74ABT74

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

Rev. 2 — 12 August 2016 Product data sheet

1. General description

The 74ABT74 high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive.

The 74ABT74 is a dual positive edge-triggered D-type flip-flop featuring individual data, clock, set, and reset inputs; also true and complementary outputs. Set ($n\overline{SD}$) and reset ($n\overline{RD}$) are asynchronous active low inputs and operate independently of the clock input. When set and reset are inactive (HIGH), data at the nD input is transferred to the nQ and $n\overline{Q}$ outputs on the LOW-to-HIGH clock transition. Data must be stable just one setup time prior to the LOW-to-HIGH clock transition for predictable operation. Clock triggering occurs at a voltage level and is not directly related to the transition time of the positive-going pulse. Following the hold time interval, data at the nD input may be changed without affecting the levels of the output.

2. Features and benefits

- Latch-up protection exceeds 500 mA per JESD78B class II level A
- 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

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74ABT74D	–40 °C to +85 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74ABT74DB	–40 °C to +85 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74ABT74PW	–40 °C to +85 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

4. Functional diagram

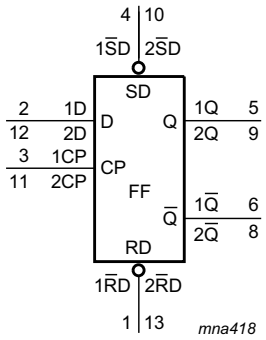


Fig 1. Logic symbol

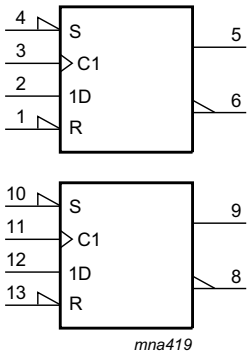


Fig 2. IEC logic symbol

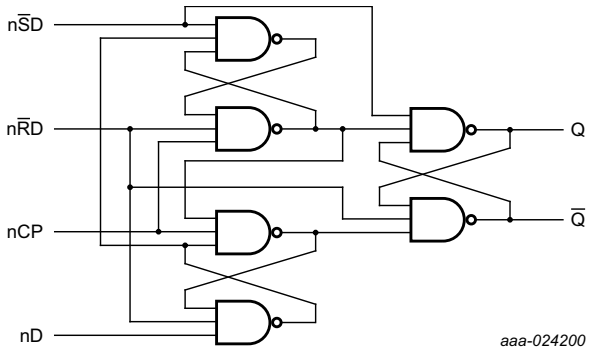


Fig 3. Logic diagram for one flip-flop

5. Pinning information

5.1 Pinning

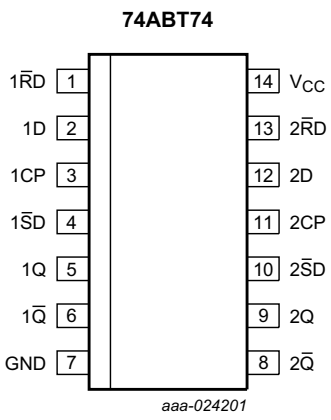


Fig 4. Pin configuration for SO14

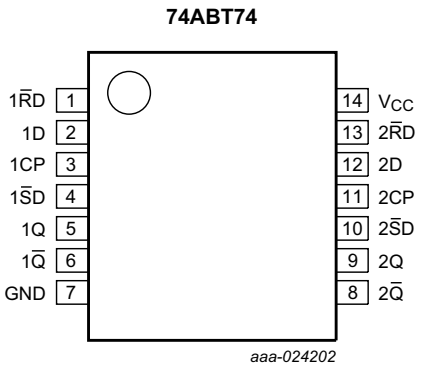


Fig 5. Pin configuration for SSOP14 and TSSOP14

5.2 Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Function table[1]

Input				Output		Operating mode
n$\overline{SD}$	n$\overline{RD}$	nCP	nD	nQ	n$\overline{Q}$	
L	H	X	X	H	L	Asynchronous set
H	L	X	X	L	H	Asynchronous reset
L	L	X	X	H	H	Undetermined[2]
H	H	↑	h	H	L	Load “1”
H	H	↑	l	L	H	Load “0”

[1] H = HIGH voltage level
h = HIGH voltage level one setup time prior to low-to-high clock transition
L = LOW voltage level
l = LOW voltage level one setup time prior to low-to-high clock transition
X = don’t care
↑ = LOW-to-HIGH clock transition

[2] This setup is unstable and changes when either set or reset returns to the high level.

