

# 74HC74; 74HCT74

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

Rev. 5 — 3 December 2015

Product data sheet

## 1. General description

The 74HC74 and 74HCT74 are dual positive edge triggered D-type flip-flop. They have individual data ( $nD$ ), clock ( $nCP$ ), set ( $n\overline{SD}$ ) and reset ( $n\overline{RD}$ ) inputs, and complementary  $nQ$  and  $n\overline{Q}$  outputs. Data at the  $nD$ -input, that meets the set-up and hold time requirements on the LOW-to-HIGH clock transition, is stored in the flip-flop and appears at the  $nQ$  output. Schmitt-trigger action in the clock input, makes the circuit highly tolerant to slower clock rise and fall times. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

## 2. Features and benefits

- Input levels:
  - ◆ For 74HC74: CMOS level
  - ◆ For 74HCT74: TTL level
- Symmetrical output impedance
- Low power dissipation
- High noise immunity
- Balanced propagation delays
- Specified in compliance with JEDEC standard no. 7A
- 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  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

## 3. Ordering information

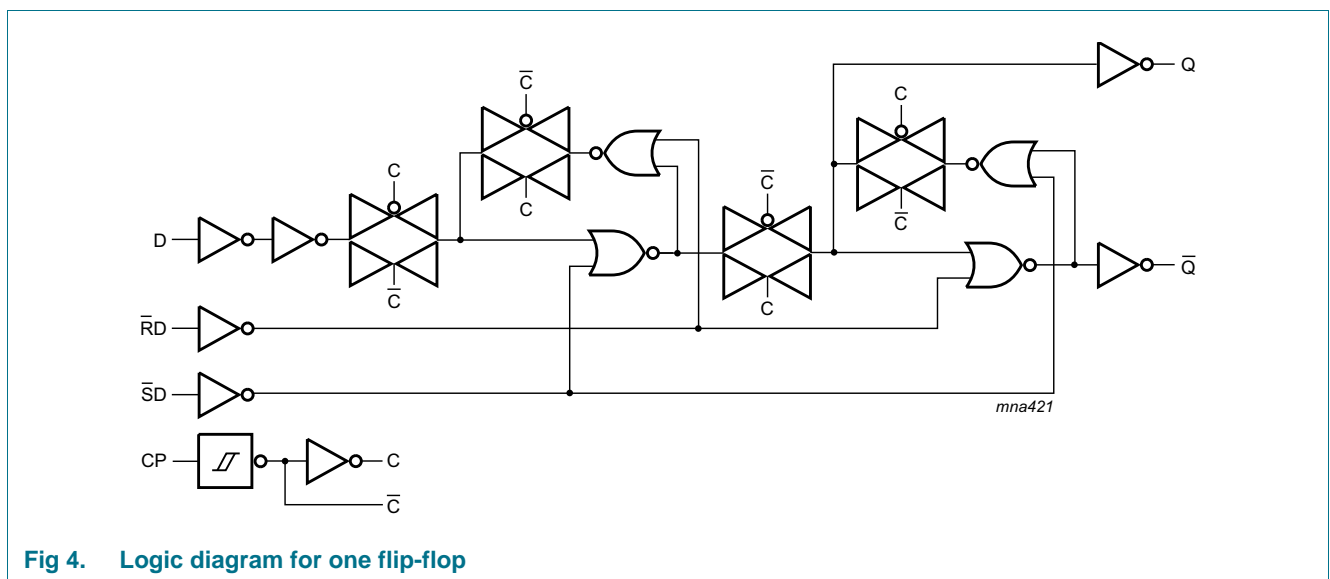
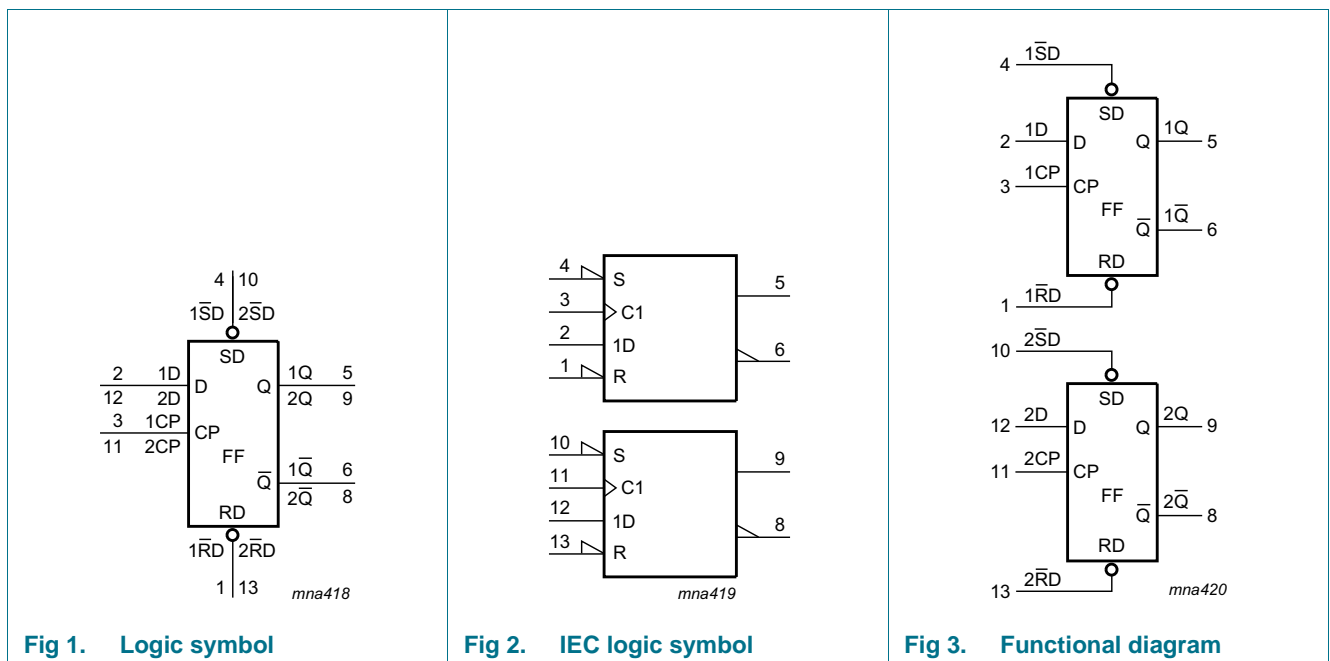
Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC74D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HCT74D				
74HC74DB	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74HCT74DB				

