LT3756, LT3756-1

DESCRIPTION

Demonstration circuit 1319A-A, 1319A-B is a high voltage and high current LED driver controller. The VIN 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 8-80V input and up to 80V LED output at 0.5A with an open LED status pin (-A) or a sync input pin (-B). DC1319A features PWM dimming, analog dimming, shutdown, and open LED overvoltage protection. Efficiency at 12VIN 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 will limit 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 is employed to turn the LEDs off when VIN drops below 8V.

DC1319A 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 given 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/-1 datasheet in the applications 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 DC1319A in order to convert the board from a boost topology LED driver to any other topology. Please consult the factory or LT3756/-1 datasheet for details regarding how to customize the DC1319A or how to design different topologies for custom specifications.

The LT3756, LT3756-1 datasheet gives a complete description of the part, operation and applications information. The datasheet must be read in conjunction with this Quick Start Guide for demonstration circuit 1319A-A, 1319A-B. The LT3756, LT3756-1 is assembled in a small 16-lead plastic MSOP or QFN package with a thermally enhanced ground pad. Demonstration circuit 1319A-A, 1319A-B uses the MSOP package. Proper board layout is essential for maximum thermal performance. See the datasheet section 'Layout Considerations'.

Design files for this circuit board are available. Call the LTC factory.

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Table 1.   Typical Performance Summary for DC1319A-A/B

PARAMETER	CONDITION	VALUE (TYPICAL)
Input Voltage PVIN Range	Operating	8V-80V
Switching Frequency	R8 = 37.4k	300kHz
I_{LED}		0.5A
Open LED Voltage		92V
Efficiency	PVIN=12V V_{LED}=80V I_{LED}=0.5A	91%
Under Voltage Lockout		8V
Peak Switch Current Limit	RS1 = 0.015Ω	6.6A

QUICK START PROCEDURE

Demonstration circuit 1319A-A, 1319A-B is easy to set up to evaluate the performance of the LT3756, 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 IntVcc on the PCB using resistor R21.

1. Connect a string of LEDs with forward voltage less than 80V, but greater than the PVIN voltage, to the LED+ and LED- (Boost) terminals on the PCB as shown in Figure 1.

2. Connect the shutdown terminal to GND.

3. With power off, connect the PVIN power supply to the PVIN and GND terminals within the ranges specified on the PCB. Make sure that the PVIN 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 IntVcc on the PCB using resistor R21. PWM must be pulled high to work. For –B, the SYNC input can be left floating.

