DESCRIPTION

TP4336 is a fully-integrated multi-function power management SOC. It integrates a linear charge, synchronous boost converter and Li-ion battery charger management system and a battery state of charge indicator controller. It provides a complete power supply solution for mobile power banks.

TP4336 integrates linear charging management, synchronous boost discharge mode, battery fuel gauge and LED indication module, and multiple protection modules.

TP4336 features internal MOSFETs with a fixed 1A charging current. The maximum synchronous boost output current is 1A, and the light-load shutdown current is 50 mA.

TP4336 features low standby power, with standby current as low as 10μA when the chip is shut down and the load is open.

TP4336 integrates internal temperature compensation plus multi-layer safety protections including thermal shutdown (OTP), over-charge, over-discharge, output over voltage protection (OVP), output over current protection (OCP), and short-circuit protection (SCP) to safeguard the IC and li-ion battery.

TP4336 requires minimal external components for a complete Li-ion charge/discharge solution with simple application circuitry, effectively reducing system cost and PCB footprint.

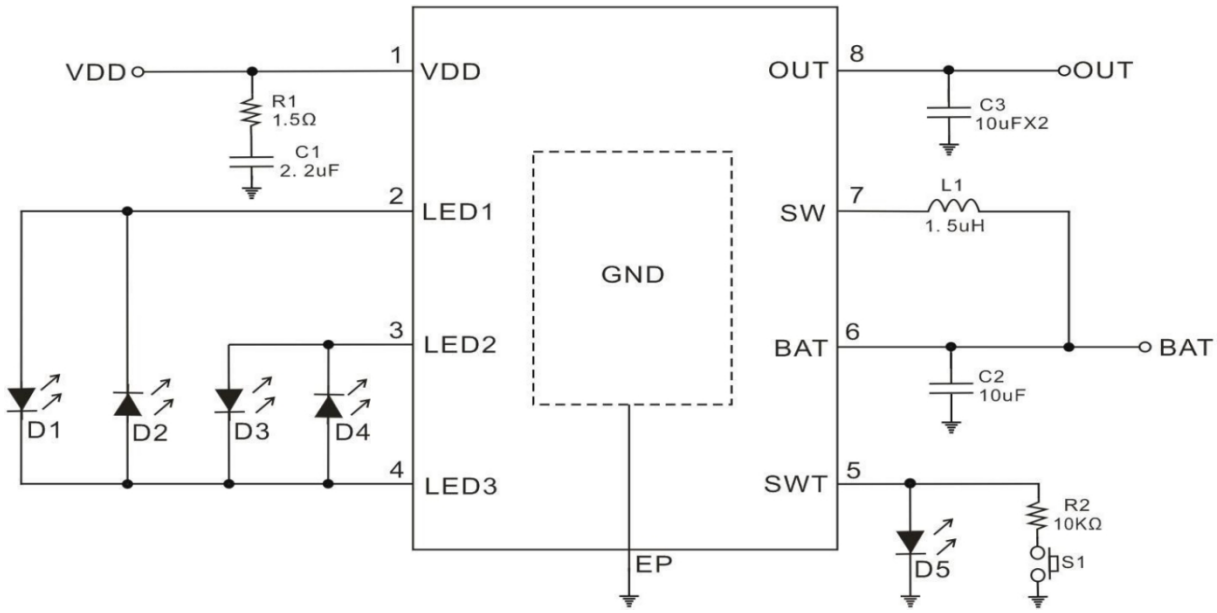
FEATURES

- Single-port Charge & Discharge
  Linear charge, synchronous boost converter
- Integrated power-path management,
  charging batteries and charging cellphones at the same time
- Up to 93% efficiency at discharge 1A
- Maximum boost output current is 1A
- Charging current: 1A
- Standby current as low as 10μA
- Light-load auto shutdown current is 50mA
- Automatic load detection for power on/off
- Single short press to power on,
- Double short press to power off.
- Built-in light drive
- Adaptive charging current control, adaptive adapter output capability
- Intelligent thermal regulation and over-temperature protection (OTP).
- Package size: ESOP-8L

