

# 74VHC595-Q100; 74VHCT595-Q100

8-bit serial-in/serial-out or parallel-out shift register with output latches

Rev. 1 — 15 November 2013

Product data sheet

## 1. General description

The 74VHC595-Q100; 74VHCT595-Q100 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7A.

The 74VHC595-Q100; 74VHCT595-Q100 are 8-stage serial shift registers with a storage register and 3-state outputs. The shift 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 is always 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Balanced propagation delays
- All inputs have Schmitt-trigger action
- Inputs accept voltages higher than  $V_{CC}$
- Input levels:
  - ◆ The 74VHC595-Q100 operates with CMOS input level
  - ◆ The 74VHCT595-Q100 operates with TTL input level
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pf}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options



3. Applications

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

4. Ordering information

Table 1. Ordering information

| Type number                         | Package           |          |  |          |
|-------------------------------------|-------------------|----------|--|----------|
|                                     | Temperature range | Name     | Description  | Version  |
| 74VHC595D-Q100<br>74VHCT595D-Q100   | −40 °C to +125 °C | SO16     | plastic small outline package; 16 leads; body width 3.9 mm   | SOT109-1 |
| 74VHC595PW-Q100<br>74VHCT595PW-Q100 | −40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads; body width 4.4 mm   | SOT403-1 |
| 74VHC595BQ-Q100<br>74VHCT595BQ-Q100 | −40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |

5. Functional diagram

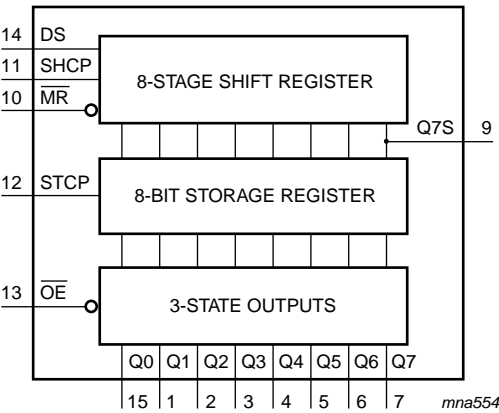


Fig 1. Functional diagram

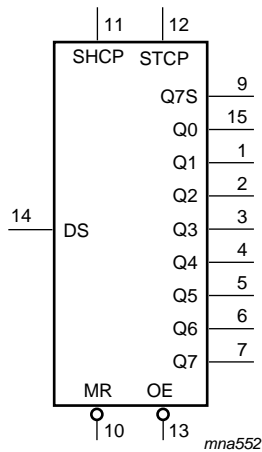


Fig 2. Logic symbol

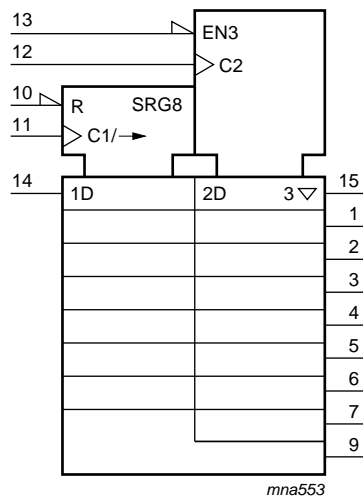


Fig 3. IEC logic symbol

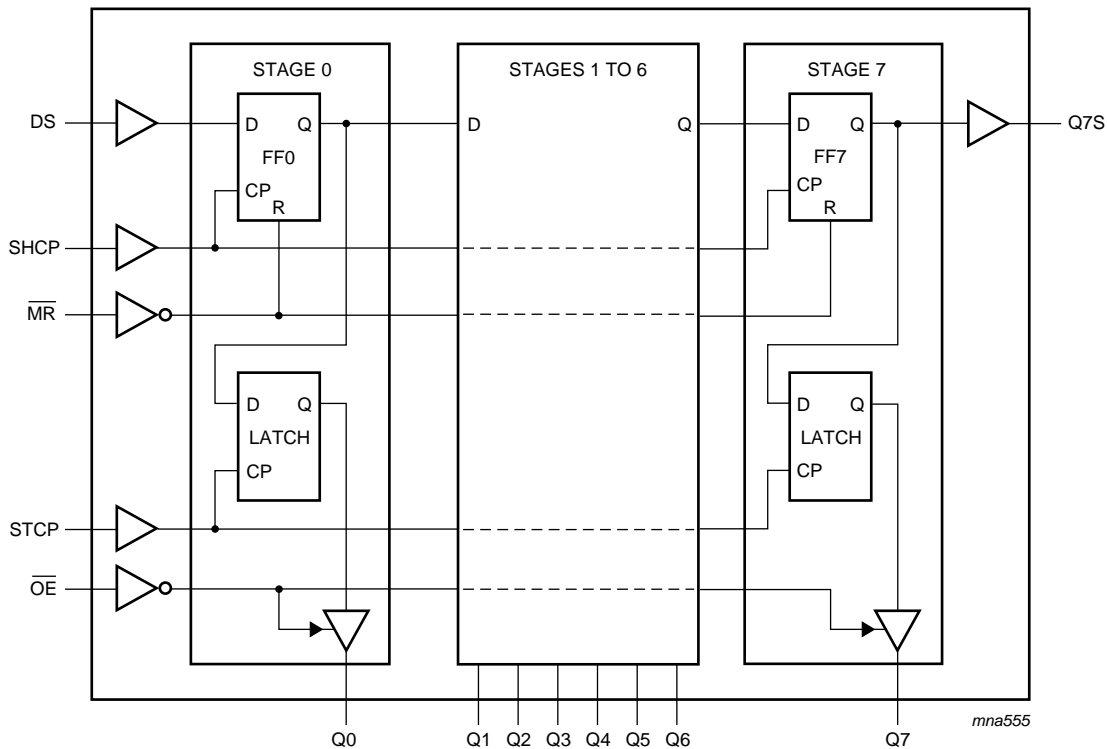
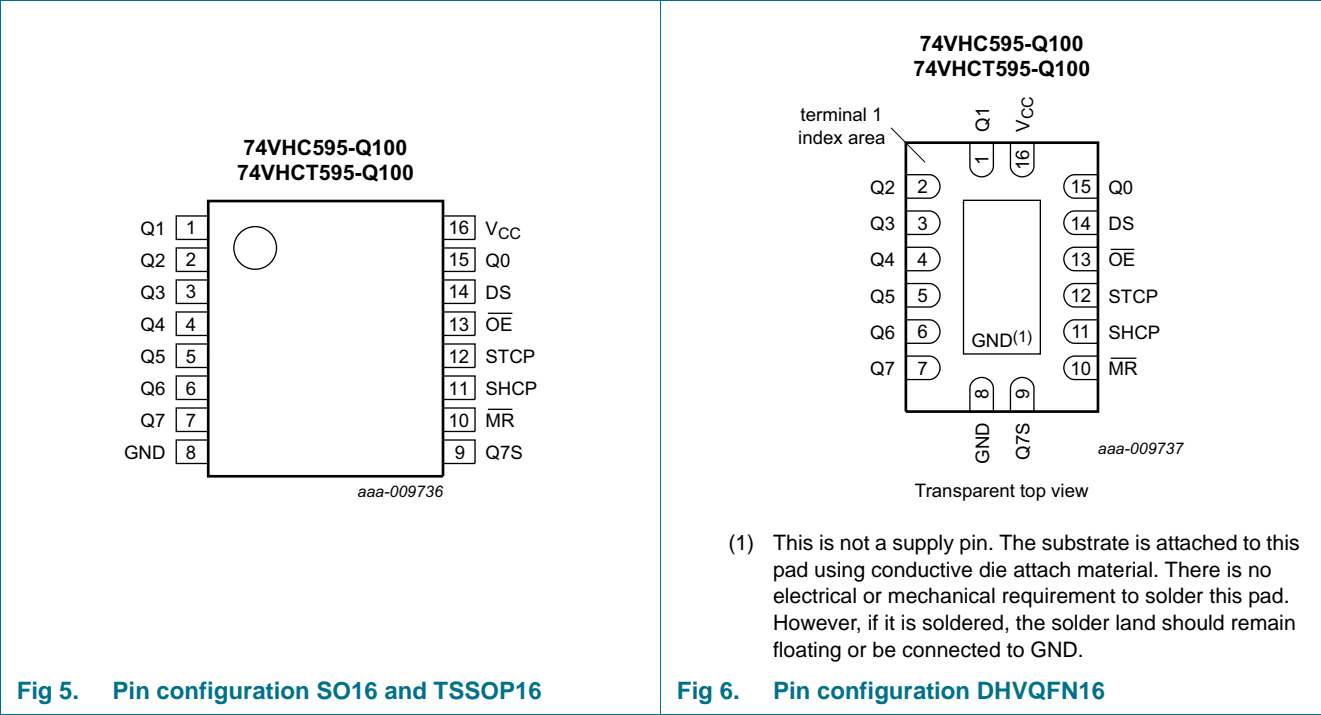


