

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 $+125\text{ }^{\circ}\text{C}$

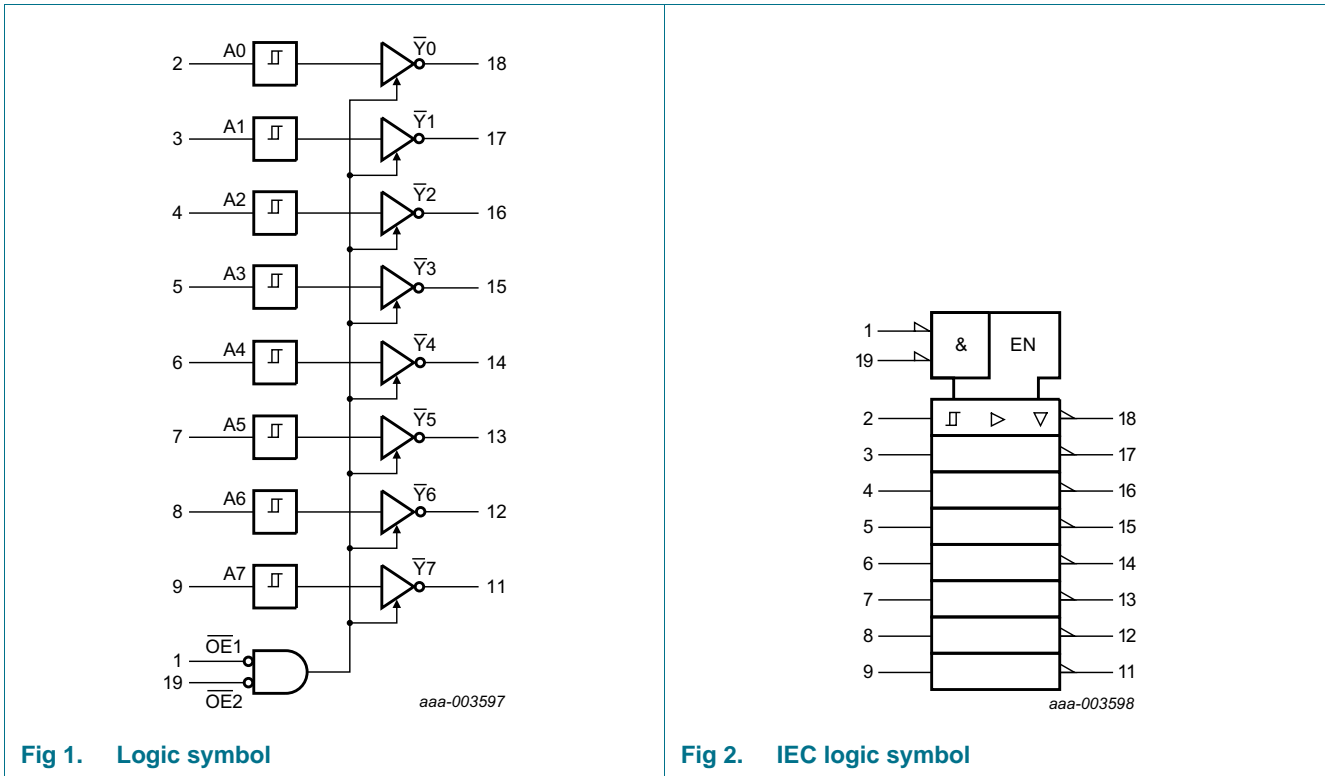
3. Ordering information

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

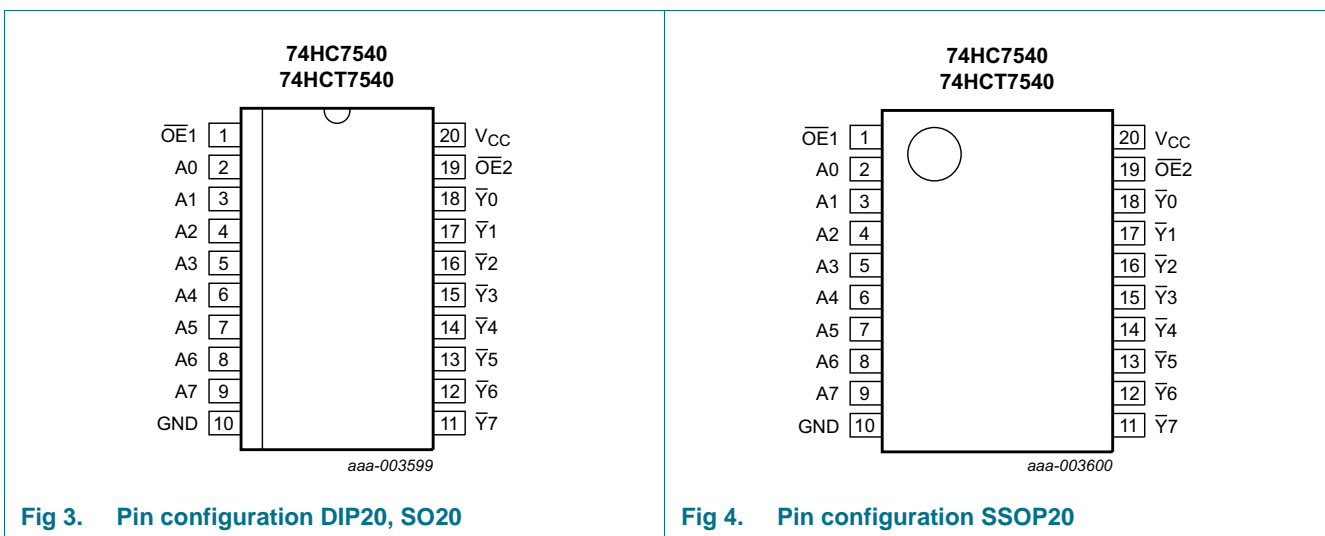


4. Functional diagram



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^[1]

Control		Input	Output
$\overline{OE}1$	$\overline{OE}2$	A _n	\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 _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V _I	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
V _O	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 _{amb} = 25 °C			T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC7540										
V _{OH}	HIGH-level output voltage	V _I = V _{T+} or V _{T-}								
		I _O = -20 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I _O = -6.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I _O = -7.8 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{T+} or V _{T-}								
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 6.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I _O = 7.8 mA; V _{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{OZ}	OFF-state output current	per input pin; V _I = V _{T+} or V _{T-} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 6.0 V; I _O = 0 A	-	-	±0.5	-	±5.0	-	±10	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT7540										
V _{OH}	HIGH-level output voltage	V _I = V _{T+} or V _{T-} ; V _{CC} = 4.5 V								
		I _O = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -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 _{amb} = 25 °C			T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V _{OL}	LOW-level output voltage	V _I = V _{T+} or V _{T-} ; V _{CC} = 4.5 V								
		I _O = 20 μA;	-	0	0.1	-	0.1	-	0.1	V
		I _O = 6.0 mA;	-	0.15	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{OZ}	OFF-state output current	per input pin; V _I = V _{T+} or V _{T-} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 5.5 V; I _O = 0 A	-	-	±0.5	-	±5.0	-	±10	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	8.0	-	80	-	160	μA
ΔI _{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	μA
		$\overline{\text{OEn}}$ input	-	130	468	-	585	-	637	μA
C _I	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](#).

