

# DATA SHEET

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## 74LVC541A

Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

Product specification  
Supersedes data of 1997 Oct 27  
IC24 Data Handbook

1998 Jul 29

# Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

## 74LVC541A

### FEATURES

- 5-volt tolerant inputs/outputs, for interfacing with 5-volt logic
- Wide supply voltage range of 2.7V to 3.6V
- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- Direct interface with TTL levels
- 5 Volt tolerant inputs/outputs, for interfacing with 5 Volt logic

### DESCRIPTION

The 74LVC541A is a high performance, low-power, low-voltage Si-gate CMOS device and superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3V or 5.0V devices. In 3-State operation, outputs can handle 5V. This feature allows the use of these devices as translators in a mixed 3.3V/5V environment.

The 74LVC541A is an octal non-inverting buffer/line driver with 5-volt tolerant inputs/outputs. The 3-State outputs are controlled by the output enable inputs  $\overline{OE}1$  and  $\overline{OE}2$ .

### QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
$t_{PHL}/t_{PLH}$	Propagation delay An to Yn	$C_L = 50$ pF; $V_{CC} = 3.3$ V	3.3	ns
$C_I$	Input capacitance		5.0	pF
$C_{PD}$	Power dissipation capacitance per buffer	Notes 1 and 2	20	pF

#### NOTES:

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

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

$f_i$  = input frequency in MHz;  $C_L$  = output load capacitance in pF;

$f_o$  = output frequency in MHz;  $V_{CC}$  = supply voltage in V;

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

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

### ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic SO	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	74LVC541A D	74LVC541A D	SOT163-1
20-Pin Plastic SSOP Type II	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	74LVC541A DB	74LVC541A DB	SOT339-1
20-Pin Plastic TSSOP Type I	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	74LVC541A PW	74LVC541APW DH	SOT360-1

### PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
1, 19	$\overline{OE}1, \overline{OE}2$	Output enable inputs (active LOW)
2, 3, 4, 5, 6, 7, 8, 9	A0 to A7	Data inputs
10	GND	Ground (0 V)
18, 17, 16, 15, 14, 13, 12, 11	Y0 to Y7	Bus outputs
20	$V_{CC}$	Positive supply voltage

### FUNCTION TABLE

INPUTS	INPUTS		OUTPUT
	$\overline{OE}1$	$\overline{OE}2$	
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

