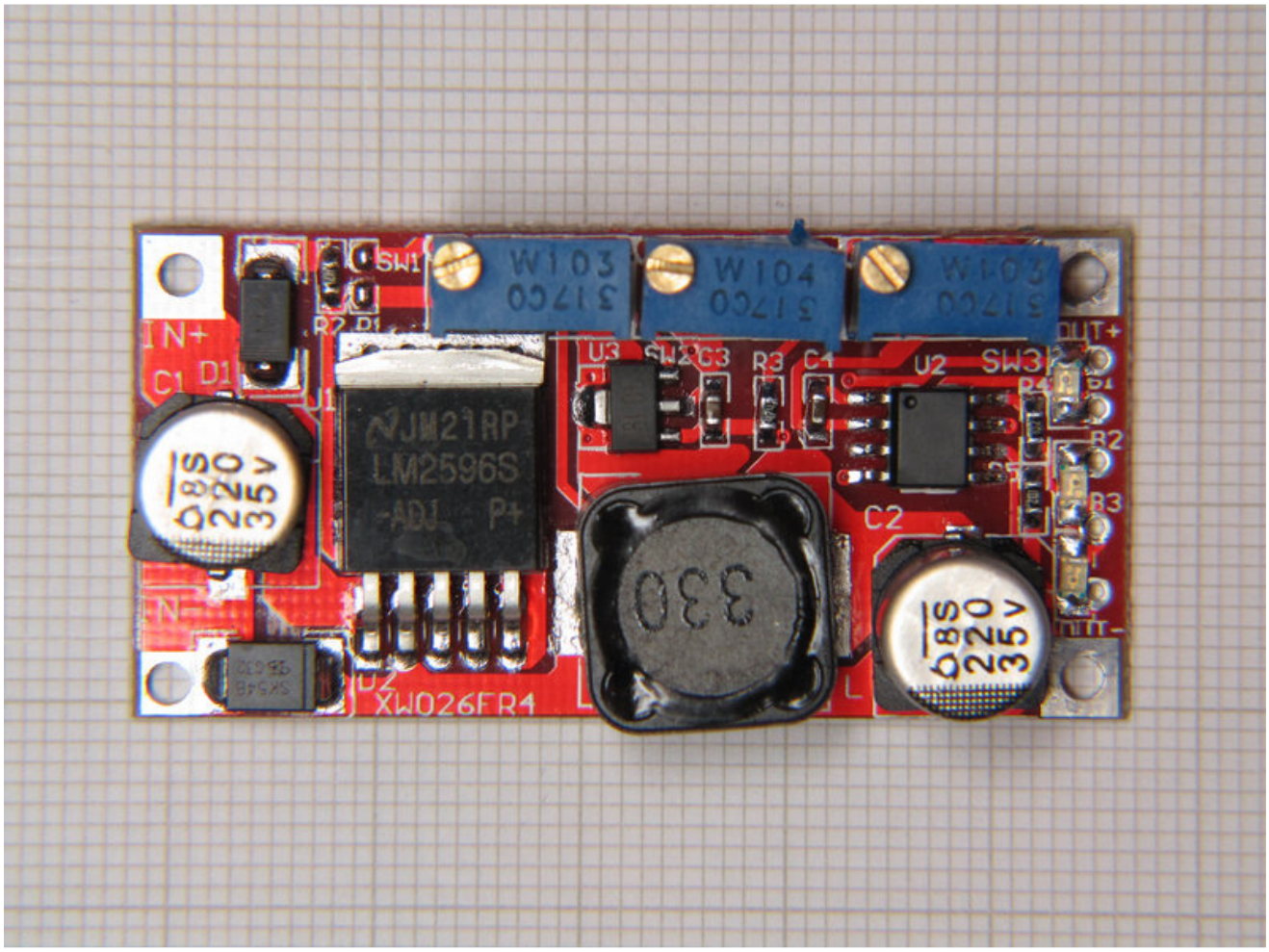
Power LED Driver

By Dushan Grujich, on February 14th. 2014

Most often microscope enthusiasts encounter a problem when converting their microscope illuminator from incandescent lamp to a power LED. Problem is usually in a choice of DC power source that is needed to supply LED as the incandescent lamp illuminators are powered by AC most often without provision of changing brightness intensity. LED-s are current devices, hence the need of limiting the current to control brightness. Currently there is a number of small low cost high efficiency DC-DC converters which were originally designed for use as chargers for various types of rechargeable battery cell packs such as NiCd, NiMH and Li Polymer. Some of these modules are capable of working as variable constant current chargers and can be used as LED drivers.



