

LT3477 and LT3003  
 High Current Multi-String LED Driver with  
 Wide PWM Dimming Range

**WARNING!**

DO NOT LOOK AT OPERATING LED.  
 This circuit produces light that can damage eyes.

## DESCRIPTION

Demonstration circuit 1130 is a High Current Multi-String LED Driver with Wide PWM Dimming Range featuring the LT3477 and LT3003. The demo circuit boosts  $V_{IN}$ , between 8V and 16V, to the required  $V_{OUT}$  for a load of three LED strings. The current in each string is 110mA. The LT3003 LED ballaster offers high efficiency and good current matching. The circuit can drive 6 to 8 white LEDs per string. For 8 LEDs, it is recommended to change R5 to 1.15M. For other colors, the number of LEDs the circuit can drive depends on the forward voltage of LEDs used. The demo circuit operates at 2MHz, offering small solution size while avoiding the frequency band of the AM radio. Pulling the SHDN terminal to ground (GND) will disable the demo board. OT1 or OT2 can be left floating.

Fast LED current turn-on and -off is made possible by adding Q1 and D2. This allows wide PWM

dimming ratio. PWM dimming offers better LED color integrity than the DC dimming. At 100Hz PWM frequency, 300:1 dimming ratio can be easily achieved with this demo circuit.

Other current levels and/or load configurations can be achieved with simple modifications. Please consult the datasheets or the factory for customization details.

The LT3477 and the LT3003 datasheets give complete description of the part, operation and application information. The datasheets must be read in conjunction with this quick start guide for working on or modifying the demo circuit 1130.

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

LT, LTC and LT are registered trademarks of Linear Technology Corporation. ThinSOT and PowerPath are trademarks of Linear Technology Corporation.

## PERFORMANCE SUMMARY

Specifications are at  $T_A = 25^\circ\text{C}$

| SYMBOL     | PARAMETER                   | CONDITIONS   | MIN | TYP | MAX | UNITS |
|------------|-----------------------------|--|-----|-----|-----|-------|
| $V_{IN}$   | Input Supply Range          |  | 8   |     | 16  | V     |
| $V_{PWM}$  | PWM Voltage                 |  | 3   |     | 6   | V     |
| $F_s$      | Switching Frequency         |  |     | 2   |     | MHz   |
| N          | Number of LED Strings       |  |     | 3   |     | N/A   |
| $I_{OUT}$  | Total Output Current        |  |     | 330 |     | mA    |
| $V_{OPEN}$ | Open Circuit Output Voltage | No Load  |     | 29  |     | V     |
| $\eta$     | Efficiency                  | $V_{IN} = 12\text{V}$<br>3 LED strings, 8 LEDs per string,<br>110mA/string |     | 78  |     | %     |

## QUICK START PROCEDURE

Demonstration circuit 1130 is easy to set up to evaluate the performance of the LT3477 and LT3003. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**NOTE.** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the  $V_{IN}$  or  $V_{OUT}$  and GND terminals. See Figure 2 for proper scope probe technique.

1. With power off, connect an input power supply to  $V_{IN}$  and GND.
2. Connect the PWM turret to a different supply.
3. Connect three (3) LED strings between  $V_{OUT}$  and LED1- to LED3- respectively.
4. Turn on  $V_{IN}$  and PWM supplies.  
**NOTE.** Make sure that the input voltage does not exceed 16V.
5. Check for the proper voltages and currents.  
**NOTE.** If the LEDs do not light up, check all the connections.
6. Once the proper operations are established, adjust the input within the operating range and observe the parameters interested.
7. To test PWM dimming, apply a PWM signal to the PWM turret and observe the relationship between the LED average current and the dimming ratio.

