DESCRIPTION

Demonstration circuit 949A-A/949A-B is a 4.5A peak switch current boost LED driver with PWM dimming featuring the LT3478-1/LT3478. DC949A-A uses the LT3478-1, a fixed 1A LED driver with the LED current sense resistor inside the IC. DC949A-B has the LT3478 adjustable LED current converter requiring an external sense resistor (R11). Both circuits are optimized to drive a 350mA LED string with a total LED voltage above the input voltage and below 40V. The wide input voltage range, internal 4.5A npn power switch, floating current sense amplifier, LED current dimming control, inrush protection, programmable switching frequency, soft-start, and overvoltage protection make the LT3478-1/LT3478 an extremely powerful and versatile LED driving IC. It can be used for boost, buck mode, and buck-boost mode LED drivers.

The LT3478-1/LT3478 has programmable overvoltage protection in case the LEDs are open or not properly attached to the terminals on the PCB. The shutdown function is activated by pulling the shutdown terminal to ground. In shutdown the boost configuration allows the input voltage to be seen on the output and if the attached LED array leaks current at the input voltage, the LEDs may not completely turn off although IC switching will cease. Tying the PWM terminal low will disable the LEDs in shutdown or during normal running operation. PWM dimming can be applied to DC949A as built. CTRL dimming can be used for analog control of LED current if the resistor networks attached to the CTRL1 and/or CTRL2 pins are removed. Inrush protection limits the V_S input current to 6A during a hotplug or startup condition. Soft-start prevents high inrush current in most conditions. See details in the 'Soft-Start' section in the LT3478-1/LT3478 datasheet.

The switching frequency is set at 1MHz and can be adjusted by changing a single resistor. Please read the datasheet for details on setting the switching frequency and selecting components such as the inductor and capacitors. The maximum rating on V_S is 36V. However, in a boost converter, the maximum normal operating voltage of V_S is the maximum LED voltage connected to the output. Using a higher voltage on V_S results in loss of control of LED current.

Modifications can be made to DC949A in order to convert the board from a boost LED driver to either a buck mode or buck-boost mode LED driver. The LT3003 three string ballaster is also available as an option for any configuration of the DC949A. Please consult the factory for customization details. Some schematics are supplied in this quick-start guide.

The LT3478-1, LT3478 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 949A-A/949A-B. The LT3478-1, LT3478 is assembled in a small 16-lead plastic TSSOP FE package with a thermally enhanced ground pad. 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.

Table 1. Typical Performance Summary for both DC949A-A and DC949A-B

PARAMETER	CONDITION	VALUE (TYPICAL)
Input Voltage V_S Range	V_{LED} > 25V, I_{LED} = 350mA	2.8 – 25V
Input Voltage V_{IN} Range	Non-transient	2.8 – 16V
I_{LED}		350mA
Maximum Output Voltage		36V
Open LED Output Voltage		36V to 40V
Switching Frequency	R6 = 31.6k	1MHz
Efficiency	V_S=12V V_{IN}=5V V_{LED}=31.5V I_{LED}=.35A	88%
Maximum PWM Dimming Ratio	V_S=12V V_{IN}=5V V_{LED}=31.5V I_{LED}=.35A	3000:1

QUICK START PROCEDURE

Demonstration circuit 949A-A/949A-B is easy to set up to evaluate the performance of the LT3478-1, LT3478. Follow the procedure below:

NOTE: Make sure that the V_s DC input voltage does not exceed 25V and the VIN DC input voltage does not exceed 16V.

1. Connect a string of LEDs with forward voltage less than 36V, but greater than the V_s input voltage, to the LED+ and LED- terminals on the PCB as shown.
2. Connect the shutdown terminal to GND.
3. With power off, connect the V_s power supply to the V_s terminal and connect the VIN power supply to the VIN terminal within the ranges specified on the PCB.
4. Connect the PWM and VIN terminals.
5. Turn the V_s and VIN power supplies on.
6. Release the shutdown/GND connection.
7. Observe the LED string running at full 350mA LED current at 100% duty cycle.
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.

