



## WHITE LED STEP-UP CONVERTER

**AP3030**

### General Description

The AP3030 is an inductor-based DC/DC converter designed to drive up to eight white LEDs in series or 2 rows of LEDs with 5 for each in parallel for backlight. Only one feedback resistor is needed to control the LED current and obtain required brightness.

A constant frequency 1.2MHz PWM control scheme is employed in this IC, which means tiny external components can be used. Specifically, 1mm tall inductor and 0.22 $\mu$ F output capacitor for a typical application are sufficient. Additionally, the schottky diode in boost circuit is integrated on this chip. AP3030 also provides a disable pin to ease its use for different systems.

The output over-voltage protection is implemented in AP3030. When any LED is broken or in other abnormal conditions, the output voltage will be clamped.

The AP3030 is available in standard SOT-23-6 and TSOT-23-6 packages.

### Features

- Inherently Uniform LED Current
- High Efficiency up to 84%
- No Need for External Schottky Diode
- Output Over-Voltage Protection (OVP)
- Fixed 1.2MHz Switching Frequency
- Uses Tiny 1mm Tall Inductor
- Requires Only 0.22 $\mu$ F Output Capacitor

### Applications

- Cellular Phones
- Digital Cameras
- LCD modules
- GPS Receivers
- PDAs, Handheld Computers

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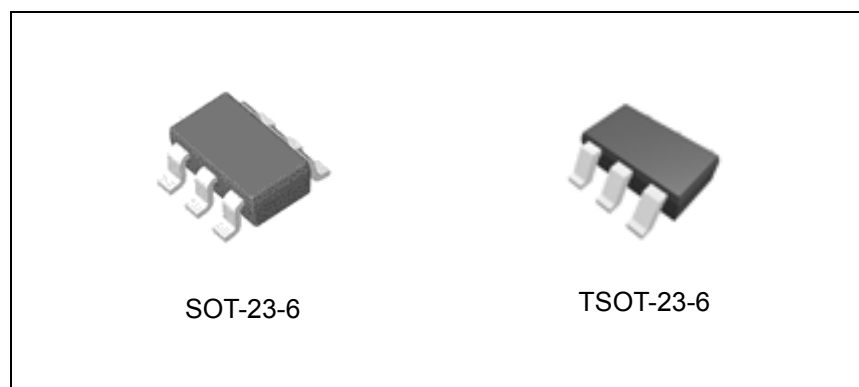


Figure 1. Package Types of AP3030

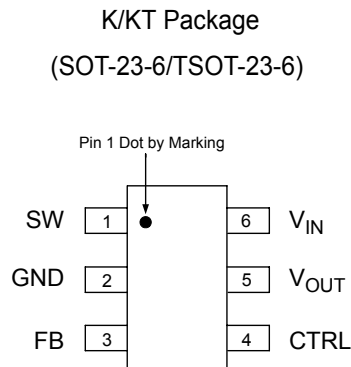

**WHITE LED STEP-UP CONVERTER**
**AP3030**
**Pin Configuration**


Figure 2. Pin Configuration of AP3030 (Top View)

**Pin Description**

Pin Number	Pin Name	Function
1	SW	Switch Pin. Connect external inductor
2	GND	Ground
3	FB	Voltage Feedback. Reference voltage is 200mV
4	CTRL	Shutdown and Dimming Pin. Connect to 1.8V or higher to enable device; Connect to 50mV or less to disable device; Connect to a voltage between 1.8V and 50mV to achieve linear dimming
5	$V_{OUT}$	Output Pin. Connected to the cathode of internal schottky diode
6	$V_{IN}$	Input Supply Pin. Must be locally bypassed



