

# 74AHC164; 74AHCT164

## 8-bit serial-in/parallel-out shift register

Rev. 02 — 29 November 2006

Product data sheet

### 1. General description

---

The 74AHC164; 74AHCT164 shift register 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 74AHC164; 74AHCT164 input signals are 8-bit serial through one of two inputs (DSA or DSB); either input can be used as an active HIGH enable for data entry through the other input. Both inputs must be connected together or an unused input must be tied HIGH.

Data shifts one place to the right on each LOW-to-HIGH transition of the clock input (CP) and enters into output Q0, which is a logical AND of the two data inputs (DSA and DSB) that existed one set-up time prior to the rising clock edge.

A LOW-level on the master reset ( $\overline{MR}$ ) input overrides all other inputs and clears the register asynchronously, forcing all outputs LOW.

### 2. Features

---

- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than  $V_{CC}$
- Input levels:
  - ◆ CMOS levels: 74AHC164 only
  - ◆ TTL levels: 74AHCT164 only
- ESD protection:
  - ◆ HBM JESD22-A114-D exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM JESD22-C101-C exceeds 1000 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. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
<b>74AHC164</b>				
74AHC164D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHC164PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHC164BQ	-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
<b>74AHCT164</b>				
74AHCT164D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74AHCT164PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74AHCT164BQ	-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

