# XR46010

## Active Load Current Regulator for Phase-Cut Dimmable AC Direct Drive LED Lamp

## Description

The XR46010 is an active load current regulator for phase-cut dimmable AC direct drive LED lamp system. The active load circuit can provide the holding current for TRIAC and also the charging current path of R/C circuit in a dimmer. It can help to stabilize TRIAC operation and increase the dimming range of the lamp system.

The application of the XR46010 is configured in parallel with an LED string. It conducts the current when the LED string is in off state, and stops conducting the current when the LED string is in on state.

The active load circuit can be placed in the same board with the LED string or a separate board in front of the LED board. The design is very flexible to meet various shape requirements.

**FEATURES**

- 3V to 80V input operation range
- 250mV low current sense voltage
- Linear over temperature protection

**APPLICATIONS**

- LED Lighting Applications
  - Downlight
  - High bay
  - Specialty
  - Architectural



## Typical Application

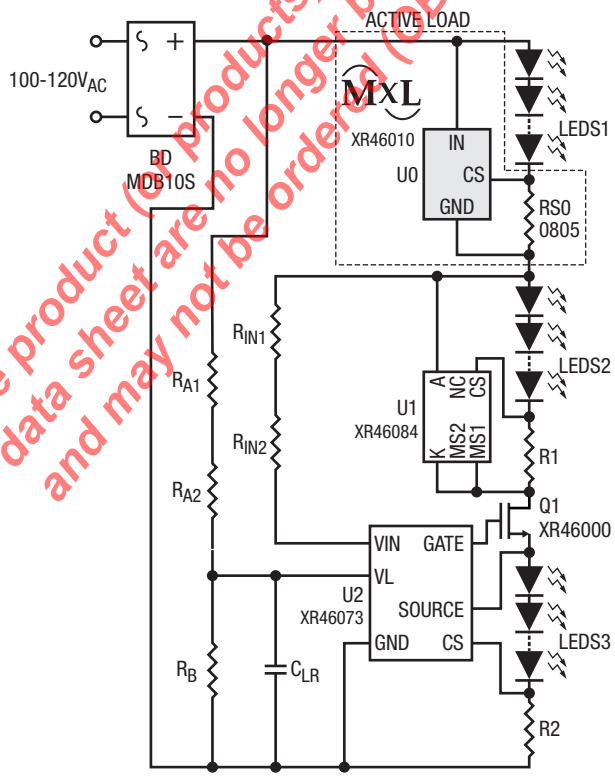



Figure 1. Typical Application

## Absolute Maximum Ratings

Stresses beyond the limits listed below may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Sustaining voltage, IN..... -0.3V to 88V

Sustaining voltage, CS ..... -0.3V to 5V

Regulating current ..... 75mA

Maximum junction temperature, $T_J$..... 165°C

Storage temperature range ..... -55°C to 150°C

Lead temperature (soldering, 10 seconds)..... 260°C

ESD Rating

HBM - human body model..... ±2kV

MM - machine model..... ±200V

## Operating Conditions

Regulating current, $I_{IN}$ ..... 60mA

Input voltage, $V_{IN}$[1] .....4V to 80V

Junction temperature range, $T_J$..... -40°C to 150°C

**NOTE:**

1. Operating free-air temperature range.

**NOTES:**

All voltages are with respect to ground. Currents are positive into negative out of the specified terminal.

All parameters having min/max specifications are guaranteed. Typical values are for reference purpose only.

Unless otherwise noted, all tests are pulsed tests at the specified temperature, therefore: $T_J = T_C = T_A$.



## Electrical Characteristics

Unless otherwise noted, typical values are at $T_A$ = 25°C.