Table 1. Ordering information ...continued

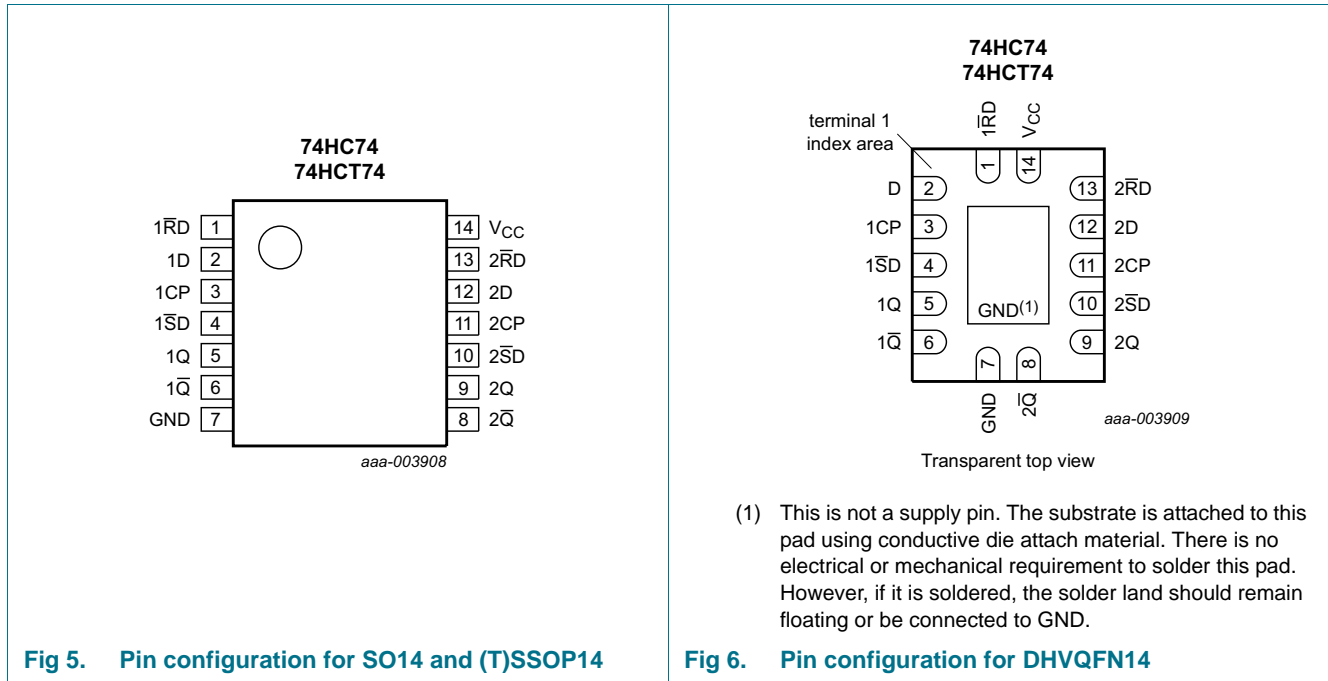
Type number	Package			Version
	Temperature range	Name	Description	
74HC74PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HCT74PW				
74HC74BQ	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat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

## 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<sup>[1]</sup>

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

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

Table 4. Function table<sup>[1]</sup>

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

[1] H = HIGH voltage level; L = LOW voltage level; ↑ = LOW-to-HIGH transition; Q<sub>n+1</sub> = state after the next LOW-to-HIGH CP transition; X = don't care.

