

LOW COST SMD SOLDERING GUIDE

HOW TO SOLDER MOST SMD PACKAGES FOR UNDER \$50

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MAY 2003



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Introduction to SMD Soldering

At one point or another, you will probably find yourself needing to solder a SMD (Surface Mount Device) package. Not to worry though, its a lot easier than it looks! Soon enough you'll be happy when a project needs a surface mount part, and groan when you have to solder *another* through-hole part.

This article will take you through the process of soldering these surface mount parts, from simple two-pin parts to more complex TQFP. And don't worry, the equipment required is fairly simple, chances are you already have some of it on-hand (like a soldering station).

Equipment

Description	Part Number	MSDS Link	Datasheet Link	Price Approx. (\$)
Temperature Controlled Soldering Iron with small tip	Any will do	NA	NA	\$150-\$500
Small tweezers	Any with a small tip	NA	NA	\$2-\$20
28 AWG (.38 mm) solder	Kester 23-6337-8806	MSDS	Datasheet	\$18.08
Rosin flux RMA 186 pen	Kester 83-1000-0186	MSDS	Datasheet	\$3.70
Rosin flux 951 no-clean pen	Kester 83-1000-0951	MSDS	Datasheet	\$3.69
0.76mm wide no-clean solder-wick	Chemtronics 60-1-5	MSDS	Datasheet	\$2.92
Magnifying glass or eye loop	Any	NA	NA	\$1-\$50

For the **soldering station**, you will want to be able to go up to around 350 C (660 F) at least. You will actually use it around 330 to 340 C (630 to 640) during soldering, but it is useful if it goes higher sometimes. Don't get too powerful one though, sometimes you will want to use a lower temperature like 270 C (520 F). Likely you will already have one of these, and it is a good idea if it has some sort of temperature control and read-out. As well be sure to keep a wet soldering sponge on-hand when working with it.

For the **tip** of the soldering station, likely the smallest you can get will be best. The tip I had on hand was pretty small, but very dirty (I couldn't get it clean with just a sponge). To clean it I removed it from my soldering station and chucked it in a drill (easiest with drill press) and turned it at a slow speed. First I used a little bit of sand-paper to remove the hardest layer of material. Once it was fairly shiny, I used a file on the very tip to reshape it slightly. Don't go too crazy though, you don't need the tip to be that sharp! It will likely just scratch the board and not have much area for heat transfer. Finally some steel wool was carefully used over the entire tip to smooth it out. Then the tip is tinned for the first time.

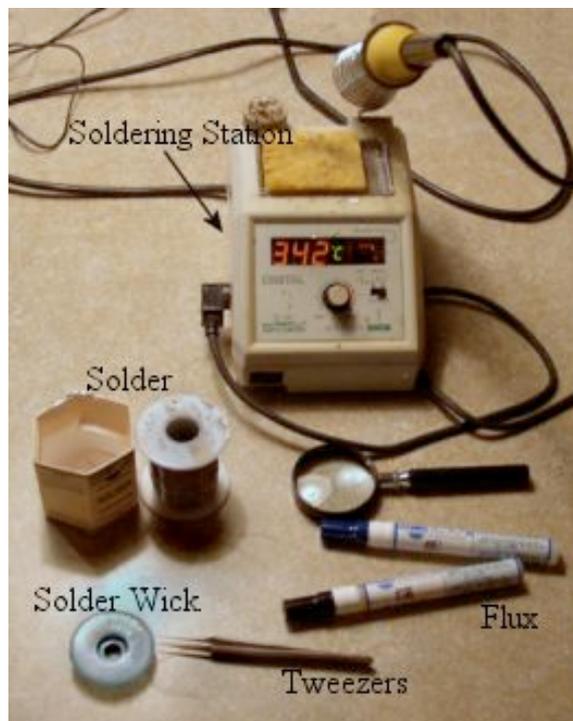
IMPORTANT: This very harsh cleaning will remove the anti-oxidation coating on the tip if you have one (most do). This will effectively destroy the tip if you remove this coating. If you do it very carefully, it may still work. First you should use just the steel wool, which is much less aggressive than the sandpaper. In my case, I had some plastic melted onto the tip that the steel wool didn't work too well on, so I resorted to sandpaper. If you can see the copper of the tip, you've definitely gone too far.

The **tweezers** are very important in the entire SAD soldering process. Save yourself the trouble of having bad ones, and get yourself some that are better than the cheap drugstore ones. Nice small points will be useful, or maybe having a few different ones as well.

Using the small diameter **solder** recommend makes the soldering process much easier. If you just use the larger diameter solder you are likely going to get solder bridges. This isn't too big a deal though, but it makes it easier if they are never there to start with. Using this small diameter solder I was easily able to solder a 64 TQFP package with no bridges.

The **flux** is very very important. It comes in pens, which makes applying the flux very easy. The pen's have a shelf life of 2 years, so they should be good for a while. The lower the number with the flux the more active it is. As a flux's activity increases, it normally makes soldering easier as it resists solder bridges more. If the activity is high enough though you **MUST** clean the flux off the board or it will eat the board away. The RMA 186 flux is nice in resisting bridge's, but it doesn't need to be cleaned off the board. Some applications might need you to clean it though, and to do that you can use rubbing alcohol and some sort of brush or swab. The 951 no-clean is designed to not need cleaning off the board. If you need a high-impedance application or very sensitive boards you will probably have to clean it anyway. The 951 doesn't resist bridges as well though. Well discuss which one to apply later.

The **solder-wick** (note: in the parts list soder-wick is the correct spelling, that is the name brand) will help you clean solder off old pads, remove excess solder from solder joints, and remove solder bridges. The one in the parts list comes in a 5 feet roll, but you can get higher (like 25 feet). The small solder wick recommend won't be very good for through-hole parts, but for SMD parts it heats up very fast, and has a bit of flux in it to help the cleaning.



Packages

There are many different types of packages. [This website](#) provides a very good overview including pictures of many different types of packages.

