

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

### DESCRIPTION

ETA9870 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 OTG operation. ETA9870 includes a power path from Vin to Vout, a Buck charger, a 5V Boost converter, and a fuel gauge for power indication. The Buck charger guarantee a 93.5% average efficiency at 2.4A charge current and the Boost converter achieved 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, ETA9870 is an ideal all-in-one solution for Li<sup>+</sup> battery charging, discharging applications.

ETA9870 is available in ESOP8 package.

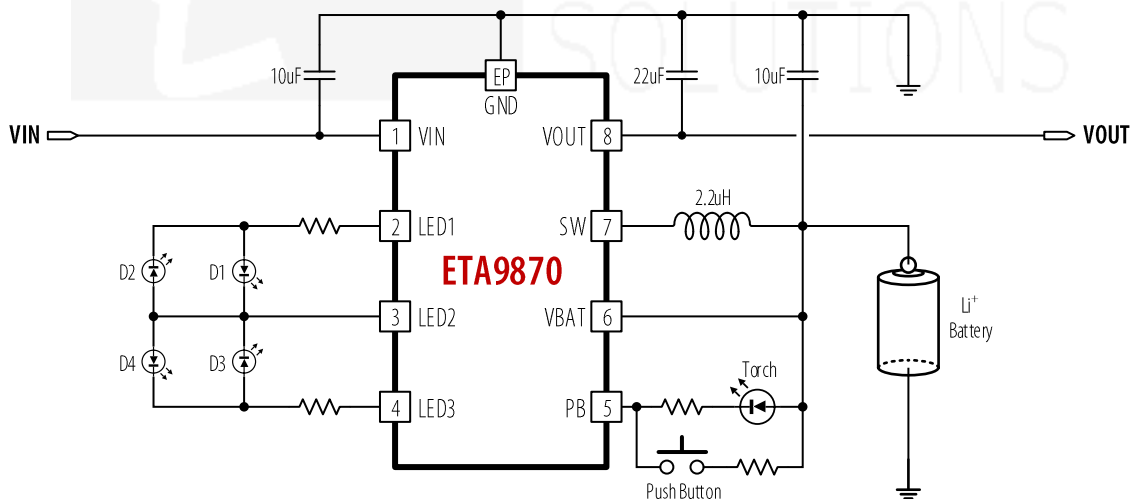
### FEATURES

- ◆ Input Standoff Voltage higher than 20V
- ◆ Bi-Directional Power conversion with Single Inductor
- ◆ Power Path from Vin to Vout
- ◆ Automatic Mode Switching
- ◆ Switching Charger
- ◆ 5V Synchronous Boost
- ◆ Up to 96% Efficiency
- ◆ No External Sense resistor
- ◆ LEDs for battery level indication and charge/discharge status indication

### APPLICATIONS

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

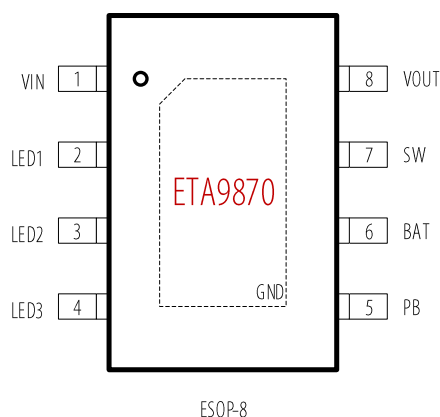
### TYPICAL APPLICATION



### ORDERING INFORMATION

| PART No.   | PACKAGE | TOP MARK         | Pcs/Reel |
|------------|---------|------------------|----------|
| ETA9870E8A | ESOP8   | ETA9870<br>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                        | $\theta_{JC}$                        | $\theta_{JA}$ |
| ESOP8 .....                               | 10                                   | 50            |
|   | °C/W                                 |               |
| Lead Temperature (Soldering, 10sec) ..... | 260°C                                |               |
| ESD HBM (Human Body Mode) .....           | 2kV                                  |               |
| ESD MM (Machine Mode) .....               | 200V                                 |               |

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = 5V$ ,  $V_{BAT} = 3.8V$ ,  $L = 1\mu H$  unless otherwise specified. Typical values are at  $T_A = 25^\circ C$ .)

