

# 74HC595; 74HCT595

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

Rev. 9 — 28 February 2017

Product data sheet

## 1 General description

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The 74HC595; 74HCT595 is an 8-bit serial-in/serial or parallel-out shift register with a storage register and 3-state outputs. Both the shift and storage register have separate clocks. The device features a serial input (DS) and a serial output (Q7S) to enable cascading and an asynchronous reset  $\overline{MR}$  input. A LOW on  $\overline{MR}$  will reset the shift register. Data is shifted on the LOW-to-HIGH transitions of the SHCP input. The data in the shift register is transferred to the storage register on a LOW-to-HIGH transition of the STCP input. If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register. Data in the storage register appears at the output whenever the output enable input ( $\overline{OE}$ ) is LOW. A HIGH on  $\overline{OE}$  causes the outputs to assume a high-impedance OFF-state. Operation of the  $\overline{OE}$  input does not affect the state of the registers. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

## 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
- Complies with JEDEC standard no. 7A
- Input levels:
  - For 74HC595: CMOS level
  - For 74HCT595: TTL level
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °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  |
|-------------|---------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|----------|
| 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

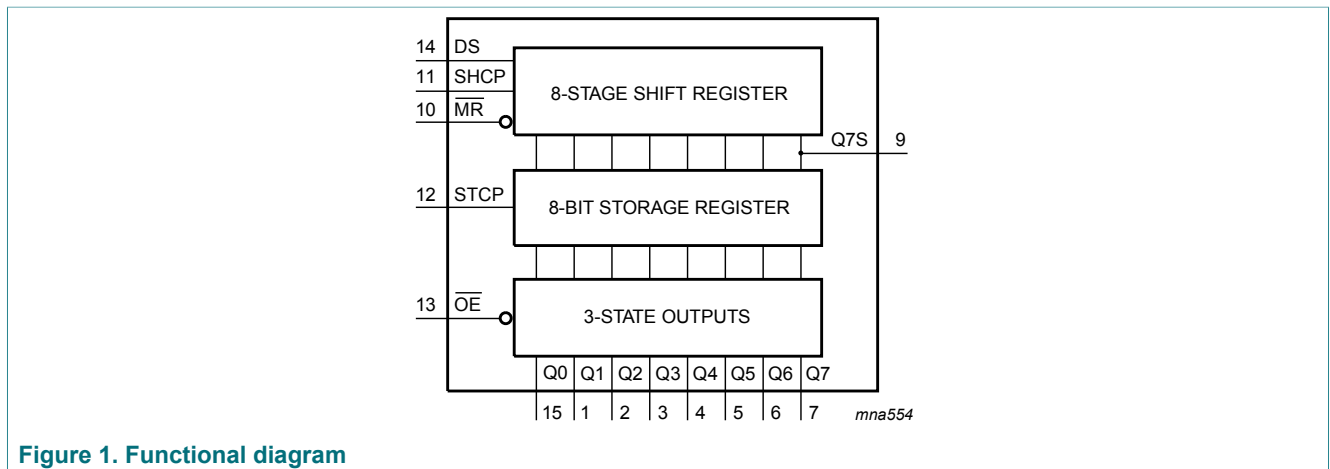


Figure 1. Functional diagram

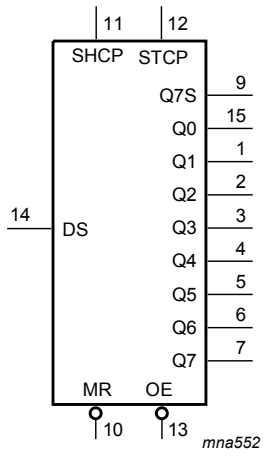


Figure 2. Logic symbol

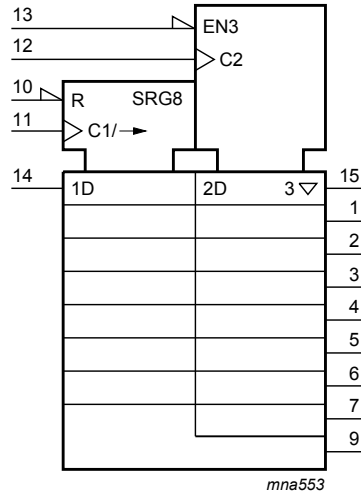


Figure 3. IEC logic symbol

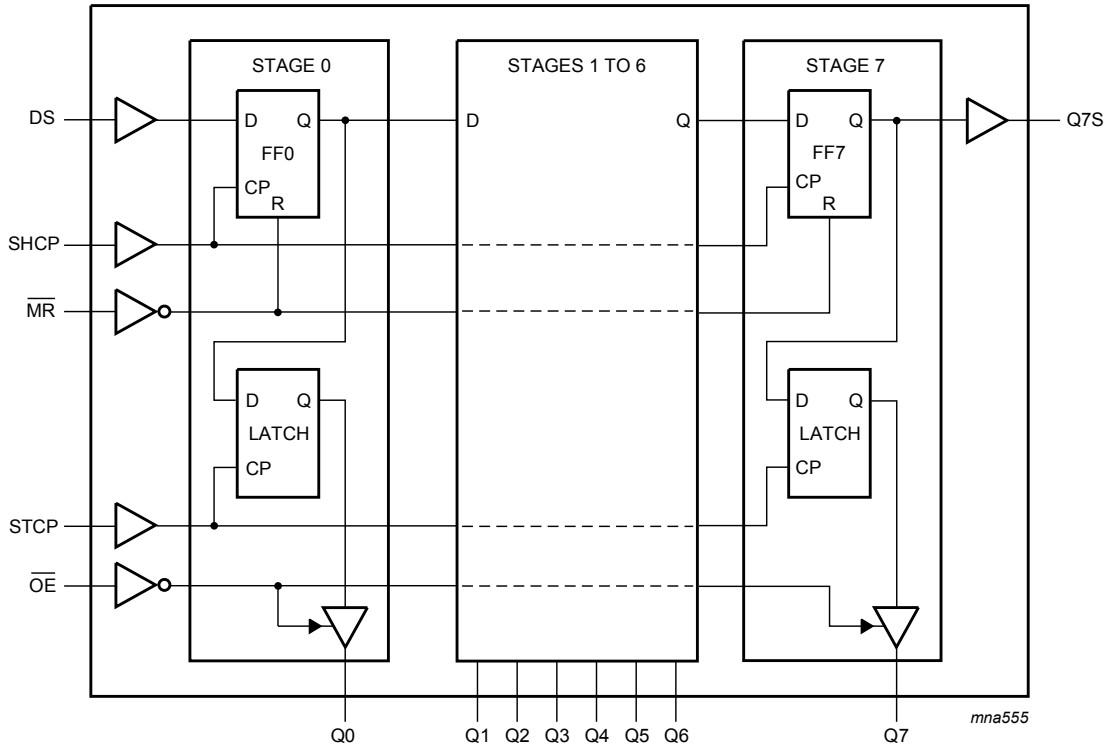


Figure 4. Logic diagram

## 6 Pinning information

### 6.1 Pinning

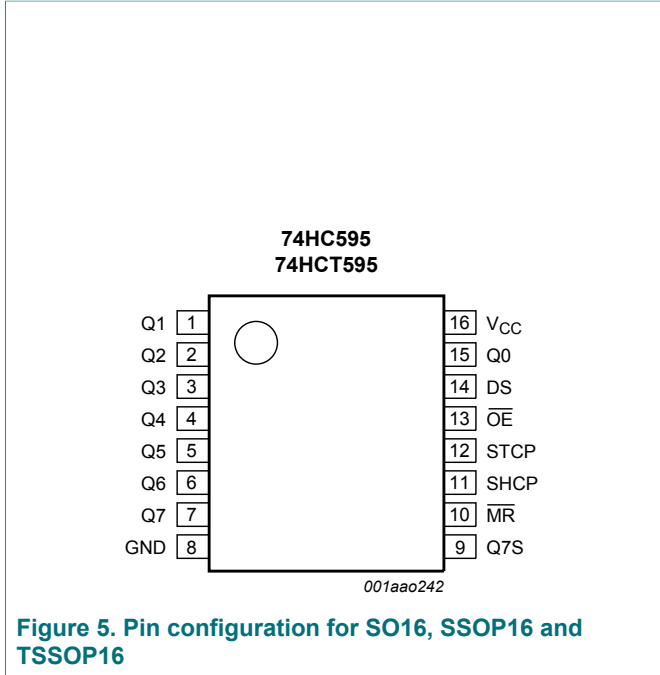
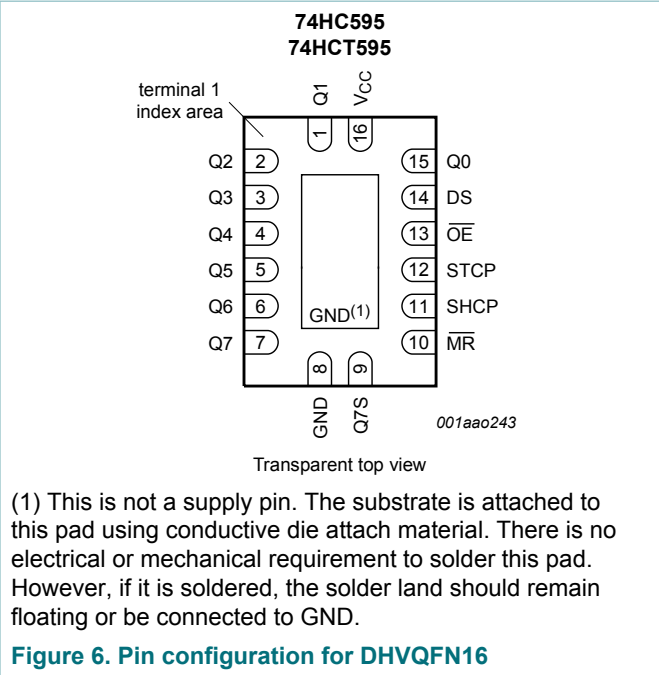


Figure 5. Pin configuration for SO16, SSOP16 and TSSOP16



(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Figure 6. Pin configuration for DHVQFN16

### 6.2 Pin description

Table 2. Pin description

| Symbol                         | Pin                     | Description                      |
|--------------------------------|-------------------------|----------------------------------|
| Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7 | 15, 1, 2, 3, 4, 5, 6, 7 | parallel data output             |
| 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.

