

## 20V Standoff, 2.4A Charger and 2.4A Boost for Power Bank All-in-One Solution

### DESCRIPTION

ETA9881 is a switching Li-Ion battery charger capable of delivering up to 2.4A of charging current to the battery and also capable of delivering up to 2.4A in boost operation. ETA9881 includes a power path from IN to OUT, a buck charger, a 5V boost converter, and a fuel gauge for power indication. It also has NTC monitor and DCP function. The buck charger guarantees a 93.5% average efficiency at 2.4A charge current and the boost converter achieves 92% efficiency at 2.4A output when battery voltage is as low as 3.3V. It greatly increases the effective battery capacity for a battery powered system, such as power bank. With all these features, ETA9881 is an ideal all-in-one solution for Li<sup>+</sup> battery charging, discharging applications.

ETA9881 is available in ESSOP10 package.

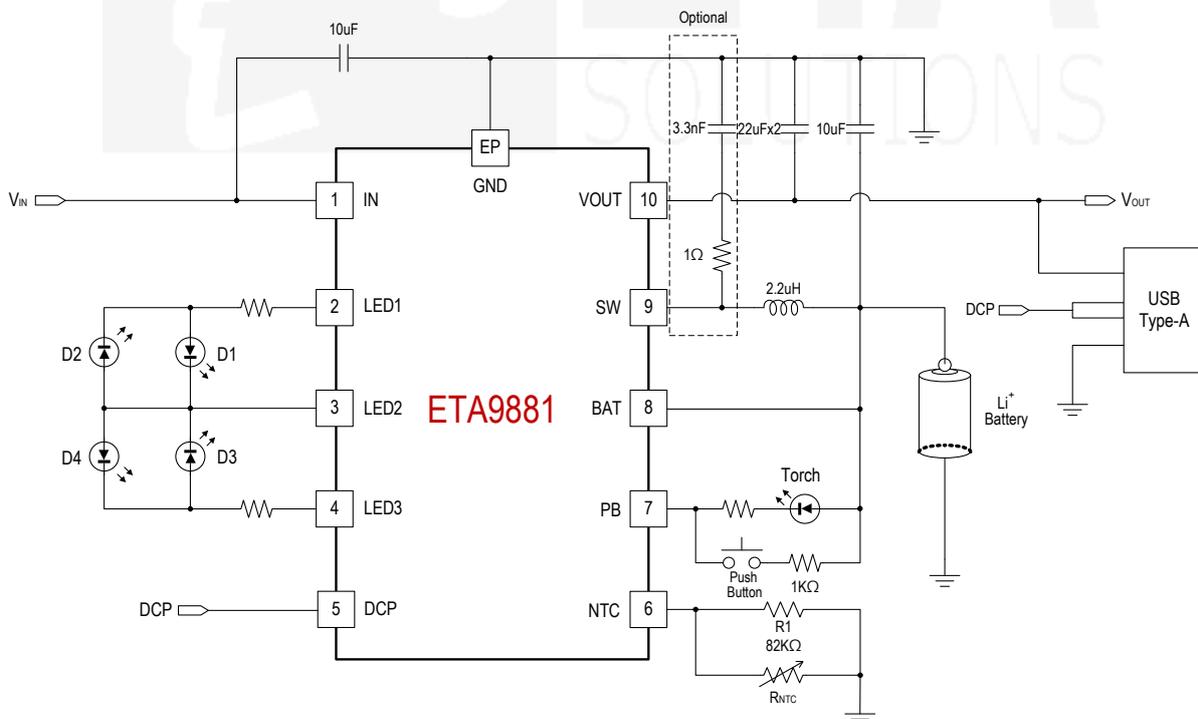
### FEATURES

- ◆ 20V Input Standoff Voltage
- ◆ Bi-Directional Power Conversion with Single Inductor
- ◆ Power Path from IN to OUT
- ◆ Automatic Mode Switching
- ◆ Switching Charger
- ◆ 5V Synchronous Boost
- ◆ Up to 96% Efficiency
- ◆ No External Sense Resistor
- ◆ NTC Monitor
- ◆ Support DCP Function
- ◆ LEDs for Battery Level Indication and Charge/Discharge Status Indication
- ◆ RoHS Compliant

