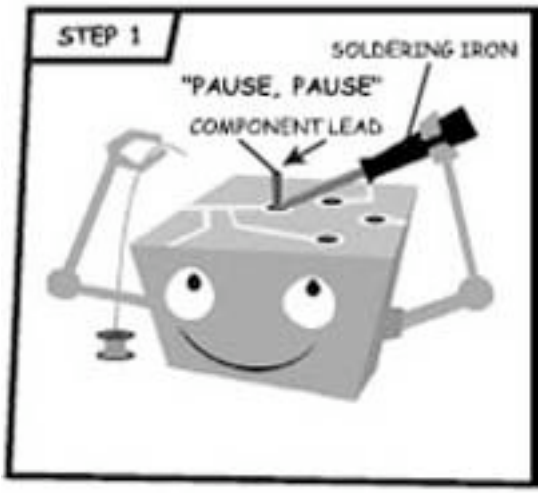
Make: technology on your time

Weekend Projects

THUMBNAIL GUIDE TO SOLDERING

This week, to go along with the Make: Video Podcast Soldering Tutorial, we present Gareth Branwyn's soldering guide with illustrations by Mark Frauenfelder which was published in Gareth's book Absolute Beginner's Guide to Building Robots This, combined with the Soldering Primer in Make: Volume 1 leaves you no excuse for not knowing to solder.



In all my years of hosting Street Tech and writing technology books, I've been amazed at how many people I've heard whining about how much they wish they could solder (or complaining about how awful they are at it). Truth be told, I used to be one of these people. And while I'm not likely to win any beauty contests for my lead-laying, I'm at least competent enough to repair damaged electronics, assemble electronics kits, and even scratch-build some of my own frakenbot creations. If you want to do the same, read on.

Soldering is not some rarified art. It does take a little bit of patience and some practice, but mainly, it's a question of having the proper tools to do it right, carefully following a few simple steps, and steering clear of a few common pitfalls. Let's take these one at a time:

THE RIGHT TOOLS FOR THE JOB

A lot of builders try to get away with what they have and don't take the time to assemble the few essential tools you need to be successful in soldering. Here's the list of critical tools and supplies:

The Soldering Iron You don't need one of those expensive professional soldering workstations you see advertised in electronics parts catalogs, but you should have a decent iron, ideally with a variable temperature feature. I've used the Xtronic 16-30 Watt iron for years and am more than happy with it. I paid under US$30 for it. A hot iron is a happy iron. You want to get in and out of there (to the solder/component/soldering pad) as quickly as possible so as to weld the component to the pad without baking the component's little brains. Discrete components are designed to take the heat, but you don't want to push your luck (and a scorched PCB is *so* not cool-looking). So you want an iron that can be as hot as it needs to be to melt the solder, but no hotter. You'll probably also want some tips of different sizes, especially really small tips if you're going to be doing a lot of work on tightly "populated" circuit boards.

A Soldering Stand Don't rely on that little stamped metal shard that usually ships with an iron. It's not sturdy, safe, or reliable enough to use for serious solder work. You want a nice, solid holster-type stand that will keep your soldering iron handy (and away from your precious flesh) until you need it.

A Cleaning Sponge A clean iron is a dutiful iron (see tips section below). Most solder stands come with a sponge and sponge reservoir. Get this type. There's also a cleaning device called a Solder Genie, which is an ash-tray-like container of brass shavings. I prefer this gizmo, but you may want to just start out with the sponge approach, as it's most common.

Desoldering Pump/Solder Sucker This device is a spring-action piston pump that, when triggered, sucks molten solder into its barrel. Such a device is essential to removing solder and soldered-on components. For the beginner, who'll likely be doing a lot of resoldering of parts, having and knowing how to use such a device is essential. There's also a product called Desolder Braid (or Wick). It's a copper-braided material that's used to "wick up" the molten solder. I prefer the sucker, but it's good to have some braid on-hand for situations where the pump is difficult to use. Try out both technologies and go with the one with which you're most comfortable.

Solder Of course, you can't do a lot of soldering if you don't have any lead in your pencil (there was an apt analogy in there somewhere). Solder is a metal alloy that melts at a fairly low temperature (anywhere below 840 °F) and is used to bond metals together. In electronics soldering, a common composition is 60% tin and 40% lead, which has a nice low melting point of below 370 °F. Because lead-based solder is not so environmentally friendly and not so meatbot friendly (that means YOU), it's a good idea to use silver solder, which is silver and tin. Also, make sure to get rosin-core solder. This is a solder that has flux in the center, a chemical compound that helps clean impurities from the bond (especially oxidized metals). Impurities/oxidation is one of the enemies of a good,

conductive solder bond. You need to keep everything clean (the tip of your iron, the solder pads, etc) and flux helps to do this. I frequently use the Radio Crap 64-025 Lead-Free Silver Bearing Solder, which is .032" diameter and comes in a handy hard plastic tube. It sells for $3 for .25 ounces.

