

# DATA SHEET

## **74LVT2952**

**3.3 V LVT octal registered transceiver  
(3-State)**

Product data sheet  
Supersedes data of 1998 Feb 19  
IC23 Data Handbook

2004 Sep 07

## 3.3 V Octal registered transceiver (3-State)

74LVT2952

## FEATURES

- 8-bit registered transceiver
- Independent registers for A and B buses
- Output capability: +64 mA/–32 mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- No bus current loading when output is tied to 5 V bus
- Power-up reset
- Power-up 3-State
- Latch-up protection exceeds 500 mA per JEDEC Std 17
- ESD protection exceeds 2000 V per MIL STD 883 Method 3015 and 200 V per Machine Model

## DESCRIPTION

The LVT2952 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3 V.

This device combines low static and dynamic power dissipation with high speed and high output drive.

The 74LVT2952 device is an 8-bit registered transceiver. Two 8-bit back-to-back registers store data flowing in both directions between two bidirectional buses.

Data applied to the inputs is entered and stored on the rising edge of the Clock (CPXX) provided that the Clock Enable ( $\overline{CEXX}$ ) is LOW. The data is then present at the 3-State output buffers, but is only accessible when the Output Enable ( $\overline{OEXX}$ ) is LOW. Data flow from A inputs to B outputs is the same as for B inputs to A outputs.

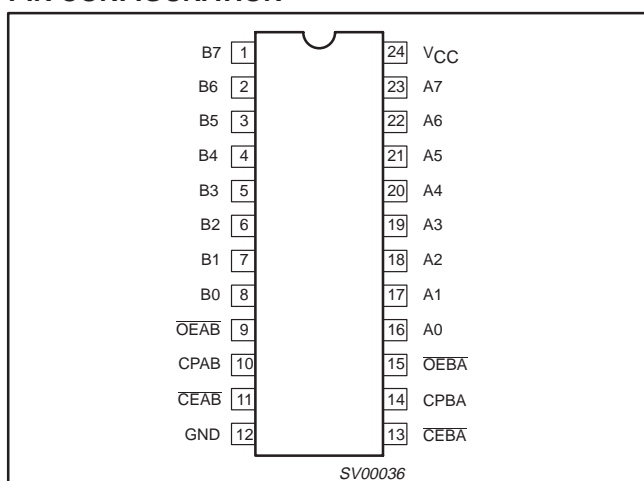
## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS $T_{amb} = 25\text{ }^{\circ}\text{C}; \text{GND} = 0\text{ V}$	TYPICAL	UNIT
$t_{PLH}$ $t_{PHL}$	Propagation delay CPBA to An or CPAB to Bn	$C_L = 50\text{ pF}; V_{CC} = 3.3\text{ V}$	3.1 3.8	ns
$C_{IN}$	Input capacitance	$V_I = 0\text{ V or }3.0\text{ V}$	4	pF
$C_{I/O}$	I/O pin capacitance	Outputs disabled; $V_{I/O} = 0\text{ V or }3.0\text{ V}$	8	pF
$I_{CCZ}$	Total supply current	Outputs disabled; $V_{CC} = 3.6\text{ V}$	0.13	mA

## ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	TYPE NUMBER	DWG NUMBER
24-Pin Plastic SOL	–40 °C to +85 °C	74LVT2952D	SOT137-1
24-Pin Plastic SSOP Type II	–40 °C to +85 °C	74LVT2952DB	SOT340-1
24-Pin Plastic TSSOP Type I	–40 °C to +85 °C	74LVT2952PW	SOT355-1

