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74HC164; 74HCT164

8-bit serial-in, parallel-out shift register

Rev. 5 — 25 November 2010

Product data sheet

1. General description

The 74HC164; 74HCT164 are high-speed Si-gate CMOS devices and are pin compatible with Low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC164; 74HCT164 are 8-bit edge-triggered shift registers with serial data entry and an output from each of the eight stages. Data is entered serially 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 (CP) input and enters into Q0, which is the 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 and benefits

- Input levels:
 - ◆ For 74HC164: CMOS level
 - ◆ For 74HCT164: TTL level
- Gated serial data inputs
- Asynchronous master reset
- Complies with JEDEC standard no. 7A
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V.
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$.



3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC164N 74HCT164N	-40 °C to +125 °C	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HC164D 74HCT164D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC164DB 74HCT164DB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1
74HC164PW 74HCT164PW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74HC164BQ 74HCT164BQ	-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

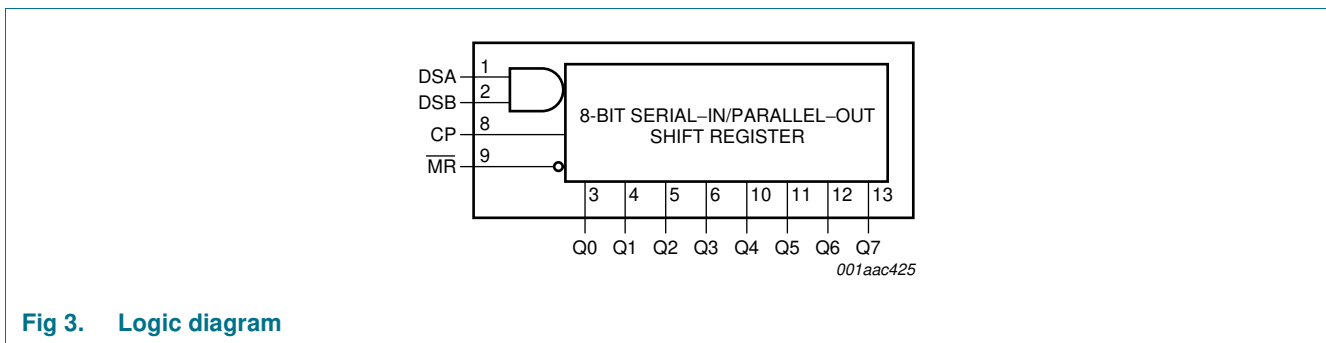
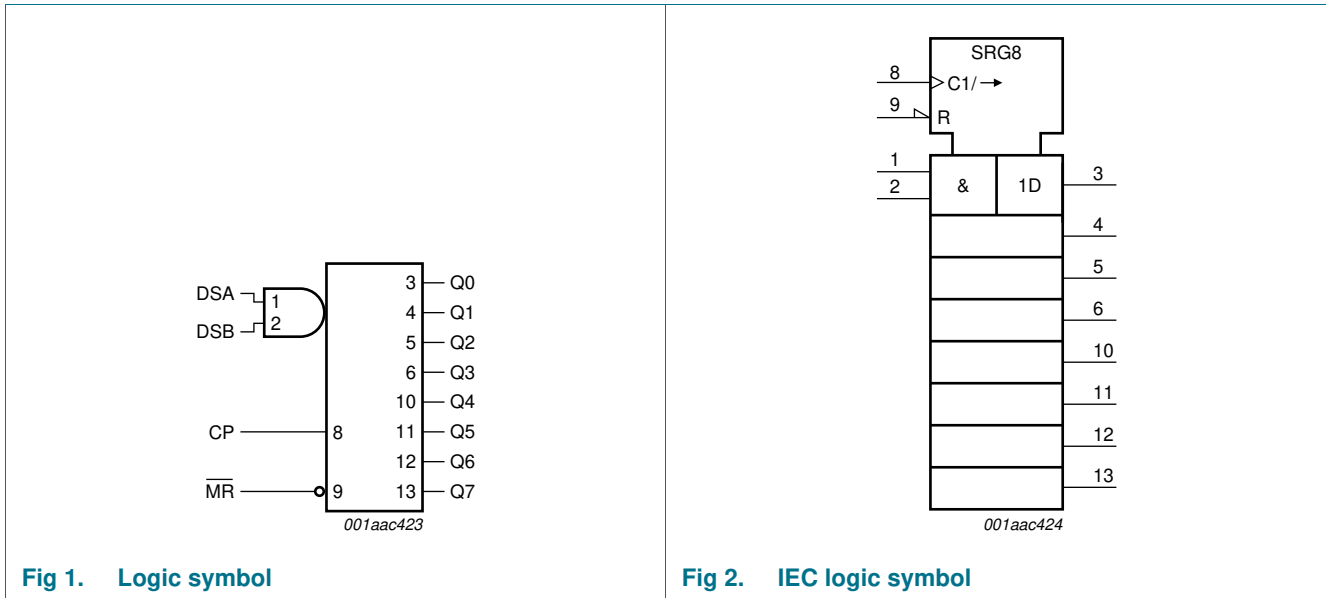


