



**THE DATASHEET OF  
74HC163DB,118**



# 74HC163; 74HCT163

Presettable synchronous 4-bit binary counter; synchronous reset

Rev. 5 — 12 October 2018

Product data sheet

## 1. General description

The 74HC163; 74HCT163 is a synchronous presettable binary counter with an internal look-ahead carry. Synchronous operation is provided by having all flip-flops clocked simultaneously on the positive-going edge of the clock (CP). The outputs (Q0 to Q3) of the counters may be preset to a HIGH or LOW. A LOW at the parallel enable input ( $\overline{PE}$ ) disables the counting action. It causes the data at the data inputs (D0 to D3) to be loaded into the counter on the positive-going edge of the clock. Preset takes place regardless of the levels at count enable inputs (CEP and CET). A LOW at the master reset input ( $\overline{MR}$ ) sets Q0 to Q3 LOW after the next positive-going transition on the clock input (CP). This action occurs regardless of the levels at input pins  $\overline{PE}$ , CET and CEP. This synchronous reset feature enables the designer to modify the maximum count with only one external NAND gate. The look-ahead carry simplifies serial cascading of the counters. Both CEP and CET must be HIGH to count. The CET input is fed forward to enable the terminal count output (TC). The TC output thus enabled will produce a HIGH output pulse of a duration approximately equal to a HIGH output of Q0. This pulse can be used to enable the next cascaded stage. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

The CP to TC propagation delay and CEP to CP set-up time determine the maximum clock frequency for the cascaded counters according to the following formula:

$$f_{\max} = \frac{1}{t_{P(\max)}(CPtoTC) + t_{SU}(CEPtoCP)}$$

## 2. Features and benefits

- Complies with JEDEC standard no. 7A
- Input levels:
  - For 74HC163: CMOS level
  - For 74HCT163: TTL level
- Synchronous counting and loading
- 2 count enable inputs for n-bit cascading
- Synchronous reset
- Positive-edge triggered clock
- ESD protection:
  - HBM JESD22-A114F exceeds 2 000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

| Type number | Package           |      |   | Version  |
|-------------|-------------------|------|---|----------|
|             | Temperature range | Name | Description   |          |
| 74HC163D    | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads;<br>body width 3.9 mm | SOT109-1 |
| 74HCT163D   |                   |      |   |          |

Pre-settable synchronous 4-bit binary counter; synchronous reset

| Type number | Package           |         |  |          |
|-------------|-------------------|---------|--|----------|
|             | Temperature range | Name    | Description  | Version  |
| 74HC163DB   | -40 °C to +125 °C | SSOP16  | plastic shrink small outline package; 16 leads; body width 5.3 mm      | SOT338-1 |
| 74HCT163DB  |                   |         |  |          |
| 74HC163PW   | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HCT163PW  |                   |         |  |          |

