DATA SHEET

74LVCH574A

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

Product specification

1996 Aug 23

IC24 Data Handbook

Philips
Semiconductors

PHILIPS

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

74LVC574A
74LVCH574A

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
- Inputs accept voltages upto 5.5V
- 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
- Flow-through pin-out architecture
- Bushold on all data inputs (LVCH574A only)

DESCRIPTION

The 74LVC(H)574A 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 74LVC(H)574A 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 '574' is functionally identical to the '374', but the '374' has a different pin arrangement.

QUICK REFERENCE DATA

GND = 0V; T_{amb} =25°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):
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ 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;
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = 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	74LVC574AD	74LVC574AD	SOT163-1
20-Pin Plastic Shrink Small Outline (SSOP) Type II	–40°C to +85°C	74LVC574ADB	74LVC574ADB	SOT339-1
20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I	–40°C to +85°C	74LVC574APW	7LVC574APW DH	SOT360-1
20-Pin Plastic Shrink Small Outline (SO)	–40°C to +85°C	74LVCH574AD	74LVCH574A D	SOT163-1
20-Pin Plastic Shrink Small Outline (SSOP) Type II	–40°C to +85°C	74LVCH574ADB	74LVCH574A DB	SOT339-1
20-Pin Plastic Thin Shrink Small Outline (TSSOP) Type I	–40°C to +85°C	74LVCH574APW	LVCH574APW DH	SOT360-1

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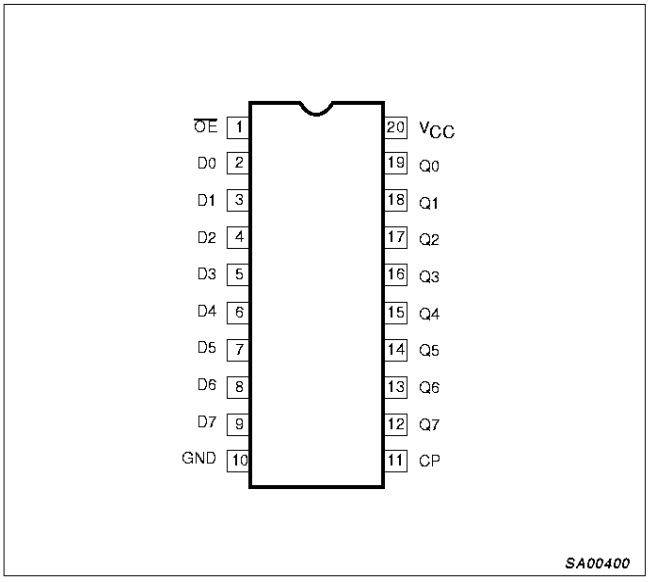
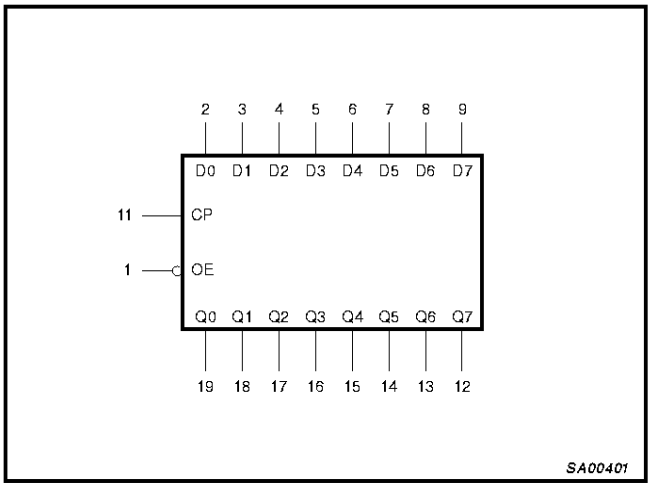
PIN DESCRIPTION

