NEW PRODUCT

Description

The AL5890 is a 500V linear constant current LED driver and it provides a cost-effective two pin solution. It has good temperature stability and the current accuracy of ±10% regulated over a wide voltage and temperature range. The AL5890 comes in various fixed output current options removing the need for external current setting resistors and creating a simple driver solution for the series of LEDs. The AL5890 supports both the high-side and low-side driving of LED chains.

The AL5890 turns on when the voltage between IN and OUT is greater than 7V. Long LED chain application up to 500V operating voltage subject to package thermal limitation.

The AL5890 is available in thermally robust PowerDI®123 (Type B) package.

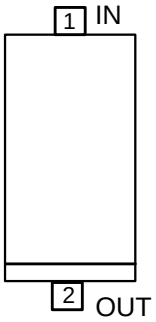
Note: PowerDI is a registered trademark of Diodes Incorporated.

Features

- DC 500V Operating Voltage With Long LED Chains Subject to Package Thermal Constraint
- ±10% LED Current Tolerance Over Wide Temperature Range
- Thermal Foldback Protection
- 10mA, 15mA, 20mA, 30mA, and 40mA Constant Output Current Options
- PowerDI123 (Type B) Thermally Enhanced Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Pin Assignments

PowerDI123 (Type B)



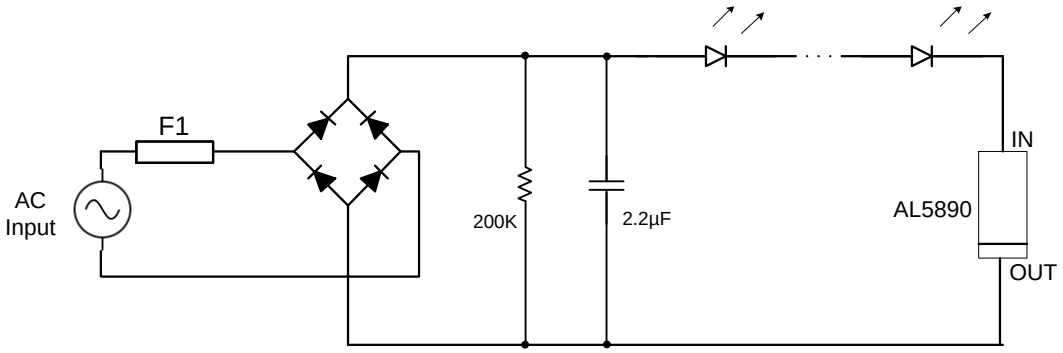
(Top View)