### 4. Functional diagram

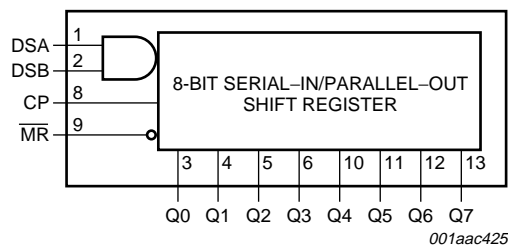


Fig 1. Functional diagram

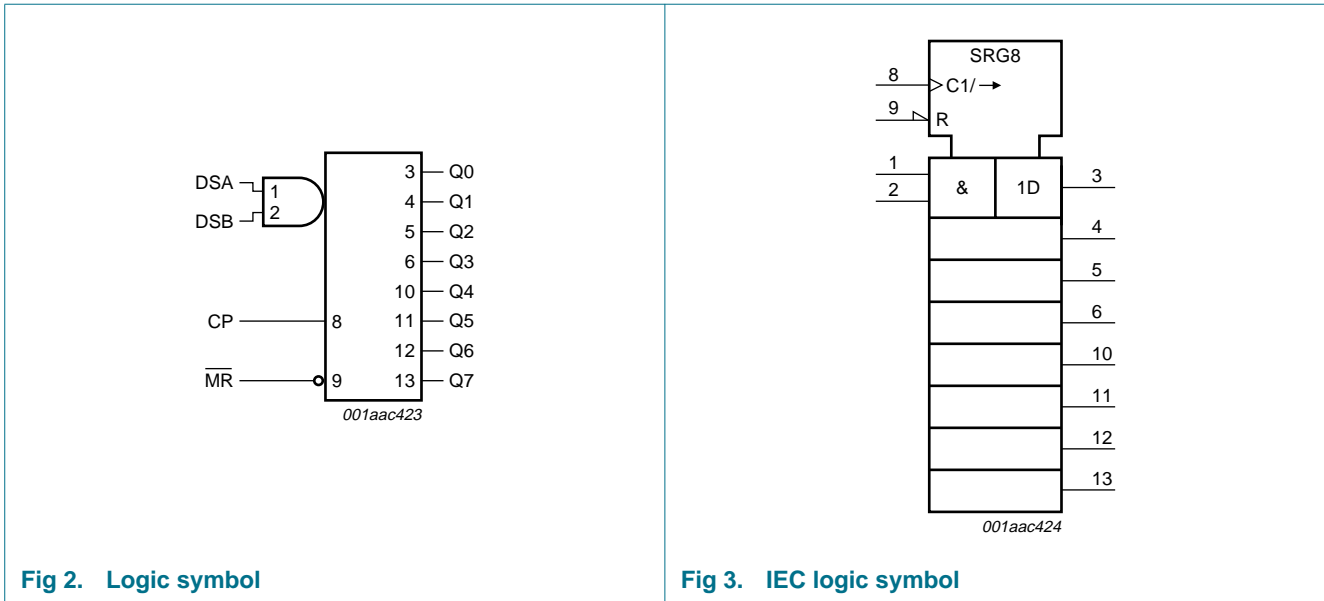


Fig 2. Logic symbol

Fig 3. IEC logic symbol

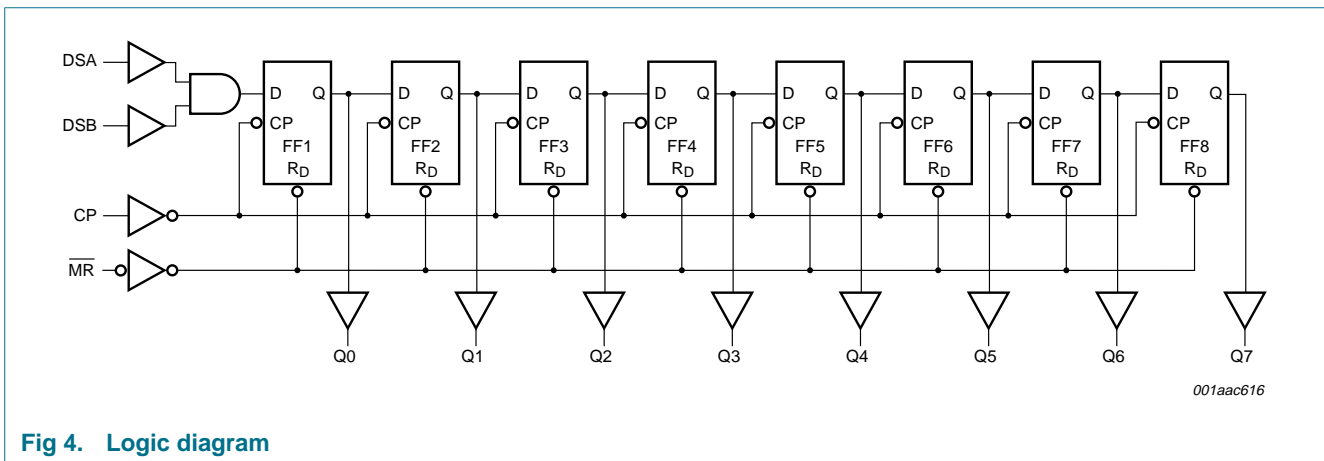
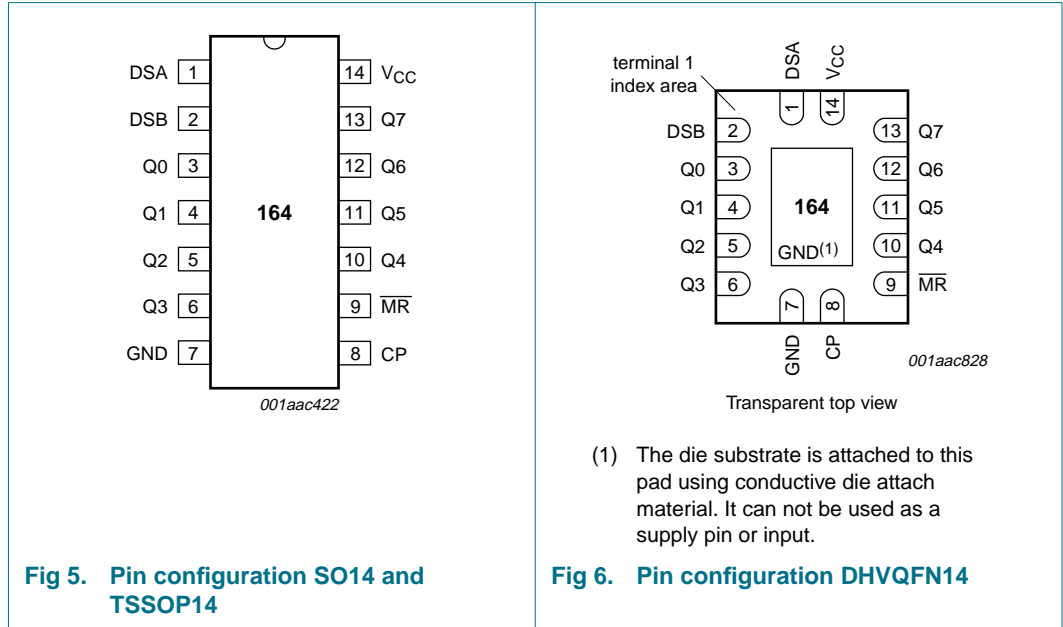


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
DSA	1	serial data input A
DSB	2	serial data input B
Q0	3	output 0
Q1	4	output 1
Q2	5	output 2
Q3	6	output 3
GND	7	ground (0 V)
CP	8	clock input (LOW-to-HIGH edge-triggered)
MR	9	master reset input (active LOW)
Q4	10	output 4
Q5	11	output 5
Q6	12	output 6
Q7	13	output 7
V <sub>CC</sub>	14	supply voltage

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

Operating mode	Control		Inputs		Output	
	$\overline{MR}$	CP	DSA	DSB	Q0	Q1 to Q7
Reset (clear)	L	X	X	X	L	L to L
Shift	H	↑	l	l	L	q0 to q6
	H	↑	l	h	L	q0 to q6
	H	↑	h	l	L	q0 to q6
	H	↑	h	h	H	q0 to q6

- [1] H = HIGH voltage level;  
 h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition;  
 L = LOW voltage level;  
 l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition;  
 ↑ = LOW-to-HIGH transition;  
 X = don't care;  
 q = lower case letter indicates the state of the referenced input one set-up time prior to the LOW-to-HIGH transition.