## PIN CONFIGURATION



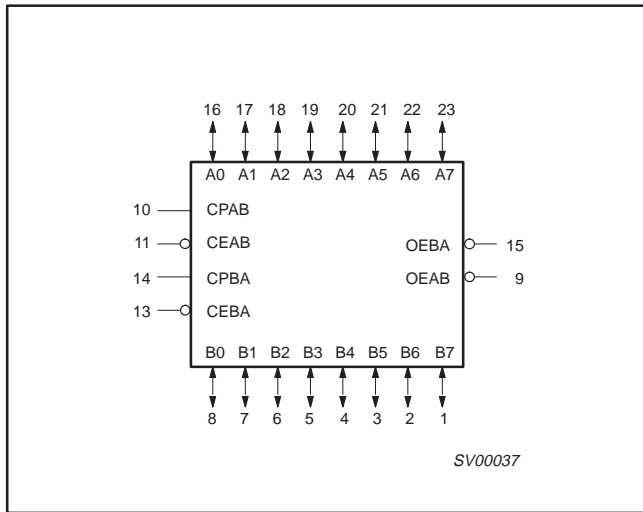
## PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
10, 14	CPAB / CPBA	Clock input A to B / Clock input B to A
11, 13	$\overline{CEAB} / \overline{CEBA}$	Clock enable input A to B / Clock enable input B to A
16, 17, 18, 19, 20, 21, 22, 23	A0 – A7	Data inputs/outputs (A side)
8, 7, 6, 5, 4, 3, 2, 1	B0 – B7	Data outputs/outputs (B side)
9, 15	$\overline{OEAB} / \overline{OEBA}$	Output enable inputs
12	GND	Ground (0 V)
24	$V_{CC}$	Positive supply voltage

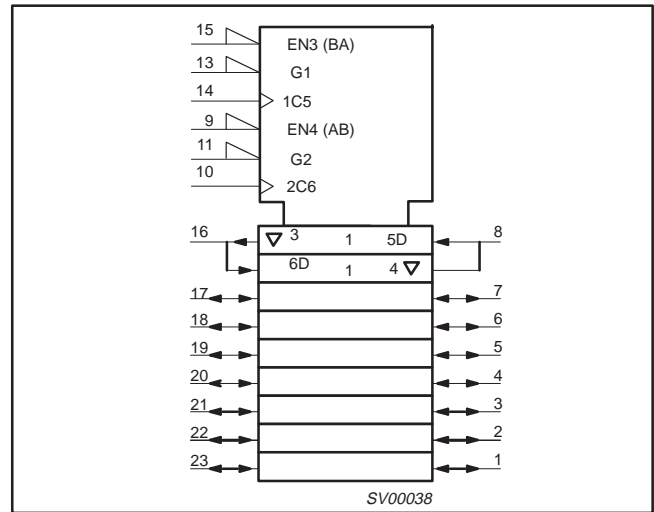
# 3.3 V Octal registered transceiver (3-State)

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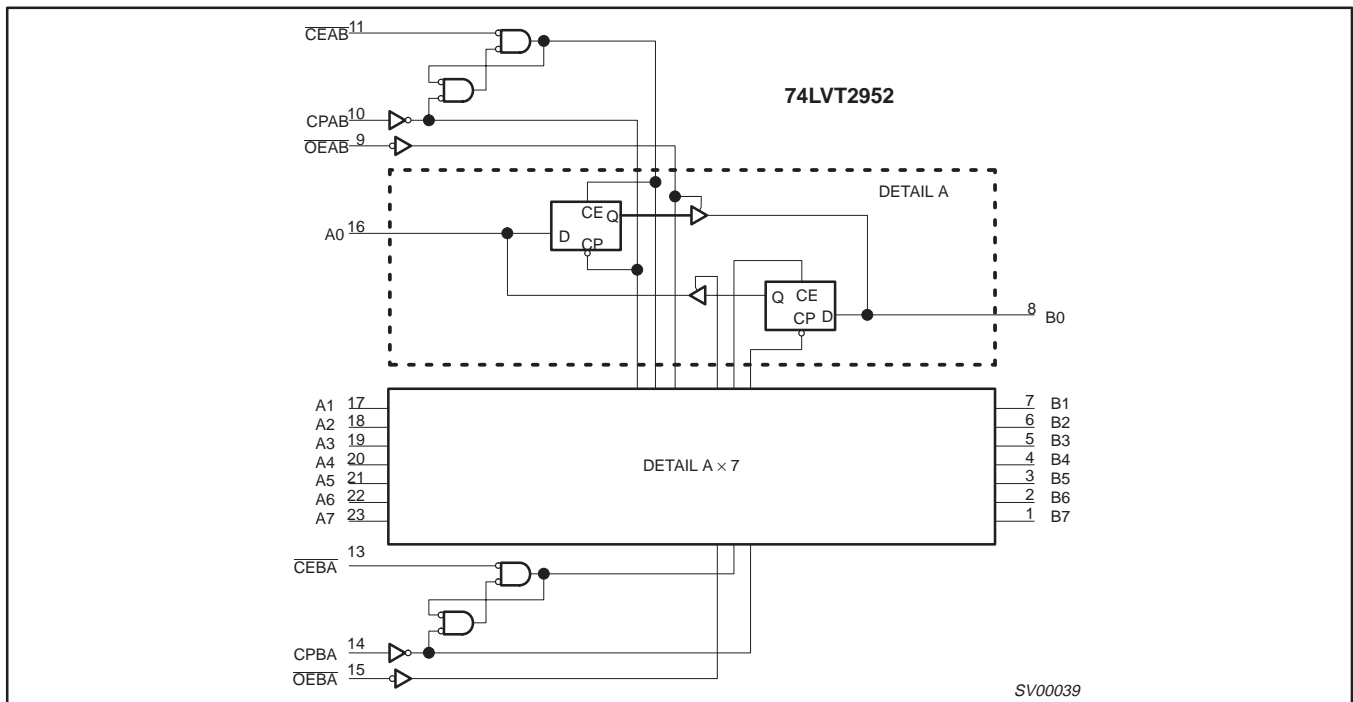
## LOGIC SYMBOL



