

# 74LVC541A

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

Rev. 5 — 13 March 2020

Product data sheet

## 1. General description

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

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

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices as translators in mixed 3.3 V and 5 V applications.

## 2. Features and benefits

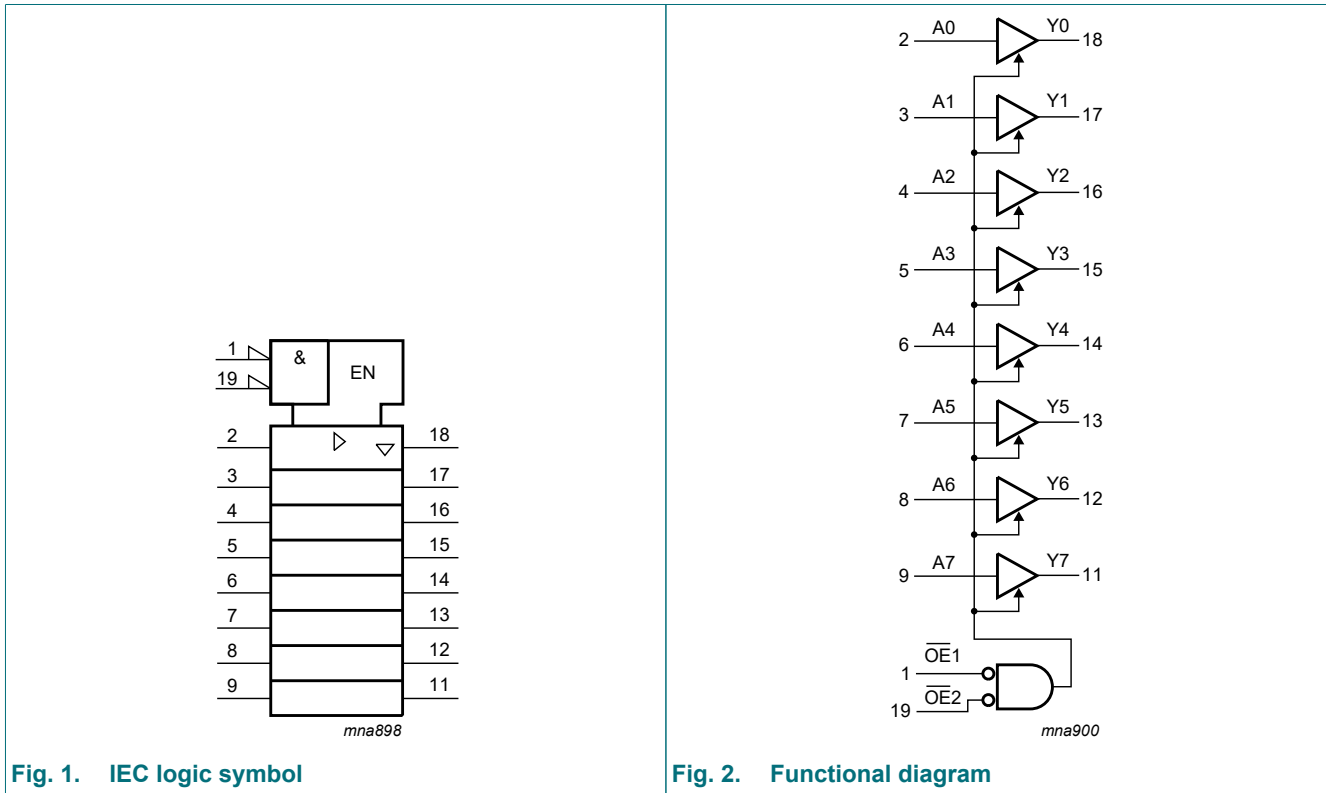
- 5 V tolerant inputs for interlacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Complies with JEDEC standard:
  - JESD8-7A (1.65 V to 1.95 V)
  - JESD8-5A (2.3 V to 2.7 V)
  - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115B exceeds 200 V
  - CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

