1-A Single Cell Battery Linear Charger with High Input Voltage

Features

- Single-Chip Charger for 1-cell Li-ion or Polymer Battery
- Constant-Current/Constant-Voltage Battery Charge
- Maximum 1000 mA Programmable Charge Current
  - Protection
  - Wide Input From 4.55 V to 6.8 V or to 10.5 V, up to 26.5 V
- Charging Current Monitor and Thermal Foldback
- Power Presence Indication
- Soft start for Inrush Current Limitation
- Automatic Battery Recharge
- No external MOSFET, Current Sensor or Diode Required
- Operation Temperature: −40°C ~ +85°C
- Package options: ESOP-8, DFN2×2, DFN3×2, DFN3×3

Applications

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

Description

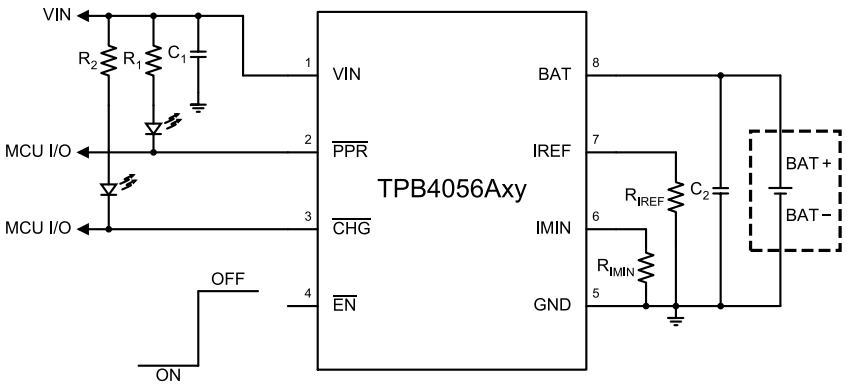
The TPB4056A is a cost-effective, high-integration linear charger for single cell Li-ion or Li-ion polymer batteries. The device support CC/CV charge from either USB port or AC adapter. Low BOM component requirement makes the whole system small in size. High input voltage range with over-voltage protection supports low-cost unregulated adapters.

The TPB4056A charge current is fully programmable up to 1000 mA with an external resistor. The TPB4056A automatically terminates the charge cycle when the charge current drops below a programmable minimal charging current of the set charge current value after reaches float voltage.

The TPB4056A implements two indication pins, $\overline{PPR}$ and $\overline{CHG}$, allowing connection to microcontroller or LED to show device status. With open-drain structure, $\overline{PPR}$ pin stays low while input voltage is within operation range, and $\overline{CHG}$ stays low during charging state, else pins are in the high impedance state.

The TPB4056A features thermal foldback function to limit the charge current and protect the device from over junction temperature fault. The TPB4056A also integrates current monitor, UVLO, OVP function to prevent device from damage.

Typical Application Circuit



Product Family Table

Order Number	Float Voltage (V)	OVP (V)	Trickle Voltage (V)	Package
TPB4056A20-ES1R	4.200	6.8	2.5	ESOP-8
TPB4056A2X-ES1R	4.200	10.5	2.5	ESOP-8
TPB4056A20-DFHR	4.200	6.8	2.5	DFN3X3-8
TPB4056A2X-DFHR	4.200	10.5	2.5	DFN3X3-8
TPB4056A20-DFGR	4.200	6.8	2.5	DFN2X2-8
TPB4056A2X-DFGR	4.200	10.5	2.5	DFN2X2-8
TPB4056A20-DFDR	4.200	6.8	2.5	DFN2X3-8
TPB4056A2X-DFDR	4.200	10.5	2.5	DFN2X3-8
TPB4056A3X-ES1R	4.350	10.5	2.6	ESOP-8
TPB4056A3X-DFHR	4.350	10.5	2..6	DFN3X3-8
TPB4056A3X-DFGR	4.350	10.5	2.6	DFN2X2-8
TPB4056A3X-DFDR	4.350	10.5	2.6	DFN2X3-8

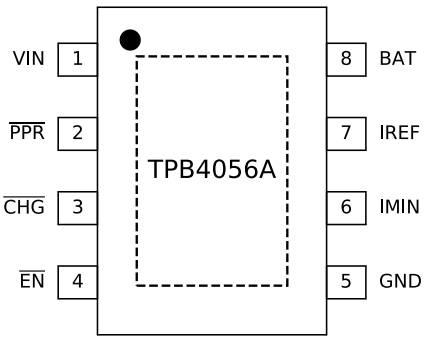
Table of Contents

Revision History

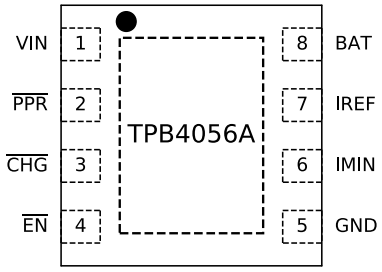
Date	Revision	Notes
2020-12-25	Rev.A.0	First Release Version
2021-02-25	Rev.A.1	Change Wide Vin Voltage from 4V to 4.55V in Features
2021-04-06	Rev.A.2	Update EOC Rising Threshold Min and Max
2021-08-10	Rev.A.3	Modify ISD Parameter and Tape and Reel Information. Change MAX Rating 26.5V,Add test condition if ISD. Update DFN2X3-6 Package

