THE DATASHEET OF

AP3009KTR-E1

WHITE LED STEP-UP CONVERTER AP3009

General Description

The AP3009 is an inductor-based DC/DC converter designed to drive up to six white LEDs in series for backlight. Only one feedback resistor is needed to control the LED current and obtain satisfied brightness.

A constant frequency 1.2MHz PWM control scheme is employed in this IC, which means the tiny external components can be used. In fact, 1mm tall inductor and 0.22μF output capacitor for the typical application is very appropriate. Additionally, the schottky diode in boost circuit is integrated in this chip. AP3009 also provide a disable port to ease its use for different systems.

The over output voltage protection is equipped in AP3009. When any LED is broken or in other abnormal conditions, the output voltage will be clamped to 30V.

The AP3009 is available in standard SOT-23-6 package.

Features

- Inherently Uniform LED Current
- High Efficiency: 83% Typical
- No Need for Extra Schottky Diode
- Over Output Voltage Protection
- Drives 2 to 6 LEDs
- Fast 1.2MHz Switching Frequency
- Uses Tiny 1mm Tall Inductor
- Requires Only 0.22μF Output Capacitor

Applications

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

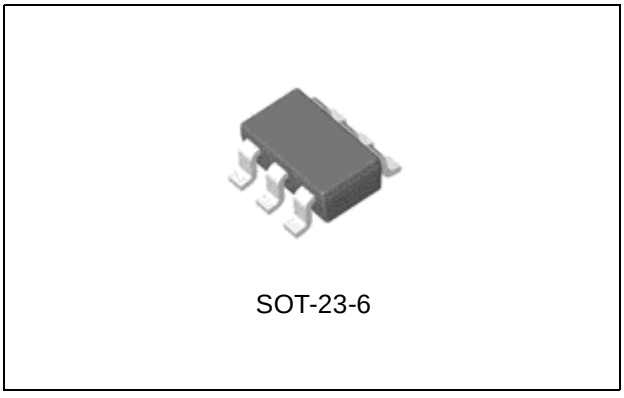


Figure 1. Package Type of AP3009

Pin Configuration

K Package
(SOT-23-6)

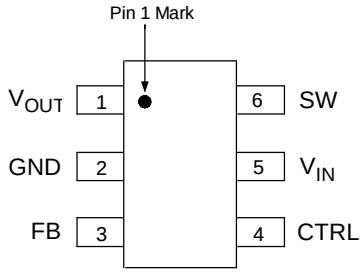


Figure 2. Pin Configuration of AP3009 (Top View)

Pin Description

Pin Number	Pin Name	Function
1	V_{OUT}	Output Pin. Connected to the cathode of internal schottky diode
2	GND	Ground Pin
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_{IN}	Input Supply Pin. Must be locally bypassed
6	SW	Switch Pin. Connect external inductor

