

# 74HC299; 74HCT299

8-bit universal shift register; 3-state

Rev. 03 — 28 July 2008

Product data sheet

## 1. General description

The 74HC299; 74HCT299 are high-speed Si-gate CMOS devices which are pin-compatible with Low-power Schottky TTL (LSTTL) devices. They are specified in compliance with JEDEC standard no. 7A.

The 74HC299; 74HCT299 contain eight edge-triggered D-type flip-flops and the interstage logic necessary to perform synchronous shift-right, shift-left, parallel load and hold operations. An operation is determined by the mode select inputs S0 and S1, as shown in [Table 3](#).

Pins I/O0 to I/O7 are flip-flop 3-state buffer outputs which allow them to operate as data inputs in parallel load mode. The serial outputs Q0 and Q7 are used for expansion in serial shifting of longer words.

A LOW signal on the asynchronous master reset input  $\overline{MR}$  overrides the Sn and clock CP inputs and resets the flip-flops. All other state changes are initiated by the rising edge of the clock pulse. Inputs can change when the clock is in either state, provided that the recommended set-up and hold times are observed.

A HIGH signal on the 3-state output enable inputs  $\overline{OE1}$  or  $\overline{OE2}$  disables the 3-state buffers and the I/O outputs are set to the high-impedance OFF-state. In this condition, the shift, hold, load and reset operations still occur when preparing for a parallel load operation. The 3-state buffers are also disabled by HIGH signals on both S0 and S1.

## 2. Features

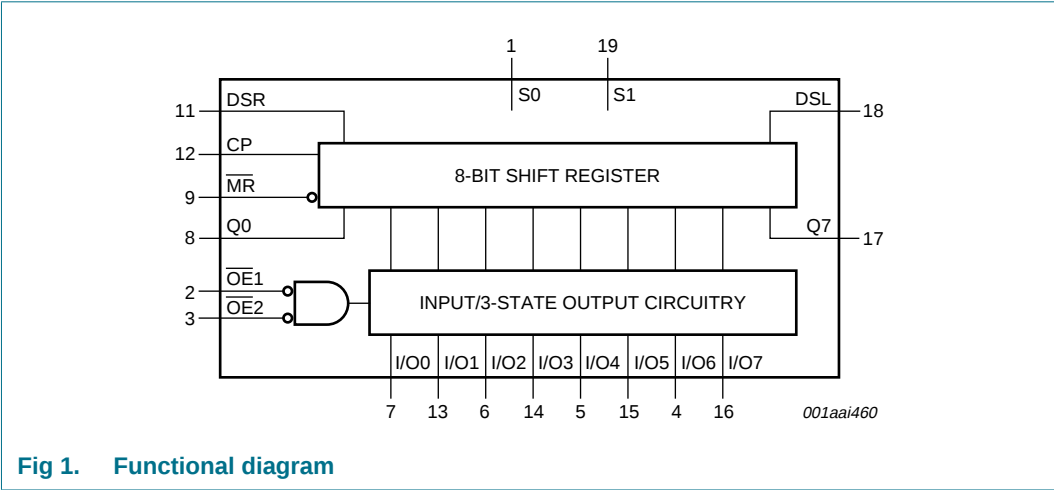
- Multiplexed inputs/outputs provide improved bit density
- Four operating modes:
  - ◆ Shift left
  - ◆ Shift right
  - ◆ Hold (store)
  - ◆ Load data
- Operates with output enable or at high-impedance OFF-state (Z)
- 3-state outputs drive bus lines directly
- Cascadable for n-bit word lengths
- ESD 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. Ordering information

Table 1. Ordering information

| Type number     | Package           |         |                                                                        |          |
|-----------------|-------------------|---------|------------------------------------------------------------------------|----------|
|                 | Temperature range | Name    | Description                                                            | Version  |
| <b>74HC299</b>  |                   |         |                                                                        |          |
| 74HC299D        | −40 °C to +125 °C | SO20    | plastic small outline package; 20 leads; body width 7.5 mm             | SOT163-1 |
| 74HC299DB       | −40 °C to +125 °C | SSOP20  | plastic shrink small outline package; 20 leads; body width 5.3 mm      | SOT339-1 |
| 74HC299N        | −40 °C to +125 °C | DIP20   | plastic dual in-line package; 20 leads (300 mil)                       | SOT146-1 |
| 74HC299PW       | −40 °C to +125 °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |
| <b>74HCT299</b> |                   |         |                                                                        |          |
| 74HCT299D       | −40 °C to +125 °C | SO20    | plastic small outline package; 20 leads; body width 7.5 mm             | SOT163-1 |
| 74HCT299DB      | −40 °C to +125 °C | SSOP20  | plastic shrink small outline package; 20 leads; body width 5.3 mm      | SOT339-1 |
| 74HCT299N       | −40 °C to +125 °C | DIP20   | plastic dual in-line package; 20 leads (300 mil)                       | SOT146-1 |
| 74HCT299PW      | −40 °C to +125 °C | TSSOP20 | plastic thin shrink small outline package; 20 leads; body width 4.4 mm | SOT360-1 |

