

# 74AHC241; 74AHCT241

Octal buffer/line driver; 3-state

Rev. 01 — 11 January 2010

Product data sheet

## 1. General description

The 74AHC241 and 74AHCT241 are 8-bit buffer/line drivers with 3-state outputs. These devices can be used as two 4-bit buffers or one 8-bit buffer. They feature two output enables ( $1\overline{OE}$  and  $2OE$ ), each controlling four of the 3-state outputs. A HIGH on  $1\overline{OE}$  or LOW on  $2OE$  causes the associated outputs to assume a high-impedance OFF-state. Inputs are over voltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

## 2. Features

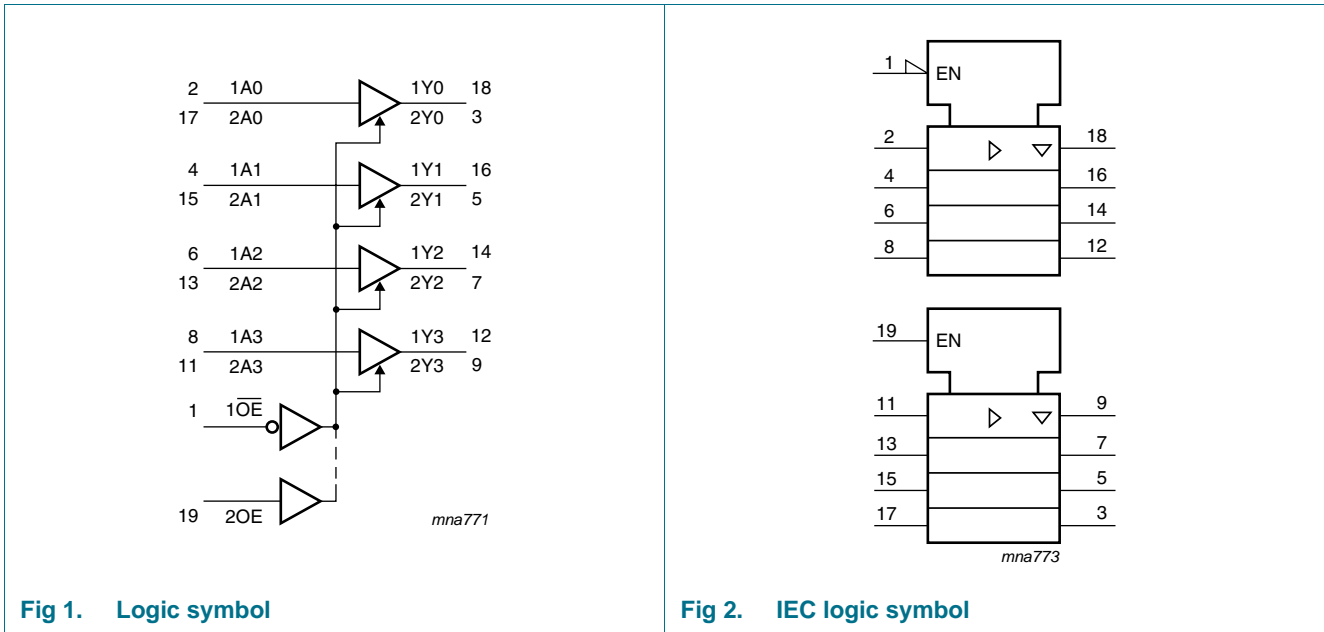
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accepts voltages higher than  $V_{CC}$
- For 74AHC241 only: operates with CMOS input levels
- For 74AHCT241 only: operates with TTL input levels
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ CDM JESD22-C101D exceeds 1000 V
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

