



# 74HC40103

## 8-bit synchronous binary down counter

Rev. 6 — 26 March 2024

Product data sheet

### 1. General description

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The 74HC40103 is an 8-bit synchronous down counter. It has control inputs for enabling or disabling the clock (CP), for clearing the counter to its maximum count and for presetting the counter either synchronously or asynchronously. In normal operation, the counter is decremented by one count on each positive-going transition of the clock (CP). Counting is inhibited when the terminal enable input ( $\overline{TE}$ ) is HIGH. The terminal count output ( $\overline{TC}$ ) goes LOW when the count reaches zero if  $\overline{TE}$  is LOW, and remains LOW for one full clock period. When the synchronous preset enable input ( $\overline{PE}$ ) is LOW, data at the jam input (P0 to P7) is clocked into the counter on the next positive-going clock transition regardless of the state of  $\overline{TE}$ . When the asynchronous preset enable input ( $\overline{PL}$ ) is LOW, data at the jam input (P0 to P7) is asynchronously forced into the counter regardless of the state of  $\overline{PE}$ ,  $\overline{TE}$ , or CP. The jam inputs (P0 to P7) represent a single 8-bit binary word. When the master reset input ( $\overline{MR}$ ) is LOW, the counter is asynchronously cleared to its maximum count (decimal 255) regardless of the state of any other input. If all control inputs except  $\overline{TE}$  are HIGH at the time of zero count, the counters will jump to the maximum count, giving a counting sequence of 256 clock pulses long. Device may be cascaded using the  $\overline{TE}$  input and the TC output, in either a synchronous or ripple mode. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

### 2. Features and benefits

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- Cascadable
- Synchronous or asynchronous preset
- Wide supply voltage range from 2.0 V to 6.0 V
- CMOS low-power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standard no. 7A
- CMOS input levels
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +80 °C and from -40 °C to +125 °C

### 3. Applications

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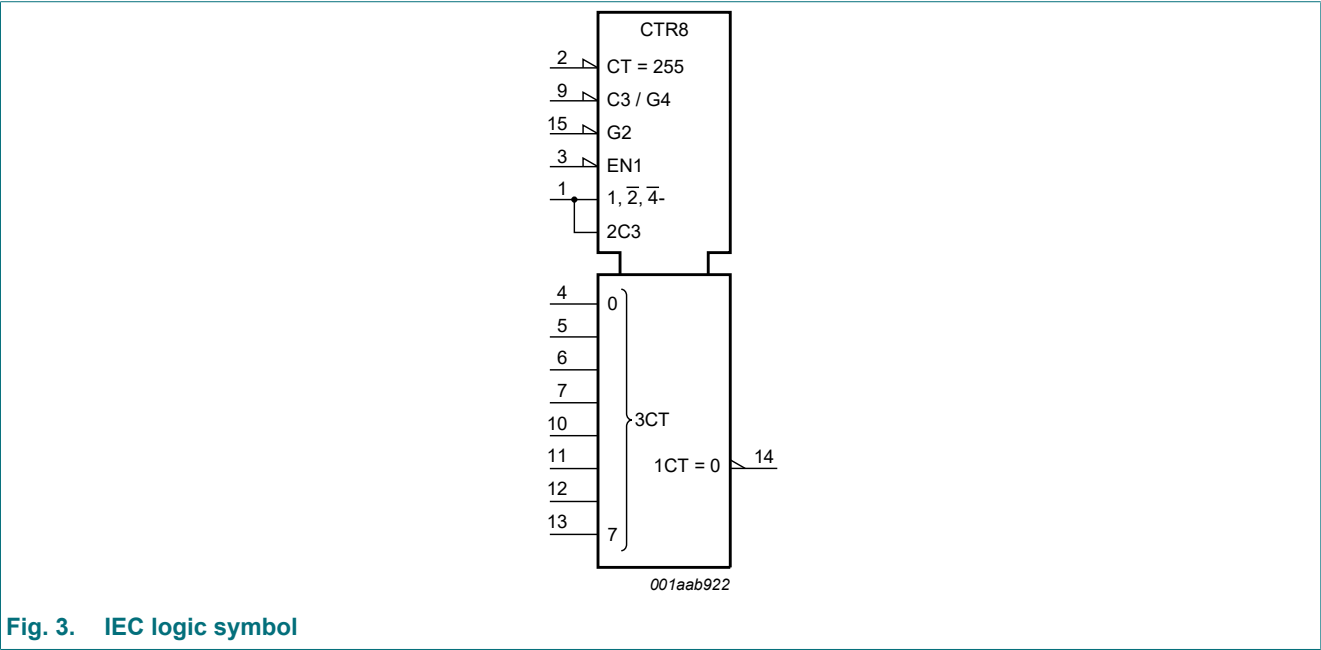
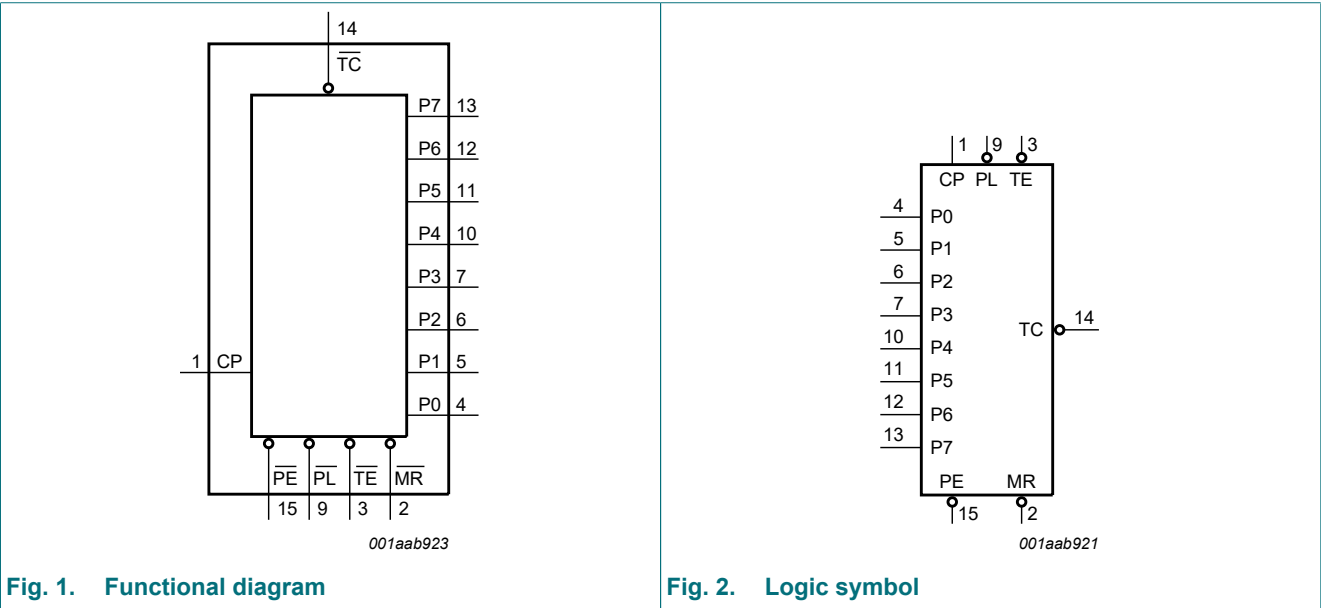
- Divide-by-n counters
- Programmable timers
- Interrupt timers
- Cycle/program counters.