**WHITE LED STEP-UP CONVERTER AP3030**

**Functional Block Diagram**

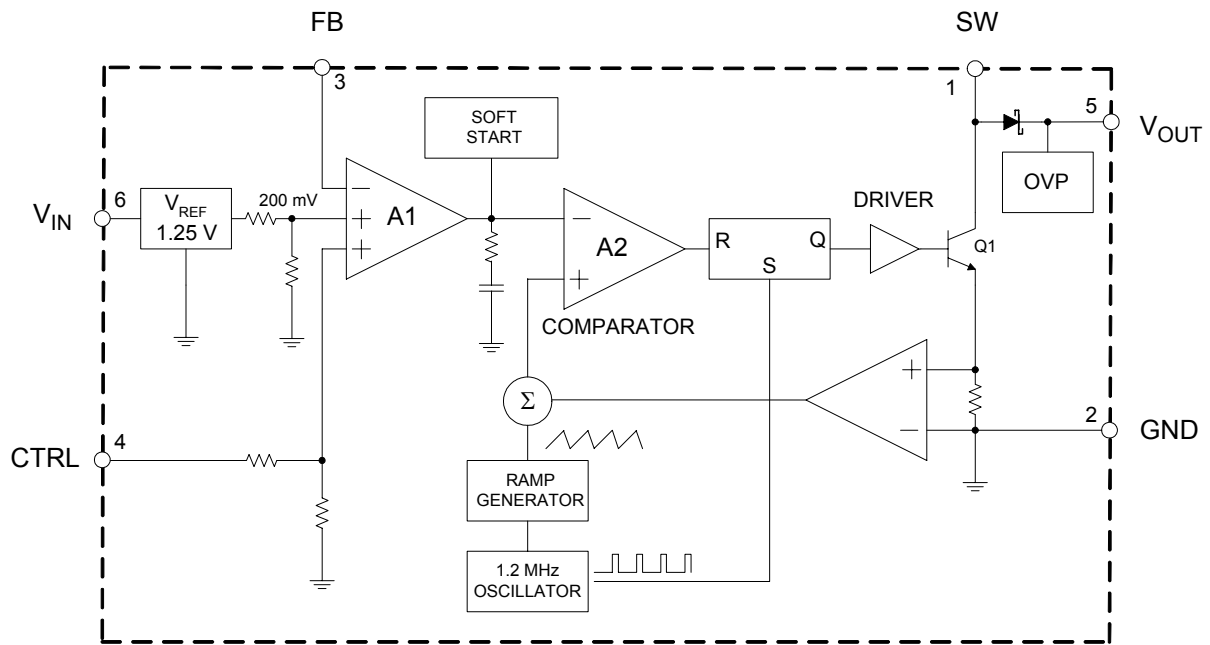
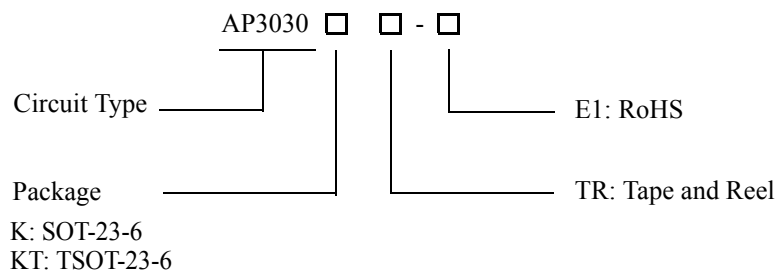


Figure 3. Functional Block Diagram of AP3030

**Ordering Information**

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Package	Temperature Range	Part Number	Marking ID	Packing Type
SOT-23-6	-40 to 85°C	AP3030KTR-E1	EEB	Tape & Reel
TSOT-23-6	-40 to 85°C	AP3030KTTR-E1	S9G	Tape & Reel

BCD Semiconductor's products as designated with "E1" suffix in the part number are RoHS compliant.

**WHITE LED STEP-UP CONVERTER****AP3030****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit
Input Voltage	$V_{IN}$	20	V
SW Voltage	$V_{SW}$	38	V
FB Voltage	$V_{FB}$	20	V
CTRL Voltage	$V_{CTRL}$	20	V
Thermal Resistance (Junction to Atmosphere, No Heat Sink)	$R_{\theta JA}$	265	$^{\circ}C/W$
Operating Junction Temperature	$T_J$	150	$^{\circ}C$
Storage Temperature Range	$T_{STG}$	-65 to 150	$^{\circ}C$
Lead Temperature (Soldering, 10sec)	$T_{LEAD}$	260	$^{\circ}C$
ESD (Machine Model)		250	V
ESD (Human Body Model)		2000	V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

**Recommended Operating Conditions**

Parameter	Symbol	Min	Max	Unit
Operating Temperature Range	$T_{OP}$	-40	85	$^{\circ}C$
Input Voltage	$V_{IN}$	2.5	16	V
CTRL Voltage	$V_{CTRL}$		16	V


