

# 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:

$$f_{\max} = \frac{1}{t_{P(\max)}(CP \text{ to } TC) + t_{SU}(CEP \text{ to } CP)}$$

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

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

4. Functional diagram

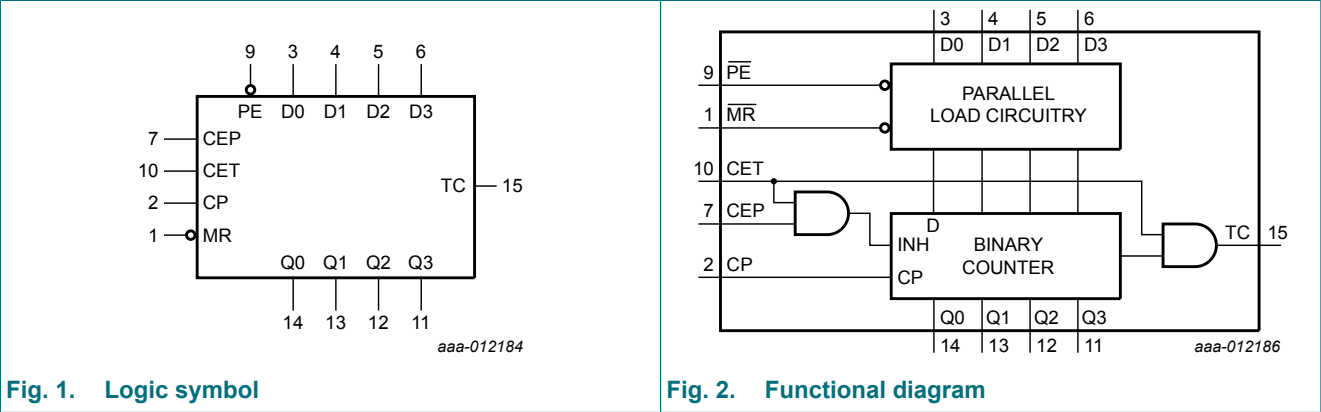


Fig. 1. Logic symbol

Fig. 2. Functional diagram

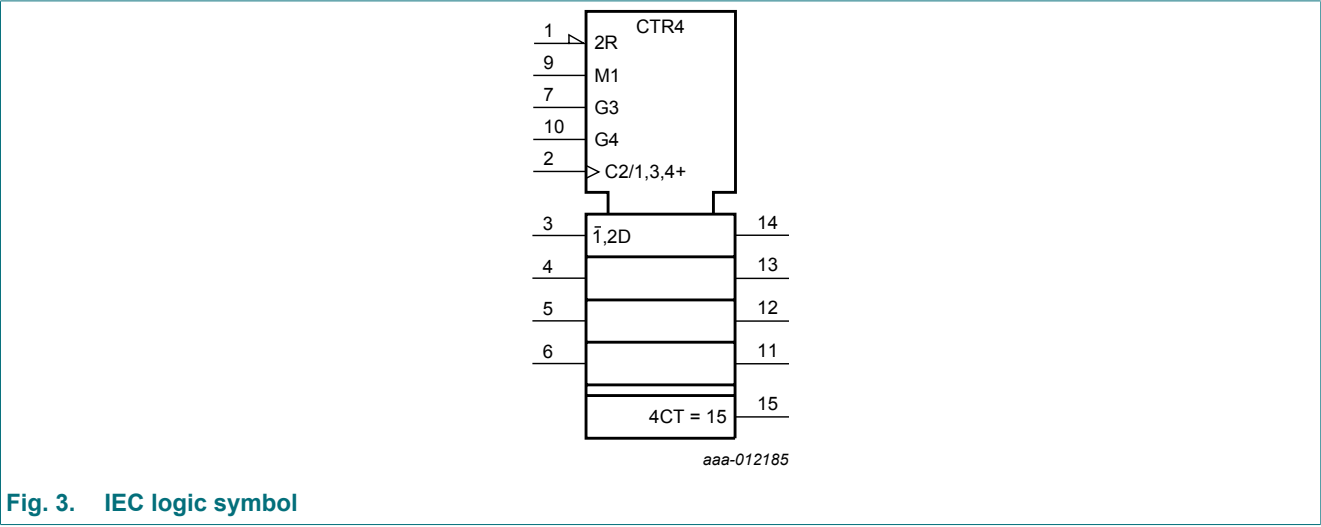


Fig. 3. IEC logic symbol

