voltage regulator current draw

Asked 2 years, 11 months agoModified 2 years, 11 months agoViewed 2k times

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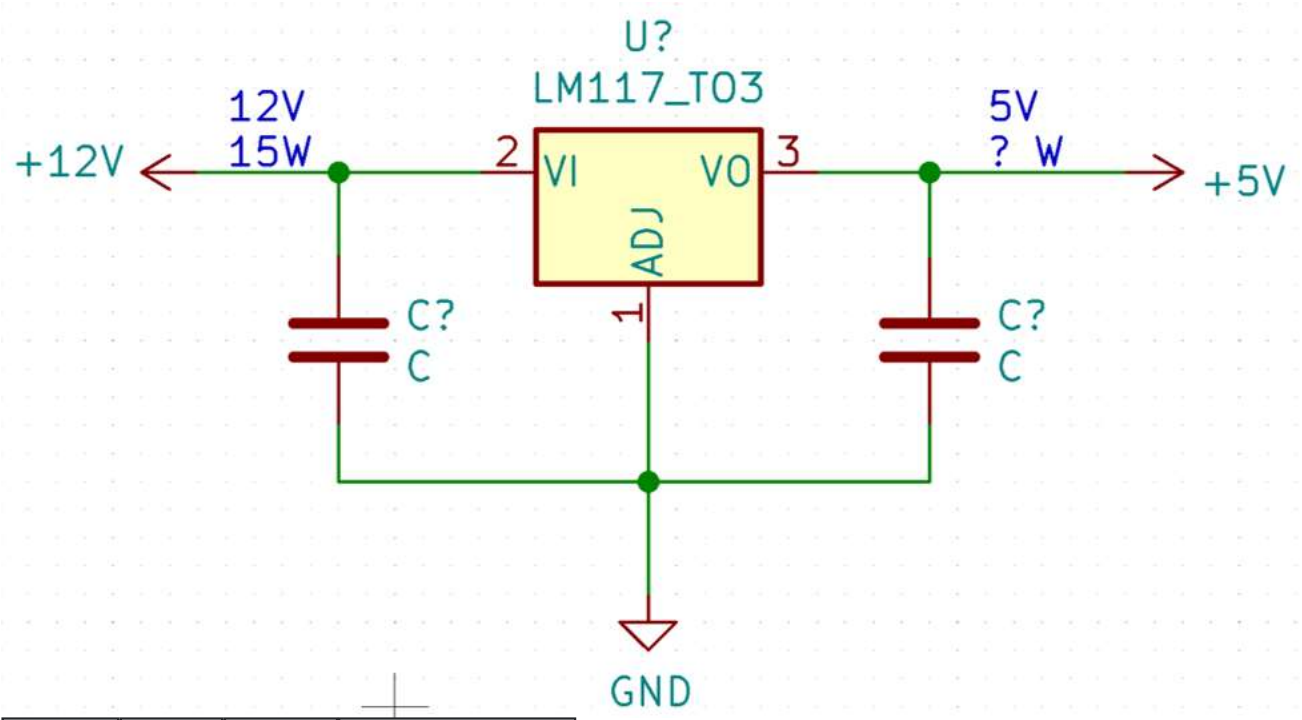
I have a question about the operation of a voltage regulator. The supply is 12V and can provide 15W (max current draw 1.25A). Now when I use a linear voltage regulator down to 5V do the 15W still apply (3A current draw)? Or do the 1.25A from the power source still apply since no current is being transformed?



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asked Oct 7, 2019 at 12:10

v3xX
405 2 12

Linear regulator : 1.25A and a lot of heat (use the right heatsink). If you want nearly 3A, use a buck (switching) regulator. – user_1818839 Oct 7, 2019 at 12:14

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You're using a **linear regulator** which simply "burns off" the excess voltage.

The **current does not change** and remains the same so you can draw up to 1.25 A at the output of the regulator. So after the regulator you're limited to 5 V, 1.25 A so 6.25 W.