**WHITE LED STEP-UP CONVERTER**
**AP3030**
**Electrical Characteristics**

 ( $V_{IN}=3V$ ,  $V_{CTRL}=3V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Minimum Operating Voltage	$V_{IN(min)}$		2.5			V
Maximum Operating Voltage	$V_{IN(max)}$				16	
Feedback Voltage	$V_{FB}$	$I_{OUT}=20mA$ , 4 LEDs, $T_A=-40^{\circ}C$ to $85^{\circ}C$	188	200	212	mV
FB Pin Bias Current	$I_{FB}$			35	100	nA
Quiescent Current	$I_Q$	$V_{FB}=V_{IN}$ , no switching	1.5	2.5	3.2	mA
Shutdown Quiescent Current	$I_{SHDN}$	$V_{CTRL}=0V$	2.0	3.2	5.0	$\mu A$
Switch Frequency	f		0.9	1.2	1.5	MHz
Maximum Duty Cycle	$D_{MAX}$		90	93		%
Switch Current Limit (Note 2)	$I_{LIMIT}$	D=40%		550		mA
		D=80%		550		
Switch $V_{CE}$ Saturation Voltage	$V_{CESAT}$	$I_{SW}=250mA$		360		mV
Switch Leakage Current		$V_{SW}=5V$		0.01	5	$\mu A$
CTRL Pin Voltage	$V_{CTRL}$	High	1.8			V
		Low			0.05	
CTRL Pin Bias Current	$I_{CTRL}$		40	55	72	$\mu A$
		$T_A=85^{\circ}C$		50		
		$T_A=-40^{\circ}C$		75		
OVP Voltage	$V_{OV}$			30		V
Schottky Forward Drop	$V_{DROP}$	$I_D=150mA$		0.7		V
Schottky Leakage Current		$V_R=23V$		0.1	4	$\mu A$
		$V_R=27V$			150	
Soft Start Time	t			300		$\mu S$
Thermal Resistance (Junction to Case)	$\theta_{JC}$	SOT-23-6		60		$^{\circ}C/W$
		TSOT-23-6		60		

Note 2: The switch current limit is related to duty cycle. Please refer to Figure 15 for detail.



## WHITE LED STEP-UP CONVERTER

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### Typical Performance Characteristics

( $V_F$ (forward voltage) of WLED is 3.45V @  $I_F=20\text{mA}$ , unless otherwise noted )

