B.Y.O.C. 10-band graphic equalizer instructions
version 1.2

Checklist

Note: Your kit will likely have 6 small extra LEDs and resistors. These components were included to add “backlighting” to the faders. We've decided that this feature complicates the build too much. We “officially” do not advertise this feature as something that is included with the kit nor do we recommend attempting to add this feature to your build. But if you insist on adding backlighting, please visit the EQ lounge at the BYOC discussion forum board.buildyourownclone.com for more details about this feature.

Resistors:
1 - 470ohm (yellow/purple/black/black/brown)
1 - 4.7k (yellow/purple/black/brown/brown)
1 - 6.8k (blue/gray/black/brown/brown)
1 - 470k (yellow/purple/black/orange/brown)
1 - 2.2m (red/red/black/yellow/brown)

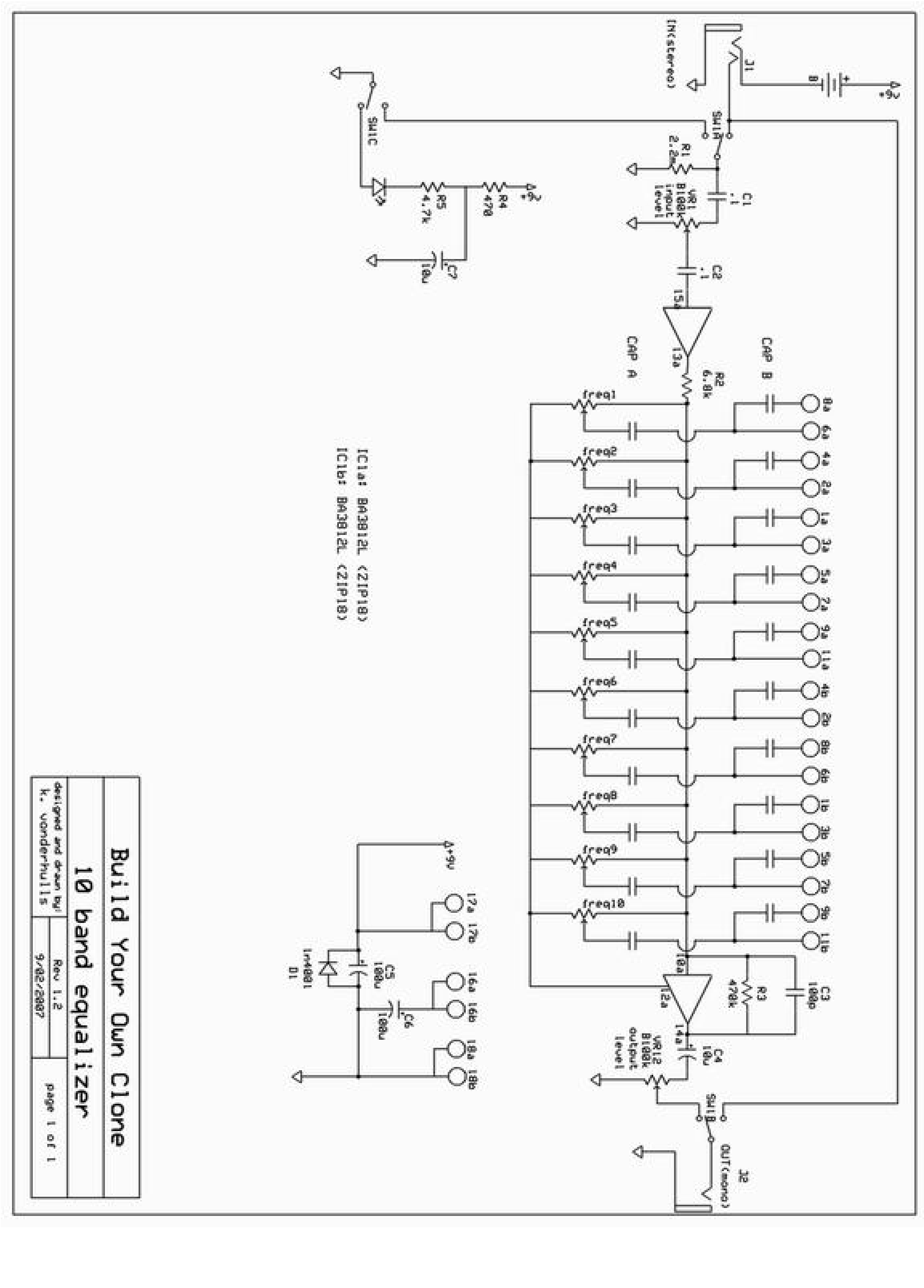
Capacitors:
1 - 100pf ceramic disc (101)
1 - 180pf ceramic disc (181)
1 - 220p ceramic disc (221)
1 - 270pf ceramic disc (271)
1 - 330pf ceramic disc (331)
1 - 470pf ceramic disc (471)
1 - 680pf ceramic disc (681)
1 - 820pf ceramic disc (821)
1 - .001uf film (102)
1 - .0027uf film (272)
1 - .0033uf film (332)
1 - .0047uf film (472)
2 - .0068uf film (682)
1 - .0082uf film (822)
2 - .01uf film (103)
1 - .015uf film (153)
1 - .018uf film (183)
2 - .027uf film (273)
1 - .033uf film (333)
1 - .068uf film (683)
1 - .082uf film (823)
3 - .1uf film (104)
1 - .15uf film (154)
1 - .18uf film (184)
1 - .27uf film (274)
1 - .33uf film (334)
1 - 1uf aluminum electrolytic
1 - 3.3uf aluminum electrolytic
2 - 10uf aluminum electrolytic
2 - 100uf aluminum electrolytic

