

# 74HC564

Octal D-type flip-flop; positive-edge trigger; 3-state; inverting

Rev. 03 — 11 November 2004

Product data sheet

## 1. General description

The 74HC564 is a high-speed Si-gate CMOS device and is pin compatible with low-power Schottky TTL (LSTTL). The 74HC564 is specified in compliance with JEDEC standard no. 7A.

The 74HC564 is a octal D-type flip-flop featuring separate D-type inputs for each flip-flop and inverting 3-state outputs for bus oriented applications. A clock (CP) and an output enable ( $\overline{OE}$ ) input are common to all flip-flops.

The 8 flip-flops will store the state of their individual D-inputs that meet the set-up and hold times requirements on the LOW-to-HIGH CP transition. When  $\overline{OE}$  is LOW, the contents of the 8 flip-flops are available at the outputs. When  $\overline{OE}$  is HIGH, the outputs go to the high-impedance OFF-state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

The 74HC564 is functionally identical to the 74HC574 but has inverting outputs. The 74HC564 is functionally identical to the 74HC534, but has a different pinning.

## 2. Features

- 3-state inverting outputs for bus oriented applications
- 8-bit positive-edge triggered register
- Common 3-state output enable input
- Independent register and 3-state buffer operation
- Low-power dissipation
- Complies with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM EIA/JESD22-A114-B exceeds 2000 V
  - ◆ MM EIA/JESD22-A115-A exceeds 200 V.
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+80\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .

# PHILIPS

### 3. Quick reference data

**Table 1: Quick reference data**

$GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ;  $t_r = t_f = 6\text{ ns}$ .

| Symbol                | Parameter                                   | Conditions                                      | Min                   | Typ | Max | Unit |
|-----------------------|---------------------------------------------|-------------------------------------------------|-----------------------|-----|-----|------|
| $t_{PHL}$ , $t_{PLH}$ | propagation delay CP to $\bar{Q}n$          | $C_L = 15\text{ pF}$ ;<br>$V_{CC} = 5\text{ V}$ | -                     | 15  | -   | ns   |
| $f_{max}$             | maximum clock frequency                     | $C_L = 15\text{ pF}$ ;<br>$V_{CC} = 5\text{ V}$ | -                     | 127 | -   | MHz  |
| $C_I$                 | input capacitance                           |                                                 | -                     | 3.5 | -   | pF   |
| $C_{PD}$              | power dissipation capacitance per flip-flop | $V_I = GND\text{ to }V_{CC}$                    | <a href="#">[1]</a> - | 27  | -   | pF   |

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

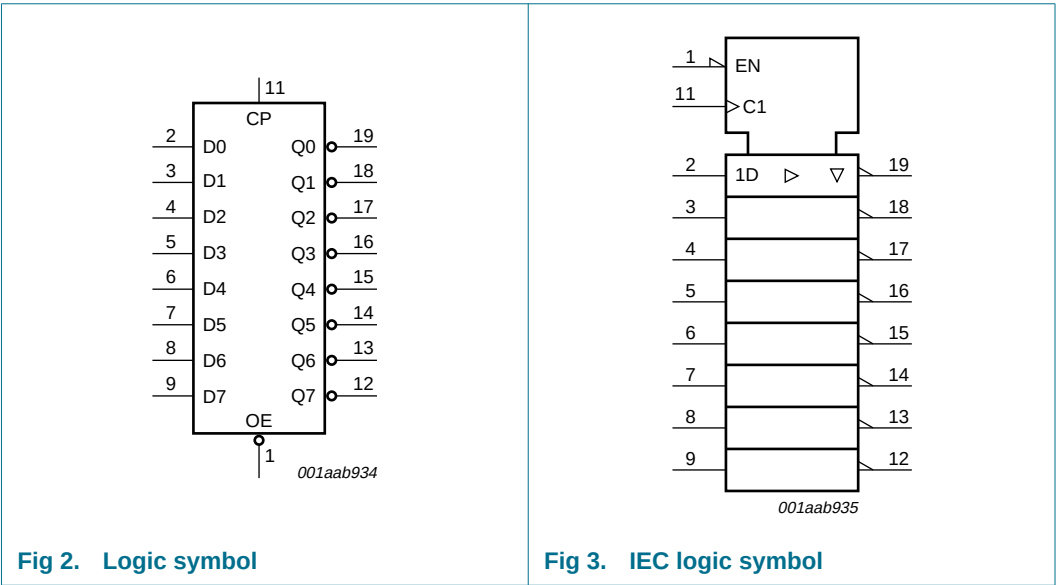
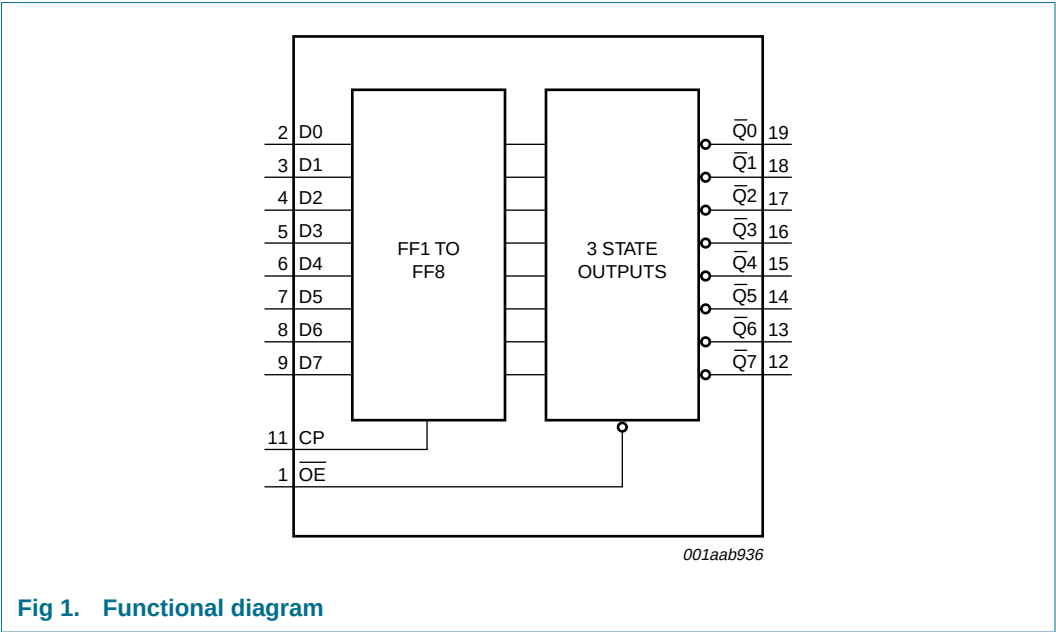
$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

