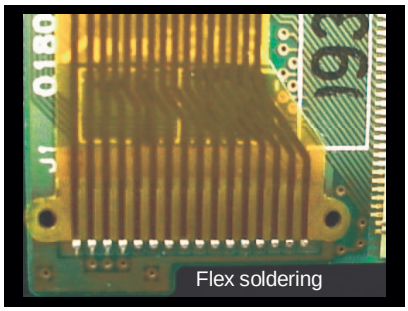
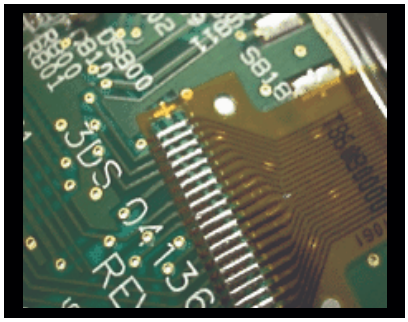
1.0 Hot-bar soldering


Flex soldering


Open Flex Soldering

Many factors are involved in producing a good reflow solder joint. Some guidelines will be discussed.

Reflow soldering is a specialised soldering process by which two metal parts are bonded together by the application of heat and pressure. Both metal have to be pre-tinned with a layer of solder, the thickness will depend on the pitch of the conductive tracks and the substrates construction. The two substrates have to be aligned accurately and held in good rigid position after which heat and pressure are applied, the solder from each piece will flow and coalesce thus forming a solid solder joint after it resolidifies.

Reflow soldering has become very popular and will remain so for the following reasons: -

1. The advance in communication technology that made previously “out of the world idea” becomes a reality. Many of these products come in miniature size for portability and therefore use miniature and slim flexible components.
2. The race between telecommunication companies in making their product slimmer and smaller.
3. Many economies, namely the Eastern Europe, Southern America, South East Asia and China has started to explore their vast human resource to produce parts very cheaply and therefore have stir up a global pricing war. This has prompt designer to use lesser components and direct connection between cables and PCB.
4. The development of a new IC package TAB for slim build.

As electronics technology become more complex, so did the need for a neat assembly process, thus a more controllable method for mounting the devices had to be developed.

2.0 Reflow soldering process

As mentioned earlier, reflow soldering involve melting of solder to flow and coalesce. The reflow soldering process consists of the following steps: -

1. The matching parts (conductive trace) are shaped so that they fit properly together Conductive traces are tinned or precoated with the right amount of solder.(refer to design guidelines).
2. Surfaces need to be cleaned and well-fluxed with mildly activated rosin flux.
3. Mating parts are aligned using rigid fixturing and magnified view through CCTV system. Parts are held in good position for reflow process.
4. Heat and pressure are applied for a specific time to allow solder reflow.
5. Heating is cut off and parts are held together until solder solidifies.
6. Parts are checked for good joint and flux removed if deem necessary (optional).

3.0 Reflow process ingredients

The following are factors to be considered: -

1. The substrate, normally made of FR-4
2. The component to be soldered
3. Solder paste, sometime referred to as " a mysterious gray sludge" is made up of small solder balls and flux. The metal portion may be around 90% of the paste weight and 50% of the volume. The flux is an inert solid at room temperatures and turns to a liquid and become active at an elevated temperature
4. Flux applied onto paste that has solidified for reflow in a TAB or Flex soldering
5. Heat transfer device
6. Applied pressure and time

4.0 Relow soldering profile

Temperature is the most important factor in a soldering process. In a reflow soldering process, the flux in the paste has already been evaporated in the reflow oven prior to reflow soldering, therefore, flux need to be added to enhance soldering. In case where cleaning of flux is not possible in a flexi cable soldering, low rosin non-clean flux has to be used. Consult flux supplier.

The first step in the profile is a preheat period that brings the assembly from room to preheat temperature for the flux to do its jobs well. It should remain there for a short period for soaking. During this time, the substrate also has an opportunity to equalise. The second step is to elevate the temperature for the solder to melt and reflow. **See *diagram J*** for a typical reflow soldering profile.

