

74HC7540; 74HCT7540

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

Rev. 5 — 26 May 2016

Product data sheet

1. General description

The 74HC7540; 74HCT7540 is an 8-bit inverting buffer/line driver with Schmitt-trigger inputs and 3-state outputs. The device features two output enables ($\overline{OE}1$ and $\overline{OE}2$). A HIGH on $\overline{OE}n$ 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

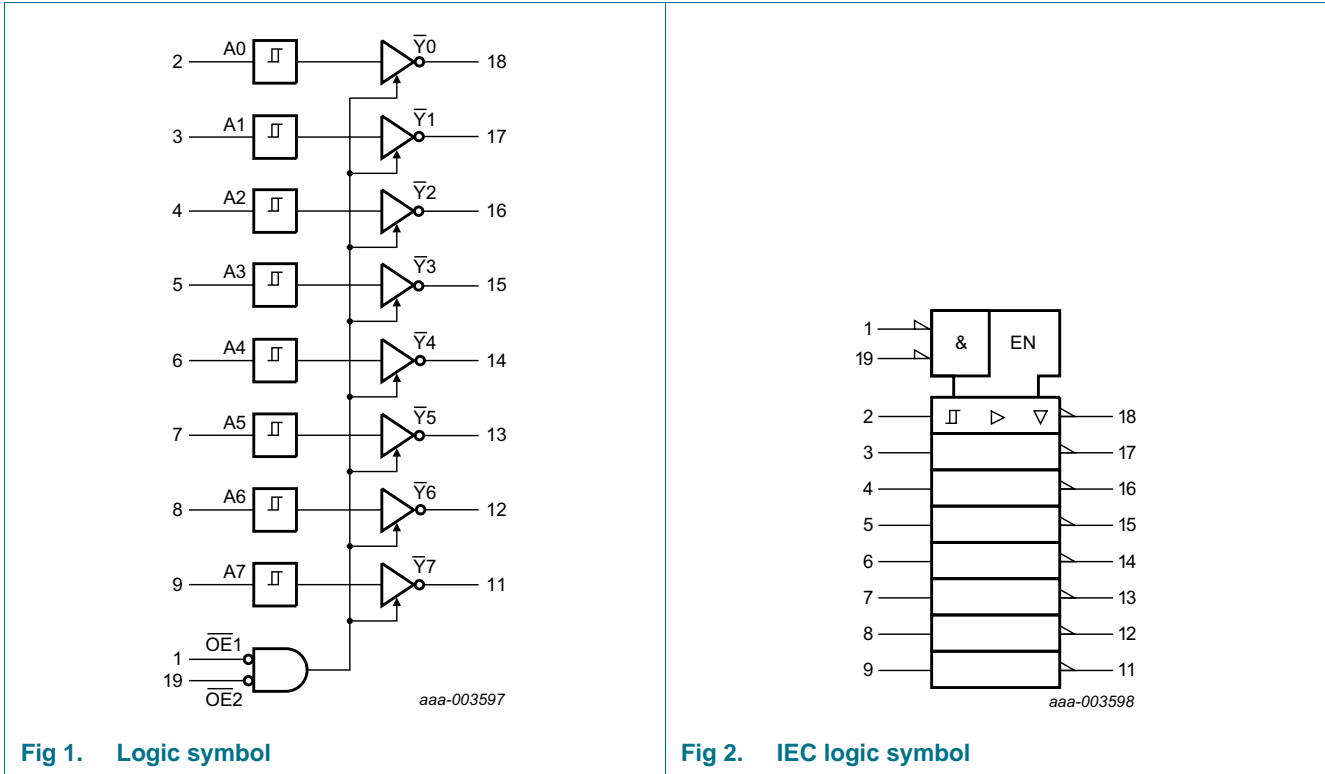
- Input levels:
 - ◆ For 74HC7540: CMOS level
 - ◆ For 74HCT7540: TTL level
- Inverting outputs
- Low-power dissipation
- Complies with JEDEC standard no. 7 A
- Multiple package options
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from $-40\text{ }^{\circ}\text{C}$ 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

