Ren48LSD Voltage Regulator Enhancements

When the Ren48LSD was initially designed, it was planned to only use 5VDC as the sole power source and no voltage regulator was required. I soon added a regulator to support voltages up to 12v since some folks wanted to use that to drive the LED strips it was designed for. It was later found out that this caused the regulator to overheat even with the supplied heatsink. This document will attempt to supply a variety of methods to support 12 or even 24v operation in some cases.

The overheating condition mainly occurs when all 48 channels are turned on for a length of time. This draws roughly 385mA of current and with the additional 5-6v of drop required within the regulator makes for a signficant power draw and overwhelms the dissipation capability of the supplied heatsink.

Option 1 (for 12v operation)

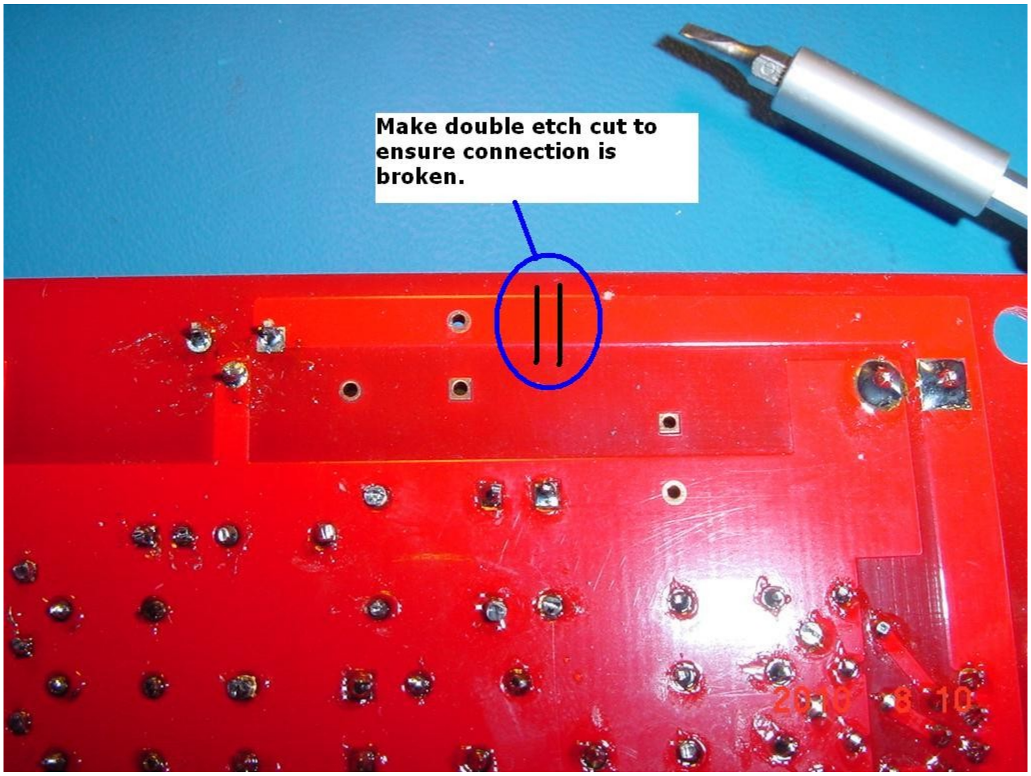
No changes at all to the board. As mentioned before, the issue turns up when using all 48 channels at the same time. With careful sequencing and/or the combination of not using all 12 strip connections, the regulator will still run quite warm but well within the maximum temperature specifications. Obviously, if you aren't careful, it could cause doom for the regulator at some point. While not the best/safest option, it's obviously the cheapest.

Option 2 (for 12v operation)