4. Functional diagram

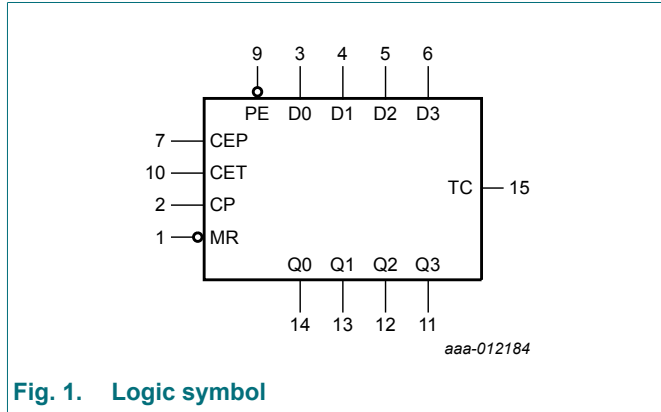


Fig. 1. Logic symbol

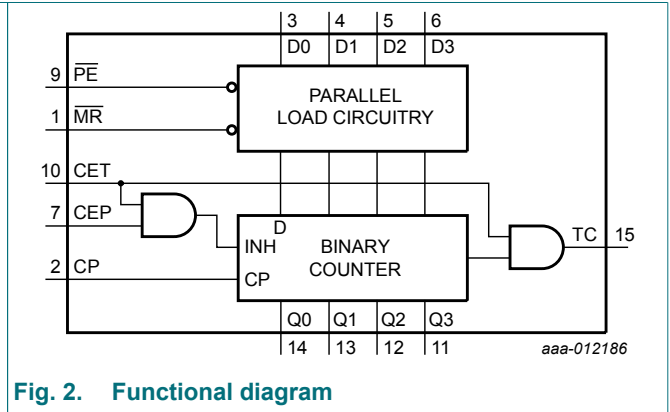


Fig. 2. Functional diagram

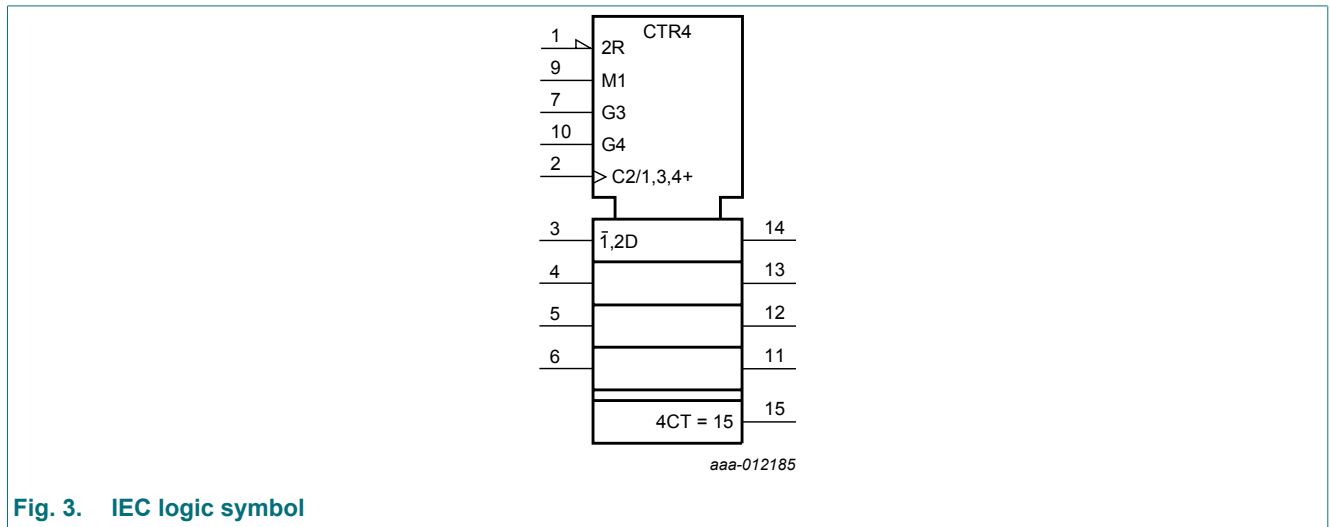
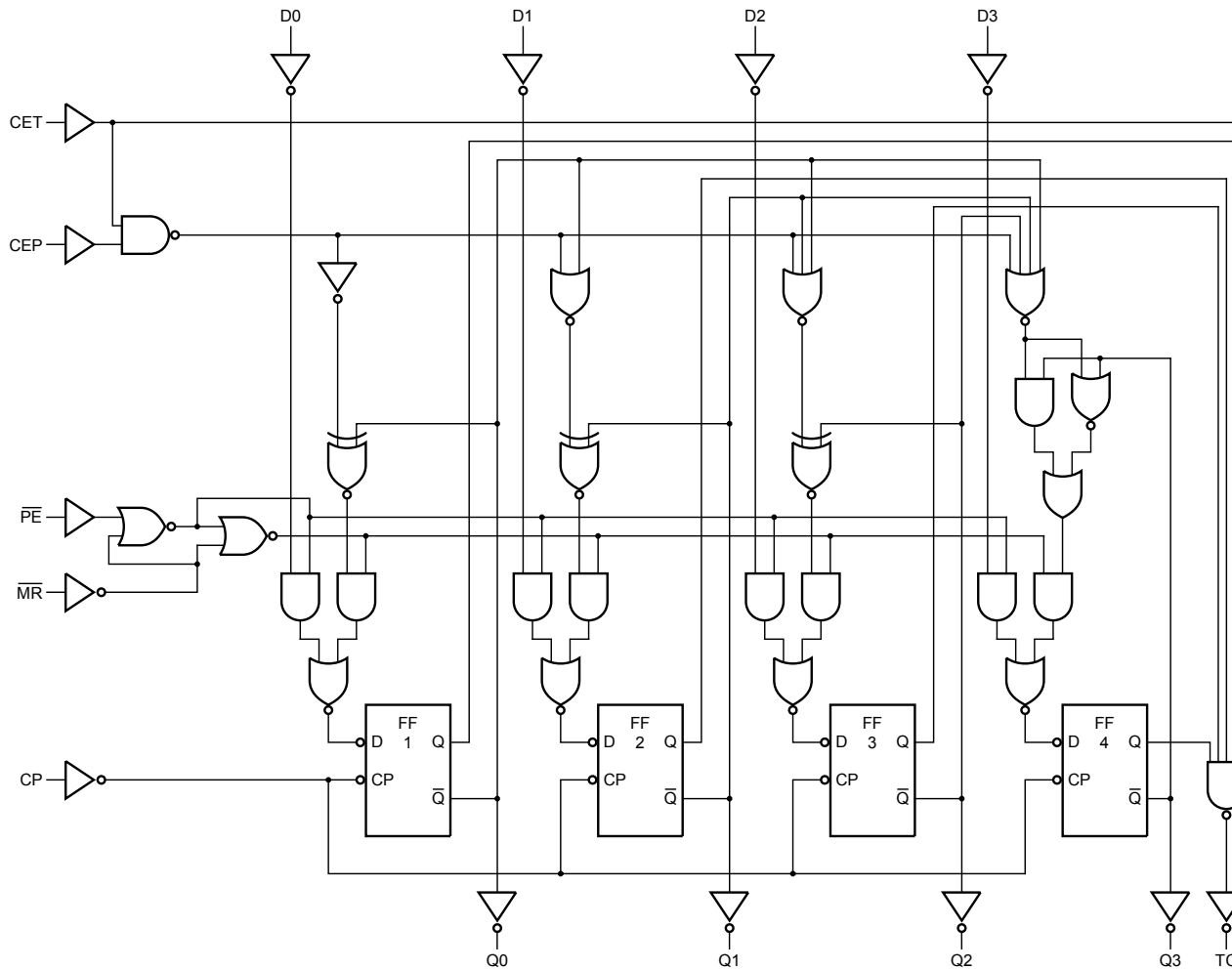


Fig. 3. IEC logic symbol

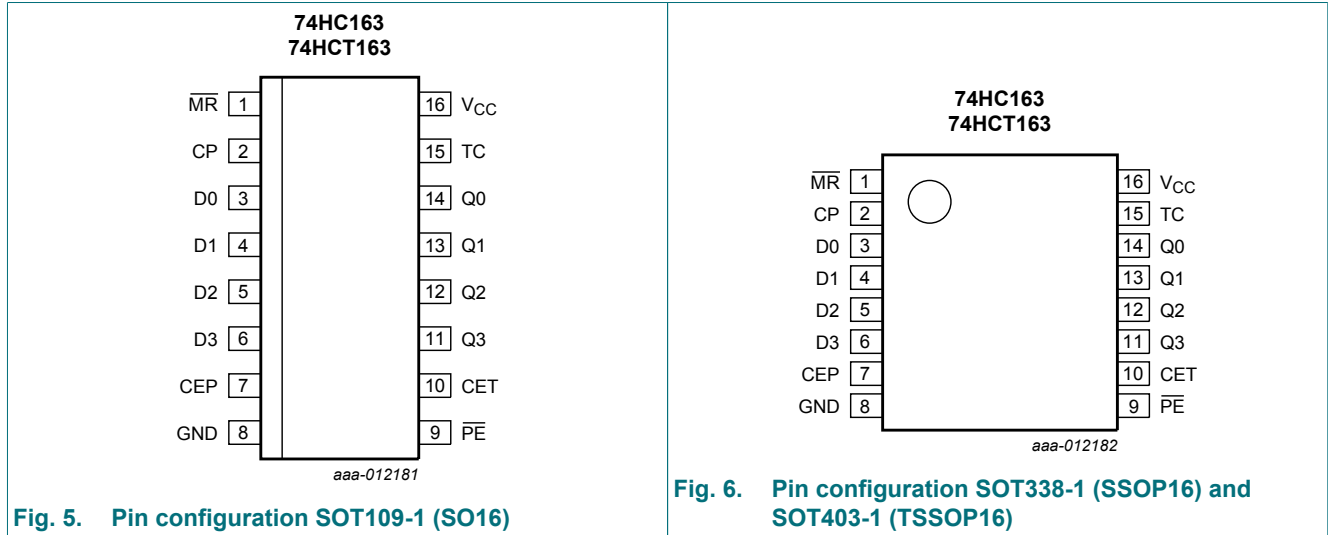


aaa-012189

Fig. 4. Logic diagram

## 5. Pinning information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

| Symbol                 | Pin            | Description                               |
|------------------------|----------------|---|
| $\overline{\text{MR}}$ | 1              | synchronous master reset (active LOW)     |
| CP                     | 2              | clock input (LOW-to-HIGH, edge triggered) |
| D0, D1, D2, D3         | 3, 4, 5, 6     | data input                                |
| CEP                    | 7              | count enable input                        |
| GND                    | 8              | ground (0 V)                              |
| PE                     | 9              | parallel enable input (active LOW)        |
| CET                    | 10             | count enable carry input                  |
| Q0, Q1, Q2, Q3         | 14, 13, 12, 11 | flip-flop output                          |
| TC                     | 15             | terminal count output                     |
| V <sub>CC</sub>        | 16             | supply voltage                            |

## 6. Functional description

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

| Operating mode    | Inputs |    |     |     |    |    | Outputs |    |
|-------------------|--------|----|-----|-----|----|----|---------|----|
|                   | MR     | CP | CEP | CET | PE | Dn | Qn      | TC |
| Reset (clear)     | l      | ↑  | X   | X   | X  | X  | L       | L  |
| Parallel load     | h      | ↑  | X   | X   | l  | l  | L       | L  |
|                   | h      | ↑  | X   | X   | l  | h  | H       | L  |
| Count             | h      | ↑  | h   | h   | h  | X  | count   |    |
| Hold (do nothing) | h      | X  | l   | X   | h  | X  | qn      | L  |
|                   | h      | X  | X   | l   | h  | X  | qn      | L  |

- [1] The TC output is HIGH when CET is HIGH and the counter is at terminal count (HHHH);  
 H = HIGH voltage level;  
 h = HIGH voltage level one set-up time prior to the LOW-to-HIGH CP transition;  
 L = LOW voltage level;  
 l = LOW voltage level one set-up time prior to the LOW-to-HIGH CP transition;  
 q = lower case letters indicate the state of the referenced output one set-up time prior to the LOW-to-HIGH CP transition;  
 X = don't care;  
 ↑ = LOW-to-HIGH clock transition.