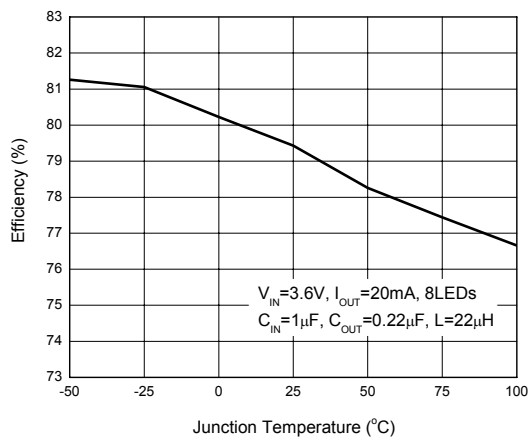


Figure 4. Efficiency vs. Junction Temperature

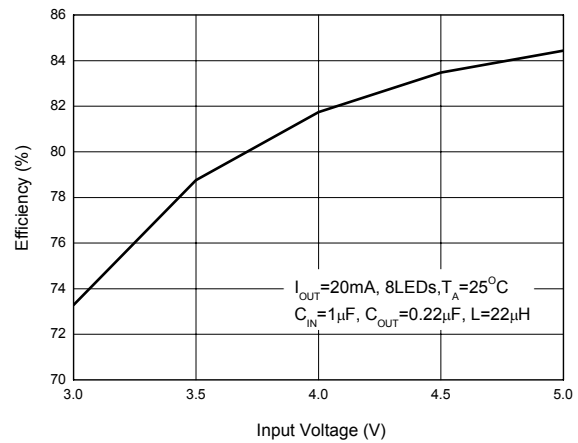


Figure 5. Efficiency vs. Input Voltage

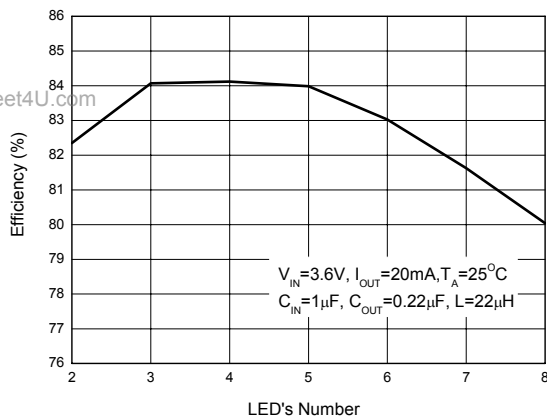


Figure 6. Efficiency vs. LED's Number

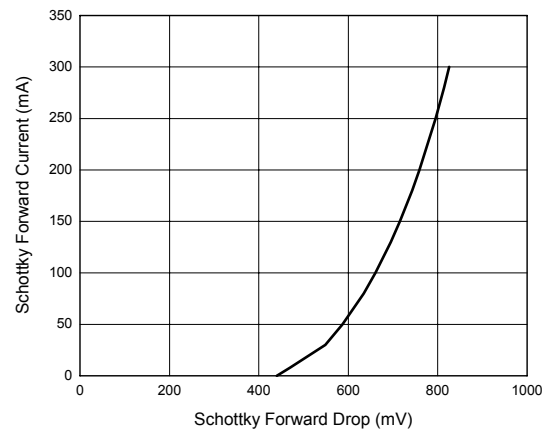


Figure 7. Schottky Forward Current vs. Schottky Forward Drop



**WHITE LED STEP-UP CONVERTER**

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**Typical Performance Characteristics (Continued)**

( $V_F$ (forward voltage) of WLED is 3.45V @  $I_F=20mA$ , unless otherwise noted )

