

# 74ALVC541

Octal buffer/line driver; 3-state

Rev. 3 — 20 January 2014

Product data sheet

## 1. General description

The 74ALVC541 is an octal non-inverting buffer/line drivers with 3-state bus compatible outputs. The 3-state outputs are controlled by the output enable inputs  $\overline{OE}0$  and  $\overline{OE}1$ . A HIGH on  $\overline{OE}n$  causes the outputs to assume a high-impedance OFF-state.

## 2. Features and benefits

- Wide supply voltage range from 1.65 V to 3.6 V
- Complies with JEDEC standard:
  - ◆ JESD8-7 (1.65 V to 1.95 V )
  - ◆ JESD8-5 (2.3 V to 2.5 V)
  - ◆ JESD8B/JESD36 (2.7 V to 3.6 V)
- 3.6 V tolerant inputs/outputs
- CMOS LOW power consumption
- Direct interface with TTL levels (2.7 V to 3.6 V)
- Power-down mode
- Latch-up performance exceeds 250 mA
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V

## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74ALVC541D	-40 °C to +85 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74ALVC541PW	-40 °C to +85 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74ALVC541BQ	-40 °C to +85 °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

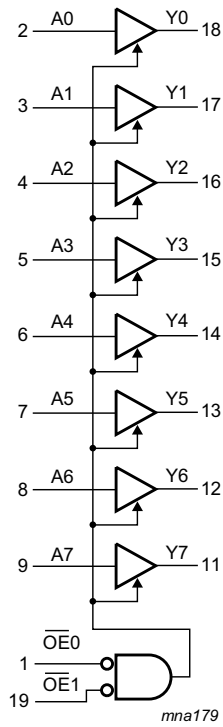


Fig 1. Logic symbol

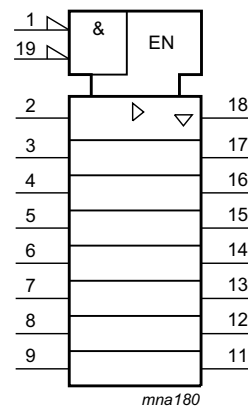
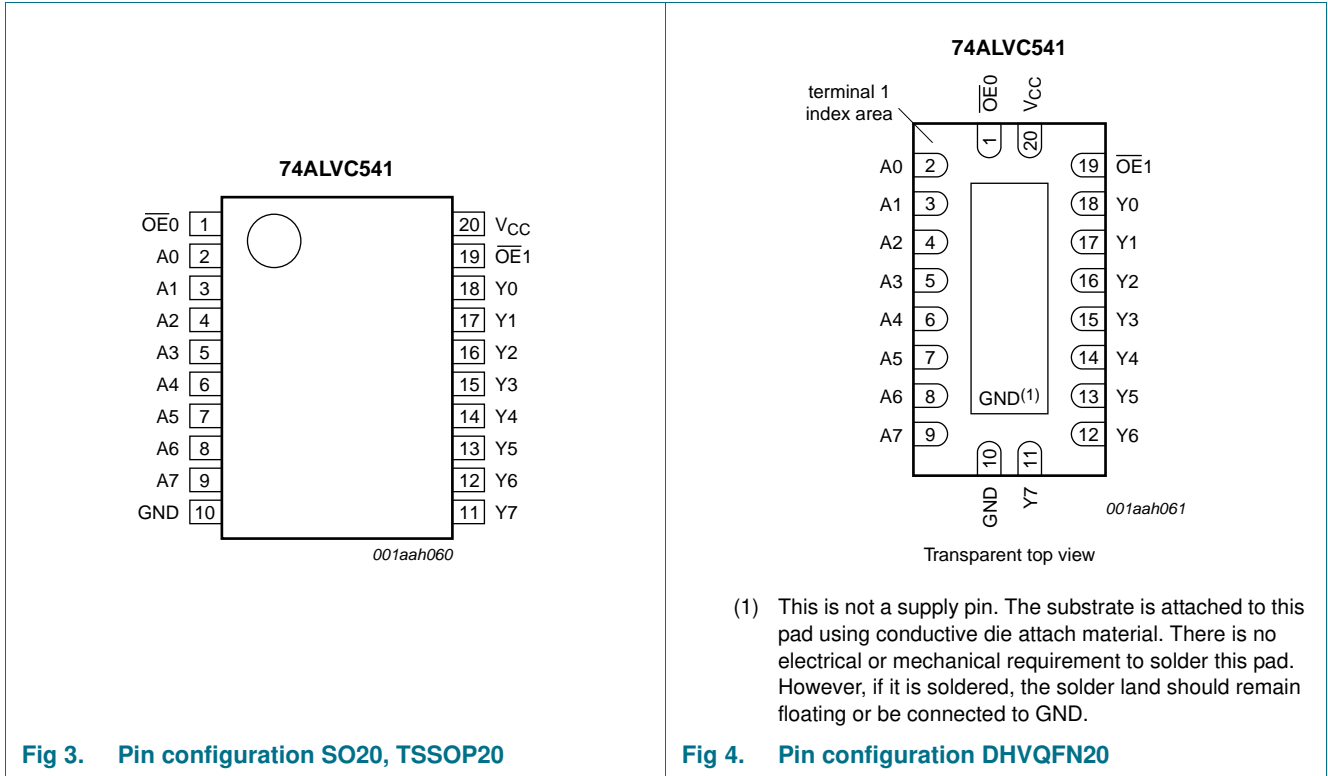


