

## Description

The AL5871 is a single-channel linear LED driver with PWM (pulse-width modulation) and analog dimming control. The AL5871 can drive up to 750mA and the LED current can be set by the low-power reference resistor connected to the REF pin.

The AL5871 regulates LED current accurate to  $\pm 4\%$ , with excellent PWM and analog dimming performance. The AL5871 enters standby mode to save power if no PWM signal is detected.

The AL5871 monitors the temperature and reduces the LED current if the chip temperature exceeds the threshold temperature. And the input undervoltage lockout (UVLO), LED string open/short protection, and overtemperature protection (OTP) are designed for applications to improve system robustness. The FAULTB pin is pulled low if any protection is triggered.

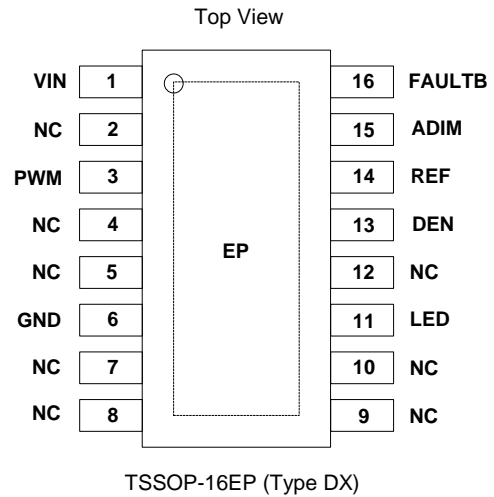
The AL5871 is a simple solution to deliver constant current for a single LED string with one-fail-all-fail function, and can work with AL5873 to address different requirements. The AL5871 is available in the TSSOP-16EP (Type DX) package.

## Features

- Wide Input Voltage Range from 5V to 55V
- Up to 750mA Output Current Capacity
- Low-Dropout Voltage on LED Pin
- Output Current Adjustable by a Low-Power External Reference Resistor
- PWM and Analog Dimming with Excellent Linearity
- Automatically Enter and Exit Standby Mode Without Enable Pin
- Internal Protections:
  - Input Undervoltage Lockout (UVLO)
  - Enable LED String Open Protection
  - LED String Short Protection
  - Overtemperature Protection (OTP)
- Diagnostic Enable with Adjustable Threshold for Low-Dropout Operation
- Thermal Foldback If Chip Temperature Exceeds the Threshold
- Fault Reporting: UVLO, OTP, LED Open, and LED Short
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet ([AL5871Q](#))**

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.  
 2. See <https://www.diodes.com/quality/lead-free/> 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.

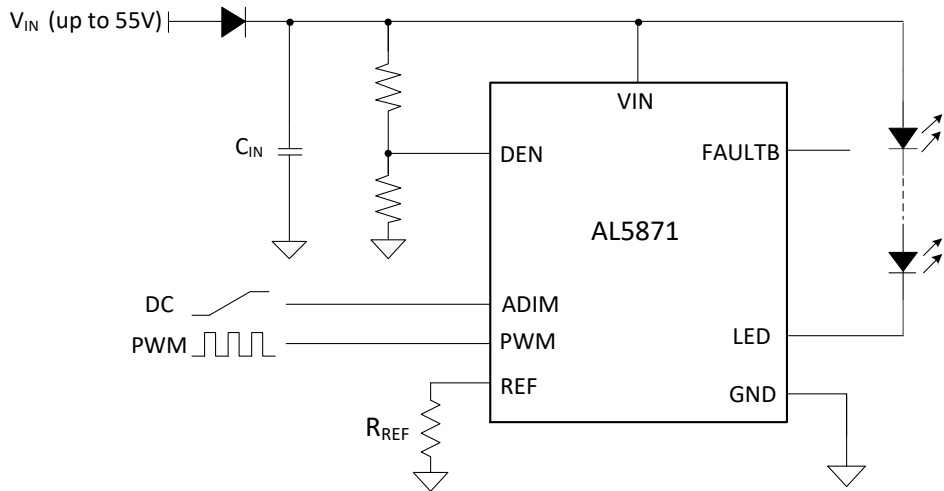
## Pin Assignments



## Applications

- Interior lighting: dome lights, reading lamps
- Exterior lighting:
  - Small lights: blind-spot detection indicators, charging inlets, door handles
  - Rear lights: rear lamps, center high mounted stop lamps, side markers

**Typical Application Circuit**

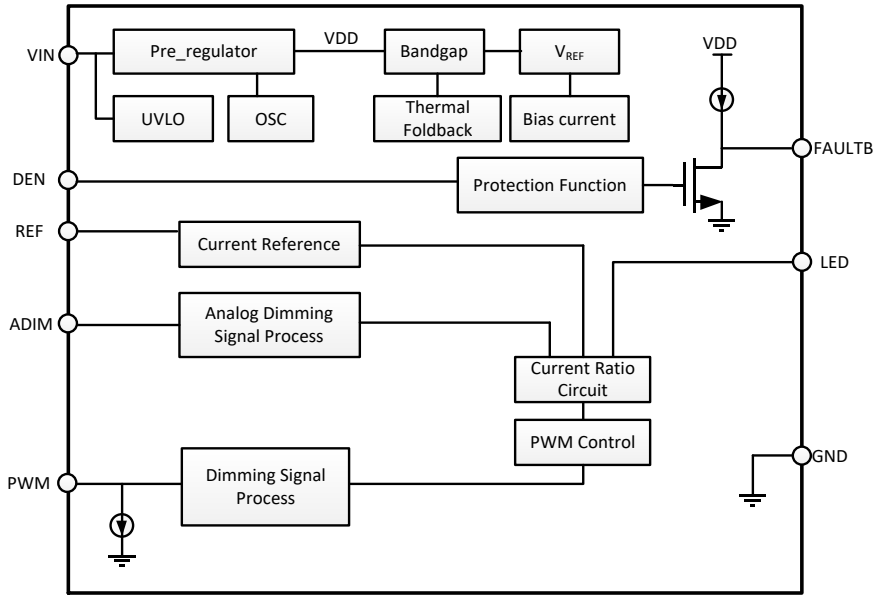


**Figure 1. Typical Application**

**Pin Descriptions**

Pin Name	Pin Number	Function
VIN	1	Power Supply for LED Driver
PWM	3	PWM Signal Input, Internally Pulled Down.
GND	6	Ground for LED Driver
LED	11	Connect to LED Cathode
DEN	13	Enable pin for LED open-circuit detection and thermal foldback function. <ul style="list-style-type: none"> <li><math>V_{DEN} &gt; 1.2V</math>, Open LED detection is enabled.</li> <li><math>V_{DEN} &lt; 1.1V</math>, Open LED detection is disabled to avoid false open diagnostics during low-dropout operation.</li> <li><math>V_{DEN} &gt; 0.3V</math>, Thermal foldback function is enabled.</li> <li><math>V_{DEN} &lt; 0.2V</math>, Thermal foldback function is disabled.</li> </ul>
REF	14	Reference Current Setting
ADIM	15	Analog Dimming Input. Drive with DC voltage ( $0.3V < V_{ADIM} < 1.5V$ )
FAULTB	16	Fault Report. Asserted Low to report faulty conditions.
NC	2, 4, 5, 7, 8, 9, 10, 12	No Connection
Exposed Pad	Exposed Pad	Exposed Pad. Internally connected to GND. It should be externally connected to GND and thermal mass for enhanced thermal impedance. It should not be used as electrical conduction path.

