

# 74HC7540; 74HCT7540

Octal Schmitt trigger buffer/line driver; 3-state; inverting

Rev. 4 — 31 December 2012

Product data sheet

## 1. General description

The 74HC7540; 74HCT7540 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7A.

The 74HC7540; 74HCT7540 provides eight inverting buffer/line drivers with 3-state outputs and Schmitt-trigger action. The 3-state outputs are controlled by the output enable inputs  $\overline{OE}1$  and  $\overline{OE}2$ . A HIGH on  $\overline{OE}n$  causes the outputs to assume a high-impedance OFF-state. Schmitt trigger action on the data inputs transforms slowly changing input signals into sharply defined, jitter-free output signals.

The 74HC7540; 74HCT7540 is identical to the 74HC540; 74HCT540 but has hysteresis on the data inputs.

## 2. Features and benefits

- Inverting outputs
- Low-power dissipation
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

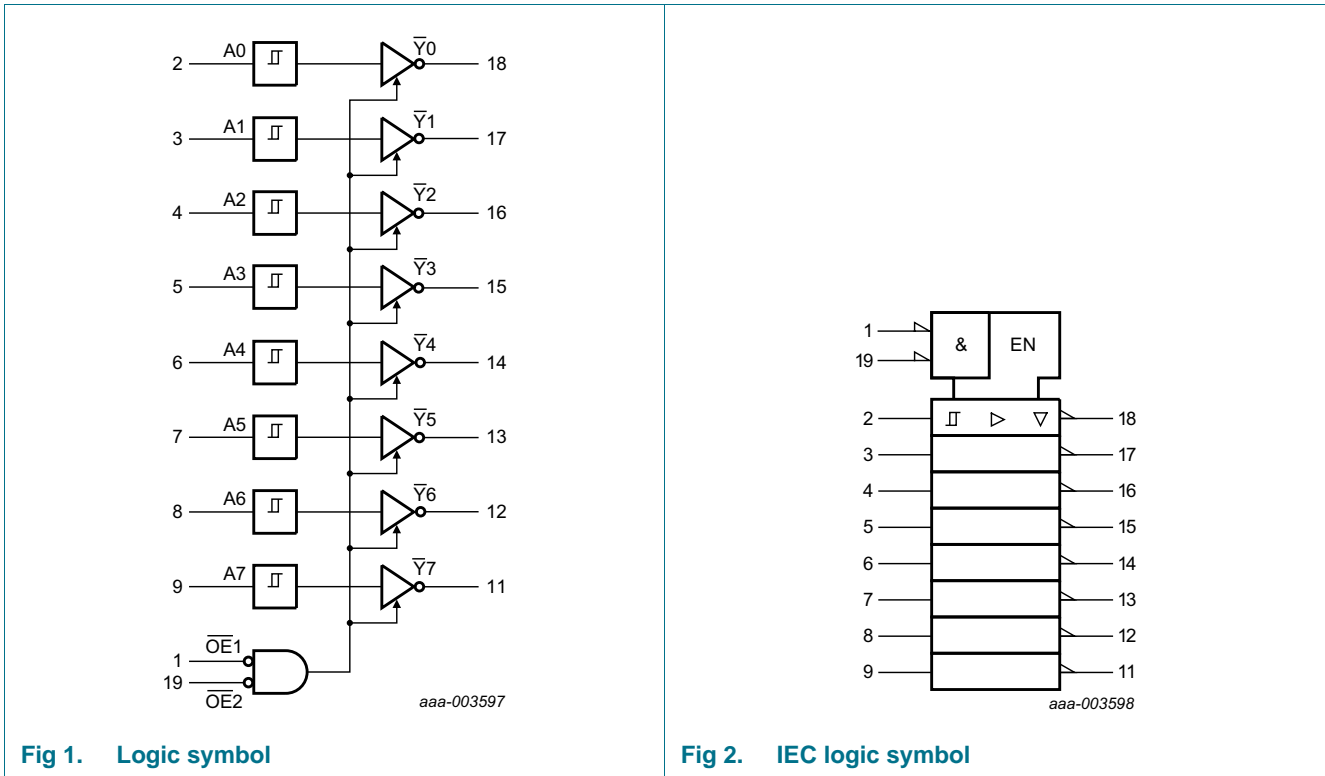
## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC7540N 74HCT7540N	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
74HC7540D 74HCT7540D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74HC7540DB	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1

