

74LVC823A-Q100

9-bit D-type flip-flop with 5 V tolerant inputs/outputs;
positive edge-trigger; 3-state

Rev. 3 — 18 June 2020

Product data sheet

1. General description

The 74LVC823A-Q100 is a 9-bit D-type flip-flop with common clock (pin CP), clock enable (pin \overline{CE}), master reset (pin \overline{MR}) and 3-state outputs (pins Qn) for bus-oriented applications. The 9 flip-flops stores the state of their individual D-inputs that meet the set-up and hold times requirements on the LOW to HIGH CP transition, provided pin \overline{CE} is LOW. When pin \overline{CE} is HIGH, the flip-flops hold their data. A LOW on pin \overline{MR} resets all flip-flops. When pin \overline{OE} is LOW, the contents of the 9 flip-flops are available at the outputs. When pin \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 flip-flops.

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 and 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
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Flow-through pinout architecture
- 9-bit positive edge-triggered register
- Independent register and 3-state buffer operation
- 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			Version
	Temperature range	Name	Description	
74LVC823ABQ-Q100	-40 °C to +125 °C	DHVQFN24	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 x 5.5 x 0.85 mm	SOT815-1

4. Functional diagram

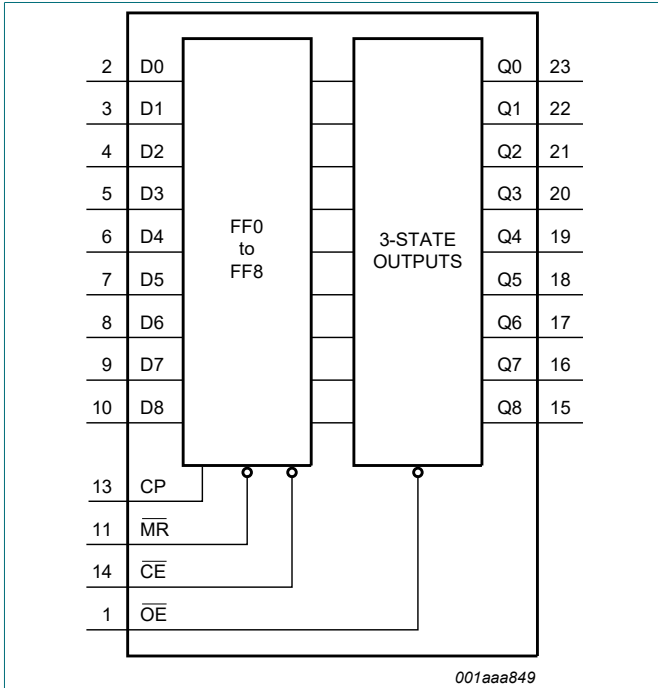


Fig. 1. Functional diagram

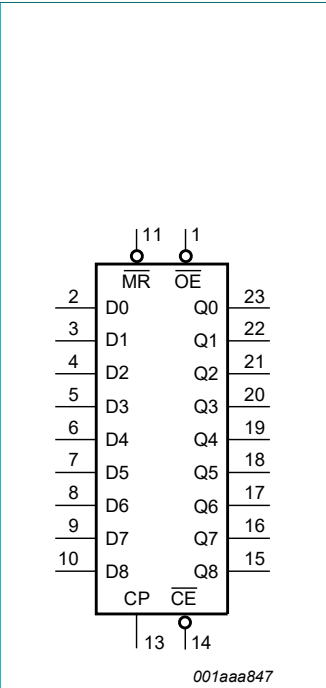


Fig. 2. Logic symbol

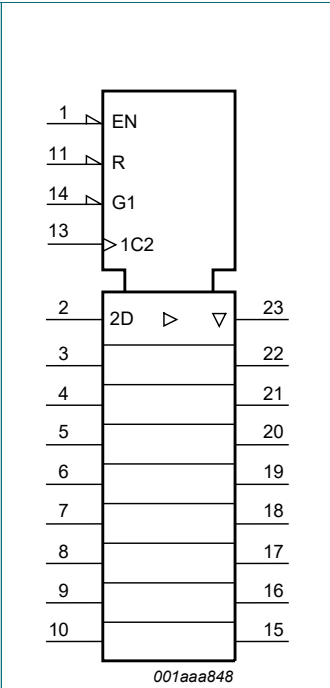


Fig. 3. IEC logic symbol

9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state

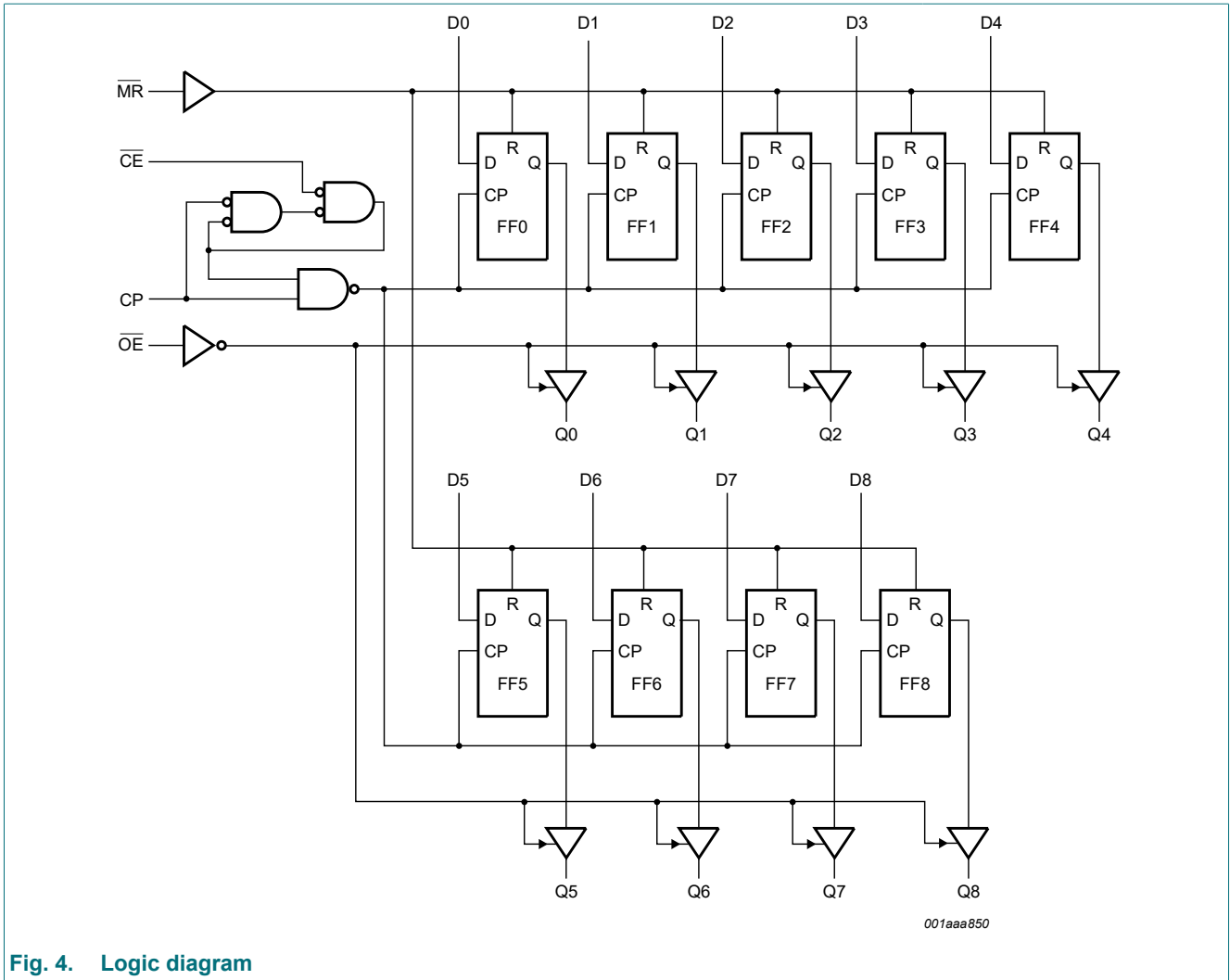
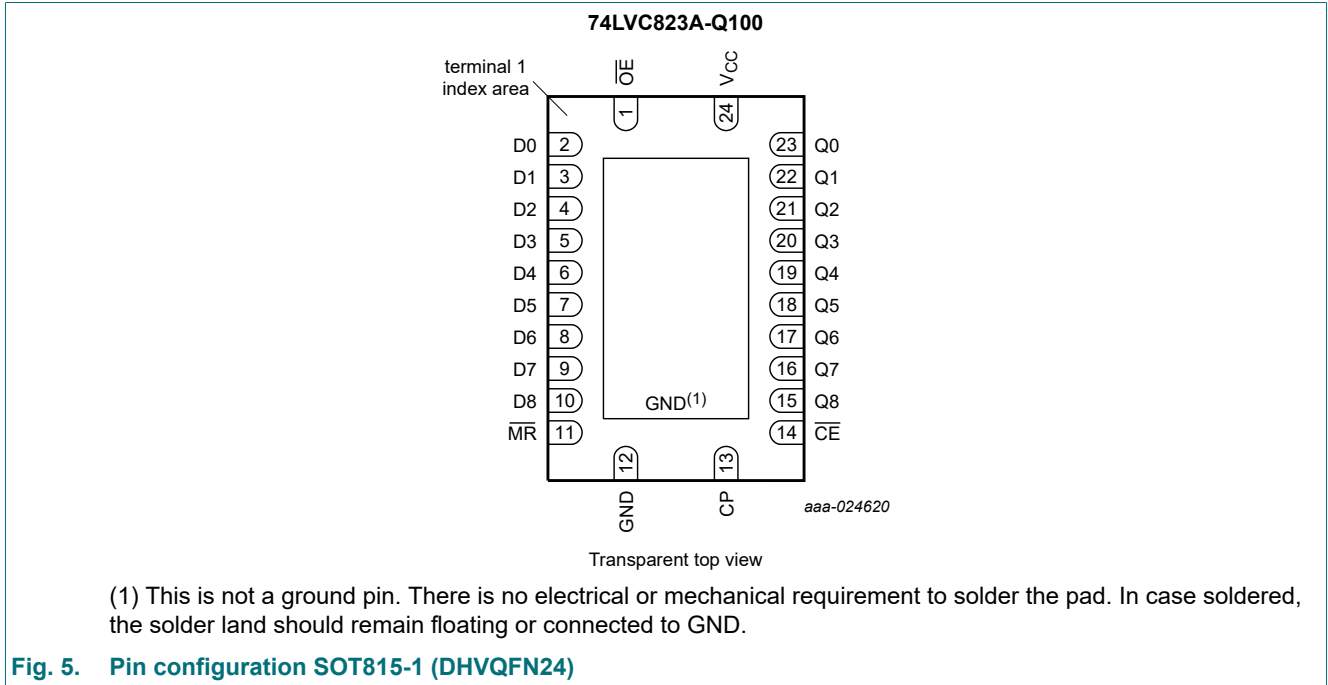


