

# 74HC85; 74HCT85

## 4-bit magnitude comparator

Rev. 5 — 2 April 2024

Product data sheet

## 1. General description

The 74HC85; 74HCT85 is a 4-bit magnitude comparator that can be expanded to almost any length. They perform comparison of two 4-bit binary, BCD or other monotonic codes and present the three possible magnitude results at the outputs ( $Q_{A>B}$ ,  $Q_{A=B}$  and  $Q_{A<B}$ ). The 4-bit inputs are weighted (A0 to A3 and B0 to B3), where A3 and B3 are the most significant bits. For proper compare operation the expander inputs ( $I_{A>B}$ ,  $I_{A=B}$  and  $I_{A<B}$ ) to the least significant position must be connected as follows:  $I_{A<B} = I_{A>B} = \text{LOW}$  and  $I_{A=B} = \text{HIGH}$ . For words greater than 4-bits, units can be cascaded by connecting outputs  $Q_{A>B}$ ,  $Q_{A=B}$  and  $Q_{A<B}$  to the corresponding inputs of the significant comparator. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

## 2. Features and benefits

- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Input levels:
  - For 74HC85: CMOS level
  - For 74HCT85: TTL level
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3. Applications

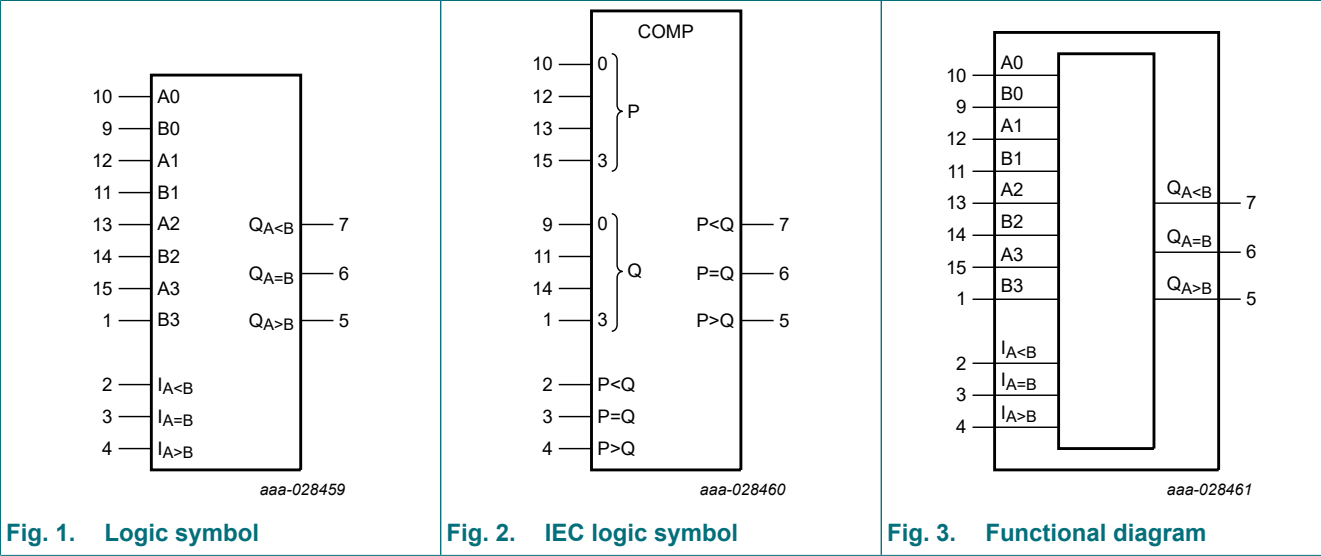
- Process controllers
- Servo-motor control

## 4. Ordering information

Table 1. Ordering information

| Type number               | Package           |         |                                                                           |                          |
|---------------------------|-------------------|---------|---------------------------------------------------------------------------|--------------------------|
|                           | Temperature range | Name    | Description                                                               | Version                  |
| <a href="#">74HC85D</a>   | -40 °C to +125 °C | SO16    | plastic small outline package; 16 leads;<br>body width 3.9 mm             | <a href="#">SOT109-1</a> |
| <a href="#">74HCT85D</a>  |                   |         |                                                                           |                          |
| <a href="#">74HC85PW</a>  | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads;<br>body width 4.4 mm | <a href="#">SOT403-1</a> |
| <a href="#">74HCT85PW</a> |                   |         |                                                                           |                          |