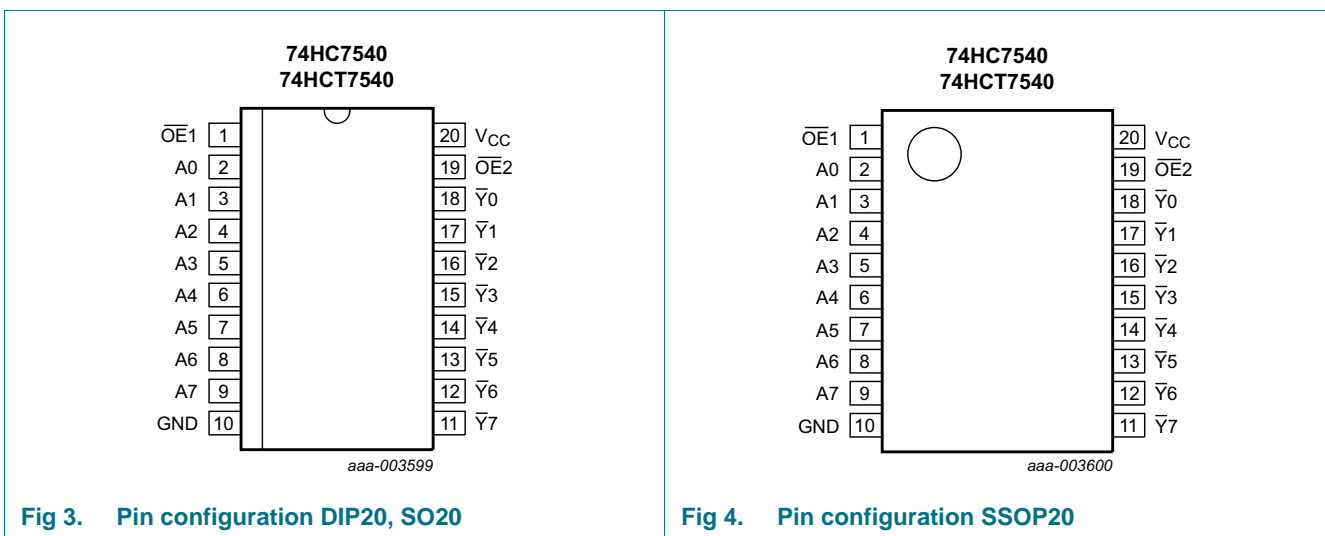


## 4. Functional diagram



## 5. Pinning information

### 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{OE}1$	1	output enable input (active LOW)
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
$\overline{Y}0$ to $\overline{Y}7$	18, 17, 16, 15, 14, 13, 12, 11	data output
$\overline{OE}2$	19	output enable input (active LOW)
$V_{CC}$	20	supply voltage

## 6. Functional description

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

Control		Input	Output
$\overline{OE}1$	$\overline{OE}2$	A <sub>n</sub>	$\overline{Y}_n$
L	L	L	H
L	L	H	L
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	+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
$I_O$	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	±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		[2]		
	DIP20		-	750	mW
	SO20, SSOP20		-	500	mW

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

[2] 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 SSOP20 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	74HC7540			74HCT7540			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	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

## 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> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC7540</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>								
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I <sub>O</sub> = -7.8 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub>								
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I <sub>O</sub> = 7.8 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>OZ</sub>	OFF-state output current	per input pin; V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V; I <sub>O</sub> = 0 A	-	-	±0.5	-	±5.0	-	±10	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> = 6.0 V	-	-	8.0	-	80	-	160	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF
<b>74HCT7540</b>										
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -6.0 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 <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>CC</sub> = 4.5 V								
		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 <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>OZ</sub>	OFF-state output current	per input pin; V <sub>I</sub> = V <sub>T+</sub> or V <sub>T-</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; I <sub>O</sub> = 0 A	-	-	±0.5	-	±5.0	-	±10	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> = 5.5 V	-	-	8.0	-	80	-	160	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; I <sub>O</sub> = 0 A; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V								
		An input	-	20	72	-	90	-	98	μA
		$\overline{O}E$ n input	-	130	468	-	585	-	637	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see [Figure 7](#).

