

Richard Greenway August 15 Seattle Robotics Society Meeting Presentation on SMT soldering

Introduce Self

Introduce Topic SMT Soldering for Everybody

Explain what we are going to cover quickly, and why it is SO easy and what makes Through hole such a Pain

First things first

Good morning, Most of you know me, I'm Richard,  
I work for Nikola Engineering, a Design engineering company in Sequim

It's mostly like a full time hobby. Designing stuff building up one maybe 2 prototypes, Finding the bugs, and just making the prototypes work, Adding a little blue wire (Hold up a spool) or making structures out of parts onto the board until it works.

Once we have the prototype working, no matter how messy it is, We send it off for approval, look at the marked up schematic and fix it in the computer and send the data off to china to go into production. We don't usually have time to build another and if it worked with the changes, then all should be good.

<Slide Change> Important concepts

Of course building only a couple boards means it's not worth doing the whole stencil, paste routine for a board and we usually just start building up a board same way you would a plated through hole board.

put the part down, and solder from the top, move to the next.

The only difference for Surface mount boards, is that you populate them much faster because they are so much easier to work on.

So don't be scared of SMT It's easy, and I'll show you everything you need to know to try it yourself Stick around for the work session after the meeting, and you can try your hand at it even.

The most important thing I find is needing good lighting, The parts are smaller, and can easily be lost with the bump of a wrist. Of course, they also don't have long sharp leads to stab you in your feet walking around in socks at night.

There are plenty of good tools on the market, Circuit Specialists sell nice hot air rework stations with iron for \$100-\$150 But I'll try to show you what you can do with nothing more then what you probably already have and also show you what can be done with more.

<Slide Change>

Of course part density is probably the first reason to choose SMT parts  
But I find it one of the least important reasons.

For me, the most important reason to do SMT is it is much easier to work on then PTH  
Because all the connections are on the top side of the board, lifting pins doesn't mean trying to cut one out of the middle of a chip.  
Changing an IC doesn't mean fighting with a solder sucker to clear the GND pins,  
Replacing a resistor doesn't mean trying to pry it out of the board without taking it out of the enclosure

And of course, as a hobbyist it is much nicer when etching your own boards,  
that you need many many fewer drill holes then when using PTH parts.

<Slide Change, Show difference in Density on common IC)

Comment that 4 of the qfn parts could fit under the dip part with room to route traces out.

I'm just going to quickly go through these tool lists as you will get to see them again later, and links on the last sides for where to get them

Tweezers are probably the only thing you really need that you wouldn't have for normal soldering.  
as you get better and the pin to pin pitches of parts you are soldering gets smaller then the rest becomes more important

Flux makes everything easier, it cleans the pads of oxides and allows the solder to easily flow onto the pads, and away from the areas that aren't metal.

This is important esp. for some pin by pin soldering techniques, where often the solder is too big to apply to a heated pin/pad and instead a ball of solder is carried on the tip of the iron to the pad. (Ewww) Doing that will burn off the flux in the solder before it can effect the pad, so extra flux helps a lot.

Solder wick will allow you to fix anything.

Magnification for checking your work is important. It can be anything from a Fancy microscope to the old eyepiece off of a duff camcorder. I usually just get by with a Magnifying lamp and only pull out the scope if in testing something seems wrong and I really need to see it.

Another easy magnification available now is a digital camera with Macro mode. Just take an in focus picture at the tightest zoom you can get, and then check on the computer or on the camera display zoomed in to full size and check your work.

No Eye Strain.

<Slide Change>

These are some extra tools that allow you to do some more advanced rework, or faster assembly.

I should have Added the Rework station from Circuit Specialists to this list So you will have to mentally add that bullet

Though by now you should be completely numb to the points, and ready for the rip roaring excitement of soldering a board....

<Slide Change>

<Slide Change>

<Slide Change>

Common Methods

Pin to Pin soldering

Drag

<Change>

Hot Air

Hot Plate

<Change Fix the Oops>

At some point you are going to need to make changes to a board that is built, it's not hard, just remember what I said about the Coffee

<Change>

This is the first SMT part I ever hand soldered.

a 132pin 68332 Microcontroller. Originally we were going

to try and make a socket for it so that it wouldn't have to be soldered, and then we learned fast that soldering even 0.5mm pitch IC's is a piece of cake.

