

74LVC377

Octal D-type flip-flop with data enable; positive-edge trigger

Rev. 6 — 20 November 2012

Product data sheet

1. General description

The 74LVC377 has eight edge-triggered D-type flip-flops with individual inputs (D) and outputs (Q). A common clock input (CP) loads all flip-flops simultaneously when data enable input ($\bar{E}$) is LOW. The state of each D input, one set-up time before the LOW to HIGH clock transition, is transferred to the corresponding output (Q_n) of the flip-flop. Input $\bar{E}$ must be stable only one set-up time prior to the LOW to HIGH transition for predictable operation.

2. Features and benefits

- Wide supply voltage range from 1.2 V to 3.6 V
- Inputs accept voltages up to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Output drive capability 50 Ω transmission lines at 125 °C
- 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 from –40 °C to +125 °C

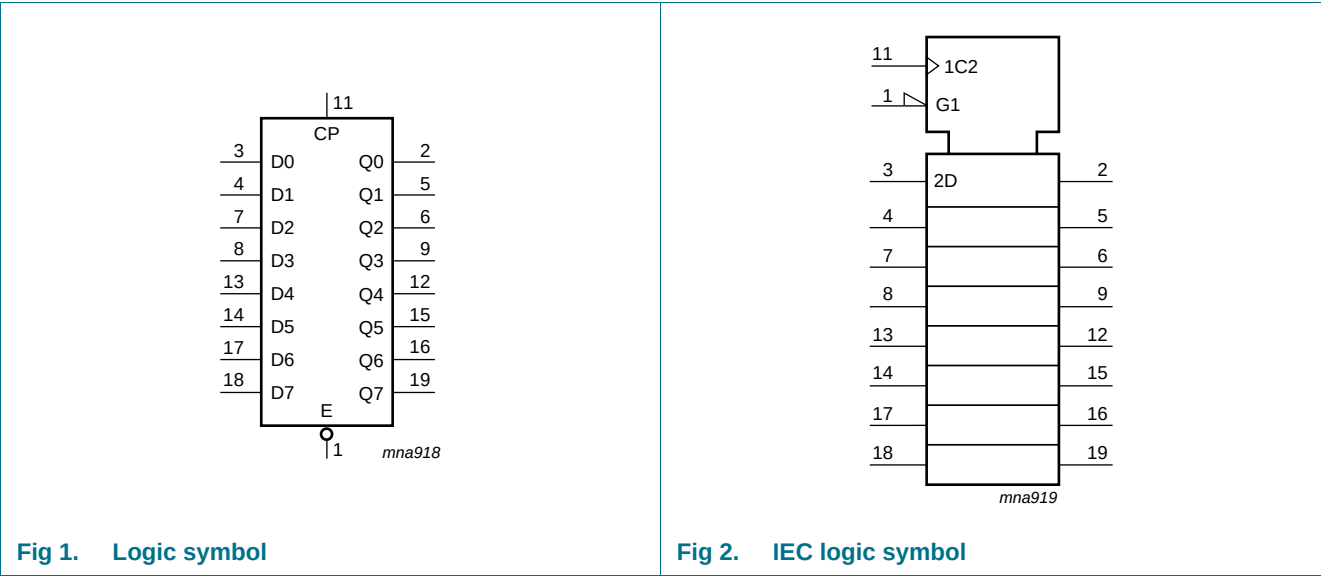
3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC377D	–40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC377DB	–40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVC377PW	–40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1

