

## CHAPTER 5

### SMD MOUNTING METHODS

	page
Introduction	5 - 2
Double-wave soldering	5 - 2
Reflow soldering	5 - 4
Replacing a soldered IC	5 - 9
Assessment of soldered joint quality	5 - 9
SMD footprints	5 - 10
BGA, HBGA, LFBGA & TFBGA footprint (reflow soldering)	5 - 12
SO & SOJ footprint (reflow soldering)	5 - 14
SO & SOJ footprint (wave soldering)	5 - 16
HTSSOP footprint (reflow soldering)	5 - 18
SSOP, TSSOP & VSO footprint (reflow soldering)	5 - 20
HTSSOP, SSOP, TSSOP & VSO footprint (wave soldering)	5 - 22
HTQFP, HLQFP footprint (reflow soldering)	5 - 24
LQFP, MSQFP, QFP, SQFP & TQFP footprint (reflow soldering)	5 - 26
HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP footprint (wave soldering)	5 - 28
PLCC footprint (reflow soldering)	5 - 32
PLCC footprint (wave soldering)	5 - 34

## INTRODUCTION

There is no one soldering method ideal for all IC packages. Many manufacturers still use, and will continue to use for some time to come, a mixture of surface-mount and through-hole components and so may prefer the wave soldering method. But for SMD types, which represent the majority of components in production today, reflow soldering may well be the preferred process. Indeed for many of the newer SMD types, such as the ball grid array (BGA) and low profile ball grid array (LFBGA) packages, reflow soldering is the only suitable method. This is because BGA packages have their ball-shaped terminals underneath the package body. These (LF)BGA are a widely used alternative for leaded high pin count devices with fine pitch (< 0.4 mm).

Table 1 gives an overview of which IC packages are suitable for the various soldering methods.

## DOUBLE-WAVE SOLDERING

Although conventional wave soldering can still be used for certain circuits, it is not recommended for soldering SMDs, or PC board with a high component density, as solder bridging and non-wetting can present major problems. The double-wave soldering method, which was specifically developed to overcome such problems, is a much better soldering technique, although even this method is not suitable for ICs with closely-spaced leads.

If wave soldering is used, the following conditions must be observed:

- the PC board footprint must incorporate solder thieves on the downstream end
- the longitudinal axis of the IC must be parallel to the direction of the solder flow.

Suitable PC board footprints for double-wave soldering are given later in this chapter.

**Table 1** Suitability of ICs for various soldering methods

	(LF)BGA	SO	SSOP	VSO	TSSOP	QFP	SQFP	LQFP	TQFP	PLCC
standard		IEC/ JEDEC				IEC/ JEDEC				JEDEC
number of leads	56-776	4-32	14-56	40-56	8-56	44-160	128-304	32-208	44-128	20-84
suitability for wave soldering <sup>(1)</sup>	not suitable	4	2 <sup>(2)</sup>	3	1 <sup>(2)</sup>	2 (at 45°) <sup>(2)</sup>	1 <sup>(2)</sup>	1 <sup>(2)</sup>	1 <sup>(2)</sup>	3
suitability for reflow soldering <sup>(1)</sup>										
Convection/IR	4	4	4	3	3	3	3	3	3	2
hot belt	–	4	4	3	3	3	3	3	3	3
hot gas	1	4	4	4	3	4	4	4	4	3
vapour phase	–	4	2	3	2	2	2	2	2	1
resistance	–	1	1	4	1	4	1	1	1	1
ease of assessing soldered joint quality	difficult	good	good	good	good	good	good	good	good	difficult

## Notes

1. Rating from 1 to 4 (1 indicates that soldering is very difficult; 4 that soldering is straightforward)
2. Wave soldering is not suitable for certain types, refer to footprint data at the end of this chapter for more details.

### Applying adhesive

To prevent movement of the IC packages during wave soldering, it is necessary to bond the IC to the PC board with a high green-strength adhesive (such as thermosetting epoxy resin Heraeus PD944 or Amicon D125F DR for small components, or Heraeus PD945 or Amicon D125F3 DR for large components) and cure it. The adhesive can be applied either by syringe, pin transfer or screen/stencil printing. The preferred method is by syringe since this allows a precisely measured amount of solder to be applied at each position.

Typical curing times for an SMD adhesive are 30 minutes at 85 °C (starting from ambient temperature), or as little as 3 minutes at 125 °C (see Fig.1).

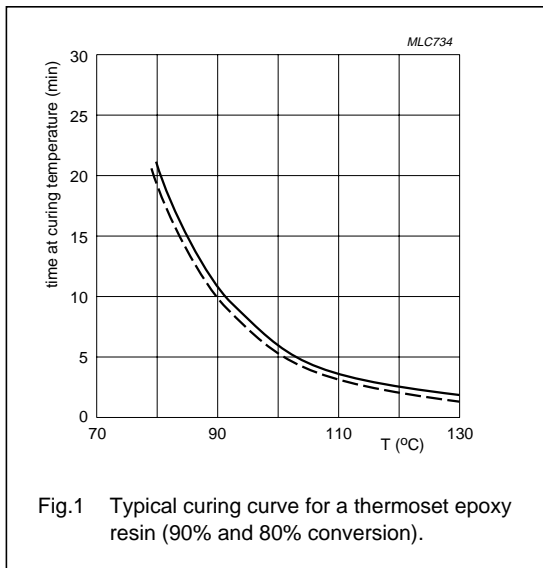


Fig.1 Typical curing curve for a thermoset epoxy resin (90% and 80% conversion).

### Positioning the IC on the PC board

ICs are usually positioned on a PC board by placement machine, however, dimensional tolerances of the IC package and PC board, combined with inaccuracy of the placement machine can lead to component misalignment. Total misalignment is expressed as the sum of deviations in the x, y directions (see Fig.2) and in component rotation with respect to the footprint position  $\phi$ . Small variations in  $\phi$  have large effects on placement accuracy, so the positioning of the leads is crucial for large multi-leaded ICs with a small pitch.

The maximum placement deviations for each IC are given with the footprint design later in this chapter.

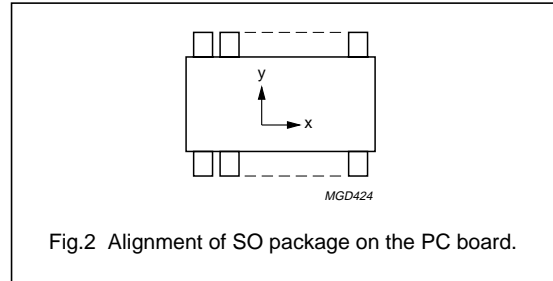


Fig.2 Alignment of SO package on the PC board.

### Double-wave soldering method

After applying adhesive, placing the ICs and curing the adhesive, the areas to be soldered are coated with a thin layer of mildly activated flux, applied by spraying or as a foam. The flux assures good wetting of the soldering surfaces.

The PC board is then preheated to around 85 °C for solvent-based fluxes, or to 115 °C for water-soluble fluxes (temperatures on the solder side of the board). Preheating serves several purposes: it reduces the flux to the required viscosity, it heats the PC board and components to reduce thermal shock and promote faster wetting, and it minimizes the time spent at soldering temperature, which prevents dissolution of component metallization (leaching).

In a double-wave soldering machine, the solder is applied by moving the inclined PC board across two successive waves of solder. It's important to note that the PC board must be loaded into the machine in such a way that the SMDs on the board come into direct contact with the solder wave (see Fig.3).

The PC board first passes over a turbulent wave of solder, which has a high vertical velocity and constant height. This ensures good solder contact with the edges of the IC and prevents joints from being missed. The second, smoother laminar wave of solder completes formation of the solder fillet and reduces bridging. A little activated oil in the second solder wave helps to prevent formation of oxide skins on the surface of the solder, thereby reducing bridging as the PC board leaves the wave. Typically, the double-wave method uses common solder alloys (such as tin 60/lead 40), a soldering temperature of  $250 \pm 3$  °C and dwell times of 0.5 to 1 s in the turbulent wave and 2 to 2.2 s in the smooth wave. To prevent board warping during soldering, the clamping force on its longer sides exerted by the transport system must not exceed 0.5 N/cm.

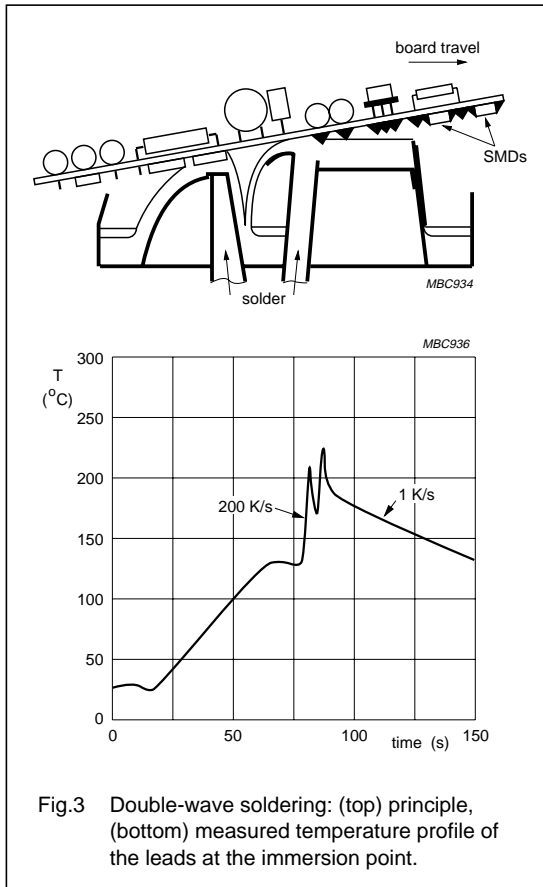


Fig.3 Double-wave soldering: (top) principle, (bottom) measured temperature profile of the leads at the immersion point.

## REFLOW SOLDERING

### The reflow soldering environment

It's recommended that for solder pasting, the equipment is located in a controlled environment maintained at a temperature of  $22 \pm 2\text{ }^{\circ}\text{C}$ , and a relative humidity of  $55 \pm 5\text{--}10\%$ .

