

**Description**

The AP8800 is a step-down DC/DC converter designed to drive LEDs with a constant current. The device can drive up to seven LEDs, depending on the forward voltage of the LEDs, in series from a voltage source of 8V to 28V. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminates the need for ballast resistors. The AP8800 switches at frequency up to 0.6MHz. This allows the use of small size external components, hence minimizing the PCB area needed.

Maximum output current of AP8800 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**

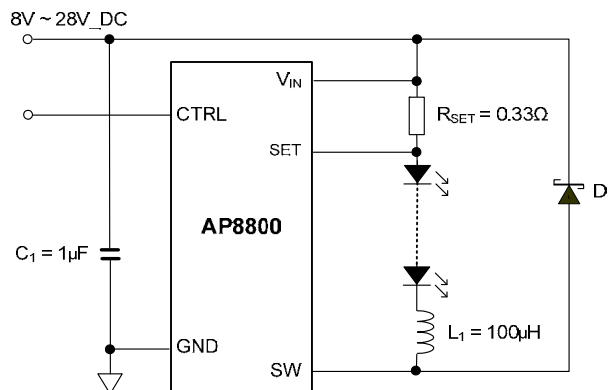
- LED driving current up to 350mA
- Compatible with 12V & 24V standard systems
- High efficiency up to 92%
- High switching frequency up to 0.6MHz
- PWM/DC input for dimming control
- Built-in soft-start function
- Built-in output open-circuit protection
- SO-8, MSOP-8 and DFN3030-10 are available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish/RoHS Compliant (Note 1)

Note: 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](http://www.diodes.com/products/lead_free.html).

**Applications**

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

**Typical Application Circuit**

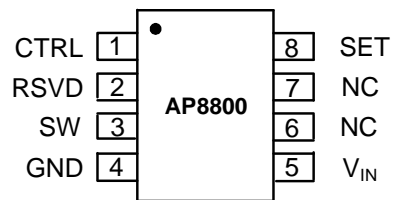


**Fig. 1 Typical Application Circuit**

**Pin Assignments**

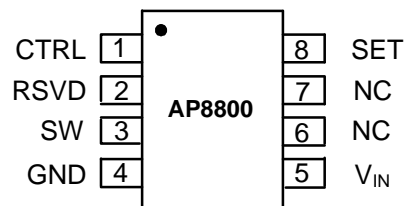
**SO-8**

( Top View )



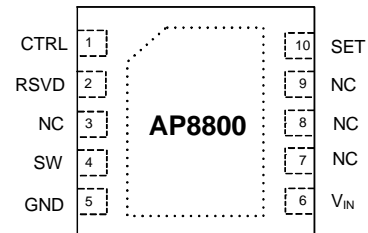
**MSOP-8**

( Top View )



**DFN3030-10**

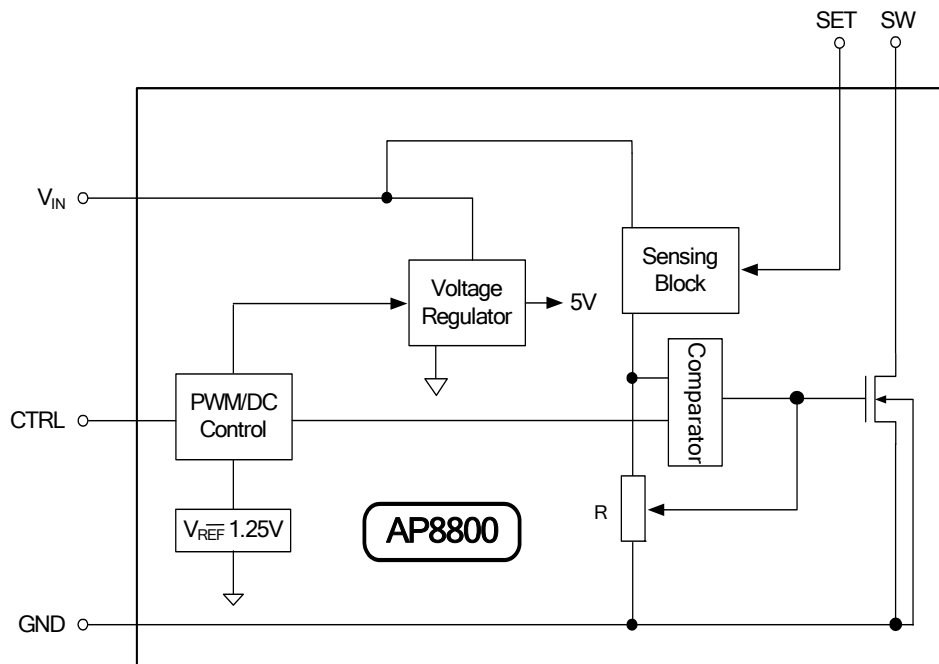
( Top View )



