

DATA SHEET

74LV374

**Octal D-type flip-flop;
positive edge-trigger (3-State)**

Product specification
Supersedes data of 1996 Feb
IC24 Data Handbook

1997 Mar 20

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

FEATURES

- Wide operating voltage: 1.0 to 5.5V
- Optimized for Low Voltage applications: 1.0 to 3.6V
- Accepts TTL input levels between $V_{CC} = 2.7V$ and $V_{CC} = 3.6V$
- Typical V_{OLP} (output ground bounce) $< 0.8V$ @ $V_{CC} = 3.3V$, $T_{amb} = 25^{\circ}C$
- Typical V_{OHV} (output V_{OH} undershoot) $> 2V$ @ $V_{CC} = 3.3V$, $T_{amb} = 25^{\circ}C$
- Common 3-State output enable input
- Output capability: bus driver
- I_{CC} category: MSI

DESCRIPTION

The 74LV374 is a low-voltage Si-gate CMOS device and is pin and function compatible with 74HC/HCT374.

The 74LV374 is an octal D-type flip-flop featuring separate D-type inputs for each flip-flop and 3-state outputs for bus oriented applications. A clock (CP) and an output enable (\overline{OE}) input are common to all flip-flops.

The eight flip-flops will store the state of their individual D-inputs that meet the set-up and hold times requirements on the LOW-to-HIGH CP transition.

When \overline{OE} is LOW, the contents of the eight flip-flops is available at the outputs. When \overline{OE} is HIGH, the outputs go to the high impedance OFF-state. Operation of the \overline{OE} input does not affect the state of the flip-flops.

QUICK REFERENCE DATA

GND = 0V; $T_{amb} = 25^{\circ}C$; $t_r = t_f \leq 2.5$ ns

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay CP to Q_n	$C_L = 15pF$ $V_{CC} = 3.3V$	14	ns
f_{max}	Maximum clock frequency		77	MHz
C_I	Input capacitance		3.5	pF
C_{PD}	Power dissipation capacitance per flip-flop	Notes 1 and 2	25	pF

NOTES:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW)
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz; C_L = output load capacity in pF;
 f_o = output frequency in MHz; V_{CC} = supply voltage in V;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
2. The condition is $V_I = GND$ to V_{CC}

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic DIL	$-40^{\circ}C$ to $+125^{\circ}C$	74LV374 N	74LV374 N	SOT146-1
20-Pin Plastic SO	$-40^{\circ}C$ to $+125^{\circ}C$	74LV374 D	74LV374 D	SOT163-1
20-Pin Plastic SSOP Type II	$-40^{\circ}C$ to $+125^{\circ}C$	74LV374 DB	74LV374 DB	SOT339-1

PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1	\overline{OE}	Output enable input (active-LOW)
2, 5, 6, 9, 12, 15, 16, 19	Q0 to Q7	3-State flip-flop outputs
3, 4, 7, 8, 13, 14, 17, 18	D0 to D7	Data inputs
10	GND	Ground (0V)
11	CP	Clock input (LOW-to-HIGH, edge-triggered)
20	V_{CC}	Positive supply voltage

FUNCTION TABLE

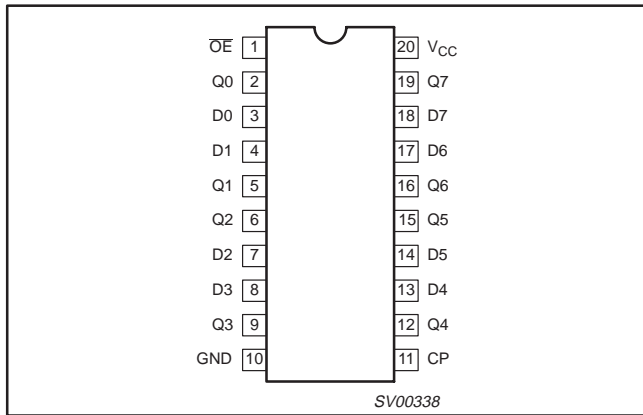
OPERATING MODES	INPUTS			INTERNAL FLIP-FLOPS	OUTPUTS Q0 to Q7
	\overline{OE}	CP	D_n		
Load and read register	L	\uparrow	l	L	L
	L	\uparrow	h	H	H
Load register and disable outputs	H	\uparrow	l	L	Z
	H	\uparrow	h	H	Z

- H = HIGH voltage level
h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition
L = LOW voltage level
l = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition
Z = High impedance OFF-state
 \uparrow = LOW-to-HIGH clock transition

