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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

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# DATA SHEET

## **74ALVCH162601**

**18-bit universal bus transceiver with  
30  $\Omega$  termination resistor; 3-state**

Product specification  
File under Integrated Circuits, IC24

1999 Oct 14

# 18-bit universal bus transceiver with 30 $\Omega$ termination resistor; 3-state

74ALVCH162601

## FEATURES

- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- Direct interface with TTL levels
- MULTIBYTE™ flow-through standard pin-out architecture
- Low inductance multiple  $V_{CC}$  and ground pins for minimum noise and ground bounce
- All data inputs have bus hold circuitry
- Integrated 30  $\Omega$  termination resistors.

## DESCRIPTION

The 74ALVCH162601 is an 18-bit universal transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. Data flow in each direction is controlled by output enable ( $\overline{OE}_{AB}$  and  $\overline{OE}_{BA}$ ), and clock ( $CP_{AB}$  and  $CP_{BA}$ ) inputs. For A-to-B data flow, the device operates in the transparent mode when  $LE_{AB}$  is HIGH. When  $LE_{AB}$  is LOW, the A data is latched if  $CP_{AB}$  is held at a HIGH or LOW logic level. If  $LE_{AB}$  is LOW, the A-bus data is stored in the latch/flip-flop on the LOW-to-HIGH transition of  $CP_{AB}$ . When  $\overline{OE}_{AB}$  is LOW, the outputs are active. When  $\overline{OE}_{AB}$  is HIGH, the outputs are in the high-impedance state. The clocks can be controlled with the clock-enable inputs ( $\overline{CE}_{BA}/\overline{CE}_{AB}$ ).

Data flow for B-to-A is similar to that of A-to-B but uses  $\overline{OE}_{BA}$ ,  $LE_{BA}$  and  $CP_{BA}$ .

To ensure the high-impedance state during power-down,  $\overline{OE}_{BA}$  and  $\overline{OE}_{AB}$  should be tied to  $V_{CC}$  through a pull-up resistor, the minimum value of the resistor is determined by the current-sinking/current-sourcing capability of the driver.

The 74ALVCH162601 is designed with 30  $\Omega$  series resistors in both HIGH or LOW output stage.

Active bus hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

## QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
$t_{PHL}/t_{PLH}$	propagation delay $A_n, B_n$ to $B_n, A_n$	$C_L = 30\text{ pF}; V_{CC} = 2.5\text{ V}$	4.0	ns
		$C_L = 50\text{ pF}; V_{CC} = 3.3\text{ V}$	3.1	ns
$C_{I/O}$	input/output capacitance		8.0	pF
$C_I$	input capacitance		4.0	pF
$C_{PD}$	power dissipation capacitance per latch	notes 1 and 2		
		outputs enabled	21	pF
	outputs disabled	3	pF	

## Notes

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

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

$C_L$  = output load capacitance in pF;

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

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

18-bit universal bus transceiver with 30 Ω termination resistor; 3-state

74ALVCH162601

**FUNCTION TABLE**

See note 1.

INPUTS					OUTPUTS	STATUS
$\overline{CE}_{XX}$	$\overline{OE}_{XX}$	$LE_{XX}$	$CP_{XX}$	$A_n, B_n$		
X	H	X	X	X	Z	disabled
X	L	H	X	H	H	transparent
X	L	H	X	L	L	
H	L	L	X	X	NC	hold
L	L	L	↑	h	H	clock and display
L	L	L	↑	l	L	
L	L	L	L	X	NC	hold
L	L	L	H	X		

**Note**

- XX = AB for A-to-B direction, BA for B-to-A direction;  
 H = HIGH voltage level;  
 L = LOW voltage level;  
 h = HIGH state must be present one set-up time before the LOW-to-HIGH transition of  $CP_{XX}$ ;  
 l = LOW state must be present one set-up time before the LOW-to-HIGH transition of  $CP_{XX}$ ;  
 X = don't care;  
 ↑ = LOW-to-HIGH level transition;  
 NC = no change;  
 Z = high-impedance OFF-state.

**ORDERING INFORMATION**

TYPE NUMBER	PACKAGE				
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74ALVCH162601DGG	-40 to +85 °C	56	TSSOP	plastic	SOT364-1

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**18-bit universal bus transceiver with 30  $\Omega$   
termination resistor; 3-state**


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**74ALVCH162601****PINNING**

<b>PIN</b>	<b>SYMBOL</b>	<b>DESCRIPTION</b>
1	$\overline{OE}_{AB}$	output enable A-to-B
2	$LE_{AB}$	latch enable A-to-B
3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26	$A_0$ to $A_{17}$	data inputs/outputs
4, 11, 18, 25, 32, 39, 46, 53	GND	ground (0 V)
7, 22, 35, 50	$V_{CC}$	DC supply voltage
27	$\overline{OE}_{BA}$	output enable B-to-A
28	$LE_{BA}$	latch enable B-to-A
29	$\overline{CE}_{BA}$	clock enable B-to-A
30	$CP_{BA}$	clock input B-to-A
31, 33, 34, 36, 37, 38, 40, 41, 42, 43, 44, 45, 47, 48, 49, 51, 52, 54	$B_{17}$ to $B_0$	data inputs/outputs
55	$CP_{AB}$	clock input A-to-B
56	$\overline{CE}_{AB}$	clock enable A-to-B

