Description

SM5340 is a multi-functional power management SOC integrating a boost converter, lithium battery charge management and battery level indication, which delivers a complete power solution for power banks.

Featuring high integration and rich functions, SM5340 needs few external components, helping shrink solution size and lower BOM cost.

Requiring just a single inductor, SM5340 supports buck and boost operations and works with low-cost inductors and capacitors.

The synchronous boost system of SM5340 delivers a maximum output current of 2.4 A with a peak conversion efficiency of 92%. Under light load, the IC automatically enters sleep mode, with quiescent current reduced to 35 μA.

Equipped with switching charging technology, SM5340 delivers up to 2.4 A charging current and 92% peak efficiency. The built-in temperature monitor works with input voltage to dynamically regulate charging current.

SM5340 supports 1/2/3/4 LED battery level display; it is packaged in QFN3x3-16.

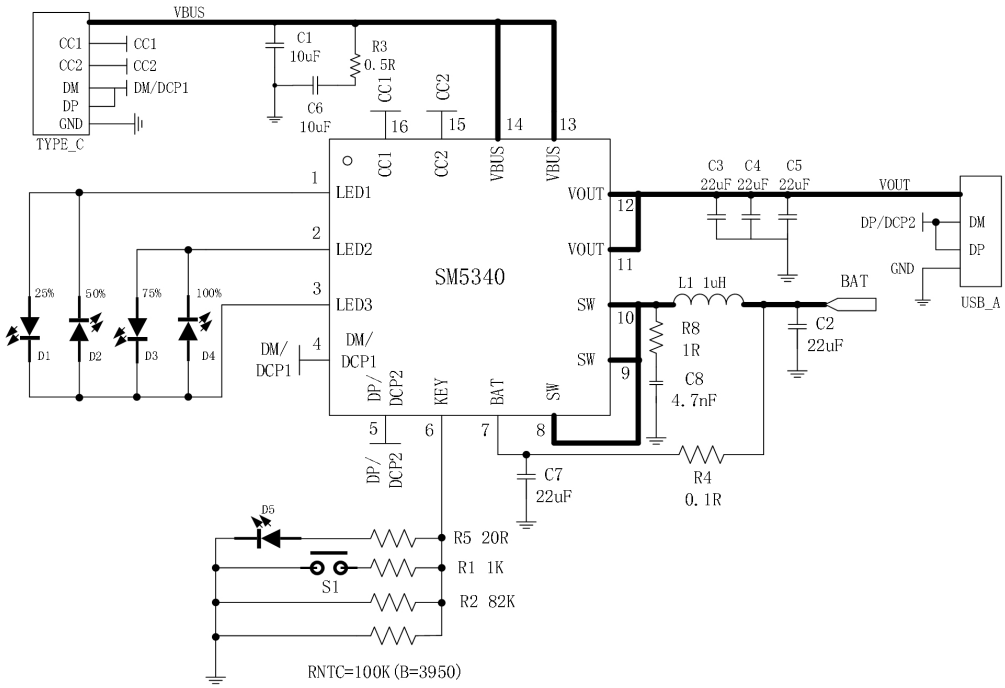
Applications

- Power bank
- Mobile phones, tablets and other portable devices

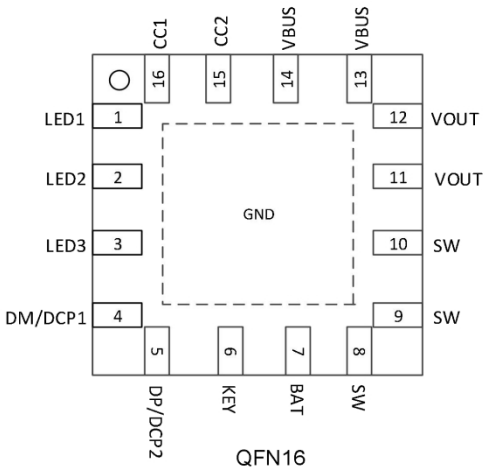
Features

- **Synchronous Switching Charging and Discharging**
  It supports 2.4 A synchronous boost conversion and 2.4 A synchronous switching charging, with boost efficiency and charging efficiency both reaching up to 92%. Equipped with built-in power path management, it enables charging while discharging.
- **Charge**
  Automatically adjust charging current to match adapter output capability.
- **QFN3x3-16, Battery Level Indicator**
  QFN16 package, supports 4/3/2/1 LED battery level indication,
  Low-battery alarm display
  Automatic LED quantity detection.
- **Battery level curve**
  Customizable display curve for different Li-ion batteries
- **Multiple functions**
  It integrates a built-in driver for flashlight.
  The device can be powered on by key, and Automatically detects phone insertion and removal.
- **Low power consumption**
  It can detect the load and enter standby mode automatically, with standby current less than 35μA.
- **Requires minimal BOM components.**
  Integrated power
- **MOSFET, charge/discharge with a single inductor**
- **ESD 4KV**
- **Packing Size: QFN3x3-16**

Typical Circuit



Pin Configuration



Pin Configuration

Pin	Pin NO.	Description
VBUS	13,14	Bidirectional DC 5V pins for input and output
CC1	16	USB CC1 pin
CC2	15	USB CC2 pin
LED1	1	Battery level LED driver LED1
LED2	2	Battery level LED driver LED2
LED3	3	Battery level LED driver LED3
DM/DCP1	4	Type-C DM pin (DP/DM for USB-C)
DP/DCP2	5	USB-A DP pin (DP/DM for USB-A)
KEY	6	Multiplexed pin for key input, flashlight driver and NTC
BAT	7	Battery terminal. Connect the battery to this pin.
SW	8,9,10	DC-DC switch pin
VOUT	11,12	5V boost output pin
GND	EPAD	Thermal pad. Connect to PCB ground and ensure good soldering.