### Applying solder paste to the PC board

Reflow soldering uses a paste consisting of small nodules of solder and a flux with binder, solvents and additives to control rheological properties. The paste is applied to the solder lands, and the ICs positioned on the PC board. On heating to a temperature above the melting point of the solder alloy, the mixture reflows to form soldered joints.

Solder paste is applied to the PC board by one of either three methods: screen printing, stenciling or dispensing syringe.

#### SCREEN PRINTING

A fine-mesh screen coated with emulsion, except the areas where paste is required, is placed over the PC board (see Fig.4). A squeegee is then passed across the screen to force solder paste through the areas in the emulsion and onto the solder lands on the PC board. An 80-mesh screen is normally used, and  $0.5$  to  $0.7\text{ mg/mm}^2$  of solder paste should be applied to the solder lands of the PC board.

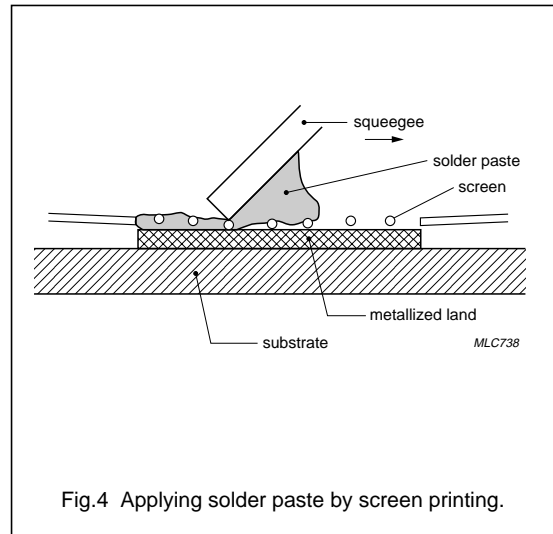


Fig.4 Applying solder paste by screen printing.

## STENCILLING

This is similar to screen printing, except that a metal stencil is used instead of a fine-mesh screen.

The stencil is usually made of stainless steel or bronze and should be 200  $\mu\text{m}$  thick with a step-etched pattern 125  $\mu\text{m}$  thick formed by chemical etching. To ensure that the edges of the openings in the stencil are always positioned within the solder lands, the dimensions of the openings should be about 10% smaller than those of the lands.

The stencil thickness is 150  $\mu\text{m}$  for the application of (LF)BGA packages. The apertures in the stencil are electro-formed or laser cut. For LFBGA packages with a ball pitch of 0.5 mm, a stencil thickness of 100  $\mu\text{m}$  will result in a larger process window.

## DISPENSING SYRINGE

This method uses an air- or mechanically-driven syringe to deposit paste to each solder land (see Fig.5). Although it is comparatively slow, it allows a precisely measured amount of paste to be deposited at each position.

Table 2 shows the amount of paste required per joint for various IC packages.

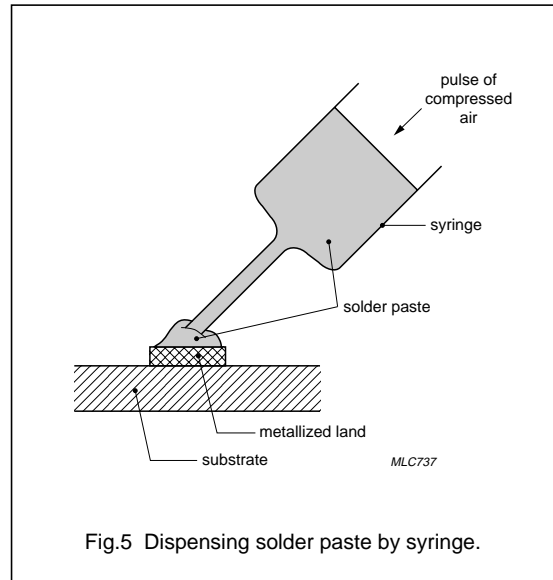


Fig.5 Dispensing solder paste by syringe.

**Table 2** Amount of dispensed paste per solder joint for various IC packages.

PACKAGE	SOLDER PASTE/JOINT (mg)
SO (6.60 mm)	0.5 to 0.7
SO (11.00 mm)	0.75
SSOP	0.25
VSO	0.5
TSSOP	0.25
QFP	0.7 to 1.0
SQFP	0.25
LQFP	0.25
TQFP	0.25
PLCC	1.0

### Positioning the IC on the PC board

Positioning ICs on the PC board is identical in practice as for wave soldering, except it is the tackiness (tack strength) of the solder paste and not an adhesive, that holds the IC in place before soldering. Tack strength depends on factors such as paste composition, drying conditions, placement pressure, dwell time and contact area.

(LF)BGA packages are self-aligning, i.e. during reflow, an (LF)BGA that has not been properly placed will float back to its normal position on the solder land due to surface tension forces. Misaligned components (BGA up to 350  $\mu\text{m}$ ) move to their normal position during reflow.

The placement force is not a critical factor for BGA placement and can range from 2 N to 10 N depending on the type of board support and construction of the placement force control unit.

### Reflow soldering methods

There are several methods available to provide the heat to reflow the solder paste. The main systems used at the present time are: infrared/convection, hot belt, hot gas, vapour phase and resistance soldering.

#### INFRARED/CONVECTION REFLOW

In mass production lines, the reflow process is usually performed in ovens fitted with conveyor belts. Heat transfer is either by heat convection, infrared radiation, or a combination of the two.

Infra ovens usually have different types of heating element, operating in the mid- to far-IR regions, normally above and below the moving belt. There are three zones: for preheating, soldering and cooling, and total throughput time is about 100 to 200 s (see Fig.6). The main limitation of IR reflow is that the components and materials used in the construction of the PC board absorb, transmit and reflect IR radiation at different rates. For example, IC leads are good IR reflectors, whereas the black IC packages make excellent IR absorbers. This results in an uneven temperature profile across the board. However, extending the exposure time can reduce this effect.

A variation on the infrared oven is the combined IR/convection oven. These ovens generally produce a lower temperature difference than IR ovens, which results in a more uniform heat distribution between board and components. In an IR/convection oven, the components' peak temperature can be 20  $^{\circ}\text{C}$  lower than in an infrared only oven.

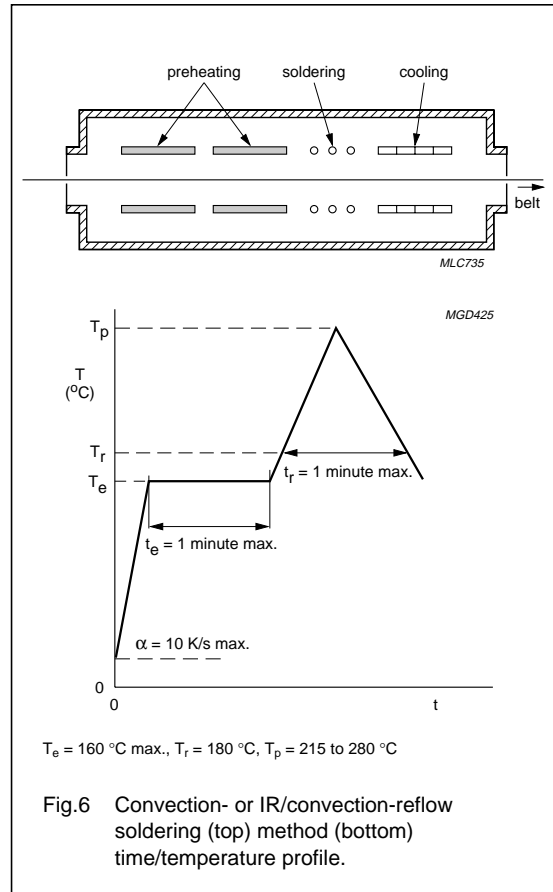


Fig.6 Convection- or IR/convection-reflow soldering (top) method (bottom) time/temperature profile.

The components and the solder paste are heated as quickly as possible to a temperature just above the solder's melting point. After a short time, the assembly is cooled rapidly; the molten solder solidifies, and the soldered joints are formed. This process can be complex in cases where a mix of small and large SMDs on the same PC board are reflow soldered. When the solder paste for the small components starts to melt, the temperature near the larger components is still far below melting point. By the time the paste for the larger components starts melting, the temperature of the small components may already have reached damaging levels. To prevent such large temperature differences, it is advisable to use a temperature profile as shown in Fig.6, and an oven with forced heat convection, which solves the problem of uneven temperatures between the substrate, and small and large SMDs.

To guarantee good soldering at the lead tips/solder joints, the peak temperature ( $T_p$ ) in the final heating zone should be at least 215 °C. This temperature, however, must not exceed the maximum temperature for glass epoxy boards which is 265 °C for double-sided reflow soldering or 280 °C for single-sided reflow soldering. Furthermore, the top-surface temperature of the packages should preferably be kept below 220 °C for thick/large packages, and below 235 °C for small/thin packages.

Many plastic SMDs are sensitive to moisture and can be damaged if stored incorrectly then soldered. If sufficient moisture is present in the plastic package during soldering, it can turn into steam, expand rapidly and, in the more severe cases, result in internal or external package cracks (the popcorn effect). To help prevent this, we assign a Moisture Sensitivity Level (MSL) to each plastic SMD package type. Packages that are sensitive to moisture are stored and shipped in a specialized sealed dry packing and provided with advice on the time allowed between unpacking the devices and soldering.

For more information on moisture sensitive devices and their packing/storage requirements, refer to *Chapter 7: IC packing methods*.

#### HOT BELT SOLDERING

With hot belt (or thermal conduction) soldering, the assembled PC boards are heated from below through a thin Teflon/fibreglass transfer belt, which is in contact with temperature-controlled hot plates. Boards lying on the moving belt pass over three or more hot plates for preheating, soldering and cooling. Overhead infrared lamps can also be used to supply additional heat during the soldering stage to ensure a more even distribution of heat. Belt speed depends on the substrate used, but is typically 25 cm/min for a 1.6 mm glass-epoxy board, and 120 cm/min for a 0.6 mm ceramic substrate.

#### HOT GAS SOLDERING

With this method, a small gun with a nozzle diameter of about 2.5 mm, issues air, nitrogen or other suitable gas at a temperature of around 400 °C and a flow rate of 1.5 litres/min. The jet should be continually move along the package leads to avoid overheating the PC board. To limit thermal stresses in the ICs, the temperature of the package should be kept below 250 °C. Ceramic substrates should be preheated to around 150 °C and the gas jet directed to each IC lead in turn.

