

# 74HC393; 74HCT393

## Dual 4-bit binary ripple counter

Rev. 03 — 6 September 2005

Product data sheet

## 1. General description

The 74HC393; HCT393 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard no. 7A.

The 74HC393; 74HCT393 contains 4-bit binary ripple counters with separate clocks ( $\overline{1CP}$  and  $2\overline{CP}$ ) and master reset (1MR and 2MR) inputs to each counter.

The operation of each half of the 74HC393; 74HCT393 is the same as the 74HC93; 74HCT93, except no external clock connections are required.

The counters are triggered by a HIGH-to-LOW transition of the clock inputs. The counter outputs are internally connected to provide clock inputs to succeeding stages. The outputs of the ripple counter do not change synchronously and should not be used for high-speed address decoding.

The master resets (1MR and 2MR) are active-HIGH asynchronous inputs to each 4-bit counter. A HIGH level on the nMR input overrides the clock and sets the outputs LOW.

## 2. Features

- 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. Quick reference data

**Table 1: Quick reference data**

$GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ;  $t_r = t_f = 6\text{ ns}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74HC393</b>						
$t_{PHL}, t_{PLH}$	propagation delay	$C_L = 15\text{ pF}$ ; $V_{CC} = 5\text{ V}$				
	$n\overline{CP}$ to nQ0		-	12	-	ns
	nQx to nQ(x+1)		-	5	-	ns
	nMR to nQx		-	11	-	ns
$f_{clk(max)}$	maximum clock frequency	$C_L = 15\text{ pF}$ ; $V_{CC} = 5\text{ V}$	-	99	-	MHz
$C_i$	input capacitance		-	3.5	-	pF
$C_{PD}$	power dissipation capacitance (per gate)		<a href="#">[1]</a> <a href="#">[2]</a>	23	-	pF

**PHILIPS**

**Table 1: Quick reference data ...continued** $GND = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ;  $t_r = t_f = 6\text{ ns}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74HCT393</b>						
$t_{PHL}, t_{PLH}$	propagation delay	$C_L = 15\text{ pF}$ ; $V_{CC} = 5\text{ V}$				
	$n\overline{CP}$ to nQ0		-	20	-	ns
	nQx to nQ(x+1)		-	6	-	ns
	nMR to nQx		-	15	-	ns
$f_{clk(max)}$	maximum clock frequency	$C_L = 15\text{ pF}$ ; $V_{CC} = 5\text{ V}$	-	53	-	MHz
$C_i$	input capacitance		-	3.5	-	pF
$C_{PD}$	power dissipation capacitance (per gate)		[1][3]	25	-	pF

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = 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;

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

[2]  $V_I = GND$  to  $V_{CC}$

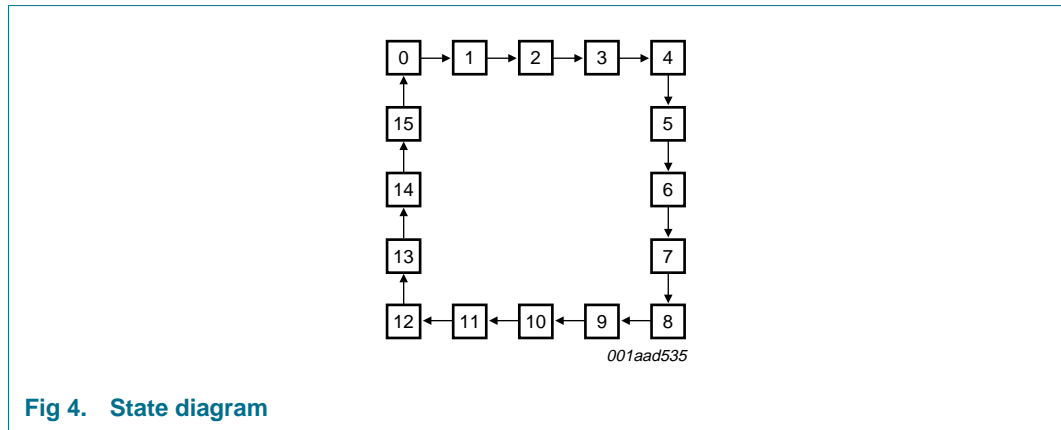
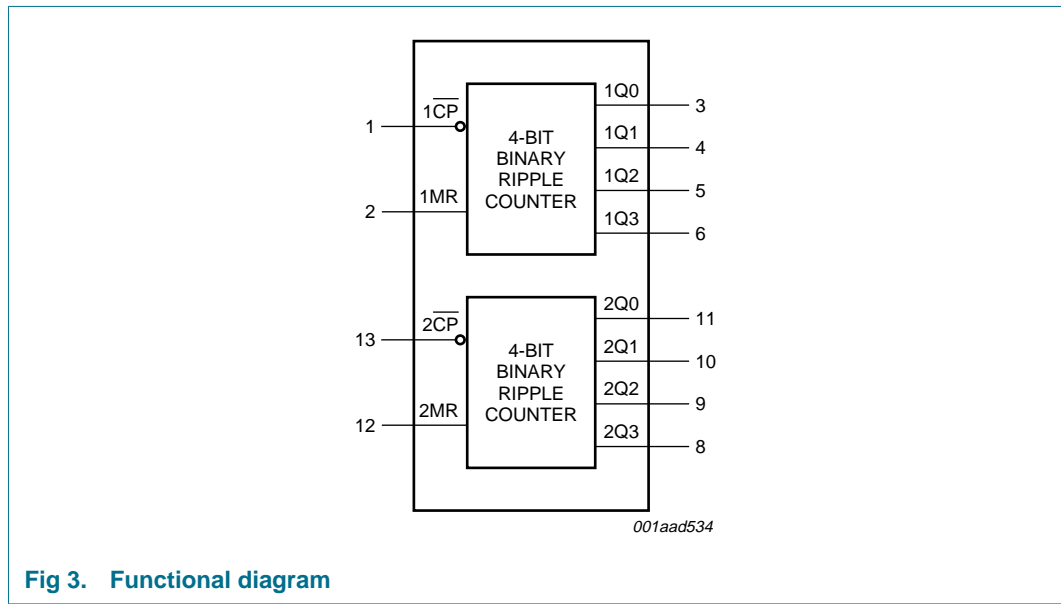
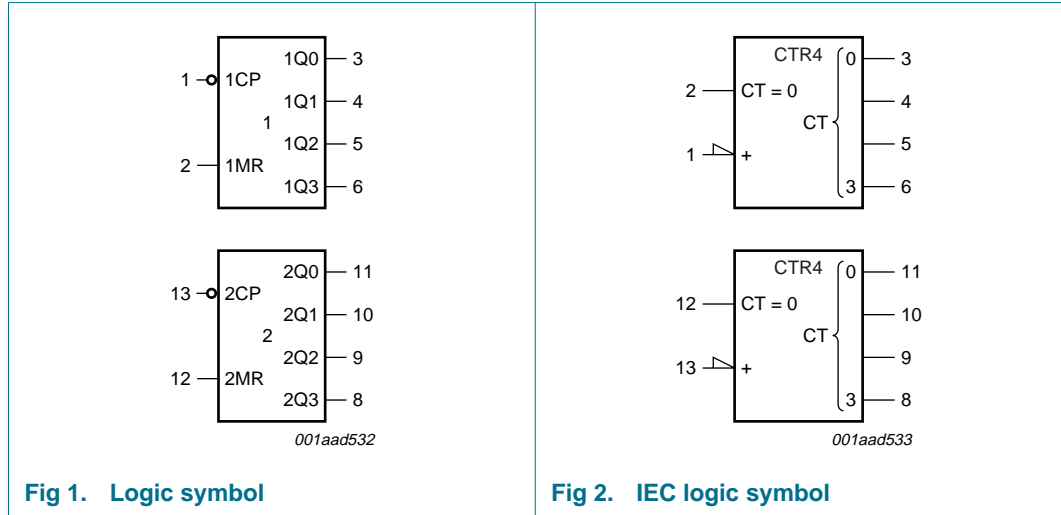
[3]  $V_I = GND$  to  $V_{CC} - 1.5\text{ V}$

