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_{CC}. 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

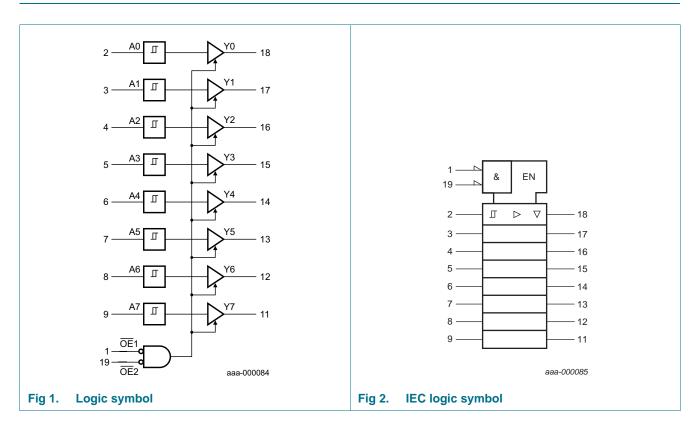
Ordering information 3.

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							

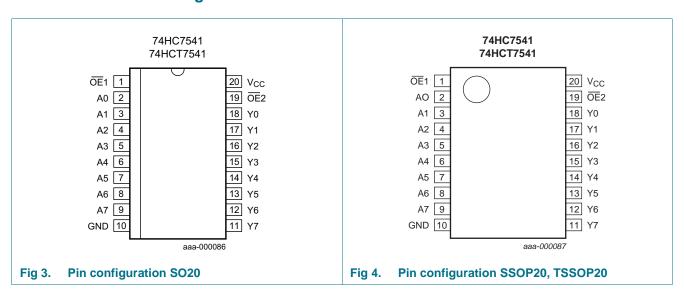


4. Functional diagram



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 _{CC}	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.

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	+7	V
I _{IK}	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$	[1]	-	±20	mA
I _{OK}	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 _{CC}	supply current			-	70	mA
I _{GND}	ground current			-70	-	mA
T _{stg}	storage temperature			-65	+150	°C
P _{tot}	total power dissipation	SO20, SSOP20, TSSOP20	[2]	-	500	mW

^[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

^[2] 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	4HC754	1	74	Unit		
			Min	Тур	Max	Min	Тур	Max	
V _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
Vo	output voltage		0	-	V _{CC}	0	-	V _{CC}	V
T _{amb}	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 _{ar}	_{nb} = 25	°C		- –40 °C 85 °C	T _{amb} = -40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC754	41									
V_{OH}	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
		$I_{O} = -20 \mu A; V_{CC} = 6.0 V$	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_{OL}	LOW-level	$V_I = V_{T+}$ or V_{T-}								
	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
		$I_O = 7.8 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	V
l _l	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μА
I _{OZ}	OFF-state output current	$V_I = V_{T+}$ or V_{T-} ; $V_{CC} = 6.0$ V; $V_O = V_{CC}$ or GND	-	-	±0.5	-	±5.0	-	±10	μА
I _{CC}	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
74HCT7	HCT7541		1	1		1		1	1	1
V_{OH}	HIGH-level	$V_{I} = V_{T+} \text{ or } V_{T-}; V_{CC} = 4.5 \text{ V}$								
	output voltage	I _O = -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	T _{amb} = 25 °C				- –40 °C 85 °C	T _{amb} = -40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
V_{OL}	LOW-level	$V_{I} = V_{T+} \text{ or } V_{T-}; V_{CC} = 4.5 \text{ V}$								
	output voltage	I _O = 20 μA;	-	0	0.1	-	0.1	-	0.1	V
		$I_{O} = 6.0 \text{ mA};$	-	0.15	0.26	-	0.33	-	0.4	V
l _l	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μΑ
l _{OZ}	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 _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	8.0	-	80	-	160	μΑ
Δl _{CC}	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.

