Technical Note

Surface Mount Rework Techniques

Technical Note

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Abstract

This Technical Note outlines, step by step, the easiest ways to remove and replace surface mounted devices, using the lowest possible temperatures.

This document discusses the following topics:

- Removal and replacement of discrete and passive components (capacitors, resistors, SOTs)
- Removal of two-sided components (SOICs, SOJs, TSOPs)
- Removal of quad components (PLCCs, QFPs)
- Replacement of quad components including fine-pitched devices

With the Metcal MX System by OK International, these tasks can all be accomplished using one RM3E Soldering/Rework Handpiece (some large, four-sided devices may require two handles and two power supplies). Removal of some components may be achieved using the Metcal TALON handpiece; techniques for removal using the TALON are available in a separate Technical Note.

The skills and techniques described in this document are designed to give the least experienced operator the power to perform some of the most difficult rework tasks in electronics today. OKi's SmartHeat® technology delivers the correct amount of thermal energy to the solder joint at lower tip temperatures—offering a means of rework that is safer for today's smaller, densely-populated, heat sensitive boards and components, while meeting the higher thermal demands of lead-free soldering.

Removing Discrete and Passive Components

OK International currently offers nearly 40 Surface Mount Tip Cartridges for its Metcal products, to remove small, discrete components. OKi calls these tips their "slot tips," and in most cases, the slot is sized to match the lead width of the component.

You must match the correct tip with the component you are removing. In a few cases, the slot of a larger tip can be tinned with wire solder to fill a void, allowing it to be used to remove a component whose footprint is slightly smaller.

There are three ways to choose the proper tip:

- Place the tip over the component leads. If the inside edges fit over the leads snugly, making contact on both sides, you have the correct tip.
- Use the Metcal tip template guide. By holding the template over the component leads, you can identify the proper tip.
- Use Metcal's STSS Tips and Accessories brochure (contact your local distributor for your copy). If you know the nomenclature of the component, it will be listed on the sheet. The corresponding part number will be listed.

Choose the correct tip temperature for the removal task. When choosing the temperature, it is always best to choose the lowest temperature possible to accomplish the job. For Metcal systems, OK International offers tips in 500, 600 and 700 series, with 700 being the recommended series for lead-free. For OKi systems, "F" series are the recommend for both lead-free and tin lead soldering. A "T" Series is available for Temperature Sensitive materials, and a "C" Series is available for Ceramics. If you are unsure of the best tip and tip temperature for your application, please contact your local OK International represenatative.

OKi's Metcal slot tips take 15-30 seconds to heat to their designed temperature. After allowing the tip to heat, tin the inside edges of the tip. Tinning the inside performs two functions. First, it assists heat

delivery for quicker removal. Second, the solder on the inside edges will help pick the component off the board once it is reflowed.

To remove components:

1. Bring the tip down directly over the component so the inside edges make direct contact with the leads of the part.
2. Allow the tip to reflow the solder completely on both sides of the component. This requires a minimal degree of skill and judgement.
3. When you are certain it is completely reflowed, slightly twist the tip in a circular motion and lift simultaneously. This action is necessary to break the surface tension bond of the solder that has been holding the component to the lands.

   By being patient and allowing sufficient time for the solder joints to reflow completely, you reduce your risk of lifted pads. On the small discrete components, this generally means just two to three seconds.

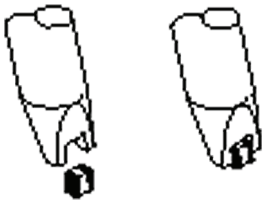


FIGURE 1:
Removing a Chip Cap

> **Note:** Many printed circuit boards now have components mounted on both the top and underside. When discrete components are mounted on the underside of a PCB, they are usually held with a chipbonder type epoxy. This will cause reflow to take a few seconds longer. In this case, you not only have to reflow the solder joints, but you must also melt the epoxy by transferring the heat through the body of the component. Don't worry–the additional reflow time is never more than a couple of seconds.

4. After you have removed the component from the board, wipe it on the wet sponge to dislodge it from the tip. Do not tap the tip on the workstand, as that may cause damage to the heater in the cartridge.

Replacing Discrete Components

OK International strongly suggests using its Metcal 500 Series fine-point STTC tip cartridges for soldering discrete components to the board, particularly when working with ceramic parts. Ceramics are more susceptible to thermal shock, and by following a few simple steps, you can virtually eliminate the chance of causing any thermal shock to your components. In addition, by using a lower temperature tip, you will significantly increase your tip life.