## LOGIC SYMBOL (IEEE/IEC)



## LOGIC DIAGRAM



### FUNCTION TABLE for Register An or Bn

INPUTS			INTERNAL Q	OPERATING MODE
An or Bn	CPXX	CEXX		
X	X	H	NC	Hold data
L	↑	L	L	Load data
H	↑	L	H	

H = HIGH voltage level  
 L = LOW voltage level  
 ↑ = LOW-to-HIGH transition  
 X = Don't care  
 XX = AB or BA  
 NC = No change

### FUNCTION TABLE for Output Enable

INPUTS	INTERNAL Q	An or Bn OUTPUTS	OPERATING MODE
OEXX			
H	X	Z	Disable outputs
L	L	L	Enable outputs
L	H	H	

H = HIGH voltage level  
 L = LOW voltage level  
 X = Don't care  
 XX = AB or BA  
 Z = High-impedance "off" state

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**ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>**

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V <sub>CC</sub>	DC supply voltage		-0.5 to +4.6	V
I <sub>IK</sub>	DC input diode current	V <sub>I</sub> < 0 V	-50	mA
V <sub>I</sub>	DC input voltage <sup>3</sup>		-0.5 to +7.0	V
I <sub>OK</sub>	DC output diode current	V <sub>O</sub> < 0 V	-50	mA
V <sub>OUT</sub>	DC output voltage <sup>3</sup>	Output in Off or HIGH state	-0.5 to +7.0	V
I <sub>OUT</sub>	DC output current	Output in HIGH state	-64	mA
		Output in LOW state	128	
T <sub>stg</sub>	Storage temperature range		-65 to 150	°C

**NOTES:**

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.
- The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

**RECOMMENDED OPERATING CONDITIONS**

SYMBOL	PARAMETER	LIMITS		UNIT
		MIN	MAX	
V <sub>CC</sub>	DC supply voltage	2.7	3.6	V
V <sub>I</sub>	Input voltage	0	5.5	V
V <sub>IH</sub>	HIGH-level input voltage	2.0	-	V
V <sub>IL</sub>	LOW-level Input voltage	-	0.8	V
I <sub>OH</sub>	HIGH-level output current	-	-32	mA
I <sub>OL</sub>	LOW-level output current	-	32	mA
	LOW-level output current; current duty cycle ≤ 50 %, f ≥ 1 kHz	-	64	
Δt/Δv	Input transition rise or fall rate; Outputs enabled	-	10	ns/V
T <sub>amb</sub>	Operating free-air temperature range	-40	+85	°C

