

74AHC541-Q100; 74AHCT541-Q100

Octal buffer/line driver; 3-state

Rev. 2 — 14 April 2020

Product data sheet

1. General description

The 74AHC541-Q100; 74AHCT541-Q100 is a high-speed Si-gate CMOS device.

The 74AHC541-Q100; 74AHCT541-Q100 are octal non-inverting buffer/line drivers with 3-state bus compatible outputs.

The output enable inputs $\overline{OE}0$ and $\overline{OE}1$, control the 3-state outputs.

A HIGH on $\overline{OE}n$ causes the outputs to assume a high-impedance OFF-state.

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 °C to +85 °C and from -40 °C to +125 °C
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accept voltages higher than V_{CC}
- For 74AHC541-Q100 only: operates with CMOS input levels
- For 74AHCT541-Q100 only: operates with TTL input levels
- 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 pF, R = 0 Ω)
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|------------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74AHC541D-Q100 | -40 °C to +125 °C | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |
| 74AHCT541D-Q100 | | | | |
| 74AHC541PW-Q100 | -40 °C to +125 °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |
| 74AHCT541PW-Q100 | | | | |
| 74AHC541BQ-Q100 | -40 °C to +125 °C | DHVQFN20 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm | SOT764-1 |
| 74AHCT541BQ-Q100 | | | | |

