

# 74LVC161

Presettable synchronous 4-bit binary counter; asynchronous reset

Rev. 6 — 30 September 2013

Product data sheet

## 1. General description

The 74LVC161 is a synchronous presettable binary counter which features an internal look-ahead carry and can be used for high-speed counting. Synchronous operation is provided by having all flip-flops clocked simultaneously on the positive-going edge of the clock (pin CP). The outputs (pins Q0 to Q3) of the counters may be preset to a HIGH-level or LOW-level. A LOW-level at the parallel enable input (pin PE) disables the counting action and causes the data at the data inputs (pins D0 to D3) to be loaded into the counter on the positive-going edge of the clock (provided that the set-up and hold time requirements for PE are met). Preset takes place regardless of the levels at count enable inputs (pins CEP and CET). A LOW-level at the master reset input (pin MR) sets all four outputs of the flip-flops (pins Q0 to Q3) to LOW-level regardless of the levels at input pins CP,  $\overline{PE}$ , CET and CEP (thus providing an asynchronous clear function).

The look-ahead carry simplifies serial cascading of the counters. Both count enable inputs (pin CEP and CET) must be HIGH to count. The CET input is fed forward to enable the terminal count output (pin TC). The TC output thus enabled will produce a HIGH output pulse of a duration approximately equal to a HIGH-level output of Q0. This pulse can be used to enable the next cascaded stage.

The maximum clock frequency for the cascaded counters is determined by  $t_{PHL}$  (propagation delay CP to TC) and  $t_{su}$  (set-up time CEP to CP) according to the formula:

$$f_{max} = \frac{1}{t_{PHL(max)} + t_{su}}$$

It is a high-performance, low-power, low-voltage, Si-gate CMOS device and superior to most advanced CMOS compatible TTL families.

## 2. Features and benefits

- 5 V tolerant inputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Asynchronous reset
- Synchronous counting and loading
- Two count enable inputs for n-bit cascading
- Positive edge-triggered clock
- Complies with JEDEC standard:
  - ◆ JESD8-7A (1.65 V to 1.95 V)
  - ◆ JESD8-5A (2.3 V to 2.7 V)

- ◆ JESD8-C/JESD36 (2.7 V to 3.6 V)
- Specified from -40 °C to +85 °C and -40 °C to +125 °C
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 V

### 3. Ordering information

Table 1. Ordering information

| Type number | Package           |          |  | Version  |
|-------------|-------------------|----------|--|----------|
|             | Temperature range | Name     | Description  |          |
| 74LVC161D   | -40 °C to +125 °C | SO16     | plastic small outline package; 16 leads; body width 3.9 mm   | SOT109-1 |
| 74LVC161DB  | -40 °C to +125 °C | SSOP16   | plastic shrink small outline package; 16 leads; body width 5.3 mm  | SOT338-1 |
| 74LVC161PW  | -40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads; body width 4.4 mm   | SOT403-1 |
| 74LVC161BQ  | -40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |

### 4. Functional diagram

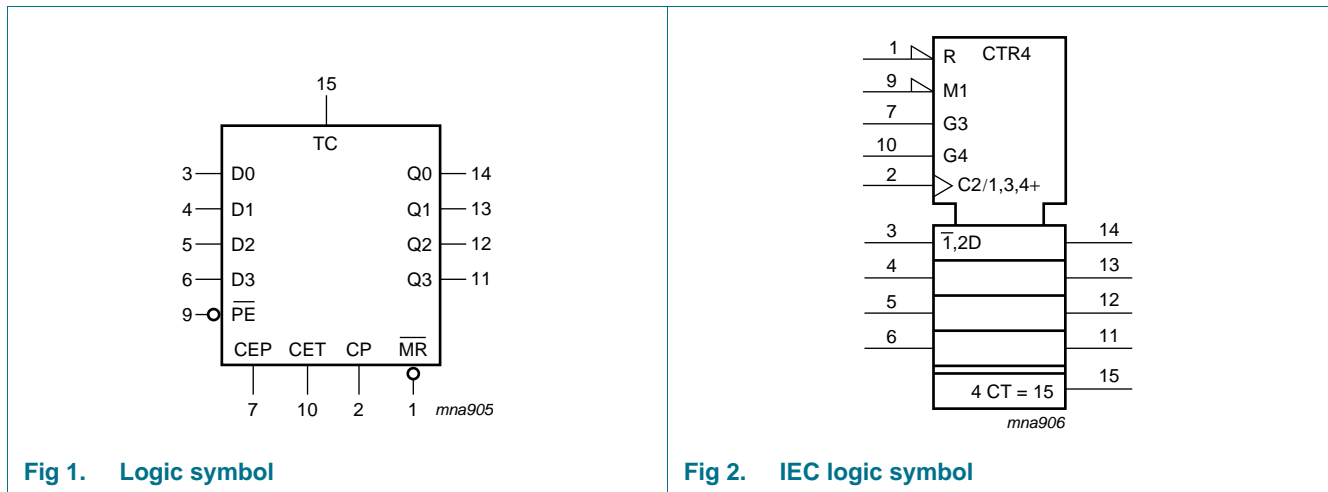




Fig 3. Functional diagram

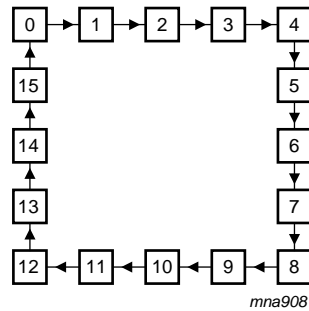
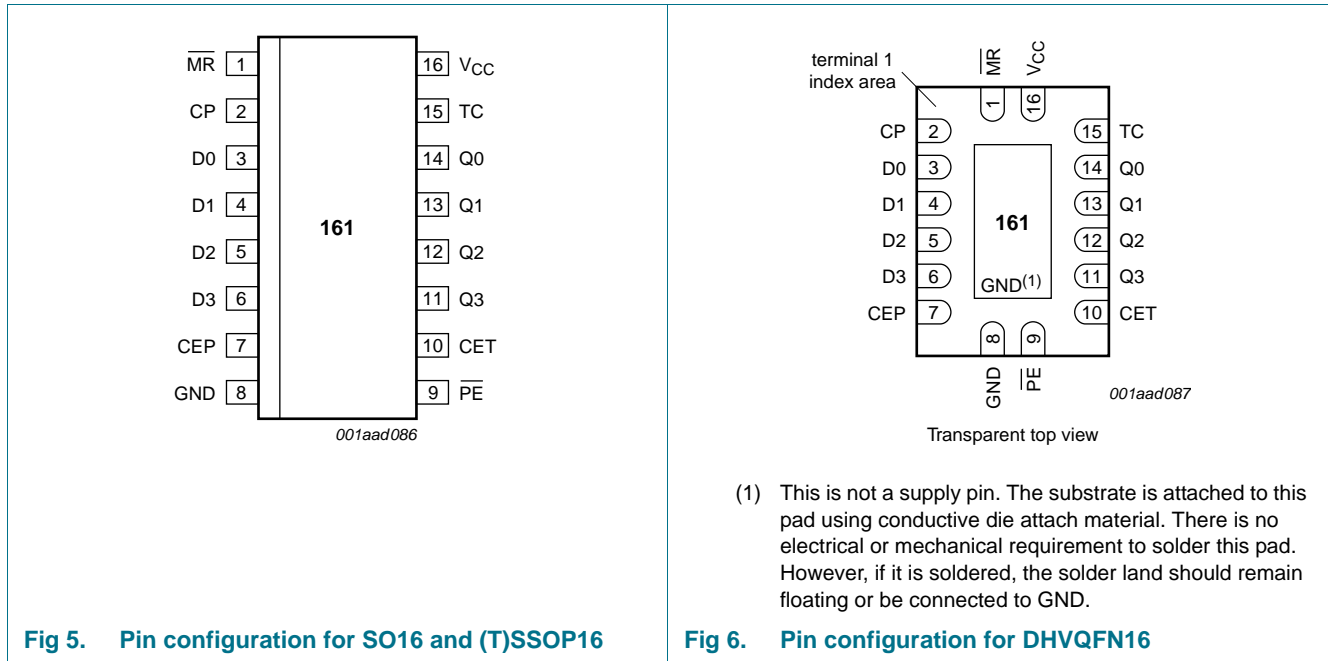


