The LYNX Assembly Manual

Introduction

Thank you for making the decision to build the LYNX HOLIDAY LIGHT DIMMER. I believe this decision will be one you will be very happy with. The Lynx is my attempt to design the best dimmer available for the do it yourselfer's like you. I set the bar high when the design began and I feel you will agree that the finished product is up to the challenge. What you are about to assemble is the outcome of many hours of design, test and redesign of the hardware as well as the firmware that operates it. The goals for the LYNX were professional looks and operation, cost effective, easy to assemble for even a novice builder, DMX compatible, software start channel programming, all in one box design. The LYNX design is not a different layout of an old design but a completely clean sheet approach to holiday light dimming. If you like technical stuff the appendix of this manual includes a technical view of what is different about the LYNX.

WARNING! This device uses potentially deadly voltages in operation. If you do not feel it is within your ability to work with these voltages please stop and get assistance, or purchase ready built commercial dimmers. This dimmer has been design for personal use as a means of education and entertainment. As such it is not rated, tested, or approved for use in commercial environments and as such is forbidden by the designer. Improper use of this equipment could be hazardous to life and property and the suitability of use is your responsibility. I assume no responsibility in the use or operation of this equipment or for the accuracy of any information made on part of itself. This device has been design for my use and my use only. This is simply an explanation of how I built my own personal dimmers for informational purposes. I make no warranties written or otherwise to it. It should be considered an experimental device with possible unknown characteristics.

Before we start assembly of the LYNX we want to do two things. First we need to take inventory and make sure we have all the components that should have come with the coop kit. Using the list on the next page verify you have the correct parts and quantity of parts before we proceed any farther. Please use static precautions in the handling of these parts. If you are not familiar in them please research on the internet prior to handling them. **You can damage you parts with improper handling**!

Parts List

Mouser PN #	Description	Quantity
625-GBPC3506W-E4	35 AMP RECTIFIER	1
579-PIC18F1220-E/P	MICROCHIP PIC (pre-programmed)	1
511-L7805ACV	5V REG	1
520-TCH4000-X	40 MHZ CLOCK MODULE	1
576-0314020.HXP	250V 20 AMP FUSE	1
576-01020071H	FUSE CLIPS	2
651-1935307	TERMINAL BLOCK 1.5/16	2
651-1714971	TERMINAL BLOCK 2P	1
511-ST485EBN	RS485 COMM CHIP 8 PIN	1
625-W005G-E4	1.5 AMP RECTIFIER 50V	2
649-65474-002LF	SHUNT TIN	2
581-SA105E104Z	.1UF CAPACITOR	7
538-22-03-2031	MOLEX .1 K.K. 3 PIN HEADER	1
571-5202604	AMP 8P8C TOP ENTRY RJ45 JACK	2
538-22-03-2021	MOLEX .1 K.K. 2 PIN HEADER	1
579-TC4467CPD	1.2 AMP QUAD NAND I/P DIP14	4
782-K847PH	OPTOCOUPLER QUAD DIP 16	4
802-DSW-520	TRANSFORMER	1
268-10-RC	10 OHM 8 PIN RES NETWORK SIP	4
652-4608X-1LF-15K	15K OHM 8 PIN BUSSED SIP RES	4
652-4608X-102-220K	220K OHM 8 PIN ISO SIP RES	4
532-7128DG	TO220 VERT HEATSINK	1
299-120-RC	120 OHM 1/8W RESISTOR	1
299-4.7-RC	4.7K OHM 1/8W RESISTOR	1
140-XRL25V100-RC	25V 100UF RADIAL CAPACITOR	2
571-1-390261-5	18 PIN DIP SOCKET	1
571-1-390261-4	16 PIN DIP SOCKET	4
571-1-390261-3	14 PIN DIP SOCKET	4
571-1-390261-9	28 PIN DIP SOCKET	1
571-1-390261-2	8 PIN DIP SOCKET	1
595-TLC5940NT	LED DRIVER DIP28 CHIP	1
511-IRF640	TO220AB MOSFET 18AMPS	16
651-1935161	TERMINAL BLOCK 2P	1
	RECT HEAT SINK/FAN	1
	3/8 STRAIN RELIEFS	2
	3/4 STRAIN RELIEFS	2

Preparing to Build

I trust you found everything in your order but should you have any issue just contact me and I will take care of it.

The next thing we want is to make sure you are up to speed on soldering and electrostatic protection of the components in your kit. If you are not an experienced printed circuit builder I recommend you visit the site:
http://curiousinventor.com/guides/How_To_Solder
And check out there extremely good video on soldering correctly. Even if you are an expert it is a good video to watch.

Another issue you must be aware of is that some electronic components can be damaged easily by electrostatic charges that can build up in you or your equipment. We have all been shocked by walking on carpet and grabbing a door knob before. This is electrostatic charge in action. It takes much less than this to hurt some of our parts. If you are unfamiliar with procedures to protect from this please use the internet to research it before opening your parts up. **You can damage your parts if handled wrong!**

You will need a few tools that do not come with your kit to build the LYNX. You will need a good soldering iron. I can not stress enough that a good soldering iron makes a big difference in these projects. The little 15w cheap irons are more apt to hurt your parts by taking too long to get the parts up to soldering temperature than a good iron which can bring it up to temp very fast. Remember it is more how long you keep the part hot than it is how hot you get it within reasonable soldering temperatures. A good soldering iron can be had for very reasonable amounts of money. You can purchase one for $30 to $60 dollars. Most anything that is called a soldering station where there is a temperature control separate from the iron itself will more than likely be fine but make sure it is rated for more than 15 watts. I myself use a cheap Weller like this one
http://www.amazon.com/Weller-Soldering-Station-WLC100-120V/dp/B000ICEMYA
It works fine and is very inexpensive. I even saw this model on sale at Sears. Radio shack has a very nice looking digital model on sale but be careful as it does not allow you to replace the tip. Tips are a part that wear out and need replacing from time to time. While we are on tips get some. I recommend you get the smaller chisel shape as this work very well for all around board building.

You need solder so buy some. I recommend .032 size as the larger sizes tend to cause you to put too much solder on. How much? Go ahead and get a 1 lb spool as it's cheaper in large volume and you will go through it faster than you think. Make sure you are getting rosin core for electronics they make some solder for plumbing that has acid as the core this is a bad mistake to make.

You need some work area to work with good lighting. Do not attempt to solder circuit boards in poorly lighted areas. If you wear reading glasses go get them you will want

them I promise you. I recommend a set of helping hands like this:
http://www.radioshack.com/product/index.jsp?productId=2104639&cp=&parentPage=search

STEP 1

If you will be running on other than 120 volts please see appendix B before proceeding.

If you will be powering you lights off a different supply than the board please see appendix C before proceeding.

