

# 74LV541A

Octal buffer/line driver; 3-state

Rev. 2 — 1 November 2016

Product data sheet

## 1. General description

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The 74LV541A 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 are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage 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

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- Wide supply voltage range from 2.0 V to 5.5 V
- Maximum  $t_{pd}$  of 6 ns at 5 V
- Typical  $V_{OL(p)} < 0.8$  V at  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Typical  $V_{OH(v)} > 2.3$  V at  $V_{CC} = 3.3$  V,  $T_{amb} = 25$  °C
- Supports mixed-mode voltage operation on all ports
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
  - ◆ HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3kV
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 2kV
- Specified from  $-40$  °C to  $+85$  °C and from  $-40$  °C to  $+125$  °C

### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LV541APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1

### 4. Functional diagram

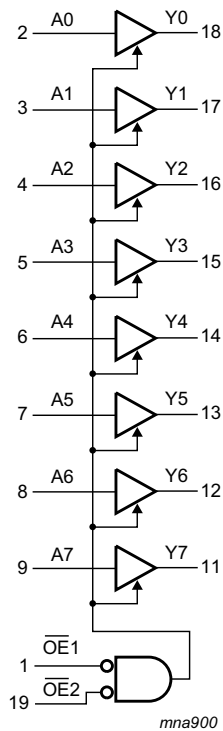


Fig 1. Logic symbol

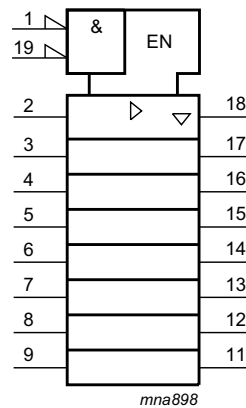


Fig 2. IEC logic symbol

## 5. Pinning information

### 5.1 Pinning

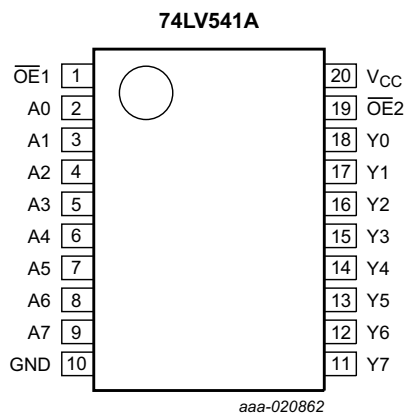


Fig 3. Pin configuration TSSOP20

### 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. Functional table<sup>[1]</sup>

Control		Input	Output
OE1	OE2	An	Yn
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

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

## 7. Limiting values

Table 4. 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	+7.0	V
$V_I$	input voltage		-0.5	+7.0	V
$V_O$	output voltage	active mode	-0.5	$V_{CC} + 0.5$	V
		power-down or 3-state mode	-0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-20	-	mA
$I_{OK}$	output clamping current	$V_O < 0$ V	-50	-	mA
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	±35	mA
$I_{CC}$	supply current		-	70	mA
$I_{GND}$	ground current		-70	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	-	500	mW

[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.

[3] This value is limited to 7.0 V maximum.