5. Functional diagram



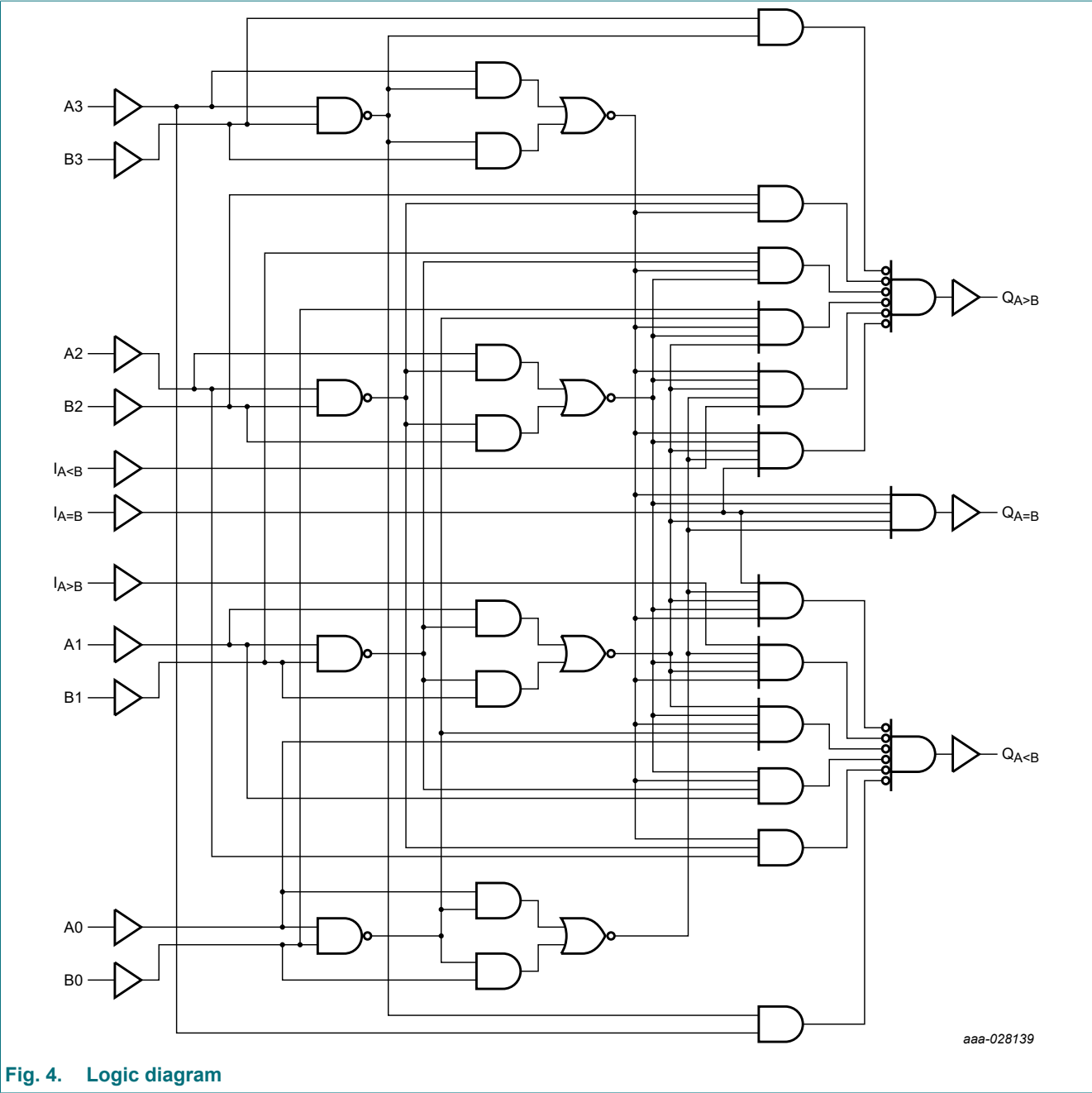


Fig. 4. Logic diagram

6. Pinning information

6.1. Pinning

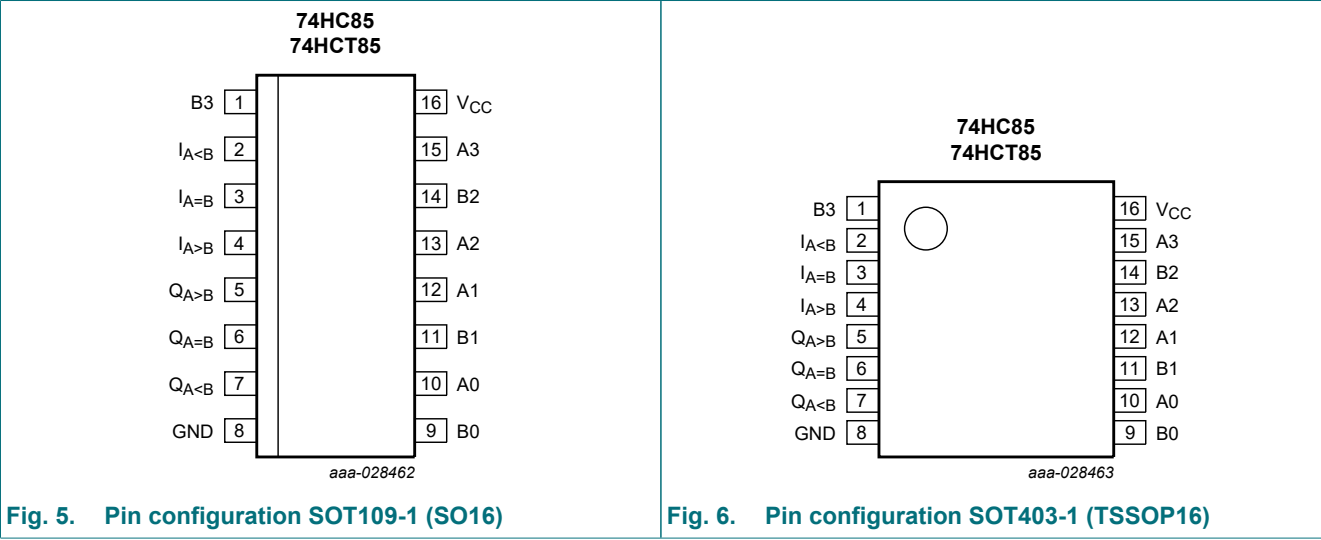


Fig. 5. Pin configuration SOT109-1 (SO16)

Fig. 6. Pin configuration SOT403-1 (TSSOP16)