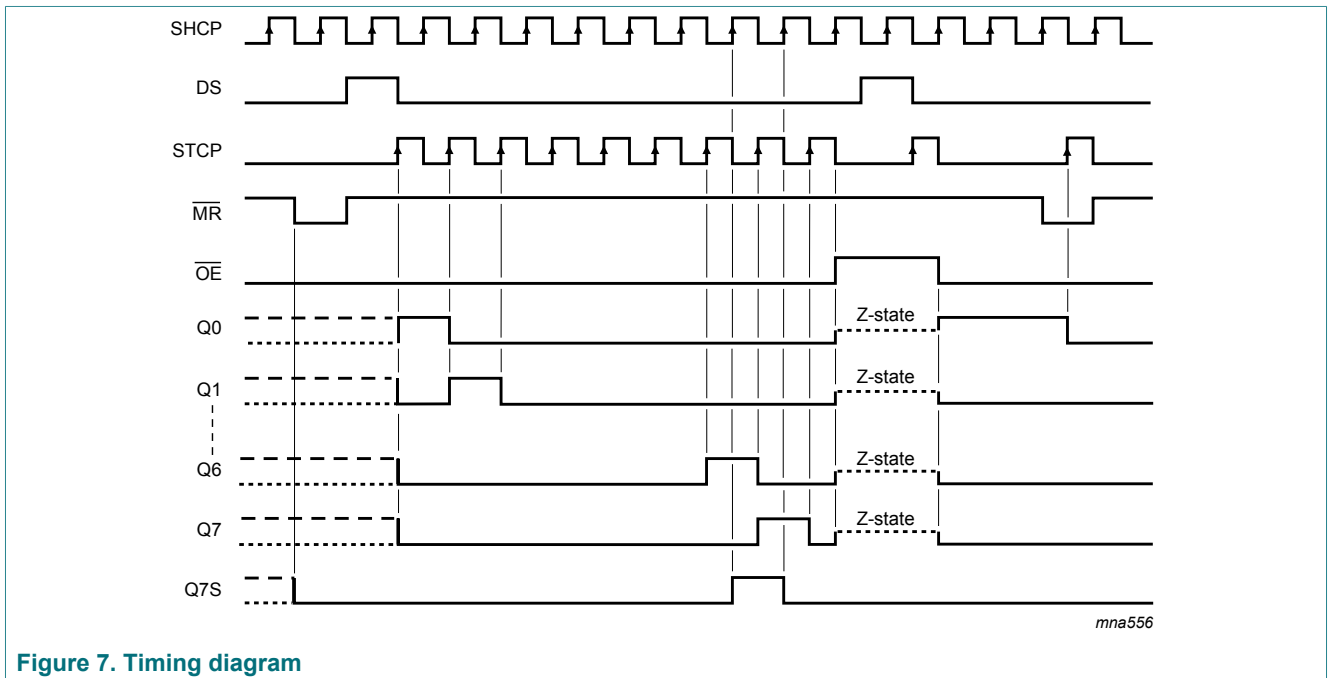


Figure 7. Timing diagram

## 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       | 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 | SO16 package <sup>[1]</sup>                            | -    | 500      | mW   |
|           |                         | SSOP16 package <sup>[2]</sup>                          | -    | 500      | mW   |
|           |                         | TSSOP16 package <sup>[2]</sup>                         | -    | 500      | mW   |
|           |                         | DHVQFN16 package <sup>[3]</sup>                        | -    | 500      | mW   |

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

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

[3] 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><br>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                 |      |      |
| V <sub>OL</sub>                                   | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>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>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   |

| Symbol          | Parameter                 | Conditions                                                                                                              | -40 °C to +85 °C |      |           | -40 °C to +125 °C |           | Unit    |
|-----------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------|------|-----------|-------------------|-----------|---------|
|                 |                           |                                                                                                                         | Min              | Typ  | Max       | Min               | Max       |         |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0$ A;<br>$V_{CC} = 6.0$ V                                                                 | -                | -    | 80        | -                 | 160       | $\mu$ A |
| $C_I$           | input capacitance         |                                                                                                                         | -                | 3.5  | -         | -                 | -         | pF      |
| <b>74HCT595</b> |                           |                                                                                                                         |                  |      |           |                   |           |         |
| $V_{IH}$        | HIGH-level input voltage  | $V_{CC} = 4.5$ V to 5.5 V                                                                                               | 2.0              | 1.6  | -         | 2.0               | -         | V       |
| $V_{IL}$        | LOW-level input voltage   | $V_{CC} = 4.5$ V to 5.5 V                                                                                               | -                | 1.2  | 0.8       | -                 | 0.8       | V       |
| $V_{OH}$        | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5$ V                                                                           |                  |      |           |                   |           |         |
|                 |                           | all outputs                                                                                                             |                  |      |           |                   |           |         |
|                 |                           | $I_O = -20$ $\mu$ A                                                                                                     | 4.4              | 4.5  | -         | 4.4               | -         | V       |
|                 |                           | Q7S output                                                                                                              |                  |      |           |                   |           |         |
|                 |                           | $I_O = -4$ mA                                                                                                           | 3.84             | 4.32 | -         | 3.7               | -         | V       |
| $V_{OL}$        | LOW-level output voltage  | $V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5$ V                                                                           |                  |      |           |                   |           |         |
|                 |                           | all outputs                                                                                                             |                  |      |           |                   |           |         |
|                 |                           | $I_O = 20$ $\mu$ A                                                                                                      | -                | 0    | 0.1       | -                 | 0.1       | V       |
| $V_{OL}$        | LOW-level output voltage  | Q7S output                                                                                                              |                  |      |           |                   |           |         |
|                 |                           | $I_O = 4.0$ mA                                                                                                          | -                | 0.15 | 0.33      | -                 | 0.4       | V       |
| $V_{OL}$        | LOW-level output voltage  | Qn bus driver outputs                                                                                                   |                  |      |           |                   |           |         |
|                 |                           | $I_O = 6.0$ mA                                                                                                          | -                | 0.16 | 0.33      | -                 | 0.4       | V       |
| $I_I$           | input leakage current     | $V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V                                                                                 | -                | -    | $\pm 1.0$ | -                 | $\pm 1.0$ | $\mu$ A |
| $I_{OZ}$        | 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;<br>other inputs at $V_{CC}$ or GND;<br>$I_O = 0$ A; $V_I = V_{CC} - 2.1$ V;<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 13](#).

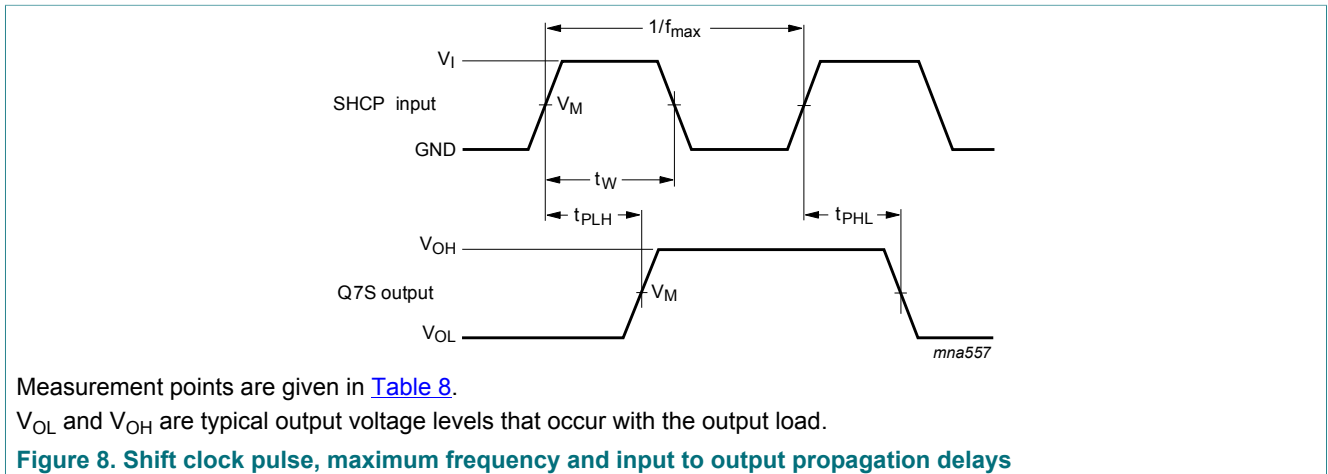
| Symbol           | Parameter                     | Conditions                                                                 | 25 °C |                    |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|----------------------------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                            | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
| 74HC595          |                               |                                                                            |       |                    |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | SHCP to Q7S; see <a href="#">Figure 8</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 9</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   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | $\overline{\text{MR}}$ to Q7S; see <a href="#">Figure 11</a>               |       |                    |     |                  |     |                   |     |      |
|                  |                               | 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                   | $\overline{\text{OE}}$ to Qn; see <a href="#">Figure 12</a> <sup>[3]</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                  | $\overline{\text{OE}}$ to Qn; see <a href="#">Figure 12</a> <sup>[4]</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 8</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 9</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   |
|                  |                               | $\overline{\text{MR}}$ LOW; see <a href="#">Figure 11</a>                  |       |                    |     |                  |     |                   |     |      |