Applications

- AC LED Lighting
- Decorative LED Lighting
- Display Signage Lighting

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Applications Circuit



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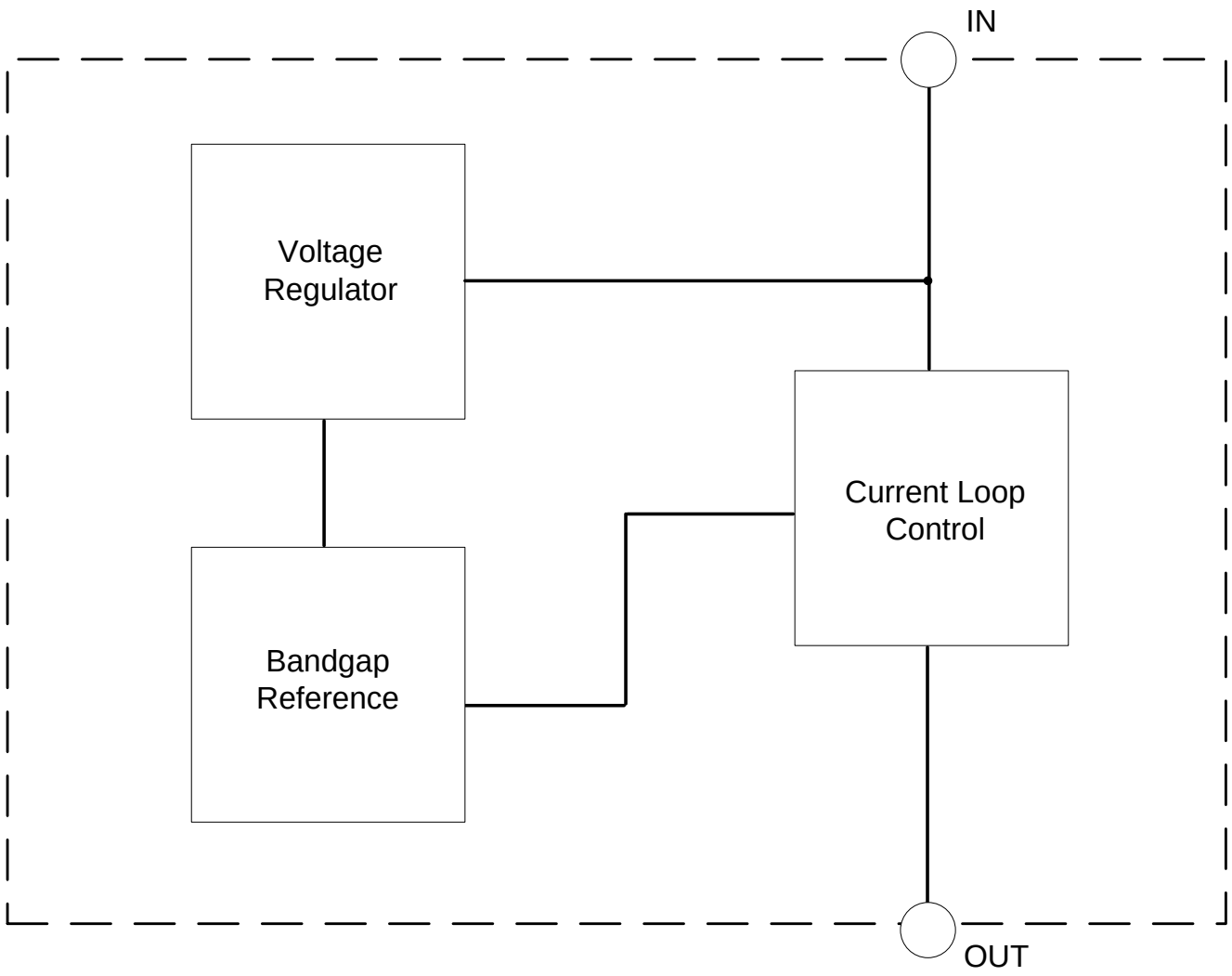
Pin Descriptions

Pin Number	Pin Name	Function
1	IN	Input Current Terminal
2	OUT	Output Current Terminal

Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameters	Ratings	Unit
V_{IN_OUT}	IN Voltage Relative to OUT Pin	-0.3 to +525	V
I_{IN_OUT}	LED Current Flows from IN to OUT Pin	50	mA
T_J	Operating Junction Temperature	-40 to +150	°C
T_{ST}	Storage Temperature	-55 to +150	°C

Note: 4. Stresses greater than the Absolute Maximum Ratings specified above may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time. 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.

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ESD Ratings

Symbol	Parameter	Rating	Unit
V_{ESD}	Human-Body Model (HBM)	2000	V
	Charged-Device Model (CDM)	1000	

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{IN_OUT}	IN Voltage Relative to OUT Pin	7	500	V
I_{IN_OUT}	Current Flows from IN to OUT Pin	10	40	mA
T_A	Operating Ambient Temperature Range	-40	+105	°C
T_J	Operating Junction Temperature	-40	+125	°C

Thermal Information (Note 5)

Symbol	Parameter	Rating	Unit
θ_{JA}	Junction-to-ambient Thermal Resistance	75.84	°C/W
θ_{JC}	Junction-to-case (top) Thermal Resistance	15.33	°C/W

Note: 5. When mounted on 50.8mm x 50.8mm GETEK PCB with 25.4mm x 25.4mm 2oz copper pads. For better thermal performance, larger copper pad for heat-sink is needed.

