DATA SHEET

74LVC244A; 74LVCH244A
Octal buffer/line driver with 5 V tolerant inputs/outputs (3-state)

Product specification
Supersedes data of 2003 May 20

2003 Oct 30

Philips Semiconductors

PHILIPS

Octal buffer/line driver with 5 V tolerant inputs/outputs (3-state)

74LVC244A; 74LVCH244A

FEATURES

- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- High-impedance when V_{CC} = 0 V
- Bushold on all data inputs (74LVCH244A only)
- Complies with JEDEC standard no. 8-1A
- ESD protection:
  HBM EIA/JESD22-A114-A exceeds 2000 V
  MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from –40 to +85 °C and –40 to +125 °C.

DESCRIPTION

The 74LVC244A/74LVCH244A 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 3.3 or 5 V devices. In 3-state operation, outputs can handle 5 V. These features allow the use of these devices as translators in a mixed 3.3 and 5 V environment.

The 74LVC244A/74LVCH244A is an octal non-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 244 is functionally identical to the 240, but the 240 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 1An to 1Yn, 2An to 2Yn	C_L = 50 pF; V_{CC} = 3.3 V	2.8	ns
C_I	input capacitance		4.0	pF
C_{PD}	power dissipation capacitance per buffer	V_{CC} = 3.3 V; notes 1 and 2	10	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz;
   f_o = output frequency in MHz;
   C_L = output load capacitance in pF;
   V_{CC} = supply voltage in Volts;
   N = total load switching outputs;
   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
2. The condition is V_I = GND to V_{CC}.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE				
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE
74LVC244AD	–40 to +125 °C	20	SO20	plastic	SOT163-1
74LVCH244AD	–40 to +125 °C	20	SO20	plastic	SOT163-1
74LVC244ADB	–40 to +125 °C	20	SSOP20	plastic	SOT339-1
74LVCH244ADB	–40 to +125 °C	20	SSOP20	plastic	SOT339-1
74LVC244APW	–40 to +125 °C	20	TSSOP20	plastic	SOT360-1
74LVCH244APW	–40 to +125 °C	20	TSSOP20	plastic	SOT360-1
74LVC244ABQ	–40 to +125 °C	20	DHVQFN20	plastic	SOT764-1
74LVCH244ABQ	–40 to +125 °C	20	DHVQFN20	plastic	SOT764-1

FUNCTION TABLE

See note 1.

INPUT		OUTPUT
$n\overline{OE}$	nAn	nYn
L	L	L
L	H	H
H	X	Z

Note

1. H = HIGH voltage level;
   a) L = LOW voltage level;
   b) X = don't care;
   c) Z = high-impedance OFF-state.

PINNING

PIN	SYMBOL	DESCRIPTION
1	$1\overline{OE}$	output enable input (active LOW)
2	1A0	data input
3	2Y0	bus output
4	1A1	data input
5	2Y1	bus output
6	1A2	data input
7	2Y2	bus output
8	1A3	data input
9	2Y3	bus output
10	GND	ground (0 V)
11	2A3	bus input
12	1Y3	bus output
13	2A2	bus input
14	1Y2	bus output
15	2A1	bus input
16	1Y1	bus output
17	2A0	bus input
18	1Y0	bus output
19	$2\overline{OE}$	output enable input (active LOW)
20	V_{CC}	supply voltage