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

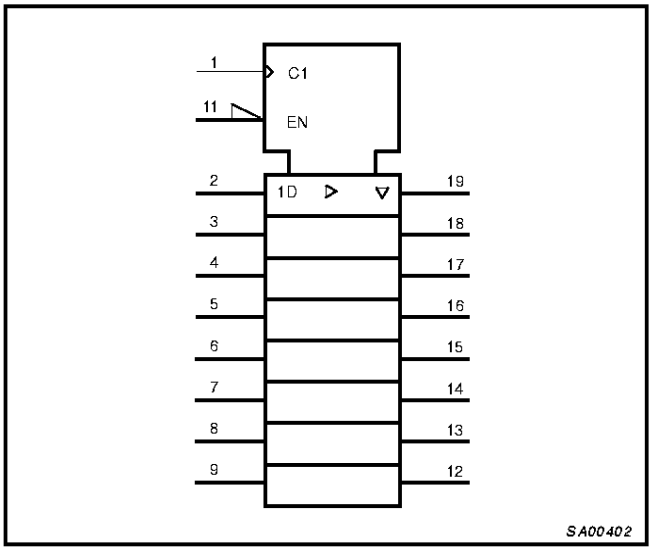
PIN CONFIGURATION



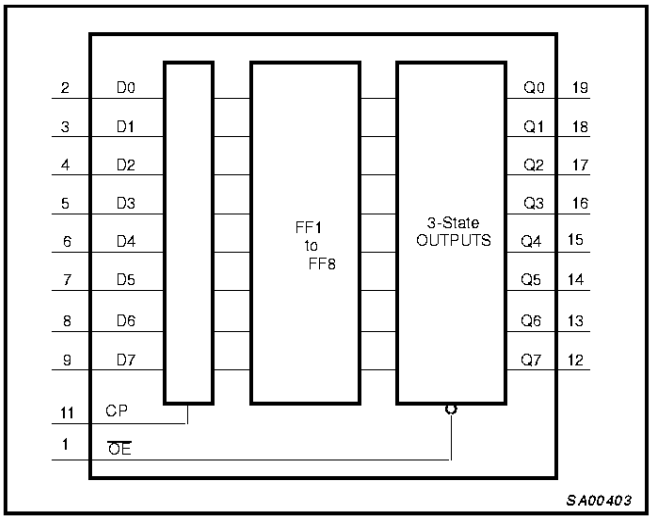
LOGIC SYMBOL



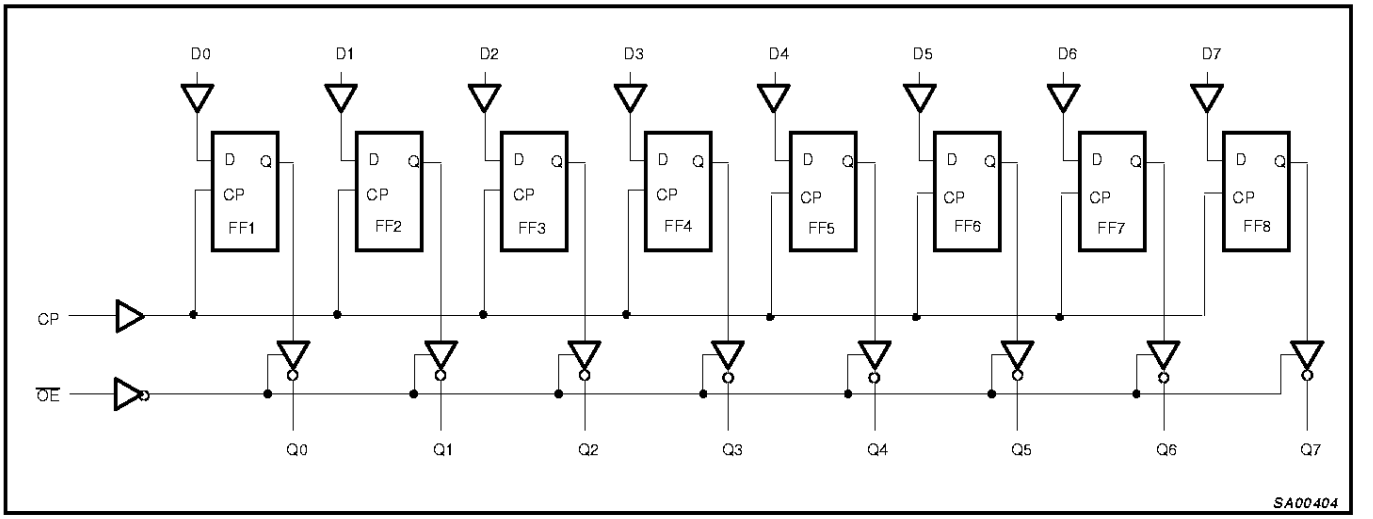
LOGIC SYMBOL (IEEE/IEC)



