AN-1407 LM3502/03 Evaluation Board

National Semiconductor
Application Note 1407
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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 PWM signal while the LM3503 LED current can be adjusted with a DC voltage or RC filtered PWM (pulse-width-modulated) 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 micro SMD package for 25V version (LM3503ITL) and 44V version (LM3502ITL). The LM3502/03 are also available in 16-LLP package (see ordering information). For further information on boost converter topology, device electrical characteristics, and component selection, please refer to the LM3502 and LM3503 datasheets.

Operating Conditions

- V_{IN} range: 2.5V ≤ V_{IN} ≤ 5.5V
- OVP options: 16V, 25V, 35V & 44V (see ordering information)
- 10 Bump MicroSMD or 16 Pin LLP package
- Ambient temperature (T_A) range: -30C to +85C
- Junction temperature (T_J) range: -30C to +125C

Typical Application

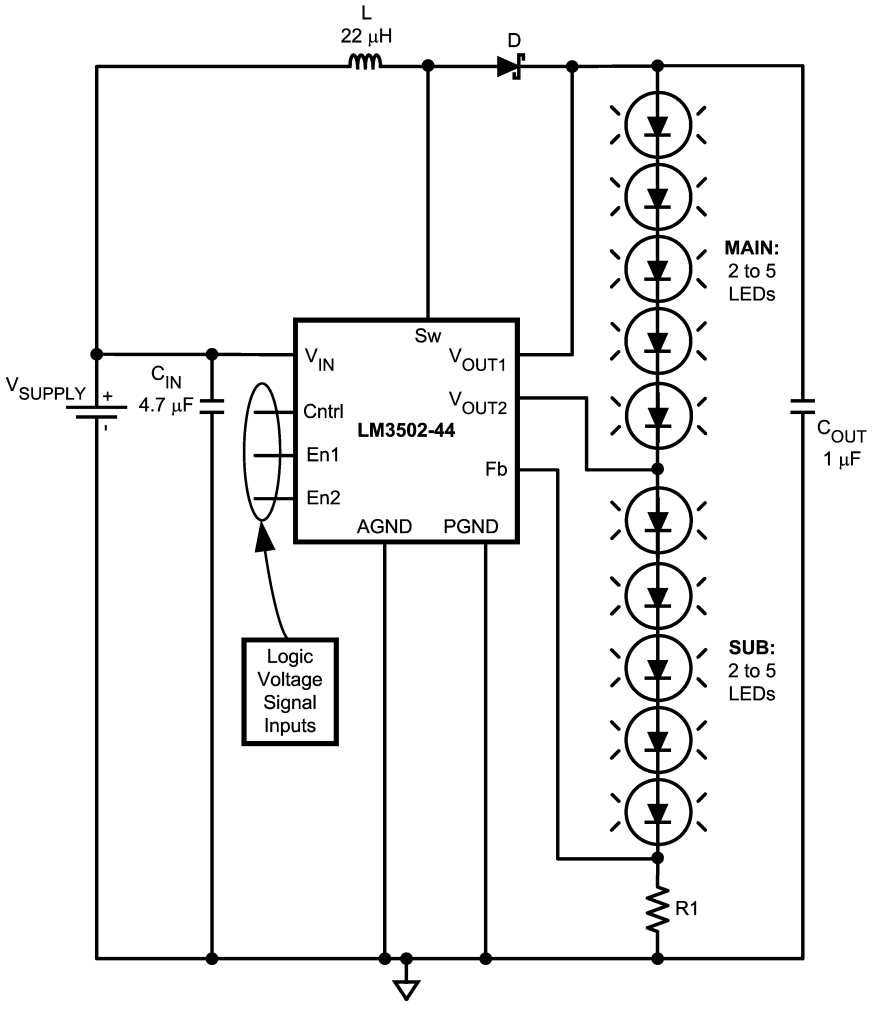


FIGURE 1. Typical Application Circuit LM3502

Typical Application (Continued)

