# 74AHC541; 74AHCT541

# Octal buffer/line driver; 3-state

Rev. 4 — 14 April 2020

**Product data sheet** 

### 1. General description

The 74AHC541; 74AHCT541 is a high-speed Si-gate CMOS device.

The 74AHC541; 74AHCT541 are octal non-inverting buffer/line drivers with 3-state bus compatible outputs.

The 3-state outputs are controlled by the output enable inputs  $\overline{\text{OE}}0$  and  $\overline{\text{OE}}1$ .

A HIGH on  $\overline{\text{OE}}$ n causes the outputs to assume a high-impedance OFF-state.

### 2. Features

- · Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accepts voltages higher than V<sub>CC</sub>
- For 74AHC541 only: operates with CMOS input levels
- For 74AHCT541 only: operates with TTL input levels
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

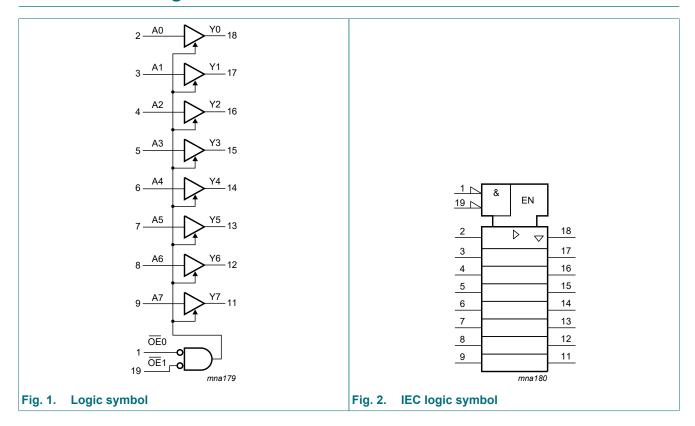
# 3. Ordering information

**Table 1. Ordering information** 

74AHC541D 74AHCT541D 74AHC541PW 74AHCT541PW	Package			
	Temperature range	Name	Description	Version
74AHC541D	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads;	SOT163-1
74AHCT541D			body width 7.5 mm	
74AHC541PW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads;	SOT360-1
74AHCT541PW			body width 4.4 mm	
74AHC541BQ	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced	SOT764-1
74AHCT541BQ			very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	

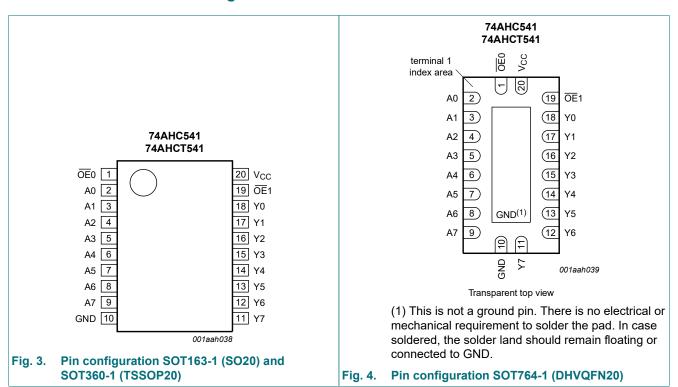


# 4. Functional diagram



## 5. Pinning information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

Table 2. Fill description		
Symbol	Pin	Description
OE0	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	data output
ŌE1	19	output enable input (active LOW)
V <sub>CC</sub>	20	supply voltage

## 6. Functional description

#### Table 3. Functional table

 $H = HIGH \text{ voltage level}; L = LOW \text{ voltage level}; X = don't care; Z = high-impedance OFF-state.}$ 

Control		Input	Output
OE0	OE1	An	Yn
L	L	L	L
L	L	Н	Н
X	Н	X	Z
Н	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	+7.0	V
VI	input voltage		-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	$V_{I} < -0.5 \text{ V}$ [1]	-20	-	mA
lok	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
Io	output current	$V_{O} = -0.5 \text{ V to } (V_{CC} + 0.5 \text{ V})$	-	±25	mA
I <sub>CC</sub>	supply current		-	75	mA
I <sub>GND</sub>	ground current		-75	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40  ^{\circ}\text{C to} + 125  ^{\circ}\text{C}$ [2]	-	500	mW

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

# 8. Recommended operating conditions

### Table 5. Recommended operating conditions

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

Symbol	Parameter	Conditions	7	4AHC54	11	74	AHCT5	41	Unit
			Min	Тур	Max	Min	Тур	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
VI	input voltage		0	-	5.5	0	-	5.5	V
Vo	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$	-	-	100	-	-	-	ns/V
		V <sub>CC</sub> = 5.0 V ± 0.5 V	-	-	20	-	-	20	ns/V

<sup>[2]</sup> For SOT163-1 (SO20) package: P<sub>tot</sub> derates linearly with 12.3 mW/K above 109 °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.

