

# 74HC595; 74HCT595

8-bit serial-in, serial or parallel-out shift register with output latches; 3-state

Rev. 6 — 12 December 2011

Product data sheet

## 1. General description

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The 74HC595; 74HCT595 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard No. 7A.

The 74HC595; 74HCT595 are 8-stage serial shift registers with a storage register and 3-state outputs. The registers have separate clocks.

Data is shifted on the positive-going transitions of the shift register clock input (SHCP). The data in each register is transferred to the storage register on a positive-going transition of the storage register clock input (STCP). If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register.

The shift register has a serial input (DS) and a serial standard output (Q7S) for cascading. It is also provided with asynchronous reset (active LOW) for all 8 shift register stages. The storage register has 8 parallel 3-state bus driver outputs. Data in the storage register appears at the output whenever the output enable input ( $\overline{OE}$ ) is LOW.

## 2. Features and benefits

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- 8-bit serial input
- 8-bit serial or parallel output
- Storage register with 3-state outputs
- Shift register with direct clear
- 100 MHz (typical) shift out frequency
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

## 3. Applications

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- Serial-to-parallel data conversion
- Remote control holding register

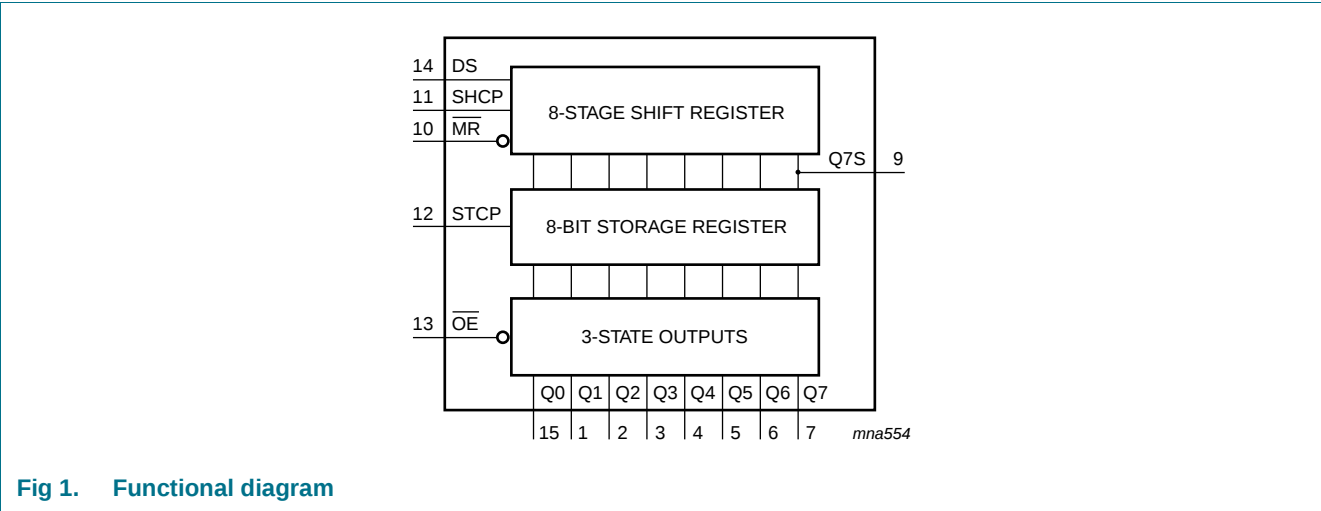


4. Ordering information

Table 1. Ordering information

| Type number | Package           |          |                                                                                                                                      |          |
|-------------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|----------|
|             | Temperature range | Name     | Description                                                                                                                          | Version  |
| 74HC595N    | −40 °C to +125 °C | DIP16    | plastic dual in-line package; 16 leads (300 mil)                                                                                     | SOT38-4  |
| 74HCT595N   |                   |          |                                                                                                                                      |          |
| 74HC595D    | −40 °C to +125 °C | SO16     | plastic small outline package; 16 leads;<br>body width 3.9 mm                                                                        | SOT109-1 |
| 74HCT595D   |                   |          |                                                                                                                                      |          |
| 74HC595DB   | −40 °C to +125 °C | SSOP16   | plastic shrink small outline package; 16 leads;<br>body width 5.3 mm                                                                 | SOT338-1 |
| 74HCT595DB  |                   |          |                                                                                                                                      |          |
| 74HC595PW   | −40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm                                                            | SOT403-1 |
| 74HCT595PW  |                   |          |                                                                                                                                      |          |
| 74HC595BQ   | −40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced<br>very thin quad flat package; no leads; 16 terminals;<br>body 2.5 × 3.5 × 0.85 mm | SOT763-1 |
| 74HCT595BQ  |                   |          |                                                                                                                                      |          |

