

AN-1407 LM3502/03 Evaluation Board

1 General Description

The LM3502/03 evaluation board is a working demonstration of a step up DC-DC converter. The LM3502/03 is a white LED driver for lighting applications. The LM3502/03 contains two LED strings designed for dual displays with independence EN pins. The LM3502 LED current can be adjusted with a PWM signal while the LM3503 LED current can be adjusted with a DC voltage or RC filtered pulse-width-modulated (PWM) signal at the Cntrl pin. The LM3502/03 can drive up to 10 white LEDs. Both devices feature internal over-voltage protection (OVP) and under-voltage protection (UVP). For evaluation purpose, the evaluation board is assembled in DSBGA package for 25V version (LM3503ITL) and 44V version (LM3502ITL). The LM3502/03 are also available in 16-WQFN package. For further information on boost converter topology, device electrical characteristics, and component selection, see the *LM3502 Step-Up Converter for White LED Applications Data Sheet* ([SNVS339](#)) and the *LM3503 Dual-Display Constant Current LED Driver with Analog Brightness Control Data Sheet* ([SNVS329](#)).

2 Operating Conditions

- V_{IN} range: $2.5V \leq V_{IN} \leq 5.5V$
- OVP options: 16V, 25V, 35V & 44V
- 10 Bump DSBGA or 16 Pin WQFN package
- Ambient temperature (T_A) range: -40C to +85C
- Junction temperature (T_J) range: -40C to +125C

