74LVT273

3.3 V octal D-type flip-flop

Rev. 03 — 10 September 2008 Product data sheet

1. General description

The 74LVT273 is a high-performance BiCMOS product designed for V_{CC} operation at 3.3 V.

This device has eight edge-triggered D-type flip-flops with individual D inputs and Q outputs. The common buffered Clock (CP) and Master Reset ($\overline{MR}$) inputs load and reset (clear) all flip-flops simultaneously.

The register is fully edge-triggered. The state of each D input, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's Q output.

All outputs will be forced LOW independent of the clock or data inputs by a LOW voltage level on the $\overline{MR}$ input. The device is useful for applications where only the true output is required and the CP and $\overline{MR}$ are common elements.

2. Features

- Eight edge-triggered D-type flip-flops
- Buffered common clock and asynchronous master reset
- Input and output interface capability to systems at 5 V supply
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Output capability: +64 mA/–32 mA
- Latch-up protection
  - JESD78 Class II exceeds 500 mA
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Bus-hold data inputs eliminate the need for external pull-up resistors for unused inputs
- Live insertion/extraction permitted
- Power-up reset
- No bus current loading when output is tied to 5 V bus

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVT273D	–40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVT273DB	–40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1
74LVT273PW	–40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVT273BQ	–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

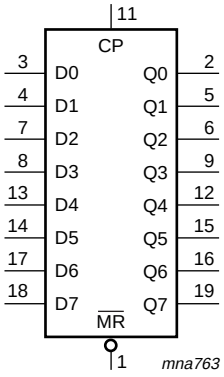


Fig 1. Logic symbol

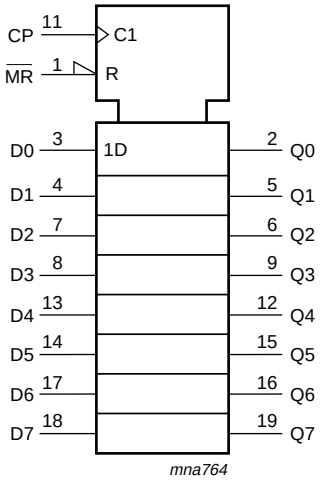


Fig 2. IEC logic symbol

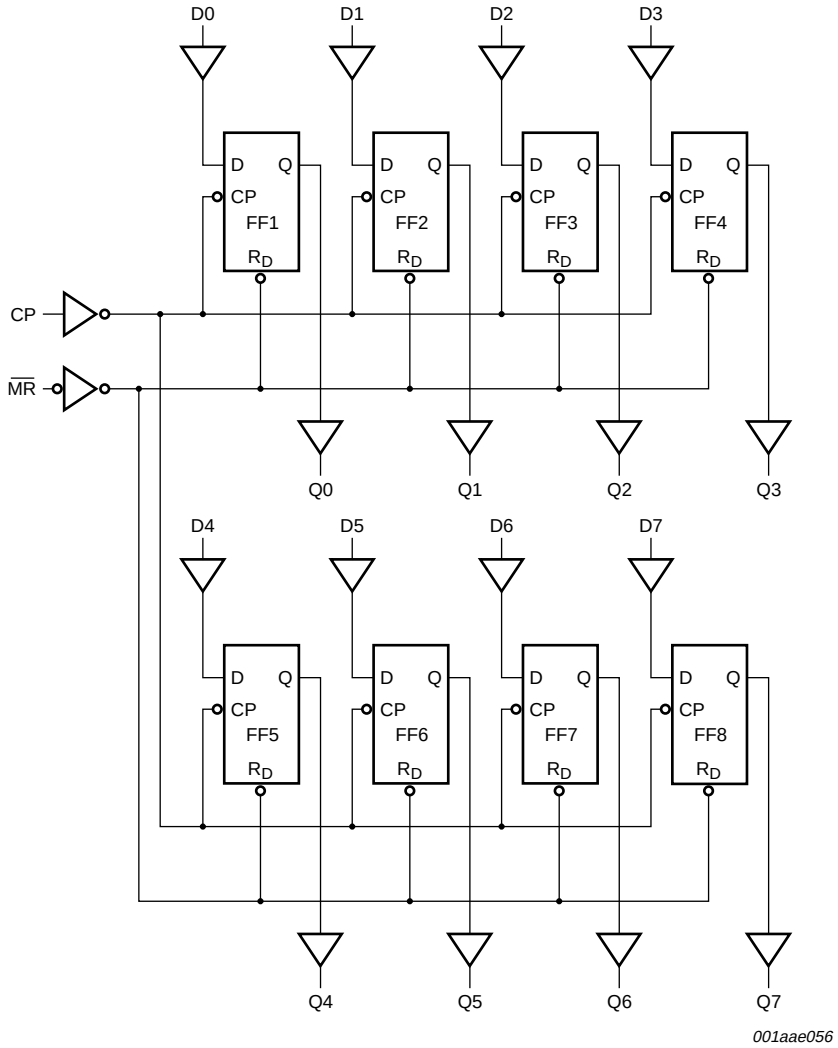


Fig 3. Logic diagram

5. Pinning information

5.1 Pinning

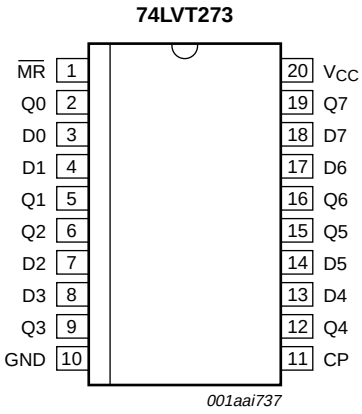
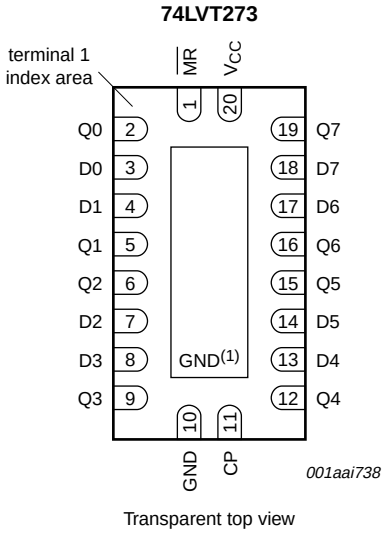


Fig 4. Pin configuration for SO20 and (T)SSOP20



Transparent top view

(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as a supply pin or input.

Fig 5. Pin configuration for DHVQFN20

5.2 Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Function selection

Inputs			Outputs	Operating mode
$\overline{MR}$	CP	Dn	Qn	
L	X	X	L	Reset (clear)
H	↑	h	H	Load 1
H	↑	l	L	Load 0
H	L	X	Q0	Retain state

[1] H = HIGH voltage level; h = HIGH voltage level one set-up time prior to the prior to the LOW-to-HIGH clock transition;
L = LOW voltage level; l = LOW voltage level one set-up time prior to the prior to the LOW-to-HIGH clock transition;
X = Don't care; ↑ = LOW-to-HIGH clock transition; Q0 = output as it was.

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 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	Typ	Max	Unit
V_{CC}	supply voltage		2.7	-	3.6	V
V_I	input voltage		0	-	5.5	V
I_{OH}	HIGH-level output current		–32	-	-	mA