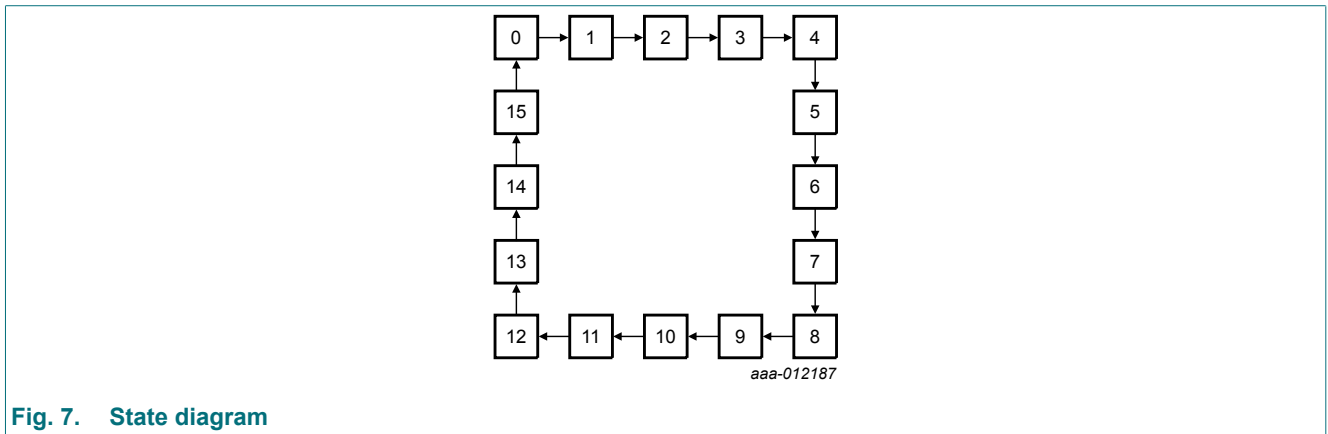


Fig. 7. State diagram

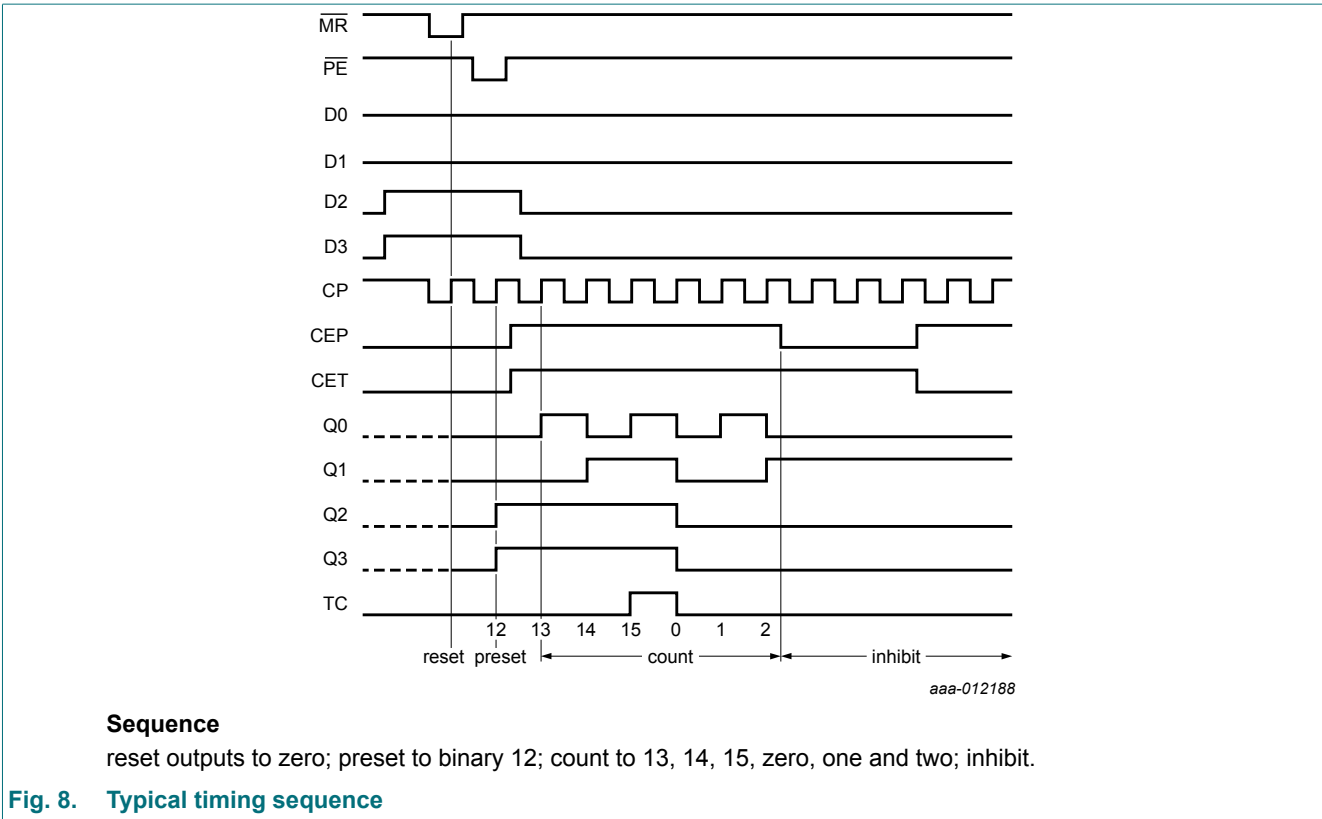


Fig. 8. Typical timing sequence

## 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 |
|-----------|-------------------------|--|------|----------|------|
| $V_{CC}$  | supply voltage          |  | -0.5 | +7.0     | 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 $V_{CC} + 0.5\text{ V}$       | -    | $\pm 25$ | mA   |
| $I_{CC}$  | supply current          |  | -    | 50       | mA   |
| $I_{GND}$ | ground current          |  | -50  | -        | mA   |
| $T_{stg}$ | storage temperature     |  | -65  | +150     | °C   |
| $P_{tot}$ | total power dissipation | SO16 package [1]                                       | -    | 500      | mW   |
|           |                         | (T)SSOP16 package [1]                                  | -    | 500      | mW   |

[1] For SO16 packages: above 70 °C the value of  $P_{tot}$  derates linearly at 8 mW/K.  
 For (T)SSOP16 packages: above 60 °C the value of  $P_{tot}$  derates linearly at 5.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

| Symbol           | Parameter                           | Conditions              | 74HC163 |      |                 | 74HCT163 |      |                 | Unit |
|------------------|-------------------------------------|-------------------------|---------|------|-----------------|----------|------|-----------------|------|
|                  |                                     |                         | Min     | Typ  | Max             | Min      | Typ  | Max             |      |
| V <sub>CC</sub>  | supply voltage                      |                         | 2.0     | 5.0  | 6.0             | 4.5      | 5.0  | 5.5             | V    |
| V <sub>I</sub>   | input voltage                       |                         | 0       | -    | V <sub>CC</sub> | 0        | -    | V <sub>CC</sub> | V    |
| V <sub>O</sub>   | output voltage                      |                         | 0       | -    | V <sub>CC</sub> | 0        | -    | V <sub>CC</sub> | V    |
| T <sub>amb</sub> | ambient temperature                 |                         | -40     | +25  | +125            | -40      | +25  | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 2.0 V | -       | -    | 625             | -        | -    | -               | ns/V |
|                  |                                     | V <sub>CC</sub> = 4.5 V | -       | 1.67 | 139             | -        | 1.67 | 139             | ns/V |
|                  |                                     | V <sub>CC</sub> = 6.0 V | -       | -    | 83              | -        | -    | -               | ns/V |

