

APPLICATION NOTE

AN248 PicoGate Logic Package

1998 October

Philips Semiconductors now offers the smallest single gate 5V logic family available, PicoGate Logic. Consisting of single gate functions packaged in a 5 pin SOT353 package, PicoGate Logic reduces board space requirements 10 times over the conventional 14 pin SO package.

Driven by applications with a very small circuit board mounting area, the PicoGate Logic family offers the most popular logic functions for space-constrained systems such as cellular phones, pagers, and portable consumer products (CD players, VCR's, cameras, hard disks, notebook computers, PC cards, CD ROM's, and Personal Digital Assistants). They can also be used as simple glue/repair logic to implement last minute design changes or to eliminate dependence on intricate line layout patterns and simplify routing.

Philips Semiconductors offers PicoGate Logic in both the HC and HCT technologies. The package used is a major breakthrough in IC packaging concepts, using the same package as leading edge discrete semiconductor components. Space savings can be compared in Figure 1.

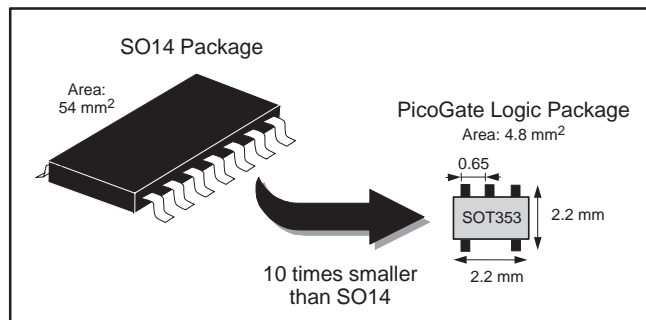


Figure 1. SO14 package comparison to 5-pin SOT353

This publication includes details on package specifications and soldering guidelines to assist you in your board design. Following you will find package dimensions, solder land guidelines, and soldering guidelines.

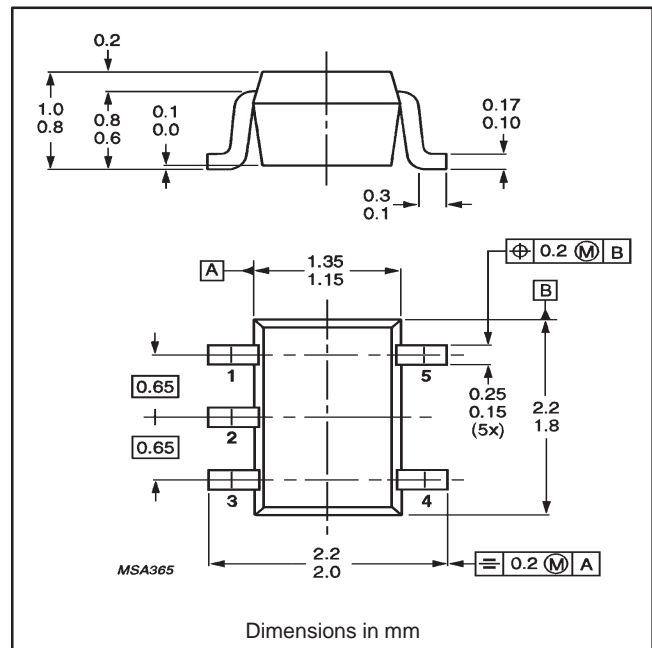


Figure 2. SOT353 package dimensions

Footprint design

The footprint design of a component for surface mounting is influenced by many factors:

- Features of the component, its dimensions, and tolerances
- Circuit board manufacturing processes
- Desired component density
- Minimum spacing between components
- Circuit tracks under the component
- Component orientation (if wave soldering)
- Positional accuracy of solder resist to solder lands
- Positional accuracy of solder paste to solder lands (if reflow soldering)
- Component placement accuracy
- Soldering process parameters
- Solder joint reliability parameters

