

# 74LVC245A; 74LVCH245A

Octal bus transceiver; 3-state

Rev. 8 — 28 June 2013

Product data sheet

## 1. General description

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The 74LVC245A; 74LVCH245A are 8-bit transceivers featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The device 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.

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 in mixed 3.3 V and 5 V applications.

The 74LVCH245A bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

## 2. Features and benefits

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- 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
- Inputs accept voltages up to 5.5 V
- High-impedance when  $V_{CC} = 0$  V
- Bus hold on all data inputs (74LVCH245A only)
- 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

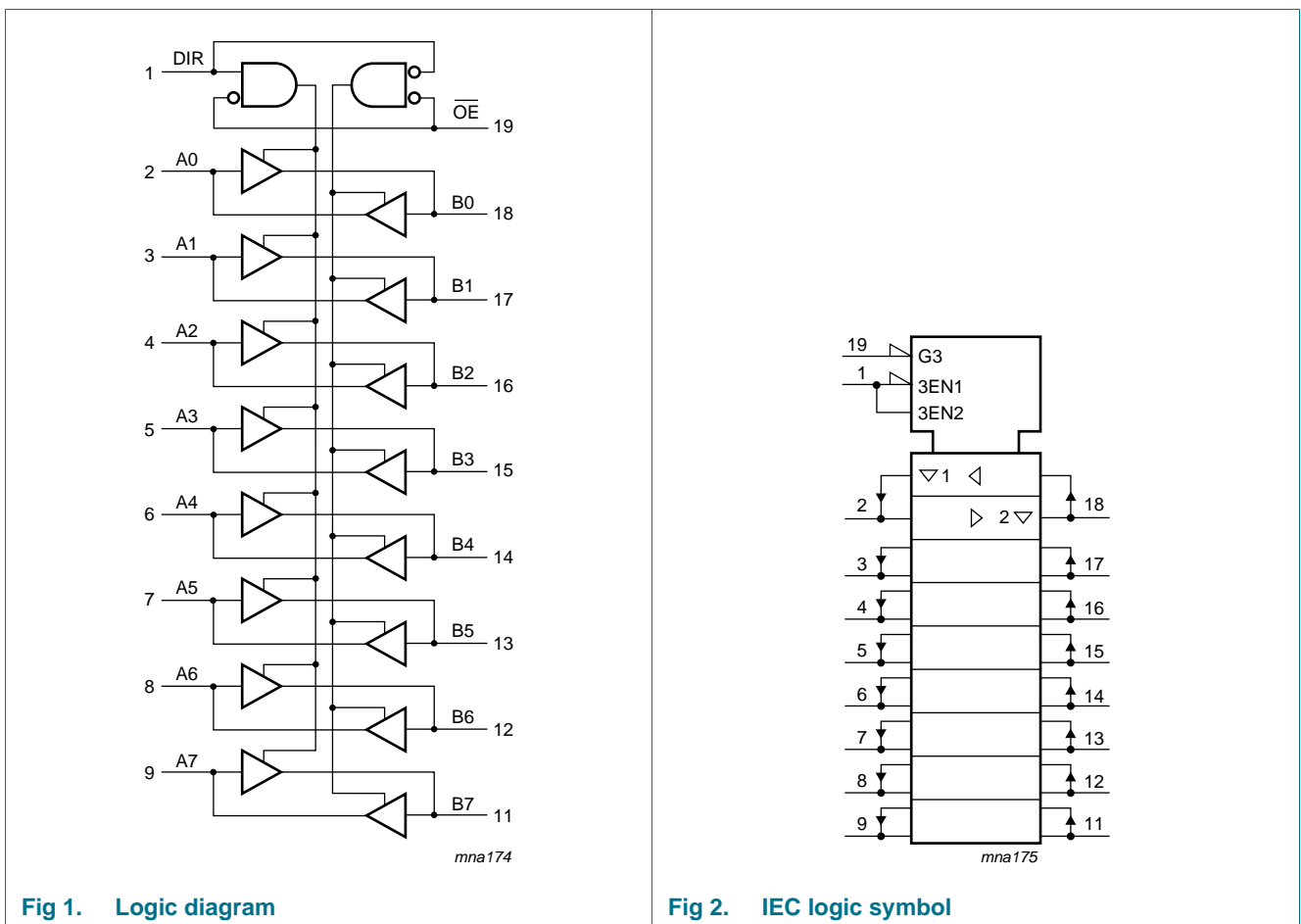


### 3. Ordering information

Table 1. Ordering information

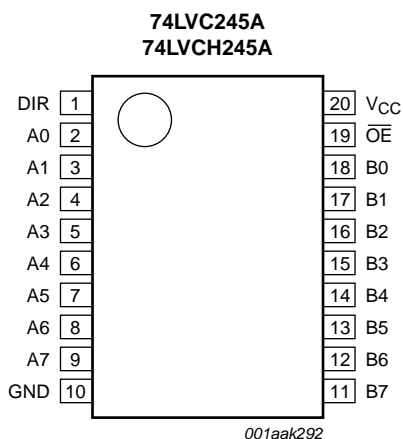
Type number	Package			Version
	Temperature range	Name	Description	
74LVC245AD 74LVCH245AD	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC245ADB 74LVCH245ADB	-40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVC245APW 74LVCH245APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVC245ABQ 74LVCH245ABQ	-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
74LVC245ABX 74LVCH245ABX	-40 °C to +125 °C	DHXQFN20	plastic dual in-line compatible thermal enhanced extremely thin quad flat package; no leads; 20 terminals; body 4.5 × 2.5 × 0.5 mm	SOT1045-2

### 4. Functional diagram

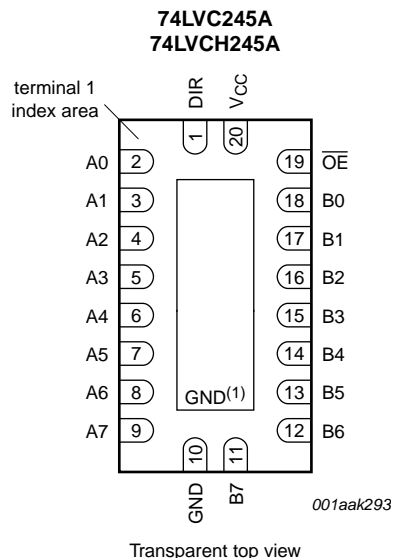


## 5. Pinning information

### 5.1 Pinning



**Fig 3. Pin configuration for SO20 and (T)SSOP20**



- (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.

**Fig 4. Pin configuration for DHVQFN20 and DHXQFN20**

### 5.2 Pin description

**Table 2. Pin description**

Symbol	Pin	Description
DIR	1	direction control
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	data input/output
GND	10	ground (0 V)
B0 to B7	18, 17, 16, 15, 14, 13, 12, 11	data input/output
$\overline{OE}$	19	output enable input (active LOW)
VCC	20	supply voltage

## 6. Functional description

Table 3. Function selection<sup>[1]</sup>

Inputs		Inputs/outputs		
OE	DIR	An	Bn	
L	L	An = Bn	inputs	
L	H	inputs	Bn = An	
H	X	Z	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
$V_{CC}$	supply voltage		-0.5	+6.5	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-50	-	mA
$V_I$	input voltage		<sup>[1]</sup> -0.5	+6.5	V
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
$V_O$	output voltage	output HIGH or LOW	<sup>[2]</sup> -0.5	$V_{CC} + 0.5$	V
		output 3-state	<sup>[2]</sup> -0.5	+6.5	V
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	±50	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °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 and DHXQFN20 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 <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	3.6	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	output HIGH or LOW	0	-	V <sub>CC</sub>	V
