

74LV165A

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

Rev. 4 — 28 March 2014

Product data sheet

1. General description

The 74LV165A is an 8-bit parallel-load or serial-in shift register with complementary serial outputs (Q_7 and $\overline{Q_7}$) 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 ($Q_0 \rightarrow Q_1 \rightarrow Q_2$, etc.) with each positive-going clock transition. This feature allows parallel-to-serial converter expansion by tying the output Q_7 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.

Schmitt-trigger action at all inputs, makes the circuit tolerant for slower input rise and fall times. It is fully specified for partial-power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the damaging current backflow through the device when it is powered down.

2. Features and benefits

- Wide supply voltage range from 2.0 V to 5.5 V
- Synchronous parallel-to-serial applications
- Synchronous serial input for easy expansion
- Latch-up performance exceeds 250 mA
- CMOS LOW power consumption
- 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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$

nexperia

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-------------|-------------------|---------|--|----------|
| | Temperature range | Name | Description | |
| 74LV165AD | -40 °C to +85 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74LV165APW | -40 °C to +85 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |

4. Functional diagram

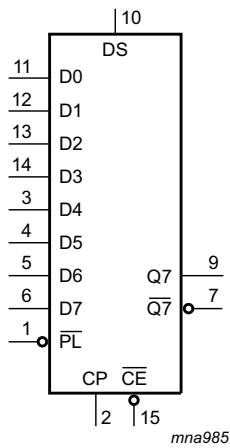


Fig 1. Logic symbol

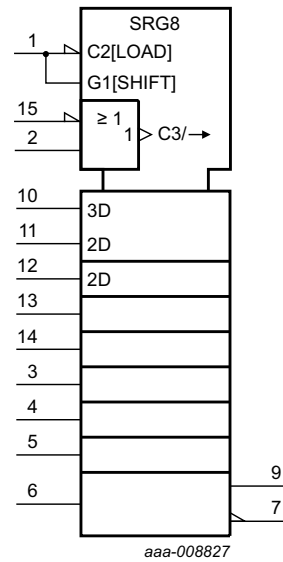


Fig 2. IEC logic symbol

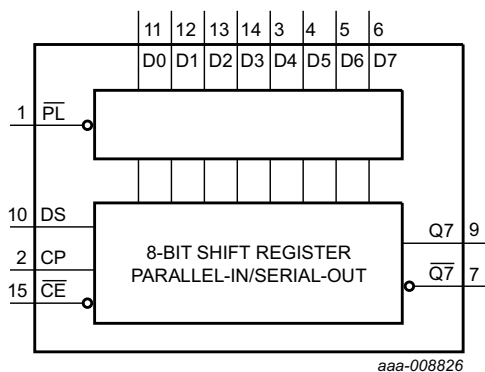


Fig 3. Functional diagram

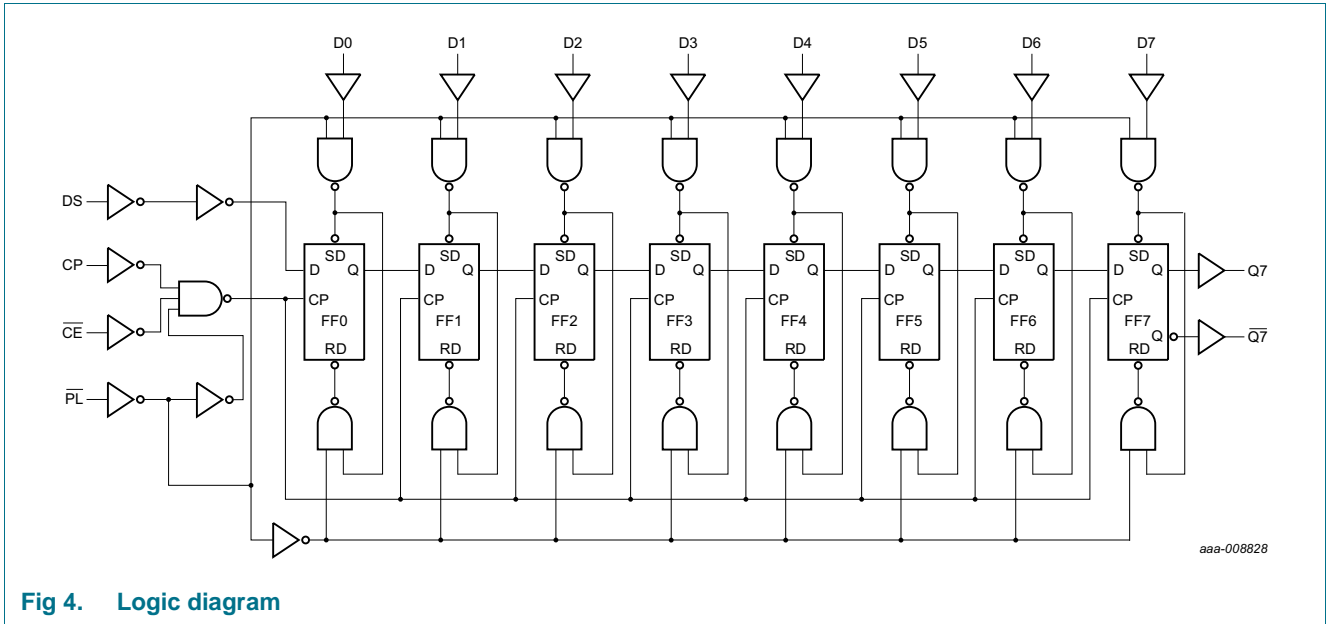
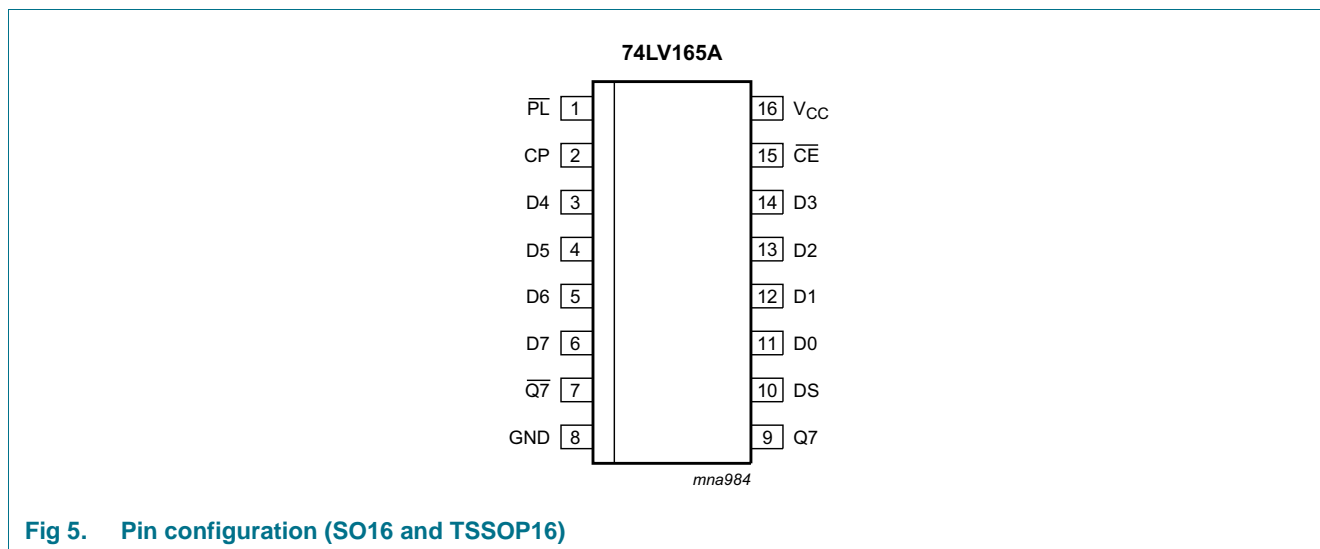


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|------------------------|----------------------------|---|
| $\overline{\text{PL}}$ | 1 | parallel enable input (active LOW) |
| CP | 2 | clock input (LOW-to-HIGH edge-triggered) |
| $\overline{\text{Q7}}$ | 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 |
| $\overline{\text{CE}}$ | 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 | $\overline{\text{q6}}$ |
| | 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 | $\overline{\text{q7}}$ |
| | H | X | H | X | X | q0 | q1 to q6 | q7 | $\overline{\text{q7}}$ |

- [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.