Packages - 2 pin SMD

Resistors Resistors have a pretty standard package. They will normally be a small rectangle, with solder connections at the ends. They are normally marked with their resistance, for example it might say 472, which is 4700 ohms. To get this simply add as many 0's as the final digit on the package. Here are some examples:

Marking on Resistor	Resistance in Ohm's
472	4700
221	220
4991	4990
4021	4020
1002	10 000
100	10

Note that the 1% parts have 4 digits on the part itself, as the resistance is known to a better number of significant digits. Almost all resistor packages have their resistance marked on them (unlike capacitors).

The resistor package is normally specified as something like 1206, 0603, 0805, or a whole host of other ones. The relationship between package size and number is straightforward:

Package	Resistor Length (inch)	Resistor Width (inch)
0603	0.06	0.03
0805	0.08	0.05
1206	0.12	0.06

0805 is pretty easy to solder, 0603 is not too bad, but getting pretty small and hard. Anything below 0603 size is going to be hard to solder (mostly because it is hard to hold). It would be almost impossible to hand solder a 0201 size device. For example an ad for one particular line of inductors has a large picture of some large and small specks, captioned "The big ones are pepper flakes. The small ones are high performance, high frequency inductors" (in 0201 size).

You will also find the sizes specified in metric as well:

Package	Resistor Length (mm)	Resistor Width (mm)	Equivalent To (Imperial)
1608	1.6	0.8	0603
2012	2.0	1.2	0805
3216	3.2	1.6	1206

Capacitors Capacitors have nowhere near a standard package. For small ones they normally have the same package size (ie: ceramic capacitors normally come in these sizes) as resistors. Refer to the above chart for package and length/width examples. Although unlike resistors often these capacitors have no markings on them. If you lack a capacitance meter, you won't be able to figure out what some of your capacitors are. The lesson here is **keep SMD capacitors in their marked packages**. This is probably a good idea for all your SMD parts, but most important with SMD capacitors

If you are using SMD tantalum capacitors you are in better luck. These are almost always marked with capacitance and working voltage. They don't have as consistent a marking scheme as resistors though. You often have to do a bit of deductive work, or a bit of guessing. Here are some examples

Marking on capacitor	Working Voltage	Capacitance
10u 25	25 volts	10 uF
476 25 K	25 volts	47 uF
226 20 K	20 volts	22 uF
10 15v	15 volts	10 uF

The capacitors with a K are from Kemet (the K has lines above and below it), and Kemet seems to use the notation instead of writing the capacitance on them. Note that the stripe on the capacitor indicates the positive side of it. Also you may want to carefully consider the use of tantalum capacitors, and your supplier. Yet another unfortunate side-effect of cell-phones is a high demand for tantalum, which has fuelled [some problems](#). It is just another matter to take into consideration.

Electrolytic surface mount capacitors are fairly constant. They are marked in a similar way to normal radial electrolytic capacitors, with their voltage, capacitance, and polarity marked. The black mark on the case indicates the negative side. There will normally be two numbers (plus sometimes a combination of numbers and letters, which is the series number), the capacitance is on top of the voltage. So if a capacitor has 100 25 marked on it (such as on the STK500) that is 100uF with 25 volt rating. Sometimes the voltage will have a V with it as well. Sometimes the capacitors don't have a voltage marked though, I have some SMD electrolytic capacitors without a working voltage marked on them.

Other Parts There are many many other small 2-pin SAD parts around. Such as diodes, inductors, LED's, etc. The easiest method is to check the data-sheet for your specific part. Many of these use the same packaging numbers as resistors. Here are a few general pointers, check the data-sheet for your specific part though first:

LED's mark their cathode with two green marks on it

Diode's often have a band that indicates ANODE, like a tantalum capacitor. With through-hole diodes though, this strip often means CATHODE, so be careful! It is highly recommend to look at your data-sheet, just to be sure!

Packages - IC's

The only information that you can normally get off an IC package is the part number, and in some cases the date code ,speed grade, and temperature grade.

The part number is normally the 'main' number on an IC and in some cases the only number. If you are using an AVR it will start with AT, here is an example of full part numbers: AT90S2313-4SC The core part number is **AT90S2313**, the -4 means **4 MHz**, and SC means **SOIC package with Commercial temperature grade**. As well there will often be a number on the AVR that looks like 9923. This means the chip was made in **1999**, week **23** of the year.

Here is another example: ATMEGA128-16AI 0212 Again, the core part number is **AtMega128**, the -16 means **16 MHz**, AI means **TQFP package (that's what the A stands for) with Industrial temperature grade**. The chip was made **2002** week **12**.

If you need to look up part numbers there are a number of resources for you: www.icmaster.com www.freetradezone.com www.google.com (a general search engine, but you would be surprised sometimes) www.findchips.com (will only find current chips that distributors stock, but still might be useful)

Two Rows of Pins Again [this website](#) provides some useful information on packages. There are many packages that look like very small DIP packages with the leads bent out, they just have two rows of pins. For example the SOIC package, which is very popular. However unlike DIP packages which are fairly standard in pin pitch, pin type, and width the SOIC packages have many different dimensions. You must check the data-sheet for the exact part you will be using to get the dimensions of the part.

Likely two of the common variants of the SOIC are the lead types, either bent under the device (J type leads) or the more 'normal' S type where the leads simply go away from the device.

As well the SSOP package is common, it is similar to the SOIC but at a smaller pin spacing.

Four Rows of Pins (squares or rectangles) As device pin count goes up, and package size goes down, the simpler two rows of pins is insufficient. Many of the AVR's come in some sort of square package for SMD, such as TQFP or MLF. The PLCC package is also very popular for large IC's, and also sockets are available for the PLCC package that are fairly low-cost.

PLCC has a pretty big pin spacing, but the pins are bent under the chip which can make things slightly harder in some cases.

TQFP isn't too hard to solder for some of the larger pin pitches, and a lot of the larger AVR's (for example AtMega128) come in this size.

MLF is hard to solder though, it is really designed for wave soldering or a similar process. It is very small, but it IS possible to solder it by hand.