6.2. Pin description

Table 2. Pin description

| Symbol              | Pin            | Description         |
|---------------------|----------------|---------------------|
| I <sub>A&lt;B</sub> | 2              | A<B expansion input |
| I <sub>A=B</sub>    | 3              | A=B expansion input |
| I <sub>A&gt;B</sub> | 4              | A>B expansion input |
| Q <sub>A&gt;B</sub> | 5              | A>B output          |
| Q <sub>A=B</sub>    | 6              | A=B output          |
| Q <sub>A&lt;B</sub> | 7              | A<B output          |
| A0, A1, A2, A3      | 10, 12, 13, 15 | word A inputs       |
| B0, B1, B2, B3      | 9, 11, 14, 1   | word B inputs       |
| GND                 | 8              | ground (0 V)        |
| V <sub>CC</sub>     | 16             | supply voltage      |

7. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

| Comparing inputs |         |         |         | Cascading inputs    |                     |                  | Outputs             |                     |                  |
|------------------|---------|---------|---------|---------------------|---------------------|------------------|---------------------|---------------------|------------------|
| A3, B3           | A2, B2  | A1, B1  | A0, B0  | I <sub>A&gt;B</sub> | I <sub>A&lt;B</sub> | I <sub>A=B</sub> | Q <sub>A&gt;B</sub> | Q <sub>A&lt;B</sub> | Q <sub>A=B</sub> |
| A3 > B3          | X       | X       | X       | X                   | X                   | X                | H                   | L                   | L                |
| A3 < B3          | X       | X       | X       | X                   | X                   | X                | L                   | H                   | L                |
| A3 = B3          | A2 > B2 | X       | X       | X                   | X                   | X                | H                   | L                   | L                |
| A3 = B3          | A2 < B2 | X       | X       | X                   | X                   | X                | L                   | H                   | L                |
| A3 = B3          | A2 = B2 | A1 > B1 | X       | X                   | X                   | X                | H                   | L                   | L                |
| A3 = B3          | A2 = B2 | A1 < B1 | X       | X                   | X                   | X                | L                   | H                   | L                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 > B0 | X                   | X                   | X                | H                   | L                   | L                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 < B0 | X                   | X                   | X                | L                   | H                   | L                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 = B0 | H                   | L                   | L                | H                   | L                   | L                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 = B0 | L                   | H                   | L                | L                   | H                   | L                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 = B0 | L                   | L                   | H                | L                   | L                   | H                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 = B0 | X                   | X                   | H                | L                   | L                   | H                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 = B0 | H                   | H                   | L                | L                   | L                   | L                |
| A3 = B3          | A2 = B2 | A1 = B1 | A0 = B0 | L                   | L                   | L                | H                   | H                   | L                |

8. Limiting values

Table 4. Limiting values

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

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

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
[2] For SOT109-1 (SO16) package: P<sub>tot</sub> derates linearly with 12.4 mW/K above 110 °C.  
For SOT403-1 (TSSOP16) package: P<sub>tot</sub> derates linearly with 8.5 mW/K above 91 °C.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

| Symbol           | Parameter                           | Conditions              | 74HC85 |      |                 | 74HCT85 |      |                 | 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    | -    | +125            | -40     | -    | +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 |

10. Static characteristics

Table 6. Static characteristics

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

| Symbol          | Parameter                 | Conditions                                                                             | 25 °C |      |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|-----------------|---------------------------|----------------------------------------------------------------------------------------|-------|------|------|------------------|------|-------------------|------|------|
|                 |                           |                                                                                        | Min   | Typ  | Max  | Min              | Max  | Min               | Max  |      |
| 74HC85          |                           |                                                                                        |       |      |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V                                                                | 1.5   | 1.2  | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                                | 3.15  | 2.4  | -    | 3.15             | -    | 3.15              | -    | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                                | 4.2   | 3.2  | -    | 4.2              | -    | 4.2               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V                                                                | -     | 0.8  | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 4.5 V                                                                | -     | 2.1  | 1.35 | -                | 1.35 | -                 | 1.35 | V    |
|                 |                           | V <sub>CC</sub> = 6.0 V                                                                | -     | 2.8  | 1.8  | -                | 1.8  | -                 | 1.8  | V    |
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                    |       |      |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V                                       | 1.9   | 2.0  | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V                                       | 4.4   | 4.5  | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V                                       | 5.9   | 6.0  | -    | 5.9              | -    | 5.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V                                      | 3.98  | 4.32 | -    | 3.84             | -    | 3.7               | -    | V    |
|                 |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V                                      | 5.48  | 5.81 | -    | 5.34             | -    | 5.2               | -    | V    |
| 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   | -                 | ±1   | 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   | -                 | 160  | μA   |
| C <sub>I</sub>  | input capacitance         |                                                                                        | -     | 3.5  | -    | -                | -    | -                 | -    | pF   |

| Symbol           | Parameter                 | Conditions                                                                                                                                              | 25 °C |      |      | -40 °C to +85 °C |      | -40 °C to +125 °C |     | Unit |
|------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------------------|------|-------------------|-----|------|
|                  |                           |                                                                                                                                                         | Min   | Typ  | Max  | Min              | Max  | Min               | Max |      |
| 74HCT85          |                           |                                                                                                                                                         |       |      |      |                  |      |                   |     |      |
| 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   | -                 | ±1  | 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   | -                 | 160 | 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 |       |      |      |                  |      |                   |     |      |
|                  |                           | I <sub>A&lt;B</sub> and I <sub>A&gt;B</sub> inputs                                                                                                      | -     | 100  | 360  | -                | 450  | -                 | 490 | µA   |
|                  |                           | A <sub>n</sub> , B <sub>n</sub> and I <sub>A=B</sub> inputs                                                                                             | -     | 150  | 540  | -                | 675  | -                 | 735 | µA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                                         | -     | 3.5  | -    | -                | -    | -                 | -   | pF   |