### APPLICATIONS

- ◆ Power Bank
- ◆ Li<sup>+</sup> Battery Powered System

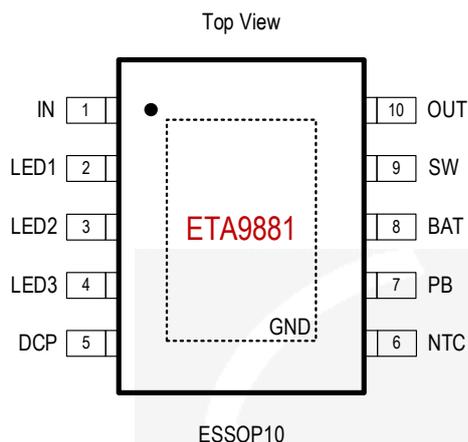
### TYPICAL APPLICATION



## ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA9881E10	ESSOP10	ETA9881 YWW2L	4000
ETA9881V435E10	ESSOP10	ETA9881 00435 YWW2L	4000

## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

IN Voltage	-0.3V to 20V		
OUT Voltage	-0.3V to 6V		
All Other Pin Voltage	$V_{OUT} - 0.3V$ to $V_{OUT} + 0.3V$		
SW, IN, OUT to ground current	Internally limited		
Operating Temperature Range	-40°C to 85°C		
Storage Temperature Range	-55°C to 150°C		
Thermal Resistance	$\theta_{JC}$	$\theta_{JA}$	
ESSOP10	10	40	°C/W
Lead Temperature (Soldering, 10sec)	260°C		

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = 5V$ ,  $V_{BAT} = 3.8V$ ,  $L = 2.2\mu H$  unless otherwise specified. Typical values are at  $T_A = 25^\circ C$ .)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>BUCK MODE</b>					
Input Standoff Voltage		20			V
Input Voltage Range		4.5		6	V
Input UVLO Voltage	Rising, Hys=500mV		4.5		V
IN to OUT R <sub>ds(on)</sub>			95		mΩ
IN to OUT Input Current Limit			3.5		A
IN to OUT Hiccup Threshold Voltage	Falling. $V_{IN} - V_{OUT} > 500mV$ Rising, Hys=100mV		500		mV
Hiccup On Time			7		mS
Hiccup Off Time			350		mS
Input OVP Voltage	Hys=500mV		6.1		V
IN Operating Current as Buck	Switcher Enable, Switching		5		mA
	Switcher Enable, No Switching		500		μA
<b>BATTERY CHARGER</b>					
Battery CV Voltage	ETA9881	4.16	4.2	4.24	V
	ETA9881V435	4.31	4.35	4.39	V

