Circuits for using High Power LED's

by **dan** on January 8, 2007

Table of Contents

intro: Circuits for using High Power LED's

High-power LED's: the future of lighting!

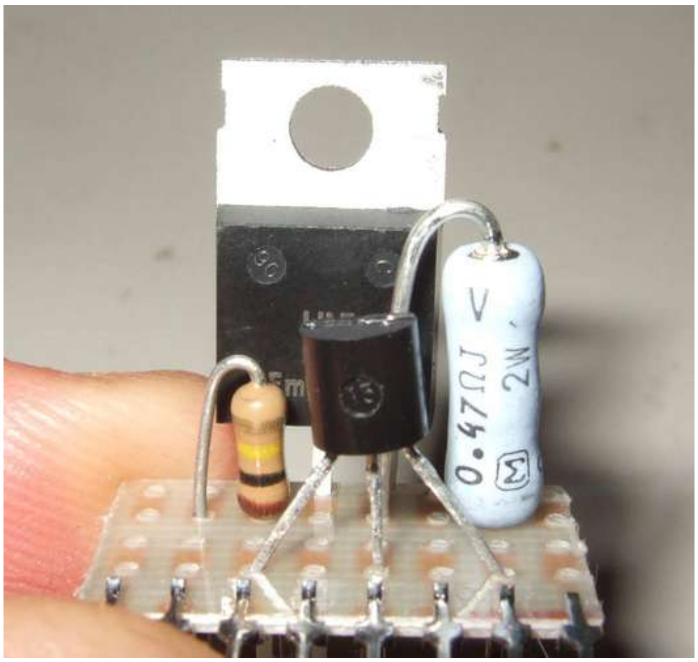
but... how do you use them? where do you get them?

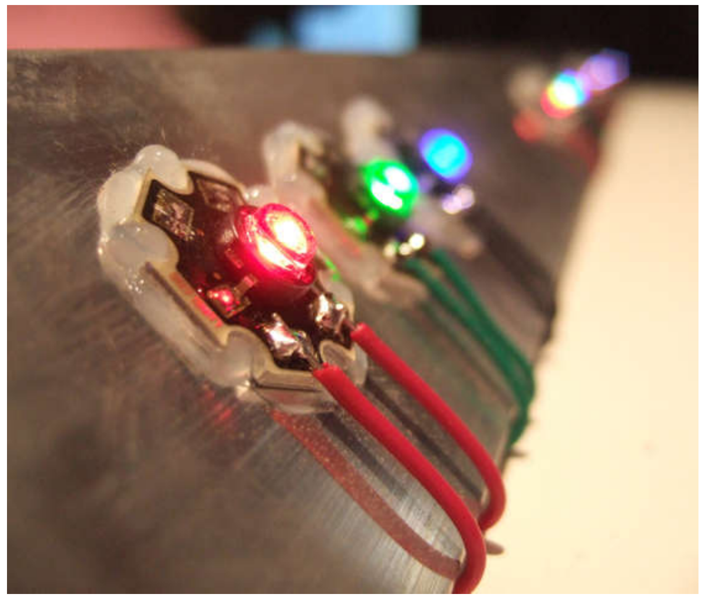
1-watt and 3-watt Power LED's are now widely available in the $3 to $5 range, so i've been working on a bunch of projects lately that use them. in the process it was bugging me that the only options anyone talks about for driving the LED's are: (1) a resistor, or (2) a really expensive electronic gizmo. now that the LED's cost $3, it feels wrong to be paying $20 for the device to drive them!

So I went back to my "Analog Circuits 101" book, and figured out a couple of simple circuits for driving power LED's that only cost $1 or $2.

This instructable will give you a blow-by-blow of all the different types of circuits for powering Big LED's, everything from resistors to switching supplies, with some tips on all of them, and of course will give much detail on my new simple Power LED driver circuits and when/how to use them (and i've got 3 other instructables so far that use these circuits). Some of this information ends up being pretty useful for small LED's too

here's my other power-LED instructables, check those out for other notes & ideas





step 1: Overview / Parts

There are several common methods out there for powering LED's. Why all the fuss? It boils down to this:
1) LED's are very sensitive to the voltage used to power them (ie, the current changes a lot with a small change in voltage)
2) The required voltage changes a bit when the LED is put in hot or cold air, and also depending on the color of the LED, and manufacturing details.

so there's several common ways that LED's are usually powered, and i'll go over each one in the following steps.

Parts

This project shows several circuits for driving power LED's. for each of the circuits i've noted at the relevant step the parts that are needed including part numbers that you can find at www.digikey.com . in order to avoid much duplicated content this project only discusses specific circuits and their pros and cons. to learn more about assembly techniques and to find out LED part numbers and where you can get them (and other topics), please refer to one of my other power LED projects.

step 2: Power LED performance data - handy reference chart

Below are some basic parameters of the Luxeon LED's which you will use for many circuits. I use the figures from this table in several projects, so here i'm just putting them all in one place that i can reference easily.

Luxeon 1 and 3 with no current (turn-off-point):
white/blue/green/cyan: 2.4V drop (= "LED forward voltage")
red/orange/amber: 1.8V drop

Luxeon-1 with 300mA current:
white/blue/green/cyan: 3.3V drop (= "LED forward voltage")
red/orange/amber: 2.7V drop

Luxeon-1 with 800mA current (over spec):
all colors: 3.8V drop

Luxeon-3 with 300mA current:
white/blue/green/cyan: 3.3V drop
red/orange/amber: 2.5V drop

Luxeon-3 with 800mA current:

white/blue/green/cyan: 3.8V drop
red/orange/amber: 3.0V drop (note: my tests disagree with spec sheet)

Luxeon-3 with 1200mA current:
red/orange/amber: 3.3V drop (note: my tests disagree with spec sheet)

Typical values for regular "small" LED's with 20mA are:
red/orange/yellow: 2.0 V drop
green/cyan/blue/purple/white: 3.5V drop

step 3: Direct Power!

Why not just connect your battery straight to the LED? It seems so simple! What's the problem? Can I ever do it?