5. Functional diagram



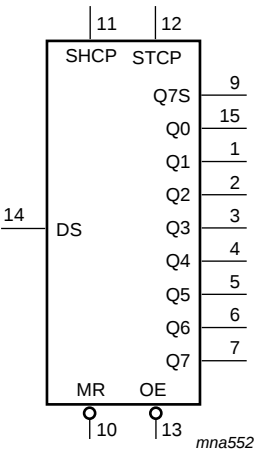


Fig 2. Logic symbol

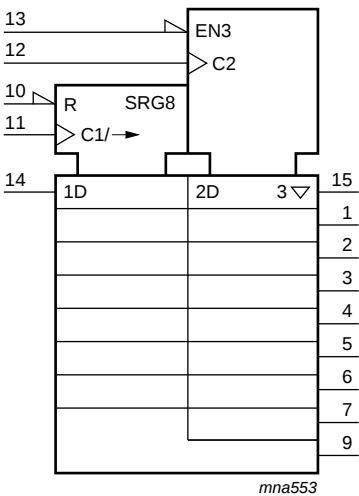


Fig 3. IEC logic symbol

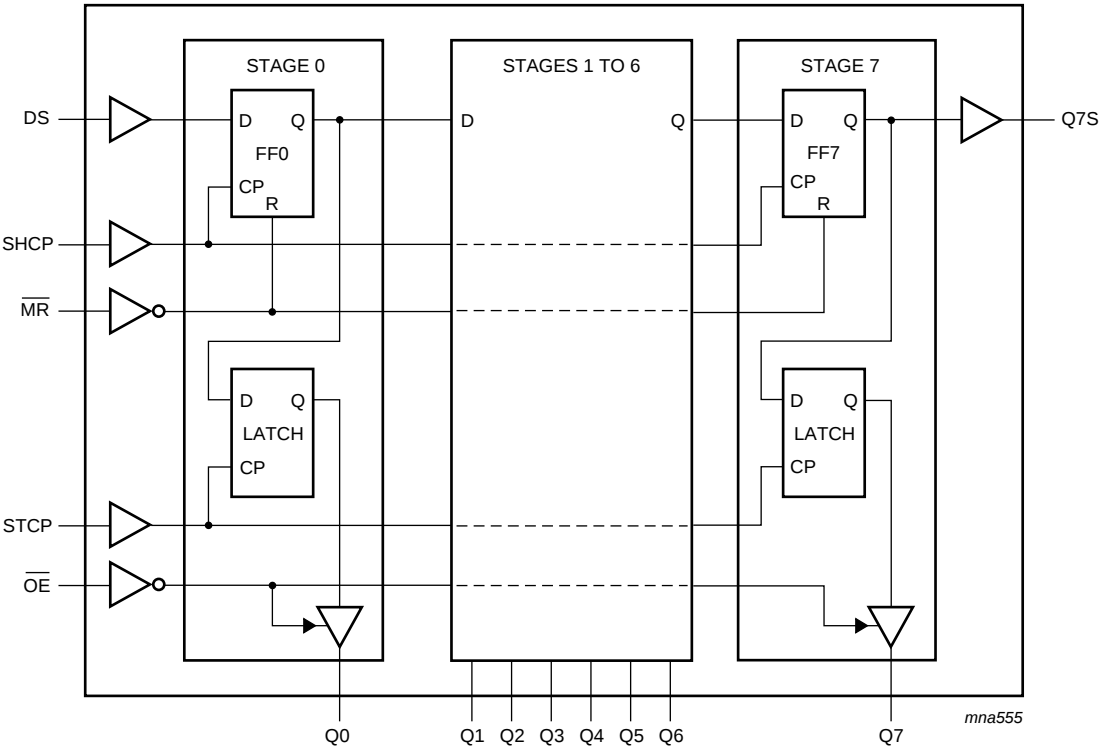
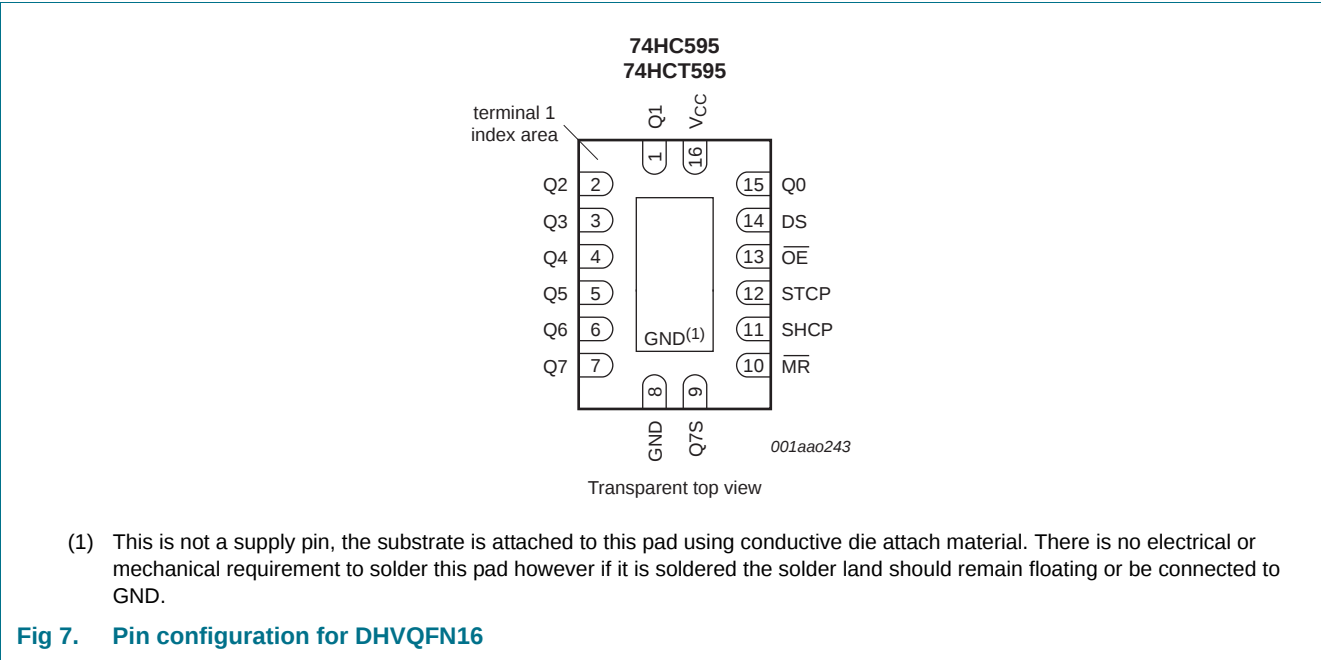
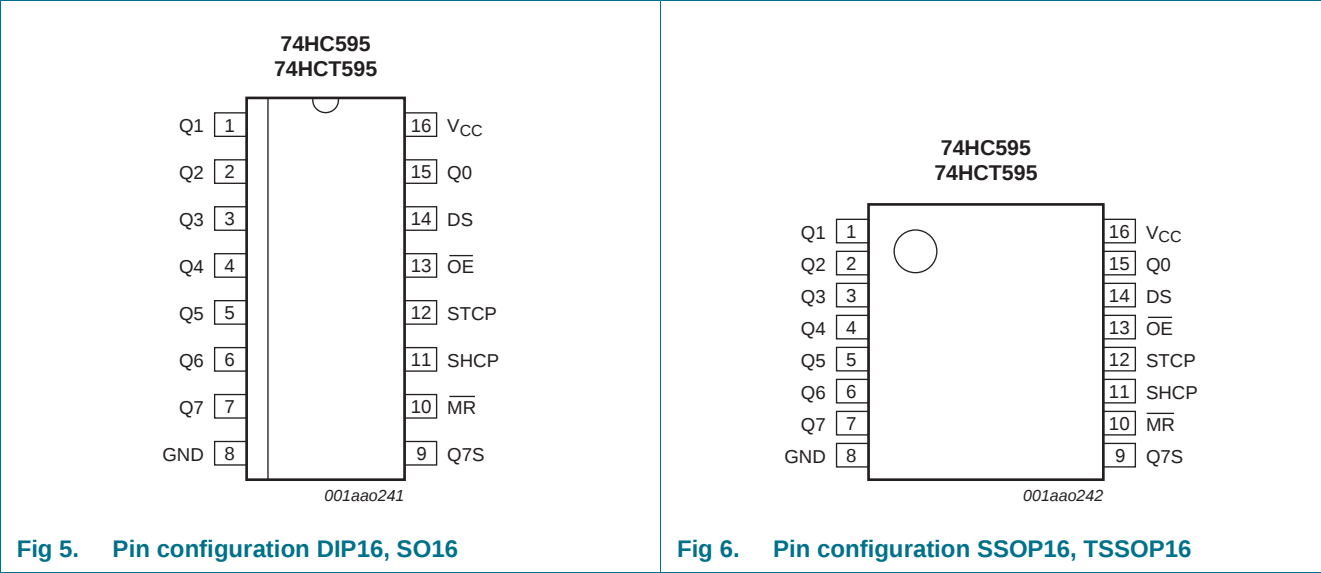


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning



## 6.2 Pin description

Table 2. Pin description

| Symbol                 | Pin | Description                      |
|------------------------|-----|----------------------------------|
| Q1                     | 1   | parallel data output 1           |
| Q2                     | 2   | parallel data output 2           |
| Q3                     | 3   | parallel data output 3           |
| Q4                     | 4   | parallel data output 4           |
| Q5                     | 5   | parallel data output 5           |
| Q6                     | 6   | parallel data output 6           |
| Q7                     | 7   | parallel data output 7           |
| GND                    | 8   | ground (0 V)                     |
| Q7S                    | 9   | serial data output               |
| $\overline{\text{MR}}$ | 10  | master reset (active LOW)        |
| SHCP                   | 11  | shift register clock input       |
| STCP                   | 12  | storage register clock input     |
| $\overline{\text{OE}}$ | 13  | output enable input (active LOW) |
| DS                     | 14  | serial data input                |
| Q0                     | 15  | parallel data output 0           |
| V <sub>CC</sub>        | 16  | supply voltage                   |

## 7. Functional description

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

| Control |      |                        |                        | Input | Output |     | Function                                                                                                                                                                                       |
|---------|------|------------------------|------------------------|-------|--------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SHCP    | STCP | $\overline{\text{OE}}$ | $\overline{\text{MR}}$ | DS    | Q7S    | Qn  |                                                                                                                                                                                                |
| X       | X    | L                      | L                      | X     | L      | NC  | a LOW-level on $\overline{\text{MR}}$ only affects the shift registers                                                                                                                         |
| X       | ↑    | L                      | L                      | X     | L      | L   | empty shift register loaded into storage register                                                                                                                                              |
| X       | X    | H                      | L                      | X     | L      | Z   | shift register clear; parallel outputs in high-impedance OFF-state                                                                                                                             |
| ↑       | X    | L                      | H                      | H     | Q6S    | NC  | logic HIGH-level shifted into shift register stage 0. Contents of all shift register stages shifted through, e.g. previous state of stage 6 (internal Q6S) appears on the serial output (Q7S). |
| X       | ↑    | L                      | H                      | X     | NC     | QnS | contents of shift register stages (internal QnS) are transferred to the storage register and parallel output stages                                                                            |
| ↑       | ↑    | L                      | H                      | X     | Q6S    | QnS | contents of shift register shifted through; previous contents of the shift register is transferred to the storage register and the parallel output stages                                      |

- [1] H = HIGH voltage state;  
 L = LOW voltage state;  
 ↑ = LOW-to-HIGH transition;  
 X = don't care;  
 NC = no change;  
 Z = high-impedance OFF-state.