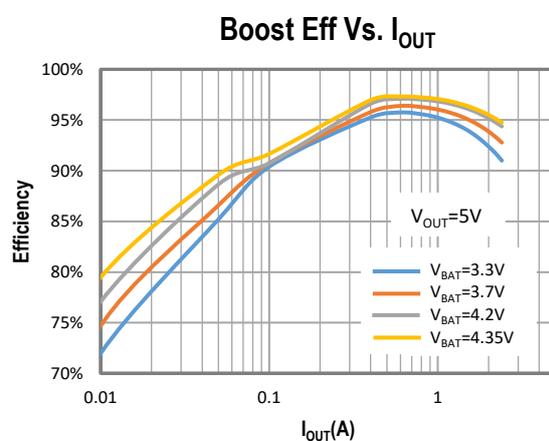
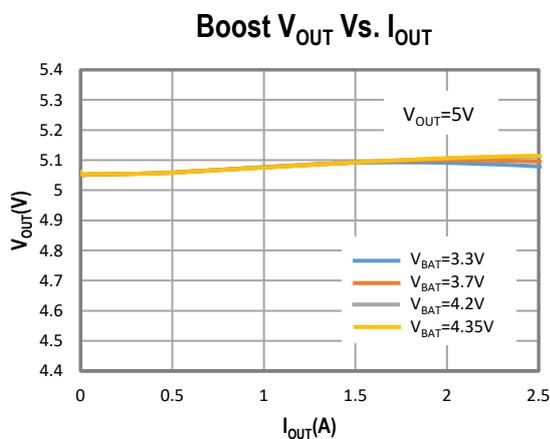
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Charger Restart Threshold			-170		mV
Battery Pre-Condition Voltage	V <sub>BAT</sub> Rising, Hys=200mV		3		V
Pre-Condition Charge Current			230		mA
Fast Charge Current			2.4		A
Charge Termination Current			230		mA
Charge Termination Blanking Time			12		S
<b>BOOST MODE</b>					
BAT OK Threshold	Rising within 50ms		3.2		V
	Falling		2.9		V
	Unlock Voltage		3.5		V
Output Voltage Range	I <sub>OUT</sub> =0A	4.95	5.05	5.15	V
Output Cord Compensation	I <sub>OUT</sub> =2.4A		150		mV
Quiescent Current at BAT Pin	Boost On		500		μA
Shutdown Supply Current at BAT Pin	Idle Mode		60		μA
Switching Frequency	V <sub>BAT</sub> <4.4V		0.5		MHz
Output Current Limit	V <sub>BAT</sub> =3.8V	2.4	2.8	3.2	A
Maximum Duty Cycle			95		%
High Side Pmos Rdson	I <sub>SW</sub> =500mA		36		mΩ
Low Side Nmos Rdson	I <sub>SW</sub> =500mA		26		mΩ
Short Circuit Hiccup Current			3		A
Over Current Detect Time			100		mS
From Short to Reboot Time			1		S
Load Current Threshold into Sleep Mode			20		mA
<b>LEDS</b>					
LED Flash Frequency			1		Hz
<b>LOGIC INPUT: PB</b>					
Logic Input High		V <sub>BAT</sub> - 0.3			V
Logic Input Low			V <sub>BAT</sub> - 1.2 or Floating		V
<b>NTC IN CHARGING MODE</b>					
Cold Threshold	Disable Charging, Rising		1.32		V
Hot Threshold	Disable Charging, Falling		0.56		V
<b>NTC IN BOOST MODE</b>					
Cold Threshold	Disable Boost, Rising		1.52		V
Hot Threshold	Disable Boost, Falling		0.38		V
<b>THERMAL PROTECTION</b>					
Charging Thermal Regulation Threshold			110		°C
Thermal Shutdown	Rising, Hys=30°C		160		°C

## PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1	IN	DC input pin. Bypass with a 10uF capacitor from this pin to GND
2	LED1	Fuel gauge LED1 connection pin
3	LED2	Fuel gauge LED2 connection pin
4	LED3	Fuel gauge LED3 connection pin
5	DCP	Dedicated charging port. It is connected to D+/D- of USB.
6	NTC	Battery temperature monitoring pin. It sets the operating temperature range for the charging or boost process. Enable NTC by setting $R1=82K$ , $R_{NTC}=100K$ . Tie NTC pin to GND to disable NTC.
7	PB	Push button pin. When the push button is pushed, and input is not present, boost operation is activated. Depending on the load at OUT, the boost may continue to supply an output voltage or go into sleep mode. When push this button sustain 0.8S, it will turn on or turn off the flashlight alternatively. Beside Push Button feature, this pin also works as Flashlight pin. An internal open drain will turn on the flashlight when this feature is ON.
8	BAT	Battery voltage sense pin. Connect a separate sensing wire to the battery positive terminal to avoid voltage drop and achieve accurate battery CV charging. Bypass with a 10uF capacitor from this pin to GND as close as possible.
9	SW	Switching pin. Connect an inductor between this pin and BAT pin.
10	OUT	USB 5.05V output during boost and charging input pin during charging. This is a power pin, bypass with 2*22uF capacitors from this pin to GND as close as possible.
EP	GND	The substrate of the chip, connected to GND, and large area of ground trace for good thermal dissipation.