5. Turn the PVIN power supply on.

6. Release the shutdown/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.
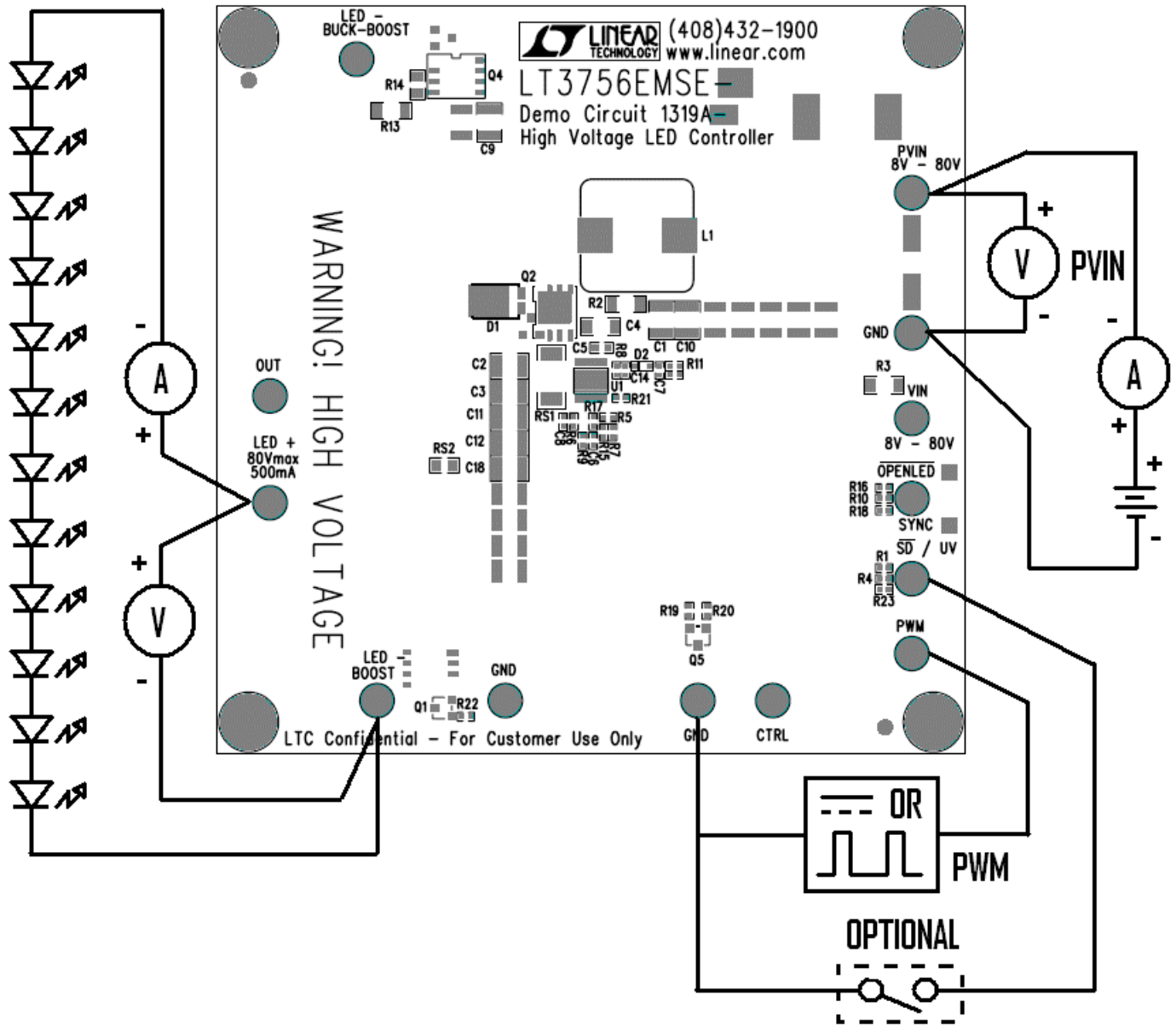
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Figure 1. Test procedure setup drawing for DC1319A-A and DC1319A-B

TWO ICS, THREE TOPOLOGIES

DC1319A features two build versions. DC1319A-A uses the LT3756EMSE with an open LED status and

DC1319A-B 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 –A version has an open LED indica-tor terminal and there is a pull-up resistor from the terminal to the internal 7V regulator IntVcc. There is also a diode between the soft start and open LED

pins and a resistor in series with the soft start capacitor for open LED output. Please consult the open LED detection section of the LT3756/-1 datasheet for details. The –B version with the sync terminal has an RC filter between the PWM input pin and the SYNC input pin. This filter provides a small delay between the PWM signal and the SYNC input when PWM is used and SYNC is not used in order to optimize high PWM dimming ratio waveforms. If high ratios are not needed, this RC filter may not be needed. If the sync input is used, this filter may be removed. Please 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 DC1319A-A/B is assembled as a boost topology LED driver, it 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 be affected by the choice of LED driver topology.

TERMINAL OPTIONS

DC1319A-A/B has both PVIN and VIN terminals. The schematic shows that the PVIN and VIN terminals are shorted together with a resistor. As assembled, only the PVIN terminal needs 8V to 80V power in order for the board to operate. However, resistor R2 can be removed and the VIN terminal can be connected to a supply that is separate from the PVIN terminal. The VIN terminal is tied directly to the VIN pin.

The VOUT terminal is available for the customer to monitor the state of the output capacitor directly. The VOUT 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 IntVcc 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.

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 PVIN drops too low. The CTRL pin voltage can easily be overridden with an external voltage supply and the resistor divider from PVIN can be removed.

