

74HC7541-Q100; 74HCT7541-Q100

Octal Schmitt trigger buffer/line driver; 3-state

Rev. 2 — 3 August 2021

Product data sheet

1. General description

The 74HC7541-Q100; 74HCT7541-Q100 is an 8-bit 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 that enable 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

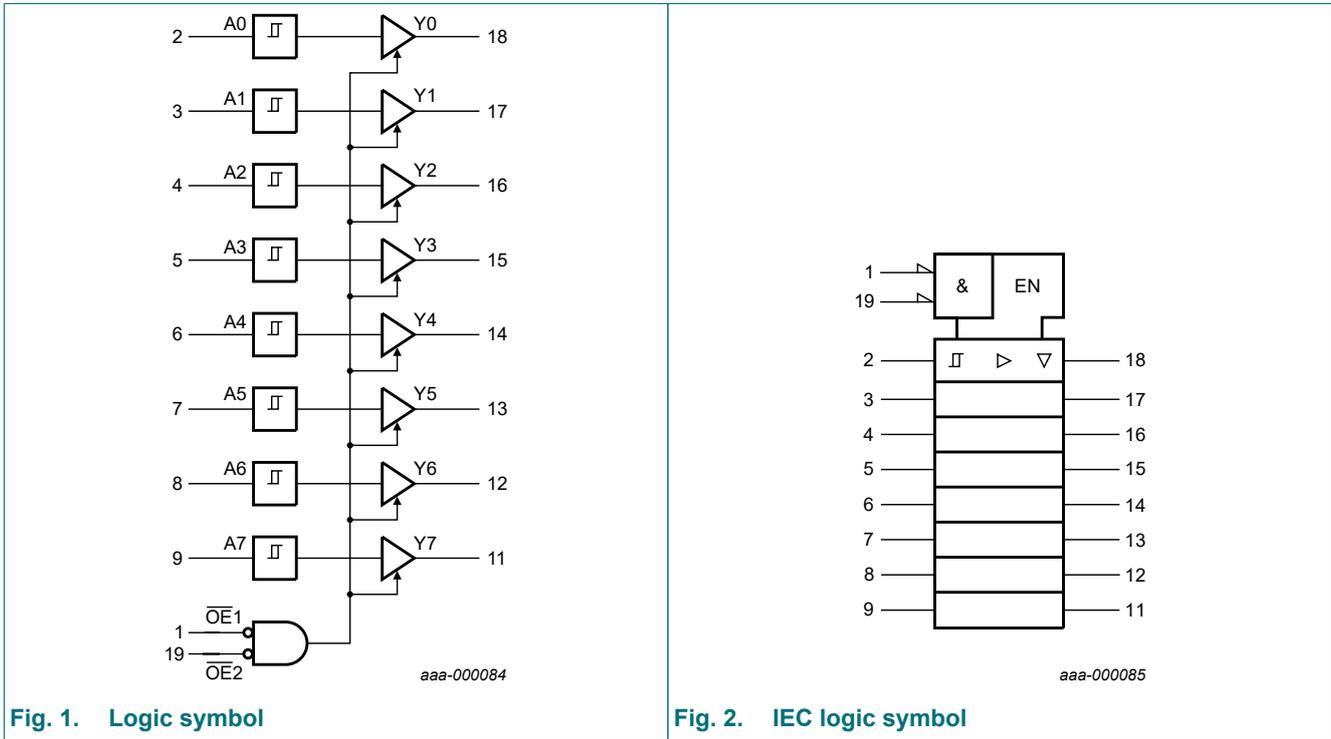
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Unlimited input rise and fall times
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- Non-inverting outputs
- Input levels:
 - For 74HC7541-Q100: CMOS level
 - For 74HCT7541-Q100: TTL level
- ESD protection:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)