4. Ordering information

Table 1. Ordering information

| Type number                 | Package           |         |                                                                           |                          |
|-----------------------------|-------------------|---------|---------------------------------------------------------------------------|--------------------------|
|                             | Temperature range | Name    | Description                                                               | Version                  |
| <a href="#">74HC40103D</a>  | -40 °C to +125 °C | SO16    | plastic small outline package; 16 leads;<br>body width 3.9 mm             | <a href="#">SOT109-1</a> |
| <a href="#">74HC40103PW</a> | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm | <a href="#">SOT403-1</a> |

5. Functional diagram



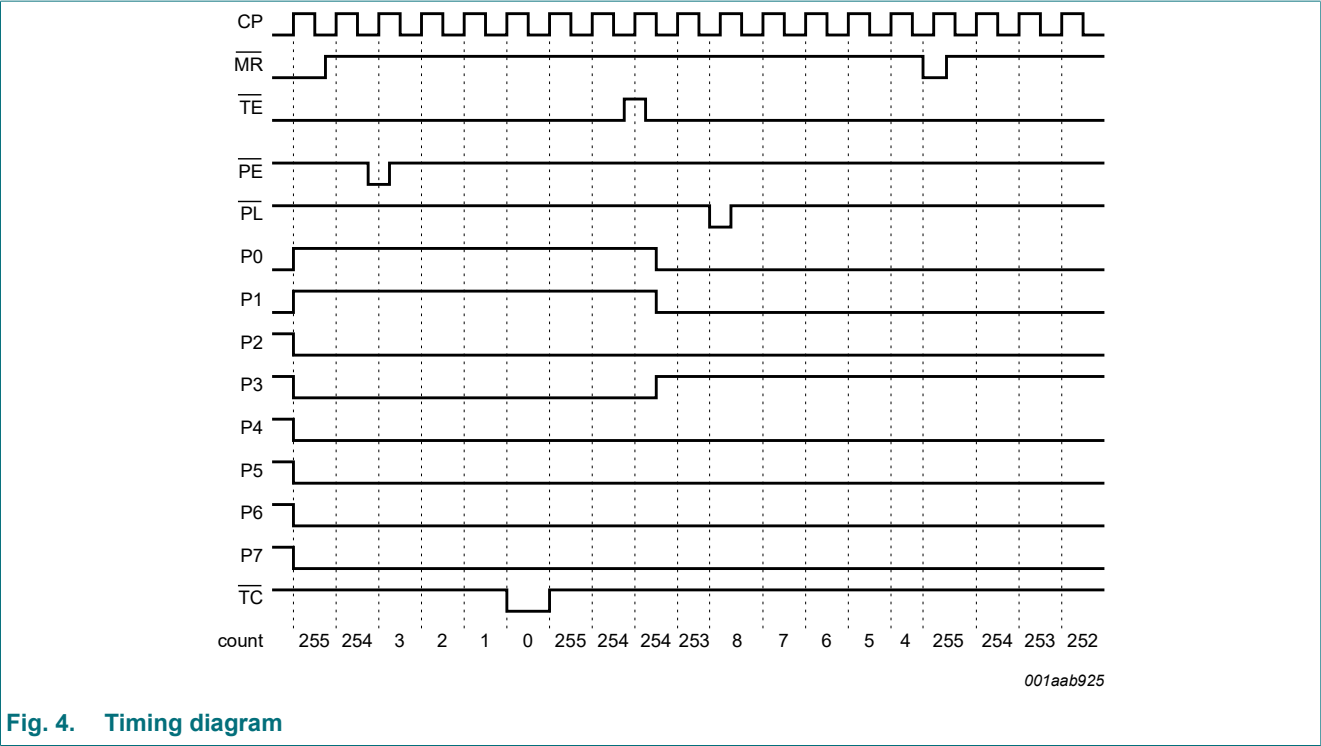
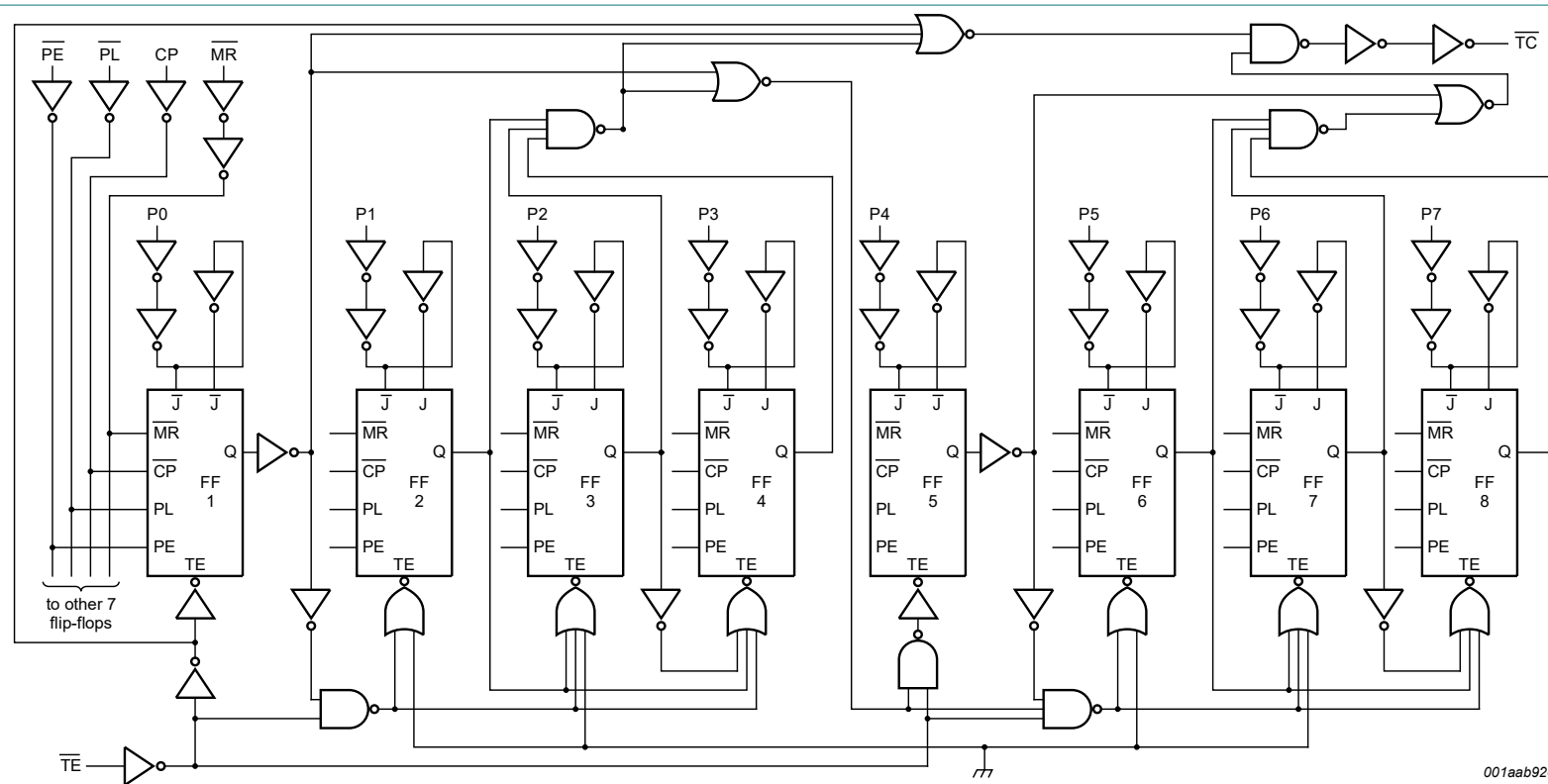