Functional Block Diagram

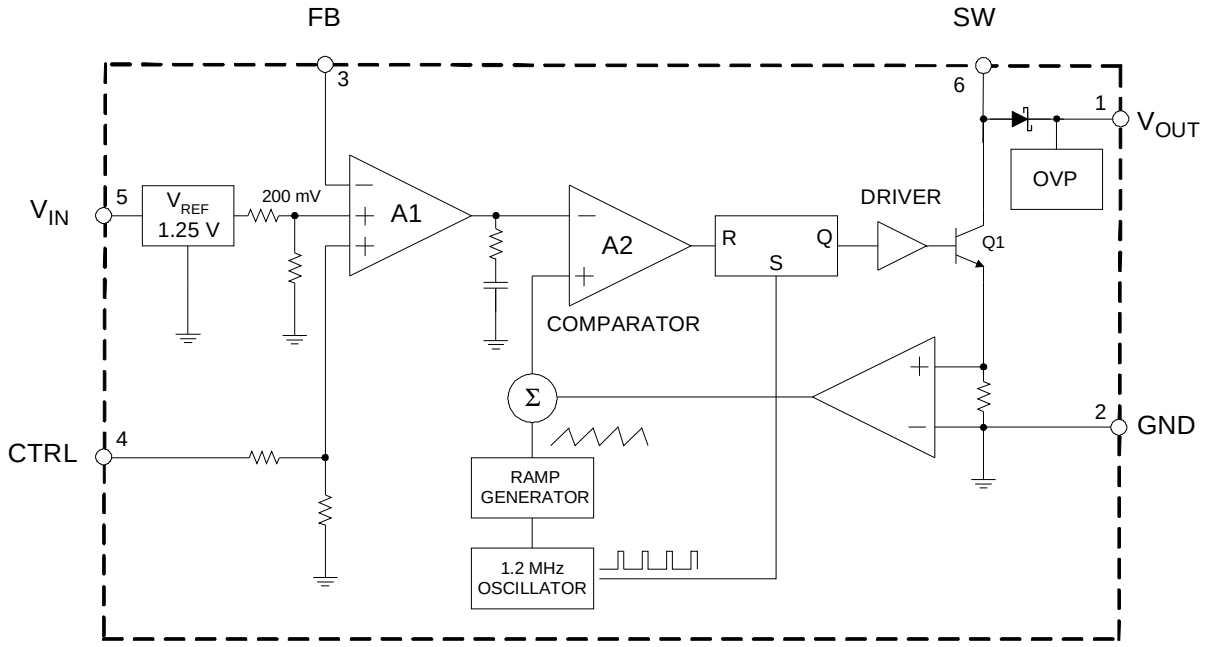
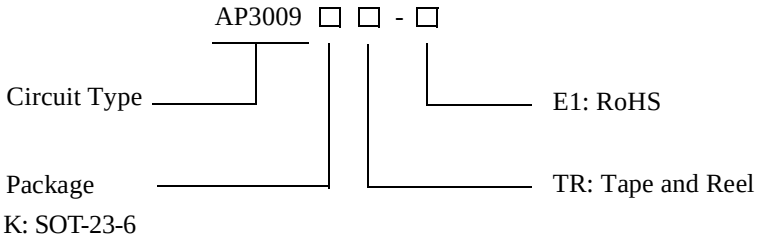


Figure 3. Functional Block Diagram of AP3009

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SOT-23-6	-40 to 85°C	AP3009KTR-E1	E9T	Tape & Reel

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

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	20	V
SW Voltage		38	V
FB Voltage		20	V
CTRL Voltage		20	V
Thermal Resistance (Junction to Atmosphere, no Heat sink)	θ_{JA}	265	°C/W
Operating Junction Temperature		150	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10sec)	T_{LEAD}	260	°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	°C
Input Voltage	V_{IN}	2.5	16	V
CTRL Voltage	V_{CTRL}		16	V

Electrical Characteristics

(V_{IN}=3V, V_{CTRL} =3V, T_A=25°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°C to 85°C	188	200	212	mV
FB Pin Bias Current	I_{FB}			35	100	nA
Supply Current	I_{CC}	V_{FB}=V_{IN}, Not Switching	1.9	2.6	3.3	mA
Supply Current	I_Q	V_{CTRL}=0V	2.0	3.2	5.0	μA
Switching Frequency	f		0.8	1.2	1.6	MHz
Maximum Duty Cycle	D_{MAX}		90	93		%
Switch Current Limit (Note 2)	I_{LIMIT}	T_A=25°C, D=40%		560		mA
		T_A=25°C, D=80%		465		
Switch V_{CE} Saturation Voltage	V_{CESAT}	I_{SW}=250mA		300		mV
Switch Leakage Current		V_{SW}=5V		0.01	5	μA
CTRL Pin Voltage	V_{CTRL}	High	1.8			V
		Low			0.05	
CTRL Pin Bias Current	I_{CTRL}		48	60	72	μA
		T_A=85°C	40	50	60	
		T_A=-40°C	60	75	90	
Schottky Forward Drop	V_{DROP}	I_D=150mA		0.7		V
Schottky Leakage Current		V_R=25V			4	μA
		V_R=30V		90		
Thermal Resistance (Junction to Case)	θ_{JC}			60.84		°C/W

Note 2: The Switch Current Limit is related to Duty Cycle. Please refer to Figure 16 for detail.

