Dale Resistor Division Products Recommended for Power Metal Strip® Resistor, Power Metal Plate™ Resistor, Thick Film Chip Resistor, and Resistor Network Styles

GENERAL

Vishay offers a wide product selection of resistors in a variety of packages. This document provides instructions on mounting for the different types of packages, specifically on the different methods of soldering.

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.

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 list is not complete.

(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) Infrared Soldering

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 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 furnace.

The temperatures of small components, soldered together with larger ones, may rise up to 280 °C.

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

As a general rule of thumb, maximum temperature should be reached within 360 s and time above solder liquids temperature should be reached in less than 180 s.

Temperature / time profiles of the entire process and the influencing parameters are given. The IR reflow profile is shown on the following page.

(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 for 5 s.

(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.

For technical questions, contact: ff2aresistors@vishay.com

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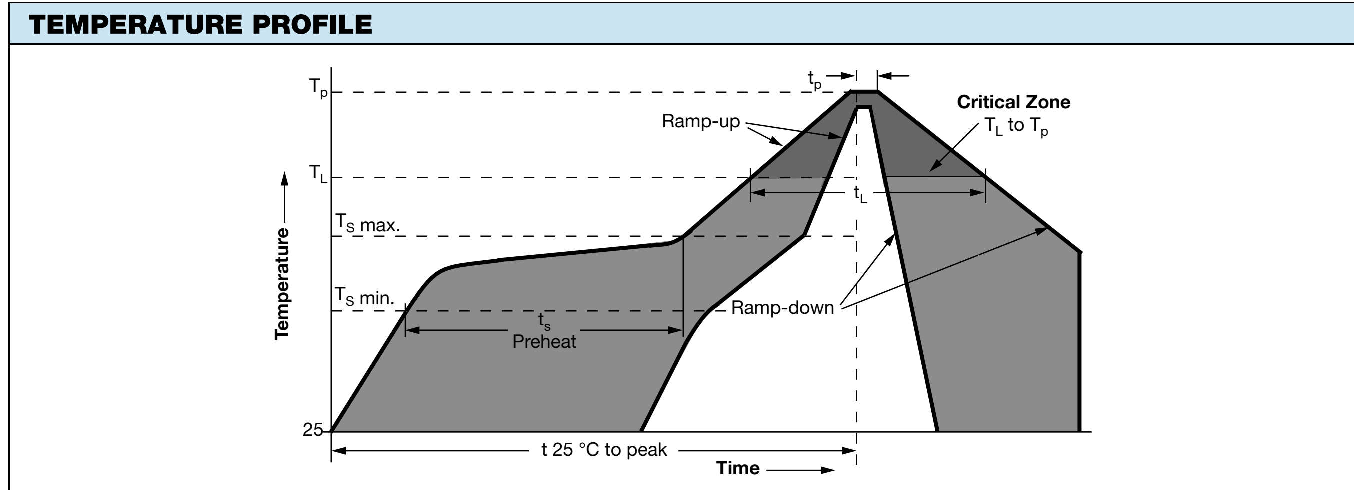
SURFACE MOUNT SOLDERING PROFILE

Solder methods for surface mount are IR, vapor phase and solder wave. IR is the most used at this time and discussion between users and vendors has resulted in recommendations for solder. A "Recommended Temperature Profile" for the IR reflow process is included which reflects the typical current usage.

TEMPERATURE PROFILE



REFLOW PROFILE

PROFILE FEATURE	TIN / LEAD REFLOW PROFILE	LEAD (Pb)-FREE REFLOW PROFILE
Average ramp-up rate ($T_{s\ max.}$ to T_p)	3 °C/s max.	3 °C/s max.
Preheat		
Temperature min. ($T_{s\ min.}$)	100 °C	150 °C
Temperature max. ($T_{s\ max.}$)	150 °C	200 °C
Time ($T_{s\ min.}$ to $T_{s\ max.}$) (t_s)	60 s to 120 s	60 s to 180 s
Time maintained above		
Temperature (T_L)	183 °C	217 °C
Time (t_L)	60 s to 150 s	60 s to 150 s
Minimum peak temperature ($T_{p\ min.}$)	215 °C	235 °C
Recommended peak temperature (T_p)	235 °C	250 °C
Maximum peak temperature ($T_{p\ max.}$)	260 °C	260 °C
Time within 5 °C of recommended peak temperature (t_p)	10 s to 30 s	10 s to 30 s
Ramp-down rate	6 °C/s max.	6 °C/s max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.
As specified in IPC / JEDEC® J-STD-020C		

As a general rule for all methods of soldering:

1. Preheat the components and the board to within +100 °C of the soldering temperature for a minimum of 60 s. This ramping should not exceed 1 $^1/_2$ °C to 3 °C per s.
   a. Reflow soldering temperature should not exceed +250 °C with a maximum time of 20 s.
   b. Wave soldering temperature should not exceed +260 °C with a maximum time of 5 s.
   c. Vapor phase reflow soldering should not exceed +220 °C with a maximum time of 40 s.
2. In all cases, gradual cooling to room temperature is recommended.

When profiling IR ovens, profile each board style with thermocouples embedded under components on the board. Expect the edges of the board to get 20 °C to 30 °C hotter than the board center.

Ultrasonic cleaning should be done with power regulated equipment. Older 25 kHz, unregulated equipment can damage joints and components.

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