AN0001 Proto Advantage

Application note revision 1.6 www.Proto-Advantage.com

Circuit Assembly Instructions for Proto Advantage PCB and Stencil Kits

1.0 Board and Stencil Kit Details

Whether you have a toaster oven, a hot plate, or a professional reflow oven, use our laser cut 4 mil (0.1 mm) thick stainless steel stencils to apply paste and reflow any surface mount chip. All you need is one of our adapter boards (example: PA*, IPC*, or FPC*), the corresponding stencil (example: PA*-S, IPC*-S, or FPC*-S), one of our mini-squeegees, and one of our mini-tubes of solder paste. We manufacture and stock the largest selection of adapter boards in the world, and can adapt almost any IC package to DIP.

For the demonstration in this application note, we have used a low cost toaster oven. Usually the cheaper ones are best since they have manual controls. This one has a manual control knob allowing temperature to be set from 95°C (200°F) to 235°C (450°F), perfect for a low temperature (Sn42/Bi57.6/Ag0.4) or leaded (Sn63/Pb37) reflow process. For prototypes, we usually recommend low temperature or leaded solder paste as it makes reflow easier due to the lower liquidus temperatures. Most lead-free packages are backwards compatible with a low temperature or leaded solder process. The only exception being lead-free BGA packages, which can still be soldered using a low temperature or leaded process, but require a higher liquidus temperature, usually around 217°C (420°F), to be exceeded for at least 30 seconds to ensure the lead-free solder balls melt.

Figure 1 below shows the syringe of solder paste, IPC* adapter board, stainless steel stencil (4 mil thick), and mini-squeegee for reflowing ICs in the lab, at work, or at home. Figure 2 shows the other equipment you will need: isopropyl alcohol, paper towels (or lint free wipes if you have them), toaster oven, temperature probe, compressed air (optional), tweezers and Scotch® tape.

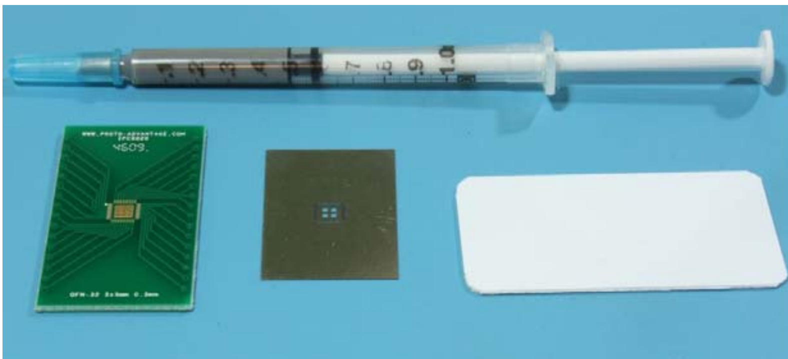


Figure 1: Proto Advantage Board and Stencil Kit.

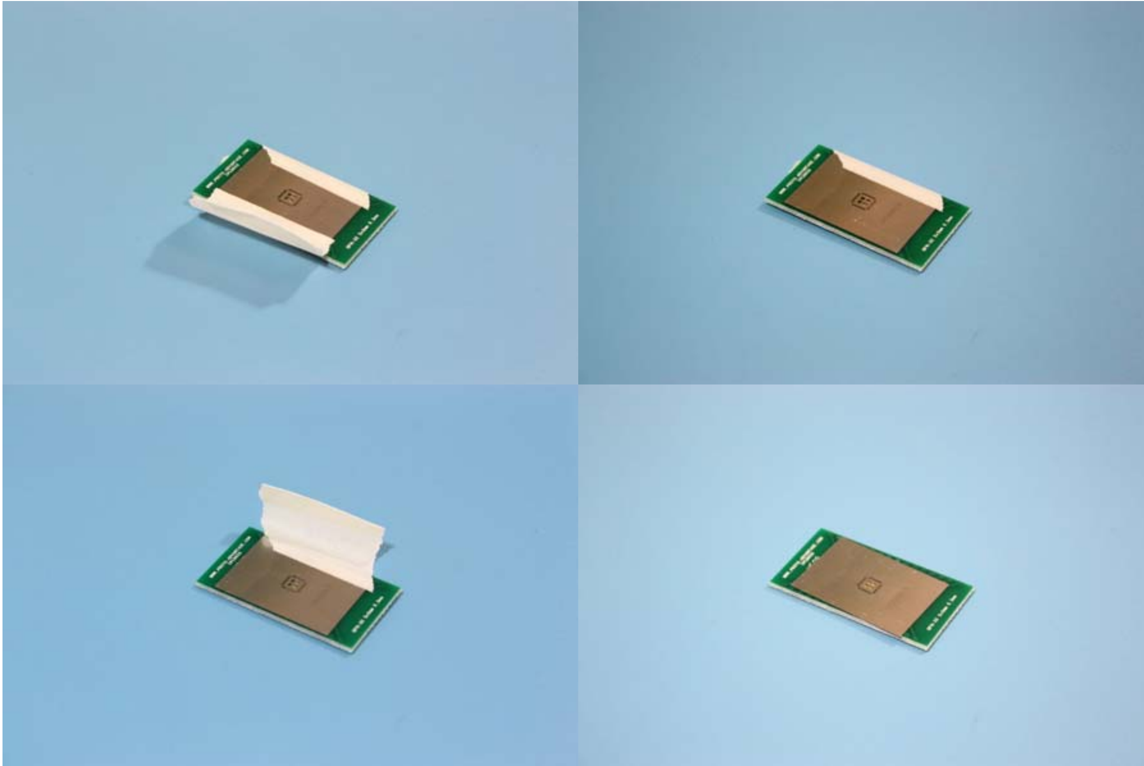
Figure 2: Other equipment you will need.