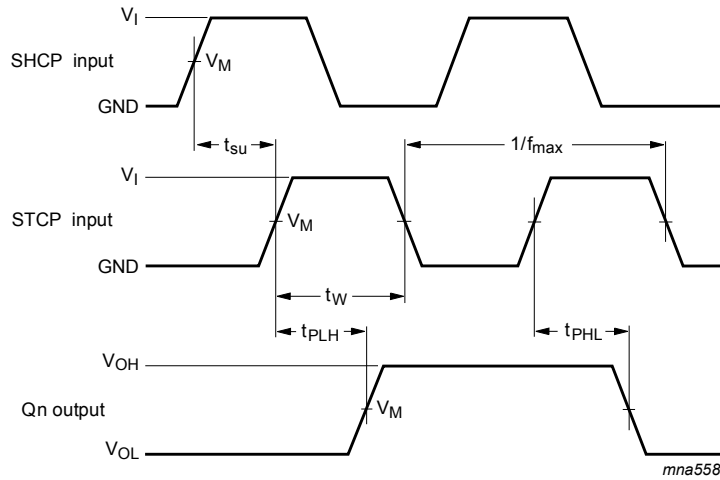
| Symbol                                             | Parameter                     | Conditions                                                              | 25 °C |                    |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|----------------------------------------------------|-------------------------------|-------------------------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
|                                                    |                               |                                                                         | Min   | Typ <sup>[1]</sup> | Max | Min              | Max | Min               | Max |      |
|                                                    |                               | $V_{CC} = 2\text{ V}$                                                   | 75    | 17                 | -   | 95               | -   | 110               | -   | ns   |
|                                                    |                               | $V_{CC} = 4.5\text{ V}$                                                 | 15    | 6                  | -   | 19               | -   | 22                | -   | ns   |
|                                                    |                               | $V_{CC} = 6\text{ V}$                                                   | 13    | 5                  | -   | 16               | -   | 19                | -   | ns   |
| $t_{su}$                                           | set-up time                   | DS to SHCP; see <a href="#">Figure 10</a>                               |       |                    |     |                  |     |                   |     |      |
|                                                    |                               | $V_{CC} = 2\text{ V}$                                                   | 50    | 11                 | -   | 65               | -   | 75                | -   | ns   |
|                                                    |                               | $V_{CC} = 4.5\text{ V}$                                                 | 10    | 4                  | -   | 13               | -   | 15                | -   | ns   |
|                                                    |                               | $V_{CC} = 6\text{ V}$                                                   | 9     | 3                  | -   | 11               | -   | 13                | -   | ns   |
|                                                    |                               | SHCP to STCP; see <a href="#">Figure 10</a>                             |       |                    |     |                  |     |                   |     |      |
|                                                    |                               | $V_{CC} = 2\text{ V}$                                                   | 75    | 22                 | -   | 95               | -   | 110               | -   | ns   |
|                                                    |                               | $V_{CC} = 4.5\text{ V}$                                                 | 15    | 8                  | -   | 19               | -   | 22                | -   | ns   |
|                                                    |                               | $V_{CC} = 6\text{ V}$                                                   | 13    | 7                  | -   | 16               | -   | 19                | -   | ns   |
| $t_h$                                              | hold time                     | DS to SHCP; see <a href="#">Figure 10</a>                               |       |                    |     |                  |     |                   |     |      |
|                                                    |                               | $V_{CC} = 2\text{ V}$                                                   | 3     | -6                 | -   | 3                | -   | 3                 | -   | ns   |
|                                                    |                               | $V_{CC} = 4.5\text{ V}$                                                 | 3     | -2                 | -   | 3                | -   | 3                 | -   | ns   |
|                                                    |                               | $V_{CC} = 6\text{ V}$                                                   | 3     | -2                 | -   | 3                | -   | 3                 | -   | ns   |
| $t_{rec}$                                          | recovery time                 | $\overline{MR}$ to SHCP; see <a href="#">Figure 11</a>                  |       |                    |     |                  |     |                   |     |      |
|                                                    |                               | $V_{CC} = 2\text{ V}$                                                   | 50    | -19                | -   | 65               | -   | 75                | -   | ns   |
|                                                    |                               | $V_{CC} = 4.5\text{ V}$                                                 | 10    | -7                 | -   | 13               | -   | 15                | -   | ns   |
|                                                    |                               | $V_{CC} = 6\text{ V}$                                                   | 9     | -6                 | -   | 11               | -   | 13                | -   | ns   |
| $f_{max}$                                          | maximum frequency             | SHCP or STCP; see <a href="#">Figure 8</a> and <a href="#">Figure 9</a> |       |                    |     |                  |     |                   |     |      |
|                                                    |                               | $V_{CC} = 2\text{ V}$                                                   | 9     | 30                 | -   | 4.8              | -   | 4                 | -   | MHz  |
|                                                    |                               | $V_{CC} = 4.5\text{ V}$                                                 | 30    | 91                 | -   | 24               | -   | 20                | -   | MHz  |
|                                                    |                               | $V_{CC} = 6\text{ V}$                                                   | 35    | 108                | -   | 28               | -   | 24                | -   | MHz  |
| $C_{PD}$                                           | power dissipation capacitance | $f_i = 1\text{ MHz}$ ; $V_I = \text{GND to } V_{CC}$ <sup>[5] [6]</sup> | -     | 115                | -   | -                | -   | -                 | -   | pF   |
| 74HCT595; $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ |                               |                                                                         |       |                    |     |                  |     |                   |     |      |
| $t_{pd}$                                           | propagation delay             | SHCP to Q7S; see <a href="#">Figure 8</a> <sup>[2]</sup>                | -     | 25                 | 42  | -                | 53  | -                 | 63  | ns   |
|                                                    |                               | STCP to Qn; see <a href="#">Figure 9</a> <sup>[2]</sup>                 | -     | 24                 | 40  | -                | 50  | -                 | 60  | ns   |
| $t_{PHL}$                                          | HIGH to LOW propagation delay | $\overline{MR}$ to Q7S; see <a href="#">Figure 11</a>                   | -     | 23                 | 40  | -                | 50  | -                 | 60  | ns   |
| $t_{en}$                                           | enable time                   | $\overline{OE}$ to Qn; see <a href="#">Figure 12</a> <sup>[3]</sup>     | -     | 21                 | 35  | -                | 44  | -                 | 53  | ns   |
| $t_{dis}$                                          | disable time                  | $\overline{OE}$ to Qn; see <a href="#">Figure 12</a> <sup>[4]</sup>     | -     | 18                 | 30  | -                | 38  | -                 | 45  | ns   |