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## DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT	
			Temp = -40 °C to +85 °C				
			MIN	TYP <sup>1</sup>	MAX		
V <sub>IK</sub>	Input clamp voltage	V <sub>CC</sub> = 2.7 V; I <sub>IK</sub> = -18 mA	-	-0.9	-1.2	V	
V <sub>OH</sub>	HIGH-level output voltage	V <sub>CC</sub> = 2.7 V to 3.6 V; I <sub>OH</sub> = -100 μA	V <sub>CC</sub> - 0.2	V <sub>CC</sub> - 0.1	-	V	
		V <sub>CC</sub> = 2.7 V; I <sub>OH</sub> = -8 mA	2.4	2.5	-		
		V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -32 mA	2.0	2.2	-		
V <sub>OL</sub>	LOW-level output voltage	V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 100 μA	-	0.1	0.2	V	
		V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 24 mA	-	0.3	0.5		
		V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 16 mA	-	0.25	0.4		
		V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 32 mA	-	0.3	0.5		
		V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 64 mA	-	0.4	0.55		
V <sub>RST</sub>	Power-up output low voltage <sup>5</sup>	V <sub>CC</sub> = 3.6 V; I <sub>O</sub> = 1 mA; V <sub>I</sub> = GND or V <sub>CC</sub>	-	0.13	0.55	V	
I <sub>I</sub>	Input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND	Control pins	-	± 0.1	± 1.0	μA
		V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V		-	1	10	
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V	I/O Data pins <sup>4</sup>	-	1	20	
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub>		-	0.1	1.0	
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 0 V		-	-1	-5.0	
I <sub>OFF</sub>	Output off current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V	-	1	± 100	μA	
I <sub>HOLD</sub>	Bus Hold current A inputs <sup>6</sup>	V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V	75	150	-	μA	
		V <sub>CC</sub> = 3 V; V <sub>I</sub> = 2.0 V	-75	-150	-		
		V <sub>CC</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 3.6 V	± 500	-	-		
I <sub>EX</sub>	Current into an output in the HIGH state when V <sub>O</sub> > V <sub>CC</sub>	V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 3.0 V	-	60	125	μA	
I <sub>PU/PD</sub>	Power-up/down 3-State output current <sup>3</sup>	V <sub>CC0</sub> ≤ 1.2 V; V <sub>O</sub> = 0.5 V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; OE/OE = Don't care	-	± 1	± 100	μA	
I <sub>CCH</sub>	Quiescent supply current	V <sub>CC</sub> = 3.6 V; Outputs HIGH, V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA	-	0.13	0.19	mA	
I <sub>CCL</sub>		V <sub>CC</sub> = 3.6 V; Outputs LOW, V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA	-	3	12		
I <sub>CCZ</sub>		V <sub>CC</sub> = 3.6 V; Outputs Disabled; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA	-	0.13	0.19		
ΔI <sub>CC</sub>	Additional supply current per input pin <sup>2</sup>	V <sub>CC</sub> = 3 V to 3.6 V; One input at V <sub>CC</sub> - 0.6 V; Other inputs at V <sub>CC</sub> or GND	-	0.1	0.2	mA	

## NOTES:

- All typical values are at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.
- This is the increase in supply current for each input at V<sub>CC</sub> = 0.6 V.
- This parameter is valid for any V<sub>CC</sub> between 0 V and 1.3 V with a transition time of up to 10 msec. From V<sub>CC</sub> = 1.3 V to V<sub>CC</sub> = 3.3 V ± 0.3 V a transition time of 100 μsec is permitted. This parameter is valid for T<sub>amb</sub> = 25 °C only.
- Unused pins at V<sub>CC</sub> or GND.
- For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.
- This is the bus hold overdrive current required to force the input to the opposite logic state.

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#### AC CHARACTERISTICS

GND = 0 V;  $t_R = t_F = 2.5$  ns;  $C_L = 50$  pF,  $R_L = 500$   $\Omega$ ;  $T_{amb} = -40$  °C to  $+85$  °C.