[4] For TSSOP20 package: above 100 °C the value of  $P_{tot}$  derates linearly with 10 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		2.0	5.5	V
$V_I$	input voltage		0	5.5	V
$V_O$	output voltage	active mode	0	$V_{CC}$	V
		power-down or 3-state mode	0	5.5	V
$T_{amb}$	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	200	ns/V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	100	ns/V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	20	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2\text{ V}$	1.5	-	-	1.5	-	1.5	-	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	$0.7V_{CC}$	-	-	$0.7V_{CC}$	-	$0.7V_{CC}$	-	V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	$0.7V_{CC}$	-	-	$0.7V_{CC}$	-	$0.7V_{CC}$	-	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$0.7V_{CC}$	-	-	$0.7V_{CC}$	-	$0.7V_{CC}$	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2\text{ V}$	-	-	0.5	-	0.5	-	0.5	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	-	$0.3V_{CC}$	V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	-	$0.3V_{CC}$	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	$0.3V_{CC}$	-	$0.3V_{CC}$	-	$0.3V_{CC}$	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								V
		$V_{CC} = 2.0\text{ V to }5.5\text{ V}; I_O = -50\text{ }\mu\text{A}$	$V_{CC}-0.1$	-	-	$V_{CC}-0.1$	-	$V_{CC}-0.1$	-	V
		$V_{CC} = 2.3\text{ V}; I_O = -2\text{ mA}$	2	-	-	2	-	2	-	V
		$V_{CC} = 3.0\text{ V}; I_O = -8\text{ mA}$	2.58	-	-	2.48	-	2.48	-	V
		$V_{CC} = 4.5\text{ V}; I_O = -16\text{ mA}$	3.94	-	-	3.8	-	3.8	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								V
		$V_{CC} = 2.0\text{ V to }5.5\text{ V}; I_O = 50\text{ }\mu\text{A}$	-	-	0.1	-	0.1	-	0.1	V
		$V_{CC} = 2.3\text{ V}; I_O = 2\text{ mA}$	-	-	0.4	-	0.4	-	0.4	V
		$V_{CC} = 3.0\text{ V}; I_O = 8\text{ mA}$	-	-	0.36	-	0.44	-	0.44	V
		$V_{CC} = 4.5\text{ V}; I_O = 16\text{ mA}$	-	-	0.44	-	0.55	-	0.55	V
$I_{OZ}$	OFF-state output current	$V_{CC} = 5.5\text{ V}; V_I = V_{IH}$ or $V_{IL}; V_O = \text{GND to }5.5\text{ V}$	-	-	$\pm 0.25$	-	$\pm 2.5$	-	$\pm 2.5$	$\mu\text{A}$

**Table 6. Static characteristics ...continued**  
 Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = \text{GND to } 5.5 \text{ V};$ $V_{CC} = 0 \text{ V}$	-	-	0.5	-	5	-	5	$\mu\text{A}$
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 0 \text{ V to } 5.5 \text{ V}$	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A};$ $V_{CC} = 5.5 \text{ V}$	-	-	2	-	20	-	20	$\mu\text{A}$

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**  
 GND = 0 V. For test circuit see [Figure 6](#).

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	Min	Max	
$t_{pd}$	propagation delay	An to Yn; see <a href="#">Figure 4</a> <a href="#">[2]</a>								
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$								
		$C_L = 15 \text{ pF}$	-	4.9	11.3	1	13.5	1	13.5	ns
		$C_L = 50 \text{ pF}$	-	6.8	15.9	1	18.5	1	18.5	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$								
		$C_L = 15 \text{ pF}$	-	3.7	7	1	8.5	1	8.5	ns
		$C_L = 50 \text{ pF}$	-	5.2	10.5	1	12	1	12	ns
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$								
$t_{en}$	enable time	$\overline{\text{OEn}}$ to Yn; see <a href="#">Figure 5</a> <a href="#">[2]</a>								
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$								
		$C_L = 15 \text{ pF}$	-	6.1	16.6	1	19.5	1	19.5	ns
		$C_L = 50 \text{ pF}$	-	8.1	20.7	1	24	1	24	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$								
		$C_L = 15 \text{ pF}$	-	4.5	10.5	1	12.5	1	12.5	ns
		$C_L = 50 \text{ pF}$	-	6.2	14	1	16	1	16	ns
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$								
$C_L = 15 \text{ pF}$	-	3.4	7.2	1	8.5	1	8.5	ns		
$C_L = 50 \text{ pF}$	-	4.7	9.2	1	10.5	1	10.5	ns		

