# 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 OE0 and OE1. A HIGH on OEn causes the outputs to assume a high-impedance OFF-state.

#### **Features and benefits** 2.

- 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

# **Ordering information**

Table 1. **Ordering information** 

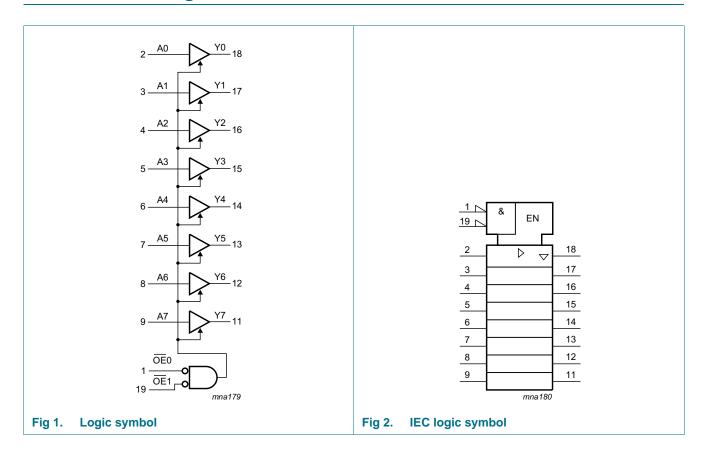
Type number	Package								
	Temperature range	Name	Description	Version					
74ALVC541D	–40 °C to +85 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1					
74ALVC541PW	–40 °C to +85 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1					
74ALVC541BQ	–40 °C to +85 °C	DHVQFN20	plastic dual-in-line compatible thermal enhanced very thin quad flat package no leads; 20 terminals; body $2.5\times4.5\times0.85$ mm	SOT764-1					



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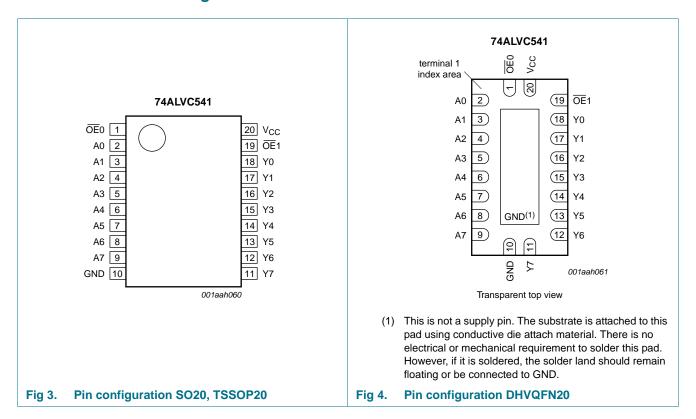
# 4. Functional diagram



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# 5. Pinning information

## 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

	•	
Symbol	Pin	Description
OE0	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
OE1	19	output enable input (active LOW)
$V_{CC}$	20	supply voltage

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# 6. Functional description

Table 3. Functional table[1]

Control		Input	Output
OE0	OE1	An	Yn
L	L	L	L
L	L	Н	Н
X	Н	X	Z
Н	X	X	Z

<sup>[1]</sup> 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
VI	input voltage			-0.5	+4.6	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	[1]	-50	-	mA
I <sub>OK</sub>	output clamping current	$V_O > V_{CC}$ or $V_O < 0 V$		-	±50	mA
Vo	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 <sub>CC</sub> = 0 V	[3]	-0.5	+4.6	V
I <sub>O</sub>	output current	$V_O = 0 V \text{ to } V_{CC}$		-	±50	mA
I <sub>CC</sub>	supply current			-	100	mA
I <sub>GND</sub>	ground current			-100	-	mA
T <sub>stg</sub>	storage temperature			-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +85  ^{\circ}\text{C}$				
	SO20 package		[4]	-	500	mW
	TSSOP20 package		[5]	-	500	mW
	DHVQFN20 package		[6]	-	500	mW

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

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

<sup>[3]</sup> When  $V_{CC} = 0$  V (Power-down mode), the output voltage can be 3.6 V in normal operation.

<sup>[4]</sup> Ptot derates linearly with 8 mW/K above 70 °C.

<sup>[5]</sup> Ptot derates linearly with 5.5 mW/K above 60 °C.

