

# 74LVC2244A

Octal buffer/line driver; 30  $\Omega$  series termination; 5 V tolerant input/output; 3-state

Rev. 5 — 3 November 2011

Product data sheet

## 1. General description

The 74LVC2244A is an octal non-inverting buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable input pins  $\overline{1OE}$  and  $\overline{2OE}$ . A HIGH on pin  $n\overline{OE}$  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 device is designed with 30  $\Omega$  series termination resistors in both HIGH and LOW output stages to reduce line noise.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices as translators in mixed 3.3 V and 5 V applications.

## 2. Features and benefits

- 5 V tolerant inputs/outputs, for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low-power consumption
- Direct interface with TTL levels
- Integrated 30  $\Omega$  termination resistors
- Complies with JEDEC standard:
  - ◆ JESD8-7A (1.65 V to 1.95 V)
  - ◆ JESD8-5A (2.3 V to 2.7 V)
  - ◆ JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

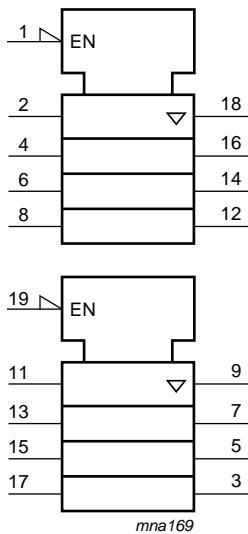
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### 3. Ordering information

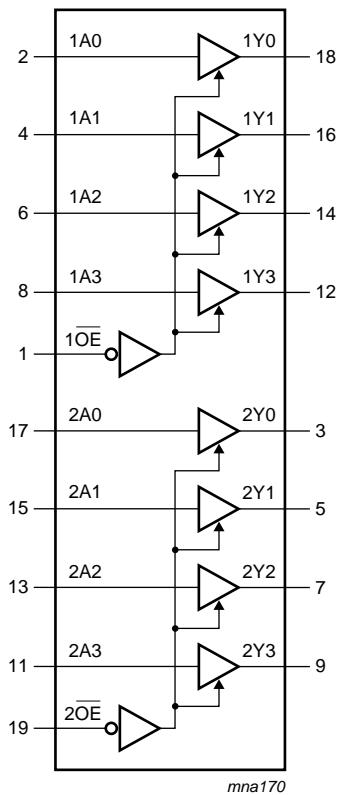
**Table 1. Ordering information**

Type number	Package				Version
	Temperature range	Name	Description		
74LVC2244AD	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm		SOT163-1
74LVC2244ADB	-40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm		SOT339-1
74LVC2244APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm		SOT360-1
74LVC2244ABQ	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm		SOT764-1