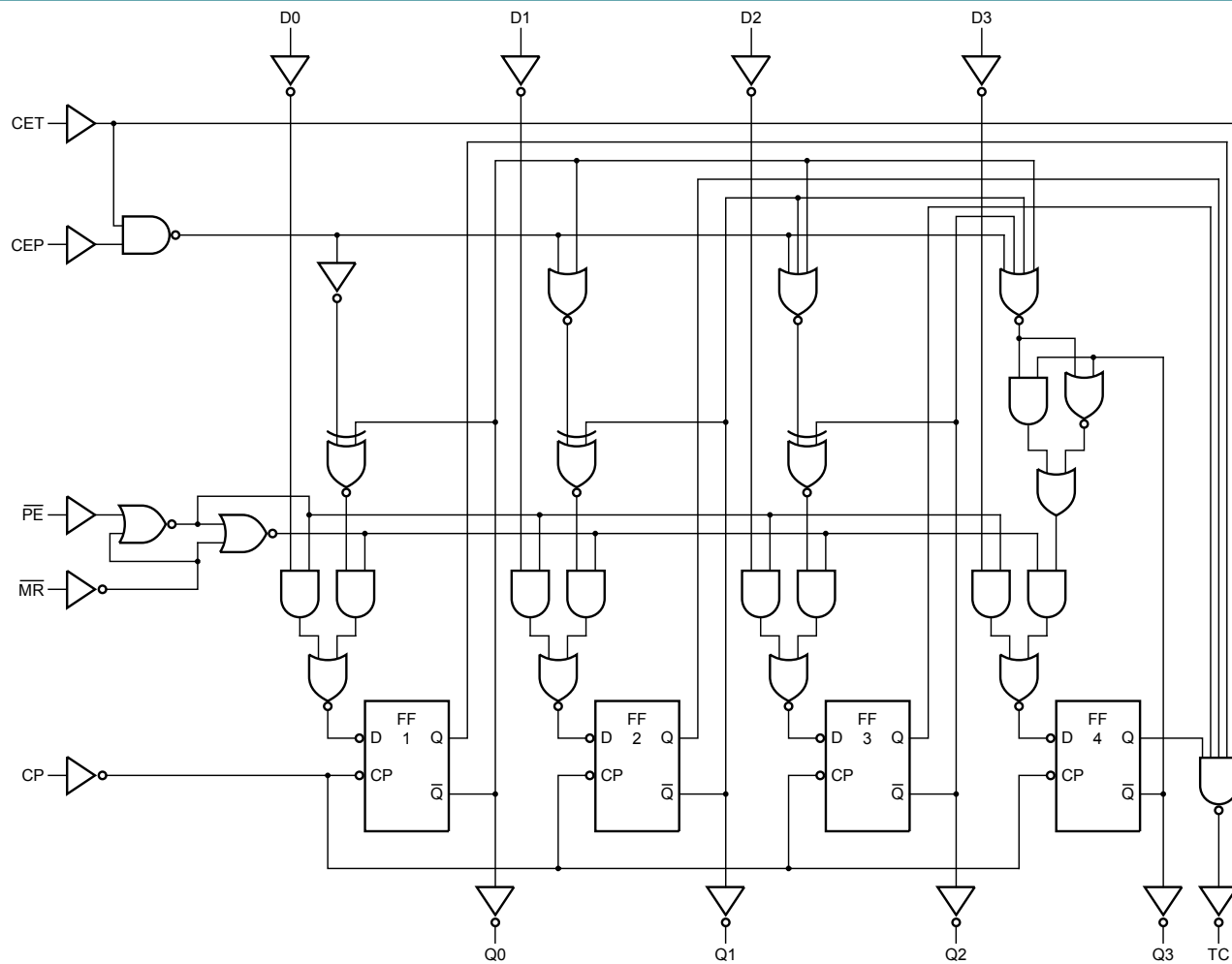
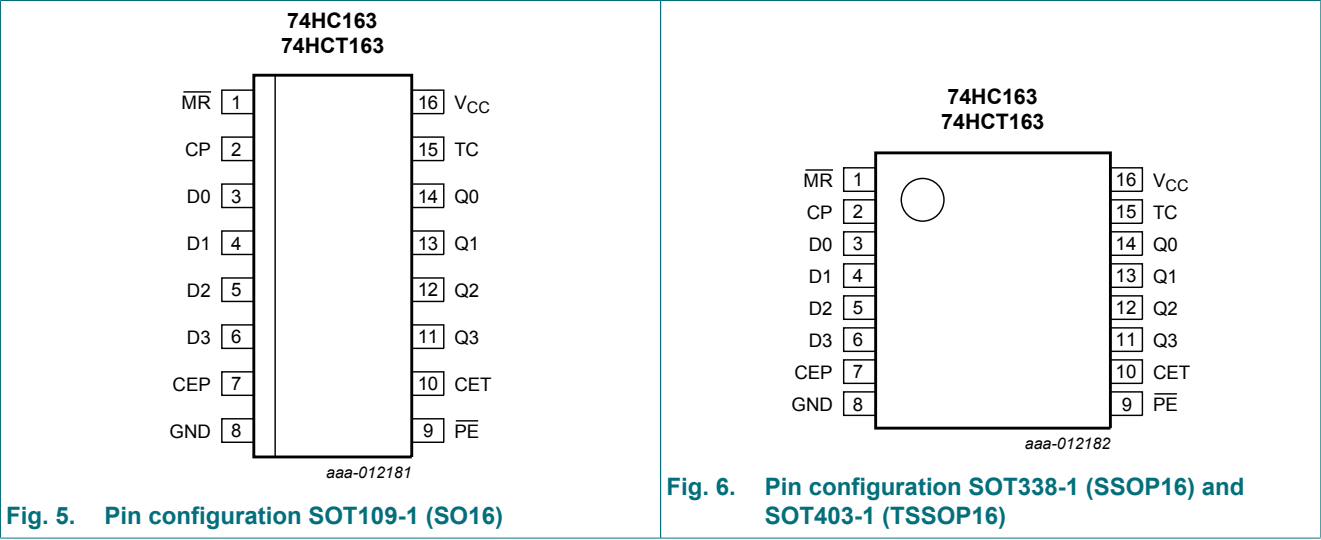


Fig. 4. Logic diagram

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol          | Pin            | Description                               |
|-----------------|----------------|-------------------------------------------|
| 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[1]

| 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.

