

# 74HC74-Q100; 74HCT74-Q100

Dual D-type flip-flop with set and reset; positive edge-trigger

Rev. 4 — 21 April 2020

Product data sheet

## 1. General description

The 74HC74-Q100; 74HCT74-Q100 are dual positive edge triggered D-type flip-flop with individual data (nD), clock (nCP), set (nSD) and reset (nRD) inputs, and complementary nQ and nQ outputs. Data at the nD-input, that meets the set-up and hold time requirements on the LOW-to-HIGH clock transition, will be stored in the flip-flop and appear at the nQ output. The Schmitt-trigger action in the clock input, makes the circuit highly tolerant to slower clock rise and fall times. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

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

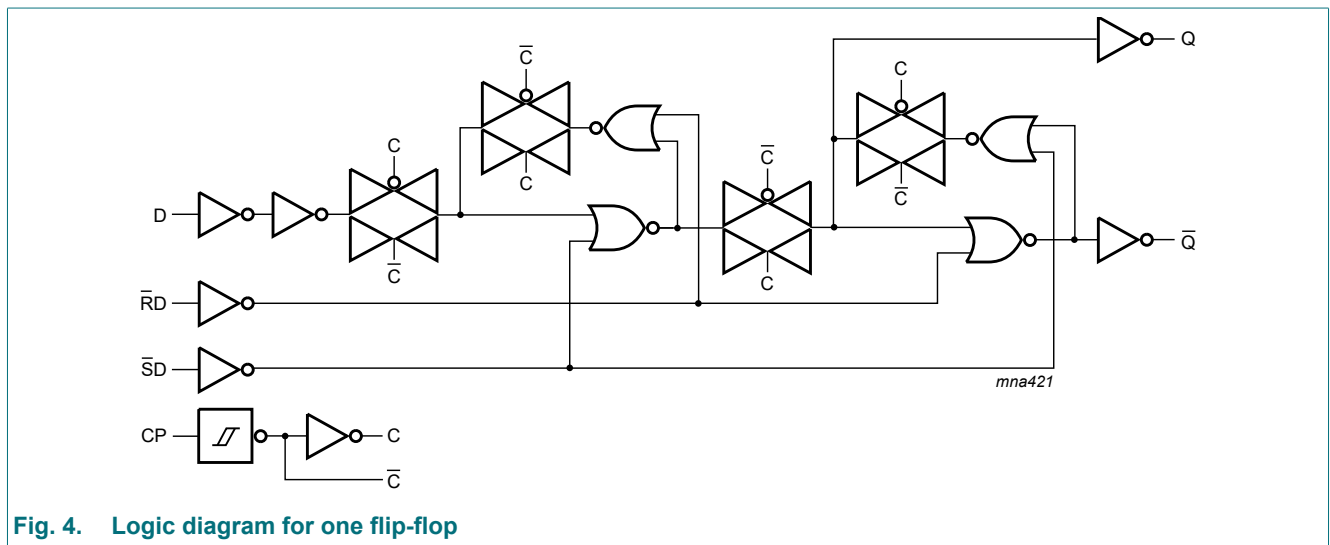
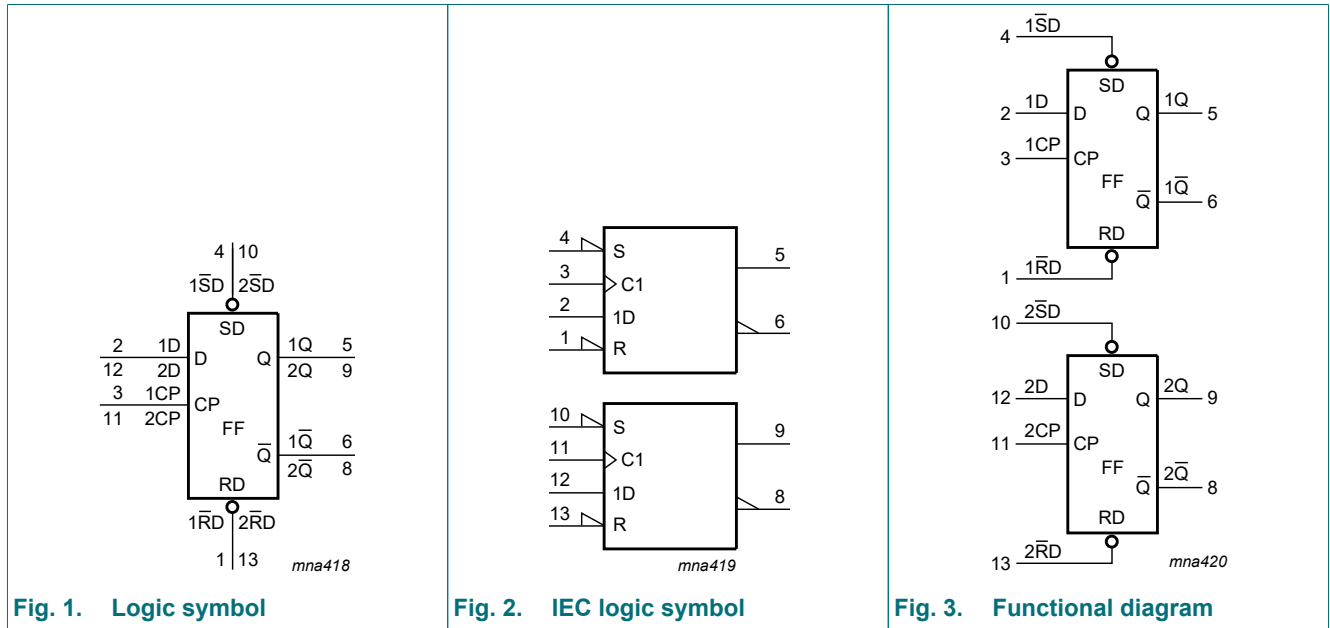
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Input levels:
  - For 74HC74-Q100: CMOS level
  - For 74HCT74-Q100: TTL level
- Symmetrical output impedance
- Low power dissipation
- High noise immunity
- Balanced propagation delays
- Specified in compliance with JEDEC standard no. 7A
- 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 Ω)
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