## 4. Ordering information

**Table 2: Ordering information**

Type number	Package			
	Temperature range	Name	Description	Version
74HC393N	-40 °C to +125 °C	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HC393D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC393DB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74HC393PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
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
74HCT393N	-40 °C to +125 °C	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HCT393D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HCT393DB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74HCT393PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HCT393BQ	-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

5. Functional diagram



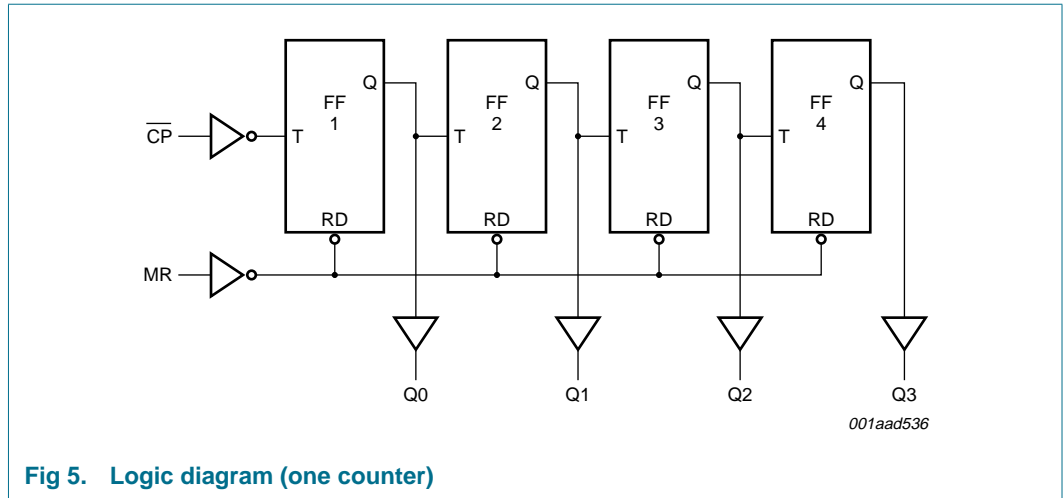


Fig 5. Logic diagram (one counter)

## 6. Pinning information

### 6.1 Pinning

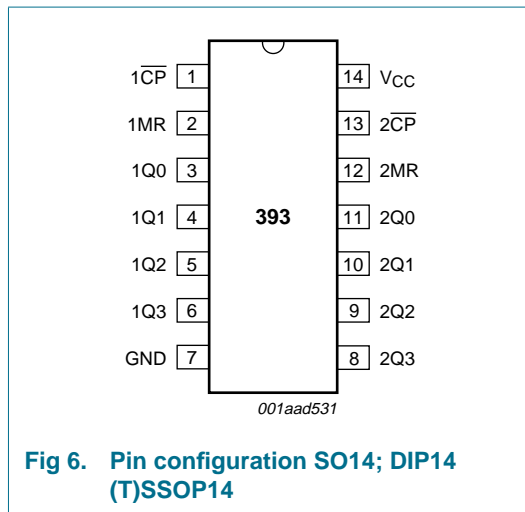


Fig 6. Pin configuration SO14; DIP14 (T)SSOP14

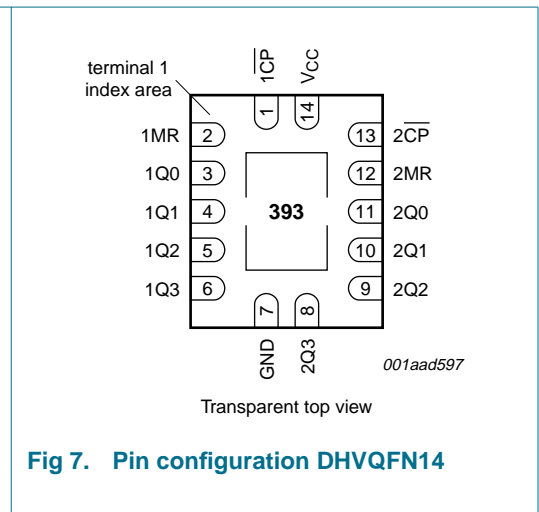


Fig 7. Pin configuration DHVQFN14

### 6.2 Pin description

Table 3: Pin description

Symbol	Pin	Description
$\overline{1CP}$	1	1 clock input (HIGH-to-LOW, edge-triggered)
1MR	2	1 asynchronous master reset input (active HIGH)
1Q0	3	1 flip-flop output 0
1Q1	4	1 flip-flop output 1
1Q2	5	1 flip-flop output 2
1Q3	6	1 flip-flop output 3
GND	7	ground (0 V)
2Q3	8	2 flip-flop output 3

Table 3: Pin description ...continued

Symbol	Pin	Description
2Q2	9	2 flip-flop output 2
2Q1	10	2 flip-flop output 1
2Q0	11	2 flip-flop output 0
2MR	12	2 asynchronous master reset input (active HIGH)
$\overline{2CP}$	13	2 clock input (HIGH-to-LOW, edge-triggered)
V <sub>CC</sub>	14	supply voltage

## 7. Functional description

### 7.1 Function table

Table 4: Count sequence for one counter [1]

Count	Output			
	Q0	Q1	Q2	Q3
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

[1] H = HIGH voltage level;  
L = LOW voltage level.

## 8. Limiting values

**Table 5: 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
$I_{CC}$	quiescent supply current		-	$\pm 50$	mA
$I_{GND}$	ground current		-	$\pm 50$	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation				
	DIP14 package		[1] -	750	mW
	SO14 package		[2] -	500	mW
	(T)SSOP14 package		[3] -	500	mW
	DHVQFN14 package		[4] -	500	mW

[1] For DIP14 package:  $P_{tot}$  derates linearly with 12 mW/K above 70 °C.

[2] For SO14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

[3] For (T)SSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

[4] For DHVQFN14 packages:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 9. Recommended operating conditions

**Table 6: Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74HC393</b>						
$V_{CC}$	supply voltage		2.0	5.0	6.0	V
$V_I$	input voltage		0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+125	°C
$t_r, t_f$	input rise and fall time	$V_{CC} = 2.0\text{ V}$	-	-	1000	ns
		$V_{CC} = 4.5\text{ V}$	-	6.0	500	ns
		$V_{CC} = 6.0\text{ V}$	-	-	400	ns
<b>74HCT393</b>						
$V_{CC}$	supply voltage		4.5	5.0	5.5	V
$V_I$	input voltage		0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+125	°C
$t_r, t_f$	input rise and fall time	$V_{CC} = 4.5\text{ V}$	-	6.0	500	ns