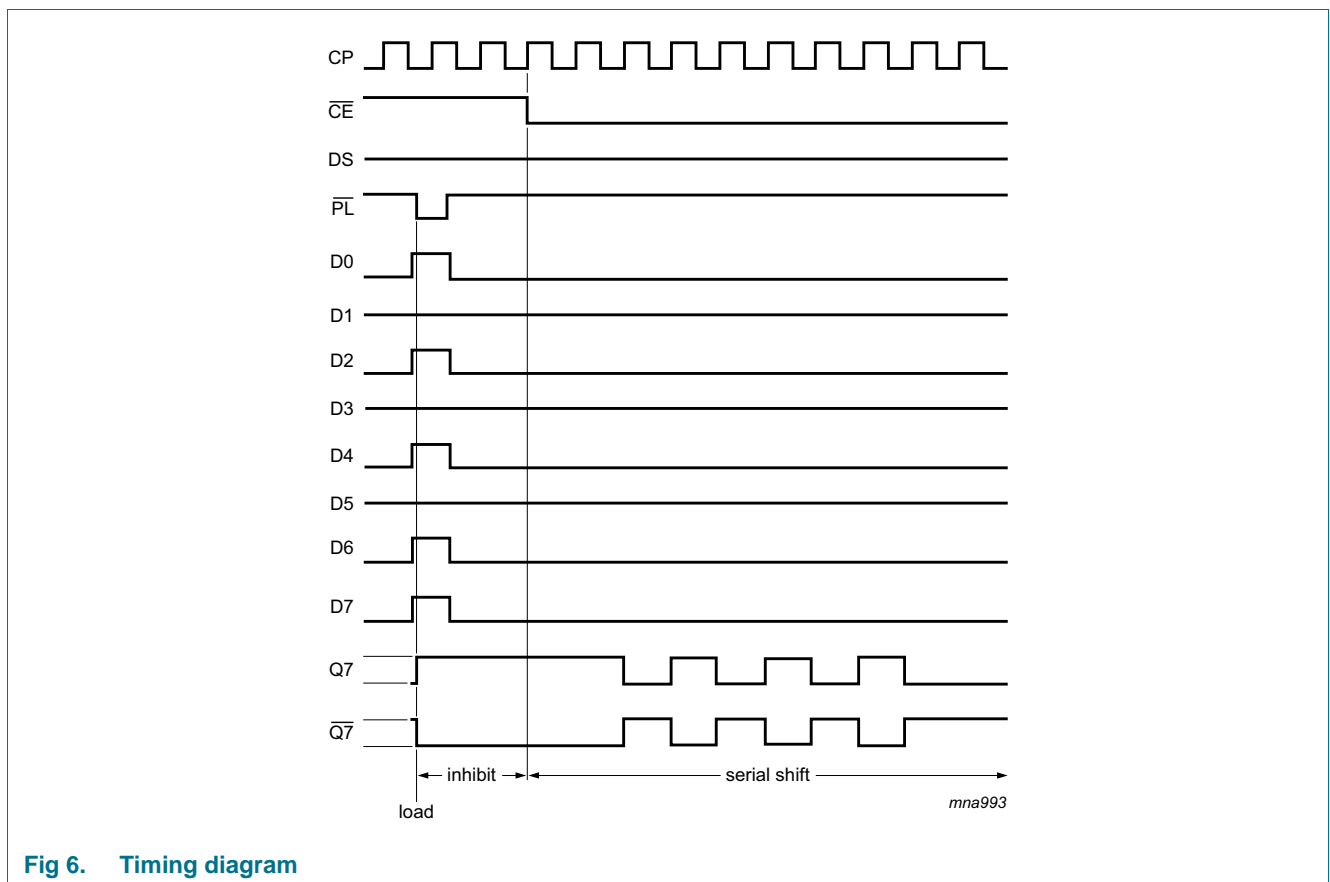


Fig 6. Timing diagram

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 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 |
| V _O | output voltage | | -0.5 | V _{CC} + 0.5 | V |
| | | power-down mode | -0.5 | +7 | V |
| I _O | output current | 0 V < V _O < V _{CC} | - | ±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 +85 °C | | | |
| | | SO16 package ^[2] | - | 500 | mW |
| | | TSSOP16 package ^[3] | - | 500 | 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 8 mW/K above 70 °C.

[3] 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 | | 2.0 | - | 5.5 | V |
| V _I | input voltage | | 0 | - | 5.5 | V |
| V _O | output voltage | | 0 | - | V _{CC} | V |
| T _{amb} | ambient temperature | | -40 | - | +85 | °C |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 2.3 V to 2.7 V | 0 | - | 200 | ns/V |
| | | V _{CC} = 3.0 V to 3.6 V | 0 | - | 100 | ns/V |
| | | V _{CC} = 4.5 V to 5.5 V | 0 | - | 20 | ns/V |

9. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | Unit |
|------------------|---------------------------|--|-------------------------------------|-------|--------------------|------|
| | | | Min | Typ | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | - | - | V |
| | | V _{CC} = 2.3 V to 2.7 V | 0.7V _{CC} | - | - | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.7V _{CC} | - | - | V |
| | | V _{CC} = 4.5 V to 5.5 V | 0.7V _{CC} | - | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | - | 0.5 | V |
| | | V _{CC} = 2.3 V to 2.7 V | - | - | 0.3V _{CC} | V |
| | | V _{CC} = 3.0 V to 3.6 V | - | - | 0.3V _{CC} | V |
| | | V _{CC} = 4.5 V to 5.5 V | - | - | 0.3V _{CC} | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | |
| | | I _O = -50 μA; V _{CC} = 2.0 V to 5.5 V | V _{CC} - 0.1 | - | - | V |
| | | I _O = -2.0 mA; V _{CC} = 2.3 V | 2.0 | - | - | V |
| | | I _O = -6.0 mA; V _{CC} = 3.0 V | 2.48 | - | - | V |
| | | I _O = -12 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 μA; V _{CC} = 2.0 V to 5.5 V | - | - | 0.10 | V |
| | | I _O = 2.0 mA; V _{CC} = 2.3 V | - | - | 0.40 | V |
| | | I _O = 6.0 mA; V _{CC} = 3.0 V | - | - | 0.44 | V |
| | | I _O = 12 mA; V _{CC} = 4.5 V | - | - | 0.55 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | ±0.01 | ±1 | μA |
| I _{OFF} | power-off leakage current | V _I or V _O = 5.5 V; V _{CC} = 0.0 V | - | ±0.05 | ±5 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | 0.2 | 20 | μA |
| C _I | input capacitance | | - | 3.0 | - | pF |

