

DATA SHEET

74LVT74 3.3V Dual D-type flip-flop

Product specification

1996 Aug 28

IC24 Data Handbook

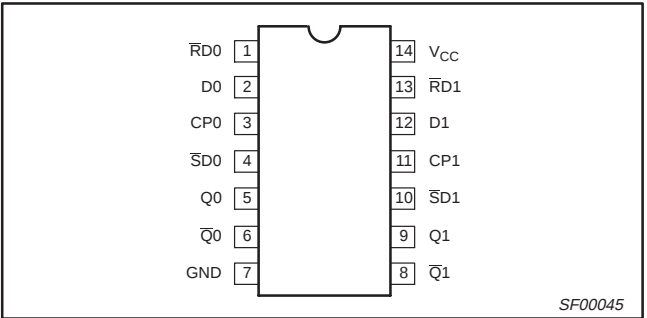
3.3V Dual D-type flip-flop

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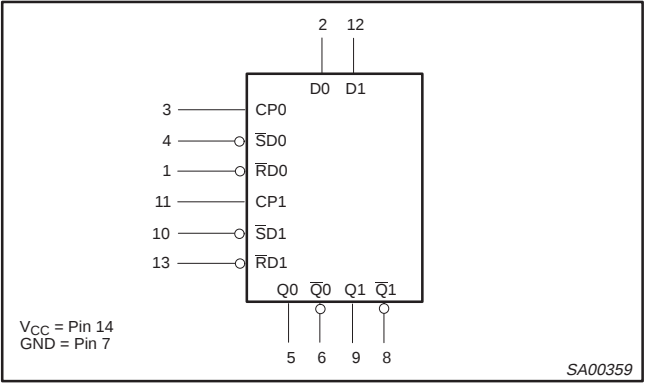
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS $T_{amb} = 25^{\circ}\text{C}$; $GND = 0V$	TYPICAL	UNIT
t_{PLH} t_{PHL}	Propagation delay CPn to Qn	$C_L = 50\text{pF}$; $V_{CC} = 3.3V$	3.1 3.6	ns
C_{IN}	Input capacitance	$V_I = 0V$ or $3.0V$	3	pF
I_{CC}	Total supply current	$V_{CC} = 3.6V$	0.5	mA

PIN CONFIGURATION



LOGIC SYMBOL



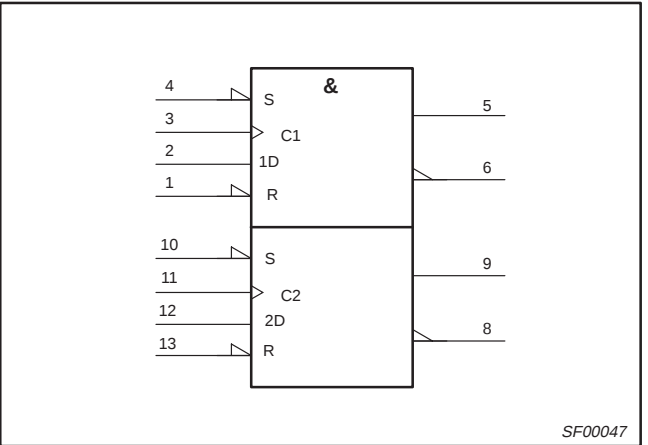
DESCRIPTION

The 74LVT74 is a dual positive edge-triggered D-type flip-flop featuring individual data, clock, set, and reset inputs; also true and complementary outputs. Set ($\overline{SD}$) and reset ($\overline{RD}$) are asynchronous active low inputs and operate independently of the clock input. When set and reset are inactive (high), data at the D input is transferred to the Q and $\overline{Q}$ outputs on the low-to-high transition of the clock. Data must be stable just one setup time prior to the low-to-high transition of the clock 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 D input may be changed without affecting the levels of the output.

PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
2, 12	D0, D1	Data inputs
3, 11	CP0, CP1	Clock inputs (active rising edge)
4, 10	$\overline{SD}0$, $\overline{SD}1$	Set inputs (active LOW)
1, 13	$\overline{RD}0$, $\overline{RD}1$	Reset inputs (active LOW)
5, 6, 8, 9	Qn, $\overline{Q}n$	Data outputs

LOGIC SYMBOL (IEEE/IEC)



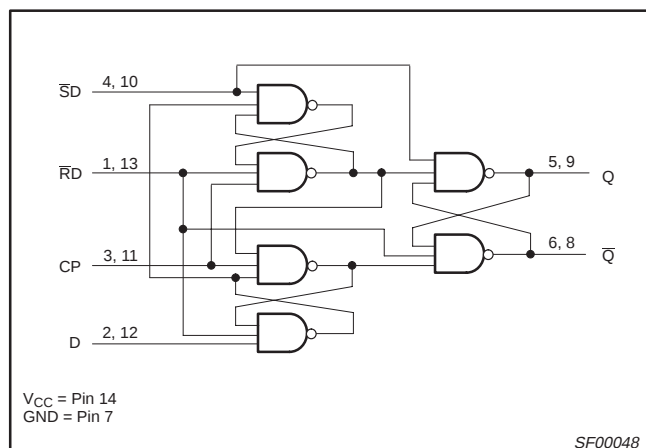
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
14-Pin Plastic SO	-40°C to +85°C	74LVT74 D	74LVT74 D	SOT108-1
14-Pin Plastic SSOP	-40°C to +85°C	74LVT74 DB	74LVT74 DB	SOT337-1
14-Pin Plastic TSSOP	-40°C to +85°C	74LVT74 PW	74LVT74PW DH	SOT402-1

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LOGIC DIAGRAM



FUNCTION TABLE

INPUTS				OUTPUTS		OPERATING MODE
$\overline{SD}$	$\overline{RD}$	CP	D	Q	$\overline{Q}$	
L	H	X	X	H	L	Asynchronous set
H	L	X	X	L	H	Asynchronous reset
L	L	X	X	H	H	Undetermined*
H	H	↑	h	H	L	Load "1"
H	H	↑	l	L	H	Load "0"
H	H	↑	X	NC	NC	Hold

NOTES:

- 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
NC = No change from the previous setup
X = Don't care
↑ = Low-to-high clock transition
↑ = Not low-to-high clock transition
* = This setup is unstable and will change when either set or reset return to the high level.

ABSOLUTE MAXIMUM RATINGS^{1, 2}

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V _{CC}	DC supply voltage		−0.5 to +4.6	V
I _{IK}	DC input diode current	V _I < 0	−50	mA
V _I	DC input voltage ³		−0.5 to +7.0	V
I _{OK}	DC output diode current	V _O < 0	−50	mA
V _{OUT}	DC output voltage ³	Output in Off or High state	−0.5 to +7.0	V
I _{OUT}	DC output current	Output in High state	−32	mA
		Output in Low state	64	
T _{stg}	Storage temperature range		−65 to 150	°C

NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- 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.
- The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS		UNIT
		MIN	MAX	
V _{CC}	DC supply voltage	2.7	3.6	V
V _I	Input voltage	0	5.5	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		−20	mA
I _{OL}	Low-level output current		32	mA
Δt/Δv	Input transition rise or fall rate; Outputs enabled		10	ns/V
T _{amb}	Operating free-air temperature range	−40	+85	°C

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DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions

Voltages are referenced to GND (ground = 0V)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			Temp = -40°C to +85°C			
			MIN	TYP ¹	MAX	
V _{IK}	Input clamp voltage	V _{CC} = 2.7V; I _{IK} = −18mA			−1.2	V
V _{OH}	High-level output voltage	V _{CC} = 2.7 to 3.6V; I _{OH} = −100μA	V _{CC} −0.2			V
		V _{CC} = 2.7V; I _{OH} = −6mA	2.4			
		V _{CC} = 3.0V; I _{OH} = −20mA	2.0			
V _{OL}	Low-level output voltage	V _{CC} = 2.7V; I _{OL} = 100μA			0.2	V
		V _{CC} = 2.7V; I _{OL} = 24mA			0.5	
		V _{CC} = 3.0V; I _{OL} = 32mA			0.5	
I _I	Input leakage current	V _{CC} = 0 or 3.6V; V _I = 5.5V			10	μA
		V _{CC} = 3.6V; V _I = V _{CC} or GND			±1	
I _{OFF}	Output off current	V _{CC} = 0V; V _I or V _O = 0 to 4.5V			±100	μA
I _{CC}	Quiescent supply current	V _{CC} = 3.6V; Outputs High, V _I = GND or V _{CC} , I _O = 0		0.5	1	mA
ΔI _{CC}	Additional supply current per input pin ²	V _{CC} = 3V to 3.6V; One input at V _{CC} −0.6V, Other inputs at V _{CC} or GND			0.2	μA
C _I	Input capacitance	V _I = 3V or 0		3		pF

NOTES:

1. All typical values are at $V_{CC} = 3.3V$ and $T_{amb} = 25^\circ C$.
2. This is the increase in supply current for each input at the specified voltage level other than V_{CC} or GND.

AC CHARACTERISTICS

GND = 0V; $t_R = t_F = 2.5ns$; $C_L = 50pF$, $R_L = 500\Omega$; $T_{amb} = -40^\circ C$ to $+85^\circ C$.

SYMBOL	PARAMETER	WAVEFORM	LIMITS				UNIT
			$V_{CC} = 3.3V \pm 0.3V$			$V_{CC} = 2.7V$	
			MIN	TYP ¹	MAX	MAX	
f_{MAX}	Maximum clock frequency	1	150	345			MHz
t_{PLH} t_{PHL}	Propagation delay CPn to Qn or $\bar{Q}n$	1	1.0 1.0	3.1 3.6	4.8 5.0	5.8 5.0	ns
t_{PLH} t_{PHL}	Propagation delay $\bar{S}Dn$, $\bar{R}Dn$ to Qn or $\bar{Q}n$	2	1.0 1.0	3.1 3.0	5.0 4.4	6.2 4.8	ns

NOTE:

1. All typical values are at $V_{CC} = 3.3V$ and $T_{amb} = 25^\circ C$.

AC SETUP REQUIREMENTS

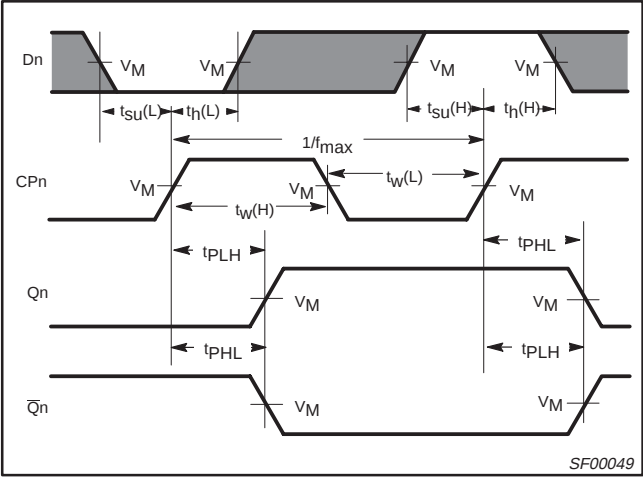
SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			$V_{CC} = 3.3V \pm 0.3V$		$V_{CC} = 2.7V$	
			MIN	TYP	MIN	
t_S (H) t_S (L)	Setup time Dn to CPn	1	1.7 1.4	0.6 0.4	1.8 1.6	ns
t_h (H) t_h (L)	Holdtime Dn to CPn	1	0.3 0	-0.3 -0.6	0.3 0	ns
t_W (H) t_W (L)	CPn Pulse Width	1	2.0 2.0	1.0 1.2	3.0 3.0	
t_W (L)	$\bar{S}Dn$, $\bar{R}Dn$ Pulse Width	2	2.0	1.0	3.0	ns
t_{rec}	Recovery time $\bar{S}Dn$, $\bar{R}Dn$ tp CPn	3	0.5	-0.3	0.5	

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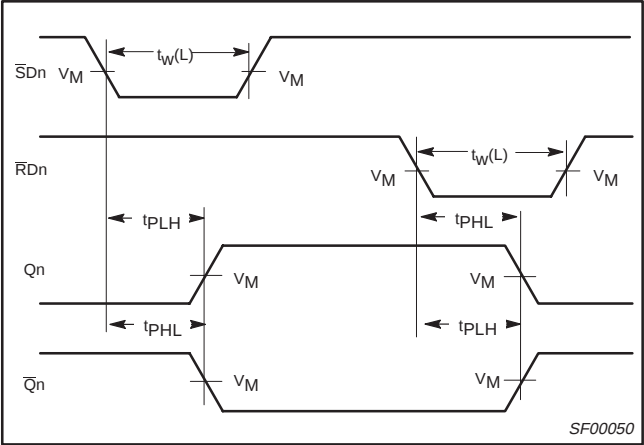
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AC WAVEFORMS