### 4. Ordering information

**Table 2: Ordering information**

| Type number | Package           |       |                                                               |          |
|-------------|-------------------|-------|---------------------------------------------------------------|----------|
|             | Temperature range | Name  | Description                                                   | Version  |
| 74HC564N    | -40 °C to +125 °C | DIP20 | plastic dual in-line package; 20 leads (300 mil)              | SOT146-1 |
| 74HC564D    | -40 °C to +125 °C | SO20  | plastic small outline package; 20 leads;<br>body width 7.5 mm | SOT163-1 |

5. Functional diagram



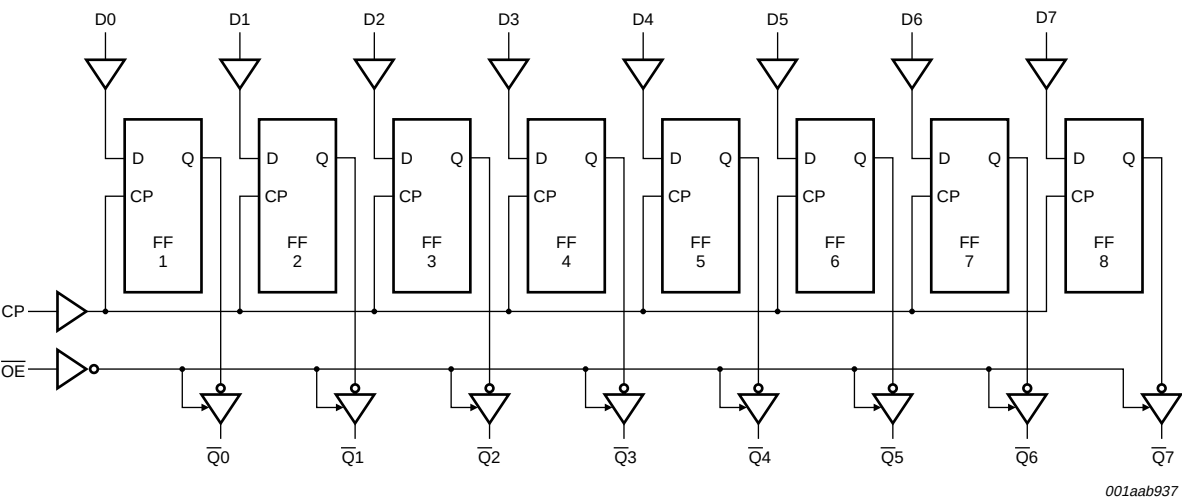


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning

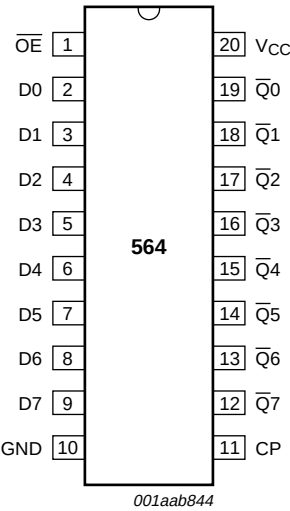


Fig 5. Pin configuration

## 6.2 Pin description

Table 3: Pin description

| Symbol          | Pin | Description                               |
|-----------------|-----|-------------------------------------------|
| $\overline{OE}$ | 1   | 3-state output enable input (active LOW)  |
| D0              | 2   | data input 0                              |
| D1              | 3   | data input 1                              |
| D2              | 4   | data input 2                              |
| D3              | 5   | data input 3                              |
| D4              | 6   | data input 4                              |
| D5              | 7   | data input 5                              |
| D6              | 8   | data input 6                              |
| D7              | 9   | data input 7                              |
| GND             | 10  | ground (0 V)                              |
| CP              | 11  | clock input (LOW-to-HIGH, edge-triggered) |
| $\overline{Q}7$ | 12  | 3-state flip-flop output 7                |
| $\overline{Q}6$ | 13  | 3-state flip-flop output 6                |
| $\overline{Q}5$ | 14  | 3-state flip-flop output 5                |
| $\overline{Q}4$ | 15  | 3-state flip-flop output 4                |
| $\overline{Q}3$ | 16  | 3-state flip-flop output 3                |
| $\overline{Q}2$ | 17  | 3-state flip-flop output 2                |
| $\overline{Q}1$ | 18  | 3-state flip-flop output 1                |
| $\overline{Q}0$ | 19  | 3-state flip-flop output 0                |
| V <sub>CC</sub> | 20  | positive supply voltage                   |

## 7. Functional description

### 7.1 Function table

Table 4: Function table [\[1\]](#)

| Operating mode                   | Input           |            |    | Internal flip-flop | Output          |
|----------------------------------|-----------------|------------|----|--------------------|-----------------|
|                                  | $\overline{OE}$ | CP         | Dn |                    | $\overline{Q}n$ |
| Load and read register           | L               | $\uparrow$ | L  | L                  | H               |
|                                  |                 |            | h  | H                  | L               |
| Load register and disable output | H               | $\uparrow$ | L  | L                  | Z               |
|                                  |                 |            | h  | H                  | Z               |

- [1] H = HIGH voltage level;  
h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition;  
L = LOW voltage level;  
l = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition;  
Z = high-impedance OFF-state;  
 $\uparrow$  = LOW-to-HIGH clock transition.

