

# 74HC40103

## 8-bit synchronous binary down counter

Rev. 5 — 21 April 2016

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
- 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  $-40\text{ }^{\circ}\text{C}$  to  $+80\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

### 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			Version
	Temperature range	Name	Description	
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

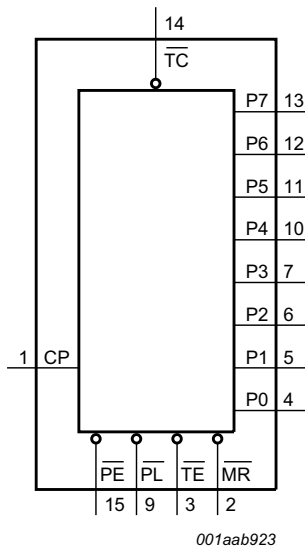


Fig 1. Functional diagram

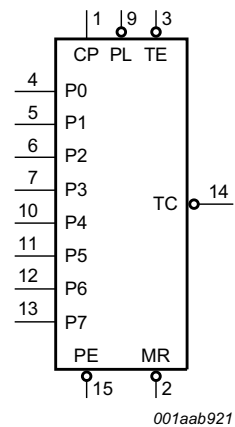


Fig 2. Logic symbol

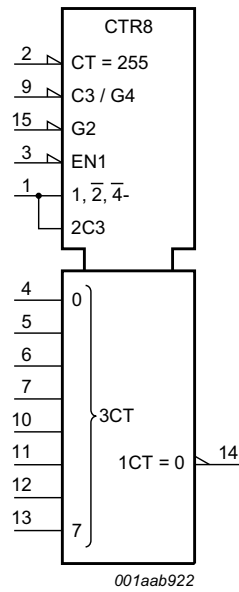


Fig 3. IEC logic symbol

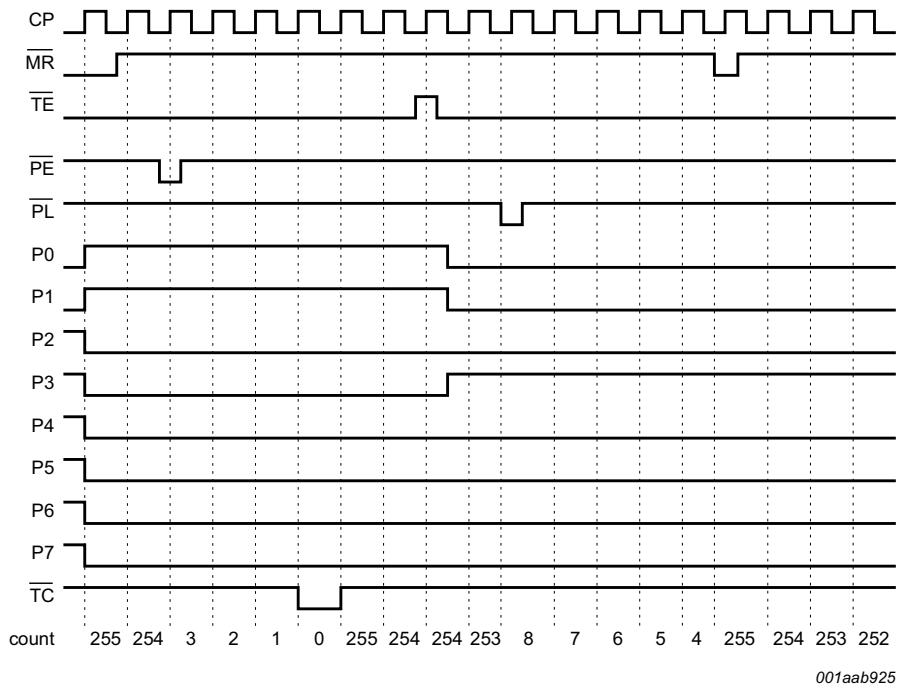
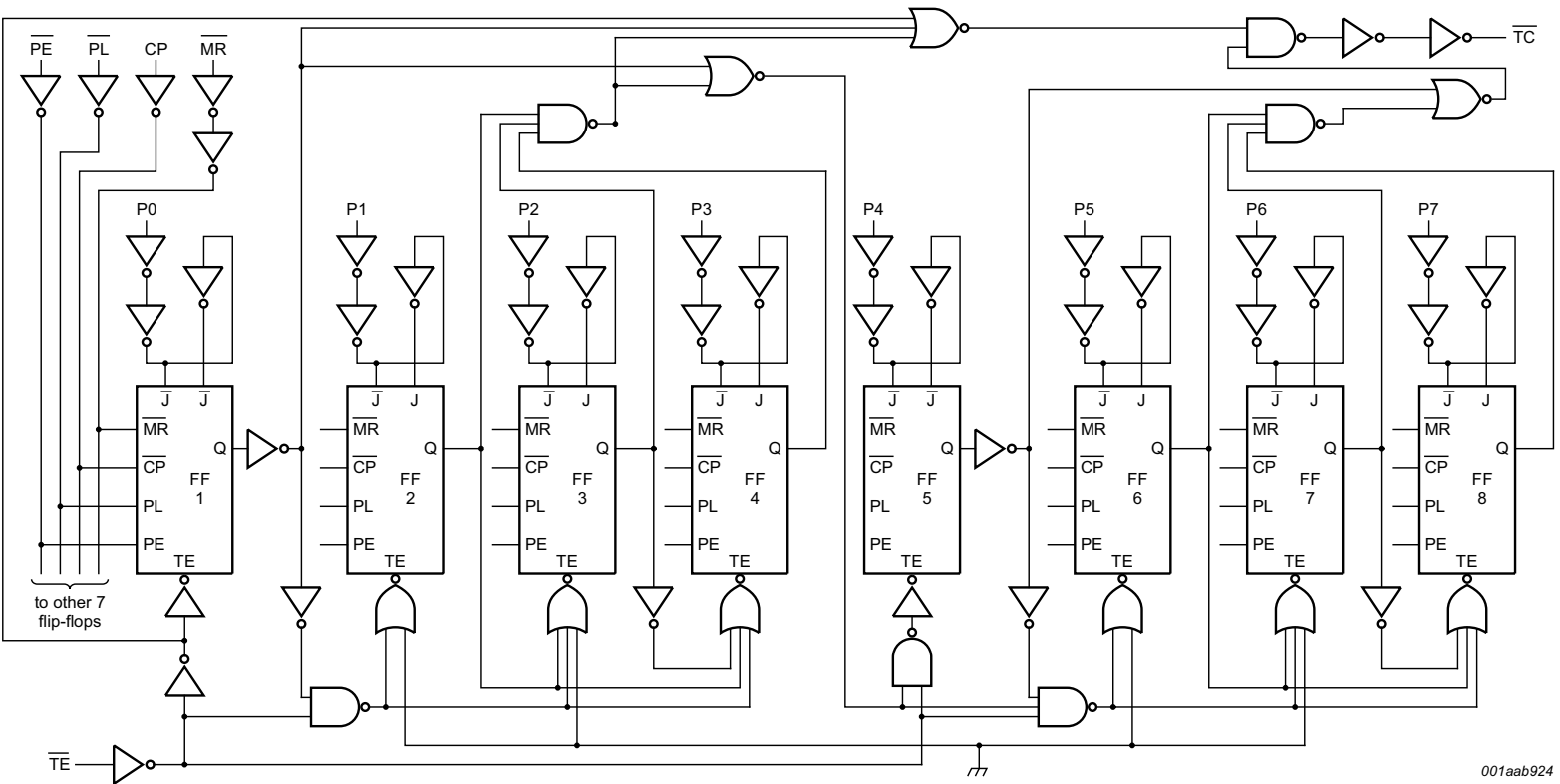