Fig 3. Logic diagram

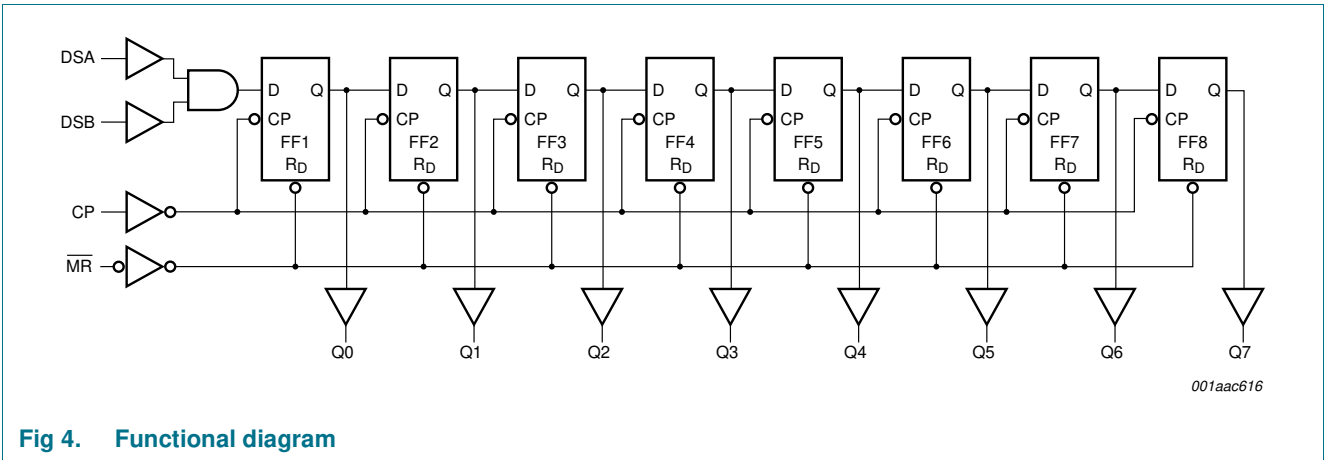


Fig 4. Functional diagram

5. Pinning information

5.1 Pinning

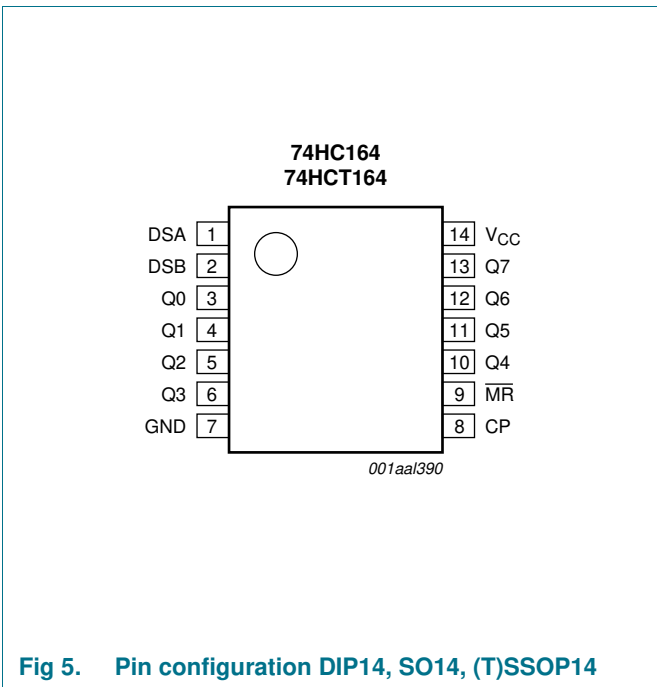


Fig 5. Pin configuration DIP14, SO14, (T)SSOP14

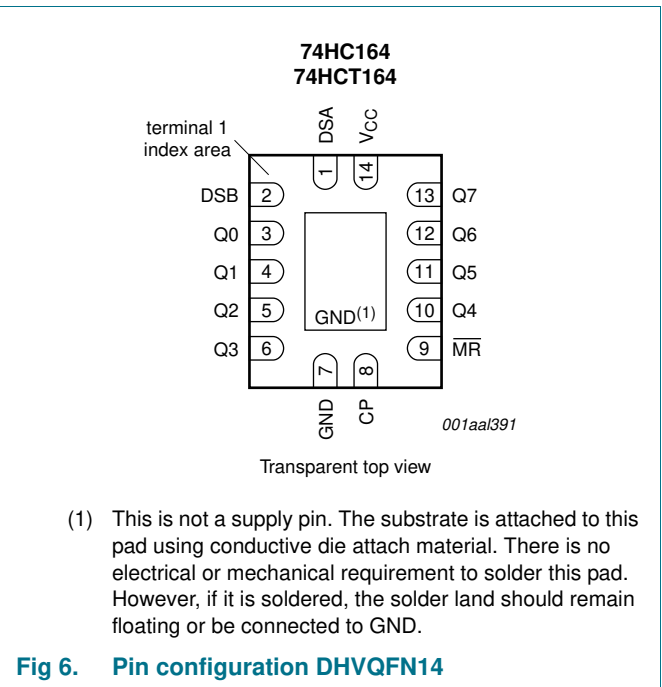


Fig 6. Pin configuration DHVQFN14

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
DSA	1	data input
DSB	2	data input
Q0 to Q7	3, 4, 5, 6, 10, 11, 12, 13	output
GND	7	ground (0 V)
CP	8	clock input (LOW-to-HIGH, edge-triggered)
$\overline{\text{MR}}$	9	master reset input (active LOW)
V_{CC}	14	positive supply voltage

6. Functional description

Table 3. Function table^[1]

Operating modes	Input				Output	
	$\overline{\text{MR}}$	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
 q = lower case letters indicate the state of the referenced input one set-up time prior to the LOW-to-HIGH clock transition
 ↑ = LOW-to-HIGH clock 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	V
I_{IK}	input clamping current	$V_{\text{I}} < -0.5 \text{ V}$ or $V_{\text{I}} > V_{\text{CC}} + 0.5 \text{ V}$	[1]	±20	mA
I_{OK}	output clamping current	$V_{\text{O}} < -0.5 \text{ V}$ or $V_{\text{O}} > V_{\text{CC}} + 0.5 \text{ V}$	[1]	±20	mA
I_{O}	output current	$-0.5 \text{ V} < V_{\text{O}} < V_{\text{CC}} + 0.5 \text{ V}$	-	±25	mA
I_{CC}	supply current		-	50	mA
I_{GND}	ground current		-50	-	mA
T_{stg}	storage temperature		-65	+150	°C