## 8. Limiting values

**Table 5: 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 diode current           | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$    | -     | $\pm 20$ | mA   |
| $I_{OK}$          | output diode current          | $V_O < -0.5\text{ V}$ or<br>$V_O > V_{CC} + 0.5\text{ V}$ | -     | $\pm 20$ | mA   |
| $I_O$             | output source or sink current | $V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$          | -     | $\pm 35$ | mA   |
| $I_{CC}, I_{GND}$ | $V_{CC}$ or GND current       |                                                           | -     | $\pm 70$ | mA   |
| $T_{stg}$         | storage temperature           |                                                           | -65   | +150     | °C   |
| $P_{tot}$         | power dissipation             |                                                           |       |          |      |
|                   | DIP20 package                 |                                                           | [1] - | 750      | mW   |
|                   | SO20 package                  |                                                           | [2] - | 500      | mW   |

[1] Above 70 °C:  $P_{tot}$  derates linearly with 12 mW/K.

[2] Above 70 °C:  $P_{tot}$  derates linearly with 8 mW/K.

## 9. Recommended operating conditions

**Table 6: Recommended operating conditions**

| Symbol     | Parameter                 | Conditions              | Min | Typ | Max      | Unit |
|------------|---------------------------|-------------------------|-----|-----|----------|------|
| $V_{CC}$   | supply voltage            |                         | 2.0 | 5.0 | 6.0      | V    |
| $V_I$      | input voltage             |                         | 0   | -   | $V_{CC}$ | V    |
| $V_O$      | output voltage            |                         | 0   | -   | $V_{CC}$ | V    |
| $t_r, t_f$ | input rise and fall times | $V_{CC} = 2.0\text{ V}$ | -   | -   | 1000     | ns   |
|            |                           | $V_{CC} = 4.5\text{ V}$ | -   | 6.0 | 500      | ns   |
|            |                           | $V_{CC} = 6.0\text{ V}$ | -   | -   | 400      | ns   |
| $T_{amb}$  | ambient temperature       |                         | -40 | -   | +125     | °C   |

## 10. Static characteristics

**Table 7: Static characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| Symbol                                    | Parameter                 | Conditions                                                                                                             | Min  | Typ  | Max  | Unit |
|-------------------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| <b>T<sub>amb</sub> = 25 °C</b>            |                           |                                                                                                                        |      |      |      |      |
| V <sub>IH</sub>                           | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                                                | 1.5  | 1.2  | -    | V    |
|                                           |                           | V <sub>CC</sub> = 4.5 V                                                                                                | 3.15 | 2.4  | -    | V    |
|                                           |                           | V <sub>CC</sub> = 6.0 V                                                                                                | 4.2  | 3.2  | -    | V    |
| V <sub>IL</sub>                           | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                                                | -    | 0.8  | 0.5  | V    |
|                                           |                           | V <sub>CC</sub> = 4.5 V                                                                                                | -    | 2.1  | 1.35 | V    |
|                                           |                           | V <sub>CC</sub> = 6.0 V                                                                                                | -    | 2.8  | 1.8  | V    |
| V <sub>OH</sub>                           | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                    |      |      |      |      |
|                                           |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V                                                                       | 1.9  | 2.0  | -    | V    |
|                                           |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                                                       | 4.4  | 4.5  | -    | V    |
|                                           |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V                                                                       | 5.9  | 6.0  | -    | V    |
|                                           |                           | I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V                                                                      | 3.98 | 4.32 | -    | V    |
|                                           |                           | I <sub>O</sub> = -7.8 mA; V <sub>CC</sub> = 6.0 V                                                                      | 5.48 | 5.81 | -    | V    |
| V <sub>OL</sub>                           | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                    |      |      |      |      |
|                                           |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 2.0 V                                                                        | -    | 0    | 0.1  | V    |
|                                           |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                        | -    | 0    | 0.1  | V    |
|                                           |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                                                        | -    | 0    | 0.1  | V    |
|                                           |                           | I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V                                                                       | -    | 0.15 | 0.26 | V    |
|                                           |                           | I <sub>O</sub> = 7.8 mA; V <sub>CC</sub> = 6.0 V                                                                       | -    | 0.16 | 0.26 | V    |
| I <sub>LI</sub>                           | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V                                                       | -    | -    | ±0.1 | µA   |
| I <sub>OZ</sub>                           | 3-state OFF-state current | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 6.0 V; V <sub>O</sub> = V <sub>CC</sub> or GND | -    | -    | ±0.5 | µA   |
| I <sub>CC</sub>                           | quiescent 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  | µA   |
| C <sub>I</sub>                            | input capacitance         |                                                                                                                        | -    | 3.5  | -    | pF   |
| <b>T<sub>amb</sub> = -40 °C to +85 °C</b> |                           |                                                                                                                        |      |      |      |      |
| V <sub>IH</sub>                           | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                                                | 1.5  | -    | -    | V    |
|                                           |                           | V <sub>CC</sub> = 4.5 V                                                                                                | 3.15 | -    | -    | V    |
|                                           |                           | V <sub>CC</sub> = 6.0 V                                                                                                | 4.2  | -    | -    | V    |
| V <sub>IL</sub>                           | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                                                | -    | -    | 0.5  | V    |
|                                           |                           | V <sub>CC</sub> = 4.5 V                                                                                                | -    | -    | 1.35 | V    |
|                                           |                           | V <sub>CC</sub> = 6.0 V                                                                                                | -    | -    | 1.8  | V    |
| V <sub>OH</sub>                           | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                    |      |      |      |      |
|                                           |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 2.0 V                                                                       | 1.9  | -    | -    | V    |
|                                           |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 4.5 V                                                                       | 4.4  | -    | -    | V    |
|                                           |                           | I <sub>O</sub> = -20 µA; V <sub>CC</sub> = 6.0 V                                                                       | 5.9  | -    | -    | V    |
|                                           |                           | I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V                                                                      | 3.84 | -    | -    | V    |
|                                           |                           | I <sub>O</sub> = -7.8 mA; V <sub>CC</sub> = 6.0 V                                                                      | 5.34 | -    | -    | V    |

