

DESCRIPTION

TP4333 is a single-chip synchronous boost converter solution specifically designed for power banks, featuring an integrated linear charging management module, a synchronous discharge management module, a battery status detection and LED indication module, and a protection module.

TP4333 features built-in charge and discharge power MOSFETs; the charge current is fixed at 0.8 A, while the synchronous boost configuration supports an output current of 1 A.

TP4333 integrates multiple safety protection functions—including temperature compensation, overtemperature protection, overcharge and overdischarge protection, output overvoltage protection, output heavy-load protection, and output short-circuit protection—to ensure the safety of both the chip and the lithium-ion battery; its application circuitry is simple, requiring only a minimal number of components to implement both charging and discharging management.

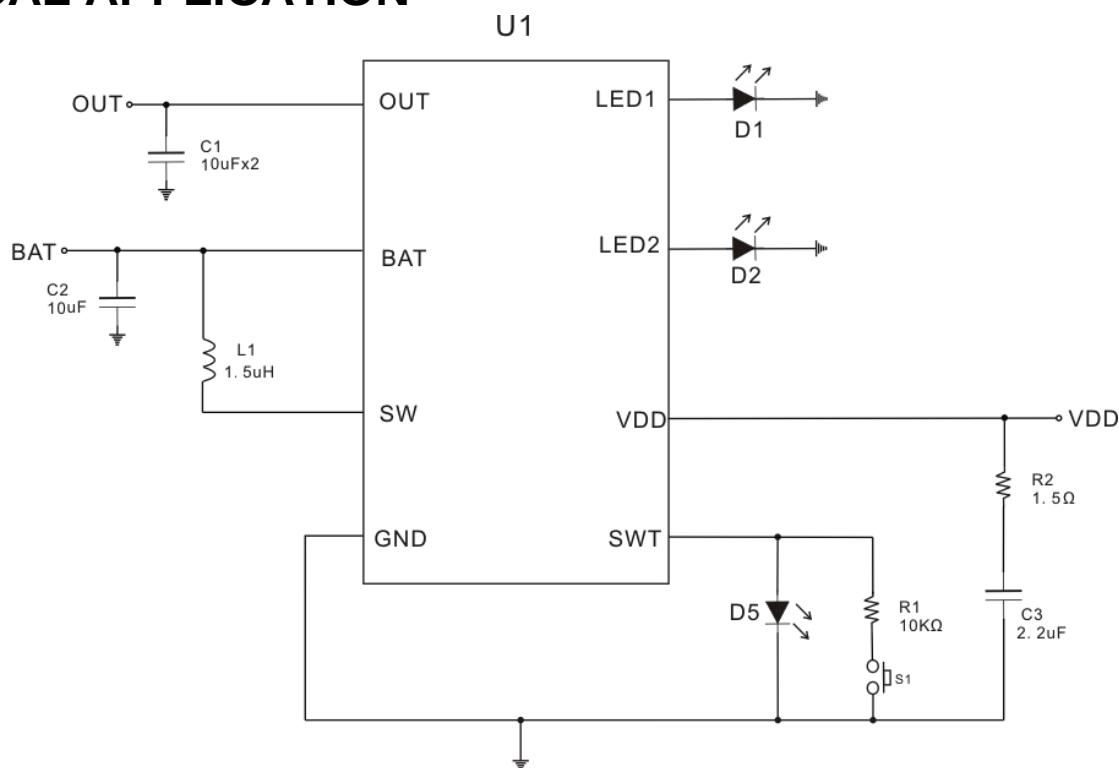
KEY FEATURES

- Discharge output: 5 V/1 A
- Charging current: 0.8 A
- Up to 93% discharge efficiency at 1 A output
- BAT discharge cut-off voltage: 2.85 V
- Optional charging voltage: 4.2 V/4.35 V
- Intelligent temperature control and thermal protection; integrated output overvoltage protection, short-circuit protection and heavy-load protection
- Integrated overcharge and overdischarge protection
- Supports trickle charge mode and 0V dead battery charging
- Flashlight output function supported
- Package: SOP8

