# 74HC541; 74HTC541

# Octal buffer/line driver; 3-state Rev. 3 — 15 April 2014

Product data sheet

#### 1. **General description**

The 74HC541; 74HCT541 is an octal non-inverting buffer/line driver with 3-state outputs. The device features two output enables (OE1 and OE2). A HIGH on OEn causes the outputs to assume a high-impedance OFF-state. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V<sub>CC</sub>.

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

- Non-Inverting outputs
- Complies with JEDEC standard no. 7A
- Input levels:
  - ◆ For 74HC541: CMOS level ◆ For 74HCT541: TTL level
- ESD protection:
  - ♦ HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

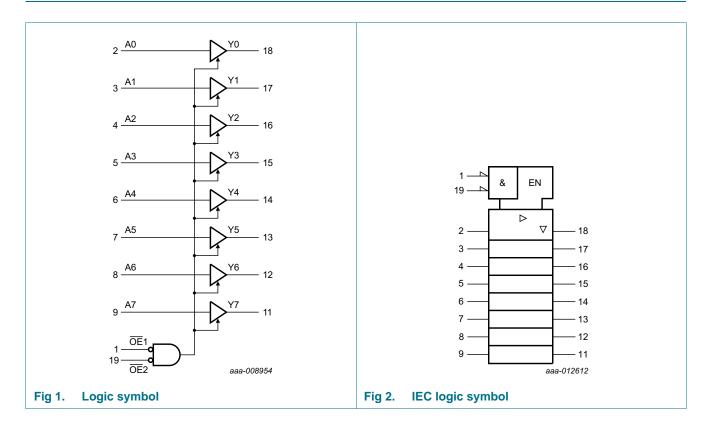
#### **Ordering information** 3.

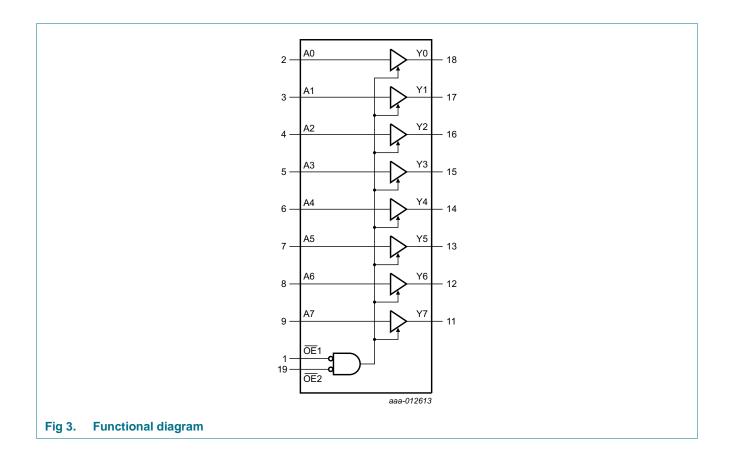
Table 1. **Ordering information** 

Type number	Package			
	Temperature range	Name	Description	Version
74HC541N	−40 °C to +125 °C	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
74HCT541N				
74HC541D	−40 °C to +125 °C	SO20	plastic small outline package; 20 leads;	SOT163-1
74HCT541D			body width 7.5 mm	
74HC541DB	–40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads;	SOT339-1
74HCT541DB			body width 5.3 mm	
74HC541PW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads;	SOT360-1
74HCT541PW			body width 4.4 mm	

