

# 74AHC74-Q100; 74AHCT74-Q100

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

Rev. 3 — 22 April 2020

Product data sheet

## 1. General description

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The 74AHC74-Q100; 74AHCT74-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 74AHC74-Q100; 74AHCT74-Q100 is a dual positive-edge triggered, D-type flip-flop with individual data inputs (D), clock inputs (CP), set inputs ( $\overline{SD}$ ) and reset inputs ( $\overline{RD}$ ). It also has complementary outputs (Q and  $\overline{Q}$ ).

The set and reset are asynchronous active LOW inputs that operate independent of the clock input. Information on the data input is transferred to the Q output on the LOW to HIGH transition of the clock pulse. The data inputs must be stable one set-up time prior to the LOW to HIGH clock transition for predictable operation.

Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

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 °C to +85 °C and from -40 °C to +125 °C
- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than  $V_{CC}$
- Input levels:
  - For 74AHC74-Q100: CMOS level
  - For 74AHCT74-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
- 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	
74AHC74D-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHCT74D-Q100				
74AHC74PW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHCT74PW-Q100				
74AHC74BQ-Q100	-40 °C to +125 °C	DHFQFN14	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
74AHCT74BQ-Q100				

### 4. Functional diagram

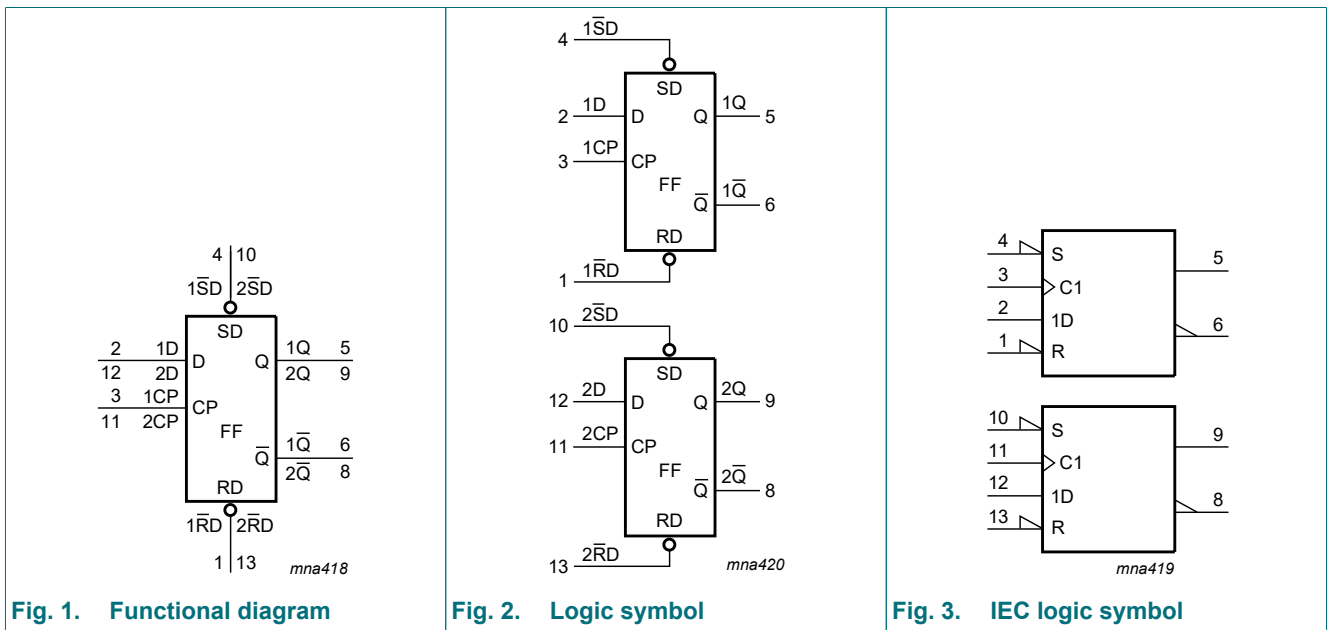


Fig. 1. Functional diagram

Fig. 2. Logic symbol

Fig. 3. IEC logic symbol

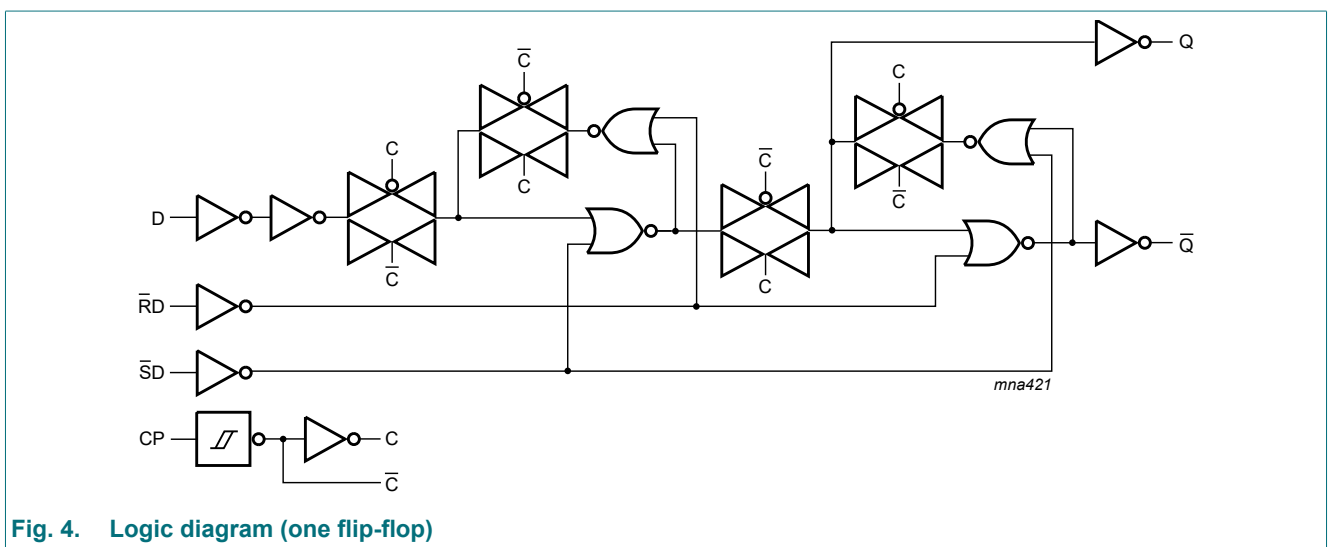
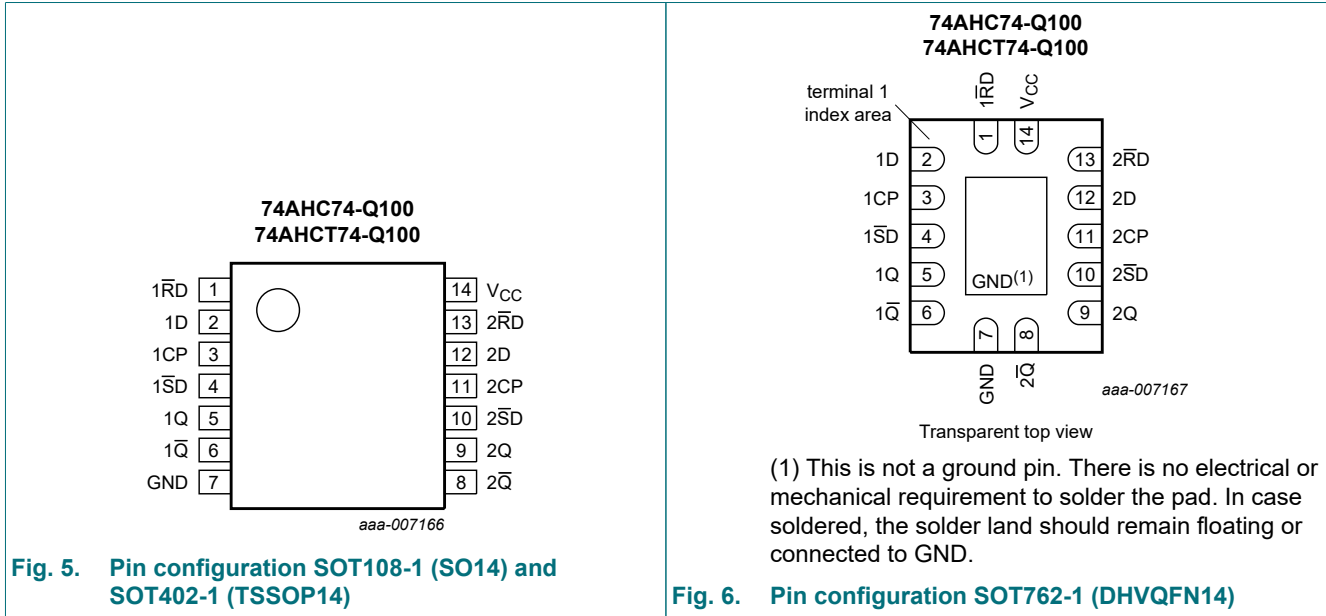