Fig. 4. Timing diagram

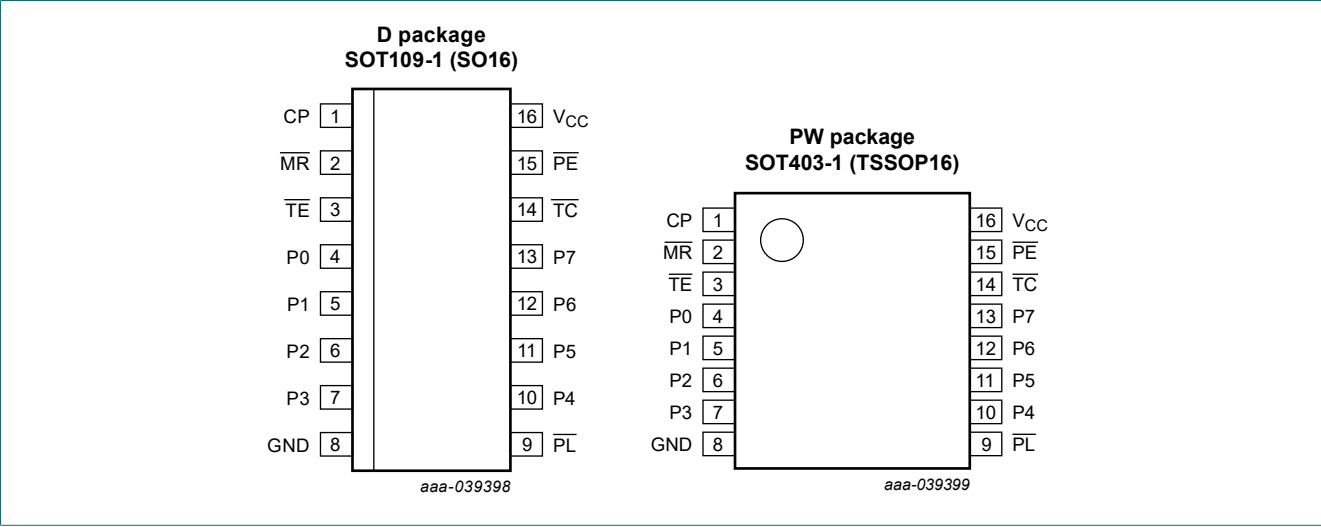


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Fig. 5. Logic diagram

6. Pinning information

6.1. Pinning



6.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description                                   |
|--------|-----|-----------------------------------------------|
| CP     | 1   | clock input (LOW-to-HIGH, edge-triggered)     |
| MR     | 2   | asynchronous master reset input (active LOW)  |
| TE     | 3   | terminal enable input (active LOW)            |
| P0     | 4   | jam input 0                                   |
| P1     | 5   | jam input 1                                   |
| P2     | 6   | jam input 2                                   |
| P3     | 7   | jam input 3                                   |
| GND    | 8   | ground (0 V)                                  |
| PL     | 9   | asynchronous preset enable input (active LOW) |
| P4     | 10  | jam input 4                                   |
| P5     | 11  | jam input 5                                   |
| P5     | 12  | jam input 6                                   |
| P7     | 13  | jam input 7                                   |
| TC     | 14  | terminal count output (active LOW)            |
| PE     | 15  | synchronous preset enable input (active LOW)  |
| VCC    | 16  | positive supply voltage                       |

7. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

| Control inputs |    |    |    | Preset mode  | Action [1]                                  |
|----------------|----|----|----|--------------|---------------------------------------------|
| MR             | PL | PE | TE |              |                                             |
| L              | X  | X  | X  | asynchronous | clear to maximum count                      |
| H              | L  | X  | X  | asynchronous | preset asynchronously                       |
|                | H  | L  | X  | synchronous  | preset on next LOW-to HIGH clock transition |
|                |    | H  | L  | synchronous  | count down                                  |
|                |    |    | H  | synchronous  | inhibit counter                             |

- [1] Clock connected to CP.  
Synchronous operation: changes occur on the LOW-to-HIGH CP transition.  
Jam inputs: MSD = P7, LSD = P0.

8. 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 | +7   | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V [1] | -    | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V [1] | -    | ±20  | mA   |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = -0.5 V to V <sub>CC</sub> + 0.5 V                      | -    | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                         | -    | +50  | mA   |
| I <sub>GND</sub> | ground current          |                                                                         | -50  | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                         | -65  | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | [2]                                                                     | -    | 500  | mW   |

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
[2] For SOT109-1 (SO16) package: P<sub>tot</sub> derates linearly with 12.4 mW/K above 110 °C.  
For SOT403-1 (TSSOP16) package: P<sub>tot</sub> derates linearly with 8.5 mW/K above 91 °C.

9. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol           | Parameter                            | Conditions              | Min | Typ  | Max             | Unit |
|------------------|--------------------------------------|-------------------------|-----|------|-----------------|------|
| V <sub>CC</sub>  | supply voltage                       |                         | 2.0 | 5.0  | 6.0             | V    |
| V <sub>I</sub>   | input voltage                        |                         | 0   | -    | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                       |                         | 0   | -    | V <sub>CC</sub> | V    |
| Δt/ΔV            | input transition rise and fall rates | V <sub>CC</sub> = 2.0 V | -   | -    | 625             | ns   |
|                  |                                      | V <sub>CC</sub> = 4.5 V | -   | 1.67 | 139             | ns   |
|                  |                                      | V <sub>CC</sub> = 6.0 V | -   | -    | 83              | ns   |
| T <sub>amb</sub> | ambient temperature                  |                         | -40 | -    | +125            | °C   |

10. Static characteristics

Table 6. Static characteristics

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

| Symbol                              | Parameter                 | Conditions                                                                             | Min  | Typ  | Max  | Unit |
|-------------------------------------|---------------------------|----------------------------------------------------------------------------------------|------|------|------|------|
| T <sub>amb</sub> = 25 °C            |                           |                                                                                        |      |      |      |      |
| 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> = -4 mA; V <sub>CC</sub> = 4.5 V                                        | 3.98 | 4.32 | -    | V    |
|                                     |                           | I <sub>O</sub> = -5.2 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> = 4 mA; V <sub>CC</sub> = 4.5 V                                         | -    | 0.15 | 0.26 | V    |
|                                     |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                       | -    | 0.16 | 0.26 | V    |
| I <sub>I</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>CC</sub>                     | 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   |
| T <sub>amb</sub> = -40 °C to +85 °C |                           |                                                                                        |      |      |      |      |
| 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> = -4 mA; V <sub>CC</sub> = 4.5 V                                        | 3.84 | -    | -    | V    |
|                                     |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V                                      | 5.34 | -    | -    | V    |

| Symbol                               | Parameter                 | Conditions                                                                             | Min  | Typ | Max  | Unit |
|--------------------------------------|---------------------------|----------------------------------------------------------------------------------------|------|-----|------|------|
| 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                                        | -    | -   | 0.1  | V    |
|                                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                        | -    | -   | 0.1  | V    |
|                                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                        | -    | -   | 0.1  | V    |
|                                      |                           | I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V                                         | -    | -   | 0.33 | V    |
|                                      |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                       | -    | -   | 0.33 | V    |
| I <sub>I</sub>                       | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V                       | -    | -   | ±1.0 | µA   |
| I <sub>CC</sub>                      | 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 | -    | -   | 80   | µA   |
| T <sub>amb</sub> = -40 °C to +125 °C |                           |                                                                                        |      |     |      |      |
| 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> = -4 mA; V <sub>CC</sub> = 4.5 V                                        | 3.7  | -   | -    | V    |
|                                      |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V                                      | 5.2  | -   | -    | 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                                        | -    | -   | 0.1  | V    |
|                                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                        | -    | -   | 0.1  | V    |
|                                      |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                        | -    | -   | 0.1  | V    |
|                                      |                           | I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V                                         | -    | -   | 0.4  | V    |
|                                      |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                       | -    | -   | 0.4  | V    |
| I <sub>I</sub>                       | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V                       | -    | -   | ±1.0 | µA   |
| I <sub>CC</sub>                      | 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 | -    | -   | 160  | µA   |



11. Dynamic characteristics

Table 7. Dynamic characteristics  
GND = 0 V;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit see Fig. 12.

| Symbol                   | Parameter                     | Conditions                                                    | Min | Typ | Max | Unit |
|--------------------------|-------------------------------|---------------------------------------------------------------|-----|-----|-----|------|
| T <sub>amb</sub> = 25 °C |                               |                                                               |     |     |     |      |
| t <sub>pd</sub>          | propagation delay             | CP to $\overline{\text{TC}}$ ; see Fig. 6 [1]                 |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | -   | 96  | 300 | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | -   | 35  | 60  | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | -   | 28  | 51  | ns   |
|                          |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF               | -   | 30  | -   | ns   |
|                          |                               | $\overline{\text{TE}}$ to $\overline{\text{TC}}$ ; see Fig. 7 |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | -   | 50  | 175 | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | -   | 18  | 35  | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | -   | 14  | 30  | ns   |
|                          |                               | PL to $\overline{\text{TC}}$ ; see Fig. 8                     |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | -   | 102 | 315 | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | -   | 37  | 63  | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | -   | 30  | 53  | ns   |
| t <sub>PHL</sub>         | HIGH to LOW propagation delay | MR to $\overline{\text{TC}}$ ; see Fig. 8                     |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | -   | 83  | 275 | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | -   | 30  | 55  | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | -   | 24  | 47  | ns   |
| t <sub>t</sub>           | transition time               | see Fig. 7 [2]                                                |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | -   | 19  | 75  | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | -   | 7   | 15  | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | -   | 6   | 13  | ns   |
| t <sub>w</sub>           | pulse width                   | CP HIGH or LOW; see Fig. 6                                    |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | 165 | 22  | -   | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | 33  | 8   | -   | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | 28  | 6   | -   | ns   |
|                          |                               | MR LOW; see Fig. 8                                            |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | 125 | 39  | -   | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | 25  | 14  | -   | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | 21  | 11  | -   | ns   |
|                          |                               | PL LOW; see Fig. 8                                            |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | 125 | 33  | -   | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | 25  | 12  | -   | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | 21  | 10  | -   | ns   |
| t <sub>rec</sub>         | recovery time                 | MR to CP, PL to CP; see Fig. 9                                |     |     |     |      |
|                          |                               | V <sub>CC</sub> = 2.0 V                                       | 50  | 14  | -   | ns   |
|                          |                               | V <sub>CC</sub> = 4.5 V                                       | 10  | 5   | -   | ns   |
|                          |                               | V <sub>CC</sub> = 6.0 V                                       | 9   | 4   | -   | ns   |

| Symbol                                                       | Parameter                     | Conditions                                     | Min | Typ | Max | Unit |
|--------------------------------------------------------------|-------------------------------|------------------------------------------------|-----|-----|-----|------|
| $t_{su}$                                                     | set-up time                   | PE to CP; see Fig. 10                          |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 75  | 22  | -   | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 15  | 8   | -   | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 13  | 6   | -   | ns   |
|                                                              |                               | TE to CP; see Fig. 11                          |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 150 | 44  | -   | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 30  | 16  | -   | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 26  | 13  | -   | ns   |
|                                                              |                               | Pn to CP; see Fig. 10                          |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 75  | 22  | -   | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 15  | 8   | -   | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 13  | 6   | -   | ns   |
| $t_h$                                                        | hold time                     | $\overline{PE}$ to CP; see Fig. 10             |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 0   | -14 | -   | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 0   | -5  | -   | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 0   | -4  | -   | ns   |
|                                                              |                               | TE to CP; see Fig. 11                          |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 0   | -30 | -   | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 0   | -11 | -   | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 0   | -9  | -   | ns   |
|                                                              |                               | Pn to CP; see Fig. 10                          |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 0   | -17 | -   | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 0   | -6  | -   | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 0   | -5  | -   | ns   |
| $f_{max}$                                                    | maximum frequency             | see Fig. 6                                     |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | 3.0 | 10  | -   | MHz  |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | 15  | 29  | -   | MHz  |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | 18  | 35  | -   | MHz  |
|                                                              |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 32  | -   | MHz  |
| $C_{PD}$                                                     | power dissipation capacitance | $V_I = \text{GND to } V_{CC}$ [3]              | -   | 24  | -   | pF   |
| <b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math></b> |                               |                                                |     |     |     |      |
| $t_{pd}$                                                     | propagation delay             | CP to $\overline{TC}$ ; see Fig. 6 [1]         |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | -   | -   | 375 | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | -   | -   | 75  | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | -   | -   | 64  | ns   |
|                                                              |                               | TE to $\overline{TC}$ ; see Fig. 7             |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | -   | -   | 220 | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | -   | -   | 44  | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | -   | -   | 37  | ns   |
|                                                              |                               | PL to $\overline{TC}$ ; see Fig. 8             |     |     |     |      |
|                                                              |                               | $V_{CC} = 2.0\text{ V}$                        | -   | -   | 395 | ns   |
|                                                              |                               | $V_{CC} = 4.5\text{ V}$                        | -   | -   | 79  | ns   |
|                                                              |                               | $V_{CC} = 6.0\text{ V}$                        | -   | -   | 40  | ns   |