Fig 4. State diagram

## 5. Pinning information

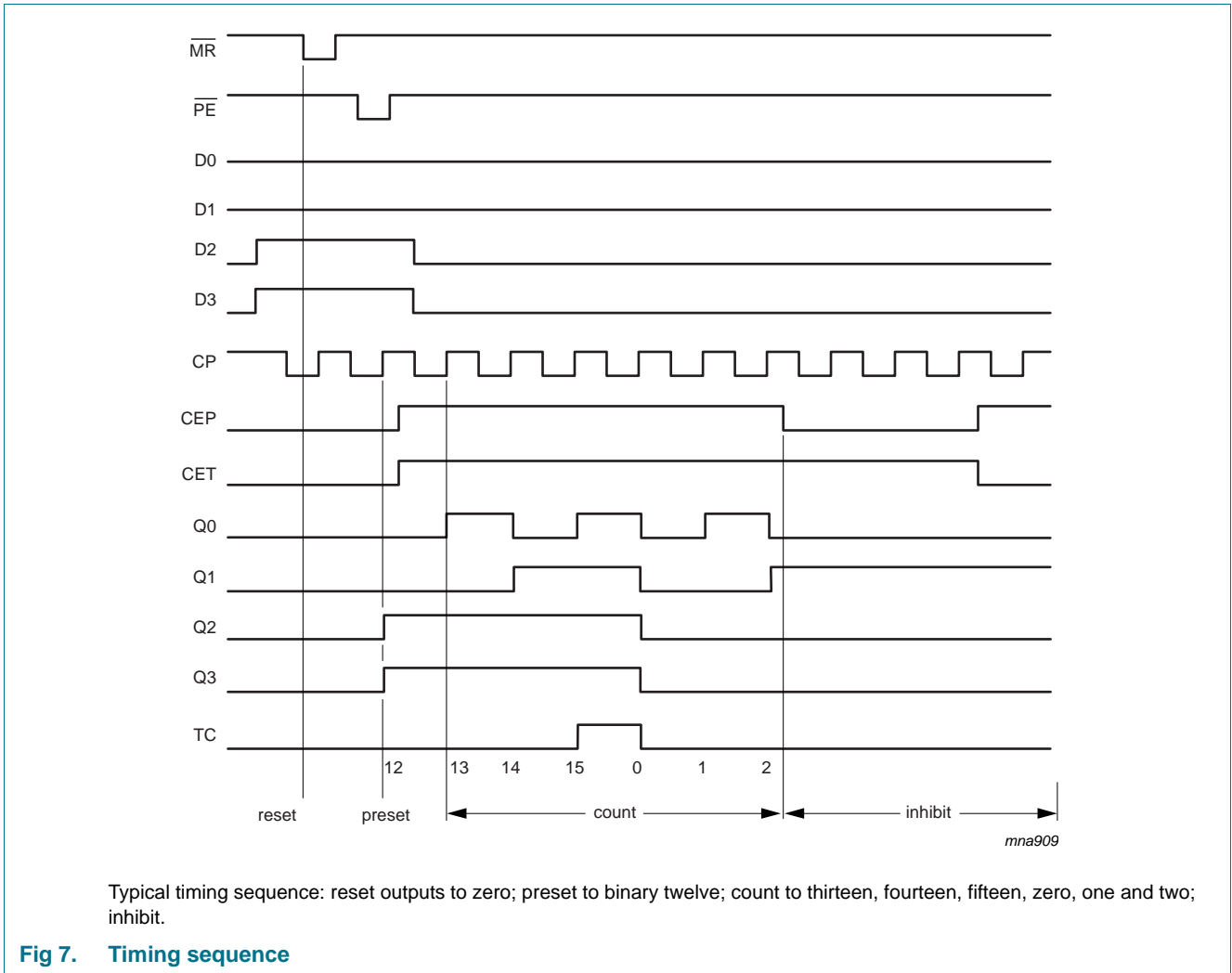
### 5.1 Pinning



### 5.2 Pin description

Table 2. Pin description

| Symbol                 | Pin            | Description                               |
|------------------------|----------------|---|
| $\overline{\text{MR}}$ | 1              | synchronous master reset (active LOW)     |
| CP                     | 2              | clock input (LOW-to-HIGH, edge-triggered) |
| D[0:3]                 | 3, 4, 5, 6     | data input                                |
| CEP                    | 7              | count enable input                        |
| GND                    | 8              | ground (0 V)                              |
| $\overline{\text{PE}}$ | 9              | parallel enable input (active LOW)        |
| CET                    | 10             | count enable carry input                  |
| Q[0:3]                 | 14, 13, 12, 11 | flip-flop output                          |
| TC                     | 15             | terminal count output                     |
| V <sub>CC</sub>        | 16             | supply voltage                            |