Pin Configuration and Functions

ESOP-8 Package
Top View



DFN2×2-8L, DFN2×3-8L, DFN3× 3-8L Package
Top View



Pin Functions

Pin		I/O	Description
No.	Name		
1	VIN	I	Power supply voltage input pin. Connect VIN to GND with a 1μF or greater capacitor.
2	$\overline{PPR}$	O	Input voltage good indication pin. Open-drain output low while input supply voltage within POR and OVP voltage range and high impedance otherwise.
3	$\overline{CHG}$	O	Charge State Indication pin. Open-drain output low when device is charging, while high impedance when end-of-charge (EOC) is qualified, or charger is disabled.
4	$\overline{EN}$	I	Enable input pin with active low. Pull this pin to low or left floating to enable charge, while pull high to disable charge.
5	GND	-	Ground.
6	IMIN	I	Minimal charging current programming pin. For charging current continues below minimal charging current I_{MIN}, an end-of-charge (EOC) is qualified. Set I_{MIN} by a resistor connecting between this pin and ground and following below equation: $$I_{MIN}=\frac{10000}{R_{IMIN}}\ (mA)$$ where R_{IMIN} unit is kΩ.
7	IREF	I	Charge current feedback pin. Connect a resistor between this pin and GND pin to set charge constant current limitation. The current is following equation: $$I_{REF}=\frac{1200}{R_{IREF}}\ (mA)$$ Where R_{IREF} unit is kΩ.
8	BAT	O	Charger output pin. Connect this pin to the positive of battery with a 1μF or greater X5R ceramic capacitor for decoupling. The BAT output is disabled, when $\overline{EN}$ pin is pulled high.
E	Pad	-	Exposed pad must be connected to PCB ground plane to maximum the thermal performance

Specifications

Absolute Maximum Ratings

Parameter		Min	Max	Unit
Input Voltage	VIN	−0.3	26.5	V
	IREF, IMIN	−0.3	6	V
	$\overline{EN}$	−0.3	26.5	V
Output Voltage	$\overline{PPR}$,$\overline{CHG}$	−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

Note: 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.

(1) This data was taken with the JEDEC low effective thermal conductivity test board.

(2) This data was taken with the JEDEC standard multilayer test boards.

ESD, Electrostatic Discharge Protection

Symbol	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	θ_{JA}	θ_{JC}	Unit
ESOP-8	148	48	°C/W
DFN3X3-8L	75	54	°C/W
DFN2X3-8L	101	55	°C/W
DFN2X2-8L	103	55	°C/W

Electrical Characteristics

All test condition is V_{IN} = 5 V, T_A = +25°C, unless otherwise noted.

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
Supply Voltage and Current							
	Maximum Supply Voltage					26.5	V
V_{IN}	Operating Supply Voltage	TPB4056A20		4.55		6.10	V
		TPB4056A35					
		TPB4056A2X		4.55		9.35	
		TPB4056A3X					
	VIN Pin Supply Current		V_{BAT} = 4.4 V, $\overline{EN}$ = Low		180	250	μA
I_{SD}	Shutdown current		$\overline{EN}$ = High, V_{IN} > UVLO(2)		80	110	μA
			IREF floating, V_{IN} > UVLO(2)		80	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_{IREF}	IREF voltage		Constant current mode, R_{IREF} = 1.2 kΩ	0.92	1	1.08	V
I_{IREF}	IREF source current		V_{IREF} = 5 V		2		μA
V_{FLOAT}	BAT pin float voltage or Battery end of charge voltage	TPB4056A20		4.158	4.2	4.242	V
		TPB4056A2X					
		TPB4056A3X		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_{IREF} = 2.4 kΩ	450	500	550	mA
			Constant current mode, R_{IREF} = 1.2 kΩ	930	1000	1070	mA
			V_{BAT} = 4.2 V		−4.0	−6	μA
			V_{IN} = 0 V		−3.2	−4	μA
t_{ss}	Soft start delay time		Charge current from 0 mA to I_{BAT}		1		ms
V_{TCK}	Battery trickle voltage	TPB4056A20	V_{BAT} < V_{TCK}, R_{IREF} = 1.2 kΩ	2.4	2.5	2.6	V
		TPB4056A2X					
		TPB4056A3X		2.5	2.6	2.7	V
	Hysteresis		R_{IREF} = 1.2 kΩ	50	110	170	mV
I_{TCK}	Battery trickle charge current		V_{BAT} < V_{TCK}, R_{IREF} = 1.2 kΩ	60	100	140	mA
$V_{BAT,LO}$	Battery charge lockout threshold, V_{IN} – V_{BAT}		V_{IN} rising	80	110	140	mV
			V_{IN} failing	15	30	55	mV

***Note: (1)** 100% tested at T_A = 25°C.

***Note: (2)** Only tested at VIN > UVLO

Electrical Characteristics (Continued)

All test condition is V_{IN} = 5 V, T_A = +25°C, unless otherwise noted.