# 9. Static characteristics

### **Table 6. Static characteristics**

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

Symbol	Parameter	Conditions		25 °C			°C to 5 °C		°C to 5 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
For type	74AHC541									
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
	input voltage	V <sub>CC</sub> = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V <sub>IL</sub>	LOW-level	V <sub>CC</sub> = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
	input voltage	V <sub>CC</sub> = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V <sub>OH</sub>	HIGH-level	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
	output voltage	I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		$I_{O}$ = -8.0 mA; $V_{CC}$ = 4.5 V	3.94	-	-	3.8	-	3.70	-	V
V <sub>OL</sub>	LOW-level	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
	output voltage	I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.36	-	0.44	-	0.55	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
l <sub>OZ</sub>	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND; $V_{CC} = 5.5$ V	-	-	±0.25	-	±2.5	-	±10.0	μA
I <sub>I</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 0$ V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	μΑ
C <sub>I</sub>	input capacitance		-	3.0	10	-	10	-	10	pF
C <sub>O</sub>	output capacitance		-	4.0	-	-	-	-	-	pF

Symbol	Parameter	Conditions		25 °C			°C to 5 °C		°C to 5 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
For type	74AHCT541		'					'		
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	Ι <sub>Ο</sub> = -50 μΑ	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -8.0 mA	3.94	-	-	3.8	-	3.70	-	V
$V_{OL}$	LOW-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	Ι <sub>Ο</sub> = 50 μΑ	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I <sub>OZ</sub>	OFF-state output current	per input pin; $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 5.5 \text{ V}$ ; $I_O = 0 \text{ A}$ ; $V_O = V_{CC}$ or GND; other pins at $V_{CC}$ or GND	-	-	±0.25	-	±2.5	-	±10.0	μА
I <sub>I</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 0$ V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}; I_O = 0 \text{ A};$ other pins at $V_{CC}$ or GND; $V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$	-	-	1.35	-	1.5	-	1.5	mA
Cı	input capacitance		-	3	10	-	10	-	10	pF
C <sub>O</sub>	output capacitance		-	4.0	-	-	-	-	-	pF

# 10. Dynamic characteristics

### **Table 7. Dynamic characteristics**

GND = 0 V. For test circuit see Fig. 7.

Symbol	Parameter	Conditions		25 °C			°C to 5 °C		°C to 5 °C	Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
For type	74AHC541									
t <sub>pd</sub>	propagation	An to Yn; see Fig. 5								
	delay	V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	5.0	7.0	1.0	8.5	1.0	9.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	7.0	10.5	1.0	12.0	1.0	13.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.5	5.0	1.0	6.0	1.0	6.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF		5.0	7.0	1.0	8.0	1.0	9.0	ns
t <sub>en</sub>	enable time	OEn to Yn; see Fig. 6 [2								
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	5.5	10.5	1.0	11.0	1.0	13.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	7.5	14.0	1.0	16.0	1.0	17.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.5	7.2	1.0	8.5	1.0	9.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.0	9.2	1.0	10.5	1.0	11.5	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Fig. 6	]							
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	6.0	11.0	1.0	12.0	1.0	14.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	9.5	15.4	1.0	17.5	1.0	19.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	4.5	7.5	1.0	8.0	1.0	9.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	6.5	8.8	1.0	10.0	1.0	11.0	ns
C <sub>PD</sub>	power dissipation capacitance	$C_L$ = 50 pF; $f_i$ = 1 MHz; [3 $V_I$ = GND to $V_{CC}$	-	10	-	-	-	-	-	pF
For type	74AHCT541			_			1			
t <sub>pd</sub>	propagation	An to Yn; see Fig. 5	]							
	delay	V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.5	5.5	1.0	6.5	1.0	7.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.0	8.5	1.0	9.5	1.0	11.0	ns
t <sub>en</sub>	enable time	OEn to Yn; see Fig. 6								
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	4.0	7.0	1.0	8.0	1.0	9.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.5	10.0	1.0	12.0	1.0	12.5	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Fig. 6	]							
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	5.0	7.0	1.0	8.0	1.0	9.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	7.0	10.0	1.0	12.0	1.0	12.5	ns
C <sub>PD</sub>	power dissipation capacitance	per buffer; $C_L = 50 \text{ pF}$ ; $f = 1 \text{ MHz}$ ; [3 $V_I = GND \text{ to } V_{CC}$	-	12	-	-	-	-	-	pF

Typical values are measured at nominal supply voltage ( $V_{CC}$  = 3.3 V and  $V_{CC}$  = 5.0 V).

