## 74LVC573A-Q100

# Octal D-type transparent latch with 5 V tolerant inputs/outputs; 3-state

Rev. 2 — 26 September 2018

**Product data sheet** 

### 1. General description

The 74LVC573A-Q100 consists of eight D-type transparent latches, featuring separate D-type inputs for each latch and 3-state true outputs for bus-oriented applications. A Latch Enable (LE) input and an Output Enable (OE) input are common to all internal latches.

When LE is HIGH, data at the Dn inputs enters the latches. In this condition, the latches are transparent, that is, a latch output changes each time its corresponding D-input changes. When LE is LOW, the latches store the information that was present at the D-inputs one set-up time preceding the HIGH-to-LOW transition of LE.

When  $\overline{OE}$  is LOW, the contents of the eight latches 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 latches.

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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

#### 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- 5 V tolerant inputs/outputs, 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<sub>CC</sub> = 0 V
- Flow-through pinout 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:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JFSD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

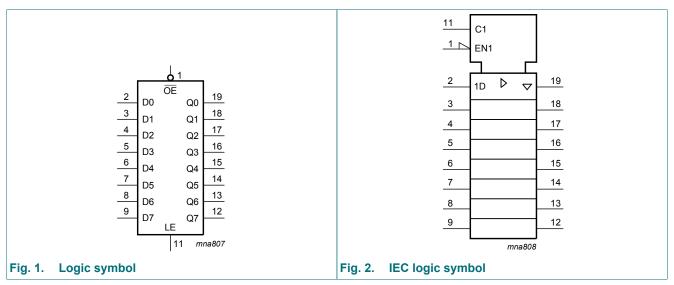


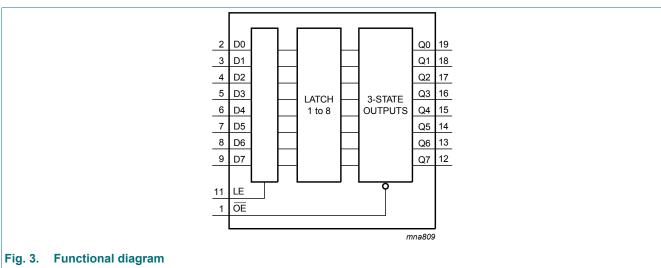
### 3. Ordering information

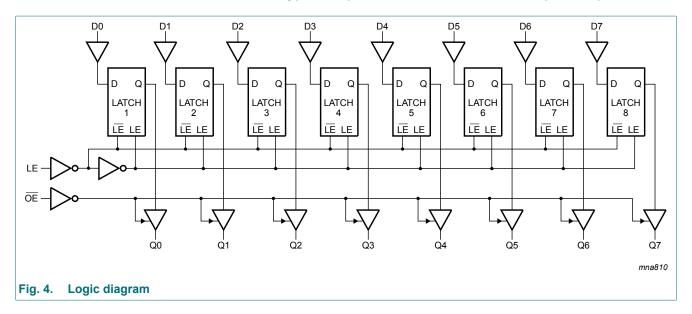
**Table 1. Ordering information** 

Type number	Package									
	Temperature range	Name	Description	Version						
74LVC573AD-Q100	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1						
74LVC573APW-Q100	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1						
74LVC573ABQ-Q100	-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

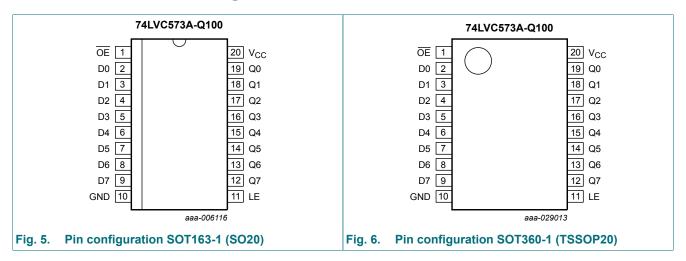


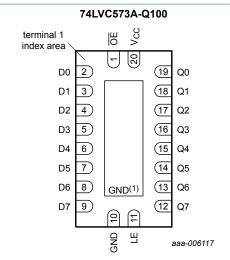




### 5. Pinning information

### 5.1. Pinning





Transparent top view

(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig. 7. Pin configuration SOT764-1 (DHVQFN20)

#### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
ŌE	1	output enable input (active LOW)
LE	11	latch enable input (active HIGH)
D0, D1, D2, D3, D4, D5, D6, D7	2, 3, 4, 5, 6, 7, 8, 9	data input
Q0, Q1, Q2,Q3, Q4, Q5, Q6, Q7	19, 18, 17, 16, 15, 14, 13, 12	data output
GND	10	ground (0 V)
Vcc	20	supply voltage

