

# **Ren48 Construction Manual**

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Version 0.1 – May 23<sup>rd</sup>, 2010 – first draft

## What is the Ren48LSD?



The Ren48LSD controller came about as a solution to drive Frank's LED Super Strips. Originally I used DCSSRs to drive them and while it's a workable solution, it tends to be somewhat bulky and requires lots of additional wiring between the controller and DCSSRs as well as to the strips themselves. Another alternative is Frank's Ren24LV which uses ULN2803 drivers. The issue with this solution is that it has limitations in how much power it can sink to the strips due to the ULN2803 package power dissipation. By the way – 'LSD' stands for **LED Strip Driver**.

The strips require up to 360mA per output (18 LEDs x 20mA) so I used an NPN bipolar transistor to drive them. The transistors support up to 600mA so there's plenty of headroom left. The transistors are fairly cheap so it makes for a simple, inexpensive solution. The controller design used the Ren24SS as a base, using the same PIC, clocking and serial interface configuration but expanded to 6 PICs to support 48 channels or driving up to 12 strips per board. Because of this, the controller supports standard Renard protocol FW using RS-232/485 as well as the DMX version. The board requires either a 5vdc well regulated supply or a good 9-12vdc supply. The input supply also drives the LED strips.

## **Ren48LSD Parts**

In addition to the PCB, you will need the following components:

<b>Mouser PN</b>	<b>Description</b>	<b>Qty</b>
579-PIC16F688-I/P	Microcontrollers (MCU) 7KB 256 RAM 12 I/O	6
571-1-390261-3	IC & Component Sockets 14P ECONOMY TIN	6
511-ST485BN	Buffers & Line Drivers Hi-Spd Lo Pwr Trans	2
571-1-390261-2	IC & Component Sockets 8P ECONOMY TIN	2
520-TCH1843-X	ECS-2100AX-18.432MHZ	1
863-MPS2222AG	Bipolar Transistors 600mA 75V NPN	48
78-1N5239B	Zener Diodes 9.1 Volt 0.5 Watt	1
78-1N5229B	Zener Diodes 4.3 Volt 0.5 Watt	1
511-L7805CV	Linear Regulators - Standard 5.0V 1.0A Positive	1
532-577102B00	Heatsinks TO-220 HORIZ/VERT SLIM CHANNEL STYLE	1
604-WP7104IT	Standard LED - Through Hole HI EFF RED TRANS	1
80-C322C104K5R	Multilayer Ceramic Capacitors (MLCC) - Leaded 50volts 0.1uF 10%	10
299-680-RC	Carbon Film Resistors 680ohms	1
299-120-RC	Carbon Film Resistors 120ohms	1
299-27K-RC	Carbon Film Resistors 27Kohms	2
299-1K-RC	Carbon Film Resistors 1.0Kohms	2
299-470-RC	Carbon Film Resistors 470ohms	48
299-10K-RC	Carbon Film Resistors 10Kohms	6
571-5520251-4	Telecom & Ethernet Connectors 8/8 SIDE ENTRY	14
571-7969492	Terminal Blocks 5.08MM VERTICAL 2P wire protector	2
571-5-146281-2	Headers & Wire Housings 2 P HEADER GOLD 30u single row	2
649-65474-002LF	Headers & Wire Housings SHUNT TIN	1

None of the components are overly critical and some can be omitted in certain cases. If you are using a well regulated 5vdc supply, you will not need the voltage regulator or its heat sink.

## Building the Ren48LSD

The Ren48LSD requires a fair bit of soldering so take your time and ensure you install the components in the correct orientation when required. Start by sorting the components by type and values. Look over the PCB before starting noting the location of the various components. Follow the standard procedure of installing the lowest profile parts first and ending up with the tallest.