Fig 2. IEC logic symbol

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{OE}0$	1	output enable input (active LOW)
A[0:7]	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y[0:7]	18, 17, 16, 15, 14, 13, 12, 11	data output
$\overline{OE}1$	19	output enable input (active LOW)
V <sub>CC</sub>	20	supply voltage

## 6. Functional description

Table 3. Functional table<sup>[1]</sup>

Control		Input		Output
OE0	OE1	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	+4.6	V
$V_I$	input voltage		-0.5	+4.6	V
$I_{IK}$	input clamping current	$V_I < 0$ V	[1] -50	-	mA
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
$V_O$	output voltage	output HIGH or LOW state	[2] -0.5	$V_{CC} + 0.5$	V
		output 3-state	[2] -0.5	+4.6	V
		power-down mode, $V_{CC} = 0$ V	[3] -0.5	+4.6	V
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	±50	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +85 °C			
	SO20 package		[4] -	500	mW
	TSSOP20 package		[5] -	500	mW
	DHVQFN20 package		[6] -	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] When  $V_{CC} = 0$  V (Power-down mode), the output voltage can be 3.6 V in normal operation.

[4]  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

[5]  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

[6]  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		1.65	3.6	V
$V_I$	input voltage		0	3.6	V
$V_O$	output voltage	output HIGH or LOW state	0	$V_{CC}$	V
		output 3-state	0	3.6	V
		power-down mode, $V_{CC} = 0$ V	0	3.6	V
$T_{amb}$	ambient temperature		-40	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65$ V to 2.7 V	-	20	ns/V
		$V_{CC} = 2.7$ V to 3.6 V	-	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	$T_{amb} = -40$ °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.65$ V to 1.95 V	$0.65 \times V_{CC}$	-	-	V
		$V_{CC} = 2.3$ V to 2.7V	1.7	-	-	V
		$V_{CC} = 2.7$ V to 3.6 V	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.65$ V to 1.95 V	-	-	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3$ V to 2.7V	-	-	0.7	V
		$V_{CC} = 2.7$ V to 3.6 V	-	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 100$ $\mu$ A; $V_{CC} = 1.65$ V to 3.6 V	$\zeta_{XX}-0.2$	-	-	V
		$I_O = 6$ mA; $V_{CC} = 1.65$ V	1.25	-	-	V
		$I_O = 12$ mA; $V_{CC} = 2.3$ V	1.8	-	-	V
		$I_O = 18$ mA; $V_{CC} = 2.3$ V	1.7	-	-	V
		$I_O = 12$ mA; $V_{CC} = 2.7$ V	2.2	-	-	V
		$I_O = 18$ mA; $V_{CC} = 3.0$ V	2.4	-	-	V
		$I_O = 24$ mA; $V_{CC} = 3.0$ V	2.2	-	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -100$ $\mu$ A; $V_{CC} = 1.65$ V to 3.6 V	-	-	0.2	V
		$I_O = -6$ mA; $V_{CC} = 1.65$ V	-	-	0.3	V
		$I_O = -12$ mA; $V_{CC} = 2.3$ V	-	-	0.4	V
		$I_O = -18$ mA; $V_{CC} = 2.3$ V	-	-	0.6	V
		$I_O = -12$ mA; $V_{CC} = 2.7$ V	-	-	0.4	V
		$I_O = -18$ mA; $V_{CC} = 3.0$ V	-	-	0.4	V
		$I_O = -24$ mA; $V_{CC} = 3.0$ V	-	-	0.55	V
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND; $V_{CC} = 3.6$ V	-	$\pm 0.1$	$\pm 10.0$	$\mu$ A