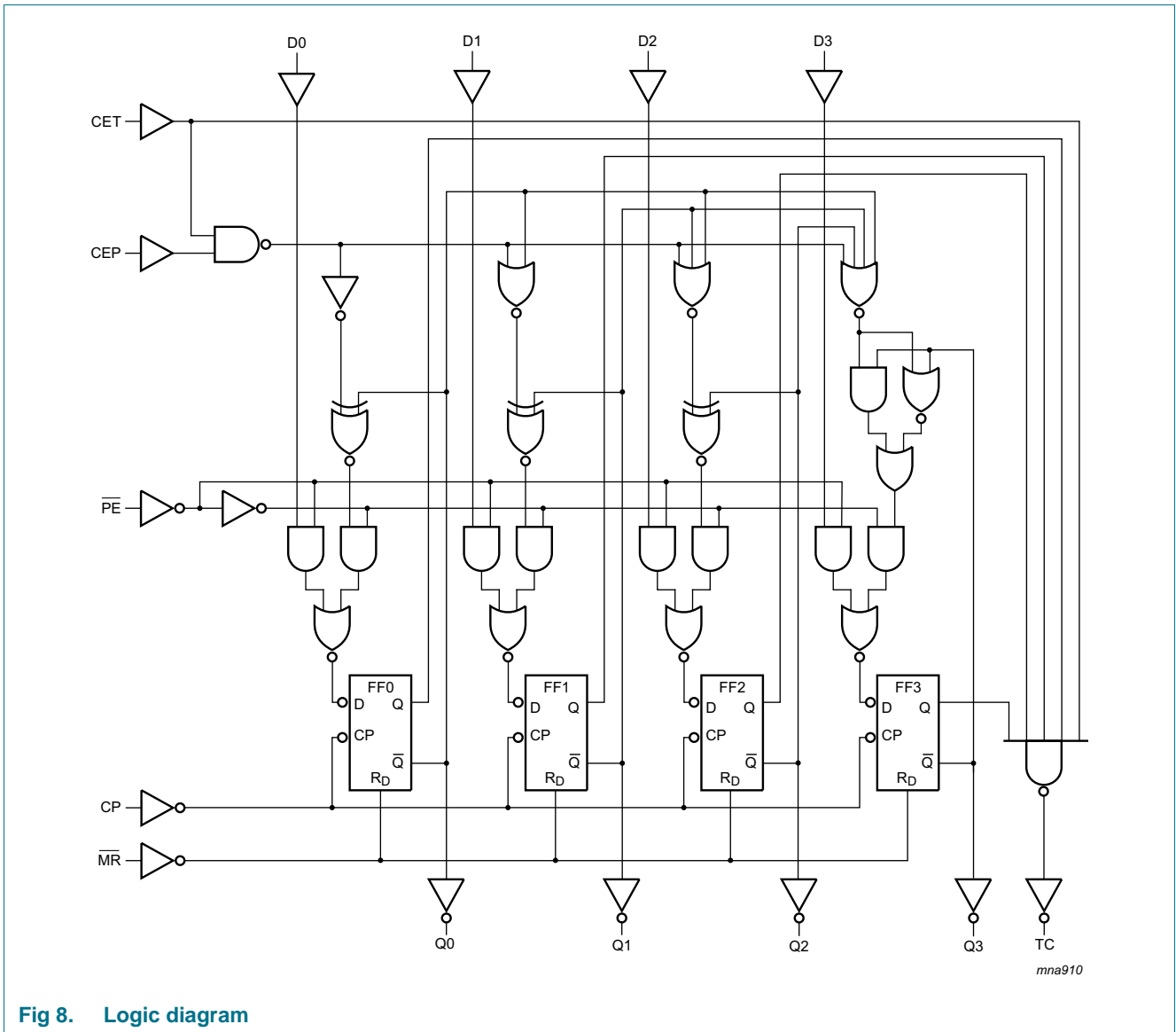


Fig 8. Logic diagram

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

| Operating modes   | Input |    |     |     |                 |    | Output         |    |
|-------------------|-------|----|-----|-----|-----------------|----|----------------|----|
|                   | MR    | CP | CEP | CET | $\overline{PE}$ | Dn | Qn             | TC |
| Reset (clear)     | L     | X  | X   | X   | X               | X  | L              | L  |
| Parallel load     | H     | ↑  | X   | X   | l               | l  | L              | L  |
|                   | H     | ↑  | X   | X   | l               | h  | H              | *  |
| Count             | H     | ↑  | h   | h   | h               | X  | count          | *  |
| Hold (do nothing) | H     | X  | l   | X   | h               | X  | q <sub>n</sub> | *  |
|                   | H     | X  | X   | l   | h               | X  | q <sub>n</sub> | L  |

[1] \* = the TC output is HIGH when CET is HIGH and the counter is at terminal count (HHHH)

H = HIGH voltage level

h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition

L = LOW voltage level

l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition

q = lower case letters indicate the state of the referenced output one set-up time prior to the LOW-to-HIGH clock transition

X = don't care

↑ = LOW-to-HIGH clock transition

## 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 <sub>CC</sub>  | supply voltage          |  | -0.5     | +6.5                  | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < 0                                     | -50      | -                     | mA   |
| V <sub>I</sub>   | input voltage           |  | [1] -0.5 | +6.5                  | V    |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 | -        | ±50                   | mA   |
| V <sub>O</sub>   | output voltage          |  | [2] -0.5 | V <sub>CC</sub> + 0.5 | V    |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = 0 V to V <sub>CC</sub>                | -        | ±50                   | mA   |
| I <sub>CC</sub>  | supply current          |  | -        | 100                   | mA   |
| I <sub>GND</sub> | ground current          |  | -100     | -                     | mA   |
| T <sub>stg</sub> | storage temperature     |  | -65      | +150                  | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C                   | [3] -    | 500                   | mW   |

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] For SO16 packages: above 70 °C the value of P<sub>D</sub> derates linearly with 8 mW/K.

For (T)SSOP16 packages: above 60 °C the value of P<sub>D</sub> derates linearly with 5.5 mW/K.

For DHVQFN16 packages: above 60 °C the value of P<sub>D</sub> derates linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol              | Parameter                           | Conditions                               | Min  | Typ | Max      | Unit |
|---------------------|-------------------------------------|--|------|-----|----------|------|
| $V_{CC}$            | supply voltage                      |  | 1.65 | -   | 3.6      | V    |
|                     |                                     | functional                               | 1.2  | -   | -        | V    |
| $V_I$               | input voltage                       |  | 0    | -   | 5.5      | V    |
| $V_O$               | output voltage                      |  | 0    | -   | $V_{CC}$ | V    |
| $T_{amb}$           | ambient temperature                 | in free air                              | -40  | -   | +125     | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65\text{ V to }2.7\text{ V}$ | 0    | -   | 20       | ns/V |
|                     |                                     | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$  | 0    | -   | 10       | ns/V |