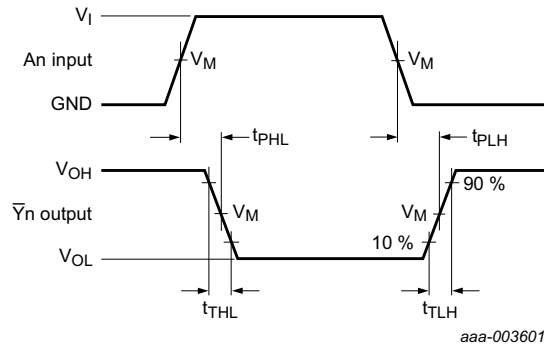
Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
74HC7540								
t _{pd}	propagation delay	An to $\overline{\text{Yn}}$; see Figure 5 [1]						
		V _{CC} = 2.0 V	-	39	120	150	180	ns
		V _{CC} = 4.5 V	-	14	24	30	36	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	11	-	-	-	ns
		V _{CC} = 6.0 V	-	11	20	26	31	ns
t _{en}	enable time	$\overline{\text{OEn}}$ to $\overline{\text{Yn}}$; see Figure 6 [1]						
		V _{CC} = 2.0 V	-	41	150	190	225	ns
		V _{CC} = 4.5 V	-	15	30	38	45	ns
		V _{CC} = 6.0 V	-	12	26	33	38	ns
t _{dis}	disable time	$\overline{\text{OEn}}$ to $\overline{\text{Yn}}$; see Figure 6 [1]						
		V _{CC} = 2.0 V	-	52	150	190	225	ns
		V _{CC} = 4.5 V	-	19	30	38	45	ns
		V _{CC} = 6.0 V	-	15	26	33	38	ns

Table 7. Dynamic characteristics
GND = 0 V; C_L = 50 pF; for test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +125 °C		Unit	
			Min	Typ	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}	[3]	-	29	-	-	-	pF
74HCT7540									
t _{pd}	propagation delay	An to $\bar{Y}n$; see Figure 5	[1]						
		V _{CC} = 4.5 V	-	19	32	40	48	ns	
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	ns	
t _{en}	enable time	$\overline{O}En$ to $\bar{Y}n$; see Figure 6	[1]						
		V _{CC} = 4.5 V	-	19	32	40	48	ns	
t _{dis}	disable time	$\overline{O}En$ to $\bar{Y}n$; see Figure 6	[1]						
		V _{CC} = 4.5 V	-	20	32	40	48	ns	
t _t	transition time	V _{CC} = 4.5 V; see Figure 5	[2]	-	5	12	15	18	ns
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC} - 1.5 V	[3]	-	31	-	-	-	pF

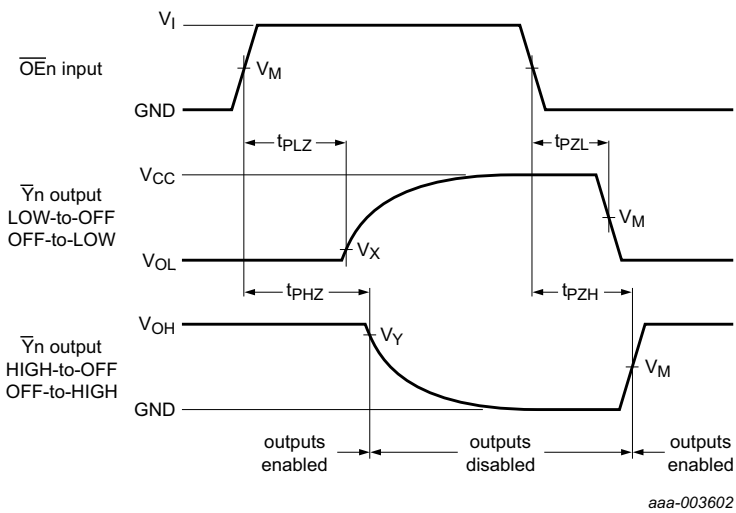
- [1] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
- [2] t_t is the same as t_{THL} and t_{TLH}.
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ 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;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = 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