**Functional Block Diagram**



**Figure 2. Functional Block Diagram**

**Absolute Maximum Ratings** (Note 4)

Symbol	Parameter	Ratings	Units
$V_{VIN}$	Input Voltage Relative to GND	-0.3 to 65	V
$V_{LED}, V_{DEN}, V_{PWM}, V_{FAULTB}$	LED, DEN, PWM and FAULTB Voltage Relative to GND	-0.3 to 65	V
$V_{REF}, V_{ADIM}$	REF and ADIM Voltage Relative to GND	-0.3 to 6	V
$T_J$	Operating Junction Temperature	-40 to +150	°C
$T_{ST}$	Storage Temperature	-55 to +150	°C
$\theta_{JA}$	Junction-to-Ambient Thermal Resistance (Note 5)	42.7	°C/W
$\theta_{JC}$	Junction-to-Case (Top) Thermal Resistance (Note 5)	3.4	°C/W
—	Human Body Model (HBM)	2000	V
—	Charged Device Model (CDM)	1000	V

- Notes:
- Stresses greater than those listed under *Absolute Maximum Ratings* can 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 can affect device reliability. Semiconductor devices are ESD sensitive and can be damaged by exposure to ESD events. Suitable ESD precautions should be taken when handling and transporting these devices
  - Device mounted on 2" x 2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad on top layer and thermal vias to bottom layer ground plane.

**Recommended Operating Conditions**

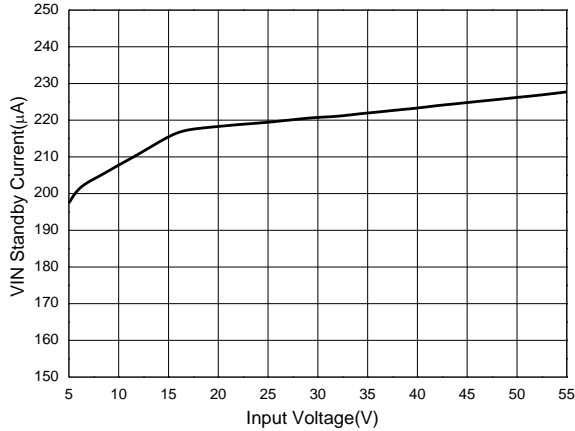
Symbol	Parameter	Min	Max	Unit
$V_{VIN}$	Input Voltage Relative to GND	5	55	V
$f_{PWM}$	PWM Frequency	0.2	1	kHz
$I_{LED}$	LED Output Current	0	750	mA
$V_{IH}$	High-Level Input Voltage on PWM	1.4	5.5	V
$V_{IL}$	Low-Level Input Voltage on PWM	0	0.4	V
$T_J$	Operating Junction Temperature	-40	+150	°C
$T_A$	Operating Ambient Temperature	-40	+105	°C

**Electrical Characteristics** (@ $T_A = +25^{\circ}\text{C}$ ,  $V_{IN} = +12\text{V}$ , unless otherwise specified.)

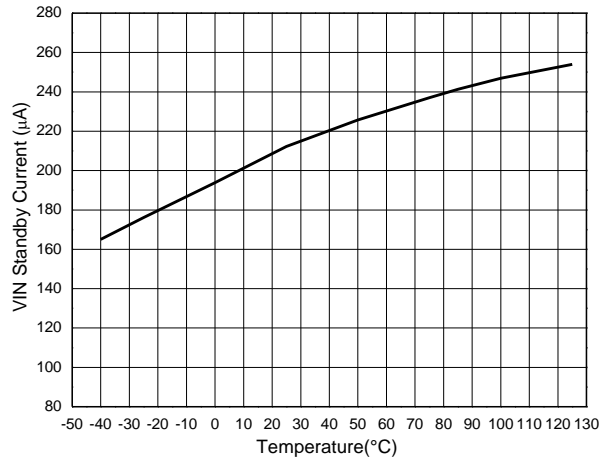
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{VIN\_UVLO}$	VIN UVLO Voltage	$V_{VIN}$ Rising	4.75	5.0	5.25	V
$V_{VIN\_UVLO\_HYS}$	VIN UVLO Hysteresis	$V_{VIN}$ Falling	—	300	—	mV
$I_{VIN\_Standby}$	Input Current in Standby Mode	Standby Mode, PWM is "L" for 7ms	—	300	—	$\mu\text{A}$
$I_{DVCC\_Q}$	Input Current in Normal Mode	Enabled, LED Pin Floating, PWM is "H", $R_{SET}$ is 48k $\Omega$	—	0.7	—	mA
$V_{IL\_DEN}$	DEN Logic-Low Voltage for Open LED Detection	—	—	1.1	—	V
$V_{IH\_DEN}$	DEN Logic-High Voltage for Open LED Detection	—	—	1.2	—	V
$V_{TH\_DEN}$	DEN Logic-Low Voltage for Thermal Foldback	—	—	0.2	—	V
$V_{TH\_DEN}$	DEN Logic-High Voltage for Thermal Foldback	—	—	0.3	—	V
$V_{IL\_PWM}$	PWM Logic-Low Voltage	—	—	—	0.4	V
$V_{IH\_PWM}$	PWM Logic-High Voltage	—	1.4	—	—	V
$I_{PWM\_PD}$	PWM Internal Pulldown	$V_{PWM} = 5\text{V}$	0.35	—	3.5	$\mu\text{A}$
$t_{PWM\_SHDN}$	Entrance Time for Standby Mode When PWM is Low	—	—	15	25	ms
$V_{ADIM}$	Voltage Range on ADIM Pin	For Analog Dimming	0.3	—	1.5	V
$V_{ADIM\_ON}$	DC Voltage on ADIM Pin for Analog Dimming On	$V_{ADIM}$ Rising	—	—	0.35	V
$V_{ADIM\_OFF}$	DC Voltage on ADIM Pin for Analog Dimming Off	$V_{ADIM}$ Falling	0.15	—	—	V
$I_{ADIM}$	ADIM Sourcing Current	—	19	20	22	$\mu\text{A}$
$V_{REF}$	Base Reference Voltage	—	1.47	1.5	1.53	V
$I_{LED\_NOM}$	Regulation Current	$R_{REF} = 48\text{k}\Omega$	—	375	—	mA
$V_{LED\_REG}$	Minimum LED Regulation Voltage	$I_{LED} = 125\text{mA}$	—	0.2	—	V
$I_{LED\_LEAK}$	LED Pin Leakage Current	$V_{PWM} = 0\text{V}$ , $V_{LED} = 12\text{V}$	—	0.1	5	$\mu\text{A}$
$I_{LED\_ACCURACY}$	LED Current Accuracy	$R_{REF} = 48\text{k}\Omega$	-4	—	4	%
$t_{LED\_SHDG}$	Short-Detection Deglitch	100% Duty-Cycle	—	5	—	ms
$N_{LED\_SHDG}$		PWM Dimming (count the number of continuous cycles when LED short is detected)	—	7	—	Cycles
$t_{LED\_SH\_HICCUP}$	LED Short Protection Hiccup Time	—	—	128	—	ms
$t_{LED\_OPDG}$	Open-Detection Deglitch	100% Duty-Cycle	—	5	—	ms
$N_{LED\_OPDG}$		PWM Dimming (count the number of continuous cycles when LED open is detected)	—	7	—	Cycles
$t_{LED\_OPDG\_CYCLE}$	Open-Detection Deglitch Time per Cycle	(Internal Only)	—	20	—	$\mu\text{s}$
$t_{LED\_OP\_HICCUP}$	LED Open Protection Hiccup Time	—	—	128	—	ms
$I_{F\_PULLUP}$	FAULTB Pullup Current	$V_{FAULTB} = 1.6\text{V}$	—	500	—	$\mu\text{A}$
$V_{F\_PULLUP}$	FAULTB Pullup Voltage	Fault Pin Floating	—	3	—	V
$V_{FOL}$	FAULTB Output Low Voltage	$I_{FAULTB} = 1\text{mA}$	—	—	600	mV
$V_{FIN\_TH}$	FAULTB Input Detect Threshold Voltage	—	—	1.33	—	V
$I_{F\_LKG}$	FAULTB Leakage Current	$V_{FAULTB} = 5\text{V}$	—	—	5	$\mu\text{A}$
$T_{SHDN}$	Thermal Shutdown Threshold	—	—	+160	—	$^{\circ}\text{C}$
$T_{REC}$	Thermal Recovery Threshold	—	—	+130	—	$^{\circ}\text{C}$