## 9. Static characteristics

**Table 6. Static characteristics**

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

| Symbol          | Parameter                 | Conditions   | 25 °C |      |      | -40 °C to +85 °C |      | -40 °C to +125 °C |       | Unit |
|-----------------|---------------------------|--|-------|------|------|------------------|------|-------------------|-------|------|
|                 |                           |  | Min   | Typ  | Max  | Min              | Max  | Min               | Max   |      |
| <b>74HC163</b>  |                           |  |       |      |      |                  |      |                   |       |      |
| 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; V <sub>CC</sub> = 4.5 V   | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -     | V    |
|                 |                           | I <sub>O</sub> = -5.2; V <sub>CC</sub> = 6.0 V   | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -     | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |      |      |                  |      |                   |       |      |
|                 |                           | 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; 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; V <sub>CC</sub> = 6.0 V | -     | -    | 8.0  | -                | 80.0 | -                 | 160.0 | μA   |
| C <sub>I</sub>  | input capacitance         |  | -     | 3.5  | -    | -                | -    | -                 | -     | pF   |

## Presettable synchronous 4-bit binary counter; synchronous reset

| Symbol           | Parameter                 | Conditions  | 25 °C |      |      | -40 °C to +85 °C |       | -40 °C to +125 °C |       | Unit |
|------------------|---------------------------|---|-------|------|------|------------------|-------|-------------------|-------|------|
|                  |                           |   | Min   | Typ  | Max  | Min              | Max   | Min               | Max   |      |
| <b>74HCT163</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> = -4.0 mA  | 3.98  | 4.32 | -    | 3.84             | -     | 3.7               | -     | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V   |       |      |      |                  |       |                   |       |      |
|                  |                           | 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; 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; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V  | -     | -    | 8.0  | -                | 80.0  | -                 | 160.0 | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V; I <sub>O</sub> = 0 A |       |      |      |                  |       |                   |       |      |
|                  |                           | pin MR  | -     | 95   | 342  | -                | 427.5 | -                 | 465.5 | µA   |
|                  |                           | pin CP  | -     | 110  | 396  | -                | 495   | -                 | 539   | µA   |
|                  |                           | pin CEP and Dn  | -     | 25   | 90   | -                | 112.5 | -                 | 122.5 | µA   |
|                  |                           | pin CET   | -     | 75   | 270  | -                | 337.5 | -                 | 367.5 | µA   |
|                  | pin PE                    | -   | 30    | 108  | -    | 135              | -     | 147               | µA    |      |
| C <sub>I</sub>   | input capacitance         |   | -     | 3.5  | -    | -                | -     | -                 | -     | pF   |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see Fig. 14.

| Symbol           | Parameter         | Conditions                            | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------|---------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                  |                   |                                       | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| <b>74HC163</b>   |                   |                                       |       |     |     |                  |     |                   |     |      |
| $t_{pd}$         | propagation delay | CP to Qn; see Fig. 9 [1]              |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | -     | 55  | 185 | -                | 230 | -                 | 280 | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | -     | 20  | 37  | -                | 46  | -                 | 56  | ns   |
|                  |                   | $V_{CC} = 5.0$ V; $C_L = 15$ pF       | -     | 17  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | $V_{CC} = 6.0$ V                      | -     | 16  | 31  | -                | 39  | -                 | 48  | ns   |
|                  |                   | CP to TC; see Fig. 9                  |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | -     | 69  | 215 | -                | 270 | -                 | 320 | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | -     | 25  | 43  | -                | 54  | -                 | 65  | ns   |
|                  |                   | $V_{CC} = 5.0$ V; $C_L = 15$ pF       | -     | 21  | -   | -                | -   | -                 | -   | ns   |
|                  |                   | $V_{CC} = 6.0$ V                      | -     | 20  | 37  | -                | 46  | -                 | 55  | ns   |
|                  |                   | CET to TC; see Fig. 10                |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | -     | 36  | 120 | -                | 150 | -                 | 180 | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | -     | 13  | 24  | -                | 30  | -                 | 36  | ns   |
|                  |                   | $V_{CC} = 5.0$ V; $C_L = 15$ pF       | -     | 11  | -   | -                | -   | -                 | -   | ns   |
| $V_{CC} = 6.0$ V | -                 | 10                                    | 20    | -   | 26  | -                | 31  | ns                |     |      |
| $t_t$            | transition time   | see Fig. 9 and Fig. 10 [2]            |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | -     | 19  | 75  | -                | 95  | -                 | 110 | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
|                  |                   | $V_{CC} = 6.0$ V                      | -     | 6   | 13  | -                | 16  | -                 | 19  | ns   |
| $t_W$            | pulse width       | CP; HIGH or LOW; see Fig. 9           |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                  |                   | $V_{CC} = 6.0$ V                      | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
| $t_{su}$         | set-up time       | MR, Dn to CP; see Fig. 11 and Fig. 12 |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | 80    | 17  | -   | 100              | -   | 120               | -   | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | 16    | 6   | -   | 20               | -   | 24                | -   | ns   |
|                  |                   | $V_{CC} = 6.0$ V                      | 14    | 5   | -   | 17               | -   | 20                | -   | ns   |
|                  |                   | PE to CP; see Fig. 11                 |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | 80    | 22  | -   | 100              | -   | 120               | -   | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | 16    | 8   | -   | 20               | -   | 24                | -   | ns   |
|                  |                   | $V_{CC} = 6.0$ V                      | 14    | 6   | -   | 17               | -   | 20                | -   | ns   |
|                  |                   | CET, CP to CP; see Fig. 13            |       |     |     |                  |     |                   |     |      |
|                  |                   | $V_{CC} = 2.0$ V                      | 175   | 58  | -   | 220              | -   | 265               | -   | ns   |
|                  |                   | $V_{CC} = 4.5$ V                      | 35    | 21  | -   | 44               | -   | 53                | -   | ns   |
| $V_{CC} = 6.0$ V | 30                | 17                                    | -     | 37  | -   | 45               | -   | ns                |     |      |