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

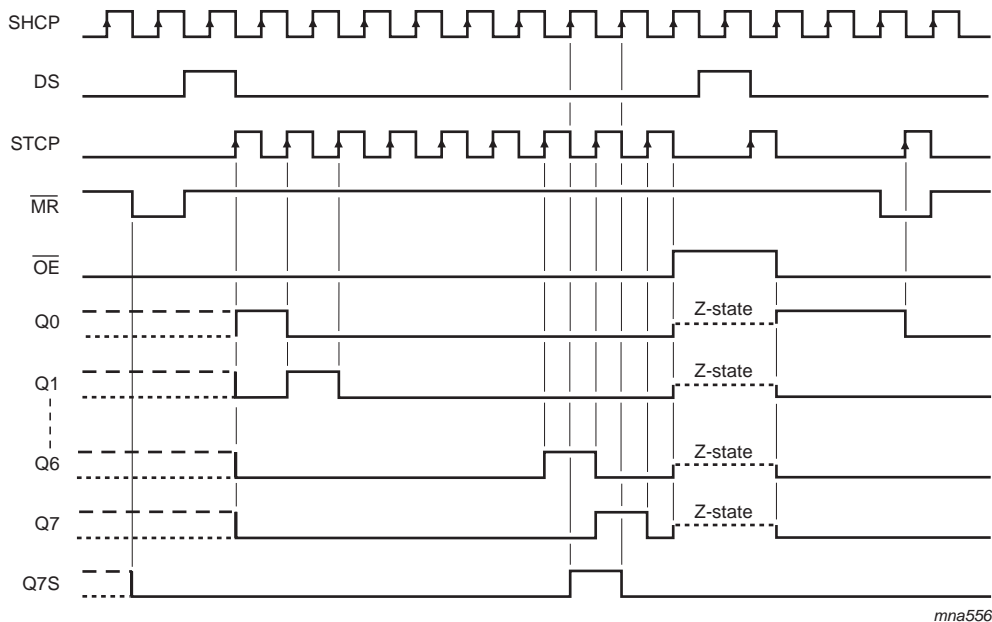
| Symbol          | Pin | Description                      |
|-----------------|-----|----------------------------------|
| Q1              | 1   | parallel data output 1           |
| Q2              | 2   | parallel data output 2           |
| Q3              | 3   | parallel data output 3           |
| 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               |
| MR              | 10  | master reset (active LOW)        |
| SHCP            | 11  | shift register clock input       |
| STCP            | 12  | storage register clock input     |
| 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 | $\overline{OE}$ | $\overline{MR}$ | DS    | Q7S    | Qn  |  |
| X       | X    | L               | L               | X     | L      | NC  | a LOW-level on $\overline{MR}$ 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.



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Fig 7. 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    | +7.0 | V    |
| $V_I$     | input voltage           |  | -0.5    | +7.0 | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5$ V                           | [1] -20 | -    | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V | [1] -20 | +20  | mA   |
| $I_O$     | output current          | $V_O = -0.5$ V to $(V_{CC} + 0.5$ V)     | -25     | +25  | mA   |
| $I_{CC}$  | supply current          |  | -       | +75  | mA   |
| $I_{GND}$ | ground current          |  | -75     | -    | mA   |
| $T_{stg}$ | storage temperature     |  | -65     | +150 | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40$ °C to +125 °C            | [2] -   | 500  | mW   |

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

[2] For SO16 packages: above 70 °C the value of  $P_{tot}$  derates linearly at 8 mW/K.

For TSSOP16 packages: above 60 °C the value of  $P_{tot}$  derates linearly at 5.5 mW/K.

For DHVQFN16 packages: above 60 °C the value of  $P_{tot}$  derates linearly at 4.5 mW/K.

## 9. Recommended operating conditions

**Table 5. Operating conditions**

| Symbol                | Parameter                           | Conditions                | Min | Typ | Max      | Unit |
|-----------------------|-------------------------------------|---------------------------|-----|-----|----------|------|
| <b>74VHC595-Q100</b>  |                                     |                           |     |     |          |      |
| $V_{CC}$              | supply voltage                      |                           | 2.0 | 5.0 | 5.5      | V    |
| $V_I$                 | input voltage                       |                           | 0   | -   | 5.5      | V    |
| $V_O$                 | output voltage                      |                           | 0   | -   | $V_{CC}$ | V    |
| $T_{amb}$             | ambient temperature                 |                           | -40 | +25 | +125     | °C   |
| $\Delta t/\Delta V$   | input transition rise and fall rate | $V_{CC} = 3.0$ V to 3.6 V | -   | -   | 100      | ns/V |
|                       |                                     | $V_{CC} = 4.5$ V to 5.5 V | -   | -   | 20       | ns/V |
| <b>74VHCT595-Q100</b> |                                     |                           |     |     |          |      |
| $V_{CC}$              | supply voltage                      |                           | 4.5 | 5.0 | 5.5      | V    |
| $V_I$                 | input voltage                       |                           | 0   | -   | 5.5      | V    |
| $V_O$                 | output voltage                      |                           | 0   | -   | $V_{CC}$ | V    |
| $T_{amb}$             | ambient temperature                 |                           | -40 | +25 | +125     | °C   |
| $\Delta t/\Delta V$   | input transition rise and fall rate | $V_{CC} = 4.5$ V to 5.5 V | -   | -   | 20       | ns/V |