Soldering

You will want some practice soldering, such as an old cell-phone or something like that.

Equipment Preparation

The first order of business is to get a damp solder sponge, this will be very important. You want to be able to keep your soldering iron tip very clean, which the damp sponge is perfect for. Throughout the solder process clean your soldering iron, and give it a few seconds to recover from the temperature drop that the sponge will cause.

Next the issue of solder tip temperature must be addressed. For the solder I used I kept the tip temperature around 330 C, which seemed to work quite well. This might seem higher than normal, but the advantage of a higher tip temperature is that the device lead very quickly heats up, which means that there isn't enough time to heat the device up. Also the solder stays above the melting point after the soldering iron is removed which gives a nice looking joint without any jagged 'peaks'.

Using Solder Wick

Also you will have to know how to use solder wick. If you haven't used it before, here is an example. We are removing a bridge in a PLCC device that has too much solder.

1. Place the solder wick over the area with excess solder in it that needs to be removed



2. Either cut off a piece of solder wick and place it where you need the excess solder removed, or just pull a bit out of the reel of solder wick and cut it off afterwards. It will likely be easier to cut the solder wick after you use it, but it is easier to photograph the solder wick pre-cut.



3. Take your soldering iron and heat the solder wick, which will heat the solder on the other side which will absorb into the solder wick



4. When the solder goes into the solder wick (with the small wick used here it should only take a few seconds) remove both the solder wick and the soldering iron. Likely that area of solder wick will now be full of solder and useless, so clip it off (unless you already did that). Note that this very fine solder wick used here fills up very fast, so you might also want a wider roll as well if you need to remove a fair amount of solder.

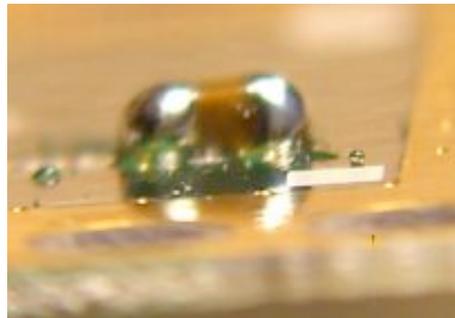


Soldering two pin devices

These are fairly easy to solder, although some of the smaller devices can be more difficult simply because they are so small. Here is the process

1. Melt small amount of solder on one pad (very little is needed)
2. Using tweezers position the part where you want it, so that it is resting on one bare PCB pad and one solder coated PCB pad
3. Now carefully grip the part with tweezers (or simply don't let go from step 2) and push downward while at the same time heating the PCB pad with solder. The solder should melt and the part will be pushed down into the pad. Remove the soldering iron, and proceed onto step 4.
4. Carefully solder the other end of the part now, by putting the soldering iron so it touches both the PCB pad and the device's pin and applying solder so it also touches both the PCB pad and the device's pin.
5. Inspect the resulting joint. If there is too much solder, use some solder wick to remove a bit. If there is too little, add some more solder.

The following pictures illustrate the joint types. Note that the solder joints as inspected in real life look much better for the 'good solder joint', but reflections in the picture make the joint look like it is broken. The good solder joint should have a nice flowing look from the PCB pad to the solder pad on the device.



Remember that you should have the soldering iron on the device for under two seconds. If something isn't working out (for example you lose grip of the device and it swivels as the solder melts), it might be best to simply remove your

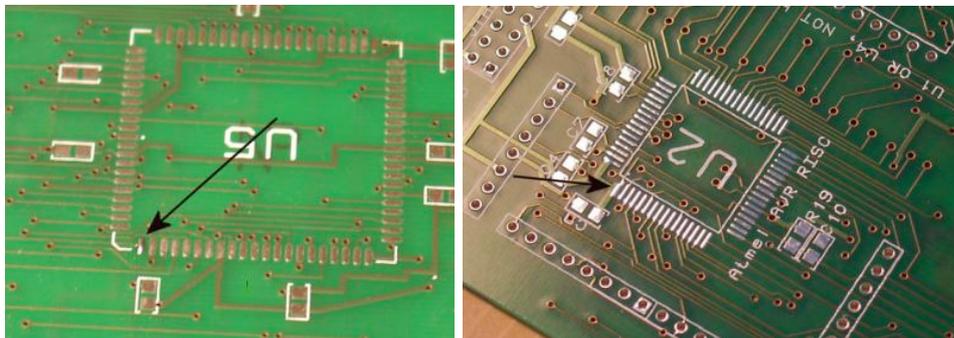
soldering iron, get a new grip, and then remelt the solder and try again.

Soldering IC's

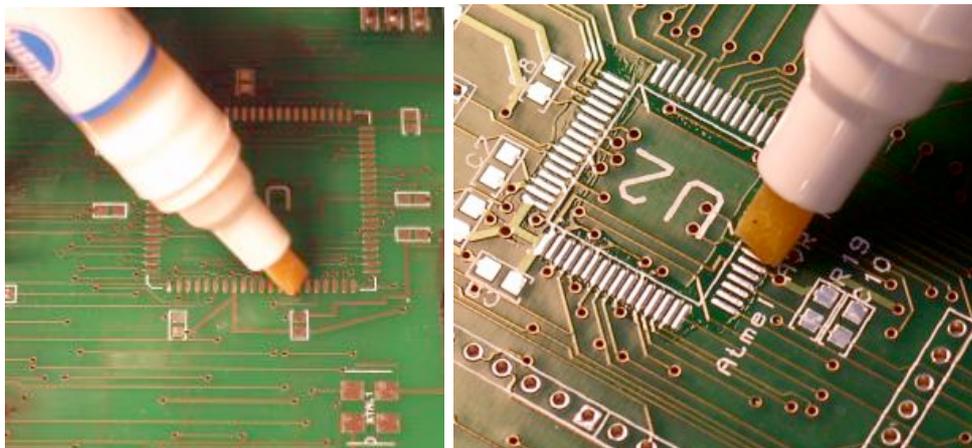
These are slightly harder than the two-pin devices, but not too bad. However first we have to discuss the flux pen. You can use either the 186 RMA or the 951 no-clean. If you will be doing a fairly fine lead pitch the 186 would probably be the better choice. If you don't need as an active flux because you will be doing a fairly large pin pitch you can use the 951 flux. For example the TQFP package will benefit from the 186 flux, but a SOIC package might not need the 186. However if you only want to buy one flux pen it should probably be the 186 as it is more universal.