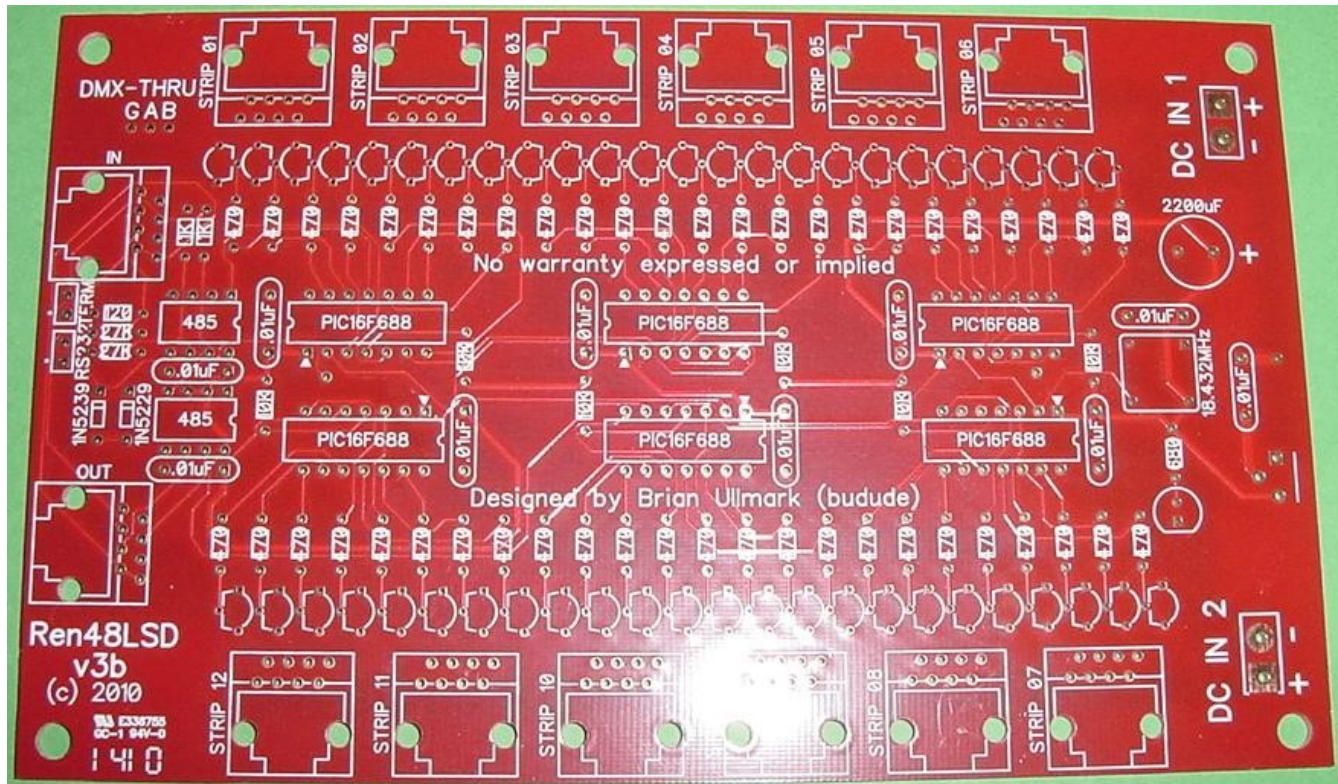
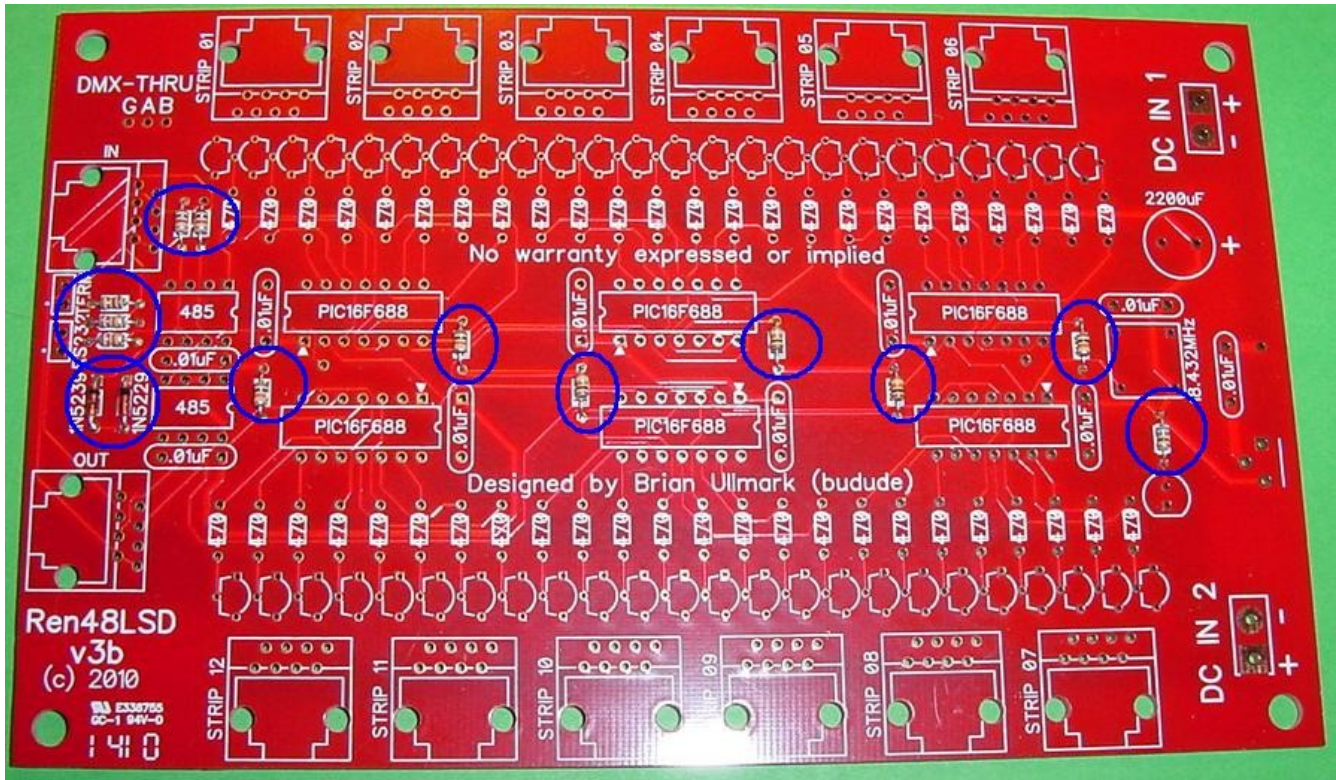