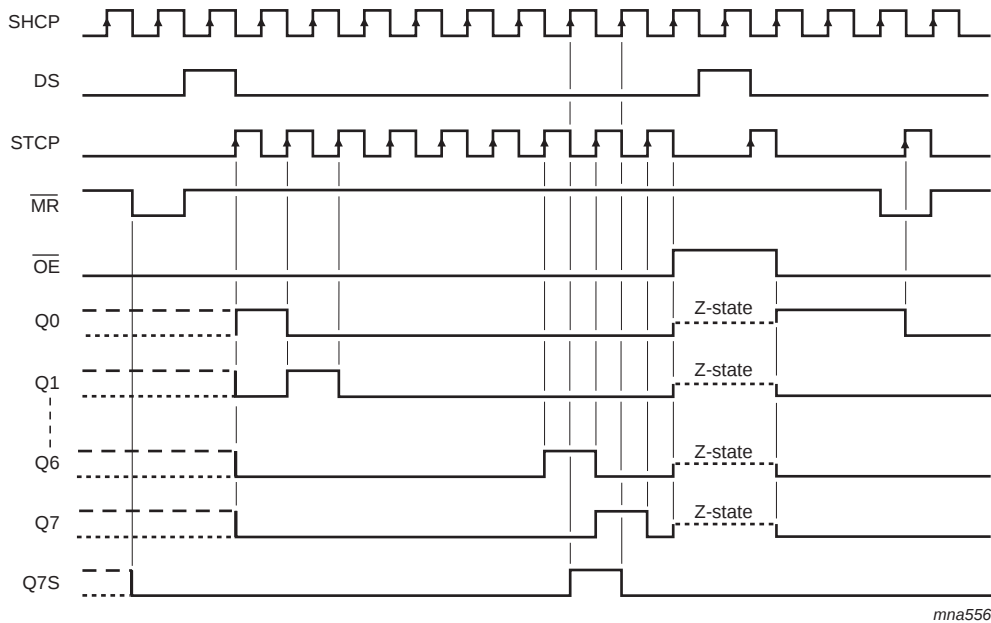


Fig 8. Timing diagram

## 8. Limiting values

Table 4. Limiting values

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

| Symbol    | Parameter               | Conditions                                               | Min  | Max      | Unit |
|-----------|-------------------------|----------------------------------------------------------|------|----------|------|
| $V_{CC}$  | supply voltage          |                                                          | -0.5 | +7       | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5 \text{ V}$ or $V_I > V_{CC} + 0.5 \text{ V}$ | -    | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5 \text{ V}$ or $V_O > V_{CC} + 0.5 \text{ V}$ | -    | $\pm 20$ | mA   |
| $I_O$     | output current          | $V_O = -0.5 \text{ V}$ to $(V_{CC} + 0.5 \text{ V})$     |      |          |      |
|           |                         | pin Q7S                                                  | -    | $\pm 25$ | mA   |
|           |                         | pins Qn                                                  | -    | $\pm 35$ | mA   |
| $I_{CC}$  | supply current          |                                                          | -    | 70       | mA   |
| $I_{GND}$ | ground current          |                                                          | -70  | -        | mA   |
| $T_{stg}$ | storage temperature     |                                                          | -65  | +150     | °C   |
| $P_{tot}$ | total power dissipation |                                                          |      |          |      |
|           | DIP16 package           | [1]                                                      | -    | 750      | mW   |
|           | SO16 package            | [2]                                                      | -    | 500      | mW   |
|           | SSOP16 package          | [3]                                                      | -    | 500      | mW   |
|           | TSSOP16 package         | [3]                                                      | -    | 500      | mW   |
|           | DHVQFN16 package        | [4]                                                      | -    | 500      | mW   |

[1] For DIP16 package:  $P_{tot}$  derates linearly with 12 mW/K above 70 °C.

[2] For SO16 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

[3] For SSOP16 and TSSOP16 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

[4] For DHVQFN16 package:  $P_{tot}$  derates linearly with 4.5 mW/K above 60 °C.

## 9. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol              | Parameter                           | Conditions              | 74HC595 |      |          | 74HCT595 |      |          | Unit |
|---------------------|-------------------------------------|-------------------------|---------|------|----------|----------|------|----------|------|
|                     |                                     |                         | Min     | Typ  | Max      | Min      | Typ  | Max      |      |
| $V_{CC}$            | supply voltage                      |                         | 2.0     | 5.0  | 6.0      | 4.5      | 5.0  | 5.5      | V    |
| $V_I$               | input voltage                       |                         | 0       | -    | $V_{CC}$ | 0        | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 0       | -    | $V_{CC}$ | 0        | -    | $V_{CC}$ | V    |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | -       | -    | 625      | -        | -    | -        | ns/V |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -       | 1.67 | 139      | -        | 1.67 | 139      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -       | -    | 83       | -        | -    | -        | ns/V |
| $T_{amb}$           | ambient temperature                 |                         | -40     | +25  | +125     | -40      | +25  | +125     | °C   |

## 10. 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  | Max  | Min               | Max  |      |
| 74HC595         |                           |                                                     |                  |      |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                             | 1.5              | 1.2  | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                             | 3.15             | 2.4  | -    | 3.15              | -    | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                             | 4.2              | 3.2  | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                             | -                | 0.8  | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                             | -                | 2.1  | 1.35 | -                 | 1.35 | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                             | -                | 2.8  | 1.8  | -                 | 1.8  | V    |
| 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               | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 4.5 V    | 4.4              | 4.5  | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 6.0 V    | 5.9              | 6.0  | -    | 5.9               | -    | V    |
|                 |                           | Q7S output                                          |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = −4 mA; V <sub>CC</sub> = 4.5 V     | 3.84             | 4.32 | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = −5.2 mA; V <sub>CC</sub> = 6.0 V   | 5.34             | 5.81 | -    | 5.2               | -    | V    |
|                 |                           | Qn bus driver outputs                               |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = −6 mA; V <sub>CC</sub> = 4.5 V     | 3.84             | 4.32 | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = −7.8 mA; V <sub>CC</sub> = 6.0 V   | 5.34             | 5.81 | -    | 5.2               | -    | V    |

**Table 6.** Static characteristics ...continued

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  | Max  | Min               | Max  |      |
| 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  | V    |
|                 |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                           | -                | 0    | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                                                           | -                | 0    | 0.1  | -                 | 0.1  | V    |
|                 |                           | Q7S output                                                                                                                |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V                                                                            | -                | 0.15 | 0.33 | -                 | 0.4  | V    |
|                 |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                                                          | -                | 0.16 | 0.33 | -                 | 0.4  | V    |
|                 |                           | Qn bus driver outputs                                                                                                     |                  |      |      |                   |      |      |
| I <sub>I</sub>  | input leakage current     | I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 4.5 V                                                                            | -                | 0.15 | 0.33 | -                 | 0.4  | V    |
|                 |                           | I <sub>O</sub> = 7.8 mA; V <sub>CC</sub> = 6.0 V                                                                          | -                | 0.16 | 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                                                          | -                | -    | ±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>CC</sub> = 6.0 V;<br>V <sub>O</sub> = V <sub>CC</sub> or GND | -                | -    | ±5.0 | -                 | ±10  | 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> = 6.0 V                                 | -                | -    | 80   | -                 | 160  | µA   |
| C <sub>I</sub>  | input capacitance         |                                                                                                                           | -                | 3.5  | -    | -                 | -    | pF   |
| <b>74HCT595</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               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                          | -                | 1.2  | 0.8  | -                 | 0.8  | 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                                             |                  |      |      |                   |      |      |
|                 |                           | all outputs                                                                                                               |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 µA                                                                                                   | 4.4              | 4.5  | -    | 4.4               | -    | V    |
|                 |                           | Q7S output                                                                                                                |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -4 mA                                                                                                    | 3.84             | 4.32 | -    | 3.7               | -    | V    |
|                 |                           | Qn bus driver outputs                                                                                                     |                  |      |      |                   |      |      |
| V <sub>OL</sub> | LOW-level output voltage  | I <sub>O</sub> = -6 mA                                                                                                    | 3.7              | 4.32 | -    | 3.7               | -    | V    |
|                 |                           | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V                                             |                  |      |      |                   |      |      |
|                 |                           | all outputs                                                                                                               |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 20 µA                                                                                                    | -                | 0    | 0.1  | -                 | 0.1  | V    |
|                 |                           | Q7S output                                                                                                                |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 4.0 mA                                                                                                   | -                | 0.15 | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>  | input leakage current     | Qn bus driver outputs                                                                                                     |                  |      |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 6.0 mA                                                                                                   | -                | 0.16 | 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> = 5.5 V                                                          | -                | -    | ±1.0 | -                 | ±1.0 | µA   |

