

# 74HC4017; 74HCT4017

Johnson decade counter with 10 decoded outputs

Rev. 03 — 8 January 2008

Product data sheet

## 1. General description

The 74HC4017; 74HCT4017 is a high-speed Si-gate CMOS device and is pin compatible with the HEF4017.

The 74HC4017; 74HCT4017 is a 5-stage Johnson decade counter with 10 decoded active HIGH outputs (Q0 to Q9), an active LOW output from the most significant flip-flop ( $\overline{Q}5-9$ ), active HIGH and active LOW clock inputs (CP0 and  $\overline{CP}1$ ) and an overriding asynchronous master reset input (MR).

The counter is advanced by either a LOW-to-HIGH transition at CP0 while  $\overline{CP}1$  is LOW or a HIGH-to-LOW transition at  $\overline{CP}1$  while CP0 is HIGH (see [Table 3](#)).

When cascading counters, the  $\overline{Q}5-9$  output, which is LOW while the counter is in states 5, 6, 7, 8 and 9, can be used to drive the CP0 input of the next counter.

A HIGH on MR resets the counter to zero (Q0 =  $\overline{Q}5-9$  = HIGH; Q1 to Q9 = LOW) independent of the clock inputs (CP0 and  $\overline{CP}1$ ).

Automatic code correction of the counter is provided by an internal circuit: following any illegal code the counter returns to a proper counting mode within 11 clock pulses.

## 2. Features

- Multiple package options
- Complies with JEDEC standard no. 7 A
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$

### 3. Ordering information

Table 1. Ordering information

| Type number      | Package           |          |                                                                                                                                      |          |
|------------------|-------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------|----------|
|                  | Temperature range | Name     | Description                                                                                                                          | Version  |
| <b>74HC4017</b>  |                   |          |                                                                                                                                      |          |
| 74HC4017N        | −40 °C to +125 °C | DIP16    | plastic dual in-line package; 16 leads (300 mil)                                                                                     | SOT38-4  |
| 74HC4017D        | −40 °C to +125 °C | SO16     | plastic small outline package; 16 leads;<br>body width 3.9 mm                                                                        | SOT109-1 |
| 74HC4017DB       | −40 °C to +125 °C | SSOP16   | plastic shrink small outline package; 16 leads;<br>body width 5.3 mm                                                                 | SOT338-1 |
| 74HC4017PW       | −40 °C to +125 °C | TSSOP16  | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm                                                            | SOT403-1 |
| 74HC4017BQ       | −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 |
| <b>74HCT4017</b> |                   |          |                                                                                                                                      |          |
| 74HCT4017N       | −40 °C to +125 °C | DIP16    | plastic dual in-line package; 16 leads (300 mil)                                                                                     | SOT38-4  |
| 74HCT4017D       | −40 °C to +125 °C | SO16     | plastic small outline package; 16 leads;<br>body width 3.9 mm                                                                        | SOT109-1 |
| 74HCT4017BQ      | −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 |