Table 4. Limiting values ...continued

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
P _{tot}	total power dissipation		[2]		
	DIP14 package		-	750	mW
	SO14, (T)SSOP14 and DHVQFN14 packages		-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

- [2] For DIP14 package: P_{tot} derates linearly with 12 mW/K above 70 °C.
 For SO14 package: P_{tot} derates linearly with 8 mW/K above 70 °C.
 For (T)SSOP14 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.
 For DHVQFN14 packages: P_{tot} derates linearly with 4.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC164			74HCT164			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
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V _{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V _{CC} = 6.0 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	
74HC164										
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

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	
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
		I _O = -5.2 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	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 _O = 5.2 mA; V _{CC} = 6.0 V	-	0.16	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	-	±1	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
74HCT164										
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
		I _O = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 5.2 mA; V _{CC} = 6.0 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	-	±1	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8	-	80	-	160	μA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V	-	100	360	-	450	-	490	μA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$; test circuit see [Figure 10](#); unless otherwise specified

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC164										
t_{pd}	propagation delay	CP to Qn; see Figure 7 ^[1]								
		$V_{CC} = 2.0\text{ V}$	-	41	170	-	215	-	255	ns
		$V_{CC} = 4.5\text{ V}$	-	15	34	-	43	-	51	ns
		$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	12	-	-	-	-	-	ns
		$V_{CC} = 6.0\text{ V}$	-	12	29	-	37	-	43	ns
t_{PHL}	HIGH to LOW propagation delay	MR to Qn; see Figure 8								
		$V_{CC} = 2.0\text{ V}$	-	39	140	-	175	-	210	ns
		$V_{CC} = 4.5\text{ V}$	-	14	28	-	35	-	42	ns
		$V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$	-	11	-	-	-	-	-	ns
		$V_{CC} = 6.0\text{ V}$	-	11	24	-	30	-	36	ns
t_t	transition time	see Figure 7 ^[2]								
		$V_{CC} = 2.0\text{ V}$	-	19	75	-	95	-	110	ns
		$V_{CC} = 4.5\text{ V}$	-	7	15	-	19	-	22	ns
		$V_{CC} = 6.0\text{ V}$	-	6	13	-	16	-	19	ns
t_w	pulse width	CP HIGH or LOW; see Figure 7								
		$V_{CC} = 2.0\text{ V}$	80	14	-	100	-	120	-	ns
		$V_{CC} = 4.5\text{ V}$	16	5	-	20	-	24	-	ns
		$V_{CC} = 6.0\text{ V}$	14	4	-	17	-	20	-	ns
		MR LOW; see Figure 8								
		$V_{CC} = 2.0\text{ V}$	60	17	-	75	-	90	-	ns
		$V_{CC} = 4.5\text{ V}$	12	6	-	15	-	18	-	ns
		$V_{CC} = 6.0\text{ V}$	10	5	-	13	-	15	-	ns
t_{rec}	recovery time	MR to CP; see Figure 8								
		$V_{CC} = 2.0\text{ V}$	60	17	-	75	-	90	-	ns
		$V_{CC} = 4.5\text{ V}$	12	6	-	15	-	18	-	ns
		$V_{CC} = 6.0\text{ V}$	10	5	-	13	-	15	-	ns
t_{su}	set-up time	DSA, and DSB to CP; see Figure 9								
		$V_{CC} = 2.0\text{ V}$	60	8	-	75	-	90	-	ns
		$V_{CC} = 4.5\text{ V}$	12	3	-	15	-	18	-	ns
		$V_{CC} = 6.0\text{ V}$	10	2	-	13	-	15	-	ns
t_h	hold time	DSA, and DSB to CP; see Figure 9								
		$V_{CC} = 2.0\text{ V}$	+4	-6	-	4	-	4	-	ns
		$V_{CC} = 4.5\text{ V}$	+4	-2	-	4	-	4	-	ns
		$V_{CC} = 6.0\text{ V}$	+4	-2	-	4	-	4	-	ns

Table 7. Dynamic characteristics ...continued
GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF; test circuit see [Figure 10](#); unless otherwise specified

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
f _{max}	maximum frequency	for Cp, see Figure 7								
		V _{CC} = 2.0 V	6	23	-	5	-	4	-	MHz
		V _{CC} = 4.5 V	30	71	-	24	-	20	-	MHz
		V _{CC} = 5.0 V; C _L = 15 pF	-	78	-	-	-	-	-	MHz
		V _{CC} = 6.0 V	35	85	-	28	-	24	-	MHz
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC} [3]	-	40	-	-	-	-	-	pF
74HCT164										
t _{pd}	propagation delay	CP to Qn; see Figure 7 [1]								
		V _{CC} = 4.5 V	-	17	36	-	45	-	54	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	14	-	-	-	-	-	ns
t _{PHL}	HIGH to LOW propagation delay	MR to Qn; see Figure 8								
		V _{CC} = 4.5 V	-	19	38	-	48	-	57	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	-	-	ns
t _t	transition time	see Figure 7 [2]								
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
t _w	pulse width	CP HIGH or LOW; see Figure 7								
		V _{CC} = 4.5 V	18	7	-	23	-	27	-	ns
		MR LOW; see Figure 8								
		V _{CC} = 4.5 V	18	10	-	23	-	27	-	ns
t _{rec}	recovery time	MR to CP; see Figure 8								
		V _{CC} = 4.5 V	16	7	-	20	-	24	-	ns
t _{su}	set-up time	DSA, and DSB to CP; see Figure 9								
		V _{CC} = 4.5 V	12	6	-	15	-	18	-	ns
t _h	hold time	DSA, and DSB to CP; see Figure 9								
		V _{CC} = 4.5 V	+4	-2	-	4	-	4	-	ns
f _{max}	maximum frequency	for Cp, see Figure 7								
		V _{CC} = 4.5 V	27	55	-	22	-	18	-	MHz
		V _{CC} = 5.0 V; C _L = 15 pF	-	61	-	-	-	-	-	MHz

