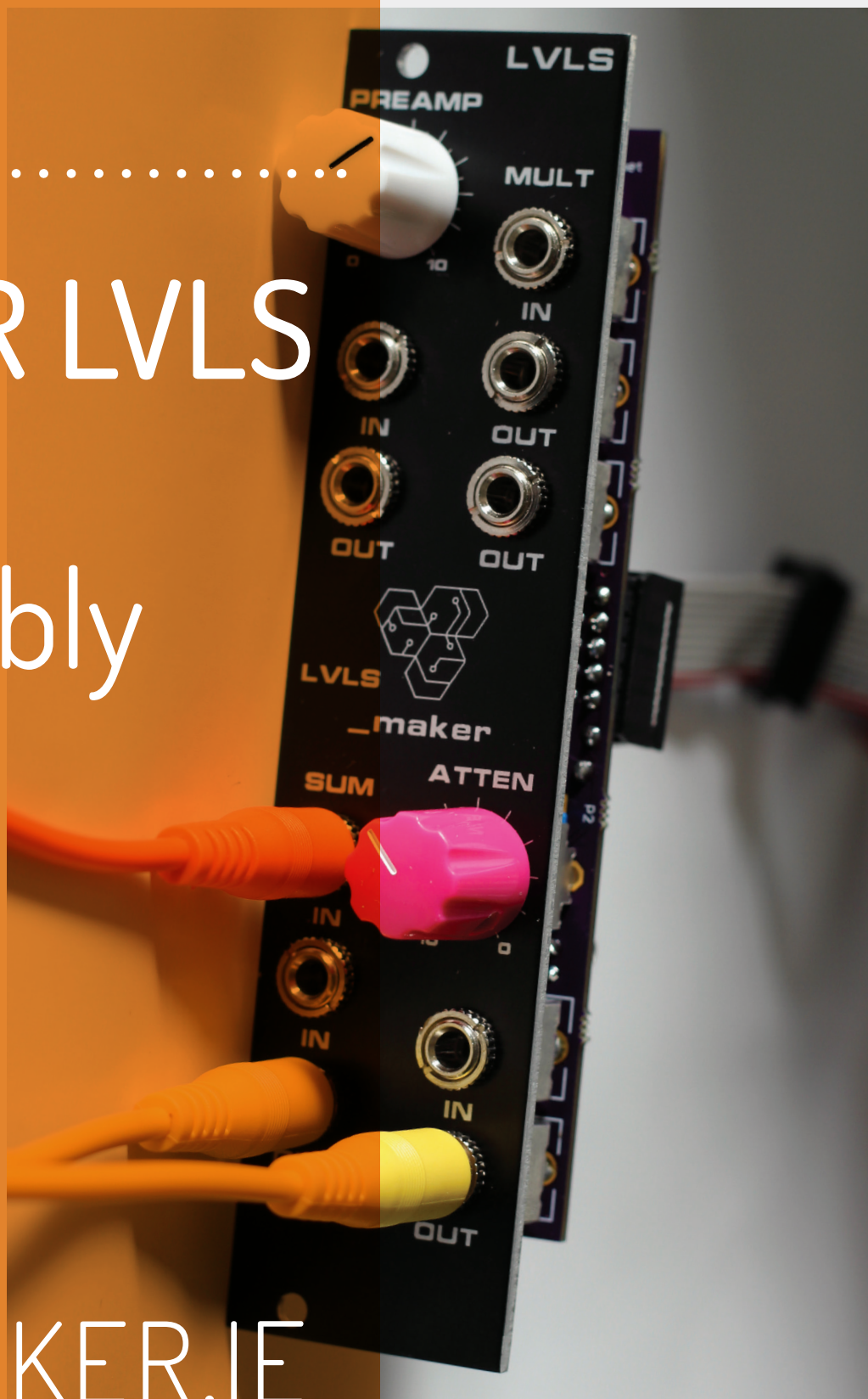


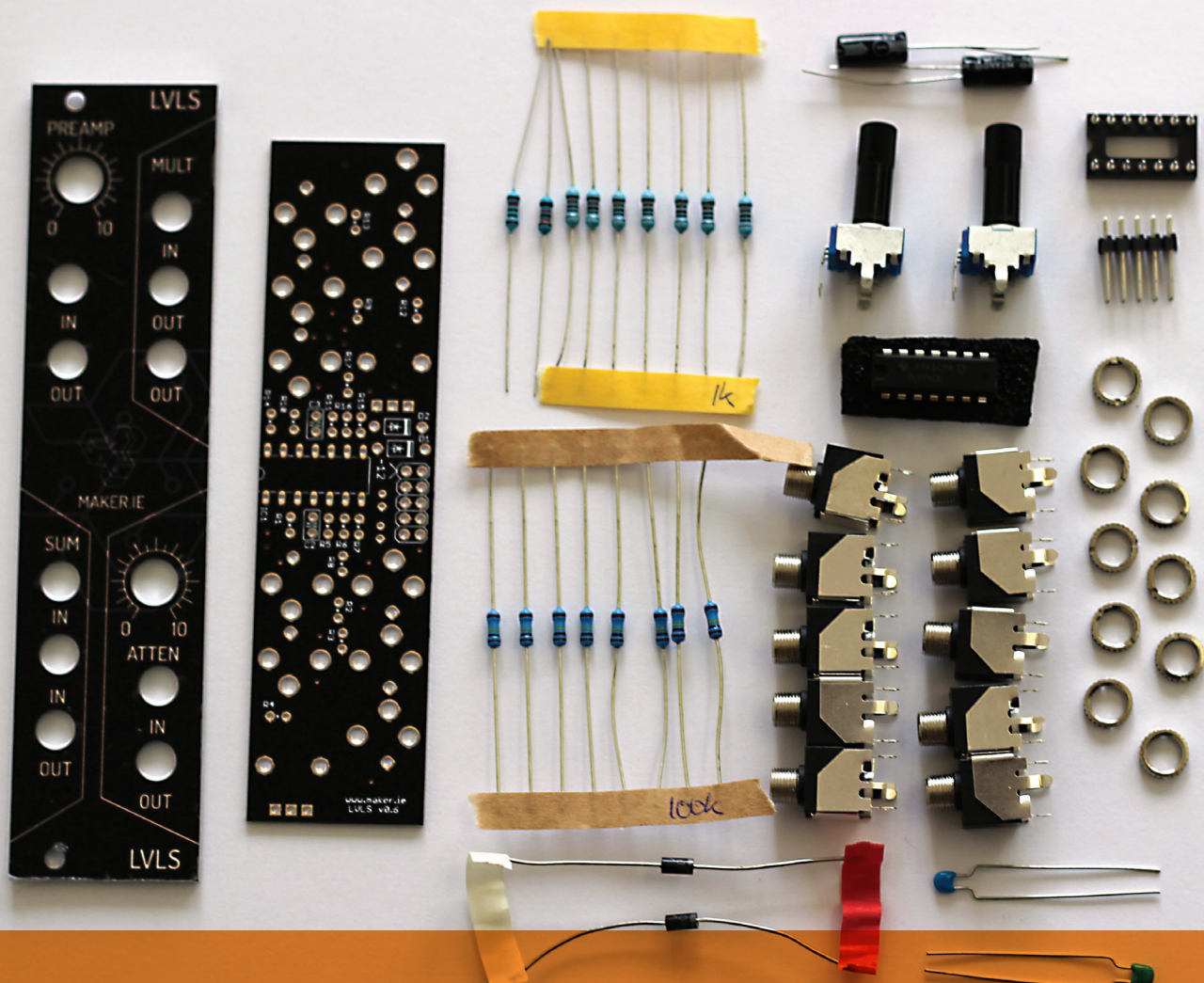
# MAKER LVLS

## Assembly Guide



MAKER.IE





## Technical Specifications

- Attenuator - non inverting attenuator, also the output jack is normalised to 10v to give an adjustable DC voltage when no input jack is present
- Pre-amp - gain of 20dB, designed for integrating ipad/ phone or other equipment with your Eurorack system
- Buffered Multiple (1:2) - two buffered output signals from one input signal
- Summing Mixer (2:1) - summing mixer for quickly summing two signals or adding a DC offset to a signal
- 6HP size, skiff friendly 30mm depth
- Current consumption +12v 15mA, -12v 8mA

## Tools

Below is a brief overview of the tools we will need :

- Soldering iron (15W will do fine, any hotter may start to burn the PCB)
- Solder
- Wire cutters
- Multi-meter
- De-soldering pump
- Helping hands/soldering stand

## Components

Here is a brief overview of the components we'll be using:

- Printed Circuit Board – Mechanically supports and electrically connects the components in the circuit