Table 7: Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| Symbol                                                                                 | Parameter                 | Conditions                                                                    | Min  | Typ | Max        | Unit          |
|----------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------|------|-----|------------|---------------|
| $V_{OL}$                                                                               | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$                                                    |      |     |            |               |
|                                                                                        |                           | $I_O = 20\ \mu\text{A}; V_{CC} = 2.0\ \text{V}$                               | -    | -   | 0.1        | V             |
|                                                                                        |                           | $I_O = 20\ \mu\text{A}; V_{CC} = 4.5\ \text{V}$                               | -    | -   | 0.1        | V             |
|                                                                                        |                           | $I_O = 20\ \mu\text{A}; V_{CC} = 6.0\ \text{V}$                               | -    | -   | 0.1        | V             |
|                                                                                        |                           | $I_O = 6.0\ \text{mA}; V_{CC} = 4.5\ \text{V}$                                | -    | -   | 0.33       | V             |
|                                                                                        |                           | $I_O = 7.8\ \text{mA}; V_{CC} = 6.0\ \text{V}$                                | -    | -   | 0.33       | V             |
| $I_{LI}$                                                                               | input leakage current     | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0\ \text{V}$                               | -    | -   | $\pm 1.0$  | $\mu\text{A}$ |
| $I_{OZ}$                                                                               | 3-state OFF-state current | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 6.0\ \text{V}$ ; $V_O = V_{CC}$ or GND | -    | -   | $\pm 5.0$  | $\mu\text{A}$ |
| $I_{CC}$                                                                               | quiescent supply current  | $V_I = V_{CC}$ or GND; $I_O = 0\ \text{A}$ ; $V_{CC} = 6.0\ \text{V}$         | -    | -   | 80         | $\mu\text{A}$ |
| <b><math>T_{amb} = -40\ ^\circ\text{C}</math> to <math>+125\ ^\circ\text{C}</math></b> |                           |                                                                               |      |     |            |               |
| $V_{IH}$                                                                               | HIGH-level input voltage  | $V_{CC} = 2.0\ \text{V}$                                                      | 1.5  | -   | -          | V             |
|                                                                                        |                           | $V_{CC} = 4.5\ \text{V}$                                                      | 3.15 | -   | -          | V             |
|                                                                                        |                           | $V_{CC} = 6.0\ \text{V}$                                                      | 4.2  | -   | -          | V             |
| $V_{IL}$                                                                               | LOW-level input voltage   | $V_{CC} = 2.0\ \text{V}$                                                      | -    | -   | 0.5        | V             |
|                                                                                        |                           | $V_{CC} = 4.5\ \text{V}$                                                      | -    | -   | 1.35       | V             |
|                                                                                        |                           | $V_{CC} = 6.0\ \text{V}$                                                      | -    | -   | 1.8        | V             |
| $V_{OH}$                                                                               | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$                                                    |      | -   |            |               |
|                                                                                        |                           | $I_O = -20\ \mu\text{A}; V_{CC} = 2.0\ \text{V}$                              | 1.9  | -   | -          | V             |
|                                                                                        |                           | $I_O = -20\ \mu\text{A}; V_{CC} = 4.5\ \text{V}$                              | 4.4  | -   | -          | V             |
|                                                                                        |                           | $I_O = -20\ \mu\text{A}; V_{CC} = 6.0\ \text{V}$                              | 5.9  | -   | -          | V             |
|                                                                                        |                           | $I_O = -6.0\ \text{mA}; V_{CC} = 4.5\ \text{V}$                               | 3.7  | -   | -          | V             |
|                                                                                        |                           | $I_O = -7.8\ \text{mA}; V_{CC} = 6.0\ \text{V}$                               | 5.2  | -   | -          | V             |
| $V_{OL}$                                                                               | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$                                                    |      | -   |            |               |
|                                                                                        |                           | $I_O = 20\ \mu\text{A}; V_{CC} = 2.0\ \text{V}$                               | -    | -   | 0.1        | V             |
|                                                                                        |                           | $I_O = 20\ \mu\text{A}; V_{CC} = 4.5\ \text{V}$                               | -    | -   | 0.1        | V             |
|                                                                                        |                           | $I_O = 20\ \mu\text{A}; V_{CC} = 6.0\ \text{V}$                               | -    | -   | 0.1        | V             |
|                                                                                        |                           | $I_O = 6.0\ \text{mA}; V_{CC} = 4.5\ \text{V}$                                | -    | -   | 0.4        | V             |
|                                                                                        |                           | $I_O = 7.8\ \text{mA}; V_{CC} = 6.0\ \text{V}$                                | -    | -   | 0.4        | V             |
| $I_{LI}$                                                                               | input leakage current     | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0\ \text{V}$                               | -    | -   | $\pm 1.0$  | $\mu\text{A}$ |
| $I_{OZ}$                                                                               | 3-state OFF-state current | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 6.0\ \text{V}$ ; $V_O = V_{CC}$ or GND | -    | -   | $\pm 10.0$ | $\mu\text{A}$ |
| $I_{CC}$                                                                               | quiescent supply current  | $V_I = V_{CC}$ or GND; $I_O = 0\ \text{A}$ ; $V_{CC} = 6.0\ \text{V}$         | -    | -   | 160        | $\mu\text{A}$ |