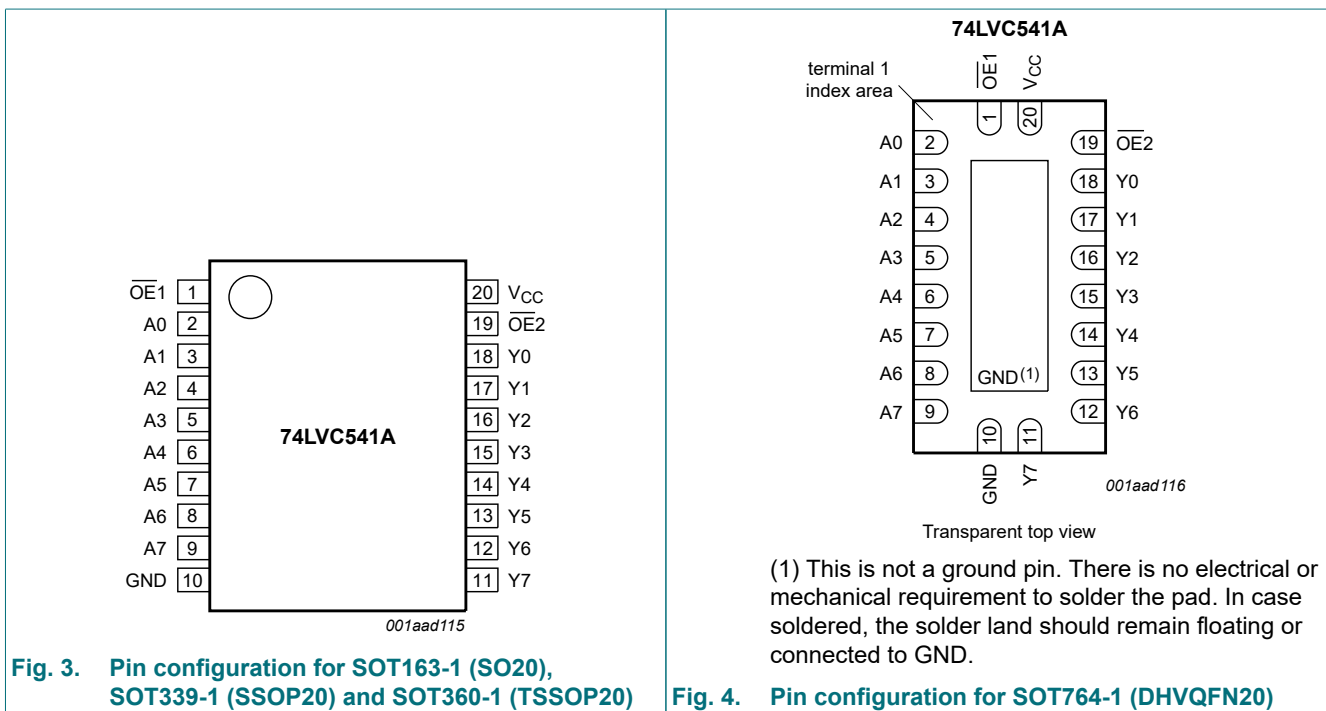
Type number	Package			
	Temperature range	Name	Description	Version
74LVC541AD	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC541ADB	-40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVC541APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVC541ABQ	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	SOT764-1

### 4. Functional diagram



### 5. Pinning information

#### 5.1. Pinning



## 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
OE1	1	output enable input (active LOW)
A0, A1, A2, A3, A4, A5, A6, A7	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7	18, 17, 16, 15, 14, 13, 12, 11	bus output
OE2	19	output enable input (active LOW)
V <sub>CC</sub>	20	supply voltage