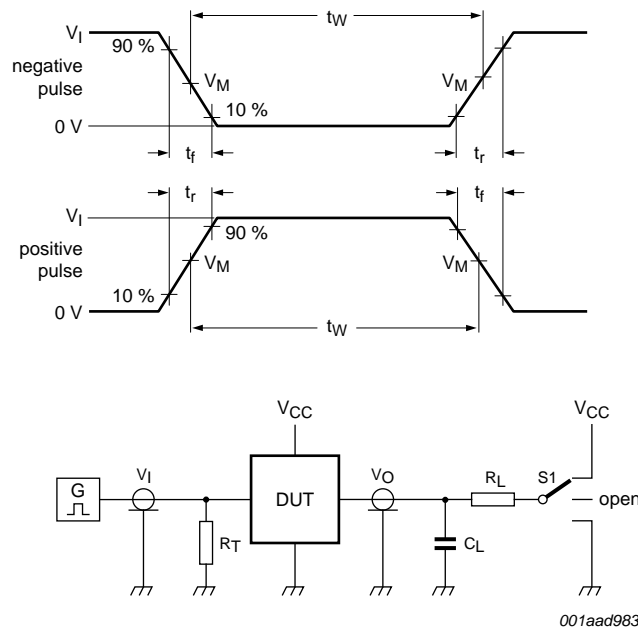


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

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 Ω	open	GND	V_{CC}
74HCT7540	3 V	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

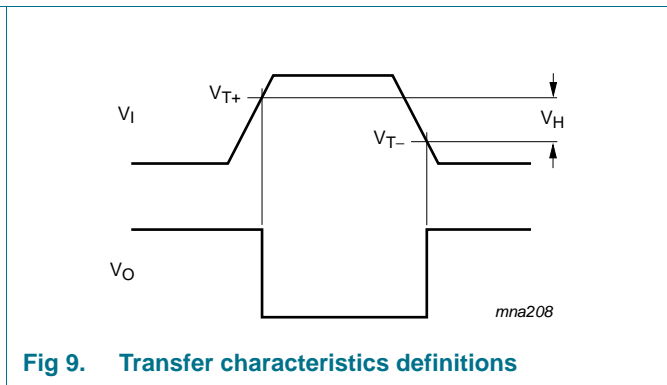
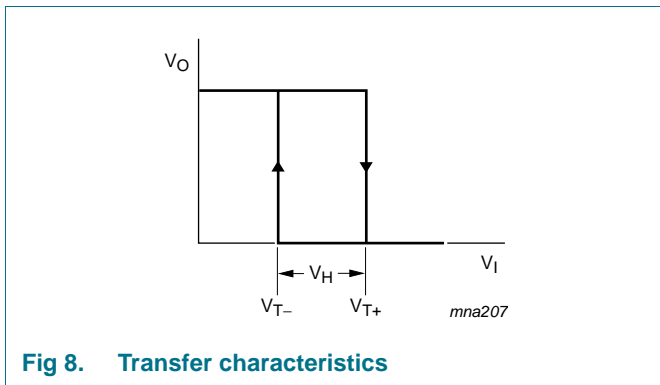
12. Transfer characteristics

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 _{amb} = 25 °C			T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC7540										
V _{T+}	positive-going threshold voltage	V _{CC} = 2.0 V	-	-	1.5	-	1.5	-	1.5	V
		V _{CC} = 4.5 V	-	-	3.15	-	3.15	-	3.15	V
		V _{CC} = 6.0 V	-	-	4.2	-	4.2	-	4.2	V
V _{T-}	negative-going threshold voltage	V _{CC} = 2.0 V	0.3	-	-	0.3	-	0.3	-	V
		V _{CC} = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
		V _{CC} = 6.0 V	1.8	-	-	1.8	-	1.8	-	V
V _H	hysteresis voltage	V _{CC} = 2.0 V	0.1	0.20	-	0.1	-	0.1	-	V
		V _{CC} = 4.5 V	0.25	0.40	-	0.25	-	0.25	-	V
		V _{CC} = 6.0 V	0.3	0.5	-	0.3	-	0.3	-	V
74HCT7540										
V _{T+}	positive-going threshold voltage	V _{CC} = 4.5 V	-	-	2.0	-	2.0	-	2.0	V
		V _{CC} = 5.5 V	-	-	2.1	-	2.1	-	2.1	V
V _{T-}	negative-going threshold voltage	V _{CC} = 4.5 V	0.7	-	-	0.64	-	0.6	-	V
		V _{CC} = 5.5 V	0.8	-	-	0.74	-	0.7	-	V
V _H	hysteresis voltage	V _{CC} = 4.5 V	0.17	0.23	-	-	-	-	-	V
		V _{CC} = 5.5 V	0.17	0.23	-	-	-	-	-	V

