AN1005

Surface Mount Soldering Recommendations

The most important consideration in reliability is achieving a good solder bond between surface mount device (SMD) and substrate since the solder provides the thermal path from the chip. A good bond is less subject to thermal fatiguing and will result in improved device reliability.

The most economic method of soldering is a process in which all different components are soldered simultaneously; for example: DO-214AA devices, capacitors and resistors.

Reflow Of Soldering

The preferred technique for mounting microminiature components on hybrid thick- and thin-film is the method of reflow soldering.

The DO-214AA is designed to be mounted directly to or on thick-film metallization which has been screened and fired on a substrate.

Recommended substrates: Alumina or P.C. Board material.

Recommended metallization: Silver palladium or molymanganese (plated with nickel or other elements to enhance solderability). For more information, consult Du Pont's Thick-Film handbook or the factory.

It is best to prep the substrate by either dipping the substrate in a solder bath or by screen printing a solder paste.

After the substrate is prepared, devices are put in place with vacuum pencils. The device may be laid in place without special alignment procedures since it is self-aligning during solder reflow process and will be held in place by surface tension.

For reliable connections, it should be kept in mind that:

(1) The maximum temperature of the leads or tab during the soldering cycle does not exceed 275°C.

(2) The flux must affect neither components nor connectors.

(3) The residue of the flux must be easy to remove.

Good flux or solder paste with these properties is available on the market.

A recommended flux is Alpha 5003 diluted with benzyl alcohol. Dilution used will vary with application and must be determined empirically.

Having first been fluxed, all components are positioned on the substrate. The slight adhesive force of the flux is sufficient to keep the components in place.

Solder paste contains a flux and, therefore, has good inherent adhesive properties which eases positioning of the components.Allow flux to dry at room temperature or in a 70°C oven. Flux should be dry to the touch. Time required will depend on flux used.

With the components in position, the substrate is heated to a point where the solder begins to flow. This can be done on a heating plate, on a conveyor belt running through an infrared tunnel, or by using vapor phase soldering.

In the vapor phase soldering process, the entire PC board is uniformly heated within a vapor phase zone at a temperature of approximately 215°C. The saturated vapor phase zone is obtained by heating an inert (inactive) fluid to the boiling point. The vapor phase is locked in place by a secondary vapor. (See Figure 18.1.) Vapor phase soldering provides uniform heating and prevents overheating.

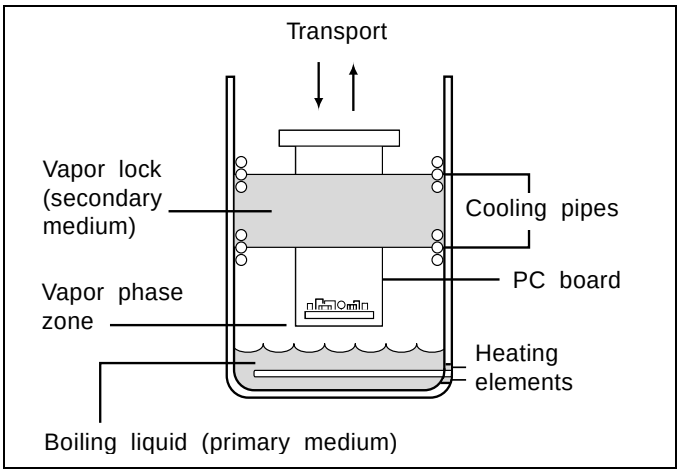

Figure 18.1 Principle of Vapor Phase Soldering

No matter which method of heating is used, the maximum allowed temperature of the plastic body must not exceed 250°C during the soldering process. For further temperature behavior during the soldering process, see Figures 18.2 and 18.3.

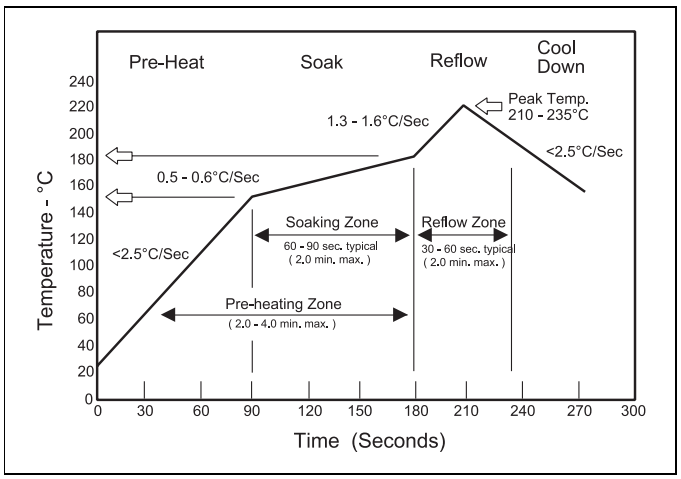

Figure 18.2 Reflow Soldering Profile

Reflow Soldering Zones

Zone 1: Initial Pre-Heating Stage (25-150°C)

- Excess solvent is driven off.
- PCB and Components are gradually heated up.
- Temperature gradient shall be < 2.5°C/Sec.