## Presettable synchronous 4-bit binary counter; synchronous reset

| Symbol  | Parameter                     | Conditions   | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |  |
|---|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|--|
|   |                               |  | Min   | Typ | Max | Min              | Max | Min               | Max |      |  |
| t <sub>h</sub>                                  | hold time                     | Dn, $\overline{PE}$ , CEP, CET, MR to CP;<br>see <a href="#">Fig. 11</a> , <a href="#">Fig. 12</a> and <a href="#">Fig. 13</a> |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 2.0 V  | 0     | -14 | -   | 0                | -   | 0                 | -   | ns   |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 0     | -5  | -   | 0                | -   | 0                 | -   | ns   |  |
|   |                               | V <sub>CC</sub> = 6.0 V  | 0     | -4  | -   | 0                | -   | 0                 | -   | ns   |  |
| f <sub>max</sub>                                | maximum frequency             | CP; see <a href="#">Fig. 9</a>   |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 2.0 V  | 5     | 15  | -   | 4                | -   | 4                 | -   | MHz  |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 27    | 46  | -   | 22               | -   | 18                | -   | MHz  |  |
|   |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF  | -     | 51  | -   | -                | -   | -                 | -   | MHz  |  |
|   |                               | V <sub>CC</sub> = 6.0 V  | 32    | 55  | -   | 26               | -   | 21                | -   | MHz  |  |
| C <sub>PD</sub>                                 | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> ; V <sub>CC</sub> = 5 V;<br>f <sub>i</sub> = 1 MHz                                     | [3]   | -   | 33  | -                | -   | -                 | -   | pF   |  |
| <b>74HCT163</b>                                 |                               |  |       |     |     |                  |     |                   |     |      |  |
| t <sub>pd</sub>                                 | propagation delay             | CP to Qn; see <a href="#">Fig. 9</a>   | [1]   |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | -     | 23  | 39  | -                | 49  | -                 | 59  | ns   |  |
|   |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF  | -     | 20  | -   | -                | -   | -                 | -   | ns   |  |
|   |                               | CP to TC; see <a href="#">Fig. 9</a>   |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | -     | 29  | 49  | -                | 61  | -                 | 74  | ns   |  |
|   |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF  | -     | 25  | -   | -                | -   | -                 | -   | ns   |  |
|   |                               | CET to TC; see <a href="#">Fig. 10</a>   |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | -     | 17  | 32  | -                | 44  | -                 | 48  | ns   |  |
| V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF | -                             | 14   | -     | -   | -   | -                | -   | ns                |     |      |  |
| t <sub>t</sub>                                  | transition time               | see <a href="#">Fig. 9</a> and <a href="#">Fig. 10</a>   | [2]   |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |  |
| t <sub>W</sub>                                  | pulse width                   | CP; HIGH or LOW; see <a href="#">Fig. 9</a>  |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 20    | 6   | -   | 25               | -   | 30                | -   | ns   |  |
| t <sub>su</sub>                                 | set-up time                   | MR, Dn to CP; see <a href="#">Fig. 11</a> and <a href="#">Fig. 12</a>  |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 20    | 9   | -   | 25               | -   | 30                | -   | ns   |  |
|   |                               | $\overline{PE}$ to CP; see <a href="#">Fig. 11</a>   |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 20    | 11  | -   | 25               | -   | 30                | -   | ns   |  |
|   |                               | CEP, CET to CP; see <a href="#">Fig. 13</a>  |       |     |     |                  |     |                   |     |      |  |
| V <sub>CC</sub> = 4.5 V                         | 40                            | 24   | -     | 50  | -   | 60               | -   | ns                |     |      |  |
| t <sub>h</sub>                                  | hold time                     | Dn, $\overline{PE}$ , CEP, CET, MR to CP;<br>see <a href="#">Fig. 11</a> , <a href="#">Fig. 12</a> and <a href="#">Fig. 13</a> |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 0     | -5  | -   | 0                | -   | 0                 | -   | ns   |  |
| f <sub>max</sub>                                | maximum frequency             | CP; see <a href="#">Fig. 9</a>   |       |     |     |                  |     |                   |     |      |  |
|   |                               | V <sub>CC</sub> = 4.5 V  | 26    | 45  | -   | 21               | -   | 17                | -   | MHz  |  |
|   |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF  | -     | 50  | -   | -                | -   | -                 | -   | MHz  |  |

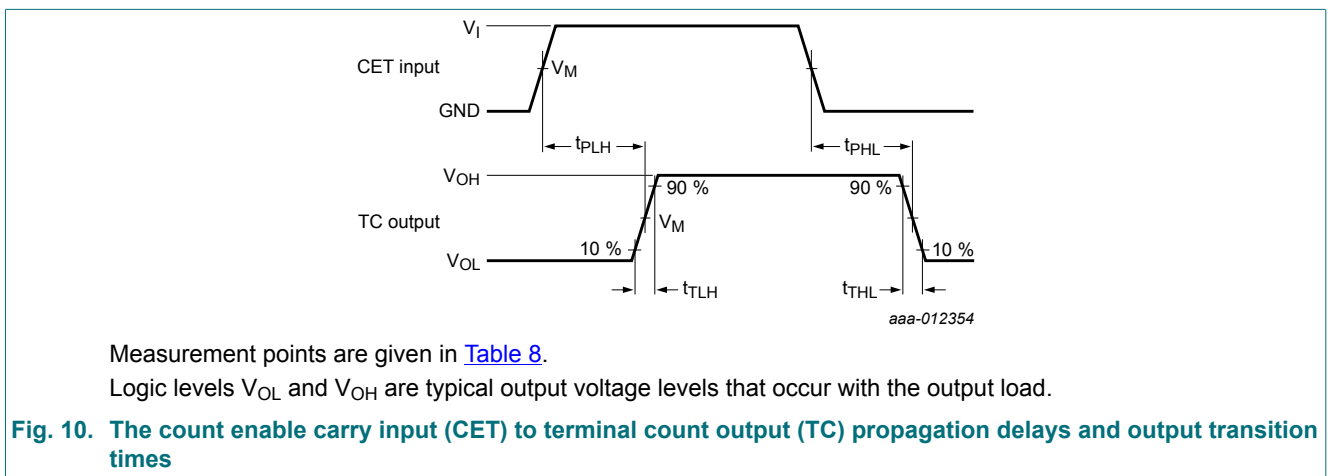
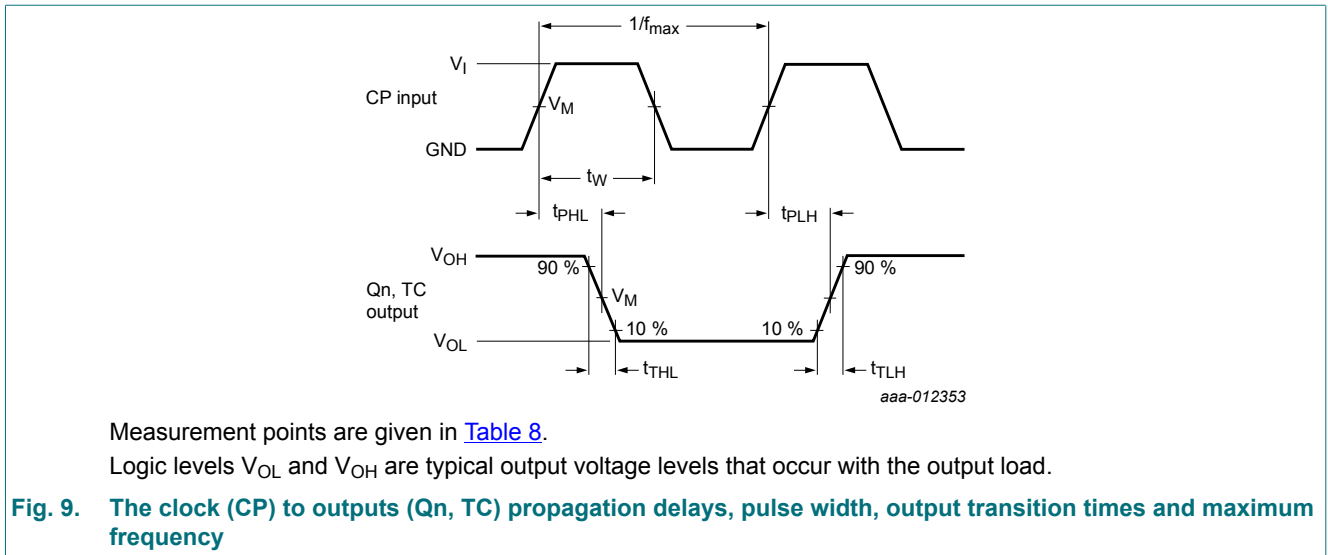
Pre-settable synchronous 4-bit binary counter; synchronous reset

| Symbol          | Parameter                     | Conditions  | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |   | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| C <sub>PD</sub> | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V;<br>V <sub>CC</sub> = 5 V; f <sub>i</sub> = 1 MHz | [3]   | -   | 35  | -                | -   | -                 | -   | pF   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>i</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$$
 where:  
 f<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in V;  
 N = number of inputs switching;  
 Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

