

74HC74; 74HCT74

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

Rev. 8 — 9 February 2023

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 (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, 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

- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Input levels:
 - For 74HC74: CMOS level
 - For 74HCT74: TTL level
- Symmetrical output impedance
- High noise immunity
- Balanced propagation delays
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

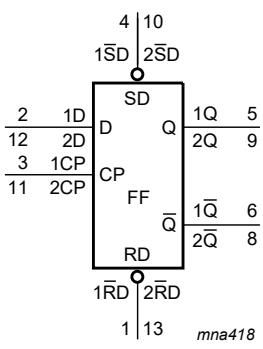
Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC74D 74HCT74D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
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

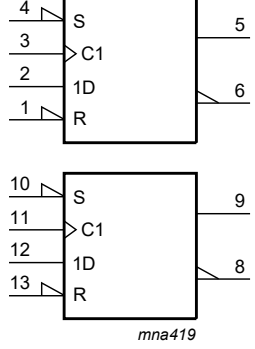
Dual D-type flip-flop with set and reset; positive edge-trigger

Type number	Package			Version
	Temperature range	Name	Description	
74HC74BZ 74HCT74BZ	-40 °C to +125 °C	DHXQFN14	plastic, leadless dual in-line compatible thermal enhanced extreme thin quad flat package; no leads; 14 terminals; 0.4 mm pitch; body 2 mm × 2 mm × 0.48 mm	SOT8014-1