- TL074 – Quad Operational Amplifier – the heart of the circuit, the 4 op amps perform the various functions
- Resistors – resist the flow of current

- Ceramic capacitors – power supply bypass capacitors
- Diodes – provide reverse power supply protection
- Variable resistor / potentiometer – used to adjust the gain or attenuation
- Pin header – this connects the power from the Eurorack system power bus to the module
- Aluminium panel – mounts to the circuit board after the components are on, so the module will fit in a rack unit
- Jack sockets – for plugging cables in and out of the module

**This is a beginner level kit. Some previous experience of completing electronic kit assembly is recommended, but not essential!\* This is the assembly guide for PCB version 0.6.**

**Okay, let's begin...**



# Soldering is easy, here's how to do it

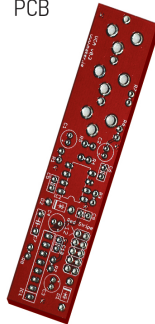
Wire cutter



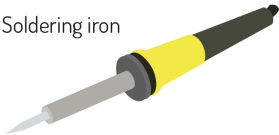
Solder



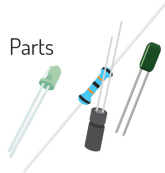
PCB



Soldering iron



Parts

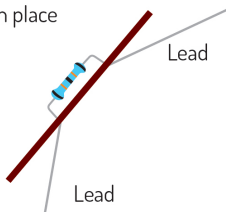


The iron is hot, be careful !