## 10. Static characteristics

**Table 6. Static characteristics**

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

| Symbol          | Parameter                 | Conditions   | 25 °C |     |       | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|--|-------|-----|-------|------------------|------|-------------------|------|------|
|                 |                           |  | Min   | Typ | Max   | Min              | Max  | Min               | Max  |      |
| 74VHC595-Q100   |                           |  |       |     |       |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V  | 1.5   | -   | -     | 1.5              | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 3.0 V  | 2.1   | -   | -     | 2.1              | -    | 2.1               | -    | V    |
|                 |                           | V <sub>CC</sub> = 5.5 V  | 3.85  | -   | -     | 3.85             | -    | 3.85              | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V  | -     | -   | 0.5   | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 3.0 V  | -     | -   | 0.9   | -                | 0.9  | -                 | 0.9  | V    |
|                 |                           | V <sub>CC</sub> = 5.5 V  | -     | -   | 1.65  | -                | 1.65 | -                 | 1.65 | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>  |       |     |       |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = –50 μA; V <sub>CC</sub> = 2.0 V   | 1.9   | 2.0 | -     | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = –50 μA; V <sub>CC</sub> = 3.0 V   | 2.9   | 3.0 | -     | 2.9              | -    | 2.9               | -    | V    |
|                 |                           | I <sub>O</sub> = –50 μA; V <sub>CC</sub> = 4.5 V   | 4.4   | 4.5 | -     | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = –4.0 mA; V <sub>CC</sub> = 3.0 V  | 2.58  | -   | -     | 2.48             | -    | 2.40              | -    | V    |
|                 |                           | I <sub>O</sub> = –8.0 mA; V <sub>CC</sub> = 4.5 V  | 3.94  | -   | -     | 3.80             | -    | 3.70              | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>  |       |     |       |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 2.0 V  | -     | 0   | 0.1   | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 3.0 V  | -     | 0   | 0.1   | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 μA; V <sub>CC</sub> = 4.5 V  | -     | 0   | 0.1   | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V   | -     | -   | 0.36  | -                | 0.44 | -                 | 0.55 | V    |
|                 |                           | I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V   | -     | -   | 0.36  | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V  | -     | -   | 0.1   | -                | 1.0  | -                 | 2.0  | 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> = 5.5 V | -     | -   | ±0.25 | -                | ±2.5 | -                 | ±10  | 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> = 5.5 V                                 | -     | -   | 4.0   | -                | 40   | -                 | 80   | μA   |
| C <sub>I</sub>  | input capacitance         |  | -     | 3   | 10    | -                | 10   | -                 | 10   | pF   |
| 74VHCT595-Q100  |                           |  |       |     |       |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V   | 2.0   | -   | -     | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V   | -     | -   | 0.8   | -                | 0.8  | -                 | 0.8  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V  |       |     |       |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = –50 μA  | 4.4   | 4.5 | -     | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = –8.0 mA   | 3.94  | -   | -     | 3.80             | -    | 3.70              | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V  |       |     |       |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 50 μA   | -     | 0   | 0.1   | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 8.0 mA  | -     | -   | 0.36  | -                | 0.44 | -                 | 0.55 | 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      |               |
| $I_I$           | input leakage current     | $V_I = 5.5\text{ V}$ or GND;<br>$V_{CC} = 0\text{ V}$ to $5.5\text{ V}$  | -     | -   | 0.1        | -                | 1.0       | -                 | 2.0      | $\mu\text{A}$ |
| $I_{OZ}$        | OFF-state output current  | $V_I = V_{IH}$ or $V_{IL}$ ;<br>$V_O = V_{CC}$ or GND per input pin;<br>other inputs at $V_{CC}$ or GND;<br>$I_O = 0\text{ A}$ ; $V_{CC} = 5.5\text{ V}$ | -     | -   | $\pm 0.25$ | -                | $\pm 2.5$ | -                 | $\pm 10$ | $\mu\text{A}$ |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ;<br>$V_{CC} = 5.5\text{ V}$   | -     | -   | 4.0        | -                | 40        | -                 | 80       | $\mu\text{A}$ |
| $\Delta I_{CC}$ | additional supply current | per input pin; $V_I = V_{CC} - 2.1\text{ V}$ ;<br>other inputs at $V_{CC}$ or GND;<br>$I_O = 0\text{ A}$ ; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$     | -     | -   | 1.35       | -                | 1.5       | -                 | 1.5      | mA            |
| $C_I$           | input capacitance         |  | -     | 3   | 10         | -                | 10        | -                 | 10       | pF            |

## 11. Dynamic characteristics

**Table 7.** Dynamic characteristicsVoltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 13](#).

| 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 |      |

### 74VHC595-Q100

|          |                   |  |   |     |      |     |      |     |      |    |
|----------|-------------------|--|---|-----|------|-----|------|-----|------|----|
| $t_{pd}$ | propagation delay | SHCP to Q7S; see <a href="#">Figure 8</a> <sup>[2]</sup> |   |     |      |     |      |     |      |    |
|          |                   | $V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$                |   |     |      |     |      |     |      |    |
|          |                   | $C_L = 15\text{ pF}$                                     | - | 5.7 | 13.0 | 1.0 | 15.0 | 1.0 | 16.5 | ns |
|          |                   | $C_L = 50\text{ pF}$                                     | - | 7.7 | 16.5 | 1.0 | 18.5 | 1.0 | 20.1 | ns |
|          |                   | $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$                |   |     |      |     |      |     |      |    |
|          |                   | $C_L = 15\text{ pF}$                                     | - | 4.0 | 8.2  | 1.0 | 9.4  | 1.0 | 10.5 | ns |
|          |                   | $C_L = 50\text{ pF}$                                     | - | 5.4 | 10.0 | 1.0 | 11.4 | 1.0 | 12.5 | ns |
|          |                   | STCP to Qn; see <a href="#">Figure 9</a> <sup>[2]</sup>  |   |     |      |     |      |     |      |    |
|          |                   | $V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$                |   |     |      |     |      |     |      |    |
|          |                   | $C_L = 15\text{ pF}$                                     | - | 5.9 | 11.9 | 1.0 | 13.5 | 1.0 | 15.0 | ns |
|          |                   | $C_L = 50\text{ pF}$                                     | - | 7.7 | 15.4 | 1.0 | 17.0 | 1.0 | 18.5 | ns |
|          |                   | $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$                |   |     |      |     |      |     |      |    |
|          |                   | $C_L = 15\text{ pF}$                                     | - | 4.2 | 7.4  | 1.0 | 8.5  | 1.0 | 9.5  | ns |
|          |                   | $C_L = 50\text{ pF}$                                     | - | 5.5 | 9.0  | 1.0 | 10.5 | 1.0 | 11.5 | ns |
|          |                   | MR to Q7S; see <a href="#">Figure 11</a> <sup>[3]</sup>  |   |     |      |     |      |     |      |    |
|          |                   | $V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$                |   |     |      |     |      |     |      |    |
|          |                   | $C_L = 15\text{ pF}$                                     | - | 5.9 | 12.8 | 1.0 | 13.7 | 1.0 | 15.0 | ns |
|          |                   | $C_L = 50\text{ pF}$                                     | - | 7.4 | 16.3 | 1.0 | 17.2 | 1.0 | 18.7 | ns |
|          |                   | $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$                |   |     |      |     |      |     |      |    |
|          |                   | $C_L = 15\text{ pF}$                                     | - | 4.4 | 8.0  | 1.0 | 9.1  | 1.0 | 10.0 | ns |
|          |                   | $C_L = 50\text{ pF}$                                     | - | 5.6 | 10.0 | 1.0 | 11.1 | 1.0 | 12.0 | ns |



