

# DATA SHEET

## **74LVC10A** Triple 3-input NAND gate

Product specification  
Supersedes data of 1998 Apr 28

2003 Jun 20

## Triple 3-input NAND gate

## 74LVC10A

## FEATURES

- Wide supply voltage range from 1.2 to 3.6 V
- Inputs accept voltages up to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Latch-up performance exceeds 250 mA
- In accordance with JEDEC standard no. 8-1A
- ESD protection:  
HBM EIA/JESD22-A114-A exceeds 2000 V  
MM EIA/JESD22-A115-A exceeds 200 V.

## DESCRIPTION

The 74LVC10A is a high-performance, low-power, low-voltage, Si-gate CMOS device and superior to most advanced CMOS compatible TTL families.

The 74LVC10A provides the 3-input NAND function.

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $t_r = t_f \leq 2.5\text{ ns}$ .

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
$t_{PHL}/t_{PLH}$	propagation delay nA, nB, nC to nY	$C_L = 50\text{ pF}$ ; $V_{CC} = 3.3\text{ V}$	3.9	ns
$C_I$	input capacitance		5.0	pF
$C_{PD}$	power dissipation capacitance per gate	notes 1 and 2	26	pF

## Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts;

$N$  = total switching outputs;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

2. The condition is  $V_I = \text{GND to } V_{CC}$ .

## ORDERING INFORMATION

TYPE NUMBER	TEMPERATURE RANGE	PACKAGE			
		PINS	PACKAGE	MATERIAL	CODE
74LVC10AD	-40 to +85 $^{\circ}\text{C}$	14	SO14	plastic	SOT108-1
74LVC10ADB	-40 to +85 $^{\circ}\text{C}$	14	SSOP14	plastic	SOT337-1
74LVC10APW	-40 to +85 $^{\circ}\text{C}$	14	TSSOP14	plastic	SOT402-1
74LVC10ABQ	-40 to +85 $^{\circ}\text{C}$	14	DHVQFN14	plastic	SOT762-1

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**FUNCTION TABLE**

See note 1.

