

# 74HC165; 74HCT165

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

Rev. 03 — 14 March 2008

Product data sheet

### 1. General description

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The 74HC165; 74HCT165 are high-speed Si-gate CMOS devices that comply with JEDEC standard no. 7A. They are pin compatible with Low-power Schottky TTL (LSTTL).

The 74HC165; 74HCT165 are 8-bit parallel-load or serial-in shift registers with complementary serial outputs ( $Q_7$  and  $\overline{Q_7}$ ) available from the last stage. When the parallel load ( $\overline{PL}$ ) input is LOW, parallel data from the D0 to D7 inputs are loaded into the register asynchronously.

When  $\overline{PL}$  is HIGH, data enters the register serially at the DS input and shifts one place to the right ( $Q_0 \rightarrow Q_1 \rightarrow Q_2$ , etc.) with each positive-going clock transition. This feature allows parallel-to-serial converter expansion by tying the  $Q_7$  output to the DS input of the succeeding stage.

The clock input is a gated-OR structure which allows one input to be used as an active LOW clock enable ( $\overline{CE}$ ) input. The pin assignment for the CP and  $\overline{CE}$  inputs is arbitrary and can be reversed for layout convenience. The LOW-to-HIGH transition of input  $\overline{CE}$  should only take place while CP HIGH for predictable operation. Either the CP or the  $\overline{CE}$  should be HIGH before the LOW-to-HIGH transition of  $\overline{PL}$  to prevent shifting the data when  $\overline{PL}$  is activated.

### 2. Features

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- Asynchronous 8-bit parallel load
- Synchronous serial input
- Complies with JEDEC standard no. 7A
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 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

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- Parallel-to-serial data conversion

## 4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC165N 74HCT165N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HC165D 74HCT165D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC165DB 74HCT165DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HC165PW 74HCT165PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HC165BQ 74HCT165BQ	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1

## 5. Functional diagram

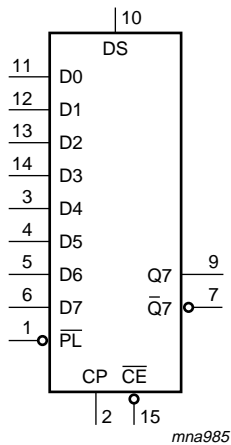


Fig 1. Logic symbol

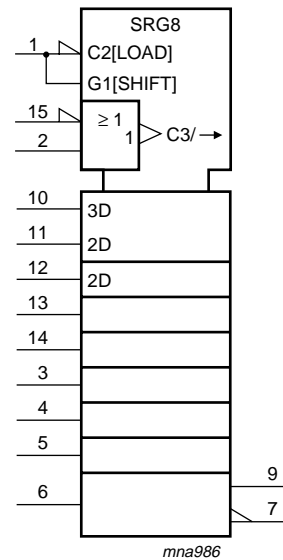


Fig 2. IEC logic symbol

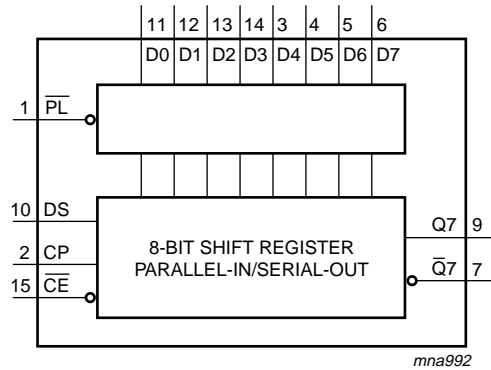


Fig 3. Functional diagram

## 6. Pinning information

### 6.1 Pinning

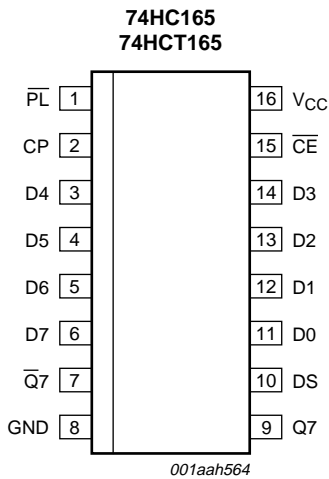
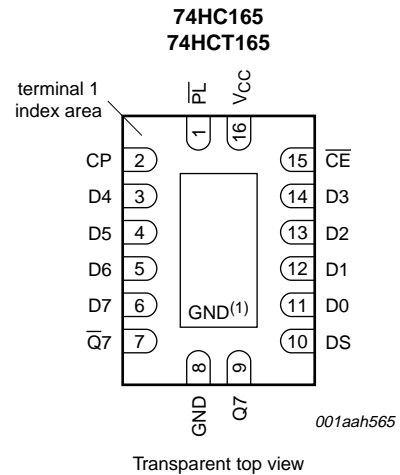


Fig 4. Pin configuration (DIP16, SO16 and (T)SSOP16)



- (1) The die substrate is attached to this pad using conductive die attach material. It can not be used as supply pin or input.

Fig 5. Pin configuration (DHVQFN16)