© 2007-2016 Proto Advantage

2.0 How to use the Board and Stencil Kits

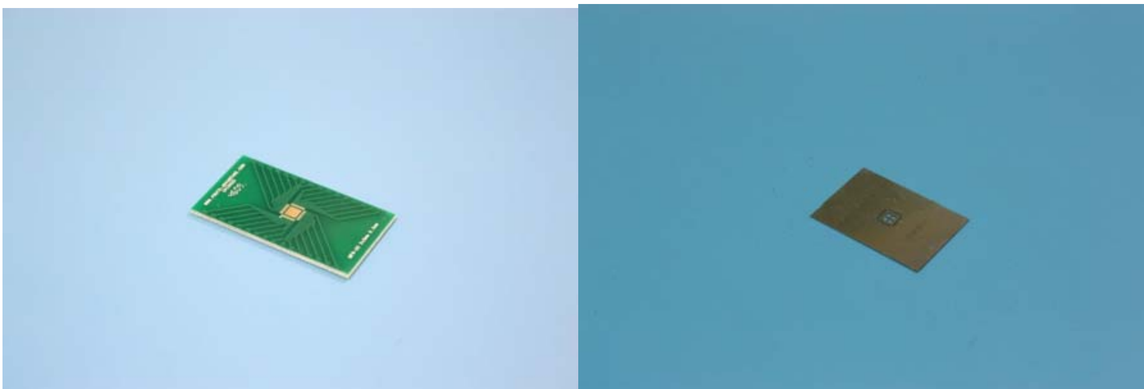
2.1 Unwrap your Stencil

First, unwrap the stencil. 4 mil thick stainless steel should be handled with care as it can bend if abused and it has sharp corners. Despite the need to handle it carefully, keep in mind that every production assembly house in the world uses stainless steel stencils because they are the best. They provide the most accurate apertures, best solder paste location and are reusable for thousands of boards. Keep the stencil and simply re-order the bare PCB next time you want to assemble another IC in the same package. The syringe of solder paste can be kept at room temperature for up to a year.



2.2 Clean the PCB and Stencil

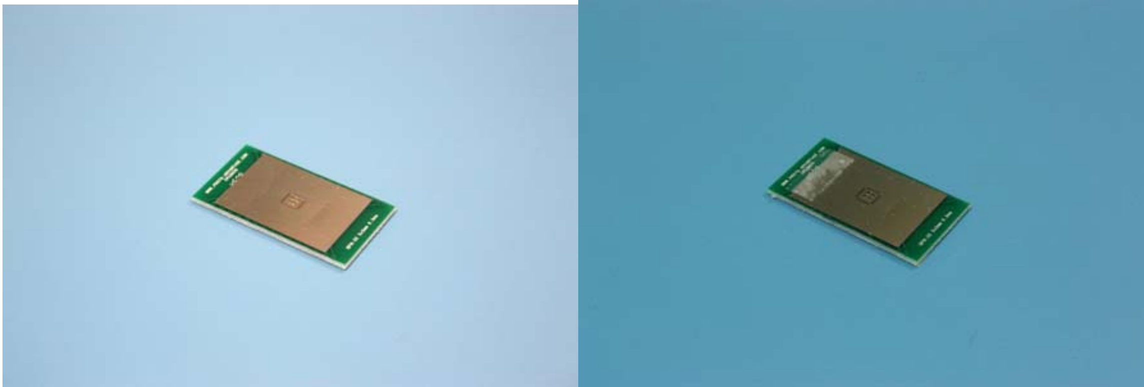
Using a small amount of isopropyl alcohol on a sheet of paper towel, wipe the PCB footprint and stencil clean.



© 2007-2016 Proto Advantage

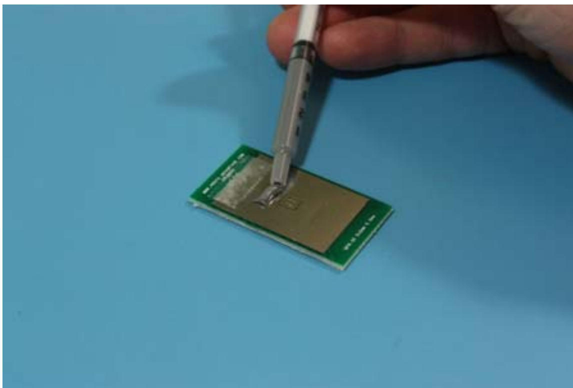
2.3 Affix the Stencil to the PCB

Position the stencil over the footprint so that all pads are visible through the stencil apertures. Tape the top edge of the stencil in place over the unassembled PCB using low residue scotch tape (Name brand 3M Scotch® tape works best). **FOR SMALL ADAPTER PCBs: ones with less than 32 DIP pins, or less than 1.6" in length, refer to Appendix A for additional instructions.**