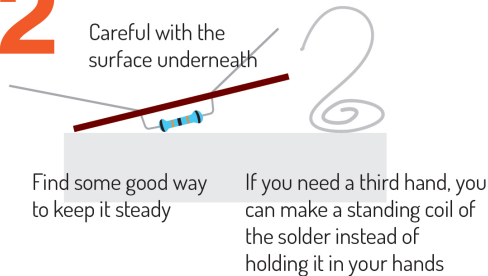
Your kit should come with instructions for what parts go where and what way !

Clean the tip of your iron before each solder connection !

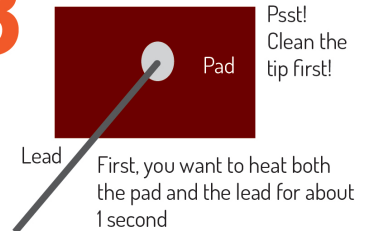
**1** Put your part in place. Bend out the leads so it stays in place



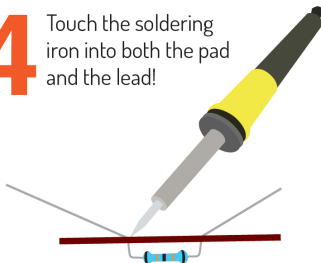
**2** Put the PCB down so you can solder. Careful with the surface underneath



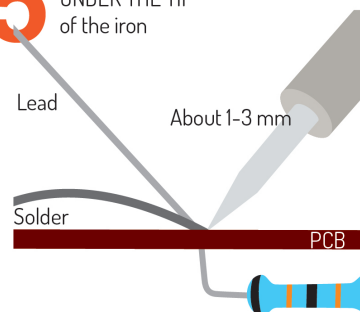
**3** O.K, Lets solder!



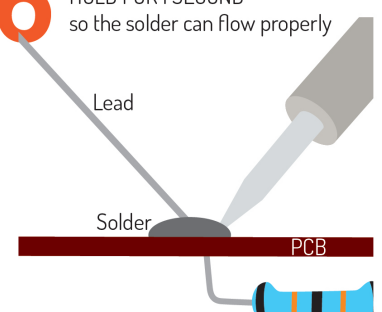
**4** Touch the soldering iron into both the pad and the lead!



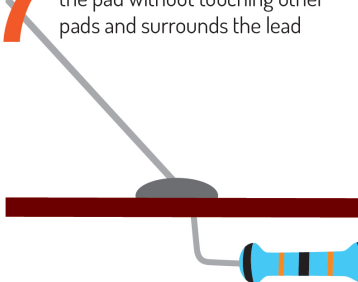
**5** Now feed the solder UNDER THE TIP of the iron



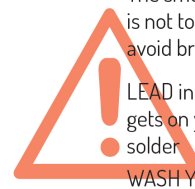
**6** Stop feeding the solder then HOLD FOR 1 SECOND so the solder can flow properly



**7** A good connection covers the pad without touching other pads and surrounds the lead



**8** Cut the leads off with the wire cutter



The smoke from the melting solder is not toxic, but blow gently on it to avoid breathing it.

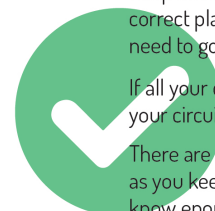
LEAD in the other hand is TOXIC, and gets on your skin when holding the solder

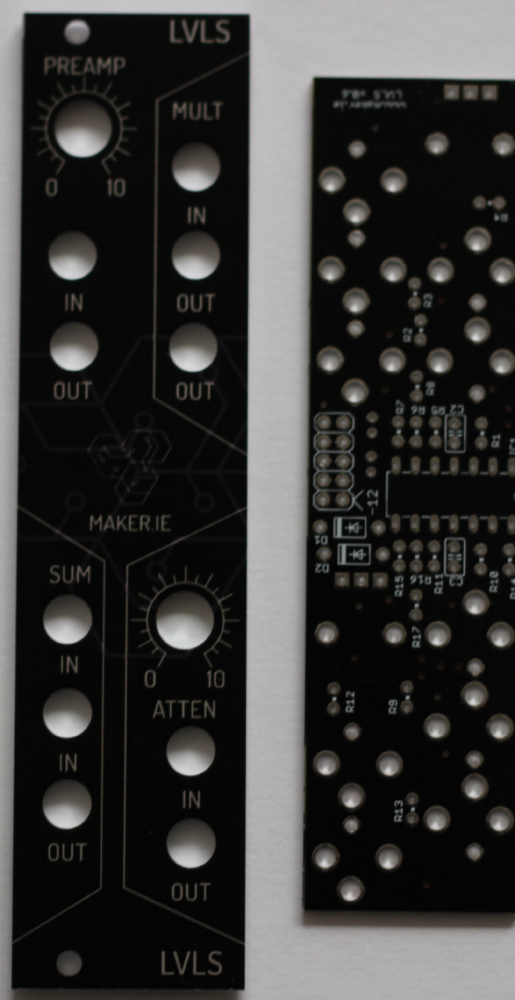
WASH YOUR HANDS WHEN YOU'RE DONE

Keep soldering each part in its correct place. Remember some parts need to go in a certain way!