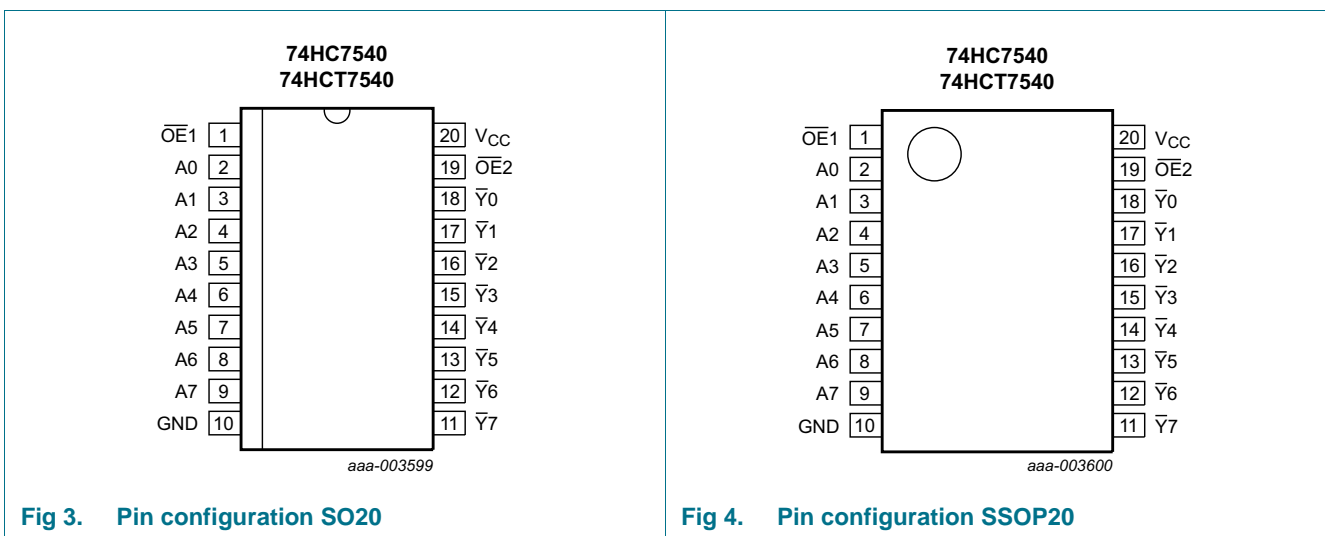
| Type number | Package | | | |
|-------------|---|--------|--|----------|
| | Temperature range | Name | Description | Version |
| 74HC7540D | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |
| 74HCT7540D | | | | |
| 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 | SO20, SSOP20 | [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 package: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
For SSOP20 package: 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 | V _I = V _{T+} or V _{T-} ; V _{CC} = 6.0 V; V _O = V _{CC} or GND | - | - | ±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 | V _I = V _{T+} or V _{T-} ; V _{CC} = 5.5 V; V _O = V _{CC} or GND | - | - | ±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 characteristicsGND = 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 characteristicsGND = 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 \overline{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{OEn} to \overline{Y}_n ; see Figure 6 [1] | | | | | | |
| | | V _{CC} = 4.5 V | - | 19 | 32 | 40 | 48 | ns |
| t _{dis} | disable time | \overline{OEn} to \overline{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):

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

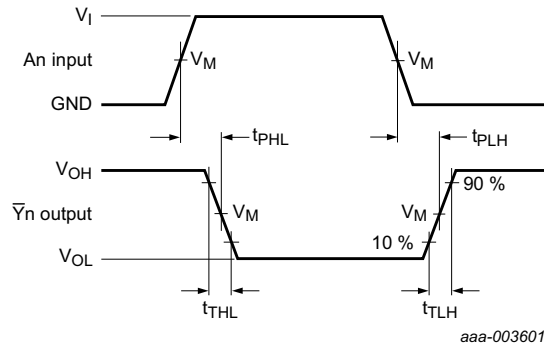
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