**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 13](#).

| 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>en</sub>  | enable time       | OE to Qn; see <a href="#">Figure 12</a> <sup>[4]</sup>           |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 |       |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF   | -     | 5.6                | 11.5 | 1.0              | 13.5 | 1.0               | 15.0 | ns   |
|                  |                   | C <sub>L</sub> = 50 pF   | -     | 7.4                | 15.0 | 1.0              | 17.0 | 1.0               | 18.5 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 |       |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF   | -     | 4.0                | 8.6  | 1.0              | 10.0 | 1.0               | 11.0 | ns   |
| t <sub>dis</sub> | disable time      | OE to Qn; see <a href="#">Figure 12</a> <sup>[5]</sup>           |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 |       |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF   | -     | 5.4                | 11.0 | 1.0              | 13.0 | 1.0               | 14.5 | ns   |
|                  |                   | C <sub>L</sub> = 50 pF   | -     | 8.7                | 15.7 | 1.0              | 16.2 | 1.0               | 17.5 | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 |       |                    |      |                  |      |                   |      |      |
|                  |                   | C <sub>L</sub> = 15 pF   | -     | 3.8                | 8.0  | 1.0              | 9.5  | 1.0               | 10.5 | ns   |
| f <sub>max</sub> | maximum frequency | SHCP or STCP; see <a href="#">Figure 8</a> and <a href="#">9</a> |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 80    | 125                | -    | 60               | -    | 40                | -    | MHz  |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 | 130   | 170                | -    | 110              | -    | 90                | -    | MHz  |
| t <sub>w</sub>   | pulse width       | SHCP HIGH or LOW; see <a href="#">Figure 8</a>                   |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|                  |                   | STCP HIGH or LOW; see <a href="#">Figure 9</a>                   |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|                  |                   | MR LOW; see <a href="#">Figure 11</a>                            |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>su</sub>  | set-up time       | DS to SHCP; see <a href="#">Figure 9</a>                         |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 3.5   | -                  | -    | 3.5              | -    | 3.5               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 | 3.0   | -                  | -    | 3.0              | -    | 3.0               | -    | ns   |
|                  |                   | SHCP to STCP; see <a href="#">Figure 10</a>                      |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 8.5   | -                  | -    | 8.5              | -    | 8.5               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>h</sub>   | hold time         | DS to SHCP; see <a href="#">Figure 10</a>                        |       |                    |      |                  |      |                   |      |      |
|                  |                   | V <sub>CC</sub> = 3.0 V to 3.6 V                                 | 1.5   | -                  | -    | 1.5              | -    | 1.5               | -    | ns   |
|                  |                   | V <sub>CC</sub> = 4.5 V to 5.5 V                                 | 2.0   | -                  | -    | 2.0              | -    | 2.0               | -    | ns   |

**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 13](#).

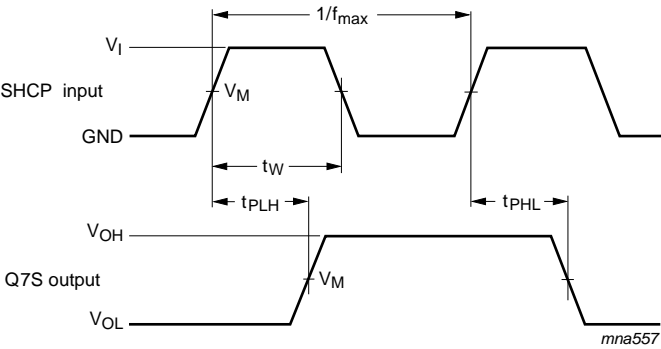
| Symbol   | Parameter                     | Conditions   | 25 °C |                    |      | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|--|-------------------------------|--|-------|--------------------|------|------------------|------|-------------------|------|------|
|  |                               |  | Min   | Typ <sup>[1]</sup> | Max  | Min              | Max  | Min               | Max  |      |
| t <sub>rec</sub>                                       | recovery time                 | MR to SHCP; see <a href="#">Figure 11</a>  |       |                    |      |                  |      |                   |      |      |
|  |                               | V <sub>CC</sub> = 3.0 V to 3.6 V   | 3.0   | -                  | -    | 3.0              | -    | 3.0               | -    | ns   |
|  |                               | V <sub>CC</sub> = 4.5 V to 5.5 V   | 2.5   | -                  | -    | 2.5              | -    | 2.5               | -    | ns   |
| 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]</a><br><a href="#">[7]</a> | -     | 180                | -    | -                | -    | -                 | -    | pF   |
| <b>74VHCT595-Q100; V<sub>CC</sub> = 4.5 V to 5.5 V</b> |                               |  |       |                    |      |                  |      |                   |      |      |
| t <sub>pd</sub>  | propagation delay             | SHCP to Q7S; see <a href="#">Figure 8</a> <a href="#">[2]</a>  |       |                    |      |                  |      |                   |      |      |
|  |                               | C <sub>L</sub> = 15 pF   | -     | 3.8                | 8.2  | 1.0              | 9.0  | 1.0               | 10.0 | ns   |
|  |                               | C <sub>L</sub> = 50 pF   | -     | 5.2                | 10.0 | 1.0              | 11.0 | 1.0               | 12.0 | ns   |
|  |                               | STCP to Qn; see <a href="#">Figure 9</a> <a href="#">[2]</a>   |       |                    |      |                  |      |                   |      |      |
|  |                               | C <sub>L</sub> = 15 pF   | -     | 4.0                | 7.4  | 1.0              | 8.5  | 1.0               | 9.5  | ns   |
|  |                               | C <sub>L</sub> = 50 pF   | -     | 5.3                | 9.0  | 1.0              | 10.5 | 1.0               | 11.5 | ns   |
|  |                               | MR to Q7S; see <a href="#">Figure 11</a> <a href="#">[3]</a>   |       |                    |      |                  |      |                   |      |      |
|  |                               | C <sub>L</sub> = 15 pF   | -     | 4.6                | 8.2  | 1.0              | 9.5  | 1.0               | 10.5 | ns   |
| t <sub>en</sub>  | enable time                   | OE to Qn; see <a href="#">Figure 12</a> <a href="#">[4]</a>  |       |                    |      |                  |      |                   |      |      |
|  |                               | C <sub>L</sub> = 15 pF   | -     | 4.8                | 9.0  | 1.0              | 11.0 | 1.0               | 12.0 | ns   |
|  |                               | C <sub>L</sub> = 50 pF   | -     | 6.2                | 11.6 | 1.0              | 13.0 | 1.0               | 14.5 | ns   |
| t <sub>dis</sub>                                       | disable time                  | OE to Qn; see <a href="#">Figure 12</a> <a href="#">[5]</a>  |       |                    |      |                  |      |                   |      |      |
|  |                               | C <sub>L</sub> = 15 pF   | -     | 3.6                | 6.9  | 1.0              | 8.0  | 1.0               | 9.0  | ns   |
|  |                               | C <sub>L</sub> = 50 pF   | -     | 5.8                | 10.3 | 1.0              | 11.0 | 1.0               | 12.0 | ns   |
| f <sub>max</sub>                                       | maximum frequency             | SHCP and STCP; see <a href="#">Figure 8</a> and <a href="#">9</a>  | 130   | 170                | -    | 110              | -    | 90                | -    | MHz  |
| t <sub>W</sub>   | pulse width                   | SHCP HIGH or LOW; see <a href="#">Figure 8</a>   | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|  |                               | STCP HIGH or LOW; see <a href="#">Figure 9</a>   | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
|  |                               | MR LOW; see <a href="#">Figure 11</a>  | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>su</sub>  | set-up time                   | DS to SHCP; see <a href="#">Figure 9</a>   | 3.0   | -                  | -    | 3.0              | -    | 3.0               | -    | ns   |
|  |                               | SHCP to STCP; see <a href="#">Figure 10</a>  | 5.0   | -                  | -    | 5.0              | -    | 5.0               | -    | ns   |
| t <sub>h</sub>   | hold time                     | DS to SHCP; see <a href="#">Figure 10</a>  | 2.0   | -                  | -    | 2.0              | -    | 2.0               | -    | ns   |
| t <sub>rec</sub>                                       | recovery time                 | MR to SHCP; see <a href="#">Figure 11</a>  | 3.0   | -                  | -    | 3.0              | -    | 3.0               | -    | ns   |