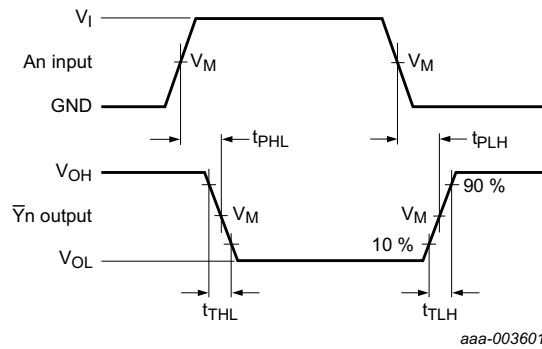
Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
<b>74HC7540</b>								
t <sub>pd</sub>	propagation delay	An to $\overline{Y}n$ ; see <a href="#">Figure 5</a> <span style="float:right">[1]</span>						
		V <sub>CC</sub> = 2.0 V	-	39	120	150	180	ns
		V <sub>CC</sub> = 4.5 V	-	14	24	30	36	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	-	11	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	11	20	26	31	ns
t <sub>en</sub>	enable time	$\overline{O}E$ n to $\overline{Y}n$ ; see <a href="#">Figure 6</a> <span style="float:right">[1]</span>						
		V <sub>CC</sub> = 2.0 V	-	41	150	190	225	ns
		V <sub>CC</sub> = 4.5 V	-	15	30	38	45	ns
		V <sub>CC</sub> = 6.0 V	-	12	26	33	38	ns
t <sub>dis</sub>	disable time	$\overline{O}E$ n to $\overline{Y}n$ ; see <a href="#">Figure 6</a> <span style="float:right">[1]</span>						
		V <sub>CC</sub> = 2.0 V	-	52	150	190	225	ns
		V <sub>CC</sub> = 4.5 V	-	19	30	38	45	ns
		V <sub>CC</sub> = 6.0 V	-	15	26	33	38	ns

**Table 7. Dynamic characteristics**  
*GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see [Figure 7](#).*

Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit	
			Min	Typ	Max	Max (85 °C)	Max (125 °C)		
t <sub>t</sub>	transition time	see <a href="#">Figure 5</a>	<a href="#">[2]</a>						
		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>	<a href="#">[3]</a>	-	29	-	-	-	pF
<b>74HCT7540</b>									
t <sub>pd</sub>	propagation delay	An to $\bar{Y}n$ ; see <a href="#">Figure 5</a>	<a href="#">[1]</a>						
		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	$\overline{O}En$ to $\bar{Y}n$ ; see <a href="#">Figure 6</a>	<a href="#">[1]</a>						
		V <sub>CC</sub> = 4.5 V	-	19	32	40	48	ns	
t <sub>dis</sub>	disable time	$\overline{O}En$ to $\bar{Y}n$ ; see <a href="#">Figure 6</a>	<a href="#">[1]</a>						
		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 <a href="#">Figure 5</a>	<a href="#">[2]</a>	-	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	<a href="#">[3]</a>	-	31	-	-	-	pF

