Building your first module
Revision 1.1.0

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Including pictures from Brian Donegan

Start building

Building your first kit can seem difficult; this guide is aimed to give the beginner guidance on how to start. We assume you do know how to solder, if not please start by reading a proper how-to and practice on some scrap parts.

Apart from the kit itself, you need some tools and materials for the project:

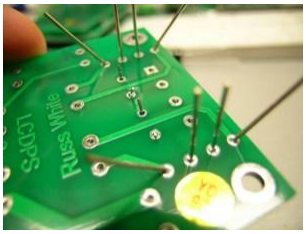
- Good soldering iron or soldering station
- Electronics grade solder (including flux)
- Pliers
- Wire cutter to cut off excess wires
- Steel wool to clean the soldering iron
- Alcohol (preferably Isopropyl alcohol) to clean the board afterwards

Preparation

- Unpack the kit and check if all parts are there, and if they are of the right type. This can be done using the Bill of Materials (BOM) on the site if available. Beware sometimes the kit gets updated, while the BOM isn't. In case of doubt, ask what to do on the forums.
- Make a template for mounting the module in the chassis later on. This can be done by printing the correct template from the site. Place the Printed Circuit Board (PCB) on the template to see if the holes align correctly. Do this now, if the PCB is populated the alignment is much harder to check.
- Sort the parts by height.

Steps

- Mount the smallest parts first. See "Mounting components" for details on how to put different types of components on the PCB.



- Turn the PCB upside down while keeping the parts in place and solder the parts. If there are too many small parts to keep them in place at once, mount them in batches. If possible work from the centre of the PCB towards the edges. That way the excess wires don't get in the way of your work. If keeping the parts in place is difficult one could bend the leads to prevent the components from falling out of the PCB.
- Solder the parts by warming the joint using the iron and then feeding enough solder while keeping the iron in place. A few mm of solder should be enough. If there is an excess of solder, clean the soldering tip using the steel wool. A damp sponge will work too, but the temperature of the tip will drop much more and this will stress the tip leading to a shorter tip life.
- Work fast, but never in haste. If you work too slowly, the heat can kill components. Too fast and there will not be a good connection.

- Cut the excess wire using a decent wire cutter. A special cutter like the one displayed will result in a flat cut, which looks much neater but it is not a requirement.
- Next, move on to the components one size taller and repeat these steps until all components are placed.

Finally

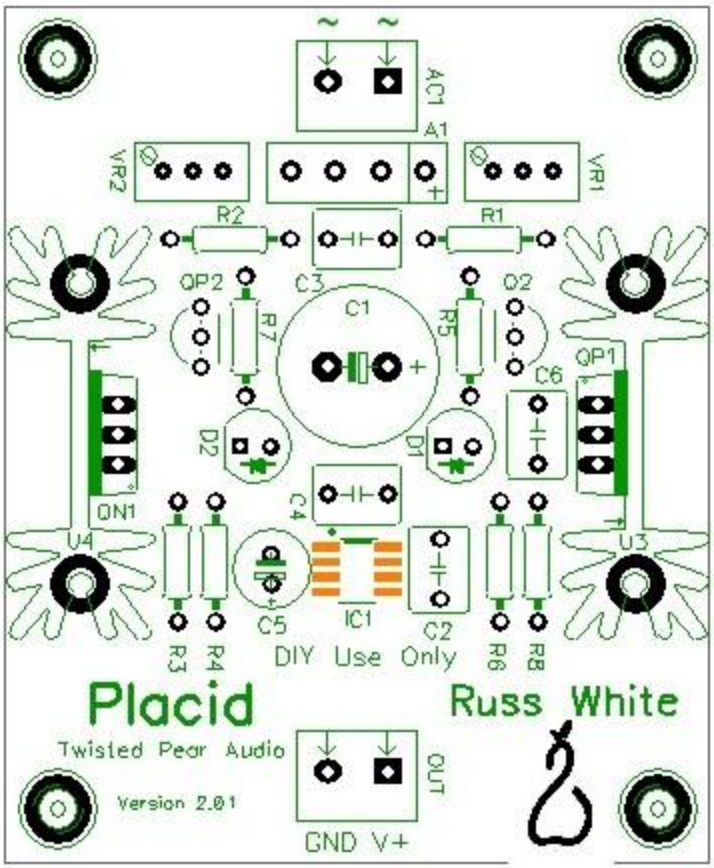
- Optionally, rework the whole board. This reduces the stress in the joints which is caused by cutting the components to length. Also, you could cover the cut with solder, protecting it from oxidation. Note: Some people prefer to cut the excess wire before soldering the joint to avoid this work. It can be more difficult to keep the components in place however, so that method almost demands the use of a special soldering frame.
- Clean the board, preferably with a little bit of Isopropyl alcohol. This easily removes the flux residue which could damage the board later on. Let the board dry before connecting it.

