Some of the online resources that I used for this project

ARDUINO LOW POWER - HOW TO RUN ATMEGA328P FOR A YEAR ON COIN CELL BATTERY

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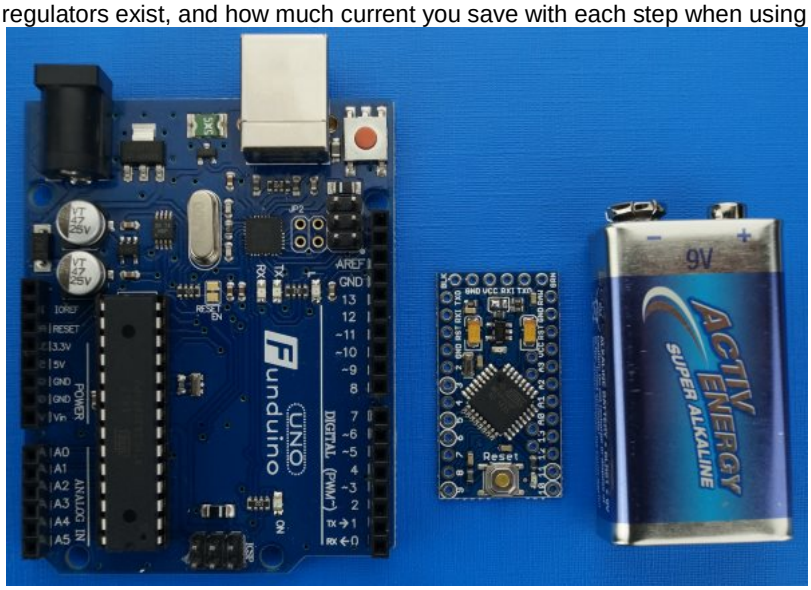
Tags: Arduino Pro Mini ATmega328P

An Arduino Uno runs less than one day on a 9 V battery because it uses about 45 mA current. Using an Arduino Pro Mini, with a simple modification, the power consumption goes down to 54 µA (0.054 mA) with the 3.3 V version or 23 µA (0.023 mA) with the 5 V version, in power-down sleep. That is 4 years on a 9 V battery with 1,200 mAh capacity or 2,000 times more efficient than the Arduino Uno. After removing the voltage regulator, the power consumption is only 4.5 µA for the 3.3 V version and 5.8 µA for the 5 V version, in power-down sleep.
The Pro Mini with the ATmega328P chip can be bought for less than $2 from China (see here).
This article explains what you should know about the Arduino Pro Mini, how to bring the Pro Mini in a low-power mode, how to disable the power LED, how to remove the voltage regulator, which alternative low quiescent current regulators exist, and how much current you save with each step when using the 3.3 V or 5 V version.



RESULTS OVERVIEW

ATmega328P Pro Mini Version	PWR Source	State	5.0 V @ 16 MHz	3.3 V @ 8 MHz
Unmodified	RAW Pin	ACT	19.9 mA	4.74 mA
Unmodified	RAW Pin	PDS	3.14 mA	0.90 mA
No Power LED	RAW Pin	ACT	16.9 mA	3.90 mA
No Power LED	RAW Pin	PDS	0.0232 mA*	0.0541 mA*
No Power LED, no Regulator	VCC Pin	ACT	12.7 mA	3.58 mA
No Power LED, no Regulator	VCC Pin	PDS	0.0058 mA	0.0045 mA

ACT - Active Mode
PDS - Dower-Down Sleep with Watchdog Timer enabled
* Here it is surprising that the 5 V version uses less current than the 3.3 V version. I cannot explain why, but the numbers were checked twice.