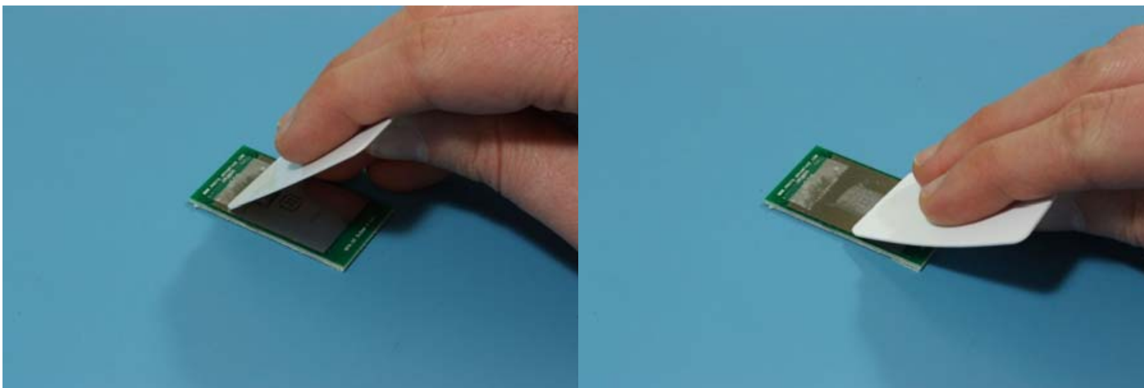


2.4 Apply the Solder Paste

Apply a bead of solder paste at the top end of the stencil, just below the tape.



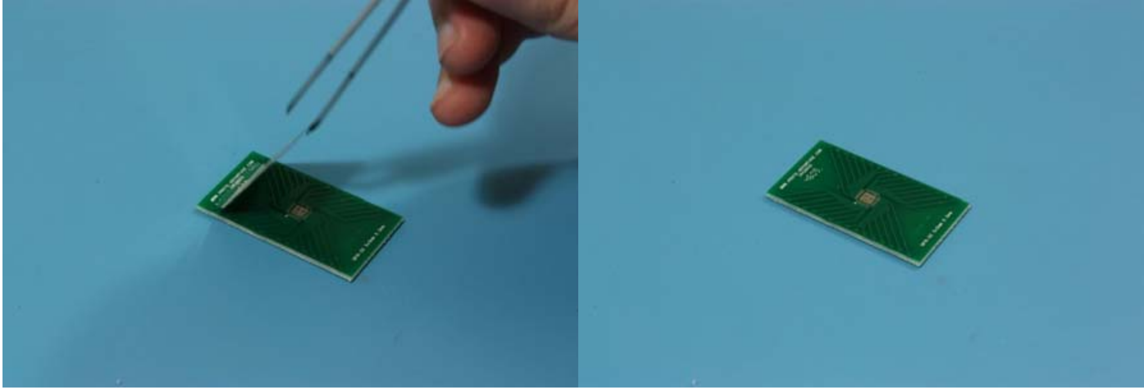
Drag the mini-squeegee from top to bottom to spread the paste. Take only one pass with the squeegee, applying even pressure to ensure the paste fills the stencil voids completely.



© 2007-2016 Proto Advantage

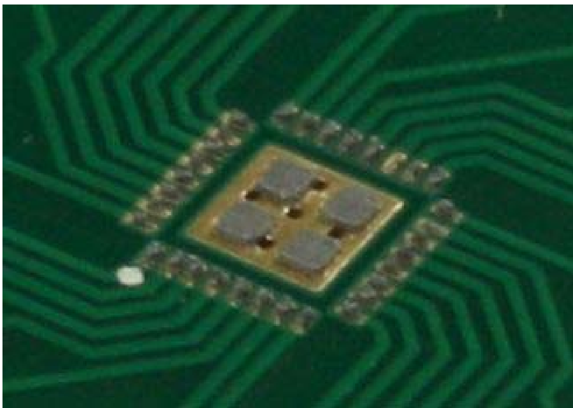
2.5 Remove the Stencil

Lift the stencil with a pair of tweezers and remove the tape.



2.6 Inspect the Solder Paste Deposited

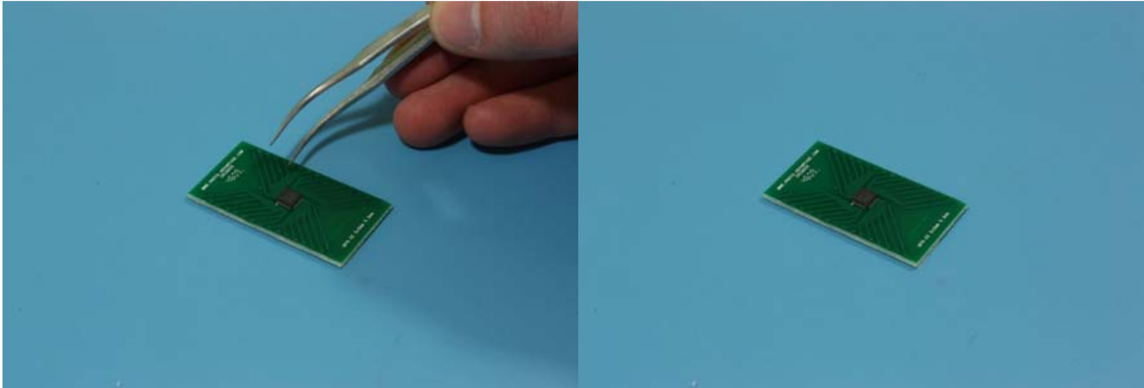
Visually inspect the solder paste to ensure it is on the pads and a uniform volume has been deposited. It should look like the paste in the image below. It doesn't have to be perfect, since the solder will flow and bond to the pads and pins during the reflow process. If you are not satisfied with how the paste was deposited, wipe off the paste using paper towel with isopropyl alcohol on it, clean the stencil with paper towel, isopropyl alcohol, and compressed air, and simply start over.



