

DATA SHEET

74LVC374A

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

Product specification

1998 Jul 29

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

74LVC374A

FEATURES

- 5-volt tolerant inputs/outputs, for interfacing with 5-volt logic
- Supply voltage range of 2.7V to 3.6V
- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- Direct interface with TTL levels
- High impedance when $V_{CC} = 0V$
- 8-bit positive edge-triggered register
- Independent register and 3-State buffer operation

DESCRIPTION

The 74LVC374A is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3V or 5V devices. In 3-State operation, outputs can handle 5V. This feature allows the use of these devices as translators in a mixed 3.3V/5V environment.

The 74LVC374A 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 setup 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.

The '374' is functionally identical to the '574', but the '574' has a different pin arrangement.

QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay CP to Q_n	$C_L = 50pF$ $V_{CC} = 3.3V$	4.8	ns
f_{max}	maximum clock frequency		150	MHz
C_I	Input capacitance		5.0	pF
C_{PD}	Power dissipation capacitance per flip-flop	Notes 1 and 2	20	pF

NOTE:

- 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 outputs.
- The condition is $V_I = GND$ to V_{CC}

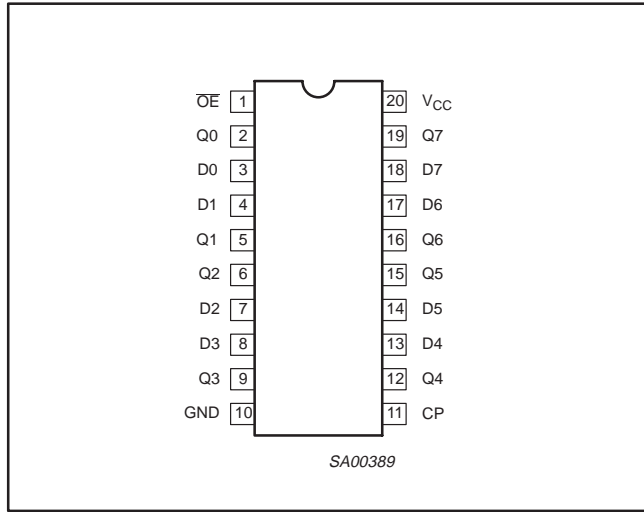
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic Shrink Small Outline (SO)	-40°C to +85°C	74LVC374A D	74LVC374A D	SOT163-1
20-Pin Plastic Shrink Small Outline (SSOP) Type II	-40°C to +85°C	74LVC374A DB	74LVC374A DB	SOT339-1
20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I	-40°C to +85°C	74LVC374A PW	7LVC374APW DH	SOT360-1

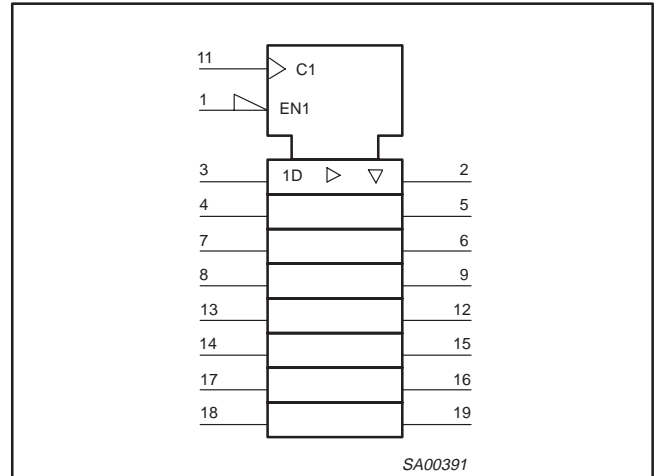
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74LVC374A