### 4. Functional diagram

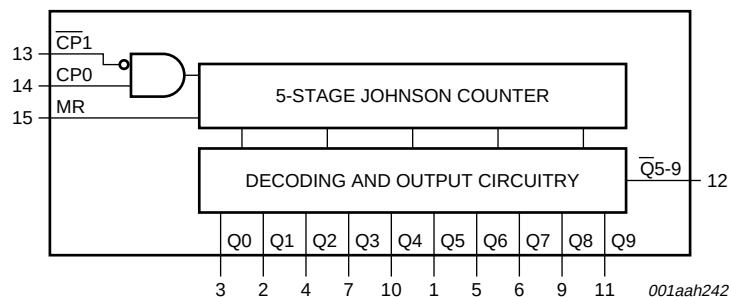


Fig 1. Functional diagram

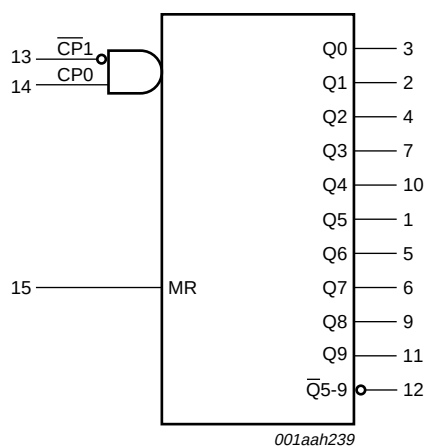


Fig 2. Logic symbol

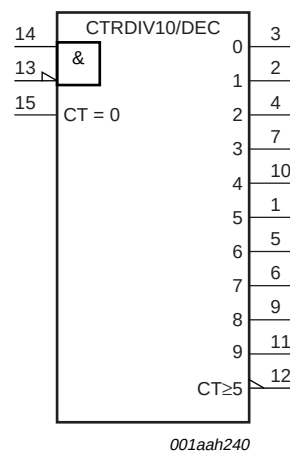


Fig 3. IEC logic symbol

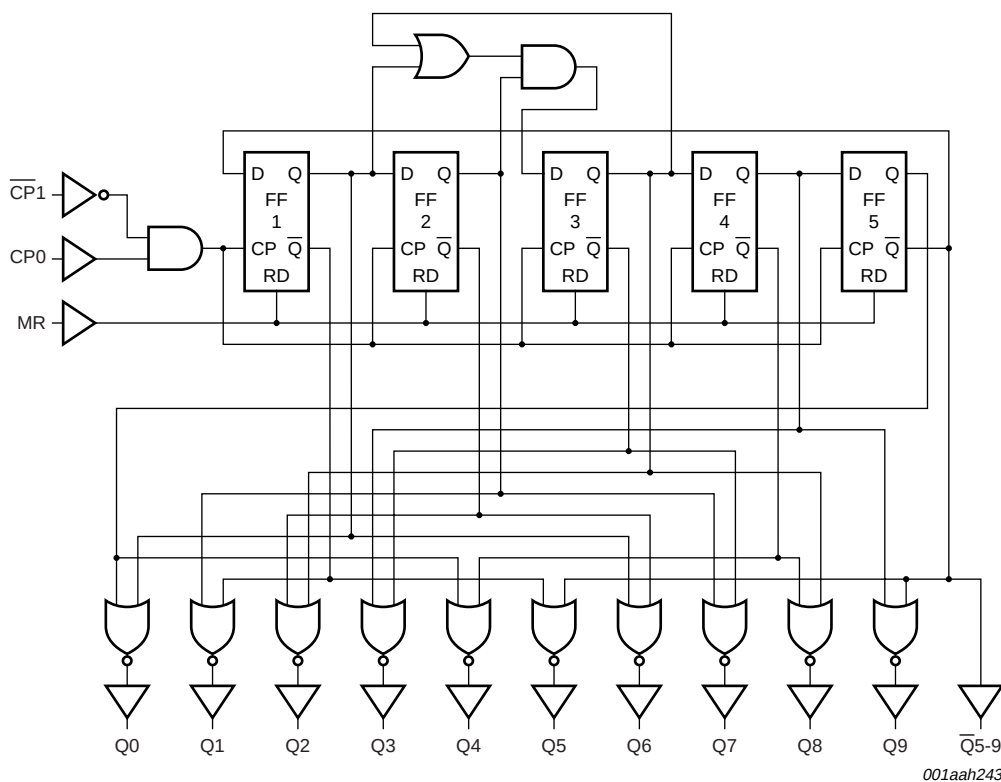


Fig 4. Logic diagram

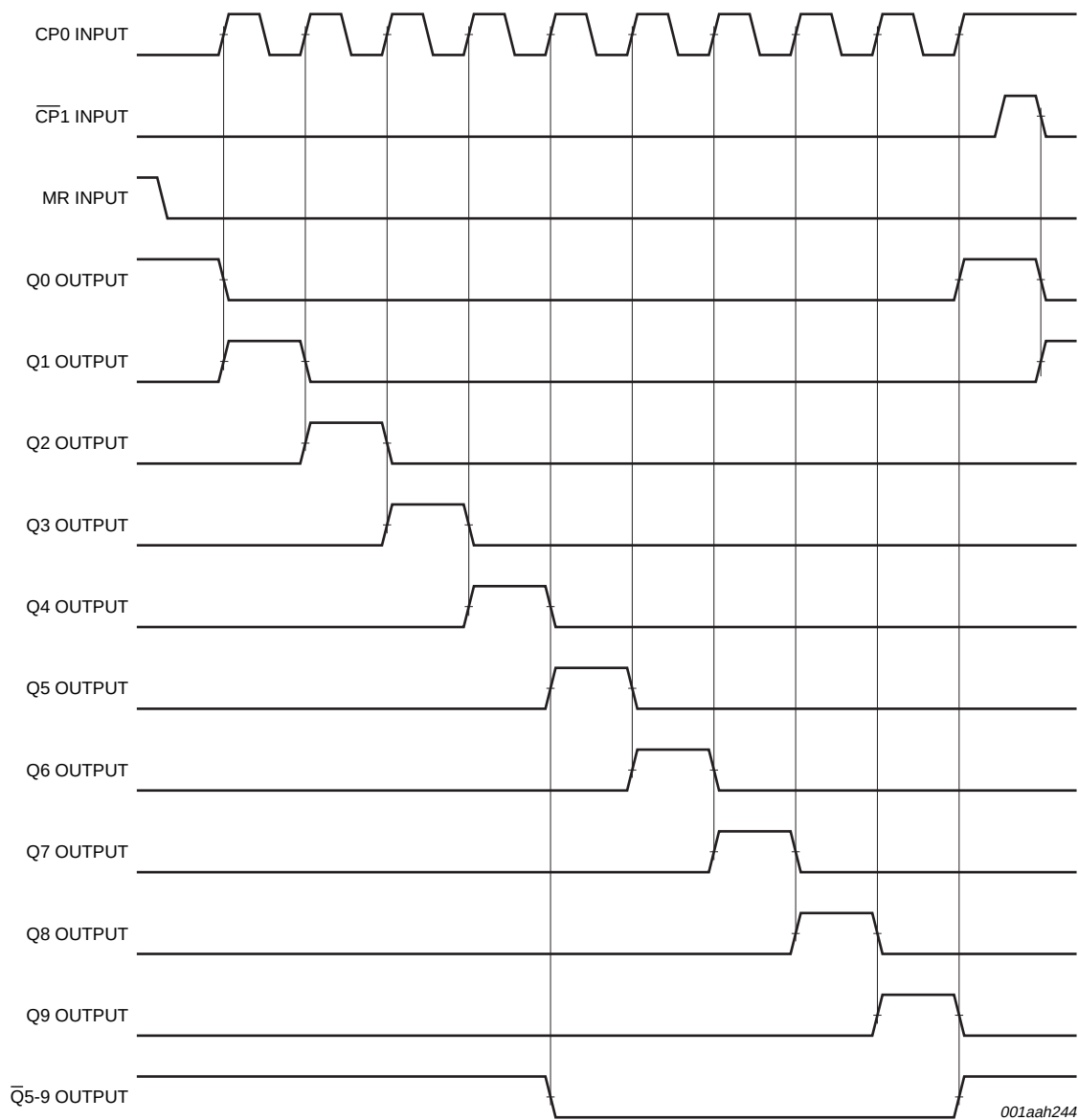


Fig 5. Timing diagram

## 5. Pinning information

### 5.1 Pinning

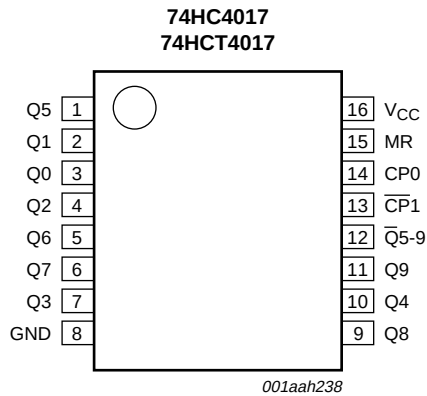


Fig 6. Pin configuration DIP16, SO16 and (T)SSOP16

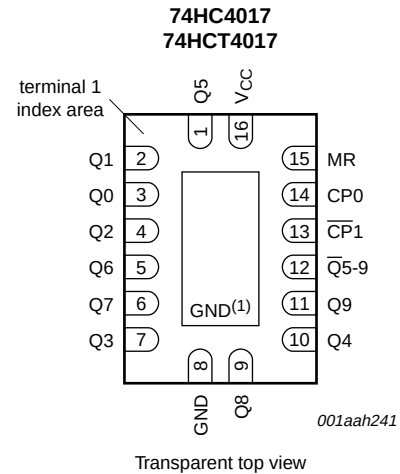


Fig 7. Pin configuration DHVQFN16

### 5.2 Pin description

Table 2. Pin description

| Symbol            | Pin                            | Description                              |
|-------------------|--------------------------------|------------------------------------------|
| Q[0:9]            | 3, 2, 4, 7, 10, 1, 5, 6, 9, 11 | decoded output                           |
| GND               | 8                              | ground (0 V)                             |
| $\overline{Q}5-9$ | 12                             | carry output (active LOW)                |
| $\overline{CP}1$  | 13                             | clock input (HIGH-to-LOW edge-triggered) |
| CP0               | 14                             | clock input (LOW-to-HIGH edge-triggered) |
| MR                | 15                             | master reset input (active HIGH)         |
| VCC               | 16                             | supply voltage                           |

## 6. Functional description

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

| MR | CP0 | CP1 | Operation                           |
|----|-----|-----|-------------------------------------|
| H  | X   | X   | Q0 = Q5-9 = HIGH;<br>Q1 to Q9 = LOW |
| L  | H   | ↓   | counter advances                    |
| L  | ↑   | L   | counter advances                    |
| L  | L   | X   | no change                           |
| L  | X   | H   | no change                           |
| L  | H   | ↑   | no change                           |
| L  | ↓   | L   | no change                           |

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

## 7. Limiting values

**Table 4.** Limiting values

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

| Symbol           | Parameter               | Conditions                                                          | Min              | Max  | Unit |
|------------------|-------------------------|---------------------------------------------------------------------|------------------|------|------|
| V <sub>CC</sub>  | supply voltage          |                                                                     | −0.5             | +7   | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < −0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < −0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V | <sup>[1]</sup> - | ±20  | mA   |
| I <sub>O</sub>   | output current          | −0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V                   | -                | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |                                                                     | -                | 50   | mA   |
| I <sub>GND</sub> | ground current          |                                                                     | −50              | -    | mA   |
| T <sub>stg</sub> | storage temperature     |                                                                     | −65              | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = −40 °C to +125 °C                                |                  |      |      |
|                  | DIP16 package           |                                                                     | <sup>[2]</sup> - | 750  | mW   |
|                  | SO16 package            |                                                                     | <sup>[3]</sup> - | 500  | mW   |
|                  | (T)SSOP16 package       |                                                                     | <sup>[4]</sup> - | 500  | mW   |
|                  | DHVQFN16 package        |                                                                     | <sup>[5]</sup> - | 500  | mW   |