18-bit universal bus transceiver with 30 Ω termination resistor; 3-state

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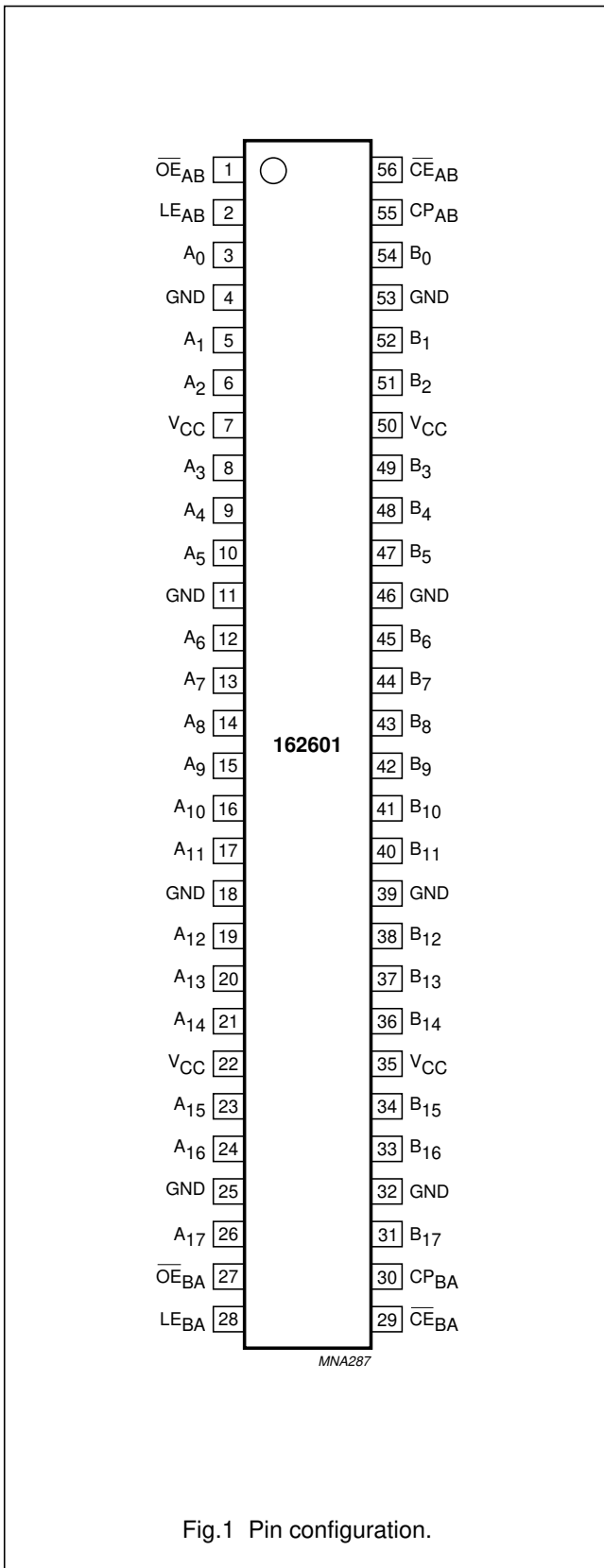
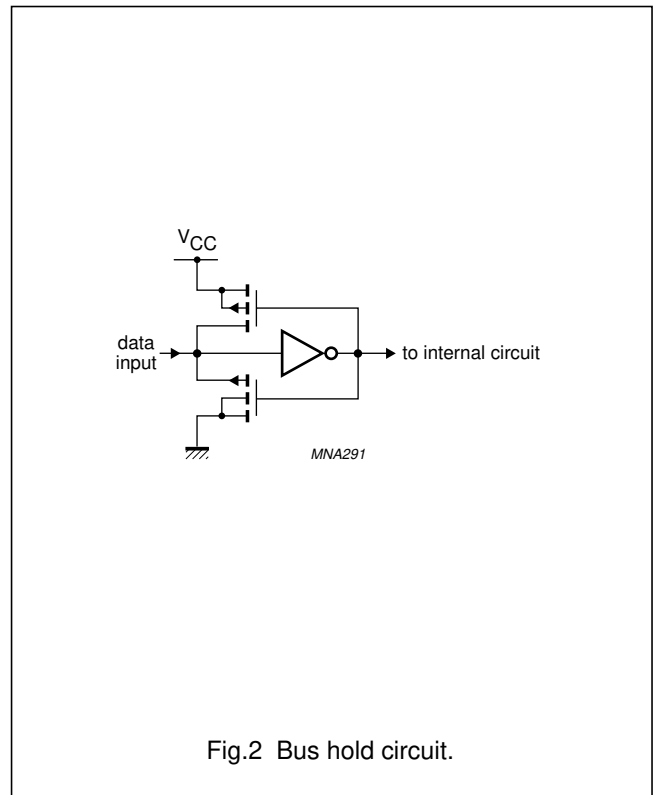


Fig.1 Pin configuration.