INPUT			OUTPUT
nA	nB	nC	nY
L	L	L	H
L	L	H	H
L	H	L	H
L	H	H	H
H	L	L	H
H	L	H	H
H	H	L	H
H	H	H	L

**Note**

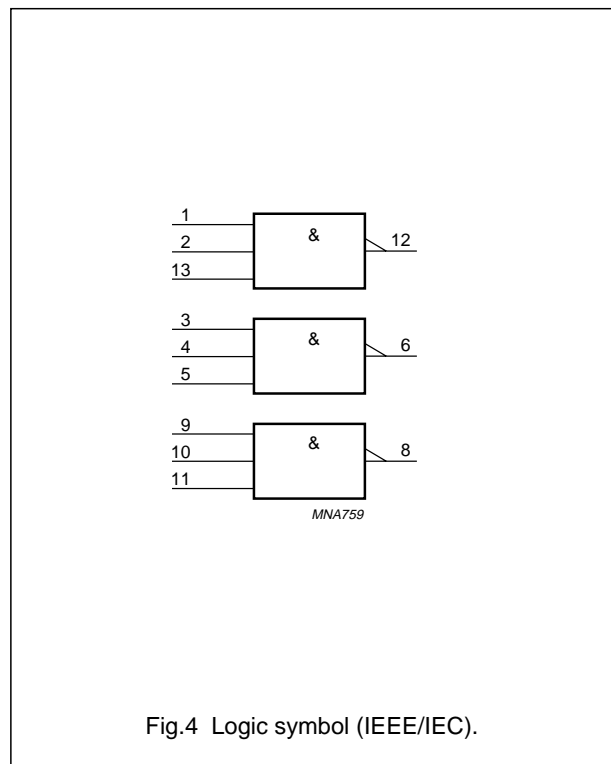
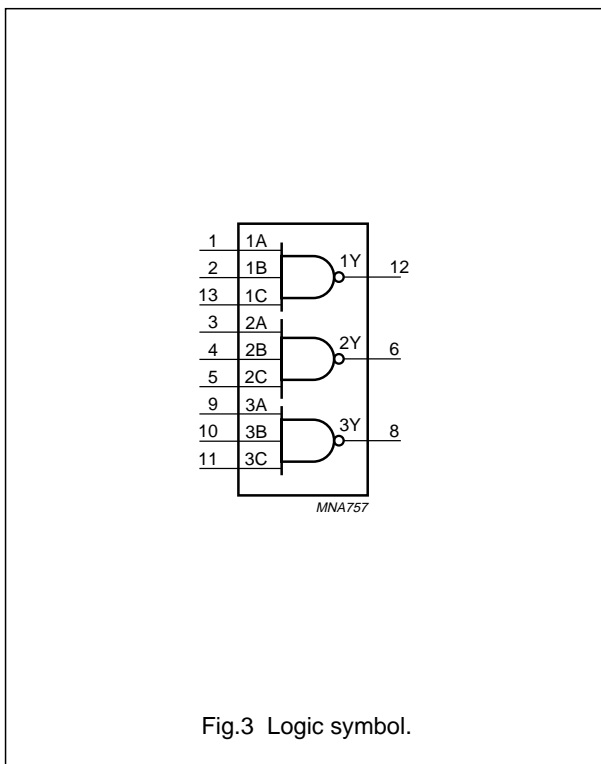
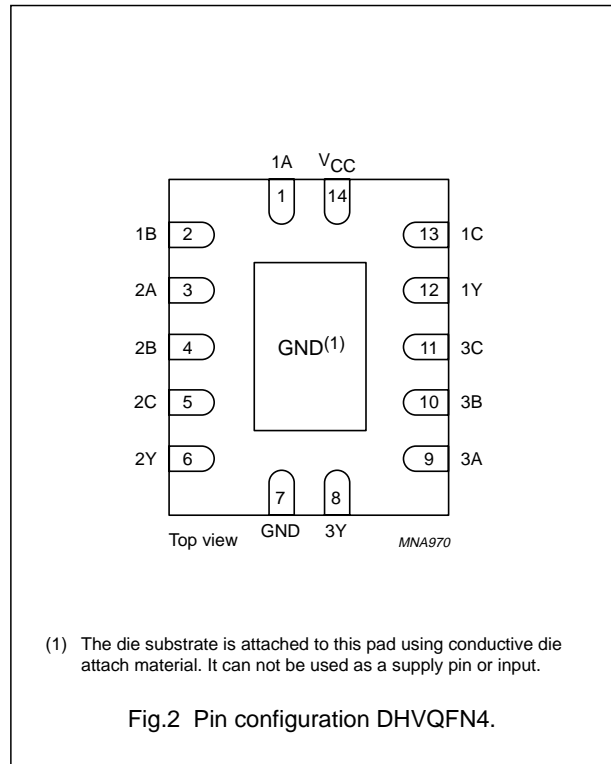
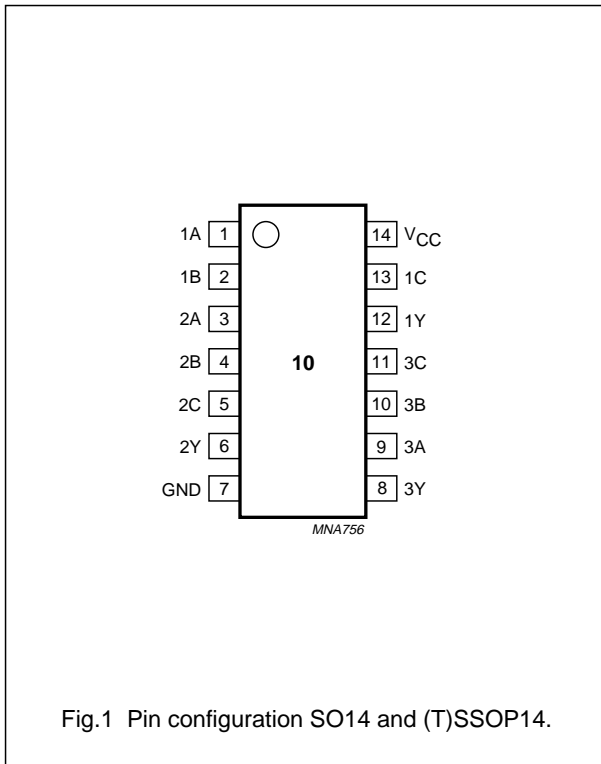
1. H = HIGH voltage level;  
L = LOW voltage level.