## 11. Dynamic characteristics

**Table 8: Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 9](#).

| Symbol                                     | Parameter                                                      | Conditions                                     | Min               | Typ | Max | Unit |
|--------------------------------------------|----------------------------------------------------------------|------------------------------------------------|-------------------|-----|-----|------|
| <b><math>T_{amb} = 25\text{ °C}</math></b> |                                                                |                                                |                   |     |     |      |
| $t_{PHL}, t_{PLH}$                         | propagation delay CP to $\overline{Qn}$                        | see <a href="#">Figure 6</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | -                 | 50  | 165 | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | -                 | 18  | 33  | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | -                 | 14  | 28  | ns   |
|                                            |                                                                | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -                 | 15  | -   | ns   |
| $t_{PZH}, t_{PZL}$                         | 3-state output enable time $\overline{OE}$ to $\overline{Qn}$  | see <a href="#">Figure 7</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | -                 | 44  | 140 | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | -                 | 16  | 28  | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | -                 | 13  | 24  | ns   |
| $t_{PHZ}, t_{PLZ}$                         | 3-state output disable time $\overline{OE}$ to $\overline{Qn}$ | see <a href="#">Figure 7</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | -                 | 50  | 135 | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | -                 | 18  | 27  | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | -                 | 14  | 23  | ns   |
| $t_{THL}, t_{TLH}$                         | output transition time                                         | see <a href="#">Figure 6</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | -                 | 14  | 60  | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | -                 | 5   | 12  | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | -                 | 4   | 10  | ns   |
| $t_W$                                      | CP clock pulse width HIGH or LOW                               | see <a href="#">Figure 6</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | 80                | 14  | -   | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | 16                | 5   | -   | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | 14                | 4   | -   | ns   |
| $t_{su}$                                   | set-up time Dn to CP                                           | see <a href="#">Figure 8</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | 60                | 6   | -   | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | 12                | 2   | -   | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | 10                | 2   | -   | ns   |
| $t_h$                                      | hold time Dn to CP                                             | see <a href="#">Figure 8</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | 5                 | 0   | -   | ns   |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | 5                 | 0   | -   | ns   |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | 5                 | 0   | -   | ns   |
| $f_{max}$                                  | maximum clock frequency                                        | see <a href="#">Figure 6</a>                   |                   |     |     |      |
|                                            |                                                                | $V_{CC} = 2.0\text{ V}$                        | 6.0               | 38  | -   | MHz  |
|                                            |                                                                | $V_{CC} = 4.5\text{ V}$                        | 30                | 115 | -   | MHz  |
|                                            |                                                                | $V_{CC} = 6.0\text{ V}$                        | 35                | 137 | -   | MHz  |
|                                            |                                                                | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -                 | 127 | -   | MHz  |
| $C_{PD}$                                   | power dissipation capacitance per flip-flop                    | $V_I = GND$ to $V_{CC}$                        | <a href="#">1</a> | -   | 27  | pF   |

**Table 8: Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 9](#).

| Symbol                                            | Parameter                                                      | Conditions                     | Min | Typ | Max | Unit |
|---------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----|-----|-----|------|
| $T_{\text{amb}} = -40\text{ °C to }+85\text{ °C}$ |                                                                |                                |     |     |     |      |
| $t_{\text{PHL}}, t_{\text{PLH}}$                  | propagation delay CP to $\overline{Qn}$                        | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 205 | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 41  | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 35  | ns   |
| $t_{\text{PZH}}, t_{\text{PZL}}$                  | 3-state output enable time $\overline{OE}$ to $\overline{Qn}$  | see <a href="#">Figure 7</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 175 | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 35  | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 30  | ns   |
| $t_{\text{PHZ}}, t_{\text{PLZ}}$                  | 3-state output disable time $\overline{OE}$ to $\overline{Qn}$ | see <a href="#">Figure 7</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 170 | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 34  | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 29  | ns   |
| $t_{\text{THL}}, t_{\text{TLH}}$                  | output transition time                                         | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 75  | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 15  | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 13  | ns   |
| $t_{\text{W}}$                                    | CP clock pulse width HIGH or LOW                               | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 100 | -   | -   | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 20  | -   | -   | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 17  | -   | -   | ns   |
| $t_{\text{su}}$                                   | set-up time Dn to CP                                           | see <a href="#">Figure 8</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 75  | -   | -   | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 15  | -   | -   | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 13  | -   | -   | ns   |
| $t_{\text{h}}$                                    | hold time Dn to CP                                             | see <a href="#">Figure 8</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 5   | -   | -   | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 5   | -   | -   | ns   |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 5   | -   | -   | ns   |
| $f_{\text{max}}$                                  | maximum clock frequency                                        | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                   |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 4.8 | -   | -   | MHz  |
|                                                   |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 24  | -   | -   | MHz  |
|                                                   |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 28  | -   | -   | MHz  |

**Table 8: Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 9](#).

| Symbol                                             | Parameter                                                      | Conditions                     | Min | Typ | Max | Unit |
|----------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----|-----|-----|------|
| $T_{\text{amb}} = -40\text{ °C to }+125\text{ °C}$ |                                                                |                                |     |     |     |      |
| $t_{\text{PHL}}, t_{\text{PLH}}$                   | propagation delay CP to $\overline{Qn}$                        | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 250 | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 50  | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 43  | ns   |
| $t_{\text{PZH}}, t_{\text{PZL}}$                   | 3-state output enable time $\overline{OE}$ to $\overline{Qn}$  | see <a href="#">Figure 7</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 210 | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 42  | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 36  | ns   |
| $t_{\text{PHZ}}, t_{\text{PLZ}}$                   | 3-state output disable time $\overline{OE}$ to $\overline{Qn}$ | see <a href="#">Figure 7</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 205 | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 41  | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 35  | ns   |
| $t_{\text{THL}}, t_{\text{TLH}}$                   | output transition time                                         | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | -   | -   | 90  | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | -   | -   | 18  | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | -   | -   | 15  | ns   |
| $t_{\text{W}}$                                     | CP clock pulse width HIGH or LOW                               | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 120 | -   | -   | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 24  | -   | -   | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 20  | -   | -   | ns   |
| $t_{\text{su}}$                                    | set-up time Dn to CP                                           | see <a href="#">Figure 8</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 90  | -   | -   | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 18  | -   | -   | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 15  | -   | -   | ns   |
| $t_{\text{h}}$                                     | hold time Dn to CP                                             | see <a href="#">Figure 8</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 5   | -   | -   | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 5   | -   | -   | ns   |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 5   | -   | -   | ns   |
| $f_{\text{max}}$                                   | maximum clock frequency                                        | see <a href="#">Figure 6</a>   |     |     |     |      |
|                                                    |                                                                | $V_{\text{CC}} = 2.0\text{ V}$ | 4.0 | -   | -   | MHz  |
|                                                    |                                                                | $V_{\text{CC}} = 4.5\text{ V}$ | 20  | -   | -   | MHz  |
|                                                    |                                                                | $V_{\text{CC}} = 6.0\text{ V}$ | 24  | -   | -   | MHz  |

