

74HC4094; 74HCT4094

8-stage shift-and-store bus register

Rev. 3 — 14 February 2011

Product data sheet

1. General description

The 74HC4094; 74HCT4094 are high-speed Si-gate CMOS devices and are pin compatible with the 4094 of the 4000B series. It is specified in compliance with JEDEC standard no. 7A.

The 74HC4094; 74HCT4094 is an 8-stage serial shift register. It has a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state outputs QP0 to QP7. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive-going clock transitions. The data in each shift register stage is transferred to the storage register when the strobe (STR) input is HIGH. Data in the storage register appears at the outputs whenever the output enable (OE) signal is HIGH.

Two serial outputs (QS1 and QS2) are available for cascading a number of 74HC4094; 74HCT4094 devices. Serial data is available at QS1 on positive-going clock edges to allow high-speed operation in cascaded systems with a fast clock rise time. The same serial data is available at QS2 on the next negative going clock edge. This is used for cascading 74HC4094; 74HCT4094 devices when the clock has a slow rise time.

2. Features and benefits

- Low-power dissipation
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2 000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Applications

- Serial-to-parallel data conversion
- Remote control holding register



4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC4094N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HCT4094N				
74HC4094D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT4094D				
74HC4094DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HCT4094DB				
74HC4094PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