FUNCTIONAL DIAGRAM



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

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 RATINGS[1]

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:

1. 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.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

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:

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

AC CHARACTERISTICS

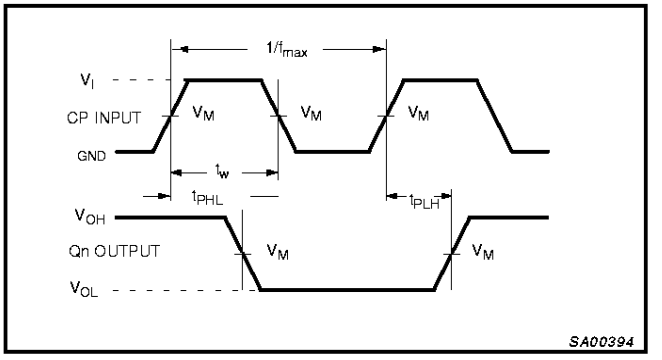
GND = 0V; $t_r = t_f \leq 2.5$ns; $C_L = 50$pF; $R_L = 500\Omega$; $T_{amb} = -40°C$ to $+85°C$.

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 $\overline{OE}$ to Q_n	3, 4	1.5	4.0	7.5	1.5	8.5	17	ns
t_{PHZ} t_{PLZ}	3-State output disable time $\overline{OE}$ to Q_n	3, 4	1.5	3.5	6.0	1.5	6.5	11	ns
t_W	Clock pulse width HIGH or LOW	1	3.4	1.7	–	3.4	–	–	ns
t_{SU}	Setup time D_n to CP	2	2.0	0.3	–	2.0	–	–	ns
t_h	Hold time D_n to CP	2	1.5	–0.2	–	1.5	–	–	ns
f_{max}	maximum clock pulse frequency	1	100		–	80	–	–	MHz

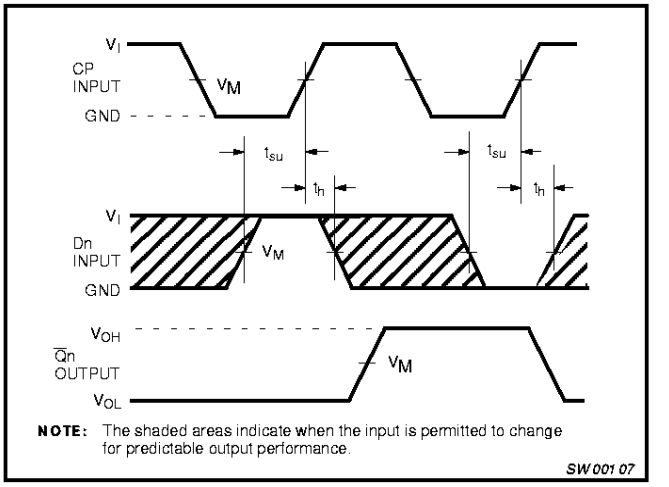
NOTE:
1. Unless otherwise stated, all typical values are at $V_{CC} = 3.3$V and $T_{amb} = 25°C$.