10. Dynamic characteristics

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

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | Unit | |
|--|-------------------|---|-------------------------------------|--------------------|------|------|----|
| | | | Min | Typ ^[1] | Max | | |
| t _{pd} | propagation delay | \overline{CE} , CP to Q7, $\overline{Q7}$; C _L = 15 pF; see Figure 7 and Figure 8 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 1.0 | 11.0 | 22.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 1.0 | 7.5 | 18.0 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 1.0 | 5.5 | 11.5 | ns |
| | | \overline{PL} to Q7, $\overline{Q7}$; C _L = 15 pF; see Figure 8 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 1.0 | 11.5 | 23.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 1.0 | 8.0 | 18.5 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 1.0 | 5.5 | 11.5 | ns |
| | | D7 to Q7, $\overline{Q7}$; C _L = 15 pF; see Figure 9 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 1.0 | 12.0 | 24.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 1.0 | 8.5 | 16.5 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 1.0 | 6.0 | 10.5 | ns |
| | | \overline{CE} , CP to Q7, $\overline{Q7}$; see Figure 7 and Figure 8 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 1.0 | 13.0 | 26.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 1.0 | 9.0 | 21.5 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 1.0 | 6.1 | 13.5 | ns |
| | | \overline{PL} to Q7, $\overline{Q7}$; see Figure 8 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 1.0 | 14.0 | 28.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 1.0 | 10.0 | 22.0 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 1.0 | 6.5 | 13.5 | ns |
| D7 to Q7, $\overline{Q7}$; see Figure 9 | | | | | | | |
| V _{CC} = 2.3 V to 2.7 V | [3] | 1.0 | 14.0 | 28.0 | ns | | |
| V _{CC} = 3.0 V to 3.6 V | [4] | 1.0 | 10.0 | 20 | ns | | |
| V _{CC} = 4.5 V to 5.5 V | [5] | 1.0 | 6.5 | 12.5 | ns | | |
| t _w | pulse width | CP input HIGH to LOW; see Figure 7 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 9.0 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 7.0 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 4.0 | - | - | ns |
| | | \overline{PL} input LOW; see Figure 8 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 13.0 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 9.0 | - | - | ns |
| V _{CC} = 4.5 V to 5.5 V | [5] | 6.0 | - | - | ns | | |
| t _{rec} | recovery time | \overline{PL} to CP, \overline{CE} ; see Figure 8 | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | [3] | 8.5 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V | [4] | 6.0 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V | [5] | 4.0 | - | - | ns |

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

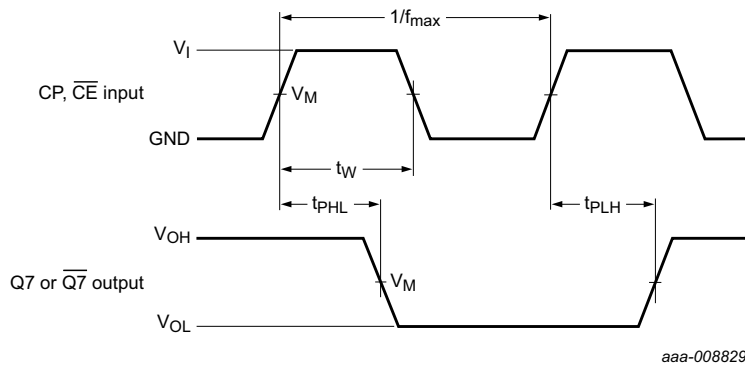
| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | Unit |
|------------------|-------------------|--|-------------------------------------|--------------------|-----|------|
| | | | Min | Typ ^[1] | Max | |
| t _{su} | set-up time | DS to CP, \overline{CE} ; see Figure 10 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 6.0 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 4.0 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 7.0 | - | - | ns |
| | | \overline{CE} to CP, CP to \overline{CE} ; see Figure 10 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 7.0 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 5.0 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 3.5 | - | - | ns |
| | | D7 to \overline{PL} ; see Figure 11 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 12 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 8.5 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 5.0 | - | - | ns |
| t _h | hold time | DS to CP, \overline{CE} ; \overline{PL} to CP, \overline{CE} ; see Figure 10 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 0 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 0 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 0.5 | - | - | ns |
| | | Dn to \overline{PL} ; see Figure 11 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 0.5 | - | - | ns |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 0.5 | - | - | ns |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 1.0 | - | - | ns |
| f _{max} | maximum frequency | CP input; C _L = 15 pF; see Figure 7 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 45 | 80 | - | MHz |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 50 | 115 | - | MHz |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 90 | 165 | - | MHz |
| | | CP input; see Figure 7 | | | | |
| | | V _{CC} = 2.3 V to 2.7 V ^[3] | 35 | 65 | - | MHz |
| | | V _{CC} = 3.0 V to 3.6 V ^[4] | 50 | 90 | - | MHz |
| | | V _{CC} = 4.5 V to 5.5 V ^[5] | 85 | 125 | - | MHz |