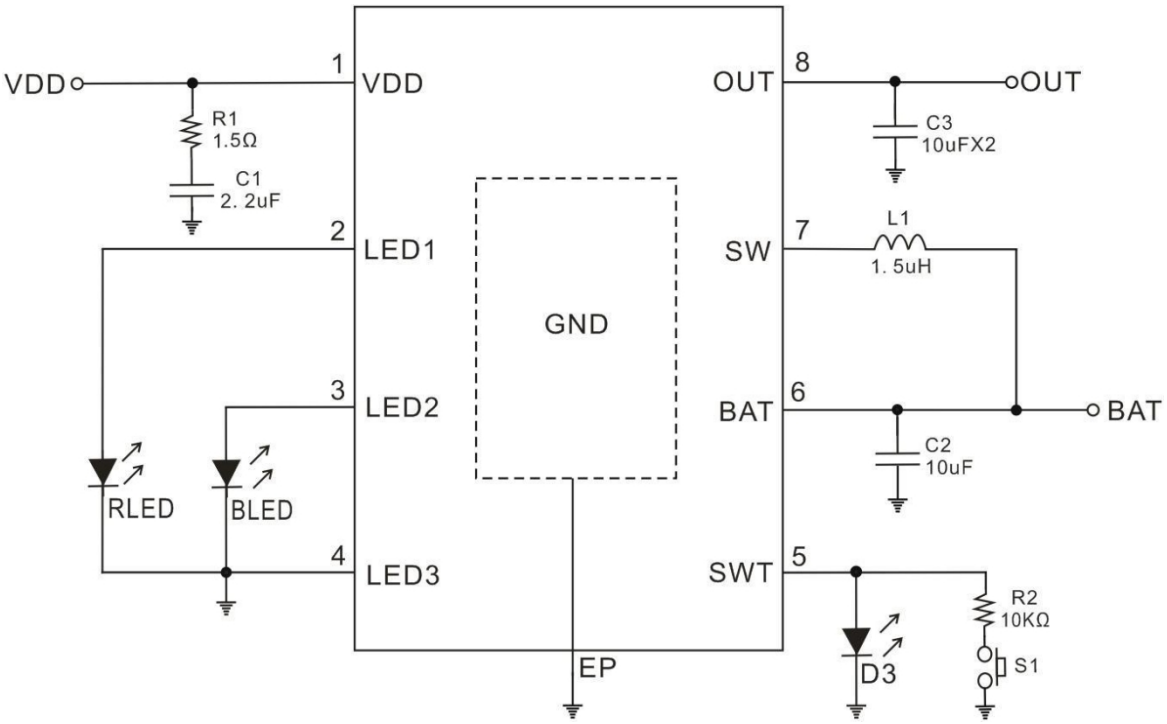
APPLICATIONS

- Power banks and handheld electronics
- Flashlights / Power stations
- Electric hand warmer / E-cig / Portable Hand Fan
- Portable Media Player
- Suitable for other charge & discharge devices

TYPICAL APPLICATION CIRCUIT



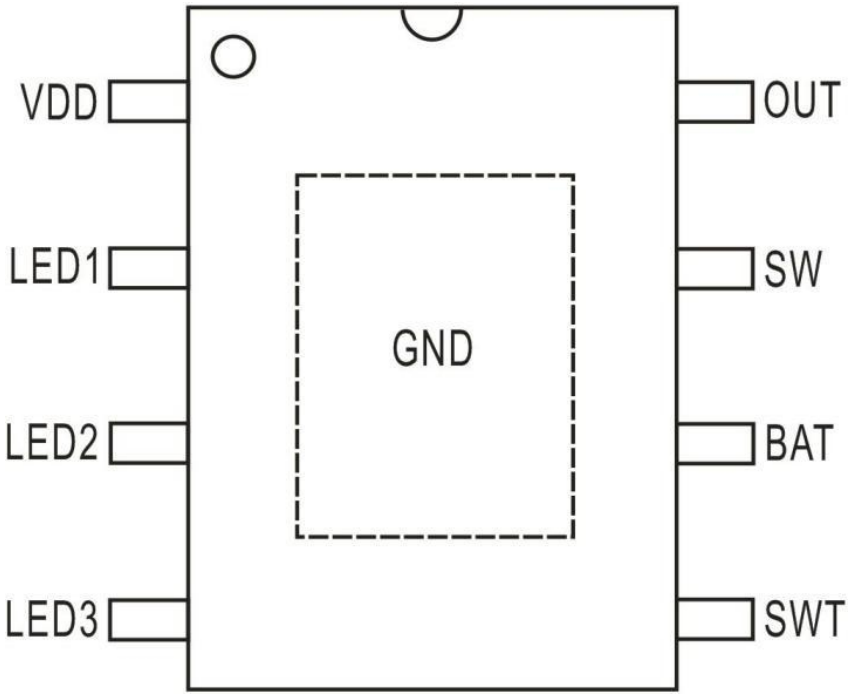
4-LED Indicator Typical Application Circuit



