MIC3223 Evaluation Board

High-Power Boost LED Driver with Integrated FET

Bringing the Power to Light™

General Description

The MIC3223 is a constant-current boost switching controller specifically designed to power a string of high-power LEDs. The MIC3223 has an input voltage range from 4.5V to 20V and is ideal for a variety of applications. The MIC3223 evaluation board is designed to accommodate for a V_{IN} of 6V to 20V.

The MIC3223 utilizes an internal power device which offers a cost-conscious solution for driving high-power LED applications. Power consumption has been minimized through the implementation of a 200mV feedback-voltage reference providing an initial accuracy of ±5%. The MIC3223 controller is dimmable via a PWM input signal. An external FET (Q1) is in series with the LED string and is used to PWM Dim the LEDs. The MIC3223 also features an enable pin for low-power shutdown.

The LED current is regulated by keeping the voltage drop across the current-sense resistor (R5) constant. The LED current can be set by selecting the value of R5. In this version of the evaluation board, the output current is limited to 700mA. Table 1 provides a summary of the evaluation 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 fixed to 1MHz ±30%.

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

How It Works

The MIC3223 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% dimming duty-cycle, simply pull DIM IN to 5V. For a different LED current, change R5 using the following equation (when R5 is 0.56Ω and the LED current is equal to 0.35A):

$$V_{FB} = V_{REF} = I_{LED} \times R5$$

where $V_{REF} = 0.2V$

PWM Dimming

The PWM DIM signal applied to the DIM IN pin switches the current to the LEDs on and off. When DIM IN is high, the MIC3223 is enabled and the boost converter regulates the LED current by keeping the voltage drop across R5 constant. DIM IN also controls the DIM OUT pin. DIM OUT drives the gate of the external dimming FET (Q1). When DIM IN is high, DIM OUT is also high. When DIM IN is low, the converter turns off and the DIM OUT pin is low while driving the gate of Q1 low. When the gate of Q1 is low, Q1 turns off and the LED current stops.

Ordering Information

Order Part Number	Description
MIC3223TE BOOST EV	Boost Evaluation Board

Quick-Start Guide

1. Connect a load (LED series string or resistive) between V_{OUT} and LED RTN (note that this is not the same as GND).
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, connect the DIM IN terminal to the EN terminal. This is a convenient way to turn on and off the converter.
    b. For PWM DIMMING, connect a function generator to the DIM IN input and GND (not LED RTN). Set the output at 0V – 5V square wave pulse at 100Hz – 20kHz. Make sure the pulse goes all the way to 0V.

Output Over-Voltage Protection (OVP)

The MIC3223 provides over-voltage protection (OVP) circuitry in order to protect the system from an over-voltage fault condition. This OVP threshold can be programmed through the use of external resistors (R3 and R4). A reference value of 1.245V is used for the OVP. The following equation can be used to calculate the resistor value for R3 to set the OVP point. Normally use 100k for R3:

$$R4 = \frac{R3}{(V_{OVP}/1.245) - 1}$$

On the evaluation board, these values have been set as follows: R4 = 3.24kΩ and R3 = 100kΩ and V_{OVP} = 40V.

Evaluation Board Design Specifications

Parameter	Minimum	Typical	Maximum
V_{IN}	6V	12	20V
Output Voltage	V_{IN}	18-25	37V
Number of LEDs		7	9
LED Current	0	0.2 – 0.5	.7A
Power Out	0	20W	15W
Efficiency		90%	
Switching Frequency (FIXED)		1MHz	
PWM Dim Frequency	0	300Hz	500Hz
Line Regulation			<5%
Load Regulation			<5%
Ambient Temperature	–40°C	+25°C	+85°C

