Octal D-type flip-flop with reset; positive-edge trigger Rev. 2 — 28 August 2020 Product data sheet

1. General description

The 74LVC273-Q100 is an octal positive-edge triggered D-type flip-flop. The device features clock (CP) and master reset (\overline{MR}) inputs. The outputs Qn will assume the state of their corresponding D inputs that meet the set-up and hold time requirements on the LOW-to-HIGH clock (CP) transition. A LOW on \overline{MR} forces the outputs LOW independently of clock and data inputs. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

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
- Wide supply voltage range from 1.2 V to 3.6 V
- Overvoltage tolerant inputs to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Output drive capability 50 Ω transmission lines at +85 °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:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

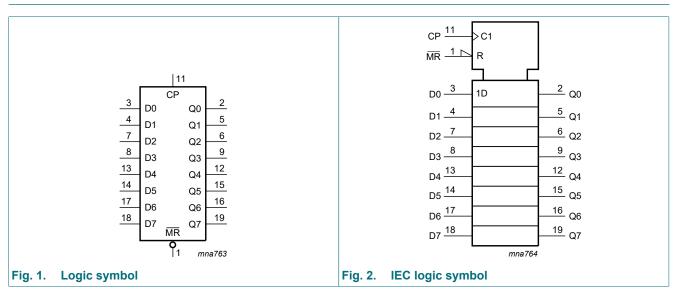
3. Ordering information

Table 1. Ordering information

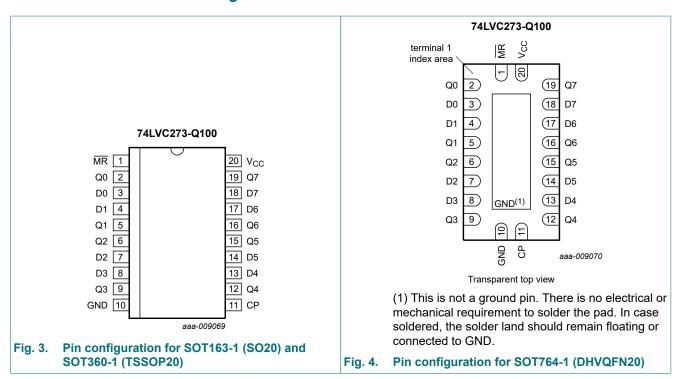
Type number	Package			
	Temperature range	Name	Description	Version
74LVC273D-Q100	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC273PW-Q100	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVC273BQ-Q100	-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

5.2. Pin description

Symbol	Pin	Description
MR	1	master reset input (active LOW)
СР	11	clock input (LOW-to-HIGH; edge-triggered)
D0, D1, D2, D3, D4, D5, D6, D7	3, 4, 7, 8, 13, 14, 17, 18	data input
Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7	2, 5, 6, 9, 12, 15, 16, 19	flip-flop output
GND	10	ground (0 V)
V _{CC}	20	supply voltage

6. Functional description

Table 3. Function table

H = HIGH voltage level; h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition

L = LOW voltage level; I = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition

 $X = don't care; \uparrow = LOW-to-HIGH clock transition$

Operating mode	Input			Output	
	MR	IR CP Dn			
Reset (clear)	L	Х	Х	L	
Load '1'	Н	1	h	Н	
Load '0'	Н	1	I	L	

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).

		U X X X			10	/
Symbol	Parameter	Conditions		Min	Max	Unit
V _{CC}	supply voltage			-0.5	+6.5	V
I _{IK}	input clamping current	V ₁ < 0 V		-50	-	mA
VI	input voltage		[1]	-0.5	+6.5	V
I _{OK}	output clamping current	$V_{\rm O}$ > $V_{\rm CC}$ or $V_{\rm O}$ < 0 V		-	50	mA
Vo	output voltage		[2]	-0.5	V _{CC} + 0.5	V
lo	output current	$V_{O} = 0 V \text{ to } V_{CC}$		-	±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 SOT163-1 (SO20) package: P_{tot} derates linearly with 12.3 mW/K above 109 °C.

