



## MIC3263 Evaluation Board

### Six-Channel WLED Driver for Backlighting Applications with Flicker-Free Dimming

Bringing the Power to Light™

## General Description

This evaluation board (EVB) is designed for the MIC3263. The MIC3263 is a high-efficiency Pulse Width Modulation (PWM) boost switching regulator that is optimized for constant-current WLED driver backlighting applications. The MIC3263 drives six channels of up to ten low-power WLEDs per channel. Each channel is matched in current to within  $\pm 3\%$  for constant brightness across the screen and can be programmed from 15mA to 30mA.

The MIC3263 provides a very flexible dimming control scheme with high accuracy and noise immunity. The dimming frequency can be set to any value between 100Hz and 20kHz by an external resistor. The dimming ratio is determined by the duty-cycle of a dimming ratio control input signal and can be set to one of 16 levels with a minimum ratio of 1%. The LED dimming current is set by an external resistor to allow programming of LED current between 15mA and 30mA.

The dimming ratio of the MIC3263 is fixed to 16 logarithmic levels to better match the sensitivity of the human eye. Each of the dimming levels has hysteresis to avoid skipping between levels resulting in Flicker-Free operation.

The MIC3263 has a programmable PWM switching frequency from 400kHz to 1.8MHz to allow small inductor sizes. The 6V to 40V wide-input voltage range of MIC3263 allows direct operation from 6V or high cell count Li-Ion batteries commonly found in notebook computers.

## Precautions

The MIC3263 evaluation board operates as a boost converter, which requires the output voltage to be greater than the input voltage. Connect a PWM dimming signal to the DRC pin. The DRC pin needs an input signal to operate.

## Requirements

1. Voltage source capable of supplying 10W
2. Load: Six LED strings
3. Scope
4. Function generator for PWM Dimming

## Getting Started

1. Set the LED current of all six channels by one resistor  $R_{ISET}$  (noted as R9 on the EVB). Use 2k $\Omega$  for 30mA and 3k $\Omega$  for 20mA. Use the following equation to find  $R_{ISET}$ :

$$R_{ISET} = \frac{60}{I_{LED}} \Omega$$

2. Connect six strings of LEDs from LED out to LED-RTN. Each one of the six LED strings needs to connect to one of the LED RTN. The cathode end of each LED string connects to one of the six LED RTN pins. The anode end of all the LED strings connects to LED OUT ( $V_{OUT}$ ). The number of LEDs in each string should be from 4 to 10.
3. Connect 12V (or other input voltage) to  $V_{IN}$  and GND.
4. Use a current probe to measure the load current and monitor the switch node with a scope to view the switching waveform
5. PWM Dimming:
  - a. Connect a function generator to the dimming input (DRC pin) 0V to 5V at 100Hz to 40kHz.
  - b. Adjust the duty-cycle of the function generator for PWM dimming. The MIC3263 converts the duty-cycle at the DRC to one of sixteen dimming ratios (DR) according to Table 1.
  - c. Follow the power-on sequence to ensure all channels turn on.
  - d. The EVB is set for 30mA LED current. For a different LED current, change R9 using the given equation.

## Power-On Sequence

$V_{IN}$  needs to be present before PWM pulses are applied to the DRC pin. Some channels may not turn on if the power-on sequence is not followed. This may be the case if the circuits that monitor the IO pins see transients during the turn on-time and may interpret voltage spikes during turn-on as a fault, preventing that channel from turning on. When a channel is off, its IO pin is at high impedance.

It is best to follow the sequence:

1.  $V_{IN}$
2. PWM dimming at DRC
3. Enable high

## MODE

This selects the internal PWM dimming frequency range. When MODE is low, the PWM dimming frequency range is 100Hz to 2kHz and it selects low-frequency (LF) mode. When MODE is high, the PWM frequency range is 1.5kHz to 20kHz and it selects high-frequency (HF) mode.

## DFS

DFS stands for Dimming Frequency Select. The dimming frequency of the LEDs is different than the input dimming frequency at the DRC input. The MIC3263 uses an internal dimming frequency. This internal dimming frequency is programmable by an external resistor to ground  $R_{DFS}$  (R8).

