DATA SHEET

74LV245
Octal bus transceiver (3-State)

Product specification
Supersedes data of 1997 Feb 19
IC24 Data Handbook

1998 Apr 20

Philips
Semiconductors

PHILIPS

Octal bus transceiver (3-State) 74LV245

FEATURES

- Wide operating voltage: 1.0 to 5.5 V
- Optimized for low voltage applications: 1.0 to 3.6 V
- Accepts TTL input levels between V_{CC} = 2.7 V and V_{CC} = 3.6 V
- Typical V_{OLP} (output ground bounce) < 0.8 V at V_{CC} = 3.3 V, T_{amb} = 25°C
- Typical V_{OHV} (output V_{OH} undershoot) > 2 V at V_{CC} = 3.3 V, T_{amb} = 25°C
- Output capability: bus driver
- I_{CC} category: MSI

DESCRIPTION

The 74LV245 is a low-voltage Si-gate CMOS device and is pin and function compatible with 74HC/HCT245.

The 74LV245 is an octal transceiver featuring non-inverting 3-State bus compatible outputs in both send and receive directions. The 74LV245 features an output enable ($\overline{OE}$) input for easy cascading and a send/receive (DIR) input for direction control. $\overline{OE}$ controls the outputs so that the buses are effectively isolated.

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 A_n to B_n; B_n to A_n	C_L = 15 pF; V_{CC} = 3.3 V	7.0	ns
C_I	Input capacitance		3.5	pF
$C_{I/O}$	Input/output capacitance		10	pF
C_{PD}	Power dissipation capacitance per buffer	V_{CC} = 3.3 V V_I = GND to V_{CC}, note 1	40	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 capacitance 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.

ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
20-Pin Plastic DIL	–40°C to +125°C	74LV245 N	74LV245 N	SOT146-1
20-Pin Plastic SO	–40°C to +125°C	74LV245 D	74LV245 D	SOT163-1
20-Pin Plastic SSOP Type II	–40°C to +125°C	74LV245 DB	74LV245 DB	SOT339-1
20-Pin Plastic TSSOP Type I	–40°C to +125°C	74LV245 PW	74LV245PW DH	SOT360-1

PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1	DIR	Direction
2, 3, 4, 5, 6, 7, 8, 9	A_0 to A_7	Data inputs/outputs
10	GND	Ground (0 V)
18, 17, 16, 15, 14, 13, 12, 11	B_0 to B_7	Data inputs/outputs
19	$\overline{OE}$	Output enable input (active LOW)
20	V_{CC}	Positive supply voltage

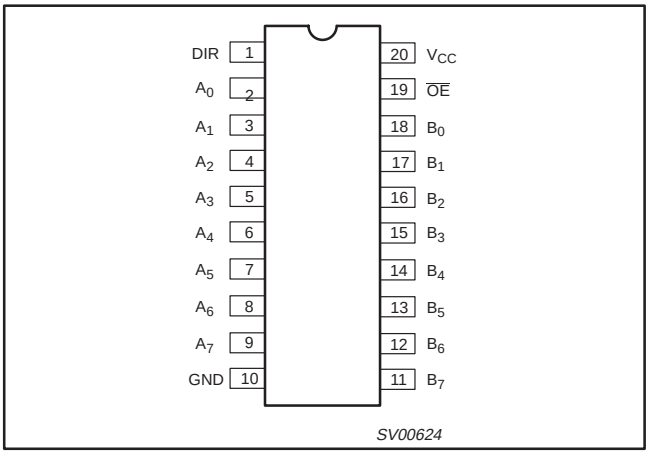
FUNCTION TABLE

INPUTS		INPUTS/OUTPUT	
$\overline{OE}$	DIR	A_n	B_n
L	L	A = B	Inputs
L	H	Inputs	B = A
H	X	Z	Z