## 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	+7.0	V
$V_I$	input voltage		-0.5	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$	[1] -	-20	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	[1] -	±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		-	75	mA
$I_{GND}$	ground current		-	-75	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$	[2] -	500	mW

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 [2] For SO14 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.  
 For TSSOP14 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.  
 For DHVQFN14 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74AHC164</b>						
$V_{CC}$	supply voltage		2.0	5.0	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	100	ns/V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	ns/V
<b>74AHCT164</b>						
$V_{CC}$	supply voltage		4.5	5.0	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	ns/V

## 9. Static characteristics

**Table 6. Static characteristics 74AHC164**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25\text{ °C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	V
		$V_{CC} = 3.0\text{ V}$	2.1	-	-	V
		$V_{CC} = 5.5\text{ V}$	3.85	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.9	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.65	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -50\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	1.9	2.0	-	V
		$I_O = -50\text{ }\mu\text{A}; V_{CC} = 3.0\text{ V}$	2.9	3.0	-	V
		$I_O = -50\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	4.4	4.5	-	V
		$I_O = -4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	2.58	-	-	V
	$I_O = -8.0\text{ mA}; V_{CC} = 4.5\text{ V}$	3.94	-	-	V	
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 50\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	-	0	0.1	V
		$I_O = 50\text{ }\mu\text{A}; V_{CC} = 3.0\text{ V}$	-	0	0.1	V
		$I_O = 50\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	-	0	0.1	V
		$I_O = 4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.36	V
	$I_O = 8.0\text{ mA}; V_{CC} = 4.5\text{ V}$	-	-	0.36	V	
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$	-	-	0.1	$\mu\text{A}$

**Table 6. Static characteristics 74AHC164 ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	4.0	$\mu$ A
$C_I$	input capacitance		-	3	10	pF
<b><math>T_{amb} = -40</math> °C to <math>+85</math> °C</b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0$ V	1.5	-	-	V
		$V_{CC} = 3.0$ V	2.1	-	-	V
		$V_{CC} = 5.5$ V	3.85	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0$ V	-	-	0.5	V
		$V_{CC} = 3.0$ V	-	-	0.9	V
		$V_{CC} = 5.5$ V	-	-	1.65	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -50$ $\mu$ A; $V_{CC} = 2.0$ V	1.9	-	-	V
		$I_O = -50$ $\mu$ A; $V_{CC} = 3.0$ V	2.9	-	-	V
		$I_O = -50$ $\mu$ A; $V_{CC} = 4.5$ V	4.4	-	-	V
		$I_O = -4.0$ mA; $V_{CC} = 3.0$ V	2.48	-	-	V
	$I_O = -8.0$ mA; $V_{CC} = 4.5$ V	3.8	-	-	V	
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 50$ $\mu$ A; $V_{CC} = 2.0$ V	-	-	0.1	V
		$I_O = 50$ $\mu$ A; $V_{CC} = 3.0$ V	-	-	0.1	V
		$I_O = 50$ $\mu$ A; $V_{CC} = 4.5$ V	-	-	0.1	V
		$I_O = 4$ mA; $V_{CC} = 3.0$ V	-	-	0.44	V
	$I_O = 8$ mA; $V_{CC} = 4.5$ V	-	-	0.44	V	
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V	-	-	1.0	$\mu$ A
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	40	$\mu$ A
<b><math>T_{amb} = -40</math> °C to <math>+125</math> °C</b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0$ V	1.5	-	-	V
		$V_{CC} = 3.0$ V	2.1	-	-	V
		$V_{CC} = 5.5$ V	3.85	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0$ V	-	-	0.5	V
		$V_{CC} = 3.0$ V	-	-	0.9	V
		$V_{CC} = 5.5$ V	-	-	1.65	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -50$ $\mu$ A; $V_{CC} = 2.0$ V	1.9	-	-	V
		$I_O = -50$ $\mu$ A; $V_{CC} = 3.0$ V	2.9	-	-	V
		$I_O = -50$ $\mu$ A; $V_{CC} = 4.5$ V	4.4	-	-	V
		$I_O = -4.0$ mA; $V_{CC} = 3.0$ V	2.40	-	-	V
	$I_O = -8.0$ mA; $V_{CC} = 4.5$ V	3.70	-	-	V	

**Table 6. Static characteristics 74AHC164 ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 2.0 V	-	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V	-	-	0.1	V
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 4.5 V	-	-	0.55	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	-	-	2.0	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	-	-	80	μA

**Table 7. Static characteristics 74AHCT164**

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-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	V
		I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V	3.94	-	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.36	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 5.5 V	-	-	0.1	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	-	-	4.0	μA
ΔI <sub>CC</sub>	additional 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; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	1.35	mA
C <sub>I</sub>	input capacitance		-	3	10	pF
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -50 μA; V <sub>CC</sub> = 4.5 V	4.4	-	-	V
		I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V	3.8	-	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.44	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 5.5 V	-	-	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	-	-	40	μA



**Table 7. Static characteristics 74AHCT164 ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$\Delta I_{CC}$	additional supply current	per input pin; $V_I = V_{CC} - 2.1$ V; other inputs at $V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 4.5$ V to 5.5 V	-	-	1.5	mA
<b><math>T_{amb} = -40</math> °C to <math>+125</math> °C</b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5$ V to 5.5 V	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5$ V to 5.5 V	-	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = -50$ $\mu$ A; $V_{CC} = 4.5$ V	4.4	-	-	V
		$I_O = -8.0$ mA; $V_{CC} = 4.5$ V	3.70	-	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$				
		$I_O = 50$ $\mu$ A; $V_{CC} = 4.5$ V	-	-	0.1	V
		$I_O = 8.0$ mA; $V_{CC} = 4.5$ V	-	-	0.55	V
$I_I$	input leakage current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 5.5$ V	-	-	2.0	$\mu$ A
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	80	$\mu$ A
$\Delta I_{CC}$	additional supply current	per input pin; $V_I = V_{CC} - 2.1$ V; other inputs at $V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 4.5$ V to 5.5 V	-	-	1.5	mA