## 10. Static characteristics

**Table 7: Static characteristics type 74HC393**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = +25 °C</b>						
V <sub>IH</sub>	HIGH-state input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	V
V <sub>IL</sub>	LOW-state input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	V
V <sub>OH</sub>	HIGH-state 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> = -4 mA	3.98	4.32	-	V
		V <sub>CC</sub> = 6 V; I <sub>O</sub> = -5.2 mA	5.48	5.81	-	V
V <sub>OL</sub>	LOW-state 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> = 4 mA	-	0.15	0.26	V
		V <sub>CC</sub> = 6 V; I <sub>O</sub> = 5.2 mA	-	0.16	0.26	V
I <sub>LI</sub>	input leakage current	V <sub>CC</sub> = 6 V	-	-	0.1	μA
I <sub>CC</sub>	quiescent supply current	V <sub>CC</sub> = 6.0 V; I <sub>O</sub> = 0 A; V <sub>I</sub> = V <sub>CC</sub> or GND	-	-	8.0	μA
C <sub>i</sub>	input capacitance		-	3.5	-	pF
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-state input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-state input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
V <sub>OH</sub>	HIGH-state 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> = -4 mA	3.98	-	-	V
		V <sub>CC</sub> = 6 V; I <sub>O</sub> = -5.2 mA	5.48	-	-	V
V <sub>OL</sub>	LOW-state 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> = 4 mA	-	-	0.33	V
		V <sub>CC</sub> = 6 V; I <sub>O</sub> = 5.2 mA	-	-	0.33	V
I <sub>LI</sub>	input leakage current	V <sub>CC</sub> = 6 V	-	-	0.1	μA
I <sub>CC</sub>	quiescent supply current	V <sub>CC</sub> = 6.0 V; I <sub>O</sub> = 0 A; V <sub>I</sub> = V <sub>CC</sub> or GND	-	-	80	μA

**Table 7: Static characteristics type 74HC393 ...continued**  
 At recommended operating conditions; voltages are referenced to GND (ground = 0V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-state input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-state input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
V <sub>OH</sub>	HIGH-state 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> = -4 mA	3.98	-	-	V
		V <sub>CC</sub> = 6 V; I <sub>O</sub> = -5.2 mA	5.48	-	-	V
V <sub>OL</sub>	LOW-state 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> = 4 mA	-	-	0.33	V
		V <sub>CC</sub> = 6 V; I <sub>O</sub> = 5.2 mA	-	-	0.33	V
I <sub>LI</sub>	input leakage current	V <sub>CC</sub> = 6 V	-	-	0.1	μA
I <sub>CC</sub>	quiescent supply current	V <sub>CC</sub> = 6.0 V; I <sub>O</sub> = 0 A; V <sub>I</sub> = V <sub>CC</sub> or GND	-	-	160	μA

**Table 8: Static characteristics type 74HCT393**  
 At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = 25 °C</b>						
V <sub>IH</sub>	HIGH-state input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	V
V <sub>IL</sub>	LOW-state input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	V
V <sub>OH</sub>	HIGH-state 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	-	V
		I <sub>O</sub> = -6 mA	3.98	4.32	-	V
V <sub>OL</sub>	LOW-state 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	V
		I <sub>O</sub> = 6.0 mA	-	0.15	0.26	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	μA
I <sub>CC</sub>	quiescent 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	μA
ΔI <sub>CC</sub>	additional quiescent supply current (per input pin)	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				
		1CP, 2CP	-	40	144	μA
		1MR, 2MR	-	100	360	μA
C <sub>i</sub>	input capacitance		-	3.5	-	pF



**Table 8: Static characteristics type 74HCT393 ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-state input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	V
V <sub>IL</sub>	LOW-state input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	V
V <sub>OH</sub>	HIGH-state 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	-	-	V
		I <sub>O</sub> = -6 mA	3.84	-	-	V
V <sub>OL</sub>	LOW-state 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	-	-	0.1	V
		I <sub>O</sub> = 6.0 mA	-	-	0.33	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±1.0	µA
I <sub>CC</sub>	quiescent 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	-	-	80	µA
ΔI <sub>CC</sub>	additional quiescent supply current (per input pin)	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				
		1CP, 2CP	-	-	180	µA
		1MR, 2MR	-	-	450	µA
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-state input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	V
V <sub>IL</sub>	LOW-state input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	V
V <sub>OH</sub>	HIGH-state 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	-	-	V
		I <sub>O</sub> = -6 mA	3.7	-	-	V
V <sub>OL</sub>	LOW-state 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	-	-	0.1	V
		I <sub>O</sub> = 6.0 mA	-	-	0.4	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±1.0	µA
I <sub>CC</sub>	quiescent 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	-	-	160	µA
ΔI <sub>CC</sub>	additional quiescent supply current (per input pin)	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				
		1CP, 2CP	-	-	196	µA
		1MR, 2MR	-	-	490	µA

## 11. Dynamic characteristics

**Table 9: Dynamic characteristics type 74HC393**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF, unless otherwise specified.

For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>T_{amb} = +25</math> °C</b>							
$t_{PHL}, t_{PLH}$	propagation delay	nCP to nQ0	see <a href="#">Figure 8</a>				
		$V_{CC} = 2.0$ V	-	41	125	ns	
		$V_{CC} = 4.5$ V	-	15	25	ns	
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	12	-	ns	
		$V_{CC} = 6.0$ V	-	12	21	ns	
		nQx to nQ(x+1)	see <a href="#">Figure 8</a>				
		$V_{CC} = 2.0$ V	-	14	45	ns	
		$V_{CC} = 4.5$ V	-	5	9	ns	
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	5	-	ns	
		$V_{CC} = 6.0$ V	-	4	8	ns	
$t_{PHL}$	propagation delay	nMR to nQx	see <a href="#">Figure 9</a>				
		$V_{CC} = 2.0$ V	-	39	140	ns	
		$V_{CC} = 4.5$ V	-	14	28	ns	
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	11	-	ns	
		$V_{CC} = 6.0$ V	-	11	24	ns	
$t_{THL}, t_{TLH}$	output transition time	see <a href="#">Figure 8</a>					
		$V_{CC} = 2.0$ V	-	19	75	ns	
		$V_{CC} = 4.5$ V	-	7	15	ns	
		$V_{CC} = 6.0$ V	-	6	13	ns	
$t_w$	pulse width	nCP HIGH or LOW	see <a href="#">Figure 8</a>				
		$V_{CC} = 2.0$ V	80	17	-	ns	
		$V_{CC} = 4.5$ V	16	6	-	ns	
		$V_{CC} = 6.0$ V	14	5	-	ns	
		nMR HIGH	see <a href="#">Figure 9</a>				
		$V_{CC} = 2.0$ V	80	19	-	ns	
		$V_{CC} = 4.5$ V	16	7	-	ns	
		$V_{CC} = 6.0$ V	14	6	-	ns	
	$t_{rec}$	recovery time	nMR to nCP	see <a href="#">Figure 9</a>			
			$V_{CC} = 2.0$ V	5	3	-	ns
		$V_{CC} = 4.5$ V	5	1	-	ns	
		$V_{CC} = 6.0$ V	5	1	-	ns	

**Table 9: Dynamic characteristics type 74HC393 ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF, unless otherwise specified.