Although this method is slow, it is useful in small production runs, in laboratory applications, for de-soldering individual ICs and for rework/repair.

## VAPOUR PHASE REFLOW

In vapour phase reflow, vapour from a suitable boiling liquid transfers latent heat of condensation to the substrate. Provided the liquid boils at a temperature higher than the melting point of the solder, the paste will reflow. Normally, a liquid that boils around 215 °C is used. The boiling liquid provides precise temperature control, a fast heating rate, uniform heating over the whole substrate, and an inert atmosphere. Vapour phase reflow uses an in-line or batch system. With an in-line system (see Fig.7) the belt travels at around 1 m/min, has a throughput time of 200 s and a dwell time in the hot vapour of about 30 s.

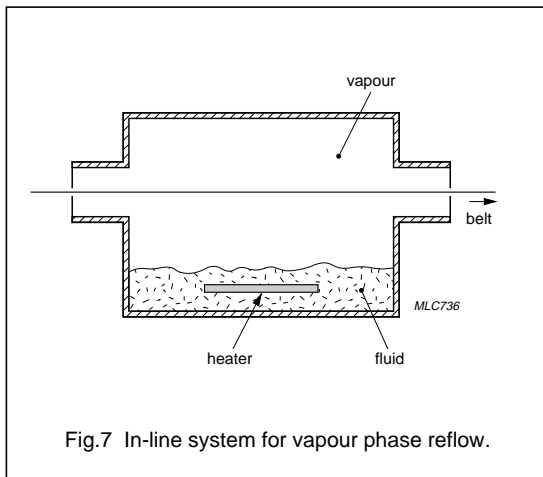


Fig.7 In-line system for vapour phase reflow.

A batch of assembled substrates is lowered into the vapour for 20 to 40 s, and then cooled by raising it into the upper vapour for 30 to 50 s. Duration depends on the batch size. Flux residues that build up in the system are removed by filtering, either continually or at the end of each day. Acid, which is a decomposition product of the secondary fluid, is removed by passing the condensate through a scrubber.

Since leads heat more quickly than the substrate, solder tends to flow onto the lands and not onto the joint (the wick effect). So if the gap between lead and solder land is more than 100  $\mu\text{m}$  the soldered joint may be incomplete, or it may not form at all. Because the temperature difference between leads and substrate is less in IR/convection heating than it is in vapour-phase heating, the gap between leads and solder can be larger (150  $\mu\text{m}$ ).

In the past, CFC liquids were used in this process. However, such chemicals are now banned because of their harmful effect on the environment. New Cl-free liquids have been developed for vapour phase reflow, which are readily available

## RESISTANCE SOLDERING

Resistance soldering uses a heated element in contact with the joint to reflow the solder. However, solder paste should not be used with this method as the solder tends to spatter during rapid heating. Instead, an extra thick layer (15 to 30  $\mu\text{m}$ ) of tin/lead solder is plated directly on to the leads.

As each IC package type and size requires its own heating element, this method is slow and will probably be restricted to development work. Soldering ICs, such as SOs and PLCCs, is also very difficult as they have leads that are too short and stiff to bend and fit the tool. However, it is an excellent tool for de-soldering and soldering QFPs, VSOs and other IC with long, flexible gull-wing leads.



## REPLACING A SOLDERED IC

### De-soldering the IC

ICs can be removed from a PC board by heating the IC leads with a heating element (see "Resistance soldering") or by heating the leads on both sides of the package with a hot air gun with a small orifice nozzle (see "Hot gas soldering"). The IC can then be removed with a pair of tweezers. However, care must be taken not to damage the solder lands or any other components on the PC board.

An important factor for the successful removal of (LF)BGA components from a board is the uniform heating of the board. If the board is heated only locally, the board will warp. On the top-side, only the component must be heated. When all the solder joints are molten, the component can be removed with (in most systems) a vacuum nozzle. Excessive solder should be removed with a solder sucker or wick. Remaining flux can be removed by brushing with a cleaning agent.

### Applying solder paste to the PC board

Before replacing the IC, a dispenser is used to place a small dot (see Table 2) of a suitable solder paste on each solder land. The application of new solder paste for (LF)BGA packages is probably not necessary. In such cases, only a required amount flux should be applied with a brush or spray.

### Positioning the new IC

The new IC can now be placed manually on the PC board. See the relevant footprint diagram for the placement accuracy of the IC.

A touchdown force of 30 N (except (LF)BGA components) distributed over the total surface area of the IC is sufficient to ensure that all its leads contact the solder lands.

For (LF)BGA components, the placement force must not exceed 10 N.

### Soldering the new IC

The solder paste can be reflowed by either a resistance element or by hot air (see "Resistance soldering" and "Hot gas soldering").

For (LF)BGA components, hot gas (air or nitrogen), IR, or laser heating can be applied (the latter system is relatively expensive).

## ASSESSMENT OF SOLDERED JOINT QUALITY

The quality of a soldered joint is assessed by inspecting the shape and appearance of the joint. This inspection is normally done with either a low-powered magnifier or microscope, however where ultra-high reliability is required, video, X-ray or laser inspection equipment should be considered.

Both sides of the PC board should be carefully examined: there should be no misaligned, missing or damaged components, soldered joints should be clean and have a similar appearance, there should be no solder bridging or residue, the length of through-hole component terminations must be within prescribed limits, and the PC board should be assessed for general cleanliness.

Unlike leaded component joints where the lead also provides added mechanical strength, the SMD relies on the quality of the soldering for both electrical and mechanical integrity. It is therefore necessary that the inspector is trained to make a visual assessment with regard to long-term reliability. Criteria used to assess the quality of an SMD solder joint include:

- correct positioning of the IC on the solder lands
- good wetting of the surfaces
- correct amount of solder
- a sound, smooth joint surface.

**Positioning** - if a lead projects over its solder land too far, an unreliable joint is obtained, which is obviously not acceptable. A projection of less than half the width of the lead can be acceptable depending on factors such as the electrical insulation distance that needs to be maintained (typically 0.2 mm for low-voltage applications). Shifting in the longitudinal direction is not a problem, provided the whole foot of the lead and the meniscus (the curved surface of the solder caused by surface tension) in the heel is on the solder land.

**Good wetting** - this produces an even flow of solder over the surface land and component lead, and thinning towards the edges of the joint. The metallic interaction that takes place during soldering should give a smooth, unbroken, adherent layer of solder on the joint.

**Correct amount of solder** - a good soldered joint should have neither too much nor too little solder: there should be enough solder to ensure electrical and mechanical integrity, but not so much that it causes solder bridging.

**Sound, smooth joint surface** - the surface of the solder should be smooth, shiny and continuous. Small irregularities on the solder surface are acceptable, but cracks are unacceptable.

**All packages (excluding PLCC and (LF)BGA)**

An optimum joint should have the wedge-shape space between the underside of the lead and the solder land filled with solder, with a meniscus height equal to the thickness of the lead (Fig.8). The acceptable minimum is a meniscus height at least half the lead thickness. The sides of the lead should be wetted, and although it is not necessary for the cut end of the foot to be wetted, a meniscus is usually present.

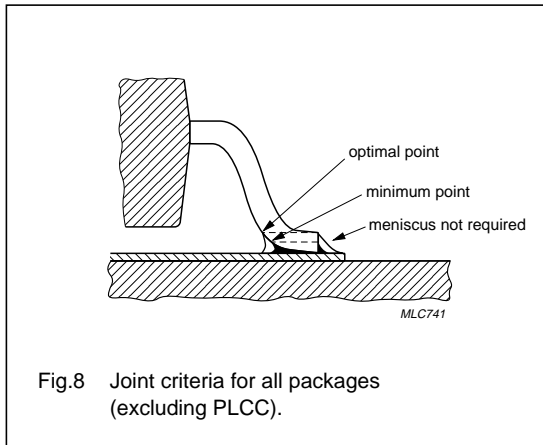


Fig.8 Joint criteria for all packages (excluding PLCC).

**PLCC packages**

In an ideal joint, the sides of the lead should be wetted and the area between the outside bend and solder land should be filled with solder to a height equal to the thickness of the lead (Fig.8). A meniscus extending to half the lead thickness is the acceptable minimum.

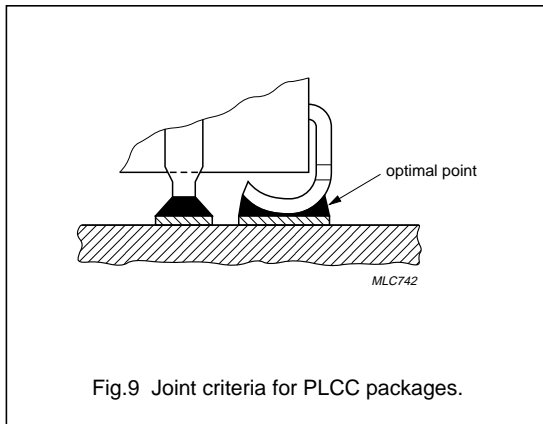


Fig.9 Joint criteria for PLCC packages.

**(LF)BGA packages**

An optimum (LF)BGA joint is void-free and has a spherical shape between the solder land on the component and the solder land on the board. Experimentation has shown that solder joints between copper-defined solder lands are more reliable than solder joints between solder resist-defined solder lands, on both the component and board (for symmetrical solder joints).

For more information on (LF)BGA packages, ask for a copy of our (LF)BGA Application Note.

**SMD FOOTPRINTS**

A footprint pattern can be represented as a set of nominal coordinates and dimensions. The actual values are distributed around the nominal values owing to positional and processing tolerances, dimensional tolerances, and placement machine tolerances.

Calculation of these patterns, using simple worst-case parameters, is impractical. A better approach is to apply statistical analysis.

The figures on the following pages show footprints for most of our IC packages. There are also details on some figures that are specific to wave soldering such as the indicated transport direction of the PC board and the location of solder thieves. The use of solder thieves (areas of metallization in addition to, or attached to, the downstream pair of solder lands of the IC footprint) is recommended for wave soldering as they reduce the likelihood of solder bridging on these lands.