When you draw that 6.25 W there is 12 V - 5 V = 7 V at 1.25 A meaning 7 V * 1.25 A = 8.75 W dissipated in the regulator. It will get hot so use a heatsink! Note how 8.75 W + 6.25 W = 15 W which is the maximum power from the supply.

If you want more current at 5 V you will need to use a **switched mode** regulator (also called a "buck converter"). Then theoretically you could draw up to 15 W at the output so 5 V, 3 A. I write theoretically because this assumes no power is lost. In practice some power is lost and 5 V, 2.5 A would be a more realistic value. An LM2596 based DCDC converter board could do this job.

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answered Oct 7, 2019 at 12:22

Bimpelrekkie
79.1k 2 91 181

thanks for the advice with the lm2596. Since I need 5V and 3.3V on the board I will look into switching regulators (this was the keyword) – v3xX Oct 7, 2019 at 12:42

Note that switching regulators, because they are constantly switching currents, are inherently noisy. There will be at best, some small ripple voltage output. 5v and 3.3v digital logic *should* be fine with small ripple, but if your application is intolerant of this, many engineers will use a "LDO" low-drop-out linear regulator after a switching regulator. So 12v to 5.6v using switcher, then 5.6v to 5.00v using LDO. The LDO will "clean up" the ripple, and since there is only a small voltage drop across it, not much power is wasted. – rdtsc Oct 7, 2019 at 13:04

2 LDOs cannot remove the high-frequency switching noise of a SwitchReg; the LDO transistors are not able to operate fast enough to remove 100,000Hz and 1.000.000Hz and 10,000,000Hz and 100,000,000Hz trash that is generated by SwitchRegs. Only LC filters (or RC filters) can do that. Place an LC filter, (avoid the DC drop of RC) before the LDO. You may need a resistor in parallel with the inductor, to dampen any ringing. – analogsystemsrf Oct 7, 2019 at 13:56

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In a linear voltage regulator as the LM117, all the *voltage drop* × *current* is turned into heat. That's about 9W in you case. You can draw 1.25A@5V from the 5V output.

If you wanted to draw more current on the 5V side than it is supplied on the 12V side and produce less heat, you had to use a switching regulator. There are some manufacturers which produce drop-in replacements for the linear regulators of the LM78xx series. (google: *7805 switching*)

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answered Oct 7, 2019 at 12:16

Janka
13.1k 1 18 33

why use linear regulators in general when all the excess energy is transferred into heat? – v3xX Oct 7, 2019 at 12:24

1 linear regulators on silicon were available (such as UA723 from Fairchild) before switching regulators (though Unitrode Corp provided such ICs, needed for space-borne radiation-hardened systems, early on; Unitrode eventually acquired by Texas Instruments.) Linear regulators can use much slower transistors than required by switching regulators. The Gemini spacecraft used germanium power transistors (discrete devices) in its switching-power-inverters. Lots of rapidly evolving design-art and system-art in power systems and power-devices (germanium, silicon, MOSFETs) over the years. – analogsystemsrf Oct 7, 2019 at 12:40

I recall a project with extreme RF fidelity requirements. The two (redundant) switching regulators might operate simultaneously, and they did not operate at exactly the same frequency because of slightly different magnetics. We had to eliminate the "beatnote" thus generated. I recall suggesting one be the Master, and always provide a Synchronizing waveform into the feedback winding of the Slave. This worked, but always dissipated about a watt, in a space-born system; but the beatnote went away. – analogsystemsrf Oct 7, 2019 at 12:45

A linear regulator just needs itself and fairly modest bypass caps on input and output, and is dead easy to

use. Even simple switching regulators require more external components (2 caps + a coil), those components need to be chosen with care because of the high ripple current, and the PC board layout around a switcher is much more critical. – TimWescott Oct 7, 2019 at 14:40

That's why I wrote there are **drop-in replacements** for LM78xx linear regulators in the market. Those have a switching regulator and all needed extra components on a tiny daughter board. All you have to do is soldering that daughter board where you had put the TO-92 LM7805 regulator before. – Janka Oct 7, 2019 at 16:12