Table 7. Dynamic characteristics ...continued
GND = 0 V; $t_r = t_f = 6 \text{ ns}$; $C_L = 50 \text{ pF}$; test circuit see [Figure 10](#); unless otherwise specified

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
C_{PD}	power dissipation capacitance	per package; $V_I = \text{GND to } V_{CC} - 1.5 \text{ V}$	-	40	-	-	-	-	-	pF

- [1] t_{pd} is the same as t_{PHL} and t_{PLH} .
- [2] t_i is the same as t_{THL} and t_{TLH} .
- [3] 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.

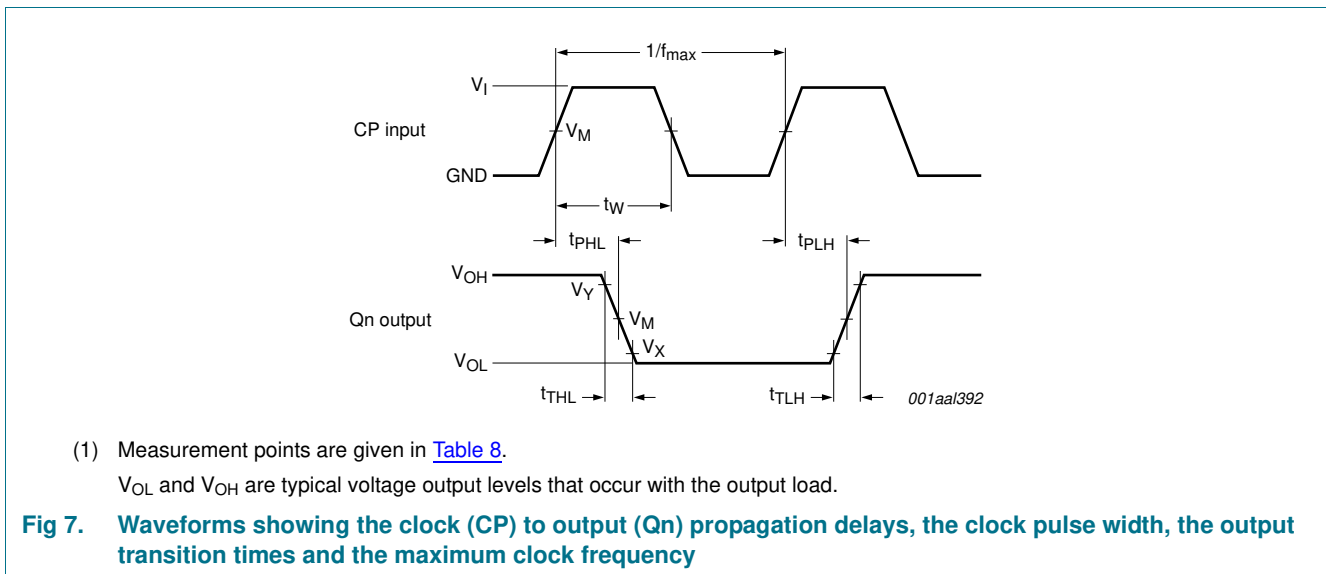
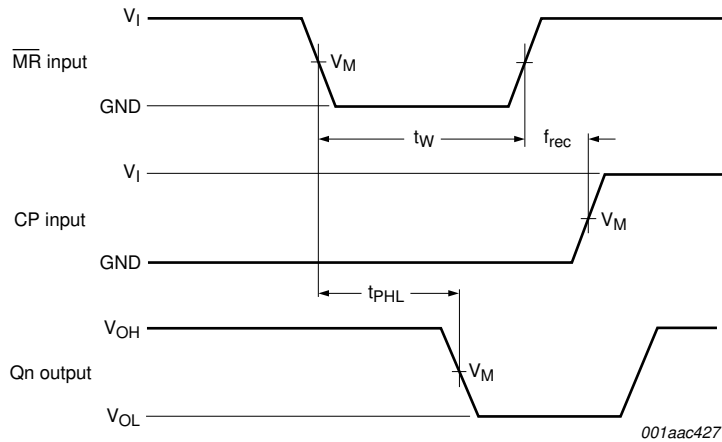


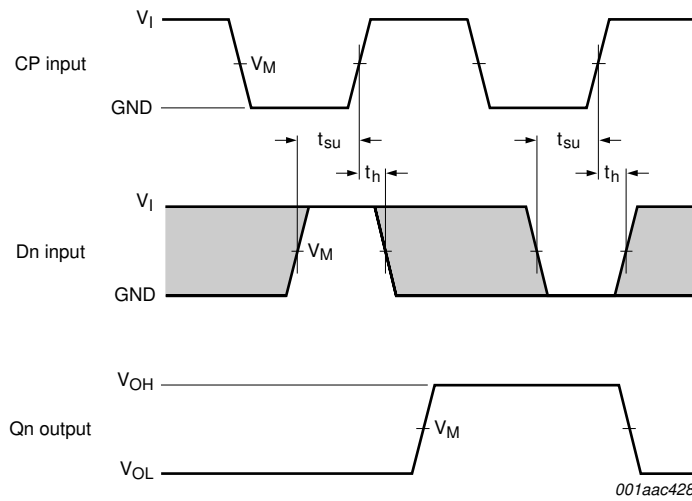
Table 8. Measurement points

Type	Input		Output		
	V_M	V_M	V_X	V_Y	V_Y
74HC164	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$	$0.9V_{CC}$
74HCT164	1.3 V	1.3 V	$0.1V_{CC}$	$0.9V_{CC}$	$0.9V_{CC}$