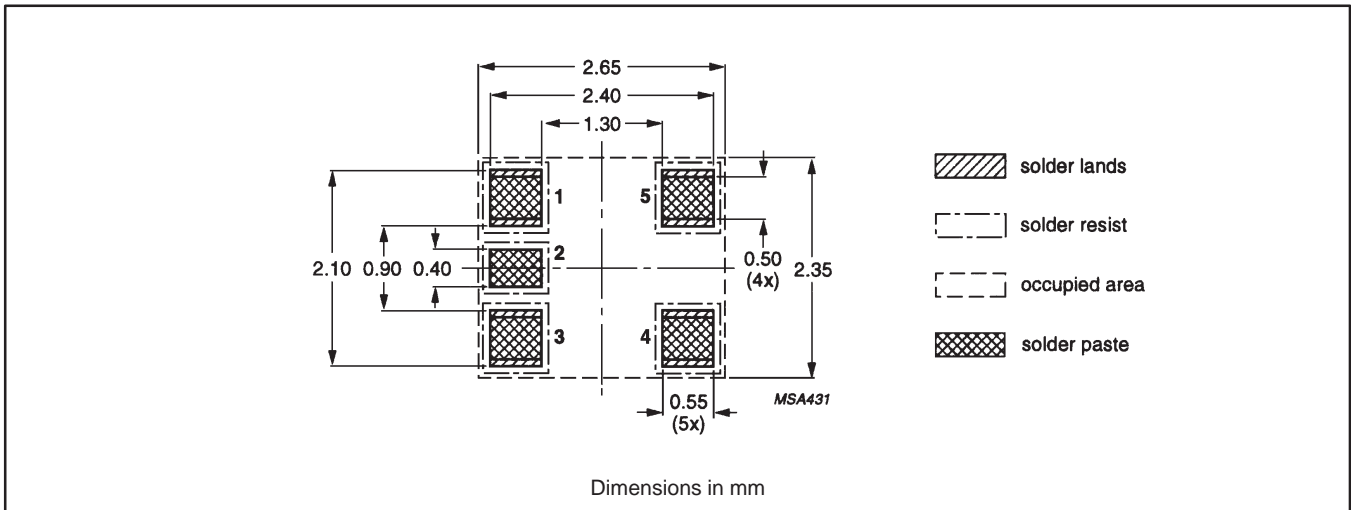


Figure 3. Reflow soldering footprint

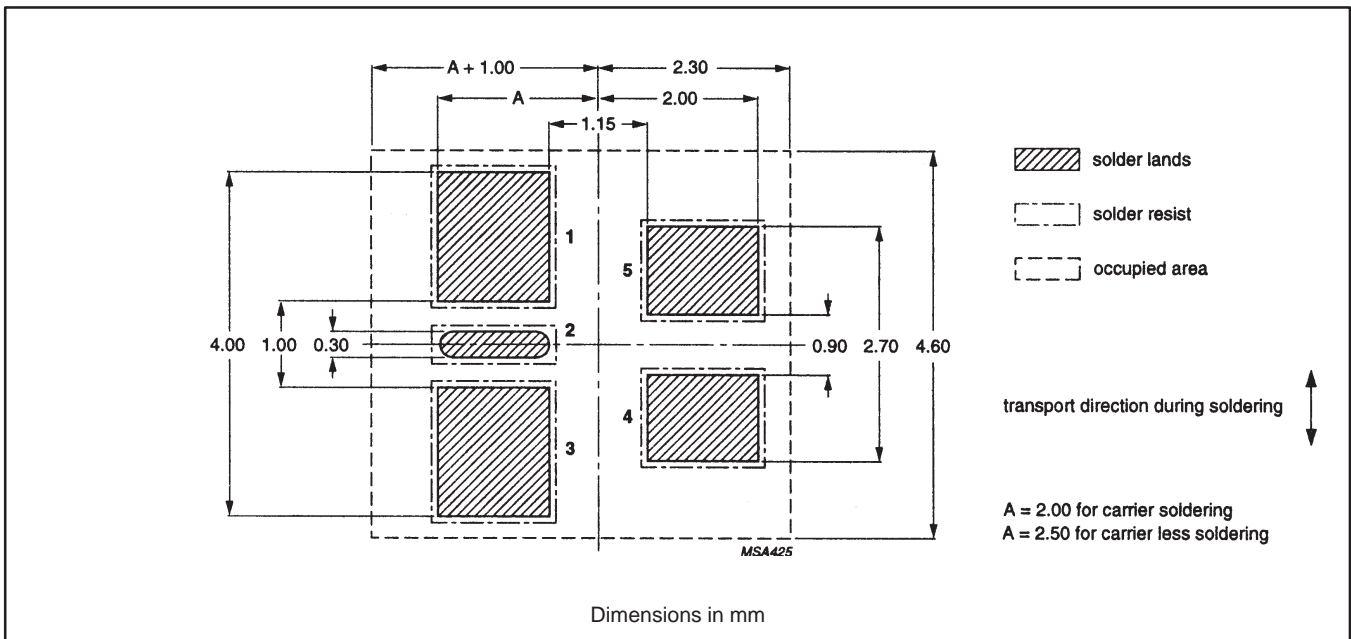


Figure 4. Wave soldering footprint for SOT353

SOLDERING

Reflow soldering

REFLOW TECHNIQUES

Thermal conduction

The prepared substrates are carried on a conveyor belt, first through a preheating stage and then through a soldering stage. Heat is transferred to the substrate by conduction through the belt. Figure 5 shows a theoretical time/temperature relationship for thermal conduction reflow soldering. This method is particularly suited to thick film substrates and is often combined with infrared heating.