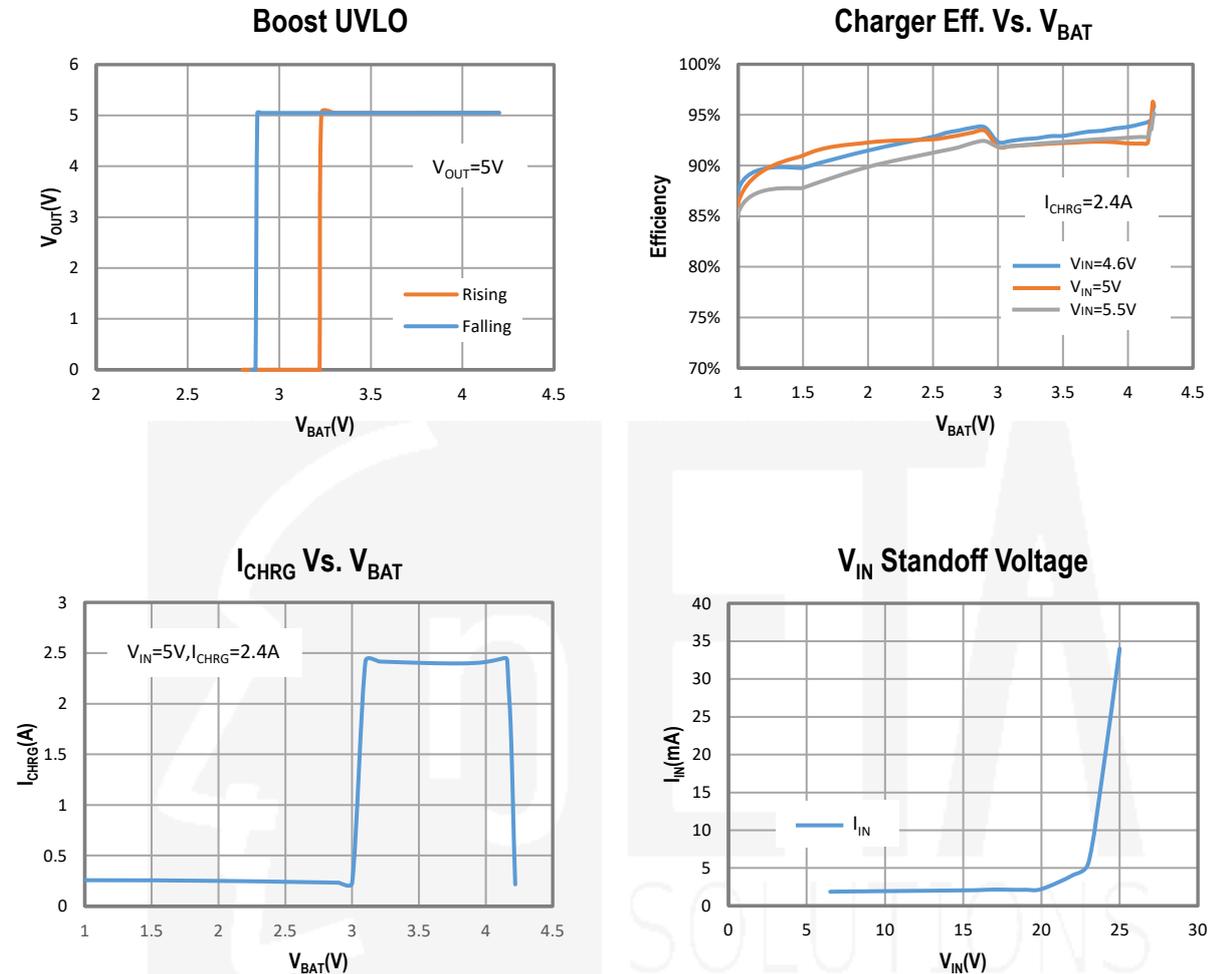
## TYPICAL CHARACTERISTICS

(Typical values are at  $T_A = 25^\circ\text{C}$  unless otherwise specified.)