### 6. Functional description

#### Table 3. Functional table

 $H = HIGH \ voltage \ level$ ;  $h = HIGH \ voltage \ level$  one set-up time prior to the HIGH-to-LOW LE transition  $L = LOW \ voltage \ level$ ;  $l = LOW \ voltage \ level$  one set-up time prior to the HIGH-to-LOW LE transition

Z = high-impedance OFF-state

Operating modes	Input			Internal latch	Output
	ŌĒ	LE	Dn		Qn
Enable and read register	L	Н	L	L	L
(transparent mode)	L	Н	Н	Н	Н
Latch and read register	L	L	I	L	L
	L	L	h	Н	Н
Latch register and disable outputs	Н	L	I	L	Z
	Н	L	h	Н	Z

### 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	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0	-50	-	mA
VI	input voltage	[1]	-0.5	+6.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0	-	±50	mA
Vo	output voltage	[2]	-0.5	V <sub>CC</sub> + 0.5	V
Io	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb}$ = -40 °C to +125 °C [3]	-	500	mW

<sup>[1]</sup> The minimum input voltage ratings may be exceeded if the input current ratings are observed.

### 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
VI	input voltage		0	-	5.5	V
Vo	output voltage	output HIGH- or LOW-state	0	-	V <sub>CC</sub>	V
		output 3-state	0	-	5.5	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 3.6 V	0	-	10	ns/V

<sup>[2]</sup> The output voltage ratings may be exceeded if the output current ratings are observed.

<sup>[3]</sup> For SO20 packages: above 70 °C the value of Ptot derates linearly with 8 mW/K.

For TSSOP20 packages: above 60  $^{\circ}$ C the value of P<sub>tot</sub> derates linearly with 5.5 mW/K.

For DHVQFN20 packages: above 60 °C the value of Ptot derates linearly with 4.5 mW/K.

### 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	Unit	
			Min	Typ [1]	Max	Min	Max	1
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V
	input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65V <sub>CC</sub>	-	-	0.65V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V <sub>IL</sub>	LOW-level	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V
	input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35V <sub>CC</sub>	-	0.35V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
	output voltage	I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 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
		$I_O = -18 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.4	-	-	2.25	-	V
		$I_{O}$ = -24 mA; $V_{CC}$ = 3.0 V	2.2	-	-	2.0	-	V
V <sub>OL</sub>	LOW-level	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
	output voltage	I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		$I_O = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	input leakage current	$V_{CC} = 3.6 \text{ V}; V_1 = 5.5 \text{ V or GND}$	-	±0.1	±5	-	±20	μΑ
l <sub>OZ</sub>	OFF-state output current	$V_I = V_{IH} \text{ or } V_{IL}; V_{CC} = 3.6 \text{ V}; V_O = 5.5 \text{ V or GND}$	-	0.1	±5	-	±20	μΑ
I <sub>OFF</sub>	power-off leakage current	$V_{CC} = 0 \text{ V}; V_{I} \text{ or } V_{O} = 5.5 \text{ V}$	-	0.1	±10	-	±20	μΑ
I <sub>CC</sub>	supply current	$V_{CC} = 3.6 \text{ V}; V_I = V_{CC} \text{ or GND}; I_O = 0 \text{ A}$	-	0.1	10	-	40	μΑ
Δl <sub>CC</sub>	additional supply current	per input pin; $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V};$ $V_{I} = V_{CC} - 0.6 \text{ V};$ $I_{O} = 0 \text{ A}$	-	5	500	-	5000	μΑ
C <sub>I</sub>	input capacitance	$V_{CC}$ = 0 V to 3.6 V; $V_{I}$ = GND to $V_{CC}$	-	5.0	-	-	-	pF

<sup>[1]</sup> 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 characteristics** 

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 12.