13. Transfer characteristics waveforms



14. Package outline

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

SOT146-1

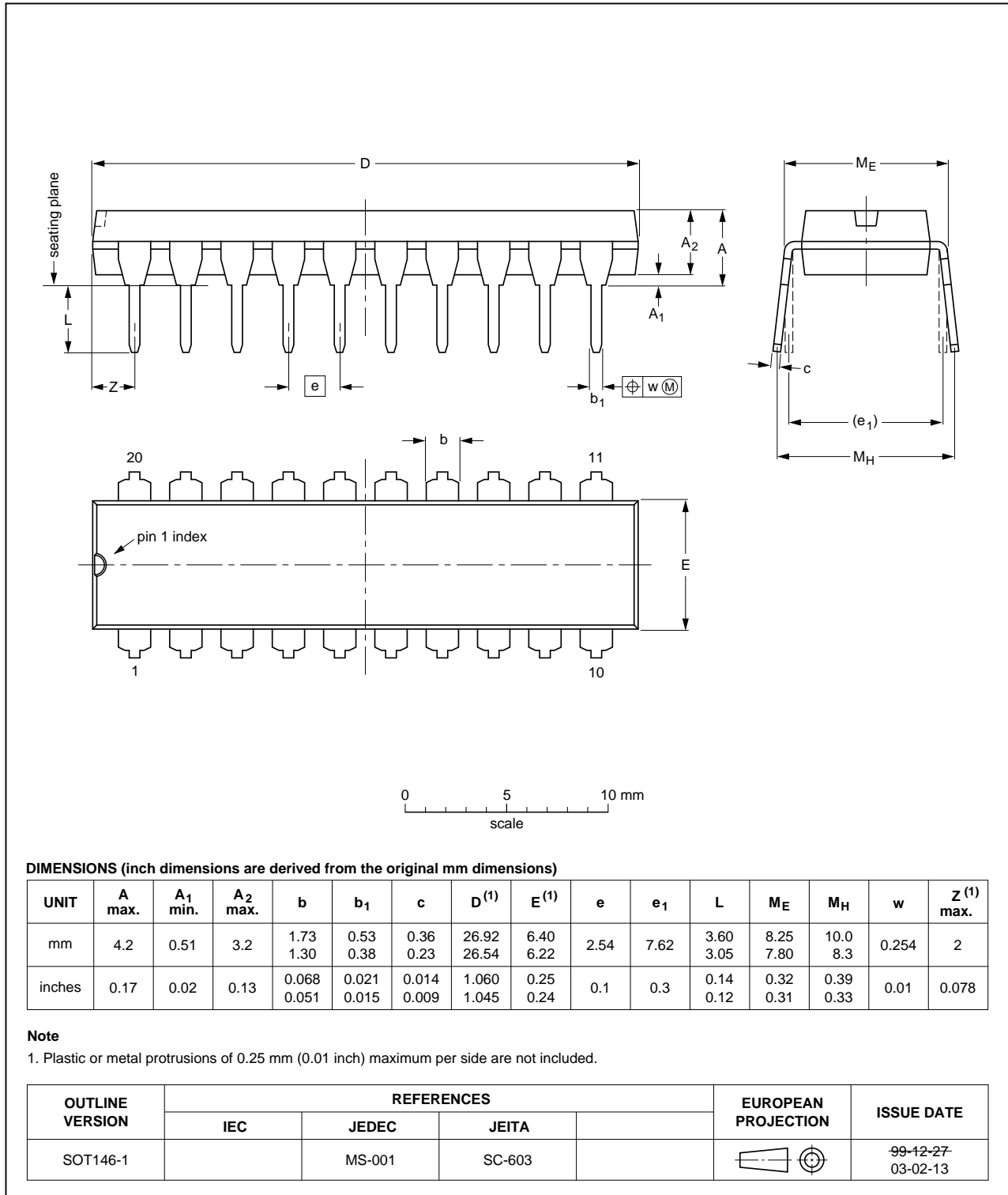


Fig 10. Package outline SOT146-1 (DIP20)