Diode:
1 - red LED status light

IC:
2 - BA3812L (ZIP 18 package)
4 - 9pin socket strips

Potentiometers:
12 - B100k miniature sliders

Hardware:
3 - 4/40 1 & 1/8” screws
3 - 3/8 round nylon spacer 6 x 3/8”
6 - 4/40 hex nut
6 - #4 tooth lock washer
4 - 6/32 screws (for enclosure)
1 - pre-tooled enclosure
1 - circuit board
1 - 3PDT foot switch
1 - 1/4” stereo jack
1 - 1/4” mono jack
1 - battery snap
1 - AC adaptor jack
4 - bumpers
hook up wire


Build Your Own Clone
10 band equalizer
designed and drawn by:
k. vanderhuils
Rev 1.2
9/02/2007
page 1 of 1
IC1a: BA3812L (ZIP18)
IC1b: BA3812L (ZIP18)
CAP A
CAP B
IN(stereo)
OUT(mono)

Selecting the frequencies

The BYOC 10 band EQ has 12 sliders. 2 are for input and output levels. The other 10 are for adjusing frequencies. The pedal can control 10 frequencies, but the kit comes with components for 15 different frequencies. So you will need to decide what you will be using this pedal for before you begin building.

You will want to tailor the frequencies to suite the situation in which you will be using the pedal. To do this you need to consider the spectrum of the speakers you will be using.

A PA system usually operates between 20Hz and 20kHz. So for example, if you wanted an EQ for your acoustic guitar, you'd likely want to build your EQ pedal with a frequency spread between 30Hz and 16kHz and omitt 5 frequencies inbetween to give yourself fairly even steps inbetween frequencies. So a good spread for use on a PA system would be as follows:

FREQ capB/capA
33Hz = .082/3.3
100Hz = .027/1
330Hz = .0082/.33
620Hz = .0047/.18
1kHz = .0027/.1
2.2kHz = .001/.068
3.3kHz = 820p/.033
6.2kHz = 470p/.018
10kHz = 270p/.01
16kHz = 180p/.0068
Keep in mind, that the higher the frequency, the less your ears will be able to differenciate between frequencies. So you'll notice the step between 33Hz(freq 1) and 100Hz(freq2) is only 67Hz. And the step between 10kHz (freq9) and 16kHz(freq10) is 6000Hz. But the audible step between the two is relatively the same.

Now if you are planning to use this EQ pedal with a guitar amp, and only a guitar amp, then the range of bandwidth is much smaller, and you will want to use a tighter frequency spread. You should check the manufacturers data sheet for your speakers to find out what frequencies it operates between. And also to find out which frequencies your speakers generate the most output on. This is important because you may want to stack your spread in this area to give you more control over the most critical range, particularly if you are tailoring your EQ pedal to one specific amp. A good spread for most electric guitar amp use would be as follows:

FREQ capB/capA
100Hz = .027/1
330Hz = .0082/.33
410Hz = .0068/.27
620Hz = .0047/.18
820Hz = .0033/.15
1kHz = .0027/.1
2.2kHz = .001/.068
3.3kHz = 820p/.033
4.1kHz = 680p/.027

6.2kHz = 470p/.018

Here is the list of capacitors and corresponding frequencies that are supplied with the BYOC 10 band EQ kit:

FREQ capB/CapA
33Hz = .082/3.3
100Hz = .027/1
330Hz = .0082/.33
410Hz = .0068/.27
620Hz = .0047/.18
820Hz = .0033/.15
1kHz = .0027/.1
2.2kHz = .001/.068
3.3kHz = 820p/.033
4.1kHz = 680p/.027
6.2kHz = 470p/.018
8.2kHz = 330p/.015
10kHz = 270p/.01
16kHz = 180p/.0068

This is a list you can use to find a lot of different frequencies with commonly available capacitor values. All frequencies are listed in Hz. All caps listed in microfarads:

FREQ capB/capA
12 = .22/10
14 = .22/8.2
15 = .18/8.2
16 = .18/6.8
18 = .15/6.8
22 = .1/6.8
25 = .1/4.7
33 = .082/3.3
41 = .068/2.7
50 = .056/2.2
56 = .047/2.2
62 = .047/1.8
68 = .039/1.8
74 = .033/1.8
82 = .033/1.5
88 = .0271.5
100 = .027/1

It's very simple to multiply a frequency by 10. The rule is for every decimal place in the frequency that you move to the right, move the decimal the same number of places to the left for the capacitors.