4. Functional diagram



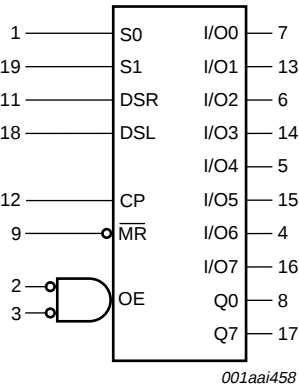


Fig 2. Logic symbol

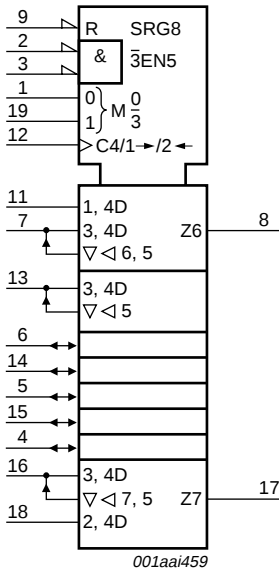


Fig 3. IEC logic symbol

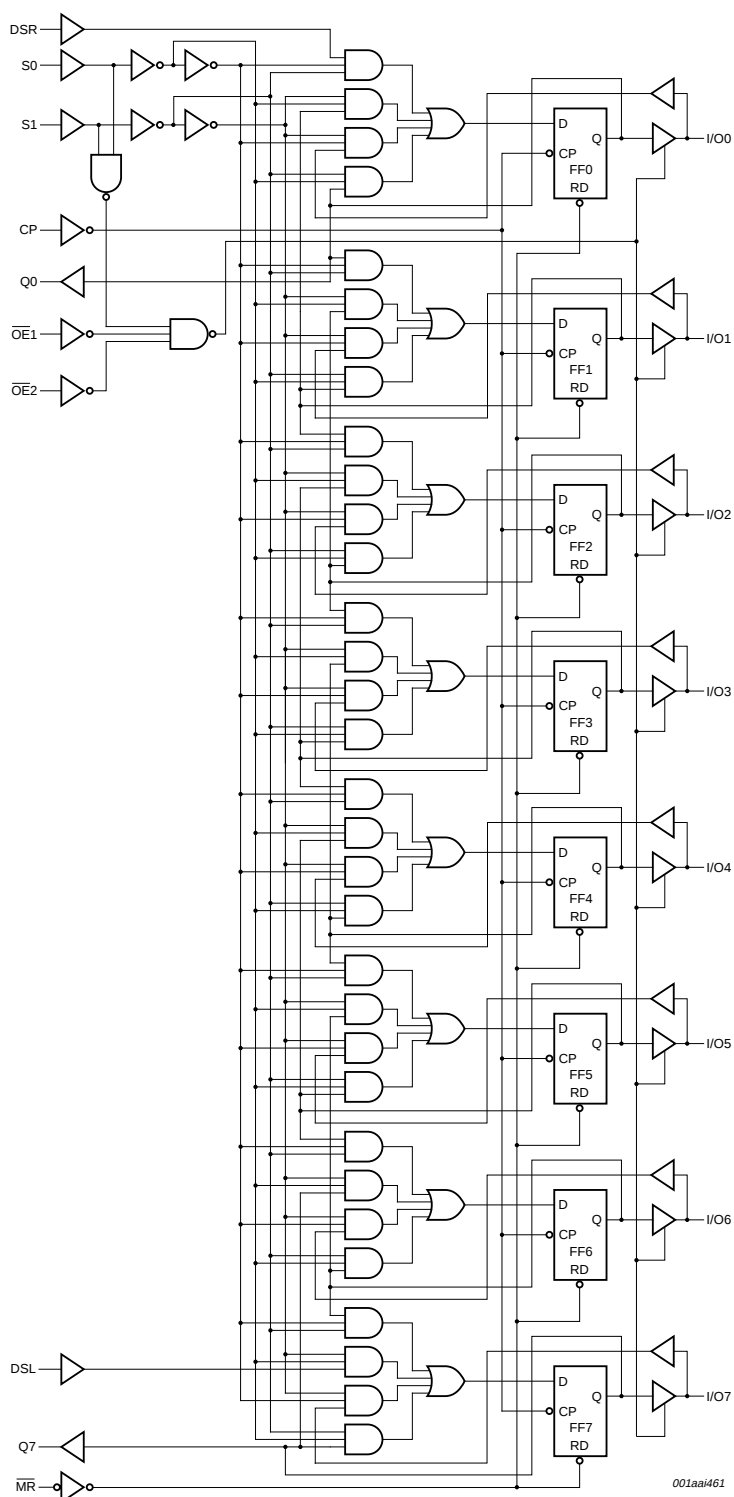


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning

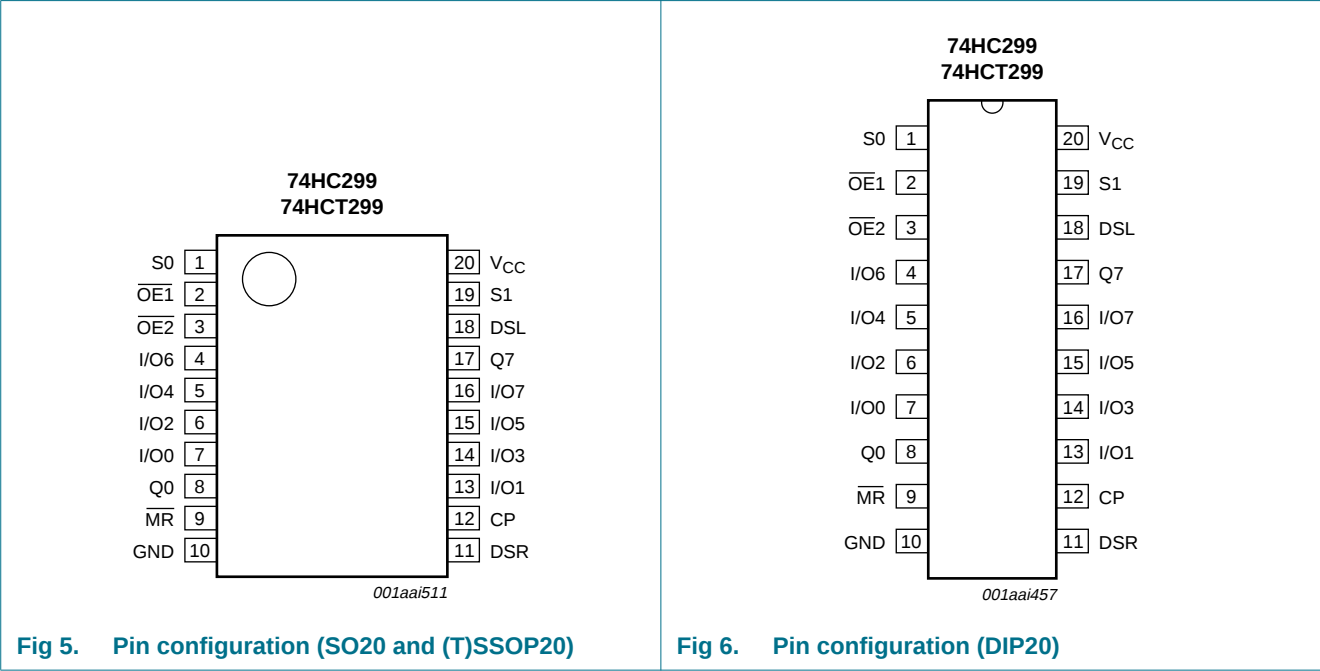


Fig 5. Pin configuration (SO20 and (T)SSOP20)

Fig 6. Pin configuration (DIP20)

5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description                                                 |
|--------|-----|-------------------------------------------------------------|
| S0     | 1   | mode select input                                           |
| OE1    | 2   | 3-state output enable input (active LOW)                    |
| OE2    | 3   | 3-state output enable input (active LOW)                    |
| I/O6   | 4   | parallel data input or 3-state parallel output (bus driver) |
| I/O4   | 5   | parallel data input or 3-state parallel output (bus driver) |
| I/O2   | 6   | parallel data input or 3-state parallel output (bus driver) |
| I/O0   | 7   | parallel data input or 3-state parallel output (bus driver) |
| Q0     | 8   | serial output (standard output)                             |
| MR     | 9   | asynchronous master reset input (active LOW)                |
| GND    | 10  | ground (0 V)                                                |
| DSR    | 11  | serial data shift-right input                               |
| CP     | 12  | clock input (LOW to HIGH, edge-triggered)                   |
| I/O1   | 13  | parallel data input or 3-state parallel output (bus driver) |
| I/O3   | 14  | parallel data input or 3-state parallel output (bus driver) |
| I/O5   | 15  | parallel data input or 3-state parallel output (bus driver) |
| I/O7   | 16  | parallel data input or 3-state parallel output (bus driver) |
| Q7     | 17  | serial output (standard output)                             |

Table 2. Pin description ...continued

| Symbol          | Pin | Description                  |
|-----------------|-----|------------------------------|
| DSL             | 18  | serial data shift-left input |
| S1              | 19  | mode select input            |
| V <sub>CC</sub> | 20  | positive supply voltage      |

## 6. Functional description

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

| Input |    |    |    | Response                             |
|-------|----|----|----|--------------------------------------|
| MR    | S1 | S0 | CP |                                      |
| L     | X  | X  | X  | asynchronous reset; Q0 to Q7 = LOW   |
| H     | H  | H  | ↑  | parallel load; I/On → Qn             |
| H     | L  | H  | ↑  | shift right; DSR → Q0, Q0 → Q1, etc. |
| H     | H  | L  | ↑  | shift left; DSL → Q7, Q7 → Q6, etc.  |
| H     | L  | L  | X  | hold                                 |

- [1] H = HIGH voltage level;  
 L = LOW voltage level;  
 ↑ = LOW to HIGH CP transition;  
 X = don't care.