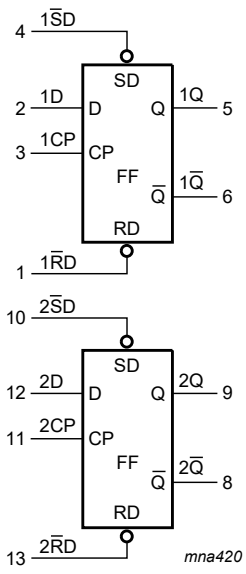
4. Functional diagram



mna418



mna419

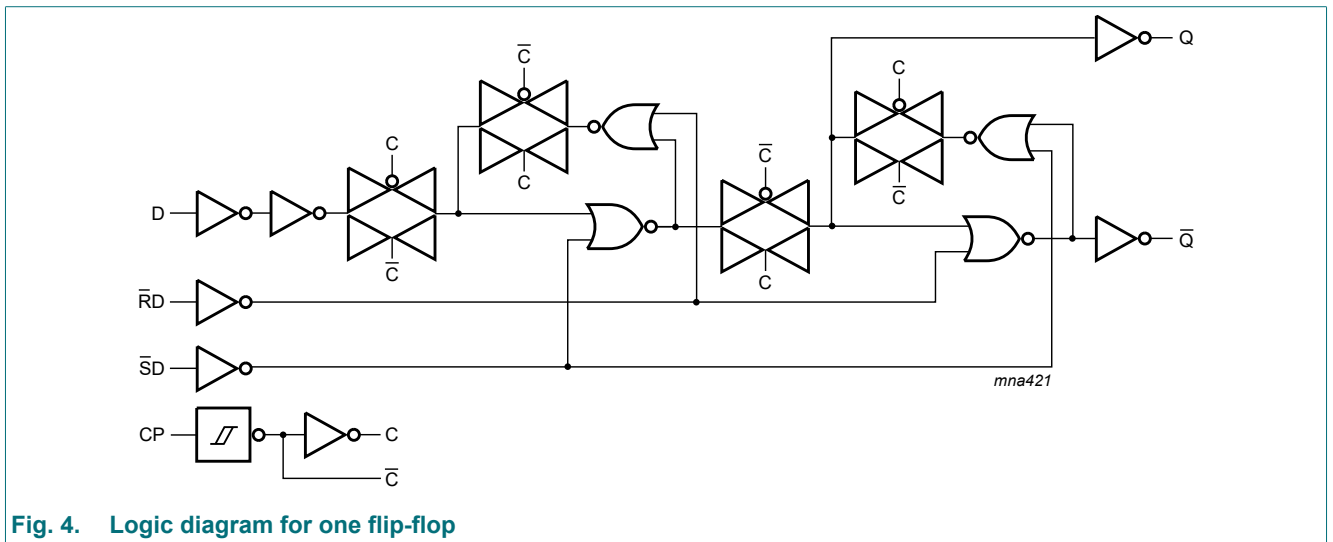


mna420

Fig. 1. Logic symbol

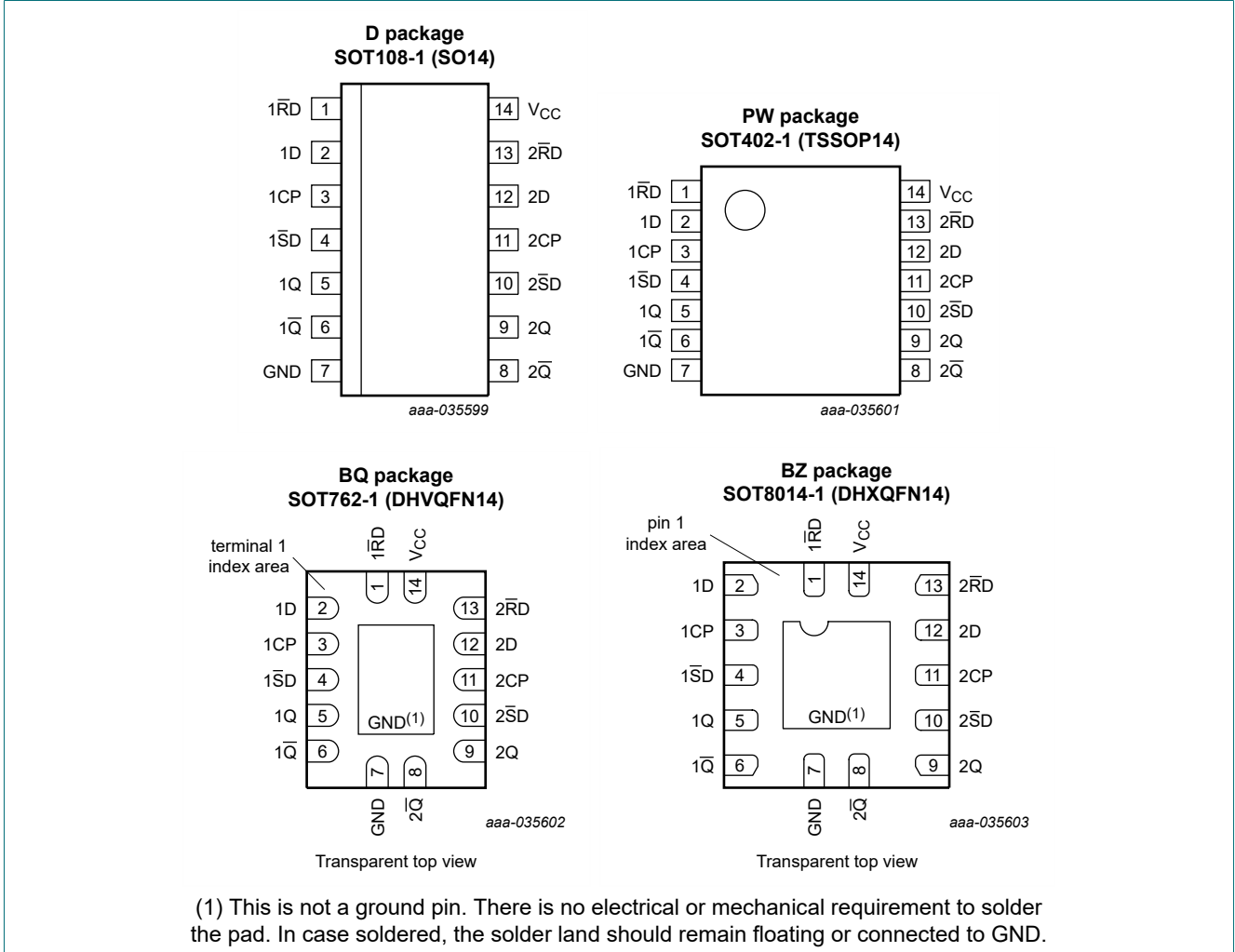
Fig. 2. IEC logic symbol

Fig. 3. Functional diagram



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	output
1Q̄	6	complement output
GND	7	ground (0 V)
2Q̄	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)
V _{CC}	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 _{n+1}	nQ̄ _{n+1}
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_{CC}	supply voltage		-0.5	+7	V
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	± 20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	± 20	mA
I_O	output current	$V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$	-	± 25	mA
I_{CC}	supply current		-	+100	mA
I_{GND}	ground current		-100	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ SOT108-1 (SO14) [1] SOT402-1 (TSSOP14) [2] SOT762-1 (DHSVFN14) [3] SOT8014-1 (DHSVFN14)	-	500	mW
			-	500	mW
			-	500	mW
			-	250	mW

[1] For SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C.

[2] For SOT402-1 (TSSOP14) package: P_{tot} derates linearly with 7.3 mW/K above 81 °C.