AC WAVEFORMS

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

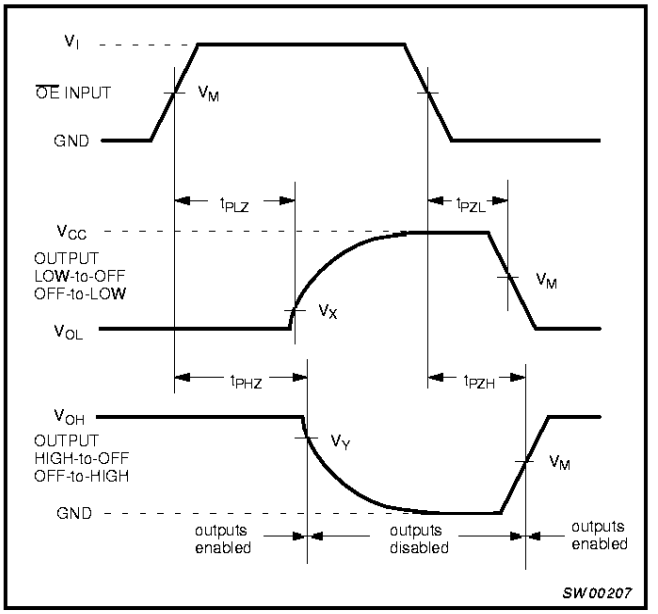


Waveform 1. Waveforms showing the clocp (CP) to output (Q_n) propagation delays, the clock pulse width, output transition times and the maximum clock pulse frequency.



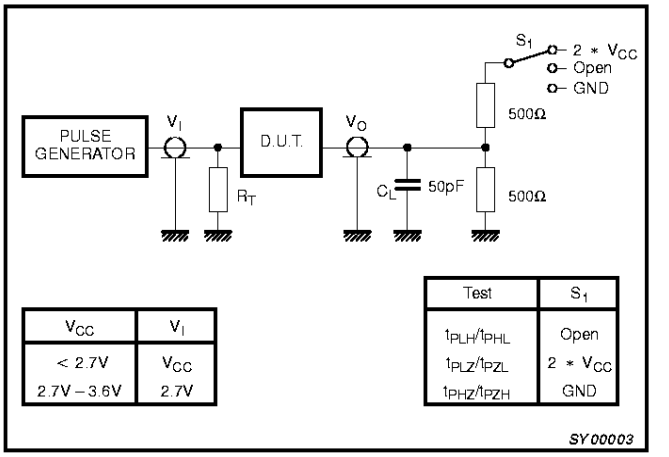
Waveform 2. Waveforms showing the data setup and hold times for the D_n input to the CP input.