Fig 4. Timing diagram

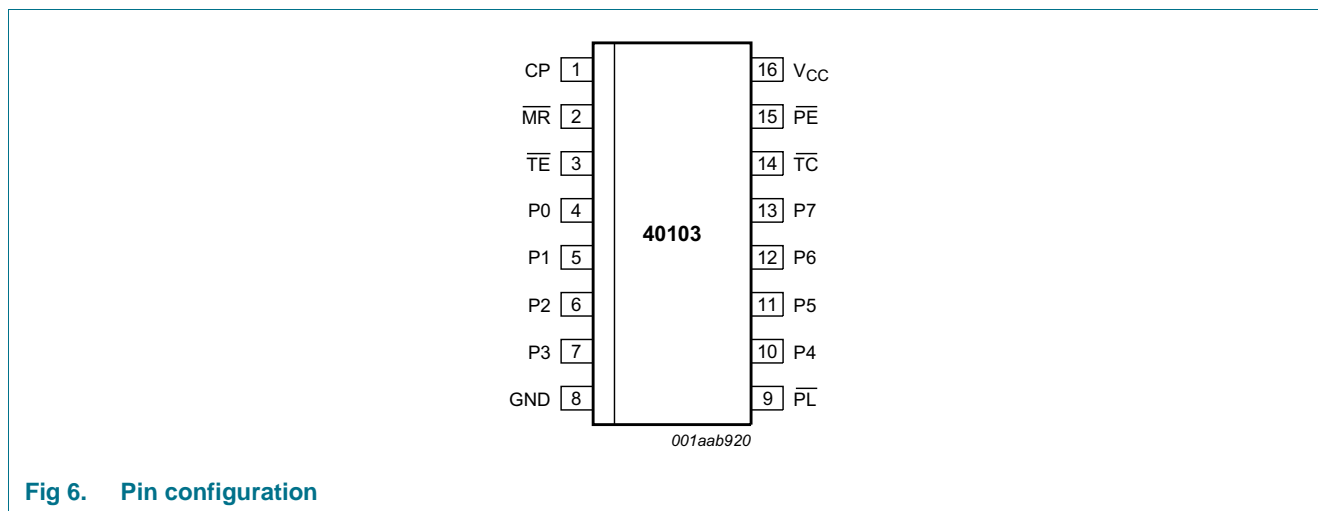


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Fig 5. Logic diagram

## 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)
$\overline{\text{MR}}$	2	asynchronous master reset input (active LOW)
$\overline{\text{TE}}$	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)
$\overline{\text{PL}}$	9	asynchronous preset enable input (active LOW)
P4	10	jam input 4
P5	11	jam input 5
P6	12	jam input 6
P7	13	jam input 7
$\overline{\text{TC}}$	14	terminal count output (active LOW)
$\overline{\text{PE}}$	15	synchronous preset enable input (active LOW)
V <sub>CC</sub>	16	positive supply voltage

## 7. Functional description

### 7.1 Function table

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

Control inputs				Preset mode	Action <sup>[2]</sup>
MR	PL	PE	TE		
L	X	X	X	asynchronous	clear to maximum count
H	L	X	X	asynchronous	preset asynchronously
		H	L	X	synchronous
	H	L	L	synchronous	count down
		H	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	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ <sup>[1]</sup>	-	±20	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ <sup>[1]</sup>	-	±20	mA
$I_O$	output current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	-	±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 <sup>[2]</sup>	-	500	mW
		TSSOP16 packages <sup>[3]</sup>	-	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	$V_{CC} = 2.0\text{ V}$	-	-	625	ns
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	ns
		$V_{CC} = 6.0\text{ V}$	-	-	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
<b><math>T_{amb} = 25\text{ °C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	1.2	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	2.4	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	3.2	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	0.8	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	2.1	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	2.8	1.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	1.9	2.0	-	V
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	4.4	4.5	-	V
		$I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	5.9	6.0	-	V
		$I_O = -4\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	3.98	4.32	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	-	0	0.1	V
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	-	0	0.1	V
		$I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	-	0	0.1	V
		$I_O = 4\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	0.15	0.26	V
	$I_O = 5.2\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$	-	0.16	0.26	V	
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$	-	-	$\pm 0.1$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 6.0\text{ V}$	-	-	8.0	$\mu\text{A}$
$C_I$	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
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	-	-	V
		I <sub>O</sub> = -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
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
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	-	-	V
		I <sub>O</sub> = -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