The problem is reliability, consistency & robustness. As mentioned, the current through an LED is very sensitive to small changes in the voltage across the LED, and also to the ambient temperature of the LED, and also to the manufacturing variances of the LED. So when you just connect your LED to a battery you have little idea how much current is going through it. "but so what, it lit up, didn't it?". ok sure. depending on the battery, you might have way too much current (led gets very hot and burns out fast), or too little (led is dim). the other problem is that even if the led is just right when you first connect it, if you take it to a new environment which is hotter or colder, it will either get dim or too bright and burn out, because the led is very temperature sensitive. manufacturing variations can also cause variability.

So maybe you read all that, and you're thinking: "so what!". if so, plow ahead and connect right to the battery. for some applications it can be the way to go.

- Summary: only use this for hacks, don't expect it to be reliable or consistent, and expect to burn out some LED's along the way.

- One famous hack that puts this method to outstandingly good use is the LED Throwie.

Notes:

- if you are using a battery, this method will work best using *small* batteries, because a small battery acts like it has an internal resistor in it. this is one of the reasons the LED Throwie works so well.

- if you actually want to do this with a power-LED rather than a 3-cent LED, choose your battery voltage so that the LED will not be at full power. this is the other reason the LED Throwie works so well.

step 4: The humble resistor

This is by far the most widely used method to power LED's. Just connect a resistor in series with your LED(s).

pros:
- this is the simplest method that works reliably
- only has one part
- costs pennies (actually, less than a penny in quantity)

cons:
- not very efficient. you must tradeoff wasted power against consistent & reliable LED brightness. if you waste less power in the resistor, you get less consistent LED performance.
- must change resistor to change LED brightness
- if you change power supply or battery voltage significantly, you need to change the resistor again.

How to do it:

There are a lot of great web pages out there already explaining this method. Typically you want to figure out:
- what value of resistor to use
- how to connect your led's in series or parallel

There's two good "LED Calculators" I found that will let you just enter the specs on your LED's and power supply, and they will design the complete series/parallel circuit and resistors for you!

http://led.linear1.org/led.wiz
http://metku.net/index.html?sect=view&n=1&path=mods/ledcalc/index_eng

When using these web calculators, use the Power LED Data Handy Reference Chart for the current and voltage numbers the calculator asks you for.

---

if you are using the resistor method with power LED's, you'll quickly want to get a lot of cheap power resistors! here's some cheap ones from digikey: "Yageo SQP500JB" are a 5-watt resistor series.

step 5: $witching regulators

Switching regulators, aka "DC-to-DC", "buck" or "boost" converters, are the fancy way to power an LED. they do it all, but they are pricey. what is it they "do" exactly? the switching regulator can either step-down ("buck") or step-up ("boost") the power supply input voltage to the exact voltage needed to power the LED's. unlike a resistor it constantly monitors the LED current and adapts to keep it constant. It does all this with 80-95% power efficiency, no matter how much the step-down or step-up is.

Pros:
- consistent LED performance for a wide range of LED's and power supply
- high efficiency, usually 80-90% for boost converters and 90-95% for buck converters
- can power LED's from both lower or higher voltage supplies (step-up or step-down)
- some units can adjust LED brightness
- packaged units designed for power-LED's are available & easy to use

Cons:
- complex and expensive: typically about $20 for a packaged unit.
- making your own requires several parts and electrical engineering skillz.

One off-the-shelf device designed specially for power-led's is the Buckpuck from LED Dynamics. I used one of these in my power-led headlamp project and was quite happy with it. these devices are available from most of the LED web stores.

step 6: The new stuff!! Constant Current Source #1

lets get to the new stuff!

The first set of circuits are all small variations on a super-simple constant-current source.

Pros:
- consistent LED performance with any power supply and LED's
- costs about $1
- only 4 simple parts to connect
- efficiency can be over 90% (with proper LED and power supply selection)
- can handle LOTS of power, 20 Amps or more no problem.
- low "dropout" - the input voltage can be as little as 0.6 volts higher than the output voltage.
- super-wide operation range: between 3V and 60V input

Cons:
- must change a resistor to change LED brightness
- if poorly configured it may waste as much power as the resistor method
- you have to build it yourself (oh wait, that should be a 'pro').
- current limit changes a bit with ambient temperature (may also be a 'pro').

So to sum it up: this circuit works just as well as the step-down switching regulator, the only difference is that it doesn't guarantee 90% efficiency. on the plus side, it only costs $1.

Simplest version first:

"Low Cost Constant Current Source #1"

This circuit is featured in my simple power-led light project.

How does it work?

- Q2 (a power NFET) is used as a variable resistor. Q2 starts out turned on by R1.

- Q1 (a small NPN) is used as an over-current sensing switch, and R3 is the "sense resistor" or "set resistor" that triggers Q1 when too much current is flowing.

- The main current flow is through the LED's, through Q2, and through R3. When too much current flows through R3, Q1 will start to turn on, which starts turning off Q2. Turning off Q2 reduces the current through the LED's and R3. So we've created a "feedback loop", which continuously monitors the LED current and keeps it exactly at the set point at all times. transistors are clever, huh!

- R1 has high resistance, so that when Q1 starts turning on, it easily overpowers R1.

- The result is that Q2 acts like a resistor, and its resistance is always perfectly set to keep the LED current correct. Any excess power is burned in Q2. Thus for maximum efficiency, we want to configure our LED string so that it is close to the power supply voltage. It will work fine if we don't do this, we'll just waste power. this is really the only downside of this circuit compared to a step-down switching regulator!

---

setting the current!

the value of R3 determines the set current.

Calculations:
- LED current is approximately equal to: 0.5 / R3
- R3 power: the power dissipated by the resistor is approximately: 0.25 / R3. choose a resistor value at least 2x the power calculated so the resistor does not get burning hot.

so for 700mA LED current:
R3 = 0.5 / 0.7 = 0.71 ohms. closest standard resistor is 0.75 ohms.
R3 power = 0.25 / 0.71 = 0.35 watts. we'll need at least a 1/2 watt rated resistor.

