

74LV165

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

Rev. 6 — 19 February 2014

Product data sheet

1. General description

The 74LV165 is an 8-bit parallel-load or serial-in shift register with complementary serial outputs (Q7 and $\overline{Q7}$) available from the last stage. When the parallel-load input (\overline{PL}) is LOW, parallel data from the inputs D0 to D7 are loaded into the register asynchronously. When input \overline{PL} is HIGH, data enters the register serially at the input DS. It shifts one place to the right (Q0 → Q1 → Q2, etc.) with each positive-going clock transition. This feature allows parallel-to-serial converter expansion by tying the output Q7 to the input DS of the succeeding stage.

The clock input is a gate-OR structure which allows one input to be used as an active LOW clock enable input (\overline{CE}) input. The pin assignment for the inputs CP and \overline{CE} is arbitrary and can be reversed for layout convenience. The LOW-to-HIGH transition of the 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 PL is activated.

2. Features and benefits

- Wide supply voltage range from 1.0 V to 5.5 V
- Synchronous parallel-to-serial applications
- Optimized for low voltage applications: 1.0 V to 3.6 V
- Synchronous serial input for easy expansion
- Latch-up performance exceeds 250 mA
- 5.5 V tolerant inputs/outputs
- Direct interface with TTL levels (2.7 V to 3.6 V)
- Power-down mode
- Complies with JEDEC standards:
 - ◆ JESD8-5 (2.3 V to 2.7 V)
 - ◆ JESD8B/JESD36 (2.7 V to 3.6 V)
 - ◆ JESD8-1A (4.5 V to 5.5 V)
- ESD protection:
 - ◆ HBM JESD22-A114-A exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

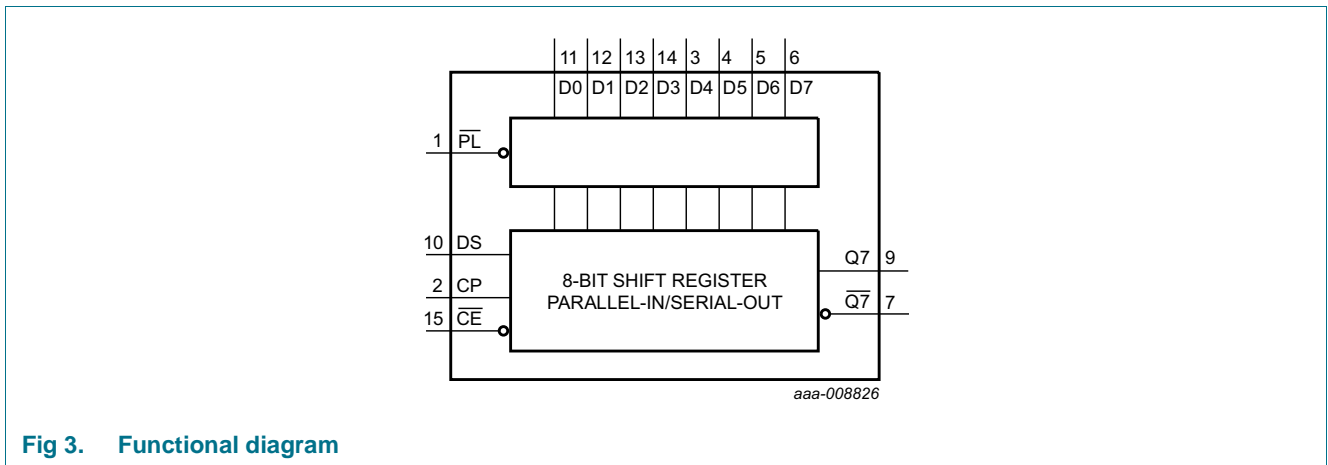
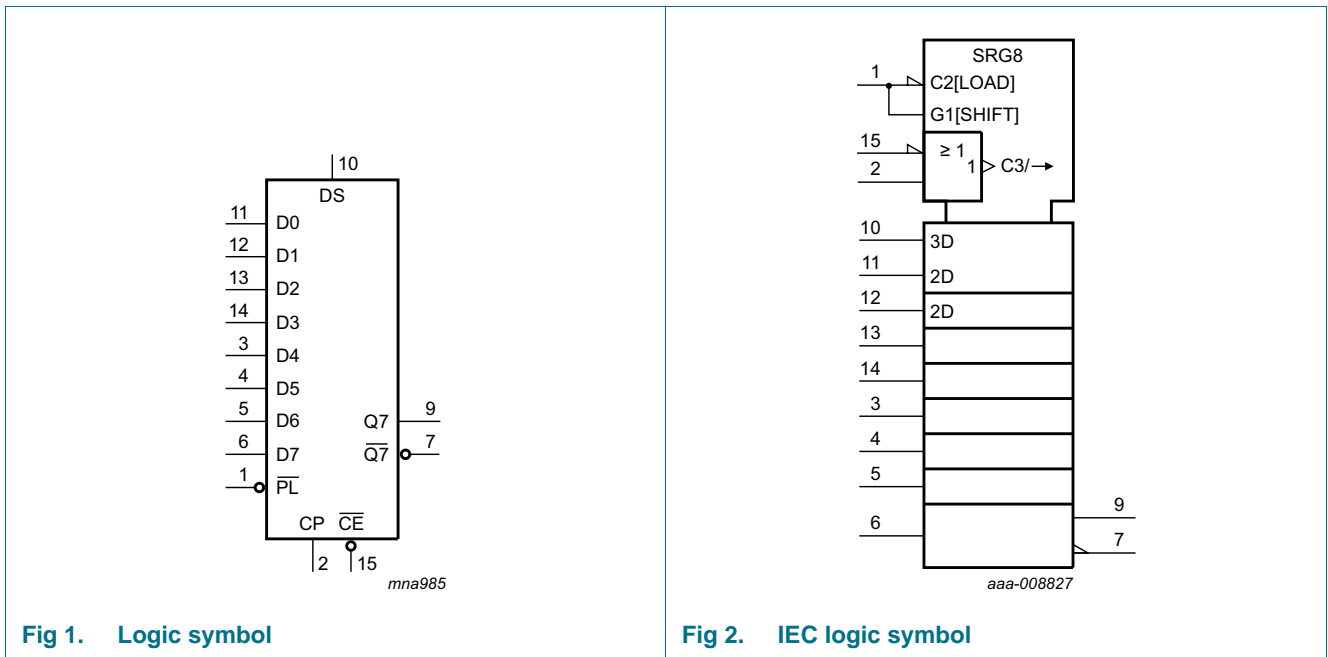


3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LV165N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74LV165D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74LV165DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74LV165PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