Max. Rating(1)

VOUT.....-0.3 ~ 6V

Junction Temperature.....-40℃ ~+150℃

Storage Temperature.....-60 ℃ ~ +150℃

Thermal Resistance (Junction to Ambient).....50 ℃/W

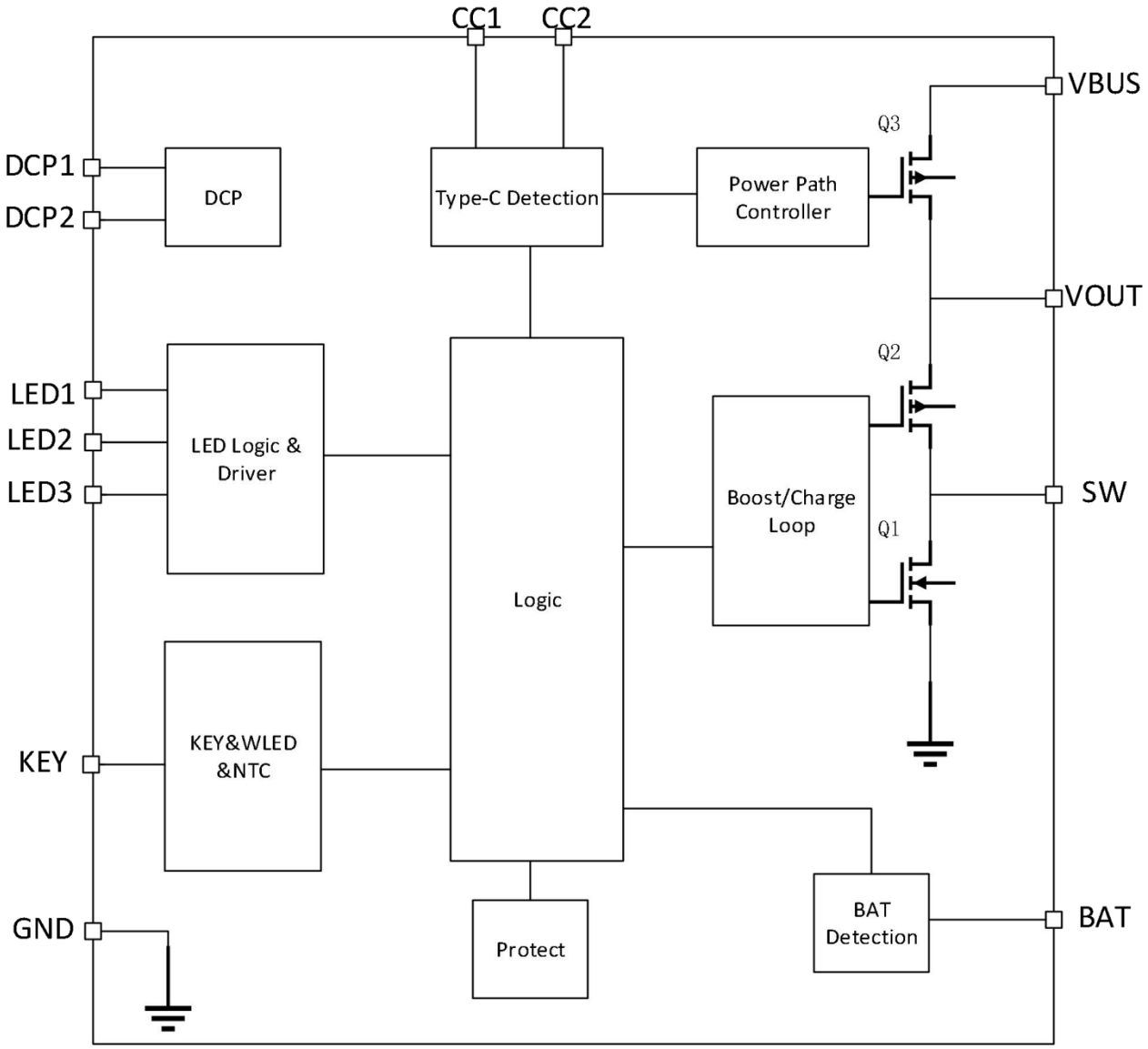
Operating Range

ESD HBM (Human Body Model) 4KV

Load Current..... 2.4 A

(1) Operation beyond absolute maximum ratings may cause device damage. Operation at or above these ratings is not advised, as continuous use will degrade reliability. Absolute maximum ratings define maximum stress limits only.

Block Diagram



Order Information

SM5340 ①②③④⑤

Symbol	Mark	Description
①	H	Single click to enable output, double click to disable output and light, long press to toggle light
	I	Single click to enable output, double click to toggle the light, long press to disable output, and extra long press to disable output and the light
	J	Single click toggles output, long press toggles light, and extra long press disables output and light
	K	Single click to enable output, long press to disable output
②	0	LED state updates only on first power-on, keeps last state for charge/discharge.
	1	In standby mode, the LED status updates according to the current battery voltage during charging and discharging.
	2	In standby mode, the LED status refreshes with the current battery voltage during discharge and keeps the previous state during charging.
③	B20	Vfloat=4.20V
	B25	Vfloat=4.25V
	B30	Vfloat=4.30V
	B35	Vfloat=4.35V
④	1	Default group LED switching voltage (with/without suffix 1 = default group)
	2	Group 2 LED switching voltage
	3	Group 3 LED switching voltage
	4	Group 4 LED switching voltage
⑤	T	Load auto-detection time : 16 s

Electrical Characteristics

(Unless otherwise specified, VBUS = 5V, TA = 25℃, L = 1.0 μH.)