**Typical Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , unless otherwise specified.)

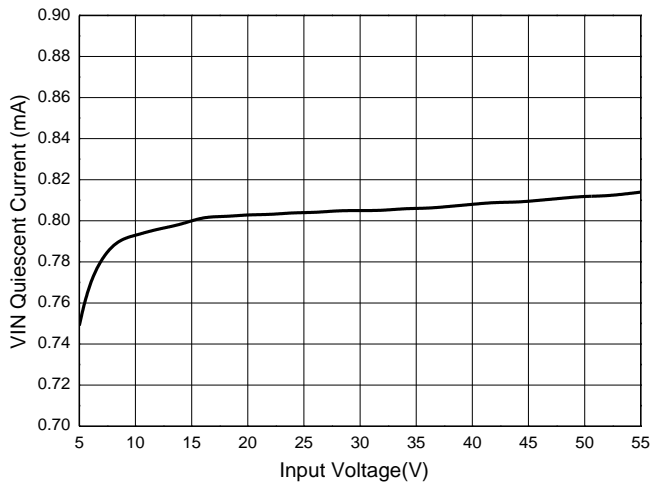
**VIN Standby Current vs. Input Voltage**



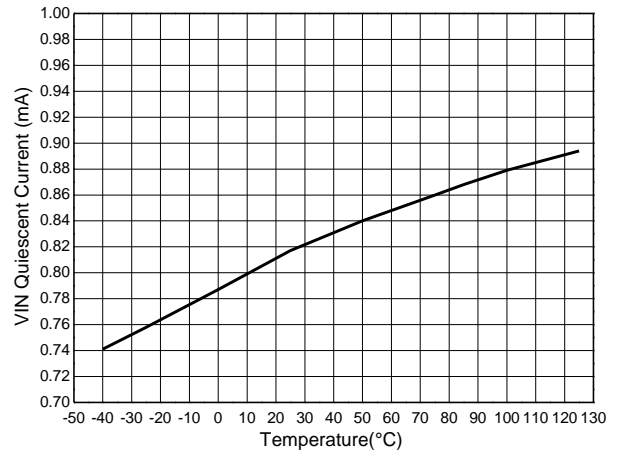
**VIN Standby Current vs. Temperature**



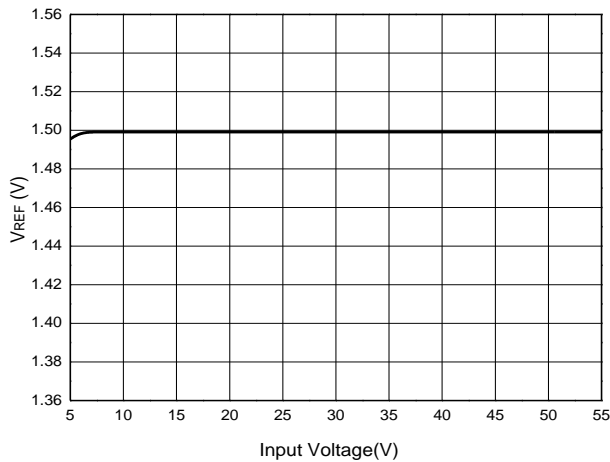
**VIN Quiescent Current vs. Input Voltage**



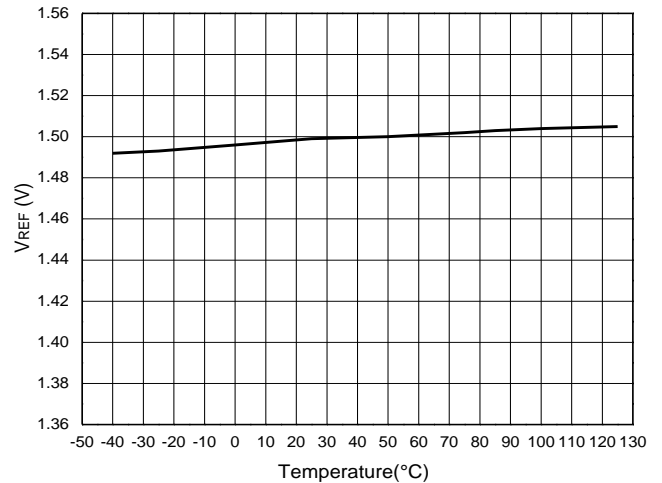
**VIN Quiescent Current vs. Temperature**



**Reference Voltage vs. Input Voltage**

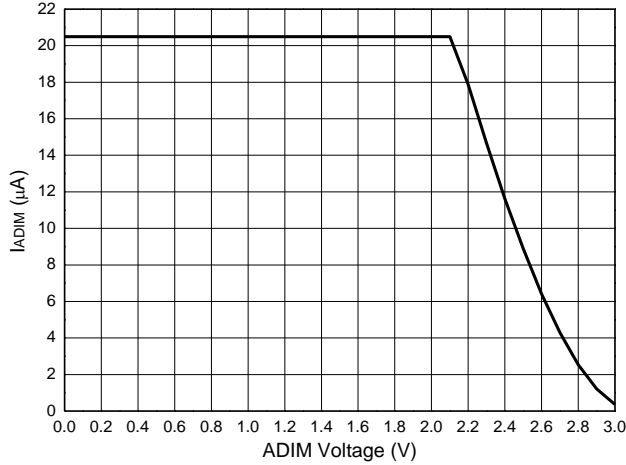


**Reference Voltage vs. Temperature**

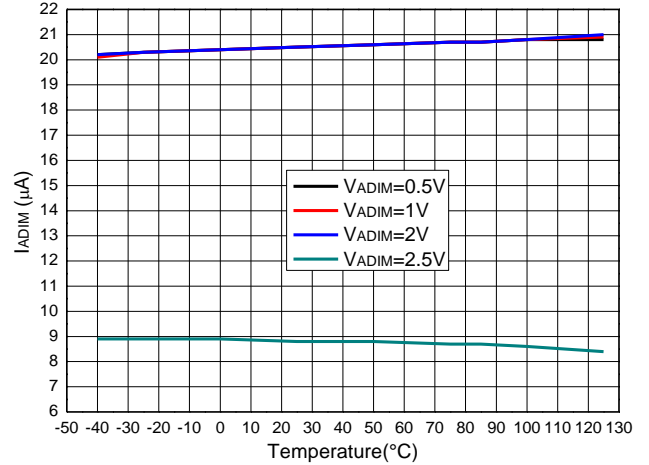


**Typical Performance Characteristics** (continued) ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , unless otherwise specified.)