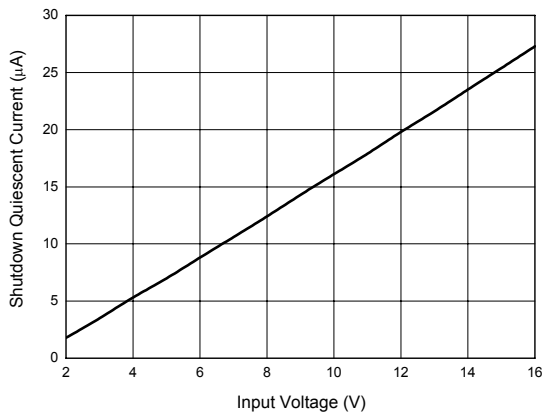


Figure 8. Shutdown Quiescent Current vs. Input Voltage

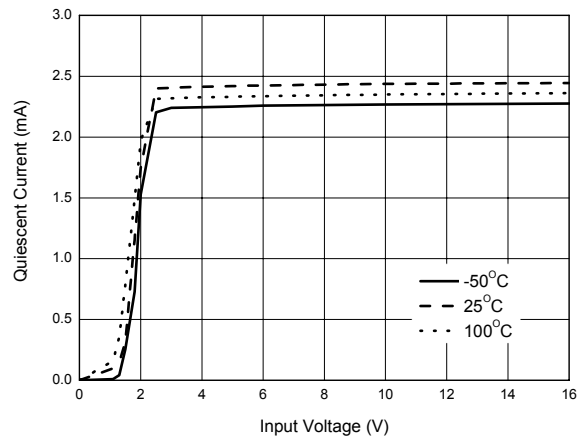


Figure 9. Quiescent Current vs. Input Voltage

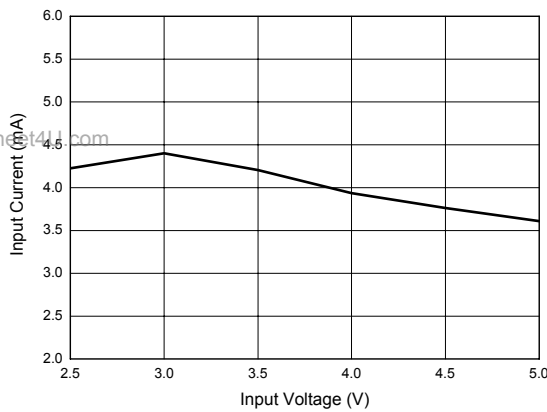


Figure 10. Input Current in Output Open Circuit vs. Input Voltage

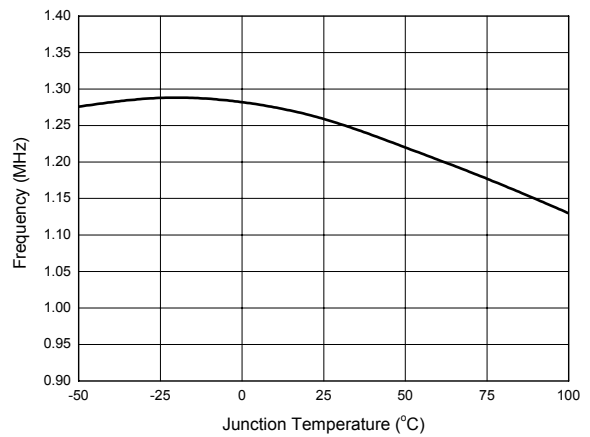


Figure 11. Switch Frequency vs. Junction Temperature



**WHITE LED STEP-UP CONVERTER**

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**Typical Performance Characteristics (Continued)**

( $V_F$ (forward voltage) of WLED is 3.45V @  $I_F=20mA$ , unless otherwise noted )

