DATA SHEET

74LVC240

Octal buffer/line driver; 3–State; inverting

Product specification
Supersedes data of February 1996
IC24 Data Handbook

1997 Mar 18

Philips
Semiconductors

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Octal buffer/line driver; 3-State; inverting 74LVC240

FEATURES

- Wide supply voltage range of 1.2 to 3.6 V
- In accordance with JEDEC standard no. 8-1A
- Inputs accept voltages up to 5.5 V
- CMOS lower power consumption
- Direct interface with TTL levels
- Output drive capability 50Ω transmission lines at 85°C
- Non-inverting data path

DESCRIPTION

The 74LVC240 is a high-performance, low-power, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in a mixed 3.3 V/5 V environment.

The 74LVC240 is an octal inverting buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable inputs $1\overline{OE}$ and $2\overline{OE}$. A HIGH on $n\overline{OE}$ causes the outputs to assume a high impedance OFF-state. Schmitt-trigger action at all inputs makes the circuit highly tolerant for slower input rise and fall times. The 74LVC240 is identical to the 74LVC244 but has inverting outputs.

QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	Propagation delay $1A_n$ to $1Y_n$; $2A_n$ to $2Y_n$	C_L = 50 pF; V_{CC} = 3.3 V	4.6	ns
C_I	Input capacitance		5.0	pF
C_{PD}	Power dissipation capacitance per buffer	V_{CC} = 3.3 V V_I = GND to V_{CC}[1]	30	pF

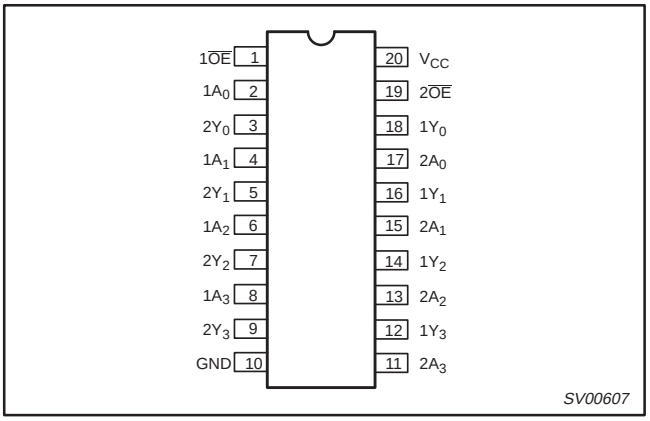
NOTE:

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 the outputs.

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic SO	–40°C to +85°C	74LVC240 D	74LVC240 D	SOT163-1
20-Pin Plastic SSOP Type II	–40°C to +85°C	74LVC240 DB	74LVC240 DB	SOT339-1
20-Pin Plastic TSSOP Type I	–40°C to +85°C	74LVC240 PW	74LVC240PW DH	SOT360-1