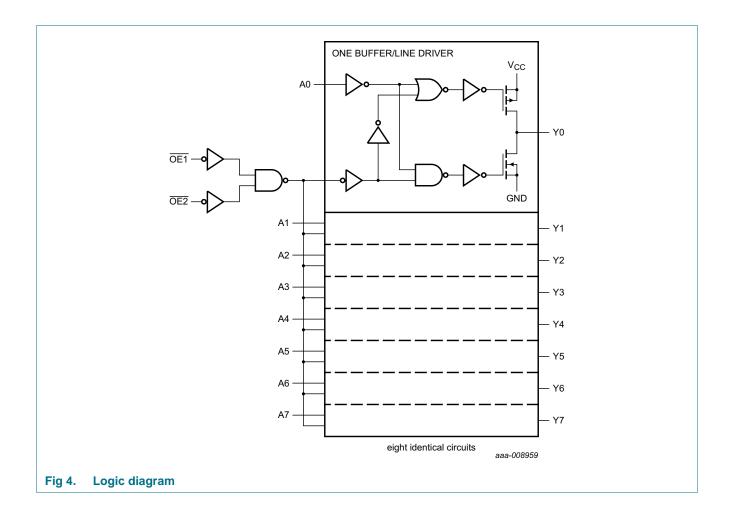


# 4. Functional diagram



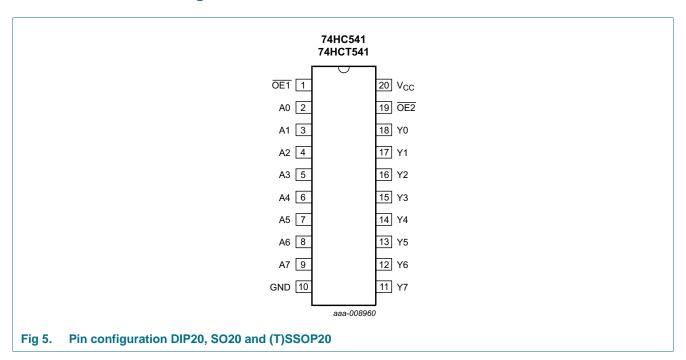


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# 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

Table 2. Pin description

	iii docoription	
Symbol	Pin	Description
OE1	1	output enable input (active LOW)
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y0 to Y7	18, 17, 16, 15, 14, 13, 12, 11	data output
OE2	19	output enable input (active LOW)
V <sub>CC</sub>	20	supply voltage

# 6. Functional description

Table 3. Functional table[1]

Control		Input	Output
OE1	OE2	An	Yn
L	L	L	L
L	L	Н	Н
X	Н	X	Z
Н	X	X	Z

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

74HC\_HCT541

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### 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	V
I <sub>IK</sub>	input clamping current	$V_{I} < -0.5 \text{ V or } V_{I} > V_{CC} + 0.5 \text{ V}$	<u>[1]</u>	-	±20	mA
I <sub>OK</sub>	output clamping current	$V_{O} < -0.5 \text{ V or } V_{O} > V_{CC} + 0.5 \text{ V}$	<u>[1]</u>	-	±20	mA
Io	output current	$-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$		-	±35	mA
I <sub>CC</sub>	supply current			-	70	mA
I <sub>GND</sub>	ground current			-70	-	mA
T <sub>stg</sub>	storage temperature			-65	+150	°C
P <sub>tot</sub>	total power dissipation		[2]			
	DIP20			-	750	mW
	SO20, SSOP20, TSSOP20			-	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	74HC	541		74HC	74HCT541			
			Min	Тур	Max	Min	Тур	Max		
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V	
VI	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	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 <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V	
		V <sub>CC</sub> = 4.5 V	-	1.67	139	-	1.67	139	ns/V	
		$V_{CC} = 6.0 \text{ V}$	-	-	83	-	-	-	ns/V	

<sup>[2]</sup> For DIP20 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 12 mW/K. For SO20 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 8 mW/K. For (T)SSOP20 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.

