DVD-94C
Rework of J-Lead Components

Below is a copy of the narration for DVD-94C. The contents for this script were developed by a review group of industry experts and were based on the best available knowledge at the time of development. The narration may be helpful for translation and technical reference.

Introduction

This is the fourth video in the Surface Mount Rework Series. In this video we're going to explain each of the techniques for removing and replacing J-Lead Components using conventional hand-held tools.

A close up look at one of the leads makes it pretty obvious where the J-lead gets it's name. There are essentially two types of J-Leaded components. the first is the plastic leaded chip carrier - or PLCC. This component has leads extending out from all four sides - in various sizes and shapes. There's a rectangular version that can have between 18 to 32 leads. And the more common *square* package - which starts at 20 and goes all the way up to 100 leads. The spacing between the center of one lead to the center of the next lead is known as the "pitch". The lead pitch of a J-Leaded component is typically 1.27mm or fifty mils. The other type of J-Lead component is the SOJ - which stands for *small outline J-Lead*. These components have leads extending from only two sides. SOJ's also come in various sizes... ranging from 16 to 40 leads.

Componet Removal

Pulse Heat Handpiece

Now let's discuss J-Lead *component removal* - using a pulse-heated hand tool. We begin by fitting the correct tip to the specific component. The four sided tips should fit around the top of the component - with just a little extra space. These particular tips are not *tinnable*. This means we won't have to tin these tips prior to use. The heat setting for the pulse-heat tool needs to be adjusted to the specific type of component. Consult your instruction manual - or standard operating procedures - for the correct temperature setting, then adjust the power supply accordingly. As an option, we can apply an external flux along the outside edges of the leads - to help speed up the heat transfer process. Make sure whenever you add any additional flux that it's compatible with all of your company's soldering and cleaning processes.

Now we're ready to fit the tip over the top of the component. The tip should be positioned as close as possible to the bottom of the leads - without touching the lands. Now squeeze the tips gently - to contact all of the leads. Then press the footswitch down to activate the heat. Within a few seconds the solder will begin to melt. After all of the solder has melted, lift the component straight up and release the foot switch to deactivate the power. Then place the component onto a heat resistant surface.

It's important never to lift the component before all of the solder joints have melted. This is an easy way to *lift* a land - and damage or destroy the board. One advantage of this particular process is that the tips can be positioned while they are cold. In high density situations, this can make component removal a little easier. It takes a few seconds for the tip to ramp up to soldering temperature - which may be safer for the component - but it does require a little extra patience. That covers the procedures for removal of J-Lead components - using a pulse-heat hand tool.

Thermal Tweezers

In this next section, we're going to discuss J-Lead component removal using a Thermal Tweezers. The Thermal Tweezers is a *constant heat* tool - with a separate heater on each side of the handpiece. This tool is capable of removing all of the PLCC's and SOJ's - from the smallest to the largest. There are three removal procedures using the Thermal Tweezers. Each procedure uses a different method to enhance heat transfer. All three techniques begin by sizing the tips to the component. We place the unheated tips against the component to check the fit. The ends of the tip should not extend past the last lead. After awhile, you'll learn to recognize the right tip for each component.

Now install the tips into the heated handpiece. A special alignment tool will help make sure that the larger tips are parallel to each other. Press them together, then tighten the set screws. You may also want to set the adjustment screw on the back of the tool so that the tips open only slightly wider than the width of the component. The operating temperature of the tips should be in the general area of 315 degrees C.

The first technique uses either a liquid or a paste flux to help increase the heat transfer rate. This compatible flux is applied at the junction between the leads and the lands. The flux will help to improve the heat transfer between the tips and the component leads. After the tips warm up, it's very important to clean and tin them properly. If there is a considerable amount of residue and oxidation inside the tips, we'll start by brushing most of it away with a fiber tool. The final cleaning is performed with a damp sponge tool. The moisture will shock the remaining oxides off the tip. Notice that we're concentrating on the inside edges - where the tips will contact the leads.

Now the tips should be ready for tinning... We'll use a large gauge flux cored solder to tin the *inside* of the tips - right where the tip will contact the leads. This fresh coating of solder will also help to transfer the heat between the tips and the component leads.

We're ready to position the tips around the component. The tips should contact the leads as low as possible - without touching the lands or the board surface. Lightly squeeze the tips together - until the solder melts and the component loosens or shifts slightly. Then lift the component straight up and place it on a heat resistant surface. We'll need to tin the tips once again - after the component removal operation is complete. This additional tinning process will help to protect the metal from oxidation - and prolong the life of the tips. And remember that it's important to avoid lifting the component before all of the solder joints have melted. The J-Leads themselves are reasonably sturdy... but the lands on the board can be pulled off or *lifted*. The two additional heat transfer techniques are especially useful to help speed up the removal process for *larger* components.