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		−0.5	+7.0	V
V_I	input voltage	[1]	−1.2	+7.0	V
V_O	output voltage	output in OFF-state or HIGH-state [1]	−0.5	+5.5	V
I_{IK}	input clamping current	$V_I < 0$ V	−18	-	mA
I_{OK}	output clamping current	$V_O < 0$ V	−50	-	mA
I_O	output current	output in LOW-state	-	40	mA
T_j	junction temperature	[2]	-	150	°C
T_{stg}	storage temperature		−65	+150	°C

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

[2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.

8. Recommended operating conditions

Table 5. Operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.5	-	5.5	V
V_I	input voltage		0	-	V_{CC}	V
V_{IH}	HIGH-level input voltage		2.0	-	-	V
V_{IL}	LOW-level input voltage		-	-	0.8	V
I_{OH}	HIGH-level output current		−15	-	-	mA
I_{OL}	LOW-level output current		-	-	20	mA
$\Delta t/\Delta V$	input transition rise and fall rate		0	-	10	ns/V
T_{amb}	ambient temperature	in free air	−40	-	+85	°C

9. Static characteristics

Table 6. Static characteristics

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		Unit
			Min	Typ	Max	Min	Max	
V_{IK}	input clamping voltage	V_{CC} = 4.5 V; I_{IK} = –18 mA	–1.2	–0.9	-	–1.2	-	V
V_{OH}	HIGH-level output voltage	V_{CC} = 4.5 V; I_{OH} = –15 mA; V_I = V_{IL} or V_{IH}	2.5	2.9	-	2.5	-	V
V_{OL}	LOW-level output voltage	V_{CC} = 4.5 V; I_{OL} = 20 mA; V_I = V_{IL} or V_{IH}	-	0.35	0.5	-	0.5	V
I_I	input leakage current	V_{CC} = 5.5 V; V_I = GND or 5.5 V	-	±0.01	±1.0	-	±1.0	µA
I_{OFF}	power-off leakage current	V_{CC} = 0 V; V_I or $V_O \leq$ 4.5 V	-	±5.0	±100	-	±100	µA
I_{CEX}	output high leakage current	HIGH-state; V_O = 5.5 V; V_{CC} = 5.5 V; V_I = GND or V_{CC}	-	5.0	50	-	50	µA
I_O	output current	V_{CC} = 5.5 V; V_O = 2.5 V [1]	–50	–75	–180	–50	–180	mA
I_{CC}	supply current	V_{CC} = 5.5 V; V_I = GND or V_{CC}	-	2	50	-	50	µA
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 5.5 V; one input at 3.4 V; other inputs at V_{CC} or GND [2]	-	0.25	500	-	500	µA
C_I	input capacitance	V_I = 0 V or V_{CC}	-	3	-	-	-	pF

[1] Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

[2] This is the increase in supply current for each input at 3.4 V.

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; for test circuit, see Figure 9.

Symbol	Parameter	Conditions	25 °C; V_{CC} = 5.0 V			–40 °C to +85 °C; V_{CC} = 5.0 V ± 0.5 V		Unit
			Min	Typ	Max	Min	Max	
f_{max}	maximum frequency	nCP; see Figure 6	180	250	-	150	-	MHz
t_{PLH}	LOW to HIGH propagation delay	nCP to nQ, n$\overline{Q}$; see Figure 6	1.0	3.0	4.2	1.0	4.7	ns
t_{PHL}	HIGH to LOW propagation delay	nCP to nQ, n$\overline{Q}$; see Figure 6	1.0	2.5	3.5	1.0	4.0	ns
t_{PLH}	LOW to HIGH propagation delay	n$\overline{SD}$, n$\overline{RD}$ to nQ, n$\overline{Q}$; see Figure 7	1.0	3.4	4.9	1.0	6.2	ns
t_{PHL}	HIGH to LOW propagation delay	n$\overline{SD}$, n$\overline{RD}$ to nQ, n$\overline{Q}$; see Figure 7	1.0	2.9	4.5	1.0	5.2	ns
$t_{sk(o)}$	output skew time	[1]	-	0.5	0.6	-	0.6	ns

