# 74HC7541; 74HCT7541

# Octal Schmitt trigger buffer/line driver; 3-state Rev. 7 — 4 March 2016

**Product data sheet** 

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

The 74HC7541; 74HCT7541 is an 8-bit buffer/line driver with Schmitt-trigger inputs and 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. This enables the use of current limiting resistors to interface inputs to voltages in excess of V<sub>CC</sub>. Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

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

- Non-inverting outputs
- Low-power dissipation
- Input levels:
  - ◆ For 74HC7541: CMOS level
  - ◆ For 74HCT7541: TTL level
- Complies with JEDEC standard no. 7A
- 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

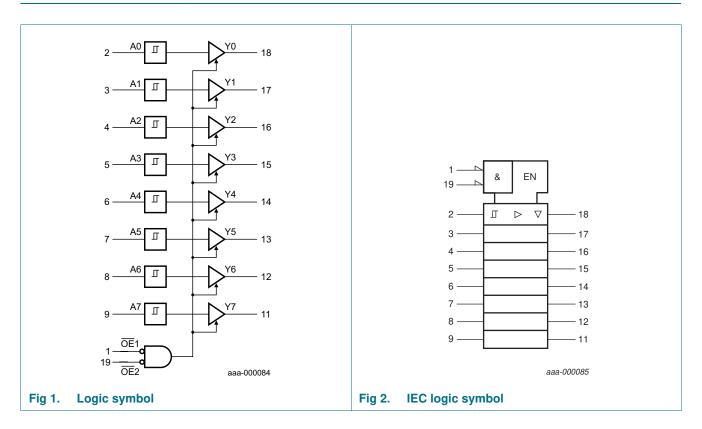
#### **Ordering information** 3.

Table 1. **Ordering information** 

Type number	Package									
	Temperature range	Name	Description	Version						
74HC7541D	−40 °C to +125 °C	SO20	plastic small outline package; 20 leads;	SOT163-1						
74HCT7541D			body width 7.5 mm							
74HC7541DB	-40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1						
74HC7541PW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads;	SOT360-1						
74HCT7541PW			body width 4.4 mm							

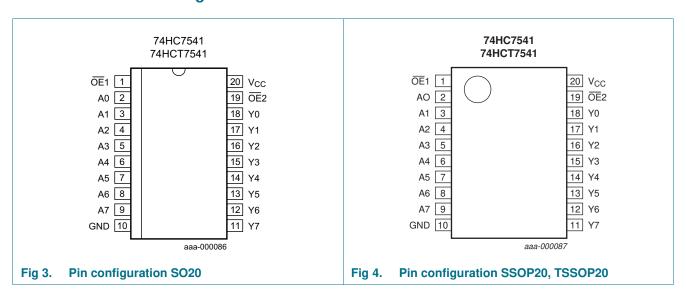


## 4. Functional diagram



# 5. Pinning information

## 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

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

<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 <sub>CC</sub>	supply voltage			-0.5	+7	V
I <sub>IK</sub>	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$	[1]	-	±20	mA
I <sub>OK</sub>	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$	[1]	-	±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	SO20, SSOP20, TSSOP20	[2]	-	500	mW

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

<sup>[2]</sup> For SO20 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 8 mW/K. For SSOP20 and TSSOP20 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.

## 8. Recommended operating conditions

### Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	7	74HC7541			74HCT7541			
			Min	Тур	Max	Min	Тур	Max		
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	٧	
VI	input voltage		0	-	V <sub>CC</sub>	0	-	$V_{CC}$	٧	
Vo	output voltage		0	-	V <sub>CC</sub>	0	-	$V_{CC}$	٧	
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C	