Parts used:

R1: small (1/4 watt) approximately 100k-ohm resistor (such as: Yageo CFR-25JB series)
R3: large (1 watt+) current set resistor. (a good 2-watt choice is: Panasonic ERX-2SJR series)
Q2: large (TO-220 package) N-channel logic-level FET (such as: Fairchild FQP50N06L)
Q1: small (TO-92 package) NPN transistor (such as: Fairchild 2N5088BU)

Maximum limits:

the only real limit to the current source circuit is imposed by NFET Q2. Q2 limits the circuit in two ways:

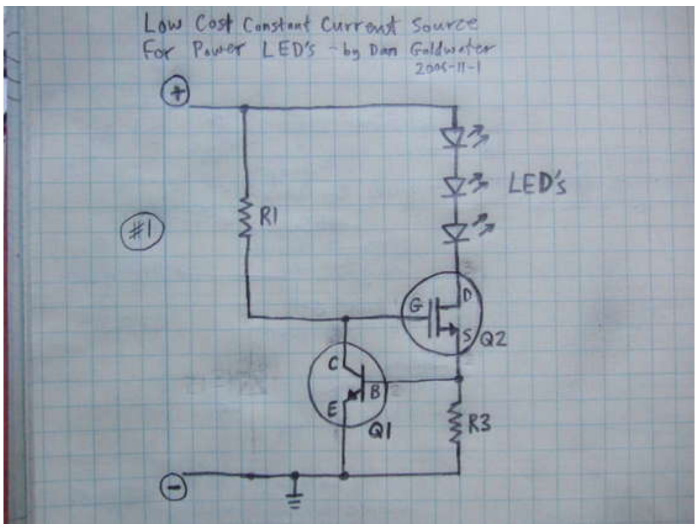
1) power dissipation. Q2 acts as a variable resistor, stepping down the voltage from the power supply to match the need of the LED's. so Q2 will need a heatsink if there is a high LED current or if the power source voltage is a lot higher than the LED string voltage. (Q2 power = dropped volts * LED current). Q2 can only handle 2/3 watt before you need some kind of heatsink. with a large heatsink, this circuit can handle a LOT of power & current - probably 50 watts and 20 amps with this exact transistor, but you can just put multiple transistors in parallel for more power.

2) voltage. the "G" pin on Q2 is only rated for 20V, and with this simplest circuit that will limit the input voltage to 20V (lets say 18V to be safe). if you use a different NFET, make sure to check the "Vgs" rating.

---

thermal sensitivity:

the current set-point is somewhat sensitive to temperature. this is because Q1 is the trigger, and Q1 is thermally sensitive. the part nuber i specified above is one of the least thermally sensitive NPN's i could find. even so, expect perhaps a 30% reduction in current set point as you go from -20C to +100C. that may be a desired effect, it could save your Q2 or LED's from overheating.



step 7: Constant current source tweaks: #2 and #3

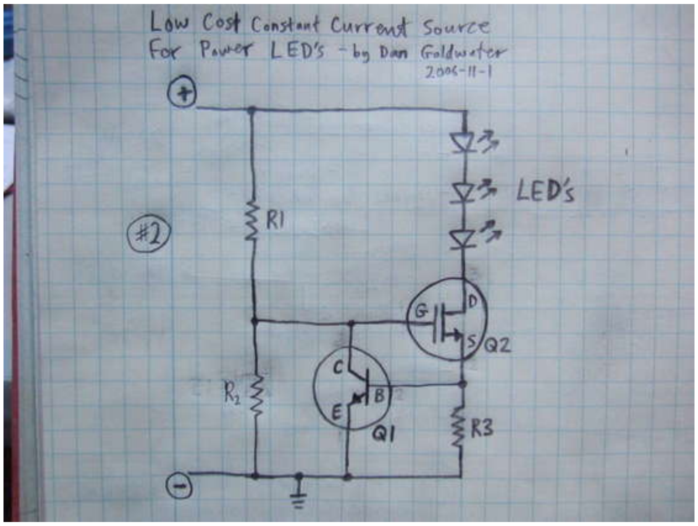
these slight modifications on circuit #1 address the voltage limitation of the first circuit. we need to keep the NFET Gate (G pin) below 20V if we want to use a power source greater than 20V. it turns out we also want to do this so we can interface this circuit with a microcontroller or computer.

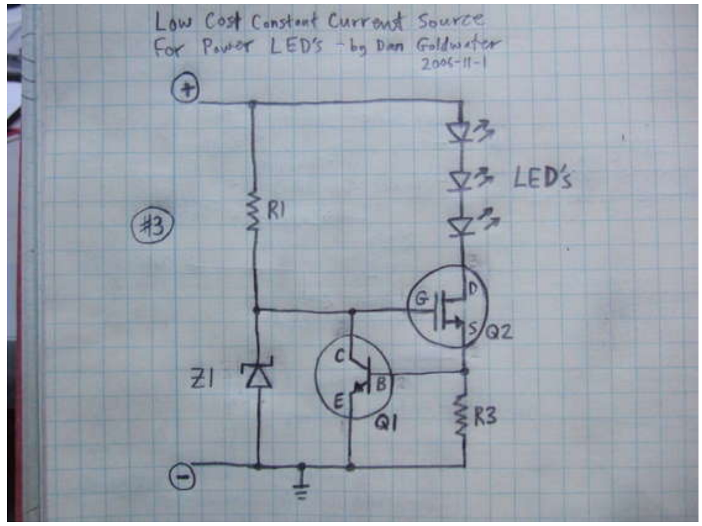
in circuit #2, i added R2, while in #3 i replaced R2 with Z1, a zener diode.

circuit #3 is the best one, but i included #2 since it's a quick hack if you don't have the right value of zener diode.

we want to set the G-pin voltage to about 5 volts - use a 4.7 or 5.1 volt zener diode (such as: 1N4732A or 1N4733A) - any lower and Q2 won't be able to turn all the way on, any higher and it won't work with most microcontrollers. if your input voltage is below 10V, switch R1 for a 22k-ohm resistor, the zener diode doesn't work unless there is 10uA going through it.

after this modification, the circuit will handle 60V with the parts listed, and you can find a higher-voltage Q2 easily if needed.





step 8: a little micro makes all the difference

Now what? connect to a micro-controller, PWM or a computer!

now you've got a fully digital controlled high-power LED light.