## 10. Dynamic characteristics

**Table 8. Dynamic characteristics 74AHC164**

 Voltages are referenced to GND (ground = 0 V); for the test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C				Unit
			Min	Typ <sup>[1]</sup>	Max	Min (85 °C)	Max (85 °C)	Min (125 °C)	Max (125 °C)	
<b>C<sub>L</sub> = 15 pF</b>										
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	CP to Qn; see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	6.5	12.8	1.0	15.0	1.0	16.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	4.5	9.0	1.0	10.5	1.0	11.5	ns
		MR to Qn; see <a href="#">Figure 8</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	5.3	12.8	1.0	15.0	1.0	16.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	4.0	8.6	1.0	10.0	1.0	11.0	ns
t <sub>PLH</sub>	LOW-to-HIGH propagation delay	CP to Qn; see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	6.5	12.8	1.0	15.0	1.0	16.0	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	4.5	9.0	1.0	10.5	1.0	11.5	ns
f <sub>max</sub>	maximum frequency	see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	80	125	-	65	-	50	-	MHz
		V <sub>CC</sub> = 4.5 V to 5.5 V	125	175	-	105	-	85	-	MHz
<b>C<sub>L</sub> = 50 pF</b>										
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	CP to Qn; see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	9.3	16.3	1.0	18.5	1.0	20.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	6.4	11.0	1.0	12.5	1.0	14.0	ns
		MR to Qn; see <a href="#">Figure 8</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	7.6	16.3	1.0	18.5	1.0	20.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	5.8	10.6	1.0	12.0	1.0	13.5	ns
t <sub>PLH</sub>	LOW-to-HIGH propagation delay	CP to Qn; see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	9.3	16.3	1.0	18.5	1.0	20.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	-	6.4	11.0	1.0	12.5	1.0	14.0	ns
t <sub>w</sub>	pulse width	CP HIGH or LOW; see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	5.0	-	-	5.0	-	5.0	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	5.0	-	-	5.0	-	5.0	-	ns
t <sub>wL</sub>	pulse width LOW	MR; see <a href="#">Figure 8</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	5.0	-	-	5.0	-	5.0	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	5.0	-	-	5.0	-	5.0	-	ns
t <sub>su</sub>	set-up time	DSA, DSB to CP; see <a href="#">Figure 9</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	5.0	-	-	6.0	-	6.0	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	4.5	-	-	4.5	-	4.5	-	ns

**Table 8. Dynamic characteristics 74AHC164 ...continued**  
 Voltages are referenced to GND (ground = 0 V); for the test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C				Unit
			Min	Typ <sup>[1]</sup>	Max	Min (85 °C)	Max (85 °C)	Min (125 °C)	Max (125 °C)	
t <sub>h</sub>	hold time	DSA, DSB to CP; see <a href="#">Figure 9</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	-	-	1.5	-	1.5	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	ns
t <sub>rec</sub>	recovery time	MR to CP; see <a href="#">Figure 8</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.5	-	-	2.5	-	2.5	-	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	2.5	-	-	2.5	-	2.5	-	ns
f <sub>max</sub>	maximum frequency	see <a href="#">Figure 7</a>								
		V <sub>CC</sub> = 3.0 V to 3.6 V	50	75	-	45	-	35	-	MHz
		V <sub>CC</sub> = 4.5 V to 5.5 V	85	115	-	75	-	65	-	MHz
C <sub>PD</sub>	power dissipation capacitance	f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub>	-	48	-	-	-	-	-	pF

- [1] All typical values are measured at nominal V<sub>CC</sub>.
- [2] 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;  
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

**Table 9. Dynamic characteristics 74AHCT164**  
 Voltages are referenced to GND (ground = 0 V); for the test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C				Unit
			Min	Typ <sup>[1]</sup>	Max	Min (85 °C)	Max (85 °C)	Min (125 °C)	Max (125 °C)	
<b>C<sub>L</sub> = 15 pF; V<sub>CC</sub> = 4.5 V to 5.5 V</b>										
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	CP to Qn; see <a href="#">Figure 7</a>	-	3.4	9.0	1.0	10.5	1.0	11.5	ns
		MR to Qn; see <a href="#">Figure 8</a>	-	3.5	8.6	1.0	10.0	1.0	11.0	ns
t <sub>PLH</sub>	LOW-to-HIGH propagation delay	CP to Qn; see <a href="#">Figure 7</a>	-	3.4	9.0	1.0	10.5	1.0	11.5	ns
f <sub>max</sub>	maximum frequency	see <a href="#">Figure 8</a>	125	175	-	105	-	85	-	MHz
<b>C<sub>L</sub> = 50 pF; V<sub>CC</sub> = 4.5 V to 5.5 V</b>										
t <sub>PHL</sub>	HIGH-to-LOW propagation delay	CP to Qn; see <a href="#">Figure 7</a>	-	4.9	11.0	1.0	12.5	1.0	14.0	ns
		MR to Qn; see <a href="#">Figure 8</a>	-	5.0	10.6	1.0	12.0	1.0	13.5	ns

