

# 74HC74; 74HCT74

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

Rev. 4 — 27 August 2012

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

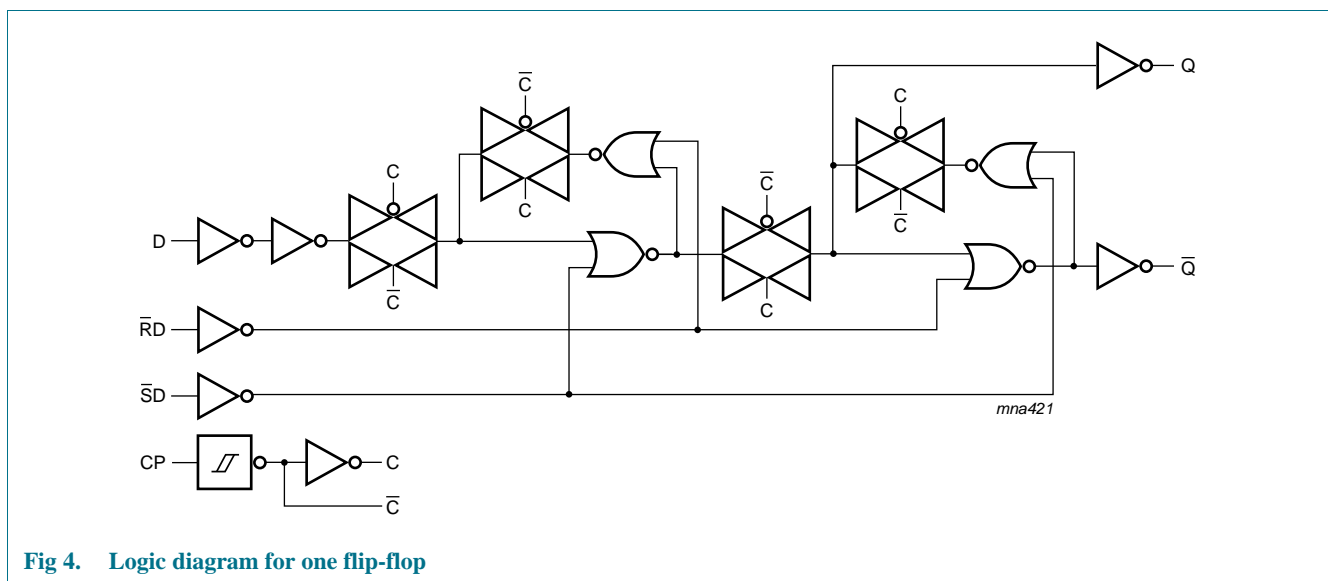
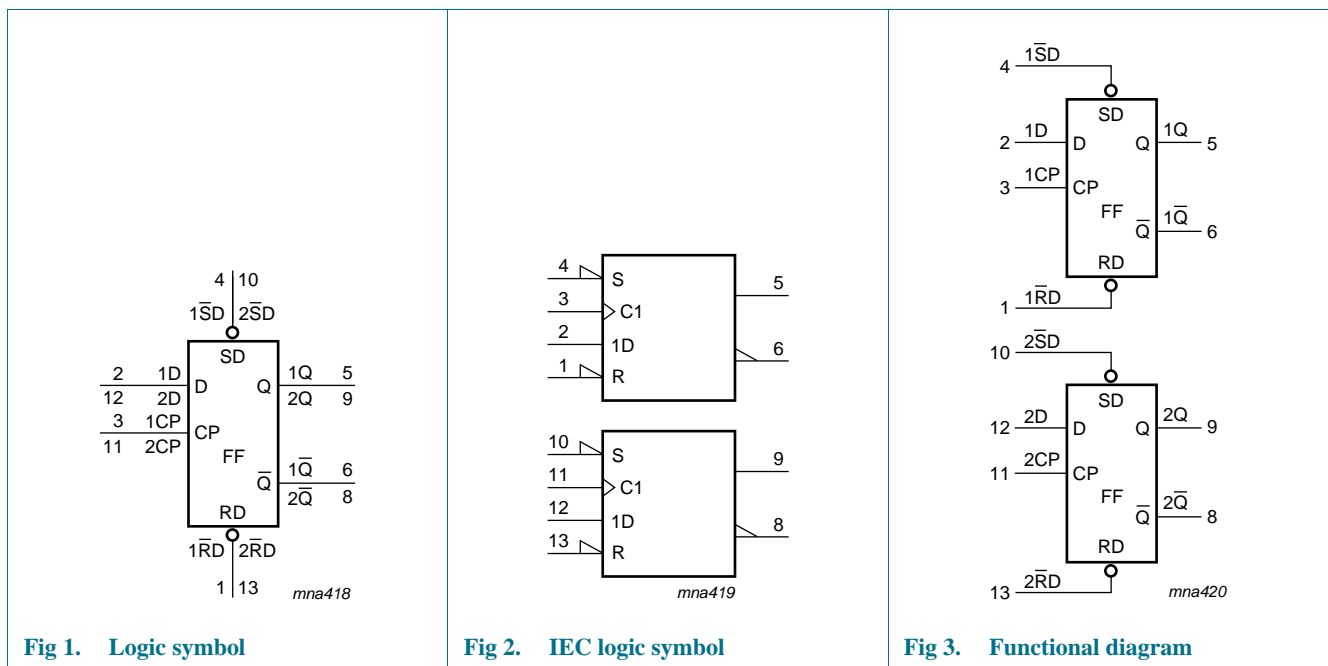
Type number	Package			
	Temperature range	Name	Description	Version
74HC74N 74HCT74N	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HC74D 74HCT74D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC74DB 74HCT74DB	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1