© 2007-2016 Proto Advantage

2.7 Place the IC Chip into the Solder Paste

Place the IC chip in the correct orientation on top of the paste, using the pin 1 silkscreen marker dot on the PCB. Keep the board upright and do not tip or jar the board. Any shock or tipping may shift the IC and could cause shorts to form during reflow.



Visually inspect the IC chip placement. It should look like the placement in the image below. If you are not satisfied with how the chip is seated, lift the chip off, clean the chip using paper towel with isopropyl alcohol on it, clean the board using paper towel with isopropyl alcohol on it, clean the stencil with paper towel, isopropyl alcohol and compressed air, and simply start over.

© 2007-2016 Proto Advantage

2.8 Reflow the Assembly

Place the board into your reflow oven. Here we are using a toaster oven, but this process will also work using a professional reflow conveyor belt oven, IR oven or hot plate. If using a toaster oven, place the temperature probe as close to the PCB as possible, being careful not to jar the PCB or touch the chip.

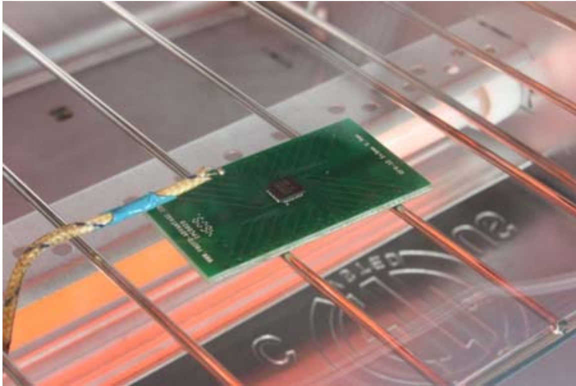


Figure 3 below shows the recommended temperature profile for low temperature (Sn42/Bi57.6/Ag0.4) solder paste reflow. All our PCB and Stencil Kits now ship with Chip Quik® Low Temperature (Sn42/Bi57.6/Ag0.4) solder paste. To successfully solder your chip it is not necessary to follow this profile exactly. It is important to hit on some key aspects however. These include the 90-180 second preheat and soak time at 90 to 130°C (194 to 266°F), as well as the time at which the liquidus temperature, 138°C (281°F), is exceeded of 60-150 seconds. The temperature profile at its peak should not exceed 165°C (329°F). Keeping the max temperature low, close to 165°C is recommended.