Parameter	Symbol	Test conditions	Min.	Typ.	Max	Unit
Charge System						
Input Voltage	VBUS		4.65	5	5.5	V
Charging Target Voltage	VTRGT			4.2		V
Charging Current	ICHRG	VBUS input current		2.4		A
Charging Switching Frequency	fs			1000		kHz
Trickle Charging Current	ITRKL	VBUS = 5V, BAT = 2.7V		200		mA
Trickle-cut-off voltage	VTRKL			3.0		V
Trickle charging hysteresis voltage	VTRHYS			200		mV
Recharge threshold voltage	V_{RCH}			4.1		V
Input Under-Voltage Protection	VUVLO	Boost voltage		4.2		V
Under-voltage protection hysteresis	VUVLOH			200		mV
Boost System						
Battery voltage	V_{BAT}		3.0		4.4	V
Switching mode battery input current	I_{BAT}	V_{BAT}=3.7V, V_{OUT}=5V, fs=500 kHz		3		mA
		VBUS=5V, Device not switching		500		μA
DC output voltage	V_{OUT}	V_{BAT}=3.7V		5.0		V
Boost enable battery voltage				3.2		V
Boost hysteresis voltage				200		mV
Output voltage ripple	ΔVOUT	V_{BAT}=3.7V, VOUT=5V, fs=500 kHz		100		mV
Boost Switching Frequency	fs			500		kHz
Boost system supply current	IVOUT			2.4		A
OCP detection time	T_{UVD}	Output current continuously >4A		10		ms
SCP detection time	T_{OCD}	Output voltage continuously <4.13V		10		μs
Control System						
PMOS On-resistance	rDSON			35		mΩ
NMOS On-resistance	rDSON			30		mΩ
VBUS and VOUT PMOS	rDSON	VBUS = 5V		40		mΩ

Battery standby current	I_{STB}	VBUS = 0V, VBAT = 3.7V		25	35	μA
LED lighting drive current	Key	V_{KEY}=2.24V, VBAT=4.2V		35		mA
LED display drive current	IL1/IL2/IL3			18		mA
Load auto-detection time	TloadD	Output current continuously <45 mA		32		s
Short key wake-up time	TOnDebounce			50		ms
Keylight ON Time	TKeylight			2		s
Thermal shutdown temperature	T_{OTP}	Temperature rise (internal temperature)		125		℃
Thermal shutdown temperature hysteresis	ΔTOTP	(Internal temperature)		40		℃

Function Description

Charge

SM5340 is a lithium-ion battery charger adopting a synchronous switching architecture with constant current and constant voltage output. When the battery voltage is lower than 3.0V, the device operates in trickle charge mode with a charging current of 250mA. Once the battery voltage exceeds 3.0V, it switches to constant current charging, and the VBUS input current limit loop is disabled. When the battery voltage rises above 4.2V, the charger enters the constant voltage charging phase. After charging is completed, the charging function will restart when the battery voltage drops by 100mV.

SM5340 adopts switching charging technology with a 1MHz switching frequency. The maximum charging current at the VBUS input is 2.4A, and the peak charging efficiency reaches 91%. It features adaptive power path management and supports simultaneous charging and discharging.

SM5340 charger automatically adjusts the charging current to adapt to adapters with different load capacities, avoiding adapter overload.