SYMBOL	PARAMETER	WAVEFORM	LIMITS				UNIT
			$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$			$V_{CC} = 2.7\text{ V}$	
			MIN	TYP <sup>1</sup>	MAX	MAX	
$f_{MAX}$	Maximum clock frequency	1	150	200			MHz
$t_{PLH}$ $t_{PHL}$	Propagation delay CPBA to An, CPAB to Bn	1	1.3 1.8	3.1 3.8	6.1 6.0	7.1 6.9	ns
$t_{PZH}$ $t_{PZL}$	Output enable time $\overline{OEBA}$ to An, $\overline{OEAB}$ to Bn	3 4	1.0 1.2	3.4 3.6	5.6 6.5	6.7 8.0	ns
$t_{PHZ}$ $t_{PLZ}$	Output disable time $\overline{OEBA}$ to An, $\overline{OEAB}$ to Bn	3 4	1.0 1.6	3.7 3.4	6.3 5.1	6.9 5.3	ns

**NOTE:**

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

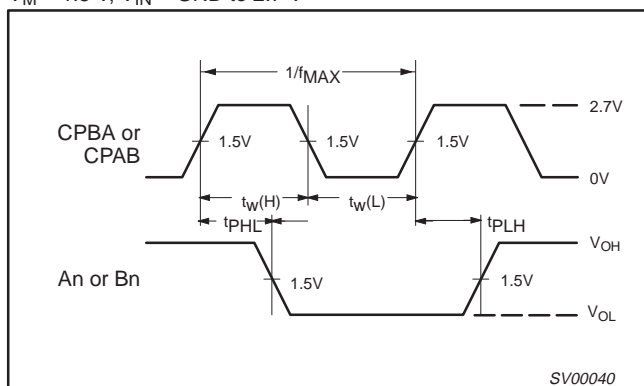
#### AC SETUP REQUIREMENTS

GND = 0 V;  $t_R = t_F = 2.5$  ns;  $C_L = 50$  pF,  $R_L = 500$   $\Omega$ ;  $T_{amb} = -40$  °C to  $+85$  °C.

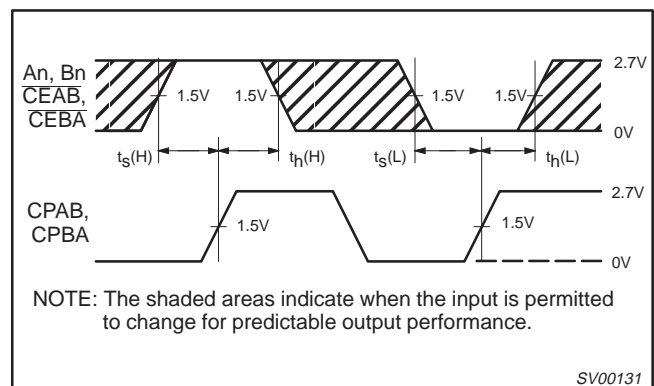
SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CC} = 2.7\text{ V}$	
			MIN	TYP <sup>1</sup>	MIN	
$t_s(H)$ $t_s(L)$	Setup time An to CPAB or Bn to CPBA	2	2.5 2.5	1 1	2.8 3.0	ns
$t_h(H)$ $t_h(L)$	Hold time An to CPAB or Bn to CPBA	2	1.5 1.5	-0.5 -0.5	0.7 2.6	ns
$t_s(H)$ $t_s(L)$	Setup time $\overline{CEAB}$ to CPAB or $\overline{CEBA}$ to CPBA	2	0.9 2.4	0.3 -0.3	0.8 2.7	ns
$t_h(H)$ $t_h(L)$	Hold time $\overline{CEAB}$ to CPAB or $\overline{CEBA}$ to CPBA	2	2.5 2.5	0.3 0	0.7 2.6	ns
$t_W(H)$ $t_W(L)$	CPAB or CPBA pulse width High or Low	1	3.3 3.3	1 1	3.3 3.3	ns

#### AC WAVEFORMS

$V_M = 1.5\text{ V}$ ,  $V_{IN} = \text{GND to } 2.7\text{ V}$



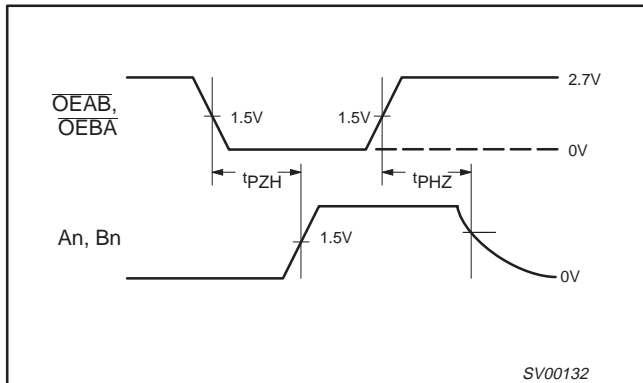
**Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width, and Maximum Clock Frequency**



