

# 74HC393; 74HCT393

## Dual 4-bit binary ripple counter

Rev. 8 — 22 October 2021

Product data sheet

## 1. General description

The 74HC393; 74HCT393 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 ( $\overline{nQ0}$  to  $\overline{nQ3}$ ). 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 of  $V_{CC}$ .

## 2. Features and benefits

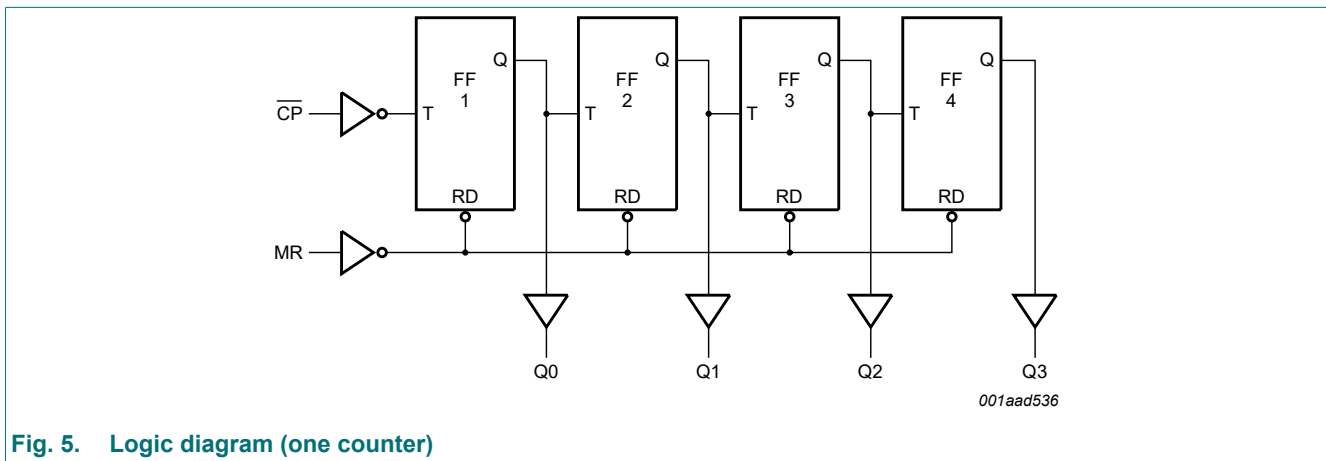