Table 1. Ordering information ...continued

Type number	Package			Version
	Temperature range	Name	Description	
74HC74PW 74HCT74PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HC74BQ 74HCT74BQ	-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

## 4. Functional diagram



## 5. Pinning information

### 5.1 Pinning

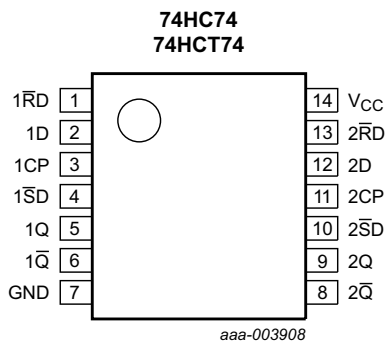


Fig 5. Pin configuration for DIP14, SO14 and (T)SSOP14

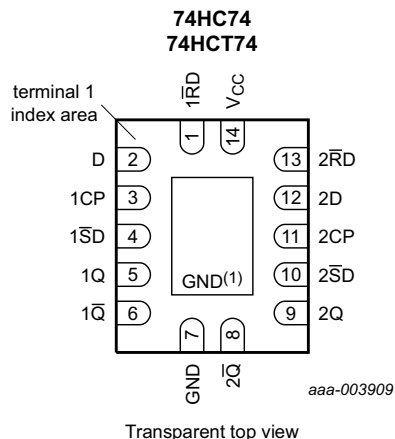


Fig 6. Pin configuration for DHVQFN14

### 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	output
1Q-bar	6	complement output
GND	7	ground (0 V)
2Q-bar	8	complement output
2Q	9	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)
VCC	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	DIP14 package	[1]	-	750	mW
		SO14, (T)SSOP14 and DHVQFN14 packages	[1]	-	500	mW

[1] For DIP14 package: P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.  
 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
<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

**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	
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>	<a href="#">[2]</a>						
		$V_{CC} = 2.0$ 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>	<a href="#">[2]</a>						
		$V_{CC} = 2.0$ 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>	<a href="#">[2]</a>						
		$V_{CC} = 2.0$ 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>	<a href="#">[3]</a>						
		$V_{CC} = 2.0$ 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	-
$V_{CC} = 4.5$ 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; $V_1 = \text{GND to } V_{CC}$	[4]	-	24	-	-	pF

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$t_{pd}$	propagation delay	nCP to nQ, n $\bar{Q}$ ; see <a href="#">Figure 7</a>	[2]					
		$V_{CC} = 4.5$ 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>	[2]					
		$V_{CC} = 4.5$ 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>	[2]					
		$V_{CC} = 4.5$ 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>	[3]					
		$V_{CC} = 4.5$ 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