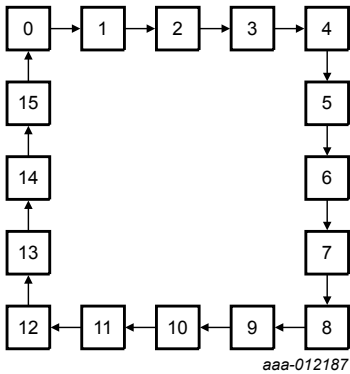
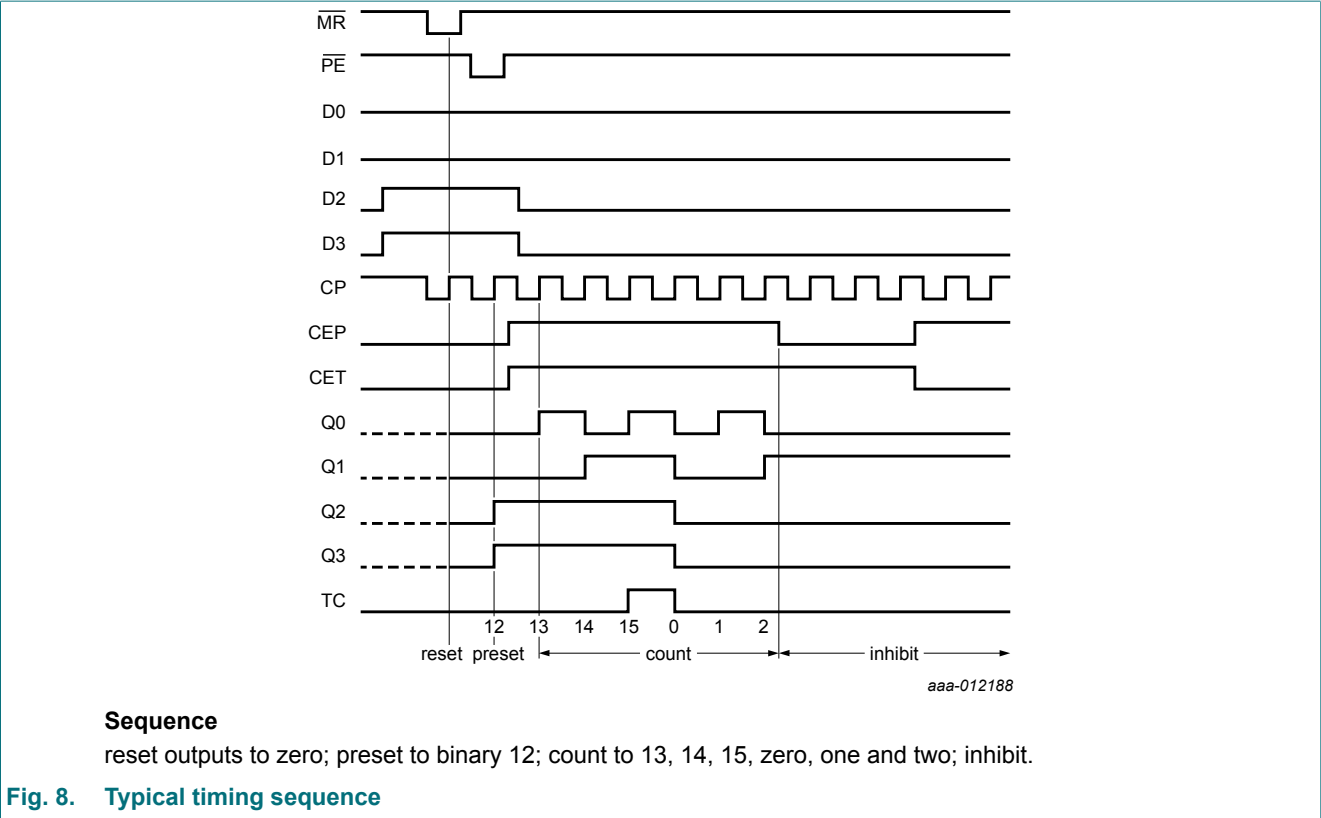


Fig. 7. State diagram



## 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   |      |
| 74HC163         |                           |                                                                                        |       |      |      |                  |      |                   |       |      |
| 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    |
| V <sub>OL</sub> | LOW-level output voltage  | I <sub>O</sub> = -5.2; V <sub>CC</sub> = 6.0 V                                         | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -     | V    |
|                 |                           | 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>I</sub>  | input leakage current     | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V                                       | -     | 0.16 | 0.26 | -                | 0.33 | -                 | 0.4   | V    |
|                 |                           | 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   |      |
| 74HCT163         |                           |                                                                                                                                                         |       |      |      |                  |       |                   |       |      |
| 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 |      |
| 74HC163         |                   |                                                                       |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub> | propagation delay | CP to Qn; see <a href="#">Fig. 9</a> [1]                              |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                                               | -     | 55  | 185 | -                | 230 | -                 | 280 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                               | -     | 20  | 37  | -                | 46  | -                 | 56  | ns   |
|                 |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                       | -     | 17  | -   | -                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                               | -     | 16  | 31  | -                | 39  | -                 | 48  | ns   |
|                 |                   | CP to TC; see <a href="#">Fig. 9</a>                                  |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                                               | -     | 69  | 215 | -                | 270 | -                 | 320 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                               | -     | 25  | 43  | -                | 54  | -                 | 65  | ns   |
|                 |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                       | -     | 21  | -   | -                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                               | -     | 20  | 37  | -                | 46  | -                 | 55  | ns   |
|                 |                   | CET to TC; see <a href="#">Fig. 10</a>                                |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                                               | -     | 36  | 120 | -                | 150 | -                 | 180 | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                               | -     | 13  | 24  | -                | 30  | -                 | 36  | ns   |
|                 |                   | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                       | -     | 11  | -   | -                | -   | -                 | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                               | -     | 10  | 20  | -                | 26  | -                 | 31  | ns   |
| t <sub>t</sub>  | transition time   | see <a href="#">Fig. 9</a> and <a href="#">Fig. 10</a> [2]            |       |     |     |                  |     |                   |     |      |
|                 |                   | 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       | CP; HIGH or LOW; see <a href="#">Fig. 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   |
| 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> = 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   |
|                 |                   | PE to CP; see <a href="#">Fig. 11</a>                                 |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                                               | 80    | 22  | -   | 100              | -   | 120               | -   | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                               | 16    | 8   | -   | 20               | -   | 24                | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                               | 14    | 6   | -   | 17               | -   | 20                | -   | ns   |
|                 |                   | CET, CET to CP; see <a href="#">Fig. 13</a>                           |       |     |     |                  |     |                   |     |      |
|                 |                   | V <sub>CC</sub> = 2.0 V                                               | 175   | 58  | -   | 220              | -   | 265               | -   | ns   |
|                 |                   | V <sub>CC</sub> = 4.5 V                                               | 35    | 21  | -   | 44               | -   | 53                | -   | ns   |
|                 |                   | V <sub>CC</sub> = 6.0 V                                               | 30    | 17  | -   | 37               | -   | 45                | -   | ns   |