**PINNING**

PIN	SYMBOL	DESCRIPTION
1	1A	data input
2	1B	data input
3	2A	data input
4	2B	data input
5	2C	data input
6	2Y	data output
7	GND	ground (0 V)
8	3Y	data output
9	3A	data input
10	3B	data input
11	3C	data input
12	1Y	data output
13	1C	data input
14	V <sub>CC</sub>	positive supply voltage

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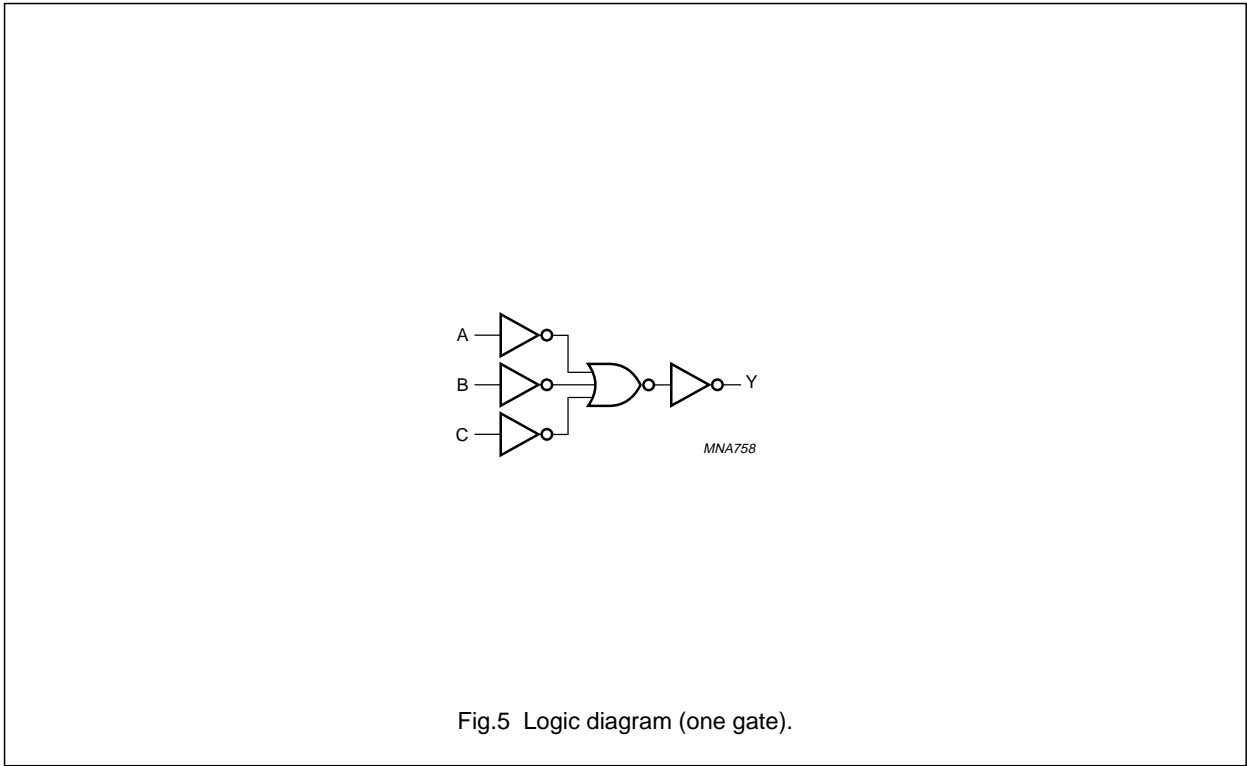


Fig.5 Logic diagram (one gate).

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**RECOMMENDED OPERATING CONDITIONS**

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CC}$	supply voltage	for maximum speed performance	2.7	3.6	V
		for low-voltage applications	1.2	3.6	V
$V_I$	input voltage range		0	5.5	V
$T_{amb}$	operating ambient temperature	in free air	-40	+85	°C
$t_r, t_f$	input rise and fall times	$V_{CC} = 1.2$ to $2.7$ V	0	20	ns/V
		$V_{CC} = 2.7$ to $3.6$ V	0	10	ns/V

**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 60134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CC}$	supply voltage		-0.5	+6.5	V
$I_{IK}$	input diode current	$V_I < 0$	-	-50	mA
$V_I$	input voltage	note 1	-0.5	+6.5	V
$I_{OK}$	output diode current	$V_O > V_{CC}$ or $V_O < 0$	-	±50	mA
$V_O$	output voltage	note 1	-0.5	$V_{CC} + 0.5$	V
$I_O$	output source or sink current	$V_O = 0$ to $V_{CC}$	-	±50	mA
$I_{CC}, I_{GND}$	$V_{CC}$ or GND current		-	±100	mA
$T_{stg}$	storage temperature range		-65	+150	°C
$P_{tot}$	power dissipation	$T_{amb} = -40$ to $+85$ °C; note 2	-	500	mW

**Notes**

- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- For SO14 packages: above 70 °C the value of  $P_D$  derates linearly with 8 mW/K.  
For (T)SSOP14 packages: above 60 °C the value of  $P_D$  derates linearly with 5.5 mW/K.  
For DHVQFN14 packages: above 60 °C the value of  $P_D$  derates linearly with 4.5 mW/K.