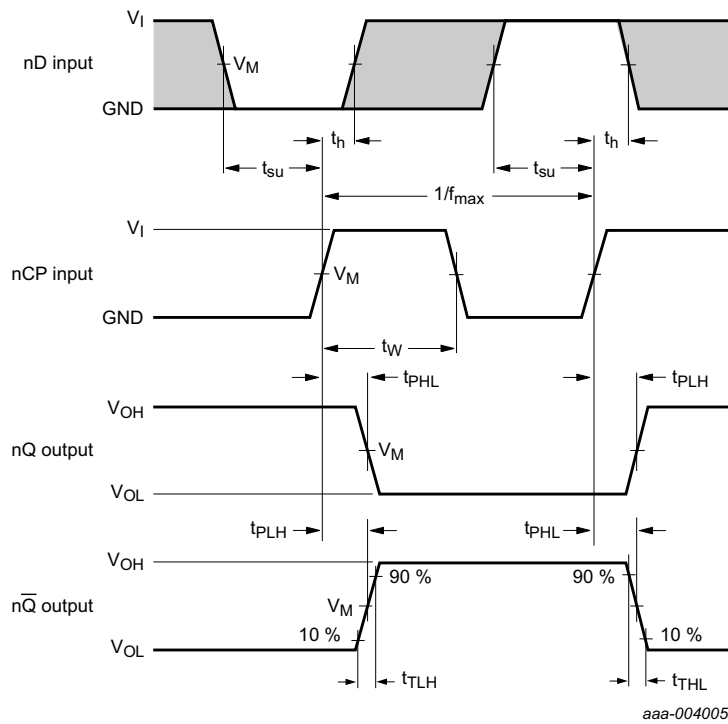
**Table 8. Dynamic characteristics ...continued**

*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> $V_{CC} = 4.5\text{ V}$	3	-3	-	3	-	ns
$f_{max}$	maximum frequency	nCP; see <a href="#">Figure 7</a> $V_{CC} = 4.5\text{ V}$	22	54	-	18	-	MHz
		$V_{CC} = 5\text{ V}; C_L = 15\text{ pF}$	-	59	-	-	-	MHz
$C_{PD}$	power dissipation capacitance	$C_L = 50\text{ pF}; f = 1\text{ MHz}; V_1 = \text{GND to } V_{CC} - 1.5\text{ V}$ <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.