To use the flux pen, simply shake it a few times then uncap it. If the pen is new or has been used a few times you will likely have to pump the pen by pushing the nib in a few times. You might want to do this over a scrap piece of cardboard or PCB just to make sure you don't get a gusher of flux that comes out at once.

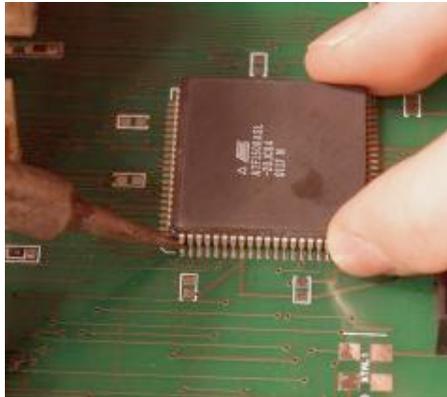
1. Apply a small amount of solder to one easily accessible pad on the PCB. Normally an end pad is a good choice for this.



2. Apply flux over all the pads of the IC that will be soldered. One pass should be enough flux, you don't need or want a massive amount of flux on the board. However you may need additional passes, as most of the time two little flux will probably be a bigger problem than too much. Try one or two passes at first, and you should get a feel for the flux pen and how the flux effects the soldering process.

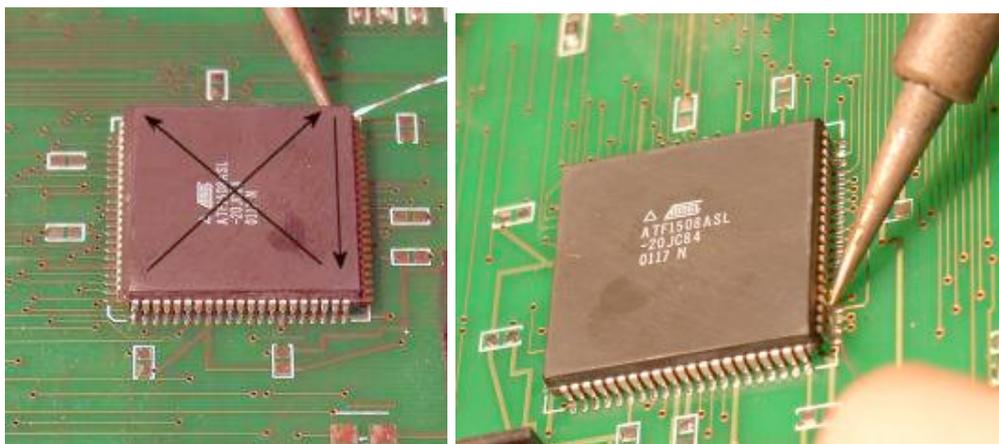


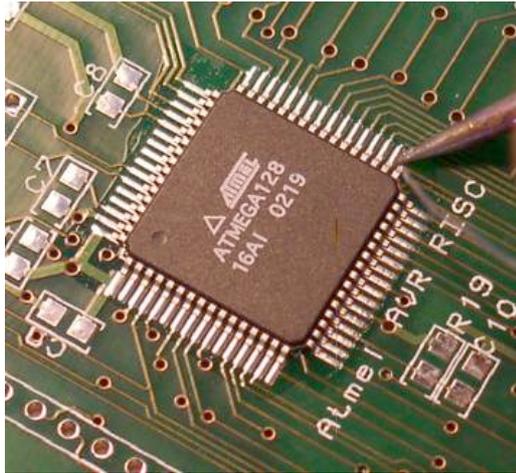
3. Place the device over the pinout now, and melt the solder on the one pin. At the same time you may need to reposition the device with tweezers or your finger.



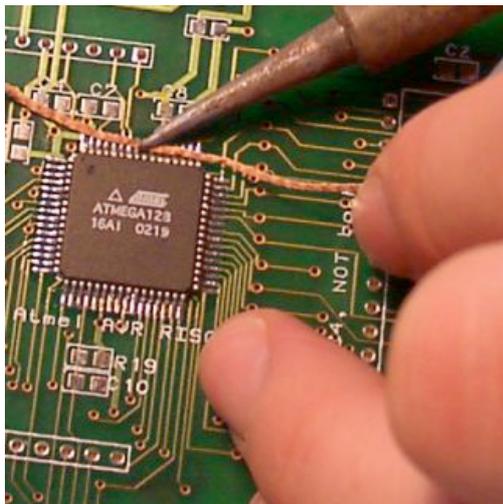
4. Inspect the entire device and see how the pins line up. If all went well in step 3 all of the pins will line up. If they don't, remelt the one pin that is soldered and use tweezers to nudge the device into alignment. Be careful though, with only the one pin soldered in if you bump the board you might shift the part and bend the pin.
5. Now continue to solder the rest of the pins, going in a criss-cross pattern at the start (for example after soldering the pin in step 3, solder the pin opposite it). This will prevent the device from shifting by accident if you solder the corners first.

Try to heat the device's pin and the PCB pad at the same time. It may help to tilt the board so you can get a more horizontal angle on the soldering iron. Also don't apply the solder onto the soldering iron, apply it between the device's pin and the PCB. It will take a few tries, but you should develop a technique for different parts. Don't worry about solder bridges yet.





6. Take a powerful magnifying glass and inspect your soldering joints. You are mostly looking for shorts, but also look for incomplete soldering joints.
7. Take a piece of solder wick and use it to remove excess solder from the leads. Also this should be used to remove bridges, this is one of the reasons such a fine solder wick is used. That is because it will heat up faster and get into smaller spaces with more control. This step is optional though if your solder joints are already ok. If you go around on all the leads though there is a chance you will remove solder bridges that you never know existed as they were too small to easily see.



