

## Sync. Rectifier Step Up Converter

## General Description

The AP2007 is a compact, high-efficiency, synchronous step-up converter with power Mosfets embedded and with output turn off true shutdown function for a single-cell Li-ion/polymer battery. The AP2007 uses only 70 $\mu$ A (typ) quiescent current and allows the converter to switch only when needed at no load and light loads, and when load is higher than 150mA, it uses fixed-frequency PWM technique at 1MHz. It features a current mode control for fast transient response with internal compensation. The AP2007 includes cycle-by-cycle current limit to maximum inductor current and over-temperature protection circuit. The AP2007 is suitable for iPad-like computers, smart phones and portable handheld devices.

The AP2007 is available in a SOP8-PP package. The operating temperature range is from -45°C to +85°C.

## Applications

- iPad-like computers, smart phones and portable handheld devices.

## Features

- Up to 90% Efficiency at  $I_{out}=2A$   $V_{OUT} = 5V$  from 3.6V Input

## Typical Application Circuit

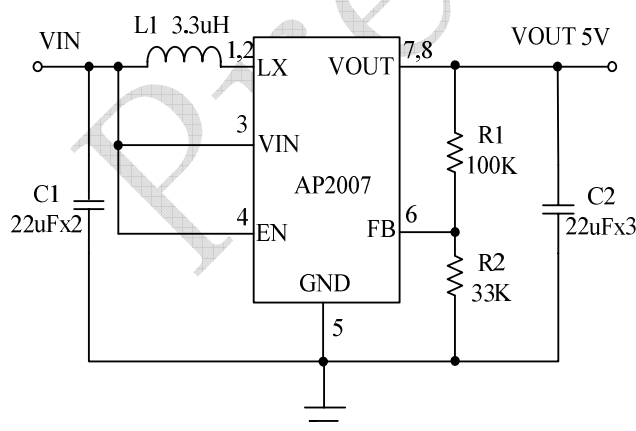


Figure 1. Basic Application Circuit with AP2007

- Low 70 $\mu$ A Quiescent Current
- Guaranteed 2A Output Current at  $V_{OUT} = 5V$  from 3.3V Input
- 1MHz PWM Switching Frequency
- Synchronous and Embedded Power Mosfets
- No Schottky Diode Required
- Internal Soft-Start to Limit Inrush Current
- Adjustable Output
- Output turn off true shutdown function
- Current Mode Operation with Internal Compensation
- For Excellent Line and Load Transient Response
- Overload/Short-Circuit Protection
- Shutdown Current <1 $\mu$ A
- Thermal Shutdown
- Compact 8 pin, SOP8-PP package

## Package

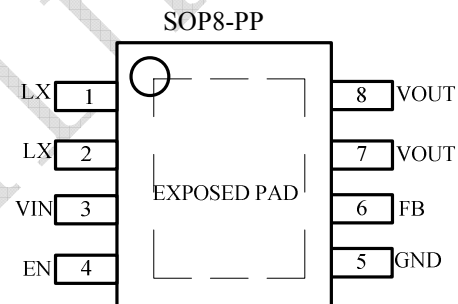


Figure 2. Typical Efficiency Curve

**Pin Description**

| Pin No. | Pin Name | Pin Function                                                                                                                                                                                 |
|---------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1,2     | LX       | Inductor Node.                                                                                                                                                                               |
| 3       | VIN      | IC Power Supply Input.                                                                                                                                                                       |
| 4       | EN       | Enable pin for the IC. Drive this pin high to enable the part, low to disable.                                                                                                               |
| 5       | GND      | IC Analog Ground.                                                                                                                                                                            |
| 6       | FB       | Converter Feedback Input.                                                                                                                                                                    |
| 7,8     | VOUT     | Converter Output.                                                                                                                                                                            |
|         | EP       | Exposed Paddle. Connect to the ground plane to optimize thermal performance. EP is internally connected to GND. EP must be connected to GND at a single point with a star ground connection. |