18-bit universal bus transceiver with 30 Ω termination resistor; 3-state

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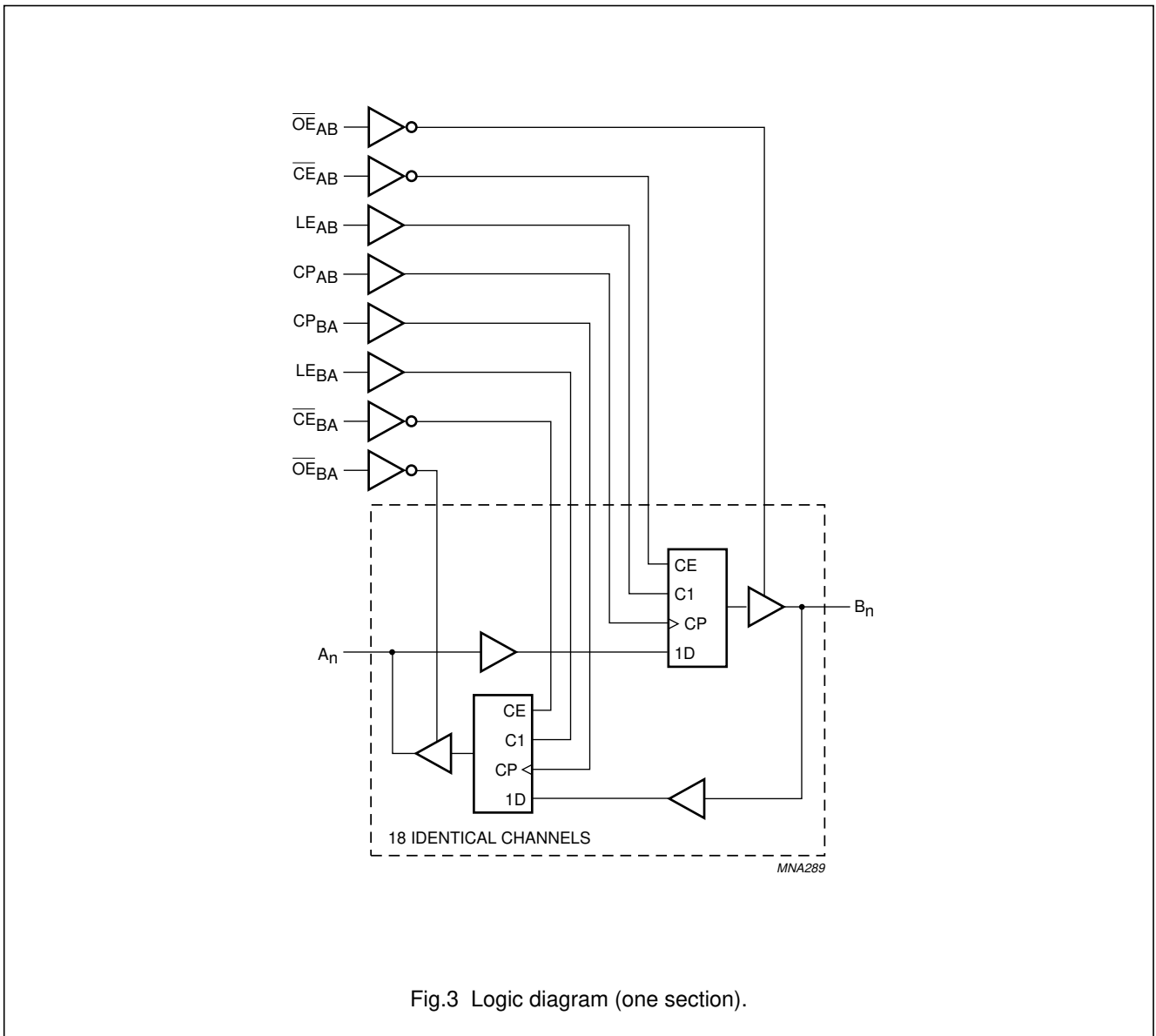


Fig.3 Logic diagram (one section).



18-bit universal bus transceiver with 30 Ω termination resistor; 3-state

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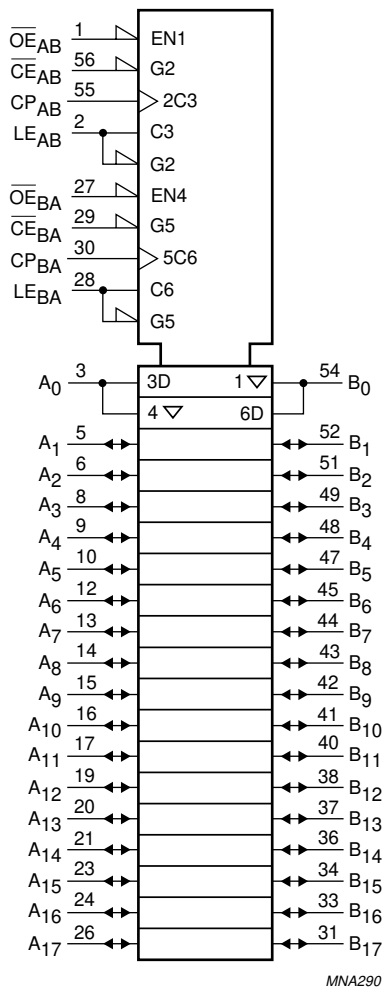


Fig.4 IEC logic symbol.

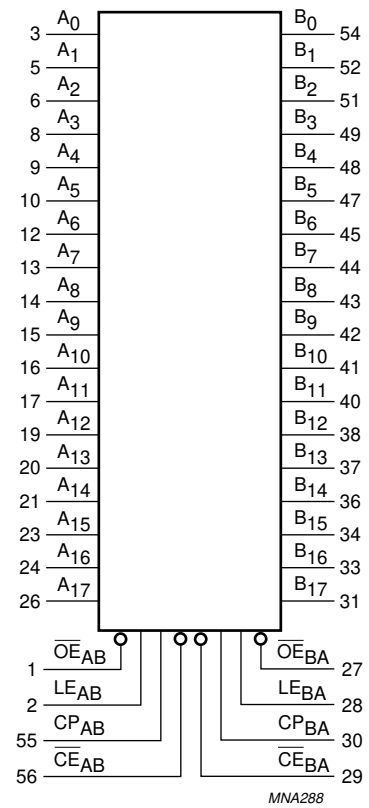


Fig.5 Logic symbol.

