

LT3756-2/LT3756-1  
High Voltage LED Controller

## DESCRIPTION

Demonstration circuit 1319B-A/1319B-B is a high voltage and high current LED driver controller. The  $V_{IN}$  pin input voltage is as high as 100V, and the LED output voltage is also as high as 100V. The demonstration circuit is assembled as a boost topology from 8V to 80V input and up to 80V LED output at 0.5A with an open-LED status pin (DC1319B-A) or a sync input pin (DC1319B-B). DC1319B features PWM dimming, analog dimming, shutdown, and open-LED overvoltage protection. Efficiency at 12V<sub>IN</sub> is as high as 91% for 40W output.

The switching frequency is set at 300kHz to accommodate the automotive switching frequency range. Small ceramic input and output capacitors are used to save space and cost and a high voltage 100V external power switch and a 100V catch diode are used for up to 40W (80V at 0.5A) output as assembled. The open-LED overvoltage protection limits the output to approximately 92V if the LED string is opened.

Note: LED output voltages above 80V, but less than the open-LED voltage of 92V, are possible with limitations to low input voltage operation. Please consult the factory.

For low input voltage operation, the CTRL pin voltage is reduced as the input voltage drops below 10V, reducing


LED brightness and restraining the peak switch currents in order to limit inductor and switch size. UVLO turns the LEDs off when  $V_{IN}$  drops below 8V.

DC1319B PWM dimming is simple. The boost topology LED string returns to the LED terminal and the PWM dimming MOSFET turns the LED string on and off with an input to the PWM dimming terminal. For the highest PWM dimming ratio, it is recommended to use 100Hz as a PWM dimming frequency. Information regarding PWM dimming ratios and performance can be found in the LT3756-2/LT3756-1 data sheet in the Applications Information section.

Soft-start is provided with a simple and small capacitor to maintain control of the switch current during turn on for high power designs.

Modifications can be made to the DC1319B in order to convert the board from a boost topology LED driver to any other topology. Please consult the factory or LT3756-2/LT3756-1 data sheet for details regarding how to customize the DC1319B or how to design different topologies for custom specifications.

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# DEMO MANUAL

## DC1319B-A/DC1319B-B

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### DESCRIPTION

The LT3756-2/LT3756-1 data sheet gives a complete description of the part, operation and applications information. The data sheet must be read in conjunction with this Quick Start Guide for demonstration circuit DC1319B-A/DC1319B-B. The LT3756-2/LT3756-1 is assembled in a small 16-lead plastic MSOP or QFN package with a thermally

enhanced ground pad. Demonstration circuit 1319B-A/1319B-B uses the MSOP package. Proper board layout is essential for maximum thermal performance. See the data sheet section Layout Considerations.

**Design files for this circuit board are available at [www.linear.com](http://www.linear.com). Type in the demo circuit number.**

**Table 1. Performance Summary**

PARAMETER	CONDITION	VALUE (TYPICAL)
Input Voltage $PV_{IN}$ Range	Operating	8V to 80V
Switching Frequency	$R8 = 37.4k$	300kHz
$I_{LED}$		0.5A
Efficiency	$PV_{IN} = 12V, V_{LED} = 80V, I_{LED} = 0.5A$	91%
Undervoltage Lockout		8V
Peak Switch Current Limit	$R_{S1} = 0.015\Omega$	6.6A

### QUICK START PROCEDURE

Demonstration circuit 1319B-A/1319B-B is easy to set up to evaluate the performance of the LT3756-2/LT3756-1. Follow the procedure below:

Note: PWM must be pulled high to work. If PWM is not used, connect PWM to a 5V source or to INTV<sub>CC</sub> on the PCB using resistor R21. PWM must be pulled high to work. For DC1319B-B, the SYNC input can be left floating but is best tied to GND if not used.