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
Charge Voltage and Current							
I_{MIN}	Minimal charging current threshold,		R_{IMIN} = 243 kΩ	15	35	70	mA
t_{MIN}	End of Charge deglitch time				2		ms
	EOC Rising Threshold		R_{IREF} = 2.4 kΩ	325	380	445	mA
t_{RECHG}	Recharge deglitch time				2		ms
Logic Input and Output							
$V_{EN,IH}$	$\overline{EN}$ logic-input high level (enable)			1.6			V
$V_{EN,IL}$	$\overline{EN}$ logic-input low level (disable)					0.4	V
R_{EN}	$\overline{EN}$ pin Internal Pulldown Resistance		V_{IN} = 5 V		200		kΩ
$V_{PPR,OL}$	$\overline{PPR}$ low level output voltage		I_{PPR} = 5 mA		0.25	0.6	V
$V_{CHG,OL}$	$\overline{CHG}$ low level output voltage		I_{CHG} = 5 mA		0.25	0.6	V
Protection							
V_{OVP}	Input over-voltage protection	TPB4056A20	V_{IN} rising	6.4	6.8	7.2	V
		TPB4056A2X		9.8	10.5	11.2	V
		TPB4056A3X					
	Hysteresis			140	200	260	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		17		mA
Junction Temperature Protection							
T_{OTP}	Over temperature protection threshold				150		°C

***Note:** 100% tested at T_A = 25°C.

Typical Performance Characteristics

All test condition: VIN = 5V, TA = +25°C, unless otherwise noted.