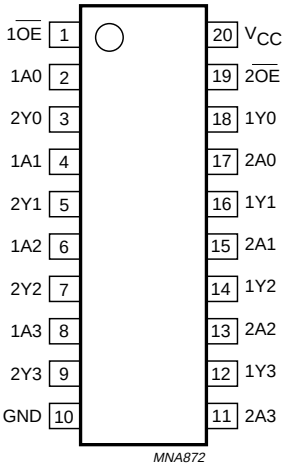
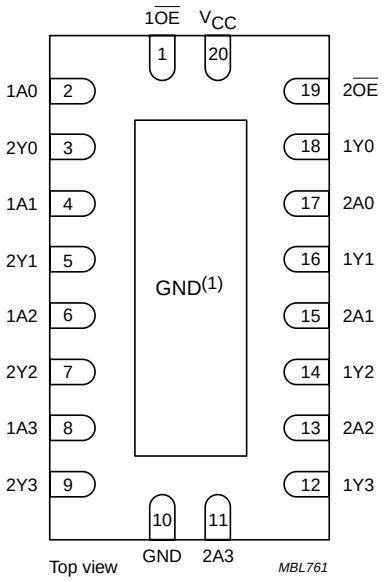


Fig.1 Pin configuration SO and (T)SSOP.



(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as a supply pin or input.

Fig.2 Pin configuration DHVQFN20.

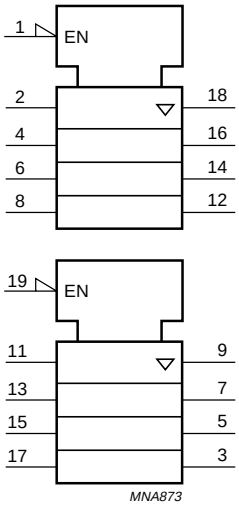


Fig.3 Logic symbol (IEEE/IEC).

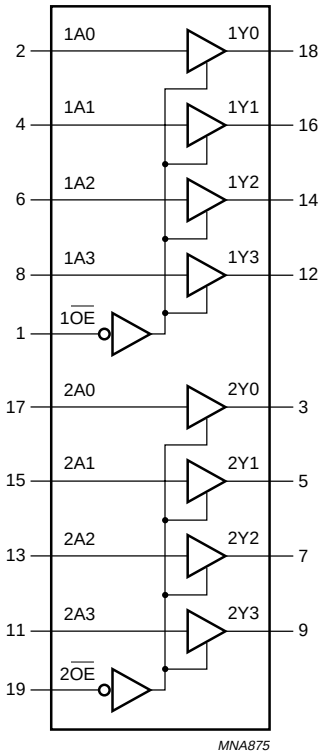


Fig.4 Functional diagram.

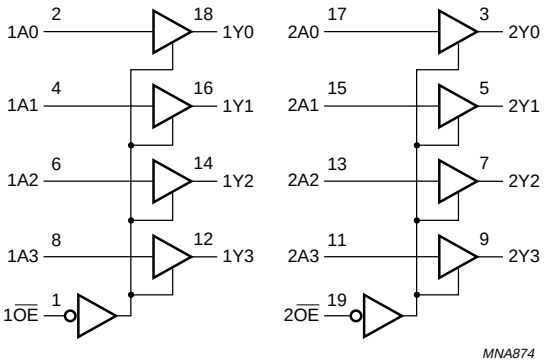


Fig.5 Logic symbol.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage	for maximum speed performance	2.7	3.6	V
		for low-voltage applications	1.2	3.6	V
V_I	input voltage		0	5.5	V
V_O	output voltage	output HIGH or LOW state	0	V_{CC}	V
		output 3-state	0	5.5	V
T_{amb}	operating ambient temperature	in free air	–40	+125	°C
t_r, t_f	input rise and fall times	V_{CC} = 1.2 to 2.7 V	0	20	ns/V
		V_{CC} = 2.7 to 3.6 V	0	10	ns/V

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage		–0.5	+6.5	V
I_{IK}	input diode current	$V_I < 0$	–	–50	mA
V_I	input voltage	note 1	–0.5	+6.5	V
I_{OK}	output diode current	$V_O > V_{CC}$ or $V_O < 0$	–	±50	mA
V_O	output voltage	output HIGH or LOW state; note 1	–0.5	V_{CC} + 0.5	V
		output 3-state; note 1	–0.5	+6.5	V
I_O	output source or sink current	V_O = 0 to V_{CC}	–	±50	mA
I_{CC}, I_{GND}	V_{CC} or GND current		–	±100	mA
T_{stg}	storage temperature		–65	+150	°C
P_{tot}	power dissipation	T_{amb} = –40 to +125 °C; note 2	–	500	mW

Notes

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. For SO20 packages: above 70 °C derate linearly with 8 mW/K.
   a) For SSOP20 and TSSOP20 packages: above 60 °C derate linearly with 5.5 mW/K.
   b) For DHVQFN20 packages: above 60 °C derate linearly with 5.5 mW/K.