Fig. 4. Logic diagram (one flip-flop)

## 5. Pinning information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1RD	1	asynchronous reset direct input (active LOW)
1D	2	data input
1CP	3	clock input (LOW to HIGH, edge-triggered)
1SD	4	asynchronous set direct input (active LOW)
1Q	5	true flip-flop output
1Q	6	complement flip-flop output
GND	7	ground (0 V)
2Q	8	complement flip-flop output
2Q	9	true flip-flop output
2SD	10	asynchronous set direct input (active LOW)
2CP	11	clock input (LOW to HIGH, edge-triggered)
2D	12	data input
2RD	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;

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

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

## 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 <sub>CC</sub>	supply voltage		-0.5	+7.0	V
V <sub>I</sub>	input voltage		-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V [1]	-20	-	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V [1]	-20	+20	mA
I <sub>O</sub>	output current	V <sub>O</sub> = -0.5 V to (V <sub>CC</sub> + 0.5 V)	-25	+25	mA
I <sub>CC</sub>	supply current		-	+75	mA
I <sub>GND</sub>	ground current		-75	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C [2]	-	500	mW

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

[2] 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 5. Operating conditions**

Symbol	Parameter	Conditions	74AHC74-Q100			74AHCT74-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	5.5	0	-	5.5	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> = 3.0 V to 3.6 V	-	-	100	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	20	-	-	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>74AHC74-Q100</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	1.65	-	1.65	-	1.65	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> = -50 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V	2.58	-	-	2.48	-	2.40	-	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> = 50 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
		V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	2.0	-	20	-	40	μA
C <sub>I</sub>	input capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND	-	3	10	-	10	-	10	pF
<b>74AHCT74-Q100</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
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> = -50 μA	4.4	4.5	-	4.4	-	4.4	-	V
V <sub>OL</sub>	LOW-level output voltage	I <sub>O</sub> = -8.0 mA	3.94	-	-	3.80	-	3.70	-	V
		V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
I <sub>I</sub>	input leakage current	I <sub>O</sub> = 50 μA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	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	-	-	2.0	-	20	-	40	μA

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$\Delta I_{CC}$	additional supply current	per input pin; $V_I = V_{CC} - 2.1$ V; other pins at $V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 4.5$ V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
$C_I$	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF

## 10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit, see Fig. 9.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Max	
<b>74AHC74-Q100</b>										
$t_{pd}$	propagation delay	nCP to nQ, n $\bar{Q}$ ; see Fig. 7 [2]								
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 15$ pF	-	5.2	11.9	1.0	14.0	1.0	15.0	ns
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 50$ pF	-	7.4	15.4	1.0	17.5	1.0	19.5	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 15$ pF	-	3.7	7.3	1.0	8.5	1.0	9.5	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 50$ pF	-	5.2	9.3	1.0	10.5	1.0	12.0	ns
		n $\bar{S}D$ , n $\bar{R}D$ to nQ, n $\bar{Q}$ ; see Fig. 8								
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 15$ pF	-	5.4	12.3	1.0	14.5	1.0	15.5	ns
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 50$ pF	-	7.7	15.8	1.0	18.0	1.0	20.0	ns
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 15$ pF	-	3.7	7.7	1.0	9.0	1.0	10.0	ns
$V_{CC} = 4.5$ V to 5.5 V; $C_L = 50$ pF	-	5.3	9.7	1.0	11.0	1.0	12.5	ns		
$f_{max}$	maximum frequency	see Fig. 7								
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 15$ pF	80	125	-	70	-	70	-	MHz
		$V_{CC} = 3.0$ V to 3.6 V; $C_L = 50$ pF	50	75	-	45	-	45	-	MHz
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 15$ pF	130	170	-	110	-	110	-	MHz
		$V_{CC} = 4.5$ V to 5.5 V; $C_L = 50$ pF	90	115	-	75	-	75	-	MHz
$t_W$	pulse width	CP HIGH or LOW; n $\bar{S}D$ , n $\bar{R}D$ LOW; see Fig. 7 and Fig. 8								
		$V_{CC} = 3.0$ V to 3.6 V	6.0	-	-	7.0	-	7.0	-	ns
		$V_{CC} = 4.5$ V to 5.5 V	5.0	-	-	5.0	-	5.0	-	ns
$t_{su}$	set-up time	nD to nCP; see Fig. 7								
		$V_{CC} = 3.0$ V to 3.6 V	6.0	-	-	7.0	-	7.0	-	ns
		$V_{CC} = 4.5$ V to 5.5 V	5.0	-	-	5.0	-	5.0	-	ns
$t_h$	hold time	nD to nCP; see Fig. 7								
		$V_{CC} = 3.0$ V to 3.6 V	0.5	-	-	0.5	-	0.5	-	ns
		$V_{CC} = 4.5$ V to 5.5 V	0.5	-	-	0.5	-	0.5	-	ns