4. Functional diagram



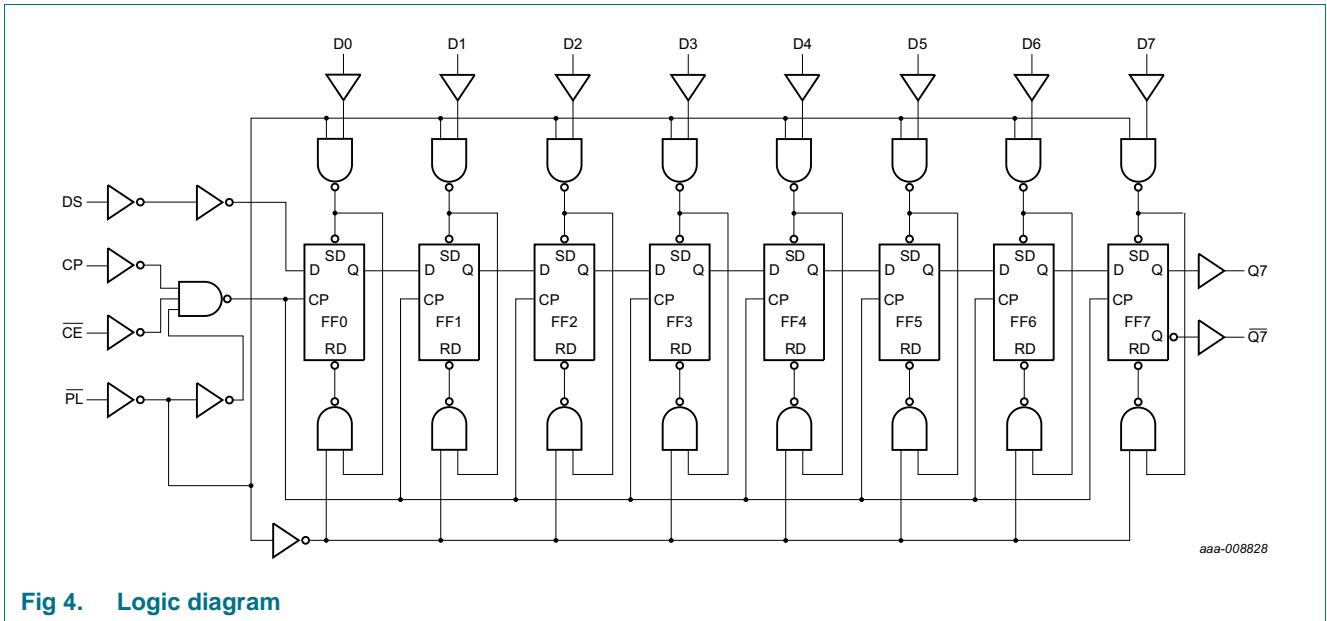


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning

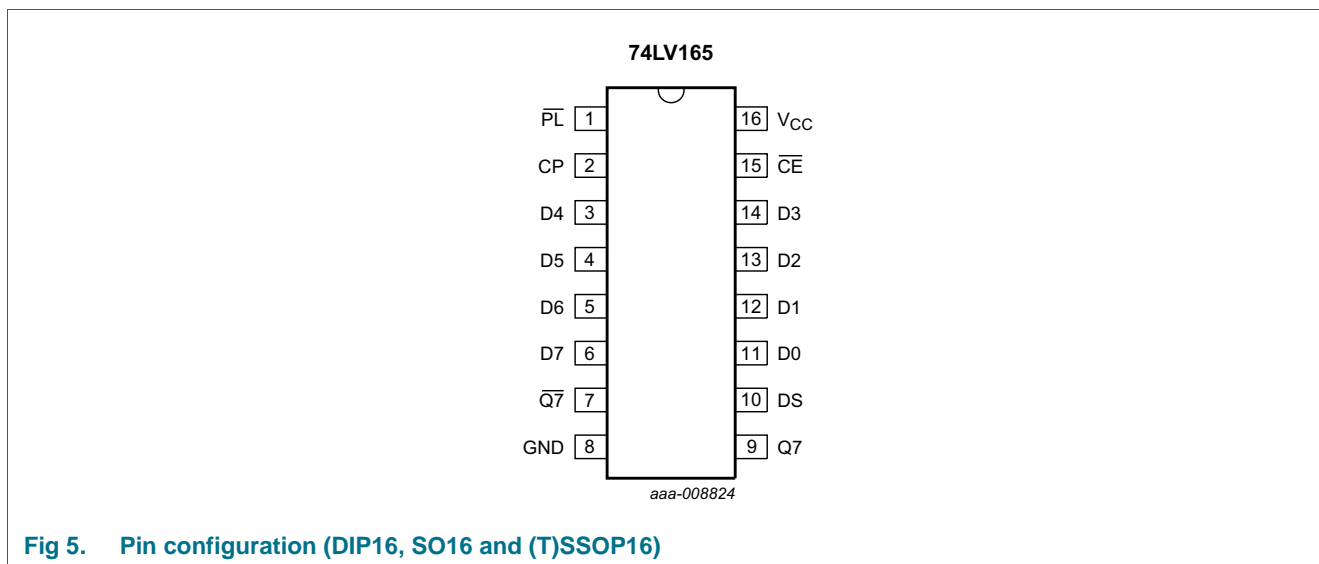


Fig 5. Pin configuration (DIP16, SO16 and (T)SSOP16)

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
\overline{PL}	1	parallel enable input (active LOW)
CP	2	clock input (LOW-to-HIGH edge-triggered)
$\overline{Q7}$	7	complementary serial 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
\overline{CE}	15	clock enable input (active LOW)
V _{CC}	16	positive supply voltage

6. Functional description

Table 3. Function table^[1]

Operating modes	Inputs					Qn registers		Output	
	$\overline{\text{PL}}$	$\overline{\text{CE}}$	CP	DS	D0 to D7	Q0	Q1 to Q6	Q7	$\overline{\text{Q7}}$
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	$\overline{\text{q6}}$
	H	L	↑	h	X	H	q0 to q5	q6	$\overline{\text{q6}}$
hold "do nothing"	H	H	X	X	X	q0	q1 to q6	q7	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.