## 6.2 Pin description

Table 2. Pin description

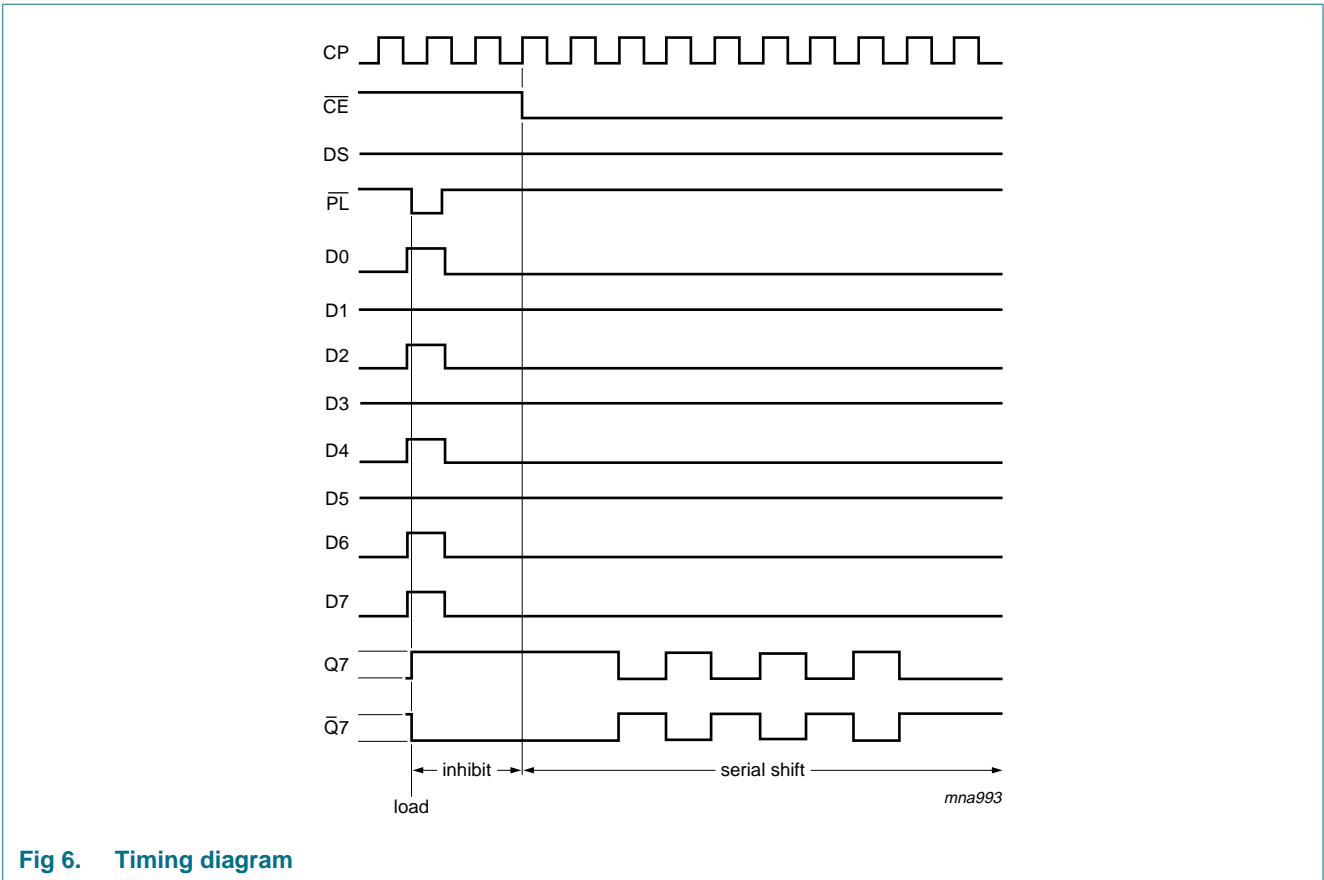
Symbol	Pin	Description
$\overline{PL}$	1	asynchronous parallel load input (active LOW)
CP	2	clock input (LOW-to-HIGH edge-triggered)
$\overline{Q7}$	7	complementary output from the last stage
GND	8	ground (0 V)
Q7	9	serial output from the last stage
DS	10	serial data input
D0 to D7	11, 12, 13, 14, 3, 4, 5, 6	parallel data inputs (also referred to as D <sub>n</sub> )
$\overline{CE}$	15	clock enable input (active LOW)
V <sub>CC</sub>	16	positive supply voltage

## 7. Functional description

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

Operating modes	Inputs					Qn registers		Outputs	
	$\overline{PL}$	$\overline{CE}$	CP	DS	D0 to D7	Q0	Q1 to Q6	Q7	$\overline{Q7}$
parallel load	L	X	X	X	L	L	L to L	L	H
	L	X	X	X	H	H	H to H	H	L
serial shift	H	L	↑	l	X	L	q0 to q5	q6	$\overline{q6}$
	H	L	↑	h	X	H	q0 to q5	q6	$\overline{q6}$
	H	↑	L	l	X	L	q0 to q5	q6	$\overline{q6}$
	H	↑	L	h	X	H	q0 to q5	q6	$\overline{q6}$
hold "do nothing"	H	H	X	X	X	q0	q1 to q6	q7	$\overline{q7}$
	H	X	H	X	X	q0	q1 to q6	q7	$\overline{q7}$

[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 = state of the referenced output one set-up time prior to the LOW-to-HIGH clock transition;  
 X = don't care;  
 ↑ = LOW-to-HIGH clock transition.



## 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 $V_I > V_{CC} + 0.5\text{ V}$	[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	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	±25	mA
$I_{CC}$	supply current		-	50	mA
$I_{GND}$	ground current		-50	-	mA
$T_{stg}$	storage temperature		-65	+150	°C

**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 <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C			
		DIP16 package	[2] -	750	mW
		SO16 package	[3] -	500	mW
		(T)SSOP16 package	[4] -	500	mW
		DHVQFN16 package	[5] -	500	mW

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

[2] P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

[3] P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

[4] P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

[5] P<sub>tot</sub> derates linearly with 4.5 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	74HC165			74HCT165			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	-	+125	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V <sub>CC</sub> = 6.0 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	
<b>74HC165</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V <sub>CC</sub> = 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 <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	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> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1	-	±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> = 6.0 V	-	-	8.0	-	80	-	160	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF
<b>74HCT165</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1	-	±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> = 6.0 V	-	-	8.0	-	80	-	160	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; V <sub>CC</sub> = 4.5 V to 5.5 V								
		Dn and DS inputs	-	35	126	-	157.5	-	171.5	μA
		CP $\overline{CE}$ , and $\overline{PL}$ inputs	-	65	234	-	292.5	-	318.5	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