**Table 6. Static characteristics ...continued**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.6 V	-	±0.1	±5.0	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 0 V	-	±0.1	±10.0	μA
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	-	0.2	10	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 3.0 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A;	-	5	750	μA
C <sub>I</sub>	input capacitance		-	3.5	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V 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 [Figure 7](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
t <sub>pd</sub>	propagation delay	An to Yn; see <a href="#">Figure 5</a> <sup>[2]</sup>				
		V <sub>CC</sub> = 1.65V to 1.95 V	1.0	3.0	4.6	ns
		V <sub>CC</sub> = 2.3V to 2.7 V	1.0	2.2	3.3	ns
		V <sub>CC</sub> = 27 V	1.0	2.5	3.3	ns
t <sub>en</sub>	enable time	$\overline{\text{OEn}}$ to Yn; see <a href="#">Figure 6</a> <sup>[2]</sup>				
		V <sub>CC</sub> = 1.65V to 1.95 V	1.0	4.2	7.5	ns
		V <sub>CC</sub> = 2.3V to 2.7 V	1.0	3.3	5.4	ns
		V <sub>CC</sub> = 27 V	1.0	3.7	5.8	ns
t <sub>dis</sub>	disable time	$\overline{\text{OEn}}$ to Yn; see <a href="#">Figure 6</a> <sup>[2]</sup>				
		V <sub>CC</sub> = 1.65V to 1.95 V	1.0	4.8	7.5	ns
		V <sub>CC</sub> = 2.3V to 2.7 V	1.0	3.1	4.5	ns
		V <sub>CC</sub> = 27 V	1.0	3.1	4.8	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.9	4.6	ns

**Table 7. Dynamic characteristics ...continued**  
 Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#).

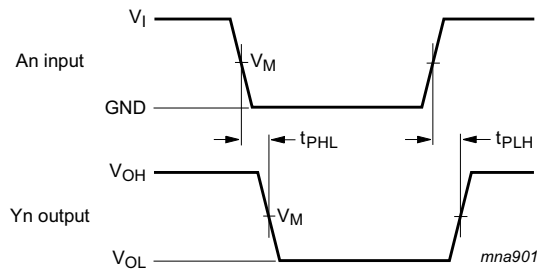
Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> ; V <sub>CC</sub> = 3.3 V <sup>[3]</sup>				
		outputs enabled	-	25	-	pF
		outputs disabled	-	0	-	pF

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

- [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>.

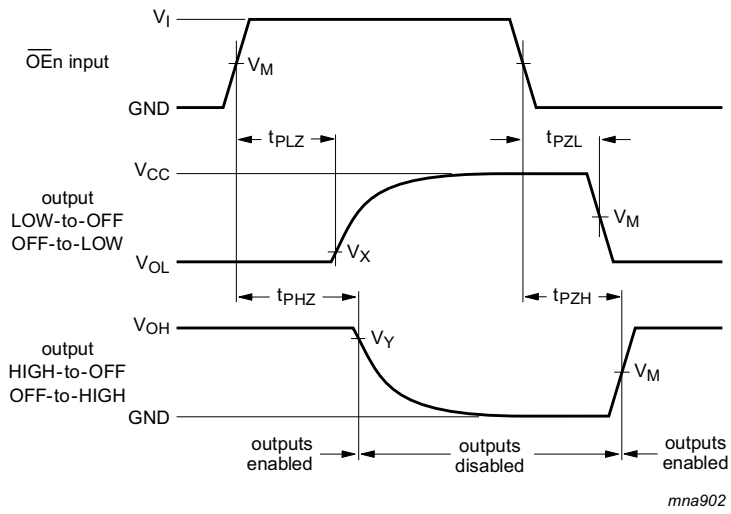
[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:  
 f<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V;  
 N = number of inputs switching;  
 Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

## 11. Waveforms



Measurement points are given in [Table 8](#).  
 V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.