The shutdown/undervoltage terminal is used to shut down the demonstration circuit. Tie the terminal to GND and the converter will stop switching. The PWMOUT pin will go low and the PWM dimming MOSFET will be turned off. As long as the PWM dimming MOSFET is used properly, the LEDs will not turn on during shutdown.
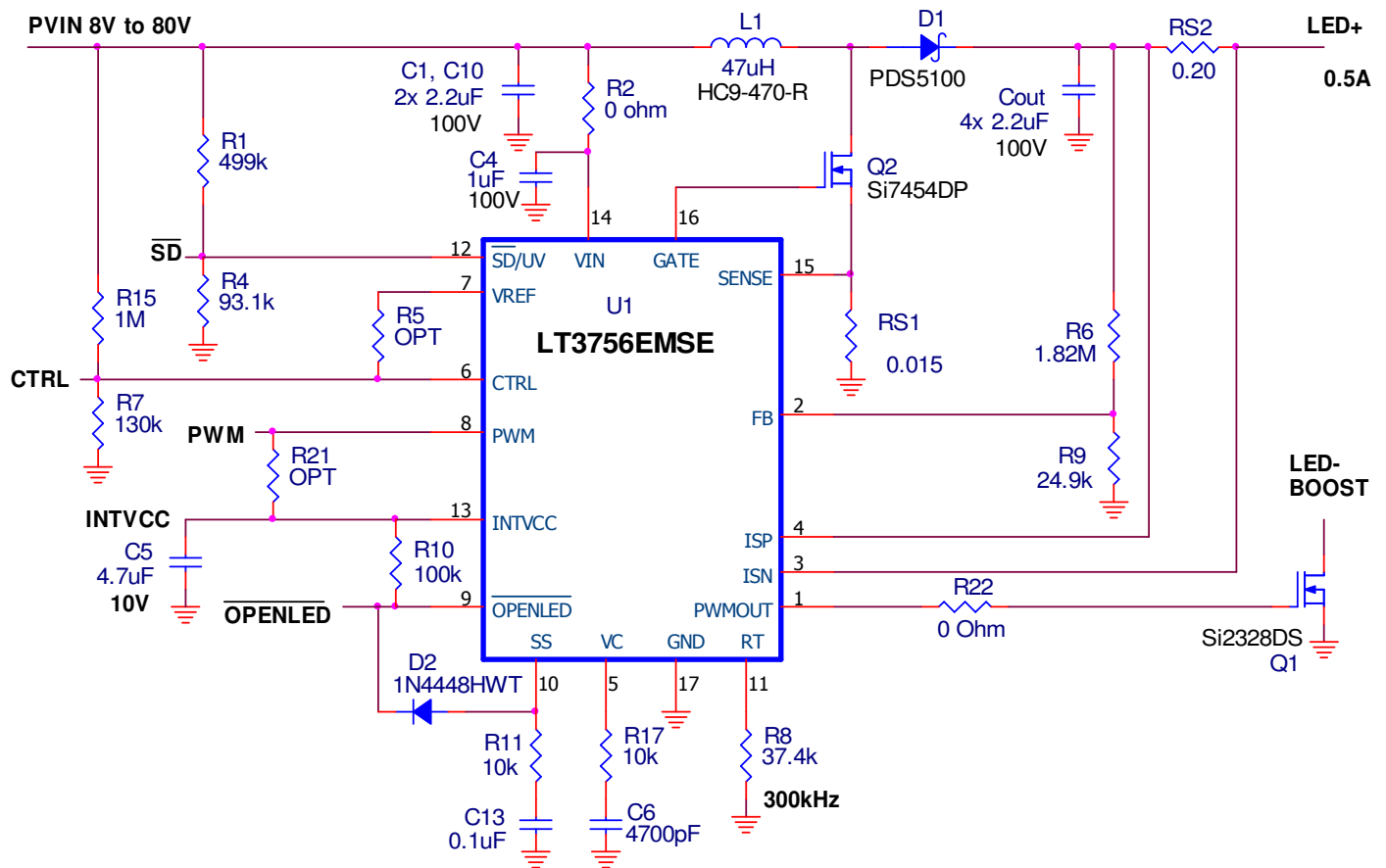
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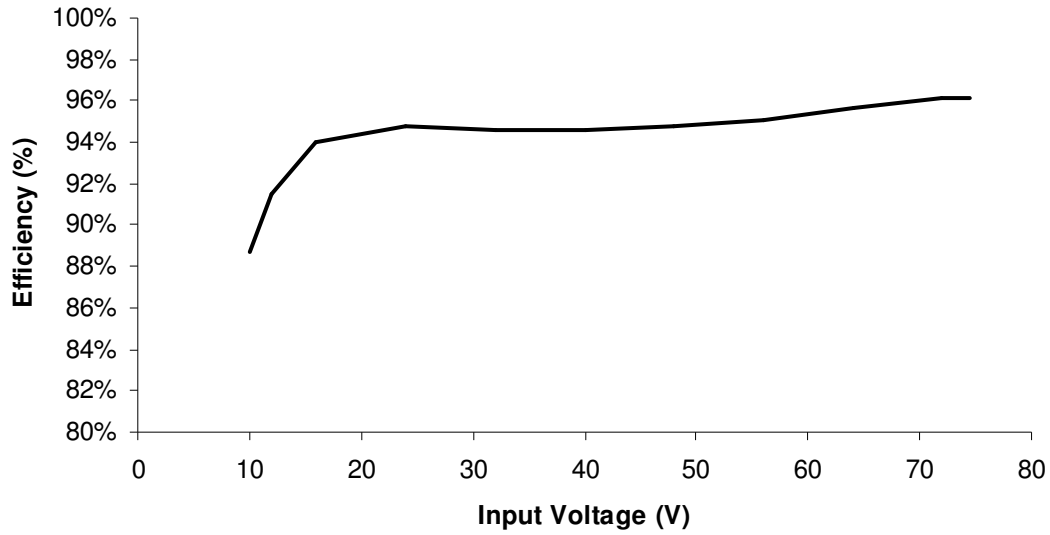**Figure 2. DC1319A-A featuring LT3756 and Open LED flag**