**Table 7. Dynamic characteristics ...continued**  
*GND = 0 V. For test circuit see Figure 6.*

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	Min	Max	
t <sub>dis</sub>	disable time	OEn to Yn; see Figure 5 <sup>[2]</sup>								
		V <sub>CC</sub> = 2.3 V to 2.7 V								
		C <sub>L</sub> = 15 pF	-	6.5	13.1	1	15	1	15	ns
		C <sub>L</sub> = 50 pF	-	11.0	17.9	1	20	1	20	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V								
		C <sub>L</sub> = 15 pF	-	5.2	11	1	12	1	12	ns
		C <sub>L</sub> = 50 pF	-	8.5	15.4	1	17.5	1	17.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V								
		C <sub>L</sub> = 15 pF	-	4.2	7.5	1	8	1	8	ns
		C <sub>L</sub> = 50 pF	-	6.3	8.8	1	10	1	10	ns
t <sub>sk(o)</sub>	skew	C <sub>L</sub> = 50 pF								
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	2	-	2	-	2	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	-	1.5	-	1.5	-	1.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	1	-	1	-	1	ns
C <sub>I</sub>	input capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.3 V	-	2	6	-	6	-	6	pF
C <sub>O</sub>	output capacitance	V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.3 V	-	5	-	-	-	-	-	pF
C <sub>PD</sub>	power dissipation capacitance	per buffer; C <sub>L</sub> = 50 pF; f = 10 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[3]</sup>								
		V <sub>CC</sub> = 3.3 V	-	9	-	-	-	-	-	pF
		V <sub>CC</sub> = 5.0 V	-	11	-	-	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 2.5 V, 3.3 V, and 5 V respectively, unless otherwise specified.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.

t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation P<sub>D</sub> (μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

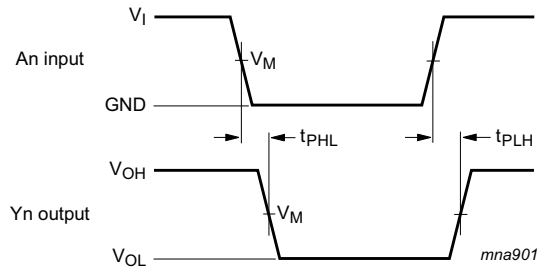
C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in Volts.

**Table 8. Noise characteristics**  
 GND = 0 V. For test circuit see [Figure 6](#).

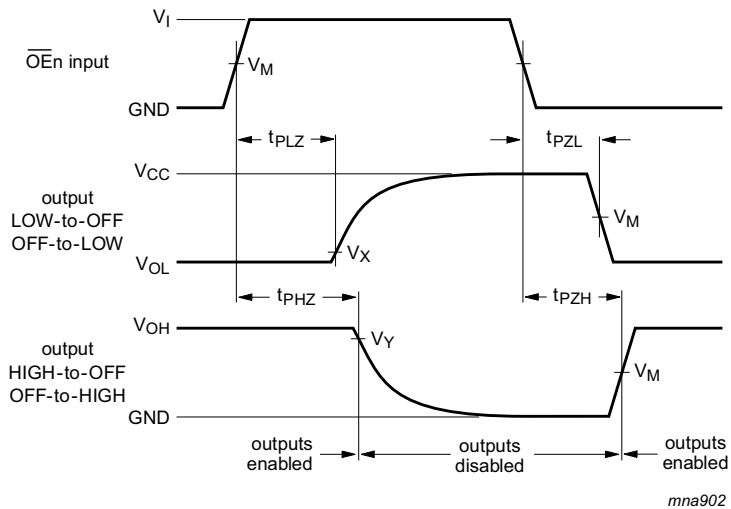
Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			Unit
			Min	Typ	Max	
<b>V<sub>CC</sub> = 3.3 V; C<sub>L</sub> = 50 pF</b>						
V <sub>OL(p)</sub>	LOW-level output voltage (peak)		-	0.3	0.8	V
V <sub>OL(v)</sub>	LOW-level output voltage (valley)		-0.8	-0.2	-	V
V <sub>OH(v)</sub>	HIGH-level output voltage (valley)		-	2.9	-	V
V <sub>IH(AC)</sub>	AC HIGH-level input voltage		2.31	-	-	V
V <sub>IL(AC)</sub>	AC LOW-level input voltage		-	-	0.99	V

## 11. Waveforms



Measurement points are given in [Table 9](#).  
 V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.

**Fig 4. Propagation delay input (An) to output (Yn)**



Measurement points are given in [Table 9](#).  
 V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.

