# 74HC40103

## 8-bit synchronous binary down counter

Rev. 5 — 21 April 2016 Product data sheet

## 1. General description

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

- Cascadable
- Synchronous or asynchronous preset
- Low-power dissipation
- Complies with JEDEC standard no. 7A
- CMOS input levels
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from −40 °C to +80 °C and from −40 °C to +125 °C

## 3. Applications

- 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 |
| 74HC40103D | –40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HC40103PW | –40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |

## 5. Functional diagram

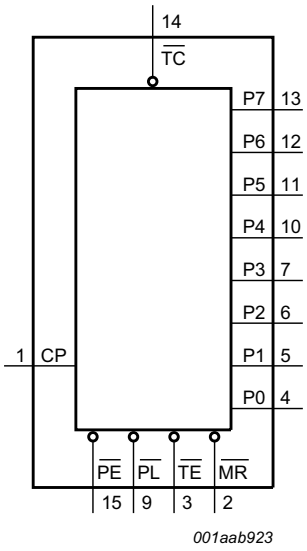



**Fig 1. Functional diagram**

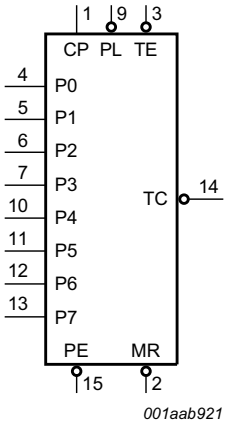



**Fig 2. Logic symbol**

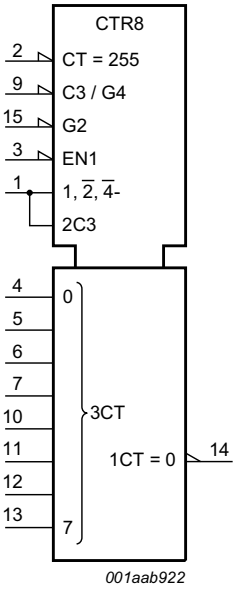



**Fig 3. IEC logic symbol**

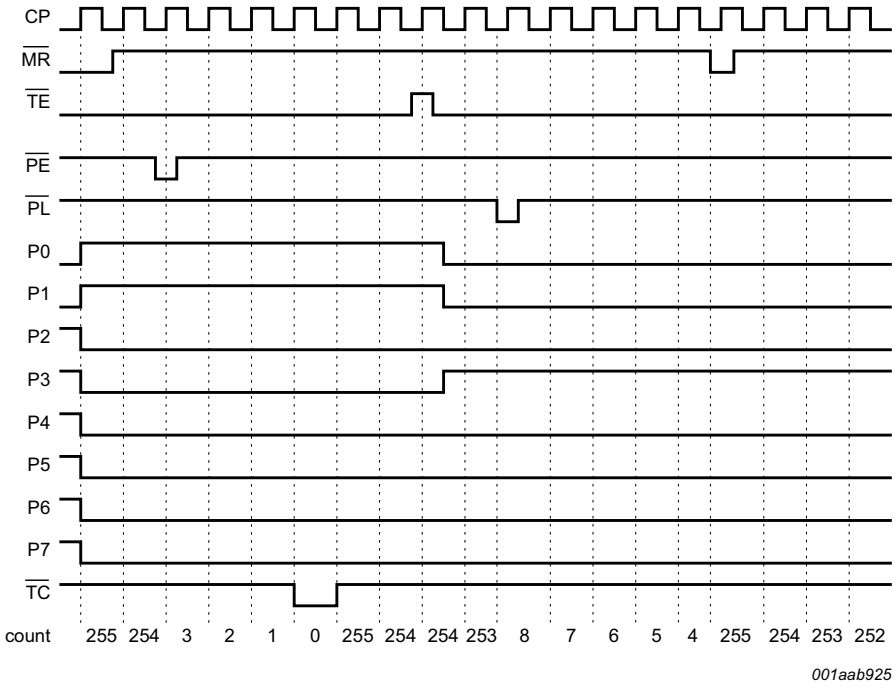



**Fig 4. Timing diagram**

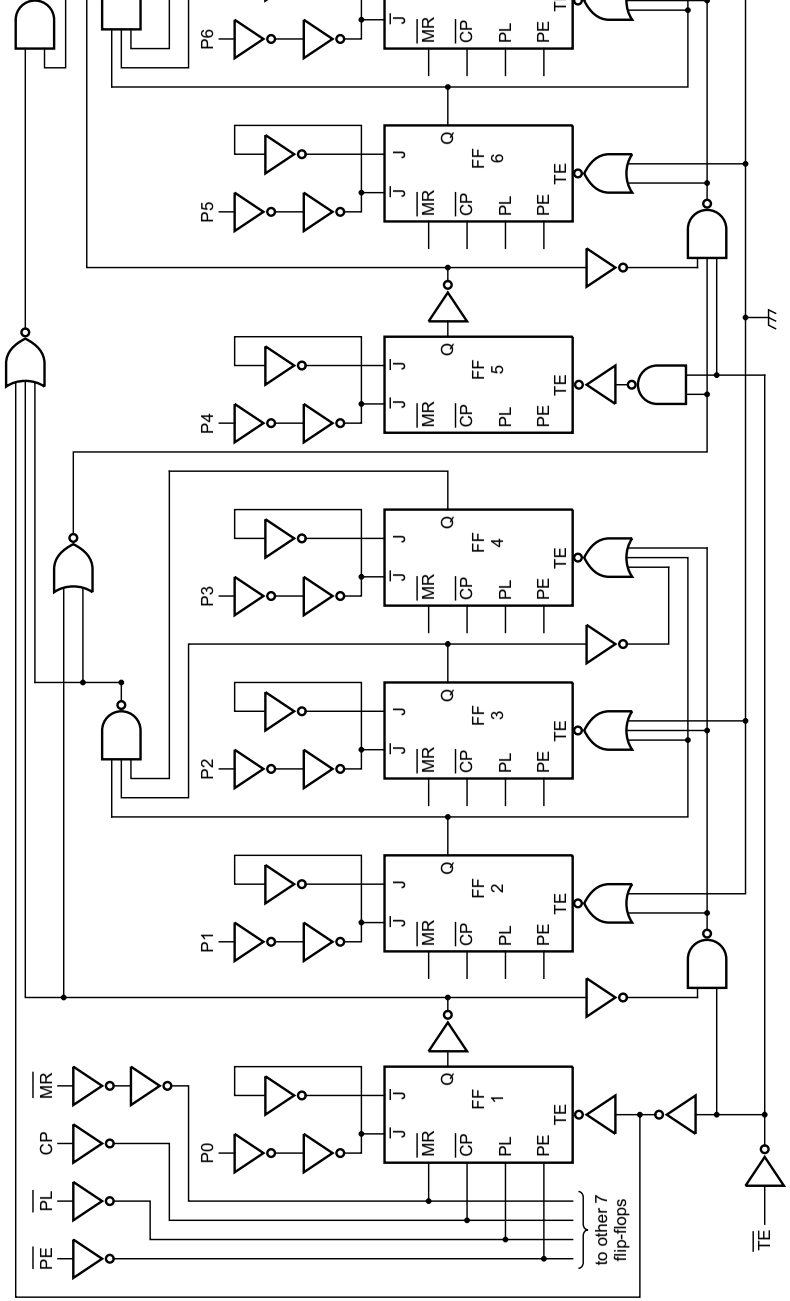



**Fig 5. Logic diagram**

# 6. Pinning information

## 6.1 Pinning

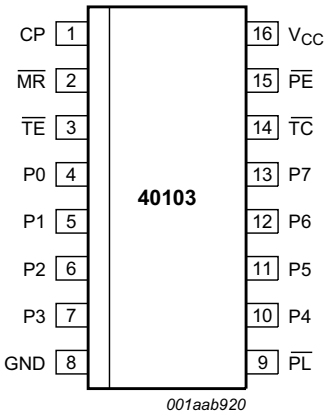



**Fig 6. Pin configuration**

## 6.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| CP | 1 | clock input (LOW-to-HIGH, edge-triggered) |
| $\overline{MR}$ | 2 | asynchronous master reset input (active LOW) |
| $\overline{TE}$ | 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) |