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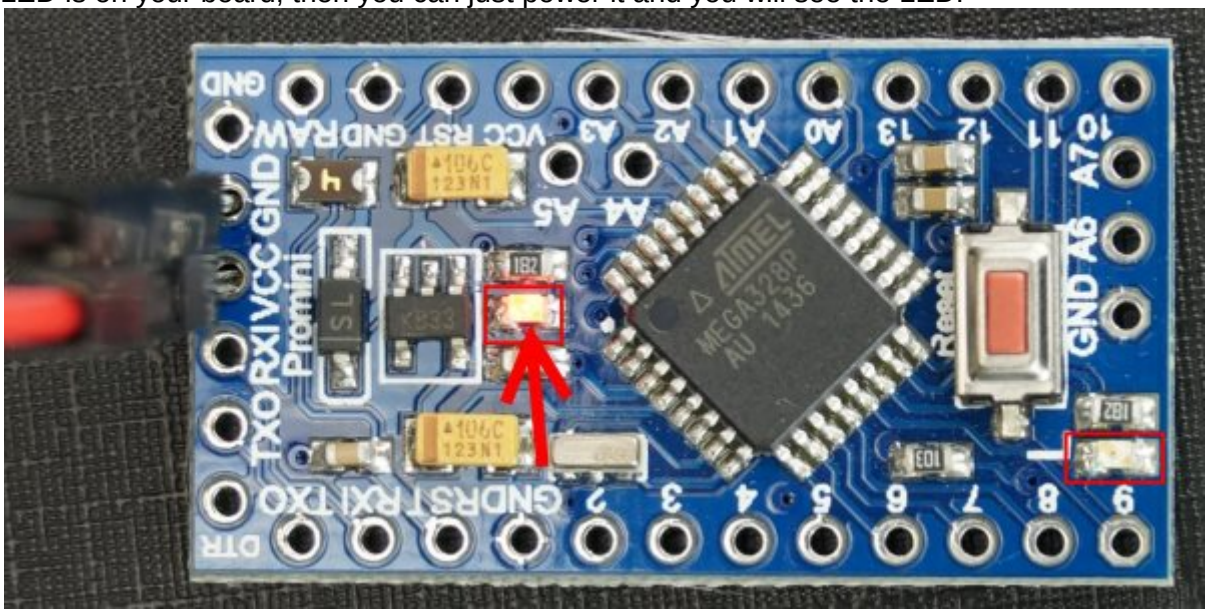
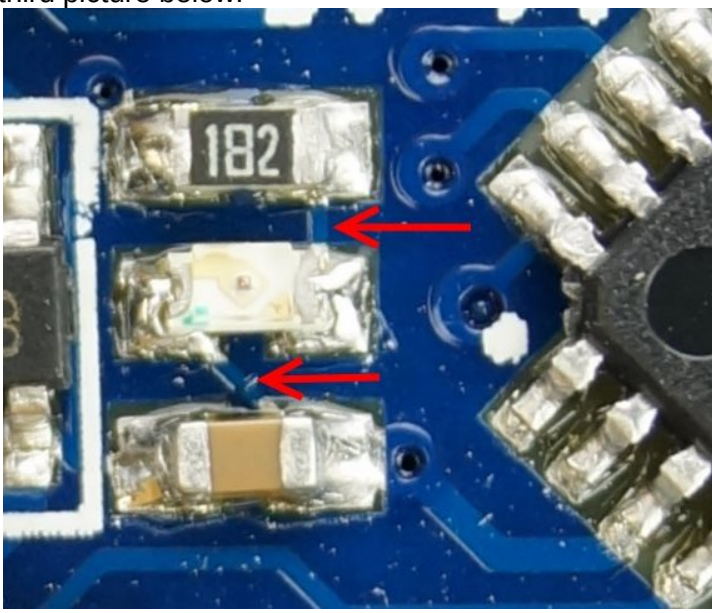
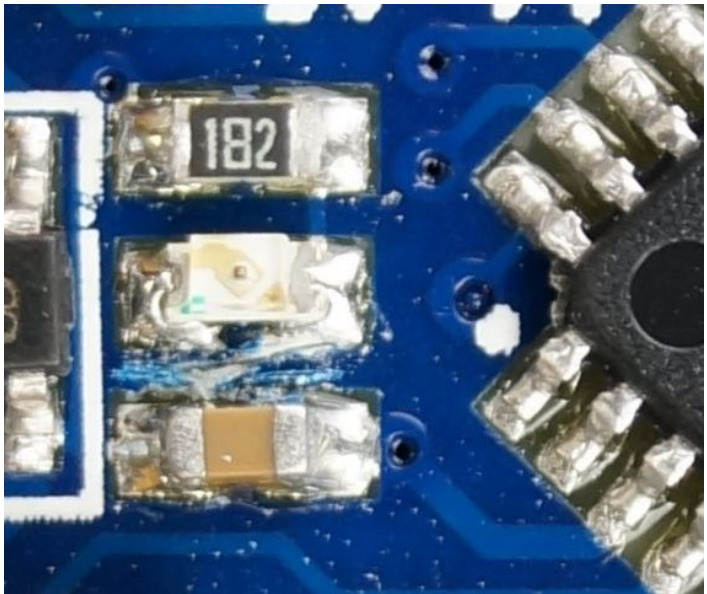
ANOTHER EXAMPLE STEP 2 - DISABLE THE POWER LED TO SAVE MORE ENERGY

Without the power LED, the 3.3 V Arduino Pro Mini uses about 0.85 mA less, the 5 V version even 3 mA less. However the ATmega328P cannot control the power LED. So, to disable the LED, you need to make a small hardware modification by cutting one of the two tiny traces which connect to the power LED.
There are two LEDs on the Pro Mini board. The two LEDs are marked with a red square in the following picture. The power LED is marked with an arrow. If you are not sure where the power LED is on your board, then you can just power it and you will see the LED.