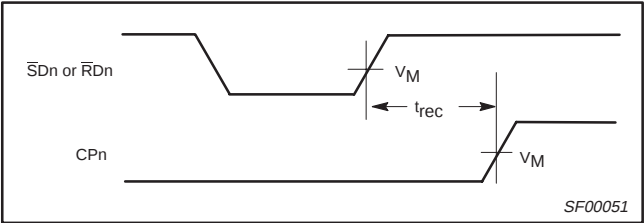
$V_M = 1.5V$, $V_{IN} = GND$ to $2.7V$



Waveform 1. Propagation delay for data to output, data setup time and hold times, and clock width, and maximum clock frequency



Waveform 2. Propagation delay for set and reset to output, set and reset pulse width



Waveform 3. Recovery time for set or reset to clock

TEST CIRCUIT AND WAVEFORMS

Test Circuit for Outputs

Input Pulse Definition

$V_M = 1.5V$

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

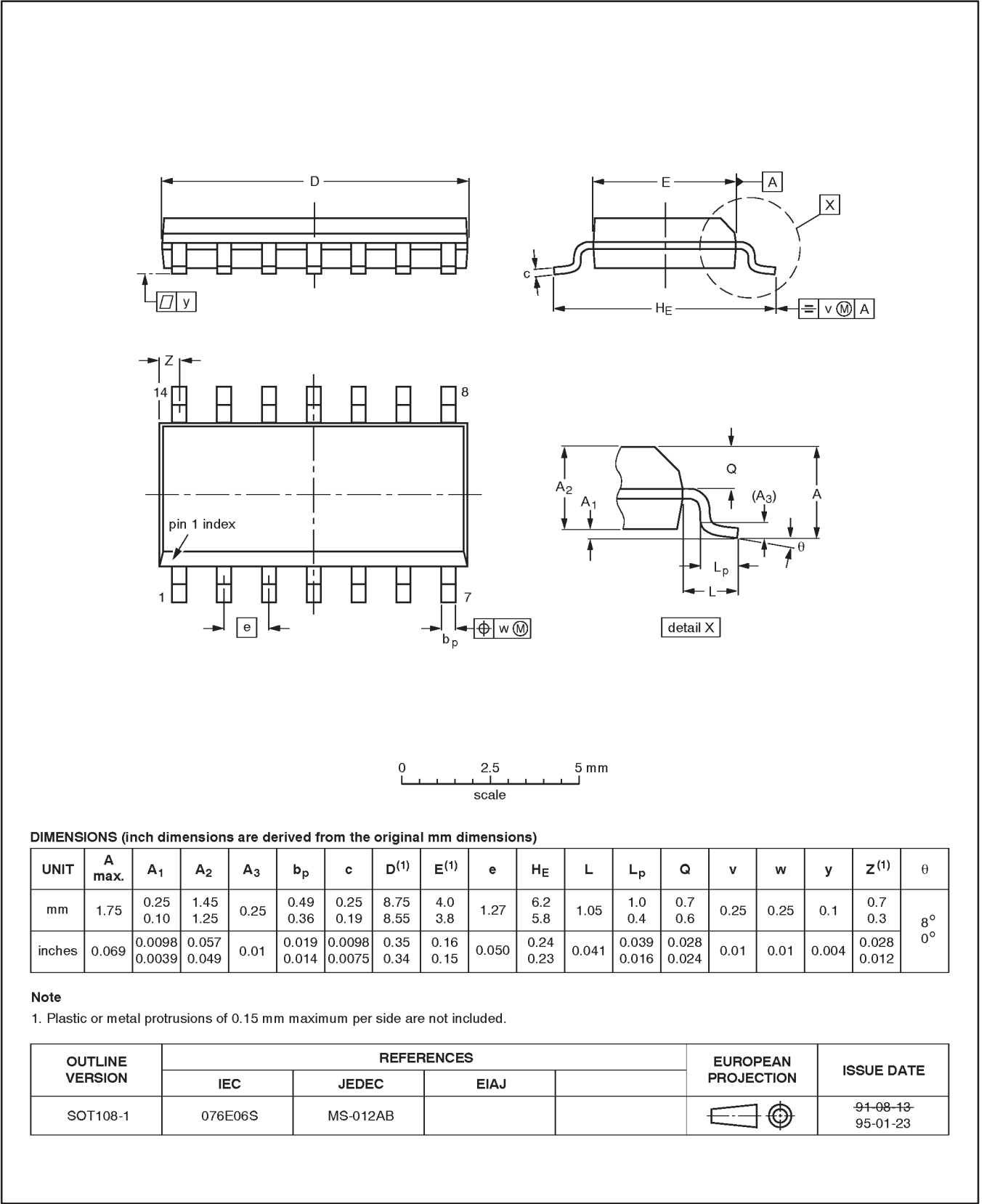
FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	t_W	t_R	t_F
74LVT	2.7V	$\leq 10MHz$	500ns	$\leq 2.5ns$	$\leq 2.5ns$