For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$f_{\text{clk(max)}}$	maximum clock frequency	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 2.0$ V	6	30	-	MHz	
		$V_{\text{CC}} = 4.5$ V	30	90	-	MHz	
		$V_{\text{CC}} = 5$ V; $C_L = 15$ pF	-	99	-	MHz	
		$V_{\text{CC}} = 6.0$ V	35	107	-	MHz	
$C_{\text{PD}}$	power dissipation capacitance (per gate)		[1][2]	-	23	pF	
<b><math>T_{\text{amb}} = -40</math> °C to <math>+85</math> °C</b>							
$t_{\text{PHL}}, t_{\text{PLH}}$	propagation delay	nCP to nQ0	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	155	ns
			$V_{\text{CC}} = 4.5$ V	-	-	31	ns
			$V_{\text{CC}} = 6.0$ V	-	-	26	ns
		nQx to nQ(x+1)	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	55	ns
			$V_{\text{CC}} = 4.5$ V	-	-	11	ns
			$V_{\text{CC}} = 6.0$ V	-	-	9	ns
$t_{\text{PHL}}$	propagation delay	nMR to nQx	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	175	ns
			$V_{\text{CC}} = 4.5$ V	-	-	35	ns
			$V_{\text{CC}} = 6.0$ V	-	-	30	ns
$t_{\text{THL}}, t_{\text{TLH}}$	output transition time	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 2.0$ V	-	-	95	ns	
		$V_{\text{CC}} = 4.5$ V	-	-	19	ns	
		$V_{\text{CC}} = 6.0$ V	-	-	16	ns	
$t_{\text{W}}$	pulse width	nCP HIGH or LOW	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	100	-	-	ns
			$V_{\text{CC}} = 4.5$ V	20	-	-	ns
			$V_{\text{CC}} = 6.0$ V	17	-	-	ns
		nMR HIGH	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 2.0$ V	100	-	-	ns
			$V_{\text{CC}} = 4.5$ V	20	-	-	ns
			$V_{\text{CC}} = 6.0$ V	17	-	-	ns
$t_{\text{rec}}$	recovery time	nMR to nCP	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 2.0$ V	5	-	-	ns
			$V_{\text{CC}} = 4.5$ V	5	-	-	ns
			$V_{\text{CC}} = 6.0$ V	5	-	-	ns

**Table 9: Dynamic characteristics type 74HC393 ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF, unless otherwise specified.

For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$f_{\text{clk(max)}}$	maximum clock frequency	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 2.0$ V	5	30	-	MHz	
		$V_{\text{CC}} = 4.5$ V	24	90	-	MHz	
		$V_{\text{CC}} = 6.0$ V	28	107	-	MHz	
<b><math>T_{\text{amb}} = -40</math> °C to <math>+125</math> °C</b>							
$t_{\text{PHL}}, t_{\text{PLH}}$	propagation delay	nCP to nQ0	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	190	ns
			$V_{\text{CC}} = 4.5$ V	-	-	38	ns
			$V_{\text{CC}} = 6.0$ V	-	-	32	ns
		nQx to nQ(x+1)	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	70	ns
$V_{\text{CC}} = 4.5$ V	-		-	14	ns		
	$V_{\text{CC}} = 6.0$ V	-	-	12	ns		
$t_{\text{PHL}}$	propagation delay	nMR to nQn	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	210	ns
			$V_{\text{CC}} = 4.5$ V	-	-	42	ns
			$V_{\text{CC}} = 6.0$ V	-	-	36	ns
$t_{\text{THL}}, t_{\text{TLH}}$	output transition time		see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	-	-	110	ns
			$V_{\text{CC}} = 4.5$ V	-	-	22	ns
			$V_{\text{CC}} = 6.0$ V	-	-	19	ns
$t_w$	pulse width	nCP HIGH or LOW	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 2.0$ V	120	-	-	ns
			$V_{\text{CC}} = 4.5$ V	24	-	-	ns
			$V_{\text{CC}} = 6.0$ V	20	-	-	ns
		nMR HIGH	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 2.0$ V	120	-	-	ns
			$V_{\text{CC}} = 4.5$ V	24	-	-	ns
			$V_{\text{CC}} = 6.0$ V	20	-	-	ns
$t_{\text{rec}}$	recovery time	nMR to nCP	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 2.0$ V	5	-	-	ns
			$V_{\text{CC}} = 4.5$ V	5	-	-	ns
			$V_{\text{CC}} = 6.0$ V	5	-	-	ns

**Table 9: Dynamic characteristics type 74HC393 ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50 \text{ pF}$ , unless otherwise specified.  
For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$f_{\text{clk(max)}}$	maximum clock frequency	see <a href="#">Figure 8</a>				
		$V_{\text{CC}} = 2.0 \text{ V}$	4	-	-	MHz
		$V_{\text{CC}} = 4.5 \text{ V}$	20	-	-	MHz
		$V_{\text{CC}} = 6.0 \text{ V}$	24	-	-	MHz

[1]  $C_{\text{PD}}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{\text{CC}}$  = supply voltage in V;

$N$  = number of inputs switching;

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

[2]  $V_I = \text{GND to } V_{\text{CC}}$

**Table 10: Dynamic characteristics type 74HCT393**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50 \text{ pF}$ , unless otherwise specified.  
For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>T_{\text{amb}} = +25 \text{ }^\circ\text{C}</math></b>							
$t_{\text{PHL}}, t_{\text{PLH}}$	propagation delay n $\overline{\text{CP}}$ to nQ0	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5 \text{ V}$	-	15	25	ns	
		$V_{\text{CC}} = 5 \text{ V}; C_L = 15 \text{ pF}$	-	20	-	ns	
	nQx to nQ(x+1)	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5 \text{ V}$	-	6	10	ns	
		$V_{\text{CC}} = 5 \text{ V}; C_L = 15 \text{ pF}$	-	6	-	ns	
$t_{\text{PHL}}$	propagation delay nMR to nQn	see <a href="#">Figure 9</a>					
		$V_{\text{CC}} = 4.5 \text{ V}$	-	18	32	ns	
		$V_{\text{CC}} = 5 \text{ V}; C_L = 15 \text{ pF}$	-	15	-	ns	
$t_{\text{THL}}, t_{\text{TLH}}$	output transition time	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5 \text{ V}$	-	7	15	ns	
$t_w$	pulse width						
		n $\overline{\text{CP}}$ HIGH or LOW	see <a href="#">Figure 8</a>				
		$V_{\text{CC}} = 4.5 \text{ V}$	19	11	-	ns	
		nMR HIGH	see <a href="#">Figure 9</a>				
		$V_{\text{CC}} = 4.5 \text{ V}$	16	6	-	ns	
$t_{\text{rec}}$	recovery time nMR to n $\overline{\text{CP}}$	see <a href="#">Figure 9</a>					
		$V_{\text{CC}} = 4.5 \text{ V}$	5	0	-	ns	

**Table 10: Dynamic characteristics type 74HCT393 ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF, unless otherwise specified.