## 3. Ordering information

Table 1. Ordering information

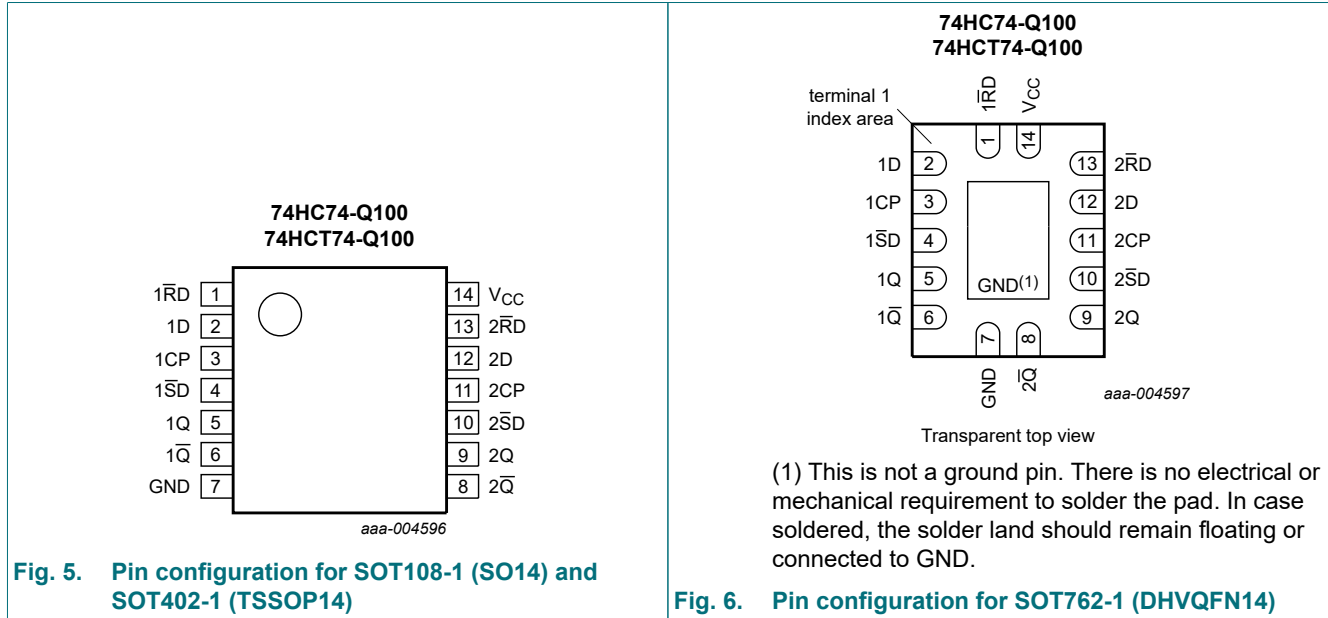
Type number	Package			Version
	Temperature range	Name	Description	
74HC74D-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HCT74D-Q100				
74HC74PW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HCT74PW-Q100				
74HC74BQ-Q100	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm	SOT762-1
74HCT74BQ-Q100				