**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 <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 characteristicsGND = 0 V; t<sub>r</sub> = t<sub>f</sub> = 6 ns; C<sub>L</sub> = 50 pF; see [Figure 13](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = 25 °C</b>						
t <sub>pd</sub>	propagation delay	CP to $\overline{TC}$ ; see <a href="#">Figure 7</a> <sup>[1]</sup>				
		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
		$\overline{TE}$ to $\overline{TC}$ ; see <a href="#">Figure 8</a>				
		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
		$\overline{PL}$ to $\overline{TC}$ ; see <a href="#">Figure 9</a>				
		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	$\overline{MR}$ to $\overline{TC}$ ; see <a href="#">Figure 9</a>				
		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 <a href="#">Figure 8</a> <sup>[2]</sup>				
		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

**Table 7. Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 13](#).

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

**Table 7. Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 13](#).

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

**Table 7. Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 13](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{\text{rec}}$	recovery time	$\overline{\text{MR}}$ to CP, $\overline{\text{PL}}$ to CP; see <a href="#">Figure 10</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	$\overline{\text{PE}}$ to CP; see <a href="#">Figure 11</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
		$\overline{\text{TE}}$ to CP; see <a href="#">Figure 12</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
		$\text{Pn}$ to CP; see <a href="#">Figure 11</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
$t_{\text{h}}$	hold time	$\overline{\text{PE}}$ to CP; see <a href="#">Figure 11</a>				
		$V_{\text{CC}} = 2.0\text{ V}$	0	-	-	ns
		$V_{\text{CC}} = 4.5\text{ V}$	0	-	-	ns
		$V_{\text{CC}} = 6.0\text{ V}$	0	-	-	ns
		$\overline{\text{TE}}$ to CP; see <a href="#">Figure 12</a>				
		$V_{\text{CC}} = 2.0\text{ V}$	0	-	-	ns
		$V_{\text{CC}} = 4.5\text{ V}$	0	-	-	ns
		$V_{\text{CC}} = 6.0\text{ V}$	0	-	-	ns
		$\text{Pn}$ to CP; see <a href="#">Figure 11</a>				
		$V_{\text{CC}} = 2.0\text{ V}$	0	-	-	ns
		$V_{\text{CC}} = 4.5\text{ V}$	0	-	-	ns
		$V_{\text{CC}} = 6.0\text{ V}$	0	-	-	ns
$f_{\text{max}}$	maximum frequency	see <a href="#">Figure 7</a>				
		$V_{\text{CC}} = 2.0\text{ V}$	2.4	-	-	MHz
		$V_{\text{CC}} = 4.5\text{ V}$	12	-	-	MHz
		$V_{\text{CC}} = 6.0\text{ V}$	14	-	-	MHz