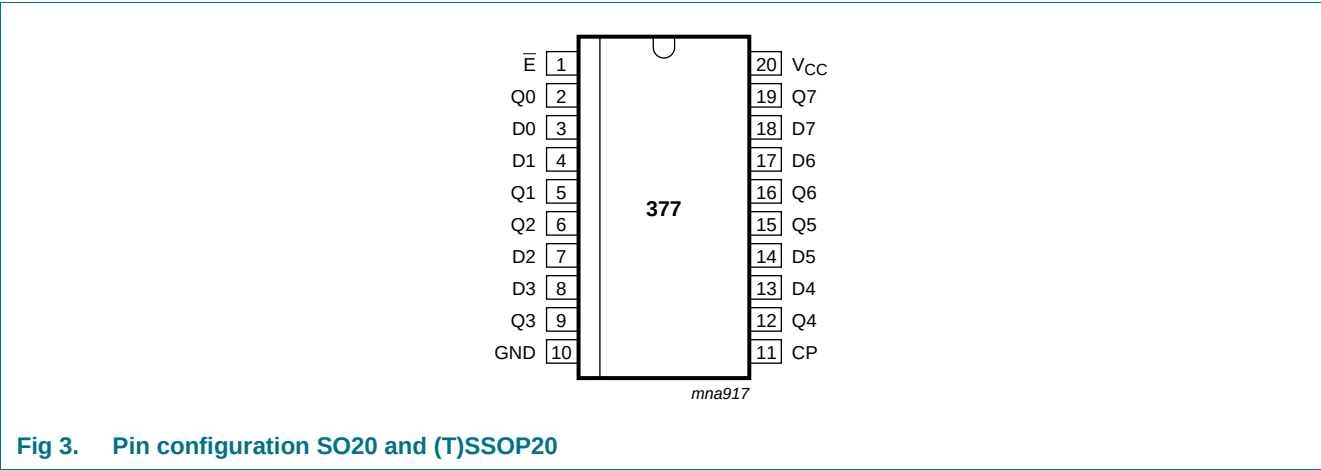
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4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{E}$	1	data enable input (active LOW)
CP	11	clock input (LOW to HIGH; edge-triggered)
D[0:7]	3, 4, 7, 8, 13, 14, 17, 18	data input

Table 2. Pin description *?continued*

Symbol	Pin	Description
Q[0:7]	2, 5, 6, 9, 12, 15, 16, 19	flip-flop output
GND	10	ground (0 V)
V _{CC}	20	power supply

6. Functional description

Table 3. Function table^[1]

Operating mode	Control		Input	Output
	CP	$\overline{E}$	Dn	Qn
Load 1	↑	L	h	H
Load 0	↑	L	L	L
Hold	↑	h	X	NC
Do nothing	X	H	X	NC

- [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 CP transition
 NC = no change
 X = don't care

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
V _I	input voltage		^[1] −0.5	+5.5	V
V _O	output voltage		^[2] −0.5	V _{CC} + 0.5	V
I _{IK}	input clamping current	V _I < 0 V	−50	-	mA
I _O	output current	V _O = 0 V to V _{CC}	-	±50	mA
I _{OK}	output clamping current	V _O > V _{CC} or V _O < 0 V	-	±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 derate linearly with 8 mW/K.
 For (T)SSOP20 packages: above 60 °C derate linearly with 5.5 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		0	-	V _{CC}	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
V _{OL}	LOW-level output voltage	I _O = -24 mA; V _{CC} = 3.0 V	2.2	-	-	2.0	-	V
		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 _I	input leakage current	I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.55	-	0.8	V
		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_{CC}	supply current	$V_{CC} = 3.6\text{ V}$; $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$	-	0.1	10	-	40	μA
ΔI_{CC}	additional supply current	per input pin; $V_{CC} = 2.7\text{ V}$ to 3.6 V ; $V_I = V_{CC} - 0.6\text{ V}$; $I_O = 0\text{ A}$	-	5	500	-	5000	μA
C_I	input capacitance	$V_{CC} = 0\text{ V}$ to 3.6 V ; $V_I = \text{GND}$ to V_{CC}	-	5.0	-	-	-	pF

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

10. Dynamic characteristics

Table 7. Dynamic characteristicsVoltages are referenced to GND (ground = 0 V). For test circuit see [Figure 6](#).

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 4 ^[2]						
		$V_{CC} = 1.2\text{ V}$	-	15	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	2.5	7.4	14.5	2.5	15.5	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	1.8	4.4	8.5	1.8	9.1	ns
		$V_{CC} = 2.7\text{ V}$	1.5	4.3	7.9	1.5	10.0	ns
		$V_{CC} = 3.0\text{ V}$ to 3.6 V	1.5	4.0	7.6	1.5	9.5	ns
t_W	pulse width	clock HIGH or LOW; see Figure 4						
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	6.0	-	-	6.0	-	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	5.0	-	-	5.0	-	ns
		$V_{CC} = 2.7\text{ V}$	5.0	1.6	-	5.0	-	ns
		$V_{CC} = 3.0\text{ V}$ to 3.6 V	4.0	1.0	-	4.0	-	ns
t_{su}	set-up time	$\overline{E}$ to CP; see Figure 5						
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	5.5	-	-	5.5	-	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	4.5	-	-	4.5	-	ns
		$V_{CC} = 2.7\text{ V}$	4.0	0.6	-	4.0	-	ns
		$V_{CC} = 3.0\text{ V}$ to 3.6 V	3.0	0.2	-	3.0	-	ns
		Dn to CP; see Figure 5						
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	5.5	-	-	5.5	-	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	4.5	-	-	4.5	-	ns
		$V_{CC} = 2.7\text{ V}$	3.0	1.0	-	3.0	-	ns
		$V_{CC} = 3.0\text{ V}$ to 3.6 V	2.0	0.7	-	2.0	-	ns

Table 7. Dynamic characteristics *continued*Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 6](#).