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	
<b>74HC165</b>										
$t_{pd}$	propagation delay	CP or $\overline{CE}$ to Q7, $\overline{Q7}$ ; see <a href="#">Figure 7</a>	<a href="#">[1]</a>							
		$V_{CC} = 2.0$ V	-	52	165	-	205	-	250	ns
		$V_{CC} = 4.5$ V	-	19	33	-	41	-	50	ns
		$V_{CC} = 6.0$ V	-	15	28	-	35	-	43	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	16	-	-	-	-	-	ns
		$\overline{PL}$ to Q7, $\overline{Q7}$ ; see <a href="#">Figure 8</a>								
		$V_{CC} = 2.0$ V	-	50	165	-	205	-	250	ns
		$V_{CC} = 4.5$ V	-	18	33	-	41	-	50	ns
		$V_{CC} = 6.0$ V	-	14	28	-	35	-	43	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	15	-	-	-	-	-	ns
		D7 to Q7, $\overline{Q7}$ ; see <a href="#">Figure 9</a>								
		$V_{CC} = 2.0$ V	-	36	120	-	150	-	180	ns
		$V_{CC} = 4.5$ V	-	13	24	-	30	-	36	ns
		$V_{CC} = 6.0$ V	-	10	20	-	26	-	31	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	11	-	-	-	-	-	ns
		$t_t$	transition time	Q7, $\overline{Q7}$ output; see <a href="#">Figure 7</a>	<a href="#">[2]</a>					
$V_{CC} = 2.0$ 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
$t_w$	pulse width	CP input HIGH or LOW; see <a href="#">Figure 7</a>								
		$V_{CC} = 2.0$ V	80	17	-	100	-	120	-	ns
		$V_{CC} = 4.5$ V	16	6	-	20	-	24	-	ns
		$V_{CC} = 6.0$ V	14	5	-	17	-	20	-	ns
		$\overline{PL}$ input LOW; see <a href="#">Figure 8</a>								
		$V_{CC} = 2.0$ 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
		$t_{rec}$	recovery time	$\overline{PL}$ to CP, $\overline{CE}$ ; see <a href="#">Figure 8</a>						
$V_{CC} = 2.0$ V	100			22	-	125	-	150	-	ns
$V_{CC} = 4.5$ V	20			8	-	25	-	30	-	ns
$V_{CC} = 6.0$ V	17			6	-	21	-	26	-	ns

**Table 7. Dynamic characteristics ...continued**  
 GND (ground = 0 V);  $C_L = 50 \text{ pF}$  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		
$t_{su}$	set-up time	DS to CP, $\overline{CE}$ ; see <a href="#">Figure 10</a>									
		$V_{CC} = 2.0 \text{ V}$	80	11	-	100	-	120	-	ns	
		$V_{CC} = 4.5 \text{ V}$	16	4	-	20	-	24	-	ns	
			$V_{CC} = 6.0 \text{ V}$	14	3	-	17	-	20	-	ns
			$\overline{CE}$ to CP and CP to $\overline{CE}$ ; see <a href="#">Figure 10</a>								
			$V_{CC} = 2.0 \text{ V}$	80	17	-	100	-	120	-	ns
			$V_{CC} = 4.5 \text{ V}$	16	6	-	20	-	24	-	ns
			$V_{CC} = 6.0 \text{ V}$	14	5	-	17	-	20	-	ns
			Dn to $\overline{PL}$ ; see <a href="#">Figure 11</a>								
			$V_{CC} = 2.0 \text{ V}$	80	22	-	100	-	120	-	ns
			$V_{CC} = 4.5 \text{ V}$	16	8	-	20	-	24	-	ns
			$V_{CC} = 6.0 \text{ V}$	14	6	-	17	-	20	-	ns
$t_h$	hold time	DS to CP, $\overline{CE}$ and Dn to $\overline{PL}$ ; see <a href="#">Figure 10</a>									
		$V_{CC} = 2.0 \text{ V}$	5	6	-	5	-	5	-	ns	
		$V_{CC} = 4.5 \text{ V}$	5	2	-	5	-	5	-	ns	
			$V_{CC} = 6.0 \text{ V}$	5	2	-	5	-	5	-	ns
			$\overline{CE}$ to CP and CP to $\overline{CE}$ ; see <a href="#">Figure 10</a>								
			$V_{CC} = 2.0 \text{ V}$	5	-17	-	5	-	5	-	ns
			$V_{CC} = 4.5 \text{ V}$	5	-6	-	5	-	5	-	ns
		$V_{CC} = 6.0 \text{ V}$	5	-5	-	5	-	5	-	ns	
$f_{max}$	maximum frequency	CP input; see <a href="#">Figure 7</a>									
		$V_{CC} = 2.0 \text{ V}$	6	17	-	5	-	4	-	MHz	
		$V_{CC} = 4.5 \text{ V}$	30	51	-	24	-	20	-	MHz	
		$V_{CC} = 6.0 \text{ V}$	35	61	-	28	-	24	-	MHz	
		$V_{CC} = 5.0 \text{ V}$ ; $C_L = 15 \text{ pF}$	-	56	-	-	-	-	-	MHz	
$C_{PD}$	power dissipation capacitance	per package; $V_I = \text{GND to } V_{CC}$	[3]	-	35	-	-	-	-	pF	

