

## 1. General Description

---

The 74LVC541A is an 8-bit buffer/line driver with 3-state outputs. The device features two output enables ( $\overline{OE}1$  and  $\overline{OE}2$ ). A HIGH on  $\overline{OE}n$  causes the associated outputs to assume a high-impedance OFF-state. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

This device is fully specified for partial power down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

## 2. Features and Benefits

---

- Wide supply voltage range from 1.2 V to 5.5 V
- Direct interface with TTL levels
- CMOS low power dissipation
- Overvoltage tolerant inputs to 5.5 V
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standards:
  - JESD8-7A (1.65 V to 1.95 V)
  - JESD8-5A (2.3 V to 2.7 V)
  - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM ANSI/ESDA/JEDEC JS-001 Class 3A exceeds 6000 V
  - CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V

### 3. Ordering Information

Table 1. Ordering information

Type number	Package		
	Name	Description	Quantity
74LVC541AD	SOP-20L	plastic small outline package; 20 leads; body width 7.5 mm	2000
74LVC541APW	TSSOP-20L	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	2500

### 4. Function Diagram

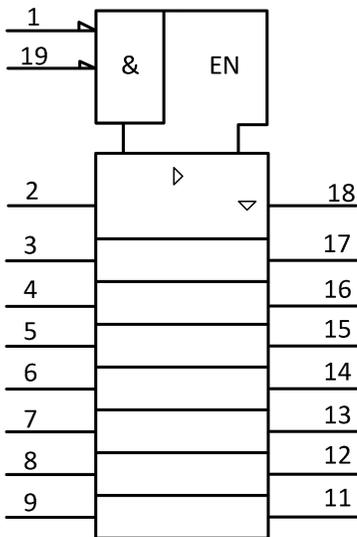


Fig. 1. IEC logic symbol

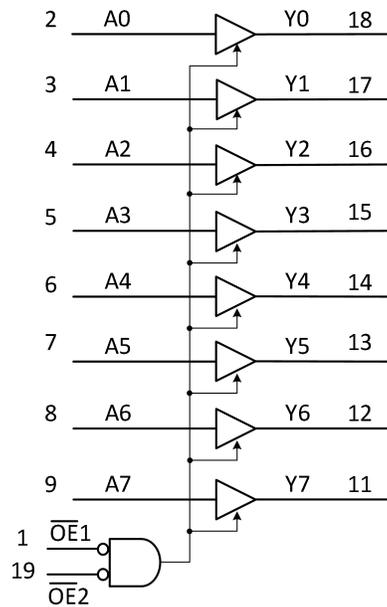
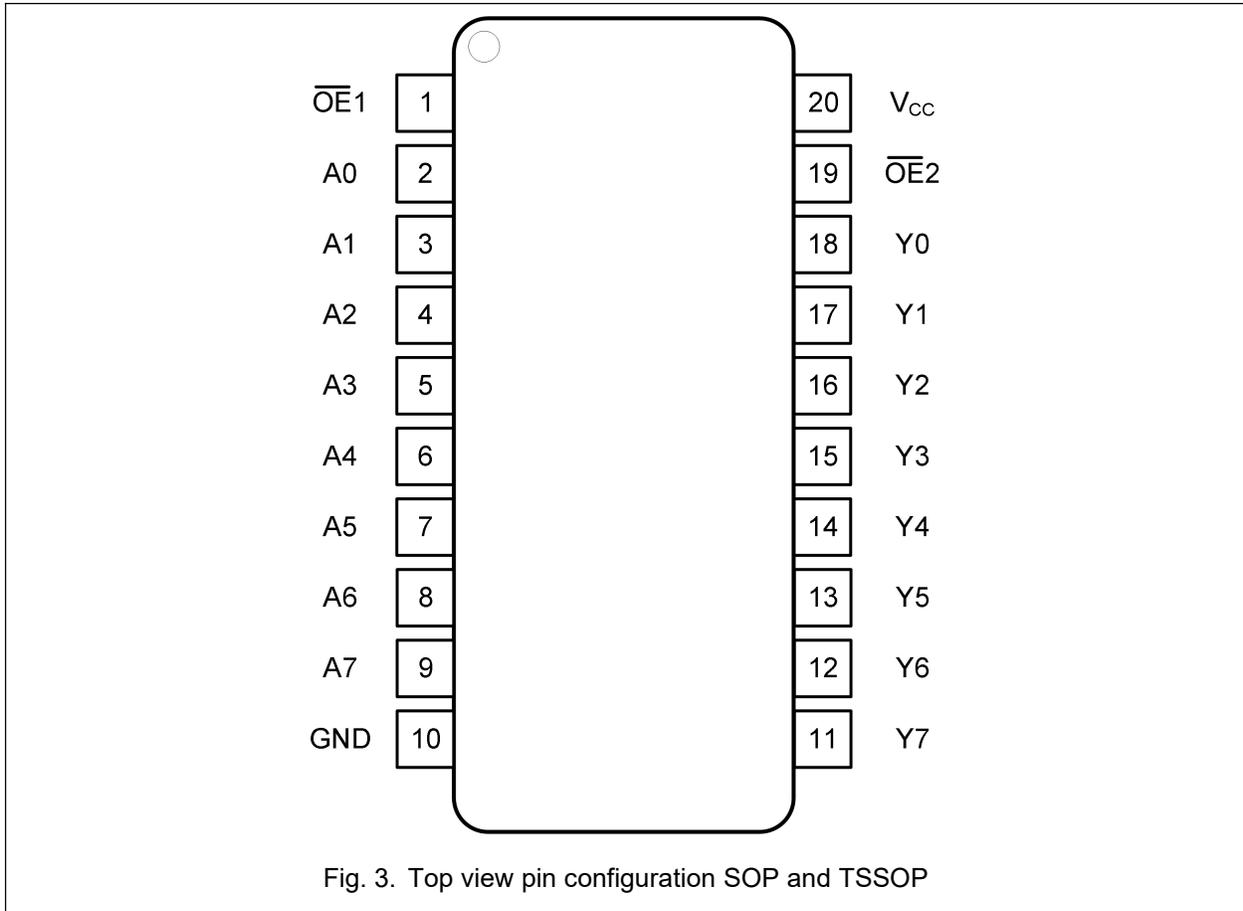


Fig. 2. Functional diagram

