74LVT374

3.3 V octal D-type flip-flop; 3-state

Rev. 4 — 22 November 2011 Product data sheet

1. General description

The 74LVT374 is a high-performance product designed for V_{CC} operation at 3.3 V.

This device is an 8-bit, edge triggered register coupled to eight 3-state output buffers. The two sections of the device are controlled independently by the clock (pin CP) and output enable (pin $\overline{OE}$) control gates. The state of each Dn input (one setup time before the LOW-to-HIGH clock transition) is transferred to the corresponding flip-flops Qn output.

The 3-state output buffers are designed to drive heavily loaded 3-state buses, MOS memories, or MOS microprocessors.

The active LOW output enable (pin $\overline{OE}$) controls all eight 3-state buffers independent of the clock operation.

When pin $\overline{OE}$ is LOW, the stored data appears at the outputs. When pin $\overline{OE}$ is HIGH, the outputs are in the high-impedance OFF-state, which means they will neither drive nor load the bus.

2. Features and benefits

- Inputs and outputs arranged for easy interfacing to microprocessors
- 3-state outputs for bus interfacing
- Common output enable control
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Bus hold data inputs eliminate need for external pull-up resistors to hold unused inputs
- Live insertion and extraction permitted
- No bus current loading when output is tied to 5 V bus
- Power-up reset
- Power-up 3-state
- Latch-up protection
  - JESD78 class II exceeds 500 mA
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from −40 °C to +85 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVT374D	–40 °C to +85 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVT374DB	–40 °C to +85 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVT374PW	–40 °C to +85 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1

4. Functional diagram

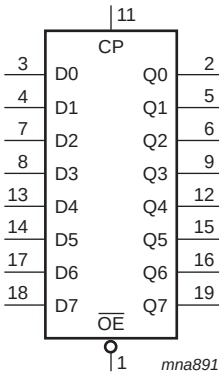


Fig 1. Logic symbol

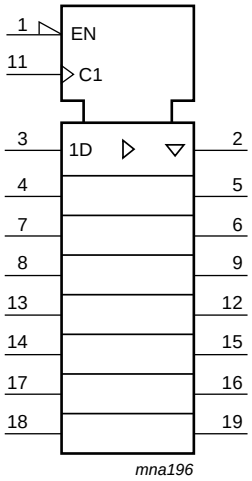


Fig 2. IEC logic symbol

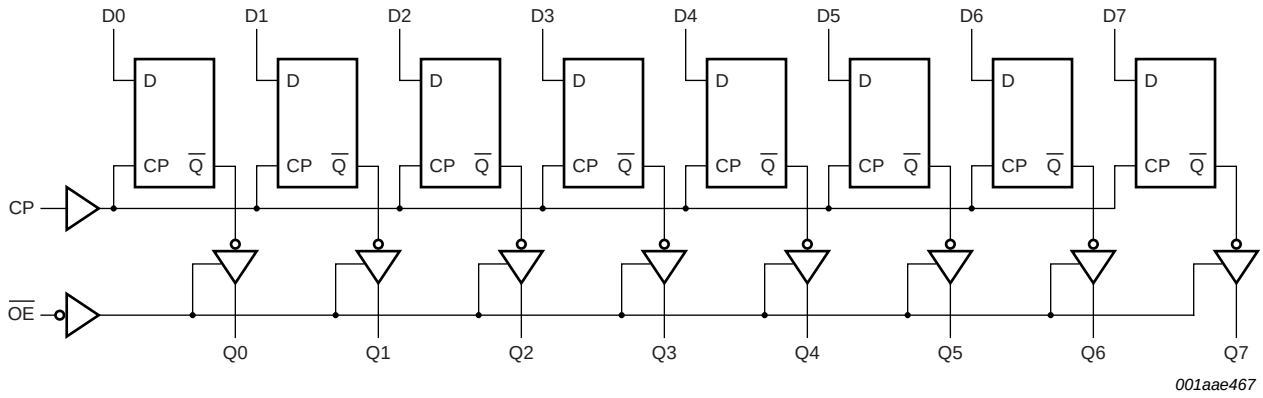


Fig 3. Logic diagram

5. Pinning information

5.1 Pinning

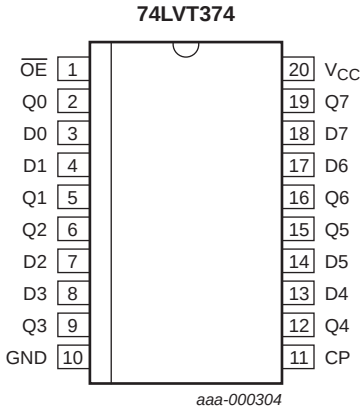


Fig 4. Pin configuration for SO20, and (T)SSOP20)