### 9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	Tai	<sub>mb</sub> = 25	5 °C		= −40 °C ⊦85 °C	T <sub>amb</sub> to +	Unit	
			Min	Тур	Max	Min	Max	Min	Max	
74HC54	1					<u>'</u>		<u> </u>		
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
	input voltage	V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V <sub>IL</sub>	LOW-level	V <sub>CC</sub> = 2.0 V		0.8	0.5	-	0.5	-	0.5	V
	input voltage	V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$								
	output voltage	$I_{O} = -20 \mu A; V_{CC} = 2.0 V$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_{O} = -20 \mu A$ ; $V_{CC} = 4.5 V$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -20 \mu A$ ; $V_{CC} = 6.0 \text{ V}$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_{O} = -6.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.98	4.32	-	3.84	-	3.7	-	V
		$I_{O} = -7.8 \text{ mA}; V_{CC} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	V
V <sub>OL</sub>	LOW-level	$V_I = V_{IH}$ or $V_{IL}$								
	output voltage	$I_O = 20 \mu A; V_{CC} = 2.0 \text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20 \mu A; V_{CC} = 6.0 \text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 6.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	V
		$I_O = 7.8 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	V
l <sub>l</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μА
l <sub>OZ</sub>	OFF-state output current	per input pin; $V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND; other inputs at $V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$ ; $I_O = 0 \text{ A}$	-	-	±0.5	-	±5.0	-	±10	μА
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0 \text{ V}$	-	-	8.0	-	80	-	160	μА
Cı	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT5	41	<u>'</u>				1				
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V		1.2	0.8	-	8.0	-	0.8	V
V <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								1
	output voltage	I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -6.0 \text{ mA}$	3.98	4.32	-	3.84	-	3.7	-	V

 Table 6.
 Static characteristics ...continued

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

Symbol	Parameter	Conditions	Tai	<sub>mb</sub> = 25	5 °C		= –40 °C ⊦85 °C		= −40 °C -125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
V <sub>OL</sub>	LOW-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_{O} = 20 \mu A;$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 6.0 \text{ mA};$	-	0.16	0.26	-	0.33	-	0.4	V
II	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μΑ
I <sub>OZ</sub>	OFF-state output current	per input pin; $V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND; other inputs at $V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$ ; $I_O = 0 \text{ A}$	-	-	±0.5	-	±5.0	-	±10	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	8.0	-	80	-	160	μА
Δl <sub>CC</sub>	additional supply current	per input pin; $I_O = 0$ A; $V_I = V_{CC} - 2.1$ V; other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5$ V to 5.5 V								
		An input	-	70	252	-	315	-	343	μΑ
		OE1 input	-	150	540	-	675	-	735	μΑ
		OE2 input	-	100	360	-	450	-	490	μΑ
Cı	input capacitance		-	3.5	-	-	-	-	-	pF

# 10. Dynamic characteristics

 Table 7.
 Dynamic characteristics

 $GND = 0 \text{ V; } C_L = 50 \text{ pF; for test circuit, see } \underline{\text{Figure 8}}.$ 

Symbol	Parameter	Conditions	Ta	<sub>mb</sub> = 2	5 °C	$T_{amb} = -40^{\circ}$	°C to +125 °C	Unit
			Min	Тур	Max	Max (85 °C)	Max (125 °C)	
74HC541	1							
t <sub>pd</sub>	propagation delay	An to Yn; see Figure 6	1					
		V <sub>CC</sub> = 2.0 V	-	33	115	145	175	ns
		V <sub>CC</sub> = 4.5 V	-	12	23	29	35	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$	-	10	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	10	20	25	30	ns
t <sub>en</sub>	enable time	OEn to Yn; see Figure 7	1					
		V <sub>CC</sub> = 2.0 V	-	55	160	200	240	ns
		V <sub>CC</sub> = 4.5 V	-	20	32	40	48	ns
		V <sub>CC</sub> = 6.0 V	-	16	27	34	41	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Figure 7	1					
		V <sub>CC</sub> = 2.0 V	-	61	160	200	240	ns
		V <sub>CC</sub> = 4.5 V	-	22	32	40	48	ns
		V <sub>CC</sub> = 6.0 V	-	18	27	34	41	ns

74HC\_HCT541

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Table 7. Dynamic characteristics