For SOT360-1 (TSSOP20) package: P_{tot} derates linearly with 10.0 mW/K above 100 °C. For SOT764-1 (DHVQFN20) package: P_{tot} derates linearly with 12.9 mW/K above 111 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
V _{CC}	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
VI	input voltage		0	-	5.5	V
Vo	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 +8	5 °C	-40 °C to	+125 °C	Unit
			Min	Typ [1]	Max	Min	Max	
VIH	HIGH-level	V _{CC} = 1.2 V	1.08	-	-	1.08	-	V
	input voltage	V _{CC} = 1.65 V to 1.95 V	0.65V _{CC}	-	-	0.65V _{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	V _{CC} = 1.2 V	-	-	0.12	-	0.12	V
	input voltage	V _{CC} = 1.65 V to 1.95 V	-	-	0.35V _{CC}	-	0.35V _{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
	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	V _I = V _{IH} or V _{IL}						
	output voltage	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

Octal D-type flip-flop with reset; positive-edge trigger

Symbol	Parameter	Conditions	-40 °C to +85 °C		3°C	-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
l _l	input leakage current	V _{CC} = 3.6 V; V _I = 5.5 V or GND	-	±0.1	±5	-	±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; $V_{CC} = 2.7 V \text{ to } 3.6 V;$ $V_{I} = V_{CC} - 0.6 V; I_{O} = 0 A$	-	5	500	-	5000	μA
Cı	input capacitance	$V_{CC} = 0 V \text{ to } 3.6 V;$ $V_I = GND \text{ to } V_{CC}$	-	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 characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 8.

Symbol	Parameter	Conditions	-40	°C to +85	5 °C	-40 °C te	o +125 °C	Unit
			Min	Typ [1]	Max	Min	Max	1
t _{pd}	propagation	CP to Qn; see Fig. 5	2]					
	delay	V _{CC} = 1.2 V	-	18	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	2.5	9.7	19.2	2.5	22.2	ns
		V _{CC} = 2.3 V to 2.7 V	1.8	4.9	9.9	1.8	11.4	ns
		V _{CC} = 2.7 V	1.5	4.5	8.4	1.5	10.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	4.1	8.2	1.5	10.5	ns
t _{PHL}	HIGH to LOW	MR to Qn; see <u>Fig. 6</u>						
	propagation delay	V _{CC} = 1.2 V	-	18	-	-	-	ns
	delay	V _{CC} = 1.65 V to 1.95 V	2.4	10.2	20.4	2.4	23.5	ns
		V_{CC} = 2.3 V to 2.7 V	1.7	5.2	10.5	1.7	12.1	ns
		V _{CC} = 2.7 V	1.5	4.7	8.9	1.5	11.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	4.3	8.7	1.5	11.0	ns
t _W	pulse width	clock HIGH or LOW; see Fig. 5						
		V _{CC} = 1.65 V to 1.95 V	6.0	-	-	6.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	5.0	-	-	5.0	-	ns
		V _{CC} = 2.7 V	5.0	1.8	-	5.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	4.0	1.2	-	4.0	-	ns
		master reset LOW; see <u>Fig. 6</u>						
		V _{CC} = 1.65 V to 1.95 V	6.0	-	-	6.0	-	ns
		V_{CC} = 2.3 V to 2.7 V	5.0	-	-	5.0	-	ns
		V _{CC} = 2.7 V	5.0	1.7	-	5.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	4.0	1.2	-	4.0	-	ns
t _{rec}	recovery time	MR to CP; see Fig. 6						
		V _{CC} = 1.65 V to 1.95 V	2.0	-	-	2.0	-	ns
		V_{CC} = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns
		V _{CC} = 2.7 V	2.0	-1.0	-	2.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	2.0	-1.0	-	2.0	-	ns