### 4. Functional diagram



**Fig 1. IEC logic symbol**



**Fig 2. Logic diagram**

## 5. Pinning information

### 5.1 Pinning

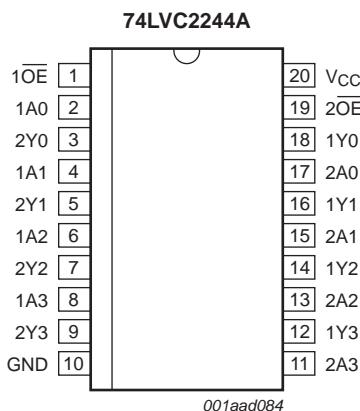


Fig 3. Pin configuration SO20 and (T)SSOP20

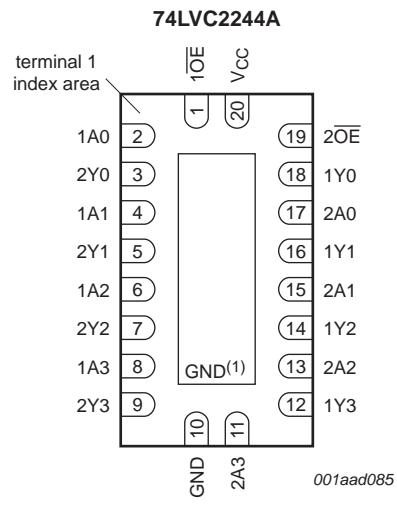


Fig 4. Pin configuration DHVQFN20

- (1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1OE	1	output enable input (active LOW)
2OE	19	output enable input (active LOW)
1A[0:3]	2, 4, 6, 8	data input
2A[0:3]	17, 15, 13, 11	data input
1Y[0:3]	18, 16, 14, 12	data output
2Y[0:3]	3, 5, 7, 9	data output
GND	10	ground (0 V)
V <sub>CC</sub>	20	supply voltage

## 6. Functional description

**Table 3. Functional table<sup>[1]</sup>**

Input		Output
nOE	nAn	nYn
L	L	L
L	H	H
H	X	Z

[1] H = HIGH voltage level

L = LOW voltage level

X = don't care

Z = high-impedance OFF-state

## 7. Limiting values

**Table 4. 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 <sub>CC</sub>	supply voltage		-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
V <sub>I</sub>	input voltage		<sup>[1]</sup> -0.5	+6.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V	-	±50	mA
V <sub>O</sub>	output voltage	output HIGH or LOW state	<sup>[2]</sup> -0.5	V <sub>CC</sub> + 0.5	V
		output 3-state	<sup>[2]</sup> -0.5	+6.5	V
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C	<sup>[3]</sup> -	500	mW

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] For SO20 packages: above 70 °C derate linearly with 8 mW/K.

For (T)SSOP20 packages: above 60 °C derate linearly with 5.5 mW/K.

For DHVQFN20 packages: above 60 °C derate linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	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
$T_{amb}$	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65 \text{ V to } 2.7 \text{ V}$	0	-	20	ns/V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	0	-	10	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.2 \text{ V}$	1.08	-	-	1.08	-	V
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.65 \times V_{CC}$	-	-	$0.65 \times V_{CC}$	-	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	-	-	1.7	-	V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2.0	-	-	2.0	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.2 \text{ V}$	-	-	0.12	-	0.12	V
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	-	-	$0.35 \times V_{CC}$	-	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	-	0.7	-	0.7	V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	-	-	0.8	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$						
		$I_O = -100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 3.6 \text{ V}$	$V_{CC} - 0.2$	$V_{CC}$	-	$V_{CC} - 0.3$	-	V
		$I_O = -2 \text{ mA}; V_{CC} = 1.65 \text{ V}$	1.2	-	-	1.05	-	V
		$I_O = -4 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.8	-	-	1.65	-	V
		$I_O = -6 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.2	-	-	2.05	-	V
		$I_O = -9 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.4	-	-	2.25	-	V
$V_{OL}$	LOW-level output voltage	$I_O = -12 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.2	-	-	2.0	-	V
		$V_I = V_{IH}$ or $V_{IL}$						
		$I_O = 100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 3.6 \text{ V}$	-	-	0.2	-	0.3	V
		$I_O = 2 \text{ mA}; V_{CC} = 1.65 \text{ V}$	-	-	0.45	-	0.65	V
		$I_O = 4 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.6	-	0.8	V
		$I_O = 6 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	-	0.4	-	0.6	V
$I_I$	input leakage current	$I_I = 12 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.55	-	0.8	V
		$V_{CC} = 3.6 \text{ V}; V_I = 5.5 \text{ V or GND}$	-	$\pm 0.1$	$\pm 5$	-	$\pm 20$	$\mu\text{A}$

**Table 6. Static characteristics ...continued**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V; V <sub>O</sub> = 5.5 V or GND;	-	±0.1	±5	-	±20	µA
I <sub>OFF</sub>	power-off leakage current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 5.5 V	-	±0.1	±10	-	±20	µA
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	0.1	10	-	40	µA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> – 0.6 V; I <sub>O</sub> = 0 A	-	5	500	-	5000	µA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	4.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 7](#).