If all your connections are good, your circuit will just work!

There are more tricks you will learn as you keep soldering, but now you know enough to make many cool things.





# Soldering.....

We are now going to begin soldering the circuit board. You will notice that the circuit board has numbers (R5, C11, etc) beside the component outlines (known as the silkscreen layer of the board). The outlines and the component numbers help us to identify which components to solder where on the PCB.

The circuit board is double sided. We will be soldering some components on the top side of the board, and some on the bottom

side. We will go through the component soldering step by step. The most important things to keep in mind are:

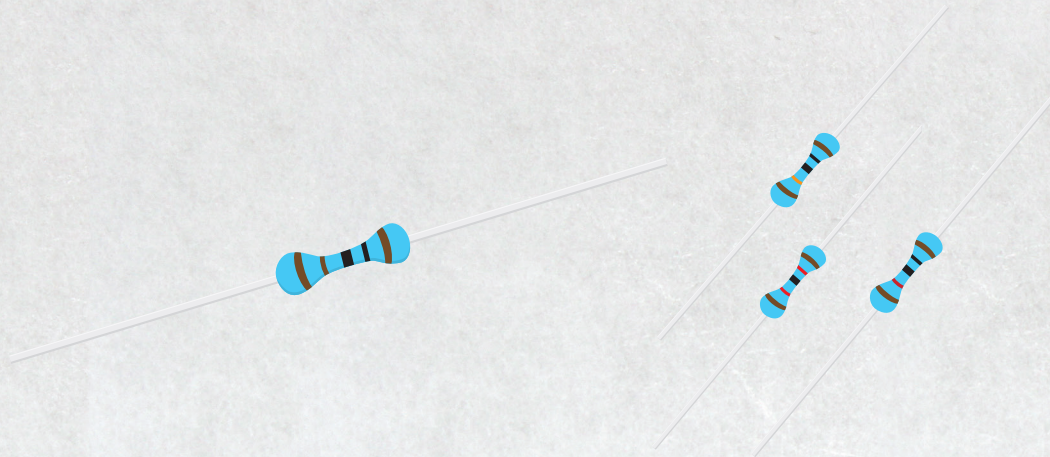
- Take your time and check the silkscreen and the orientation of the components; some components are polarised or must be orientated in a certain direction
- You want to make sure the solder joints are good and solid and they should fill in the pad on the

board that the component leg is coming through

- Do not let solder cross between the solder pads on the board. This will cause a short circuit and will mean your circuit will not work. A de-solder pump can easily fix this problem,
- Components which must be orientated correctly include the diodes, electrolytic capacitors, IC sockets and ICs, jacks and the variable potentiometer



# Step 1- Resistors .....



Solder the resistors following the numbers on the PCB and the guide below. Check the resistor colour codes and measure the values first with a multi-meter before soldering in place. All resistors in the kit are 1% tolerance.. Insert the resistors vertically through the bottom side of the board where the numbers are marked, and solder to the pads on the top side

1k - (Brown, Black, Black, Brown, Brown) - R6, R8, R2, R4, R15, R9

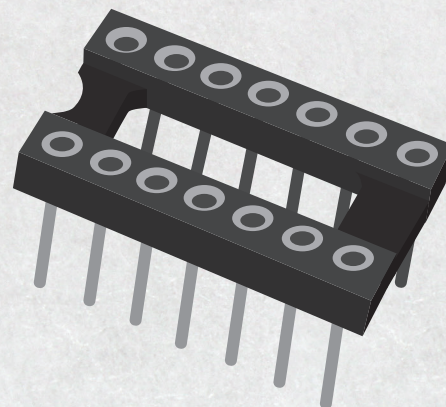
100k - (Brown, Black, Black, Orange, Brown) - R7, R3, R5, R14, R10, R16, R17, R13

10k - (Brown, Black, Black, Red, Brown) - R1, R11

12k - (Brown, Red, Black, Red, Brown) - R12

# Step 2- IC Sockets .....

Solder the IC socket in the IC positions on the top side of the PCB. Check the orientation, the little notch on the socket should match up with the notch on the PCB. Solder the tails on the socket to the solder pads on the bottom side of the board. Use a small piece of cello tape to hold the socket in place while soldering.