Typical Performance Characteristics

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

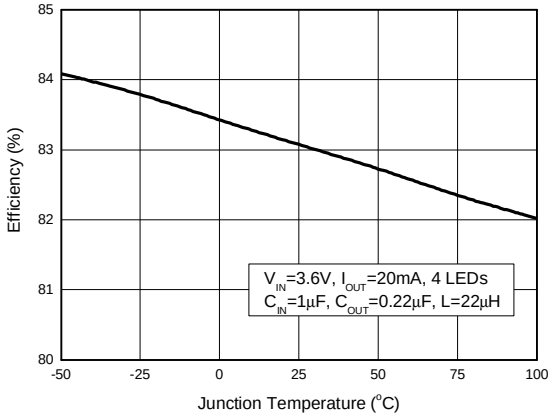


Figure 4. Efficiency vs. Junction Temperature

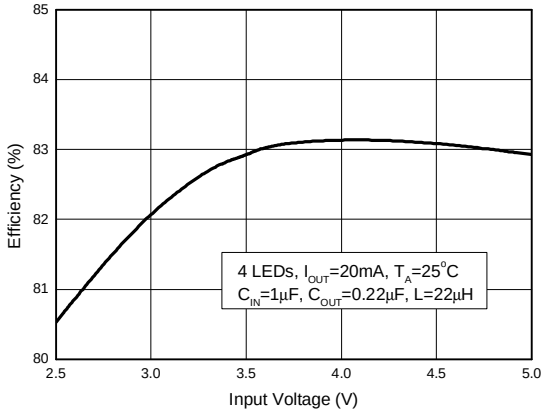


Figure 5. Efficiency vs. Input Voltage

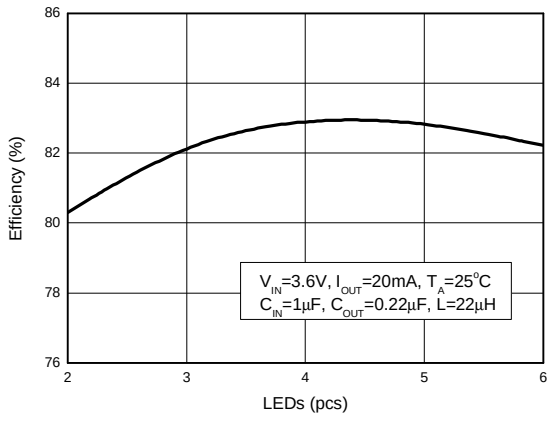


Figure 6. Efficiency vs. LED's Number

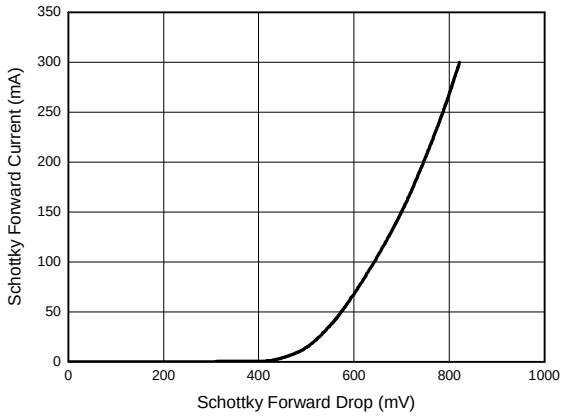


Figure 7. Schottky Forward Current vs. Schorttky Forward Drop

Typical Performance Characteristics (Continued)