| Symbol           | Parameter                     | Conditions                                     | Min | Typ | Max | Unit |
|------------------|-------------------------------|------------------------------------------------|-----|-----|-----|------|
| $t_{\text{PHL}}$ | HIGH to LOW propagation delay | MR to TC; see <a href="#">Fig. 8</a>           |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | -   | -   | 345 | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | -   | -   | 69  | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | -   | -   | 59  | ns   |
| $t_{\text{t}}$   | transition time               | see <a href="#">Fig. 7</a> [2]                 |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | -   | -   | 95  | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | -   | -   | 19  | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | -   | -   | 16  | ns   |
| $t_{\text{W}}$   | pulse width                   | CP HIGH or LOW; see <a href="#">Fig. 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   |
|                  |                               | MR LOW; see <a href="#">Fig. 8</a>             |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | 155 | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | 31  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | 26  | -   | -   | ns   |
|                  |                               | PL LOW; see <a href="#">Fig. 8</a>             |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | 155 | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | 31  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | 26  | -   | -   | ns   |
| $t_{\text{rec}}$ | recovery time                 | MR to CP, PL to CP; see <a href="#">Fig. 9</a> |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | 65  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | 13  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | 11  | -   | -   | ns   |
| $t_{\text{su}}$  | set-up time                   | PE to CP; see <a href="#">Fig. 10</a>          |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | 95  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | 19  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | 16  | -   | -   | ns   |
|                  |                               | TE to CP; see <a href="#">Fig. 11</a>          |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | 190 | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | 38  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | 33  | -   | -   | ns   |
|                  |                               | Pn to CP; see <a href="#">Fig. 10</a>          |     |     |     |      |
|                  |                               | $V_{\text{CC}} = 2.0 \text{ V}$                | 95  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 4.5 \text{ V}$                | 19  | -   | -   | ns   |
|                  |                               | $V_{\text{CC}} = 6.0 \text{ V}$                | 16  | -   | -   | ns   |

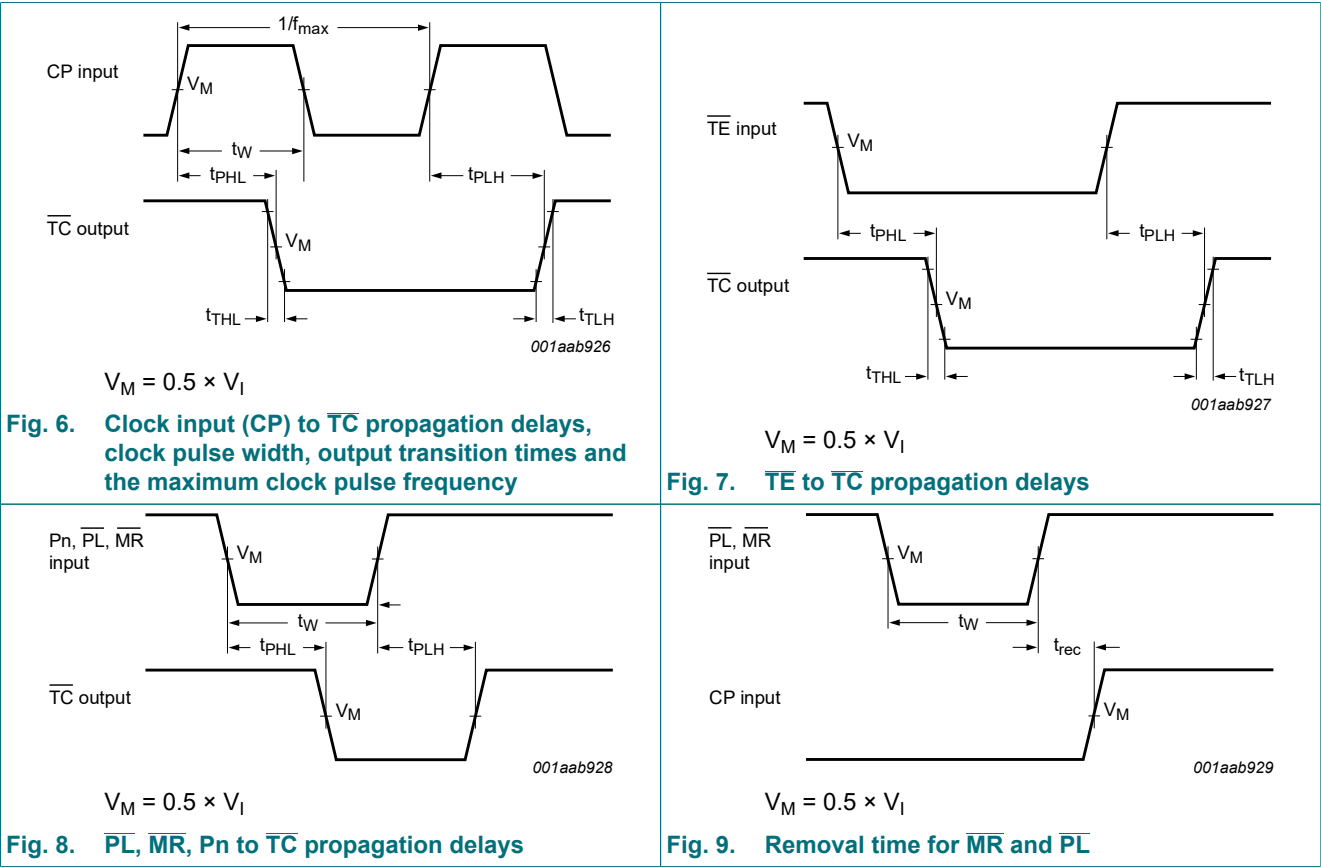
| Symbol                               | Parameter                     | Conditions                               | Min | Typ | Max | Unit |
|--------------------------------------|-------------------------------|------------------------------------------|-----|-----|-----|------|
| t <sub>h</sub>                       | hold time                     | PE to CP; see <a href="#">Fig. 10</a>    |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | 0   | -   | -   | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | 0   | -   | -   | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | 0   | -   | -   | ns   |
|                                      |                               | TE to CP; see <a href="#">Fig. 11</a>    |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | 0   | -   | -   | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | 0   | -   | -   | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | 0   | -   | -   | ns   |
|                                      |                               | Pn to CP; see <a href="#">Fig. 10</a>    |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | 0   | -   | -   | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | 0   | -   | -   | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | 0   | -   | -   | ns   |
| f <sub>max</sub>                     | maximum frequency             | see <a href="#">Fig. 6</a>               |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | 2.4 | -   | -   | MHz  |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | 12  | -   | -   | MHz  |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | 14  | -   | -   | MHz  |
| T <sub>amb</sub> = -40 °C to +125 °C |                               |                                          |     |     |     |      |
| t <sub>pd</sub>                      | propagation delay             | CP to TC; see <a href="#">Fig. 6</a> [1] |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | -   | -   | 450 | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | -   | -   | 90  | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | -   | -   | 77  | ns   |
|                                      |                               | TE to TC; see <a href="#">Fig. 7</a>     |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | -   | -   | 265 | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | -   | -   | 53  | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | -   | -   | 45  | ns   |
|                                      |                               | PL to TC; see <a href="#">Fig. 8</a>     |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | -   | -   | 475 | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | -   | -   | 95  | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | -   | -   | 81  | ns   |
| t <sub>PHL</sub>                     | HIGH to LOW propagation delay | MR to TC; see <a href="#">Fig. 8</a>     |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | -   | -   | 415 | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | -   | -   | 83  | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | -   | -   | 71  | ns   |
| t <sub>t</sub>                       | transition time               | see <a href="#">Fig. 7</a> [2]           |     |     |     |      |
|                                      |                               | V <sub>CC</sub> = 2.0 V                  | -   | -   | 110 | ns   |
|                                      |                               | V <sub>CC</sub> = 4.5 V                  | -   | -   | 22  | ns   |
|                                      |                               | V <sub>CC</sub> = 6.0 V                  | -   | -   | 19  | ns   |