## 5. Pinning Information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{OE}1$	1	Output enable input (active LOW)
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	Data input
GND	10	Ground (0 V)
Y0 to Y7	18, 17, 16, 15, 14, 13, 12, 11	Data output
$\overline{OE}2$	19	Output enable input (active LOW)
$V_{CC}$	20	Supply voltage

## 6. Functional Description

**Table 3. Function table**

H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

Input			Output
$\overline{OE}1$	$\overline{OE}2$	An	Yn
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

## 7. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

**Table 4. Absolute Maximum Ratings**

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND.

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	6.5	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-50		mA
$V_I$	Input voltage	[1]	-0.5	6.5	V
$I_{OK}$	output clamping current	$V_O < 0$ V or $V_O > V_{CC}$		$\pm 50$	mA
$V_O$	output voltage	output HIGH or LOW [2]	-0.5	$V_{CC}+0.5$	V
		output 3-state	-0.5	6.5	V
$I_O$	output current	$V_O = 0$ V to $V_{CC}$		$\pm 50$	mA
$I_{CC}$	supply current			100	mA
$I_{GND}$	ground current		-100		mA
$P_{tot}$	total power dissipation			500	mW
$T_{stg}$	storage temperature		-65	150	°C

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

## 8. Recommended Operating Conditions

## 74LVC541A

### Octal buffer/line driver with 5 V tolerant inputs/outputs; 3-state

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. EnergyMath does not recommend exceeding them or designing to Absolute Maximum Ratings.