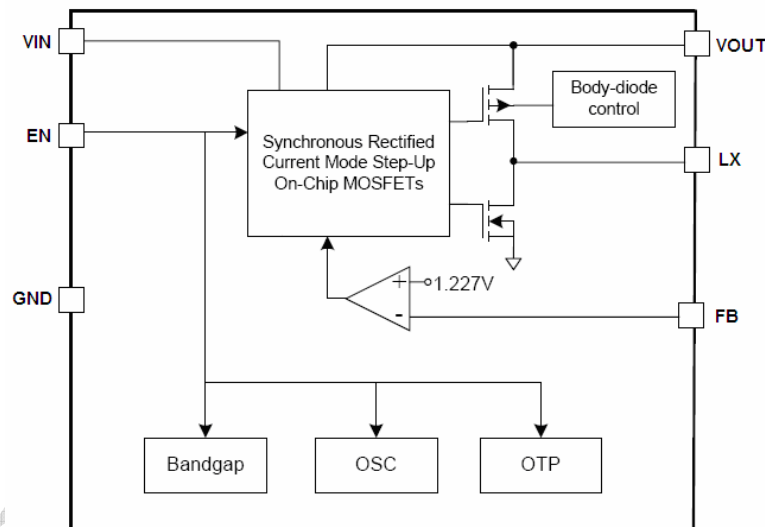
**Functional Block Diagram**

Figure 3. AP2007 Block Diagram

**Absolute Maximum Rating** <sup>(Note 1)</sup>

|                           |              |
|---------------------------|--------------|
| Input Supply Voltage..... | -0.3V to +6V |
| LX Voltage.....           | -0.3V to +6V |
| VOUT Voltages.....        | -0.3V to +6V |
| FB Voltages.....          | -0.3V to +6V |
| VIN Voltages.....         | -0.3V to +6V |
| EN Voltages.....          | -0.3V to +6V |

(Note 2)

**Package Thermal Resistance**

|                     |        |
|---------------------|--------|
| $\theta_{JA}$ ..... | 50°C/W |
| $\theta_{JC}$ ..... | 10°C/W |

Operating Temperature Range.....-40°C to +85°C  
 Storage Temperature Range.....-65°C to +150°C  
 Lead Temperature (Soldering, 10s).....+260°C

### Electrical Characteristics <sup>(Note 3)</sup>

(VOUT=5V, VIN = 3.6V, T<sub>A</sub> = 25°C, Test Circuit of Figure 1, unless otherwise noted.)

| Parameter                       | Symbol    | Test Conditions                                                                | Min   | Typ   | Max   | Unit |
|---------------------------------|-----------|--------------------------------------------------------------------------------|-------|-------|-------|------|
| Input operation voltage         | VIN       |                                                                                | 2.5   |       | 5     | V    |
| Output voltage                  | VOUT      | Line and Load Regulation in CCM<br>(IL>100mA) VIN=2.5V~4.5V                    | 4.925 | 5     | 5.075 | V    |
| Input Quiescent current         | IIN       | VIN =3.6V FB=1.28V<br>No load, no switching<br>(exclude input current from EN) |       | 50    | 70    | uA   |
| Shutdown supply current         | IIN       | EN=0                                                                           |       | 0.1   | 1     | uA   |
| Switching Frequency             | Fosc      |                                                                                | 0.7   | 1     | 1.3   | MHz  |
| Soft-Start Interval             | SS        |                                                                                |       | 0.2   |       | ms   |
| FB Regulation Voltage           | VFB       |                                                                                | 1.208 | 1.227 | 1.246 | V    |
| FB Input Current                | IFB       | FB=1.0V                                                                        |       |       | 100   | nA   |
| Maximum Duty Cycle              | Dmax      | FB=0.95V                                                                       | 86    | 93    | 96    | %    |
| VOUT Leakage Current            | IPVOUT_LK | EN=0, VOUT=5V                                                                  |       | 1     | 5     | uA   |
| LX Leakage Current              | ILX_LK    | EN=0, VOUT=5V                                                                  |       | 1     | 5     | uA   |
| Switch ON Resistance            | RON-N     |                                                                                |       | 52    | 70    | mΩ   |
|                                 | RON-P     |                                                                                |       | 49    | 65    | mΩ   |
| Peak Current Limit              | I_LIM     |                                                                                |       | 5     |       | A    |
| Efficiency                      |           | EN=1, VIN=3V, VOUT=5V, IOUT=2A                                                 |       | 87    |       | %    |
| Thermal Shutdown Threshold      |           | Rising Edge, 20°C hysteresis                                                   |       | 150   |       | °C   |
| EN Input High Level             | Vih_EN    |                                                                                | 1.5   |       | 5.5   | V    |
| EN Input Low Level              | Vil_EN    |                                                                                | 0     |       | 0.5   | V    |
| EN Internal Pull-Low Resistance | Rin_EN    |                                                                                | 200   | 250   | 300   | kΩ   |

