

# 74AHC273-Q100; 74AHCT273-Q100

Octal D-type flip-flop with reset; positive-edge trigger

Rev. 1 — 27 March 2013

Product data sheet

## 1. General description

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The 74AHC273-Q100; 74AHCT273-Q100 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7-A.

The 74AHC273-Q100; 74AHCT273-Q100 has eight edge-triggered, D-type flip-flops with individual D inputs and Q outputs.

The common clock (CP) and master reset ( $\overline{MR}$ ) inputs, load and reset (clear) all flip-flops simultaneously. The state of each D input, one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding output (Qn) of the flip-flop.

All outputs are forced LOW, independent of clock or data inputs, by a LOW on the  $\overline{MR}$  input.

The device is useful for applications where only the true output is required and the clock and master reset are common to all storage elements.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

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- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than  $V_{CC}$
- Ideal buffer for MOS microcontroller or memory
- Common clock and master reset
- Input levels:
  - ◆ For 74AHC273-Q100: CMOS level
  - ◆ For 74AHCT273-Q100: TTL level
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0  $\Omega$ )
- Multiple package options

## 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
<b>74AHC273-Q100</b>				
74AHC273D-Q100	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74AHC273PW-Q100	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74AHC273BQ-Q100	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	SOT764-1
<b>74AHCT273-Q100</b>				
74AHCT273D-Q100	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74AHCT273PW-Q100	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74AHCT273BQ-Q100	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	SOT764-1