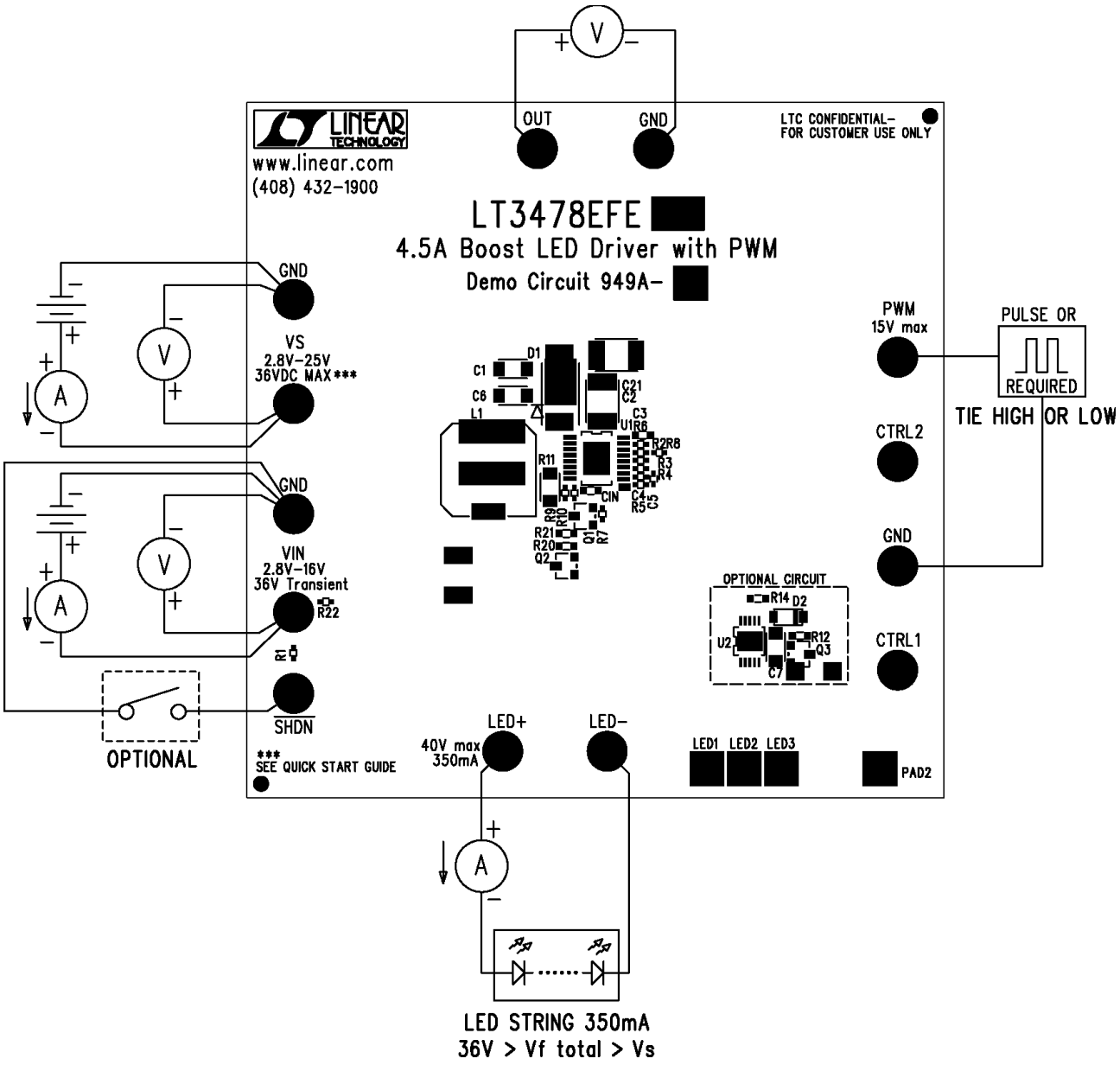


Figure 1. Test procedure setup drawing for DC949A-A DC949A-B

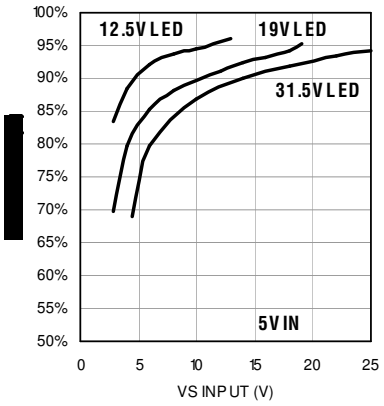


Figure 2. DC949A-A efficiency

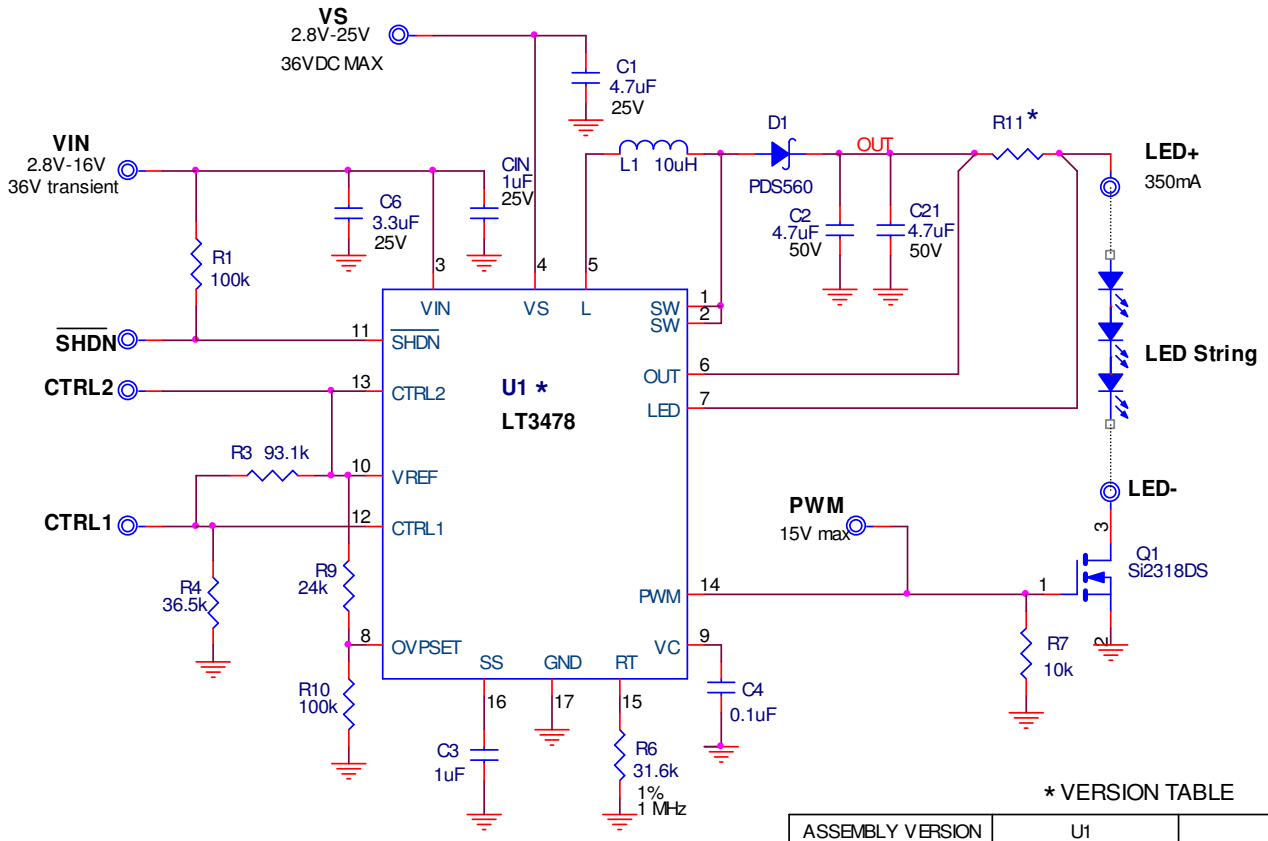
TWO ICS, THREE TOPOLOGIES

DC949A has two build versions. DC949A-A uses the LT3478-1 1A fixed LED current IC with internal sense resistor. It can be set at full 1A current or less than 1A LED current with CTRL1,2 resistor divider network. DC949A-B uses the LT3478 adjustable LED current IC with a required external sense resistor to set the LED current. It can be set at LED currents above and below 1A. Please see the datasheet for details regarding the use of the