Electrical Characteristics (V_{IN_OUT} = 10V, T_A = +25°C, Unless Otherwise Noted.)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V_{IN_OUT}	Supply Voltage	-	7	-	500	V
V_{MIN}	Minimum Power Up Voltage	Increase V_{IN_OUT} (Note 6)	2.5	5	7	V
I_{IN_OUT}	LED Current	AL5890-10P1-13, 0°C to +105°C , T_J < +125 °C	9.0	10	11.0	mA
		AL5890-15P1-13, 0°C to +105°C , T_J < +125 °C	13.5	15	16.5	
		AL5890-20P1-13, 0°C to +105°C , T_J < +125 °C	18.0	20	22.0	
		AL5890-30P1-13, 0°C to +105°C , T_J < +125 °C	27.0	30	33.0	
		AL5890-40P1-13, 0°C to +105°C , T_J < +125 °C	36.0	40	44.0	
I_{LINE}	Line Regulation	0°C to +105°C , T_J < +125 °C	-	3	5	%
t_{ON}	Turn On Delay Time	-	-	6	-	µs
t_{OFF}	Turn Off Delay Time	-	-	0.3	-	µs
t_R	Rising Time	-	-	6	-	µs
t_F	Falling Time	-	-	0.1	-	µs
f_{PWM}	PWM Dimming Frequency	Square wave, 0 to 4V Gate Voltage, V_{IN_OUT}= 20V Duty Cycle from 0 to 100%	1	-	20	kHz
T_{FOLD}	Thermal Foldback Junction Temperature	Junction Temperature	-	+130	-	°C

Note: 6. Apply the power supply voltage linearly to the chip until the device starts to turn on (output LED current reaches 5% of the desired current options). The minimum power up voltage may vary with different current options.

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Typical Performance Characteristics ((PowerDI123 (Type B), 20mA Device))