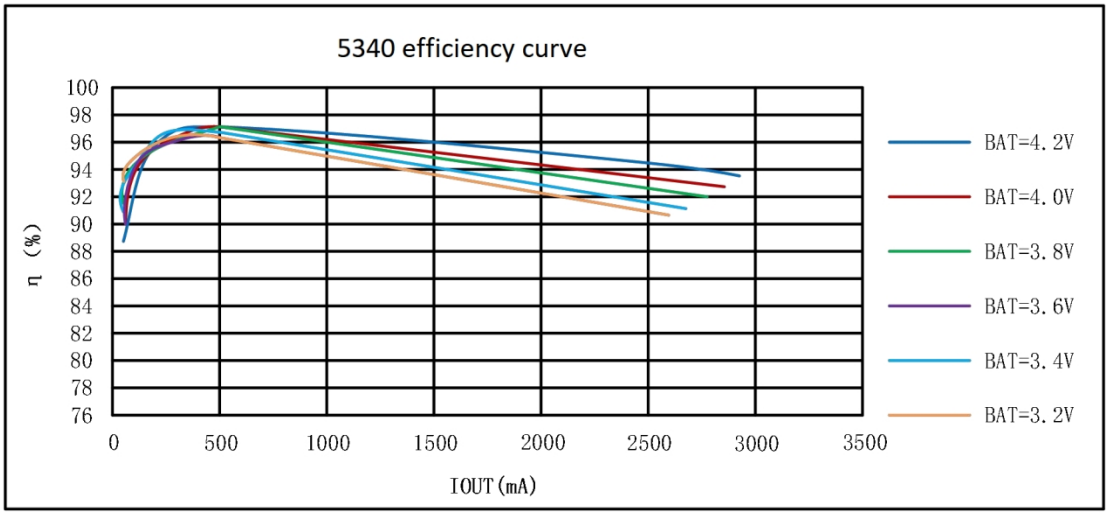
Boost

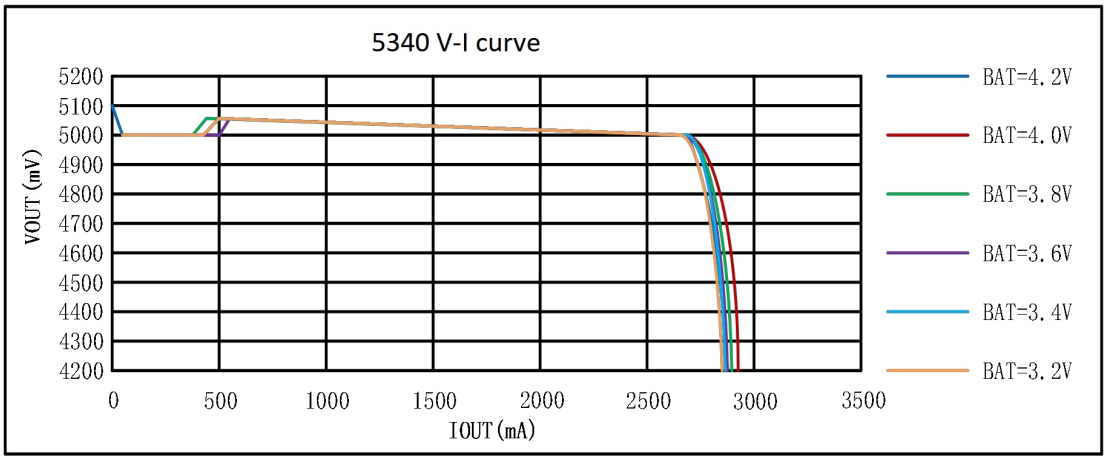
The SM5340 integrates a boost DC-DC converter with a 5V output and a 2.4A load capability. Its switching frequency is 500 kHz. When the input battery voltage is 3.8V, the converter delivers 5V/2.1A output with an efficiency of 92%. The chip features built-in soft-start to prevent faults caused by excessive inrush current during startup. It also integrates comprehensive protections, including output over-current, short-circuit, over-voltage, and over-temperature. Once over-current or short-circuit is detected, the output will be re-enabled every 1 s to ensure stable and reliable system operation. After the output of SM5340 is enabled, if the output current is less than 45 mA, the power indicator will be turned off after 32 s, and the chip will enter low-power mode.

During discharge, if the SM5340 detects the BAT voltage drops below 3.0V, it will disable the output and

trigger an 8-second low-battery alarm flash at 2 Hz. After the flashing period ends, the chip enters standby lock mode.

In standby lock mode, charging is required for activation. The output can be normally enabled only when the BAT voltage rises above 3.2V.





TYPE-C

SM5340 integrates Type-C input and output identification interfaces, and can automatically identify the charging and discharging properties of plugged-in devices by automatically switching the built-in pull-up resistor. And with the Try. SRC function, when connected to the other party is a DRP device, it can give priority to the other party's charging.

When operating as a DFP, the CC pin is configured to output 1.5A current capability information externally, and when operating as an UFP, the output current capability of the other party can be identified.

Table 1

Name	Value
Ip	180μA (Default)
Rd	5.1 kΩ

The following is referenced from (USB Type-C Spec R2.2 - October 2022)

Comparator threshold when the pull-up resistor Rp is enabled

Table 2 CC Voltages on the Source Side—1.5A@5V

	Minimum voltage	Maximum voltage	Threshold
Powered cable/adapter (vRa)	0.00V	0.35V	0.40V
Sink (vRa)	0.45V	1.50V	1.60V
No connect (vOPEN)	1.65V		

Table 3 CC Voltages on the Source Side-3.0A@5V

	Minimum voltage	Maximum voltage	Threshold
Powered cable/adapter (vRa)	0.00V	0.75V	0.80V
Sink (vRd)	0.85V	2.45V	2.6V
No connect (vOPEN)	2.75V		

Comparator threshold when pull-down resistor Rp is enabled

Table 4 Voltage on Sink CC pins (Multiple Source Current Advertisements)

Detection	Min voltage	Max voltage	Threshold
vRa	-0.25V	0.15V	0.2V
vRd-Connect	0.25V	2.04V	
vRd-USB	0.25V	0.61V	0.66V
vRd-1.5	0.70V	1.16V	1.23V
vRd-3.0	1.31V	2.04V	