### 4. Functional diagram



## 5. Pinning information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1 $\overline{RD}$	1	asynchronous reset-direct input (active LOW)
1D	2	data input
1CP	3	clock input (LOW-to-HIGH, edge-triggered)
1 $\overline{SD}$	4	asynchronous set-direct input (active LOW)
1Q	5	output
1 $\overline{Q}$	6	complement output
GND	7	ground (0 V)
2 $\overline{Q}$	8	complement output
2Q	9	output
2 $\overline{SD}$	10	asynchronous set-direct input (active LOW)
2CP	11	clock input (LOW-to-HIGH, edge-triggered)
2D	12	data input
2 $\overline{RD}$	13	asynchronous reset-direct input (active LOW)
V <sub>CC</sub>	14	supply voltage

## 6. Functional description

**Table 3. Function table**

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

Input				Output	
nSD	nRD	nCP	nD	nQ	nQ̄
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H

**Table 4. Function table**

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

↑ = LOW-to-HIGH transition;  $Q_{n+1}$  = state after the next LOW-to-HIGH CP transition.

Input				Output	
nSD	nRD	nCP	nD	nQ <sub>n+1</sub>	nQ̄ <sub>n+1</sub>
H	H	↑	L	L	H
H	H	↑	H	H	L

## 7. Limiting values

**Table 5. 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	-	±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	-	±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		-	+100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation		[1]	500	mW

- [1] For SOT108-1 (SO14) package: P<sub>tot</sub> derates linearly with 10.1 mW/K above 100 °C.  
 For SOT402-1 (TSSOP14) package: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °C.  
 For SOT762-1 (DHVQFN14) package: P<sub>tot</sub> derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC74-Q100			74HCT74-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V <sub>CC</sub> = 6.0 V	-	-	83	-	-	-	ns/V

## 9. Static characteristics

**Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
<b>74HC74-Q100</b>								
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	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> = -4.0 mA; V <sub>CC</sub> = 4.5 V	3.84	4.32	-	3.7	-	V
		I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.34	5.81	-	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> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.33	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.33	-	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	-	±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	-	-	40	-	80	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	pF
<b>74HCT74-Q100</b>								
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	V

## Dual D-type flip-flop with set and reset; positive edge-trigger

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V I <sub>O</sub> = -4 mA	3.84	4.32	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V I <sub>O</sub> = 4.0 mA	-	0.15	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±1.0	-	±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> = 5.5 V	-	-	40	-	80	µA
ΔI <sub>CC</sub>	additional supply current	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V; I <sub>O</sub> = 0 A						
		per input pin; nD, nRD inputs	-	70	315	-	343	µA
		per input pin; nSD, nCP input	-	80	360	-	392	µA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	pF

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); C<sub>L</sub> = 50 pF unless otherwise specified; for test circuit see Fig. 9.

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
<b>74HC74-Q100</b>								
t <sub>pd</sub>	propagation delay	nCP to nQ, nQ̄; see Fig. 7 [2]						
		V <sub>CC</sub> = 2.0 V	-	47	220	-	265	ns
		V <sub>CC</sub> = 4.5 V	-	17	44	-	53	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	14	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	14	37	-	45	ns
		nSD to nQ, nQ̄; see Fig. 8 [2]						
		V <sub>CC</sub> = 2.0 V	-	50	250	-	300	ns
		V <sub>CC</sub> = 4.5 V	-	18	50	-	60	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	15	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	14	43	-	51	ns
		nRD to nQ, nQ̄; see Fig. 8 [2]						
		V <sub>CC</sub> = 2.0 V	-	52	250	-	300	ns
		V <sub>CC</sub> = 4.5 V	-	19	50	-	60	ns
V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	16	-	-	-	ns		
V <sub>CC</sub> = 6.0 V	-	15	43	-	51	ns		
t <sub>t</sub>	transition time	nQ, nQ̄; see Fig. 7 [3]						
		V <sub>CC</sub> = 2.0 V	-	19	95	-	110	ns
		V <sub>CC</sub> = 4.5 V	-	7	19	-	22	ns
		V <sub>CC</sub> = 6.0 V	-	6	16	-	19	ns