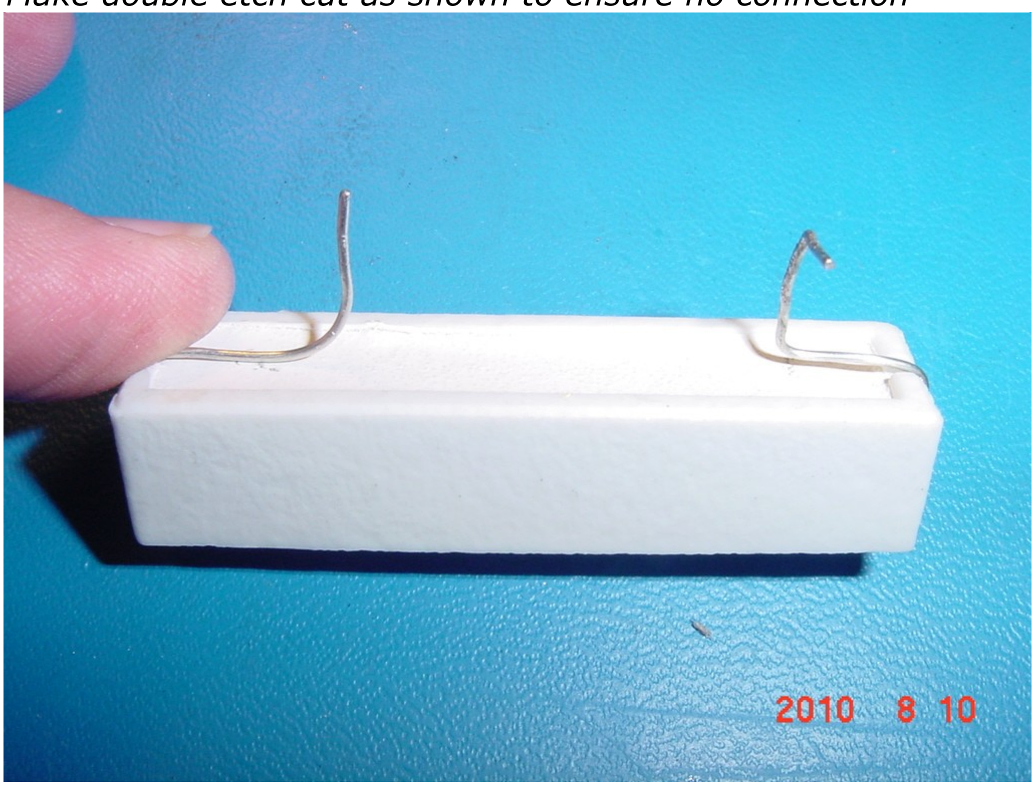
Basically a modification of Option #1, you can add/replace the heat sink specified in the original BOM with a larger one. Installing a large square (whatever size will fit) of aluminum stock (straight, 90deg or “U”) will help dissipate more heat and give you more headroom. You just need to be sure that the heatsink does not make contact with other other components as it is at +5v potential when touching the back of the regulator.

Option 3 (for 12v operation)

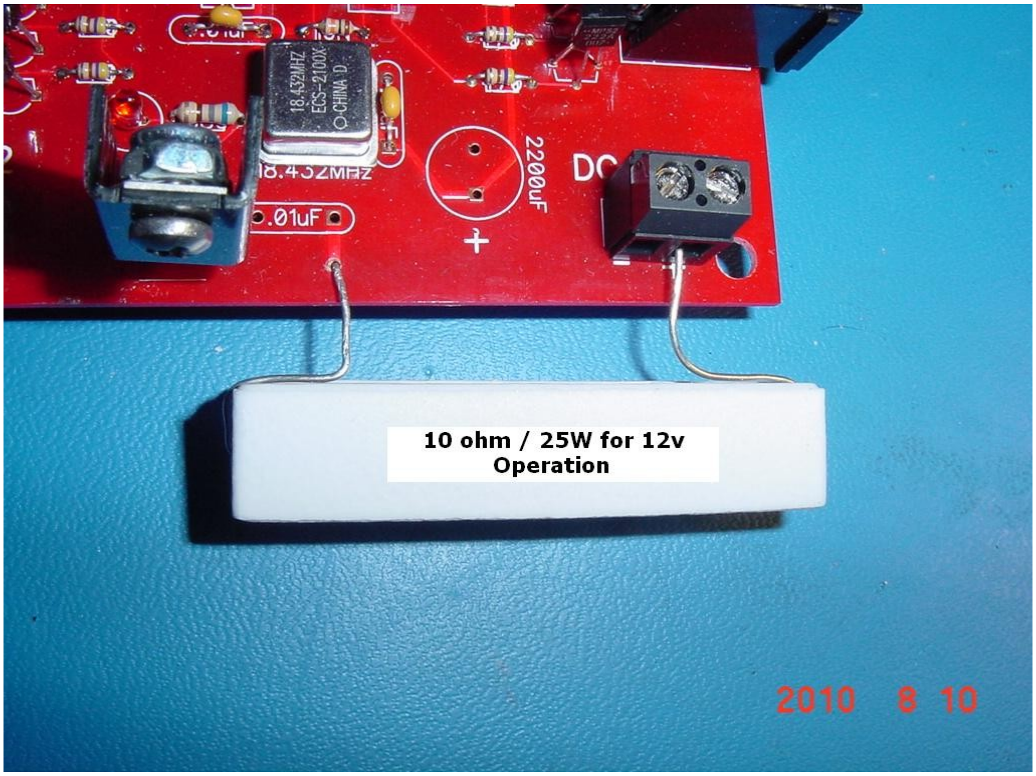
This option involves cutting a trace and installing a large resistor to reduce the voltage coming into the regulator. Through some measuring, it appears that a 10 ohm/25W resistor will drop the voltage from 12v to just over 8v when at full load. Note that even with this modification the regulator will still run very warm but well within tolerances. Follow the steps below to make this modification. Note that the use of a resistor will mean the voltage going into the regulator will swing a bit since it's dependant on the current draw. You could easily see 8-11v at the regulator but since the current usage is less, the total power dissipation would also be less which results in less heat at the regulator.