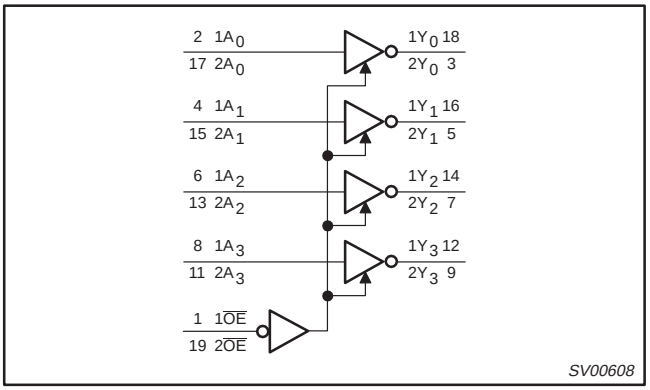
PIN CONFIGURATION



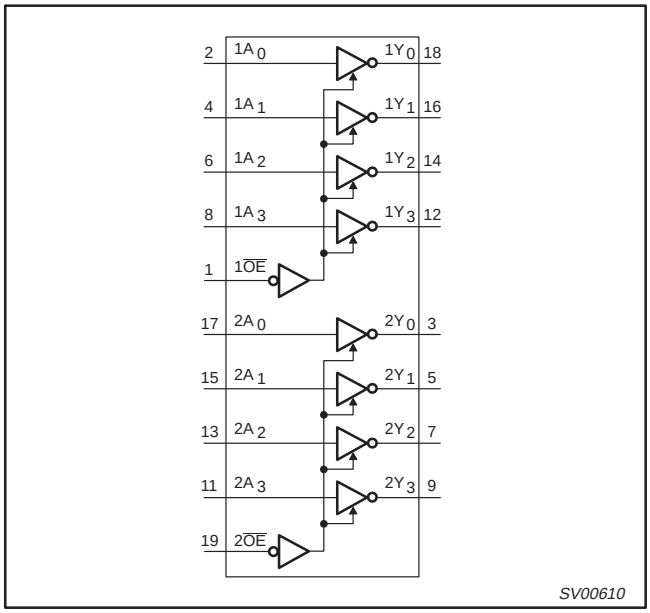
PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1	$1\overline{OE}$	Output enable input (active LOW)
2, 4, 6, 8	$1A_0$ to $1A_3$	Data inputs
3, 5, 7, 9	$2Y_0$ to $2Y_3$	Bus outputs
10	GND	Ground (0 V)
17, 15, 13, 11	$2A_0$ to $2A_3$	Data inputs
18, 16, 14, 12	$1Y_0$ to $1Y_3$	Bus outputs
19	$2\overline{OE}$	Output enable input (active LOW)
20	V_{CC}	Positive supply voltage

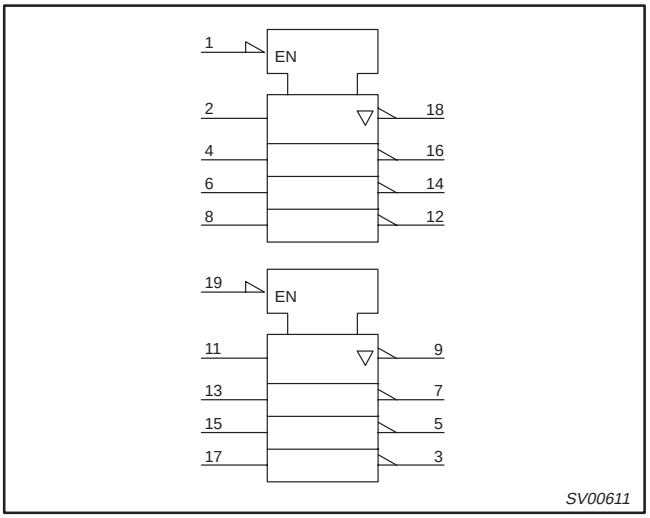
LOGIC SYMBOL



FUNCTIONAL DIAGRAM



LOGIC SYMBOL (IEEE/IEC)



FUNCTION TABLE

INPUTS		OUTPUT
$n\overline{OE}$	nA_n	nY_n
L	L	H
L	H	L
H	X	Z

NOTES:
H = HIGH voltage level
L = LOW voltage level
X = don't care
Z = high impedance OFF-state

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
$V_{I/O}$	DC input voltage range for I/Os		0	V_{CC}	V
V_O	DC output voltage range		0	V_{CC}	V
T_{amb}	Operating free-air temperature range		–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 +5.5	V
$V_{I/O}$	DC input voltage range for I/Os		–0.5 to V_{CC} +0.5	V
I_{OK}	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	±50	mA
V_{OUT}	DC output voltage	Note 2	–0.5 to V_{CC} +0.5	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 = –12mA	V_{CC} – 0.6			
		V_{CC} = 3.0V; $V_I = V_{IH}$ or V_{IL}; I_O = –24mA	V_{CC} – 1.0			
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	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	V_{CC} = 3.6V; $V_I = V_{CC}$ 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}; $V_O = V_{CC}$ or GND		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

NOTE:
1. All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.