| $\overline{PL}$ | 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 |
| $\overline{TC}$ | 14 | terminal count output (active LOW) |
| $\overline{PE}$ | 15 | synchronous preset enable input (active LOW) |
| $V_{CC}$ | 16 | positive supply voltage |

# 7. Functional description

## 7.1 Function table

**Table 3. Function table[1]**

| Control inputs | | | | Preset mode | Action[2] |
|---|---|---|---|---|---|
| $\overline{MR}$ | $\overline{PL}$ | $\overline{PE}$ | $\overline{TE}$ | | |
| 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] H = HIGH voltage level;
L = LOW voltage level;
X = don't care.

[2] 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 |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | | −0.5 | +7 | V |
| $I_{IK}$ | input clamping current | $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V | [1] | - | ±20 | mA |
| $I_{OK}$ | output clamping current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V | [1] | - | ±20 | mA |
| $I_O$ | output current | $V_O = -0.5$ V to $V_{CC} + 0.5$ V | | - | ±25 | mA |
| $I_{CC}$ | supply current | | | - | +50 | mA |
| $I_{GND}$ | ground current | | | −50 | - | mA |
| $T_{stg}$ | storage temperature | | | −65 | +150 | °C |
| $P_{tot}$ | total power dissipation | SO16 package | [2] | - | 500 | mW |
| | | TSSOP16 packages | [3] | - | 500 | mW |

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

[2] For SO16 package: above 70 °C, $P_{tot}$ derates linearly with 8 mW/K.