TYPE-C Detection Period

DRP Timing

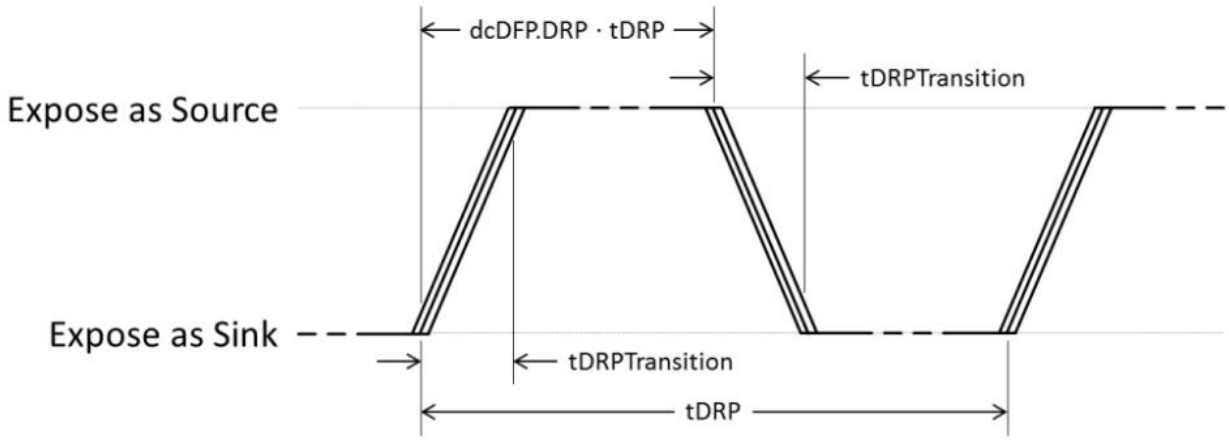
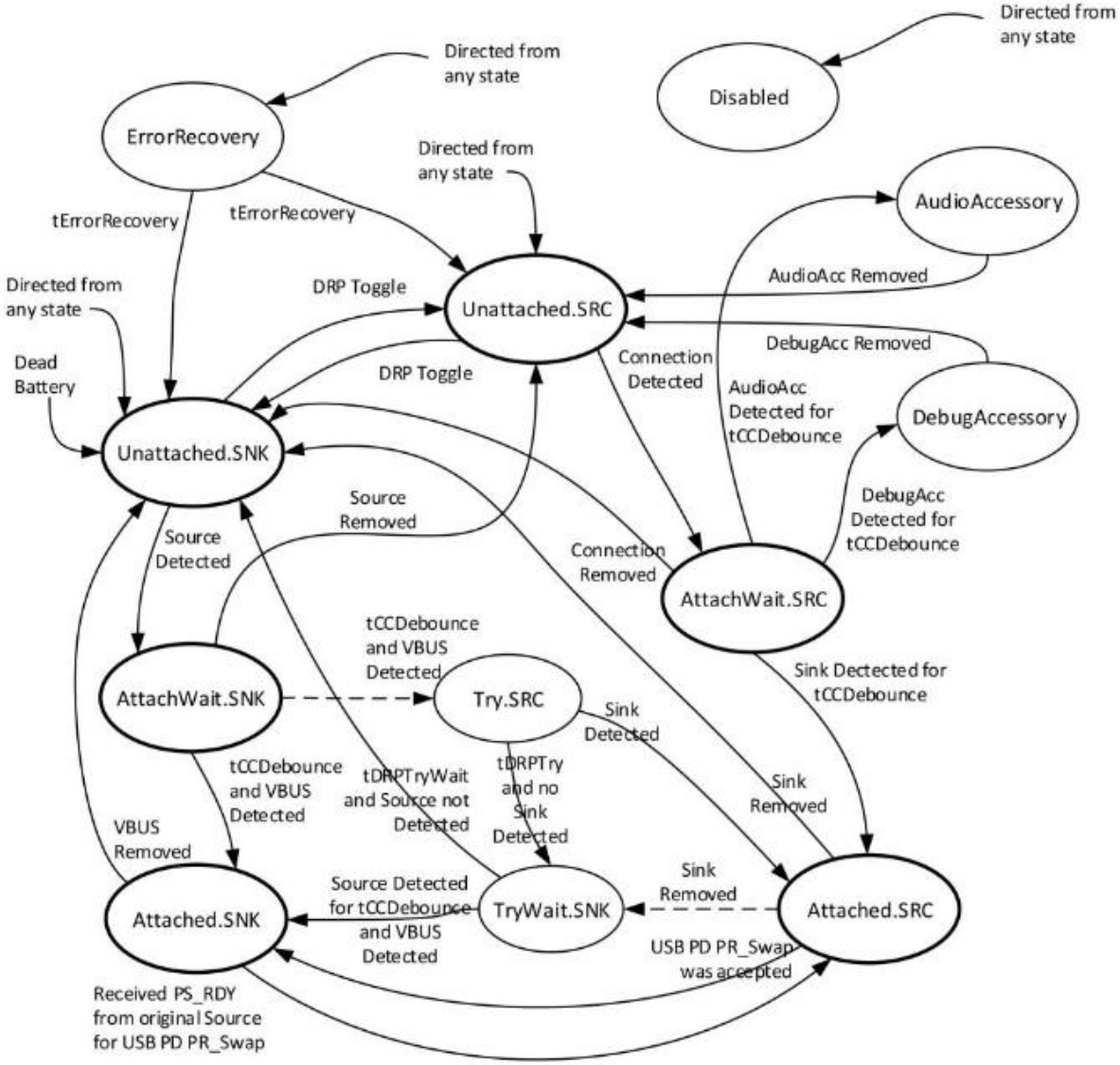


Table 5 DRP Timing Parameters:

	Minimum	Maximum	Description
tDRP	50 ms	100 ms	The period a DRP shall complete a Source to Sink and back advertisement
dsSRC. DRP	30%	70%	The percent of time that a DRP shall advertise Source during tDRP
tDRPTransition	0 ms	1 ms	The time a DRP shall complete transition between Source and Sink roles during role resolution
tDRPTry	75 ms	150ms	Wait time associated with the Try. SRC state
tDRPTryWait	400 ms	800 ms	Wait time associated with the TryWait. SNK state

TYPE-C Detection state transition:

Connection State Diagram: DRP with Accessory and Try. SRC Support



DCP Function

SM5340 integrates the intelligent identification function of mobile phone charging current, which automatically switches

DP and DM line connections for connected mobile phone devices, so that the mobile phone charging current can be adapted to the maximum value and speed up the charging speed of mobile phones. SM5340 supports Apple, Samsung, and BC1.2 interface specifications DP, DM switching, default DP=2.7 V, DM=2.7 V. Dedicated USB charging port with DP, DM short connect.