		output 3-state	0	-	5.5	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.2 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 3.6 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 <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V	
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	0.65 × V <sub>CC</sub>	-	V	
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V	
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V	
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V	
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	-	0.35 × V <sub>CC</sub>	V	
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V	
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V	
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>							
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V	
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V	
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V	
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V	
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	V	
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>							
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V	
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V	
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V	
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V	
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V	
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V	<sup>[2]</sup>	-	±0.1	±5	-	±20	μA

**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>O</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V	[3]	-	±0.1	±5	-	±20	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0.0 V		-	±0.1	±10	-	±20	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V		-	0.1	10	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.7 V to 3.6 V		-	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
C <sub>I/O</sub>	input/output capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>		-	10	-	-	-	pF
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 1.65; V <sub>I</sub> = 0.58 V	[4][5]	10	-	-	10	-	μA
		V <sub>CC</sub> = 2.3; V <sub>I</sub> = 0.7 V		30	-	-	25	-	μA
		V <sub>CC</sub> = 3.0; V <sub>I</sub> = 0.8 V		75	-	-	60	-	μA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 1.65; V <sub>I</sub> = 1.07 V	[4][5]	-10	-	-	-10	-	μA
		V <sub>CC</sub> = 2.3; V <sub>I</sub> = 1.7 V		-30	-	-	-25	-	μA
		V <sub>CC</sub> = 3.0; V <sub>I</sub> = 2.0 V		-75	-	-	-60	-	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current	V <sub>CC</sub> = 1.95 V		200	-	-	200	-	μA
		V <sub>CC</sub> = 2.7 V		300	-	-	300	-	μA
		V <sub>CC</sub> = 3.6 V	[4][6]	500	-	-	500	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 1.95 V		-200	-	-	-200	-	μA
		V <sub>CC</sub> = 2.7 V		-300	-	-	-300	-	μA
		V <sub>CC</sub> = 3.6 V	[4][6]	-500	-	-	-500	-	μA

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.[2] The bus hold circuit is switched off when V<sub>I</sub> > V<sub>CC</sub> allowing 5.5 V on the input terminal.[3] For I/O ports the parameter I<sub>OZ</sub> includes the input leakage current.