Module capable of sourcing constant current

According to manufacturer this module is capable of delivering 15 W of power at a maximal current of 3 Amps, capable of sourcing constant current. Practically ideal for use to drive LED-s of 3 - 10 Watt power.

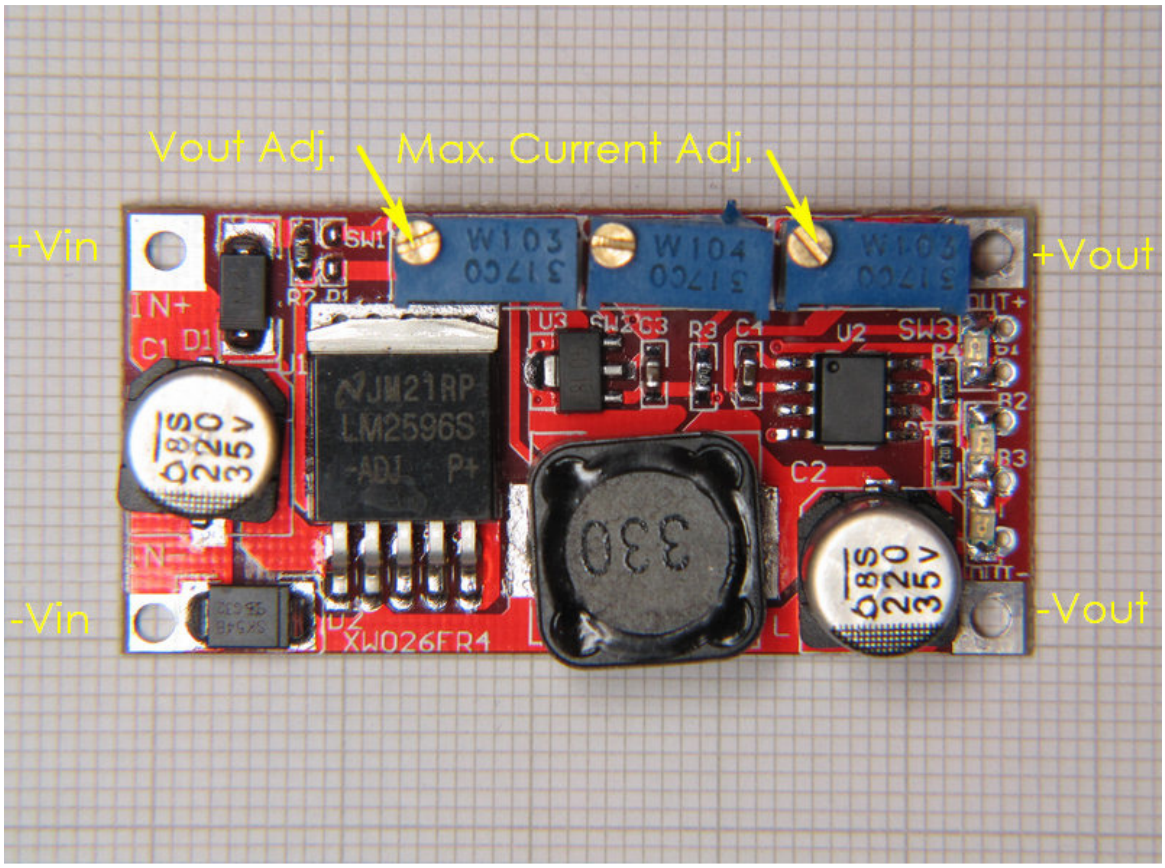
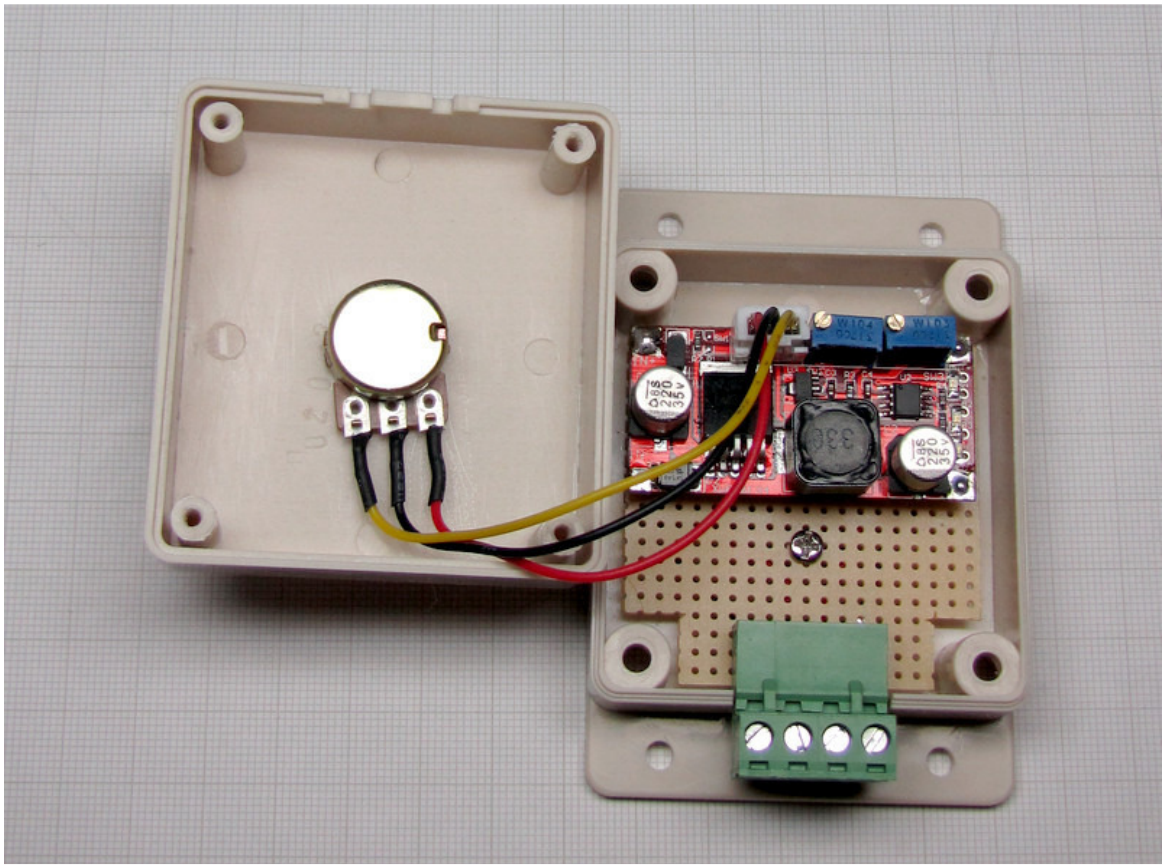