## Dual D-type flip-flop with set and reset; positive edge-trigger

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t <sub>w</sub>	pulse width	nCP HIGH or LOW; see Fig. 7						
		V <sub>CC</sub> = 2.0 V	100	19	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	20	7	-	24	-	ns
		V <sub>CC</sub> = 6.0 V	17	6	-	20	-	ns
		nSD, nRD LOW; see Fig. 8						
		V <sub>CC</sub> = 2.0 V	100	19	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	20	7	-	24	-	ns
V <sub>CC</sub> = 6.0 V	17	6	-	20	-	ns		
t <sub>rec</sub>	recovery time	nSD, nRD; see Fig. 8						
		V <sub>CC</sub> = 2.0 V	40	3	-	45	-	ns
		V <sub>CC</sub> = 4.5 V	8	1	-	9	-	ns
		V <sub>CC</sub> = 6.0 V	7	1	-	8	-	ns
t <sub>su</sub>	set-up time	nD to nCP; see Fig. 7						
		V <sub>CC</sub> = 2.0 V	75	6	-	90	-	ns
		V <sub>CC</sub> = 4.5 V	15	2	-	18	-	ns
		V <sub>CC</sub> = 6.0 V	13	2	-	15	-	ns
t <sub>h</sub>	hold time	nD to nCP; see Fig. 7						
		V <sub>CC</sub> = 2.0 V	3	-6	-	3	-	ns
		V <sub>CC</sub> = 4.5 V	3	-2	-	3	-	ns
		V <sub>CC</sub> = 6.0 V	3	-2	-	3	-	ns
f <sub>max</sub>	maximum frequency	nCP; see Fig. 7						
		V <sub>CC</sub> = 2.0 V	4.8	23	-	4.0	-	MHz
		V <sub>CC</sub> = 4.5 V	24	69	-	20	-	MHz
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	76	-	-	-	MHz
		V <sub>CC</sub> = 6.0 V	28	82	-	24	-	MHz
C <sub>PD</sub>	power dissipation capacitance	C <sub>L</sub> = 50 pF; f = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [4]	-	24	-	-	-	pF
<b>74HCT74-Q100</b>								
t <sub>pd</sub>	propagation delay	nCP to nQ, nQ̄; see Fig. 7 [2]						
		V <sub>CC</sub> = 4.5 V	-	18	44	-	53	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	15	-	-	-	ns
		nSD to nQ, nQ̄; see Fig. 8 [2]						
		V <sub>CC</sub> = 4.5 V	-	23	50	-	60	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	18	-	-	-	ns
		nRD to nQ, nQ̄; see Fig. 8 [2]						
		V <sub>CC</sub> = 4.5 V	-	24	50	-	60	ns
V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	18	-	-	-	ns		

## Dual D-type flip-flop with set and reset; positive edge-trigger

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			T <sub>amb</sub> = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t <sub>t</sub>	transition time	nQ, n $\bar{Q}$ ; see Fig. 7 [3]						
		V <sub>CC</sub> = 4.5 V	-	7	19	-	22	ns
t <sub>W</sub>	pulse width	nCP HIGH or LOW; see Fig. 7						
		V <sub>CC</sub> = 4.5 V	23	9	-	27	-	ns
		n $\bar{S}$ D, n $\bar{R}$ D LOW; see Fig. 8						
		V <sub>CC</sub> = 4.5 V	20	9	-	24	-	ns
t <sub>rec</sub>	recovery time	n $\bar{S}$ D, n $\bar{R}$ D; see Fig. 8						
		V <sub>CC</sub> = 4.5 V	8	1	-	9	-	ns
t <sub>su</sub>	set-up time	nD to nCP; see Fig. 7						
		V <sub>CC</sub> = 4.5 V	15	5	-	18	-	ns
t <sub>h</sub>	hold time	nD to nCP; see Fig. 7						
		V <sub>CC</sub> = 4.5 V	3	-3	-	3	-	ns
f <sub>max</sub>	maximum frequency	nCP; see Fig. 7						
		V <sub>CC</sub> = 4.5 V	22	54	-	18	-	MHz
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	59	-	-	-	MHz
C <sub>PD</sub>	power dissipation capacitance	C <sub>L</sub> = 50 pF; f = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [4]	-	29	-	-	-	pF

