

DATA SHEET

74LVCH374A

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

Product specification

1996 Aug 23

IC24 Data Handbook

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

**74LVC374A
74LVCH374A**

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
- Bushold on all data inputs (LVCH374A only)

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 74LVC(H)374A 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.

DESCRIPTION

The 74LVC(H)374A is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

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:

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

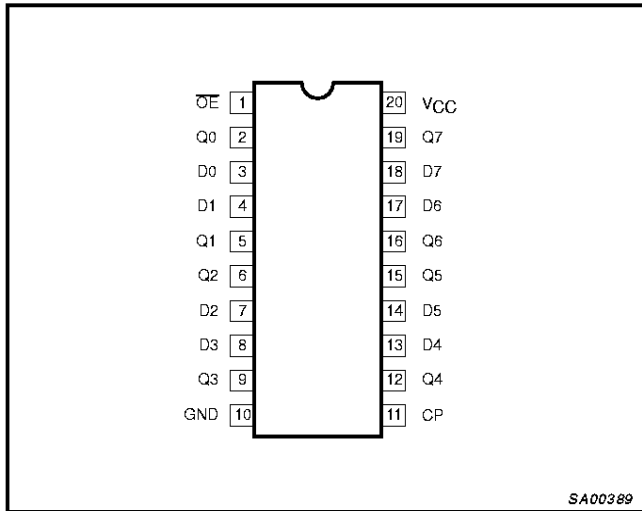
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic Shrink Small Outline (SO)	-40°C to +85°C	74LVC374AD	74LVC374AD	SOT163-1
20-Pin Plastic Shrink Small Outline (SSOP) Type II	-40°C to +85°C	74LVC374ADB	74LVC374ADB	SOT339-1
20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I	-40°C to +85°C	74LVC374APW	7LVC374APW DH	SOT360-1
20-Pin Plastic Shrink Small Outline (SO)	-40°C to +85°C	74LVCH374AD	74LVCH374A D	SOT163-1
20-Pin Plastic Shrink Small Outline (SSOP) Type II	-40°C to +85°C	74LVCH374ADB	74LVCH374A DB	SOT339-1
20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I	-40°C to +85°C	74LVCH374APW	LVCH374APW DH	SOT360-1

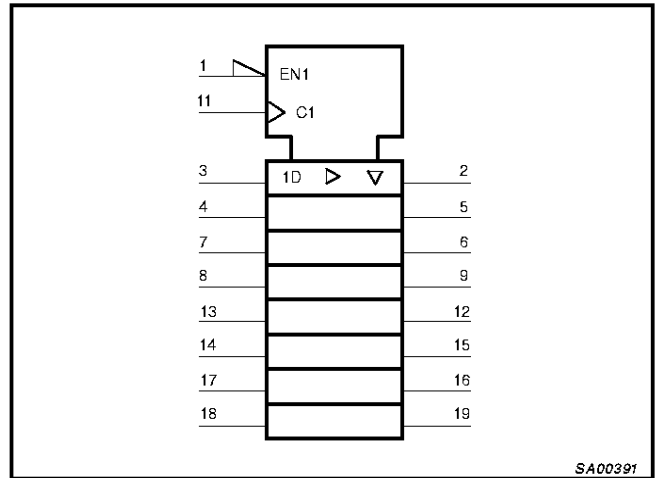
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PIN CONFIGURATION



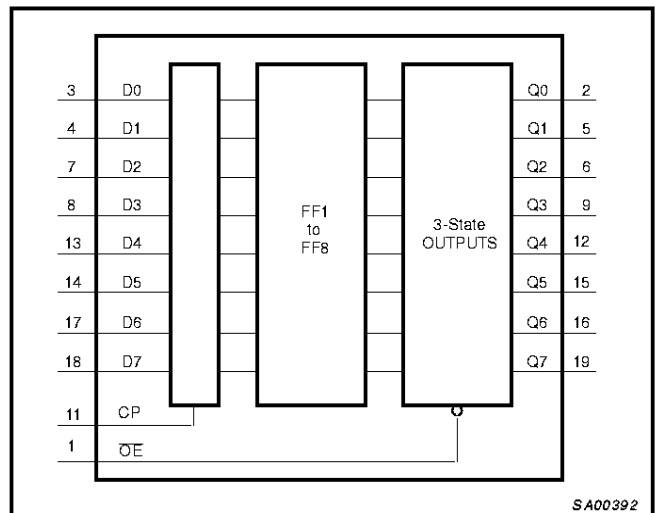
LOGIC SYMBOL (IEEE/IEC)