## 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	SO14, (T)SSOP14 and DHVQFN14 packages <sup>[1]</sup>	-	500	mW

[1] For SO14 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.  
 For (T)SSOP14 packages: P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.  
 For DHVQFN14 packages: P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC74			74HCT74			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 <sup>[1]</sup>	Max	Min	Max	
<b>74HC74</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

**Table 7. Static characteristics ...continued**

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 <sup>[1]</sup>	Max	Min	Max	
<b>74HCT74</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
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);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 9](#).

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
<b>74HC74</b>								
$t_{pd}$	propagation delay	nCP to nQ, n $\bar{Q}$ ; see <a href="#">Figure 7</a> <sup>[2]</sup>						
		$V_{CC} = 2.0$ V	-	47	220	-	265	ns
		$V_{CC} = 4.5$ V	-	17	44	-	53	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	14	-	-	-	ns
		$V_{CC} = 6.0$ V	-	14	37	-	45	ns
		n $\bar{S}D$ to nQ, n $\bar{Q}$ ; see <a href="#">Figure 8</a> <sup>[2]</sup>						
		$V_{CC} = 2.0$ V	-	50	250	-	300	ns
		$V_{CC} = 4.5$ V	-	18	50	-	60	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	15	-	-	-	ns
		$V_{CC} = 6.0$ V	-	14	43	-	51	ns
		n $\bar{R}D$ to nQ, n $\bar{Q}$ ; see <a href="#">Figure 8</a> <sup>[2]</sup>						
		$V_{CC} = 2.0$ V	-	52	250	-	300	ns
		$V_{CC} = 4.5$ V	-	19	50	-	60	ns
$V_{CC} = 5$ V; $C_L = 15$ pF	-	16	-	-	-	ns		
$V_{CC} = 6.0$ V	-	15	43	-	51	ns		
$t_t$	transition time	nQ, n $\bar{Q}$ ; see <a href="#">Figure 7</a> <sup>[3]</sup>						
		$V_{CC} = 2.0$ V	-	19	95	-	110	ns
		$V_{CC} = 4.5$ V	-	7	19	-	22	ns
		$V_{CC} = 6.0$ V	-	6	16	-	19	ns
$t_{w}$	pulse width	nCP HIGH or LOW; see <a href="#">Figure 7</a>						
		$V_{CC} = 2.0$ V	100	19	-	120	-	ns
		$V_{CC} = 4.5$ V	20	7	-	24	-	ns
		$V_{CC} = 6.0$ V	17	6	-	20	-	ns
		n $\bar{S}D$ , n $\bar{R}D$ LOW; see <a href="#">Figure 8</a>						
		$V_{CC} = 2.0$ V	100	19	-	120	-	ns
		$V_{CC} = 4.5$ V	20	7	-	24	-	ns
$V_{CC} = 6.0$ V	17	6	-	20	-	ns		
$t_{rec}$	recovery time	n $\bar{S}D$ , n $\bar{R}D$ ; see <a href="#">Figure 8</a>						
		$V_{CC} = 2.0$ V	40	3	-	45	-	ns
		$V_{CC} = 4.5$ V	8	1	-	9	-	ns
		$V_{CC} = 6.0$ V	7	1	-	8	-	ns

**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 9](#).

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_{su}$	set-up time	nD to nCP; see <a href="#">Figure 7</a>						
		$V_{CC} = 2.0$ V	75	6	-	90	-	ns
		$V_{CC} = 4.5$ V	15	2	-	18	-	ns
		$V_{CC} = 6.0$ V	13	2	-	15	-	ns
$t_h$	hold time	nD to nCP; see <a href="#">Figure 7</a>						
		$V_{CC} = 2.0$ V	3	-6	-	3	-	ns
		$V_{CC} = 4.5$ V	3	-2	-	3	-	ns
		$V_{CC} = 6.0$ V	3	-2	-	3	-	ns
$f_{max}$	maximum frequency	nCP; see <a href="#">Figure 7</a>						
		$V_{CC} = 2.0$ V	4.8	23	-	4.0	-	MHz
		$V_{CC} = 4.5$ V	24	69	-	20	-	MHz
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	76	-	-	-	MHz
		$V_{CC} = 6.0$ V	28	82	-	24	-	MHz
$C_{PD}$	power dissipation capacitance	$C_L = 50$ pF; $f = 1$ MHz; $V_I = \text{GND to } V_{CC}$ <sup>[4]</sup>	-	24	-	-	-	pF
<b>74HCT74</b>								
$t_{pd}$	propagation delay	nCP to nQ, n $\bar{Q}$ ; see <a href="#">Figure 7</a> <sup>[2]</sup>						
		$V_{CC} = 4.5$ V	-	18	44	-	53	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	15	-	-	-	ns
		n $\bar{S}D$ to nQ, n $\bar{Q}$ ; see <a href="#">Figure 8</a> <sup>[2]</sup>						
		$V_{CC} = 4.5$ V	-	23	50	-	60	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	18	-	-	-	ns
		n $\bar{R}D$ to nQ, n $\bar{Q}$ ; see <a href="#">Figure 8</a> <sup>[2]</sup>						
		$V_{CC} = 4.5$ V	-	24	50	-	60	ns
$V_{CC} = 5$ V; $C_L = 15$ pF	-	18	-	-	-	ns		
$t_t$	transition time	nQ, n $\bar{Q}$ ; see <a href="#">Figure 7</a> <sup>[3]</sup>						
		$V_{CC} = 4.5$ V	-	7	19	-	22	ns
$t_W$	pulse width	nCP HIGH or LOW; see <a href="#">Figure 7</a>						
		$V_{CC} = 4.5$ V	23	9	-	27	-	ns
		n $\bar{S}D$ , n $\bar{R}D$ LOW; see <a href="#">Figure 8</a>						
$V_{CC} = 4.5$ V	20	9	-	24	-	ns		
$t_{rec}$	recovery time	n $\bar{S}D$ , n $\bar{R}D$ ; see <a href="#">Figure 8</a>						
		$V_{CC} = 4.5$ V	8	1	-	9	-	ns
$t_{su}$	set-up time	nD to nCP; see <a href="#">Figure 7</a>						
		$V_{CC} = 4.5$ V	15	5	-	18	-	ns