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

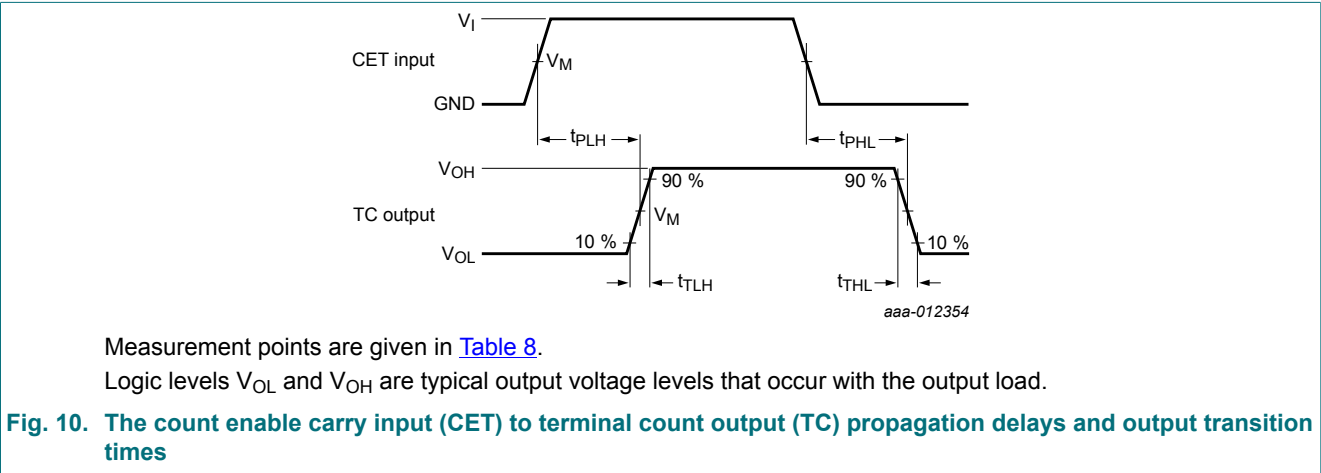
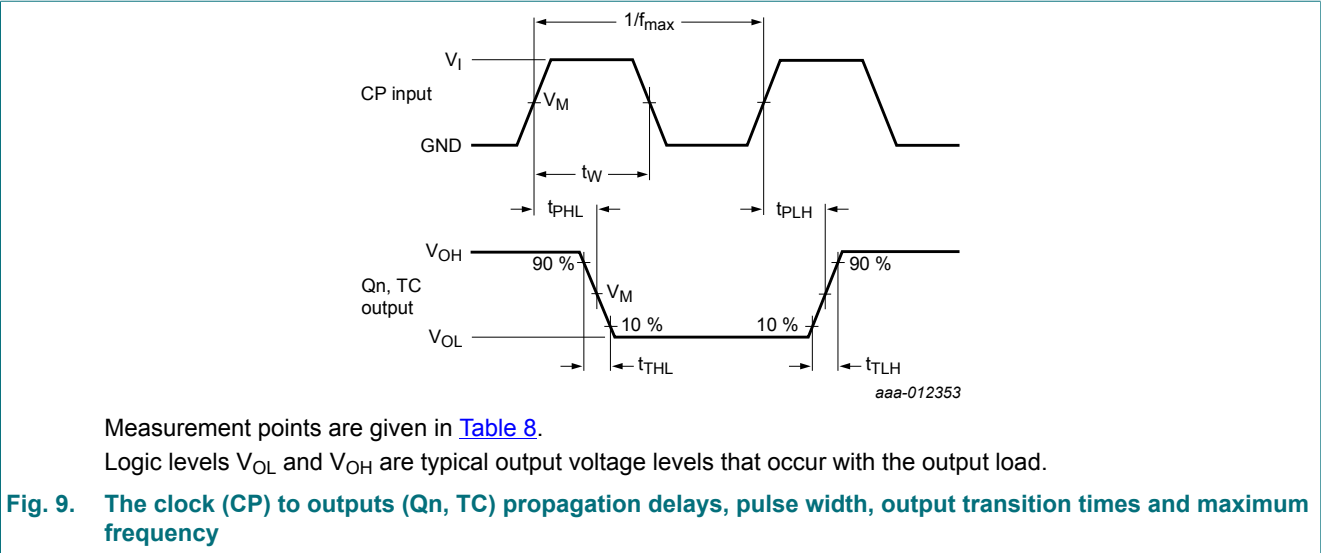
| Symbol          | Parameter                     | Conditions                                                                                                                     | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|------------------------------------------------------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

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 |      |
| 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 | -     | 35  | -   | -                | -   | -                 | -   | pF   |