Symbol	Parameter	Conditions		-40	°C to +85	5 °C	-40 °C to	o +125 °C	Unit
				Min	Typ [1]	Max	Min	Max	1
t _{su}	set-up time	Dn to CP; see <u>Fig. 7</u>							
		V _{CC} = 1.65 V to 1.95 V		5.0	-	-	5.0	-	ns
		V _{CC} = 2.3 V to 2.7 V		3.5	-	-	3.5	-	ns
		V _{CC} = 2.7 V		3.0	1.0	-	3.0	-	ns
		V _{CC} = 3.0 V to 3.6 V		1.0	0.0	-	1.0	-	ns
t _h	hold time	Dn to CP; see <u>Fig. 7</u>							
		V _{CC} = 1.65 V to 1.95 V		3.0	-	-	3.0	-	ns
		V _{CC} = 2.3 V to 2.7 V		2.5	-	-	2.5	-	ns
		V _{CC} = 2.7 V		2.0	-0.2	-	2.0	-	ns
		V _{CC} = 3.0 V to 3.6 V		1.0	0.0	-	1.0	-	ns
f _{max}	maximum	see <u>Fig. 5</u>							
	frequency	V _{CC} = 1.65 V to 1.95 V		80	-	-	64	-	MHz
		V _{CC} = 2.3 V to 2.7 V		100	-	-	80	-	MHz
		V _{CC} = 2.7 V		150	-	-	150	-	MHz
		V _{CC} = 3.0 V to 3.6 V		150	230	-	150	-	MHz
t _{sk(o)}	output skew time	V _{CC} = 3.0 V to 3.6 V	[3]	-	-	1.0	-	1.5	ns
C _{PD}	power	per flip-flop; V_I = GND to V_{CC}	[4]						
	dissipation capacitance	V _{CC} = 1.65 V to 1.95 V		-	14.0	-	-	-	pF
	Capacitarice	V _{CC} = 2.3 V to 2.7 V		-	17.7	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V		-	21.0	-	-	-	pF

Octal D-type flip-flop with reset; positive-edge trigger

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. [1]

[2] [3] t_{pd} is the same as t_{PLH} and $t_{\text{PHL}}.$

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 μW). [4]

 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma (C_L \times V_{CC}^2 \times f_o)$ where:

 f_i = input frequency in MHz; f_o = output frequency in MHz

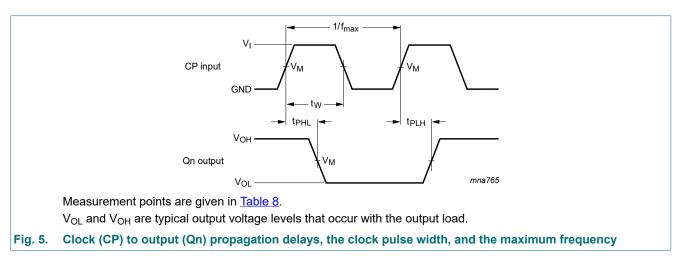
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volt

N = number of inputs switching

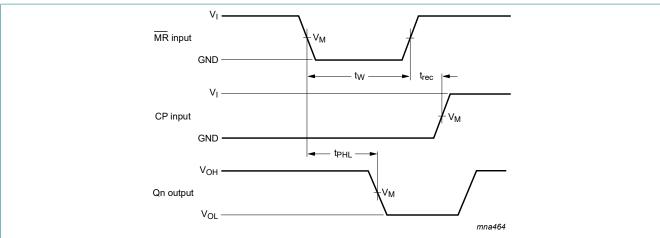
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs

10.1. Waveforms and test circuit



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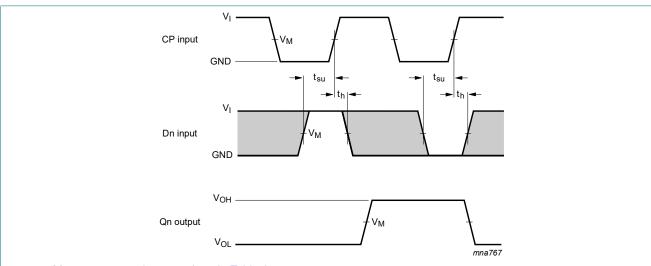
Octal D-type flip-flop with reset; positive-edge trigger



Measurement points are given in Table 8.