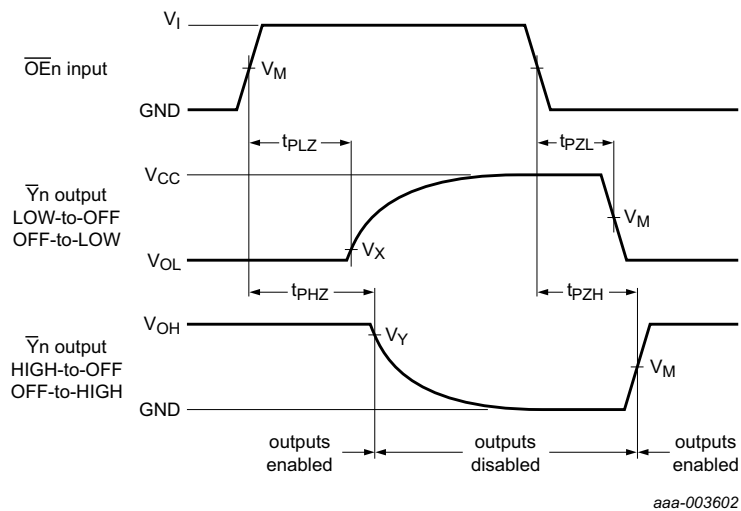
- [1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.  
t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.  
t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.
- [2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<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;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

11. Waveforms



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 5. Input to output propagation delays

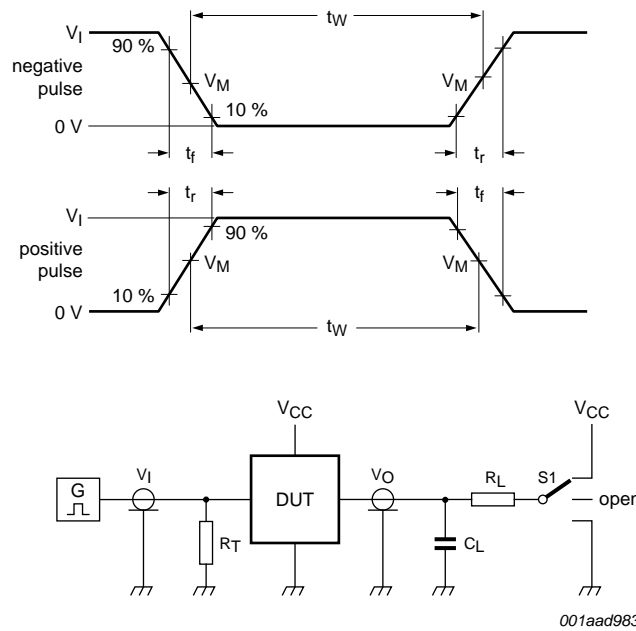


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Fig 6. 3-state enable and disable times

Table 8. Measurement points

Type	Input	Output		
	$V_M$	$V_M$	$V_X$	$V_Y$
74HC7540	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$
74HCT7540	1.3 V	1.3 V	$0.1V_{CC}$	$0.9V_{CC}$



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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 resistance

S1 = Test selection switch

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

**Table 9. Test data**

Type	Input		Load		S1 position		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHL}, t_{PLH}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
74HC7540	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$
74HCT7540	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	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	T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = -40 °C to +85 °C		T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC7540</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 2.0 V	-	-	1.5	-	1.5	-	1.5	V
		V <sub>CC</sub> = 4.5 V	-	-	3.15	-	3.15	-	3.15	V
		V <sub>CC</sub> = 6.0 V	-	-	4.2	-	4.2	-	4.2	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 2.0 V	0.3	-	-	0.3	-	0.3	-	V
		V <sub>CC</sub> = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
		V <sub>CC</sub> = 6.0 V	1.8	-	-	1.8	-	1.8	-	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 2.0 V	0.1	0.20	-	0.1	-	0.1	-	V
		V <sub>CC</sub> = 4.5 V	0.25	0.40	-	0.25	-	0.25	-	V
		V <sub>CC</sub> = 6.0 V	0.3	0.5	-	0.3	-	0.3	-	V
<b>74HCT7540</b>										
V <sub>T+</sub>	positive-going threshold voltage	V <sub>CC</sub> = 4.5 V	-	-	2.0	-	2.0	-	2.0	V
		V <sub>CC</sub> = 5.5 V	-	-	2.1	-	2.1	-	2.1	V
V <sub>T-</sub>	negative-going threshold voltage	V <sub>CC</sub> = 4.5 V	0.7	-	-	0.64	-	0.6	-	V
		V <sub>CC</sub> = 5.5 V	0.8	-	-	0.74	-	0.7	-	V
V <sub>H</sub>	hysteresis voltage	V <sub>CC</sub> = 4.5 V	0.17	0.23	-	-	-	-	-	V
		V <sub>CC</sub> = 5.5 V	0.17	0.23	-	-	-	-	-	V

