

3.3V 16-bit edge-triggered D-type flip-flop
(3-State)

74LVT16374A

FEATURES

- 16-bit edge-triggered flip-flop
- 3-State buffers
- Output capability: +64mA/-32mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- Power-up reset
- Power-up 3-State
- No bus current loading when output is tied to 5V bus
- Latch-up protection exceeds 500mA per JEDEC Std 17
- ESD protection exceeds 2000V per MIL STD 883 Method 3015 and 200V per Machine Model

DESCRIPTION

The 74LVT16374A is a high-performance BiCMOS product designed for V_{CC} operation at 3.3V.

This device is a 16-bit edge-triggered D-type flip-flop featuring non-inverting 3-State outputs. The device can be used as two 8-bit flip-flops or one 16-bit flip-flop. On the positive transition of the clock (CP), the Q outputs of the flip-flop take on the logic levels set up at the D inputs.

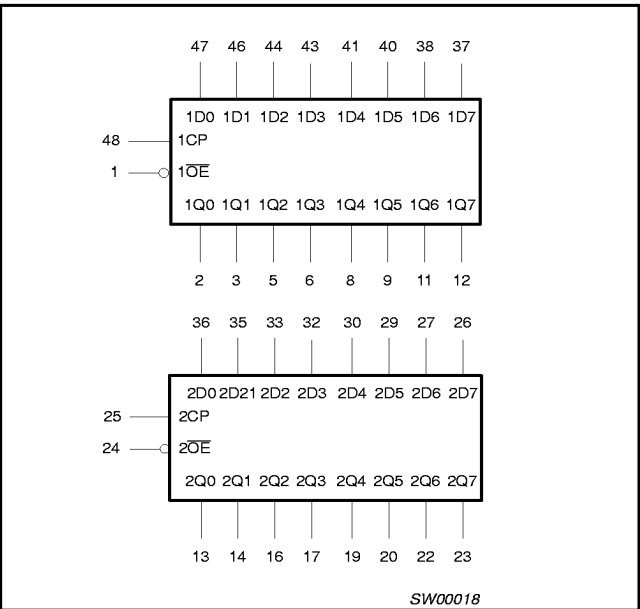
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS T _{amb} = 25°C	TYPICAL	UNIT
t _{PLH} t _{PHL}	Propagation delay nCP to nQx	C _L = 50pF; V _{CC} = 3.3V	2.9	ns
C _{IN}	Input capacitance	V _I = 0V or 3.0V	3	pF
C _{OUT}	Output pin capacitance	Outputs disabled; V _O = 0V or 3.0V	9	pF
I _{CCZ}	Total supply current	Outputs disabled; V _{CC} = 3.6V	70	μA

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	DWG NUMBER
48-Pin Plastic SSOP Type III	−40°C to +85°C	74LVT16374A DL	VT16374A DL	SOT370-1
48-Pin Plastic TSSOP Type II	−40°C to +85°C	74LVT16374A DGG	VT16374A DGG	SOT362-1