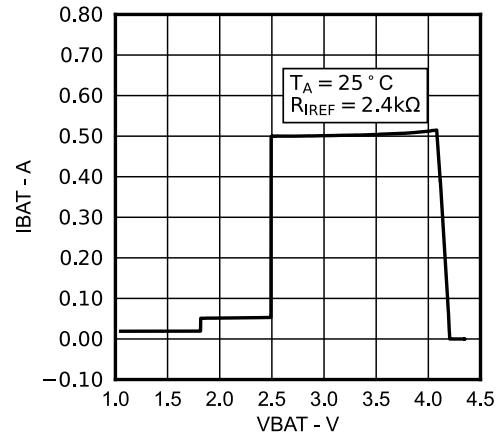


Figure 1 Charging Current IBAT vs VBAT Voltage

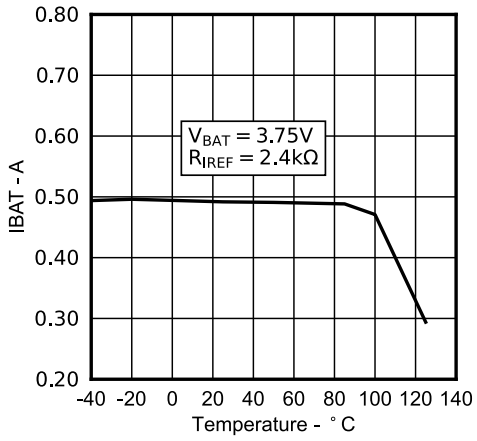


Figure 2 Charging Current IBAT vs Temperature

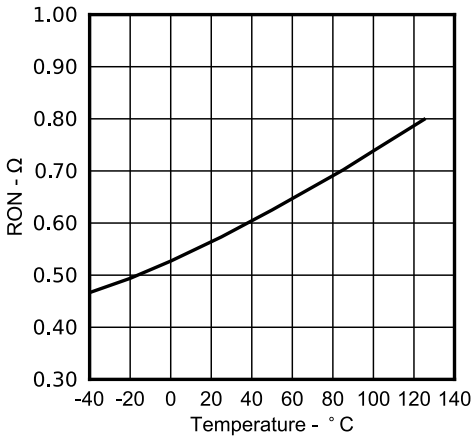


Figure 3 RON vs Temperature

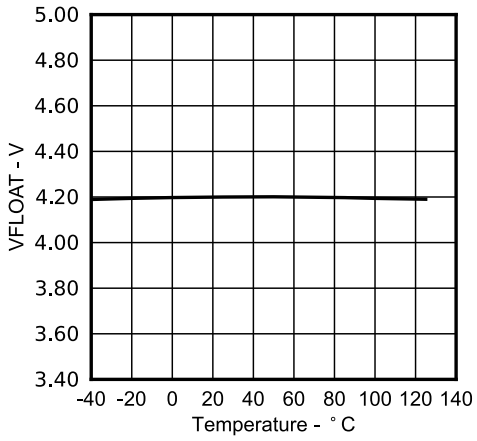


Figure 4 VFloat Voltage vs Temperature

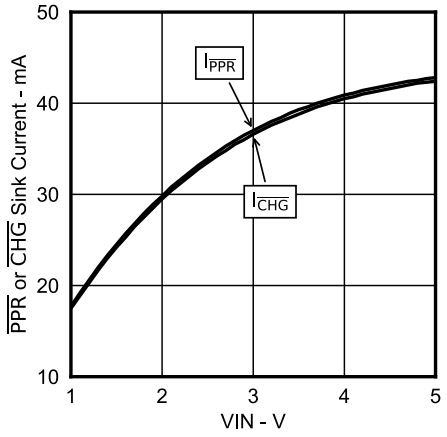


Figure 5 Sink Current of $\overline{PPR}$ or $\overline{CHG}$ vs VIN

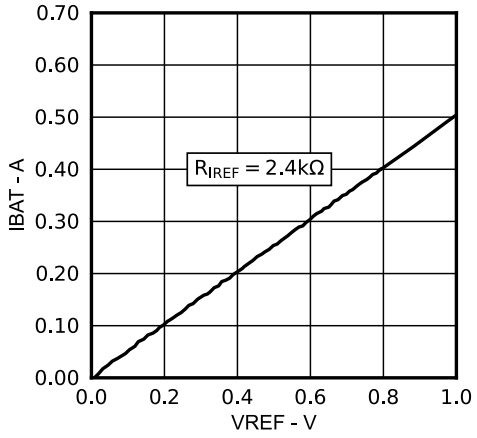


Figure 6 Charging Current IBAT vs IREF Voltage VREF

Detailed Description

Overview

The TPB4056A is a cost-effective, high-integrated linear charger for single cell Li-ion or Li-ion polymer batteries. The device support CC/CV charge from either USB port or AC adapter. Low BOM component requirement makes the whole system small in size. High input voltage range with over-voltage protection supports low-cost unregulated adapters. The TPB4056A charge current is fully programmable from 50 mA to 1000 mA with an external resistor, and the charge current can automatically terminate the charge cycle when the charge current drops below a minimal current which is set by external resistor on IMIN pin with a range from 5% (or 10 mA, which one is higher) to 50% of constant current set by IREF pin after reaches float voltage.

Feature Description

Enable ($\overline{EN}$)

The TPB4056A is in shutdown mode when chip enable pin ($\overline{EN}$) is high. Connect this pin to the GPIO of an external processor or digital logic control circuit to enable and disable the device. Or connect this pin to the VIN pin for self-bias applications.

Under-voltage Lockout (UVLO)

The TPB4056A uses an under-voltage lockout circuit to keep the device in shutdown mode until the supply voltage is higher than UVLO threshold.

Over Voltage Protection (OVP)

The TPB4056A uses an over-voltage protection circuit to prevent the device from damage when the supply voltage is higher than OVP threshold. The internal power FET, if previously on, turns off after a certain 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 TPB4056A provides fully programmable charge current from 50 mA to 1000 mA under normal charge conditions. A single current-programming resistor connected from IREF 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 to calculate the resistor value.

$$I_{BAT} = \frac{1200}{R_{IREF}} \quad (1)$$

Where,

I_{BAT} is the desired constant charge current,

R_{IREF} is the external current setting resistor.

The TPB4056A implements IREF pin short protection function. When the R_{IREF} resister set too small or short to GND unintentionally, short protection occurs, and the battery charge current is limited to 1.5 A, IREF short protection charge current. Meanwhile the thermal foldback and over temperature protection still limit the constant current I_{BAT}.

When TPB4056A is powered up, the whole battery charging process can be divided into five sections below:

Trickle Current Battery Charge

The TPB4056A operates in the trickle charge mode when detects the battery voltage below the trickle charge threshold, V_{TCK}. In trickle charge mode, battery charge current is limited to small current range, I_{TCK}, to protect the battery.

Constant Current Battery Charge

The TPB4056A enters constant current (CC) battery charge mode when the battery voltage ramps higher than trickle charge threshold V_{TCK}. In this mode, constant current, determined by the resistor from IREF to GND, flows out from BAT pin to the positive side of load battery.

Constant Voltage Battery Charge

The TPB4056A 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}.

Battery Charge Termination

When the charge current falls below I_{MIN}, the TPB4056A terminates the battery charge cycle after a deglitch period with $\overline{CHG}$ pin goes to high. Meanwhile, TPB4056A keeps a very small charging current to force battery stays at full charged.

Battery Recharge

In battery charge standby mode, the TPB4056A monitors the battery voltage continuously. Figure 7 shows the typical behavior during one battery charging cycle.

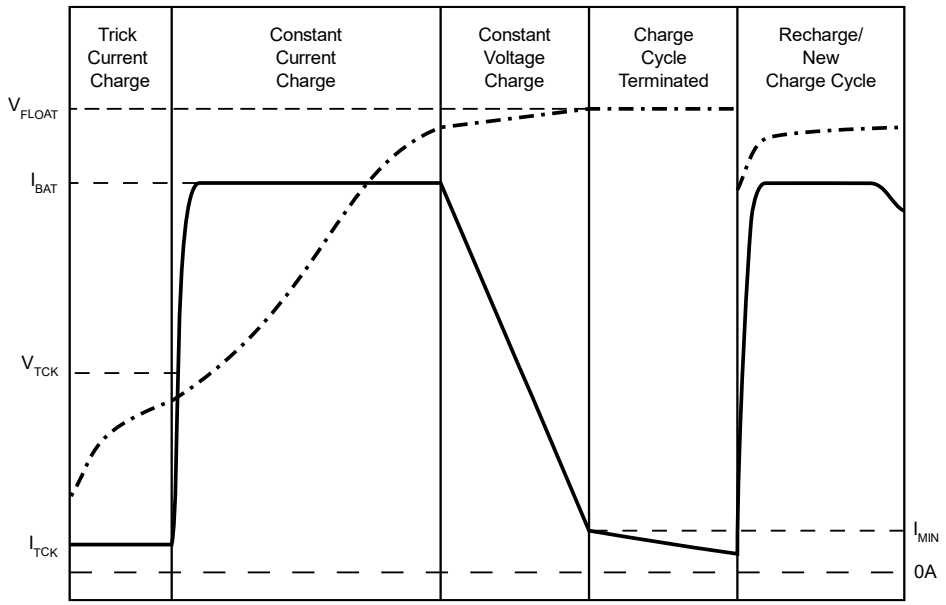


Figure 7 Current and Voltage During One Charging Cycle

Soft-start

The TPB4056A integrates a soft-start circuit to reduce the inrush current after new charge cycle starts. When one new charge cycle starts, the battery charge current is limited to ramp up from 0 to set value in 20 μs.