5. Functional diagram

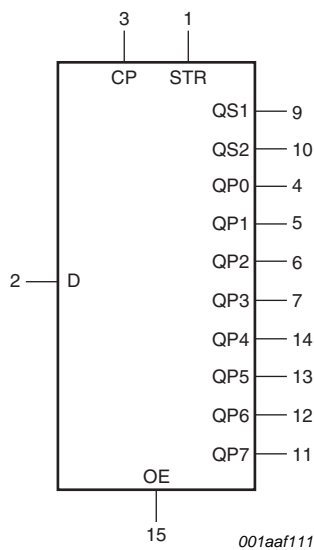


Fig 1. Functional diagram

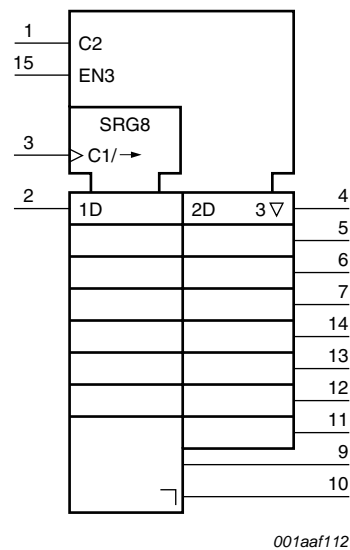


Fig 2. Logic symbol

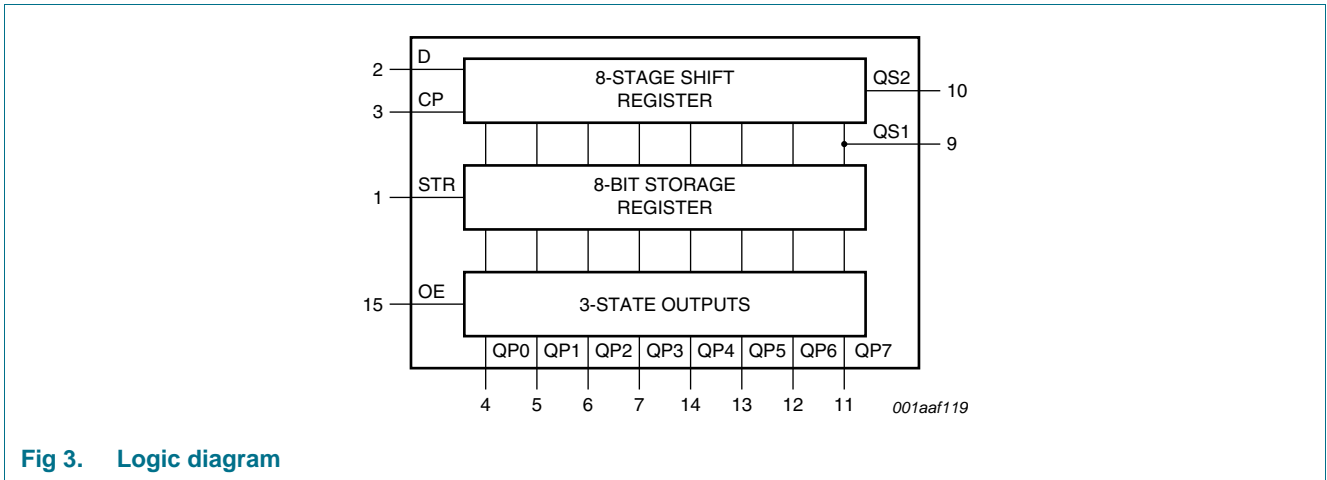


Fig 3. Logic diagram

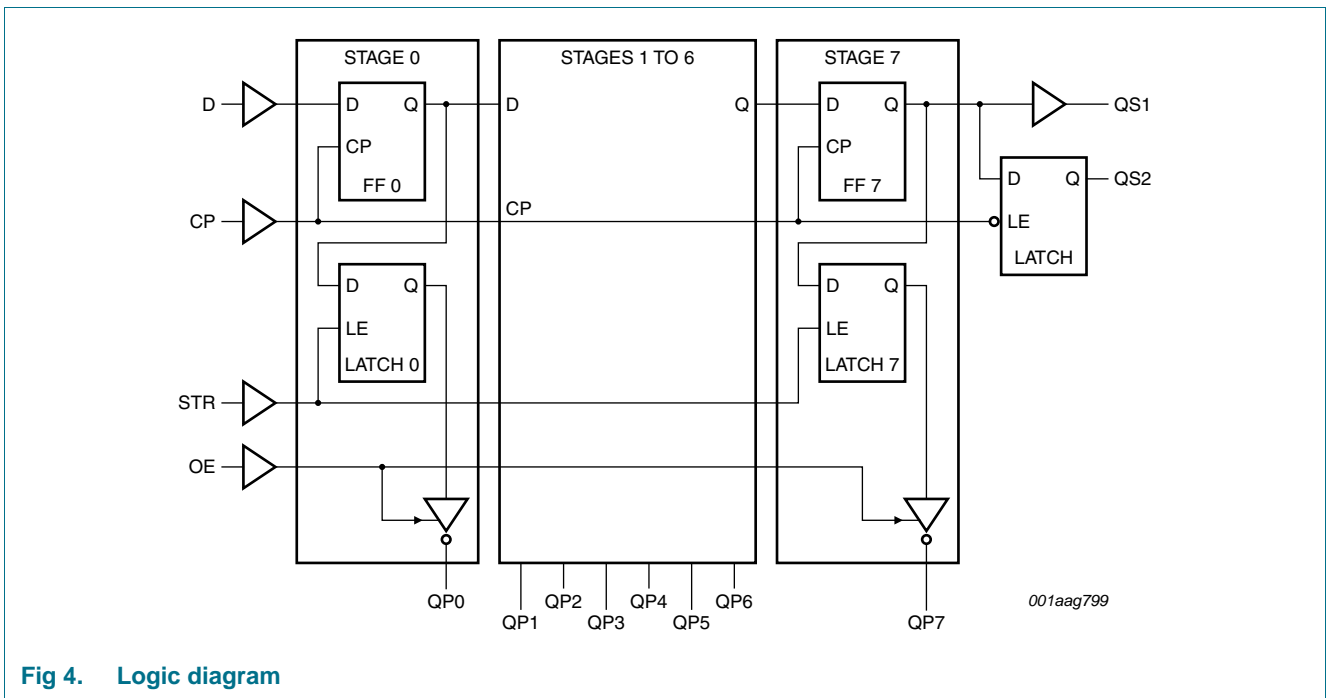


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning

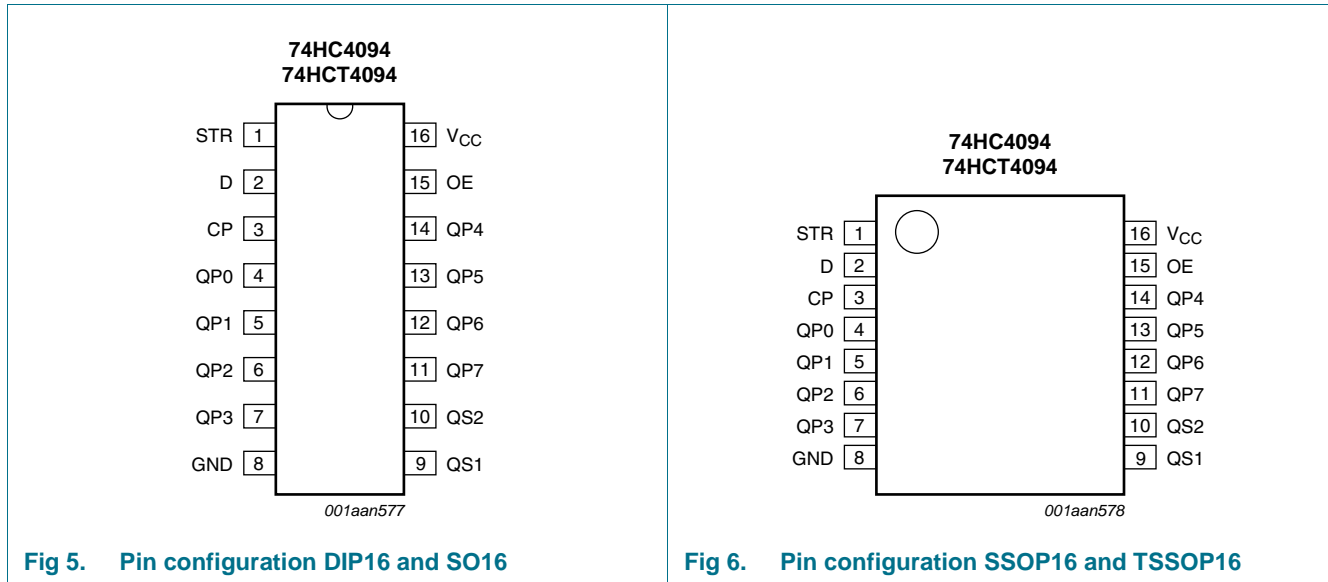


Fig 5. Pin configuration DIP16 and SO16

Fig 6. Pin configuration SSOP16 and TSSOP16

6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
STR	1	strobe input
D	2	data input
CP	3	clock input
QP0 to QP7	4, 5, 6, 7, 14, 13, 12, 11	parallel output
V _{SS}	8	ground supply voltage
QS1, QS2	9, 10	serial output
OE	15	output enable input
V _{DD}	16	supply voltage

7. Functional description

Table 3. Function table^[1]

Inputs				Parallel outputs		Serial outputs	
CP	OE	STR	D	QP0	QPn	QS1	QS2
↑	L	X	X	Z	Z	Q6S	NC
↓	L	X	X	Z	Z	NC	Q7S
↑	H	L	X	NC	NC	Q6S	NC
↑	H	H	L	L	QPn - 1	Q6S	NC
↑	H	H	H	H	QPn - 1	Q6S	NC
↓	H	H	H	NC	NC	NC	Q7S

- [1] At the positive clock edge, the information in the 7th register stage is transferred to the 8th register stage and the QSn outputs.
 H = HIGH voltage level; L = LOW voltage level; X = don't care;
 ↑ = positive-going transition; ↓ = negative-going transition;
 Z = HIGH-impedance OFF-state; NC = no change;
 Q6S = the data in register stage 6 before the LOW to HIGH clock transition;
 Q7S = the data in register stage 7 before the HIGH to LOW clock transition.

