Surface-Mount Assembly Instruction

When assembling IrDC transceivers on a printed circuit board (PCB), it is useful to have an understanding of the properties of the materials used during manufacturing.

While IrDC transceivers use semiconductor dice and other constituents processed in the semiconductor industry, there are considerable differences between transceivers and other semiconductor devices. One of the most important differences is the molding material that is used for its manufacture.

Packaging material used for transceivers must be transparent to infrared radiation in order to emit and receive optical signals. However, visible light might disturb the proper performance of the transceiver ASIC. A special dye is mixed into the encapsulant to block visible light. This results in the transceiver appearing black. The need for good optical performance requires the use of pure resin. No other ingredients can be added.

The encapsulant used for standard integrated circuits (IC), however, is a mixture of resin (typically 30 %) and other ingredients (e.g. nearly 70 % silica sand). This mixture results in more uniform mechanical properties of semiconductor die, leadframe, and encapsulant.

Fig. 1 and Fig. 2 show the difference between filled and unfilled epoxy resin.

The following Table 1 shows the main differences between the two types of mold compound.

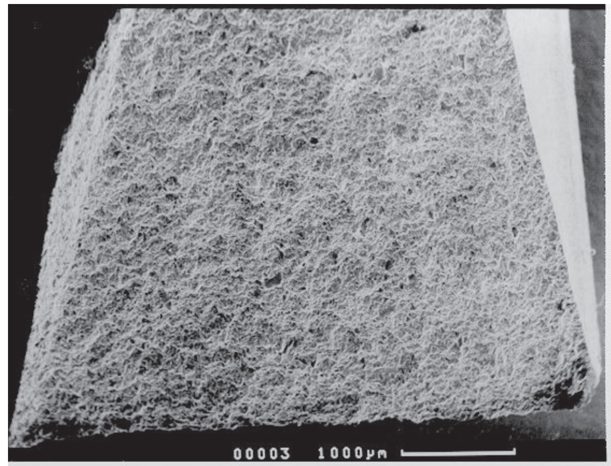

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Fig. 1 - IC Molding Compound (30 % resin)

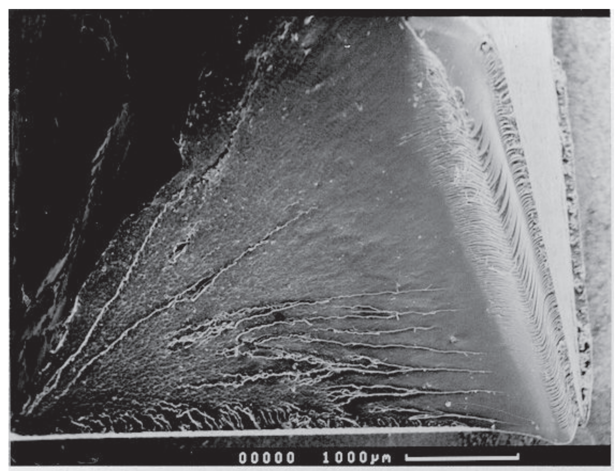

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Fig. 2 - Clear Molding Compound (100 % resin)

TABLE 1

CHARACTERISTICS	IC MOLD COMPOUND	IrDC MOLD COMPOUND
Optical properties	Light blocking	Transparent
Hardness	High	Low (brittle)
Coefficient of thermal expansion	Low (matched to leadframe & die)	High
Glass transition temperature	High (160 °C)	Low (120 °C to 140 °C)
Thermal conductivity	High	Low
Moisture ingress	Low	High

A standard molded integrated circuit will have its constituents nicely matched to each other in terms of thermal expansion. The typical IC package is rather free of mechanical stress compared to an IrDC transceiver, which experience more mechanical stresses during manufacturing.

SOLDERING METHODS

There are several commonly used methods to solder devices onto the circuit board.

(a) Reflow Soldering

Reflow soldering uses contact-free heating and derives the energy for soldering the components either from convection heating or from direct infrared radiation.

The heating rate in an IR oven depends on the heat absorption of the components' surfaces and on the ratio of the components' masses to their irradiated surfaces.

The relevant temperature for components soldered in a reflow process is defined as the package peak temperature (PPT), sometimes misleadingly referred to the peak reflow temperature (PRT). Both terms refer to the temperature at the top of the package, not the temperature of the solder joint.

The PPT of a component in an IR oven cannot be determined through calculation. The PPT of a component may be obtained by measuring its temperature while it is being transported through the oven.

The solder profile for a given board often depends on reliably soldering the larger, more massive components. The PPTs of smaller components tend to react more quickly than the larger ones. Care should be taken that their maximum ratings are not exceeded.

The parameters which influence the PPT of the component are the following:

- Time in the oven and power of the oven
- Mass of the component
- Size of the component
- Size of the printed circuit board
- Absorption coefficient of the surfaces
- Layout density
- Optical spectrum of the radiation source
- Ratio of radiated to convected energy

A PPT vs. time profile of the reflow process, suitable for SMD devices, is given in Fig. 3.

Soldering Instructions

- Reflow soldering must be done according to MSL4 within 72 h after opening the dry pack envelope, and while stored below a maximum temperature of 30 °C and below a relative humidity of 60 %
- Set the furnace temperatures for pre-heating and heating such that the PPT of the component does not exceed the reflow temperature profile shown in the diagram. Exercise extreme care to keep the PPT below 260 °C
- Handling after reflow should be done only after the assembly has cooled off

(b) Soldering iron

The process of hand soldering with an iron cannot be carried out in a repeatable and controlled way.

This process should not be considered for use in applications where reliability is important. There is no SMD classification for this process.