3 Typical Application

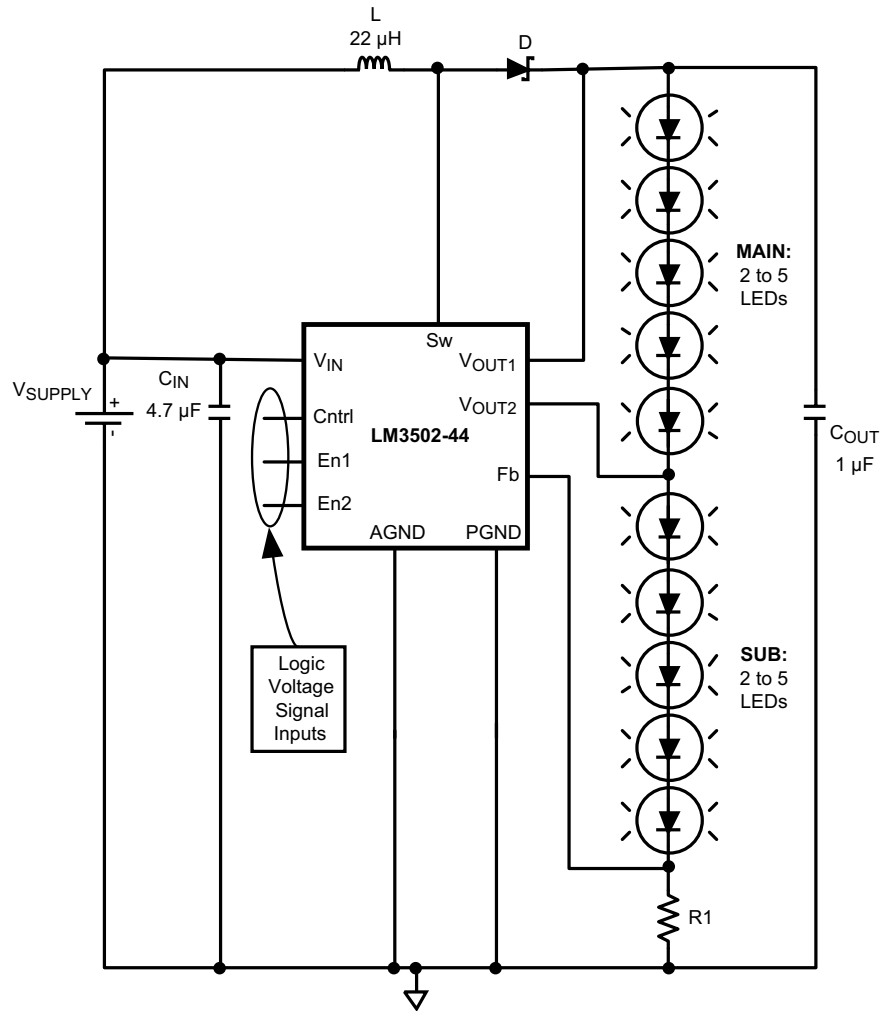


Figure 1. Typical Application Circuit LM3502

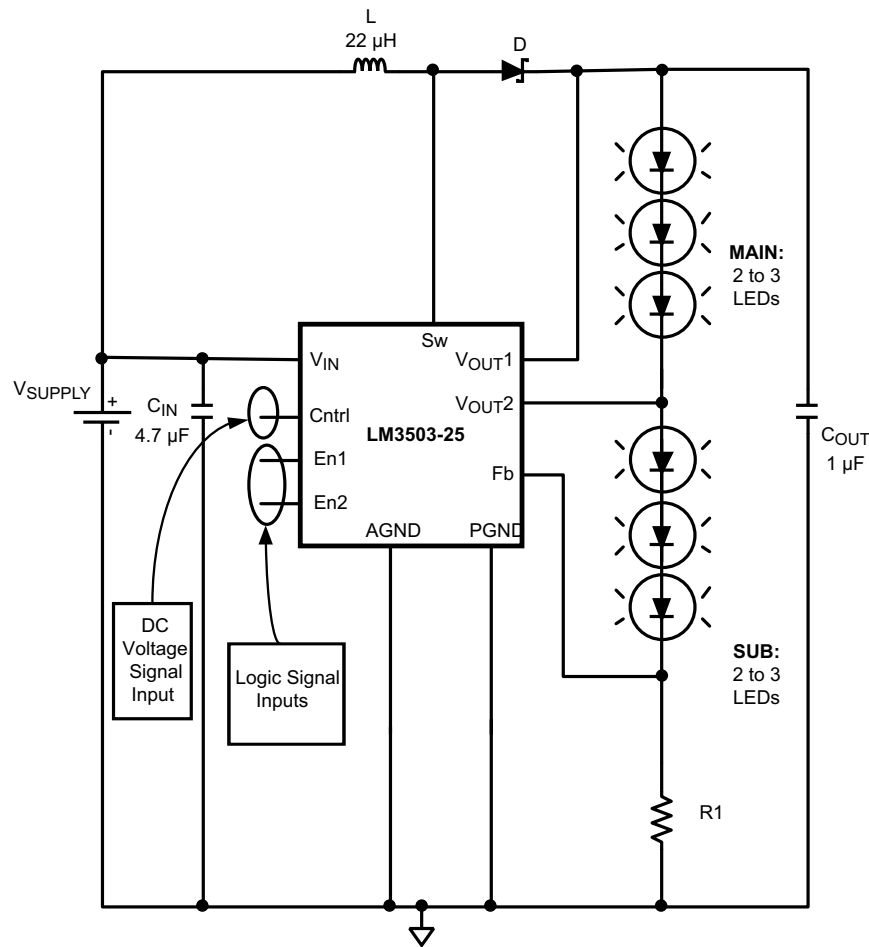


Figure 2. Typical Application Circuit for LM3503

4 PWM Dimming

If PWM dimming is desired to control the brightness of the LED string, care must be taken to balance the tradeoffs between audible noise and brightness control. For best PWM duty cycle vs current linearity, the recommended PWM frequency should be between 200Hz to 500Hz for the LM3502.

Similarly if PWM dimming is desired to control the brightness, a RC filter is necessary at the control pin for the LM3503 (Figure 3). To select the PWM frequency, use Equation 1 and Equation 2.