PIN CONFIGURATION



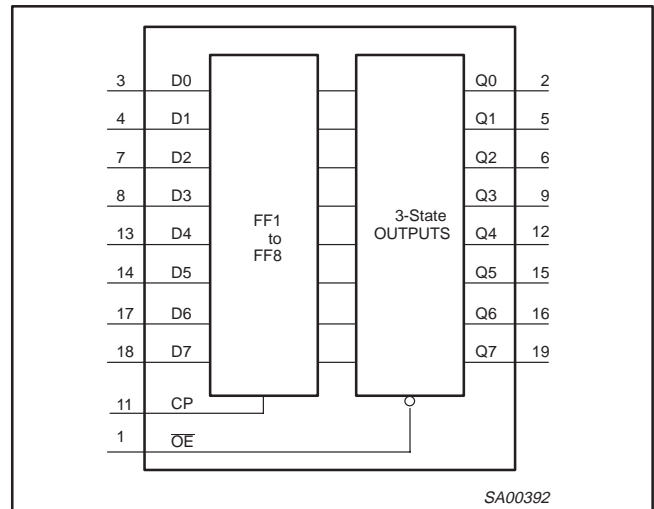
LOGIC SYMBOL (IEEE/IEC)



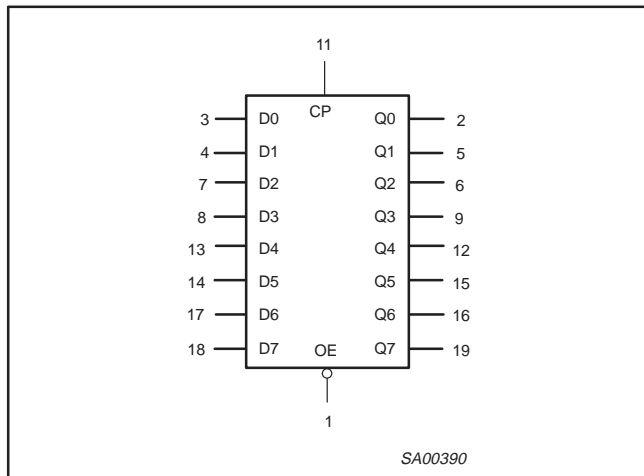
PIN DESCRIPTION

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

FUNCTIONAL DIAGRAM



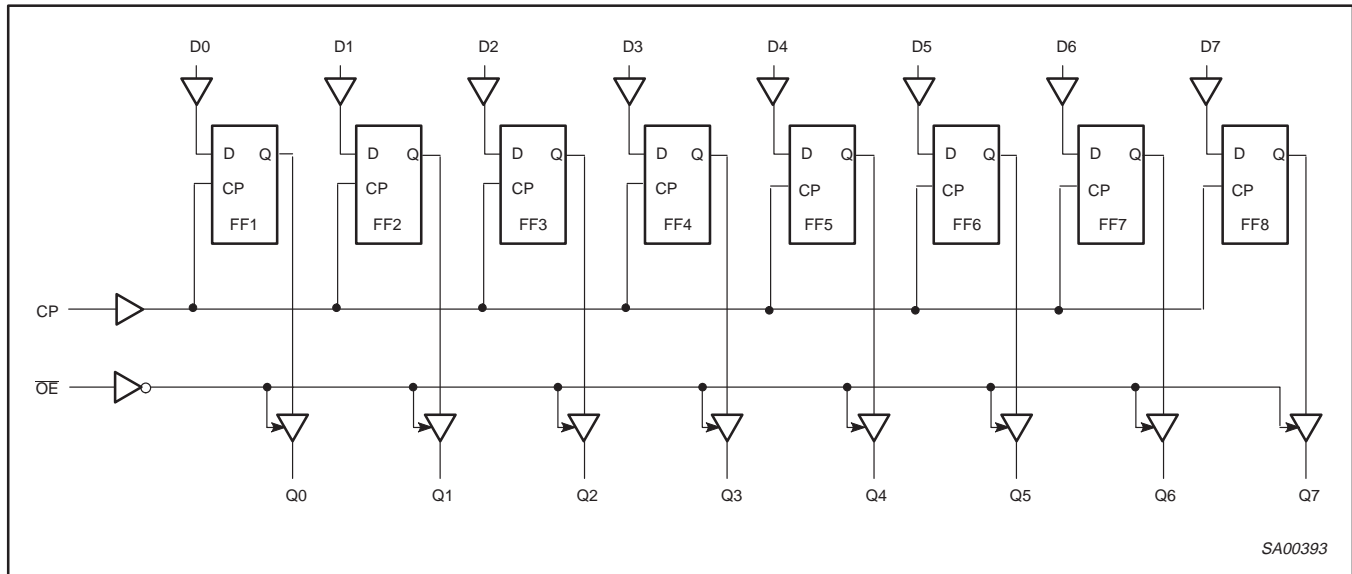
LOGIC SYMBOL



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74LVC374A

LOGIC DIAGRAM



FUNCTION TABLE

OPERATING MODES	INPUTS			INTERNAL FLIP-FLOPS	OUTPUTS
	\overline{OE}	LE	D_n		Q_0 to Q_7
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Load register and disable outputs	H	↑	l	L	Z
	H	↑	h	H	Z

H = HIGH voltage level
 h = HIGH voltage level one setup time prior to the LOW-to-HIGH CP transition
 L = LOW voltage level
 l = LOW voltage level one setup time prior to the LOW-to-HIGH CP transition
 Z = High impedance OFF-state
 ↑ = LOW-to-HIGH clock transition

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74LVC374A

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V_{CC}	DC supply voltage (for max. speed performance)		2.7	3.6	V
	DC supply voltage (for low-voltage applications)		1.2	3.6	
V_I	DC input voltage range		0	5.5	V
V_O	DC output voltage range; output HIGH or LOW state		0	V_{CC}	V
	DC output voltage range; output 3-State		0	5.5	
T_{amb}	Operating ambient temperature range in free-air		-40	+85	°C
t_r, t_f	Input rise and fall times	$V_{CC} = 1.2$ to $2.7V$	0	20	ns/V
		$V_{CC} = 2.7$ to $3.6V$	0	10	

ABSOLUTE MAXIMUM RATINGS¹

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 +6.5	V
I_{IK}	DC input diode current	$V_I < 0$	-50	mA
V_I	DC input voltage	Note 2	-0.5 to +6.5	V
I_{OK}	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	±50	mA
V_O	DC output voltage; output HIGH or LOW state	Note 2	-0.5 to $V_{CC} + 0.5$	V
	DC output voltage; output 3-State	Note 2	-0.5 to 6.5	
I_O	DC output source or sink current	$V_O = 0$ to V_{CC}	±50	mA
I_{GND}, I_{CC}	DC V_{CC} or GND current		±100	mA