H = HIGH voltage level

L = LOW voltage level

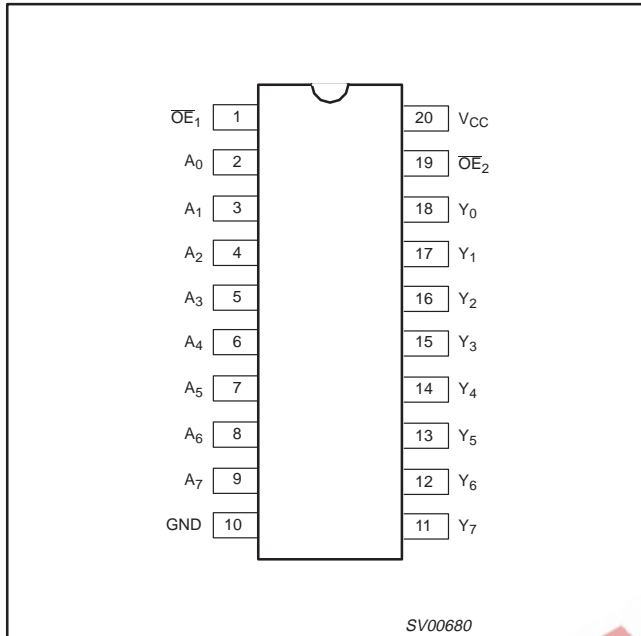
X = don't care

Z = high impedance OFF-state

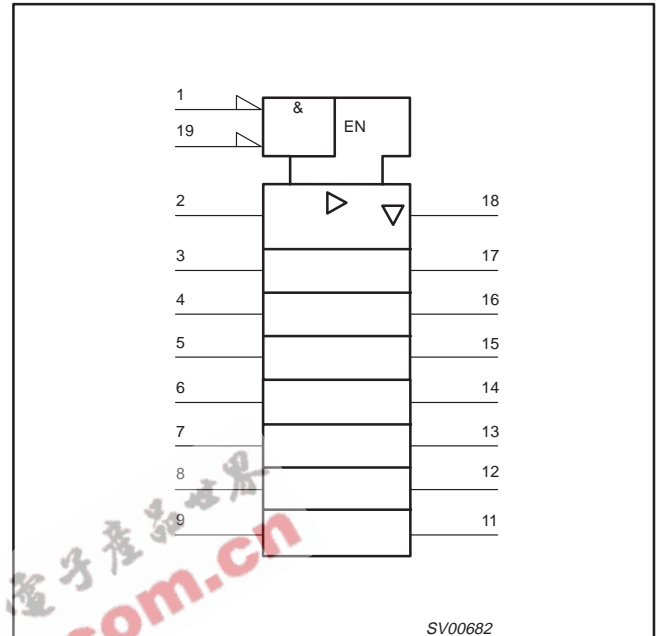
# Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

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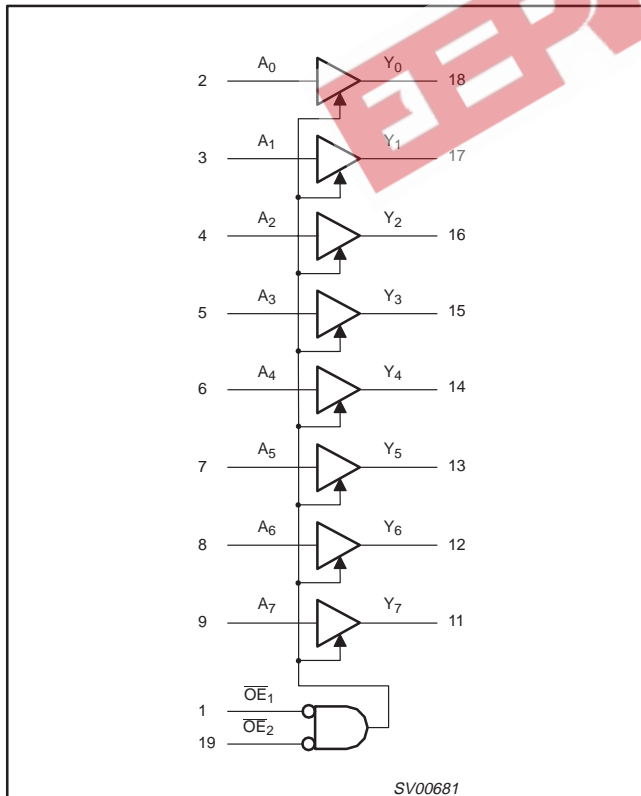
## PIN CONFIGURATION



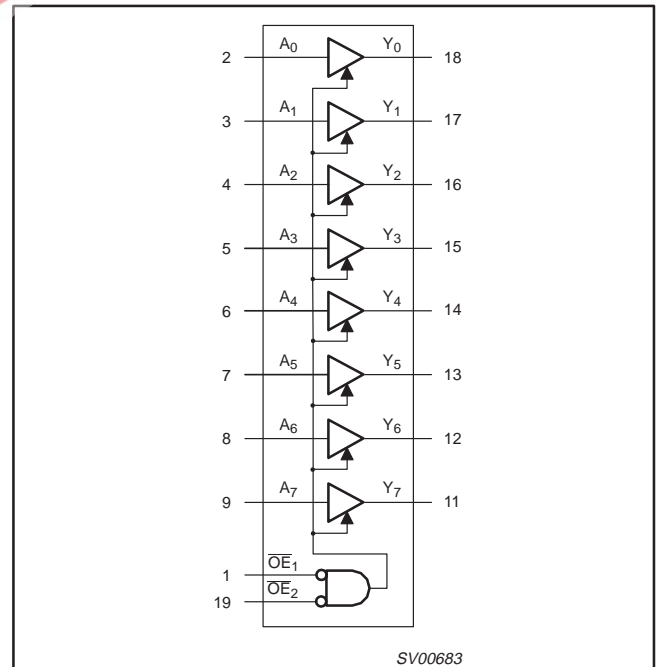
## LOGIC SYMBOL (IEEE/IEC)