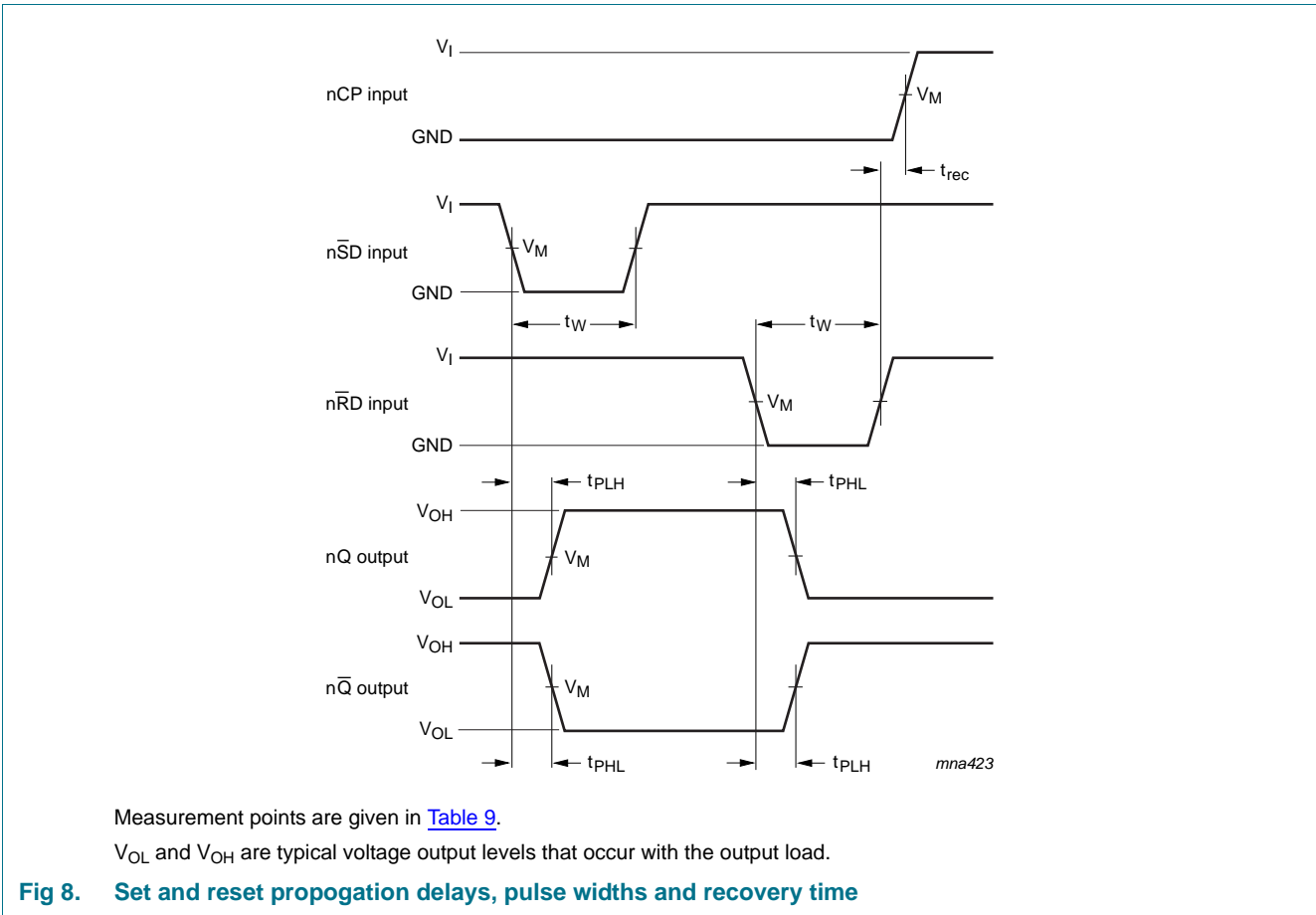
11. Waveforms



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

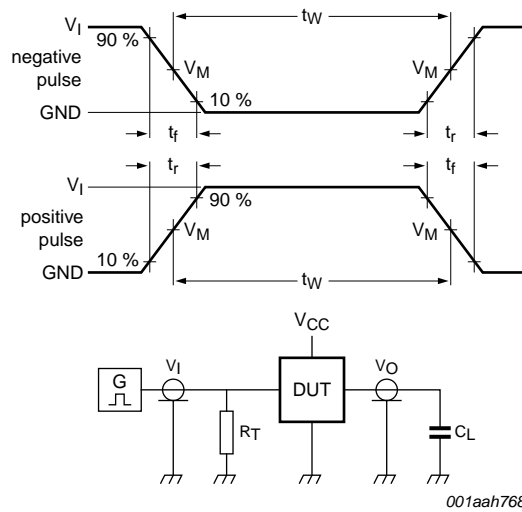
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 7. Input to output propagation delay, output transition time, clock input pulse width and maximum frequency**



