



DESCRIPTION

The A4068 is a highly integrated power management system-on-chip (SoC) designed for portable power bank applications. It integrates a synchronous boost converter, lithium-ion battery charger, and battery level indication functions into a single device, providing a complete and cost-effective power solution.

Its high level of integration and rich feature set minimizes the number of required external components, significantly reducing overall solution size and BOM cost.

The A4068 utilizes a single-inductor architecture to support both buck and boost operation, enabling the use of low-cost external inductors and capacitors.

The integrated synchronous boost converter delivers up to 2.4A output current with conversion efficiency of up to 92%. Under no-load conditions, the device automatically enters sleep mode, reducing quiescent current to as low as 10µA.

The integrated switching charger supports up to 2.1A charging current with charging efficiency of up to 91%. Intelligent charging current regulations based on IC temperature and input voltage conditions is also incorporated to optimize charging performance and system reliability.

In addition, the A4068 supports 1-, 2-, 3-, and 4-LED battery level indication for convenient battery capacity monitoring.

The A4068 is available in PSOP8 package

ORDERING INFORMATION

Package Type	Part Number	
PSOP8 SPQ: 4,000pcs/Reel	MP8	A4068MP8R
		A4068MP8VR
Note	V: Halogen free package R: Tape & Reel	
AiT provides all RoHS products		

FEATURES

Power Management

- Synchronous switching charging and discharging architecture
- 2.4A synchronous boost converter and 2.1A synchronous switching charger
- Boost conversion efficiency up to 92%
- Charging efficiency up to 91%
- Integrated power path management supporting simultaneous charging and discharging (pass-through operation)

Battery Charging

- Adaptive charging current regulation
- Adaptive input adapter compatibility
- Supports 4.20V / 4.30V / 4.35V / 4.40V Li-ion battery chemistries

Battery Level Indication

- Supports 1-,2-,3-, and 4-LED battery level indication
- Supports low battery warning indication

Rich System Features

- Push-button power-on control
- Integrated flashlight LED driver
- Automatic detection of mobile device insertion & removal

Low Power Consumption

- Intelligent load detection with automatic standby mode
- Ultra-low standby current of less than 10µA

Minimal BOM Solution

- Integrated power MOSFETs
- Single-inductor architecture for both charging and discharging operation

Comprehensive Protection and High Reliability

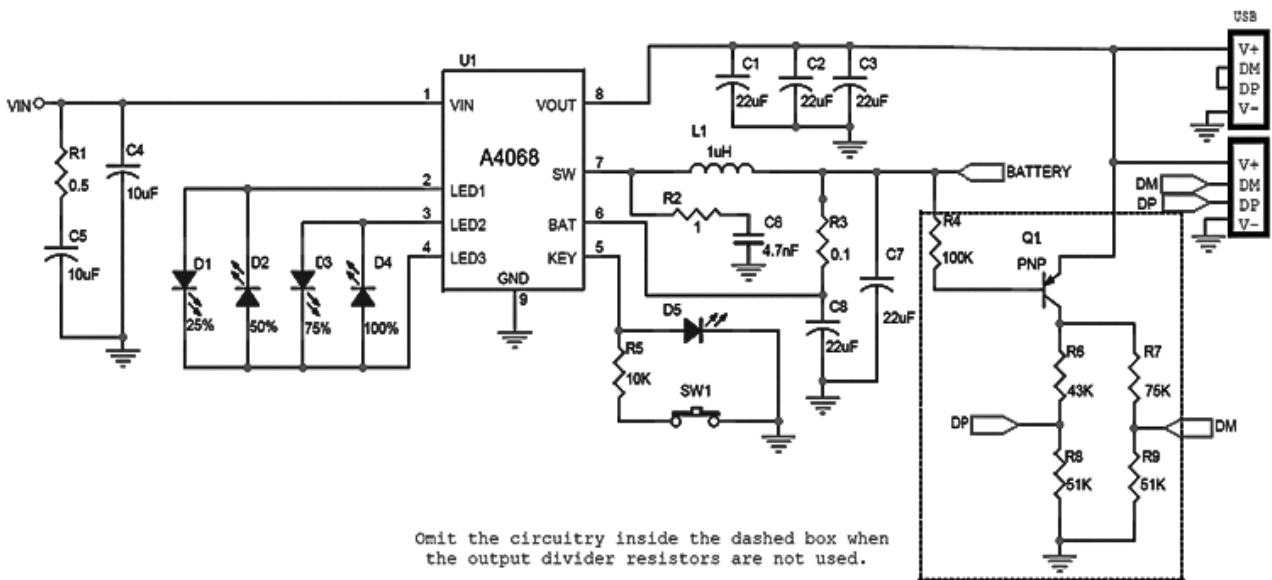
- Output over-current protection (OCP)
- Output over-voltage protection (OVP)
- Output short-circuit protection (SCP)
- Input over-voltage protection
- Battery over-charge protection
- Battery over-discharge protection
- Discharge over-current protection
- System over-temperature protection