| 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>W</sub>   | pulse width                   | SHCP HIGH or LOW; see <a href="#">Figure 8</a>                                                | 16    | 6                  | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | STCP HIGH or LOW; see <a href="#">Figure 9</a>                                                | 16    | 5                  | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | MR LOW; see <a href="#">Figure 11</a>                                                         | 20    | 8                  | -   | 25               | -   | 30                | -   | ns   |
| t <sub>su</sub>  | set-up time                   | DS to SHCP; see <a href="#">Figure 9</a>                                                      | 16    | 5                  | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | SHCP to STCP; see <a href="#">Figure 9</a>                                                    | 16    | 8                  | -   | 20               | -   | 24                | -   | ns   |
| t <sub>h</sub>   | hold time                     | DS to SHCP; see <a href="#">Figure 10</a>                                                     | 3     | -2                 | -   | 3                | -   | 3                 | -   | ns   |
| t <sub>rec</sub> | recovery time                 | MR to SHCP; see <a href="#">Figure 11</a>                                                     | 10    | -7                 | -   | 13               | -   | 15                | -   | ns   |
| f <sub>max</sub> | maximum frequency             | SHCP and STCP; see <a href="#">Figure 8</a> and <a href="#">Figure 9</a>                      | 30    | 52                 | -   | 24               | -   | 20                | -   | MHz  |
| C <sub>PD</sub>  | power dissipation capacitance | f <sub>i</sub> = 1 MHz; <sup>[5] [6]</sup><br>V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V | -     | 130                | -   | -                | -   | -                 | -   | 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>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.
- [4] t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.
- [5] 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;  
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of outputs;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V.
- [6] All 9 outputs switching.

### 11.1 Waveforms and test circuit

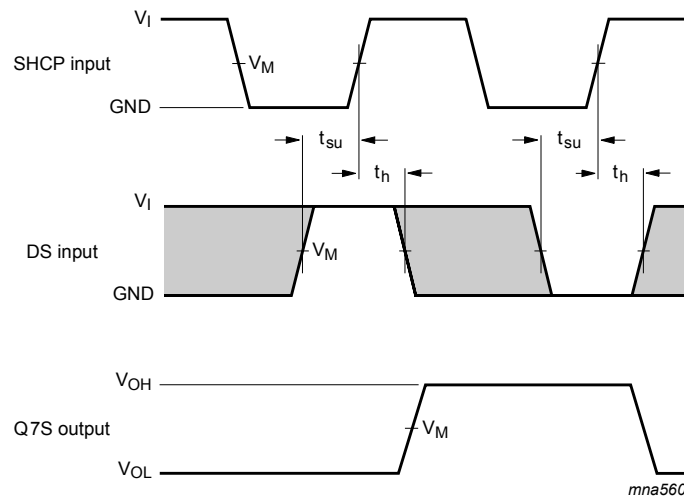




Measurement points are given in [Table 8](#).

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

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

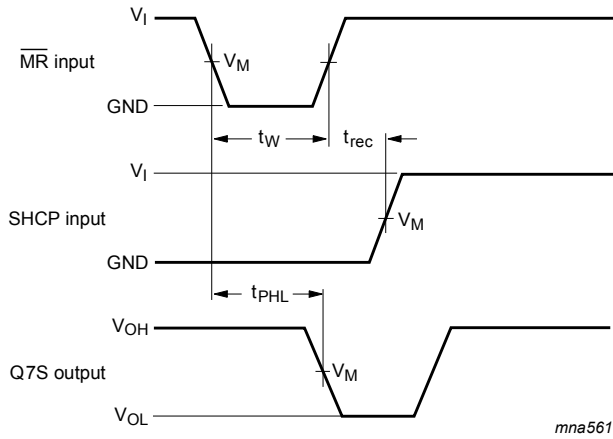


Measurement points are given in [Table 8](#).

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.

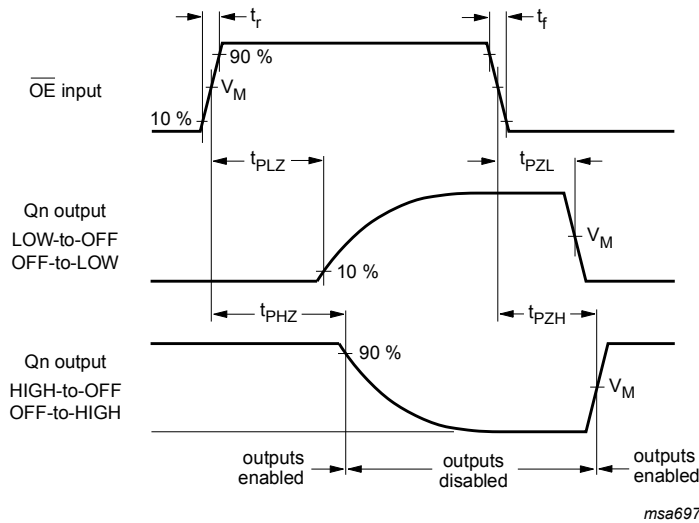
**Figure 10. Data set-up and hold times**