## 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 <sub>CC</sub>  | supply voltage          |                                                                     | -0.5             | +7   | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>O</sub>   | output current          | -0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V                   |                  |      |      |
|                  | standard outputs        |                                                                     | -                | ±25  | mA   |
|                  | bus driver outputs      |                                                                     | -                | ±35  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                     |                  |      |      |
|                  | standard outputs        |                                                                     | -                | 50   | mA   |
|                  | bus driver outputs      |                                                                     | -                | 70   | mA   |
| I <sub>GND</sub> | ground current          |                                                                     |                  |      |      |
|                  | standard outputs        |                                                                     | -50              | -    | mA   |
|                  | bus driver outputs      |                                                                     | -70              | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                     | -65              | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C                                |                  |      |      |
|                  |                         | DIP20 package                                                       | <sup>[2]</sup> - | 750  | mW   |
|                  |                         | SO20 package                                                        | <sup>[3]</sup> - | 500  | mW   |
|                  |                         | (T)SSOP20 package                                                   | <sup>[4]</sup> - | 500  | mW   |

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

[2]  $P_{\text{tot}}$  derates linearly at 12 mW/K above 70 °C.

[3]  $P_{\text{tot}}$  derates linearly at 8 mW/K above 70 °C.

[4]  $P_{\text{tot}}$  derates linearly at 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                      | 74HC299 |      |                 | 74HCT299 |      |                 | Unit |
|---------------------|-------------------------------------|---------------------------------|---------|------|-----------------|----------|------|-----------------|------|
|                     |                                     |                                 | Min     | Typ  | Max             | Min      | Typ  | Max             |      |
| $V_{\text{CC}}$     | supply voltage                      |                                 | 2.0     | 5.0  | 6.0             | 4.5      | 5.0  | 5.5             | V    |
| $V_{\text{I}}$      | input voltage                       |                                 | 0       | -    | $V_{\text{CC}}$ | 0        | -    | $V_{\text{CC}}$ | V    |
| $V_{\text{O}}$      | output voltage                      |                                 | 0       | -    | $V_{\text{CC}}$ | 0        | -    | $V_{\text{CC}}$ | V    |
| $T_{\text{amb}}$    | ambient temperature                 |                                 | -40     | -    | +125            | -40      | -    | +125            | °C   |
| $\Delta t/\Delta V$ | input transition rise and fall rate |                                 |         |      |                 |          |      |                 |      |
|                     |                                     | $V_{\text{CC}} = 2.0 \text{ V}$ | -       | -    | 625             | -        | -    | -               | ns/V |
|                     |                                     | $V_{\text{CC}} = 4.5 \text{ V}$ | -       | 1.67 | 139             | -        | 1.67 | 1.39            | ns/V |
|                     |                                     | $V_{\text{CC}} = 6.0 \text{ V}$ | -       | -    | 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  |      |
| 74HC299         |                          |                         |       |     |      |                  |      |                   |      |      |
| 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>                                                                    |       |      |      |                  |      |                   |       |      |
|                  |                               | all outputs                                                                                                            |       |      |      |                  |      |                   |       |      |
|                  |                               | 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    |
|                  |                               | standard outputs                                                                                                       |       |      |      |                  |      |                   |       |      |
|                  |                               | 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    |
|                  |                               | bus driver outputs                                                                                                     |       |      |      |                  |      |                   |       |      |
|                  |                               | I <sub>O</sub> = –6.0 mA; V <sub>CC</sub> = 4.5 V                                                                      | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -     | V    |
|                  |                               | I <sub>O</sub> = –7.8 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>                                                                    |       |      |      |                  |      |                   |       |      |
|                  |                               | all outputs                                                                                                            |       |      |      |                  |      |                   |       |      |
|                  |                               | 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    |
|                  |                               | standard outputs                                                                                                       |       |      |      |                  |      |                   |       |      |
|                  |                               | 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    |
|                  |                               | bus driver outputs                                                                                                     |       |      |      |                  |      |                   |       |      |
|                  |                               | I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V                                                                       | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4   | V    |
|                  |                               | I <sub>O</sub> = 7.8 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 | -                | ±1.0 | -                 | ±1.0  | µA   |
| I <sub>OZ</sub>  | OFF-state output current      | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V | -     | -    | ±0.5 | -                | ±5.0 | -                 | ±10.0 | 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> = 6.0 V                                 | -     | -    | 8.0  | -                | 80   | -                 | 160   | µA   |
| C <sub>I</sub>   | input capacitance             |                                                                                                                        | -     | 3.5  | -    | -                | -    | -                 | -     | pF   |
| C <sub>I/O</sub> | input/output capacitance      |                                                                                                                        | -     | 10   | -    | -                | -    | -                 | -     | pF   |
| C <sub>PD</sub>  | power dissipation capacitance | per package <a href="#">[1]</a>                                                                                        | -     | 120  | -    | -                | -    | -                 | -     | pF   |
| <b>74HCT299</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    |

**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>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<br>all outputs                                                                                                          |       |      |      |                  |       |                   |       |      |
|                  |                               | I <sub>O</sub> = –20 µA                                                                                                                                                                               | 4.4   | 4.5  | -    | 4.4              | -     | 4.4               | -     | V    |
|                  |                               | standard outputs<br>I <sub>O</sub> = –4.0 mA                                                                                                                                                          | 3.98  | 4.32 | -    | 3.84             | -     | 3.7               | -     | V    |
|                  |                               | bus driver outputs<br>I <sub>O</sub> = –6.0 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<br>all outputs                                                                                                          |       |      |      |                  |       |                   |       |      |
|                  |                               | I <sub>O</sub> = 20 µA                                                                                                                                                                                | -     | 0    | 0.1  | -                | 0.1   | -                 | 0.1   | V    |
|                  |                               | standard outputs<br>I <sub>O</sub> = 4.0 mA                                                                                                                                                           | -     | 0.15 | 0.26 | -                | 0.33  | -                 | 0.4   | V    |
|                  |                               | bus driver outputs<br>I <sub>O</sub> = 6.0 mA                                                                                                                                                         | -     | 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;<br>V <sub>CC</sub> = 5.5 V                                                                                                                                   | -     | -    | ±0.1 | -                | ±1.0  | -                 | ±1.0  | µA   |
| I <sub>OZ</sub>  | OFF-state output current      | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND per input pin; other inputs at V <sub>CC</sub> or GND;<br>I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V | -     | -    | ±0.5 | -                | ±5.0  | -                 | ±10.0 | µA   |
| I <sub>CC</sub>  | supply current                | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V                                                                                                             | -     | -    | 8.0  | -                | 80    | -                 | 160   | µA   |
| ΔI <sub>CC</sub> | additional supply current     | per input pin;<br>V <sub>I</sub> = V <sub>CC</sub> – 2.1 V;<br>other inputs at V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 4.5 V to 5.5 V                                      |       |      |      |                  |       |                   |       |      |
|                  |                               | I/On, DSR, DSL, MR and S1                                                                                                                                                                             | -     | 25   | 90   | -                | 112.5 | -                 | 122.5 | µA   |
|                  |                               | CP, S0                                                                                                                                                                                                | -     | 60   | 216  | -                | 270   | -                 | 294   | µA   |
|                  |                               | $\overline{\text{OE}}_{\text{n}}$                                                                                                                                                                     | -     | 30   | 108  | -                | 135   | -                 | 147   | µA   |
| C <sub>I</sub>   | input capacitance             |                                                                                                                                                                                                       | -     | 3.5  | -    | -                | -     | -                 | -     | pF   |
| C <sub>I/O</sub> | input/output capacitance      |                                                                                                                                                                                                       | -     | 10   | -    | -                | -     | -                 | -     | pF   |
| C <sub>PD</sub>  | power dissipation capacitance | per package <a href="#">[1]</a>                                                                                                                                                                       | -     | 125  | -    | -                | -     | -                 | -     | pF   |