13. Transfer characteristics waveforms

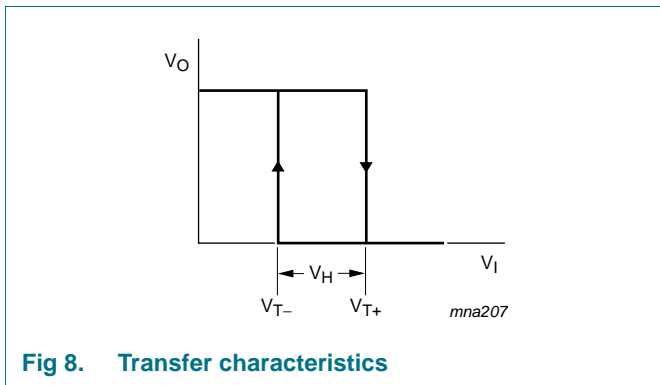


Fig 8. Transfer characteristics

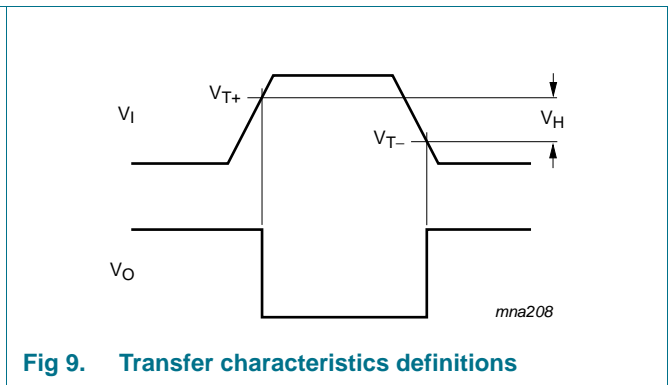


Fig 9. Transfer characteristics definitions

14. Package outline

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

SOT146-1

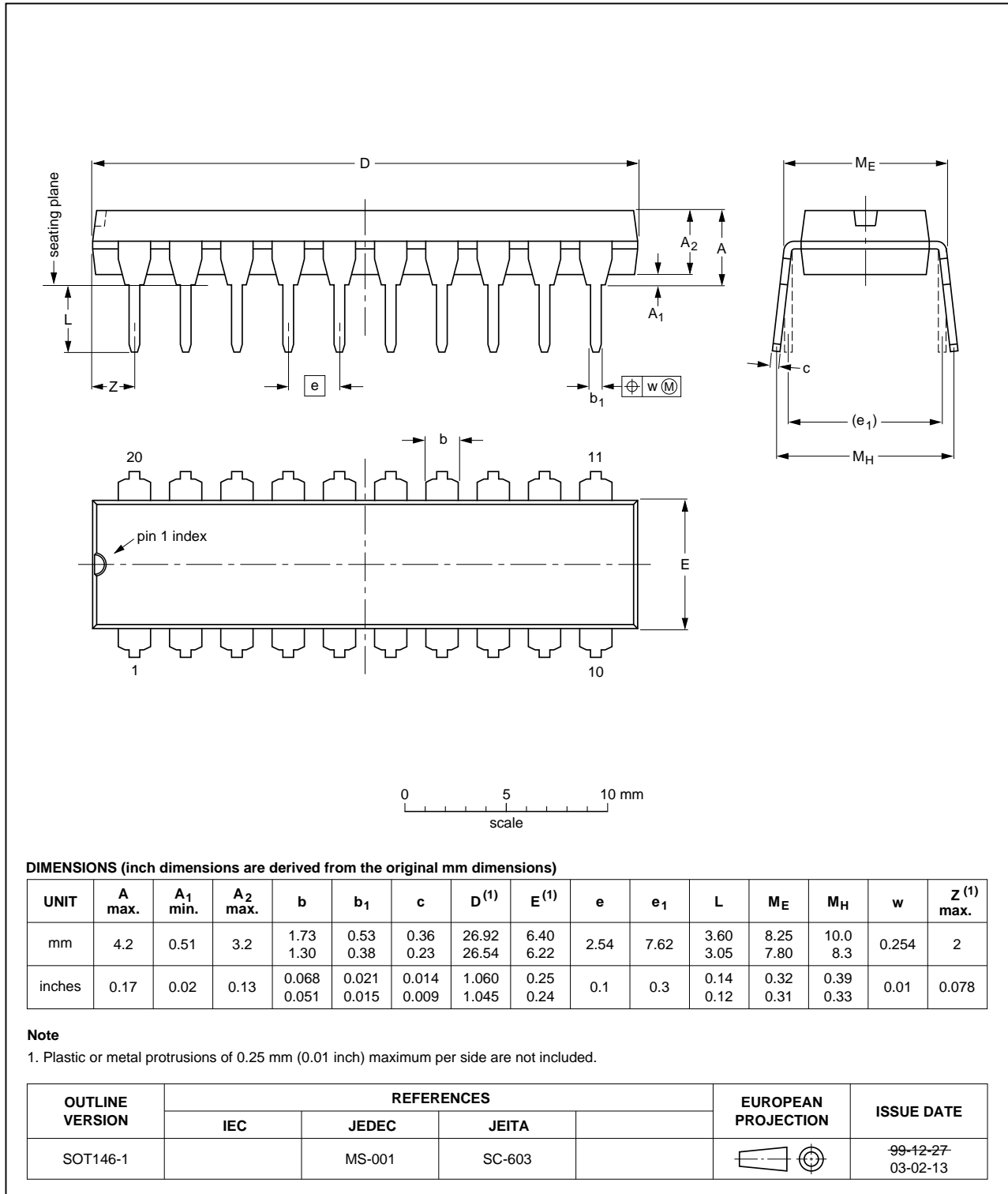


Fig 10. Package outline SOT146-1 (DIP20)