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

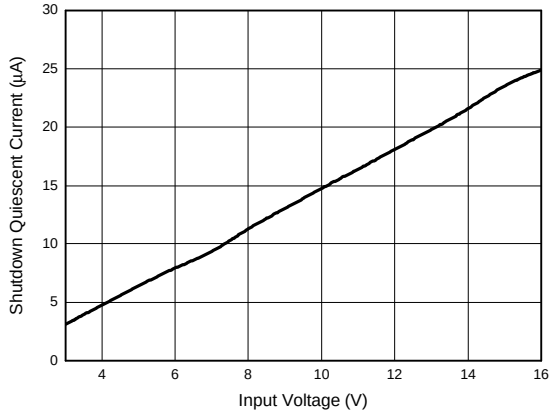


Figure 8. Shutdown Quiescent Current vs. Input Voltage

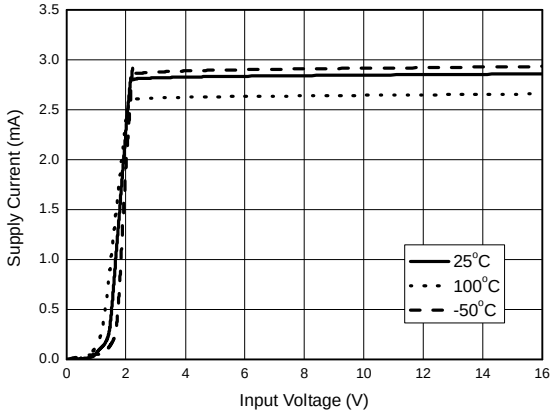


Figure 9. Supply Current vs. Input Voltage

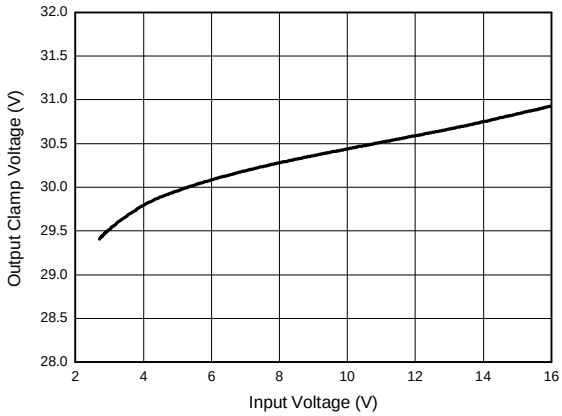


Figure 10. Output Clamp Voltage vs. Input Voltage

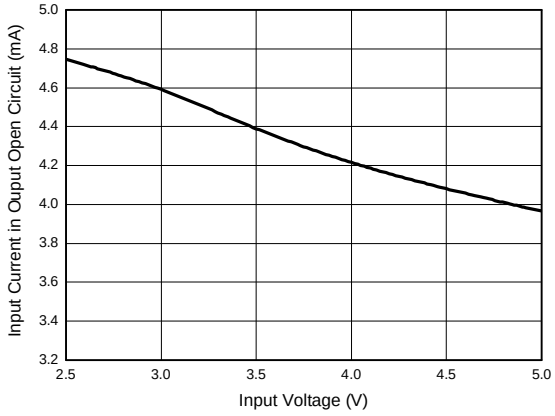


Figure 11. Input Current in Output Open Circuit vs. Input Voltage

Typical Performance Characteristics (Continued)