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
[2] P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.  
[3] P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.  
[4] P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.  
[5] P<sub>tot</sub> derates linearly with 4.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol              | Parameter                           | Conditions              | Min | Typ  | Max      | Unit |
|---------------------|-------------------------------------|-------------------------|-----|------|----------|------|
| <b>74HC4017</b>     |                                     |                         |     |      |          |      |
| $V_{CC}$            | supply voltage                      |                         | 2.0 | 5.0  | 6.0      | V    |
| $V_I$               | input voltage                       |                         | 0   | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 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      | ns/V |
|                     |                                     | $V_{CC} = 6.0\text{ V}$ | -   | -    | 83       | ns/V |
| $T_{amb}$           | ambient temperature                 |                         | -40 | -    | +125     | °C   |
| <b>74HCT4017</b>    |                                     |                         |     |      |          |      |
| $V_{CC}$            | supply voltage                      |                         | 4.5 | 5.0  | 5.5      | V    |
| $V_I$               | input voltage                       |                         | 0   | -    | $V_{CC}$ | V    |
| $V_O$               | output voltage                      |                         | 0   | -    | $V_{CC}$ | V    |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 4.5\text{ V}$ | -   | 1.67 | 139      | ns/V |
| $T_{amb}$           | ambient temperature                 |                         | -40 | -    | +125     | °C   |

## 9. Static characteristics

**Table 6. Static characteristics**

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

| Symbol          | Parameter                 | Conditions                                          | 25 °C |      |      | −40 °C to +85 °C |      | −40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|-----------------------------------------------------|-------|------|------|------------------|------|-------------------|------|------|
|                 |                           |                                                     | Min   | Typ  | Max  | Min              | Max  | Min               | Max  |      |
| 74HC4017        |                           |                                                     |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                             | 1.5   | 1.2  | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                             | 3.15  | 2.4  | -    | 3.15             | -    | 3.15              | -    | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                             | 4.2   | 3.2  | -    | 4.2              | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                             | -     | 0.8  | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                             | -     | 2.1  | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                             | -     | 2.8  | 1.8  | -                | 1.8  | -                 | 1.8  | V    |
| 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> = −20 μA; V <sub>CC</sub> = 2.0 V    | 1.9   | 2.0  | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 4.5 V    | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = −20 μA; V <sub>CC</sub> = 6.0 V    | 5.9   | 6.0  | -    | 5.9              | -    | 5.9               | -    | V    |
|                 |                           | I <sub>O</sub> = −4.0 mA; V <sub>CC</sub> = 4.5 V   | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = −5.2 mA; V <sub>CC</sub> = 6.0 V   | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -    | V    |

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

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

| Symbol           | Parameter                 | Conditions                                                                                                                                                          | 25 °C |      |      | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------------------|------|-------------------|------|------|
|                  |                           |                                                                                                                                                                     | Min   | Typ  | Max  | Min              | Max  | Min               | Max  |      |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                                                                                 |       |      |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 2.0 V                                                                                                                     | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V                                                                                                                     | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 6.0 V                                                                                                                     | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V                                                                                                                    | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
|                  |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                                                                                                    | -     | 0.16 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 6.0 V                                                                                                 | -     | -    | ±0.1 | -                | ±1.0 | -                 | ±1.0 | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 6.0 V                                                                           | -     | -    | 8.0  | -                | 80   | -                 | 160  | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                                                     | -     | 3.5  | -    | -                | -    | -                 | -    | pF   |
| <b>74HCT4017</b> |                           |                                                                                                                                                                     |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub>  | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                                                                    | 2.0   | 1.6  | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub>  | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V                                                                                                                                    | -     | 1.2  | 0.8  | -                | 0.8  | -                 | 0.8  | V    |
| V <sub>OH</sub>  | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V                                                                                       |       |      |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –20 µA                                                                                                                                             | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | I <sub>O</sub> = –4 mA                                                                                                                                              | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -    | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V                                                                                       |       |      |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 20 µA                                                                                                                                              | -     | 0    | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 4.0 mA                                                                                                                                             | -     | 0.15 | 0.26 | -                | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 5.5 V                                                                                                 | -     | -    | ±0.1 | -                | ±1.0 | -                 | ±1.0 | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 5.5 V; I <sub>O</sub> = 0 A                                                                           | -     | -    | 8.0  | -                | 80   | -                 | 160  | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin;<br>V <sub>I</sub> = V <sub>CC</sub> – 2.1 V;<br>other inputs at V <sub>CC</sub> or GND;<br>V <sub>CC</sub> = 4.5 V to 5.5 V;<br>I <sub>O</sub> = 0 A |       |      |      |                  |      |                   |      |      |
|                  |                           | CP0 input                                                                                                                                                           | -     | 25   | 90   | -                | 113  | -                 | 123  | µA   |
|                  |                           | CP1 input                                                                                                                                                           | -     | 40   | 144  | -                | 180  | -                 | 196  | µA   |
|                  |                           | MR input                                                                                                                                                            | -     | 50   | 180  | -                | 225  | -                 | 245  | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                                                     | -     | 3.5  | -    | -                | -    | -                 | -    | pF   |



## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 11](#).

| Symbol                  | Parameter                     | Conditions                                                                                      | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-------------------------|-------------------------------|-------------------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                         |                               |                                                                                                 | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC4017                |                               |                                                                                                 |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub>         | propagation delay             | CP0 to Qn; CP0 to $\overline{Q}$ 5-9; see <a href="#">Figure 10</a> <a href="#">[1]</a>         |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | -     | 63  | 230 | -                | 290 | -                 | 345 | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | -     | 23  | 46  | -                | 58  | -                 | 69  | ns   |
|                         |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                 | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                         |                               | V <sub>CC</sub> = 6.0 V                                                                         | -     | 18  | 39  | -                | 49  | -                 | 59  | ns   |
|                         |                               | $\overline{CP}$ 1 to Qn; $\overline{CP}$ 1 to $\overline{Q}$ 5-9; see <a href="#">Figure 10</a> |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | -     | 61  | 250 | -                | 315 | -                 | 375 | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | -     | 22  | 50  | -                | 63  | -                 | 75  | ns   |
|                         |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                 | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                         |                               | V <sub>CC</sub> = 6.0 V                                                                         | -     | 18  | 43  | -                | 54  | -                 | 64  | ns   |
| t <sub>PHL</sub>        | HIGH to LOW propagation delay | MR to Q[1:9]; see <a href="#">Figure 10</a>                                                     |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | -     | 52  | 230 | -                | 290 | -                 | 345 | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | -     | 19  | 46  | -                | 58  | -                 | 69  | ns   |
|                         |                               | V <sub>CC</sub> = 6.0 V                                                                         | -     | 15  | 39  | -                | 49  | -                 | 59  | ns   |
| t <sub>PLH</sub>        | LOW to HIGH propagation delay | MR to $\overline{Q}$ 5-9, Q0; see <a href="#">Figure 10</a>                                     |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | -     | 55  | 230 | -                | 290 | -                 | 345 | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | -     | 20  | 46  | -                | 58  | -                 | 69  | ns   |
|                         |                               | V <sub>CC</sub> = 6.0 V                                                                         | -     | 16  | 39  | -                | 49  | -                 | 59  | ns   |
| t <sub>t</sub>          | transition time               | see <a href="#">Figure 10</a> <a href="#">[2]</a>                                               |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|                         |                               | V <sub>CC</sub> = 6.0 V                                                                         | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |
| t <sub>w</sub>          | pulse width                   | CP0 and $\overline{CP}$ 1 (HIGH or LOW); see <a href="#">Figure 9</a>                           |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                         |                               | V <sub>CC</sub> = 6.0 V                                                                         | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|                         |                               | MR (HIGH); see <a href="#">Figure 9</a>                                                         |       |     |     |                  |     |                   |     |      |
|                         |                               | V <sub>CC</sub> = 2.0 V                                                                         | 80    | 19  | -   | 100              | -   | 120               | -   | ns   |
|                         |                               | V <sub>CC</sub> = 4.5 V                                                                         | 16    | 7   | -   | 20               | -   | 24                | -   | ns   |
| V <sub>CC</sub> = 6.0 V | 14                            | 6                                                                                               | -     | 17  | -   | 20               | -   | ns                |     |      |