**Table 7. Dynamic characteristics ...continued**  
 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	
<b>74HCT165</b>										
$t_{pd}$	propagation delay	$\overline{CE}$ , CP to Q7, $\overline{Q7}$ ; see <a href="#">Figure 7</a> <span style="float:right">[1]</span>								
		$V_{CC} = 4.5$ V	-	17	34	-	43	-	51	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	14	-	-	-	-	-	ns
		$\overline{PL}$ to Q7, $\overline{Q7}$ ; see <a href="#">Figure 8</a>								
		$V_{CC} = 4.5$ V	-	20	40	-	50	-	60	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	17	-	-	-	-	-	ns
		D7 to Q7, $\overline{Q7}$ ; see <a href="#">Figure 9</a>								
		$V_{CC} = 4.5$ V	-	14	28	-	35	-	42	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	11	-	-	-	-	-	ns
$t_t$	transition time	Q7, $\overline{Q7}$ output; see <a href="#">Figure 7</a> <span style="float:right">[2]</span>								
		$V_{CC} = 4.5$ V	-	7	15	-	19	-	22	ns
$t_W$	pulse width	CP input; see <a href="#">Figure 7</a>								
		$V_{CC} = 4.5$ V	16	6	-	20	-	24	-	ns
		$\overline{PL}$ input; see <a href="#">Figure 8</a>								
		$V_{CC} = 4.5$ V	20	9	-	25	-	30	-	ns
$t_{rec}$	recovery time	$\overline{PL}$ to CP, $\overline{CE}$ ; see <a href="#">Figure 8</a>								
		$V_{CC} = 4.5$ V	20	8	-	25	-	30	-	ns
$t_{su}$	set-up time	DS to CP, $\overline{CE}$ ; see <a href="#">Figure 10</a>								
		$V_{CC} = 4.5$ V	20	2	-	25	-	30	-	ns
		$\overline{CE}$ to CP and CP to $\overline{CE}$ ; see <a href="#">Figure 10</a>								
		$V_{CC} = 4.5$ V	20	7	-	25	-	30	-	ns
		Dn to $\overline{PL}$ ; see <a href="#">Figure 11</a>								
		$V_{CC} = 4.5$ V	20	10	-	25	-	30	-	ns
$t_h$	hold time	DS to CP, $\overline{CE}$ and Dn to $\overline{PL}$ ; see <a href="#">Figure 10</a>								
		$V_{CC} = 4.5$ V	7	-1	-	9	-	11	-	ns
		$\overline{CE}$ to CP and CP to $\overline{CE}$ ; see <a href="#">Figure 10</a>								
		$V_{CC} = 4.5$ V	0	-7	-	0	-	0	-	ns
$f_{max}$	maximum frequency	CP input; see <a href="#">Figure 7</a>								
		$V_{CC} = 4.5$ V	26	44	-	21	-	17	-	MHz
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	48	-	-	-	-	-	MHz

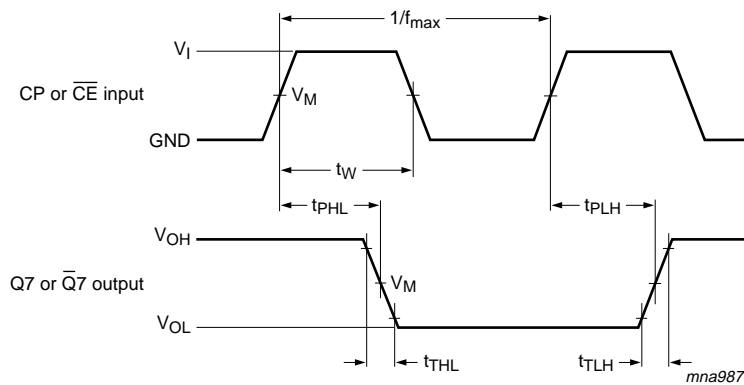
**Table 7. Dynamic characteristics ...continued**

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	
$C_{PD}$	power dissipation capacitance	per package; $V_I = GND$ to $V_{CC} - 1.5$ V	[3]	-	35	-	-	-	-	pF

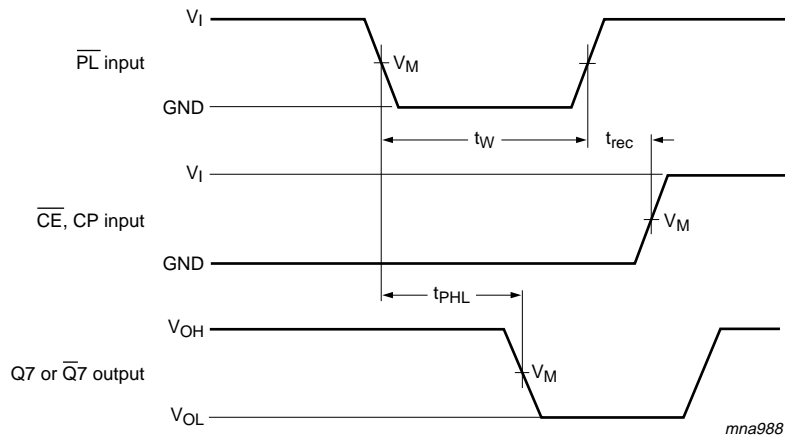
- [1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$  where:  
 $f_i$  = input frequency in MHz;  
 $f_o$  = output frequency in MHz;  
 $\Sigma (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs;  
 $C_L$  = output load capacitance in pF;  
 $V_{CC}$  = supply voltage in V.

## 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.

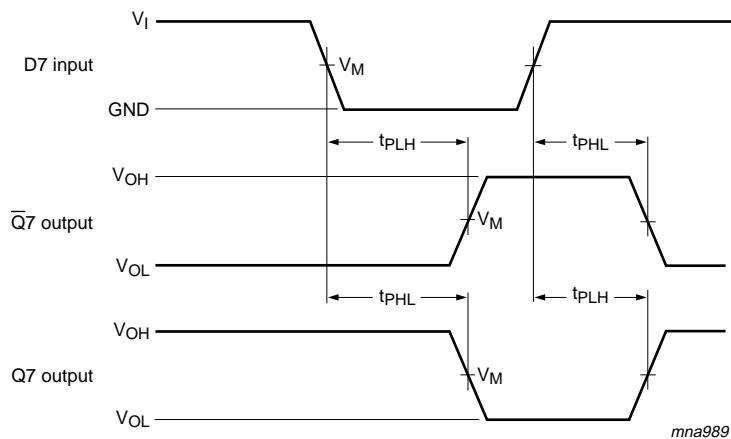
**Fig 7. The clock (CP) or clock enable ( $\overline{CE}$ ) to output ( $Q_7$  or  $\overline{Q_7}$ ) propagation delays, the clock pulse width, the maximum clock frequency and the output transition times**