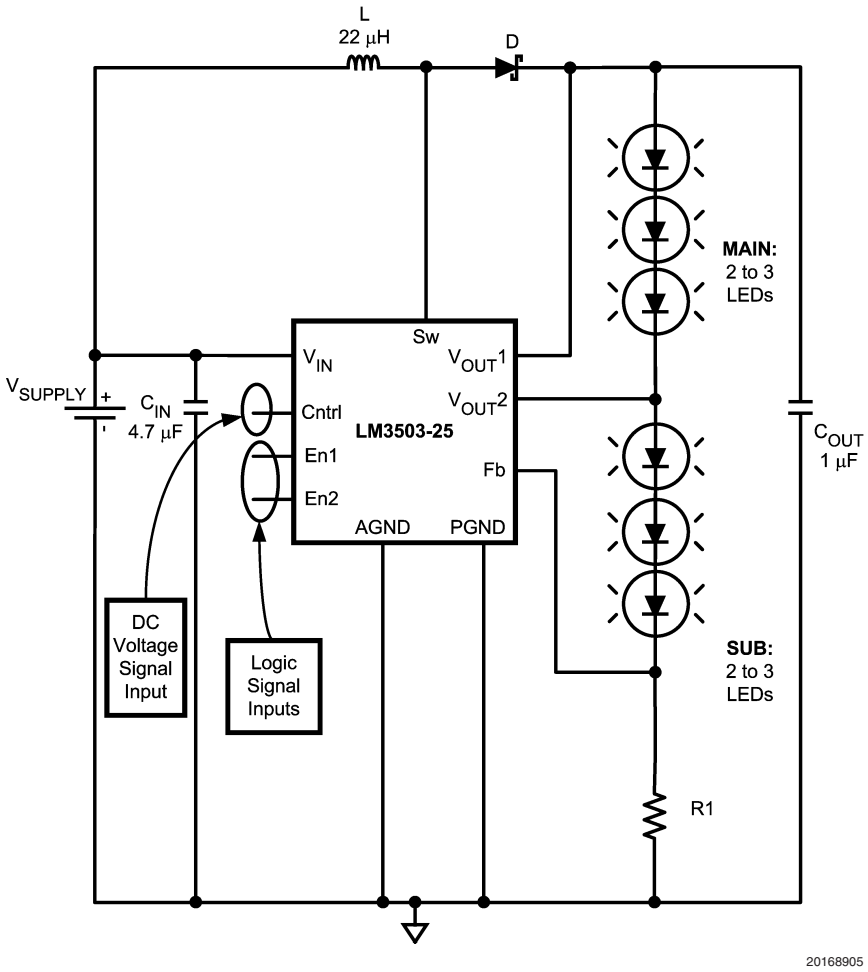


FIGURE 2. Typical Application Circuit for LM3503

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 brigthness 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(see Figure 3). To select the PWM frequency, use equations below.

$$F_{PWM} > 10 * F_{RC}$$

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

F_{PWM}: PWM Singal Frequency

F_{RC}: RC Filter Bandwidth Cutoff Frequency

R: Chosen Filter Resistor

C: Chosen Filter Capacitor

PWM Dimming (Continued)