1. Clean the old solder from the lands of the component you just removed. Use a standard soldering tip and some desoldering wick.
2. Place the new component, holding it in place with a pair of tweezers or solder aid stick.
3. Use a fine point tip to solder the leads to the pads. The tip should be placed at the junction where the lead meets the pad. This is the correct method for making the solder joint and it allows the tip to ramp the temperature of the component.

   Caution: *Avoid placing the tip directly on the lead; placing the tip on the lead may thermally shock the component.*
4. After you have made the first solder joint, check component alignment, then solder the next lead in the same manner.

Removal of SOICS, SOJS, and SOPS

Removing multi-leaded, two-sided components is very similar to removing discrete components. The choice of tip is more crucial, however. Each Metcal SMTC removal tip cartridge made by OK International is component-specific. If you remove many different two-sided components every day, you may want to look into purchasing a TALON SMD Removal Handpiece, which will work with your current PS2/E or RFG-30 power supply.

To remove multi-leaded, two-sided components:

1. Identify the component. If you know the component identification, you can find the proper SMTC tip in OKi's Metcal catalog.

   If you need help identifying the part, use the Metcal tip template guide by placing it over the component and matching the leads with the layout on the guide. If you have the correct size, the part number will be listed on the template.

2. Choose the proper tip temperature. Again, OKi makes these removal tips in several temperature series, but we suggest using a 600 Series for most applications. Exceptions would be heavy ground plane boards or components that are much larger and more dense.
3. After plugging in the tip and allowing it to heat, fully tin the inside edges of the tip.
4. Bring the tip straight down on top of the leads of the component. Make sure that you have contact with all of the leads.
5. Leave the tip on the leads without rocking or twisting the tip on the component. An approximate time would be one second per two leads. Patience is the key to not lifting a pad.
6. Once you are certain all leads are reflowed, use a slight twisting and wiping motion to remove the component off the board. The surface tension of the tip's tinned edges will hold the component in the tip.
7. Wipe the component on the wet sponge to dislodge it from the tip.

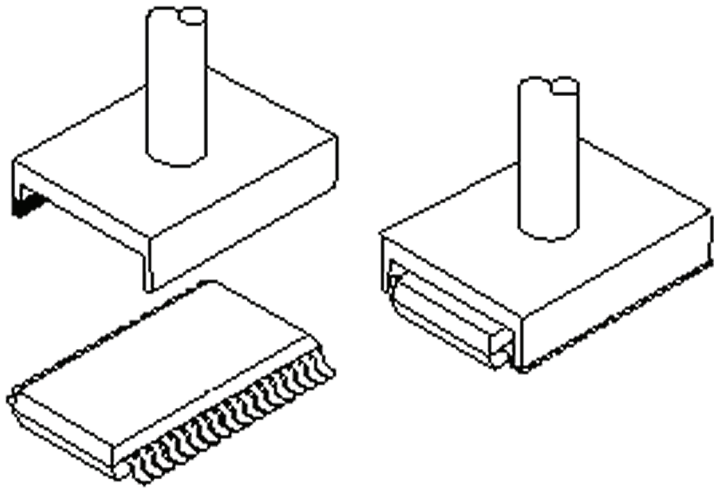


FIGURE 2: Removal of a Two Sided Component

Pad Clean Up and Preparation

The following steps may be used for both two- and four-sided components regardless of the lead configuration or pitch. You will be using a blade tip in conjunction with a desoldering braid to clean off the pads.

Proper wicking always uses the tip working with the grain of the pad. Never use a solder tip or a blade to wick by dragging it down the row of pads. The heat combined with the abrasive action may cause the epoxy holding the land to the board to lift the pad.

1. Choose the blade tip size that best fits the row of pads. OKi makes different size blade tips for cleaning the old solder off the pads.

> **Note:** Use a 600 Series blade tip. A 700 (or 800) Series tip will not remove the old solder more quickly, and the excess heat may burn the board or lift a pad.

2. Lay the wick along the row of pads. Use the beveled edge of the blade tip. This edge gives better surface contact and will make the job quicker.
3. Bring the blade down on the wick and give it two or three seconds to reflow the solder.
4. Wipe the solder with the grain of the pad, working the wick towards the inside of the component layout.
5. If the row of leads is longer than the blade, repeat this process for the remaining leads.
6. Repeat all of the above steps for each side of leads.