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{OE}$	1	output enable input (active LOW)
D0 to D7	3, 4, 7, 8, 13, 14, 17, 18	data input
GND	10	ground (0 V)
CP	11	clock pulse input (active rising edge)
Q0 to Q7	2, 5, 6, 9, 12, 15, 16, 19	data output
V_{CC}	20	supply voltage

6. Functional description

6.1 Function table

Table 3. Function table [1]

Operating mode	Control		Input	Internal register	Output
	$\overline{OE}$	CP	Dn		Qn
Load and read register	L	↑	l	L	L
			h	H	H
Hold	L	NC	X	NC	NC
Disable outputs	H	L or H	X	NC	Z
		↑	Dn	Dn	Z

[1] H = HIGH voltage level;
L = LOW voltage level;
↑ = LOW-to-HIGH clock transition;
h = HIGH voltage level one setup time prior to the LOW-to-HIGH clock transition;
l = LOW voltage level one setup time prior to the LOW-to-HIGH clock transition;
Z = high-impedance OFF-state;
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	+4.6	V
V_I	input voltage		[1]	−0.5	+7.0	V
V_O	output voltage	output in OFF-state or HIGH-state	[1]	−0.5	+7.0	V
I_{IK}	input clamping current	$V_I < 0$ V		-	−50	mA
I_{OK}	output clamping current	$V_O < 0$ V		-	−50	mA
I_O	output current	output in LOW-state		-	128	mA
		output in HIGH-state		-	−64	mA
T_{stg}	storage temperature			−65	+150	°C
T_j	junction temperature		[2]	-	150	°C
P_{tot}	total power dissipation	T_{amb} = −40 °C to +85 °C	[3]	-	500	mW

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

[2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.

[3] For SO20 packages: above 70 °C derate linearly with 8 mW/K.
For SSOP20 and TSSOP20 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	Max	Unit
V_{CC}	supply voltage		2.7	3.6	V
V_I	input voltage		0	5.5	V
V_{IH}	HIGH-level input voltage		2.0	-	V
V_{IL}	LOW-level input voltage		-	0.8	V
I_{OH}	HIGH-level output current		-	–32	mA
I_{OL}	LOW-level output current		-	32	mA
		current duty cycle ≤ 50 %; $f_i \geq 1$ kHz	-	64	mA
T_{amb}	ambient temperature	in free air	–40	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	outputs enabled	-	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	T_{amb} = –40 °C to +85 °C			Unit
			Min	Typ[1]	Max	
V_{IK}	input clamping voltage	V_{CC} = 2.7 V; I_{IK} = –18 mA	–1.2	–0.9	-	V
V_{OH}	HIGH-level output voltage	V_{CC} = 2.7 V to 3.6 V; I_{OH} = –100 µA	V_{CC} – 0.2	V_{CC} – 0.1	-	V
		V_{CC} = 2.7 V; I_{OH} = –8 mA	2.4	2.5	-	V
		V_{CC} = 3.0 V; I_{OH} = –32 mA	2.0	2.2	-	V
V_{OL}	LOW-level output voltage	V_{CC} = 2.7 V				
		I_{OL} = 100 µA	-	0.1	0.2	V
		I_{OL} = 24 mA	-	0.3	0.5	V
		V_{CC} = 3.0 V				
		I_{OL} = 16 mA	-	0.25	0.4	V
		I_{OL} = 32 mA	-	0.3	0.5	V
		I_{OL} = 64 mA	-	0.4	0.55	V
$V_{OL(pu)}$	power-up LOW-level output voltage	V_{CC} = 3.6 V; I_O = 1 mA; V_I = GND or V_{CC} [2]	-	0.13	0.55	V
I_I	input leakage current	all input pins; V_{CC} = 0 V or 3.6 V; V_I = 5.5 V	-	1	10	µA
		control pins; V_{CC} = 3.6 V; V_I = V_{CC} or GND	-	±0.1	±1	µA
		data pins; V_{CC} = 3.6 V [3]				
		V_I = V_{CC}	-	0.1	1	µA
		V_I = 0 V	–5	–1	-	µA
I_{OFF}	power-off leakage current	V_{CC} = 0 V; V_I or V_O = 0 V to 4.5 V	-	1	±100	µA
I_{LO}	output leakage current	V_O = 5.5 V and V_{CC} = 3.0 V; output HIGH [4]	-	60	125	µA
I_{BHL}	bus hold LOW current	V_{CC} = 3.0 V; V_I = 0.8 V	75	150	-	µA
I_{BHH}	bus hold HIGH current	V_{CC} = 3.0 V; V_I = 2.0 V [4]	-	–150	–75	µA
I_{BHHO}	bus hold HIGH overdrive current	V_{CC} = 3.6; V_I = 0 V to 3.6 V [4]	-	-	500	µA