| Symbol           | Parameter     | Conditions                                                                             | Min | Typ | Max | Unit |
|------------------|---------------|----------------------------------------------------------------------------------------|-----|-----|-----|------|
| t <sub>W</sub>   | pulse width   | CP HIGH or LOW; see <a href="#">Fig. 6</a>                                             |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 250 | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 50  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 43  | -   | -   | ns   |
|                  |               | $\overline{\text{MR}}$ LOW; see <a href="#">Fig. 8</a>                                 |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 190 | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 38  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 32  | -   | -   | ns   |
|                  |               | $\overline{\text{PL}}$ LOW; see <a href="#">Fig. 8</a>                                 |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 190 | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 38  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 32  | -   | -   | ns   |
| t <sub>rec</sub> | recovery time | $\overline{\text{MR}}$ to CP, $\overline{\text{PL}}$ to CP; see <a href="#">Fig. 9</a> |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 75  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 15  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 13  | -   | -   | ns   |
| t <sub>su</sub>  | set-up time   | $\overline{\text{PE}}$ to CP; see <a href="#">Fig. 10</a>                              |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 110 | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 22  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 19  | -   | -   | ns   |
|                  |               | $\overline{\text{TE}}$ to CP; see <a href="#">Fig. 11</a>                              |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 225 | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 45  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 38  | -   | -   | ns   |
|                  |               | $\overline{\text{Pn}}$ to CP; see <a href="#">Fig. 10</a>                              |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 110 | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 22  | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 19  | -   | -   | ns   |
| t <sub>h</sub>   | hold time     | $\overline{\text{PE}}$ to CP; see <a href="#">Fig. 10</a>                              |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 0   | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 0   | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 0   | -   | -   | ns   |
|                  |               | $\overline{\text{TE}}$ to CP; see <a href="#">Fig. 11</a>                              |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 0   | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 0   | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 0   | -   | -   | ns   |
|                  |               | $\overline{\text{Pn}}$ to CP; see <a href="#">Fig. 10</a>                              |     |     |     |      |
|                  |               | V <sub>CC</sub> = 2.0 V                                                                | 0   | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 4.5 V                                                                | 0   | -   | -   | ns   |
|                  |               | V <sub>CC</sub> = 6.0 V                                                                | 0   | -   | -   | ns   |

| Symbol           | Parameter         | Conditions              | Min | Typ | Max | Unit |
|------------------|-------------------|-------------------------|-----|-----|-----|------|
| f <sub>max</sub> | maximum frequency | see Fig. 6              |     |     |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V | 2.0 | -   | -   | MHz  |
|                  |                   | V <sub>CC</sub> = 4.5 V | 10  | -   | -   | MHz  |
|                  |                   | V <sub>CC</sub> = 6.0 V | 12  | -   | -   | MHz  |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub>, t<sub>PLH</sub>.
- [2] t<sub>i</sub> is the same as t<sub>THL</sub>, t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) 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;  
Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