## 6. Functional description

Table 3. Functional table

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

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

## 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 <sub>CC</sub>	supply voltage		-0.5	+6.5	V	
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA	
V <sub>I</sub>	input voltage	[1]	-0.5	+5.5	V	
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V	-	±50	mA	
V <sub>O</sub>	output voltage	output HIGH or LOW state	[2]	-0.5	V <sub>CC</sub> + 0.5	V
		output 3-state or power-down	[2]	-0.5	+6.5	V
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA	
I <sub>CC</sub>	supply current		-	100	mA	
I <sub>GND</sub>	ground current		-100	-	mA	
T <sub>stg</sub>	storage temperature		-60	+150	°C	
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C	[3]	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] For SOT163-1 (SO20) package: P<sub>tot</sub> derates linearly with 12.3 mW/K above 109 °C.  
For SOT339-1 (SSOP20) packages: P<sub>tot</sub> derates linearly with 10.0 mW/K above 100 °C.  
For SOT360-1 (TSSOP20) package: P<sub>tot</sub> derates linearly with 10.0 mW/K above 100 °C.  
For SOT764-1 (DHVQFN20) package: P<sub>tot</sub> derates linearly with 12.9 mW/K above 111 °C.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	output HIGH or LOW state	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> = 2.3 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 3.6 V	0	-	10	ns/V

## 9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65V <sub>CC</sub>	-	-	0.65V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35V <sub>CC</sub>	-	0.35V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.2	-	-	2.0	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V	-	±0.1	±5	-	±20	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V	-	±0.1	±5	-	±20	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0.0 V	-	±0.1	±10	-	±20	μA

## 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 <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V	-	0.1	10	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.7 V to 3.6 V	-	5	500	-	5000	μA
C <sub>I</sub>	input capacitance		-	5.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 7.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t <sub>pd</sub>	propagation delay	An to Yn; see Fig. 5 [2]						
		V <sub>CC</sub> = 1.2 V	-	14.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.5	6.5	13.8	1.5	16.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.5	6.8	1.0	7.9	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.5	5.6	1.5	7.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.9	5.1	1.0	6.5	ns
t <sub>en</sub>	enable time	OE <sub>n</sub> to Yn; see Fig. 6 [2]						
		V <sub>CC</sub> = 1.2 V	-	20.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.8	7.7	16.0	1.8	18.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.3	8.8	1.5	10.2	ns
		V <sub>CC</sub> = 2.7 V	1.5	4.4	7.5	1.5	9.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.5	7.0	1.0	9.0	ns
t <sub>dis</sub>	disable time	OE <sub>n</sub> to Yn; see Fig. 6 [2]						
		V <sub>CC</sub> = 1.2 V	-	11.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	3.0	4.9	10.3	3.0	11.9	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.7	5.9	1.0	6.8	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.7	7.0	1.5	9.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.3	6.0	1.0	7.5	ns
C <sub>PD</sub>	power dissipation capacitance	per input; V <sub>I</sub> = GND to V <sub>CC</sub> [3]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	7.7	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	11.3	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	14.4	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

[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> in μW).

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

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

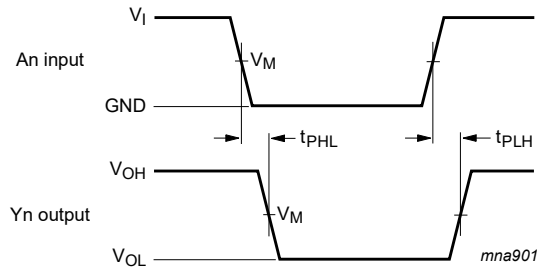
C<sub>L</sub> = output load capacitance in pF