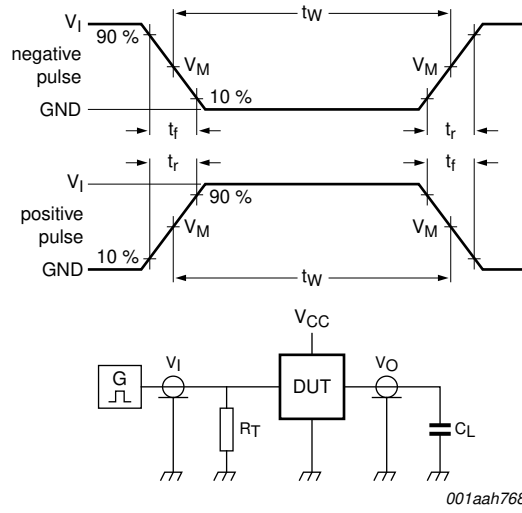
- (1) Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 8. Waveforms showing the master reset (\overline{MR}) pulse width, the master reset to output (Q_n) propagation delays and the master reset to clock (CP) removal time



- (1) Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.
 The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 9. Waveforms showing the data set-up and hold times for D_n inputs



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 10. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74HC164	V_{CC}	6.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74HCT164	3.0 V	6.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

11. Package outline

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

SOT27-1

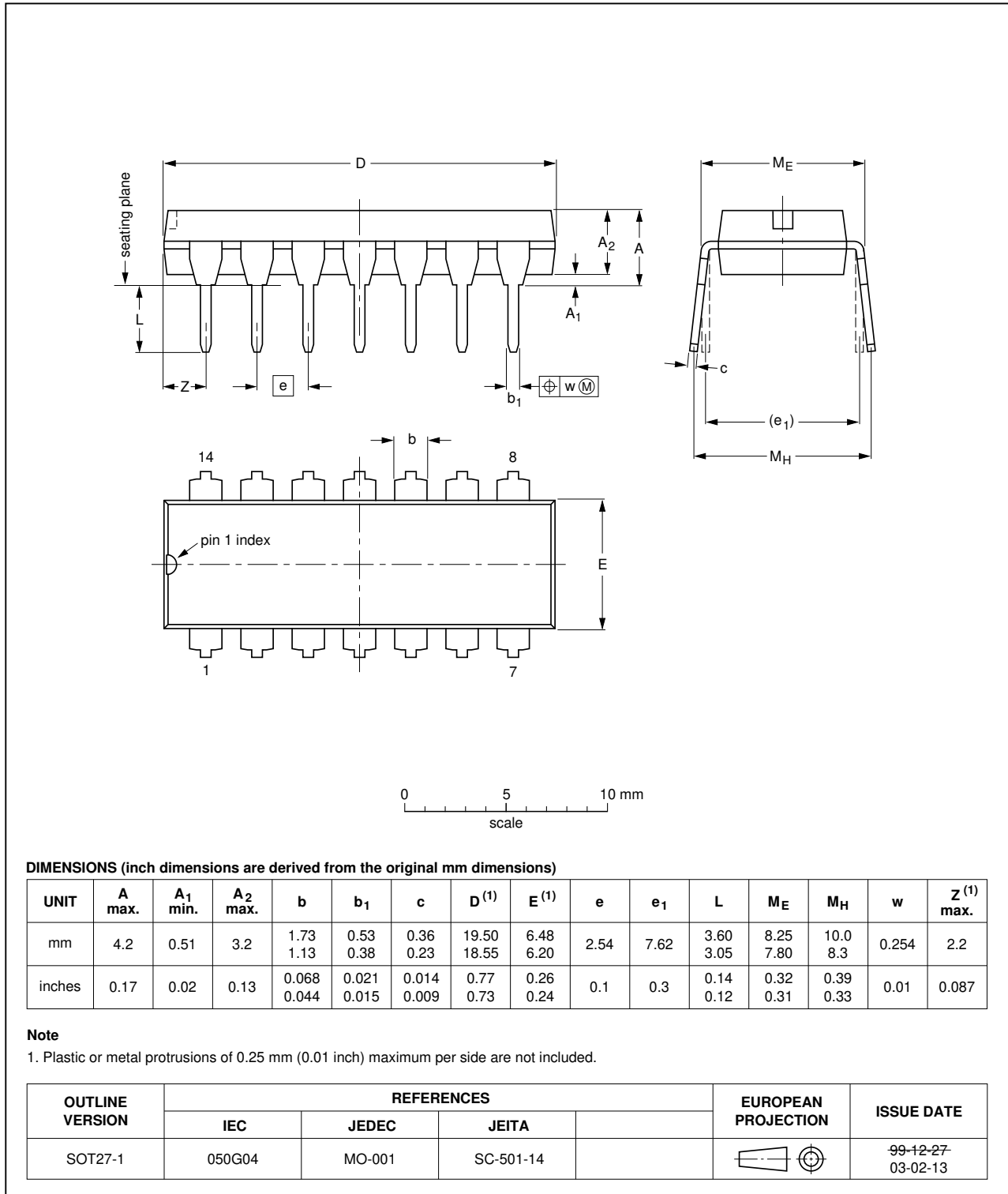


Fig 11. Package outline SOT27-1 (DIP14)