**Table 7. Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 13](#).

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

**Table 7. Dynamic characteristics ...continued**  
 $GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 13](#).

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

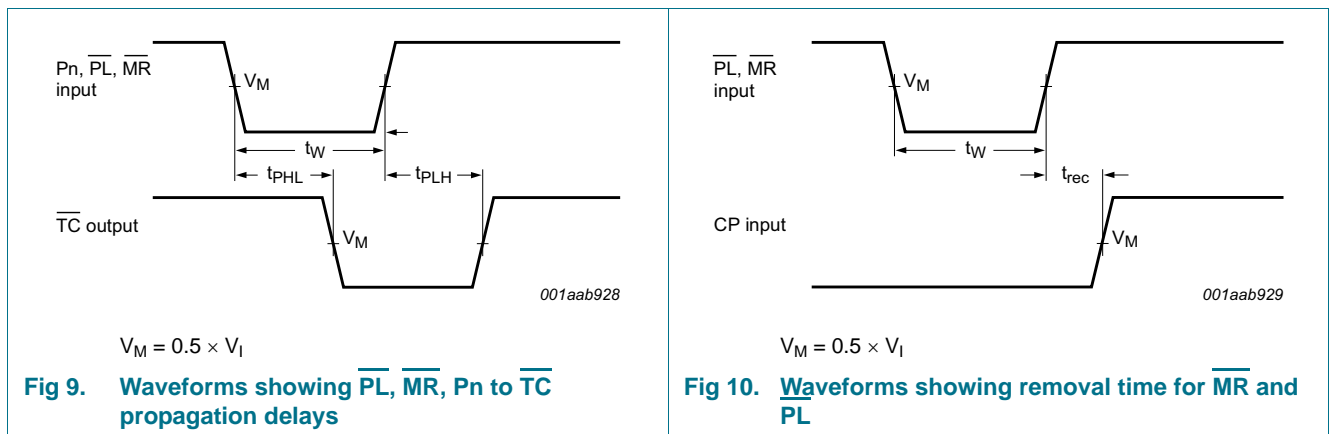
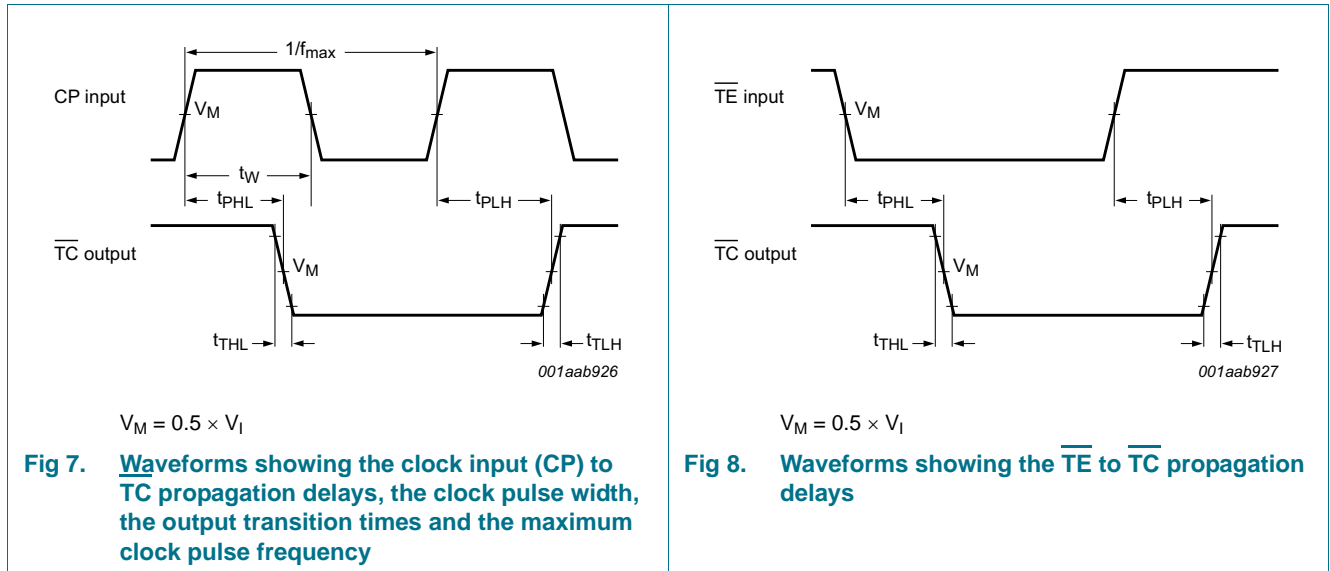
$C_L$  = output load capacitance in pF;