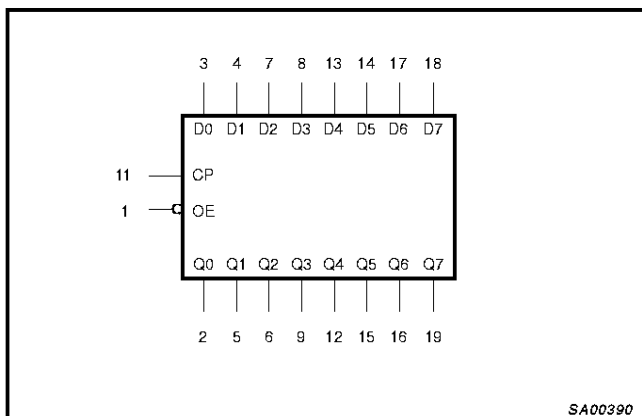
PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1	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	VCC	Positive supply voltage

FUNCTIONAL DIAGRAM



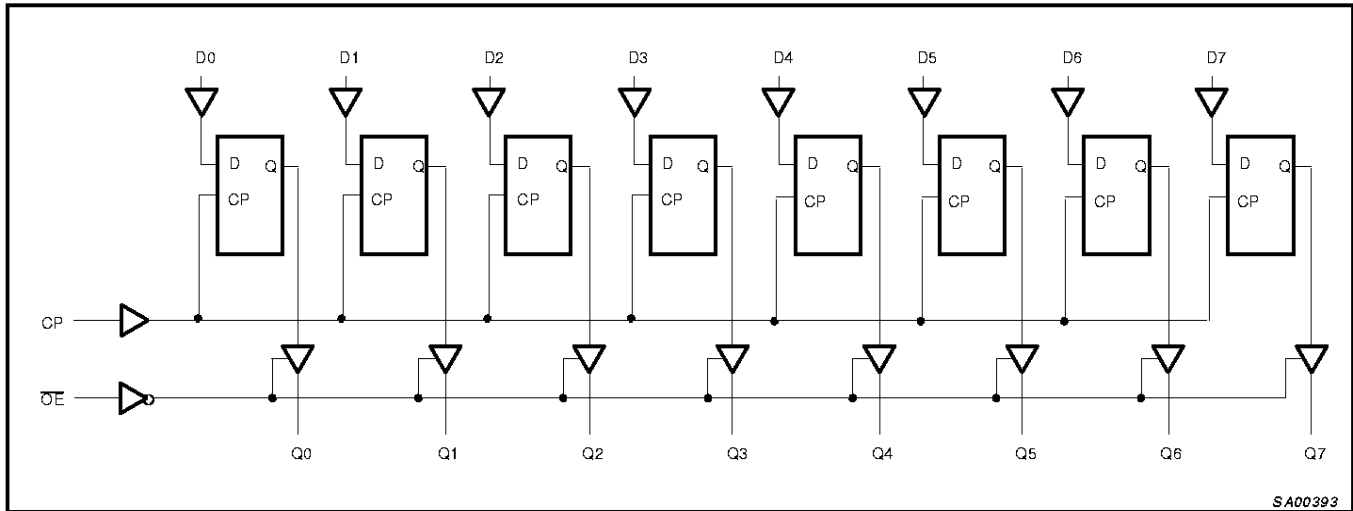
LOGIC SYMBOL



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LOGIC DIAGRAM



SA00393

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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RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT
			MIN	MAX	
V_{CC}	DC supply voltage (for max. speed performance)		2.7	3.6	V
V_{CC}	DC supply voltage (for low-voltage applications)		1.2	3.6	V
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
V_O	DC output voltage range; output 3-State		0	5.5	V
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 $2.7V$ $V_{CC} = 2.7$ to $3.6V$	0 0	20 10	ns/V

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_{OUT}	DC output voltage; output HIGH or LOW state	Note 2	-0.5 to $V_{CC} + 0.5$	V
V_{OUT}	DC output voltage; output 3-State	Note 2	-0.5 to 6.5	V
I_{OUT}	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		-60 to +150	°C
P_{TOT}	Power dissipation per package -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	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.