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

SOT108-1

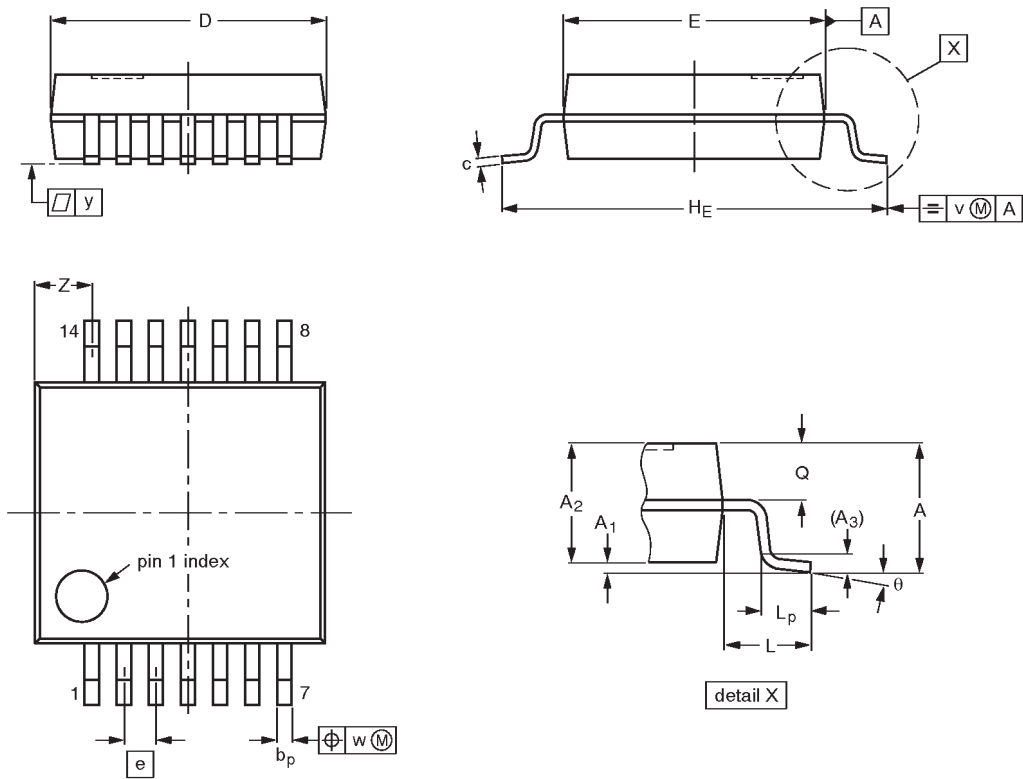


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SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

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	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° 0°

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	EIAJ			
SOT337-1		MO-150AB				95-02-04 96-01-18

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

SOT402-1



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NOTES

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DEFINITIONS		
Data Sheet Identification	Product Status	Definition
Objective Specification	Formative or in Design	This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.
Preliminary Specification	Preproduction Product	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
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