[3] For SOT762-1 (DHSVFN14) package: P_{tot} 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			74HCT74			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_I	input voltage		0	-	V_{CC}	0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	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	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
74HC74								
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	V
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	V
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	V
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = -4.0 mA; V _{CC} = 4.5 V	3.84	4.32	-	3.7	-	V
		I _O = -5.2 mA; V _{CC} = 6.0 V	5.34	5.81	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = 4.0 mA; V _{CC} = 4.5 V	-	0.15	0.33	-	0.4	V
		I _O = 5.2 mA; V _{CC} = 6.0 V	-	0.16	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±1.0	-	±1.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	40	-	80	µA
C _I	input capacitance		-	3.5	-	-	-	pF
74HCT74								
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V						
		I _O = -4 mA	3.84	4.32	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V						
		I _O = 4.0 mA	-	0.15	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±1.0	-	±1.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	40	-	80	µA
ΔI _{CC}	additional supply current	V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V; I _O = 0 A						
		per input pin; nD, nRD inputs	-	70	315	-	343	µA
		per input pin; nSD, nCP input	-	80	360	-	392	µA
C _I	input capacitance		-	3.5	-	-	-	pF

[1] All typical values are measured at T_{amb} = 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 Fig. 7.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
74HC74								
t_{pd}	propagation delay	nCP to nQ, n \bar{Q} ; see Fig. 5 [2]						
		$V_{CC} = 2.0$ 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 Fig. 6 [2]						
		$V_{CC} = 2.0$ 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 Fig. 6 [2]						
		$V_{CC} = 2.0$ 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 Fig. 5 [3]						
		$V_{CC} = 2.0$ 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 Fig. 5						
		$V_{CC} = 2.0$ 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 Fig. 6						
		$V_{CC} = 2.0$ 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 Fig. 6						
		$V_{CC} = 2.0$ V	40	3	-	45	-	ns
		$V_{CC} = 4.5$ V	8	1	-	9	-	ns
		$V_{CC} = 6.0$ V	7	1	-	8	-	ns

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

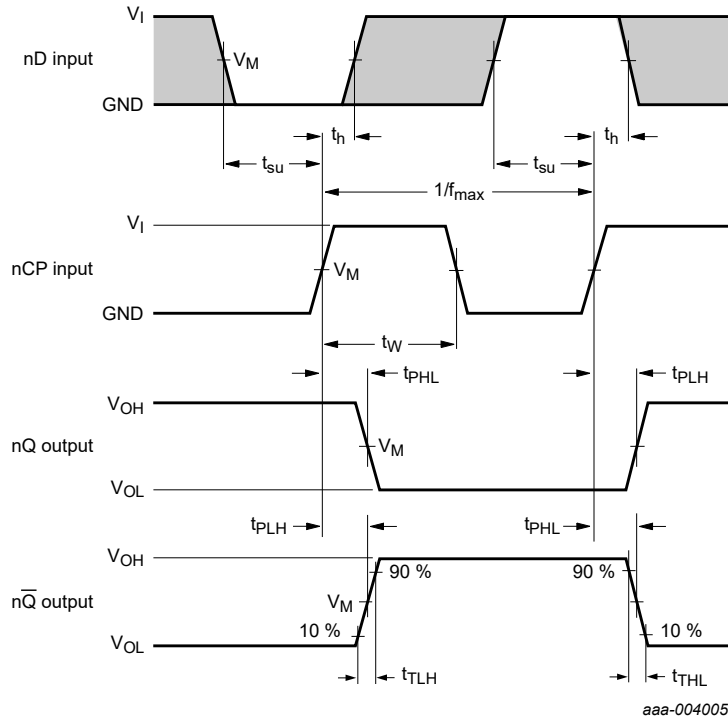
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t _{su}	set-up time	nD to nCP; see Fig. 5						
		V _{CC} = 2.0 V	75	6	-	90	-	ns
		V _{CC} = 4.5 V	15	2	-	18	-	ns
		V _{CC} = 6.0 V	13	2	-	15	-	ns
t _h	hold time	nD to nCP; see Fig. 5						
		V _{CC} = 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 Fig. 5						
		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 = GND to V _{CC} [4]	-	24	-	-	-	pF