Battery Short Circuit and Reverse Polarity Protection

The TPB4056A features the BAT output short to ground protection and the battery reverse polarity protection.

When the TPB4056A 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.

When the TPB4056A detects the BAT output voltage below the reverse protection threshold, the battery reverse protection works after a deglitch period, and the leakage current of BAT pin is limited to 100 μA.

Battery Charge Status Indication

The TPB4056A has two pins to indicate power present status and the battery charge status: $\overline{PPR}$ and $\overline{CHG}$. Connect these two pins to the GPIO of a microcontroller to read the TPB4056A working status or to connect with LEDs pull up circuit as the status indicators. Pull down these two pins to ground directly when status indication function is not used.

Table 1 Battery Charge Status indication

Conditions	$\overline{CHG}$ Pin/LED
Battery charging	Low/On
Battery fully charged	High-Z/Off
No battery connected or battery reverse connected	
$\overline{EN}$ = High	
IREF floating	
V_{IN} > OVP or V_{IN} < UVLO or $V_{IN} - V_{BAT} < V_{BAT,LO}$	
Over temperature Protection	
Conditions	**$\overline{PPR}$ Pin/LED**
V_{IN} < UVLO	High-Z/Off
V_{IN} > OVP	
$V_{IN} - V_{BAT} < V_{BAT,LO}$	
UVLO < V_{IN} < OVP & $V_{IN} - V_{BAT} > V_{BAT,LO}$	Low/On

Over Temperature Protection (OTP)

The TPB4056Aintegrates Foldback circuit and over-temperature protection to prevent device from over-heated and damage. When the junction temperature is higher than T_{OTP}, 150°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 180°C, the device will shut down charging loop until T_J drops below 100°C.

Application and Implementation

NOTE

Information in the following applications 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 TPB4056A is a cost-effective, high-integrated linear charger for single cell Li-ion or Li-ion polymer batteries. The device support CC/CV charge from either USB port or AC adapter. Low BOM component requirement makes the whole system small in size. The following sections show a typical application of the TPB4056A.

Typical Application

Figure 8 shows the typical application schematic of the TPB4056A.

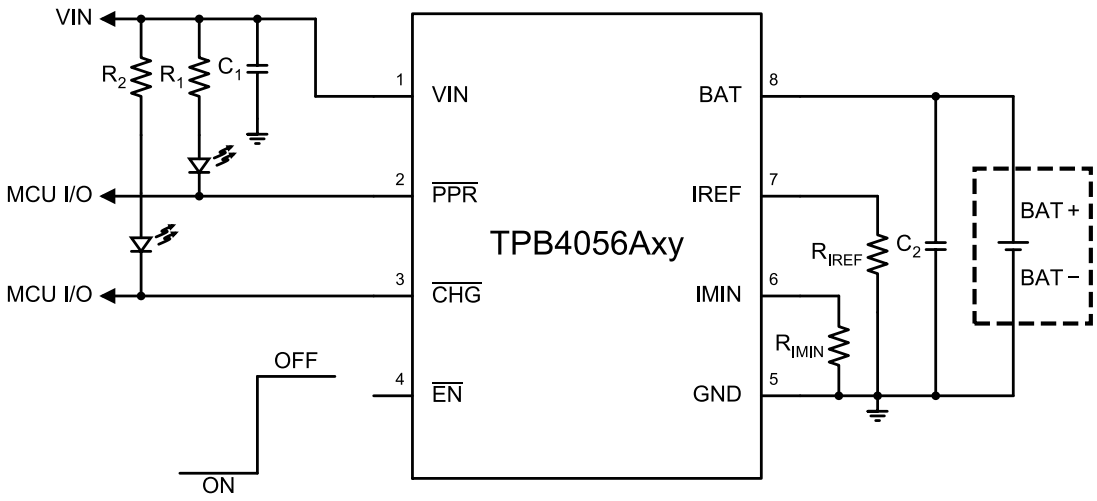


Figure 8 TPB4056A Typical Application Circuit

VIN Input Capacitor and BAT Output Capacitor

3PEAK recommends to add 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 to select a 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 150°C. When junction temperature exceeds 150°C, the charge current decreases with the temperature value. Using Equation 2 and Equation 3 to calculate the power dissipation and estimate the junction temperature.

The maximum power dissipation can be calculated using Equation 2.

$$P_D = (V_{IN} - V_{BAT}) \times I_{BAT} = \frac{T_{J,max} - T_A}{\theta_{JA}} \quad (2)$$

Where,

$T_{J,max}$ is the junction temperature limitation, 150°C,

T_A is the ambient temperature,

θ_{JA} is the junction-to-ambient thermal resistance

Solve Equation 2, the constant charge current value is calculated in Equation 3.

$$I_{BAT} = \frac{150°C - T_A}{(V_{IN} - V_{BAT}) \times \theta_{JA}} \quad (3)$$