 $GND = 0 \text{ V; } C_L = 50 \text{ pF; for test circuit, see } Figure 8.$ 

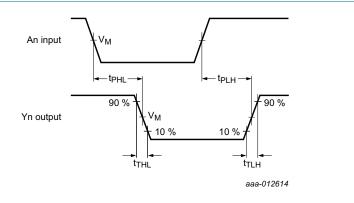
Symbol	Parameter	Conditions		Tan	<sub>nb</sub> = 25	°C	$T_{amb} = -40$ °	C to +125 °C	Unit
			Min	Тур	Max	Max (85 °C)	Max (125 °C)		
t <sub>t</sub>	transition time	see Figure 6	[2]						
		V <sub>CC</sub> = 2.0 V		-	14	60	75	90	ns
		V <sub>CC</sub> = 4.5 V		-	5	12	15	18	ns
		V <sub>CC</sub> = 6.0 V		-	4	10	13	15	ns
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub>	[3]	-	37	-	-	-	pF
74HCT54	<b>41</b>						+		
t <sub>pd</sub>	propagation delay	An to Yn; see Figure 6	[1]						
		V <sub>CC</sub> = 4.5 V		-	15	28	35	42	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	12	-	-	-	ns
t <sub>en</sub>	enable time	OEn to Yn; see Figure 7	<u>[1]</u>						
		V <sub>CC</sub> = 4.5 V		-	21	35	44	53	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Figure 7	[1]						
		V <sub>CC</sub> = 4.5 V		-	21	35	44	53	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see <u>Figure 6</u>	[2]	-	5	12	15	18	ns
$C_{PD}$	power dissipation capacitance				39	-	-	-	pF

- [1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
  - $t_{\text{en}}$  is the same as  $t_{\text{PZL}}$  and  $t_{\text{PZH}}.$
  - $t_{\mbox{\scriptsize dis}}$  is the same as  $t_{\mbox{\scriptsize PLZ}}$  and  $t_{\mbox{\scriptsize PHZ}}.$
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ):

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

- $f_i$  = input frequency in MHz;
- $f_o = output frequency in MHz;$
- C<sub>L</sub> = output load capacitance in pF;
- V<sub>CC</sub> = supply voltage in V;
- N = number of inputs switching;
- $\sum \left( C_L \times V_{CC}{}^2 \times f_o \right)$  = sum of outputs.

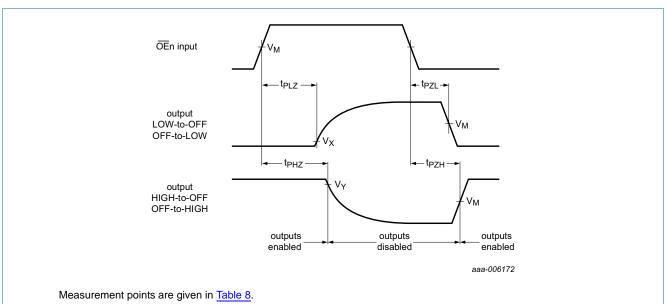
### 11. Waveforms



Measurement points are given in Table 8.

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

Fig 6. Input to output propagation delays



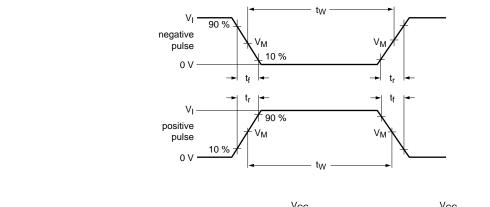
 $V_{\text{OL}}$  and  $V_{\text{OH}}$  are typical voltage output levels that occur with the output load.

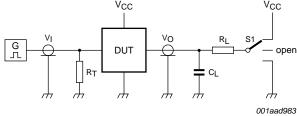
3-state enable and disable times

Table 8. Measurement points

Туре	Input	Output		
	V <sub>M</sub>	V <sub>M</sub>	V <sub>Y</sub>	
74HC541	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>
74HCT541	1.3 V	1.3 V	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>

Fig 7.