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

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

[3] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

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

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

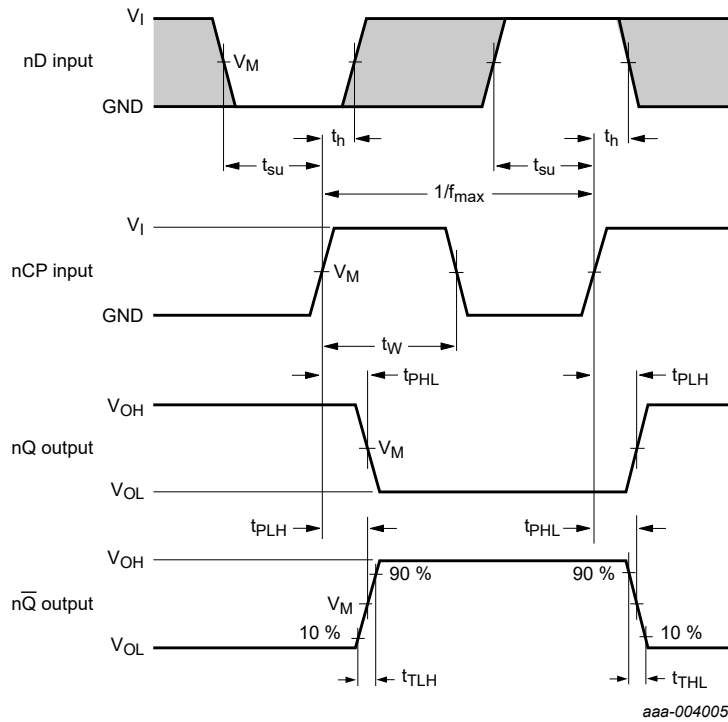
V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

