

Description

The AP8802 is a step-down DC/DC converter designed to drive LEDs with a constant current. The device can drive up to thirteen LEDs, depending on the forward voltage of the LEDs, in series from a voltage source of 8V to 48V. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminating the need for ballast resistors. The AP8802 switches at frequency up to 500kHz. This allows the use of small size external components, hence minimizing the PCB area needed.

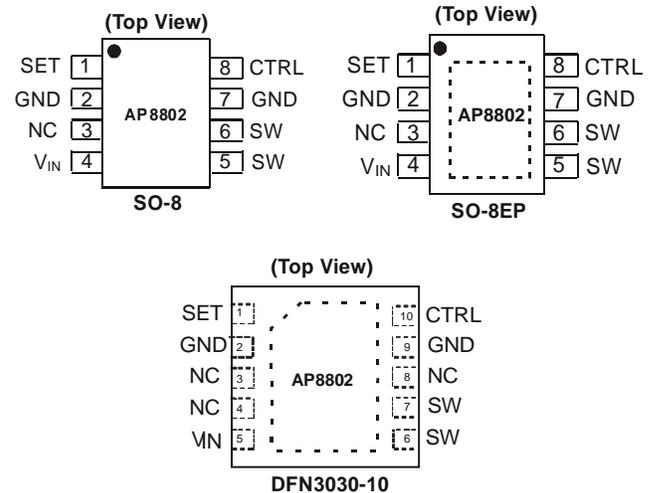
Maximum output current of AP8802 is set via an external resistor connected between the V_{IN} and SET input pins. Dimming is achieved by applying either a DC voltage or a PWM signal at the CTRL input pin. An input voltage of 0.2V or lower at CTRL shuts down the output at SW and puts the device into a low-current standby state.

Features

- LED driving current up to 1A
- High efficiency up to 92%
- Operating input voltage up to 48V
- High switching frequency up to 500kHz
- PWM/DC input for dimming control
- Built-in output open-circuit protection
- SO-8, SO-8EP and DFN3030-10 are available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish/ RoHS Compliant (Note 1)

Notes: 1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied. Please visit our website at http://www.diodes.com/products/lead_free.html.

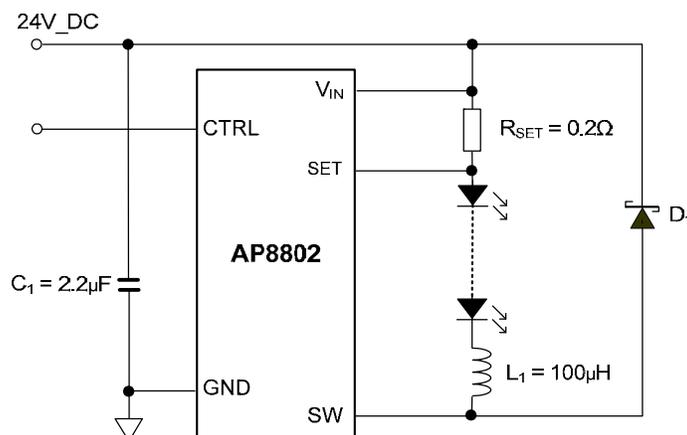
Pin Assignments



Applications

- Commercial & industrial lighting
- Small LCD panel backlight
- Appliances interior lighting
- Architecture Detail lighting