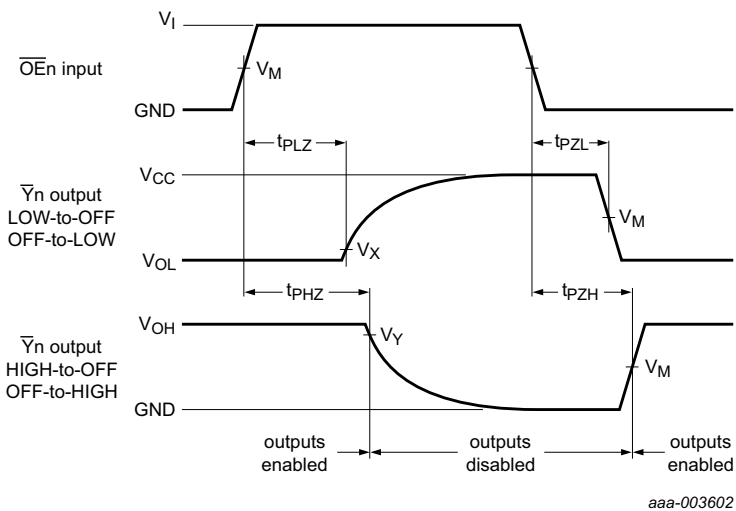
11. Waveforms



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



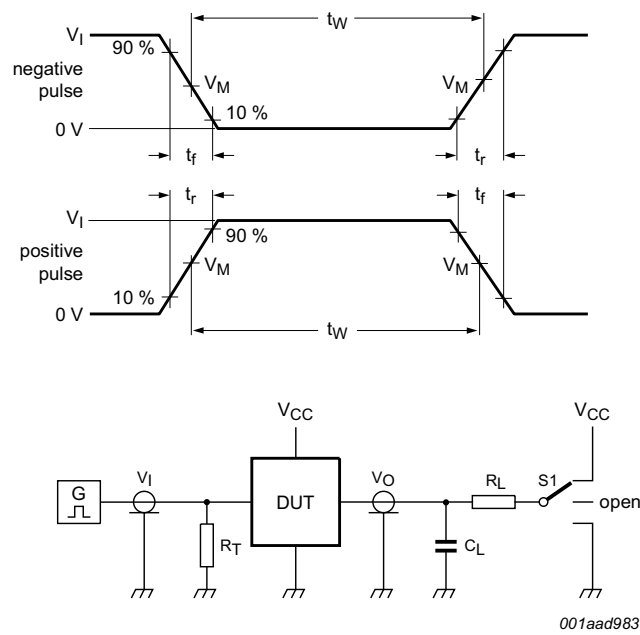
Measurement points are given in [Table 8](#).

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 | $0.1V_{CC}$ | $0.9V_{CC}$ |