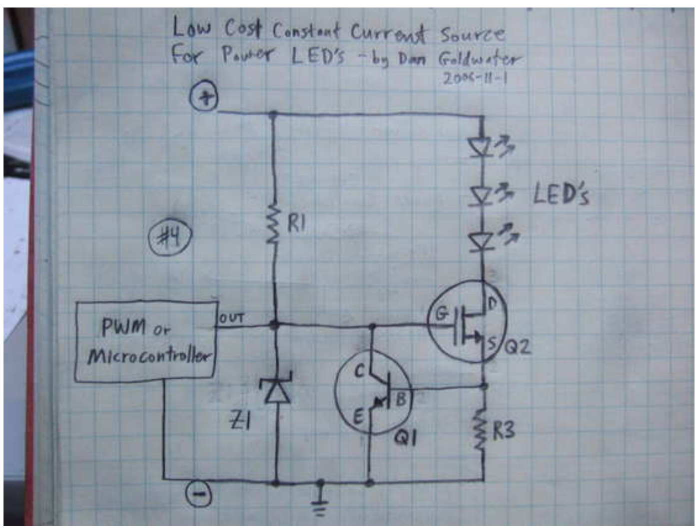
the micro-controller's output pins are only rated for 5.5V usually, that's why the zener diode is important.

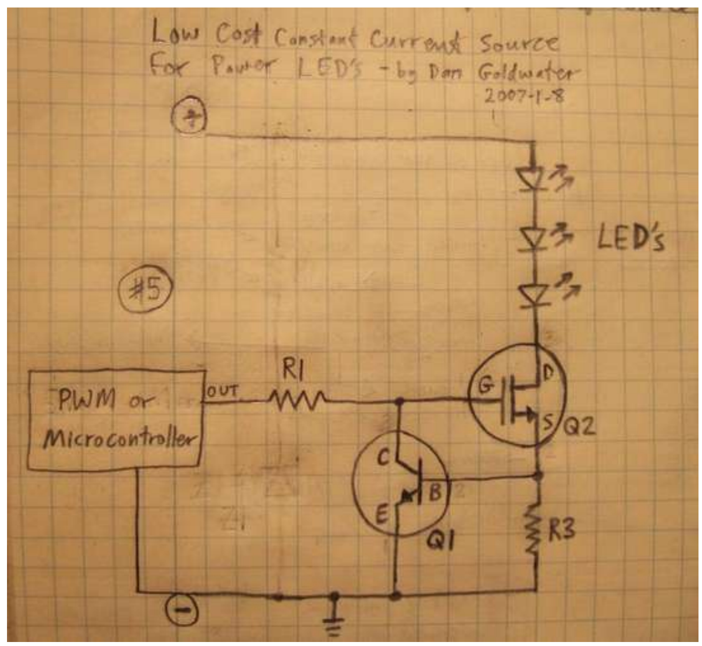
if your micro-controller is 3.3V or less, you need to use circuit #4, and set your micro-controller's output pin to be "open collector" - which allows the micro to pull down the pin, but lets the R1 resistor pull it up to 5V which is needed to fully turn on Q2.

if your micro is 5V, then you can use the simpler circuit #5, doing away with Z1, and set the micro's output pin to be normal pull-up/pull-down mode - the 5V micro can turn on Q2 just fine by itself.

now that you've got a PWM or micro connected, how do you make a digital light control? to change the brightness of your light, you "PWM" it: you blink it on and off rapidly (200 Hz is a good speed), and change the ratio of on-time to off-time.

this can be done with just a few lines of code in a micro-controller. to do it using just a '555' chip, try this circuit. to use that circuit get rid of M1, D3 and R2, and their Q1 is our Q2.





step 9: another dimming method

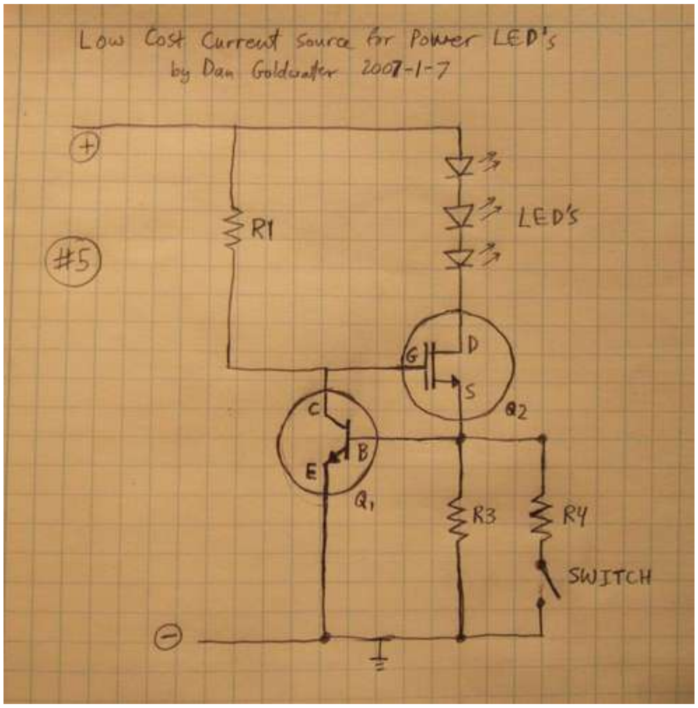
ok, so maybe you don't want to use a microcontroller? here's another simple modification on "circuit #1"

the simplest way to dim the LED's is to change the current set-point. so we'll change R3!

shown below, i added R4 an a switch in parallel with R3. so with the switch open, the current is set by R3, with the switch closed, the current is set by the new value of R3 in parallel with R4 - more current. so now we've got "high power" and "low power" - perfect for a flashlight.

perhaps you'd like to put a variable-resistor dial for R3? unfortunately, they don't make them in such a low resistance value, so we need something a bit more complicated to do that.