Install all chip sockets and the clock module

LYNX board after the sockets and Clock module is installed

Ok we are ready to start assembly of the LYNX. Begin by opening and removing all of the chip sockets (DIP SOCKETS). There are a number of different sizes (5 sizes, 11 total sockets). We will start with the smallest of these which is the 8 pin socket. Now all of the components have marking on the top side of the PCB board to show their location but you must pay attention to their orientation so they have the correct pins in the correct place. The socket locations all have rectangles with little round notches on one end of them with the other end being flat. The notched end is the end that pin #1 of the chip will go to. On the circuit board you will find the area marked out for the 8 pin socket and it will be labeled RS485. The marking will have one end with a round notch on it. The notches on all the sockets with the exception being the largest one will face to the right looking at the board as it is in the image above. When I reference left or right top or bottom in these instructions it will be as the board sits in the photo.

All soldering takes place on the bottom or (back) of the board away from the markings. Remember that when you turn the board over to the back every thing reverses on you.

Everyone has they own way of holding the socket in until they are soldered in. I like to turn the board over to the back and put the least amount of solder I can over one of the middle holes on one side of the socket. This allows you to put the pins of the other side of the socket through and hold the socket while pushing extremely easy. Then you heat that one hole on the back. When the solder melts the socket will drop in. remove the iron and it will cool and hold the socket in until you are done. Make sure to reheat this pin while doing the others to insure you have a good joint. Some people prefer to use tape to hold them in and some even super glue them on first and then solder. Make sure your socket is in the correct holes and that it faces the correct way and then solder the other pins in. If you are happy with it you can go ahead and start soldering the other sockets in. Be careful on the largest socket as it faces different than the rest. And check each one for direction before soldering it. Pay careful attention that you are putting the right size socket in the correct set of holes

Now once the sockets are all in lets find the 40 MHz clock module pn # 520tch4000-x. It is a shiny square with four pins. The spot for it is next to and right of the RS485 chip where we started as is marked XTAL. Notice that there is a white dot on the bottom right of the markings for it. A dot next to a device usually indicates where pin #1 goes. If you look on the module you will see a small black dot above one of the pins. Make sure the two dots are as close together as you can get them when you insert the module into the board. Now if it is correct solder the four pins to the board.

That’s a lot of soldering so take a break. If you try to do too much in one sitting you will start making too many mistakes and mistakes with solder are costly in time. Notice that we started with fairly short items. It is best to put short items on and work out to the taller items as you go. As you progress you will understand better why this is. The image at the top of this section is what it should look like at this point.

STEP 2

LYNX after step 2

We will now install the first set of Sip resistors. Sip (Single Inline Package) resistors allow us to use less space and save time as well as money in designing systems. They are a number of resistors in one little multi legged package. The first ones we will install are the 220k ohm resisters pn # 652-4608X-102-220K these are orange in color (there are two different sets of sip resistors colored orange so check the pn on the dip should be 8x-2-224). They go just above the Warning High Voltage Line. It can sometimes matter as you will see which direction these sips are inserted into the board as some times where pin 1 is matters. In this case it does not matter but I put the printing toward the bottom of the board. You will see the four spots for these marked clearly with a rectangle around 8 holes and the lettering 220k on the left of each one. Solder them in once you are sure they are correctly inserted.

Next locate the sip resistors pn# 268-10-RC these are 10 ohm and black in color. You will see just above the sips we just installed the same type of setup marked 10 on the left. Install all four of these also and the direction once again is not important but I always put the text to the bottom edge of the board. Solder them in when your sure their in the correct location.

Now we will install the last sip resistors in the board. These are 15k
pn # 652-4608X-1LF-15K sips and are also orange in color.

WARNING it does matter which way these go into the board. Notice there is a white dot printed on the board at the right side of the location for the sip on the top side. Make sure you put the dot on one side of the sip part to the dot on the board. Not doing so will make for very bad day for you. The text on the side of this sip should be facing the upper edge of the board.

STEP 3

LYNX after install of parts from step 3

Locate the seven little capacitors pn # 581-SA105E104Z these are tiny little orange bumps on leads. Now locate the seven capsule shaped marking on the board. Four are on the right side of the tc4467 chip sockets (14 pin sockets at bottom) and are vertical. Three are at the top of the top three sockets and are horizontal. These have no polarity as some capacitors do so you may insert them any way you like through the two holes inside the capsule shape area. Solder them in.

Now locate the 4.7 k resistor pn# 299-4.7K-RC (it's the smaller of the two single resistors) you will find a location marked for it between two of the capacitors we just installed at the top of the board. It will be just under the label "DMX IN" and is marked with a rectangle and the marking 4.7 K. Install it and again the direction does not matter.

Now let's insert the small rectifier's pn# 625-W005G-E4 you will find marking for the locations of these two devices just to the left of the transformer location. They are marked "Rect" and are circles with four holes in them. Make note that there are "+" signs in the lower left corner of each. It is very important that you line the "+" mark on the part and the "+" mark on the board up as close to each other as possible when installing these parts.

Now find the fuse pn# 576-0314020.hxp and the two fuse clips pn# 576-01020071H it is best to assemble these parts together before we insert then into the board and solder. Notice that the clips have one side that goes to the outside of the fuse to keep it from sliding past it. Put both the clips on the fuse and insert the clips into the board making sure the clips are down flush with the board and then solder them in place using plenty of solder and heat. (You may want to turn up your soldering iron for these they will suck up your heat). These joints need to be good as all of the current of the system runs through them.

Find your 35 amp rectifier pn# 625-GBPC3506W-E4 which is a good size part. It may have a black heat sink attached to it already. It will go into the location marked as GBPC 3506 on the board under the transformer. Notice that there is a cut corner on the square of the image on the board. Now this needs to be soldered well also and will need your iron setup higher as it is a large piece of metal. Use plenty of heat, time and solder on all four legs as again all the current goes through here. The last parts we will install in this section are the 3 pin jumper header pn# 538-22-03-2031 and the 2 pin one pn# 538-22-03-2021. The 3 pin one goes at the top edge of the board between the labels that say "Program Address" and "Operate". The two pin one goes just above the label "Terminate DMX" these go with the long legs up. Just above this 2 pin header is a place for the 120 ohm resistor pn# 299-120-RC. There is a rectangle there for it with two holes and it is labeled 120. Once this soldering is complete take a moment to look over the board as a whole for any missed pins that you have installed but missed when soldering. And make sure you are happy with the look of all your solder joints. They should not look rough and grainy. If you find any that look like that reheat them and add the smallest amount of solder you can to add some flux and they should reflow out better. You have come a long way and this completes step 3 so take a break. You will be making "blinky blinky" in no time now. ☺