8. Again inspect your joints!! Inspection is your friend in these SMD circuits. The optimum system would be a 20-30x stereo microscope, although they are very pricey. You may be able to get the "Intel QX3+ Microscope" to work for this though, as it can be used out of its stand (although it may be hard to focus in this mode) and connected to your computer for a nice large image. The magnification of it is fixed though at 10x, 60x, or 200x. You will probably have to get one off e-bay though, as they are discontinued as well. The results of this are acceptable, but not amazing. See <http://www.robotroom.com/Microscope.html> where someone has used one of these microscopes and posted results. The microscope has a very short depth of field, which seems to cause problems.

I have had a lot of success with an eye loupe that I picked up at a local surplus store for a few dollars. It spotted a few tiny shorts between pins

when I soldered in the AtMega128. The eye loupe's flared end is just held up to your eye by a scrunched eyebrow.



Other variants: Instead of tacking the chip in with solder in step 3, use a bit of blue-tack at the end of the chip. This will only really work for two-sided IC's though (see this site for more information).

More on Soldering IC's

The example above will work well for fairly large pin spacing (ie: AtMega8 TQFP package can be soldered in a fashion similar to above). However if you use a smaller pin spacing you probably won't be able to solder each pin individually. Instead you may want to do something like this:

1. Do steps 1-4 as above (for step 1 don't worry about getting solder on only one pin, as long as the device is secure)
2. Solder the pins opposite the pin soldered in step 1 (again if you get solder on more than one pin don't worry), just you want the device secure
3. Go along one side at a time of the device with the soldering iron and solder, so in a smooth flowing motion you apply solder and heat the pins at the same time. The flux should keep the solder from bridging too badly as long as there isn't too much solder.
4. Use solder wick to remove the excess solder and the bridges that may happen.

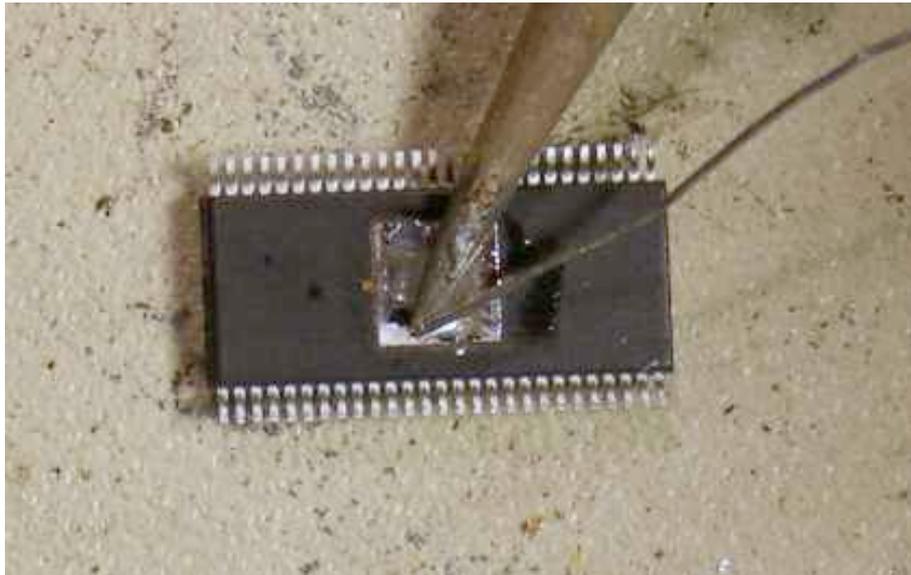
Soldering IC's With an Underside Pad

You may come across an IC that has a pad on its underside that must be soldered onto the board. The 'proper' way to do this is with solder paste and hot air, but it is possible to do it without any fancy equipment.

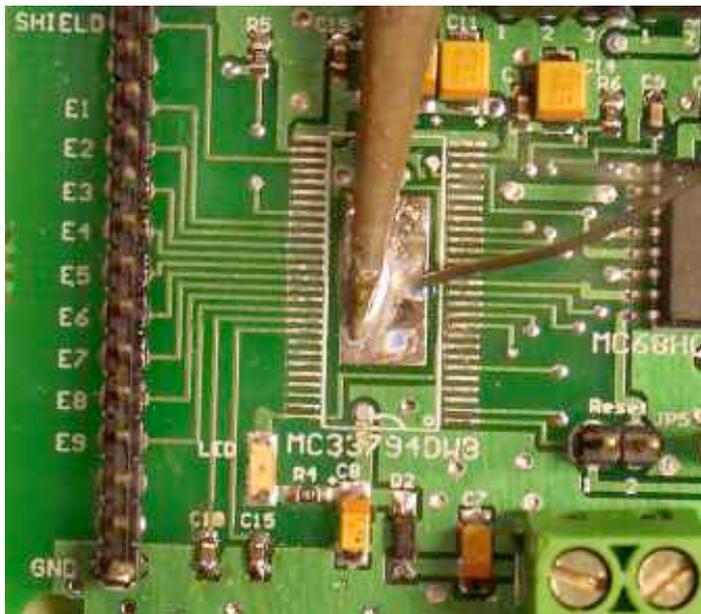
Likely the best method is to use a toaster oven as a reflow oven and solder paste, but there are other ways.

The next best way would be to use a hot air gun (described in the 'reflow soldering' section).