- [1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.
- [2] t<sub>t</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;  
 $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

10.1. Waveforms and test circuit



Presettable synchronous 4-bit binary counter; synchronous reset

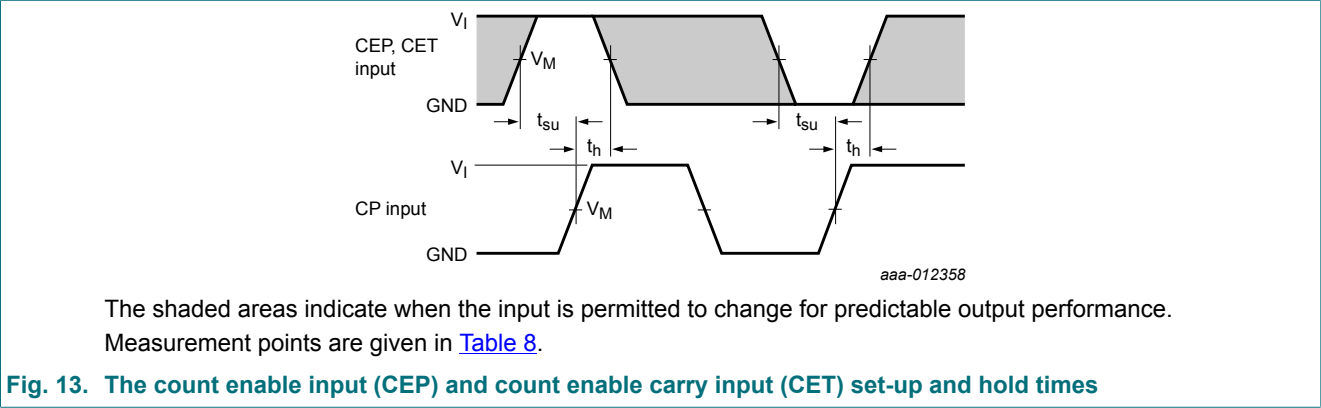
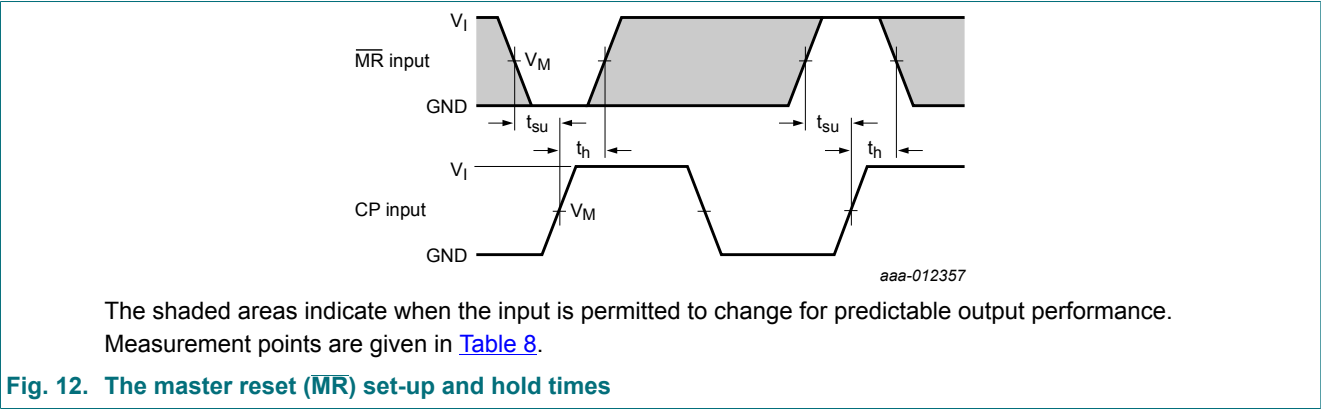
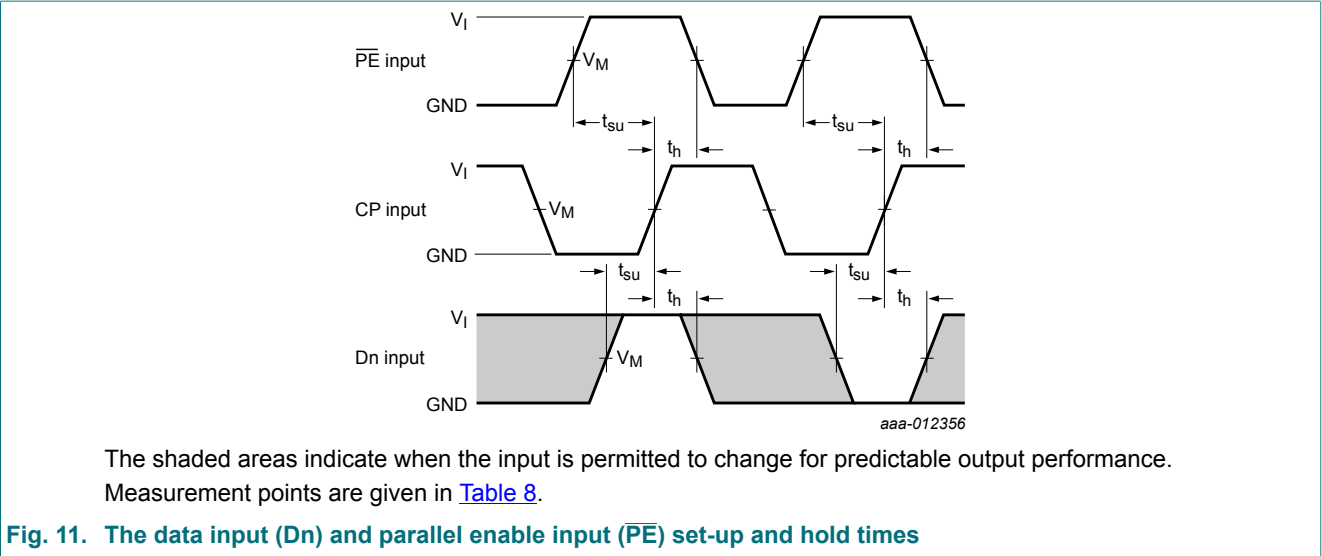