DC CHARACTERISTICS

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = −40 to +85 °C							
V_{IH}	HIGH-level input voltage		1.2	V_{CC}	–	–	V
			2.7 to 3.6	2.0	–	–	V
V_{IL}	LOW-level input voltage		1.2	–	–	GND	V
			2.7 to 3.6	–	–	0.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = −100 µA	2.7 to 3.6	V_{CC} − 0.2	V_{CC}	–	V
		I_O = −12 mA	2.7	V_{CC} − 0.5	–	–	V
		I_O = −18 mA	3.0	V_{CC} − 0.6	–	–	V
		I_O = −24 mA	3.0	V_{CC} − 0.8	–	–	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = 100 µA	2.7 to 3.6	–	GND	0.20	V
		I_O = 12 mA	2.7	–	–	0.40	V
		I_O = 24 mA	3.0	–	–	0.55	V
I_{LI}	input leakage current	V_I = 5.5 V or GND; notes 2	3.6	–	±0.1	±5	µA
I_{OZ}	3-state output OFF-state current	V_I = V_{IH} or V_{IL}; V_O = 5.5 V or GND; notes 2	3.6	–	0.1	±5	µA
I_{off}	power-off leakage supply current	V_I or V_O = 5.5 V	0.0	–	0.1	±10	µA
I_{CC}	quiescent supply current	V_I = V_{CC} or GND; I_O = 0	3.6	–	0.1	10	µA
ΔI_{CC}	additional quiescent supply current per input pin	V_I = V_{CC} − 0.6 V; I_O = 0	2.7 to 3.6	–	5	500	µA
$I_{BH(L)}$	bushold LOW sustaining current	V_I = 0.8 V; notes 3 and 4	3.0	75	–	–	µA
$I_{BH(H)}$	bushold HIGH sustaining current	V_I = 2.0 V; notes 3 and 4	3.0	−75	–	–	µA
$I_{BH(LO)}$	bushold LOW overdrive current	notes 3 and 5	3.6	500	–	–	µA
$I_{BH(HO)}$	bushold HIGH overdrive current	notes 3 and 5	3.6	−500	–	–	µA

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.(1)	MAX.	UNIT
		OTHER	V_{CC} (V)				
T_{amb} = −40 to +125 °C							
V_{IH}	HIGH-level input voltage		1.2	V_{CC}	–	–	V
			2.7 to 3.6	2.0	–	–	V
V_{IL}	LOW-level input voltage		1.2	–	–	GND	V
			2.7 to 3.6	–	–	0.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = –100 µA	2.7 to 3.6	V_{CC} – 0.3	–	–	V
		I_O = –12 mA	2.7	V_{CC} – 0.65	–	–	V
		I_O = –18 mA	3.0	V_{CC} – 0.75	–	–	V
		I_O = –24 mA	3.0	V_{CC} – 1	–	–	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = 100 µA	2.7 to 3.6	–	–	0.3	V
		I_O = 12 mA	2.7	–	–	0.6	V
		I_O = 24 mA	3.0	–	–	0.8	V
I_{LI}	input leakage current	V_I = 5.5 V or GND; notes 2	3.6	–	–	±20	µA
I_{OZ}	3-state output OFF-state current	V_I = V_{IH} or V_{IL}; V_O = 5.5 V or GND; notes 2	3.6	–	–	±20	µA
I_{off}	power-off leakage supply current	V_I or V_O = 5.5 V	0.0	–	–	±20	µA
I_{CC}	quiescent supply current	V_I = V_{CC} or GND; I_O = 0	3.6	–	–	40	µA
ΔI_{CC}	additional quiescent supply current per input pin	V_I = V_{CC} – 0.6 V; I_O = 0	2.7 to 3.6	–	–	5000	µA
$I_{BH(L)}$	bushold LOW sustaining current	V_I = 0.8 V; notes 3 and 4	3.0	60	–	–	µA
$I_{BH(H)}$	bushold HIGH sustaining current	V_I = 2.0 V; notes 3 and 4	3.0	–60	–	–	µA
$I_{BH(LO)}$	bushold LOW overdrive current	notes 3 and 5	3.6	500	–	–	µA
$I_{BH(HO)}$	bushold HIGH overdrive current	notes 3 and 5	3.6	–500	–	–	µA

