

74LV393-Q100

Dual 4-bit binary ripple counter

Rev. 3 — 19 March 2021

Product data sheet

1. General description

The 74LV393-Q100 is a dual 4-stage binary ripple counter. Each counter features a clock input (\overline{nCP}), an overriding asynchronous master reset input (\overline{nMR}) and 4 buffered parallel outputs ($nQ0$ to $nQ3$). The counter advances on the HIGH-to-LOW transition of \overline{nCP} . A HIGH on \overline{nMR} clears the counter stages and forces the outputs LOW, independent of the state of \overline{nCP} . Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess V_{CC} .

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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Optimized for low voltage applications: 1.0 V to 3.6 V
- Accepts TTL input levels between $V_{CC} = 2.7\text{ V}$ and $V_{CC} = 3.6\text{ V}$
- Typical V_{OLP} (output ground bounce) 0.8 V at $V_{CC} = 3.3\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$
- Typical V_{OHV} (output V_{OH} undershoot) 2 V at $V_{CC} = 3.3\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$
- Two 4-bit binary counters with individual clocks
- Divide-by any binary module up to 28 in one package
- Two master resets to clear each 4-bit counter individually
- Complies with JEDEC standard no. 7A
- ESD protection:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LV393D-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LV393PW-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

4. Functional diagram

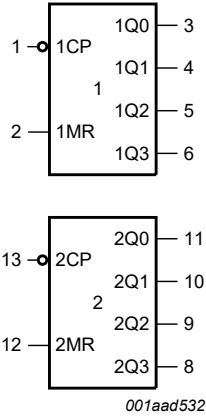


Fig. 1. Logic symbol

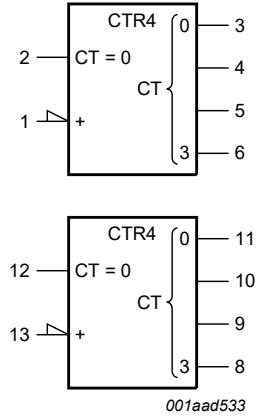


Fig. 2. IEC logic symbol

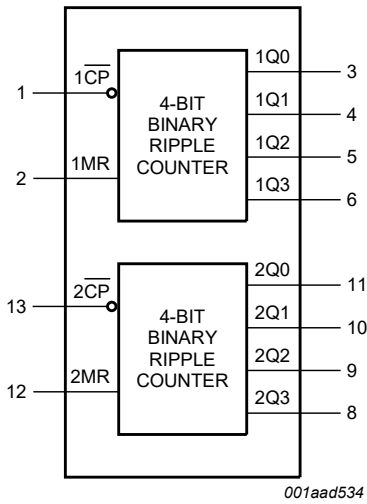


Fig. 3. Functional diagram

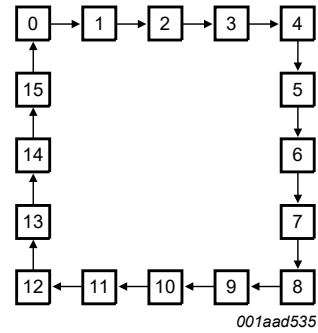


Fig. 4. State diagram

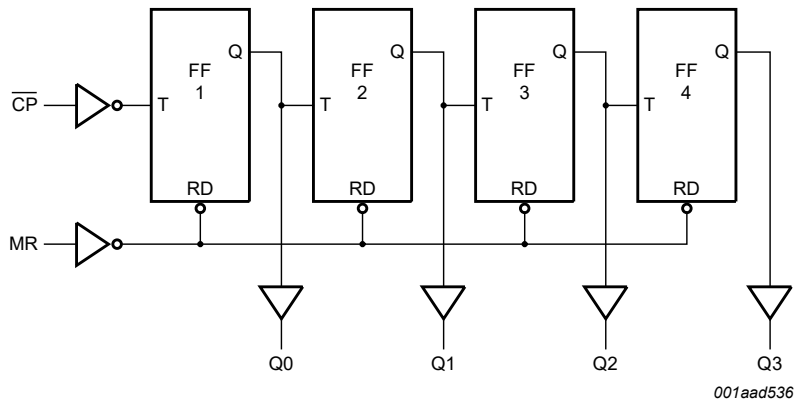


Fig. 5. Logic diagram (one counter)