Table 8. Measurement points

| 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               |

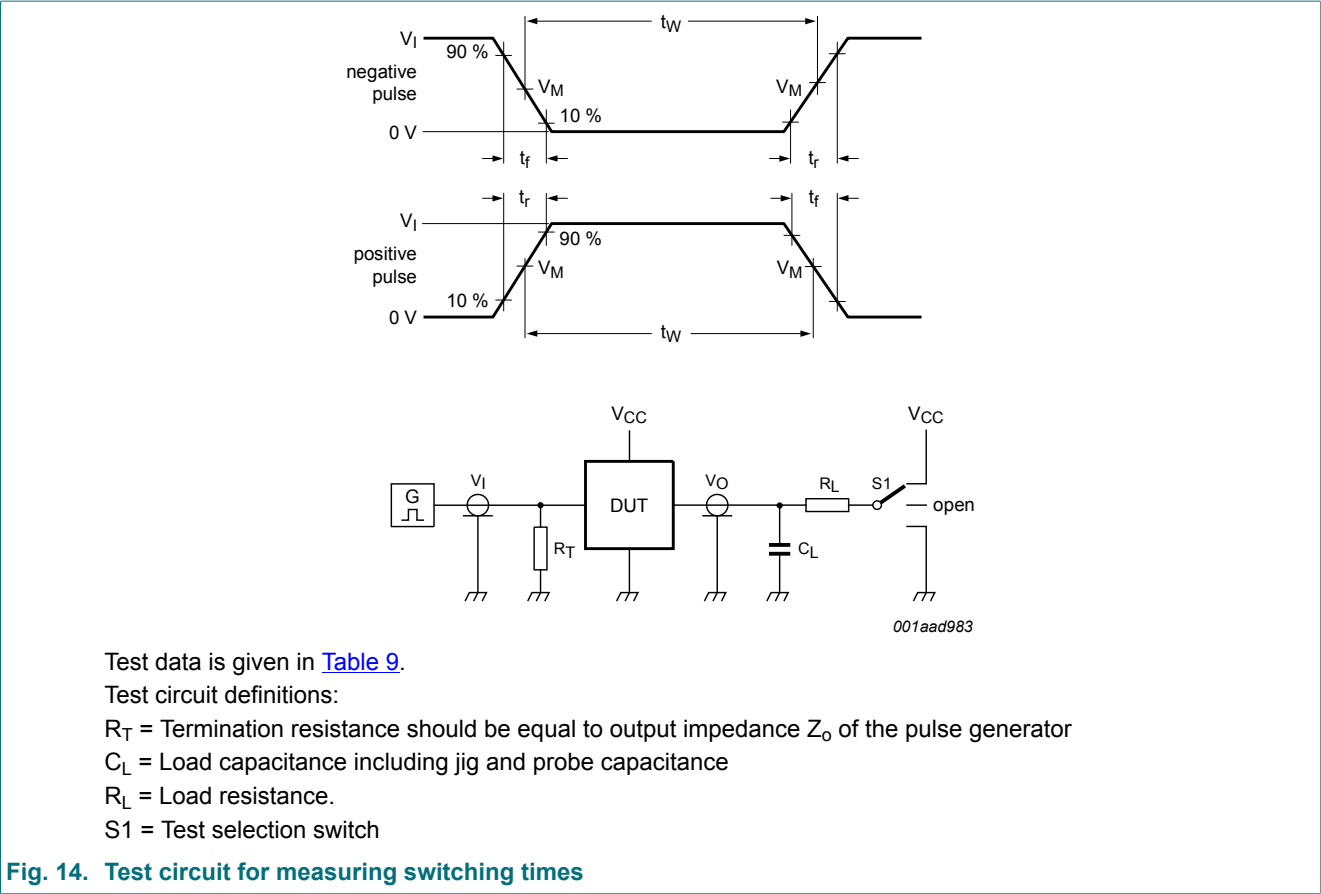


Fig. 14. Test circuit for measuring switching times

Table 9. Test data

| Type     | Input    |            | Load         |              | S1 position |
|----------|----------|------------|--------------|--------------|-------------|
|          | $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$        |             |
| 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.