STEP 4

LYNX after step 4

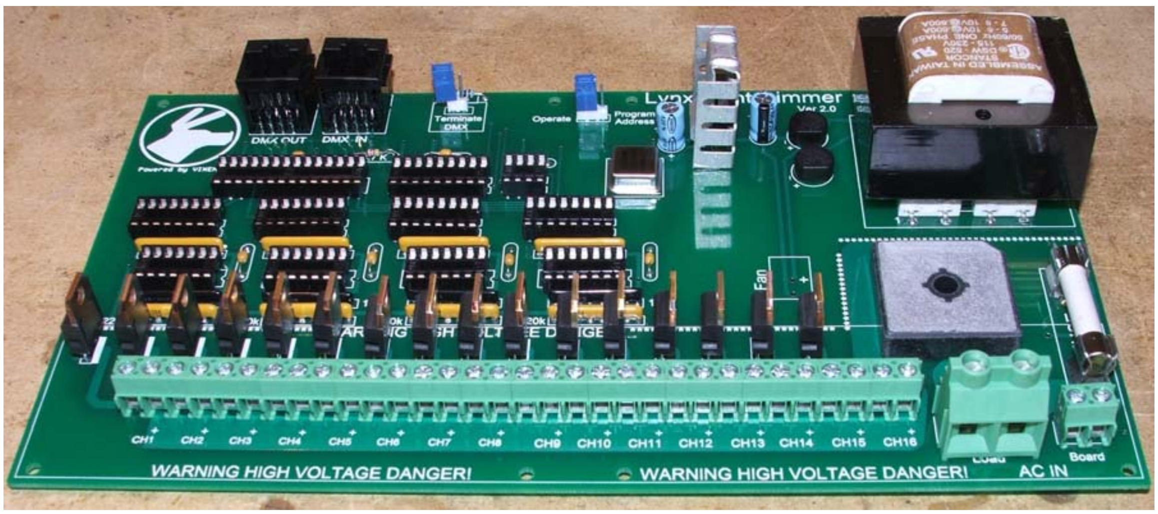
OK now that you're ready to proceed lets finish up the digital power supply section of the board. Find the two 100uf capacitors pn# 140-xrl25v100-RC and locate there positions to the left of the small rectifiers we already installed. There are marked with two small circles with 100uf above them. These a sensitive to the direction of install so notice that one hole in the board is marked with a very small "+". Now find on the capacitors that one side of them are marked with a black line with a "-"on it. This side goes away from the "+" on the board. Make sure this is in correctly and the parts are straight and solder them in. Now find the 5v regulator pn# 511-L7805ACV This will look just like the mosfet transistors that you have 16 of so check careful and make sure you have the correct part and not one of them. You will locate its place between the two capacitors we just install and it is marked 7805 on the PCB. The right side of its location has a white solid rectangle to indicate the direction it must go in. The flat metal back of the regulator must face this solid rectangle. Make sure you do not put it in too deep into the board it should fall in the holes a ways down and then stop on its own. If you look at its legs you will see it gets bigger at one point to get the spacing correct and will stop when you put it in (hold it up a little off of where it stops to allow the heats sink to lock on good). Solder it in making sure it is straight up and down.

Now that you're an expert at that do it 16 more times using the PN # 511-IRF640 mosfet transistors. You will see the identical same type of markings as you did with the 5v regulator along the bottom edge of the board just below the "Warning High Voltage Danger" line. Again follow the same procedure and align the flat metal side of the mosfet with the solid rectangle of the PCB location. Make sure there are no solder bridges and that you do not over use solder. These pins are close together and will be carrying line voltage so we don't want any short circuits here.

Let's install our "LOAD" terminal block PN # 651-1714971 it fits in to the two larger holes just above the AC IN marking on the board in the right bottom of the board. Make sure you have the square holes on the sides of the block facing the bottom edge of the board. Then install the "Board" terminal block PN # 651-1935161 left of it in the two little holes for it.

This completes step 4 so take another break you are almost done soldering.

STEP 5



LYNX after step 5

Let's finish up the soldering on your LYNX. Find two of the 16 connector terminal blocks pn # 651-1935307 these blocks need to be connected together to create one 32 connector block. Find the sides with the notch on one and the tit on the other and slide one up from the bottom to lock them together. Make sure the square holes are on the same side of both. Once you have done this place it into the 32 holes along the bottom of the board making sure the holes face the bottom edge of the board and solder this into place.

Find the two cat5 cable jacks pn # 571-5202604 and locate their positions at the left top of the board. They are labeled "DMX IN" and "DMX OUT". The picture up top shows four of them but this was the prototype and there should only be two on your board. Line up the eight little pins into the holes and snap the plastic legs into the holes of the board until the jack is flush with the board. Now it will hold itself while you solder. Get both of them soldered in.

Let's install the transformer next. It is pn # 802-DSW-520. Find the markings on the transformer next to the pins and locate the side with the numbers 1, 2, 3 and 4. This side goes to the bottom of the board. You should have no problem finding the location for it marked Transformer. Solder it in making sure it is firmly sitting flush against the board. It weights a lot and we don't want it flexing its pins when we move our dimmer around.

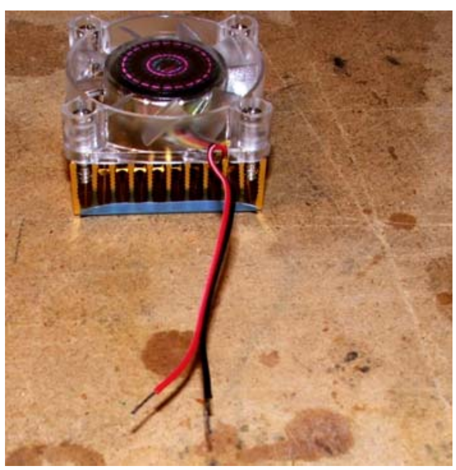
Find the Heat sink pn # 532-7128DG and locate along its bottom the three little tabs that stick down. Take you cutters and cut these off and any extra metal to make the bottom of the heat sink flat. If you have some put some heat sink compound on the 7805 5v regulator we installed earlier and slide this heat sink down on to it until it locks lightly on it. Be careful not to bend up you regulator pushing too hard. The flat side should be on the side the transformer is on.

Find the shunt tins pn # 649-65474-002LF and put one each on the three pin and the two pin header at the top of the board jumper the one marked "Terminate DMX" and jumper the side mark "OPERATE" on the three pin.

Pull out the Heatsink/Fan unit. Remove the stickers from the power cord. Cut the end off of the three wires close up leaving the full length of wire on the fan.

Now separate the yellow wire from the red and black all the way to the fan. Cut the yellow wire completely off close to the fan.

Cut the red and black wire 2 ½ inches from the fan and separate the two for inch. Strip the bare leaving about ¼ inch of bare wire at the ends. Twist the strands of fine metal wire tight and then add the smallest amount of solder you can to prepare them to be inserted into the board. See the picture below.

