

# 74ALVC541-Q100

Octal buffer/line driver; 3-state

Rev. 1 — 19 May 2014

Product data sheet

## 1. General description

The 74ALVC541-Q100 is an octal non-inverting buffer/line driver with 3-state bus compatible outputs. The output enable inputs  $\overline{OE}_0$  and  $\overline{OE}_1$ , control the 3-state outputs. A HIGH on  $\overline{OEn}$  causes the outputs to assume a high-impedance OFF-state.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 3) and is suitable for use in automotive applications.

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 3)
  - ◆ Specified from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Wide supply voltage range from 1.65 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
- 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)
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200 \text{ pF}$ ,  $R = 0 \Omega$ )

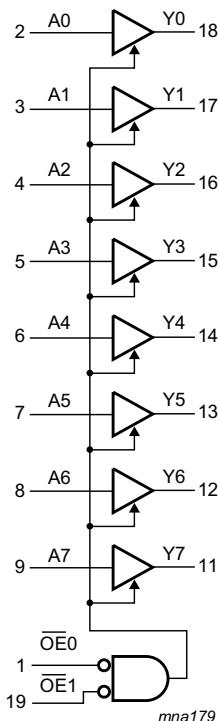
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### 3. Ordering information

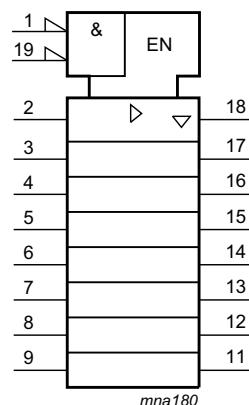
**Table 1. Ordering information**

Type number	Package				Version
	Temperature range	Name	Description		
74ALVC541D-Q100	-40 °C to +85 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm		SOT163-1
74ALVC541PW-Q100	-40 °C to +85 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm		SOT360-1
74ALVC541BQ-Q100	-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

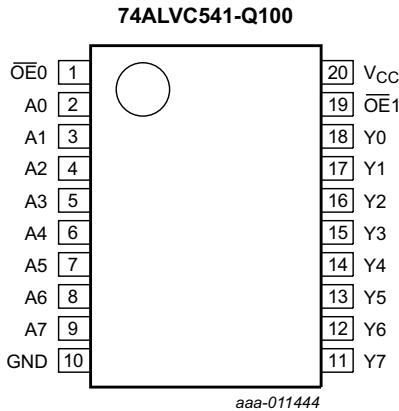


Fig 3. Pin configuration SO20, TSSOP20

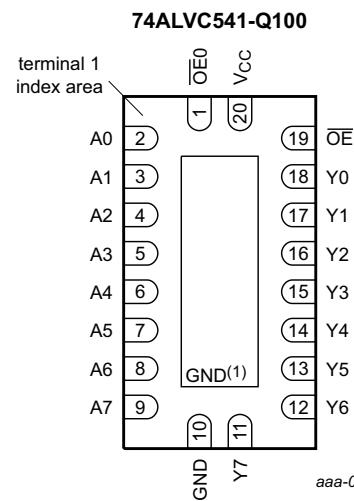


Fig 4. Pin configuration DHVQFN20

### 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 <sub>CC</sub>	20	supply voltage

## 6. Functional description

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

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

[4]  $P_{tot}$  derates linearly with 8 mW/K above  $70 \text{ }^{\circ}\text{C}$ .

[5]  $P_{tot}$  derates linearly with 5.5 mW/K above  $60 \text{ }^{\circ}\text{C}$ .

[6]  $P_{tot}$  derates linearly with 4.5 mW/K above  $60 \text{ }^{\circ}\text{C}$ .