3. Ordering information

Table 1. Ordering information

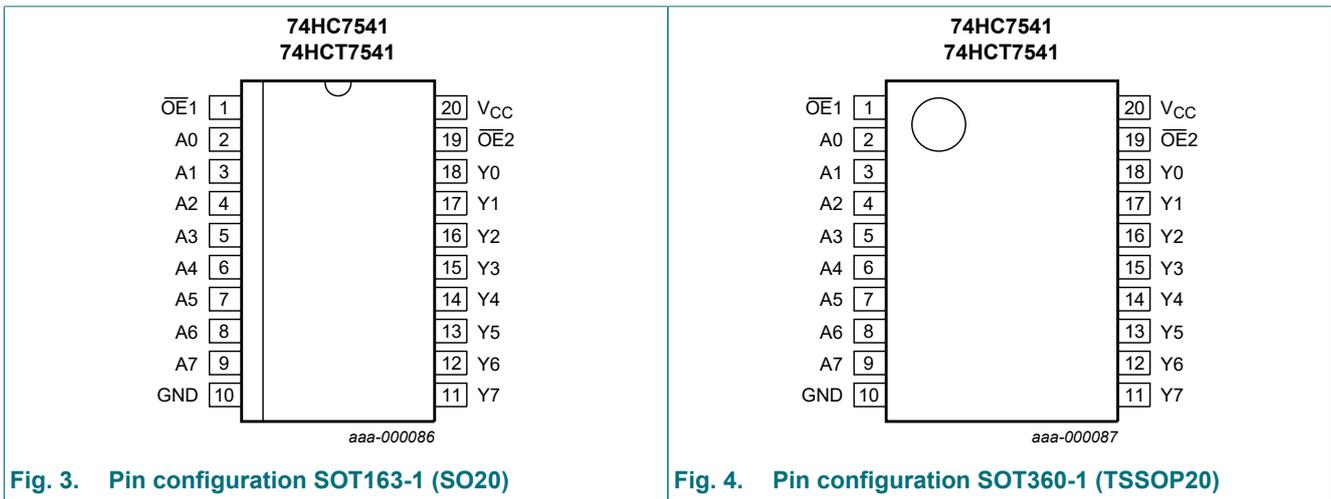
| Type number | Package | | | |
|------------------|---|---------|--|----------|
| | Temperature range | Name | Description | Version |
| 74HC7541D-Q100 | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |
| 74HCT7541D-Q100 | | | | |
| 74HC7541PW-Q100 | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |
| 74HCT7541PW-Q100 | | | | |

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, A1, A2, A3, A4, A5, A6, A7 | 2, 3, 4, 5, 6, 7, 8, 9 | data input |
| GND | 10 | ground (0 V) |
| Y0, Y1, Y2, Y3, Y4, Y5, Y6, 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

H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

| Control | | Input | Output |
|---------|-----|-------|--------|
| OE1 | OE2 | An | Yn |
| L | L | L | L |
| L | L | H | H |
| X | H | X | Z |
| H | X | X | Z |

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 V or V _I > V _{CC} + 0.5 V [1] | - | ±20 | mA |
| I _{OK} | output clamping current | V _O < -0.5 V or V _O > V _{CC} + 0.5 V [1] | - | ±20 | mA |
| I _O | output current | -0.5 V < V _O < V _{CC} + 0.5 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] | - | 500 | mW |

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

[2] For SOT163-1 (SO20) package: P_{tot} derates linearly with 12.3 mW/K above 109 °C.

For SOT360-1 (TSSOP20) package: P_{tot} derates linearly with 10.0 mW/K above 100 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

| Symbol | Parameter | Conditions | 74HC7541-Q100 | | | 74HCT7541-Q100 | | | 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 | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|----------------------|---------------------------|---|-------|------|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC7541-Q100 | | | | | | | | | | |
| 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 |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------------|---------------------------|--|-------|------|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HCT7541-Q100 | | | | | | | | | | |
| 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 |
| 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 characteristics