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

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

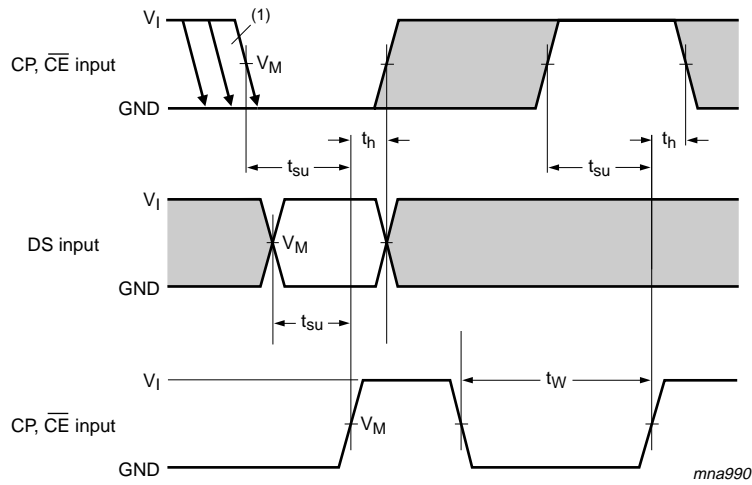
**Fig 8. The parallel load ( $\overline{PL}$ ) pulse width, the parallel load to output ( $Q7$  or  $\overline{Q7}$ ) propagation delays, the parallel load to clock ( $CP$ ) and clock enable ( $\overline{CE}$ ) recovery time**



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. The data input ( $D7$ ) to output ( $Q7$  or  $\overline{Q7}$ ) propagation delays when  $\overline{PL}$  is LOW**

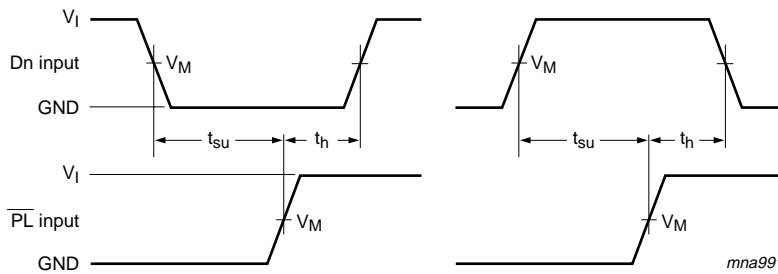


The shaded areas indicate when the input is permitted to change for predictable output performance. Measurement points are given in [Table 8](#).

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

(1)  $\overline{CE}$  may change only from HIGH-to-LOW while CP is LOW, see [Section 1](#).

**Fig 10. The set-up and hold times from the serial data input (DS) to the clock (CP) and clock enable ( $\overline{CE}$ ) inputs, from the clock enable input ( $\overline{CE}$ ) to the clock input (CP) and from the clock input (CP) to the clock enable input ( $\overline{CE}$ )**



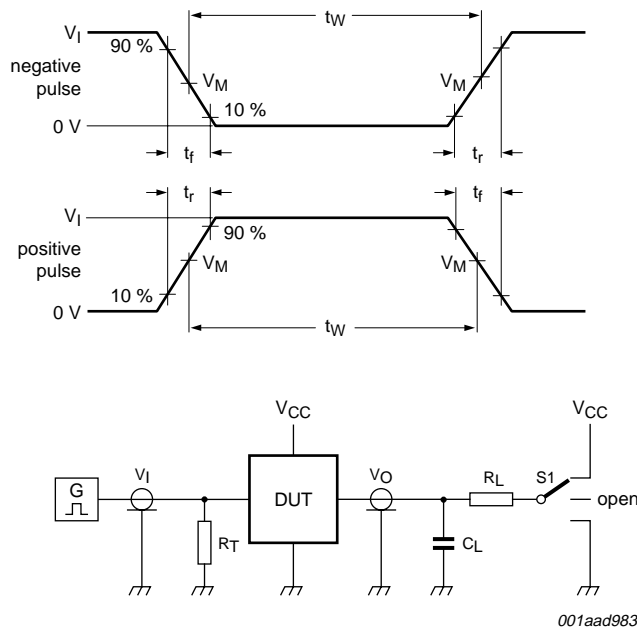
Measurement points are given in [Table 8](#).

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

**Fig 11. The set-up and hold times from the data inputs (Dn) to the parallel load input ( $\overline{PL}$ )**

**Table 8. Measurement points**

Type	Input		Output
	$V_I$	$V_M$	$V_M$
74HC165	$V_{CC}$	$0.5V_{CC}$	$0.5V_{CC}$
74HCT165	3 V	1.3 V	1.3 V



Test data is given in [Table 9](#).

Definitions for 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.

$R_L$  = Load resistance.

S1 = Test selection switch

**Fig 12. Test circuit for measuring switching times**

**Table 9. Test data**

Type	Input		Load			S1 position
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHL}, t_{PLH}$	
74HC165	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	open	
74HCT165	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	open	