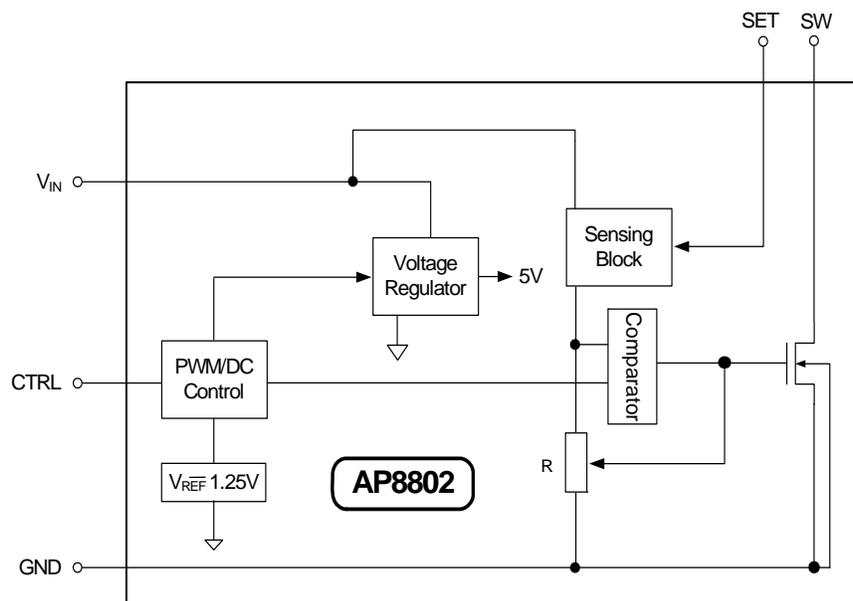
Typical Application Circuit



Pin Descriptions

| Name | SO-8 | SO-8EP | DFN3030-10 | Description |
|-----------------|------|--------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SW | 6, 5 | 6, 5 | 7, 6 | Switch Pin. Connect inductor/freewheeling diode here, minimizing track length at this pin to reduce EMI. |
| GND | 2 | 2 | 2, 9 | GND pin |
| SET | 1 | 1 | 1 | Set Nominal Output Current Pin. Configure the output current of the device. |
| CTRL | 8 | 8 | 10 | Dual function dimming control pin. <ul style="list-style-type: none"> Input voltage of 0.2V or lower forces the device into low current standby mode and shuts off the output. A PWM signal (driven by an open-drain/collector source) allows the output current to be adjusted over a wide range up to 100%. An analog voltage between 0.3V and 2.5V adjusts the output current between 25% and 200% of the current set by $0.2V/R_S$. <p>The input impedance is about 50kΩ, and if the pin is left open $V_{CTRL} = V_{REF}$</p> |
| V _{IN} | 4 | 4 | 5 | Input Supply Pin. Must be locally bypassed. |
| NC | 3 | 3 | 3, 4, 8 | No connection |

Functional Block Diagram



Absolute Maximum Ratings (T_A = 25°C)

| Symbol | Parameter | Rating | Unit |
|-------------------|-----------------------------|-------------|------|
| V _{IN} | V _{IN} pin voltage | -0.3~50 | V |
| V _{SW} | SW voltage | -0.3~50 | V |
| T _J | Junction Temperature | 150 | °C |
| T _{LEAD} | Lead Temperature Soldering | 300 | °C |
| T _{ST} | Storage Temperature Range | -65 to +150 | °C |

Caution: These are stress ratings only. Operation outside the absolute maximum ratings may cause device failure. Operation at the absolute maximum rating for extended periods may reduce device reliability. Semiconductor devices are ESD sensitive and may be damaged by exposure to ESD events. Suitable ESD precautions should be taken when handling and transporting these devices

Recommended Operating Conditions (T_A = 25°C)

| Symbol | Parameter | Min | Max | Unit |
|---------------------|-------------------------------------------------------------------|-----|------|------|
| V _{IN} | Operating Input Voltage relative to GND | 8.0 | 48 | V |
| V _{CTRLDC} | Voltage range for 24% to 200% DC dimming relative to GND (Note 2) | 0.3 | 2.5 | V |
| V _{CTRLLL} | Voltage Low for PWM dimming relative to GND | 0 | 0.2 | V |
| f _{OSC} | Maximum Switching Frequency | | 600 | kHz |
| T _A | Ambient Temperature Range | -40 | 105 | °C |
| Duty Cycle | Using Inductor ≥ 100μH (Note 3) | 0.1 | 0.95 | |

Notes: 2. For 100% brightness either leave floating or connect to 1.25V relative to GND.
 3. For most applications the LED current will be within 8% over the duty cycle range specified. Duty cycle accuracy is also dependent on propagation delay. Smaller size inductors can be used but LED current accuracy may be greater than 8% at extremes of duty cycle. This is most noticeable at low duty cycles (less than 0.1) or when the input voltage is high and only one LED is being driven.

Electrical Characteristics (T_A = 25°C, V_{IN} = 12V; unless otherwise specified)

| Symbol | Parameter | Conditions | Min | Typ. | Max | Unit |
|-------------------------|----------------------------------------|-----------------------------------------|-----|------|-----|------|
| I _{OUT} | Continuous switch current | (Note 4) | | | 1 | A |
| I _Q | Quiescent Current | | - | 75 | 120 | μA |
| V _{THD} | Internal Threshold Voltage | | 184 | 200 | 216 | mV |
| V _{REF} | Internal Reference Voltage | | - | 1.25 | - | V |
| SET | SET pin input current | V _{SET} = V _{IN} -0.2 | - | 5 | - | μA |
| R _{DS(ON)} | On Resistance of MOSFET | I _{SW} = 0.8A | | 0.65 | 1.1 | Ω |
| I _{SW_Leakage} | Switch leakage current | | - | - | 8 | μA |
| θ _{JA} | Thermal Resistance Junction-to-Ambient | SO-8 (Note 5) | - | 82 | - | °C/W |
| | | SO-8EP (Note 5) | - | 45 | - | °C/W |
| | | DFN3030-10 (Note 5) | - | 38 | - | °C/W |
| θ _{JC} | Thermal Resistance Junction-to-Case | SO-8 (Note 5) | - | 52 | - | °C/W |
| | | SO-8EP (Note 5) | - | 7 | - | °C/W |
| | | DFN3030-10 (Note 5) | - | 24 | - | °C/W |