<sup>[6]</sup> P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

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# 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		1.65	3.6	V
VI	input voltage		0	3.6	V
Vo	output voltage	output HIGH or LOW state	0	$V_{CC}$	V
		output 3-state	0	3.6	V
		power-down mode, V <sub>CC</sub> = 0 V	0	3.6	V
T <sub>amb</sub>	ambient temperature		-40	+85	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	-	20	ns/V
		V <sub>CC</sub> = 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 <sub>amb</sub> =	-40 °C to	+85 °C	Unit
			Min	Typ[1]	Max	
$V_{IH}$	HIGH-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	$0.65 \times V_{CC}$	-	-	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{V}$	1.7	-	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	$0.35 \times V_{CC}$	V
		V <sub>CC</sub> = 2.3 V to 2.7V	-	-	0.7	V
		V <sub>CC</sub> = 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	ςXX-0.2	-	-	V
		$I_{O} = 6mA$ ; $V_{CC} = 1.65 V$	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
		$I_{O} = 18 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.4	-	-	V
		$I_{O} = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	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
		$I_{O} = -6mA$ ; $V_{CC} = 1.65 V$	-	-	0.3	V
		$I_{O} = -12 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.4	V
		$I_{O} = -18 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.6	V
		$I_{O} = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	-	0.4	V
		$I_{O} = -18 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.4	V
		$I_{O} = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.55	V
l <sub>OZ</sub>	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND; $V_{CC} = 3.6 \text{ V}$	-	±0.1	±10.0	μΑ

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 Table 6.
 Static characteristics ...continued

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

Symbol	Parameter	Conditions	T <sub>amb</sub> =	Unit		
			Min	Typ[1]	Max	
I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 3.6 \text{ V}$	-	±0.1	±5.0	μΑ
I <sub>OFF</sub>	power-off leakage current	$V_I$ or $V_O = 0$ V to 3.6 V; $V_{CC} = 0$ V	-	±0.1	±10.0	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 3.6$ V	-	0.2	10	μΑ
$\Delta I_{CC}$	additional supply current	per input pin; $V_{CC}$ = 3.0 V to 3.6 V; $V_I = V_{CC} - 0.6$ V; $I_O = 0$ A;	-	5	750	μΑ
C <sub>I</sub>	input capacitance		-	3.5	-	pF

<sup>[1]</sup> All typical values are measured at  $V_{CC}$  = 3.3 V and Tamb = 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>aml</sub>	<sub>b</sub> = -40 °C to	+85 °C	Unit
					Typ[1]	Max	
t <sub>pd</sub>	propagation	An to Yn; see Figure 5	[2]				·
	delay	$V_{CC} = 1.65V \text{ to } 1.95 \text{ V}$		1.0	3.0	4.6	ns
		$V_{CC} = 2.3V \text{ to } 2.7 \text{ V}$		1.0	2.2	3.3	ns
		V <sub>CC</sub> = 27 V		1.0	2.5	3.3	ns
	$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$		1.0	2.3	3.0	ns	
t <sub>en</sub>	enable time	OEn to Yn; see Figure 6	[2]				
		$V_{CC} = 1.65V \text{ to } 1.95 \text{ V}$		1.0	4.2	7.5	ns
		$V_{CC} = 2.3V \text{ to } 2.7 \text{ V}$		1.0	3.3	5.4	ns
		V <sub>CC</sub> = 27 V		1.0	3.7	5.8	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$		1.0	3.3	4.9	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Figure 6	[2]				
		$V_{CC} = 1.65V \text{ to } 1.95 \text{ V}$		1.0	4.8	7.5	ns
		$V_{CC} = 2.3V \text{ to } 2.7 \text{ V}$		1.0	3.1	4.5	ns
		V <sub>CC</sub> = 27 V		1.0	3.1	4.8	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$		1.0	2.9	4.6	ns

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**Dynamic characteristics** ...continued Table 7.

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7.

Symbol	Parameter	Conditions	Conditions		<sub>o</sub> = -40 °C to ·	+85 °C	Unit
				Min	Typ[1]	Max	
C <sub>PD</sub> power		per buffer; $V_I = GND$ to $V_{CC}$ ; $V_{CC} = 3.3 \text{ V}$	[3]				
	dissipation capacitance	outputs enabled		-	25	-	pF
	capacitance	outputs disabled		-	0	-	pF

- [1] All typical values are measured at Tamb = 25  $^{\circ}$ C and V<sub>CC</sub> = 1.8 V, 2.5 V, 2.7 V and 3.3 V.
- [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  $\mu W$ ).