5. Pinning information

5.1. Pinning

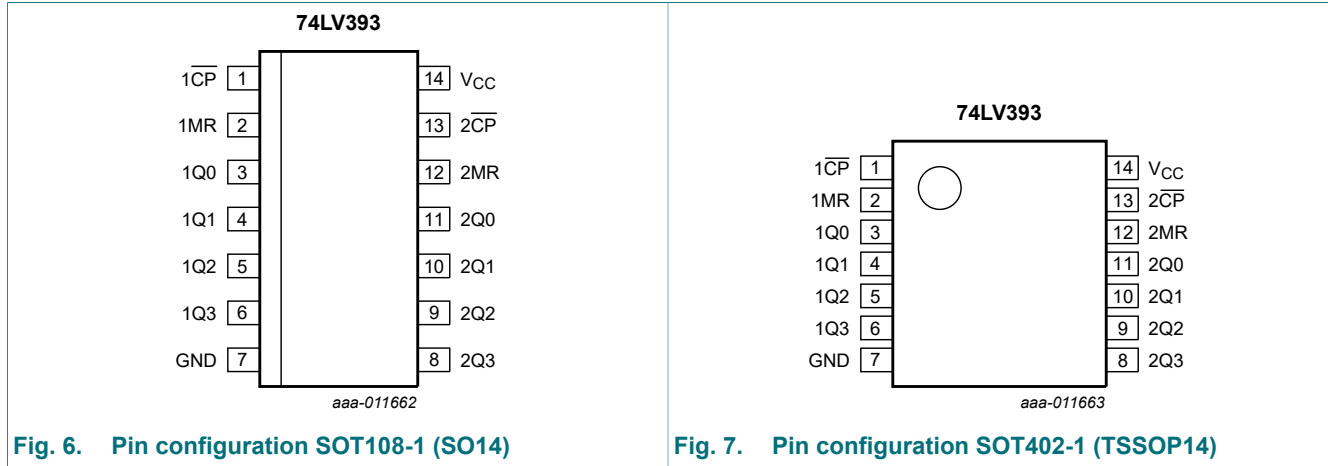


Fig. 6. Pin configuration SOT108-1 (SO14)

Fig. 7. Pin configuration SOT402-1 (TSSOP14)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1CP, 2CP	1, 13	clock input (HIGH-to-LOW, edge-triggered)
1MR, 2MR	2, 12	asynchronous master reset input (active HIGH)
1Q0, 1Q1, 1Q2, 1Q3	3, 4, 5, 6	flip-flop output
GND	7	ground (0 V)
2Q0, 2Q1, 2Q2, 2Q3	11, 10, 9, 8	flip-flop output
V _{CC}	14	supply voltage

6. Functional description

Table 3. Count sequence for one counter

H = HIGH voltage level; L = LOW voltage level.

Count	Output			
	nQ0	nQ1	nQ2	nQ3
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
10	L	H	L	H
11	H	H	L	H
12	L	L	H	H
13	H	L	H	H
14	L	H	H	H
15	H	H	H	H

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
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	± 20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	± 50	mA
I_O	output current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	-	± 25	mA
I_{CC}	supply current		-	+50	mA
I_{GND}	ground current		-50	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$ [1]	-	500	mW