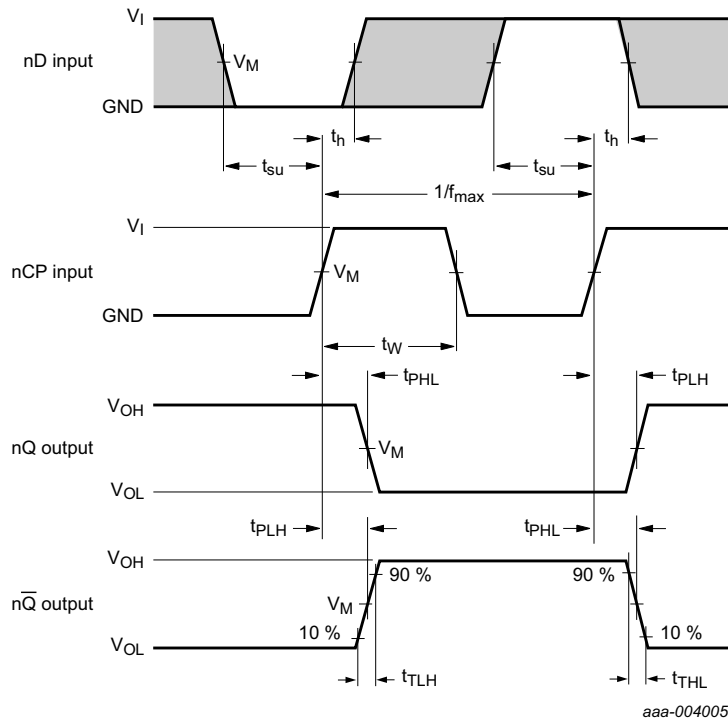
**Table 8. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 9](#).

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_h$	hold time	nD to nCP; see <a href="#">Figure 7</a>						
		$V_{CC} = 4.5$ V	3	-3	-	3	-	ns
$f_{max}$	maximum frequency	nCP; see <a href="#">Figure 7</a>						
		$V_{CC} = 4.5$ V	22	54	-	18	-	MHz
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	59	-	-	-	MHz
$C_{PD}$	power dissipation capacitance	$C_L = 50$ pF; $f = 1$ MHz; $V_1 = \text{GND to } V_{CC} - 1.5$ V <sup>[4]</sup>	-	29	-	-	-	pF

- [1] All typical values are measured at  $T_{amb} = 25\text{ °C}$ .
- [2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [3]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).
- $$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$$
- 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.

11. Waveforms

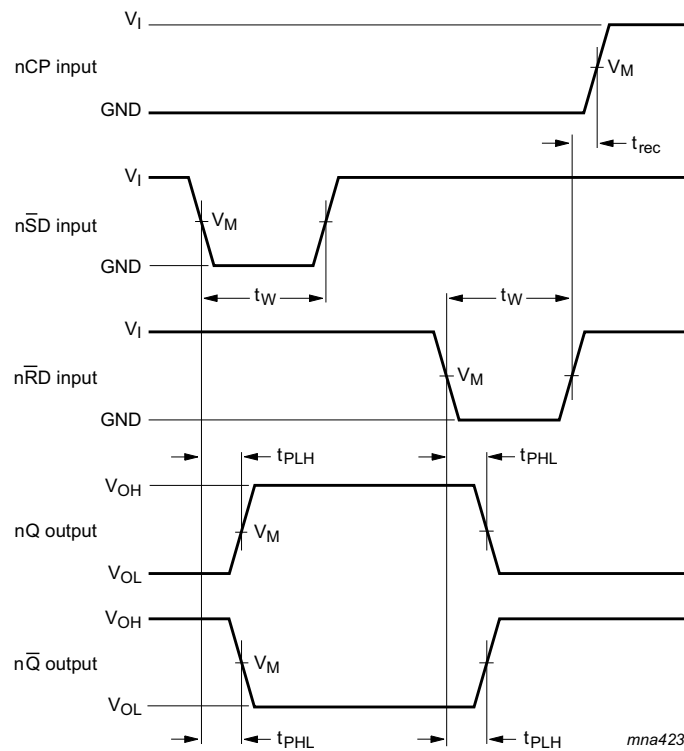


aaa-004005

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. Input to output propagation delay, output transition time, clock input pulse width and maximum frequency**