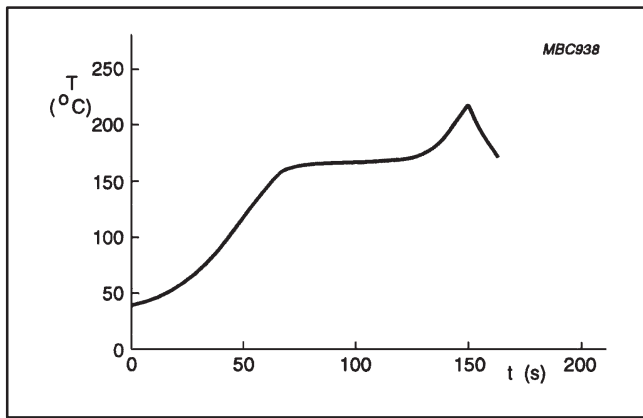


Figure 5. Theoretical time/temperature curve for a typical thermal conductive reflow cycle

Infrared

An infrared oven has several heating elements giving a broad spectrum of infrared radiation, normally above and below a closed loop belt system. There are separate zones for preheating, soldering, and cooling. Dwell time in the soldering zone is kept as short as possible to prevent damage to components and substrate. A typical heating profile is shown in Figure 6. This reflow method is often applied in double-sided prints.

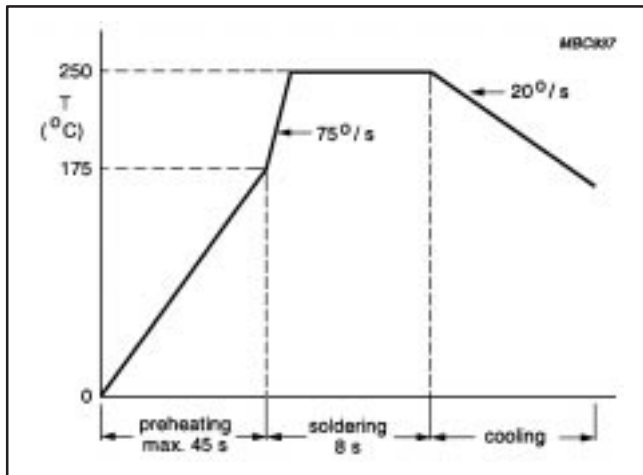


Figure 6. Typical temperature profile of an infrared oven operating at a belt speed of 0.41 mm/min.

Vapor phase

A substrate is immersed in vapors of a suitable boiling liquid. The vapors transfer latent heat of condensation to the substrate and solder reflow takes place. Temperature is controlled precisely by the boiling point of the liquid at a given pressure. Some systems employ two vapor zones, one above the other. An elevator tray, suspended from a hoist mechanism passes the substrate vertically through the first vapor zone into the secondary soldering zone and then hoists it out of the vapor to be cooled. A theoretical time/temperature relationship for this method is shown in Figure 7.

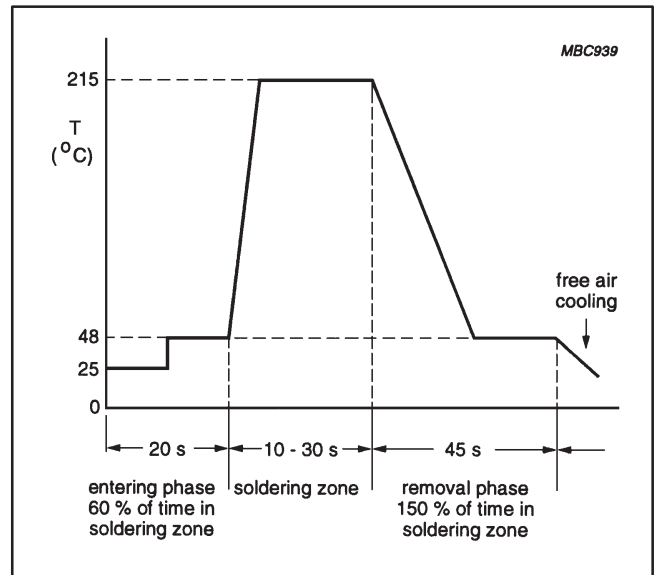


Figure 7. Theoretical time/temperature curve relationship for dual vapor reflow soldering

Wave soldering

Wave soldering is usually the best method to use when high throughput rates are required. The single wave soldering principle (see Figure 8) is the most straightforward method and can be used on simple substrates with two-terminal SMD components. More complex substrates with increased circuit density and closer spacing of conductors can pose the problem of non-wetting (dry joints) and solder bridging. Bridging can occur across the closely spaced leads of multi-leaded devices as well as across adjacent leads on neighboring components. Non-wetting is usually caused by components with plastic bodies. The plastic is not wetted by solder and creates a depression in the solder wave, which is augmented by surface tension. This can cause a shadow behind the component and prevent solder from reaching the joint surfaces. A smooth laminar solder wave is required to avoid bridging and a high pressure wave is needed to completely cover the areas that are difficult to wet. These conflicting demands are difficult to attain in a single wave, but dual wave techniques go a long way in overcoming the problem.