T_{stg}	Storage temperature range		-65 to +150	°C
P_{TOT}	Power dissipation per package			mW
	- plastic mini-pack (SO) - plastic shrink mini-pack (SSOP and TSSOP)	above +70°C derate linearly with 8 mW/K above +60°C derate linearly with 5.5 mW/K	500 500	

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.

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

74LVC374A

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 _{IH}	HIGH level Input voltage	V _{CC} = 1.2V	V _{CC}			V
		V _{CC} = 2.7 to 3.6V	2.0			
V _{IL}	LOW level Input voltage	V _{CC} = 1.2V			GND	V
		V _{CC} = 2.7 to 3.6V			0.8	
V _{OH}	HIGH level output voltage	V _{CC} = 2.7V; V _I = V _{IH} or V _{IL} ; I _O = -12mA	V _{CC} - 0.5			V
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = -100μA	V _{CC} - 0.2	V _{CC}		
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = -18mA	V _{CC} - 0.6			
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = -24mA	V _{CC} - 0.8			
V _{OL}	LOW level output voltage	V _{CC} = 2.7V; V _I = V _{IH} or V _{IL} ; I _O = 12mA			0.40	V
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 100μA		GND	0.20	
		V _{CC} = 3.0V; V _I = V _{IH} or V _{IL} ; I _O = 24mA			0.55	
I _I	Input leakage current ²	V _{CC} = 3.6V; V _I = 5.5V or GND		±0.1	±5	μA
I _{OZ}	3-State output OFF-state current	V _{CC} = 3.6V; V _I = V _{IH} or V _{IL} ; V _O = 5.5V or GND		0.1	±10	μA
I _{off}	Power off leakage supply	V _{CC} = 0.0V; V _I or V _O = 5.5V		0.1	±10	μA
I _{CC}	Quiescent supply current	V _{CC} = 3.6V; V _I = V _{CC} or GND; I _O = 0		0.1	10	μA
ΔI _{CC}	Additional quiescent supply current per input pin	V _{CC} = 2.7V to 3.6V; V _I = V _{CC} - 0.6V; I _O = 0		5	500	μA

NOTES:

- All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.
- The specified overdrive current at the data input forces the data input to the opposite logic input state.