Symbol	Parameter	Conditions	T,	_{imb} = 25	5 °C	$T_{amb} = -40^{\circ}$	°C to +125 °C	Unit
			Min	Тур	Max	Max (85 °C)	Max (125 °C)	
74HC754	41			'				
t _{pd}	propagation delay	An to Yn; see Figure 5	[1]					
		V _{CC} = 2.0 V	-	39	120	150	180	ns
		V _{CC} = 4.5 V	-	14	24	30	36	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$	-	10	-	-	-	ns
		V _{CC} = 6.0 V	-	11	20	26	32	ns
t _{en}	enable time	OEn to Yn; see Figure 6	[1]					
		V _{CC} = 2.0 V	-	44	160	200	240	ns
		V _{CC} = 4.5 V	-	16	32	40	48	ns
		V _{CC} = 6.0 V	-	13	27	34	41	ns
t _{dis}	disable time	OEn to Yn; see Figure 6	[1]					
		V _{CC} = 2.0 V	-	58	160	200	240	ns
		V _{CC} = 4.5 V	-	21	32	40	48	ns
		V _{CC} = 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		Tan	_{nb} = 25	°C	T _{amb} = -40 °	C to +125 °C	Unit
			Min	Тур	Max	Max (85 °C)	Max (125 °C)		
t _t	transition time	see Figure 5	[2]						
		V _{CC} = 2.0 V		-	14	60	75	90	ns
		V _{CC} = 4.5 V		-	5	12	15	18	ns
		V _{CC} = 6.0 V		-	4	10	13	15	ns
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC}		-	30	-	-	-	pF
74HCT7	541								
t _{pd}	propagation delay	An to Yn; see Figure 5	[1]						
		V _{CC} = 4.5 V		-	19	32	40	48	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	16	-	-	-	ns
t _{en}	enable time	OEn to Yn; see Figure 6	[1]						
		V _{CC} = 4.5 V		-	18	32	40	48	ns
t _{dis}	disable time	OEn to Yn; see Figure 6	[1]						
		V _{CC} = 4.5 V		-	20	32	40	48	ns
t _t	transition time	V _{CC} = 4.5 V; see <u>Figure 5</u>	[2]	-	5	12	15	18	ns
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC} – 1.5 V	[3]	-	32	-	-	-	pF

[1] t_{pd} is the same as t_{PLH} and t_{PHL} .

 t_{en} is the same as t_{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 μW):

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

f_i = input frequency in MHz;

 f_o = output frequency in MHz;

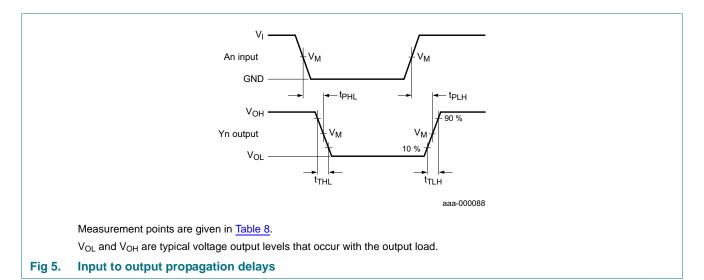
C_L = output load capacitance in pF;

V_{CC} = 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



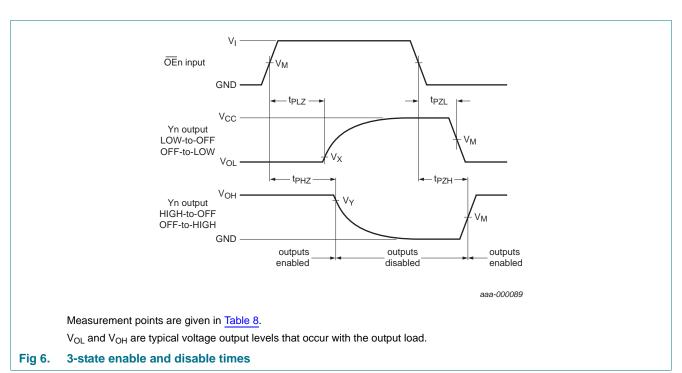
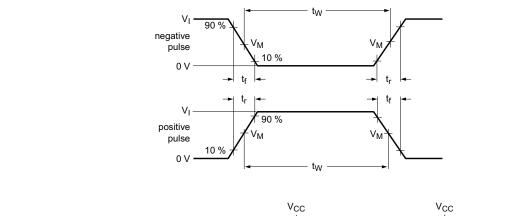
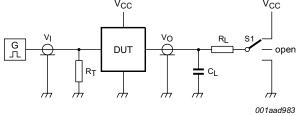