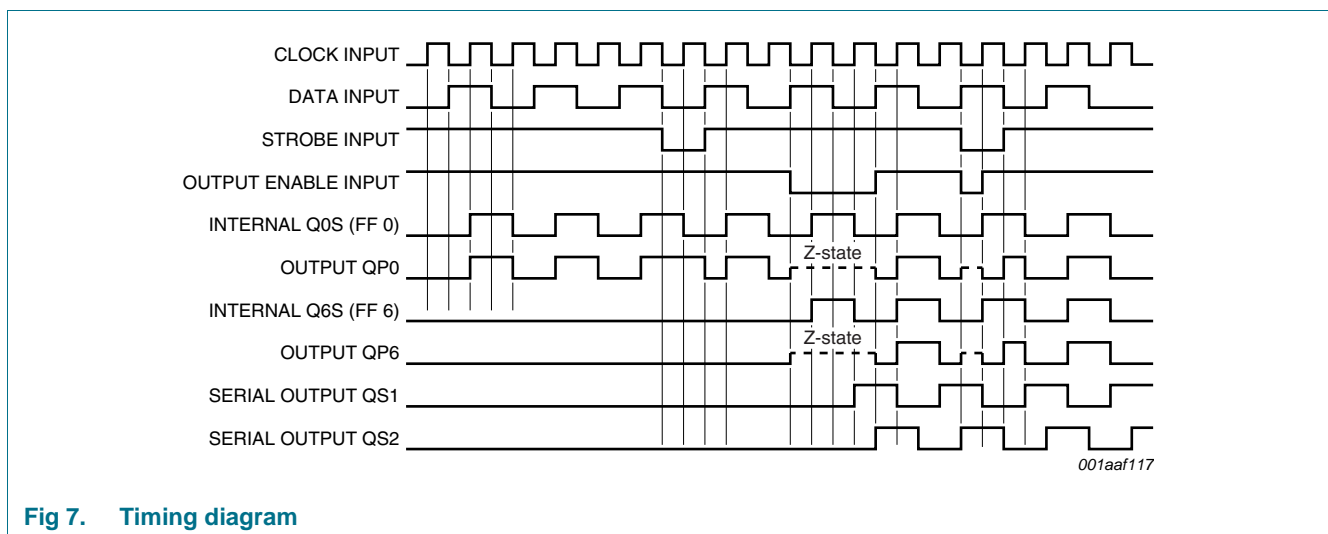


Fig 7. Timing diagram

8. 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 $V_I > V_{CC} + 0.5\text{ V}$	-	± 20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	± 20	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	DIP16 package	[1] -	750	mW
		SO16, SSOP16 and TSSOP16 packages	[2] -	500	mW

[1] For DIP16 package: P_{tot} derates linearly with 12 mW/K above 70 °C.

[2] For SO16: P_{tot} derates linearly with 8 mW/K above 70 °C.

For SSOP16 and TSSOP16 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC4094			74HCT4094			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

10. 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					
74HC4094														
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V				
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V				
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V				
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V				
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V				
		V _{CC} = 6.0 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 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V				
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V				
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V				
		I _O = -4.0 mA; V _{CC} = 4.5 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 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V				
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V				
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V				
		I _O = 4.0 mA; V _{CC} = 4.5 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 V	-	-	±0.1	-	±1.0	-	±1.0	μA				
		I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.5	-	±5.0	-	±10.0	μA		
				I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA
				C _I	input capacitance		-	3.5	-				pF	
				74HCT4094										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V				
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V				
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V												
		I _O = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V				
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V												
		I _O = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V				
V _{OL}	LOW-level output voltage	I _O = 20 μA	-	0	0.1	-	0.1	-	0.1	V				
		I _O = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V				

Table 6. Static characteristics ...continued

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		
I_I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V	-	-	± 0.1	-	± 1.0	-	± 1.0	μA	
I_{OZ}	OFF-state output current	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 5.5$ V; $V_O = V_{CC}$ or GND per input pin; other inputs at V_{CC} or GND; $I_O = 0$ A	-	-	± 0.5	-	± 5.0	-	± 10	μA	
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	8.0	-	80	-	160	μA	
ΔI_{CC}	additional supply current	$V_I = V_{CC} - 2.1$ V; other inputs at V_{CC} or GND; $V_{CC} = 4.5$ V to 5.5 V; $I_O = 0$ A	per input pin; STR input	-	100	360	-	450	-	490	μA
			per input pin; OE input	-	150	540	-	675	-	735	μA
			per input pin; CP input	-	150	540	-	675	-	735	μA
			per input pin; D input	-	40	144	-	180	-	196	μA
C_I	input capacitance		-	3.5	-					pF	

11. 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 [Figure 12](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4094										
t_{pd}	propagation delay	CP to QS1; see Figure 8 ^[1]								
		$V_{CC} = 2.0$ V	-	50	150	-	190	-	225	ns
		$V_{CC} = 4.5$ V	-	18	30	-	38	-	45	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	15	-	-	-	-	-	ns
		$V_{CC} = 6.0$ V	-	14	26	-	33	-	38	ns
		CP to QS2; see Figure 8 ^[1]								
		$V_{CC} = 2.0$ V	-	44	135	-	170	-	205	ns
		$V_{CC} = 4.5$ V	-	16	27	-	34	-	41	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	13	-	-	-	-	-	ns
		$V_{CC} = 6.0$ V	-	13	23	-	29	-	35	ns
		CP to QPn; see Figure 8 ^[1]								
		$V_{CC} = 2.0$ V	-	63	195	-	245	-	295	ns
		$V_{CC} = 4.5$ V	-	23	39	-	49	-	59	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	20	-	-	-	-	-	ns
		$V_{CC} = 6.0$ V	-	18	33	-	42	-	50	ns
		STR to QPn; see Figure 9 ^[1]								
$V_{CC} = 2.0$ V	-	58	180	-	225	-	270	ns		
$V_{CC} = 4.5$ V	-	21	36	-	45	-	54	ns		
$V_{CC} = 5$ V; $C_L = 15$ pF	-	18	-	-	-	-	-	ns		
$V_{CC} = 6.0$ V	-	17	31	-	38	-	46	ns		
t_{en}	enable time	OE to QPn; see Figure 11 ^[2]								
		$V_{CC} = 2.0$ V	-	55	175	-	220	-	265	ns
		$V_{CC} = 4.5$ V	-	20	35	-	44	-	53	ns
		$V_{CC} = 6.0$ V	-	16	30	-	37	-	45	ns
t_{dis}	disable time	OE to QPn; see Figure 11 ^[3]								
		$V_{CC} = 2.0$ V	-	41	125	-	155	-	190	ns
		$V_{CC} = 4.5$ V	-	15	25	-	31	-	38	ns
		$V_{CC} = 6.0$ V	-	12	21	-	26	-	32	ns
t_t	transition time	QPn; see Figure 8 ^[4]								
		$V_{CC} = 2.0$ V	-	19	75	-	95	-	110	ns
		$V_{CC} = 4.5$ V	-	7	15	-	19	-	22	ns
		$V_{CC} = 6.0$ V	-	6	13	-	16	-	19	ns

Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit see [Figure 12](#).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t_W	pulse width	CP HIGH or LOW; see Figure 8								
		$V_{CC} = 2.0$ V	80	14	-	100	-	120	-	ns
		$V_{CC} = 4.5$ V	16	5	-	20	-	24	-	ns
		$V_{CC} = 6.0$ V	14	4	-	17	-	20	-	ns
		STR HIGH; see Figure 9								
		$V_{CC} = 2.0$ V	80	14	-	100	-	120	-	ns
t_{SU}	set-up time	D to CP; see Figure 10								
		$V_{CC} = 2.0$ V	50	14	-	65	-	75	-	ns
		$V_{CC} = 4.5$ V	10	5	-	13	-	15	-	ns
		$V_{CC} = 6.0$ V	9	4	-	11	-	13	-	ns
		CP to STR; see Figure 9								
		$V_{CC} = 2.0$ V	100	28	-	125	-	150	-	ns
t_H	hold time	D to CP; see Figure 10								
		$V_{CC} = 2.0$ V	3	-6	-	3	-	3	-	ns
		$V_{CC} = 4.5$ V	3	-2	-	3	-	3	-	ns
		$V_{CC} = 6.0$ V	3	-2	-	3	-	3	-	ns
		CP to STR; see Figure 9								
		$V_{CC} = 2.0$ V	0	-14	-	0	-	0	-	ns
f_{max}	maximum frequency	CP; see Figure 8								
		$V_{CC} = 2.0$ V	6.0	28	-	4.8	-	4.0	-	MHz
		$V_{CC} = 4.5$ V	30	87	-	24	-	20	-	MHz
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	95	-	-	-	-	-	MHz
C_{PD}	power dissipation capacitance	$V_{CC} = 6.0$ V	35	103	-	28	-	24	-	MHz
		$C_L = 50$ pF; $f = 1$ MHz; $V_I = GND$ to V_{CC}	5	-	83	-	-	-	-	pF

Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit see [Figure 12](#).

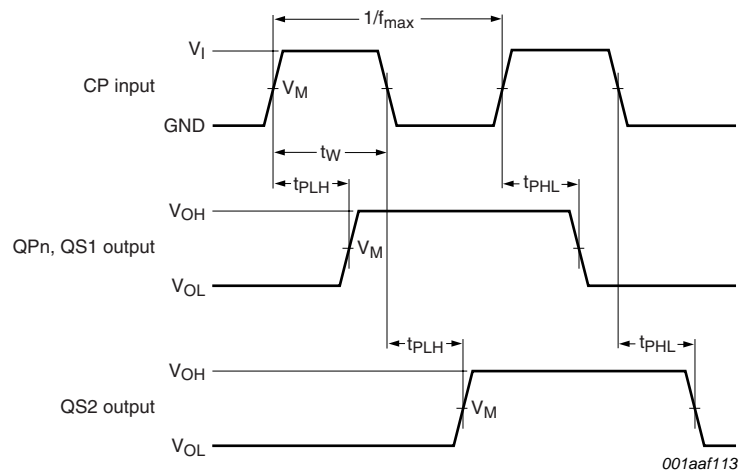
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HCT4094										
t_{pd}	propagation delay	CP to QS1; see Figure 8 [1]								
		$V_{CC} = 4.5$ V	-	23	39	-	49	-	59	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	19	-	-	-	-	-	ns
		CP to QS2; see Figure 8 [1]								
		$V_{CC} = 4.5$ V	-	21	36	-	45	-	54	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	18	-	-	-	-	-	ns
		CP to QPn; see Figure 8 [1]								
		$V_{CC} = 4.5$ V	-	25	43	-	54	-	65	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	21	-	-	-	-	-	ns
t_{en}	enable time	STR to QPn; see Figure 9 [1]								
		$V_{CC} = 4.5$ V	-	22	39	-	49	-	59	ns
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	19	-	-	-	-	-	ns
t_{dis}	disable time	OE to QPn; see Figure 11 [2]								
		$V_{CC} = 4.5$ V	-	20	35	-	44	-	53	ns
t_t	transition time	QFn; see Figure 8 [4]								
		$V_{CC} = 4.5$ V	-	7	15	-	19	-	22	ns
t_W	pulse width	CP HIGH or LOW; see Figure 8								
		$V_{CC} = 4.5$ V	16	7	-	20	-	24	-	ns
		STR HIGH; see Figure 9								
t_{su}	set-up time	Dn to CP; see Figure 10								
		$V_{CC} = 4.5$ V	10	4	-	13	-	15	-	ns
t_h	hold time	CP to STR; see Figure 9								
		$V_{CC} = 4.5$ V	20	9	-	25	-	30	-	ns
		Dn to CP; see Figure 10								
f_{max}	maximum frequency	$V_{CC} = 4.5$ V	4	0	-	4	-	4	-	ns
		CP to STR; see Figure 9								
		$V_{CC} = 4.5$ V	0	-4	-	0	-	0	-	ns
C_{PD}	power dissipation capacitance	CP; see Figure 8								
		$V_{CC} = 4.5$ V	30	80	-	24	-	20	-	MHz
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	86	-	-	-	-	-	MHz
C_{PD}	power dissipation capacitance	$C_L = 50$ pF; $f = 1$ MHz; $V_I = \text{GND to } V_{CC}$ [5]	-	92	-	-	-	-	-	pF

[1] t_{pd} is the same as t_{PLH} and t_{PHL} .

[2] t_{en} is the same as t_{PZH} and t_{PZL} .