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

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

 $f_o$  = output frequency in MHz;

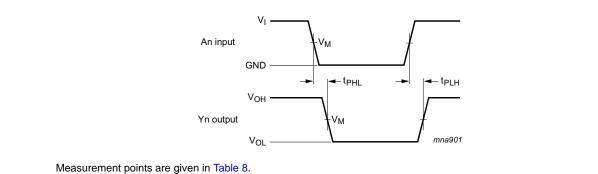
C<sub>L</sub> = output load capacitance in pF;

 $V_{CC}$  = supply voltage in V;

N = number of inputs switching;

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

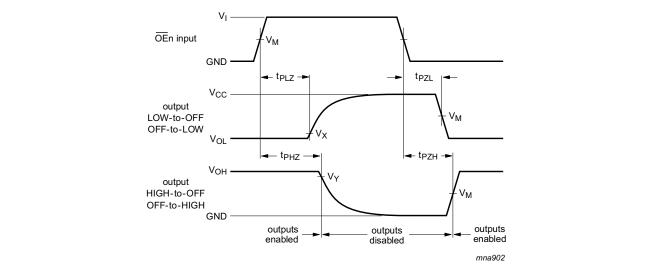
## 11. Waveforms



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

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

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Measurement points are given in Table 8.

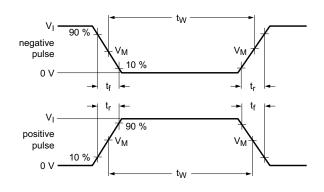
 $V_{\mbox{\scriptsize OL}}$  and  $V_{\mbox{\scriptsize OH}}$  are typical voltage output levels that occur with the output load.

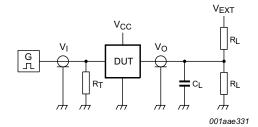
Fig 6. Enable and disable times

Table 8. Measurement points

Supply voltage	Input		Output			
V <sub>CC</sub>	V <sub>I</sub>	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>	
1.65 V to 1.65V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	V <sub>OL</sub> + 0.15 V	$V_{OH}-0.15\ V$	
2.3 V to 2.7 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	V <sub>OL</sub> + 0.15 V	$V_{OH}-0.15\ V$	
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL}$ + 0.3 $V$	$V_{OH}-0.3\ V$	
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	V <sub>OL</sub> + 0.3 V	$V_{OH}-0.3~V$	

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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<sub>L</sub> = Load capacitance including jig and probe capacitance

R<sub>L</sub> = Load resistor

Fig 7. Test circuit for measuring switching times

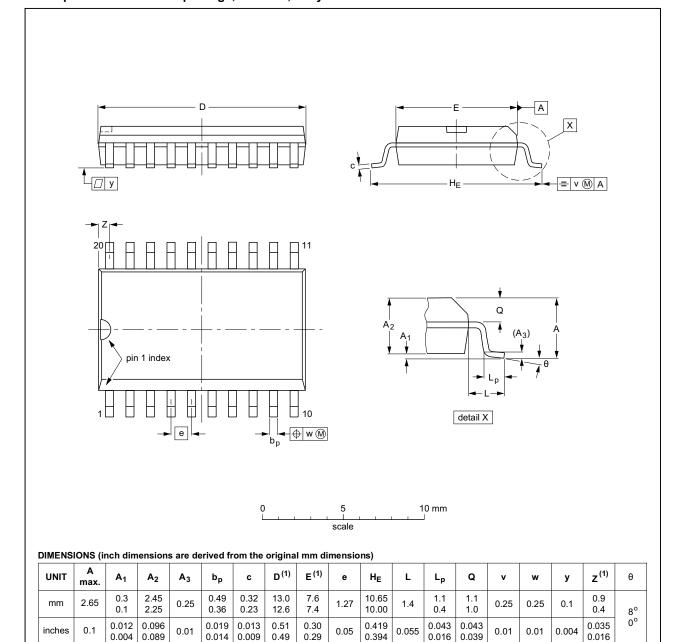
Table 9. Test data

Supply voltage	Input		Load		V <sub>EXT</sub>		
V <sub>CC</sub>	VI	t <sub>r</sub> , t <sub>f</sub>	CL	R <sub>L</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>	t <sub>PLZ</sub> , t <sub>PZL</sub>	t <sub>PHZ</sub> , t <sub>PZH</sub>
1.65 V to 1.95 V	$V_{CC}$	$\leq$ 2.0 ns	30 pF	1 kΩ	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	≤ 2.5 ns	50 pF	500 Ω	open	6	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	6	GND