Symbol	Parameter	Conditions	-40	°C to +85	°C	-40 °C to	+125 °C	Unit
			Min	Typ [1]	Max	Min	Max	1
t <sub>pd</sub>	propagation delay	Dn to Qn; see Fig. 8 [2]						
		V <sub>CC</sub> = 1.2 V	-	16.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.1	7.8	16.3	2.1	18.8	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.1	8.0	1.5	9.2	ns
		V <sub>CC</sub> = 2.7 V	1.5	4.1	7.2	1.5	9.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.4	6.2	1.5	8.0	ns
		LE to Qn; see Fig. 9 [2]						
		V <sub>CC</sub> = 1.2 V	-	16.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.0	7.7	16.0	2.0	18.4	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.1	7.8	1.5	9.1	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.7	7.5	1.5	9.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.4	6.5	1.5	8.5	ns
t <sub>en</sub>	enable time	OE to Qn; see Fig. 10 [2]						
		V <sub>CC</sub> = 1.2 V	-	18.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.7	7.5	17.5	1.7	20.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.2	9.2	1.5	10.6	ns
		V <sub>CC</sub> = 2.7 V	1.5	4.2	8.5	1.5	11.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.4	7.5	1.5	9.5	ns
t <sub>dis</sub>	disable time	OE to Qn; see Fig. 10 [2]						
		V <sub>CC</sub> = 1.2 V	-	8.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	3.3	10.1	1.0	11.6	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.3	1.8	5.7	0.3	6.6	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.0	6.5	1.5	8.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	2.5	6.0	1.5	7.5	ns
t <sub>W</sub>	pulse width	LE HIGH; see Fig. 9						
		V <sub>CC</sub> = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V <sub>CC</sub> = 2.7 V	3.2	-	-	3.2	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	3.2	1.6	-	3.2	-	ns
t <sub>su</sub>	set-up time	Dn to LE; see Fig. 11						
		V <sub>CC</sub> = 1.65 V to 1.95 V	4.0	-	-	4.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	2.5	-	-	2.5	-	ns
		V <sub>CC</sub> = 2.7 V	1.7	-	-	1.7	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.7	-	-	1.7	-	ns
t <sub>h</sub>	hold time	Dn to LE; see Fig. 11						
		V <sub>CC</sub> = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.9	-	-	1.9	-	ns
		V <sub>CC</sub> = 2.7 V	1.5	-	-	1.5	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.4	-	-	1.4	-	ns

Symbol	Parameter	Conditions		-40	°C to +85	°C	-40 °C to	Unit	
				Min	Typ [1]	Max	Min	Max	
t <sub>sk(0)</sub>	output skew time	V <sub>CC</sub> = 3.0 V to 3.6 V	3]	-	-	1.0	-	1.5	ns
C <sub>PD</sub>	power dissipation	per latch; $V_I = GND$ to $V_{CC}$	1]						
	capacitance	V <sub>CC</sub> = 1.65 V to 1.95 V		-	7.1	-		-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V		-	10.3	-		-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V		-	13.2	-		-	pF

- 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]  $t_{\text{pd}}$  is the same as  $t_{\text{PLH}}$  and  $t_{\text{PHL}}$ .
  - $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .
  - t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.
- Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
- $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).  $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma (C_L \times V_{CC}^2 \times f_o)$  where:

f<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 Volts

N = number of inputs switching

 $\Sigma(C_L \times V_{CC}^2 \times f_0)$  = sum of the outputs

#### 10.1. Waveforms and test circuit

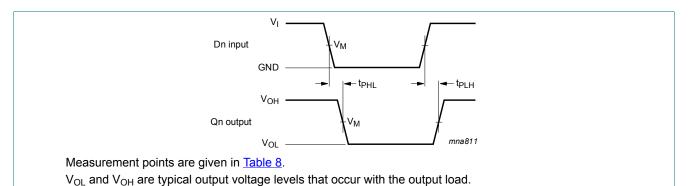
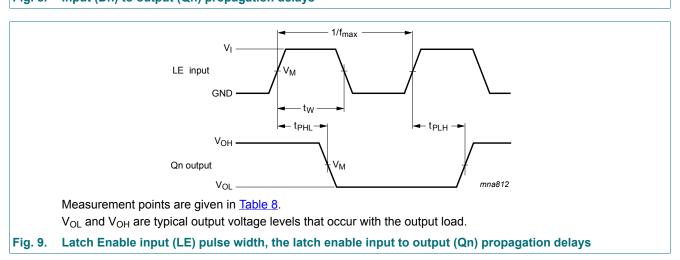