Table 6. Static characteristics *…continued*

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

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
I_{BHLO}	bus hold LOW overdrive current	V_{CC} = 3.6; V_I = 0 V to 3.6 V		–500	-	-	μA
$I_{O(pu/pd)}$	power-up/power-down output current	$V_{CC} \leq$ 1.2 V; V_O = 0.5 V to V_{CC}; V_I = GND or V_{CC}; $\overline{OE}$ = don't care	[5]	-	1	±100	μA
I_{OZ}	OFF-state output current	V_{CC} = 3.6 V; V_I = V_{IH} or V_{IL}					
		output HIGH: V_O = 3.0 V		-	1	5	μA
		output LOW: V_O = 0.5 V		–5	1	-	μA
I_{CC}	supply current	V_{CC} = 3.6 V; V_I = GND or V_{CC}; I_O = 0 A					
		outputs HIGH		-	0.13	0.19	mA
		outputs LOW		-	3	12	mA
		outputs disabled	[6]	-	0.13	0.19	mA
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 3 V to 3.6 V; one input at V_{CC} – 0.6 V and other inputs at V_{CC} or GND	[7]	-	0.1	0.2	mA
C_I	input capacitance	V_I = 0 V or 3.0 V		-	4	-	pF
C_O	output capacitance	outputs disabled; V_O = 0 V or 3.0 V		-	7	-	pF

[1] Typical values are measured at V_{CC} = 3.3 V and T_{amb} = 25 °C.

[2] For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.

[3] Unused pins at V_{CC} or GND.

[4] This is the bus hold overdrive current required to force the input to the opposite logic state.

[5] This parameter is valid for any V_{CC} between 0 V and 1.2 V with a transition time of up to 10 ms. From V_{CC} = 1.2 V to V_{CC} = 3.3 V ± 0.3 V a transition time of 100 μs is permitted. This parameter is valid for T_{amb} = 25 °C only.

[6] I_{CC} is measured with outputs pulled to V_{CC} or GND.

[7] This is the increase in supply current for each input at the specified voltage level other than V_{CC} or GND.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to ground (GND = 0 V); for test circuit see Figure 9.

Symbol	Parameter	Conditions	T_{amb} = –40 °C to +85 °C			Unit
			Min	Typ[1]	Max	
t_{PLH}	LOW to HIGH propagation delay	CP to Qn; see Table 6				
		V_{CC} = 3.0 V to 3.6 V	1.7	3.2	5.1	ns
		V_{CC} = 2.7 V	-	-	5.8	ns
t_{PHL}	HIGH to LOW propagation delay	CP to Qn; see Table 6				
		V_{CC} = 3.0 V to 3.6 V	2.2	3.5	5.2	ns
		V_{CC} = 2.7 V	-	-	5.5	ns
t_{PZH}	OFF-state to HIGH propagation delay	$\overline{OE}$ to Qn; see Figure 6				
		V_{CC} = 3.0 V to 3.6 V	1.5	3.2	5.3	ns
		V_{CC} = 2.7 V	-	-	7.3	ns

Table 7. Dynamic characteristics *...continued*

Voltages are referenced to ground (GND = 0 V); for test circuit see Figure 9.