Symbol	Parameter	Conditions	$T_{amb} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$			$-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_{pd}$	propagation delay	nAn to nYn; see <a href="#">Figure 5</a>	<a href="#">[2]</a>					
		$V_{CC} = 1.2\text{ V}$	-	35	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to $1.95\text{ V}$	1.9	7.8	17.7	1.9	18.6	ns
		$V_{CC} = 2.3\text{ V}$ to $2.7\text{ V}$	1.5	4.1	8.7	1.5	9.6	ns
		$V_{CC} = 2.7\text{ V}$	1.5	4.1	6.4	1.5	7.0	ns
$t_{en}$	enable time	$\overline{nOE}$ to nYn; see <a href="#">Figure 6</a>	<a href="#">[2]</a>					
		$V_{CC} = 1.2\text{ V}$	-	38	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to $1.95\text{ V}$	2.3	8.9	19.7	2.3	20.7	ns
		$V_{CC} = 2.3\text{ V}$ to $2.7\text{ V}$	1.9	5.0	10.3	1.9	11.4	ns
		$V_{CC} = 2.7\text{ V}$	1.5	5.1	8.1	1.5	9.0	ns
$t_{dis}$	disable time	$\overline{nOE}$ to nYn; see <a href="#">Figure 6</a>	<a href="#">[2]</a>					
		$V_{CC} = 1.2\text{ V}$	-	9.0	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to $1.95\text{ V}$	2.9	4.7	9.3	2.9	9.8	ns
		$V_{CC} = 2.3\text{ V}$ to $2.7\text{ V}$	1.0	2.6	5.0	1.0	5.6	ns
		$V_{CC} = 2.7\text{ V}$	1.5	3.4	6.4	1.5	7.0	ns
$t_{sk(o)}$	output skew time	$V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$	<a href="#">[3]</a>	-	-	1.0	-	1.5 ns
		per input; $V_I = \text{GND}$ to $V_{CC}$	<a href="#">[4]</a>					
				$V_{CC} = 1.65\text{ V}$ to $1.95\text{ V}$	-	1.8	-	pF
				$V_{CC} = 2.3\text{ V}$ to $2.7\text{ V}$	-	4.9	-	pF
				$V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$	-	7.7	-	pF

[1] Typical values are measured at  $T_{amb} = 25^{\circ}\text{C}$  and  $V_{CC} = 1.2\text{ V}$ ,  $1.8\text{ V}$ ,  $2.5\text{ V}$ ,  $2.7\text{ V}$ , and  $3.3\text{ V}$  respectively.

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

$t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .

$t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$  where:

$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

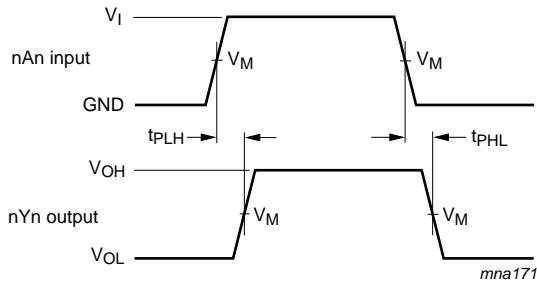
$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