- [1] For SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C.
 For SOT402-1 (TSSOP14) package: P_{tot} derates linearly with 7.3 mW/K above 81 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		1.0	3.3	3.6	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.0\text{ V to }2.0\text{ V}$	-	-	500	ns/V
		$V_{CC} = 2.0\text{ V to }2.7\text{ V}$	-	-	200	ns/V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	100	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	$V_{CC} = 1.2\text{ V}$	0.9	-	-	0.9	-	V
		$V_{CC} = 2.0\text{ V}$	1.4	-	-	1.4	-	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2.0	-	-	2.0	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.2\text{ V}$	-	-	0.3	-	0.3	V
		$V_{CC} = 2.0\text{ V}$	-	-	0.6	-	0.6	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	0.8	-	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = -100\ \mu\text{A}; V_{CC} = 1.2\text{ V}$	-	1.2	-	-	-	V
		$I_O = -100\ \mu\text{A}; V_{CC} = 2.0\text{ V}$	1.8	2.0	-	1.8	-	V
		$I_O = -100\ \mu\text{A}; V_{CC} = 2.7\text{ V}$	2.5	2.7	-	2.5	-	V
		$I_O = -100\ \mu\text{A}; V_{CC} = 3.0\text{ V}$	2.80	3.0	-	2.8	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = 100\ \mu\text{A}; V_{CC} = 1.2\text{ V}$	-	0	-	-	-	V
		$I_O = 100\ \mu\text{A}; V_{CC} = 2.0\text{ V}$	-	0	0.2	-	0.2	V
		$I_O = 100\ \mu\text{A}; V_{CC} = 2.7\text{ V}$	-	0	0.2	-	0.2	V
		$I_O = 100\ \mu\text{A}; V_{CC} = 3.0\text{ V}$	-	0	0.2	-	0.2	V
I_I	input leakage current	$V_I = V_{CC}\text{ or GND}; V_{CC} = 3.6\text{ V}$	-	-	1.0	-	1.0	μA
		$V_I = V_{CC}\text{ or GND}; I_O = 0\text{ A}; V_{CC} = 3.6\text{ V}$	-	-	20.0	-	160	μA
ΔI_{CC}	additional supply current	per input; $V_I = V_{CC} - 0.6\text{ V}; V_{CC} = 2.7\text{ V to }3.6\text{ V}$	-	-	500	-	850	μA
C_I	input capacitance		-	3.5	-	-	-	pF

[1] All typical values are measured at $T_{amb} = 25\text{ °C}$.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; 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	n \overline{CP} to nQ0; see Fig. 8 [2]						
		$V_{CC} = 1.2$ V	-	75	-	-	-	ns
		$V_{CC} = 2.0$ V	-	26	49	-	60	ns
		$V_{CC} = 2.7$ V	-	19	36	-	44	ns
		$V_{CC} = 3.3$ V, $C_L = 15$ pF	-	12	-	-	-	ns
		$V_{CC} = 3.0$ V to 3.6 V [3]	-	14	29	-	35	ns
		nQ to nQn+1; see Fig. 8 [2]						
		$V_{CC} = 1.2$ V	-	25	-	-	-	ns
		$V_{CC} = 2.0$ V	-	9	17	-	20	ns
		$V_{CC} = 2.7$ V	-	6	13	-	15	ns
		$V_{CC} = 3.3$ V, $C_L = 15$ pF	-	4	-	-	-	ns
		$V_{CC} = 3.0$ V to 3.6 V [3]	-	5	10	-	12	ns
t_{PHL}	HIGH to LOW propagation delay	nMR to nQx; see Fig. 9						
		$V_{CC} = 1.2$ V	-	70	-	-	-	ns
		$V_{CC} = 2.0$ V	-	24	44	-	54	ns
		$V_{CC} = 2.7$ V	-	18	33	-	40	ns
		$V_{CC} = 3.3$ V, $C_L = 15$ pF	-	11	-	-	-	ns
		$V_{CC} = 3.0$ V to 3.6 V [3]	-	13	26	-	32	ns
t_w	pulse width	n \overline{CP} HIGH or LOW; see Fig. 8						
		$V_{CC} = 2.0$ V	34	10	-	41	-	ns
		$V_{CC} = 2.7$ V	25	8	-	30	-	ns
		$V_{CC} = 3.0$ V to 3.6 V [3]	20	6	-	24	-	ns
		nMR HIGH; see Fig. 9						
		$V_{CC} = 2.0$ V	34	12	-	41	-	ns
		$V_{CC} = 2.7$ V	25	9	-	30	-	ns
		$V_{CC} = 3.0$ V to 3.6 V [3]	20	7	-	24	-	ns
t_{rec}	recovery time	nMR to n \overline{CP} ; see Fig. 9						
		$V_{CC} = 1.2$ V	-	5	-	-	-	ns
		$V_{CC} = 2.0$ V	5	2	-	5	-	ns
		$V_{CC} = 2.7$ V	5	2	-	5	-	ns
		$V_{CC} = 3.0$ V to 3.6 V [3]	5	1	-	5	-	ns
f_{max}	maximum frequency	see Fig. 8						
		$V_{CC} = 2.0$ V	14	53	-	12	-	MHz
		$V_{CC} = 2.7$ V	19	72	-	16	-	MHz
		$V_{CC} = 3.3$ V, $C_L = 15$ pF	-	99	-	-	-	MHz
		$V_{CC} = 3.0$ V to 3.6 V [3]	24	90	-	20	-	MHz