## 3. Ordering information

Table 1. Ordering information

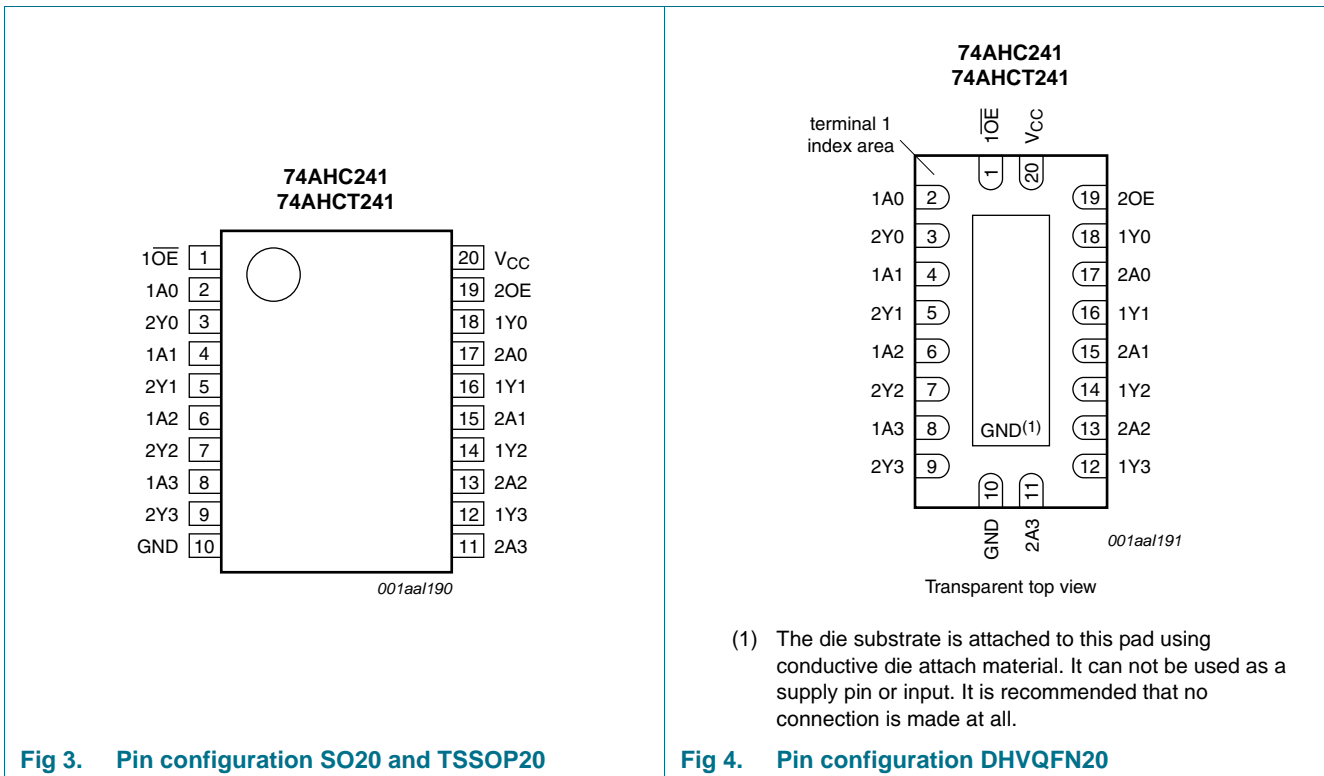
Type number	Package			
	Temperature range	Name	Description	Version
74AHC241D 74AHCT241D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74AHC241PW 74AHCT241PW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74AHC241BQ 74AHCT241BQ	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body $2.5 \times 4.5 \times 0.85\text{ mm}$	SOT764-1

## 4. Functional diagram



## 5. Pinning information

### 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$1\overline{OE}$	1	output enable input (active LOW)
2OE	19	output enable input (active HIGH)
1A0, 1A1, 1A2, 1A3	2, 4, 6, 8	data input
2A0, 2A1, 2A2, 2A3	17, 15, 13, 11	data input
1Y0, 1Y1, 1Y2, 1Y3	18, 16, 14, 12	data output
2Y0, 2Y1, 2Y2, 2Y3	3, 5, 7, 9	data output
GND	10	ground (0 V)
V <sub>CC</sub>	20	power supply