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



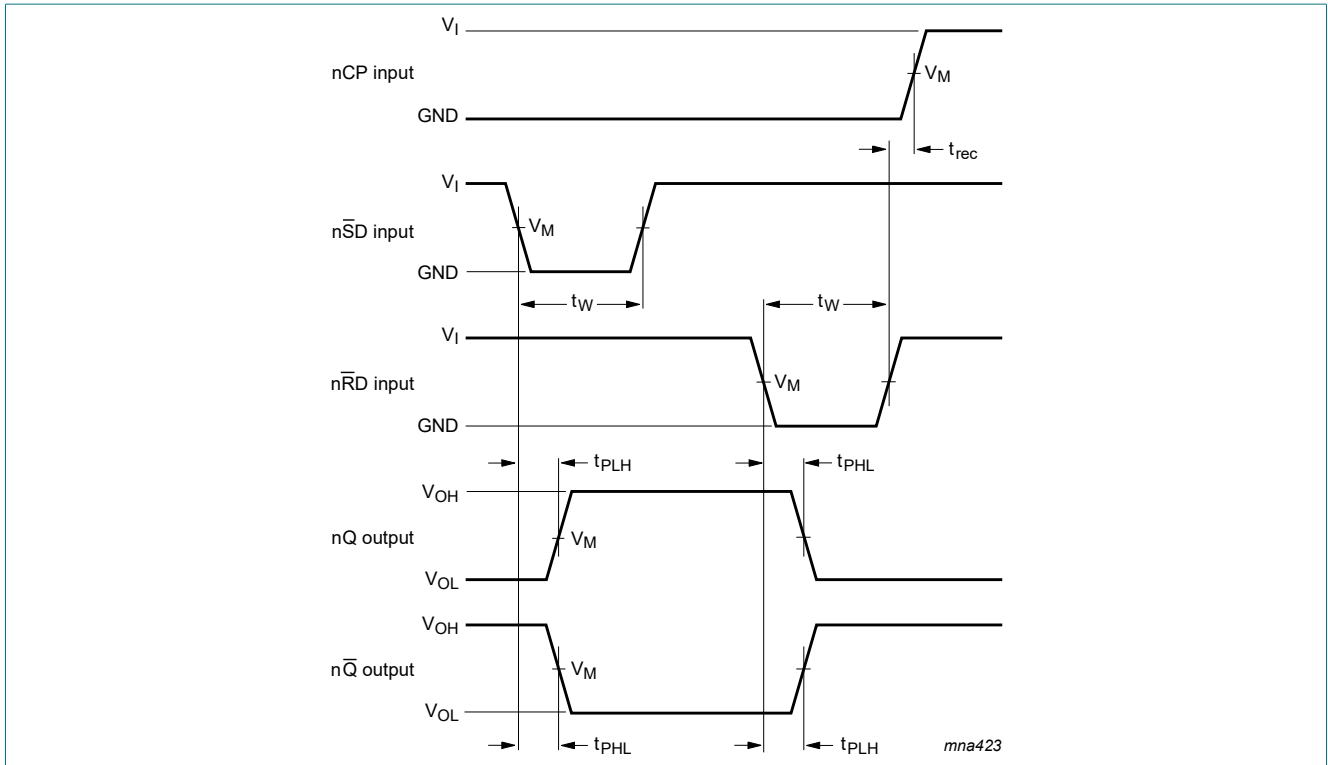
10.1. Waveforms



Measurement points are given in [Table 9](#).

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

**Fig. 7. Propagation delay input (CP) to output (Qn), output transition time, clock input (CP) pulse width and the maximum frequency (CP)**



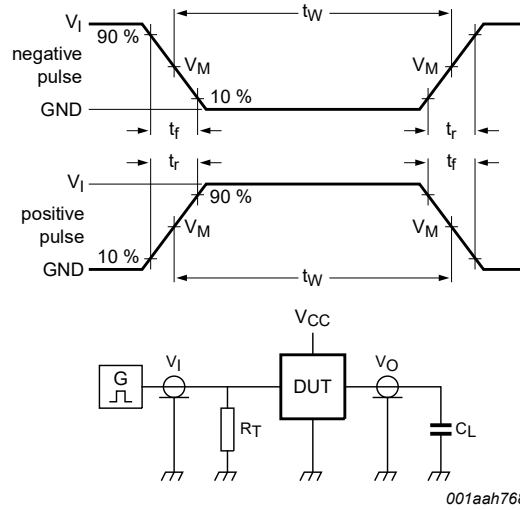
Measurement points are given in [Table 9](#).

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

**Fig. 8. The set ( $n\overline{SD}$ ) and reset ( $n\overline{RD}$ ) input to output ( $nQ, n\overline{Q}$ ) propagation delays, set and reset pulse widths and the  $n\overline{SD}, n\overline{RD}$  to  $n\overline{CP}$  recovery time**

**Table 9. Measurement points**

Type	Input	Output
	$V_M$	$V_M$
74HC74-Q100	$0.5V_{CC}$	$0.5V_{CC}$
74HCT74-Q100	1.3 V	1.3 V



Test data is given in [Table 10](#).

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.

$R_L$  = Load resistance.

S1 = Test selection switch.

**Fig. 9. Test circuit for measuring switching times**

**Table 10. Test data**

Type	Input		Load		Test
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	
74HC74-Q100	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	$t_{PLH}, t_{PHL}$
74HCT74-Q100	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	$t_{PLH}, t_{PHL}$

11. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



Fig. 10. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



Fig. 11. Package outline SOT402-1 (TSSOP14)

DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1



Fig. 12. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model
TTL	Transistor-Transistor Logic

## 13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT74_Q100 v.4	20200421	Product data sheet	-	74HC_HCT74_Q100 v.3
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> updated.</li> <li><a href="#">Table 5</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74HC_HCT74_Q100 v.3	20151204	Product data sheet	-	74HC_HCT74_Q100 v.2
Modifications:	<ul style="list-style-type: none"> <li>Type number 74HC74N-Q100 (SOT27-1) removed.</li> </ul>			
74HC_HCT74_Q100 v.2	20130906	Product data sheet	-	74HC_HCT74_Q100 v.1
Modifications:	<ul style="list-style-type: none"> <li>74HC74N-Q100 (DIP14) added.</li> </ul>			
74HC_HCT74_Q100 v.1	20120807	Product data sheet	-	-

## 14. 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".
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