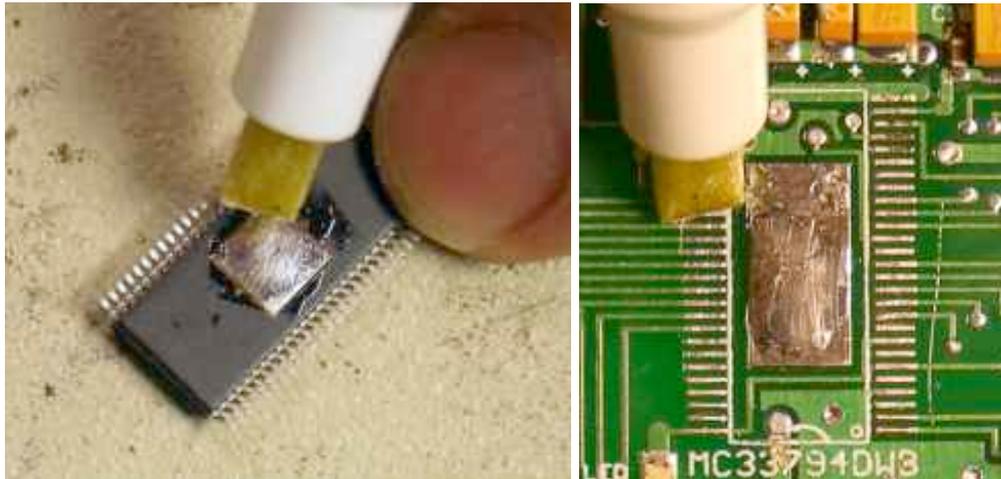
1. Add a tiny bit of solder on the base of the IC pad. In the picture too much is shown added, as I later took most of it off with some solder wick.



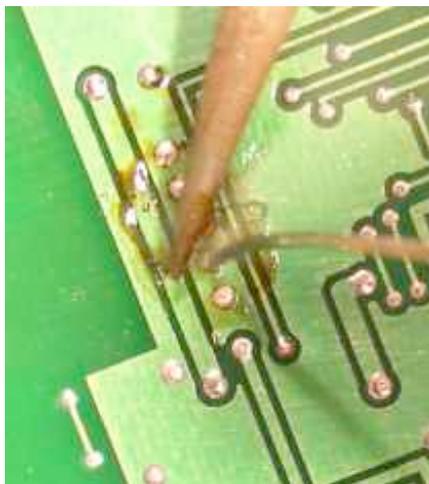
2. Add a tiny bit of solder to the pad on the PCB, again later most of the solder shown in the picture was removed with solder wick.



3. Apply flux



4. Position IC in proper place, and solder one of the pins on the IC down to hold it in place.
5. Now flip the board over. You should have put vias in the PCB right under the large pad on the IC, these can be used to conduct heat. Now get a large glob of solder and start heating the area. Two things will happen; (1) the heat will get conducted through the circuit board (hopefully not delaminating it) and (2) a small amount of solder will wick through the vias to the underside where it will fill in gaps in the pad connection.



6. Solder the remaining down, and inspect the joints. The underneath pad is almost impossible to inspect unless you have some sort of access to X-Ray equipment unfortunately.

Reflow Soldering

There will be cases where you will need to solder a device with inaccessible pins. This will be much harder, and will require more practice than the touch method. However, it can work fairly well. This will require some extra materials though, mainly a heat gun of some sort. The one I use is a Weller PropylPen with the hot air attachment. As a bonus you can use it as a portable soldering iron, and it can be set to be much more powerful than my normal electronic soldering iron (great for connecting very thick wire with a large thermal mass).



However getting solder on the pads is tricky. You could try pre-soldering the pads and place the chip on it (making sure to include lots of flux). Or you could use something called solder paste. Solder paste comes in a syringe (normally). Note that solder paste should be stored in a cool spot (in my case my basement is around 6-20 C normally), a fridge would work well (just be extremely careful to store it in several zip-lock bags so it doesn't contaminate your food!). As well solder paste does have a shelf life, and will dry up eventually.

To use it, you apply it across all the pads, place the chip down, then heat. The heating technique is important though, and should go something like this:

1. Preheat area slightly by holding heat gun on a fairly low setting
2. Move closer into pins on a higher setting, slowly going around the chip
3. Circle the chip until the solder past melts and sticks

You don't want this to take too long (especially steps 2 and 3), or you can burn the board. You will need as much practice as possible using this technique, an old cell phone would really be perfect.

For more information on reflow soldering there is a page at http://www.seattlerobotics.org/encoder/200006/oven_art.htm that shows the use of solder paste. As well it shows how to use a toaster oven to do the reflow soldering.

The page is cached [here](#) (thanks to Google) in case the original website goes down.

De-Soldering

There will come a time when you need to get a part off the board. Removing parts is slightly harder than putting them on the board, but don't fear it can be done! Lets break it down into the two major ways of removing the parts:

Removing Parts via Hot Metal Contact

Using some form of hot metal contact (ie: a soldering iron) works great on most small two-pin parts. There are a few possible ways to remove them with a soldering iron.

Two pin part removal - method 1 (Quick hands)

1. Heat one side of the part until the solder melts
2. Very quickly heat the other side, getting the solder to melt before the first side cools
3. Use the soldering iron to flick the part away

This method can work well, but you have to be fast. Also many two-pin parts have a bit of glue under them as well and the soldering iron may not break it away

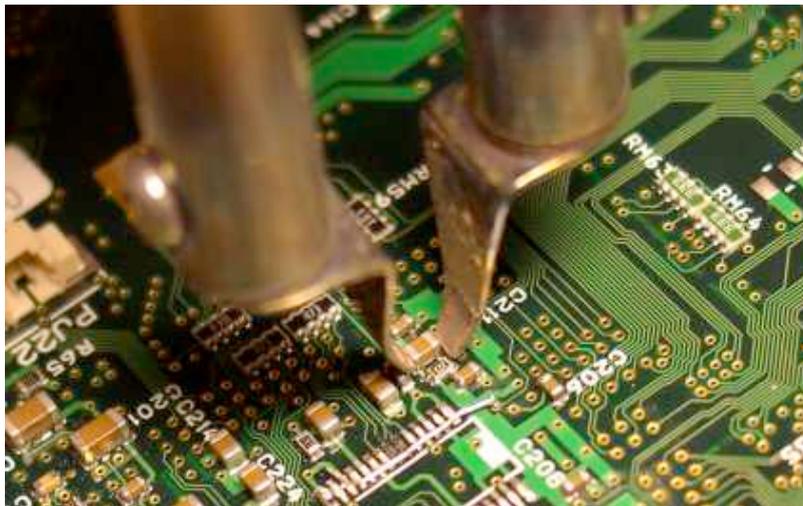
Two pin part removal - method 2 (Solder wick)

1. Use solder wick on both sides to remove the solder
2. Use tweezers to twist the part, breaking the glue under the part

This method may damage the tracks if you don't get all the solder away.