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Max	
t <sub>rec</sub>	recovery time	nRD to nCP; see Fig. 8								
		V <sub>CC</sub> = 3.0 V to 3.6 V	5.0	-	-	5.0	-	5.0	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	3.0	-	-	3.0	-	3.0	-	ns
C <sub>PD</sub>	power dissipation capacitance	f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [3]	-	12	-	-	-	-	-	pF
<b>74AHCT74-Q100</b>										
t <sub>pd</sub>	propagation delay	nCP to nQ, nQ̄; see Fig. 7 [2]								
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.3	7.8	1.0	9.0	1.0	10.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	4.8	8.8	1.0	10.0	1.0	11.0	ns
		nSD, nRD to nQ, nQ̄; see Fig. 8								
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.7	10.4	1.0	12.0	1.0	13.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.3	11.4	1.0	13.0	1.0	14.5	ns
f <sub>max</sub>	maximum frequency	see Fig. 7								
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	100	160	-	80	-	80	-	MHz
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	80	140	-	65	-	65	-	MHz
t <sub>W</sub>	pulse width	CP HIGH or LOW; nSD, nRD LOW; V <sub>CC</sub> = 4.5 V to 5.5 V; see Fig. 7 and Fig. 8	5.0	-	-	5.0	-	5.0	-	ns
t <sub>su</sub>	set-up time	nD to nCP; V <sub>CC</sub> = 4.5 V to 5.5 V; see Fig. 7	5.0	-	-	5.0	-	5.0	-	ns
t <sub>h</sub>	hold time	nD to nCP; V <sub>CC</sub> = 4.5 V to 5.5 V; see Fig. 7	0	-	-	0	-	0	-	ns
t <sub>rec</sub>	recovery time	nRD to nCP; V <sub>CC</sub> = 4.5 V to 5.5 V; see Fig. 8	3.5	-	-	3.5	-	3.5	-	ns
C <sub>PD</sub>	power dissipation capacitance	f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [3]	-	16	-	-	-	-	-	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] 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;

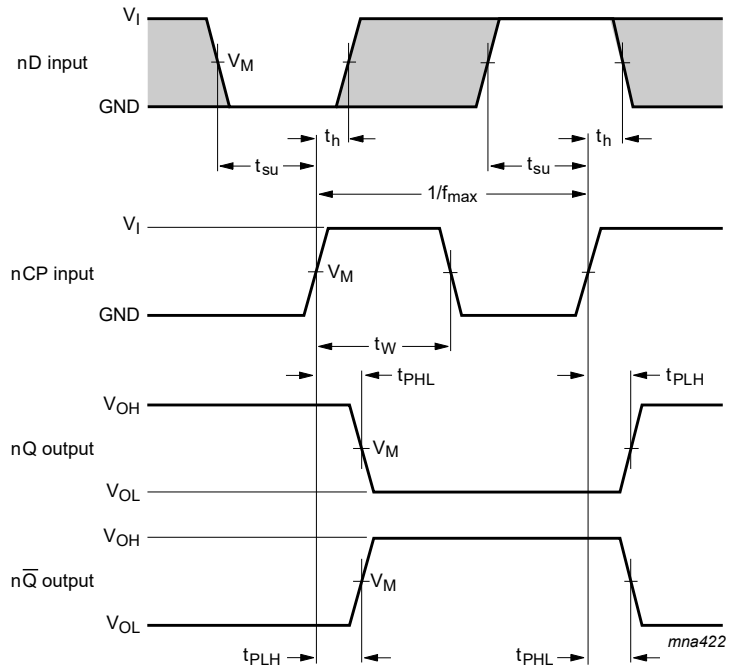
C<sub>L</sub> = output load capacitance in pF;