10.1. Waveforms and test circuit



Presettable synchronous 4-bit binary counter; synchronous reset

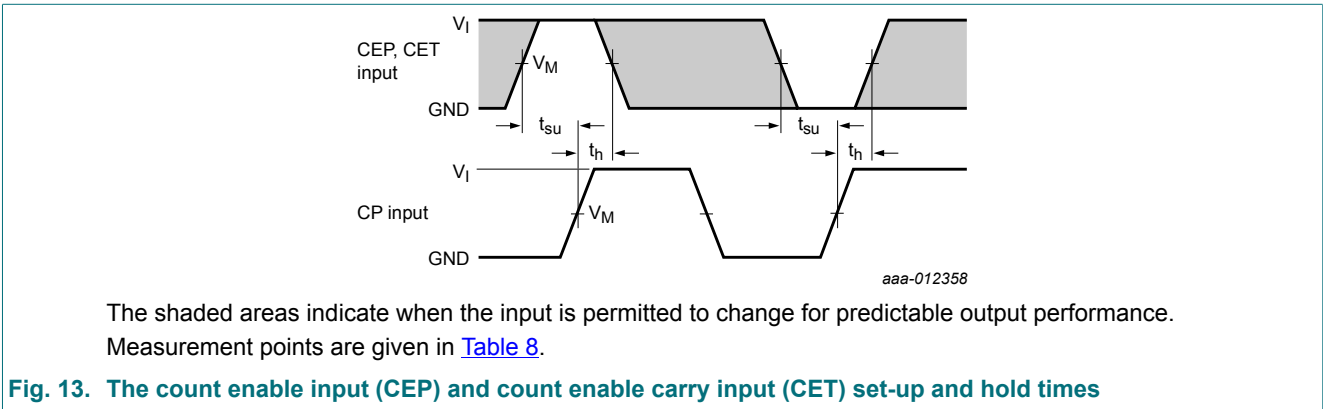
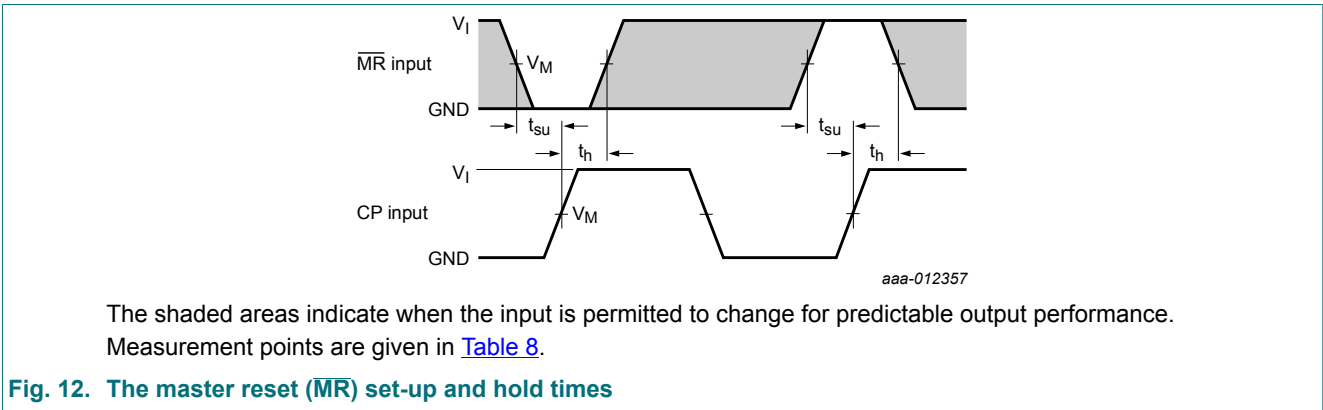
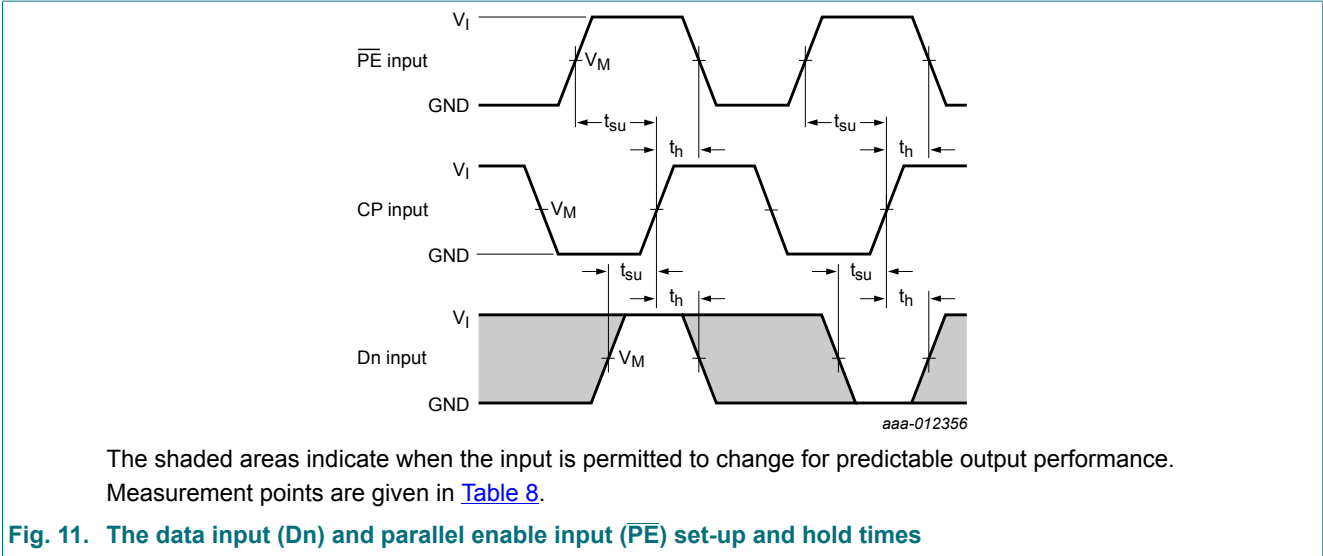


Table 8. Measurement points

| Type     | Input               |                 | Output              |
|----------|---------------------|-----------------|---------------------|
|          | $V_M$               | $V_I$           | $V_M$               |
| 74HC163  | $0.5 \times V_{CC}$ | GND to $V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT163 | 1.3 V               | GND to 3 V      | 1.3 V               |