## 4. Functional diagram



Fig 1. Logic symbol



Fig 2. IEC logic symbol



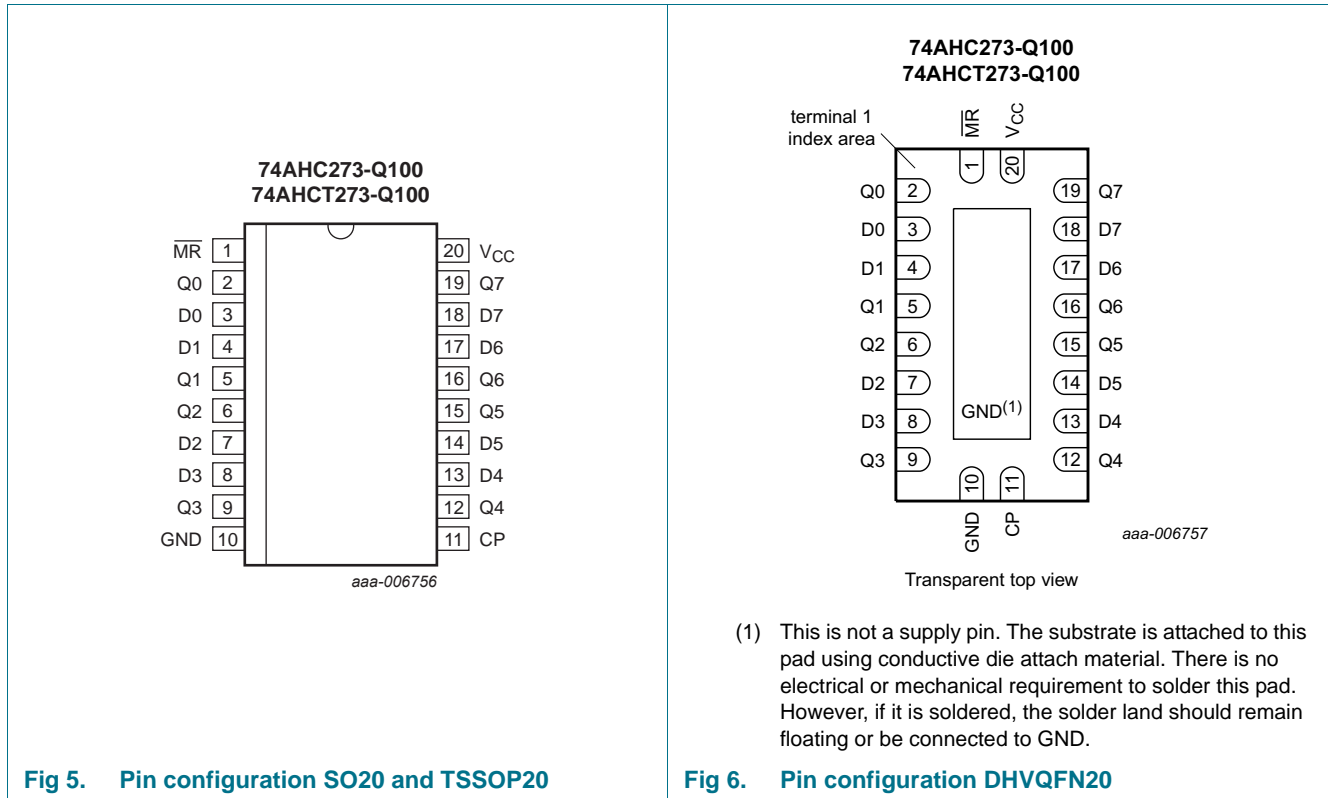
Fig 3. Logic diagram



Fig 4. Functional diagram

## 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{MR}$	1	master reset input (active LOW)
Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7	2, 5, 6, 9, 12, 15, 16, 19	flip-flop output
D0, D1, D2, D3, D4, D5, D6, D7	3, 4, 7, 8, 13, 14, 17, 18	data input
GND	10	ground (0 V)
CP	11	clock input (LOW-to-HIGH edge-triggered)
V <sub>CC</sub>	20	supply voltage

## 6. Functional description

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

Operating mode	Control		Input	Output
	$\overline{\text{MR}}$	CP	Dn	Qn
Reset (clear)	L	X	X	L
Load '1'	H	↑	h	H
Load '0'	H	↑	l	L

- [1] H = HIGH voltage level;  
 h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition;  
 L = LOW voltage level;  
 l = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition;  
 ↑ = LOW-to-HIGH;  
 X = don't care.

## 7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+7.0	V
$V_I$	input voltage		-0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5 \text{ V}$	<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	+20	mA
$I_O$	output current	$V_O = -0.5 \text{ V}$ to $(V_{CC} + 0.5 \text{ V})$	-25	+25	mA
$I_{CC}$	supply current		-	+75	mA
$I_{GND}$	ground current		-75	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40 \text{ °C}$ to $+125 \text{ °C}$	<sup>[2]</sup> -	500	mW

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

- [2] For SO20 packages: above 70 °C the value of  $P_{tot}$  derates linearly at 8 mW/K.  
 For TSSOP20 packages: above 60 °C the value of  $P_{tot}$  derates linearly at 5.5 mW/K.  
 For DHVQFN20 packages: above 60 °C the value of  $P_{tot}$  derates linearly at 4.5 mW/K.

## 8. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74AHC273-Q100</b>						
$V_{CC}$	supply voltage		2.0	5.0	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	100	ns/V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	ns/V
<b>74AHCT273-Q100</b>						
$V_{CC}$	supply voltage		4.5	5.0	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	ns/V

## 9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74AHC273-Q100</b>										
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	1.5	-	1.5	-	V
		$V_{CC} = 3.0\text{ V}$	2.1	-	-	2.1	-	2.1	-	V
		$V_{CC} = 5.5\text{ V}$	3.85	-	-	3.85	-	3.85	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	-	0.5	-	0.5	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.9	-	0.9	-	0.9	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.65	-	1.65	-	1.65	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$I_O = -50\ \mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -50\ \mu\text{A}$ ; $V_{CC} = 3.0\text{ V}$	2.9	3.0	-	2.9	-	2.9	-	V
		$I_O = -50\ \mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -4.0\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	2.58	-	-	2.48	-	2.40	-	V
	$I_O = -8.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	3.94	-	-	3.80	-	3.70	-	V	
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$I_O = 50\ \mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 50\ \mu\text{A}$ ; $V_{CC} = 3.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 50\ \mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0\text{ mA}$ ; $V_{CC} = 3.0\text{ V}$	-	-	0.36	-	0.44	-	0.55	V
	$I_O = 8.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	-	0.36	-	0.44	-	0.55	V	