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**DC CHARACTERISTICS**

At recommended operating conditions voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP. <sup>(1)</sup>	MAX.	UNIT
		OTHER	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 to +85 °C</b>							
V <sub>IH</sub>	HIGH level input voltage		1.2	V <sub>CC</sub>	–	–	V
			2.7 to 3.6	2.0	–	–	V
V <sub>IL</sub>	LOW-level input voltage		1.2	–	–	GND	V
			2.7 to 3.6	–	–	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = -12 mA I <sub>O</sub> = -100 µA I <sub>O</sub> = -12 mA I <sub>O</sub> = -24 mA	2.7	V <sub>CC</sub> - 0.5	–	–	V
			3.0	V <sub>CC</sub> - 0.2	V <sub>CC</sub>	–	V
			3.0	V <sub>CC</sub> - 0.6	–	–	V
			3.0	V <sub>CC</sub> - 1.0	–	–	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>O</sub> = 12 mA I <sub>O</sub> = 100 µA I <sub>O</sub> = 24 mA	2.7	–	–	0.40	V
			3.0	–	–	0.20	V
			3.0	–	–	0.55	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND	3.6	–	±0.1	±5	µA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0	3.6	–	0.1	10	µA
ΔI <sub>CC</sub>	additional quiescent supply current per input pin	V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0	2.7 to 3.6	–	5	500	µA

**Note**

1. All typical values are at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.

**AC CHARACTERISTICS**GND = 0 V; t<sub>r</sub> = t<sub>f</sub> ≤ 2.5 ns; C<sub>L</sub> = 50 pF.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP. <sup>(1)</sup>	MAX.	UNIT
		WAVEFORMS	V <sub>CC</sub> (V)				
<b>T<sub>amb</sub> = -40 to +85 °C</b>							
t <sub>PHL</sub> /t <sub>PLH</sub>	propagation delay nA, nB, nC to nY	see Figs 6 and 7	2.7	1.5	–	6.7	ns
			3.0 to 3.6	1.5	3.9	5.7	ns

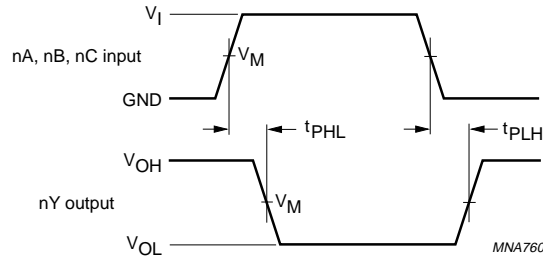
**Note**

1. Typical value is measured at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.

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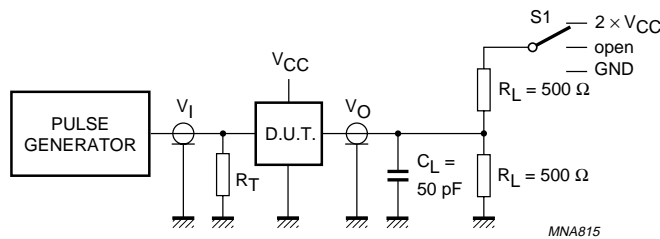
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AC WAVEFORMS



$V_M = 1.5\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$ .  
 $V_M = 0.5V_{CC}$  at  $V_{CC} < 2.7\text{ V}$ .  
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.

Fig.6 Input (nA, nB and nC) to output (nY) propagation delays.



SWITCH POSITION	
TEST	S1
$t_{PLH}/t_{PHL}$	open

$V_{CC}$	$V_I$
$< 2.7\text{ V}$	$V_{CC}$
$2.7\text{ to }3.6\text{ V}$	$2.7\text{ V}$

Definitions for test circuit:  
 $R_L$  = load resistor.  
 $C_L$  = load capacitance including jig and probe capacitance.  
 $R_T$  = termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

Fig.7 Load circuitry for switching times.