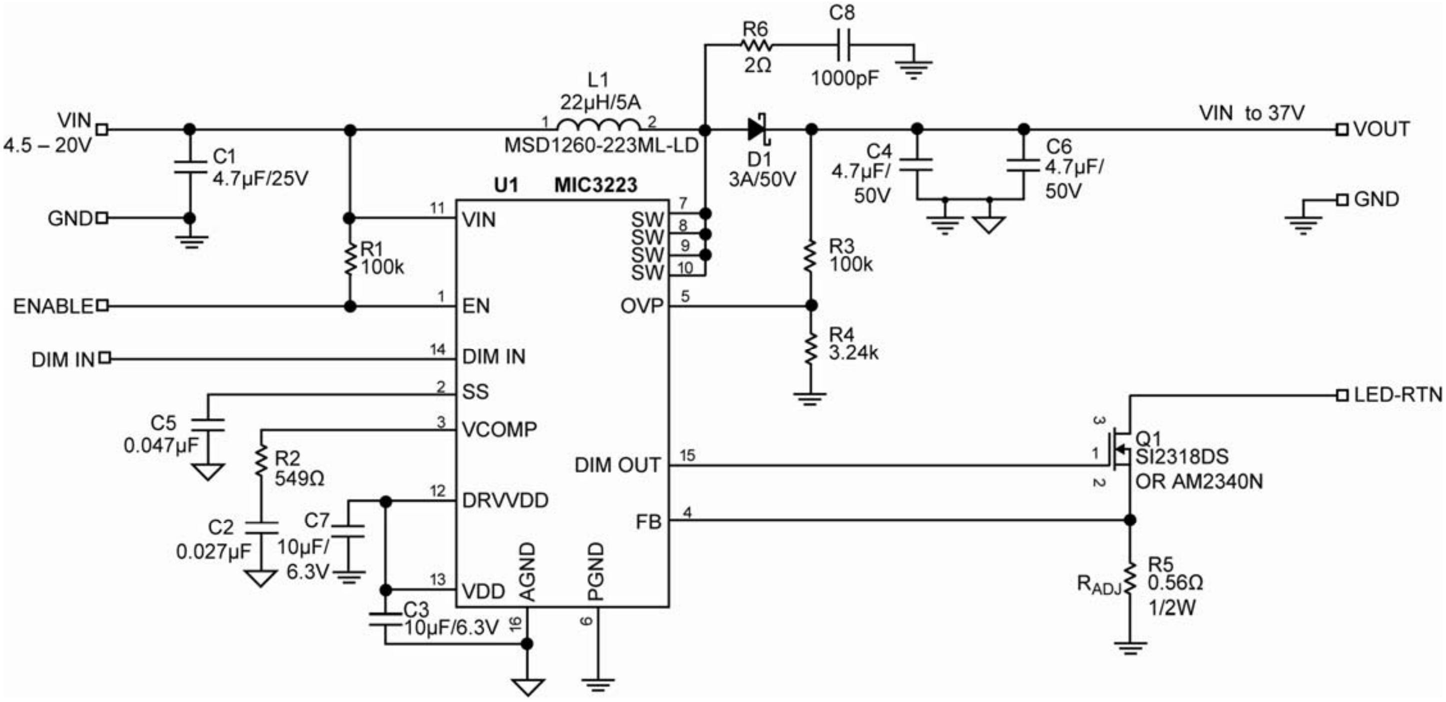
Table 1. Evaluation Board Design Specifications

LED Current Selection

R5 (Ω)	I_LED
5	40mA
2	100mA
1	200mA
0.62	320mA
0.5	400mA
0.56	350mA
0.4	500mA
0.28	700mA