Fig. 4. Logic diagram

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Pin	Name	Description
OE	1	output enable input (active LOW)
MR	11	master reset input (active LOW)
D0, D1, D2, D3, D4, D5, D6, D7, D8	2, 3, 4, 5, 6, 7, 8, 9, 10	data input
Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	23, 22, 21, 20, 19, 18, 17, 16, 15	3-state flip-flop output
CP	13	clock input (LOW to HIGH; edge-triggered)
CE	14	clock enable input (active LOW)
GND	12	ground (0 V)
V _{CC}	24	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; l = LOW voltage level one set-up time prior to the LOW to HIGH CP transition

↑ = LOW to HIGH level transition

Z = high-impedance OFF-state; X = don't care; NC = no change

Operating mode	Input					Internal flip-flop	Output Qn
	OE	MR	CE	CP	Dn		
Clear	L	L	X	X	X	L	L
Load and read register	L	H	L	↑	l	L	L
	L	H	L	↑	h	H	H
Load register and disable outputs	H	H	L	↑	l	L	Z
	H	H	L	↑	h	H	Z
Hold	L	H	H	NC	X	NC	NC

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	
I_{IK}	input clamping current	$V_I < 0$ V	-50	-	mA	
V_I	input voltage	[1]	-0.5	+6.5	V	
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA	
V_O	output voltage	HIGH or LOW state	[2]	-0.5	$V_{CC} + 0.5$	V
		3-state	[2]	-0.5	+6.5	V
I_O	output current	$V_O = 0$ V 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 SOT815-1 (DHVQFN24) package: P_{tot} derates linearly with 15.0 mW/K above 117 °C.

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	HIGH or LOW state	0	-	V _{CC}	V
		3-state	0	-	5.5	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	0.65V _{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 input voltage	V _{CC} = 1.2 V	-	-	0.12	-	0.12	V
		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
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
		I _O = -24 mA; V _{CC} = 3.0 V	2.2	-	-	2.0	-	V
V _{OL}	LOW-level output voltage	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 _O = 24 mA; V _{CC} = 3.0 V	-	-	0.55	-	0.8	V
I _I	input leakage current	V _{CC} = 3.6 V; V _I = 5.5 V or GND	-	±0.1	±5	-	±20	μA
I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _{CC} = 3.6 V; V _O = 5.5 V or GND	-	0.1	±5	-	±20	μA

9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
I_{OFF}	power-off leakage current	$V_{CC} = 0\text{ V}$; V_I or $V_O = 5.5\text{ V}$	-	0.1	± 10	-	± 20	μA
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 characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 10.

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 Fig. 6 [2]						
		$V_{CC} = 1.2\text{ V}$	-	20	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	2.4	8.4	18.7	2.4	21.5	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	1.7	4.4	9.6	1.7	11.1	ns
		$V_{CC} = 2.7\text{ V}$	1.5	4.1	8.9	1.5	11.5	ns
t_{PHL}	HIGH to LOW propagation delay	MR to Qn; see Fig. 8						
		$V_{CC} = 1.2\text{ V}$	-	15	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	2.1	9.5	21.4	2.1	24.7	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	1.5	4.9	10.5	1.5	12.1	ns
		$V_{CC} = 2.7\text{ V}$	1.5	4.7	8.8	1.5	11.0	ns
t_{en}	enable time	\overline{OE} to Qn; see Fig. 9 [2]						
		$V_{CC} = 1.2\text{ V}$	-	18	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	1.7	7.4	16.5	1.7	19.0	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	1.5	4.2	9.1	1.5	10.5	ns
		$V_{CC} = 2.7\text{ V}$	1.5	4.3	8.3	1.5	10.5	ns
t_{dis}	disable time	\overline{OE} to Qn; see Fig. 9 [2]						
		$V_{CC} = 1.2\text{ V}$	-	8.0	-	-	-	ns
		$V_{CC} = 1.65\text{ V}$ to 1.95 V	2.3	4.2	10.0	2.3	11.5	ns
		$V_{CC} = 2.3\text{ V}$ to 2.7 V	1.0	2.3	5.6	1.0	6.5	ns
		$V_{CC} = 2.7\text{ V}$	1.5	3.2	7.1	1.5	9.0	ns
		$V_{CC} = 3.0\text{ V}$ to 3.6 V	1.5	2.9	6.0	1.5	7.5	ns