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

N = number of inputs switching

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

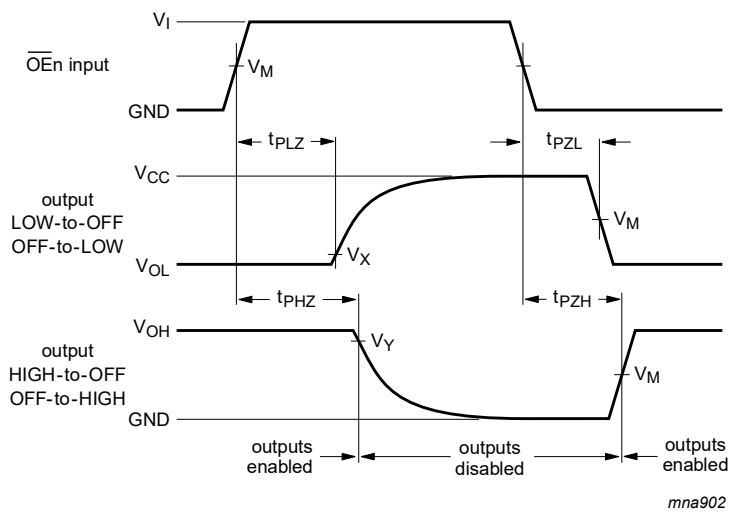
10.1. Waveforms and test circuit



Measurement points are given in [Table 8](#).

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

Fig. 5. Input (An) to output (Yn) propagation delays



Measurement points are given in [Table 8](#).

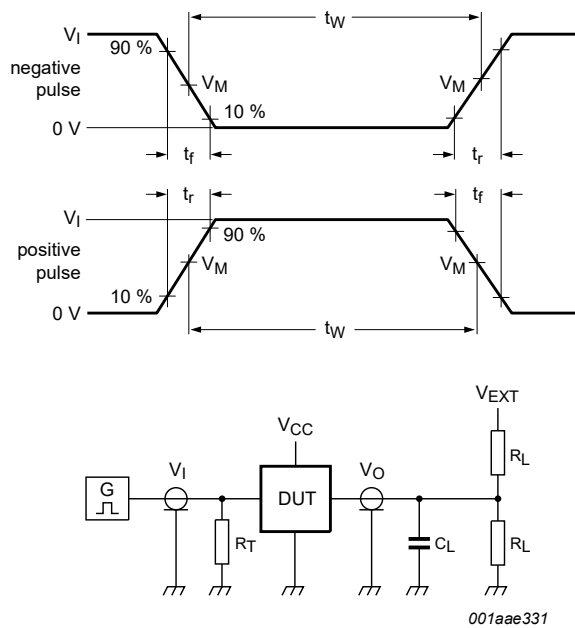
$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

Fig. 6. 3-state enable and disable times

Table 8. Measurement points

Supply voltage	Input	Output		
$V_{CC}$	$V_M$	$V_M$	$V_X$	$V_Y$
< 2.7 V	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.15 V$	$V_{OH} - 0.15 V$
$\geq 2.7 V$	1.5 V	1.5 V	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$

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



Test data is given in [Table 9](#).

Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

$V_{EXT}$  = External voltage for measuring switching times.