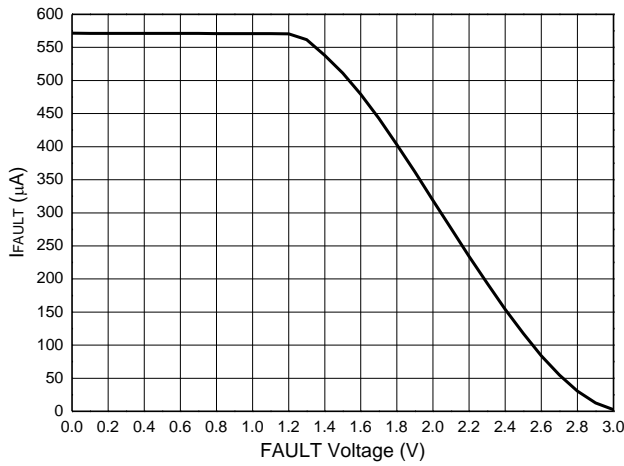
**ADIM Sourcing Current vs. ADIM Voltage**



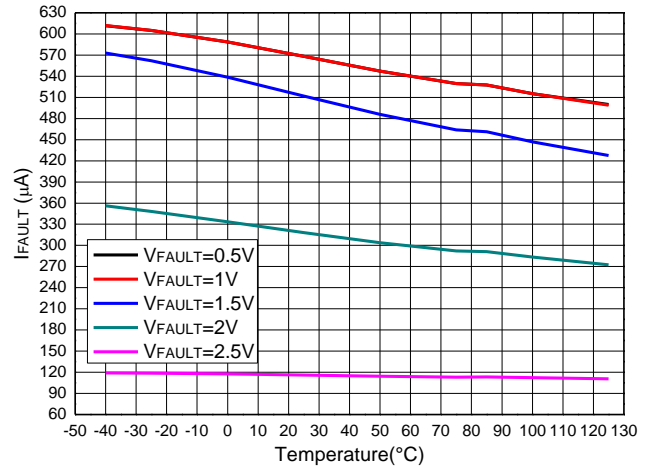
**ADIM Sourcing Current vs. Temperature**



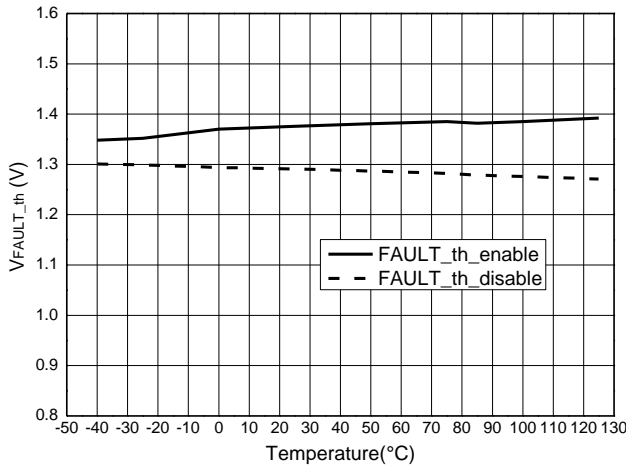
**FAULT Sourcing Current vs. FAULT Voltage**



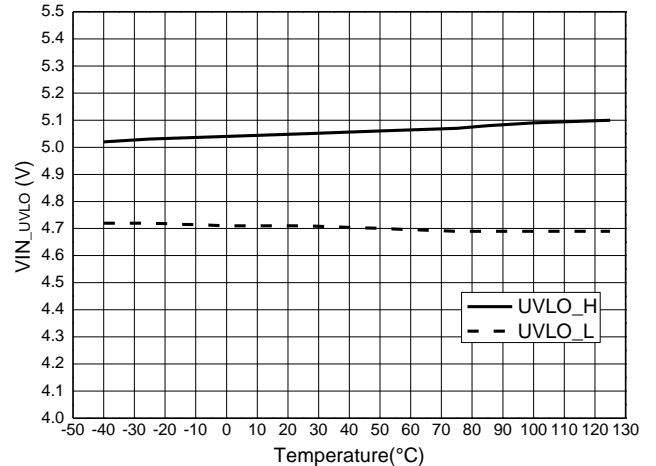
**FAULT Sourcing Current vs. Temperature**



**FAULT Input Detection Threshold vs. Temperature**

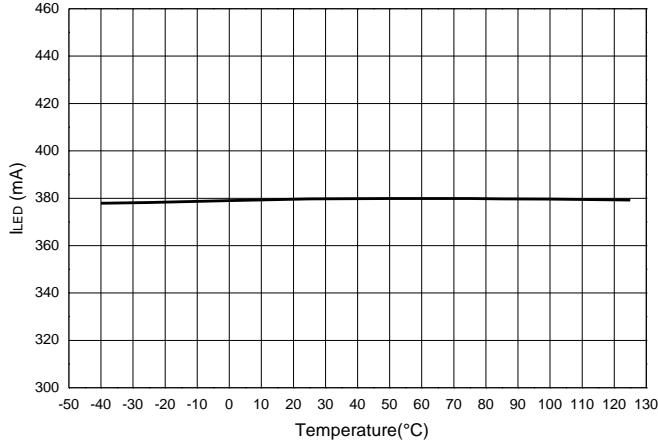


**VIN UVLO Voltage vs. Temperature**

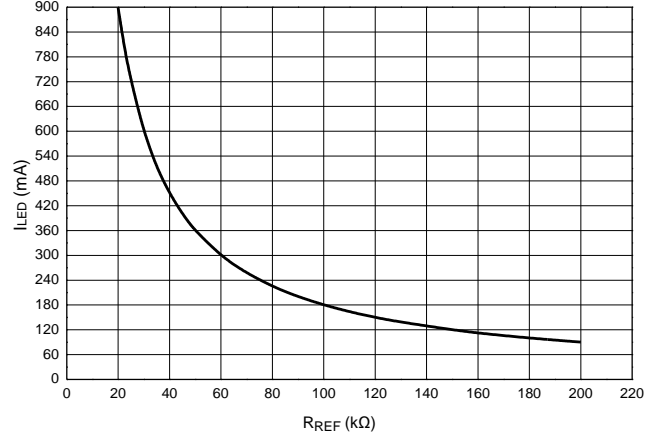


**Typical Performance Characteristics** (continued) ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , unless otherwise specified.)