N = number of inputs switching

$\sum(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs

## 11. Waveforms

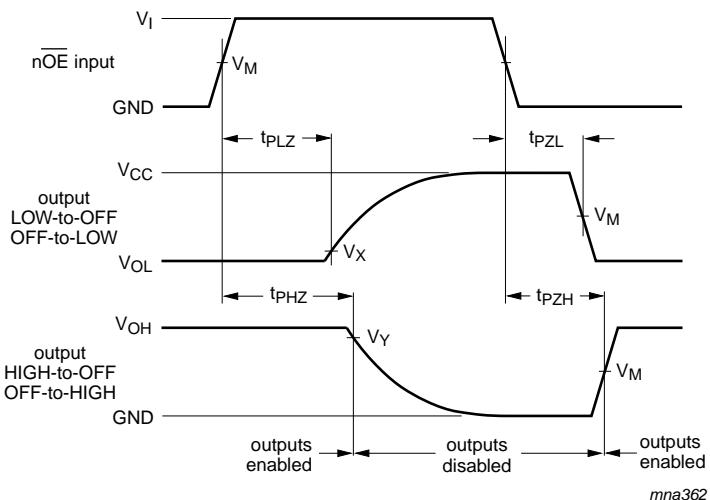


$V_M = 1.5 \text{ V at } V_{CC} \geq 2.7 \text{ V.}$

$V_M = 0.5 \times V_{CC} \text{ at } V_{CC} < 2.7 \text{ V.}$

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

**Fig 5. The input (nAn) to output (nYn) propagation delays**



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

$V_M = 0.5 \times V_{CC} \text{ at } V_{CC} < 2.7 \text{ V.}$

$V_X = V_{OL} + 0.3 \text{ V at } V_{CC} \geq 2.7 \text{ V;}$

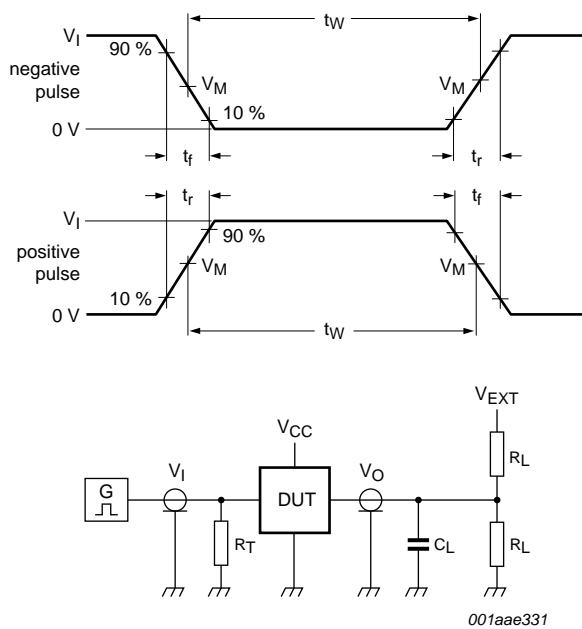
$V_X = V_{OL} + 0.15 \text{ V at } V_{CC} < 2.7 \text{ V.}$

$V_Y = V_{OH} - 0.3 \text{ V at } V_{CC} \geq 2.7 \text{ V;}$

$V_Y = V_{OH} - 0.15 \text{ V at } V_{CC} < 2.7 \text{ V.}$

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

**Fig 6. 3-state enable and disable times**



Test data is given in [Table 8](#).

Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

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

$V_{EXT}$  = External voltage for measuring switching times.