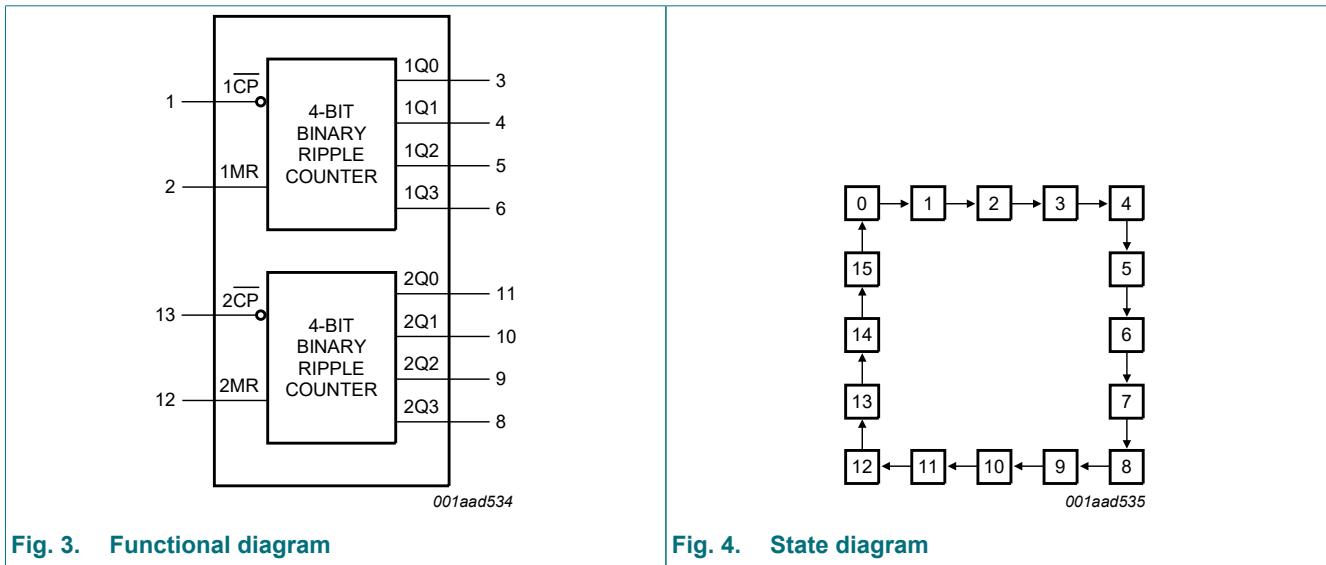
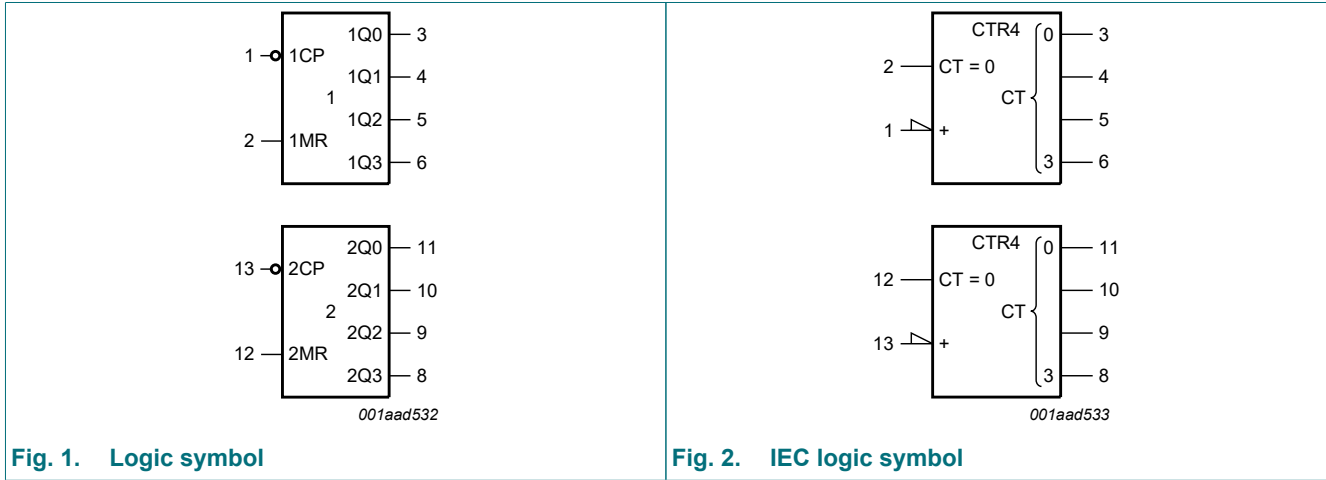
- Wide supply voltage range from 2.0 V to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- Input levels:
  - For 74HC393: CMOS level
  - For 74HCT393: TTL level
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V.
- 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