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
74HCT74								
t _{pd}	propagation delay	nCP to nQ, n \bar{Q} ; see Fig. 5 [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 Fig. 6 [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 Fig. 6 [2]						
		V _{CC} = 4.5 V	-	24	50	-	60	ns
t _t	transition time	nQ, n \bar{Q} ; see Fig. 5 [3]						
		V _{CC} = 4.5 V	-	7	19	-	22	ns
t _w	pulse width	nCP HIGH or LOW; see Fig. 5						
		V _{CC} = 4.5 V	23	9	-	27	-	ns
		n \bar{S} D, n \bar{R} D LOW; see Fig. 6						
		V _{CC} = 4.5 V	20	9	-	24	-	ns
t _{rec}	recovery time	n \bar{S} D, n \bar{R} D; see Fig. 6						
		V _{CC} = 4.5 V	8	1	-	9	-	ns
t _{su}	set-up time	nD to nCP; see Fig. 5						
		V _{CC} = 4.5 V	15	5	-	18	-	ns
t _h	hold time	nD to nCP; see Fig. 5						
		V _{CC} = 4.5 V	3	-3	-	3	-	ns
f _{max}	maximum frequency	nCP; see Fig. 5						
		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 _I = GND to V _{CC} - 1.5 V [4]	-	29	-	-	-	pF

- [1] All typical values are measured at T_{amb} = 25 °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 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_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;
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

10.1. Waveforms and test circuit

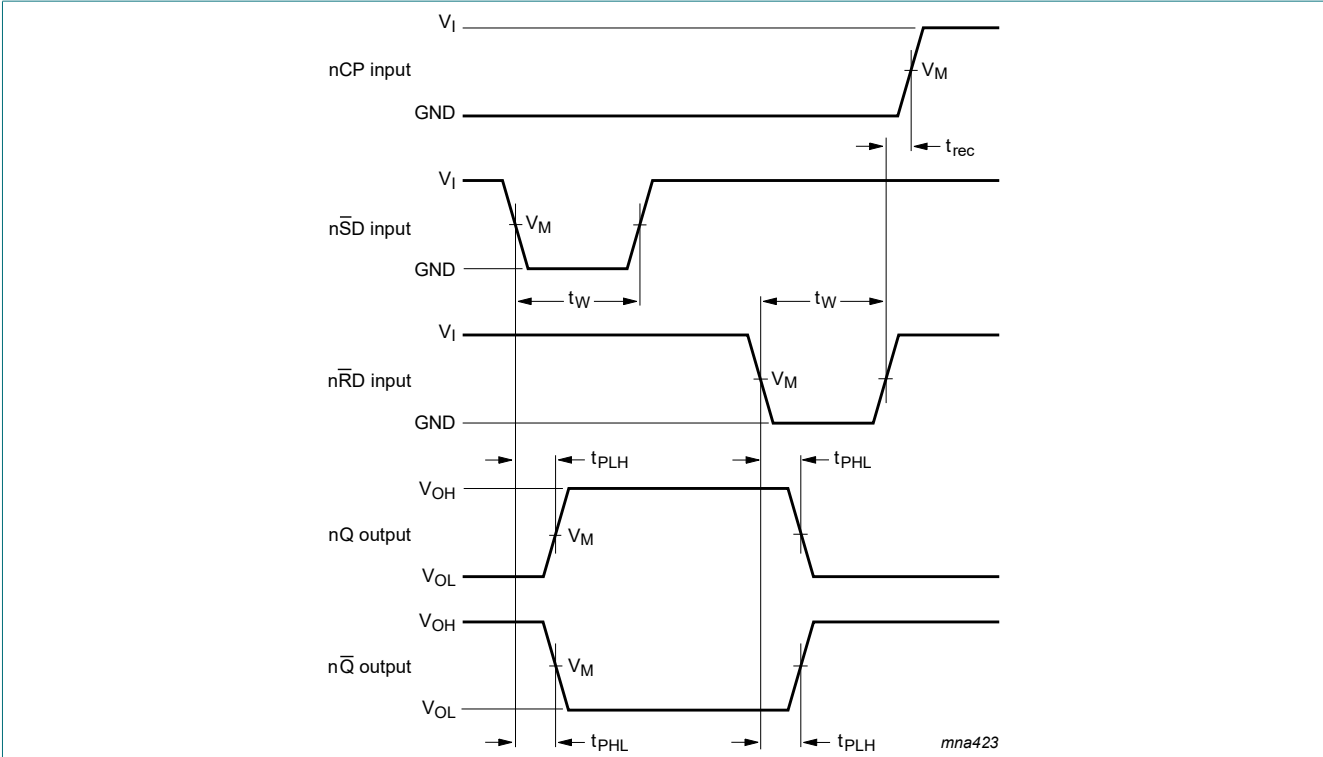


Measurement points are given in [Table 9](#).