11. Dynamic characteristics

Table 7. Dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V);  
 $C_L = 50\text{ pF}$  unless otherwise specified; for test circuit, see Fig. 8

| Symbol          | Parameter                     | Conditions                                                                                                                                         | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |                                                                                                                                                    | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HC85          |                               |                                                                                                                                                    |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub> | propagation delay             | An, Bn to Q <sub>A&gt;B</sub> ; [1]                                                                                                                |       |     |     |                  |     |                   |     |      |
|                 |                               | An, Bn to Q <sub>A&lt;B</sub> ; see Fig. 7                                                                                                         |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                                                                                                                            | -     | 63  | 195 | -                | 245 | -                 | 295 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 23  | 39  | -                | 49  | -                 | 59  | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                                                                                                                            | -     | 18  | 33  | -                | 42  | -                 | 50  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | An, Bn to Q <sub>A=B</sub> ; see Fig. 7                                                                                                            |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                                                                                                                            | -     | 58  | 175 | -                | 220 | -                 | 265 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 21  | 35  | -                | 44  | -                 | 53  | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                                                                                                                            | -     | 17  | 30  | -                | 37  | -                 | 45  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 18  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | I <sub>A=B</sub> or I <sub>A&gt;B</sub> to Q <sub>A&lt;B</sub> ;<br>I <sub>A&lt;B</sub> or I <sub>A=B</sub> to Q <sub>A&gt;B</sub> ;<br>see Fig. 7 |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                                                                                                                            | -     | 50  | 140 | -                | 175 | -                 | 210 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 18  | 28  | -                | 35  | -                 | 42  | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                                                                                                                            | -     | 14  | 24  | -                | 30  | -                 | 36  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 15  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | I <sub>A=B</sub> to Q <sub>A=B</sub> ; see Fig. 7                                                                                                  |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 2.0 V                                                                                                                            | -     | 39  | 120 | -                | 150 | -                 | 180 | ns   |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 14  | 24  | -                | 30  | -                 | 36  | ns   |
|                 |                               | V <sub>CC</sub> = 6.0 V                                                                                                                            | -     | 11  | 20  | -                | 26  | -                 | 31  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 11  | -   | -                | -   | -                 | -   | ns   |
| t <sub>t</sub>  | transition time               | see Fig. 7 [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   |
| C <sub>PD</sub> | power dissipation capacitance | per package; V <sub>I</sub> = GND to V <sub>CC</sub> [3]                                                                                           | -     | 18  | -   | -                | -   | -                 | -   | pF   |



| Symbol          | Parameter                     | Conditions                                                                                                                                         | 25 °C |     |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                               |                                                                                                                                                    | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| 74HCT85         |                               |                                                                                                                                                    |       |     |     |                  |     |                   |     |      |
| t <sub>pd</sub> | propagation delay             | An, Bn to Q <sub>A&gt;B</sub> ; [1]<br>An, Bn to Q <sub>A&lt;B</sub> ; see Fig. 7                                                                  |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 26  | 44  | -                | 55  | -                 | 66  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 22  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | An, Bn to Q <sub>A=B</sub> ; see Fig. 7                                                                                                            |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 24  | 40  | -                | 50  | -                 | 60  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 20  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | I <sub>A=B</sub> or I <sub>A&gt;B</sub> to Q <sub>A&lt;B</sub> ;<br>I <sub>A&lt;B</sub> or I <sub>A=B</sub> to Q <sub>A&gt;B</sub> ;<br>see Fig. 7 |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 18  | 31  | -                | 39  | -                 | 47  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 15  | -   | -                | -   | -                 | -   | ns   |
|                 |                               | I <sub>A=B</sub> to Q <sub>A=B</sub> ; see Fig. 7                                                                                                  |       |     |     |                  |     |                   |     |      |
|                 |                               | V <sub>CC</sub> = 4.5 V                                                                                                                            | -     | 18  | 31  | -                | 39  | -                 | 47  | ns   |
|                 |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                                                                                                    | -     | 15  | -   | -                | -   | -                 | -   | ns   |
| t <sub>t</sub>  | transition time               | V <sub>CC</sub> = 4.5 V; see Fig. 7 [2]                                                                                                            | -     | 7   | 15  | -                | 19  | -                 | 22  | ns   |
| C <sub>PD</sub> | power dissipation capacitance | per package; [3]<br>V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V                                                                                | -     | 20  | -   | -                | -   | -                 | -   | 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<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> + Σ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) where:  
f<sub>i</sub> = input frequency in MHz;  
f<sub>o</sub> = output frequency in MHz;  
Σ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs;  
C<sub>L</sub> = output load capacitance in pF;  
V<sub>CC</sub> = supply voltage in V.