[3] For TSSOP16 package: above 60 °C, $P_{tot}$ derates linearly with 5.5 mW/K.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 2.0 | 5.0 | 6.0 | V |
| $V_I$ | input voltage | | 0 | - | $V_{CC}$ | V |
| $V_O$ | output voltage | | 0 | - | $V_{CC}$ | V |
| $\Delta t/\Delta V$ | input transition rise and fall rates | $V_{CC}$ = 2.0 V | - | - | 625 | ns |
| | | $V_{CC}$ = 4.5 V | - | 1.67 | 139 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 83 | ns |
| $T_{amb}$ | 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 |
|---|---|---|---|---|---|---|
| **$T_{amb}$ = 25 °C** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 2.0 V | 1.5 | 1.2 | - | V |
| | | $V_{CC}$ = 4.5 V | 3.15 | 2.4 | - | V |
| | | $V_{CC}$ = 6.0 V | 4.2 | 3.2 | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 2.0 V | - | 0.8 | 0.5 | V |
| | | $V_{CC}$ = 4.5 V | - | 2.1 | 1.35 | V |
| | | $V_{CC}$ = 6.0 V | - | 2.8 | 1.8 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = −20 μA; $V_{CC}$ = 2.0 V | 1.9 | 2.0 | - | V |
| | | $I_O$ = −20 μA; $V_{CC}$ = 4.5 V | 4.4 | 4.5 | - | V |
| | | $I_O$ = −20 μA; $V_{CC}$ = 6.0 V | 5.9 | 6.0 | - | V |
| | | $I_O$ = −4 mA; $V_{CC}$ = 4.5 V | 3.98 | 4.32 | - | V |
| | | $I_O$ = −5.2 mA; $V_{CC}$ = 6.0 V | 5.48 | 5.81 | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 2.0 V | - | 0 | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 4.5 V | - | 0 | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 6.0 V | - | 0 | 0.1 | V |
| | | $I_O$ = 4 mA; $V_{CC}$ = 4.5 V | - | 0.15 | 0.26 | V |
| | | $I_O$ = 5.2 mA; $V_{CC}$ = 6.0 V | - | 0.16 | 0.26 | V |
| $I_I$ | input leakage current | $V_I$ = $V_{CC}$ or GND; $V_{CC}$ = 6.0 V | - | - | ±0.1 | μA |
| $I_{CC}$ | supply current | $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 6.0 V | - | - | 8.0 | μA |
| $C_I$ | input capacitance | | - | 3.5 | - | pF |

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

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **$T_{amb}$ = –40 °C to +85 °C** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 2.0 V | 1.5 | - | - | V |
| | | $V_{CC}$ = 4.5 V | 3.15 | - | - | V |
| | | $V_{CC}$ = 6.0 V | 4.2 | - | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 2.0 V | - | - | 0.5 | V |
| | | $V_{CC}$ = 4.5 V | - | - | 1.35 | V |
| | | $V_{CC}$ = 6.0 V | - | - | 1.8 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = –20 μA; $V_{CC}$ = 2.0 V | 1.9 | - | - | V |
| | | $I_O$ = –20 μA; $V_{CC}$ = 4.5 V | 4.4 | - | - | V |
| | | $I_O$ = –20 μA; $V_{CC}$ = 6.0 V | 5.9 | - | - | V |
| | | $I_O$ = –4 mA; $V_{CC}$ = 4.5 V | 3.84 | - | - | V |
| | | $I_O$ = –5.2 mA; $V_{CC}$ = 6.0 V | 5.34 | - | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 2.0 V | - | - | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 4.5 V | - | - | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 6.0 V | - | - | 0.1 | V |
| | | $I_O$ = 4 mA; $V_{CC}$ = 4.5 V | - | - | 0.33 | V |
| | | $I_O$ = 5.2 mA; $V_{CC}$ = 6.0 V | - | - | 0.33 | V |
| $I_I$ | input leakage current | $V_I$ = $V_{CC}$ or GND; $V_{CC}$ = 6.0 V | - | - | ±1.0 | μA |
| $I_{CC}$ | supply current | $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 6.0 V | - | - | 80 | μA |
| **$T_{amb}$ = –40 °C to +125 °C** | | | | | | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 2.0 V | 1.5 | - | - | V |
| | | $V_{CC}$ = 4.5 V | 3.15 | - | - | V |
| | | $V_{CC}$ = 6.0 V | 4.2 | - | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 2.0 V | - | - | 0.5 | V |
| | | $V_{CC}$ = 4.5 V | - | - | 1.35 | V |
| | | $V_{CC}$ = 6.0 V | - | - | 1.8 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I$ = $V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = –20 μA; $V_{CC}$ = 2.0 V | 1.9 | - | - | V |
| | | $I_O$ = –20 μA; $V_{CC}$ = 4.5 V | 4.4 | - | - | V |
| | | $I_O$ = –20 μA; $V_{CC}$ = 6.0 V | 5.9 | - | - | V |
| | | $I_O$ = –4 mA; $V_{CC}$ = 4.5 V | 3.7 | - | - | V |
| | | $I_O$ = –5.2 mA; $V_{CC}$ = 6.0 V | 5.2 | - | - | V |