**Table 6.** Static characteristics ...continued

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 | Max       | Min               | Max      |         |
| $I_{OZ}$        | OFF-state output current  | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 5.5$ V;<br>$V_O = V_{CC}$ or GND                                           | -                | -   | $\pm 5.0$ | -                 | $\pm 10$ | $\mu A$ |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0$ A;<br>$V_{CC} = 5.5$ V                                                           | -                | -   | 80        | -                 | 160      | $\mu A$ |
| $\Delta I_{CC}$ | additional supply current | per input pin; $I_O = 0$ A; $V_I = V_{CC} - 2.1$ V; other inputs at $V_{CC}$ or GND;<br>$V_{CC} = 4.5$ V to 5.5 V |                  |     |           |                   |          |         |
|                 |                           | pins $\overline{MR}$ , SHCP, STCP, $\overline{OE}$                                                                | -                | 150 | 675       | -                 | 735      | $\mu A$ |
|                 |                           | pin DS                                                                                                            | -                | 25  | 113       | -                 | 123      | $\mu A$ |
| $C_I$           | input capacitance         |                                                                                                                   | -                | 3.5 | -         | -                 | -        | pF      |

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 14](#).

| Symbol           | Parameter         | Conditions                                               | 25 °C |                    |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------|----------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                  |                   |                                                          | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| 74HC595          |                   |                                                          |       |                    |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay | SHCP to Q7S; see <a href="#">Figure 9</a> <sup>[2]</sup> |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | -     | 52                 | 160 | -                | 200 | -                 | 240 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 19                 | 32  | -                | 40  | -                 | 48  | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | -     | 15                 | 27  | -                | 34  | -                 | 41  | ns   |
|                  |                   | STCP to Qn; see <a href="#">Figure 10</a> <sup>[2]</sup> |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | -     | 55                 | 175 | -                | 220 | -                 | 265 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 20                 | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | -     | 16                 | 30  | -                | 37  | -                 | 45  | ns   |
|                  |                   | MR to Q7S; see <a href="#">Figure 12</a> <sup>[3]</sup>  |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | -     | 47                 | 175 | -                | 220 | -                 | 265 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 17                 | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | -     | 14                 | 30  | -                | 37  | -                 | 45  | ns   |
| t <sub>en</sub>  | enable time       | OE to Qn; see <a href="#">Figure 13</a> <sup>[4]</sup>   |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | -     | 47                 | 150 | -                | 190 | -                 | 225 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 17                 | 30  | -                | 38  | -                 | 45  | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | -     | 14                 | 26  | -                | 33  | -                 | 38  | ns   |
| t <sub>dis</sub> | disable time      | OE to Qn; see <a href="#">Figure 13</a> <sup>[5]</sup>   |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | -     | 41                 | 150 | -                | 190 | -                 | 225 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | -     | 15                 | 30  | -                | 38  | -                 | 45  | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | -     | 12                 | 27  | -                | 33  | -                 | 38  | ns   |
| t <sub>w</sub>   | pulse width       | SHCP HIGH or LOW; see <a href="#">Figure 9</a>           |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | 75    | 17                 | -   | 95               | -   | 110               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | 15    | 6                  | -   | 19               | -   | 22                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | 13    | 5                  | -   | 16               | -   | 19                | -   | ns   |
|                  |                   | STCP HIGH or LOW; see <a href="#">Figure 10</a>          |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | 75    | 11                 | -   | 95               | -   | 110               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | 15    | 4                  | -   | 19               | -   | 22                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | 13    | 3                  | -   | 16               | -   | 19                | -   | ns   |
|                  |                   | MR LOW; see <a href="#">Figure 12</a>                    |       |                    |     |                  |     |                   |     |      |
|                  |                   | V <sub>CC</sub> = 2 V                                    | 75    | 17                 | -   | 95               | -   | 110               | -   | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V                                  | 15    | 6                  | -   | 19               | -   | 22                | -   | ns   |
|                  |                   | V <sub>CC</sub> = 6 V                                    | 13    | 5                  | -   | 16               | -   | 19                | -   | ns   |

**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 14](#).

| Symbol           | Parameter                     | Conditions                                                                             | 25 °C |                    |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|----------------------------------------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                                        | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| t <sub>su</sub>  | set-up time                   | DS to SHCP; see <a href="#">Figure 10</a>                                              |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2 V                                                                  | 50    | 11                 | -   | 65               | -   | 75                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                | 10    | 4                  | -   | 13               | -   | 15                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6 V                                                                  | 9     | 3                  | -   | 11               | -   | 13                | -   | ns   |
|                  |                               | SHCP to STCP;<br>see <a href="#">Figure 11</a>                                         |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2 V                                                                  | 75    | 22                 | -   | 95               | -   | 110               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                | 15    | 8                  | -   | 19               | -   | 22                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6 V                                                                  | 13    | 7                  | -   | 16               | -   | 19                | -   | ns   |
| t <sub>h</sub>   | hold time                     | DS to SHCP; see <a href="#">Figure 11</a>                                              |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2 V                                                                  | 3     | –6                 | -   | 3                | -   | 3                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                | 3     | –2                 | -   | 3                | -   | 3                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6 V                                                                  | 3     | –2                 | -   | 3                | -   | 3                 | -   | ns   |
| t <sub>rec</sub> | recovery time                 | MR to SHCP; see <a href="#">Figure 12</a>                                              |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2 V                                                                  | 50    | –19                | -   | 65               | -   | 75                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                | 10    | –7                 | -   | 13               | -   | 15                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6 V                                                                  | 9     | –6                 | -   | 11               | -   | 13                | -   | ns   |
| f <sub>max</sub> | maximum frequency             | SHCP or STCP;<br>see <a href="#">Figure 9</a> and <a href="#">10</a>                   |       |                    |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2 V                                                                  | 9     | 30                 | -   | 4.8              | -   | 4                 | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                | 30    | 91                 | -   | 24               | -   | 20                | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 6 V                                                                  | 35    | 108                | -   | 28               | -   | 24                | -   | MHz  |
| C <sub>PD</sub>  | power dissipation capacitance | f <sub>i</sub> = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[6][7]</a> | -     | 115                | -   | -                | -   | -                 | -   | pF   |

**74HCT595; V<sub>CC</sub> = 4.5 V to 5.5 V**

|                  |                   |                                                    |                     |    |    |    |    |    |    |    |    |
|------------------|-------------------|----------------------------------------------------|---------------------|----|----|----|----|----|----|----|----|
| t <sub>pd</sub>  | propagation delay | SHCP to Q7S; see <a href="#">Figure 9</a>          | <a href="#">[2]</a> | -  | 25 | 42 | -  | 53 | -  | 63 | ns |
|                  |                   | STCP to Qn; see <a href="#">Figure 10</a>          | <a href="#">[2]</a> | -  | 24 | 40 | -  | 50 | -  | 60 | ns |
|                  |                   | MR to Q7S; see <a href="#">Figure 12</a>           | <a href="#">[3]</a> | -  | 23 | 40 | -  | 50 | -  | 60 | ns |
| t <sub>en</sub>  | enable time       | OE to Qn; see <a href="#">Figure 13</a>            | <a href="#">[4]</a> | -  | 21 | 35 | -  | 44 | -  | 53 | ns |
| t <sub>dis</sub> | disable time      | OE to Qn; see <a href="#">Figure 13</a>            | <a href="#">[5]</a> | -  | 18 | 30 | -  | 38 | -  | 45 | ns |
| t <sub>w</sub>   | pulse width       | SHCP HIGH or LOW;<br>see <a href="#">Figure 9</a>  |                     | 16 | 6  | -  | 20 | -  | 24 | -  | ns |
|                  |                   | STCP HIGH or LOW;<br>see <a href="#">Figure 10</a> |                     | 16 | 5  | -  | 20 | -  | 24 | -  | ns |
|                  |                   | MR LOW; see <a href="#">Figure 12</a>              |                     | 20 | 8  | -  | 25 | -  | 30 | -  | ns |
| t <sub>su</sub>  | set-up time       | DS to SHCP; see <a href="#">Figure 10</a>          |                     | 16 | 5  | -  | 20 | -  | 24 | -  | ns |
|                  |                   | SHCP to STCP;<br>see <a href="#">Figure 11</a>     |                     | 16 | 8  | -  | 20 | -  | 24 | -  | ns |
| t <sub>h</sub>   | hold time         | DS to SHCP; see <a href="#">Figure 11</a>          |                     | 3  | –2 | -  | 3  | -  | 3  | -  | ns |

**Table 7.** Dynamic characteristics ...continuedVoltages are referenced to GND (ground = 0 V); for test circuit see [Figure 14](#).