Image above shows connection terminals and locations of the trim-pot adjustments



I have mounted module on a piece of prototyping PCB, and mounted it into the Dimmer box. Module was modified only by removal of the 10 k Ohm Voltage adjustment trim-pot and replaced with 1 k Ohm potentiometer that was part of the original dimmer circuit. The new 1 k Ohm value provides intensity control from zero to full brightness, allowing output voltage change from 1.25 V to approximately 4 V.

The maximal output current is limited by adjusting trim pot SW3 to whatever the maximum rating of the LED is. Thus the circuit operates in variable voltage mode 1.25-4.0 V until the current reaches allowed maximum, it then changes the operating mode to constant current. For other values of Voltage out, one should choose value of the potentiometer other 1 kOhm. The choice can be determined experimentally, by using the 10 kOhm trim-pot (it is connected as a variable resistor, not as potentiometer, see circuit diagram) to set voltage output to a needed level, then disconnect power and measure resistance of the trim-pot. Measured resistance value should now be resistance of the potentiometer, of course, pots are manufactured with resistance preferred values, and so one should choose the first lower preferred value and add fixed resistor in series to reach measured resistance.

Driving LED with variable constant current source, if not limited by some means, requires current monitoring while setting. Perhaps a panel meter, otherwise one can allow too much current to flow and burn out the LED. Thus, in order to have some sort of protection, I decided to vary the voltage and instead of monitoring current I have used the current setting trim pot to limit the output current to a maximum allowable so that current cannot be increased above the limit by varying voltage, no need for current panel meter.