[4] Valid for data inputs of bus hold parts only (74LVCH245A). Note that control inputs do not have a bus hold circuit.

[5] The specified sustaining current at the data input holds the input below the specified V<sub>I</sub> level.

[6] The specified overdrive current at the data input forces the data input to the opposite input state.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ <sup>[2]</sup>	Max	Min	Max		
t <sub>pd</sub>	propagation delay	nAn to nBn; nBn to nAn; see <a href="#">Figure 5</a> <sup>[1]</sup>							
		V <sub>CC</sub> = 1.2 V	-	17.0	-	-	-	ns	
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.5	6.5	14.6	1.5	16.9	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.4	7.6	1.0	8.7	ns	
		V <sub>CC</sub> = 2.7 V	1.5	3.4	7.3	1.5	9.5	ns	
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	2.9	6.3	1.5	8.0	ns	
t <sub>en</sub>	enable time	nOE to nAn, nBn; see <a href="#">Figure 6</a> <sup>[1]</sup>							
		V <sub>CC</sub> = 1.2 V	-	22.0	-	-	-	ns	
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.9	8.3	19.5	1.9	22.5	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.6	10.7	1.5	12.4	ns	
		V <sub>CC</sub> = 2.7 V	1.5	4.8	9.5	1.5	12.0	ns	
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.7	8.5	1.5	11.0	ns	
t <sub>dis</sub>	disable time	nOE to nAn, nBn; see <a href="#">Figure 6</a> <sup>[1]</sup>							
		V <sub>CC</sub> = 1.2 V	-	12.0	-	-	-	ns	
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.9	5.5	12.3	2.9	14.2	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.1	7.1	1.0	8.2	ns	
		V <sub>CC</sub> = 2.7 V	1.5	3.9	8.0	1.5	10.0	ns	
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.7	3.6	7.0	1.7	9.0	ns	
t <sub>sk(o)</sub>	output skew time		<sup>[3]</sup>	-	-	1.0	-	1.5	ns
C <sub>PD</sub>	power dissipation capacitance	per input; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[4]</sup>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	7.7	-	-	-	pF	
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	11.3	-	-	-	pF	
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	14.4	-	-	-	pF	

[1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.

t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.

[2] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

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

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz

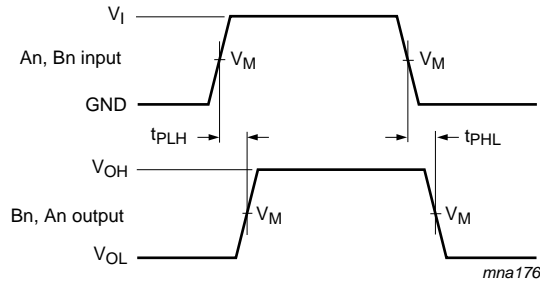
C<sub>L</sub> = output load capacitance in pF

V<sub>CC</sub> = supply voltage in Volts

N = number of inputs switching

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

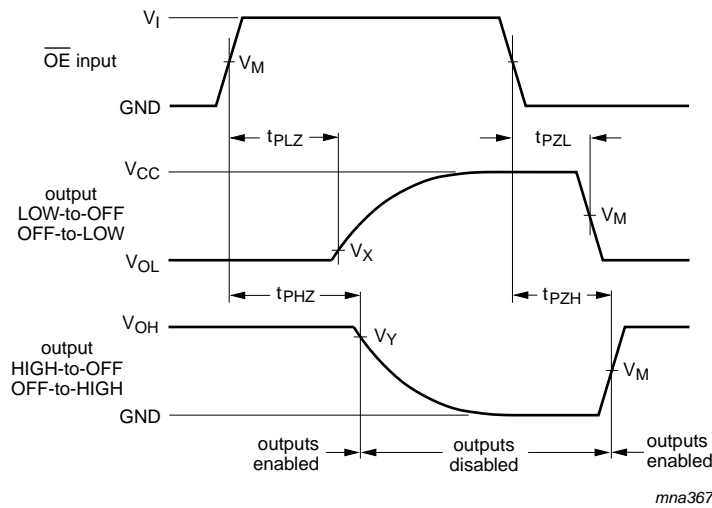
11. AC waveforms



See Table 8 for measurement points

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

Fig 5. Input (An, Bn) to output (Bn, An) propagation delays and output transition times