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
t_{PZL}	OFF-state to LOW propagation delay	$\overline{OE}$ to Qn; see Figure 7					
		V_{CC} = 3.0 V to 3.6 V		2.0	3.4	5.2	ns
		V_{CC} = 2.7 V		-	-	6.1	ns
t_{PHZ}	HIGH to OFF-state propagation delay	$\overline{OE}$ to Qn; see Figure 6					
		V_{CC} = 3.0 V to 3.6 V		1.9	4.3	6.7	ns
		V_{CC} = 2.7 V		-	-	7.1	ns
t_{PLZ}	LOW to OFF-state propagation delay	$\overline{OE}$ to Qn; see Figure 7					
		V_{CC} = 3.0 V to 3.6 V		2.0	3.4	5.1	ns
		V_{CC} = 2.7 V		-	-	5.1	ns
t_{su}	set-up time	Dn to CP; see Figure 8	[2]				
		V_{CC} = 3.0 V to 3.6 V		2.0	0.7	-	ns
		V_{CC} = 2.7 V		2.0	-	-	ns
t_h	hold time	Dn to CP; see Figure 8	[3]				
		V_{CC} = 3.0 V to 3.6 V		0.3	–0.5	-	ns
		V_{CC} = 2.7 V		0	-	-	ns
t_W	pulse width	CP input HIGH; see Figure 5	[4]				
		V_{CC} = 3.0 V to 3.6 V		1.5	0.8	-	ns
		V_{CC} = 2.7 V		1.5	-	-	ns
		CP input LOW; see Figure 5	[4]				
		V_{CC} = 3.0 V to 3.6 V		2.5	1.7	-	ns
		V_{CC} = 2.7 V		3.0	-	-	ns
f_{max}	maximum frequency	CP input; see Figure 5					
		V_{CC} = 3.0 V to 3.6 V		125	200	-	MHz
		V_{CC} = 2.7 V		125	-	-	MHz

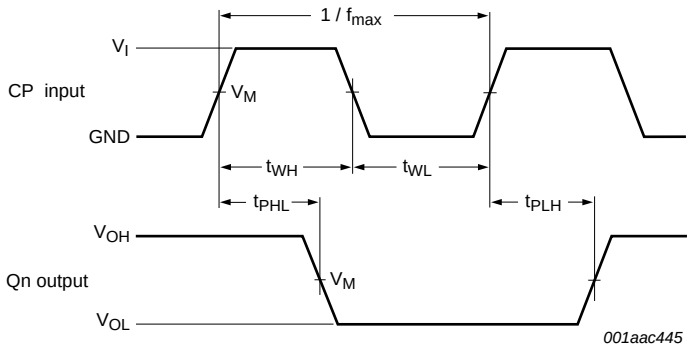
[1] Typical values are at V_{CC} = 3.3 V and T_{amb} = 25 °C.

[2] t_{su} is the same as $t_{su(H)}$ and $t_{su(L)}$

[3] t_h is the same as $t_{h(H)}$ and $t_{h(L)}$

[4] t_W is the same as t_{WH} and t_{WL}

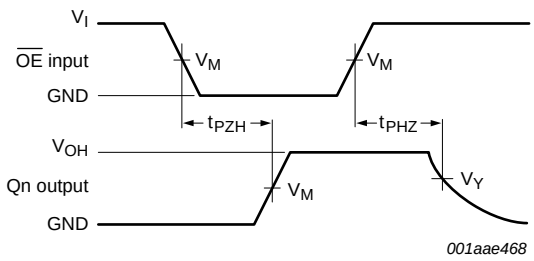
11. Waveforms



Measurement points are given in Table 8

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

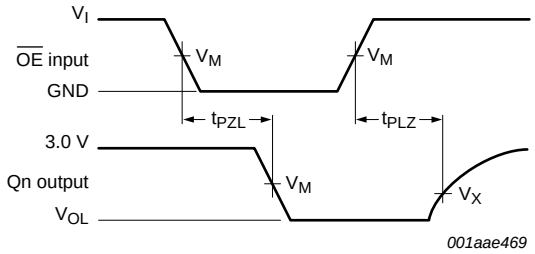
Fig 5. Propagation delay clock input (CP) to output (Qn), pulse width clock (CP) and maximum clock frequency