## 9. Static characteristics

**Table 6. Static characteristics**

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

| Symbol   | Parameter                 | Conditions  | -40 °C to +85 °C     |                    |                      | -40 °C to +125 °C    |                      | Unit          |
|----------|---------------------------|---|----------------------|--------------------|----------------------|----------------------|----------------------|---------------|
|          |                           |   | Min                  | Typ <sup>[1]</sup> | Max                  | Min                  | Max                  |               |
| $V_{IH}$ | HIGH-level input voltage  | $V_{CC} = 1.2\text{ V}$   | 1.08                 | -                  | -                    | 1.08                 | -                    | V             |
|          |                           | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$                         | $0.65 \times V_{CC}$ | -                  | -                    | $0.65 \times V_{CC}$ | -                    | V             |
|          |                           | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$                           | 1.7                  | -                  | -                    | 1.7                  | -                    | V             |
|          |                           | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$                           | 2.0                  | -                  | -                    | 2.0                  | -                    | V             |
| $V_{IL}$ | LOW-level input voltage   | $V_{CC} = 1.2\text{ V}$   | -                    | -                  | 0.12                 | -                    | 0.12                 | V             |
|          |                           | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$                         | -                    | -                  | $0.35 \times V_{CC}$ | -                    | $0.35 \times V_{CC}$ | V             |
|          |                           | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$                           | -                    | -                  | 0.7                  | -                    | 0.7                  | V             |
|          |                           | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$                           | -                    | -                  | 0.8                  | -                    | 0.8                  | V             |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}\text{ or }V_{IL}$                                   |                      |                    |                      |                      |                      |               |
|          |                           | $I_O = -100\ \mu\text{A}; V_{CC} = 1.65\text{ V to }3.6\text{ V}$ | $V_{CC} - 0.2$       | -                  | -                    | $V_{CC} - 0.3$       | -                    | V             |
|          |                           | $I_O = -4\text{ mA}; V_{CC} = 1.65\text{ V}$                      | 1.2                  | -                  | -                    | 1.05                 | -                    | V             |
|          |                           | $I_O = -8\text{ mA}; V_{CC} = 2.3\text{ V}$                       | 1.8                  | -                  | -                    | 1.65                 | -                    | V             |
|          |                           | $I_O = -12\text{ mA}; V_{CC} = 2.7\text{ V}$                      | 2.2                  | -                  | -                    | 2.05                 | -                    | V             |
|          |                           | $I_O = -18\text{ mA}; V_{CC} = 3.0\text{ V}$                      | 2.4                  | -                  | -                    | 2.25                 | -                    | V             |
| $V_{OL}$ | LOW-level output voltage  | $V_I = V_{IH}\text{ or }V_{IL}$                                   |                      |                    |                      |                      |                      |               |
|          |                           | $I_O = 100\ \mu\text{A}; V_{CC} = 1.65\text{ V to }3.6\text{ V}$  | -                    | -                  | 0.2                  | -                    | 0.3                  | V             |
|          |                           | $I_O = 4\text{ mA}; V_{CC} = 1.65\text{ V}$                       | -                    | -                  | 0.45                 | -                    | 0.65                 | V             |
|          |                           | $I_O = 8\text{ mA}; V_{CC} = 2.3\text{ V}$                        | -                    | -                  | 0.6                  | -                    | 0.8                  | V             |
|          |                           | $I_O = 12\text{ mA}; V_{CC} = 2.7\text{ V}$                       | -                    | -                  | 0.4                  | -                    | 0.6                  | V             |
|          |                           | $I_O = 24\text{ mA}; V_{CC} = 3.0\text{ V}$                       | -                    | -                  | 0.55                 | -                    | 0.8                  | V             |
| $I_I$    | input leakage current     | $V_{CC} = 3.6\text{ V}; V_I = 5.5\text{ V or GND}$                | -                    | $\pm 0.1$          | $\pm 5$              | -                    | $\pm 20$             | $\mu\text{A}$ |



**Table 6. Static characteristics ...continued**

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

| Symbol           | Parameter                 | Conditions  | -40 °C to +85 °C |                    |     | -40 °C to +125 °C |      | Unit |
|------------------|---------------------------|---|------------------|--------------------|-----|-------------------|------|------|
|                  |                           |   | Min              | Typ <sup>[1]</sup> | Max | Min               | Max  |      |
| I <sub>CC</sub>  | supply current            | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A                                | -                | 0.1                | 10  | -                 | 40   | μA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin;<br>V <sub>CC</sub> = 2.7 V to 3.6 V;<br>V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A | -                | 5                  | 500 | -                 | 5000 | μA   |
| C <sub>I</sub>   | input capacitance         | V <sub>CC</sub> = 0 V to 3.6 V;<br>V <sub>I</sub> = GND to V <sub>CC</sub>  | -                | 5.0                | -   | -                 | -    | pF   |

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 14](#).

| Symbol          | Parameter         | Conditions   | -40 °C to +85 °C |                    |      | -40 °C to +125 °C |      | Unit |
|-----------------|-------------------|--|------------------|--------------------|------|-------------------|------|------|
|                 |                   |  | Min              | Typ <sup>[1]</sup> | Max  | Min               | Max  |      |
| t <sub>pd</sub> | propagation delay | CP to Q <sub>n</sub> ; see <a href="#">Figure 9</a> <sup>[2]</sup> |                  |                    |      |                   |      |      |
|                 |                   | V <sub>CC</sub> = 1.2 V  | -                | 17                 | -    | -                 | -    | ns   |
|                 |                   | V <sub>CC</sub> = 1.65 V to 1.95 V                                 | 1.5              | 7.0                | 14.5 | 1.5               | 16.7 | ns   |
|                 |                   | V <sub>CC</sub> = 2.3 V to 2.7 V                                   | 2.5              | 4.0                | 8.1  | 2.5               | 9.4  | ns   |
|                 |                   | V <sub>CC</sub> = 2.7 V  | 1.5              | 3.8                | 7.2  | 1.5               | 9.0  | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                   | 1.5              | 3.6                | 7.3  | 1.5               | 9.5  | ns   |
|                 |                   | CP to TC; see <a href="#">Figure 9</a> <sup>[2]</sup>              |                  |                    |      |                   |      |      |
|                 |                   | V <sub>CC</sub> = 1.2 V  | -                | 20                 | -    | -                 | -    | ns   |
|                 |                   | V <sub>CC</sub> = 1.65 V to 1.95 V                                 | 1.8              | 8.1                | 15.5 | 1.8               | 17.9 | ns   |
|                 |                   | V <sub>CC</sub> = 2.3 V to 2.7 V                                   | 2.8              | 4.6                | 8.7  | 2.8               | 10.1 | ns   |
|                 |                   | V <sub>CC</sub> = 2.7 V  | 1.5              | 4.3                | 7.8  | 1.5               | 10.0 | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                   | 1.5              | 4.2                | 7.8  | 1.5               | 10.0 | ns   |
|                 |                   | CET to TC; see <a href="#">Figure 10</a> <sup>[2]</sup>            |                  |                    |      |                   |      |      |
|                 |                   | V <sub>CC</sub> = 1.2 V  | -                | 16                 | -    | -                 | -    | ns   |
|                 |                   | V <sub>CC</sub> = 1.65 V to 1.95 V                                 | 1.5              | 5.9                | 11.9 | 1.5               | 13.7 | ns   |
|                 |                   | V <sub>CC</sub> = 2.3 V to 2.7 V                                   | 1.9              | 3.4                | 6.7  | 1.9               | 7.7  | ns   |
|                 |                   | V <sub>CC</sub> = 2.7 V  | 1.5              | 3.6                | 6.5  | 1.5               | 8.5  | ns   |
|                 |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                   | 1.5              | 3.1                | 6.0  | 1.5               | 7.5  | ns   |