2-LED Indicator Typical Application Circuit

Notice: PCB layout, C1 and C3 must be placed close to the chip, C2 should be placed close to the chip and inductor.

PIN CONFIGURATION



ORDER INFORMATION

Pin No.	Pin Name	Description
1	VDD	Input voltage
2	LED1	4-LED: battery level LED driver. 2-LED: charging indicator LED driver
3	LED2	4-LED: battery level LED driver. 2-LED: discharging indicator LED driver
4	LED3	4-LED: battery level LED driver. 2-LED: short LED3 pin to GND
5	SWT	Push-button input: Single short press / shows battery level, double short press / power off
6	BAT	Lithium-ion battery positive terminal
7	SW	DC/DC switch node, connect to inductor
8	OUT	Synchronous boost output
Exposed PAD	GND	Thermal pad. Connect to chip ground, soldering well to PCB ground.

ORDER INFORMATION

Ordering Part Number	Description
TP4336	Package size: ESOP-8L

ABSOLUTE MAXIMUM RATINGS (NOTE1)

PARAMETER	Range	Unit
VDD to GND voltage	-0.3~+6.5	V
Other pin to GND voltage	-0.3~+6.0	V
Storage temperature	-50~+150	℃
Operating junction temperature	-40~+150	℃

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	Range	Unit
V_{BUS_IN}	Input Voltage	4.5~5.5	V
T_A	Operating ambient temperature	-20~85	℃