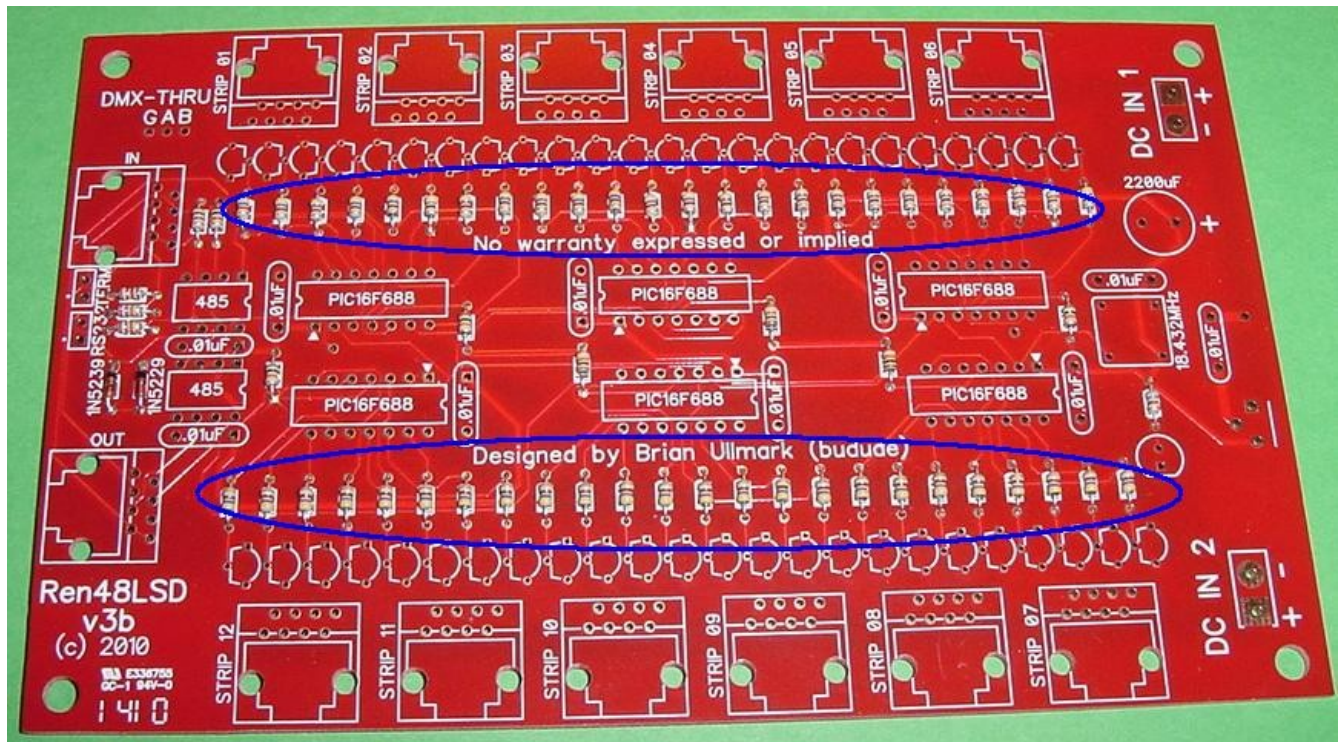
Illustration 1: Bare Ren48LSD PCB (v3b)

1. Install the six 10k resistors near each PIC
2. Install the two 1k resistors near the 485 chips
3. Install the two 27k resistors near the 485 chips
4. Install the one 120 resistor near the 485 chips
5. Install the 1N5229 diode near the 485 chips – note the correct orientation
6. Install the 1N5239 diode near the 485 chips – note the correct orientation



