

LED Constant Current Source Scheme

Theory of Operation

Prepared by: Mark Scholten
Senior Applications Engineer



ON Semiconductor®

<http://onsemi.com>

The LM317L wants to see 1.25 V between its V_{OUT} pin and the V_{adj} pin, and it will do whatever it can to keep that voltage differential between them. So if a resistor is put in series with the output, and the V_{adj} pin is connected to the load side of the sense resistor, a current source is set up which follows Equation 1:

$$I_{OUT} = \frac{1.25}{R_{sense}} \quad (\text{Approximately}) \quad (\text{eq. 1})$$

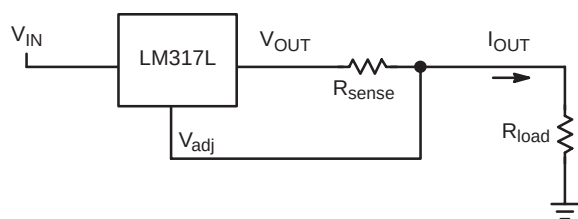


Figure 1.

In order to set up a constant current source for an LED string, the same circuit can be used by simply substituting R_{load} with an LED string, as shown below.

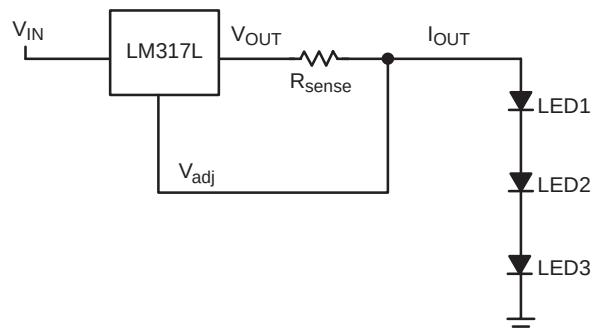


Figure 2.

But what if a series/parallel combination of LEDs is wanted? The following circuit works fine, assuming that there are not large variations in the forward voltage drop of the LEDs. There could be a problem however if one of the strings opens up for some reason. The LEDs that remain would have 50% more current flowing through them, which could cause them to be driven too hard and fail. So how does one get around this problem?

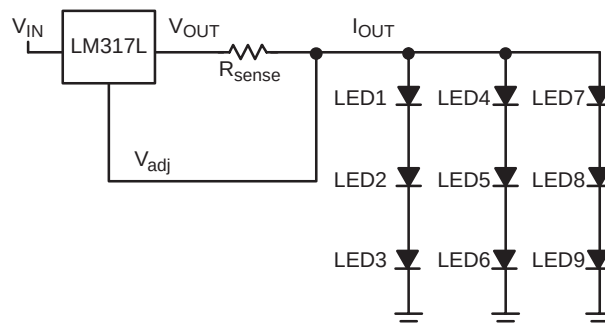


Figure 3.

The following circuit takes care of this issue by splitting up the current sense resistor into three resistors, one for each leg of the LED string. The current through any one of the LED strings is set by Equation 2:

$$I_{OUT} = \frac{1.25 \text{ V} + V_{sat}}{R1} \quad (\text{Approximately}) \quad (\text{eq. 2})$$

AND8109/D

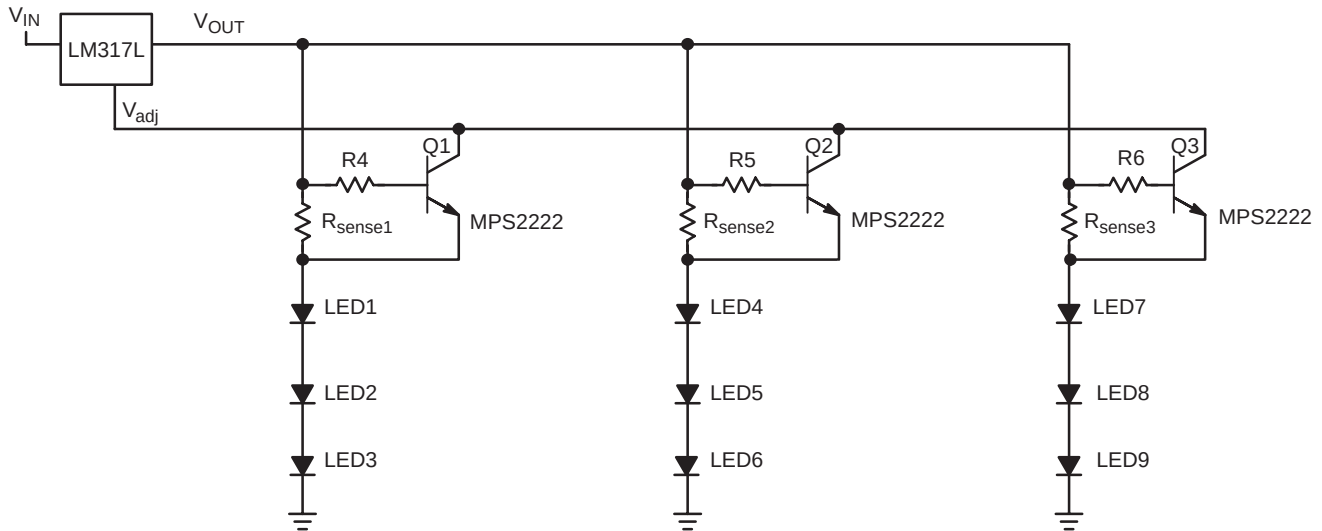


Figure 4.

When the circuit operates properly and all the LEDs are running, the three sense resistors have about 1.25 V across them, which turns the transistor switches 'on'. This connects all three sense resistors back to the V_{adj} pin allowing the proper current to go through each leg. If one string opens up,

the sense resistor for that leg won't have any voltage across it, turning 'off' the transistor and disconnecting its sense resistor from the V_{adj} pin. Therefore, the other two LED strings are unaffected by the fault. This same scheme can be expanded to accommodate as many LED strings as needed.

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

PUBLICATION ORDERING INFORMATION

Literature Fulfillment:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

JAPAN: ON Semiconductor, Japan Customer Focus Center

2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051

Phone: 81-3-5773-3850

Email: r14525@onsemi.com

ON Semiconductor Website: <http://onsemi.com>

For additional information, please contact your local Sales Representative.