**Table 7. Dynamic characteristics ...continued**  
GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF; see [Figure 11](#).

| Symbol           | Parameter                     | Conditions                                                                                       | 25 °C               |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|--------------------------------------------------------------------------------------------------|---------------------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                                                  | Min                 | Typ | Max | Min              | Max | Min               | Max |      |
| $t_{su}$         | set-up time                   | $\overline{CP1}$ to CP0; CP0 to $\overline{CP1}$ ;<br>see <a href="#">Figure 8</a>               |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 2.0$ V                                                                                 | 50                  | –8  | –   | 65               | –   | 75                | –   | ns   |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | 10                  | –3  | –   | 13               | –   | 15                | –   | ns   |
|                  |                               | $V_{CC} = 6.0$ V                                                                                 | 9                   | –2  | –   | 11               | –   | 13                | –   | ns   |
| $t_h$            | hold time                     | $\overline{CP1}$ to CP0; CP0 to $\overline{CP1}$ ;<br>see <a href="#">Figure 8</a>               |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 2.0$ V                                                                                 | 50                  | 17  | –   | 65               | –   | 75                | –   | ns   |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | 10                  | 6   | –   | 13               | –   | 15                | –   | ns   |
|                  |                               | $V_{CC} = 6.0$ V                                                                                 | 9                   | 5   | –   | 11               | –   | 13                | –   | ns   |
| $t_{rec}$        | recovery time                 | MR to CP0 and<br>MR to $\overline{CP1}$ ; see <a href="#">Figure 9</a>                           |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 2.0$ V                                                                                 | 5                   | –17 | –   | 5                | –   | 5                 | –   | ns   |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | 5                   | –6  | –   | 5                | –   | 5                 | –   | ns   |
|                  |                               | $V_{CC} = 6.0$ V                                                                                 | 5                   | –5  | –   | 5                | –   | 5                 | –   | ns   |
| $f_{max}$        | maximum frequency             | CP0 or $\overline{CP1}$ ; see <a href="#">Figure 9</a>                                           |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 2.0$ V                                                                                 | 6.0                 | 23  | –   | 4.8              | –   | 4.0               | –   | MHz  |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | 30                  | 70  | –   | 24               | –   | 20                | –   | MHz  |
|                  |                               | $V_{CC} = 5.0$ V;<br>$C_L = 15$ pF                                                               | –                   | 77  | –   | –                | –   | –                 | –   | MHz  |
|                  |                               | $V_{CC} = 6.0$ V                                                                                 | 25                  | 83  | –   | 28               | –   | 24                | –   | MHz  |
| $C_{PD}$         | power dissipation capacitance | $V_I = \text{GND to } V_{CC}$ ;<br>$V_{CC} = 5$ V; $f_i = 1$ MHz                                 | <a href="#">[3]</a> | –   | 35  | –                | –   | –                 | –   | pF   |
| <b>74HCT4017</b> |                               |                                                                                                  |                     |     |     |                  |     |                   |     |      |
| $t_{pd}$         | propagation delay             | CP0 to Qn; CP0 to $\overline{Q5-9}$ ;<br>see <a href="#">Figure 10</a>                           |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | –                   | 25  | 46  | –                | 58  | –                 | 69  | ns   |
|                  |                               | $V_{CC} = 5.0$ V;<br>$C_L = 15$ pF                                                               | –                   | 21  | –   | –                | –   | –                 | –   | ns   |
|                  |                               | $\overline{CP1}$ to Qn; $\overline{CP1}$ to $\overline{Q5-9}$ ;<br>see <a href="#">Figure 10</a> |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | –                   | 25  | 50  | –                | 63  | –                 | 75  | ns   |
|                  |                               | $V_{CC} = 5.0$ V;<br>$C_L = 15$ pF                                                               | –                   | 21  | –   | –                | –   | –                 | –   | ns   |
| $t_{PHL}$        | HIGH to LOW propagation delay | MR to Q[1:9];<br>see <a href="#">Figure 10</a>                                                   |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | –                   | 22  | 46  | –                | 58  | –                 | 69  | ns   |
| $t_{PLH}$        | LOW to HIGH propagation delay | MR to $\overline{Q5-9}$ , Q0;<br>see <a href="#">Figure 10</a>                                   |                     |     |     |                  |     |                   |     |      |
|                  |                               | $V_{CC} = 4.5$ V                                                                                 | –                   | 20  | 46  | –                | 58  | –                 | 69  | ns   |

**Table 7. Dynamic characteristics ...continued**  
GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF; see [Figure 11](#).

| Symbol    | Parameter                     | Conditions                                                                                          | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------|-------------------------------|-----------------------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|           |                               |                                                                                                     | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| $t_t$     | transition time               | see <a href="#">Figure 10</a> <a href="#">[2]</a><br>$V_{CC} = 4.5$ V                               | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| $t_W$     | pulse width                   | CP0 and $\overline{CP1}$ (HIGH or LOW); see <a href="#">Figure 9</a><br>$V_{CC} = 4.5$ V            | 16    | 7   | -   | 20               | -   | 24                | -   | ns   |
|           |                               | MR (HIGH); see <a href="#">Figure 9</a><br>$V_{CC} = 4.5$ V                                         | 16    | 4   | -   | 20               | -   | 24                | -   | ns   |
|           |                               | $\overline{CP1}$ to CP0; CP0 to $\overline{CP1}$ ; see <a href="#">Figure 8</a><br>$V_{CC} = 4.5$ V | 10    | –3  | -   | 13               | -   | 15                | -   | ns   |
| $t_{th}$  | hold time                     | $\overline{CP1}$ to CP0; CP0 to $\overline{CP1}$ ; see <a href="#">Figure 8</a><br>$V_{CC} = 4.5$ V | 10    | 6   | -   | 13               | -   | 15                | -   | ns   |
| $t_{rec}$ | recovery time                 | MR to CP0 and MR to CP1; see <a href="#">Figure 9</a><br>$V_{CC} = 4.5$ V                           | 5     | –5  | -   | 5                | -   | 5                 | -   | ns   |
| $f_{max}$ | maximum frequency             | CP0 or $\overline{CP1}$ ; see <a href="#">Figure 9</a><br>$V_{CC} = 4.5$ V                          | 30    | 61  | -   | 24               | -   | 20                | -   | MHz  |
|           |                               | $V_{CC} = 5.0$ V;<br>$C_L = 15$ pF                                                                  | -     | 67  | -   | -                | -   | -                 | -   | MHz  |
|           |                               |                                                                                                     |       |     |     |                  |     |                   |     |      |
| $C_{PD}$  | power dissipation capacitance | $V_I = \text{GND to } V_{CC} - 1.5$ V; <a href="#">[3]</a><br>$V_{CC} = 5$ V; $f_i = 1$ MHz         | -     | 36  | -   | -                | -   | -                 | -   | pF   |