Fig. 8. Input (Dn) to output (Qn) propagation delays



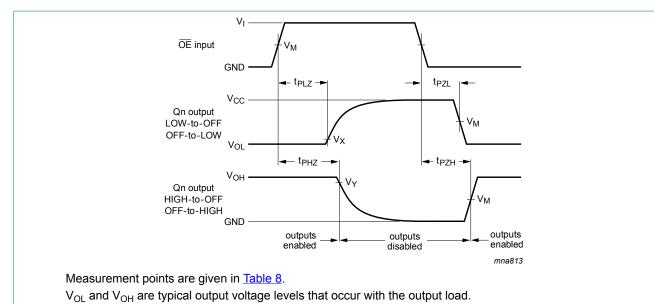
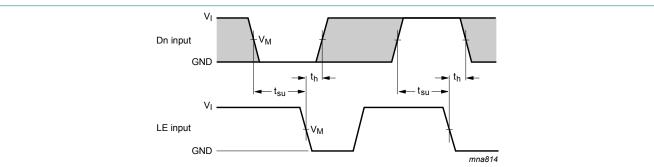


Fig. 10. 3-state enable and disable times



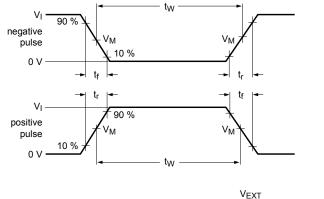
Measurement points are given in Table 8.

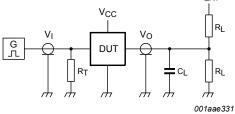
The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig. 11. Data set-up and hold times for the Dn input to the LE input

**Table 8. Measurement points** 

Supply voltage	Input		Output	Output					
V <sub>CC</sub>	V <sub>I</sub>	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>				
1.2 V	V <sub>CC</sub>	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V				
1.65 V to 1.95 V	V <sub>CC</sub>	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V				
2.3 V to 2.7 V	V <sub>CC</sub>	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>	V <sub>OL</sub> + 0.15 V	V <sub>OH</sub> - 0.15 V				
2.7 V	2.7 V	1.5 V	1.5 V	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V				
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	V <sub>OL</sub> + 0.3 V	V <sub>OH</sub> - 0.3 V				





Test data is given in <u>Table 9</u>. 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  $Z_0$  of the pulse generator.

V<sub>EXT</sub> = External voltage for measuring switching times.

Fig. 12. Test circuit for measuring switching times

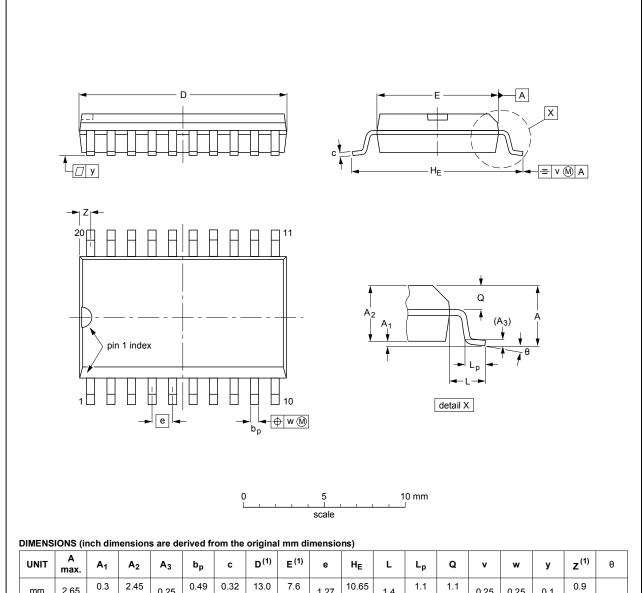
Table 9. Test data

Supply voltage	Input		Load	Load		V <sub>EXT</sub>		
	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	CL	R <sub>L</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>	t <sub>PLZ</sub> , t <sub>PZL</sub>	t <sub>PHZ</sub> , t <sub>PZH</sub>	
1.2 V	V <sub>CC</sub>	≤ 2 ns	30 pF	1 kΩ	open	2 × V <sub>CC</sub>	GND	
1.65 V to 1.95 V	V <sub>CC</sub>	≤ 2 ns	30 pF	1 kΩ	open	2 × V <sub>CC</sub>	GND	
2.3 V to 2.7 V	V <sub>CC</sub>	≤ 2 ns	30 pF	500 Ω	open	2 × V <sub>CC</sub>	GND	
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V <sub>CC</sub>	GND	
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V <sub>CC</sub>	GND	

### 11. Package outline



SOT163-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	Q	v	w	у	z <sup>(1)</sup>	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°
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	0°