Table 2. LED Current Selection

Evaluation Board Schematic



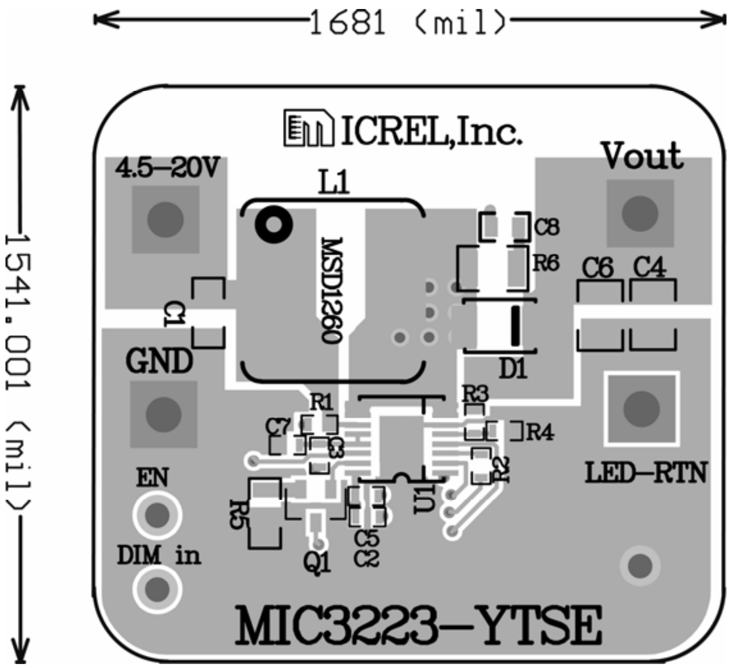
Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1	GRM319R61E475KA12D	muRata[(1)]	Ceramic Capacitor, 4.7µF, 25V, X7R, Size 1206	1
	C3216X7R1E475M	TDK[(2)]		
	12063D475KAT2A	AVX[(3)]		
C2	GRM188R71C273KA01D	muRata[(1)]	Ceramic Capacitor, 0.027µF, 6.3V,X7R, Size 0603	1
C3, C7	GRM188R60J106ME47D	muRata[(1)]	Ceramic Capacitor, 10µF, 6.3V X7R, Size 0603	2
	C1608X5R0J106K	TDK[(2)]		
	08056D106MAT2A	AVX[(3)]		
C4, C6	12105C475KAZ2A	AVX[(3)]	Ceramic Capacitor, 4.7µF, 50V, Size 1210, X7R	2
	GRM32ER71H475KA88L.	muRata[(1)]		
C5	GRM188R71C473KA01D	muRata[(1)]	Ceramic Capacitor, 0.047µF, 6.3V,X7R, Size 0603	1
	0603YC473K4T2A	AVX[(3)]		
C8	GRM188R72A102KA37D	muRata[(1)]	Ceramic Capacitor, 1000pF, 100V, X7R 060	
D1	SK35B	MCC[(4)]	Schottky Diode, 3A, 50V (SMB)	1
L1	MSD1260-223ML-LD	Coilcraft[(5)]	Inductor, 22µH, 5A	1
R1, R3	CRCW0603100KFKEA	Vishay Dale[(6)]	Resistor, 100k, 1%, Size 0603	2
R2	CRCW0603549RFKEA	Vishay Dale[(6)]	Resistor, 549Ω, 1%, Size 0603	1
R4	CRCW06033K24FKEA	Vishay Dale[(6)]	Resistor, 3.24k, 1%, Size 0603	1
R5	CRCW1206R560FKEA	Vishay Dale[(6)]	Resistor, 0.56Ω, 1%, 1/2W, Size 1206 (for .35A LED current change for different ILED)	1
R6	RMC 1/4 2 1% R	SEI Stackpole Electronics, Inc.[(7)]	Resistor, 2Ω, 1%, 1/2W, Size 1210	1
Q1	Si2318DS	Vishay Siliconix[(6)]	N-Channel, 40V, MOSFET	1
	AM2340N	Analog Power[(8)]		
U1	**MIC3223**	**Micrel, Inc.[(9)]**	**High-Power Boost LED Driver with Integrated FET**	**1**