Figure 3. DC1319A-A/B Efficiency with 80V LEDs at 0.5A
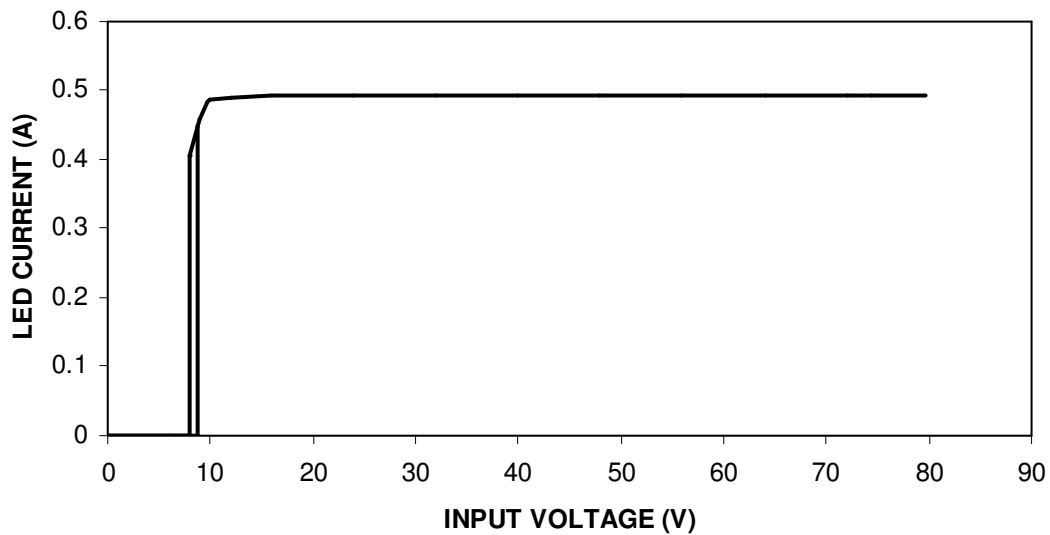
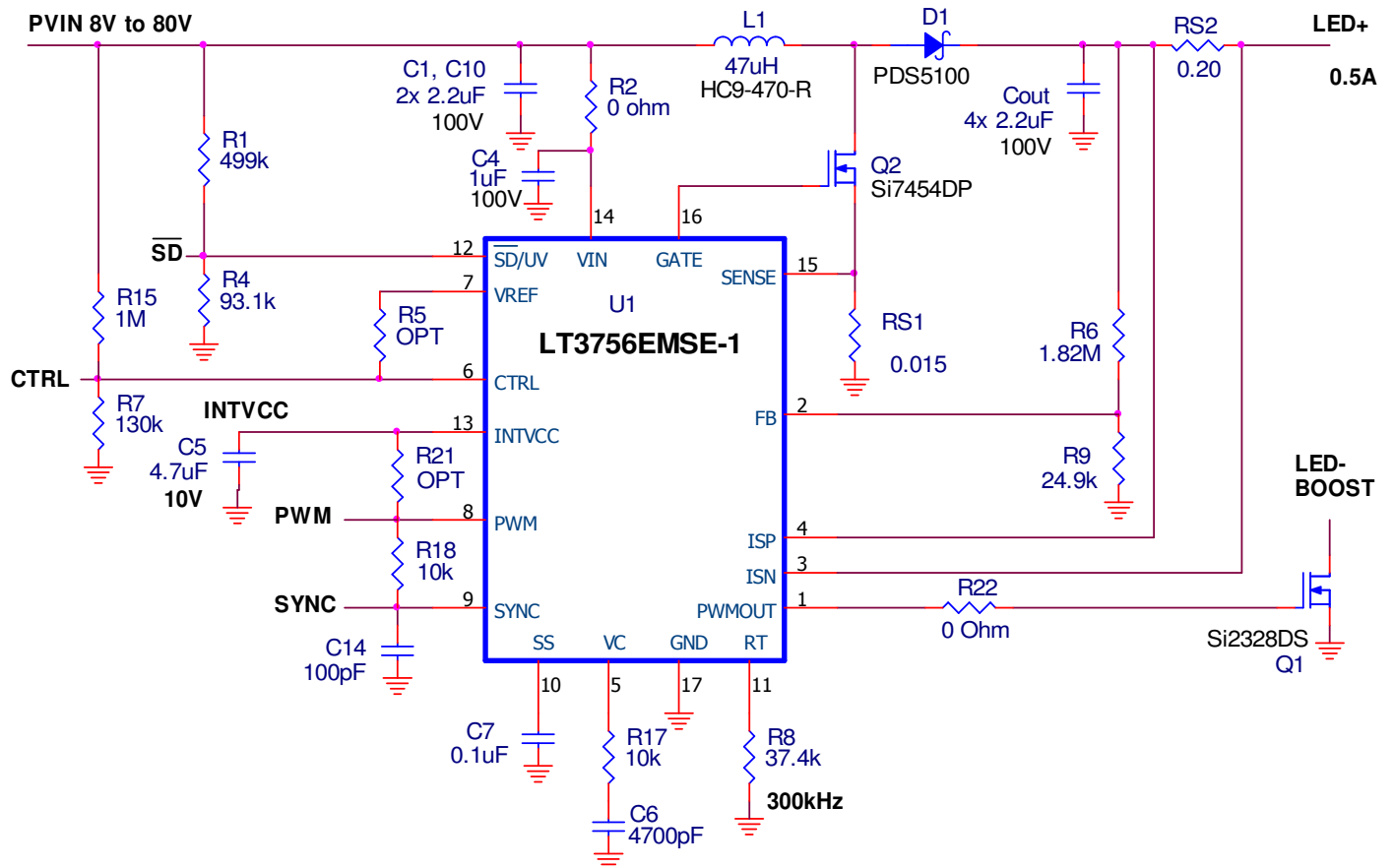**Figure 4. DC1319A-A/B LED Current Drops at Low VIN (CTRL) and Turns Off at Lower VIN (UVLO)**

Figure 5. DC1319A-B featuring LT3756-1 and SYNC input