When using internal dimming the range is determined by the MODE pin and the actual frequency is determined by  $R_{DFS}$ . Connect a resistor-to-ground to select a dimming frequency.

Use the following equations to determine the value for  $R_{DFS}$ :

$$R_{DFS}(k\Omega) = -20 \times f_{DIM}(kHz) + 432 \text{ (HF Mode)}$$

$$R_{DFS}(k\Omega) = -335 \times f_{DIM}(kHz) + 433 \text{ (LF Mode)}$$

For direct dimming control, connect DFS to  $V_{DD}$  and use the MODE pin for the input dimming pulse. This method bypasses the internal dimming control and allows for dimming control by the external PWM pulse.

## OVP

This is the over-voltage protection monitor. Also this is the feedback signal that connects to the error amplifier input. The output voltage that the OVP will trigger is set according to the following equation. Using the values for this example gives a max output voltage of:

$$V_{OVP} = 2.4 \times (R1+R2)/R1 = 38V$$

## Internal PWM Dimming

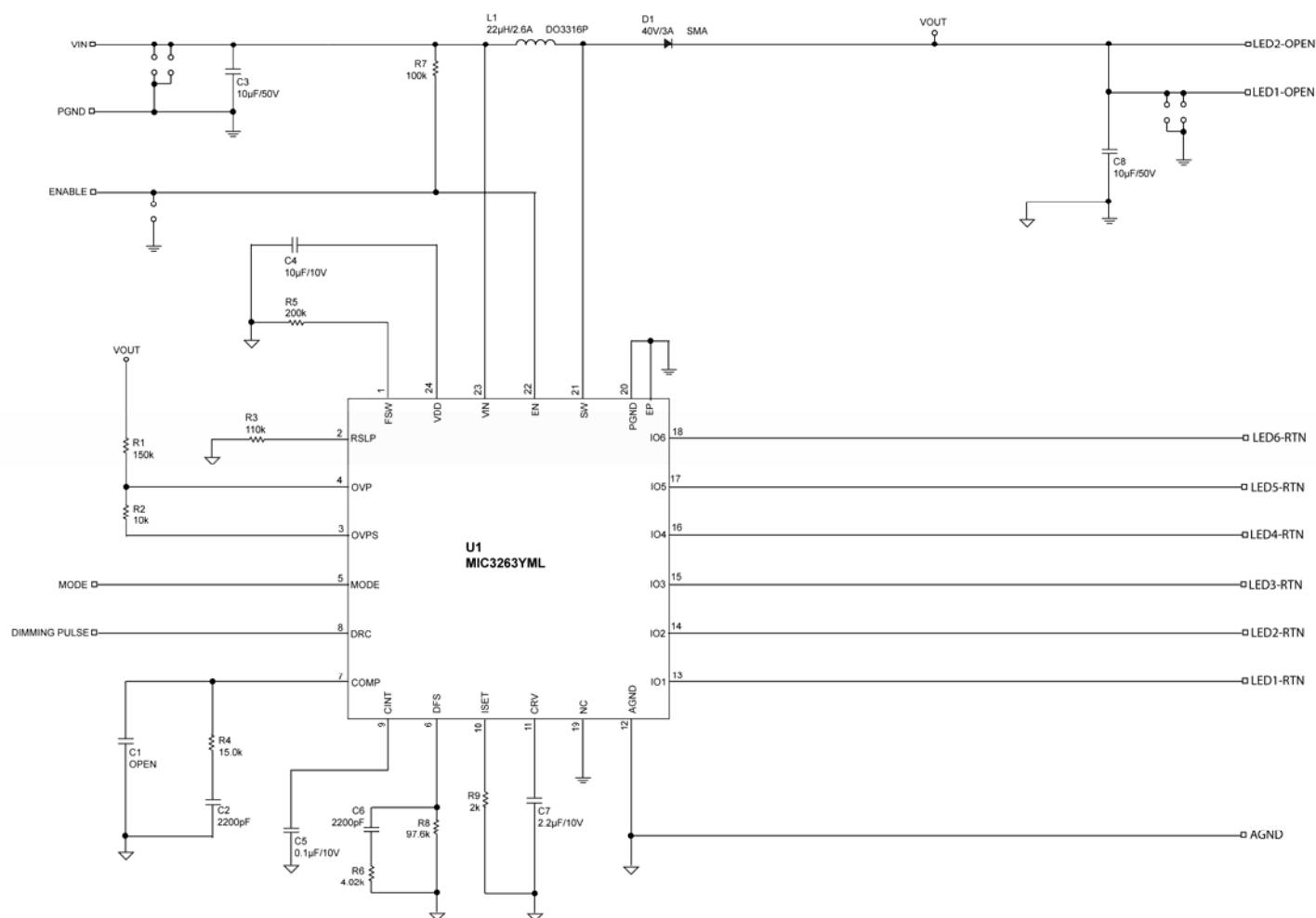
The duty-cycle of the PWM pulse applied to the DRC input is converted to 16 log levels. This logarithmic dimming is a unique feature of the MIC3263 which better matches the sensitivity of the human eye compared to linear dimming. The DRC duty-cycle to DR duty-cycle conversion is shown in Table 2.