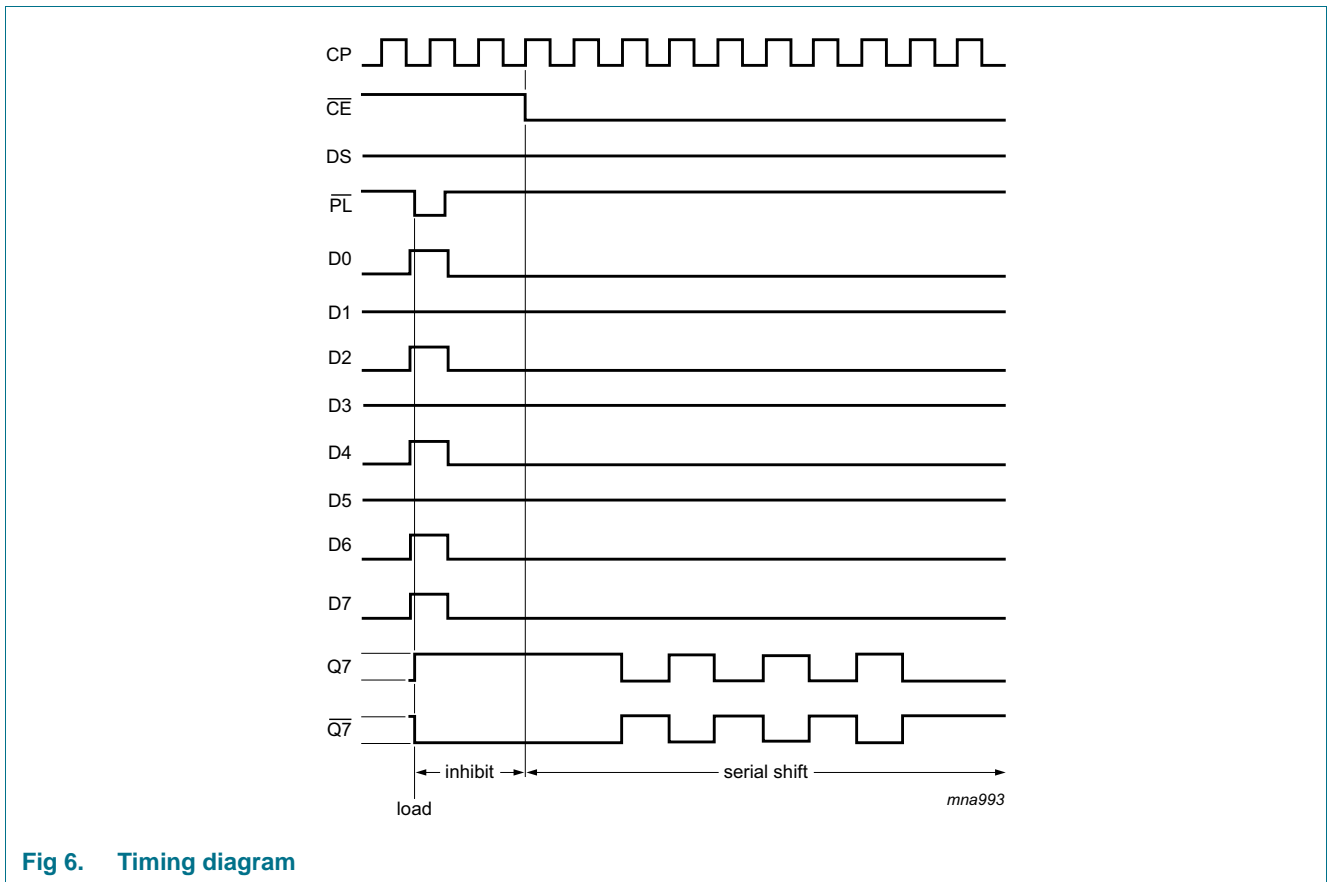


Fig 6. Timing diagram

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)^[1]

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.5	+7	V
I _{IK}	input clamping current	V _I < -0.5 V or V _I > V _{CC} + 0.5 V	-	20	mA
V _I	input voltage		-0.5	+7	V
I _{OK}	output clamping current	V _O > V _{CC} or V _O < 0	-	±50	mA
I _O	output current	-0.5 V < V _O < V _{CC} + 0.5 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	T _{amb} = -40 °C to +125 °C			
		DIP16 package	^[2] -	750	mW
		SO16 package	^[3] -	500	mW
		(T)SSOP16 package	^[4] -	400	mW

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

[2] P_{tot} derates linearly with 12 mW/K above 70 °C.

[3] P_{tot} derates linearly with 8 mW/K above 70 °C.

[4] P_{tot} derates linearly with 5.5 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	Min	Typ	Max	Unit
V _{CC}	supply voltage		1.0	3.3	5.5	V
V _I	input voltage		0	-	V _{CC}	V
V _O	output voltage		0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	-	+85	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 1.0 V to 2.0 V	0	-	500	ns/V
		V _{CC} = 2.0 V to 2.7 V	0	-	200	ns/V
		V _{CC} = 2.7 V to 3.6 V	0	-	100	ns/V
		V _{CC} = 3.6 V to 5.5 V	0	-	50	ns/V

9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ ^[1]	Max	Min	Max		
V _{IH}	HIGH-level input voltage	V _{CC} = 1.2 V	0.9	-	-	0.9	-	V	
		V _{CC} = 2.3 V to 2.7 V	1.4	-	-	1.4	-	V	
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V	
		V _{CC} = 4.5 V to 5.5 V	0.7V _{CC}	-	-	0.7V _{CC}	-	V	
V _{IL}	LOW-level input voltage	V _{CC} = 1.2 V	-	-	0.3	-	0.3	V	
		V _{CC} = 2.3 V to 2.7 V	-	-	0.6	-	0.6	V	
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V	
		V _{CC} = 4.5 V to 5.5 V	-	-	0.3V _{CC}	-	0.3V _{CC}		
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; I _O = -100 μA							
		V _{CC} = 1.2 V	-	1.2	-	-	-		
		V _{CC} = 2.0 V	1.8	2.0	-	1.8	-	V	
		V _{CC} = 2.7 V	2.5	2.7	-	2.5	-	V	
		V _{CC} = 3.0 V	2.8	3.0	-	2.8	-	V	
		V _{CC} = 4.5 V	4.3	4.5	-	4.3	-	V	
		standard outputs: V _I = V _{IH} or V _{IL}							
		V _{CC} = 3.0 V; I _O = -6 mA	2.40	2.82	-	2.20	-	V	
V _{CC} = 4.5 V; I _O = -12 mA	3.60	4.20	-	3.50	-	V			
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; I _O = 100 μA							
		V _{CC} = 1.2 V	-	0	-	-	-		
		V _{CC} = 2.0 V	-	0	0.2	1.8	0.2	V	
		V _{CC} = 2.7 V	-	0	0.2	2.5	0.2	V	
		V _{CC} = 3.0 V	-	0	0.2	2.8	0.2	V	
		V _{CC} = 4.5 V	-	0	0.2	4.3	0.2	V	
		standard outputs: V _I = V _{IH} or V _{IL}							
		V _{CC} = 3.0 V; I _O = 6 mA	-	0.25	0.40	-	0.50	V	
V _{CC} = 4.5 V; I _O = 12 mA	-	0.35	0.55	-	0.65	V			
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±1	-	±1	μA	
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	20	-	160	μA	
ΔI _{CC}	additional supply current	V _I = V _{CC} - 0.6 V; V _{CC} = 2.7 V to 3.6 V	-	-	500	-	850	μA	
C _I	input capacitance		-	3.5	-			pF	

[1] Typical values are measured at T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V); for test circuit, see [Figure 12](#)