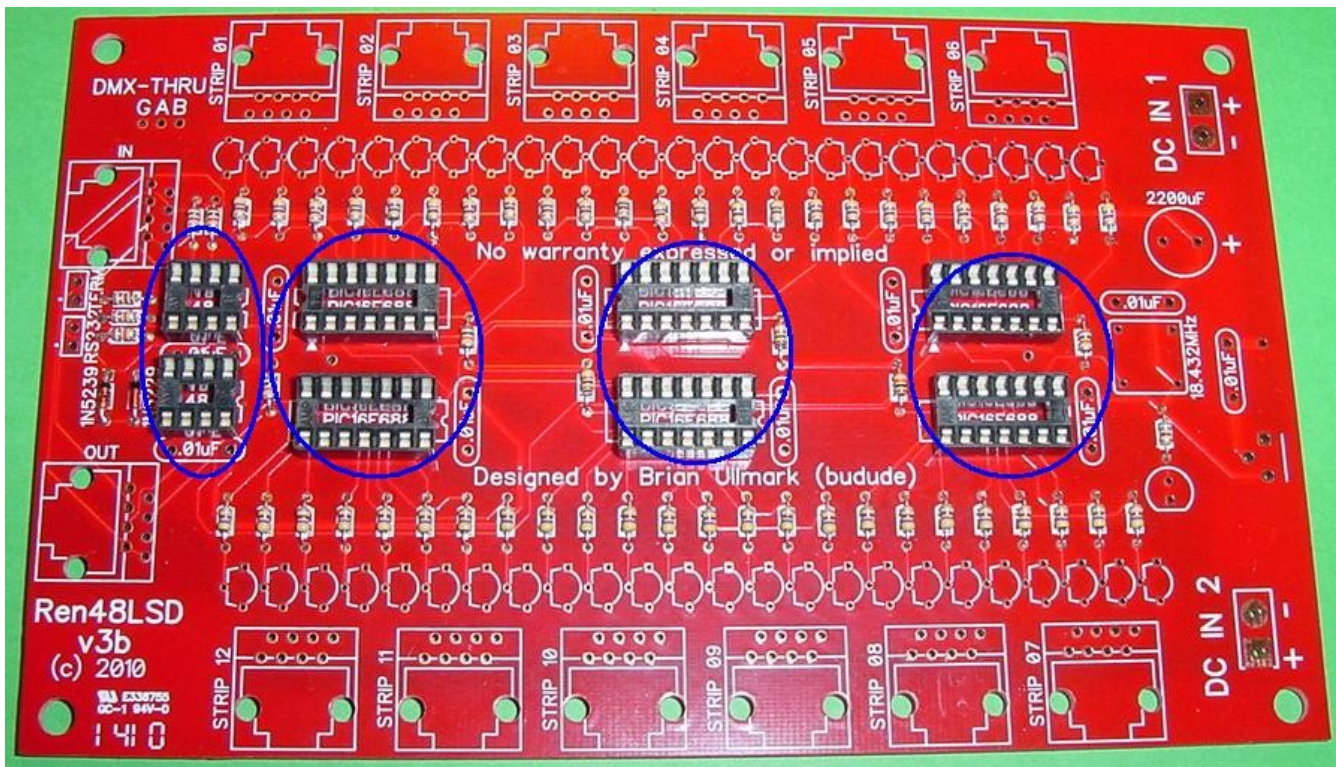
*Illustration 2: Inner resistors and diodes installed*

Install all forty-eight 470 ohm resistors doing 4-8 at a time.



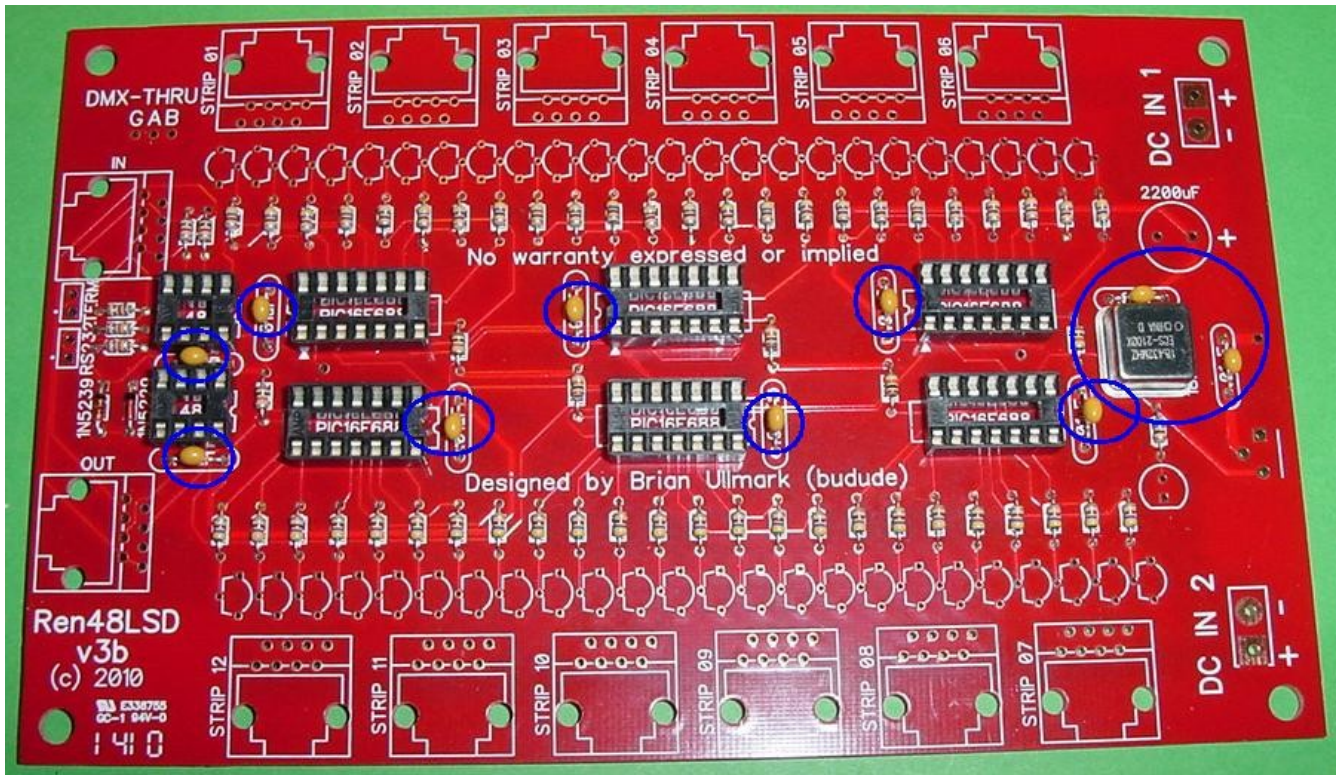
*Illustration 3: All forty-eight 470 ohm resistors installed*