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

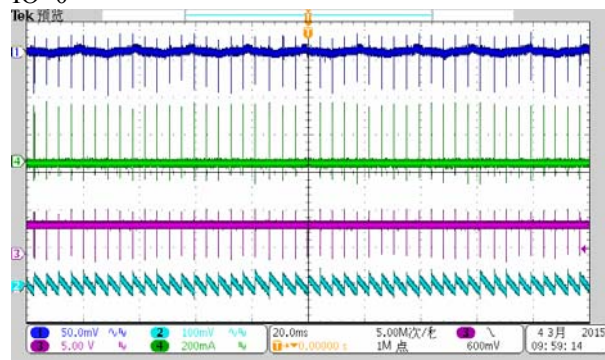
**Note 2:** Thermal Resistance is specified with approximately 1 square of 1oz copper.

**Note 3:** 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

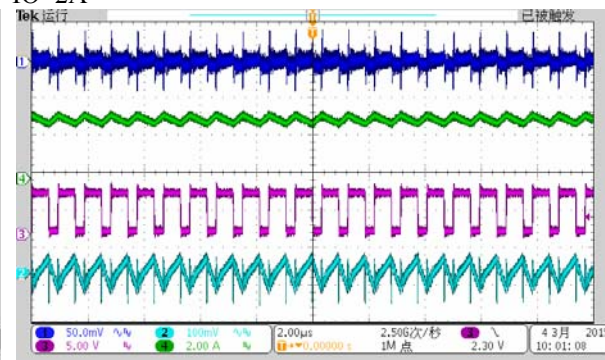
## Typical Performance Characteristics

Operation (CH1=VIN,CH2=VO,CH3=LX,CH4=ILX)

IO=0

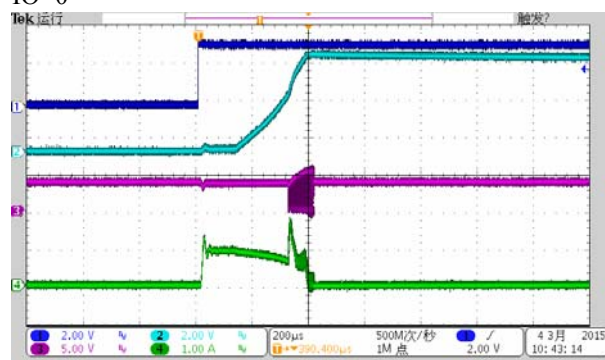


IO=2A

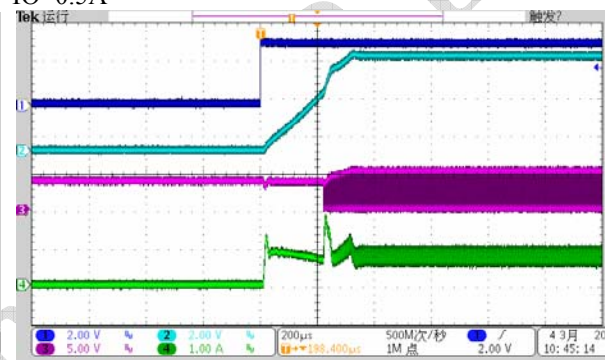


Start Up (CH1=EN,CH2=VO,CH3=LX,CH4=ILX)