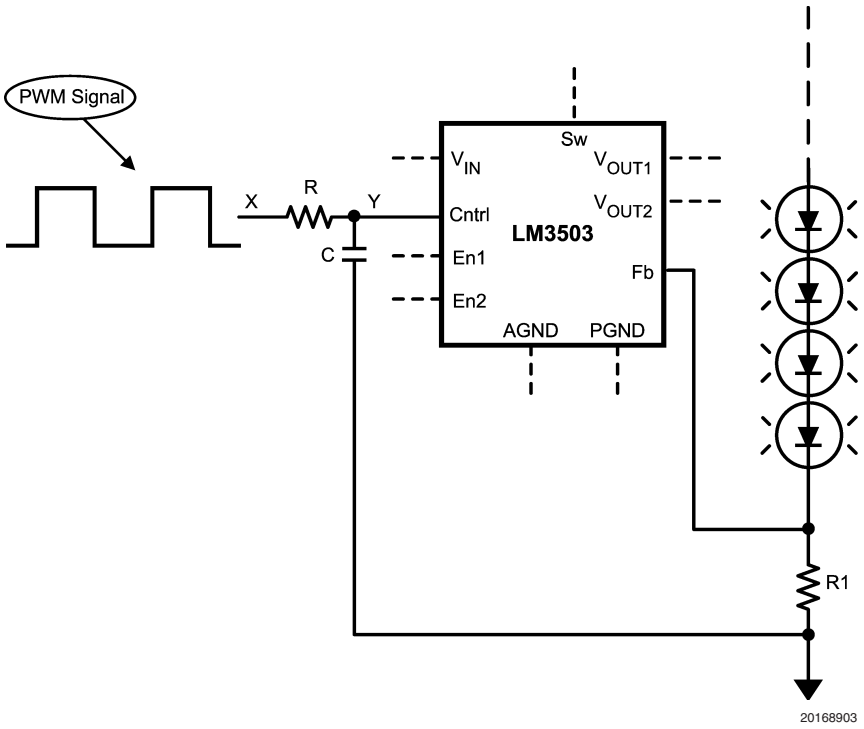


FIGURE 3. Typical Circuit for PWM Dimming (LM3503)

LED Current Setting

LEDcurrent is set using the following equation for LM3502/LM3503:

$$I_{LED} = \frac{V_{Fb}}{R1}$$

If analog control is used for brightness control in the LM3503, the relationship between V_{FB} and V_{CNTRL} can be determined by using the following equation:

$$V_{FB} = (0.156) * (V_{Cntrl})$$

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 .

Connection Diagram and Package Mark Information

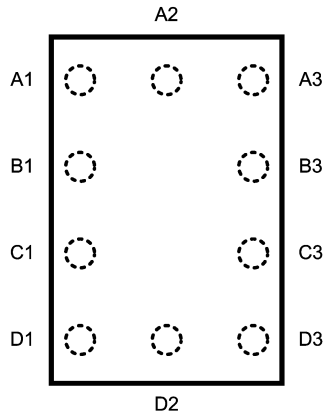


FIGURE 4. 10 bump MicroSMD Package

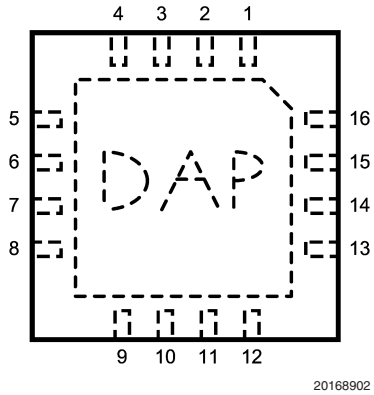


FIGURE 5. 16-Thin Leadless Leadframe Package (SQA16A)