13. Package outline

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

SOT38-4

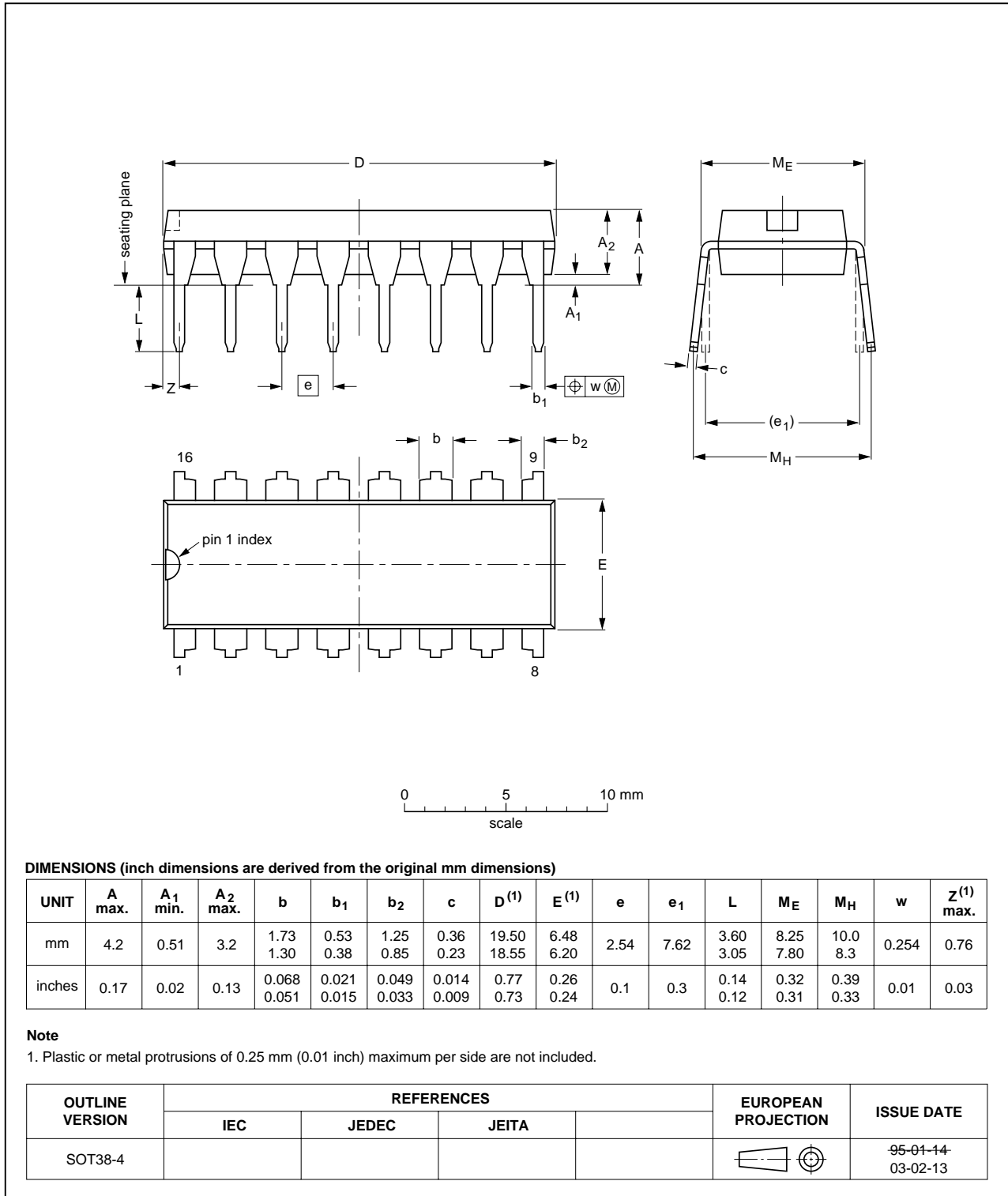


Fig 13. Package outline SOT38-4 (DIP16)

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

SOT109-1

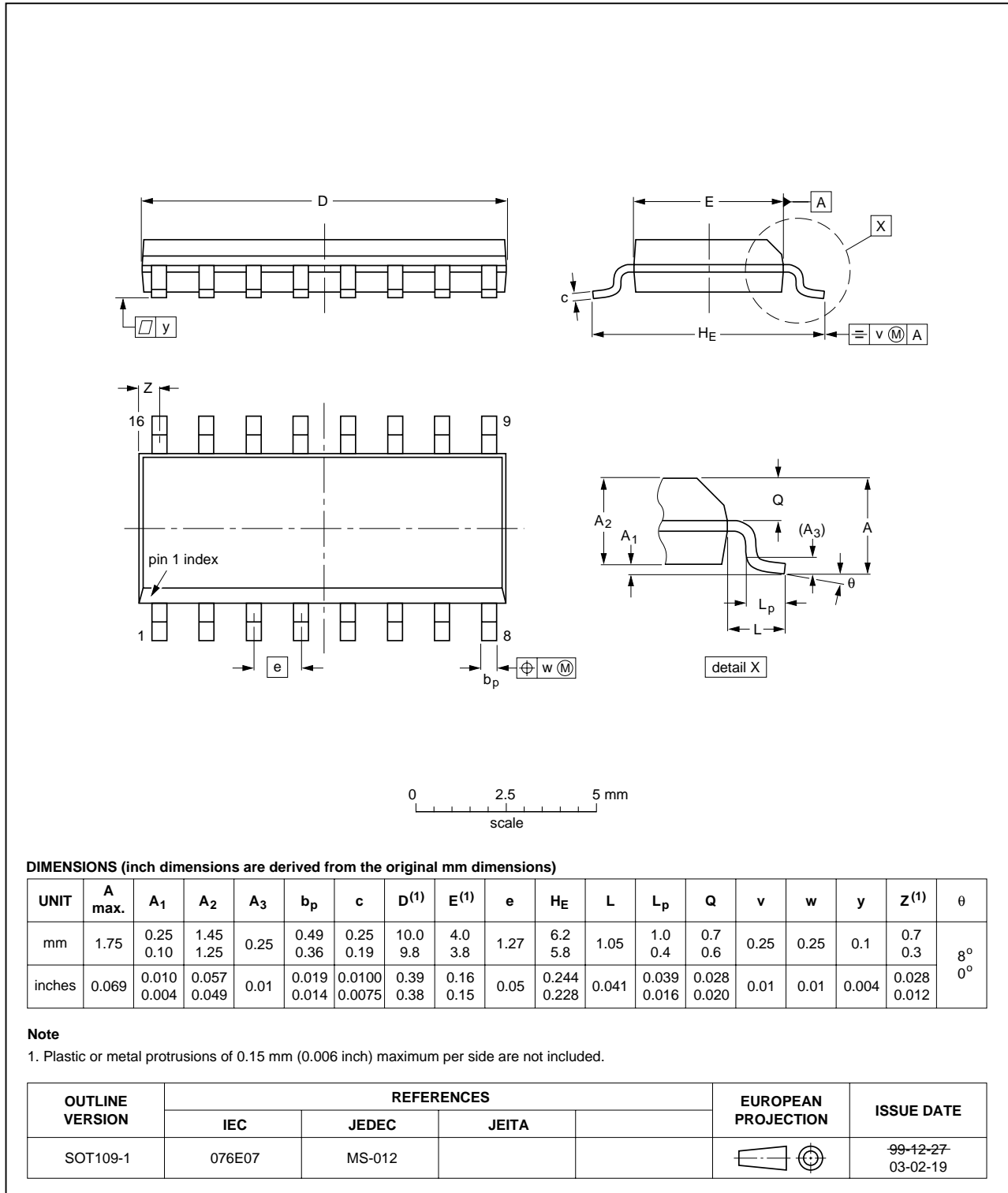


Fig 14. Package outline SOT109-1 (SO16)