So for example, the formula above states that 15Hz uses 0.18uf for capcaitor B and 8.2uf for capcaitor A. If we want 15kHz(15000Hz), we need to move the decimal of the capacitors 3 places to the left, because we moved the decimal in the frequency 3 places to the right. So cap

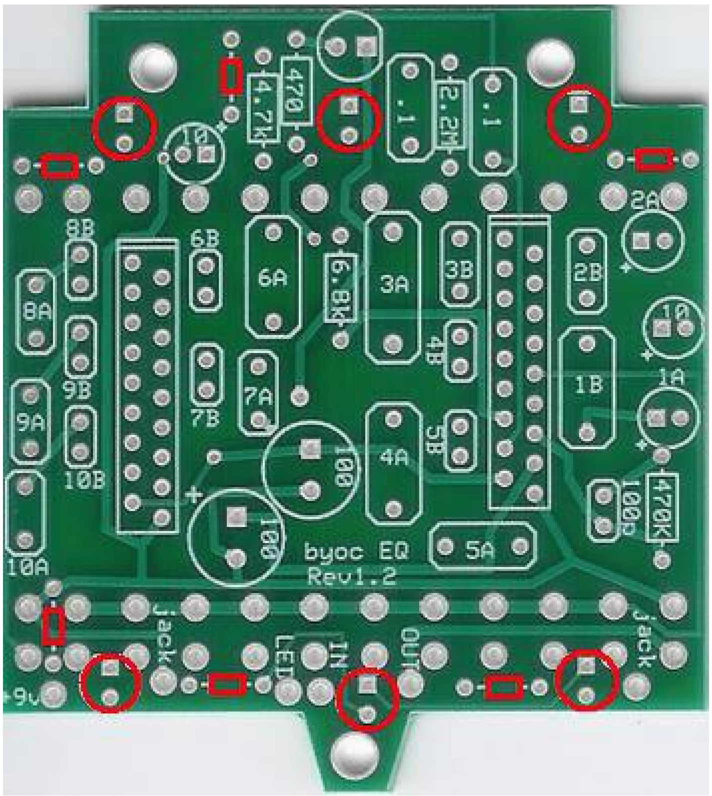
A would be .0082uf and cap B would be .00018uf. Cap B will be a little tricky though, because most brands of capacitors don't market with a value that has 3 zeroes to the right of the decimal. Once you get smaller than 2 zeroes to the right of the decimal point, values switch to pf (picofarads). .00018uf would convert to 180pf. When converting from uF(microfarads) to pf(picofarads) simply move the decimal 6 places to the right.

If you want a very exact frequency that's not supplied above here's the fomula to figure out the capacitor combination:

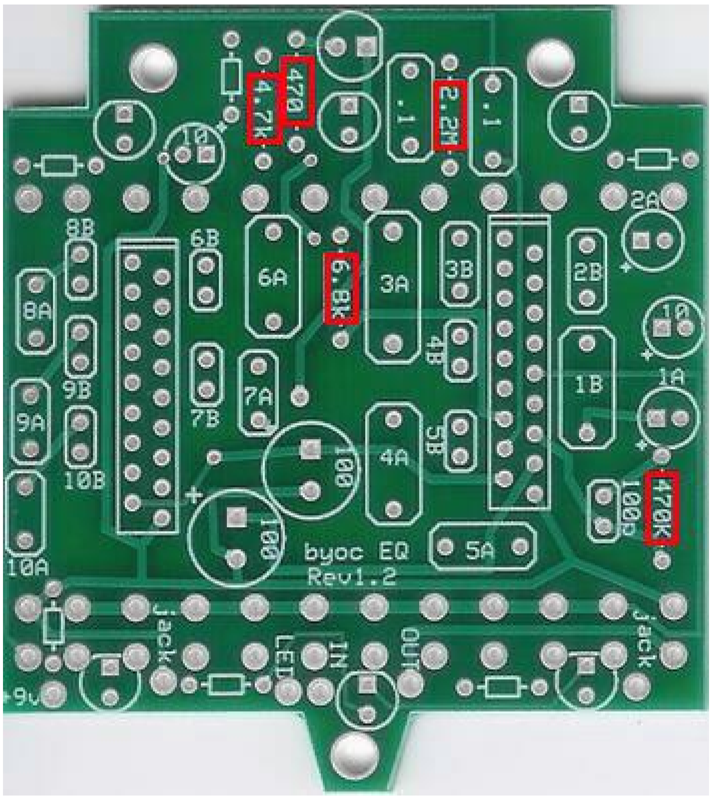
$$Hz = \frac{1}{2\pi\sqrt{1.2k \times 68k \times CX \times CY}}$$

CX = Cap A and CY = Cap B. Refer to the schematic on page 4.