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	3.6	V
V <sub>I</sub>	input voltage		0	3.6	V
V <sub>O</sub>	output voltage	output HIGH or LOW state	0	V <sub>CC</sub>	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
$\Delta t/\Delta V$	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 <sup>[1]</sup>	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	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	ζXX-0.2	-	-	V
		I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 1.65 V	1.25	-	-	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	V
		I <sub>O</sub> = 18 mA; V <sub>CC</sub> = 2.3 V	1.7	-	-	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	V
		I <sub>O</sub> = 18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	2.2	-	-	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	V
		I <sub>O</sub> = -6 mA; V <sub>CC</sub> = 1.65 V	-	-	0.3	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.3 V	-	-	0.4	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	-	-	0.4	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	V
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> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.6 V	-	±0.1	±10.0	µA

**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 Y <sub>n</sub> ; see <a href="#">Figure 5</a> [2]				
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	3.0	4.6	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.2	3.3	ns
		V <sub>CC</sub> = 27 V	1.0	2.5	3.3	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.3	3.0	ns
t <sub>en</sub>	enable time	OE <sub>n</sub> to Y <sub>n</sub> ; see <a href="#">Figure 6</a> [2]				
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	4.2	7.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.3	5.4	ns
		V <sub>CC</sub> = 27 V	1.0	3.7	5.8	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.3	4.9	ns
t <sub>dis</sub>	disable time	OE <sub>n</sub> to Y <sub>n</sub> ; see <a href="#">Figure 6</a> [2]				
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	4.8	7.5	ns
		V <sub>CC</sub> = 2.3 V 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	[3]			
		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<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) where:

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

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

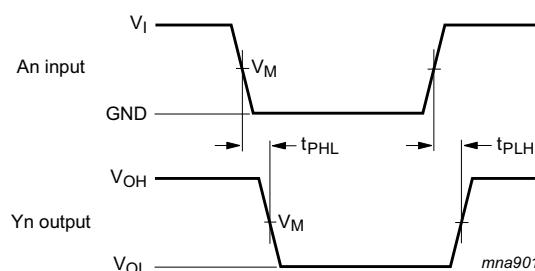
C<sub>L</sub> = output load capacitance in pF;

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.

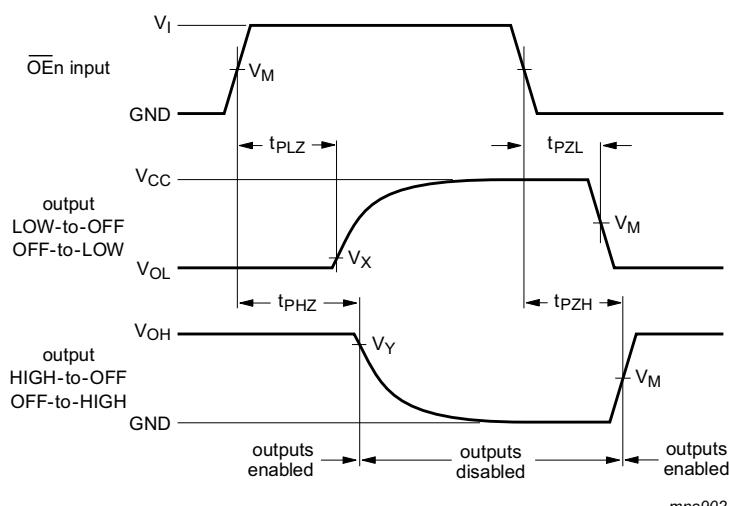
## 11. Waveforms



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)**



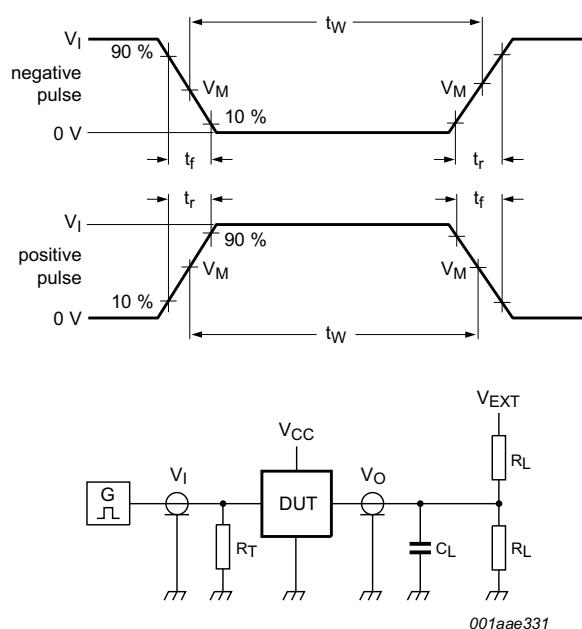
Measurement points are given in [Table 8](#).