Symbol	Parameter	Conditions	–40 °C to +85 °C			–40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
t_h	hold time	$\bar{E}$ to CP; see Figure 5						
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	1.5	-	-	1.5	-	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0.5	-	-	0.5	-	ns
		$V_{CC} = 2.7 \text{ V}$	0.0	–1.0	-	0.0	-	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	1.0	0	-	1.0	-	ns
		Dn to CP; see Figure 5						
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	1.5	-	-	1.5	-	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0.5	-	-	0.5	-	ns
		$V_{CC} = 2.7 \text{ V}$	0.0	–1.1	-	0.0	-	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	0.0	–1.0	-	0.0	-	ns
f_{max}	maximum frequency	see Figure 4						
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	80	-	-	64	-	MHz
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	100	-	-	80	-	MHz
		$V_{CC} = 2.7 \text{ V}$	150	-	-	120	-	MHz
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	150	330	-	120	-	MHz
$t_{sk(o)}$	output skew time	$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ ^[3]	-	-	1.0	-	1.5	ns
C_{PD}	power dissipation capacitance	per flip-flop; $V_I = \text{GND to } V_{CC}$ ^[4]						
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	-	12.1	-	-	-	pF
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	15.8	-	-	-	pF
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	-	19.0	-	-	-	pF

[1] Typical values are measured at $T_{amb} = 25 \text{ °C}$ and $V_{CC} = 1.2 \text{ V}, 1.8 \text{ V}, 2.5 \text{ V}, 2.7 \text{ V}$ and 3.3 V respectively.[2] t_{pd} is the same as t_{PLH} and t_{PHL} .

[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. Waveforms

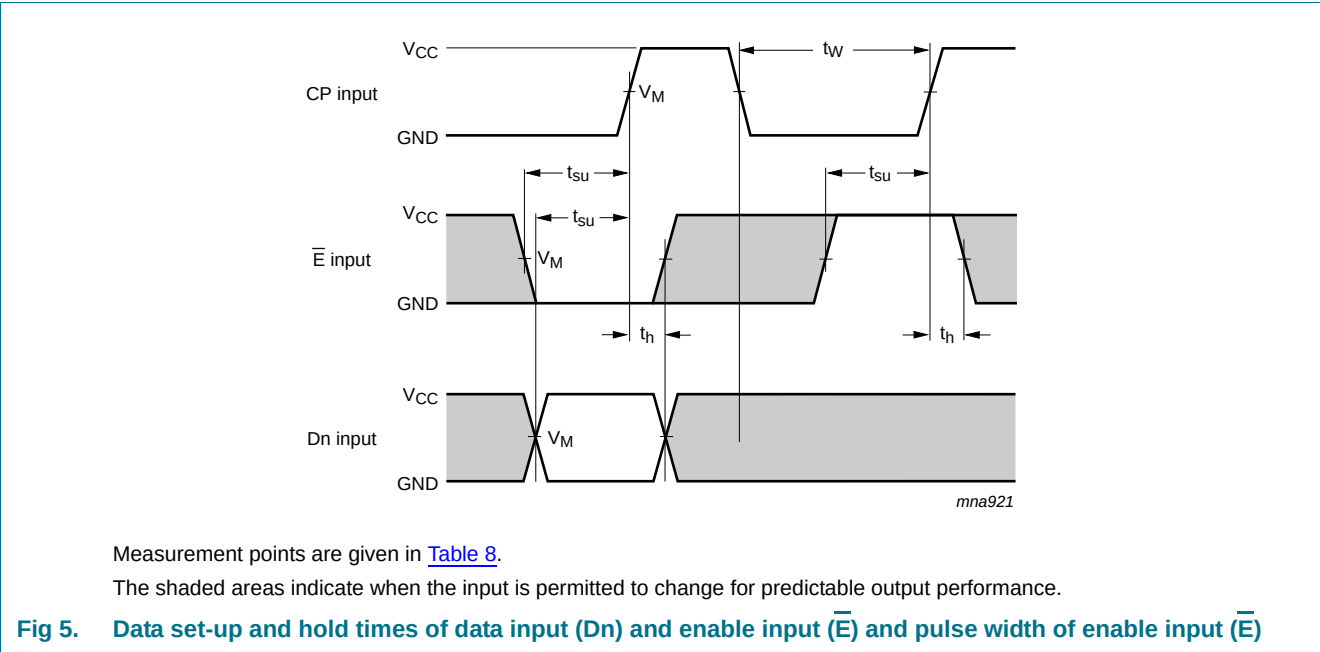
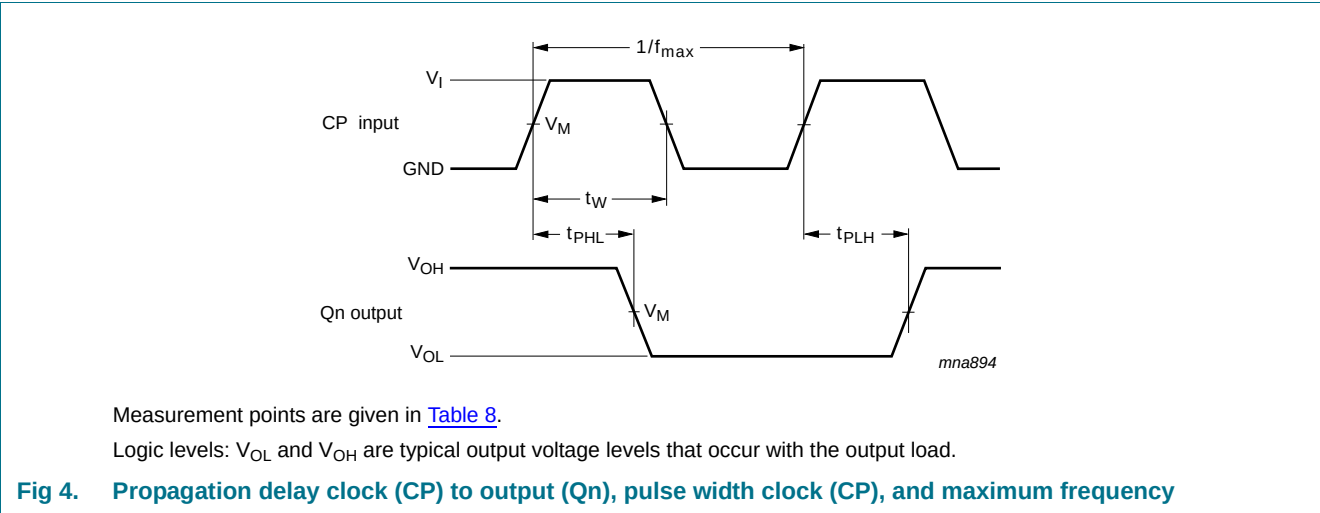
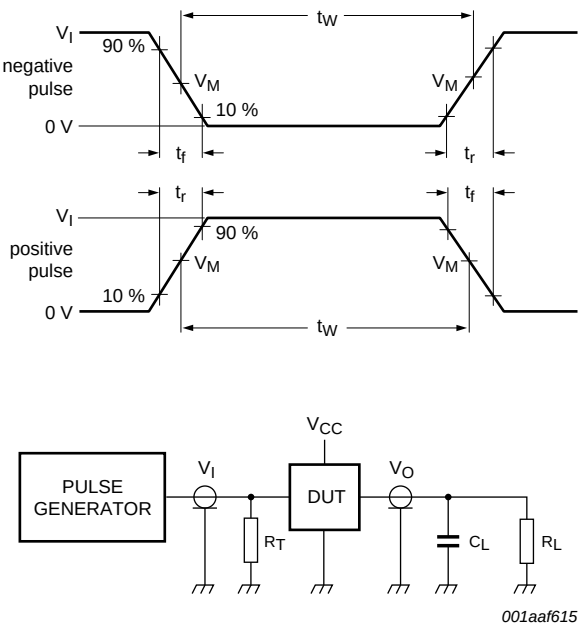


Table 8. Measurement points

Supply voltage	Input	Output
V _{CC}	V _M	V _M
1.2 V	0.5 × V _{CC}	0.5 × V _{CC}
1.65 V to 1.95V	0.5 × V _{CC}	0.5 × V _{CC}
2.3 V to 2.7 V	0.5 × V _{CC}	0.5 × V _{CC}
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 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.