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

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

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$I_I$	input leakage current	$V_I = 5.5 \text{ V}$ or GND; $V_{CC} = 0 \text{ V}$ to 5.5 V	-	-	0.1	-	1.0	-	2.0	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	$\mu\text{A}$
$C_I$	input capacitance		-	3	10	-	10	-	10	pF
$C_O$	output capacitance		-	4	-	-	-	-	-	pF
<b>74AHCT273-Q100</b>										
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V}$ to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
		$I_O = -50 \mu\text{A}$	4.4	-	-	4.4	-	4.4	-	V
		$I_O = -8.0 \text{ mA}$	3.94	-	-	3.80	-	3.70	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
		$I_O = 50 \mu\text{A}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 8.0 \text{ mA}$	-	-	0.36	-	0.44	-	0.55	V
$I_I$	input leakage current	$V_I = 5.5 \text{ V}$ or GND; $V_{CC} = 0 \text{ V}$ to 5.5 V	-	-	0.1	-	1.0	-	2.0	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	$\mu\text{A}$
$\Delta I_{CC}$	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}$ ; other pins at $V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
$C_I$	input capacitance		-	3	10	-	10	-	10	pF
$C_O$	output capacitance		-	4	-	-	-	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

 Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit	
			Min	Typ <sup>[1]</sup>	Max	Min	Max	Min	Max		
<b>74AHC273-Q100</b>											
$t_{pd}$	propagation delay	CP to Qn; see <a href="#">Figure 7</a> <sup>[2]</sup>									
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$									
		$C_L = 15\text{ pF}$	-	6.0	13.6	1.0	16.0	1.0	17.0	ns	
		$C_L = 50\text{ pF}$	-	8.6	17.1	1.0	19.5	1.0	21.5	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$									
		$C_L = 15\text{ pF}$	-	4.2	9	1.0	10.5	1.0	11.5	ns	
			$C_L = 50\text{ pF}$	-	6.0	11.0	1.0	12.5	1.0	14.0	ns
			MR to Qn; see <a href="#">Figure 8</a> <sup>[3]</sup>								
			$V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
			$C_L = 15\text{ pF}$	-	5.1	13.6	1.0	16.0	1.0	17.0	ns
			$C_L = 50\text{ pF}$	-	7.3	17.1	1.0	19.5	1.0	21.5	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$									
		$C_L = 15\text{ pF}$	-	3.7	8.5	1.0	10.0	1.0	11.0	ns	
		$C_L = 50\text{ pF}$	-	5.3	10.5	1.0	12.0	1.0	13.5	ns	
$f_{max}$	maximum frequency	see <a href="#">Figure 7</a>									
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$									
		$C_L = 15\text{ pF}$	75	120	-	65	-	65	-	MHz	
		$C_L = 50\text{ pF}$	50	75	-	45	-	45	-	MHz	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$									
		$C_L = 15\text{ pF}$	120	165	-	100	-	100	-	MHz	
		$C_L = 50\text{ pF}$	80	110	-	70	-	70	-	MHz	
$t_w$	pulse width	CP HIGH or LOW; see <a href="#">Figure 7</a>									
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	5.0	-	-	6.5	-	6.5	-	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	5.0	-	-	5.0	-	5.0	-	ns	
		MR LOW; see <a href="#">Figure 8</a>									
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	5.0	-	-	6.0	-	6.0	-	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	5.0	-	-	5.0	-	5.0	-	ns	
$t_{su}$	set-up time	Dn to CP; see <a href="#">Figure 9</a>									
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	3.0	-	-	3.0	-	3.0	-	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	3.0	-	-	3.0	-	3.0	-	ns	
$t_h$	hold time	Dn to CP; see <a href="#">Figure 9</a>									
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	-	1.0	-	1.0	-	ns	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	1.0	-	-	1.0	-	1.0	-	ns	