## LOGIC SYMBOL



## FUNCTIONAL DIAGRAM



# Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

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## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V <sub>CC</sub>	DC supply voltage (for max. speed performance)		2.7	3.6	V
	DC supply voltage (for low-voltage applications)		1.2	3.6	
V <sub>I</sub>	DC input voltage range		0	5.5	V
V <sub>O</sub>	DC output voltage range; output HIGH or LOW state		0	V <sub>CC</sub>	V
	DC output voltage range; output 3-State		0	5.5	
T <sub>amb</sub>	Operating free-air temperature range		-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input rise and fall times	V <sub>CC</sub> = 1.2 to 2.7V V <sub>CC</sub> = 2.7 to 3.6V	0	20	ns/V
			0	10	

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

In accordance with the Absolute Maximum Rating System (IEC 134)

Voltages are referenced to GND (ground = 0V)

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V <sub>CC</sub>	DC supply voltage		-0.5 to +6.5	V
I <sub>IK</sub>	DC input diode current	V <sub>I</sub> < 0	-50	mA
V <sub>I</sub>	DC input voltage	Note 2	-0.5 to +5.5	V
I <sub>OK</sub>	DC output diode current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0	±50	mA
V <sub>O</sub>	DC output voltage; output HIGH or LOW	Note 2	-0.5 to V <sub>CC</sub> +0.5	V
	DC output voltage; output 3-State	Note 2	-0.5 to +6.5	
I <sub>O</sub>	DC output diode current	V <sub>O</sub> = 0 to V <sub>CC</sub>	±50	mA
I <sub>GND</sub> , I <sub>CC</sub>	DC V <sub>CC</sub> or GND current		±100	mA
T <sub>stg</sub>	Storage temperature range		-60 to +150	°C
P <sub>TOT</sub>	Power dissipation per package			
	- plastic mini-pack (SO) - plastic shrink mini-pack (SSOP and TSSOP)	above +70°C derate linearly with 8 mW/K above +60°C derate linearly with 5.5 mW/K	500 500	mW

### 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 input and output voltage ratings may be exceeded if the input and output current ratings are observed.

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## DC ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			Temp = -40°C to +85°C			
			MIN	TYP <sup>1</sup>	MAX	
V <sub>IH</sub>	HIGH level Input voltage	V <sub>CC</sub> = 1.2V	V <sub>CC</sub>			V
		V <sub>CC</sub> = 2.7 to 3.6V	2.0			
V <sub>IL</sub>	LOW level Input voltage	V <sub>CC</sub> = 1.2V			GND	V
		V <sub>CC</sub> = 2.7 to 3.6V			0.8	
V <sub>OH</sub>	HIGH level output voltage	V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA	V <sub>CC</sub> - 0.5			V
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -100μA	V <sub>CC</sub> - 0.2	V <sub>CC</sub>		
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -18mA	V <sub>CC</sub> - 0.6			
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -24mA	V <sub>CC</sub> - 0.8			
V <sub>OL</sub>	LOW level output voltage	V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA			0.40	V
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100μA			0.20	
		V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 24mA			0.55	
I <sub>I</sub>	Input leakage current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 5.5V or GND		±0.1	±5	μA
I <sub>OZ</sub>	3-State output OFF-state current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = 5.5V or GND		0.1	±5	μA
I <sub>OFF</sub>	Power off leakage supply	V <sub>CC</sub> = 0.0V; V <sub>I</sub> or V <sub>O</sub> = 5.5V			±10	μA
I <sub>CC</sub>	Quiescent supply current	V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0		0.1	10	μA
ΔI <sub>CC</sub>	Additional quiescent supply current per input pin	V <sub>CC</sub> = 2.7V to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0		5	500	μA

### NOTES:

- All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.
- The specified overdrive current at the data input forces the data input to the opposite logic input state.