**Table 7. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 14](#).

| Symbol           | Parameter                     | Conditions   | -40 °C to +85 °C |                    |      | -40 °C to +125 °C |      | Unit |
|------------------|-------------------------------|--|------------------|--------------------|------|-------------------|------|------|
|                  |                               |  | Min              | Typ <sup>[1]</sup> | Max  | Min               | Max  |      |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | $\overline{\text{MR}}$ to Q <sub>n</sub> ; see <a href="#">Figure 11</a> |                  |                    |      |                   |      |      |
|                  |                               | V <sub>CC</sub> = 1.2 V  | -                | 17                 | -    | -                 | -    | ns   |
|                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                                       | 1.5              | 6.2                | 12.7 | 1.5               | 14.6 | ns   |
|                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V   | 1.9              | 3.6                | 7.1  | 1.9               | 8.3  | ns   |
|                  |                               | V <sub>CC</sub> = 2.7 V  | 1.5              | 3.9                | 7.1  | 1.5               | 9.0  | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V   | 1.5              | 3.2                | 6.4  | 1.5               | 8.0  | ns   |
|                  |                               | $\overline{\text{MR}}$ to TC; see <a href="#">Figure 11</a>              |                  |                    |      |                   |      |      |
|                  |                               | V <sub>CC</sub> = 1.2 V  | -                | 18                 | -    | -                 | -    | ns   |
|                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                                       | 1.7              | 8.3                | 15.9 | 1.7               | 18.4 | ns   |
|                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V   | 2.7              | 4.8                | 8.9  | 2.7               | 10.3 | ns   |
| t <sub>w</sub>   | pulse width                   | clock HIGH or LOW; see <a href="#">Figure 9</a>                          |                  |                    |      |                   |      |      |
|                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                                       | 6.0              | -                  | -    | 6.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V   | 5.0              | -                  | -    | 5.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 2.7 V  | 5.0              | -                  | -    | 5.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V   | 4.0              | 1.2                | -    | 4.0               | -    | ns   |
|                  |                               | master reset LOW; see <a href="#">Figure 11</a>                          |                  |                    |      |                   |      |      |
|                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                                       | 5.0              | -                  | -    | 5.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V   | 4.0              | -                  | -    | 4.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 2.7 V  | 4.0              | -                  | -    | 4.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V   | 3.0              | 1.6                | -    | 3.0               | -    | ns   |
| t <sub>rec</sub> | recovery time                 | $\overline{\text{MR}}$ to CP; see <a href="#">Figure 11</a>              |                  |                    |      |                   |      |      |
|                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V                                       | 1.0              | -                  | -    | 1.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V   | 1.0              | -                  | -    | 1.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 2.7 V  | 0.0              | -                  | -    | 0.0               | -    | ns   |
|                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V   | 0.5              | 0.0                | -    | 0.5               | -    | ns   |

**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 14](#).

| Symbol                           | Parameter                     | Conditions  | -40 °C to +85 °C    |                    |     | -40 °C to +125 °C |     | Unit |    |
|----------------------------------|-------------------------------|---|---------------------|--------------------|-----|-------------------|-----|------|----|
|                                  |                               |   | Min                 | Typ <sup>[1]</sup> | Max | Min               | Max |      |    |
| t <sub>su</sub>                  | set-up time                   | Dn to CP; see <a href="#">Figure 12</a>   |                     |                    |     |                   |     |      |    |
|                                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V  | 5.0                 | -                  | -   | 5.0               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V  | 4.0                 | -                  | -   | 4.0               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 2.7 V   | 3.0                 | -                  | -   | 3.0               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V  | 2.5                 | 1.0                | -   | 2.5               | -   | ns   |    |
|                                  |                               | P <sub>E</sub> to CP; see <a href="#">Figure 12</a>                                       |                     |                    |     |                   |     |      |    |
|                                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V  | 4.5                 | -                  | -   | 4.5               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V  | 4.0                 | -                  | -   | 4.0               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 2.7 V   | 3.5                 | -                  | -   | 3.5               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V  | 3.0                 | 1.2                | -   | 3.0               | -   | ns   |    |
|                                  |                               | CEP, CET to CP; see <a href="#">Figure 13</a>   |                     |                    |     |                   |     |      |    |
|                                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V  | 8.0                 | -                  | -   | 8.0               | -   | ns   |    |
| V <sub>CC</sub> = 2.3 V to 2.7 V | 6.0                           | -   | -                   | 6.0                | -   | ns                |     |      |    |
| V <sub>CC</sub> = 2.7 V          | 5.5                           | -   | -                   | 5.5                | -   | ns                |     |      |    |
| V <sub>CC</sub> = 3.0 V to 3.6 V | 5.0                           | 2.1   | -                   | 5.0                | -   | ns                |     |      |    |
| t <sub>h</sub>                   | hold time                     | Dn, P <sub>E</sub> , CEP, CET to CP; see <a href="#">Figure 12</a> and <a href="#">13</a> |                     |                    |     |                   |     |      |    |
|                                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V  | 3.0                 | -                  | -   | 3.0               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V  | 2.5                 | -                  | -   | 2.5               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 2.7 V   | 0.0                 | -                  | -   | 0.0               | -   | ns   |    |
|                                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V  | 0.5                 | 0.0                | -   | 0.5               | -   | ns   |    |
| f <sub>max</sub>                 | maximum frequency             | see <a href="#">Figure 9</a>  |                     |                    |     |                   |     |      |    |
|                                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V  | 100                 | -                  | -   | 80                | -   | MHZ  |    |
|                                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V  | 125                 | -                  | -   | 100               | -   | MHZ  |    |
|                                  |                               | V <sub>CC</sub> = 2.7 V   | 150                 | -                  | -   | 120               | -   | MHZ  |    |
|                                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V  | 150                 | 200                | -   | 120               | -   | MHZ  |    |
| t <sub>sk(o)</sub>               | output skew time              | V <sub>CC</sub> = 3.0 V to 3.6 V  | <a href="#">[3]</a> | -                  | -   | 1.0               | -   | 1.5  | ns |
| C <sub>PD</sub>                  | power dissipation capacitance | per input; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[4]</a>                    |                     |                    |     |                   |     |      |    |
|                                  |                               | V <sub>CC</sub> = 1.65 V to 1.95 V  | -                   | 11.1               | -   | -                 | -   | pF   |    |
|                                  |                               | V <sub>CC</sub> = 2.3 V to 2.7 V  | -                   | 14.7               | -   | -                 | -   | pF   |    |
|                                  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V  | -                   | 17.9               | -   | -                 | -   | pF   |    |