Zone 2: Soak Stage (150-180°C)

- Flux components start activation and begin to reduce the oxides on component leads and PCB pads.
- PCB components are brought nearer to the temperature at which solder bonding can occur.
- Allows different mass components to reach the same temperature.
- Activated flux keeps metal surfaces from re-oxidizing.

Zone 3: Reflow Stage (180-235°C)

- Paste is brought to the alloy's melting point.
- Activated flux reduces surface tension at the metal interface so metallurgical bonding occurs.

Zone 4: Cool Down Stage (180-25°C)

- Assembly is cooled evenly so thermal shock to the components or PCB is reduced.

The surface tension of the liquid solder tends to draw the leads of the device towards the center of the soldering area and has, thus, a correcting effect on slight mispositionings. However, if the layout leaves something to be desired, the same effect can result in undesirable shifts; particularly if the soldering areas on the substrate and the components are not concentrically arranged. This problem can be solved using a standard contact pattern which leaves sufficient scope for the self-positioning effect (See Figure 18.3). The reflow soldering procedure is shown in Figure 18.4.

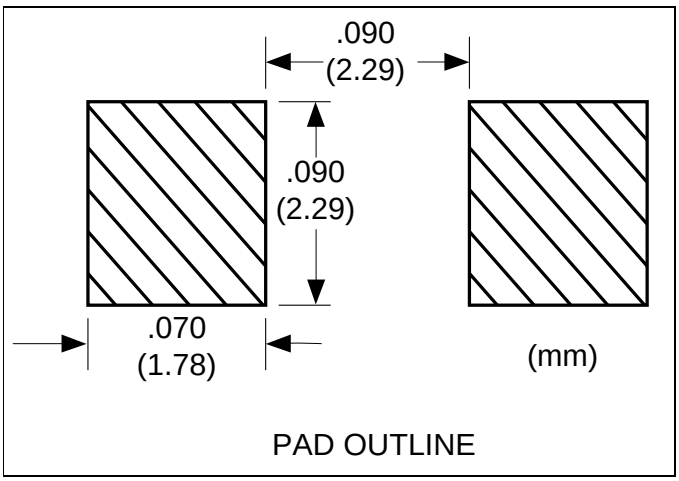

Figure 18.3 Minimum Required Dimensions of Metal Connection of typical DO-214AA Pads on Hybrid Thick- and Thin-Film Substrates