## AC CHARACTERISTICS

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

SYMBOL	PARAMETER	WAVEFORM	LIMITS							UNIT
			V <sub>CC</sub> = 3.3V ±0.3V			V <sub>CC</sub> = 2.7V			V <sub>CC</sub> = 1.2V	
			MIN	TYP <sup>1</sup>	MAX	MIN	TYP	MAX	TYP	
t <sub>PHL</sub> /t <sub>PLH</sub>	Propagation delay A <sub>n</sub> to Y <sub>n</sub>	Figures 1, 3	1.5	3.3	5.6	1.5	3.9	6.6	14	ns
t <sub>PZH</sub> /t <sub>PZL</sub>	3-State output enable time O <sub>En</sub> to Y <sub>n</sub>	Figures 2, 3	1.5	4.4	7.4	1.5	5.2	8.4	2.2	ns
t <sub>PHZ</sub> /t <sub>PLZ</sub>	3-State output disable time O <sub>En</sub> to Y <sub>n</sub>	Figures 2, 3	1.5	3.8	6.0	1.5	4.3	7.0	11	ns

### NOTE:

- Unless otherwise stated, all typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.

# Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

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## AC WAVEFORMS

$V_M = 1.5 \text{ V}$  at  $V_{CC} \geq 2.7 \text{ V}$   
 $V_M = 0.5 \cdot V_{CC}$  at  $V_{CC} < 2.7 \text{ V}$   
 $V_X = V_{OL} + 0.3 \text{ V}$  at  $V_{CC} \geq 2.7 \text{ V}$   
 $V_X = V_{OL} + 0.1 \cdot V_{CC}$  at  $V_{CC} < 2.7 \text{ V}$   
 $V_Y = V_{OH} - 0.3 \text{ V}$  at  $V_{CC} \geq 2.7 \text{ V}$   
 $V_Y = V_{OH} - 0.1 \cdot V_{CC}$  at  $V_{CC} < 2.7 \text{ V}$   
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.

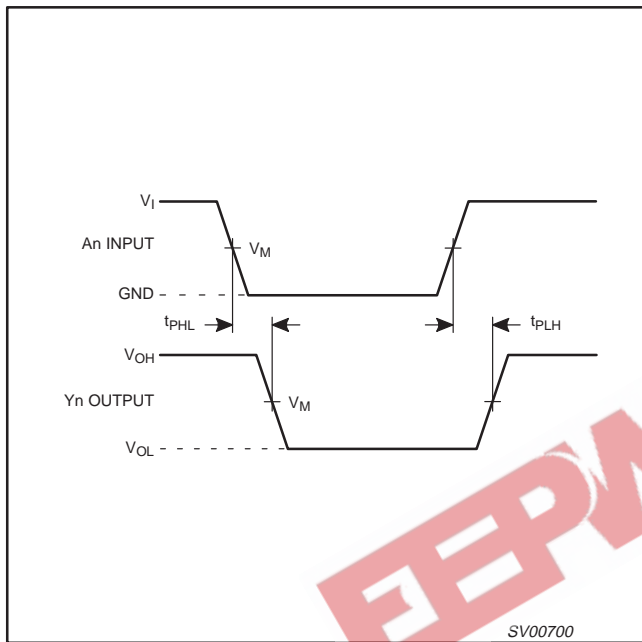


Figure 1. Input ( $A_n$ ) to output ( $Y_n$ ) propagation delays.