## 6. Functional description

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

Input		Output	Input		Output
$1\overline{OE}$	1An	1Yn	2OE	2An	2Yn
L	L	L	H	L	L
L	H	H	H	H	H
H	X	Z	L	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	+7.0	V
V <sub>I</sub>	input voltage		-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V	[1] -20	-	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V	[1] -	±20	mA
I <sub>O</sub>	output current	V <sub>O</sub> = -0.5 V to (V <sub>CC</sub> + 0.5 V)	-	±25	mA
I <sub>CC</sub>	supply current		-	75	mA
I <sub>GND</sub>	ground current		-75	-	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	[2] -	500	mW

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

[2] For SO20 package: above 70 °C the value of P<sub>tot</sub> derates linearly with 8.0 mW/K.  
 For TSSOP20 package: above 60 °C the value of P<sub>tot</sub> derates linearly with 5.5 mW/K.  
 For DHVQFN20 package: above 60 °C the value of P<sub>tot</sub> derates linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74AHC241</b>						
V <sub>CC</sub>	supply voltage		2.0	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 3.3 V ± 0.3 V	-	-	100	ns/V
		V <sub>CC</sub> = 5 V ± 0.5 V	-	-	20	ns/V
<b>74AHCT241</b>						
V <sub>CC</sub>	supply voltage		4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 5 V ± 0.5 V	-	-	20	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74AHC241</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	1.65	-	1.65	-	1.65	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> = -50 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V	3.94	-	-	3.80	-	3.70	-	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> = 50 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.36	-	0.44	-	0.55	V

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

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$I_I$	input leakage current	$V_I = 5.5 \text{ V}$ or GND; $V_{CC} = 0 \text{ V}$ to 5.5 V	-	-	0.1	-	1.0	-	2.0	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	$\pm 0.25$	-	$\pm 2.5$	-	$\pm 10.0$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	$\mu\text{A}$
$C_I$	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF
$C_O$	output capacitance		-	4	-	-	-	-	-	pF

**74AHCT241**

$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V}$ to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$ $I_O = -50 \mu\text{A}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -8.0 \text{ mA}$	3.94	-	-	3.80	-	3.70	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$ $I_O = 50 \mu\text{A}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 8.0 \text{ mA}$	-	-	0.36	-	0.44	-	0.55	V
$I_I$	input leakage current	$V_I = 5.5 \text{ V}$ or GND; $V_{CC} = 0 \text{ V}$ to 5.5 V	-	-	0.1	-	1.0	-	2.0	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND per input pin; other inputs at $V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	$\pm 0.25$	-	$\pm 2.5$	-	$\pm 10.0$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	$\mu\text{A}$
$\Delta I_{CC}$	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}$ ; other pins at $V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
$C_I$	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF
$C_O$	output capacitance		-	4	-	-	-	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

 Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max (85 °C)	Max (125 °C)	
<b>74AHC241</b>									
t <sub>pd</sub>	propagation delay	nAn to nYn; see <a href="#">Figure 5</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	4.5	8.4	1.0	9.7	11.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	6.5	12.2	1.0	14.5	16.9	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.2	5.4	1.0	6.2	7.8	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	3.2	7.9	1.0	9.2	11.2	ns
t <sub>en</sub>	enable time	1OE to 1Yn; see <a href="#">Figure 6</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	8.9	10.4	1.0	12.2	14.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	5.5	14.8	1.0	17.8	19.6	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	6.1	6.6	1.0	7.6	9.1	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	3.9	9.4	1.0	11.0	12.2	ns
		2OE to 2Yn; see <a href="#">Figure 7</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	6.5	10.4	1.0	12.2	14.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	5.6	14.8	1.0	17.8	19.6	ns
t <sub>dis</sub>	disable time	1OE to 1Yn; see <a href="#">Figure 6</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	5.1	10.2	1.0	11.8	13.3	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	7.2	14.4	1.0	15.8	19.2	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.6	7.3	1.0	8.2	9.2	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.1	9.9	1.0	10.8	13.0	ns
		2OE to 2Yn; see <a href="#">Figure 7</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 15 pF	-	5.0	10.2	1.0	11.8	13.3	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V; C <sub>L</sub> = 50 pF	-	7.1	14.4	1.0	15.8	19.2	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> ; C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz <sup>[3]</sup>	-	9	-	-	-	-	pF
<b>74AHCT241</b>									
t <sub>pd</sub>	propagation delay	nAn to nYn; see <a href="#">Figure 5</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.5	5.7	1.0	6.5	7.9	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.1	7.9	1.0	9.2	11.2	ns