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ ^[1]	Max	Min	Max		
t _{pd}	propagation delay	\overline{CE} , CP to Q7, $\overline{Q7}$; see Figure 7 and Figure 8		[2]					
		V _{CC} = 1.2 V	-	115	-	-	-	ns	
		V _{CC} = 2.0 V	-	38	61	-	76	ns	
		V _{CC} = 2.7 V	-	27	43	-	54	ns	
		V _{CC} = 3.0 V to 3.6 V	[3]	22	36	-	45	ns	
		V _{CC} = 3.3 V; C _L = 15 pF		18	-	-	-	ns	
		V _{CC} = 4.5 V to 5.5 V	[4]	15	24	-	30	ns	
		\overline{PL} to Q7, $\overline{Q7}$; see Figure 8							
		V _{CC} = 1.2 V	-	110	-	-	-	ns	
		V _{CC} = 2.0 V	-	35	56	-	70	ns	
		V _{CC} = 2.7 V	-	24	39	-	49	ns	
		V _{CC} = 3.0 V to 3.6 V	[3]	20	33	-	41	ns	
		V _{CC} = 3.3 V; C _L = 15 pF		18	-	-	-	ns	
		V _{CC} = 4.5 V to 5.5 V	[4]	14	22	-	27	ns	
		D7 to Q7, $\overline{Q7}$; C _L = 15 pF; see Figure 9							
		V _{CC} = 1.2 V	-	90	-	-	-	ns	
		V _{CC} = 2.0 V	-	28	45	-	56	ns	
		V _{CC} = 2.7 V	-	20	32	-	40	ns	
V _{CC} = 3.0 V to 3.6 V	[3]	17	27	-	33	ns			
V _{CC} = 3.3 V; C _L = 15 pF		14	-	-	-	ns			
V _{CC} = 4.5 V to 5.5 V	[4]	11	18	-	22	ns			
t _w	pulse width	CP input HIGH to LOW; see Figure 7							
		V _{CC} = 2.0 V	34	10	-	41	-	ns	
		V _{CC} = 2.7 V	25	8	-	30	-	ns	
		V _{CC} = 3.0 V to 3.6 V	[3]	20	7	-	24	-	ns
		V _{CC} = 4.5 V to 5.5 V	[4]	15	5	-	18	-	ns
		\overline{PL} input LOW; see Figure 8							
		V _{CC} = 2.0 V	34	10	-	41	-	ns	
		V _{CC} = 2.7 V	25	8	-	30	-	ns	
		V _{CC} = 3.0 V to 3.6 V	[3]	20	7	-	24	-	ns
		V _{CC} = 4.5 V to 5.5 V	[4]	15	5	-	18	-	ns

Table 7. Dynamic characteristics ...continued
 GND (ground = 0 V); for test circuit, see [Figure 12](#)

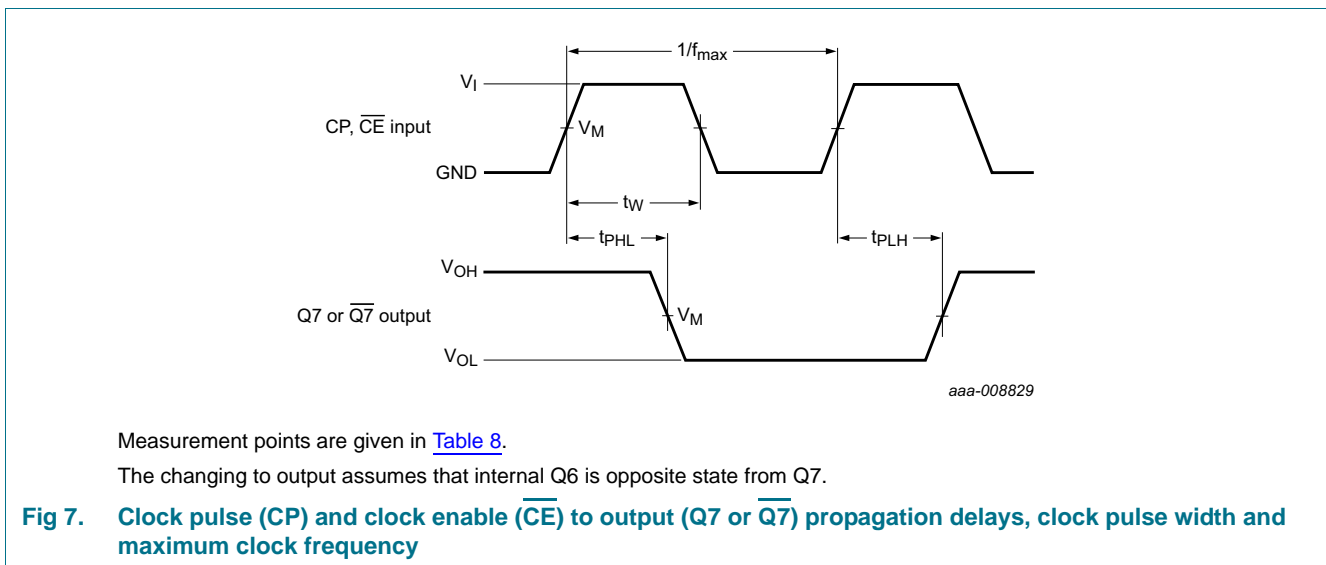
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit		
			Min	Typ ^[1]	Max	Min	Max			
t _{rec}	recovery time	\overline{PL} to CP, \overline{CE} ; see Figure 8								
		V _{CC} = 1.2 V	-	40	-	-	-	ns		
		V _{CC} = 2.0 V	24	15	-	30	-	ns		
		V _{CC} = 2.7 V	18	11	-	23	-	ns		
		V _{CC} = 3.0 V to 3.6 V [3]	17	10	-	21	-	ns		
		V _{CC} = 4.5 V to 5.5 V [4]	12	7	-	15	-	ns		
t _{su}	set-up time	DS to CP, \overline{CE} ; see Figure 10								
		V _{CC} = 1.2 V	-	-8	-	-	-	ns		
		V _{CC} = 2.0 V	22	-2	-	26	-	ns		
		V _{CC} = 2.7 V	16	-1	-	19	-	ns		
		V _{CC} = 3.0 V to 3.6 V [3]	13	-1	-	15	-	ns		
		V _{CC} = 4.5 V to 5.5 V [4]	9	0	-	10	-	ns		
		\overline{CE} to CP, CP to \overline{CE} ; see Figure 10								
		V _{CC} = 1.2 V	-	20	-	-	-	ns		
		V _{CC} = 2.0 V	22	7	-	26	-	ns		
		V _{CC} = 2.7 V	16	5	-	19	-	ns		
		V _{CC} = 3.0 V to 3.6 V [3]	13	4	-	15	-	ns		
		V _{CC} = 4.5 V to 5.5 V [4]	9	3	-	10	-	ns		
		Dn to \overline{PL} ; see Figure 11								
		V _{CC} = 1.2 V	-	25	-	-	-	ns		
		V _{CC} = 2.0 V	22	8	-	26	-	ns		
		V _{CC} = 2.7 V	16	6	-	19	-	ns		
		V _{CC} = 3.0 V to 3.6 V [3]	13	5	-	15	-	ns		
		V _{CC} = 4.5 V to 5.5 V [4]	9	4	-	10	-	ns		
		t _h	hold time	DS to CP, \overline{CE} ; Dn to \overline{PL} ; see Figure 10 and Figure 11						
				V _{CC} = 1.2 V	-	20	-	-	-	ns
				V _{CC} = 2.0 V	22	7	-	26	-	ns
V _{CC} = 2.7 V	16			5	-	19	-	ns		
V _{CC} = 3.0 V to 3.6 V [3]	13			4	-	15	-	ns		
V _{CC} = 4.5 V to 5.5 V [4]	9			3	-	10	-	ns		
\overline{CE} to CP, CP to \overline{CE} ; see Figure 10										
V _{CC} = 1.2 V	-			-30	-	-	-	ns		
V _{CC} = 2.0 V	5			-8	-	5	-	ns		
V _{CC} = 2.7 V	5			-6	-	5	-	ns		
V _{CC} = 3.0 V to 3.6 V [3]	5			-5	-	5	-	ns		
V _{CC} = 4.5 V to 5.5 V [4]	5			-4	-	5	-	ns		