[1] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in µW).P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> + Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) where:f<sub>i</sub> = input frequency in MHz;f<sub>o</sub> = output frequency in MHz;

$\Sigma(C_L \times V_{CC}^2 \times f_0)$  = sum of outputs.

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$V_I$  = GND to  $V_{CC}$  for 74HC299;

$V_I$  = GND to ( $V_{CC} - 1.5$  V) for 74HCT299.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

GND (ground = 0 V); for test circuit, see [Figure 11](#).

| Symbol          | Parameter         | Conditions                                         | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------------|-------------------|----------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                   |                                                    | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC299         |                   |                                                    |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub> | propagation delay | CP to Q0, Q7; see <a href="#">Figure 7</a>         | [1]   |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                            | -     | 66  | 200 | -                | 250 | -                 | 300 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                            | -     | 24  | 40  | -                | 50  | -                 | 60  | ns   |
|                 |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF    | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                            | -     | 19  | 34  | -                | 43  | -                 | 51  | ns   |
|                 |                   | CP to I/On; see <a href="#">Figure 7</a>           |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                            | -     | 66  | 200 | -                | 250 | -                 | 300 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                            | -     | 24  | 40  | -                | 50  | -                 | 60  | ns   |
|                 |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF    | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                            | -     | 19  | 34  | -                | 43  | -                 | 51  | ns   |
|                 |                   | MR to Q0, Q7 or I/On; see <a href="#">Figure 8</a> | [2]   |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                            | -     | 66  | 200 | -                | 250 | -                 | 300 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                            | -     | 24  | 40  | -                | 50  | -                 | 60  | ns   |
|                 |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF    | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                            | -     | 19  | 34  | -                | 43  | -                 | 51  | ns   |
| t <sub>t</sub>  | transition time   | bus driver (I/On); see <a href="#">Figure 7</a>    | [3]   |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                            | -     | 14  | 60  | -                | 75  | -                 | 90  | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                            | -     | 5   | 12  | -                | 15  | -                 | 18  | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                            | -     | 4   | 10  | -                | 13  | -                 | 15  | ns   |
|                 |                   | standard (Q0, Q7); see <a href="#">Figure 7</a>    |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                            | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                            | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                            | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |

**Table 7. Dynamic characteristics ...continued**  
 GND (ground = 0 V); for test circuit, see [Figure 11](#).

| Symbol    | Parameter                           | Conditions                                                              | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------|-------------------------------------|-------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|           |                                     |                                                                         | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_w$     | pulse width                         | CP HIGH or LOW; see <a href="#">Figure 7</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   |
|           |                                     | $\overline{MR}$ LOW; see <a href="#">Figure 8</a>                       |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 2.0\text{ V}$                                                 | 80    | 19  | -   | 100              | -   | 120               | -   | ns   |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                                 | 16    | 7   | -   | 20               | -   | 24                | -   | ns   |
| $t_{PZH}$ | OFF-state to HIGH propagation delay | $\overline{OE_n}$ to I/On; see <a href="#">Figure 10</a> <sup>[4]</sup> |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 2.0\text{ V}$                                                 | -     | 50  | 155 | -                | 195 | -                 | 235 | ns   |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                                 | -     | 18  | 31  | -                | 39  | -                 | 47  | ns   |
|           |                                     | $V_{CC} = 6.0\text{ V}$                                                 | -     | 14  | 26  | -                | 33  | -                 | 40  | ns   |
| $t_{PLZ}$ | OFF-state to LOW propagation delay  | $\overline{OE_n}$ to I/On; see <a href="#">Figure 10</a>                |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 2.0\text{ V}$                                                 | -     | 41  | 130 | -                | 165 | -                 | 195 | ns   |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                                 | -     | 15  | 26  | -                | 33  | -                 | 39  | ns   |
|           |                                     | $V_{CC} = 6.0\text{ V}$                                                 | -     | 12  | 22  | -                | 28  | -                 | 33  | ns   |
| $t_{PHZ}$ | HIGH to OFF-state propagation delay | $\overline{OE_n}$ to I/On; see <a href="#">Figure 10</a> <sup>[5]</sup> |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 2.0\text{ V}$                                                 | -     | 66  | 185 | -                | 230 | -                 | 280 | ns   |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                                 | -     | 24  | 37  | -                | 46  | -                 | 56  | ns   |
|           |                                     | $V_{CC} = 6.0\text{ V}$                                                 | -     | 19  | 31  | -                | 39  | -                 | 48  | ns   |
| $t_{PLZ}$ | LOW to OFF-state propagation delay  | $\overline{OE_n}$ to I/On; see <a href="#">Figure 10</a>                |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 2.0\text{ V}$                                                 | -     | 55  | 155 | -                | 195 | -                 | 235 | ns   |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                                 | -     | 20  | 31  | -                | 39  | -                 | 47  | ns   |
|           |                                     | $V_{CC} = 6.0\text{ V}$                                                 | -     | 16  | 26  | -                | 33  | -                 | 40  | ns   |
| $t_{rec}$ | recovery time                       | $\overline{MR}$ to CP; see <a href="#">Figure 8</a>                     |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 2.0\text{ V}$                                                 | 5     | -14 | -   | 5                | -   | 5                 | -   | ns   |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                                 | 5     | -5  | -   | 5                | -   | 5                 | -   | ns   |
|           |                                     | $V_{CC} = 6.0\text{ V}$                                                 | 5     | -4  | -   | 5                | -   | 5                 | -   | ns   |