Measurement points are given in Table 8

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

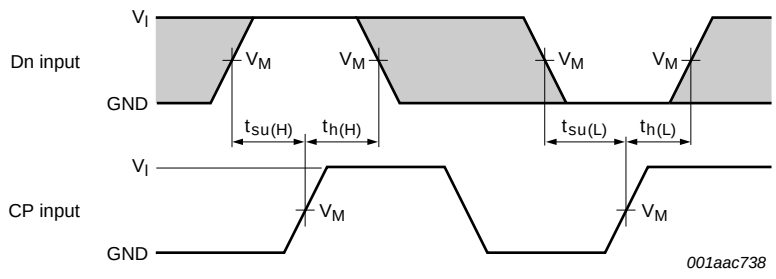
Fig 6. Output enable time to HIGH-state and output disable time from HIGH-state



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. Output enable time to LOW-state and output disable time from LOW-state



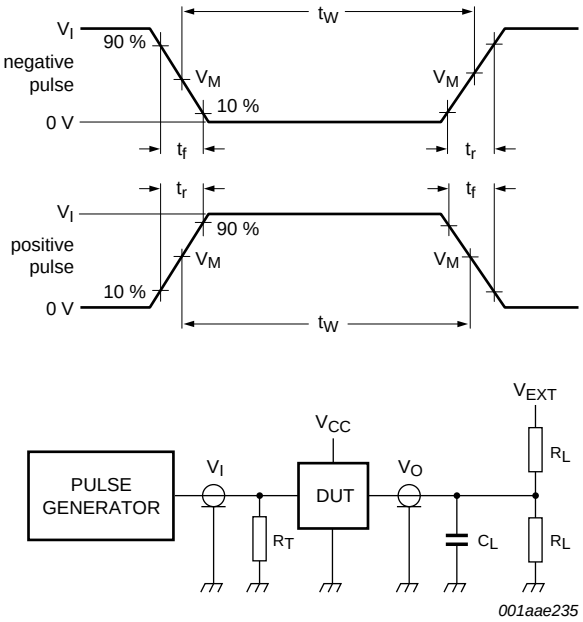
Measurement points are given in Table 8

Remark: The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 8. Data setup and hold times

Table 8. Measurement points

Input	Output		
V_M	V_M	V_X	V_Y
1.5 V	1.5 V	V_{OL} + 0.3 V	V_{OH} − 0.3 V



Test data is given in Table 9.

Definitions 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} = Test voltage for switching times.

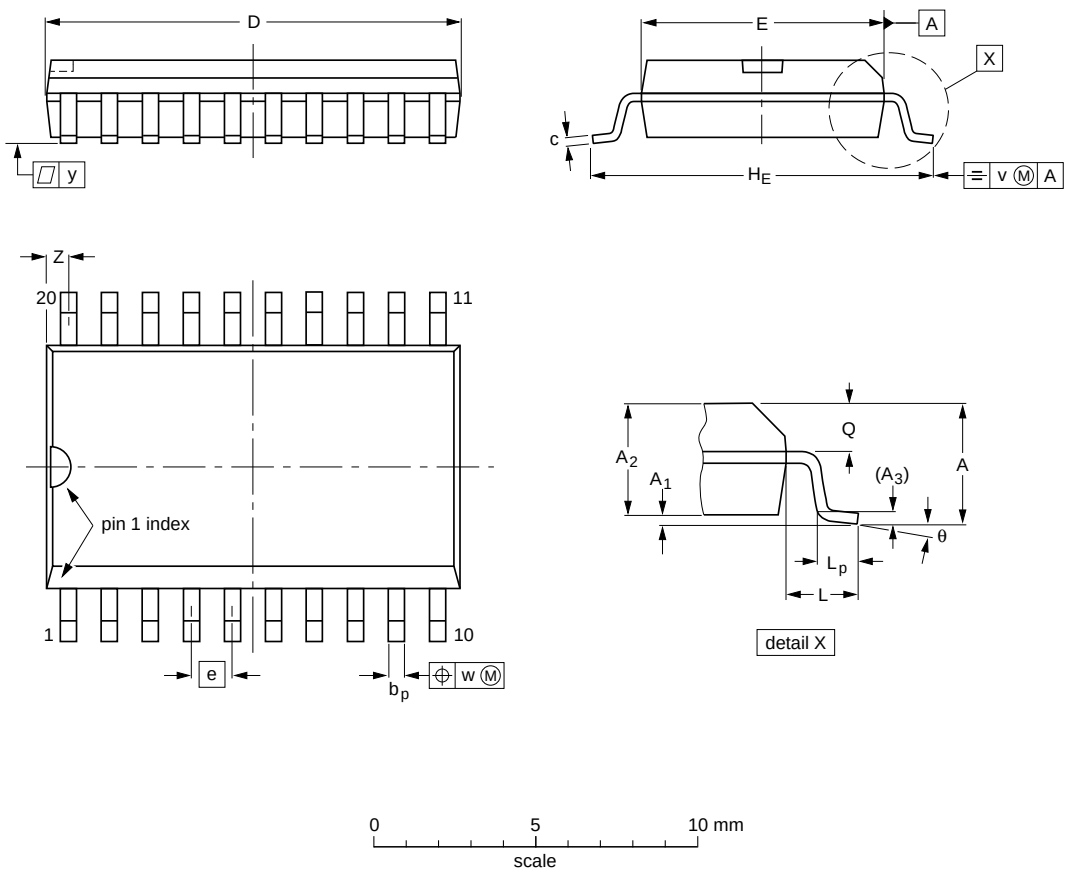
Fig 9. Load circuitry for switching times