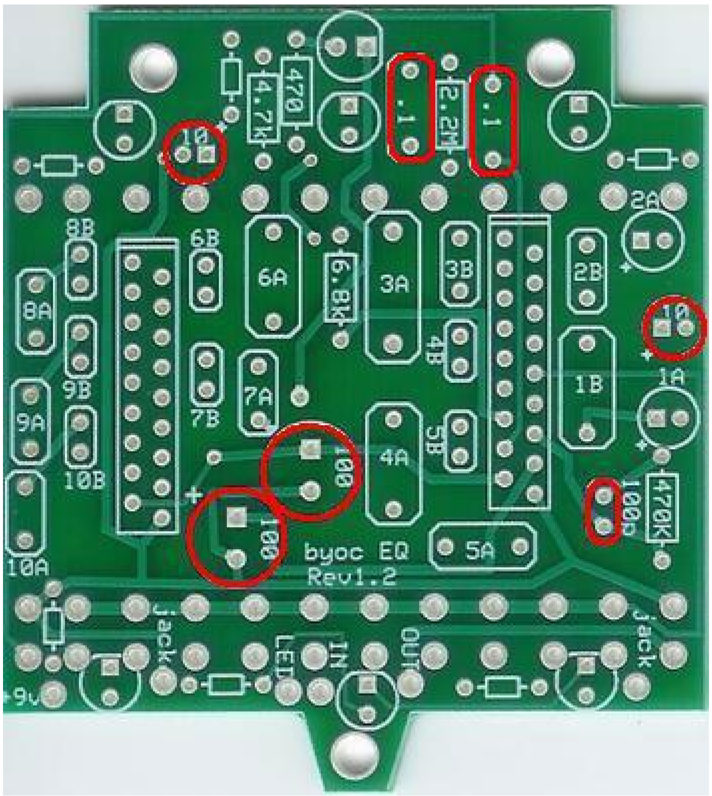
Populating the Circuit board



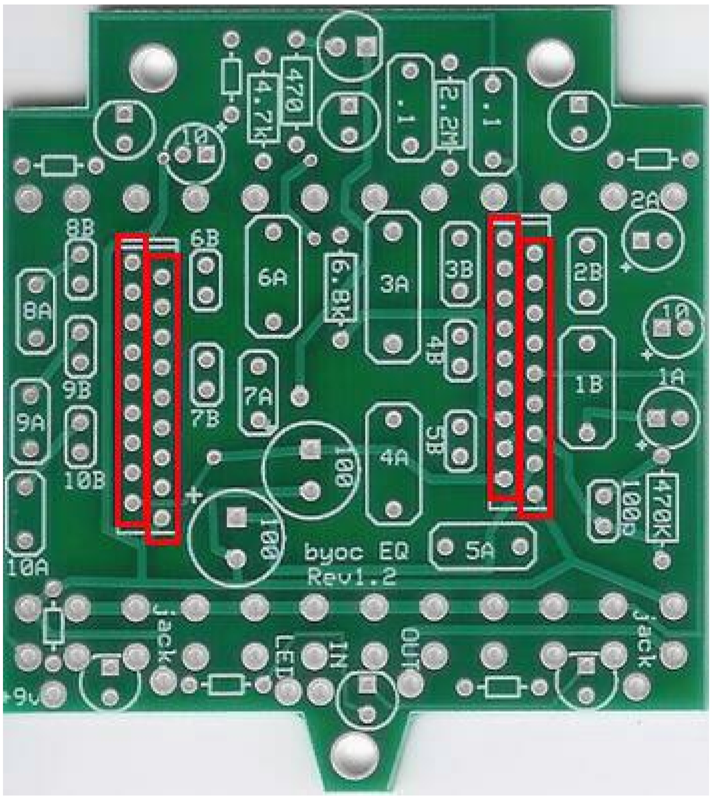
1. Before you start, make note that there are slots on the PCB for the LED backlighting system. These areas are highlighted in red here. Do not put anything in these spaces.



Step 2: Add the resistors. Resistors are not polarized and can go in either direction.

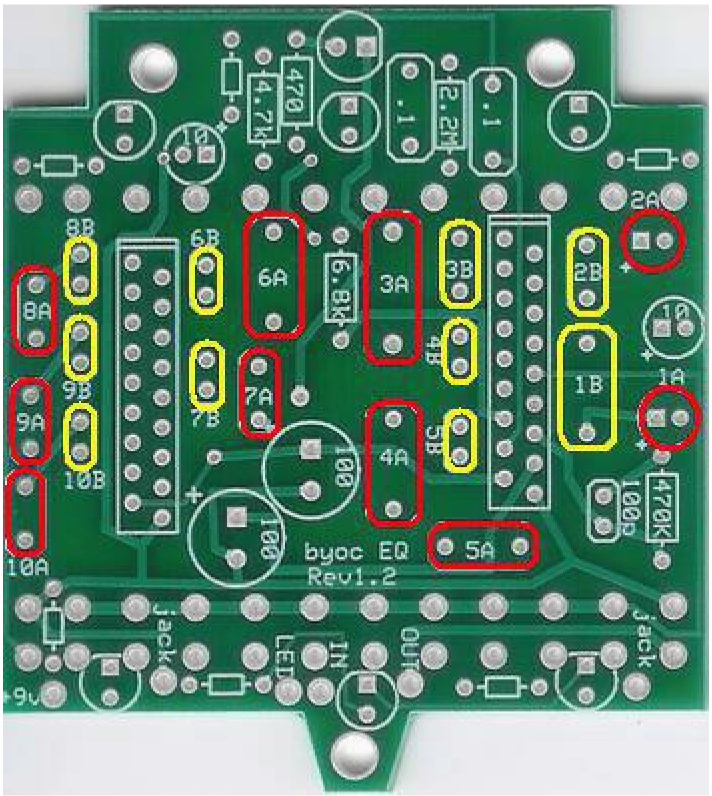


Step 3: Add the common capacitors. These are the capacitors that you will use regardless of what frequencies you want your pedal to have. The electrolytic capacitors are polarized. The longer leads go in the square solder pads. The .1uf film caps and 100pf ceramic disc cap are not polarized and can go in either direction..