**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

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

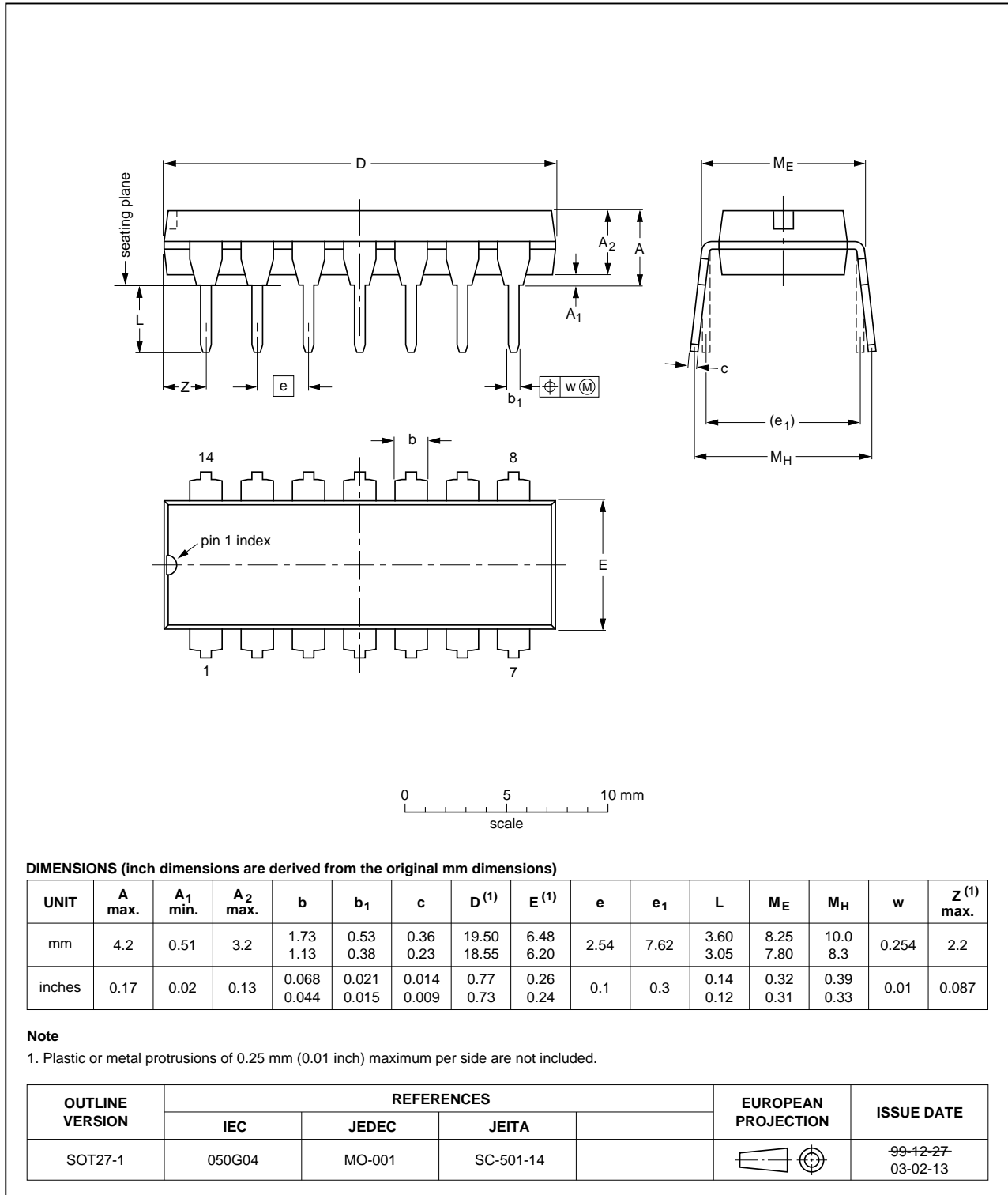


Fig 10. Package outline SOT27-1 (DIP14)