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

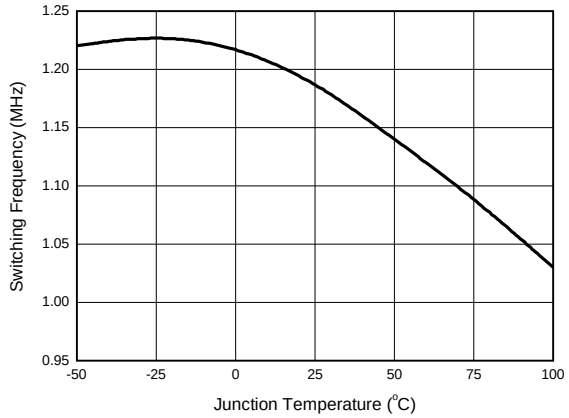


Figure 12. Switching Frequency vs. Junction Temperature

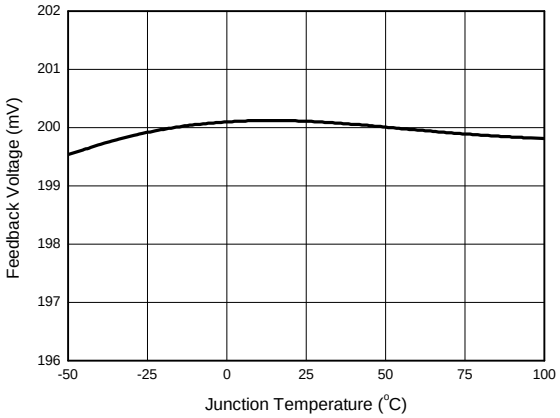


Figure 13. Feedback Voltage vs. Junction Temperature

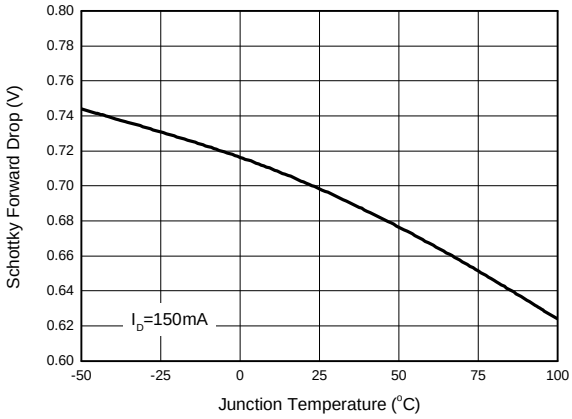


Figure 14. Schottky Forward Drop vs. Junction Temperature

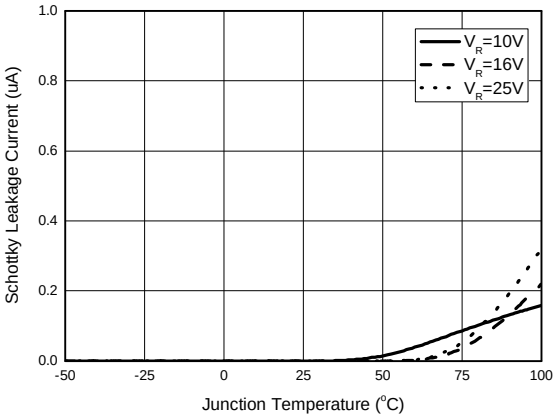


Figure 15. Schottky Leackage Current vs. Junction Temperature

Typical Performance Characteristics (Continued)