Layout

Layout Guideline

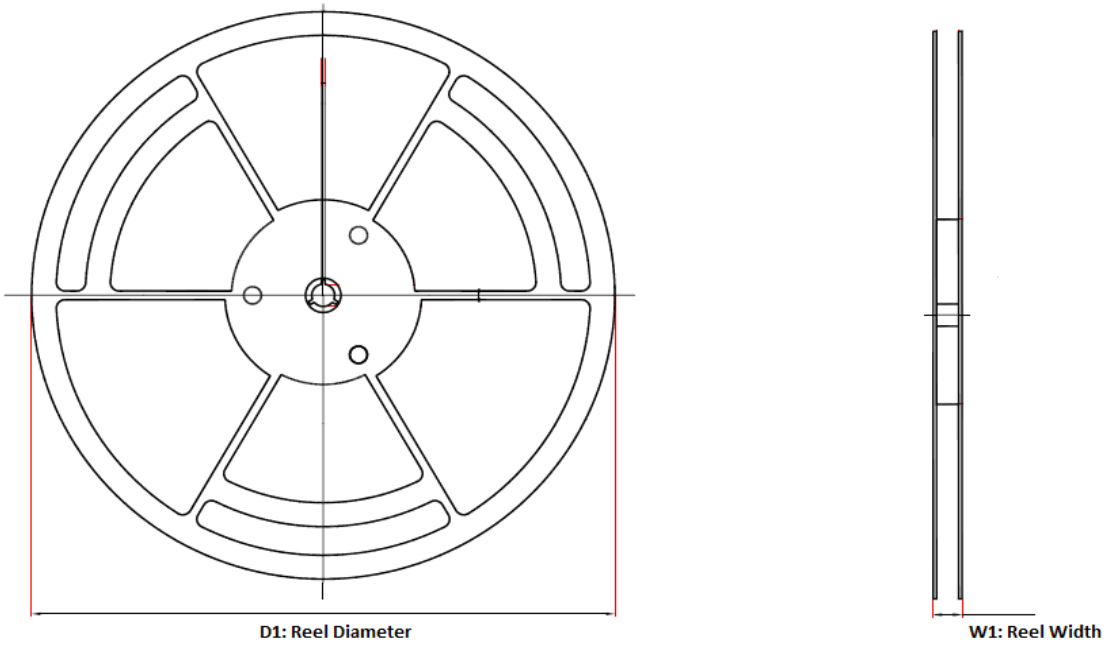
Both input capacitors and output capacitors must be placed to the device pins as close as possible.

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, IN pin and the GND pin of the system must be as small as possible.

It is recommended to use wide trace lengths or thick copper weight to minimize I×R drop and heat dissipation.

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.