**Table 7. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +125 °C			Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max (85 °C)	Max (125 °C)	
t <sub>en</sub>	enable time	1OE to 1Yn; see <a href="#">Figure 6</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.7	6.6	1.0	7.8	9.2	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.4	9.5	1.0	11.1	12.4	ns
		2OE to 2Yn; see <a href="#">Figure 7</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	3.7	6.6	1.0	7.8	9.2	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	5.4	9.5	1.0	11.1	12.4	ns
t <sub>dis</sub>	disable time	1OE to 1Yn; see <a href="#">Figure 6</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	4.8	7.8	1.0	8.8	9.7	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	7.1	10.5	1.0	11.4	13.5	ns
		2OE to 2Yn; see <a href="#">Figure 7</a> <sup>[2]</sup>							
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 15 pF	-	4.8	7.8	1.0	8.8	9.7	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V; C <sub>L</sub> = 50 pF	-	7.1	10.5	1.0	11.4	13.5	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> ; C <sub>L</sub> = 50 pF; f <sub>i</sub> = 1 MHz <sup>[3]</sup>	-	9	-	-	-	-	pF

[1] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V and V<sub>CC</sub> = 5.0 V).

[2] 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>PZH</sub> and t<sub>PZL</sub>; t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

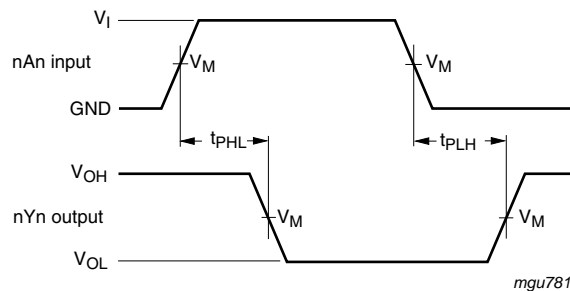
C<sub>L</sub> = output load capacitance in pF;

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

N = number of inputs switching;

∑(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

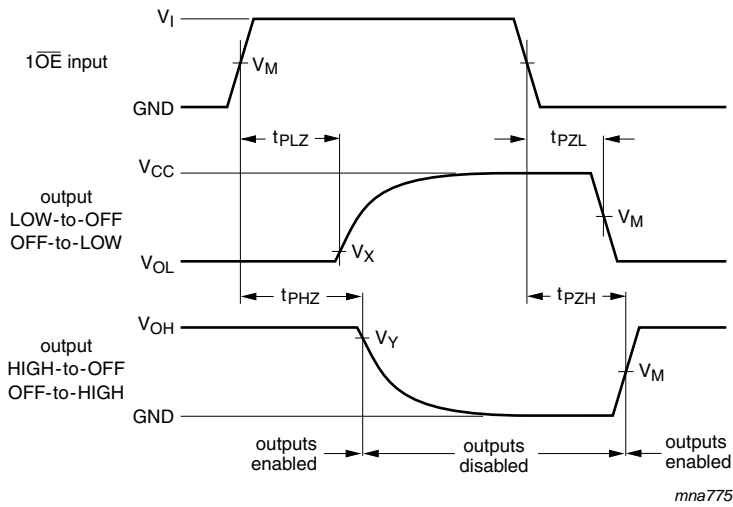
## 11. Waveforms



Measurement points are given in [Table 8](#).

