Assembly Instructions

GENERAL

Vishay offers a wide product selection of optocouplers and solid state relays in a variety of packages. This document provides instructions on mounting for the different types of packages, specifically on the different methods of soldering.
For DIP packages, they can be mounted in DIP sockets or directly on a pre-designed PCB with holes.
The preferred solder process for SMD packages is reflow soldering. Certain SMD families are also qualified for wave soldering; please see table 1. The moisture sensitivity Level (MSL) = 1 for all couplers.
If the device is to be mounted near heat-generating components, consideration must be given to the resultant increase in ambient temperature.

SOLDERING INSTRUCTIONS

Protection against overheating is essential when a device is being soldered. Therefore, the connection wires or PCB traces should be left as long as possible. The maximum permissible soldering temperature is governed by the maximum permissible heat that may be applied to the package.
The maximum soldering iron (or solder bath) temperatures are given in the individual datasheets. During soldering, no forces must be transmitted from the pins to the case (e.g., by spreading the pins).

SOLDERING METHODS

There are several methods for soldering devices onto the substrate. The following is a partial list.

(a) Soldering in the vapor phase

Soldering in saturated vapor is also known as condensation soldering. This soldering process is used as a batch system (dual vapor system) or as a continuous single vapor system. Both systems may also include a pre-heating of the assemblies to prevent high-temperature shock and other undesired effects.

(b) Reflow soldering of lead (Pb)-free SMD devices

By using infrared (IR) reflow soldering, the heating is contact-free and the energy for heating the assembly is derived from direct infrared radiation and from convection.
The heating rate in an IR furnace depends on the absorption coefficients of the material surfaces and on the ratio of the component's mass to an as-irradiated surface.
The temperature of parts in an IR furnace, with a mixture of radiation and convection, cannot be determined in advance. Temperature measurement may be performed by measuring the temperature of a certain component while it is being transported through the reflow oven.

Influencing parameters on the internal temperature of the component are as follows:

- Time and power
- Mass of the component
- Size of the component
- Size of the printed circuit board
- Absorption coefficient of the surfaces
- Packing density
- Wavelength spectrum of the radiation source
- Ratio of radiated and convected energy

Temperature/time profiles of the entire process and the influencing parameters are given. The IR reflow profile is shown in figure 1. Two cycles of reflow are allowed.

(c) Wave soldering

In wave soldering one or more continuously replenished waves of molten solder are generated, while the substrates to be soldered are moved in one direction across the crest of the wave. Maximum soldering temperature should not exceed 260 °C.
Temperature/time profiles of the entire process are given in figure 2.
For SMD devices which are qualified for wave soldering, the temperature profile under figure 2 is also valid. For wave soldering two cycles are allowed.

(d) Iron soldering

This process cannot be carried out in a controlled situation. It should therefore not be used in applications where reliability is important. There is no SMD classification for this process.

(e) Laser soldering

This is an excess heating soldering method. The energy absorbed may heat the device to a much higher temperature than desired. There is no SMD classification for this process at the moment.

(f) Resistance soldering

This is a soldering method which uses temperature-controlled tools (thermodes) for making solder joints. There is no SMD classification for this process at the moment.