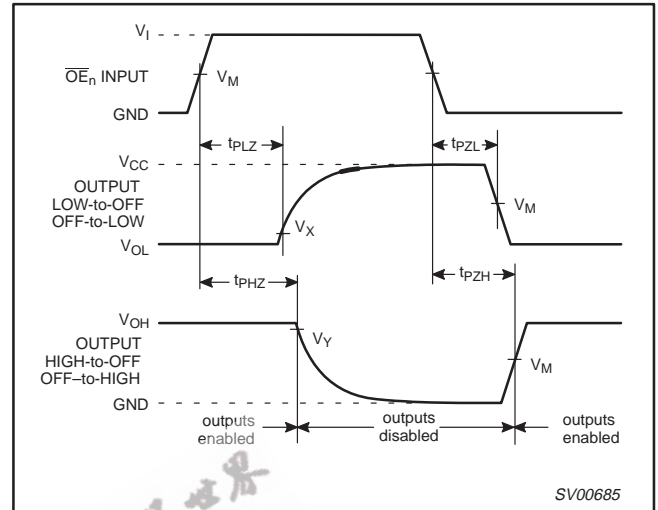


Figure 2. 3-state enable and disable times.

## TEST CIRCUIT

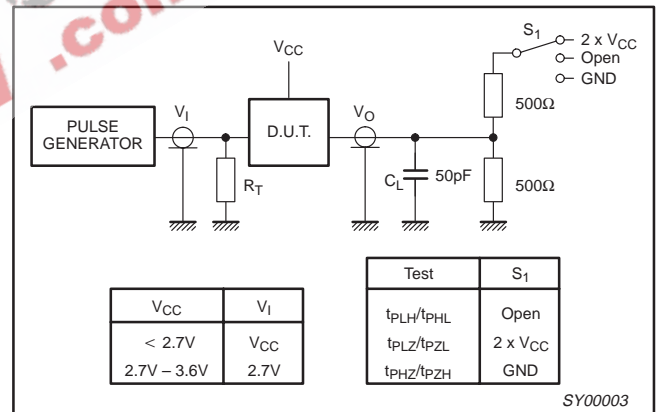


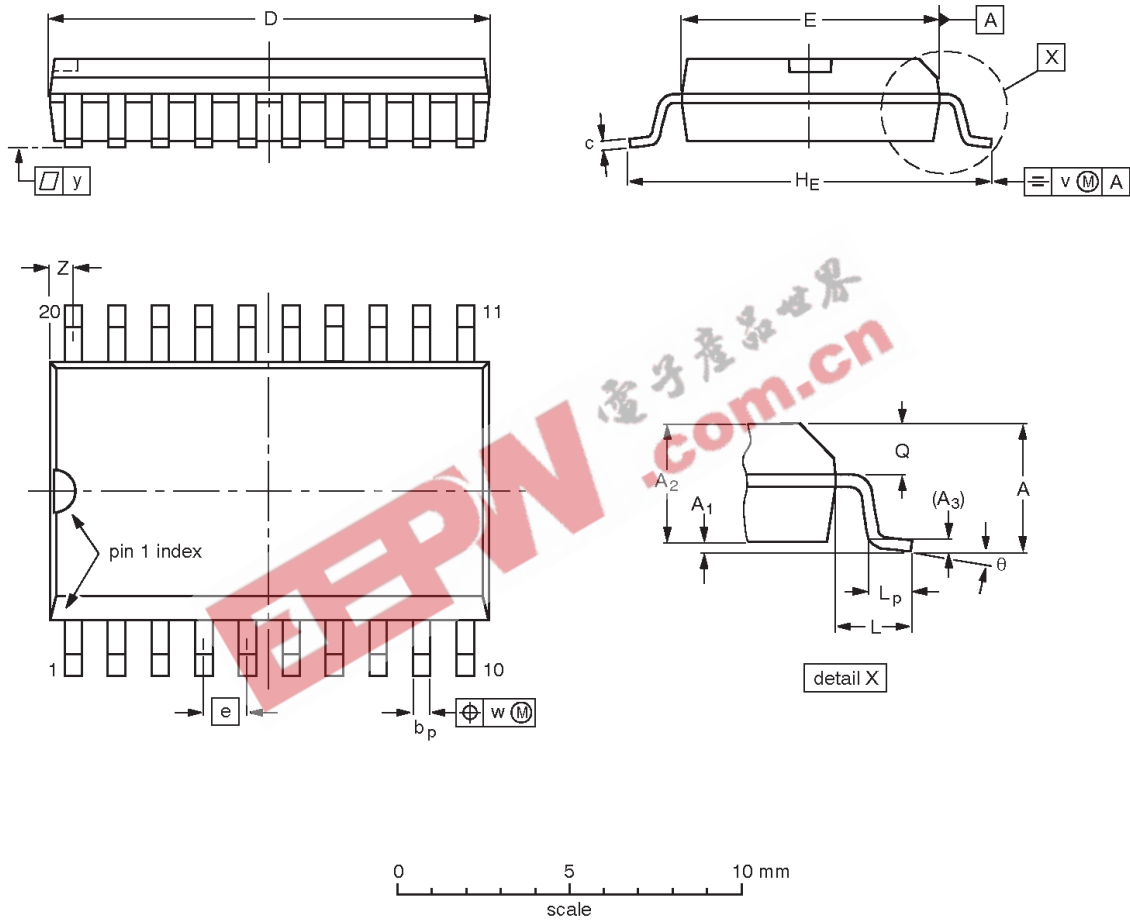
Figure 3. Load circuitry for switching times.

Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

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SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



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	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	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	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	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 maximum per side are not included.

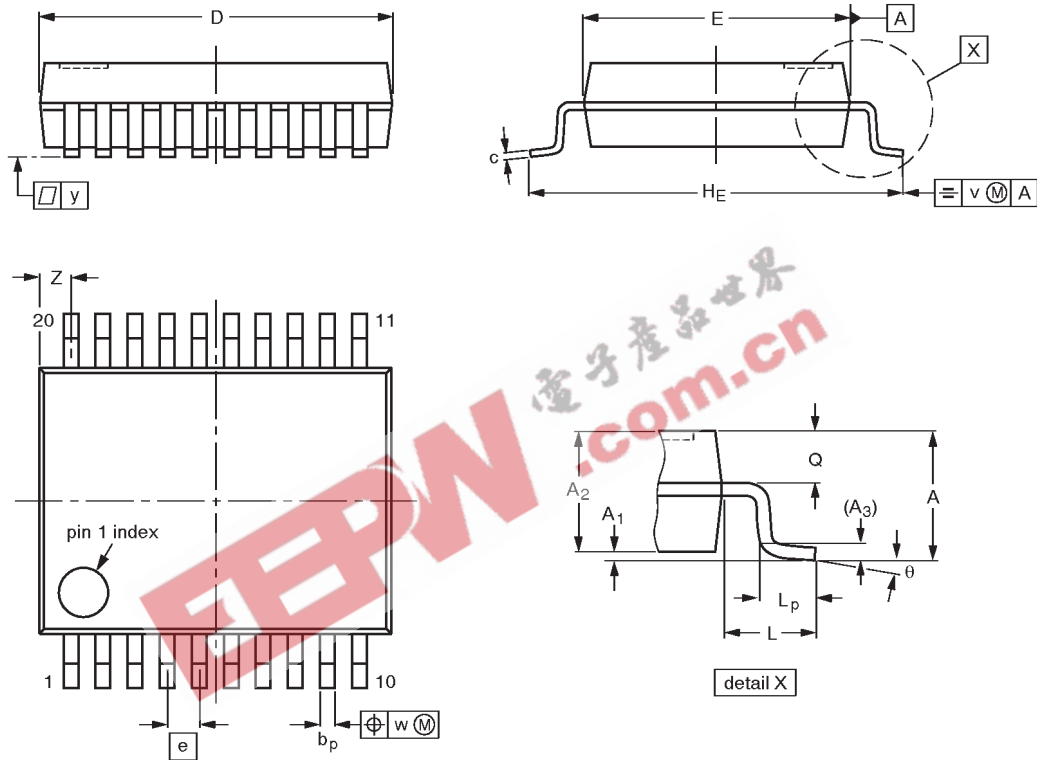
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013AC				95-01-24 97-05-22

Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

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SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1



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	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	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	0.9 0.5	8° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				93-09-08 95-02-04

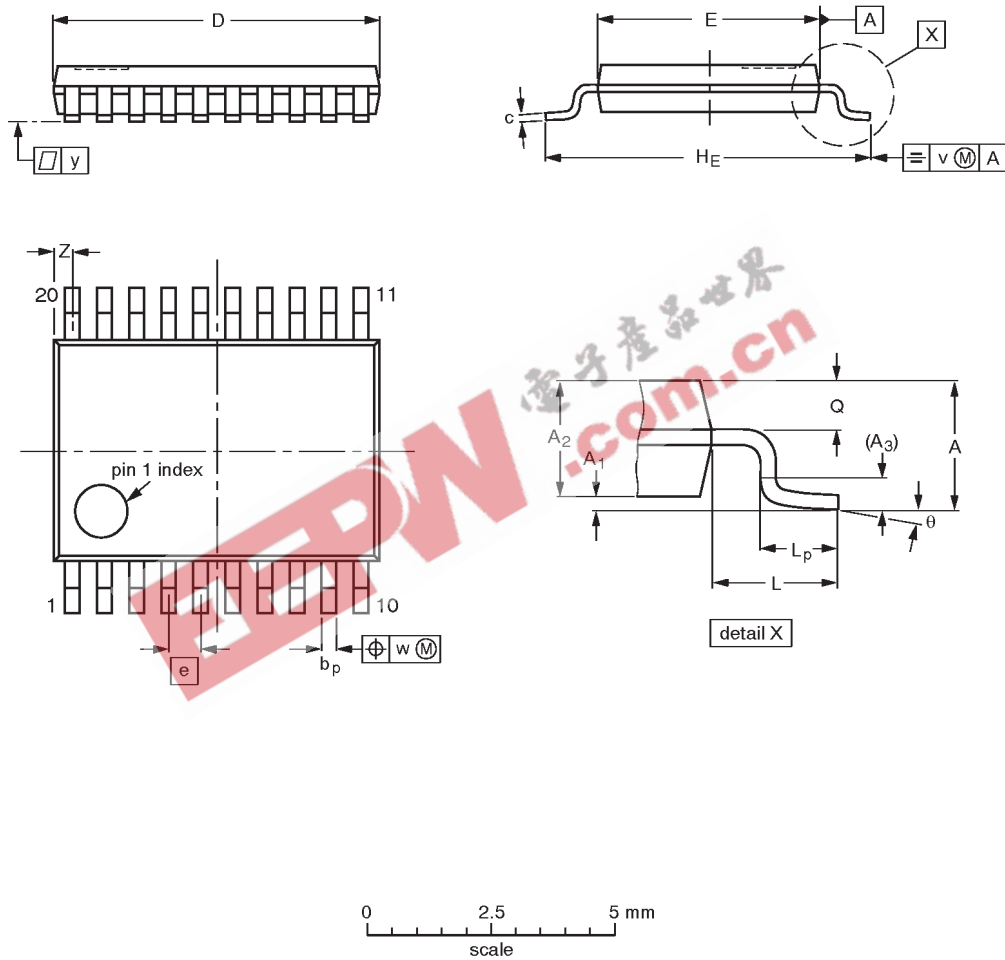


Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

74LVC541A

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



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	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	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	EIAJ			
SOT360-1		MO-153AC				93-06-16 95-02-04

# Octal buffer/line driver with 5-volt tolerant inputs/outputs (3-State)

74LVC541A

## Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

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**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.

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