**Fig 7. Test circuit for measuring switching times**

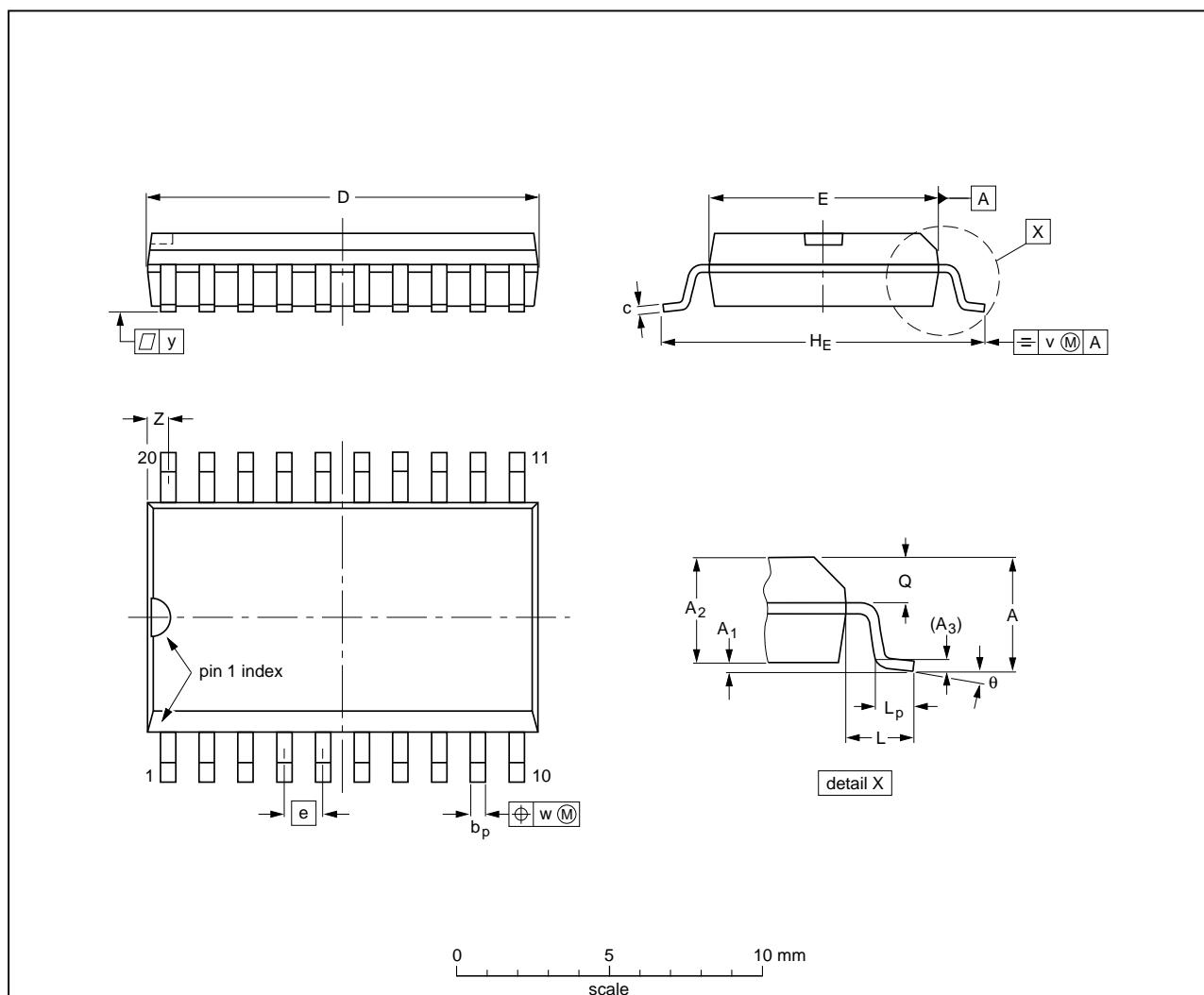
**Table 8. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PZL}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 Ω	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND

## 12. Package outline

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 <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2.65 0.1	0.3 2.25	2.45	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°
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	0°