## 9. Static characteristics

#### Table 6. Static characteristics

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

Symbol	Parameter	Conditions	T <sub>ar</sub>	<sub>nb</sub> = 25	°C		: –40 °C 85 °C	T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC75	41									
V <sub>OH</sub>	HIGH-level	$V_I = V_{T+}$ or $V_{T-}$								
	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	$V_I = V_{T+}$ or $V_{T-}$								
output vo	output voltage	$I_O = 20 \mu A; V_{CC} = 2.0 V$	-	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
		$I_O = 20 \mu A; V_{CC} = 6.0 V$	-	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
			0.4	V						
I <sub>I</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μΑ
l <sub>OZ</sub>	OFF-state output current	$V_I = V_{T+}$ or $V_{T-}$ ; $V_{CC} = 6.0 \text{ V}$ ; $V_O = V_{CC}$ or GND	-	-	±0.5	-	±5.0	-	±10	μΑ
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	μΑ
Cı	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT7	541	1	1	1		1			1	
V <sub>OH</sub>	HIGH-level	$V_{I} = V_{T+} \text{ or } V_{T-}; V_{CC} = 4.5 \text{ V}$								
	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	-	٧

 Table 6.
 Static characteristics ...continued

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C				= –40 °C 85 °C	T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
V <sub>OL</sub>	LOW-level	$V_{I} = V_{T+} \text{ or } V_{T-}; V_{CC} = 4.5 \text{ V}$								
	output voltage	I <sub>O</sub> = 20 μA;	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 6.0 mA;	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μΑ
l <sub>OZ</sub>	OFF-state output current	$V_I = V_{T+}$ or $V_{T-}$ ; $V_{CC} = 5.5$ V; $V_O = V_{CC}$ or GND	-	-	±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	μΑ
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	-	20	72	-	90	-	98	μΑ
		OEn input	-	130	468	-	585	-	637	μΑ
Cı	input capacitance		-	3.5	-	-	-	-	-	pF

# 10. Dynamic characteristics

### Table 7. Dynamic characteristics

 $GND = 0 \ V; \ C_L = 50 \ pF;$  for test circuit see Figure 7.

74HC754	Parameter	Conditions	Т	<sub>amb</sub> = 25	5 °C	$T_{amb} = -40^{\circ}$	°C to +125 °C	Unit
			Min	Тур	Max	Max (85 °C)	Max (125 °C)	
74HC754	<b>1</b> 1							
t <sub>pd</sub>	propagation delay	An to Yn; see Figure 5	[1]					
		V <sub>CC</sub> = 2.0 V	-	39	120	150	180	ns
		V <sub>CC</sub> = 4.5 V	-	14	24	30	36	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$	-	10	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	11	20	26	32	ns
t <sub>en</sub>	enable time	OEn to Yn; see Figure 6	[1]					
		V <sub>CC</sub> = 2.0 V	-	44	160	200	240	ns
		V <sub>CC</sub> = 4.5 V	-	16	32	40	48	ns
		V <sub>CC</sub> = 6.0 V	-	13	27	34	41	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Figure 6	[1]					
		V <sub>CC</sub> = 2.0 V	-	58	160	200	240	ns
		V <sub>CC</sub> = 4.5 V	-	21	32	40	48	ns
		V <sub>CC</sub> = 6.0 V	-	17	27	34	41	ns

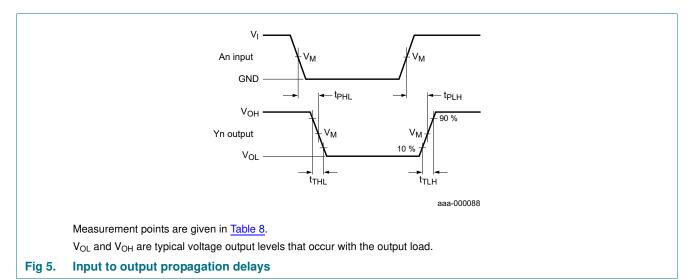
Table 7. Dynamic characteristics

 $GND = 0 \ V; \ C_L = 50 \ pF;$  for test circuit see <u>Figure 7</u>.