**Table 9. Dynamic characteristics 74AHCT164 ...continued**  
 Voltages are referenced to GND (ground = 0 V); for the test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +125 °C				Unit
			Min	Typ <sup>[1]</sup>	Max	Min (85 °C)	Max (85 °C)	Min (125 °C)	Max (125 °C)	
t <sub>PLH</sub>	LOW-to-HIGH propagation delay	CP to Qn; see <a href="#">Figure 7</a>	-	4.9	11.0	1.0	12.5	1.0	14.0	ns
t <sub>W</sub>	pulse width	CP HIGH or LOW; see <a href="#">Figure 7</a>	5.0	-	-	5.0	-	5.0	-	ns
t <sub>WL</sub>	pulse width LOW	$\overline{MR}$ ; see <a href="#">Figure 8</a>	5.0	-	-	5.0	-	5.0	-	ns
t <sub>su</sub>	set-up time	DSA, DSB to CP; see <a href="#">Figure 9</a>	4.5	-	-	4.5	-	4.5	-	ns
t <sub>h</sub>	hold time	DSA, DSB to CP; see <a href="#">Figure 9</a>	2.0	-	-	2.0	-	2.0	-	ns
t <sub>rec</sub>	recovery time	$\overline{MR}$ to CP; see <a href="#">Figure 8</a>	2.5	-	-	2.5	-	2.5	-	ns
f <sub>max</sub>	maximum frequency	see <a href="#">Figure 7</a>	85	115	-	75	-	65	-	MHz
C <sub>PD</sub>	power dissipation capacitance	f <sub>i</sub> = 1 MHz; V <sub>i</sub> = GND to V <sub>CC</sub> <a href="#">[2]</a>	-	51	-	-	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 5.0 V.

[2] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

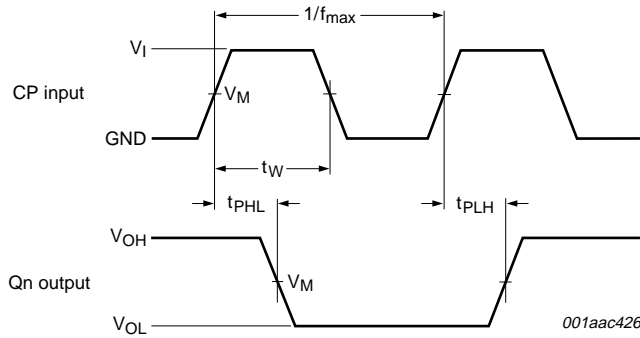
C<sub>L</sub> = output load capacitance in pF;

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 the outputs.

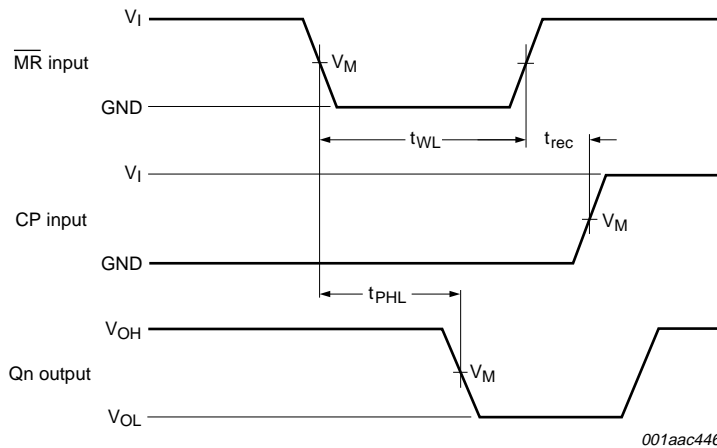
11. Waveforms



Measurement points are given in [Table 10](#).

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

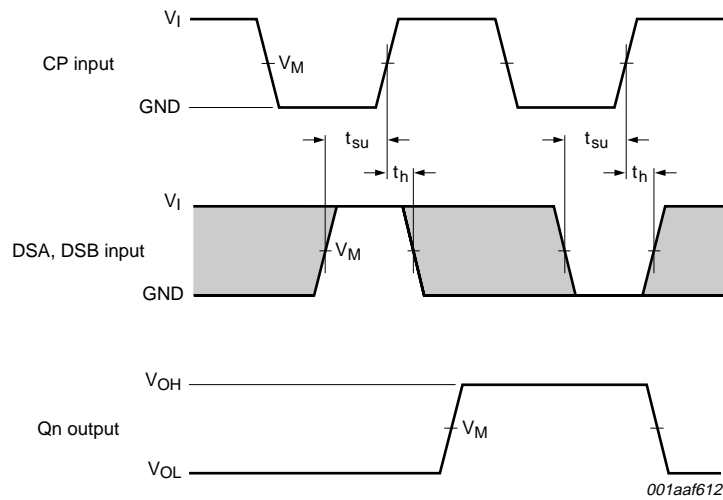
**Fig 7. The clock (CP) to output (Qn) propagation delays, the clock (CP) pulse width and the maximum clock (CP) frequency**



Measurement points are given in [Table 10](#).