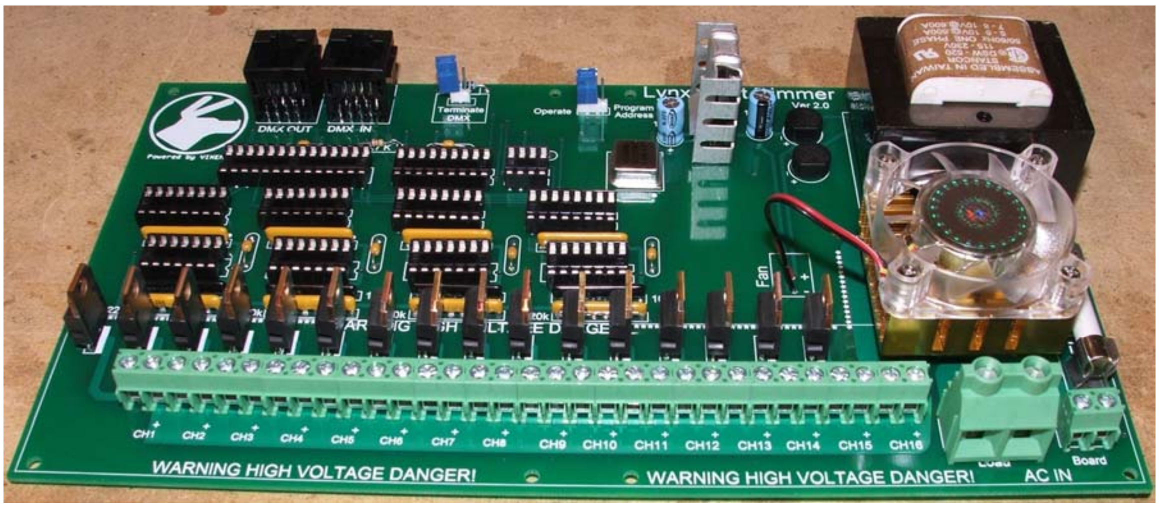


Ok now this is a VERY IMPORTANT PART! Do not skip this. Get yourself a paper towel and some household rubbing alcohol. Wet the towel and clean the large square rectifier that is just above the "LOAD" connector. Leave no lint and do not touch it. Now go wash your hands and dry them completely while the alcohol dries.

First test fit the unit by putting it in place centered on the top of the rectifier with the wire exiting on the left bottom corner of the fan. The wire should be able to go to the points marked on the board for the fan power. Now remove the blue tape and without touching the rectifier or the bottom of the heatsink push it straight down on the rectifier and hold down on it for a few seconds.

Now stick the red wire in the hole marked fan + and the black in the – hole and solder.

Great we are done soldering so turn you iron off put away all those items and get ready to do the final assemble of the LYNX.

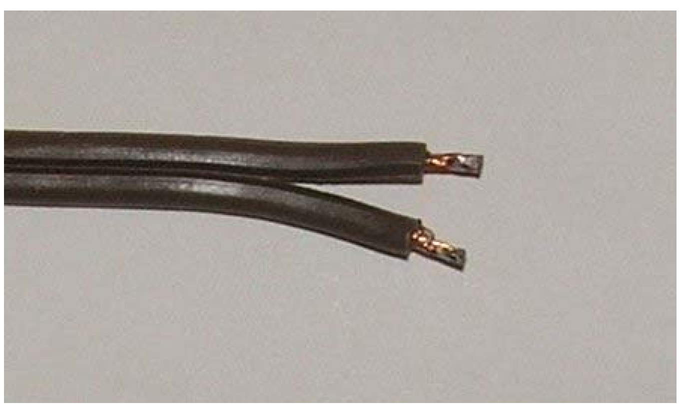


Lynx at this stage

Final Assembly

Now we need to insert the chips into there correct sockets. There is not much chance of you getting them in the wrong ones as the chips are all of different pin counts. There are four 847 chips and four 4467 chips. The rest all have only one each. The board is marked for the correct part. Get them oriented correctly with pin one in the correct position. Pin one is marked on the chips as a notch on the end where pin 1 is and sometimes a dot over pin one. All of the pin # 1 notches should face the side with the transformer on it except **the largest chip which is the other way do to layout requirements**. Make sure you put chips in very careful and do not bend any pins as they sometimes can be a challenge to insert straight. Take your time here and before pushing them in look over both side to make sure all pins are started straight. **TAKE YOUR TIME HERE!**

Now we must install the power cables.



Start by cutting the male end off the output power cords you intend to use for your LYNX. I use 15' indoor power cords you buy at big lots or dollar tree for about $1.50. You can use shorter but then you have to run more ext cords. It's a matter of opinion so do what works for you. Now strip and solder the ends where you cut the male plug off. Then cut them fairly short like in the photo above. You will need 16 of them ready to go.

You also need a heavy duty extension cord to cut the female end off of for the power input cable if you are supply both load and board from the same supply. Use only an outdoor rated heavy duty cable that's rated for 20 amps or more. Cut the female end off and use the black and the white conductor. Remove the ground conductor. Keep these very short (Review the images in final assembly before making this cable up.). This connects to the "Load" connecter if doing a single supply. If doing separate supplies the power cord for the board can be a cheap extension cord as the board will pull less than an amp. In the case of dual supplies feed the Power for the lights in the "Load" connector and the "Load" cable will need to be able to handle the full current.

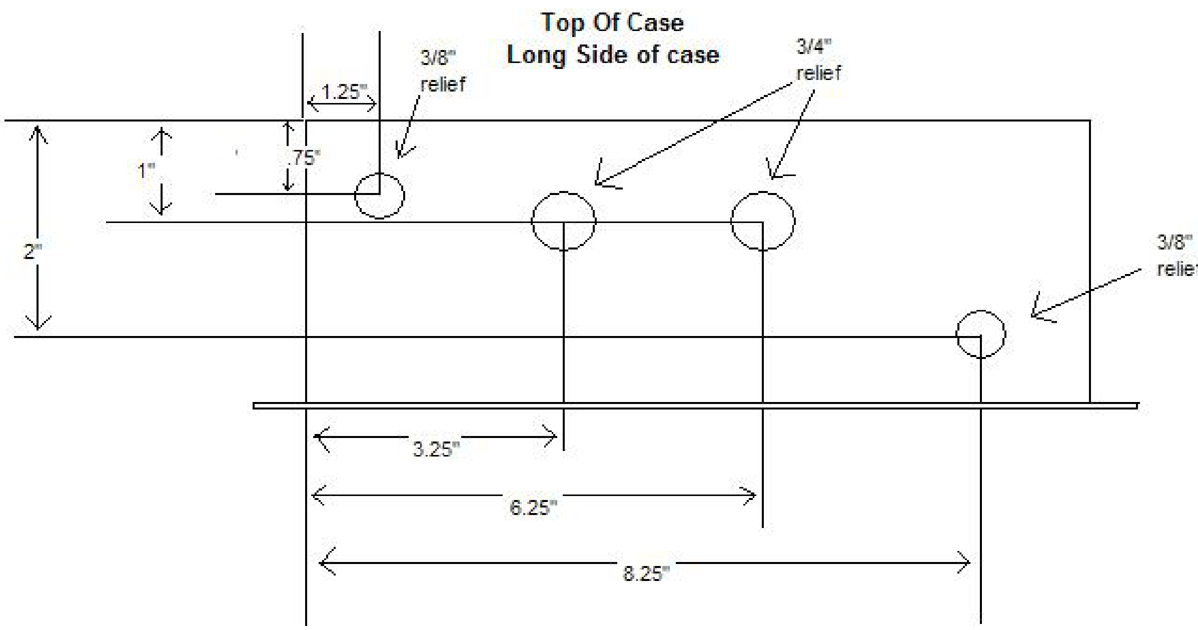
The PCB is setup for a single input of 120 volt AC in the Load connector to run the board and the lights by default. If you have not done Appendix B or C it is in this configuration!