Two pin part removal - method 3 (Hot tweezers)

1. Use hot tweezers to heat both sides and twist all in one motion.



This method is fast and easy, and probably the best. The downside is you have to have the **hot tweezers** (some soldering stations offer these as an attachment as well). The house powered version heats up very fast, but it also stays at a fairly high temperature. This means you must be fast or you will burn the part.

These soldering tweezers can be used for part placement as well as removal.

IC Removal - method 1 (Small Wire)

IC removal is slightly harder, especially for 'J' leaded packages using hot metal contact. If you have a small part you could use hot tweezers with a large tip that could contact all the pins at once. Lacking that, the wire method works well.

This method only works on gull-wing packages or other parts where the leads go away from the package of the IC. It is referenced around the internet, and I also found it to be useful (this is not a method I created, it seems to be fairly widely used). Here is the method:

1. Strip a piece of fine 28 to 30 AWG wire (wire-wrap)
2. Use the solder wick to remove as much solder as possible from the parts
3. Feed the wire under the pins, and anchor it to a nearby via or pad.



4. While gently pulling the wire out, go along heating each pad. The remaining solder should melt and the wire will slip under the pad. The wire will bend the pad up the slightest amount, which will prevent it from making contact with the solder again.



5. Repeat with all sides, and remove the component.

This method works well, I have used it on various packages including an AtMega128 64 TQFP. Be careful though, as it can often leave one or two of the traces the chip was on moved or even stripped off. So inspect the PCB carefully after removing the part.

IC Removal - method 2 (ChipQuik)

There is another method as well, but it involves purchasing more equipment. The idea is to add to the solder something that will make it melt at a lower temperature, so it will stay molten longer. [ChipQuik](#) did this, see their website for more information on using it. ChipQuik is supposed to work for all types of IC's, although some of the larger packages may not be removable using hot metal contact as the solder does not stay molten for long enough. The ChipQuik alloy melts at a very low temperature, below 150 C (300 F).

In testing the ChipQuik system it was found that it worked very well. An AtMega128 (the same one that was soldered on with the soldering tutorial). The procedure is as follows:

1. Apply flux to all pins of SMD parts (the flux is provided with the ChipQuik).
2. Melt the ChipQuik alloy in with the rest of the solder on the SMD part. You have to make sure the temperature is hot enough to melt the solder on the SMD part, and not only the ChipQuik alloy. You don't need a lot of the ChipQuik alloy on the pins.
3. Use the soldering iron to go around all the pins, using a normal tip temperature (you want the solder to stay molten for some time after you remove the heat).
4. When all the solder is molten at one time, the chip should come off the pads.
5. You will need to remove the solder from the pins, as it seems to stick to it fairly well. To do this I found the small solder wick works well. Cut off a piece of the solder wick, and place it under the pads of the IC package. Then heat the IC package pins (which should heat the solder wick at the same time) and the solder should flow off the pins into the flux. Make sure your solder iron tip is clean before doing this, or you will just remove the excess solder from the soldering iron tip wasting the solder wick!
6. Use rubbing alcohol to remove the flux from the chip, and a wipe to remove the flux from the board.

IC Removal - method 3 (Destructive)

This is the easiest and quickest method probably, not counting using other equipment. It is also pretty much destructive removal, useful if you have destroyed a SMD part on the board. Its quite simple, but effective.

1. Start at the end, insert the tip under the SMD pin
2. Apply an upward pressure so when the pin heats up enough and melts the solder the pin will be forced upwards
3. Move on to the next pin, getting clearance from the previous pin that has been bent upwards

This can cause some problems though, as you will end up applying a bit of pressure on the pad which could move it. Andreas Lenze presents a good solution to this problem, which is more precise and much safer (to your circuit board):

The 'lift a pin off the pad' technique often results in the trace/pad underneath being lifted off the PCB as well. A needle (stolen from Mom's sewing kit) with a

short and sharply bent tip is a good make-shift tool to hook under the tiny J- and L-leads for cautiously lifting single leads.

IC Removal - method 4 (Puddles of solder)

This technique is contributed by Andreas Lenze: I've also had good results desoldering ICs (specimens which definitely are defective) by first winding lots of (flux-core) solder closely around the chip, then heating up everything until you see a nice puddle of molten tin embedding the chip - it will come off almost automatically (this is definitely a 'must' if you're in the lucky position to own desoldering tools).

IC Removal - method 5 (Destructive)

This technique is contributed by Thomas Jäger: If I have a smaller device I normally use the method 4 (Puddles of solder). If it comes to a bigger device like an AT Mega and the part is destroyed anyways, I cut off the pins with a very sharp knife. Then you can lift off the body of the chip leaving the pins on the board. Then you can easily take the cut off pins of the board without harming the pads. This method is destructive for the chip but at least it is better than your method 3 with lifting off every pin of the device separately. It is much faster, since it only takes seconds and the problem with destroying the pads is very rare. I successfully use this method for many years.

Removing Parts via Hot Air

Hot air seems to work very well for removing parts. If you need to remove a lot of parts it works very well, as you can simply go along heating the board and flicking the parts off. This is also a disadvantage. If you want to remove just one part on a densely populated board, that may be difficult. You will need to use heat barriers, you could use brass strips from the model store for example. Something like clay might also be useful, just you have to be careful about residues. Aluminum foil might work as well, but be careful not to melt it. The method is the same for two-pin parts as for larger parts, so this method is written for larger parts but applies to any.