9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state

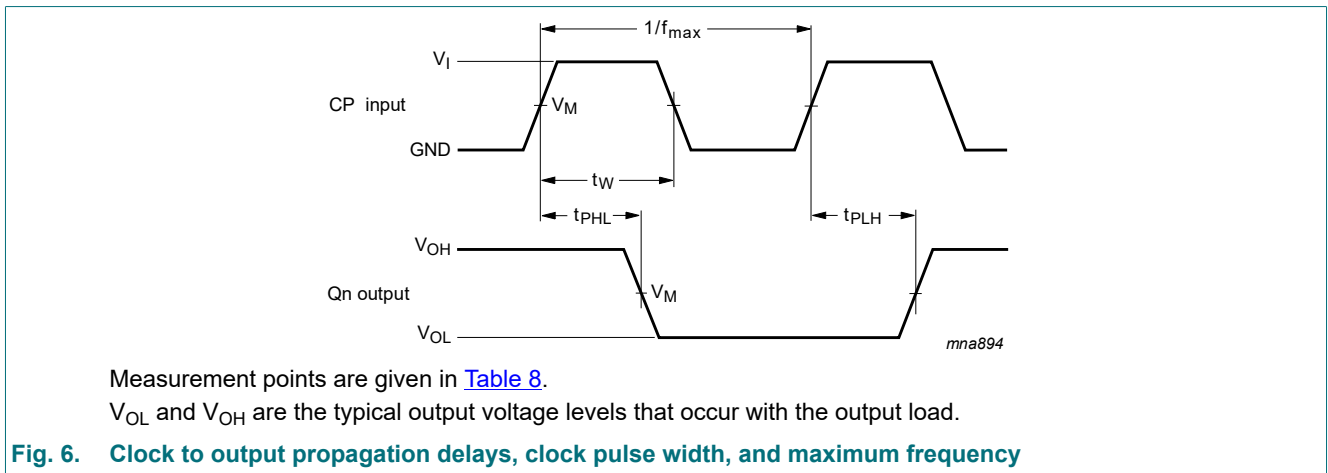
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t _w	pulse width	CP HIGH or LOW; see Fig. 6						
		V _{CC} = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V _{CC} = 2.7 V	3.3	-	-	3.3	-	ns
		V _{CC} = 3.0 V to 3.6 V	3.3	1.7	-	3.3	-	ns
		MR HIGH or LOW; see Fig. 8						
		V _{CC} = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V _{CC} = 2.7 V	3.3	-	-	3.3	-	ns
t _{su}	set-up time	Dn to CP; see Fig. 7						
		V _{CC} = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns
		V _{CC} = 2.7 V	1.0	-	-	1.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	+1.8	-0.8	-	+1.8	-	ns
		CE to CP; see Fig. 7						
		V _{CC} = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns
		V _{CC} = 2.7 V	1.8	-	-	1.8	-	ns
t _{rec}	recovery time	MR; see Fig. 8						
		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	-	-	2.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	+1.0	-0.5	-	+1.0	-	ns
t _h	hold time	Dn to CP; see Fig. 7						
		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	-	-	2.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	2.0	0.8	-	2.0	-	ns
		CE to CP; see Fig. 7						
		V _{CC} = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns
		V _{CC} = 2.7 V	1.3	-	-	1.3	-	ns
f _{max}	maximum frequency	CP; see Fig. 6						
		V _{CC} = 1.65 V to 1.95 V	100	-	-	80	-	MHz
		V _{CC} = 2.3 V to 2.7 V	125	-	-	100	-	MHz
		V _{CC} = 2.7 V	150	-	-	120	-	MHz
		V _{CC} = 3.0 V to 3.6 V	150	200	-	120	-	MHz
t _{sk(o)}	output skew time	Qn; V _{CC} = 3.0 V to 3.6 V [3]	-	-	1.0	-	1.5	ns