**Fig 5. Enable and disable times**



Table 9. Measurement points

Input	Output		
$V_M$	$V_M$	$V_X$	$V_Y$
$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$

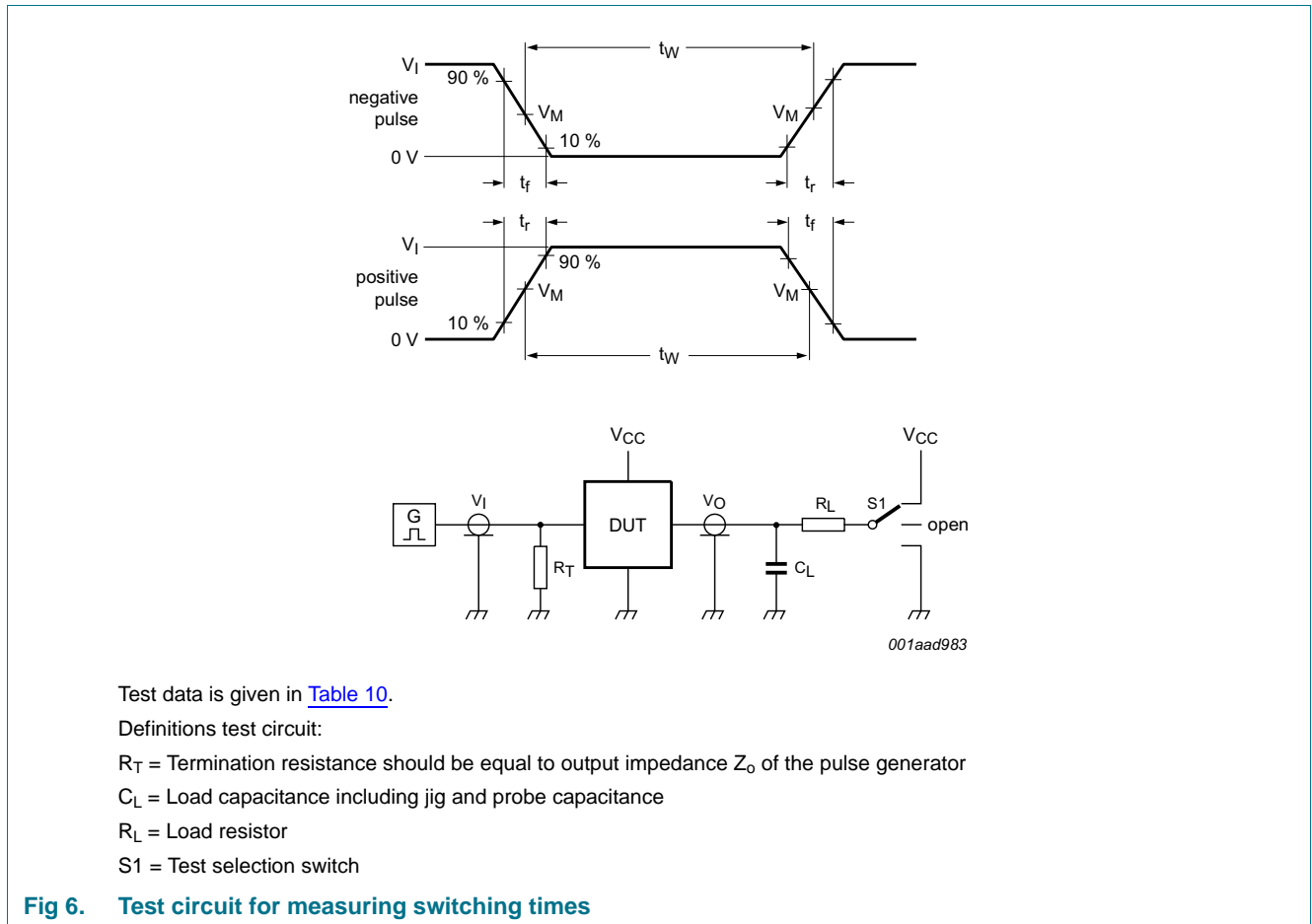


Fig 6. Test circuit for measuring switching times

Table 10. Test data

Input		Load		S1 position		
$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHL}, t_{PLH}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
GND to $V_{CC}$	3.0 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$