(see circuit #1 for how to choose the component values)



step 10: the analog adjustable driver

This circuit lets you have an adjustable-brightness, but without using a microcontroller. It's fully analog! it costs a little more - about $2 or $2.50 total - i hope you won't mind.

The main difference is that the NFET is replaced with a voltage regulator. the voltage regulator steps-down the input voltage much like the NFET did, but it is designed so that its output voltage is set by the ratio between two resistors (R2+R4, and R1).

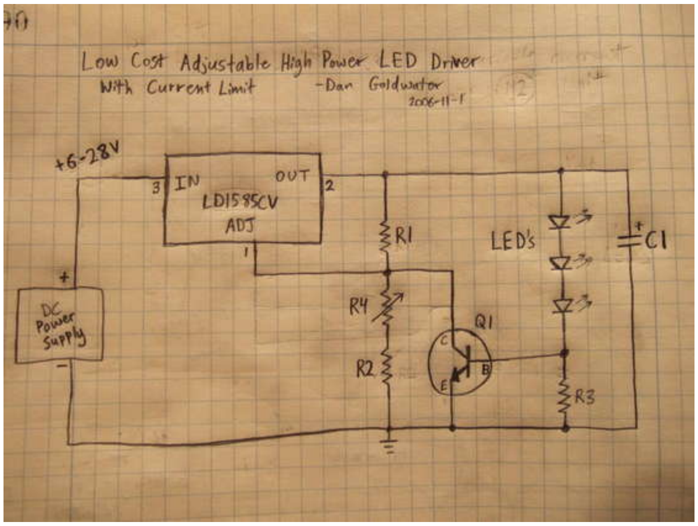
The current-limit circuit works the same way as before, in this case it reduces the resistance across R2, lowering the output of the voltage regulator.

This circuit lets you set the voltage on the LED's to any value using a dial or slider, but it also limits the LED current as before so you can't turn the dial past the safe point.

I used this circuit in my RGB Color Controlled Room/Spot lighting project.

please see the above project for part numbers and resistor value selection.

this circuit can operate with an input voltage from 5V to 28V, and up to 5 amps current (with a heatsink on the regulator)



step 11: an *even simpler* current source

ok, so it turns out there's an even simpler way to make a constant-current source. the reason i didn't put it first is that it has at least one significant drawback too.

This one doesn't use an NFET or NPN transistor, it just has a single Voltage Regulator.

Compared to the previous "simple current source" using two transistors, this circuit has:

- even fewer parts.
- much higher "dropout" of 2.4V, which will significantly reduce efficiency when powering only 1 LED. if you're powering a string of 5 LED's, perhaps not such a big deal.
- no change in current set-point when temperature changes
- less current capacity (5 amps - still enough for a lot of LED's)

---

how to use it:

resistor R3 sets the current. the formula is: LED current in amps = 1.25 / R3

so for a current of 550mA, set R3 to 2.2 ohms
you'll need a power resistor usually, R3 power in watts = 1.56 / R3

this circuit also has the drawback that the only way to use it with a micro-controller or PWM is to turn the entire thing on and off with a power FET.

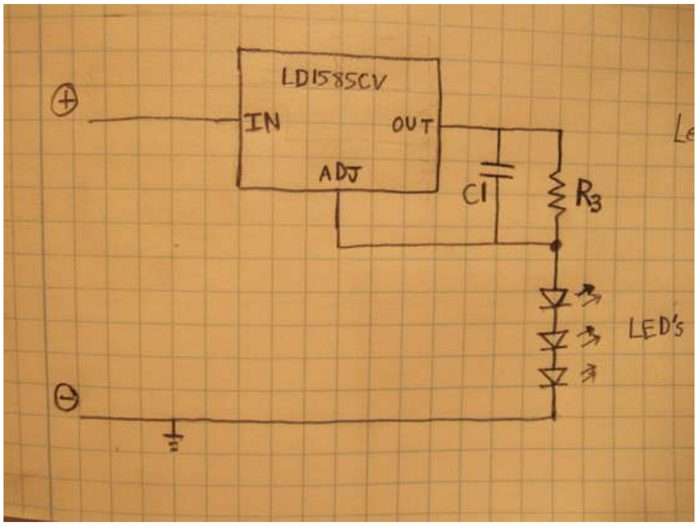
and the only way to change the LED brightness is to change R3, so refer to the earlier schematic for "circuit #5" which shows adding a low/high power switch in.

regulator pinout:
ADJ = pin 1
OUT = pin 2
IN = pin 3

---

parts:
regulator: either LD1585CV or LM1084IT-ADJ
capacitor: 10u to 100u capacitor, 6.3 volt or greater (such as: Panasonic ECA-1VHG470)
resistor: a 2-watt resistor minimum (such as: Panasonic ERX-2J series)

you can build this with pretty much any linear voltage regulator, the two listed have a good general performance and price. the classic "LM317" is cheap, but the dropout is even higher - 3.5 volts total in this mode. there are now a lot of surface mount regulators with ultra-low dropouts for low current use, if you need to power 1 LED from a battery these can be worth looking into.



Related Instructables

Comments

50 comments Add Comment view all 207 comments

gigi_boeru says: Apr 6, 2009. 3:21 AM REPLY

how can I use the 555 circuit? i don't understand from that link... can you post the complete circuit (555 & this led driver)?
thank you

geeklord says: Mar 31, 2009. 6:47 PM REPLY

Okay, so I'm tryin to figure out *how* this works, because I always do that. I can't decide if that's a curse or a blessing :D. So Q1's base is "monitoring" the current going through the LED's, the FET, and R3. If the current through that part of the circuit is too high, it pulls that gate of the FET low, lowering the current through the LED's. Right?

ddickenson says: Mar 10, 2009. 1:29 PM REPLY

Does anyone smarter than me know how to adjust the calculations to use 350mA LED's? I am using "Luxeon I Star (hex) High Power LED Red Lambertian 350 mA" I forget the part number but I need to calculate this for either 4 or 8 of these led's in series.