- [3] t_{dis} is the same as t_{PLZ} and t_{PHZ} .
- [4] t_t is the same as t_{THL} and t_{TLH} .
- [5] 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.

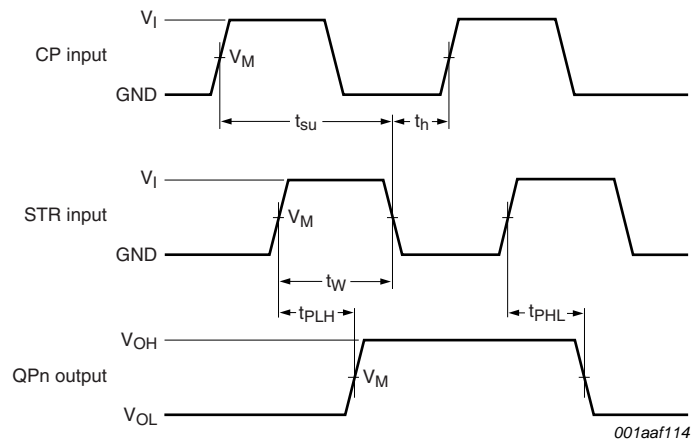
12. Waveforms



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

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

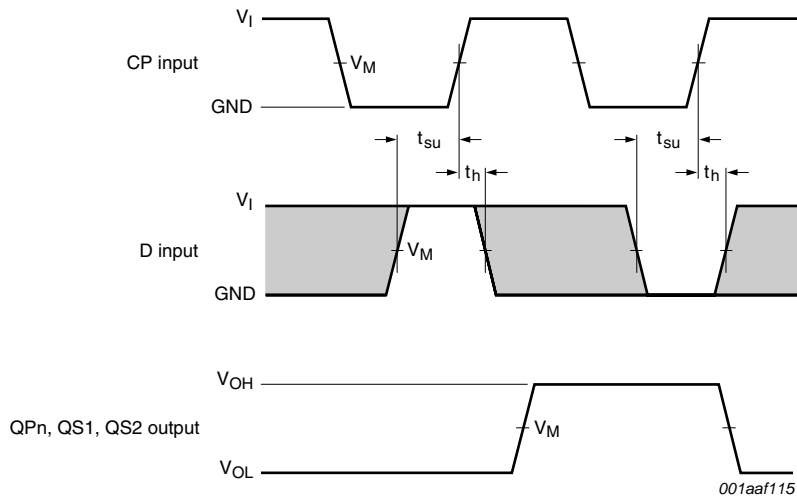
Fig 8. Propagation delay input (CP) to output (QPn, QS1, QS2), output transition time, clock input (CP) pulse width and the maximum frequency (CP)



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

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

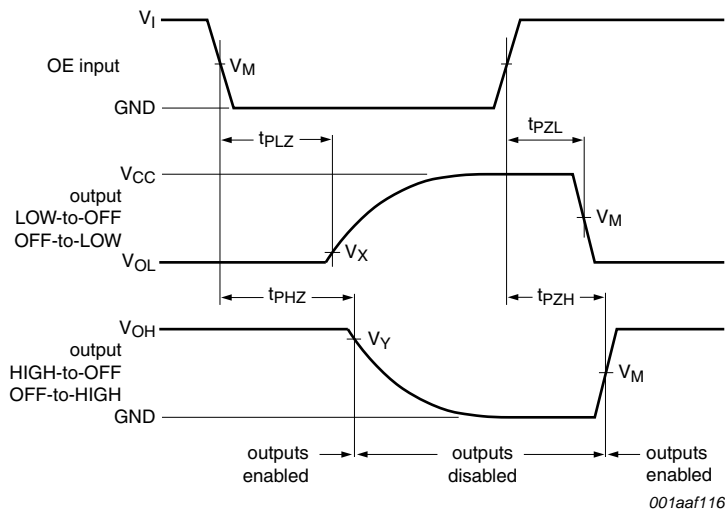
Fig 9. Propagation delay strobe input (STR) to output (QPn), strobe input (STR) pulse width and the clock set-up and hold times for strobe input



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

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

Fig 10. The data input (D) to clock input (CP) set-up times and clock input (CP) to data input (D) hold times



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

Fig 11. Enable and disable times

Table 8. Measurement points

Type	Input	Output
	V_M	V_M
74HC4094	$0.5V_{CC}$	$0.5V_{CC}$
74HCT4094	1.3 V	1.3 V