$V_{OL}$  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		
$V_{CC}$	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
1.65 V to 1.65 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
2.3 V to 2.7 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15$ 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	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ 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**

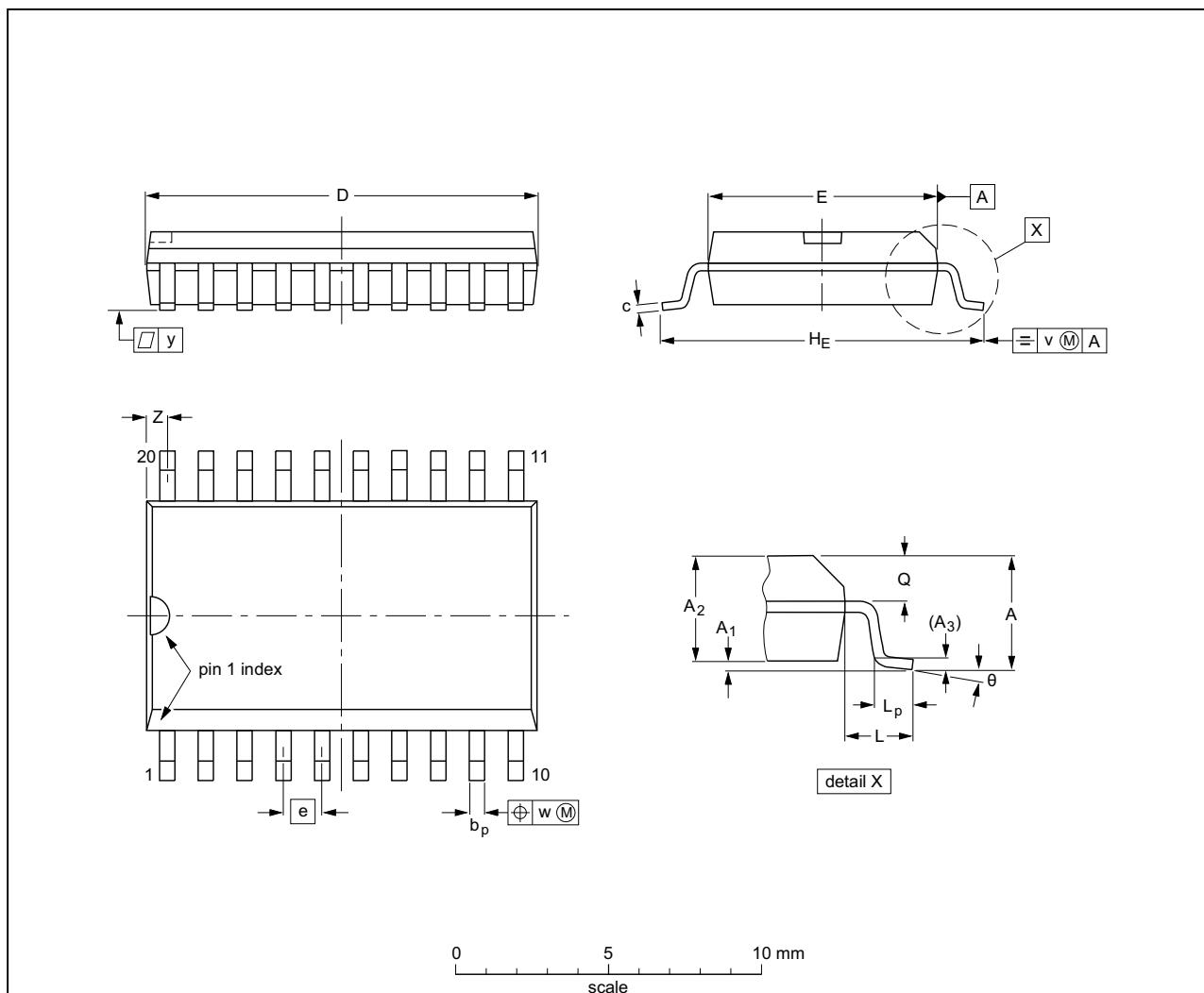
**Table 9. Test data**

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



### DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2.65 0.1	0.3 2.25	2.45	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

### Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT163-1	075E04	MS-013				99-12-27 03-02-19

Fig 8. Package outline SOT163-1 (SO20)

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

SOT360-1

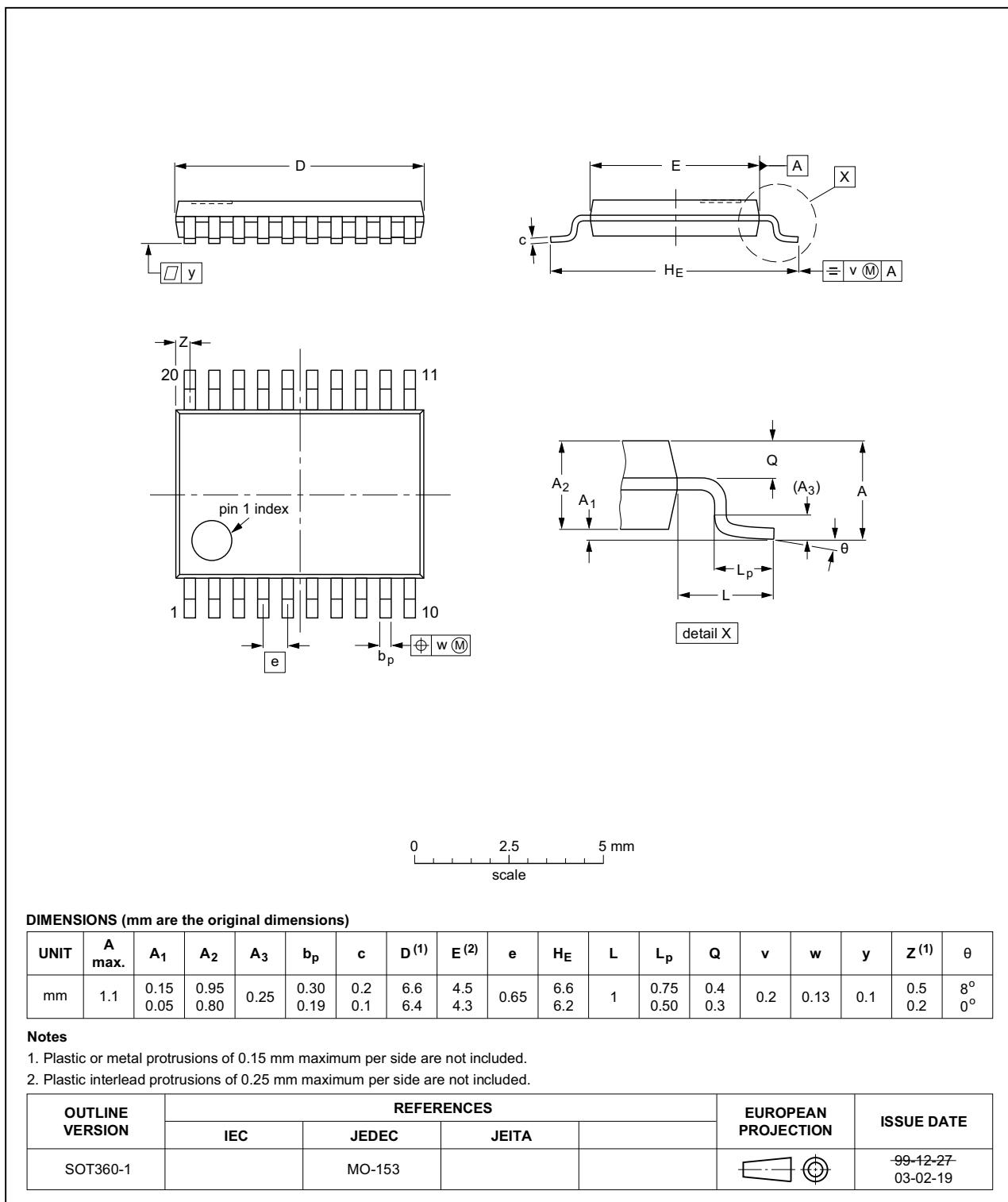


Fig 9. Package outline SOT360-1 (TSSOP20)