Samples Ordering Information

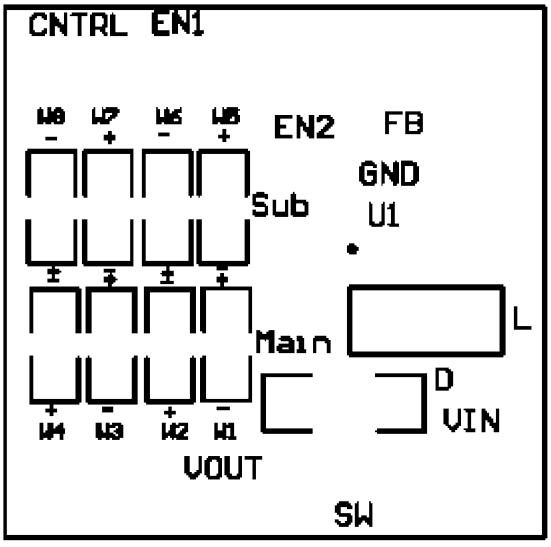
Voltage Option (V)	Order Number LM3502	Package Marking	Order Number LM3503	Package Marking	Supplied As
16	LM3502ITL-16	SANB	LM3503ITL-16	SBHB	250 units T&R
16	LM3502ITLX-16	SANB	LM3503ITLX-16	SBHB	3000 units T&R
16	LM3502SQ-16	L00048B	LM3503SQ-16	L00045B	1000 units T&R
16	LM3502SQX-16	L00048B	LM3503SQX-16	L00045B	4500 units T&R
25	LM3502ITL-25	SAPB	LM3503ITL-25	SBJB	250 units T&R
25	LM3502ITLX-25	SAPB	LM3503ITLX-25	SBJB	3000 units T&R
25	LM3502SQ-25	L00049B	LM3503SQ-25	L00046B	1000 units T&R
25	LM3502SQX-25	L00049B	LM3503SQX-25	L00046B	4500 units T&R
35	LM3502ITL-35	SARB	LM3503ITL-35	SBKB	250 units T&R
35	LM3502ITLX-35	SARB	LM3503ITLX-35	SBKB	3000 units T&R
35	LM3502SQ-35	L00044B	LM3503SQ-35	L00047B	1000 units T&R
35	LM3502SQX-35	L00044B	LM3503SQX-35	L00047B	4500 units T&R
44	LM3502ITL-44	SDLB	LM3503ITL-44	SDNB	250 units T&R
44	LM3502ITLX-44	SDLB	LM3503ITLX-44	SDNB	3000 units T&R
44	LM3502SQ-44	L00050B	LM3503SQ-44	L00053B	1000 units T&R
44	LM3502SQX-44	L00050B	LM3503SQX-44	L00053B	4500 units T&R

Pin Descriptions

Bump #	LLP Pin #	Name	Description
A1	9	Cntrl	LED Current Control Connection
B1	7	Fb	Feeback 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 & 3	SW	Drain Connection of Power NMOS Switch
D3	15 & 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

Printed Circuit Board (PCB) Layout

Top Silk Screen



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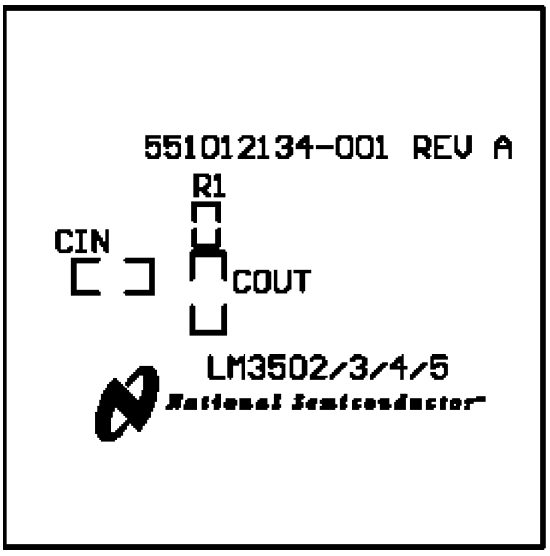
Bottom Silk Screen



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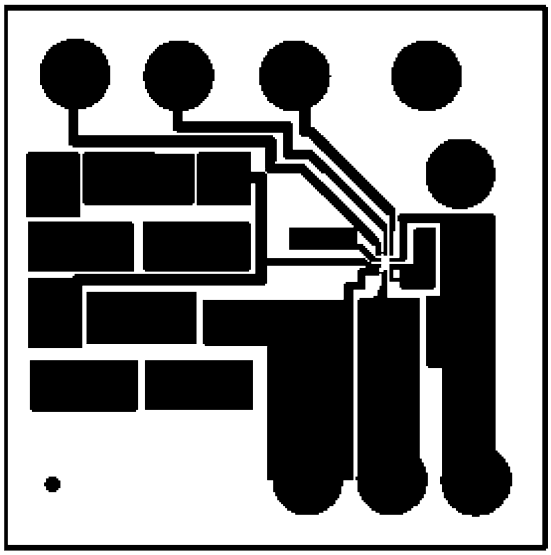
Printed Circuit Board (PCB) Layout (Continued)