AC CHARACTERISTICS

GND = 0 V; $t_r = t_f \leq 2.5$ 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	TYP	MAX	TYP	
t_{PHL}/t_{PLH}	Propagation delay $1A_n$ to $1Y_n$; $2A_n$ to $2Y_n$	Figure 1, 3	1.5	4.6	8.0	1.5	4.8	9.0	21	ns
t_{PZH}/t_{PZL}	3-State output enable time $1\overline{OE}$ to $1Y_n$; $2\overline{OE}$ to $2Y_n$	Figure 2, 3	1.5	6.0	8.5	1.5	6.3	9.5	42	ns
t_{PHZ}/t_{PLZ}	3-State output disable time $1\overline{OE}$ to $1Y_n$; $2\overline{OE}$ to $2Y_n$	Figures 2, 3	1.5	3.3	8.0	1.5	3.4	9.0	6.5	ns

NOTE:
1. These typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.

AC WAVEFORMS

V_M = 1.5 V at $V_{CC} \geq 2.7$ V
$V_M = 0.5 \times V_{CC}$ 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
$V_X = V_{OL} + 0.1\ V \times V_{CC}$ at $V_{CC} < 2.7$ V
$V_Y = V_{OH} - 0.3$ V at $V_{CC} \geq 2.7$ V
$V_Y = V_{OH} - 0.1 \times V_{CC}$ at $V_{CC} < 2.7$ V

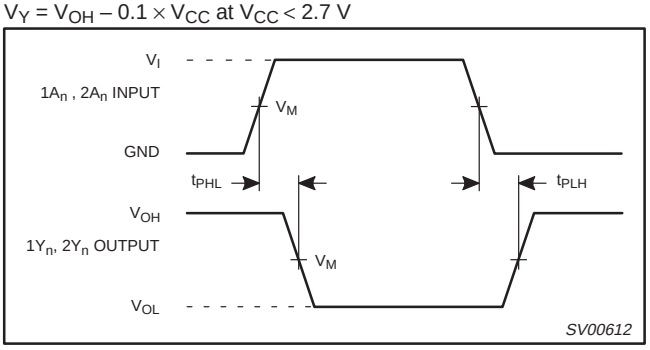


Figure 1. Input ($1A_n$, $2A_n$) to output ($1Y_n$, $2Y_n$) propagation delays.

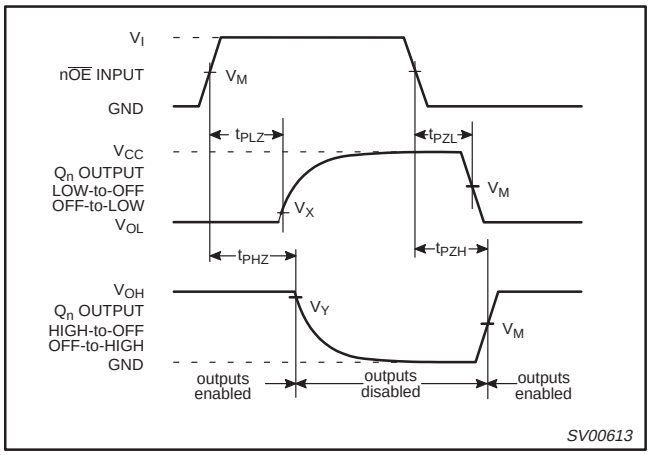
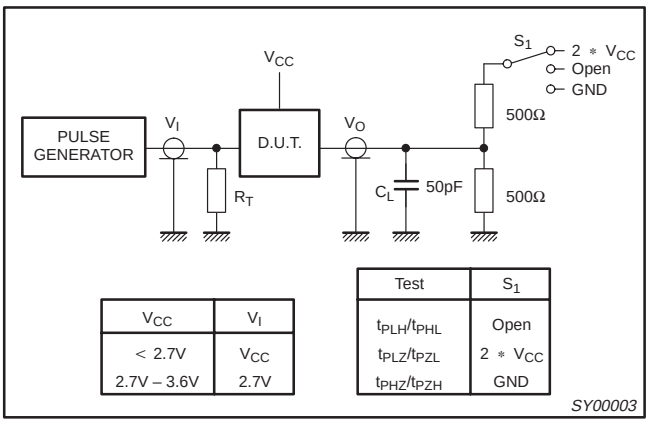


Figure 2. 3-State enable and disable times.