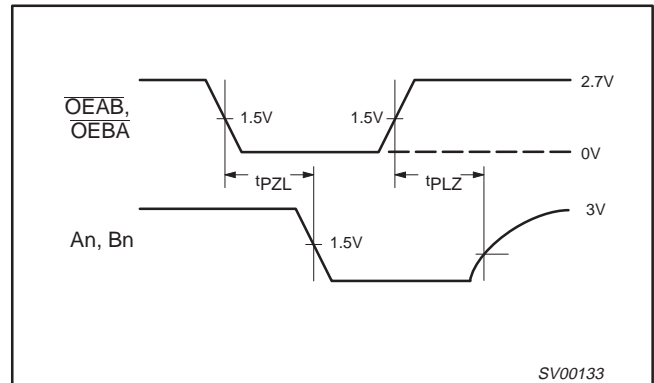
**Waveform 2. Data Setup and Hold Times**

### 3.3 V Octal registered transceiver (3-State)

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Waveform 3. 3-State Output Enable Time to High Level and Output Disable Time from High Level



Waveform 4. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level

### TEST CIRCUIT AND WAVEFORMS

Test Circuit for 3-State Outputs

$V_M = 1.5\text{ V}$   
Input Pulse Definition

**SWITCH POSITION**

TEST	SWITCH
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6V
$t_{PHZ}/t_{PZH}$	GND

**DEFINITIONS**

$R_L$  = Load resistor; see AC CHARACTERISTICS for value.

$C_L$  = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

$R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	$t_W$	$t_R$	$t_F$
74LVT	2.7 V	$\leq 10\text{ MHz}$	500 ns	$\leq 2.5\text{ ns}$	$\leq 2.5\text{ ns}$