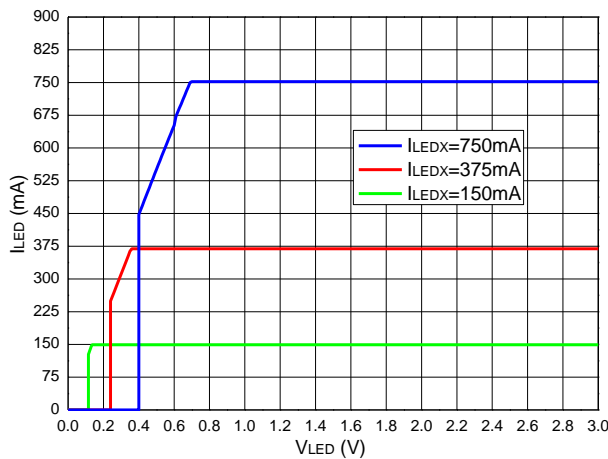
**LED Current vs. Temperature**



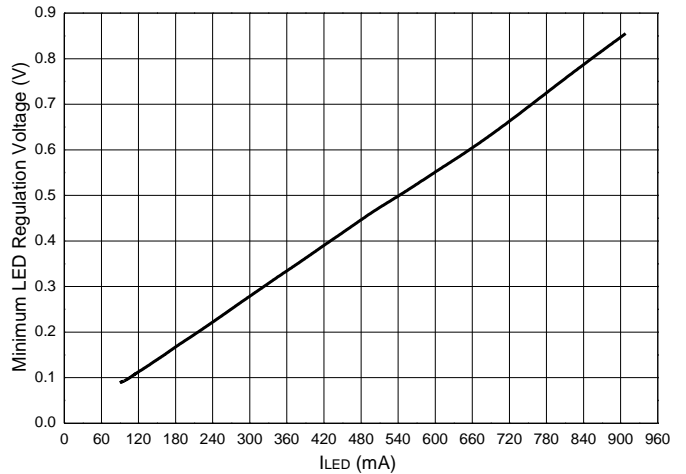
**LED Current vs.  $R_{REF}$**



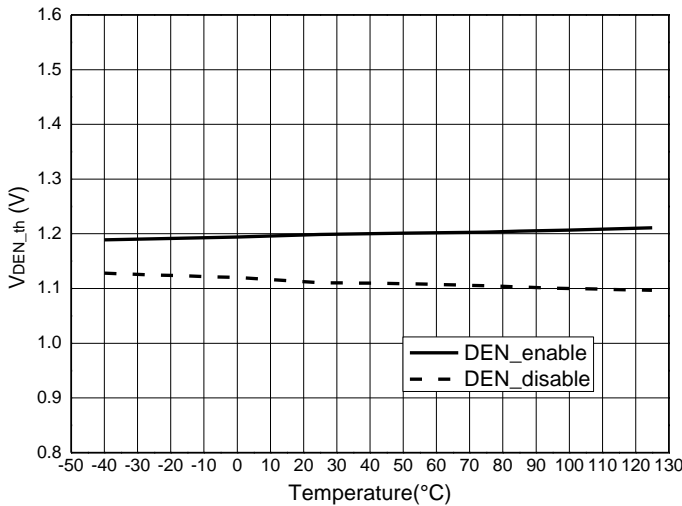
**LED Current vs.  $V_{LED}$  Voltage**



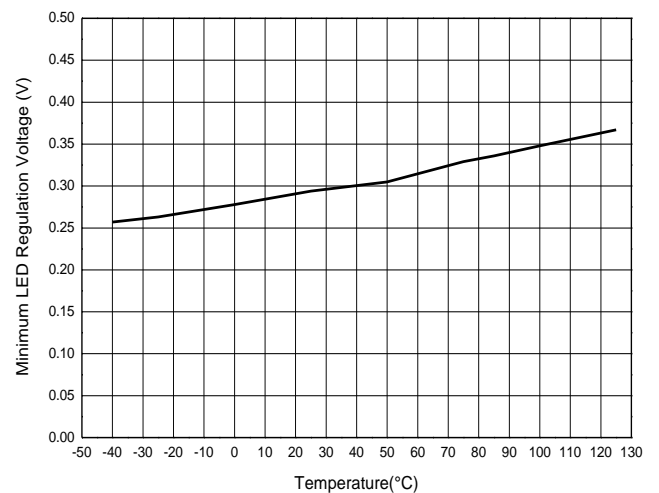
**Minimum LED Voltage vs. LED Regulation Current**



**DEN Open LED Detection vs. Temperature**

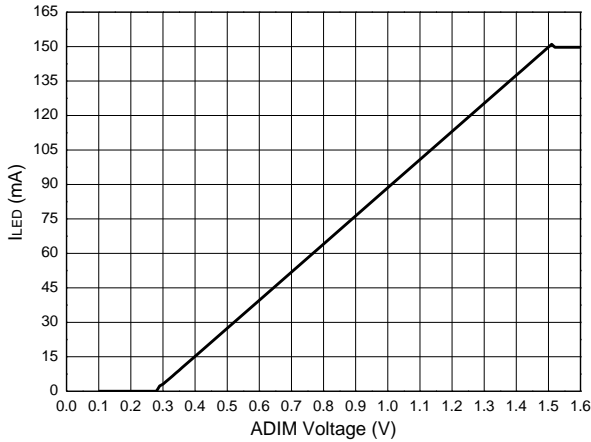


**Minimum LED Voltage vs. Temperature**

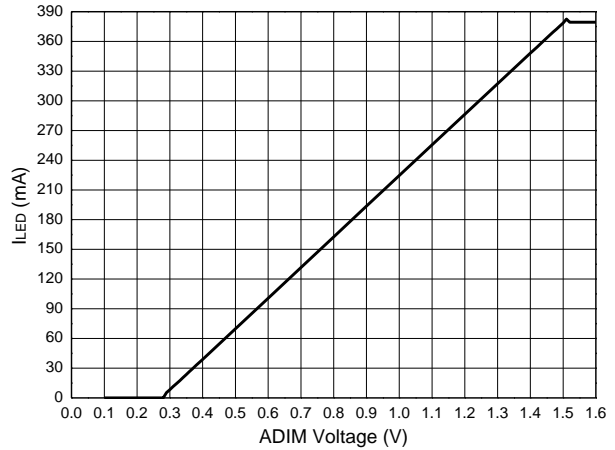


**Typical Performance Characteristics** (continued) ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , unless otherwise specified.)

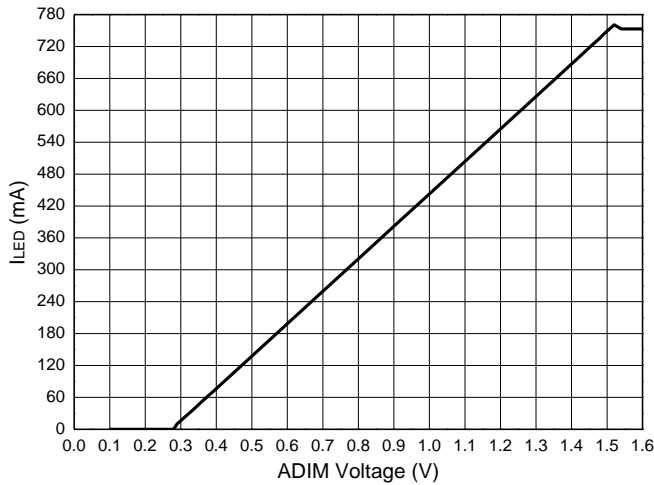
**LED Current vs. ADIM Voltage**  
( $R_{REF} = 120\text{k}\Omega$ ,  $I_{LED} = 150\text{mA}$ )



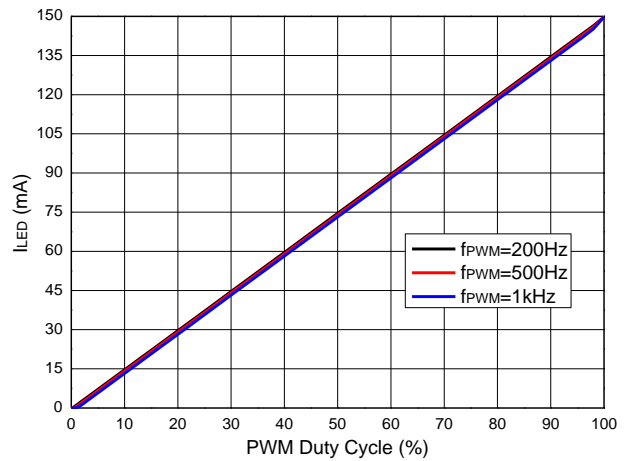
**LED Current vs. ADIM Voltage**  
( $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ )



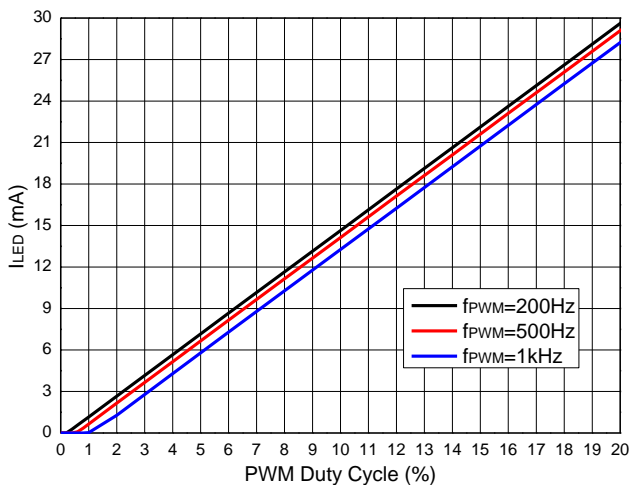
**LED Current vs. ADIM Voltage**  
( $R_{REF} = 24\text{k}\Omega$ ,  $I_{LED} = 750\text{mA}$ )