Table 9. Test data

Input				Load		V_{EXT}		
V_I	f_i	t_W	t_r, t_f	C_L	R_L	t_{PHZ}, t_{PZH}	t_{PLZ}, t_{PZL}	t_{PLH}, t_{PHL}
2.7 V	≤ 10 MHz	500 ns	≤ 2.5 ns	50 pF	500 Ω	GND	6 V	open

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_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.3 0.1	2.45 2.25	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^o 0^o
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	

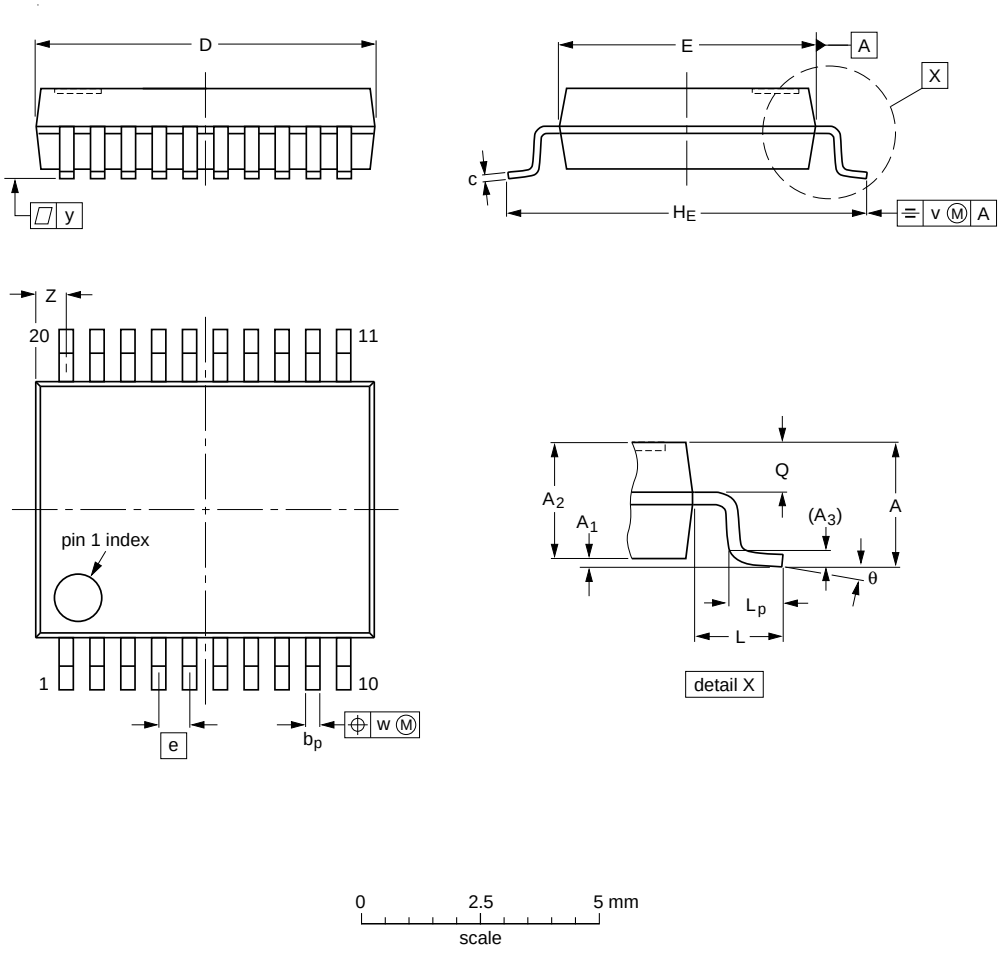
Note

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 10. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm **SOT339-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8^o 0^o