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

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

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

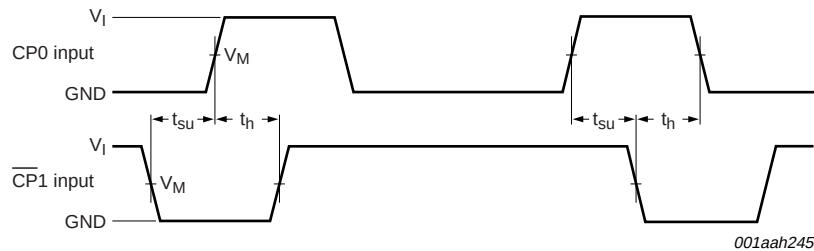
$C_L$  = output load capacitance in pF;

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

$N$  = number of inputs switching;

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

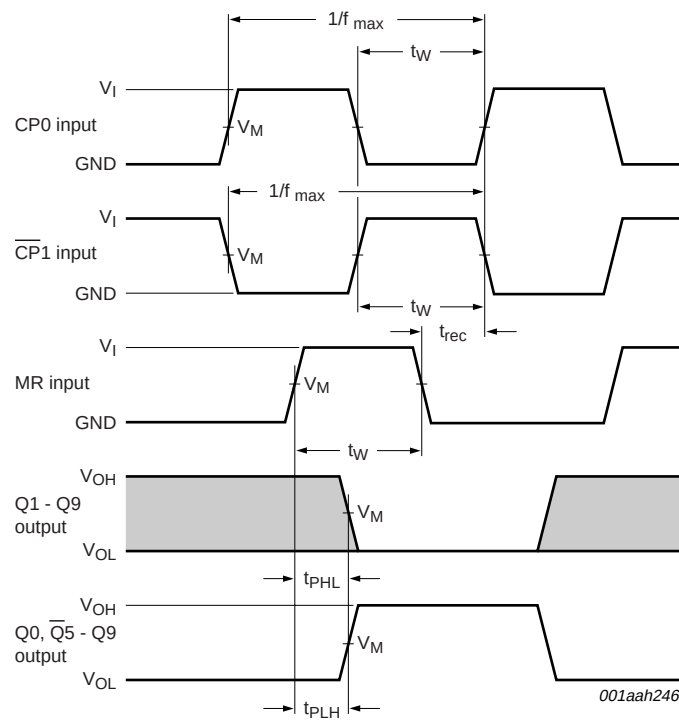
## 11. Waveforms



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

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

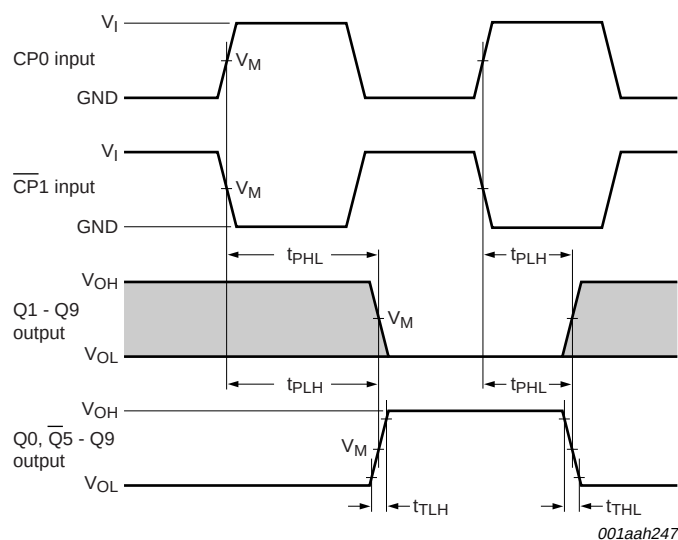
**Fig 8. Waveforms showing the set-up and hold times for CP0 to  $\overline{CP1}$  and  $\overline{CP1}$  to CP0**



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

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

**Fig 9. Waveforms showing the minimum pulse width for CP0,  $\overline{CP1}$  and MR input; the maximum frequency for CP0 and  $\overline{CP1}$  input; the recovery time for MR and the MR input to Qn and Q5-9 output propagation delays**



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

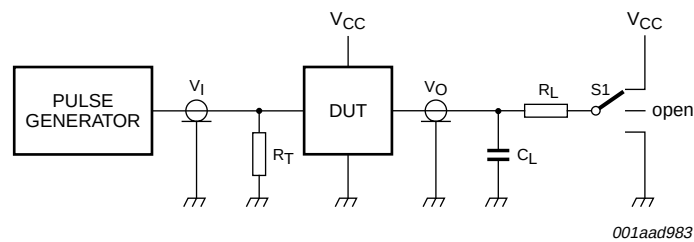
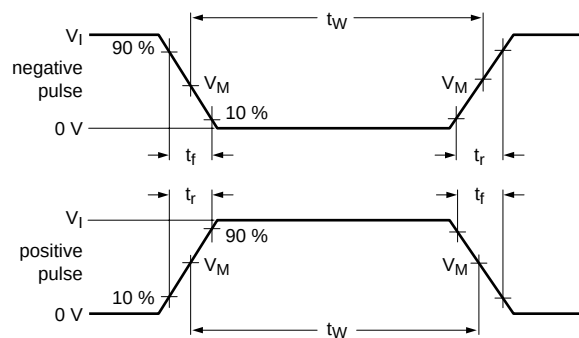
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

Conditions:  $\overline{CP1}$  = LOW while CP0 is triggered on a LOW-to-HIGH transition and CP0 = HIGH, while  $\overline{CP1}$  is triggered on a HIGH-to-LOW transition.

**Fig 10. Waveforms showing the propagation delays for CP0, CP1 to Qn, Q5-9 outputs and the output transition times**

**Table 8. Measurement points**

| Type      | Input               | Output              |
|-----------|---------------------|---------------------|
|           | $V_M$               | $V_M$               |
| 74HC4017  | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT4017 | 1.3 V               | 1.3 V               |



Test data is given in [Table 9](#).

Definitions test circuit:

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_L$  = Load resistance.

S1 = Test selection switch.

Fig 11. Load circuitry for measuring switching times

Table 9. Test data

| Type      | Input    |            | Load         |              | S1 position        |                    |                    |
|-----------|----------|------------|--------------|--------------|--------------------|--------------------|--------------------|
|           | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 74HC4017  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |
| 74HCT4017 | 3 V      | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               | GND                | $V_{CC}$           |

## 12. Application information

Some examples of applications for the 74HC4017; 74HCT4017 are:

- Decade counter with decimal decoding
- 1 out of n decoding counter (when cascaded)
- Sequential controller
- Timer

[Figure 12](#) shows a technique for extending the number of decoded output states for the 74HC4017; 74HCT4017. Decoded outputs are sequential within each stage and from stage to stage, with no dead time (except propagation delay).