Warning! If you have not completed the instructions in Appendix C you are not able to use separate supplies and the Load and Board connecters are interconnected at this point so you must only hook up one supply of the proper voltage!

If you have not done the instructions in Appendix B you must only attach 120 volts AC to the board it is not setup for 240 volts!

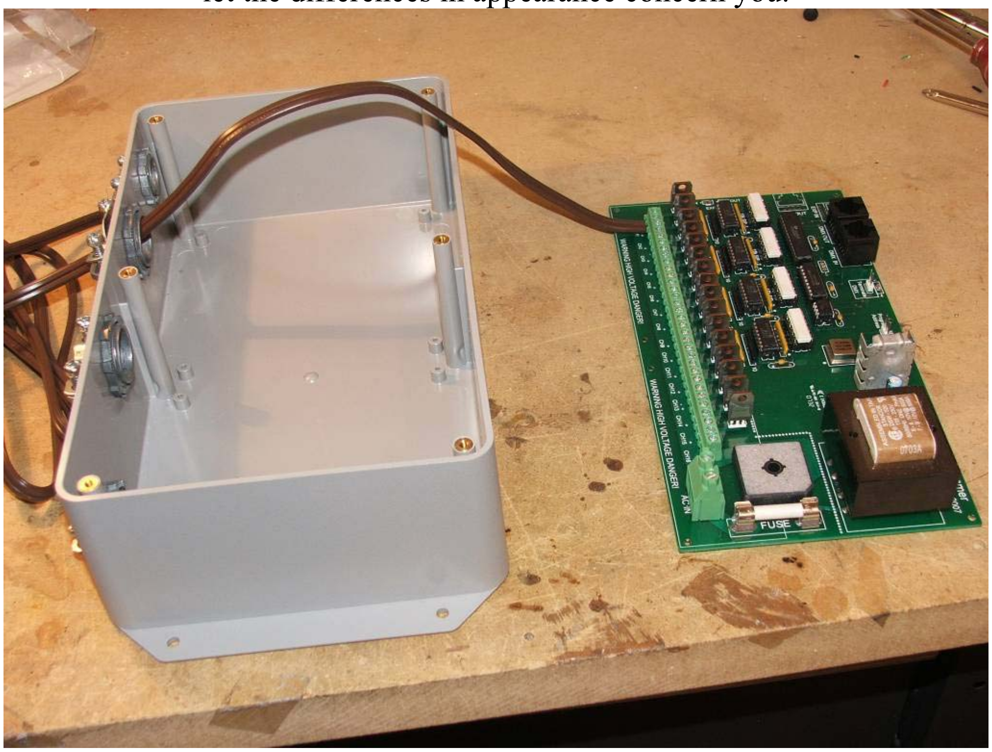
Strain Relief layout

We need to drill the holes and install the strain reliefs in the case next. Use the diagram below next to drill the holes for the reliefs



Drill the holes as outlined above to fit the reliefs tight. All measurements are in inches and are taken from the flat side of the case not the rounded corners.

The following pictures are of the protoboard prior to the heatsink being attached do not let the differences in appearance concern you.

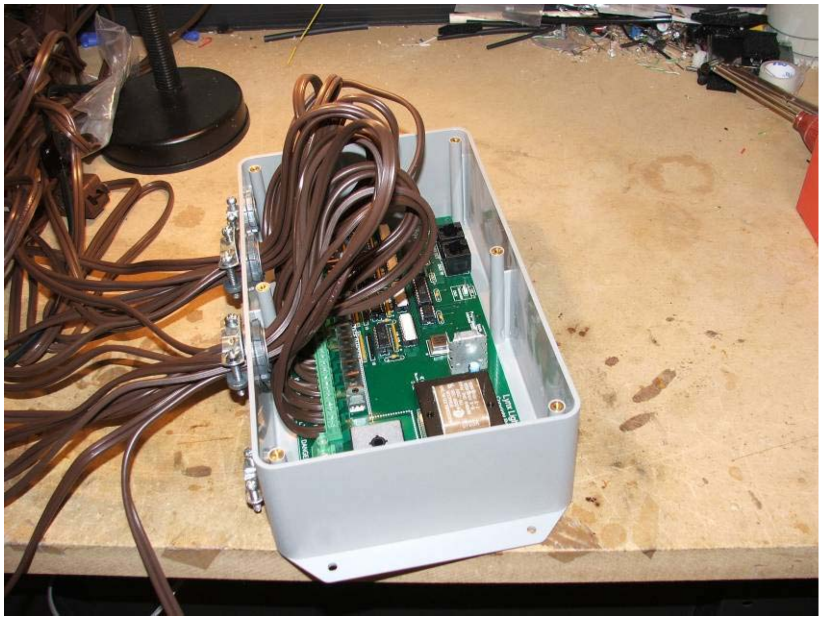


Now pull the first one through the left large strain relief all the way over the case and put the ends into the channel # 1 holes on the 32 connector terminal block. The lead connected to the larger slot on plugs that have it should connect to the channel connector **without** the "+" next to it. You will find that the wires on the cables normal are ribbed on the "-"side and smooth on the "+" side so make sure and hook up the polarity correct to the board.