GND = 0 V; C_L = 50 pF; for test circuit see Fig. 7.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|----------------------|-------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC7541-Q100 | | | | | | | | | | |
| t _{pd} | propagation delay | An to Yn; see Fig. 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 | - | 10 | - | - | - | - | - | ns |
| | | V _{CC} = 6.0 V | - | 11 | 20 | - | 26 | - | 32 | ns |
| t _{en} | enable time | $\overline{\text{OEn}}$ to Yn; see Fig. 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 | $\overline{\text{OEn}}$ to Yn; see Fig. 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 |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _t | transition time | see Fig. 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] | - | 30 | - | - | - | - | - | pF |
| 74HCT7541-Q100 | | | | | | | | | | |
| t _{pd} | propagation delay | An to Yn; see Fig. 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 | OE̅n to Yn; see Fig. 6 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 18 | 32 | - | 40 | - | 48 | ns |
| t _{dis} | disable time | OE̅n to Yn; see Fig. 6 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 20 | 32 | - | 40 | - | 48 | ns |
| t _t | transition time | V _{CC} = 4.5 V; see Fig. 5 [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_{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):

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

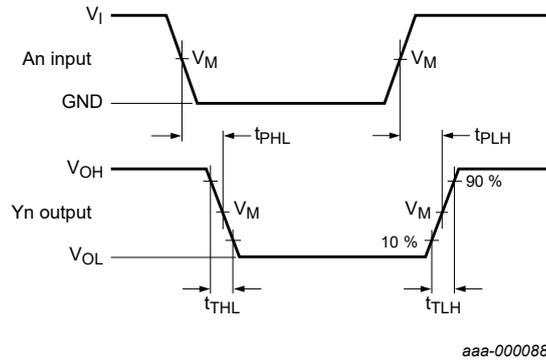
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

Σ(C_L × V_{CC}² × f_o) = sum of outputs.

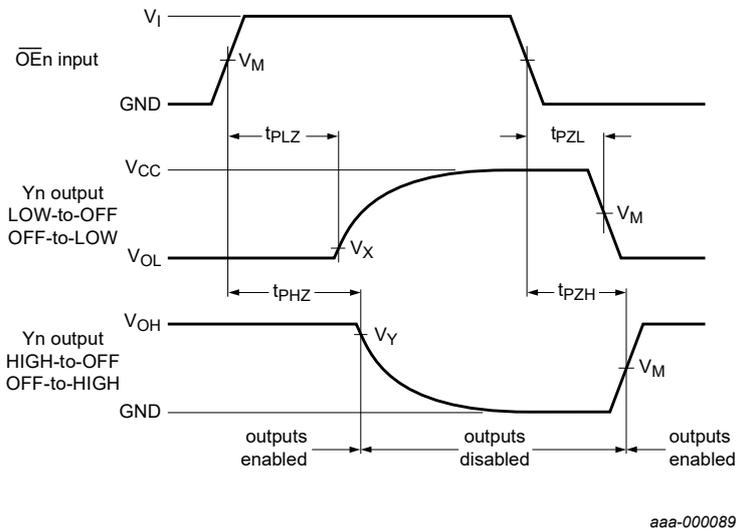
10.1. Waveforms and test circuit



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 |
| 74HC7541-Q100 | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |
| 74HCT7541-Q100 | 1.3 V | 1.3 V | $0.1V_{CC}$ | $0.9V_{CC}$ |