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

SOT108-1

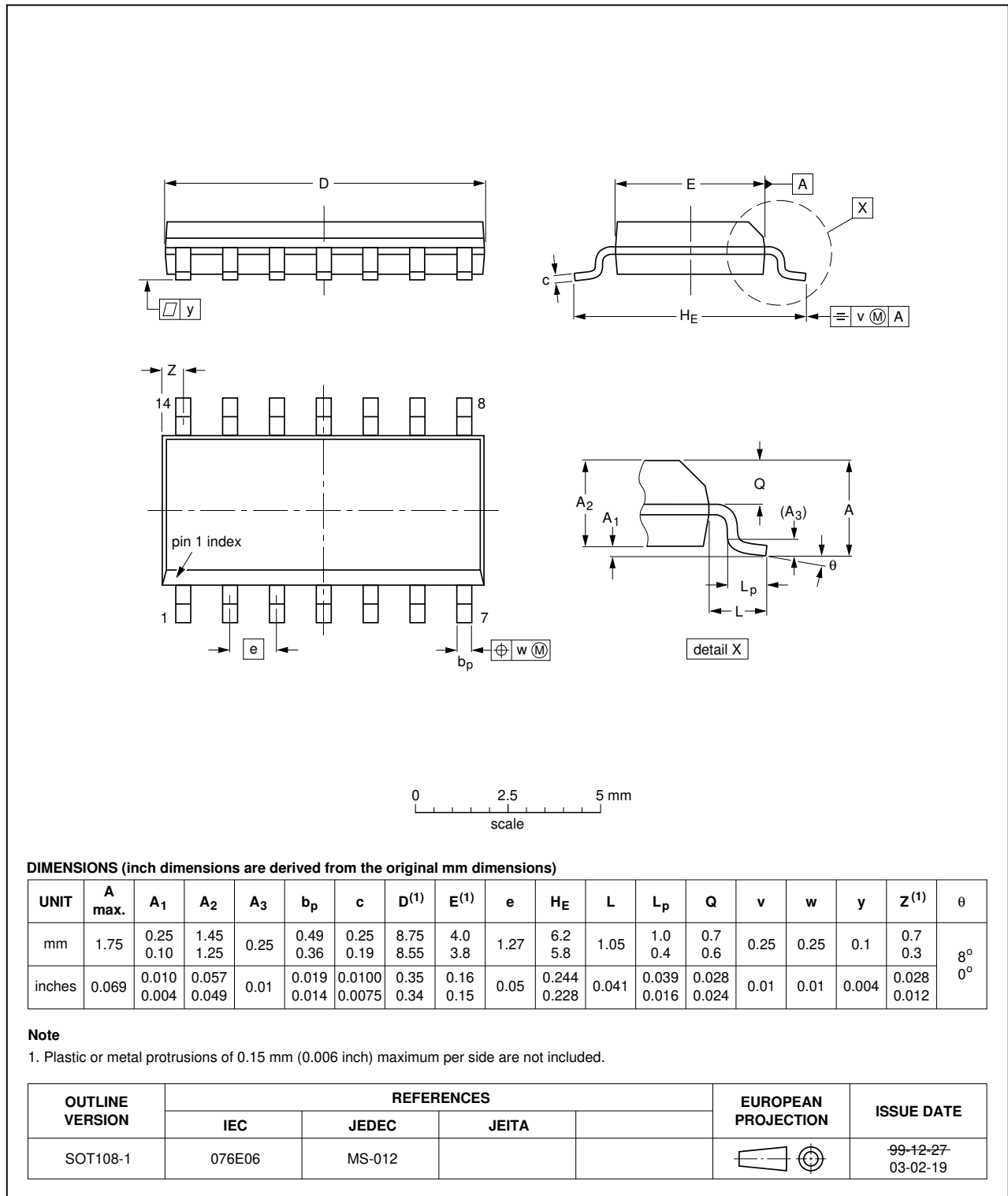


Fig 12. Package outline SOT108-1 (SO14)