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{CS}$ | CS pin reference voltage | $V_{IN}$ = 5V | 225 | 250 | 275 | mV |
| $V_{DROP}$ | Dropout voltage[1] | IN to GND | | 3 | 4 | V |
| $\Delta V_{LR}/V_{CS}$ | CS pin reference voltage line regulation[2] | $V_{IN}$ = 5V and 40V, $R_{CS}$ = 50Ω | | ±1 | ±2 | % |
| $T_{TP}$ | Thermal protection trip temperature[3][4] | When $T_J$ is higher than $T_{TP}$, the $V_{CS}$ decreases to $V_{CS,OTP}$ linearly | 110 | 125 | | °C |
| $\Delta V_{CS}/\Delta T_J$ | Thermal protection mode $V_{CS}$ decreasing slope[2] | $T_J > T_{TP}$ | | -1.1 | | %/°C |

**NOTES:**

1. Dropout voltage = $V_{IN}$ at ($I_{LED}$ = 90% × ($I_{LED}$ at $V_{IN}$ = 5V)).
2. The CS pin reference voltage line regulation is defined as: $\frac{\Delta V_{LR}}{V_{CS}} = \frac{V_{CS}(V_{IN}=40V) - V_{CS}(V_{IN}=5V)}{V_{CS}(V_{IN}=5V)}$.
3. Guarantee by design, not by production test.
4. When $T_J > T_{TP}$, the $V_{CS}$ decreases linearly to around 50% at 170°C.

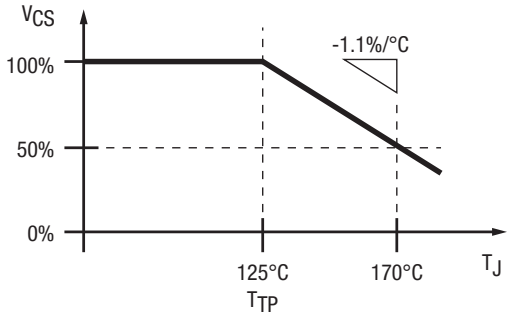
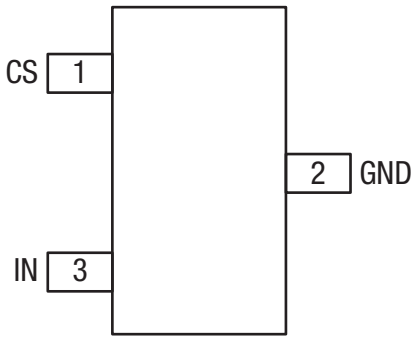



Figure 2. $V_{CS}$ vs. $T_J$

## Pin Configuration




Top View

## Pin Functions

| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | CS | Current sense and setting pin $I_{LED} = V_{CS}/R_{CS} = 0.25V/R_{CS}$ |
| 2 | GND | Chip ground pin |
| 3 | IN | Power source input pin |



## Functional Block Diagram

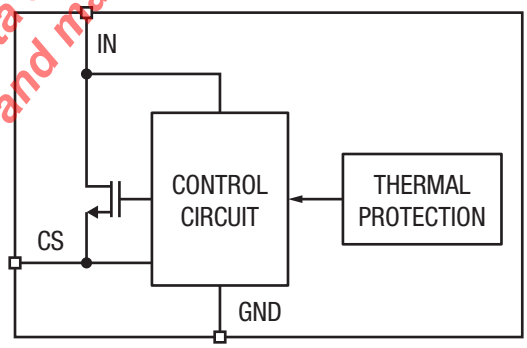



Figure 3. Functional Block Diagram

## Applications Information

The addition of XR46010 active load circuit to the XR46084 or the XR46073 system can provide better dimming performance to make it compatible with more types of TRIAC dimmers (phase-cut dimmers), as shown below:

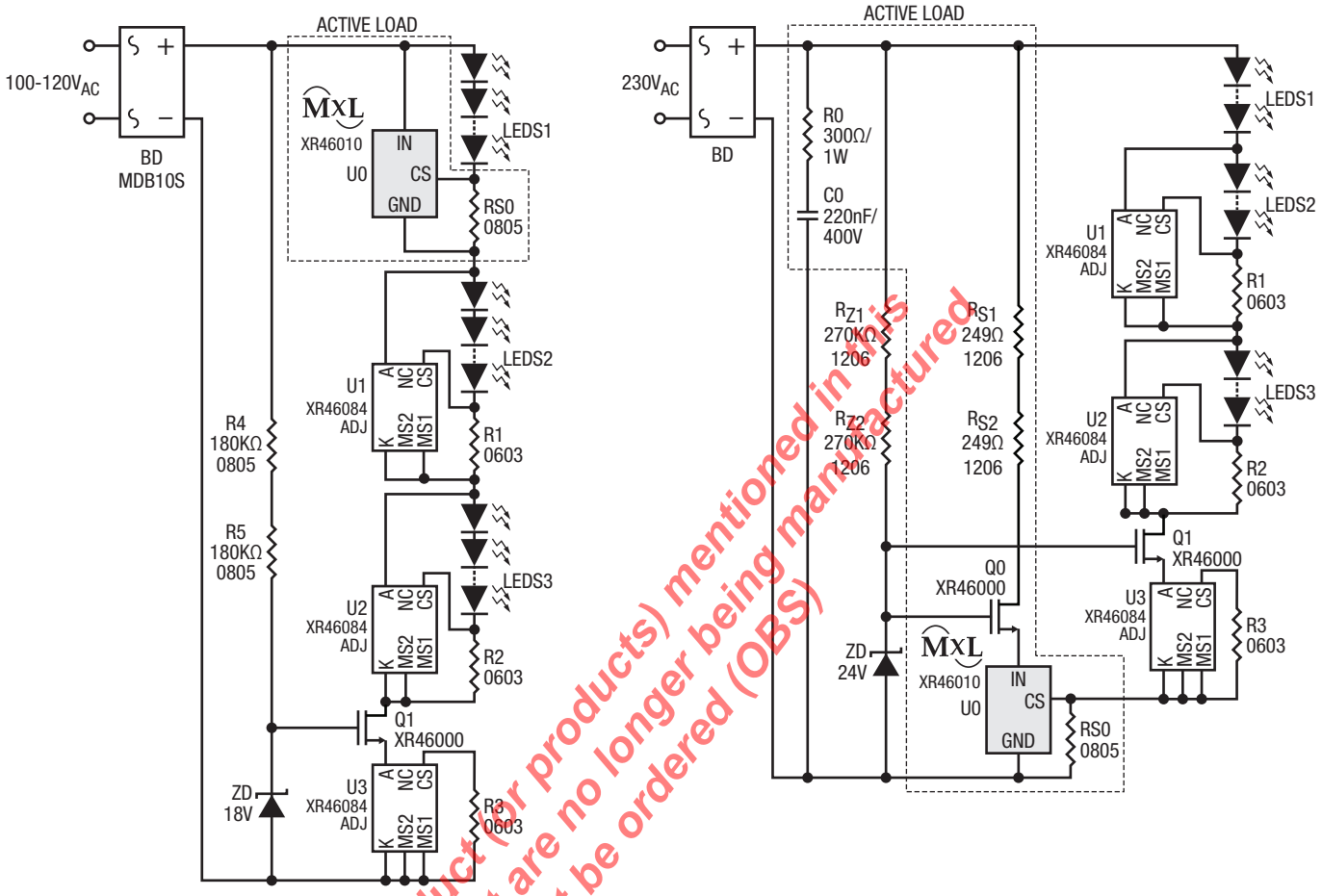



Figure 4. XR46084 3-Step Lamp System

## Applications Information (Continued)

