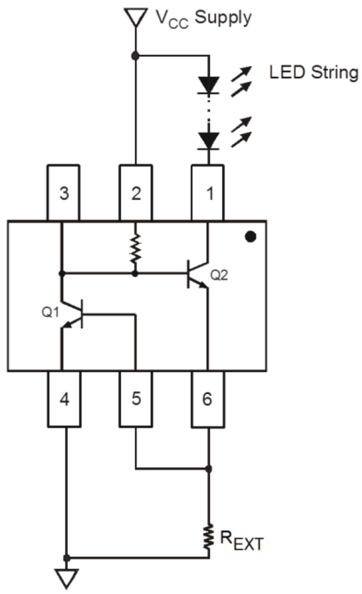
Typical Application Circuit



Pin Descriptions

Pin Number	Name	Function
1	OUT	Open-collector LED driver output
2	BIAS	Biases the open collector output transistor
3	EN	Enable pin for PWM dimming. Provides access to the base of Q2 and collector of Q1
4	GND	Ground reference point for setting LED current
5	FB	Feedback pin. Should be connected to pin 6.
6	REXT	Current sense pin. LED current sensing resistor should be connected from here to GND.

Functional Block Diagram

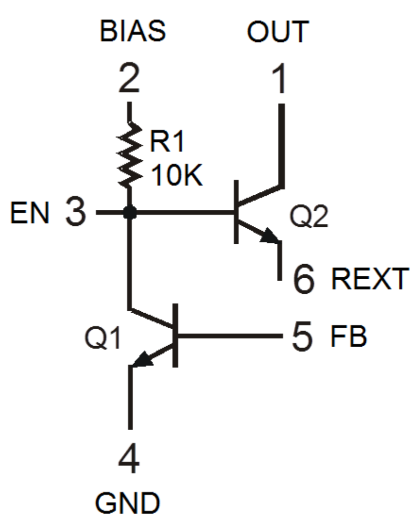


Fig. 1 Block Diagram

Absolute Maximum Ratings

These are stress ratings only. Operation outside the absolute maximum ratings may cause device failure.
Operation at the absolute maximum rating for extended periods may reduce device reliability.

Symbol	Characteristics	Values	Unit
V_{OUT}	Output voltage relative to GND	30	V
V_{BIAS}	BIAS voltage relative to GND (Note 4)	30	V
V_{FB}	LED voltage relative to GND	6	V
V_{EN}	EN voltage relative to GND	6	V
V_{REXT}	REXT voltage relative to GND	6	V
I_{OUT}	Output current	150	mA
T_J	Operating junction temperature	-40 to +150	°C
T_{ST}	Storage temperature	-55 to +150	°C

Note: 4. With pins 5 and 6 connected together.

Package Thermal Data

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5) @ T_A = +25°C Power Dissipation (Note 6) @ T_A = +25°C	P_D	0.37 0.87	W
Thermal Resistance, Junction to Ambient Air (Note 5) @ T_A = +25°C Thermal Resistance, Junction to Ambient Air (Note 6) @ T_A = +25°C	$R_{\theta JA}$	335 143	°C/W

Notes: 5. Device mounted on FR-4 PCB, 2oz with minimum recommended pad layout.
6. Device mounted on 25mm x 25mm 2oz copper board.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{BIAS}	Supply voltage range	4.5	30	V
V_{OUT}	OUT voltage range	0.8	30	
I_{LED}	LED pin current (Note 7)	10	120	mA
T_A	Operating ambient temperature range	-40	+125	°C

Note: 7. Subject to ambient temperature, power dissipation and PCB.

Electrical Characteristics – NPN Transistor – Q1 (@ T_A = +25°C, unless otherwise specified.)

Symbol	Characteristic	Test Condition	Min	Typ	Max	Unit
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage (Note 8)	I_C = 1.0mA, I_B = 0	40	—	—	V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 10μA, I_C = 0	6.0	—	—	V
I_{CEX}	Collector Cutoff Current	V_{CE} = 30V, $V_{EB(OFF)}$ = 3.0V	—	—	50	nA
I_{BL}	Base Cutoff Current	V_{CE} = 30V, $V_{EB(OFF)}$ = 3.0V	—	—	50	nA
h_{FE}	DC Current Gain	I_C = 100μA, V_{CE} = 1.0V I_C = 1.0mA, V_{CE} = 1.0V I_C = 10mA, V_{CE} = 1.0V	40 70 100	— — —	— — 300	—
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage (Note 8)	I_C = 10mA, I_B = 1.0mA	—	—	0.20	V
$V_{BE(SAT)}$	Base-Emitter Saturation Voltage	I_C = 10mA, I_B = 1.0mA	0.65	—	0.85	V

Electrical Characteristics – NPN Pre-biased Transistor – Q2 (@ T_A = +25°C, unless otherwise specified.)