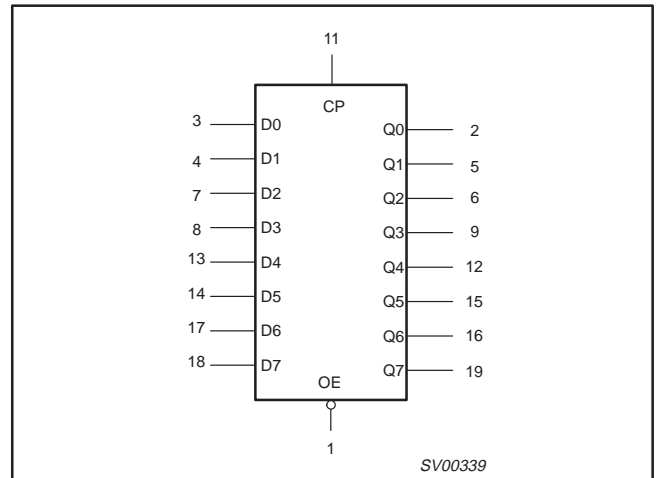
Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

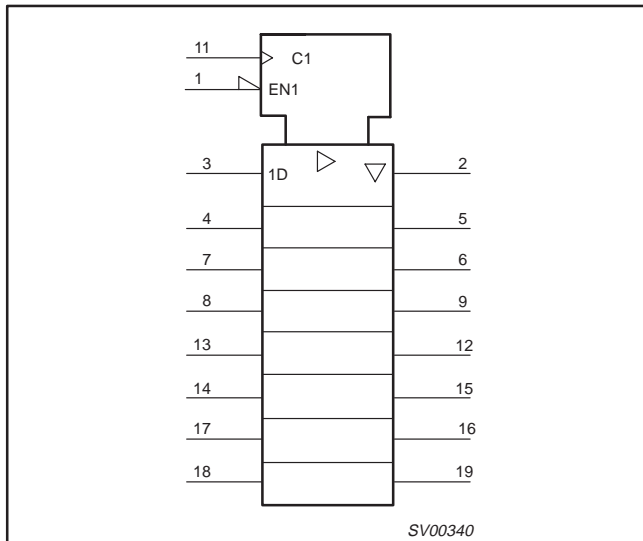
PIN CONFIGURATION



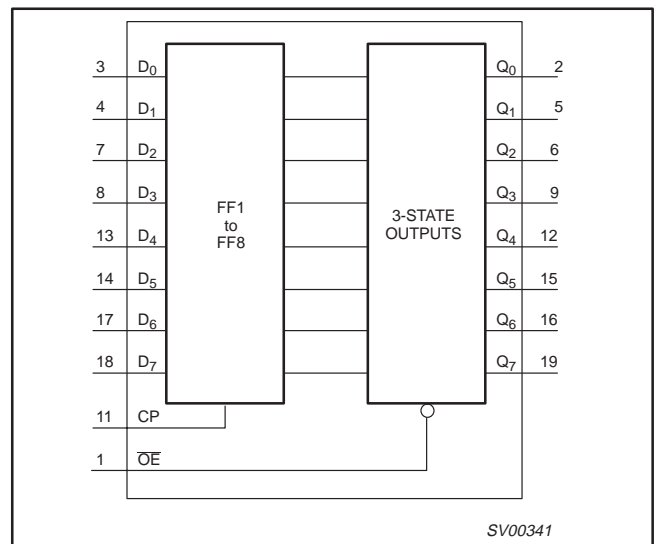
LOGIC SYMBOL



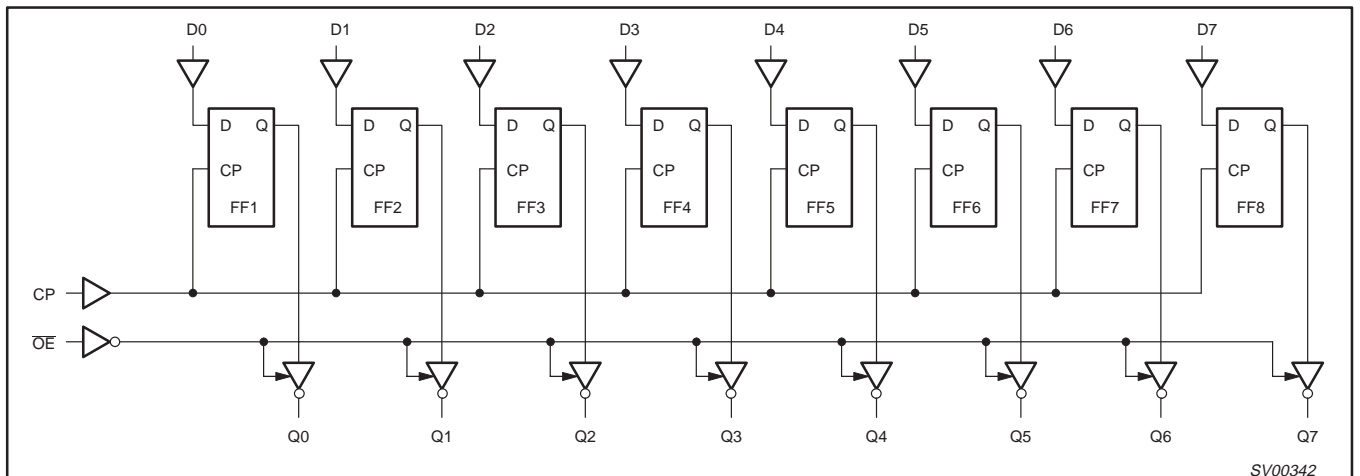
LOGIC SYMBOL (IEEE/IEC)