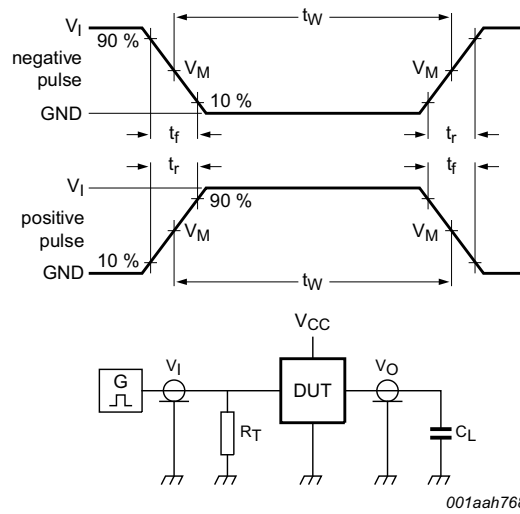
Measurement points are given in [Table 9](#).

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

**Fig 8. Set and reset propagation delays, pulse widths and recovery time**

**Table 9. Measurement points**

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



001aah768

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	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	$t_{PLH}, t_{PHL}$
74HCT74	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	$t_{PLH}, t_{PHL}$

12. Package outline

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

SOT108-1

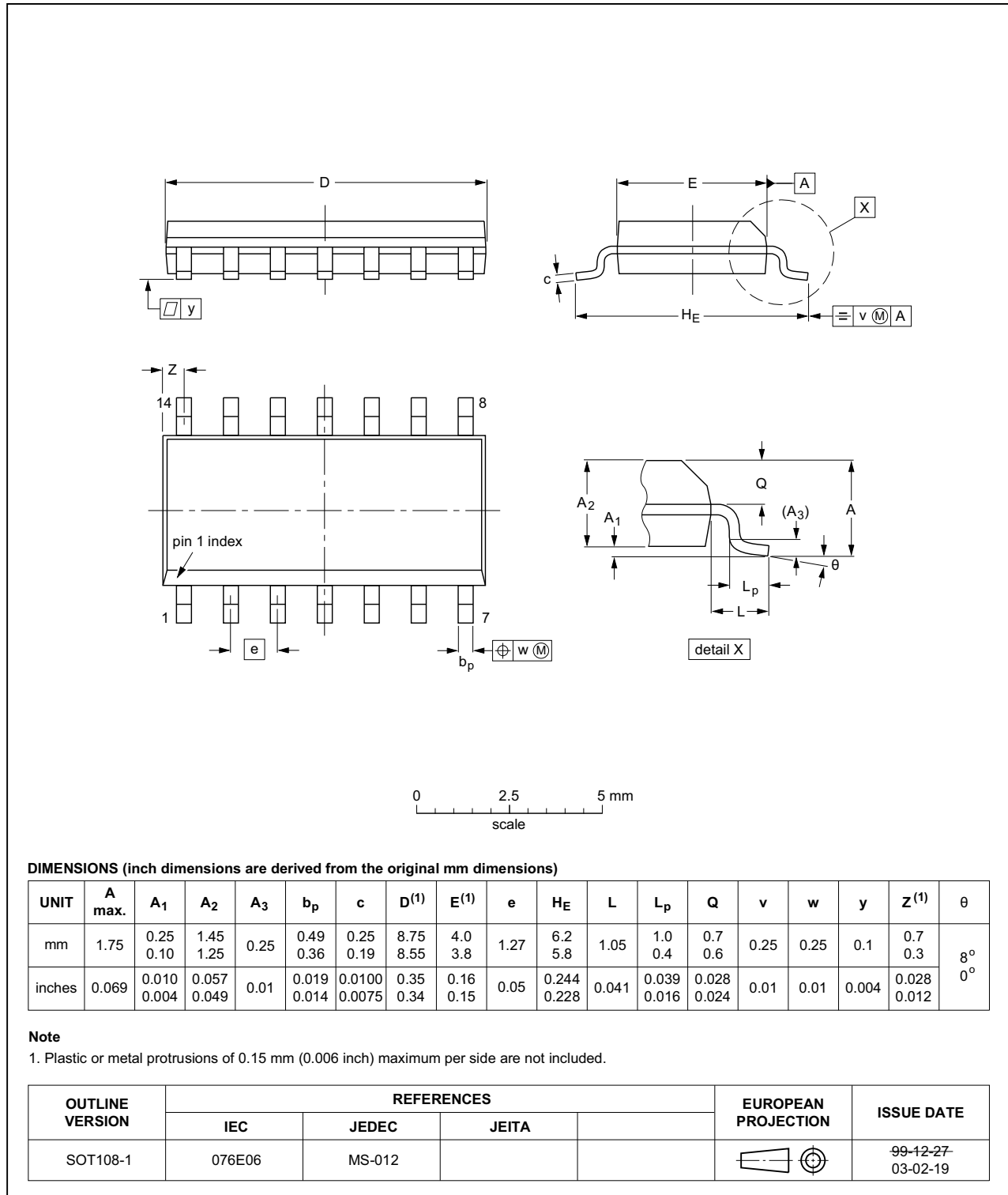


Fig 10. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

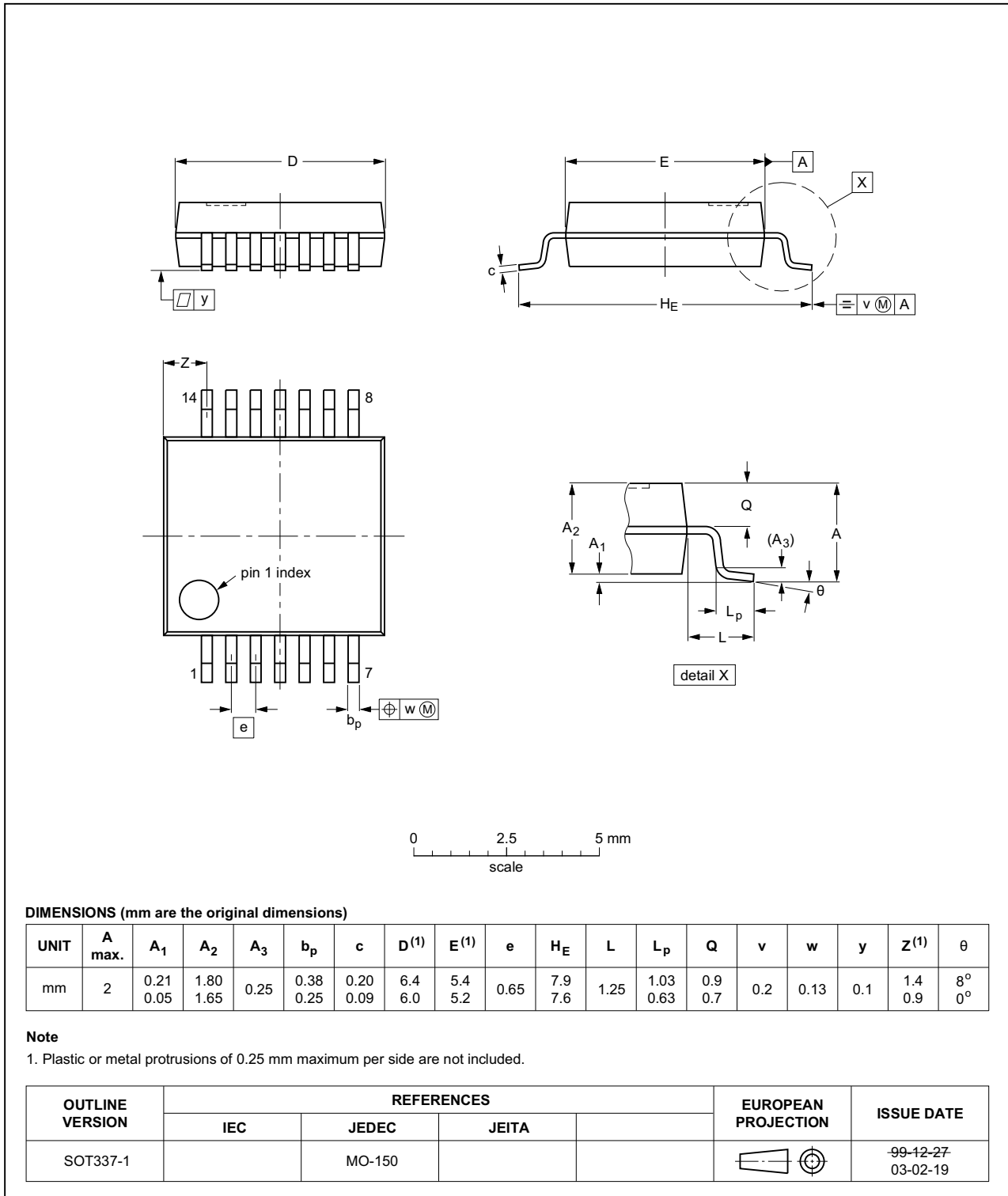


Fig 11. Package outline SOT337-1 (SSOP14)