**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	Min	Max	
t <sub>rec</sub>	recovery time	$\overline{\text{MR}}$ to CP; see <a href="#">Figure 8</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.5	-	-	2.5	-	2.5	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	ns
C <sub>PD</sub>	power dissipation capacitance	f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[4]</sup>	-	14	-	-	-	-	-	pF
<b>74AHCT273-Q100; V<sub>CC</sub> = 4.5 V to 5.5 V</b>										
t <sub>pd</sub>	propagation delay	CP to Qn; see <a href="#">Figure 7</a> <sup>[2]</sup>								
		C <sub>L</sub> = 15 pF	-	4.0	7.5	1.0	8.8	1.0	9.5	ns
		C <sub>L</sub> = 50 pF	-	5.8	9.2	1.0	10.5	1.0	11.5	ns
		$\overline{\text{MR}}$ to Qn; see <a href="#">Figure 8</a> <sup>[3]</sup>								
		C <sub>L</sub> = 15 pF	-	3.9	10.0	1.0	11.6	1.0	12.5	ns
		C <sub>L</sub> = 50 pF	-	5.6	11.0	1.0	12.6	1.0	14.0	ns
f <sub>max</sub>	maximum frequency	see <a href="#">Figure 7</a>								
		C <sub>L</sub> = 15 pF	75	120	-	65	-	65	-	MHz
		C <sub>L</sub> = 50 pF	50	75	-	45	-	45	-	MHz
t <sub>W</sub>	pulse width	CP HIGH or LOW; see <a href="#">Figure 7</a>	5.0	-	-	6.5	-	6.5	-	ns
		$\overline{\text{MR}}$ LOW; see <a href="#">Figure 8</a>	5.0	-	-	6.0	-	6.0	-	ns
t <sub>su</sub>	set-up time	Dn to CP; see <a href="#">Figure 9</a>	3.0	-	-	3.0	-	3.0	-	ns
t <sub>h</sub>	hold time	Dn to CP; see <a href="#">Figure 9</a>	1.0	-	-	1.0	-	1.0	-	ns
t <sub>rec</sub>	recovery time	$\overline{\text{MR}}$ to CP; see <a href="#">Figure 8</a>	2.5	-	-	2.5	-	2.5	-	ns
C <sub>PD</sub>	power dissipation capacitance	f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[4]</sup>	-	18	-	-	-	-	-	pF

[1] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V and V<sub>CC</sub> = 5.0 V).

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

[3] t<sub>pd</sub> is the same as t<sub>PHL</sub> only.

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

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

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

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

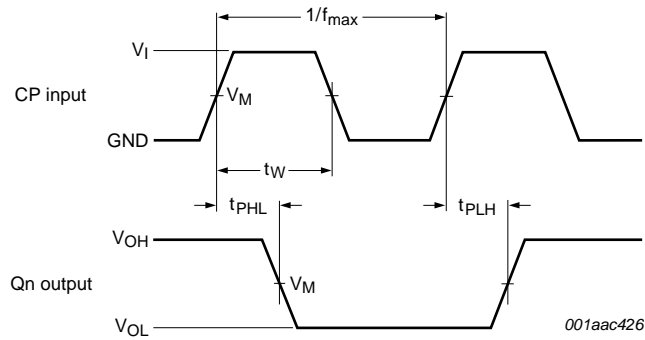
C<sub>L</sub> = output load capacitance in pF;

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 the outputs.

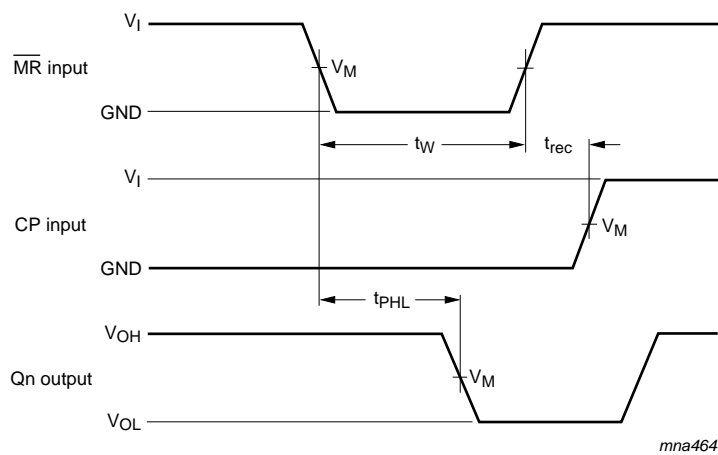
## 11. Waveforms



Measurement points are given in [Table 8](#).