FUNCTIONAL DIAGRAM



LOGIC DIAGRAM



Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

ABSOLUTE MAXIMUM RATINGS^{1, 2}

In accordance with the Absolute Maximum Rating System (IEC 134)

Voltages are referenced to GND (ground = 0V)

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		-0.5 to +7.0	V
$\pm I_{IK}$	DC input diode current	$V_I < -0.5$ or $V_I > V_{CC} + 0.5V$	20	mA
$\pm I_{OK}$	DC output diode current	$V_O < -0.5$ or $V_O > V_{CC} + 0.5V$	50	mA
$\pm I_O$	DC output source or sink current – standard outputs – bus driver outputs	$-0.5V < V_O < V_{CC} + 0.5V$	25 35	mA
$\pm I_{GND}$, $\pm I_{CC}$	DC V_{CC} or GND current for types with –standard outputs –bus driver outputs		50 70	mA
T_{stg}	Storage temperature range		-65 to +150	°C
P_{TOT}	Power dissipation per package –plastic DIL –plastic mini-pack (SO) –plastic shrink mini-pack (SSOP and TSSOP)	for temperature range: -40 to +125°C above +70°C derate linearly with 12mW/K above +70°C derate linearly with 8 mW/K above +60°C derate linearly with 5.5 mW/K	750 500 400	mW

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 input and output voltage ratings may be exceeded if the input and output current ratings are observed.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT
V_{CC}	DC supply voltage	See Note1	1.0	3.3	5.5	V
V_I	Input voltage		0	–	V_{CC}	V
V_O	Output voltage		0	–	V_{CC}	V
T_{amb}	Operating ambient temperature range in free air	See DC and AC characteristics per device	-40 -40		+85 +125	°C
t_r, t_f	Input rise and fall times except for Schmitt-trigger inputs	$V_{CC} = 1.0V$ to $2.0V$ $V_{CC} = 2.0V$ to $2.7V$ $V_{CC} = 2.7V$ to $3.6V$ $V_{CC} = 3.6V$ to $5.5V$	– – – –	– – – –	500 200 100 50	ns/V

NOTES:

- The LV is guaranteed to function down to $V_{CC} = 1.0V$ (input levels GND or V_{CC}); DC characteristics are guaranteed from $V_{CC} = 1.2V$ to $V_{CC} = 5.5V$.