## TYPICAL CHARACTERISTICS Cont'd

(Typical values are at  $T_A = 25^\circ\text{C}$  unless otherwise specified.)



## APPLICATION INFORMATION

ETA9881 is a switching Li-Ion battery charger, which is capable of delivering 2.4A of charging current and can deliver up to 2.4A output current in boost operation.

### Normal Charge Cycle

The ETA9881 initiates a charge cycle once the voltage at the IN pin rises above the UVLO threshold level. If the voltage at the BAT pin is less than 3V, the charger enters pre-condition charge mode. In this mode, the charge current is reduced to 230mA until the battery voltage is raised to a safe level for full current charging.

The charger switches to constant-current mode as the BAT pin voltage rises above 3V, and the charge current is 2.4A. When the final float voltage (4.2V/4.35V) is reached, the ETA9881 enters constant-voltage mode and the charge current begins to decrease until it drops to 230mA and ends the charge cycle.

## LED Display Mode

The ETA9881 uses D1, D2, D3, D4 LEDs to show the battery voltage level.

Table 1 D1, D2, D3, D4 Battery Voltage Level Indicator

State	Battery Voltage Level(C)	D1	D2	D3	D4
Charging	$C \leq 25\%$	1Hz flash	off	off	off
	$25\% < C \leq 50\%$	on	1Hz flash	Off	off
	$50\% < C \leq 75\%$	on	on	1Hz flash	off
	$C > 75\%$	on	on	on	1Hz flash
	Charging Done	on	on	on	on
Discharging	$75\% < C \leq 100\%$	on	on	on	on
	$50\% < C \leq 75\%$	on	on	on	Off
	$25\% < C \leq 50\%$	on	on	off	off
	$3\% < C \leq 25\%$	on	off	off	off
	$C \leq 3\%$	1Hz flash	off	off	off

## High Temperature Fold-back

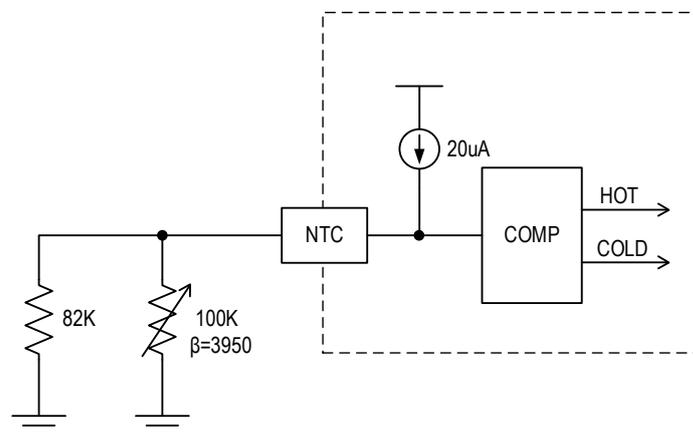
Build-in feedback circuitry mechanism can reduce the value of the programmed charge current once the die temperature tends to rise above  $110^{\circ}\text{C}$ , hence prevents the temperature from further increase and ensure device safe operation.

## Automatic Recharge

After the termination of the charge cycle, the ETA9881 constantly monitors the BAT pin voltage and starts a new charge cycle when the battery voltage falls more than 170mV, keeping the battery at fully charged condition.