Notes

1. All typical values are measured at V_{CC} = 3.3 V and T_{amb} = 25 °C.
2. For bushold parts, the bushold circuit is switched off when V_I > V_{CC} allowing 5.5 V on the input pin.
3. Valid for data inputs of bushold parts (74LVCH244A) only. 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.

AC CHARACTERISTICS

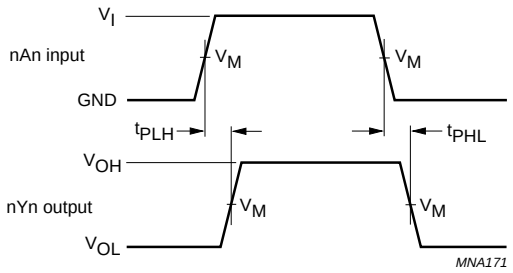
GND = 0 V; $t_r = t_f \leq 2.5$ ns.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		WAVEFORMS	V_{CC} (V)				
T_{amb} = −40 to +85 °C							
t_{PHL}/t_{PLH}	propagation delay 1An to 1Yn, 2An to 2Yn	see Figs 6 and 8	1.2	–	17.0	–	ns
			2.7	1.5	3.3	6.9	ns
			3.0 to 3.6	1.5	2.8(1)	5.9	ns
t_{PZH}/t_{PZL}	3-state output enable time $1\overline{OE}$ to 1Yn, $2\overline{OE}$ to 2Yn	see Figs 7 and 8	1.2	–	24.0	–	ns
			2.7	1.5	3.3	8.6	ns
			3.0 to 3.6	1.0	3.4(1)	7.6	ns
t_{PHZ}/t_{PLZ}	3-state output disable time $1\overline{OE}$ to 1Yn, $2\overline{OE}$ to 2Yn	see Figs 7 and 8	1.2	–	9.0	–	ns
			2.7	1.5	3.2	6.8	ns
			3.0 to 3.6	1.5	2.9(1)	5.8	ns
$t_{sk(0)}$	skew	note 2		–	–	1.0	ns
T_{amb} = −40 to +125 °C							
t_{PHL}/t_{PLH}	propagation delay 1An to 1Yn, 2An to 2Yn	see Figs 6 and 8	1.2	–	–	–	ns
			2.7	1.5	–	9.0	ns
			3.0 to 3.6	1.5	–	7.5	ns
t_{PZH}/t_{PZL}	3-state output enable time $1\overline{OE}$ to 1Yn, $2\overline{OE}$ to 2Yn	see Figs 7 and 8	1.2	–	–	–	ns
			2.7	1.5	–	11	ns
			3.0 to 3.6	1.0	–	9.5	ns
t_{PHZ}/t_{PLZ}	3-state output disable time $1\overline{OE}$ to 1Yn, $2\overline{OE}$ to 2Yn	see Figs 7 and 8	1.2	–	–	–	ns
			2.7	1.5	–	8.5	ns
			3.0 to 3.6	1.5	–	7.5	ns
$t_{sk(0)}$	skew	note 2		–	–	1.5	ns