TABLE 1 - SOLDERING METHODES AND TEMPERATURE PROFILES FOR OPTOCOUPLER					
			REFLOW	WAVE SOLDERING 260 °C	
			SMD	SMD	THROUGH HOLE
				PACKAGE THROUGH WAVE	PACKAGE NOT THROUGH WAVE
PACKAGE	PART NUMBER EXAMPLES	ASSEMBLY METHOD	TEMP. PROFILE FIG. 1	TEMP. PROFILE FIG. 2	TEMP. PROFILE FIG. 2
DIP-6	IL1; IL2; H11; IL250; IL410	Through hole			X
DIP-8	IL300; SFH6700; 6N135	Through hole			X
DIP-4/8/16	SFH617A-2; SFH615	Through hole			X
DIP-6	CNY17; SFH615ABM	Through hole			X
DIP-4/8/16	TCET1104; TCET1104G	Through hole			X
DIP-4/8/16	VO615A	Through hole			X
DIP-6	CQY80NG; CNY75B; TCDT	Through hole			X
DIP-4/8/16	VO615A series	SMD bend.opt.	X	No	
DIP-4/8/16	SFH617A-2X007; 9; SFH6106	SMD bend.opt.	X	Yes	
DIP-8 high speed	SFH6700; 6N135; SFH6325	SMD bend.opt.	X	No	
DIP-6	Types with option 7, 8 or 9	SMD bend.opt.	X	No	
DIP-8; DIP-16	ILD2; ILQ2	SMD bend.opt.	X	No	
DIP-8	IL300	SMD bend.opt.	X	No	
SOP low profile	TCMT; TCLT series	SMD	X	Yes	
SOP-16 low profile	SFH6916	SMD	X	No	
SOP-4 (Miniflat)	SFH690	SMD	X	No	
SO8	IL205T; ILD207AT	SMD	X	Yes	
SO8	VO026..; VO46..; VO06..	SMD	X	Yes	
PCMCIA	IL388	SMD	X	No	
Minicoupler	SFH6943	SMD	X	No	
SSR's					
DIP-4	LH1546AD	Through hole			X
DIP-6	LH1500AT	Through hole			X
DIP-8	LH1526AB	Through hole			X
DIP-6	LHxxxBT	Through hole			X
DIP-8	LHxxxBB	Through hole			X
DIP-4	LH1546ADF	SMD bend.opt.	X	No	
DIP-6	LH1500AAB	SMD bend.opt.	X	No	
DIP-8	LH1526AAC	SMD bend.opt.	X	No	
Miniflat	LH1546AEF; VO14..	SMD	X	No	
Flatpak's	LH1556FP	SMD bend.opt.	X	No	
DIP-6	LHxxxBAB	SMD bend.opt.	X	No	
DIP-8	LHxxxBAC	SMD bend.opt.	X	No	

TEMPERATURE-TIME PROFILES

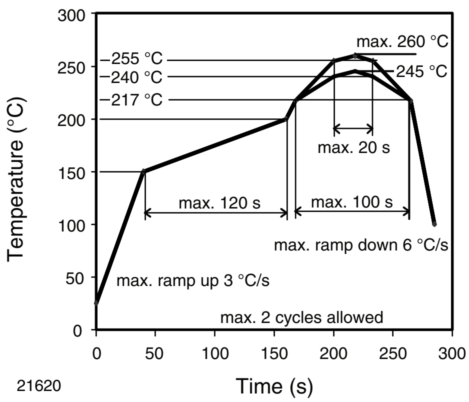

Fig. 1 - Temperature Profile for Lead (Pb)-free Opto Devices

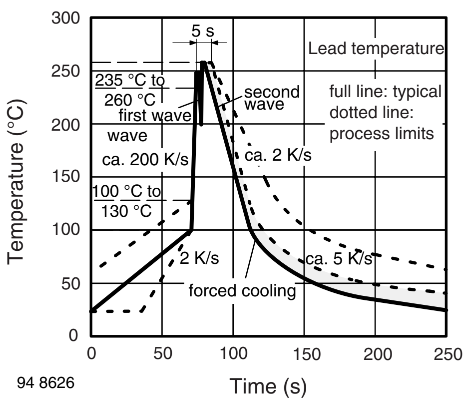

Fig. 2 - Wave Soldering Double Wave Opto Devices

HEAT REMOVAL

The heat generated in the semiconductor junction(s) must be moved to the ambient. In the case of low-power devices, the natural heat conductive path between case and surrounding air is usually adequate for this purpose.

In the case of medium-power devices, however, heat conduction may have to be improved by the use of star- or flag-shaped heat dissipators which increase the heat radiating surface.

The heat generated in the junction is conveyed to the case or header by conduction rather than convection; a measure of the effectiveness of heat conduction is the inner thermal resistance or junction-to-case thermal resistance, R_{thJC}, whose value is given by the construction of the device.

Any heat transfer from the case to the surrounding air involves radiation convection and conduction, the effectiveness of transfer being expressed in terms of an R_{thCA} value, i.e., the case-to-ambient thermal resistance. The total thermal resistance, junction-to-ambient is therefore:

$R_{thJA} = R_{thJC} + R_{thCA}$

The total maximum power dissipation, $P_{totmax.}$, of a semiconductor device can be expressed as follows:

$$P_{totmax.} = \frac{T_{jmax.} - T_{amb}}{R_{thJA}} = \frac{T_{jmax.} - T_{amb}}{R_{thJC} + R_{thCA}}$$

where:

- $T_{jmax.}$ the maximum allowable junction temperature
- T_{amb} the highest ambient temperature likely to be reached under the most unfavorable conditions
- R_{thJC} the thermal resistance, junction-to-case
- R_{thJA} the thermal resistance, junction-to-ambient
- R_{thCA} the thermal resistance, case-to-ambient, depends on cooling conditions. If a heat dissipator or sink is used, then R_{thCA} depends on the thermal contact between case and heat sink, heat propagation conditions in the sink and the rate at which heat is transferred to the surrounding air.