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

Fig. 6. Master reset (MR) pulse width, the master reset to output (Qn) propagation delays, and the master reset to clock (CP) recovery time



Measurement points are given in <u>Table 8</u>.

 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. 7. Data set-up and hold times for the data input (Dn)

Table 8. Measurement points

Supply voltage Input			Output	Output				
V _{cc}	VI	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 V	V _{OH} - 0.15 V			
1.65 V to 1.95 V	V _{CC}	0.5 × V _{CC}	$0.5 \times V_{CC}$	V _{OL} + 0.15 V	V _{OH} - 0.15 V			
2.3 V to 2.7 V	V _{CC}	0.5 × V _{CC}	$0.5 \times V_{CC}$	V _{OL} + 0.15 V	V _{OH} - 0.15 V			
2.7 V	2.7 V	1.5 V	1.5 V	V _{OL} + 0.3 V	V _{OH} - 0.3 V			
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	V _{OL} + 0.3 V	V _{OH} - 0.3 V			

Octal D-type flip-flop with reset; positive-edge trigger

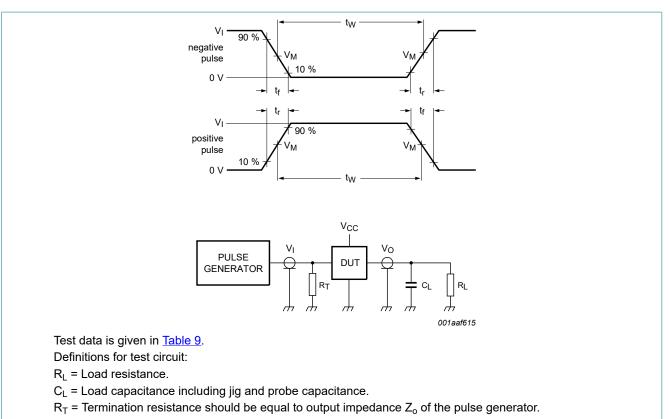


Fig. 8. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V _{EXT}	V _{EXT}			
V _{cc}	VI	t _r , t _f	CL	RL	t _{PLH} , t _{PHL}	t _{PLZ} , t _{PZL}	t _{PHZ} , t _{PZH}		
1.2 V	V _{CC}	≤ 2 ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND		
1.65 V to 1.95 V	V _{CC}	≤ 2 ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND		
2.3 V to 2.7 V	V _{CC}	≤ 2 ns	30 pF	500 Ω	open	2 × 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		

11. Package outline

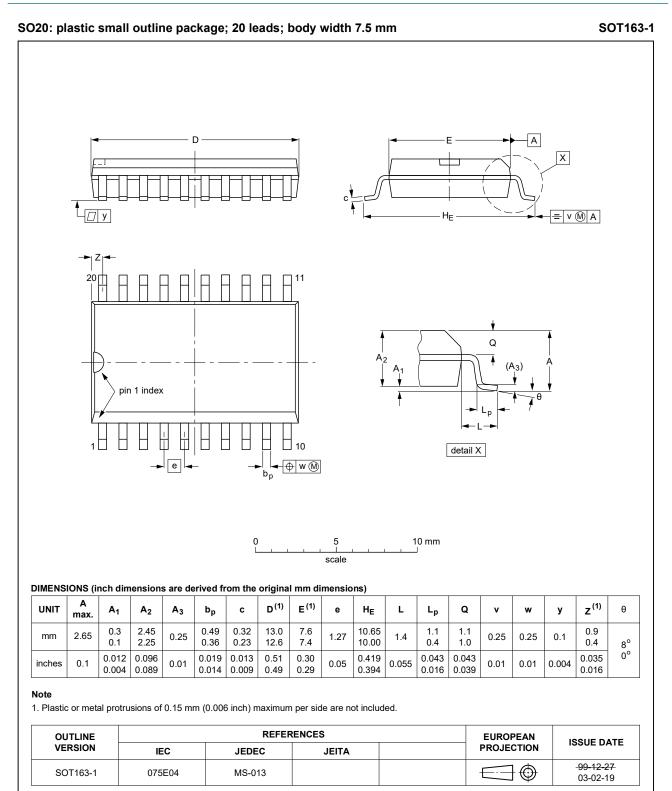


Fig. 9. Package outline SOT163-1 (SO20)