Solder Paste Not really a necessity, but solder, or flux, paste is a good bit of kit to have. If you're having trouble with getting a good solder bond, especially if working with recycled components or repairing old electronics where there might be a lot of dirt and oxidation, you can use some flux paste to clean everything beforehand to achieve a good weld.

Helping Hand You will quickly learn, in doing electronics, that you just don't have enough appendages to hold an iron, the solder, your component(s), the PCB or whatever else you're trying to join together. You have at least four things to hold and only two appendages available (assuming you're not handy with your feet) and we don't recommend using your mouth (although we can't say we haven't done so in the past). You can use other housemates or unusually docile pets, but after a while, they get grumpy and start making Union-like demands. The answer is a little widget called a Helping Hand, or sometimes, a Third Hand. It's a jig that has (usually) two adjustable "arms" with alligator clips on the ends. These things are only a couple of bucks at electronics stores. I recommend having at least two. You can even make quick n' dirty ones with a piece of thick, bendable wire nailed to a board with alligator clips attached to the ends, but again, since they're so cheap, buying them won't break your bank.

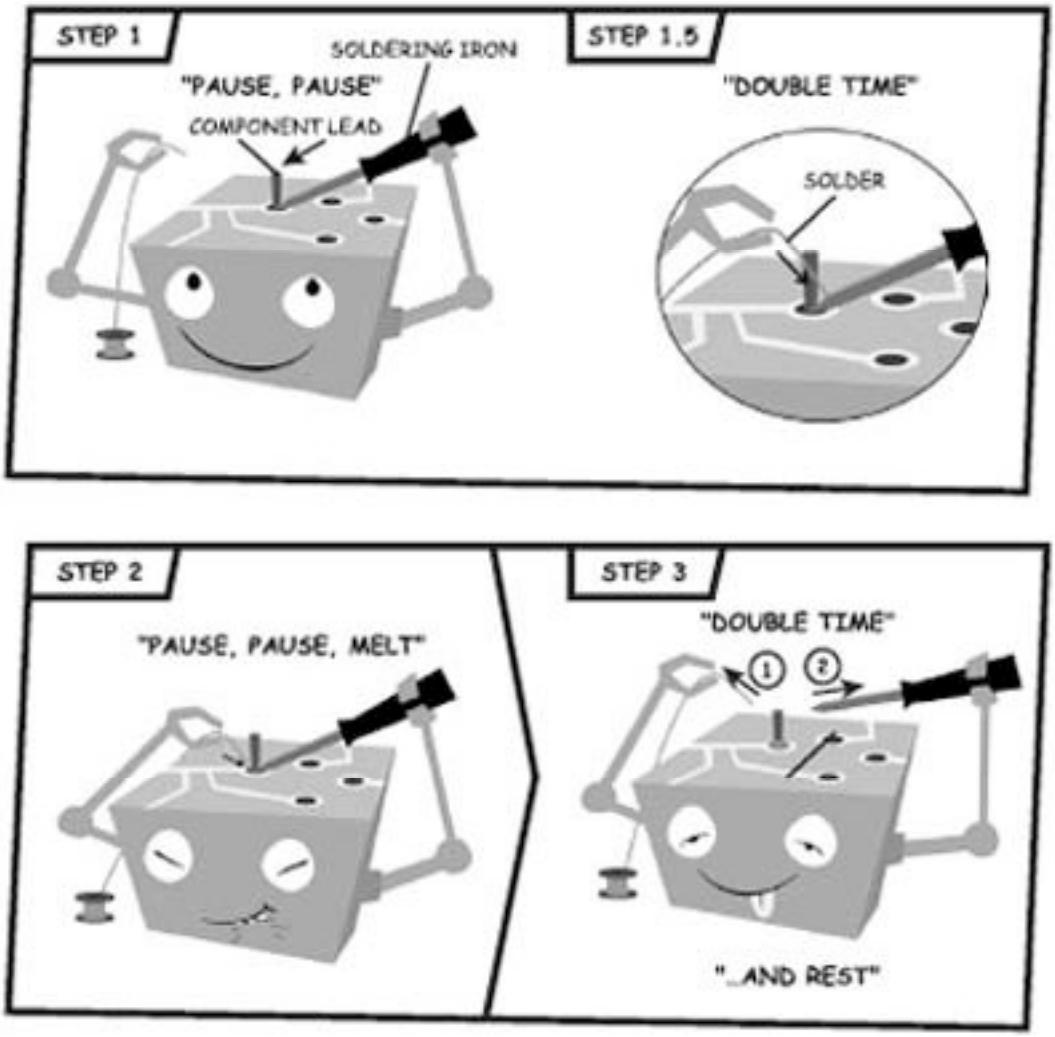
Needlenose Pliers, Diagonal Cutters, Wire Stripper There are all sorts of cool tools you can collect related to electronics work, from expensive German mini screw driver sets to digital multimeters and oscilloscopes, but three specialty tools you'll definitely need are a pair of small needlenose pliers, small diagonal cutters (for flush-cutting component leads after soldering), and wire strippers, for cutting the insulating jacket from wires for soldering. You don't need to get expensive ones. I use the ones that came with a computer repair toolset I bought over a decade again. I use it nearly every day and no tool has broken or failed yet. The entire kit (with a cheap soldering iron and most of the other tools listed here) only cost $35.