11.1. Waveforms and test circuit

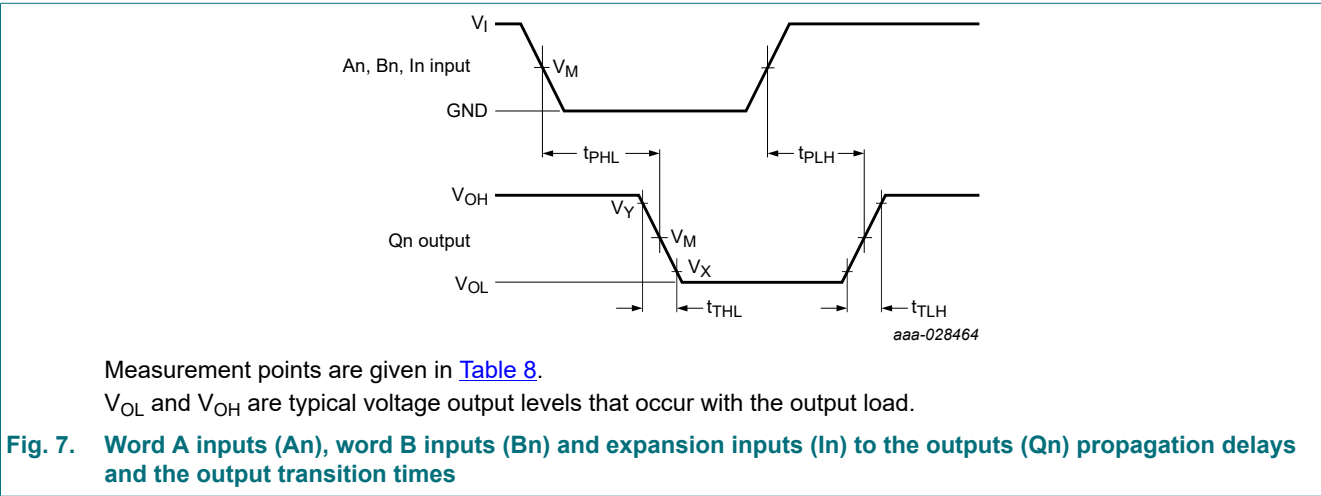


Table 8. Measurement points

| Type    | Input    |             | Output      |              |              |
|---------|----------|-------------|-------------|--------------|--------------|
|         | $V_I$    | $V_M$       | $V_M$       | $V_X$        | $V_Y$        |
| 74HC85  | $V_{CC}$ | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1 V_{CC}$ | $0.9 V_{CC}$ |
| 74HCT85 | 3 V      | 1.3 V       | 1.3 V       | $0.1 V_{CC}$ | $0.9 V_{CC}$ |

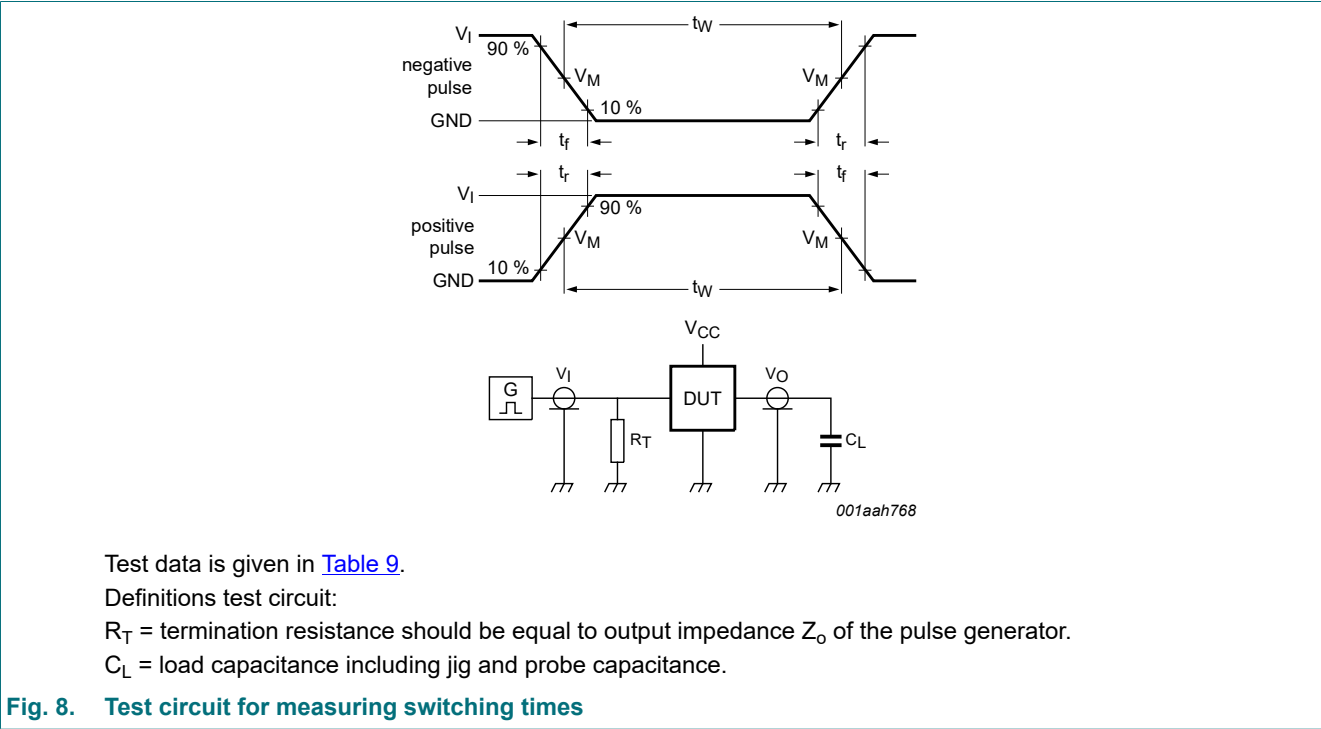


Table 9. Test data

| Type    | Input    |            | Load         | Test               |
|---------|----------|------------|--------------|--------------------|
|         | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC85  | $V_{CC}$ | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74HCT85 | 3.0 V    | 6.0 ns     | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