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

**Fig 8. The master reset ( $\overline{MR}$ ) pulse width, the master reset ( $\overline{MR}$ ) to output (Qn) propagation delays and the master reset ( $\overline{MR}$ ) to clock (CP) recovery time**



Measurement points are given in [Table 10](#).

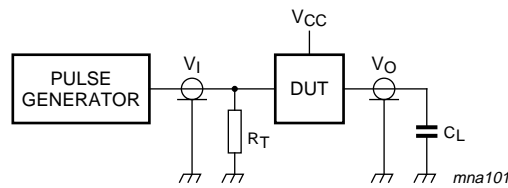
The shaded areas indicate when the input is permitted to change for predictable output performance.

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

**Fig 9. The data set-up and hold times for the (DSA and DSB) inputs**

**Table 10. Measurement points**

Type	Input		Output
	$V_M$	$V_M$	$V_M$
74AHC164	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT164	1.5 V	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$



Test data is given in [Table 11](#).

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 10. Load circuitry for measuring switching times**

**Table 11. Test data**

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74AHC164	$V_{CC}$	$\leq 3.0$ ns	50 pF, 15 pF	$t_{PLH}, t_{PHL}$
74AHCT164	3.0 V	$\leq 3.0$ ns	50 pF, 15 pF	$t_{PLH}, t_{PHL}$

12. Package outline

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

SOT108-1

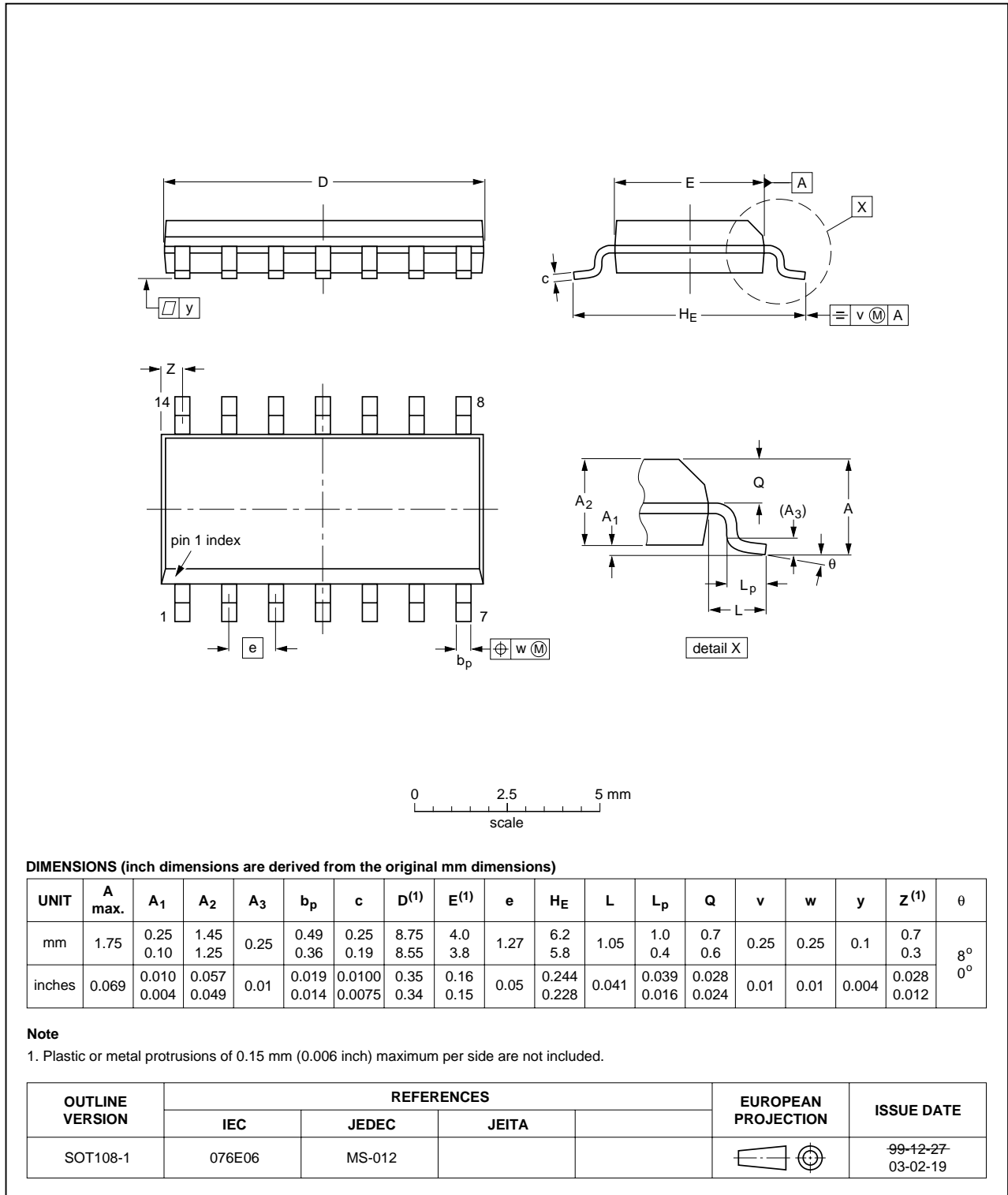


Fig 11. Package outline SOT108-1 (SO14)