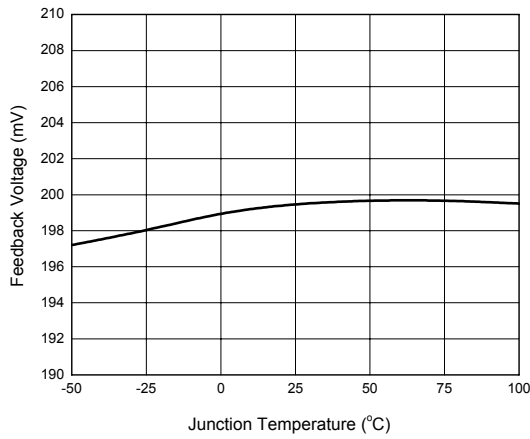


Figure 12. Feedback Voltage vs. Junction Temperature

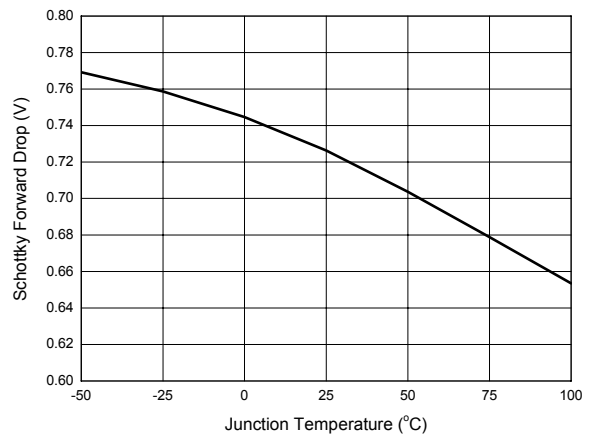


Figure 13. Schottky Forward Drop vs. Junction Temperature

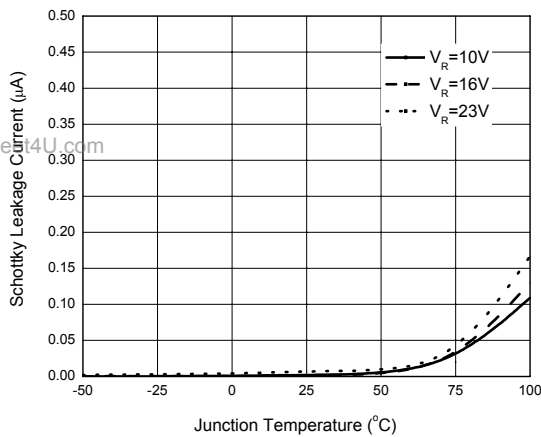


Figure 14. Schottky Leakage Current vs. Junction Temperature

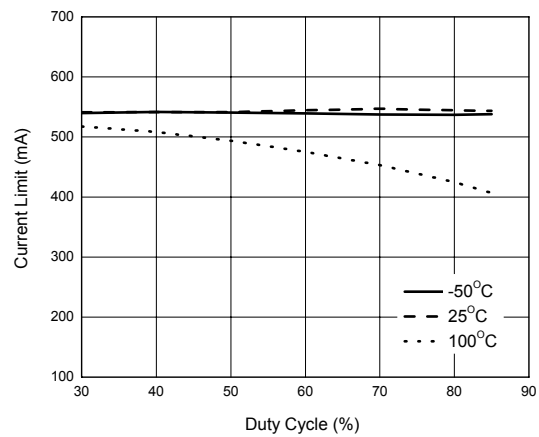


Figure 15. Switch Current Limit vs. Duty Cycle




**WHITE LED STEP-UP CONVERTER**
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**Typical Performance Characteristics (Continued)**

( $V_F$ (forward voltage) of WLED is 3.45V @  $I_F=20\text{mA}$ , unless otherwise noted )

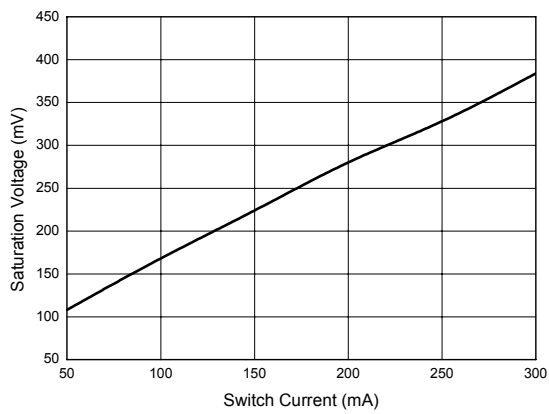


Figure 16. Switch Saturation Voltage vs. Switch Current

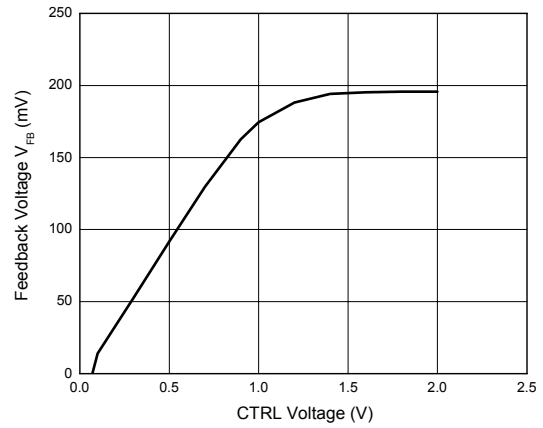


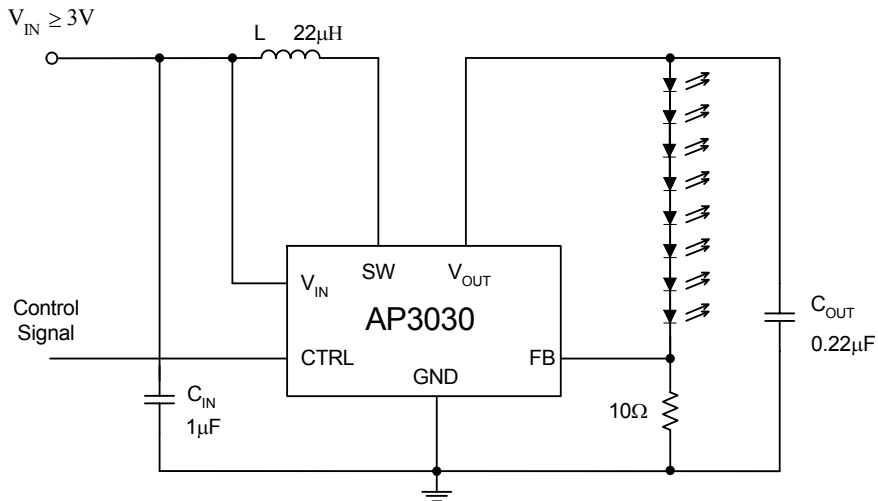
Figure 17. Feedback Voltage vs. CTRL Pin Voltage