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

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | |
| | | $I_O$ = 20 μA; $V_{CC}$ = 2.0 V | - | - | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 4.5 V | - | - | 0.1 | V |
| | | $I_O$ = 20 μA; $V_{CC}$ = 6.0 V | - | - | 0.1 | V |
| | | $I_O$ = 4 mA; $V_{CC}$ = 4.5 V | - | - | 0.4 | V |
| | | $I_O$ = 5.2 mA; $V_{CC}$ = 6.0 V | - | - | 0.4 | V |
| $I_I$ | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC}$ = 6.0 V | - | - | ±1.0 | μA |
| $I_{CC}$ | supply current | $V_I = V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 6.0 V | - | - | 160 | μA |

# 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

*GND = 0 V; $t_r = t_f$ = 6 ns; $C_L$ = 50 pF; see Figure 13.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **$T_{amb}$ = 25 °C** | | | | | | |
| $t_{pd}$ | propagation delay | CP to $\overline{TC}$; see Figure 7 [1] | | | | |
| | | $V_{CC}$ = 2.0 V | - | 96 | 300 | ns |
| | | $V_{CC}$ = 4.5 V | - | 35 | 60 | ns |
| | | $V_{CC}$ = 6.0 V | - | 28 | 51 | ns |
| | | $V_{CC}$ = 5.0 V; $C_L$ = 15 pF | - | 30 | - | ns |
| | | $\overline{TE}$ to $\overline{TC}$; see Figure 8 | | | | |
| | | $V_{CC}$ = 2.0 V | - | 50 | 175 | ns |
| | | $V_{CC}$ = 4.5 V | - | 18 | 35 | ns |
| | | $V_{CC}$ = 6.0 V | - | 14 | 30 | ns |
| | | $\overline{PL}$ to $\overline{TC}$; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | - | 102 | 315 | ns |
| | | $V_{CC}$ = 4.5 V | - | 37 | 63 | ns |
| | | $V_{CC}$ = 6.0 V | - | 30 | 53 | ns |
| $t_{PHL}$ | HIGH to LOW propagation delay | $\overline{MR}$ to $\overline{TC}$; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | - | 83 | 275 | ns |
| | | $V_{CC}$ = 4.5 V | - | 30 | 55 | ns |
| | | $V_{CC}$ = 6.0 V | - | 24 | 47 | ns |
| $t_t$ | transition time | see Figure 8 [2] | | | | |
| | | $V_{CC}$ = 2.0 V | - | 19 | 75 | ns |
| | | $V_{CC}$ = 4.5 V | - | 7 | 15 | ns |
| | | $V_{CC}$ = 6.0 V | - | 6 | 13 | ns |

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

*GND = 0 V; $t_r = t_f$ = 6 ns; $C_L$ = 50 pF; see Figure 13.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_W$ | pulse width | CP HIGH or LOW; see Figure 7 | | | | |
| | | $V_{CC}$ = 2.0 V | 165 | 22 | - | ns |
| | | $V_{CC}$ = 4.5 V | 33 | 8 | - | ns |
| | | $V_{CC}$ = 6.0 V | 28 | 6 | - | ns |
| | | $\overline{MR}$ LOW; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | 125 | 39 | - | ns |
| | | $V_{CC}$ = 4.5 V | 25 | 14 | - | ns |
| | | $V_{CC}$ = 6.0 V | 21 | 11 | - | ns |
| | | $\overline{PL}$ LOW; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | 125 | 33 | - | ns |
| | | $V_{CC}$ = 4.5 V | 25 | 12 | - | ns |
| | | $V_{CC}$ = 6.0 V | 21 | 10 | - | ns |
| $t_{rec}$ | recovery time | $\overline{MR}$ to CP, $\overline{PL}$ to CP; see Figure 10 | | | | |
| | | $V_{CC}$ = 2.0 V | 50 | 14 | - | ns |
| | | $V_{CC}$ = 4.5 V | 10 | 5 | - | ns |
| | | $V_{CC}$ = 6.0 V | 9 | 4 | - | ns |
| $t_{su}$ | set-up time | $\overline{PE}$ to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 75 | 22 | - | ns |
| | | $V_{CC}$ = 4.5 V | 15 | 8 | - | ns |
| | | $V_{CC}$ = 6.0 V | 13 | 6 | - | ns |
| | | $\overline{TE}$ to CP; see Figure 12 | | | | |
| | | $V_{CC}$ = 2.0 V | 150 | 44 | - | ns |
| | | $V_{CC}$ = 4.5 V | 30 | 16 | - | ns |
| | | $V_{CC}$ = 6.0 V | 26 | 13 | - | ns |
| | | Pn to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 75 | 22 | - | ns |
| | | $V_{CC}$ = 4.5 V | 15 | 8 | - | ns |
| | | $V_{CC}$ = 6.0 V | 13 | 6 | - | ns |
| $t_h$ | hold time | $\overline{PE}$ to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | –14 | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | –5 | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | –4 | - | ns |
| | | $\overline{TE}$ to CP; see Figure 12 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | –30 | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | –11 | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | –9 | - | ns |
| | | Pn to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | –17 | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | –6 | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | –5 | - | ns |

