MIC3230/1 Evaluation Board

High Voltage Boost HBLED Driver with PWM Dimming Control

Bringing the Power to Light™

General Description

The MIC3230/1 are constant current boost switching controllers specifically designed to power one or more strings of high power LEDs. The MIC3230/1 have an input voltage range from 6V to 45V and are ideal for a variety of applications.

The MIC3230/1 utilizes an external power device which offers a cost conscious solution for driving high power LED applications. Power consumption has been minimized through the implementation of a 250mV feedback voltage reference providing an accuracy of ±3%. The MIC3230/1 are dimmable via a PWM input signal and also features an enable pin for low power shutdown.

The LED current is regulated by keeping the voltage drop across the current sense resistor (R7) constant. The LED current can be set by selecting the value of R7. In this version of the eval board, the output current is limited to 750mA.

Multiple MIC3230 ICs can be synchronized to a common operating frequency by connecting the ICs together through the SYNC pin. This feature is only good on the MIC3230. The clocks of these synchronized devices can be used together which help reduce noise and errors in a system.

The MIC3231 offers a dither feature to assist in the reduction of EMI. This is particularly useful in sensitive EMI applications, and provides for a reduction in emissions by approximately 10dB.

Table 1 provides a summary of the eval board specifications. The evaluation board schematic is shown in Figure 1 and the parts list is shown in the Bill of Materials table.

The switching frequency is determined by the selection of R1. The chart in Figure 2 can be used to select the desired frequency. The board is set at approximately 500kHz.

Requirements

1. Voltage source capable of supplying 50 Watts
2. Load: LED, resistive or electronic load
3. Scope
4. Voltage meter
5. (Optional) Function generator for PWM Dimming

Precautions

The evaluation board does not have input reverse polarity protection. Applying a negative voltage at the VIN terminal may damage the board. When the controller is off there is a current path through the inductor and the flyback diode to the output. No current limit exists for this current path so care must be taken not to short circuit the output.

How it works

The MIC3230/1 evaluation board is set to operate as a boost converter, which requires the output voltage to be greater than the input voltage. It is important to have the series LED forward voltage drops be greater than the input voltage because when the converter is off the input is connected to the output through the inductor (L1) and diode (D1). V_{IN} is effectively applied across the LEDs and will turn on if the series sum of their forward voltage drop is not greater than V_{IN}. For 100% duty cycle, simply pull PWMD high or leave open. For a different LED current change R7 using the following equation. When R7 is 0.62Ω, the LED current is equal to 0.4A. The evaluation board is currently set to this output current value.

$$I_{LED} = \frac{V_{REF}}{R7} \quad \text{Where} \quad V_{REF} = 0.25V$$

PWM Dimming

A PWM signal applied to the PWMD pin turns the current to the load LEDs on and off. When PWMD is high the MIC3230/1 is enabled and the boost converter regulates the LED current by keeping the voltage drop across R7 constant. When PWMD is low the converter turns off and the LED current discharges the output caps and LED current stops.

Ordering Information

Part Number	Description
MIC3230ML BOOST EV	Boost evaluation board for the MIC3230YML IC
MIC3231ML BOOST EV	Boost evaluation board for the MIC3231YML IC

Quick-Start Guide

1. Connect a load (LED series string or resistive load) between V_{OUT} and LED RTN (this is not the same as ground).
2. Connect 12V (or other input voltage) to V_{IN} and GND.
3. Use a current probe to measure the load current. and Monitor the Switch node with a scope to view the switch waveform
4. PWM Dimming:
   a. For no PWM dimming, leave the PWMD terminal open
   b. For PWM DIMMING connect a function generator to the PWM DIM input and GND (not LED RTN). Set the output at 0-5V square wave pulse at 300Hz. Make sure the pulse goes all the way to 0V.

R_{SET} – Current Limit Sensing

The MIC3230/1 features current limit sensing. Current limit is set by an external resistor by the following equation:

$$I_S = 0.5V = R6 \times I_{Q1}$$

Where, I_{Q1} is the peak FET current that will trigger the current limit, the Default setting for the evaluation board is R6 = 75mΩ with the current limit set at 6.7A.

OVP – Setting the over voltage protection

OVP is set with R9 according to this equation;

$$OVP = 1.245V = \frac{(R9 \times V_{O,MAX})}{(R8 + R9)}$$

On the evaluation board, these values have been set to: R9 = 2kΩ and R8 = 100kΩ and $V_{O,MAX}$ = 64V.