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

SOT402-1

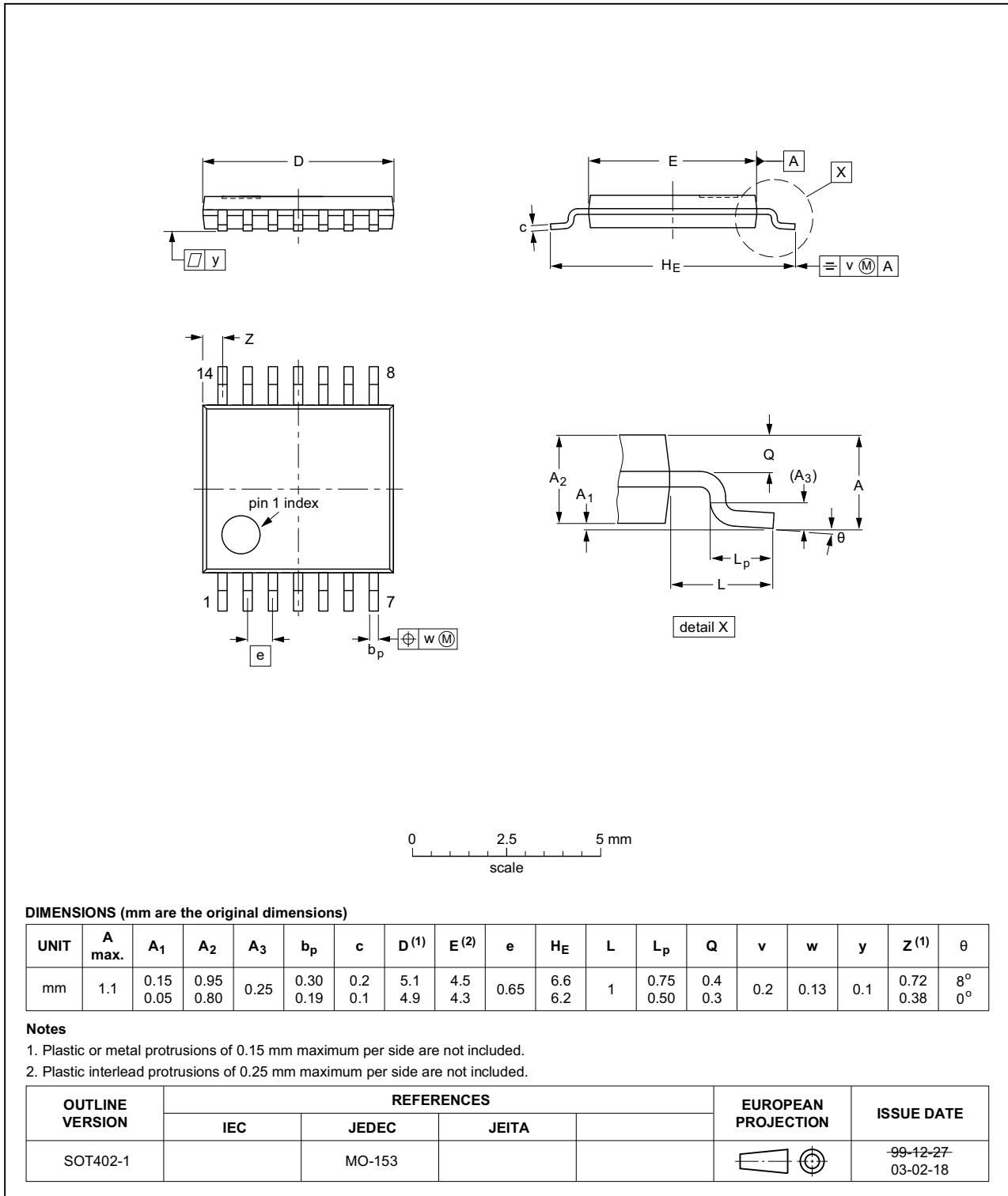


Fig 12. Package outline SOT402-1 (TSSOP14)