1. Install the six 14-pin PIC chip sockets
2. Install the two 8-pin 485 chip sockets



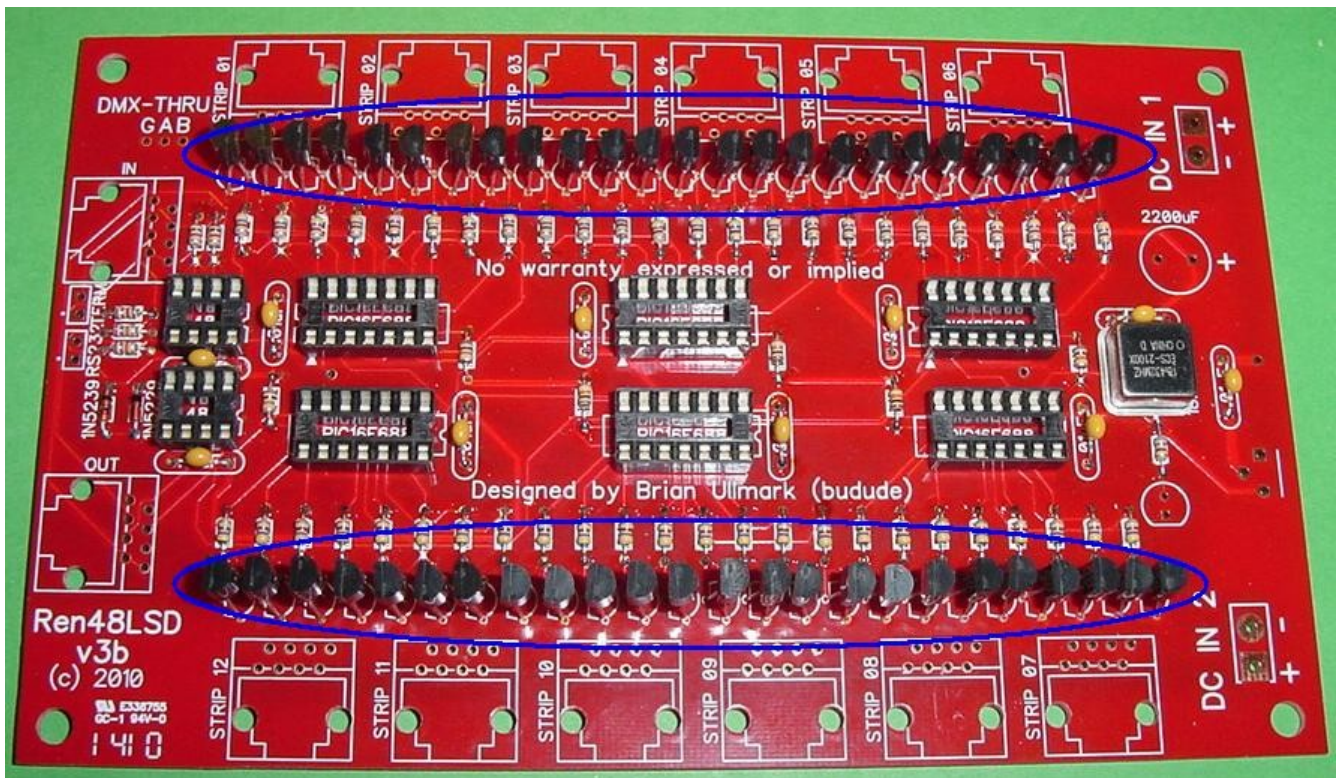
*Illustration 4: IC Sockets installed*

1. Install the 18.432MHz oscillator – note the squared corner for correct orientation
2. Install the ten decoupling capacitors near the IC sockets, oscillator and regulator