[1]  $C_{\text{PD}}$  is used to determine the dynamic power dissipation ( $P_{\text{D}}$  in  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

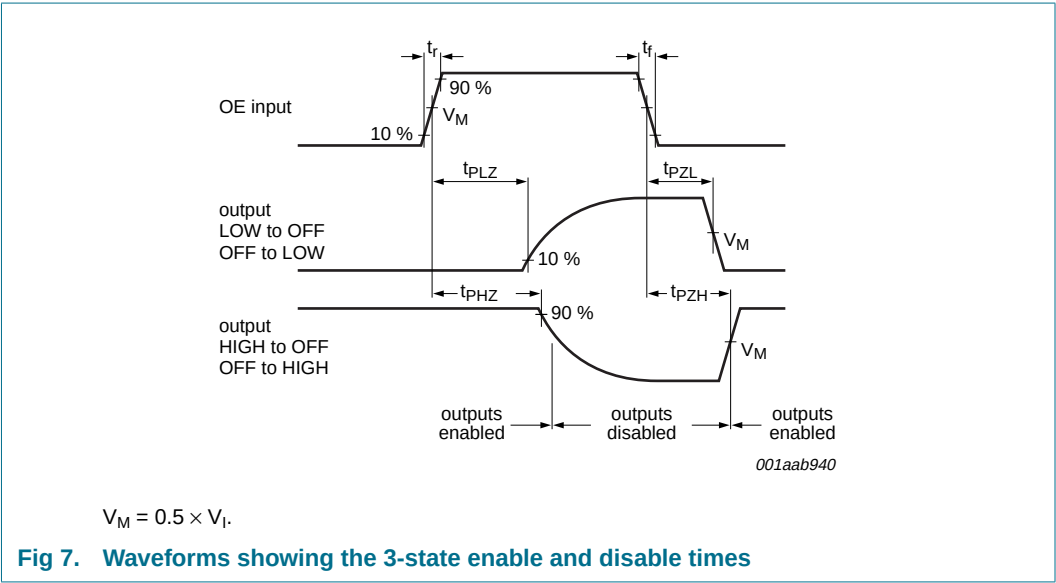
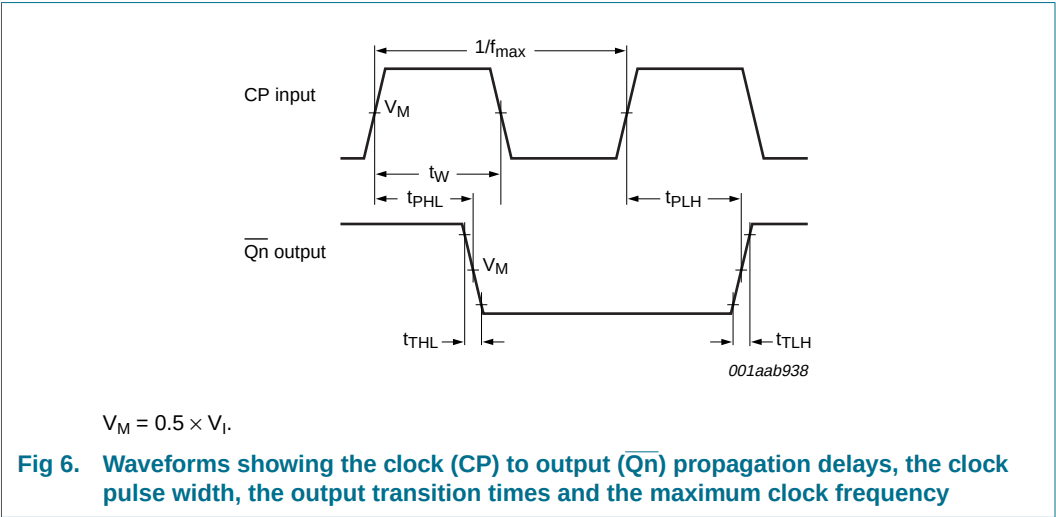
$V_{\text{CC}}$  = supply voltage in V;

$N$  = number of inputs switching;