1. Connect a string of LEDs with forward voltage less than 80V, but greater than the PV<sub>IN</sub> voltage, to the LED<sup>+</sup> and LED<sup>-</sup> (BOOST) terminals on the PCB as shown in Figure 1.
2. Connect the shutdown terminal to GND.
3. With power off, connect the PV<sub>IN</sub> power supply to the PV<sub>IN</sub> and GND terminals within the ranges specified on the PCB. Make sure that the PV<sub>IN</sub> DC input voltage does not exceed 80V or the forward voltage of the LED string.

4. Connect the PWM terminal. If PWM is not used, connect PWM to a 5V source or to INTV<sub>CC</sub> on the PCB using resistor R21. PWM must be pulled high to work. For DC1319B-B, the SYNC input can be left floating but is best tied to GND if not used.
5. Turn the PV<sub>IN</sub> power supply on.
6. Release the shutdown-to-GND connection.
7. Observe the LED string running at the programmed LED current.
8. For PWM dimming, connect a PWM (100Hz or higher) signal to the PWM terminal.
9. Observe the reduction of brightness in the LED string when PWM dimming.

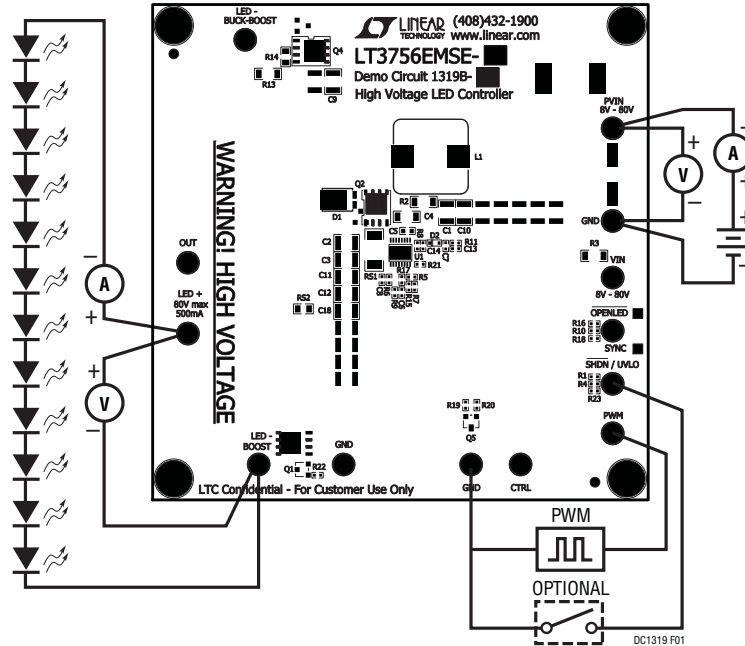


Figure 1. Test Setup for the DC1319B-A/DC1319B-B

### OPERATION

#### Two ICs, LT3756-2/LT3756-1

The DC1319B features two build versions. DC1319B-A uses the LT3756EMSE-2 with an open-LED status and DC1319B-B which uses the LT3756EMSE-1 with sync. Each board is clearly marked indicating which IC is used. The schematic for each is attached to this document. The open-LED indicator has a pull-up resistor from the terminal to the internal 7V regulator  $INTV_{CC}$ . Note that when PWM and SYNC are both used, optimal PWM dimming occurs when there is at least a 200ns delay from the PWM rising edge and the SYNC rising edge—with the PWM edge occurring first. For more questions regarding this matter, please consult the factory.

Although DC1319B-A/DC1319B-B are assembled as boost topology LED drivers, they can be reconfigured for buck-boost mode, buck mode and SEPIC LED driver topologies. Please keep in mind that the chosen topology should reflect the relationship between the entire input voltage range and the LED voltage range. Other circuit requirements such as short circuit between terminals or ground can affect the choice of LED driver topology.

#### Terminal Options

DC1319B-A/DC1319B-B have both  $PV_{IN}$  and  $V_{IN}$  terminals. The schematic shows that the  $PV_{IN}$  and  $V_{IN}$  terminals are shorted together with a resistor. As assembled, only the  $PV_{IN}$  terminal needs 8V to 80V power in order for the board to operate. However, resistor R2 can be removed and the  $V_{IN}$  terminal can be connected to a supply that is separate from the  $PV_{IN}$  terminal. The  $V_{IN}$  terminal is tied directly to the  $V_{IN}$  pin.