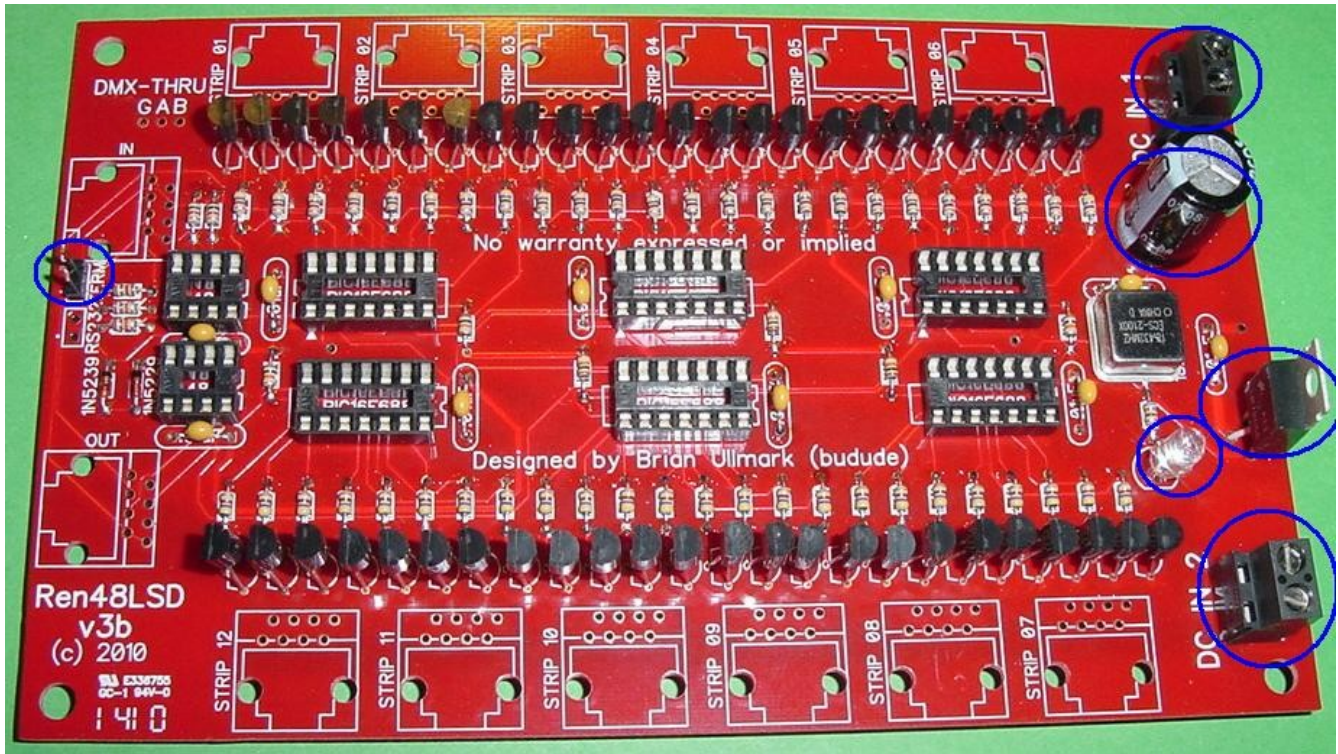
*Illustration 5: Capacitors and Oscillator installed*

Install the 48 transistors – note the correct orientation – the emitter is nearest the PICs, base in the middle and collector near the RJ45 jacks



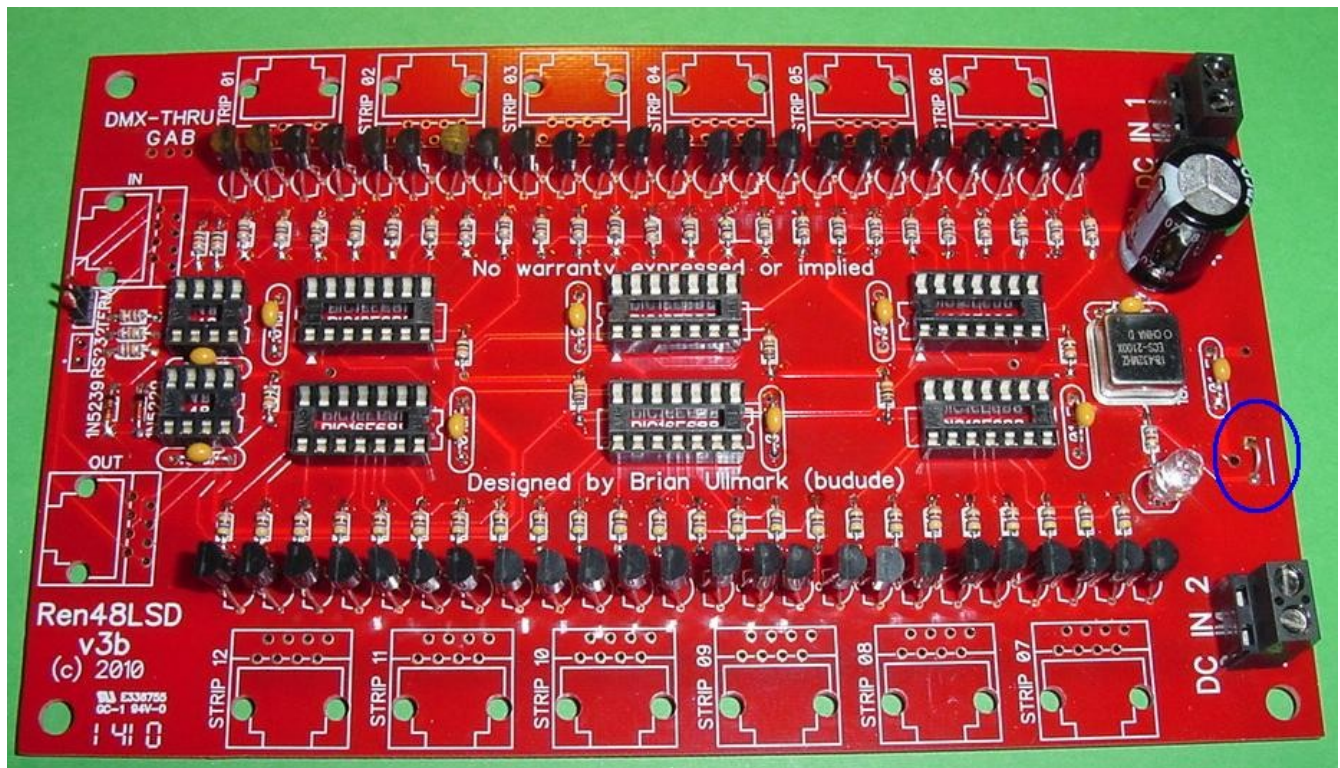
*Illustration 6: All transistors installed*