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

Fig. 5. Propagation delay input (CP) to output (Qn), output transition time, clock input (CP) pulse width and the maximum frequency (CP)

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



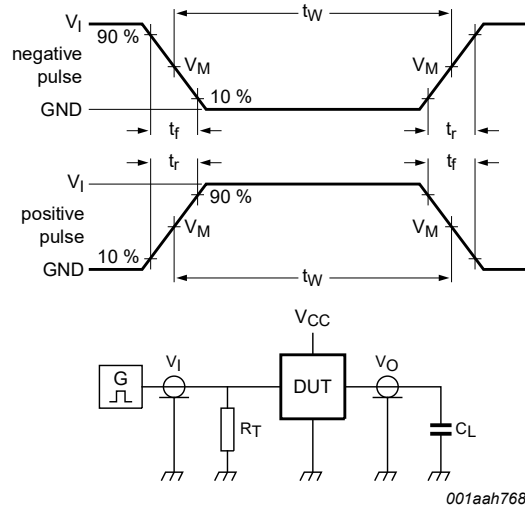
Measurement points are given in [Table 9](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig. 6. The set ($n\bar{S}D$) and reset ($n\bar{R}D$) input to output ($nQ, n\bar{Q}$) propagation delays, set and reset pulse widths and the $n\bar{S}D, n\bar{R}D$ to nCP 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

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



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. 7. 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 Ω	t_{PLH}, t_{PHL}
74HCT74	3 V	6 ns	15 pF, 50 pF	1 k Ω	t_{PLH}, t_{PHL}

11. Package outline

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

SOT108-1

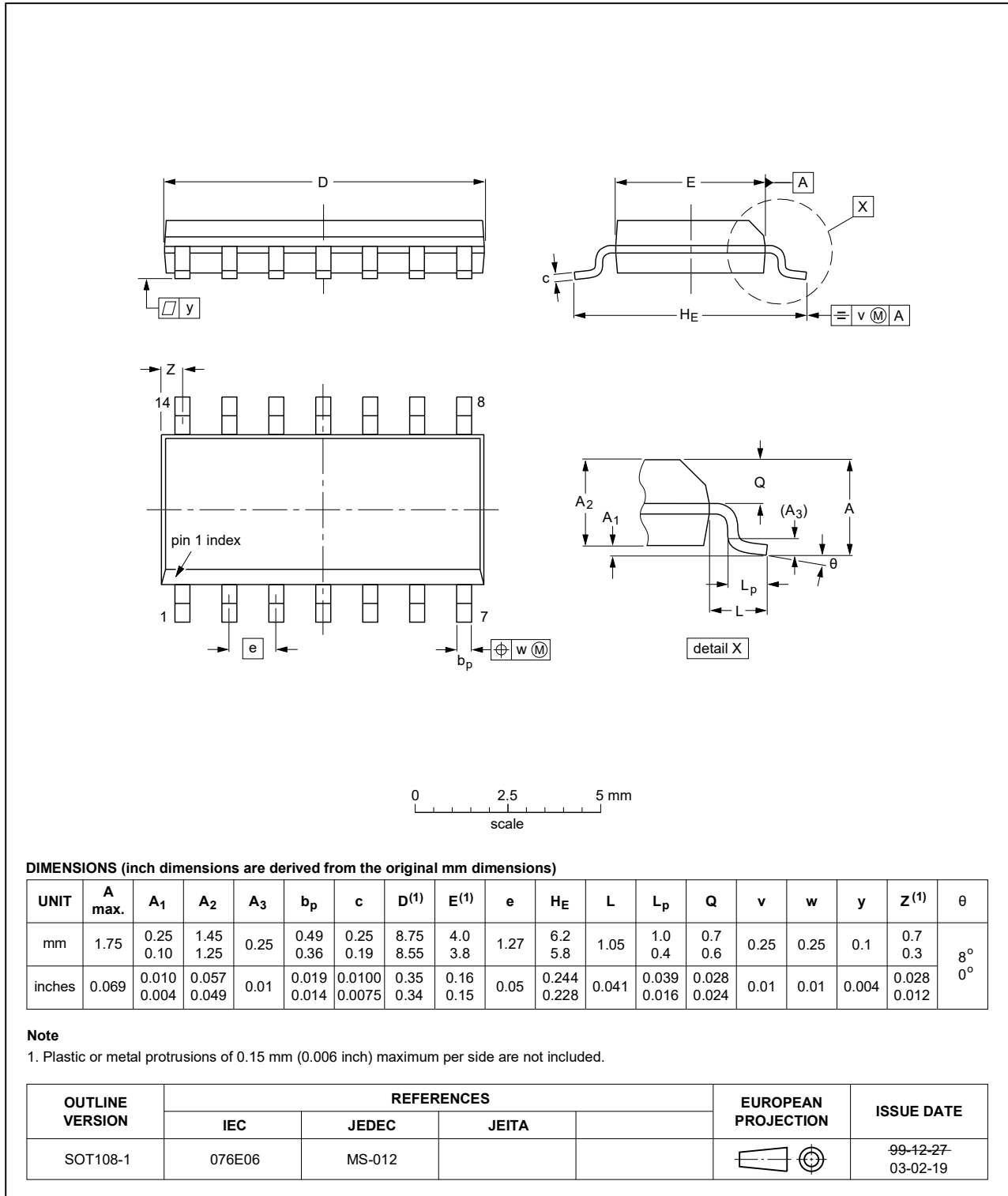


Fig. 8. Package outline SOT108-1 (SO14)