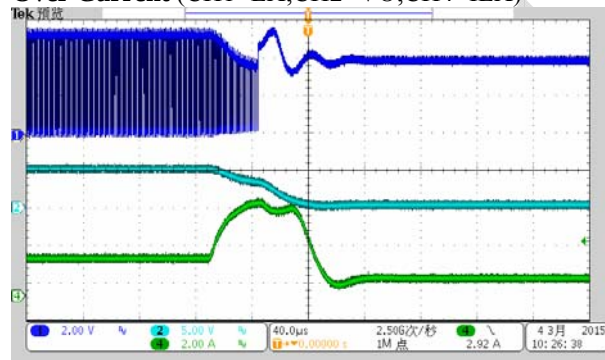
IO=0



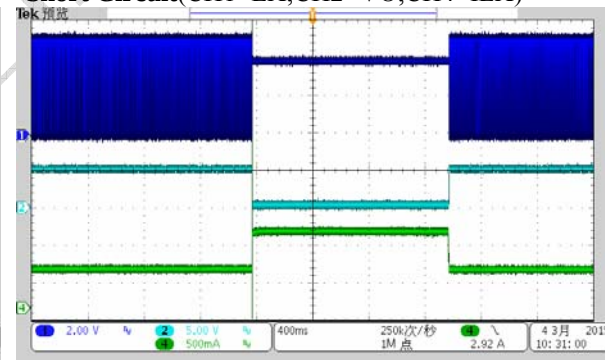
IO=0.5A



Over Current (CH1=LX,CH2=VO,CH4=ILX)

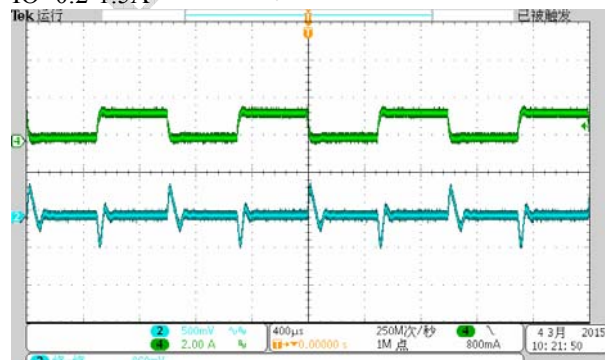


Short Circuit (CH1=LX,CH2=VO,CH4=ILX)

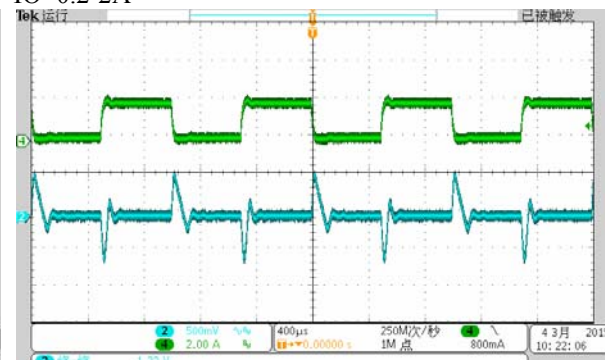


Load Transient Response (CH2=VO,CH4=IO)

IO=0.2-1.5A



IO=0.2-2A



**Ordering Information**

| Part number | Mark                         | Package |
|-------------|------------------------------|---------|
| AP2007SPER  | AP2007<br>YYWWP <sup>1</sup> | SOP8-PP |