TEST CIRCUIT

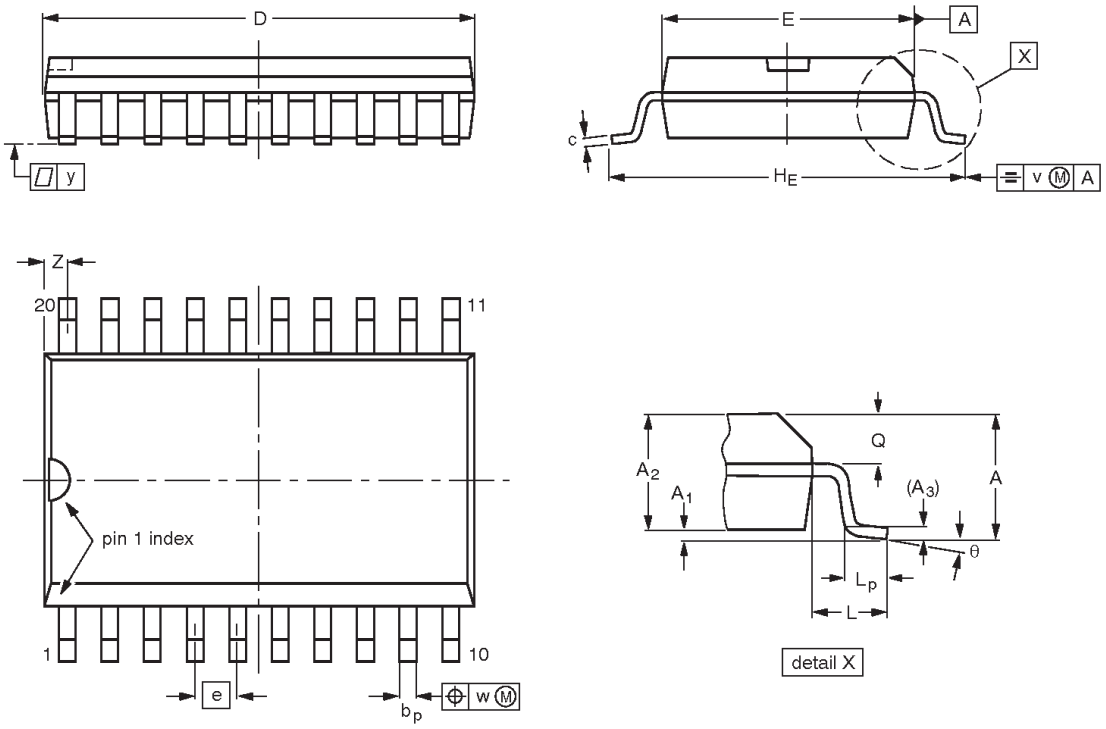


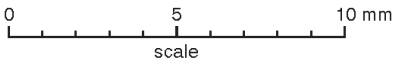
V_{CC}	V_I
< 2.7V	V_{CC}
2.7V – 3.6V	2.7V

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

Figure 3. 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)