# 18-bit universal bus transceiver with 30 $\Omega$ termination resistor; 3-state

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## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CC}$	DC supply voltage for max. speed performance for max. speed performance for low-voltage applications	$C_L = 30$ pF	2.3	2.5	2.7	V
		$C_L = 50$ pF	3.0	3.3	3.6	V
			1.2	2.4	3.6	V
$V_I$	DC input voltage		0	–	$V_{CC}$	V
$V_O$	DC output voltage		0	–	$V_{CC}$	V
$T_{amb}$	operating ambient temperature	in free air	–40	–	+85	$^{\circ}$ C
$t_r, t_f$	input rise and fall times	$V_{CC} = 2.3$ to $3.0$ V	0	–	20	ns/V
		$V_{CC} = 3.0$ to $3.6$ V	0	–	10	ns/V

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CC}$	DC supply voltage		–0.5	+4.6	V
$I_{IK}$	DC input diode current	$V_I < 0$	–	–50	mA
$V_I$	DC input voltage	note 1	–0.5	+4.6	V
$I_{OK}$	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	–	$\pm 50$	mA
$V_O$	DC output voltage	note 1	–0.5	$V_{CC} + 0.5$	V
$I_O$	DC output source or sink current	$V_O = 0$ to $V_{CC}$	–	$\pm 50$	mA
$I_{CC}, I_{GND}$	DC $V_{CC}$ or GND current		–	$\pm 100$	mA
$T_{stg}$	storage temperature		–65	+150	$^{\circ}$ C
$P_{tot}$	power dissipation	for temperature range: –40 to +125 $^{\circ}$ C; note 2	–	600	mW

## Notes

- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- Above 55  $^{\circ}$ C the value of  $P_{tot}$  derates linearly with 8 mW/K.

# 18-bit universal bus transceiver with 30 $\Omega$ termination resistor; 3-state

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## DC CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS			$T_{amb} = -40 \text{ TO } +85 \text{ }^\circ\text{C}$			UNIT
		$V_I$ (V)	OTHER	$V_{CC}$ (V)	MIN.	TYP. <sup>(1)</sup>	MAX.	
$V_{IH}$	HIGH-level input voltage			2.3 to 2.7	1.7	1.2	–	V
				2.7 to 3.6	2.0	1.5	–	
$V_{IL}$	LOW-level input voltage			2.3 to 2.7	–	1.2	0.7	V
				2.7 to 3.6	–	1.5	0.8	
$V_{OH}$	HIGH-level output voltage	$V_{IH}$ or $V_{IL}$	$I_O = -100 \mu\text{A}$	2.3 to 3.6	$V_{CC} - 0.2$	$V_{CC}$	–	V
			$I_O = -4 \text{ mA}$	2.3	$V_{CC} - 0.4$	$V_{CC} - 0.11$	–	
			$I_O = -6 \text{ mA}$	2.3	$V_{CC} - 0.6$	$V_{CC} - 0.17$	–	
			$I_O = -4 \text{ mA}$	2.7	$V_{CC} - 0.5$	$V_{CC} - 0.09$	–	
			$I_O = -8 \text{ mA}$	2.7	$V_{CC} - 0.7$	$V_{CC} - 0.19$	–	
			$I_O = -6 \text{ mA}$	3.0	$V_{CC} - 0.6$	$V_{CC} - 0.13$	–	
			$I_O = -12 \text{ mA}$	3.0	$V_{CC} - 1.0$	$V_{CC} - 0.27$	–	
$V_{OL}$	LOW-level output voltage	$V_{IH}$ or $V_{IL}$	$I_O = 100 \mu\text{A}$	2.3 to 3.6	–	GND	0.20	V
			$I_O = 4 \text{ mA}$	2.3	–	0.07	0.40	
			$I_O = 6 \text{ mA}$	2.3	–	0.11	0.55	
			$I_O = 4 \text{ mA}$	2.7	–	0.06	0.40	
			$I_O = 8 \text{ mA}$	2.7	–	0.13	0.60	
			$I_O = 6 \text{ mA}$	3.0	–	0.09	0.55	
			$I_O = 12 \text{ mA}$	3.0	–	0.19	0.80	
$I_I$	input leakage current	$V_{CC}$ or GND		2.3 to 3.6	–	0.1	5	$\mu\text{A}$
$I_{OZ}$	3-state output OFF-state current	$V_{IH}$ or $V_{IL}$	$V_O = V_{CC}$ or GND	2.3 to 3.6	–	0.1	10	$\mu\text{A}$
$I_{CC}$	quiescent supply voltage	$V_{CC}$ or GND	$I_O = 0$	2.3 to 3.6	–	0.2	40	$\mu\text{A}$
$\Delta I_{CC}$	additional quiescent supply current given per data I/O pin with bus hold	$V_{CC} - 0.6$	$I_O = 0$	2.3 to 3.6	–	150	750	$\mu\text{A}$
$I_{BHL}$	bus hold LOW sustaining current	0.7 <sup>(2)</sup>		2.3 <sup>(2)</sup>	45	–	–	$\mu\text{A}$
		0.8 <sup>(2)</sup>		3.0 <sup>(2)</sup>	75	150	–	
$I_{BHH}$	bus hold HIGH sustaining current	1.7 <sup>(2)</sup>		2.3 <sup>(2)</sup>	–45	–	–	$\mu\text{A}$
		2.0 <sup>(2)</sup>		3.0 <sup>(2)</sup>	–75	–175	–	
$I_{BHLO}$	bus hold LOW overdrive current			3.6 <sup>(2)</sup>	500	–	–	$\mu\text{A}$
$I_{BHHO}$	bus hold LOW overdrive current			3.6 <sup>(2)</sup>	–500	–	–	$\mu\text{A}$

### Notes

1. All typical values are measured at  $T_{amb} = 25 \text{ }^\circ\text{C}$ .
2. Valid for data inputs of bus hold parts.

# 18-bit universal bus transceiver with 30 $\Omega$ termination resistor; 3-state

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## AC CHARACTERISTICS FOR $V_{CC} = 2.3$ TO $2.7$ V

Ground = 0 V;  $t_r = t_f \leq 2.0$  ns;  $C_L = 30$  pF.