**Table 7. Dynamic characteristics ...continued**  
 Voltages are referenced to GND (ground = 0 V); for test circuit, see [Figure 13](#).

| 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 |      |
| 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]</a><br><a href="#">[7]</a> | -                  | 190 | -                | -   | -                 | -   | pF   |

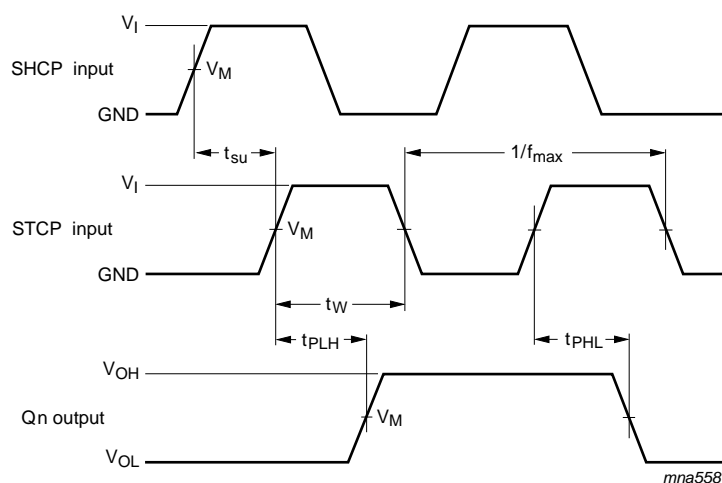
- [1] Typical values are measured at nominal supply voltage.
- [2] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [3] t<sub>pd</sub> is the same as t<sub>PHL</sub> only.
- [4] t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.
- [5] t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.
- [6] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:  
 f<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V.
- [7] All 9 outputs switching.

## 12. Waveforms



Measurement points are given in [Table 8](#).  
 V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

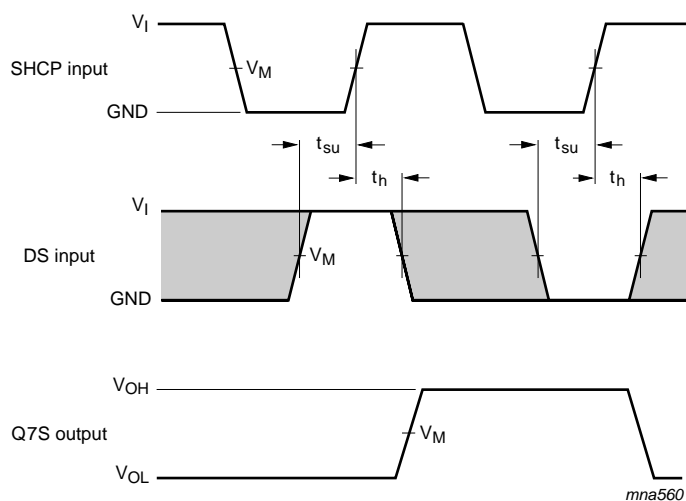
**Fig 8. Shift clock pulse, maximum frequency and input to output propagation delays**