Step 4: Add the sockets for the BA3812L chips. Only solder the sockets to the PCB. Do not

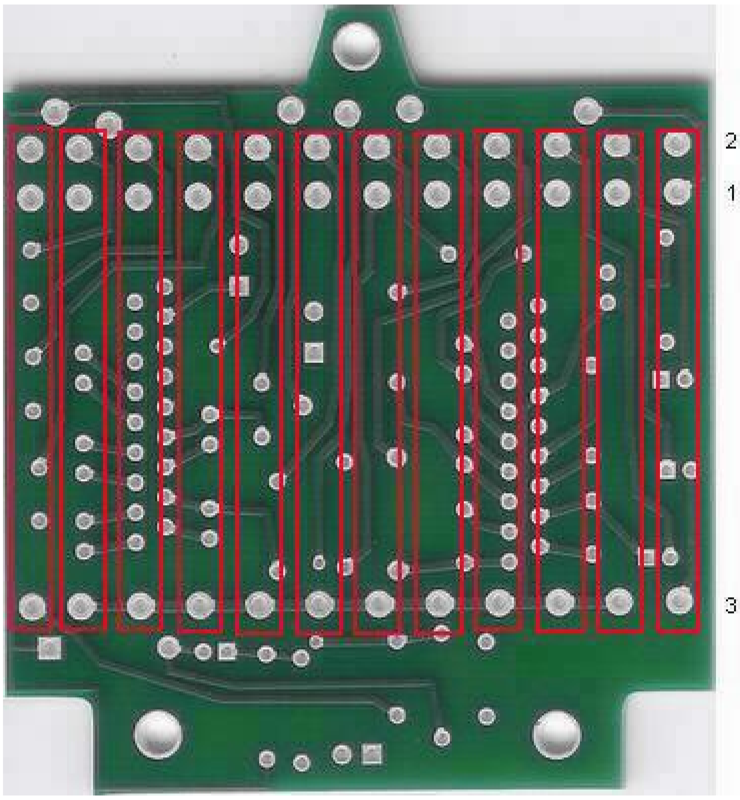
solder the actual chips to the PCB. It seems that preformed ZIP18 sockets have never been in production. The best available solution for socketing this oddly packaged chip is to use 2 rows of breakaway SIP sockets. Each row consists of 9 pins. The sockets that are supplied with your kit may have more than 9 pins attached to a row. If this is the case, just simply use a pair of pliers to snap off the unwated pin(s). You may accidentally break off some of the black plastic casing for the socket. This is not important. This doesn't render your socket useless. Only the actual metal part that has a receptical for the chip and the solder pin is what is important.



Step 5: Add the "frequency" capacitors. Take your time doing this. It can be a little confusing at times. Usually you want to add components in the order of their height- shortest to tallest - so that when you flip the PCB over to solder, the shorter components don't fall out. But in this case it's probably best to start with frequency 1 first, then frequency 2, then frequency 3 and so on, so that it's easier to keep track of which component value goes where.

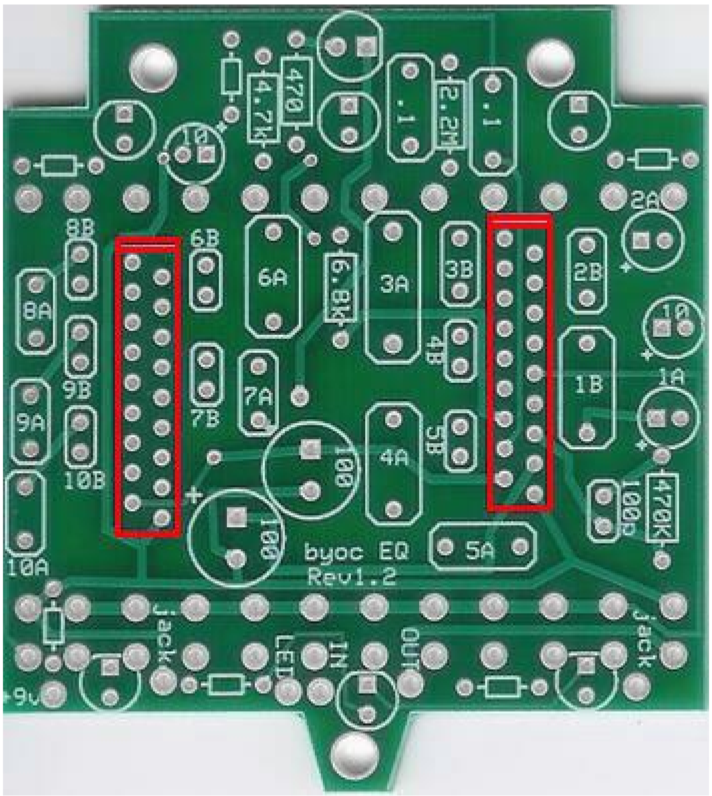
Keep in mind that the film and ceramic disc caps are not polarized and can go in either direction. The electrolytic caps are polarized. The longer lead needs to go in the square solder pad.