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

SOT163-1

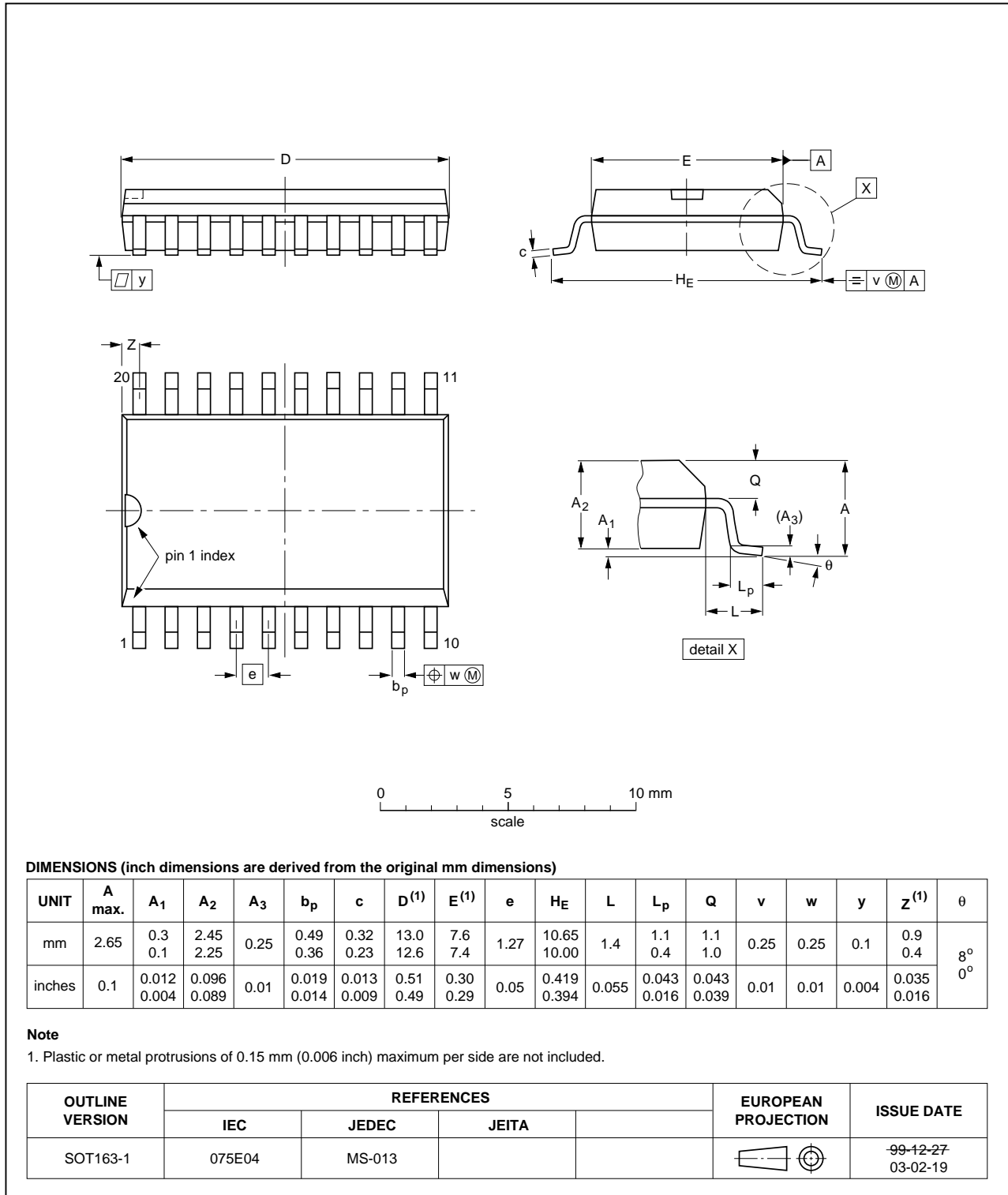


Fig 11. Package outline SOT163-1 (SO20)