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

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

**Fig 9. Storage clock to output propagation delays**

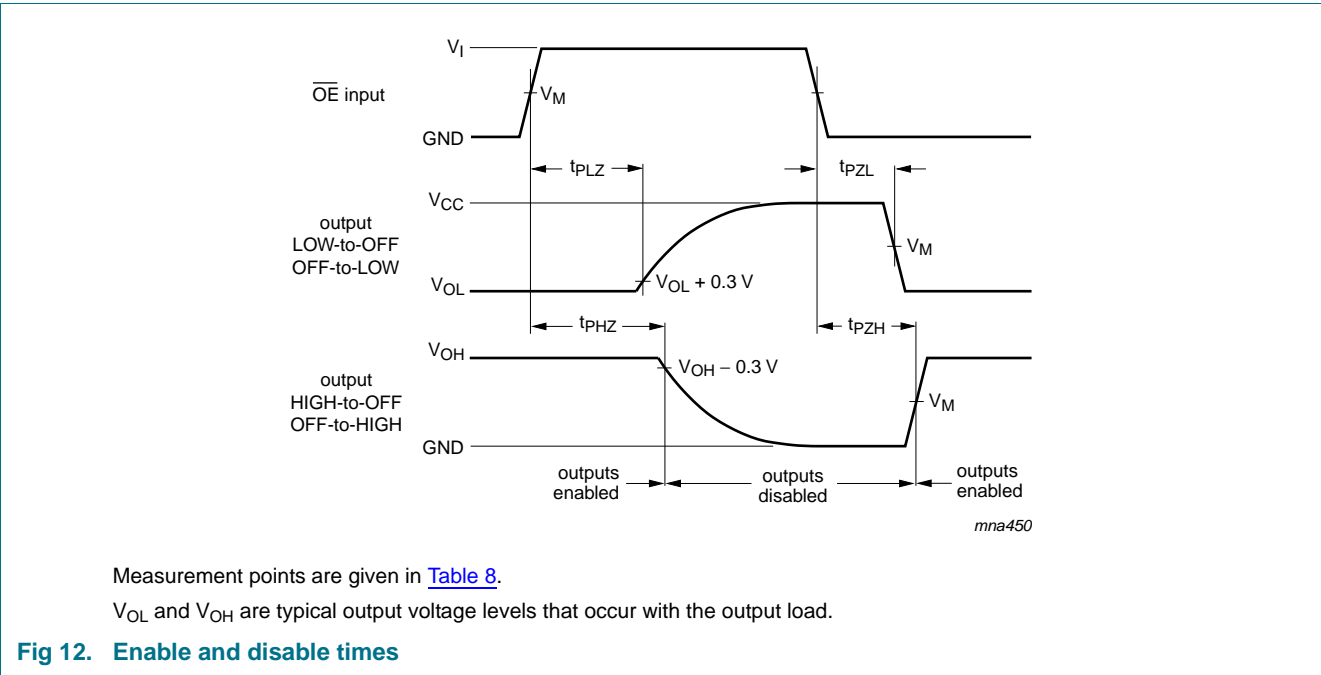
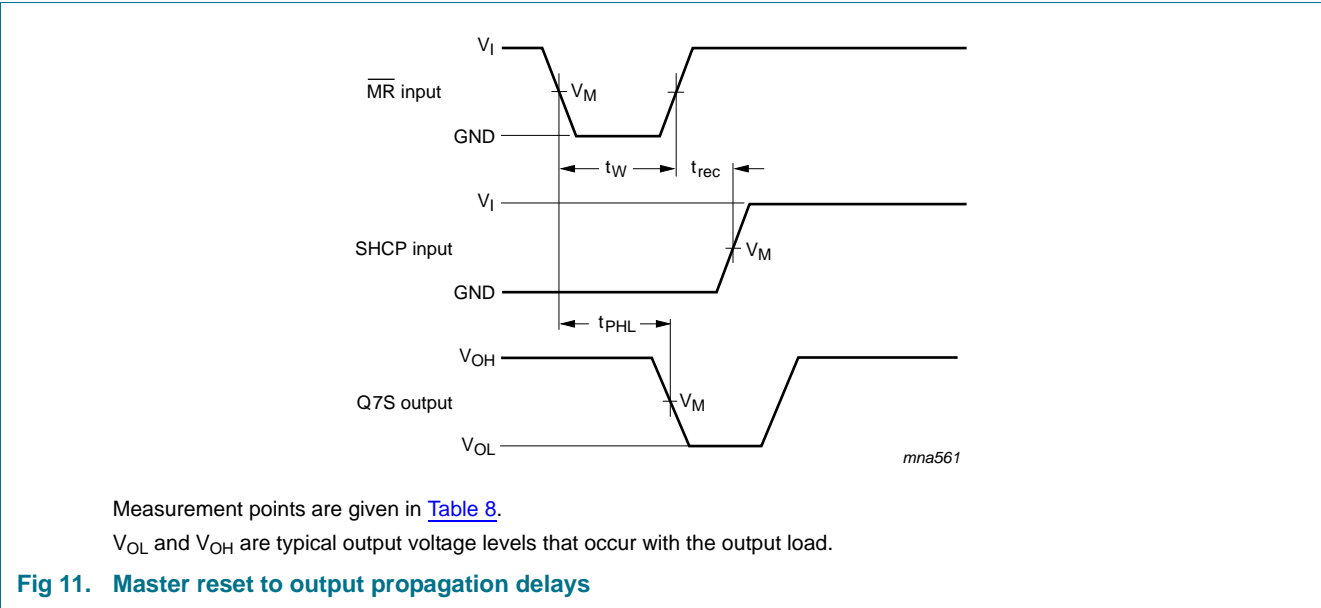


Measurement points are given in [Table 8](#).

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 10. Data set-up and hold times**



**Table 8. Measurement points**

| Type           | Input       | Output      |
|----------------|-------------|-------------|
|                | $V_M$       | $V_M$       |
| 74VHC595-Q100  | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74VHCT595-Q100 | 1.5 V       | $0.5V_{CC}$ |