Symbol	Characteristic	Test Condition	Min	Typ	Max	Unit
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	I_C = 50μA, I_E = 0	30	—	—	V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage (Note 8)	I_C = 1mA, I_B = 0	30	—	—	V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 50μA, I_C = 0	5.0	—	—	V
I_{CBO}	Collector Cut-Off Current	V_{CB} = 30V, I_E = 0	—	—	0.5	μA
I_{EBO}	Emitter Cut-Off Current	V_{EB} = 4V, I_C = 0	—	—	0.5	μA
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage (Note 8)	I_C = 10mA, I_B = 1mA	—	—	0.3	V
h_{FE}	DC Current Gain (Note 9)	V_{CE} = 5V, I_C = 150mA	100	—	—	—
R_1	Input Resistance	—	7	10	13	kΩ

*Characteristics of transistor only.

Note: 8. Short duration pulse test used to minimize self-heating effect.

Thermal Characteristics

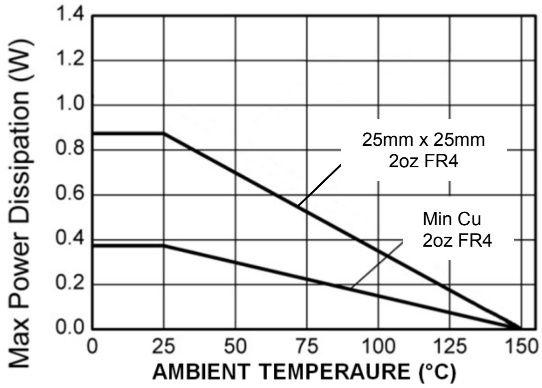