Octal D-type flip-flop with reset; positive-edge trigger

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm SOT360-1 Α Х 🛛 у H_E = v 🕅 A 20 Q ٨ (A₃) A2 A₁ pin 1 index T 10 detail X 0 w @ bp е 2.5 5 mm 0 scale DIMENSIONS (mm are the original dimensions) D ⁽¹⁾ E ⁽²⁾ Z ⁽¹⁾ Α UNIT **A**₁ **A**₂ A_3 bp С е ${\rm H}_{\rm E}$ L Lp Q ۷ w у θ max. 8° 0° 0.30 0.75 0.5 0.2 0.15 0.95 0.2 6.6 4.5 6.6 0.4 mm 1.1 0.25 0.65 1 0.2 0.13 0.1 6.2 0.05 0.80 0.19 0.1 4.3 0.50 0.3 6.4 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. REFERENCES OUTLINE EUROPEAN ISSUE DATE VERSION PROJECTION IEC JEDEC JEITA 99-12-27 \bigcirc SOT360-1 MO-153 03-02-19

Fig. 10. Package outline SOT360-1 (TSSOP20)

74LVC273_Q100

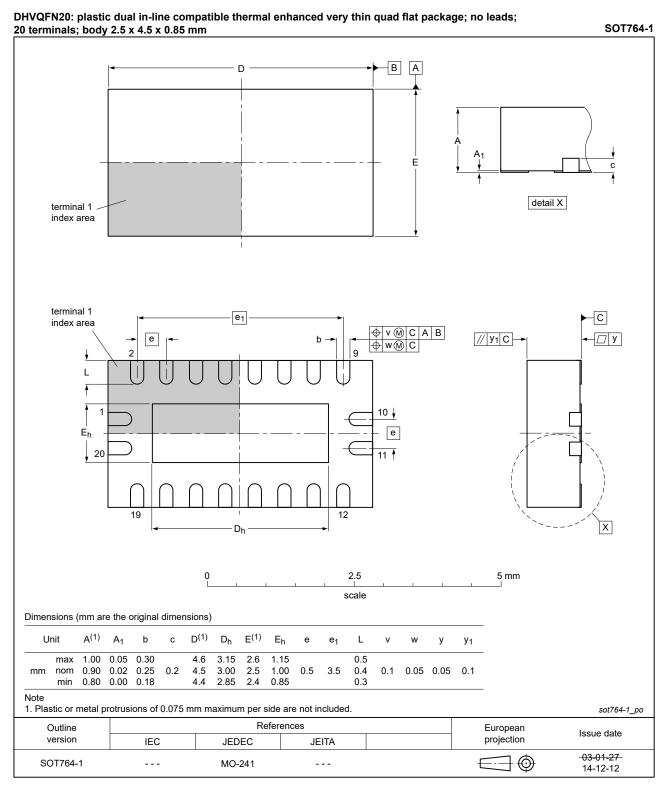


Fig. 11. Package outline SOT764-1 (DHVQFN20)

12. Abbreviations

Table 10. Abbreviations				
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	
74LVC273_Q100 v.2	20200828	Product data sheet	-	74LVC273_Q100 v.1	
Modifications:	 The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. <u>Section 1</u> and <u>Section 2</u> updated. <u>Table 4</u>: Derating values for P_{tot} total power dissipation updated. <u>Fig. 11</u>: Package outline drawing SOT764-1 (DHVQFN20) updated. 				
74LVC273_Q100 v.1	20130916	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".
- [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 <u>https://www.nexperia.com</u>.

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