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

DC CHARACTERISTICS FOR THE LV FAMILY

Over recommended operating conditions voltages are referenced to GND (ground = 0V)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS					UNIT
			-40°C to +85°C			-40°C to +125°C		
			MIN	TYP ¹	MAX	MIN	MAX	
V _{IH}	HIGH level Input voltage	V _{CC} = 1.2V	0.9			0.9		V
		V _{CC} = 2.0V	1.4			1.4		
		V _{CC} = 2.7 to 3.6V	2.0			2.0		
		V _{CC} = 4.5 to 5.5V	0.7*V _{CC}			0.7*V _{CC}		
V _{IL}	LOW level Input voltage	V _{CC} = 1.2V			0.3		0.3	V
		V _{CC} = 2.0V			0.6		0.6	
		V _{CC} = 2.7 to 3.6V			0.8		0.8	
		V _{CC} = 4.5 to 5.5			0.3*V _{CC}		0.3*V _{CC}	
V _{OH}	HIGH level output voltage; all outputs	V _{CC} = 1.2V; V _I = V _{IH} or V _{IL} ; -I _O = 100µA		1.2				V
		V _{CC} = 2.0V; V _I = V _{IH} or V _{IL} ; -I _O = 100µA	1.8	2.0		1.8		
		V _{CC} = 2.7V; V _I = V _{IH} or V _{IL} ; -I _O = 100µA	2.5	2.7		2.5		
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; -I _O = 100µA	2.8	3.0		2.8		
		V _{CC} = 4.5V; V _I = V _{IH} or V _{IL} ; -I _O = 100µA	4.3	4.5		4.3		
V _{OH}	HIGH level output voltage; STANDARD outputs	V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; -I _O = 6mA	2.40	2.82		2.20		V
		V _{CC} = 4.5V; V _I = V _{IH} or V _{IL} ; -I _O = 12mA	3.60	4.20		3.50		
V _{OH}	HIGH level output voltage; BUS driver outputs	V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; -I _O = 8mA	2.40	2.82		2.20		V
		V _{CC} = 4.5V; V _I = V _{IH} or V _{IL} ; -I _O = 16mA	3.60	4.20		3.50		
V _{OL}	LOW level output voltage; all outputs	V _{CC} = 1.2V; V _I = V _{IH} or V _{IL} ; I _O = 100µA		0				V
		V _{CC} = 2.0V; V _I = V _{IH} or V _{IL} ; I _O = 100µA		0	0.2		0.2	
		V _{CC} = 2.7V; V _I = V _{IH} or V _{IL} ; I _O = 100µA		0	0.2		0.2	
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 100µA		0	0.2		0.2	
		V _{CC} = 4.5V; V _I = V _{IH} or V _{IL} ; I _O = 100µA		0	0.2		0.2	
V _{OL}	LOW level output voltage; STANDARD outputs	V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 6mA		0.25	0.40		0.50	V
		V _{CC} = 4.5V; V _I = V _{IH} or V _{IL} ; I _O = 12mA		0.35	0.55		0.65	
V _{OL}	LOW level output voltage; BUS driver outputs	V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 8mA		0.20	0.40		0.50	V
		V _{CC} = 4.5V; V _I = V _{IH} or V _{IL} ; I _O = 16mA		0.35	0.55		0.65	
I _I	Input leakage current	V _{CC} = 5.5V; V _I = V _{CC} or GND			1.0		1.0	µA
I _{OZ}	3-State output OFF-state current	V _{CC} = 5.5V; V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND			5		10	µA
I _{CC}	Quiescent supply current; SSI	V _{CC} = 5.5V; V _I = V _{CC} or GND; I _O = 0			20.0		40	µA
	Quiescent supply current; flip-flops	V _{CC} = 5.5V; V _I = V _{CC} or GND; I _O = 0			20.0		80	
I _{CC}	Quiescent supply current; MSI	V _{CC} = 5.5V; V _I = V _{CC} or GND; I _O = 0			20.0		160	µA
	Quiescent supply current; LSI	V _{CC} = 5.5V; V _I = V _{CC} or GND; I _O = 0			500		1000	
ΔI _{CC}	Additional quiescent supply current per input	V _{CC} = 2.7V to 3.6V; V _I = V _{CC} - 0.6V			500		850	µA

NOTE:1. All typical values are measured at T_{amb} = 25°C.

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

AC CHARACTERISTICS

GND = 0V; $t_r = t_f = 2.5\text{ns}$; $C_L = 50\text{pF}$; $R_L = 500\Omega$

SYMBOL	PARAMETER	WAVEFORM	CONDITION	LIMITS -40 to +85 °C			LIMITS -40 to +125 °C		UNIT
				MIN	TYP	MAX	MIN	MAX	
t_{PHL}/t_{PLH}	Propagation delay CP to Qn	Figure 1	1.2	–	90	–	–	–	ns
			2.0	–	31	39	–	49	
			2.7	–	23	29	–	36	
			3.0 to 3.6	–	17 ²	23	–	29	
			4.5 to 5.5	–	–	19	–	24	
t_{PZH}/t_{PZL}	Propagation delay OE to Qn	Figure 2	1.2	–	75	–	–	–	ns
			2.0	–	26	34	–	43	
			2.7	–	19	25	–	31	
			3.0 to 3.6	–	14 ²	20	–	25	
			4.5 to 5.5	–	–	17	–	21	
t_{PHZ}/t_{PLZ}	Propagation delay OE to Qn	Figure 2	1.2	–	80	–	–	–	ns
			2.0	–	29	39	–	48	
			2.7	–	22	29	–	36	
			3.0 to 3.6	–	17 ²	24	–	29	
			4.5 to 5.5	–	–	20	–	24	
t_w	Clock pulse width HIGH or LOW	Figure 1	2.0	34	12	–	41	–	ns
			2.7	25	9	–	30	–	
			3.0 to 3.6	20	7 ²	–	24	–	
t_{su}	Set-up time Dn to CP	Figure 3	1.2	–	25	–	–	–	ns
			2.0	22	9	–	26	–	
			2.7	16	6	–	19	–	
			3.0 to 3.6	13	5 ²	–	15	–	
t_h	Hold time Dn to CP	Figure 3	1.2	–	–10	–	–	–	ns
			2.0	5	–3	–	5	–	
			2.7	5	–2	–	5	–	
			3.0 to 3.6	5	–2 ²	–	5	–	
f_{max}	Maximum clock pulse frequency	Figure 2	2.0	15	40	–	12	–	MHz
			2.7	19	58	–	16	–	
			3.0 to 3.6	24	70 ²	–	20	–	