Support DM application 2.7V voltage, DP application 2.7V voltage Apple 2.4 A charging port.

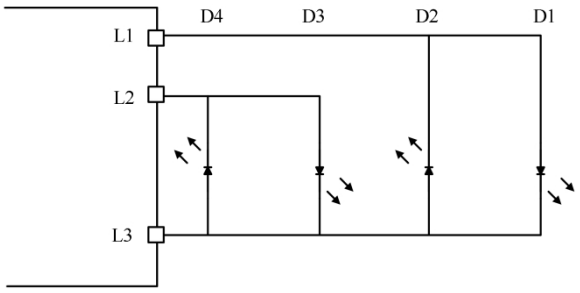
The phone is plugged in with auto-detection and light-load auto-standby

SM5340 supports auto detection on sink devices/phone attachments/plug-ins. Once the attachment is detected, the boost will be turned on to charge the sink device/phone, so non-key solutions are supported.

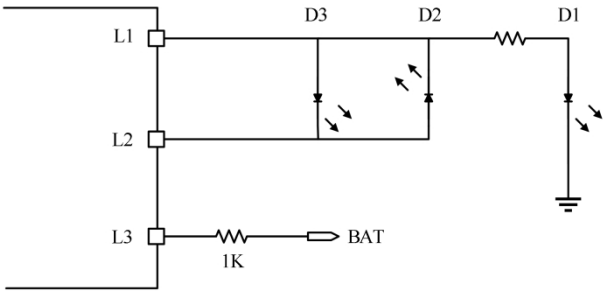
SM5340 supports light-load automatic standby; when the load current of the VOUT terminal is less than 45 mA and lasts for 32 s, it will automatically enter the standby state.

When the output current is less than 45 mA and lasts for 32 s, the output port will continue to be normally open and automatically enter the low-power mode, and the power indicator will be turned off.

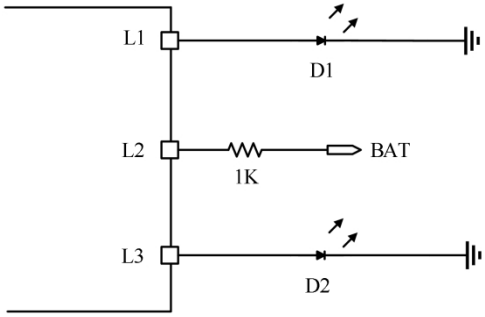
Battery level display for LED mode



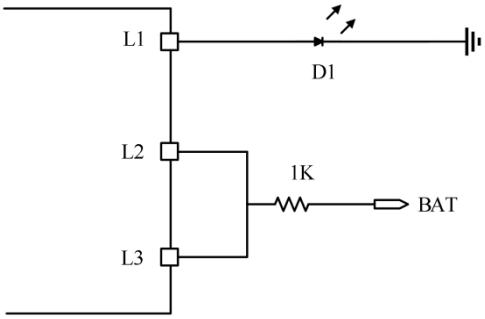
4 LEDs



3 LEDs



2 LEDs



One LED

4 LEDs

Charge

Battery level C (%)	D1	D2	D3	D4
C≥75%	on	on	on	on
50%≤C＜75%	on	on	on	off
25%≤C＜50%	on	on	off	off
3%≤C＜25%	on	off	off	off
0%＜C＜3%	2Hz Blinking	off	off	off

Discharge

Battery level C (%)	D1	D2	D3	D4
Full charge	on	on	on	on
75%≤C	on	on	on	1 Hz Blinking
50%≤C＜75%	on	on	1 Hz Blinking	off
25%≤C＜50%	on	1 Hz Blinking	off	off
C＜25%	1 Hz Blinking	off	off	off

3 LEDs

The 3 LEDs display operates similarly to the 4 LEDs mode. The battery level corresponding to each LED is listed in the table below.

	D1	D2	D3	D4
3 LEDs	33%	66%	99%	none
4 LEDs	25%	50%	75%	100%

2 LEDs

	Status	D1	D2
Charge	Charging process	Blinking	off
	Full charge	on	off
Discharge	Normal discharge	off	on
	Low battery	off	Blinking