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

*GND = 0 V; $t_r = t_f$ = 6 ns; $C_L$ = 50 pF; see Figure 13.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $f_{max}$ | maximum frequency | see Figure 7 | | | | |
| | | $V_{CC}$ = 2.0 V | 3.0 | 10 | - | MHz |
| | | $V_{CC}$ = 4.5 V | 15 | 29 | - | MHz |
| | | $V_{CC}$ = 6.0 V | 18 | 35 | - | MHz |
| | | $V_{CC}$ = 5.0 V; $C_L$ = 15 pF | - | 32 | - | MHz |
| $C_{PD}$ | power dissipation capacitance | $V_I$ = GND to $V_{CC}$ [3] | - | 24 | - | pF |
| **$T_{amb}$ = –40 °C to +85 °C** | | | | | | |
| $t_{pd}$ | propagation delay | CP to $\overline{TC}$; see Figure 7 [1] | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 375 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 75 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 64 | ns |
| | | $\overline{TE}$ to $\overline{TC}$; see Figure 8 | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 220 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 44 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 37 | ns |
| | | $\overline{PL}$ to $\overline{TC}$; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 395 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 79 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 40 | ns |
| $t_{PHL}$ | HIGH to LOW propagation delay | $\overline{MR}$ to $\overline{TC}$; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 345 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 69 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 59 | ns |
| $t_t$ | transition time | see Figure 8 [2] | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 95 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 19 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 16 | ns |
| $t_W$ | pulse width | CP HIGH or LOW; see Figure 7 | | | | |
| | | $V_{CC}$ = 2.0 V | 205 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 41 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 35 | - | - | ns |
| | | $\overline{MR}$ LOW; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | 155 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 31 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 26 | - | - | ns |
| | | $\overline{PL}$ LOW; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | 155 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 31 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 26 | - | - | ns |

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

*GND = 0 V; $t_r = t_f$ = 6 ns; $C_L$ = 50 pF; see Figure 13.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{rec}$ | recovery time | $\overline{MR}$ to CP, $\overline{PL}$ to CP; see Figure 10 | | | | |
| | | $V_{CC}$ = 2.0 V | 65 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 13 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 11 | - | - | ns |
| $t_{su}$ | set-up time | $\overline{PE}$ to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 95 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 19 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 16 | - | - | ns |
| | | $\overline{TE}$ to CP; see Figure 12 | | | | |
| | | $V_{CC}$ = 2.0 V | 190 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 38 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 33 | - | - | ns |
| | | Pn to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 95 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 19 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 16 | - | - | ns |
| $t_h$ | hold time | $\overline{PE}$ to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | - | - | ns |
| | | $\overline{TE}$ to CP; see Figure 12 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | - | - | ns |
| | | Pn to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | - | - | ns |
| $f_{max}$ | maximum frequency | see Figure 7 | | | | |
| | | $V_{CC}$ = 2.0 V | 2.4 | - | - | MHz |
| | | $V_{CC}$ = 4.5 V | 12 | - | - | MHz |
| | | $V_{CC}$ = 6.0 V | 14 | - | - | MHz |

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

*GND = 0 V; $t_r = t_f$ = 6 ns; $C_L$ = 50 pF; see Figure 13.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **$T_{amb}$ = –40 °C to +125 °C** | | | | | | |
| $t_{pd}$ | propagation delay | CP to $\overline{TC}$; see Figure 7 [1] | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 450 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 90 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 77 | ns |
| | | $\overline{TE}$ to $\overline{TC}$; see Figure 8 | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 265 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 53 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 45 | ns |
| | | $\overline{PL}$ to $\overline{TC}$; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 475 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 95 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 81 | ns |
| $t_{PHL}$ | HIGH to LOW propagation delay | $\overline{MR}$ to $\overline{TC}$; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 415 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 83 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 71 | ns |
| $t_t$ | transition time | see Figure 8 [2] | | | | |
| | | $V_{CC}$ = 2.0 V | - | - | 110 | ns |
| | | $V_{CC}$ = 4.5 V | - | - | 22 | ns |
| | | $V_{CC}$ = 6.0 V | - | - | 19 | ns |
| $t_W$ | pulse width | CP HIGH or LOW; see Figure 7 | | | | |
| | | $V_{CC}$ = 2.0 V | 250 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 50 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 43 | - | - | ns |
| | | $\overline{MR}$ LOW; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | 190 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 38 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 32 | - | - | ns |
| | | $\overline{PL}$ LOW; see Figure 9 | | | | |
| | | $V_{CC}$ = 2.0 V | 190 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 38 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 32 | - | - | ns |
| $t_{rec}$ | recovery time | $\overline{MR}$ to CP, $\overline{PL}$ to CP; see Figure 10 | | | | |
| | | $V_{CC}$ = 2.0 V | 75 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 15 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 13 | - | - | ns |