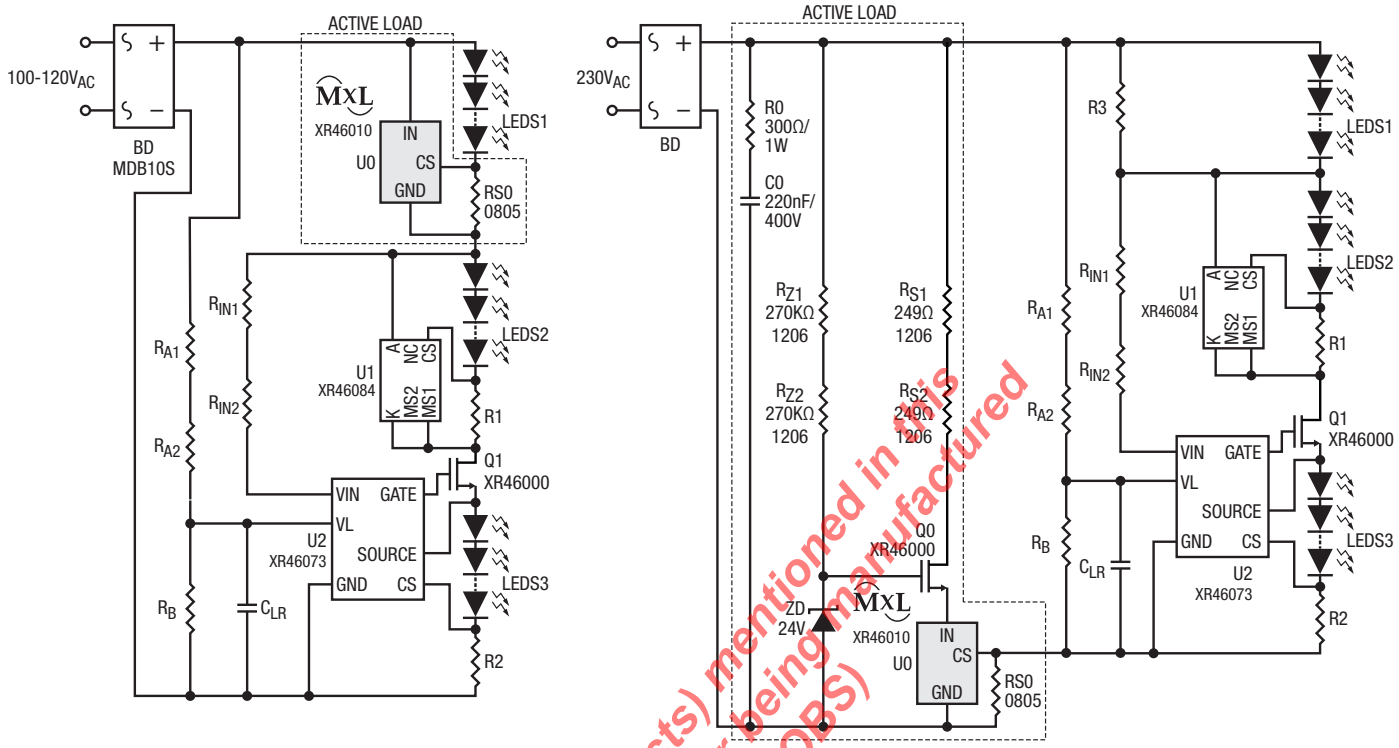
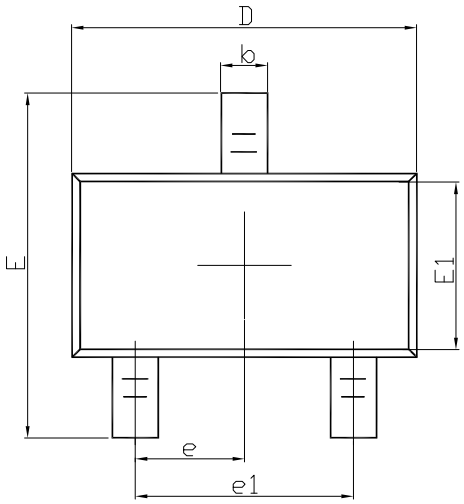
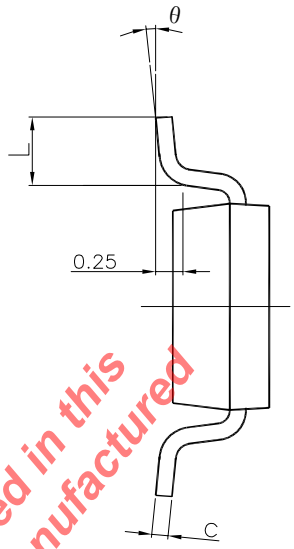