When you found the power LED, then try to locate at least one trace that leads to the LED. In the second picture below, I marked the traces on my board. A high-resolution picture with a lot of light helps to find the traces.
When you found a trace to the power LED, then you take a knife and break the trace, so that it will not conduct any more. You can see my result in the third picture below.

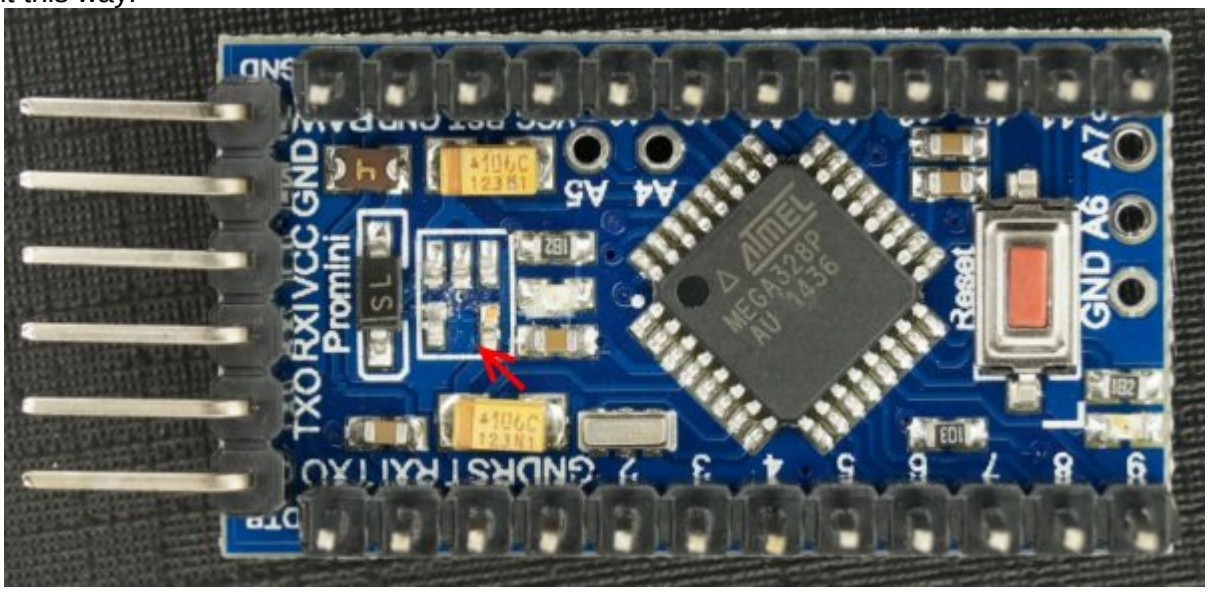




Granulations, your Pro Mini should now only use about 54 µA (0.054 mA) in power-down mode if it is the 3.3 V version and about 23 µA (0.023 mA) if it is the 5 V version.

STEP 3 - REPLACE OR REMOVE THE VOLTAGE REGULATOR TO MINIMIZE ENERGY USAGE

All Arduino Pro Mini clones, that I came across, use the same voltage regulator, the *MIC5205-KB50/KB33/KBAA*. The datasheet of the regulator reveals that the lost current or *Ground Pin Current* at 50 mA load is typically 0.350 mA and at 0.1 mA load it is 0.080 mA (datasheet linked in sources). So, ignoring the voltage drop, the efficiency at 50 mA load is 99.3 % and at 0.1 mA load it is only 20 %. For 0.0045 mA load at 3.3 V the efficiency is about 10 % because I measured about ten times more current consumption with the regulator than without (see table above).
Even though the standard voltage regulator is not efficient at low current, it is still good enough to run the 3.3 V Pro Mini on 3 AA Alkaline batteries for more than one year, based on the measured power consumption of 54 µA in power-down sleep and 3.90 mA in active mode.
If you really want to, you can remove the voltage regulator as follows. Before proceeding, you may want to check if you have the Sparkfun version of the Arduino Pro Mini. In that case you just need to unsolder a jumper (see Schematic on sparkfun.com).
To remove the voltage regulator, take a gripper tongs and pull it out. You find the regulator at the position shown in the second picture below. The regulator will be destroyed when removing it this way.