**Table 7. Dynamic characteristics ...continued**  
 GND (ground = 0 V); for test circuit, see [Figure 11](#).

| Symbol           | Parameter         | Conditions                                                             | 25 °C               |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------|------------------------------------------------------------------------|---------------------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                   |                                                                        | Min                 | Typ | Max | Min              | Max | Min               | Max |      |
| t <sub>su</sub>  | set-up time       | DSR, DSL to CP; see <a href="#">Figure 7</a>                           |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                | 100                 | 33  | -   | 125              | -   | 150               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | 20                  | 12  | -   | 25               | -   | 30                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                | 17                  | 10  | -   | 21               | -   | 26                | -   | ns   |
|                  |                   | S0, S1 to CP; see <a href="#">Figure 9</a>                             |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                | 100                 | 33  | -   | 125              | -   | 150               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | 20                  | 12  | -   | 25               | -   | 30                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                | 17                  | 10  | -   | 21               | -   | 26                | -   | ns   |
|                  |                   | I/On to CP; see <a href="#">Figure 7</a>                               |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                | 125                 | 39  | -   | 155              | -   | 190               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | 25                  | 14  | -   | 31               | -   | 38                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                | 21                  | 11  | -   | 26               | -   | 32                | -   | ns   |
| t <sub>h</sub>   | hold time         | I/On, DSR, DSL to CP; see <a href="#">Figure 7</a>                     |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                | 0                   | –14 | -   | 0                | -   | 0                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | 0                   | –5  | -   | 0                | -   | 0                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                | 0                   | –4  | -   | 0                | -   | 0                 | -   | ns   |
|                  |                   | S0, S1 to CP; see <a href="#">Figure 9</a>                             |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                | 0                   | –28 | -   | 0                | -   | 0                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | 0                   | –10 | -   | 0                | -   | 0                 | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                | 0                   | –8  | -   | 0                | -   | 0                 | -   | ns   |
|                  |                   |                                                                        |                     |     |     |                  |     |                   |     |      |
| f <sub>max</sub> | maximum frequency | CP input; see <a href="#">Figure 7</a>                                 |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2.0 V                                                | 5.0                 | 15  | -   | 4.0              | -   | 3.4               | -   | MHz  |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | 25                  | 45  | -   | 20               | -   | 17                | -   | MHz  |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                        | -                   | 50  | -   | -                | -   | -                 | -   | MHz  |
|                  |                   | V <sub>CC</sub> = 6.0 V                                                | 29                  | 54  | -   | 24               | -   | 20                | -   | MHz  |
| 74HCT299         |                   |                                                                        |                     |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay | CP to Q0, Q7; see <a href="#">Figure 7</a>                             | <a href="#">[1]</a> |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | -                   | 22  | 37  | -                | 46  | -                 | 56  | ns   |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                        | -                   | 19  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | CP to I/On; see <a href="#">Figure 7</a>                               |                     |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | -                   | 22  | 37  | -                | 46  | -                 | 56  | ns   |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                        | -                   | 19  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | $\overline{\text{MR}}$ to Q0, Q7 or I/On; see <a href="#">Figure 8</a> | <a href="#">[2]</a> |     |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 4.5 V                                                | -                   | 27  | 46  | -                | 58  | -                 | 69  | ns   |
|                  |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                        | -                   | 23  | -   | -                | -   | -                 | ns  |      |

**Table 7. Dynamic characteristics ...continued**  
 GND (ground = 0 V); for test circuit, see [Figure 11](#).

| Symbol    | Parameter                           | Conditions                                                  | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------|-------------------------------------|-------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|           |                                     |                                                             | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_t$     | transition time                     | bus driver (I/On); see <a href="#">Figure 7</a> [3]         |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | -     | 5   | 12  | -                | 15  | -                 | 18  | ns   |
|           |                                     | standard (Q0, Q7); see <a href="#">Figure 7</a>             |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| $t_W$     | pulse width                         | clock HIGH or LOW; see <a href="#">Figure 7</a>             |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 20    | 10  | -   | 25               | -   | 30                | -   | ns   |
|           |                                     | master reset LOW; see <a href="#">Figure 8</a>              |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 20    | 11  | -   | 25               | -   | 30                | -   | ns   |
| $t_{en}$  | enable time                         | $\overline{OEn}$ to I/On; see <a href="#">Figure 10</a> [4] |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | -     | 19  | 30  | -                | 38  | -                 | 45  | ns   |
| $t_{PHZ}$ | HIGH to OFF-state propagation delay | $\overline{OEn}$ to I/On; see <a href="#">Figure 10</a> [5] |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | -     | 24  | 37  | -                | 46  | -                 | 56  | ns   |
| $t_{PLZ}$ | LOW to OFF-state propagation delay  | $\overline{OEn}$ to I/On; see <a href="#">Figure 10</a>     |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | -     | 20  | 32  | -                | 40  | -                 | 48  | ns   |
| $t_{rec}$ | recovery time                       | $\overline{MR}$ to CP; see <a href="#">Figure 8</a>         |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 10    | 2   | -   | 9                | -   | 11                | -   | ns   |
| $t_{su}$  | set-up time                         | I/On, DSR, DSL to CP; see <a href="#">Figure 7</a>          |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 25    | 14  | -   | 31               | -   | 38                | -   | ns   |
|           |                                     | S0, S1 to CP; see <a href="#">Figure 9</a>                  |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 32    | 18  | -   | 40               | -   | 48                | -   | ns   |
| $t_h$     | hold time                           | I/On, DSR, DSL to CP; see <a href="#">Figure 7</a>          |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 0     | -11 | -   | 0                | -   | 0                 | -   | ns   |
|           |                                     | S0, S1 to CP; see <a href="#">Figure 9</a>                  |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 0     | -17 | -   | 0                | -   | 0                 | -   | ns   |
| $f_{max}$ | maximum frequency                   | CP input; see <a href="#">Figure 7</a>                      |       |     |     |                  |     |                   |     |      |
|           |                                     | $V_{CC} = 4.5\text{ V}$                                     | 25    | 42  | -   | 20               | -   | 17                | -   | MHz  |
|           |                                     | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$              | -     | 46  | -   | -                | -   | -                 | -   | MHz  |

[1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .

[2]  $t_{pd}$  is the same as  $t_{PHL}$ .

[3]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

[4]  $t_{en}$  is the same as  $t_{PZH}$  and  $t_{PZL}$ .

[5]  $t_{dis}$  is the same as  $t_{PHZ}$  and  $t_{PLZ}$ .

[6]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

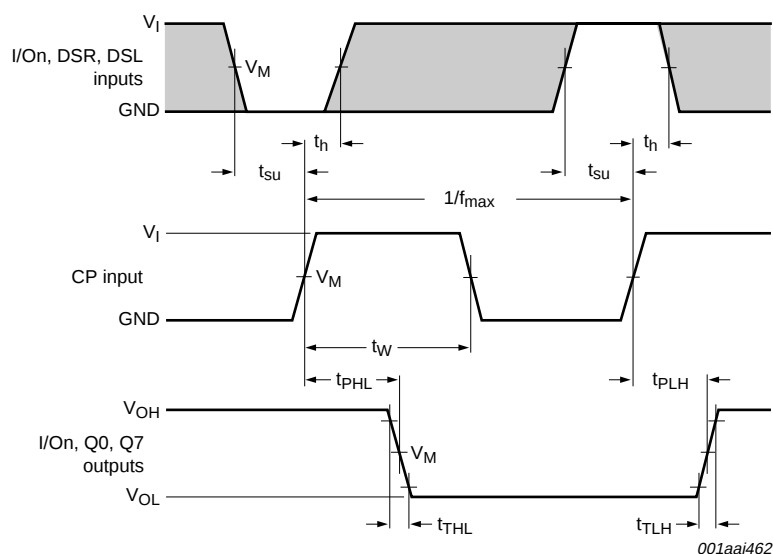
$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching.