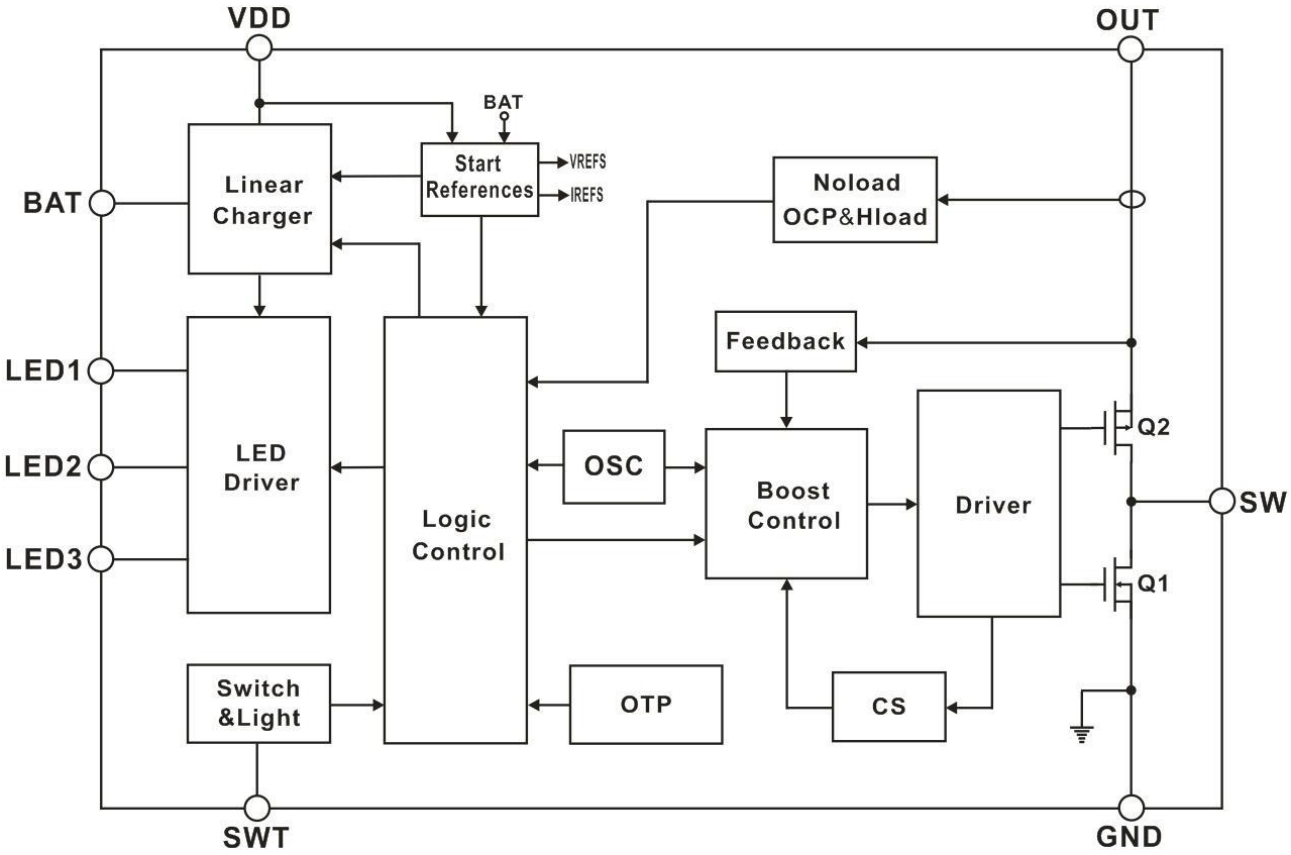
Note 1:
Exceeding the absolute maximum rating range may result in permanent damage to the IC. Within the recommended operating range, the IC works properly without full warranty for all individual parameters, though not all performance specifications are guaranteed under every condition.
Electrical Characteristics define DC and AC electrical specifications of the device under specified test conditions within the recommended operating range to guarantee designated performance parameters; accuracy is not warranted for parameters lacking min/max specs, while typical values represent typical device characteristics.

ELECTRICAL CHARACTERISTICS

VDD=5V, BAT=3.7V, Ta=25℃

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Linear Charger						
VDD	Input voltage		4.5	5	6.0	V
VDD_OVP	Input voltage OVP			6.15		V
VDDOVP_HYS	Input Voltage OVP hysteresis			300		mV
VBAT	Recharge threshold		4.15	4.2	4.25	V
△ VRECHRG	Recharge threshold voltage	VBAT-VRECHRG		130		mV
IBAT	Battery constant charging current	VBAT = 3.7 V		1		A
ITRK	Battery trickle charging current	VBAT = 2.7 V		10% * IBAT		mA
IFULL	Battery termination charging current			10%*IBAT		mA
VTRK	Trickle charge threshold voltage	VBAT Rising		2.85		V
VTRK_HYS	Trickle charge hysteresis	VBAT Falling		100		mV
TST	Temp compensation start threshold			115		℃
TZERO	Zero-current temperature			135		℃
VSD	VDD-VBAT lockout threshold	VDD Rising		180		mV
		VDD Falling		80		mV
Synchronous Boost						
VOUT	Output voltage	IOUT = 1A, VBAT = 3.7V		5.0		V
FOSC	Switching frequency			1000		kHz
DMAX	Maximum duty cycle			90		%
VOVP	Output voltage protection (OVP)			5.25		V
VOCP	Output OCP voltage			4.3		V
TOCP	Output OCP delay time			8		ms
VSHORT	Output SCP voltage			2.8		V
TShort	Output SCP delay time			500		μs
VUV_BAT	Battery UVLO threshold voltage	VBAT Rising		3.1		V
VWN_BAT	Battery low voltage warning	VBAT Falling		3.05		V
VBAT_END	Battery discharge termination voltage			2.8		V
ISD_BAT	Battery stand-by current	VBAT=3.0V~4.2V, output open		10		uA
IOFF	Light-load auto shutdown current	VBAT = 3.7V		50		mA
TOFF	Output auto shutdown delay time			16		S
IST	Load power-on startup current		8			uA
TDSWT	Single press valid duration time		50			mS
TDCLICK	Double press gap time				500	mS
TDSWT_LIT	Flashlight turn-on duration time		2			S
TOTP	Over temperature protection threshold			150		℃
TOTP_HYS	Over temperature protection hysteresis			20		℃
LED Indication						
ILEDx_4LED	LED x driver, 4-LED mode	VBAT = 4.2V, Boost Mode, Blue LED on		3		mA
		VBAT = 4.2V, Charging Mode, Blue LED on		4		mA
ILEDx_2LED	LED x driver, 2-LED mode	VBAT = 4.2V, Boost Mode, Blue LED on		3.3		mA
		VBAT = 4.2V, Charging Mode, Red LED on		3.3		mA
FLEDx_C	Charging blink frequency			1		Hz
FLED_WN	Low battery blink frequency			2		Hz
ILED_LIT	Flashlight current	VBAT = 4.2V		60		mA