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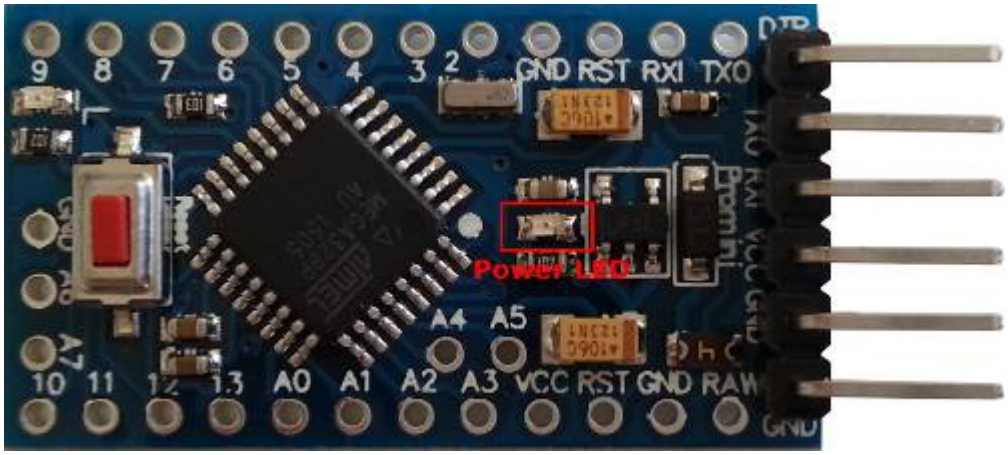
Removing the power LED

LEDs use a lot of power. Especially if they are on all the time and cannot be turned off like the power LED on the Arduino Pro Mini. So the first order of business for me was to try to desolder the power LED. Unfortunately the LED is tiny and wedged between two other components that probably shoudn't be damaged.



Mehtod 1: Scratching it off

I used solder wick to remove the small solder blobs at the front and back of the LED. Solder wick is a dense mesh like copper wire, which sucks up the solder through capillary action. It is also really easy to use. You just put a small stripe on top of the solder and press down on it with your hot soldering iron until the solder melts.
This worked really well and most of the solder was gone. Unfortunately the LED was still stuck and wouldn't move. In the end I had to slowly and carefully scratch it off destroying it in the process. Once it was gone I cleaned the now empty solder pads with solder wick.

Mehtod 2: Adding more solder

Since removing the LED by basically scratching it off was such a mess, I tried a different approach with my second Arduino Pro Mini. This Youtube-Video demonstrates it very nicely. Instead of removing solder, you add more of it to merge the two solder pads of the LED. This way a thermal bridge is created between the front and back and both ends can be heated at the same time. Because of the surface tension of the solder, the LED is lifted off its pad immediately and can be easily removed with the tip of the soldering iron.

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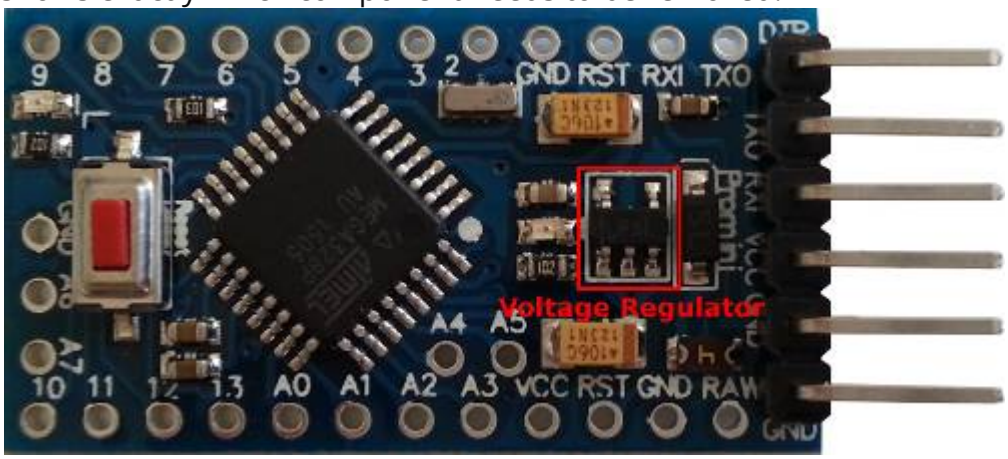
Removing the voltage regulator

Since I am a lowly software engineer and not an electronics engineer, I had no clue where to look for the voltage regulator. Then I found this very detailed article, which shows exactly which component needs to be removed:



In contrast to what is stated in the article, I found that it isn't necessary to destroy the power regulator. It is very easy to desolder it with solder wick. After the solder is removed from every pin, the regulator comes off easily. The result looks like this: