

74LVC574A

Octal D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state

Rev. 5 — 18 December 2012

Product data sheet

1. General description

The 74LVC574A is an octal D-type flip-flop featuring separate D-type inputs for each flip-flop and 3-state outputs for bus-oriented applications. A clock (CP) and an Output Enable ($\overline{OE}$) input are common to all flip-flops.

The eight flip-flops will store the state of their individual D-inputs that meet the set-up and hold times requirements on the LOW to HIGH CP transition.

When $\overline{OE}$ is LOW, the contents of the eight flip-flops are available at the outputs. When $\overline{OE}$ is HIGH, the outputs go to the high-impedance OFF-state. Operation of the $\overline{OE}$ input does not affect the state of the flip-flops.

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 or 5 V applications.

The 74LVC574A is functionally identical to the 74LVC374A, but has a different pin arrangement.

2. Features and benefits

- 5 V tolerant inputs for interfacing with 5 V logic
- Supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- High-impedance when $V_{CC} = 0$ V
- 8-bit positive edge-triggered register
- Independent register and 3-state buffer operation
- Flow-through pin-out architecture
- 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-A115-B exceeds 200 V
 - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to $+85$ °C and -40 °C to $+125$ °C

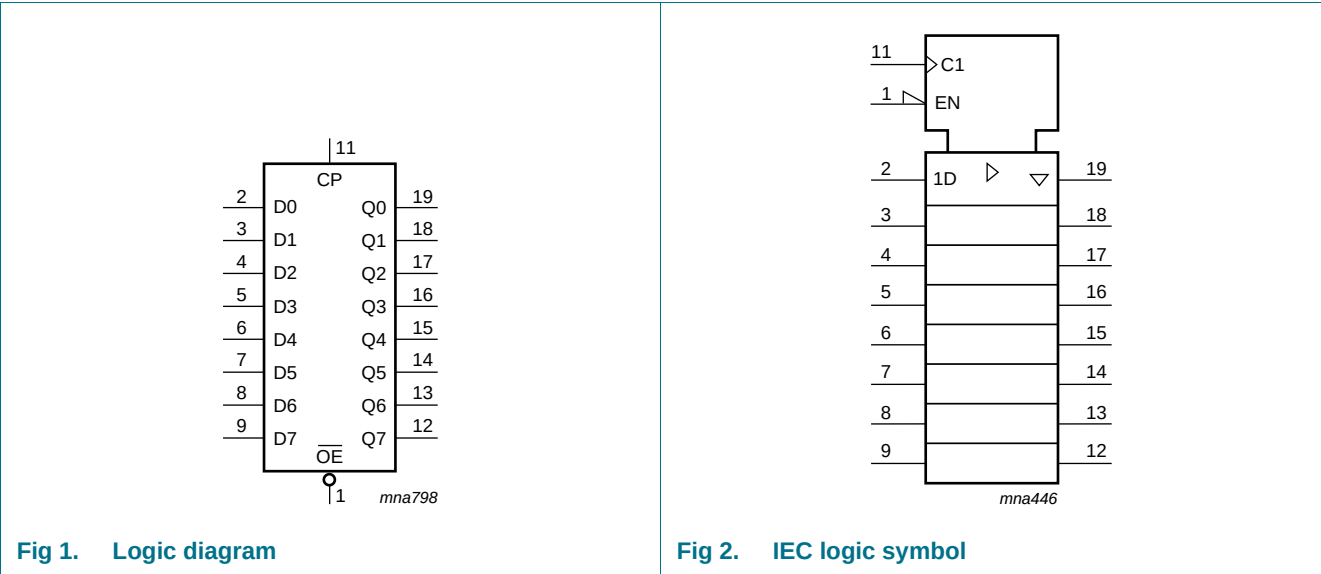


3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC574AD	−40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC574ADB	−40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVC574APW	−40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVC574ABQ	−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



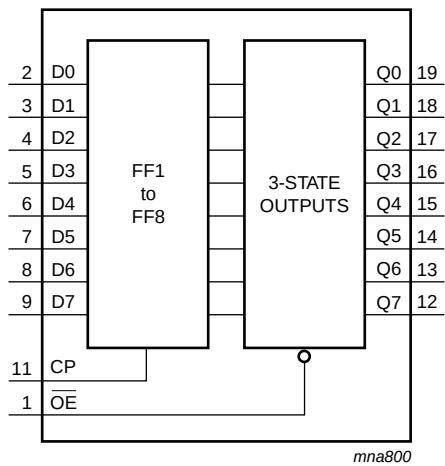


Fig 3. Functional diagram

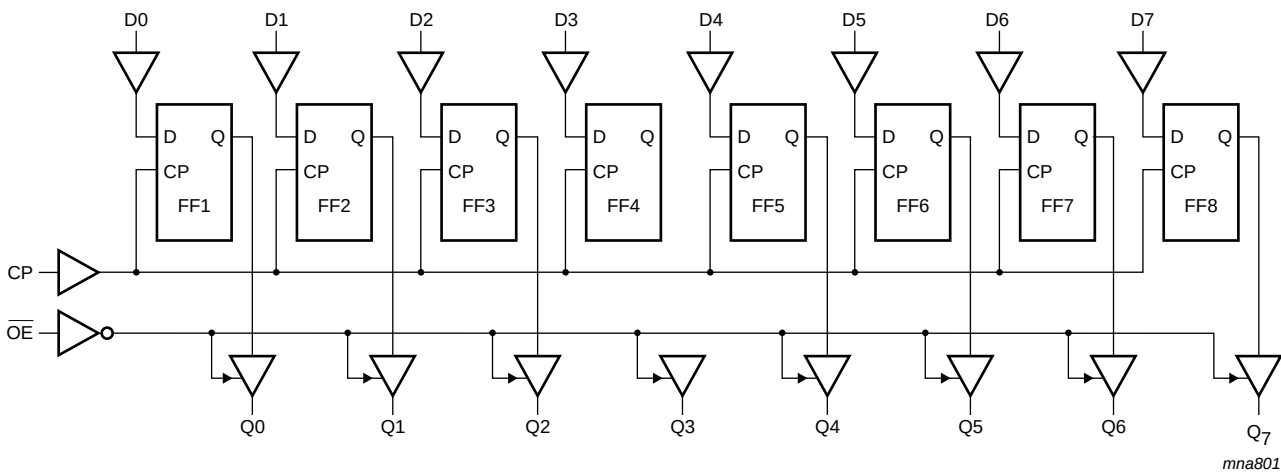
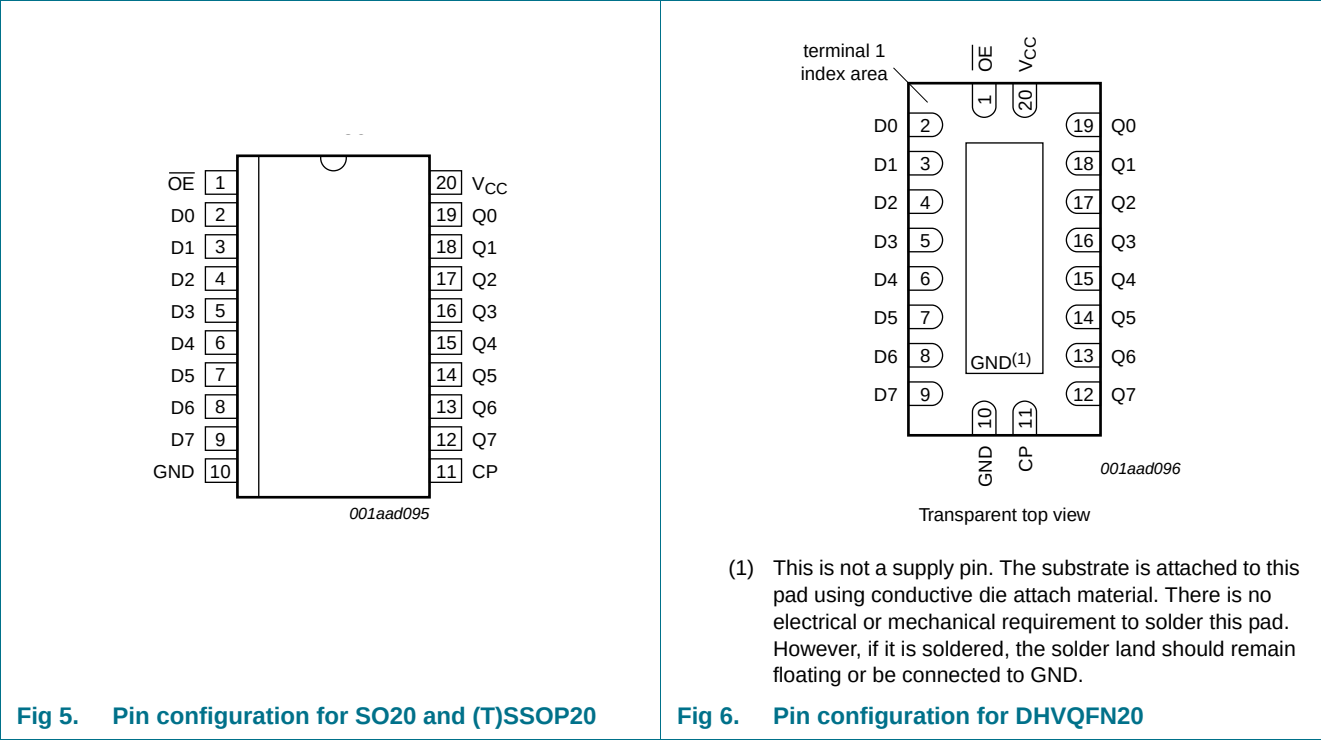


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description		
Symbol	Pin	Description
$\overline{OE}$	1	output enable input (active LOW)
CP	11	clock input (LOW to HIGH; edge triggered)
D[0:7]	2, 3, 4, 5, 6, 7, 8, 9	data input
Q[0:7]	19, 18, 17, 16, 15, 14, 13, 12	data output
GND	10	ground (0 V)
V _{CC}	20	supply voltage

6. Functional description

Table 3. Functional table^[1]

Operating modes	Input			Internal flip-flop	Output Qn
	OE	CP	Dn		
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Load register and disable outputs	H	↑	l	L	Z
	H	↑	h	H	Z

- [1] H = HIGH voltage level
 h = HIGH voltage level one set-up time prior to the LOW to HIGH CP transition
 L = LOW voltage level
 l = LOW voltage level one set-up time prior to the LOW to HIGH CP transition
 ↑ = LOW to HIGH clock transition
 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	−50	-	mA
V _I	input voltage		^[1] −0.5	+6.5	V
I _{OK}	output clamping current	V _O > V _{CC} or V _O < 0	-	±50	mA
V _O	output voltage	output HIGH or LOW state	^[2] −0.5	V _{CC} + 0.5	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	^[3] -	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 the value of P_{tot} derates linearly with 8 mW/K.
 For (T)SSOP20 packages: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.
 For DHVQFN20 packages: above 60 °C the value of P_{tot} derates 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	in free air	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 1.65 V to 2.7 V	0	-	20	ns/V
		V _{CC} = 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 ^[1]	Max	Min	Max	
V _{IH}	HIGH-level input voltage	V _{CC} = 1.2 V	1.08	-	-	1.08	-	V
		V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}	-	-	0.65 × V _{CC}	-	V
		V _{CC} = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.2 V	-	-	0.12	-	0.12	V
		V _{CC} = 1.65 V to 1.95 V	-	-	0.35 × V _{CC}	-	0.35 × V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = -100 μA; V _{CC} = 1.65 V to 3.6 V	V _{CC} - 0.2	-	-	V _{CC} - 0.3	-	V
		I _O = -4 mA; V _{CC} = 1.65 V	1.2	-	-	1.05	-	V
		I _O = -8 mA; V _{CC} = 2.3 V	1.8	-	-	1.65	-	V
		I _O = -12 mA; V _{CC} = 2.7 V	2.2	-	-	2.05	-	V
		I _O = -18 mA; V _{CC} = 3.0 V	2.4	-	-	2.25	-	V
		I _O = -24 mA; V _{CC} = 3.0 V	2.2	-	-	2.0	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = 100 μA; V _{CC} = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I _O = 4 mA; V _{CC} = 1.65 V	-	-	0.45	-	0.65	V
		I _O = 8 mA; V _{CC} = 2.3 V	-	-	0.6	-	0.8	V
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.4	-	0.6	V
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.55	-	0.8	V
I _I	input leakage current	V _{CC} = 3.6 V; V _I = 5.5 V or GND	-	±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 ^[1]	Max	Min	Max	
I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _{CC} = 3.6 V; V _O = 5.5 V or GND;	-	0.1	±10	-	±20	μA
I _{OFF}	power-off leakage supply	V _{CC} = 0 V; V _I or V _O = 5.5 V	-	0.1	±10	-	±20	μA
I _{CC}	supply current	V _{CC} = 3.6 V; V _I = V _{CC} or GND; I _O = 0 A	-	0.1	10	-	40	μA
ΔI _{CC}	additional supply current	per input pin; V _{CC} = 2.7 V to 3.6 V; V _I = V _{CC} – 0.6 V; I _O = 0 A	-	5	500	-	5000	μA
C _I	input capacitance	V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC}	-	5.0	-	-	-	pF

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristicsVoltages are referenced to GND (ground = 0 V). For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	–40 °C to +85 °C			–40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
t _{pd}	propagation delay	CP to Qn; see Figure 7 ^[2]						
		V _{CC} = 1.2 V	-	17.0	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	4.6	6.4	13.1	4.6	15.1	ns
		V _{CC} = 2.3 V to 2.7 V	2.6	3.9	7.9	2.6	9.1	ns
		V _{CC} = 2.7 V	1.5	3.7	8.0	1.5	10.0	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	3.5	7.0	1.5	9.0	ns
t _{en}	enable time	OE to Qn; see Figure 9 ^[2]						
		V _{CC} = 1.2 V	-	19.0	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	1.5	7.0	17.1	1.5	19.8	ns
		V _{CC} = 2.3 V to 2.7 V	1.5	4.0	9.4	1.5	10.9	ns
		V _{CC} = 2.7 V	1.5	4.1	8.5	1.5	11.0	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	3.2	7.5	1.5	9.5	ns
t _{dis}	disable time	OE to Qn; see Figure 9 ^[2]						
		V _{CC} = 1.2 V	-	9.0	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	2.5	4.1	10.1	2.5	11.6	ns
		V _{CC} = 2.3 V to 2.7 V	1.0	2.3	5.7	1.0	6.6	ns
		V _{CC} = 2.7 V	1.5	3.1	6.5	1.5	8.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	2.9	6.0	1.5	7.5	ns

Table 7. Dynamic characteristics ...continuedVoltages are referenced to GND (ground = 0 V). For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	–40 °C to +85 °C			–40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
t _W	pulse width	clock HIGH or LOW; see Figure 7						
		V _{CC} = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V _{CC} = 2.7 V	3.3	-	-	3.3	-	ns
		V _{CC} = 3.0 V to 3.6 V	3.3	1.7	-	3.3	-	ns
t _{su}	set-up time	Dn to CP; see Figure 8						
		V _{CC} = 1.65 V to 1.95 V	4.0	-	-	4.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	2.5	-	-	2.5	-	ns
		V _{CC} = 2.7 V	2.0	-	-	2.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	2.0	0.3	-	2.0	-	ns
t _h	hold time	Dn to CP; see Figure 8						
		V _{CC} = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns
		V _{CC} = 2.7 V	1.5	-	-	1.5	-	ns
		V _{CC} = 3.0 V to 3.6 V	+1.5	–0.2	-	+1.5	-	ns
f _{max}	maximum frequency	see Figure 7						
		V _{CC} = 1.65 V to 1.95 V	100	-	-	80	-	MHz
		V _{CC} = 2.3 V to 2.7 V	125	-	-	100	-	MHz
		V _{CC} = 2.7 V	150	-	-	120	-	MHz
		V _{CC} = 3.0 V to 3.6 V	150	200	-	120	-	MHz
t _{sk(0)}	output skew time	V _{CC} = 3.0 V to 3.6 V ^[3]	-	-	1.0	-	1.5	ns
C _{PD}	power dissipation capacitance	per flip-flop; V _I = GND to V _{CC} ^[4]						
		V _{CC} = 1.65 V to 1.95 V	-	11.2	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	13.2	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	14.9	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 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 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

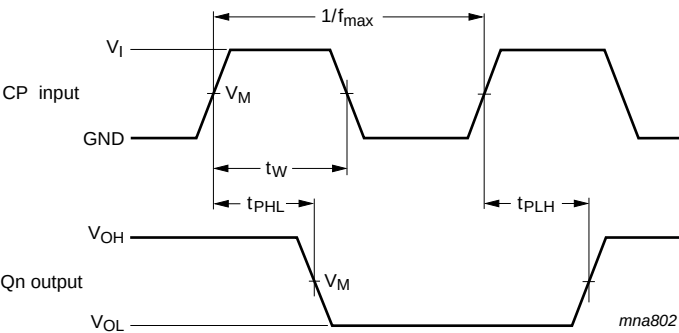
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volts

N = number of inputs switching

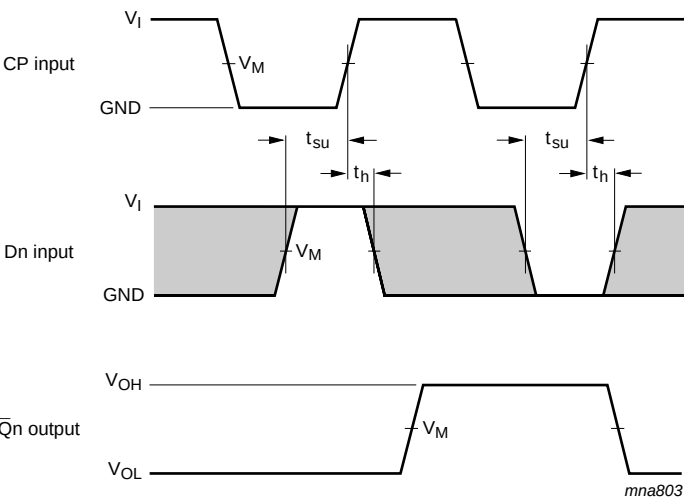
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs

11. AC waveforms



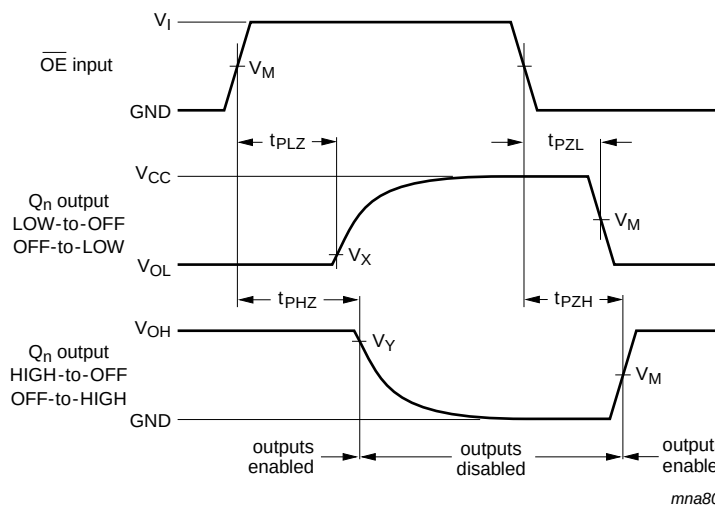
Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 7. Clock (CP) to output (Qn) propagation delays, the clock pulse width, output transition times, and the maximum frequency



Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.
The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 8. Data set-up and hold times for the Dn input to the CP input

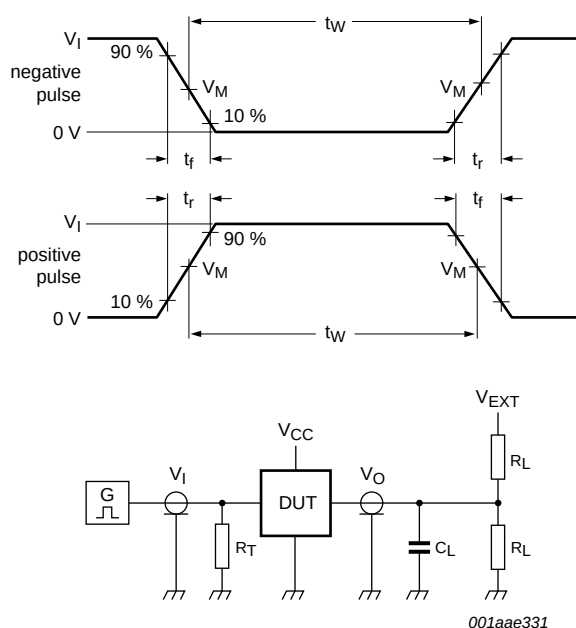


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 9. 3-state enable and disable times

Table 8. Measurement points

Supply voltage	Input		Output		
V_{CC}	V_I	V_M	V_M	V_X	V_Y
1.2 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.65 V to 1.95 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



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 10. Test circuitry 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}	≤ 2 ns	30 pF	1 k Ω	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 k Ω	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	30 pF	500 Ω	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	≤ 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

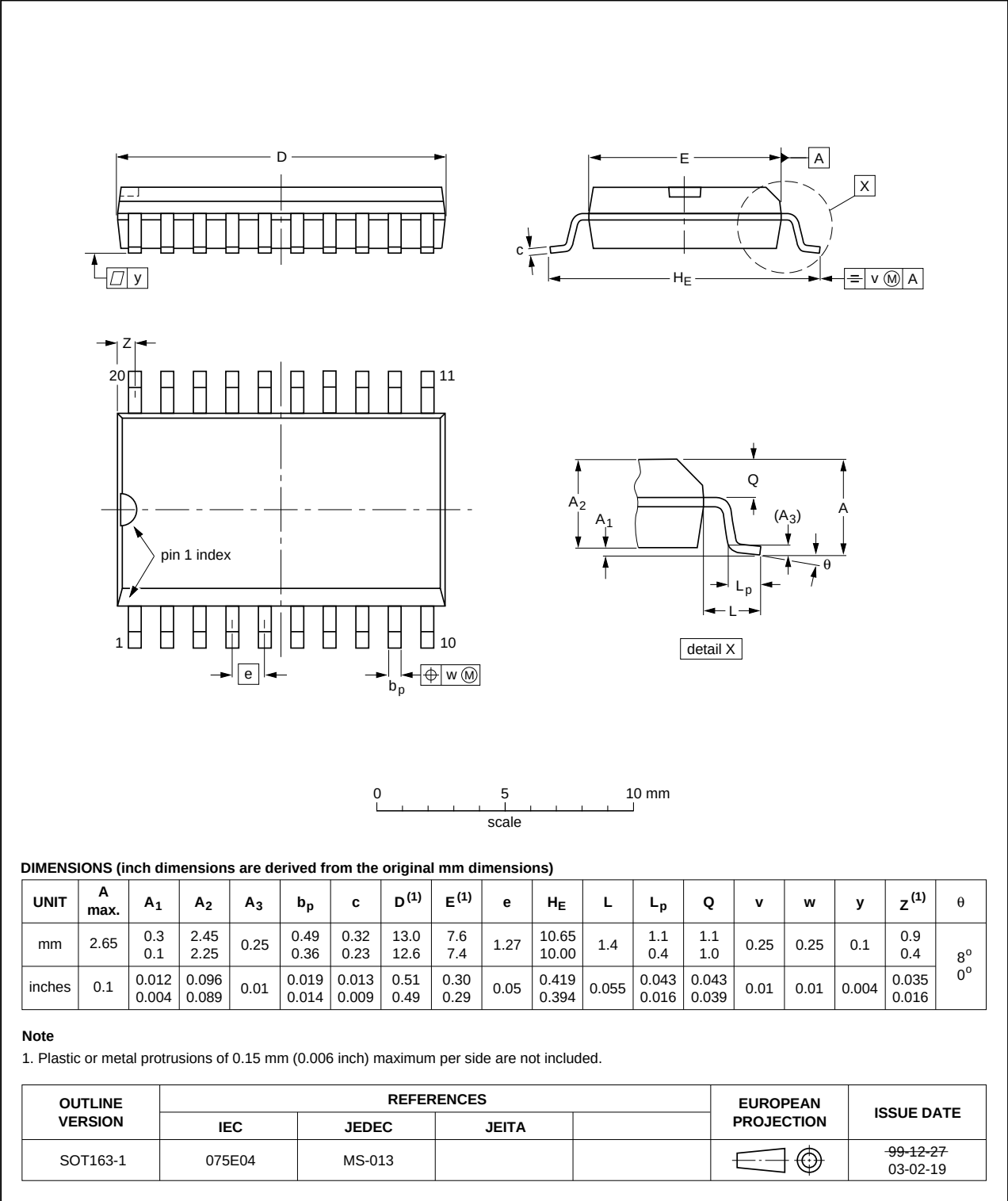


Fig 11. Package outline SOT163-1 (SO20)