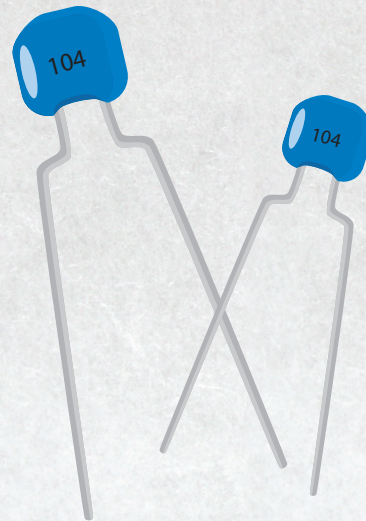




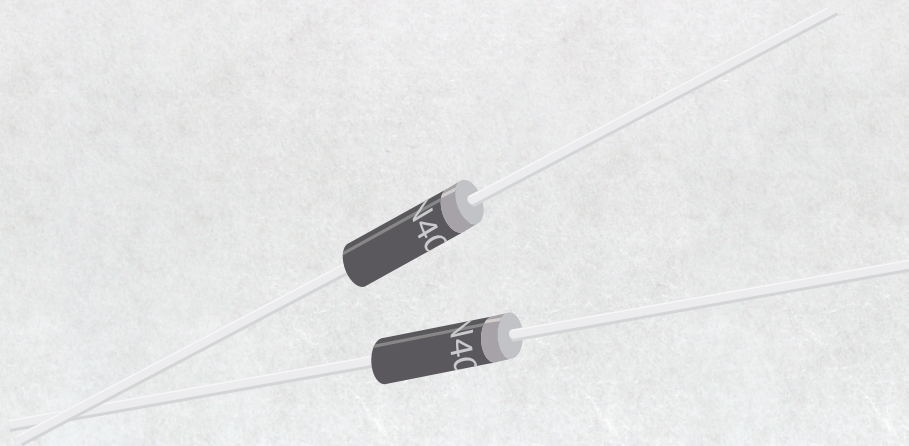
## Step 3- Ceramic Capacitors .....

Insert the ceramic capacitors through the top side of the board and solder to the pads on the bottom side of the board. These capacitors are not polarised. Follow the below guide (from the top left of the board and moving clockwise);

C3, C2 – these are 100n value and they are marked 104 on the capacitor.



## ..... Step 4- Diodes



Next we will solder the diodes. Diodes are polarised, meaning there is a positive and a negative pin, and must be soldered in the correct orientation for the circuit to work. Insert the diodes through the top side of the board and solder to the pads on the bottom side of the board. Again moving clockwise from the top left of the board:

D2– 1N4001 – inserted horizontally, match the marking on the diode with the marking on the circuit board

D1 – 1N4001 – inserted horizontally, match the marking on the diode with the marking on the circuit board

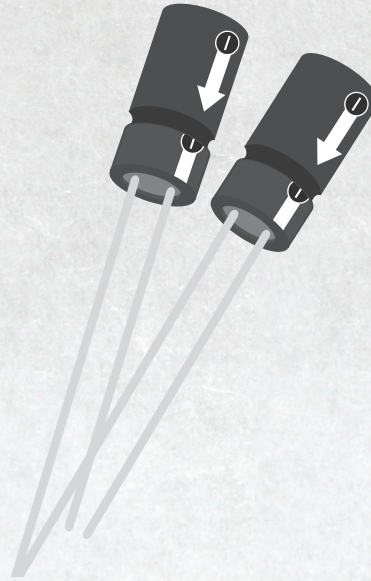


## Step 5- Electrolytic Capacitors .....

Insert the Electrolytic Capacitors through the bottom side of the board (following the silk-screen markings) and solder to the pads on the tops side of the board. These capacitors are polarised; the positive (+) pin must go through the pad marked (+) on the PCB. Clockwise from the top left of the board the values are:

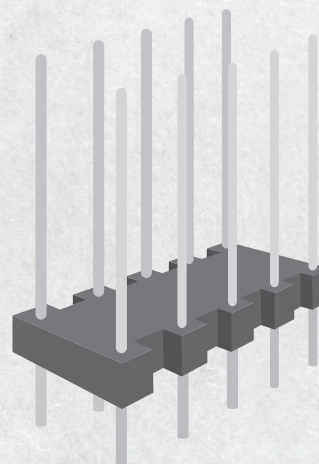
C1 – 10uF

C2 – 10uF



## Step 6- Power Pin Header .....

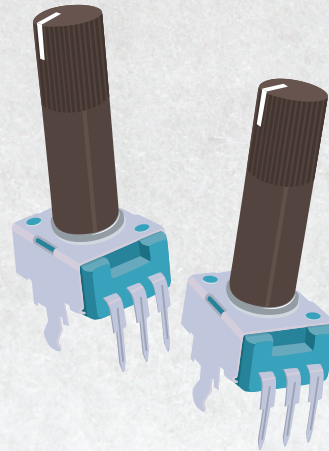
Insert the power pin header through the top side of the board and solder the tails on the header to the solder pads on the bottom side of the board. The header is not polarised. Use a small piece of cello tape to hold the header in place before soldering.



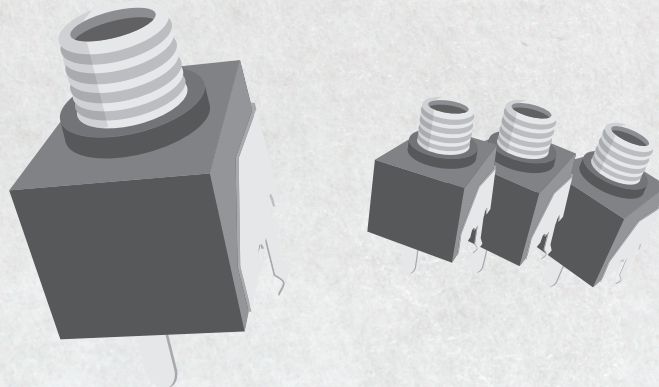


## Step 7- Potentiometers .....

Turn the board over and insert potentiometer P1 (value 10k, log, marked A103) through the top side of the board, and solder to the pads on the bottom side of the board. The potentiometer should snap to the board fairly tightly so should stay in place fine for soldering. Follow with P2, (value 100k, linear, marked B104).