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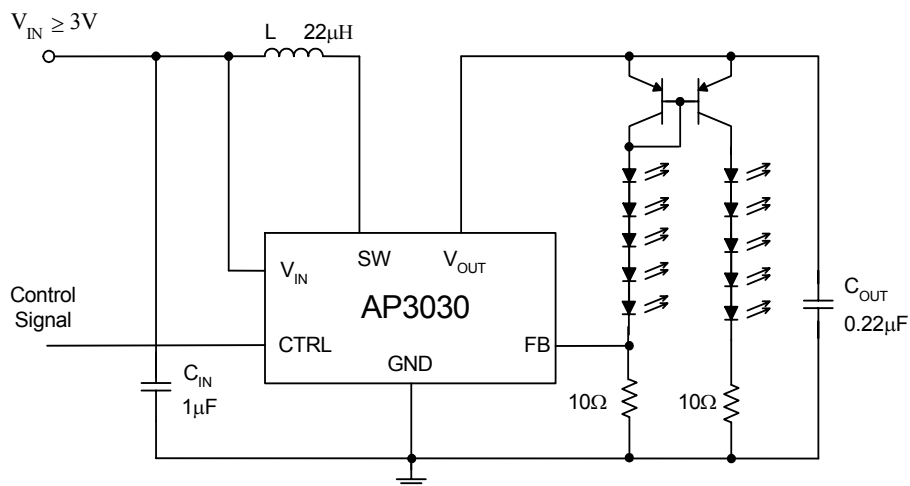
## AP3030

### Typical Application



C: X5R or X7R Dielectric  
 L: SUMIDA CDRH5D28R-220NC or Equivalent  
 This circuit can work in full temperature

Figure 18. Typical Application of Eight LED Drivers



C: X5R or X7R Dielectric  
 L: SUMIDA CDRH5D28R-220NC or Equivalent  
 Two transistors are recommended to use Dual Matched transistor pairs  
 This circuit can work in full temperature

Figure 19. Typical Application of Ten LED Drivers



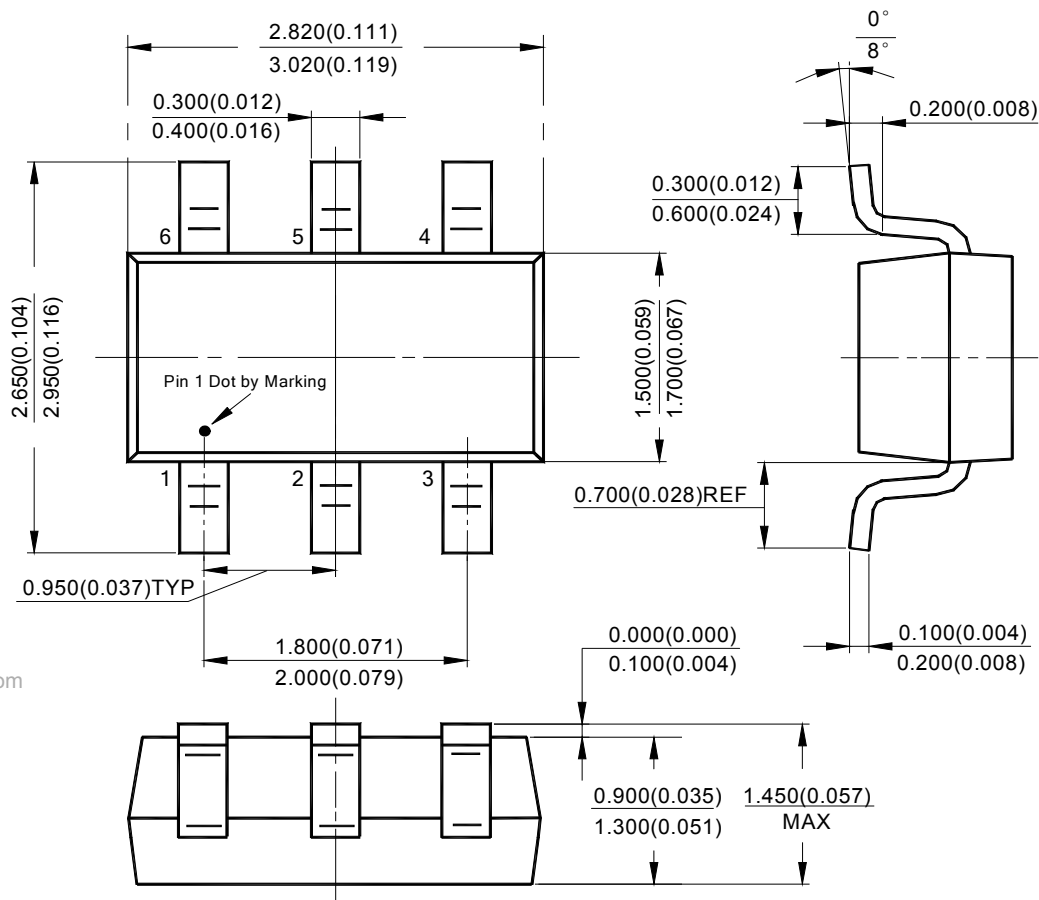
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**Mechanical Dimensions**