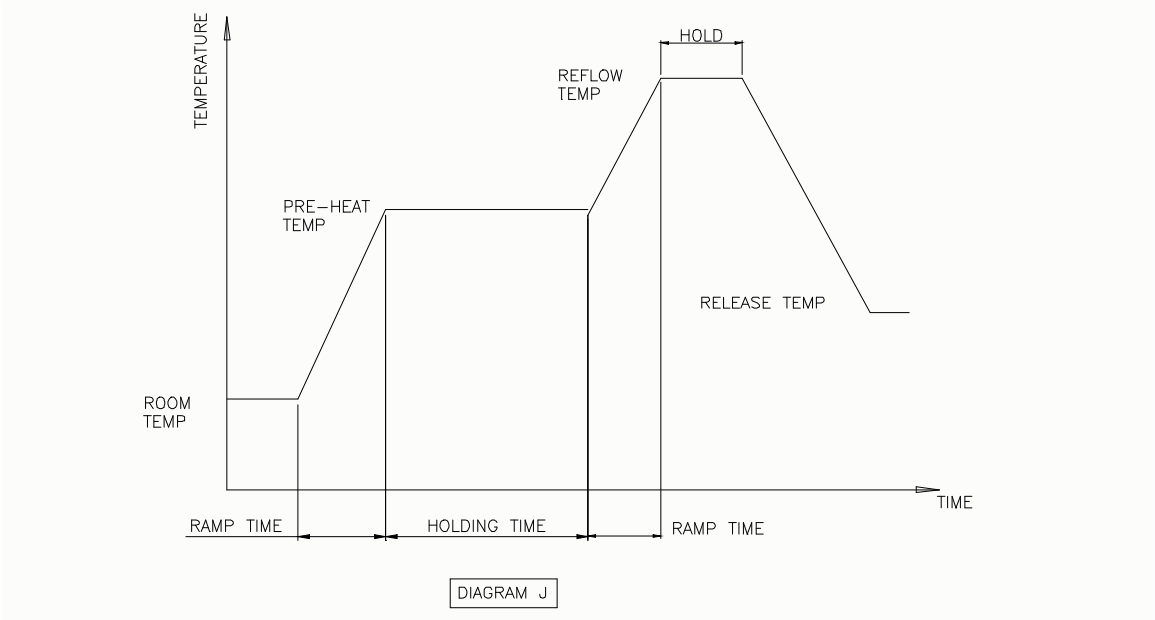


DIAGRAM J

The pre-heat temperature is around 140-160°C at around 4-5 seconds and a reflow temperature of 240°C at around 4 seconds.

4.1 Designing reflow soldering profile

Make sure equipment and fixture are set up properly and working environment is clean and stable before working. Developing the reflow profile is a very systematic process. There are four important factors to consider when designing a reflow profile, they are: -

1. Material
   The size and composition of metals being joined and the temperature-sensitivity of materials near the metal. Heat energy for bigger reflow area will be higher
2. Temperature
   The amount of heat required to get the material hot enough for the solder to reflow. The temperature required for reflow is normally in the range of 50-degree C above melting point of solder. The set temperature on the thermode will defer according to the type of reflow soldering process performed. For open soldering on lead (TAB), set temperature will be the reflow temperature while close soldering for cable (Flexi), set temperature will be higher to compensate temperature lost due to conduction transfer. Temperature should not be set too high to prevent burning of part and quick evaporation of flux.
3. Force
   Pressure is required to hold mating parts rigidly in place while solder reflow. Pressure, which is a function of force over area, must be applied evenly throughout the whole length of leads. Therefore, the force required will depend on
   the size and number of pads to be reflowed. Many other factors will affect the force required, therefore, there is no fixed formula for force in relation to size
   lone. For edge connector soldering, more force may be required to ensure consistent pressure against all the leads.
   In general, a pressure of 4kg per square centimeter may be taken as a good starting point for engineer.
4. Time
   Duration of heat application is needed to allow for solder to completely wet and coalesce. As with force and temperature, the duration of heat depends on the surface area to be contacted. Shorter time should be used if there are other heat sensitive parts in the soldering area. Excessive high heat at long duration can result in oxidation of the solder joint.
   The temperature, time and force selection must be derived with considerable evaluation and trial in order to obtain the optimum value for a reliable production. Keeping in mind that any excessive use of the three parameters will result in higher variable in process output.

4.2 The need for profiling

Trimech advocate thermal profiling, for only by profiling do we have any idea of what is actually occurring in a reflow soldering process. Profiling has two main objectives: -

1. Determining the correct process settings for a given assembly.
2. Verifying the process consistency for repeatable results

Quality of solder joint, in general is characterised by its appearance, strength and fillet that form between the joining parts. Temperature, pressure and time are all very important parameters for reflow soldering process and must be delivered with clockwork precision.

Pulse heated reflow soldering use AC current to heat up a small cross sectional area, also known as resistance heating, this method of heating offer sensitive control of temperature. The small cross section area enable instant heating and cooling of the thermode surface. Advance electronic control has enable accurate control of temperature for a specific period and relatively fast cooling by air. Quick cooling can be achieved by using force air. Pulse heating has offer to the process engineer a reliable

soldering profile previously not possible with constant heating technology which uses heater cartridge to fire a conductive metal mass.

5.0 Design guidelines and manufacturability

Although the soldering equipment plays a pivotal role in achieving a good solder joint, parts design plays an equally important role. Some design guidelines will be discussed and although they may be useful for designers and engineers, they are strictly for reference only.

5.1 Pads design

Pad width of PCB should be wider than mating pad's width of component. This is to allow fillet to form and achieve 50% of thickness of lead.

5.2 Solder coating

The most common solder material is composed of 63% tin and 37% lead. This provides the maximum strength at the lowest melting point of both metals in combination.

Amount of solder coating depends on the size of pads. Typically, a coating of 25 micron for open lead soldering (TAB) and 15 micron for close up soldering (Flexi-cable). Consistency of solder coating thickness will determine the quality of joint. Sold should be arrange in array form to allow for reflow. See *diagram K*

5.3 Flexible cable thickness

Polyamide material should be as thin as possible for adequate heat transfer to melt solder for proper reflow. The base material will hinder heat transfer through conduction, which is a good insulator. Higher temperature to compensate for this lost in heat will burn the base material if it exceed the material operating temperature. Typical thickness should be 25 micron.

5.4 Location of parts

Pitch of mating pads is normally small, making alignment and holding difficult. If space permit, two location holes of at least diameter 1mm should be provide on mating parts.

5.5 Keep out area

Area directly below reflow area should be left free for adequate support.

END NOTES

This technical manual is solely for reference only and most materials are from many individuals who have been working in this manufacturing field for many years. All information is true and new at the time of writing and will change as technology advance. Trimech intend to update this manual periodically and therefore welcome any suggestions at all time.