Fig 6. Test circuit for switching times

Table 9. Test data

Supply voltage	Input		Load	
	V_I	t_r, t_f	C_L	R_L
1.2 V	V_{CC}	$\leq 2 \text{ ns}$	30 pF	1 k Ω
1.65 V to 1.95 V	V_{CC}	$\leq 2 \text{ ns}$	30 pF	1 k Ω
2.3 V to 2.7 V	V_{CC}	$\leq 2 \text{ ns}$	30 pF	500 Ω
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 Ω
3.0 V to 3.6 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 Ω

12. Package outline

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

SOT163-1

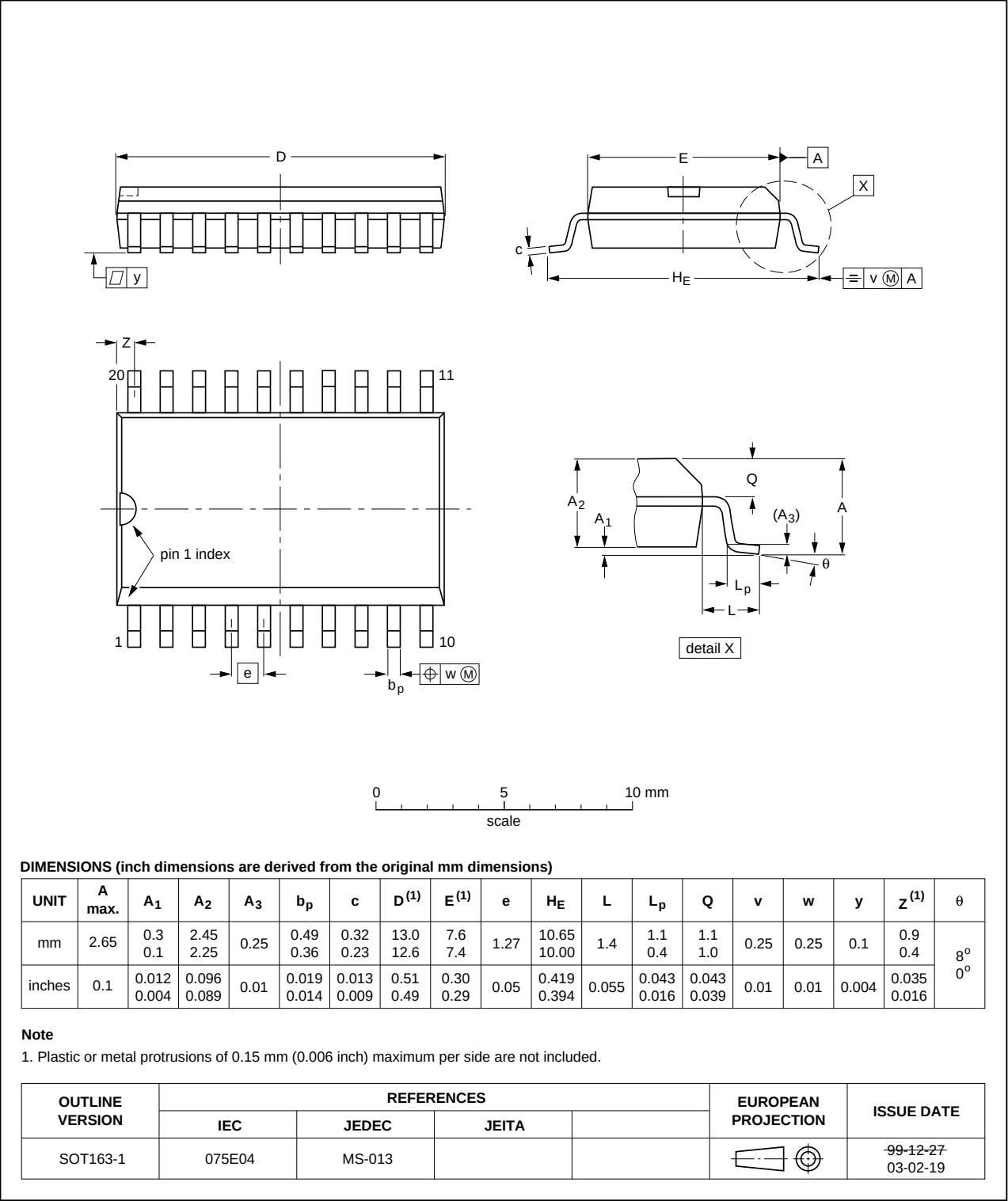


Fig 7. Package outline SOT163-1 (SO20)