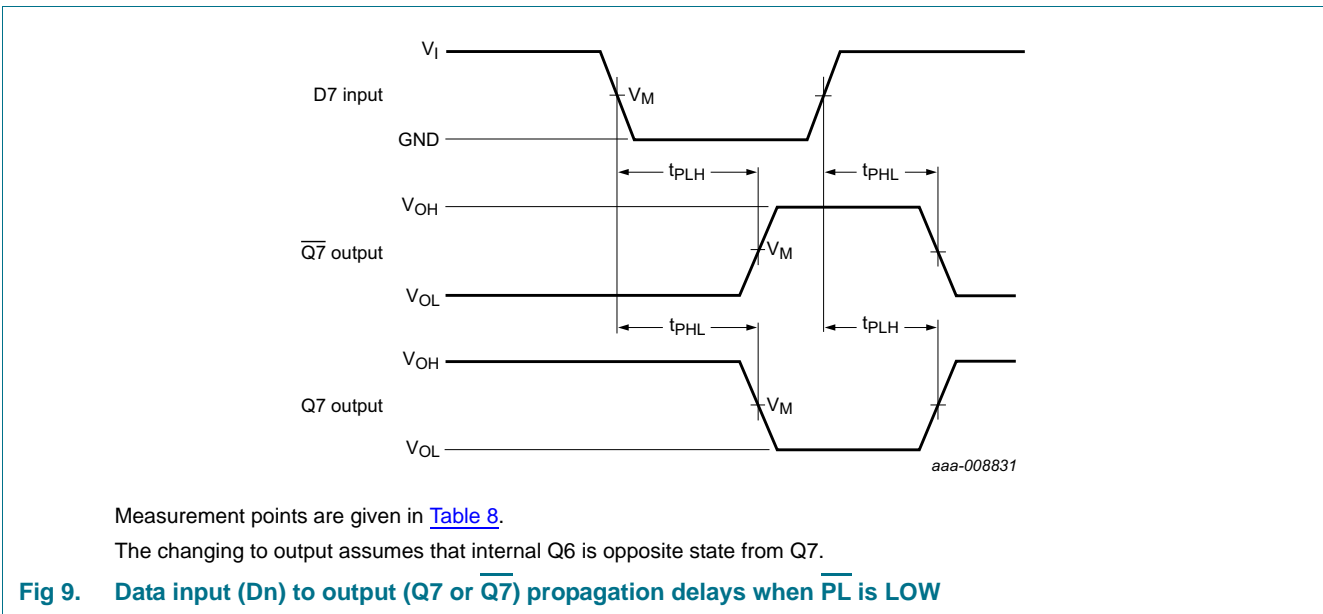
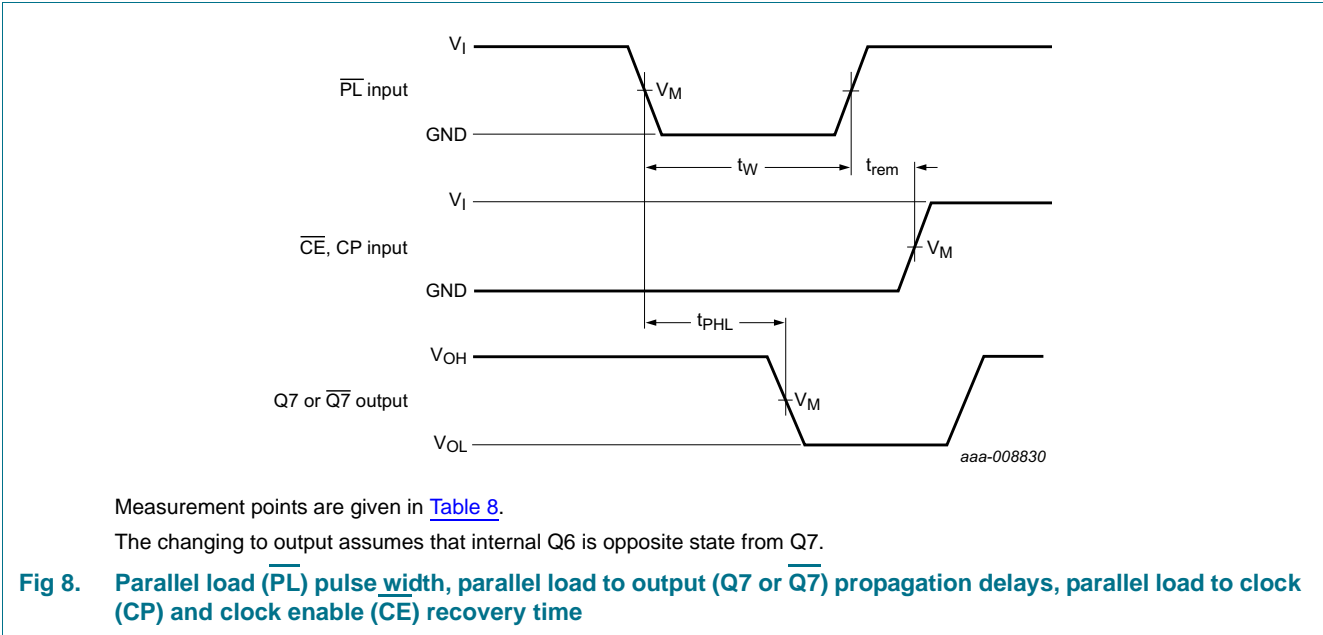
Table 7. Dynamic characteristics ...continued
 GND (ground = 0 V); for test circuit, see [Figure 12](#)