$$F_{PWM} > 10 * F_{RC} \quad (1)$$

$$F_{RC} = \frac{1}{2 * \pi * R * C} \quad (2)$$

F_{PWM} : PWM Singal Frequency

F_{RC} : RC Filter Bandwidth Cutoff Frequency

R: Chosen Filter Resistor

C: Chosen Filter Capacitor

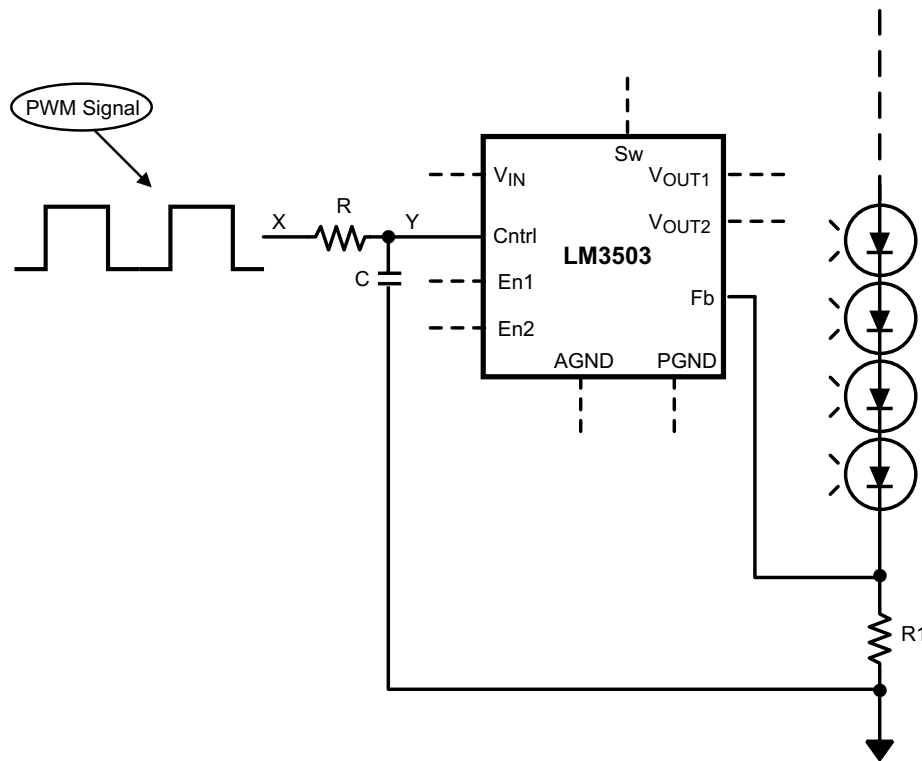


Figure 3. Typical Circuit for PWM Dimming (LM3503)

5 LED Current Setting

LED current is set using [Equation 3](#) for LM3502/LM3503:

$$I_{LED} = \frac{V_{FB}}{R_1} \quad (3)$$

If analog control is used for brightness control in the LM3503, the relationship between V_{FB} and V_{CNTRL} can be determined by using [Equation 4](#):

$$V_{FB} = (0.156) * (V_{CNTRL}) \quad (4)$$

For LM3502, the typical V_{FB} is 0.25V to solve for I_{LED} , or by rearranging I_{LED} equation to solve for R_1 .

6 Connection Diagram and Package Mark Information

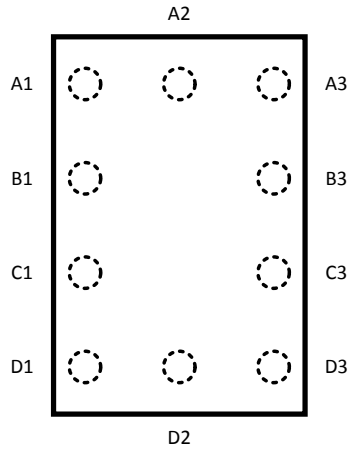


Figure 4. 10 Bump DSBGA Package

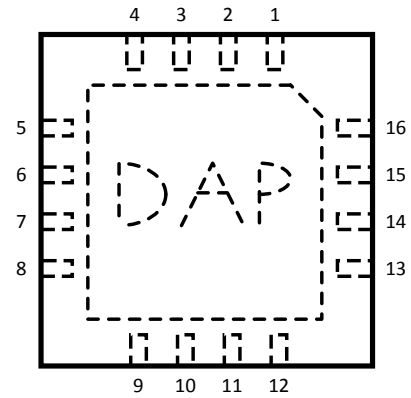


Figure 5. 16-Thin WQFN (RGH0016A)

Table 1. Pin Descriptions

Bump No	WQFN Pin No	Name	Description
A1	9	Cntrl	LED Current Control Connection
B1	7	Fb	Feedback Voltage Connection ($0.2V < V_{CNTRL} < 3.5V$)
C1	6	V_{OUT2}	Drain Connections of the NMOS and PMOS Field Transistor (FET) Switches. Connect 100nF at V_{OUT2} node if V_{OUT2} is not used
D1	4	V_{OUT1}	Over-Voltage Protection (OVP) and source connection of the PMOS FET switch
D2	2 and 3	SW	Drain Connection of Power NMOS Switch
D3	15 and 16	Pgnd	Power Ground Connection
C3	14	Agnd	Analog Ground Connection
B3	13	V_{IN}	Input Voltage Connection
A3	12	En1	NMOS FET Switch Control Connection
A2	10	En2	PMOS FET Switch Control Connection
	1	NC	No connect
	5	NC	No connect
	8	NC	No connect
	11	NC	No connect
	DAP	DAP	Die Attache Pad (DAP), to be soldered to the printed circuit board's ground plane for enhanced thermal dissipation