12. Package outline

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

SOT360-1

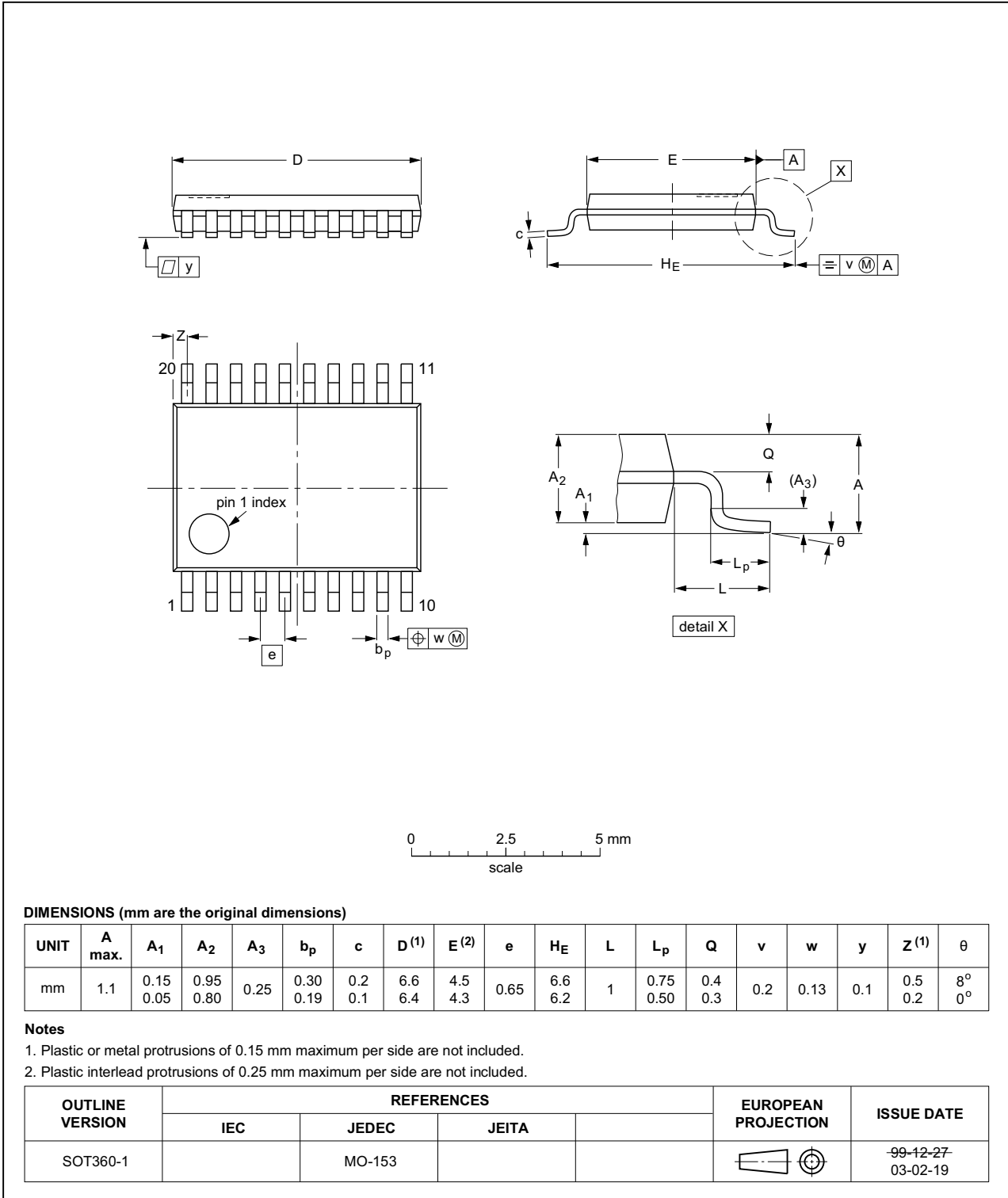


Fig 7. Package outline SOT360-1 (TSSOP20)

## 13. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charge Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV541A v.2	20161101	Product data sheet	-	74LV541A v.1
Modifications:	• Type number 74LV541ABQ removed.			
74LV541A v.1	20151223	Product data sheet	-	-

## 15. Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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

[2] The term 'short data sheet' is explained in section "Definitions".

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## 17. Contents

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