Presettable synchronous 4-bit binary counter; synchronous reset

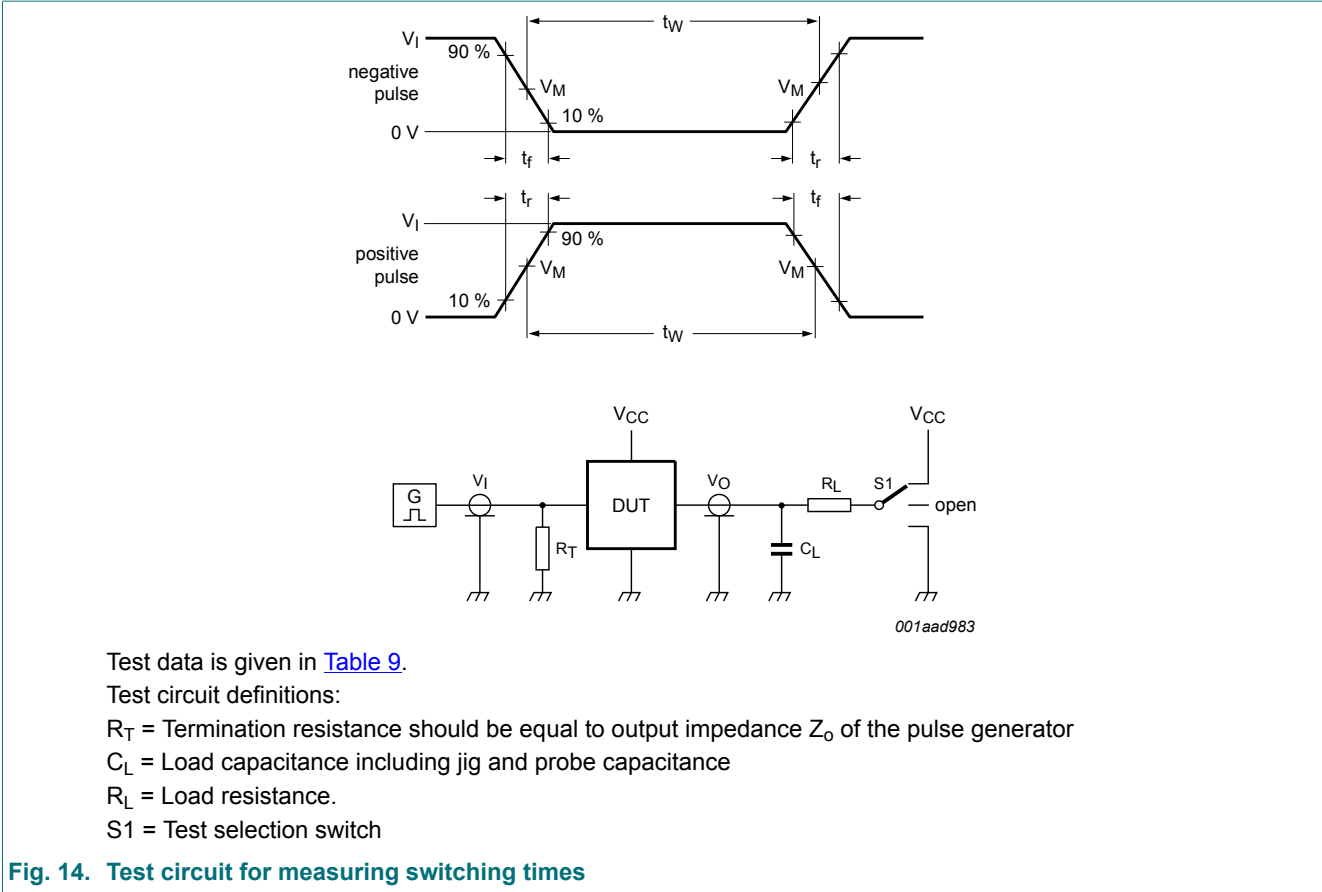


Fig. 14. Test circuit for measuring switching times

Table 9. Test data

| Type     | Input    |            | Load         |              | S1 position        |
|----------|----------|------------|--------------|--------------|--------------------|
|          | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ |
| 74HC163  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               |
| 74HCT163 | 3 V      | 6 ns       | 15 pF, 50 pF | 1 k $\Omega$ | open               |

## 11. Application information

The 74HC163; 74HCT163 facilitate designing counters of any modulus with minimal external logic. The output is glitch-free due to the synchronous reset.

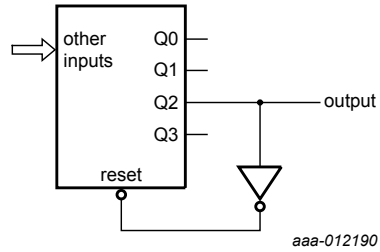


Fig. 15. Modulo-5 counter

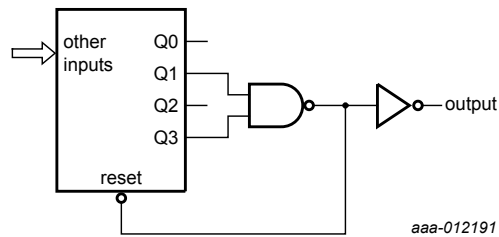
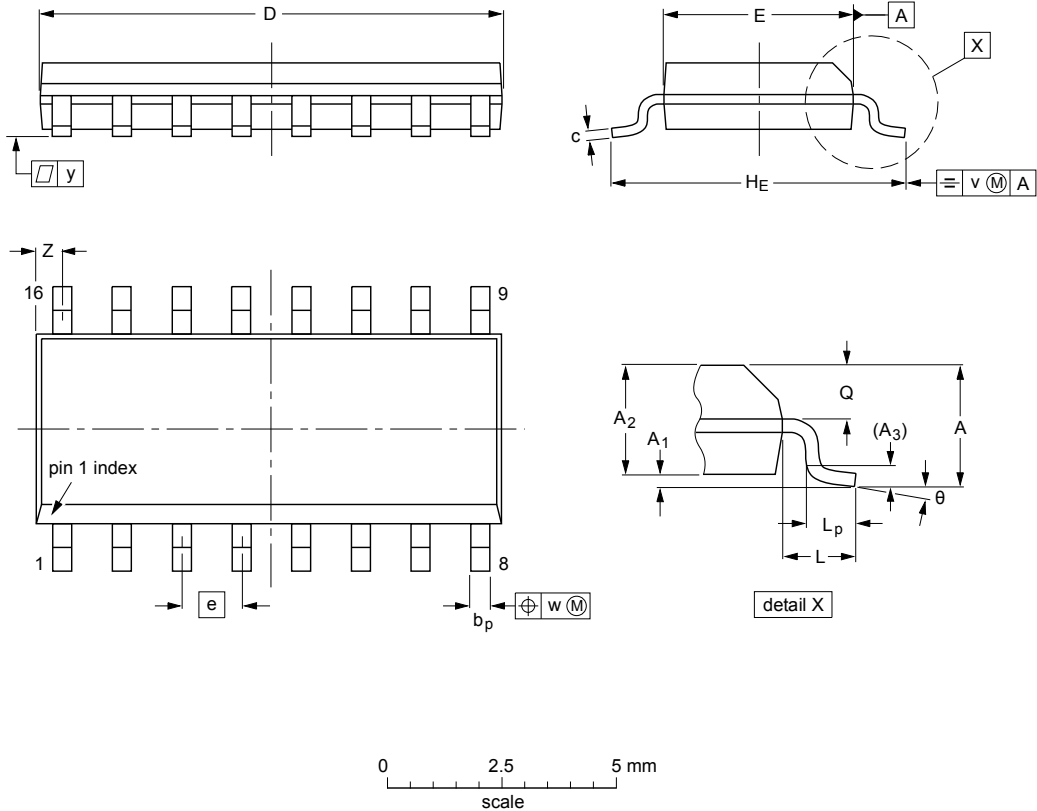


Fig. 16. Modulo-11 counter

12. Package outline

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

Fig. 17. Package outline SOT109-1 (SO16)