SYMBOL	PARAMETER	TEST CONDITIONS		$T_{amb} = -40$ TO $+85$ °C			UNIT
		WAVEFORMS	$V_{CC}$ (V)	MIN.	TYP. <sup>(1)</sup>	MAX.	
$t_{PHL}/t_{PLH}$	propagation delay $A_n, B_n$ to $B_n, A_n$	see Figs 6 and 10	2.3 to 2.7	1.3	4.0	5.3	ns
	propagation delay $LE_{AB}, LE_{BA}$ to $B_n, A_n$	see Figs 7 and 10	2.3 to 2.7	1.0	4.5	6.0	ns
	propagation delay $CP_{AB}, CP_{BA}$ to $B_n, A_n$	see Figs 7 and 10	2.3 to 2.7	1.5	4.7	6.4	ns
$t_{PZH}/t_{PZL}$	3-state output enable time $OE_{AB}, OE_{BA}$ to $B_n, A_n$	see Figs 8 and 10	2.3 to 2.7	1.6	3.9	6.1	ns
$t_{PHZ}/t_{PLZ}$	3-state output disable time $OE_{AB}, OE_{BA}$ to $B_n, A_n$	see Figs 8 and 10	2.3 to 2.7	1.8	2.6	5.7	ns
$t_W$	clock pulse width HIGH $LE_{AB}$ or $LE_{BA}$	see Figs 7 and 10	2.3 to 2.7	3.3	1.6	–	ns
	clock pulse width HIGH or LOW $CP_{AB}$ or $CP_{BA}$	see Figs 7 and 10	2.3 to 2.7	3.3	2.0	–	ns
$t_{su}$	set-up time $A_n, B_n$ to $CP_{AB}, CP_{BA}$	see Figs 9 and 10	2.3 to 2.7	+2.3	–0.2	–	ns
	set-up time $A_n, B_n$ to $LE_{AB}, LE_{BA}$	see Figs 9 and 10	2.3 to 2.7	1.3	0.1	–	ns
	set-up time $\overline{CE}_{AB}, \overline{CE}_{BA}$ to $CP_{AB}, CP_{BA}$		2.3 to 2.7	+2.0	–0.4	–	ns
$t_h$	hold time $A_n, B_n$ to $CP_{AB}, CP_{BA}$	see Figs 9 and 10	2.3 to 2.7	1.2	0.3	–	ns
	hold time $A_n, B_n$ to $LE_{AB}, LE_{BA}$	see Figs 9 and 10	2.3 to 2.7	1.3	0.2	–	ns
	hold time $\overline{CE}_{AB}, \overline{CE}_{BA}$ to $CP_{AB}, CP_{BA}$		2.3 to 2.7	1.1	0.4	–	ns
$f_{max}$	maximum clock pulse frequency	see Figs 7 and 10	2.3 to 2.7	150	190	–	MHz

### Note

1. All typical values are measured at  $T_{amb} = 25$  °C and  $V_{CC} = 2.5$  V.

18-bit universal bus transceiver with 30  $\Omega$   
termination resistor; 3-state

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AC CHARACTERISTICS FOR  $V_{CC} = 2.7\text{ V}$  AND  $V_{CC} = 3.0\text{ TO }3.6\text{ V}$

Ground = 0 V;  $t_r = t_f \leq 2.5\text{ ns}$ ;  $C_L = 50\text{ pF}$ .

SYMBOL	PARAMETER	TEST CONDITIONS		$T_{amb} = -40\text{ TO }+85\text{ }^\circ\text{C}$			UNIT
		WAVEFORMS	$V_{CC}$ (V)	MIN.	TYP. <sup>(1)</sup>	MAX.	
$t_{PHL}/t_{PLH}$	propagation delay $A_n, B_n$ to $B_n, A_n$	see Figs 6 and 10	2.7	–	3.9	5.2	ns
			3.0 to 3.6	1.6	3.1 <sup>(2)</sup>	4.5	
	propagation delay $LE_{AB}, LE_{BA}$ to $B_n, A_n$	see Figs 7 and 10	2.7	–	4.3	5.9	ns
			3.0 to 3.6	1.5	3.5 <sup>(2)</sup>	5.1	
	propagation delay $CP_{AB}, CP_{BA}$ to $B_n, A_n$	see Figs 7 and 10	2.7	–	4.5	6.3	ns
			3.0 to 3.6	1.6	3.7 <sup>(2)</sup>	5.5	
$t_{PZH}/t_{PZL}$	3-state output enable time $\overline{OE}_{AB}, \overline{OE}_{BA}$ to $B_n, A_n$	see Figs 8 and 10	2.7	–	3.9	6.7	ns
			3.0 to 3.6	1.6	3.1 <sup>(2)</sup>	5.7	
$t_{PHZ}/t_{PLZ}$	3-state output disable time $\overline{OE}_{AB}, \overline{OE}_{BA}$ to $B_n, A_n$	see Figs 8 and 10	2.7	–	3.2	5.3	ns
			3.0 to 3.6	1.8	2.9 <sup>(2)</sup>	4.8	
$t_w$	clock pulse width $LE_{AB}, LE_{BA}$ to $CP_{AB}, CP_{BA}$	see Figs 7 and 10	2.7	3.3	0.7	–	ns
			3.0 to 3.6	3.3	0.9 <sup>(2)</sup>	–	
	clock pulse width HIGH or LOW $CP_{AB}, CP_{BA}$	see Figs 7 and 10	2.7	3.3	1.2	–	ns
			3.0 to 3.6	3.3	0.9 <sup>(2)</sup>	–	
$t_{su}$	set-up time $A_n, B_n$ to $CP_{AB}, CP_{BA}$	see Figs 9 and 10	2.7	2.4	0.0	–	ns
			3.0 to 3.6	+2.1	–0.2 <sup>(2)</sup>	–	
	set-up time $A_n, B_n$ to $LE_{AB}, LE_{BA}$	see Figs 9 and 10	2.7	+1.2	–0.2	–	ns
			3.0 to 3.6	1.1	0.3 <sup>(2)</sup>	–	
	set-up time $\overline{CE}_{AB}, \overline{CE}_{BA}$ to $CP_{AB}, CP_{BA}$		2.7	+2.0	–0.7	–	ns
			3.0 to 3.6	+1.7	–0.2 <sup>(2)</sup>	–	
$t_h$	hold time $A_n, B_n$ to $CP_{AB}, CP_{BA}$	see Figs 9 and 10	2.7	1.1	0.3	–	ns
			3.0 to 3.6	+1.0	–0.1 <sup>(2)</sup>	–	
	hold time $A_n, B_n$ to $LE_{AB}, LE_{BA}$	see Figs 9 and 10	2.7	1.6	0.1	–	ns
			3.0 to 3.6	1.4	0.1 <sup>(2)</sup>	–	
	hold time $\overline{CE}_{AB}, \overline{CE}_{BA}$ to $CP_{AB}, CP_{BA}$		2.7	1.2	0.6	–	ns
			3.0 to 3.6	1.1	0.4 <sup>(2)</sup>	–	
$f_{max}$	maximum clock pulse frequency	see Figs 7 and 10	2.7	150	190	–	MHz
			3.0 to 3.6	150	240 <sup>(2)</sup>	–	