11.1. Waveforms and test circuit



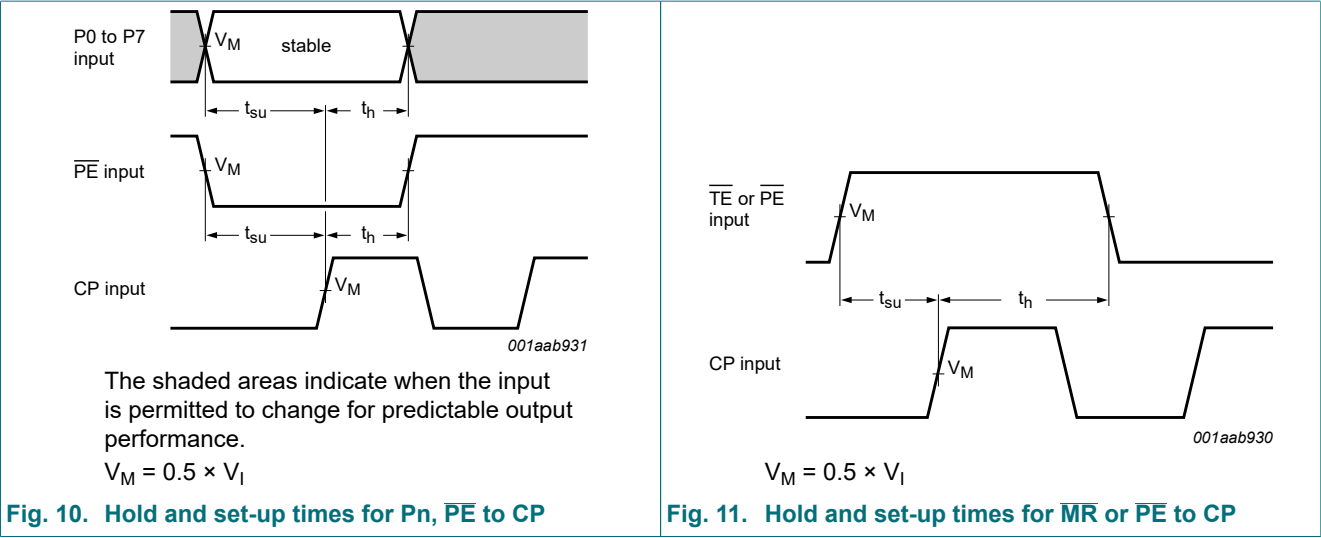


Fig. 10. Hold and set-up times for Pn,  $\overline{PE}$  to CP

Fig. 11. Hold and set-up times for  $\overline{MR}$  or  $\overline{PE}$  to CP

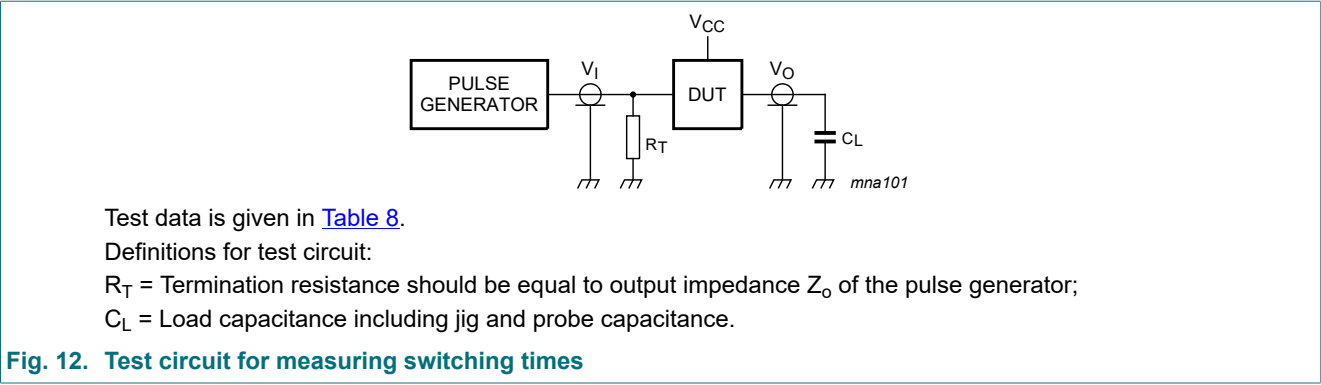


Fig. 12. Test circuit for measuring switching times

Table 8. Test data

| Supply   | Input    |            | Load  |
|----------|----------|------------|-------|
| $V_{CC}$ | $V_I$    | $t_r, t_f$ | $C_L$ |
| 2.0 V    | $V_{CC}$ | 6 ns       | 50 pF |
| 4.5 V    | $V_{CC}$ | 6 ns       | 50 pF |
| 6.0 V    | $V_{CC}$ | 6 ns       | 50 pF |
| 5.0 V    | $V_{CC}$ | 6 ns       | 15 pF |