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

SOT339-1

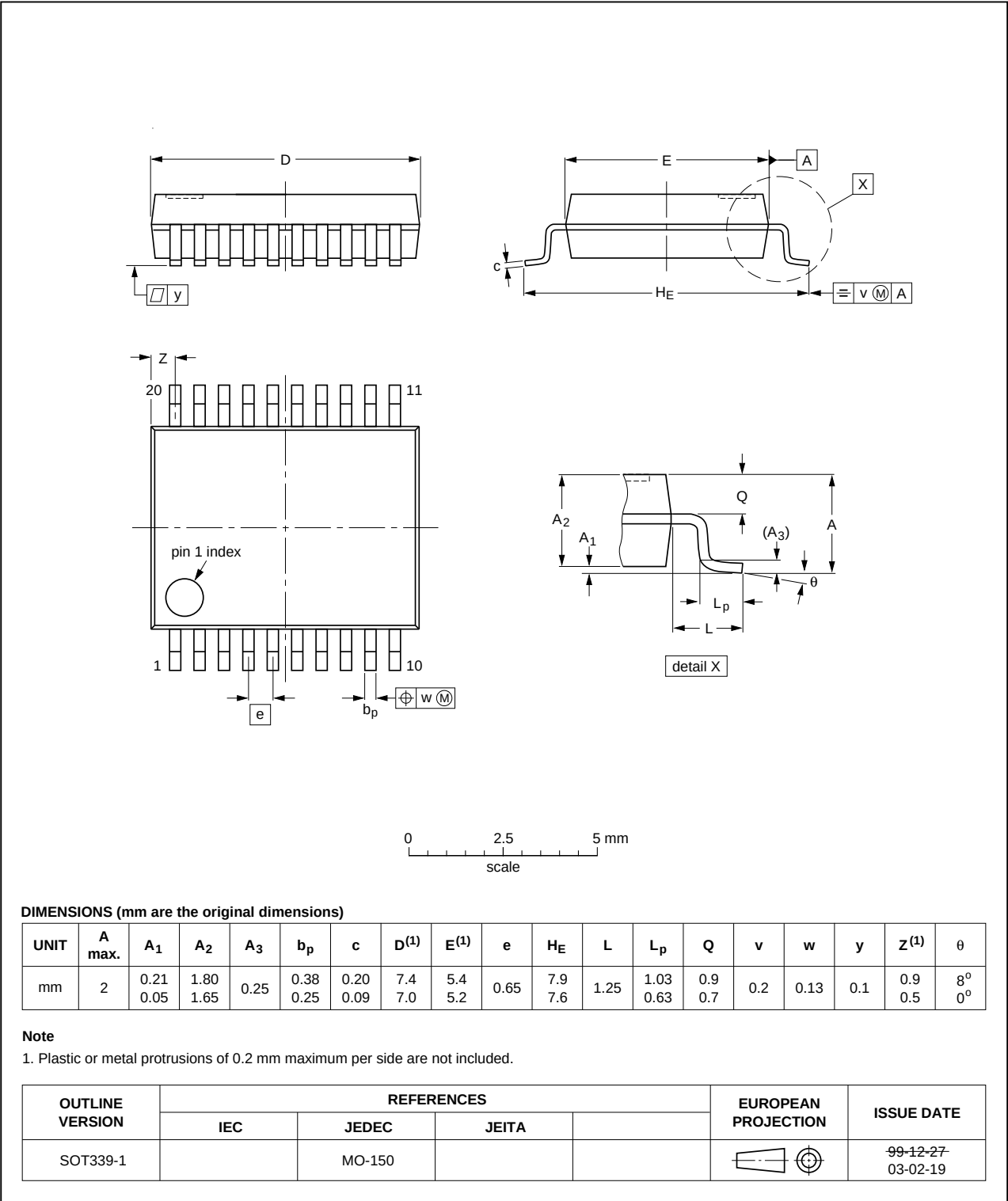


Fig 12. Package outline SOT339-1 (SSOP20)

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

SOT360-1

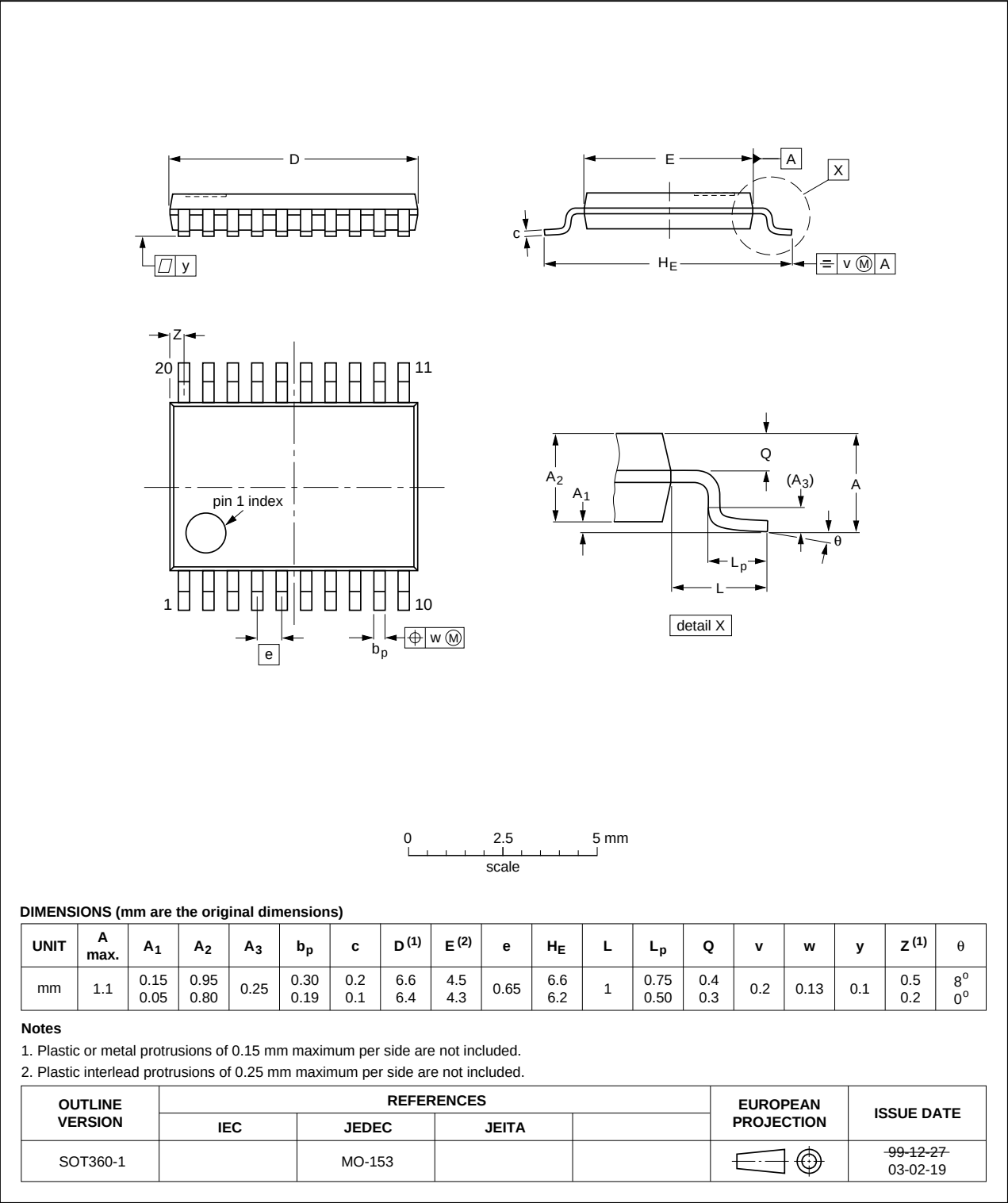


Fig 13. Package outline SOT360-1 (TSSOP20)