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

SOT338-1

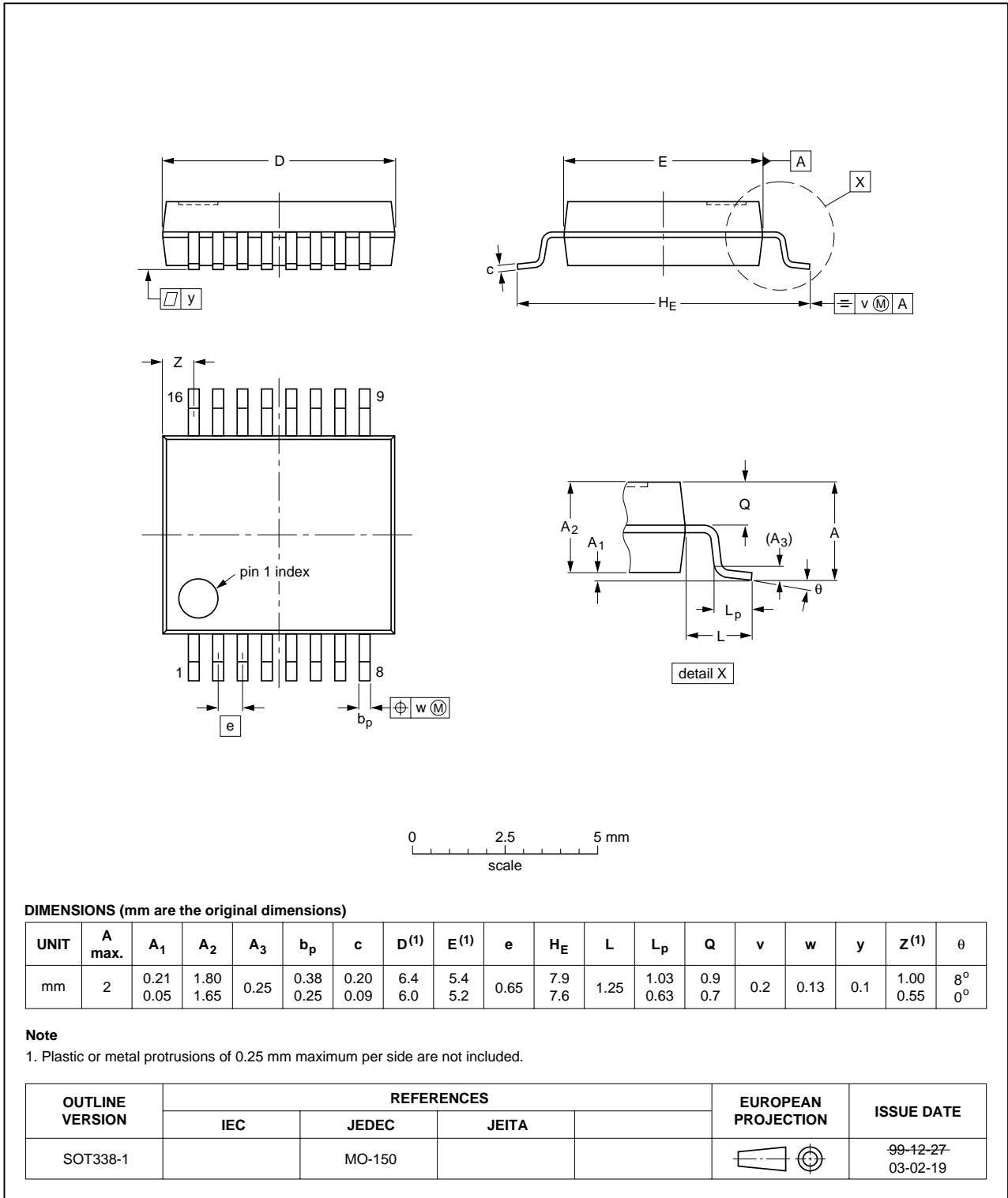


Fig 15. Package outline SOT338-1 (SSOP16)