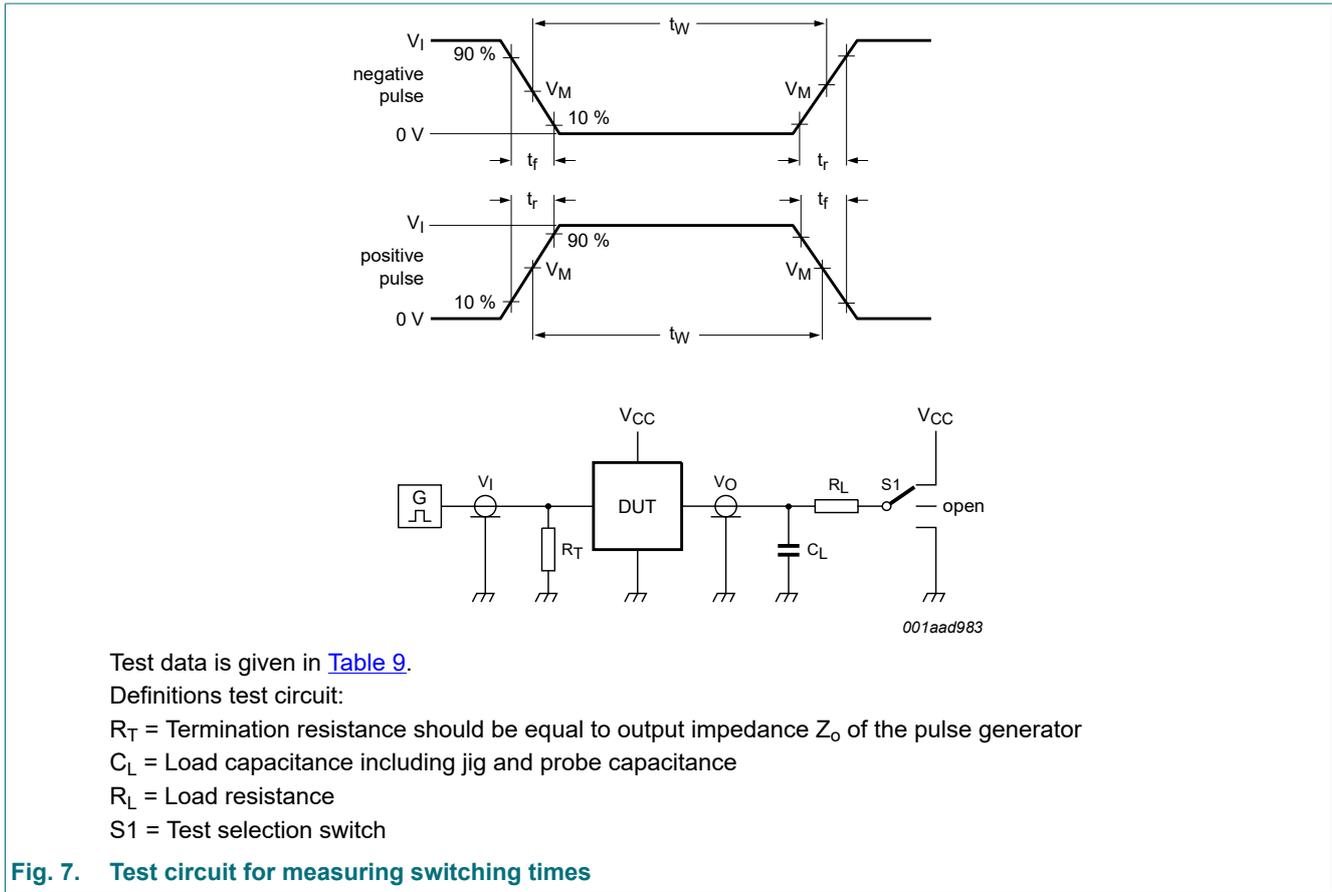


Fig. 7. Test circuit for measuring switching times

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} |
| 74HC7541-Q100 | V_{CC} | 6 ns | 15 pF, 50 pF | 1 k Ω | open | GND | V_{CC} |
| 74HCT7541-Q100 | 3 V | 6 ns | 15 pF, 50 pF | 1 k Ω | open | GND | V_{CC} |