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

SOT338-1

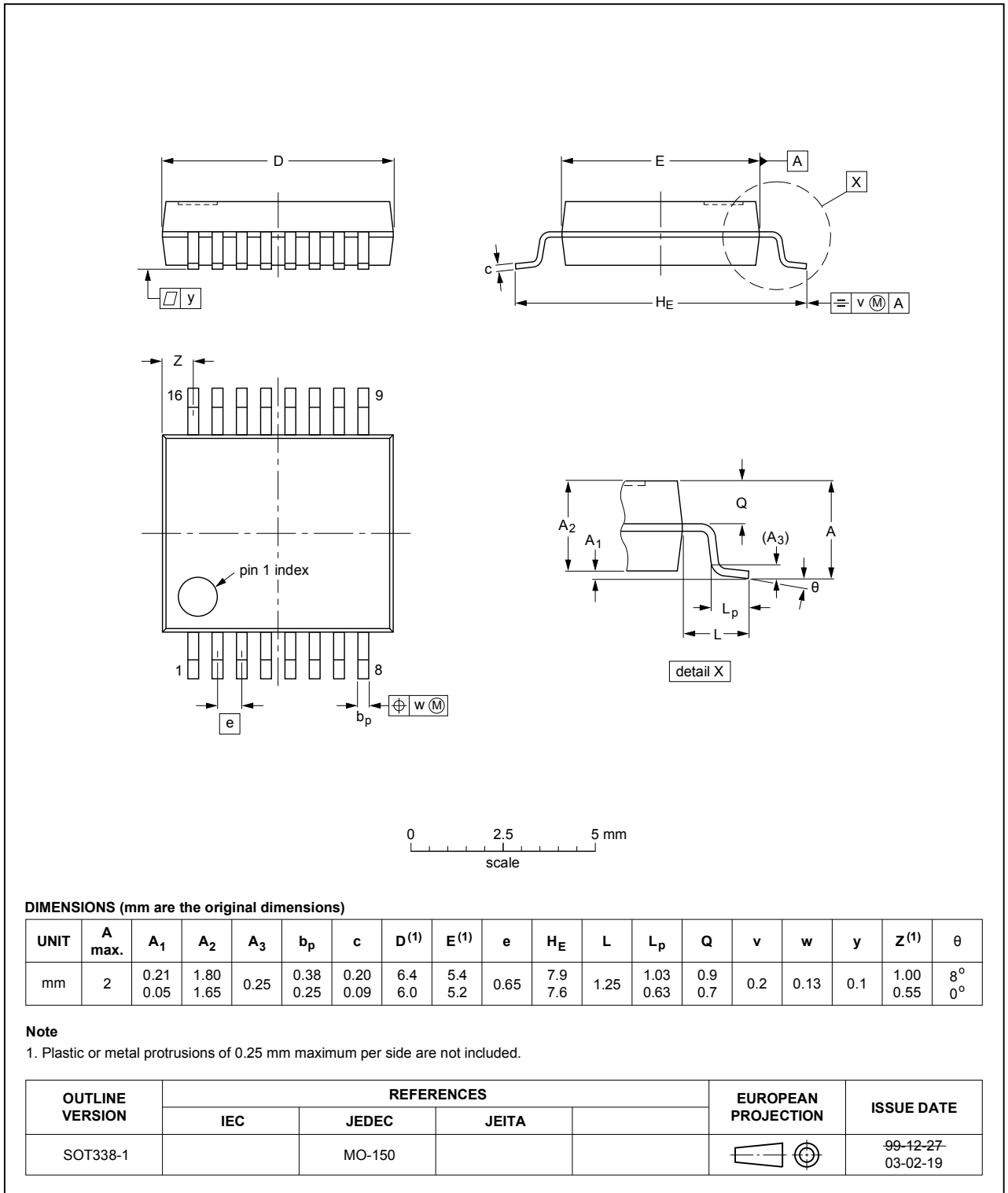
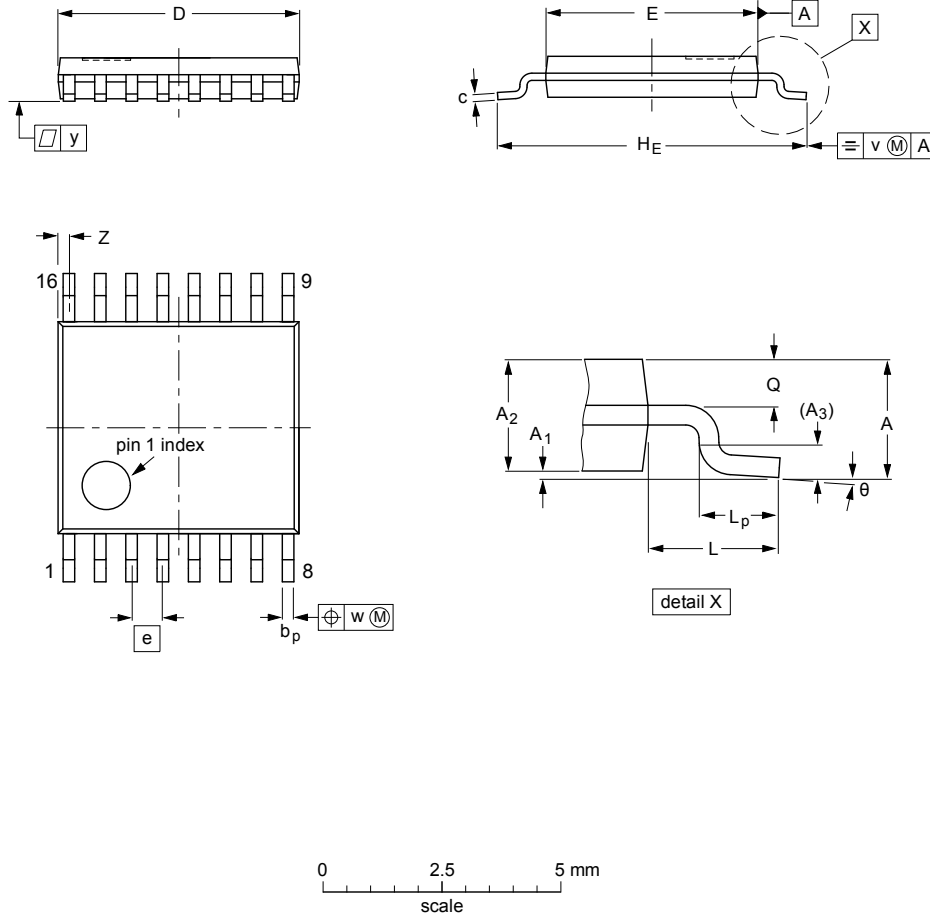


Fig. 18. Package outline SOT338-1 (SSOP16)

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

SOT403-1



**DIMENSIONS (mm are the original dimensions)**

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

Fig. 19. Package outline SOT403-1 (TSSOP16)

## 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_HCT163 v.5     | 20181012  | Product data sheet    | -             | 74HC_HCT163 v.4     |
| 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> <li>Typo corrected for pin name Q0: <a href="#">Fig. 5</a> and <a href="#">Fig. 6</a>.</li> </ul> |                       |               |                     |
| 74HC_HCT163 v.4     | 20151228  | Product data sheet    | -             | 74HC_HCT163 v.3     |
| Modifications:      | <ul style="list-style-type: none"> <li>Type numbers 74HC163N and 74HCT163N (SOT38-4) removed.</li> </ul>  |                       |               |                     |
| 74HC_HCT163 v.3     | 20140602  | Product data sheet    | -             | 74HC_HCT163_CNV v.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> </ul>   |                       |               |                     |
| 74HC_HCT163_CNV v.2 | 19930927  | Product specification | -             | -                   |

## 15. Legal information

### Data sheet status

| Document status [1][2]         | Product status [3] | 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 <https://www.nexperia.com>.

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