**Pin Descriptions**

Pin Name	Pin number			Description
	SO-8	MSOP-8	DFN3030-10	
SW	3	3	4	Switch Pin. Connect inductor/freewheeling diode here. Minimize trace area at this pin to reduce EMI.
GND	4	4	5	GND pin
SET	8	8	10	Set Nominal Output Current Pin. To configure the output current of the device.
CTRL	1	1	1	Dimming and On/Off Control Input. Input voltage of 0.2V or lower forces the device into low current standby mode and shuts off the output. A PWM signal allows the output current to be adjusted above or below the level set by the resistor connected to SET input pin. The input impedance is about 200kΩ, and if the pin is left open $V_{CTRL} = V_{REF}$
$V_{IN}$	5	5	6	Input Supply Pin. Must be locally bypassed.
RSVD	2	2	2	Reserved. Normally connected to Ground
NC	6, 7	6, 7	2, 7, 8, 9	No Connection.

**Functional Block Diagram**



**Fig. 2 AP8800 Block Diagram**

### Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
$V_{IN}$	VIN pin voltage	-0.3~30	V
$V_{SET}$	Set voltage relative to $V_{IN}$	$V_{IN} - 5 \sim V_{IN} + 0.3$	V
$V_{SW}$	SW voltage	-0.3~30	V
$V_{CTRL}$	CTRL pin input voltage	-0.3 ~ 5	V
$T_J$	Maximum Junction Temperature	125	°C
$T_{LEAD}$	Maximum Lead Temperature	300	°C
$T_{ST}$	Storage Temperature Range	-55 to +125	°C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any condition. 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

Symbol	Parameter	Min	Max	Unit
$T_A$	Ambient Temperature Range	-40	85	°C
Duty Cycle	Using Inductor $\geq 100\mu\text{H}$ (Note 2)	0.1	0.95	
$V_{ENH}$	CTRL input voltage to attain 100% LED current	1.25		V
$V_{ENL}$	CTRL input voltage below which device turns off		0.2	

Note: 2. 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 ( $V_{IN} = 12\text{V}$ , $T_A = 25^\circ\text{C}$ , unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
$V_{IN}$	Operating input voltage		8.0	-	28	V
$I_{OUT}$	Continuous switch current	(Note 3)	-	-	350	mA
$I_Q$	Quiescent current		-	20	30	$\mu\text{A}$
$F_{OSC}$	Switching frequency		-	0.25	-	MHz
$V_{THD}$	Internal current sense threshold voltage	$V_{IN} - V_{SET}$	92	100	108	mV
$V_{REF}$	Internal reference voltage		-	1.25	-	V
SET	SET pin input current	$V_{SET} = V_{IN} - 0.1$	-	1.3	-	$\mu\text{A}$
$R_{DS(on)}$	On-resistance of internal switch			1.7	2.2	$\Omega$
$I_{SW\_Leakage}$	Switch pin leakage current		-	-	5	$\mu\text{A}$
$\theta_{JA}$	Thermal resistance junction-to-ambient	SO-8 (Note 4)	-	92	-	°C/W
		MSOP-8 (Note 4)	-	120	-	°C/W
		DFN3030-10 (Note 4)	-	46	-	°C/W
$\theta_{JC}$	Thermal resistance junction-to-case	SO-8 (Note 4)	-	60	-	°C/W
		MSOP-8 (Note 4)	-	98	-	°C/W
		DFN3030-10 (Note 4)	-	32	-	°C/W

Notes: 3. Refer to figure 5 for the device derating curve.  
4. Test condition for SOP-8L, MSOP-8L 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.