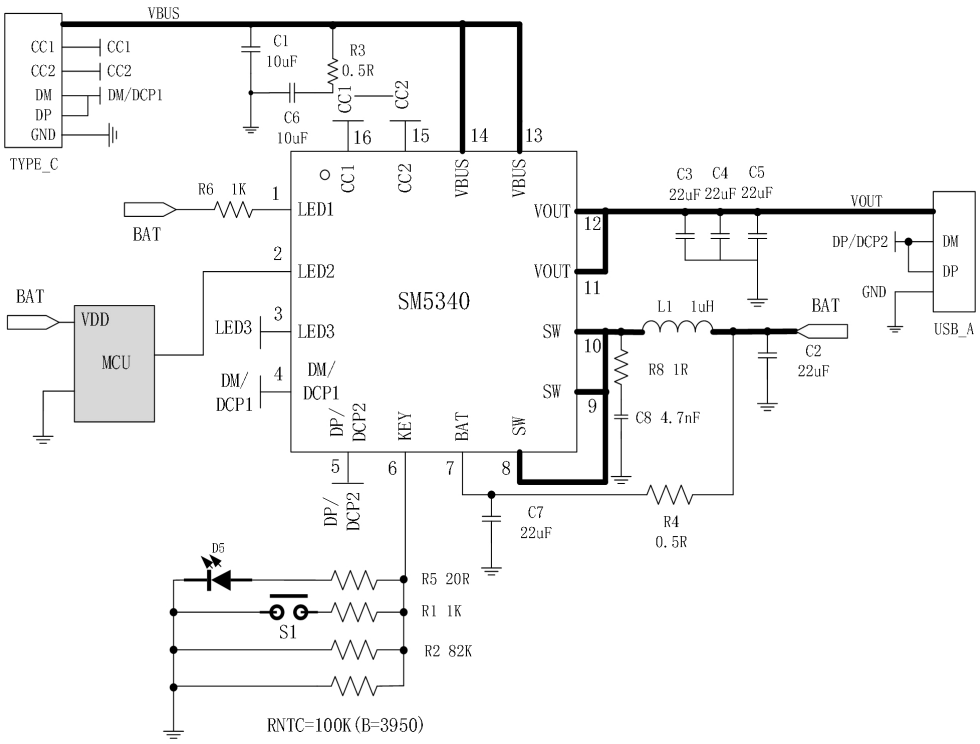
One LED

	Status	D1
Charge	Charging process	Blinking
	Full charge	on
Discharge	Normal discharge	on
	Low battery	Blinking

Note: The BAT voltage shall reach 2.9 V at the first power-up to complete LED status reading.

MCU status reading function

Remove the LEDs. With LED1 left floating, LED2 pin outputs a square wave. The current status of the IC can be acquired by reading the frequency of LED2 via the MCU.



LED2 Output frequency	Status
0Hz	Standby
32Hz	No battery connected
64HZ	Full charge
128Hz	charging
256Hz	Discharging boost output current lower than light-load shutdown current
512Hz	Discharging: Boost output current higher than light-load shutdown current
1kHz	Low battery alarm (Discharge Boost)
2kHz	Abnormal state (Input OVP, OCP, OTP)

KEY and lights

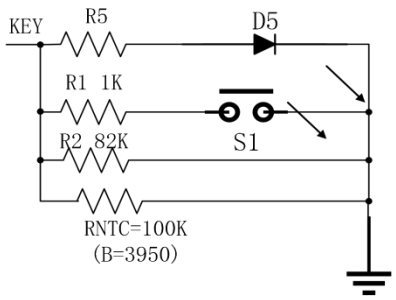
SM5340 can recognize short press or long press operation.

- If the duration of the button is longer than 50 ms but less than 2 s, it is a short press action, and the short press will turn on the power indicator and boost output.
- If the light is on, press and hold to enter standby; the light will remain on, and the light will be turned off when double-clicked.
- Buttons less than 50 ms will not have any response.
- Pressing the button twice in a row within 1 s will turn the light on or off.
- Long press for 10 s to reset the whole system.

NTC

SM5340 integrated NTC function, which can detect battery temperature; When the SM5340 is working, the NTC pin and the KEY pin, and the WLED pin are time-sharing multiplexed on the KEY pin, and the KEY/WLED/NTC function is realized by time-sharing multiplexing. The KEY PIN outputs 20μA of current, and an external NTC resistor generates a voltage, and the voltage of the NTC pin is detected inside the chip to determine the temperature of the current battery. The output current is 20 μA with an 82 kΩ resistor and a 100 kΩ thermistor.

If the NTC function is not required, the RNTC resistor and the 82kΩ resistor can be omitted, and the RNTC resistor can be replaced with a 51kΩ resistor grounded.



In the state of charge:

When the NTC voltage is lower than 0.56V, it means the battery temperature is higher than 45℃, and the charging is stopped.

When the NTC voltage is higher than 1.32V, it means the battery temperature is lower than 0℃, and the charging is stopped.

In the state of discharge:

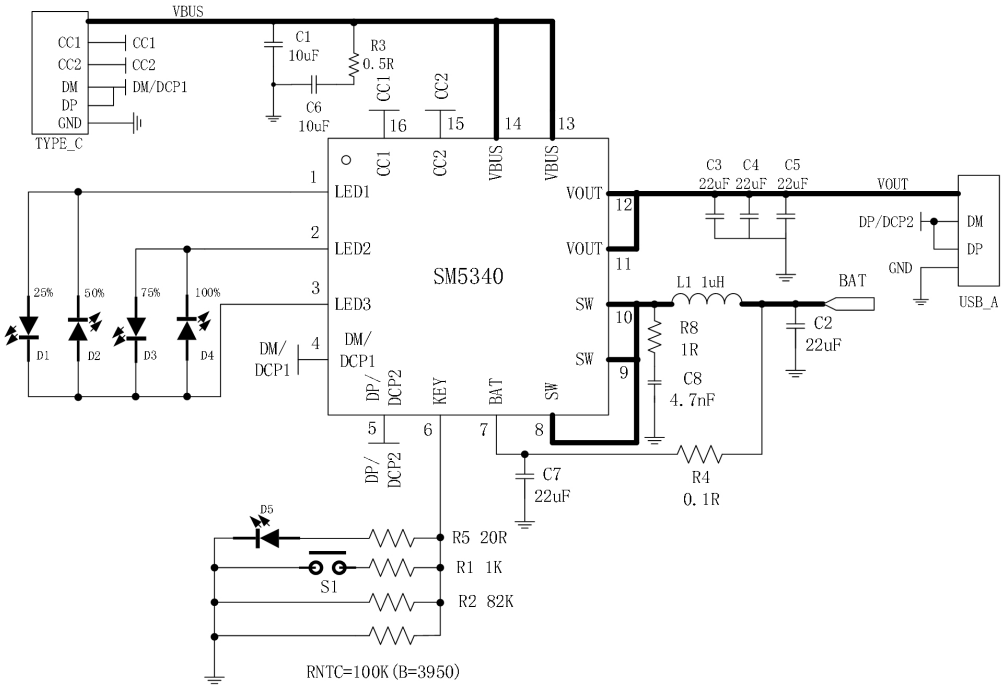
When the NTC voltage is lower than 0.43V, it means the battery temperature is higher than 55℃, and the discharging is stopped.