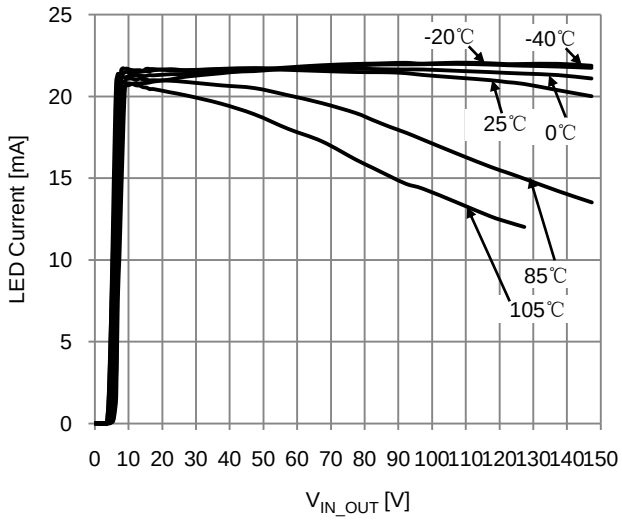

Figure 1. LED Current (-40°C to +105°C) vs. V_{IN_OUT}

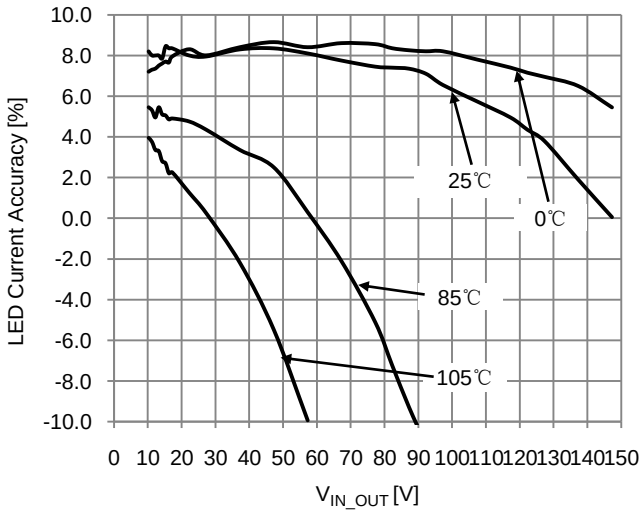

Figure 2. LED Current Accuracy (0°C to +105°C) vs. V_{IN_OUT}

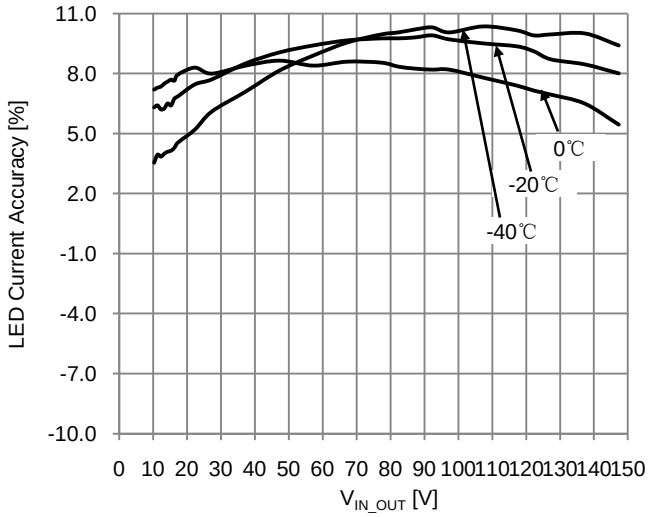

Figure 3. LED Current Accuracy (-40°C to 0°C) vs. V_{IN_OUT}

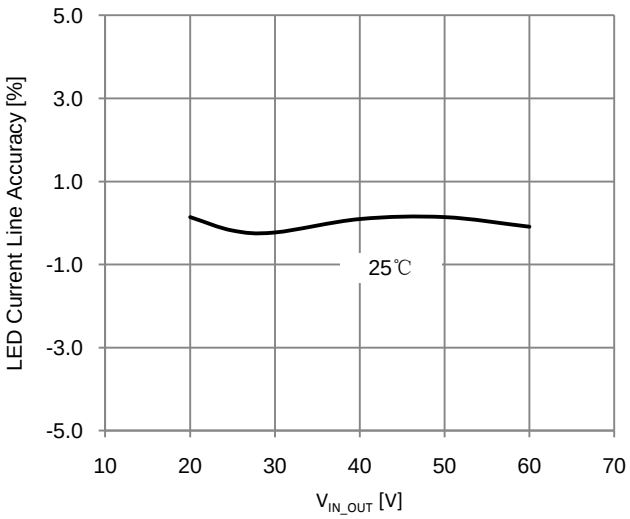

Figure 4. LED Line Regulation (% @ +25°C) vs. V_{IN_OUT} (20V to 60V)

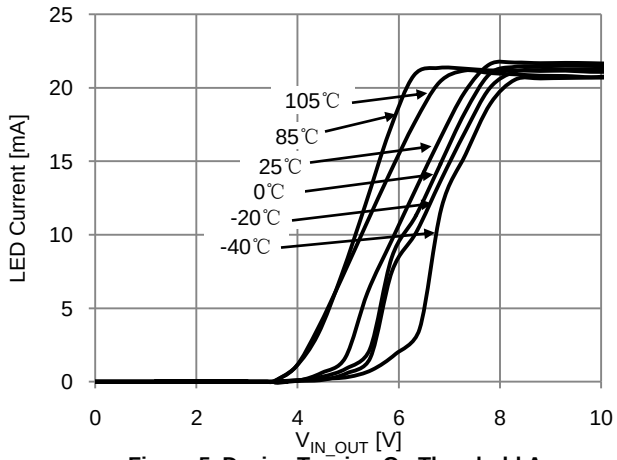

Figure 5. Device Turning On Threshold Across Temperature

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Application Information

Description

The AL5890 is a constant current Linear LED driver and can be connected in series with LEDs as a High Side or a Low Side constant current regulator. The AL5890 offers various current settings from 10mA to 40mA and different current settings available upon request.

Simple LED String (DC Configuration)

The AL5890 can be connected in series with LEDs as a Low Side or High Side constant current regulator. The number of the LEDs can vary from one to as many as supported by the input supply voltage. The designer needs to calculate the maximum voltage between IN pin and OUT pin by taking the maximum input voltage less the voltage across the LED string (Figures 6 & 7).