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

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | Unit |
|-----------------|-------------------------------|--|-------------------------------------|--------------------|-----|------|
| | | | Min | Typ ^[1] | Max | |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} ; V _{CC} = 3.3 V ^[6] | - | 24 | - | pF |

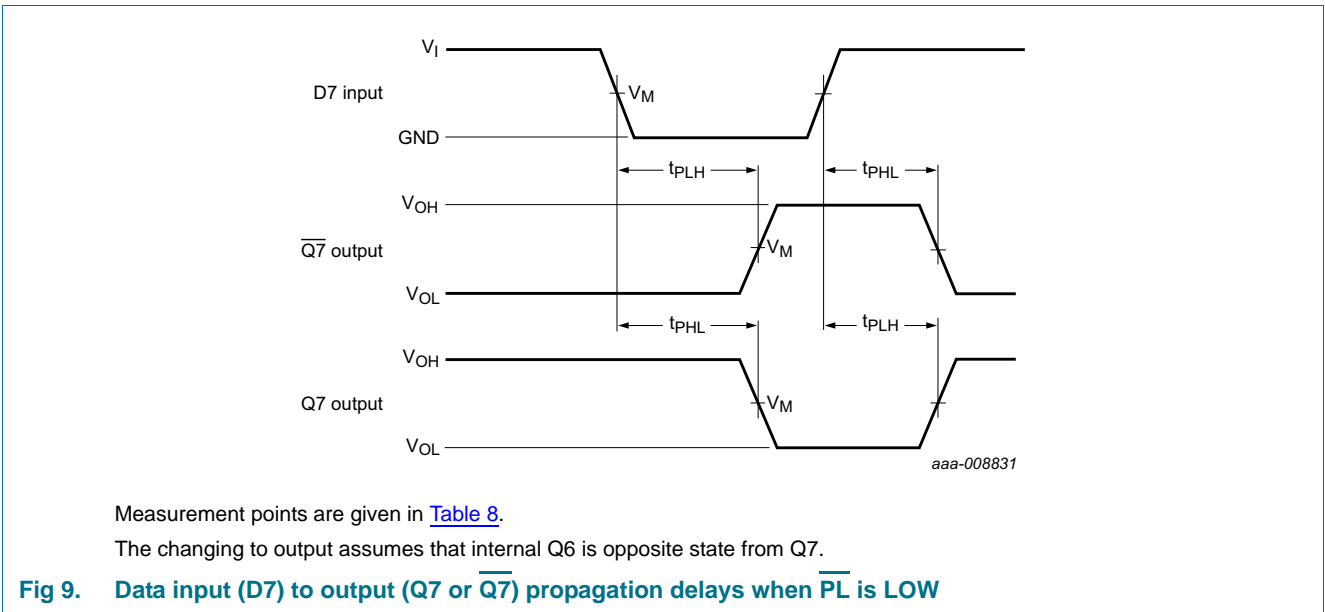
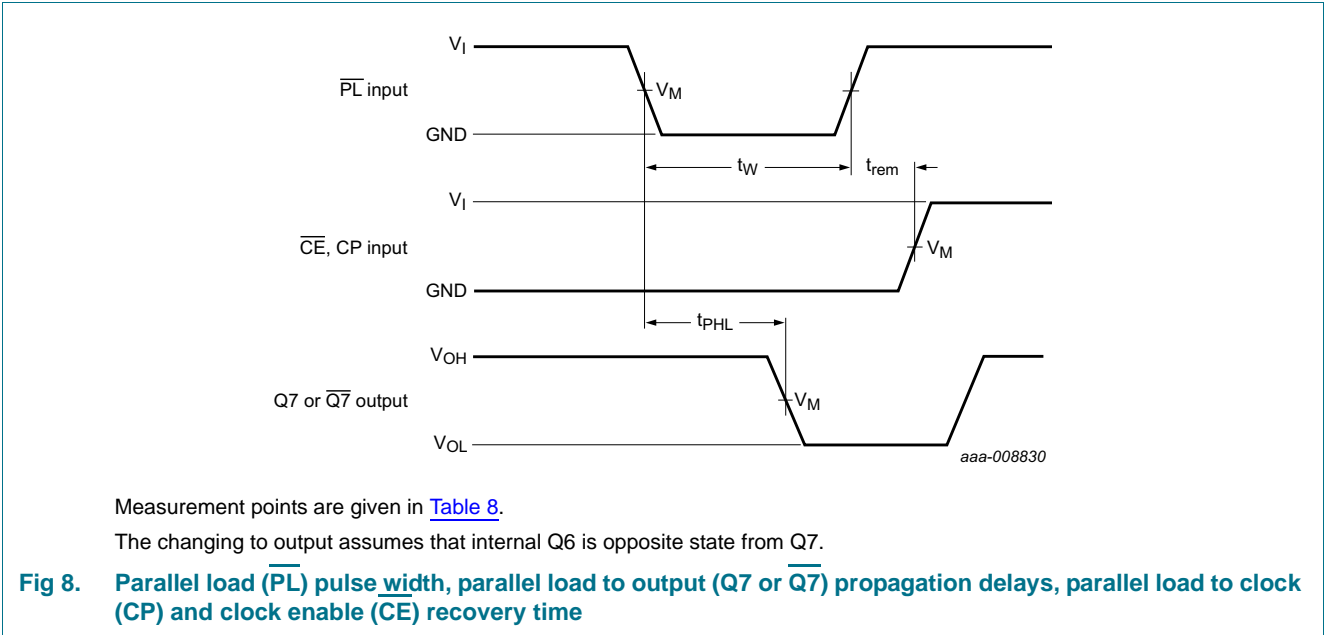
- [1] Typical values are measured at T_{amb} = 25 °C and nominal V_{CC}.
- [2] t_{pd} is the same as t_{PHL} and t_{PLH}.
- [3] Typical values are measured at V_{CC} = 2.5 V.
- [4] Typical values are measured at V_{CC} = 3.3 V.
- [5] Typical values are measured at V_{CC} = 5.0 V.
- [6] C_{PD} is used 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.