## ..... Step 8- Jacks and Panel



Now, insert the 3 jacks through the bottom side of the board. There is only one orientation that will fit. Don't solder these yet.

Next, place the panel over the bottom of the board with the

jack and pot shafts matching the panel cut-outs. Screw the knurled nuts over the jack shafts, taking care just to use your fingers and not to scrape the panel. Screw these tight by hand, and the panel should be held firmly in place.

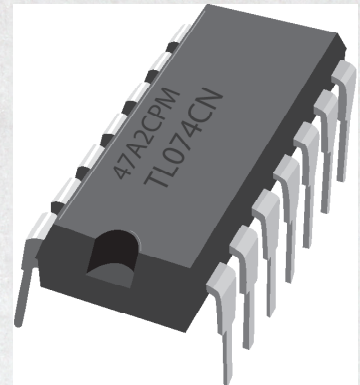
Finally solder the jacks to the solder pads on the top side of the board.



## Step 9- Insert the ICs .....

Carefully insert the TL074 into the IC socket. Two things to watch out for here, The IC pins can be quite fragile and easily broken. Usually the pins will require some gentle bending to fit them into the socket. Some people use an IC insertion tool for this job. If you're taking an IC out of the socket,

you could use a small flat headed screwdriver or tweezer blade and slide it under the IC, which works as well as an insertion tool. Also make sure to check the orientation of the IC, the little notch on the IC should match up with the notch on the IC socket.



## Step 10-Testing and Troubleshooting .....

Before you power on the circuit, double check your soldering work and check for any bad/cold solder joints or any points where there may be bridging (where two pads close together are connected by small pieces of solder). You can use a multi-meter on continuity range to check if any two pads or points you're not sure about are connected or not. De-fluxing is recommended also. Be thorough, even a very tiny piece of solder is enough to create a short in the circuit.

Connecting the power pin header – (important!) match the red stripe on the power cable with the red stripe / -12V marking on the PCB. This is assuming your eurorack power bus is following the convention that Red Stripe is equal to -12V! The circuit has reverse polarity protection included, so in the case that you do plug your power cable in the wrong

way, plug it out quickly and insert it the correct way round.

On power up the LED rate indicator should blink and change as the potentiometer is adjusted. Plug in an audio cable and test the audio outputs.

If the circuit is not working, the most likely causes are:

- **IC CHIP MIS-SOCKETED**  
Check the orientation of the the chips. The notches on the chips should match up with the notches on the PCB. If your socket has been soldered in with the wrong orientation, it won't matter as long as the IC is the right way round.
- **EXPOSED METAL CAUSING A SHORT CIRCUIT**  
Are solder lugs or bits of wire from one component touching another? This may be causing a short

circuit. Adjust the component's position or de-solder / re-solder the component to the pad.

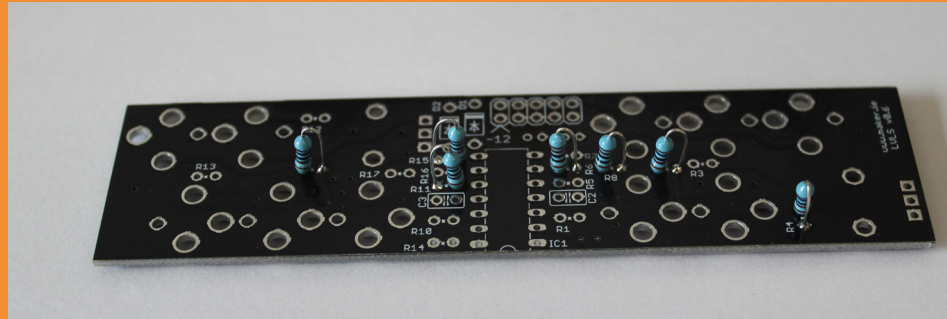
- **COMPONENTS INSERTED IN WRONG ORIENTATION**  
Double check the orientation of all the polarised components (diodes, capacitors, ICs) with the markings on the PCB and the circuit schematic.

- **BAD SOLDER JOINT**  
A bad solder joint can be caused by a number of reasons. Often dirt can get in and create a weak bond between the solder pad and the component. Re-heating the joint or applying a small piece of extra solder can help in these situations. Be careful re-soldering on certain components as extended periods of heat can damage them. If you think the component may be damaged by excess heat, it might be best to replace the component.