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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 _{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 ⁶	V _{CC} = 3.6V; V _I = 5.5V or GND Not for I/O pins		±0.1	±5	µA
I _{IHZ} /I _{ILZ}	Input current for common I/O pins ⁶	V _{CC} = 3.6V; V _I = 5.5V or GND		±0.1	±15	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	20	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
I _{BHL}	Bushold LOW sustaining current ^{2, 3, 4}	V _{CC} = 3.0V; V _I = 0.8V	75	-	-	µA
I _{BHH}	Bushold HIGH sustaining current ^{2, 3, 4}	V _{CC} = 3.0V; V _I = 2.0V	-75	-	-	µA
I _{BHLO}	Bushold LOW overdrive current ^{2, 3, 5}	V _{CC} = 3.6V	500	-	-	µA
I _{BHHO}	Bushold HIGH overdrive current ^{2, 3, 5}	V _{CC} = 3.6V	-500	-	-	µA

NOTES:

- All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.
- Valid for data inputs of bushold parts (LVCH-A) only.
- For data inputs only, control inputs do not have a bushold circuit.
- The specified sustaining current at the data inputs do not have a bushold circuit.
- The specified overdrive current at the data input forces the data input to the opposite logic input state.
- For bushold parts, the bushold circuit is switched off when V_I exceeds V_{CC} allowing 5.5V on the input terminal.

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AC CHARACTERISTICS

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

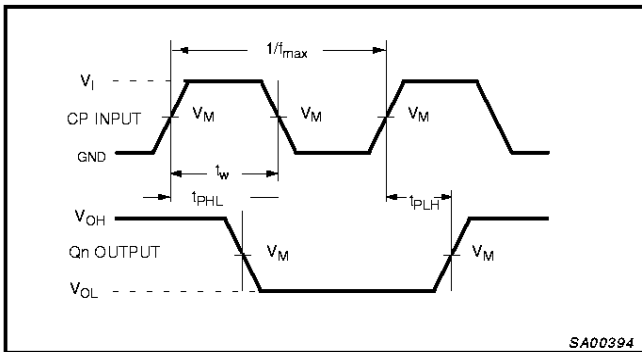
SYMBOL	PARAMETER	WAVEFORM	LIMITS						UNIT
			$V_{CC} = 3.3V \pm 0.3V$			$V_{CC} = 2.7V$		$V_{CC} = 1.2V$	
			MIN	TYP ¹	MAX	MIN	MAX	TYP	
t_{PHL} t_{PLH}	Propagation delay CP to Q_n	1, 4	1.5	4.8	7.0	1.5	8.0	21	ns
t_{PZH} t_{PZL}	3-State output enable time \overline{OE} to Q_n	3, 4	1.5	4.8	7.5	1.5	8.5	22	ns
t_{PHZ} t_{PLZ}	3-State output disable time \overline{OE} to Q_n	3, 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	2	2.0	0	—	2.0	—	—	ns
t_h	Hold time D_n to CP	2	1.5	0.6	—	1.5	—	—	ns
f_{max}	maximum clock pulse frequency	1	100	—	—	80	—	—	MHz

NOTE:

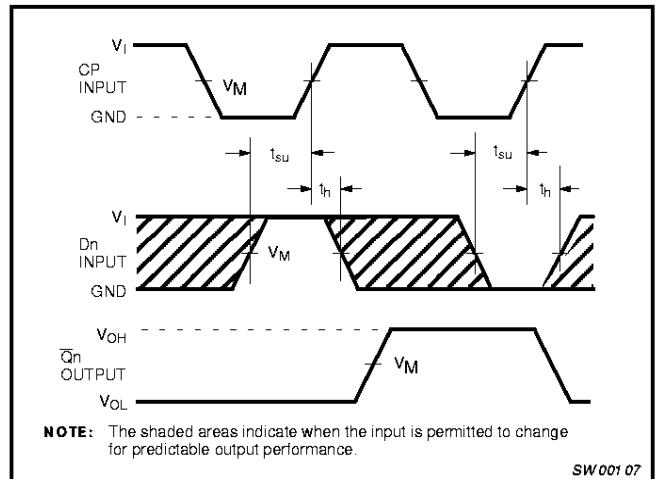
1. Unless otherwise stated, all typical values are at $V_{CC} = 3.3V$ and $T_{\text{amb}} = 25^\circ\text{C}$.