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

Fig 8. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1

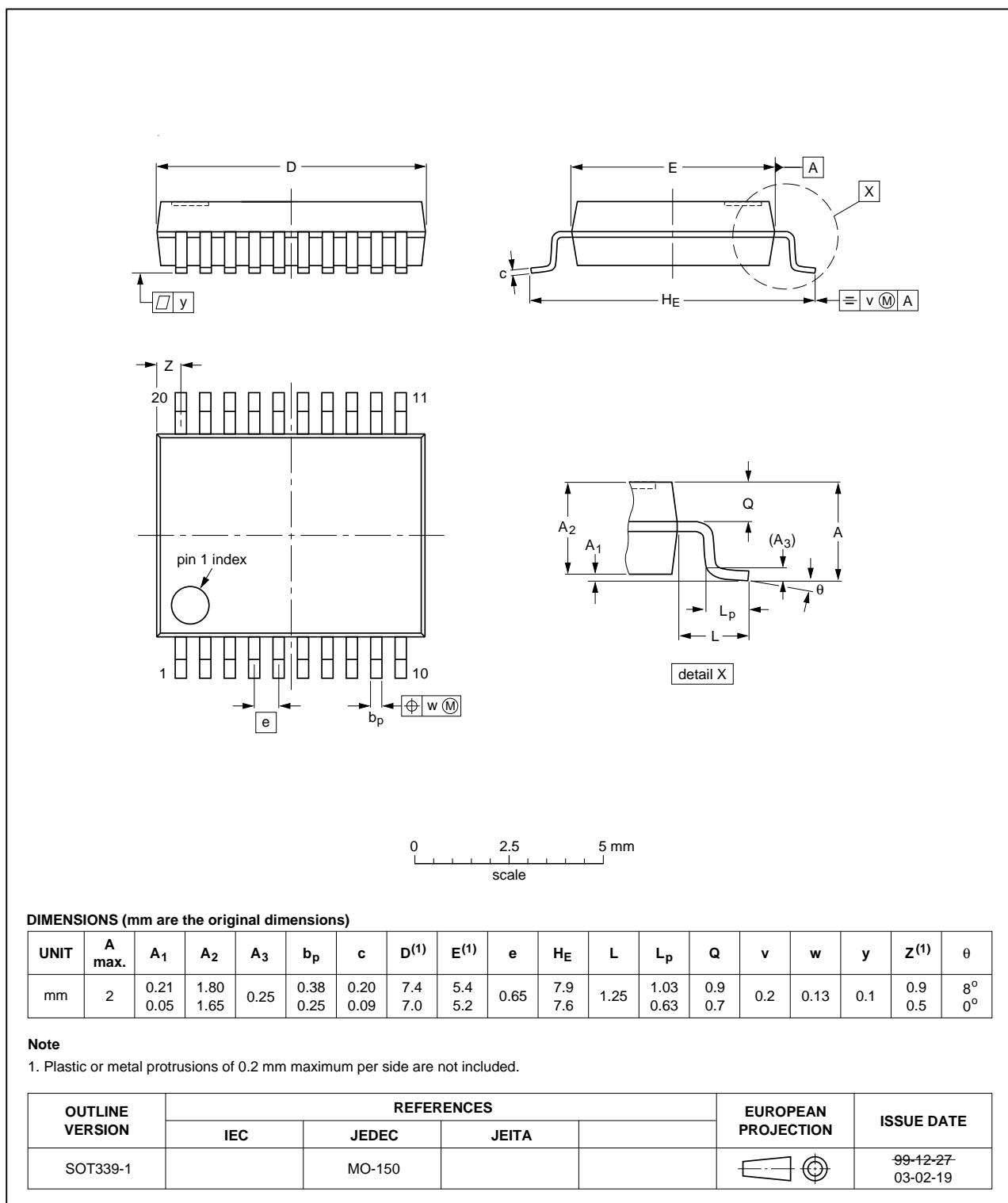


Fig 9. Package outline SOT339-1 (SSOP20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1