## Battery Temperature Monitoring

When in charging or boost mode, the NTC pin outputs 20uA current to monitor the voltage of NTC pin, then detect the temperature of the battery. NTC function can be disabled by connecting NTC pin to GND.



In charging mode: When the voltage of NTC pin is 1.32V, it represents that the battery temperature is 0°C, then stop charging the battery. And when the voltage of NTC pin is 0.56V, it represents that the battery temperature is 45°C, then stop charging the battery.

In boost mode: When the voltage of NTC pin is 1.52V, it represents that the battery temperature is -20°C, then stop boost. And when the voltage of NTC pin is 0.38V, it represents that the battery temperature is 60°C, then stop boost.

## *DCP*

To improve the charging speed of mobile phone, ETA9881 has DCP pin which can be connected to D+/D- of USB port so that the charging current of the mobile phone is adapted to the maximum value. DCP pin can support the following standards:

- BC1.2
- Apple 2.4A
- Samsung fast charging

## *Boost Operation*

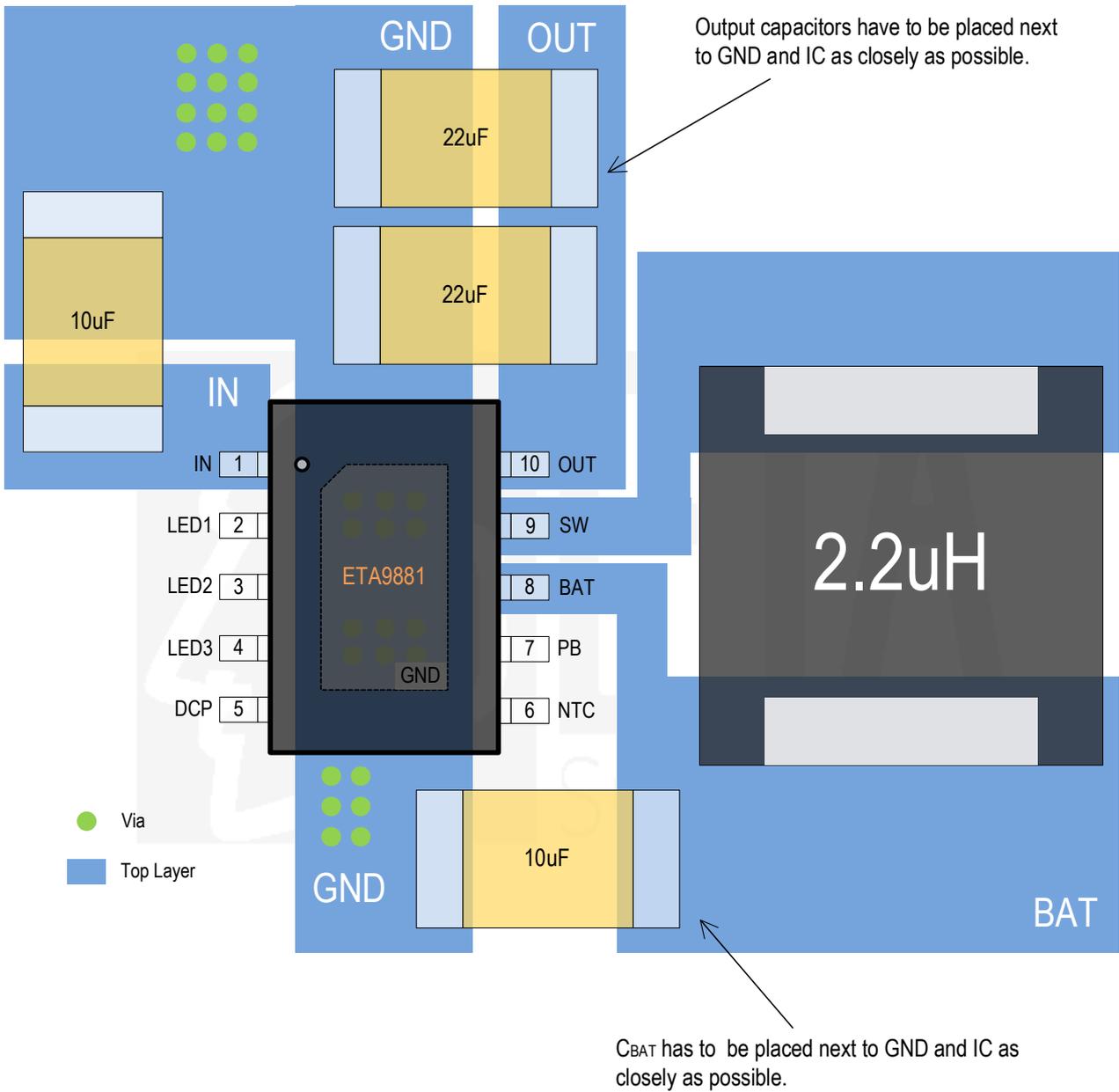
Generally, the boost is working in a fixed constant frequency PWM mode. At light load, the boost is working in power saving mode to improve the convert efficiency. When the load is very low, the boost will go into sleep mode.