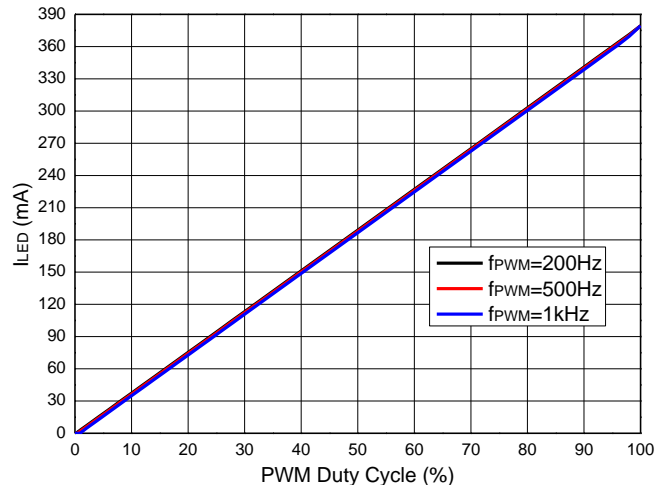
**LED Current vs. PWM Duty Cycle**  
( $R_{REF} = 120\text{k}\Omega$ ,  $I_{LED} = 150\text{mA}$ , 0 to 100% Duty)



**LED Current vs. PWM Duty Cycle**  
( $R_{REF} = 120\text{k}\Omega$ ,  $I_{LED} = 150\text{mA}$ , 0 to 20% Duty)



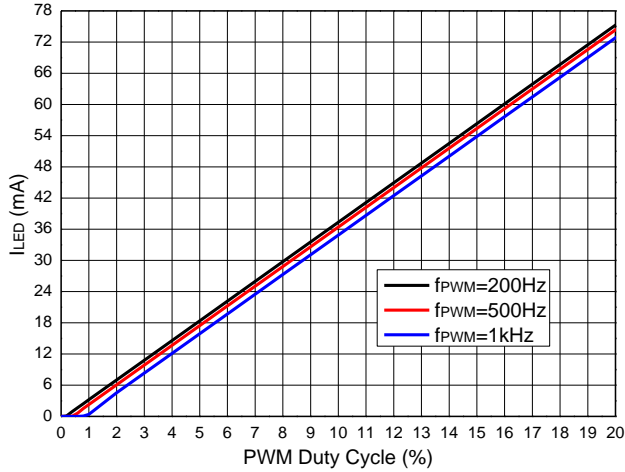
**LED Current vs. PWM Duty Cycle**  
( $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , 0 to 100% Duty)



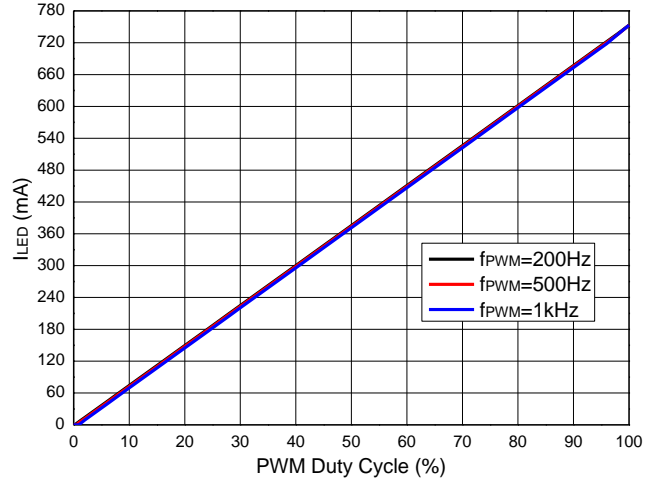


**Typical Performance Characteristics** (continued) ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , unless otherwise specified.)

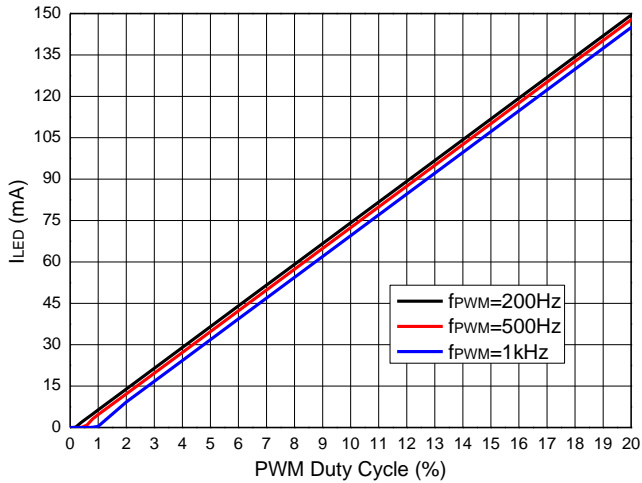
**LED Current vs. PWM Duty Cycle**  
( $R_{REF} = 48\text{k}\Omega$ ,  $I_{LED} = 375\text{mA}$ , 0 to 20% Duty)



**LED Current vs. PWM Duty Cycle**  
( $R_{REF} = 24\text{k}\Omega$ ,  $I_{LED} = 750\text{mA}$ , 0 to 100% Duty)



**LED Current vs. PWM Duty Cycle**  
( $R_{REF} = 24\text{k}\Omega$ ,  $I_{LED} = 750\text{mA}$ , 0 to 20% Duty)



## Function Description

The AL5871 is a cost-effective constant-current linear driver optimized for LED applications. The AL5871 can drive up to 750mA output LED current. The LED current can be controlled by digital PWM signal or analog dimming signal.

The AL5871 detects fault conditions and reports its status on the FAULTB pin. It features LED open detection, LED short detection, overtemperature protection (OTP), and undervoltage lockout (UVLO).

Integrated thermal foldback function reduces the regulated current level at high junction temperatures to limit power dissipation.

### LED Current Setting

The AL5871 current is set by the current setting resistor  $R_{REF}$ . The LED current level is expressed as below:

$$I_{LEDX} = 12000 \times \frac{V_{REF}}{R_{REF}}$$

where  $V_{REF}$  is nominally 1.5V,  $I_{LED}$  is in mA, and  $R_{REF}$  in k $\Omega$ . For example, if  $R_{REF}$  is 24k $\Omega$ , the AL5871 provides 750mA output current.

### Undervoltage Lockout

Undervoltage lockout function (UVLO) guarantees that the device is initially off during startup. AL5871 is not turned ON until the power supply has reached 5.0V. Whenever the input voltage falls below approximately 4.7V, the device is turned off. The UVLO circuit has a hysteresis of 300mV. During UVLO, a FAULTB status will be reported.

### Enable and Startup LED Drivers

The AL5871 is enabled when the voltage at PWM pin is greater than typical voltage of 1.4V, and disabled when PWM is lower than 0.4V. Upon PWM pin is asserted and VIN pin is ramped up beyond minimum operation voltage, a startup process will be performed.

### Standby Mode

When PWM pin is pulled down to voltage lower than 0.4V for 25ms or longer, the AL5871 will automatically enter the standby mode for power-saving purpose. When in the standby mode, most of blocks in the AL5871 are turned off to reduce the quiescent supply current. When the PWM pin is pulled up to voltage higher than 1.4V, the AL5871 will automatically exit the standby mode and perform its designated functions properly.