Notes: 4. Refer to figure 8 for the device derating curve.
 5. Test condition for SO-8, SO-8EP and DFN3030-10: Device mounted on FR-4 PCB, 2"x2", 2oz copper, minimum recommended pad layout on top layer and thermal vias to bottom layer ground plane. For better thermal performance, larger copper pad for heat-sink is needed.

Application Information

LED Current Control

The LED current is controlled by the resistor RSET in Figure 1 connected between VIN and SET. The nominal average output current in the LED(s) is defined as:

$$I_{LED} = \frac{V_{THD}}{R_{SET}}$$

If the CTRL pin is driven by an external voltage (lower than 2.5V), the average LED current is:

$$I_{LED} = \frac{V_{CTRL}}{V_{REF}} \frac{V_{THD}}{R_{SET}}$$

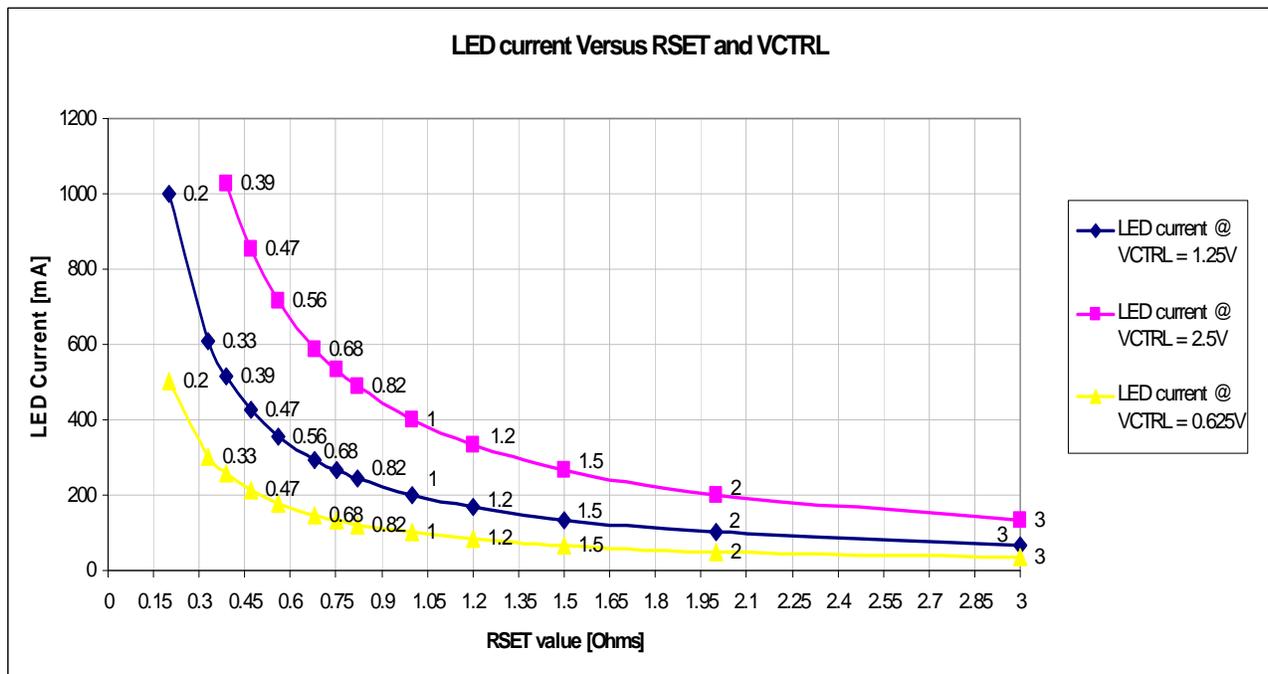


Fig. 1 LED Current setting vs. RSET and VCTRL

Application Information (cont.)

Inductor Selection

This section highlights how to select the inductor suitable for the application requirements in terms of switching frequency, LED current accuracy and temperature.