Fig. 2 Derating Curve

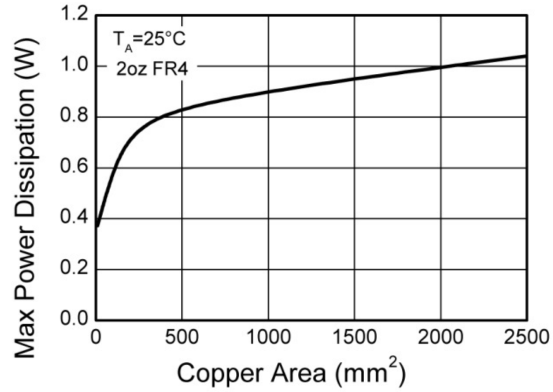


Fig. 3 Max Power vs. Area

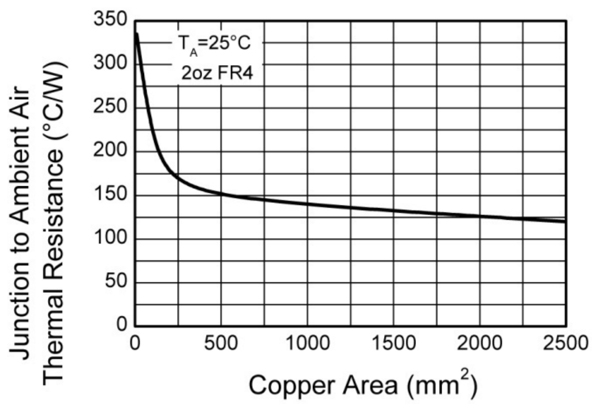


Fig. 4 Thermal Resistance vs. Area

Typical Performance Characteristics

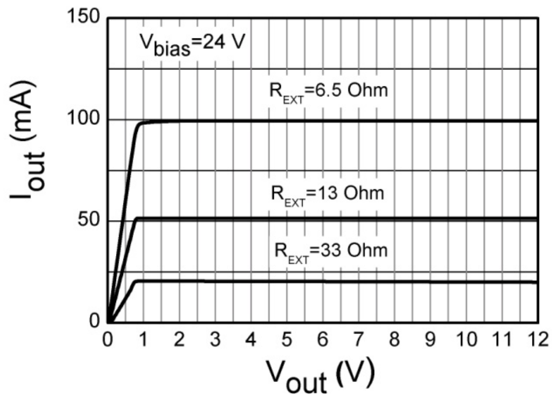


Fig. 5 Output Current vs. V_{OUT}

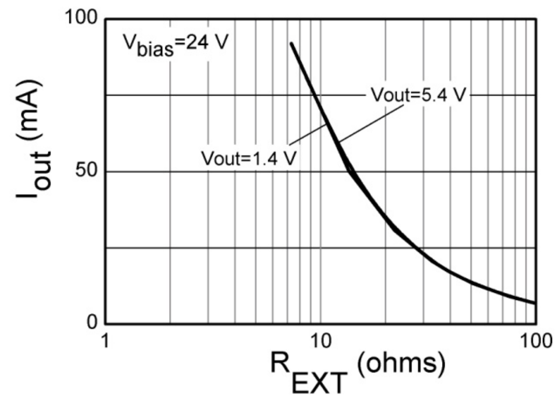


Fig. 6 Output Current vs. R_{EXT}

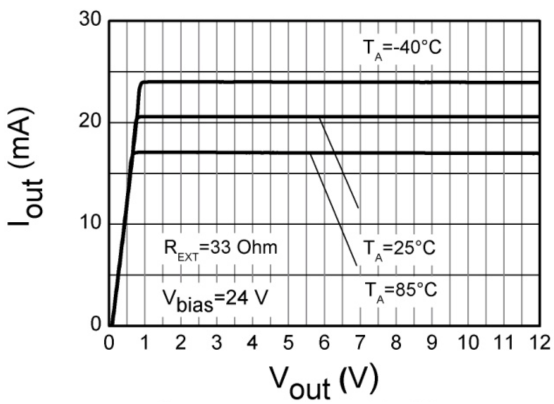


Fig. 7 Output Current vs. V_{OUT}

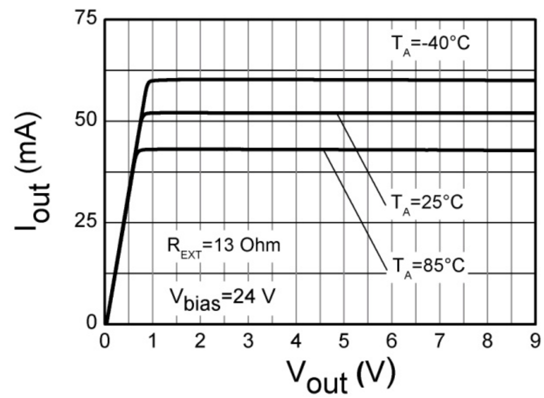


Fig. 8 Output Current vs. V_{OUT}

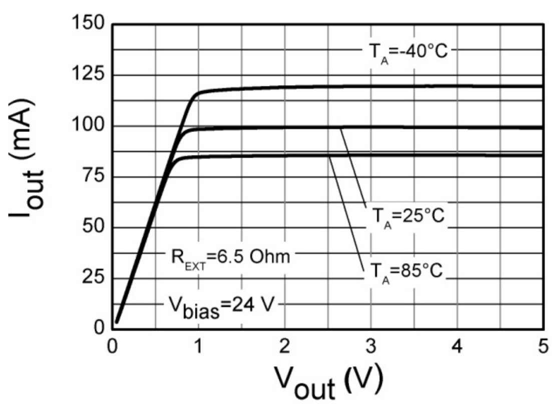


Fig. 9 Output Current vs. V_{OUT}

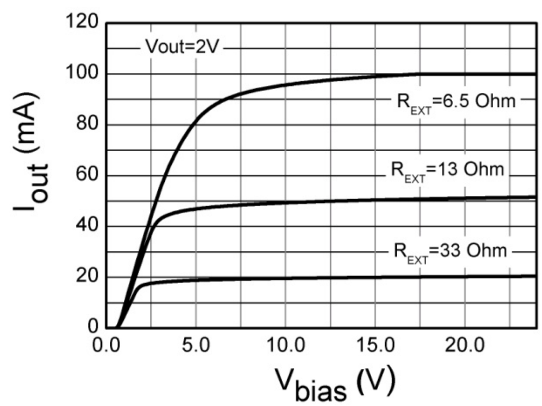


Fig. 10 Output Current vs. V_{BIAS}

Note: 10. V_{OUT} in the "Output Current vs. V_{OUT}" graphs limited by power dissipation in the device.