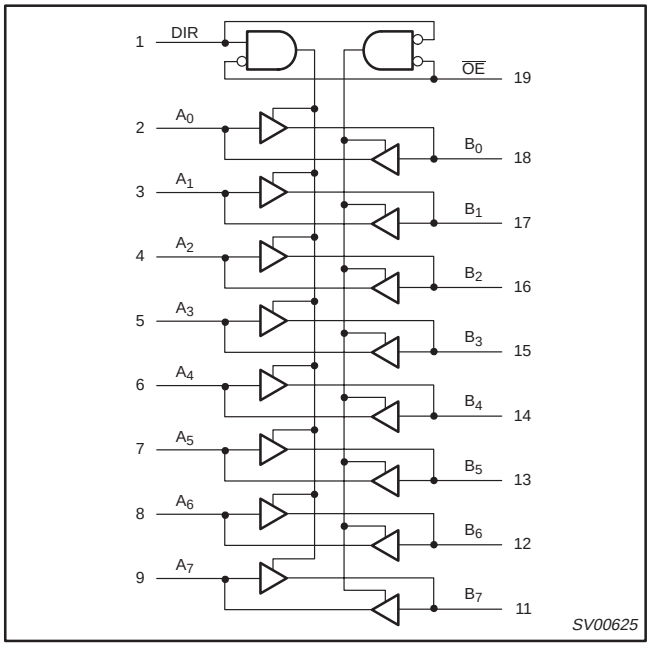
NOTES:

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

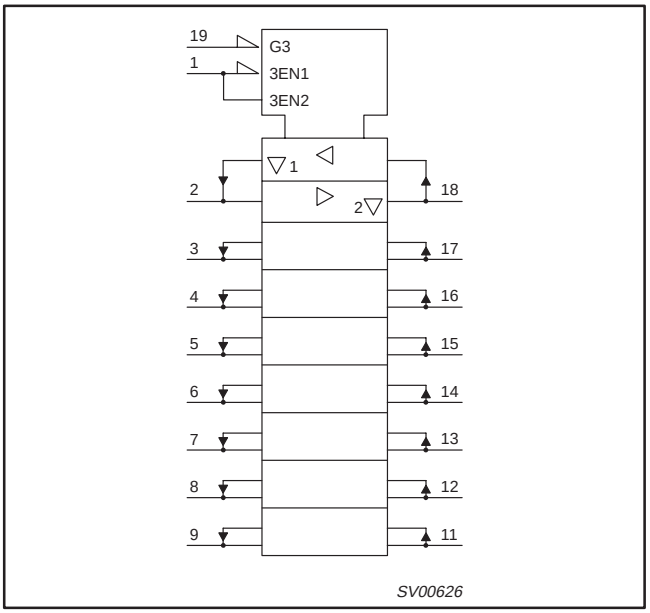
PIN CONFIGURATION



LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT
V_{CC}	DC supply voltage	See Note 1	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	–40 –40		+85 +125	°C
t_r, t_f	Input rise and fall times	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

NOTE:
1. 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.

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 – bus driver outputs	$-0.5V < V_O < V_{CC} + 0.5V$	35	mA
$\pm I_{GND}$, $\pm I_{CC}$	DC V_{CC} or GND current for types with – bus driver outputs		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 12 mW/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:
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
			-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; 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; 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; MSI	V_{CC} = 5.5V; V_I = V_{CC} or GND; I_O = 0			20.0		160	µA
ΔI_{CC}	Additional quiescent supply current	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.

AC CHARACTERISTICS

GND = 0V; $t_r = t_f \leq 2.5$ns; $C_L = 50$pF; $R_L = 1$KΩ

SYMBOL	PARAMETER	WAVEFORM	CONDITION	LIMITS					UNIT
				–40 to +85 °C			–40 to +125 °C		
			V_{CC}(V)	MIN	TYP[1]	MAX	MIN	MAX	
t_{PHL}/t_{PLH}	Propagation delay A_n to B_n; B_n to A_n	Figures 1	1.2		45	28			ns
			2.0		15	28		34	
			2.7		11	19		24	
			3.0 to 3.6		9[2]	16		20	
			4.5 to 5.5		8[3]	11		14	
t_{PZH}/t_{PZL}	3-State output enable time $\overline{OE}$ to A_n; $\overline{OE}$ to B_n	Figures 2	1.2		55				ns
			2.0		19	31		39	
			2.7		14	23		29	
			3.0 to 3.6		10[2]	18		23	
			4.5 to 5.5		8.5[3]	14		18	
t_{PHZ}/t_{PLZ}	3-State output disable time $\overline{OE}$ to A_n; $\overline{OE}$ to B_n	Figures 2	1.2		65				ns
			2.0		24	32		39	
			2.7		18	24		29	
			3.0 to 3.6		14[2]	20		24	
			4.5 to 5.5		11.5[3]	16		19	