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

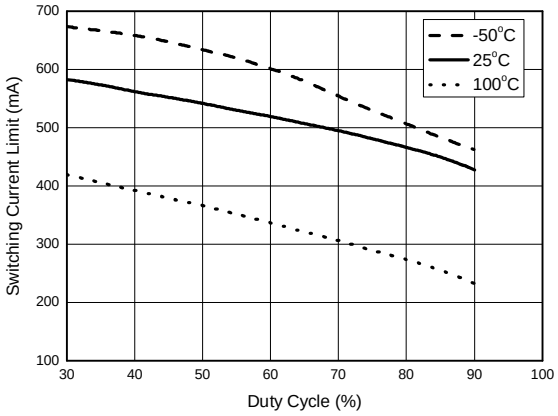


Figure 16. Switch Current Limit vs. Duty Cycle

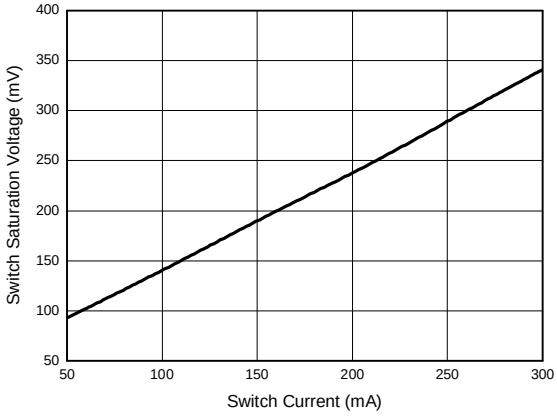


Figure 17. Switch Saturation Voltage vs. Switch Current

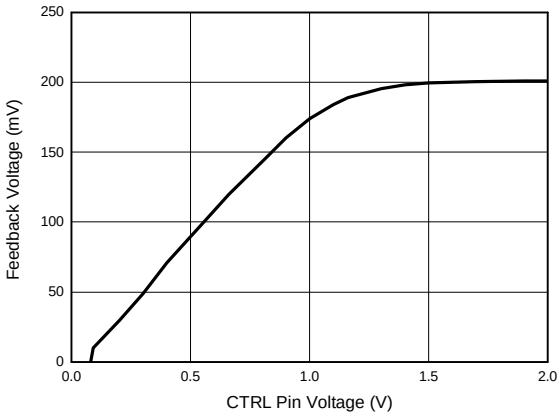
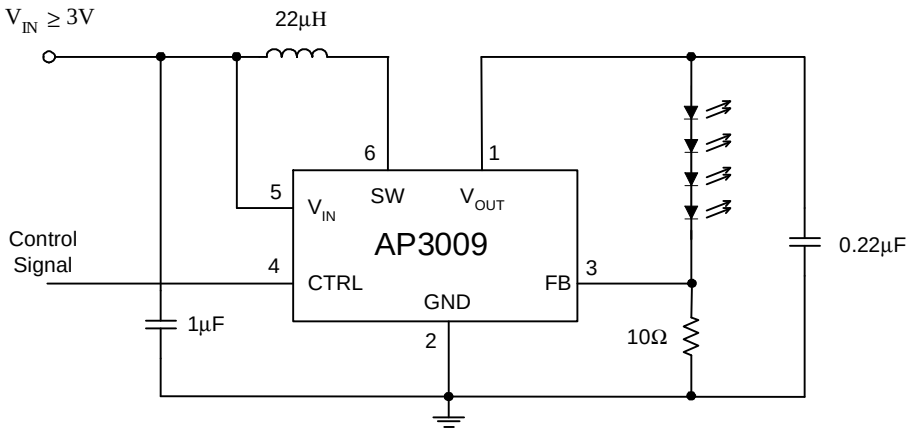
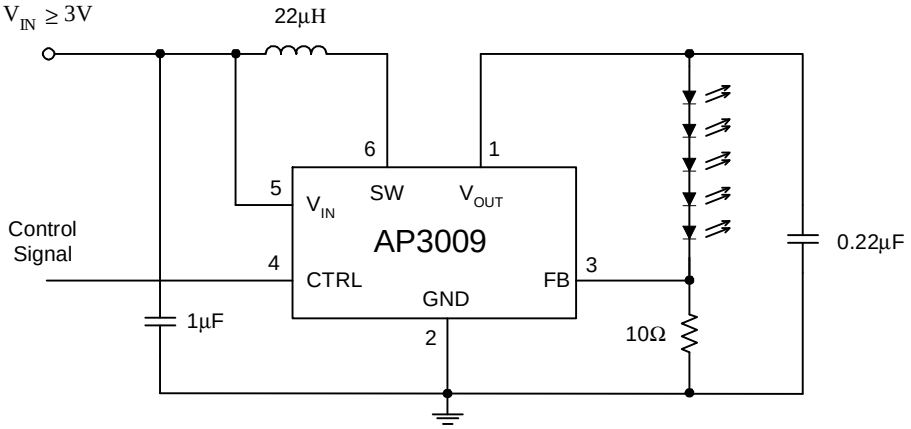