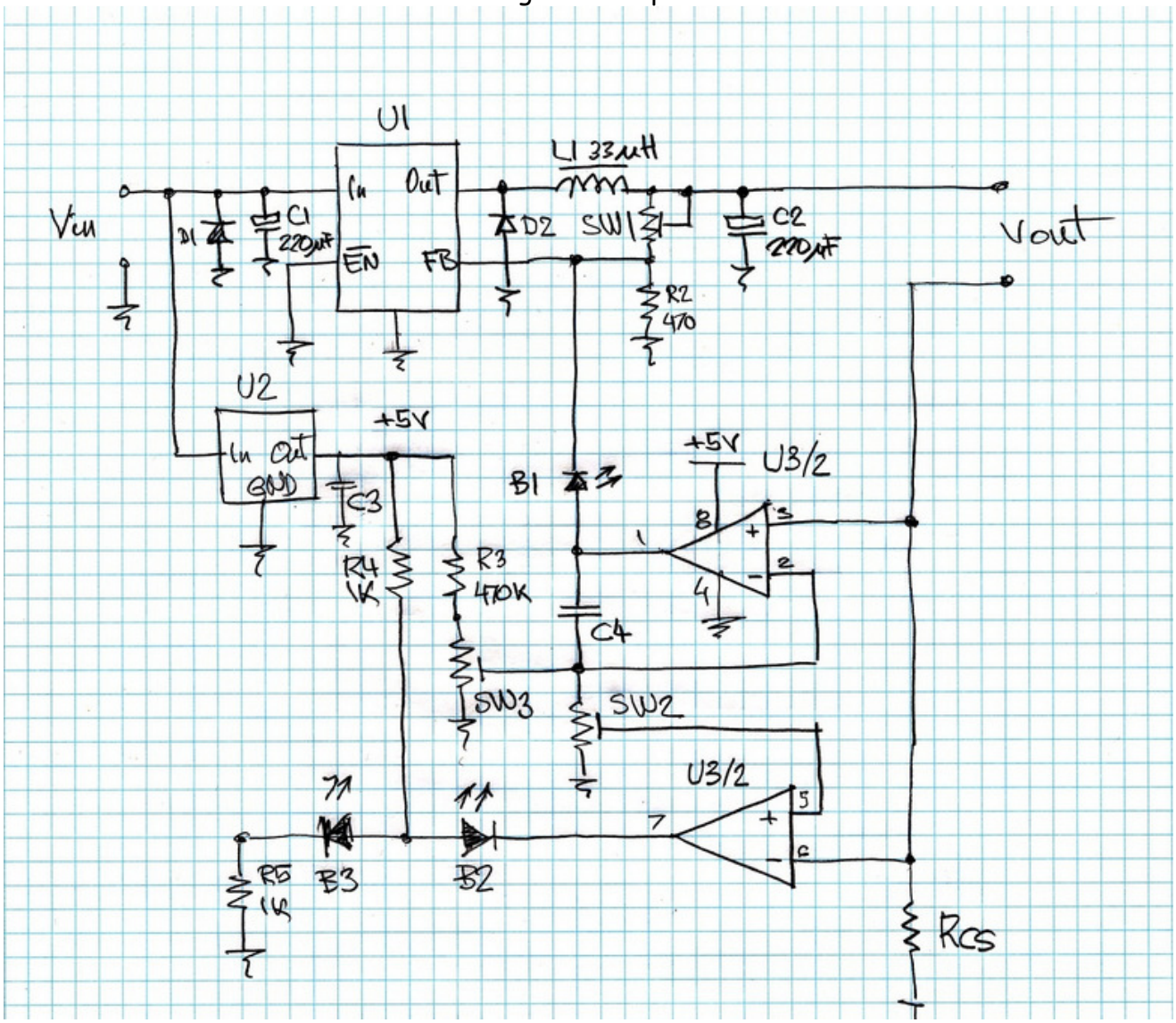
One should keep in mind that under certain circumstances it may be necessary to be able to set the LED brightness at some exact value, as was perhaps done at some instance in the past, so this is when a panel meter indicating current level flowing through the LED is needed.

There is large number of possible choices for choosing source of DC power, one can use the low cost Wall Wart power adaptor rated at least 20 Watt with any voltage output between 7 and 35 Volts, or even one of the switch mode lab power supplies that have appeared on the market in the recent years with cost lower than the cost of parts needed for making one. Total cost of this power LED driver should not exceed $10, plus cost of suitable wall wart, they start on eBay as low as $5, so total cost should not go above $20. Most components bought on eBay are usually shipped free.

Parts required:

LM2596S module	1 pc.	DC-DC converter	$4.- (on eBay)
LED Dimmer	1 pc.		$3.95 (on eBay)
Proto-board	1 pc.	2" square	$1.- at electronics hobby stores, Radio Shack, Bürklin, Maplin etc
Wall Wart	1 pc.	110/240VAC, 7-30V DC out, rated 20W or more	$8.- (on eBay for 12VDC @ 2Amps, 24 W)

For those who might use this module in perhaps some other arrangement below is shown circuit diagram with parts list.



Circuit diagram of DC-DC step down module

Parts of the module:

U1	LM2596S -ADJ	Simple switcher IC
U2	LM78L05	Voltage regulator IC
U3	LM358	Dual op-amp IC
D1	1N4004	Rectifier diode
D2	SK54B	Schottky rectifier diode
R_{CS}	~ 10 mOhm	Current sense resistor PCB track
SW1	10 kOhm	Voltage adjustment
SW2	100 kOhm	not used - do not remove
SW3	10 kOhm	Current adjustment

References:

1. LM2577S-ADJ Datasheet - National Semiconductor, June 1999