## 3. Ordering information

Table 1. Ordering information

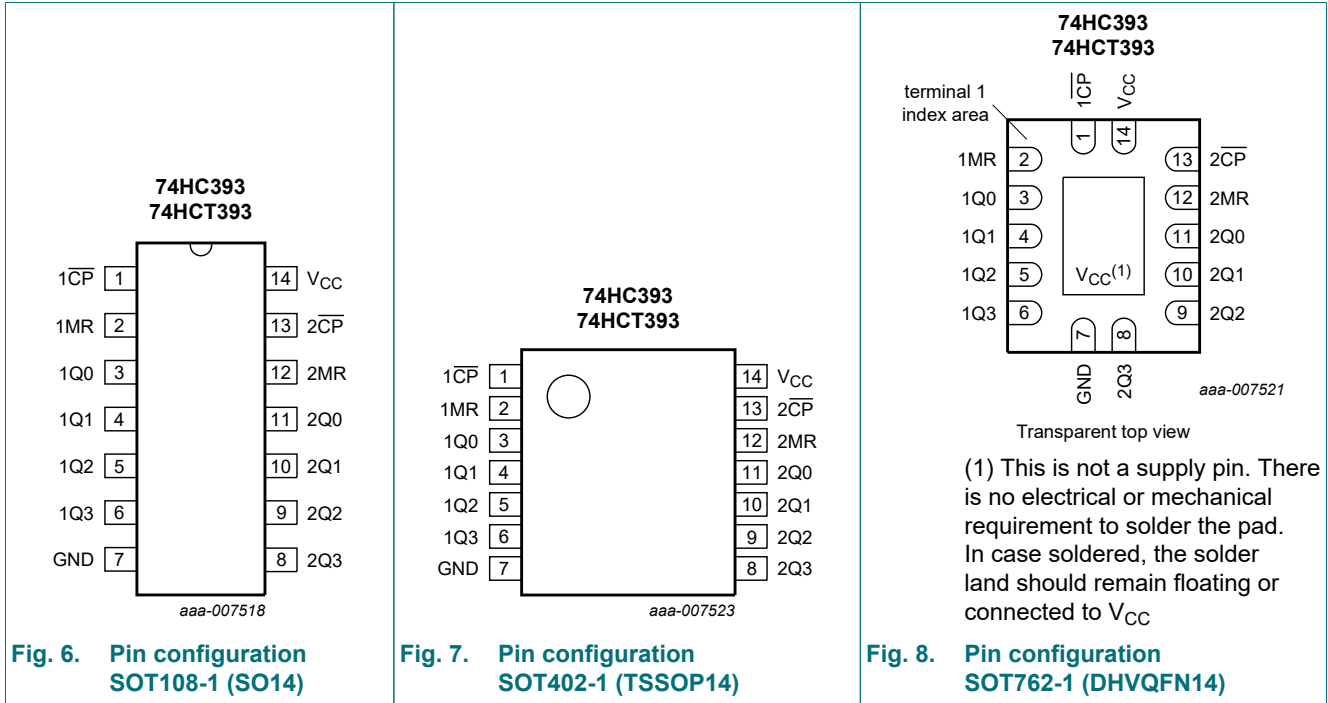
Type number	Package			Version
	Temperature range	Name	Description	
74HC393D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HCT393D				
74HC393PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HCT393PW				
74HC393BQ	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm	SOT762-1
74HCT393BQ				

4. Functional diagram



## 5. Pinning information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1CP	1	clock input (HIGH-to-LOW, edge-triggered)
1MR	2	asynchronous master reset input (active HIGH)
1Q0, 1Q1, 1Q2, 1Q3	3, 4, 5, 6	flip-flop output
GND	7	ground (0 V)
2Q3, 2Q2, 2Q1, 2Q0	8, 9, 10, 11	flip-flop output
2MR	12	asynchronous master reset input (active HIGH)
2CP	13	clock input (HIGH-to-LOW, edge-triggered)
V <sub>CC</sub>	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	+7	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_O$	output current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	-	$\pm 25$	mA
$I_{CC}$	supply current		-	$\pm 50$	mA
$I_{GND}$	ground current		-	$\pm 50$	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	[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.  
 For SOT762-1 (DHVQFN14) package:  $P_{tot}$  derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC393			74HCT393			Unit
			Min	Typ	Max	Min	Typ	Max	
$V_{CC}$	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
$V_I$	input voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	83	-	-	-	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC393</b>										
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	1.2	-	1.5	-	1.5	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	2.4	-	3.15	-	3.15	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	3.2	-	4.2	-	4.2	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	0.8	0.5	-	0.5	-	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	2.1	1.35	-	1.35	-	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	2.8	1.8	-	1.8	-	1.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$I_O = -20\ \mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -20\ \mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -20\ \mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_O = -4.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	3.98	4.32	-	3.84	-	3.7	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$								
		$I_O = 20\ \mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20\ \mu\text{A}$ ; $V_{CC} = 4.5\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20\ \mu\text{A}$ ; $V_{CC} = 6.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0\text{ mA}$ ; $V_{CC} = 4.5\text{ V}$	-	0.15	0.26	-	0.33	-	0.4	V
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$	-	-	$\pm 0.1$	-	$\pm 1.0$	-	$\pm 1.0$	$\mu\text{A}$
		$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 6.0\text{ V}$	-	-	8.0	-	80	-	160	$\mu\text{A}$
$C_I$	input capacitance		-	3.5	-	-	-	-	pF	