**Table 5. Recommended Operating Conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65		5.5	V
		functional	1.2		5.5	V
V <sub>I</sub>	input voltage		0		5.5	V
V <sub>O</sub>	output voltage	output HIGH or LOW	0		V <sub>CC</sub>	V
		output 3-state	0		5.5	V
T <sub>amb</sub>	ambient temperature		-40		125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.2 V to 2.7 V			20	ns/V
		V <sub>CC</sub> = 2.7 V to 5.5 V			10	ns/V

## 9. Static Characteristics

**Table 6. Static characteristics**

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V). Typical values measured at  $T_{amb} = 25^{\circ}\text{C}$  (unless otherwise noted).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.2\text{ V}$	1.08			1.08		V
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.65V_{CC}$			$0.65V_{CC}$		V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7			1.7		V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2.0			2.0		V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$0.7V_{CC}$			$0.7V_{CC}$		V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.2\text{ V}$			0.12		0.12	V
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			$0.35V_{CC}$		$0.35V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			0.7		0.7	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$			0.8		0.8	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			$0.3V_{CC}$		$0.3V_{CC}$	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = -100\ \mu\text{A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$	$V_{CC} - 0.1$			$V_{CC} - 0.1$		V
		$I_O = -4\text{ mA}; V_{CC} = 1.65\text{ V}$	1.2			1.05		V
		$I_O = -8\text{ mA}; V_{CC} = 2.3\text{ V}$	1.9			1.7		V
		$I_O = -12\text{ mA}; V_{CC} = 2.7\text{ V}$	2.2			2.1		V
		$I_O = -24\text{ mA}; V_{CC} = 3.0\text{ V}$	2.2			2.0		V
		$I_O = -32\text{ mA}; V_{CC} = 4.5\text{ V}$	3.8			3.4		V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = 100\ \mu\text{A}; V_{CC} = 1.65\text{ V to }5.5\text{ V}$			0.1		0.1	V
		$I_O = 4\text{ mA}; V_{CC} = 1.65\text{ V}$			0.45		0.65	V
		$I_O = 8\text{ mA}; V_{CC} = 2.3\text{ V}$			0.6		0.8	V
		$I_O = 12\text{ mA}; V_{CC} = 2.7\text{ V}$			0.4		0.6	V
		$I_O = 24\text{ mA}; V_{CC} = 3.0\text{ V}$			0.55		0.8	
		$I_O = 32\text{ mA}; V_{CC} = 4.5\text{ V}$			0.55		0.8	V
$I_I$	input leakage current	$V_I = V_{CC}\text{ or GND}; V_{CC} = 5.5\text{ V}$			$\pm 2$		$\pm 10$	$\mu\text{A}$

## 74LVC541A

### Octal buffer/line driver with 5 V tolerant inputs/outputs; 3-state

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 5.5$ V ; $V_O = V_{CC}$ or GND			$\pm 5$		$\pm 10$	$\mu A$
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 5.5$ V ; $V_{CC} = 0$ V			$\pm 10$		$\pm 20$	$\mu A$
$I_{CC}$	supply current	$V_I = V_{IH}$ or GND ; $I_O = 0$ A ; $V_{CC} = 5.5$ V			10		20	$\mu A$
$\Delta I_{CC}$	additional supply current	per input pin ; $V_I = V_{CC} - 0.6$ V ; $I_O = 0$ A ; $V_{CC} = 2.7$ V to 5.5 V			500		5000	$\mu A$
$C_i$	input capacitance			5.0				pF

[1] All typical values are measured at  $V_{CC} = 3.3$  V (unless stated otherwise) and  $T_{amb} = 25$  °C.