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

*GND = 0 V; $t_r = t_f$ = 6 ns; $C_L$ = 50 pF; see Figure 13.*

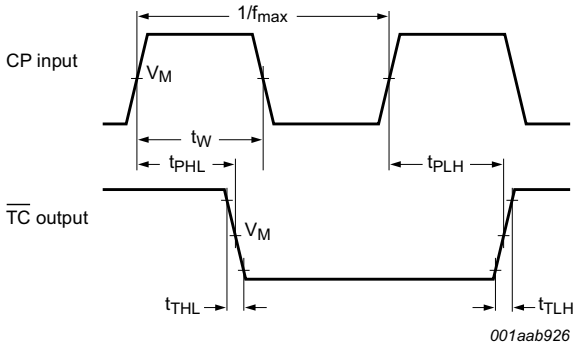
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{su}$ | set-up time | $\overline{PE}$ to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 110 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 22 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 19 | - | - | ns |
| | | $\overline{TE}$ to CP; see Figure 12 | | | | |
| | | $V_{CC}$ = 2.0 V | 225 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 45 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 38 | - | - | ns |
| | | Pn to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 110 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 22 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 19 | - | - | ns |
| $t_h$ | hold time | $\overline{PE}$ to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | - | - | ns |
| | | $\overline{TE}$ to CP; see Figure 12 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | - | - | ns |
| | | Pn to CP; see Figure 11 | | | | |
| | | $V_{CC}$ = 2.0 V | 0 | - | - | ns |
| | | $V_{CC}$ = 4.5 V | 0 | - | - | ns |
| | | $V_{CC}$ = 6.0 V | 0 | - | - | ns |
| $f_{max}$ | maximum frequency | see Figure 7 | | | | |
| | | $V_{CC}$ = 2.0 V | 2.0 | - | - | MHz |
| | | $V_{CC}$ = 4.5 V | 10 | - | - | MHz |
| | | $V_{CC}$ = 6.0 V | 12 | - | - | MHz |

[1] $t_{pd}$ is the same as $t_{PHL}$, $t_{PLH}$.

[2] $t_t$ is the same as $t_{THL}$, $t_{TLH}$.

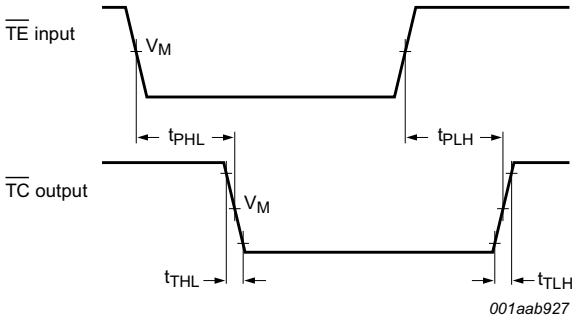
[3] $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in μW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ where:
$f_i$ = input frequency in MHz;
$f_o$ = output frequency in MHz;
$C_L$ = output load capacitance in pF;
$V_{CC}$ = supply voltage in V;
N = number of inputs switching;
$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

## 12. Waveforms



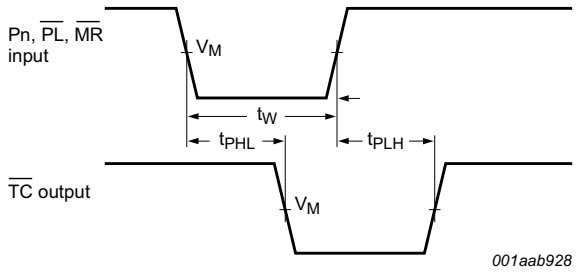

$V_M = 0.5 \times V_I$

**Fig 7. Waveforms showing the clock input (CP) to TC propagation delays, the clock pulse width, the output transition times and the maximum clock pulse frequency**



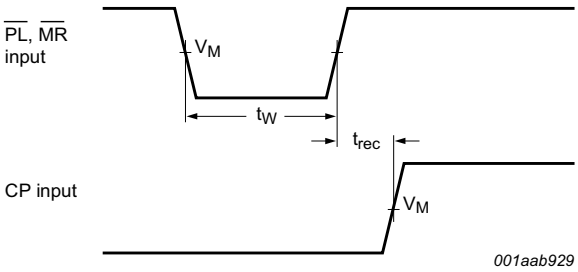

$V_M = 0.5 \times V_I$

**Fig 8. Waveforms showing the $\overline{TE}$ to $\overline{TC}$ propagation delays**



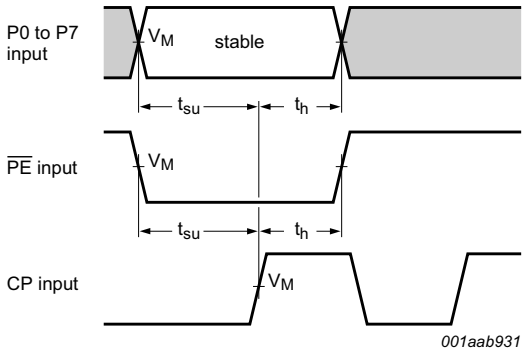

$V_M = 0.5 \times V_I$

**Fig 9. Waveforms showing $\overline{PL}$, $\overline{MR}$, Pn to $\overline{TC}$ propagation delays**




$V_M = 0.5 \times V_I$

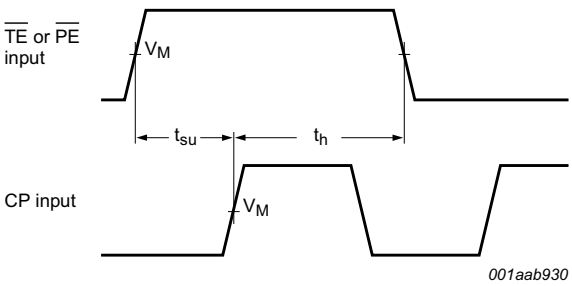
**Fig 10. Waveforms showing removal time for $\overline{MR}$ and $\overline{PL}$**