$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

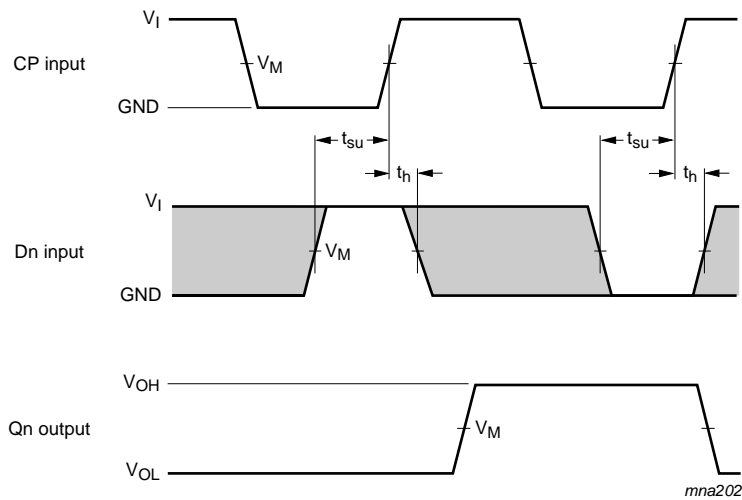
**Fig 7. Clock pulse width, maximum frequency and input to output propagation delays**



Measurement points are given in [Table 8](#).

$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 8. Master reset pulse width, recovery time and propagation delay**

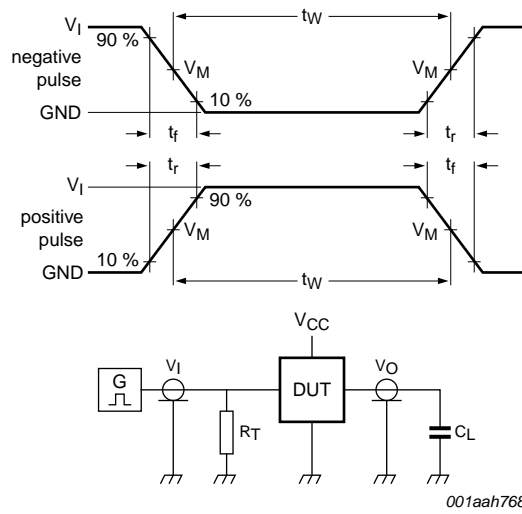


Measurement points are given in [Table 8](#).  
 The shaded areas indicate when the input is permitted to change for predictable output performance.  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 9. Data set-up and hold times**

**Table 8. Measurement points**

Type	Input	Output
	$V_M$	$V_M$
74AHC273-Q100	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT273-Q100	1.5 V	$0.5 \times V_{CC}$



Test data is given in [Table 9](#).

Definitions 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 10. Test circuit for measuring switching times**

**Table 9. Test data**

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74AHC273-Q100	$V_{CC}$	$\leq 3.0$ ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74AHCT273-Q100	3.0 V	$\leq 3.0$ ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$

## 12. Package outline

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

SOT163-1



Fig 11. Package outline SOT163-1 (SO20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



Fig 12. Package outline SOT360-1 (TSSOP20)

**DHVQFN20:** plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1



Fig 13. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

**Table 10. Abbreviations**

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model
MIL	Military
MOS	Metal-Oxide Semiconductor

## 14. Revision history

**Table 11. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT273_Q100 v.1	20130327	Product data sheet	-	-



## 15. Legal information

### 15.1 Data sheet status

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

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

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

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