See Table 8 for measurement points

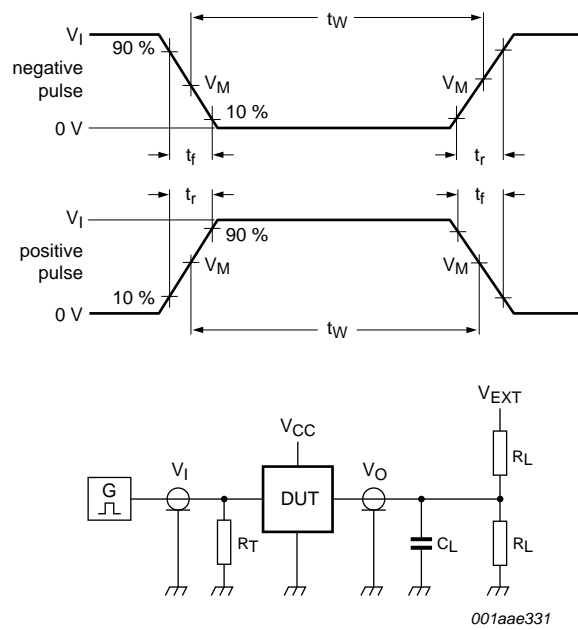
V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

Fig 6. Enable and disable times

Table 8. Measurement points

Supply voltage	V <sub>M</sub>	Input			
		V <sub>I</sub>	t <sub>r</sub> = t <sub>f</sub>	V <sub>X</sub>	V <sub>Y</sub>
V <sub>CC</sub>					
1.2 V	0.5 × V <sub>CC</sub>	V <sub>CC</sub>	≤ 2.5 ns	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V
1.65 V to 1.95 V	0.5 × V <sub>CC</sub>	V <sub>CC</sub>	≤ 2.5 ns	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V
2.3 V to 2.7 V	0.5 × V <sub>CC</sub>	V <sub>CC</sub>	≤ 2.5 ns	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V
2.7 V	1.5 V	2.7 V	≤ 2.5 ns	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V
3.0 V to 3.6 V	1.5 V	2.7 V	≤ 2.5 ns	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V





Test data is given in [Table 9](#).