Notes

1. All typical values are measured at  $T_{amb} = 25\text{ }^\circ\text{C}$ .
2. Typical values at  $V_{CC} = 3.3\text{ V}$ .

# 18-bit universal bus transceiver with 30 $\Omega$ termination resistor; 3-state

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## AC WAVEFORMS

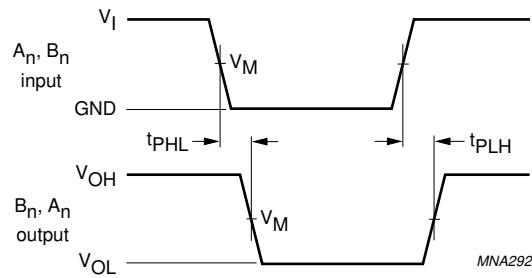


Fig.6 The input A<sub>n</sub>, B<sub>n</sub> to output B<sub>n</sub>, A<sub>n</sub> propagation delay times.

### Notes: V<sub>CC</sub> = 2.3 to 2.7 V

$$V_M = 0.5V_{CC};$$

$$V_X = V_{OL} + 150 \text{ mV};$$

$$V_Y = V_{OH} - 150 \text{ mV};$$

$$V_I = V_{CC};$$

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage drop that occur with the output load.

### Notes: V<sub>CC</sub> = 3.0 to 3.6 V and V<sub>CC</sub> = 2.7 V

$$V_M = 1.5 \text{ V};$$

$$V_X = V_{OL} + 300 \text{ mV};$$

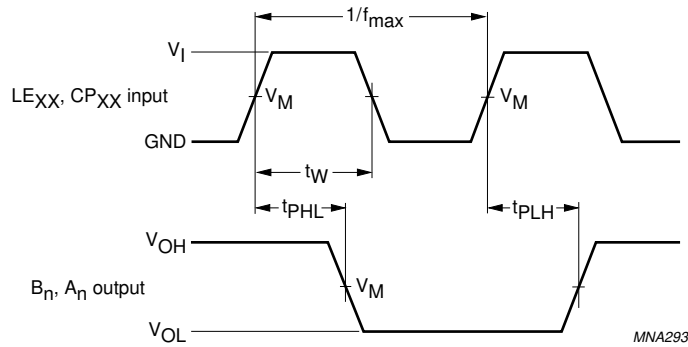
$$V_Y = V_{OH} - 300 \text{ mV};$$

$$V_I = 2.7 \text{ V};$$

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage drop that occur with the output load.

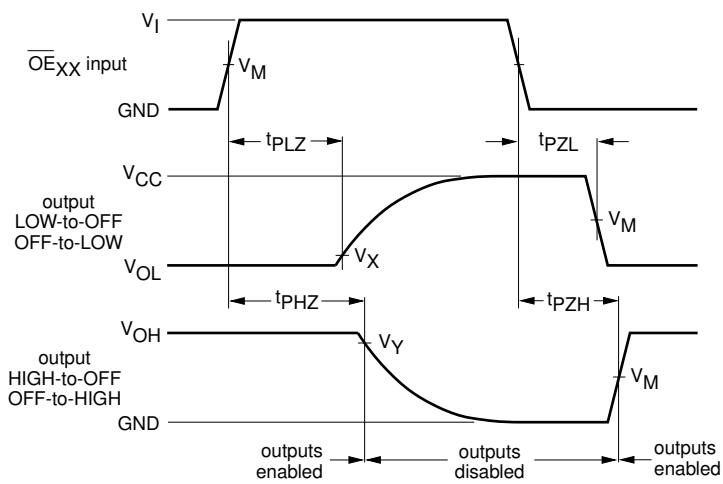
# 18-bit universal bus transceiver with 30 Ω termination resistor; 3-state

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MNA293

Fig.7 Latch enable input LE<sub>AB</sub>, LE<sub>BA</sub> and clock input CP<sub>AB</sub>, CP<sub>BA</sub> to output B<sub>n</sub>, A<sub>n</sub> propagation delay times; pulse width and  $f_{max}$  of CP<sub>AB</sub>, CP<sub>BA</sub>.