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} |

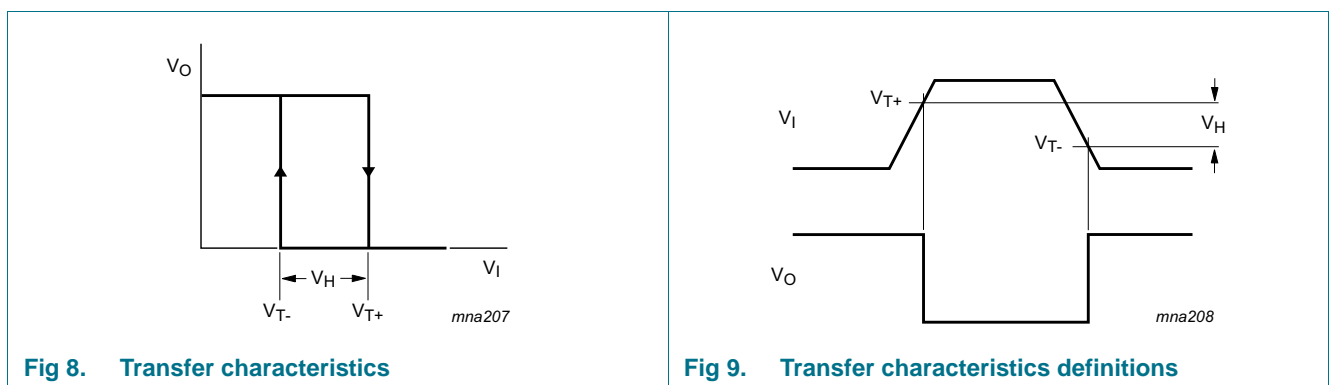
12. Transfer characteristics

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

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

SOT163-1

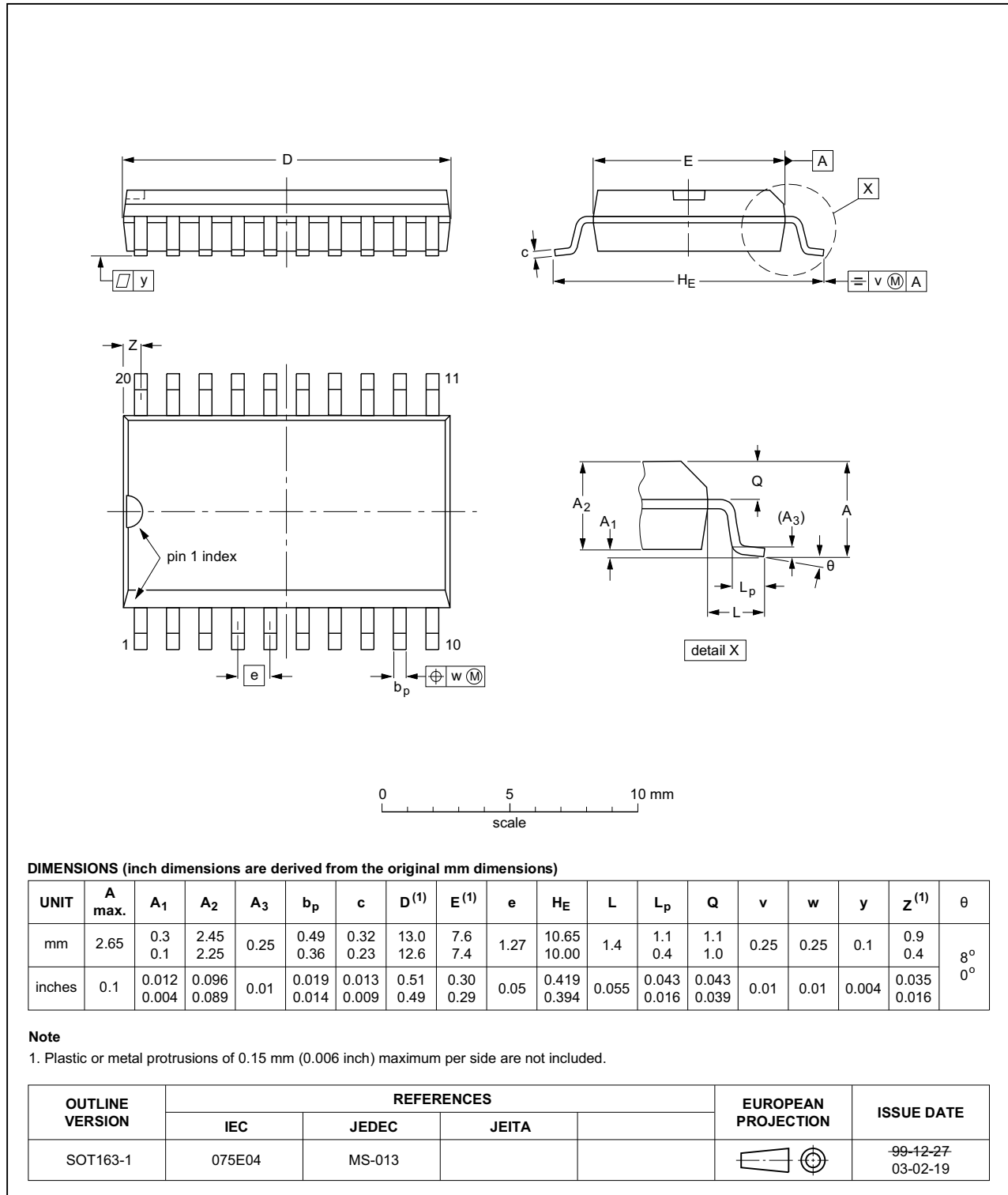


Fig 10. Package outline SOT163-1 (SO20)