Typical Performance Characteristics (continued)

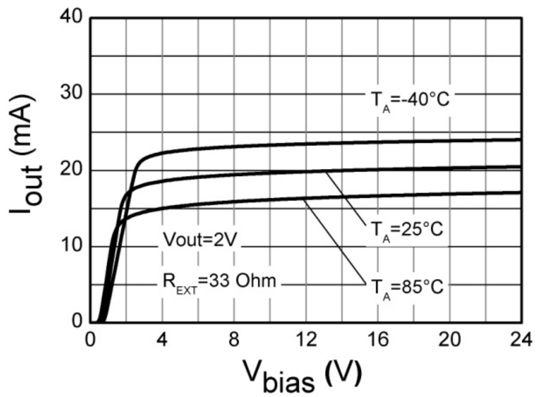


Fig. 11 Output Current vs. V_{BIAS}

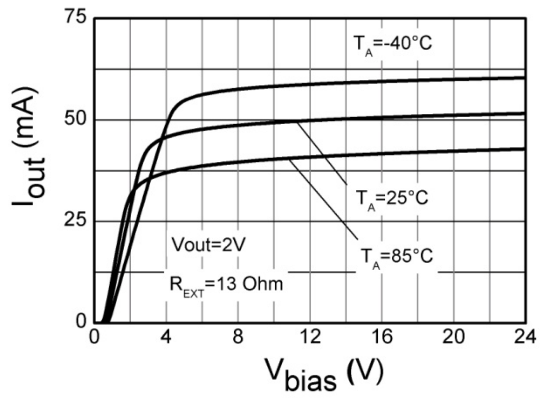


Fig. 12 Output Current vs. V_{BIAS}

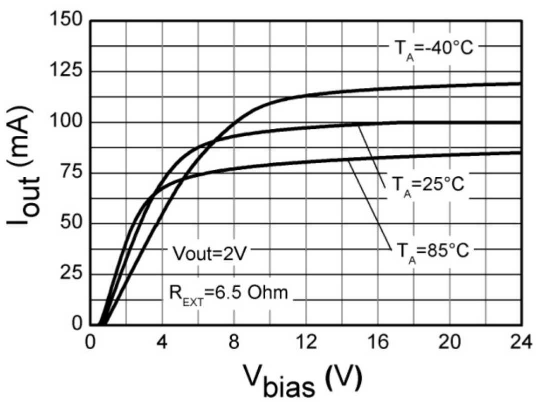


Fig. 13 Output Current vs. V_{BIAS}

Application Information

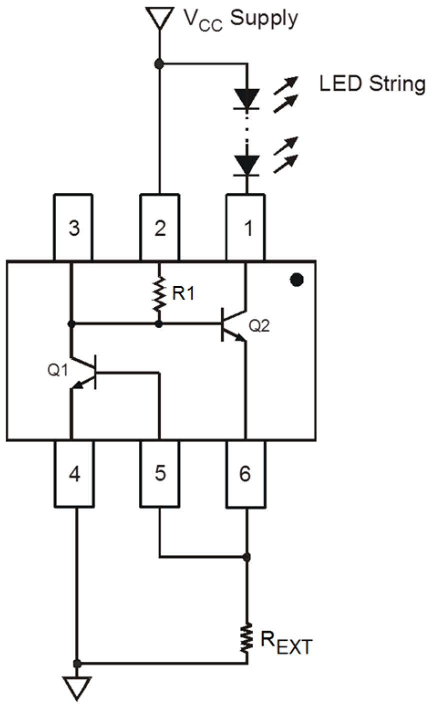


Fig. 14 Typical Application Circuit for
Linear Mode Current Sink LED Driver

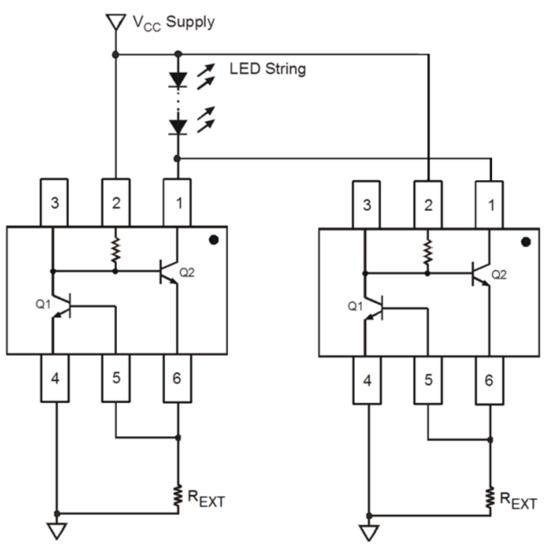


Fig. 15 Application Circuit for Increasing LED Current

The AL5802 is designed for driving low current LEDs with a typical LED current of 20mA to 100mA. It provides a cost effective way for driving low current LEDs compared to more complex switching regulator solutions. Furthermore, it reduces the PCB board area of the solution as there is no need for external components like inductors, capacitors, and switching diodes.

Figure 14 shows a typical application circuit diagram for driving an LED or string of LEDs. The NPN transistor Q1 measures the LED current by sensing the voltage across the external resistor R_{EXT}. Q1 uses its V_{BE} as a reference to set the voltage across the R_{EXT} and to control the base current into Q2. Q2 operates in linear mode to regulate the LED current. The LED current is,

$$I_{LED} = V_{BE(Q1)} / R_{EXT}$$

From this, necessary LED currents by the external resistor R_{EXT} can be calculated from,

$$R_{EXT} = V_{BE(Q1)} / I_{LED}$$