APPLICATION

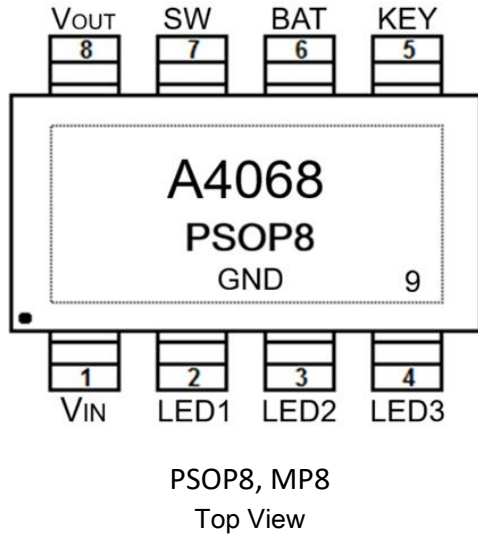
- Cellular Telephones, Tablet PC
- Portable Power Bank
- GPS Applications

TYPICAL APPLICATION





PIN DESCRIPTION



Pin #	Symbol	Function
1	VIN	DC 5V input pin for battery charging
2.	LED1	LED output driver pin
3	LED2	LED output driver pin
4	LED3	LED output driver pin
5	KEY	Multiplexed pin for push-button input and flashlight LED driver control.
6	BAT	Boost converter input pin. Connect this pin to the positive terminal of the Li-ion battery.
7	SW	DC-DC switching node (SW) pin
8	VOUT	5V boosts converter output pin
9	PAD	Exposed thermal pad connected to ground

**ABSOLUTE MAXIMUM RATINGS**

V _{IN} , Input Supply Voltage	-0.3V~ +6V
LED, KEY, BAT and SW pin Voltage	-0.3V~ +5.5V
T _{OPA} , Operating Ambient Temperature	-40°C ~ +125°C
T _{STR} , Storage Temperature	-40°C ~ +125°C
ESD, HBM	2000V
Lead Temperature (Soldering, 10s)	260°C

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Charging System						
Input Supply Voltage	V _{IN}		4.65	5.0	5.5	V
Charging Target Voltage	V _{TRGT}			4.2		V
Charge Current	I _{CHRG}	V _{IN} Input Current	-	1800	-	mA
Charging Switch Frequency	f _s		-	1000	-	KHz
Trickle Charge Current	I _{TRKL}	V _{IN} =5V, BAT=2.7V	-	200	-	mA
Trickle Charge Termination Voltage	V _{TRKL}			3.0		V
Trickle Charge Hysteresis Voltage	V _{TRHYS}			200		mV
Recharge threshold voltage	V _{RCH}			4.1		V
Input Undervoltage Lockout Threshold	V _{UVLO}	Rising Voltage		4.5		V
UVLO Hysteresis Voltage	V _{UVLOH}			200		mV