| PARAMETER                          | CONDITIONS   | MIN  | TYP  | MAX  | UNITS |
|------------------------------------|--|------|------|------|-------|
| <b>BUCK MODE</b>                   |  |      |      |      |       |
| IN Standoff Voltage                |  |      | 20   |      | V     |
| IN Range                           |  | 4.5  |      | 6    | V     |
| IN UVLO Voltage                    | Rising, Hys=500mV  |      | 4.5  |      | V     |
| IN to OUT R <sub>DS(on)</sub>      |  |      | 60   |      | mΩ    |
| IN to OUT Input current limit      |  |      | 5    |      | A     |
| IN to OUT Hiccup threshold Voltage | Falling, $V_{in} - V_{out} > 500mV$<br>Rising, Hys=100mV |      | 500  |      | mV    |
| Hiccup on time                     |  |      | 7    |      | mS    |
| Hiccup off time                    |  |      | 200  |      | mS    |
| IN 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                 | Default, $I_{BAT} = 0mA$                                 | 4.16 | 4.2  | 4.24 | V     |
|                                    | $C_{LED3} = 1nF$ , $I_{BAT} = 0mA$                       | 4.3  | 4.35 | 4.4  | V     |
| Charger Restart Threshold          |  |      | -170 |      | mV    |
| Battery Pre-Condition Voltage      | $V_{BAT}$ Rising Hys=200mV                               |      | 3    |      | V     |
| Pre-Condition Charge Current       |  |      | 200  |      | mA    |
| Fast Charge Current                |  | 2.16 | 2.4  | 2.64 | A     |
| Charge Termination Current         |  |      | 230  |      | mA    |
| Charge Termination Blanking time   |  |      | 12   |      | S     |
| <b>BOOST MODE</b>                  |  |      |      |      |       |

| PARAMETER                              | CONDITIONS               | MIN                   | TYP  | MAX                               | UNITS |
|--|--------------------------|-----------------------|------|-----------------------------------|-------|
| BAT OK Threshold                       | Rising within time 100ms |                       | 3.2  |                                   | V     |
|  | Rising exceed 100ms      |                       | 3.52 |                                   | V     |
| Output Voltage Range                   | I <sub>OUT</sub> =0A     | 4.95                  | 5.05 | 5.15                              | V     |
| Output load compensation               | I <sub>OUT</sub> =2.4A   |                       | 150  |                                   | mV    |
| Quiescent Current At BATT              | Boost On                 |                       | 250  |                                   | μA    |
| Shutdown Supply Current At BATT        | Idle Mode                |                       | 65   |                                   | μA    |
| Switching Frequency                    | V <sub>BATT</sub> <4.4V  |                       | 0.5  |                                   | MHz   |
| Load Current Limit                     | V <sub>BATT</sub> =3.8V  | 2.4                   | 2.6  | 2.9                               | A     |
| Maximum Duty Cycle                     |                          |                       | 95   |                                   | %     |
| Highside Pmos R <sub>dson</sub>        | I <sub>SW</sub> =500mA   |                       | 36   |                                   | mΩ    |
| Lowside Nmos R <sub>dson</sub>         | I <sub>SW</sub> =500mA   |                       | 26   |                                   | mΩ    |
| Short Circuit Hiccup Current           |                          |                       | 3    |                                   | A     |
| Over Current Detect Time               |                          |                       | 1    |                                   | S     |
| From Short to reboot time              |                          |                       | 60   |                                   | S     |
| Load current threshold into sleep mode |                          |                       | 20   |                                   | mA    |
| <b>LEDS</b>                            |                          |                       |      |                                   |       |
| LED Flash Frequency                    |                          |                       | 1    |                                   | Hz    |
| <b>LOGIC INPUT: BUTT</b>               |                          |                       |      |                                   |       |
| Logic Input High                       |                          | V <sub>BAT</sub> -0.3 |      |                                   | V     |
| Logic Input Low                        |                          |                       |      | V <sub>BAT</sub> -1.2 or Floating | V     |
| <b>THERMAL PROTECTION</b>              |                          |                       |      |                                   |       |
| Charging Thermal Regulation threshold  |                          |                       | 110  |                                   | °C    |
| Thermal Shutdown                       | Rising, Hys=30°C         |                       | 160  |                                   | °C    |