Figure 5. XR46073 3-Step Lamp System

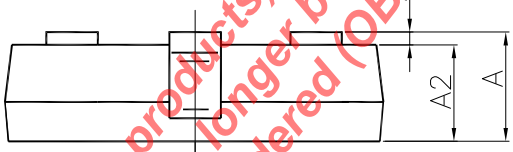
## Mechanical Dimensions




TOP VIEW




SIDE VIEW - 1




SIDE VIEW - 2

| DIM / SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | – | NA | 0.90 |
| A1 | 0.000 | 0.050 | 0.100 |
| A2 | 0.700 | 0.750 | 0.800 |
| b | 0.350 | 0.425 | 0.500 |
| c | 0.080 | 1.140 | 0.200 |
| D | 2.820 | 2.920 | 3.020 |
| E | 2.650 | 2.800 | 2.950 |
| E1 | 1.600 | 1.650 | 1.700 |
| e | 0.950(BSC) | | |
| e1 | 1.900(BSC) | | |
| L | 0.300 | 0.450 | 0.600 |
| θ | 0 | 4 | 8 |

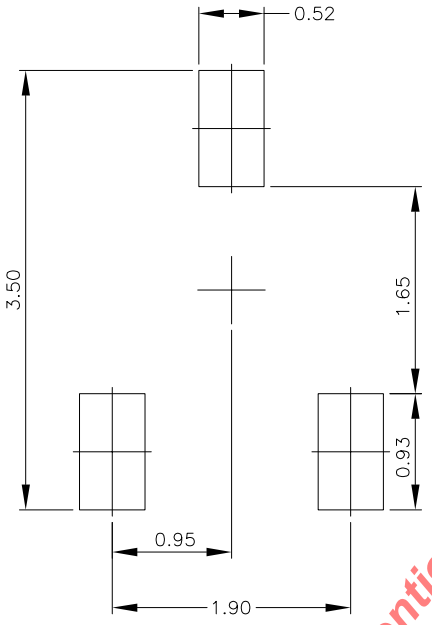
**TERMINAL DETAILS**

- ALL DIMENSIONS ARE IN MILLIMETERS, ANGLES ARE IN DEGREES.
- DIMENSIONS AND TOLERANCE PER JEDEC MO-193.

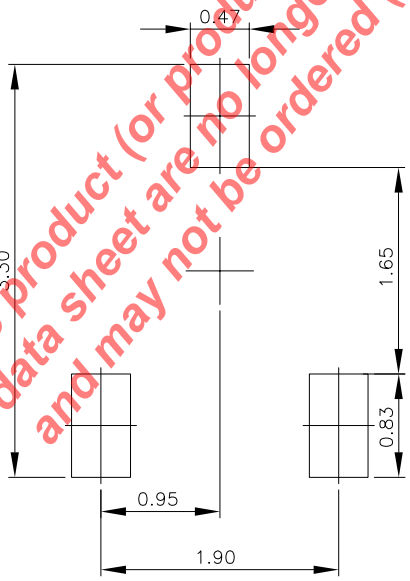
Drawing No.: POD-00000073

Revision: B

## Recommended Land Pattern and Stencil




TYPICAL RECOMMENDED LAND PATTERN




TYPICAL RECOMMENDED STENCIL



Drawing No.: POD-00000073

Revision: B

## Ordering Information

| Part Number | Junction Temperature Range | Lead-Free | Package | Packaging Method |
|---|---|---|---|---|
| XR46010ISBTR | -40°C ≤ $T_J$ ≤ 150°C | Yes[2] | TSOT-23-3L | Reel |

**NOTE:**
1. Refer to www.exar.com/XR46010 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

## Revision History

| Revision | Date | Description |
|---|---|---|
| 1.0 | June 2015 | Initial Release |
| 1.1 | October 2015 | Change Typical Application Circuit |
| 1A | July 2016 | Change to new datasheet format and correct typo in Package Description table |
| 1B | March 2017 | Corrected typographical errors; clarified temperature range. |
| 1C | May 2018 | Updated to MaxLinear logo. Update format. |



**Corporate Headquarters:**
5966 La Place Court
Suite 100
Carlsbad, CA 92008
Tel.:+1 (760) 692-0711
Fax: +1 (760) 444-8598
www.maxlinear.com

**High Performance Analog:**
1060 Rincon Circle
San Jose, CA 95131
Tel.: +1 (669) 265-6100
Fax: +1 (669) 265-6101
www.exar.com