Notes

1. All typical values are measured at V_{CC} = 3.3 V and T_{amb} = 25 °C.
2. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

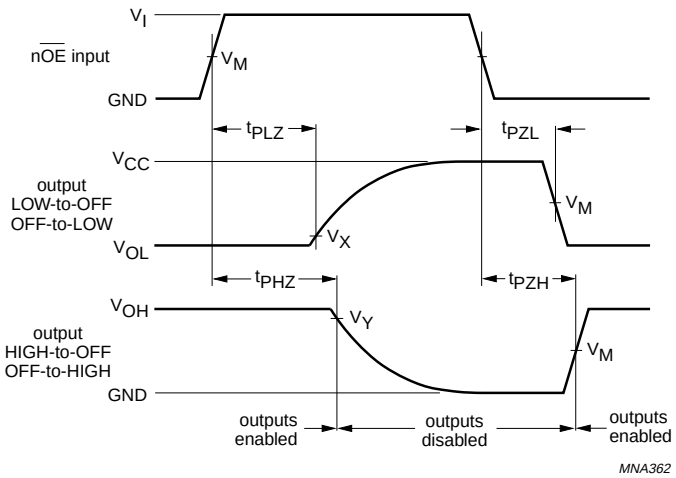
AC WAVEFORMS



V_M = 1.5 V at $V_{CC} \geq$ 2.7 V.
V_M = 0.5V_{CC} at V_{CC} < 2.7 V.

V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

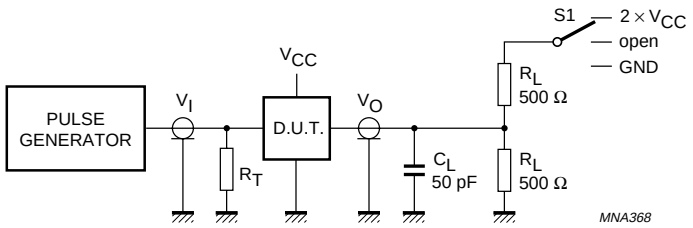
Fig.6 Input nAn to output nYn propagation delays.



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

V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

Fig.7 3-state enable and disable times.



SWITCH POSITION	
TEST	**S1**
t_{PLH}/t_{PHL}	open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND

V_{CC}	V_{IN}
<2.7 V	V_{CC}
2.7 to 3.6 V	2.7 V

Definitions for test circuits:

R_L = Load resistor.