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

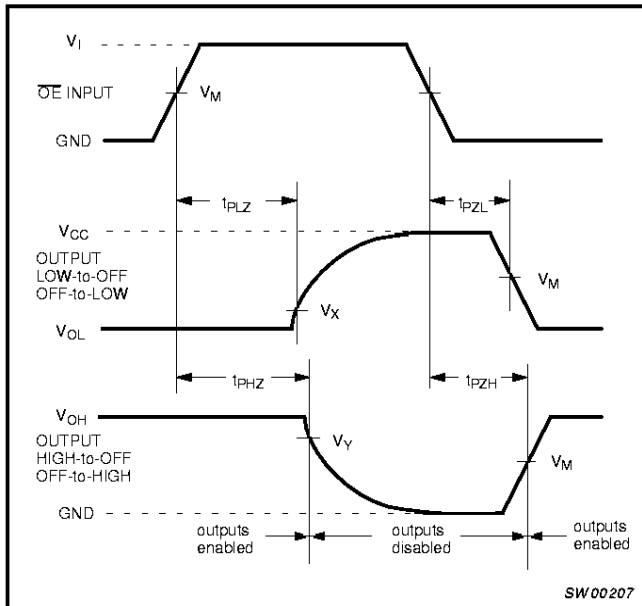


Waveform 2. Waveforms showing the data setup and hold times for the D_n input to the CP input.

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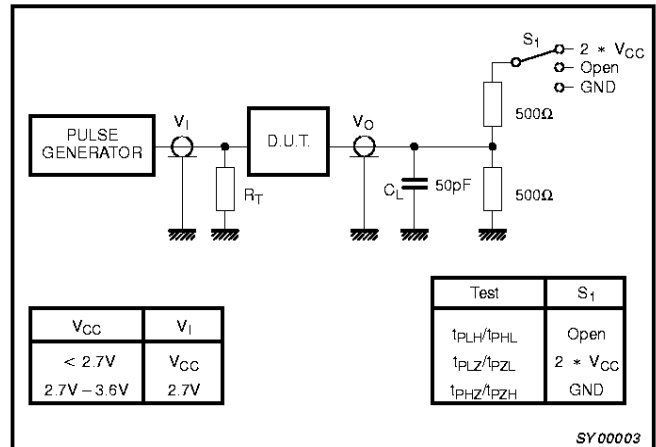
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AC WAVEFORMS (Continued)



Waveform 3. Waveforms showing the 3-State enable and disable times.