Boost Power System						
Battery Operating Voltage	V _{BAT}		3.0		4.4	V
Battery Input Current During Switching Operation	I _{BAT}	V _{BAT} =3.7V, V _{OUT} =5V, fs=500KHZ		3		mA
		V _{IN} =5V, Device Not Switching		100		μA
DC Output Voltage	V _{OUT}	V _{BAT} =3.7V				V
Battery Voltage Threshold for Boost Enable				3.2		V
Boost Hysteresis Voltage				200		mV
Output voltage ripple	ΔV _{OUT}	V _{BAT} =3.7V, V _{OUT} =5V, fs=500KHZ		100		mV
Boost Switching Frequency	fs			500		KHz
Boost System Output Supply Current	I _{VOUT}			2.4		A
Over-Current Detection Delay Time	T _{UVD}	Output voltage continuously below 4.4V		10		mA
Short-Circuit Detection Delay Time	T _{OCD}	Output current continuously greater than 4A		10		μs
Control System						
PMOS on resistance (R _{DS(ON)})	P-R _{DSON}			35		mΩ
NMOS on resistance (R _{DS(ON)})	N-R _{DSON}			30		mΩ
Battery Input Standby Current	I _{STB}	V _{IN} =0V, V _{BAT} =3.7V		10		μA
LED Flashlight Driver Current	Key			17		mA
LED Display Driver Current	I _{L1} /I _{L2} /I _{L3}			6		mA
Automatic Load Detection Time	T _{LOAD}	Load current continuously below 45 mA		32		s
Short Key Wake-up Debounce Time	T _{OnDebounce}			50		ms
Flashlight Turn-On Time	T _{keylight}			2		s
Thermal Shutdown Temperature	T _{OTP}	Rising temperature		125		°C
Thermal Shutdown Temperature Hysteresis	ΔT _{OTP}			40		°C



FUNCTION DESCRIPTION

Boost Converter & System Operation Description

The A4068 integrates a synchronous boost DC-DC converter with a 5V output capability and up to 2.4A load drive strength. The switching frequency is set to 500kHz. When the battery voltage is 3.8V, the boost converter delivers 5V/2.1A output with a peak efficiency of up to 92%. The device includes a soft-start function to limit inrush current during startup and prevent system malfunction. It also integrates comprehensive protection functions, including output over-current protection (OCP), short-circuit protection (SCP), over-voltage protection (OVP), and over-temperature protection (OTP). In the event of an over-current or short-circuit condition, the device automatically attempts restart every 1 second to ensure safe and stable operation.

System Power-On and Power Management Behavior

When the battery voltage rises above 3.2V, the A4068 automatically enables the 5V boost output and battery level indication function. If the load current is lower than 45mA, the device will disable LED indication after 32 seconds and enter low-power mode while maintaining a regulated 5V output. When the battery voltage drops below 3.0V, the boost output is disabled. The system requires battery recharge activation before normal output operation can resume after voltage recovery. During discharge operation, if the battery voltage falls below 3.0V, the device shuts down the output and enters an 8-second low-battery warning mode with LED flashing at 2Hz. After the warning period, the system enters standby mode.

Low Battery and Wake-Up Behavior

In standby mode, if the battery voltage remains between 2.8V and 3.0V, any key press or load detection event will trigger a boost start attempt; however, the output will remain disabled, and the LED will continue to indicate a low-battery warning. After the warning sequence, the device returns to standby mode.

Only when the battery voltage rises above 3.2V, either a load detection event or key trigger will successfully enable the boost converter, providing a regulated 5V output while restoring normal LED battery indication behavior.

Battery Charging Description

The A4068 integrates a synchronous CC/CV lithium-ion battery charger. When the battery voltage is below 3.0V, a 200mA trickle charge mode is applied. When the battery voltage rises above 3.0V, the system enters constant-current (CC) charging mode, and the input current limit loop is disabled. When the battery voltage exceeds 4.2V, the charger enters constant-voltage (CV) charging mode. After charging is completed, if the battery voltage drops below 4.1V, the charging process is automatically restarted.