sense resistor and setting the LED current. Both DC949A-A and DC949A-B are built to provide 350mA LED current in the boost LED driver topology.

Although DC949A is a boost LED driver, it can be reconfigured for buck-boost mode LED driving and buck mode LED driving. The datasheet details some of these changes and the figures below show sample schematics with the demonstration circuit reference designators that can be used in the different modes. There may be a cut or two required on the PCB to make these changes. Please ask for further documentation detailing the changes in DC949A for conversion to buck mode or buck-boost mode LED driving.

OPTIONAL LT3003 BALLASTER

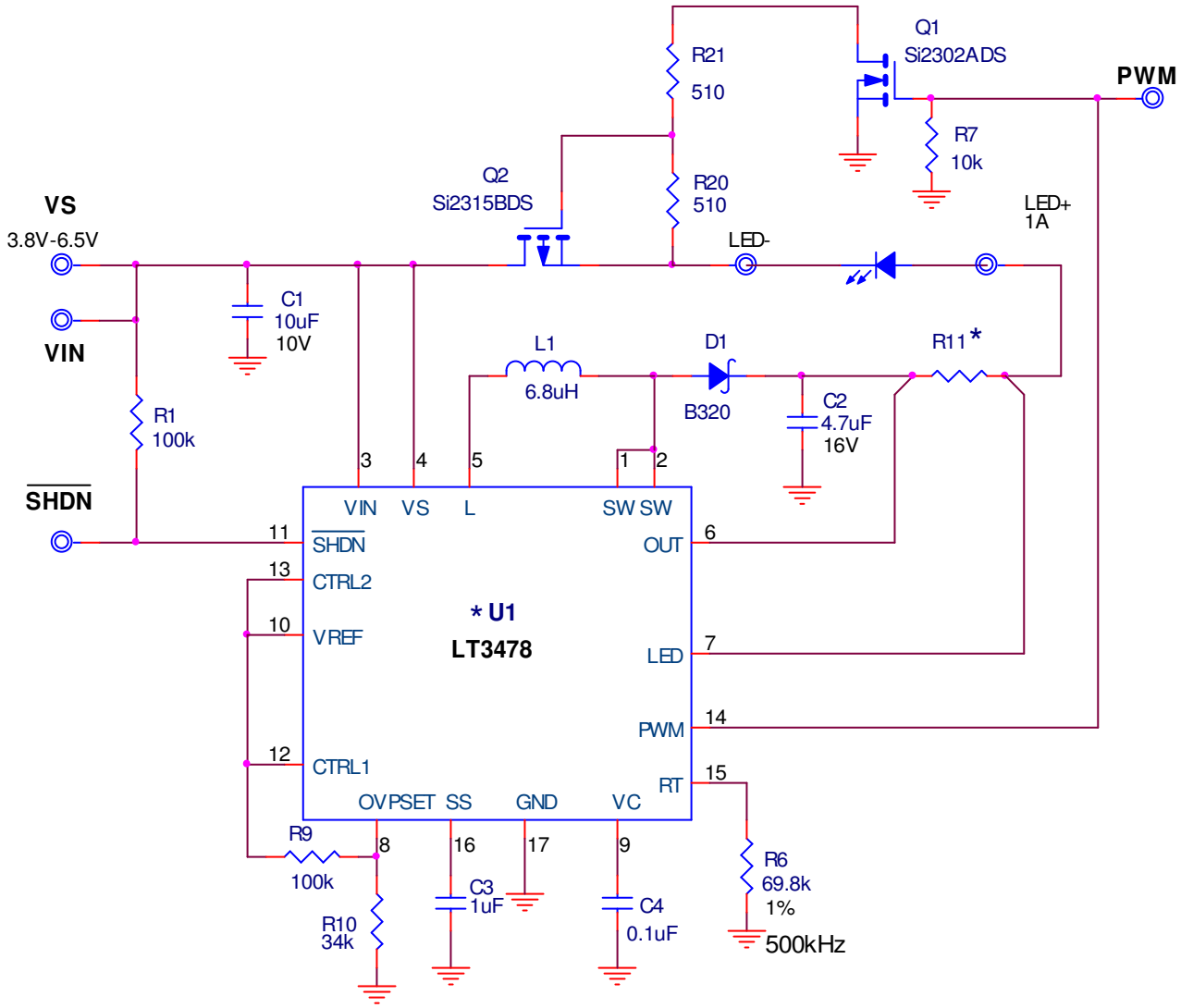
The LT3003 is available for three-channel LED ballasting. With 1A or less output using the DC949A, three parallel channels of LED strings can be driven and PWM dimmed in all three topologies using the LT3003 with the LT3478-1 or LT3478. For details regarding the connection of the LT3003 and the LT3478 please see the LT3003 and LT3478 datasheets. When not being used, the LT3003 circuit should be left unstuffed. Please note that there is a small pad near the LT3478 Vc pin that connects internally to the LT3003 /OT2 output for overtemp protection. It is shown in the schematic of the LT3478 and it is easy to connect these functions using the DC949A.