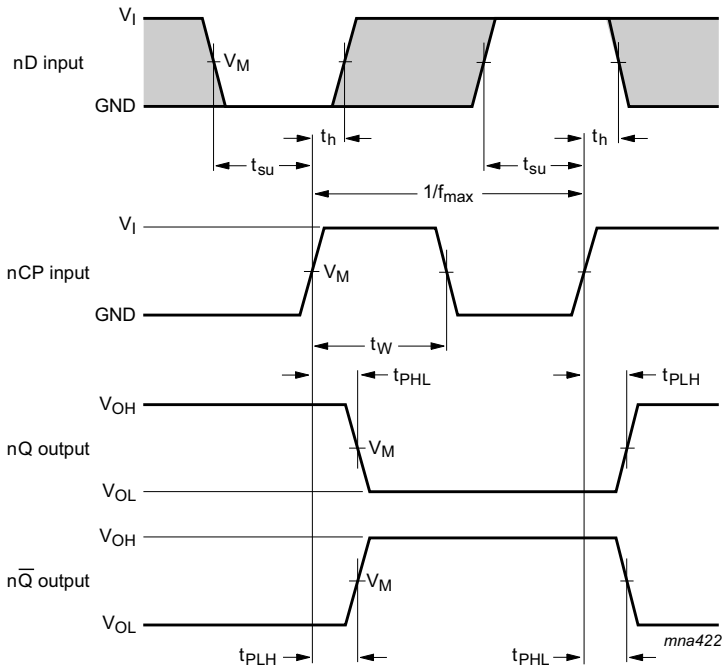
Table 7. Dynamic characteristics *...continued*

GND = 0 V; for test circuit, see Figure 9.

Symbol	Parameter	Conditions	25 °C; V_{CC} = 5.0 V			–40 °C to +85 °C; V_{CC} = 5.0 V ± 0.5 V		Unit
			Min	Typ	Max	Min	Max	
t_{su}	set-up time	nD to nCP HIGH; see Figure 6	2.6	1.4	-	2.6	-	ns
		nD to nCP LOW; see Figure 6	2.4	1.4	-	2.4	-	ns
t_h	hold time	nD to nCP HIGH or LOW; see Figure 6	0	–1.4	-	0	-	ns
t_W	pulse width	nCP HIGH or LOW; see Figure 6	1.7	1.0	-	2.1	-	ns
		$n\overline{SD}$, $n\overline{RD}$ LOW; see Figure 7	2.0	1.3	-	2.2	-	ns
t_{rec}	recovery time	$n\overline{SD}$, $n\overline{RD}$ to nCP; see Figure 8	2.1	1.4	-	2.4	-	ns

[1] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

11. Waveforms

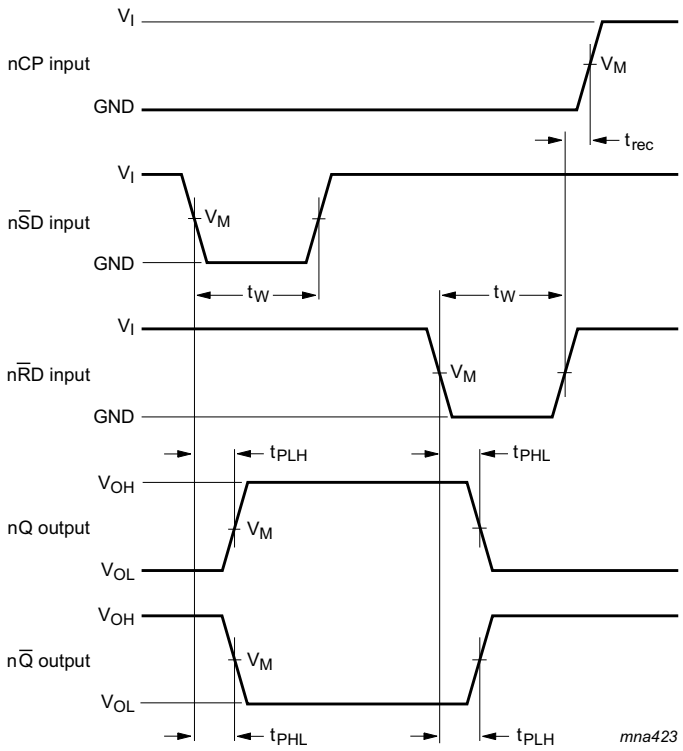


V_M = 1.5 V

The shaded areas indicate when the input is permitted to change for predictable output performance.