Figure 18. Feedback Voltage vs. CTRL Pin Voltage

Typical Application

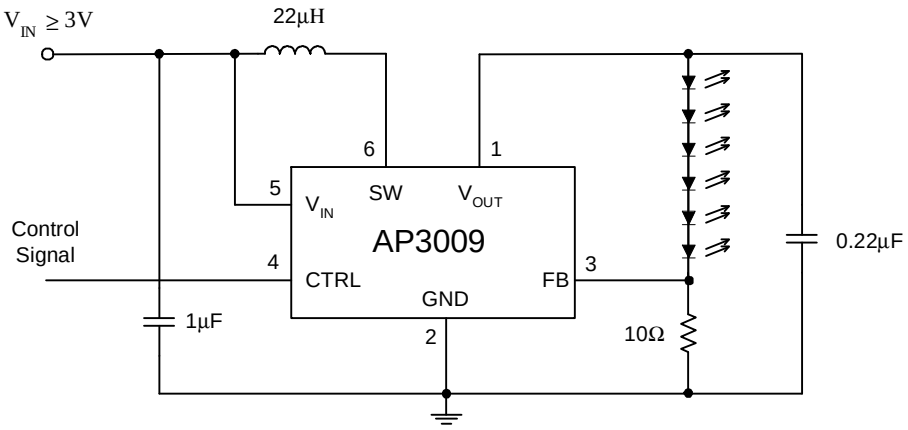


a. Four White LEDs Driver



b. Five White LEDs Driver

Typical Application (Continued)