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

SOT402-1

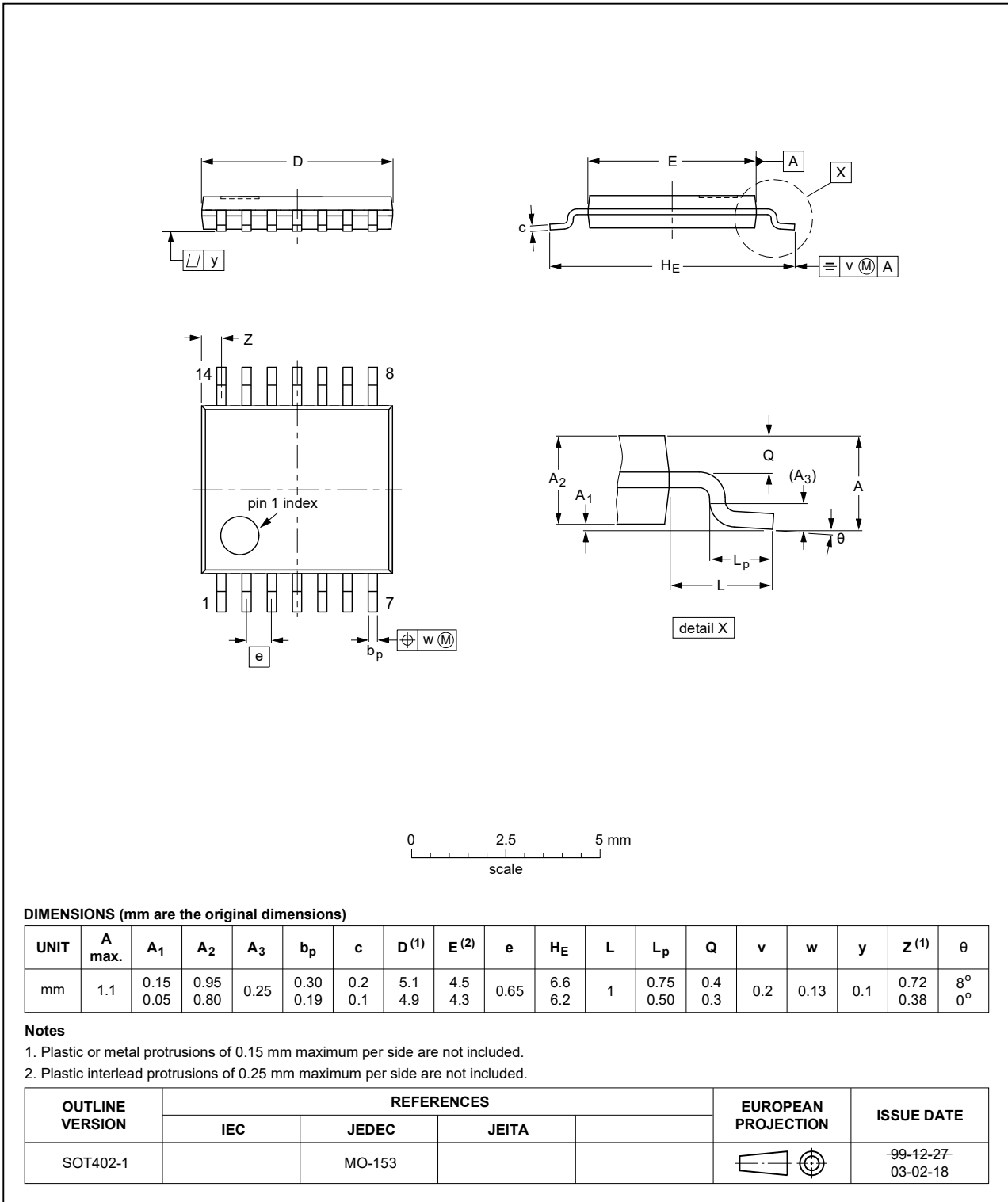


Fig. 9. Package outline SOT402-1 (TSSOP14)

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

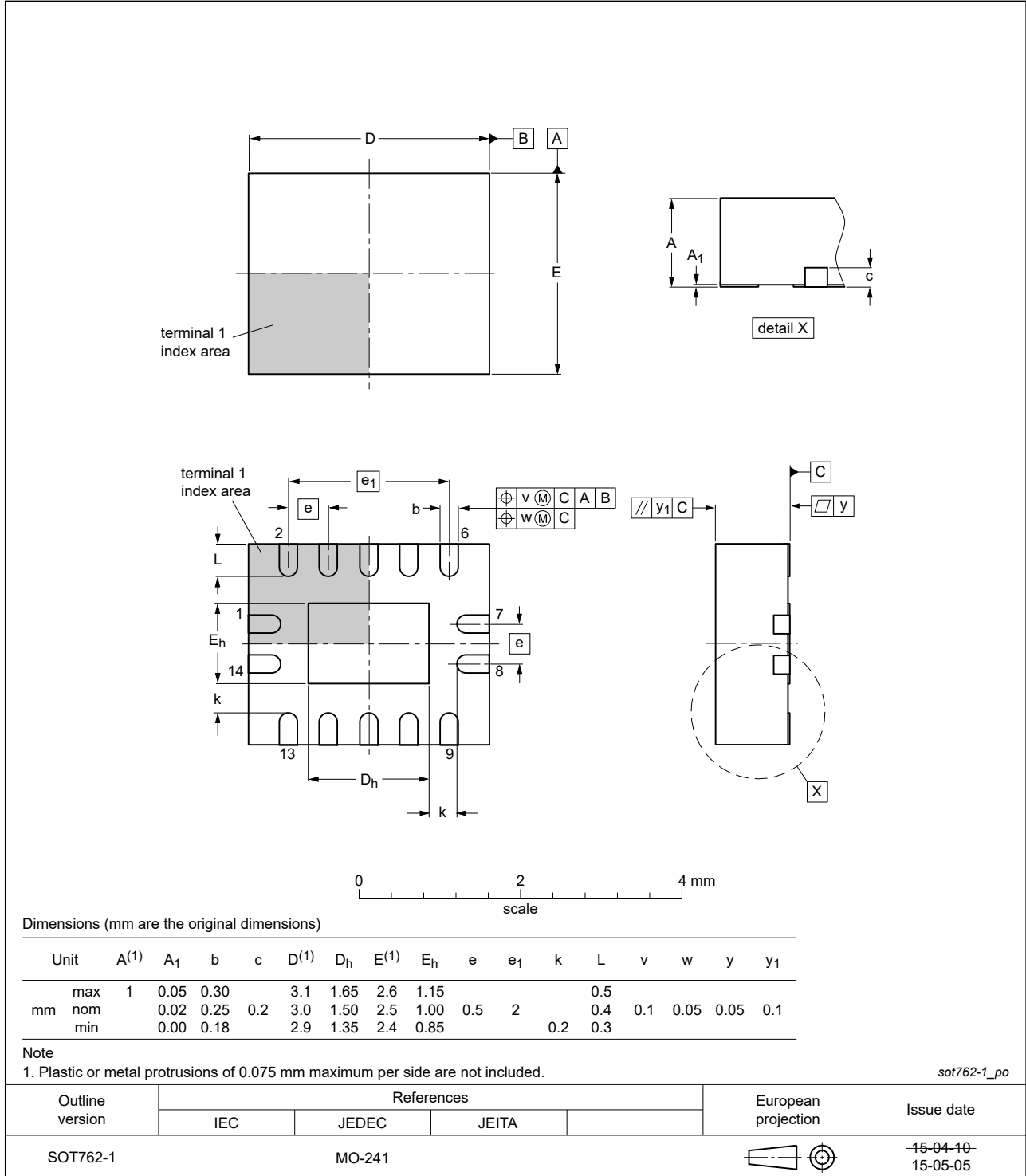


Fig. 10. Package outline SOT762-1 (DHVQFN14)

DHXQFN14: plastic, leadless dual in-line compatible thermal enhanced extreme thin quad flat package; no leads; 14 terminals; 0.4 mm pitch; body 2 mm x 2 mm x 0.48 mm