Tip

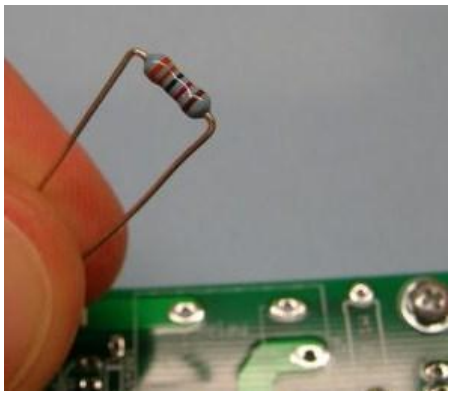
Virtually all components are capable of withstanding the heat of the soldering for a maximum of 10 seconds. If you don't get the joint right well within that timeframe, stop working on that part of the PCB. Let the work cool off and retry later. You could try cleaning the tip, board and component as dirt is often the cause of problems.

Mounting components

Mounting components requires some attention to their orientation. This part describes the most common components and what you should know how to mount them correctly on the PCB. As an example we use the Placid PCB, as this is a fairly small module but still uses many different types of components.



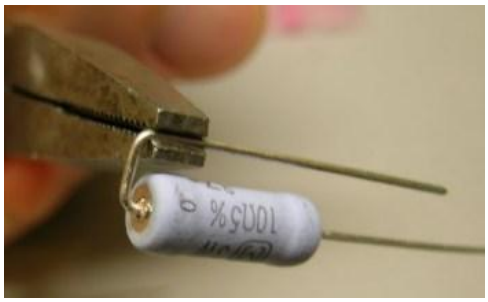
Mounting resistors

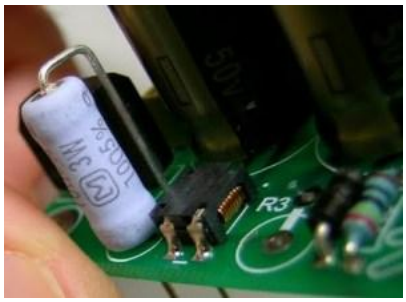


Resistors have no + or – side, so the orientation does not really matter. Small resistors are usually mounted horizontally on the PCB. Bend both their legs using pliers so they fit nicely in place.

The bigger the resistors are, the higher their wattage. Please remember they produce heat, which should be dissipated. Do NOT mount big resistors flush to the PCB, but keep some distance from the PCB to help dissipation.

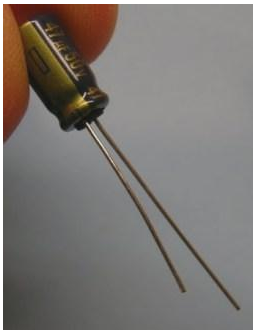
In some cases, resistors are mounted in an upright (vertical) position. This is often marked by a circle on the PCB. In that case, do not bend both legs but bend just one in a 180 degree turn as shown below.





Resistors are normally marked with a rectangle on the PCB, and often designated with an R… number. See R1 to R8 on the lay-out of the Placid.

Mounting capacitors

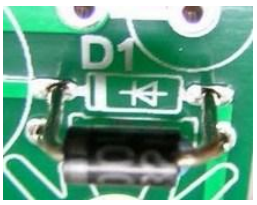


In regards to mounting there are 2 main types of capacitors: the normal ones or the polarized ones. A normal capacitor can simply be put in place without regard to orientation. The legs of a normal capacitor are often of equal length. See C2 to C4 and C6 as examples in the Placid lay-out.

On the polarized version, one side is +, the other side is -. Usually the – is clearly marked on one side of the capacitor, and often the legs are of different lengths. If there is no marking: the long leg is the positive one. Please beware that on the PCB, often the + is marked. This can be clearly seen with C1 in the Placid lay-out.

Capacitors are often designated with a C… number.

Mounting Diodes



Diodes are components that conduct only in one direction. So the orientation is critical. Usually there is a stripe on the diode to designate the cathode (- side), this tells you in what direction the current is allowed to flow. The direction aligns with the arrowhead on the PCB.

Diodes are often designated with a D… number.