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

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

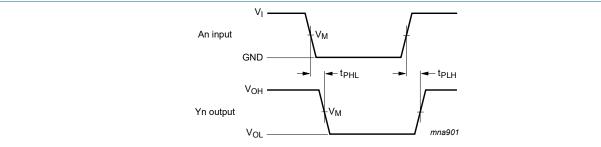
f<sub>o</sub> = output frequency in MHz;

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

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

 $t_{pd}$  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  $t_{PHZ}$ .  $t_{CPD}$  is used to determine the dynamic power dissipation  $t_{PD}$  ( $t_{PM}$ ).

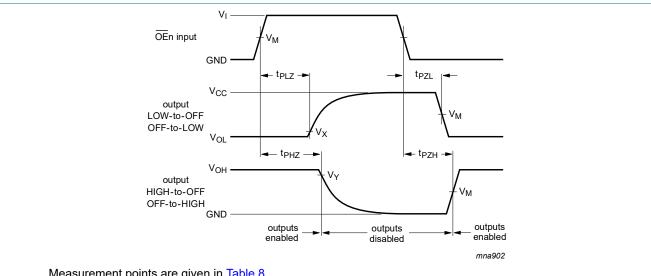
### 10.1. Waveforms



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.

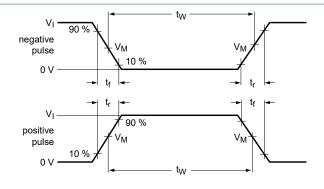
V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.

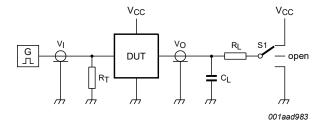
**Enable and disable times** 

**Table 8. Measurement points** 

Туре	Input	Output	Dutput				
	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>			
74AHC541	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V			
74AHCT541	1.5 V	0.5V <sub>CC</sub>	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V			

**Product data sheet** 





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<sub>L</sub> = Load resistor

S1 = Test selection switch

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

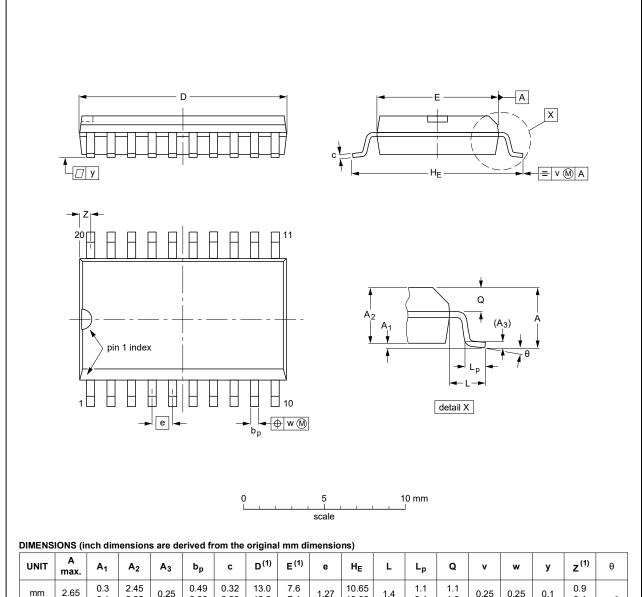
Table 9. Test data

Туре	Input		Load		S1 position			
	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	C <sub>L</sub>	$R_L$	t <sub>PHL</sub> , t <sub>PLH</sub>	t <sub>PZH</sub> , t <sub>PHZ</sub>	$t_{PZL}$ , $t_{PLZ}$	
74AHC541	V <sub>CC</sub>	3.0 ns	15 pF, 50 pF	1 kΩ	open	GND	V <sub>CC</sub>	
74AHCT541	3.0 V	3.0 ns	15 pF, 50 pF	1 kΩ	open	GND	V <sub>CC</sub>	