N	DRC Duty Cycle %	PWM Dimming Ratio (DR) $DR = 10^{(N-1)/7}$ %
0	0	0
1	6.25	1.0
2	12.5	1.4
3	18.75	1.9
4	25	2.7
5	31.25	3.7
6	37.5	5.2
7	43.75	7.2
8	50	10
9	56.25	14
10	62.5	19
11	68.75	27
12	75	37
13	81.25	52
14	87.5	72
15	93.75	100

Table 1. Dimming Ratio

## Ordering Information

Order Part Number	Description
MIC3263YML EV	Boost Evaluation Board



## Evaluation Board Design Specifications

Parameter	Minimum	Typical	Maximum
V <sub>IN</sub>	6V	6	40V
Output Voltage		18-25	38V
Number of LEDs/Channel	4	8	10
LED Current	15mA		30mA
Power Out	0	5W	7W
Efficiency		90%	
Switching Frequency (FIXED)	400kHz	1MHz	1.8MHz
PWM Dim Frequency	100Hz	300Hz	20kHz
Line Regulation			<±3%
Load Regulation			<±3%
Ambient Temperature	−40°C	+25°C	+85°C

**Table 1. Evaluation Board Design Specifications**

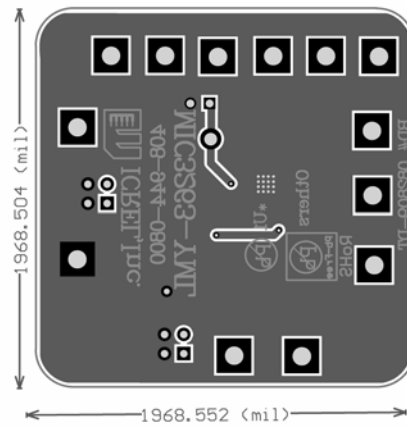
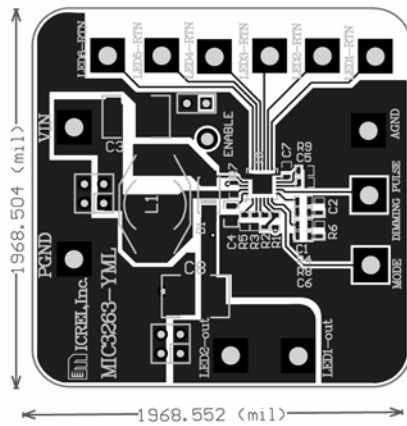
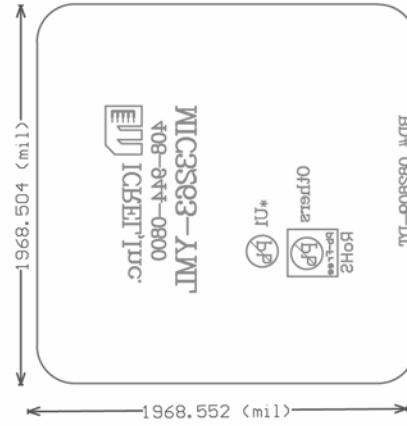
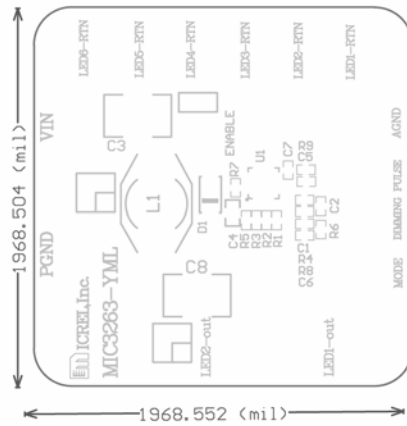
## Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1			OPEN	
C2, C6	0603ZC222KAT2A	AVX <sup>(1)</sup>	2200pF, 10V, X7R, 0603	2
	C1608X7R1H222K	TDK <sup>(2)</sup>		
	GRM188R71H222K	muRata <sup>(3)</sup>		
C3, C8	C5750X7R1H106M	TDK <sup>(2)</sup>	10μF, 50V, X7R, 2220	2
	22205C106KAZ2A	AVX <sup>(1)</sup>		
C4	GRM21BR71A106KE51L	muRata <sup>(3)</sup>	10μF, 10V, X7R, 0805	1
	0805ZD106KAT2A	AVX <sup>(1)</sup>		
C5	0603YC104KAT2A	AVX <sup>(1)</sup>	0.1μF, 16V, X7R, 0603	1