* VERSION TABLE

ASSEMBLY VERSION	U1	R11
DC949A-A	LT3478EFE-1	DO NOT STUFF
DC949A-B	LT3478EFE	0.1 ohm 1%

Figure 3. Customer friendly schematic for boost (as-built) DC949A. 40V is the maximum that the output will see, but OVP might be as low as 36V without any adjustments.



* VERSION TABLE

ASSEMBLY VERSION	U1	R11
DC949A-A	LT3478EFE-1	DO NOT STUFF
DC949A-B	LT3478EFE	0.1 ohm 1%

Figure 4. Customer friendly schematic for buck-boost mode LED driver DC949A. This circuit requires changes to the standard demo circuit such as addition of new components and a trace cut on the top-side of the board between the drain of Q1 and the LED- terminal.

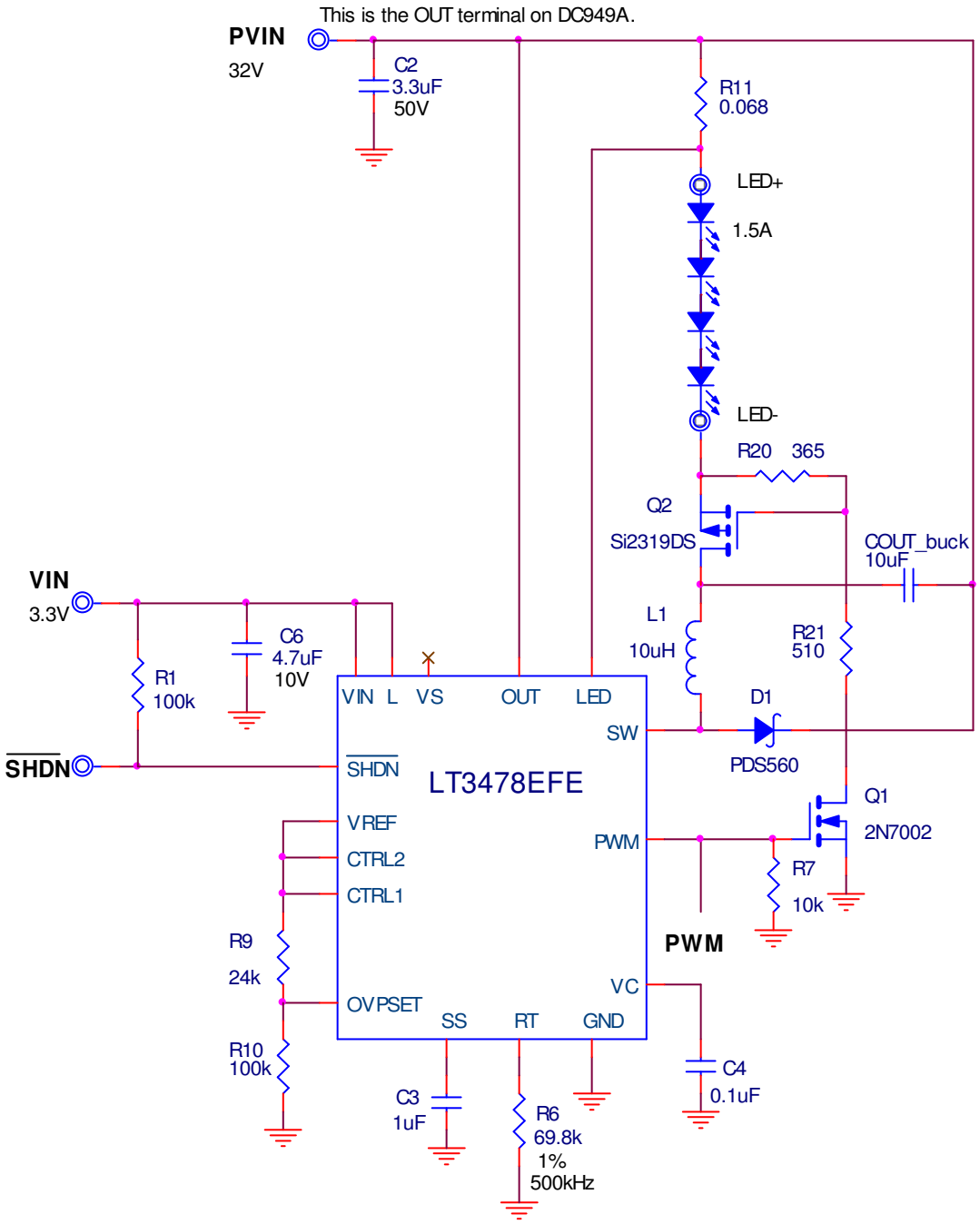
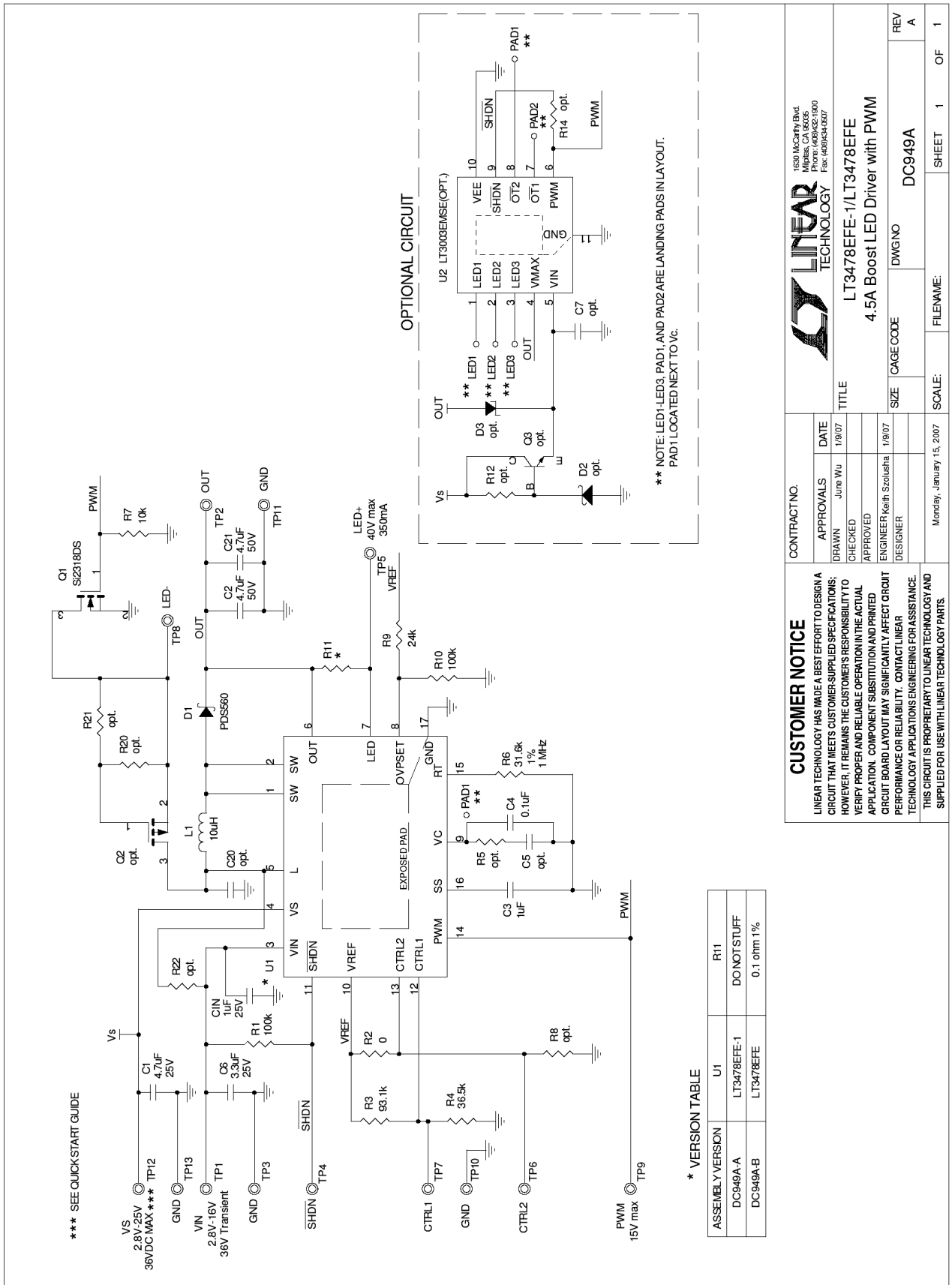