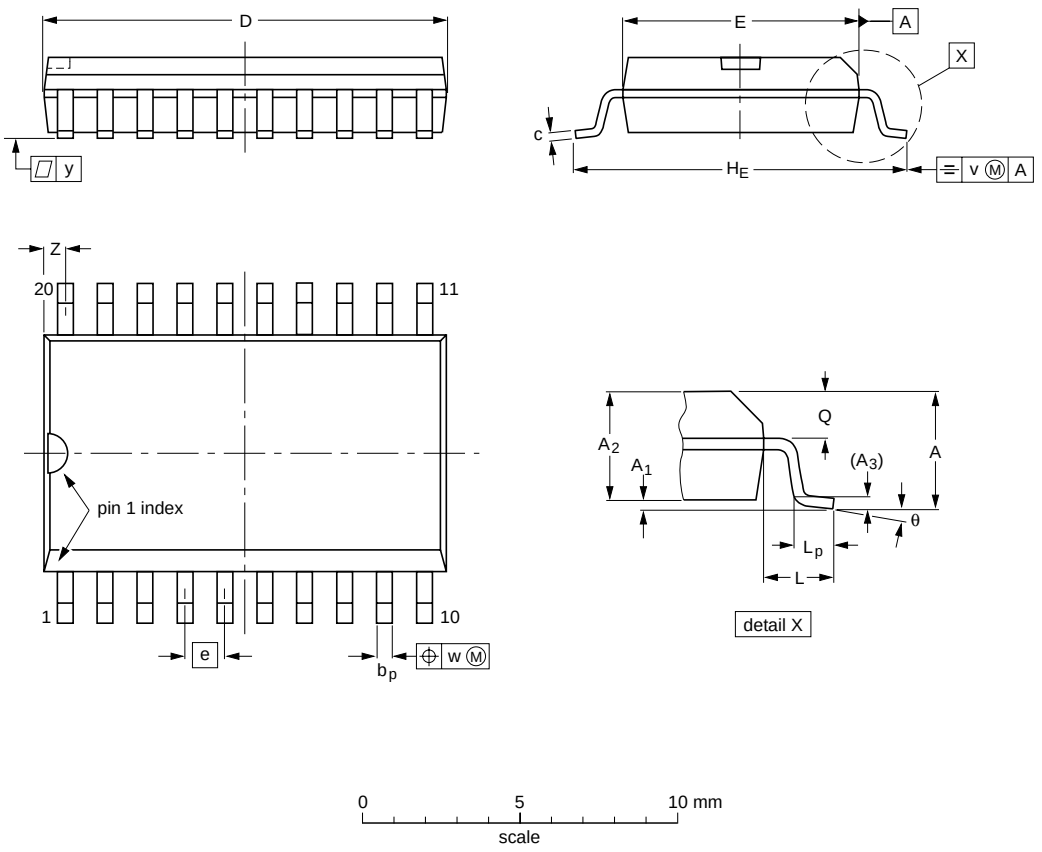
C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to Z_o of the pulse generator.

Fig.8 Load circuitry for switching times.

PACKAGE OUTLINES

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



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

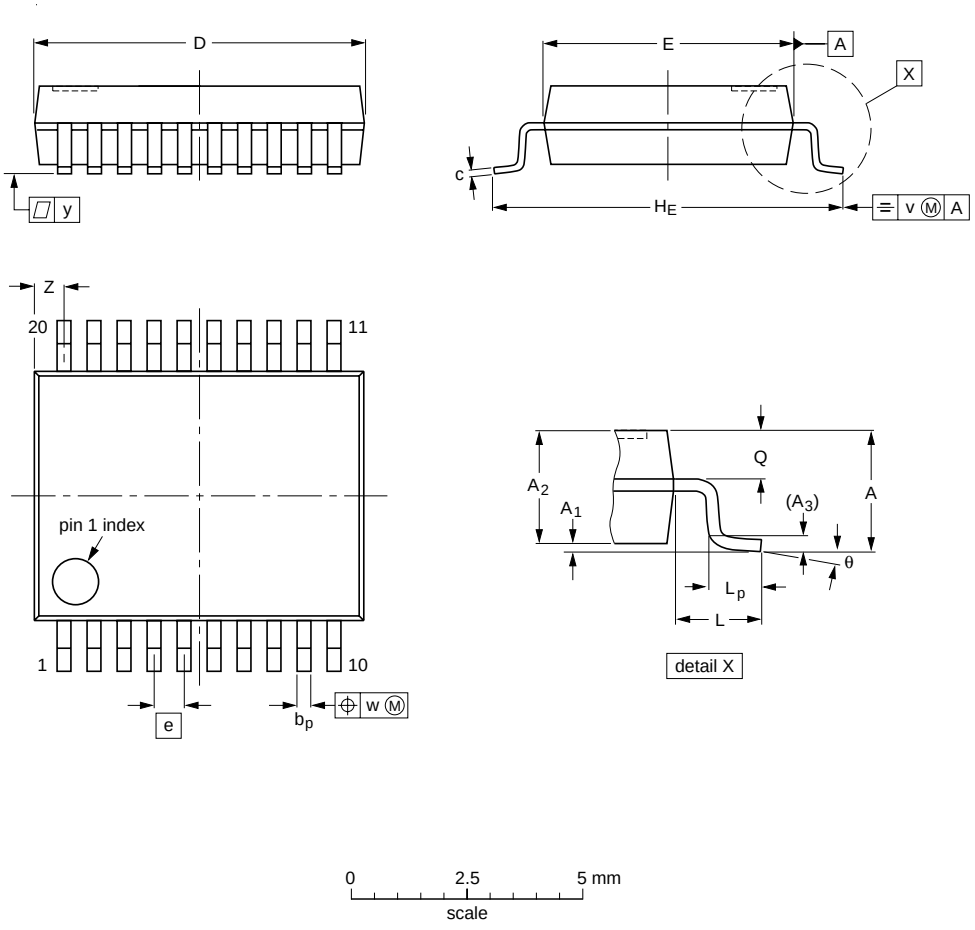
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 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 (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT163-1	075E04	MS-013				~~99-12-27~~ 03-02-19