	C1608X7R1C104K	TDK <sup>(2)</sup>		
	GRM188R71C104K	muRata <sup>(3)</sup>		
C7	0603ZD225KAT2A	AVX <sup>(1)</sup>	2.2μF, 10V, X5R, 0603	1
	GRM188R61A225KE34D	muRata <sup>(3)</sup>		
	C1608X5R1A225K	TDK <sup>(2)</sup>		
D1	SK34A	MCC <sup>(4)</sup>	Schottky 3A, 40V (SMA)	1
	B349LA-13	Diode, Inc. <sup>(5)</sup>		
L1	DO3316P-223ML	Coilcraft <sup>(6)</sup>	22μH, 2.6A	1
R1	CRCW0603150KFKEA	Vishay Dale <sup>(7)</sup>	150k	2
R2	CRCW060310K0FKEA	Vishay Dale <sup>(7)</sup>	10k	1
R3	CRCW0603110KFKEA	Vishay Dale <sup>(7)</sup>	110k (RSLP)	1
R4	CRCW060315K0FKEA	Vishay Dale <sup>(7)</sup>	15.0k (R <sub>COMP</sub> )	1
R5	CRCW0603200KFKEA	Vishay Dale <sup>(7)</sup>	200k	1
R6	CRCW060340K2FKEA	Vishay Dale <sup>(7)</sup>	4.02k	
R7	CRCW0603100KFKEA	Vishay Dale <sup>(7)</sup>	100k	1
R8	CRCW060326K7FKEA	Vishay Dale <sup>(7)</sup>	97.6k	1
R9	CRCW06032K00FKEA	Vishay Dale <sup>(7)</sup>	2k	1
U1	MIC3263YML	Micrel, Inc. <sup>(8)</sup>	Six-Channel WLED Driver for Backlighting Applications	1

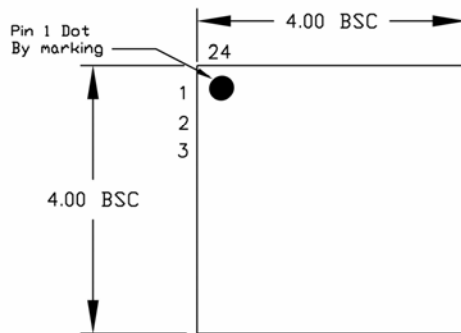
### Notes:

1. AVX: [www.avx.com](http://www.avx.com).
2. TDK: [www.tdk.com](http://www.tdk.com).
3. Murata Tel: [www.murata.com](http://www.murata.com).
4. MCC: [www.mccsemi.com](http://www.mccsemi.com).
5. Diode, Inc.: [www.diodes.com](http://www.diodes.com).
6. Coilcraft: [www.coilcraft.com](http://www.coilcraft.com).
7. Vishay: [www.vishay.com](http://www.vishay.com).
8. Micrel, Inc.: [www.micrel.com](http://www.micrel.com).