11. Transfer characteristics

Table 10. Transfer characteristics

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

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------------|----------------------------------|-------------------------|-------|------|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC7541-Q100 | | | | | | | | | | |
| V_{T+} | positive-going threshold voltage | $V_{CC} = 2.0\text{ V}$ | - | - | 1.5 | - | 1.5 | - | 1.5 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | - | 3.15 | - | 3.15 | - | 3.15 | V |
| | | $V_{CC} = 6.0\text{ V}$ | - | - | 4.2 | - | 4.2 | - | 4.2 | V |
| V_{T-} | negative-going threshold voltage | $V_{CC} = 2.0\text{ V}$ | 0.3 | - | - | 0.3 | - | 0.3 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 1.35 | - | - | 1.35 | - | 1.35 | - | V |
| | | $V_{CC} = 6.0\text{ V}$ | 1.8 | - | - | 1.8 | - | 1.8 | - | V |
| V_H | hysteresis voltage | $V_{CC} = 2.0\text{ V}$ | 0.1 | 0.20 | - | 0.1 | - | 0.1 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 0.25 | 0.40 | - | 0.25 | - | 0.25 | - | V |
| | | $V_{CC} = 6.0\text{ V}$ | 0.3 | 0.5 | - | 0.3 | - | 0.3 | - | V |
| 74HCT7541-Q100 | | | | | | | | | | |
| V_{T+} | positive-going threshold voltage | $V_{CC} = 4.5\text{ V}$ | - | - | 2.0 | - | 2.0 | - | 2.0 | V |
| | | $V_{CC} = 5.5\text{ V}$ | - | - | 2.1 | - | 2.1 | - | 2.1 | V |
| V_{T-} | negative-going threshold voltage | $V_{CC} = 4.5\text{ V}$ | 0.7 | - | - | 0.64 | - | 0.6 | - | V |
| | | $V_{CC} = 5.5\text{ V}$ | 0.8 | - | - | 0.74 | - | 0.7 | - | V |
| V_H | hysteresis voltage | $V_{CC} = 4.5\text{ V}$ | 0.17 | 0.23 | - | - | - | - | - | V |
| | | $V_{CC} = 5.5\text{ V}$ | 0.17 | 0.23 | - | - | - | - | - | V |