For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$f_{\text{clk(max)}}$	maximum clock frequency	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5$ V	27	48	-	MHz	
		$V_{\text{CC}} = 5$ V; $C_L = 15$ pF	-	53	-	MHz	
$C_{\text{PD}}$	power dissipation capacitance (per gate)		[1][2]	25	-	pF	
<b><math>T_{\text{amb}} = -40</math> °C to <math>+85</math> °C</b>							
$t_{\text{PHL}}, t_{\text{PLH}}$	propagation delay	n $\overline{\text{CP}}$ to nQ0	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 4.5$ V	-	-	31	ns
			nQx to nQ(x+1)	see <a href="#">Figure 8</a>			
		$V_{\text{CC}} = 4.5$ V	-	-	13	ns	
$t_{\text{PHL}}$	propagation delay	nMR to nQx	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 4.5$ V	-	-	40	ns
$t_{\text{THL}}, t_{\text{TLH}}$	output transition time	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5$ V	-	-	19	ns	
$t_{\text{W}}$	pulse width	n $\overline{\text{CP}}$ HIGH or LOW	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 4.5$ V	24	-	-	ns
			nMR HIGH	see <a href="#">Figure 9</a>			
		$V_{\text{CC}} = 4.5$ V	20	-	-	ns	
$t_{\text{rec}}$	recovery time	nMR to n $\overline{\text{CP}}$	see <a href="#">Figure 9</a>	5	-	-	ns
$f_{\text{clk(max)}}$	maximum clock frequency	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5$ V	22	-	-	MHz	
<b><math>T_{\text{amb}} = -40</math> °C to <math>+125</math> °C</b>							
$t_{\text{PHL}}, t_{\text{PLH}}$	propagation delay	n $\overline{\text{CP}}$ to nQ0	see <a href="#">Figure 8</a>				
			$V_{\text{CC}} = 4.5$ V	-	-	38	ns
			nQx to nQ(x+1)	see <a href="#">Figure 8</a>			
		$V_{\text{CC}} = 4.5$ V	-	-	15	ns	
$t_{\text{PHL}}$	propagation delay	nMR to nQx	see <a href="#">Figure 9</a>				
			$V_{\text{CC}} = 4.5$ V	-	-	48	ns
$t_{\text{THL}}, t_{\text{TLH}}$	output transition time	see <a href="#">Figure 8</a>					
		$V_{\text{CC}} = 4.5$ V	-	-	22	ns	

**Table 10: Dynamic characteristics type 74HCT393 ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF, unless otherwise specified.

For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_W$	pulse width					
	n $\overline{CP}$ HIGH or LOW	see <a href="#">Figure 8</a>				
		$V_{CC} = 4.5$ V	29	-	-	ns
	nMR HIGH	see <a href="#">Figure 9</a>				
		$V_{CC} = 4.5$ V	24	-	-	ns
$t_{rec}$	recovery time					
	nMR to n $\overline{CP}$	see <a href="#">Figure 9</a>	5	0	-	ns
$f_{clk(max)}$	maximum clock frequency	see <a href="#">Figure 8</a>				
		$V_{CC} = 4.5$ V	18	-	-	MHz

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).

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

$f_i$  = 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;

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

[2]  $V_I$  = GND to  $V_{CC} - 1.5$  V.

12. Waveforms

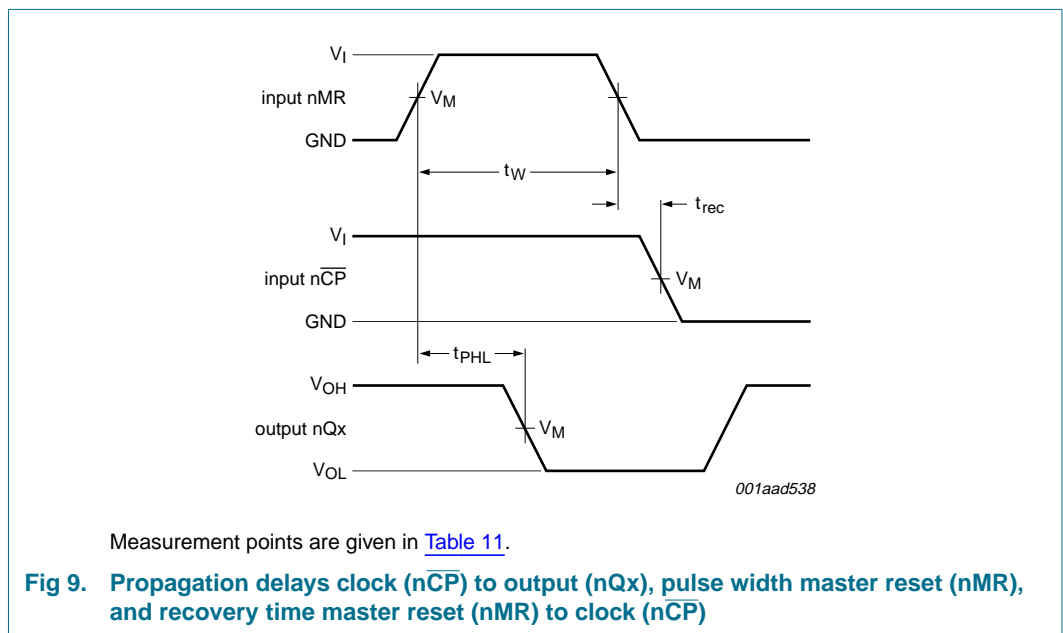
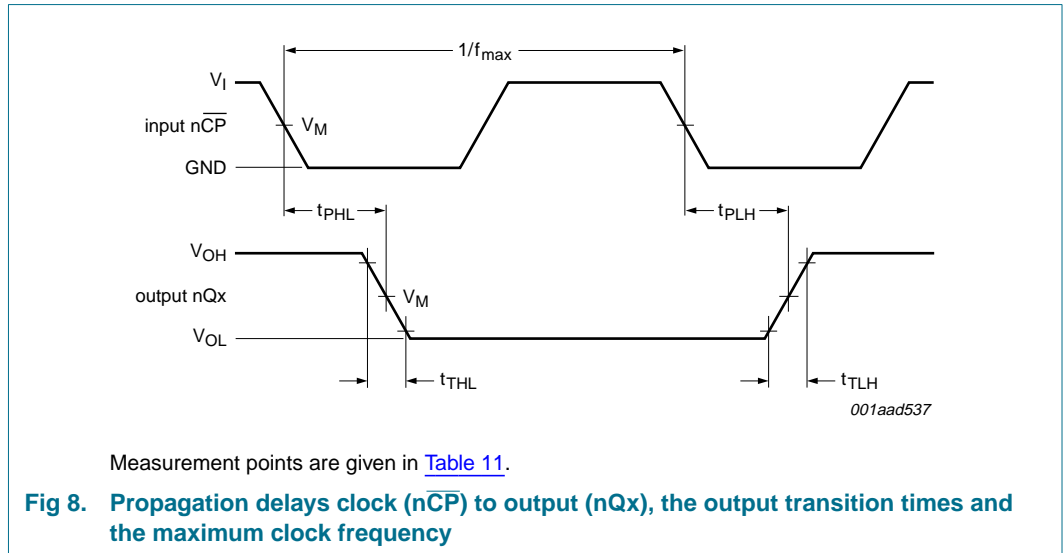
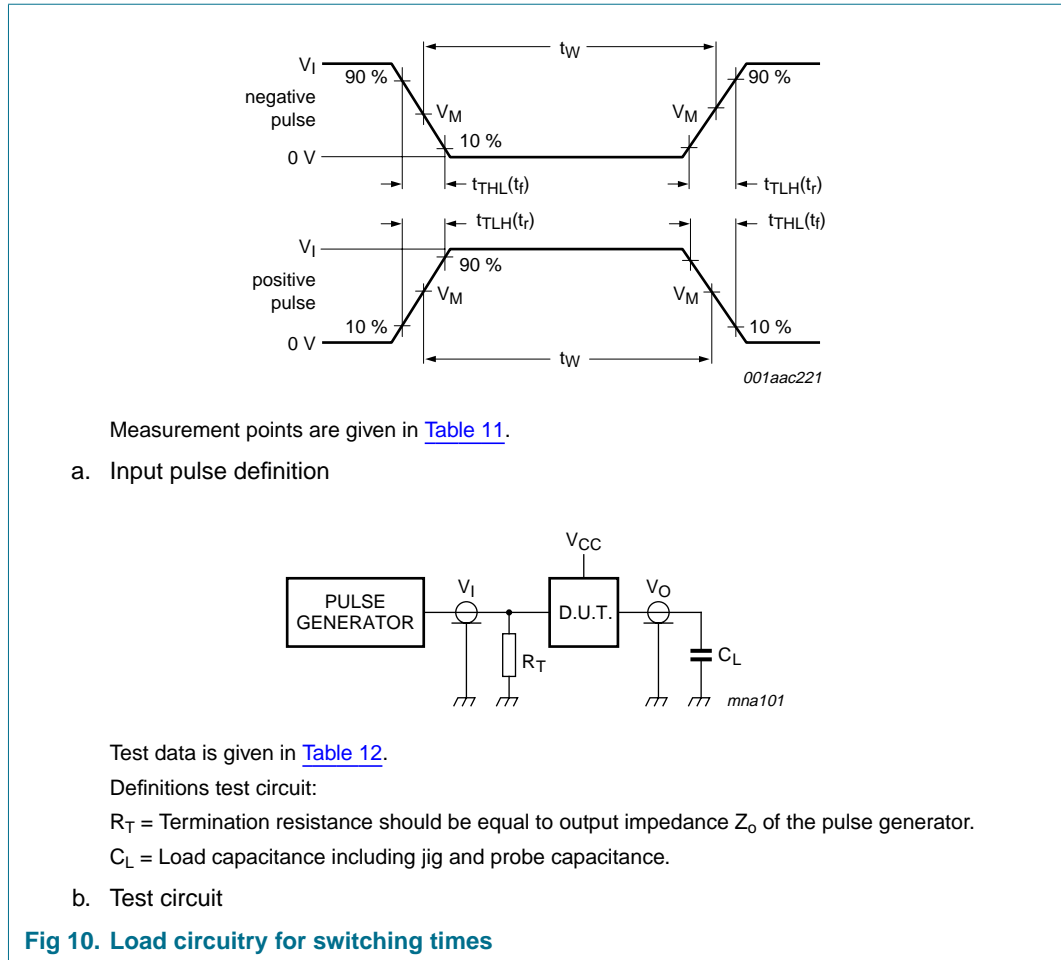