4. Functional diagram



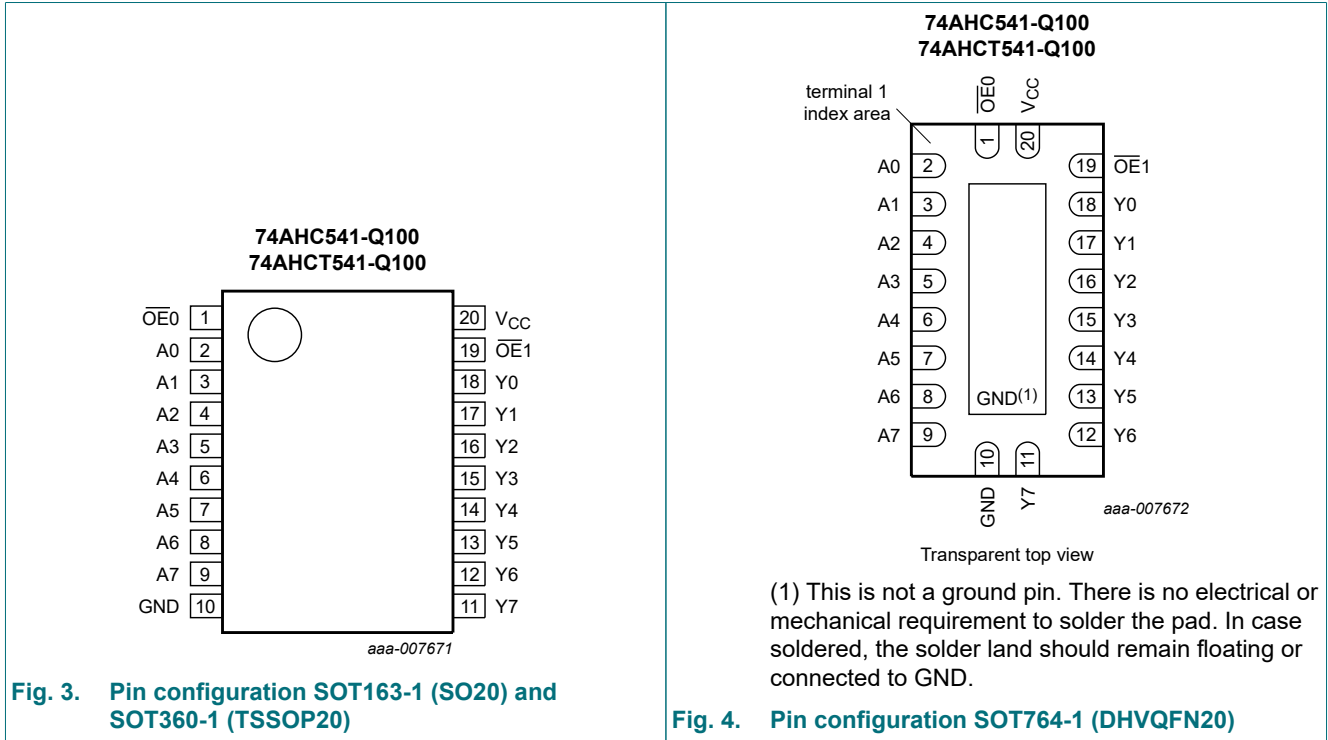
Fig. 1. Logic symbol



Fig. 2. IEC logic symbol

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|--------------------------------|--------------------------------|----------------------------------|
| $\overline{OE}0$ | 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 |
| $\overline{OE}1$ | 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 |
|------------------|------------------|----------------|----------------|
| $\overline{OE}0$ | $\overline{OE}1$ | A _n | Y _n |
| 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 | +7.0 | V |
| V_I | input voltage | | -0.5 | +7.0 | V |
| I_{IK} | input clamping current | $V_I < -0.5$ 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 | $V_O = -0.5$ V to $(V_{CC} + 0.5$ V) | - | ± 25 | mA |
| I_{CC} | supply current | | - | 75 | mA |
| I_{GND} | ground current | | -75 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to +125 °C [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.

For SOT764-1 (DHVQFN20) package: P_{tot} derates linearly with 12.9 mW/K above 111 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | 74AHC541-Q100 | | | 74AHCT541-Q100 | | | Unit |
|---------------------|-------------------------------------|------------------------------|---------------|-----|----------|----------------|-----|----------|------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| V_{CC} | supply voltage | | 2.0 | 5.0 | 5.5 | 4.5 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | 0 | - | 5.5 | V |
| V_O | output voltage | | 0 | - | V_{CC} | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | -40 | +25 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 3.3$ V \pm 0.3 V | - | - | 100 | - | - | - | ns/V |
| | | $V_{CC} = 5.0$ V \pm 0.5 V | - | - | 20 | - | - | 20 | ns/V |