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

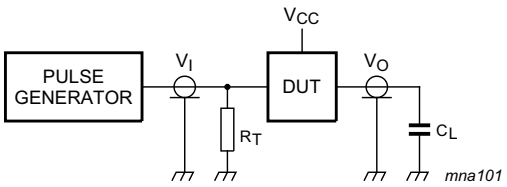
$V_M = 0.5 \times V_I$

**Fig 11. Waveforms showing hold and set-up times for Pn, PE to CP**




$V_M = 0.5 \times V_I$

**Fig 12. Waveforms showing hold and set-up times for MR or PE to CP**




Test data is given in Table 8.

Definitions for test circuit:

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

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

**Fig 13. 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 |

## 13. Application information

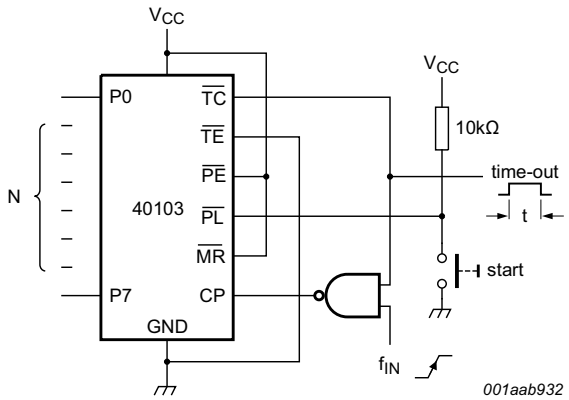



**Fig 14. Programmable timer**

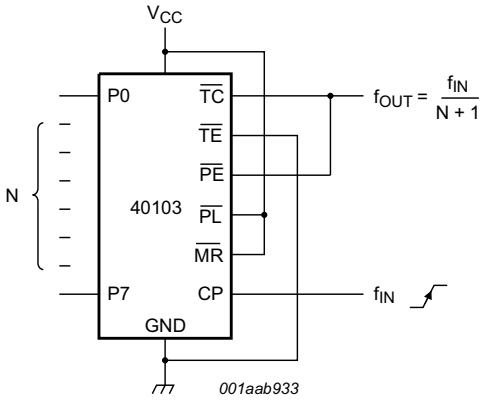
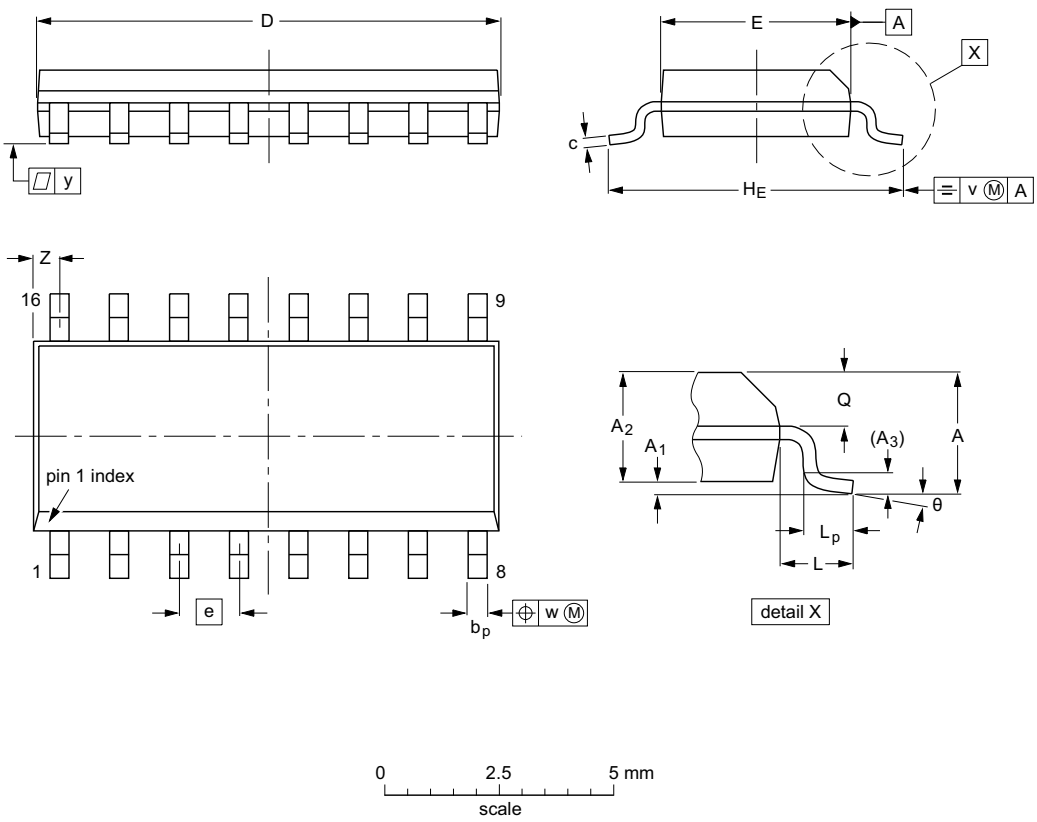