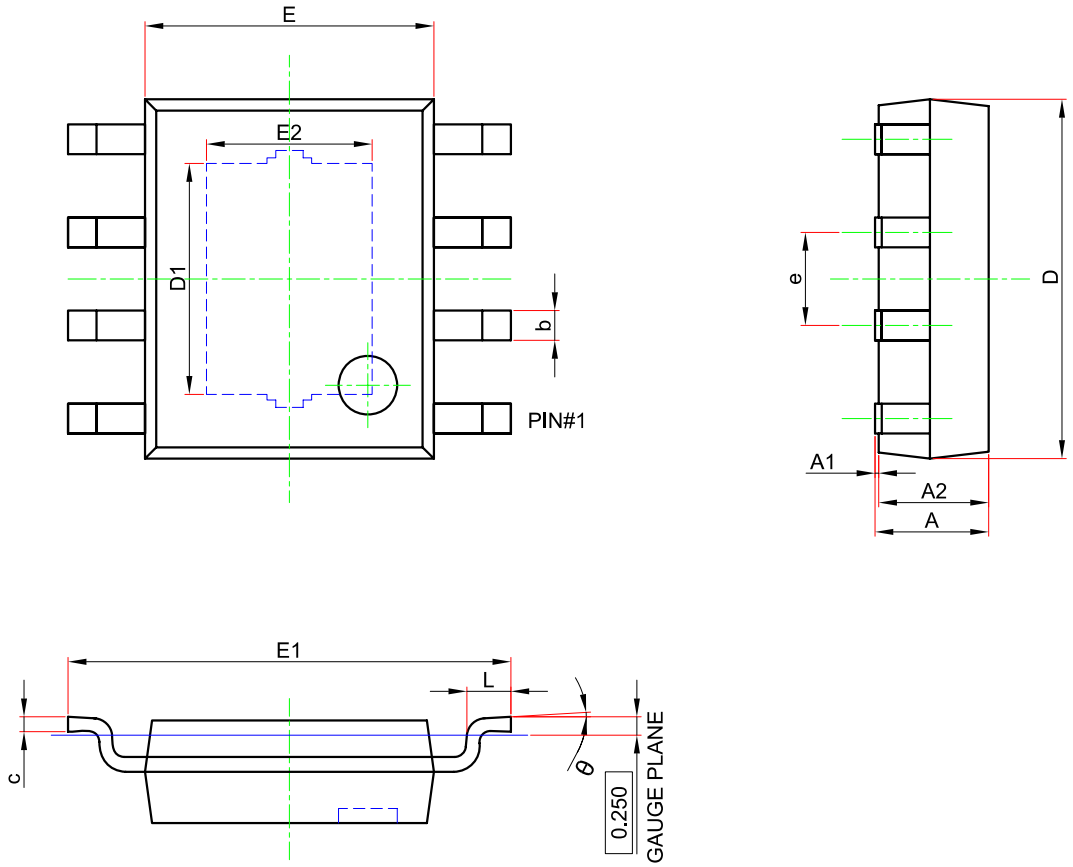
Tape and Reel Information



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPB4056A20-ES1R	ESOP-8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPB4056A2X-ES1R	ESOP-8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPB4056A20-DFHR	DFN3X3-8	330.0	17.6	3.3	3.3	1.1	8.0	12.0	Q1
TPB4056A2X-DFHR	DFN3X3-8	330.0	17.6	3.3	3.3	1.1	8.0	12.0	Q1
TPB4056A20-DFGR	DFN2X2-8	180.0	13.1	2.3	2.3	1.1	4.0	8.0	Q1
TPB4056A2X-DFGR	DFN2X2-8	180.0	13.1	2.3	2.3	1.1	4.0	8.0	Q1
TPB4056A20-DFDR	DFN2X3-8	180.0	13.1	3.3	2.3	1.1	4.0	8.0	Q1
TPB4056A2X-DFDR	DFN2X3-8	180.0	13.1	3.3	2.3	1.1	4.0	8.0	Q1
TPB4056A3X-ES1R	ESOP-8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPB4056A3X-DFHR	DFN3X3-8	330.0	17.6	3.3	3.3	1.1	8.0	12.0	Q1
TPB4056A3X-DFGR	DFN2X2-8	180.0	13.1	2.3	2.3	1.1	4.0	8.0	Q1
TPB4056A3X-DFDR	DFN2X3-8	180.0	13.1	3.3	2.3	1.1	4.0	8.0	Q1

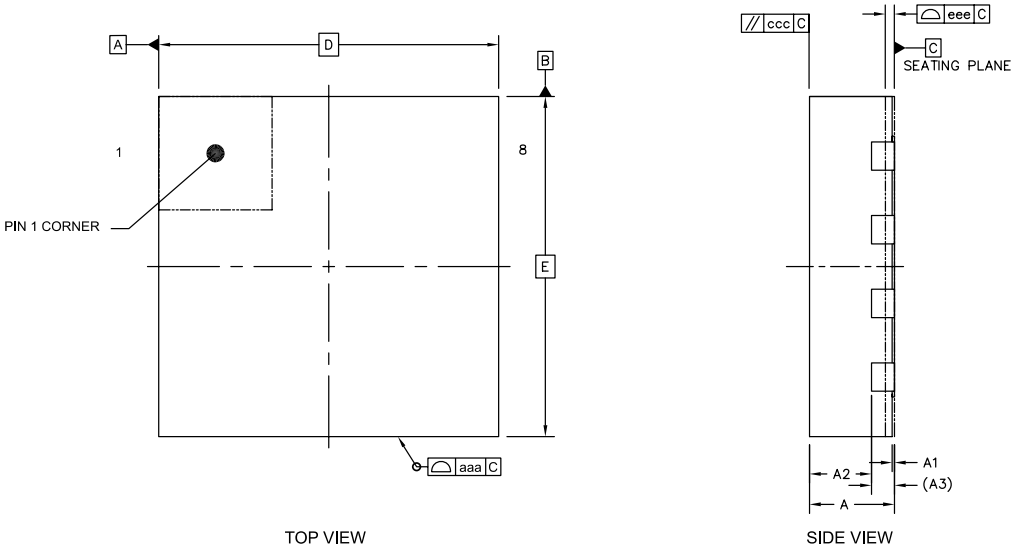
Package Outline Dimensions

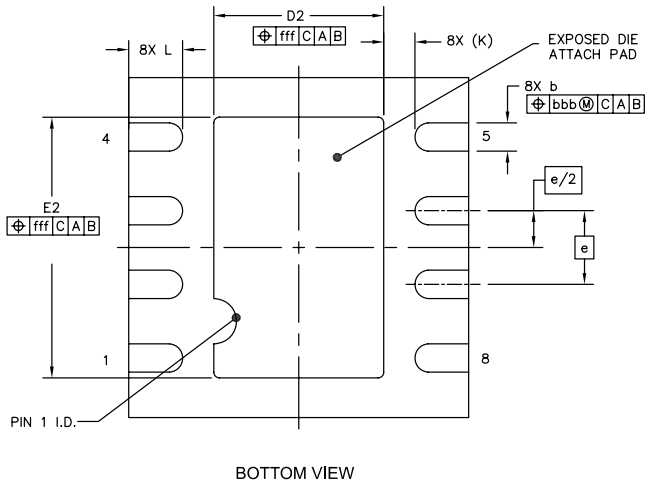
ESOP-8



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
E	3.800	4.000	0.150	0.157
D1	3.050	3.350	0.120	0.132
E1	5.800	6.200	0.228	0.244
E2	2.160	2.360	0.085	0.093
e	1.270BSC.		0.050BSC.	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

DFN3X3-8

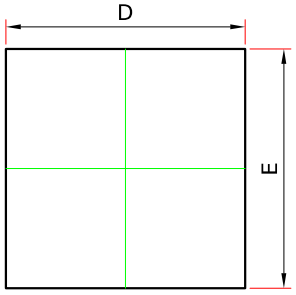




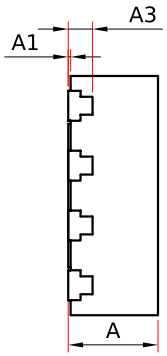
BOTTOM VIEW

		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2		0.55	
L/F THICKNESS		A3		0.203 REF	
LEAD WIDTH		b	0.2	0.25	0.3
BODY SIZE	X	D		3 BSC	
	Y	E		3 BSC	
LEAD PITCH		e		0.65 BSC	
EP SIZE	X	D2	1.45	1.5	1.55
	Y	E2	2.25	2.3	2.35
LEAD LENGTH		L	0.375	0.475	0.575
LEAD TIP TO EXPOSED PAD EDGE		K		0.275 REF	
PACKAGE EDGE TOLERANCE		aaa		0.05	
MODE FLATNESS		ccc		0.1	
CAPLANARITY		eee		0.08	
LEAD OFFSET		bbb		0.1	
EXPOSED PAD OFFSET		fff		0.1	