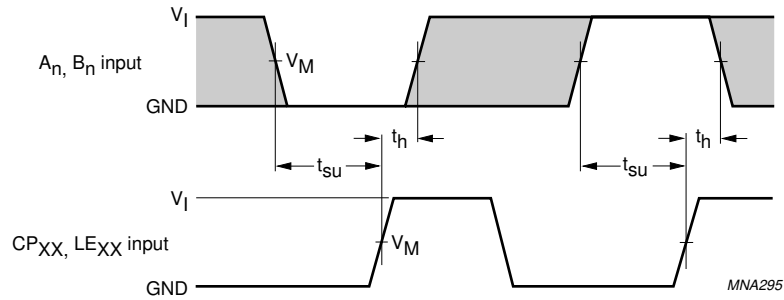


MNA294

Fig.8 3-state enable and disable times.

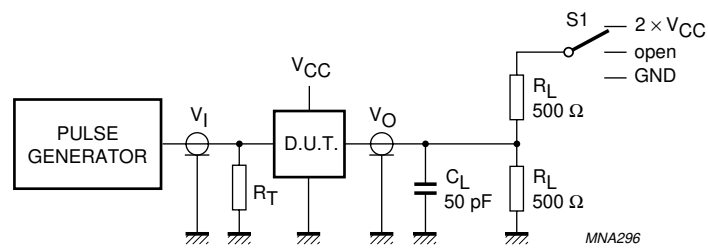
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The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig.9 Data set-up and hold times for A<sub>n</sub> and B<sub>n</sub> inputs to LE<sub>AB</sub>, LE<sub>BA</sub>, CP<sub>AB</sub> or CP<sub>BA</sub> inputs.



TEST	S1
t <sub>PLH</sub> /t <sub>PHL</sub>	open
t <sub>PLZ</sub> /t <sub>PZL</sub>	2 × V <sub>CC</sub>
t <sub>PHZ</sub> /t <sub>PZH</sub>	GND

V <sub>CC</sub>	V <sub>I</sub>
<2.7 V	V <sub>CC</sub>
2.7 to 3.6 V	2.7 V

Definitions for test circuit.

C<sub>L</sub> = load capacitance including jig and probe capacitance (See Chapter "AC characteristics").

R<sub>L</sub> = load resistance.

R<sub>T</sub> = termination resistance should be equal to the output impedance Z<sub>o</sub> of the pulse generator.

Fig.10 Load circuitry for switching times.



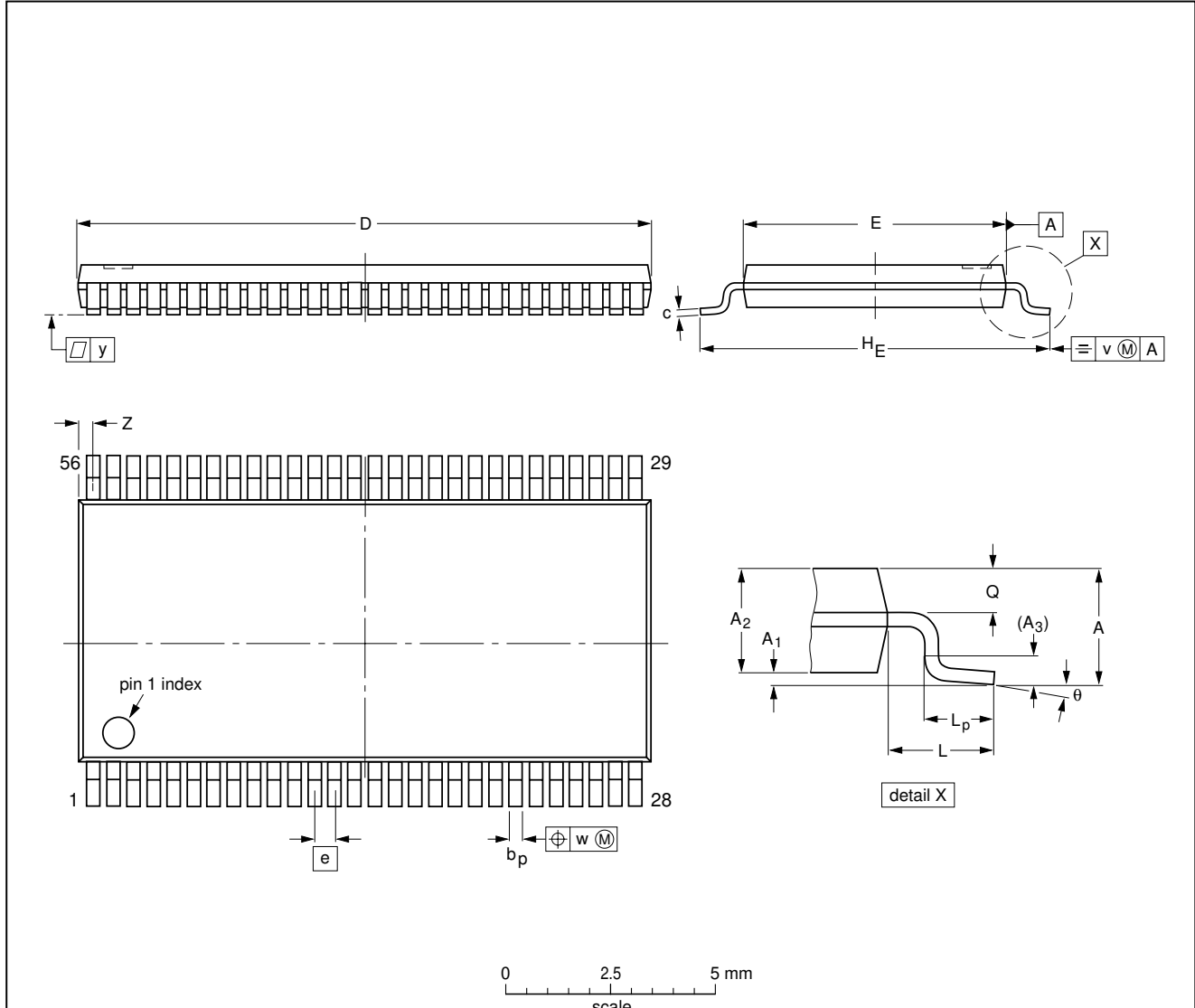
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PACKAGE OUTLINE

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1



DIMENSIONS (mm are the original dimensions).