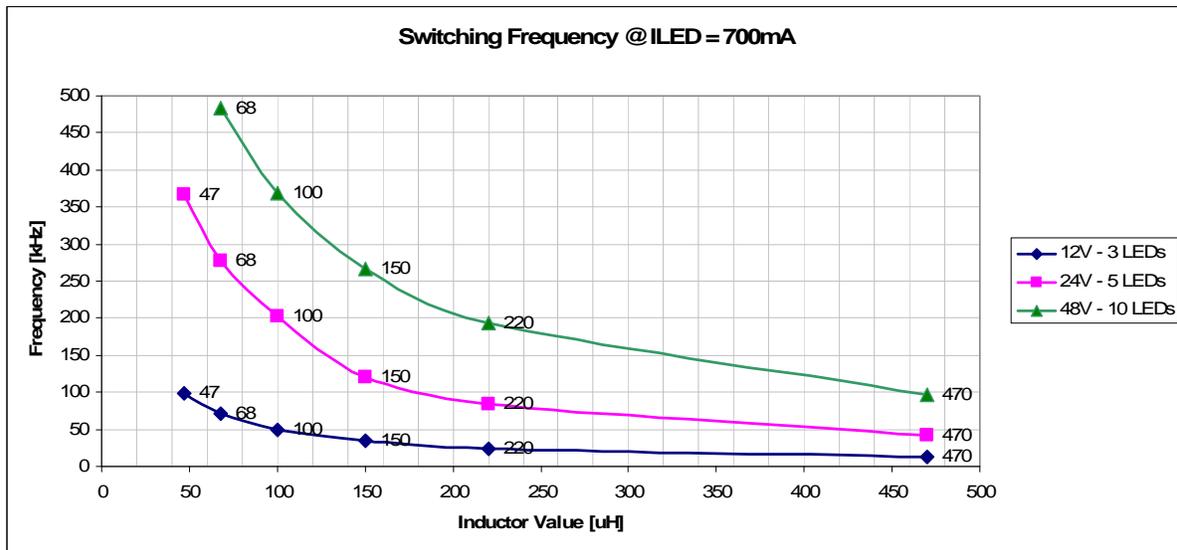


Fig. 2 Switching Frequency vs. Inductor Value

The inductor influences the LED current accuracy that the system is able to provide. The following section highlights how to select the inductor in relation to the device packages and the LED current, while maintaining the chip temperature below 70°C.

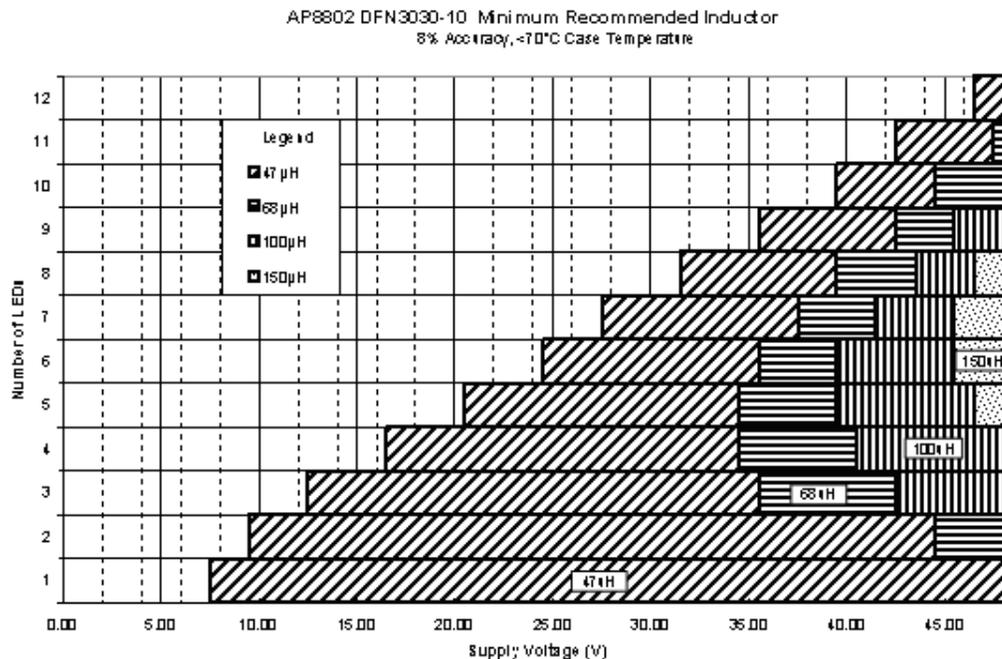


Fig. 3 DFN3030-10 recommended inductor with 1A LED current

Application Information (cont.)