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

SOT339-1

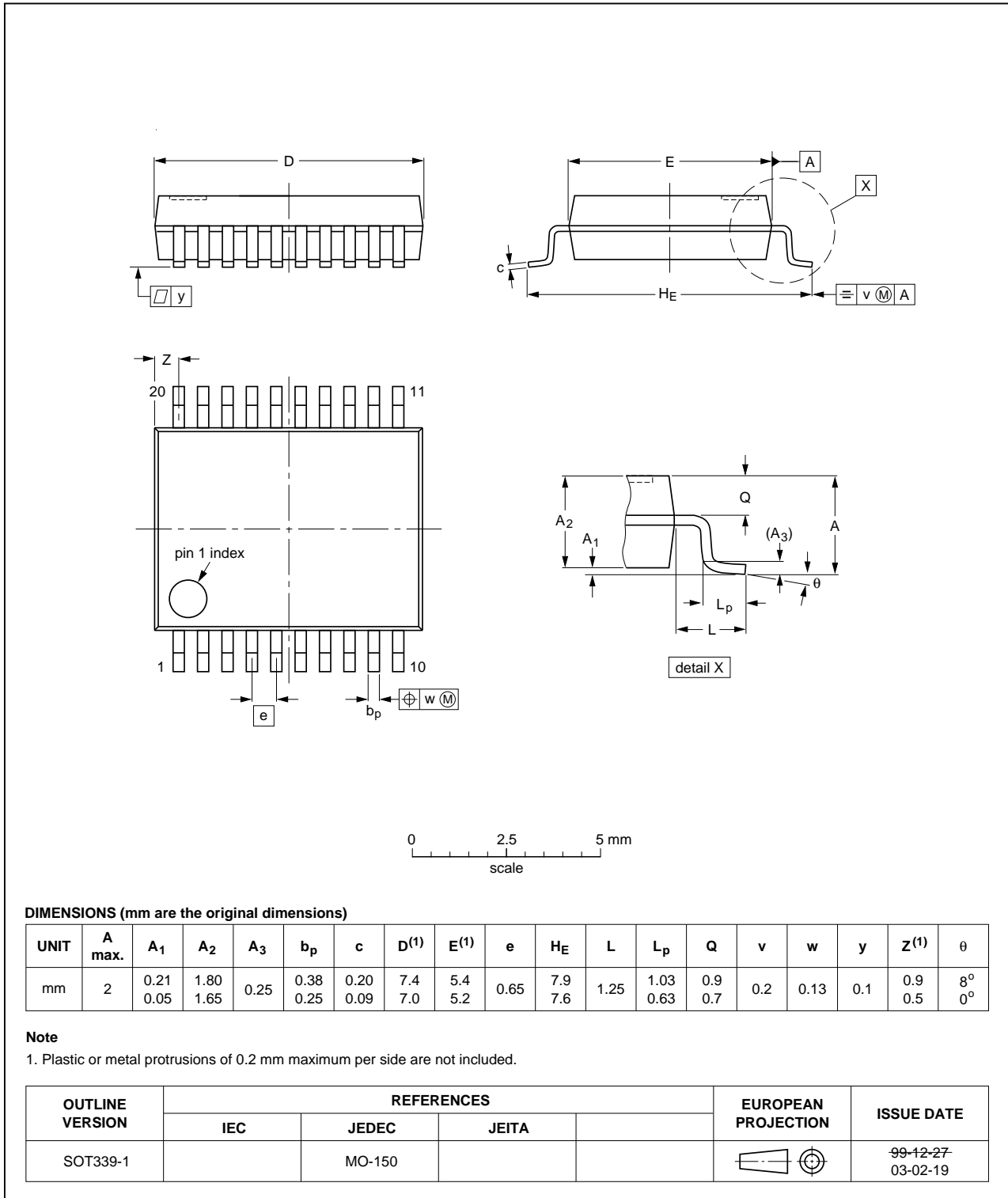


Fig 12. Package outline SOT339-1 (SSOP20)

## 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_HCT7540 v.4	20121231	Product data sheet	-	74HC_HCT7540 v.3
Modifications:	<ul style="list-style-type: none"> <li>• I<sub>OZ</sub> added to static characteristics table.</li> </ul>			
74HC_HCT7540 v.3	20120827	Product data sheet	-	74HC_HCT7540_CNV v.2
Modifications:	<ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74HC_HCT7540_CNV v.2	19970917	Product specification	-	-

## 17. Legal information

### 17.1 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.nxp.com>.

### 17.2 Definitions

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## 19. Contents

<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features and benefits</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>1</b>
<b>4</b>	<b>Functional diagram</b> .....	<b>2</b>