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

SOT339-1

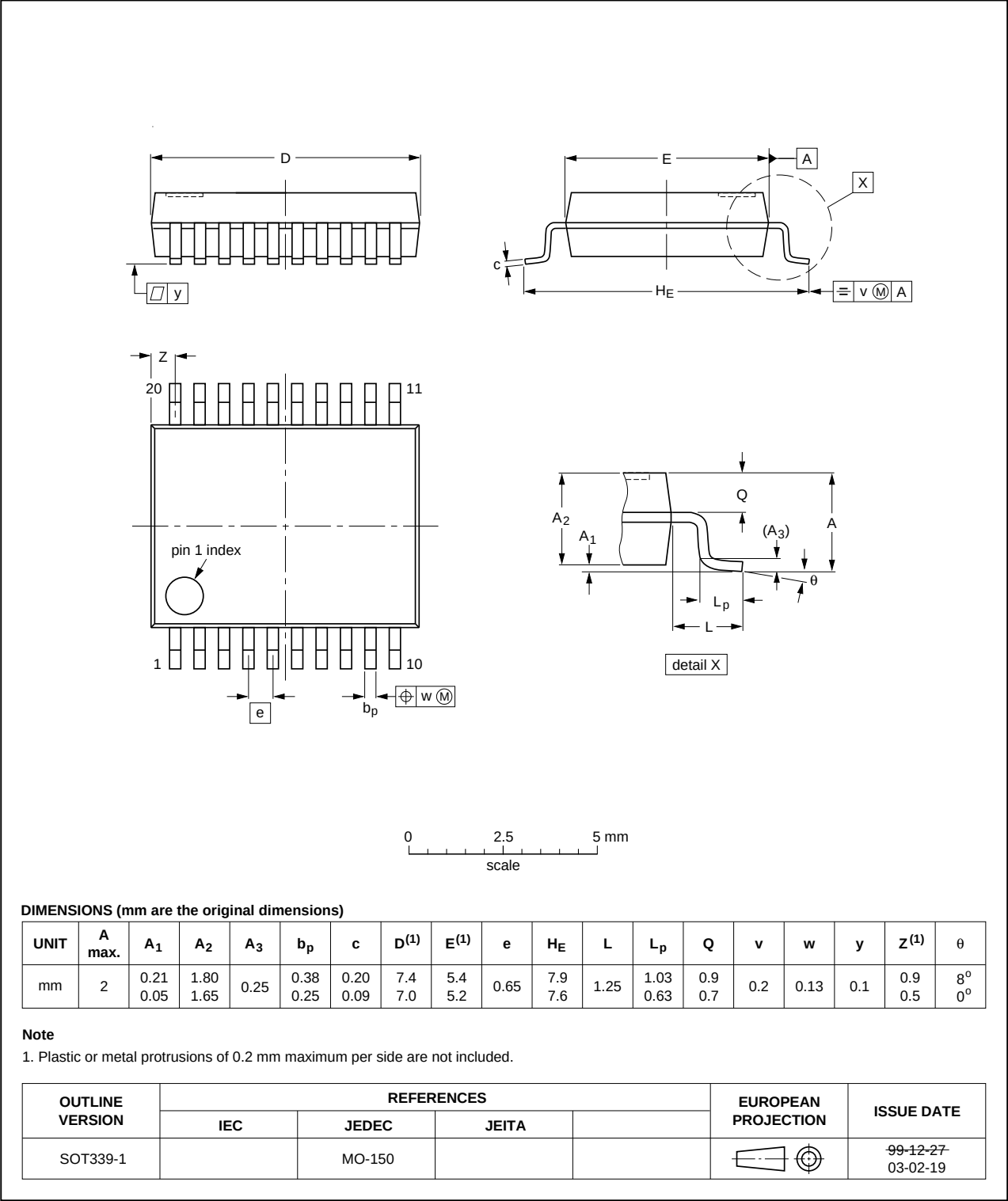


Fig 8. Package outline SOT339-1 (SSOP20)