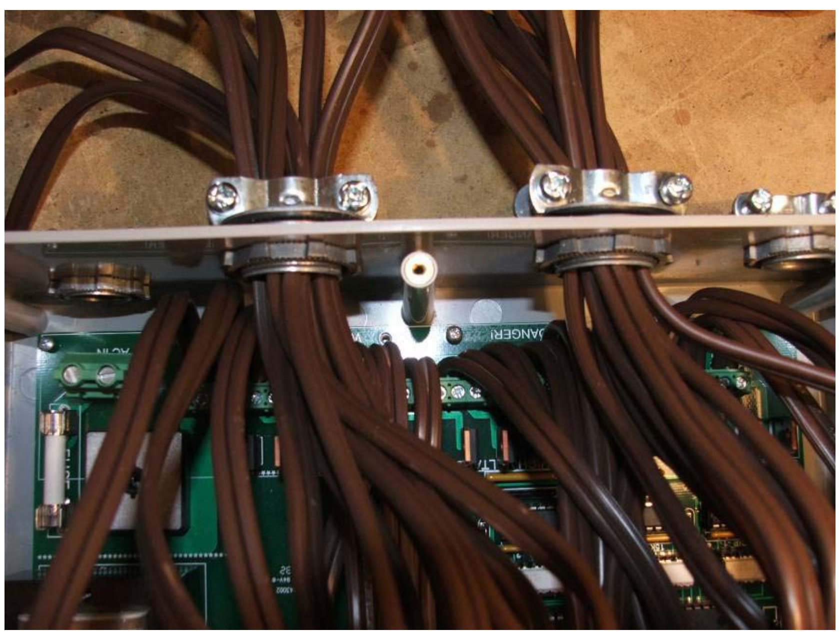
I recommend strongly that you mark the ends with the channel number so you can tell when you are hooking it up which end is which channel. I use permanent marker but you can do it anyway that works for you. Make sure they are inserted all the way in and no metal is showing. Tighten the screws down tight and then pull on the cable to make sure it's tight. Continue with the next seven cables then move to the next big strain relief to do the next eight.

Now we will install the board into the enclosure. Leave the slack of the cables and lift the board up while arching the cables up like in the image above.

Now tilt the bottom edge of the board down into the case and slide it into the bottom as I'm doing in the photo above.

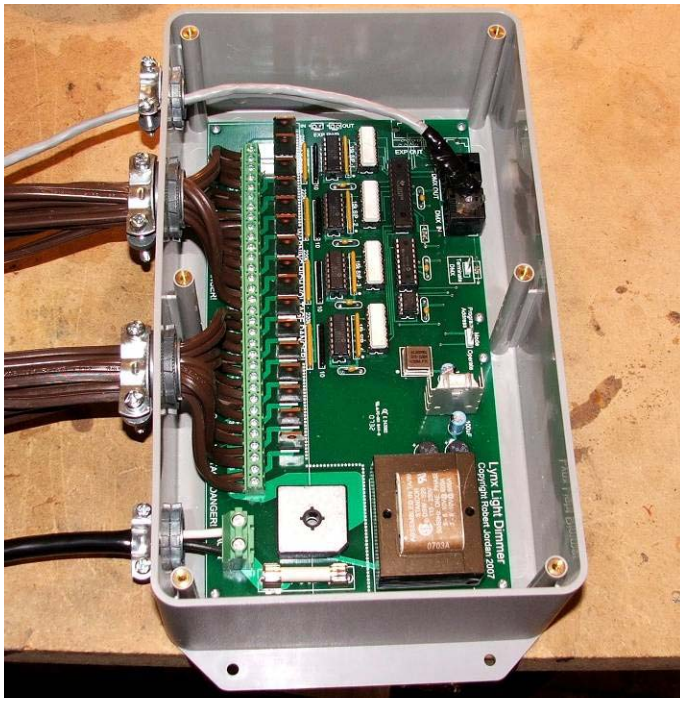


And with that the board is in. Now using the screws that held the board in when you received it put all the screws in but the middle bottom ones but do not tighten any of them yet.



Pull the cords forward out of your way and install the middle screws in the bottom and tighten them. Then tighten the others also. There are eight in all to install.

Now pull the slack out of each cable one at a time until you have it all out but are not pulling on the board and tighten up the strain relief's holding them to where pulling on the cables would never pull on the board.



Install you power cable as shown in this image. The outer housing should go into the strain relief and be tighten down on the outer insulation not the inner conductors. Make sure the two connector terminal block is tight we don't want these wires slipping out.

Bring you cat5 DMX cable into the upper strain relief and plug it into the "DMX IN" jack.

Congratulation you have a finished LYNX!

Make sure you are not in contact with any part of the LYNX and power it up while being ready to disconnect it. If you have no mistakes in the soldering or building, nothing should happen it will sit there without doing a thing. This is a good sign (no magic smoke escaped).

Sit back take a deep breath you did it! Pat yourself on the back and have a cold whatever it is you enjoy. When you're ready you can move on to the operation section and learn how to use it.

<u>Programming and Operation of the LYNX</u>

You will need a DMX dongle on your computer to create DMX. I can only recommend the Enttec DMX Pro at this time. I have found it to work very well. The DMX open I have does not have very reliable timing and to try and get stable operation with Vixen K.C. had to add a delay between frames which hurts its update speed. The Pro will provide you with perfect DMX all the time and no errors. To wire up your DMX dongle to the LYNX use a XLR end and solder a cat5 cable to it. The pin out should be

DMX DONGLE	LYNX CAT 5 END
Pin #2	Pin #2
Pin #3	Pin #1

That's it. Once you have your cable ready we need to setup your LYNX.

The LYNX first needs to be programmed for its starting channel. This is the channel that #1 output cable will be addressed by in the DMX data. If you want this LYNX to handle channels 80 – 86 you would assign it the starting channel of 80.

To program it we need to fire up vixen and setup a sequence with 512 channels and the plug-in setup for the Enttec DMX Pro on the com port yours is on.

There is a jumper on the board marked "Terminate DMX" This should be on if this is the only DMX device on your string "universe" or the last one. Otherwise if it's not the last DMX device on the line move it over so it does not connect the two pins and make sure the last device has itself terminated. In this case it is the only device so With the **LYNX UNPLUGGED!** put it on.

Now set the channel #1 intensity to the channel number you want to be your starting address and all other channels to 0 or off. If it is higher than 255 then set #1 at 255 and set channel #2 to the additional amount it will take to get to that channel. For example if I want my starting address to be 300 I would set channel #1 to 255 and channel #2 to 45 since 255 + 45 = 300. Make sure vixen is set to repeat. Start the sequence so that we have the channel #1 and #2 data going out.

With the **LYNX UNPLUGGED!** Move the jumper to the program address side. Now power up the LYNX for three full seconds and then turn it off by unplugging it. **Now with it unplugged** move the jumper back to the operate side.

That's it! It is set to operate on the channel you wanted. You can change it anytime and as often as you need. It will remember the address for at least 20 years with no power applied.

Put your case top on for safety and try your new dimmer out.

Do not load the LYNX with more than 2 amps (six strings of 100 mini lights typical) on any channel and no more than 18 amps total (5400 mini lights). It is fused at 20 amps but we need some headroom and we don't want any blown fuses at critical parts of shows ruining our good time do we.

Being DMX the lynx can be controlled from programs other than Vixen if you so choose. it should work with any DMX devices and I have tested it using a number of downloadable software from the internet including the trial edition of Light Factory that comes with the DMX PRO.

When using Vixen I recommend you set Vixen to "draw at 255 levels" instead of 0-100 levels. You want to have 0 -255 levels this will give you access to all 256 levels it provides and not limiting it to just 100 steps you can manual set.

To connect another LYNX to this one simply use a standard straight through Cat5 cable to go from the "DMX OUT" jack to the next LYNX and connect it to the "DMX IN" jack.