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

SOT163-1

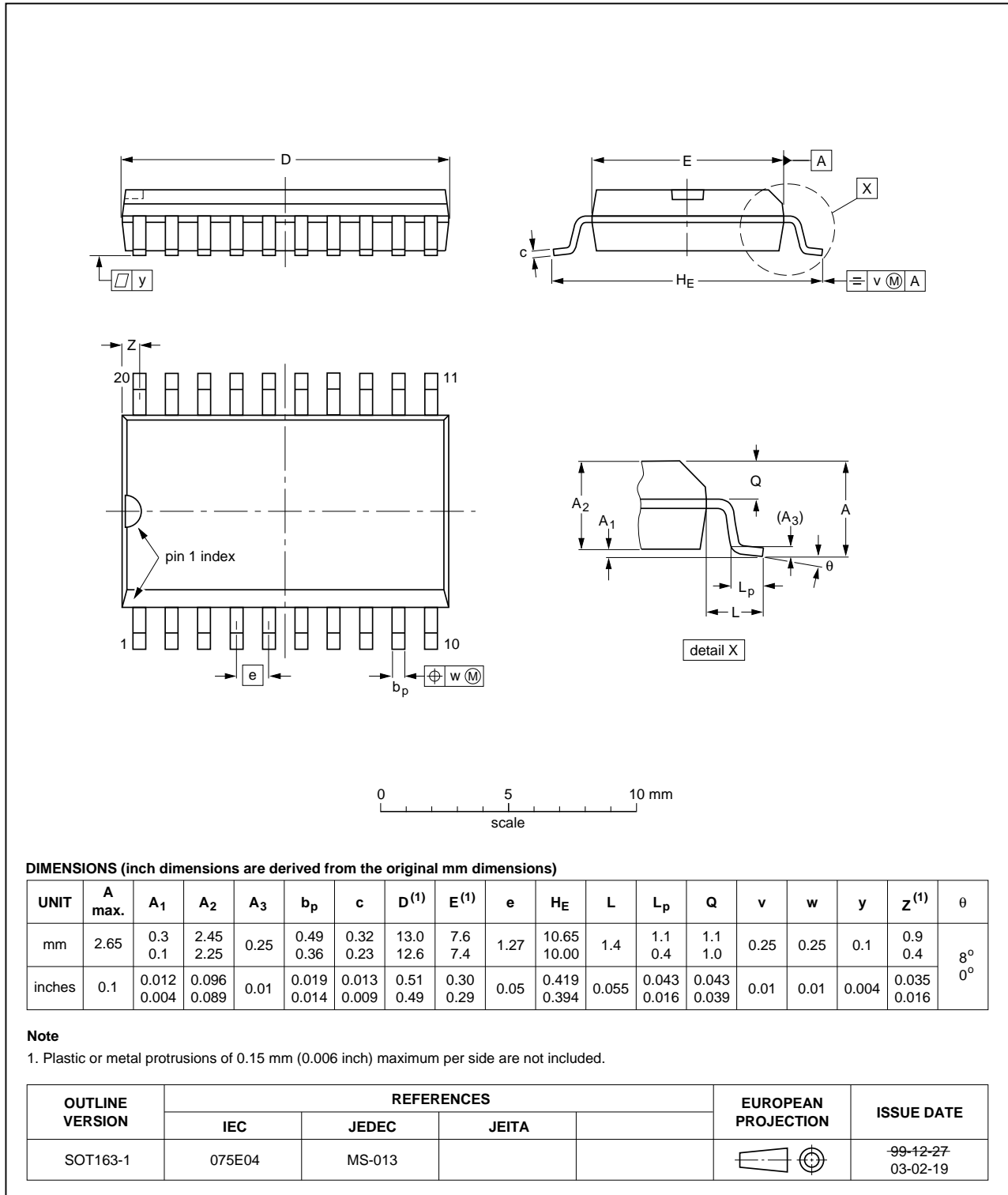


Fig 11. Package outline SOT163-1 (SO20)