Make double etch cut as shown to ensure no connection



Bend the leads of the resistor like this first



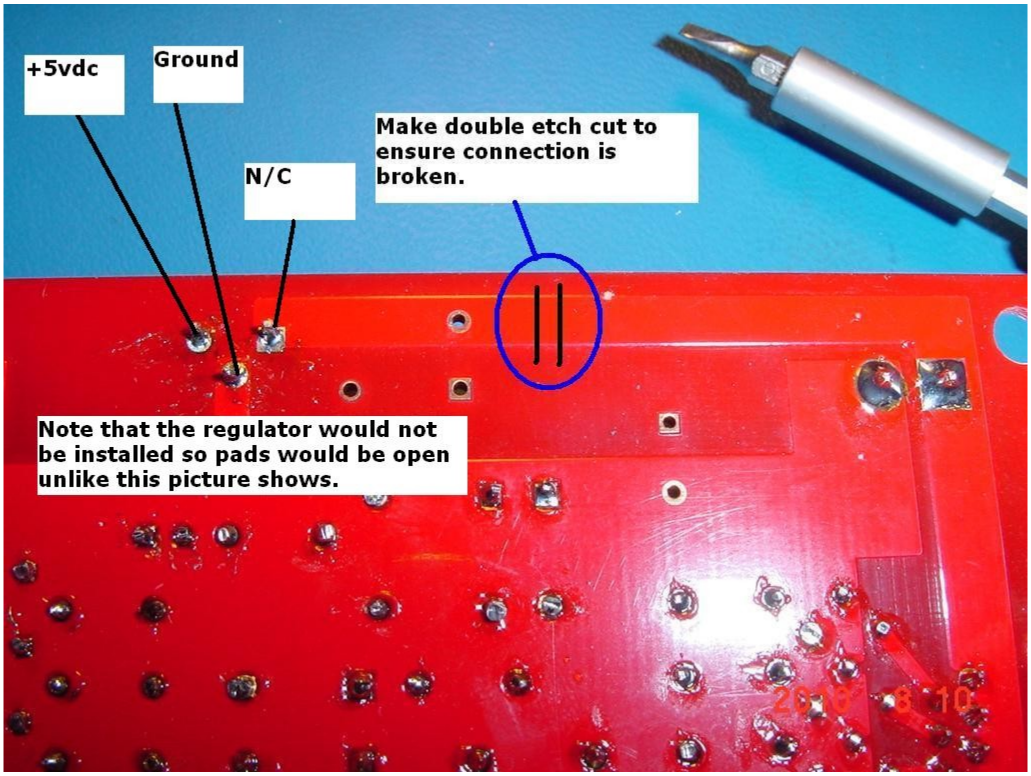
Install the resistor as shown between the +DC input and unused pad by the regulator

Option 4 (for 12v or 24v operation)

This option is somewhat clunky but works in a similar way to Option #3. Instead of using a resistor which is very dependant on the voltages used and current required, this option uses a load of diodes in series to drop the voltage. The trace cuts would be required as shown in Option #3. If you are using 12v, then five (5) large rectifier diodes (e.g. 1N4004) soldered together in series would drop the voltage down to just over 8v. If using 24v, you would need about twenty-two (22) diodes (hence – very clunky). With careful arrangement of the diodes, you could fold them up (with proper insulation of course) into a square(ish) package. The cathode would connect to the +DC IN 1 connector and the anode would connect to the empty pad. This solution ensures the voltage going into the regulator would always be around 8-9 volts maximum regardless of current draw. Again, the regulator would continue to run very warm but within specifications.

Option 5 (for 5-24v operation)

Make the trace cuts as shown in Option #3. Using a good switching style **well regulated** 5vdc wall power supply, install the +5v lead into pin 3 of the regulator pad and the Common lead into pin 2 of the regulator pad. This should leave pin 1 of the reguator empty. While the trace cuts are not absolutely necessary in this case, it would be catastrophic if the leads touched the higher voltage input coming into pin 1. It would feed the higher voltage directly to all the ICs as well as the wall power supply and probably damage all of them. The use of the separate power supply allows you to run a wide range of voltages for the strip outputs.