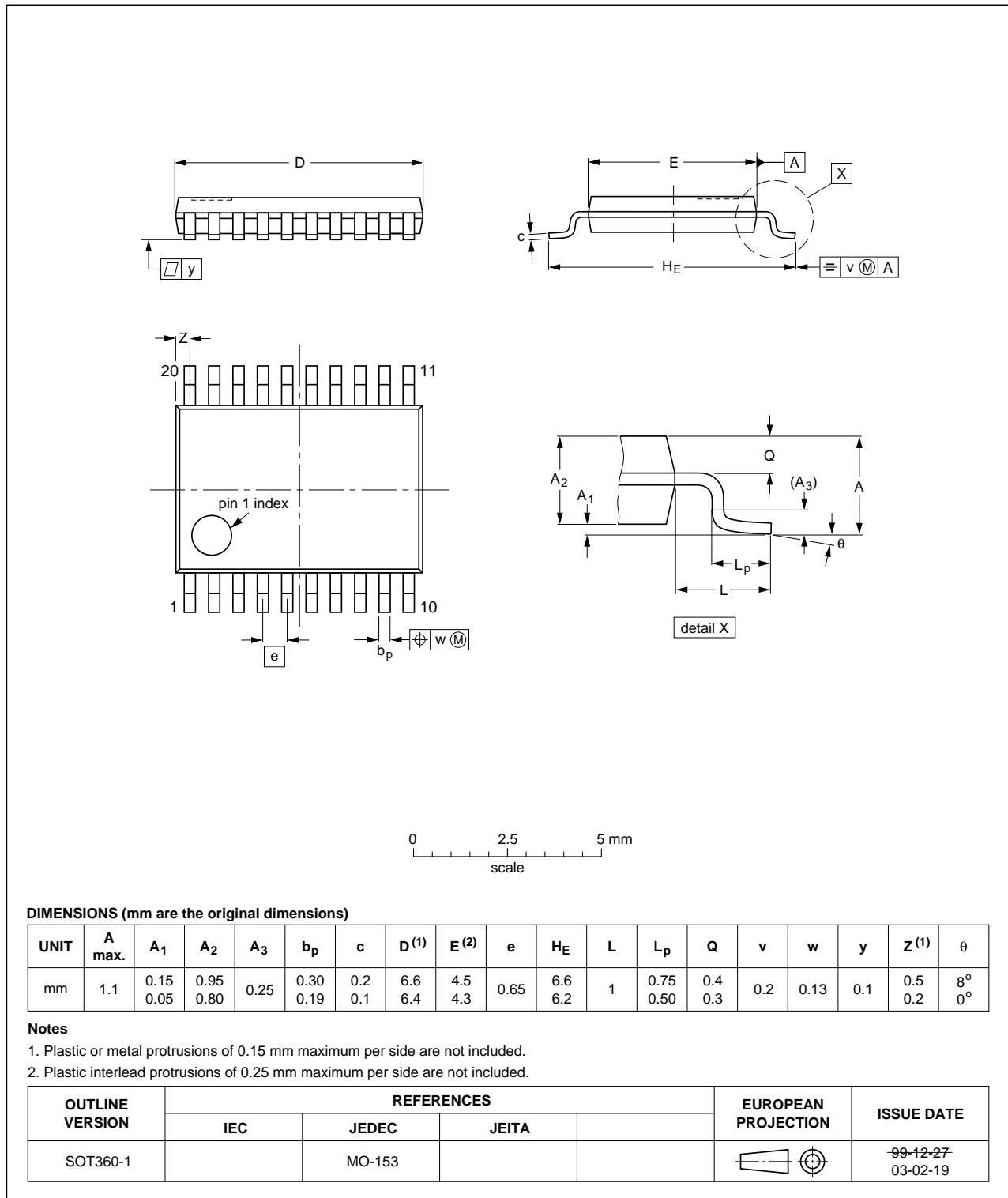


Fig 10. Package outline SOT360-1 (TSSOP20)