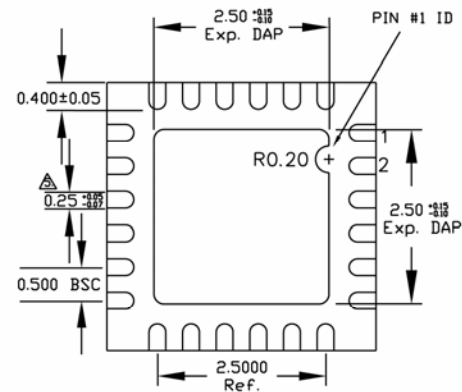
## Evaluation Board PCB Layout



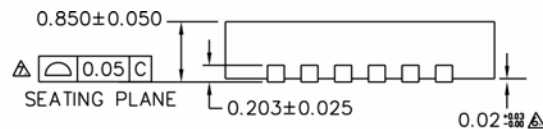
## Package Information



TOP VIEW



BOTTOM VIEW



SIDE VIEW

**NOTE:**

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. MAX. PACKAGE WARPAGE IS 0.05 mm.
3. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
4. PIN #1 ID ON TOP WILL BE LASER/INK MARKED.
5. DIMENSION APPLIES TO METALIZED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25 mm FROM TERMINAL TIP.
6. APPLIED ONLY FOR TERMINALS.
7. APPLIED FOR EXPOSED PAD AND TERMINALS.

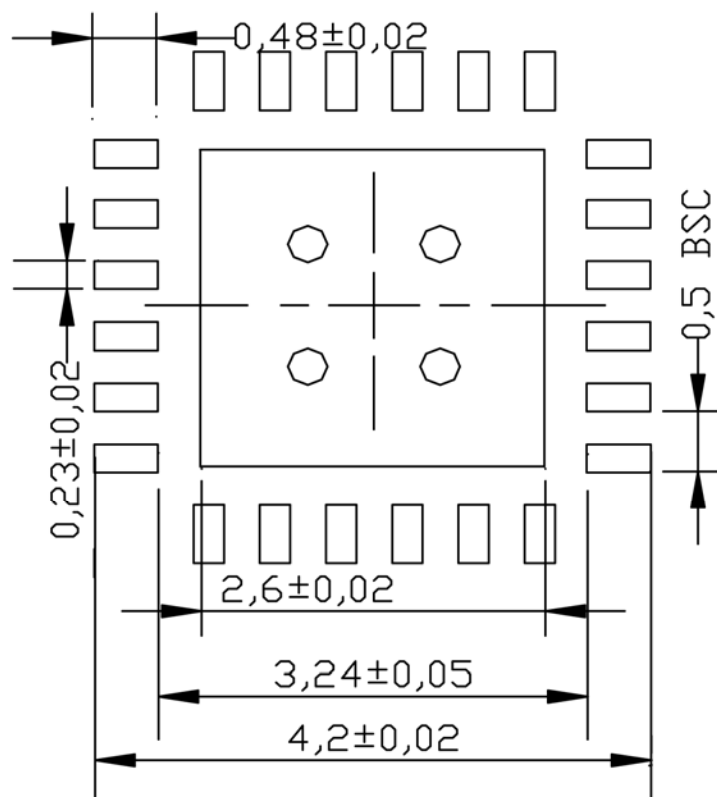
**24-Pin 4mm x 4mm (MLF<sup>®</sup>)**

## Recommended Land Pattern

LP # MLF44Q-24LD-LP-1

All units are in mm

Tolerance  $\pm 0.05$  if not noted



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