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 9. Test data**

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

12. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1

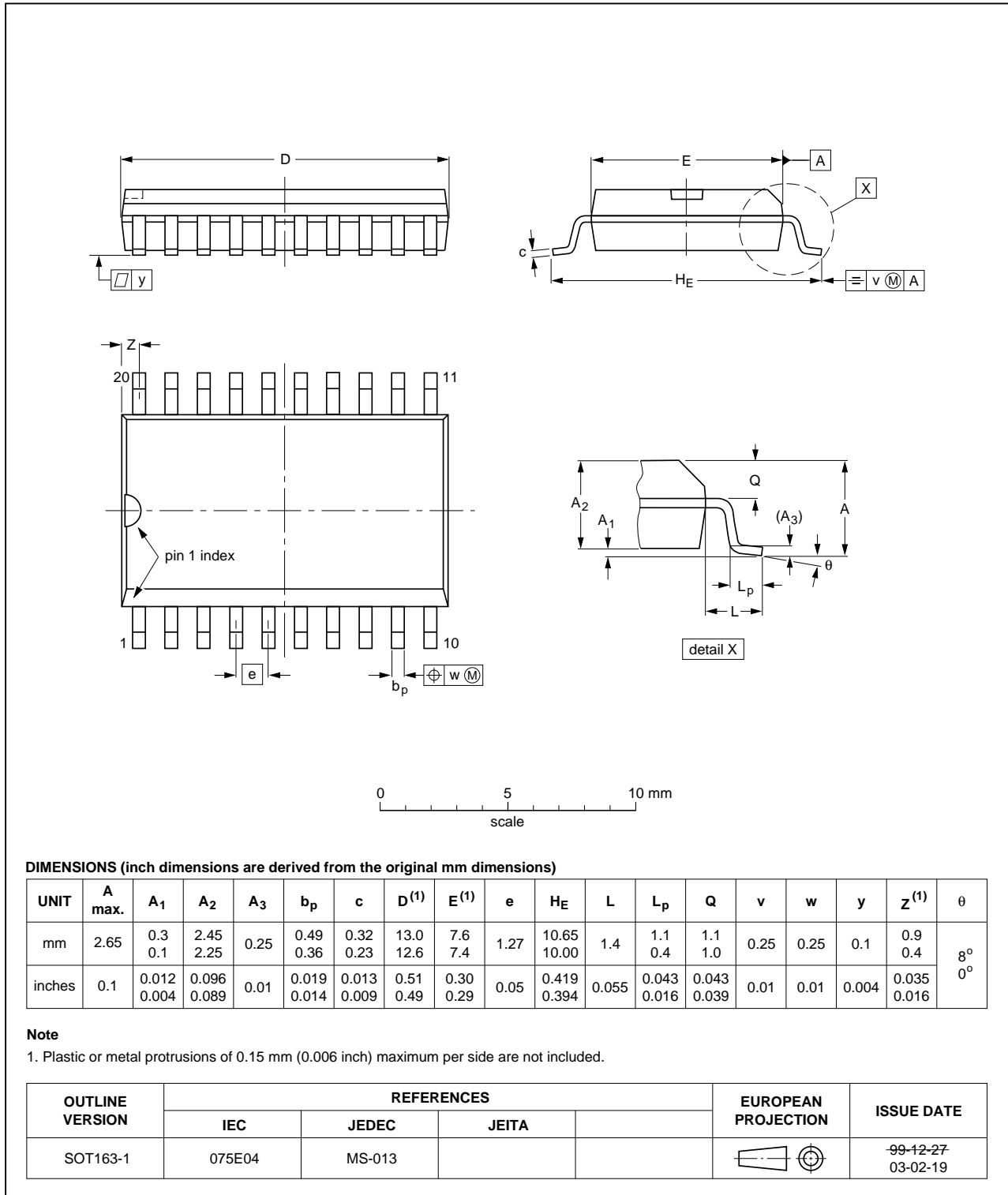