Also note, that since there are a variety of capacitor sizes that will be used in each designated slot depending on what frequencies the builder has selected to use, some of the capacitors may not fit very well. Some may capacitors may have a lead spacing that is smaller than their slot on the PCB and you will need to bend the leads outwards. Some capacitors may have a lead spacing that is larger than their slot on the PCB and you will need to bend the leads inwards. Use a pair of pliers to do this. Don't try to force the capacitor into its slot if it doesn't fit perfectly. Slot 2A will probably give you the most trouble.



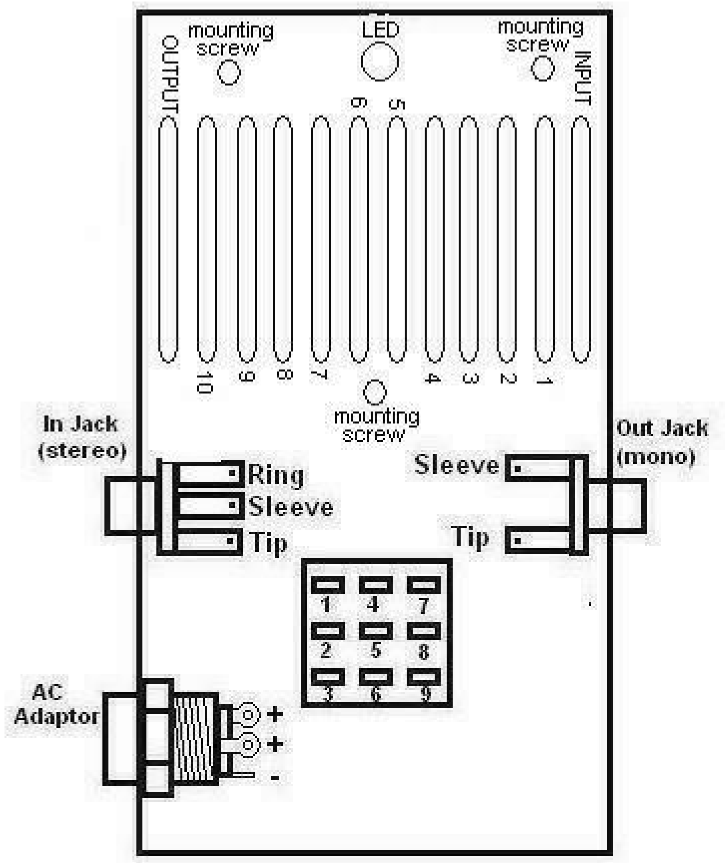
Step 6: Add the sliders. **These will go on the bottom side of the PCB**. It should be fairly obvious how to orientate them since there is only one way they can fit in the board.

SOLDER ON THE TOP SIDE OF THE PBC.



Step 7: Add the two BA3812L's. MAKE SURE TO PROPERLY ORIENTATE THESE CHIPS!!!. Line up the end that has the notch in it with the end of the layout that has the double lines. Make sure all the pins are straight and alligned before you try sticking it in.

Assembly

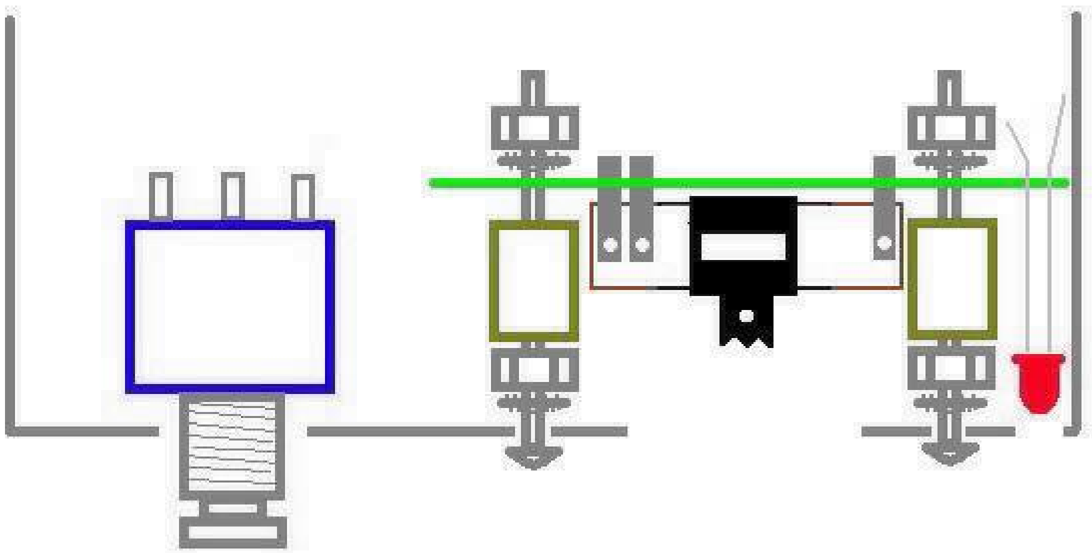


1. Install the jacks first. If you are looking down inside the enclosure, the mono jack goes on the right side and the stereo jack goes on the left. Place the washer on the outside of the enclosure. Use a 1/2" wrench to tighten.