### PWM Dimming Control

The AL5871 features PWM dimming control for three output channels. High level of PWM signal will turn on the current sink to flow current through the LED and low level will turn it off. Consequently, the LED current and LED brightness of each channel can be adjusted in according to the duty cycle of PWM signal. The PWM frequency is recommended to be greater than 200Hz and less than 1kHz for better dimming linearity.

### Analog Dimming Control

In addition to PWM dimming, the AL5871 also provides an analog dimming feature on the ADIM pin. The LED current can be linearly adjusted from 0 to 100% by varying the voltage at ADIM pin from 0.3V to 1.5V. AL5871 shuts the LED current when the voltage on ADIM pin is lower than 0.15V. The LED current is constant, rather than switching when PWM dimming.

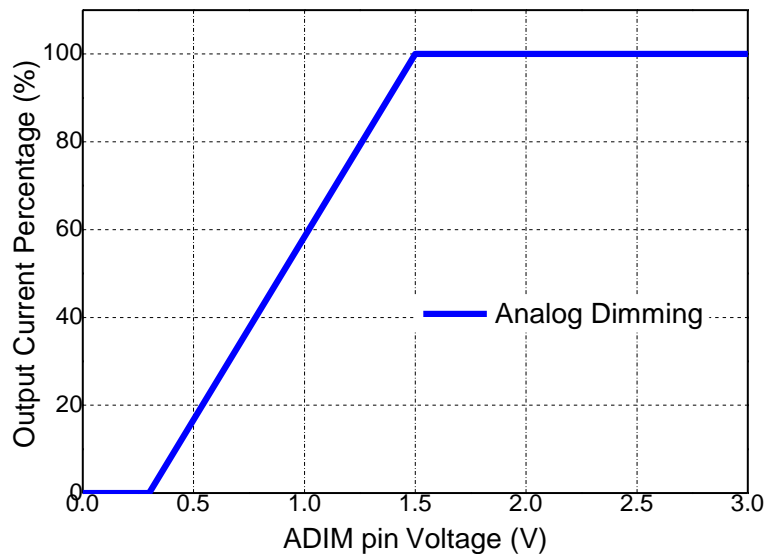


Figure 3. Analog Dimming Diagram

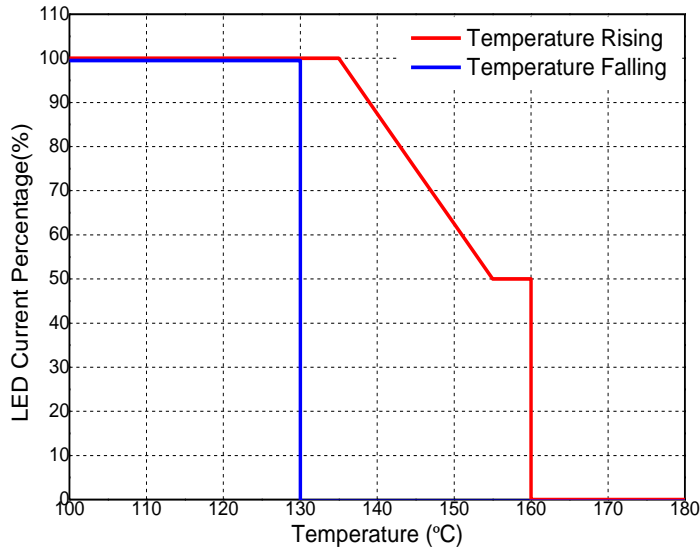
**Function Description** (continued)

**Thermal Foldback and Overtemperature Protection**

The AL5871 integrates overtemperature protection to prevent the device from overheating. When the junction temperature of IC is higher than +160°C, the device will enter OTP in which all current sinks are shut down and no current flows to LED strings. When the chip is cooled down and temperature is lower than +130°C, the AL5871 will trigger a startup process and the LED current will be automatically restored to its set current value. OTP protection is reported on the FAULTB pin.

In addition, to prevent LEDs from flickering because of rapid thermal changes, the AL5871 features thermal foldback function to reduce power dissipation at high junction temperatures. As shown in Figure 4, the AL5871 reduces the LED current as the silicon junction temperature of device increases above the threshold temperature (+135°C). As the temperature rising, the LED current drops down to 50% of nominal value and keeps constant. If the junction temperature of IC is continually rising above +160°C, the OTP will be triggered and shut down the LED current. By mounting the AL5871 on the same thermal substrate with LEDs, this feature can also limit the dissipation of the LEDs, protecting the IC and LEDs.

The AL5871 supports enable/disable thermal foldback function via DEN pin. The thermal foldback function is enabled when the voltage on DEN is higher than 0.3V, and disabled when the voltage on DEN pin is less than 0.2V.



**Figure 4. Thermal Foldback Diagram**

**LED Open Protection**

The AL5871 detects the LED open status by monitoring the current and voltage status of the LED strings. The voltage at LED pin is compared with a reference voltage proportional to LED current. The comparator will output high if the voltage at LED pin is lower than reference voltage. When LED opens and lasts for a short time period, the AL5871 enters protection and shuts down output. The time period is 7 cycles of the input PWM signal or 5ms timer when the PWM duty is 100%. The abnormal channel will be periodically rechecked every 128ms afterward to see if the abnormal condition is cleared. The LED driver will be re-activated if the abnormal condition is cleared. FAULTB pin will be pulled low if LED open condition happens, and will resume high if LED open condition is removed. The comparator in LED open protection has a typical deglitch time of 20µs to avoid wrong trigger, therefore the LED open protection is invalid when the PWM on time is shorter than 20µs during PWM dimming.

The AL5871 supports the DEN pin with an accurate threshold to disable the LED open-circuit diagnostic functions. The DEN pin can be used to enable or disable LED open-circuit protection based on input voltage sensed by an external resistor divider. When the voltage on the DEN pin is higher than 1.2V, the device enables LED open-circuit protection. When the voltage on the DEN pin is lower than 1.1V, the device disables LED open-circuit protection. With this feature, the device is able to avoid false error reports due to low-dropout voltage and to drive maximum current when the input voltage is not high enough for current regulation.

**Function Description** (continued)

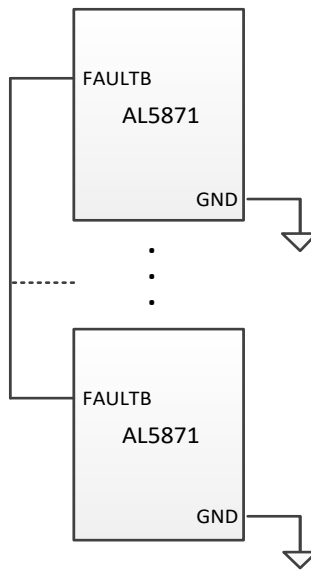
**LED Short Protection**

The AL5871 detects the LED short status by monitoring voltage at the LED pin. When the LED string anode is short to cathode,  $V_{LED}$  will be pulled up to nearly  $V_{IN}$ . And if the voltage gap ( $V_{IN} - V_{LED}$ ) is less than 1V and lasts for a short time period, the AL5871 enters protection and shuts down output. The time period is 7 cycles of the input PWM signal or 5ms timer when the PWM duty is 100%. The abnormal channel will be periodically rechecked every 128ms afterward to check if the abnormal condition is cleared. The LED driver will be re-activated if the abnormal condition is cleared. FAULTB pin will be pulled low if LED short condition happens, and will resume high if LED short condition is removed. The comparator in LED short protection has a typical deglitch time of 20 $\mu$ s to avoid wrong trigger, therefore the LED short protection is invalid when the PWM on time is shorter than 20 $\mu$ s during PWM dimming.