NOTE:

1. Unless otherwise stated, all typical values are at $T_{amb} = 25^\circ\text{C}$.
2. Typical value measured at $V_{CC} = 3.3\text{V}$.
3. Typical value measured at $V_{CC} = 5.0\text{V}$.

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

AC WAVEFORMS

$V_M = 1.5V$ at $V_{CC} \geq 2.7V \leq 3.6V$
 $V_M = 0.5V * V_{CC}$ at $V_{CC} < 2.7V$ and $\geq 4.5V$
 V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.

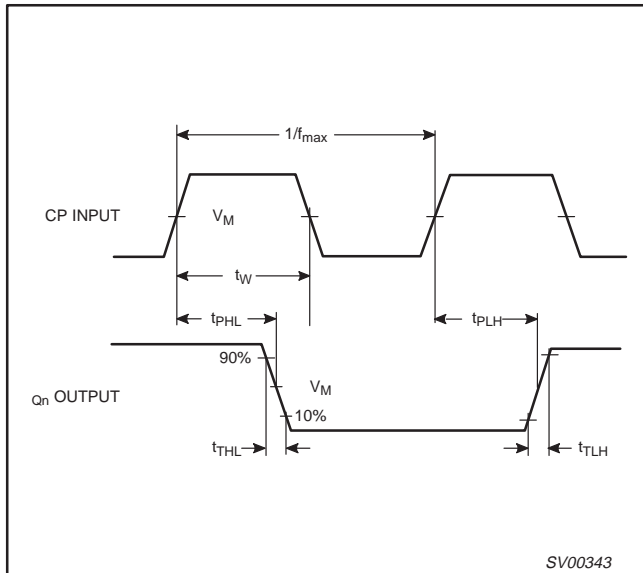


Figure 1. Waveforms showing the clock (CP) to output (Qn) propagation delays, the clock pulse width, output transition times and the maximum clock pulse frequency

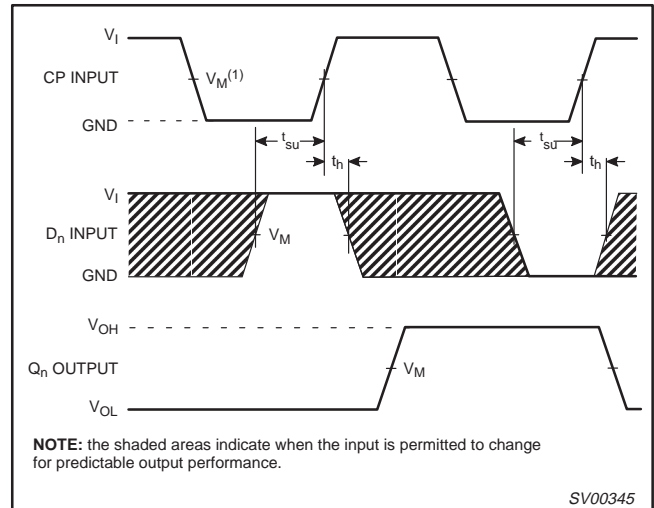


Figure 3. Waveforms showing the data set-up and hold times for the Dn input to the CP input