AC WAVEFORMS *(Continued)*



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

TEST CIRCUIT

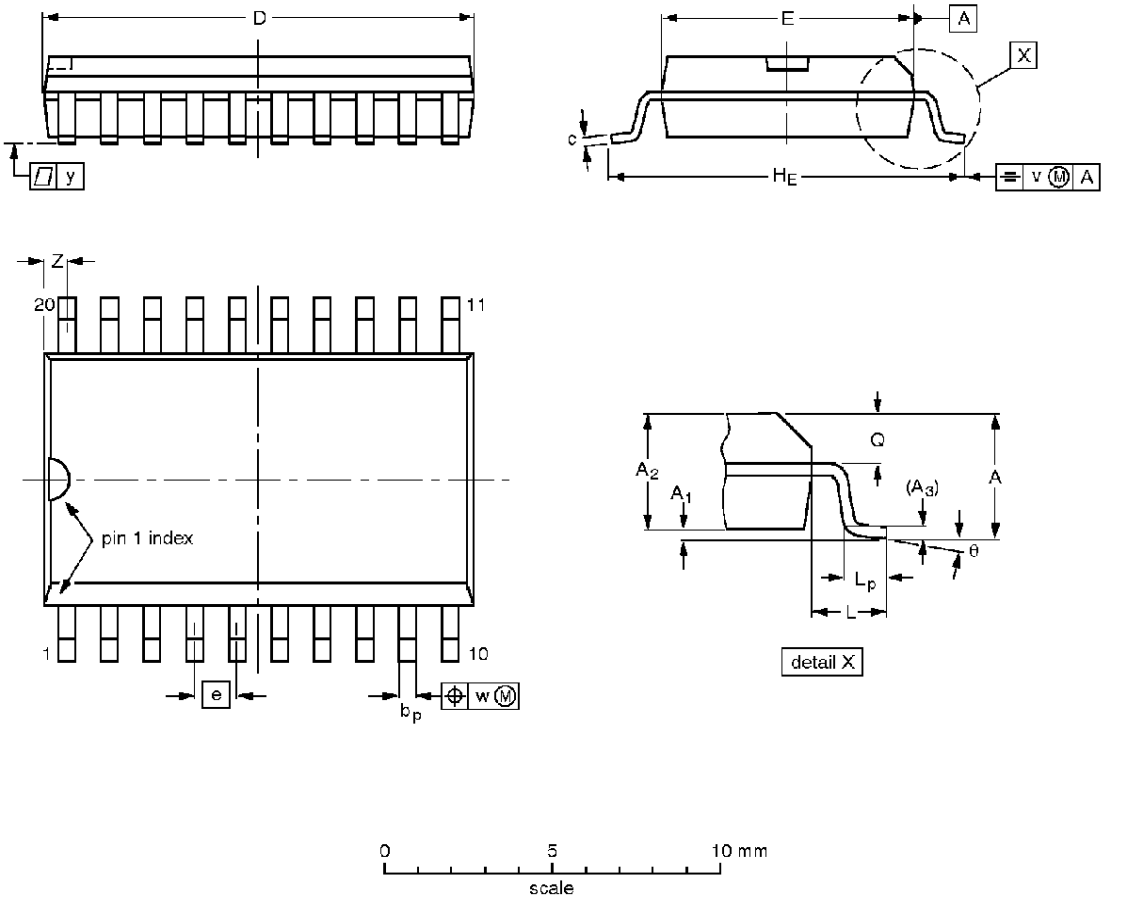


V_{CC}	V_I
< 2.7V	V_{CC}
2.7V – 3.6V	2.7V

Test	S_1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	2 * V_{CC}
t_{PHZ}/t_{PZH}	GND

Waveform 4. Load circuitry for switching times.

SO20: plastic small outline package; 20 leads; body width 7.5 mm **SOT163-1**



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

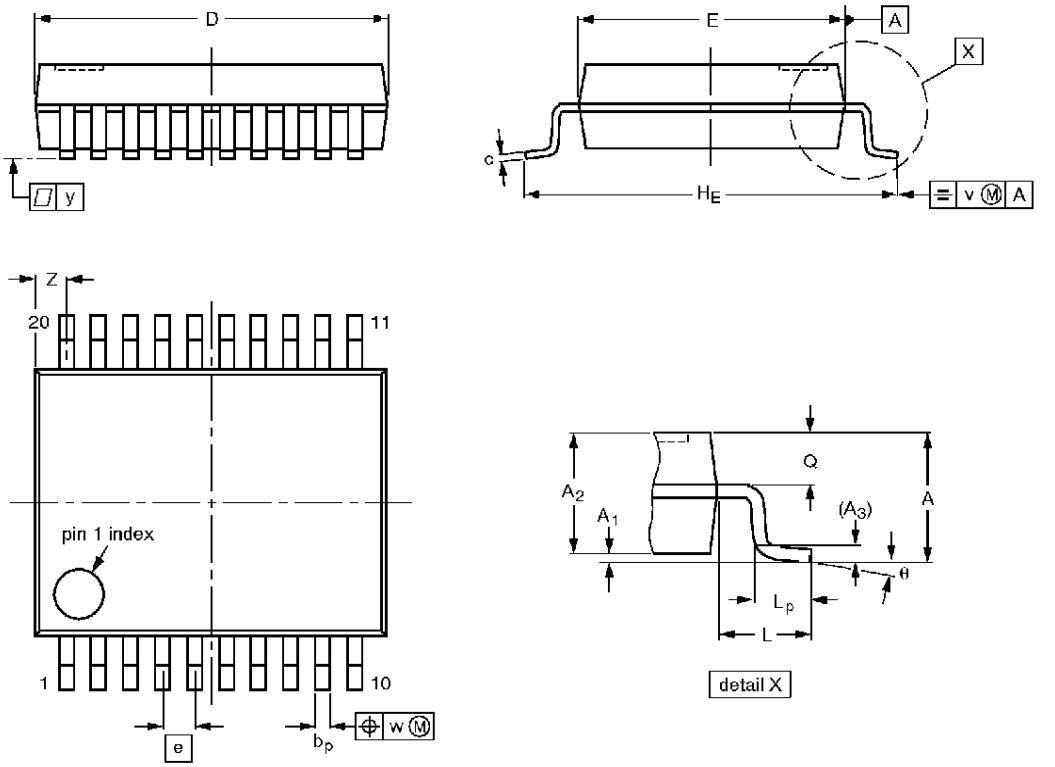
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	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	