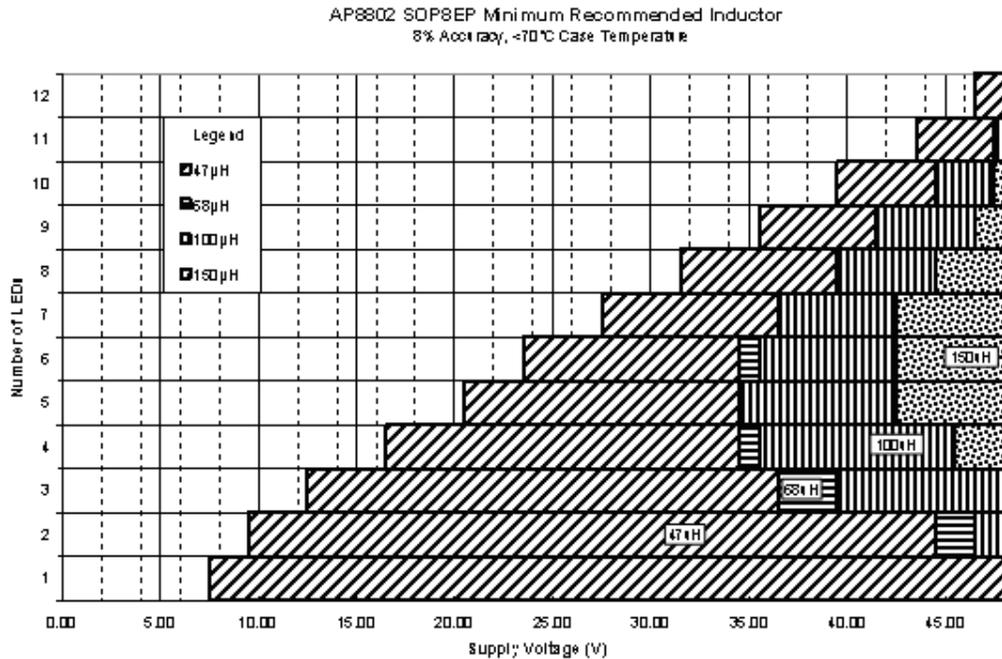


Fig. 4 SO-8EP recommended inductor with 1A LED current

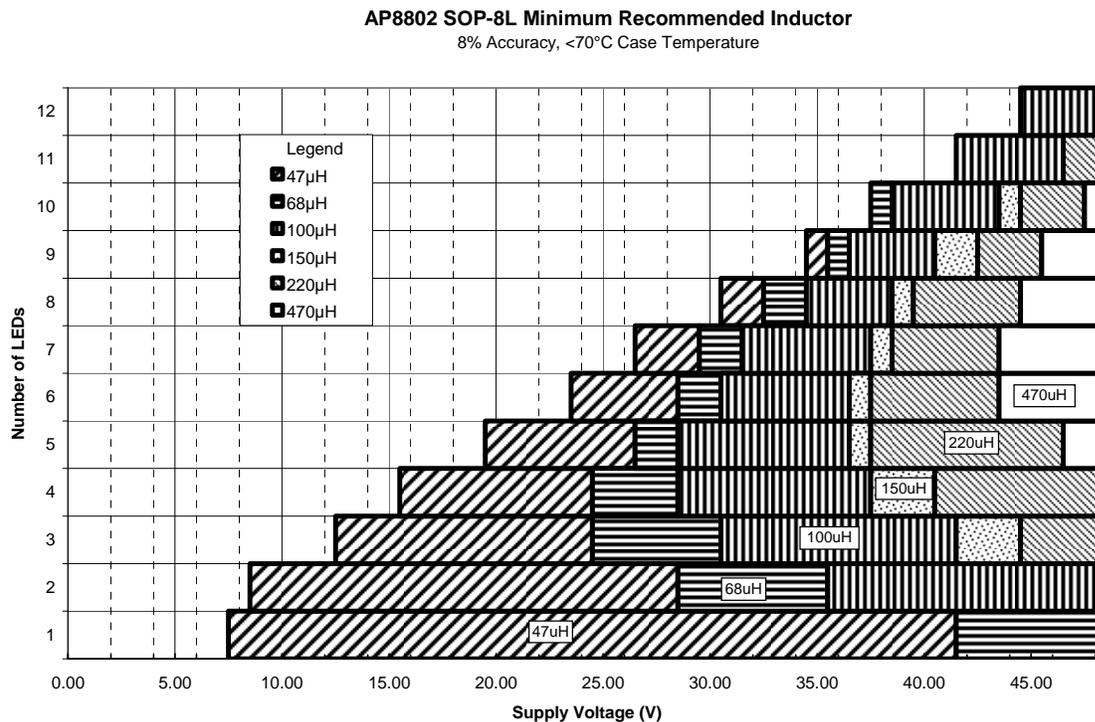


Fig. 5 SO-8 recommended inductor with 700mA LED current

Application Information (cont.)