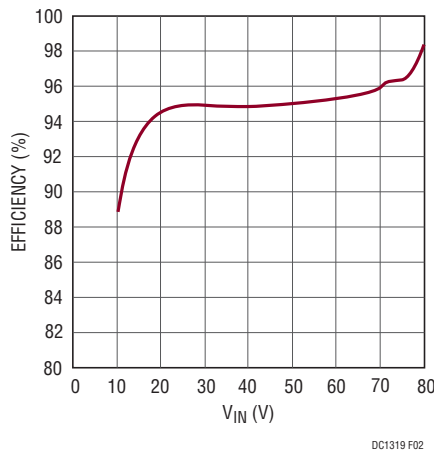
The  $V_{OUT}$  terminal is available for the customer to monitor the state of the output capacitor directly. The  $V_{OUT}$  terminal can also be used as an input for buck mode topology.

**The PWM terminal must be pulled high in order for the board to operate.** It is preferable to tie the PWM terminal/pin to  $INTV_{CC}$  of the controller by shorting R21 if PWM dimming is not used, but for board evaluation it can be tied to an external 5V source as well.

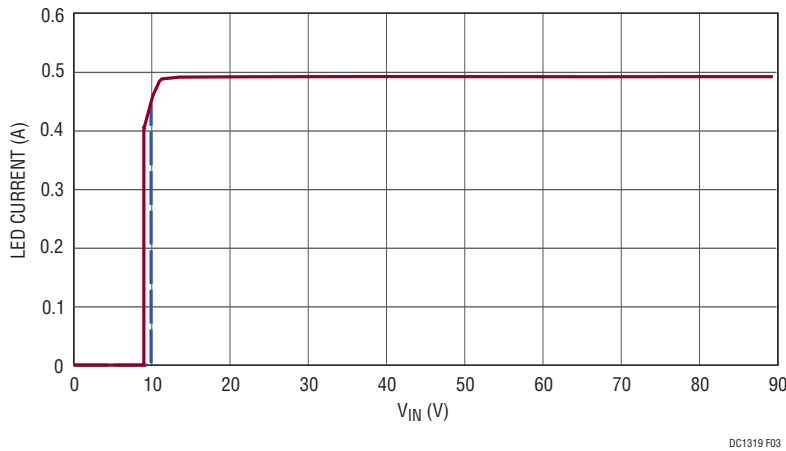
### OPERATION

The CTRL terminal is used for analog dimming. The CTRL pin is tied directly to the terminal and it is already being used to reduce the LED current when  $PV_{IN}$  drops too low. The CTRL pin voltage can easily be overridden with an external voltage supply and the resistor divider from  $PV_{IN}$  can be removed.

The shutdown/undervoltage terminal is used to shut down the demonstration circuit. Tie the terminal to GND and the converter stops switching. The PWMOUT pin goes low and the PWM dimming MOSFET is turned off. As long as the PWM dimming MOSFET is used properly, the LEDs do not turn on during shutdown.