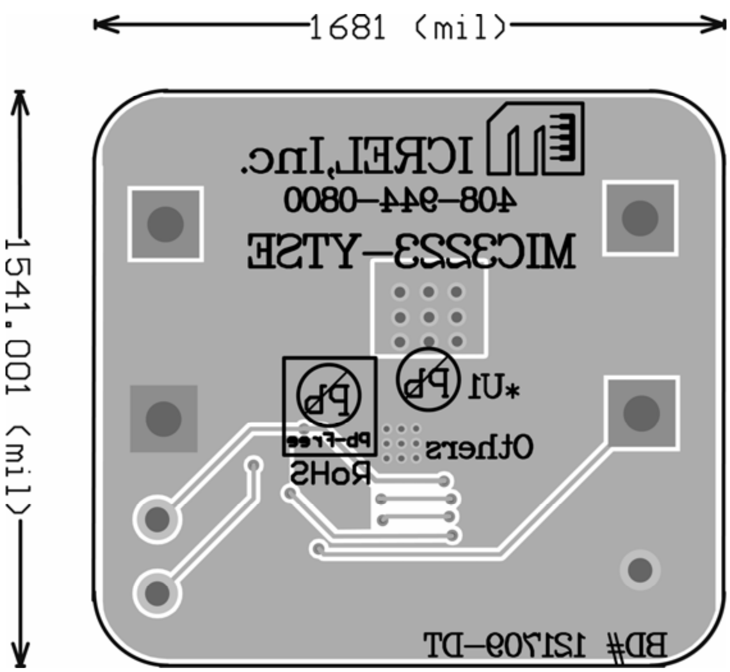
Notes:

1. Murata: www.murata.com.
2. TDK: www.tdk.com.
3. AVX: www.avx.com.
4. MCC: www.mccsemi.com.
5. Coilcraft: www.coilcraft.com.
6. Vishay: www.vishay.com.
7. SEI Stackpole Electronics, Inc.: www.seielect.com.
8. Analog Power: www.analogpowerinc.com.
9. **Micrel, Inc.: www.micrel.com.**