Capacitor Selection

The small size of ceramic capacitors makes them ideal for AP8802 applications. X5R and X7R types are recommended because they retain their capacitance over wider voltage and temperature ranges than other types such as Z5U. A 2.2 μ F input capacitor is sufficient for most intended applications of AP8802. A 4.7 μ F input capacitor is suggested for application with an input voltage equal or higher than 40V.

Diode Selection

Schottky diodes, e.g. B2100 or B1100, with their low forward voltage drop and fast reverse recovery, are the ideal choice for AP8802 applications.

PWM Dimming

A Pulse Width Modulated (PWM) signal with a max resolution of 8bit, can be applied to the CTRL pin to change the output current to a value above or below the nominal average value set by resistor RSET. To achieve this resolution the PWM frequency has to be lower than 500Hz.

Thermal Considerations

The graph below in figure 6, gives details for power derating. This assumes the device to be mounted on a 25x25mm PCB with 1oz copper standing in still air.

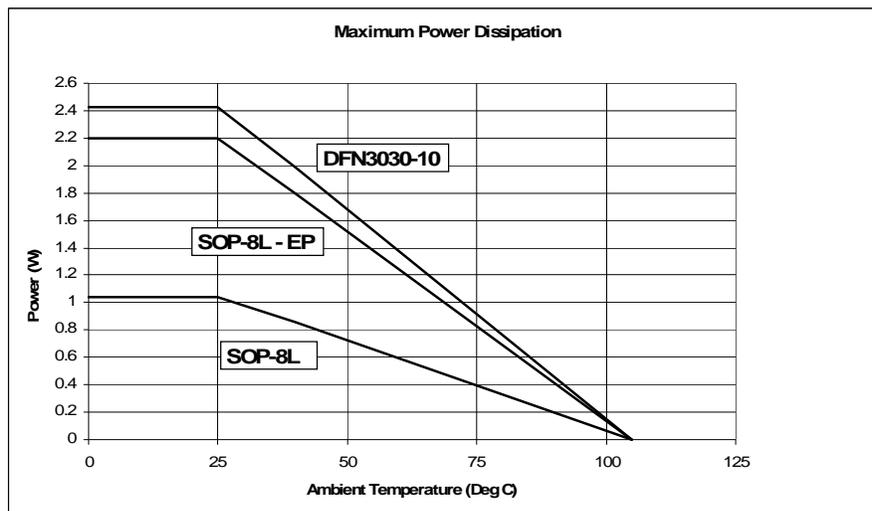


Fig. 6 AP8802 derating curves

Package Selection

The device comes with a wide selection of packages. The suggested package is able to provide a case temperature below 70°C (with an ambient temperature of 25°C) for the combination of input voltage and load requested.

Application Information (cont.)