11.1. Transfer characteristics waveforms

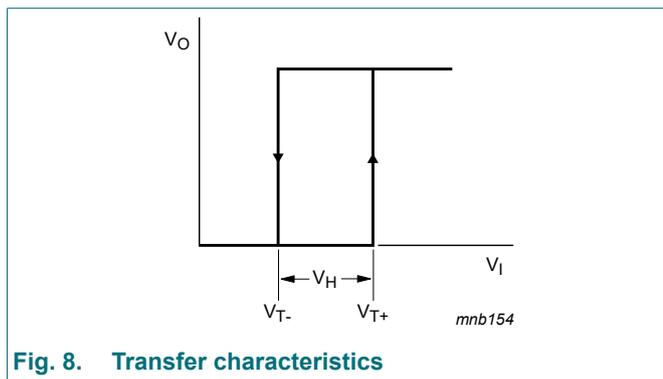


Fig. 8. Transfer characteristics

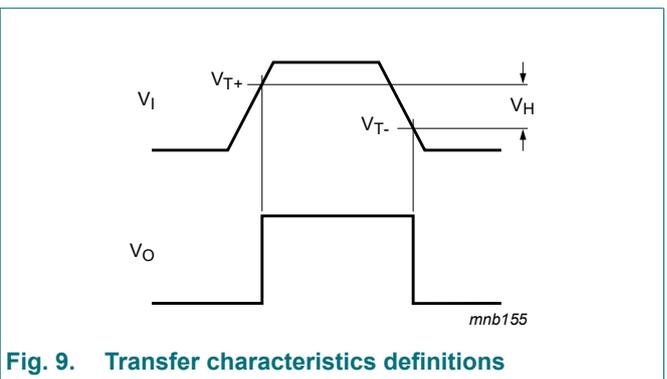


Fig. 9. Transfer characteristics definitions

12. Package outline

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

SOT163-1

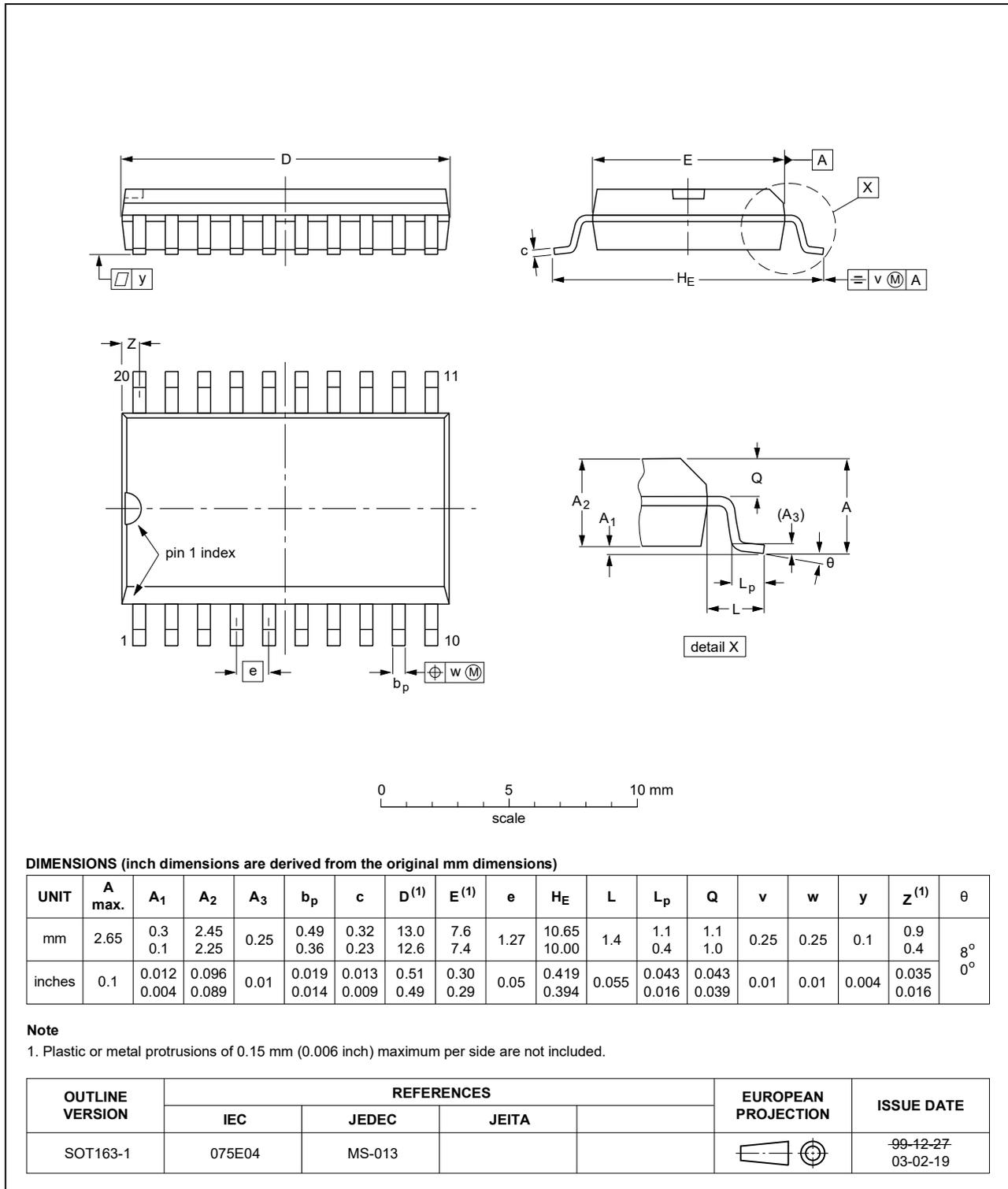


Fig. 10. Package outline SOT163-1 (SO20)