1. Keeping hot air gun on a low setting, go around part pre-heating the area and bringing it up to temperature
2. Increase heat setting slightly, and move in closer to chip.
3. Keep a screwdriver or something else under the chip, so that when the solder starts to melt you will see the chip move.
4. Slowly move around the chip until you start to see the solder softening as you pass over it. Then increase the speed so you more rapidly move around the chip, hopefully keeping all the solder melted.
5. Use some tool to remove the chip.

This would be easier if you use the [ChipQuik](#), as then the solder will melt at a lower temperature. You may even be able to use some sort of larger heat gun (paint stripper for instance) which could heat all sides at once if the ChipQuik is used since the temperature could be lower. See the method 2 in hot metal contact area, simply using hot air to melt the solder instead of the soldering iron (once you have gone around to melt the ChipQuik alloy in using a normal soldering iron). If your part has an underside pad, the best way to do this is with hot air. I successfully removed a part using this method:

1. Use ChipQuik on all visible leads so they will melt at a low temperature

2. Put hot air gun over chip, pre-heating area on low temperature
3. Increase temperature slightly and air air so that it will go under the chip (if possible), while applying a light pressure on the chip.
4. When the underside pad melts, the rest of the connections will be hot enough for the ChipQuik to melt and the chip will be removed by the light pressure.

Other SMD Tips

This section presents a few miscellaneous points that may come in useful as you work with surface mount parts.

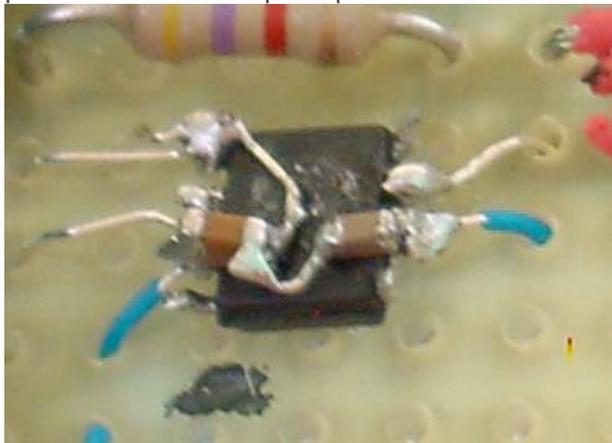
Decoupling Capacitors

If you have a through-hole chip on your board that needs decoupling capacitors, you can fit an 0805 or 0603 capacitor inbetween the leads of the IC for decoupling. Here an AtMega8's decoupling capacitor is nice and close to the chip:



Dead-bug Mounting

If you only need one or two small SMD IC's on a board, you might mount them dead-bug style. This is where they are upside down with their leads pointing up, and they look like a dead bug. Just take note of which is pin 1 before flipping the part. Here a SMD op-amp is used to buffer the AREF signal from an AtMega8.



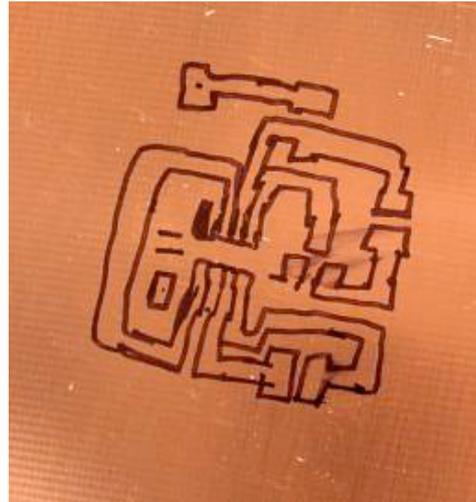
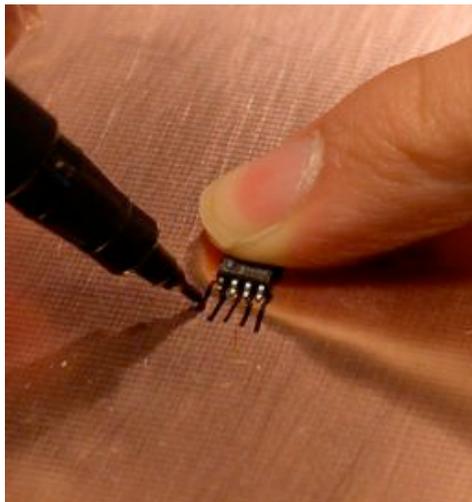
Making Surface-Mount Prototype boards

When working with parts, sometimes you need to make a simple circuit board with SMD parts. You can easily do this with a Dremel (or similar rotary tool) and the proper bit. The bit looks like this:

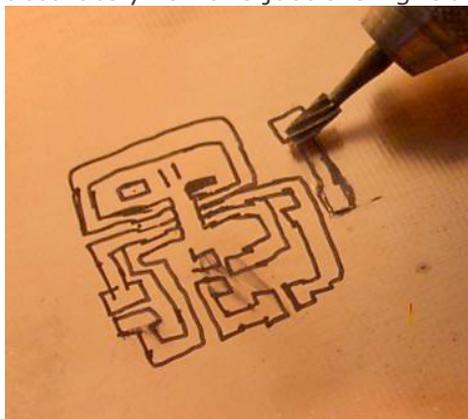


The steps are as follows:

1. Clean the copper circuit board (steel wool works well)
2. Take a marker and draw out the circuit board. Wherever you draw a line you will REMOVE the copper. So the circuit board will end up having a lot of copper plus a few small divisions.



3. Take the dremel, and use the edge of the bit to remove the copper where you drew lines. This will take a bit of practice, but soon you will be able to accurately remove just the right amount of copper.



4. Check for shorts or spots you didn't remove the copper on (use inspection visually and with a continuity check)
5. Wash with rubbing alcohol to remove any remaining marker, and solder parts on board

Conclusion

This article has presented a few different soldering techniques and information that should be useful when you start using the surface mount version of the AVR and its support components.

There is much more to be on surface mount though, and you are encouraged to read and also more important experiment!