AC CHARACTERISTICS

GND = 0V; t_r = t_f ≤ 2.5ns; C_L = 50pF; R_L = 500Ω; T_{amb} = -40°C to +85°C.

SYMBOL	PARAMETER	WAVEFORM	LIMITS						UNIT
			V _{CC} = 3.3V ±0.3V			V _{CC} = 2.7V		V _{CC} = 1.2V	
			MIN	TYP ¹	MAX	MIN	MAX	TYP	
t _{PHL} t _{PLH}	Propagation delay CP to Q _n	1, 4	1.5	4.8	7.0	1.5	8.0	21	ns
t _{PZH} t _{PZL}	3-State output enable time OE to Q _n	2, 4	1.5	4.8	7.5	1.5	8.5	22	ns
t _{PHZ} t _{PLZ}	3-State output disable time OE to Q _n	2, 4	1.5	4.3	6.0	1.5	7.0	15	ns
t _W	Clock pulse width HIGH or LOW	1	3.0	1.5	–	3.0	–	–	ns
t _{SU}	Setup time D _n to CP	3	2.0	0	–	2.0	–	–	ns
t _H	Hold time D _n to CP	3	1.5	0.6	–	1.5	–	–	ns
f _{max}	maximum clock pulse frequency	1	100	–	–	80	–	–	MHz

NOTE:

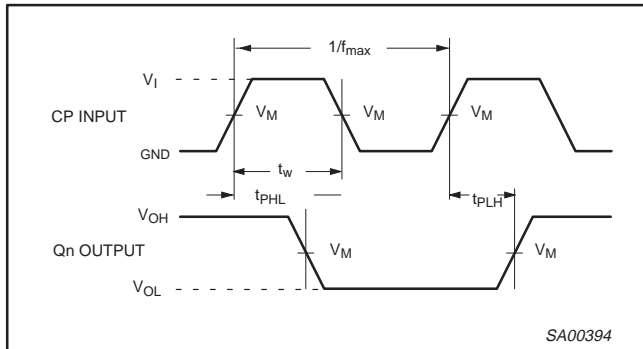
- Unless otherwise stated, all typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