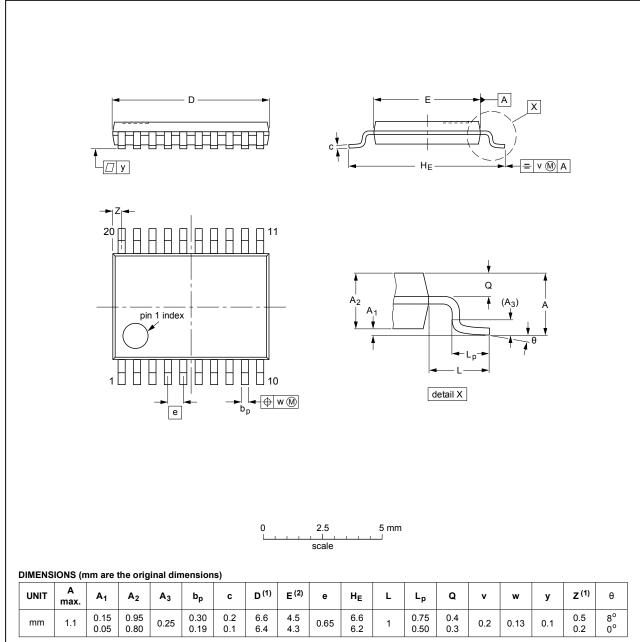
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE		REFER	ENCES	EUROPEAN	ISSUE DATE
VERSION	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE
SOT163-1	075E04	MS-013			<del>99-12-27</del> 03-02-19

Fig. 13. Package outline SOT163-1 (SO20)

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

SOT360-1



#### 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	ISSUE DATE
	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT360-1		MO-153				<del>99-12-27</del> 03-02-19

Fig. 14. Package outline SOT360-1 (TSSOP20)

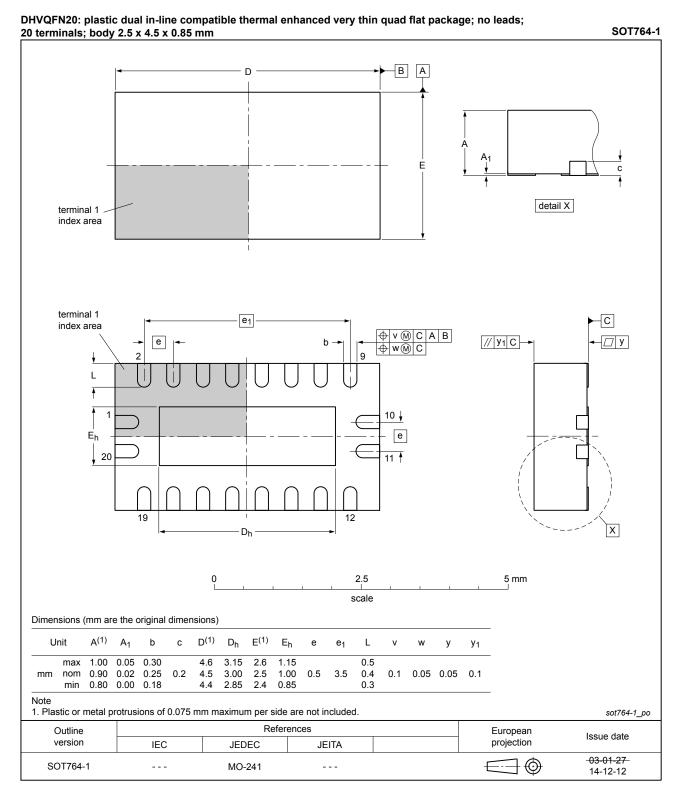


Fig. 15. Package outline SOT764-1 (DHVQFN20)

### 12. Abbreviations

#### Table 10. Abbreviations

Table 10. Abbieviations			
Acronym	Description		
CMOS	Complementary Metal-Oxide Semiconductor		
DUT	Device Under Test		
ESD	ElectroStatic Discharge		
НВМ	Human Body Model		
MIL	Military		
MM	Machine Model		
TTL	Transistor-Transistor Logic		

### 13. Revision history

#### **Table 11. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes	
74LVC573A_Q100 v.2	20180926	Product data sheet	-	74LVC573A_Q100 v.1	
Modifications:	<ul> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Package outline drawing <u>SOT764-1</u> updated</li> </ul>				
74LVC573A_Q100 v.1	20130129	Product data sheet	-	-	

### 14. Legal information

#### **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.	

- 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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### **Contents**

1. General description	1
2. Features and benefits	1
3. Ordering information	2
4. Functional diagram	2
5. Pinning information	3
5.1. Pinning	3
5.2. Pin description	4
6. Functional description	4
7. Limiting values	
8. Recommended operating conditions	5
9. Static characteristics	6
10. Dynamic characteristics	7
10.1. Waveforms and test circuit	8
11. Package outline	11
12. Abbreviations	14
13. Revision history	14
14. Legal information	

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