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HCT393</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 µA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	8.0	-	80	-	160	µA
ΔI <sub>CC</sub>	additional supply current	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V; I <sub>O</sub> = 0 A								
		per input pin; nCP	-	40	144	-	180	-	196	µA
		per input pin; nMR	-	100	360	-	450	-	490	µA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); C<sub>L</sub> = 50 pF unless otherwise specified; for test circuit see Fig. 11.

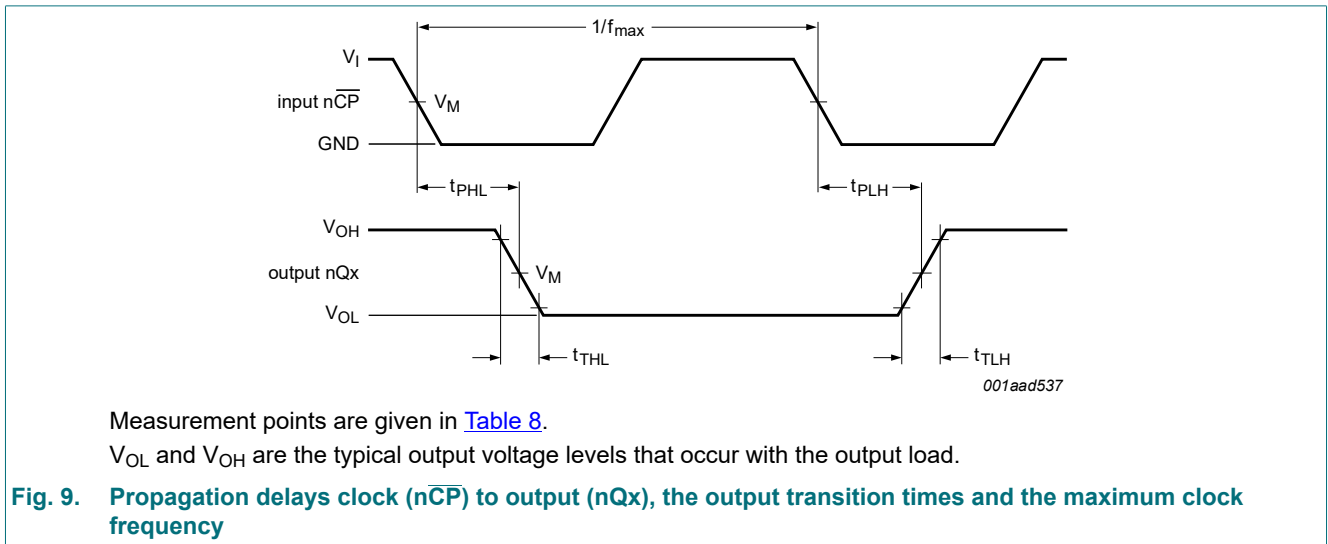
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC393</b>										
t <sub>pd</sub>	propagation delay	nCP to nQ0; see Fig. 9 [1]								
		V <sub>CC</sub> = 2.0 V	-	41	125	-	155	-	190	ns
		V <sub>CC</sub> = 4.5 V	-	15	25	-	31	-	38	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	12	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	12	21	-	26	-	32	ns
		nQx to nQ(x+1); see Fig. 9 [1]								
		V <sub>CC</sub> = 2.0 V	-	14	45	-	55	-	70	ns
		V <sub>CC</sub> = 4.5 V	-	5	9	-	11	-	14	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	5	-	-	-	-	ns	
		V <sub>CC</sub> = 6.0 V	-	4	8	-	9	-	12	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>PHL</sub>	HIGH to LOW propagation delay	nMR to nQx; see Fig. 10								
		V <sub>CC</sub> = 2.0 V	-	39	140	-	175	-	210	ns
		V <sub>CC</sub> = 4.5 V	-	14	28	-	35	-	42	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	11	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	11	24	-	30	-	36	ns
t <sub>t</sub>	transition time	Qn; see Fig. 9 [2]								
		V <sub>CC</sub> = 2.0 V	-	19	75	-	95	-	110	ns
		V <sub>CC</sub> = 4.5 V	-	7	15	-	19	-	22	ns
		V <sub>CC</sub> = 6.0 V	-	6	13	-	16	-	19	ns
t <sub>w</sub>	pulse width	nCP HIGH or LOW; see Fig. 9								
		V <sub>CC</sub> = 2.0 V	80	17	-	100	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	16	6	-	20	-	24	-	ns
		V <sub>CC</sub> = 6.0 V	14	5	-	17	-	20	-	ns