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

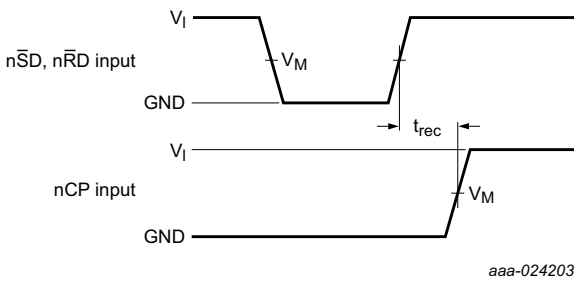
Fig 6. Propagation delay clock input (nCP) to output (nQ, $n\overline{Q}$), set-up and hold times data input (nD) to clock input, clock pulse width and maximum clock (nCP) frequency



V_M = 1.5 V

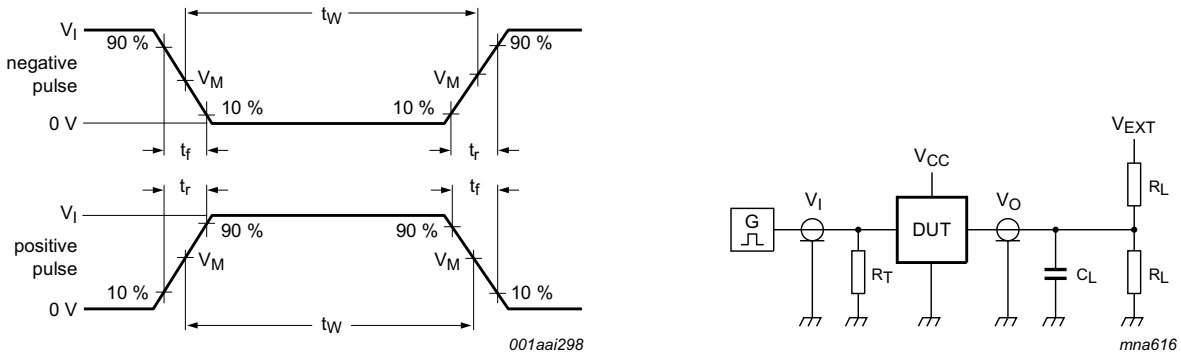
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load

Fig 7. Propagation delay set ($\overline{nSD}$) and reset ($\overline{nSD}$) input to output (nQ, $\overline{nQ}$), and set ($\overline{nSD}$) and reset $\overline{nRD}$ pulse width.



V_M = 1.5 V

Fig 8. Recovery time set ($\overline{nSD}$) and reset ($\overline{nRD}$) to nCP



a. Input pulse definition

b. Test circuit

Test data is given in Table 8.

R_L = Load resistance.

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.

V_{EXT} = External voltage for measuring switching times.