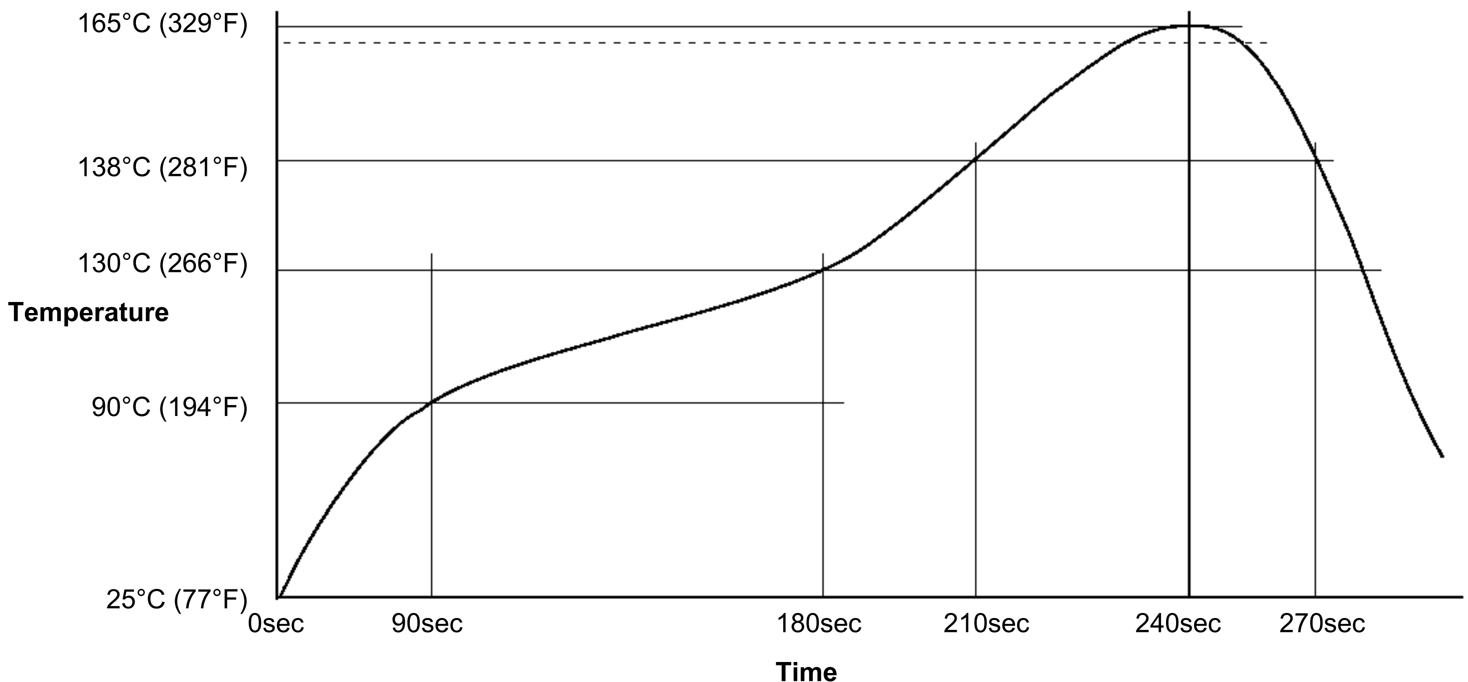


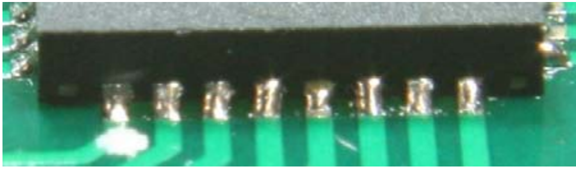
Figure 3: Proto Advantage recommended reflow profile for low temperature (Sn42/Bi57.6/Ag0.4) solder assembly.

To achieve the above reflow profile: Place the board into the toaster oven. At time=0sec, set the oven temperature dial to 125°C (250°F). At time=150sec, set the oven temperature dial to 175°C (350°F). Some ovens run hotter than their dial says and often setting to 160°C is enough. At time=240sec, turn the oven off and open its door slowly. Leave the assembly to cool in the oven. Depending on the toaster oven, tweaking the profile may be necessary. You can do a dry run using just your toaster oven and temperature probe to make sure that the preheat and soak time & temperature, and the liquidus time & temperature, ranges are met.

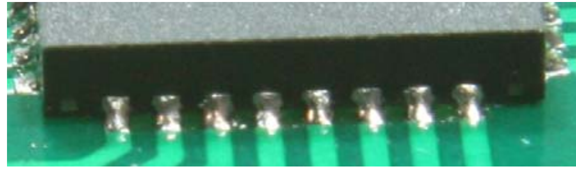
© 2007-2016 Proto Advantage

2.9 Inspect the Finished Assembly

After reflowing the assembly, and allowing it to cool, inspect the solder joints visually on all sides. A magnifying glass or eye loupe makes this much easier. Below, we can see the shine on all joints for this 32 pin package. Each joint has a good solder fillet. The solder joint on pin 19 looks a little light on the volume of solder, but we can see that a good connection is still being made between the pin and the pad on the board.

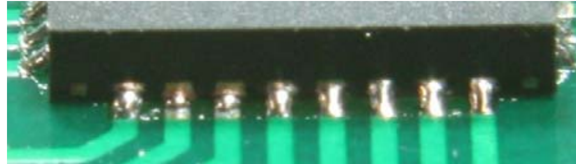


Pins 1-8



Pins 9-16

Pins 17-24



Pins 25-32

3.0 Clean up

All our stainless steel stencils are reusable, as are the mini-squeegees and unused solder paste left in the syringe. Proper cleaning of the stencil and any unused PCBs and IC chips will allow many more assemblies to be reflowed.

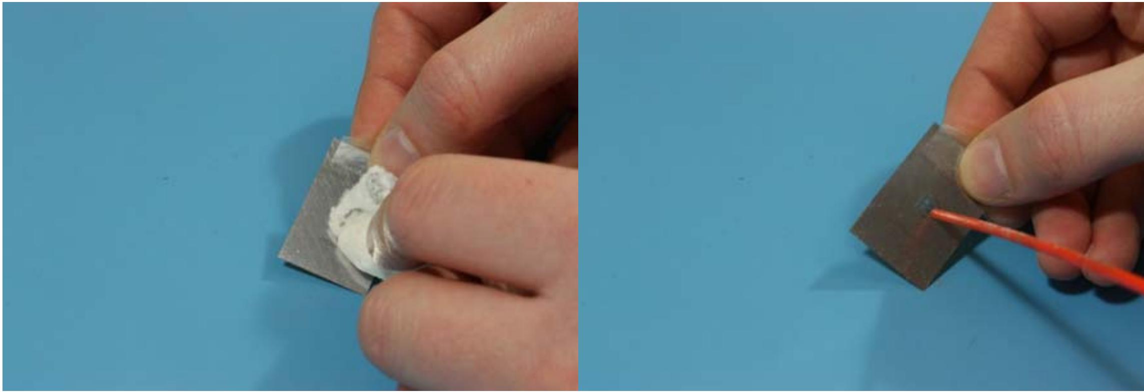
3.1 Cleaning Solder Paste off an IC

Using paper towel with a little isopropyl alcohol on it, wipe the solder paste off the bottom of the chip.