**AP8802 - suggested package @
ILED=1A and 100µH Inductor**

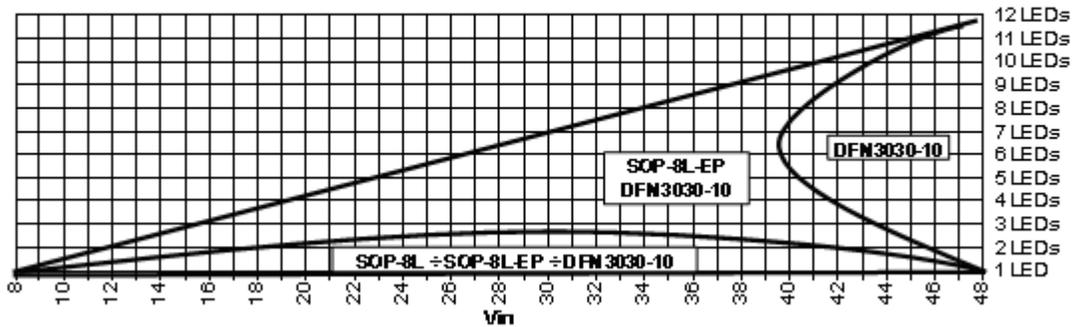


Fig. 7 Suggested package for a 1A application

**AP8802 - suggested package @
ILED=700mA and 100µH Inductor**

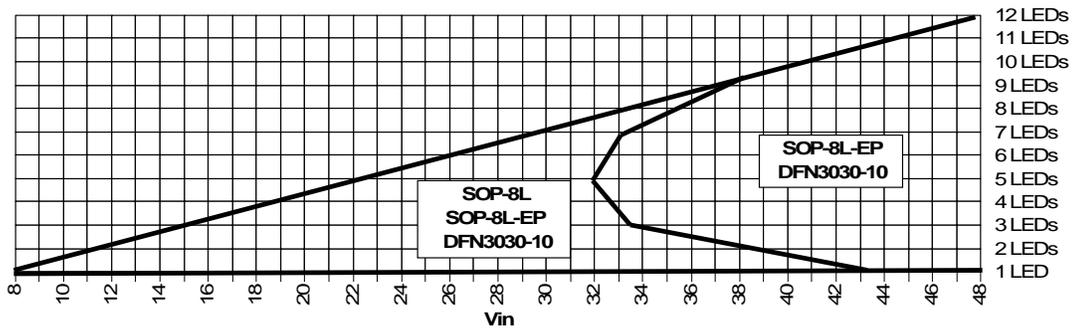
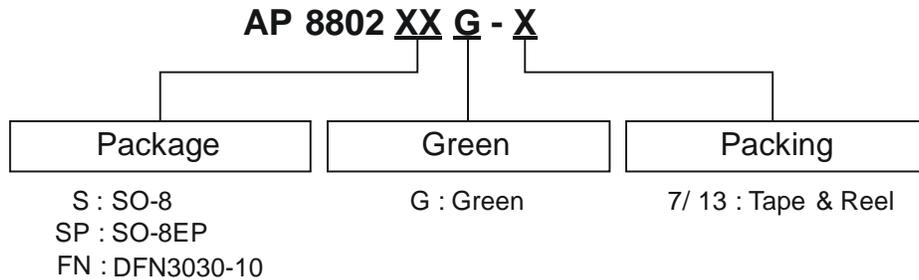


Fig. 8 Suggested package for a 700mA application

Ordering Information

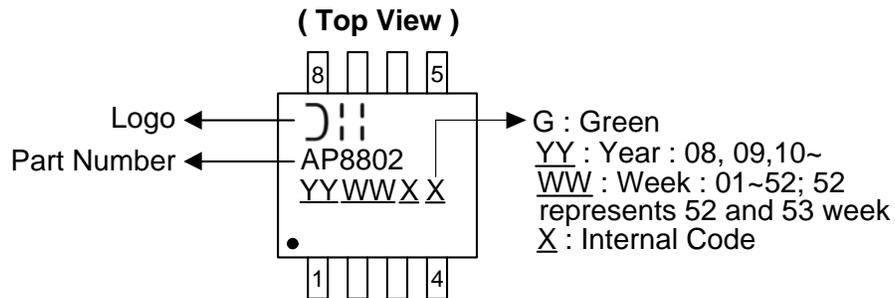


| Device | Package Code | Packaging (Note 6) | 7"/13" Tape and Reel | |
|--------------|--------------|--------------------|----------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| AP8802SG-13 | S | SO-8 | 2500/Tape & Reel | -13 |
| AP8802SPG-13 | SP | SO-8EP | 2500/Tape & Reel | -13 |
| AP8802FNG-7 | FN | DFN3030-10 | 3000/Tape & Reel | -7 |

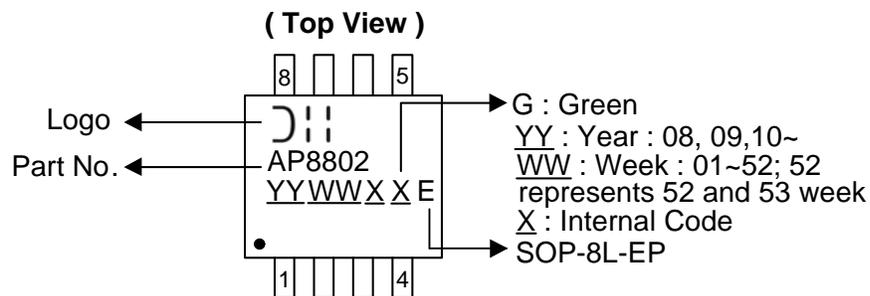
Notes: 6. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

Marking Information

(1) SO-8



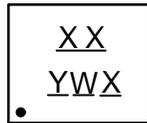
(2) SO-8EP



Marking Information (cont.)