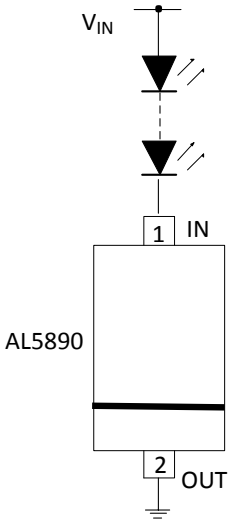


Figure 6. Low Side IC Application

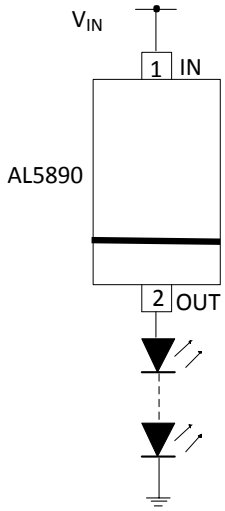
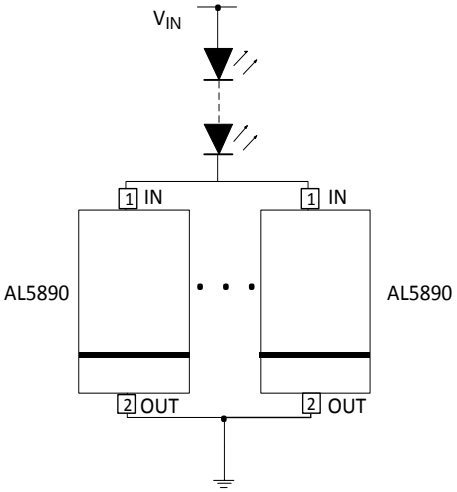


Figure 7. High Side IC Application

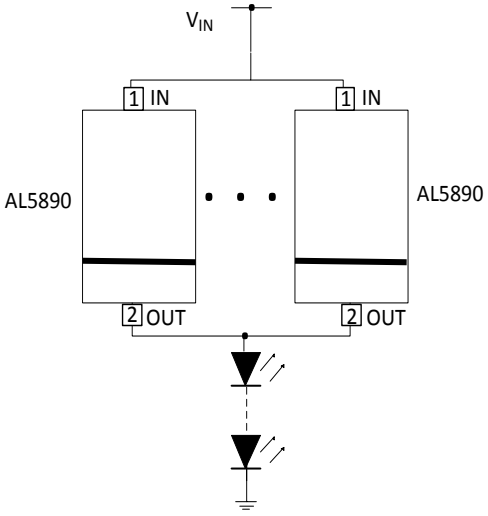
The AL5890 can also be used at the high side of the IC, see Figure 7. The minimum system input voltage can be calculated by:

$V_{IN(MIN)} = V_{LED\_CHAIN} + 7V$, Where V_{LED_CHAIN} is the LED chain voltage.

The LED current can be increased by connecting two or more AL5890 in parallel in Figure 8.



(a) Low Side Configuration



(b) High Side Configuration

Figure 8. Parallel Configuration of AL5890

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Application Information (Cont.)

PWM Dimming

The AL5890 can be used to provide LED current dimming driving the OUT pin via the MOSFET switch to ground (Figure 9a), applying a PWM signal from 0 to 4V gate voltage with a frequency range between 1KHz and 20KHz. The OUT pin current is then effectively switched on and off to modulate the output LED current. The dimming effect can be achieved by varying the PWM signal duty cycle.

(a) PWM Dimming by External MOSFET **(b) PWM Dimming through Power Supply VIN ON/OFF**