## 10. Dynamic Characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 6. Typical values measured at  $T_{amb} = 25^{\circ}\text{C}$  (unless otherwise noted).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$t_{pd}$	propagation delay	An to Yn; see Fig. 4 [2]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			35	40	ns	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			20	25	ns	
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$			15	20	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			10	15	ns	
$t_{en}$	enable time	$\overline{OEn}$ to Yn; see Fig. 5 [2]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			35	40	ns	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			20	25	ns	
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$			15	20	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			10	15	ns	
$t_{dis}$	disable time	$\overline{OEn}$ to Yn; see Fig. 5 [2]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			35	40	ns	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			20	25	ns	
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$			15	20	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			10	15	ns	
$C_{PD}$	power dissipation capacitance	Per buffer ; $V_{CC} = 3.3\text{ V}$ $V_I = \text{GND to } V_{CC}$ [3]		18				pF

[1] Typical values are measured at  $T_{amb} = 25^{\circ}\text{C}$  and  $V_{CC} = 1.8\text{ V}, 2.5\text{ V}, 3.3\text{ V},$  and  $5\text{ V}$  respectively.

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .  $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .  $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .

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

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

$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

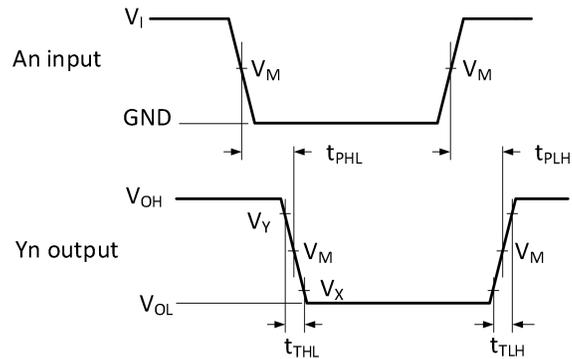
$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

$N$  = number of inputs switching

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

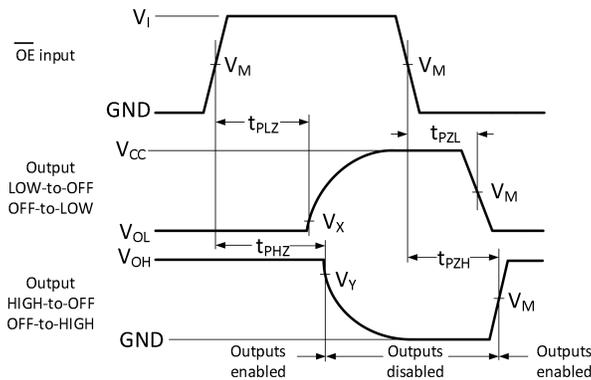
### 10.1. Waveforms and test circuit



Measurement points are given in Table 8.

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig. 4. The input An to output Yn propagation delays