Two or more AL5802 devices can be connected in parallel to construct higher current LED strings, as shown in Figure 15.

Consideration of the expected linear-mode power dissipation must be factored into the design with respect to the AL5802's thermal resistance. The maximum voltage across the device can be calculated by using the maximum supply voltage and the voltage across the LED string.

$$V_{CE(Q2)} = V_{CC} - V_{LED} - V_{BE(Q1)}$$
$$P_D = V_{CE(Q2)} * I_{LED} + (V_{CC} - V_{BE(Q2)} - V_{BE(Q1)})^2 / R_1$$

As the output current of AL5802 increases, it is necessary to provide appropriate thermal relief to the device. The power dissipation supported by the device is dependent upon the PCB board material, the copper area, and the ambient temperature. The maximum dissipation the device can handle is given by,

$$P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$$

Refer to the thermal characteristic graphs on page 5 for selecting the appropriate PCB copper area.

Application Information (continued)

PWM dimming can be achieved by driving the EN pin. An external open-collector NPN transistor or open-drain N-channel MOSFET can be used to drive the EN pin, as shown in Figure 16. Dimming is achieved by turning the LEDs ON and OFF for a portion of a single cycle. The PWM signal can be provided by a micro-controller or analog circuitry. Figure 17 is a typical response of LED current vs. PWM duty cycle on the EN pin.