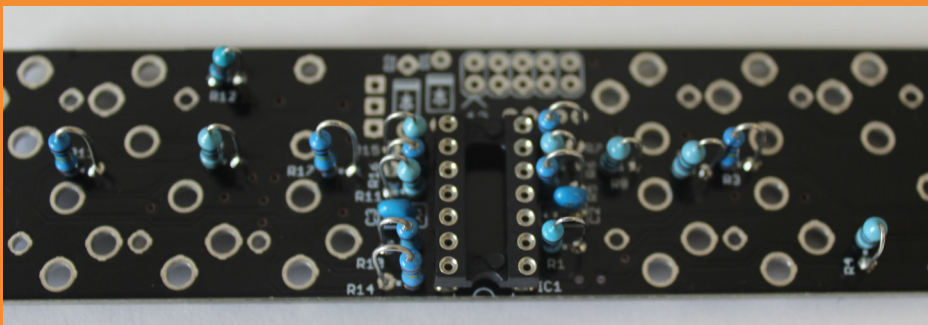
# Maker LVLS- Step by Step.....

# Resistors

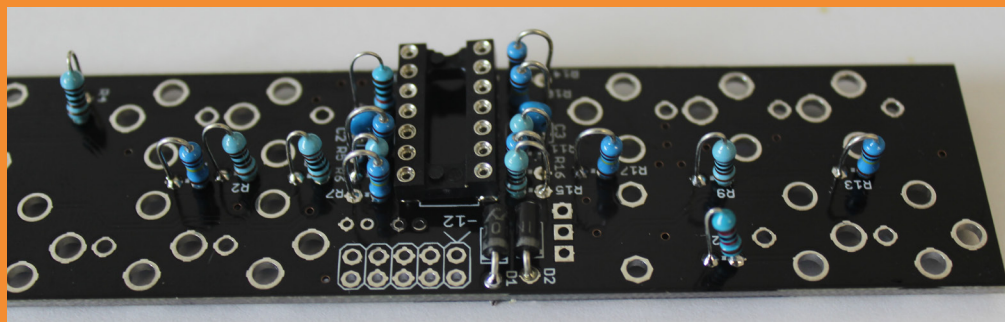


# IC Sockets

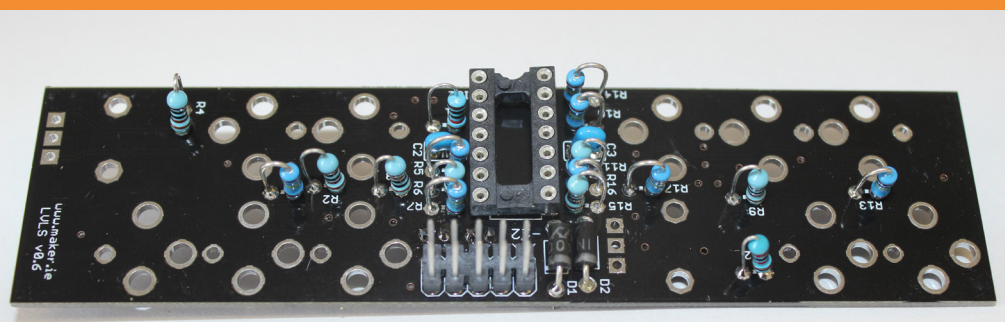
## Ceramic Capacitors



# Diodes

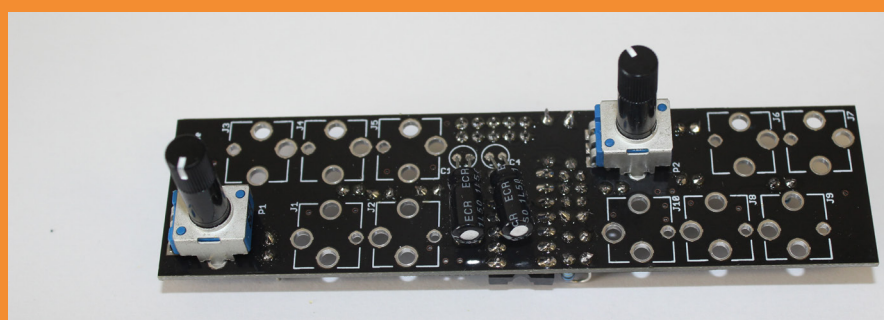


## Power Pin header



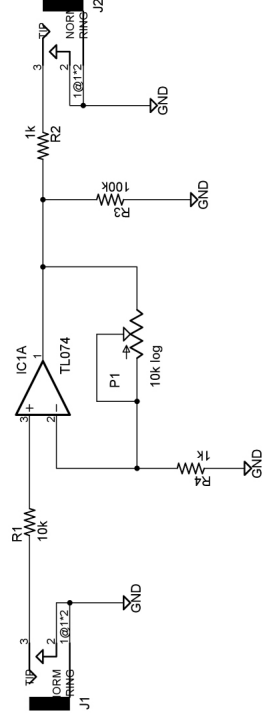
# Electrolytic Capacitors

## Pots

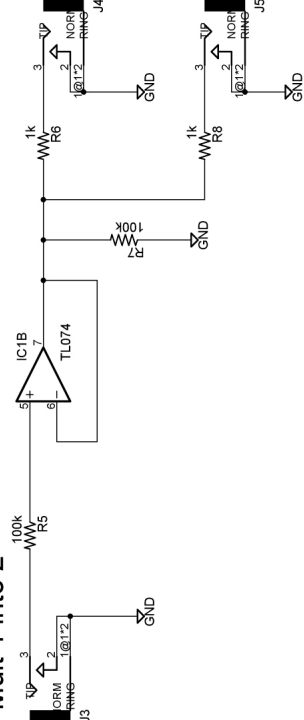




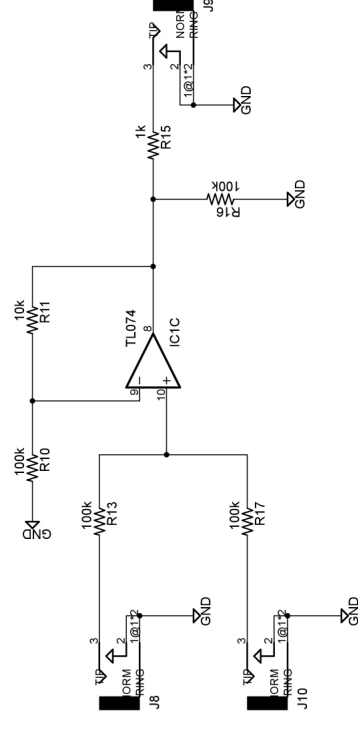
## Preamp



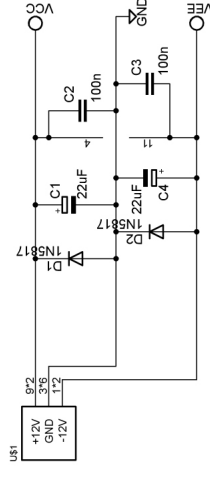
## Mult 1 into 2



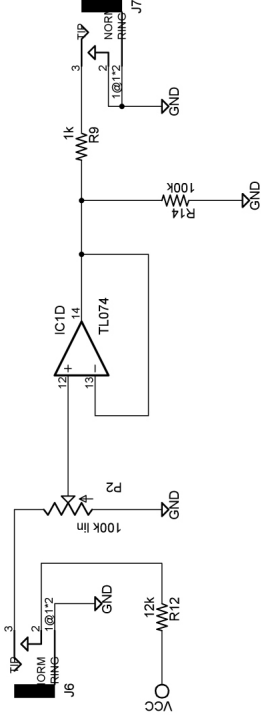
## 2:1 summing mixer



## Power



## Attenuator



Title: Level's v0.6

Version: andy@maker.ie

02/10/2015 01:02:30

Drawn By: 1/1



# Circuit Description.....

## What's happening in the circuit?

Power is provided to the circuit using the Eurorack power bus, which supplies +12v, -12v and Ground (0v). Diodes D1 and D2 provide reverse polarity protection; in the event that the input power polarity is reversed, the current travels through the diodes (path of least resistance) to Ground. Capacitors C1 and C4 smooth out ripples in the power supply voltages. The op-amps IC1 and IC2 are powered by the +12v and -12v voltages.

IC1A is the pre-amplifier section. The circuit is a non-inverting amplifier configuration, which means that the output signal is in phase with the input signal, and amplified. The amplification ratio is given by the equation  $AV(\text{Gain}) = 1 + (P1/R4)$ , which at the values in the circuit is a maximum of 11, or in decibels, 20.8dB, (given by  $(20\log(10) \times 11)$ ). This circuit is useful for amplifying a signal of less than 1v up to anywhere between 1 and 10 volts approximately, allowing low level signals from an iphone or ipad to be amplified up to modular system levels.