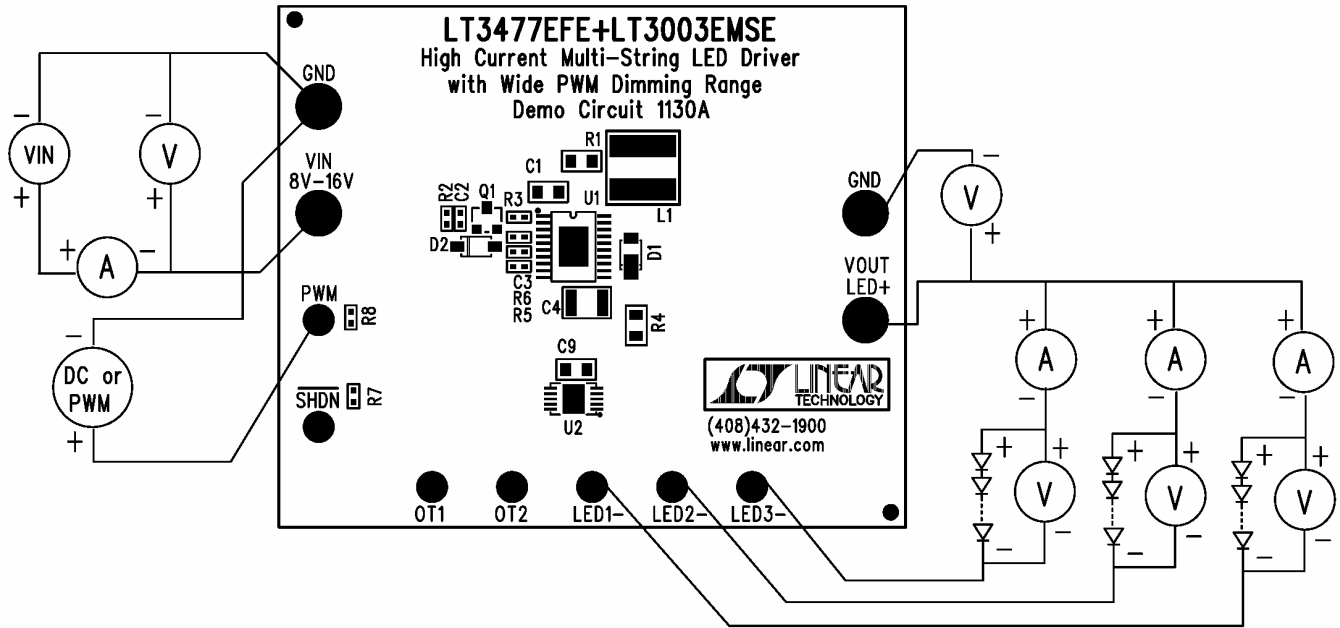


Figure 1. Proper Measurement Equipment Setup

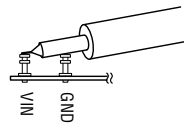
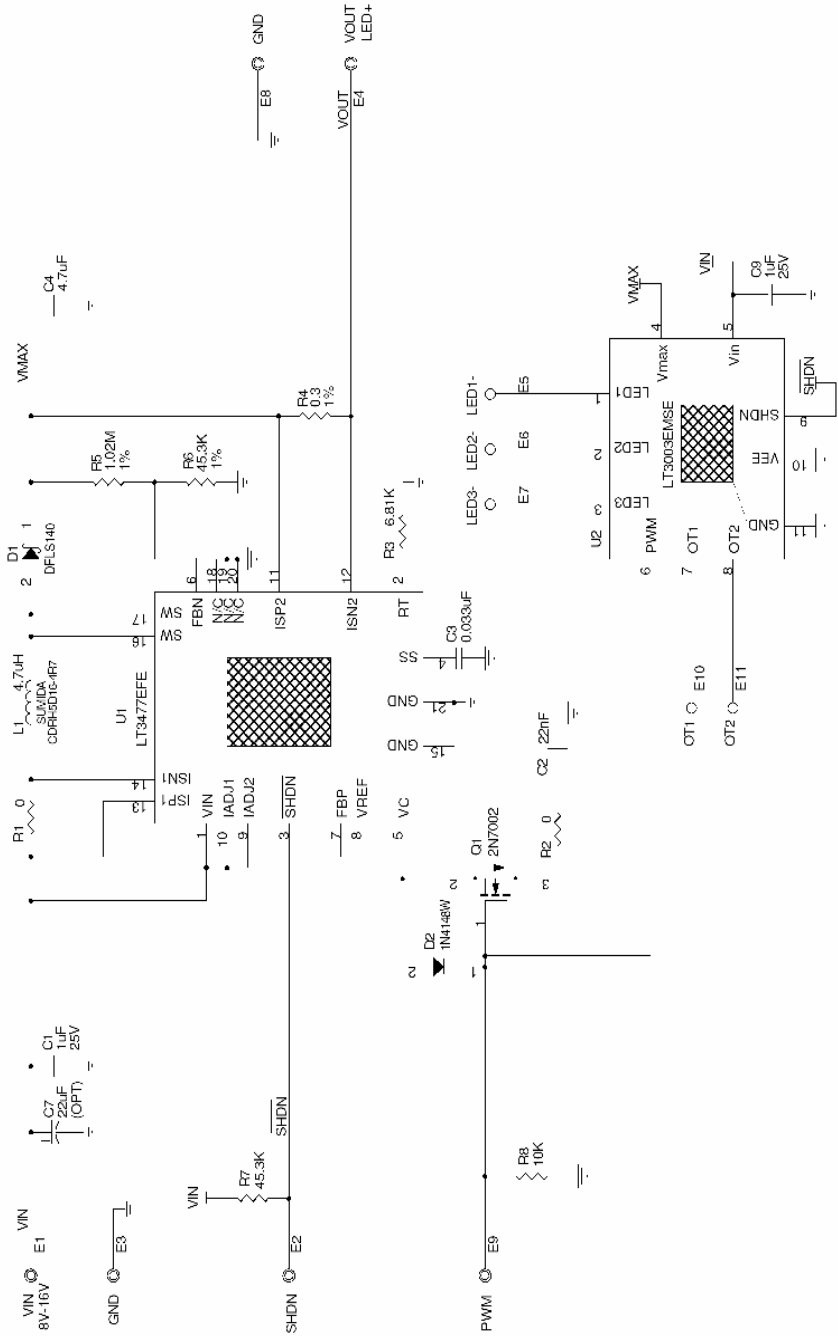