Optimum solder flow during wave soldering is obtained when SO, VSO, SSOP and TSSOP packages are mounted lengthwise (central axis parallel to the direction of travel over the wave, as shown in Fig.10). If board space is limited, mounting SO packages transversely (central axis at 90° to the direction of travel over the wave) is possible, see Fig.11. However, we do not recommend this mounting method for packages with lead pitches below 1.0 mm, and is unsuitable for packages with lead pitches of 0.5 mm or less. QFP, SQFP, LQFP and TQFP packages can only be soldered if placed at a 45° angle to the solder wave direction.

ICs have no orientation preference for reflow soldering.

Although the ideal would be to locate an IC exactly in its correct position on the solder lands, in practice some tolerance is allowed. This tolerance is usually expressed as the placement accuracy, that is, the deviation of a component lead from its nominal position on the solder lands.

The maximum placement deviations for each IC are given with the relevant footprint design.

All footprint dimensions are based on our experience with both development and production boards, and are reproduced for guidance only.

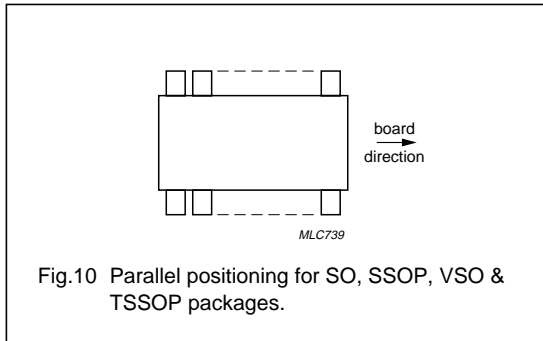


Fig.10 Parallel positioning for SO, SSOP, VSO & TSSOP packages.

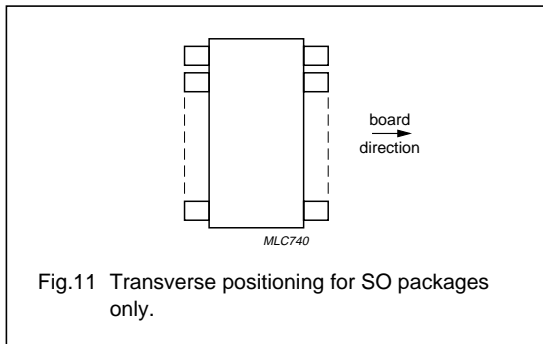


Fig.11 Transverse positioning for SO packages only.

### Solder resist patterns

The footprint diagrams on the following pages also include recommended solder resist patterns for each package type. Solder resist serves two functions: it prevents solder flowing away from the solder lands during soldering, thus reducing the possibility of short circuits, and it increases the insulation resistance between adjacent circuit details. As such, solder lands must be completely free of solder resist while tracks must be fully covered.

The dimensions of the solder resist cut-outs depend on the print technique used to produce the circuit board. If the photo-defined technique is used, the solder resist pattern must be at least 0.15 mm larger than the relevant solder land and have a minimum width of 0.2 mm. If the screen-print technique is used, the solder resist pattern must be at least 0.4 mm larger than the relevant solder land and have a minimum width of 0.3 mm.

Although the dimensions of the solder resist patterns are not given in the footprint diagrams on the following pages, they can be calculated from these guidelines.

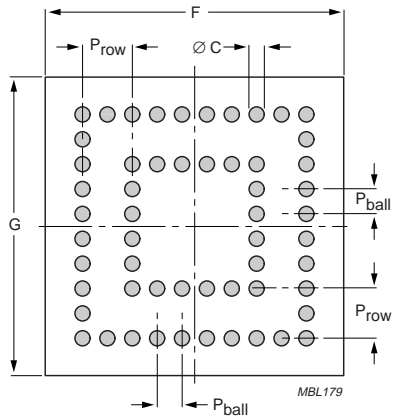


Fig.12 PC board footprint for mounting BGA, HBGA, LFBGA & TFBGA packages (reflow soldering).

BGA, HBGA, LFBGA & TFBGA FOOTPRINT (REFLOW SOLDERING)

Reflow soldering<sup>(1)</sup>

PACKAGE NAME	PHILIPS OUTLINE CODE	FOOTPRINT DIMENSIONS (mm)						PLACEMENT ACCURACY
		P <sub>ball</sub>	P <sub>row</sub>	P <sub>ball dia</sub>	C	F	G	
BGA15 6	SOT472-1	1.00	1.00	0.50	0.45	15.30	15.30	±0.10
BGA256	SOT466-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
BGA256	SOT471-1	1.27	1.27	0.50	0.60	27.30	27.30	±0.10
BGA292	SOT489-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
BGA316	SOT531-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
BGA388	SOT532-1	1.27	1.27	0.75	0.60	35.50	35.50	±0.10
BGA492	SOT514-1	1.27	1.27	0.75	0.60	35.40	35.40	±0.10
HBGA292	SOT553-1	1.27	1.27	0.75	0.60	27.30	27.30	±0.10
LFBGA40	SOT515-1	0.50	1.00	0.30	0.255	5.20	5.20	±0.10
LFBGA48	SOT488-1	0.50	1.00	0.30	0.255	5.75	5.75	±0.10
LFBGA56	SOT516-1	0.50	1.00	0.30	0.255	6.20	6.20	±0.10
LFBGA64	SOT534-1	0.80	0.80	0.46	0.425	8.30	8.30	±0.10
LFBGA84	SOT518-1	0.50	1.00	0.30	0.255	7.20	7.20	±0.10
LFBGA96	SOT536-1	0.80	0.80	0.46	0.425	5.80	13.80	±0.10
LFBGA114	SOT537-1	0.80	0.80	0.46	0.425	5.80	16.30	±0.10
LFBGA144	SOT512-1	0.80	0.80	0.40	0.425	10.30	10.30	±0.10
TFBGA56	SOT542-1	0.50	1.00	0.32	0.275	6.20	6.20	±0.10
TFBGA64	SOT543-1	0.50	0.50	0.32	0.275	6.20	6.20	±0.10

**Note**

1. The BGA family of packages are not suitable for wave soldering.

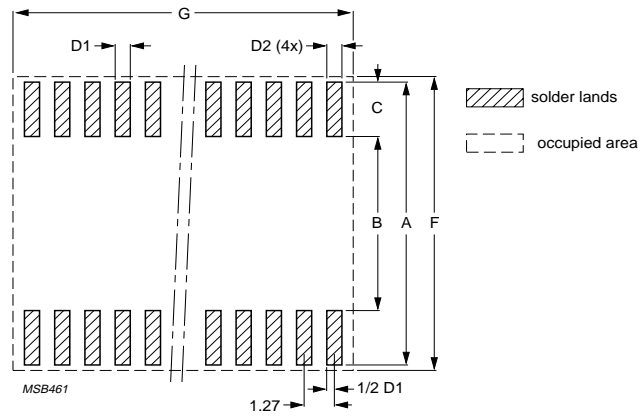


Fig.13 PC board footprint for mounting SO & SOJ packages (reflow soldering).

SO & SOJ FOOTPRINT (REFLOW SOLDERING)

## Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)							PLACEMENT ACCURACY
			A	B	C	D1	D2	F	G	
SO4	SOT223-1	4	For footprint and dimensions, refer to Data Handbook SC18.							
SO8	SOT96-1	8	6.60	4.00	1.30	0.60	0.60	7.00	5.50	±0.25
SO8	SOT176-1	8	11.00	8.00	1.50	0.60	0.60	11.40	8.40	±0.25
SO14	SOT108-1	14	6.60	4.00	1.30	0.60	0.60	7.00	9.30	±0.25
SO16	SOT109-1	16	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25
SO16	SOT109-2	16	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25
SO16	SOT109-3	16	6.60	4.00	1.30	0.60	0.60	7.00	10.50	±0.25
SO16	SOT162-1	16	11.00	8.00	1.50	0.60	0.60	11.40	10.90	±0.25
SO20	SOT163-1	20	11.00	8.00	1.50	0.60	0.60	11.40	13.40	±0.25
SO24	SOT137-1	24	11.00	8.00	1.50	0.60	0.60	11.40	16.00	±0.25
SO28	SOT136-1	28	11.00	8.00	1.50	0.60	0.60	11.40	18.50	±0.25
SO32	SOT287-1	32	11.00	8.00	1.50	0.60	0.60	11.40	21.20	±0.25
SOJ40	SOT449-1	40	12.10	7.30	2.40	0.70	0.85	12.35	26.50	±0.25

SO & SOJ FOOTPRINT (WAVE SOLDERING)

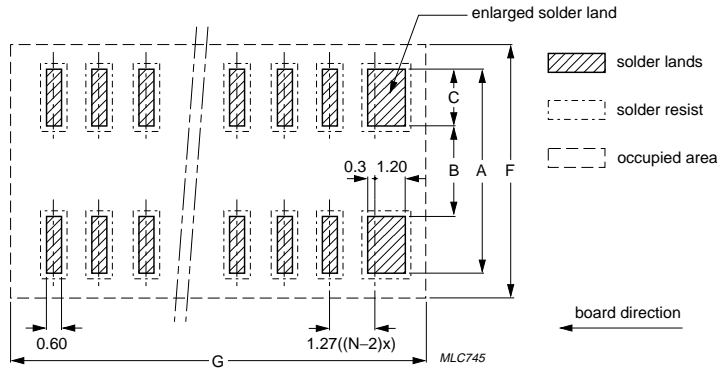


Fig.14 PC board footprint for mounting SO & SOJ packages (wave soldering).



## Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)					PLACEMENT ACCURACY
			A	B	C	F	G	
SO4	SOT223-1	4	For footprint and dimensions, refer to Data Handbook SC18.					
SO8	SOT96-1	8	6.60	4.00	1.30	7.00	5.50	±0.25
SO8	SOT176-1	8	11.00	8.00	1.50	11.40	8.40	±0.25
SO14	SOT108-1	14	6.60	4.00	1.30	7.00	9.30	±0.25
SO16	SOT109-1	16	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT109-2	16	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT109-3	16	6.60	4.00	1.30	7.00	10.50	±0.25
SO16	SOT162-1	16	11.00	8.00	1.50	11.40	10.90	±0.25
SO20	SOT163-1	20	11.00	8.00	1.50	11.40	13.40	±0.25
SO24	SOT137-1	24	11.00	8.00	1.50	11.40	16.00	±0.25
SO28	SOT136-1	28	11.00	8.00	1.50	11.40	18.50	±0.25
SO32	SOT287-1	32	11.00	8.00	1.50	11.40	21.20	±0.25
SOJ40	SOT449-1	40	Not suitable for wave soldering.					