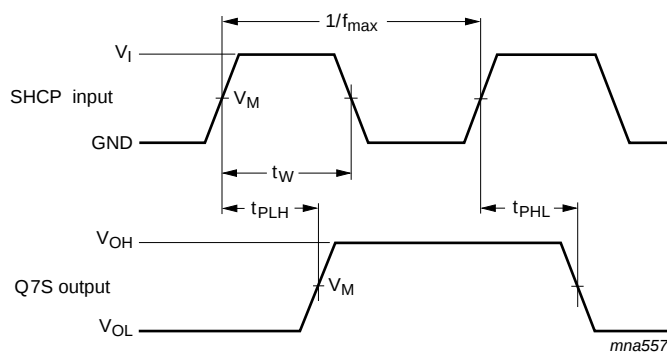
| Symbol           | Parameter                     | Conditions                                                                                              | 25 °C |                    |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|---------------------------------------------------------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                                                         | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| $t_{\text{rec}}$ | recovery time                 | MR to SHCP; see <a href="#">Figure 12</a>                                                               | 10    | –7                 | –   | 13               | –   | 15                | –   | ns   |
| $f_{\text{max}}$ | maximum frequency             | SHCP and STCP; see <a href="#">Figure 9</a> and <a href="#">10</a>                                      | 30    | 52                 | –   | 24               | –   | 20                | –   | MHz  |
| $C_{\text{PD}}$  | power dissipation capacitance | $f_i = 1 \text{ MHz}$ ; $V_i = \text{GND to } V_{\text{CC}}$ <a href="#">[6]</a><br><a href="#">[7]</a> | –     | 130                | –   | –                | –   | –                 | –   | pF   |

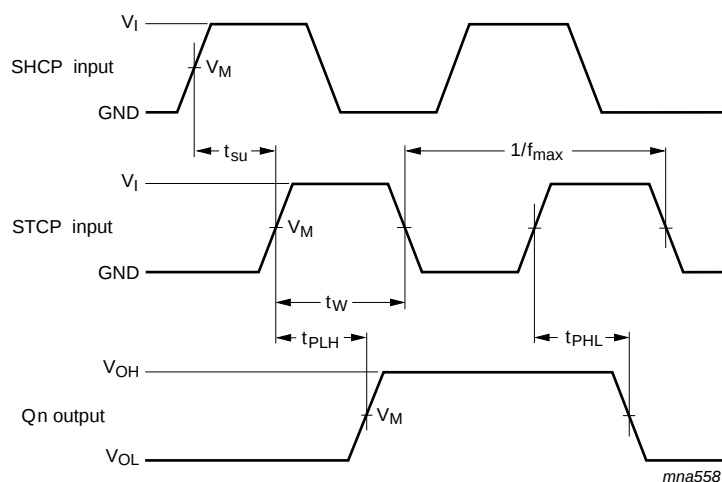
[1] Typical values are measured at nominal supply voltage.

[2]  $t_{\text{pd}}$  is the same as  $t_{\text{PHL}}$  and  $t_{\text{PLH}}$ .[3]  $t_{\text{pd}}$  is the same as  $t_{\text{PHL}}$  only.[4]  $t_{\text{en}}$  is the same as  $t_{\text{PZL}}$  and  $t_{\text{PZH}}$ .[5]  $t_{\text{dis}}$  is the same as  $t_{\text{PLZ}}$  and  $t_{\text{PHZ}}$ .[6]  $C_{\text{PD}}$  is used to determine the dynamic power dissipation ( $P_{\text{D}}$  in  $\mu\text{W}$ ). $P_{\text{D}} = C_{\text{PD}} \times V_{\text{CC}}^2 \times f_i + \Sigma(C_{\text{L}} \times V_{\text{CC}}^2 \times f_o)$  where: $f_i$  = input frequency in MHz; $f_o$  = output frequency in MHz; $\Sigma(C_{\text{L}} \times V_{\text{CC}}^2 \times f_o)$  = sum of outputs; $C_{\text{L}}$  = output load capacitance in pF; $V_{\text{CC}}$  = supply voltage in V.

[7] All 9 outputs switching.

## 12. Waveforms

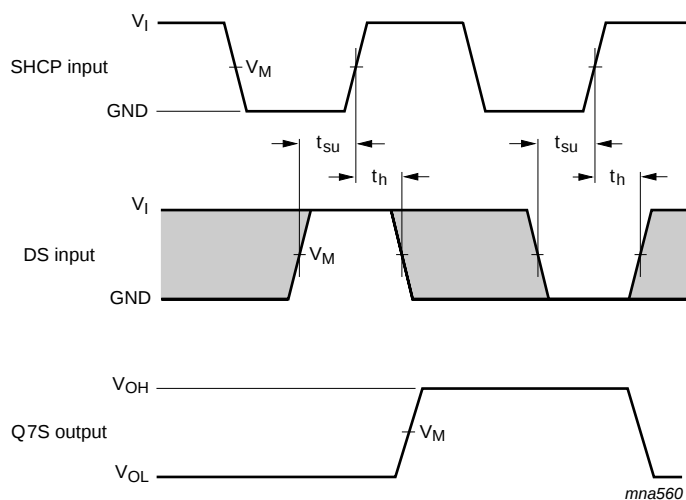
Measurement points are given in [Table 8](#). $V_{\text{OL}}$  and  $V_{\text{OH}}$  are typical output voltage levels that occur with the output load.**Fig 9.** Shift clock pulse, maximum frequency and input to output propagation delays



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

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

**Fig 10. Storage clock to output propagation delays**

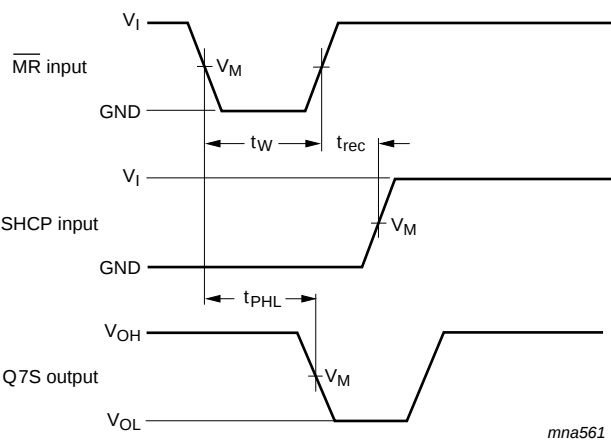


Measurement points are given in [Table 8](#).