FIGURE 3: Blade Tip

Replacing Two- and Four-Sided Components

OKi makes one tip geometry for replacing most component configurations—gull-winged and J-lead—regardless of the number of leads or the lead pitch. We call this the multi-lead soldering tip (some people refer to it as a "hoof" tip, because it is shaped like a horse's hoof, with a bevel on one side). This tip is designed to solder an entire row of leads at one time by depositing solder directly to the face of the tip. It is specifically designed for multi-lead soldering, allowing longer life without sacrificing performance. Once you have practiced a bit, you will find it is the easiest and fastest way to solder surface mount components. We suggest using a 600 Series tip.

FIGURE 4:
"Hoof Tip"

Replacing Standard Pitch Gull-Wing Components

1. Align the component to the pads on the board.

Note: If you do not feel comfortable with the steadiness of your hands or your eyesight, OK International has different vision assist and fixturing products. Contact your local distributor for more information.

2. Align the leads with the pads, making sure the number one lead is lined up with the number one pad. Directly center the leads onto the lands.
3. Holding the component steady with one hand, flux the opposing corner leads of the part.
4. Place enough solder onto the face of the tip so that it covers about one third of the tip. Keep the solder down towards the "toe" of the tip.
5. Bring the tip down and "paint" the leads where you applied the flux. The object here is to tack the part down, not make good solder joints.

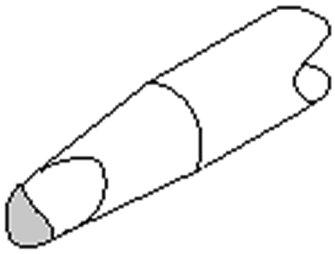


FIGURE 5: 1/3 of the Tip

6. Wipe the excess solder from the tip.
7. Make sure that the face of the hoof is shiny and wettable. You will not get good results if the tip is oxidized. If solder balls up on the face, you need to tin the tip. Once the tip is tinned and shiny, the solder should flow on the tip.
8. Apply enough solder to cover approximately one-half of the tip. The amount of solder will vary with the number of leads you have. For fewer leads, apply less solder.
9. Flux one entire row of leads at a time. Work with the row of leads going from left to right in front of you. Work from left to right if you are right handed, and vice-versa if you are left handed.
10. Hold the tip so the toe of the hoof runs parallel along the row of leads.
11. Bring the tip in on a flat landing onto the first lead. Immediately begin running the tip down the row of leads drawing a straight line.
12. When you reach the end, wipe the tip down the lead towards you.
13. Repeat these steps for each row of leads.

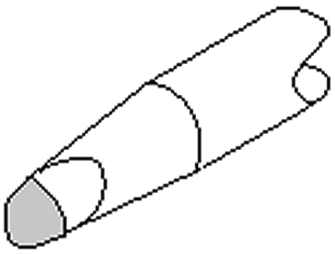


FIGURE 6: 1/2 of the Tip

Additional information:

- The angle of the tip should be parallel, but can be up to 30 degrees for good results.
- If the toe of the hoof is the front, then the right side should make contact right at the bend of the leg of the lead. It should be held in that position for the entire process. If you are left-handed, it will be just the opposite.
- The speed is more crucial than the angle. The speed should be steady and slow enough to deposit the solder from the tip onto each of the leads as you draw it across. An approximate time is one second per lead. As you get more comfortable with the procedure, the speed becomes less crucial.

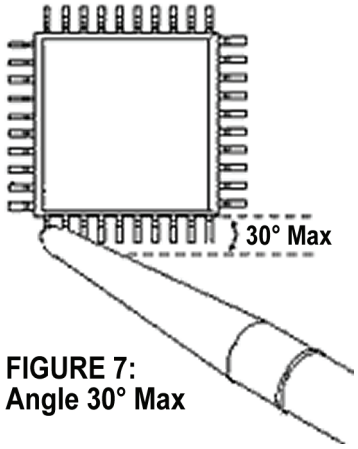


FIGURE 7:
Angle 30° Max

Replacing Fine Pitch Gull-Wing Components

1. Align the component to the pads on the board. Alignment of fine pitch components can be tricky. Take your time to ensure proper alignment.
2. After alignment, tack the component as you would for a standard pitch part. Use a little less solder on the end of the tip for "painting" the leads.
3. Working with one row of leads at a time, apply flux to an entire row of leads.
4. Wipe all excess solder from the face and top of the tip and start with fresh solder.
5. Apply enough solder on the toe of the face of the tip to cover approximately one third to one fourth of the tip. Now, not only the number of leads will vary the amount of solder, but the pitch of the leads will also. The finer the leads, the less solder you will need.
6. Working from left to right, bring the tip in flat. Keeping the tip flat is more crucial on a fine pitch part (so imagine an airplane coming in and touching down all three wheels at the same time).
7. Immediately start drawing the tip down the row of leads until you reach the end. Do not stop and restart or bridging will occur.