NOTES:
1. Unless otherwise stated, all typical values are measured at $T_{amb} = 25°C$
2. Typical values are measured at $V_{CC} = 3.3$ V.
3. Typical values are measured at $V_{CC} = 5.0$ V.

AC WAVEFORMS

$V_M = 1.5$ V at $V_{CC} \geq 2.7$ V and ≤ 3.6 V
$V_M = 0.5\ V \times V_{CC}$ at $V_{CC} < 2.7$ V and ≥ 4.5 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 and ≤ 3.6 V
$V_X = V_{OL} + 0.1 \times V_{CC}$ at $V_{CC} < 2.7$ V and ≥ 4.5 V
$V_Y = V_{OH} - 0.3$ V at $V_{CC} \geq 2.7$V and ≤ 3.6 V
$V_Y = V_{OH} - 0.1 \times V_{CC}$ at $V_{CC} < 2.7$ V and ≥ 4.5 V

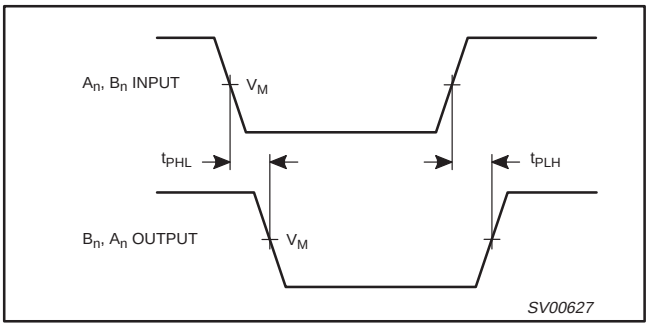


Figure 1. Input (A_n, B_n) to output (B_n, A_n) propagation delays and the output transition times.

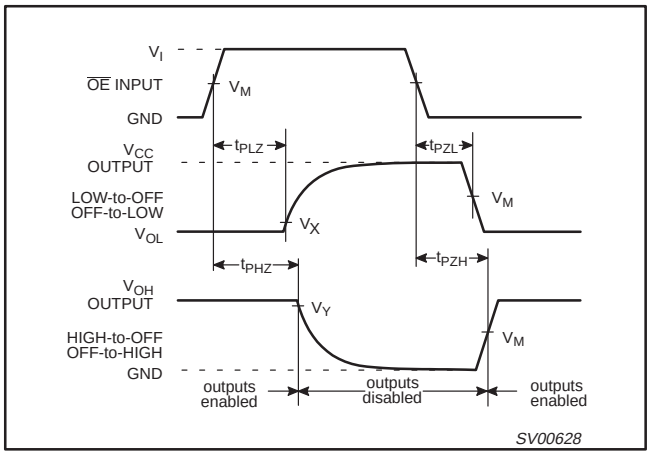
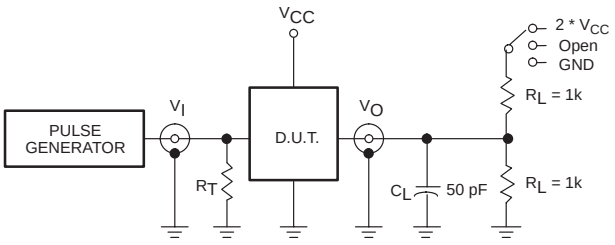


Figure 2. 3-State enable and disable times.