## PIN DESCRIPTION

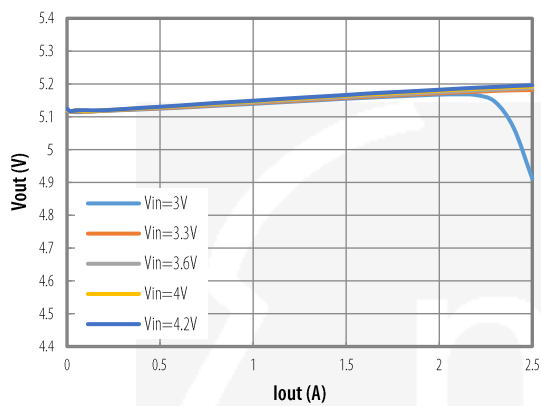
| PIN # | NAME | DESCRIPTION  |
|-------|------|--|
| 1     | VIN  | DC Input pins. Bypass with a 10uF capacitor from this pin to GND   |
| 2     | LED1 | Fuel gauge LED1 connection pin   |
| 3     | LED2 | Fuel gauge LED2 connection pin   |
| 4     | LED3 | Fuel gauge LED3 connection pin   |
| 5     | PB   | Push Button pin. When the push button is pushed, and input is not present, boost operation is activated. Depending on the loading 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 Flashlight when this feature is ON. |
| 6     | BAT  | Battery Voltage sense pin. Connect to the battery positive terminal with a separate sensing wire to avoid voltage drop to achieve accurate battery CV charging   |
| 7     | SW   | Switching Pin. Connect with an inductor between this pin and BATT.   |

| PIN # | NAME | DESCRIPTION   |
|-------|------|---|
| 8     | VOUT | USB 5.15V output during boost and charging input pin during charging. This is a power pin, bypass with 22uF MLCC caps to the pin and PGND as close as possible. |
| 9 /EP | GND  | The substrate of the chip, connected to GND, and large area of ground trace for good thermal dissipation.   |

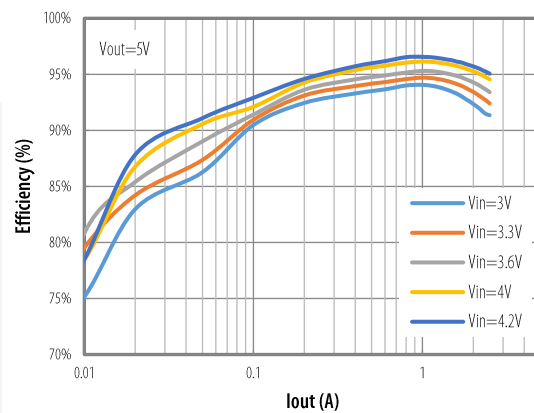
## TYPICAL CHARACTERISTICS

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

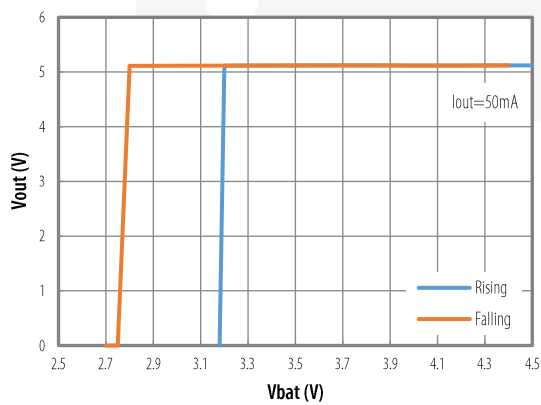
**Boost Vout Vs. Iout**



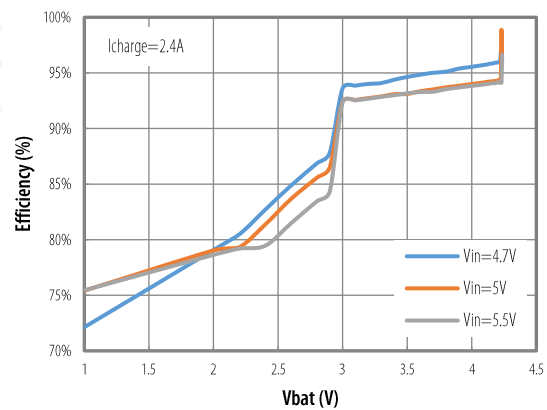
**Boost Eff Vs. Iout**



**Boost UVLO**

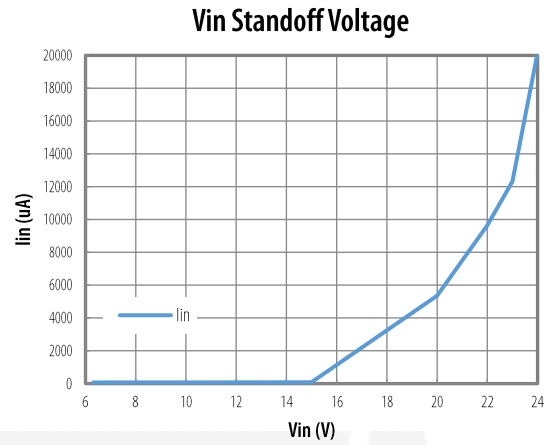
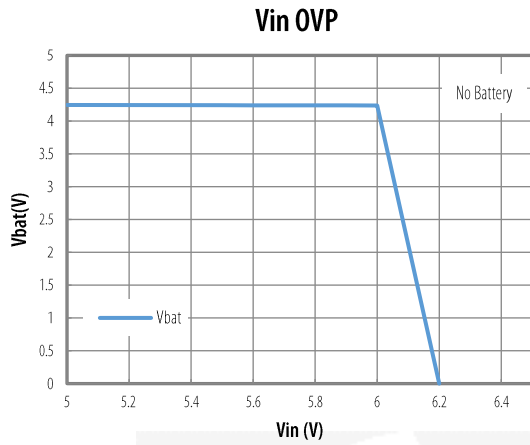