Symbol	Parameter	Conditions		Tar	<sub>nb</sub> = 25	°C	T <sub>amb</sub> = -40 °	C to +125 °C	Unit
			Min	Тур	Max	Max (85 °C)	Max (125 °C)		
t <sub>t</sub>	transition time	see Figure 5	[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	ver package; V <sub>I</sub> = GND to V <sub>CC</sub>		-	30	-	-	-	pF
74HCT7	541	•				*		•	
t <sub>pd</sub>	propagation delay	An to Yn; see Figure 5	<u>[1]</u>						
		V <sub>CC</sub> = 4.5 V		-	19	32	40	48	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF		-	16	-	-	-	ns
t <sub>en</sub>	enable time	OEn to Yn; see Figure 6	<u>[1]</u>						
		V <sub>CC</sub> = 4.5 V		-	18	32	40	48	ns
t <sub>dis</sub>	disable time	OEn to Yn; see Figure 6	<u>[1]</u>						
		V <sub>CC</sub> = 4.5 V		-	20	32	40	48	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see <u>Figure 5</u>	[2]	-	5	12	15	18	ns
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> – 1.5 V	[3]	-	32	-	-	-	pF

- [1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
  - $t_{\text{en}}$  is the same as  $t_{\text{PZL}}$  and  $t_{\text{PZH}}.$
  - $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .
- [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;
  - $\sum (C_L \times V_{CC}^2 \times f_0) = \text{sum of outputs.}$

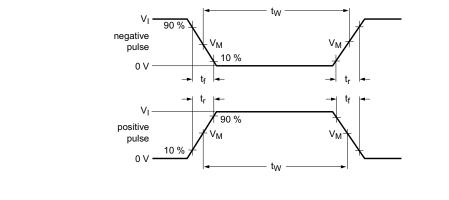
## 11. Waveforms

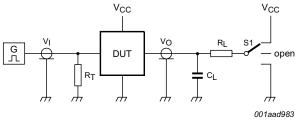


OEn input GND  $t_{PZL}$ t<sub>PLZ</sub>  $V_{CC}$ Yn output LOW-to-OFF OFF-to-LOW  $t_{\text{PHZ}}$ t<sub>PZH</sub> Yn output HIGH-to-OFF OFF-to-HIGH GND outputs outputs outputs enabled disabled enabled aaa-000089 Measurement points are given in Table 8.  $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load. 3-state enable and disable times Fig 6.

Table 8. Measurement points

Туре	Input	Output						
	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>				
74HC7541	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>				
74HCT7541	1.3 V	1.3 V	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>				





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 7. Test circuit for measuring switching times

Table 9. Test data

Туре	Input		Load		S1 position			
	VI	t <sub>r</sub> , t <sub>f</sub>	CL	RL	t <sub>PHL</sub> , t <sub>PLH</sub>	t <sub>PZH</sub> , t <sub>PHZ</sub>	t <sub>PZL</sub> , t <sub>PLZ</sub>	
74HC7541	V <sub>CC</sub>	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V <sub>CC</sub>	
74HCT7541	3 V	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V <sub>CC</sub>	

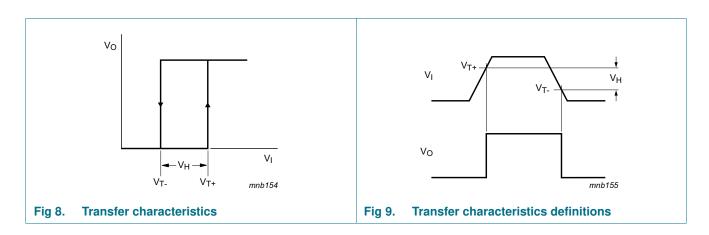
## 12. Transfer characteristics

#### Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see Figure 8 and Figure 9.