Manual Soldering for SMD

- Use a soldering iron of 25 W or less. Adjust the temperature of the soldering iron below 350 °C
- Finish soldering within 3 s
- Handle products only after the temperature has cooled off

TEMPERATURE-TIME PROFILES

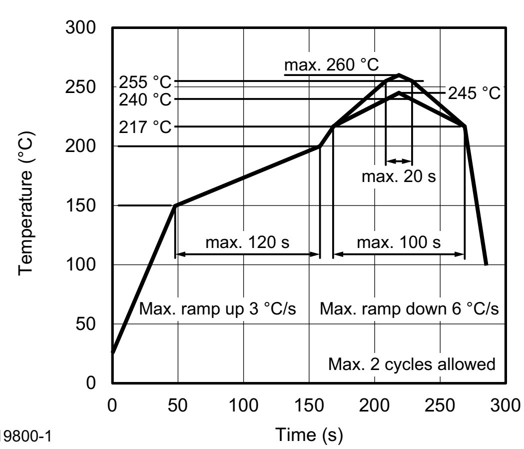


Fig. 3 - Infrared Reflow Soldering of Opto Devices (SMD package only)

MOISTURE SENSITIVITY

The high rate of moisture ingress is another property of the optical clear molding compound. The saturation value for room temperature of moisture intake is roughly a factor of ten larger than for filled molding compound. Due to this high rate of moisture ingress transceivers are more prone to the "popcorn effect".

Any possible void (delamination, bubble) inside the package will be filled very quickly with moisture. Even the whole package can soak up a considerable amount of moisture. Whenever the package is heated up above the boiling point of water, a very high vapor pressure builds up inside the voids. This pressure can cause the package to crack or creates severe delamination.

The amount of moisture absorbed by the package is determined by the exposure time to humid air. The exposure time allowed for a particular package is defined by a moisture sensitivity level (MSL) according to JEDEC® standard J-STD-020.

Vishay transceivers are designed to withstand three subsequent passes through a reflow soldering oven using our recommended reflow temperature-time profile when the package has been exposed not longer than 72 hours to environmental conditions of ≤ 30 °C / 60 % RH. This correlates to MSL 4.

The parts will be delivered in a moisture barrier bag containing desiccant and a humidity indicator card. As long as the parts are stored in the sealed bag, the performance will not degrade. As soon as the bag is opened, the material should be consumed within 72 hours or must be stored in a dry place (chamber which is purged with a dry gas like air or nitrogen) or baked according to the sticker on the reel.

WARNING

Opto devices are sensitive to damage due to moisture release if they are subjected to infrared reflow or a similar soldering process (e.g. wave soldering) without being properly dried.

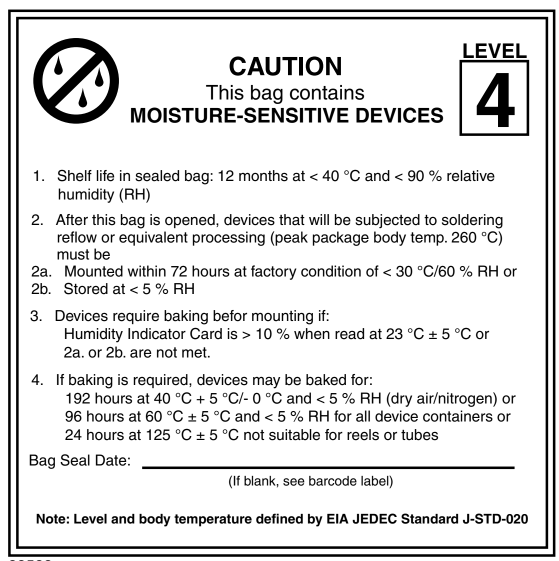
Dry box storage is recommended as soon as the aluminum shipping bag has been opened to prevent moisture absorption by the devices. The following conditions should be observed if dry boxes are not available:

- Storage temperature 10 °C to 30 °C
- Storage humidity at 60 % RH maximum

If the devices are stored for more than 72 h under these conditions, the moisture content will then be too high for reliable reflow soldering. The devices can be reconditioned to recover to an acceptable moisture content by drying under the following conditions:

192 h at 40 °C + 5 °C / - 0 °C and < 5 % RH (dry air / nitrogen)
or
24 h at 125 °C + 5 ° not suitable for reel or tubes
or
96 h at 60 °C ± 5 °C and < 5 % RH for all device containers.

An EIA JEDEC® standard JSTD-020 level 4 label is included on all dry packs.


CAUTION
This bag contains
MOISTURE-SENSITIVE DEVICES

LEVEL
4

1. Shelf life in sealed bag: 12 months at < 40 °C and < 90 % relative humidity (RH)
2. After this bag is opened, devices that will be subjected to soldering reflow or equivalent processing (peak package body temp. 260 °C) must be
2a. Mounted within 72 hours at factory condition of < 30 °C/60 % RH or
2b. Stored at < 5 % RH
3. Devices require baking befor mounting if:
Humidity Indicator Card is > 10 % when read at 23 °C ± 5 °C or
2a. or 2b. are not met.
4. If baking is required, devices may be baked for:
192 hours at 40 °C + 5 °C/- 0 °C and < 5 % RH (dry air/nitrogen) or
96 hours at 60 °C ± 5 °C and < 5 % RH for all device containers or
24 hours at 125 °C ± 5 °C not suitable for reels or tubes

Bag Seal Date: ______________________
(If blank, see barcode label)

Note: Level and body temperature defined by EIA JEDEC Standard J-STD-020

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Fig. 4 - Example of JSTD-020 Level 4 Label