gnodev says: Feb 1, 2009. 12:26 PM REPLY

Do you know about the ZXLD1350?
This simple integrated circuit costs about $1.50 (small quantity) and has a complete LED driver in it for 350mA LEDs. It uses switching technology, so it is efficient. It can be regulated with a variable resistor, or with PWM. And you only need about 4 other components (0.3 Ohm resistor, protection zener, small coil 50 to 200 microH, capacitor) to use it.

uberdum05 says: Feb 16, 2009. 2:50 AM REPLY

Yes but where are you going to find a 0.3 ohm resistor because that might be costly

gnodev says: Feb 16, 2009. 6:31 AM REPLY

A wirewound 1W resistor is $0.25 and the thick film equivalent is $0.55 (at a well known internet electronics giant you can easily find on the web).
The biggest problem would be soldering those very small components. It takes some skill and a lot of patience.

gnodev says: Feb 16, 2009. 6:34 AM REPLY

Now that I think of it, you can also use 3 1 Ohm resistors in parallel, which might be something you have lying around some where already. The little chip resistors are easily stacked to make a 3 resistors in parallel combination.

ac-dc says: Jan 11, 2008. 8:39 AM REPLY

Efficiency of this circuit is usually as bad as with a resistor. The one large benefit is the variability to different supply voltage like when batteries are used.

It does not work as well as a switching current regulator, it does waste as much power as a resistor in typical uses since even one "poorly configured" is an equivalent state to just picking a different resistor.

So it is indeed better than a resistor to control current as supply voltage drops but I feel we can ignore this method altogether as there's little point. Switching controllers are not expensive anymore, and smaller, and require fewer supportive parts. Switching controllers are better and cheaper, and faster to implement.

Even so, it is good to be thorough showing this method, it just isn't ever the better option _today_ to power LEDs. See my prior comment for sources of the current regulating controllers for about $2 each and no time prototyping to use them.

smartroad says: Jan 31, 2009. 8:26 AM REPLY

Valid points, although I feel you are being a bit harsh saying this can be "ignored". I am designing a circuit which doesn't need to worry too much about efficiency as it is still more efficient then the normal bulb it replaces. It has to fit into a very tight space on the circuit board and this circuit does it nicely. Most switching circuits I have seen need far more then 4 components, and also need coils and capacitors which again take up more space.

So yes, if efficiency is the aim of the game and you have the space for the circuitry then don't use this circuit, find a good switcher. If you have something in a tight space with limited board area and you don't need anything more efficient then a resistor, but have an environment where the voltage can change, then this could be the kiddy. Its cheap and effective.

ac-dc says: Jan 31, 2009. 12:00 PM REPLY

If the space on a circuit board is tight, it's unlikely you will have enough space to heatsink the transistors. An entire switching regulation circuit can fit within 1 sq. in, less area than is needed to heatsink the LEDs so that swamps the area difference from the regulation circuits.

While you are right that it becomes more useful when the input voltage changes, generally this is a backwards approach to engineering. Instead of taking a limited purpose design and envisioning where it might be used, generally one looks at the functional requirements and THEN designs a circuit to meet those. Plus, you still had to have an input voltage higher than the sum forward drop of all LEDs in a series so once again a switching regulator makes more sense. The voltage needed to be close to the forward drop of these LEDs so there wasn't excessive heat buildup, and yet in this case the scenario of having fluctuating voltage is necessarily going to be minimized.

With switching controllers costing $5 or less, or to run several high powered LEDs you have a bit higher cost for the controller but still a small cost relative to the cost of all those LEDs, heatsink, enclosure, etc. There's very little reason to use such a lossy design unless you were in a hurry and happened to have the parts in your spare parts bin. Otherwise postage will cost more than the parts.

smartroad says: Feb 1, 2009. 5:51 AM REPLY

I for one never said I was use a power LED, in fact I am using 5mm leds and not that many of them. I have changed the FET to better meet the power and thermal requirements to not need a heatsink. Yes switching CONTROLLERS are getting cheaper, however they still need a number of support components that can push this price up fast.

I didn't take this design and "envision where it might be needed", I had already decided what functionality I needed then started the hunt for a simple design that would achieve this. This one happened to fit all the needs I had plus I am able to get all the parts from my local electronics supplier on my way home from work.

I appreciate that you have a passion for SMPS and high efficiency systems, however although this is a less efficient design it is simple and effective, it does what it says it does without fuss or a high component count.

ac-dc says: Feb 1, 2009. 8:27 AM REPLY

In that case, yes it's a good way to cut cost with low powered LEDs, as you can't even get a typical controller with low enough current to run low powered LEDs unless they're in a parallel topology with a resistive current limiter (or separate IC for this).

I was not necessarily claiming the circuit would not work acceptably with any specific purpose, rather than it is not assumed universally useful without considering the project requirements first. The component count need not be very high on a switcher though, and when I spoke of switching controllers I was speaking of the entire circuit like used in flashlight drivers, not just the IC which needs support parts, BUT these were mentioned in the context of using higher powered LEDs instead of the 100mW 2.5-10mm encapsulated type.

ewitte says: Sep 3, 2008. 1:33 PM REPLY

Please show me a *cheap* switching controller that will drive 56 3w ;) Multiples is ok but when it costs $20 to drive only a small handfull the cost adds up.

ac-dc says: Sep 3, 2008. 4:43 PM REPLY

Some of the kaidomain and dealextreme drivers have selectable steps to change brightness. Others do not.

ac-dc says: Sep 3, 2008. 4:31 PM **REPLY**

Why would a 168W specialty controller be cheap? It won't be. Your best bet is to get a bag of low ohm resistors from some electronics surplus 'site (to lower cost) and then use a typical ATX PC PSU. Because these PSU are so common the commodity pricing makes them most affordable but since they are voltage regulating you'll need the series resistors to limit current.

Any online LED resistor calculator will show the right value to use, then if you select a PSU with a potentiometer adjustment inside you can fine tune the resultant current.

Anyway, that's about as cheap as it gets, you could pick up a PSU with suitable current on it's 5V rail for about $20 and the bag of resistors is $2 or so if you find the right 'site with a deal on the values you need.