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

SOT108-1

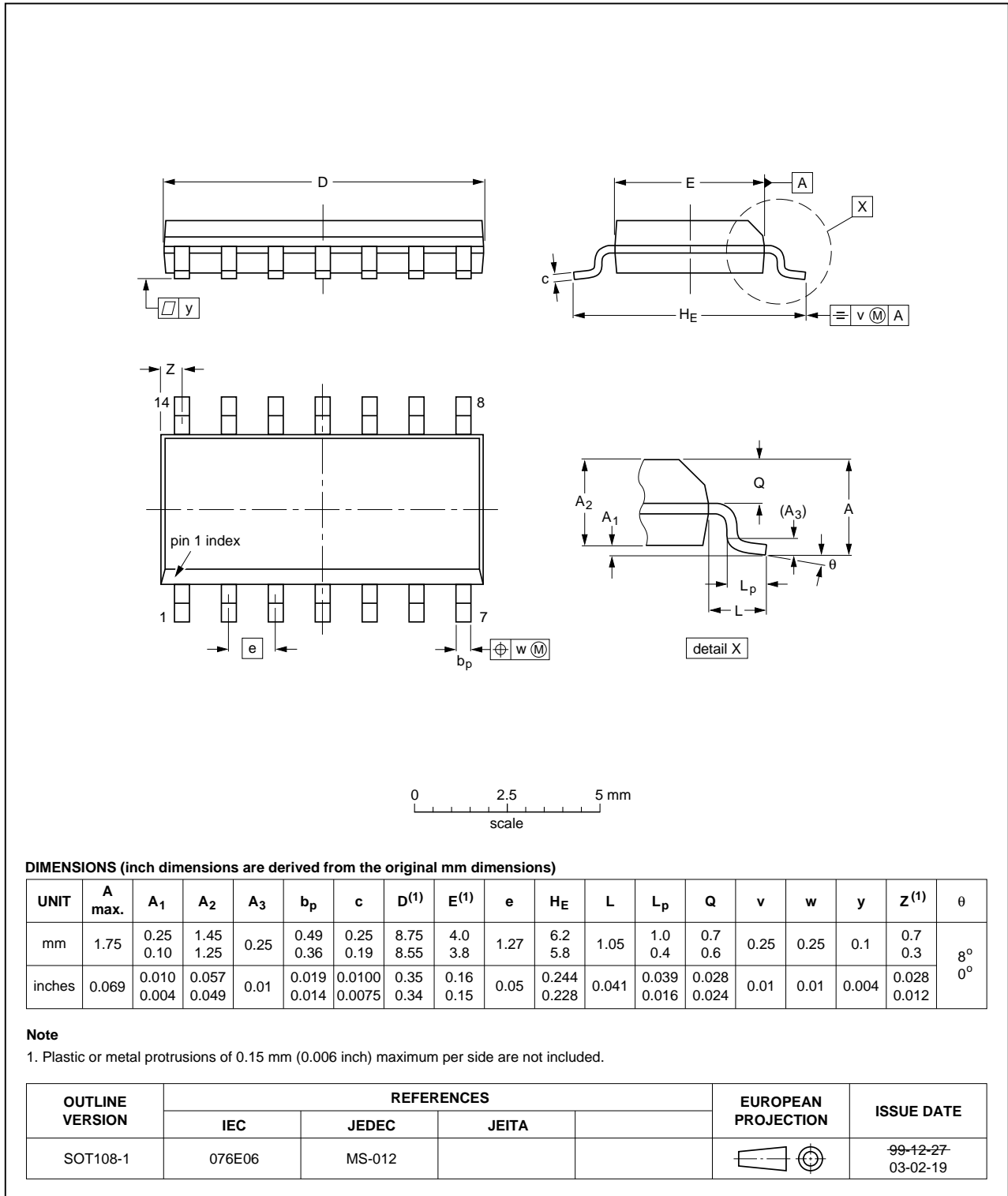


Fig 11. Package outline SOT108-1 (SO14)