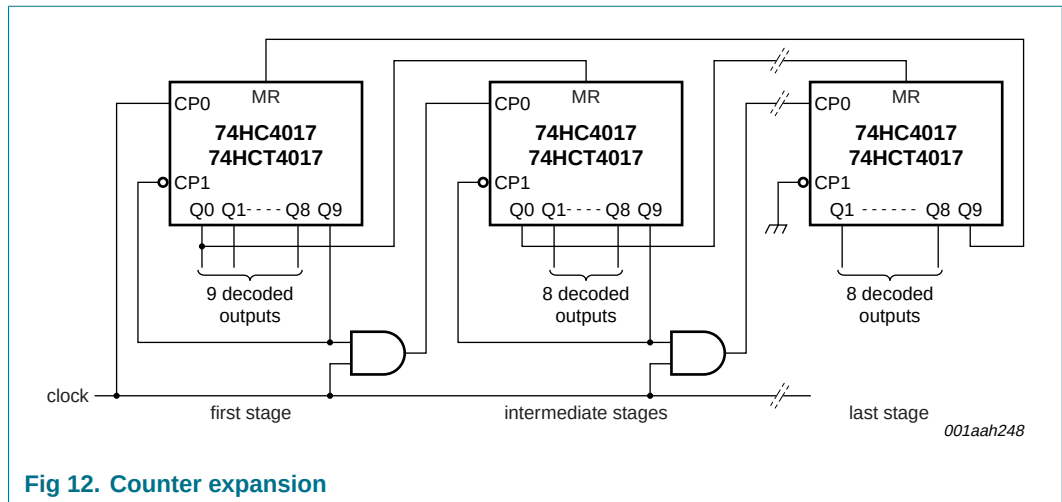


Fig 12. Counter expansion

**Remark:** It is essential not to enable the counter on  $\overline{CP1}$  when CP0 is HIGH, or on CP0 when CP1 is LOW, as this would cause an extra count.

Figure 13 shows an example of a divide-by 2 through divide-by 10 circuit using one 74HC4017; 74HCT4017. Since the 74HC4017; 74HCT4017 has an asynchronous reset, the output pulse widths are narrow (minimum expected pulse width is 6 ns). The output pulse widths can be enlarged by inserting an RC network at the MR input.