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

N = number of inputs switching;

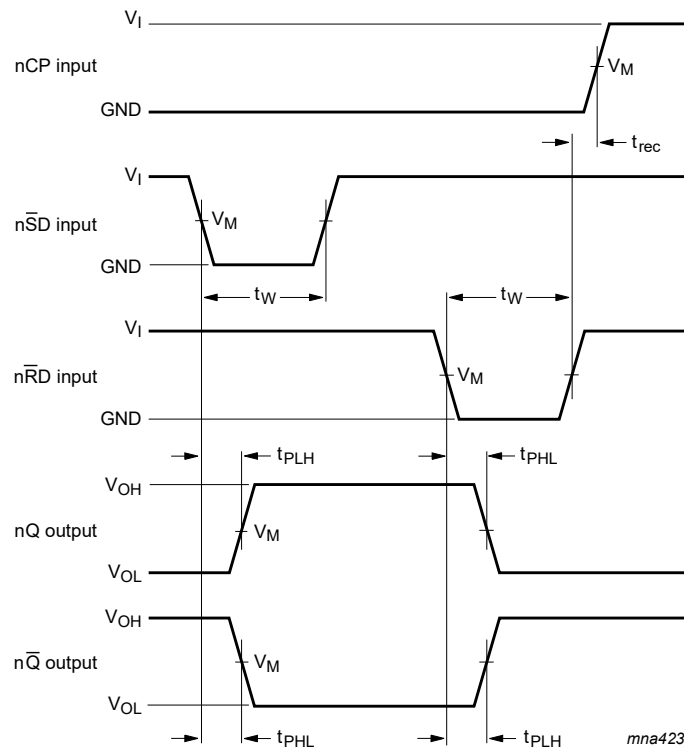
Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

10.1. Waveforms



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

Fig. 7. Clock pulse width, maximum frequency, set-up times, hold times and input to output propagation delays



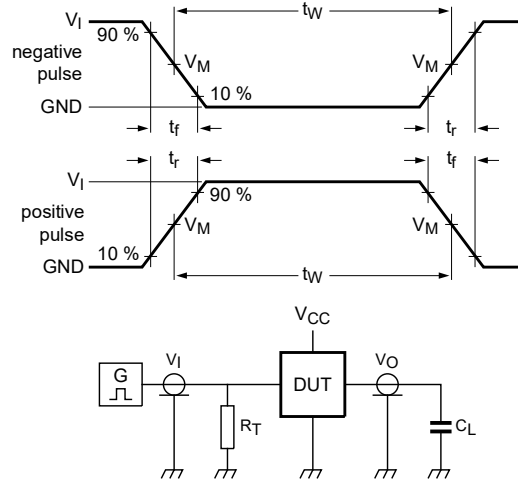
Measurement points are given in [Table 8](#).  
 V<sub>OL</sub> and V<sub>OH</sub> are typical voltage output levels that occur with the output load.

Fig. 8. Set and reset pulse widths, recovery time and input to output propagation delays



Table 8. Measurement points

Type	Input	Output
	$V_M$	$V_M$
74AHC74-Q100	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT74-Q100	1.5 V	$0.5 \times V_{CC}$



001aah768

For test data, see [Table 9](#).