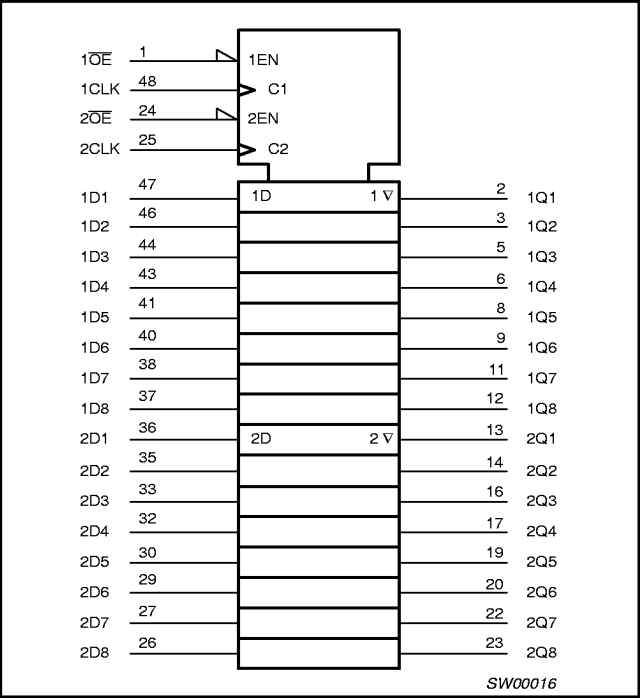
LOGIC SYMBOL



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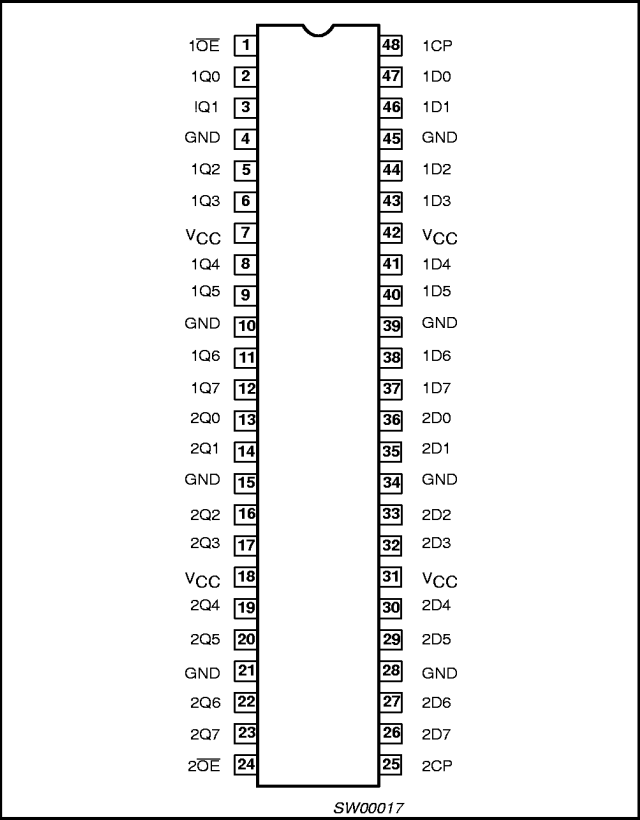
LOGIC SYMBOL (IEEE/IEC)



PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
47, 46, 44, 43, 41, 40, 38, 37 36, 35, 33, 32, 30, 29, 27, 26	1D0 - 1D7 2D0 - 2D7	Data inputs
2, 3, 5, 6, 8, 9, 11, 12 13, 14, 16, 17, 19, 20, 22, 23	1Q0 - 1Q7 2Q0 - 2Q7	Data outputs
1, 24	1OE, 2OE	Output enable inputs (active-Low)
48, 25	1CP, 2CP	Clock pulse inputs (active rising edge)
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	VCC	Positive supply voltage

PIN CONFIGURATION



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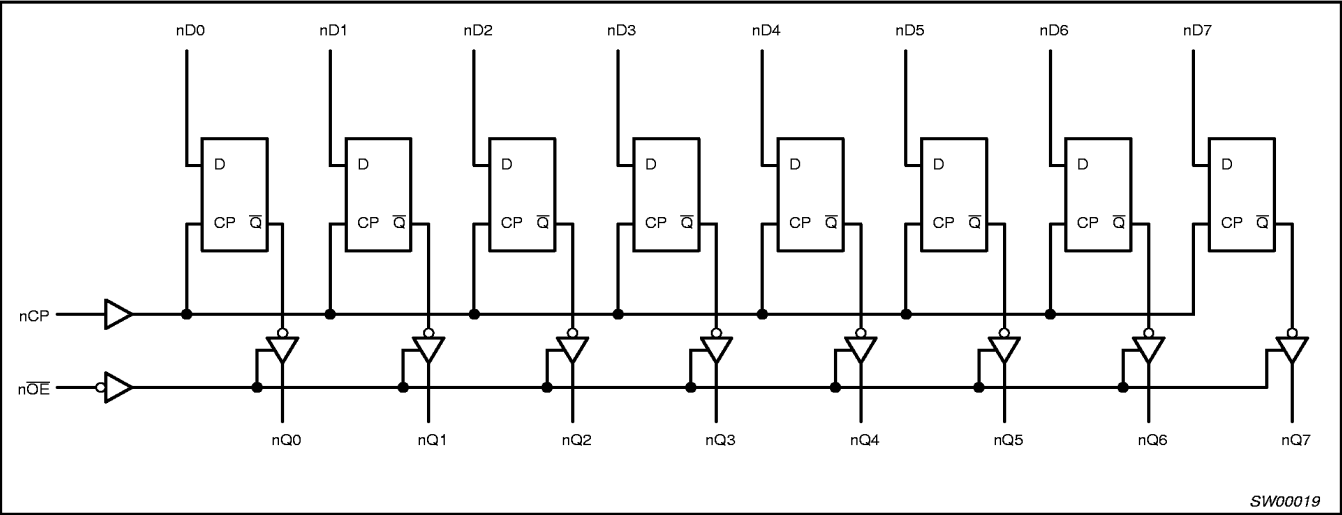
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FUNCTION TABLE