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

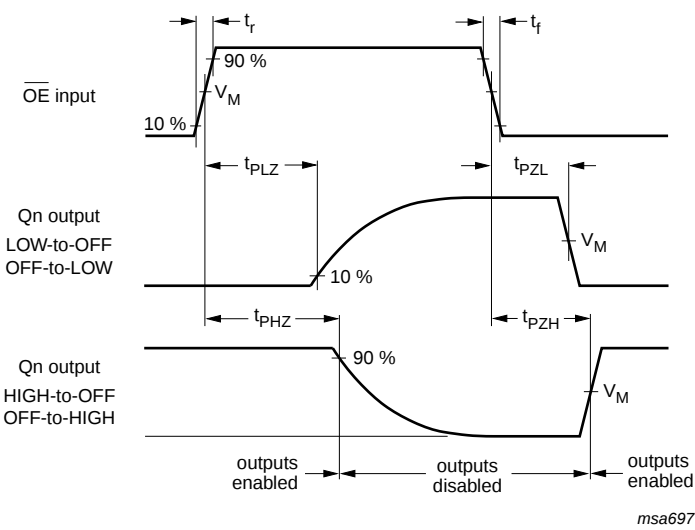
$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 11. Data set-up and hold times**



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

**Fig 12. Master reset to output propagation delays**



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

**Fig 13. Enable and disable times**

**Table 8. Measurement points**

| Type     | Input       | Output      |
|----------|-------------|-------------|
|          | $V_M$       | $V_M$       |
| 74HC595  | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74HCT595 | 1.3 V       | 1.3 V       |

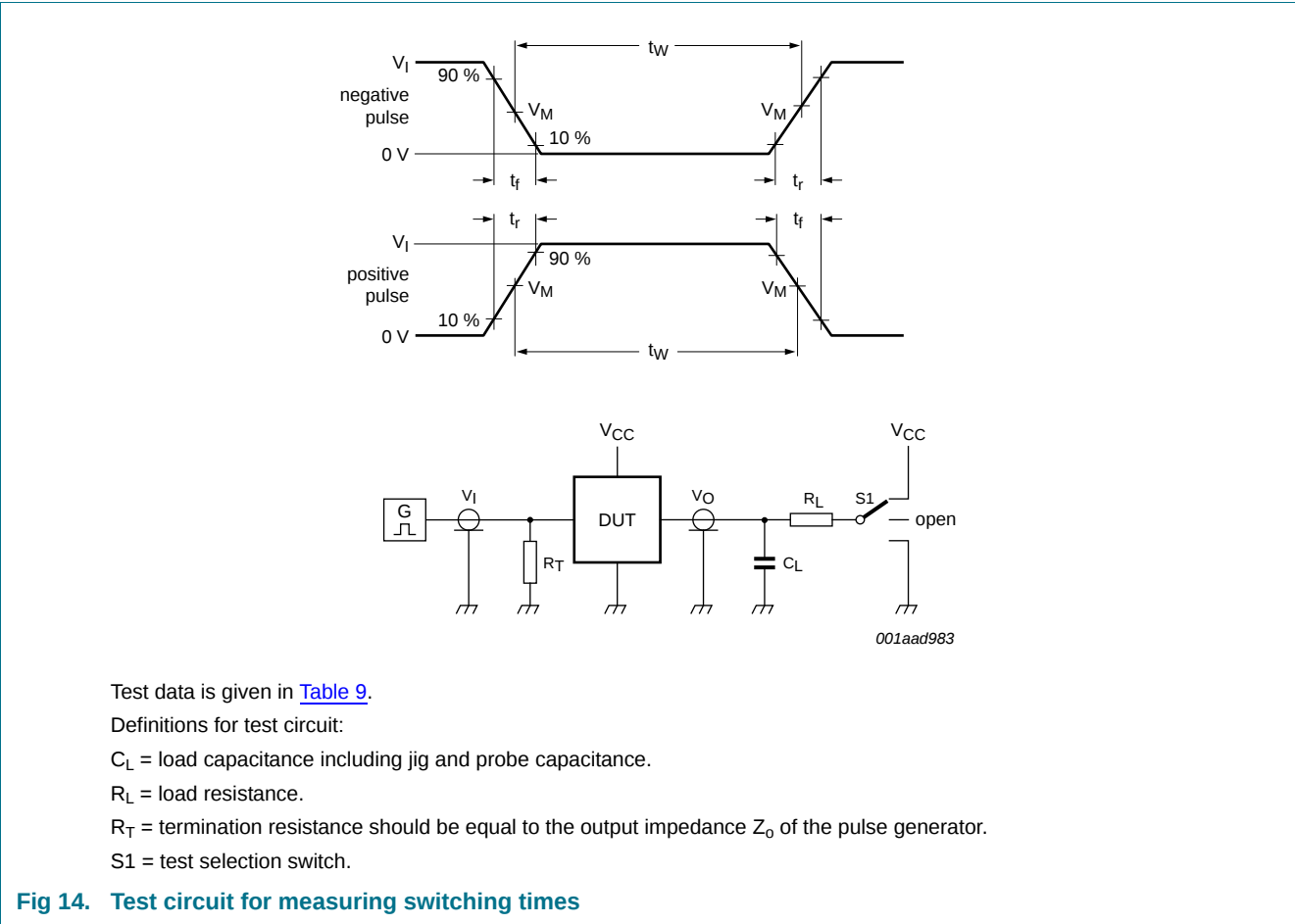


Table 9. Test data

| Type     | Input    |            | Load  |              | S1 position        |                    |                    |
|----------|----------|------------|-------|--------------|--------------------|--------------------|--------------------|
|          | $V_I$    | $t_r, t_f$ | $C_L$ | $R_L$        | $t_{PHL}, t_{PLH}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 74HC595  | $V_{CC}$ | 6 ns       | 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |
| 74HCT595 | 3 V      | 6 ns       | 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |

13. Package outline

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

SOT38-4

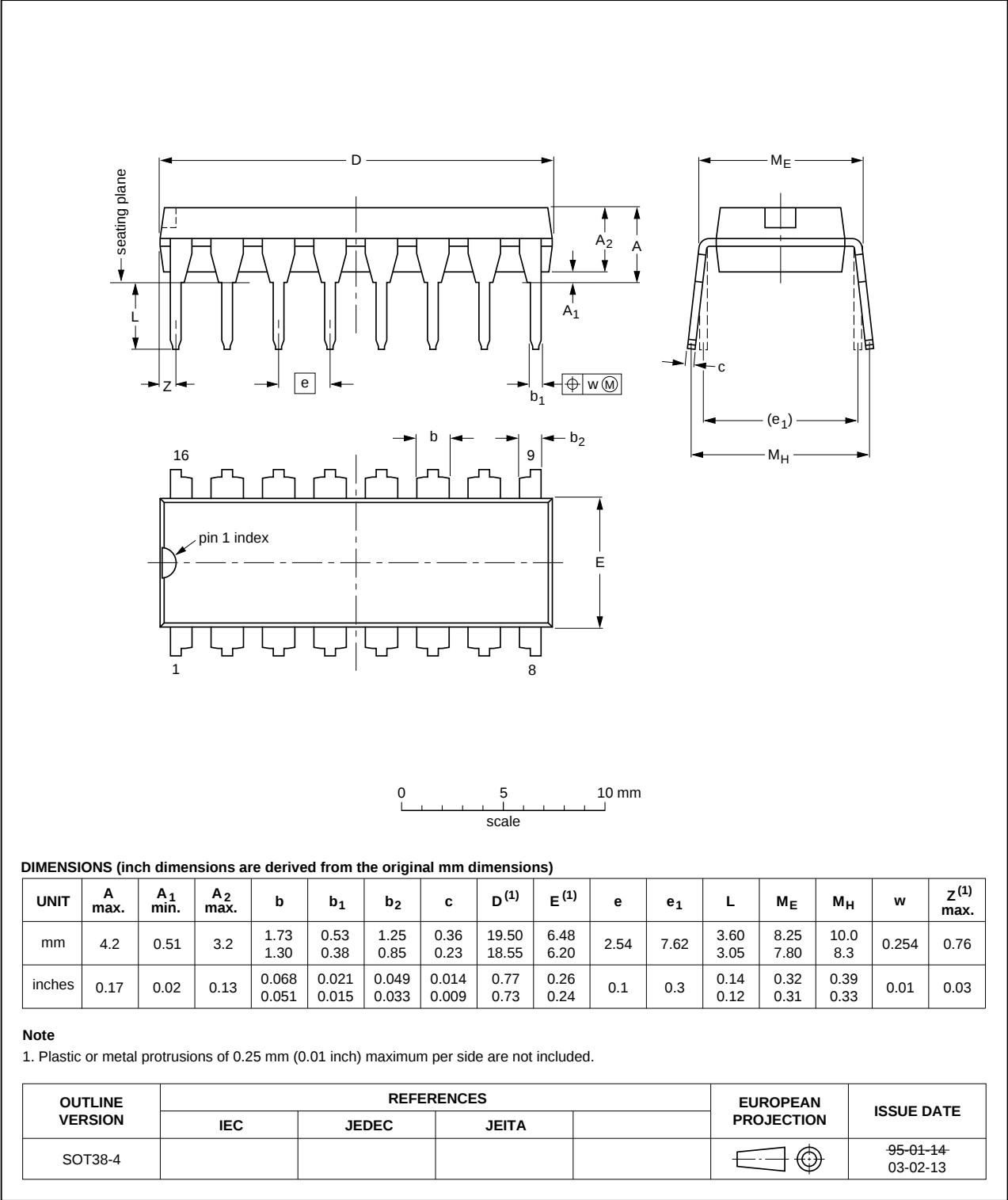
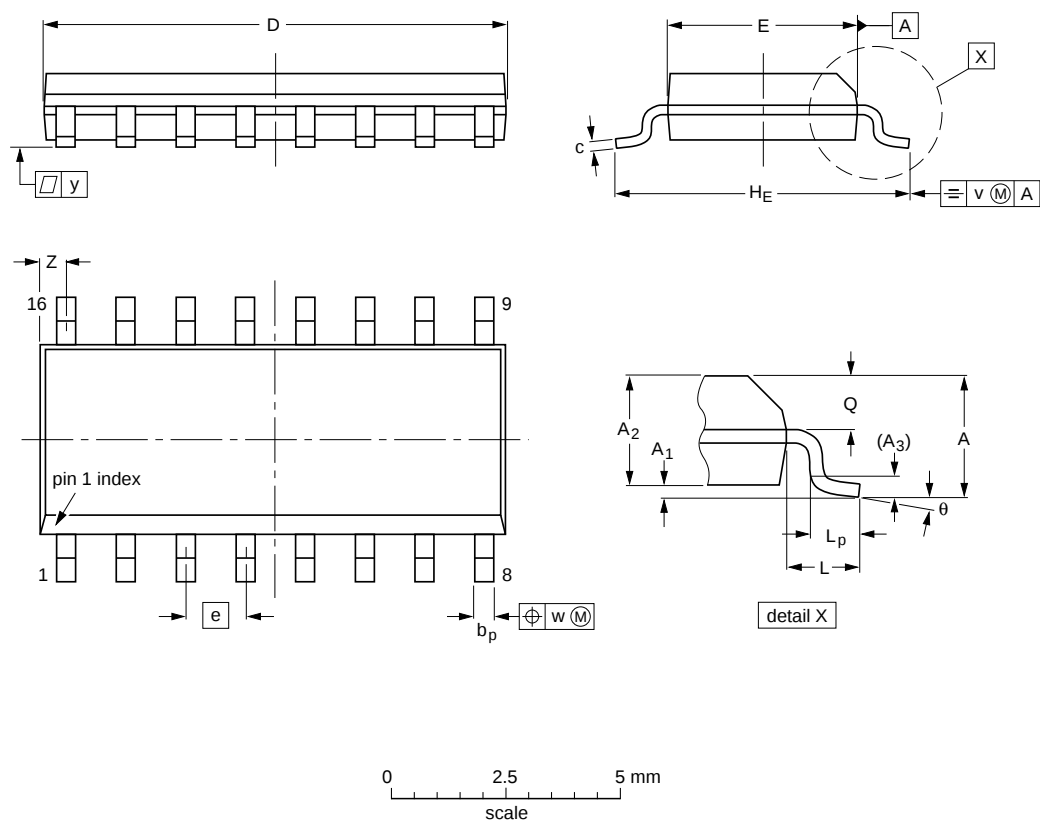


Fig 15. Package outline SOT38-4 (DIP16)

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

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT   | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c                | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | z <sup>(1)</sup> | θ        |
|--------|-----------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75      | 0.25<br>0.10   | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 10.0<br>9.8      | 4.0<br>3.8       | 1.27 | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069     | 0.010<br>0.004 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38     | 0.16<br>0.15     | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012   |          |

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                      |
| SOT109-1           | 076E07     | MS-012 |       |  |                        | 99-12-27<br>03-02-19 |

Fig 16. Package outline SOT109-1 (SO16)

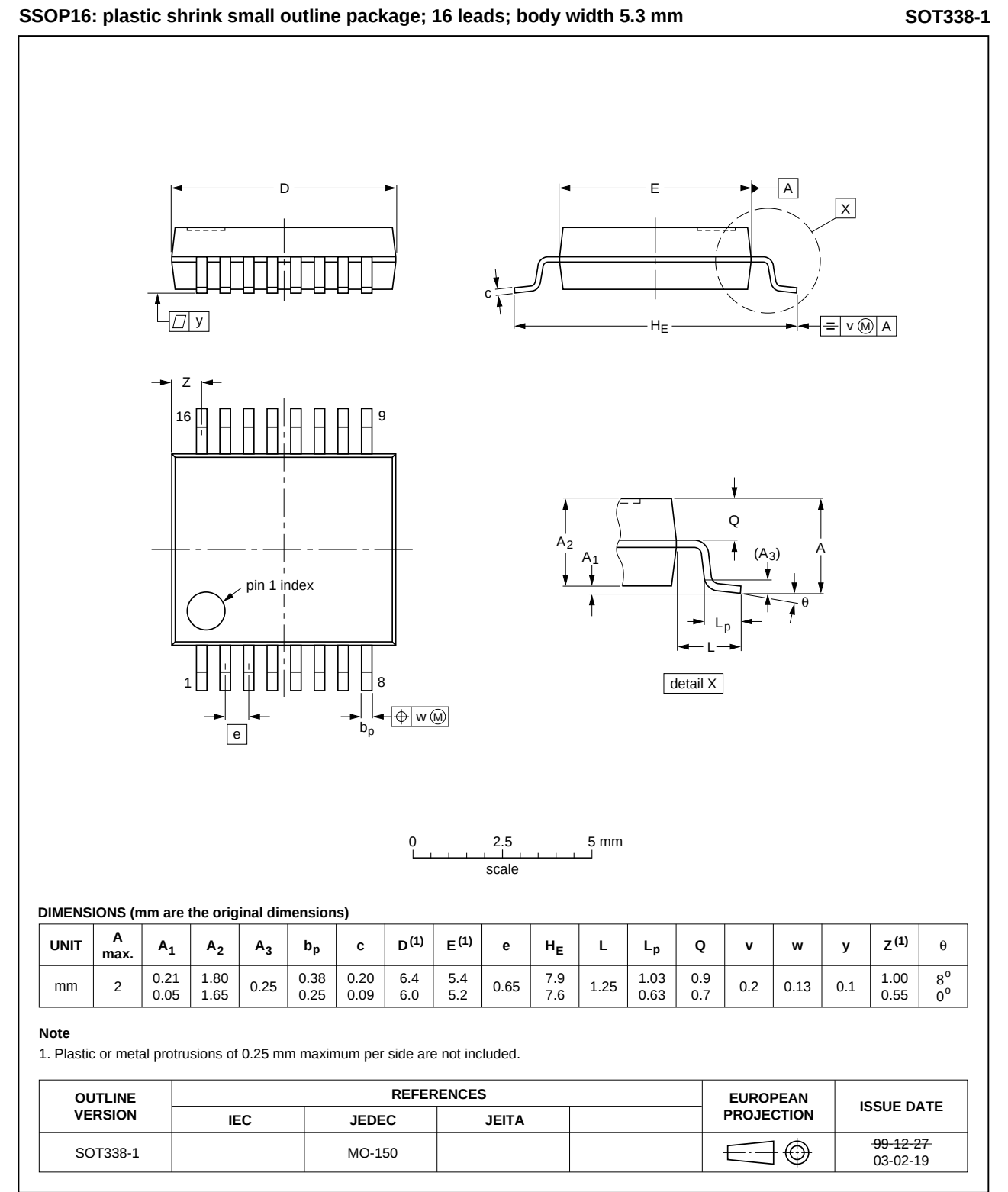


Fig 17. Package outline SOT338-1 (SSOP16)