Symbol	Parameter	Conditions	Tan	<sub>nb</sub> = 25	°C	T <sub>amb</sub> = -40	°C to +85 °C	$T_{amb} = -40$	°C to +125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC754	¥1									
$V_{T+}$	positive-going	$V_{CC} = 2.0 \text{ V}$	-	-	1.5	-	1.5	-	1.5	V
	threshold voltage	$V_{CC} = 4.5 \text{ V}$	-	-	3.15	-	3.15	-	3.15	V
	voitage	$V_{CC} = 6.0 \text{ V}$	-	-	4.2	-	4.2	-	4.2	٧
V <sub>T</sub> negative-going	$V_{CC} = 2.0 \text{ V}$	0.3	-	-	0.3	-	0.3	-	٧	
	threshold	$V_{CC} = 4.5 \text{ V}$	1.35	-	-	1.35	-	1.35	-	٧
voltage	$V_{CC} = 6.0 \text{ V}$	1.8	-	-	1.8	-	1.8	-	٧	
$V_{H}$	hysteresis	$V_{CC} = 2.0 \text{ V}$	0.1	0.20	-	0.1	-	0.1	-	٧
	voltage	$V_{CC} = 4.5 \text{ V}$	0.25	0.40	-	0.25	-	0.25	-	٧
		$V_{CC} = 6.0 \text{ V}$	0.3	0.5	-	0.3	-	0.3	-	٧
74HCT7	541					'				
$V_{T+}$	positive-going	$V_{CC} = 4.5 \text{ V}$	-	-	2.0	-	2.0	-	2.0	٧
	threshold voltage	V <sub>CC</sub> = 5.5 V	-	-	2.1	-	2.1	-	2.1	V
$V_{T-}$	negative-going	$V_{CC} = 4.5 \text{ V}$	0.7	-	-	0.64	-	0.6	-	V
املم مام ماط	V <sub>CC</sub> = 5.5 V	0.8	-	-	0.74	-	0.7	-	V	
$V_{H}$	hysteresis	$V_{CC} = 4.5 \text{ V}$	0.17	0.23	-	-	-	-	-	٧
	14	$V_{CC} = 5.5 \text{ V}$	0.17	0.23	-	-	-	-	-	V

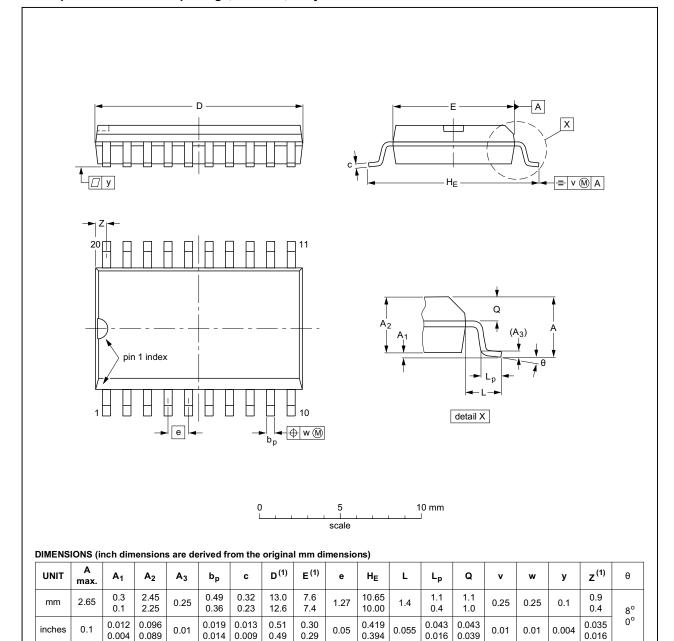
## 13. Transfer characteristics waveforms