---

ewitte says: Sep 3, 2008. 5:28 PM **REPLY**

My plan is to run this circuit at 20v or so with 5 on the blue and 6 on reds. There shouldn't be that much loss. I can actually get a 210w 24v power controller for about the same as a 450W computer PSU. Or I might just use several old laptop ac adapters.

---

ac-dc says: Jan 31, 2009. 12:14 PM **REPLY**

Then consider these values:

6 x blue LED (@ 3.6V fwd drop) = 21.6V
(24V - 21.6V) * 1A = 2.4W

2.4W dissipation is going to require a larger chassis vent system and significant (for what it is) heatsink, both of which add to project cost and overall size. Granted, the transistor could be heatsunk to the same 'sink used by the LEDs, but either way this does still increase that heatsink size, overall size, and project cost by more than a typical switching regulator.

A 210W PSU seems overkill when your load is under 50W, but I could see the practical side of using what you have or are familiar with - in that situation the feedback circuit of the supply could be tweaked to drop the voltage down closer to that of the sum forward drop of the LEDs in series, OR use of a voltage divider in the feedback loop could cause the target current to result in the voltage drop the PSU's comparator circuit uses to regulate (similar to how it's already done in a typical LED switching regulator) and arrive at the target current with very little addt'l power loss and heat.

---

larams says: Apr 9, 2008. 2:43 AM **REPLY**

Except those current regulating drivers your talking about from places like kaidomain can't be PWM to control brightness like you can with dans circuit can they?

---

ac-dc says: Sep 3, 2008. 4:31 PM **REPLY**

Some of the kaidomain and dealextreme drivers have selectable steps to change brightness. Others do not.

---

smartroad says: Jan 31, 2009. 1:49 AM **REPLY**

In the calculations where does the 0.5 and 0.25 come from, or are they just contants?

---

smartroad says: Jan 31, 2009. 6:54 AM **REPLY**

Actually scrub that, the 0.5 is the voltage drop across the FET I belive from reading your LED Instructable. I wanted to know as I have just tried building this for a different project at much lower power levels and changed the FET. Somehow I really messed up the calculations for the resistors LOL back on course now. I have used a BS170 N-FET which isn't logic level but works just as well from a 12v source :)

---

nevery says: Jan 15, 2009. 9:42 AM **REPLY**

Why was my comment removed??

I'm looking for a circut that will drive a high powered Luxeon off a variable power supply. from 3v or so to 19v, up to 2amps. can someone help me figure this out?

Thanks

---

kdris says: Jan 13, 2009. 5:41 PM **REPLY**

would circuit #5 work for an led array with a source voltage of 36V or would the zener diode still have to be used since it is over 20v.

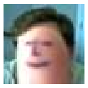
Thanks in advance!

---

nevery says: Jan 13, 2009. 4:44 AM

(removed by author or community request)

nevery says: Jan 13, 2009. 4:45 AM REPLY
DC circuit, btw.

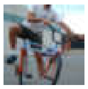


Quazar says: Dec 31, 2008. 10:39 AM REPLY
Dan,

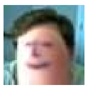
Great project! I'm looking for a design for a universal input module that can take anywhere from 3VAC/DC up to about 24VAC/DC. I thought I could use this circuit to drive an opto-isolator and add a full-wave-bridge on the input side.

Does this seem like a reasonable approach, or is this circuit overkill for my application?

Thanks in advance,
- Dean

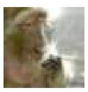


dan says: Dec 31, 2008. 12:04 PM REPLY
i dont think this is what you want. maybe you just want a 2-FET input buffer, it depends on what this optoisolator wants.

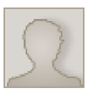


Quazar says: Jan 5, 2009. 10:50 AM REPLY
Dan, thanks for the speedy reply! I haven't picked a particular optoisolator yet; I figured I needed to get an idea of the driving circuit before I settled on one.

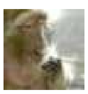
Originally, I was thinking that a 5W zener with a suitable series resistor could get me in the ballpark to drive the opto, but I don't have much experience with constant current sources, particularly when used with wide voltage ranges.



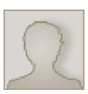
geeklord says: Dec 3, 2008. 6:08 AM REPLY
couldn't you use a pair of AA's in series and then connect them in parallel with another set of 2 AA's?? How man mA does 1 AA typicaly put out??



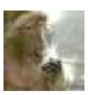
bumsugger says: Dec 25, 2008. 10:34 AM REPLY
Just seen your post,and without looking further,I know of some (rechargeable) AA cells rated @2500Ma,in fact they're all I'll use in my High power LED headlamp (by DAN last year).



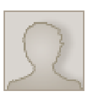
geeklord says: Dec 25, 2008. 5:00 PM REPLY
You sure thats not milliamp hours?



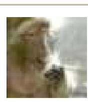
bumsugger says: Dec 26, 2008. 1:33 AM REPLY
Well yeah,but 2500Ma is 2.4 amps??



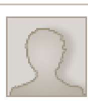
geeklord says: Dec 26, 2008. 8:24 AM REPLY
2.5amps, which is surprising to me...... What device runs on 1.5v and 2 amps?



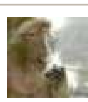
bumsugger says: Dec 26, 2008. 11:54 AM REPLY
Does'nt matter "what device runs on 1.5v and 2amps," that is simply what the cell is capable of supplying,so if your device uses L-E-S-S,then your power supply will last longer,.............................according to Ohms law at least.



geeklord says: Dec 26, 2008. 2:37 PM REPLY
I know that... Just thinking out loud.



bumsugger says: Dec 26, 2008. 3:16 PM REPLY
oooooooooh,not the thing to do on a site like this ,methinks??



geeklord says: Dec 27, 2008. 3:08 PM REPLY
sure....

aburton says: Dec 7, 2008. 9:21 PM **REPLY**
I'm looking to power 5 arrays of 41 parallel LEDS. I'm a mechanical engineer by education, so I'm not entirely familiar with the world of microcontrollers. If I wanted to be able to dim them, how would you recommend I go about doing this?