Top Traces



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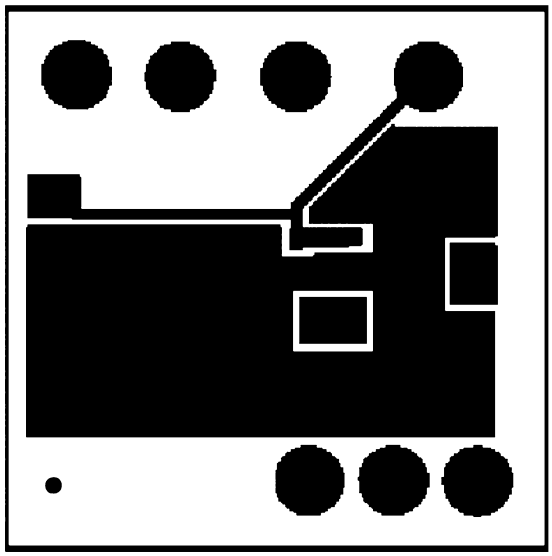
Bottom Traces



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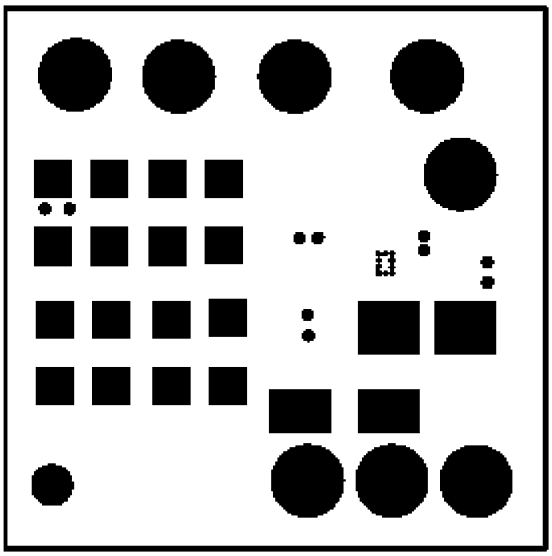
Top Pads



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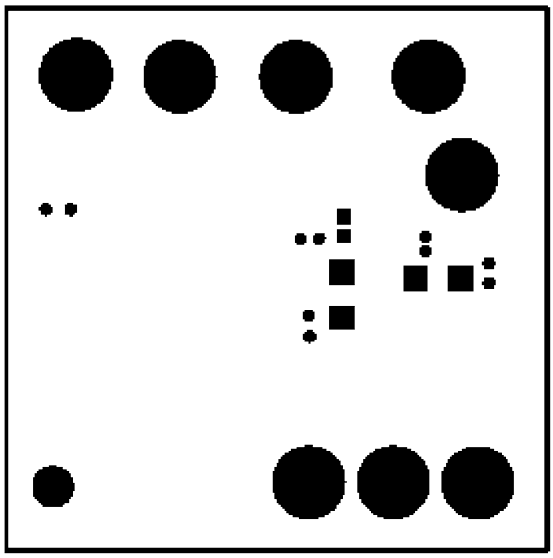
Bottom Pads



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Printed Circuit Board (PCB) Layout (Continued)

Bill of Materials for LM3502ITL & LM3503ITL

Device	Description	Manufacture #
LM3502ITL-44	44V version (Drive up to 10 LEDs)	National Semiconductor
LM3503ITL-25	25V Version (Drive up to 6 LEDs)	National Semiconductor
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 & GND	Turret 0.09 inches	

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