Table 8. Measurement points

Туре	Input	Output							
	V _M	V _M	V _X	V _Y					
74HC7541	0.5V _{CC}	0.5V _{CC}	0.1V _{CC}	0.9V _{CC}					
74HCT7541	1.3 V	1.3 V	0.1V _{CC}	0.9V _{CC}					





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_L = Load capacitance including jig and probe capacitance

R_L = 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 _r , t _f	CL	R _L	t _{PHL} , t _{PLH}	t _{PZH} , t _{PHZ}	t _{PZL} , t _{PLZ}	
74HC7541	V _{CC}	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V _{CC}	
74HCT7541	3 V	6 ns	15 pF, 50 pF	1 kΩ	open	GND	V _{CC}	

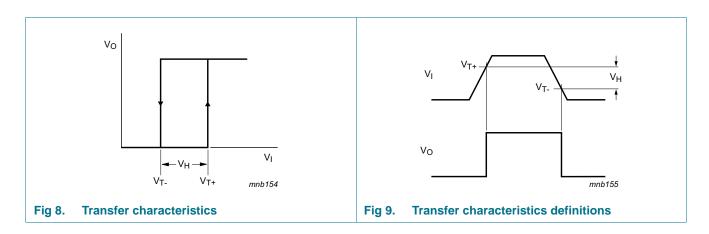
12. Transfer characteristics

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	_{nb} = 25	°C	$T_{amb} = -40$	°C to +85 °C	$T_{amb} = -40$	°C to +125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC754	11									
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
	voltage	$V_{CC} = 6.0 \text{ V}$	-	-	4.2	-	4.2	-	4.2	V
V _T negative-going	$V_{CC} = 2.0 \text{ V}$	0.3	-	-	0.3	-	0.3	-	V	
	threshold	V _{CC} = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
voltage	$V_{CC} = 6.0 \text{ V}$	1.8	-	-	1.8	-	1.8	-	V	
V _H	hysteresis	$V_{CC} = 2.0 \text{ V}$	0.1	0.20	-	0.1	-	0.1	-	V
	voltage	V _{CC} = 4.5 V	0.25	0.40	-	0.25	-	0.25	-	V
		$V_{CC} = 6.0 \text{ V}$	0.3	0.5	-	0.3	-	0.3	-	V
74HCT7	541					'				
V _{T+}	positive-going	$V_{CC} = 4.5 \text{ V}$	-	-	2.0	-	2.0	-	2.0	V
	threshold voltage	V _{CC} = 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
throobold	V _{CC} = 5.5 V	0.8	-	-	0.74	-	0.7	-	V	
V _H	hysteresis	$V_{CC} = 4.5 \text{ V}$	0.17	0.23	-	-	-	-	-	V
	voltage	V _{CC} = 5.5 V	0.17	0.23	-	-	-	-	-	V

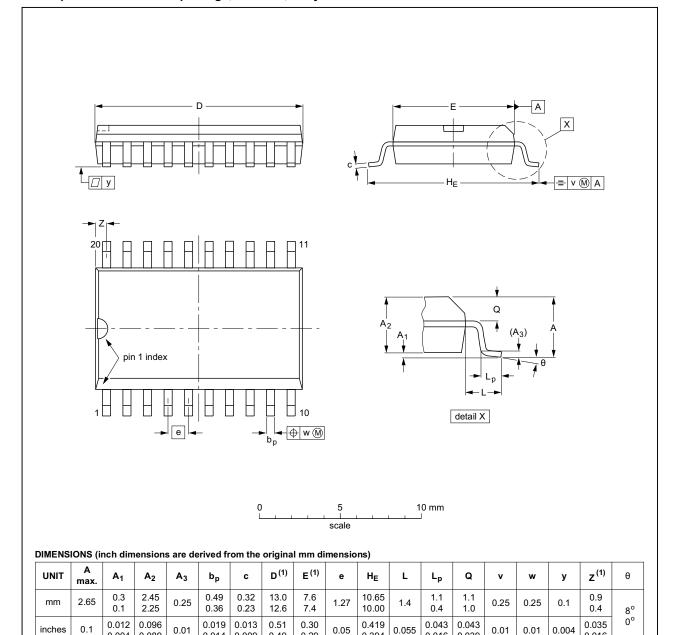
13. Transfer characteristics waveforms



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.