9. Static characteristics

Table 6. Static characteristics

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 | |
| For type 74AHC541-Q100 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | - | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 3.0 V | 2.1 | - | - | 2.1 | - | 2.1 | - | V |
| | | V _{CC} = 5.5 V | 3.85 | - | - | 3.85 | - | 3.85 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | - | 0.5 | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 3.0 V | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| | | V _{CC} = 5.5 V | - | - | 1.65 | - | 1.65 | - | 1.65 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = -50 μA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -50 μA; V _{CC} = 3.0 V | 2.9 | 3.0 | - | 2.9 | - | 2.9 | - | V |
| | | I _O = -50 μA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -4.0 mA; V _{CC} = 3.0 V | 2.58 | - | - | 2.48 | - | 2.40 | - | V |
| I _O = -8.0 mA; V _{CC} = 4.5 V | 3.94 | - | - | 3.8 | - | 3.70 | - | V | | |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = 50 μA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 3.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 3.0 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I _O = 8.0 mA; V _{CC} = 4.5 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V | | |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±0.25 | - | ±2.5 | - | ±10.0 | μA |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 4.0 | - | 40 | - | 80 | μA |
| C _I | input capacitance | | - | 3.0 | 10 | - | 10 | - | 10 | pF |
| C _O | output capacitance | | - | 4.0 | - | - | - | - | - | pF |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|--------------------------------|---------------------------|--|-------|-----|-------|------------------|------|-------------------|-------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| For type 74AHCT541-Q100 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | - | - | 2.0 | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | - | 0.8 | - | 0.8 | - | 0.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = -50 µA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -8.0 mA | 3.94 | - | - | 3.8 | - | 3.70 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = 50 µA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 8.0 mA | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I _{OZ} | OFF-state output current | per input pin; V _I = V _{IH} or V _{IL} ; V _{CC} = 5.5 V; I _O = 0 A; V _O = V _{CC} or GND; other pins at V _{CC} or GND | - | - | ±0.25 | - | ±2.5 | - | ±10.0 | µA |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | µA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 4.0 | - | 40 | - | 80 | µA |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other pins at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |
| C _I | input capacitance | | - | 3 | 10 | - | 10 | - | 10 | pF |
| C _O | output capacitance | | - | 4.0 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$. For test circuit see Fig. 7.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|--------------------------------|-------------------------------|--|-------|--------|------|------------------|------|-------------------|------|------|
| | | | Min | Typ[1] | Max | Min | Max | Min | Max | |
| For type 74AHC541-Q100 | | | | | | | | | | |
| t_{pd} | propagation delay | An to Yn; see Fig. 5 [2] | | | | | | | | |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 15\text{ pF}$ | - | 5.0 | 7.0 | 1.0 | 8.5 | 1.0 | 9.0 | ns |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 50\text{ pF}$ | - | 7.0 | 10.5 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 15\text{ pF}$ | - | 3.5 | 5.0 | 1.0 | 6.0 | 1.0 | 6.5 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$ | | 5.0 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| t_{en} | enable time | $\overline{O}E_n$ to Yn; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 15\text{ pF}$ | - | 5.5 | 10.5 | 1.0 | 11.0 | 1.0 | 13.5 | ns |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 50\text{ pF}$ | - | 7.5 | 14.0 | 1.0 | 16.0 | 1.0 | 17.5 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 15\text{ pF}$ | - | 3.5 | 7.2 | 1.0 | 8.5 | 1.0 | 9.0 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$ | - | 5.0 | 9.2 | 1.0 | 10.5 | 1.0 | 11.5 | ns |
| t_{dis} | disable time | $\overline{O}E_n$ to Yn; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 15\text{ pF}$ | - | 6.0 | 11.0 | 1.0 | 12.0 | 1.0 | 14.0 | ns |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 50\text{ pF}$ | - | 9.5 | 15.4 | 1.0 | 17.5 | 1.0 | 19.5 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 15\text{ pF}$ | - | 4.5 | 7.5 | 1.0 | 8.0 | 1.0 | 9.5 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$ | - | 6.5 | 8.8 | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| C_{PD} | power dissipation capacitance | $C_L = 50\text{ pF}; f_i = 1\text{ MHz}; V_i = GND\text{ to }V_{CC}$ [3] | - | 10 | - | - | - | - | - | pF |
| For type 74AHCT541-Q100 | | | | | | | | | | |
| t_{pd} | propagation delay | An to Yn; see Fig. 5 [2] | | | | | | | | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 15\text{ pF}$ | - | 3.5 | 5.5 | 1.0 | 6.5 | 1.0 | 7.0 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$ | - | 5.0 | 8.5 | 1.0 | 9.5 | 1.0 | 11.0 | ns |
| t_{en} | enable time | $\overline{O}E_n$ to Yn; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 15\text{ pF}$ | - | 4.0 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$ | - | 5.5 | 10.0 | 1.0 | 12.0 | 1.0 | 12.5 | ns |
| t_{dis} | disable time | $\overline{O}E_n$ to Yn; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 15\text{ pF}$ | - | 5.0 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$ | - | 7.0 | 10.0 | 1.0 | 12.0 | 1.0 | 12.5 | ns |
| C_{PD} | power dissipation capacitance | per buffer; $C_L = 50\text{ pF}; f = 1\text{ MHz}; V_i = GND\text{ to }V_{CC}$ [3] | - | 12 | - | - | - | - | - | pF |

[1] Typical values are measured at nominal supply voltage ($V_{CC} = 3.3\text{ V}$ and $V_{CC} = 5.0\text{ V}$).

[2] 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} .

[3] C_{PD} is used to determine the dynamic power dissipation P_D (μW).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in Volts.