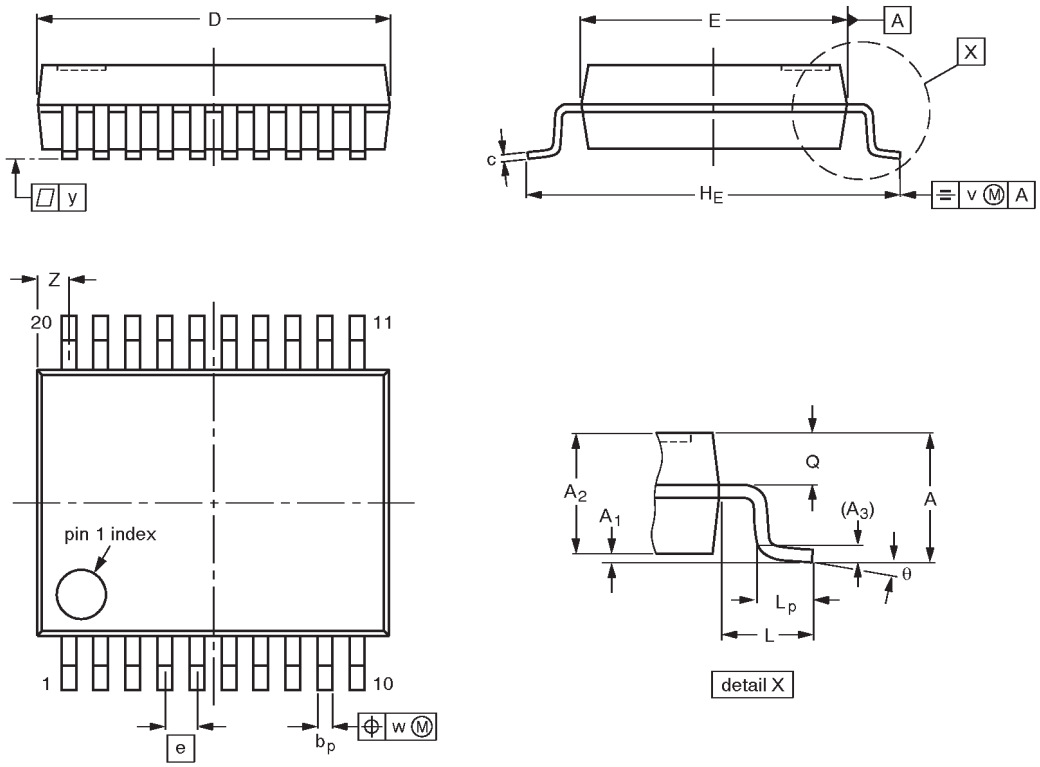
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 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)

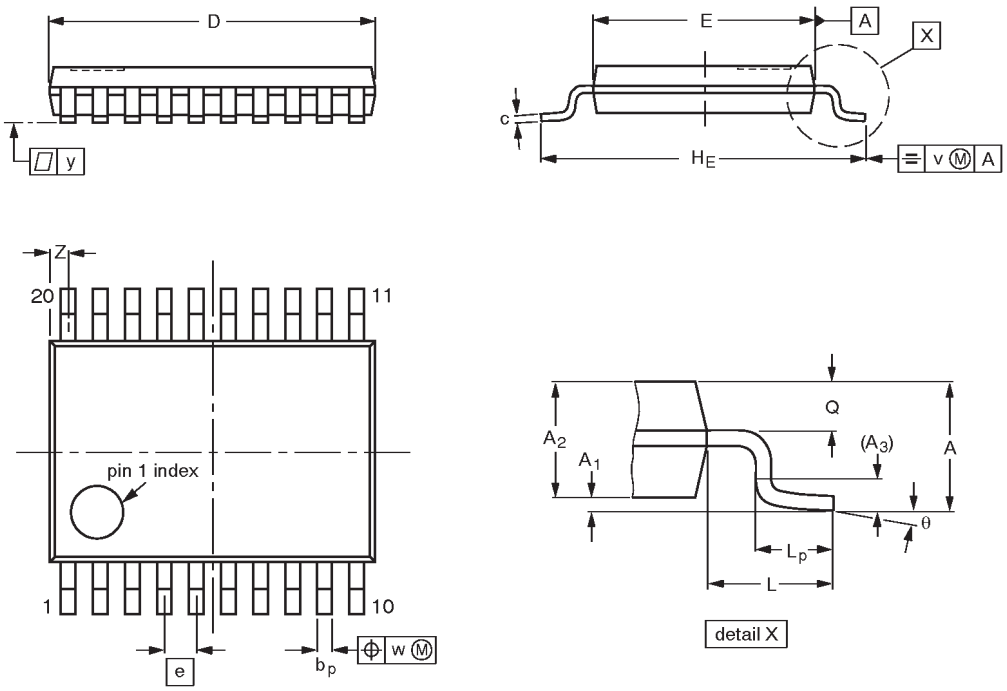
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

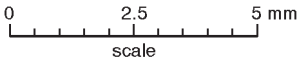
Note

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

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.

Philips Semiconductors
811 East Arques Avenue
P.O. Box 3409
Sunnyvale, California 94088–3409
Telephone 800-234-7381

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