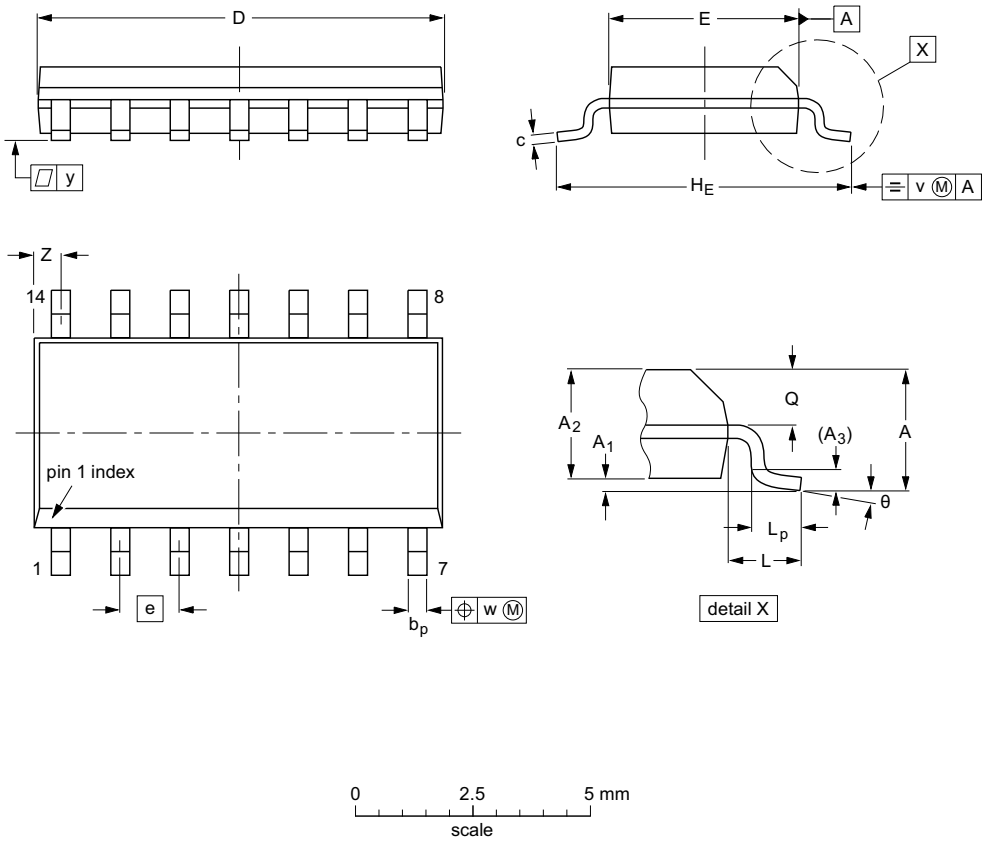
Fig 9. Test circuit for measuring switching times

Table 8. Test data

Input				Load		V_{EXT}		
V_I	f_i	t_W	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
3.0 V	1 MHz	500 ns	≤ 2.5 ns	50 pF	500 Ω	open	open	7.0 V

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

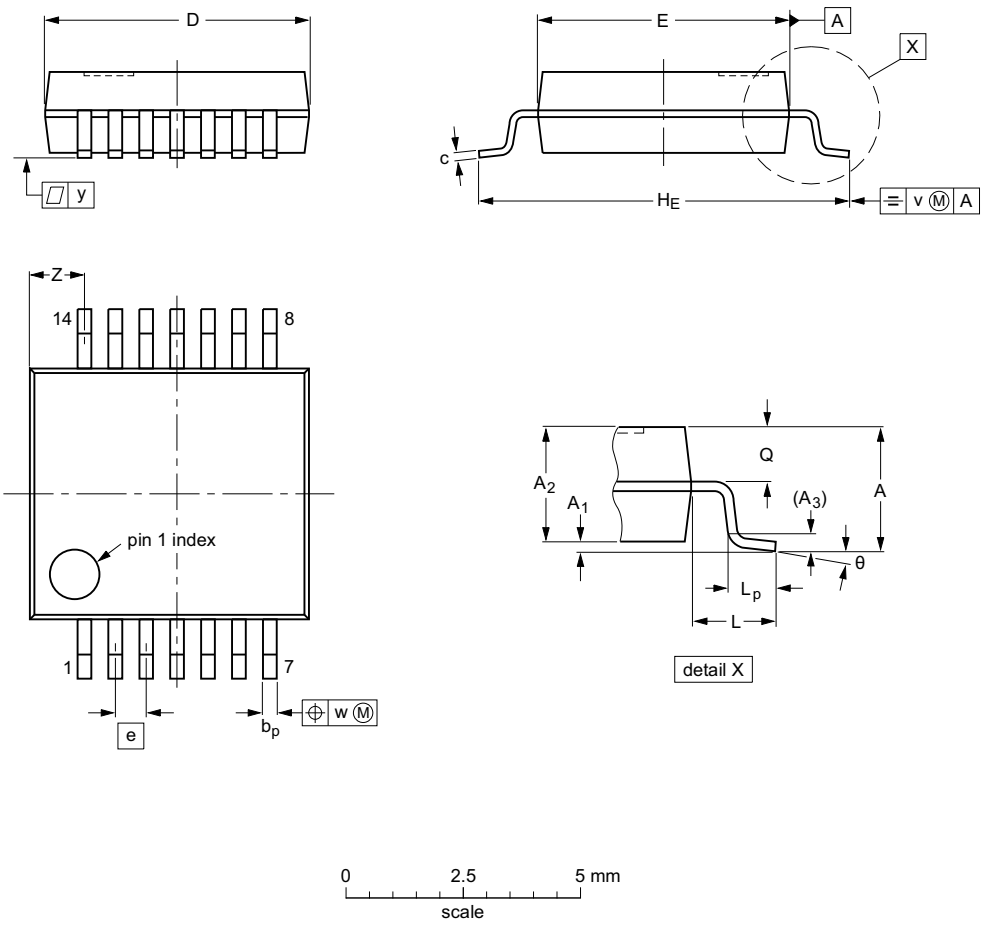
Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT108-1	076E06	MS-012				~~99-12-27~~ 03-02-19

