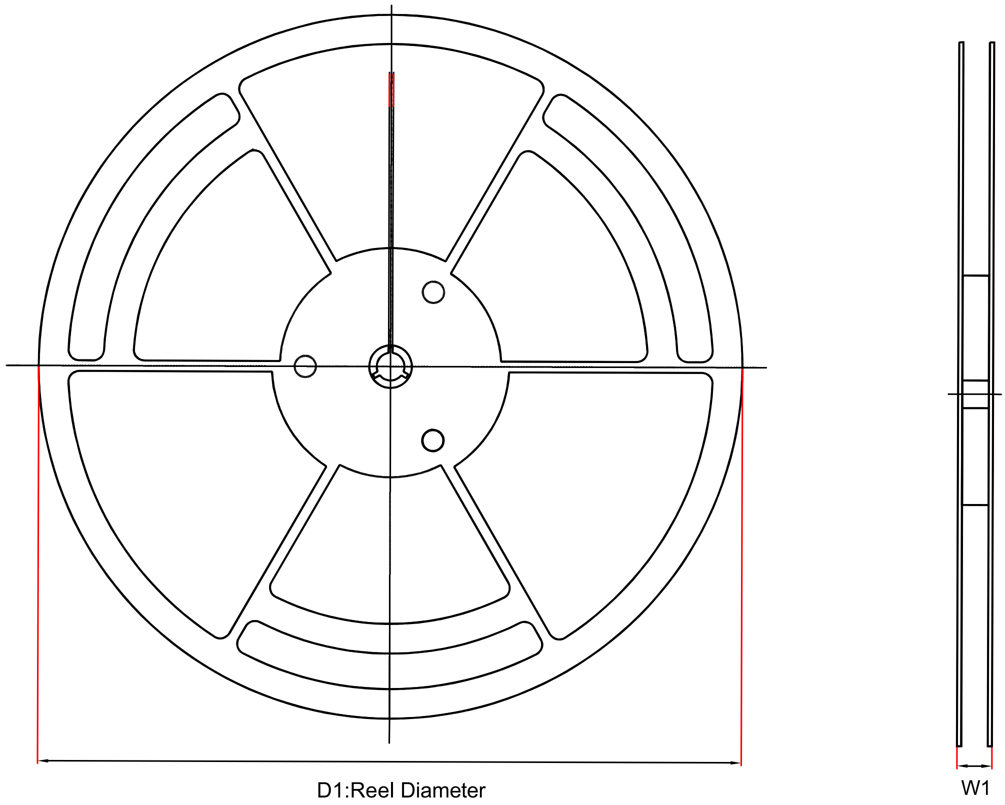
$$I_{BAT} = \frac{T_{J,max} - T_A}{(V_{IN} - V_{BAT}) \times \theta_{JA}} \quad (5)$$

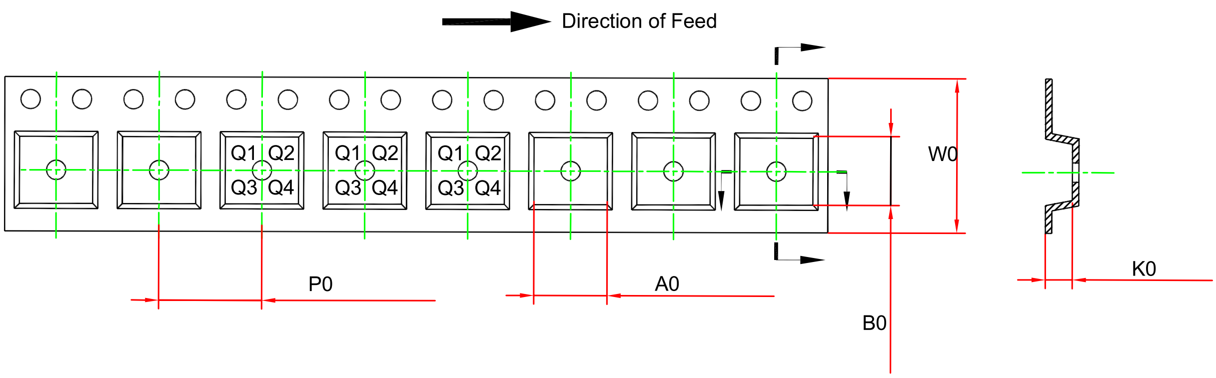
# Layout

## Layout Guideline

- Both input capacitors and output capacitors must be placed to the device pins as close as possible.
- It is recommended to bypass the input pin to ground with a 0.1-μF bypass capacitor. The loop area formed by the bypass capacitor connection, the IN pin, and the GND pin of the system must be as small as possible.
- It is recommended to use wide and thick trace to minimize I×R drop and heat dissipation.
- The exposed pad must be connected to the PCB ground plane directly, the copper area must be as large as possible. To get the best thermal performance, thermal vis should be placed under and around the exposed pad with enough number and size.