Let's begin with the Solder Bridge or *Bridge-Fill* Method. We'll be using a hand soldering iron with a large single-sided chisel tip - to bridge all of the leads together with solder. We won't be adding any external flux - since the flux would help to reduce the *bridging* tendency of the solder. Just keep melting the solder until all of the leads are bridged together. After the bridge-fill is completed, you now have the option of adding external flux all the way around - to help transfer the heat between the bridged solder and the tweezer tips.

After preparing the tips like we did before, we place the tips over the component - and the solder bridge - then gently squeeze the tips together until the solder bridge melts. Now lift the component straight up and place it on a heat resistant surface. Once again, we always want to retin the tips after the component removal operation is complete - to preserve the life of the tips. One advantage of the Bridge-Fill method is that it provides an almost instantaneous heat transfer to all of the solder joints - since all of the solder is combined in one mass. The Bridge-Fill method is also unlikely to cause damage to the lands or the components - especially for inexperienced operators - since it insures faster and more efficient heat transfer to all of the solder joints. However, the bridge-fill and reflow operations do require *two* separate heating cycles.

Some companies may prefer to avoid this additional heating process by using only the external flux for heat transfer - or with the *Solder-Wrap* technique. Again, the tip selection, installation, and preparation processes will remain the same as both of the previous processes. This time we'll tack the end of a large gauge solder wire onto one of the corner leads - then wrap the solder wire around the component. Notice the position of the solder wrap - right where the lead meets the land. After the solder wire is wrapped all the way around - we'll cut it off - or melt it with the tip - so that the end of the solder wire extends just beyond the final lead of the last row. For the *Solder-Wrap* process, the tips will need to be adjusted to open slightly wider than the outside edge of the solder wrap. An optional flux application onto both the component leads and the solder wire will further improve the heat transfer process.

Now we're ready to position the tips around the component - as low as possible - without touching the lands. Lightly squeeze the tips together - until both the solder wrap and all of the solder connections melt. Then lift the component straight up and place it on a heat resistant surface to cool. And remember to retin the tip.

Land Preparation

After the component is removed, we'll need to prepare the lands before we can replace the component. There are two different methods that are commonly used to remove the *used* or remaining solder from the component lands. We do this mostly to provide a flat surface for the component to sit on during the replacement process. The *old* solder *may* also be detrimental to the overall quality of the new solder joints. The residue from the removal operation can also contaminate the fresh solder during the component replacement operation - unless these residues are removed as well. We explained both of these land preparation methods in the previous video on Gull Wing Components. The techniques for J-Lead and Gull Wing land preparation are essentially similar. In case you haven't previously learned these methods, you may wish to review the Gull Wing Rework Video - which explains both of these procedures in detail. Let's stop once again and review the information covered in this section.

Component Installation

Hand Soldering Iron

In this next section, we're going to discuss component orientation, and the hand soldering replacement processes for J-Lead components. In most cases, you will be replacing the old component with a new one. Be sure to review *your* company's policy on *reusing* previously soldered components - whenever a component is being replaced simply because of misalignment. The first thing we need to do is to make sure that the orientation of the replacement component is correct. Almost all J-Lead components have a beveled edge on one side of the component body. There should also be a notch or circular indentation somewhere along this beveled edge which marks the location of the number 1 lead. The circuit board will usually have some type of corresponding marker for lead number one. This might be a circle or triangle that is printed on the board. In other cases, the number one land may be slightly longer than the rest of the lands. We'll position the component so that the number one lead sits on the corresponding land.

Now we're ready to begin the soldering process. At this point, we have the option of adding external flux. Remember that a reworked assembly may be older than a new board - which means that there may be oxidation on the lands and component leads. The additional flux will help to remove this oxidation - which can result in improved solder wetting. After fluxing, we need to make sure that the component is perfectly aligned on all four sides. We want all of the leads to be centered over the lands - front to back - and side to side. PLCC's and SOJ's can generally be aligned by eye - by looking straight down from the top.

Before we start soldering, we should check to make sure that the tip temperature is as low as possible, somewhere around 315 degrees C. We'll be using a small chisel tip for this soldering operation. Start by adding a little bit of solder to the tip, then touch the tip to one of the corner joints - while holding the component in alignment. After this first joint is tacked, repeat this same process on the opposite corner joint. With two corners tacked down, the component will be held in position.

We're ready to begin soldering - on one of the corners that we did *not* tack down. First touch the tip to the junction of the land and lead. Then touch the solder wire to this junction to start the solder melt... and form the required fillet. A J-Lead connection will require much more solder than a Gull Wing joint. A proper J-Lead solder joint will have a good fillet on both the heel and the toe of the connection. This is a good indication of proper wetting. For more information on acceptance criteria for all of the variations in J-Lead solder joints - you may want to review the IPC training video on this subject.

Most solder joints *will* fall within an acceptable range, but learning how much solder to add to create the ideal fillet shape can take a little practice. Just keep soldering one joint after the next.