Other Things That Are Nice to Have On Hand You don't have to have these, but they're nice to have around: Scrubby pads (for cleaning contacts, PCB pads, wire, etc. before soldering), Heat-shrink tubing (for covering wire joins, motor connections, and other component wiring with insulating plastic jackets), electrical tape, poster putty (for temporarily holding things in place), and two-part epoxy and super glue (for bonding things that don't take kindly to molten metal).

LET'S DO THE SOLDER DANCE!

Like many good things in life, good soldering has a lot to do with rhythm. It's a sort of dance where you have to get the sequence and the timing just right. And, like dancing, as you learn, it will go from something you feel like a fumbling klutz at, to something you can really get into the groove of and start to rock. There's nothing like having a lot of components to solder on a PCB and getting on a roll and seeing these near-perfect little solder beads being laid down in quick succession like you're some kind of precision solderbot. You'll know you've finally become good at soldering when you look at that empty PCB and a big pile o' parts and feel excited to get crankin', rather than feeling a sense of dread, like you're about to start working on your Federal tax return.

To emphasize the sequence and timing aspects of soldering, we've tried to illustrate it as a type of dance. Following along with us, won't you?



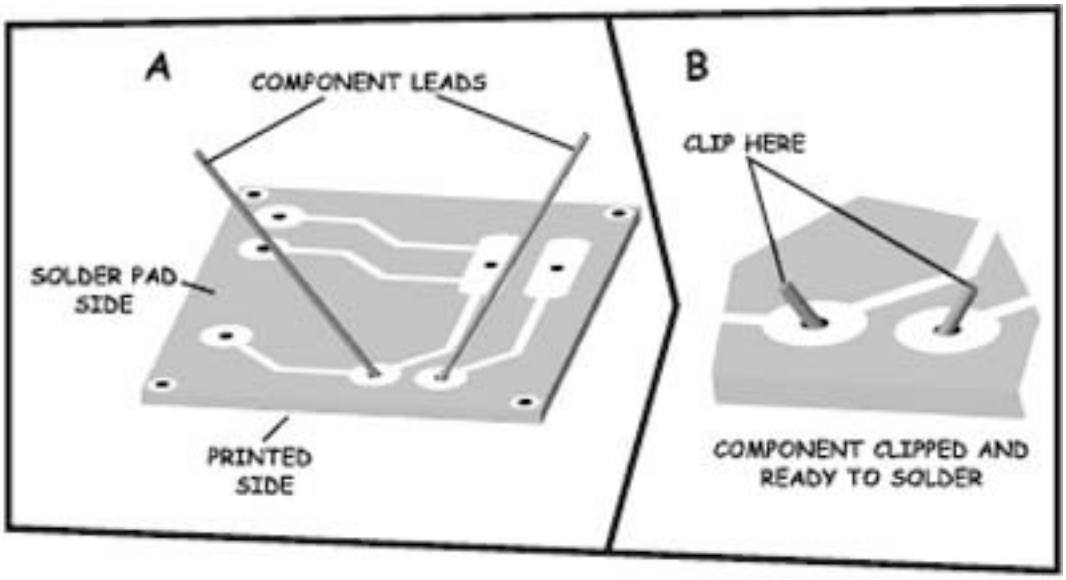
Step 1: The first step in our little fire stick and molten alloy rumba involves touching the hot, clean iron (use the moist sponge on your stand) to both the component lead that you've poked up through the PCB and the copper solder pad. You want to heat both these elements, as they need to both accept the solder.

Step 1.5: A little side-step trick, after heating the pad/component lead, is to touch the tip of the solder wire to the iron to sort of get it in the mood for melting. Just a quick touch to the iron is all you need.