9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state

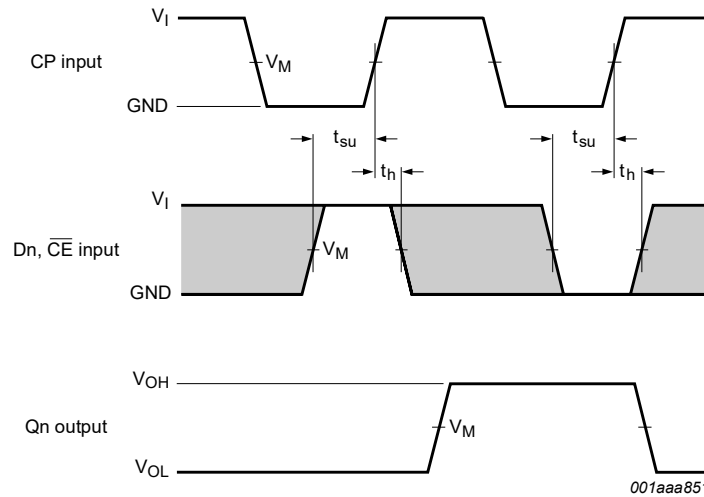
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
C _{PD}	power dissipation capacitance	per input; V _I = GND to V _{CC}						
		V _{CC} = 1.65 V to 1.95 V	-	12.4	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	14.5	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	16.4	-	-	-	pF

- [1] 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_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.
- [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).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ 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
 Σ(C_L × V_{CC}² × f_o) = sum of the outputs

10.1. Waveforms and test circuit

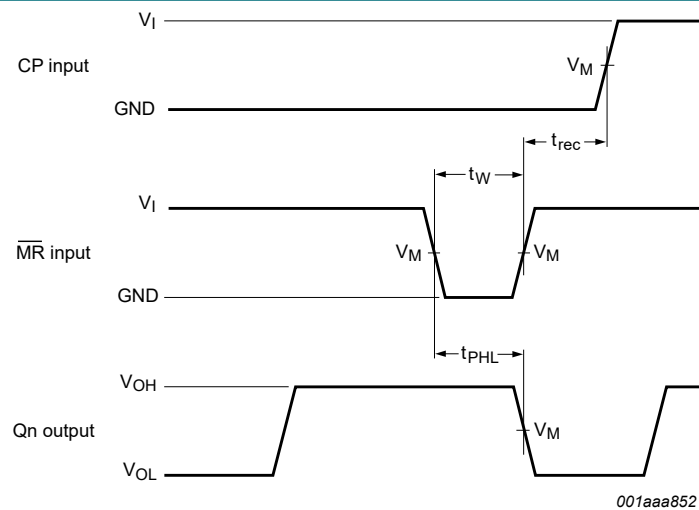


9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state



Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are the 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. 7. Data set-up and hold times for data and clock enable inputs to clock input



Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are the typical output voltage levels that occur with the output load.

Fig. 8. Master reset pulse width, master reset to clock removal time and master reset to output propagation delay