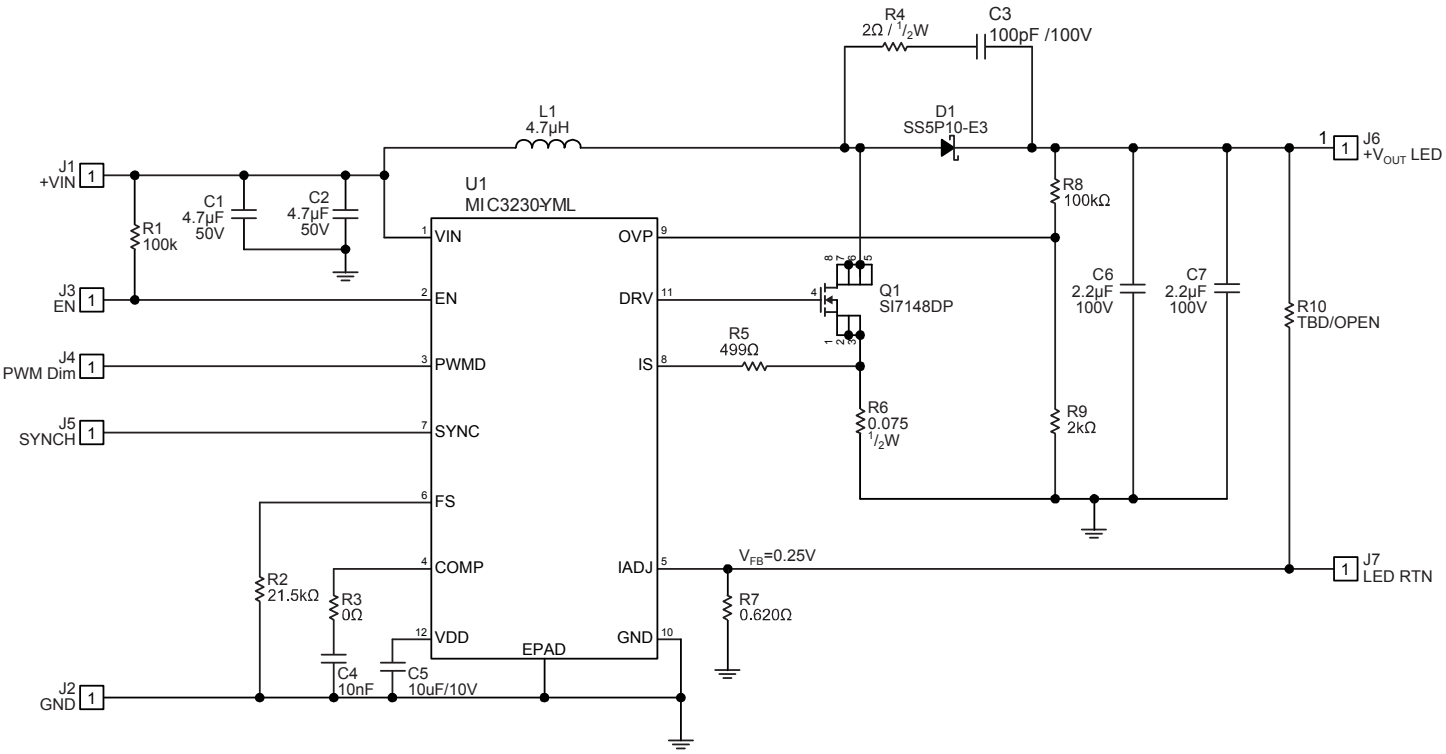


Figure 1. Schematic Diagram

Evaluation Board Design Specifications

	MIN	TYP	MAX
V_{IN}	6V	12-24	45V
Output Voltage	Vin	12-20 Series LEDs	70V
LED Current	0	0.2-0.5	1A
Power Out	0	20W	70W
Efficiency		90%	
Switching Frequency	100kHz	400kHz	1MHz
PWM Dim Frequency	0	300Hz	500Hz
Line Regulation			<3%
Load Regulation			<3%
Ambient Temperature	–40°C	+25°C	+85°C

