Soldering: How it's done

In just about all modern electronic equipment, and in most electronics kits, the various components are soldered into a printed circuit (PC) board which has etched copper tracks to form the 'wiring'. This means that assembling a kit is not just good fun, but a great way to get skilled in soldering — as well as learning about electronics. Soldering isn't hard once you get the idea, as this quick guide will show you.

As you're probably aware already, the various parts that make up an electronic circuit can't be just glued together. They have to be joined up with good metal-to-metal connections, so tiny electrical currents can flow easily between them. The way this is done is by making the joins using **solder** — an alloy of two metals (lead and tin) which is easily melted at a relatively low temperature, to make a joint that conducts electricity.

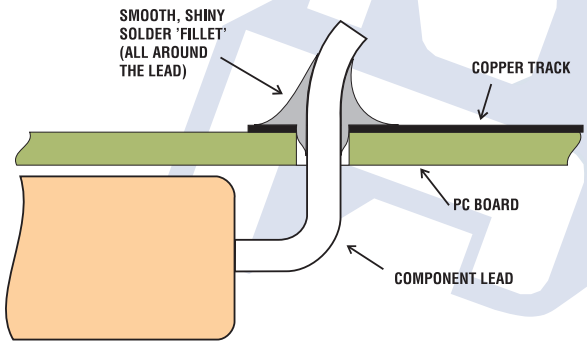
The basic idea is that the two metal surfaces to be joined (say the lead or 'pigtail' of a resistor, and a copper 'pad' on the PC board) are brought together and both heated up quickly using the tip of an electric soldering iron. They're heated to about 183°C, which is the melting temperature of the '60/40' solder alloy (60% tin, 40% lead) used in most electronic work. Then the solder (usually in the form of fairly fine wire) is touched on both surfaces, along with with some resin powder (already inside modern 'resin cored' solder wire). The solder melts, and the resin acts as a 'flux' which dissolves any oxide on the metal surfaces so that the molten solder can 'wet' them and form a good permanent bond. Finally the soldering iron tip is removed carefully, allowing the solder to solidify again as a smooth and relatively strong metal 'joint'.

Sound easy? It really isn't hard, although it is a bit like riding a bike: you generally have to practice a while before you can make good solder joints without even thinking about it.

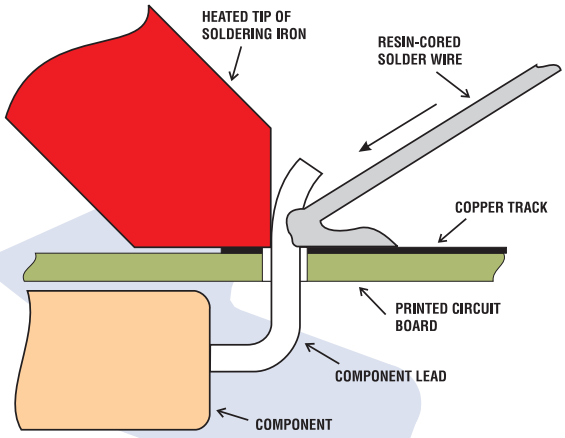
Here are some practical tips, to get you off to a good start with your soldering:

1. Get yourself a good lightweight 'electronics' type soldering iron, with a small tip and not too much heating power. An iron rated at 25 watts is more than enough for most general electronics work. A good example is the Jaycar Cat No. TS-1450, which is also available as part of the Jaycar Soldering Kit TS-1650 complete with a nifty bench stand/holster, a tip cleaning sponge, some resin-cored solder and even some 'solder wick' braid to help remove solder when you need to.

Even better, if your budget will stretch that far, is a *temperature controlled* soldering station like the Duratech (Jaycar Cat No. TS-1380). This has a professional-type low voltage soldering iron with an adjustable thermostat to control tip temperature, plus a really solid bench stand and cleaning sponge, etc.



A good solder joint has a smooth and shiny 'fillet' of solder metal, bonding all around to both the lead and the PC board pad.



How to solder a component lead to its PCB pad. The tip of the iron heats BOTH the lead and the copper pad, so the end of the solder melts when it's pushed into contact with them.

(Don't try to use a heavyweight plumber's soldering iron — it'll not only make your arm and hand tired, but also risk overheating your delicate electronic parts and PC board. The same tends to apply to gas-fired soldering torches and irons — although when you get skilled, one of the *very small* gas-fired soldering pencils is OK.)

2. The two metal surfaces to be soldered need to be **clean**, and preferably 'tinned' already — either plated with pure tin, like the leads of many modern components (and the copper tracks of some PC boards), or cleaned and given a thin coating of solder using a soldering iron and solder.