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz

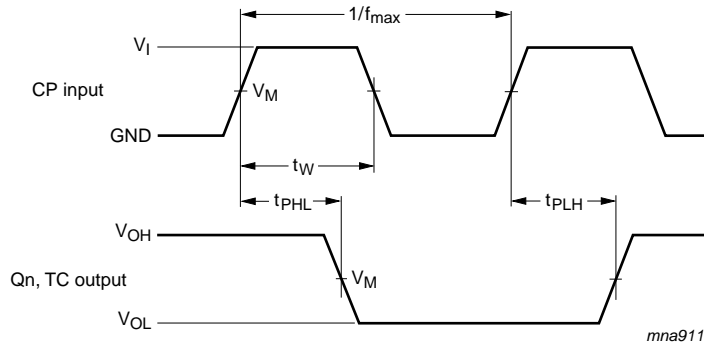
C<sub>L</sub> = output load capacitance in pF

V<sub>CC</sub> = supply voltage in V

N = number of inputs switching

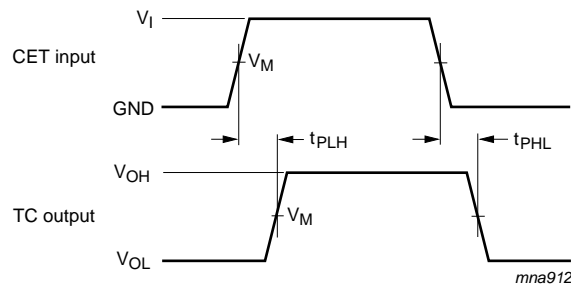
$\sum(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs

11. Waveforms



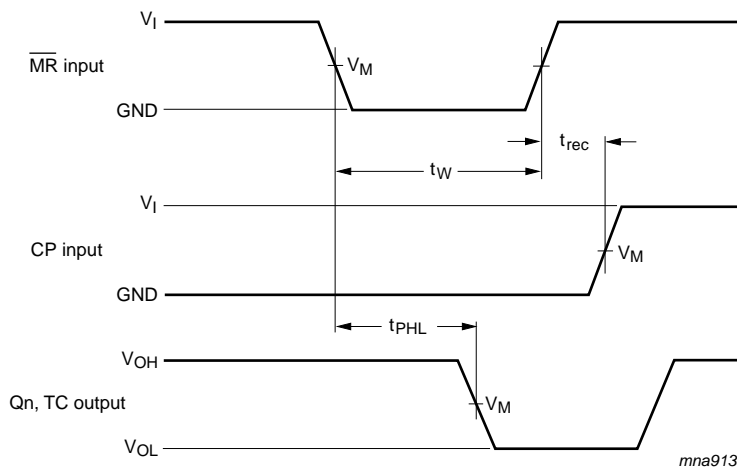
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 9. Clock (CP) to outputs (Qn, TC) propagation delays, the clock pulse width, and maximum frequency**

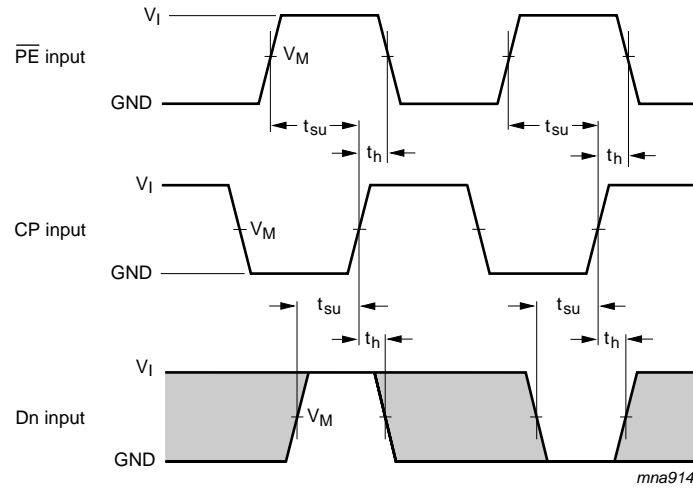


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 10. Input (CET) to output (TC) propagation delays**

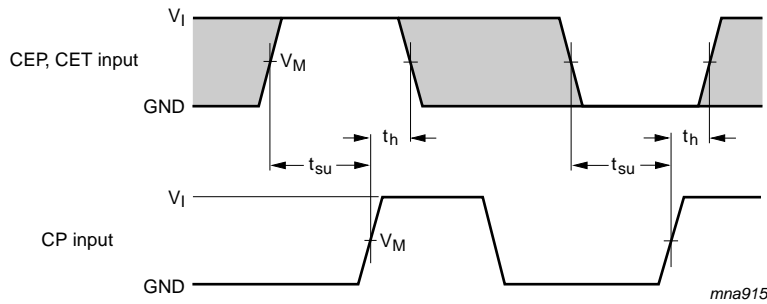


**Fig 11. Master reset ( $\overline{MR}$ ) pulse width, the master reset to output (Qn, TC) propagation delays, and the master reset to clock (CP) removal times**



The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 12. Set-up and hold times for the input (Dn) and parallel enable input ( $\overline{PE}$ )

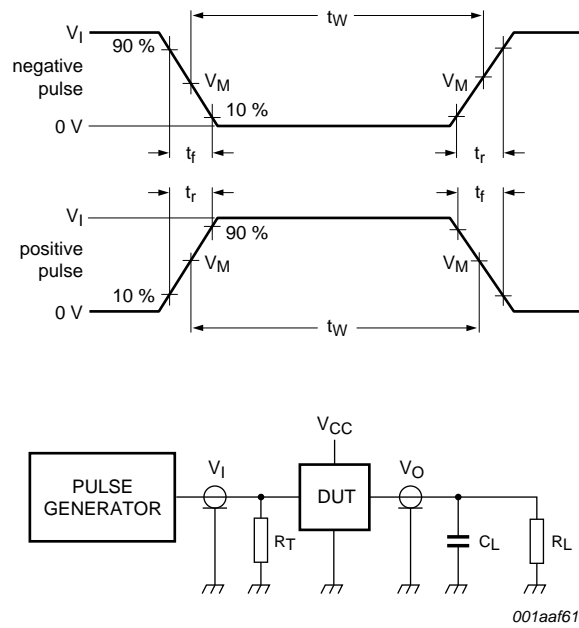


The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 13. CEP and CET set-up and hold times

Table 8. Measurement points

| Supply voltage   | Input    |                     | Output              |
|------------------|----------|---------------------|---------------------|
| $V_{CC}$         | $V_I$    | $V_M$               | $V_M$               |
| 1.2 V            | $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 1.65 V to 1.95 V | $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 2.3 V to 2.7 V   | $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 2.7 V            | 2.7 V    | 1.5 V               | 1.5 V               |
| 3.0 V to 3.6 V   | 2.7 V    | 1.5 V               | 1.5 V               |



Test data is given in [Table 9](#). Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