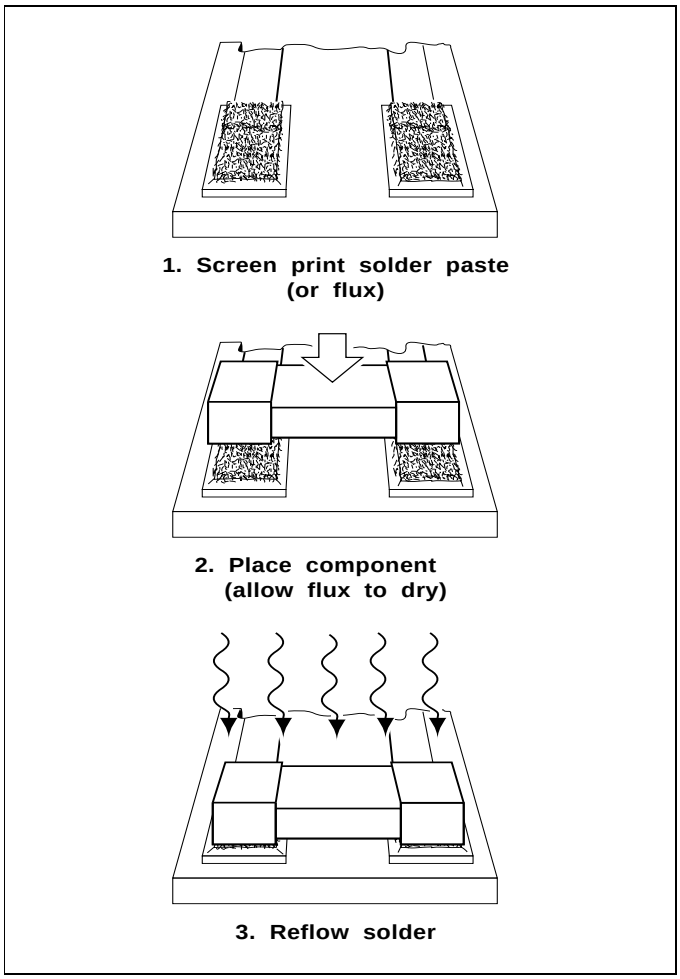

Figure 18.4 Reflow Soldering Procedure

After the solder has set and cooled, the connections are visually inspected and, where necessary, put right with a soldering iron. Finally the remnants of the flux must be removed carefully.

Use vapor degrease with an azeotrope solvent or equivalent to remove flux. Allow to dry.

After drying procedure is complete, the assembly is ready for testing and/or further processing.

Wave Soldering

Wave soldering is the most commonly used method for soldering components in PCB assemblies. As with other soldering processes, a flux is applied before soldering. After the flux is applied, the surface mount devices are glued into place on a PC board. The board is then placed in contact with a molten wave of solder at a temperature between 240°C-260°C which affixes the component to the board. Dual wave solder baths are also in use. This procedure is the same as mentioned above except a second wave of solder removes excess solder. Although wave soldering is the most popular method of PCB assembly, there are some drawbacks. The negative features include solder bridging and shadows (pads and leads not completely wetted) as board density increases, as well as this method having the sharpest thermal gradient. To prevent thermal shock, some sort of pre-heating device must be used. Procedures for wave soldering PCBs with (a) surface mount devices only and (b) both surface mount and leaded components are shown in Figures 18.5 and 18.6.