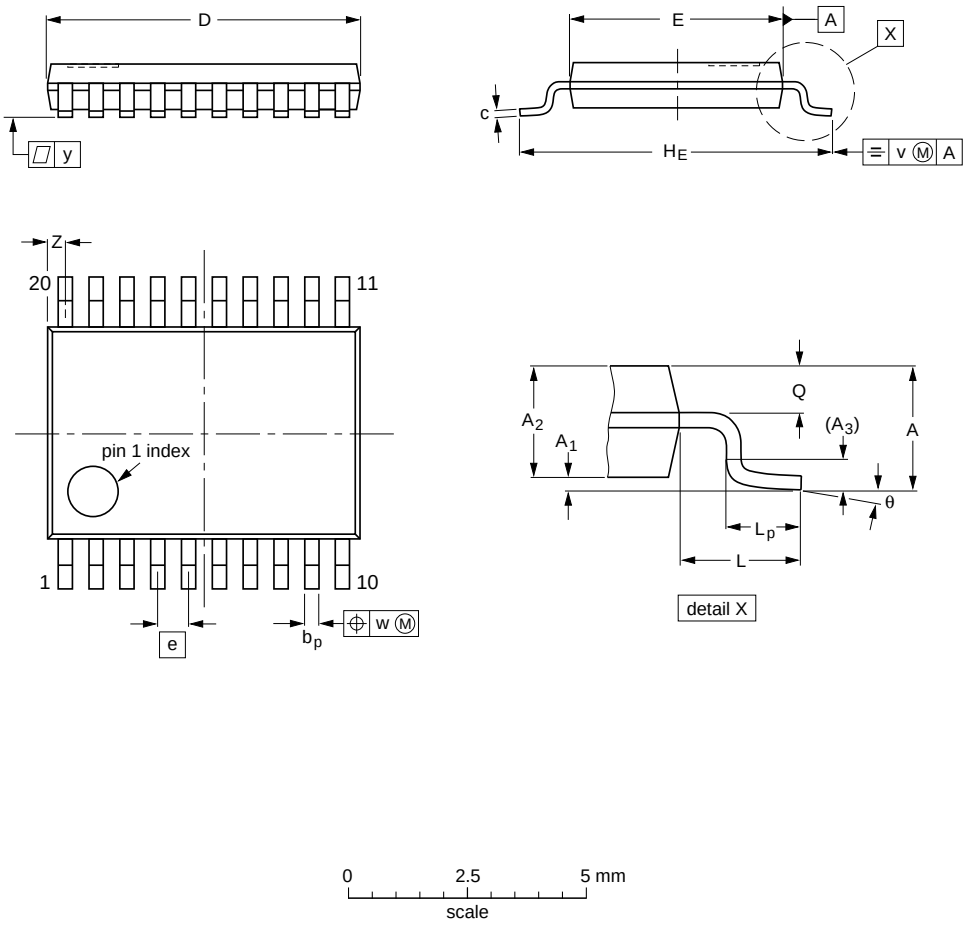
Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT339-1		MO-150				~~99-12-27~~ 03-02-19

Fig 11. Package outline SOT339-1 (SSOP20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm **SOT360-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT360-1		MO-153				~~99-12-27~~ 03-02-19

Fig 12. Package outline SOT360-1 (TSSOP20)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVT374 v.4	20111122	Product data sheet	-	74LVT374 v.3
Modifications:	• Legal pages updated.			
74LVT374 v.3	20110914	Product data sheet	-	74LVT374 v.2
74LVT374 v.2	19980219	product specification	-	74LVT374 v.1
74LVT374 v.1	19960208	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.

15.2 Definitions

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16. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

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