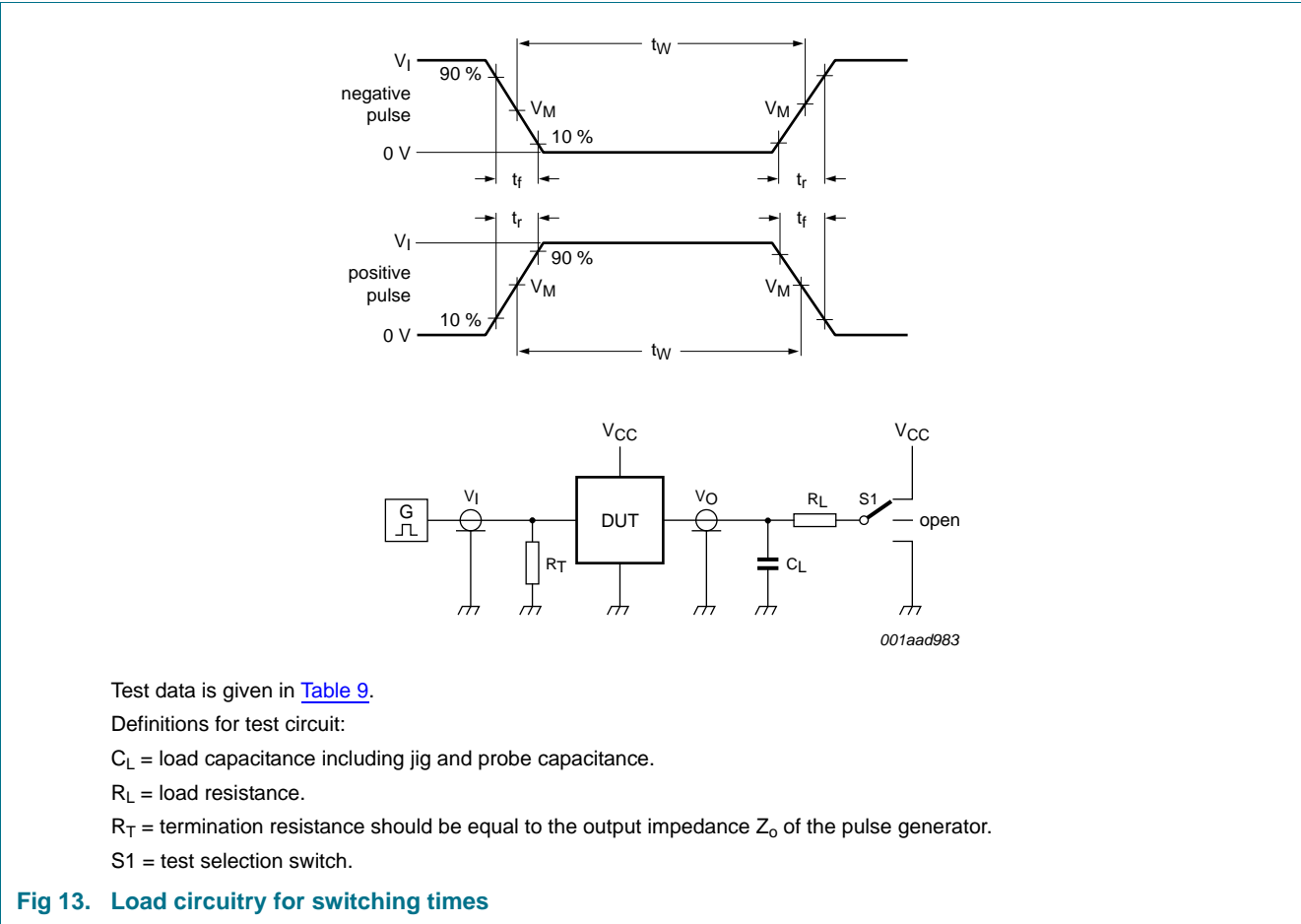


Table 9. Test data

| Type           | Input    |                       | Load         |              | S1 position        |                    |                    |
|----------------|----------|-----------------------|--------------|--------------|--------------------|--------------------|--------------------|
|                | $V_I$    | $t_r, t_f$            | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 74VHC595-Q100  | $V_{CC}$ | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |
| 74VHCT595-Q100 | 3.0 V    | $\leq 3.0 \text{ ns}$ | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |

## 13. Package outline

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

SOT109-1

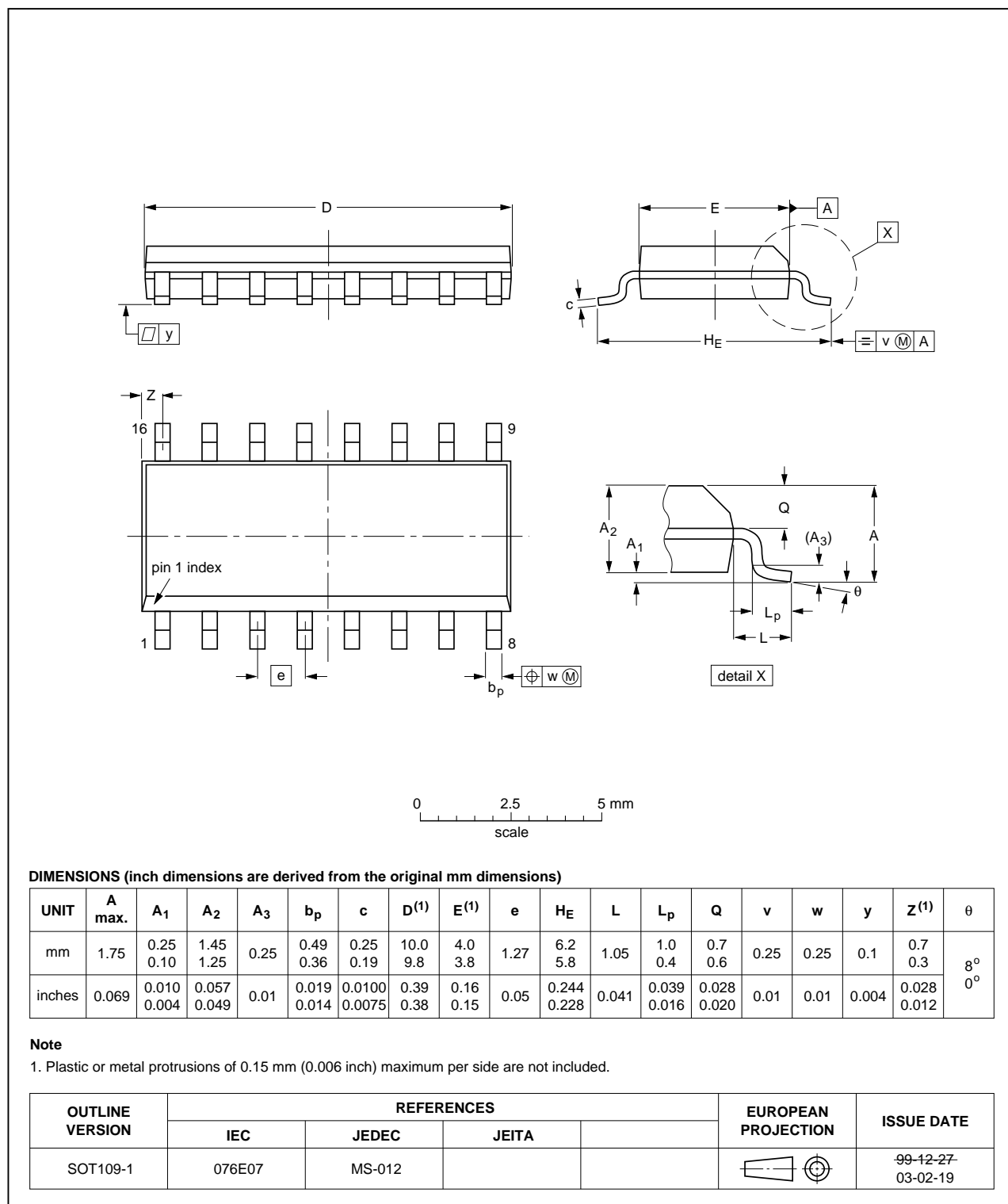


Fig 14. Package outline SOT109-1 (SO16)