## 11. Waveforms

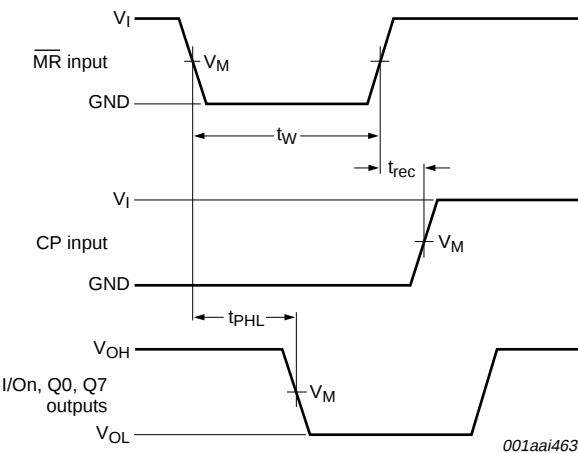


The shaded areas indicate when the input is permitted to change for predictable output performance.

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

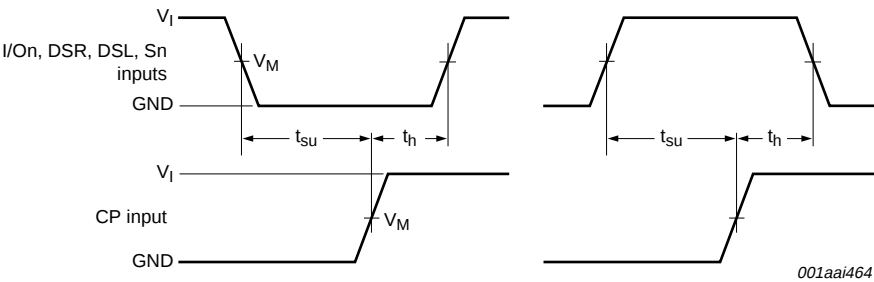
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 7. Clock pulse to outputs I/On, Q0, Q7 propagation delays, the clock pulse width, the I/On, DSR and DSL to clock pulse set-up and hold times, the output transition times and the maximum clock frequency**

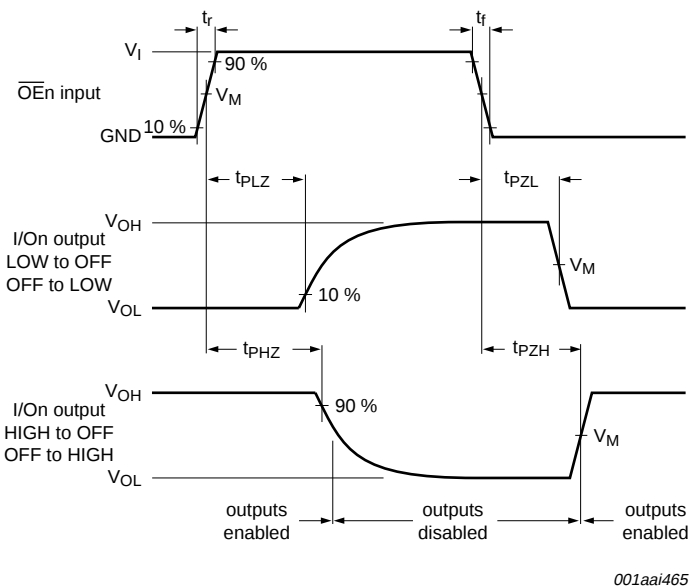


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 8. The master reset pulse width (LOW), the master reset to outputs I/On, Q0, Q7 propagation delays and the master reset to clock pulse removal time**



Measurement points are given in [Table 8](#).  
**Fig 9. Set-up and hold times from the mode control inputs S0, S1 to the clock pulse**

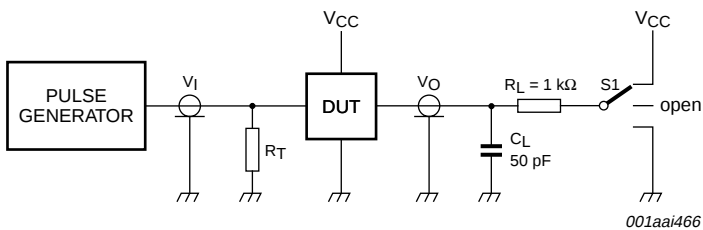


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**Fig 10. 3-state enable and disable times for  $\overline{OE}$  inputs**

**Table 8. Measurement points**

| Type     | Input    |             | Output      |
|----------|----------|-------------|-------------|
|          | $V_I$    | $V_M$       | $V_M$       |
| 74HC299  | $V_{CC}$ | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74HCT299 | 3 V      | 1.3 V       | 1.3 V       |



Test data is given in [Table 9](#).  
 Definitions for test circuit:  
 DUT = Device Under Test.  
 $R_T$  = 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 11. Test circuit for measuring switching times**

Table 9. Test data

| Type     | Input           |                                 | Load           |                | S1 position                         |
|----------|-----------------|---------------------------------|----------------|----------------|-------------------------------------|
|          | V <sub>I</sub>  | t <sub>r</sub> , t <sub>f</sub> | C <sub>L</sub> | R <sub>L</sub> | t <sub>PHL</sub> , t <sub>PLH</sub> |
| 74HC299  | V <sub>CC</sub> | 6 ns                            | 15 pF, 50 pF   | 1 kΩ           | open                                |
| 74HCT299 | 3 V             | 6 ns                            | 15 pF, 50 pF   | 1 kΩ           | open                                |

12. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm SOT163-1

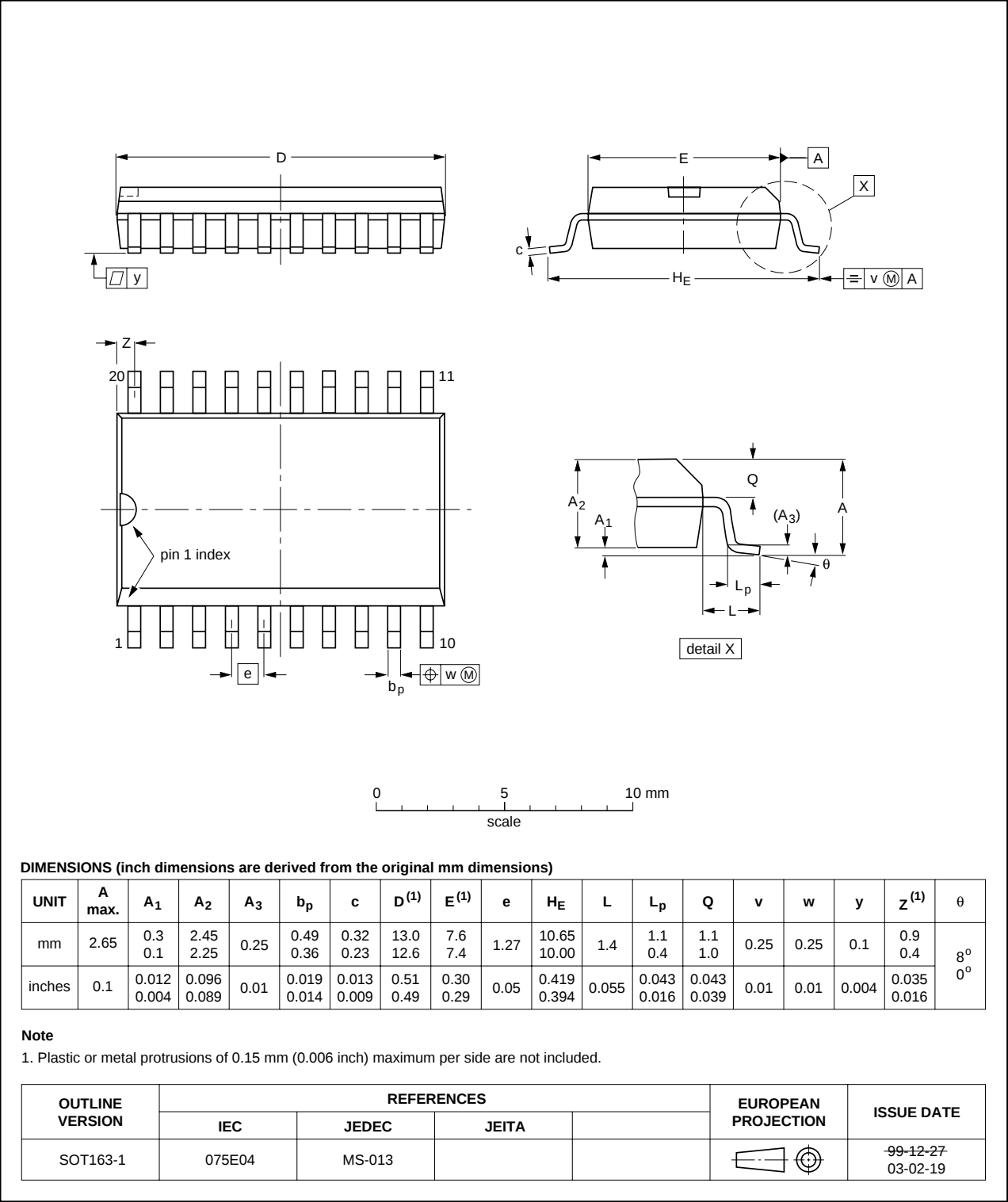


Fig 12. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1

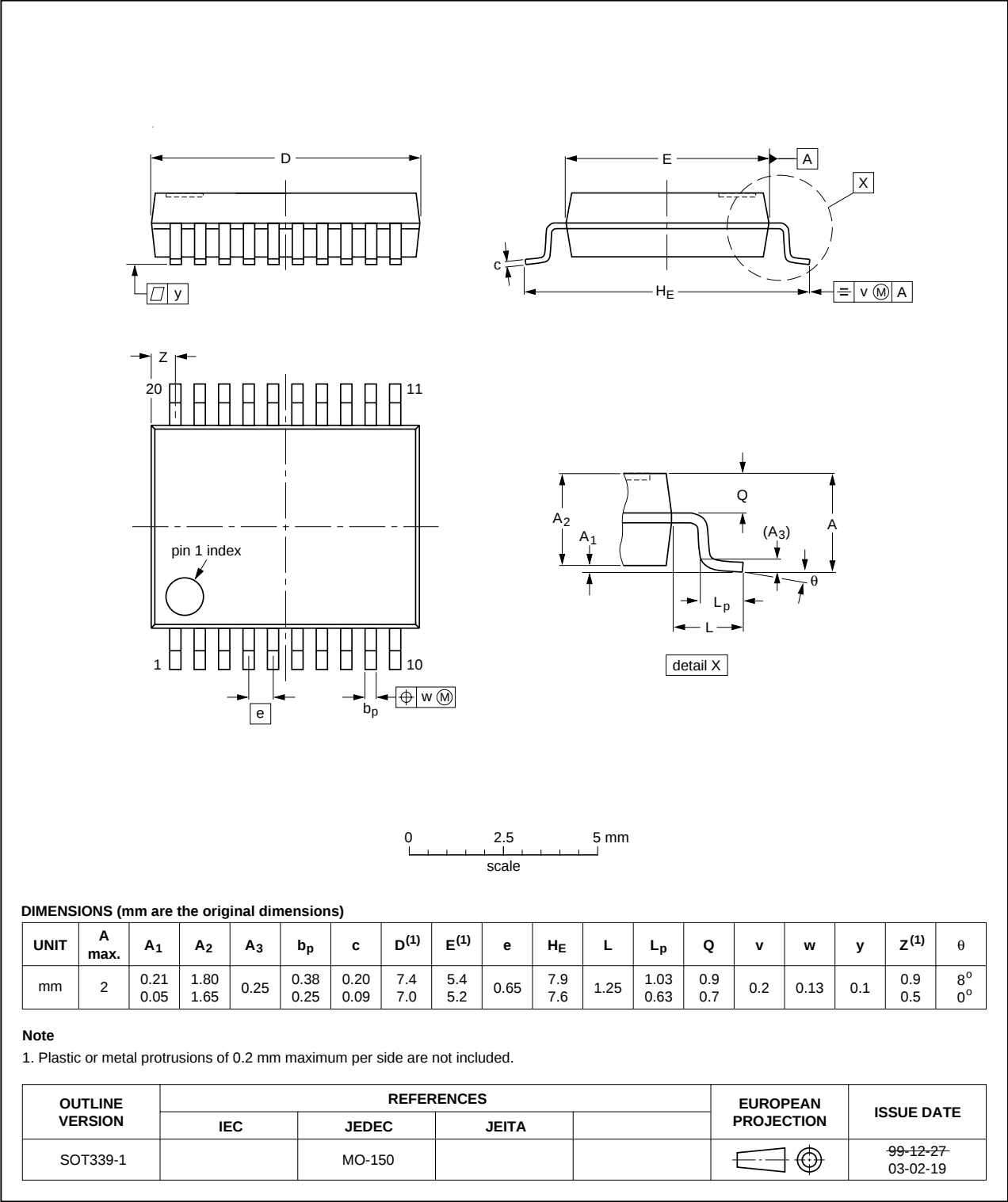


Fig 13. Package outline SOT339-1 (SSOP20)

DIP20: plastic dual in-line package; 20 leads (300 mil)