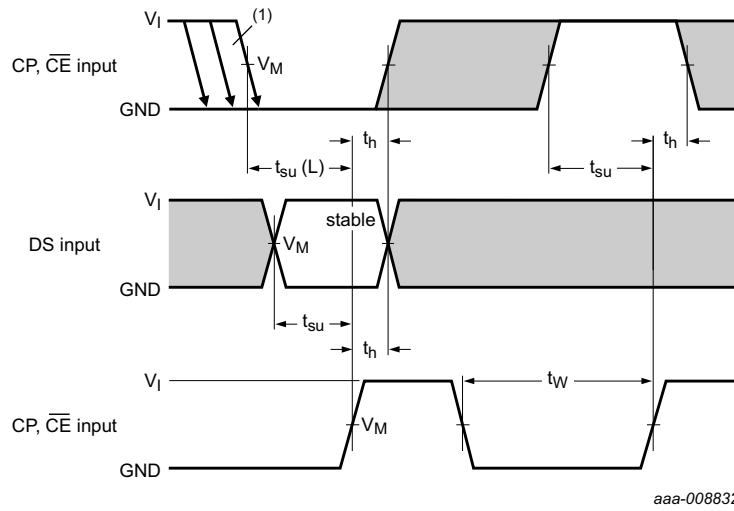
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	
f _{max}	maximum frequency	see Figure 7						
		V _{CC} = 2.0 V	14	40	-	12	-	MHz
		V _{CC} = 2.7 V	19	60	-	16	-	MHz
		V _{CC} = 3.0 V to 3.6 V ^[3]	24	65	-	20	-	MHz
		V _{CC} = 3.3 V; C _L = 15 pF	-	78	-	-	-	MHz
		V _{CC} = 4.5 V to 5.5 V ^[4]	36	75	-	30	-	MHz
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} ; V _{CC} = 3.3 V ^[5]	-	35	-			pF

- [1] Typical values are measured at T_{amb} = 25 °C.
- [2] t_{pd} is the same as t_{PHL} and t_{PLH}.
- [3] Typical values are measured at V_{CC} = 3.3 V.
- [4] Typical values are measured at V_{CC} = 5.0 V.
- [5] C_{PD} is used to determine the dynamic power dissipation P_D = C_{PD} × V_{CC}² × f_i + Σ (C_L × V_{CC}² × f_o) (P_D in μW), where:
 f_i = input frequency in MHz;
 f_o = output frequency in MHz;
 Σ (C_L × V_{CC}² × f_o) = sum of outputs;
 C_L = output load capacitance in pF;
 V_{CC} = supply voltage in V.

11. Waveforms



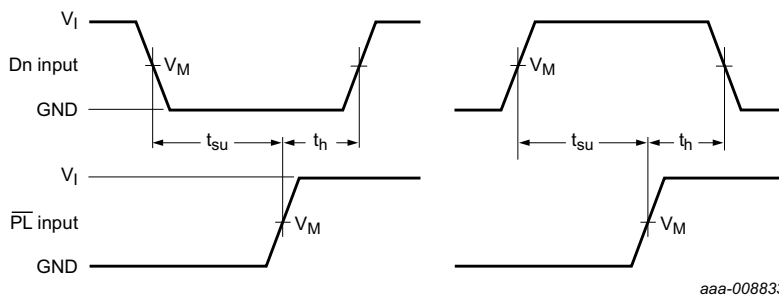




Measurement points are given in [Table 8](#).

- (1) CE may change only from HIGH-to-LOW while CP is LOW. The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig 10. Set-up and hold times

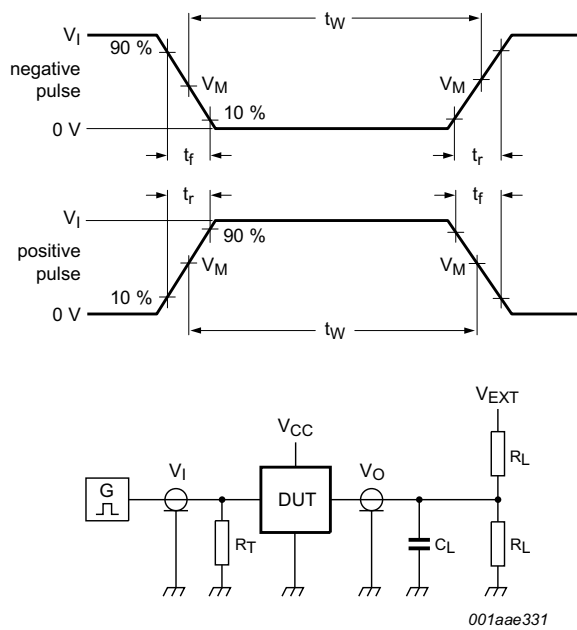


Measurement points are given in [Table 8](#).

Fig 11. Set-up and hold times from the data inputs (Dn) to the parallel load input (PL)

Table 8. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
< 2.7 V	$0.5V_{CC}$	$0.5V_{CC}$
2.7 V to 3.6 V	1.5 V	1.5 V
≥ 4.5 V	$0.5V_{CC}$	$0.5V_{CC}$



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

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig 12. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V_{EXT}
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
< 2.7 V	V_{CC}	2.5 ns	50 pF	1 k Ω	open
2.7 V to 3.6 V	2.7 V	2.5 ns	50 pF, 15 pF	1 k Ω	open
≥ 4.5 V	V_{CC}	2.5 ns	50 pF	1 k Ω	open