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

SOT339-1

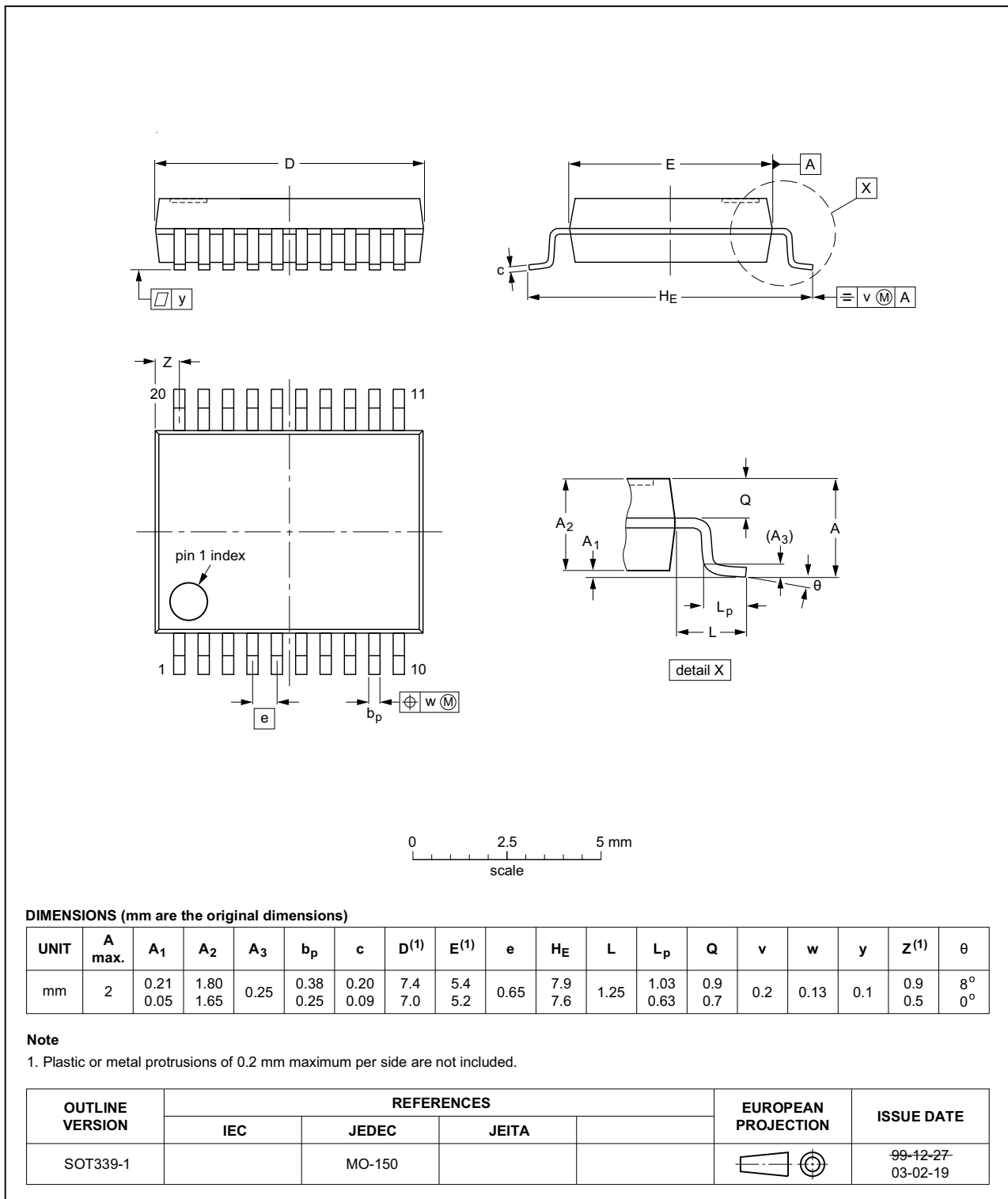


Fig 11. Package outline SOT339-1 (SSOP20)

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.5 | 20160526 | Product data sheet | - | 74HC_HCT7540 v.4 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74HC7540N and 74HCT7540N (SOT146-1) removed. Table 6: conditions for OFF-state output current have changed. | | | |
| 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".

[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.nexperia.com>.

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

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