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

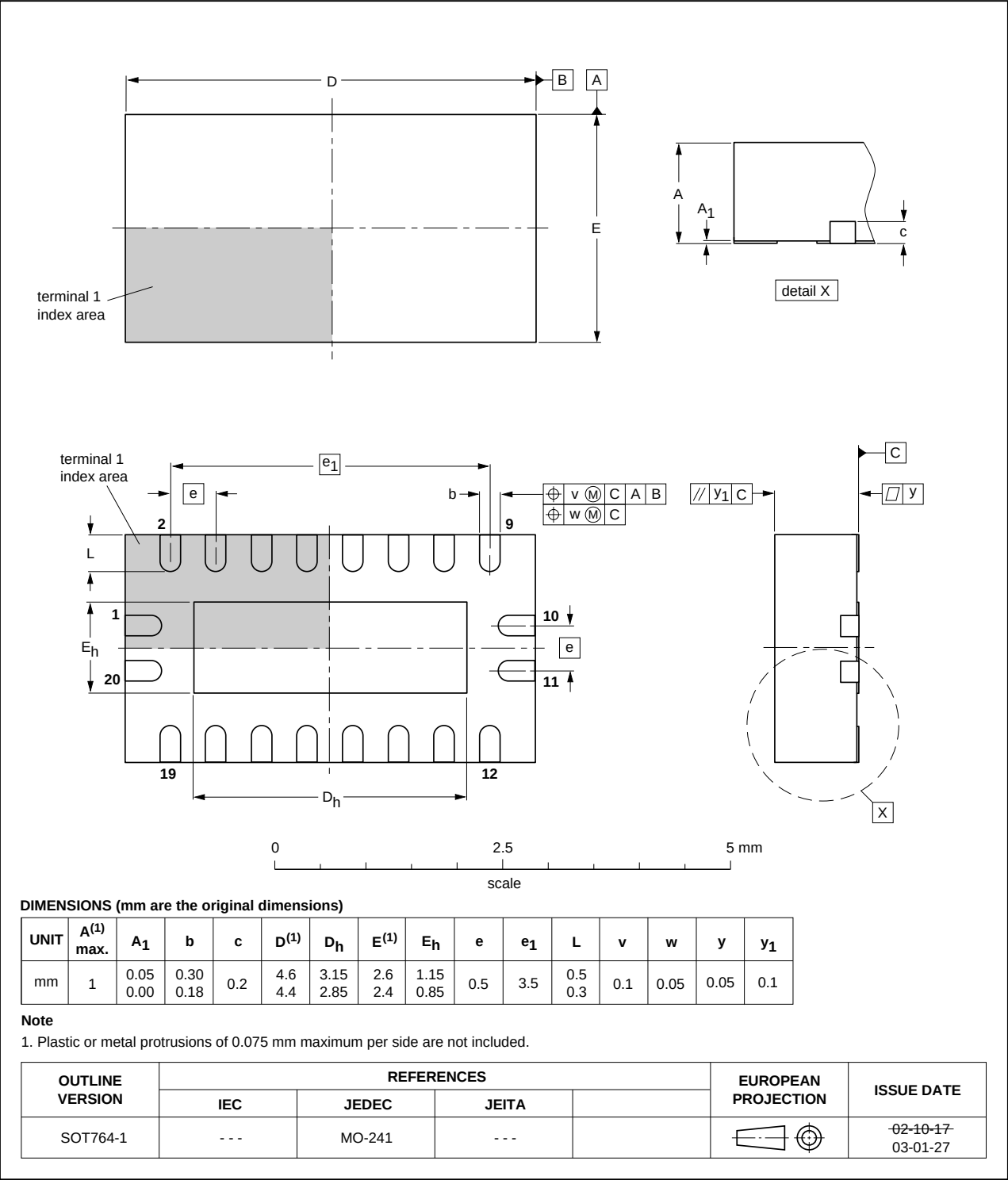


Fig 14. Package outline SOT764-1 (DHVQFN20)

13. Abbreviations

Table 10. 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 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC574A v.5	20121218	Product data sheet	-	74LVC574A v.4
Modifications:	Changed interlacing into interfacing (errata) in features list.			
74LVC574A v.4	20121203	Product data sheet	-	74LVC574A v.3
Modifications:	- The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. - Legal texts have been adapted to the new company name where appropriate. Table 4, Table 5, Table 6, Table 7, Table 8 and Table 9: values added for lower voltage ranges.			
74LVC574A v.3	20040322	Product specification	-	74LVC574A v.2
74LVC574A v.2	20030620	Product specification	-	74LVC574A v.1
74LVC574A v.1	19980729	Product specification	-	-

15. Legal information

15.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	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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