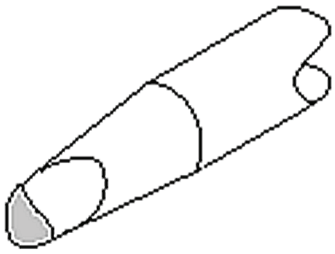


FIGURE 8:
1/3 - 1/4 of the Tip

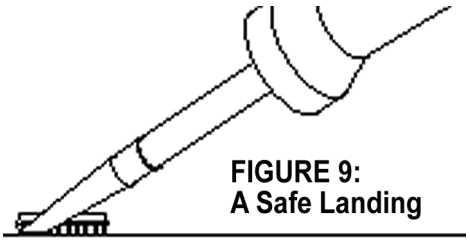


FIGURE 9:
A Safe Landing

Hint: *Remember to hold the tip parallel to 30 degrees, and to keep it at the bend of the leads. As the pitch gets finer, you can work faster. But don't work too fast or you will get good toe but poor heel fillets.*

8. Repeat these steps for all sides of the component.

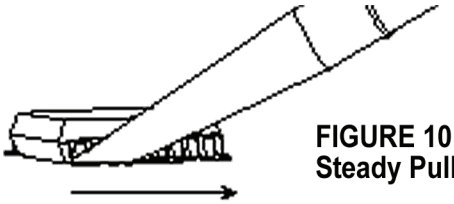


FIGURE 10: Steady Pull

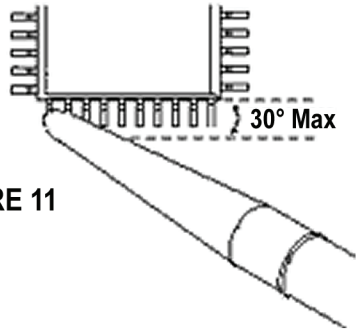


FIGURE 11

Removing Shorts Between Gull-Wing Leads

Your chances of getting shorts or bridges between leads are greatly increased as the distance between the leads gets shorter. Working with fine pitch leads requires more skill and experience whether you are reworking with OKi's multi-lead soldering tip or any other type of equipment. Removal of these shorts is very simple following these steps.

1. Use OKi's Metcal SMTC-x147 tip in either 500 or 600 Series. Having more heat at the tip makes removing shorts more difficult.
2. Apply flux to the bridged leads.
3. Wipe all excess solder from the face and the top of the tip. Make sure the tip is shiny and wettable.
4. Bring the tip in with the flat surface, making contact with the bridge; again holding the tip parallel to 30 degrees to the leads.
5. Wipe the bridge down the leads and away from the component.
6. The excess solder on the joints will naturally go to the heat source, i.e., the tip. Look at the face of the hoof and you should see the excess solder.
7. If you did not remove all of the bridge on the first try, wipe the excess solder from the tip and repeat the procedure.
8. If the bridge is extreme you can use your blade tip by wiping it free of solder on both edges. Then, using the beveled edged down, wipe the blade in the same manner down the fluxed leads.

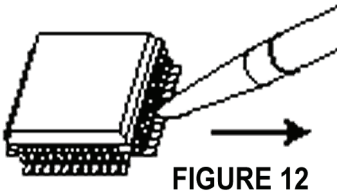
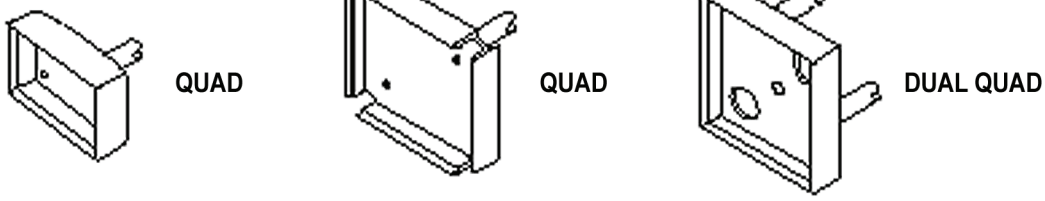


FIGURE 12

Caution: *If you leave the heat on the leads too long when performing these steps, the shorts will tend to stay. This occurs when you have heated the leads and pads too much, causing them to act as the heat source instead of the tip. If this happens, blow on the leads a little to cool them, then try the procedure again.*

Removing Four-Sided Components



Removing larger component packages will generally require more heat and the use of flux for the best, fastest results. Two of the steps below—the application of flux and the wrapping of wire solder—are optional. You should check your written procedures to see if these steps are prohibited.