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

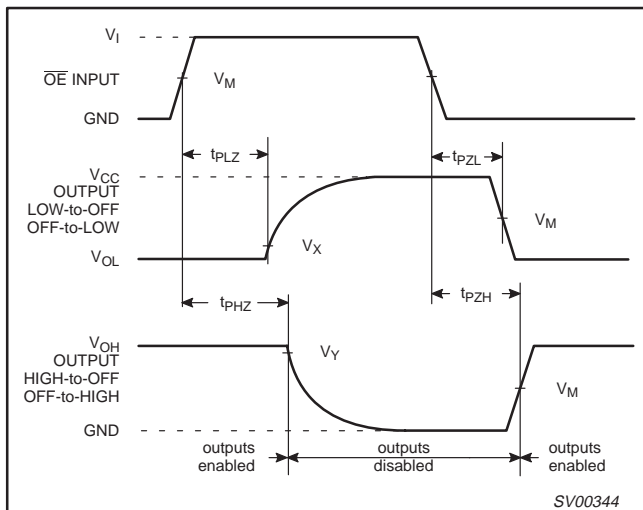


Figure 2. Waveforms showing the 3-state enable and disable times

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

TEST CIRCUIT

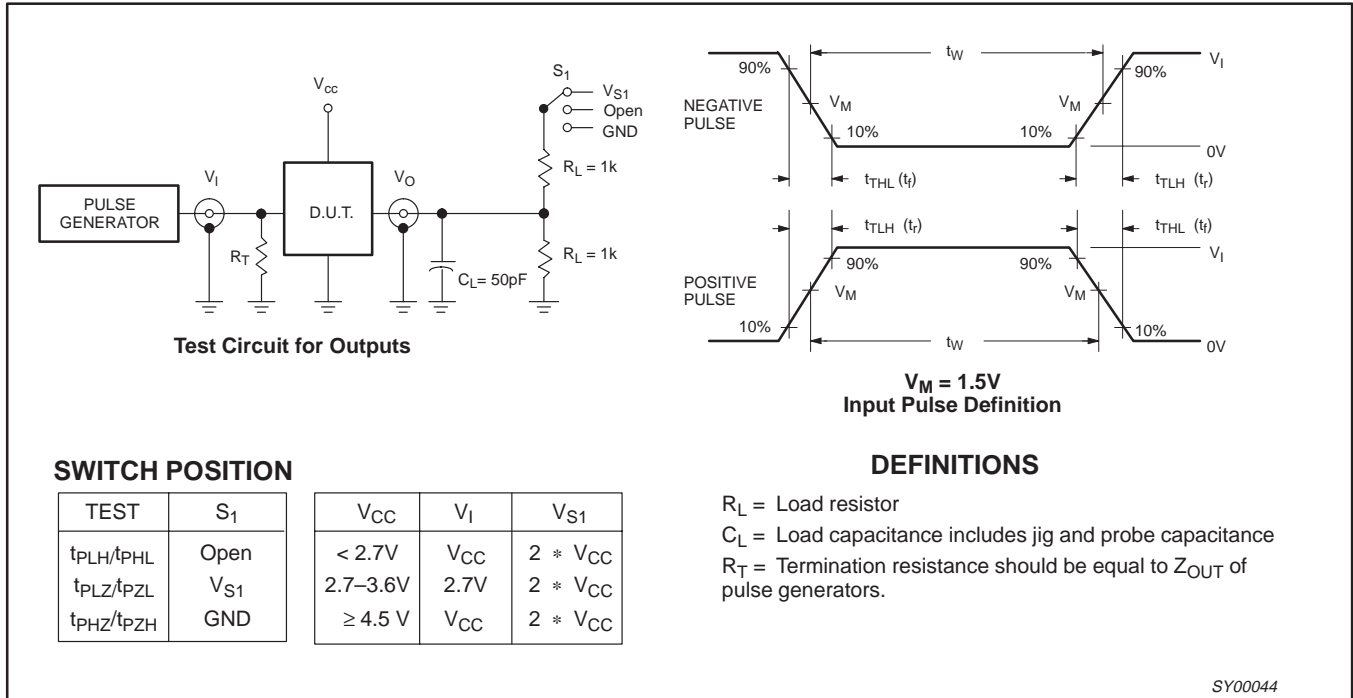


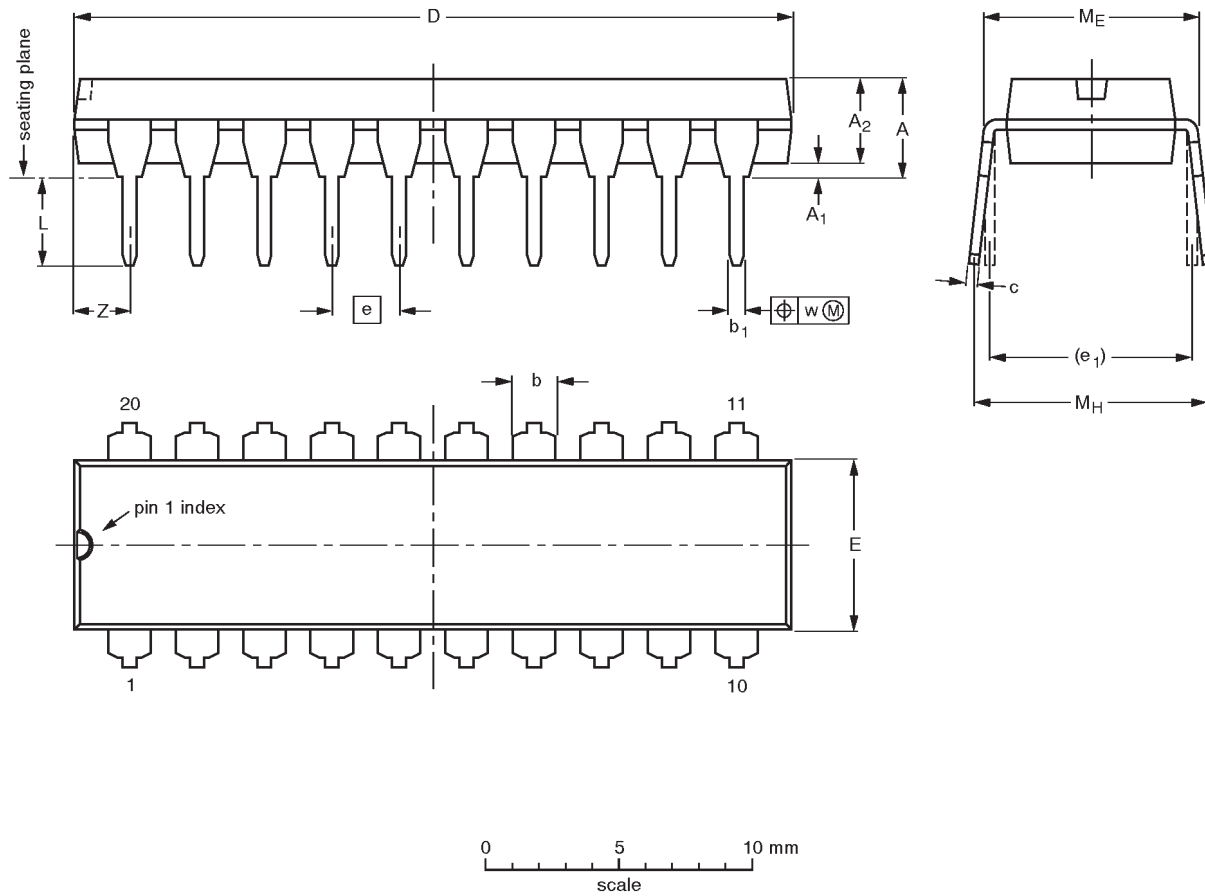
Figure 4. Load circuitry for switching times