Therefore, the maximum allowable total power dissipation for a given semiconductor device can be influenced only by changing T_{amb} and R_{thCA}. The value of R_{thCA} could be obtained either from the data of heat sink suppliers or through direct measurements.

In the case of cooling plates as heat sinks, the approach outlined in fig. 3 and 4 can be used as guidelines. The curves shown in both fig. 3 and 4 give the thermal resistance R_{thCA} of square plates of aluminium with edge length, a, and with different thicknesses. The case of the device should be mounted directly onto the cooling plate.

The edge length, **a**, derived from fig. 3 and 4 in order to obtain a given R_{thCA} value, must be multiplied

with α and β:

$\alpha' = \alpha \times \beta$

where

α = 1.00 for vertical arrangement

α = 1.15 for horizontal arrangement

β = 1.00 for bright surface

β = 0.85 for dull black surface

Example

For an IR emitter with $T_{jmax.}$ = 100 °C and R_{thJC} = 100 K/W, calculate the edge length for a 2 mm thick aluminum square sheet having a dull black surface (β = 0.85) and vertical arrangement (α = 1),

T_{amb} = 70 °C and $P_{tot\ max.}$ = 200 mW.

$$P_{totmax.} = \frac{T_{jmax.} - T_{amb}}{R_{thJC} + R_{thCA}}$$

$$R_{thCA} = \frac{T_{jmax.} - T_{amb}}{P_{totmax}} - R_{thJC}$$

$$R_{thCA} = \frac{100\ °C - 70\ °C}{0.2\ W} - 100\ K/W$$

$$R_{thCA} = \frac{30}{0.2} - 100 \text{ K/W}$$

$$R_{thCA} = 50 \text{ K/W}$$

$$\Delta T = T_{case} - T_{amb}$$

can be calculated from the relationship:

$$P_{totmax.} = \frac{T_{jmax.} - T_{amb}}{R_{thJC} + R_{thCA}} = \frac{T_{case} - T_{amb}}{R_{thCA}}$$

$$\Delta T = T_{case} - T_{amb} = \frac{R_{thCA}(T_{jmax.} - T_{amb})}{R_{thJC} + R_{thCA}}$$

$$\Delta T = \frac{50 \text{ K/W} \times 100\ °C - 70\ °C}{150 \text{ K/W}}$$

$$\Delta T = \frac{50 \text{ K/W} \times 30\ °C}{150 \text{ K/W}}$$

$$\Delta T = 10\ °C = 10 \text{ K}$$

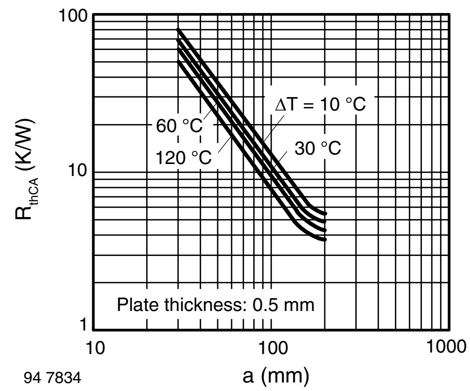

Fig. 3

With R_{thCA} = 50 k/W and ΔT = 10 °C, a plate of 2 mm thickness has an edge length α = 28 µ.

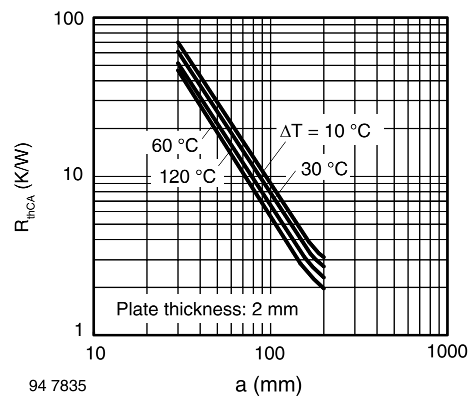

Fig. 4

However, equipment life and reliability have to be taken into consideration and therefore a larger sink would normally be used to avoid operating the devices continuously at their maximum permissible junction temperature.