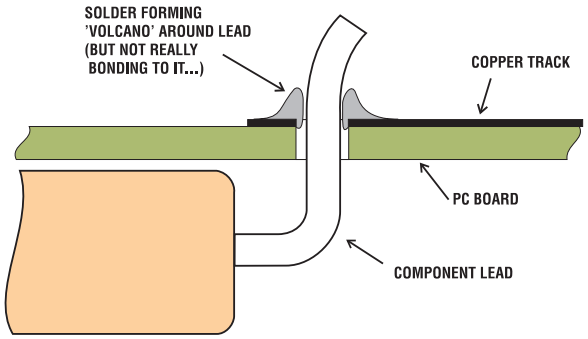
3. The tip of your soldering iron needs to be clean too, and it should also have a coating of tin or solder. Most modern iron tips are tin plated, but before making each joint it's a good idea to clean off any oxide, burnt flux etc by wiping it over a small piece of sponge which is moistened with water. The hot tip turns some of the water to steam, which in turn 'steam cleans' the iron tip.

4. Make sure the soldering iron tip has reached the correct temperature. If it isn't hot enough, you won't be able to make a good joint. If you're using a soldering station or iron with a thermostat, this usually begins 'ticking' when the correct temperature is reached. Otherwise, try touching the end of the solder wire against the (cleaned) tip — it should melt easily.

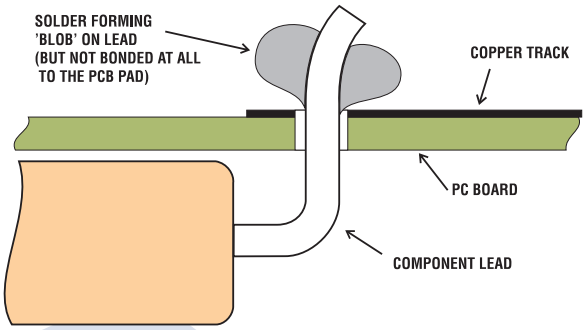
5. Try to touch the iron tip to *both metal surfaces together*, so they both heat up to soldering temperature in the shortest time. Otherwise one might get too hot before the other gets hot enough. This can cause damage to delicate components like ICs, and/or overheat the PC board pad so the copper 'lifts' away from the board.

6. Almost immediately after applying the iron tip, touch the end of the solder wire to both metal surfaces. That way, the solder itself will melt and run into the joint the instant the right temperature has been reached. Push just enough solder into the joint to flow a nice 'fillet' of molten solder around the two surfaces, then remove the solder. Finally move the iron away too, taking care not to bump the joint before the solder solidifies again (this generally only takes a couple of seconds).

By the way, if the solder doesn't seem to want to melt against one of the metal surfaces, a good trick is to brush the end against the tip of the iron — so it starts to melt and run



One kind of 'dry' joint: the solder has bonded to the PC board pad, but isn't bonded at all to the component lead. There's no reliable electrical connection, so it'll cause trouble if it isn't re-soldered...



Another kind of dry joint. Here the solder has bonded to the component lead, but not at all to the PC board pad. Again there's no reliable electrical connection, so it needs to be re-done.

between the surfaces. The molten solder itself will help bring the two metal surfaces up to temperature, and 'start the ball rolling'.

7. Try to make the joint *as quickly as possible*, because the longer you take the higher the risk that the component itself and the PCB pad and track will overheat and be damaged. But don't work so quickly that you can't make a good joint — having to do it over again will also increase the risk of damage. So 'speed with care' is the motto...

8. While the solder is cooling, take a careful look at the joint you've made, to make sure there's a smooth and shiny metal 'fillet' around it. This should be 'concave' in broad shape, showing that the solder has formed a good bond to both metal surfaces. If it has a rough and dull surface, or just forms a 'ball' on the component lead, or a 'volcano' on the PC board pad with the lead emerging from the 'crater', you have a **DRY JOINT** which needs doing again — perhaps after cleaning one of the metal surfaces again. See the drawings for what you need to look for.

9. For projects that use a number of ICs, with their closely-spaced pins, you may find it easier to use fairly *fine gauge* solder (less than 1mm diameter). This reduces the risk of applying too much solder to each joint, and forming 'bridges' to an adjacent PC board pad or track.

That's about it for the basics of soldering. But if you're new to soldering, why not get in a bit of 'hands on' practice before you start work on your first real project. Find yourself a piece of old PC board and a few surplus resistors or bits of hookup wire, and try making a few solder joints. You'll soon get the hang of it.