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



DIMENSIONS (mm are the original dimensions)

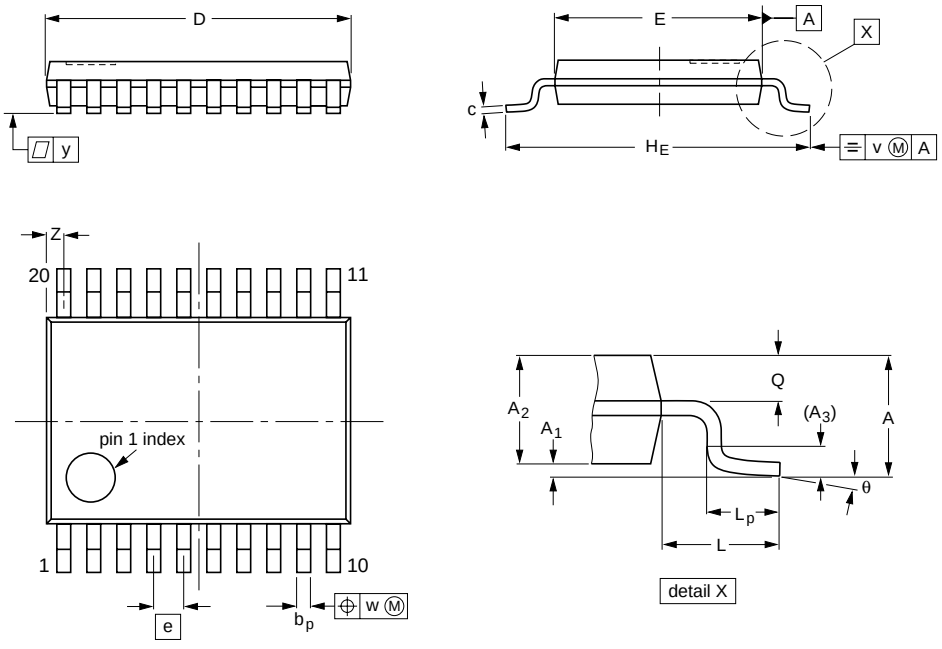
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8^o 0^o

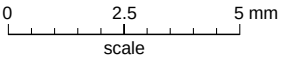
Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT339-1		MO-150				~~99-12-27~~ 03-02-19

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm **SOT360-1**





DIMENSIONS (mm are the original dimensions)