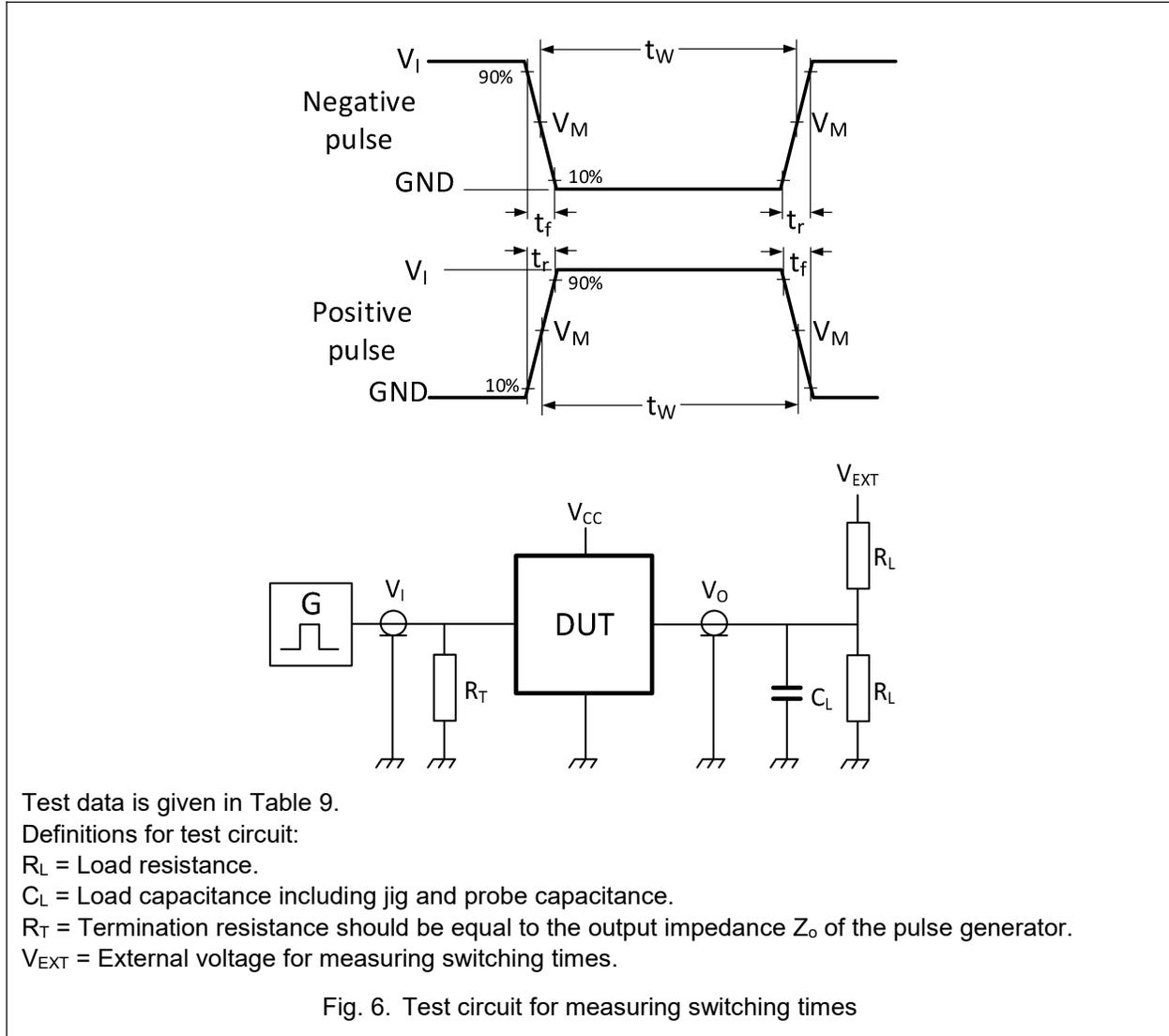
Measurement points are given in Table 8.

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig. 5. 3-state enable and disable times