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

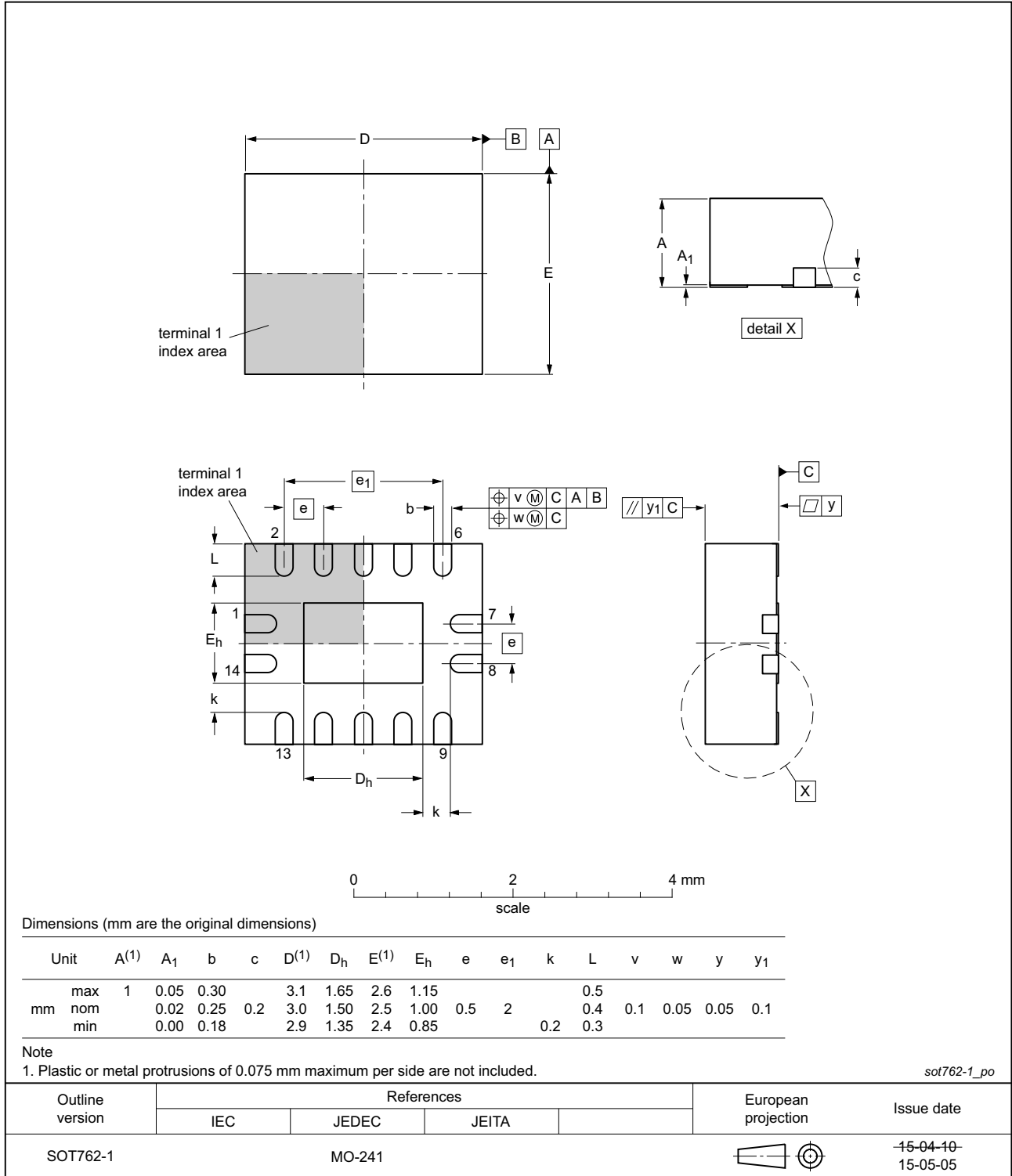


Fig 13. Package outline SOT762-1 (DHVQFN14)



## 13. Abbreviations

Table 11. Abbreviations

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

## 14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT74 v.5	20151203	Product data sheet	-	74HC_HCT74 v.4
Modifications:	<ul style="list-style-type: none"> <li>Type numbers 74HC74N and 74HCT74N (SOT27-1) removed.</li> </ul>			
74HC_HCT74 v.4	20120827	Product data sheet	-	74HC_HCT74 v.3
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74HC_HCT74 v.3	20030710	Product data sheet	-	74HC_HCT74_CNV v.2
74HC_HCT74_CNV v.2	19980223	Product specification	-	-

## 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".

[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>.

### 15.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

**Product specification** — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

### 15.3 Disclaimers

**Limited warranty and liability** — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of Nexperia.

**Right to make changes** — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of a Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

**Terms and conditions of commercial sale** — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

**Non-automotive qualified products** — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond

Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

**Translations** — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

## 15.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 16. Contact information

For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

## 17. Contents

---

<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features and benefits</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>1</b>
<b>4</b>	<b>Functional diagram</b> .....	<b>2</b>
<b>5</b>	<b>Pinning information</b> .....	<b>3</b>
5.1	Pinning .....	3
5.2	Pin description .....	3
<b>6</b>	<b>Functional description</b> .....	<b>4</b>
<b>7</b>	<b>Limiting values</b> .....	<b>4</b>
<b>8</b>	<b>Recommended operating conditions</b> .....	<b>5</b>
<b>9</b>	<b>Static characteristics</b> .....	<b>5</b>
<b>10</b>	<b>Dynamic characteristics</b> .....	<b>7</b>
<b>11</b>	<b>Waveforms</b> .....	<b>10</b>
<b>12</b>	<b>Package outline</b> .....	<b>13</b>
<b>13</b>	<b>Abbreviations</b> .....	<b>17</b>
<b>14</b>	<b>Revision history</b> .....	<b>17</b>
<b>15</b>	<b>Legal information</b> .....	<b>18</b>
15.1	Data sheet status .....	18
15.2	Definitions .....	18
15.3	Disclaimers .....	18
15.4	Trademarks .....	19
<b>16</b>	<b>Contact information</b> .....	<b>19</b>
<b>17</b>	<b>Contents</b> .....	<b>20</b>