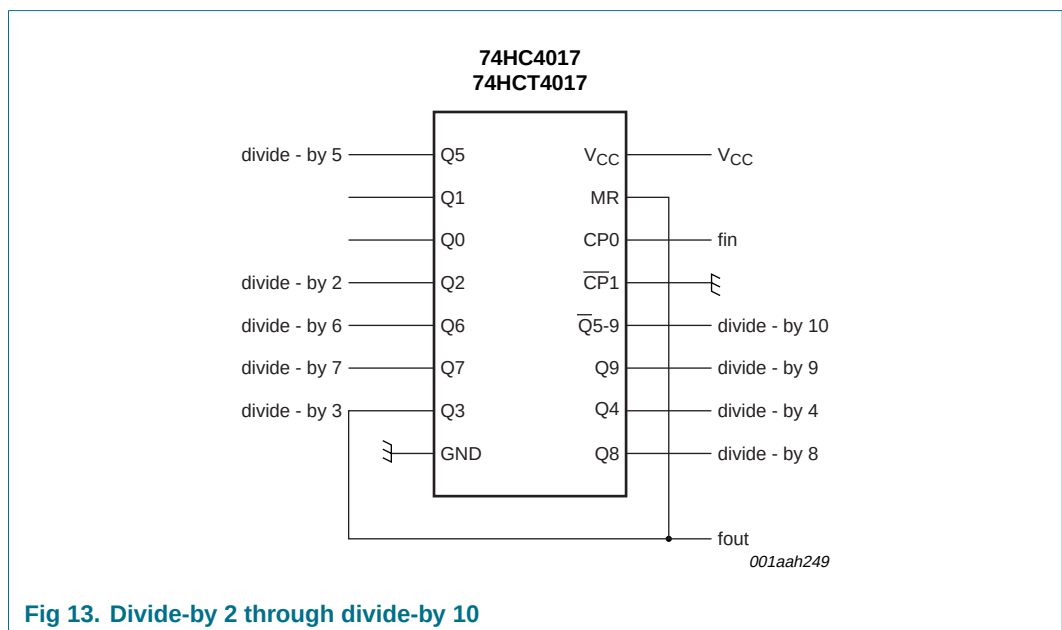


Fig 13. Divide-by 2 through divide-by 10

## 13. Package outline

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

SOT38-4

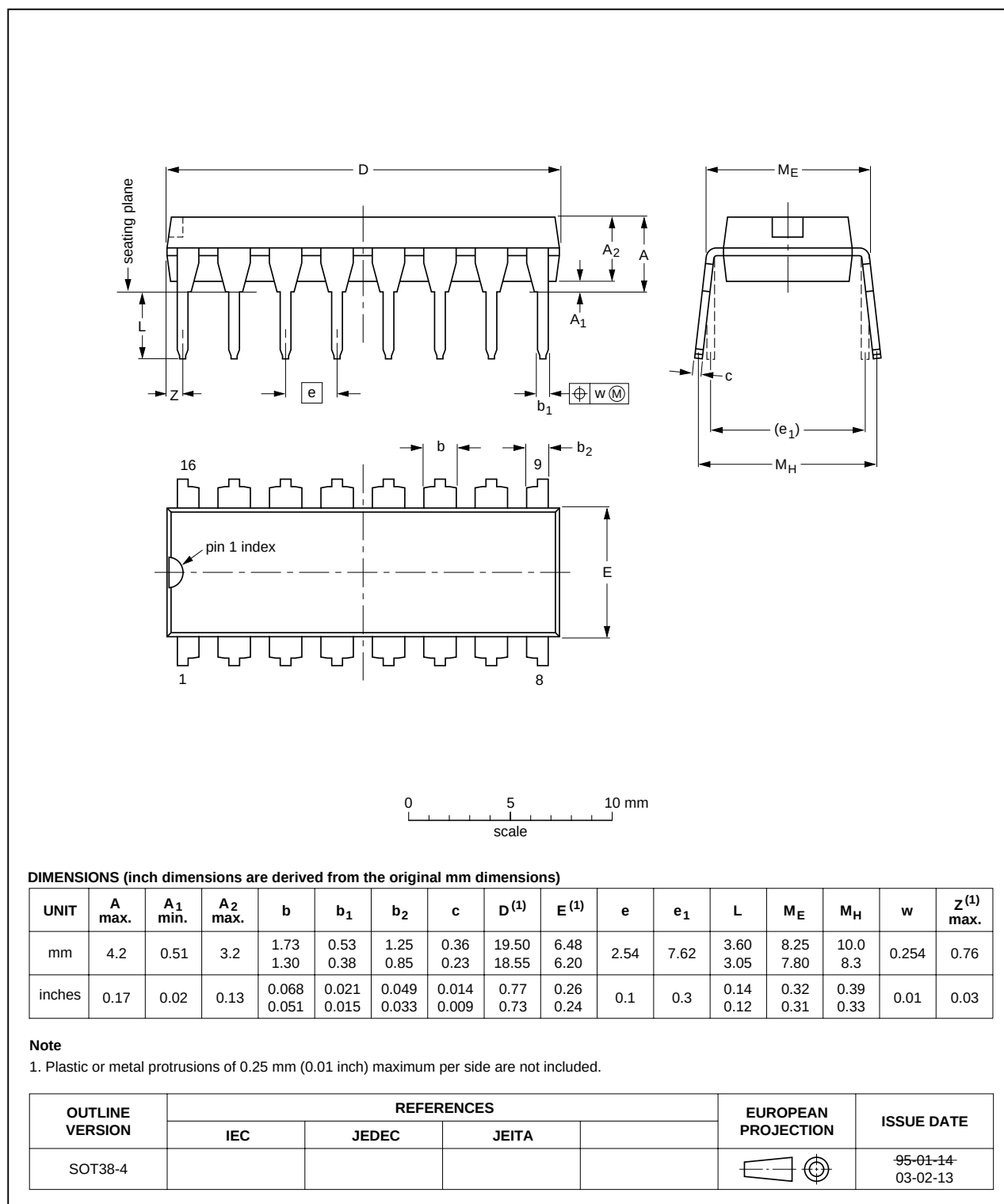
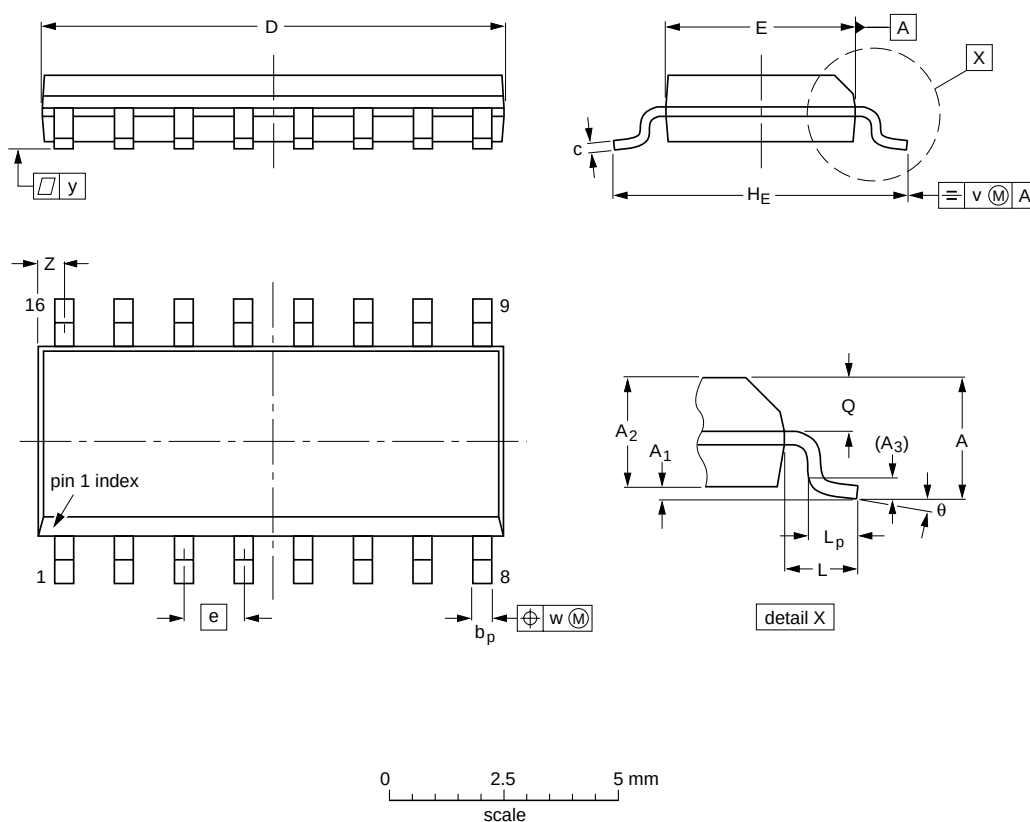


Fig 14. Package outline SOT38-4 (DIP16)



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

SOT109-1



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

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

**Note**

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

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

Fig 15. Package outline SOT109-1 (SO16)

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

SOT338-1

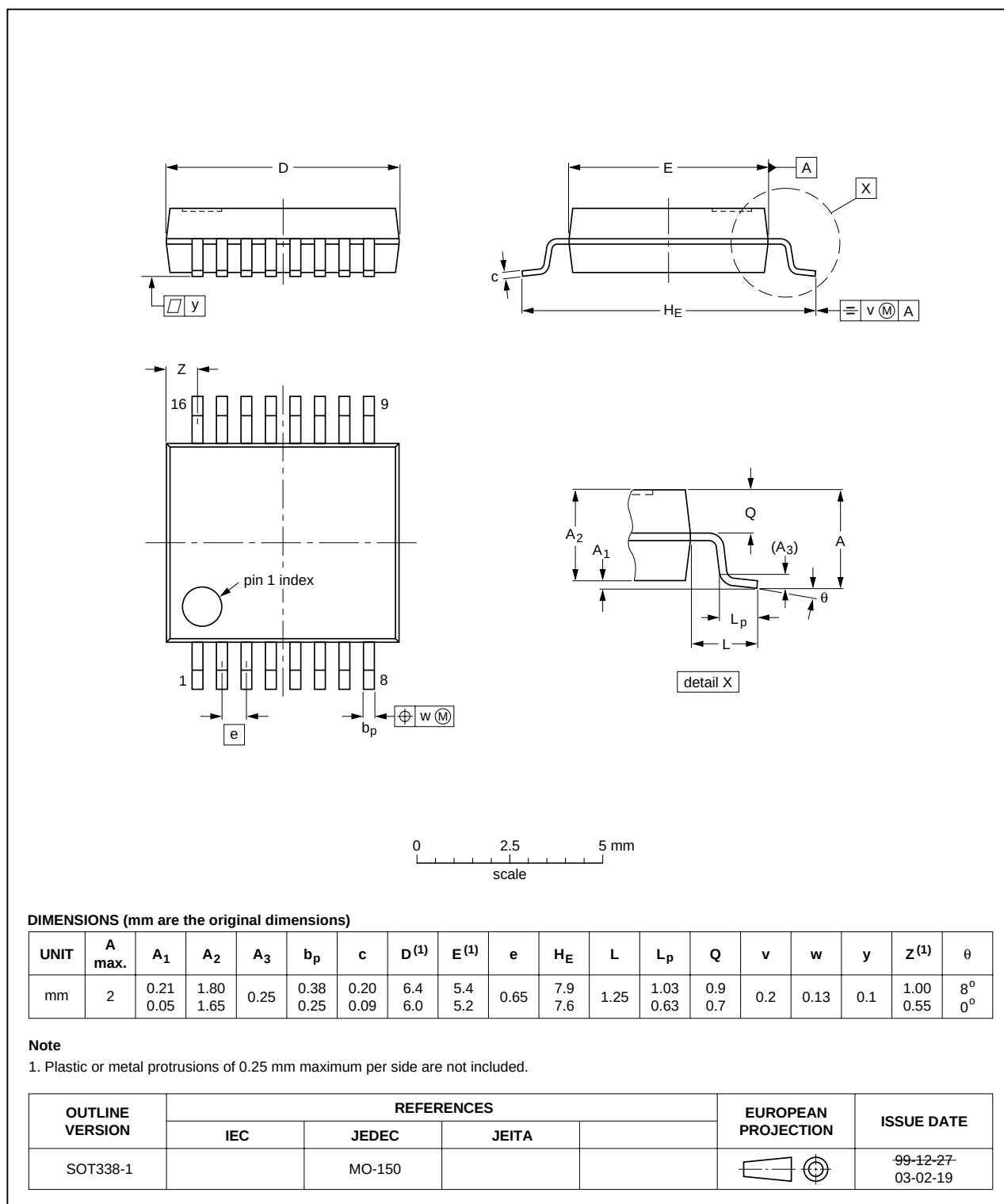
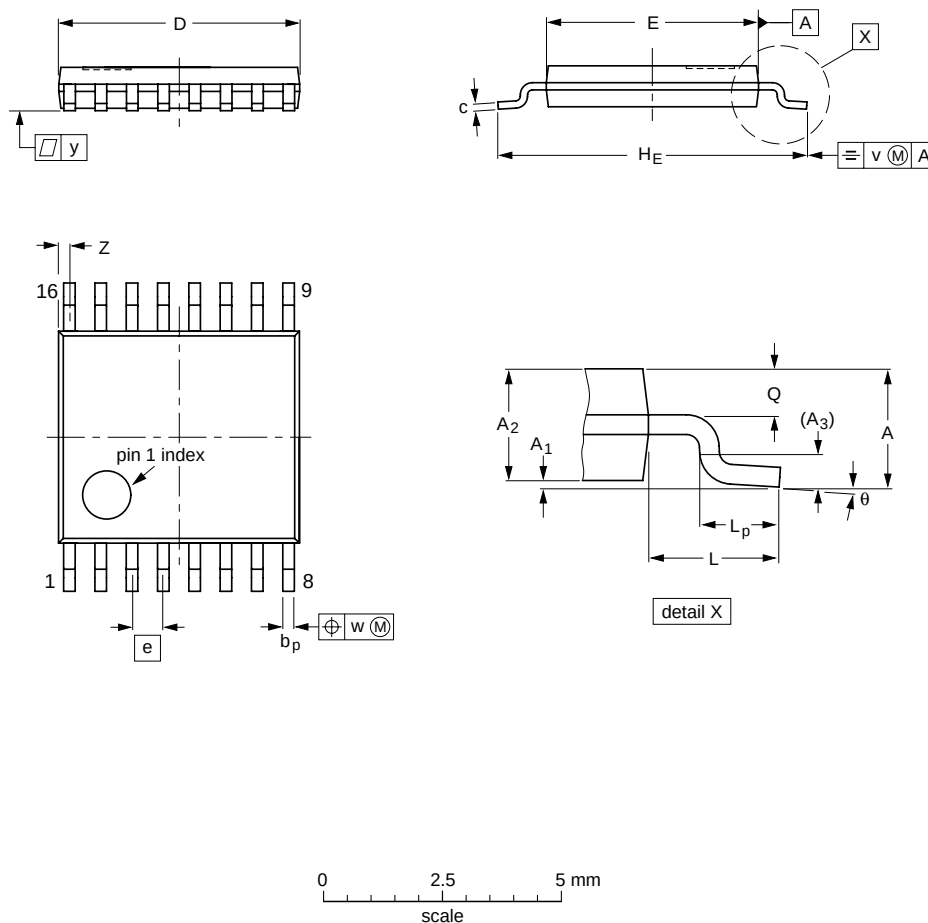