**Figure 2. DC1319B-A/DC1319B-B Efficiency with 80V LEDs at 0.5A**



**Figure 3. DC1319B-A/DC1319B-B LED Current Drops at Low  $V_{IN}$  (CTRL) and Turns Off at Lower  $V_{IN}$  (UVLO)**

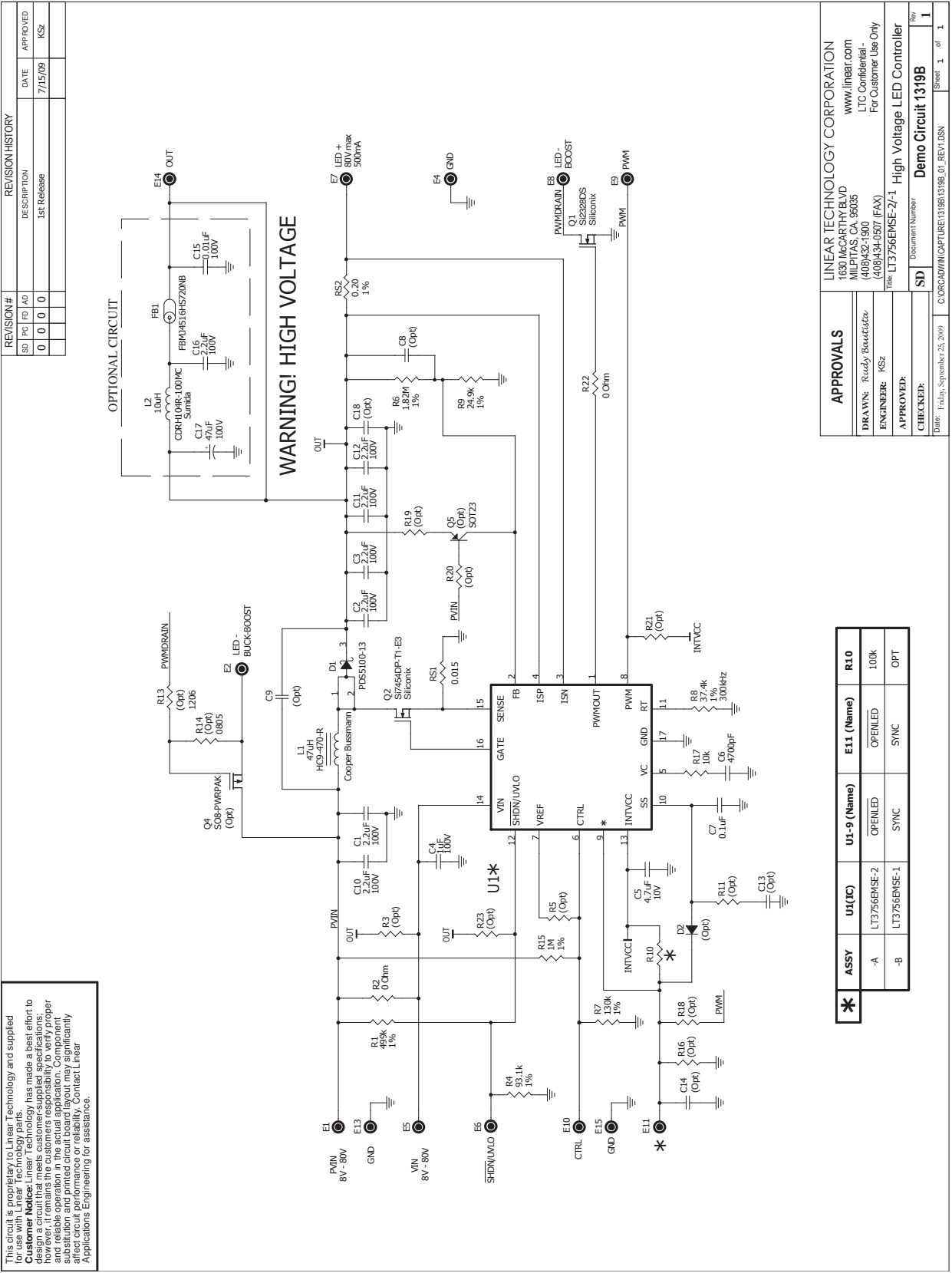
# DEMO MANUAL

## DC1319B-A/DC1319B-B

### PARTS LIST

QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>REQUIRED ELECTRICAL COMPONENTS</b>			
6	C1, C2, C3, C10, C11, C12	Capacitor., X7R 2.2µF 100V 20% 1210	TDK C3225X7R2A225M
1	C4	Capacitor., X7R 1µF 100V 20% 1206	AVX 12061C105MAT2A
1	C5	Capacitor., X5R 4.7µF 10V 10% 0603	Taiyo Yuden LMK107BJ475KA
1	C6	Capacitor., X7R 4700pF 25V 20% 0402	AVX 04023C472MAT2A
1	C7	Capacitor., X5R 0.1µF 16V 20% 0402	AVX 0402YD104MAT2A
1	D1	Schottky Diode 5A PowerDi5	Diodes Inc. PDS5100-13
1	L1	Inductor, 47µH HC9-SERIES	Cooper HC9-470-R
1	Q1	MOSFET N-Channel, 100V	Siliconix Si2328DS
1	Q2	MOSFET N-Channel, 100V	Siliconix Si7454DP-T1-E3
1	RS1	Resistor, 0.015 1/2W 1% 2010	Vishay Dale WSL2010R0150FEA
1	RS2	Resistor, 0.20 0.125W 1% 0805	Vishay Dale WSL0805R2000FEA
1	R1	Resistor, Chip 499k 0.06W 1% 0402	Vishay CRCW0402499KFED
1	R4	Resistor, Chip 93.1k 0.06W 1% 0402	Vishay CRCW040293K1FKED
1	R6	Resistor, Chip 1.82M 0.06W 1% 0402	Vishay CRCW04021M82FKED
1	R8	Resistor, Chip 37.4k 0.06W 1% 0402	Vishay CRCW040237K4FKED
1	R9	Resistor, Chip 24.9k 0.06W 1% 0402	Vishay CRCW040224K9FKED
1	R17	Resistor, Chip 10k 0.06W 5% 0402	Vishay CRCW040210K0JNED