2. Install the AC adaptor jack. The bolt goes on the inside. Use a 3/4" or 14mm wrench to tighten.

3. Install the footswitch. The first bolt and metal washer go inside. The plastic washer and second bolt go on the outside. It does not matter which side you designate as the "leading edge" of the footswitch as long as you orientate it so that the flat sides of the solder lugs are aligned in horizontal rows, not vertical columns.

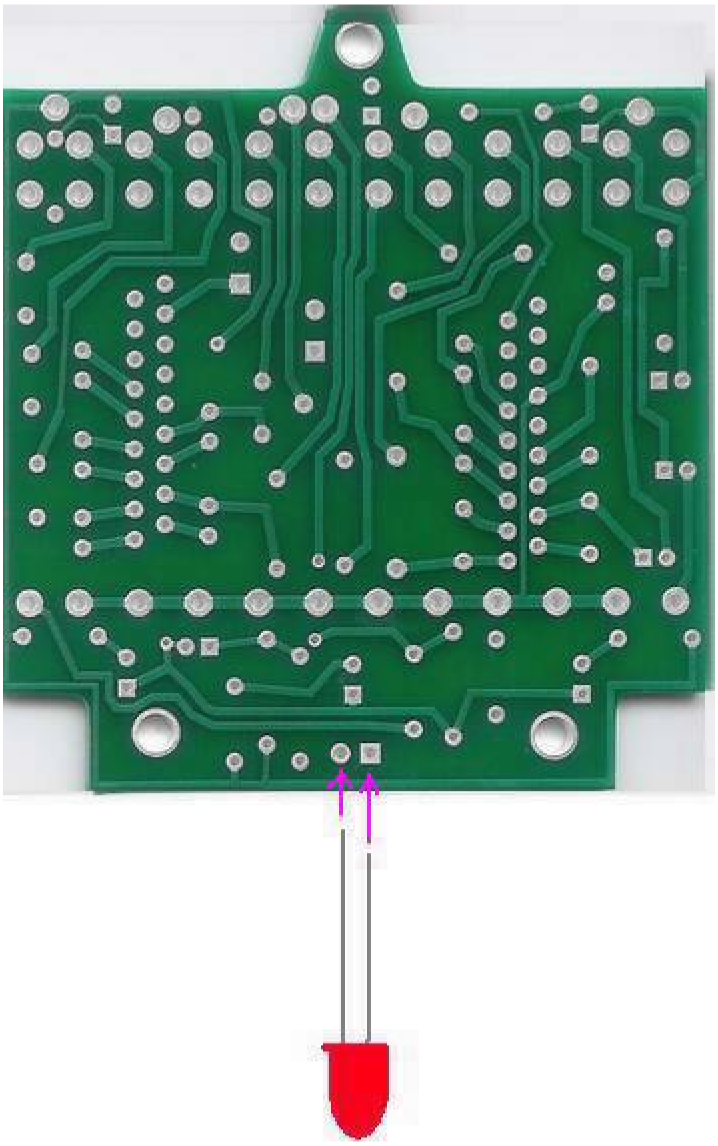
Mounting the Circuit Board



Step 1: Insert the three 4/40 screws from the outside of the enclosure. Then add one #4 toothed lock washer to each screw on the inside of the enclosure. Then add one 4/40 hex nut to each screw and tighten.

Step 2: Add one 3/8 nylon spacer to each screw.

Step3: Insert the LED into the slider side of the PCB. Put the longer LED lead (anode) into the round solder pad hole and the shorter LED lead (cathode) into the square solder pad hole. Do not solder the LED yet. Only bend the ends of the LED leads so that you can flip it over and not have the LED fall out.