BLOCK DIAGRAM



APPLICATION DESCRIPTION

Linear Charge

TP4336 operates in linear charging mode. When the battery voltage is below 2.85V, the device operates in trickle charge mode with trickle current at 10%*IBAT.

When VBAT exceeds 2.85V, the chip enters constant current (CC) charging mode, with a charging current of IBAT. When the battery voltage approaches 4.2V, the device enters constant voltage (CV) mode, and the charge current gradually decreases. When the charge current decreases to 10%*IBAT, the linear charging cycle completes, and the device enters standby mode.

TP4336 features intelligent recharge function. In standby mode, the chip will monitor battery voltage. When the battery voltage drops to 4.08 V, the chip will recharge the battery, starting a new charge cycle.

TP4336 constant current charge current is fixed at 1A, eliminating external charge current setting resistors.

Power Path

TP4336 integrates power path management, supporting pass-through operation. When both a charging source is connected and a load is present at the output.

TP4336 operates in pass-through mode; if the battery voltage is over 3.1V, the BAT pin provides boosted voltage output to the output terminal at linear charging mode. When the power charger is removed, the IC works in synchronous boost mode to supply output current to the output terminal.

TP4336 also features output overcurrent and short-circuit protection. When an overcurrent or short circuit occurs at the output, the IC immediately shuts down the discharge output while keeping the charging path unaffected. The discharge path automatically re-enables when the load is disconnected and reconnected

Automatic Power On/Off and Push-Button Power On/Off

TP4336 features automatic load detection. When a load is connected to the output, the TP4336 automatically detects it and enables the synchronous boost output. The minimum load detection current for automatic power on is 8μA.
TP4336 internally resets the 16 s no-load shutdown delay. Controlling the SWT key enables the TP4336 to avoid shutdown under light-load conditions. After the boost output is disabled, the TP4336 enters low-power standby mode with standby current as low as 10μA.
TP4336 integrates key ON/OFF control. A single key press longer than 50 ms turns on the boost output; a double press within 500 ms thereafter shuts down the boost output and puts the IC into low-power standby mode. In standby mode, the BAT pin connects to the OUT pin through a 120kΩ resistor. OUT = VBAT at no load, and the output voltage changes along with tiny load current.

Flashlight Illumination

The SWT pin can drive an LED for the flashlight function. The maximum sourcing current for the flashlight LED is 60mA. A series resistor can be added with the LED to reduce the flashlight current.
The SWT pin also serves as the flashlight control pin. Holding the SWT pin for 2 s turns the flashlight on, and another 2 s long press of the SWT pin will turn it off. The flashlight output is disabled when the battery voltage drops below the BAT under voltage lockout threshold to prevent the battery cell from over-discharge.

Battery Low Voltage Protection

At start-up, the boost circuit turns on when VBAT > 3.1V. In normal operation, the indicator LED blinks at 2 Hz to warn of a low battery when VBAT drops below 3.05V. If VBAT falls further below 2.8V, discharge output is disabled and TP4336 enters low-current standby mode.

Input Overvoltage Protection

Charging stops at VDD>6.1V for protection, and charging recovers when VDD<5.85V.