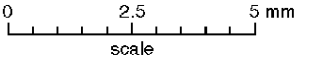
Note

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

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm **SOT339-1**





DIMENSIONS (mm are the original dimensions)

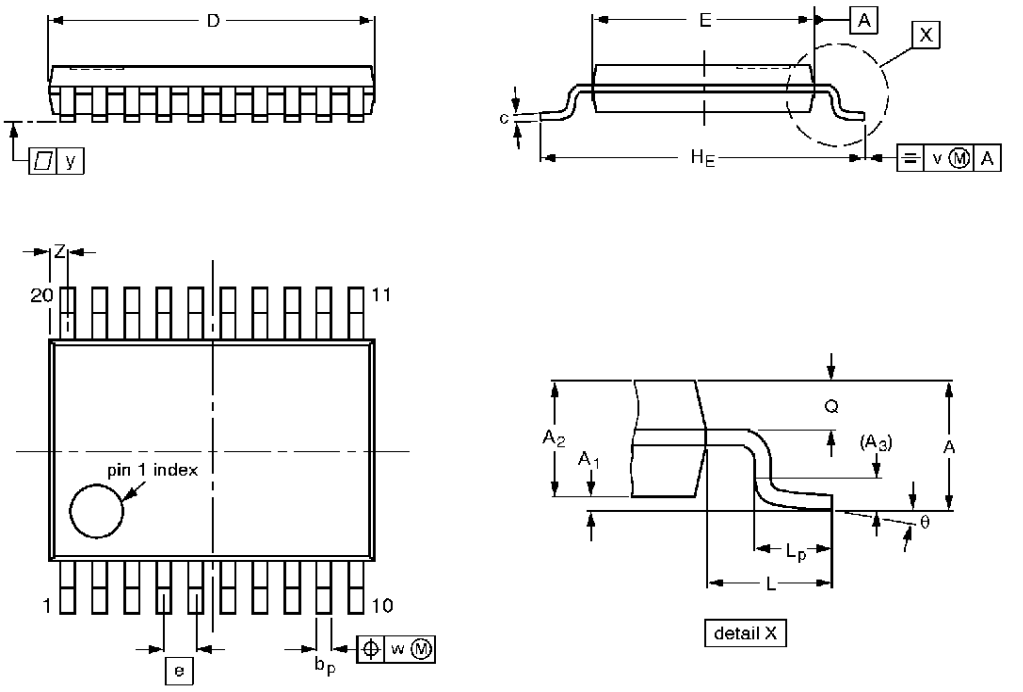
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

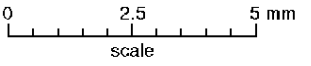
Note

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

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

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

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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.
Product Specification	Full Production	This data sheet contains Final Specifications. 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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