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



12. Waveforms



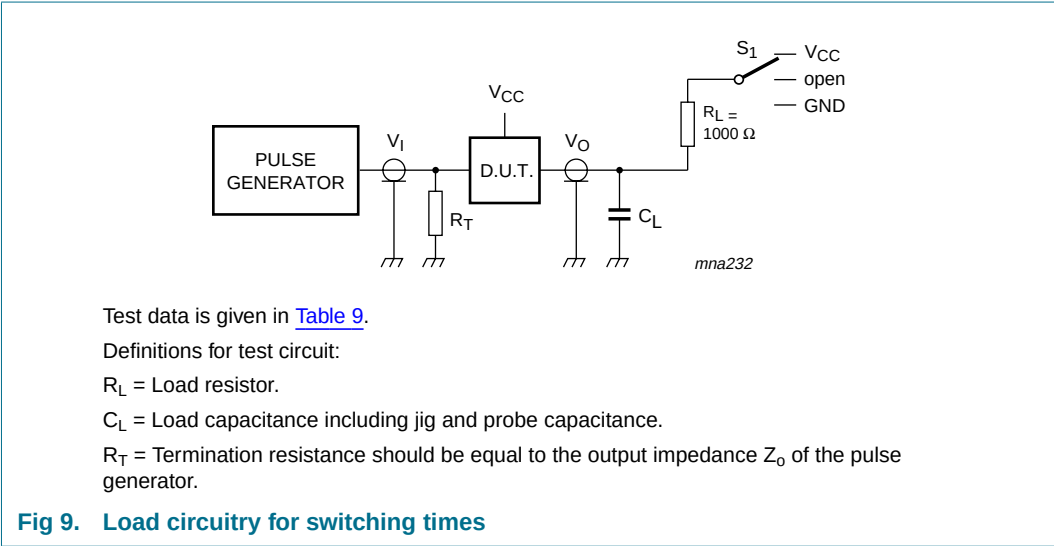
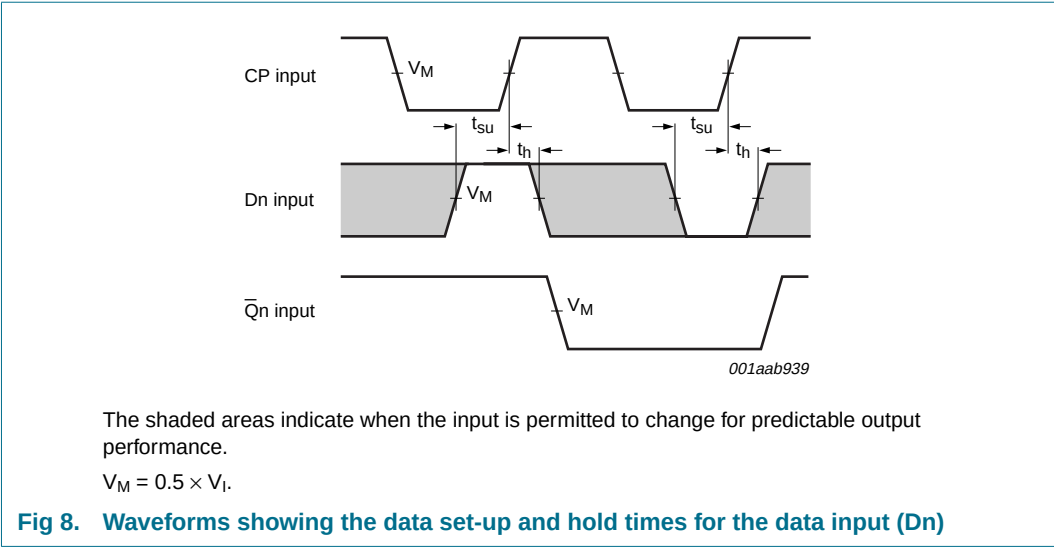


Table 9: Test data

| Supply   | Input    |             | Load  |              | S1                 |                    |                    |
|----------|----------|-------------|-------|--------------|--------------------|--------------------|--------------------|
| $V_{CC}$ | $V_I$    | $t_r = t_f$ | $C_L$ | $R_L$        | $t_{pZL}, t_{PLZ}$ | $t_{pZH}, t_{PHZ}$ | $t_{PHL}, t_{PLH}$ |
| 2.0 V    | $V_{CC}$ | 6 ns        | 50 pF | 1 k $\Omega$ | $V_{CC}$           | GND                | open               |
| 4.5 V    | $V_{CC}$ | 6 ns        | 50 pF | 1 k $\Omega$ | $V_{CC}$           | GND                | open               |
| 6.0 V    | $V_{CC}$ | 6 ns        | 50 pF | 1 k $\Omega$ | $V_{CC}$           | GND                | open               |
| 5.0 V    | $V_{CC}$ | 6 ns        | 15 pF | 1 k $\Omega$ | $V_{CC}$           | GND                | open               |