## *Output Short-Circuit Protection*

Unlike most step-up converters, the ETA9881 allows for short circuits on the output. In the event of a short circuit, the device first turns off the high-side MOS when the sensed current reaches the current limit. When  $V_{OUT}$  drops below  $V_{IN}$ , the device then enters a linear charge period with the current limited same as with the start-up period. In addition, the thermal shutdown circuits disable switching if the die temperature rises above 160°C.

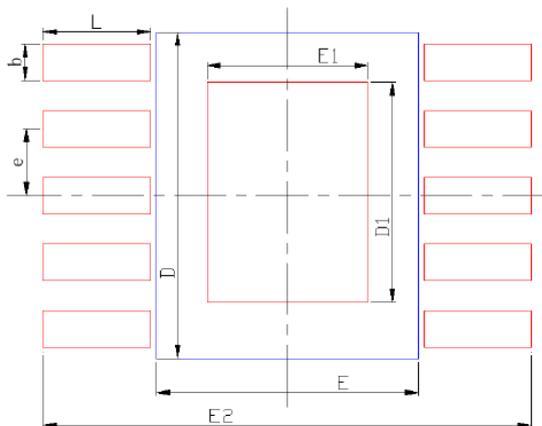
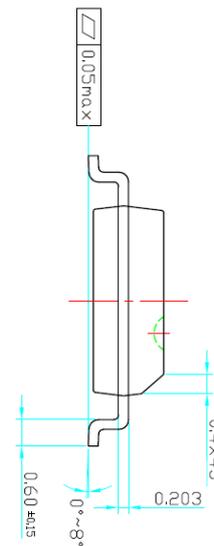
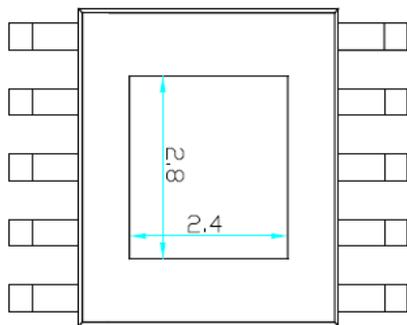
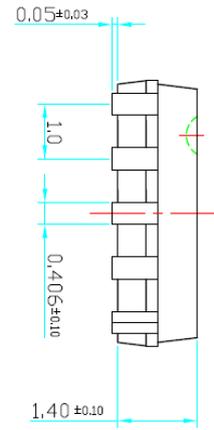
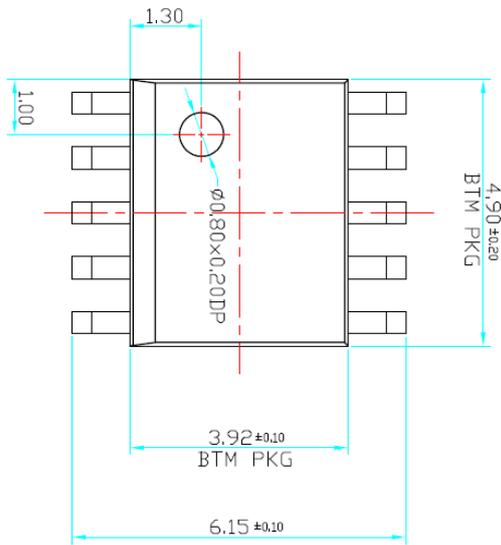
## PCB GUIDELINE