**Table 8. Measurement points**

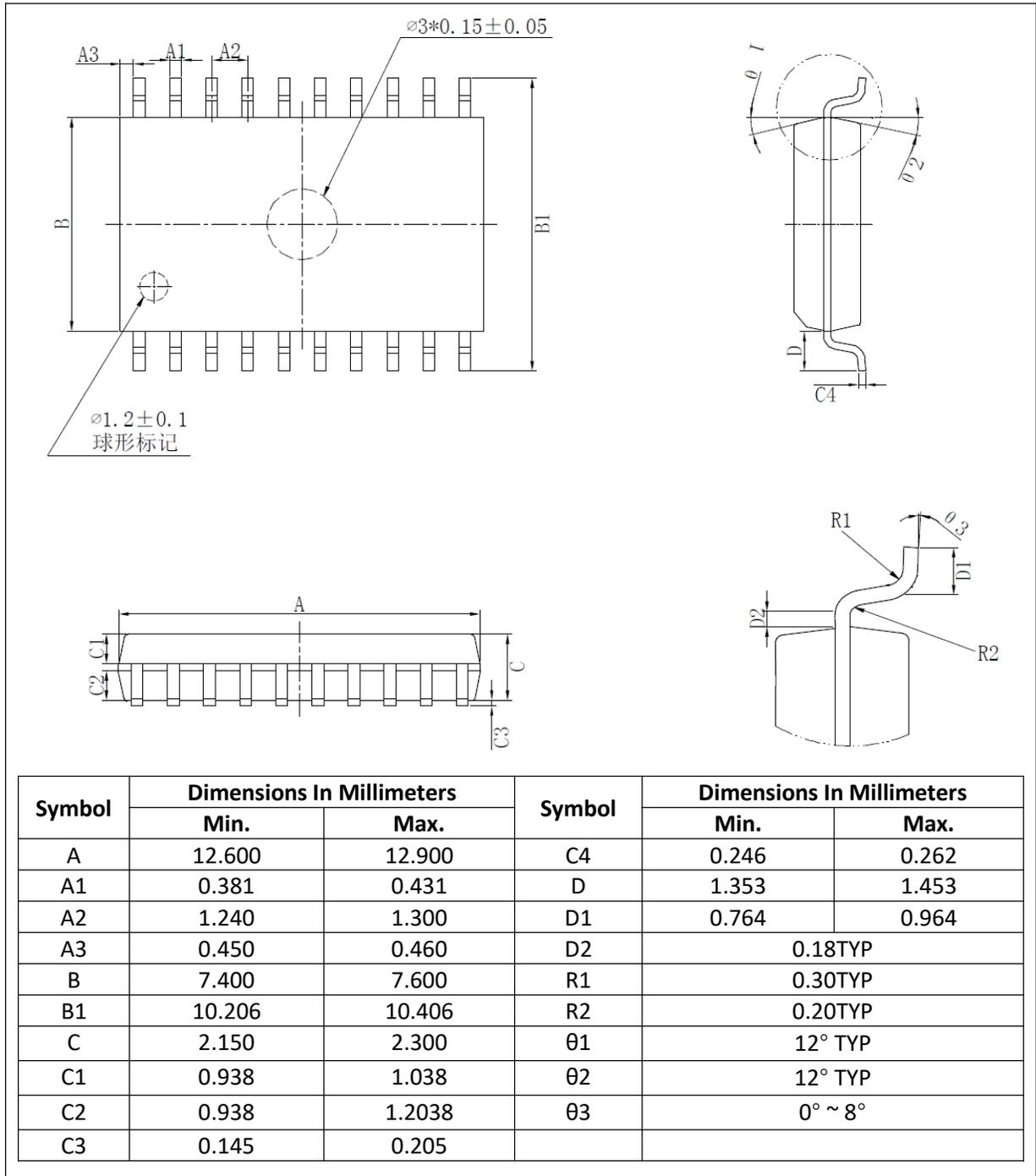
Supply voltage	Input		Output		
$V_{CC}$	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
1.65 V to 1.95 V	$V_{CC}$	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.15 V$	$V_{OH} - 0.15 V$
2.3 V to 2.7 V	$V_{CC}$	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.15 V$	$V_{OH} - 0.15 V$
3.0 V to 3.6 V	$V_{CC}$	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$
4.5 V to 5.5 V	$V_{CC}$	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$


**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r = t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
1.65V to 1.95V	$V_{CC}$	$\leq 2$ ns	15 pF	2k $\Omega$	open	GND	$2V_{CC}$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	15 pF	2k $\Omega$	open	GND	$2V_{CC}$
3.0 V to 3.6 V	$V_{CC}$	$\leq 2$ ns	15 pF	2k $\Omega$	open	GND	$2V_{CC}$
4.5 V to 5.5 V	$V_{CC}$	$\leq 2$ ns	15 pF	2k $\Omega$	open	GND	$2V_{CC}$