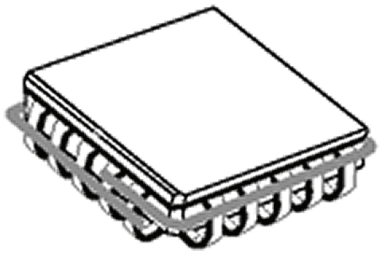


FIGURE 13: Wire Wrap

1. Select the proper tip by using the SMTC matrix or the tip template book.

   Large four-sided components will require dual heater tips, which use two RM3E handpieces and two power supplies. This is to deliver 80 watts of power. When using a dual heater tip, use a dual handle support (STSS-DHS) over the handpieces to keep the shaft of the tip cartridge from bending.

Note: This is the one time OKi suggests using 700 Series cartridges; it will make a tremendous difference in removal time. Remember–it is not only the temperature you put on the board that counts. It is the temperature plus the amount of time the component is left on that makes the difference. By removing the component more quickly, you reduce the chances of thermal damage.

2. Allow the tip to heat fully. This is important, because if it is not up to full temperature, your removal time will be increased.
3. Tin all inside edges of the tip. Just like your blade or hoof tip, the removal tips must remain shiny and wettable.

Note: If you try removing a component with a tip that is oxidized in certain areas, the reflow will take longer. This increases the chances of lifting pads because you will see some leads being reflowed. Those leads will be the areas of the tip that were tinned. The sections of the tip that were oxidized will take longer to reflow, in which case you may try to remove the component before it is ready.

Hint: *If your tip is oxidized, or there are flux residues prohibiting you from tinning the tip, use a brass brush (stss-brush) to clean the inside edges. Heat the tip and wipe edges with the brush.*

4. Flux all sides of the component.
5. Take some wire solder (.025 or .031 works best) and wrap it around the leads of the component. On J-leaded components this step is easy. The wire will wrap easily around the leads and stay in place.

> ***Hint:*** *On gull-winged parts, this is a little more difficult. Try sticking the end of the solder behind the legs on one corner of the component and anchor the wire there. Then wrap the wire around the outside of the legs. This will help hold it in place.*

6. Bring the tip straight down on top of the part, making full contact on all four sides of the leads.
7. Hold the tip in place for about 10-15 seconds without moving back and forth or rocking. Once you practice this step a little, you will get a feel for the reflow and will actually find that it becomes a little faster.
8. When you are certain you have full reflow, twist the handle between your thumb and forefinger just slightly. If you do have complete reflow you will feel the component move. If you do not, the cartridge will twist in the handle. This is a built-in mechanism to prevent you from removing a component that is not ready, thereby decreasing the chances for lifting pads.
9. If you feel the component move, wipe it to one side just slightly and lift simultaneously. The component should be held in the tinned tip.

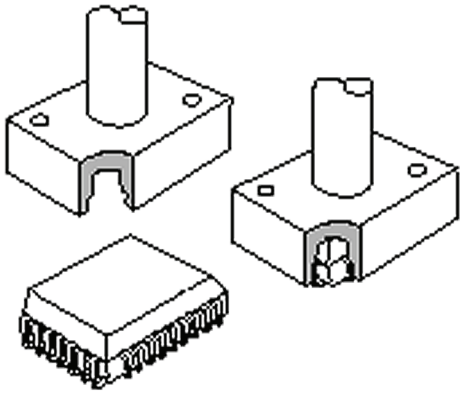


FIGURE 14: Removing a PLCC

10. Remove the component immediately by wiping it on the sponge or tapping it on the stand gently.

Replacing J-Leaded Components

Doing multi-lead soldering of J-leaded components is done with the same tip as with gull-winged parts. The skill level required is still minimal but the steps need to be followed more precisely. Select a 600 Series tip for this procedure.

There is more than one way to tack a J-leaded part to the board, but the best way is to add the solder to the leads after alignment. There is a process by which you can pre-tin the pads and then reflow those leads to fix the part to the board, but you run the risk of coplanarity problems if the part doesn't settle to the board properly.

Tack the component using the following steps:

1. Flux the pads on opposing corners.
2. Make sure your tip is clean and wettable, and apply solder to the face of the tip to cover approximately one-half of the face.
3. Align the component to the board—number one lead to number one pad.