Figure 2. Measuring Input or Output Ripple

# LT3477 AND LT3003



**CONTRACT NO.** 1601AC0674ed  
**LINEAR TECHNOLOGY**  
 1601AC0674ed  
 1601AC0674ed  
 1601AC0674ed

**CUSTOMER NOTICE**  
 LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS OUR SPECIFICATIONS. WE DO NOT WARRANT OR REPRESENT THAT THE CIRCUIT WILL OPERATE PROPERLY IN ALL APPLICATIONS. VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION MAY 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.

**APPROVALS**  
 DATE  
 CHECKED: HELEN 11/26/03  
 APPROVED: LUCIANELLI 11/26/03  
 DESIGNER: WELSH EA 11/26/03

**TITLE**  
 LT3477EFE-LT3003EMSE: High Current Multi-String LED Driver with Wide PWM Dimming Range

**SIZE** (PAGE CODE) **DWG NO** DC1130A  
**REV** REV A

**SCALE:** 1:1  
**DATE:** 11/26/03  
**DESIGNED BY:** 94FF1 1 QF 1

| Item   | Qty | Reference       | Part Description                   | Manufacturer / Part #             |
|--|-----|-----------------|------------------------------------|-----------------------------------|
| <b>REQUIRED CIRCUIT COMPONENTS:</b>              |     |                 |                                    |                                   |
| 1  | 2   | C1,C9           | CAP., X5R, 1uF,25V,10%, 0805       | AVX, 08053D105KAT2A               |
| 2  | 1   | C2              | CAP., X7R, 22nF, 25V, 10%, 0402    | TDK, C1005X7R1E223K               |
| 3  | 1   | C3              | CAP., X7R, 0.033uF, 16V, 10%, 0402 | TDK, C1005X7R1C333K               |
| 4  | 1   | C4              | CAP., X7R, 4.7uF, 50V, 10%, 1210   | Murata, GRM32ER71H475KA88L        |
| 5  | 1   | D1              | DIODE, SCHOTTKY RECT, POWERDI1     | DIODES INC, DFLS140-7             |
| 6  | 1   | D2              | DIODE, SWITCHING DIODE,SOD-123     | DIODES INC, 1N4148W-7-F           |
| 7  | 1   | L1              | INDUCTOR., 4.7uH                   | SUMIDA, CDRH5D16NP-4R7NC          |
| 8  | 1   | Q1              | N-CHANNEL MOSFET, SOT-23           | DIODES INC, 2N7002-7              |
| 9  | 1   | R3              | RES., CHIP, 6.81K, 1/16W, 1%, 0402 | AAE, CR05-6811FM                  |
| 10   | 1   | R4              | RES., CHIP, 0.3, 1/16W, 1%, 0805   | THIN FILM INC, RL 1220SR30-F      |
| 11   | 1   | R5              | RES., CHIP, 1.02M, 1/16W 1%,0402   | VISHAY, CRCW04021M02FKED          |
| 12   | 1   | R6              | RES., CHIP, 45.3K, 1/16W, 1%, 0402 | AAE, CR05-4532FM                  |
| 13   | 1   | U1              | I.C, LT3477EFE, TSSOP(4.4mm)       | LINEAR TECH., LT3477EFE           |
| 14   | 1   | U2              | I.C LT3003EMSE#PBF,10-lead, MSOP   | LINEAR TECH., LT3003EMSE#PBF      |
| <b>ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS:</b> |     |                 |                                    |                                   |
| 1  | 1   | C7              | CAP., TANT, 22uF, 25V, 20%,        | AVX, TAJC226M025R                 |
| 2  | 1   | R1              | RES., CHIP, 0, 1/16W, 0805         | AAE, CJ10-000M                    |
| 3  | 1   | R2              | RES., CHIP, 0, 1/16W, 0402         | AAE, CJ05-000M                    |
| 4  | 1   | R7              | RES., CHIP, 45.3K, 1/16W, 1%, 0402 | AAE, CR05-4532FM                  |
| 5  | 1   | R8              | RES., CHIP, 10K, 1/16W, 1%, 0402   | VISHAY, CRCW0402103D              |
| <b>HARDWARE-FOR DEMO BOARD ONLY:</b>             |     |                 |                                    |                                   |
| 1  | 4   | E1,E3,E4,E8     | TESTPOINT, TURRET, .095"           | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2  | 7   | E2,E5-E7,E9-E11 | TESTPOINT, TURRET, .065"           | MILL-MAX, 2308-2-00-80-00-00-07-0 |