Intelligent Temperature Control

The TP4336 integrates an internal temperature feedback loop to ensure system stability. During charging, if the internal die temperature rises to 115 °C, the charging current decreases intelligently with rising internal IC temperature to reduce system power consumption and suppress excessive temperature rise to protect the IC from high-temperature damage, thermal shutdown at 150 °C, and auto-restart when the temperature falls to 130 °C.

Protection Features

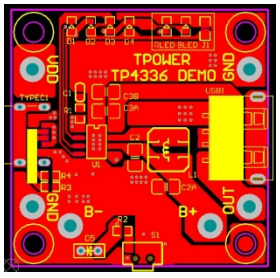
TP4336 has OVP/OCP/SCP/thermal/over charge/overdischarge protections to protect the Li-ion battery and the IC. An external lithium protection IC is optional for dual protection design.
TP4336 features latch-type output short-circuit and over-current protection. After the protection latch triggers, the synchronous boost circuit restarts and re-detects overcurrent/short faults either by disconnecting and reconnecting the output load or a single key press; normal operation resumes only after the fault is cleared.

Component Selection

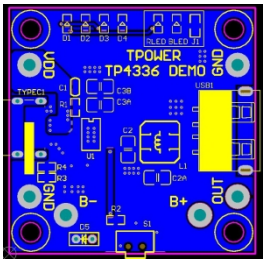
1. Use low-ESR SMD capacitors on the output to avoid excessive output ripple.
2. Inductor L1 shall be a power inductor with a saturation current rated to meet application requirements; otherwise, inductor saturation may cause abnormal IC operation.

PCB Layout Guide

1. Copper pour GND underneath the IC. Maximize the area of the ground plane, and route other non-critical traces around it accordingly.
2. The BAT capacitor shall be placed near the IC BAT pin and inductor. Connect its GND directly to the large ground plane, avoiding routing through thin ground tracks.
3. Place the VDD capacitor close to the VDD pin of the IC. Connect its ground directly to the large ground plane; do not route the ground through narrow ground traces to reach the IC or main ground plane.
4. Place the (OUT) output capacitor as close to the IC as possible. Connect its ground directly to the large ground plane, and avoid routing through narrow ground traces to the IC or main ground plane.
5. The inductor shall be placed near the BAT capacitor. Mount the inductor, BAT capacitor, and IC on one layer without vias. Route short and wide traces from the inductor to the SWT pin.



TP4336-Top



TP4336-Bottom

OPERATING STATUS AND BATTERY LEVEL INDICATION

1: 4-LED Mode

LED1 ~ LED4 indicate charging/discharging status and remaining power level. The LED behaviors under different operating conditions are specified as follows:

① Connect to VDD, LED1 ~ LED4 light up in sequence, then indicate charging status based on battery level. The LED corresponding to the reached charge level remains on steadily. The LED for the current battery level flashes at 1 Hz. When fully charged, all LEDs 1~4 stay lit. All LEDs turn on when fully charged.

② During discharge, LED1 ~ LED4 indicates the current battery level based on battery voltage. If the battery voltage is below 3.05 V, LED1 will flash at a 2 Hz frequency rapidly to indicate a low battery, until the battery voltage drops below 2.8 V, discharge stops, and the device enters low-power undervoltage protection mode. Discharging can only resume after the battery is recharged to above 3.1 V.

LED1 ~ LED4 Operating Status Table

IC Part Number	Charge					Discharge				
	Battery Voltage (V)	LED1	LED2	LED3	LED4	Battery Voltage (V)	LED1	LED2	LED3	LED4
TP4336	V_{BAT}<3.50	Blinking	OFF	OFF	OFF	VBAT <2.8	OFF	OFF	OFF	OFF
						2.8≤V_{BAT}＜3.05	Fast Blinking	OFF	OFF	OFF
						3.05≤V_{BAT}＜3.50	ON	OFF	OFF	OFF
	3.50≤V_{BAT}＜3.70	ON	Blinking	OFF	OFF	3.50≤V_{BAT}＜3.70	ON	ON	OFF	OFF
	3.70≤V_{BAT}＜3.89	ON	ON	Blinking	OFF	3.70≤V_{BAT}＜3.95	ON	ON	ON	OFF
	3.89≤V_{BAT}＜4.2	ON	ON	ON	Blinking	3.95 ≤ VBAT	ON	ON	ON	ON
	4.2 ≤ VBAT	ON	ON	ON	ON	-	-	-	-	-

Note: The battery voltages listed in the table are typical values.