**Fig. 7. Test circuit for measuring switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

11. Package outline

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

SOT163-1

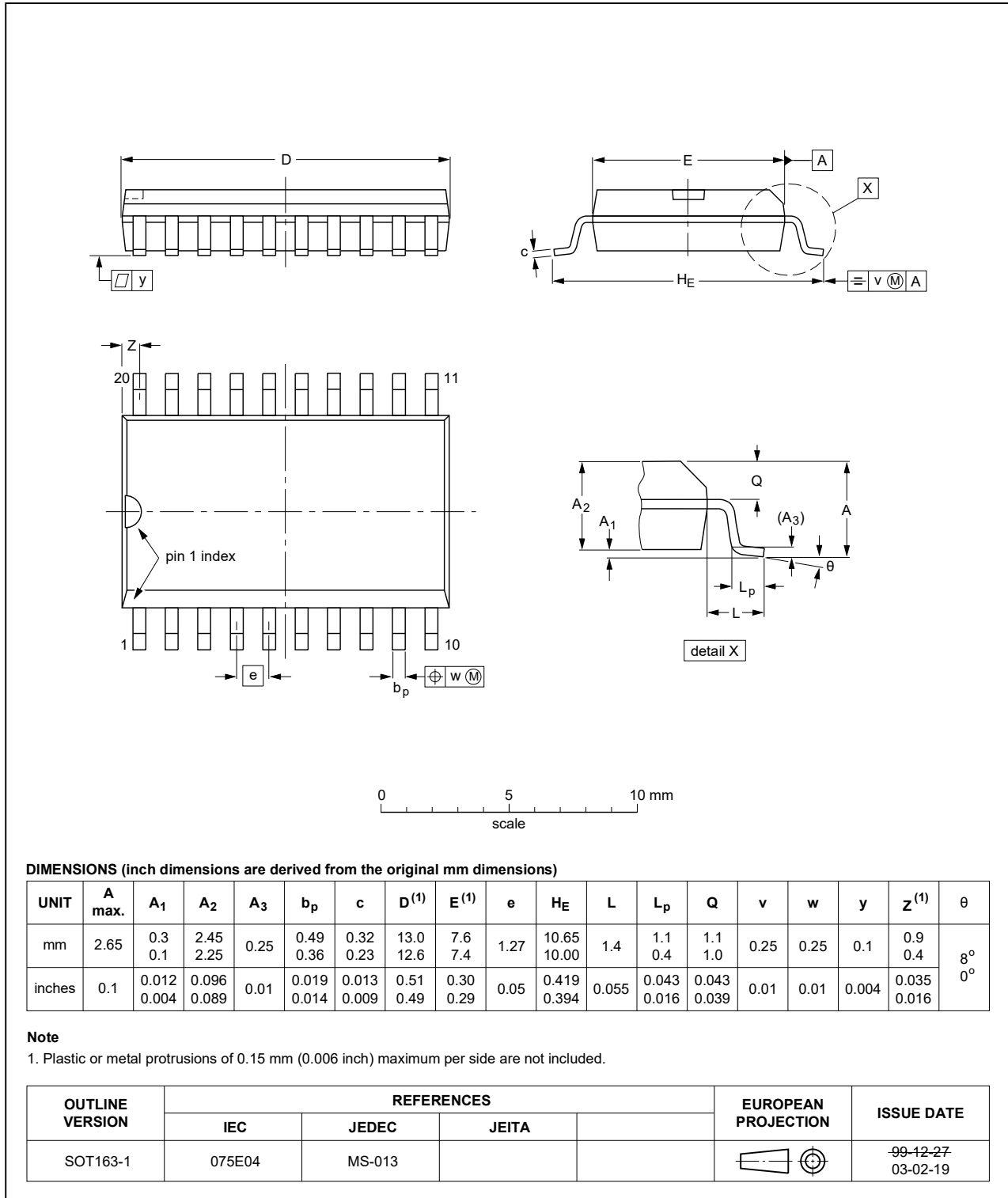


Fig. 8. Package outline SOT163-1 (SO20)