The charger adopts switching charging architecture with a switching frequency of 1MHz. The maximum charging current from V_{IN} is 1.8A, with a peak charging efficiency of up to 91%. The device integrates adaptive power path management, enabling simultaneous charging and discharging operation (pass-through mode). The charging current is dynamically adjusted according to the capability of the input adapter, preventing overload or excessive loading of the power source.

Key Button Operation

The A4068 supports both short-press and long-press key detection via PIN5. When the key function is not used, PIN5 should be left floating.

(1) Short Press Operation

A key press duration between 50ms and 2s is recognized as a short press.

A short press will enable the battery level indicator and turn on the boost output.

(2) Long Press Operation

A key press duration longer than 2s is recognized as a long press.

A long press will toggle the flashlight LED on or off (special version only).

(3) Invalid Key Operation

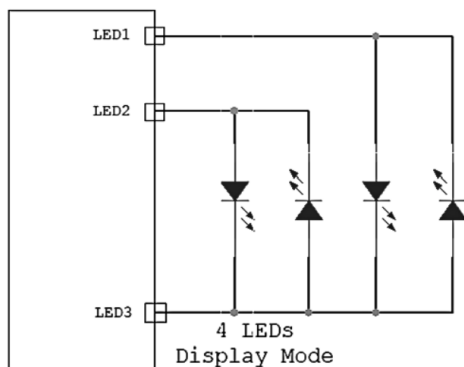
A key press duration shorter than 50ms is ignored and will not trigger any response.

(4) Double Short Press Function

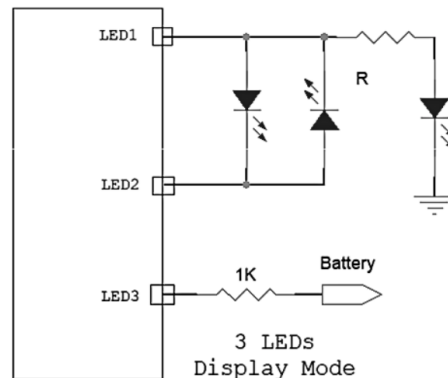
Two short presses within 1 second will disable the boost output, battery level indicator, and flashlight LED (Special version only)

LED DISPLAY MODE

A.

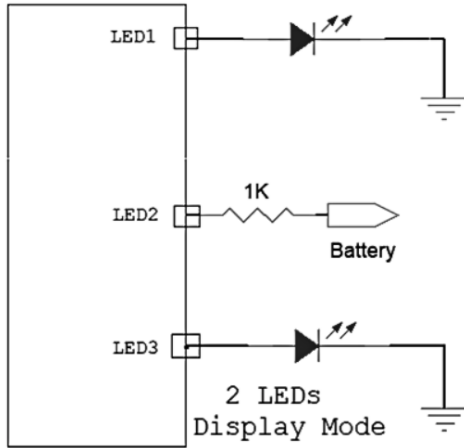


B.

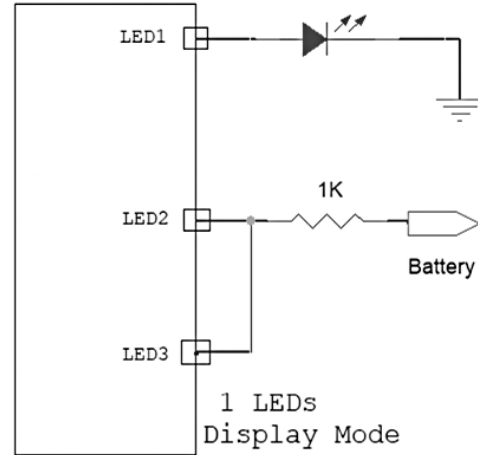




C.



D.