REMEMBER ALWAYS HAVE IT UNPLUGGED WHEN WORKING WITH IT. THERE IS LINE POWER ON THE BOARD AT ALL TIMES IT IS PLUGGED IN AND THE OUTLETS HAVE POWER AT THEM. BE SAFE!

Thank you, enjoy your LYNX and
MAY GOD BLESS YOU IN ALL YOU DO!

RJ

APPENDIX A

Technical Theory of Operation

Most light dimmers you see today are "Phase Angle" dimmers and take in AC power and use a microcontroller to monitor when the AC waveform falls through the zero cross point. They then wait a preset amount of time and then trigger a triac on. Triacs once turned on will stay on as long as there is enough current flowing through them. This means once triggered you can't turn off the triac. It will only shut off when the current flowing through it drops close to zero. This will only occur when you approach zero cross again. This also means you can have problems sometimes controlling LED or low power devices as they might not draw enough current to keep the triac on once triggered. To have half brightness you would find the zero cross point and since you know that the triac is off at this point you wait one quarter of a cycle and then you trigger the triac on. It is then on for one quarter of a cycle till you approach the next zero cross point at the half cycle point when the current will reach close to zero allowing the triac to turn off. Since that was half the time it should have been on the average voltage will be half of what it should have been. While it works well it can be better. At some points in the cycle you have a voltage slope that is very steep so very little difference in on time makes a fairly big difference in the voltage it starts conducting at. Now also imagine that you have to divide this up into 256 chunks of time and we are limited to being a quarter cycle divided by 256. If you divide it equal and you think about an AC waveform you can see that the same amount of time in the beginning and the end of the cycle makes big differences while the same time in the middle of the waveform at the top where it curves over and starts down would make much less voltage difference. This causes an issue where the lights have less resolution in the beginning and at the end than in the middle and vary at low levels slightly. Add these together and you have a system that is still good it's just not as good as it could be. There are ways to limit these issues and some dimmers of course try to limit it while others do not bother. The very high end commercial stage dimmers use every trick in the book to reduce these variations and do a good job but not too many of us can afford these.

One of the newer, more advanced methods to dim lights is called "Sine Wave Dimming"

In phase angle we control how long the power is on. In "Sine Wave Dimming" it is a little different. Since all we can control is time on or amplitude of the wave to control energy delivered, it controls the amplitude. By breaking the wave into many little sections and using PWM to sample a part of them. If done quickly we can recreate the same wave form at different amplitude. This technique would be a little costly on the

DIY scale as you would need to control both side of an AC waveform to do true “Sine Wave Dimming” so I came up with a “close enough” method to make it work cheaper for us.

Read this it explains better than I can:
http://www.mikrocontroller.net/attachment/5402/Sinewave_Dimmer_Technology.pdf

The Lynx works a little different. I will call it “Pulsed Wave Dimming” For lack of a better term. First we convert your incoming AC power to Pulsed DC. Why? I’m glad you asked. Pulsed DC gives me half sine wave that I can switch with just a mosfet. Mosfets can be turned on and off at our will not based on the zero cross. They will trigger on and off at very precise points that are very repeatable. This puts us in the drivers seat not the other way around. If you think about pulsed DC it looks like an AC waveform folded onto itself. This is where we get the big difference. We are no longer tied to a fixed time period for our pulse width modulation. We choose how long a period to chop into 256 pieces. Imagine we chose to do this in one tenth of a quarter cycle instead of a complete quarter cycle? We would then sample in our example of half brightness 50 percent of each section of the waveform not 50 percent of the waveform itself. This would lead to an averaging of the time verses voltage change equation. And if we made sure we did not use an even factor like 10 times but instead maybe 9 times we could make it average out across cycles also. The Lynx is a simplified version of this thinking. There is one more trick we have up our sleeve to help when needed. If we made our PWM divide instead of by 256 steps 4096 steps instead we would have even more ability to control the characteristics of the output. This is accomplished by using a dedicated hardware PWM chip instead of the microcontroller. We see very accurate PWM this way that will not vary do to the interruptions of the microcontroller when it need to handle communication and house keeping chores.

How does the Lynx do this? It uses a pic chip to run the communications and then streams the levels needed to the TLC5940 PWM chip. This chip is designed to dim LEDs using the PWM it creates and do so with unbelievable accuracy. We then output this PWM to the mosfets. But first we use an optocoupler chip K847P to isolate the digital side from the Power side for safety as well as to prevent you computer from getting fried. Then since we want to be able to switch the mosfets on and off very fast and with a clean high current charge that will prevent them from spending too much time in the linear phase of switching causing them to heat up (this is why no heatsink is required). We take this signal and trigger a mosfet driver chip TC4467 which will then trigger the mosfet. The driver is a charge pump and Schmitt trigger which can hit the mosfet with enough current to overcome the capacitance of it very fast and cleanly. You will notice there are two different 10v outputs being used from the transformer. These provide power for the digital circuits through a 5v regulator on one side and 10 volts to power the mosfets drivers on the other. These must stay separated to insure isolation of our system from the output power. The reason for this is we must tie the ground of the mosfet driver power to the ground of the DC output mosfets to allow the driver to trigger the mosfets. This isolation runs down the middle of the K847P chips and between the two small rectifiers and then down the middle of the Transformer.

One point is the Lynx is in idle mode at this time. What I mean is the hardware has so much more potential than I have it doing. For one example the PWM frequency which controls the sampling rate is running pretty slow compared to it capability. It is many times faster than 120 Hz the phase angle dimmers are tied to, but much slower than it can run. I did this since it worked well at this and I wanted to prevent RF frequency noise from becoming a problem.

I also have 4096 levels of PWM instead of the 256 levels I am using on it. This gives me the ability to do all kinds of tweaking to custom fit applications. For example I could move to 4096 and setup a value lookup table to customize the dimming curve to match different lighting to have exact dimming curves so they all dim the same. Your Led's could be at the same light output as you minis at the same level, ETC. In the end the Lynx is my design to meet my standards. It is targeted to be able to be adaptable so we can handle all the new LED designs as they come out.