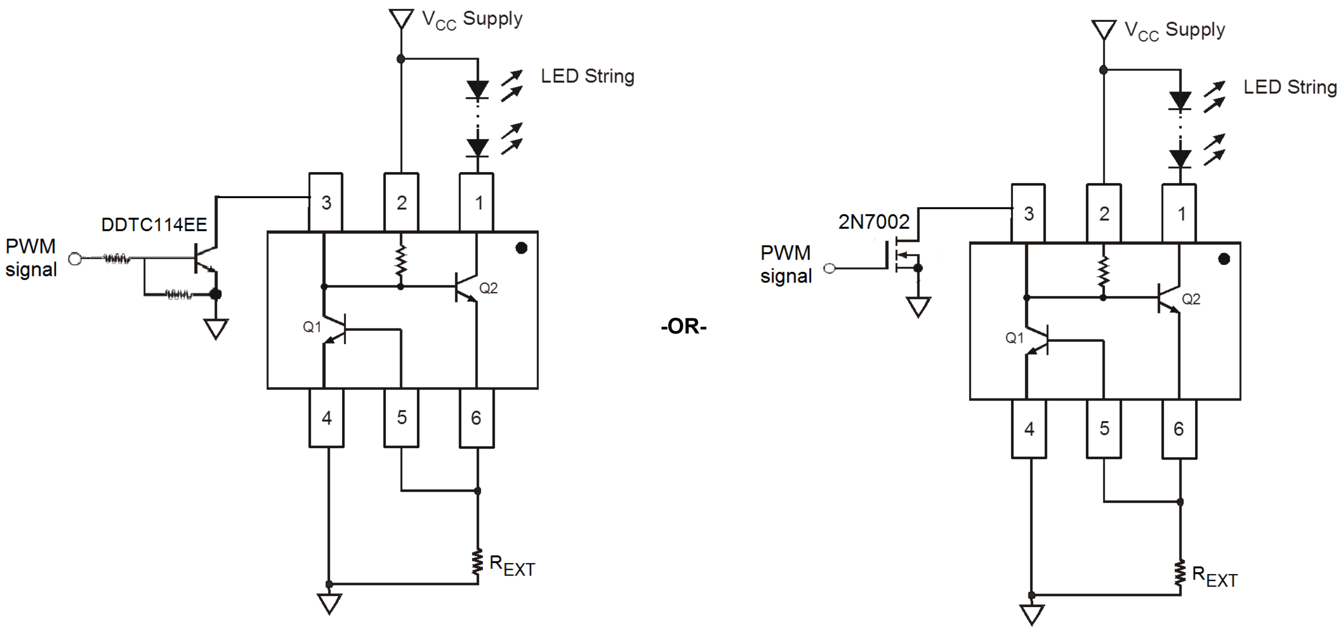


Fig. 16 Application Circuits for LED Driver with PWM Dimming Functionality

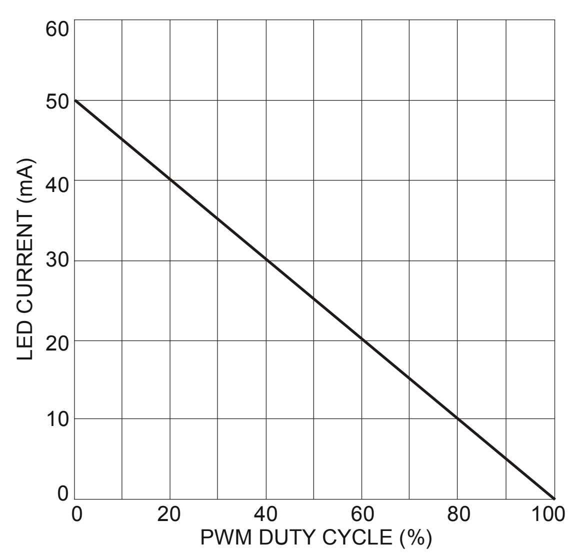


Fig. 17 Typical LED current response vs. PWM duty cycle for R_{EXT} = 13Ω at 400Hz PWM frequency

Application Information (continued)

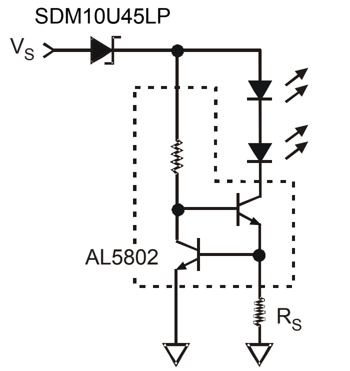


Fig. 18 Application circuit for LED driver with reverse polarity protection

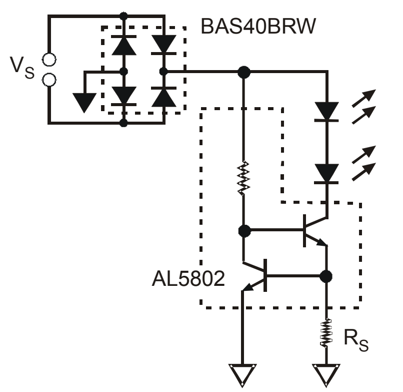


Fig. 19 Application circuit for LED driver with assured operation regardless of polarity

To remove the potential of incorrect connection of the power supply damaging the lamp's LEDs, many systems use some form of reverse polarity protection.

One solution for reverse input polarity protection is to simply use a diode with a low V_F in-line with the driver/LED combination. The low V_F increases the available voltage to the LED stack and dissipates less power. A circuit example is presented in Fig. 18 using Diodes Inc. SBR® (Super Barrier Rectifier) technology. An SDM10U45LP (0.1A/45V) is shown, providing exceptionally low V_F for its package size of 1mm x 0.6mm, equivalent to 0402 chip style package. Other reverse voltage ratings are also available on Diodes' website, such as the SBR02U100LP (0.2A/100V) or SBR0220LP (0.2A/20V).