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

SOT403-1

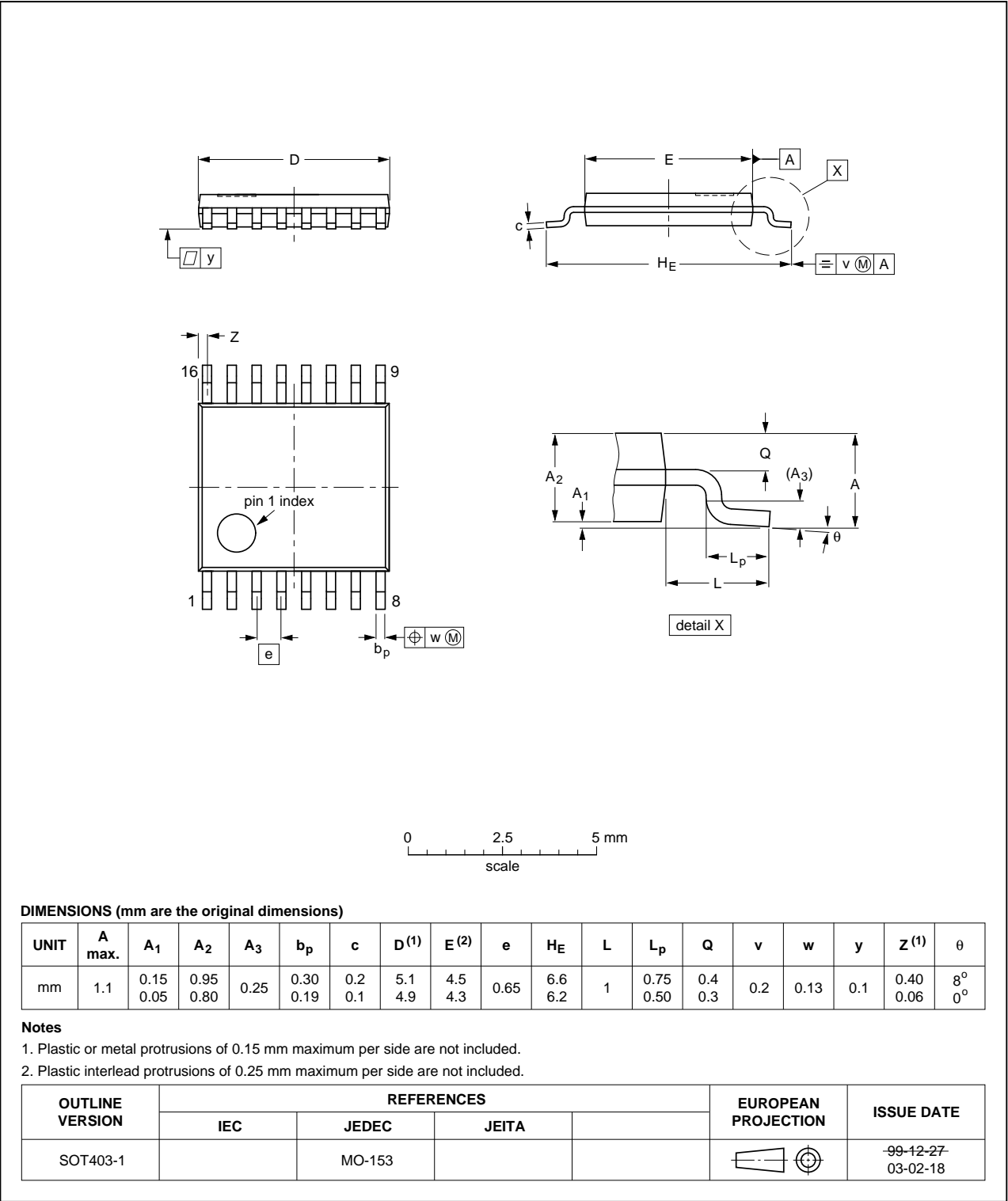


Fig 15. Package outline SOT403-1 (TSSOP16)



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

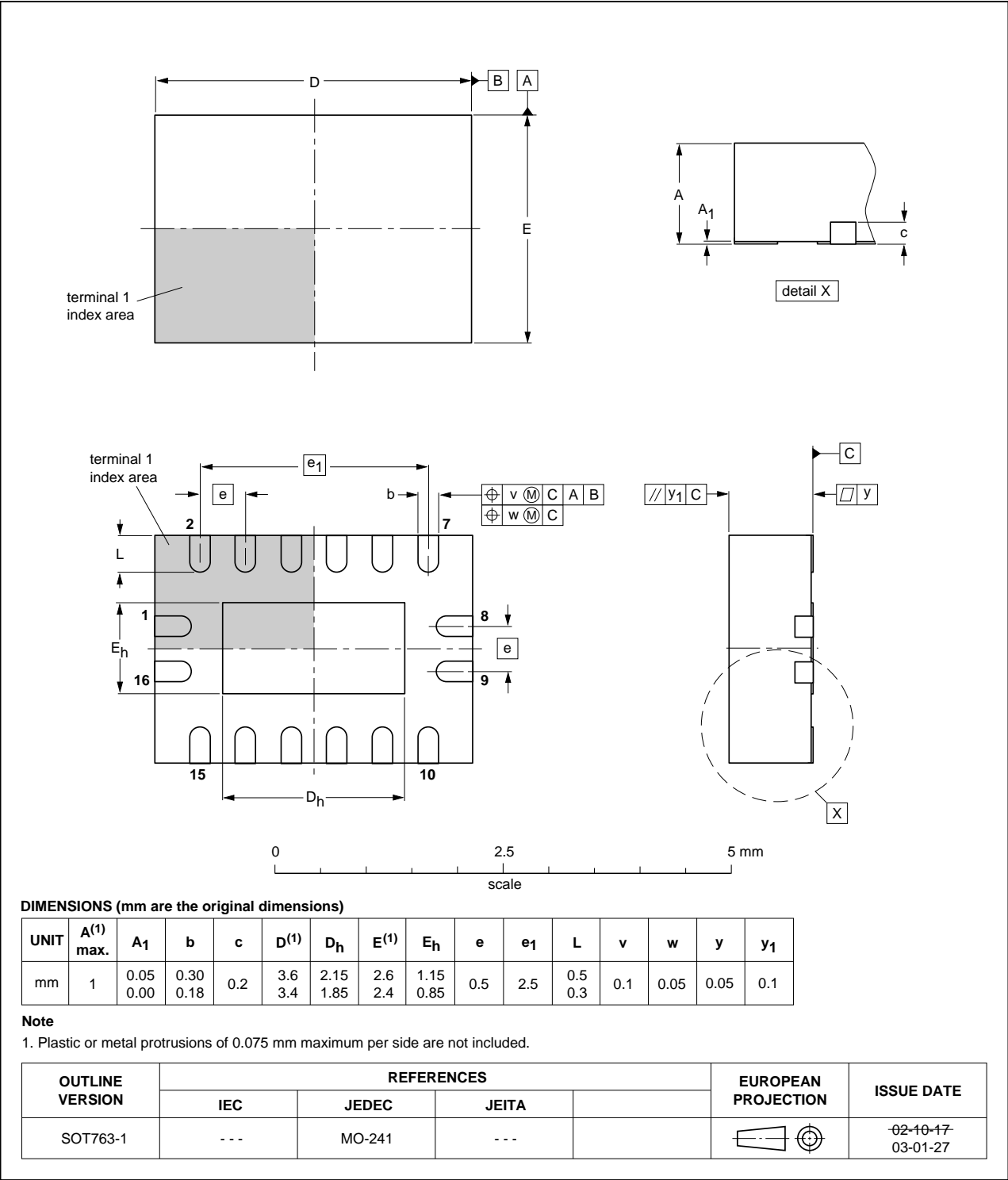


Fig 16. Package outline SOT763-1 (DHVQFN16)

## 14. Abbreviations

Table 10. Abbreviations

| Acronym | Description                             |
|---------|---|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MIL     | Military                                |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 15. Revision history

Table 11. Revision history

| Document ID            | Release date | Data sheet status  | Change notice | Supersedes |
|------------------------|--------------|--------------------|---------------|------------|
| 74VHC_VHCT595_Q100 v.1 | 20131115     | Product data sheet | -             | -          |

## 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".

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