9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state

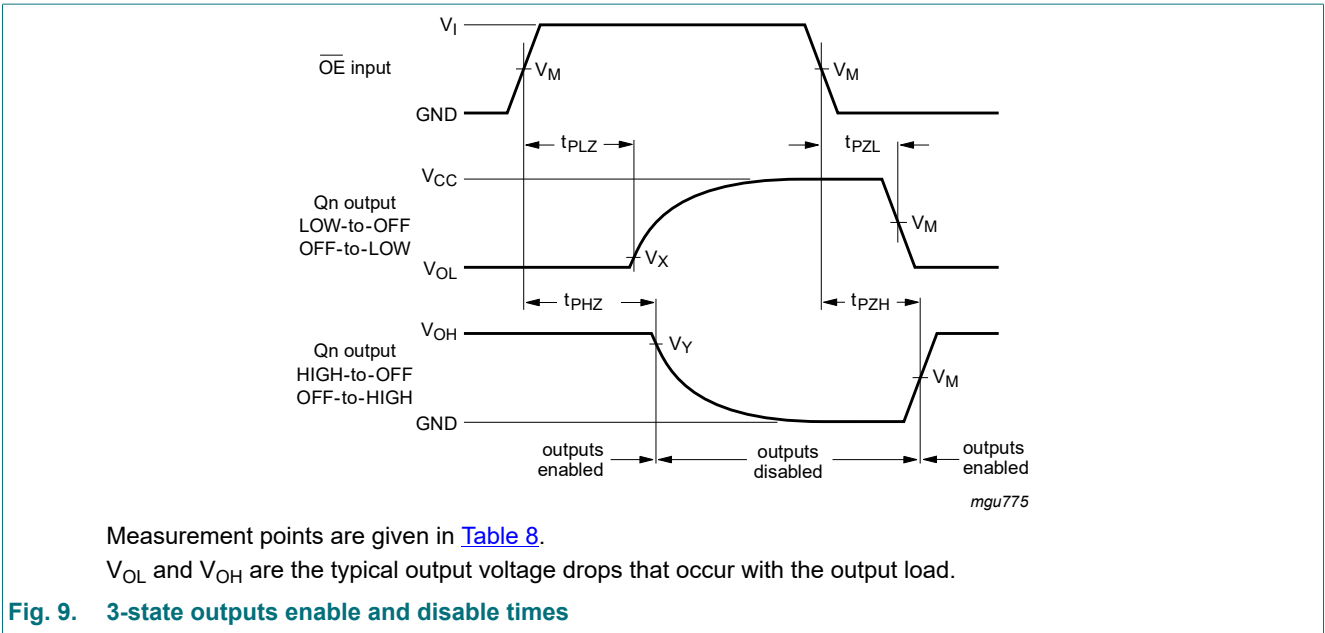
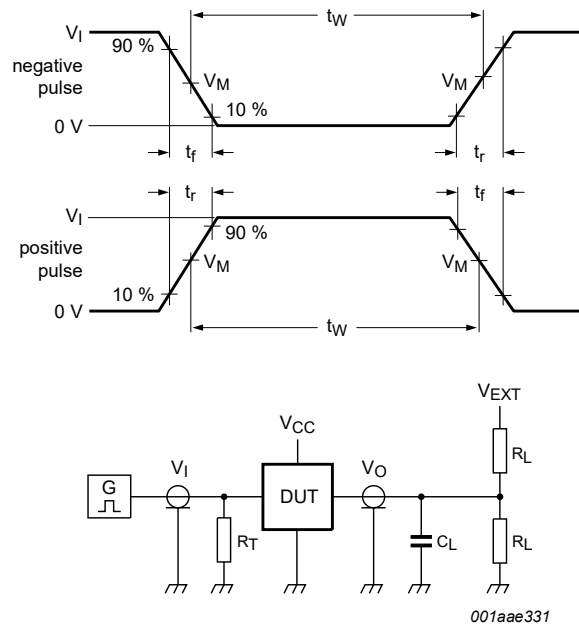


Table 8. Measurement points

Supply voltage	Input		Output		
	V_I	V_M	V_M	V_X	V_Y
1.2 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.65 V to 1.95 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$

9-bit D-type flip-flop with 5 V tolerant inputs/outputs; positive edge-trigger; 3-state



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.

V_{EXT} = External voltage for measuring switching times.

Fig. 10. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V_{EXT}		
	V_I	t_r, t_f	C_L	R_L	t_{PLH}, t_{PHL}	t_{PLZ}, t_{PZL}	t_{PHZ}, t_{PZH}
1.2 V	V_{CC}	≤ 2 ns	30 pF	1 k Ω	open	2 x V_{CC}	GND
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 k Ω	open	2 x V_{CC}	GND
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	30 pF	500 Ω	open	2 x V_{CC}	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 x V_{CC}	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 x V_{CC}	GND