13. Package outline

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

SOT146-1

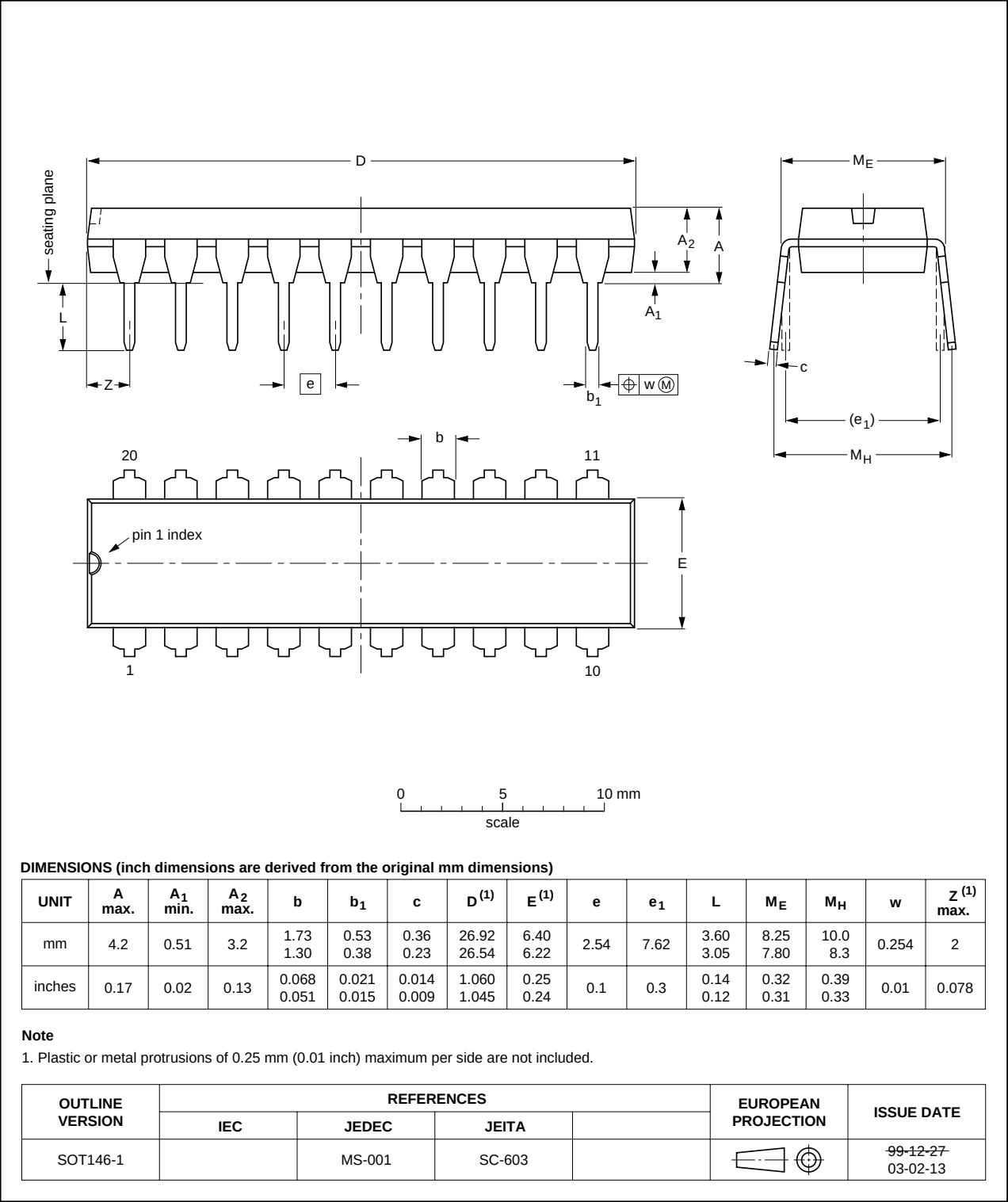


Fig 10. Package outline SOT146-1 (DIP20)

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

SOT163-1

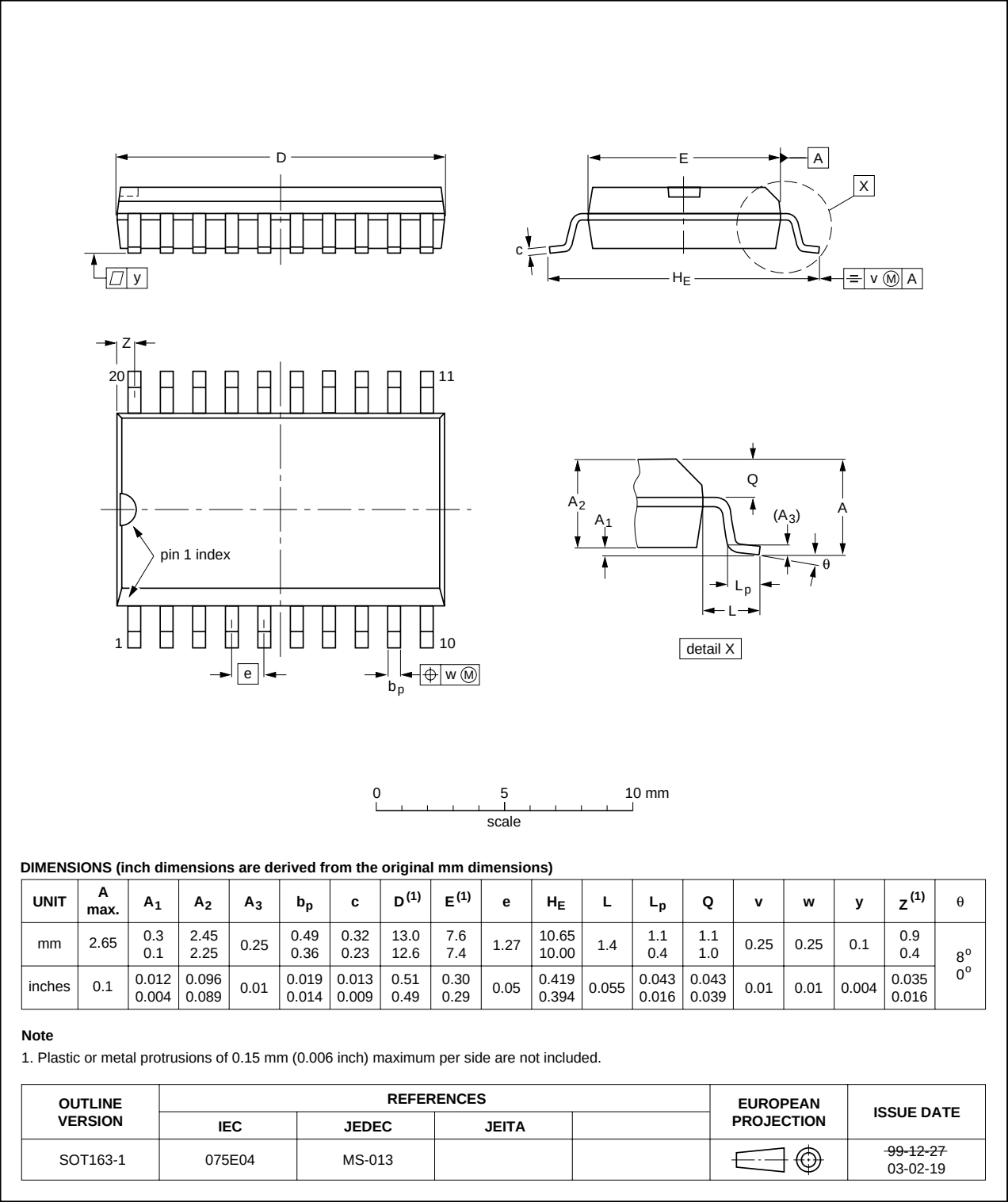


Fig 11. Package outline SOT163-1 (SO20)

## 14. Revision history

Table 10: Revision history

| Document ID       | Release date                                                                                                                                                                                                                                                                     | Data sheet status     | Change notice | Doc. number    | Supersedes        |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|----------------|-------------------|
| 74HC564_3         | 20041111                                                                                                                                                                                                                                                                         | Product data sheet    | -             | 9397 750 13814 | 74HC_HCT564_CNV_2 |
| Modifications:    | <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the current presentation and information standard of Philips Semiconductors.</li><li>• Removed type number 74HCT564.</li><li>• Inserted family specification.</li></ul> |                       |               |                |                   |
| 74HC_HCT564_CNV_2 | 19970905                                                                                                                                                                                                                                                                         | Product specification | -             | -              | 74HC_HCT564_1     |
| 74HC_HCT564_1     | 19901201                                                                                                                                                                                                                                                                         | Product specification | -             | -              | -                 |



## 15. Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | Definition                                                                                                                                                                                                                                                                                     |
|-------|----------------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I     | Objective data                   | Development                       | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.                                                                                                    |
| II    | Preliminary data                 | Qualification                     | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
| III   | Product data                     | Production                        | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 16. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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## 19. Contents

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