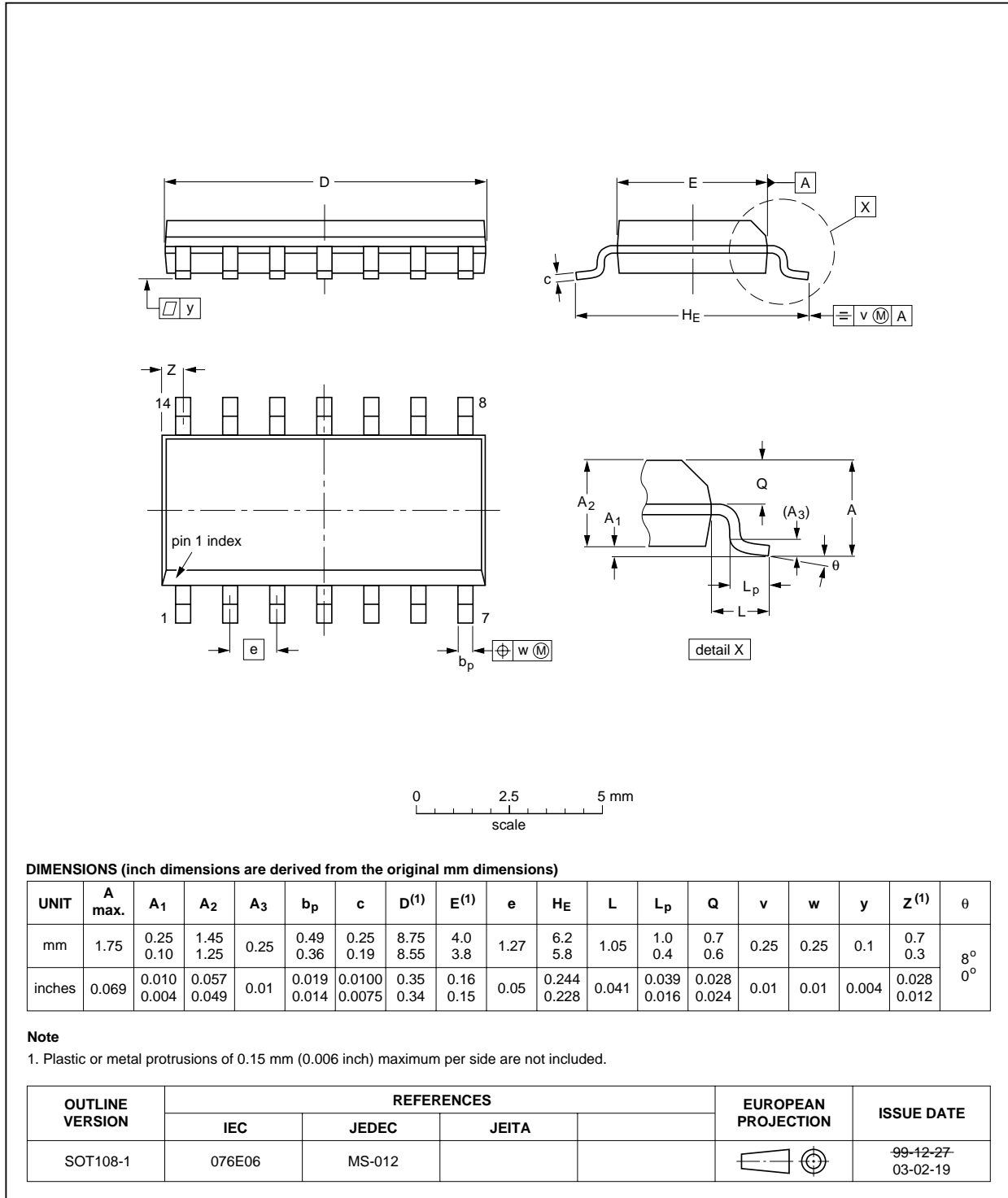
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PACKAGE OUTLINES