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

SOT339-1

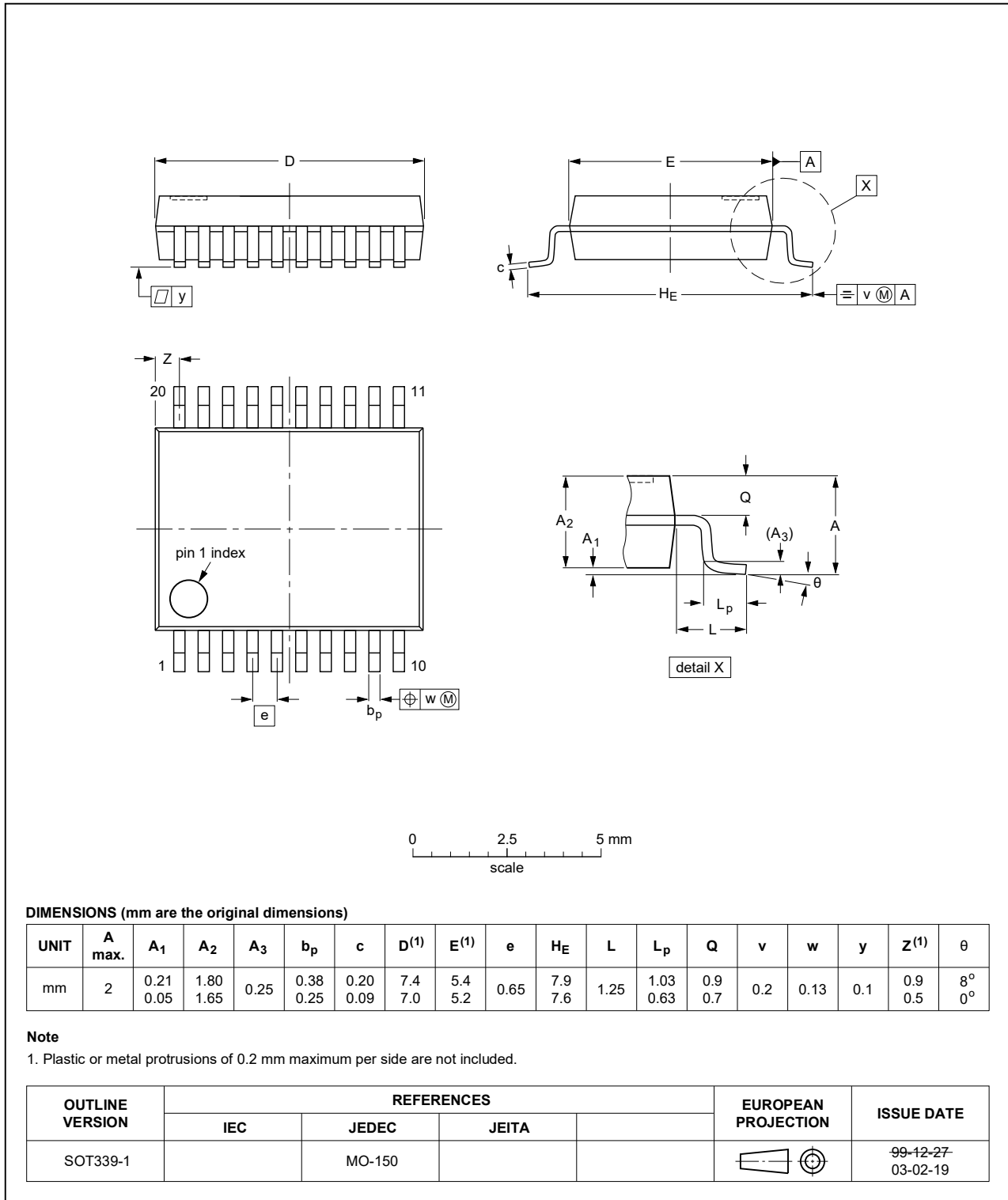


Fig. 9. Package outline SOT339-1 (SSOP20)