Table 5. Recommended operating conditions *…continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{OL}	LOW-level output current		-	-	64	mA
T_{amb}	ambient temperature	in free air	–40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate; output 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		–40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
V_{IK}	input clamping voltage	V_{CC} = 2.7V; I_{IK} = –18 mA		–1.2	–0.9	-	V
V_{IH}	HIGH-level input voltage			2.0	-	-	V
V_{IL}	LOW-level input voltage			-	-	0.8	
V_{OH}	HIGH-level output voltage	V_{CC} = 2.7 V to 3.6V; 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
		V_{CC} = 2.7 V; I_{OL} = 24 mA		-	0.3	0.5	V
		V_{CC} = 3.0 V; I_{OL} = 16 mA		-	0.25	0.4	V
		V_{CC} = 3.0 V; I_{OL} = 32 mA		-	0.3	0.5	V
		V_{CC} = 3.0 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	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	[3]				
		V_{CC} = 3.6 V; V_I = V_{CC}		-	0.1	1	µA
		V_{CC} = 3.6 V; 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_{CC} = 3.0 V; V_O = 5.5 V; output HIGH		-	60	125	µA
I_{BHL}	bus hold LOW current	V_{CC} = 3.0 V; V_I = 0.8 V	[4]	75	150	-	µA
I_{BHH}	bus hold HIGH current	V_{CC} = 3.0 V; V_I = 2.0 V		-	–150	–75	µA
I_{BHHO}	bus hold HIGH overdrive current	V_{CC} = 3.6 V; V_I = 0 V to 3.6 V		-	-	500	µA
I_{BHLO}	bus hold LOW overdrive current	V_{CC} = 3.6 V; V_I = 0 V to 3.6 V		–500	-	-	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			Unit
				Min	Typ[1]	Max	
I_{CC}	supply current	V_{CC} = 3.6 V; V_I = V_{CC} or GND; I_O = 0 A					
		outputs HIGH		-	0.13	0.19	mA
		outputs LOW		-	3	12	mA
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 3.0 V to 3.6 V; one input = V_{CC} – 0.6 V other inputs at V_{CC} or GND	[5]	-	0.1	0.2	mA
C_I	input capacitance	V_I = 0 V or 3.0 V		-	4	-	pF

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

[2] For valid test results data must not be loaded into the flip-flops (or latches) after applying the 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] 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 GND (ground = 0 V). For test circuit see Figure 9.

Symbol	Parameter	Conditions		–40 °C to +85 °C			Unit
				Min	Typ[1]	Max	
t_{PLH}	LOW to HIGH propagation delay	CP to Qn; Figure 6					
		V_{CC} = 2.7 V		-	-	6.3	ns
		V_{CC} = 3.3 V ± 0.3 V		1.7	3.5	5.5	ns
t_{PHL}	HIGH to LOW propagation delay	CP to Qn; Figure 6					
		V_{CC} = 2.7 V		-	-	5.9	ns
		V_{CC} = 3.3 V ± 0.3 V		1.9	3.5	5.5	ns
		$\overline{MR}$ to Qn; see Figure 7					
		V_{CC} = 2.7 V		-	-	6.2	ns
		V_{CC} = 3.3 V ± 0.3 V		1.3	3.2	6.2	ns
t_{su}	set-up time	Dn to CP HIGH; see Figure 7	[2]				
		V_{CC} = 2.7 V		2.7	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V		2.3	1.0	-	ns
		Dn to CP LOW; see Figure 7					
		V_{CC} = 2.7 V		2.7	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V		2.3	1.0	-	ns
t_h	hold time	Dn to CP HIGH; see Figure 8	[3]				
		V_{CC} = 2.7 V		0	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V		0	–0.6	-	ns
		Dn to CP LOW; see Figure 8					
		V_{CC} = 2.7 V		0	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V		0	–0.6	-	ns

Table 7. Dynamic characteristics *...continued*

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

Symbol	Parameter	Conditions	–40 °C to +85 °C			Unit
			Min	Typ[1]	Max	
t_W	pulse width	CP input HIGH or LOW; see Figure 6 [4]				
		V_{CC} = 2.7 V	3.3	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V	3.3	1.5	-	ns
		$\overline{MR}$ input LOW; see Figure 7				
		V_{CC} = 2.7 V	3.3	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V	3.3	1.5	-	ns
t_{rec}	recovery time	see Figure 7				
		V_{CC} = 2.7 V	3.2	-	-	ns
		V_{CC} = 3.3 V ± 0.3 V	2.7	1.0	-	ns
f_{max}	maximum frequency	CP input; see Figure 7	150	-	-	MHz