© 2007-2016 Proto Advantage

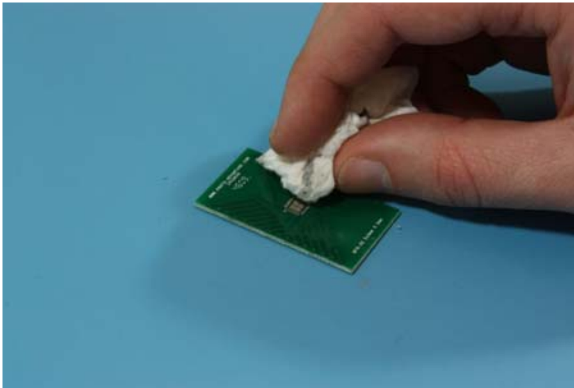
3.2 Cleaning Solder Paste off the Stencil

Clean the left over solder paste off the stencil using paper towel with isopropyl alcohol on it. Use a can of compressed air to blow out any remaining solder left in the stencil voids.



3.3 Cleaning Solder Paste off the PCB

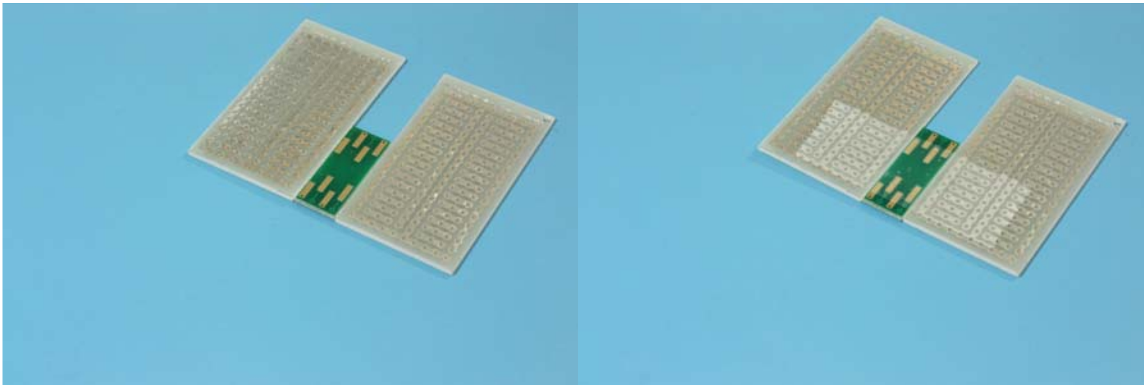
Using paper towel with a little isopropyl alcohol on it, wipe the solder paste off the PCB.



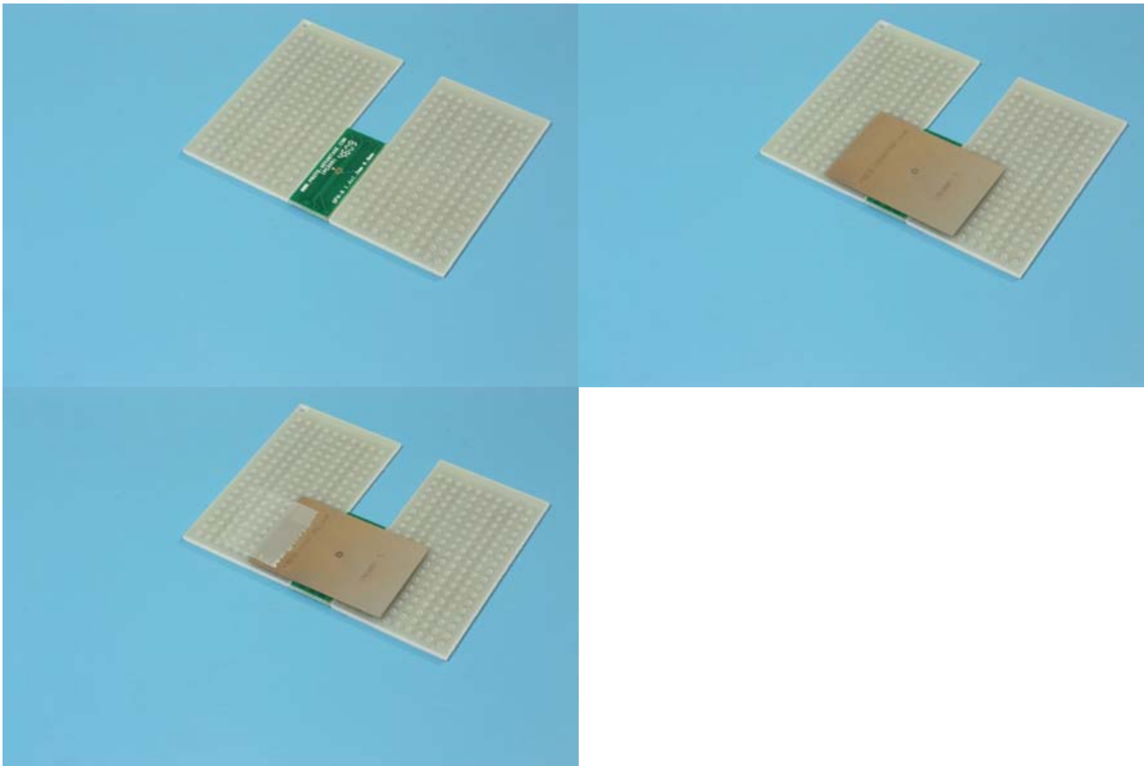
© 2007-2016 Proto Advantage

Appendix A: Additional Instructions for Small Adapters (Less than 1.6” in length)

For smaller PCBs, it is best to tape two additional PCBs that are 1.6mm (62.5 mil) thick on each end. This will allow the stencil to be affixed correctly and will also support the stencil during the squeegee procedure. Place the additional PCBs at the top and bottom edge of the overturned adapter and tape them in place as shown. Here we have used two Proto Advantage SBB1602-1 PCBs, but any two similar ones will do.