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

SOT360-1

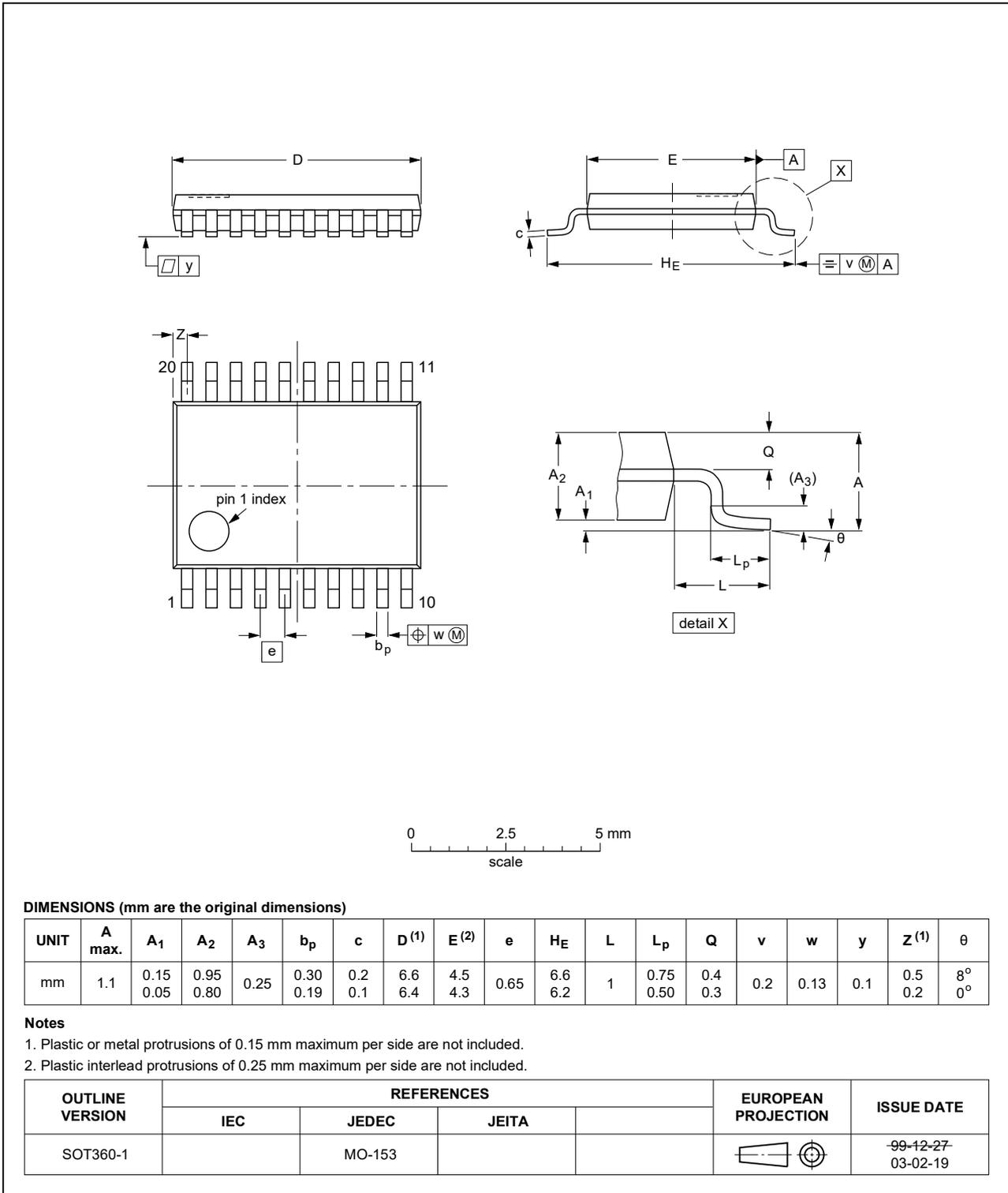


Fig. 11. Package outline SOT360-1 (TSSOP20)

13. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|---|
| CMOS | Complementary Metal Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MIL | Military |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

14. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-----------------------|---|--------------------|---------------|-----------------------|
| 74HC_HCT7541_Q100 v.2 | 20210803 | Product data sheet | - | 74HC_HCT7541_Q100 v.1 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Section 2 updated. Section 7: Derating values for P_{tot} total power dissipation updated. | | | |
| 74HC_HCT7541_Q100 v.1 | 20140324 | Product data sheet | - | - |

15. Legal information

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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