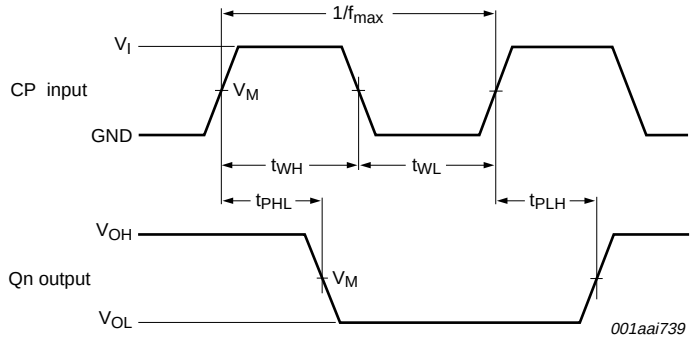
[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 3.3 V

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

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

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

11. Waveforms



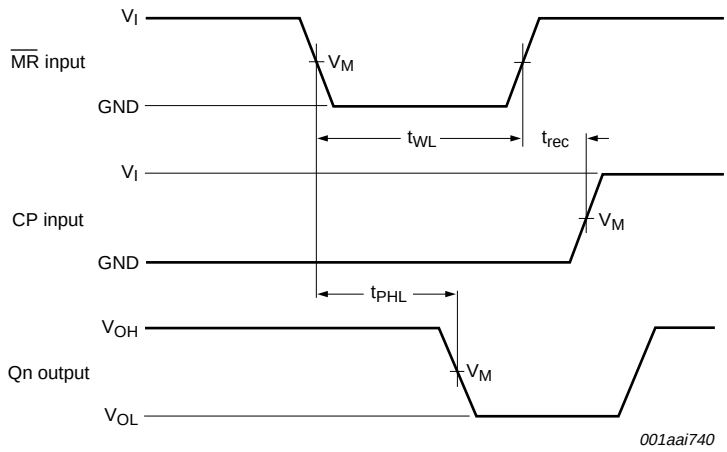
see Table 8 for measurement points.

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

Fig 6. CP Input to Qn output propagation delays and clock pulse width and maximum frequency

Table 8. Measurement points

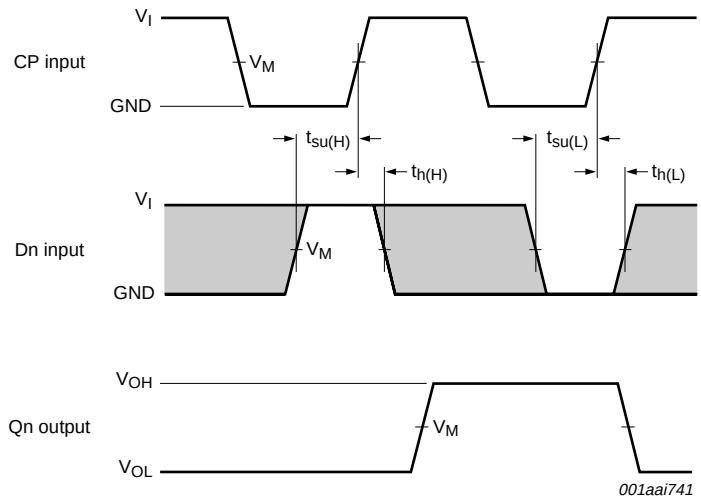
Input		Output
V_I	V_M	V_M
2.7 V	1.5 V	1.5 V



see Table 8 for measurement points.