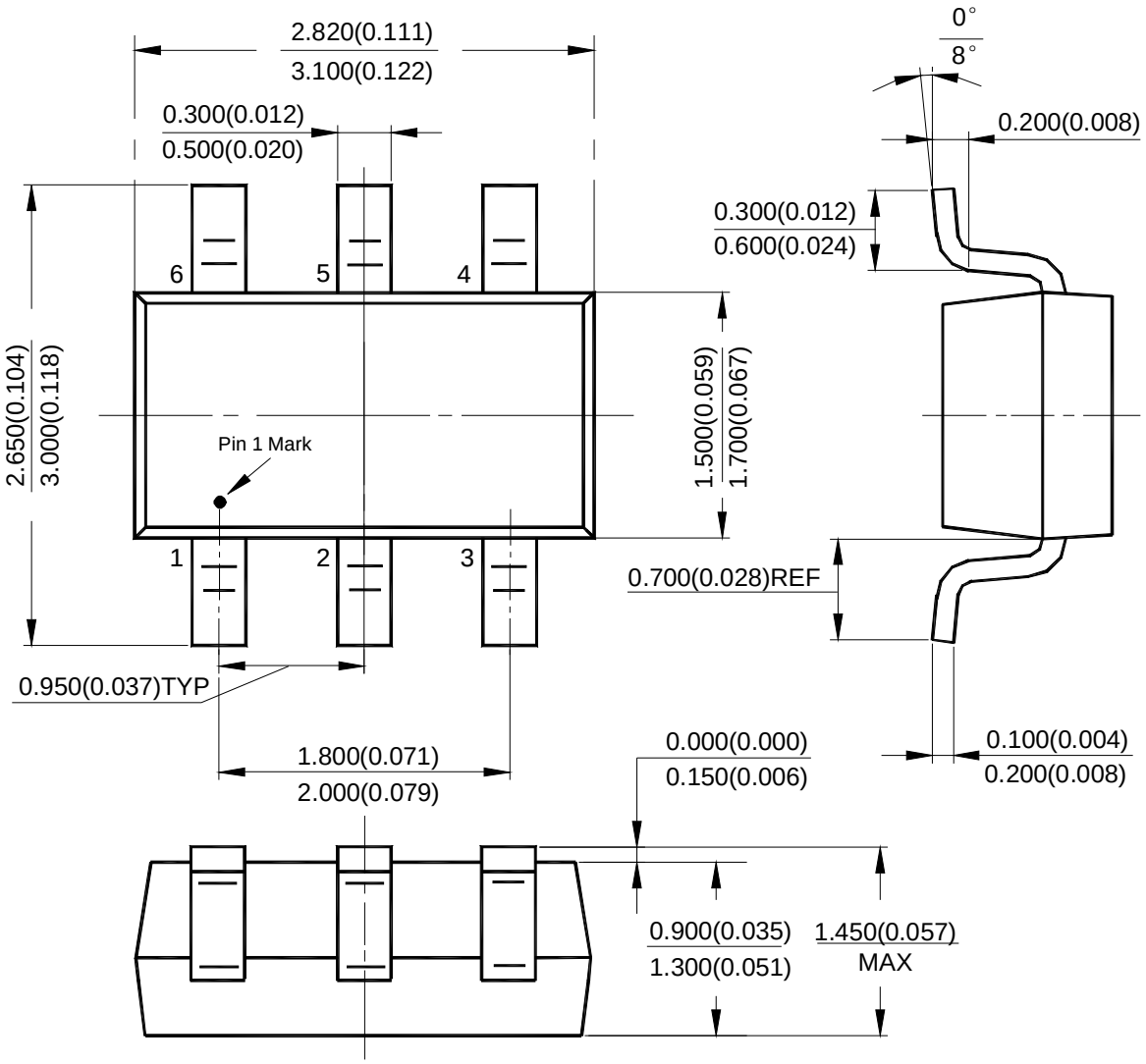
c. Six White LEDs Driver

C: X5R or X7R Dielectric
L: SUMIDA CDRH5D28R-220NC or Equivalent
All these circuits can work in full temperature

Figure 19. Typical White LED Drivers

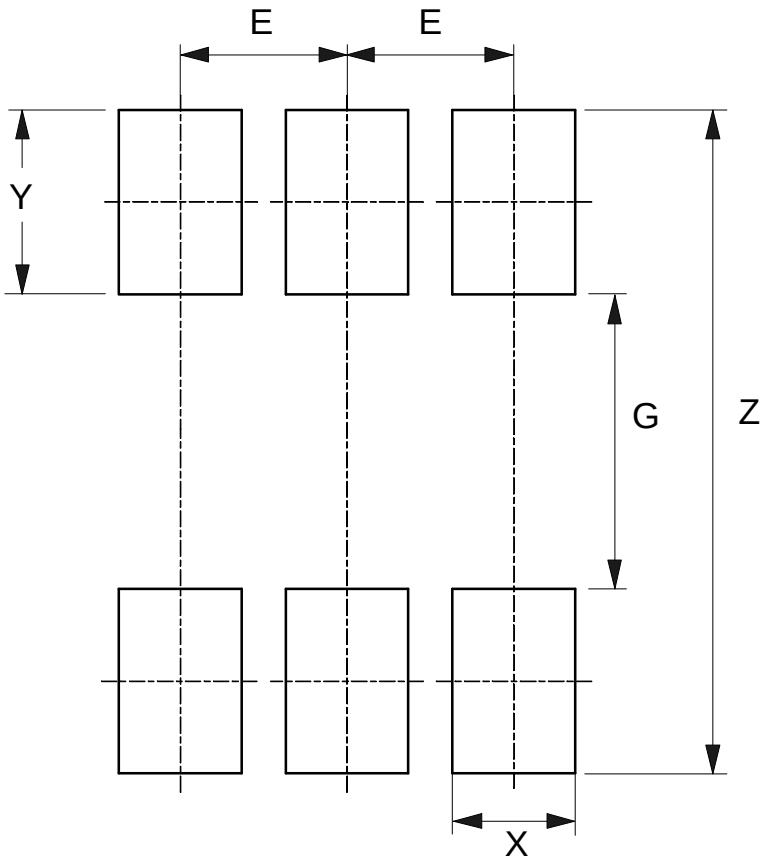
Mechanical Dimensions

SOT-23-6 **Unit: mm(inch)**



Mounting Pad Layout

SOT-23-6



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037

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