Definitions for test circuit:

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

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

Fig. 9. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74AHC74-Q100	$V_{CC}$	$\leq 3.0$ ns	50 pF, 15 pF	$t_{PLH}, t_{PHL}$
74AHCT74-Q100	3.0 V	$\leq 3.0$ ns	50 pF, 15 pF	$t_{PLH}, t_{PHL}$

### 11. Package outline

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

SOT108-1

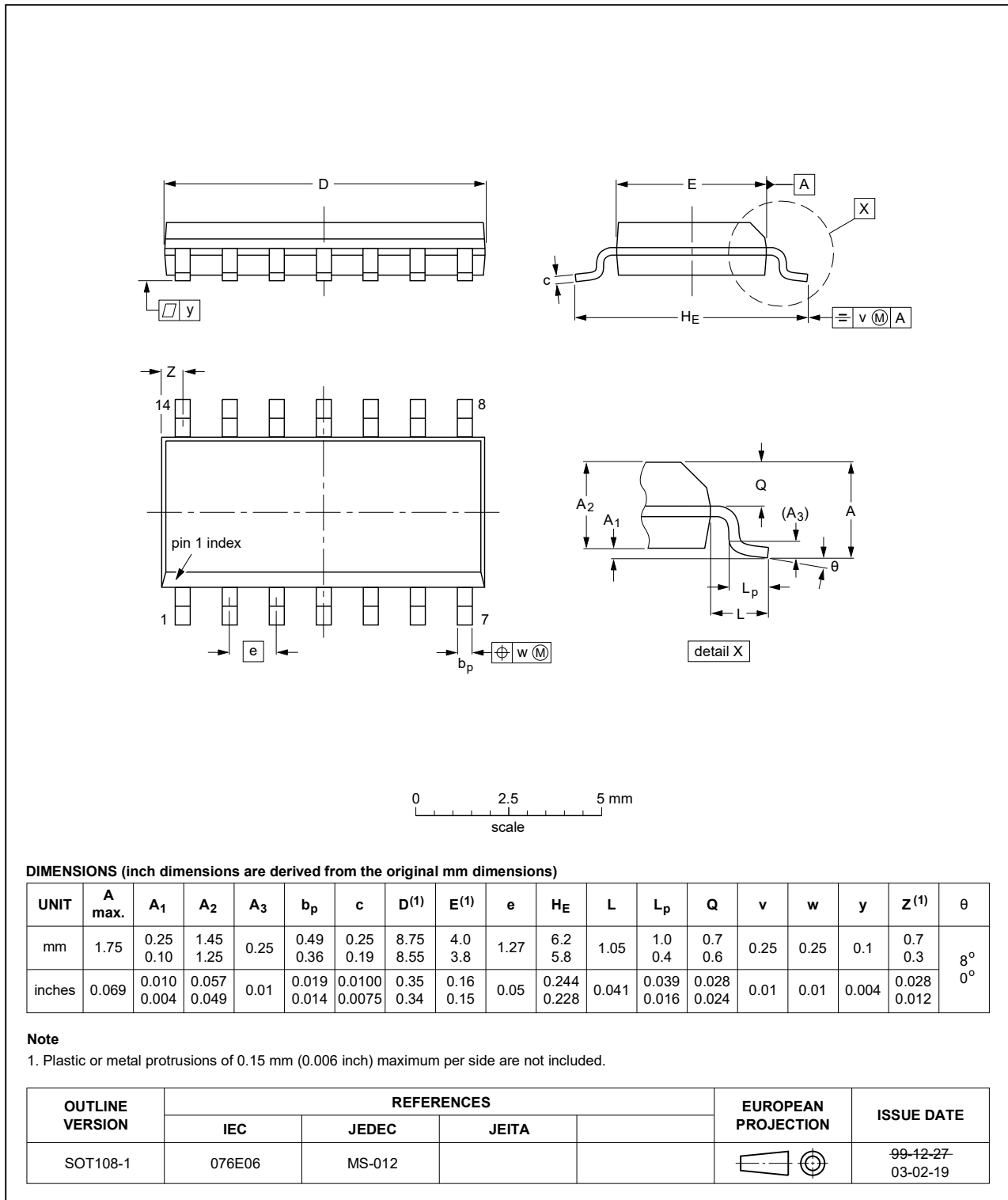


Fig. 10. Package outline SOT108-1 (SO14)