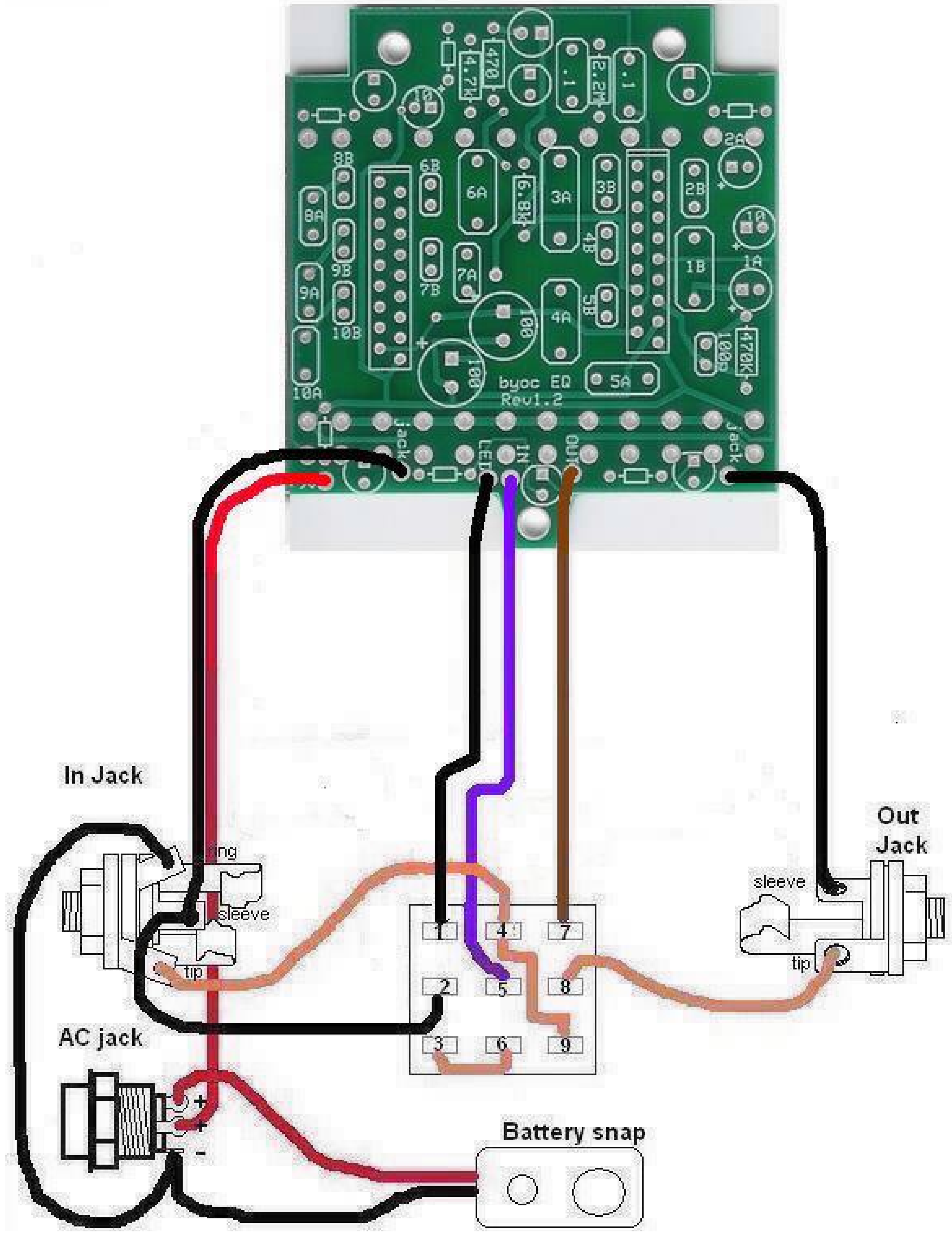
Step 4: Install the circuit board so that the 3 screws fit into the 3 mounting holes in the circuit board. CAREFULLY !!!!!!!!! slide the circuit board all the way down to the nylon spacers. The slider knobs will probably not line up with their respective channels. You will need to use some sort of probe-like tool like a very small screwdriver and insert it into the trouble channels and very gently bend the entire slide to one side so that it is properly aligned with its channel.

Even if the slider knob fit into its channel without any trouble, you should still go through all of the sliders and “center” any that are not perfectly aligned.

Step 5:Add a toothed lock washer followed by a 4/40 hex nut to each of the 3 mounting screws and tighten.

Step 6: Grab the LED leads that are sticking out of the “component side” of the PCB and guide the LED into its hole. You only want the tip of the LED to stick out. You don't want it to stick all the way out. Once you position the LED, solder it in place.

EQ wiring diagram



Finishing Up

Add the enclosure cover and screws and test the pedal. Here are some common problems:

1. No sound at all in either the bypass or on position. If you aren't getting sound in bypass then you did not wire your footswitch correctly. Getting the bypass to work is the first thing you need to worry about.
2. Bypass works and the LED lights up when "on", but there's no sound. You either have a problem with the wiring from the in to the out of the circuit board and foot switch. . Or you have a problem with something on the circuit board.
3. Bypass works, but there's sound when on and the LED does not come on. You probably aren't getting any power to the circuit. .

The nice thing about this particular pedal is that if you get it to "mostly" work, it's very easy to find the problem. If a particular frequency isn't working then you likely have a cold solder joing on one of the 2 capacitors or slider that affects that frequency. If you notice that the lower 5 frequencies work but not the upper 5 frequencies, then you likely have a problem with ICb. If the problem is the opposite, then you likely have a problem with ICa.

If none of this helps, and you can't seem to figure out the problem, I always find that it is best to just set the pedal aside for a day or 2 and then come back to it with a fresh pair of eyes. Then the problem usually jumps right out at you….usually.

If you still can't get it working, start a thread on the BYOC forum and ask for help.
board.buildyourownclone.com