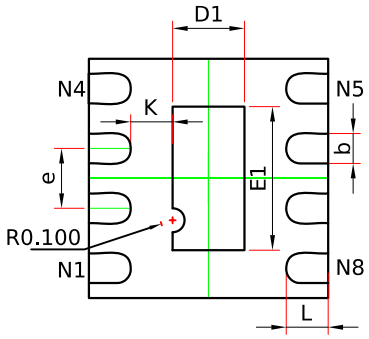
DFN2X2-8



TOP VIEW



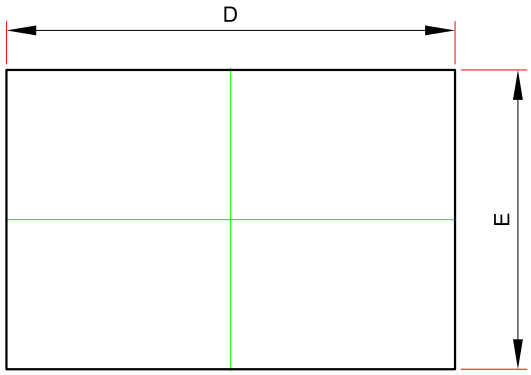
SIDE VIEW



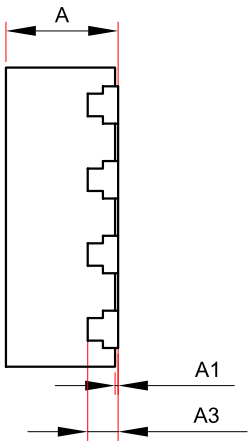
BOTTOM VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D1	0.500	0.700	0.020	0.028
E1	1.100	1.300	0.043	0.051
k	0.350REF.		0.014REF.	
b	0.200	0.300	0.008	0.012
e	0.500BSC.		0.020BSC.	
L	0.274	0.426	0.011	0.017

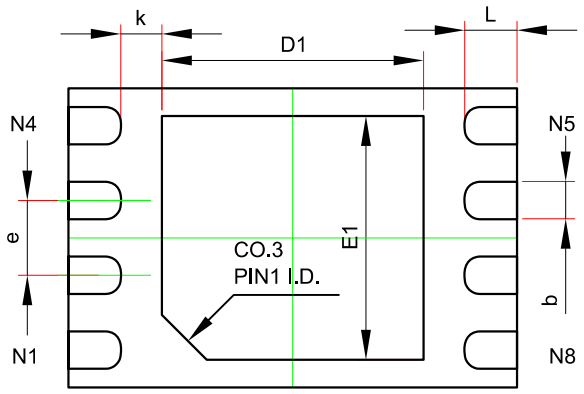
DFN2X3-8



TOP VIEW



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203 REF.		0.008 REF.	
D	2.900	3.100	0.114	0.122
E	1.900	2.100	0.075	0.083
D1	1.400	1.600	0.055	0.063
E1	1.400	1.600	0.055	0.063
b	0.180	0.280	0.007	0.011
e	0.500 BSC.		0.020 BSC.	
k	0.450 REF.		0.018 REF.	
L	0.250	0.350	0.010	0.014

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPB4056A20-ES1R	−40 to 85°C	ESOP-8	6A20	3	Tape and Reel, 4000	Green
TPB4056A2X-ES1R	−40 to 85°C	ESOP-8	6A2X	3	Tape and Reel, 4000	Green
TPB4056A20-DFHR	−40 to 85°C	DFN3×3-8	6A20	3	Tape and Reel, 4000	Green
TPB4056A2X-DFHR	−40 to 85°C	DFN3×3-8	6A2X	3	Tape and Reel, 4000	Green
TPB4056A20-DFGR	−40 to 85°C	DFN2×2-8	A20	3	Tape and Reel, 3000	Green
TPB4056A2X-DFGR	−40 to 85°C	DFN2×2-8	A2X	3	Tape and Reel, 3000	Green
TPB4056A20-DFDR	−40 to 85°C	DFN2×3-8	A20	3	Tape and Reel, 3000	Green
TPB4056A2X-DFDR	−40 to 85°C	DFN2×3-8	A2X	3	Tape and Reel, 3000	Green
TPB4056A3X-ES1R	−40 to 85°C	ESOP-8	6A3X	3	Tape and Reel, 4000	Green
TPB4056A3X-DFHR	−40 to 85°C	DFN3×3-8	6A3X	3	Tape and Reel, 4000	Green
TPB4056A3X-DFGR	−40 to 85°C	DFN2×2-8	A3X	3	Tape and Reel, 3000	Green
TPB4056A3X-DFDR	−40 to 85°C	DFN2×3-8	A3X	3	Tape and Reel, 3000	Green

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