(3) DFN3030-10

(Top View)

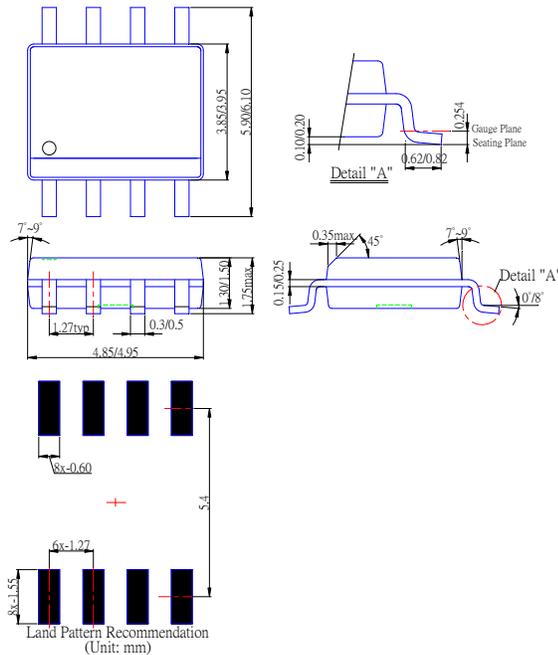


XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Green

| Part Number | Package | Identification Code |
|-------------|------------|---------------------|
| AP8802FNG-7 | DFN3030-10 | A5 |

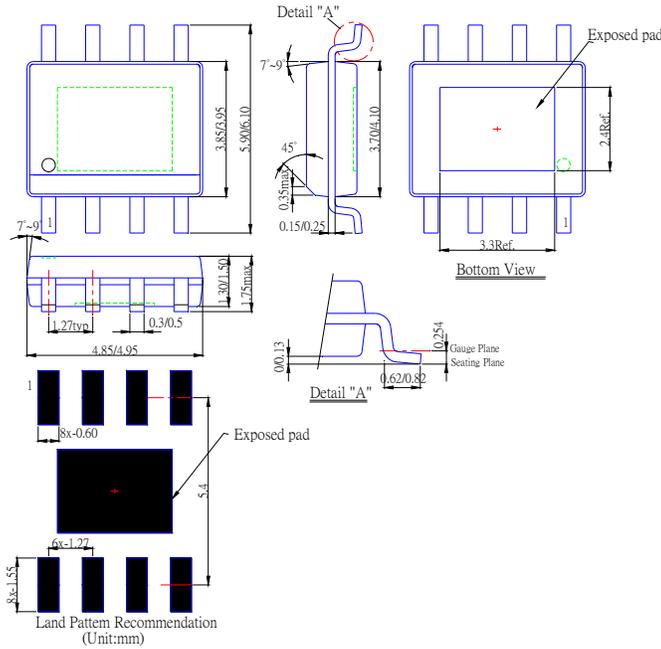
Package Outline Dimensions (All Dimensions in mm)

(1) Package Type: SO-8

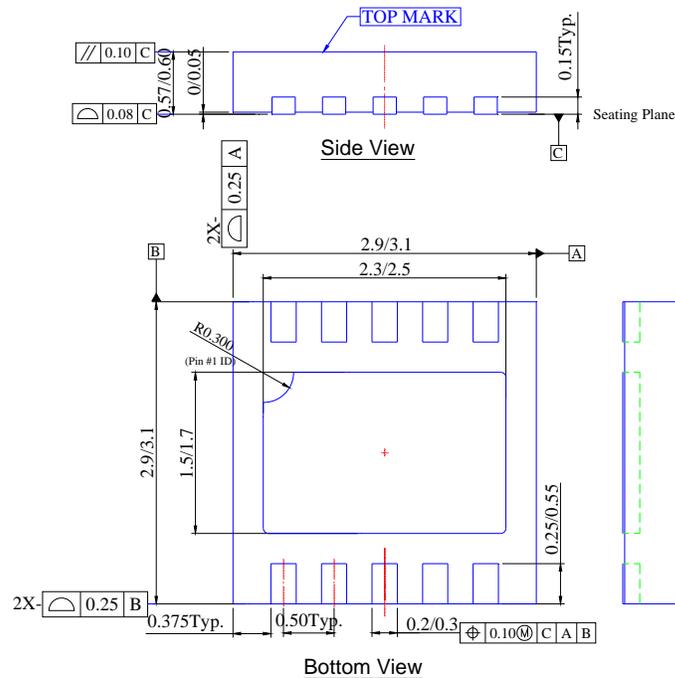


Package Outline Dimensions (cont.) (All Dimensions in mm)

(2) Package Type: SO-8EP



(3) Package Type: DFN3030-10



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