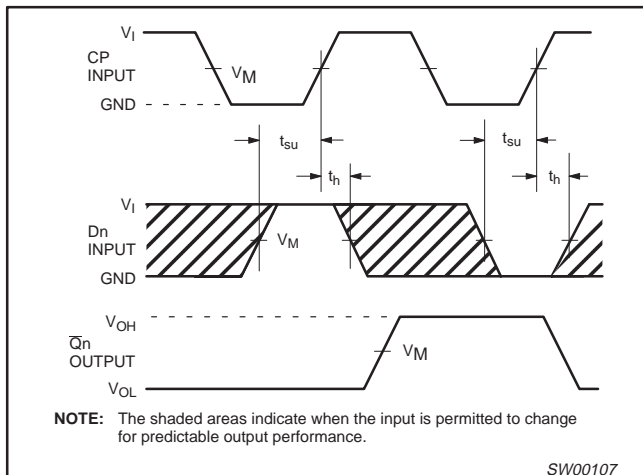
74LVC374A

AC WAVEFORMS

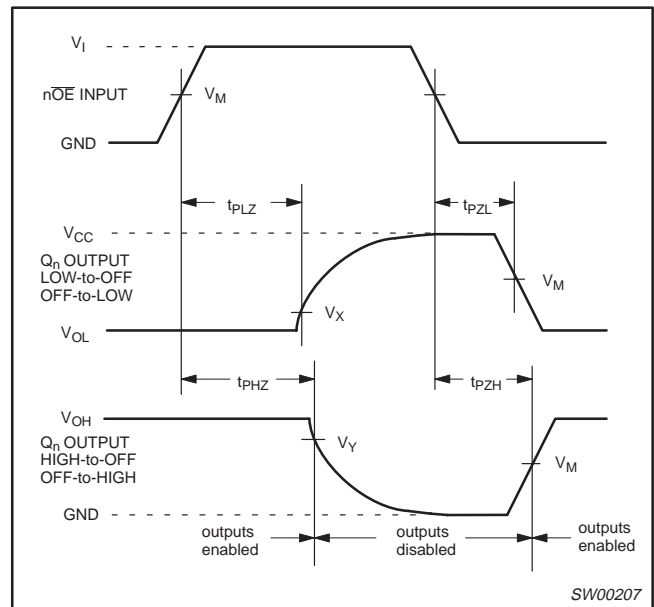
$V_M = 1.5V$ at $V_{CC} \geq 2.7V$; $V_M = 0.5 V_{CC}$ at $V_{CC} < 2.7V$.
 V_{OL} and V_{OH} are the typical output voltage drop that occur with the output load.
 $V_X = V_{OL} + 0.3V$ at $V_{CC} \geq 2.7V$; $V_X = V_{OL} + 0.1 V_{CC}$ at $V_{CC} < 2.7V$
 $V_Y = V_{OH} - 0.3V$ at $V_{CC} \geq 2.7V$; $V_Y = V_{OH} - 0.1 V_{CC}$ at $V_{CC} < 2.7V$



Waveform 1. Clock (CP) to output (Q_n) propagation delays, the clock pulse width, output transition times and the maximum clock pulse frequency.

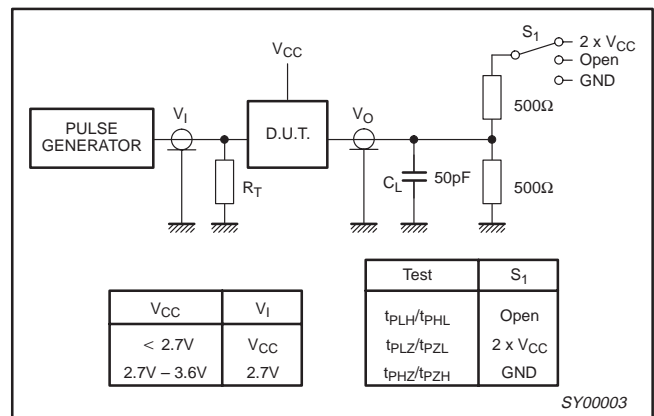


Waveform 2. Data setup and hold times for the D_n input to the CP input.



Waveform 3. 3-State enable and disable times.