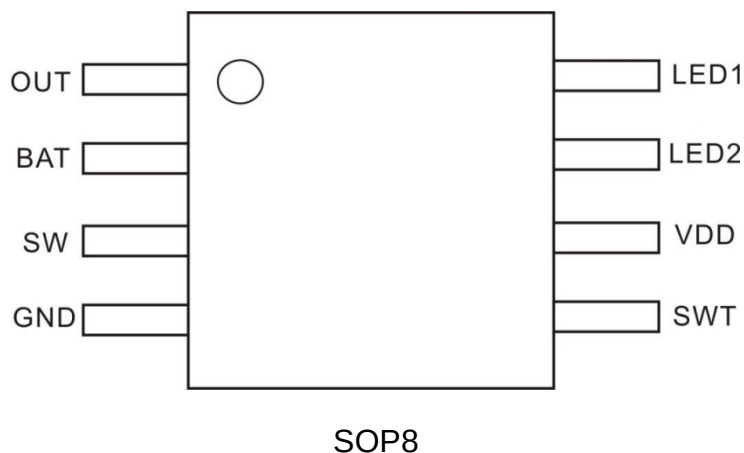
APPLICATION

- Power Banks

TYPICAL APPLICATION



PIN CONFIGURATION



ORDER INFORMATION

Order model	Product description
TP4333	Package: ESOP8

ORDER DESCRIPTION

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
T _{BAT_SHT}	BAT Short Circuit Duration	Continuous	-
I _{BAT}	BAT Pin Current	600	mA
I _{PROG}	PROG Pin Current	600	μA
T _{OP}	Operating Ambient Temperature	-40~85	°C
T _{STG}	Storage Temperature	-65~125	°C
ESD	HBM	2000	V
	MM	200	V

ABSOLUTE MAXIMUM RATINGS (NOTE 1)

Parameter	Range	Unit
All pins to GND	-0.3~+7	V
Storage ambient temperature	-50~+150	°C
Operating temperature range	-40~150	°C
HBM	3000	V
MM	300	V

RECOMMENDED OPERATING RANGE

Symbol	Parameter	Range	Unit
VDD	Charging input voltage	4.5~5.5	V
TOP	operating ambient temperature	-20~85	°C

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

Unless otherwise specified, VIN = 5 V, Ta = 25°C

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
VDD	Charging input voltage		4.3	5	5.5	V
VBAT	Predefined charging voltage	For the 4.2 V specification		4.2		V
		For the 4.35 V specification		4.35		V
IBAT	BAT Constant Current Charging Current	Constant Current Charging Mode		0.8		A
ITRK	BAT Trickle Charge Current	trickle charging mode		100		mA
VTRK	Trickle charge threshold voltage	VBAT Raising		2.9		V
VTRK_HYS	trickle charging hysteresis voltage			100		mV
TST	Charging Temperature Compensation Threshold			120		°C
TZERO	Zero-current charging temperature			135		°C
VUV_BAT	BAT Under-Voltage Lockout Threshold Voltage	VBAT Raising		3.2		V
VWN_BAT	BAT Low Voltage Alarm Voltage	VBAT Falling		3		V
VBAT_END	BAT Discharge Termination Voltage			2.85		V
ISD_BAT	BAT standby current	VBAT=3.7 V		50	80	uA
VSD	VDD-VBAT Locking Threshold	VDD Raising		180		mV
		VDD Falling		80		mV
VOU	Boost output voltage	ILOAD=1 A, VBAT=3.7 V	4.8	5V	5.2	V
ILEDx	LEDx drive current	BAT=4 V		2		mA
FLED1_C	LED1 Charging flashing frequency			1		Hz
FLED2_WN	LED2 Low battery alarm frequency			1		Hz
RON_CHRG	Charge PMOS On-resistance			300		mΩ
RON_NMOS	Discharge NMOS On-resistance			65		mΩ
RON_PMOS	Discharge PMOS On-resistance			65		mΩ
FOSC	Boost converter operating frequency		0.7	1	1.3	MHz

OPERATION DESCRIPTION

Charging Mode

TP4333 integrates an internal temperature feedback loop. During operation, once the internal junction temperature of the IC rises to 120°C (approximately 80°C on the chip surface), the charging or discharging current will decrease with rising temperature to reduce system power consumption and temperature rise. Benefiting from temperature feedback control, the IC enters constant temperature mode without risk of damage or forced shutdown under excessive temperature.

Charging Mode

If the lithium-ion battery voltage is lower than 2.9 V before charging, TP4333 enters trickle charge mode to protect the battery with a charging current of 100 mA. When the battery voltage rises above 2.9 V, the device switches to constant current charge mode at 0.8 A charging current. When the battery voltage reaches 4.2 V, TP4333 operates in constant voltage charge mode, where the BAT voltage is stabilized and the charging current gradually declines. The charging cycle terminates and the charging current drops to zero when the charging current reduces to 100 mA.

Load Detection & Low-Power Intelligent Standby

LED1 is connected to an indicator LED: it flashes at 1 Hz during charging and stays steadily ON once the battery is fully charged.

LED2 is connected to an indicator LED: it remains ON during discharge. When the battery voltage drops below 3.0 V, LED2 flashes at 1 Hz as a low-battery warning alert.

Flashlight Output

The SWT pin drives the LED for flashlight lighting with a maximum driving current of 50 mA. A series resistor can be added to the LED to limit flashlight current. SWT also serves as the key input pin: long-press key S1 for 2 seconds to turn on the flashlight; long-press S1 for another 2 seconds to turn off the flashlight output.

Low Battery Protection

Upon startup, the boost converter activates only when the BAT voltage exceeds 3.2 V. During operation, LED2 flashes at 1 Hz to signal low battery when the BAT voltage falls below 3.0 V. Once the BAT voltage drops to 2.85 V, the discharge output is disabled and the TP4333 enters low-current standby mode.