You also don't need to *skip* leads - like you do with through-hole components. The reason is that the amount of heat required to melt a through-hole solder joint is much greater than a surface mount joint. The heat buildup inside surface mount boards is not a serious problem when the soldering is performed quickly and properly.

Hand soldering each individual lead can be a rather tedious operation - which most companies would rather avoid. An alternate method - using a single sided chisel tip - can melt solder into a whole row of connections in one continuous motion. Once again this method begins with properly prepared lands. The position of lead number one should always match the corresponding land on the board, and all of the leads should be centered over each of the lands. This time, fluxing *will* be necessary. The flux will help to keep the solder from bridging between the leads. After you've fluxed all four rows, you need to make sure that the final lead to land alignment is exactly where it belongs.

Now we're ready to tack two of the corner leads - just like we did before. After two opposite corners are tacked, we're ready to prepare the tip. First make sure that the tip is properly cleaned. Now we'll need to add some fresh solder to the tip. You'll learn how much to add with a little practice. Then position the tip against the first solder joint. As the tip moves from one joint to the next, the required amount of solder will transfer from the tip to the leads - if you move at the right speed. You should be able to watch each connection form as you proceed. When you come to the end of the row, just keep moving the tip past the final lead in a continuous motion. If you stop the movement of the tip at the end of the row, you may end up with too much solder on the final lead - or even a solder bridge.

If you do create a solder bridge anywhere along the row of leads, you can just stop and reflux the bridge. Next clean off any solder from the tip onto a damp sponge. Then reposition the tip on the bridge - and remove the excess solder. Now you should be ready to solder the next row of leads - using the same technique. After all of the leads are soldered, you may be required to clean the flux residues off the board. This should be done *before* they harden and become difficult to remove.

We'll start by applying a solvent to soften the flux residue. Your company will supply you with a compatible solvent - and an approved brush or cleaning tool. You'll need to work all the way around the component - to soften all of the sticky residue. Then blot dry everything you can reach with an ESD safe lint free cloth. This completes the *rough-cleaning* process... even though some of the cleaning solvent and flux residue will remain underneath the component - where you can't reach it. That's why it's a good idea to process the board through an approved cleaning machine - as soon as possible after all of the rework has been completed on that assembly. This will insure the complete removal of any potentially harmful flux residues. Let's stop now to review the information we just covered.

Hot Air Pencil

In this final section, we're going to discuss component replacement - using a *hot air pencil*. Again, we always start with properly prepared lands. We can either apply the solder paste first - or later on - after the component is already placed on the lands. Let's apply the paste first this time - right across each of the lands. Knowing exactly how much solder paste to apply is also learned by experience. Paste quantity will depend on needle size, application pressure, and speed of movement. And remember that a J-Lead solder joint requires more solder than a Gull Wing connection.

Now position the component on top of the paste - in the correct orientation. We don't want to smear the paste by moving the component around too much - so you need to be careful when you place it down. You'll probably need to align the component slightly after it's been positioned. When the component *is* in final position, we're ready to prepare the hot air pencil. Tip selection is based on your personal preference. A flat tip will speed up the process, but it may also reduce the amount of control you have in soldering each individual connection.

Let's use a flat end tip for our demonstration. The temperature of the tool should be set to approximately 425 degrees C. Keep in mind that air will not transfer heat as efficiently as a soldering iron tip. To adjust the air pressure, we'll position the tip about one half of a centimeter above a paper tissue. Then well move the tip slowly across the tissue and turn up the air pressure until it begins to scorch. Additional adjustments may be necessary - depending on the thickness of the board and other factors. Now we should be ready to begin the soldering operation.

We'll need to *predry* all of the solder paste in the row by passing the heated tip back and forth. The tip should be held about two centimeters away from the paste. After you see that the solvents in the paste have evaporated out, and the texture of the paste begins to change. Then move the tip in closer - to around 1 centimeter away from the first lead. The tip should also be blowing hot air *toward* the next lead to be soldered. After the first joint is completely melted and formed, move the heat forward and reflow the next connection. You should be able to watch each solder joint being formed as you move along the row. When the first row is completed, repeat the same procedure on the next row.

After all of the connections have been formed, you can clean the flux residue with solvent and a lint free cloth. The rest of the cleaning operation will be the same as we discussed before. We also mentioned that you can apply the solder paste *after* the component is positioned on the lands. In this case, we'll align the component first then tack two of the corner joints. Now we can apply the solder paste at the junction between the lands and the leads. Again, the correct amount of solder paste is best learned by experience. The preheating and soldering operation will be identical to the previous method. The advantage of this technique is that there is less likelihood of smearing the solder paste during the component alignment process. The disadvantage of this technique is that it may result in less solder underneath the leads.

Reliability testing has shown that an optimum amount of solder between the lead and the land helps to make the solder joints more flexible - and last longer. But as long as the solder connections exhibit a proper heel and toe fillet, this should be sufficient to insure solder joint reliability. That covers the installation of J-Lead components using the hot air pencil.