Soldering to Semiconductor Leads—a supplement to manufacturer's specifications

Application Bulletin 202

Normal lead soldering information furnished on semiconductor product data sheets is limited to the maximum temperature, the maximum time at this temperature and the minimum distance from the temperature to the case of the unit. This bulletin discusses some of the aspects of soldering using an iron, a pot, or a flow bath. This will involve discussions of both hermetic or metal packaged parts and plastic encapsulated parts.

General Discussion

A variety of different methods are used to make a solder joint between a semiconductor product and the circuit to which it is wired. Care and expertise are required to minimize unit loss and maximize unit yield. A few technique improvements, and suggestions as to proper solder and flux selections are discussed. Familiarization with the points brought out in this bulletin will assist the user to minimize solder problems.

Performance Characteristics

A typical data sheet will have the following information in the absolute maximum ratings: lead soldering temperature—240° C (1/16 inch from case for 3 seconds). These conditions except for "time" are readily controlled in flow soldering and solder pot applications. It becomes difficult to control the maximum temperature in solder iron applications. The normal solder used is 60/40 lead tin which softens at 180°C and flows at 220°C. If the temperature of the iron or the time it is in contact with the solder lead interface is not controlled, the 240°C can be significantly exceeded. Several techniques or controls are helpful in preventing this overheating.

1. Limiting the maximum temperature of the iron by controlling the power to the iron. The slower the operator is, the cooler the iron should be.
2. Careful selection of proper solder, flux, iron, tip and surface preparation can minimize problems.
3. Verbal explanation, knowledgeable tutoring and assistance, and pictorial examples can also be helpful.
4. Proper design of the work station to minimize fatigue and encourage repeatable operator steps such that the solder operation is done in the same sequence by the same motions.
5. Once the technique is learned, it is very important to encourage speed. Normally, the higher the output, the higher the quality level once the basic technique has been mastered.
6. Design of the PC board land patterns with the unit and method of soldering of uppermost importance can be of significant help. The subsequent discussion on soldering of the pill package will illustrate this.

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Table 1 lists the solder, flux, dwell times and distances recommended by Optek on their hermetic and plastic encapsulated components.

TABLE I – Soldering Components Listing

PACKAGE	TYPE OF SOLDER	TYPE OF FLUX	MAX DWELL TIME	DISTANCE FROM CASE	COMMENTS
Flow Soldering					
Hermetic	63/37 Tin Lead Bar	Active Rosin foaming flux (Kester 197 is suitable)	10 Sec	1/16"	Except for "pill" packages
Plastic	63/37 Tin Lead Bar		10 Sec	1/16"	
Solder Pot					
Hermetic	63/37 Tin Lead Bar	Kester 1544 is suitable	10 Sec	1/16"	Use water white rosin flux on pills (Alpha 100 is suitable)
Plastic	63/37 Tin Lead Bar		10 Sec	1/16"	
Solder Iron					
Hermetic	60/40 Tin Lead Wire Rosin Core, as small a diameter as possible		3 Sec	1/16"	If fluxing is required, use mildly activated rosin flux dispensed from hypodermic needle. Kester 1544 is suitable.
Plastic			3 Sec	1/16"	

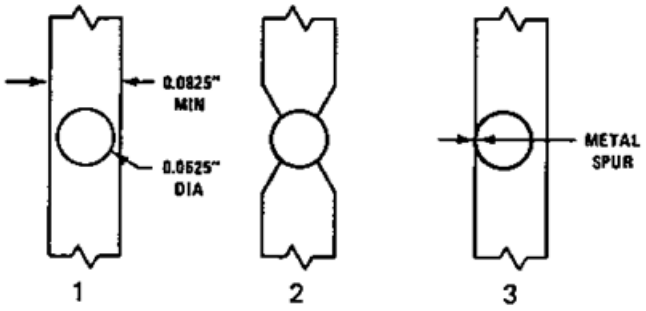
All rosin flux residue can be removed with isopropyl alcohol and water rinses. (All recommended fluxes are rosin base.)

The pill package (OP600-OP123 types) requires more care than any other package. The unit is designed for solder contact on either side of a PC board by any of the three techniques. It is not normally flow soldered since two passes must be made through the machine, and tooling can be complicated. Care must be taken in the PC board design to be drilled to 0.0625" ±0.001". The following should be considered when designing the land area for the lens side of the device:

1. If space permits, allow a minimum of 0.010" on either side of mounting holes.
2. Design with cutaways when lands are narrow or consistent orientation of tabs is desired.
3. Hole off center with narrow lands will create fingers of land pattern due to "undercut" that may short the unit as the package is inserted into the hole.

FIGURE 1

PC Land Pattern Design



The two desirable factors are: To have as much surface area of land pattern adjacent to the unit as possible to ensure support of both lens mounting tabs to prevent tilting, and to provide mechanical strength of land pattern when unit is being reworked or removed.

Hand Soldering

Once the packages are inserted into the PC board, the board should be turned so lens side is down and resting on a hard rubber or similar surface that will prevent damage to the glass lens but firmly support it. The operator will then press firmly down on the board with one hand. The iron is held in the other hand with the tip resting on the land pattern approximately 1/4" from the unit. The tip is slowly moved toward the unit; while watching the land pattern melt ahead of the tip. The speed of travel is as fast as the operator can handle the movement comfortably ensuring the land pattern melts. At the time the tip reaches the unit, solder is fed by the hand resting on the board without removing the downward pressure. The iron is wiped around the unit at the same rate of travel as was used on the land pattern. Once the 360° circle is complete, the solder wire is removed. The operator may make another 360° turn with the iron. Experience will show the best way. After all the plug sides are soldered, the board will be inverted and the lens tabs will be soldered to the two land patterns. The same technique is used except omit the 360° circle. The tabs are soldered in two operations.

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Solder Pot or Dip Soldering

A popular method of soldering pills in PC boards, when the design permits, is dip soldering or immersing the pill in the PC board in molten solder. The following conditions called out in Table II should be used.

TABLE II – Dip Soldering

Temperature of solder	230°C ±5°C
Insertion or retraction rate	0.25 inches/second
Dwell Time	3–5 seconds
Flux	"R" type (non-activated)
Flux Dilution	Methanol

CAUTION: After removing from the solder pot, the unit should be held still until the solder has hardened. Vertical insertion and removal with minimum lateral movement is required for minimum problems (inadequate coverage or shorts). There should be a minimum of 0.025" clearance between lands to prevent bridging.

All solder joints on all other packages in 0.062" PC boards should be soldered on the side away from the component. This guarantees the minimum distance of 1/16" from device to heat source. On open air solder joints, a pair of long nose pliers or some other heat sink gripping the lead between the joint and the unit can prevent problems. By following the information given above and exercising good judgment and common sense, the user will encounter very few problems related to solder joints on Optek components.

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