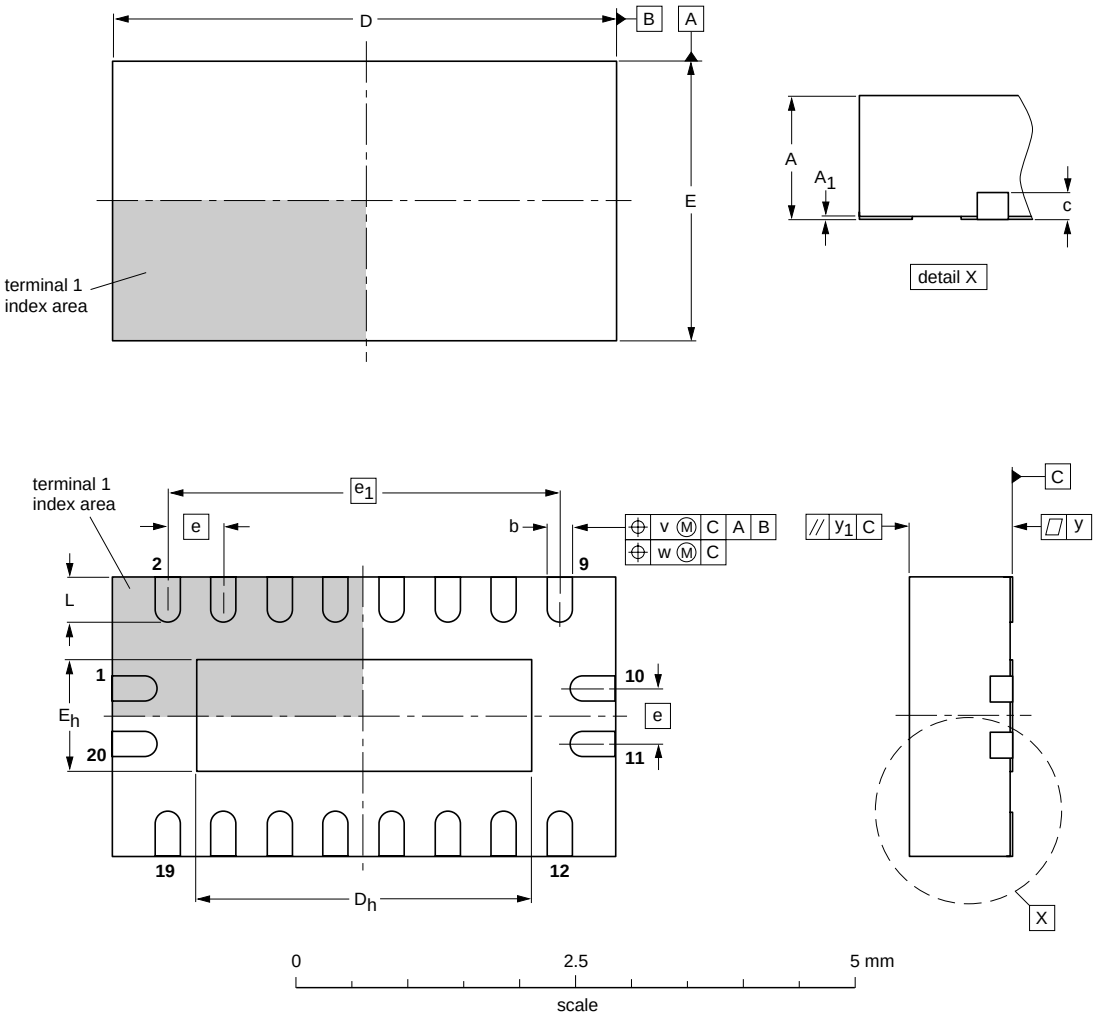
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8^o 0^o

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	JEITA			
SOT360-1		MO-153				~~99-12-27~~ 03-02-19

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm **SOT764-1**



DIMENSIONS (mm are the original dimensions)

UNIT	$A^{(1)}$ max.	A_1	b	c	$D^{(1)}$	D_h	$E^{(1)}$	E_h	e	e_1	L	v	w	y	y_1
mm	1	0.05 0.00	0.30 0.18	0.2	4.6 4.4	3.15 2.85	2.6 2.4	1.15 0.85	0.5	3.5	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT764-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS[1]	PRODUCT STATUS[2][3]	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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 60134). 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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SCA75

Printed in The Netherlands R20/04/pp17 Date of release: 2003 Oct 30 Document order number: 9397 750 12177

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