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

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

**Figure 11. Master reset to output propagation delays**



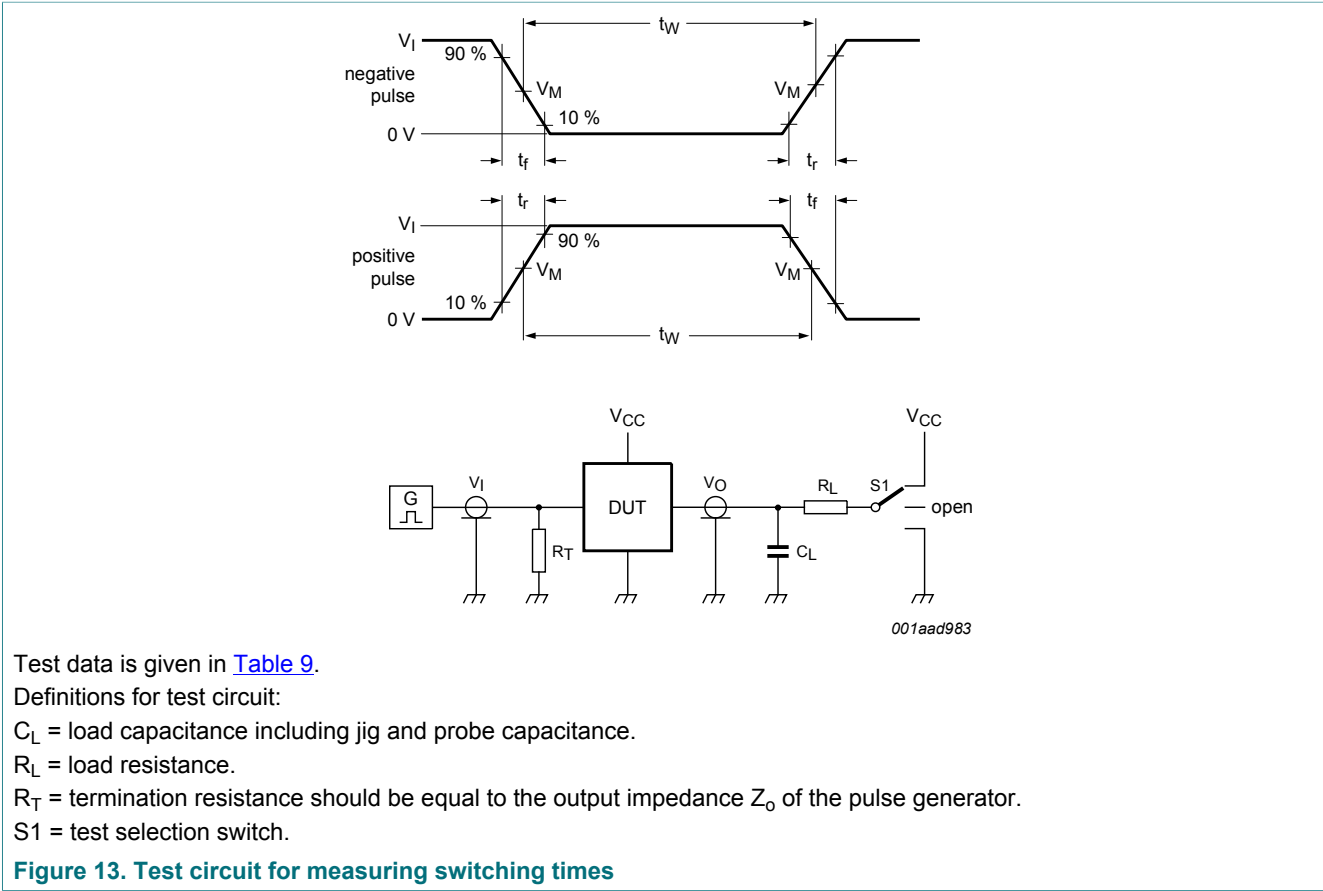
Measurement points are given in [Table 8](#).