TEST CIRCUIT



Test Circuit for Outputs

DEFINITIONS

R_L = Load resistor

C_L = Load capacitance includes jig and probe capacitiance.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

SWITCH POSITION

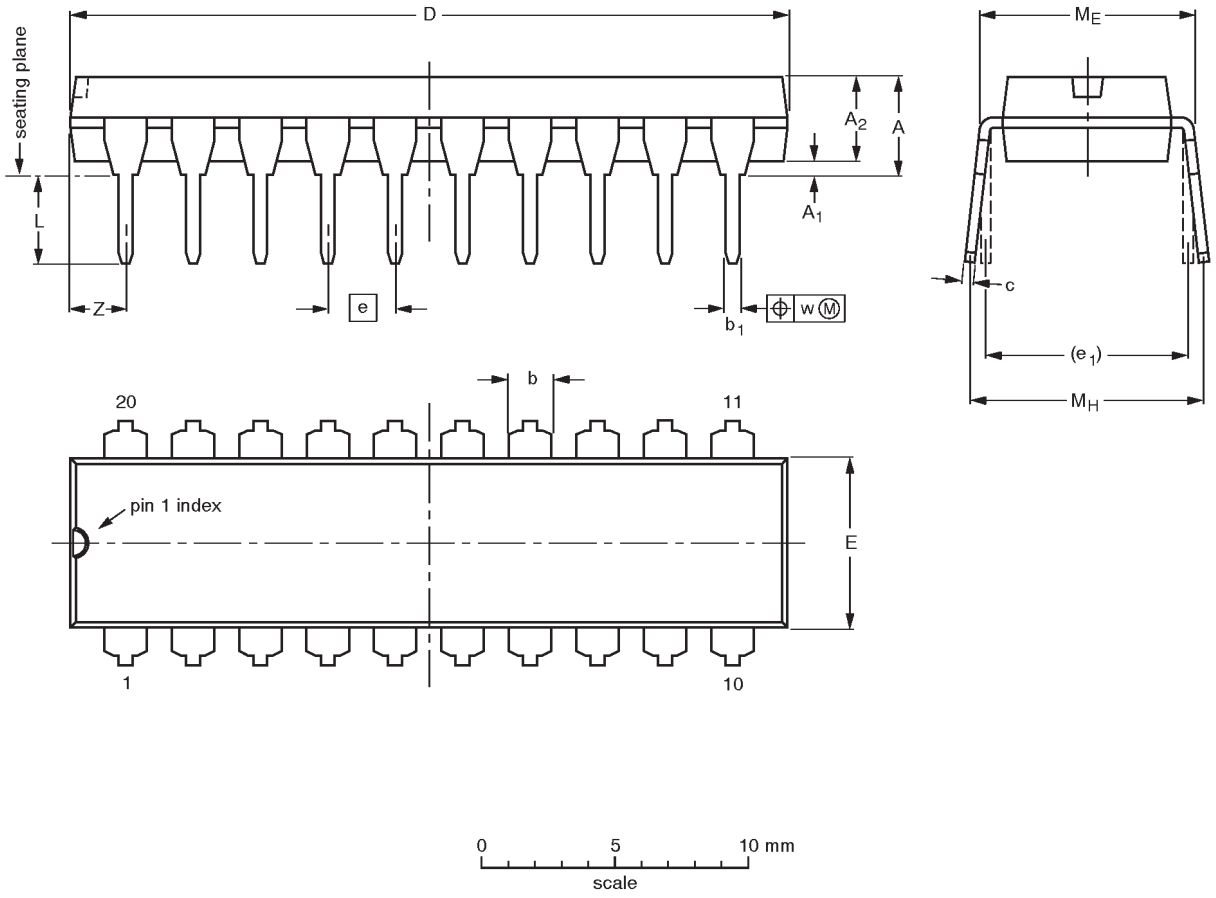
TEST	S_1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	2 * V_{CC}
t_{PHZ}/t_{PZH}	GND

V_{CC}	V_I
< 2.7V	V_{CC}
2.7–3.6V	2.7V
≥ 4.5V	V_{CC}

SV00896

Figure 3. Load circuitry for switching times.