		nMR HIGH; see Fig. 10								
		V <sub>CC</sub> = 2.0 V	80	19	-	100	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	16	7	-	20	-	24	-	ns
		V <sub>CC</sub> = 6.0 V	14	6	-	17	-	20	-	ns
t <sub>rec</sub>	recovery time	nMR to nCP; see Fig. 10								
		V <sub>CC</sub> = 2.0 V	5	3	-	5	-	5	-	ns
		V <sub>CC</sub> = 4.5 V	5	1	-	5	-	5	-	ns
		V <sub>CC</sub> = 6.0 V	5	1	-	5	-	5	-	ns
f <sub>clk(max)</sub>	maximum clock frequency	see Fig. 9								
		V <sub>CC</sub> = 2.0 V	6	30	-	5	-	4	-	MHz
		V <sub>CC</sub> = 4.5 V	30	90	-	24	-	20	-	MHz
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	99	-	-	-	-	-	MHz
C <sub>PD</sub>	power dissipation capacitance	C <sub>L</sub> = 50 pF; f = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [3]	-	23	-	-	-	-	-	pF
<b>74HCT393</b>										
t <sub>pd</sub>	propagation delay	nCP to nQ0; see Fig. 9 [1]								
		V <sub>CC</sub> = 4.5 V	-	15	25	-	31	-	38	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	20	-	-	-	-	-	ns
		nQx to nQ(x+1); see Fig. 9 [1]								
		V <sub>CC</sub> = 4.5 V	-	6	10	-	13	-	15	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	V <sub>CC</sub> = 4.5 V	-	18	32	-	40	-	48	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	15	-	-	-	-	-	ns
t <sub>t</sub>	transition time	Qn; see Fig. 9 [2]								
		V <sub>CC</sub> = 4.5 V	-	7	15	-	19	-	22	ns

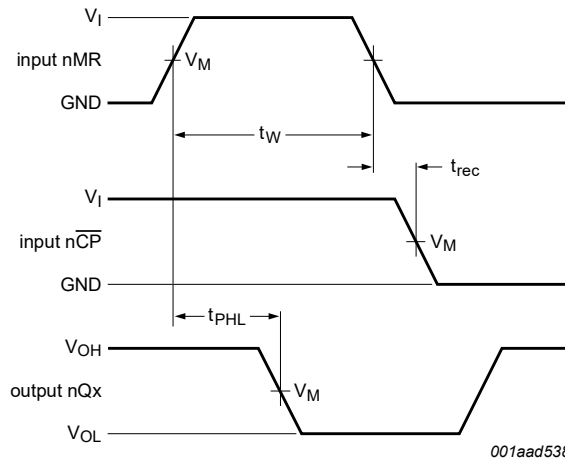
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>W</sub>	pulse width	nCP HIGH or LOW; see Fig. 9								
		V <sub>CC</sub> = 4.5 V	19	11	-	24	-	29	-	ns
t <sub>rec</sub>	recovery time	nMR HIGH; see Fig. 10								
		V <sub>CC</sub> = 4.5 V	16	6	-	20	-	24	-	ns
f <sub>clk(max)</sub>	maximum clock frequency	see Fig. 9								
		V <sub>CC</sub> = 4.5 V	27	48	-	22	-	18	-	MHz
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	53	-	-	-	-	-	MHz
C <sub>PD</sub>	power dissipation capacitance	C <sub>L</sub> = 50 pF; f = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [3]	-	25	-	-	-	-	-	pF