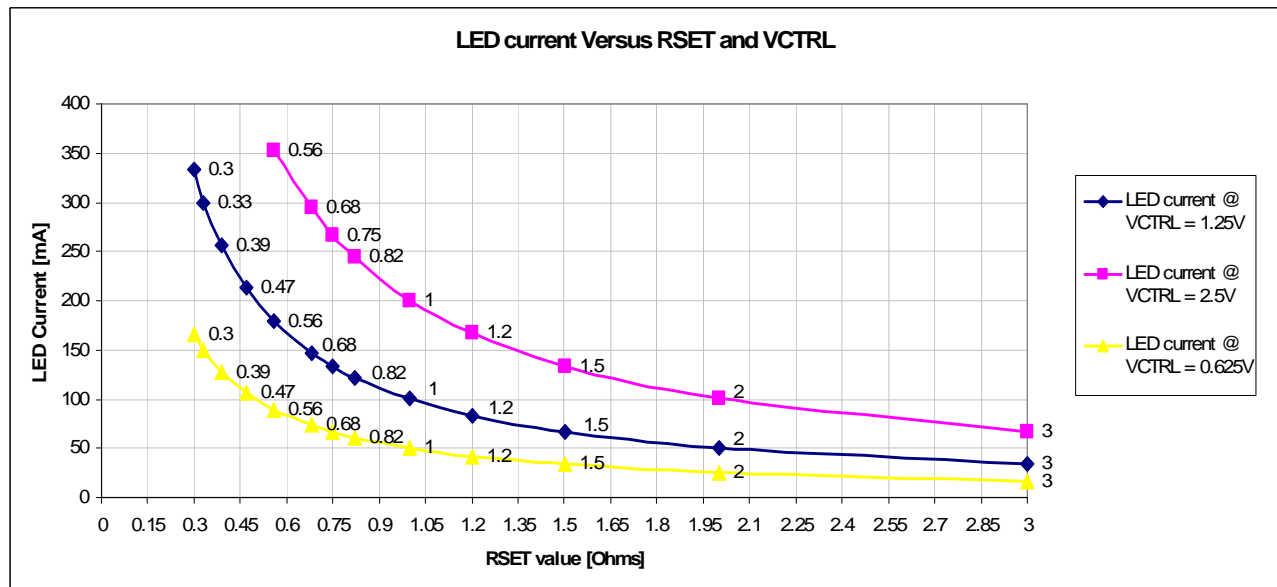
If the CTRL pin is floating and at a nominal voltage of VREF, the external current sense resistor RSET (greater than 0.3 Ω) is connected between VIN and SET and defines the nominal average output current in the LED(s) as:

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

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

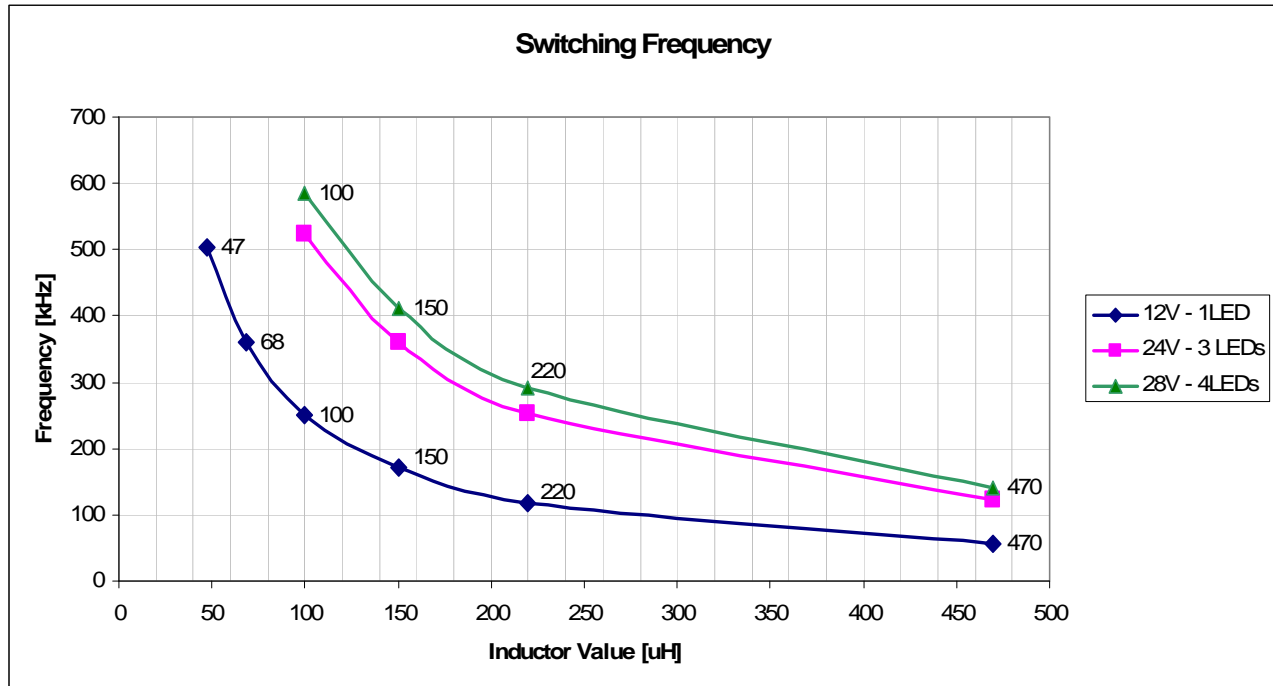
$$I_{LED} = \frac{V_{CTRL}}{V_{REF}} \frac{V_{THD}}{R_{SET}}$$

The graph in figure 3 gives values of nominal average output current for several values of current setting resistor (RSET) in the typical application circuit shown on Figure 1, for different voltages applied on the CTRL pin.



**Fig. 3 LED Current setting vs. RSET and VCTRL**

**Application Information (cont.)**



**Fig 4. Switching Frequency vs. Supply voltage, Inductor, and number of LEDs**

**Capacitor Selection**

The small size of ceramic capacitors makes them ideal for AP8800 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 1µF input capacitor is sufficient for most intended applications of AP8800.

**Diode Selection**

Schottky diode, e.g. B140, with their low forward voltage drop and fast reverse recovery, is the ideal choice for AP8800 applications.

**PWM Dimming**

A Pulse Width Modulated (PWM) signal with a max resolution of 8bit can be applied to the CTRL pin to regulate the output current to a value above or below the nominal average value set by resistor RSET.

**Miscellaneous**

To ensure optimal performance, RSVD pin should be connected to the GND pin with the shortest trace length.