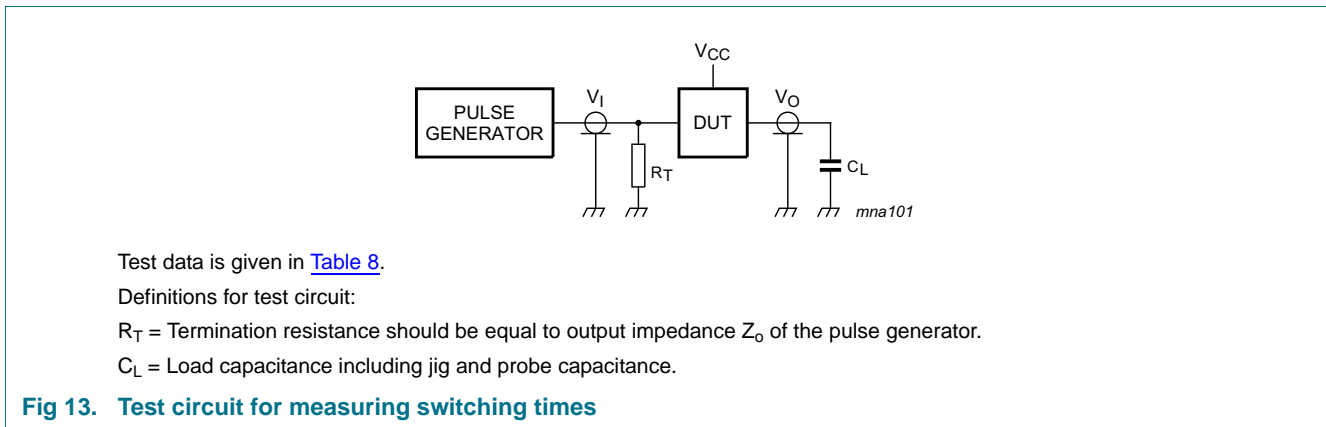
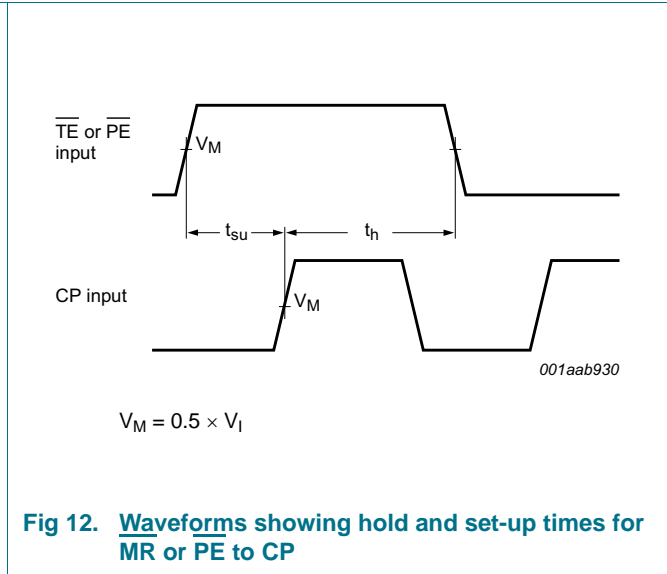
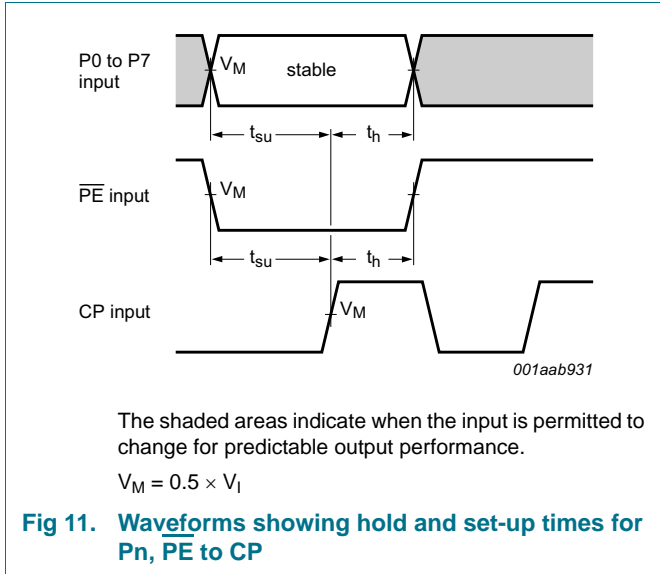
$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching;

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

12. Waveforms





**Table 8. Test data**

Supply	Input	Load
$V_{CC}$	$V_I$	$C_L$
2.0 V	$V_{CC}$	50 pF
4.5 V	$V_{CC}$	50 pF
6.0 V	$V_{CC}$	50 pF
5.0 V	$V_{CC}$	15 pF