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	V _I = GND to V _{CC} [3] [4]	-	23	-	-	-	pF

- [1] All typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}.
- [3] Typical values are measured at V_{CC} = 3.3 V.
- [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 V;
 N = number of inputs switching;
 $\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

10.1. Waveforms and test circuit

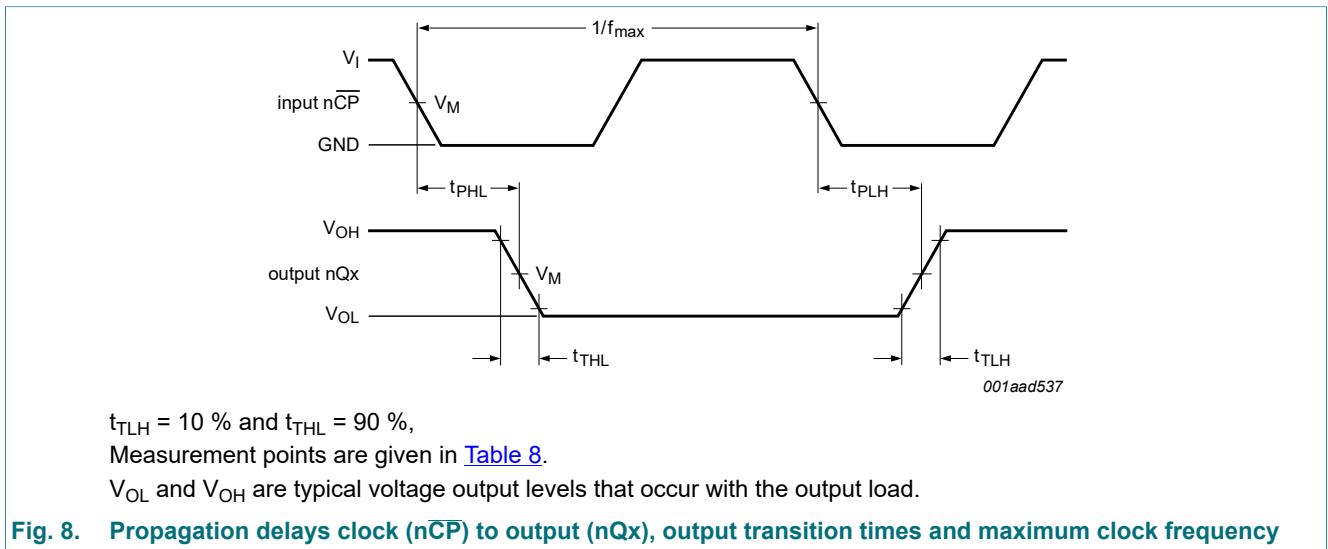
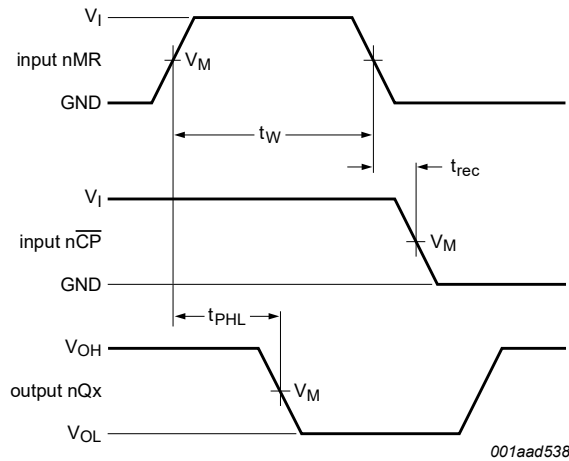