12. Package outline

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

SOT38-4

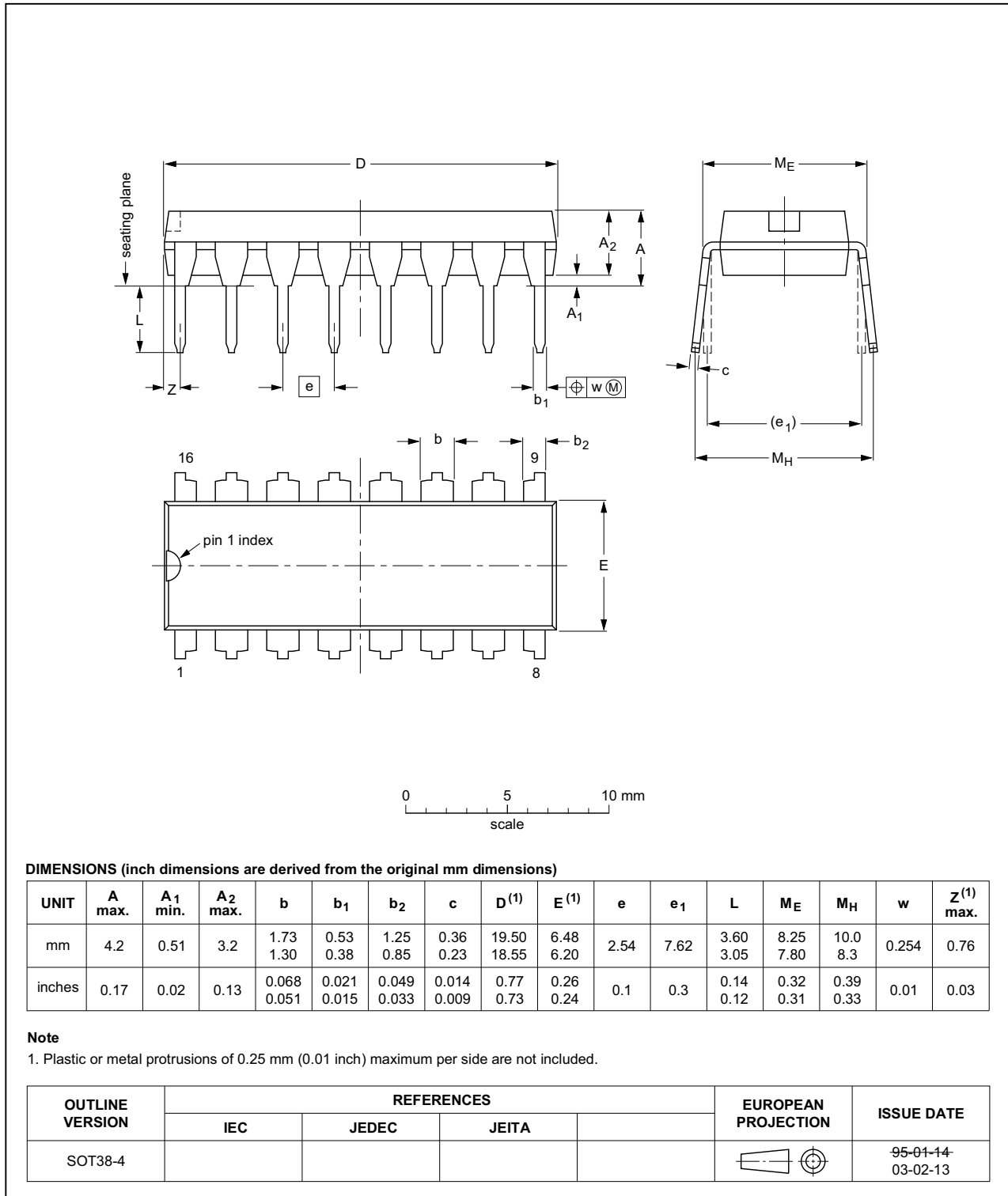


Fig 13. Package outline SOT38-4 (DIP16)

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

SOT109-1

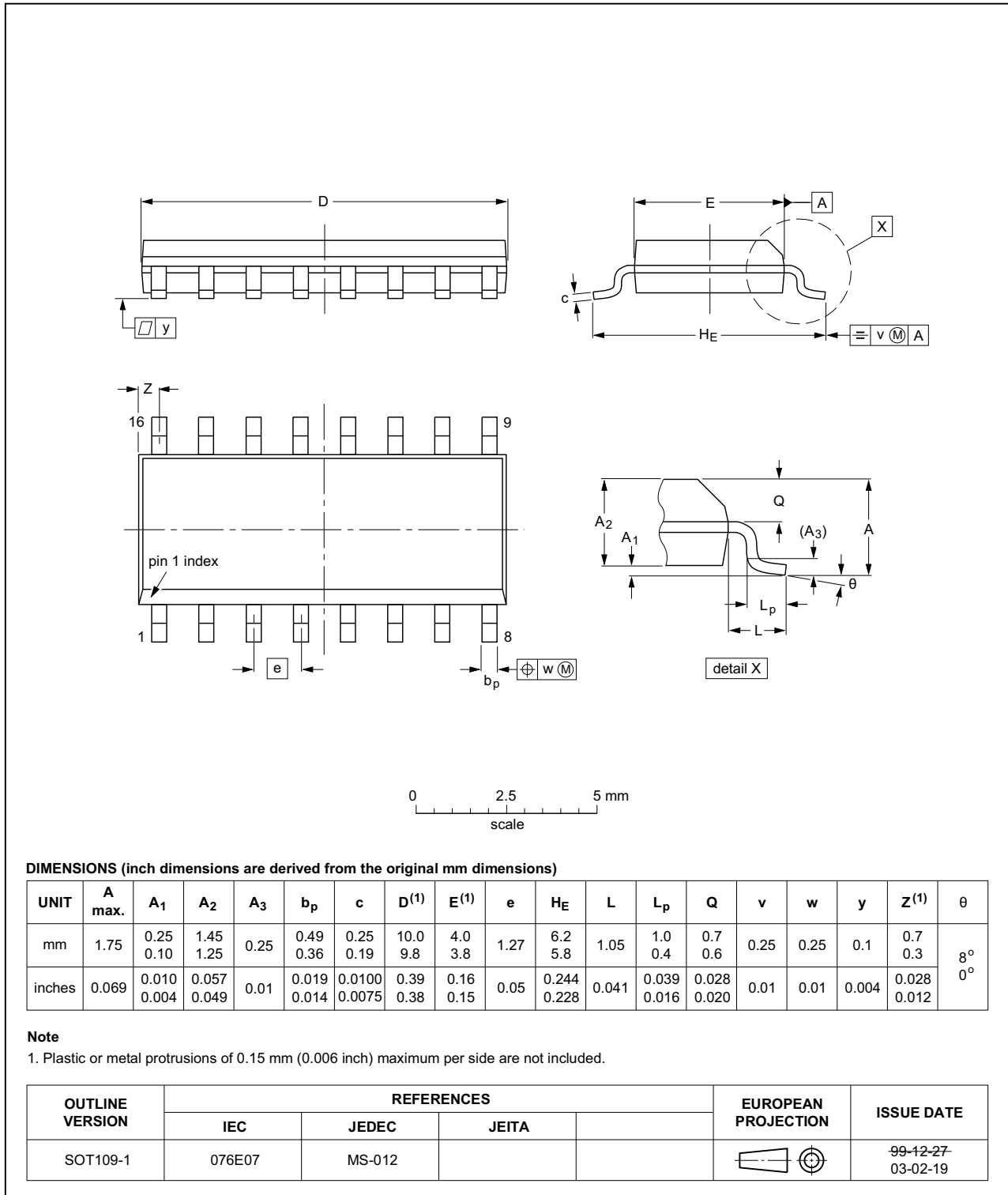


Fig 14. Package outline SOT109-1 (SO16)