**Fig 5. Propagation delay input (An) to output (Yn)**



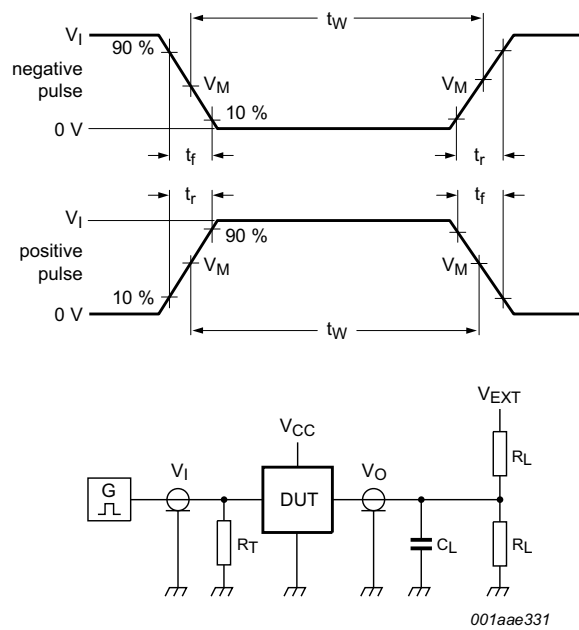
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 6. Enable and disable times**

**Table 8. Measurement points**

Supply voltage	Input		Output		
	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
1.65 V to 1.65V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$





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

Definitions test circuit:

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

$C_L$  = Load capacitance including jig and probe capacitance

$R_L$  = Load resistor

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

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ 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	6	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	6	GND

12. Package outline

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

SOT163-1

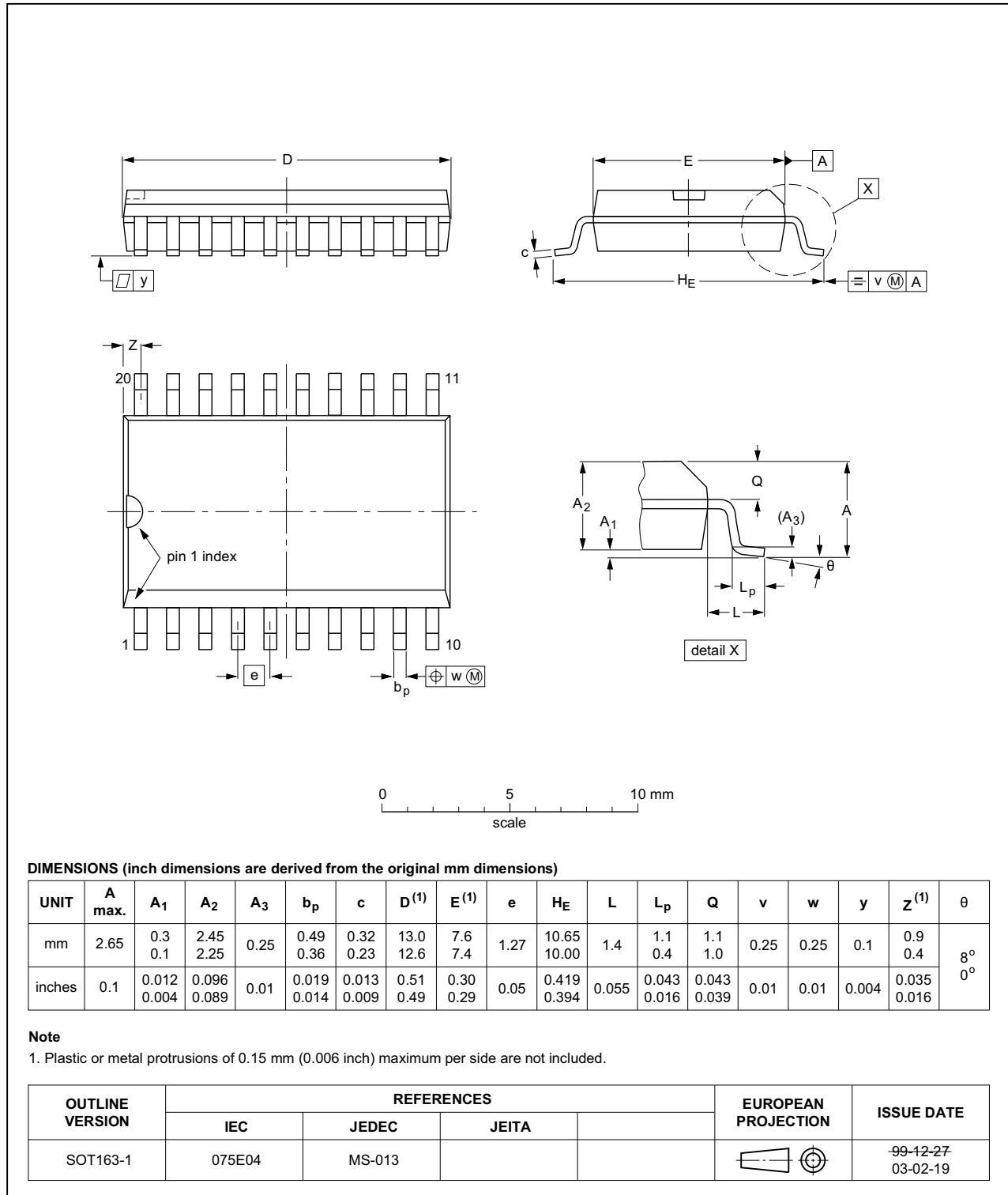


Fig 8. Package outline SOT163-1 (SO20)