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1



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

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

Note

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

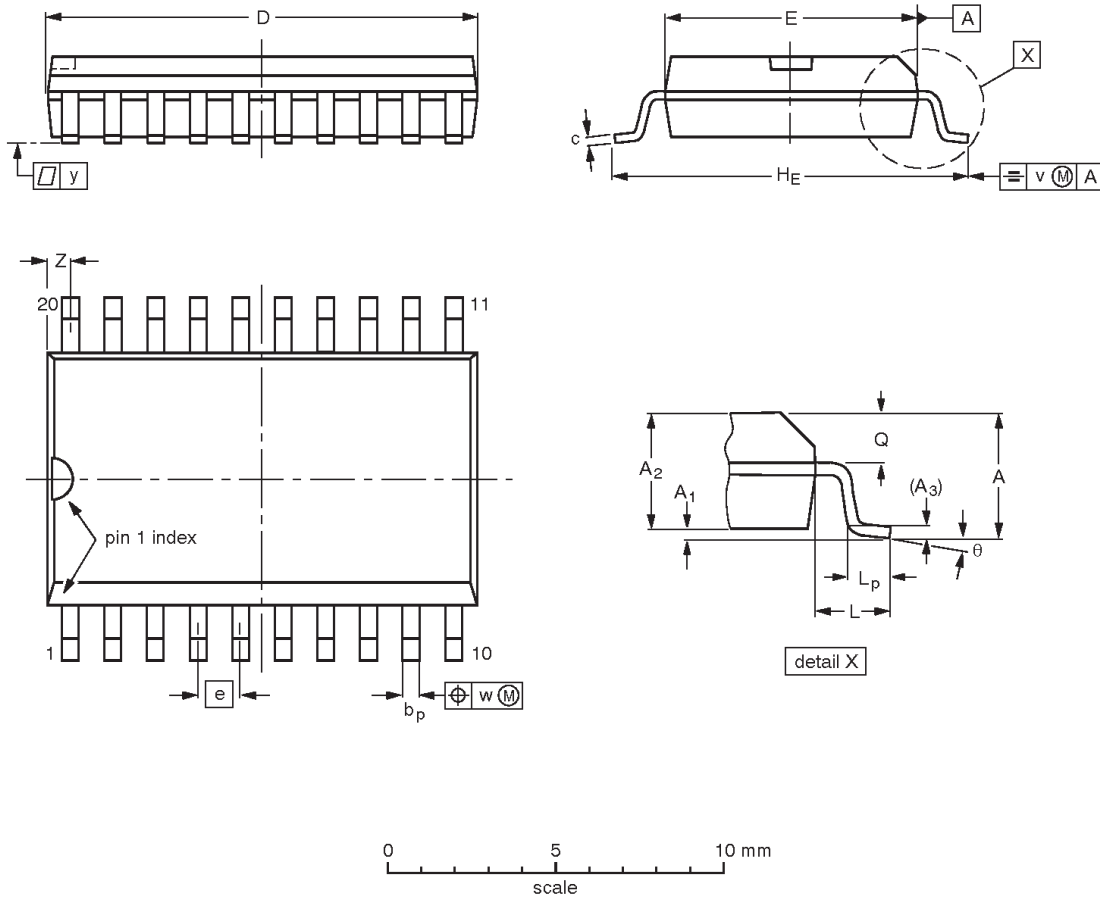
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT146-1			SC603			92-11-17 95-05-24