**Inductor Selection**

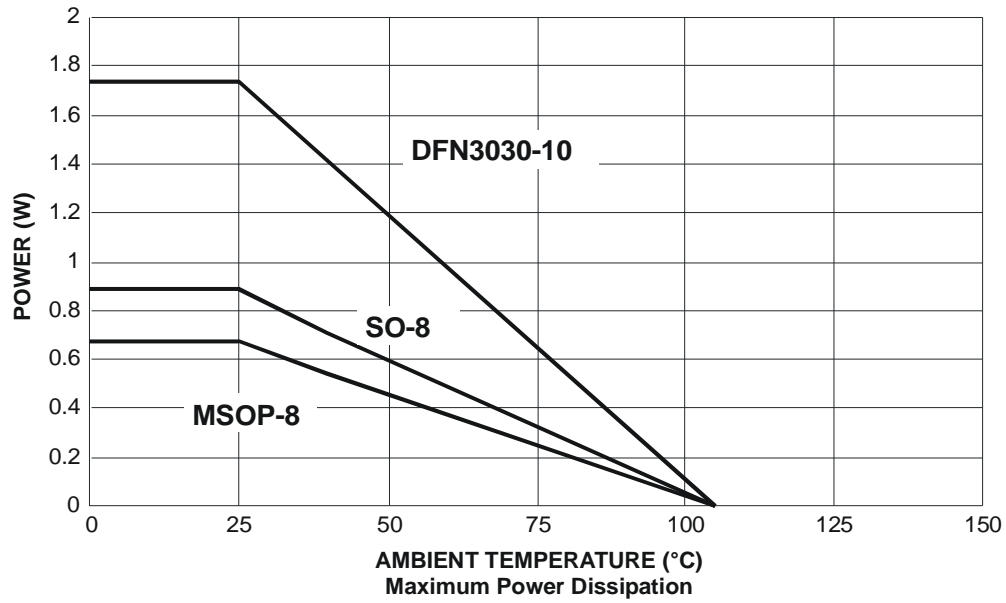
A 100µH inductor is recommended for most AP8800 applications with input voltage at 24V.

Figure 4 displays the resulting switching frequency varying the main circuit parameters: Supply voltage, Inductor value and number of LEDs to be driven.

**Thermal Considerations**

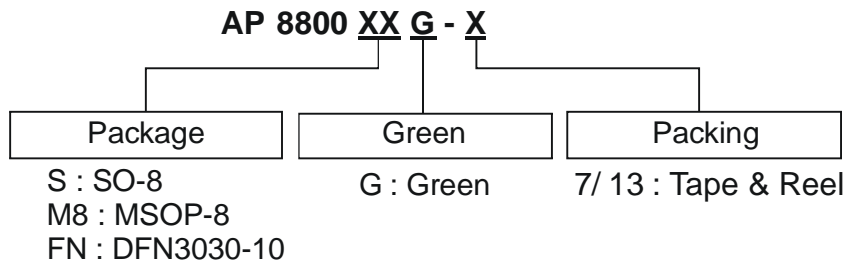
The graph below in figure 5, gives details for power derating. This assumes the device to be mounted on a 25x25mm PCB with 1oz copper standing in still air.

**Application Information (cont.)**



**Fig. 5 Derating curve**

**Ordering Information**

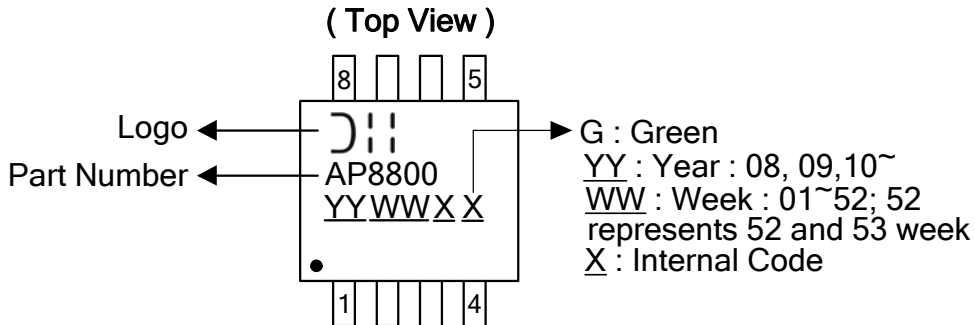


Device	Package Code	Packaging (Note 5)	7"/13" Tape and Reel	
			Quantity	Part Number Suffix
AP8800SG-13	S	SO-8	2500/Tape & Reel	-13
AP8800M8G-13	M8	MSOP-8	2500/Tape & Reel	-13
AP8800FNG-7	FN	DFN3030-10	3000/Tape & Reel	-7