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

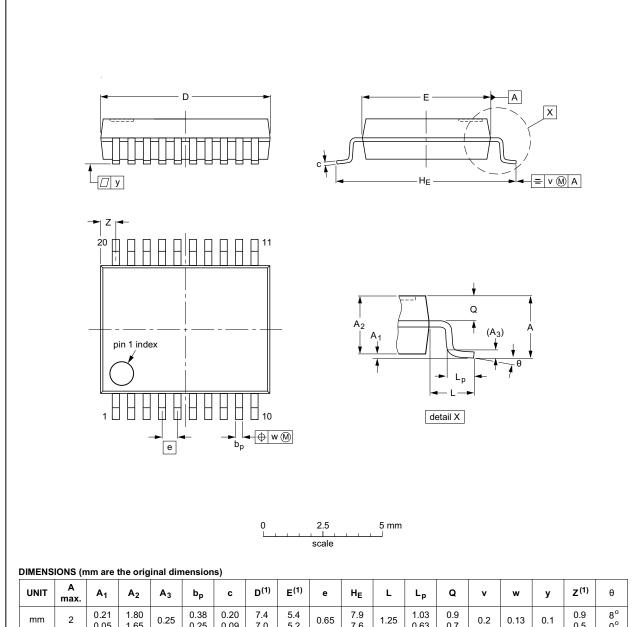
Fig 10. Package outline SOT163-1 (SO20)

74HC\_HCT7541

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

SOT339-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	<b>A</b> <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	ø	v	¥	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°

#### Note

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

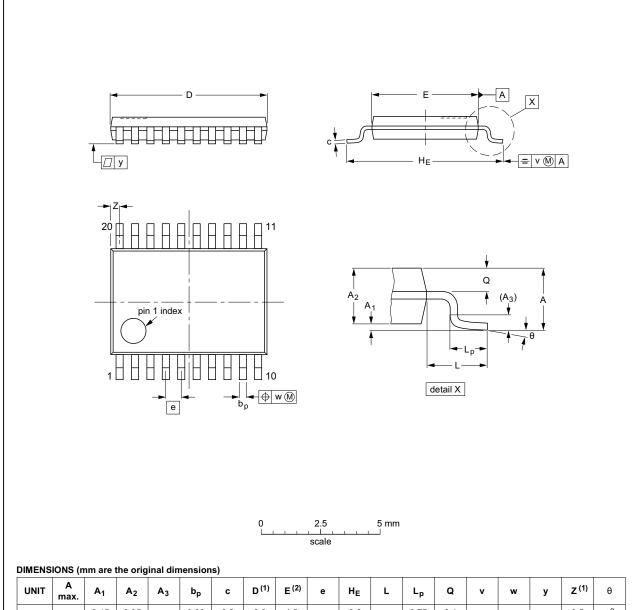
OUTLINE		REFER	RENCES	EUROPEAN	ISSUE DATE	
VERSION	IEC	C JEDEC	JEITA	PROJECTION	ISSUE DATE	
SOT339-1		MO-150			<del>99-12-27</del> 03-02-19	

Fig 11. Package outline SOT339-1 (SSOP20)

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

SOT360-1



							-,												
UI	NIT	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
m	m	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 12. Package outline SOT360-1 (TSSOP20)

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## 15. Abbreviations

### Table 11. 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

# 16. Revision history

## Table 12. Revision history

	•			
Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT7541 v.7	20160304	Product data sheet	-	74HC_HCT7541 v.6
Modifications:	Type numbers	s 74HC7541N and 74HCT754	1N (SOT146-1) remo	oved.
74HC_HCT7541 v.6	74HC_HCT7541 v.6 20131216		-	74HC_HCT7541 v.5
Modifications:	New general	description (errata).		
74HC_HCT7541 v.5	20121231	Product data sheet	-	74HC_HCT7541 v.4
Modifications:	I <sub>OZ</sub> added to s	static characteristics table.		
74HC_HCT7541 v.4	20111219	Product data sheet	-	74HC_HCT7541 v.3
Modifications:	• Legal pages ι	ıpdated.		
74HC_HCT7541 v.3	20110725	Product data sheet	-	74HC_HCT7541_CNV v.2
74HC_HCT7541_CNV v.2	19970917	Product specification	-	-

## 17. Legal information

#### 17.1 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.
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## Octal Schmitt trigger buffer/line driver; 3-state

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