*Evaluation Board parts are rated to 75V

Table 1. Evaluation Board Design Specifications

LED current selection

R7 (Ω)	I_LED
5	50mA
2	125mA
1	250mA
0.62	404mA
0.5	500mA
0.4	625mA
.25	1A

Table 2. LED current selection

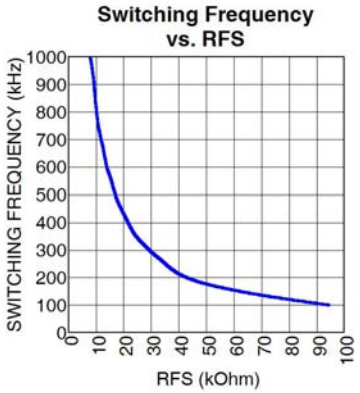


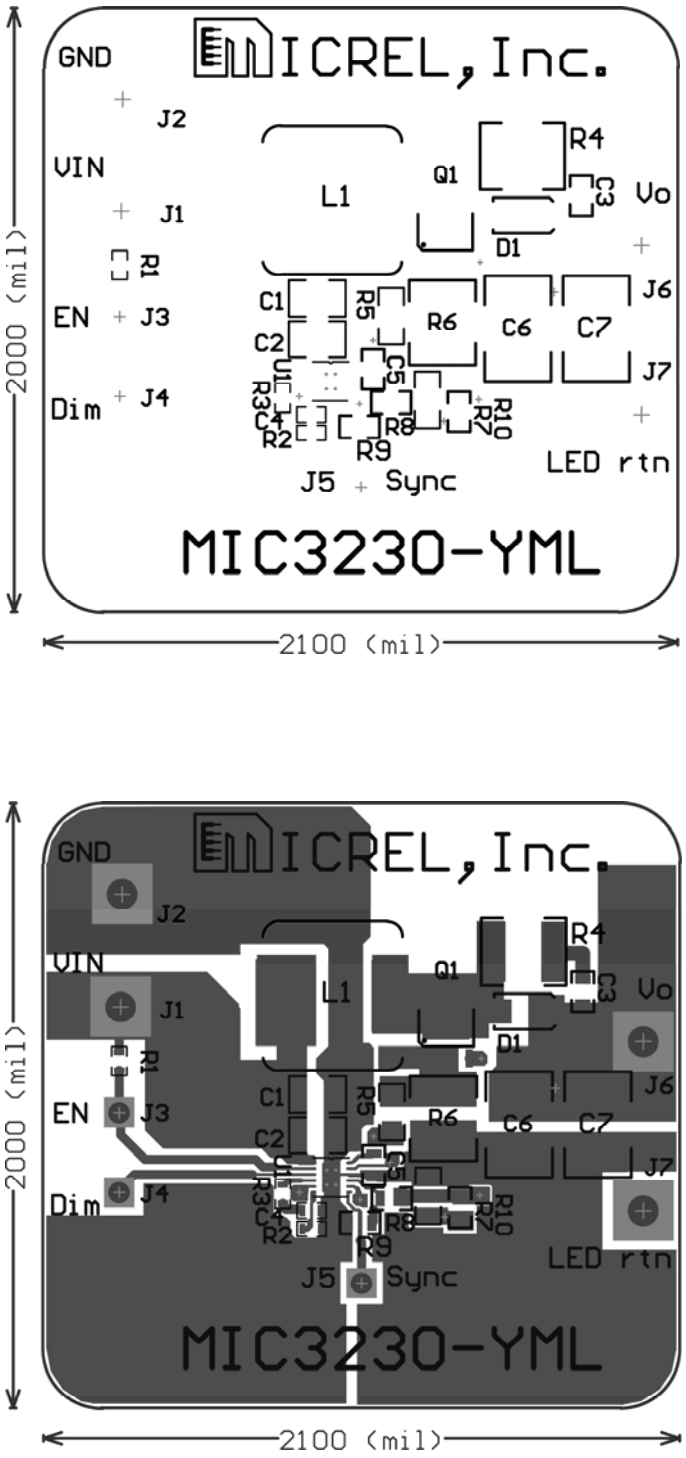
Figure 2. Frequency selection

Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1, C2	GRM32ER71H475KA88L	Murata	4.7µF/50V,1210, Ceramic capacitor	2
C3	VJ0805Y102KXBAT	Vishay Vitramon	1nF/100V, 0805, Ceramic capacitor	1
	GRM2195C2A102JA01B	Murata		
	C2012X7R2A102K	TDK		
C4	VJ0603Y103KXBAT	Vishay Vitramon	10nF/50V, 0603, Ceramic capacitor	1
	GRM188R71H103KA01D	Murata		
C5	GRM21BR61A106KE19L	Murata	10µF/10V, 0805 , Ceramic capacitor	1
	C0805C106K8PACTU	Kemet		
	LMK212BJ106KD-T	Taiyo Yuden		
C6, C7	GRM32ER72A225KA35L	Murata	2.2µF/100V, 1210, Ceramic capacitor	2
	C4352X7R2A225K	TDK	2.2µF/100V, 1812, Ceramic capacitor	
R1,R8	CRCW0603100KFKEA	Vishay Dale	100kΩ, 0603, 1%	2
R2	CRCW060321K5FKEA	Vishay Dale	21.5kΩ, 0603	1
R3	CRCW06030000FKEA	Vishay Dale	0Ω, 0603	1
R4	CRCW2010R00FKEF	Vishay Dale	2Ω, 1/2W, 2010	1
R5	CRCW06034990FKEA	Vishay Dale	499Ω, 1/4W, 0603	1
R6	WSL2010-R0750-FKEA	Vishay Dale	0.075Ω, 1/2W, 1812	1
R7	CRCW1206R620JNTALR	Vishay Dale	0.620Ω, 1/4W, 1206	1
R9	CRCW06032K00FKEA	Vishay Dale	2kΩ, 0603	1
L1	MSD1278-473ML	Coilcraft	47µH, rate 5.2A inductor	1
D1	SS5P10-E3	Vishay Corp.	5A, 100V schottky diode	1
Q1	Si7148DP-T1	Vishay Siliconix	N-Channel 75V MOSFET	1
U1	**MIC3230-YML**	**Micrel, Inc**	**Boost controller for High Power LEDs**	**2**
	MIC3231-YML			