INPUTS			INTERNAL REGISTER	OUTPUTS	OPERATING MODE
nOE	nCP	nDx		nQ0 - nQ7	
L L	↑ ↑	l h	L H	L H	Load and read register
L	⊠	X	NC	NC	Hold
H H	⊠ ↑	X nDx	NC nDx	Z Z	Disable outputs

H = High voltage level
h = High voltage level one set-up time prior to the High-to-Low E transition
L = Low voltage level
l = Low voltage level one set-up time prior to the High-to-Low E transition
NC= No change
X = Don't care
Z = High impedance "off" state
↑ = Low-to-High clock transition
⊠ = Not a Low-to-High clock transition

LOGIC DIAGRAM



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 Low state	128	mA
		Output in High 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.

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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}	Input voltage		0.8	V
I_{OH}	High-level output current		-32	mA
I_{OL}	Low-level output current		32	mA
	Low-level output current; current duty cycle $\leq 50\%$; $f \geq 1\text{kHz}$		64	
$\Delta t/\Delta v$	Input transition rise or fall rate; Outputs enabled		10	ns/V
T_{amb}	Operating free-air temperature range	-40	+85	$^{\circ}\text{C}$

DC ELECTRICAL CHARACTERISTICS

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			-0.85	-1.2	V	
V _{OH}	High-level output voltage	V _{CC} = 2.7 to 3.6V; I _{OH} = -100μA		V _{CC} -0.2	V _{CC}		V	
		V _{CC} = 2.7V; I _{OH} = -8mA		2.4	2.5			
		V _{CC} = 3.0V; I _{OH} = -32mA		2.0	2.3			
V _{OL}	Low-level output voltage	V _{CC} = 2.7V; I _{OL} = 100μA			0.07	0.2	V	
		V _{CC} = 2.7V; I _{OL} = 24mA			0.3	0.5		
		V _{CC} = 3.0V; I _{OL} = 16mA			0.25	0.4		
		V _{CC} = 3.0V; I _{OL} = 32mA			0.3	0.5		
		V _{CC} = 3.0V; I _{OL} = 64mA			0.4	0.55		
V _{RST}	Power-up output Low voltage ⁵	V _{CC} = 3.6V; I _O = 1mA; V _I = GND or V _{CC}			0.1	0.55	V	
I _I	Input leakage current	V _{CC} = 3.6V; V _I = V _{CC} or GND	Control pins		0.1	±1	μA	
		V _{CC} = 0 or 3.6V; V _I = 5.5V			0.4	10		
		V _{CC} = 3.6V; V _I = V _{CC}	Data pins ⁴		0.1	1		
		V _{CC} = 3.6V; V _I = 0			-0.4	-5		
I _{OFF}	Output off current	V _{CC} = 0V; V _I or V _O = 0 to 4.5V				0.1	±100	μA
I _{HOLD}	Bus Hold current D inputs ⁷	V _{CC} = 3V; V _I = 0.8V		75	135		μA	
		V _{CC} = 3V; V _I = 2.0V		-75	-135			
		V _{CC} = 0V to 3.6V; V _{CC} = 3.6V		±500				
I _{EX}	Current into an output in the High state when V _O > V _{CC}	V _O = 5.5V; V _{CC} = 3.0V				50	125	μA
I _{PU/PD}	Power up/down 3-State output current ³	V _{CC} ≤ 1.2V; V _O = 0.5V to V _{CC} ; V _I = GND or V _{CC} ; OE/OE = Don't care				1	±100	μA
I _{OZH}	3-State output High current	V _{CC} = 3.6V; V _O = 3.0V; V _I = V _{IH} or V _{IL}				0.5	5	μA
I _{OZL}	3-State output Low current	V _{CC} = 3.6V; V _O = 0.5V; V _I = V _{IH} or V _{IL}				0.5	-5	
I _{CCH}	Quiescent supply current	V _{CC} = 3.6V; Outputs High, V _I = GND or V _{CC} , I _O = 0				0.07	0.12	mA
I _{CCL}		V _{CC} = 3.6V; Outputs Low, V _I = GND or V _{CC} , I _O = 0				4	6	
I _{CCZ}		V _{CC} = 3.6V; Outputs Disabled; V _I = GND or V _{CC} , I _O = 0 ⁶				0.07	0.12	
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				0.1	0.2	mA