**SOT-23-6**

**Unit: mm(inch)**



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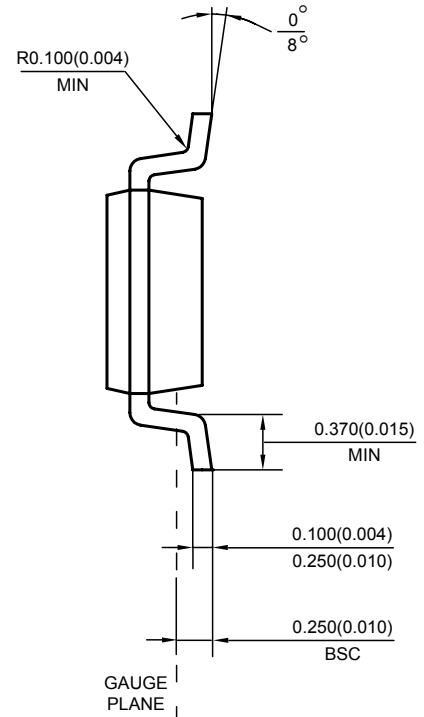
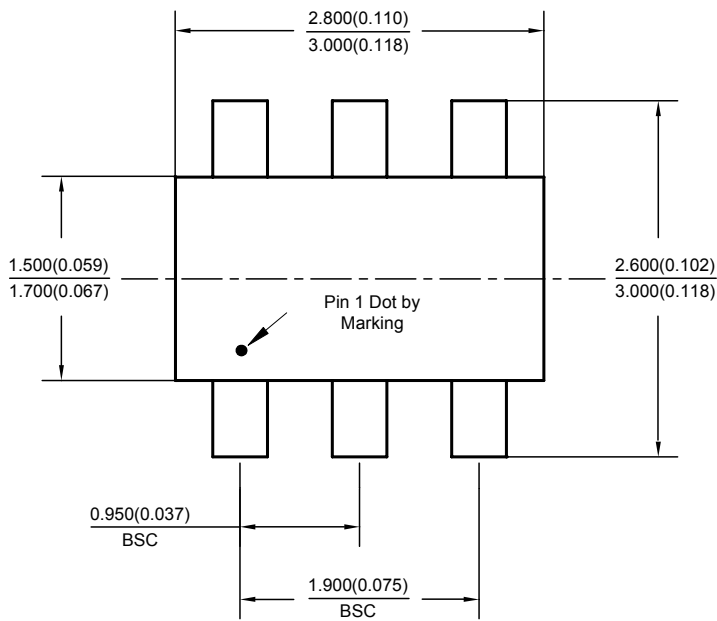
**WHITE LED STEP-UP CONVERTER**

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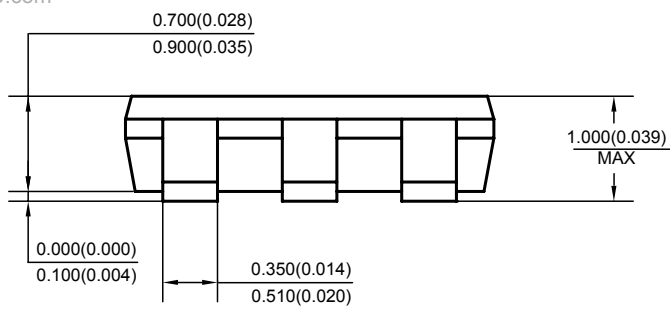
**Mechanical Dimensions (Continued)**

**TSOT-23-6**

**Unit: mm(inch)**



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