0.014

0.009

OUTLINE		REFER	RENCES	EUROPEAN	ISSUE DATE
VERSION	IEC	JEDEC	JEITA	PROJECTION	1330E DATE
SOT163-1	075E04	MS-013			99-12-27 03-02-19

0.394

0.016

0.039

Fig 10. Package outline SOT163-1 (SO20)

0.004

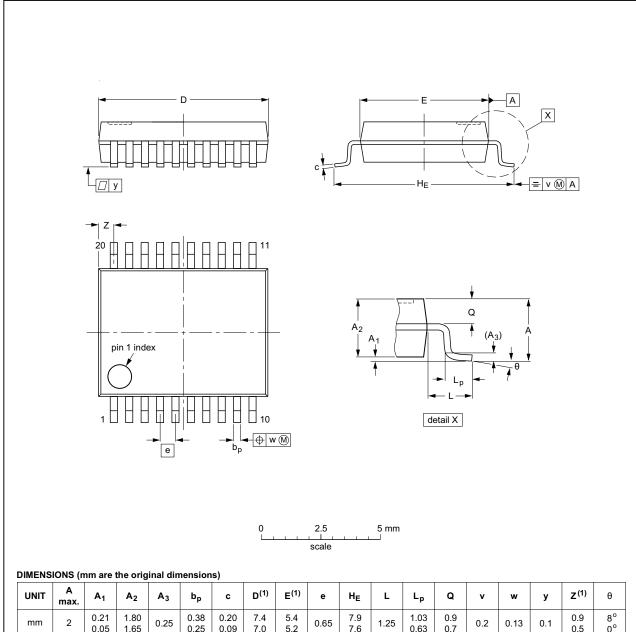
0.089

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 ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E ⁽¹⁾	е	HE	L	Lp	ø	v	¥	у	Z ⁽¹⁾	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	ENCES	EUROPEAN	ISSUE DATE	
VERSION	IEC JEDEC	JEDEC	JEITA	PROJECTION	ISSUE DATE	
SOT339-1		MO-150			99-12-27 03-02-19	

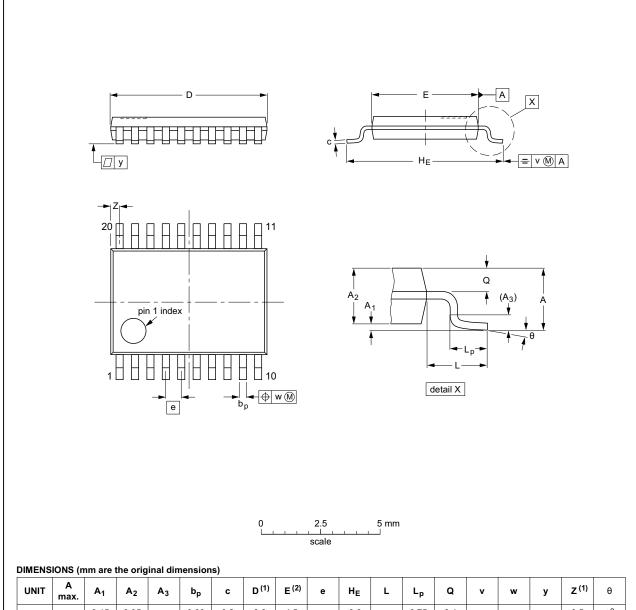
Fig 11. Package outline SOT339-1 (SSOP20)

74HC_HCT7541

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

SOT360-1



 				,		-,												
UNIT	A max.	A ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E (2)	е	HE	L	Lp	Q	v	w	у	Z ⁽¹⁾	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	RENCES	EUROPEAN	ISSUE DATE
VERSION	IEC JEDEC JEITA		PROJECTION	ISSUE DATE	
SOT360-1		MO-153			99-12-27 03-02-19

Fig 12. Package outline SOT360-1 (TSSOP20)

74HC_HCT7541 All information provided in this document is subject to legal disclaimers.

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) rem	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 _{OZ} added to s	static characteristics table.		
74HC_HCT7541 v.4	20111219	Product data sheet	-	74HC_HCT7541 v.3
Modifications:	• Legal pages u	updated.		
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.
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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74HC7541; 74HCT7541

Octal Schmitt trigger buffer/line driver; 3-state

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For more information, please visit: http://www.nexperia.com

For sales office addresses, please send an email to: salesaddresses@nexperia.com

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