---

lux_manish says: Nov 16, 2008. 12:25 AM **REPLY**
can you please tell me how I can drive aa 1watt LED with LM1117 or other low drop out voltage IC as my input voltage is 5-6.8volt

---

brianpxbd says: Nov 12, 2008. 10:36 AM **REPLY**
If you are into model control, you probably use LIPO batteries, if you have such a battery with a duff cell, you can use one of the other cells as a battery for a 3W lED. The voltage of approx 3.9 volts is about perfect to drive a white 3W LED. No series resistor should be needed, if you have a worry about the battery being short circuited then place a fuse or fusible resistor in series.
Naturally one must be take special care with LIPO cells as they can burn or explode if abused by short circuit or overcharging. If you make a LED torch using such a LIPO cell then be sure it is safely protected when in use and only recharge with a correct LIPO type charger. Lipo cell are usually spoilt if the cell voltage drops below 2Volts, but this shouldn't be a problem with Your LED torch, as the power led will go out as soon as the voltage drops to about 2 volts. Take great care when stripping the old battery assembly that you do not accidentally short any of the cells, and do it outside away from any objects that could burn. I have been using such a torch now for about 8 months and find it super light and efficient, only requiring charging after many hours of use. Once again *Take care with LIPO cells*"

---

samphantom says: Oct 1, 2008. 9:11 AM **REPLY**
Hello Dan

I was looking in the FEt transistor, is this a N-channel or P-channel, I'm implementing this same circuit connected to AC power line ovbiously increasing the capacity of this driver, using FQPF10N50CF as Fet and C3743 as the transistor, but still I'm confusing with the FET 'cuz in your drawing appears as P-channel and the number in your post is N-channel.

Thank you for your time

---

dan says: Oct 1, 2008. 1:14 PM **REPLY**
it is an NFET

South_B says: Aug 30, 2008. 5:46 PM **REPLY**
what is the maximum number of LEDs that these circuits will power. Would it power enough LEDs to work for grow lighting Say 20 3W LEDs? I am thinking about aquaponics and I was considering LEDs as an altenative to fluorescent lighting

PS. where did you learn your electronics

---

sjmusic2 says: Aug 5, 2008. 9:16 PM **REPLY**
Dan,
If I wanted to use an LED array of 6 strings containing 3 SSC p7's (3.6Vf; 2.8A each) how would your 555 timer circuit look ? Secondly, would it be better (more consistent lighting) to provide individual Q2's & R's for each string - how would this circuit look and would it change the value of R1 or R3 ?

PSU will be 12v, 20A (cctv psu)

TIA (from a noob)

---

batchku says: Aug 1, 2008. 10:45 PM **REPLY**
Hello,
I'm working with a mictrocontroller whose output PWMs go from 0 to ~ 3.2 V.
In the instructions, it is indicated:

"if your micro-controller is 3.3V or less, you need to use circuit #4, and set your micro-controller's output pin to be "open collector" - which allows the micro to pull down the pin, but lets the R1 resistor pull it up to 5V which is needed to fully turn on Q2."

what exactly does that mean?
does it mean change the value of R1 according to the voltage range of your microcontroller?
or do i simply need a different Q1 or Q2....?

thank you in advance.

batchku

---

msmall says: Mar 12, 2008. 6:30 PM **REPLY**
Dan,
I am quite new to the LED scene so please bear with me as I will probably ask some pretty moronic questions. But I have been thinking about using LED's for the lighting of chicken houses. Yes Chicken Houses...BIG ONES! 24,000 chicks per house! I have always noticed how the chickens will concentrate around a spot of sunlight that reaches the floor. The present method is the use of 60 watt incandescent bulbs (about 80 per house)mounted on the ceiling. I would like to try to illuminate their feed pans only with the use of LED's. I have 4 augers with 100 Feed Pans that I would require 4 LED's per pan or 400 LED's per run with a total of 1600 LED's per house. It would be helpful if the intensity could be reduced during their growth cycle. My questions are: Can a constant current power supply be made that can handle this number of lights? Can a multi-position selector switch with different resistors be used to allow for the control of intensity? Another concern is to create a system that is energy efficient. Do you have any suggestions? And remember...Eat more chicken. LOL

computerwiz_222 says: Mar 18, 2008. 12:43 PM **REPLY**

wow! That is one big setup.

I would assume that you are going to build the 4 LED cluster packs your self?

If you are doing something like this, I can recommend doing it very cheaply or very complicated.

Cheap - Simply wire enough LEDs in series to run directly from 120VAC and wire them through a dimmer. At 20 ma / LED, you would be looking at 32000 mA. This works out to 32 amps. This is quite a draw. (nothing compared to the incandescents. At 60 watts, the bulbs are drawing 500 ma each!) They would be wired similar to christmas lights. One thing I must note is that the LEDs will only run at half duty because they only function in one direction. So there would be a slight flicker in your light, at 60 Hz. I would recommend staying away from this method because eventually, you would be running a high amount of current through the first LED. This method is very dangerous.

Expensive - the recommended method above with a hefty DC power supply. Something like a computer power supply (maybe multiple).

These are just suggestions, don't take them seriously, they are just thoughts on your idea. If you hurt yourself, I am not responsible.

baubstae says: Jul 25, 2008. 7:25 AM **REPLY**

If, as you suggest, you wire enough LEDs in series to run directly from 120V, then the current through the whole string will only be 20mA, not 32A as you suggest. If they were in parallel, you would add the currents, but in series, you add the voltages.

I still suspect you would need some kind of controller circuit, as techchese has done above with his square array.

Derin says: Jul 18, 2008. 6:46 AM **REPLY**

LM317?

jsbarrie says: Jun 11, 2008. 12:11 PM **REPLY**

Dan-

This looks great! I am about to work on an LED lighting system in Latin America. We are using 3.6v 1W white LEDs (Lumileds) and locally they like to use 12v photovoltaic systems (probably because so many things work off of auto current)

Anyway, how would you maximize the efficiency of your design considering these two parameters?

Thanks,

jsbarrie

view all 207 comments