IC1B is configured as a buffered multiple. An input signal at the non-inverting input of the op-amp is buffered to provide a low-impedance output, with 2 outputs. The op-amp buffer prevents the outputs from loading the input signal, as would occur in a passive multiple.

IC1C is configured as a non-inverting summing mixer. The output voltage is calculated by the

relationship between both the input voltages summed and divided by 2, multiplied by the gain of the op-amp, which in this case is  $1 + R11/R10$  or 1.01. This means that the summing mixer operates at approximately unity gain.

IC1D is configured as a non-inverting attenuator. The input signal is attenuated before the op-amp input by potentiometer P2, then buffered by the op-amp to give a low-impedance output. When no jack is plugged into the input socket, the signal from the 12v power bus is attenuated by R12 to approximately 10v and sent through the attenuator. When an input jack is inserted this signal is replaced by the input signal.

On all channels, the 1k resistor in series with the output jack protects the op-amp output from external signals, and also prevents the op-amp output from directly "seeing" the capacitance of the output cable, so the signal can travel over a reasonably long stretch of cable. The 100k resistor to ground prevents "pops" when a cable is unplugged. The input resistors in series with the input jacks approximately set the input impedance of the channels to 100k, and 10k for the pre-amplifier.

Capacitors C2 and C3 are bypass capacitors, which are located close to the IC pins to provide a local reservoir of power and provide a low impedance path to ground for power supply current returns.



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