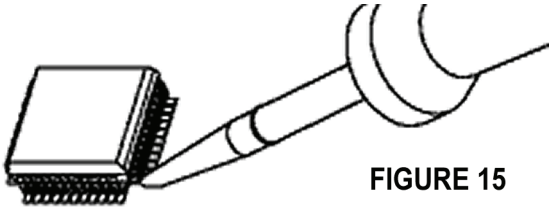


FIGURE 15

4. Bring the tip in with the toe in flat, meeting the lead and the fluxed pad at the same time.
5. Continue to hold the part with a finger or solder aid stick, and repeat this for the remaining pads.

6. Now the component should be fixed firmly on at least two corners. The solder joints won't look good, but their function is merely to hold the component while soldering.

Now you are ready to solder. Work with one side at a time.

1. Wipe the tip free of excess solder on the face and the top. You need to make certain that both sides of the tip are shiny and wettable. It is important not to have oxidation on either side of the tip.
2. Feed enough solder to cover approximately one half of the tip, keeping the solder down toward the toe.
3. Feed the same amount of solder to the top, keeping it toward the toe as well.
4. Work with the component leads in front of you going from left to right. If you are right handed, start soldering from the far left lead. If you are left handed, work in reverse.

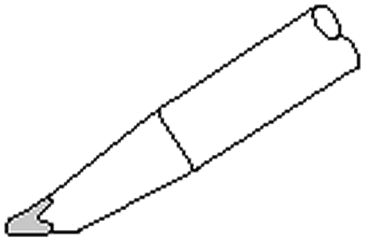


FIGURE 16: Apply Solder to the Top and Bottom

5. Bring the tip in at a 45 degree angle in relation to the row of leads. The right side of the tip will make contact with the leads.
6. Touch down with the tip face flat, but with the right toes against where the leads meet the pads under the body of the component.
7. Start drawing the tip straight down the row of leads. The speed should be approximately one second per lead. Keep the speed steady and slow.
8. Remember to keep the face flat down on the pads while you are drawing the tip.
9. Watch the solder wick right down to the leads, depositing an even amount to each lead. It will appear to short until you draw the tip down the row further. As long as you keep the speed steady you will not get shorts. If you do get a short, you can easily remove it as discussed below.

   If you added too little solder to the tip, you may run out before you reach the end of the row. If this happens, you can flux from where you ran out of solder to the end of the row. Then, add solder to the face and top of the tip and repeat from where you ran out to the end. Starting in the middle of the component may cause a bridge.

   If you added too much solder to the tip, you will probably get a short at the end. Follow the steps in the section that follows to remove the excess.

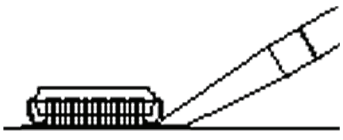


FIGURE 17: Face Flat, Yet Digging into the Leads

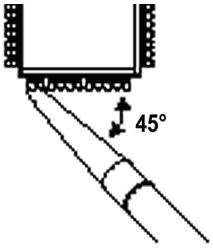


FIGURE 18: Keep the Speed Steady and Slow

Removing Shorts From J-Leaded Components

1. Apply flux to the bridged leads.
2. Wipe all solder from the face and top of the tip.
3. Bring the tip in with the face flat on the pad and the toe hitting the lead, with the pad under the component body.
4. With the face flat, stand the tip up so the top side hits the shoulder of the lead.
5. Immediately wipe the excess solder down the shoulder and away from the component.
6. Look at the tip; you should see the excess solder you've removed on top.
7. If the bridges were excessive, you may have to repeat the process once or twice.

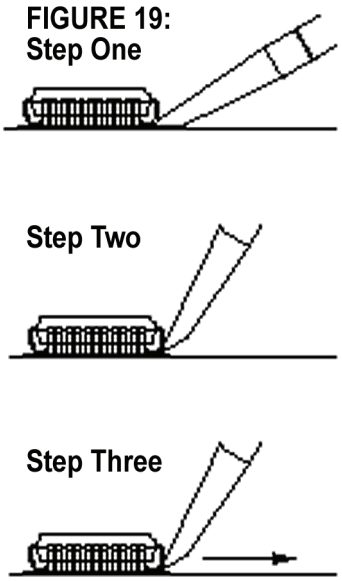


FIGURE 19:

Contact Us

If you have any questions about these techniques, or about tip selection, contact your local OK International distributor or representative. They are rework experts, and can help you solve any problems you might have.