

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

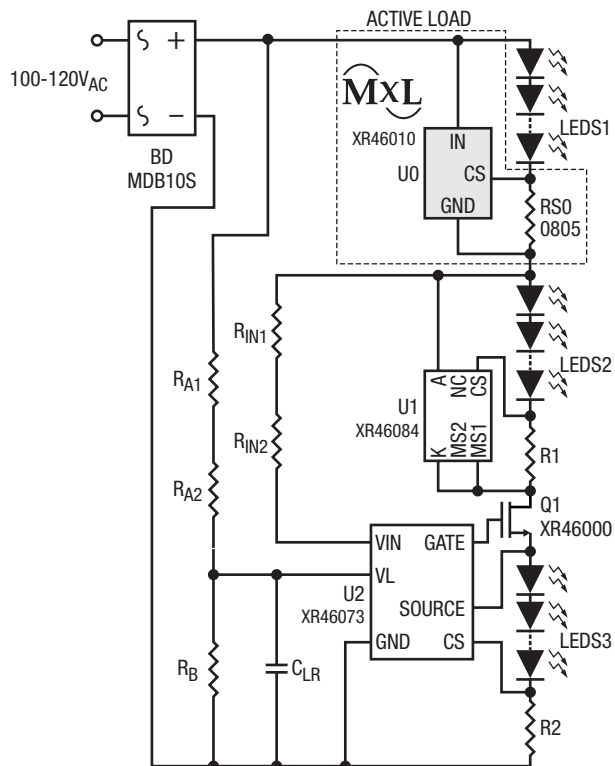


Figure 1. Typical Application

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, I_{IN}	-0.3V to 88V
Sustaining voltage, I_{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 $T_A = 25^\circ\text{C}$.

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, $R_{CS} = 50\Omega$		±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:

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

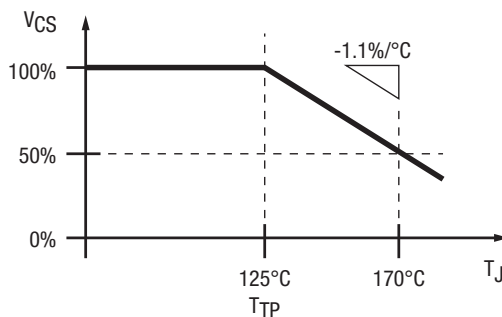
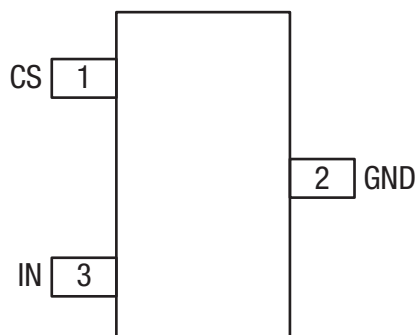


Figure 2. V_{CS} vs. T_J

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

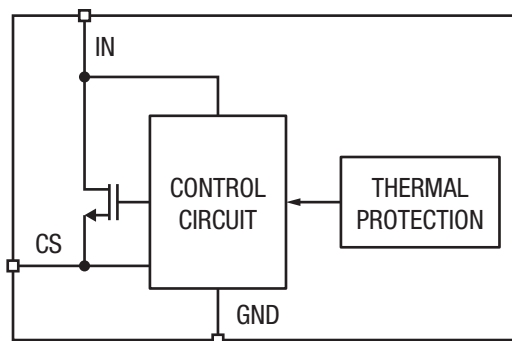


Figure 3. Functional Block Diagram

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:

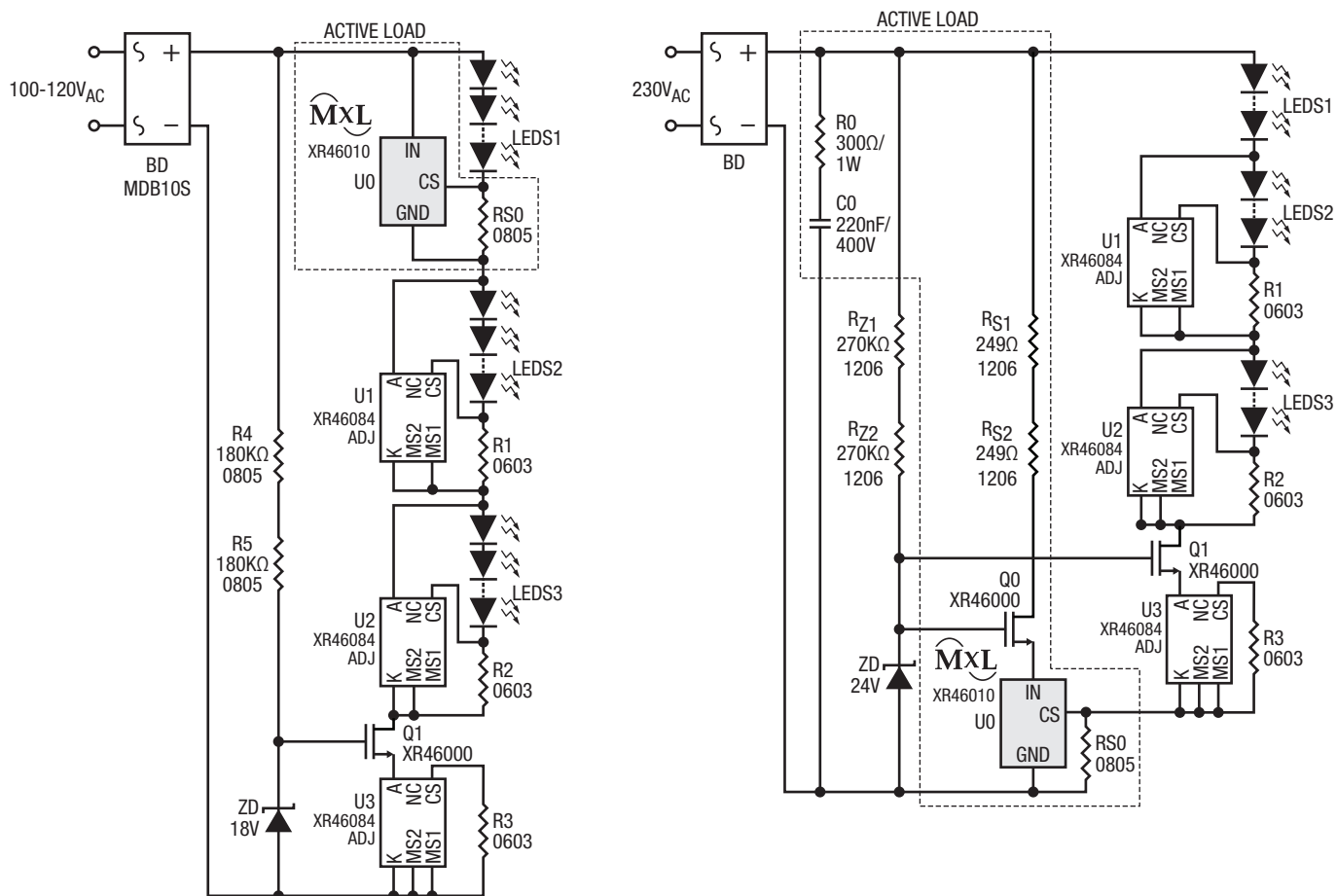


Figure 4. XR46084 3-Step Lamp System

Applications Information (Continued)