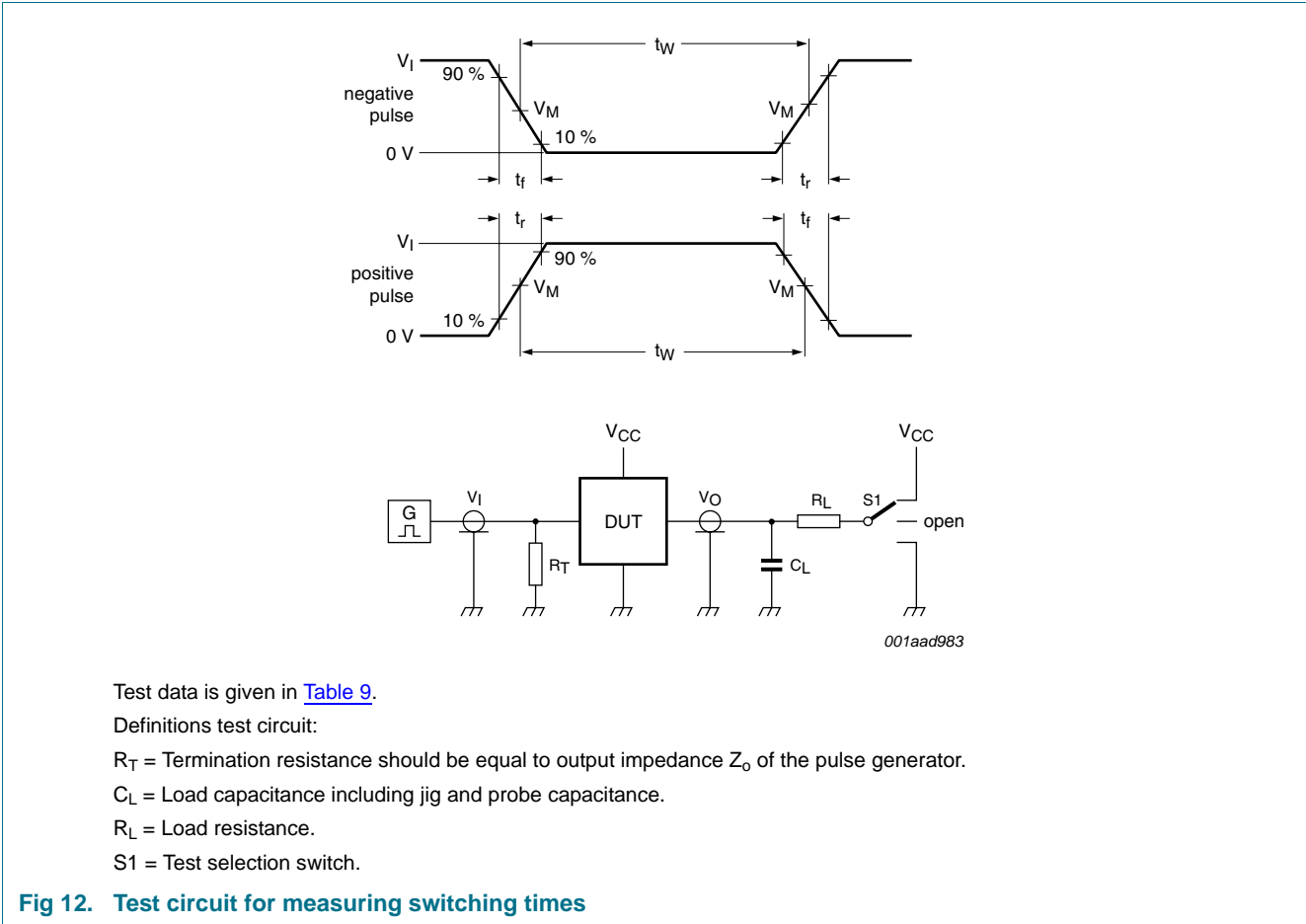


Table 9. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74HC4094	V_{CC}	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}
74HCT4094	3 V	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4

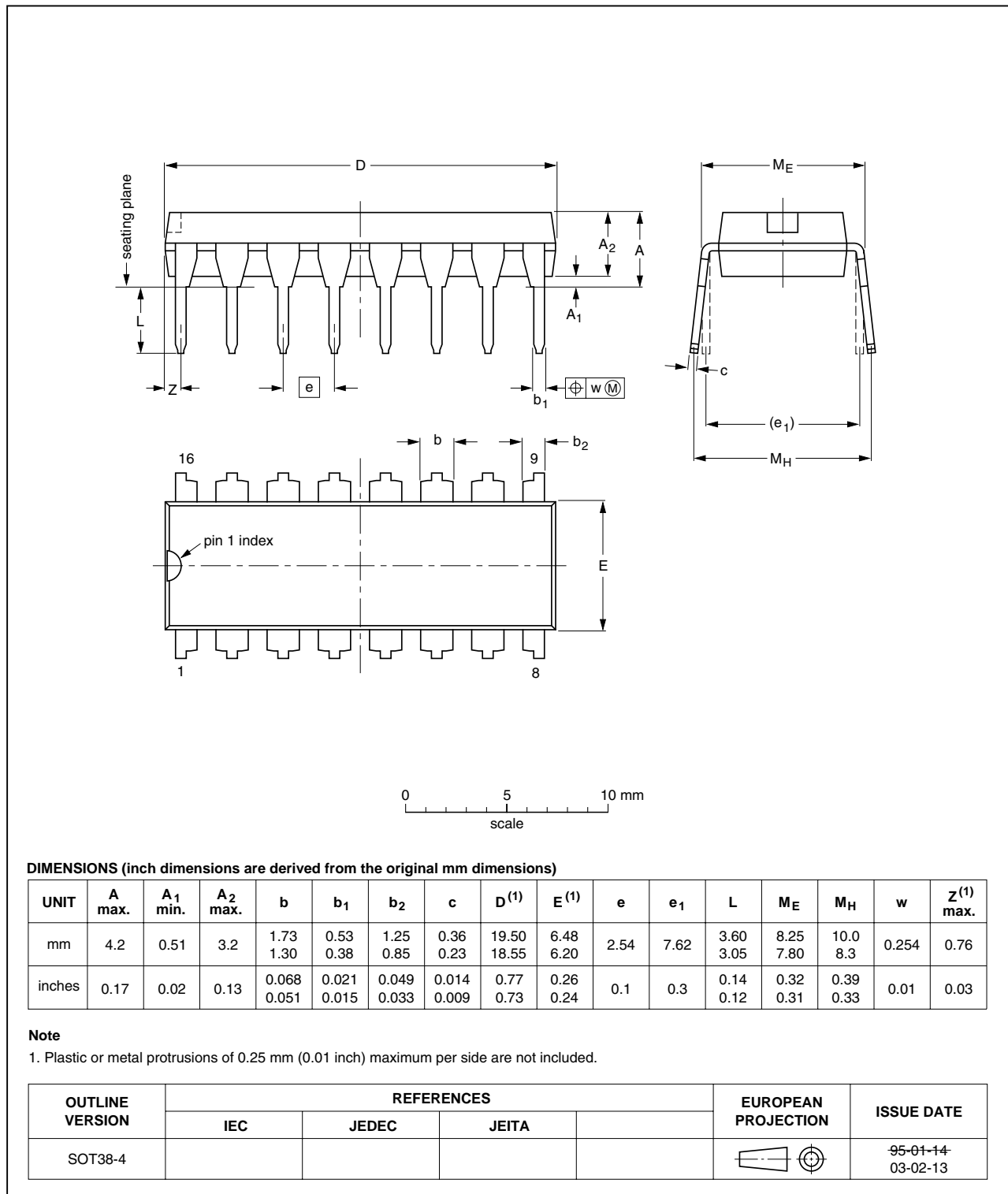


Fig 13. Package outline SOT38-4 (DIP16)