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

SOT339-1

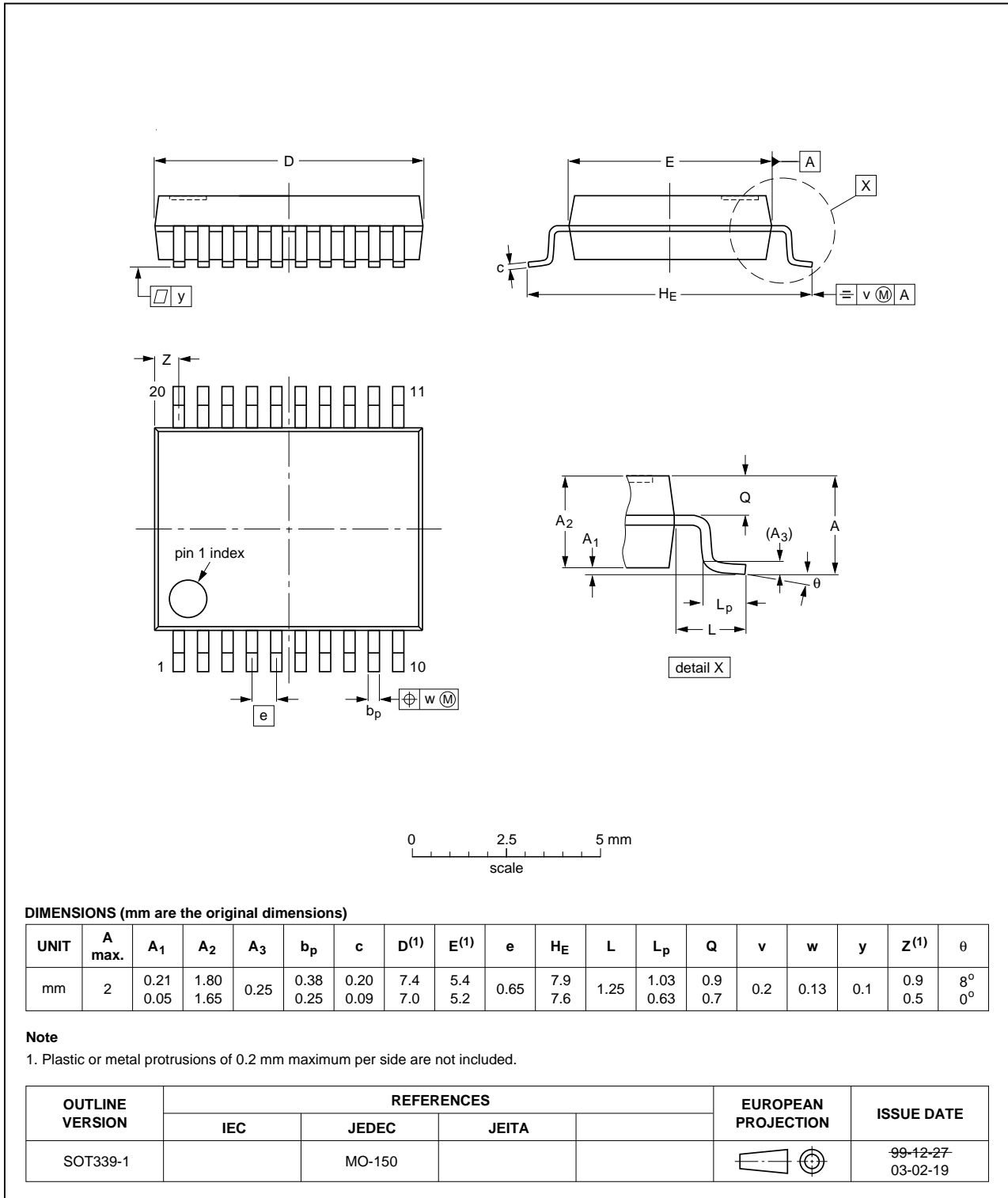


Fig 12. Package outline SOT339-1 (SSOP20)

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"> • I_{OZ} added to static characteristics table. 			
74HC_HCT7540 v.3	20120827	Product data sheet	-	74HC_HCT7540_CNV v.2
Modifications:	<ul style="list-style-type: none"> • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. 			
74HC_HCT7540_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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