SOT8014-1

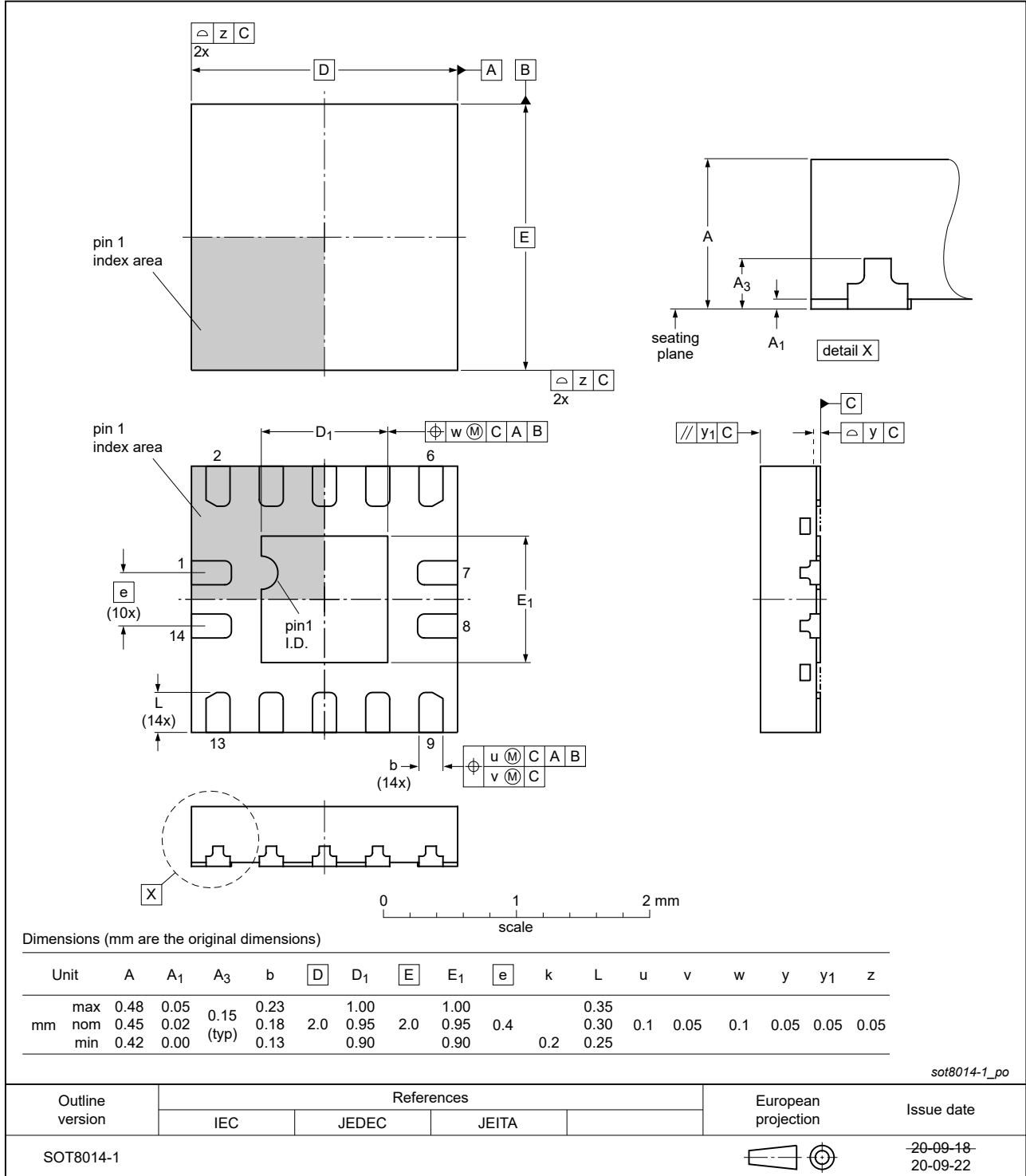


Fig. 11. Package outline SOT8014-1 (DHXQFN14)

12. 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

13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT74 v.8	20230209	Product data sheet	-	74HC_HCT74 v.7
Modifications:	<ul style="list-style-type: none"> Added type numbers 74HC74BZ and 74HCT74BZ (SOT8014-1/DHXQFN14). 			
74HC_HCT74 v.7	20210913	Product data sheet	-	74HC_HCT74 v.6
Modifications:	<ul style="list-style-type: none"> Type numbers 74HC74DB and 74HCTDB (SOT337-1/SSOP14) removed. Section 2 updated. 			
74HC_HCT74 v.6	20200421	Product data sheet	-	74HC_HCT74 v.5
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Section 5.1: Pin configuration for SOT762-1 (DHSVQFN14) corrected (errata). Table 5: Derating values for P_{tot} total power dissipation updated. 			
74HC_HCT74 v.5	20151203	Product data sheet	-	74HC_HCT74 v.4
Modifications:	<ul style="list-style-type: none"> Type numbers 74HC74N and 74HCT74N (SOT27-1) removed. 			
74HC_HCT74 v.4	20120827	Product data sheet	-	74HC_HCT74 v.3
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. 			
74HC_HCT74 v.3	20030710	Product data sheet	-	74HC_HCT74_CNV v.2
74HC_HCT74_CNV v.2	19980223	Product specification	-	-

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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