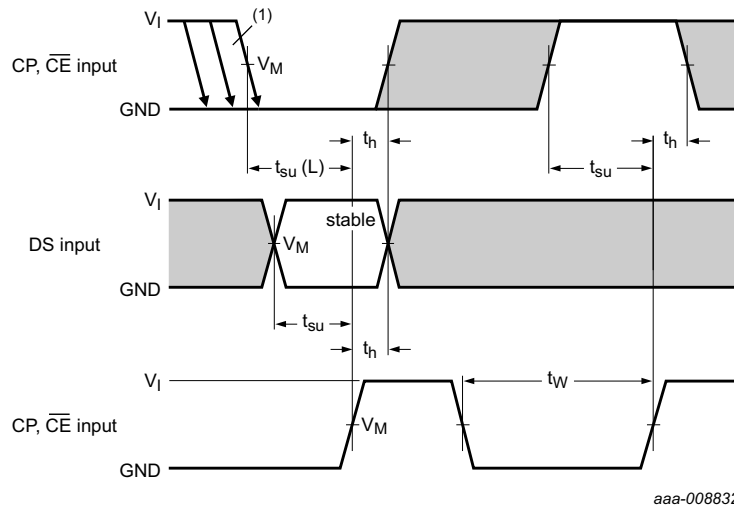
11. Waveforms



Measurement points are given in [Table 8](#).
 The changing to output assumes that internal Q6 is opposite state from Q7.

Fig 7. Clock pulse (CP) and clock enable (\overline{CE}) to output (Q7 or $\overline{Q7}$) propagation delays, clock pulse width and maximum clock frequency



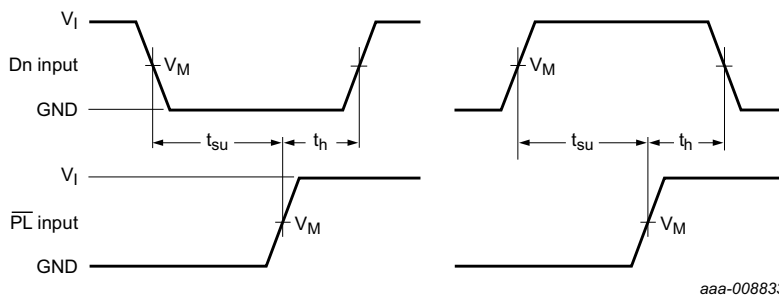


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Measurement points are given in [Table 8](#).