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

SOT360-1

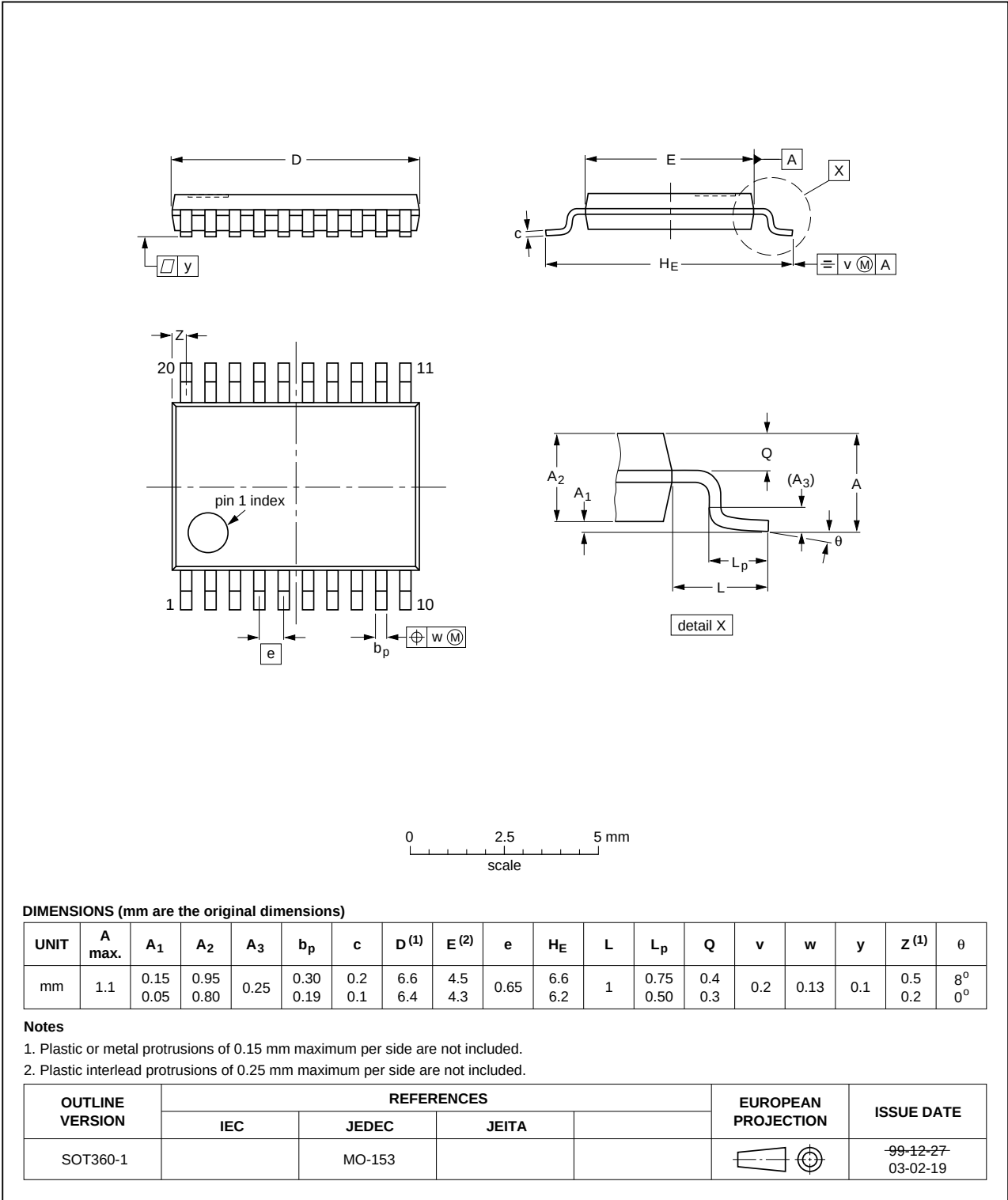


Fig 9. Package outline SOT360-1 (TSSOP20)

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
74LVC377 v.6	20121120	Product data sheet	-	74LVC377 v.5
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.			
74LVC377 v.5	20050221	Product specification	-	74LVC377 v.4
74LVC377 v.4	20040528	Product specification	-	74LVC377 v.3
74LVC377 v.3	20021023	Product specification	-	74LVC377 v.2
74LVC377 v.2	19980729	Product specification	-	74LVC377 v.1
74LVC377 v.1	19990606	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".

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17. Contents

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