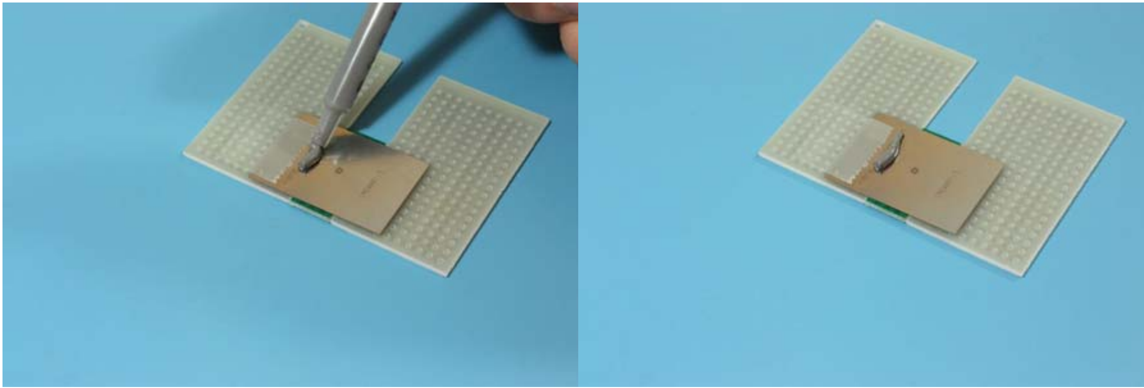


After taping the bottom of the three boards together as shown above, flip them right side up. Align the stencil over the footprint and affix it at the top edge with a single piece of tape as shown.

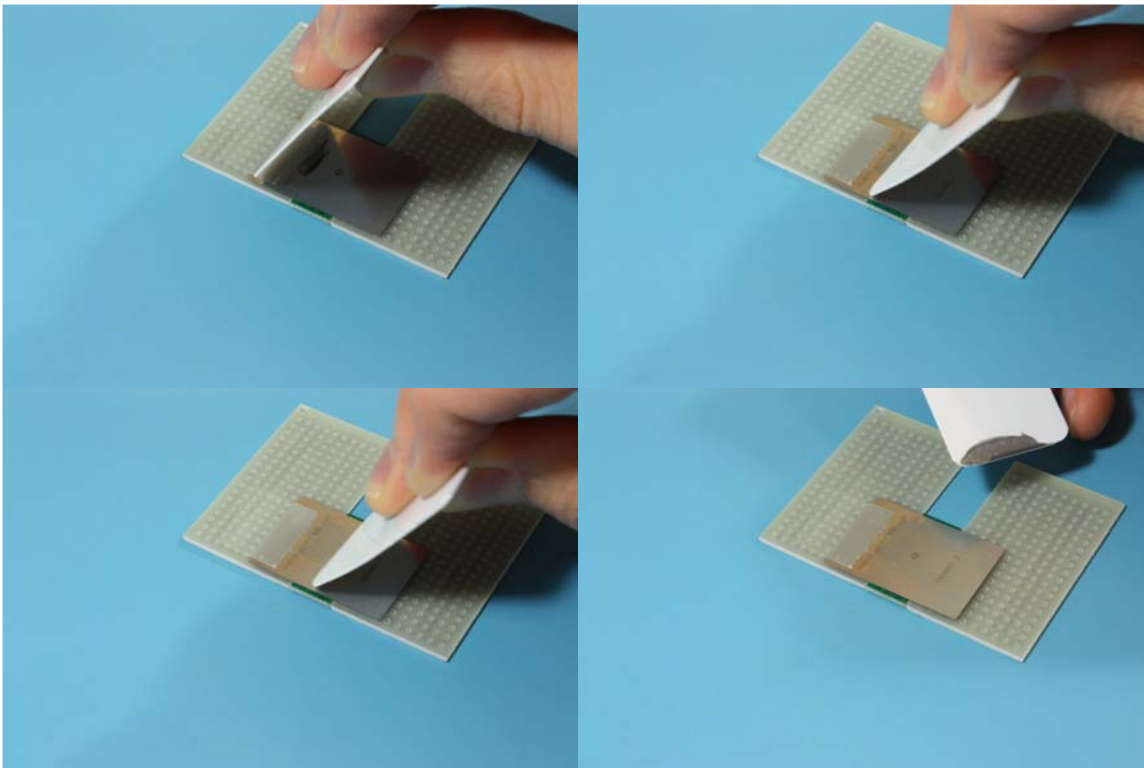


© 2007-2016 Proto Advantage

Apply a bead of paste at the top edge of the stencil, just below the tape.