**Fault Reporting**

When the PWM is active, AL5871 detects and reports the FAULTB status upon the occurrence of OTP, LED short protection, LED open protection, and UVLO. The FAULTB pin is an open-drain output design. Multiple devices can share a single FAULTB signal by connecting all FAULTB pins together with an external pullup resistor. Any FAULTB assertion from any device pulls the signal down and informs MCU of the faulty condition.

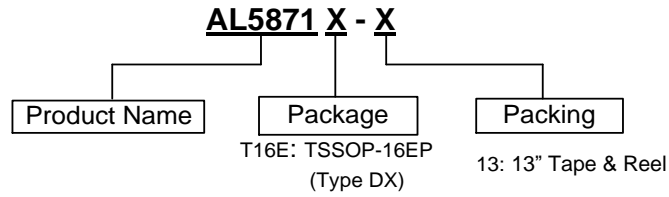
In case there is no MCU, up to 15 FAULTB pins can be connected together. When one or more devices have errors, the respective FAULTB pin goes low, pulling the connected FAULTB bus down and shutting down all devices outputs. Figure 5 shows the fault-line bus connection. The device releases the FAULTB bus when external circuitry pulls the FAULTB pin high, on toggling of the EN pin, or on a power cycle of the device. In case there is no MCU, only a power cycle clears the fault.



**Figure 5. Fault-Line Bus Connection**

The AL5871 pulls the FAULTB low upon the occurrence of thermal shutdown, LED short protection, and LED open protection. For thermal shutdown and LED open protection, the FAULTB pin is released when the fault condition is removed. For LED short protection, the FAULTB pin stays low even if the fault condition does not exist. Clearing the faults requires a power cycle of the device.

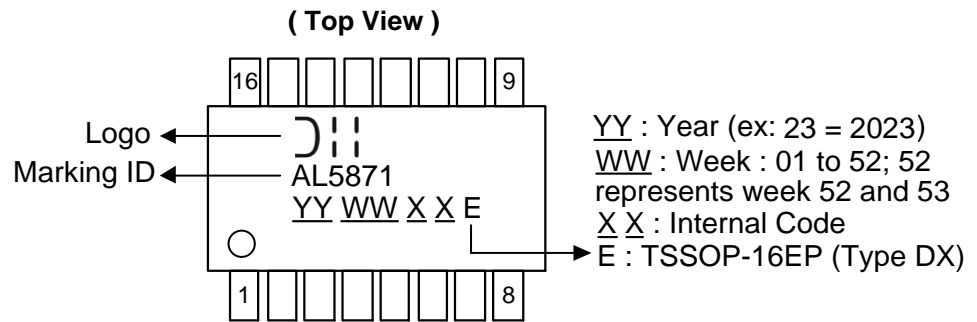
### Ordering Information



Part Number	Part Number Suffix	Package Code	Package	Packing	
				Qty.	Carrier
AL5871T16E-13	-13	T16E	TSSOP-16EP (Type DX)	2500	13" Tape & Reel

### Marking Information

Package Type: TSSOP-16EP (Type DX)



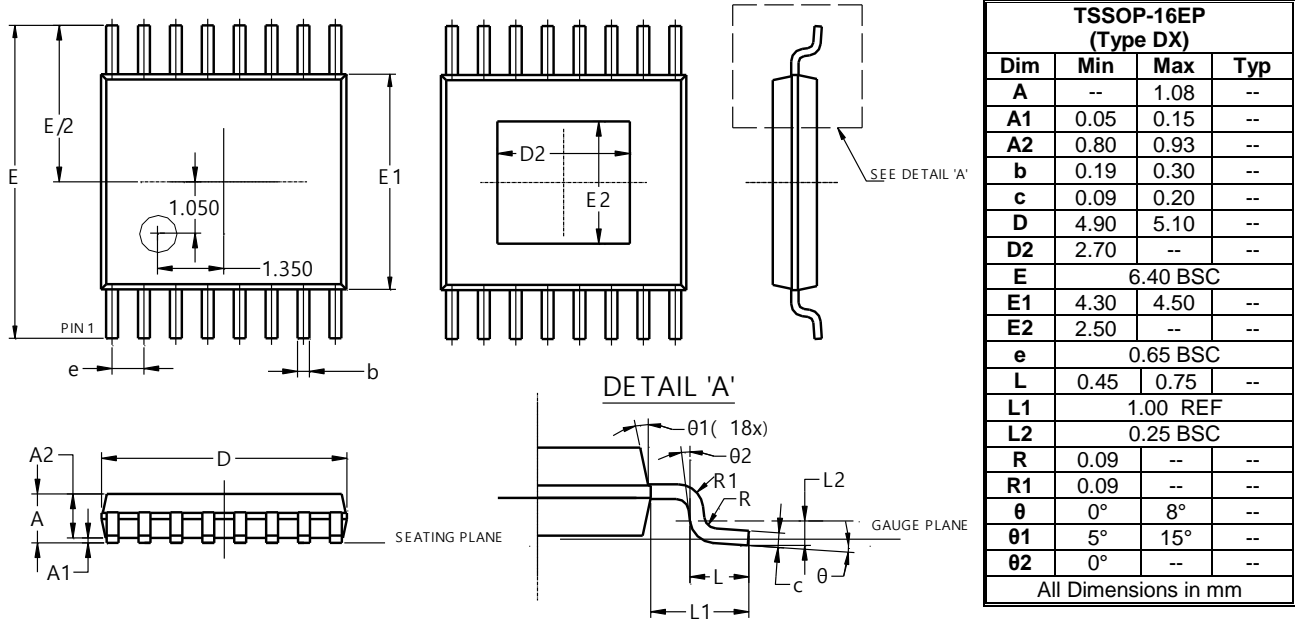
### Design Tools (<https://www.diodes.com/design/tools/>)

- Evaluation Board User Guides
- Spice Models (PSPICE Digital Simulation)
- Calculators

**Package Outline Dimensions**

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

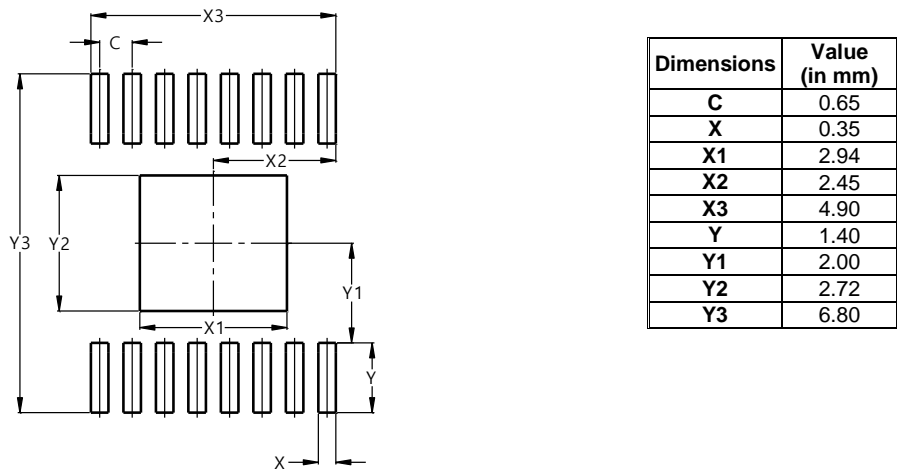
**TSSOP-16EP (Type DX)**



**Suggested Pad Layout**

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

**TSSOP-16EP (Type DX)**



**Mechanical Data**

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per JESD22-B102 (e3)
- Weight: 0.055 grams (Approximate)

**IMPORTANT NOTICE**

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.
9. This Notice may be periodically updated with the most recent version available at <https://www.diodes.com/about/company/terms-and-conditions/important-notice>

The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.  
All other trademarks are the property of their respective owners.  
© 2023 Diodes Incorporated. All Rights Reserved.

[www.diodes.com](http://www.diodes.com)