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

SOT360-1

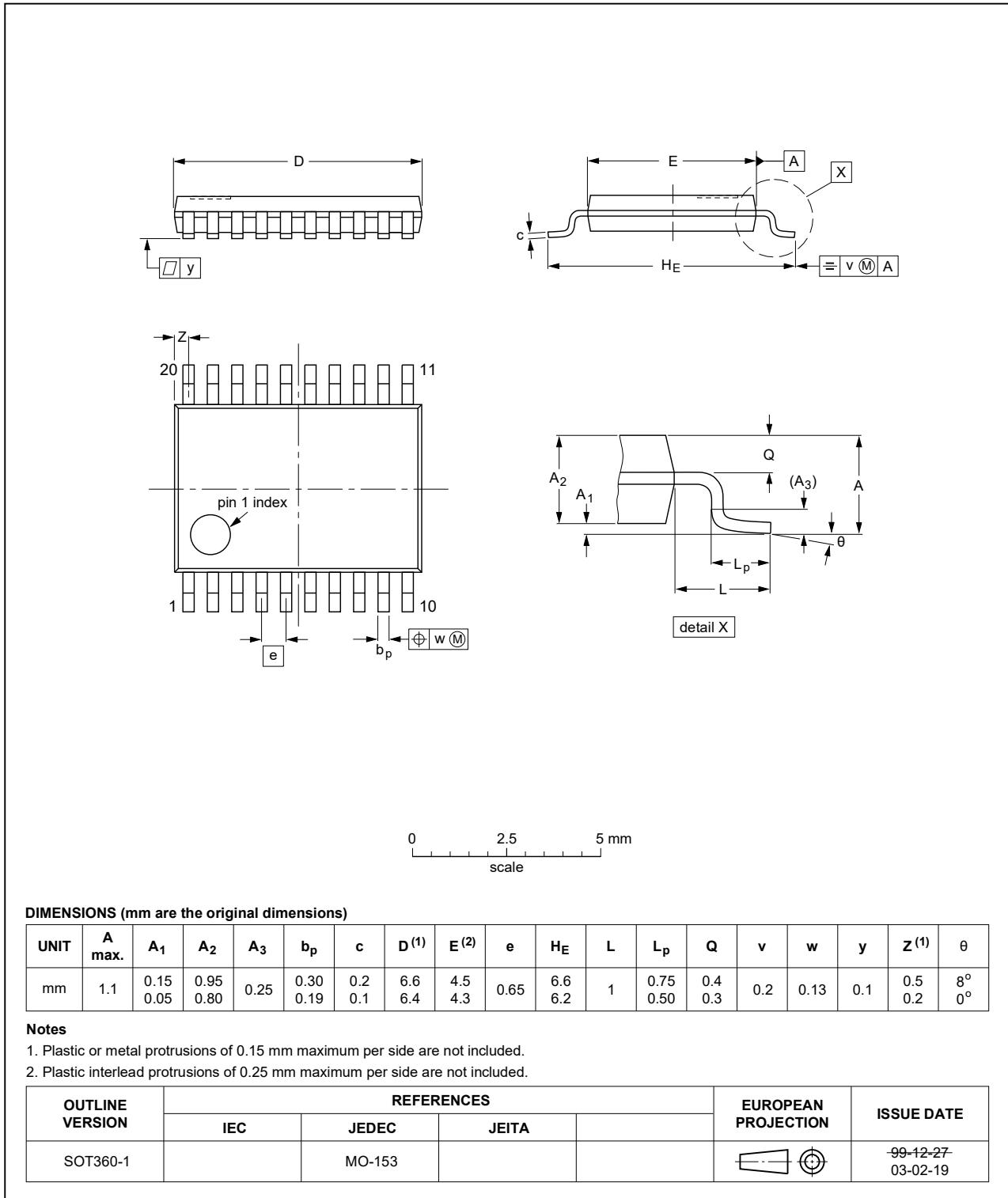
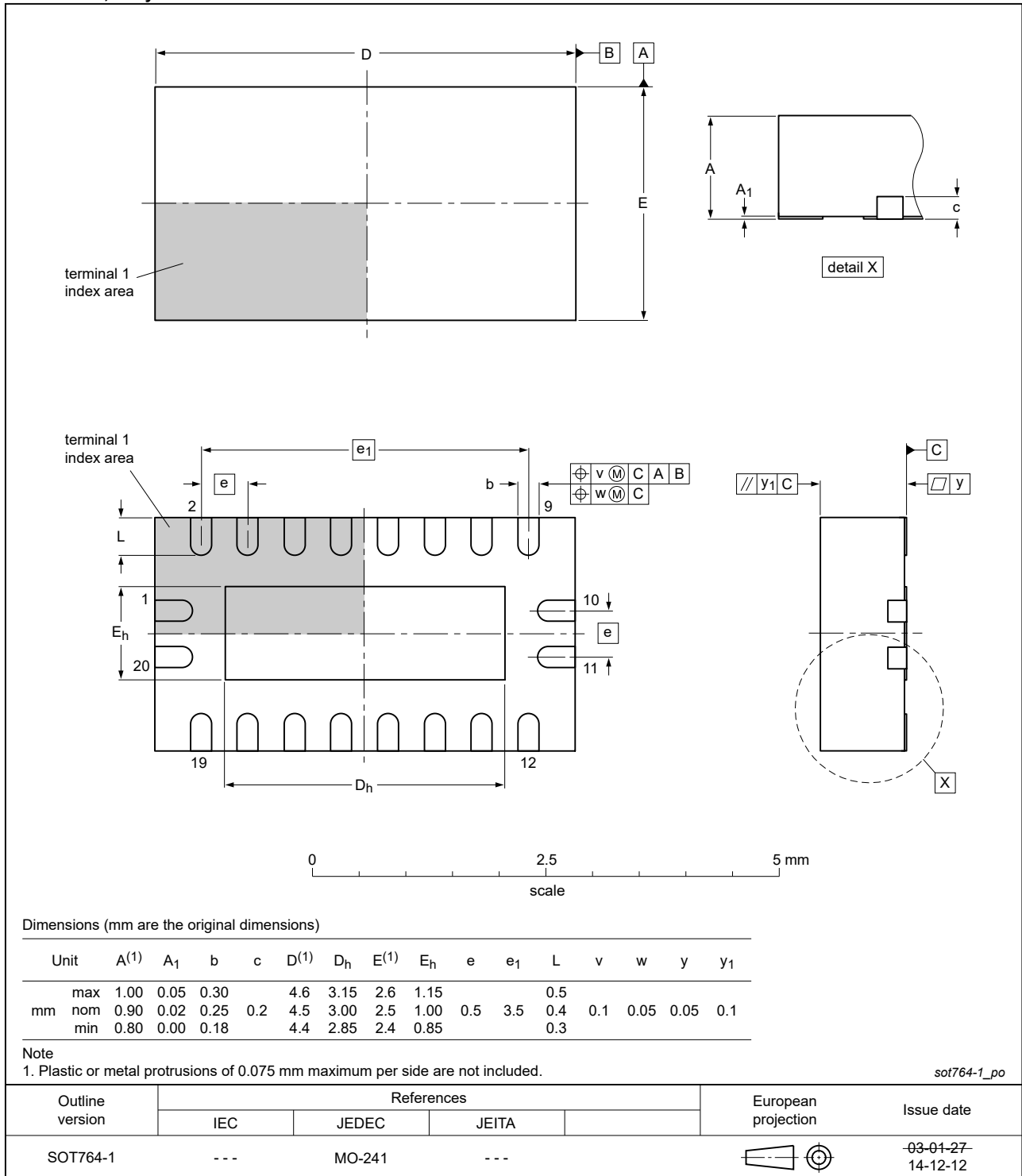


Fig. 10. Package outline SOT360-1 (TSSOP20)

**DHVQFN20:** plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1



**Fig. 11. Package outline SOT764-1 (DHVQFN20)**

## 12. Abbreviations

Table 10. Abbreviations

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

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC541A v.5	20200313	Product data sheet	-	74LVC541A v.4
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> <li><a href="#">Measurements points</a> table added.</li> <li>Package outline drawing <a href="#">SOT764-1</a> (DHVQFN20) updated.</li> </ul>			
74LVC541A v.4	20111125	Product data sheet	-	74LVC541A v.3
Modifications:	<ul style="list-style-type: none"> <li>The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a> and <a href="#">Table 9</a>: values added for lower voltage ranges.</li> </ul>			
74LVC541A v.3	20031112	Product specification	-	74LVC541A v.2
74LVC541A v.2	20030514	Product specification	-	74LVC541A v.1
74LVC541A v.1	19980729	Product specification	-	-

## 14. Legal information

### Data sheet status

Document status [1][2]	Product status [3]	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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