7 Printed Circuit Board (PCB) Layout

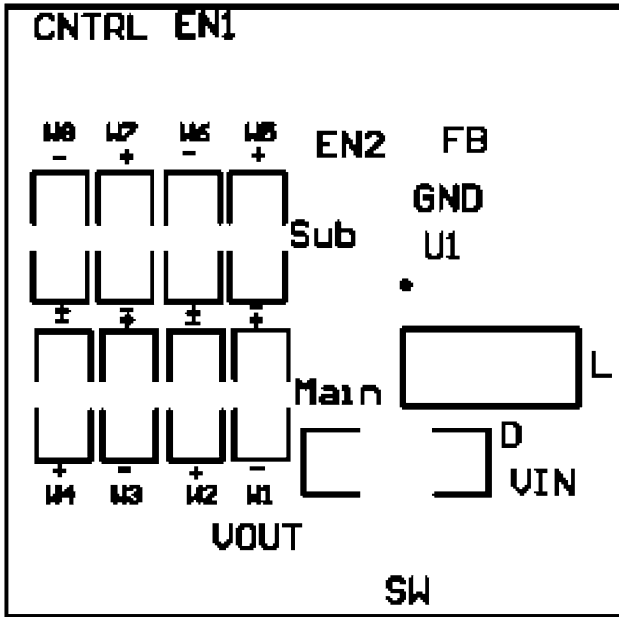


Figure 6. Top Silk Screen

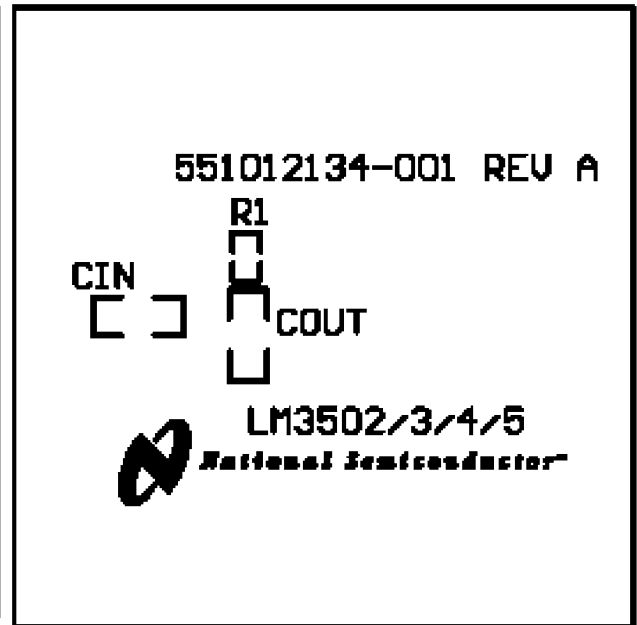


Figure 7. Bottom Silk Screen

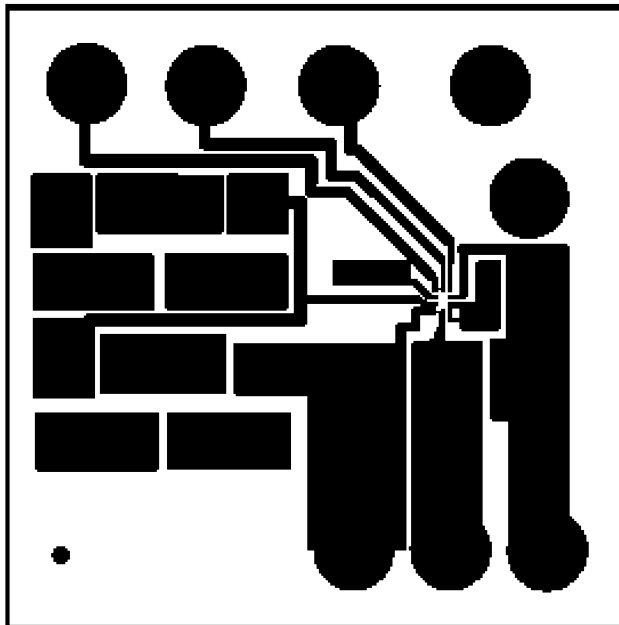


Figure 8. Top Traces

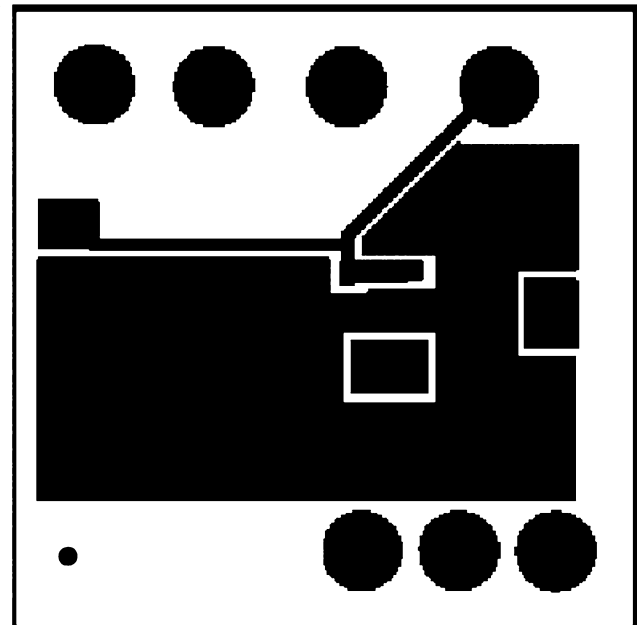


Figure 9. Bottom Traces

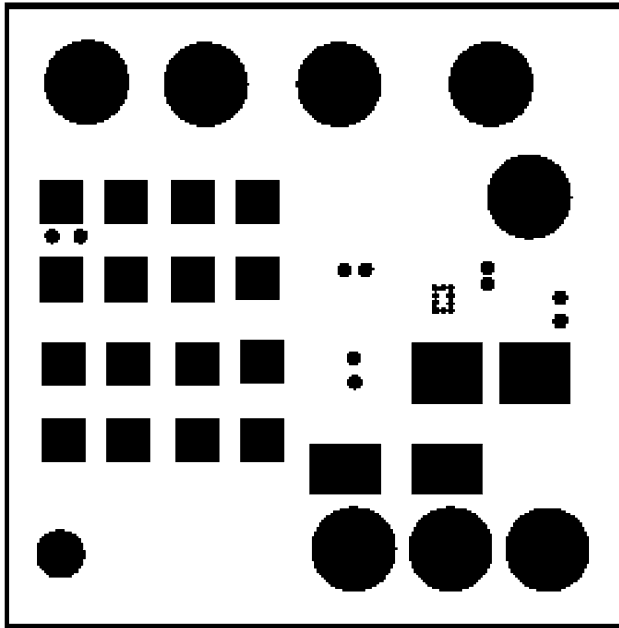


Figure 10. Top Pads

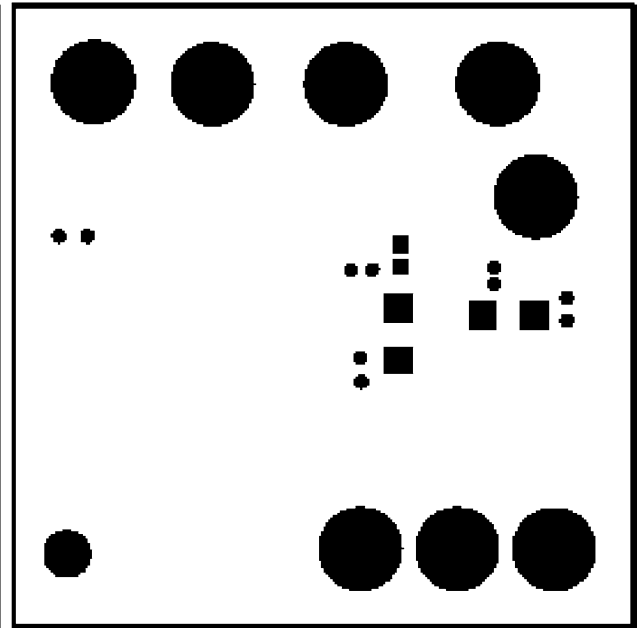


Figure 11. Bottom Pads

Table 2. Bill of Materials (BOM) for LM3502ITL and LM3503ITL

Device	Description	Manufacture No
LM3502	44V version (Drive up to 10 LEDs)	Texas Instruments
LM3503	25V Version (Drive up to 6 LEDs)	Texas Instruments
C _{IN}	4.7μF, 16V (3216X7R1C475K)	TDK
C _{OUT}	1μF, 50V (3216X7R1H105K)	TDK
R1	CRCW060328R0F (28 ohms)	Vishay
DIODE	SS16	Vishay
WHITE LED	LTW67C	Osram
INDUCTOR	DO1608C-223C (22μH)	Coilcraft
Test pins: VOUT, SW, VIN, FB, CNTRL, EN1, EN2 and GND	Turret 0.09 inches	

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