# 12. Package outline

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

SOT163-1



#### Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE		REFER	RENCES	EUROPEAN	ISSUE DATE
VERSION	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE
SOT163-1	075E04	MS-013			<del>99-12-27</del> 03-02-19

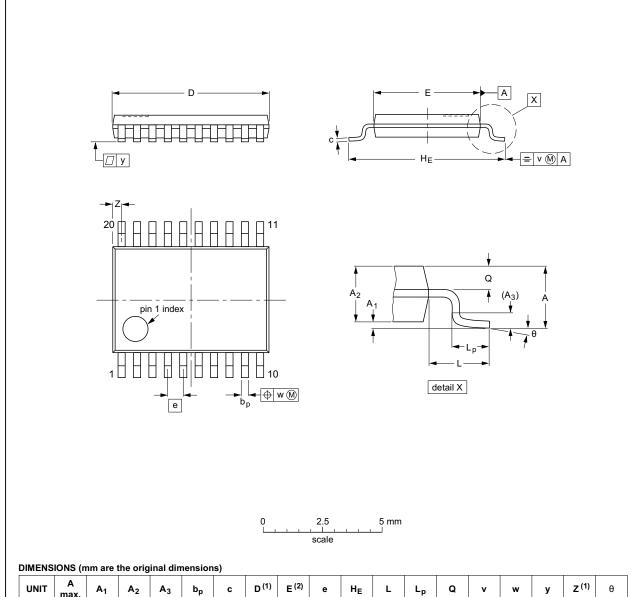
Fig 8. Package outline SOT163-1 (SO20)

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

SOT360-1



						-,												
UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E (2)	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	θ
mm	1.1	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	0.75 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.

	REFER	EUROPEAN	ISSUE DATE			
IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
	MO-153				<del>99-12-27</del> 03-02-19	
	IEC	IEC JEDEC		IEC JEDEC JEITA	IEC JEDEC JEITA PROJECTION	

Fig 9. Package outline SOT360-1 (TSSOP20)

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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

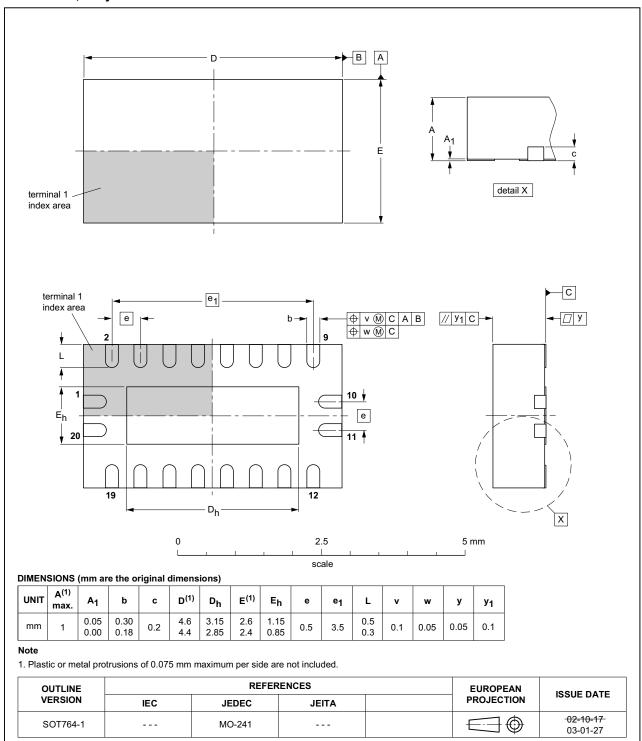


Fig 10. Package outline SOT764-1 (DHVQFN20)

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# 13. Abbreviations

## Table 10. Abbreviations

Acronym	Description
CDM	Charge Device Model
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	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> <li>The format of of NXP Semice</li> </ul>	this data sheet has been red onductors.	esigned to comply with	the new identity guidelines	
	<ul> <li>Legal texts have</li> </ul>	ve been adapted to the new	company name where	appropriate.	
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[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"
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <a href="http://www.nexperia.com">http://www.nexperia.com</a>.

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#### Octal buffer/line driver; 3-state

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## Octal buffer/line driver; 3-state

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- Техническая поддержка проекта;
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