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

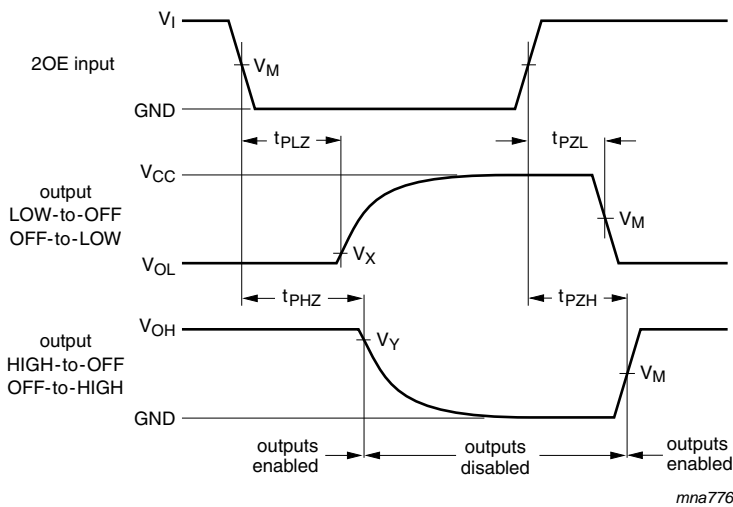
**Fig 5. Propagation delay input (nAn) to output (nYn)**



Measurement points are given in [Table 8](#).

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

**Fig 6. Enable and disable times for input  $\overline{1OE}$**



Measurement points are given in [Table 8](#).

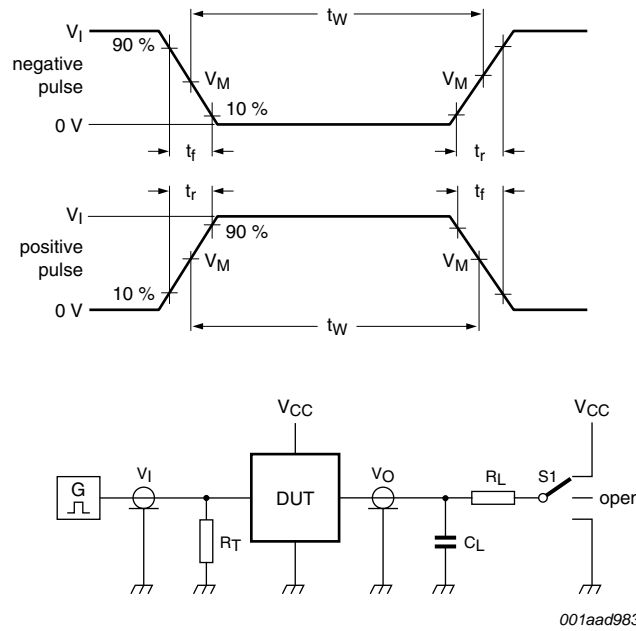
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 7. Enable and disable times for input 2OE**

**Table 8. Measurement points**

Type	Input		Output	
	$V_M$	$V_M$	$V_X$	$V_Y$
74AHC241	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$
74AHCT241	1.5 V	$0.5V_{CC}$	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$





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

Definitions test circuit:

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

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

$R_L$  = Load resistance.

S1 = Test selection switch.