1. YYWW=date code

P= Package factory

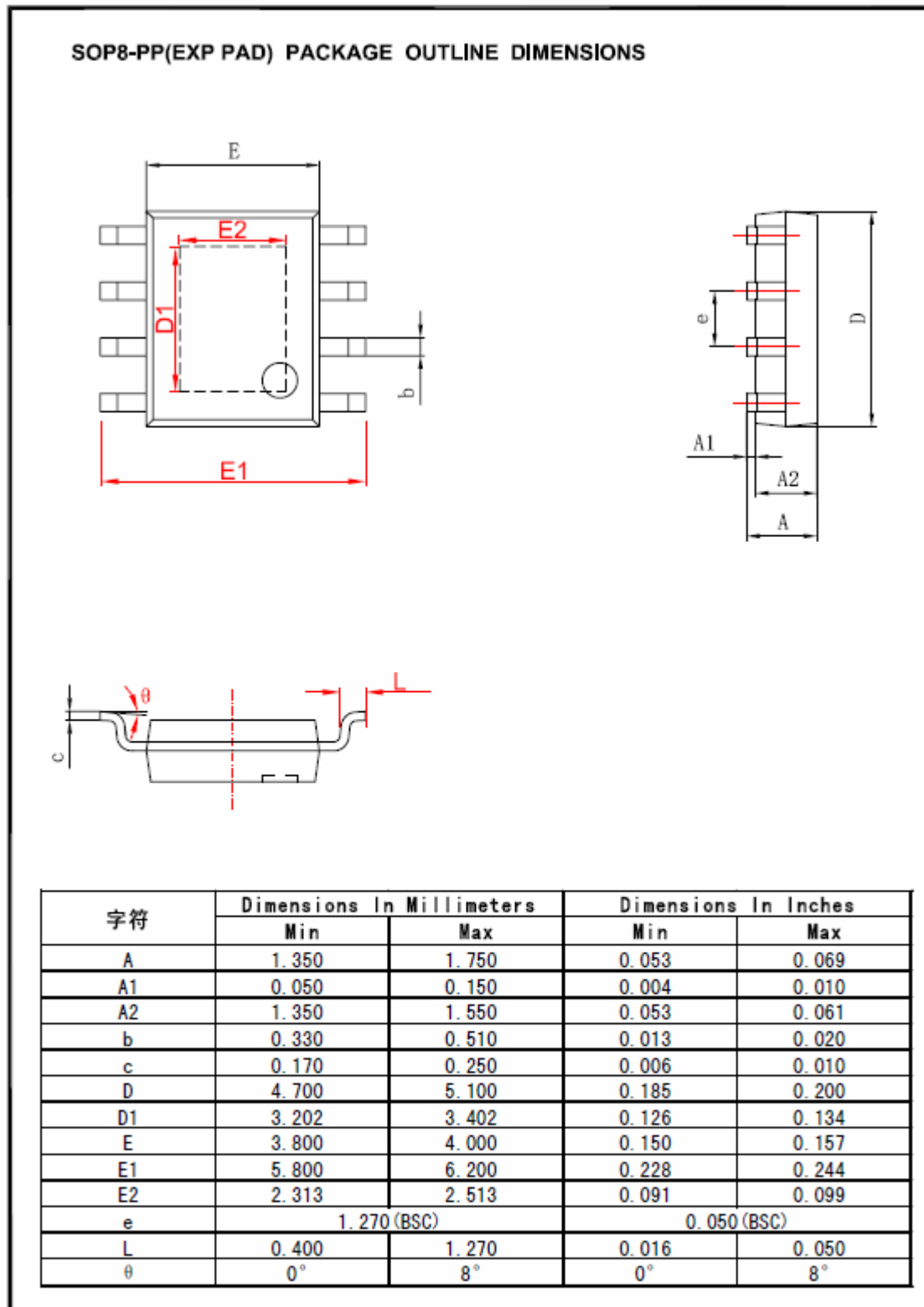
**Operation**

The AP2007 current-mode step-up DC-DC switching converter uses a fixed-frequency PWM architecture with output shutdown. In light-load mode, the converter switches when needed, consuming only 70μA of quiescent current. In heavy-load mode of higher than 150mA, the converter switches every cycle at a constant frequency as fixed-PWM, thus enabling noise filtering. The AP2007 is highly efficient, with internal and synchronous switches. Shutdown reduces the quiescent current to less than 0.1μA. Low quiescent current and high efficiency make this device ideal for portable equipment.

The AP2007 step-up DC-DC switching converter typically generates a 5V output voltage from a single-cell battery input voltage. The minimum output peak current limit is 5A in SOP8-PP package. When an over-current, short-circuit or thermal shutdown condition is encountered. The converter will turn off until the over-current or over-temperature condition is removed. The AP2007 is adjustable by 2 external resistors with calculating the value for R1 as  $R1 = R2 (VOUT/VFB - 1)$ .

The AP2007 switches at a 1MHz frequency, allowing for tiny external components. The AP2007 is optimized for use in iPad-like computers, smart phones, portable handheld devices and other applications requiring low quiescent current for maximum battery life.

## Package Information



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Preliminary