Fig 8. Package outline SOT163-1 (SO20)

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

SOT339-1

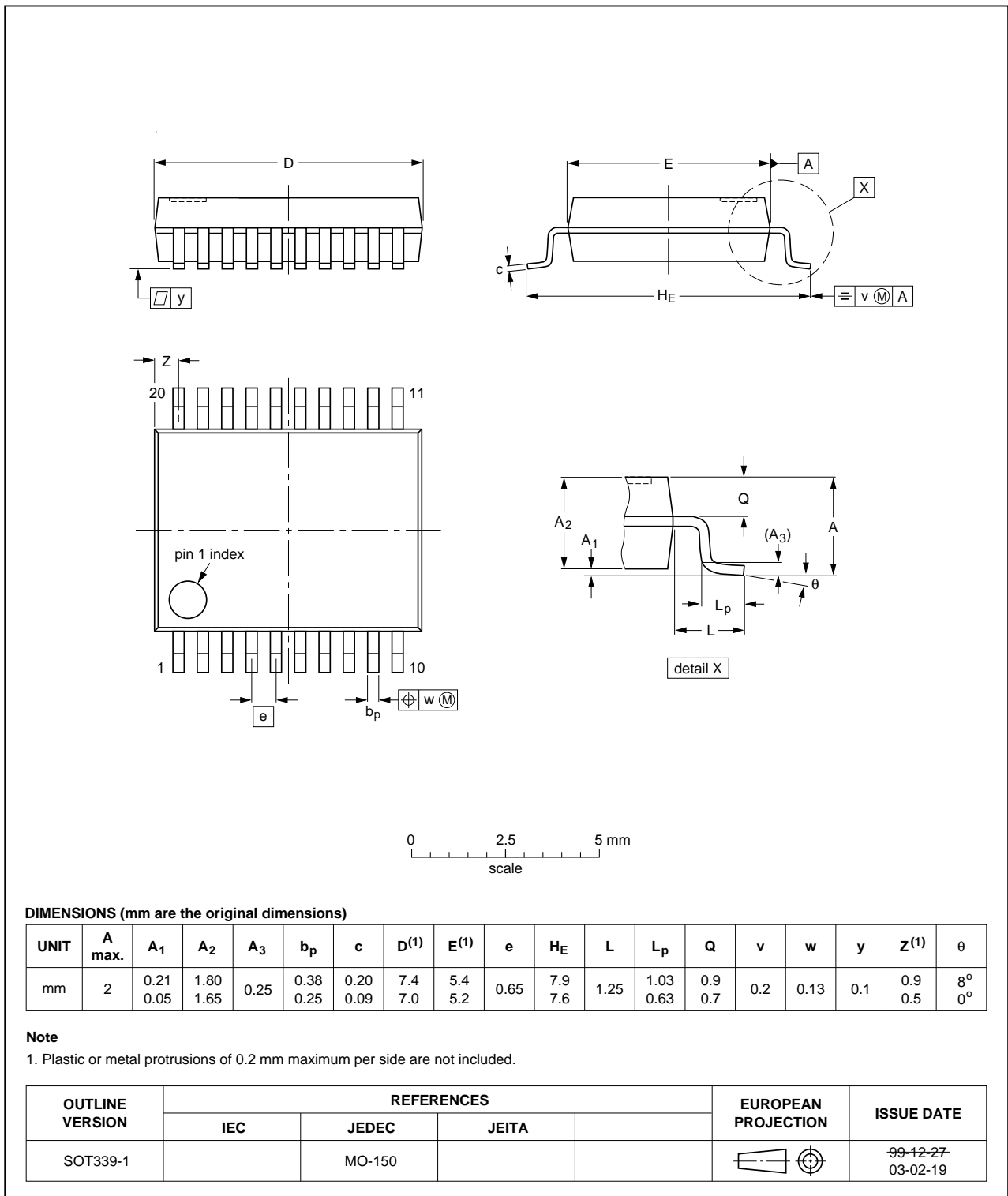


Fig 9. Package outline SOT339-1 (SSOP20)