Figure 9. PWM Dimming

Dimming Curves

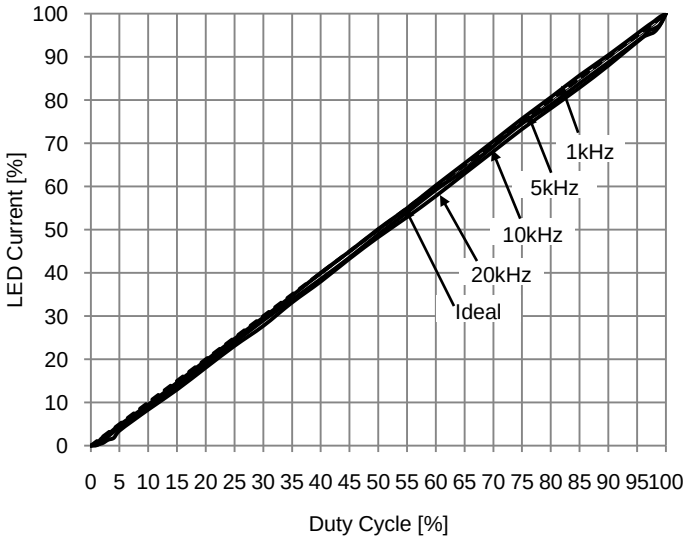

Figure 10. PWM Dimming 20mA vs. Duty Cycle

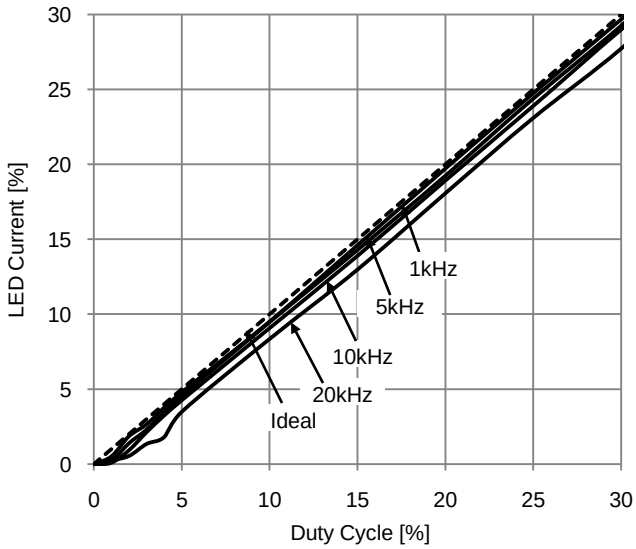

Figure 11. Area Zoom In within Duty Cycle 30% of Figure 10

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Application Information (Cont.)

Thermal Foldback Protection (TFP)

The AL5890 has a thermal foldback protection (TFP) function and adopts self-adaptive control method, which can prevent the system from breaking down caused by high temperature. The typical overheating temperature is set at +130°C, when the junction temperature of the IC is higher than +130°C, the device will linearly decrease the internal reference voltage to decrease the output current. As a result of this feature, the device can control the system's output power at high ambient temperature, to control the quantity of heat of the system. This enhances the safety of the system at high temperature.

Thermal foldback waveform is shown below:

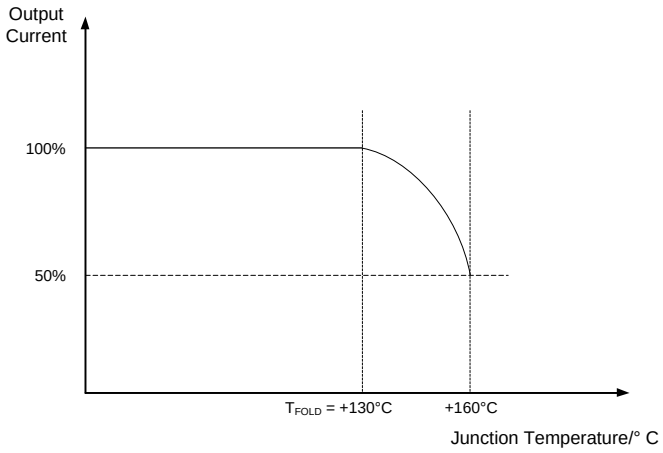


Figure 12. Thermal Foldback Characteristic

NEW PRODUCT

Ordering Information

AL5890 – X X – X

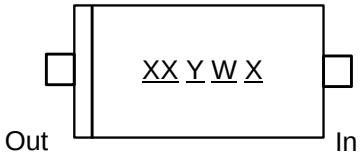
- Product Name
- Current Option
  - 10: 10mA
  - 15: 15mA
  - 20: 20mA
  - 30: 30mA
  - 40: 40mA
- Package
  - P1: PowerDI123 (Type B)
- Packing
  - 13: Tape and Reel

Part Number	LED Current Option	Package Code	Packaging	13'' Tape and Reel	
				Quantity	Part Number Suffix
AL5890-10P1-13	10mA	P1	PowerDI123 (Type B)	10,000/ Tape & Reel	-13
AL5890-15P1-13	15mA	P1	PowerDI123 (Type B)	10,000/ Tape & Reel	-13
AL5890-20P1-13	20mA	P1	PowerDI123 (Type B)	10,000/ Tape & Reel	-13
AL5890-30P1-13	30mA	P1	PowerDI123 (Type B)	10,000/ Tape & Reel	-13
AL5890-40P1-13	40mA	P1	PowerDI123 (Type B)	10,000/ Tape & Reel	-13

Marking Information

(1) PowerDI123 (Type B)

(Top View)



XX : Identification code

Y : Year 0 to 9

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

X : Internal code

Part Number	Package	Identification Code
AL5890-10P1-13	PowerDI123 (Type B)	B2
AL5890-15P1-13	PowerDI123 (Type B)	B3
AL5890-20P1-13	PowerDI123 (Type B)	B4
AL5890-30P1-13	PowerDI123 (Type B)	B5
AL5890-40P1-13	PowerDI123 (Type B)	B6