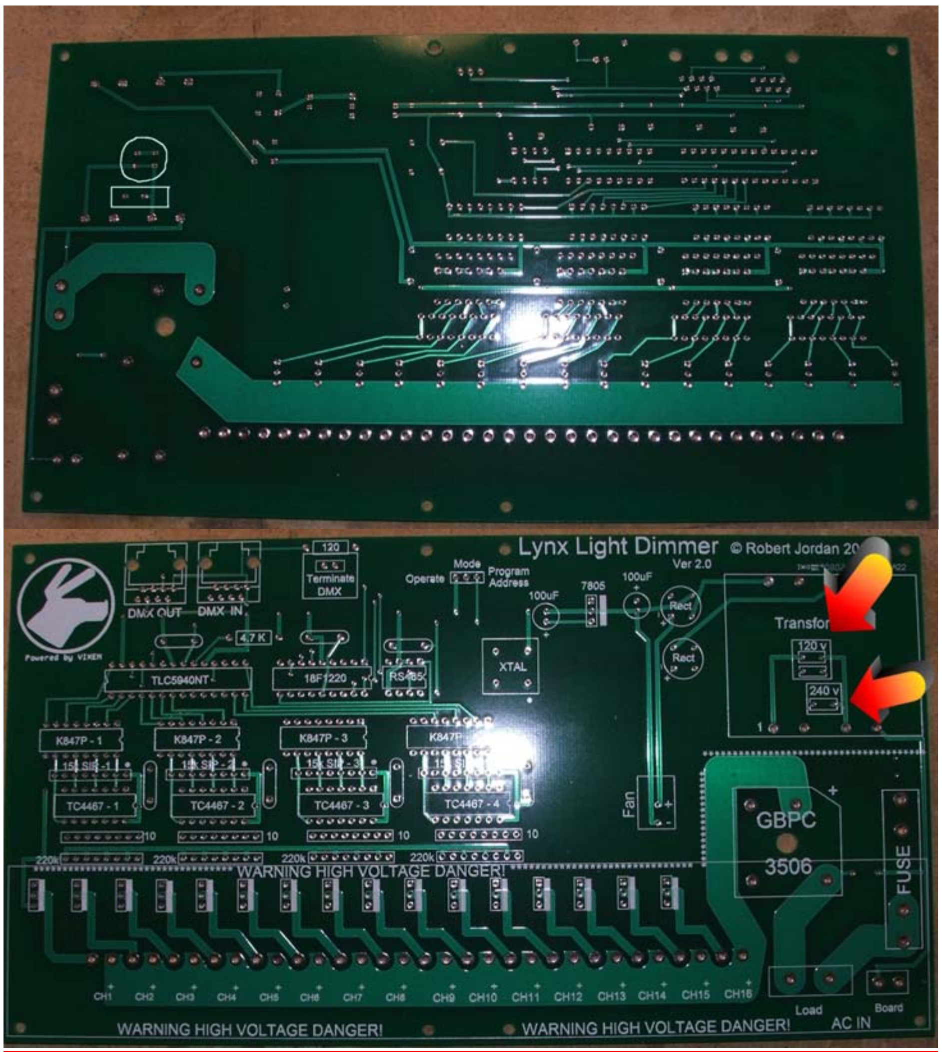
In the long run this is a simple solution that got me what I was looking for. Plug some mini lights in, set the level to 5 turn the lights out and get your eyes adjusted. I think you will agree that what you see is a steady low level dimming good enough for anyone. Do a few very slow fades and see if it meets you standards I hope it does.

I hope this gives you a feel for how the Lynx operates.

RJ

APPENDIX B

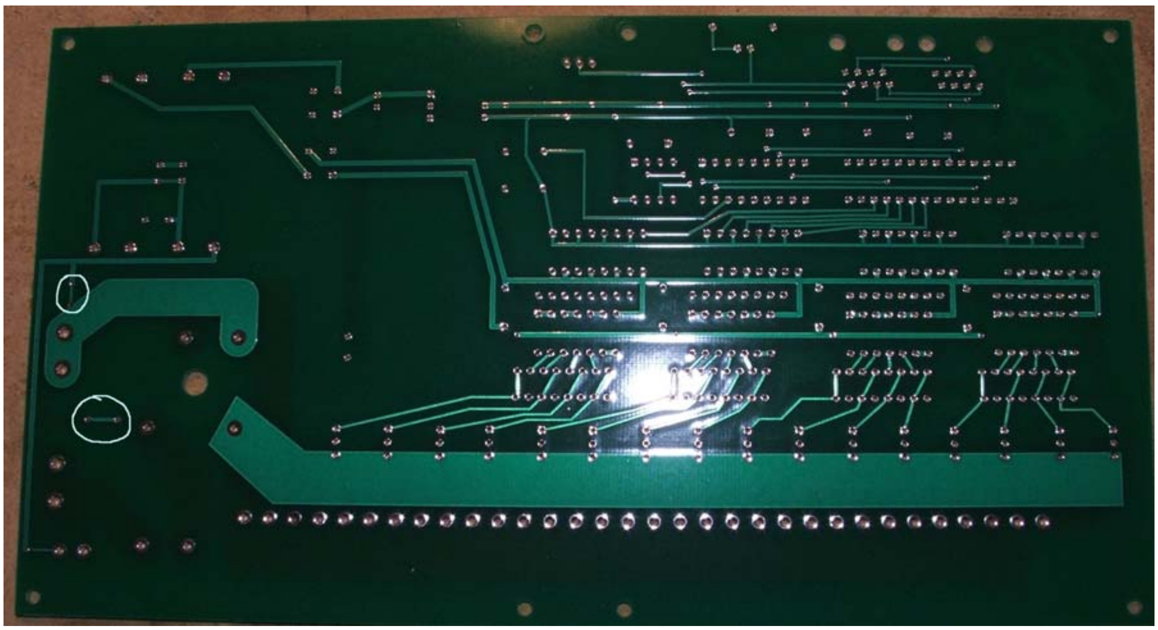
To operate from 240 volts we must make a few changes to the board before beginning construction of it. Find the two traces circled in the photo below. These are on the bottom of the board not the top side where the printing is. On the top side of the board they are under the transformer and have rectangles marked 120v.



You need to cut the 120v traces on the bottom between the two pads.
Now find the two pads that I have a rectangle around on the first photo. On the top it is marked as 240v. Jumper these pads on the bottom of the board and trim the leads close on the top so it does not interfere with you putting the transformer in. Your board is now ready for 240v input power.

APPENDIX C

To use a different supply for the lights than the for the board power, such as running low voltage lights, we need to cut the trace jumpers that interconnect the two circuits. Find the two traces on the back of the board circled in this picture and cut them between the pads.



This will separate the “Load” and “Board” inputs so they may be feed with different supplies. Make sure and feed the board with 120volts ac, or 240 volts ac if you have changed the 120/240 jumpers as outlined in appendix B, thought the “Board” ac in connector. And feed the lights via the “Load” input connector. The “Load” can be supplied either AC or DC between 5v – 200v.

Troubleshooting

The only quick and easy test is to check for power. There are two power systems and you need to be careful not to short the two together and break isolation as this could have a bad outcome. Never test on the board with it hooked to your DMX source so if you do this you would not harm you computer or DMX dongle. Check for voltage at the two points in the photo below. These are both little .1 uf capacitors and you check across the two leads of them. The one above the Pic chip should have 4.9 – 5.2 volts across it. And the one next to the 4467 mosfet driver should have 10 – 12 volts on it. Be careful as when the board is powered up there is high voltage on it.

If you have these it gets a little more complicated to diagnose and you should contact me.