- [1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.
- [2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  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 V;  
 N = number of inputs switching;  
 Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

### 10.1. Waveforms







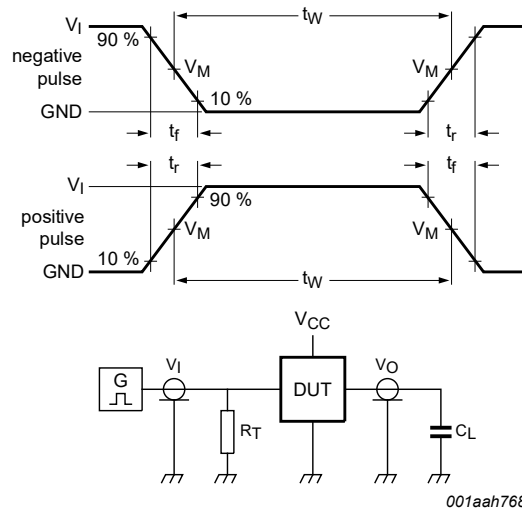
Measurement points are given in [Table 8](#).

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

**Fig. 10. Propagation delays clock (nCP) to output (nQx), pulse width master reset (nMR), and recovery time master reset (nMR) to clock (nCP)**

**Table 8. Measurement points**

Type	Input		Output
	$V_M$		$V_M$
74HC393	$0.5V_{CC}$		$0.5V_{CC}$
74HCT393	1.3 V		1.3 V



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.

**Fig. 11. Test circuit for measuring switching times**

**Table 9. Test data**

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74HC393	$V_{CC}$	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74HCT393	3.0 V	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$