- (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



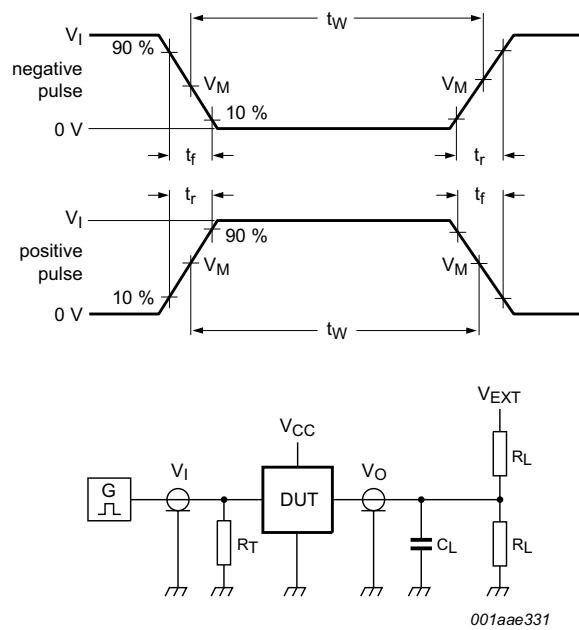
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Measurement points are given in [Table 8](#).

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 |
| 2.0 V to 5.5 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} |
| 2.0 V to 5.5 V | V_{CC} | 3.0 ns | 50 pF, 15 pF | 1 k Ω | open |

12. Package outline

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

SOT109-1

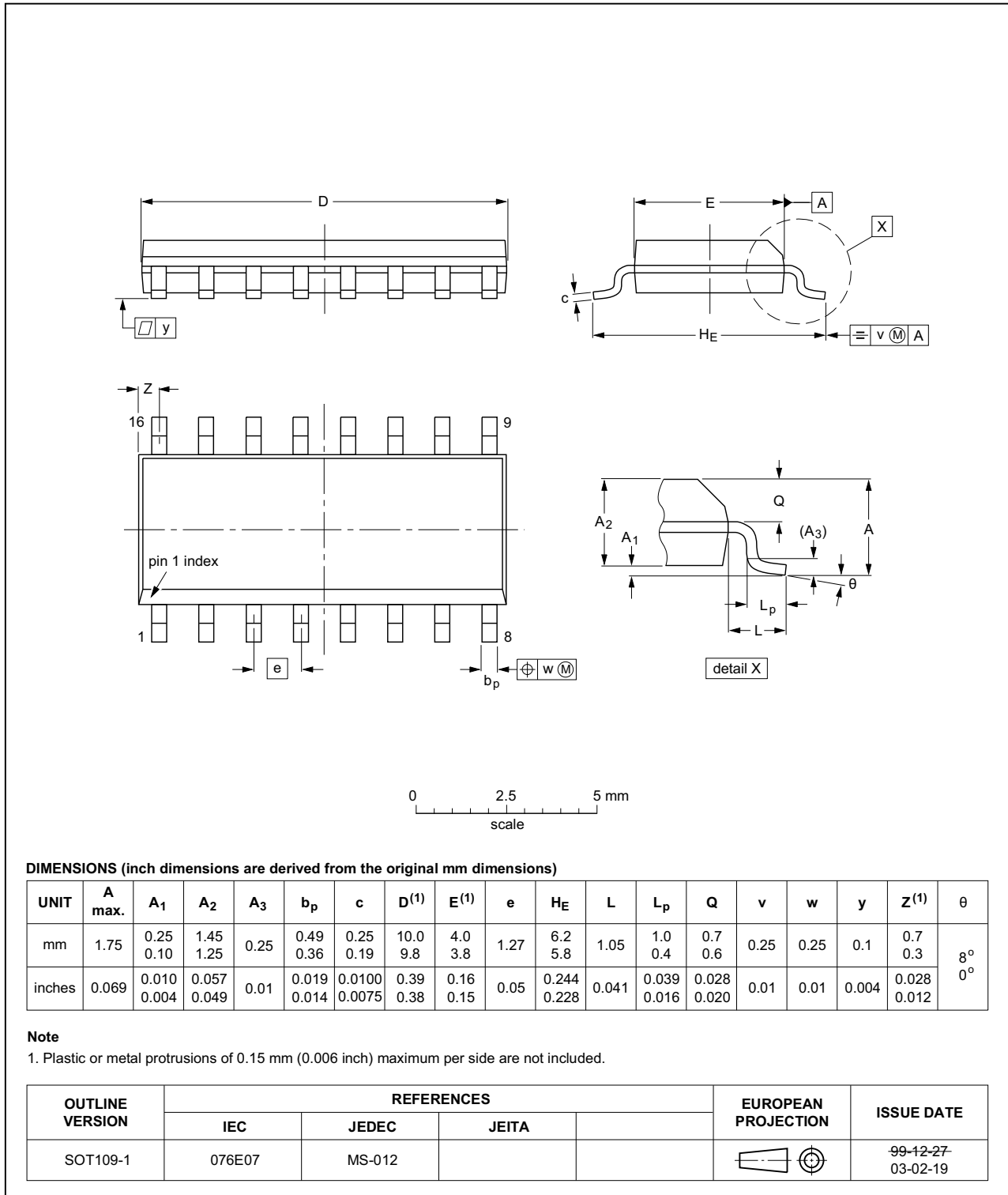


Fig 13. Package outline SOT109-1 (SO16)