11. Package outline

DHVQFN24: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 x 5.5 x 0.85 mm

SOT815-1

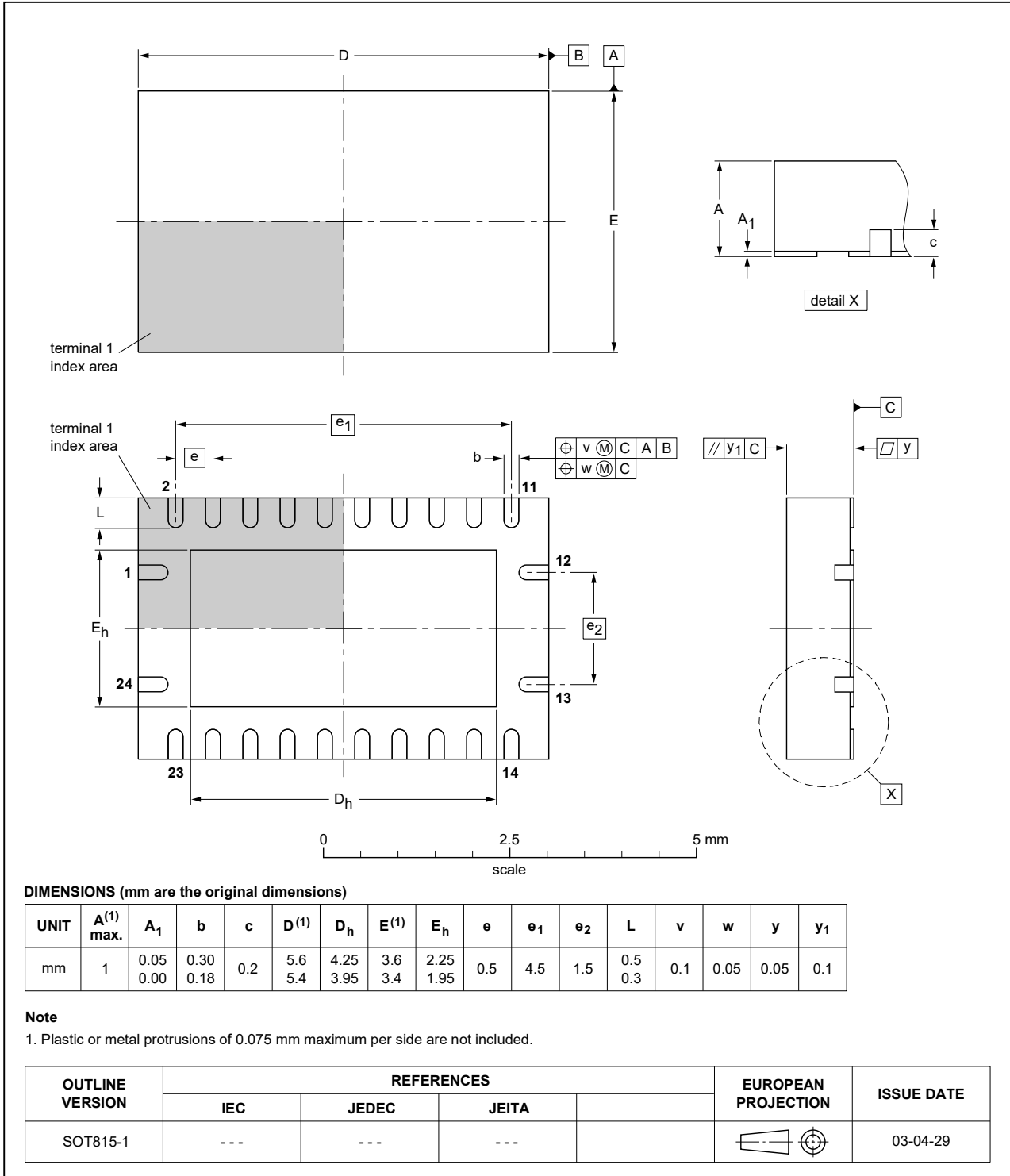


Fig. 11. Package outline SOT815-1 (DHVQFN24)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	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
74LVC823A_Q100 v.3	20200618	Product data sheet	-	74LVC823A_Q100 v.2
Modifications:	<ul style="list-style-type: none"> • Section 2 updated. • Table 4: Derating values for P_{tot} total power dissipation have been updated. 			
74LVC823A_Q100 v.2	20190501	Product data sheet	-	74LVC823A_Q100 v.1
Modifications:	<ul style="list-style-type: none"> • 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. 			
74LVC823A_Q100 v.1	20160915	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.

- [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 <https://www.nexperia.com>.

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