**Fig 8. Load circuitry for switching times**

**Table 9. Test data**

Type	Input		Load		S1 position		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHL}, t_{PLH}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
74AHC241	$V_{CC}$	3.0 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$
74AHCT241	3.0 V	3.0 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$

## 12. Package outline

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

SOT163-1

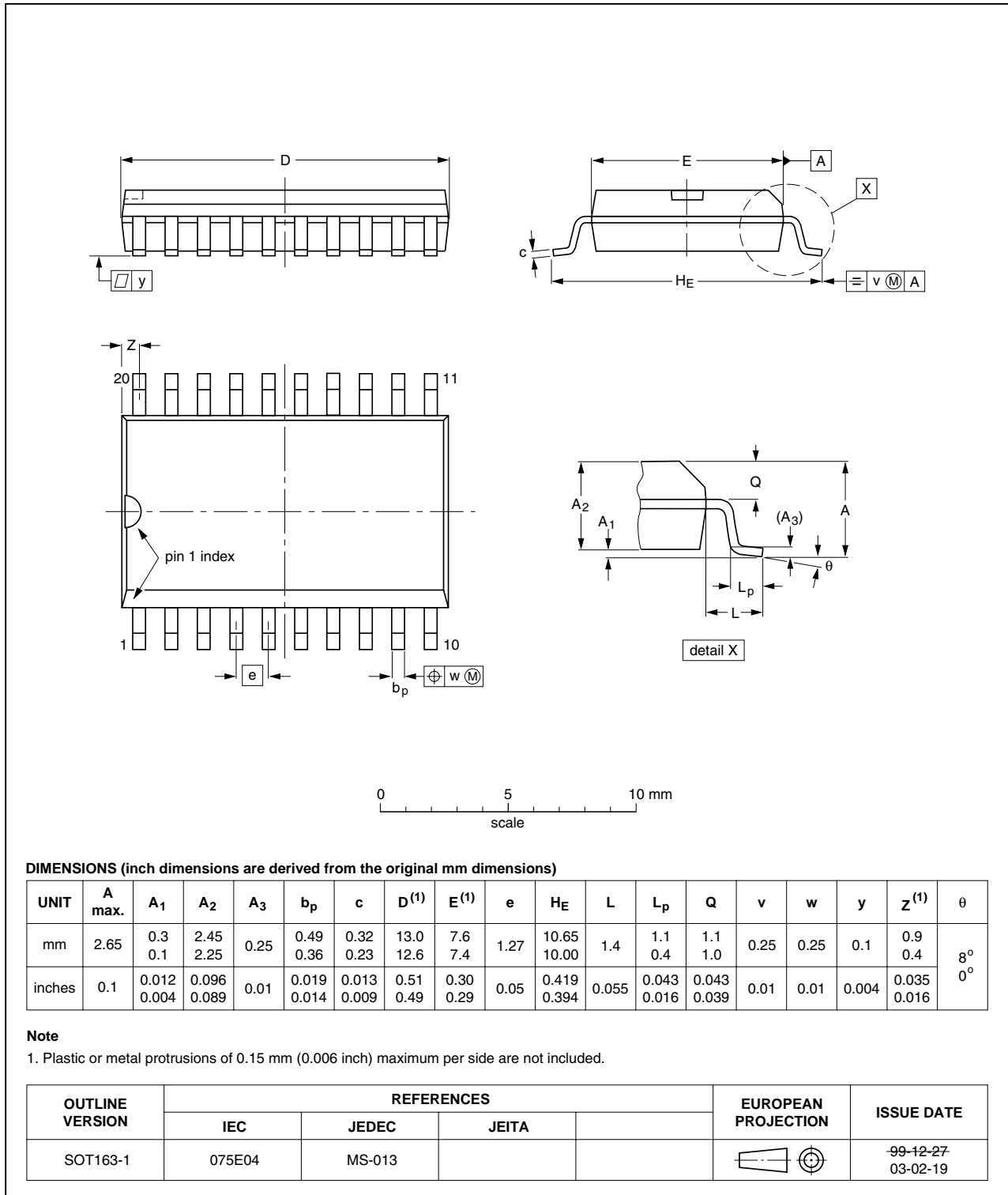


Fig 9. Package outline SOT163-1 (SO20)