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

SOT403-1

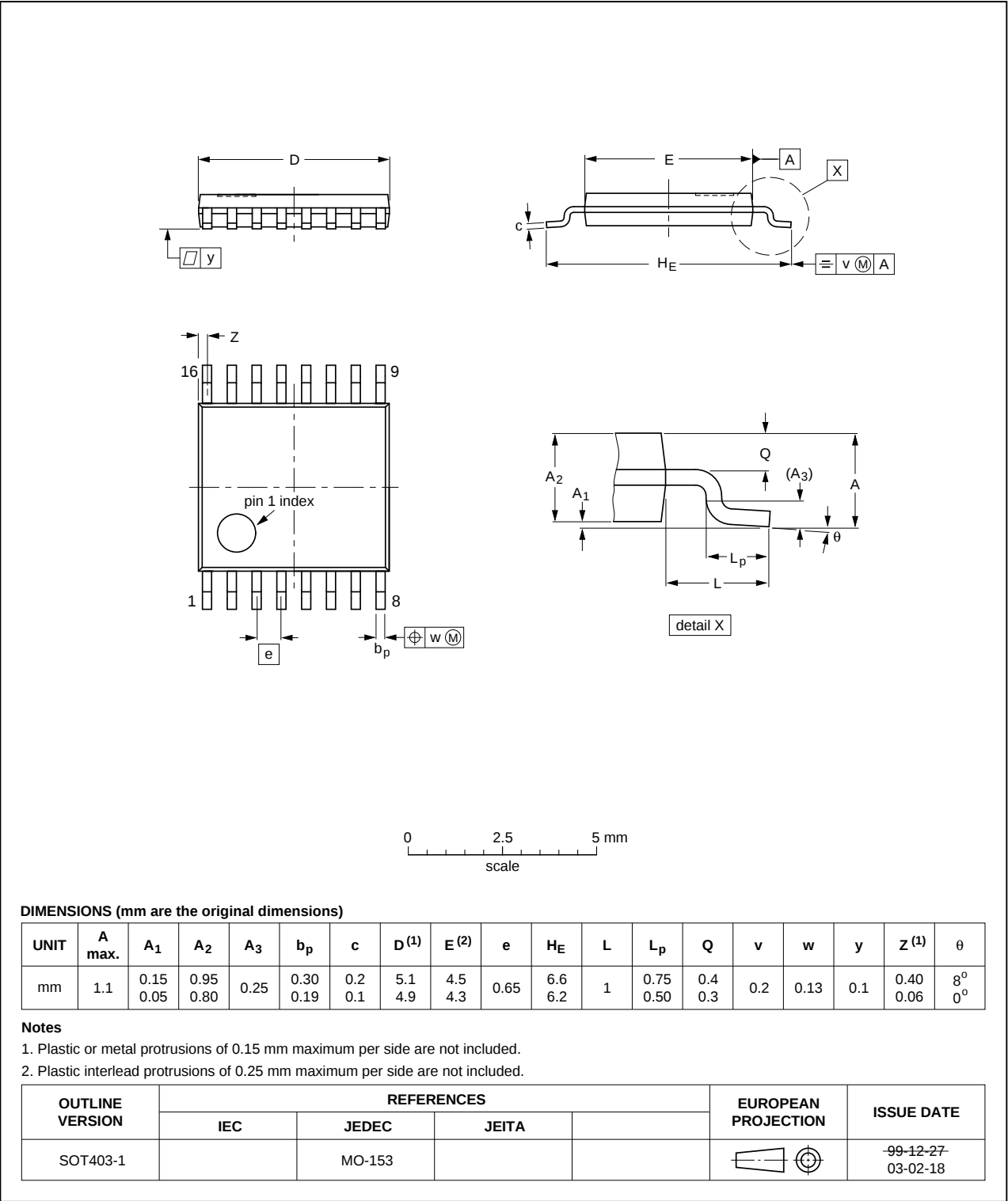


Fig 18. Package outline SOT403-1 (TSSOP16)

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

SOT763-1

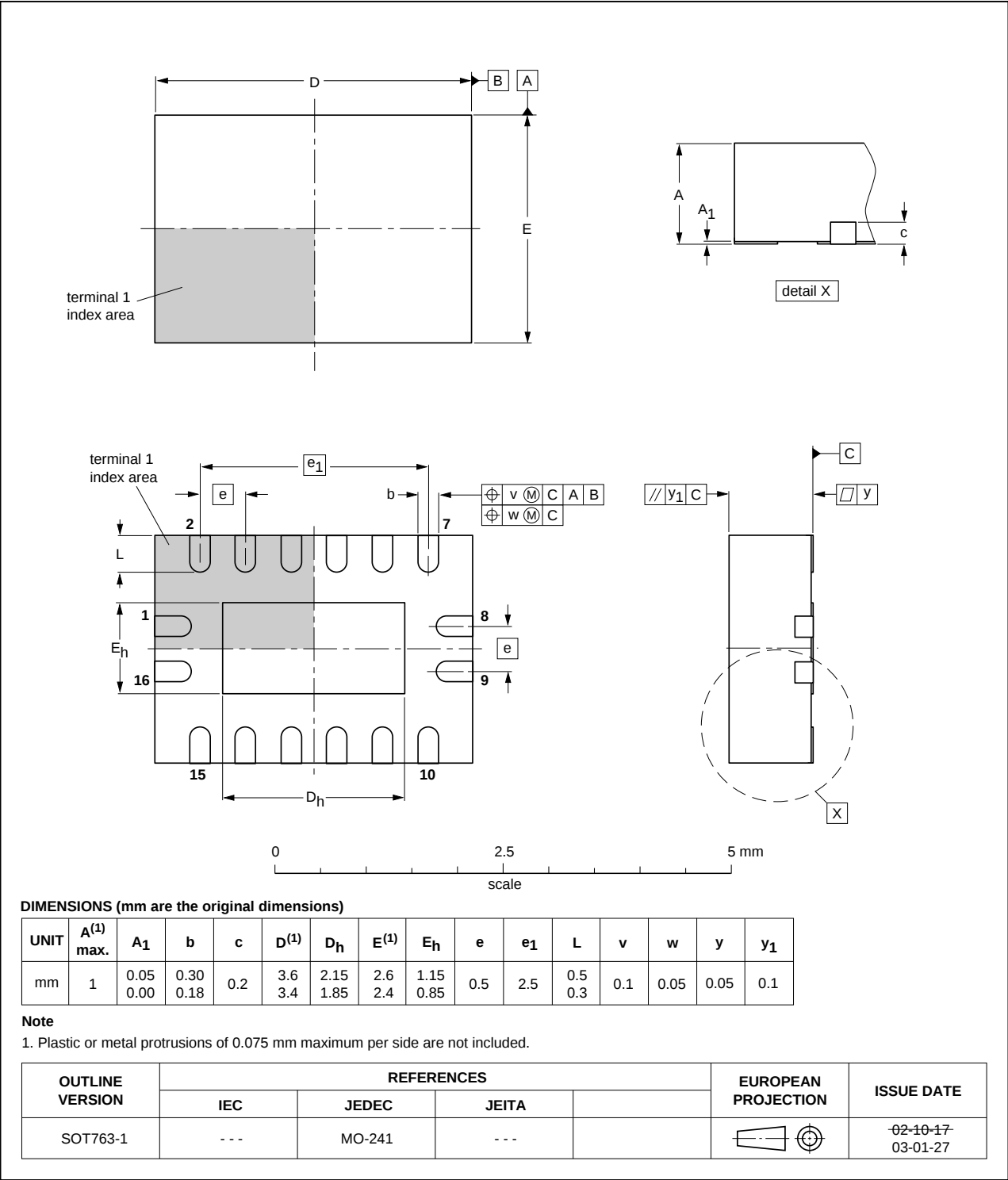


Fig 19. Package outline SOT763-1 (DHVQFN16)

## 14. Abbreviations

Table 10. Abbreviations

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

## 15. Revision history

Table 11. Revision history

| Document ID         | Release date           | Data sheet status     | Change notice | Supersedes          |
|---------------------|------------------------|-----------------------|---------------|---------------------|
| 74HC_HCT595 v.6     | 20111212               | Product data sheet    | -             | 74HC_HCT595 v.5     |
| Modifications:      | • Legal pages updated. |                       |               |                     |
| 74HC_HCT595 v.5     | 20110628               | Product data sheet    | -             | 74HC_HCT595 v.4     |
| 74HC_HCT595 v.4     | 20030604               | Product specification | -             | 74HC_HCT595_CNV v.3 |
| 74HC_HCT595_CNV v.3 | 19980604               | Product specification | -             | -                   |

## 16. Legal information

### 16.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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