10.1. Waveforms

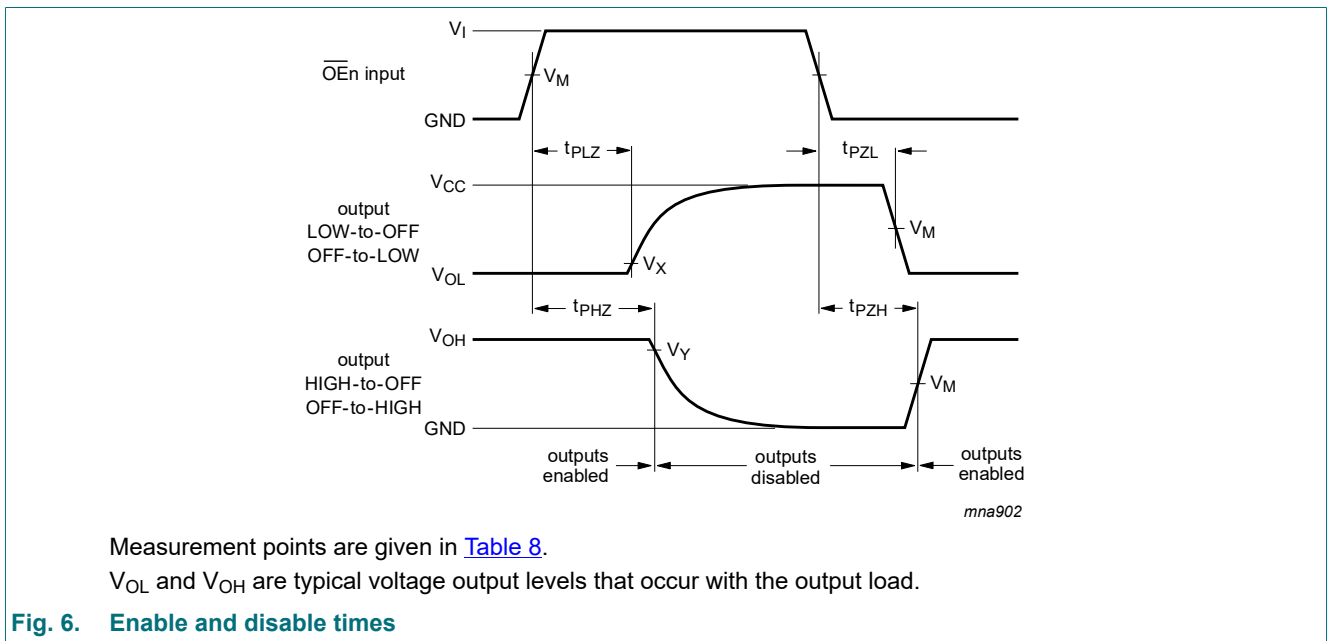
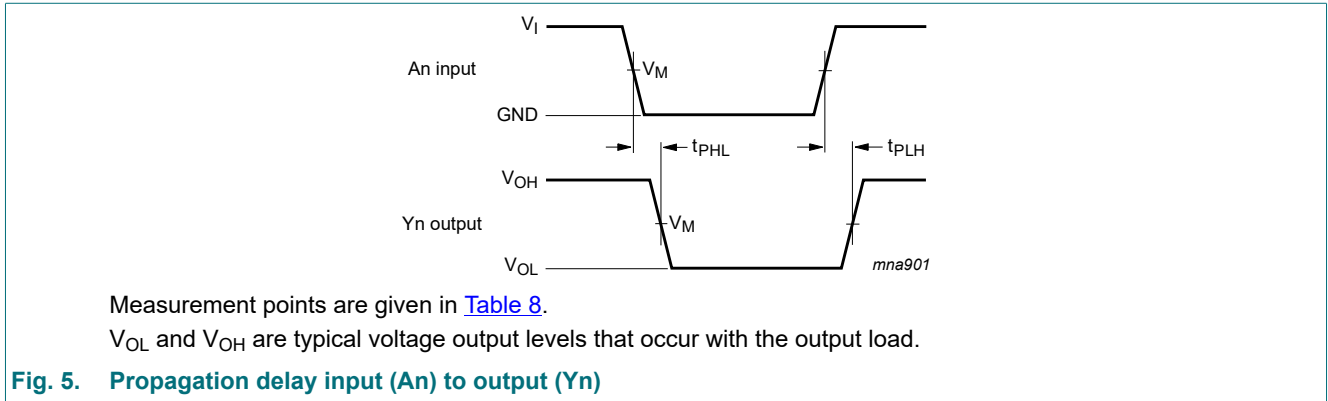


Table 8. Measurement points

| Type | Input | Output | | |
|----------------|-------------|-------------|------------------|------------------|
| | V_M | V_M | V_X | V_Y |
| 74AHC541-Q100 | $0.5V_{CC}$ | $0.5V_{CC}$ | $V_{OL} + 0.3 V$ | $V_{OH} - 0.3 V$ |
| 74AHCT541-Q100 | 1.5 V | $0.5V_{CC}$ | $V_{OL} + 0.3 V$ | $V_{OH} - 0.3 V$ |



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} |
| 74AHC541-Q100 | V_{CC} | 3.0 ns | 15 pF, 50 pF | 1 k Ω | open | GND | V_{CC} |
| 74AHCT541-Q100 | 3.0 V | 3.0 ns | 15 pF, 50 pF | 1 k Ω | open | GND | V_{CC} |