TEST CIRCUIT



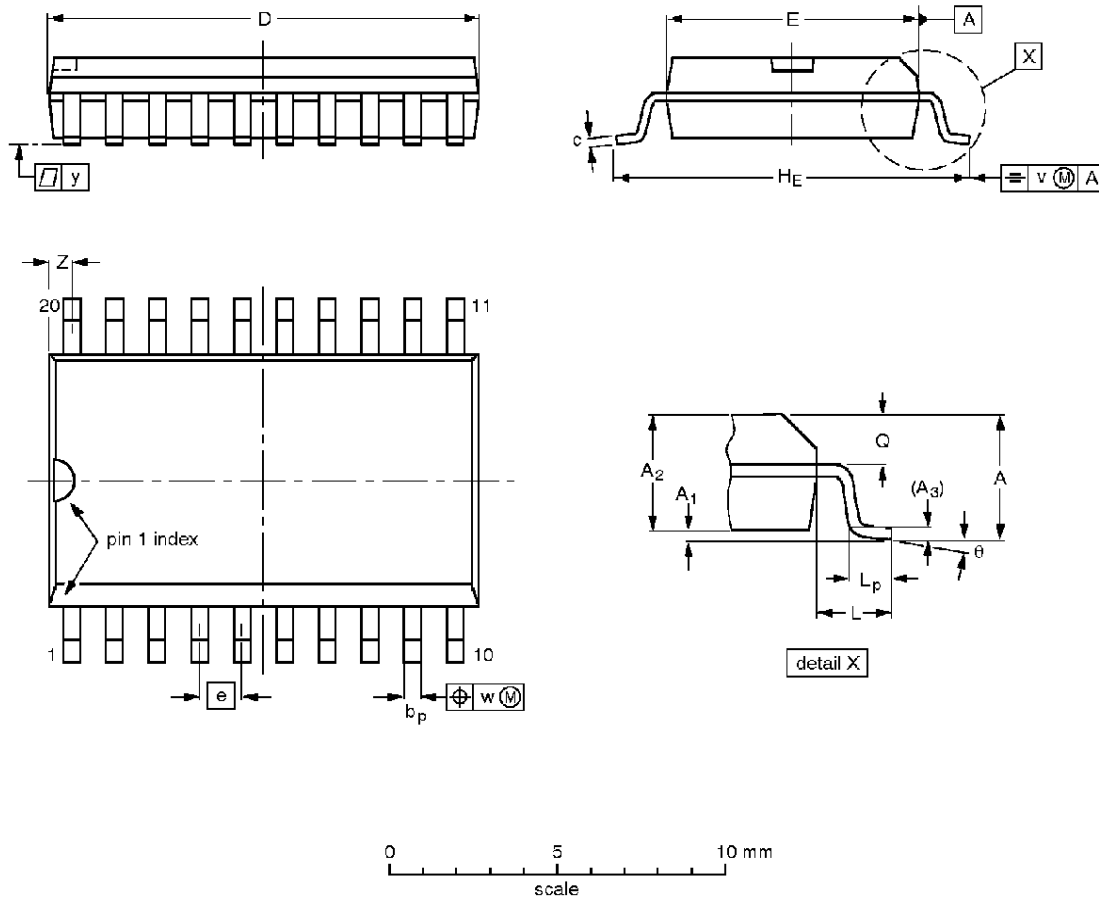
Waveform 4. Load circuitry for switching times.

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

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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	10.85 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.

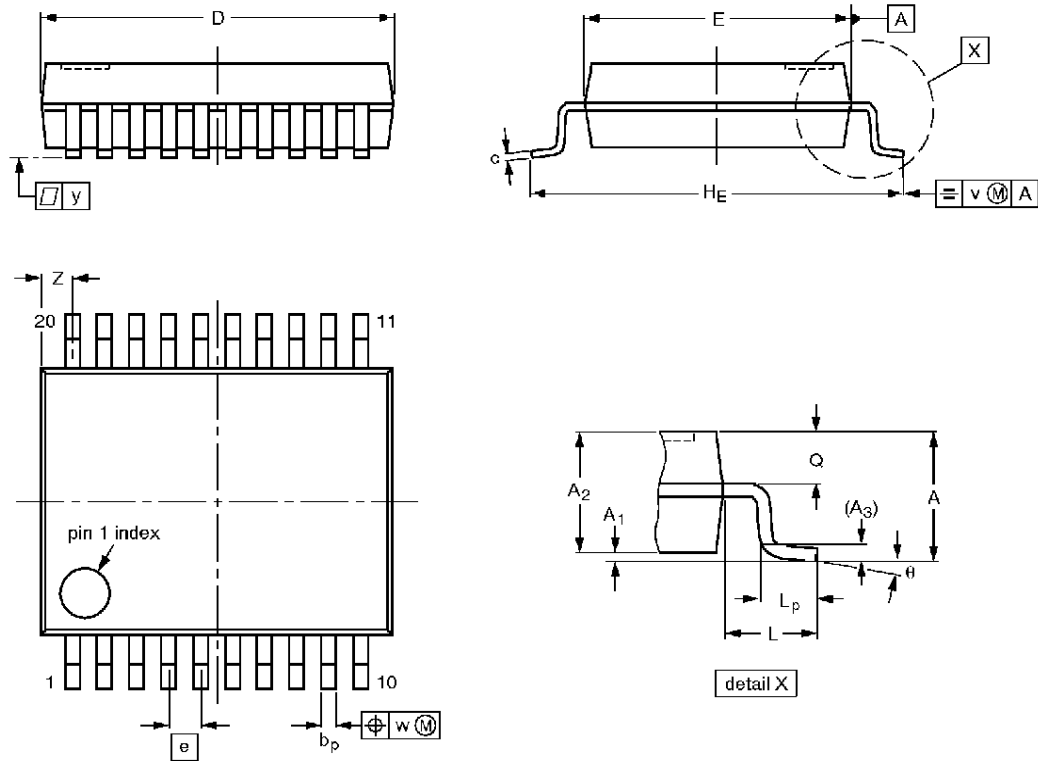
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIA/J			
SOT163-1	075E04	MS-013AC				92-11-17 95-01-24