1	U1 (DC1319B-A Assembly)	IC, LED Driver MSOP(16)-MSE	Linear Tech. Corp. LT3756EMSE-2
1	U1 (DC1319B-B Assembly)	IC, LED Driver MSOP(16)-MSE	Linear Tech. Corp. LT3756EMSE-1
<b>OPTIONAL ELECTRICAL COMPONENTS</b>			
0	C8, C13, C14 (Opt)	Capacitor., 0402	
0	C9, C16, C18 (Opt)	Capacitor., 1210	
0	C15 (Opt)	Capacitor., X5R 0.01µF 100V 20% 0603	TDK C1608X5R2A103M
0	C17 (Opt)	Capacitor., Alum 47µF 100V 25%	SUNCON 100CE47BS
0	D2 (Opt)	Diode, SOD-523	
0	FB1 (Opt)	Ferrite Bead, 6A 1806	Taiyo Yuden FBMJ4516HS720NB
0	L2 (Opt)	Inductor, 10µH CDRH104	Sumida CDRH104R-100MC
0	Q4 (Opt)	MOSFET P SO8-PWRPAK-SGL	
0	Q5 (Opt)	PNP SOT23	
1	R2	Resistor/Jumper, Chip 0Ω 1/4W 1A 1206	Vishay CRCW1206000Z
0	R3, R13 (Opt)	Resistor, 1206	
0	R5, R11, R16, R18, R19, R20, R21, R23 (Opt)	Resistor, 0402	
1	R7	Resistor, Chip 130k 0.06W 1% 0402	Vishay CRCW0402130KFED
1	R10 (DC1319B-A assembly)	Resistor, Chip 100k 0.06W 5% 0402	Vishay CRCW0402100KJNED
0	R10 (DC1319B-B assembly)	Resistor, 0402	
0	R14 (Opt)	Resistor, 0805	
1	R15	Resistor, Chip 1M 0.06W 1% 0402	Vishay CRCW04021M00FKED
1	R22	Resistor/Jumper, Chip 0 Ohm 1/16W 1A 0402	Vishay CRCW0402000Z
<b>HARDWARE</b>			
13	E1, E2, E4, E5, E6, E7, E8, E9, E10, E11, E13, E14, E15	Turret, Testpoint	Mill Max 2501-2-00-80-00-00-07-0

## SCHEMATIC DIAGRAM



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# DEMO MANUAL

## DC1319B-A/DC1319B-B

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