Step 2: Now touch the pre-heated tip of the solder to the OTHER side of the component lead (from the iron). So, you have the solder, then the component lead in the middle, and then the iron on the other side. It should only take a few seconds for the solder to flow. It's very important that the iron is clean and hot and that you're heating both the pad and the lead at the same time.

Step 3: As soon as the solder flows and you have a nice plump little mound of solder, pull away the solder wire first and then the iron. If you pull away the iron first, the solder will instantly cool and weld the solder wire to your solder point. Not good. Doing this 1-2 step without getting it backwards is part of learning the dance. If you do solder the wire to the lead, no biggie, just heat it up again, remove the wire, and start over.

And that's basically all there is to it. Let's look at the steps a tiny bit closer before we move on.



To prep your component for soldering, you need to feed it through the appropriate holes of your circuit board so that the component leads protrude from the solder pad side of the PCB (the component itself being on the printed side of the board). One way of getting the

component to stay in place for soldering is to bend the leads as shown in A above. This will also bring the leads down closer to the pad so that you can make good iron contact with both the lead and the pad. If the leads are too long (so that they're in your way), you can clip them down before soldering, as seen in B above. You don't have to do this unless it makes access to the solder point easier. For a neat and tidy finished board, make sure your components are tight-down and flush with the PCB before soldering.

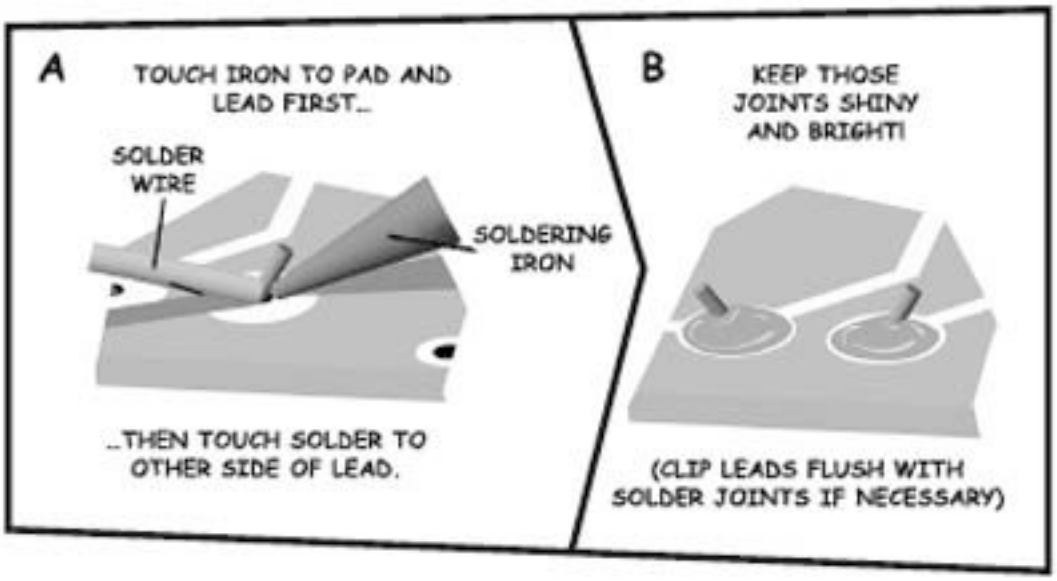


Image A above shows a good angle for iron-to-pad/lead contact and where the solder makes contact with your solder point. Image B shows what you should end up with: plump, shiny mounds of solder that fully surround the component and make complete contact with the PCB pad. Solder welds that are dull-looking, have dark spots in them (impurities), pits, depressions, or do not make complete contact with the PCB surface and the component lead are called cold solder joints. You need to desolder and resolder these as they can lead to component failure.

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 865 NORTH HOLLYWOOD, CA

POSTAGE WILL BE PAID BY ADDRESSEE

MAKE
PO BOX 17046
N HOLLYWOOD CA 91615-9587

SUBSCRIBE FOR JUST $8.73 per volum

For faster service, please order at:
makezine.com/subscribe
use promotion code **B6CMB**

Cover Price	YOUR PRICE	You SAVE
$14.99	$8.73	41.7%

☑ **Yes!** Send me a full year (4 quarterly volumes) for just $34.95. I save almost 42%

Name (please print)

Address Apt.#

City/State/Zip

Email Address
MAKE will only use your email address to contact you regarding MAKE or other O'Reilly Media products and services that may be of interest. You may opt out at any time.

4 Volume Rate: $34.95. Savings based on $14.99 cover price.
Canadian Rate: $39.95 USD (includes GST). All other countries: $49.95 USD

Fill out, cut out, fold, and glue!