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

Fig 7. $\overline{MR}$ pulse width, $\overline{MR}$ to CP recovery time and $\overline{MR}$ to Qn delay

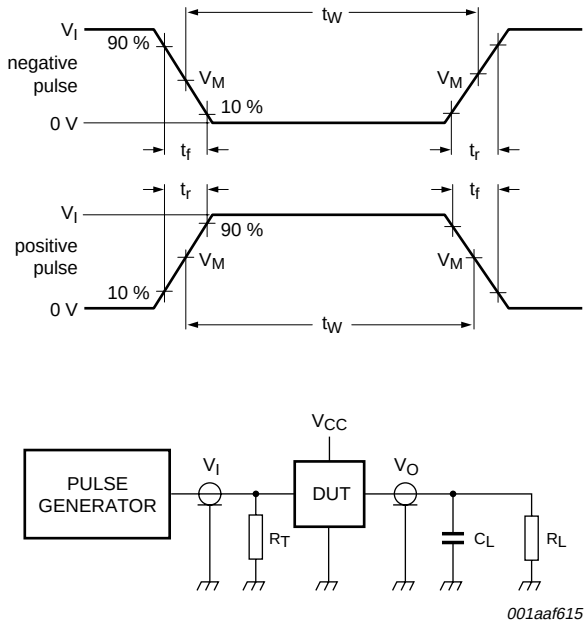


see Table 8 for measurement points.

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 predicable output performance.

Fig 8. Data set-up and hold times



Test data is given in 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.

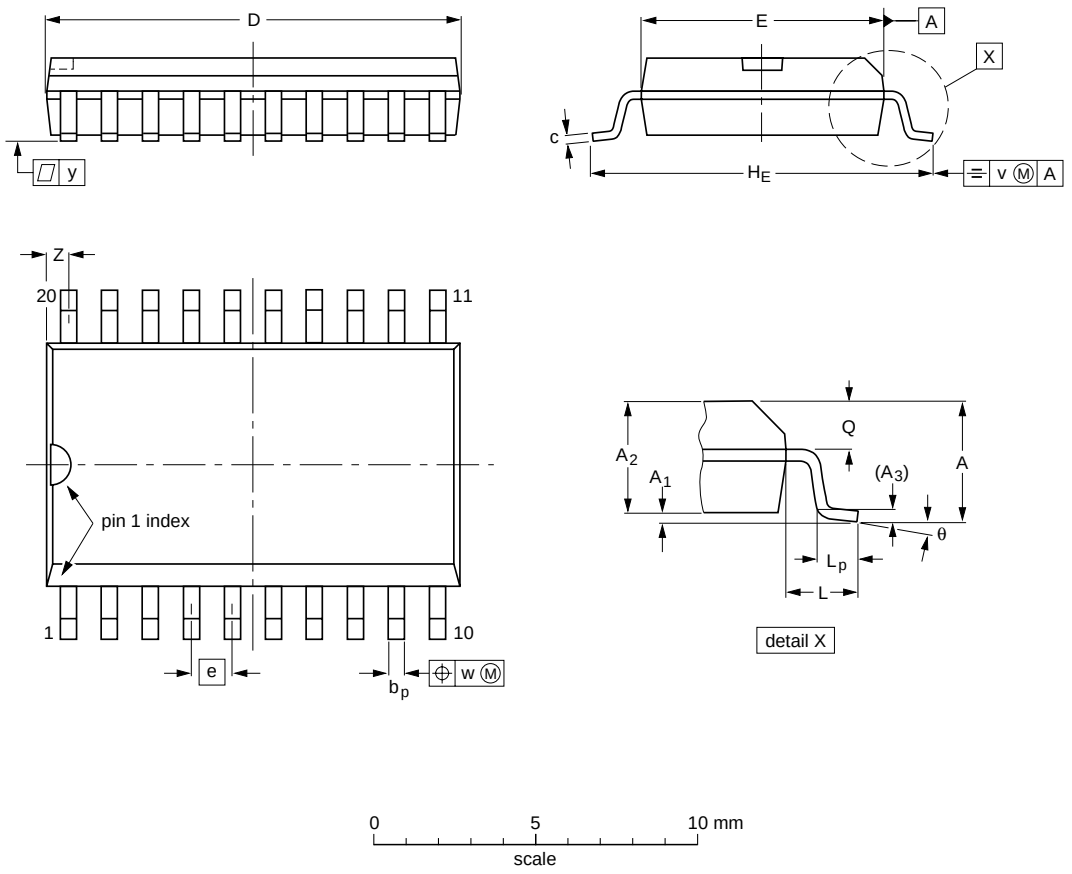
Fig 9. Load circuitry for switching times