Table 11: Measurement points

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 12](#).

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.

b. Test circuit

**Fig 10. Load circuitry for switching times**

**Table 12: Test data**

Supply	Input		Load
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$
2.0 V to 6.0 V	GND to $V_{CC}$	6 ns	15 pF, 50 pF

13. Package outline

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

SOT108-1

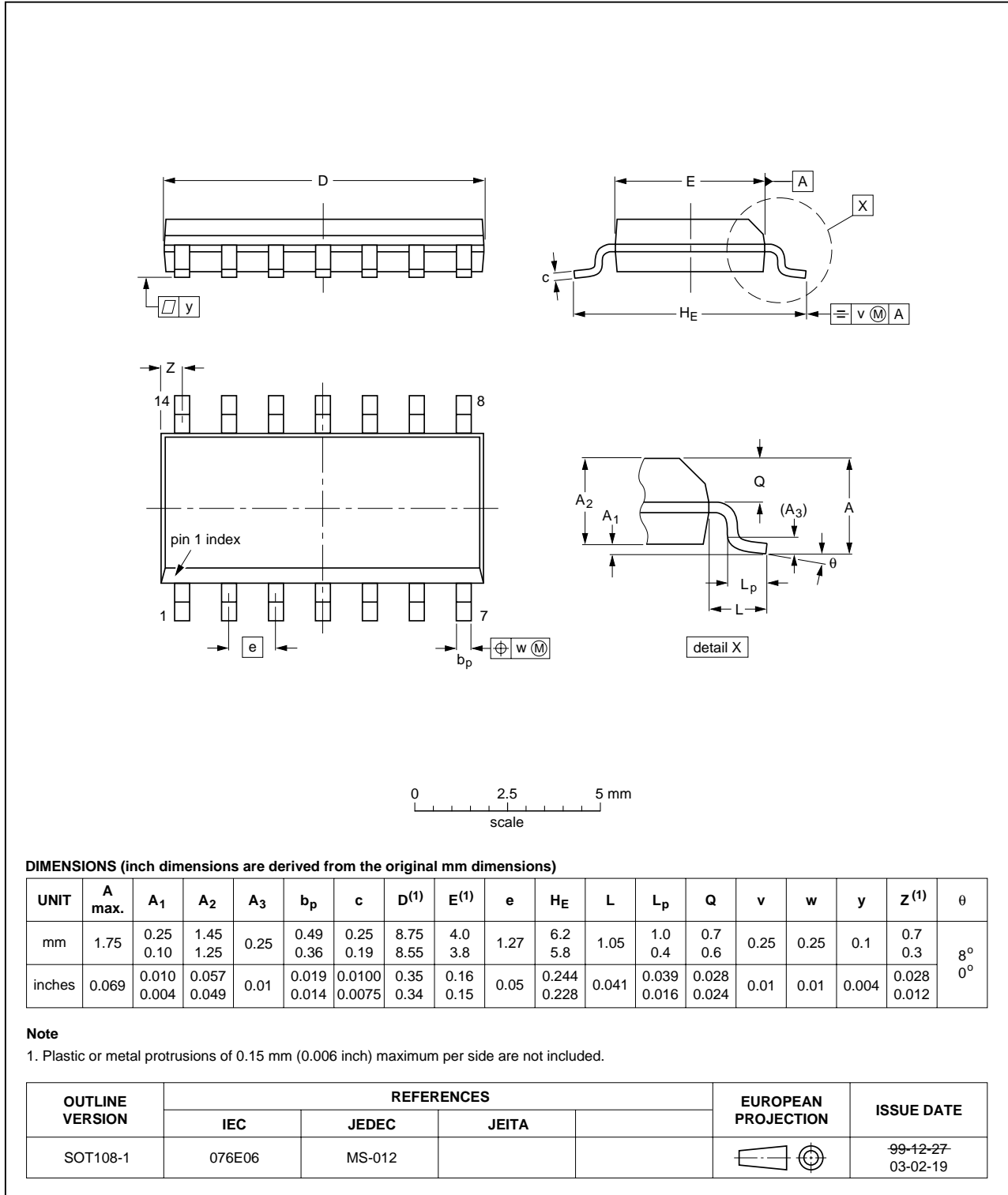


Fig 11. Package outline SOT108-1 (SO14)