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

SOT338-1

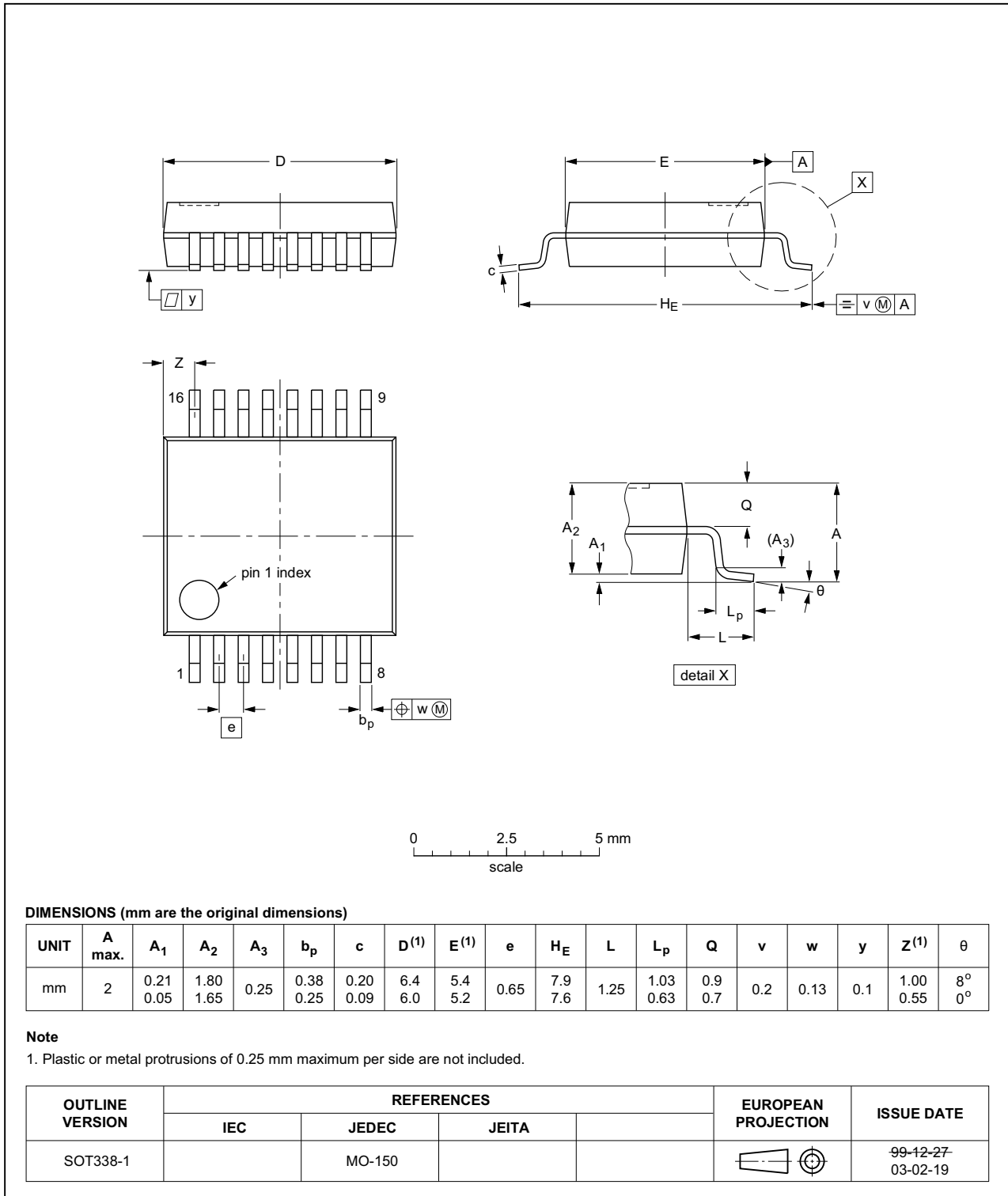


Fig 15. Package outline SOT338-1 (SSOP16)

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

SOT403-1

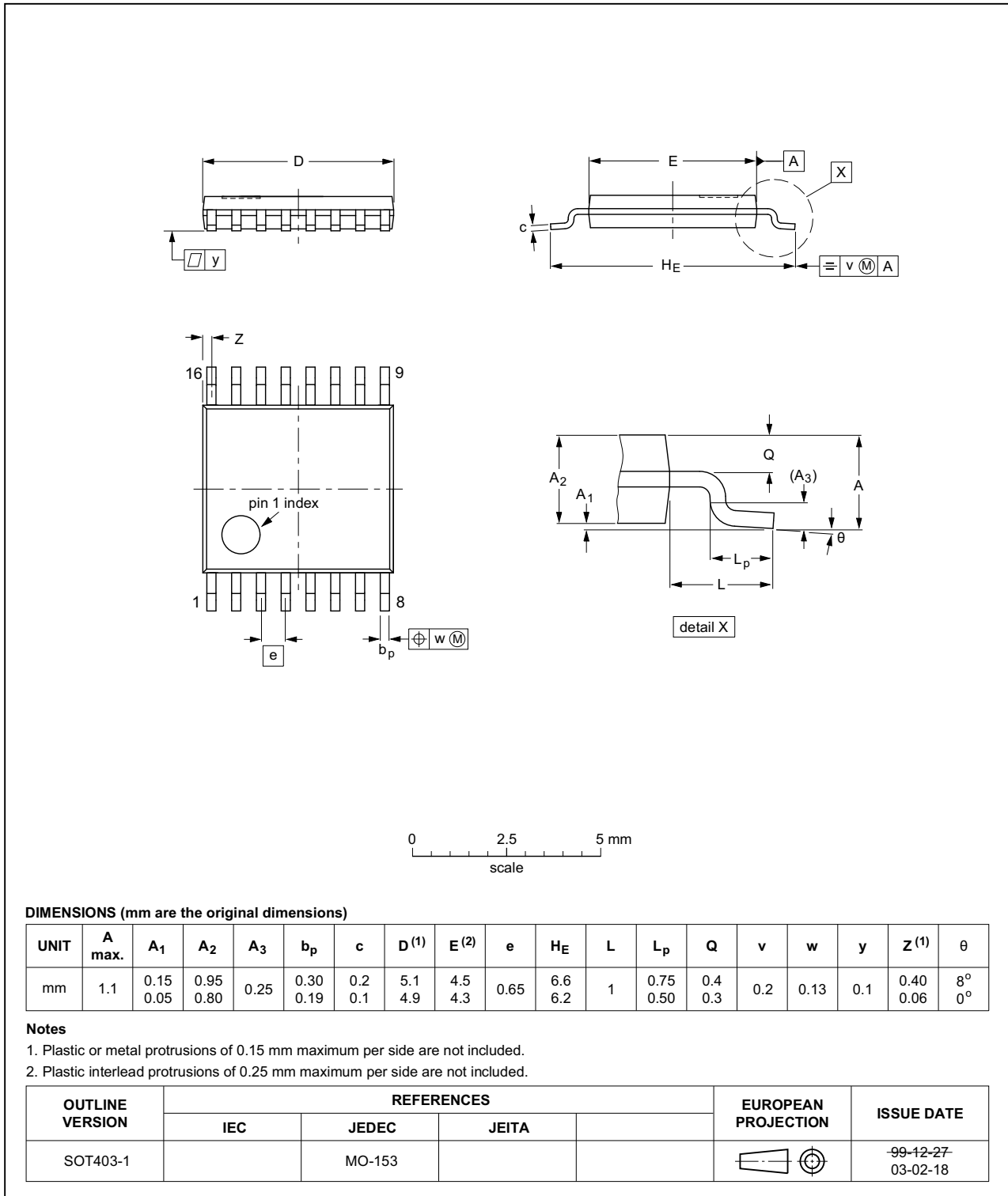


Fig 16. Package outline SOT403-1 (TSSOP16)

13. 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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV165 v.6	20140219	Product data sheet	-	74LV165 v.5
Modifications:	<ul style="list-style-type: none"> • Typo corrected in Table 2 "Pin description" 			
74LV165 v.5	20130909	Product data sheet	-	74LV165 v.4
Modifications:	<ul style="list-style-type: none"> • Typo corrected in the header of Table 6 "Static characteristics" 			
74LV165 v.4	20130830	Product data sheet	-	74LV165_CNV_3
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. • Family data added, see Section 9 "Static characteristics" 			
74LV165_CNV_3	December 1998	Product specification	-	-

15. Legal information

15.1 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.
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