HTSSOP FOOTPRINT (REFLOW SOLDERING)

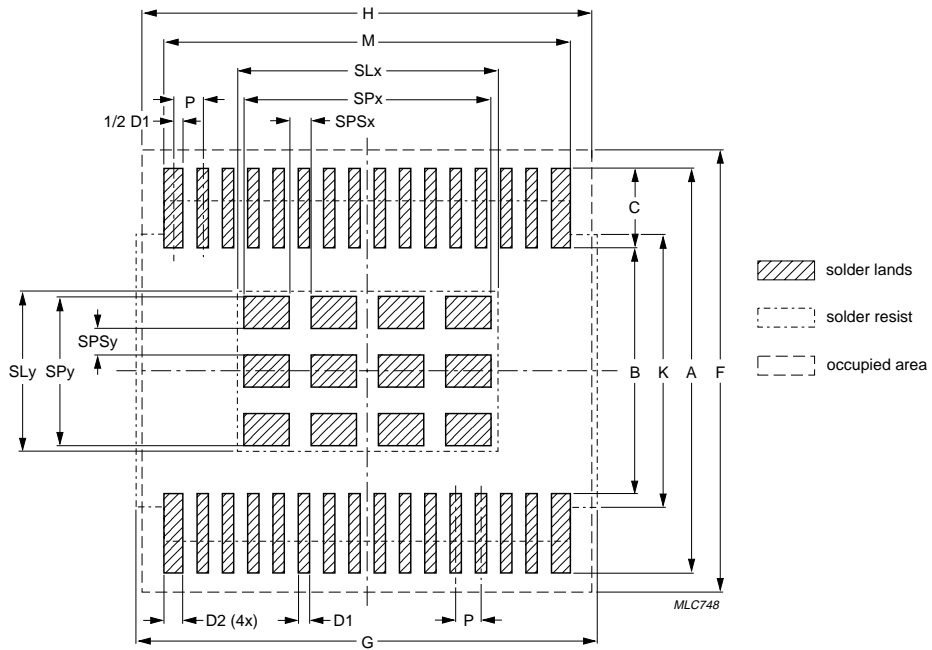


Fig.15 PC board footprint for mounting HTSSOP packages (reflow soldering).

## Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)										PLACEMENT ACCURACY	
			P	A	B	C	D1	D2	F	G	H	K		M
HTSSOP20 <sup>(1)</sup>	SOT527-1	20	0.65	6.80	4.40	1.20	0.40	0.40	7.05	6.75	6.75	7.05	6.25	±0.15
HTSSOP32 <sup>(1)</sup>	SOT549-1	32	0.65	8.50	6.10	1.20	0.40	0.50	8.75	11.25	10.446	6.40	10.15	±0.15

## Note

1. These packages have a heatsink soldered to the board. The dimensions of these solder lands are given in the following table.

PACKAGE NAME	PHILIPS OUTLINE CODE	SOLDER LAND DIMENSIONS (mm)					
		SLx	SLy	SPx	SPy	SPSx	SPSy
HTSSOP20	SOT527-1	4.20	3.00	4.10	2.90	0.30	0.30
HTSSOP32	SOT549-1	5.20	3.80	5.10	3.70	0.30	0.65

SSOP, TSSOP & VSO FOOTPRINT (REFLOW SOLDERING)

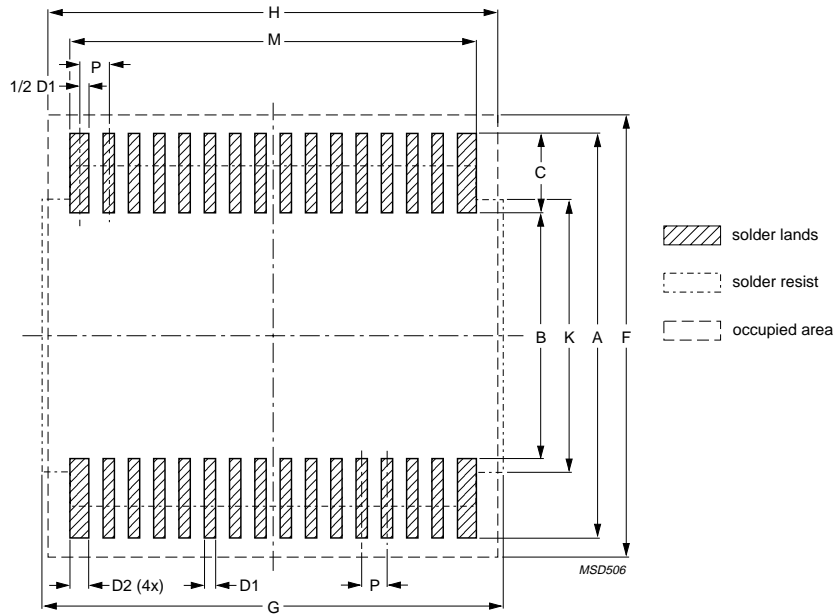


Fig.16 PC board footprint for mounting SSOP, TSSOP & VSO packages (reflow soldering).

## Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)											PLACEMENT ACCURACY
			P	A	B	C	D1	D2	F	G	H	K	M	
SSOP14	SOT337-1	14	0.65	8.10	5.70	1.20	0.40	0.40	8.35	6.50	4.55	5.55	4.30	±0.15
SSOP16	SOT338-1	16	0.65	8.10	5.70	1.20	0.40	0.40	8.35	6.50	5.20	5.55	4.95	±0.15
SSOP16	SOT369-1	16	0.65	6.80	4.80	1.00	0.40	0.40	7.05	5.55	5.55	7.05	4.95	±0.15
SSOP16	SOT519-1	16	0.635	6.40	4.00	1.20	0.40	0.40	6.65	5.151	5.151	6.65	4.845	±0.15
SSOP20	SOT266-1	20	0.65	6.80	4.80	1.00	0.40	0.40	6.65	6.85	6.85	7.05	6.25	±0.15
SSOP20	SOT339-1	20	0.65	8.10	5.90	1.10	0.40	0.40	8.35	7.50	6.50	5.55	6.25	±0.15
SSOP24	SOT340-1	24	0.65	8.10	5.90	1.10	0.40	0.40	8.35	8.50	7.80	5.55	7.55	±0.15
SSOP24	SOT556-1	24	0.635	6.40	4.00	1.20	0.40	0.40	6.65	8.95	7.70	6.65	7.385	±0.15
SSOP28	SOT341-1	28	0.65	8.10	5.90	1.10	0.40	0.40	8.35	10.50	9.10	5.60	8.85	±0.15
SSOP48	SOT370-1	48	0.635	10.60	8.20	1.20	0.40	0.40	10.85	16.15	15.255	7.80	15.005	±0.15
SSOP56	SOT371-1	56	0.635	10.60	8.20	1.20	0.40	0.40	10.85	18.70	17.795	7.80	17.545	±0.15
TSSOP8	SOT505-1	8	0.65	5.40	3.20	1.10	0.40	0.50	6.00	3.60	3.15	3.70	2.55	±0.15
TSSOP10	SOT552-1	10	0.50	5.40	3.20	1.10	0.25	0.40	6.00	3.70	3.15	3.90	2.50	±0.15
TSSOP14	SOT402-1	14	0.65	6.80	4.60	1.10	0.40	0.40	7.05	5.25	4.55	4.65	4.30	±0.15
TSSOP16	SOT403-1	16	0.65	6.80	4.60	1.10	0.40	0.40	7.05	5.25	5.25	7.05	4.95	±0.15
TSSOP20	SOT360-1	20	0.65	6.80	4.60	1.10	0.40	0.40	7.05	6.75	6.75	7.05	6.25	±0.15
TSSOP24	SOT355-1	24	0.65	6.80	4.60	1.10	0.40	0.40	7.05	8.05	8.05	7.05	7.55	±0.15
TSSOP28	SOT361-1	28	0.65	6.80	4.60	1.10	0.40	0.40	7.05	9.95	9.10	4.70	8.85	±0.15
TSSOP32	SOT487-1	32	0.65	8.50	6.10	1.20	0.40	0.40	8.75	11.25	10.446	6.40	10.15	±0.10
TSSOP38	SOT510-1	38	0.50	6.80	4.60	1.10	0.285	0.285	7.05	9.90	9.90	7.05	9.29	±0.10
TSSOP48	SOT362-1	48	0.50	8.50	6.50	1.00	0.285	0.285	9.75	13.035	13.035	9.75	11.785	±0.10
TSSOP56	SOT364-1	56	0.50	8.50	6.50	1.00	0.285	0.285	9.75	15.035	15.035	9.75	13.785	±0.10
VSO40	SOT158-1	40	0.762	12.60	8.20	2.20	0.40	0.40	13.00	16.20	–	–	–	±0.10
VSO40	SOT158-2	40	0.762	12.60	8.20	2.20	0.40	0.40	13.00	16.20	–	–	–	±0.10
VSO56	SOT190-1	56	0.75	16.10	11.90	2.10	0.40	0.40	16.50	22.20	–	–	–	±0.10
VSO56	SOT190-2	56	0.75	16.10	11.90	2.10	0.40	0.40	16.50	22.20	–	–	–	±0.10

HTSSOP, SSOP, TSSOP & VSO FOOTPRINT (WAVE SOLDERING)

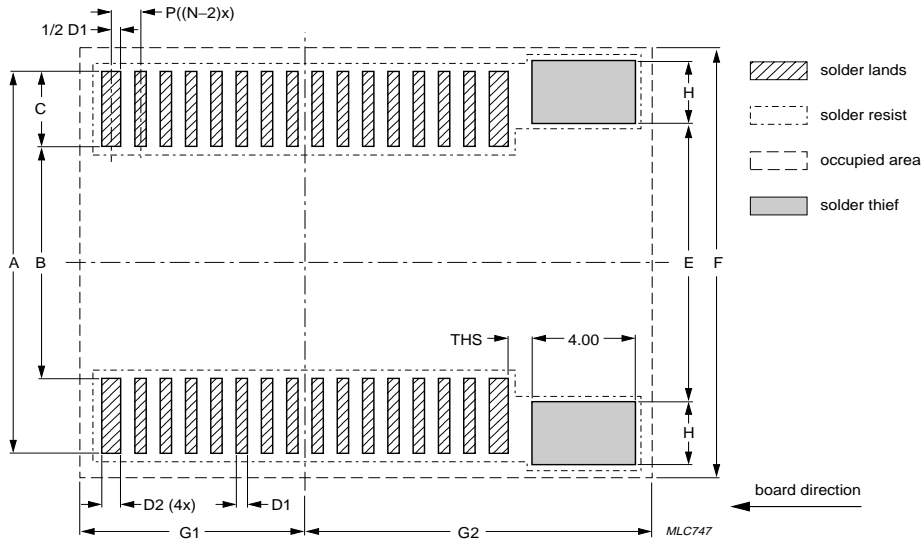


Fig.17 PC board footprint for mounting HTSSOP, SSOP, TSSOP & VSO packages (wave soldering).

## Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	N	FOOTPRINT DIMENSIONS (mm)											THS	PLACEMENT ACCURACY
			P	A	B	C	D1	D2	E	F	G1	G2	H		
HTSSOP20	SOT527-1	Not suitable for wave soldering.													
HTSSOP32	SOT549-1	Not suitable for wave soldering.													
SSOP14	SOT337-1	14	0.65	9.15	5.35	1.90	0.30	0.30	6.15	10.65	4.25	6.75	2.00	0.40	±0.10
SSOP16	SOT338-1	16	0.65	9.15	5.35	1.90	0.30	0.30	6.15	10.65	4.25	7.075	2.00	0.40	±0.10
SSOP16	SOT369-1	16	0.65	8.30	4.50	1.90	0.30	0.30	5.30	9.80	3.55	7.075	2.00	0.40	±0.15
SSOP16	SOT519-1	Not suitable for wave soldering.													
SSOP20	SOT266-1	20	0.65	8.30	4.50	1.90	0.30	0.30	5.30	9.80	4.20	7.725	2.00	0.40	±0.15
SSOP20	SOT339-1	20	0.65	9.15	5.55	1.80	0.30	0.30	6.30	10.80	4.75	7.725	2.00	0.40	±0.10
SSOP24	SOT340-1	24	0.65	9.15	5.55	1.80	0.30	0.30	6.30	10.80	5.25	8.375	2.00	0.40	±0.10
SSOP24	SOT556-1	Not suitable for wave soldering.													
SSOP28	SOT341-1	28	0.65	9.15	5.55	1.80	0.30	0.30	6.30	10.80	6.25	9.025	2.00	0.40	±0.10
SSOP48	SOT370-1	Not suitable for wave soldering.													
SSOP56	SOT371-1	Not suitable for wave soldering.													
TSSOP8	SOT505-1	Not suitable for wave soldering.													
TSSOP10	SOT552-1	Not suitable for wave soldering.													
TSSOP14	SOT402-1	14	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	3.20	6.75	2.075	0.40	±0.15
TSSOP16	SOT403-1	16	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	3.20	7.075	2.075	0.40	±0.15
TSSOP20	SOT360-1	20	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	3.95	7.725	2.075	0.40	±0.15
TSSOP24	SOT355-1	24	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	4.60	8.375	2.075	0.40	±0.15
TSSOP28	SOT361-1	28	0.65	8.30	4.50	1.90	0.30	0.30	5.15	9.80	5.55	9.025	2.075	0.40	±0.15
TSSOP32	SOT487-1	32	0.65	10.40	6.35	2.025	0.30	0.50	6.35	13.75	7.50	9.875	3.20	0.30	±0.15
TSSOP38	SOT510-1	Not suitable for wave soldering.													
TSSOP48	SOT362-1	Not suitable for wave soldering.													
TSSOP56	SOT364-1	Not suitable for wave soldering.													
VSO40	SOT158-1	40	0.762	12.80	8.20	2.30	0.35	0.35	9.20	14.30	9.50	12.10	2.30	0.40	±0.10
VSO40	SOT158-2	40	0.762	12.80	8.20	2.30	0.35	0.35	9.20	14.30	9.50	12.10	2.30	0.40	±0.10
VSO56	SOT190-1	56	0.75	16.20	11.80	2.20	0.35	0.35	12.80	17.70	12.70	15.00	2.20	0.40	±0.10
VSO56	SOT190-1	56	0.75	16.20	11.80	2.20	0.35	0.35	12.80	17.70	12.70	15.00	2.20	0.40	±0.10

HTQFP, HLQFP FOOTPRINT (REFLOW SOLDERING)

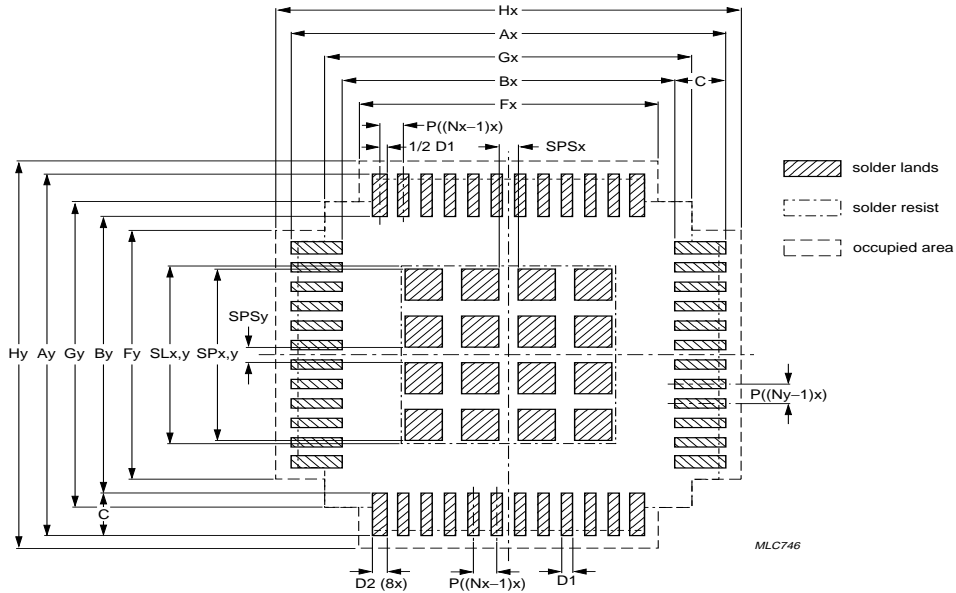


Fig.18 PC board footprint for mounting HTQFP, HLQFP packages (reflow soldering).



## Reflow soldering (Table 1 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)														PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C	D1	D2	Fx	Fy	Gx	Gy	Hx	Hy	
HTQFP32 <sup>(1)</sup>	SOT-547-1	8	8	0.50	7.40	7.40	5.50	5.50	0.95	0.25	0.30	4.45	4.45	5.90	5.90	8.00	8.00	±0.10
HTQFP32 <sup>(1)</sup>	SOT547-2	8	8	0.50	7.40	7.40	5.30	5.30	1.05	0.28	0.40	4.65	4.65	5.90	5.90	8.00	8.00	±0.10
HTQFP48 <sup>(1)</sup>	SOT545-2	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.25	0.30	7.20	7.20	7.20	7.20	10.75	10.75	±0.10
HTQFP80 <sup>(1)</sup>	SOT513-1	20	20	0.65	16.35	16.35	14.15	14.15	1.10	0.40	0.40	13.11	13.11	14.25	14.25	16.60	16.60	±0.10
HLQFP100 <sup>(1)</sup>	SOT470-1	25	25	0.50	16.50	16.50	14.20	14.20	1.15	0.30	0.40	12.75	12.75	14.90	14.90	16.75	16.75	±0.10
LQFP32	SOT358-1	8	8	0.80	9.50	9.50	7.30	7.30	1.10	0.40	0.40	6.40	6.40	7.25	7.25	9.75	9.75	±0.15
LQFP32	SOT401-1	8	8	0.50	7.40	7.40	5.20	5.20	1.10	0.30	0.40	4.25	4.25	5.90	5.90	7.65	7.65	±0.15
LQFP44	SOT389-1	11	11	0.80	12.35	12.35	10.35	10.35	1.00	0.40	0.40	8.80	8.80	10.25	10.25	12.60	12.60	±0.15
LQFP48	SOT313-2	12	12	0.50	9.50	9.50	7.30	7.30	1.10	0.285	0.285	7.20	7.20	7.20	7.20	10.75	10.75	±0.10
LQFP64	SOT314-2	16	16	0.50	12.50	12.50	10.30	10.30	1.10	0.285	0.285	9.035	9.035	10.20	10.20	13.75	13.75	±0.10
LQFP64	SOT414-1	16	16	0.40	9.40	9.40	7.20	7.20	1.10	0.23	0.30	6.62	6.62	6.90	6.90	9.65	9.65	±0.10
LQFP80	SOT315-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	0.285	11.04	11.035	12.20	12.20	15.75	15.75	±0.10
LQFP100	SOT407-1	25	25	0.50	16.50	16.50	14.20	14.20	1.15	0.300	0.40	12.75	12.75	14.90	14.90	16.75	16.75	±0.10
LQFP128	SOT420-1	32	32	0.40	16.40	16.40	14.20	14.20	1.10	0.23	0.30	13.02	13.02	14.90	14.90	16.65	16.65	±0.10
LQFP128	SOT425-1	38	26	0.50	22.50	16.50	20.30	14.30	1.10	0.285	0.285	20.04	14.035	20.20	14.20	23.75	17.75	±0.10
LQFP144	SOT486-1	36	36	0.50	22.35	22.35	20.15	20.15	1.10	0.285	0.285	18.11	18.11	20.20	20.20	22.60	22.60	±0.10
LQFP160	SOT435-1	40	40	0.50	26.35	26.35	24.15	24.15	1.10	0.285	0.285	20.11	20.11	24.20	24.20	26.60	26.60	±0.10
LQFP176	SOT506-1	44	44	0.50	26.35	26.35	24.15	24.15	1.10	0.285	0.285	20.11	20.11	24.20	24.20	26.60	26.60	±0.10

## Note

- These packages have a heatsink soldered to the board. The dimensions of these solder lands are given in the following table.