TEST CIRCUIT



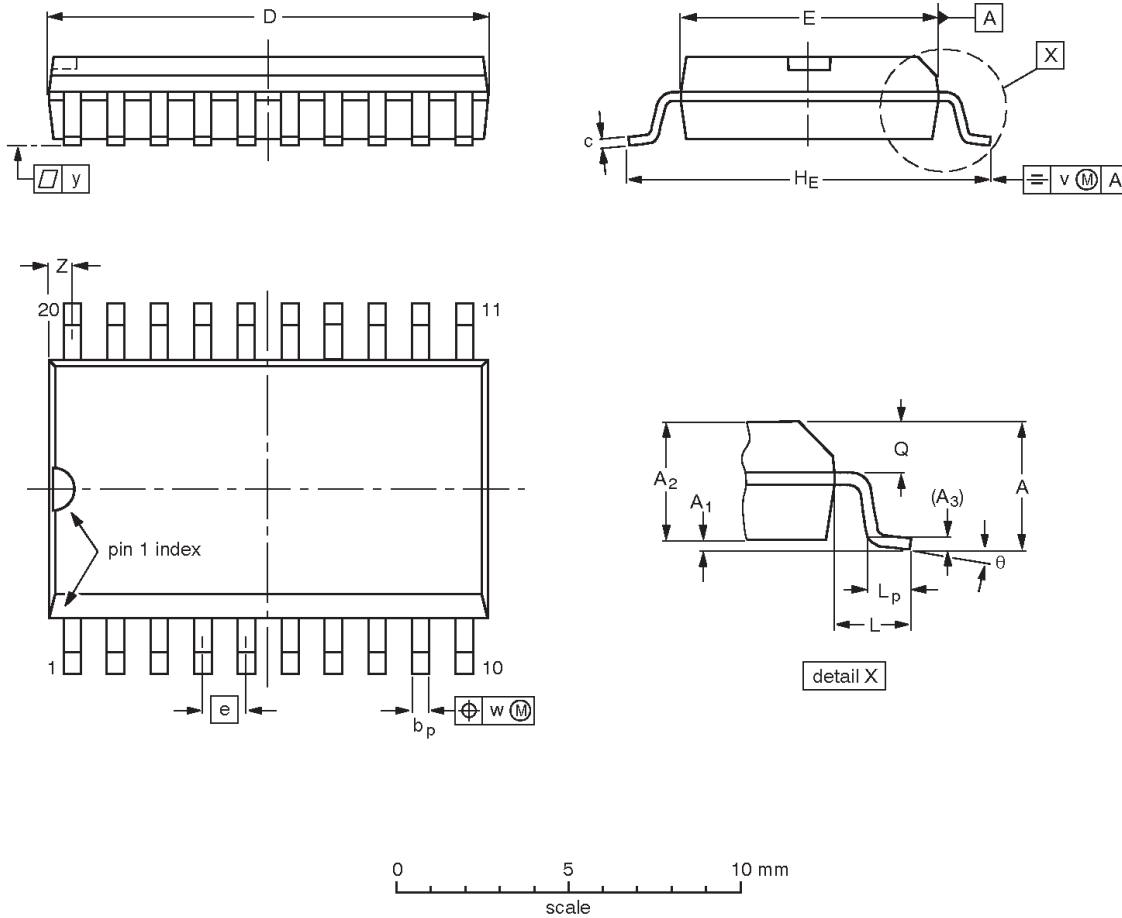
Waveform 4. Load circuitry for switching times.

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

74LVC374A

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	HE	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	0.419 0.394	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.

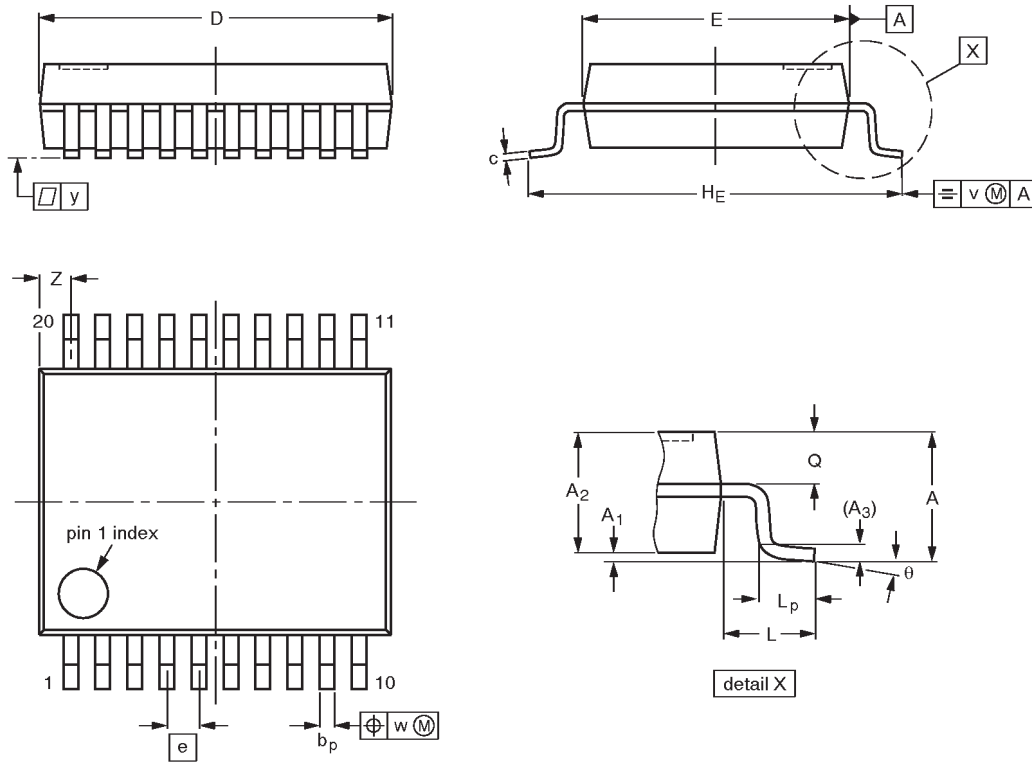
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013AC				95-01-24 97-05-22