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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.

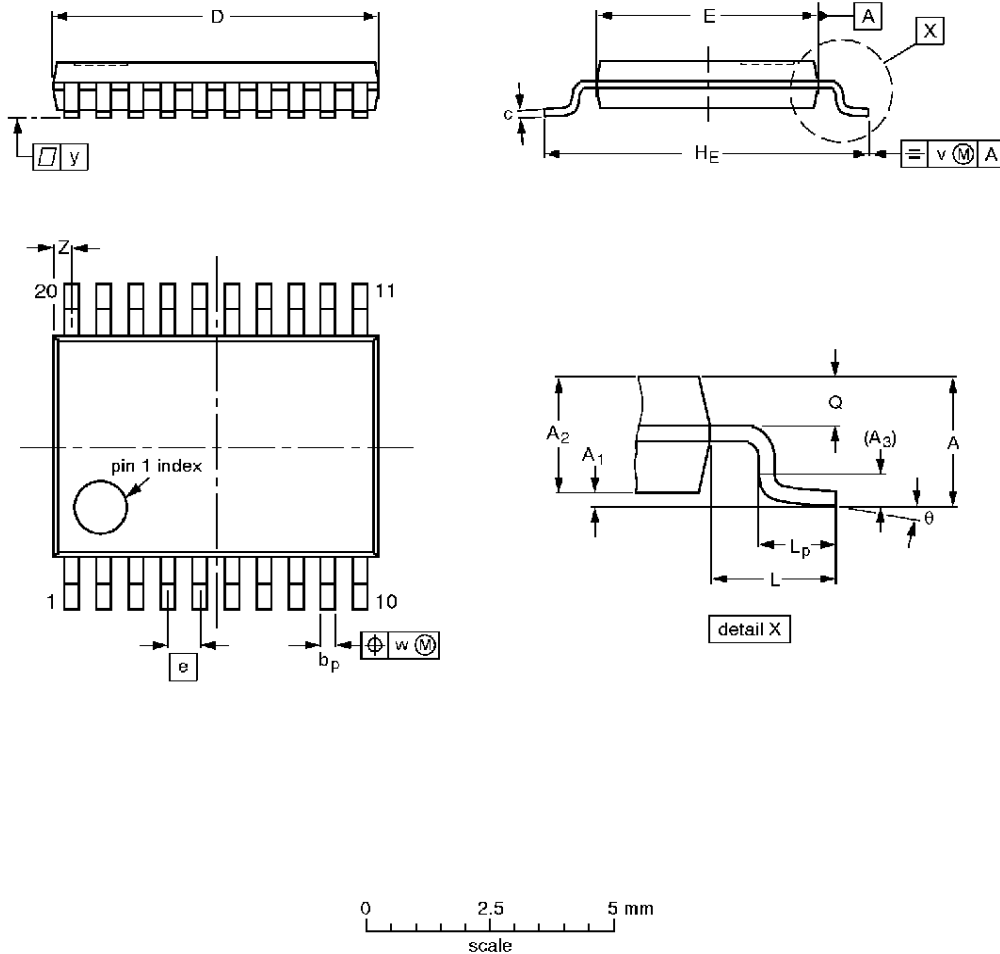
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT339-1		MO-150AE				93-09-08 95-02-04

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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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NOTES

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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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