LED DISPLAY TABLE

4 LEDS Mode

Discharge				
Percentage	25%	50%	75%	100%
Battery level C (%)	D1	D2	D3	D4
$C \geq 75\%$	ON	ON	ON	ON
$50\% \leq C < 75\%$	ON	ON	ON	OFF
$25\% \leq C < 50\%$	ON	ON	OFF	OFF
$3\% \leq C < 25\%$	ON	OFF	OFF	OFF
$0\% \leq C < 3\%$	2Hz flash	OFF	OFF	OFF
Charge				
Battery level C (%)	D1	D2	D3	D4
FULL	ON	ON	ON	ON
$75\% \leq C$	ON	ON	ON	1Hz flash
$50\% \leq C < 75\%$	ON	ON	1Hz flash	OFF
$25\% \leq C < 50\%$	ON	1Hz flash	OFF	OFF
$C < 25\%$	1Hz flash	OFF	OFF	OFF



3 LEDS Mode

The 3-LED indication mode is similar to the 4-LED mode. The battery level corresponding to each LED is listed in the table below.

Battery level C (%)	D1	D2	D3	D4
4 LEDs Display	25%	50%	75%	100%
3 LEDs Display	33%	66%	100%	None

2 LEDS Mode

	Status	D1	D2
Charge	Charging process	FLASH	OFF
	Full	ON	OFF
Discharge		OFF	ON
	Low battery	OFF	FLASH

1 LEDS Mode

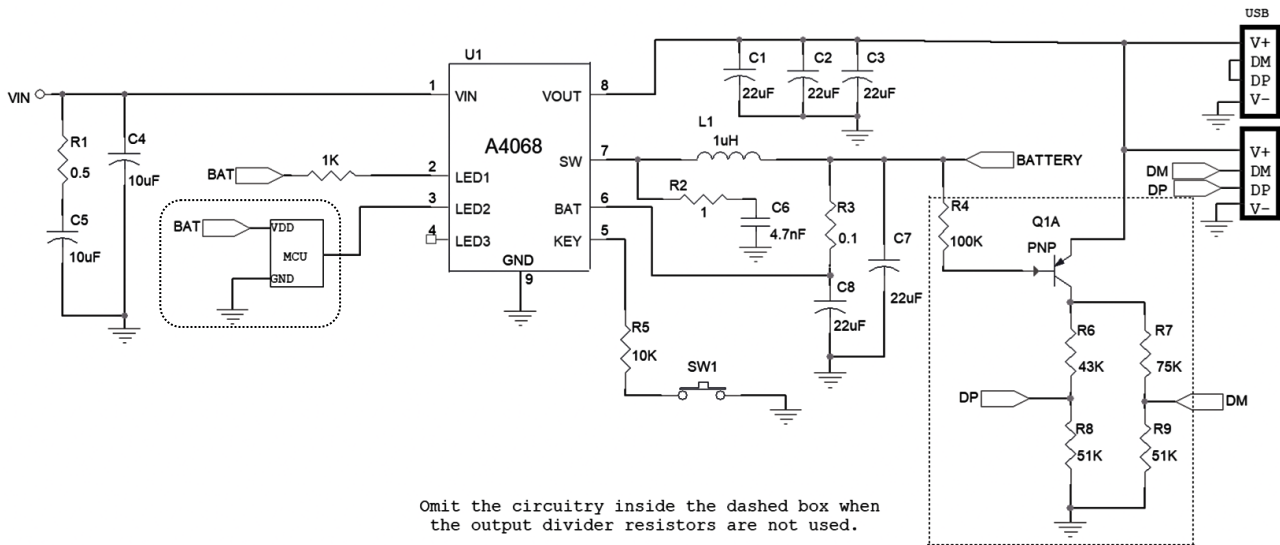
	Status	D1
Charge	Charging process	FLASH
	Full	ON
Discharge	Normal Discharge	ON
	Low battery	FLASH

Note: Upon initial BAT power-up, the battery voltage must reach 2.9V to complete the LED status detection.



MCU Status Read Function

Without external LEDs installed, connect LED1 to BAT. LED2 functions as a status output pin and generates a square-wave signal. The MCU can identify the current IC operating state by monitoring the output frequency of LED2.