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

74LVC374A

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	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	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.

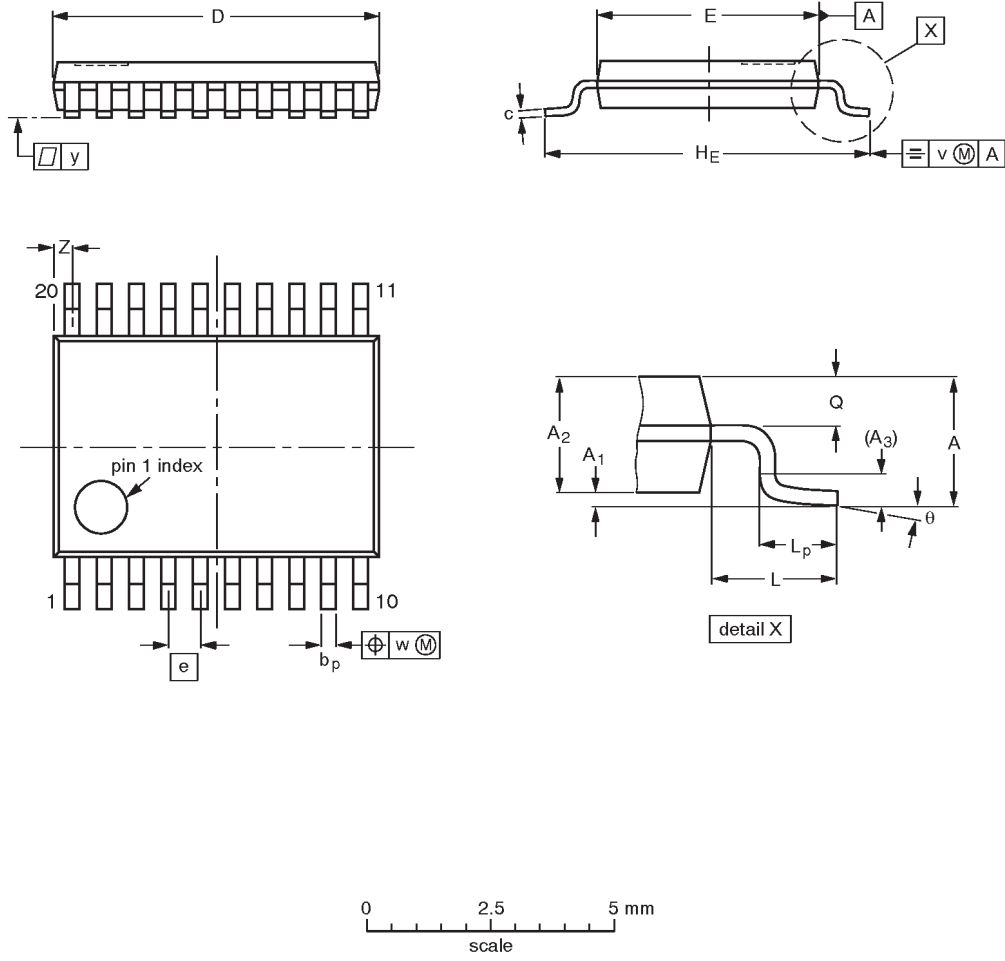
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				93-09-08 95-02-04

Octal D-type flip-flop with 5-volt tolerant inputs/outputs; positive edge-trigger (3-State)

74LVC374A

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



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	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	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	EIAJ			
SOT360-1		MO-153AC				-93-06-16 95-02-04

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74LVC374A

NOTES

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74LVC374A

Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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