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

SOT337-1

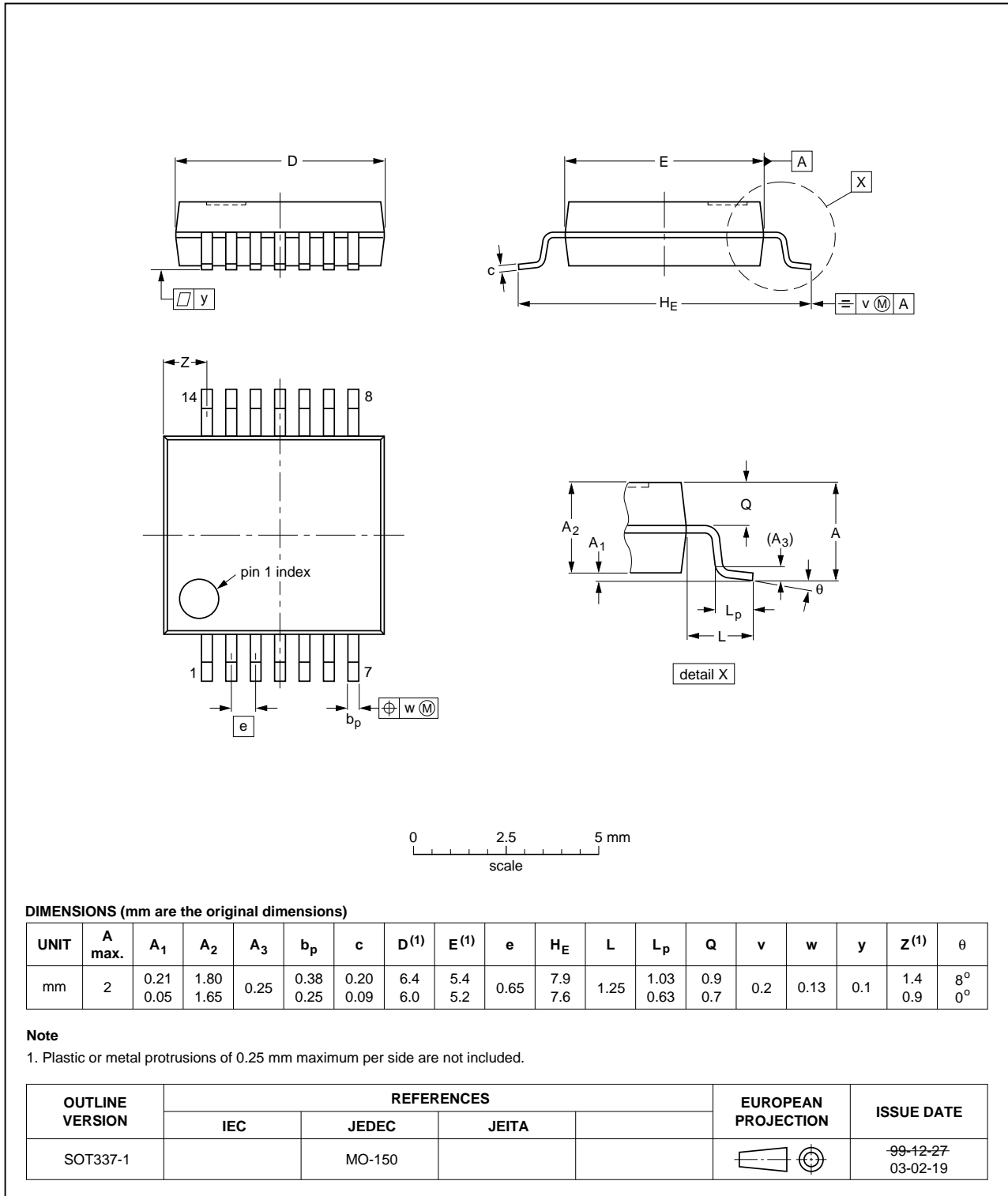


Fig 12. Package outline SOT337-1 (SSOP14)