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

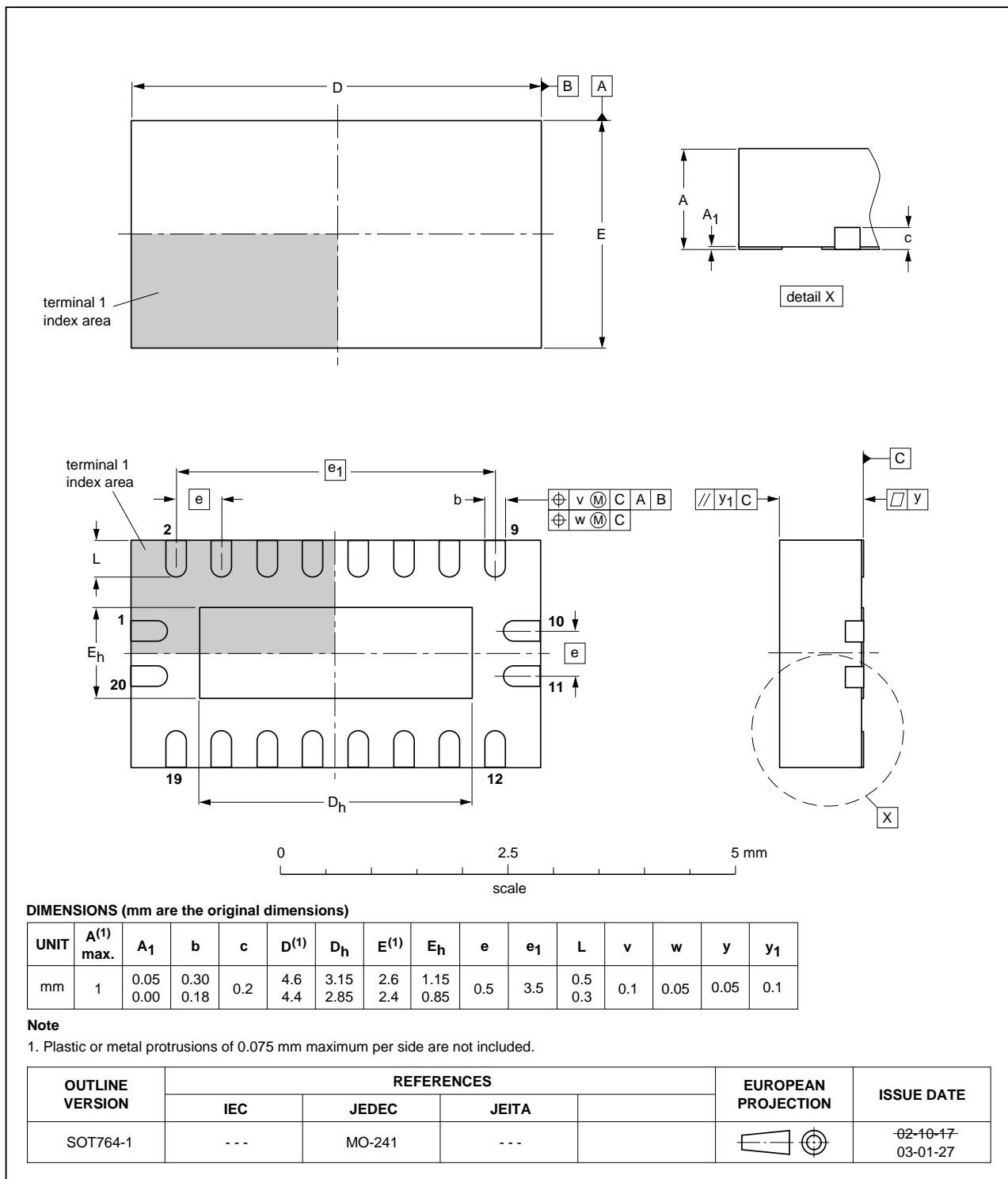


Fig 11. Package outline SOT764-1 (DHVQFN20)

## 13. Abbreviations

**Table 9. Abbreviations**

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 14. Revision history

**Table 10. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2244A v.5	20111103	Product data sheet	-	74LVC2244A v.4
Modifications:				
		<ul style="list-style-type: none"> <li>• The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• <a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a> and <a href="#">Table 8</a>: values added for lower voltage ranges.</li> </ul>		
74LVC2244A v.4	20040407	Product specification	-	74LVC2244A v.3
74LVC2244A v.3	20021213	Product specification	-	74LVC2244A v.2
74LVC2244A v.2	20020618	Product specification	-	74LVC2244A v.1
74LVC2244A v.1	19990930	Product specification	-	-

## 15. Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

### 15.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

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## 16. Contact information

For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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