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

SOT337-1

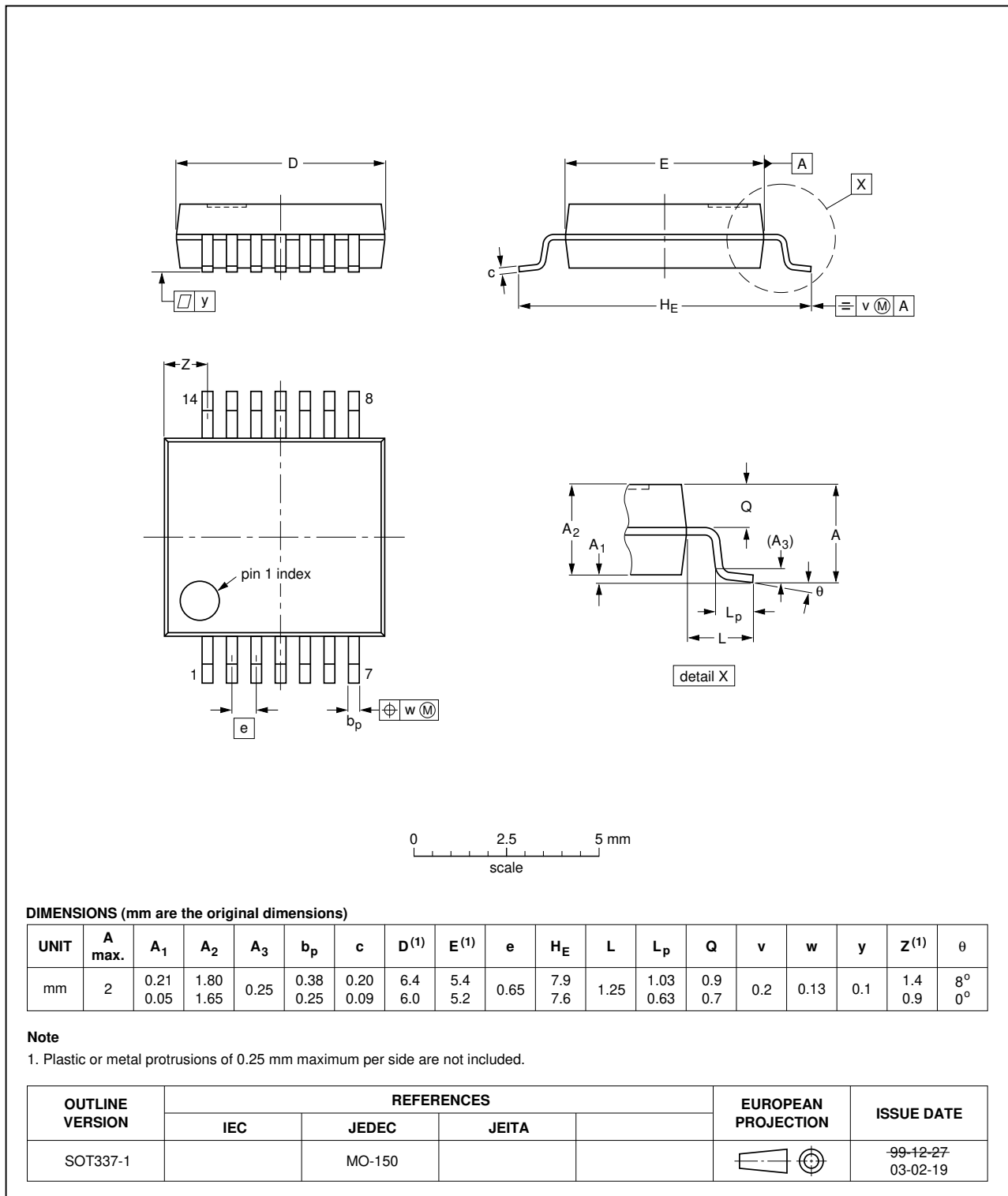


Fig 13. Package outline SOT337-1 (SSOP14)

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

SOT402-1

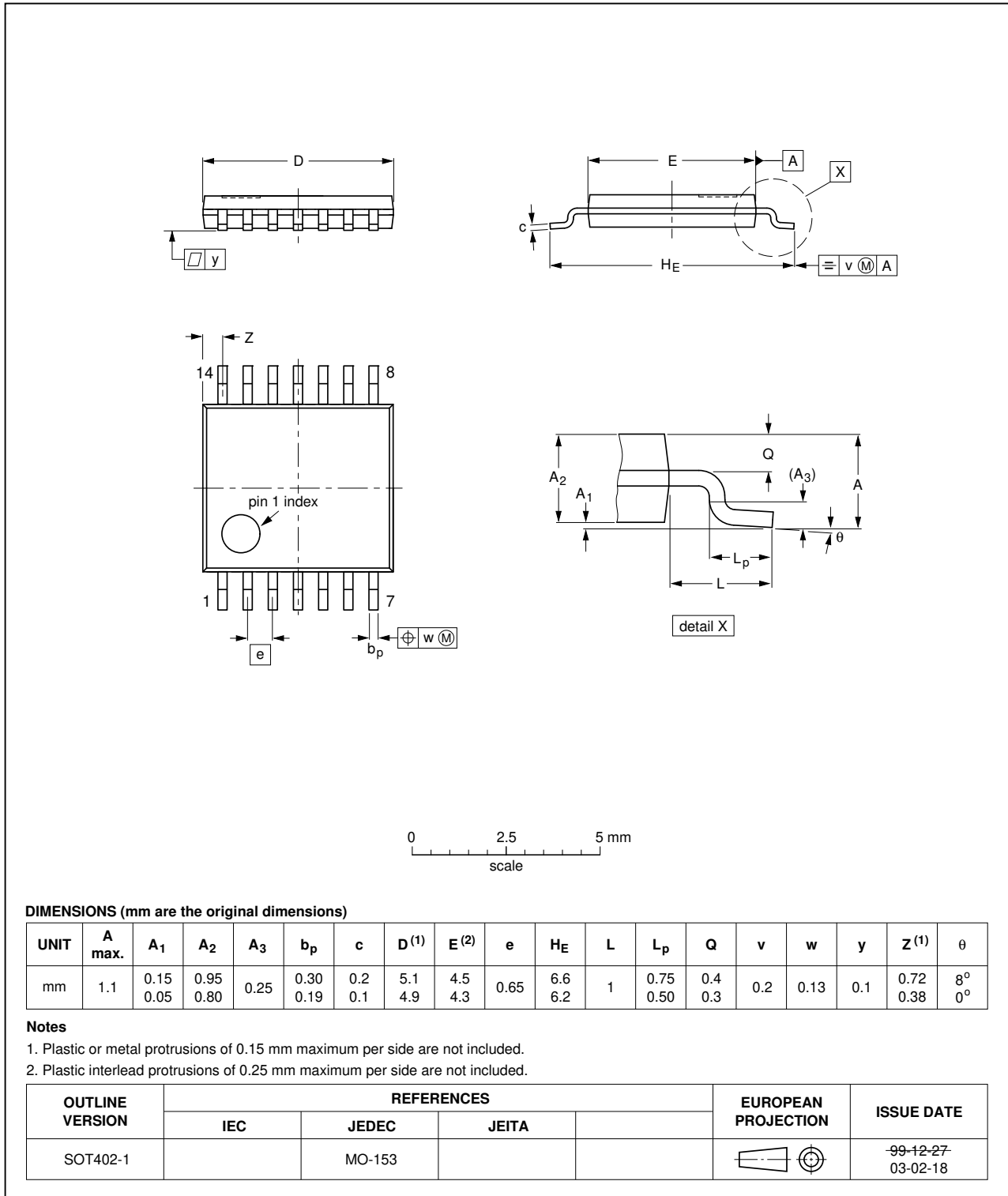


Fig 14. Package outline SOT402-1 (TSSOP14)