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

SOT403-1

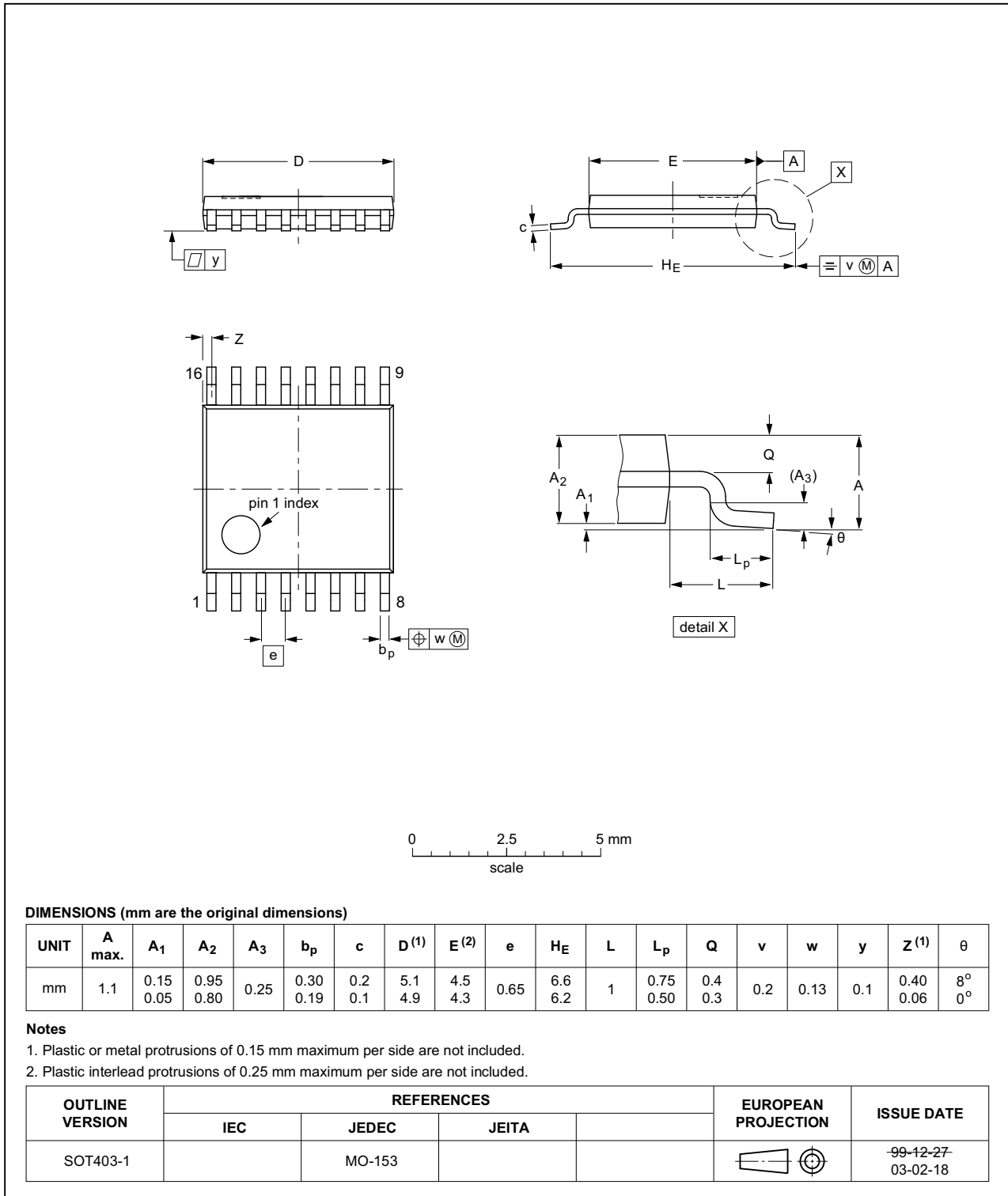


Fig 14. Package outline SOT403-1 (TSSOP16)

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 |
|----------------|--|-----------------------|---------------|----------------|
| 74LV165A v.4 | 20140328 | Product data sheet | - | 74LV165A v.3 |
| Modifications: | <ul style="list-style-type: none"> Minimum limit V_{OH} for $V_{CC} = 4.5$ V corrected from 3.0 V to 3.8 V (errata) in Table 6 "Static characteristics" | | | |
| 74LV165A v.3 | 20140220 | Product data sheet | - | 74LV165A v.2 |
| Modifications: | <ul style="list-style-type: none"> Typo corrected in Table 2 "Pin description" | | | |
| 74LV165A v.2 | 20130904 | Product data sheet | - | 74LV165A_CNV_1 |
| 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" | | | |
| 74LV165A_CNV_1 | December 1990 | 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. |
| 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.nexperia.com>.

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16. Contact information

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

For sales office addresses, please send an email to: salesaddresses@nexperia.com

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