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

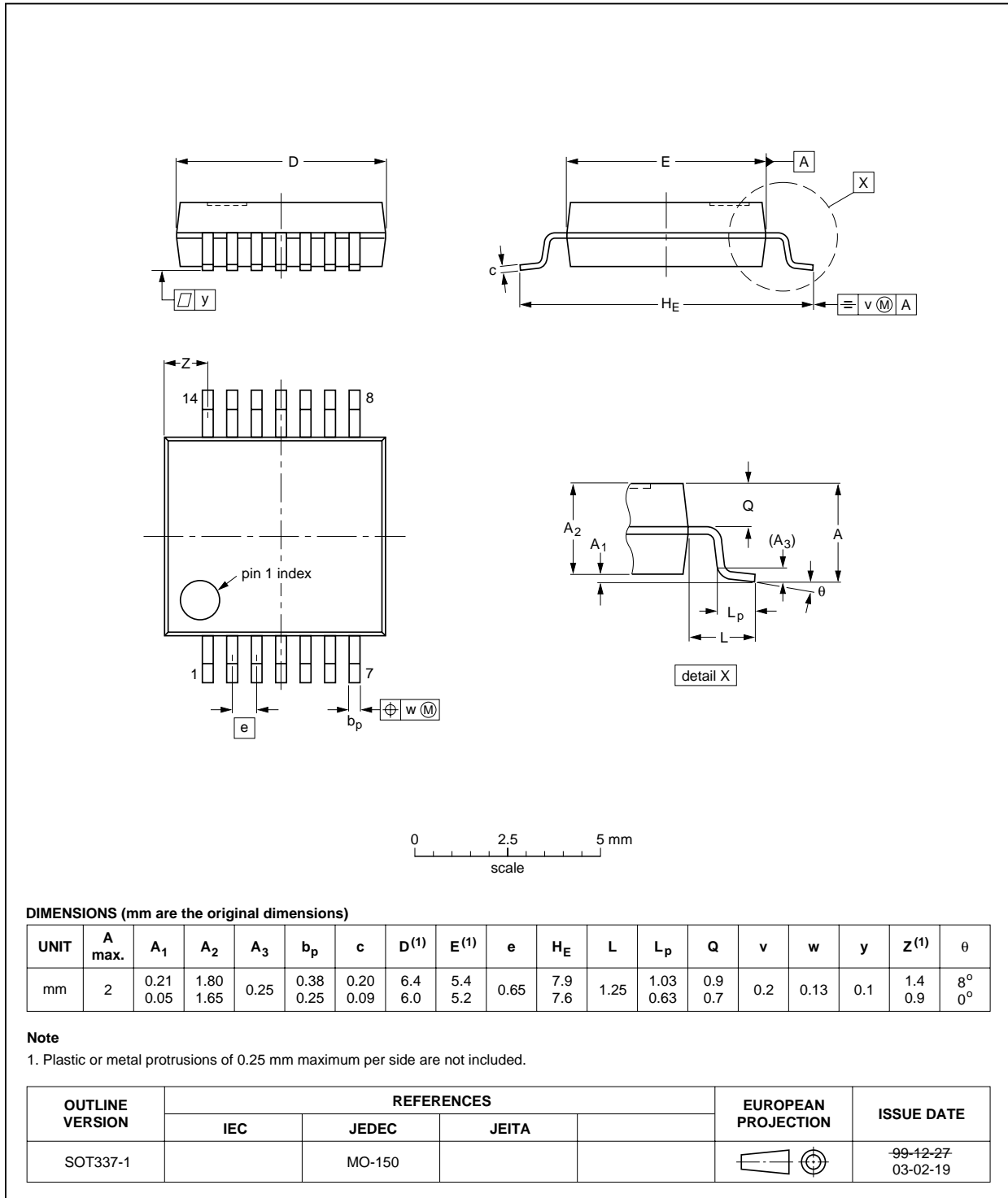


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SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