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

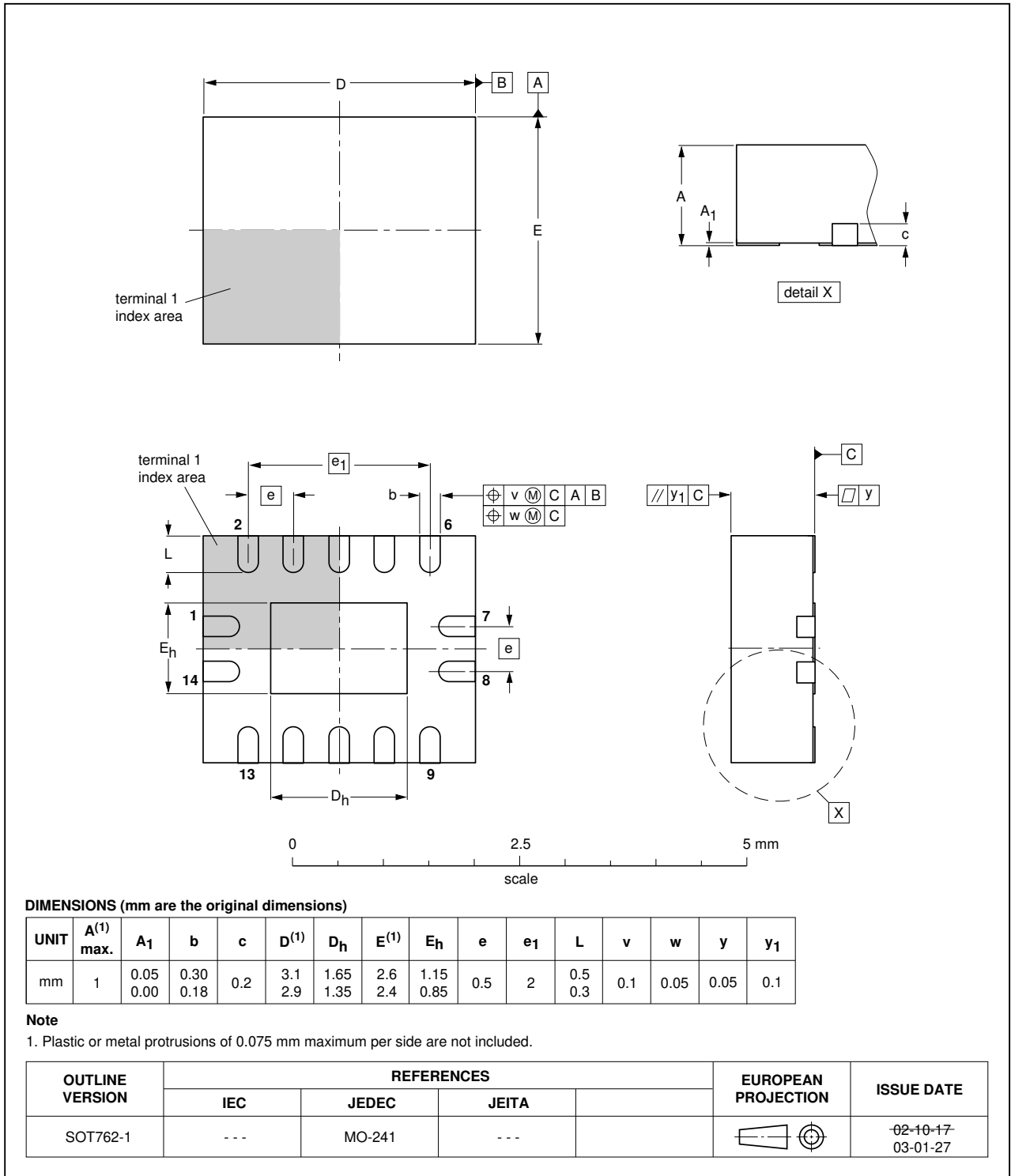


Fig 15. Package outline SOT762-1 (DHVQFN14)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model
TTL	Transistor-Transistor Logic

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT164 v.5	20101125	Product data sheet	-	74HC_HCT164 v.4
Modifications:	• Figure note [1] of Figure 6 : changed.			
74HC_HCT164 v.4	20100202	Product data sheet	-	74HC_HCT164 v.3
74HC_HCT164 v.3	20050404	Product data sheet	-	74HC_HCT164_CNV v.2
74HC_HCT164_CNV v.2	19901201	Product specification	-	-

14. Legal information

14.1 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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16. Contents

1	General description	1
2	Features and benefits	1
3	Ordering information	2
4	Functional diagram	2
5	Pinning information	3
5.1	Pinning	3
5.2	Pin description	4
6	Functional description	4
7	Limiting values	4
8	Recommended operating conditions	5
9	Static characteristics	5
10	Dynamic characteristics	7
11	Package outline	12
12	Abbreviations	17
13	Revision history	17
14	Legal information	18
14.1	Data sheet status	18
14.2	Definitions	18
14.3	Disclaimers	18
14.4	Trademarks	19
15	Contact information	19
16	Contents	20

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Date of release: 25 November 2010

Document identifier: 74HC_HCT164