11. Package outline

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

SOT108-1

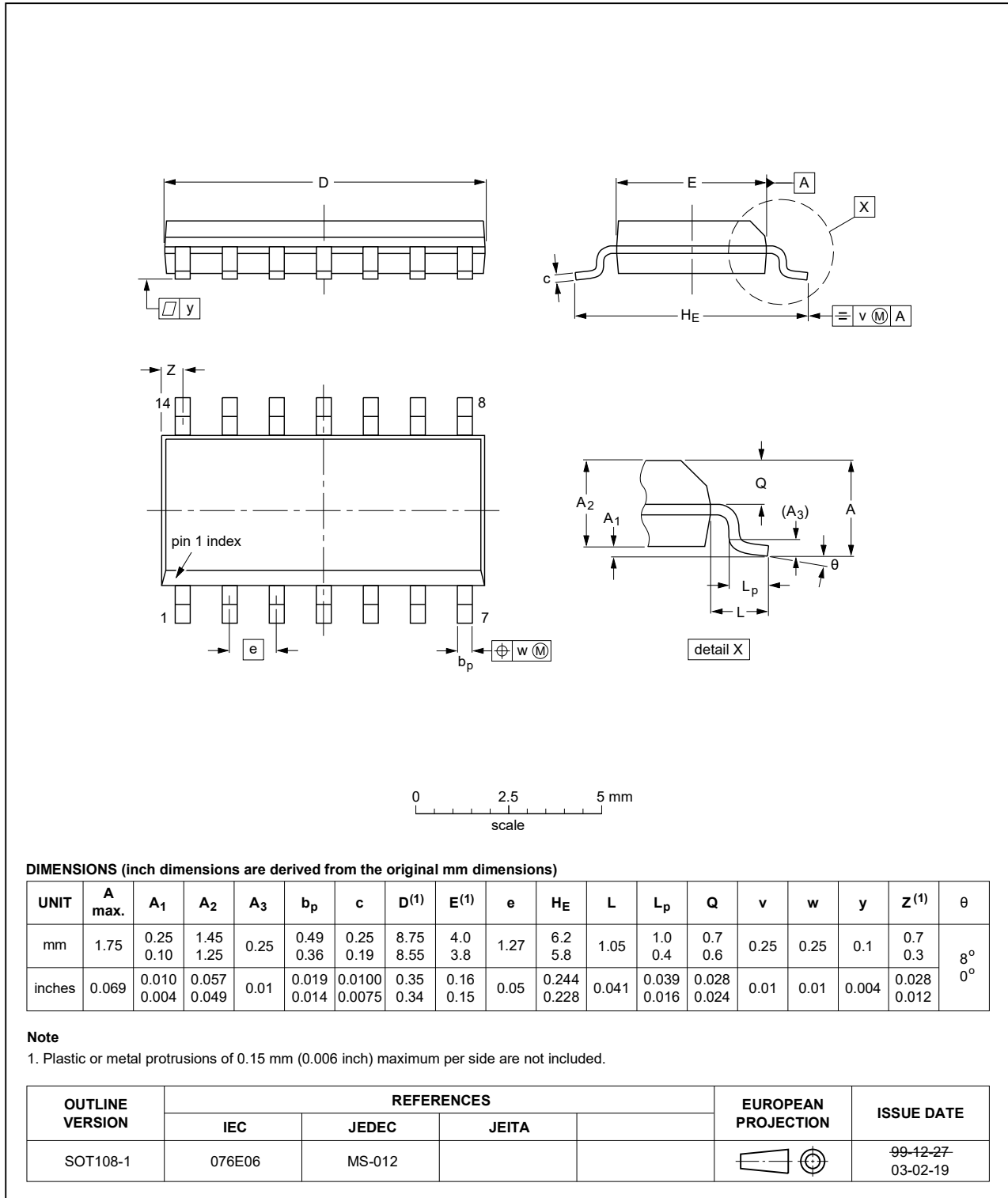


Fig. 12. Package outline SOT108-1 (SO14)