Make cuts as shown and solder in +5vdc supply leads as shown

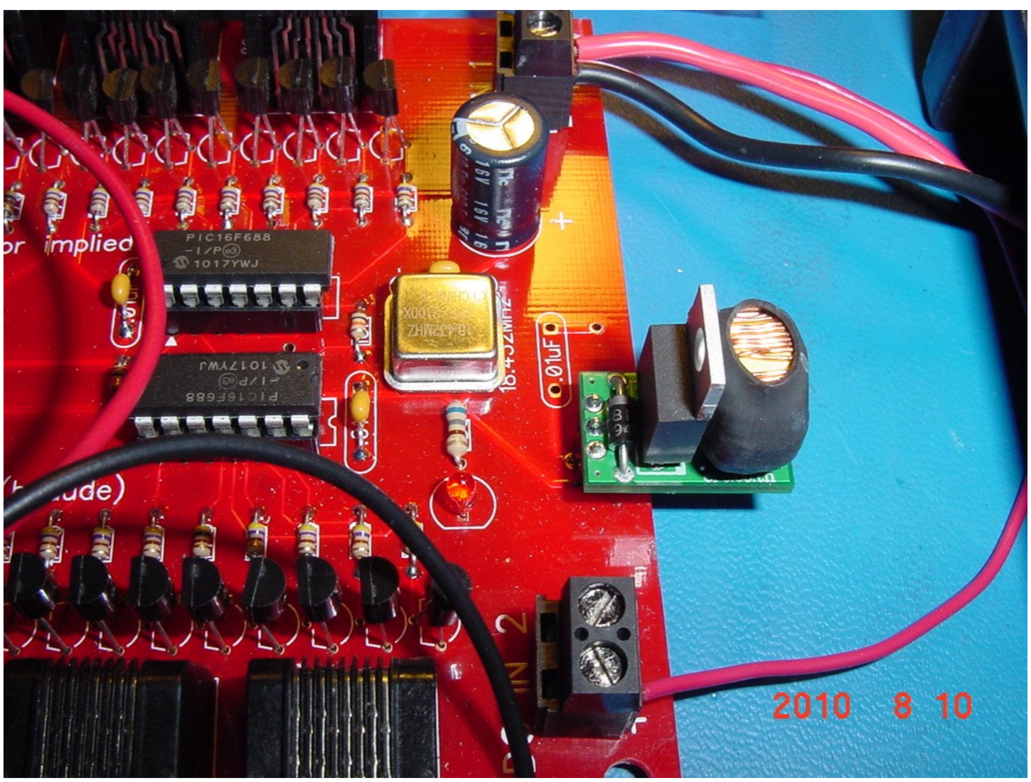
Option 6 (9-24v operation)

This option requires no physical change to the board but does require new components to be installed. If you have already installed the regulator it must be removed. Instead of the linear regulator (LM7805) a switching style DC-DC converter will be used. While the most expensive option, it is the way I suggest to use for all owners. I have tried two different regulators and unfortunately neither are supplied by the large component warehouses such as Mouser, Digi-Key, etc.

The first is the RG2575-5 and can be found here:
http://www.ereshop.com/index.php?main_page=product_info&cPath=75&products_id=188

This part is a drop-in replacement for the LM7805 regulator. The only caveat when using it with the Ren48LSD is that the leads must be bent to fit the 'triangle' patteron on the board (this will be changed in subsequent releases of the board). The datasheet suggests the use of a 100uF/50v electrolytic capacitor for the input and a 330uF/16v electrolytic capacitor for the output. However, if you are using a regulated power supply (e.g. a PC power supply) then this is not really necessary and the components supplied with the original BOM should be fine to use.

RG2575-5 module



RG2575-5 module installed - note overhang

The only issue with this particular module is that there is a signficant overhang over the board and this may conflict with installation into your enclosure. If this is not a problem for you, then this is a fairly cheap option. I did find that the LM2575 regulator got very warm at 24v (~52 degC) and only slightly cooler at 12v (~48 degC) when driving all outputs full on. I may use this particular circuit using the discrete components for the next board layout.

The other option is to use the Aimtec AMSR1-7805-NZ switching module located here: https://dcomponents.com/?content=details&idpart=8386

I do not have pictures with this device but the installation is a simple replacement of the LM7805 regulator but again you must bend the leads to fit the 'triangle' pattern. An input capacitor of 22uF/50v and and output capacitor of 100uF/25v are suggested in the datasheet however with a regulated power source the standard BOM components can be used. This part is somewhat expensive but it ran nearly cool to the touch even with all 48 channels on at 24v.

Summary

I think the AMSR1-7805-NZ is the overall best solution in the interim. While somewhat expensive, it offers the cleanest and best operation. For future boards I will be looking at implementing the LM2575 regulator module circuit into the layout when using 9-24vdc as your source.

Many thanks to member n1ist for his suggestions/comments regarding the switching regulator options. Also a special thanks to member oldcqr for his initial discovery of the overheating issue and helping to remedy it.

Version 1.0 – Released 8/11/2010 - budude