NOTES:

- All typical values are at $V_{CC} = 3.3\text{V}$ and $T_{amb} = 25^{\circ}\text{C}$.
- This is the increase in supply current for each input at the specified voltage level other than V_{CC} or GND.
- This parameter is valid for any V_{CC} between 0V and 1.2V with a transition time of up to 10msec . From $V_{CC} = 1.2\text{V}$ to $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$ a transition time of $100\mu\text{sec}$ is permitted. This parameter is valid for $T_{amb} = 25^{\circ}\text{C}$ only.
- Unused pins at V_{CC} or GND.
- For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.
- I_{CCZ} is measured with outputs pulled to V_{CC} or GND.
- This is the bus hold overdrive current required to force the input to the opposite logic state.

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AC CHARACTERISTICS

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

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				MHz
t_{PLH} t_{PHL}	Propagation delay nCP to nDx	1	1.5 1.5	2.9 3.0	5.0 5.0	5.6 5.6	ns
t_{PZH} t_{PZL}	Output enable time to High and Low level	3 4	1.5 1.5	3.2 3.0	4.8 4.6	6.0 5.2	ns
t_{PHZ} t_{PLZ}	Output disable time from High and Low Level	3 4	1.5 1.5	3.9 3.4	5.4 4.6	6.0 5.0	ns

NOTE:

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

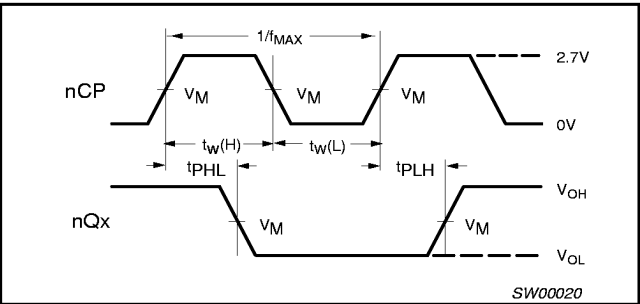
AC SETUP REQUIREMENTS

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

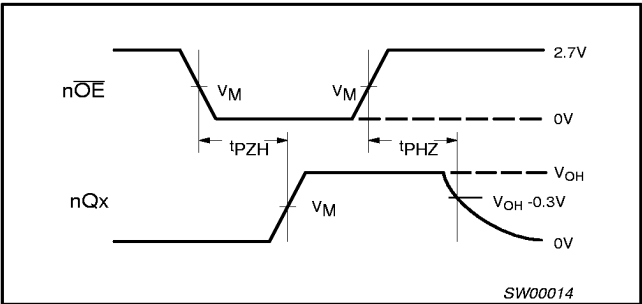
SYMBOL	PARAMETER	WAVEFORM	LIMITS			UNIT
			$V_{CC} = 3.3V \pm 0.3V$		$V_{CC} = 2.7V$	
			MIN	TYP	MIN	
$t_{\text{S(H)}}$ $t_{\text{S(L)}}$	Setup time nDx to nE	3	2.5 2.5	0.7 0.7	2.5 2.5	ns
$t_{\text{H(H)}}$ $t_{\text{H(L)}}$	Hold time nDx to nE	3	0.5 0.5	0 0	0 0	ns
$t_{\text{W(H)}}$ $t_{\text{W(L)}}$	nE pulse width High or Low	1	1.5 3.0	0.6 1.6	1.5 3.0	ns