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

SOT402-1

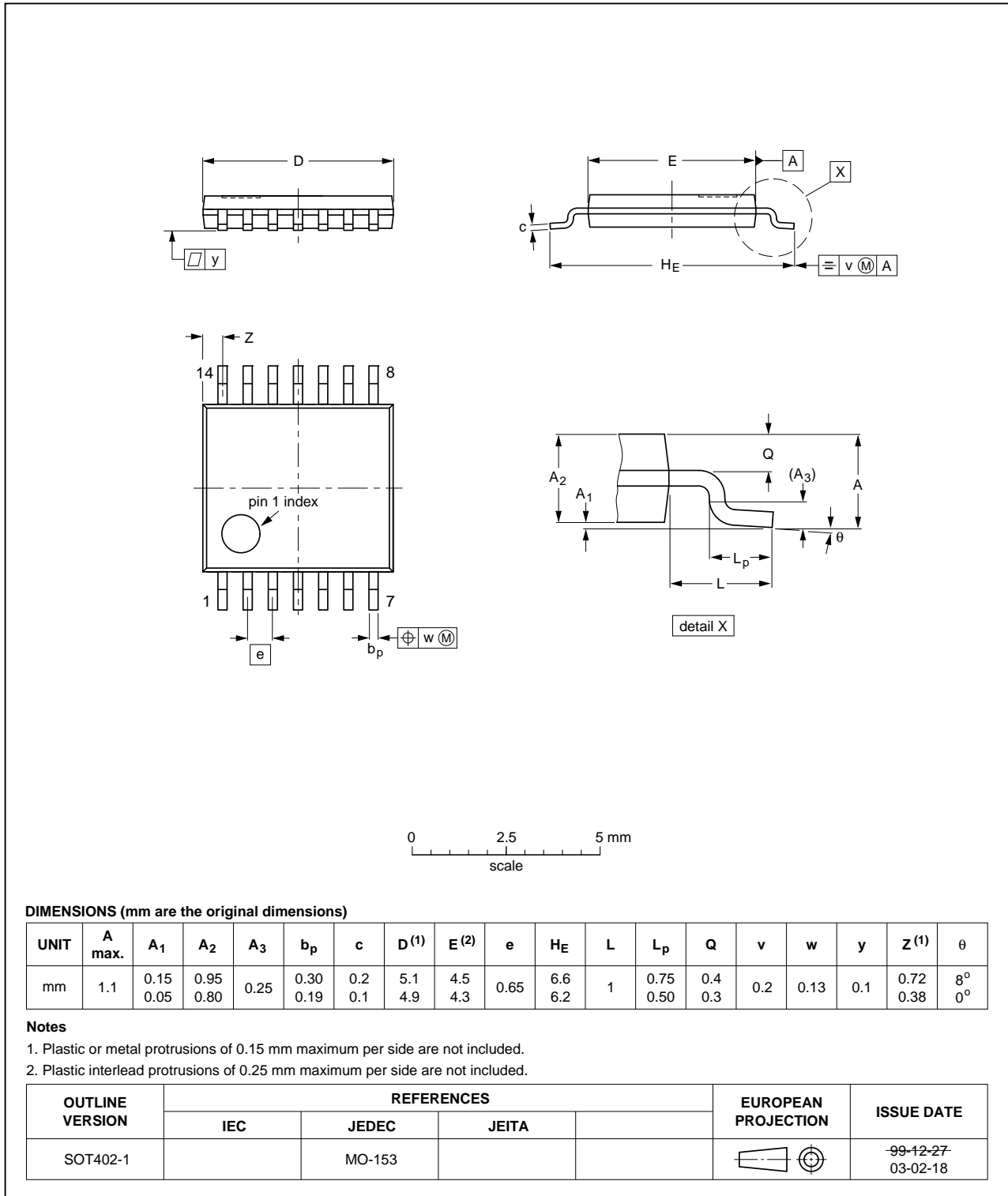
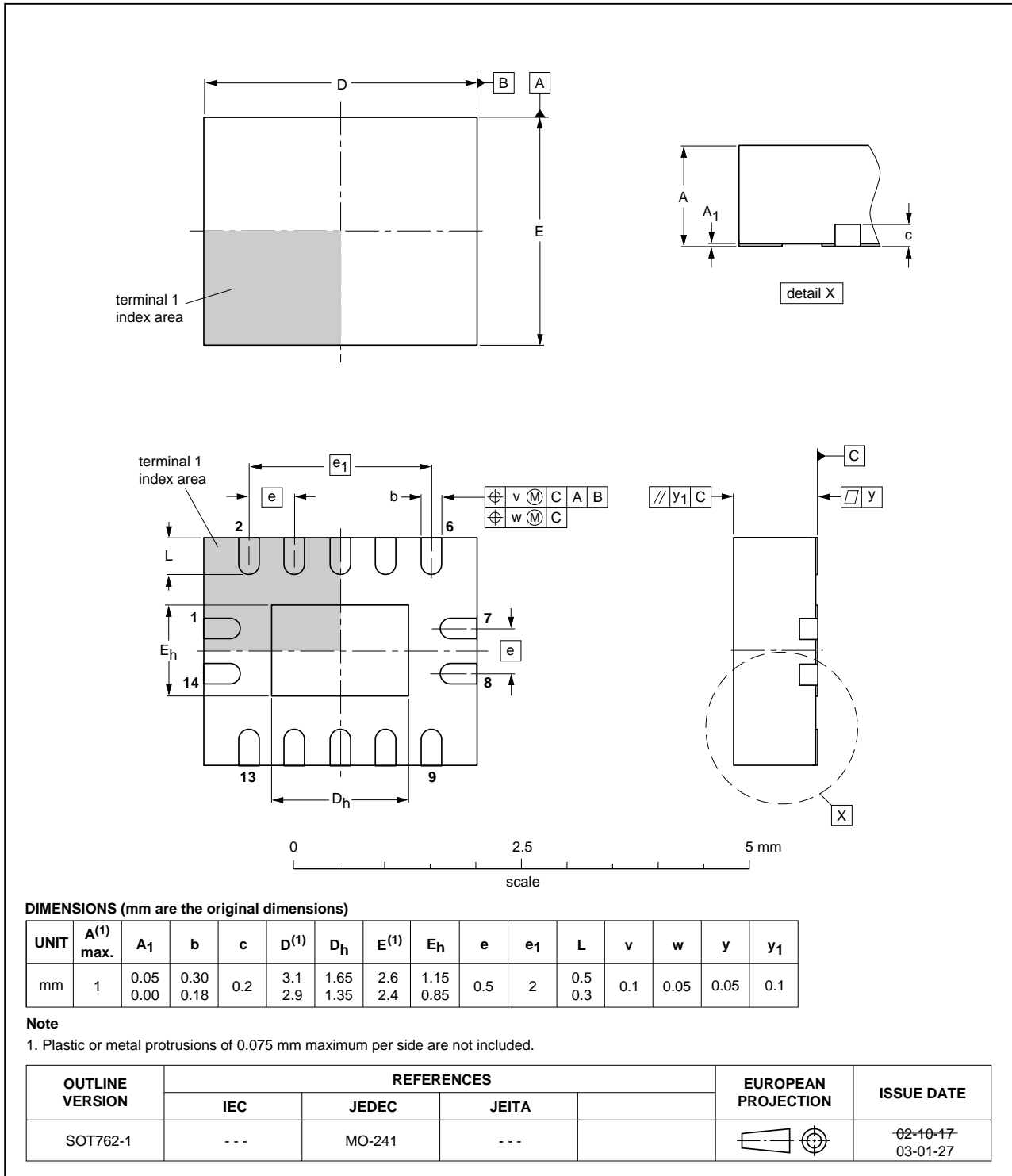


Fig 13. Package outline SOT402-1 (TSSOP14)



**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 14. 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.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.nxp.com>.

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