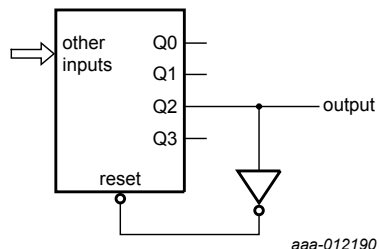


Fig. 15. Modulo-5 counter

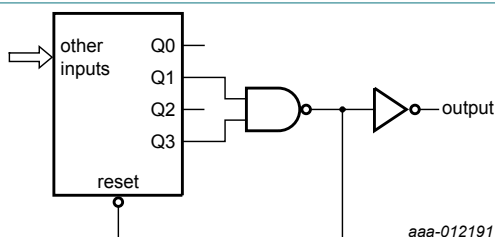
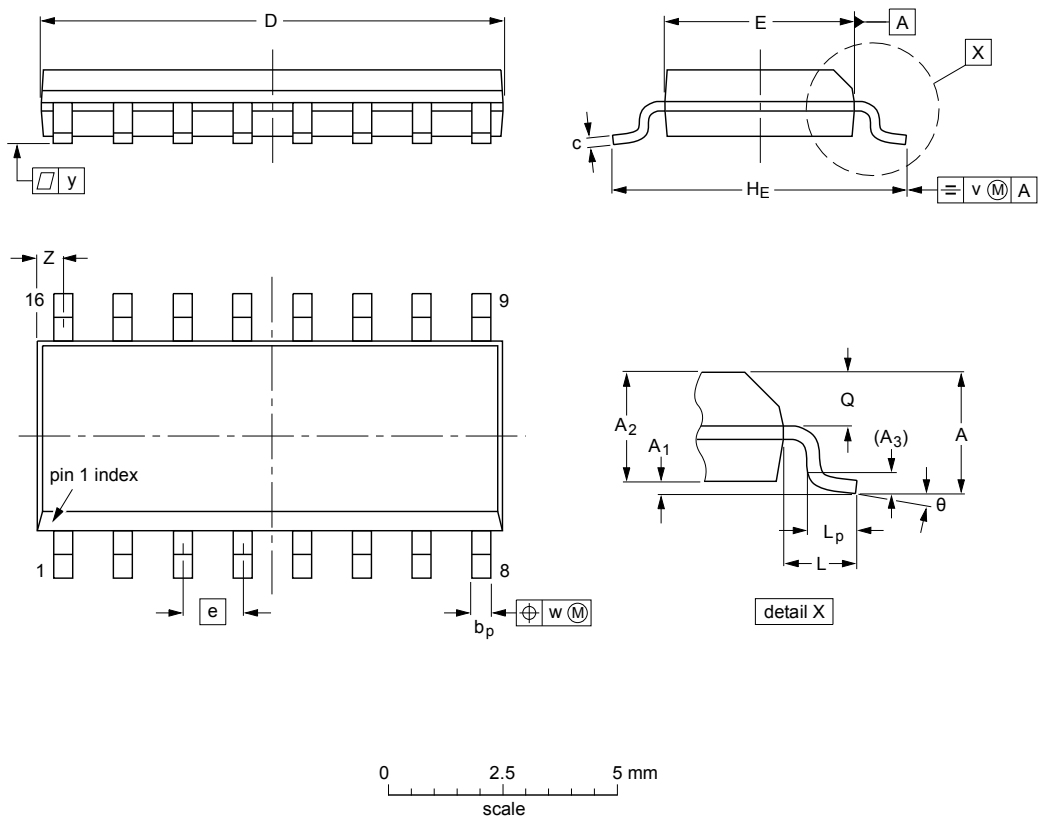


Fig. 16. Modulo-11 counter

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<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.

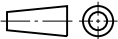
| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE           |
|--------------------|------------|--------|-------|--|---------------------------------------------------------------------------------------|----------------------|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