# 11. Package outline

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

SOT163-1



U	TINI	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	ø	v	w	у	z <sup>(1)</sup>	θ
1	mm	2.65	0.3 0.1	2.45 2.25	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°
in	ches	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	0°

#### Note

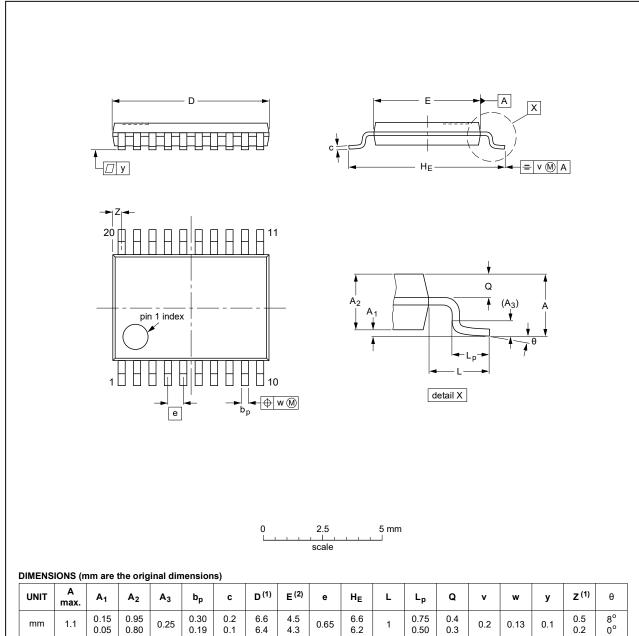
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE		REFERENCES 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)

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.

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT360-1		MO-153				<del>99-12-27</del> 03-02-19

Fig. 9. Package outline SOT360-1 (TSSOP20)

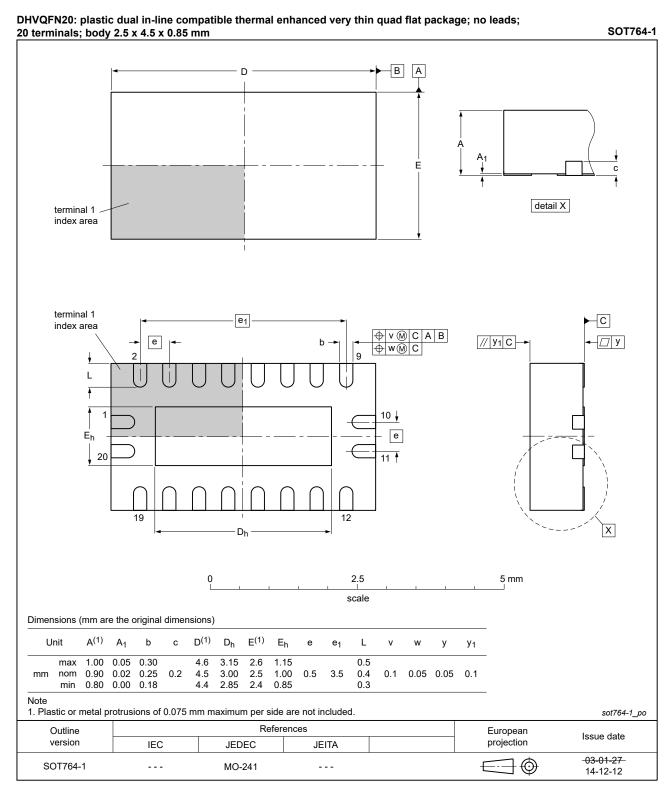


Fig. 10. Package outline SOT764-1 (DHVQFN20)

## 12. Abbreviations

### **Table 10. Abbreviations**

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	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
74AHC_AHCT541 v.4	20200414	Product data sheet	-	74AHC_AHCT541_3
Modifications:	guidelines of Legal texts  Table 4: De	of this data sheet has beer of Nexperia. have been adapted to the rating values for P <sub>tot</sub> total p ckage outline drawing SOT	new company nar ower dissipation ເ	ne where appropriate. updated.
74AHC_AHCT541_3	20071112	Product data sheet		74AHC_AHCT541_2
Modifications:	guidelines of Legal texts  Section 3: E  Section 7: of Sec	of this data sheet has been of NXP Semiconductors. have been adapted to the DHVQFN20 package added for Derating values added for Doutline drawing added for I	new company nar d. htVQFN20 packa	ne where appropriate.
74AHC_AHCT541_2 (939775006301)	19991124	Product specification		74AHC_AHCT541_1
74AHC_AHCT541_1 (939775004256)	19980921	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.

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