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

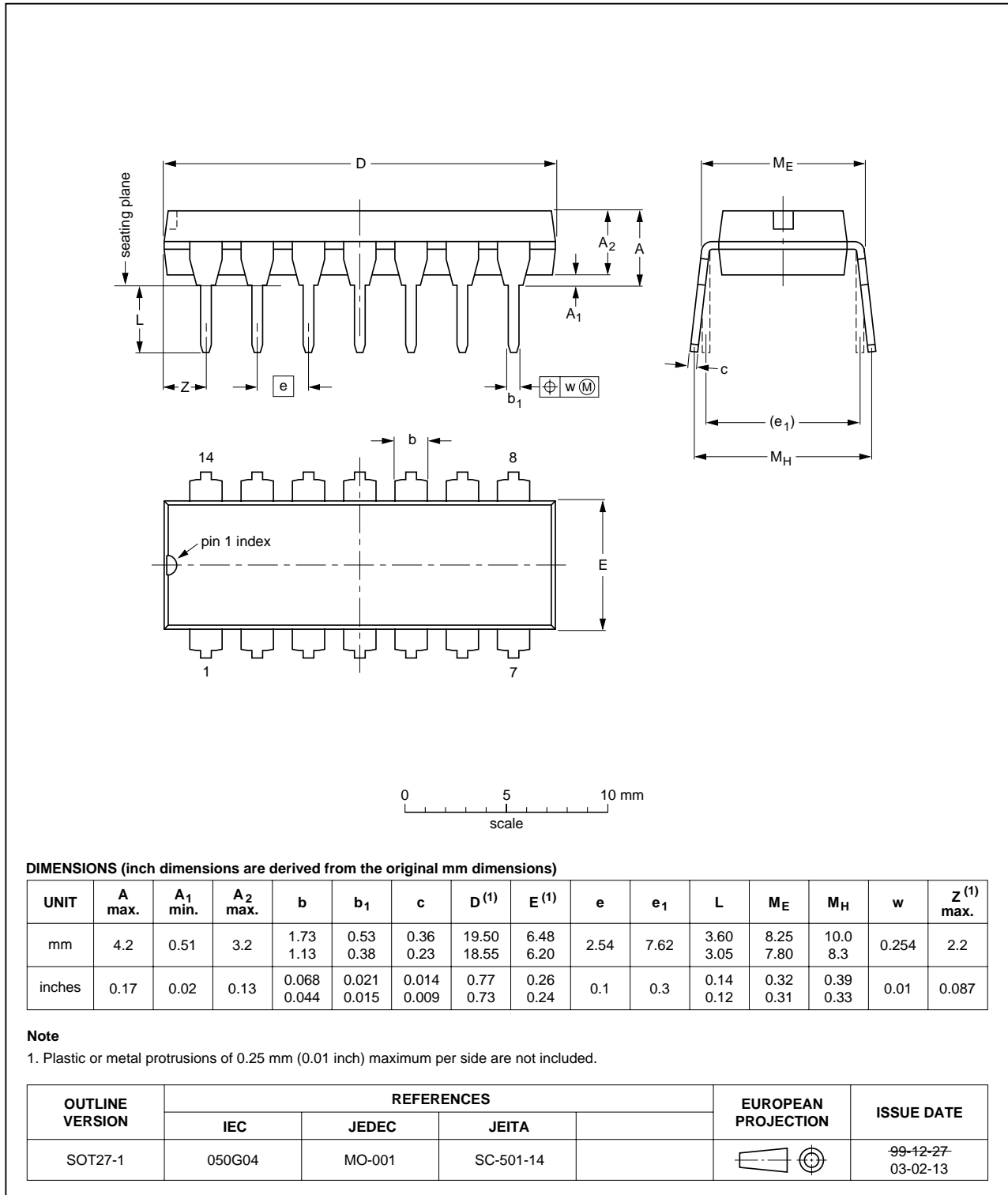


Fig 12. Package outline SOT27-1 (DIP14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