In a dual wave machine (see Figure 9), the substrate first come into contact with a turbulent wave which has a high vertical velocity. This ensures good solder contact with both edges of the components and prevents joints from being missed. The second smooth laminar wave completes the formation of the solder fillet, removes excess solder, and prevents bridging. Figure 10 indicates the time/temperature relationship measured at the soldering site in dual wave soldering.

New methods for wave soldering are developing continually. For example, Omega System is a single wave agitated by pulses, which combines the functions smoothness and turbulence. In another, a lambda wave injects air bubbles in the final part of the wave. A further innovation is the hollow jet wave in which the solder wave flows in the opposite direction to the substrate.

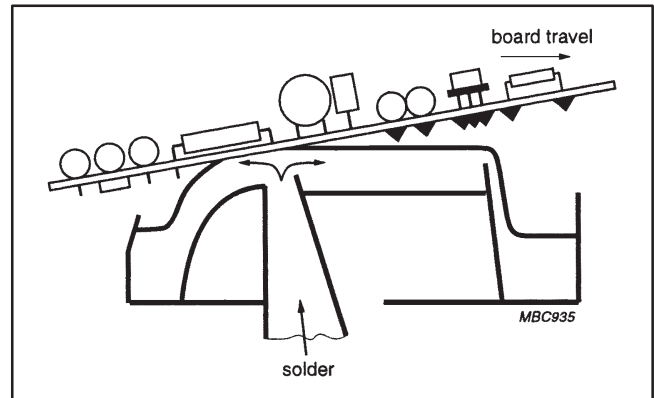


Figure 8. Single wave soldering principle

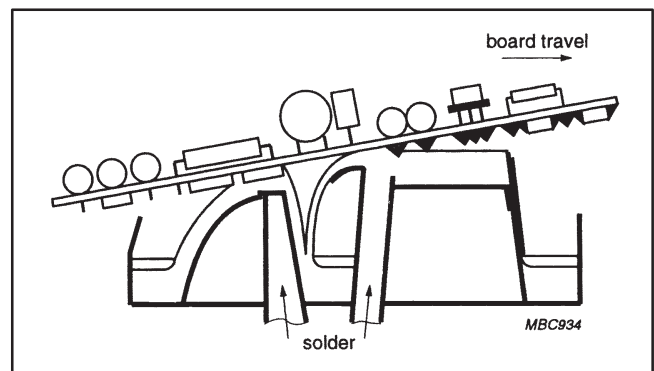


Figure 9. Double wave soldering principle

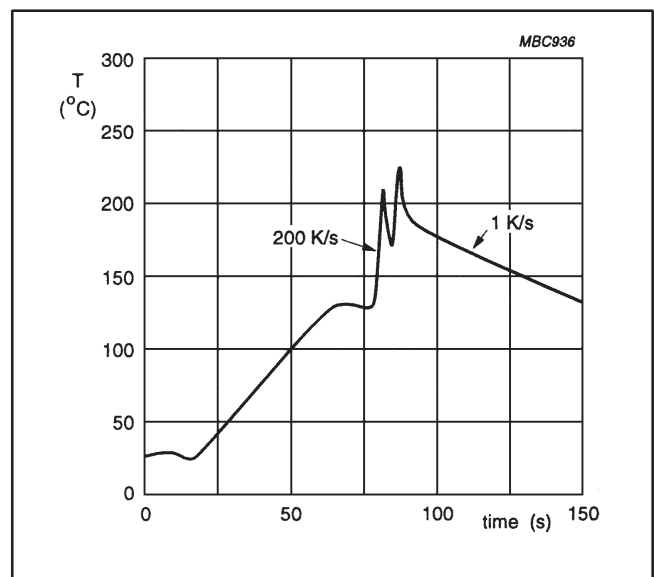


Figure 10. Typical time/temperature curve measured at the soldering site

PicoGate Logic Package

AN248

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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Philips Semiconductors
811 East Arques Avenue
P.O. Box 3409
Sunnyvale, California 94088-3409
Telephone 800-234-7381

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