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

SOT402-1

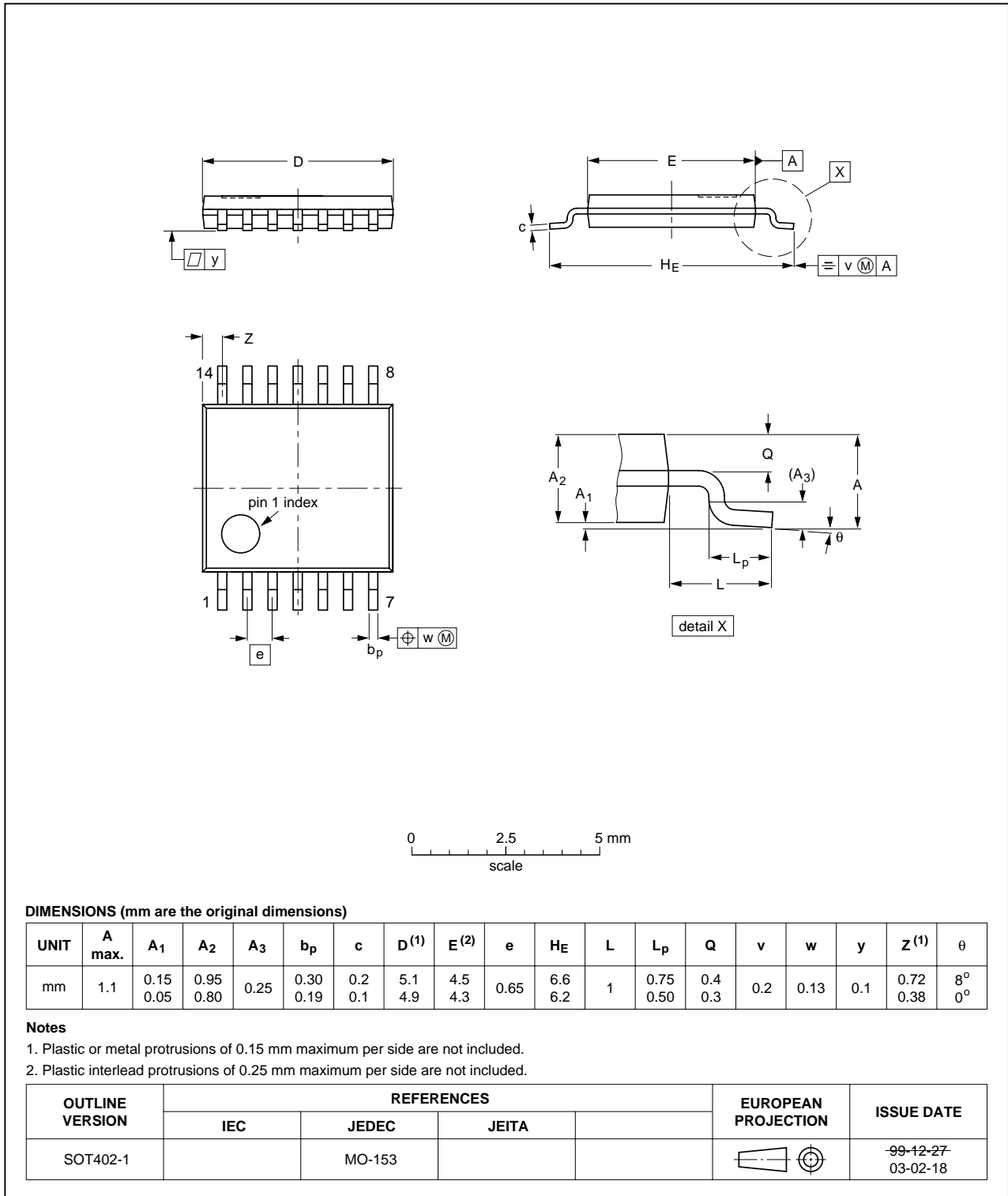
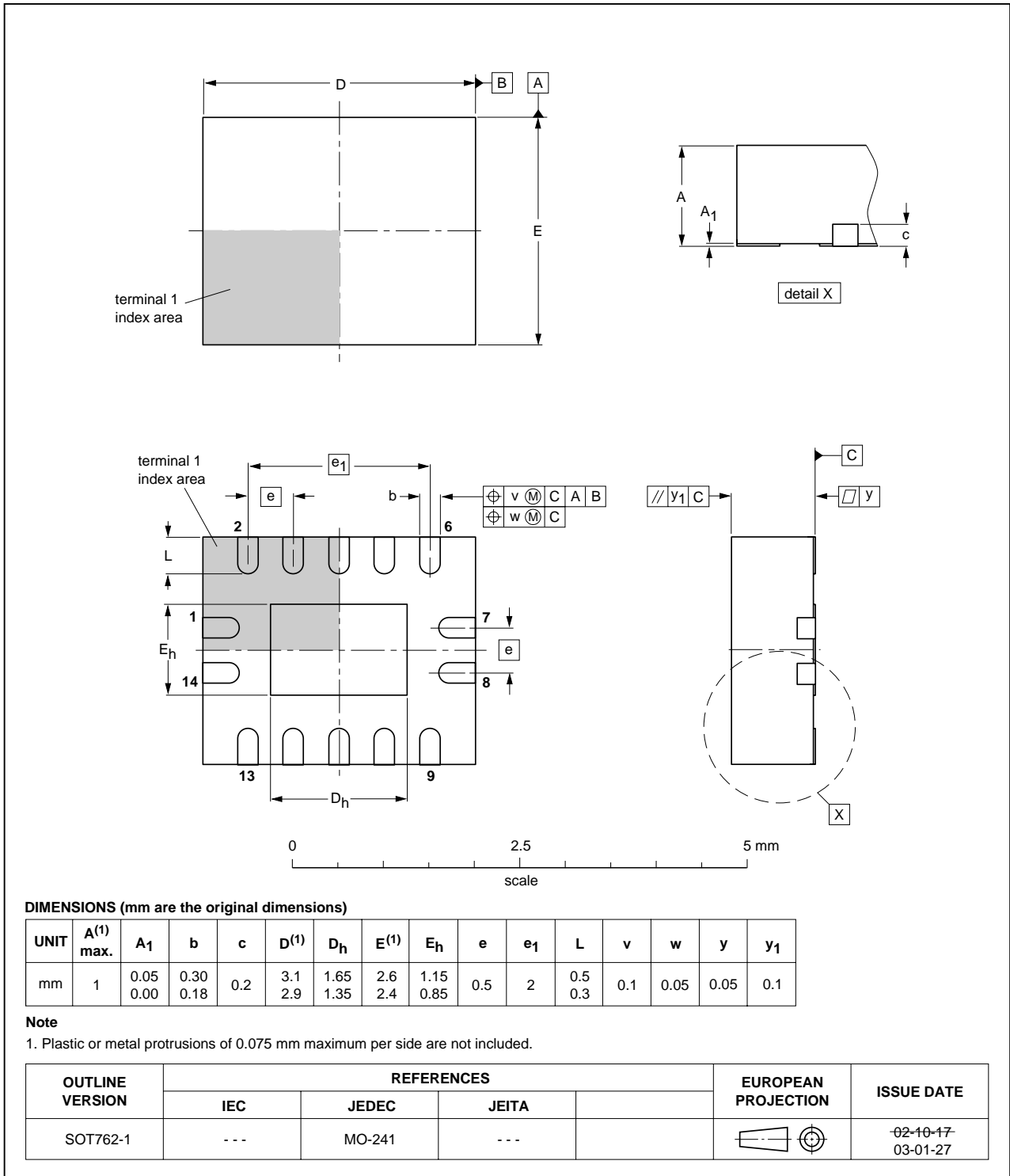