Fig 16. Package outline SOT338-1 (SSOP16)

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 |

Fig 17. 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

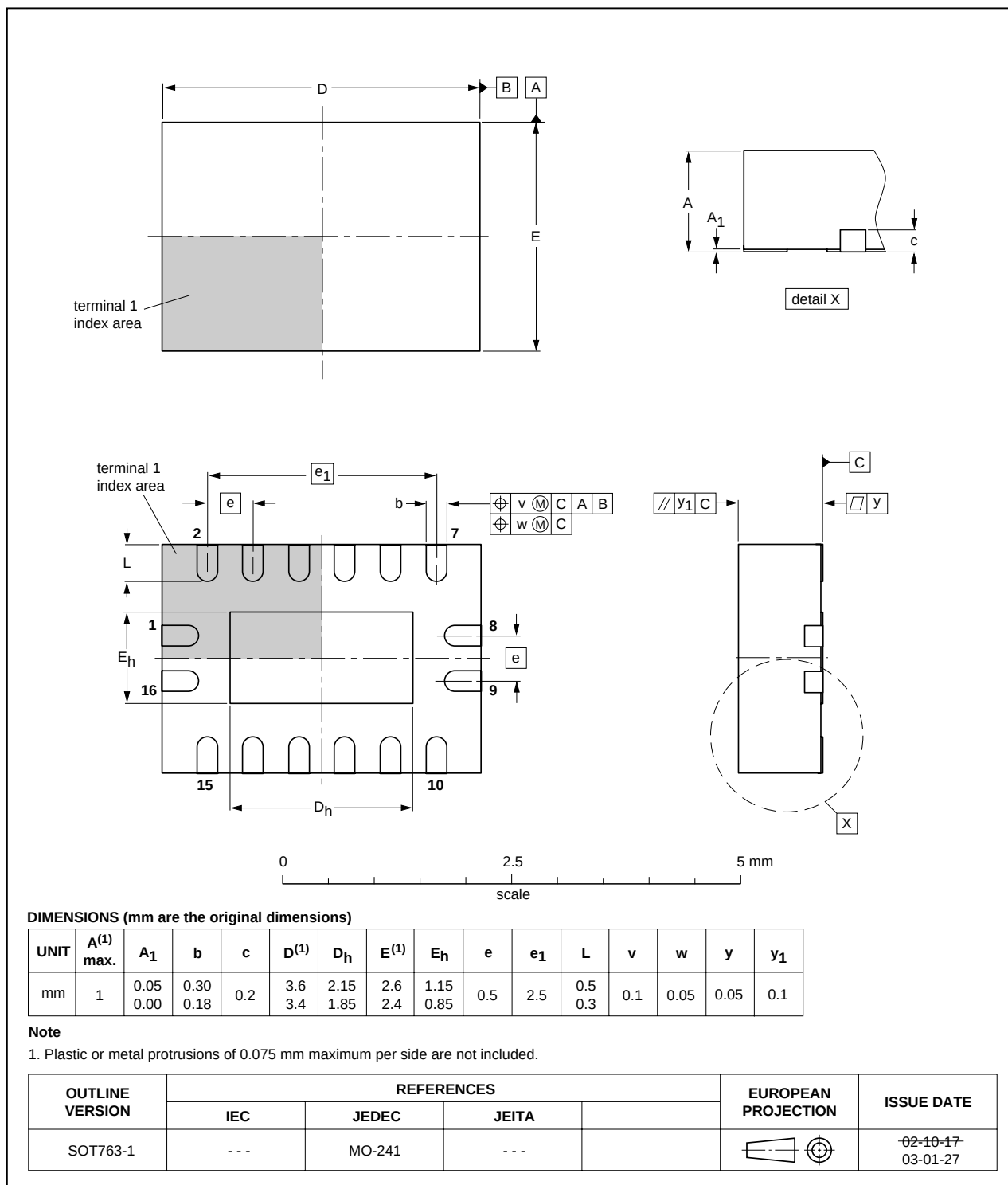


Fig 18. Package outline SOT763-1 (DHVQFN16)

## 14. 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             |

## 15. Revision history

Table 11. Revision history

| Document ID        | Release date                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Data sheet status     | Change notice | Supersedes         |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|--------------------|
| 74HC_HCT4017_3     | 20080108                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Product data sheet    | -             | 74HC_HCT4017_CNV_2 |
| Modifications:     | <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• <a href="#">Section 3</a>: DHVQFN16 package added.</li><li>• <a href="#">Section 7</a>: derating values added for DHVQFN16 package.</li><li>• <a href="#">Section 13</a>: outline drawing added for DHVQFN16 package.</li></ul> |                       |               |                    |
| 74HC_HCT4017_CNV_2 | 19970829                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Product specification | -             | -                  |

## 16. Legal information

### 16.1 Data sheet status

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

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

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

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

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