In your kit you will find a printed circuit board and some components. Identify the individual components then follow these instructions for trouble-free construction.

**CIRCUIT BOARDS**
A printed circuit board has metal tracks on one side and pictures and lettering on the other. Components are fitted to the **picture** side of the board, and then soldered to the **metal** side. Soldering secures the component to the board and makes the electrical connection.

**RESISTORS**
- Resistors have coloured bands around their bodies to indicate their values. The component sheet for a kit gives the colours for each resistor.
- Bend the wire 'legs' on a resistor into a U-shape, then push the legs through the two holes in the board.
- Resistors can be fitted either way around, and should be fitted flat on the board.

**DIODES**
- The positive leg of a diode is marked by a stripe around the body.
- Bend the legs into a U-shape and fit the diode flat on the board, with the positive leg in the hole marked by a plus sign (+).

**PIEZOS**
- Piezos can be fitted either way around.

**VARIABLE RESISTORS**
- Variable resistors have three legs and can only be fitted in one way.

**CAPACITORS**
- Capacitors come in two types, electrolytic and non-electrolytic.
- Non-electrolytic capacitors can be fitted either way around.
- Electrolytic capacitors **must** be fitted the right way around. Put the shorter leg of an electrolytic capacitor (the negative leg) into the hole with the minus sign (−).
- The negative leg is also marked by a stripe on the body of the capacitor.
To make the battery connection stronger, the battery snap leads are threaded through support holes in the board before being soldered.

Push the battery snap leads up through the larger holes in the board from the metal side of the board.

Fit the metal tip of the red lead into the BATTERY + hole, and the metal tip of the black lead into the BATTERY – hole.

Solder the metal tips to the tracks on the board, then pull the loops back.

Integrated circuits ('chips') are very delicate so they are not soldered directly to the board. Instead you solder a socket to the board, and then fit the chip into the socket.

Match the notch in one end of the chip socket to the notch in the picture on the board. Make sure that all the legs go through the holes in the board and that none of the legs are bent underneath the socket. Bend the legs a little outwards to keep the socket in place.

Take care when soldering as the legs are close together and it is easy for solder bridges to occur. (A solder bridge is where the solder runs over the gap between two tracks.)

Don’t put a chip into its socket until the board has been finished and checked.

To fit the chip into its socket you will need to bend its legs a little inwards. Do this carefully with your fingers. Match the notch in one end to the notch in the socket. Make sure that a leg goes into each hole, then push the chip gently but firmly into place.

Never insert or remove a chip while the battery is connected.

An LED light has one leg slightly shorter than the other. Put the shorter leg into the hole with the line.

LED’s also have a slightly flattened edge on the rim on the same side as the shorter leg.

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A joint which is badly soldered is called a ‘dry’ joint. These are some examples:

- The joint is cratered and dull or grainy looking.
- The solder has not spread over the pad properly.
- A spike of solder means that the joint has been overheated.

Use the right amount of solder. Too little and it may not form a good joint. Too much and it may cause a short circuit. A good solder joint covers the solder pad and component wire completely and is smooth and shiny.

This is what a good joint looks like.

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Clean the tip of the hot soldering iron from time to time on a DAMP sponge.

If you make a mistake use a solder sucker to remove the solder.

Treat any burns IMMEDIATELY with cold running water for ten minutes.

MadLab runs a repair service for kits. Contact us if you can't get your kit to work.

**TROUBLESHOOTING** *(WHAT TO DO IF IT DOESN'T WORK)*

- Carefully check that the components are fitted correctly. Check that all the components are in the right place.
- Check the colours of the resistors against the component sheet, it is easy to mix them up. Pay particular attention to electrolytic capacitors, LEDs and battery snaps. Are they the right way around?
- Check that transistors haven't been soldered into the board backwards.
- Check all your soldering. A good solder joint looks shiny and smooth and covers the hole completely.
- Hold your board up to the light. If any light shows through a hole then more solder is needed.
- Check that large blobs of solder are not causing short circuits, particularly with chip sockets. If too much solder has been used it is often better to remove it completely using a solder sucker and then to re-solder.
- Also check for streaks of solder bridging tracks, and any hairline cracks in tracks. Hairline cracks can be repaired by soldering over the gap.

For contact details, the latest MadLab kits, hints & tips, ClubMad and lots more, see our website:

http://www.madlab.org

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