13. Application information

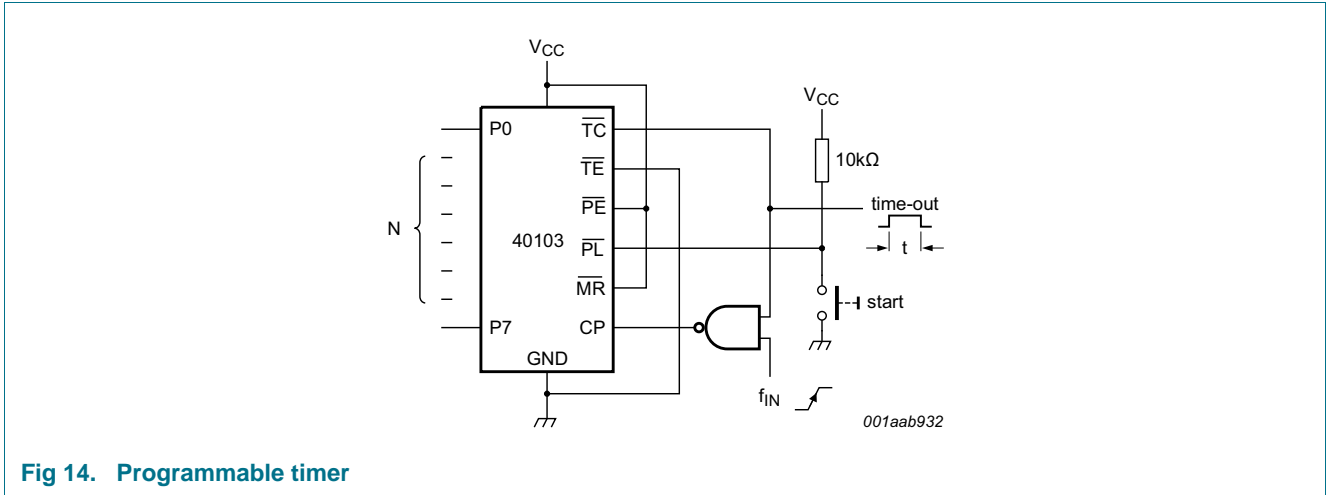


Fig 14. Programmable timer

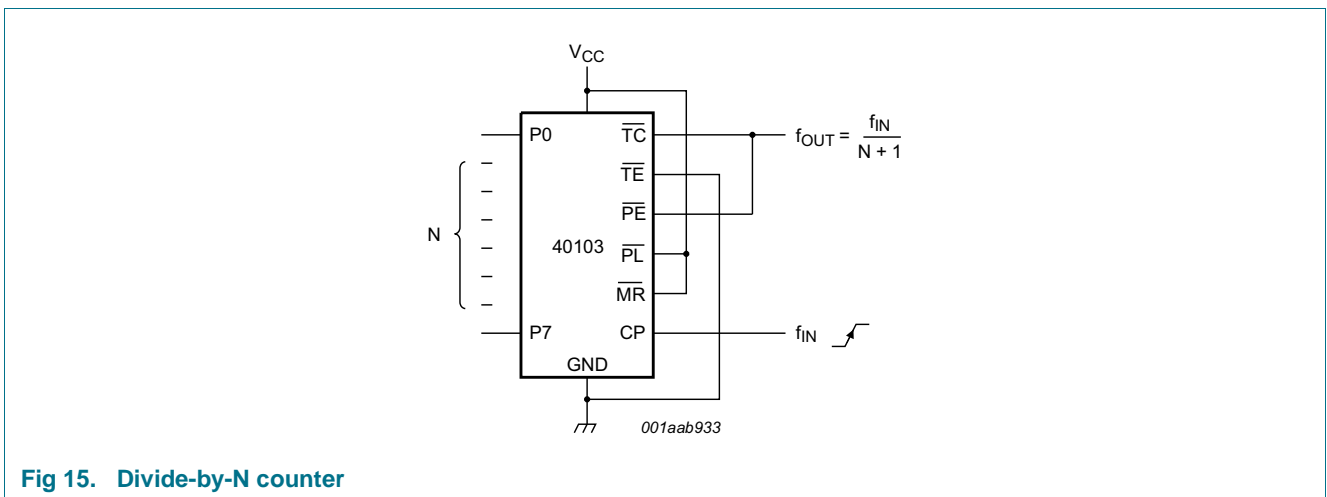


Fig 15. Divide-by-N counter

14. Package outline

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

SOT109-1

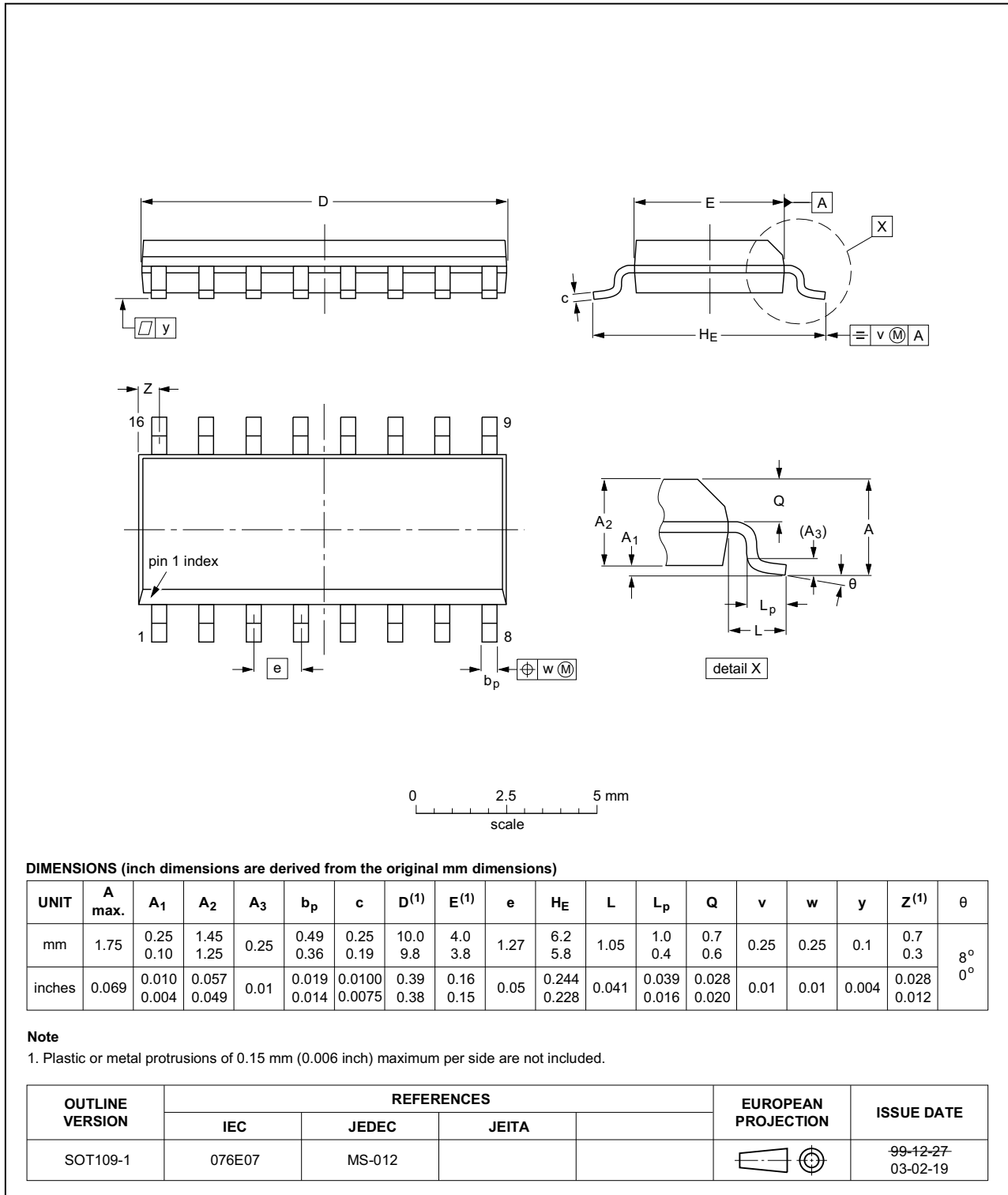


Fig 16. Package outline SOT109-1 (SO16)

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

SOT403-1



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:	<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	-	-

## 17. Legal information

### 17.1 Data sheet status

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

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

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

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

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