**Fig 15. Divide-by-N counter**

# 14. Package outline

**SO16: plastic small outline package; 16 leads; body width 3.9 mm** **SOT109-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 10.0<br>9.8 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

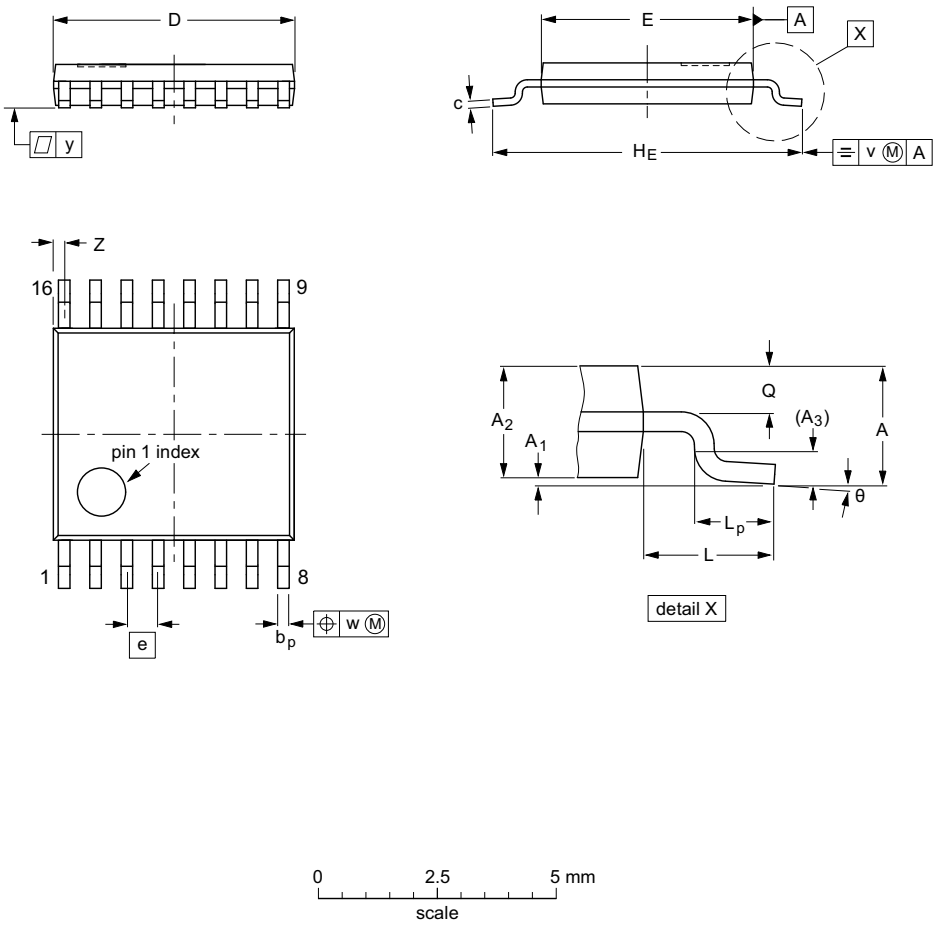
**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT109-1 | 076E07 | MS-012 | | | | ~~99-12-27~~<br>03-02-19 |

**Fig 16. Package outline SOT109-1 (SO16)**

**TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm** **SOT403-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 5.1<br>4.9 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.40<br>0.06 | 8°<br>0° |

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT403-1 | | MO-153 | | | | ~~99-12-27~~<br>03-02-18 |

**Fig 17. Package outline SOT403-1 (TSSOP16)**

## 15. Abbreviations

**Table 9. Abbreviations**

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

## 16. Revision history

**Table 10. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74HC40103 v.5 | 20160421 | Product data sheet | - | 74HC40103 v.4 |
| Modifications: | • Type number 74HC40103DB (SOT338-1) removed. | | | |
| 74HC40103 v.4 | 20160127 | Product data sheet | - | 74HC40103 v.3 |
| Modifications: | • Type number 74HC40103N (SOT38-4) removed. | | | |
| 74HC40103 v.3 | 20041112 | Product data sheet | - | 74HC_HCT40103_CNV v.2 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the current presentation and information standard of Philips Semiconductors.<br>• Removed type number 74HCT40103.<br>• Inserted family specification. | | | |
| 74HC_HCT40103_CNV v.2 | 19970918 | Product specification | - | 74HC_HCT40103 v.1 |
| 74HC_HCT40103 v.1 | 19901201 | Product specification | - | - |

# 17. Legal information

## 17.1 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 URL http://www.nexperia.com.

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