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

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

SOT338-1

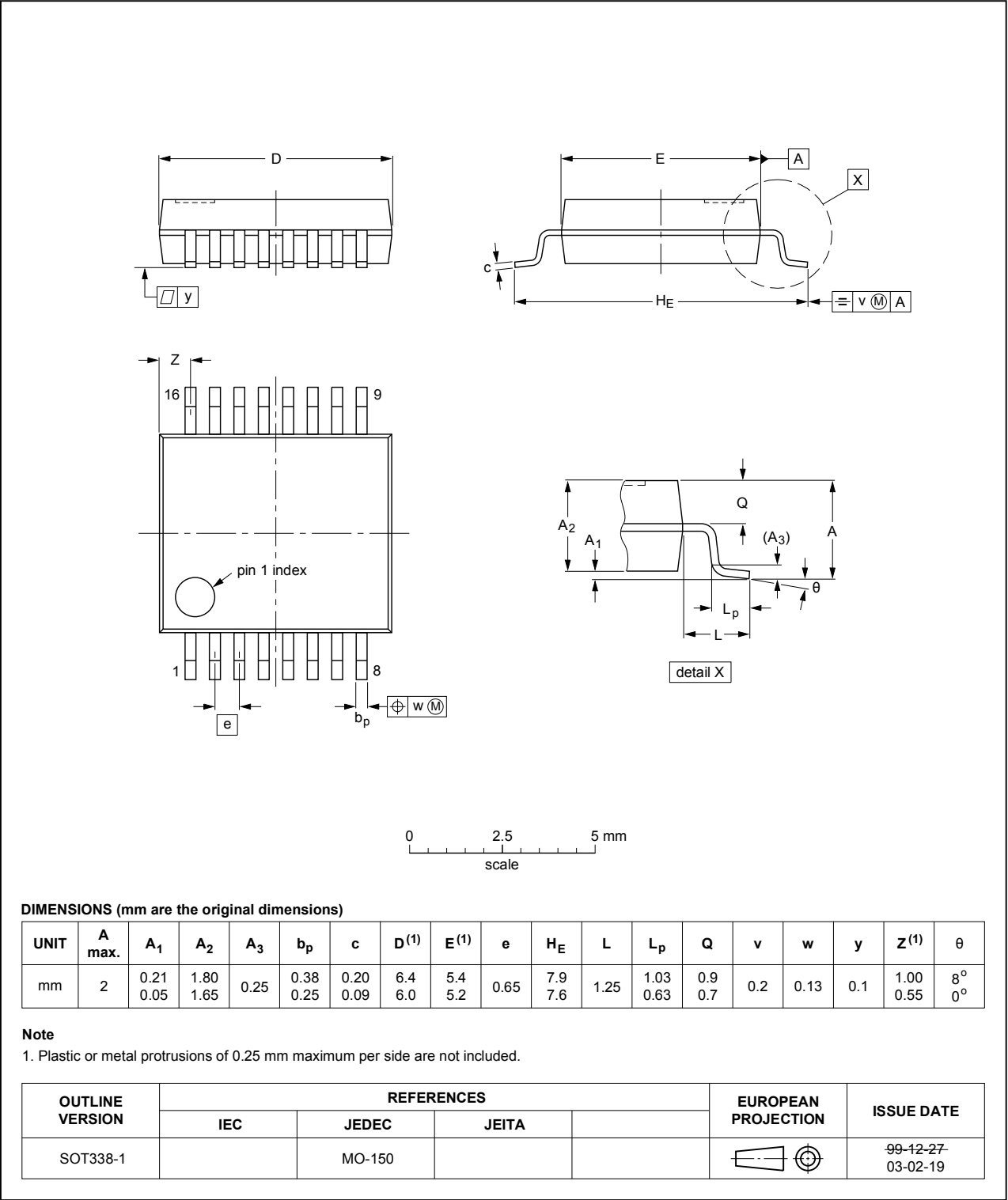
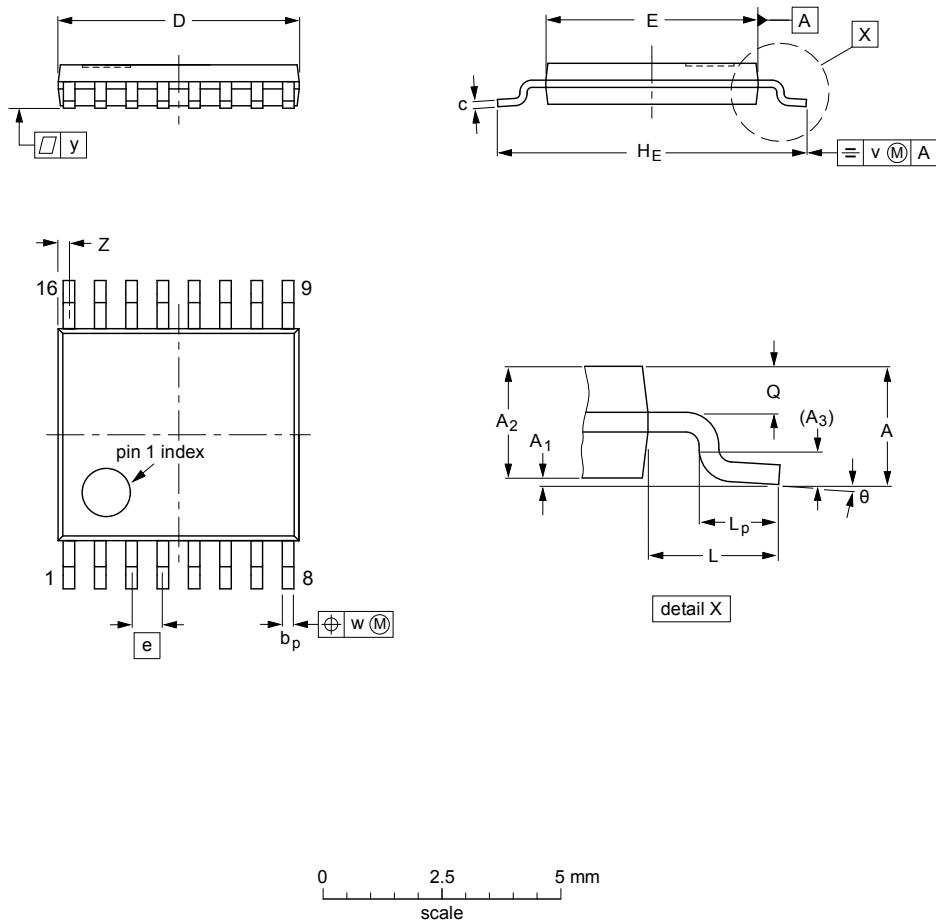


Fig. 18. Package outline SOT338-1 (SSOP16)



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

SOT403-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A <sub>max.</sub> | 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. 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<br>[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>.

### Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

**Product specification** — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

### Disclaimers

**Limited warranty and liability** — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

**Right to make changes** — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal

injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Quick reference data** — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

**Terms and conditions of commercial sale** — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

**No offer to sell or license** — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

**Non-automotive qualified products** — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

**Translations** — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

### Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

## Contents

|                                            |           |
|--------------------------------------------|-----------|
| <b>1. General description</b>              | <b>1</b>  |
| <b>2. Features and benefits</b>            | <b>1</b>  |
| <b>3. Ordering information</b>             | <b>1</b>  |
| <b>4. Functional diagram</b>               | <b>2</b>  |
| <b>5. Pinning information</b>              | <b>4</b>  |
| 5.1. Pinning                               | 4         |
| 5.2. Pin description                       | 4         |
| <b>6. Functional description</b>           | <b>5</b>  |
| <b>7. Limiting values</b>                  | <b>6</b>  |
| <b>8. Recommended operating conditions</b> | <b>7</b>  |
| <b>9. Static characteristics</b>           | <b>7</b>  |
| <b>10. Dynamic characteristics</b>         | <b>9</b>  |
| 10.1. Waveforms and test circuit           | 11        |
| <b>11. Application information</b>         | <b>14</b> |
| <b>12. Package outline</b>                 | <b>15</b> |
| <b>13. Abbreviations</b>                   | <b>18</b> |
| <b>14. Revision history</b>                | <b>18</b> |
| <b>15. Legal information</b>               | <b>19</b> |

© Nexperia B.V. 2018. All rights reserved

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

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

Date of release: 12 October 2018