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

SOT360-1

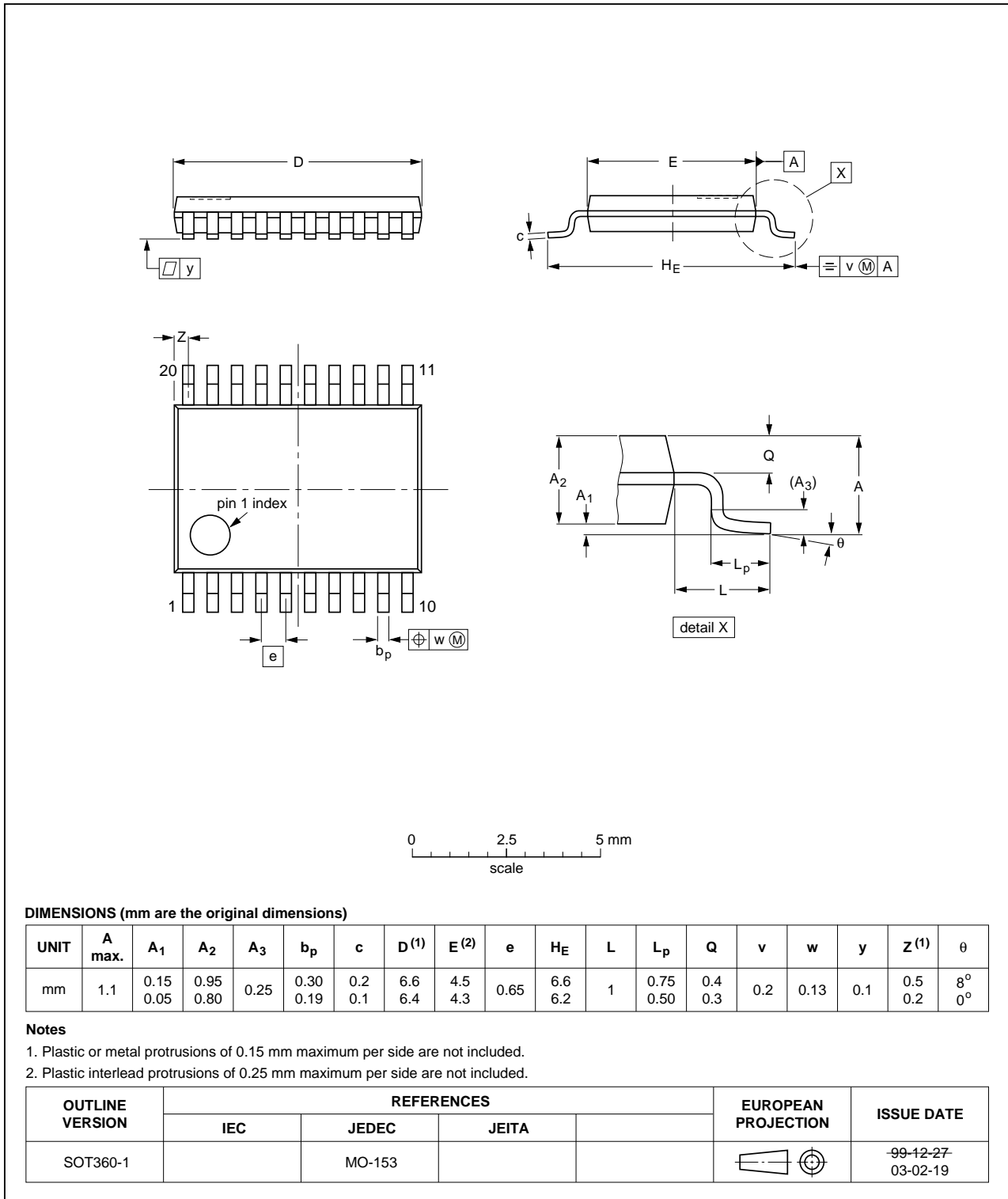
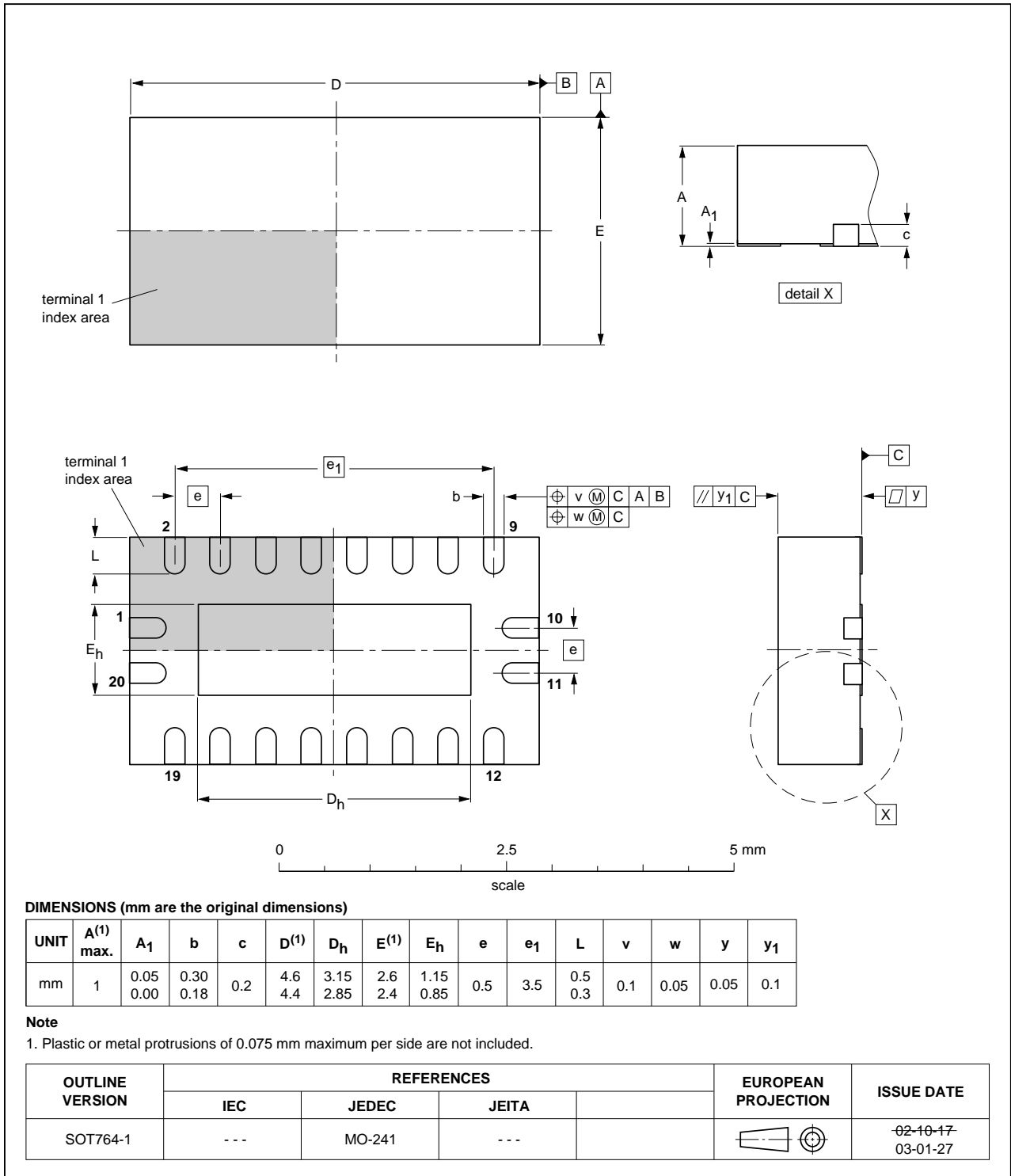