Protection Functions

TP4333 integrates multi-layer protection mechanisms including overcharge protection, overdischarge protection, charging temperature compensation, thermal protection, output overvoltage protection, heavy-load protection and output short-circuit protection. An additional DW01 IC can be added to the system for dual-layer protection.

Component Selection

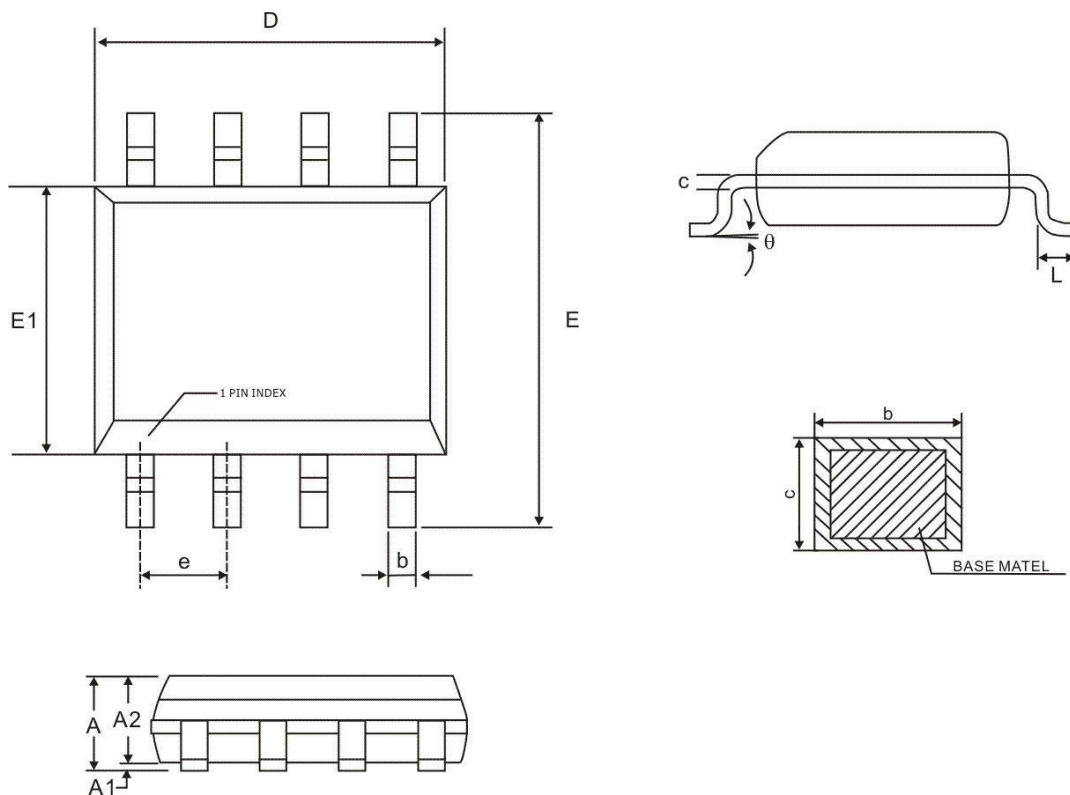
1. Select high-quality low-ESR chip multilayer ceramic capacitors for the output capacitor C1; otherwise, output ripple performance will be degraded.
2. The saturation current of inductor L1 must be higher than 3 A. Inductor saturation may cause abnormal operation of the IC.
3. The leakage current of the flashlight LED shall be less than 1 μ A when the voltage is below 1.5 V. If this requirement cannot be met, a 100 k Ω pull-up resistor shall be added between the BAT and SWT pins.

PCB Layout Guidelines

1. Maximize the area of the ground copper plane. Route all non-critical signal traces around the ground region to reserve sufficient grounding area.
2. It is recommended to place a 10 μ F capacitor near the inductor and a 1 μ F capacitor close to the IC's BAT pin. If only one BAT capacitor is used, it must be placed close to both the IC and the inductor. Connect the ground trace of the capacitor directly to the large ground plane; avoid routing through narrow ground paths between the IC and the main ground plane.
3. Mount output capacitor C1 as close to the IC as possible. Route its ground trace straight to the large ground plane instead of passing through narrow ground tracks.
4. Place the inductor adjacent to the BAT capacitor. The inductor, BAT capacitor C2, and the IC should preferably be arranged on the same PCB layer without vias. Keep the trace between the inductor and SW pin short and wide.

PACKAGE DIMENSIONS

SOP8L



Symbol	mm		
	Min.	Typ.	Max
A	1.35	1.6	1.77
A1	0.08	0.15	0.28
A2	1.2	1.4	1.65
b	0.33	-	0.51
c	0.17	-	0.26
D	4.7	4.9	5.1
E	5.8	6	6.2
E1	3.7	3.9	4.1
e	1.27BSC.		
L	0.38	0.6	1.27
q	0°	-	8°

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