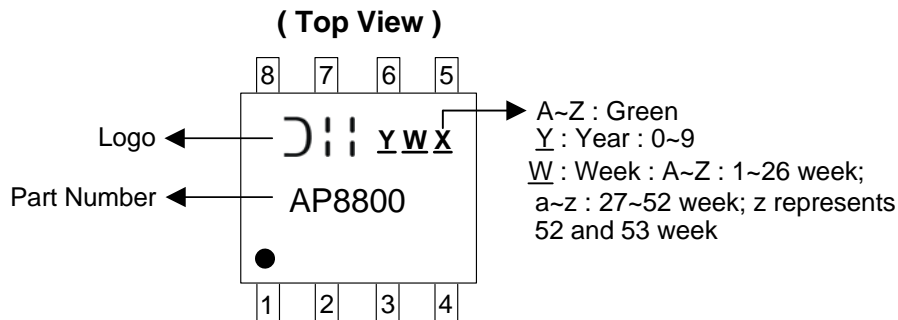
Notes: 5. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

**Marking Information**

**SO-8**



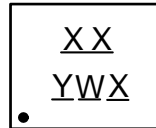
**MSOP-8**



**Marking Information (cont.)**

DFN3030-10

( Top View )



XX : Identification Code

Y : Year : 0~9

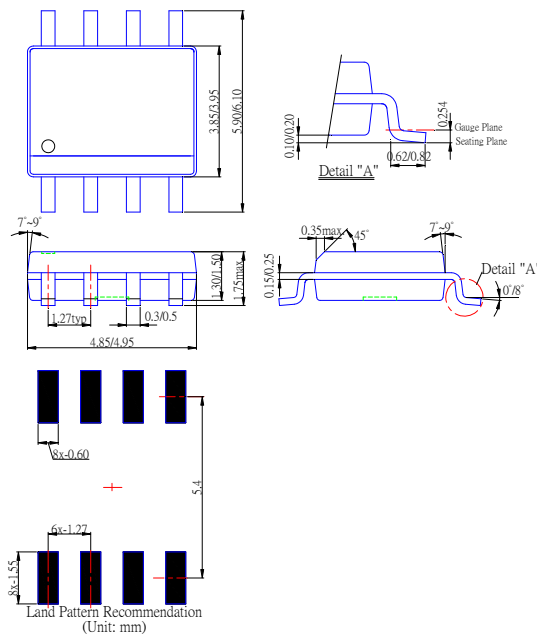
W : Week : A~Z : 1~26 week;  
a~z : 27~52 week; z represents  
52 and 53 week