Fig 10. Package outline SOT360-1 (TSSOP20)

**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)**

DHXQFN20U: plastic dual in-line compatible thermal enhanced extremely thin quad flat package; no leads; 20 terminals; UTLP based; body 2.5 x 4.5 x 0.5 mm

SOT1045-1

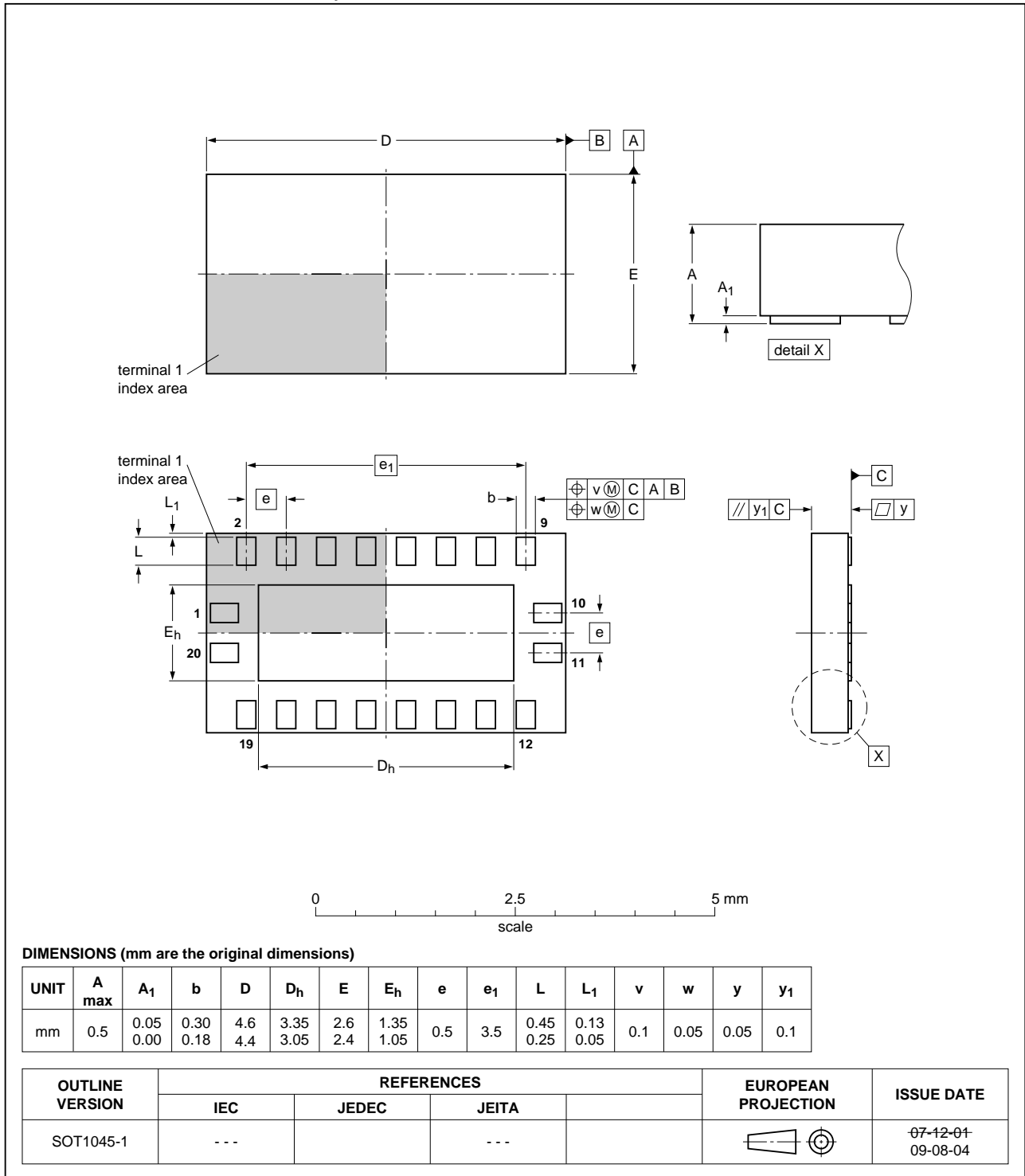


Fig 12. Package outline SOT1045-2 (DHXQFN20)

## 13. Abbreviations

Table 10. Abbreviations

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

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC_LVCH245A v.8	20130628	Product data sheet	-	74LVC_LVCH245A v.7
Modifications:	<ul style="list-style-type: none"> <li>For type numbers 74LVC245ABX and 74LVCH245ABX DHXQFN20U (SOT1045-1) has changed to DHXQFN20 (SOT1045-2).</li> </ul>			
74LVC_LVCH245A v.7	20120405	Product data sheet	-	74LVC_LVCH245A v.6
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table note 4</a> of <a href="#">Table 6</a>: corrected (errata)</li> </ul>			
74LVC_LVCH245A v.6	20111125	Product data sheet	-	74LVC_LVCH245A v.5
Modifications:	<ul style="list-style-type: none"> <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 9</a>: values added for lower voltage ranges.</li> </ul>			
74LVC_LVCH245A v.5	20090825	Product data sheet	-	74LVC_LVCH245A v.4
74LVC_LVCH245A v.4	20090703	Product data sheet	-	74LVC_LVCH245A v.3
74LVC_LVCH245A v.3	20030507	Product specification	-	74LVC245A_74LVCH245A v.2
74LVC245A_74LVCH245A v.2	20020620	Product specification	-	74LVC245A_74LVCH245A v.1
74LVC245A_74LVCH245A v.1	19971219	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.
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[2] The term 'short data sheet' is explained in section "Definitions".

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Date of release: 28 June 2013

Document identifier: 74LVC\_LVCH245A