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

SOT402-1

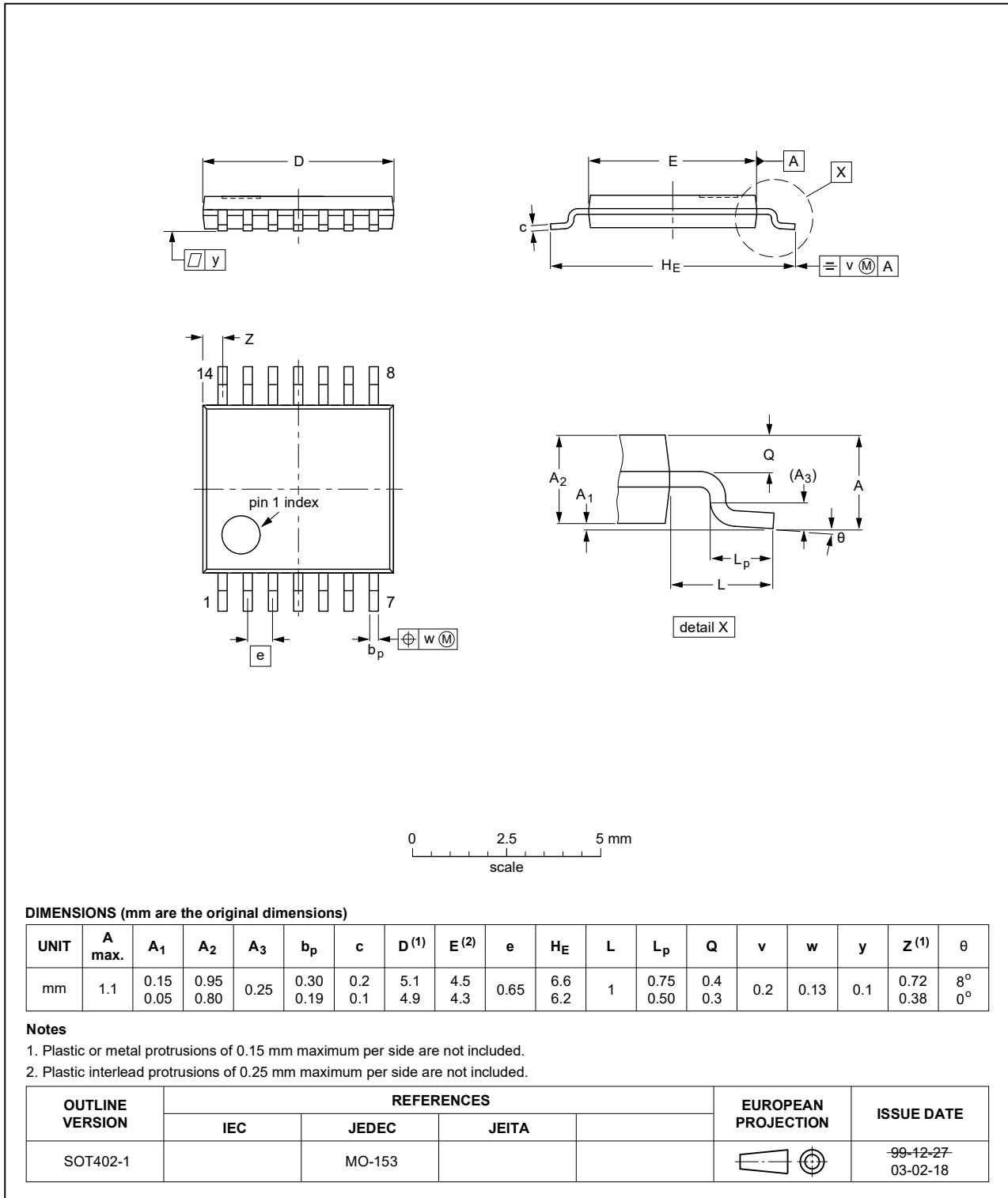


Fig. 11. Package outline SOT402-1 (TSSOP14)



## 12. Abbreviations

Table 10. Abbreviations

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

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT74_Q100 v.3	20200422	Product data sheet	-	74AHC_AHCT74_Q100 v.2
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 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> <li><a href="#">Table 7</a>: minimum <math>f_{max}</math> values at 3.0 V to 3.6 V for 74AHC74 corrected (errata).</li> <li><a href="#">Fig. 12</a>: Package outline drawing SOT762-1 (DHVQFN14) updated.</li> </ul>			
74AHC_AHCT74_Q100 v.2	20150421	Product data sheet	-	74AHC_AHCT74_Q100 v.1
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 3</a> corrected (errata).</li> </ul>			
74AHC_AHCT74_Q100 v.1	20130416	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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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