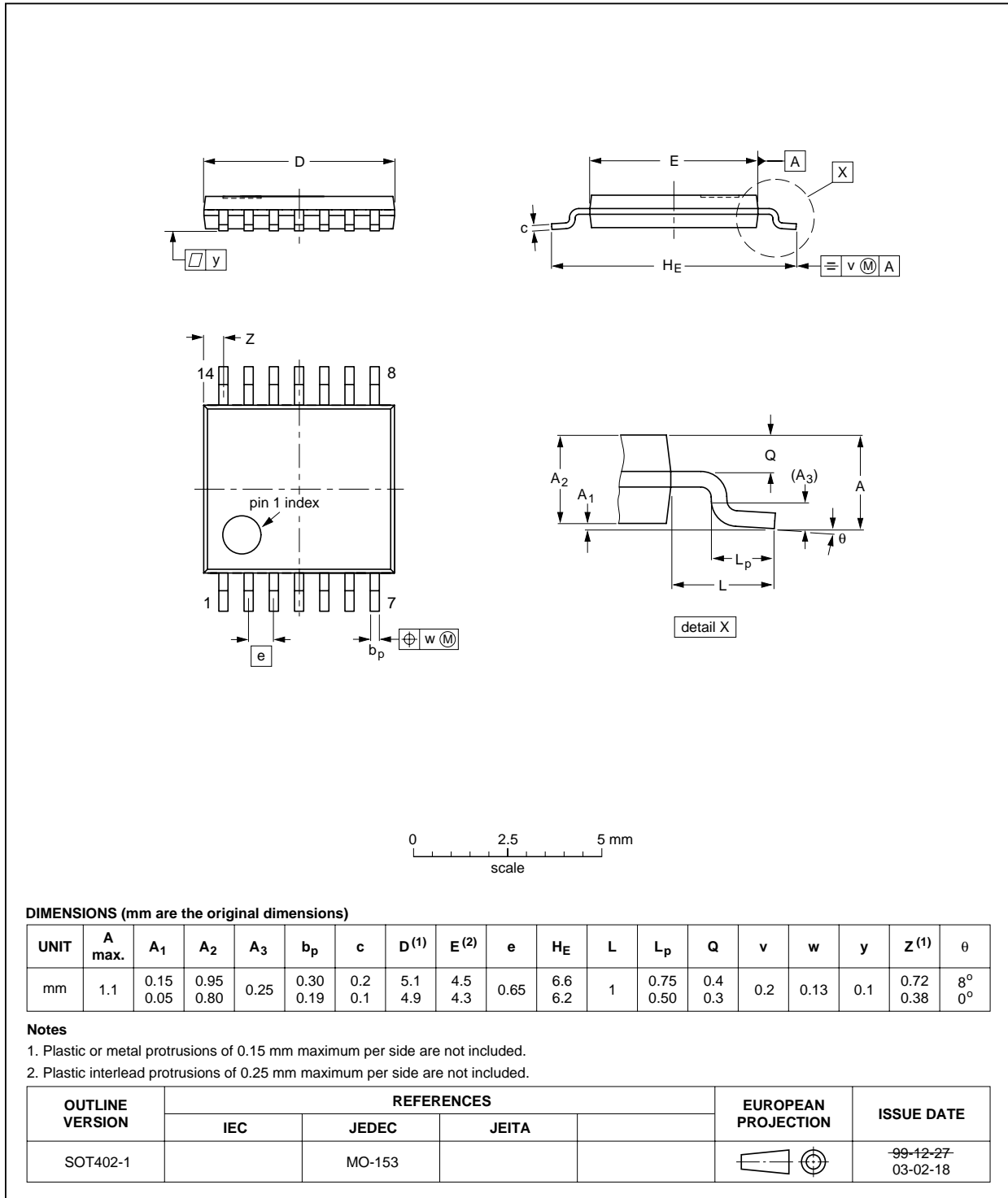


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TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