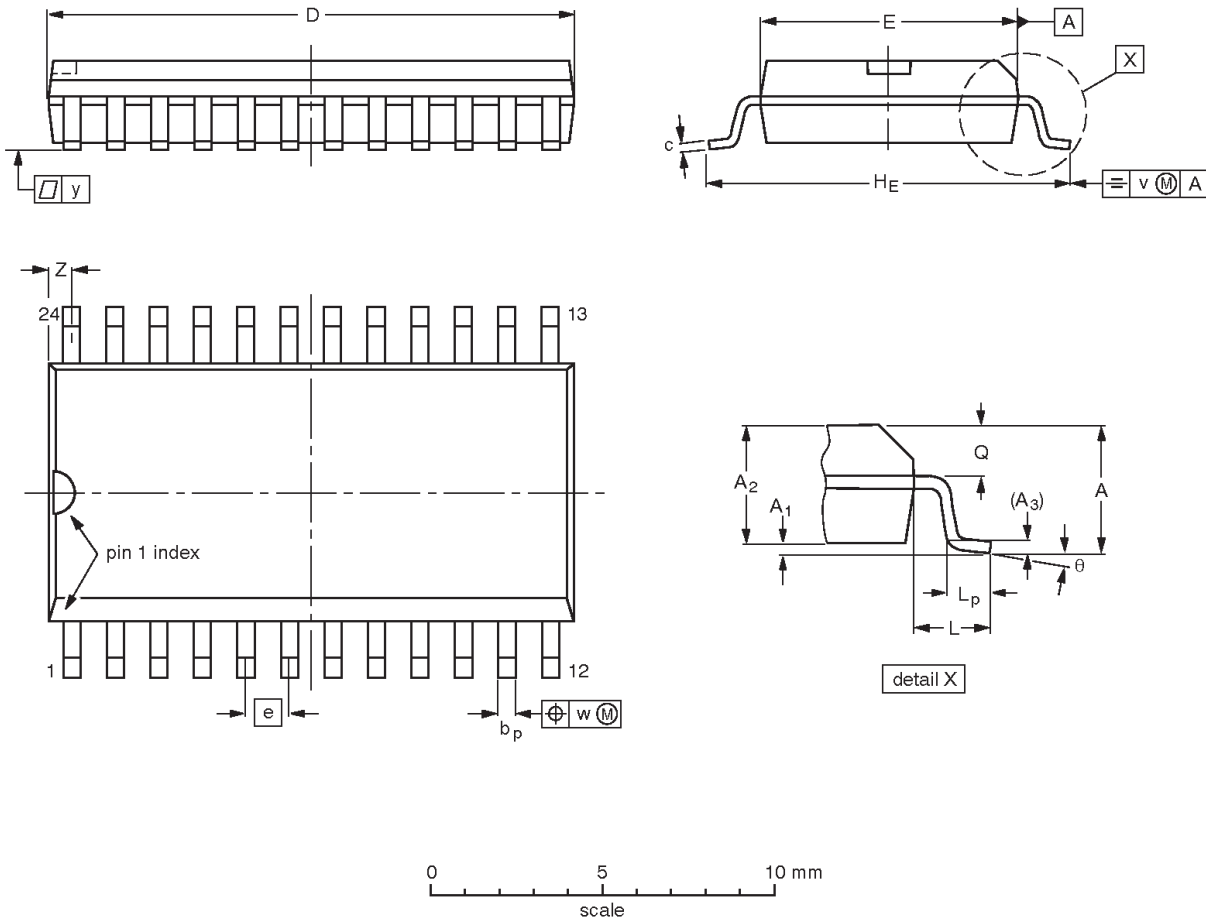
SV00092

### 3.3 V Octal registered transceiver (3-State)

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SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1



**DIMENSIONS (inch dimensions are derived from the original mm 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>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT137-1	075E05	MS-013				-99-12-27 03-02-19

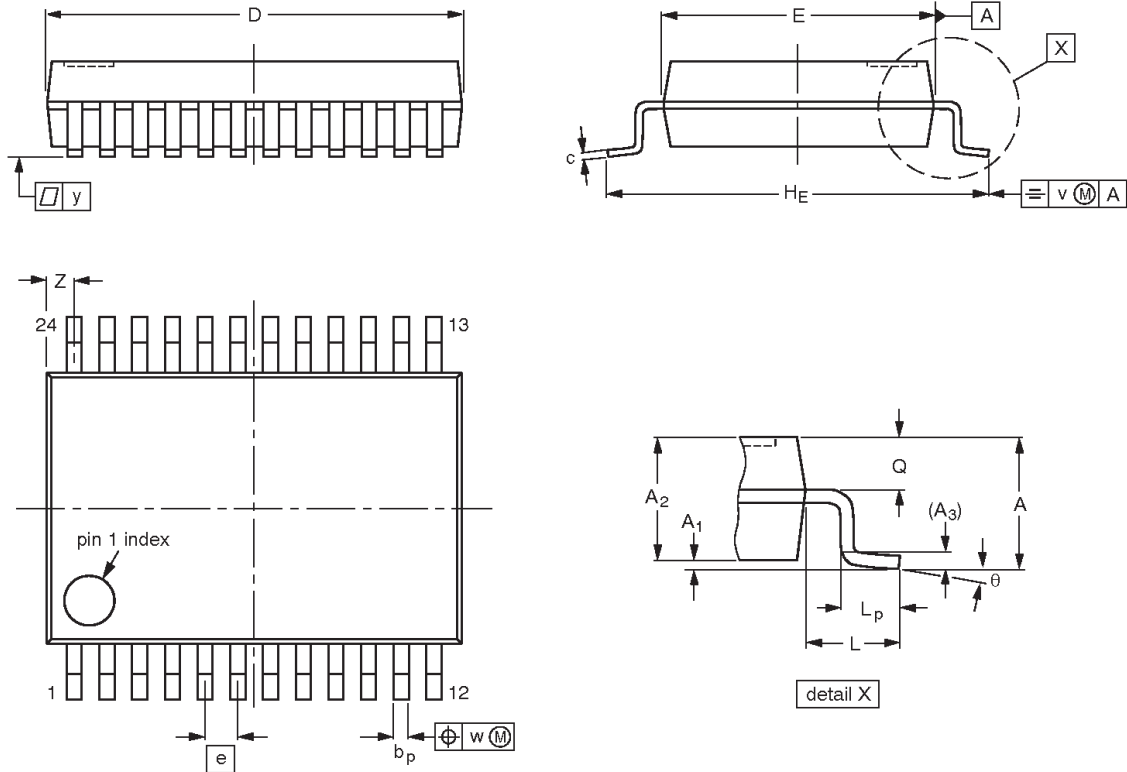


### 3.3 V Octal registered transceiver (3-State)

74LVT2952

**SSOP24:** plastic shrink small outline package; 24 leads; body width 5.3 mm

**SOT340-1**



**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>(1)</sup>	e	HE	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	8.4 8.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.8 0.4	8° 0°