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

**Figure 12. 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                | $V_{CC}$           |

12 Package outline

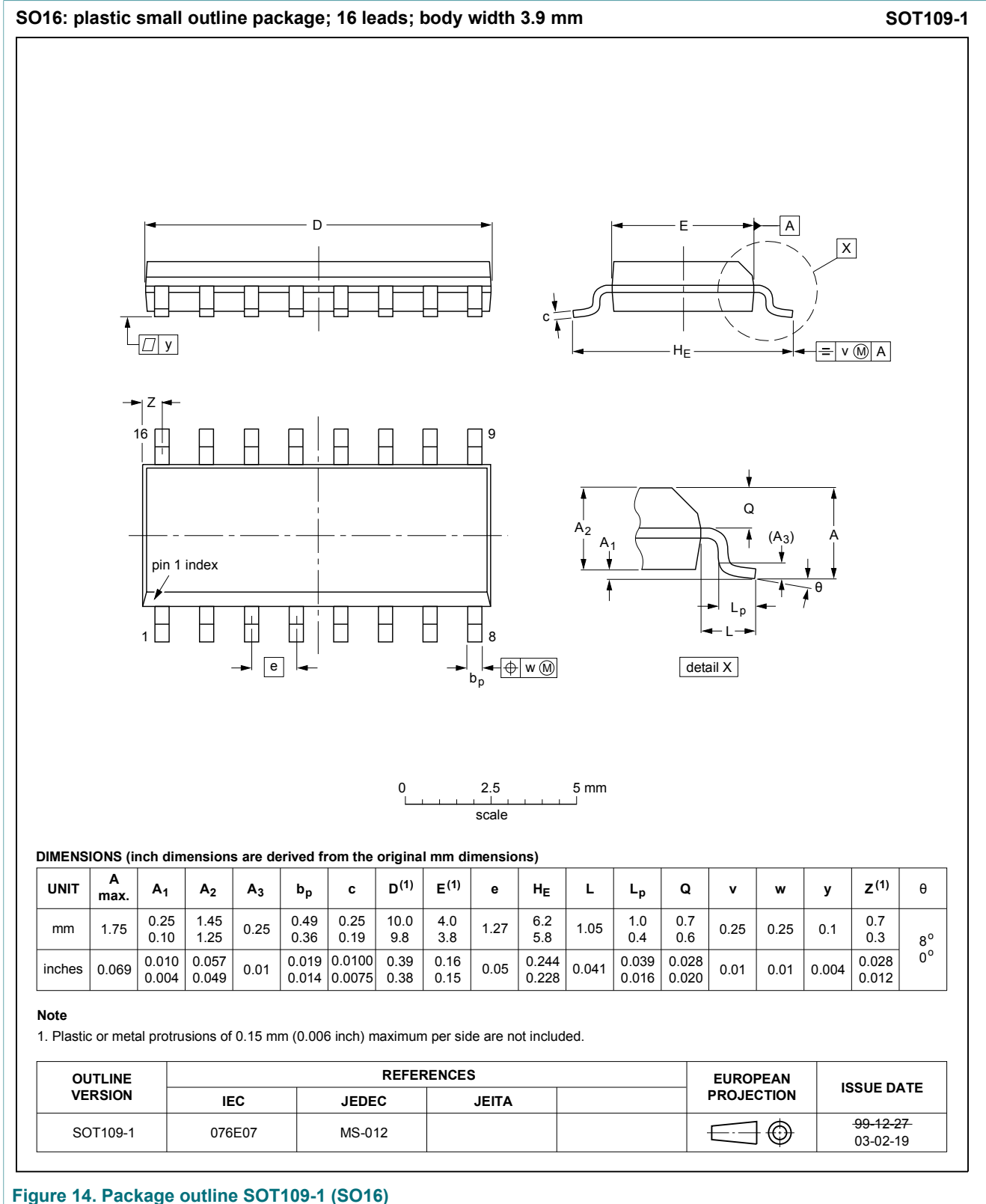
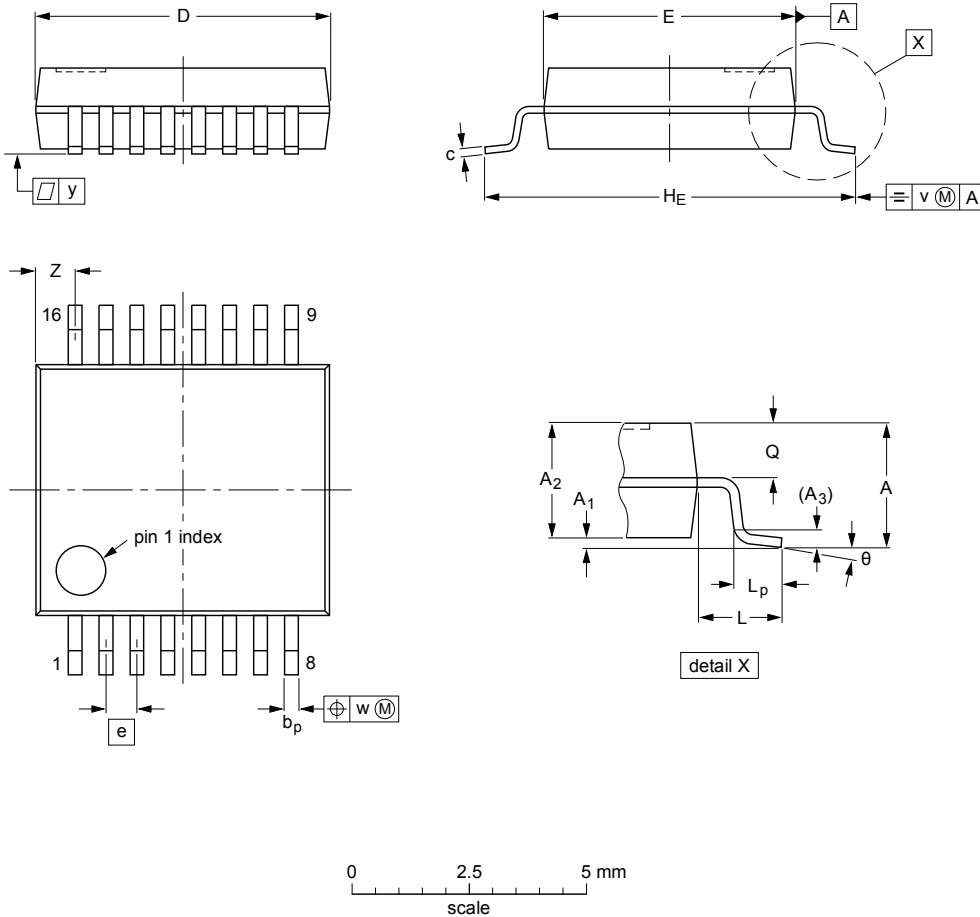


Figure 14. Package outline SOT109-1 (SO16)

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

SOT338-1



**DIMENSIONS (mm are the original 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   | 2         | 0.21<br>0.05   | 1.80<br>1.65   | 0.25           | 0.38<br>0.25   | 0.20<br>0.09 | 6.4<br>6.0       | 5.4<br>5.2       | 0.65 | 7.9<br>7.6     | 1.25 | 1.03<br>0.63   | 0.9<br>0.7 | 0.2 | 0.13 | 0.1 | 1.00<br>0.55     | 8°<br>0° |

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

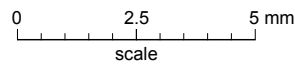
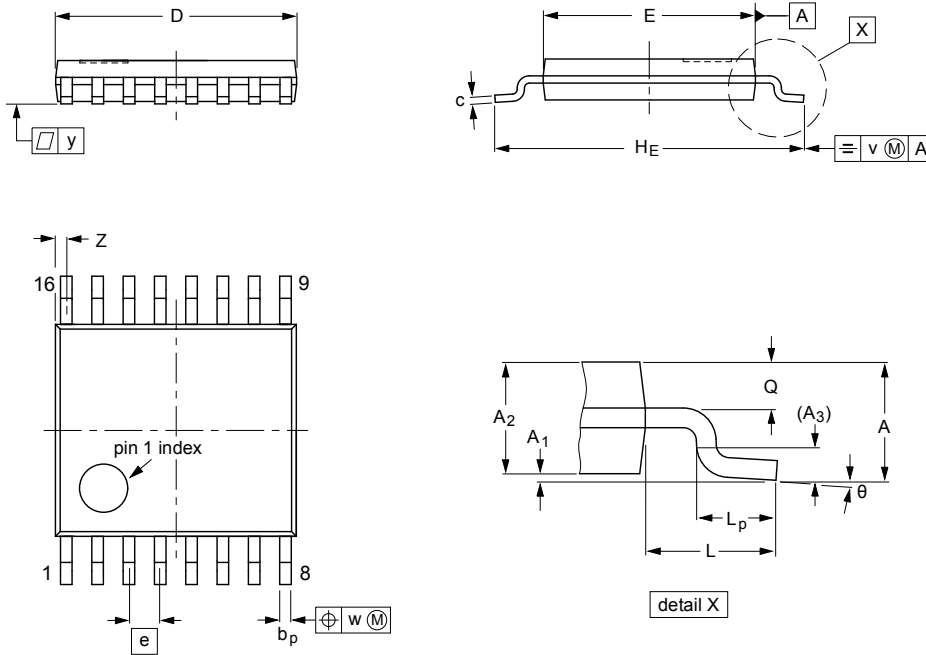
| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                      |
| SOT338-1           |            | MO-150 |       |  |                        | 99-12-27<br>03-02-19 |