Fig 10. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm **SOT337-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8^o 0^o

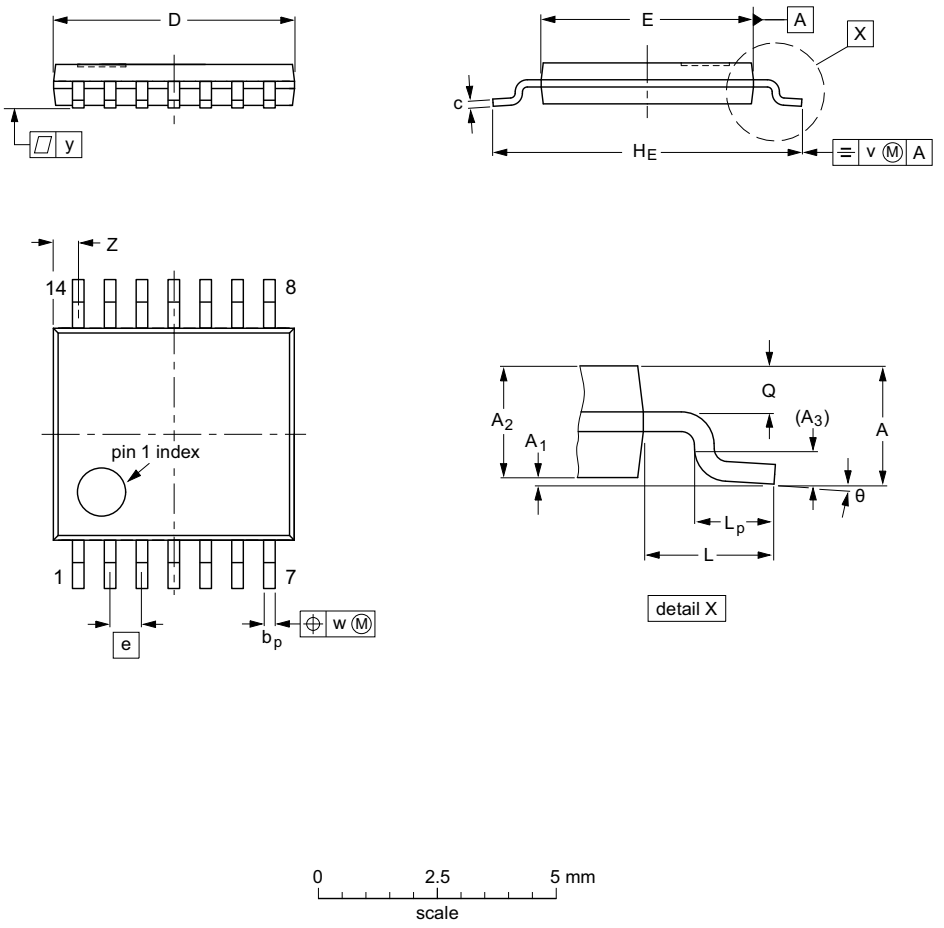
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT337-1		MO-150				~~99-12-27~~ 03-02-19

Fig 11. Package outline SOT337-1 (SSOP14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm **SOT402-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				~~99-12-27~~ 03-02-18

Fig 12. Package outline SOT402-1 (TSSOP14)

13. Abbreviations

Table 9. Abbreviations

Acronym	Description
BiCMOS	Bipolar Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74ABT74A v.2	20160812	Product data sheet	-	74ABT74A v.1
Modifications:	• 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.			
74ABT74A v.1	19950922	Product specification	-	-

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15.1 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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17. Contents

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Document identifier: 74ABT74