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	0.2 0.1	14.1 13.9	6.2 6.0	0.5	8.3 7.9	1.0	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.5 0.1	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT364-1		MO-153EE				93-02-03 95-02-10

## 18-bit universal bus transceiver with 30 $\Omega$ termination resistor; 3-state

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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 is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

#### 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.

Several methods exist for reflowing; for example, infrared/convection 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 250 °C. The top-surface temperature of the packages should preferably be kept below 230 °C.

#### 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 is 4 seconds at 250 °C.

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	SOLDERING METHOD	
	WAVE	REFLOW <sup>(1)</sup>
BGA, SQFP	not suitable	suitable
HLQFP, HSQFP, HSOP, HTSSOP, SMS	not suitable <sup>(2)</sup>	suitable
PLCC <sup>(3)</sup> , SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended <sup>(3)(4)</sup>	suitable
SSOP, TSSOP, VSO	not recommended <sup>(5)</sup>	suitable

### Notes

- 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 packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
- If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
- Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or 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 only suitable for SSOP and TSSOP 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.

### DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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**NOTES**

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# Philips Semiconductors – a worldwide company

**Argentina:** see South America

**Australia:** 3 Figtree Drive, HOMEBUSH, NSW 2140,  
Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

**Austria:** Computerstr. 6, A-1101 WIEN, P.O. Box 213,  
Tel. +43 1 60 101 1248, Fax. +43 1 60 101 1210

**Belarus:** Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,  
220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

**Belgium:** see The Netherlands

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**Bulgaria:** Philips Bulgaria Ltd., Energoproject, 15th floor,  
51 James Bourchier Blvd., 1407 SOFIA,  
Tel. +359 2 68 9211, Fax. +359 2 68 9102

**Canada:** PHILIPS SEMICONDUCTORS/COMPONENTS,  
Tel. +1 800 234 7381, Fax. +1 800 943 0087

**China/Hong Kong:** 501 Hong Kong Industrial Technology Centre,  
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Tel. +852 2319 7888, Fax. +852 2319 7700

**Colombia:** see South America

**Czech Republic:** see Austria

**Denmark:** Sydhavnsgade 23, 1780 COPENHAGEN V,  
Tel. +45 33 29 3333, Fax. +45 33 29 3905

**Finland:** Sinikalliontie 3, FIN-02630 ESPOO,  
Tel. +358 9 615 800, Fax. +358 9 6158 0920

**France:** 51 Rue Carnot, BP317, 92156 SURESNES Cedex,  
Tel. +33 1 4099 6161, Fax. +33 1 4099 6427

**Germany:** Hammerbrookstraße 69, D-20097 HAMBURG,  
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**Hungary:** see Austria

**India:** Philips INDIA Ltd, Band Box Building, 2nd floor,  
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,  
Tel. +91 22 493 8541, Fax. +91 22 493 0966

**Indonesia:** PT Philips Development Corporation, Semiconductors Division,  
Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510,  
Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

**Ireland:** Newstead, Clonskeagh, DUBLIN 14,  
Tel. +353 1 7640 000, Fax. +353 1 7640 200

**Israel:** RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,  
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

**Italy:** PHILIPS SEMICONDUCTORS, Via Casati, 23 - 20052 MONZA (MI),  
Tel. +39 039 203 6838, Fax +39 039 203 6800

**Japan:** Philips Bldg 13-37, Kohnan 2-chome, Minato-ku,  
TOKYO 108-8507, Tel. +81 3 3740 5130, Fax. +81 3 3740 5057

**Korea:** Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,  
Tel. +82 2 709 1412, Fax. +82 2 709 1415

**Malaysia:** No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,  
Tel. +60 3 750 5214, Fax. +60 3 757 4880

**Mexico:** 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,  
Tel. +9-5 800 234 7381, Fax +9-5 800 943 0087

**Middle East:** see Italy

**Netherlands:** Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,  
Tel. +31 40 27 82785, Fax. +31 40 27 88399

**New Zealand:** 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,  
Tel. +64 9 849 4160, Fax. +64 9 849 7811

**Norway:** Box 1, Manglerud 0612, OSLO,  
Tel. +47 22 74 8000, Fax. +47 22 74 8341

**Pakistan:** see Singapore

**Philippines:** Philips Semiconductors Philippines Inc.,  
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Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

**Poland:** Al.Jerozolimskie 195 B, 02-222 WARSAW,  
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**Spain:** Balmes 22, 08007 BARCELONA,  
Tel. +34 93 301 6312, Fax. +34 93 301 4107

**Sweden:** Kottbygatan 7, Akalla, S-16485 STOCKHOLM,  
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ISTANBUL, Tel. +90 216 522 1500, Fax. +90 216 522 1813

**Ukraine:** PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,  
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

**United Kingdom:** Philips Semiconductors Ltd., 276 Bath Road, Hayes,  
MIDDLESEX UB3 5BX, Tel. +44 208 730 5000, Fax. +44 208 754 8421

**United States:** 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,  
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**Yugoslavia:** PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,  
Tel. +381 11 62 5344, Fax.+381 11 63 5777

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