PACKAGE NAME	PHILIPS OUTLINE CODE	SOLDER LAND DIMENSIONS (mm)					
		SLx	SLy	SPx	SPy	SPSx	SPSy
HTQFP32	SOT-547-1	3.60	3.60	3.50	3.50	0.55	0.55
HTQFP32	SOT547-2	3.20	3.20	3.10	3.10	0.50	0.50
HTQFP48	SOT545-2	4.70	4.70	4.60	4.60	0.40	0.40
HTQFP80	SOT513-1	5.30	6.00	5.20	5.90	0.20	0.25

LQFP, MSQFP, QFP, SQFP & TQFP FOOTPRINT (REFLOW SOLDERING)

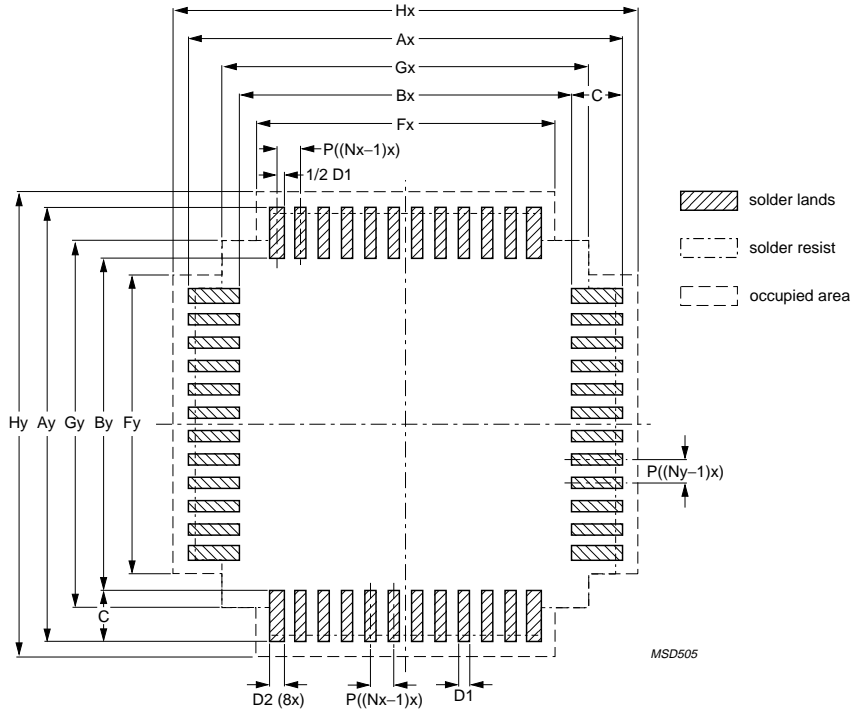


Fig.19 PC board footprint for mounting LQFP, MSQFP, QFP, SQFP & TQFP packages (reflow soldering).

Reflow soldering (Table 2 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)														PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C	D1	D2	Fx	Fy	Gx	Gy	Hx	Hy	
LQFP208	SOT459-1	52	52	0.50	30.35	30.35	28.15	28.15	1.10	0.285	0.285	26.11	26.11	28.20	28.20	30.60	30.60	±0.10
MSQFP240	SOT474-2	60	60	0.50	35.00	35.00	32.80	32.80	1.10	0.285	0.285	30.13	30.13	31.95	31.95	35.25	35.25	±0.10
QFP44	SOT205-1	11	11	1.00	19.40	19.40	14.80	14.80	2.30	0.60	0.60	11.00	11.00	14.40	14.40	19.65	19.65	±0.25
QFP44	SOT307-2	11	11	0.80	13.50	13.50	10.50	10.50	1.50	0.40	0.40	8.75	8.75	10.25	10.25	13.35	13.35	±0.15
QFP52	SOT379-1	13	13	0.65	13.65	13.65	10.85	10.85	1.40	0.40	0.40	8.45	8.45	10.25	10.25	13.90	13.90	±0.15
QFP64	SOT319-1	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT319-2	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT319-5	19	13	1.00	24.40	18.40	21.60	15.60	1.40	0.60	0.60	19.00	13.00	20.40	14.40	24.65	18.65	±0.25
QFP64	SOT393-1	16	16	0.80	17.65	17.65	14.85	14.85	1.40	0.40	0.40	12.80	12.80	14.25	14.25	17.90	17.90	±0.15
QFP64	SOT393-2	16	16	0.80	17.65	17.65	14.85	14.85	1.40	0.40	0.40	12.80	12.80	14.25	14.25	17.90	17.90	±0.15
QFP80	SOT310-1	24	16	0.80	23.80	17.80	21.00	15.00	1.40	0.40	0.40	19.20	12.80	20.25	14.25	24.05	18.05	±0.15
QFP80	SOT318-1	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65	±0.15
QFP80	SOT318-2	24	16	0.80	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.20	12.80	20.25	14.25	24.65	18.65	±0.15
QFP80	SOT496-1	20	20	0.65	17.65	17.65	14.85	14.85	1.40	0.40	0.40	13.11	13.11	14.25	14.25	17.90	17.90	±0.15
QFP100	SOT317-1	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT317-2	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT317-3	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP100	SOT382-1	30	20	0.65	23.65	17.65	20.85	14.85	1.40	0.40	0.40	19.50	13.00	20.25	14.25	23.90	17.90	±0.15
QFP100	SOT382-2	30	20	0.65	24.40	18.40	21.60	15.60	1.40	0.40	0.40	19.50	13.00	20.25	14.25	24.65	18.65	±0.15
QFP120	SOT349-2	30	30	0.80	33.90	33.90	28.00	28.00	1.50	0.50	0.60	24.50	24.50	28.50	28.50	32.50	32.50	±0.15
QFP128	SOT320-2	32	32	0.80	31.70	31.70	28.60	28.60	1.55	0.50	0.60	26.10	26.10	28.60	28.60	32.40	32.40	±0.15
QFP160	SOT322-2	40	40	0.65	31.65	31.65	28.85	28.85	1.40	0.40	0.40	26.05	26.05	28.20	28.20	31.90	31.90	±0.10
SQFP128	SOT387-3	36	28	0.50	23.70	17.70	20.90	14.90	1.40	0.285	0.285	20.20	14.20	20.20	20.20	24.95	18.95	±0.10
SQFP208	SOT316-1	52	52	0.50	31.10	31.10	28.70	28.70	1.20	0.285	0.285	27.03	27.03	28.20	28.20	32.35	32.35	±0.10
TQFP44	SOT376-1	11	11	0.80	12.40	12.40	10.40	10.40	1.00	0.40	0.40	8.70	8.70	10.30	10.30	12.65	12.65	±0.15
TQFP64	SOT357-1	16	16	0.50	12.40	12.40	10.40	10.40	1.00	0.285	0.285	9.035	9.035	10.25	10.25	13.65	13.65	±0.10
TQFP80	SOT375-1	20	20	0.50	14.50	14.50	12.30	12.30	1.10	0.285	0.285	11.035	11.035	12.20	12.20	15.75	15.75	±0.10
TQFP100	SOT386-1	25	25	0.50	16.50	16.50	14.30	14.30	1.10	0.285	0.285	13.535	13.535	14.20	14.20	17.75	17.75	±0.10

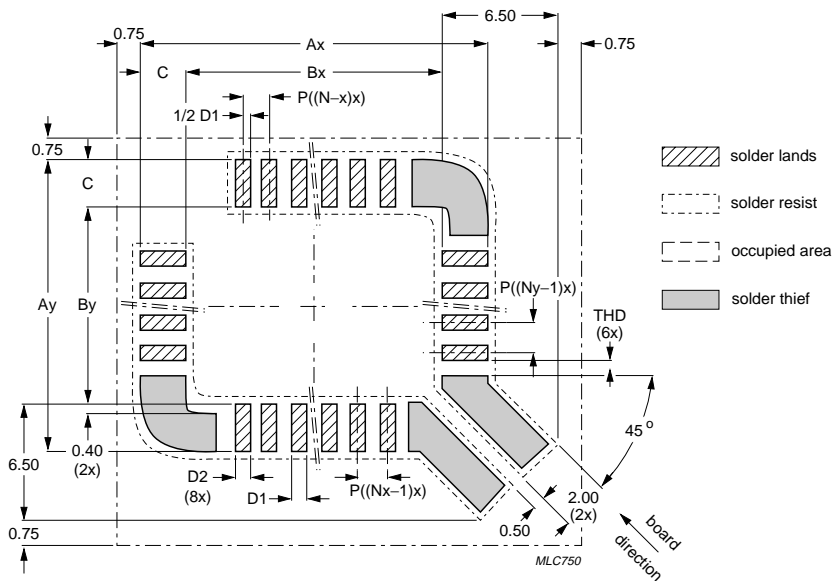


Fig.20 PC board footprint for mounting HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP packages (wave soldering).

Wave soldering (Table 1 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)								D2	THS	W	PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C	D1					
HTQFP32	SOT-547-1	Not suitable for wave soldering.													
HTQFP32	SOT547-2	Not suitable for wave soldering.													
HTQFP48	SOT545-2	Not suitable for wave soldering.													
HTQFP80	SOT513-1	Not suitable for wave soldering.													
HLQFP100	SOT470-1	Not suitable for wave soldering.													
LQFP32	SOT358-1	8	8	0.80	10.95	10.95	7.15	7.15	1.90	0.40	0.40	0.40	0.20	±0.15	
LQFP32	SOT401-1	Not suitable for wave soldering.													
LQFP44	SOT389-1	11	11	0.80	13.90	13.90	10.10	10.10	1.90	0.40	0.40	0.40	0.20	±0.15	
LQFP48	SOT313-2	Not suitable for wave soldering.													
LQFP64	SOT314-2	Not suitable for wave soldering.													
LQFP64	SOT414-1	Not suitable for wave soldering.													
LQFP80	SOT315-1	Not suitable for wave soldering.													
LQFP100	SOT407-1	Not suitable for wave soldering.													
LQFP128	SOT420-1	Not suitable for wave soldering.													
LQFP128	SOT425-1	Not suitable for wave soldering.													
LQFP144	SOT486-1	Not suitable for wave soldering.													
LQFP160	SOT435-1	Not suitable for wave soldering.													
LQFP176	SOT506-1	Not suitable for wave soldering.													
LQFP208	SOT459-1	Not suitable for wave soldering.													
MSQFP240	SOT474-2	Not suitable for wave soldering.													

HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP FOOTPRINT (WAVE SOLDERING)

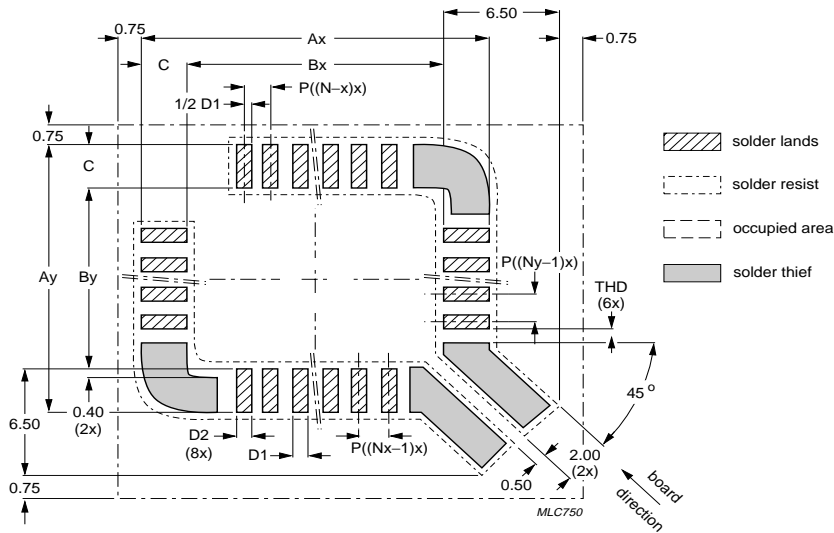


Fig.21 PC board footprint for mounting HTQFP, HLQFP, LQFP, MSQFP, QFP, SQFP & TQFP packages (wave soldering).

Wave soldering (Table 2 of 2)

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)								D2	THS	W	PLACEMENT ACCURACY
				P	Ax	Ay	Bx	By	C	D1					
QFP44	SOT205-1	11	11	1.00	19.80	19.80	14.40	14.40	2.70	0.50	0.50	0.40	2.00	±0.25	
QFP44	SOT307-2	11	11	0.80	13.90	13.90	10.30	10.30	1.80	0.40	0.40	0.40	2.00	±0.15	
QFP52	SOT379-1	Not suitable for wave soldering.													
QFP64	SOT319-1	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	0.50	0.40	2.00	±0.25	
QFP64	SOT319-2	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	0.50	0.40	2.00	±0.25	
QFP64	SOT319-5	13	19	1.00	18.90	24.90	15.30	21.30	1.80	0.50	0.50	0.40	2.00	±0.25	
QFP64	SOT393-1	16	16	0.80	17.95	17.95	14.75	14.75	1.60	0.40	0.40	0.40	2.00	±0.15	
QFP64	SOT393-2	16	16	0.80	17.95	17.95	14.75	14.75	1.60	0.40	0.40	0.40	2.00	±0.15	
QFP80	SOT310-1	16	24	0.80	18.10	24.10	14.70	20.70	1.70	0.40	0.40	0.40	2.00	±0.15	
QFP80	SOT318-1	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	0.40	0.40	2.00	±0.15	
QFP80	SOT318-2	16	24	0.80	18.70	24.70	15.50	21.50	1.60	0.40	0.40	0.40	2.00	±0.15	
QFP80	SOT496-1	20	20	0.65	18.65	18.65	14.50	14.50	1.875	0.30	0.50	0.30	2.30	±0.15	
QFP100	SOT317-1	Not suitable for wave soldering.													
QFP100	SOT317-2	Not suitable for wave soldering.													
QFP100	SOT317-3	Not suitable for wave soldering.													
QFP100	SOT382-1	Not suitable for wave soldering.													
QFP100	SOT382-2	Not suitable for wave soldering.													
QFP120	SOT349-2	30	30	0.80	32.65	32.65	28.90	28.90	1.875	0.40	0.60	0.30	2.30	±0.15	
QFP128	SOT320-2	32	32	0.80	32.70	32.70	29.30	29.30	1.70	0.40	0.40	0.40	2.00	±0.15	
QFP160	SOT322-2	40	40	0.65	32.65	32.65	28.90	28.90	1.875	0.30	0.50	0.30	2.30	±0.15	
SQFP128	SOT387-3	Not suitable for wave soldering.													
SQFP208	SOT316-1	Not suitable for wave soldering.													
TQFP44	SOT376-1	11	11	0.80	13.95	13.95	10.15	10.15	1.90	0.40	0.40	0.40	2.00	±0.15	
TQFP64	SOT357-1	Not suitable for wave soldering.													
TQFP80	SOT375-1	Not suitable for wave soldering.													
TQFP100	SOT386-1	Not suitable for wave soldering.													

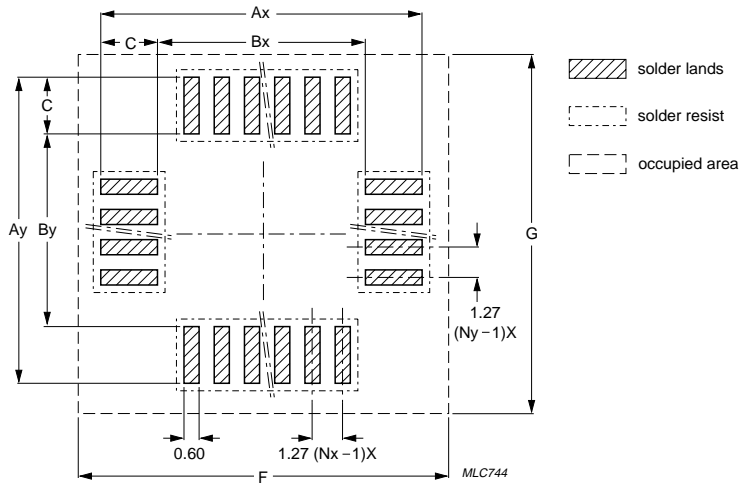


Fig.22 PC board footprint for mounting PLCC packages (reflow soldering).

PLCC FOOTPRINT (REFLOW SOLDERING)



## Reflow soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)							PLACEMENT ACCURACY
				Ax	Ay	Bx	By	C	F	G	
PLCC20	SOT380-1	5	5	10.30	10.30	6.60	6.60	1.85	10.70	10.70	±0.25
PLCC28	SOT261-2	7	7	12.80	12.80	9.10	9.10	1.85	13.20	13.20	±0.25
PLCC28	SOT261-3	7	7	12.80	12.80	9.10	9.10	1.85	13.20	13.20	±0.25
PLCC44	SOT187-2	11	11	17.90	17.90	14.20	14.20	1.85	18.30	18.30	±0.25
PLCC52	SOT238-2	13	13	20.40	20.40	16.70	16.70	1.85	20.80	20.80	±0.25
PLCC52	SOT238-3	13	13	20.40	20.40	16.70	16.70	1.85	20.80	20.80	±0.25
PLCC68	SOT188-2	17	17	25.50	25.50	21.80	21.80	1.85	25.90	25.90	±0.25
PLCC68	SOT188-3	17	17	25.50	25.50	21.80	21.80	1.85	25.90	25.90	±0.25
PLCC84	SOT189-2	21	21	30.60	30.60	26.90	26.90	1.85	31.00	31.00	±0.25
PLCC84	SOT189-3	21	21	30.60	30.60	26.90	26.90	1.85	31.00	31.00	±0.25

PLCC FOOTPRINT (WAVE SOLDERING)

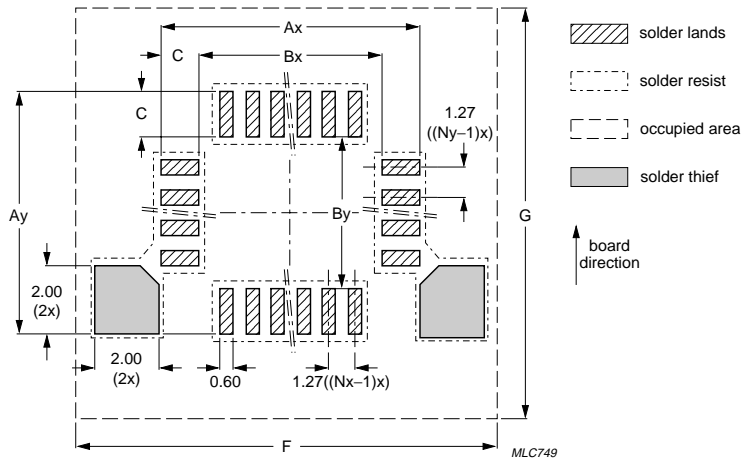


Fig.23 PC board footprint for mounting PLCC packages (wave soldering).

## Wave soldering

PACKAGE NAME	PHILIPS OUTLINE CODE	Nx	Ny	FOOTPRINT DIMENSIONS (mm)							PLACEMENT ACCURACY
				Ax	Ay	Bx	By	C	F	G	
PLCC20	SOT380-1	5	5	9.70	9.70	6.60	6.60	1.55	15.35	15.35	±0.25
PLCC28	SOT261-2	7	7	12.20	12.20	9.10	9.10	1.55	17.85	17.85	±0.25
PLCC28	SOT261-3	7	7	12.20	12.20	9.10	9.10	1.55	17.85	17.85	±0.25
PLCC44	SOT187-2	11	11	17.30	17.30	14.20	14.20	1.55	22.95	22.95	±0.25
PLCC52	SOT238-2	13	13	19.80	19.80	16.70	16.70	1.55	25.50	25.50	±0.25
PLCC52	SOT238-3	13	13	19.80	19.80	16.70	16.70	1.55	25.50	25.50	±0.25
PLCC68	SOT188-2	17	17	24.30	24.30	21.80	21.80	1.55	30.55	30.55	±0.25
PLCC68	SOT188-3	17	17	24.30	24.30	21.80	21.80	1.55	30.55	30.55	±0.25
PLCC84	SOT189-2	21	21	30.00	30.00	26.90	26.90	1.55	35.65	35.65	±0.25
PLCC84	SOT189-3	21	21	30.00	30.00	26.90	26.90	1.55	35.65	35.65	±0.25