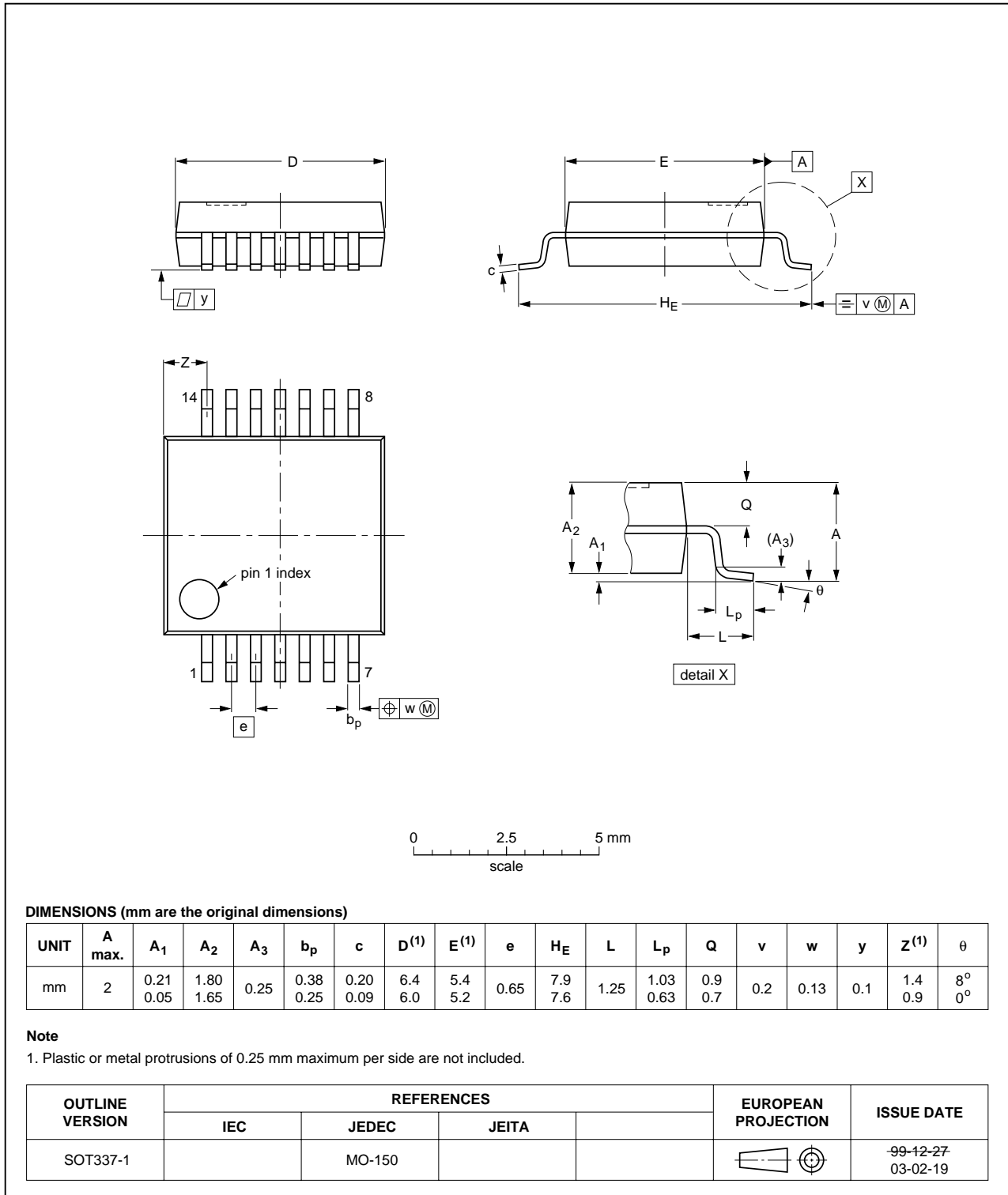


Fig 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

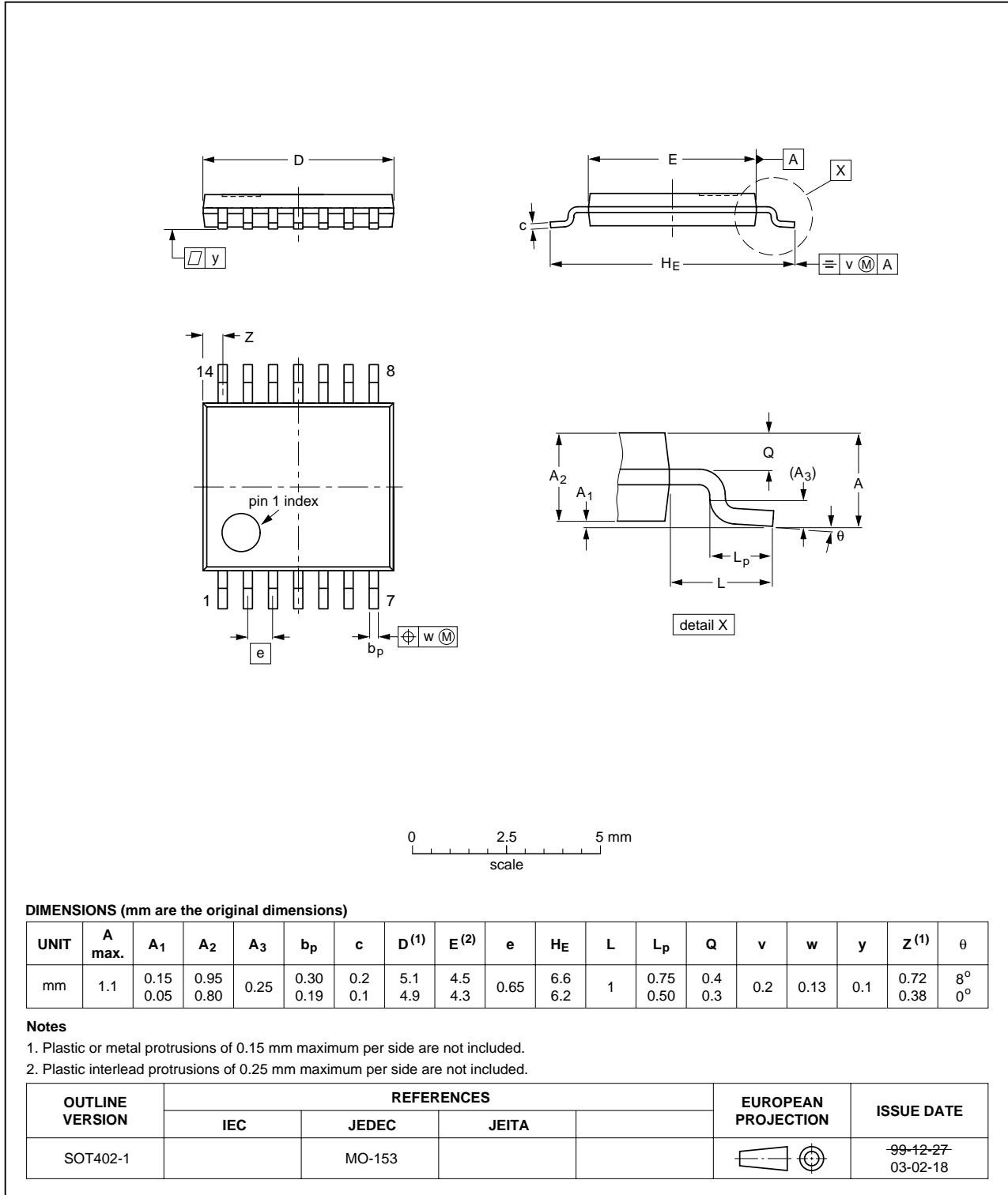


Fig 14. Package outline SOT402-1 (TSSOP14)

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

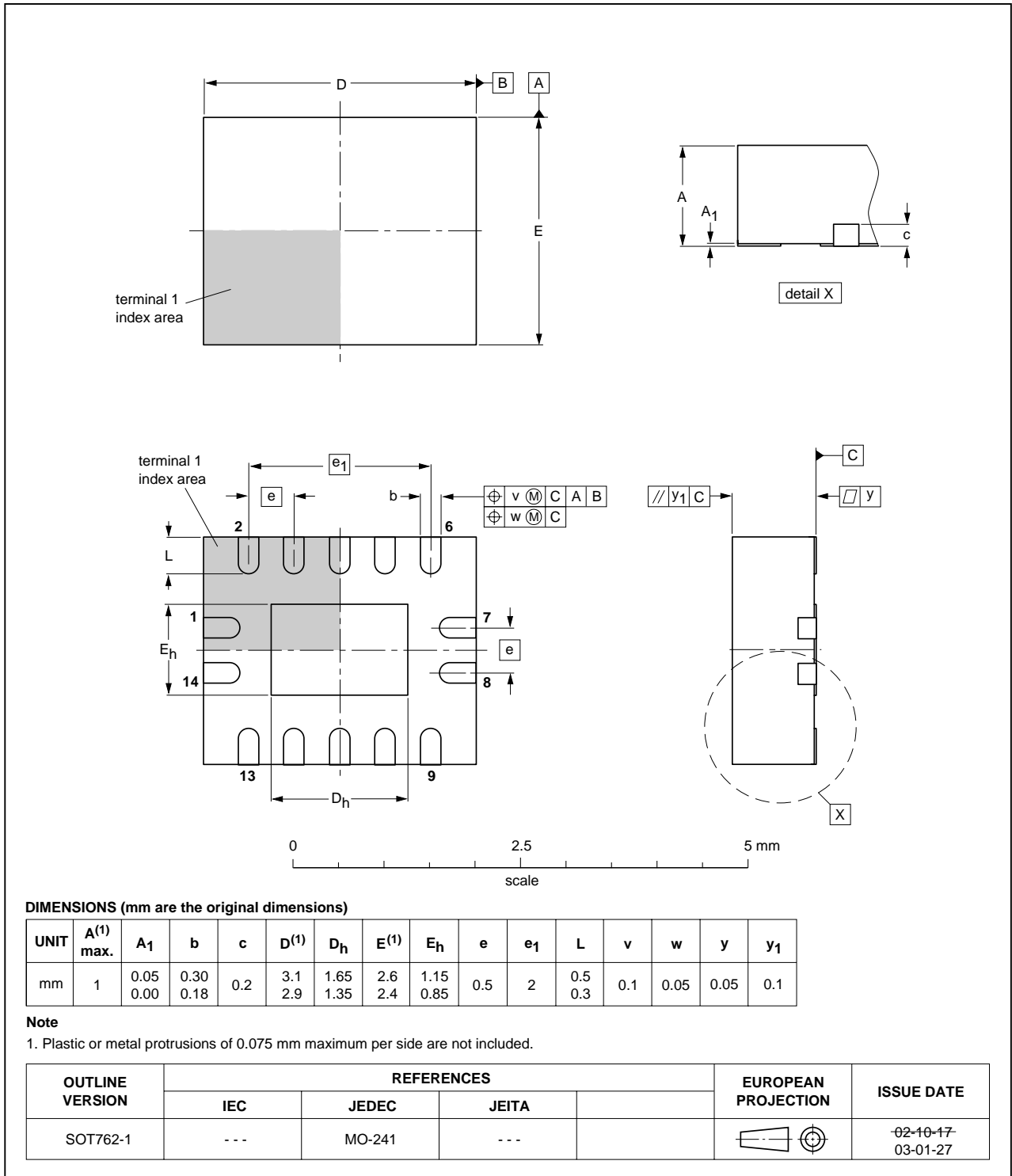


Fig 15. Package outline SOT762-1 (DHVQFN14)

## 14. Abbreviations

Table 13: Abbreviations table

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
TTL	Transistor Transistor Logic
LSTTL	Low-power Schottky Transistor Transistor Logic
DUT	Device Under Test

## 15. Revision history

Table 14: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
74HC_HCT393_3	20050906	Product data sheet	-	-	74HC_HCT393_CNV_2
Modifications:					<ul style="list-style-type: none"> <li>The format of this data sheet is redesigned to comply with the current presentation and information standard of Philips Semiconductors.</li> <li>Added family specifications.</li> <li>Added type numbers 74HC393BQ and 74HCT393BQ (package DHVQFN14).</li> </ul>
74HC_HCT393_CNV_2	19901201	Product specification			74HC_HCT393_CNV_1
74HC_HCT393_CNV_1					-

## 16. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 17. Definitions

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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