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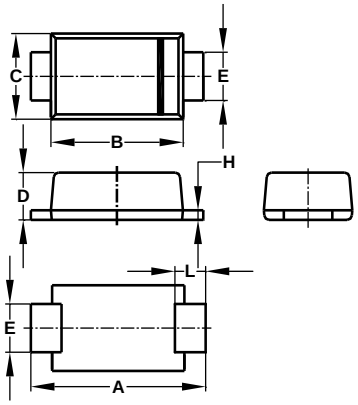
Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

PowerDI123 (Type B)

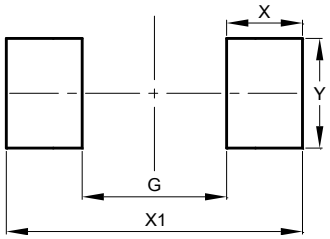


PowerDI123 (Type B)			
Dim	Min	Max	Typ
A	3.50	3.90	3.70
B	2.60	3.00	2.80
C	1.63	1.93	1.78
D	0.93	1.00	0.98
E	0.85	1.25	1.00
H	0.15	0.25	0.20
L	0.50	0.80	0.65
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

PowerDI123 (Type B)



Dimensions	Value (in mm)
G	2.000
X	1.050
X1	4.100
Y	1.500

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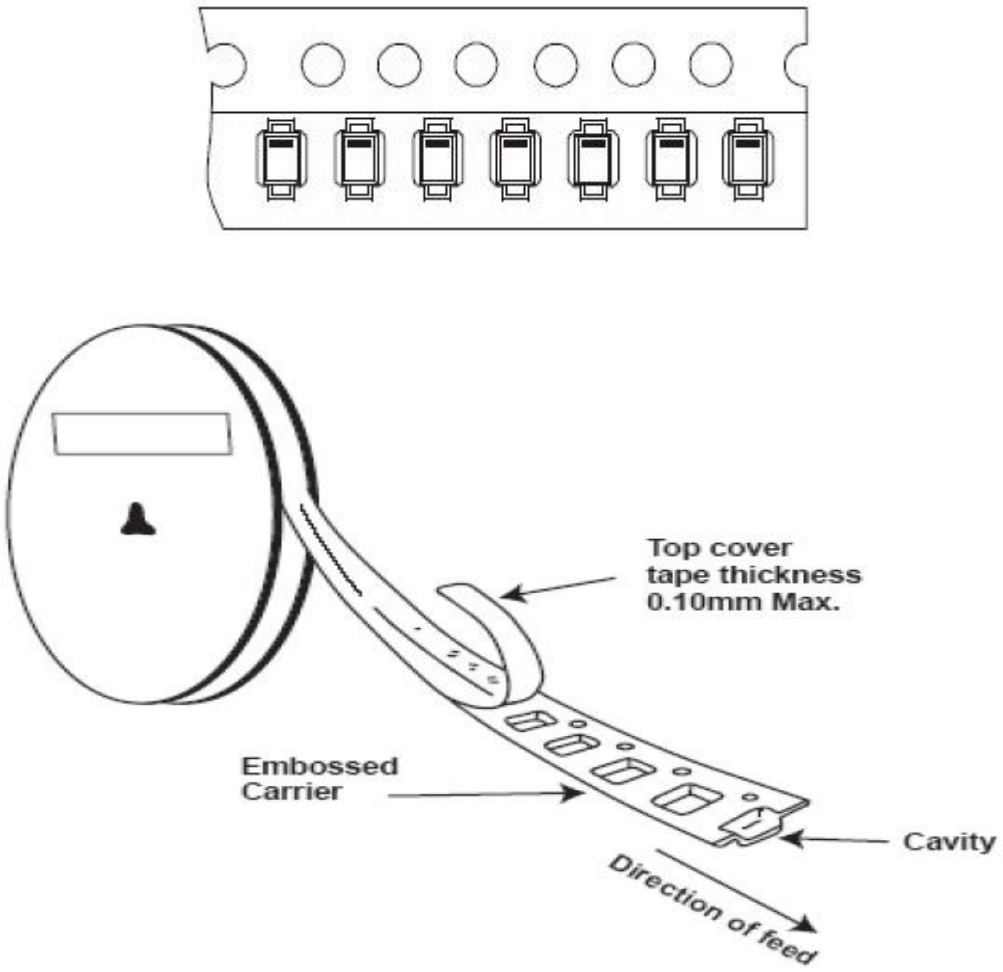
Taping Orientation

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

PowerDI123 (Type B)



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