AC WAVEFORMS

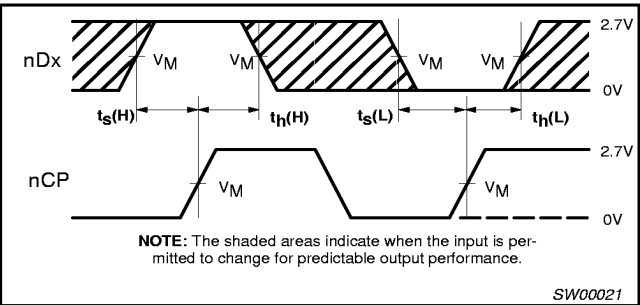
$V_M = 1.5V$, $V_{\text{IN}} = \text{GND to } 3.0V$



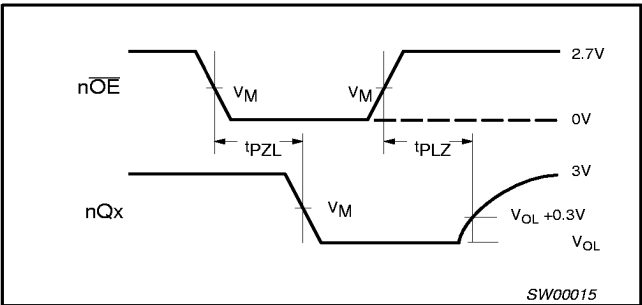
Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width, and Maximum Clock Frequency



Waveform 3. 3-State Output Enable Time to High Level and Output Disable Time from High Level