## Tape and Reel Information



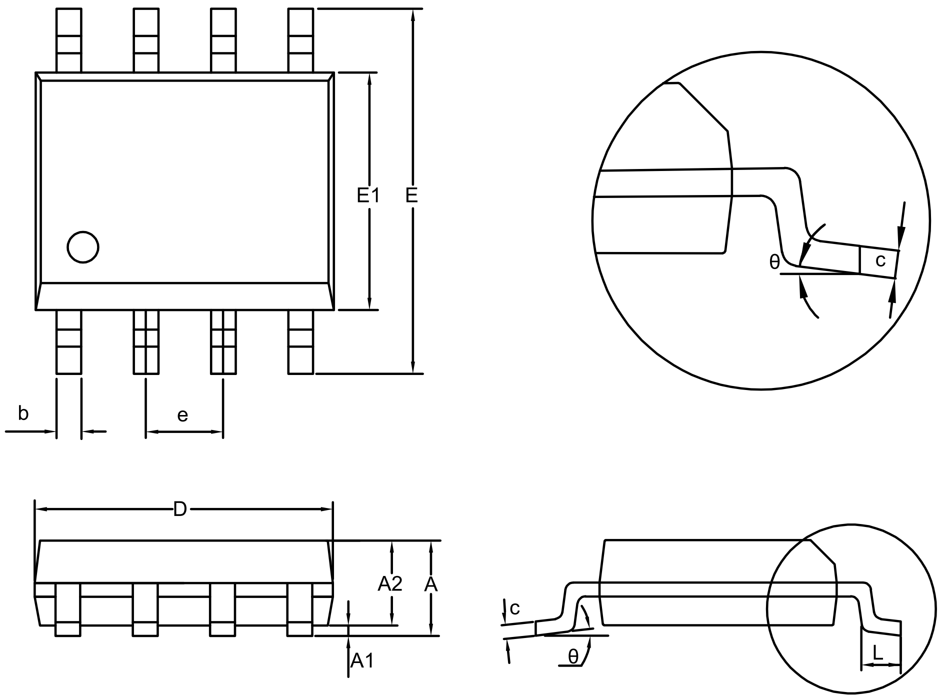

| Order Number | Package | D1 (mm) | W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | W0 (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|
| TPB4056B2X-ES1R | ESOP-8 | 330.0 | 17.6 | 6.4 | 5.4 | 2.1 | 8.0 | 12.0 | Q1 |
| TPB4056B2X-EV1R | EMSOP-8 | 330.0 | 17.6 | 5.2 | 3.3 | 1.5 | 8.0 | 12.0 | Q1 |
| TPB4056B3X-ES1R | ESOP-8 | 330.0 | 17.6 | 6.4 | 5.4 | 2.1 | 8.0 | 12.0 | Q1 |

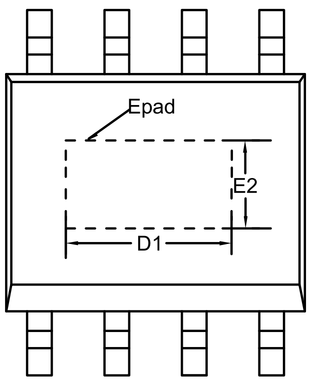
| Order Number | Package | D1 (mm) | W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | W0 (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|
| TPB4056B3X-EV1R | EMSOP-8 | 330.0 | 17.6 | 5.2 | 3.3 | 1.5 | 8.0 | 12.0 | Q1 |

## Package Outline Dimensions

### ESOP8

Package Outline Dimensions ES1(ESOP-8-F)