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

SOT360-1

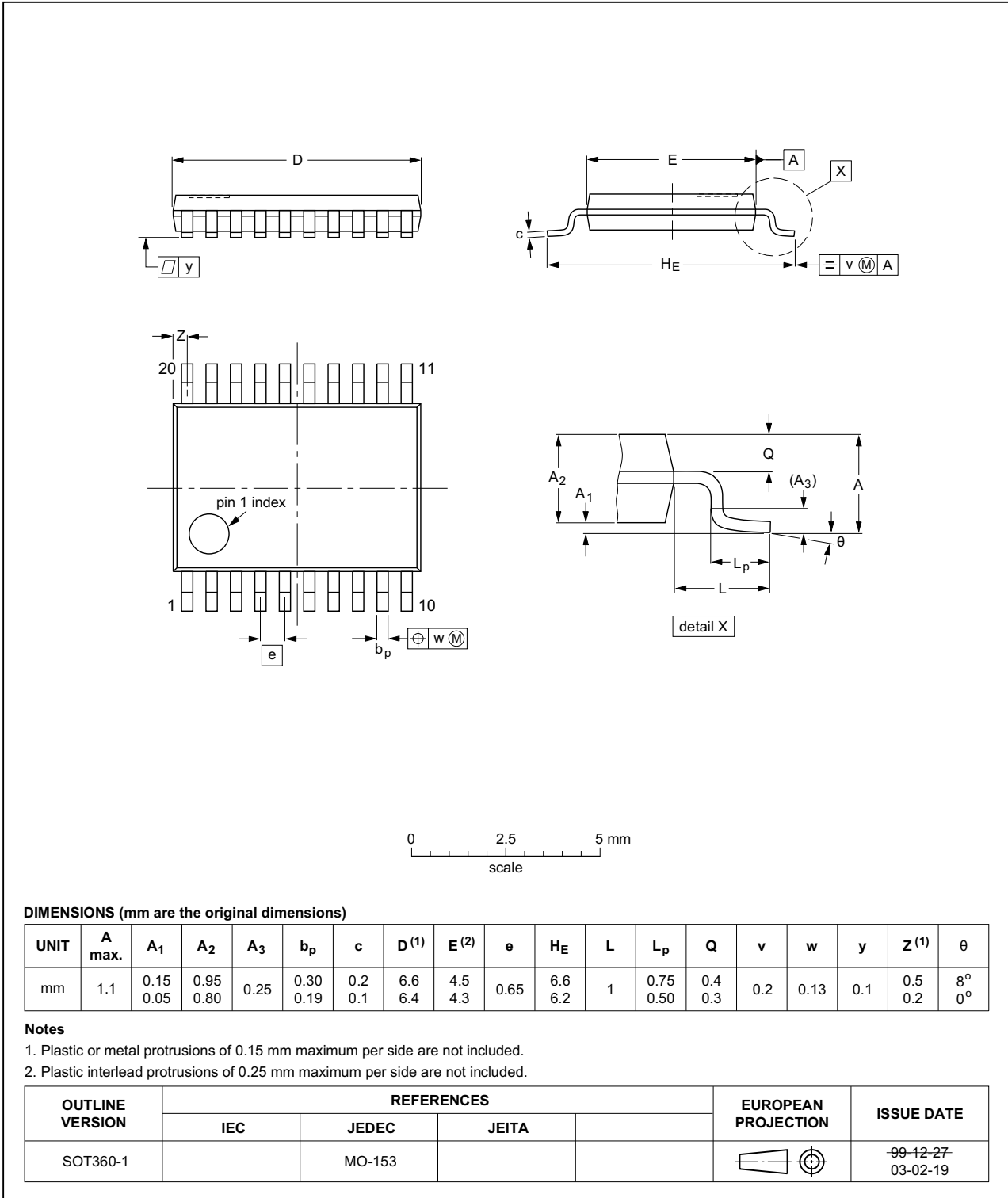


Fig 9. Package outline SOT360-1 (TSSOP20)