When the NTC voltage is higher than 1.52V, it means the battery temperature is lower than -20℃, and the discharging is stopped.

Tip：

The above temperature range refers to the NTC resistor (B=3950), which is different from other models and needs to be adjusted.

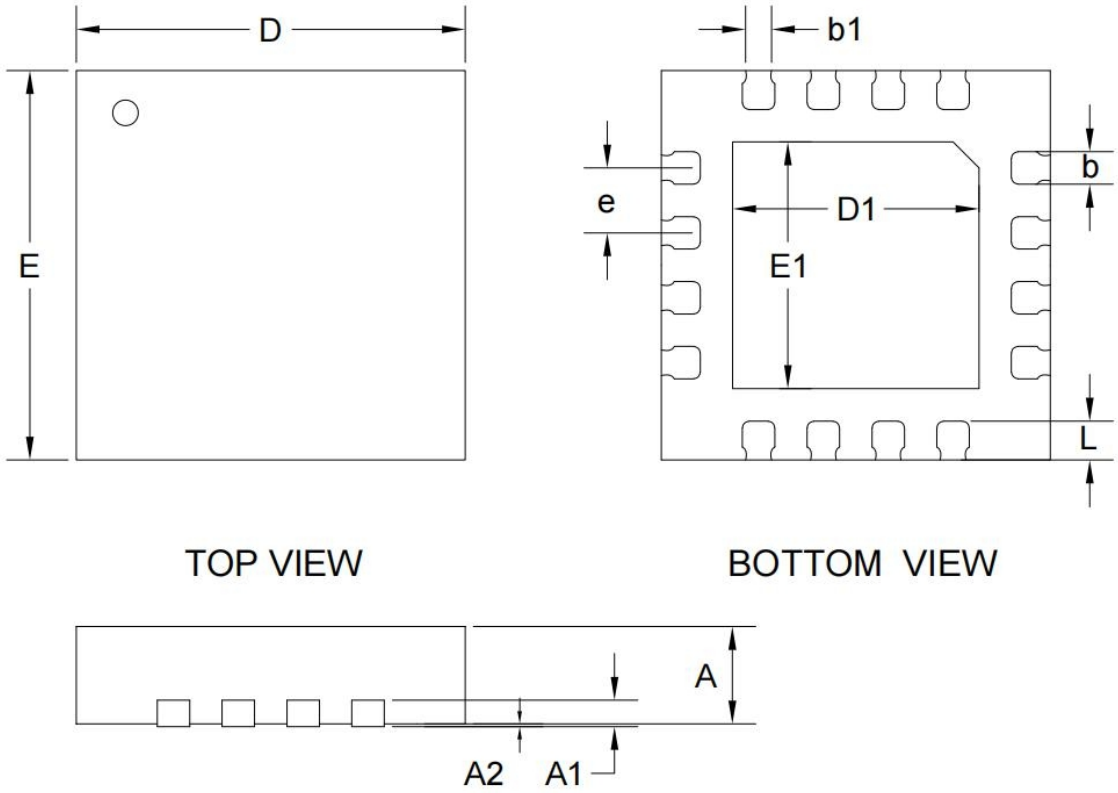
Typical application



PCB Layout

1. The chip GND is implemented as an EPAD. Ensure reliable contact between the EPAD and PCB ground during soldering.
2. Place the RC circuit as close to the SW pin as possible. The SW pin must connect to the inductor via the RC circuit.
3. Place the BAT capacitor close to the BAT pin. Route the track from the BAT pin through the capacitor and resistor before connecting it to the battery.
4. Place VBUS capacitors close to the VBUS pin and EPAD. Place VOUT capacitors close to the VOUT pin and EPAD. All traces shall run through the capacitors before connecting to the corresponding pins.
5. Only capacitors with X5R or X7R dielectric shall be used in the application circuit.
6. High-frequency oscillation exists between the inductor and the SW pin. Keep them closely placed and minimize the routing area. Locate other sensitive components far from the inductor to reduce coupling effects.
7. For high-current loops such as BAT, VOUT, and GND, use sufficiently wide traces. If vias are required for high-current paths, multiple vias are recommended to reduce impedance.
8. Inductors shall adopt package size CD75 or above, with saturation current higher than 6.5A.

Package Size: QFN3X3-16



symbol	dimensions		
	millimeters		
	min	nom	max
D	2.95	3.00	3.05
E	2.95	3.00	3.05
D1	1.875	1.90	1.925
E1	1.875	1.90	1.925
L	0.275	0.30	0.325
b	0.225	0.25	0.275
b1	0.175	0.20	0.225
e		0.50BSC	
A	0.70	0.75	0.80
A1		0.203REF	
A2	0.00	0.02	0.05

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