Test data is given in Table 9.

Definitions test circuit:

 $R_T$  = Termination resistance should be equal to output impedance  $Z_0$  of the pulse generator

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

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

S1 = Test selection switch

Fig 8. Test circuit for measuring switching times

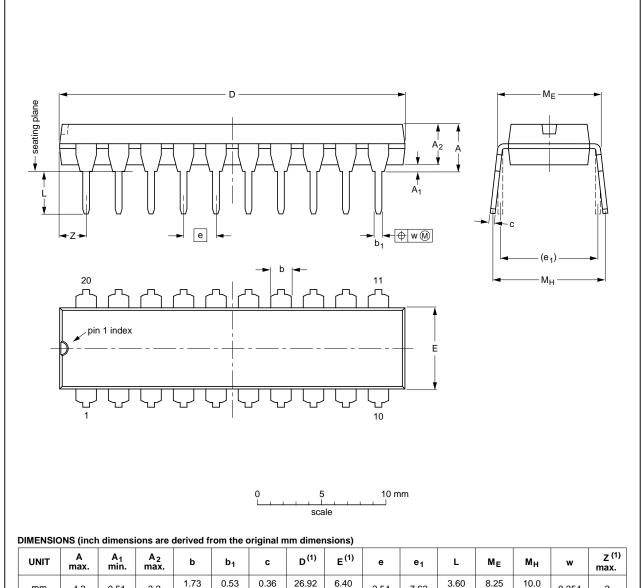
Table 9. Test data

Туре	Input		Load		S1 position			
	$V_{I}$	t <sub>r</sub> , t <sub>f</sub>	CL	$R_L$	t <sub>PHL</sub> , t <sub>PLH</sub>	t <sub>PZH</sub> , t <sub>PHZ</sub>	t <sub>PZL</sub> , t <sub>PLZ</sub>	
74HC541	$V_{CC}$	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V <sub>CC</sub>	
74HCT541	3 V	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V <sub>CC</sub>	

### 12. Package outline

### DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1



UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	e <sub>1</sub>	L	ME	Мн	w	Z <sup>(1)</sup> max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2
inches	0.17	0.02	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

### Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE		REFER	ENCES	EUROPEAN	ISSUE DATE	
VERSION	IEC	IEC JEDEC		PROJECTION	ISSUE DATE	
SOT146-1		MS-001	SC-603		<del>99-12-27</del> 03-02-13	

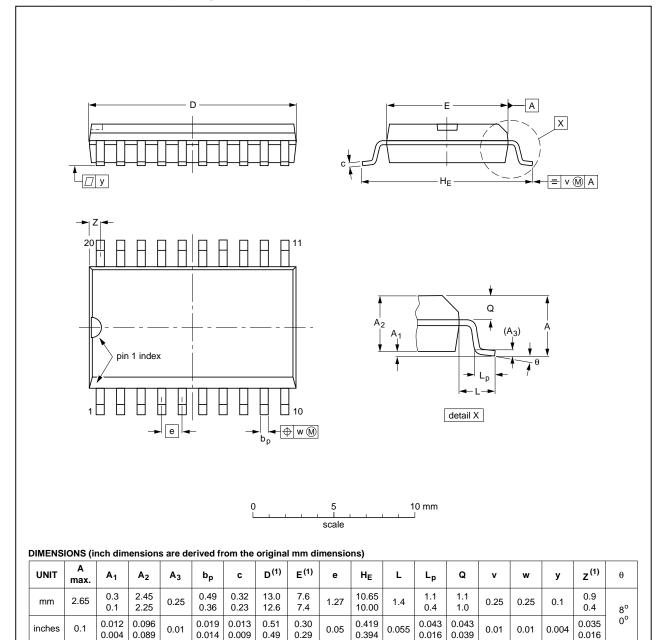
Fig 9. Package outline SOT146-1 (DIP20)