12. Application information

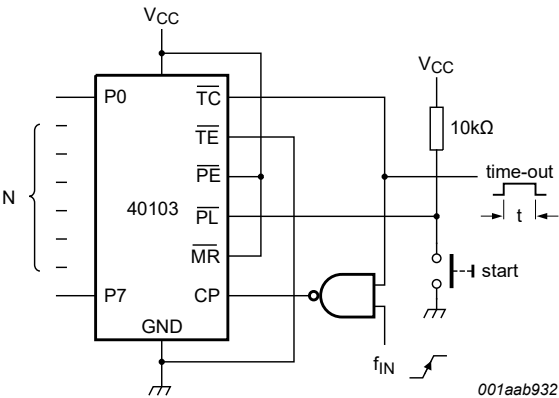


Fig. 13. Programmable timer

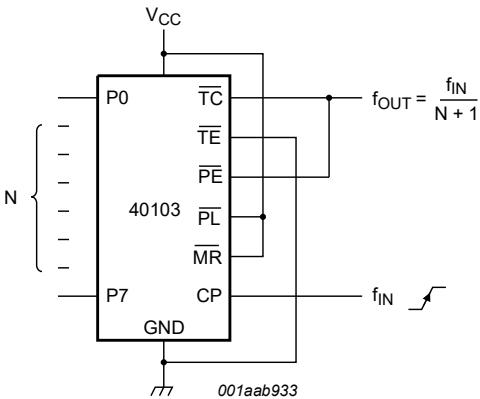


Fig. 14. Divide-by-N counter



13. Package outline

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

SOT109-1

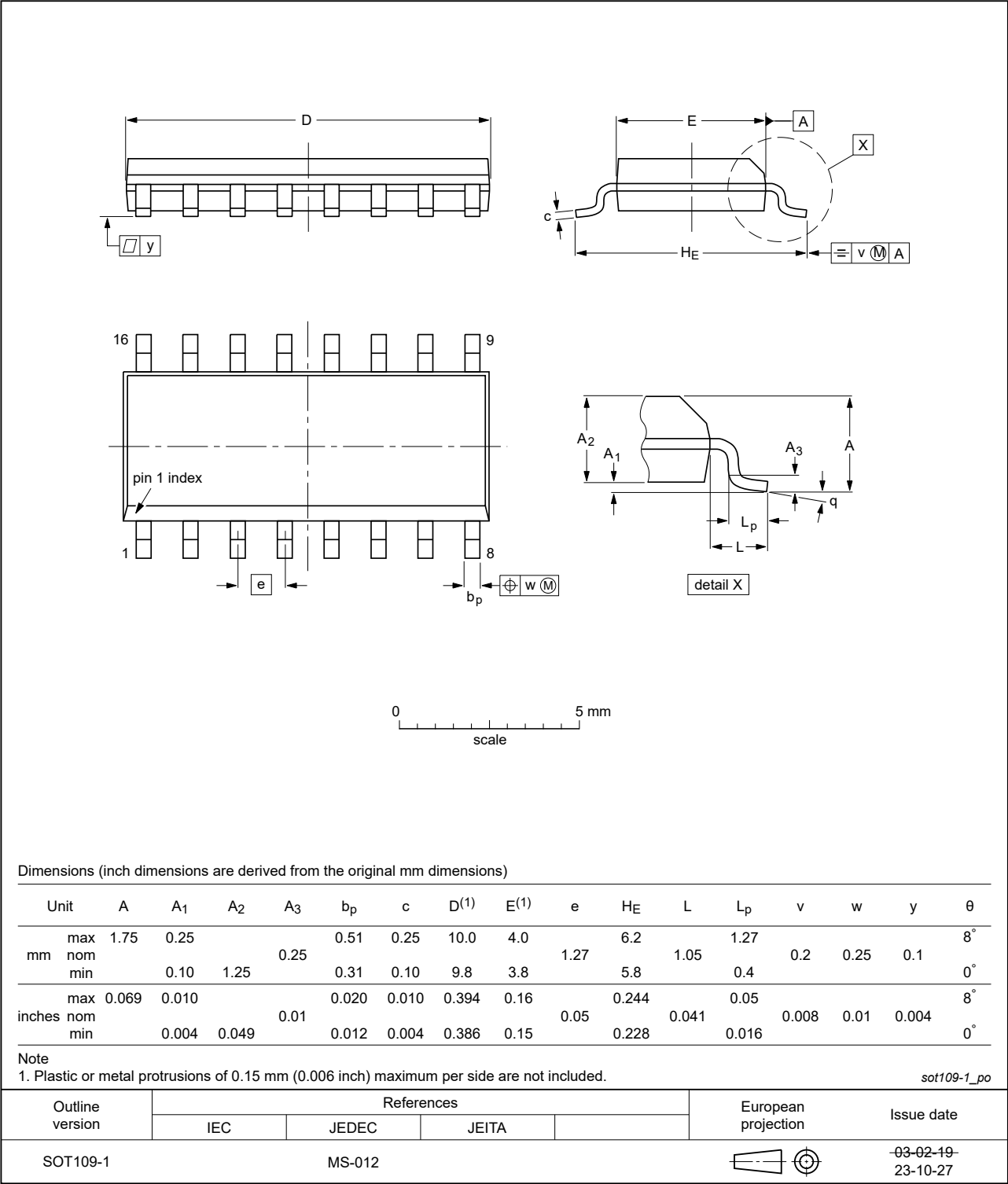


Fig. 15. Package outline SOT109-1 (SO16)

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

SOT403-1

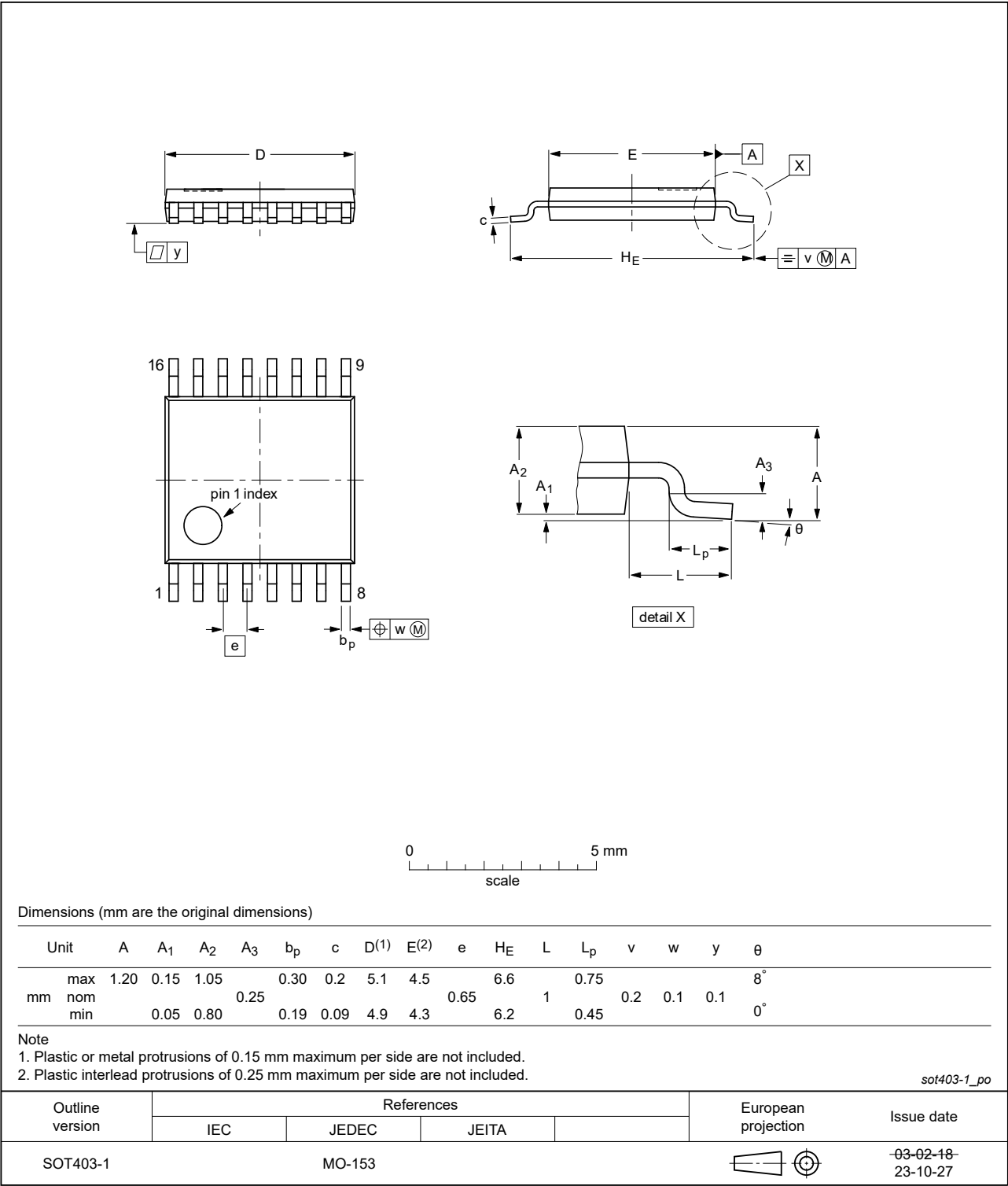


Fig. 16. Package outline SOT403-1 (TSSOP16)

14. Abbreviations

Table 9. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CDM     | Charged Device Model                    |
| CMOS    | Complementary Metal Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |

15. Revision history

Table 10. Revision history

| Document ID           | Release date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Data sheet status     | Change notice | Supersedes            |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|-----------------------|
| 74HC40103 v.6         | 20240326                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC40103 v.5         |
| Modifications:        | <ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li><a href="#">Section 2</a>: ESD specification updated according to the latest JEDEC standard.</li><li><a href="#">Table 4</a>: Derating values for P<sub>tot</sub> total power dissipation updated.</li><li><a href="#">Fig. 15</a>, <a href="#">Fig. 16</a>: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153</li></ul> |                       |               |                       |
| 74HC40103 v.5         | 20160421                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC40103 v.4         |
| Modifications:        | <ul style="list-style-type: none"><li>Type number 74HC40103DB (SOT338-1) removed.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |               |                       |
| 74HC40103 v.4         | 20160127                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC40103 v.3         |
| Modifications:        | <ul style="list-style-type: none"><li>Type number 74HC40103N (SOT38-4) removed.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |               |                       |
| 74HC40103 v.3         | 20041112                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC_HCT40103_CNV v.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 74HCT40103.</li><li>Inserted family specification.</li></ul>                                                                                                                                                                                                                                                                                                         |                       |               |                       |
| 74HC_HCT40103_CNV v.2 | 19970918                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Product specification | -             | 74HC_HCT40103 v.1     |
| 74HC_HCT40103 v.1     | 19901201                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Product specification | -             | -                     |

## 16. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | Definition                                                                            |
|--------------------------------|--------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet   | Development        | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification      | This document contains data from the preliminary specification.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [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 <https://www.nexperia.com>.

### Definitions

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