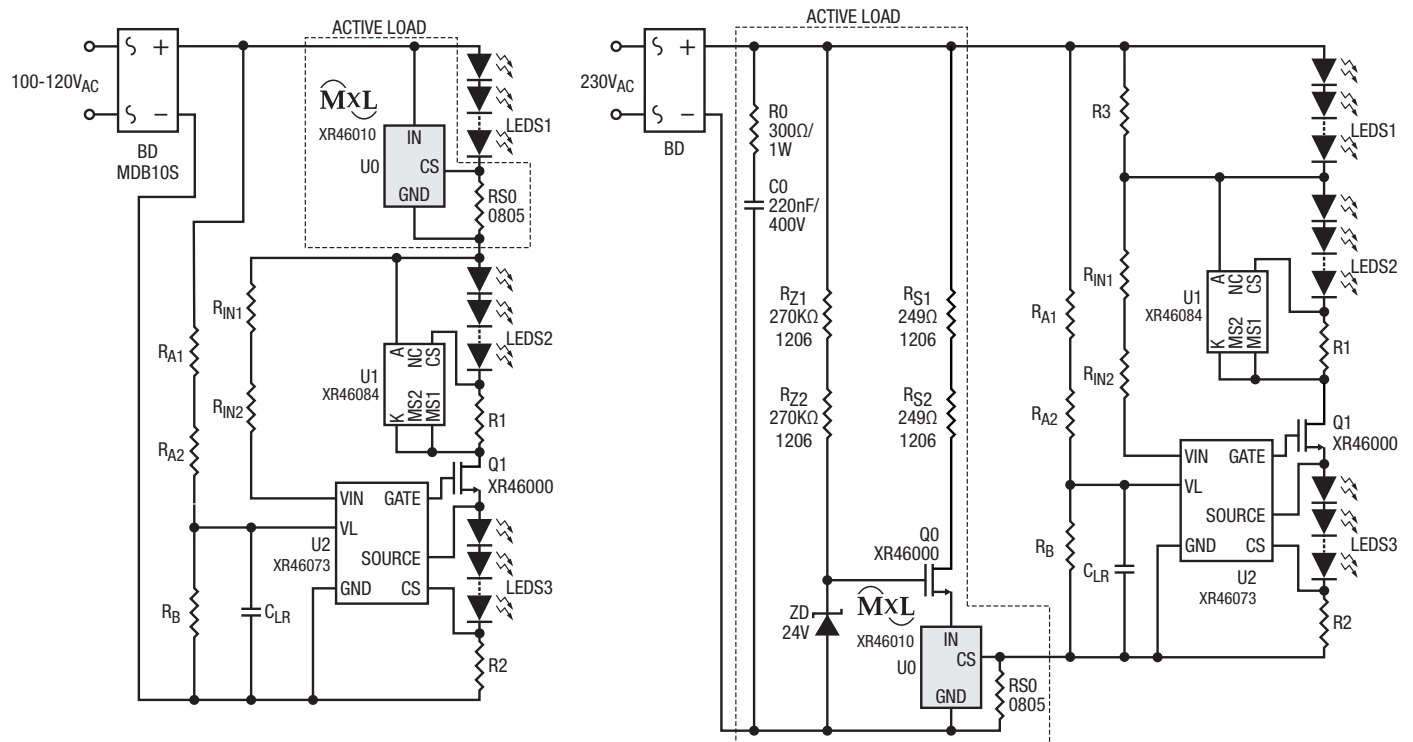
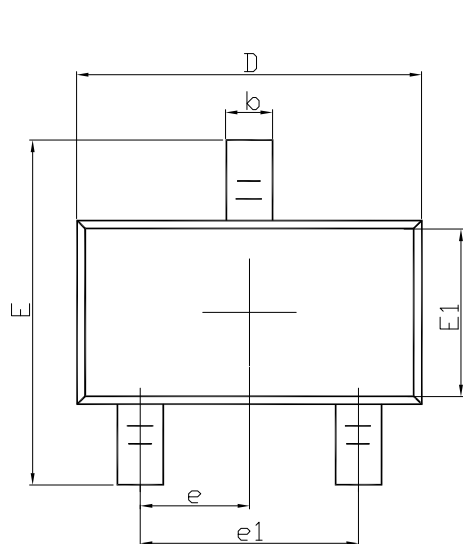
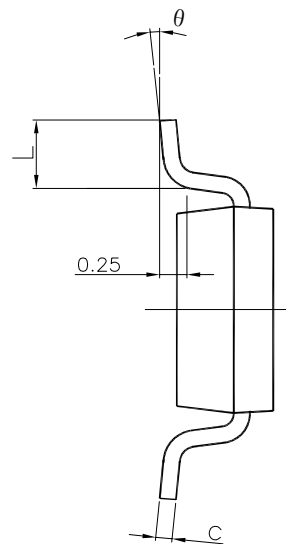


Figure 5. XR46073 3-Step Lamp System

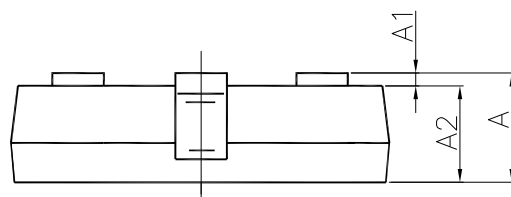
Mechanical Dimensions



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

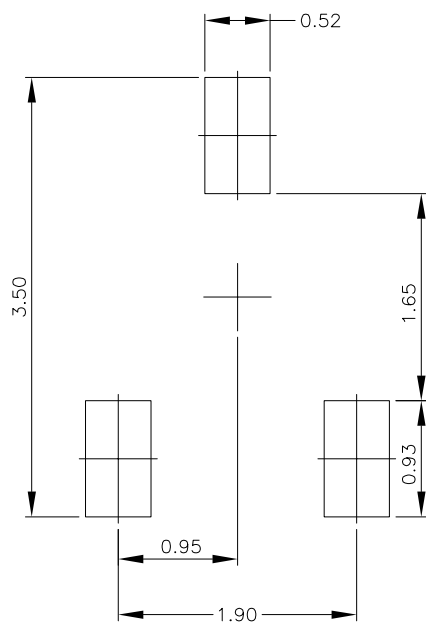
TERMINAL DETAILS

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

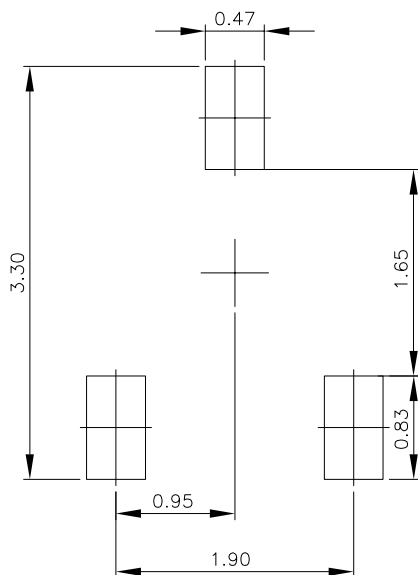
Drawing No.: POD-00000073

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	$-40^{\circ}\text{C} \leq T_J \leq 150^{\circ}\text{C}$	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.



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