Figure 15. Package outline SOT338-1 (SSOP16)



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

SOT403-1



**DIMENSIONS (mm are the original 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>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | Z <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1       | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 5.1<br>4.9       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.40<br>0.06     | 8°<br>0° |

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|--------|-------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                        |                       |
| SOT403-1           |            | MO-153 |       |  |                        | -99-12-27<br>03-02-18 |

Figure 16. 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**

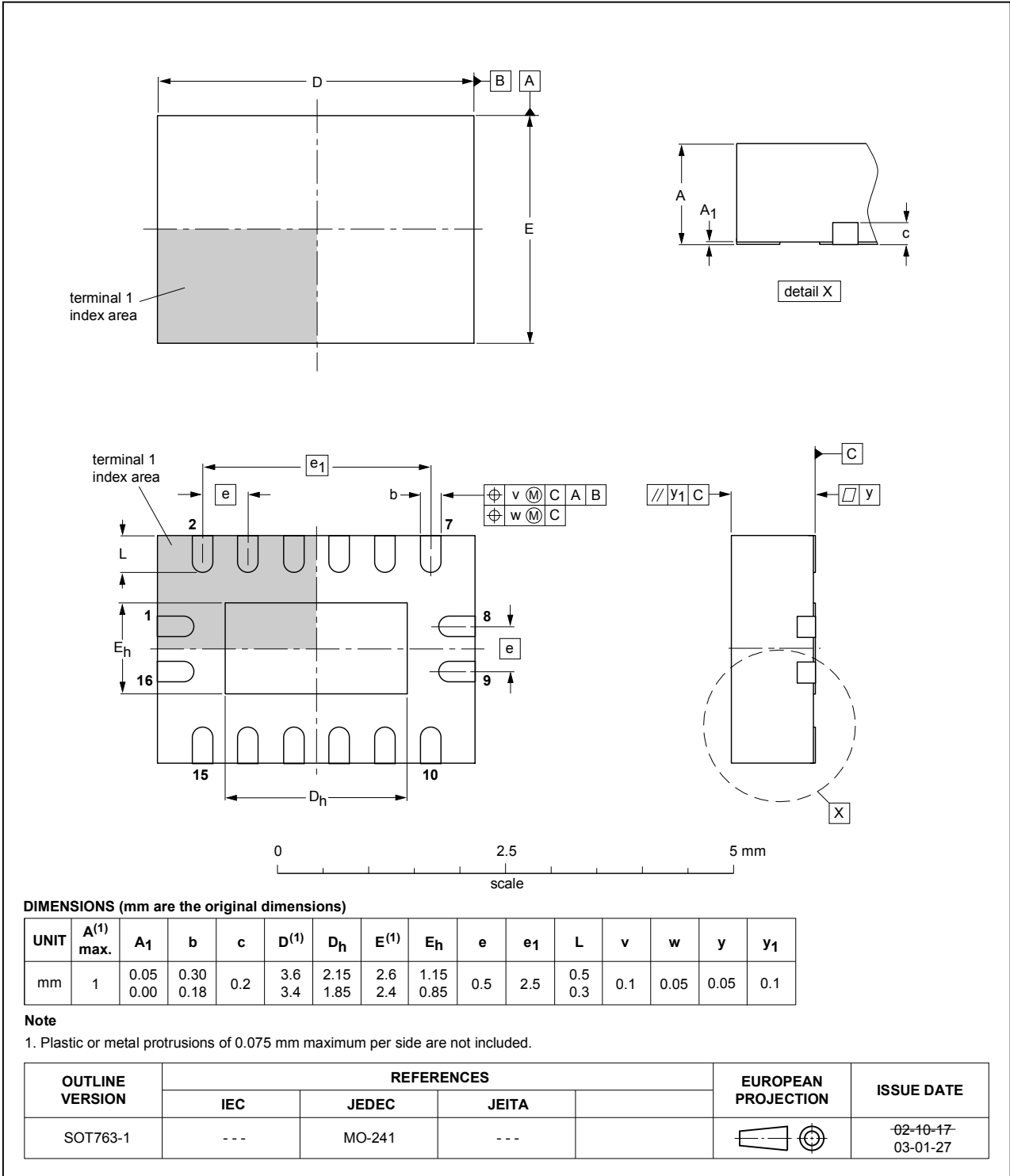


Figure 17. Package outline SOT763-1 (DHVQFN16)

## 13 Abbreviations

Table 10. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 14 Revision history

Table 11. Revision history

| Document ID         | Release date                                                                                                                                                                                                                              | Data sheet status     | Change notice | Supersedes          |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|---------------------|
| 74HC_HCT595 v.9     | 20170228                                                                                                                                                                                                                                  | Product data sheet    | -             | 74HC_HCT595 v.8     |
| Modifications:      | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul> |                       |               |                     |
| 74HC_HCT595 v.8     | 20160225                                                                                                                                                                                                                                  | Product data sheet    | -             | 74HC_HCT595 v.7     |
| Modifications:      | <ul style="list-style-type: none"> <li>Type numbers 74HC595N and 74HCT595N (SOT38-4) removed.</li> </ul>                                                                                                                                  |                       |               |                     |
| 74HC_HCT595 v.7     | 20150126                                                                                                                                                                                                                                  | Product data sheet    | -             | 74HC_HCT595 v.6     |
| Modifications:      | <ul style="list-style-type: none"> <li>Table 7: Power dissipation capacitance condition for 74HCT595 is corrected.</li> </ul>                                                                                                             |                       |               |                     |
| 74HC_HCT595 v.6     | 20111212                                                                                                                                                                                                                                  | Product data sheet    | -             | 74HC_HCT595 v.5     |
| Modifications:      | <ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>                                                                                                                                                                    |                       |               |                     |
| 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 | -             | -                   |

## 15 Legal information

### 15.1 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.nexperia.com>.

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

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9