**Fig 14. Test circuit for measuring switching times**

**Table 9. Test data**

| Supply voltage   | Input    |               | Load  |              |
|------------------|----------|---------------|-------|--------------|
|                  | $V_I$    | $t_r, t_f$    | $C_L$ | $R_L$        |
| 1.2 V            | $V_{CC}$ | $\leq 2$ ns   | 30 pF | 1 k $\Omega$ |
| 1.65 V to 1.95 V | $V_{CC}$ | $\leq 2$ ns   | 30 pF | 1 k $\Omega$ |
| 2.3 V to 2.7 V   | $V_{CC}$ | $\leq 2$ ns   | 30 pF | 500 $\Omega$ |
| 2.7 V            | 2.7 V    | $\leq 2.5$ ns | 50 pF | 500 $\Omega$ |
| 3.0 V to 3.6 V   | 2.7 V    | $\leq 2.5$ ns | 50 pF | 500 $\Omega$ |

12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



Fig 15. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

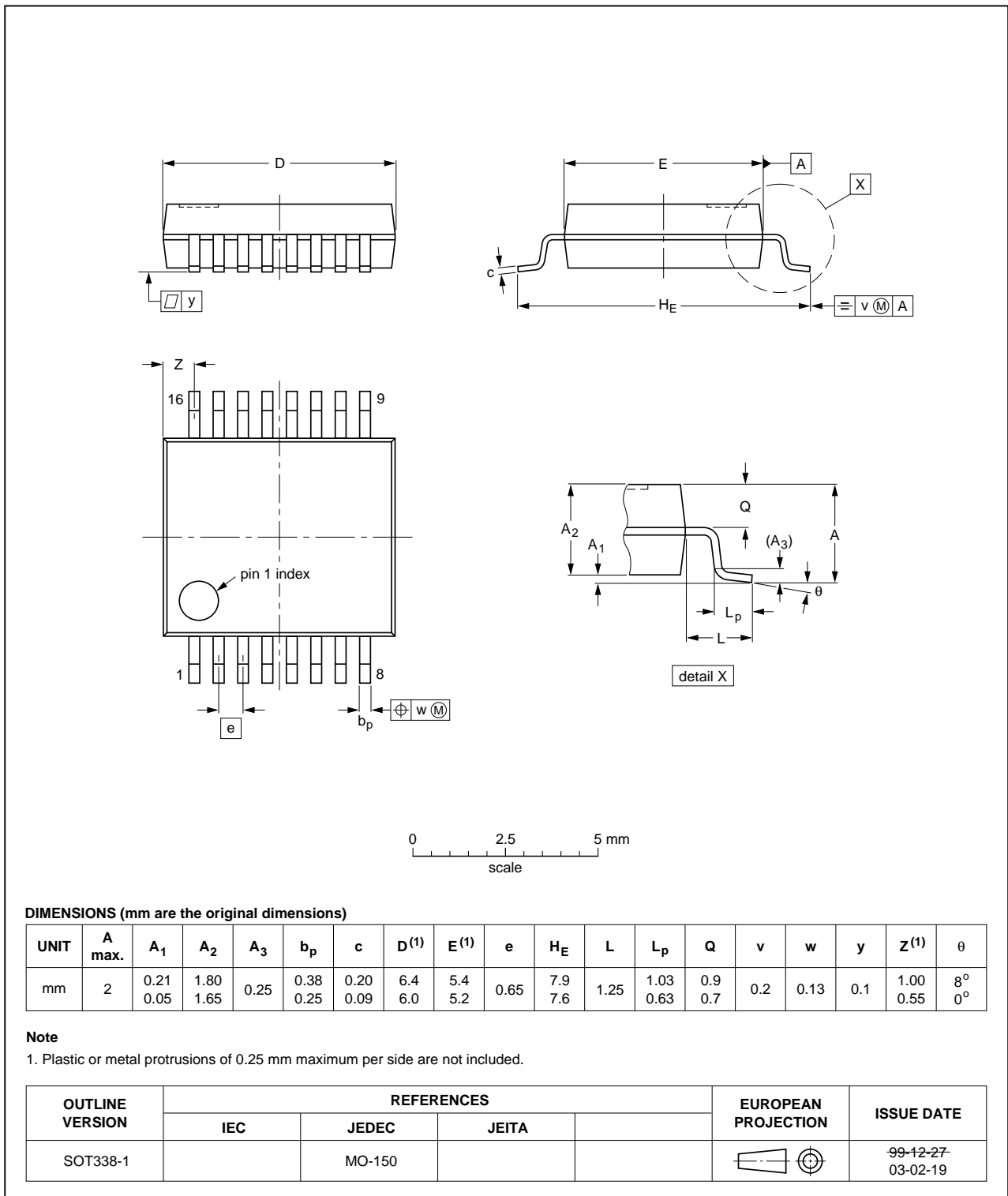


Fig 16. Package outline SOT338-1 (SSOP16)



TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

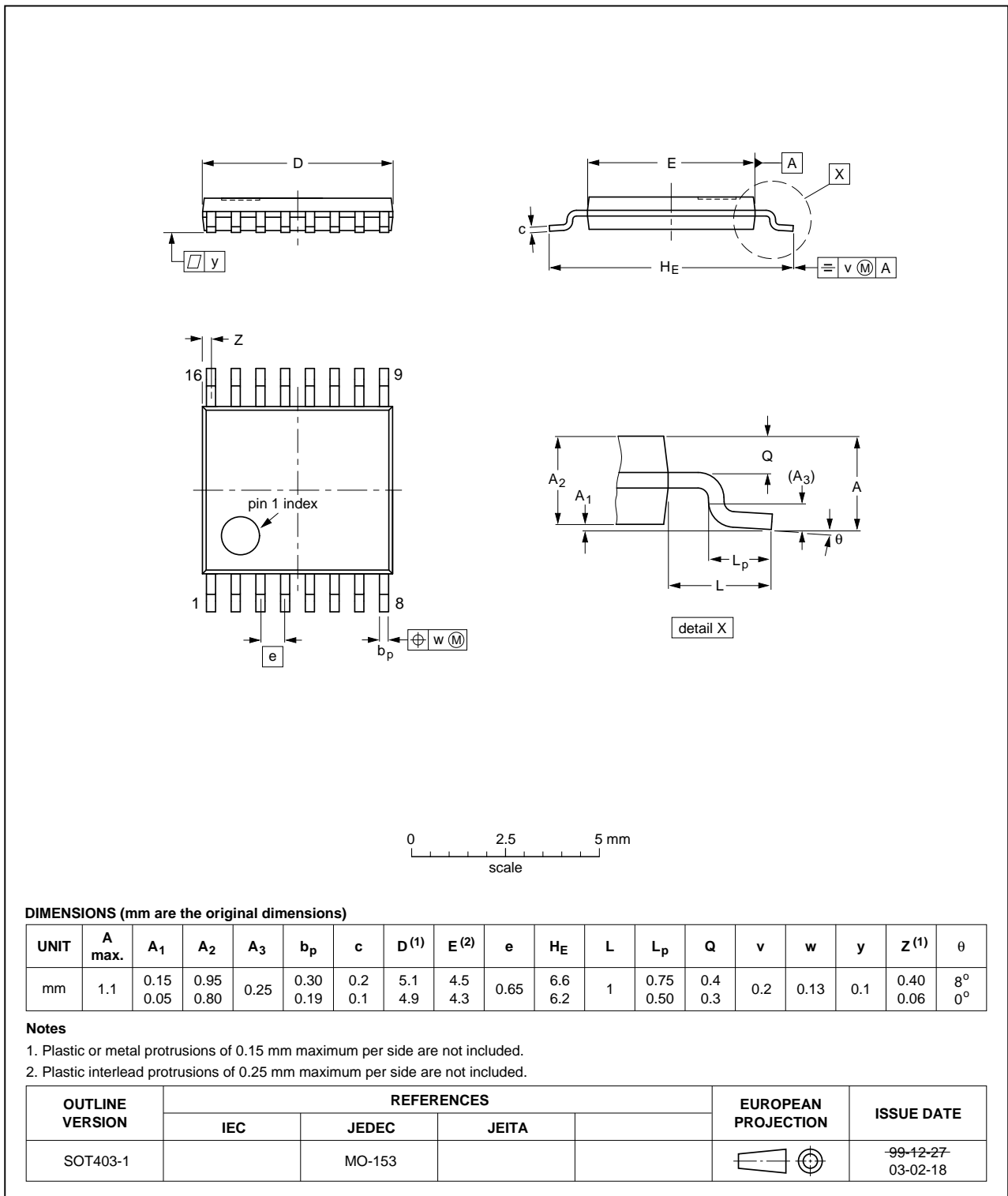


Fig 17. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

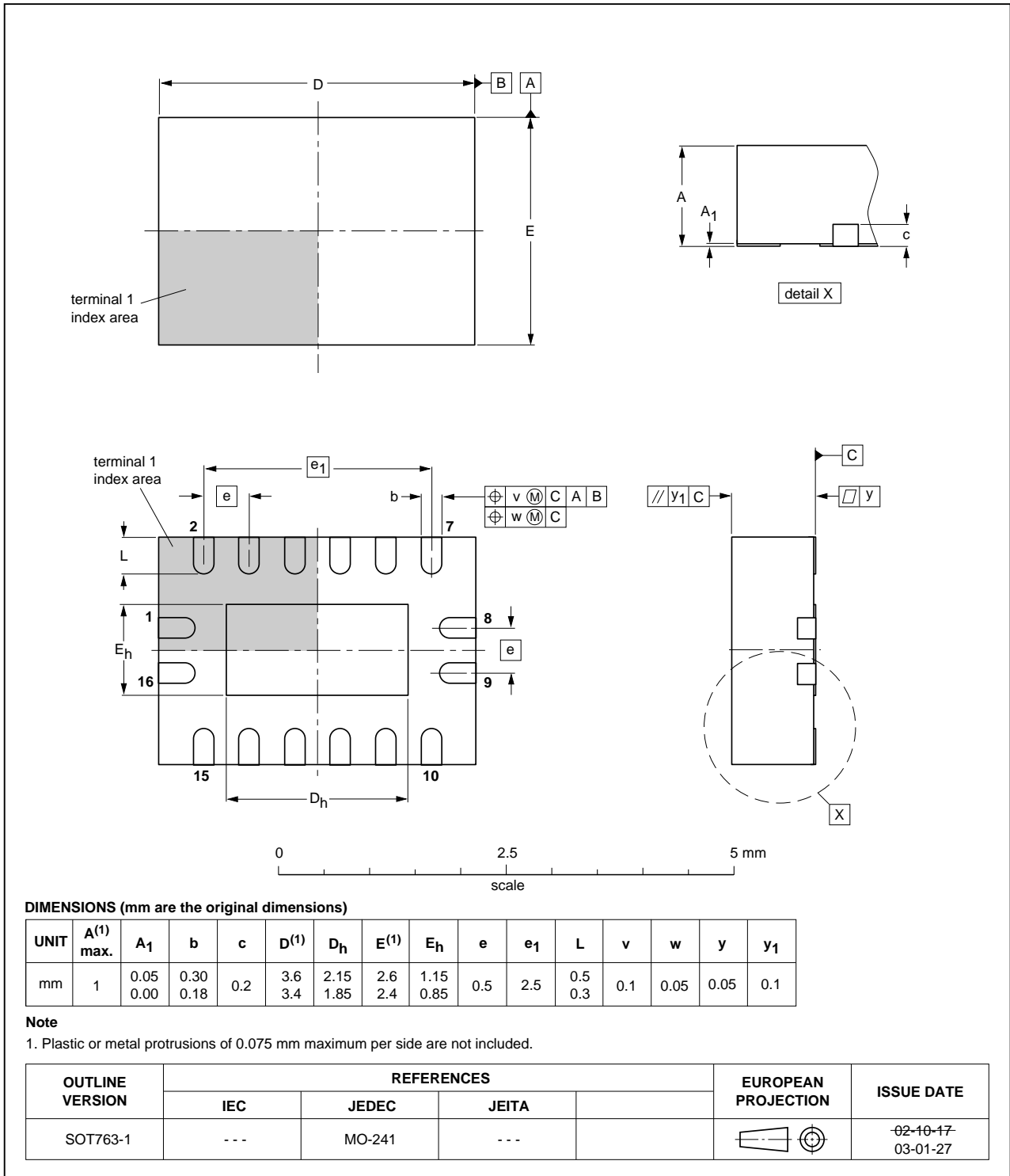


Fig 18. Package outline SOT763-1 (DHVQFN16)

## 13. Abbreviations

Table 10. Abbreviations

| Acronym | Description                 |
|---------|-----------------------------|
| CDM     | Charged Device Model        |
| DUT     | Device Under Test           |
| ESD     | ElectroStatic Discharge     |
| HBM     | Human Body Model            |
| MM      | Machine Model               |
| TTL     | Transistor-Transistor Logic |

## 14. Revision history

Table 11. Revision history

| Document ID    | Release date   | Data sheet status     | Change notice | Supersedes   |
|----------------|--|-----------------------|---------------|--------------|
| 74LVC161 v.6   | 20130930   | Product data sheet    | -             | 74LVC161 v.5 |
| Modifications: | <ul style="list-style-type: none"> <li>Figure 8 corrected (errata).</li> </ul> |                       |               |              |
| 74LVC161 v.5   | 20121123   | Product data sheet    | -             | 74LVC161 v.4 |
| 74LVC161 v.4   | 20121122   | Product data sheet    | -             | 74LVC161 v.3 |
| 74LVC161 v.3   | 20040330   | Product specification | -             | 74LVC161 v.2 |
| 74LVC161 v.2   | 19980520   | Product specification | -             | 74LVC161 v.1 |
| 74LVC161 v.1   | 19960823   | Product specification | -             | -            |

## 15. Legal information

### 15.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А