DIP20: plastic dual in-line package; 20 leads (300 mil) **SOT146-1**



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

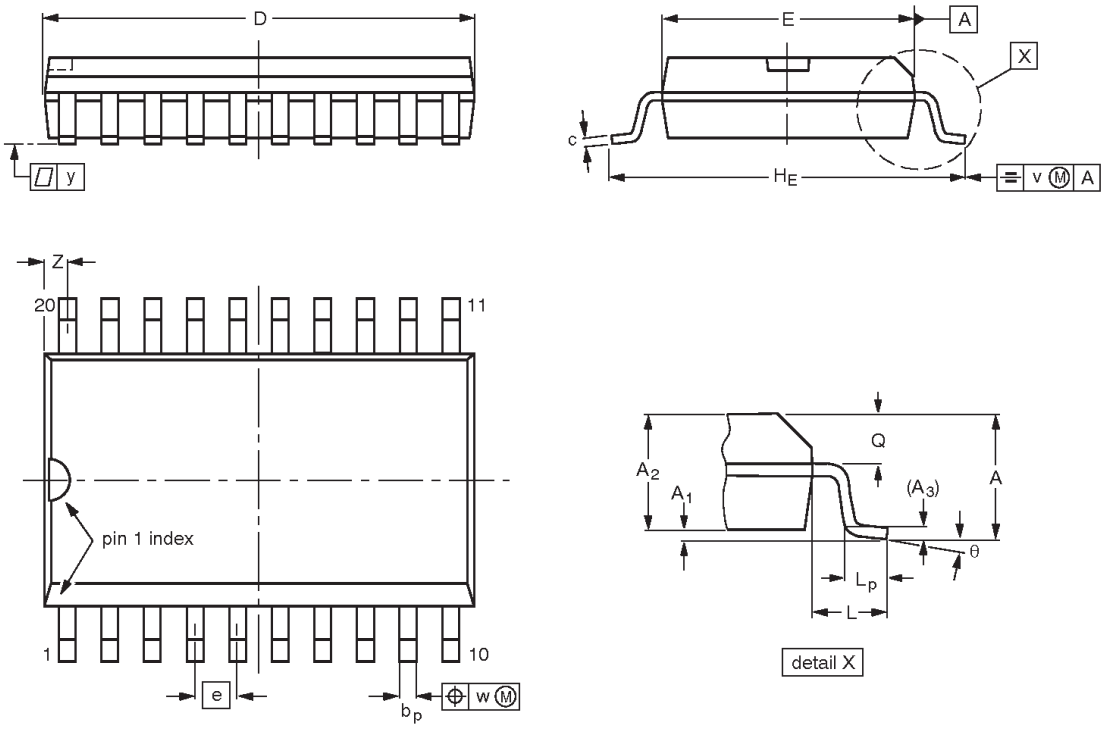
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