Figure 5. Customer friendly schematic for buck mode LED driver DC949A-B. This circuit requires changes to the standard demo circuit such as addition of new components and a trace cut on the top-side of the board between the drain of Q1 and the LED- terminal. The input PVIN must be connected to the OUT terminal. The connection between pin L and the inductor must be cut on the topside of the board. Pin L can be connected to VIN terminal via R22 with a zero ohm resistor. Terminal Vs can be left floating. The COUT_buck capacitor must be added to the board.


OPTIONAL CIRCUIT
U2 LT3009EMSE(OPT.)
** NOTE: LED1-LED3, PAD1, AND PAD2 ARE LANDING PADS IN LAYOUT. PAD1 LOCATED NEXT TO Vc.
*** SEE QUICK START GUIDE
* VERSION TABLE
ASSEMBLY VERSION | U1 | R11
DC949A-A | LT3478EFE-1 | DO NOT STUFF
DC949A-B | LT3478EFE | 0.1 ohm 1%
CUSTOMER NOTICE
LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.
CONTRACT NO.
APPROVALS | DATE
DRAWN June Wu | 1/9/07
CHECKED
APPROVED
ENGINEER Keith Szolusha | 1/9/07
DESIGNER
Monday, January 15, 2007
TITLE
LT3478EFE-1/LT3478EFE
4.5A Boost LED Driver with PWM
SIZE | CAGE CODE | DWG NO | REV
DC949A | A
SCALE: | FILENAME: | SHEET 1 OF 1
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