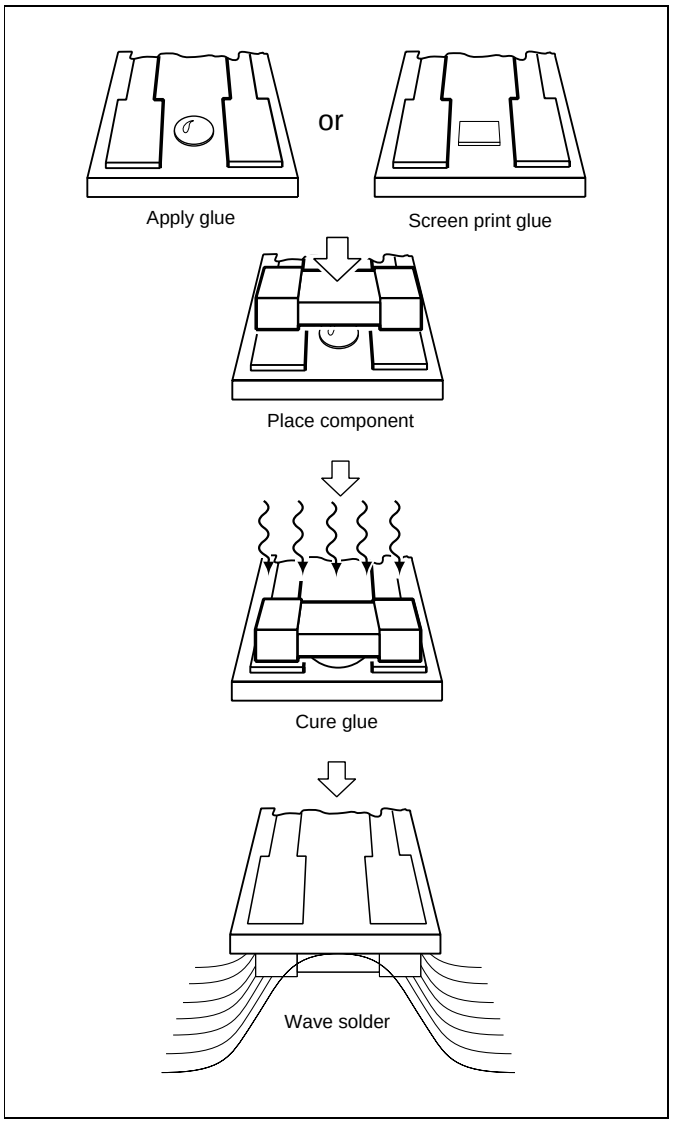

Figure 18.5 Wave Soldering PCBs With Surface Mount Devices Only

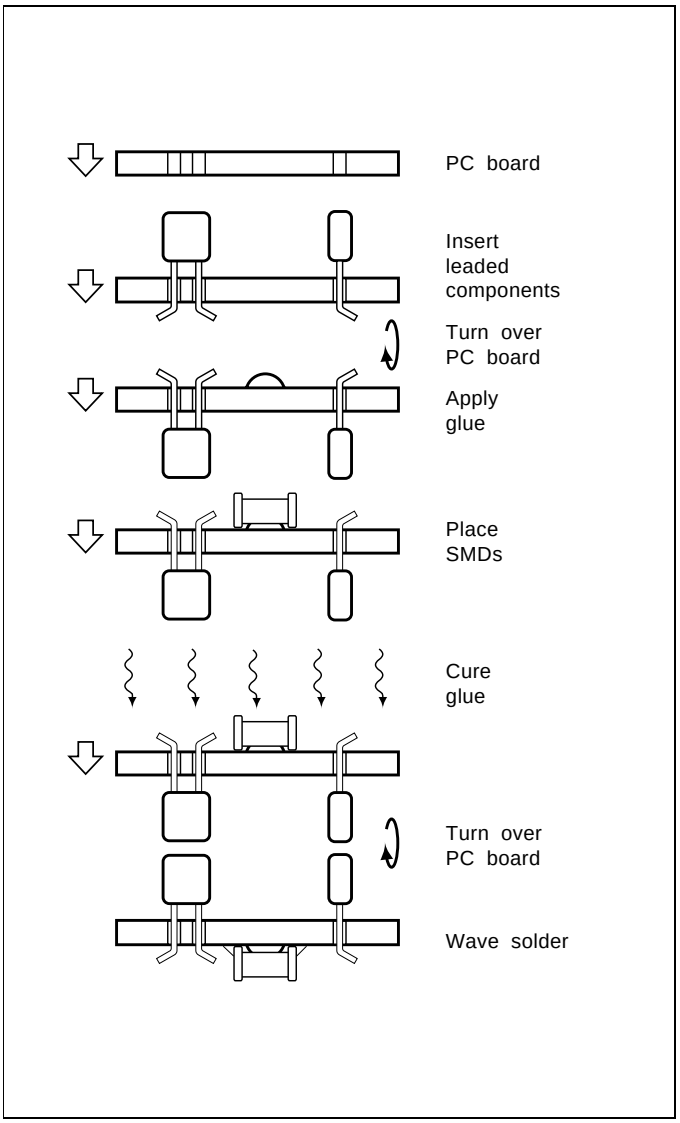

Figure 18.6 Wave Soldering PCBs With Both Surface Mount and Leaded Components

Immersion Soldering

Maximum allowed temperature of the soldering bath is 235°C. Maximum duration of soldering cycle is 5 seconds and forced cooling must be applied.

Hand Soldering

It is possible to solder the DO-214AA devices with a miniature hand-held soldering iron, but this method has particular drawbacks and should, therefore, be restricted to laboratory use and/or incidental repairs on production circuits.

Recommended Metal-alloy

(1) 63/37 Sn/Pb
(2) 60/40 Sn/Pb

Pre-Heating

Pre-heating is recommended for good soldering and avoiding damage to the DO-214AA devices, other components and the substrate. Maximum pre-heating temperature is 165°C while the maximum pre-heating duration may be 10 seconds. However, atmospheric pre-heating is permissible for several minutes provided temperature does not exceed 125°C.

Gluing Recommendations

Prior to wave soldering, surface mount devices (SMD) must be fixed to the PCB or substrate by means of an appropriate adhesive. The adhesive (in most cases a multicomponent adhesive) has to fulfill the following demands:

- Uniform viscosity to ensure easy coating
- No chemical reactions upon hardening in order not to deteriorate component and PC board.
- Straightforward exchange of components in case of repair.

Cleaning Recommendations

PC board or substrate cleaning in solvents is permitted at approximately 70°C to 80°C.

The soldered parts should be cleaned with azeotrope solvent followed by a solvent such as methol, thhyl, or isopropyl alcohol.

Ultrasonic cleaning of surface mount components on PCBs or substrates is possible.

The following is recommended when using ultrasonic cleaning:

- Cleaning agent: Isopropanol
- Bath temperature: approximately 30°C
- Duration of cleaning: maximum 30 sec.
- Ultrasonic frequency: 40 kHz
- Ultrasonic changing pressure: approximately 0.5 bar

Cleaning of the parts is best accomplished using an ultrasonic cleaner which has approximately 20 watts of output per one liter of solvent. The solvent should be replaced on a regular basis.