SOT146-1

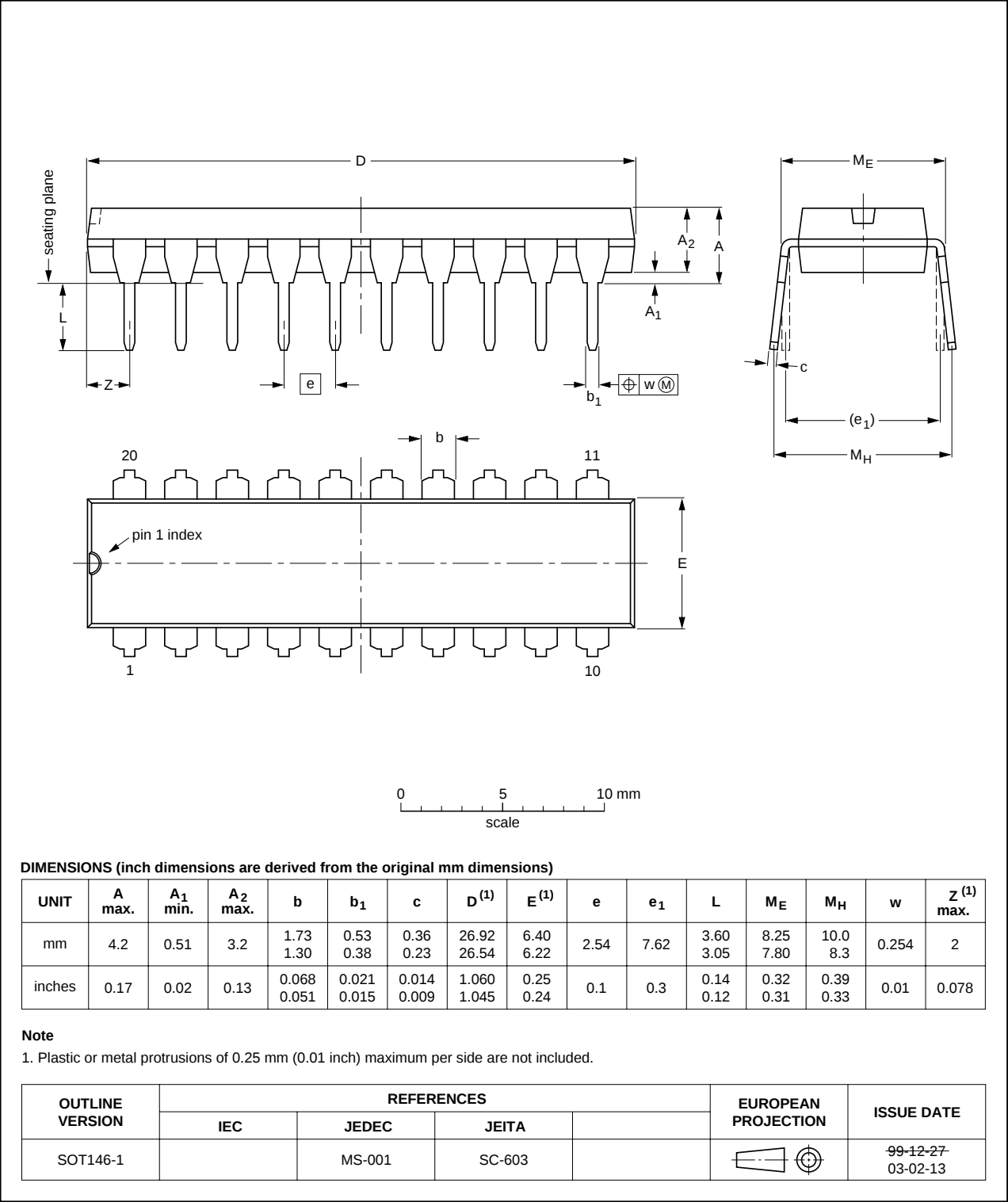


Fig 14. Package outline SOT146-1 (DIP20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1

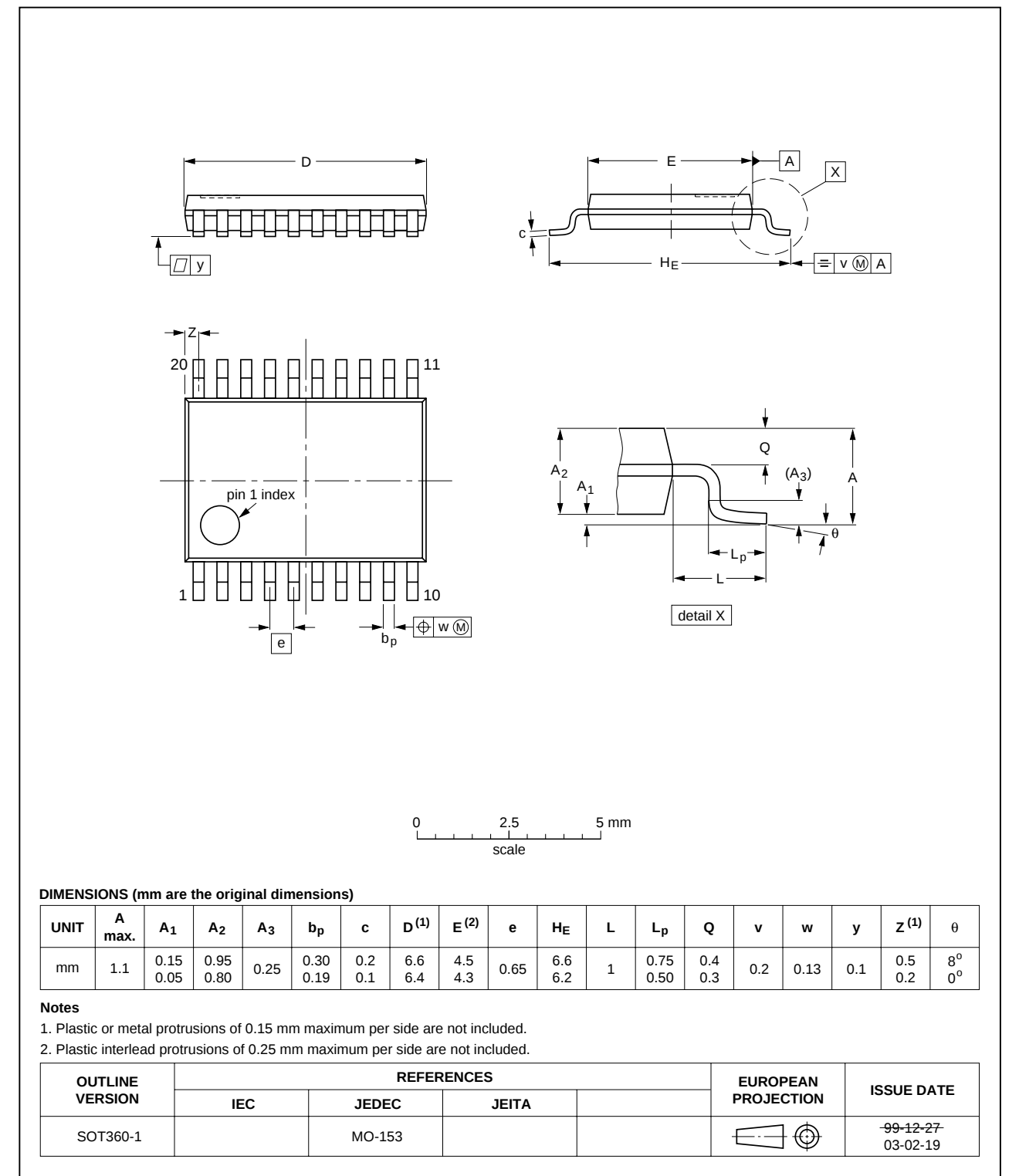


Fig 15. Package outline SOT360-1 (TSSOP20)

### 13. Revision history

Table 10. Revision history

| Document ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Release date | Data sheet status     | Change notice | Supersedes        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|-------------------|
| 74HC_HCT299_3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 20080728     | Product data sheet    | -             | 74HC_HCT299_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><a href="#">Section 3</a>: Ordering information added</li><li><a href="#">Section 12</a>: Package outline drawings added</li><li><a href="#">Section 9 "Static characteristics"</a>: Family data added</li><li><a href="#">Section 11 "Waveforms"</a>: Test circuit added</li></ul> |              |                       |               |                   |
| 74HC_HCT299_CNV_2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 19970828     | 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>.

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