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



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	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

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

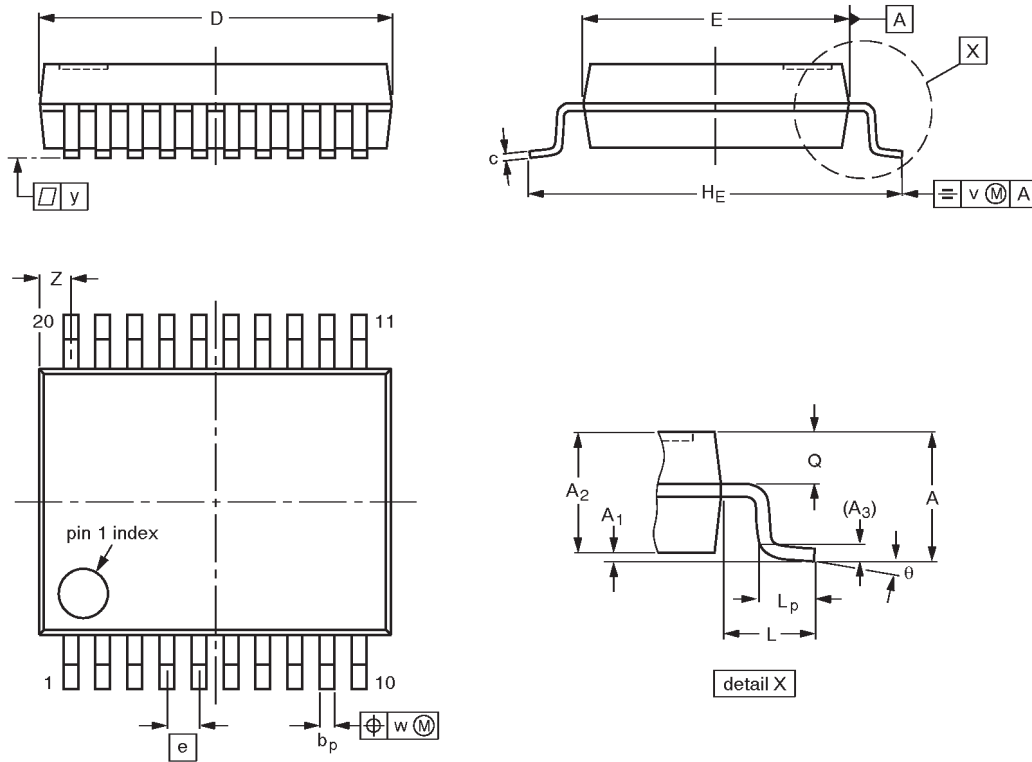
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013AC				92-11-17 95-01-24

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	HE	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	7.4 7.0	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	0.9 0.5	8° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				93-09-08 95-02-04

Octal D-type flip-flop; positive edge-trigger (3-State)

74LV374

DEFINITIONS

Data Sheet Identification	Product Status	Definition
<i>Objective Specification</i>	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.
<i>Preliminary Specification</i>	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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