Automotive applications commonly use this method for reverse battery protection.

A second approach, shown in Fig. 19, improves upon the method shown in Fig. 18. Whereas the method in Fig. 18 protects the light engine, it will not function until the problem has been diagnosed and corrected.

The method shown in Fig. 19 not only provides reverse polarity protection, it also corrects the reversed polarity, allowing the light engine to function.

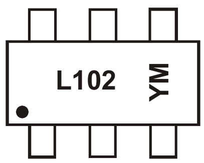
The BAS40BRW incorporates four low V_F, Schottky diodes into a single package, allowing more voltage available for the LED stack and dissipating less power than that of standard rectifier bridges.

Ordering Information (Note 11)

Device	Qualification	Packaging	Tape and Reel	
			Quantity	Part Number Suffix
AL5802	Commercial	SOT26 (SC74R)	3,000/Tape & Reel	-7
AL5802	Commercial	SOT26 (SC74R)	10,000/Tape & Reel	-13

Note: 11. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information



L102 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: B = 2014)
M = Month (ex: 9 = September)

Date Code Key

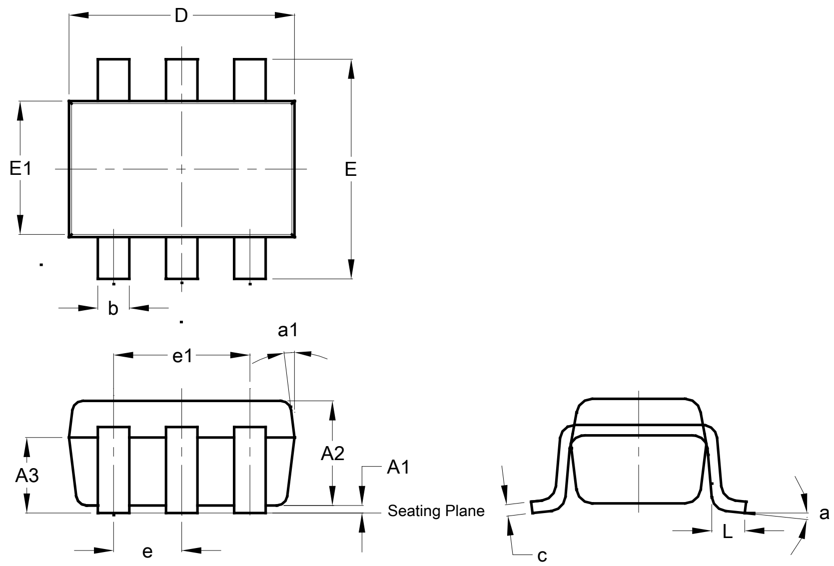
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019
Code	Y	Z	A	B	C	D	E	F	G

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

Package Outline Dimensions

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

SOT26 (SC74R)

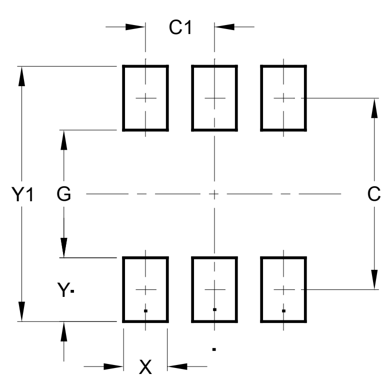


SOT26 (SC74R)			
Dim	**Min**	**Max**	**Typ**
A1	0.013	0.10	0.05
A2	1.00	1.30	1.10
A3	0.70	0.80	0.75
b	0.35	0.50	0.38
c	0.10	0.20	0.15
D	2.90	3.10	3.00
e	-	-	0.95
e1	-	-	1.90
E	2.70	3.00	2.80
E1	1.50	1.70	1.60
L	0.35	0.55	0.40
a	-	-	8°
a1	-	-	7°
All Dimensions in mm			

Suggested Pad Layout

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

SOT26 (SC74R)



Dimensions	Value (in mm)
C	2.40
C1	0.95
G	1.60
X	0.55
Y	0.80
Y1	3.20

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