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

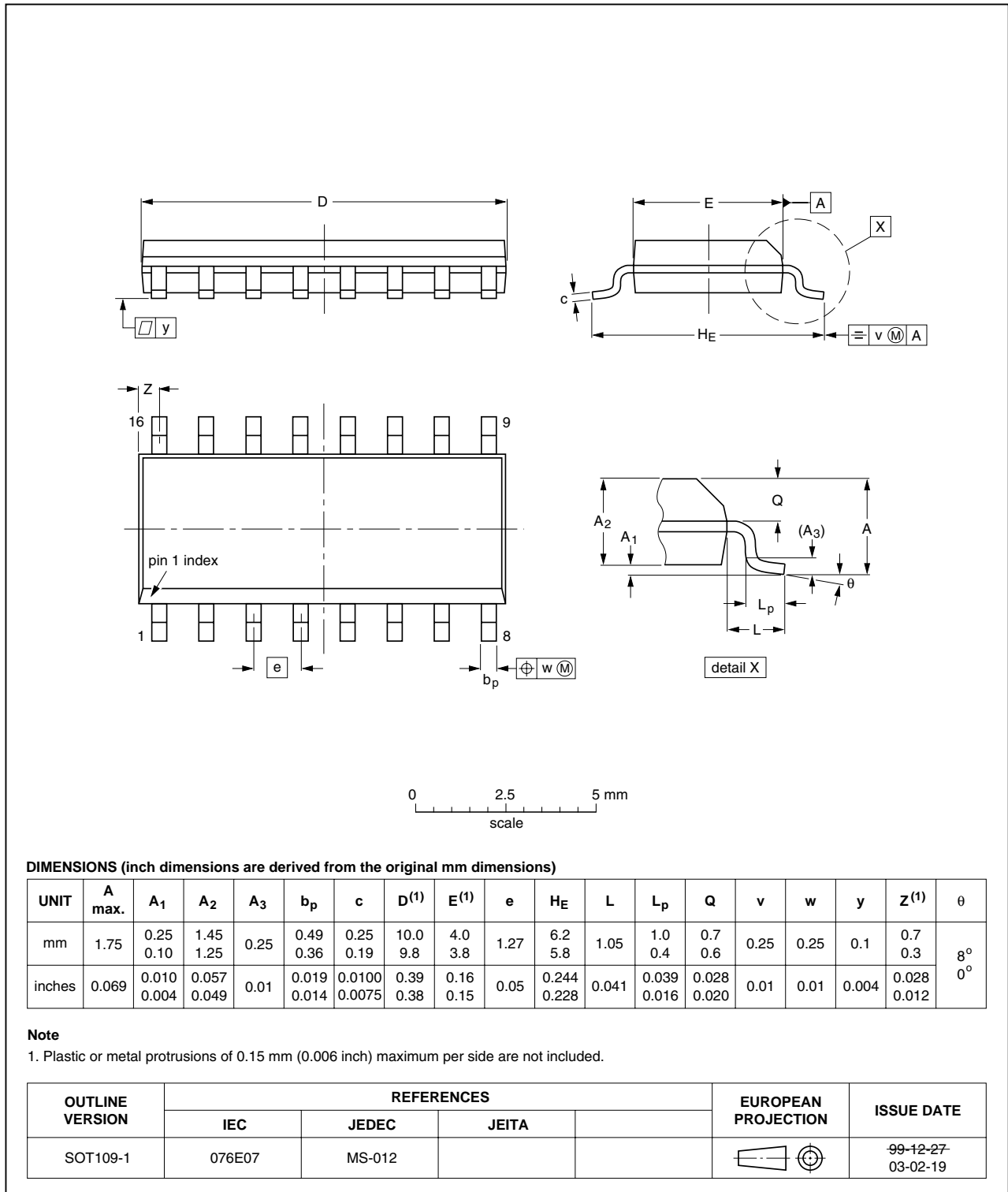


Fig 14. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

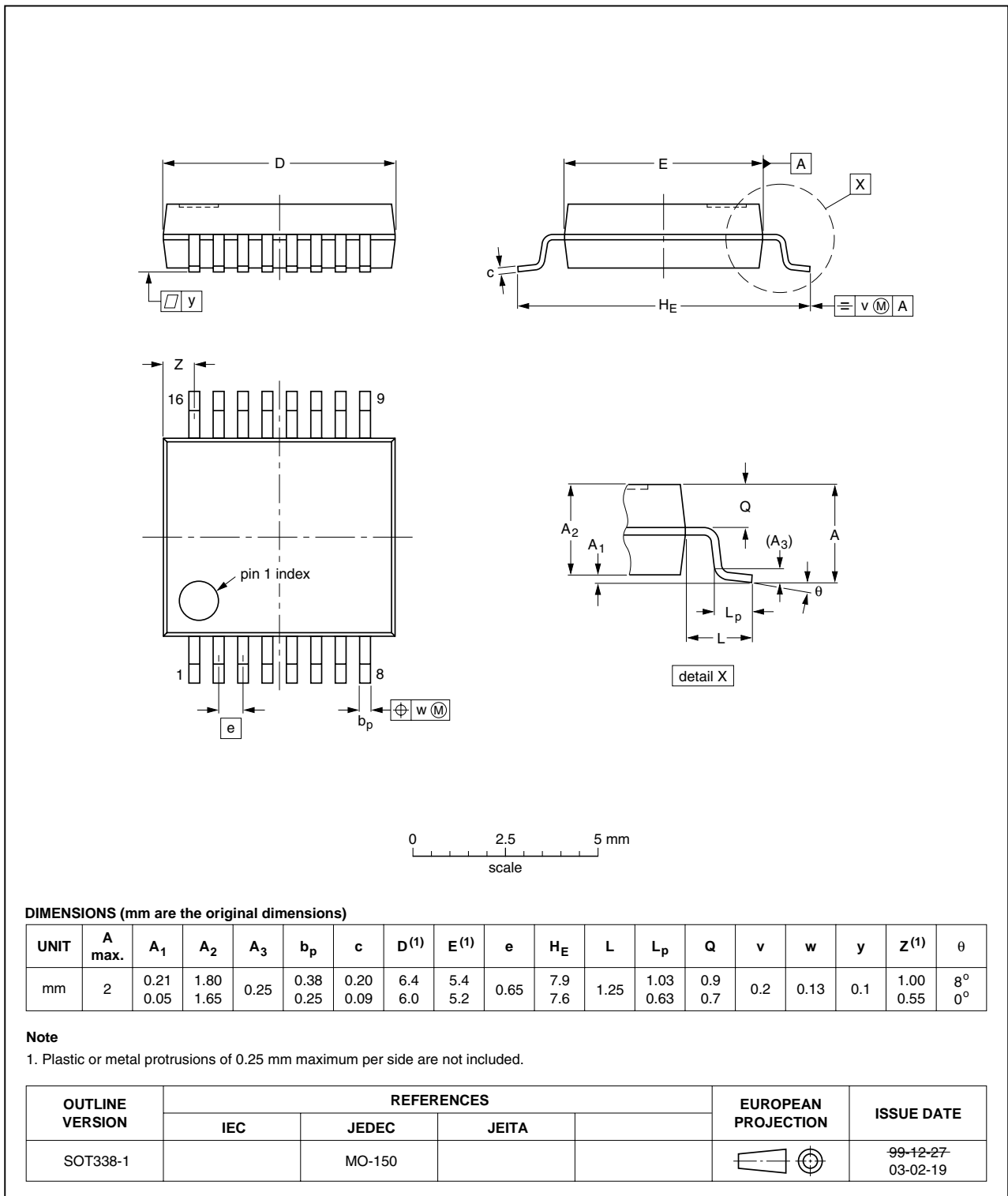


Fig 15. Package outline SOT338-1 (SSOP16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

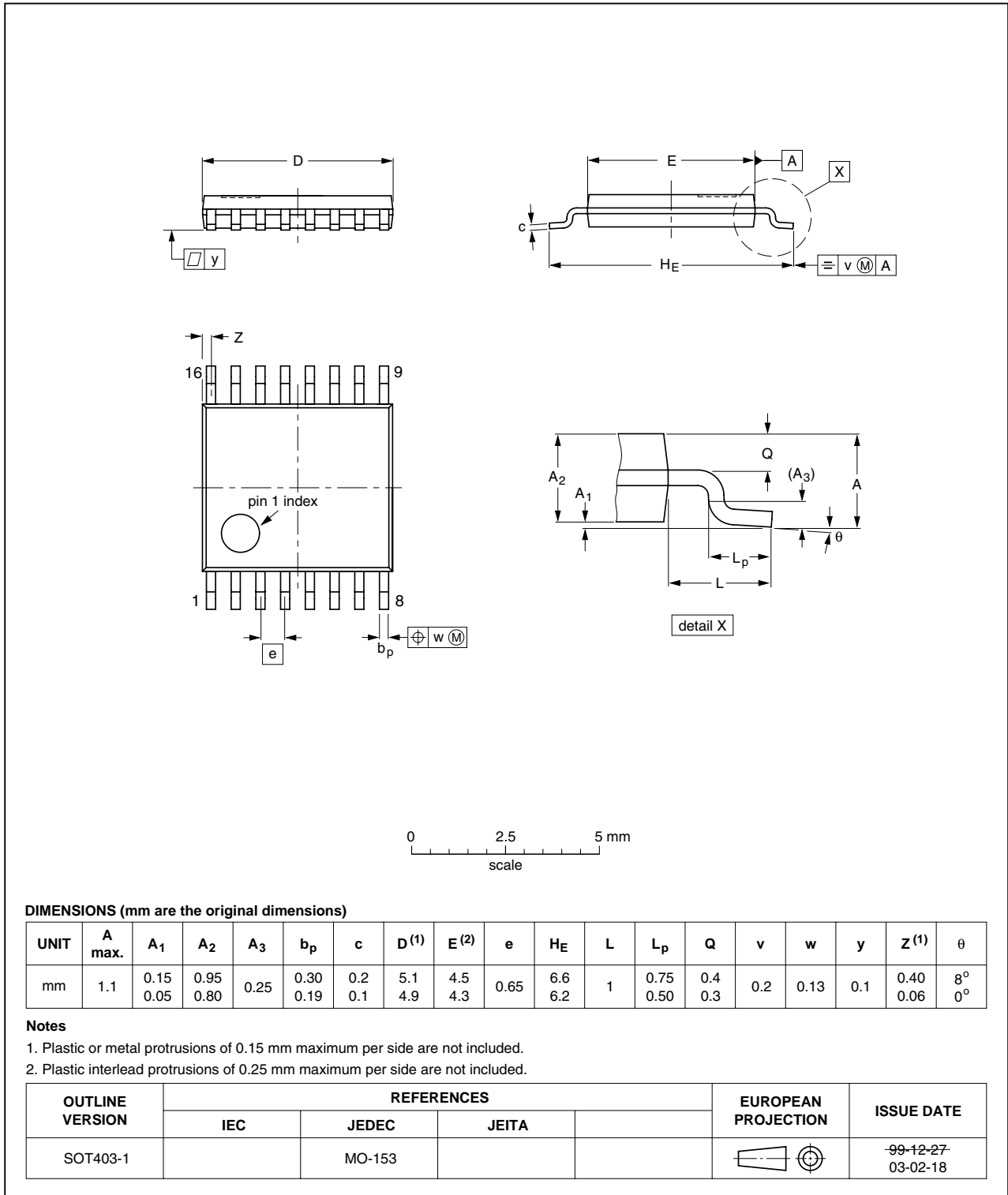


Fig 16. Package outline SOT403-1 (TSSOP16)

14. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

15. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4094 v.3	20110214	Product data sheet	-	74HC_HCT4094_CNV v.2
Modifications:				
				<ul style="list-style-type: none">• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.• Legal texts have been adapted to the new company name where appropriate.
74HC_HCT4094_CNV v.2	19970901	Product specification	-	-

16. Legal information

16.1 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 URL <http://www.nxp.com>.

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Date of release: 14 February 2011

Document identifier: 74HC_HCT4094