74HC\_HCT541

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

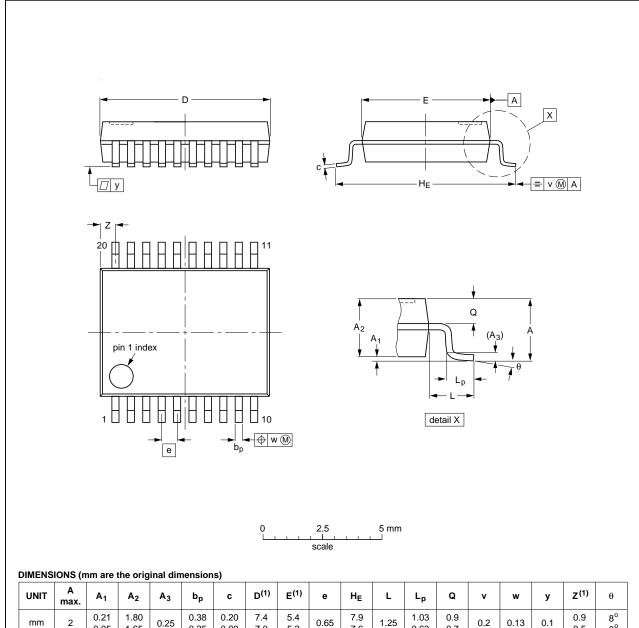
Fig 10. Package outline SOT163-1 (SO20)

74HC\_HCT541

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

SOT339-1



							٠,												
u	JNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	θ
	mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE		REFER	ENCES	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA	PROJECTION	135UE DATE		
SOT339-1		MO-150			<del>99-12-27</del> 03-02-19		

Fig 11. Package outline SOT339-1 (SSOP20)

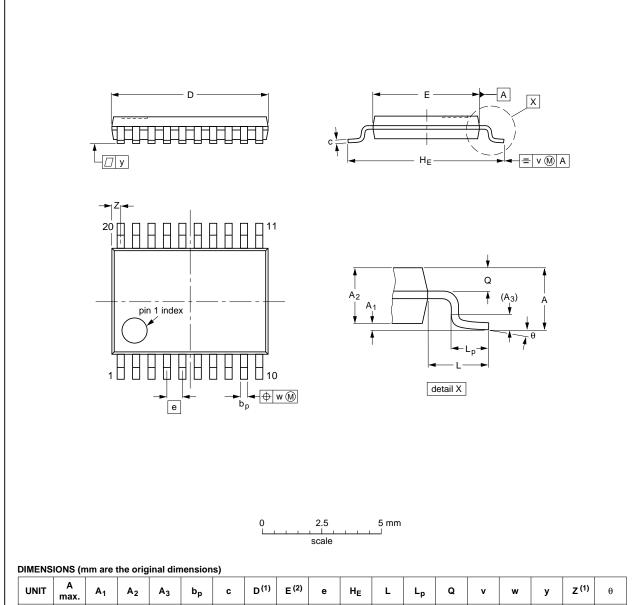
74HC\_HCT541

**Product data sheet** 

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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 <sup>(2)</sup>	e	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°

- 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.

		EUROPEAN	ISSUE DATE			
IEC	JEDEC	JEITA		PROJECTION	1000E DATE	
	MO-153				<del>99-12-27</del> 03-02-19	
	IEC				IEC JEDEC JEITA	

Fig 12. Package outline SOT360-1 (TSSOP20)

74HC\_HCT541

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### 13. Abbreviations

### Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model

# 14. Revision history

### Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes			
74HC_HCT541 v.3	20140415	Product data sheet	-	74HC_HCT541_CNV v.2			
Modifications:		<ul> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> </ul>					
	<ul> <li>Legal texts ha</li> </ul>	ive been adapted to the new c	ompany name where	e appropriate.			
74HC_HCT541_CNV v.2	19901201	Product specification	-	-			

### 15. Legal information

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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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# 74HC541; 74HTC541

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

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### **NXP Semiconductors**

Octal buffer/line driver; 3-state

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