X : A~Z : Green

Part Number	Package	Identification Code
AP8800FNG-7	DFN3030-10	A4

**Package Outline Dimensions (All Dimensions in mm)**

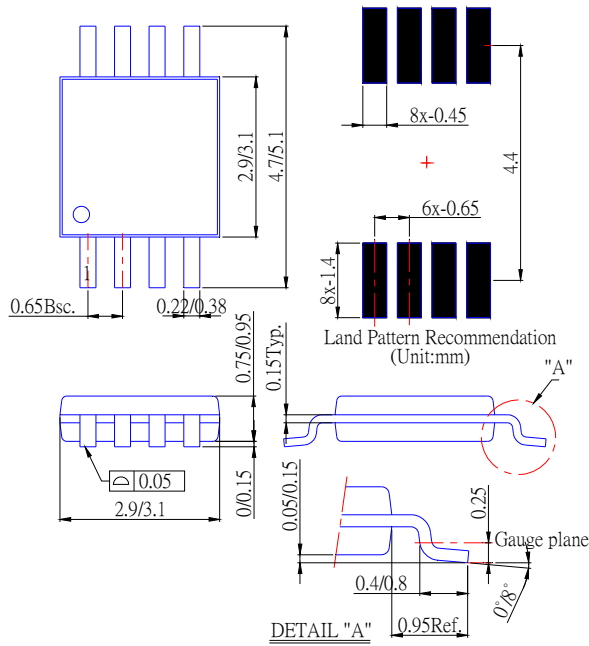
Package Type: SO-8



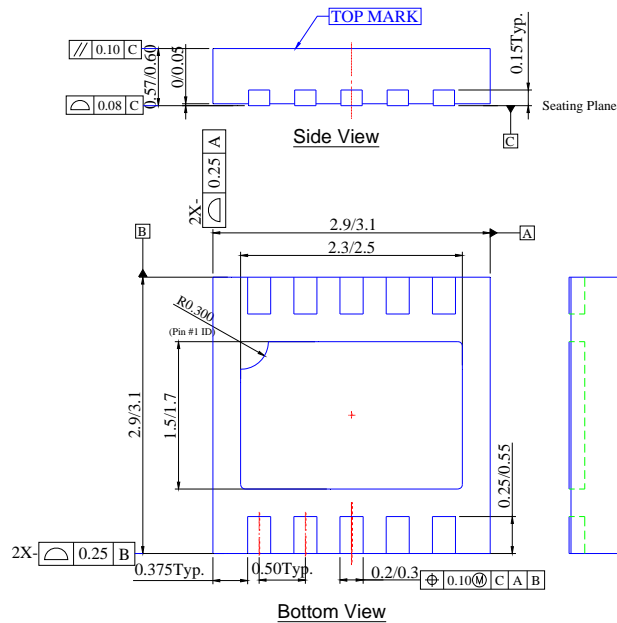


**Package Outline Dimensions (All Dimensions in mm) (cont.)**

**Package Type: MSOP-8**



**Package Type: DFN3030-10**

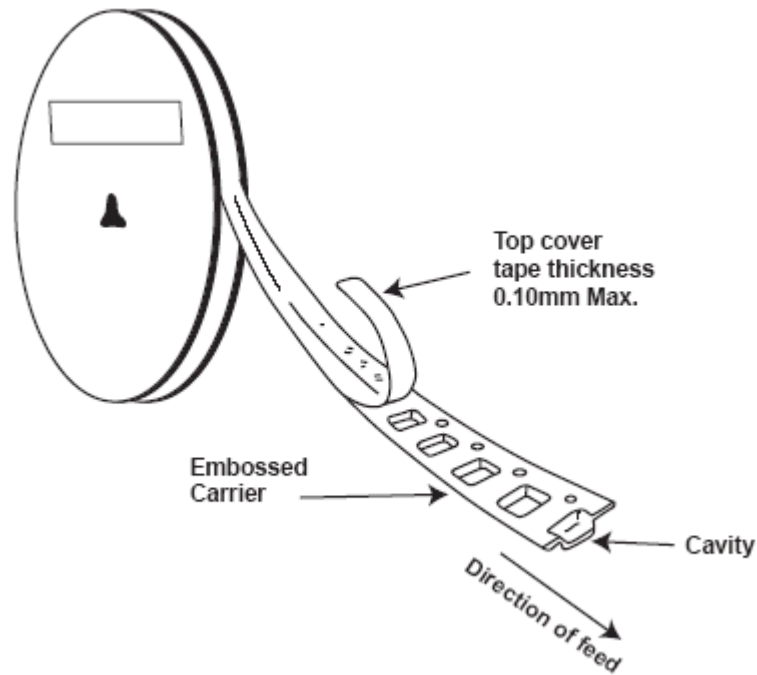
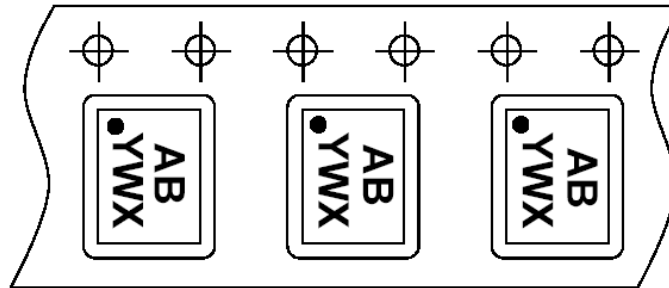


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**Tape Orientation (Note 6)**

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For DFN3030-10



Notes: 6. The taping orientation of the other package type can be found on our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

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