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

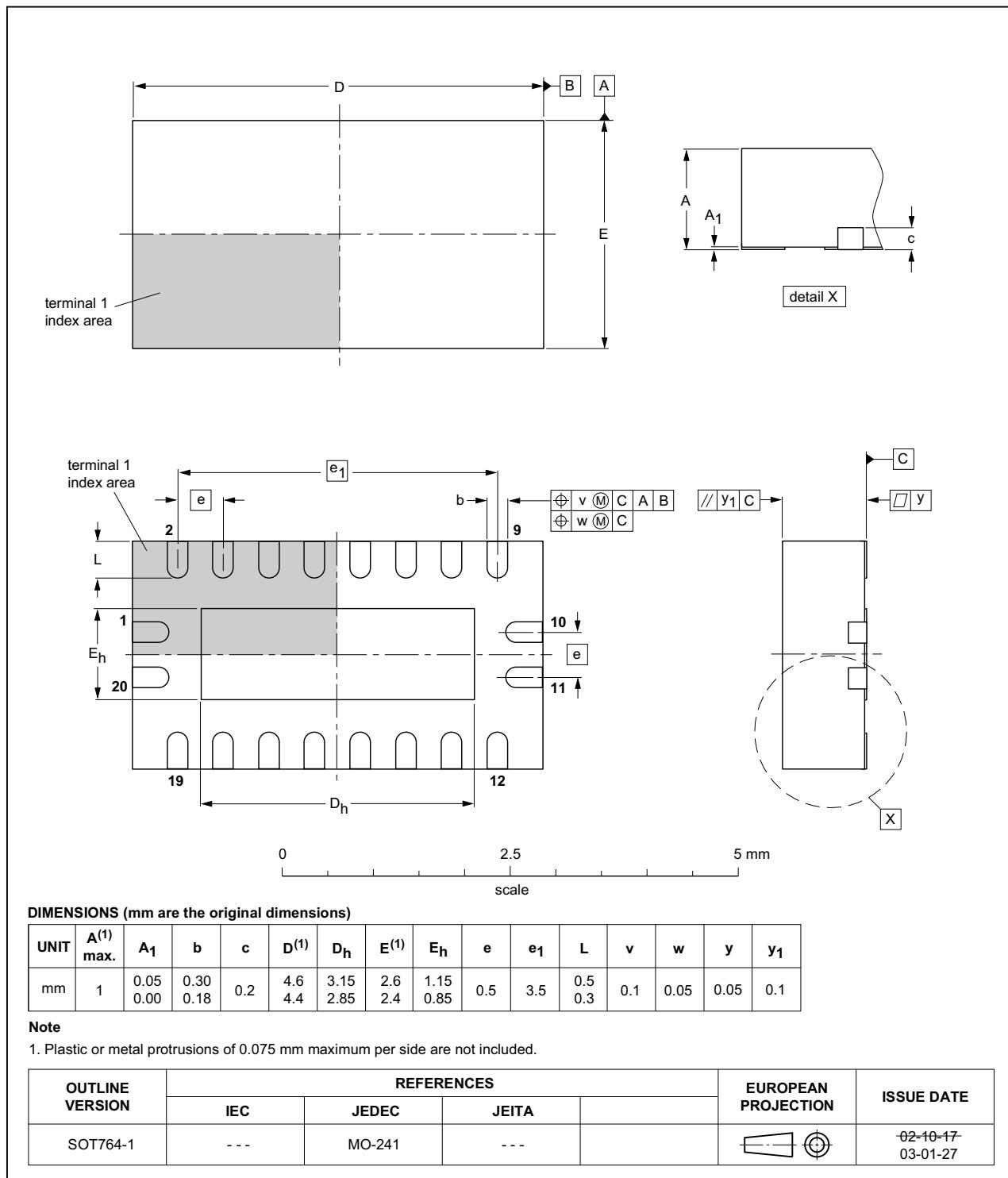


Fig 10. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
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_Q100 v.1	20140519	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".

[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 <http://www.nexperia.com>.

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