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

SOT402-1

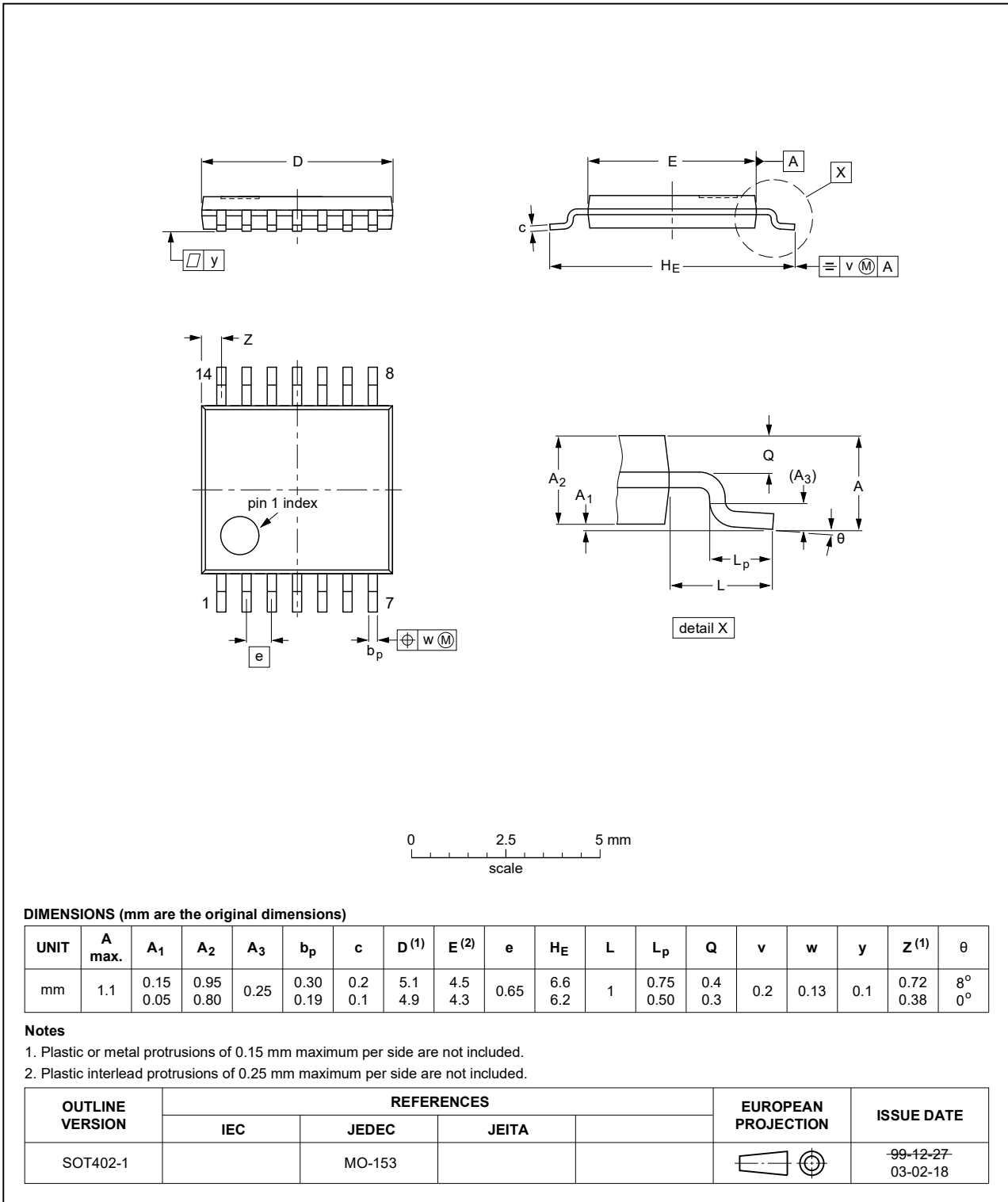


Fig. 13. Package outline SOT402-1 (TSSOP14)

DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1



Fig. 14. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT393 v.8	20211022	Product data sheet	-	74HC_HCT393 v.7.1
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 6</a>: <math>V_{OH}</math> and <math>V_{OL}</math> conditions for 74HCT393 corrected. (Errata)</li> </ul>			
74HC_HCT393 v.7.1	20201021	Product data sheet	-	74HC_HCT393 v.6
Modifications:	<ul style="list-style-type: none"> <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>Type numbers 74HC393DB and 74HCT393DB (SOT337-1/SSOP14) removed.</li> <li><a href="#">Section 1</a> (Errata) and <a href="#">Section 2</a> updated.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> <li>v.7.1: <a href="#">Table 6</a>: Values input leakage current for 74HC393 aligned with 74HCT393. (Errata)</li> </ul>			
74HC_HCT393 v.6	20151203	Product data sheet	-	74HC_HCT393 v.5
Modifications:	<ul style="list-style-type: none"> <li>Type numbers 74HC393N and 74HCT393N (SOT27-1) removed.</li> </ul>			
74HC_HCT393 v.5	20140401	Product data sheet	-	74HC_HCT393 v.4
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Table 7</a>: The conditions for <math>C_{PD}</math> have been corrected (errata).</li> </ul>			
74HC_HCT393 v.4	20130516	Product data sheet	-	74HC_HCT393 v.3
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74HC_HCT393 v.3	20050906	Product data sheet	-	74HC_HCT393_CNV v.2
74HC_HCT393_CNV v.2	19901201	Product specification	-	-

## 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.
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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".
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