<Change>

And hopefully you don't make this kind of mistake too often.

I can only take comfort in the fact that I didn't design this board, and I didn't put any of the rest of the components on either

I just had to fix the using the wrong decal for the part error.

Just took a few minutes after the super glue dried holding the part down, and then stripping the wire to make new leads.

<Change>

Ok, Lets go ahead and Show off this stuff.

I'm going to try and keep this stuff where I can see it, and you can see it.

The part I am putting down on here is a 64pin 0.5mm package microcontroller

This on is part of Atmels new 32bit line.

add note on Soldering Iron technique, temperatures etc.

I have already made a messy tack on one corner, and soldered one side down (Hey I had to practice something)

That solder bridge there will be no problem to fix in a bit.

The most time consuming part of all large package fine pitch soldering is getting the part aligned on all sides with the pads

Just put a good blob of solder down, and keep it molten while tweaking the part into place with tweezers

once it is set remove the heat and let the joint cool to hold things in place. Then start soldering on the opposite side

I'm going to switch to the other iron here now with a large tip and show my favorite way for soldering larger packages

This will work for any package that has rows of pins, like SOIC or TSSOP as well as the qfp packages.

It is the Drag or Mini wave solder method. We flux all the pins well, and then get a large ball of solder on the large tip of the iron.

Now we are going to use the weight of the ball and the motion of the iron to roll the ball over the pins,

the flux boiling off will pull just the right amount of solder under the pads, and surface tension of the ball will roll back the solder bridges into itself.

That was fast and neat huh? Perfect solder joints and just needs the flux residues washed off with some flux cleaner and it will look all professional

You can leave the flux there for hobby stuff, and really for any prototype. Sure some fluxes will start to eat the metal but

most all rma fluxes are safe to leave on, they just look a little tacky

If you don't have flux, only have a big tip, and only have large solder don't count yourself out yet though. Solder wick will come to your rescue by having plenty of flux built in to suck up your bridges in no time.

Now this next method has been quite popular lately.

It's a fast way of assembling a board that you have all the parts for, and gives consistent great results

It's quite affordable with the paste only costing a few dollars for the small amount you need, And a generic electric skillet you can pick up at a good will or any discount store

Just squeeze a small bead of paste out across the pads and set the part down and align.

Solder paste is little balls of solder suspended in flux, and as we know, Flux makes everything easy with SMT

Before I bake this I am going to do another a different way.

Using a mask

spread carefully, and try to place the part just once right.

One thing that hobbyists often worry about with paste is that it has an expiration date

What happens when the paste "expires" is that oxides have built up on enough of the spheres

to enough of an extent that when it is reflowed using standard soldering curves, they may not melt

through the harder oxide layer to merge with the

greater solder joint being formed Remaining behind trapped into the corners of the solder mask as little balls.

for the hobby and prototype applications, I say don't worry about it. If you do worry, just add some new flux and stir it in well.

otherwise if you don't wash the flux off the board, the balls will be safely encased, and even if they aren't

they are usually too small to short out pins even on fine pitch parts...

But if you are going to go into production and make many boards... Best to use fresh paste

Or at least get some good inspection gear

<Change>

Ok, well that's the common ways to build a board, but lets quickly show how to make some changes to a board too

These are just some old circuit boards from CD drives, I haven't scavenged too many parts off of yet.

I'm going to use a \$20 hot air gun to do this, a more expensive gun with proper tips will allow you to do this without

worrying about damaging plastic parts around the dead bit. I will usually just put down some cardboard to make a shield if I care about the parts.

Once the part is off, I can use solder wick to bring the pads back to flat, then I can put a new, or a used part down.

the task of removing a 40pin microcontroller to reuse in another project is a real pain, doing it with an SMT part just takes a few minutes.

Removing an SMT resistor is pretty easy too.

Soldering Tweezers are also available for removing parts, just like they sound they are two soldering irons joined with a sprigged hinge with various tip shapes for removing everything from single super small 2pin devices, to large tqfp parts

But they also can be pretty pricy, and you don't need them that often, making the investment not too justifiable.

So that really covers everything you need to know. Any questions?

Great so I hope that now everyone knows a little more, and is willing to try something new, because

Like most things, new stuff is usually easier to do than the old way. Just need to learn new habits.