1. Install the two 2-pin shunt jumpers (note picture shows only one installed)
2. Install the LED – note correct orientation
3. Install the DC input terminal blocks – note correct orientation
4. Install the 5v regulator (OPTIONAL)
5. Install the large capacitor – note correct orientation



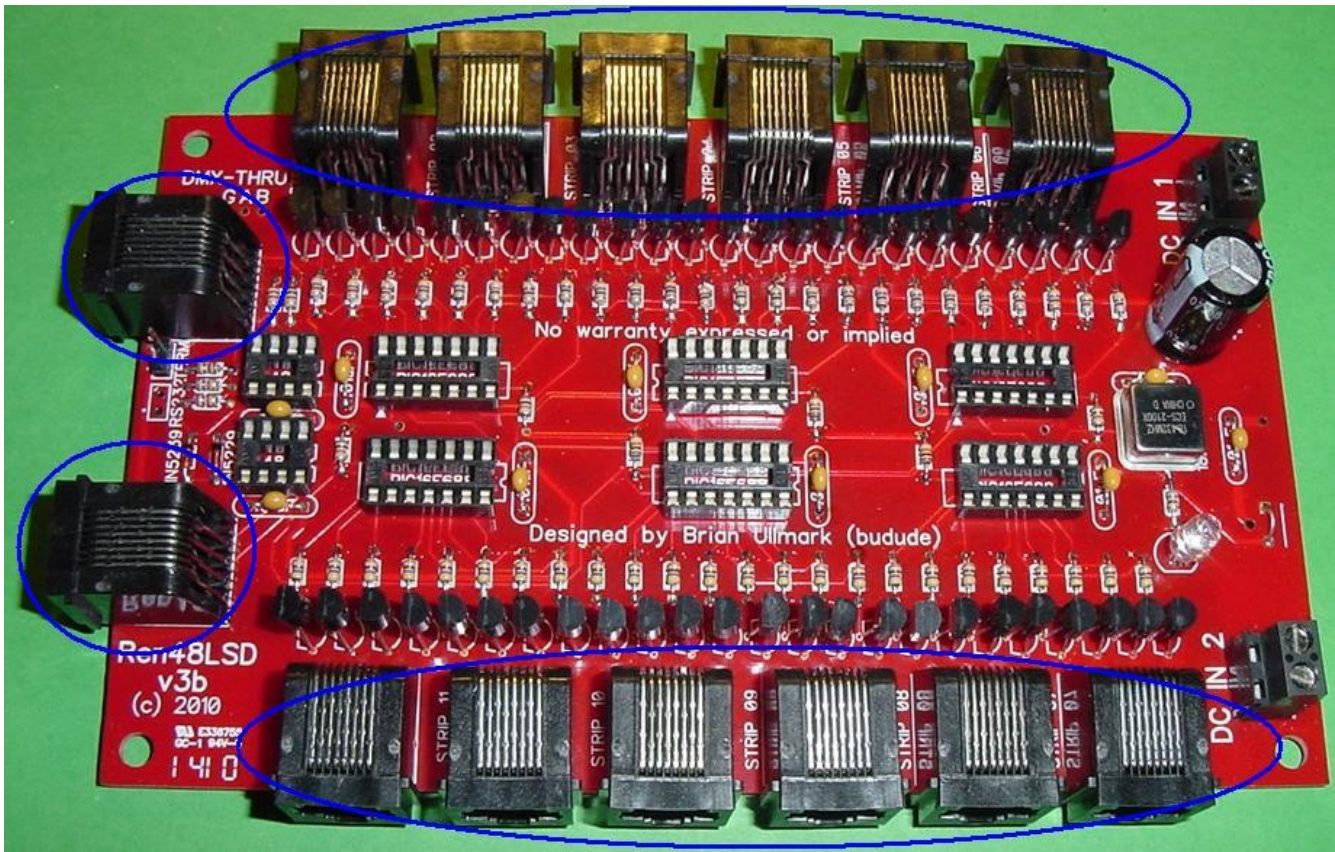
*Illustration 7: Miscellaneous components installed*

If you are not using the 5v regulator then you need to install a jumper across the input/output of where the regulator goes. A 1/2W resistor lead is good for this but any 18-20 gauge wire is fine.