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

SOT403-1

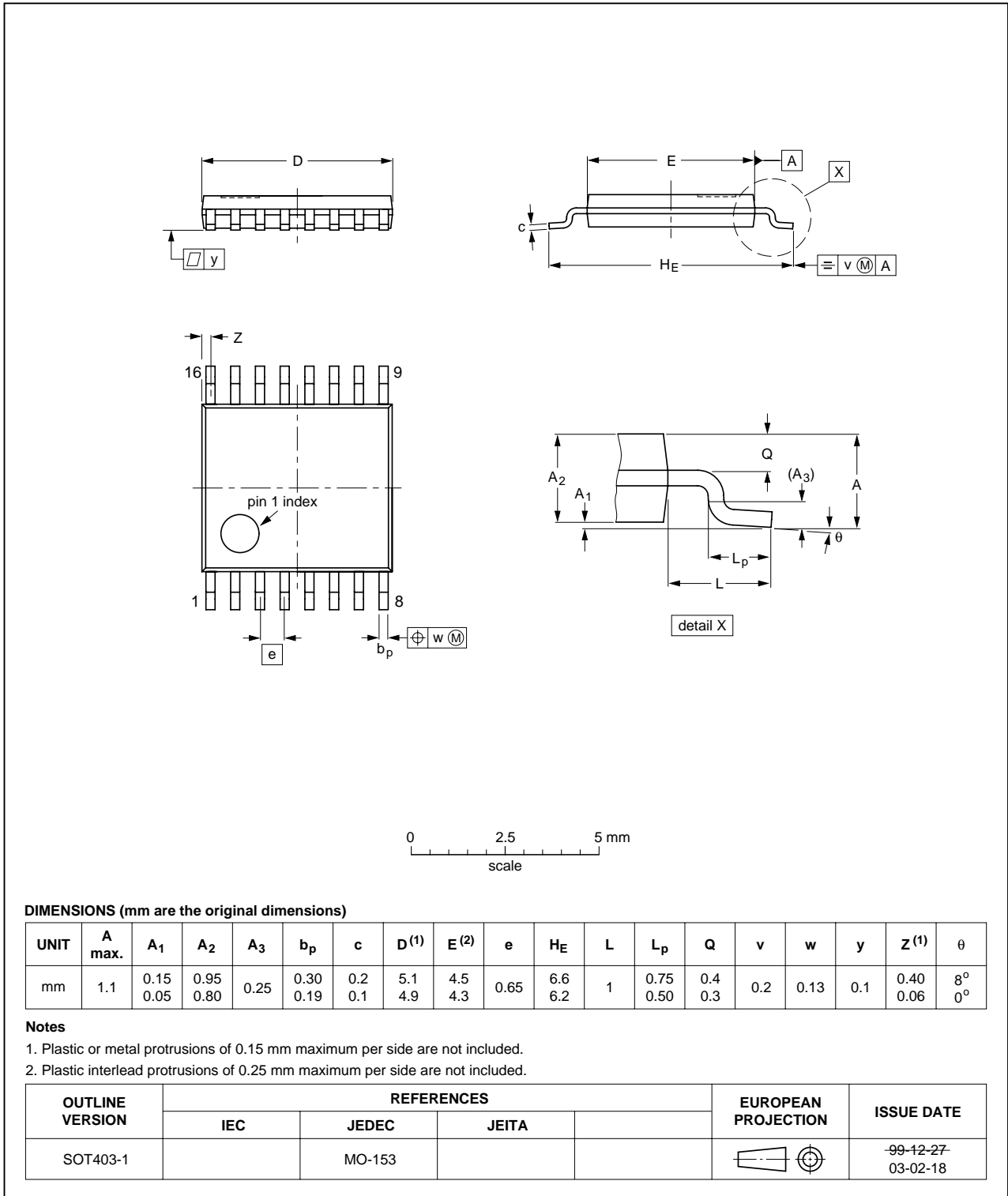


Fig 16. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

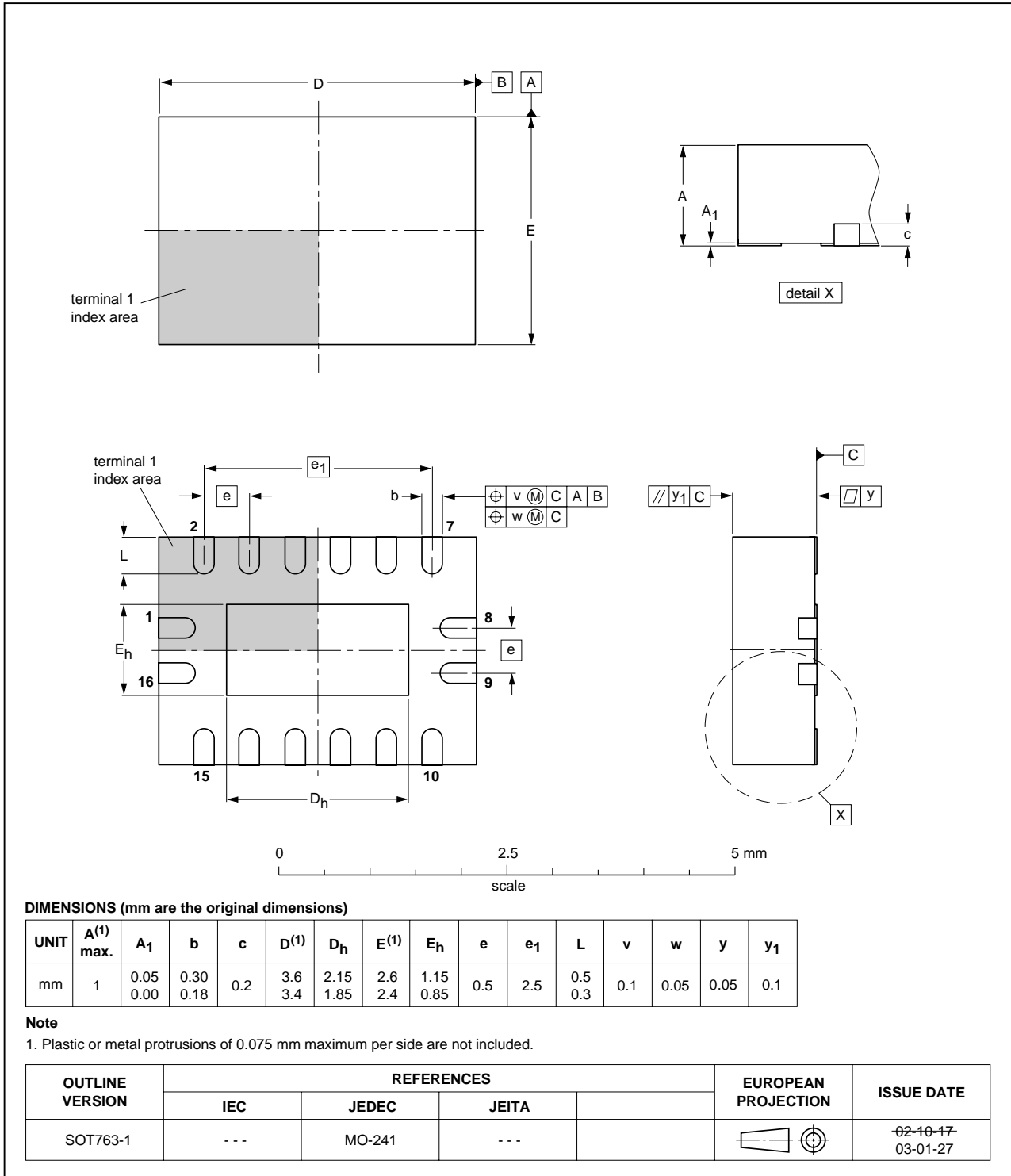


Fig 17. Package outline SOT763-1 (DHVQFN16)

## 14. Abbreviations

**Table 10. Abbreviations**

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

## 15. Revision history

**Table 11. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT165_3	20080314	Product data sheet	-	74HC_HCT165_CNV_2
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>Package SOT763-1 (DHVQFN16) added to <a href="#">Section 4 “Ordering information”</a> and <a href="#">Section 13 “Package outline”</a>.</li> <li>Family data added, see <a href="#">Section 10 “Static characteristics”</a></li> </ul>			
74HC_HCT165_CNV_2	December 1990	Product specification	-	-

## 16. Legal information

### 16.1 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>.

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