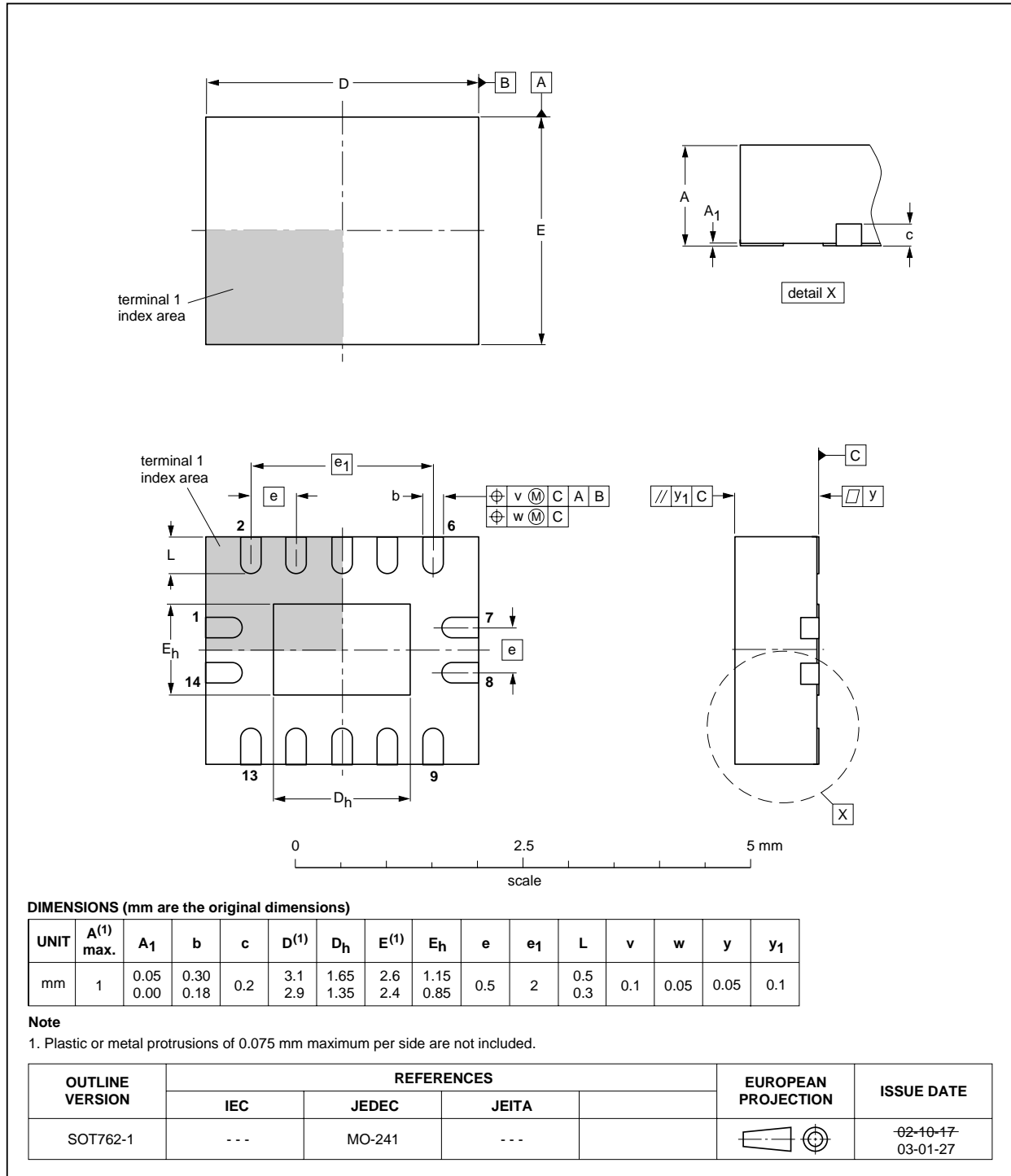


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**DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm**

**SOT762-1**



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### SOLDERING

#### Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "Data Handbook IC26; Integrated Circuit Packages" (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

#### Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement. Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 270 °C depending on solder paste material. The top-surface temperature of the packages should preferably be kept:

- below 220 °C (SnPb process) or below 245 °C (Pb-free process)
  - for all BGA and SSOP-T packages
  - for packages with a thickness  $\geq 2.5$  mm
  - for packages with a thickness  $< 2.5$  mm and a volume  $\geq 350$  mm<sup>3</sup> so called thick/large packages.
- below 235 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness  $< 2.5$  mm and a volume  $< 350$  mm<sup>3</sup> so called small/thin packages.

Moisture sensitivity precautions, as indicated on packing, must be respected at all times.

#### Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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**Suitability of surface mount IC packages for wave and reflow soldering methods**

PACKAGE <sup>(1)</sup>	SOLDERING METHOD	
	WAVE	REFLOW <sup>(2)</sup>
BGA, LBGA, LFBGA, SQFP, SSOP-T <sup>(3)</sup> , TFBGA, VFBGA	not suitable	suitable
DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, HVSON, SMS	not suitable <sup>(4)</sup>	suitable
PLCC <sup>(5)</sup> , SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended <sup>(5)(6)</sup>	suitable
SSOP, TSSOP, VSO, VSSOP	not recommended <sup>(7)</sup>	suitable

**Notes**

- For more detailed information on the BGA packages refer to the “(LF)BGA Application Note” (AN01026); order a copy from your Philips Semiconductors sales office.
- All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the “Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods”.
- These transparent plastic packages are extremely sensitive to reflow soldering conditions and must on no account be processed through more than one soldering cycle or subjected to infrared reflow soldering with peak temperature exceeding  $217\text{ °C} \pm 10\text{ °C}$  measured in the atmosphere of the reflow oven. The package body peak temperature must be kept as low as possible.
- These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
- If wave soldering is considered, then the package must be placed at a  $45^\circ$  angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
- Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
- Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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## DATA SHEET STATUS

LEVEL	DATA SHEET STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)(3)</sup>	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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## Notes

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3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 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 60134). 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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