# 11. Package Outline

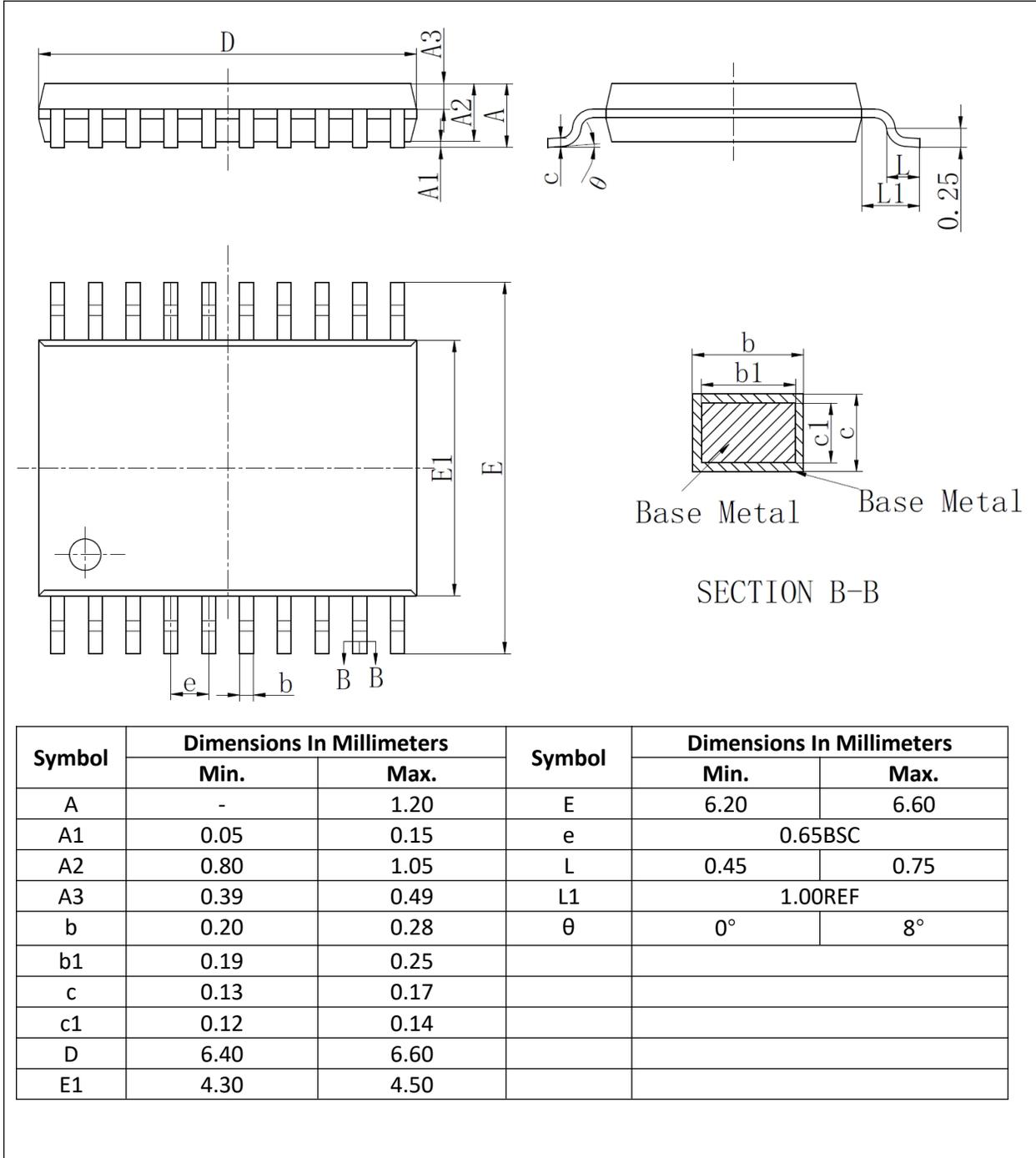
SOP-20L



# 74LVC541A

Octal buffer/line driver with 5 V tolerant inputs/outputs; 3-state

## TSSOP-20L



## 12. Abbreviations

---

**Table 10. Abbreviations**

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
CDM	Charged Device Model

## 13. Revision History

---

**Table 11. Revision history**

Document ID	Release Date	Data sheet status	Change notice	Supersedes
74LVC541A Rev. 1.0	Aug 08, 2024	Draft datasheet		