**Note**

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

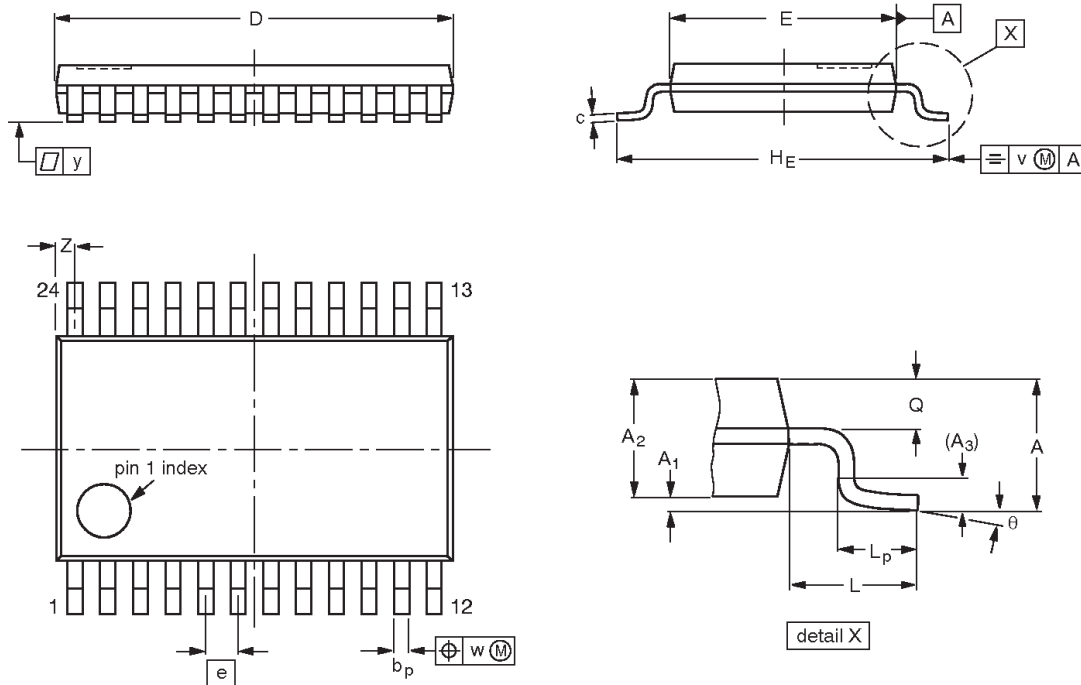
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT340-1		MO-150				99-12-27 03-02-19

### 3.3 V Octal registered transceiver (3-State)

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TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1



**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 <sup>(1)</sup>	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	7.9 7.7	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	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	JEITA			
SOT355-1		MO-153				-99-12-27 03-02-19

## 3.3 V Octal registered transceiver (3-State)

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## REVISION HISTORY

Rev	Date	Description
_3	20040907	<b>Product data sheet (9397 750 04331). ECN 853-1765 18987 of 19 February 1998. Supersedes data of 1994 September 27.</b> Modifications: <ul style="list-style-type: none"><li>● Ordering information table on page 2: remove 'North America' column; rename 'Outside North America' column to 'Type number'.</li><li>● Logic diagram on page 3: add inversion symbols on clock signals before CP inputs.</li></ul>
_2	19980219	<b>Product specification (9397 750 03546). ECN 853-1765 18987 of 19 February 1998. Supersedes data of 1994 September 27.</b>
_1	19940927	

## 3.3 V Octal registered transceiver (3-State)

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## Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definitions
I	Objective data sheet	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.
II	Preliminary data sheet	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data sheet	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[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.

**Application information** — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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