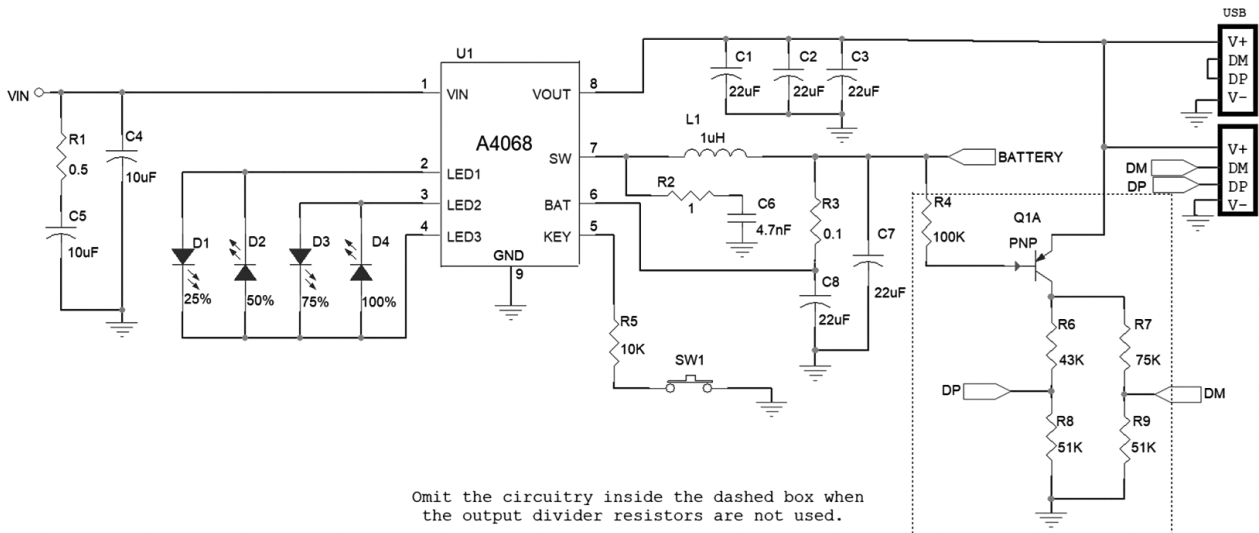


LED Output Frequency	Status
0 Hz	Standby Mode
128 Hz	Charging
64 Hz	Charging Complete
256 Hz	Boost Discharge Output Current is Less Than 1A
512 Hz	Boost Discharge Output Current is Less Than 1A
1K Hz	Low Battery Warning (Boost Discharge)
2K Hz	Abnormal Conditions (Charge Over-current / Output short-circuit / Thermal Abnormality)