Fig 12. Package outline SOT402-1 (TSSOP14)



**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 13. Package outline SOT762-1 (DHVQFN14)**

## 13. Revision history

**Table 12. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT164_2	20061129	Product data sheet	-	74AHC_AHCT164_1
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><li>• The dynamic characteristics table has been reformatted.</li><li>• Type numbers 74AHC164BQ and 74AHCT164BQ (package DHVQFN14) have been added.</li></ul>		
74AHC_AHCT164_1 (9397 750 07332)	20000815	Product specification	-	-

## 14. Legal information

### 14.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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>.

### 14.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

### 14.3 Disclaimers

**General** — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

**Right to make changes** — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or

malfunction of a NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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

**Terms and conditions of sale** — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

### 14.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## 15. Contact information

For additional information, please visit: <http://www.nxp.com>

For sales office addresses, send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

## 16. Contents

<b>1</b>	<b>General description</b> .....	<b>1</b>
<b>2</b>	<b>Features</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>2</b>
<b>4</b>	<b>Functional diagram</b> .....	<b>2</b>
<b>5</b>	<b>Pinning information</b> .....	<b>4</b>
5.1	Pinning .....	4
5.2	Pin description .....	4
<b>6</b>	<b>Functional description</b> .....	<b>5</b>
<b>7</b>	<b>Limiting values</b> .....	<b>5</b>
<b>8</b>	<b>Recommended operating conditions</b> .....	<b>6</b>
<b>9</b>	<b>Static characteristics</b> .....	<b>6</b>
<b>10</b>	<b>Dynamic characteristics</b> .....	<b>10</b>
<b>11</b>	<b>Waveforms</b> .....	<b>13</b>
<b>12</b>	<b>Package outline</b> .....	<b>15</b>
<b>13</b>	<b>Revision history</b> .....	<b>18</b>
<b>14</b>	<b>Legal information</b> .....	<b>19</b>
14.1	Data sheet status .....	19
14.2	Definitions .....	19
14.3	Disclaimers .....	19
14.4	Trademarks .....	19
<b>15</b>	<b>Contact information</b> .....	<b>19</b>
<b>16</b>	<b>Contents</b> .....	<b>20</b>

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.



© NXP B.V. 2006.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

Date of release: 29 November 2006

Document identifier: 74AHC\_AHCT164\_2