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

SOT360-1

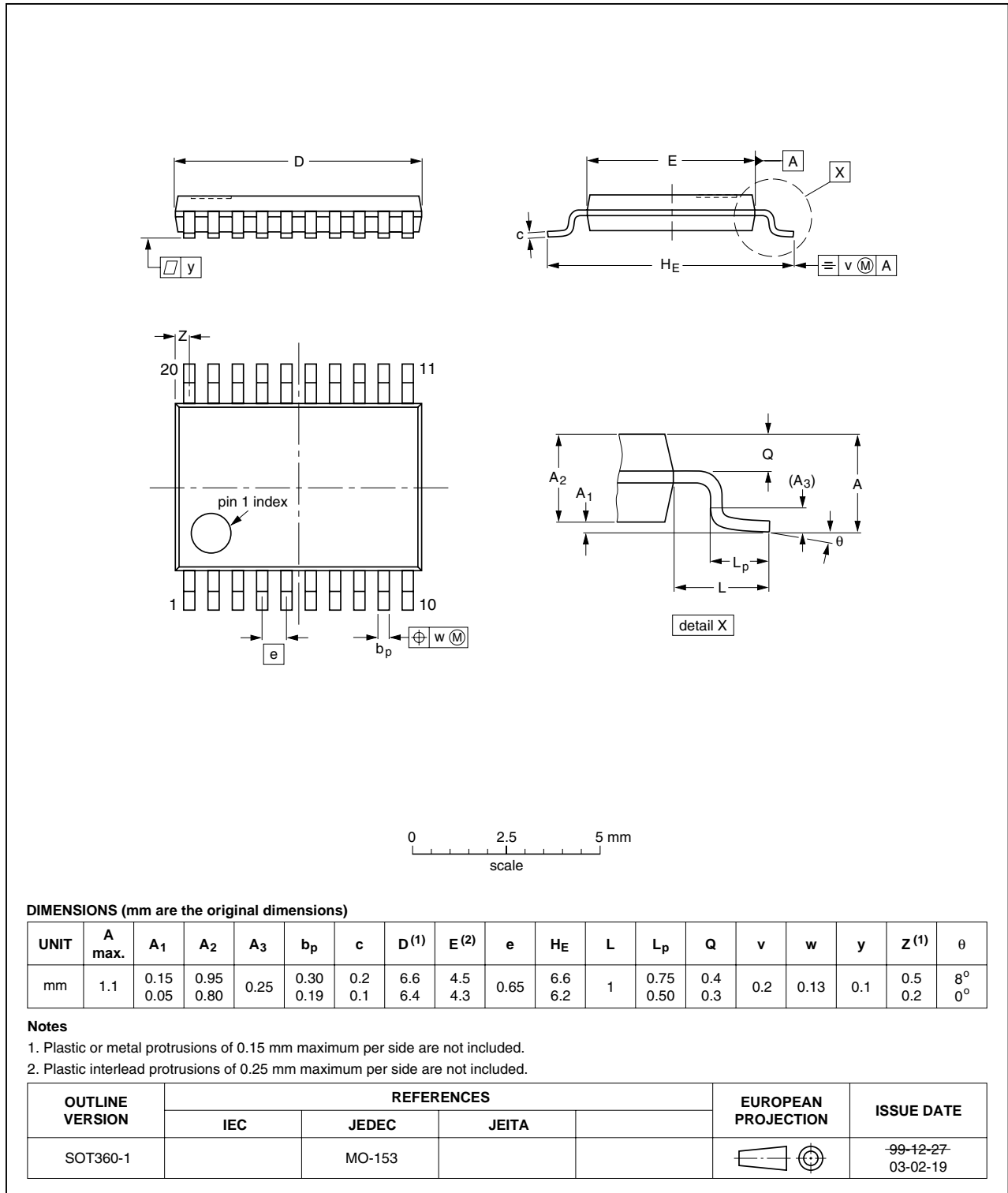
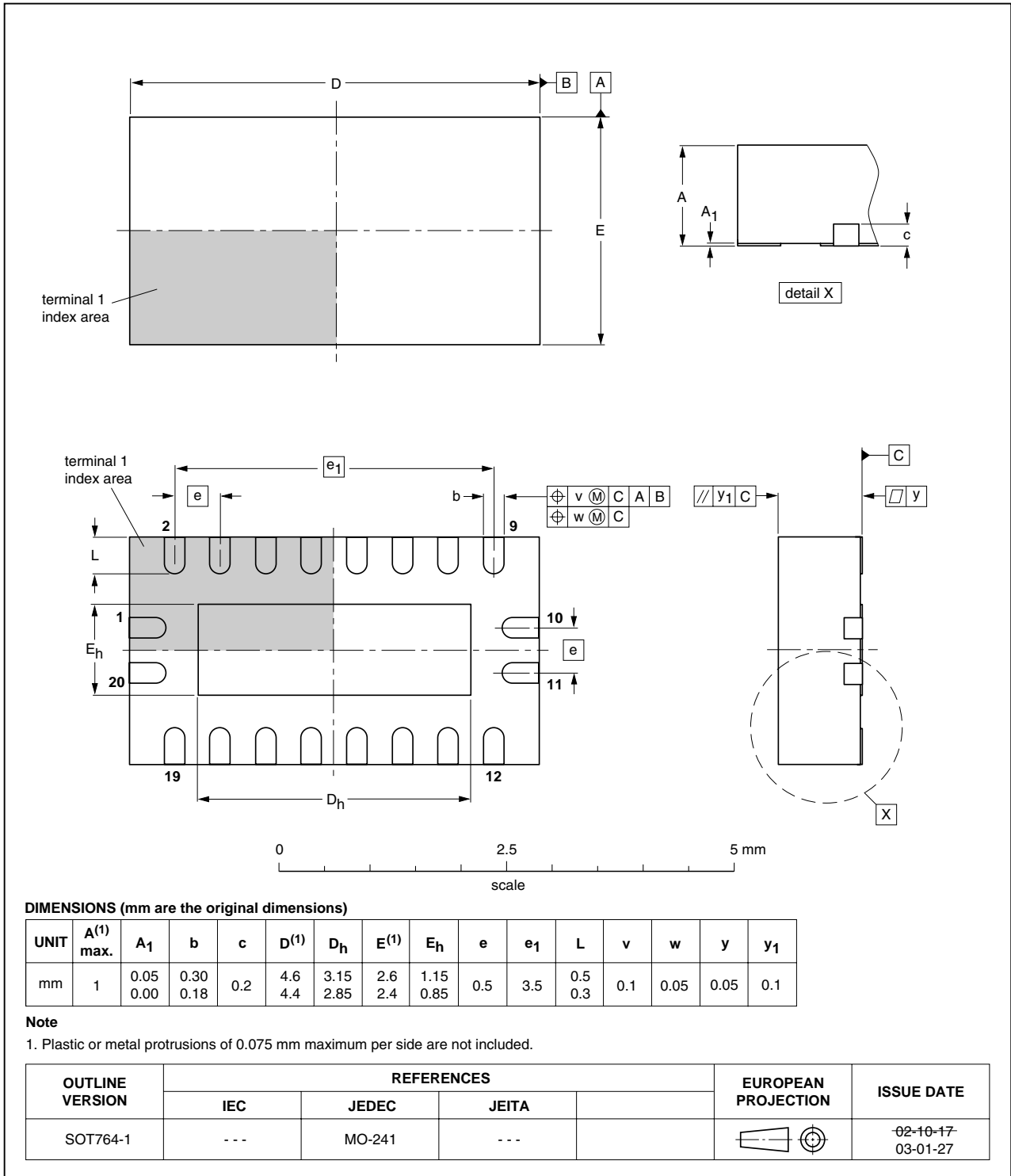


Fig 10. Package outline SOT360-1 (TSSOP20)

**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 10. Abbreviations

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

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT241_1	20100111	Product data sheet	-	-

## 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.nxp.com>.

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