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

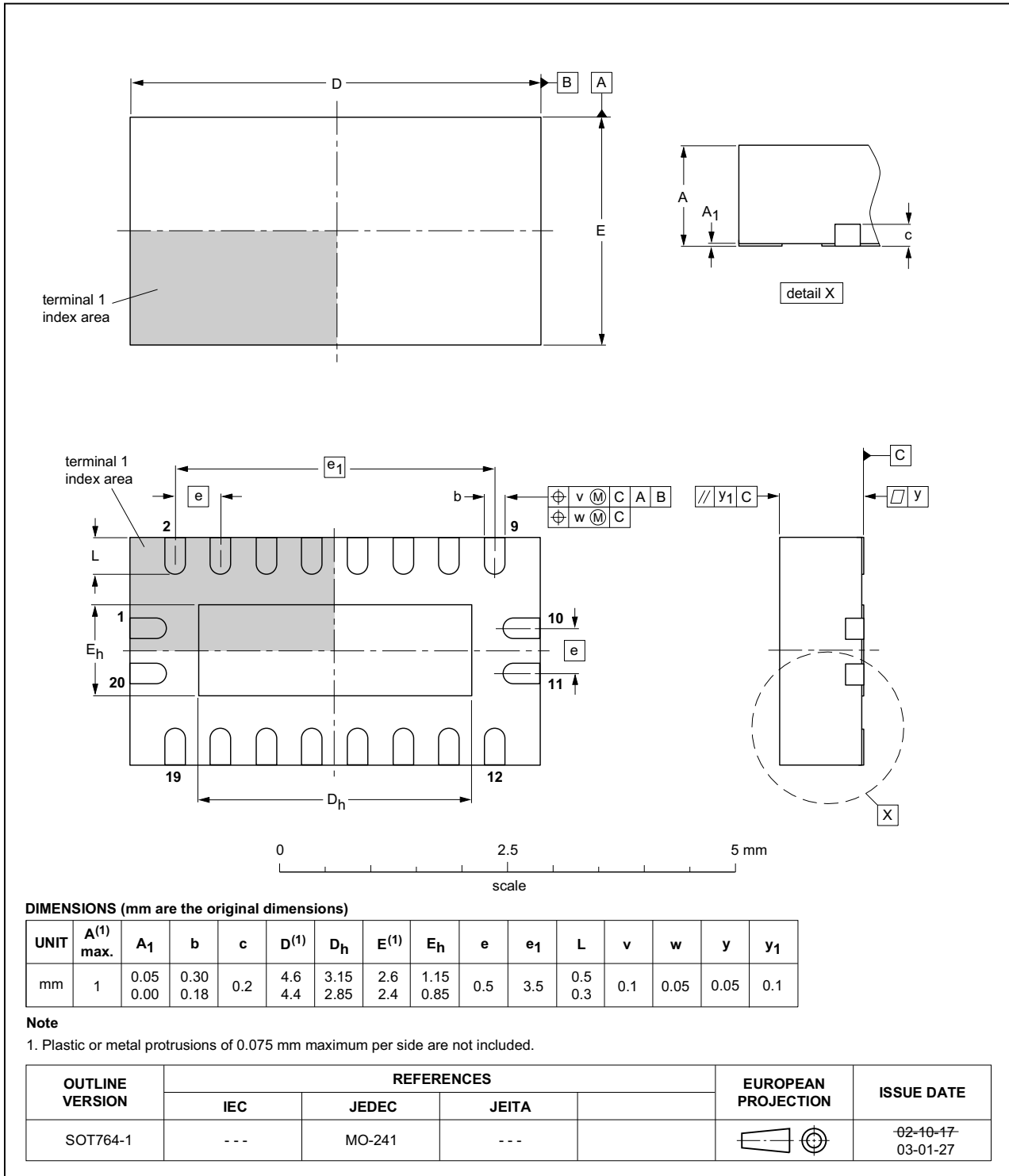


Fig 10. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charge 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

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74ALVC541 v.3	20140120	Product data sheet	-	74ALVC541 v.2
				<ul style="list-style-type: none"><li>The format of this data sheet 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></ul>
74ALVC541 v.2	20071210	Product data sheet	-	74ALVC541 v.1
74ALVC541 v.1	20021115	Product specification	-	-

## 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.
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Product [short] data sheet	Production	This document contains the product specification.

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

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