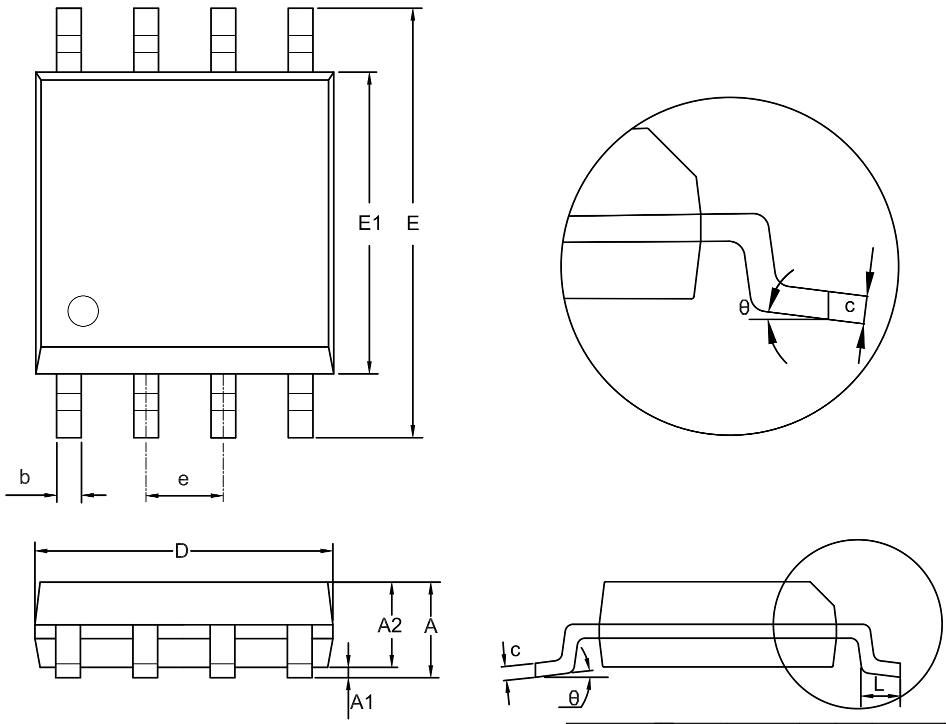

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.300 | 1.700 | 0.051 | 0.067 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.007 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.201 |
| D1 | 3.050 | 3.250 | 0.120 | 0.128 |
| E | 5.800 | 6.200 | 0.228 | 0.244 |
| E1 | 3.800 | 4.000 | 0.150 | 0.157 |
| E2 | 2.160 | 2.360 | 0.085 | 0.093 |
| e | 1.270 BSC | | 0.050 BSC | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0 | 8° | 0 | 8° |

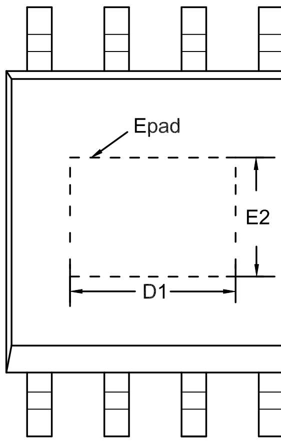
NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

## EMSOP8

### Package Outline Dimensions EV1(EMSOP-8-A)




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.800 | 1.100 | 0.031 | 0.043 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| D1 | 1.700 | 1.900 | 0.067 | 0.075 |
| E | 4.700 | 5.100 | 0.185 | 0.201 |
| E1 | 2.900 | 3.100 | 0.114 | 0.122 |
| E2 | 1.450 | 1.650 | 0.057 | 0.065 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0 | 8° | 0 | 8° |

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

## Order Information

| Order Number | Operating Temperature Range | Package | Marking Information | MSL | Transport Media, Quantity | Eco Plan |
|---|---|---|---|---|---|---|
| TPB4056B2X-ES1R | −40 to 85°C | ESOP-8 | 6B2X | 3 | Tape and Reel, 4000 | Green |
| TPB4056B2X-EV1R | −40 to 85°C | EMSOP-8 | 6B2X | 3 | Tape and Reel, 3000 | Green |
| TPB4056B3X-ES1R | −40 to 85°C | ESOP-8 | 6B2X | 3 | Tape and Reel, 4000 | Green |
| TPB4056B3X-EV1R | −40 to 85°C | EMSOP-8 | 6B2X | 3 | Tape and Reel, 3000 | Green |

**Green**: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

# IMPORTANT NOTICE AND DISCLAIMER