Keep the power devices as close to the chip as possible to achieve the smallest power loop area, which leads to the best EMI performance;  $C_{IN}$  is always placed nearest to IN and GND.



## PACKAGE OUTLINE

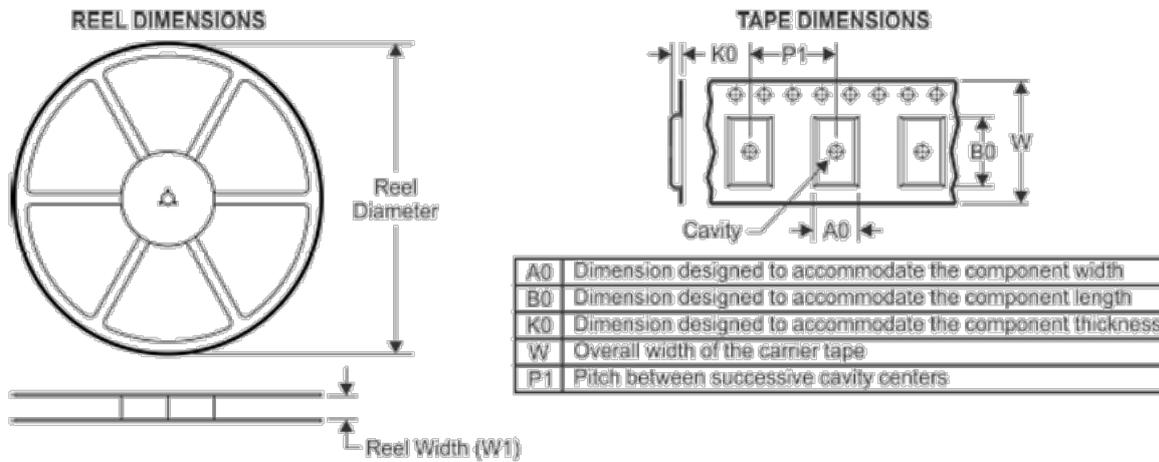
Package: ESSOP10



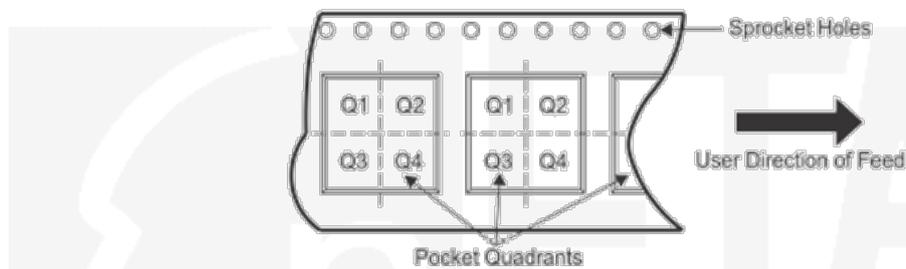
RECOMMENDED LAND PATTERN

Dimensions	Value (in mm)
D	4.9
E	3.92
D1	3.3
E1	2.4
E2	7.3
b	0.55
L	1.6
e	1

## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ETA9881E10	ESSOP10	10	4000	330	12.7	6.6	5.4	2.05	8	12	Q1
ETA9881V435E10	ESSOP10	10	4000	330	12.7	6.6	5.4	2.05	8	12	Q1