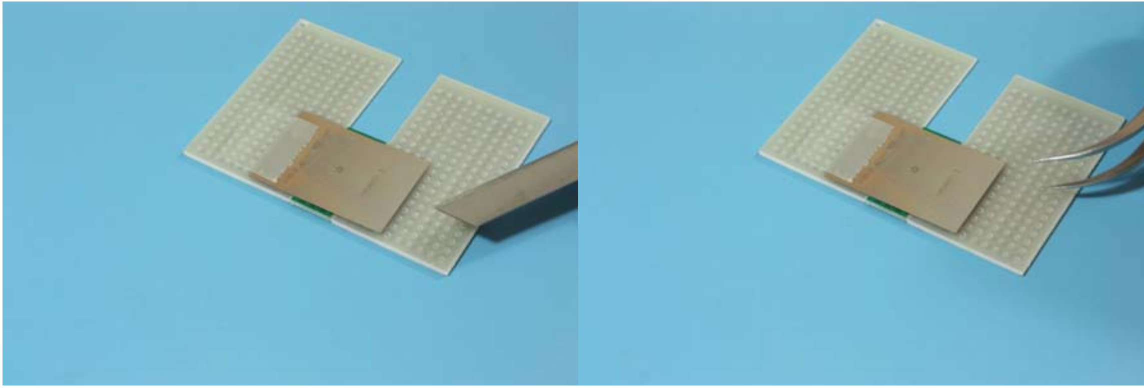


Drag the mini-squeegee from top to bottom to spread the paste. Take only one pass with the squeegee, applying even pressure to ensure the paste fills the stencil voids completely.

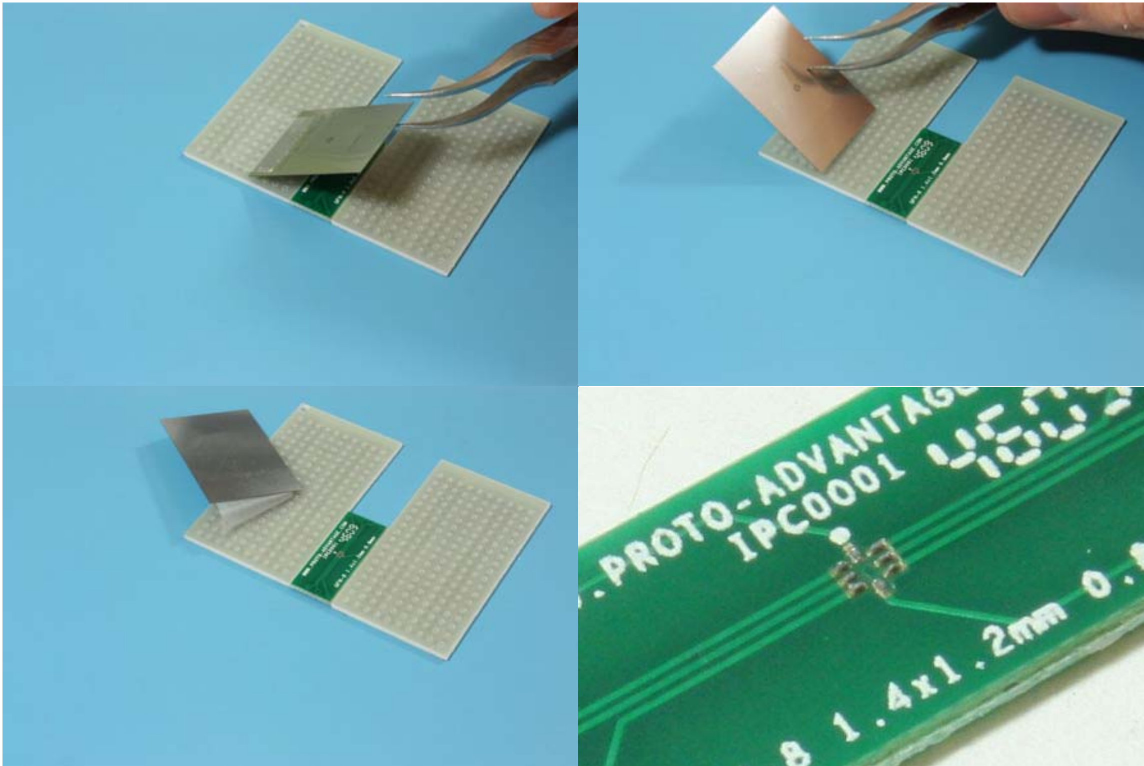


© 2007-2016 Proto Advantage

Lift the stencil from the bottom edge using a knife or tweezers. It is important to get under the stencil and not push, shift or flex it, since this could smear the paste.



Gently lift the stencil away and remove its tape. Remove the two additional boards and the tape holding them together. Visually inspect the solder paste to ensure it is on the pads and a uniform volume has been deposited. It should look like the paste in the image below. It doesn't have to be perfect, since the solder will flow and bond to the pads and pins during the reflow process. If you are not satisfied with how the paste was deposited, wipe off the paste using paper towel with isopropyl alcohol on it, clean the stencil with paper towel, isopropyl alcohol, and compressed air, and simply start over.



Return to step 2.7 to place the chip.

© 2007-2016 Proto Advantage