Table 9. Test data

Input				Load	
V_I	Repetition rate	t_W	t_r, t_f	R_L	C_L
2.7 V	≤ 10 MHz	500 ns	≤ 2.5 ns	500 Ω	50 pF

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	

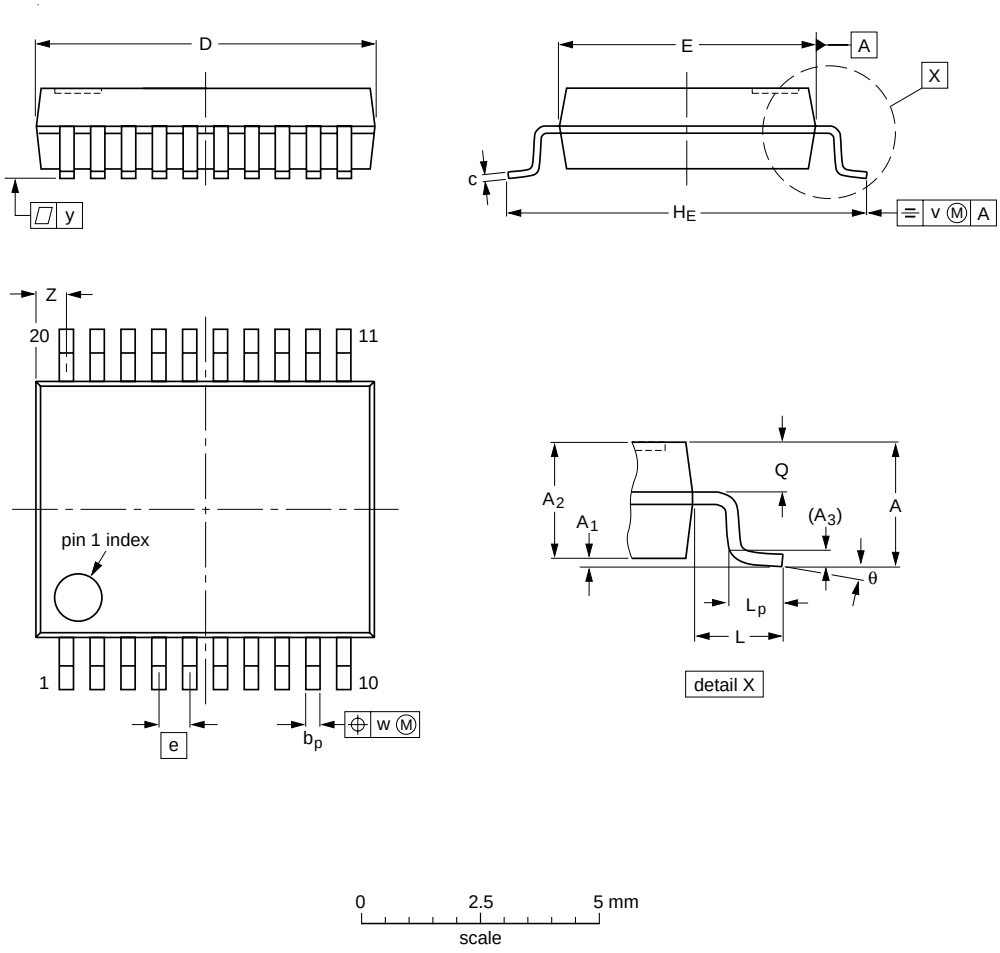
Note

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

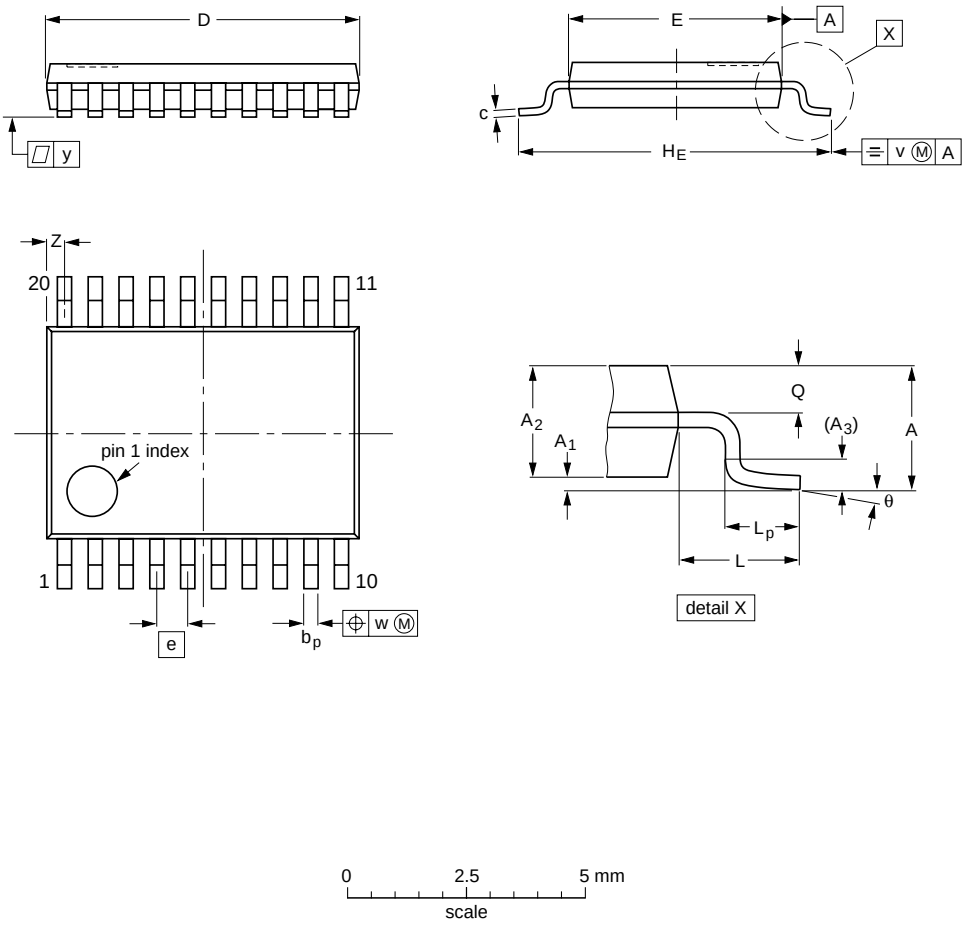
Note

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

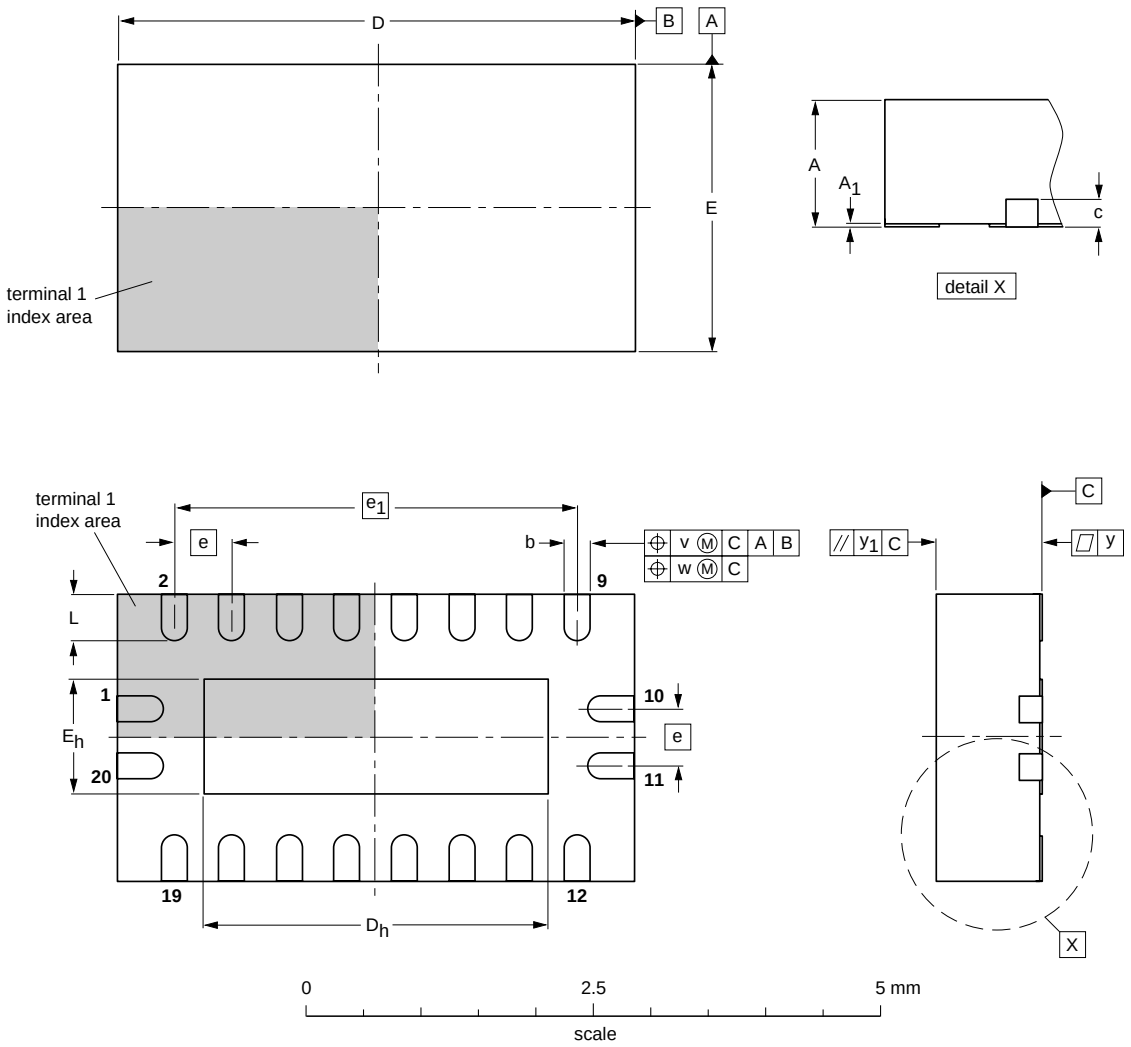
Notes

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)

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**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max.	A_1	b	c	D(1)	D_h	E(1)	E_h	e	e_1	L	v	w	y	y_1
mm	1	0.05 0.00	0.30 0.18	0.2	4.6 4.4	3.15 2.85	2.6 2.4	1.15 0.85	0.5	3.5	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT764-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27

Fig 13. Package outline SOT764-1 (DHVQFN20)

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
BiCMOS	Integrated Bipolar junction transistors and CMOS
CDM	Charged Device Model
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
74LVT273_3	20080910	Product data sheet	-	74LVT273_2
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. • Title changed to 3.3 V octal D-type flip-flop • Section 3 “Ordering information” and Section 12 “Package outline” DHVQFN20 package added. • Table 4 “Limiting values” T_j and P_{tot} values added.			
74LVT273_2	19980219	Product specification	-	-

15. Legal information

16. 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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18. Contents

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