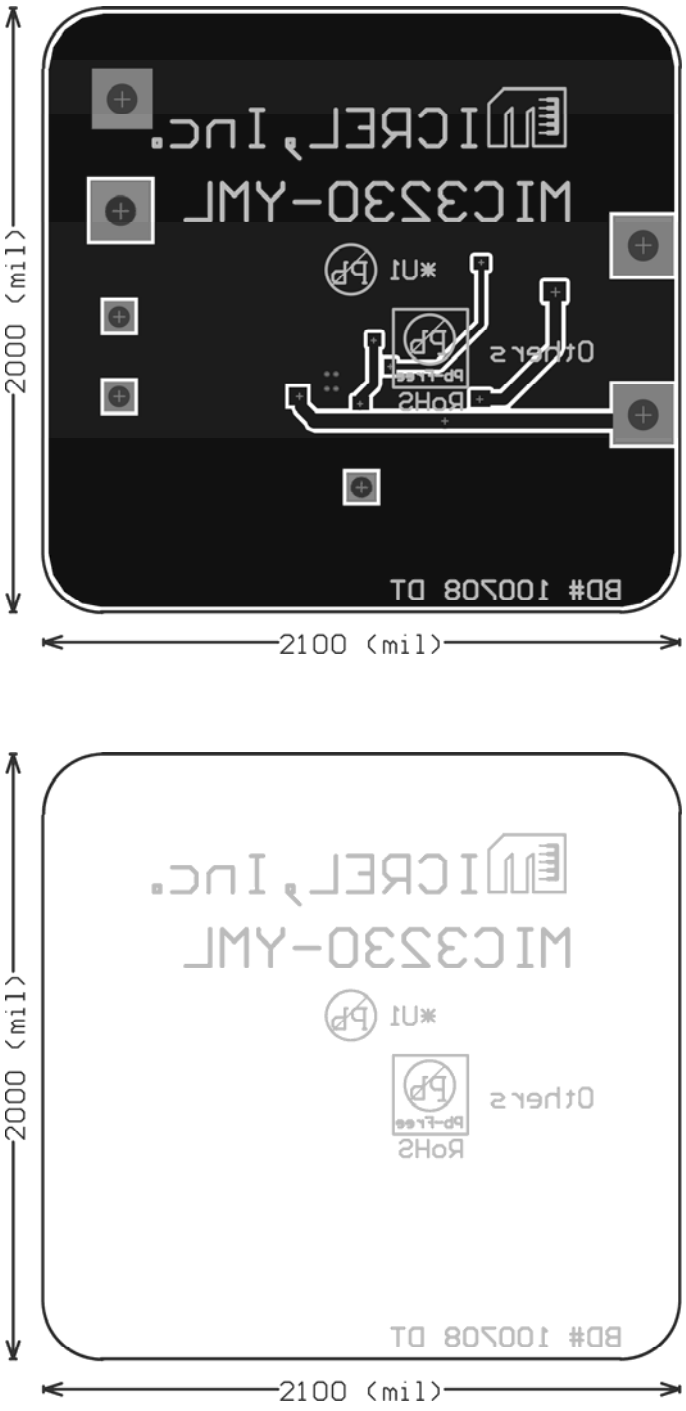
Notes:

1. DigiKey: www.digikey.com
2. Murata: www.murata.com
3. Vishay: www.vishay.com
4. AVX: www.avx.com
5. TDK: www.tdk.com
6. Diodes, Inc.: www.diodes.com
7. Sumida: www.sumida.com
8. International Rectifier: www.irf.com
9. **Micrel, Inc: www.micrel.com**


GND
MICREL, Inc.
J2
VIN
J1
R1
EN
J3
Dim
J4
L1
Q1
R4
C3
Vo
D1
J6
C1
R5
R6
C6
C7
C2
U1
C5
J7
R3
C4
R2
R8
R9
R10
J5
Sync
LED rtn
MIC3230-YML
2000 (mil)
2100 (mil)

GND
MICREL, Inc.
J2
VIN
J1
R1
EN
J3
Dim
J4
L1
Q1
R4
C3
Vo
D1
J6
C1
R5
R6
C6
C7
C2
J7
R3
C4
R2
R8
R9
R10
J5
Sync
LED rtn
MIC3230-YML
2000 (mil)
2100 (mil)

Top Layer



Bottom Layer

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