11. Package outline

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

SOT163-1

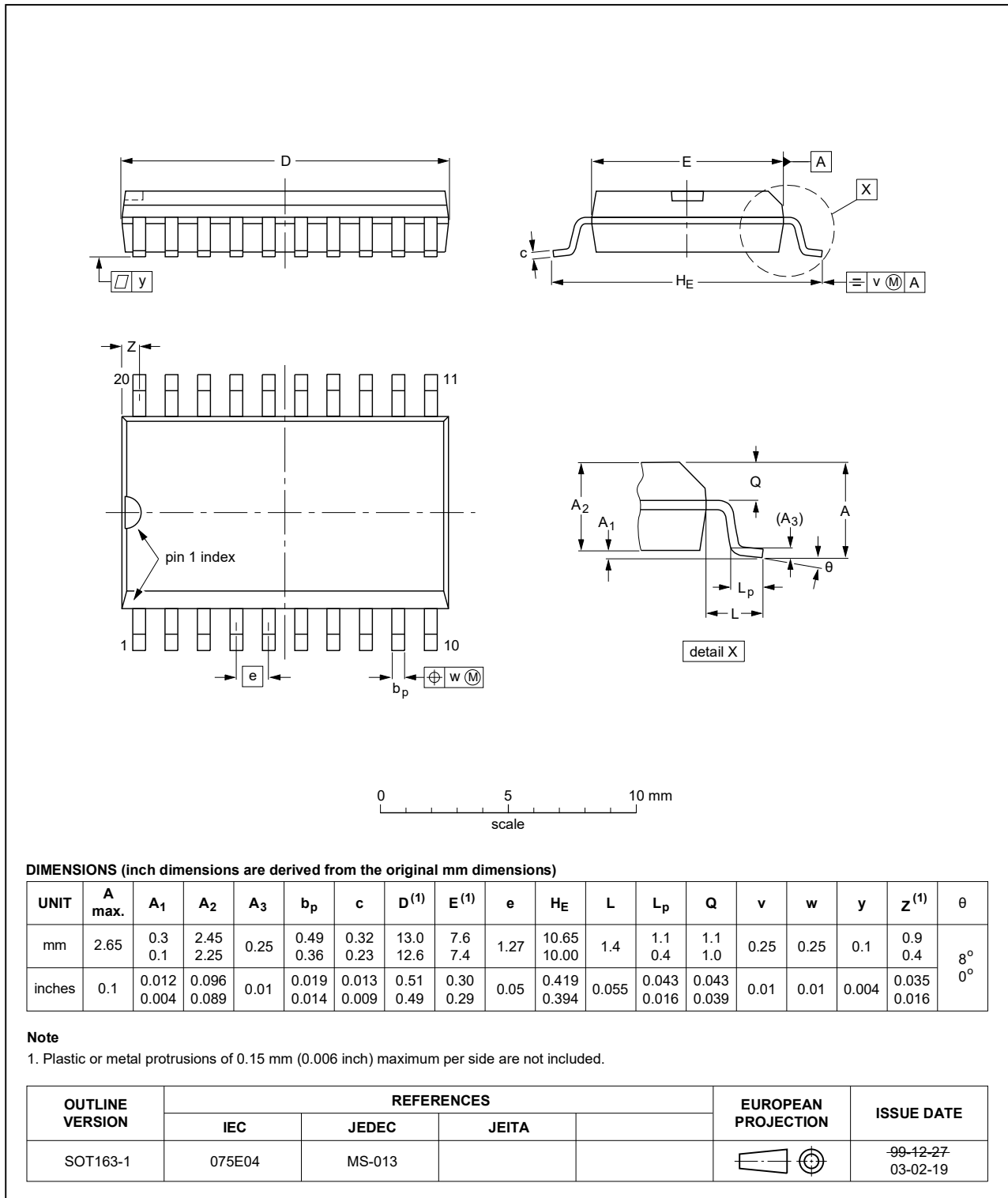


Fig. 8. Package outline SOT163-1 (SO20)

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

SOT360-1



Fig. 9. Package outline SOT360-1 (TSSOP20)

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1



Fig. 10. Package outline SOT764-1 (DHVQFN20)

12. Abbreviations

Table 10. 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 |

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------------|--|--------------------|---------------|------------------------|
| 74AHC_AHCT541_Q100 v.2 | 20200414 | Product data sheet | - | 74AHC_AHCT541_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. Table 4: Derating values for P_{tot} total power dissipation updated. Fig. 10: Package outline drawing SOT764-1 (DHVQFN20) updated. | | | |
| 74AHC_AHCT541_Q100 v.1 | 20130606 | Product data sheet | - | - |

14. 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. |

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- [2] The term 'short data sheet' is explained in section "Definitions".
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