**Charger Eff Vs. Vbat**



### TYPICAL CHARACTERISTICS cont'

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

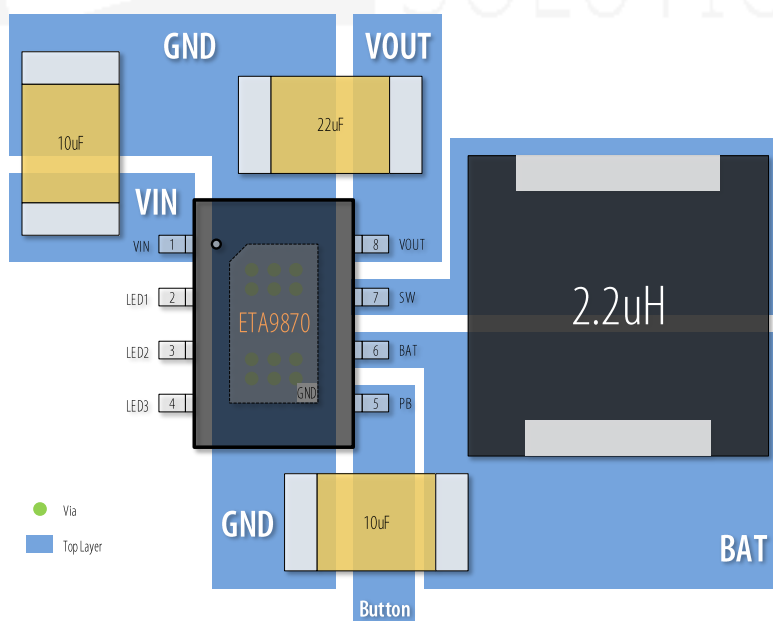


### APPLICATION NOTE

#### Setting for 4.35V battery

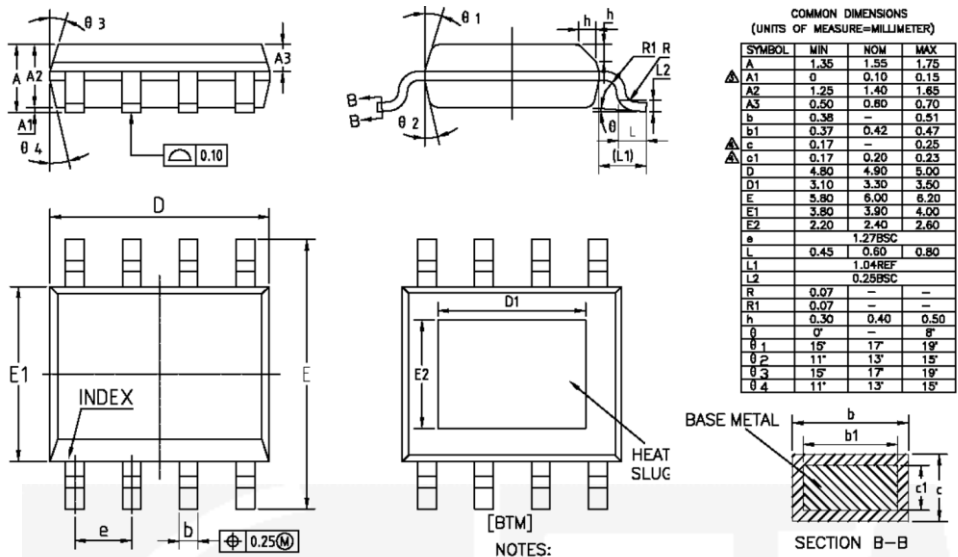
If the LED3 pin (pin #4) is connected by a 1nF capacitor (or larger) to GND, the ETA9870 will take the battery as a 4.35V battery, otherwise 4.2V battery if the pin is found having no such capacitor to GND.

### PCB GUIDELINE



PACKAGE OUTLINE

Package: ESOP8



NOTES:  
ALL DIMENSIONS REFER TO JEDEC STANDARD MS-012 AA  
DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.