Table 8. Measurement points

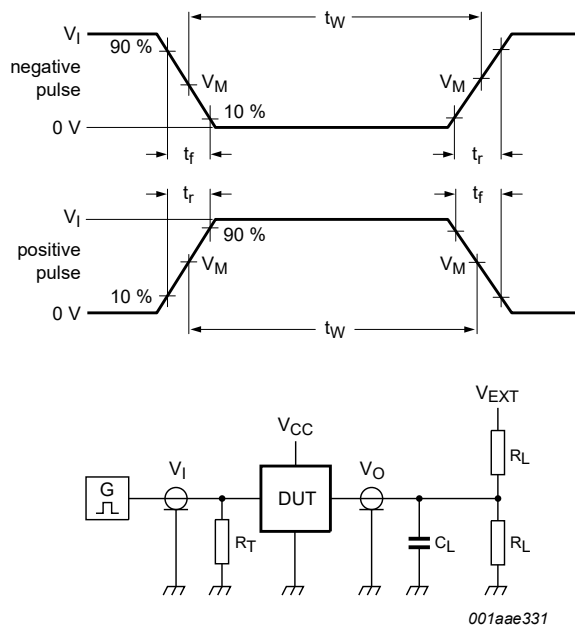
Supply voltage V _{CC}	Input		Output	
	V _M	V _M	V _X	V _Y
< 2.7 V	0.5V _{CC}	0.5V _{CC}	V _{OL} + 0.1V _{CC}	V _{OH} - 0.1V _{CC}
2.7 V to 3.6 V	1.5V _{CC}	1.5V _{CC}	V _{OL} + 0.3V _{CC}	V _{OH} - 0.3V _{CC}



Measurement points are given in [Table 8](#).

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

Fig. 9. Propagation delays clock (nCP) to output (nQx), pulse width master reset (nMR), and recovery time master reset (nMR) to clock (nCP)



Test data is given in [Table 9](#).

Definitions test circuit:

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

C_L = Load capacitance including jig and probe capacitance.

R_L = Load resistance.

S1 = Test selection switch.

Fig. 10. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input	Load			V_{EXT}
V_{CC}	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
< 2.7 V	V_{CC}	≤ 2.5 ns	50 pF	1 k Ω	open
2.7 V to 3.6 V	2.7 V	≤ 2.5 ns	15 pF, 50 pF	1 k Ω	open

11. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



Fig. 11. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



Fig. 12. Package outline SOT402-1 (TSSOP14)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV393_Q100 v.3	20210319	Product data sheet	-	74LV393_Q100 v.2
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. Section 1 updated. Section 7: Derating values for P_{tot} total power dissipation updated. 			
74LV393_Q100 v.2	20140917	Product data sheet	-	74LV393_Q100 v.1
Modifications:	<ul style="list-style-type: none"> Fig. 10 and Table 9 updated because of a missing load resistance in the test circuit. 			
74LV393_Q100 v.1	20140526	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.

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