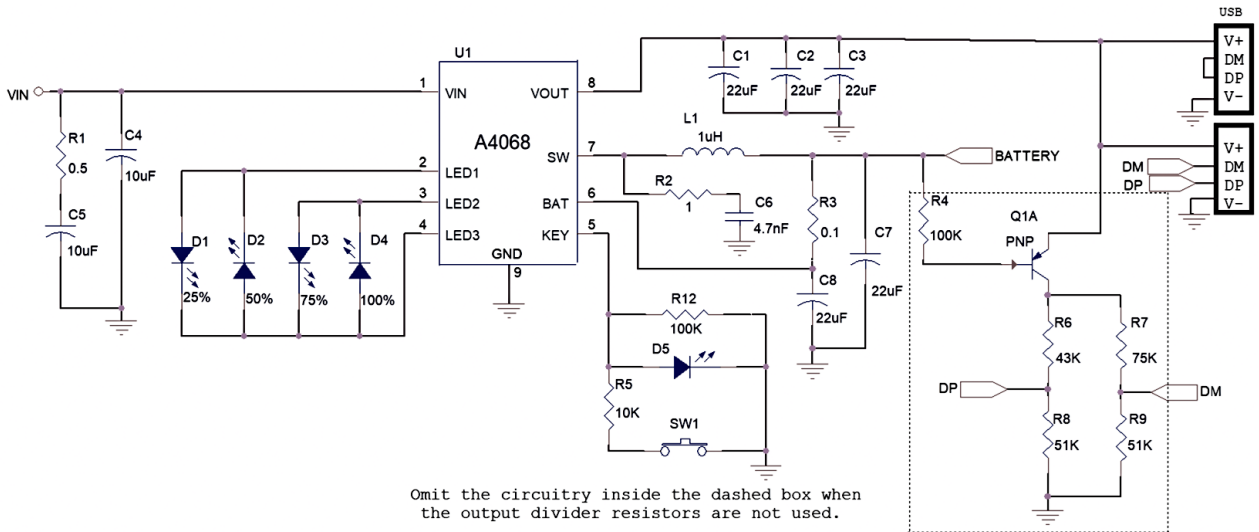


Typical Application

A. Flashlight function not available -4 LEDs Mode



B. With flashlight function- 4 LEDs Mode





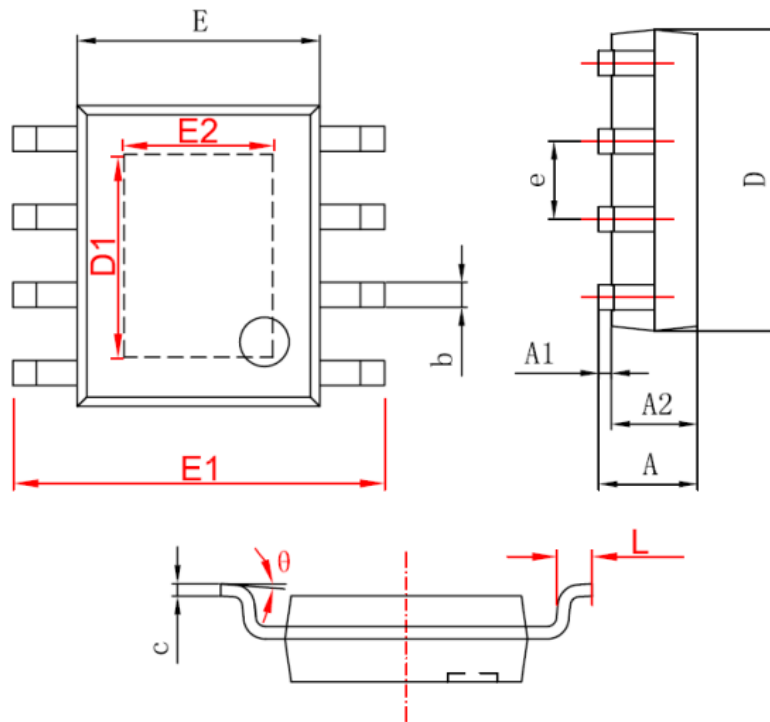
PCB LAYOUT GUIDELINES

1. EPAD is the IC ground. Ensure good soldering and solid contact between the EPAD and PCB ground.
2. R2 and C6 should be placed as close as possible to the SW pin. The SW pin must connect through R2 and C6 before reaching the inductor.
3. C8 should be placed close to the BAT pin. The BAT pin should connect through the capacitor before connecting to R3.
4. C4 should be placed close to V_{IN} . C1, C2, and C3 should be placed close to VOUT. All traces should pass through the capacitors before reaching the corresponding pins.
5. Capacitors used in the application circuit must be X5R or X7R dielectric types.
6. High-frequency switching exists between the inductor L be placed close to each other and the routing loop area should be minimized. Sensitive components should be kept away from the inductor to reduce coupling effects.
7. High-current paths such as BAT, VOUT, and GND should use wide traces. If vias are required for high current routing, multiple vias are recommended to reduce impedance.
8. The inductor must be PIP7050 (AiT SEMi) package or larger, with a saturation current greater than 6.5A.



PACKAGE INFORMATION

Dimension in PSOP8 Package (Unit: mm)



Symbol	Min	Max
A	1.350	1.750
A1	0.050	0.150
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
D1	3.202	3.402
E	3.800	4.000
E1	5.800	6.200
E2	2.313	2.513
e	1.270(BSC)	
L	0.400	1.270
θ	0°	8°



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