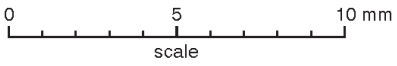
Note

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

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





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

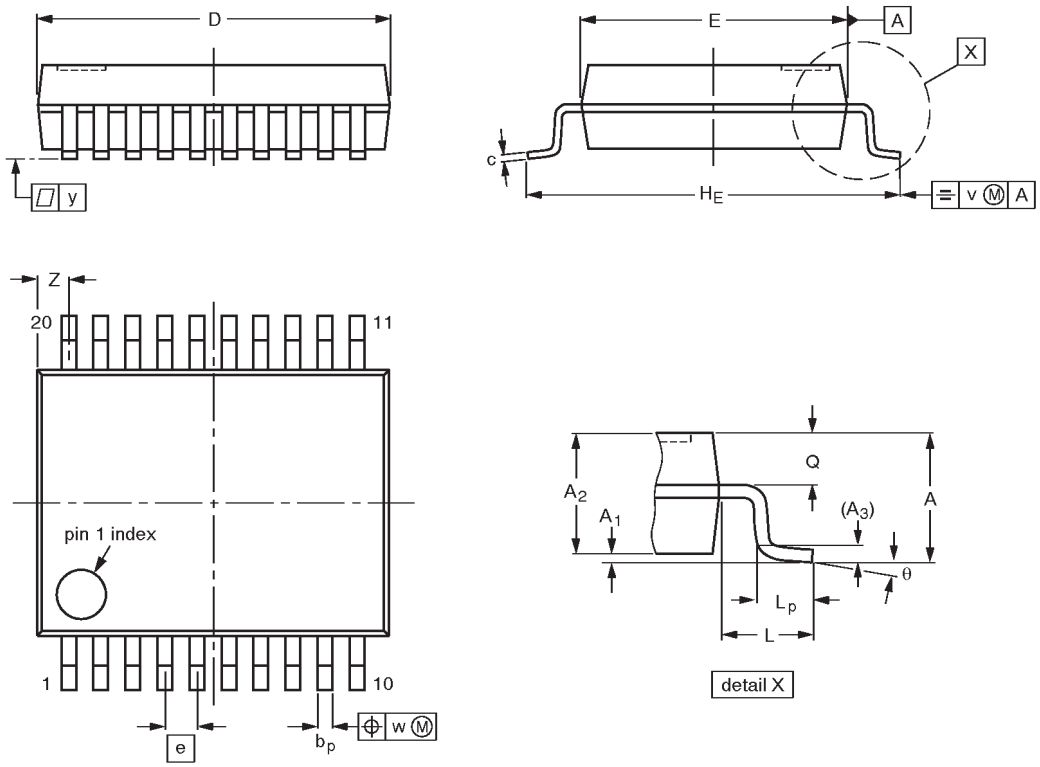
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42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

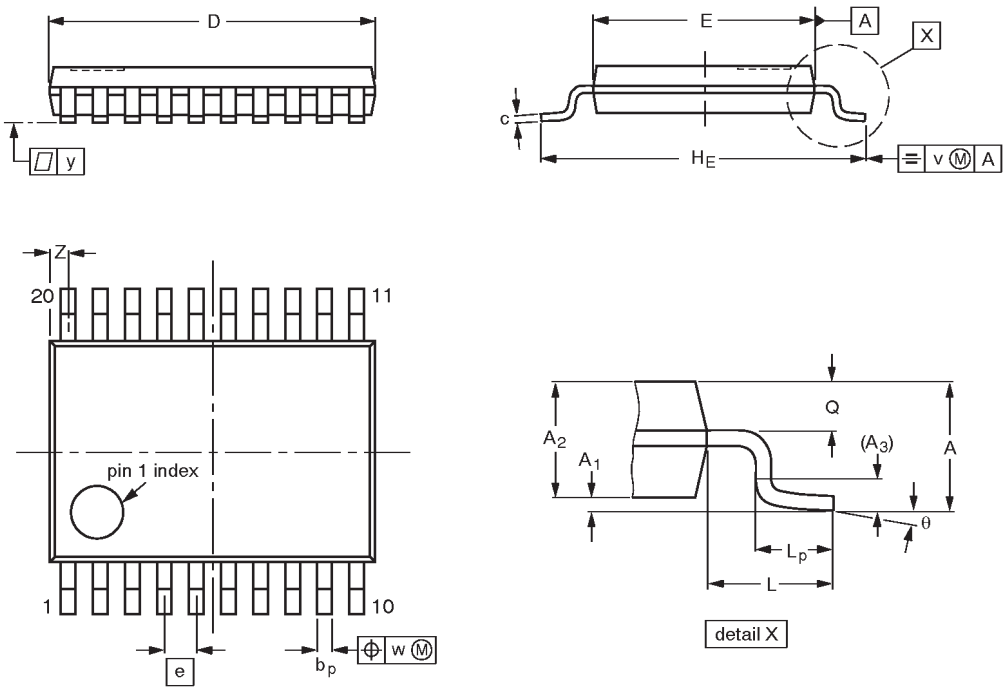
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

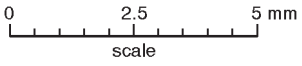
Note

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.

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