Waveform 2. Data Setup and Hold Times

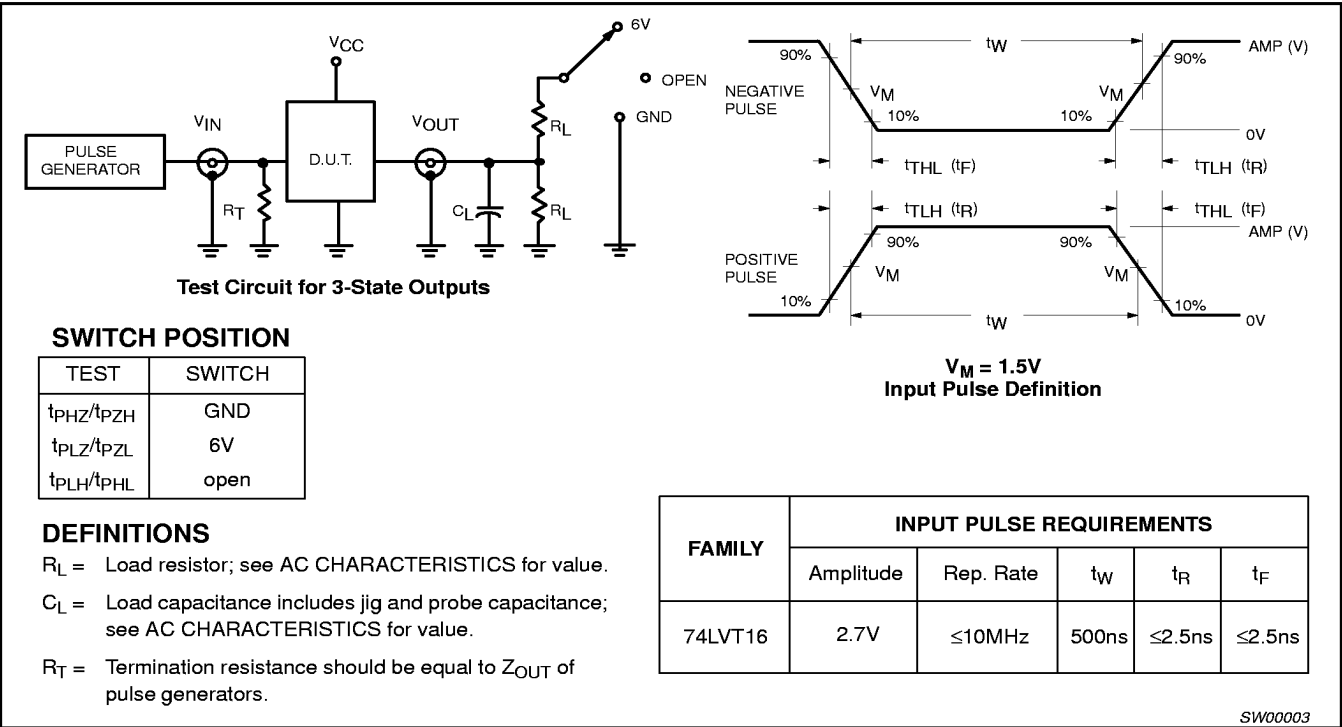


Waveform 4. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level

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TEST CIRCUIT AND WAVEFORMS



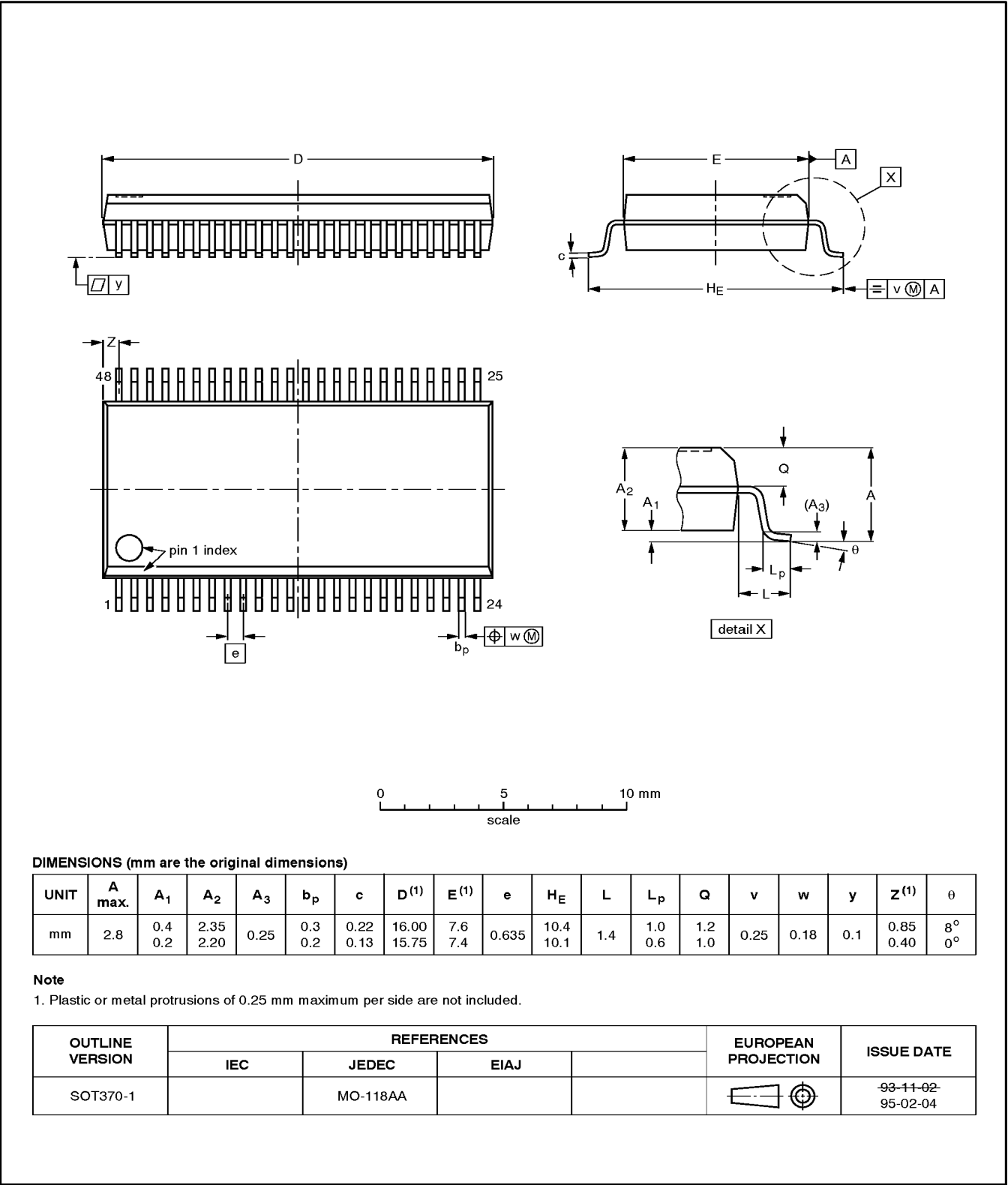
3.3V LVT 16-bit edge-triggered D-type flip-flop

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SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1



3.3V LVT 16-bit edge-triggered D-type flip-flop
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TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1mm

SOT362-1