PCB Layout Recommendations

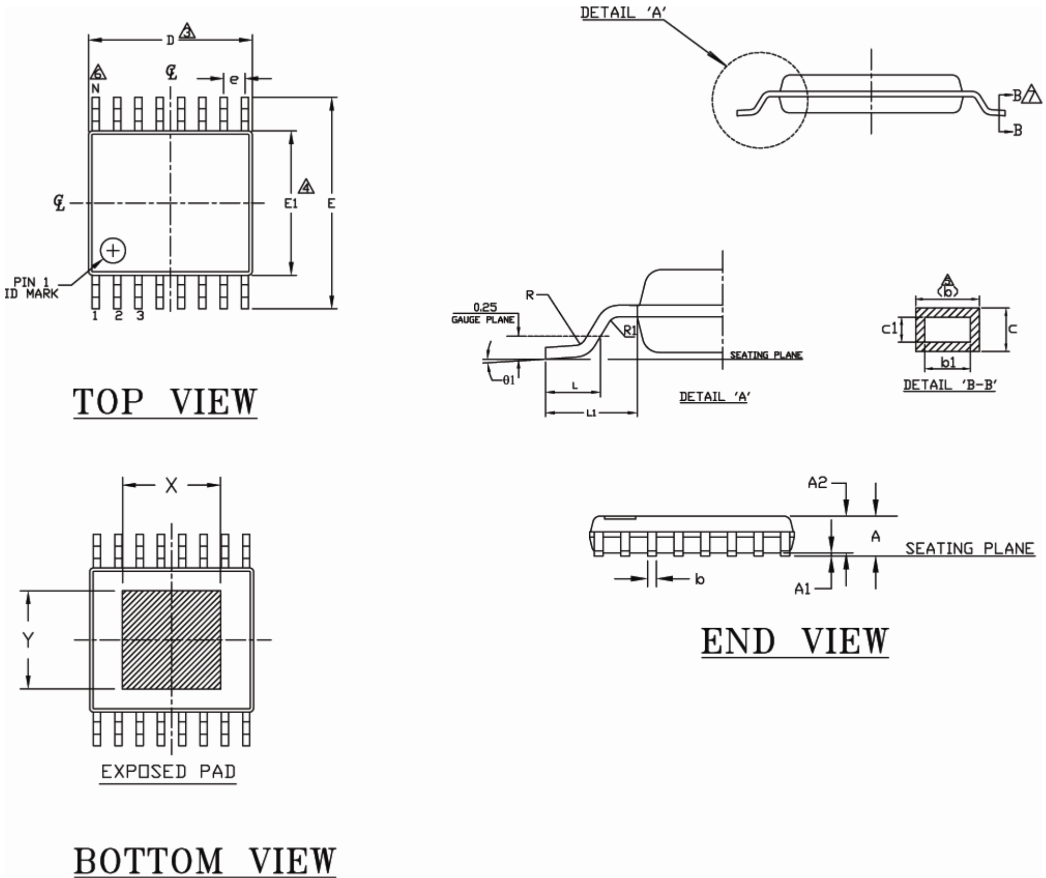


Top Layer



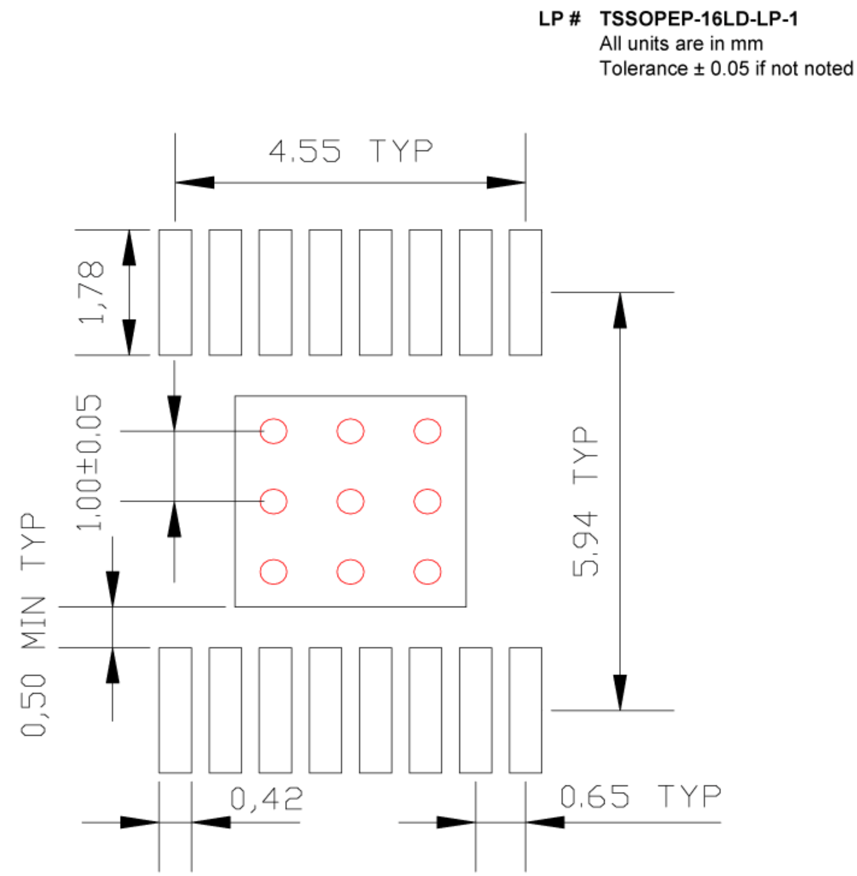
Bottom Layer

Package Information



16-Pin EPAD TSSOP (TSE)

Recommended Land Pattern



Red circle indicates Thermal Via. Size should be .300-.350 mm in diameter and it should be connected to GND plane for maximum thermal performance.

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