2: 2-LED Mode

LED1 and LED2 are pins for indicating charging and discharging status. The LED states under different conditions are as follows:

① Connect to VDD, LED2 turns off, and LED1 lights up to indicate charging status based on battery voltage. It flashes at 1 Hz before the battery is fully charged, and remains steadily on once fully charged.

② During discharge, LED1 turns off while LED2 lights up to indicate discharge status according to battery voltage. LED2 remains steadily on when the battery voltage is higher than 3.05 V. If the battery voltage drops below 3.05 V, LED2 flashes rapidly at 2 Hz to warn of a low battery. When the voltage falls below 2.8V, LED2 turns off, discharge stops, and the system enters low-power under-voltage protection mode. Discharge can only be resumed after recharging the battery to above 3.1V.

③ In 2-LED mode, LED3 pin should be shorted to GND.

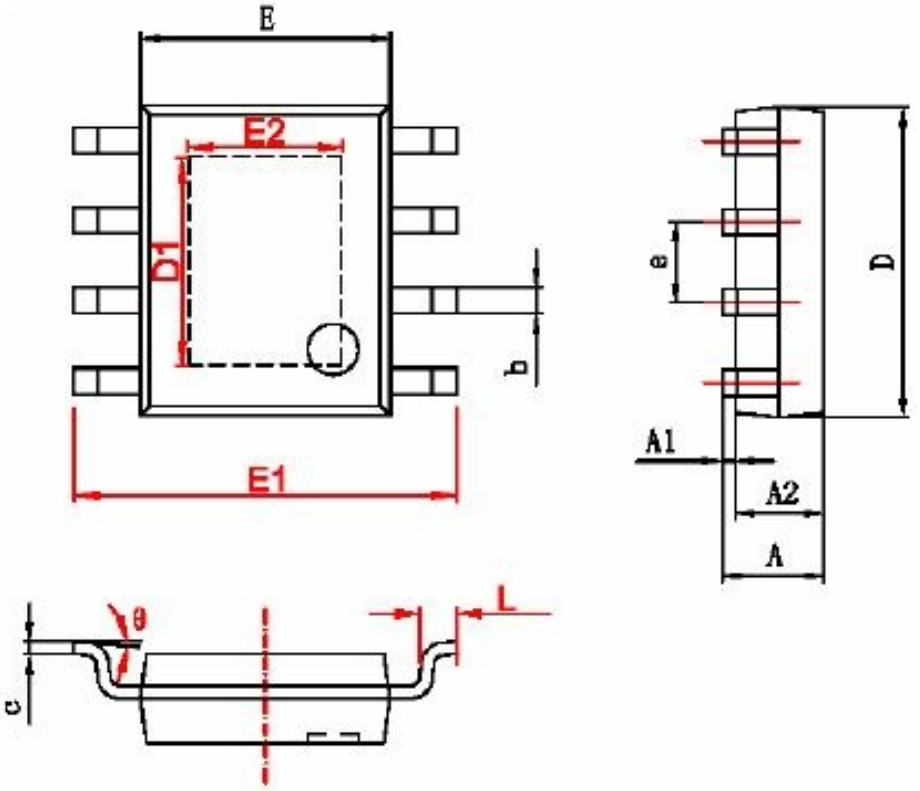
LED1～LED2 Operating Status Table

IC Part Number	Charge		Discharge	
	Battery Voltage (V)	LED1	Battery Voltage (V)	LED2
TP4336	V_{BAT}<4.2	Blinking	V_{BAT}<2.80	OFF
			2.8≤V_{BAT}＜3.05	Fast Blinking
	4.2 ≤ VBAT	ON	3.05 ≤ VBAT	ON

Note: The battery voltages listed in the table are typical values.

PACKAGE DIMENSIONS

ESOP-8L



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

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