<b>5</b>	<b>Pinning information</b> .....	<b>2</b>
5.1	Pinning .....	2
5.2	Pin description .....	3
<b>6</b>	<b>Functional description</b> .....	<b>3</b>
<b>7</b>	<b>Limiting values</b> .....	<b>3</b>
<b>8</b>	<b>Recommended operating conditions</b> .....	<b>4</b>
<b>9</b>	<b>Static characteristics</b> .....	<b>4</b>
<b>10</b>	<b>Dynamic characteristics</b> .....	<b>5</b>
<b>11</b>	<b>Waveforms</b> .....	<b>7</b>
<b>12</b>	<b>Transfer characteristics</b> .....	<b>9</b>
<b>13</b>	<b>Transfer characteristics waveforms</b> .....	<b>9</b>
<b>14</b>	<b>Package outline</b> .....	<b>10</b>
<b>15</b>	<b>Abbreviations</b> .....	<b>13</b>
<b>16</b>	<b>Revision history</b> .....	<b>13</b>
<b>17</b>	<b>Legal information</b> .....	<b>14</b>
17.1	Data sheet status .....	14
17.2	Definitions .....	14
17.3	Disclaimers .....	14
17.4	Trademarks .....	15
<b>18</b>	<b>Contact information</b> .....	<b>15</b>
<b>19</b>	<b>Contents</b> .....	<b>16</b>

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