*Illustration 8: Regulator bypass wire installed*

1. Install the fourteen RJ45 jacks – note that top-entry jacks can be substituted
2. Mount the 5v regulator heat sink if you installed the regulator – use a small amount of heat sink compound



*Illustration 9: RJ45 Jacks installed*

Congratulations! That completes the construction of the Ren48LSD!

### ***Initial Testing***

The first thing you will want to do in any PCB construction project is to double check that you have all components installed and in the proper orientation. You will then want to inspect the board for any cold/bridged solder joints. Take your time with this step and go over each and every joint.

Connect your power supply the "DC IN 1" - it supplies power to controller portion of the board as well as strip outputs 1-6. "DC IN 2" is a separate input to drive strips 7-12. Note that the ground is shared between the two inputs. Turn on the supply and verify the power LED lights up. Verify you have 5v between pins 1 and 14 on each PIC socket as well as between pins 5 and 8 on the 485 chips.

## ***Programming the PIC controllers***

The Ren48LSD does not supply or use a ZeroCross input and therefore the Renard firmware (either Renard or DMX protocol) must be configured for DC/PWM operation. In addition, if you are using the DMX firmware, you may want to set the initial starting address but generally, this can be left at '1' for all PICs since the code is self-addressing. Also – like the ULN2803 drivers, the transistors invert the output so the firmware uses positive outputs.

### **Renard Protocol**

Obtain the standard Renard firmware from here:

<http://www.christmasinshirley.com/wiki/images/d/d3/Renard-20071229.asm>

Make the following changes:

```
#define PWM_build 1 – change from '0'
#define DC_build 1 – change from '0'
#define CTR_LOCKOUT 1 – change from '15'
;#define OUTPUT_NEGATIVE_TRUE – comment this out
```

Compile the code into hex code and program all six PICs with the same code.

### **Renard-DMX Protocol**

Obtain the standard Renard firmware from here:

<http://www.christmasinshirley.com/wiki/images/e/ea/Renard-dmx-20080814.asm>

Make the following changes:

```
#define DC_build 1 – change from '0'
#define CTR_LOCKOUT 0 – change from '40'
#define SINK_map 0x00 – change from '0xFF'
```

If you want to change the DMX starting address then alter it below – this is only required on the first PIC in the chain. If you have multiple Ren48LSD controllers, you can leave the second/subsequent PICs at '1' and they will automatically start off where the last PIC left off.

```
#define DMX_START_ADDRESS 1
```

Compile the code into hex code and program all six PICs with the same code (unless using a starting address).

Whichever firmware you choose, install the flashed PICs into the sockets noting the correct orientation. Also install the two 485 chips into their sockets noting the correct orientation. You are now ready for final testing.

## ***Final Testing***

I chose not to design in the diagnostic LEDs as those used on the RenSS series of controllers. The design is fairly straight-forward and as long as you are sure of the voltage inputs and the PICs are flashed properly you should not have any issues if your soldering is good.

I'm assuming at this point that you have built one or more of the LED SuperStrips to test with. If not - - well - - do it...

Note that the strips have one caveat – I have found that the LED colors go in Red, Blue, Green and White order – not Red, Green, Blue and White order. The RJ45 outputs are as follows:

1. Common +DC
2. Red Ground
3. Common +DC
4. Blue Ground
5. Common +DC
6. Green Ground
7. Common +DC
8. White Ground

What does this mean to you? Well – if you use standard straight-thru RJ45/Ethernet cables, the color order will be **RBGW** channel order in Vixen so if you want to use an **RGBW** order, you'll need to change the channel order in Vixen. The other alternative (and the way I do it) is to swap pins 4 and 6 at **one** end of the RJ45 cable. I did this because I thought it made more sense to keep the natural pin order versus color order. Note that pins 1, 3, 5 and 7 are tied together both on the PCB as well as the strips – there is no way to have separate +DC runs with the strips.

Connect the Ren48LSD to your PC using standard wiring practices as on the Wiki for other Renard controllers. Develop a Vixen sequence to turn on/off each channel in groups of four using the appropriate Renard/DMX plug-in. Channels 1, 5, 9, etc should have the same programming but only have 1 channel in the group (1,2,3,4) on at a time. This helps ensure you have unique channel addressing from each RJ45 output.

With the sequence running, plug in a strip into each RJ45 and ensure each color turns on in order (remember that the B & G colors are swapped). Once that is complete you change the on/off to ramp up/downs to verify dimming operation. Finally, you can perform a full load test with 12 strips installed.

## **FAQ**

Q1: Can this use 24vdc?

A1: The board was not designed to use 24vdc – however it may be possible but requires some hacking to work. The issue is with the 5v regulator that it will get very hot at 24vdc input even with a heat sink. One option would be to install a resistor between the +DC input and the input leg of the regulator of sufficient size/wattage to drop the input voltage to the regulator to keep it cooler. This is similar to what is done with the Ren24LV. I have not tested this myself but with a bit of experimentation, should not be hard to determine. Since the current draw is much higher with this (post regulator) than the 24LV and it won't be the same value.