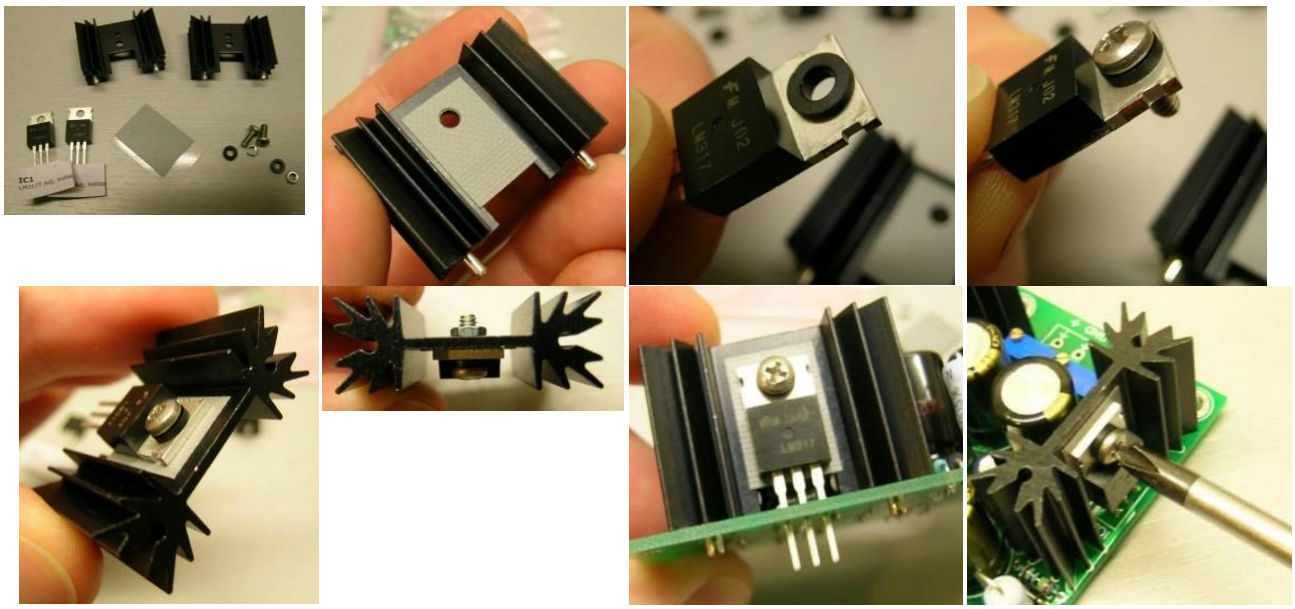
Mounting LEDs
LEDs are nothing more than diodes that give light, hence the name Light Emitting Diode (LED). Like normal diodes, the orientation is critical. The orientation of a LED is often marked using a flat side on the lower part of the LED. See D1 and D2 in the picture. If the flat side is not obvious to see, revert to the length of the leg (same rule as capacitors). The longer leg is +.

As LEDs are diodes they too are often designated with a D… number.

Mounting ICs
Integrated circuits often have a notch or dot which tells you how they should be oriented. Align the dot on the chip with the dot on the PCB. See the small dot above the IC1 position in the Placid lay-out. If an IC socket is to be used, insert the IC **after** finishing the board. A lot of IC's are sensitive to Electro Static Discharge (ESD).

Heat sinks
Components that need a small heat sink (QN1 and QP1 in the lay-out) are usually best mounted with the heat sink already in place. That way, you are sure to fix the components at the right height so the heat sink will fit.

When attaching a heat sink, one should apply thermal interface material (TIM). In the most basic form this is just a bit of thermal grease that increases the heat transfer from the component to the heat sink. If electric isolation is required, a special pad is often used which electrically isolates the component from the heat sink, yet acts as a decent thermal conductor.



In that case the steps to take are as follows:

- Unpack the pad
- Attach the pad to either the heat sink or the component
- Put the plastic ring in place. Beware the collar should be pointed toward the heat sink.
- Attach the component to the heat sink and bolt it in place.
- Insert this combination at the right position on the board and solder it.
- Tighten the screw

Medium sized heat sinks like the one displayed often can be soldered to the PCB for added mechanical strength. But do bear in mind that attaching them to the board can be difficult as it requires a powerful soldering iron. Having them fixed in place also makes repairs much more difficult.

Other components

As is clear from the lay-out of the Placid, there are many other types of components that you can run into. Take for example the rectifier A1 in the picture, just below the input AC1 at the centre-top position. In the lay-out, there clearly is a big + sign on the PCB. This aligns with the + that is on the rectifier. And again, the + has a longer leg.

Other components like for instance transistors (QP2) often are marked by their shape for correctly positioning them on the board. If you look closely, you'll see clues about placement on the PCB for most components.

SMD components

SMD soldering can be done by hand, but it's more difficult due to the tiny components one is working with. It is not recommended for a beginner to try to build this type of module. Most DIY kits avoid using SMD components or ship them with the SMD parts already in place.