12. Application information

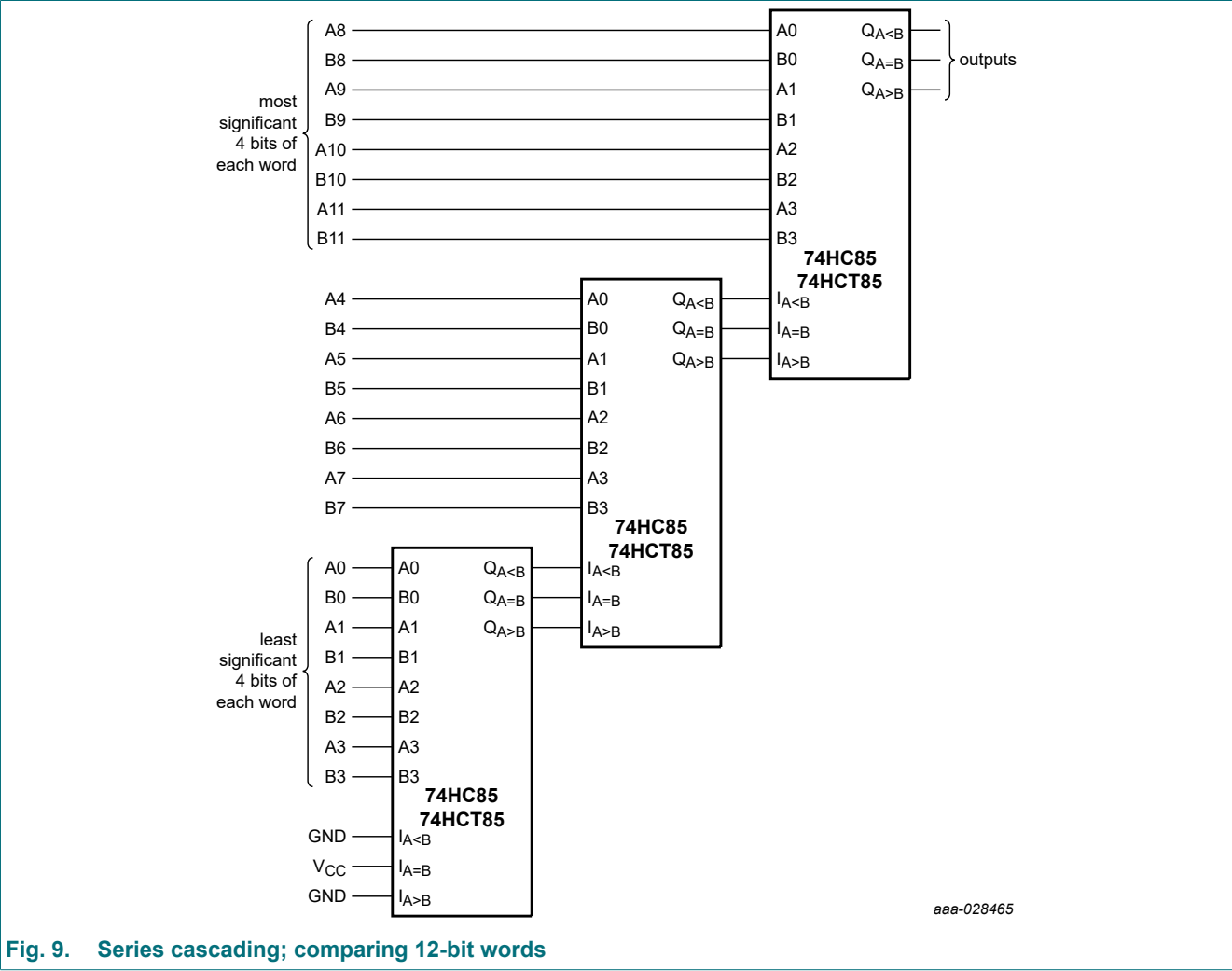


Fig. 9. Series cascading; comparing 12-bit words

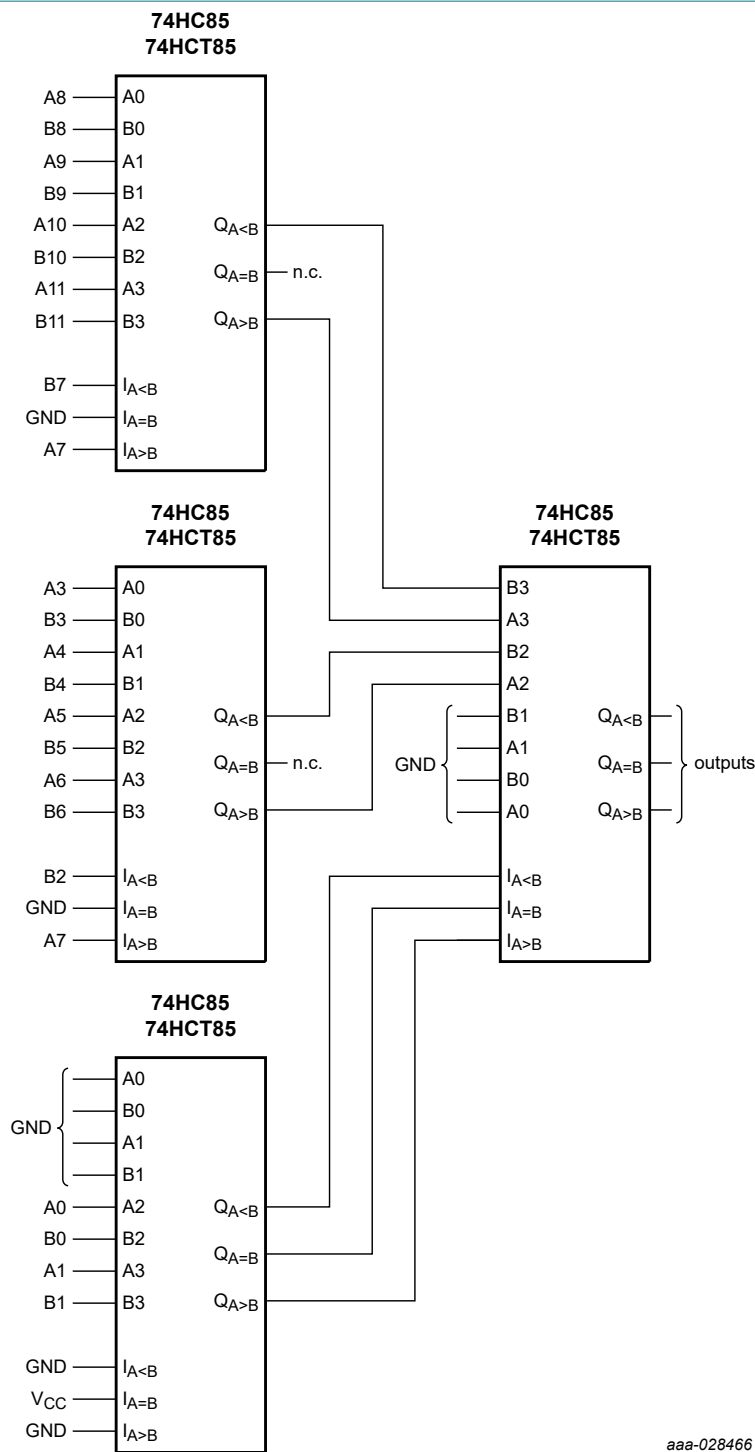


Fig. 10. Parallel cascading; comparing 12-bit words

13. Package outline

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

SOT109-1

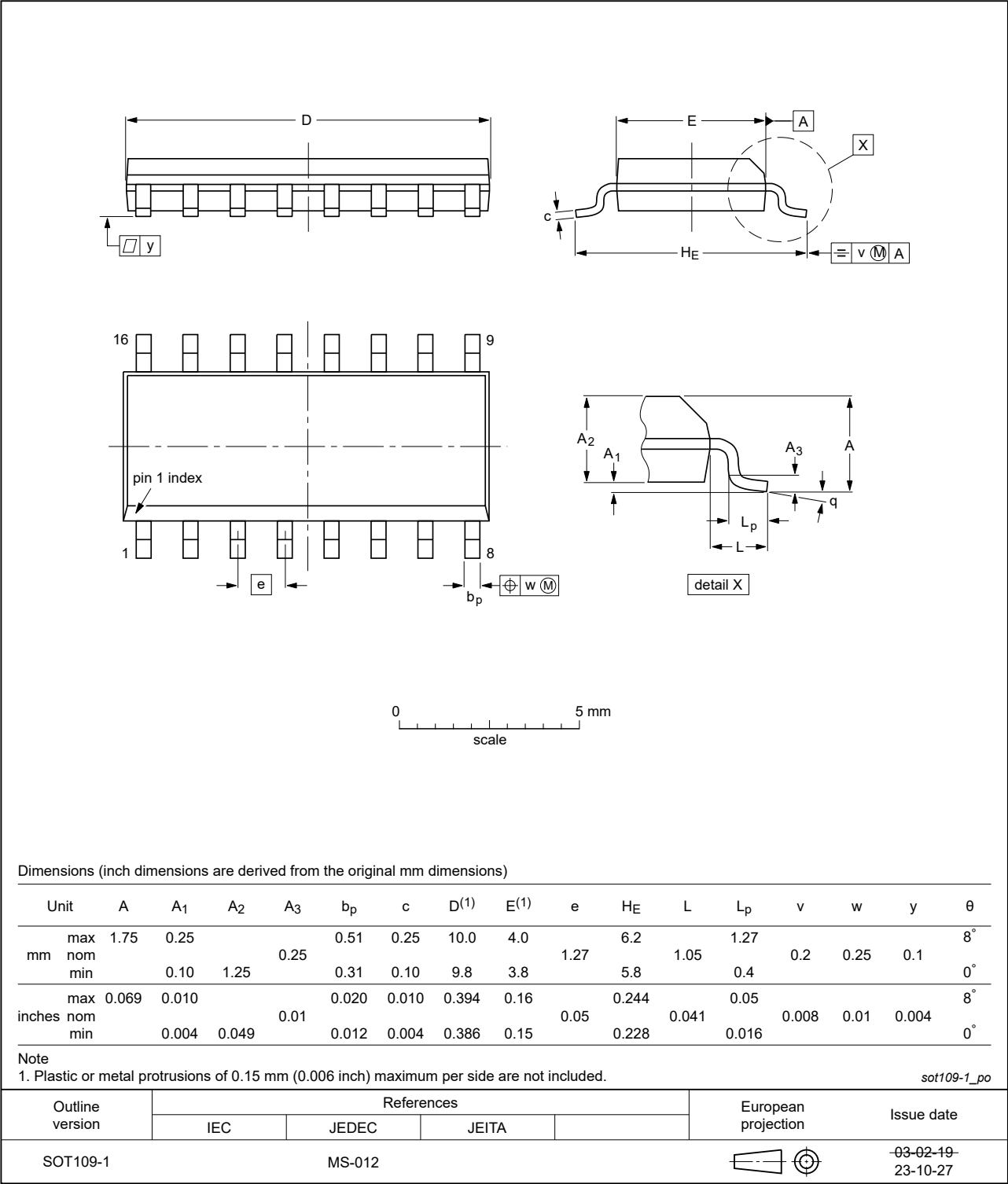


Fig. 11. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm SOT403-1

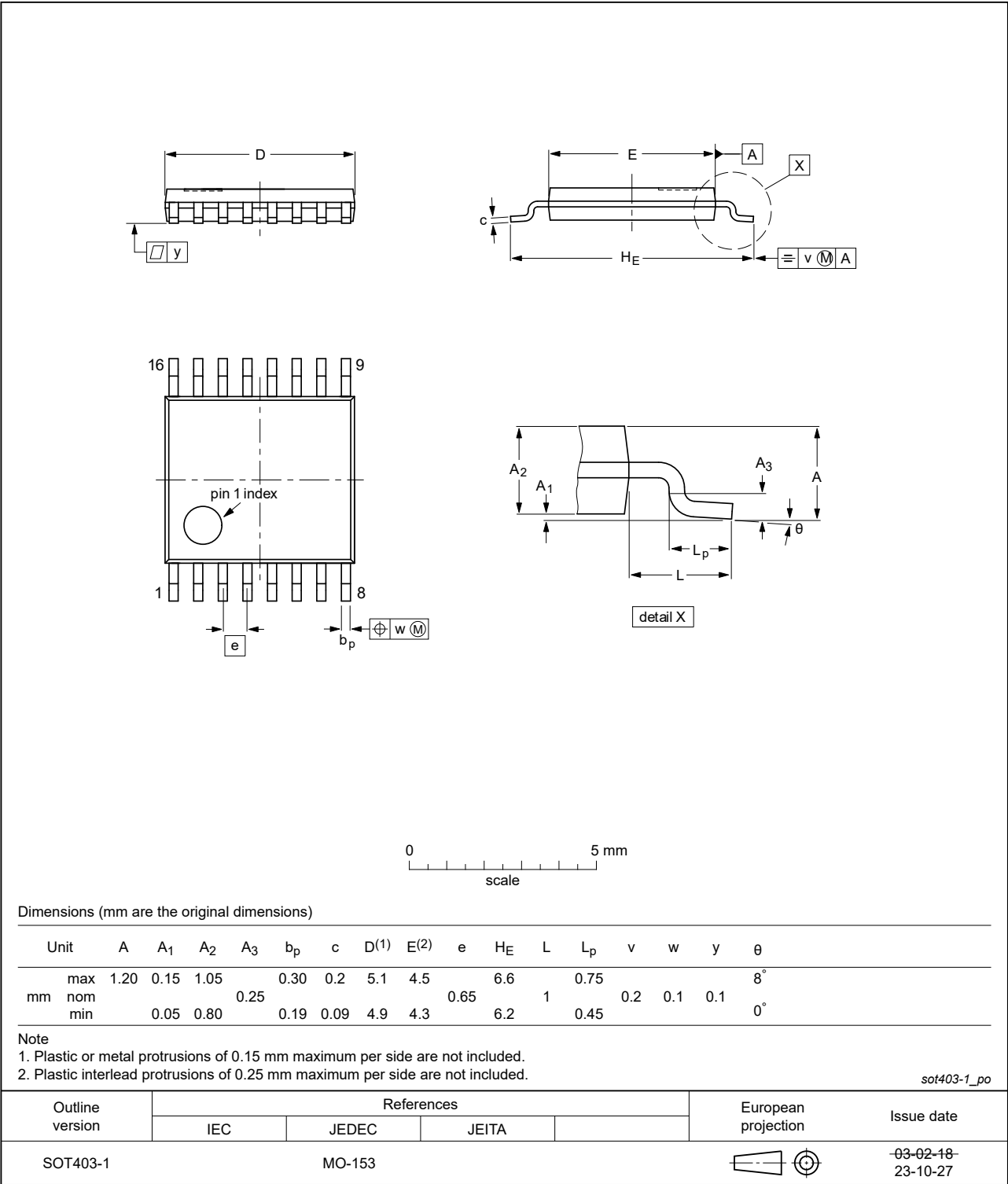


Fig. 12. Package outline SOT403-1 (TSSOP16)

14. Abbreviations

Table 10. Abbreviations

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

15. Revision history

Table 11. Revision history

| Document ID    | Release date                                                                                                                                                                                                                                                                         | Data sheet status     | Change notice | Supersedes     |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|----------------|
| 74HC_HCT85 v.5 | 20240402                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC_HCT85 v.4 |
| Modifications: | <ul style="list-style-type: none"><li>• <a href="#">Fig. 11</a>, <a href="#">Fig. 12</a>: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153.</li><li>• <a href="#">Section 2</a>: ESD specification updated according to the latest JEDEC standard.</li></ul> |                       |               |                |
| 74HC_HCT85 v.4 | 20210804                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC_HCT85 v.3 |
| Modifications: | <ul style="list-style-type: none"><li>• Type number 74HCT85PW (SOT403-1/TSSOP16) added.</li><li>• Type numbers 74HC85DB and 74HCT85DB (SOT338-1/SSOP16) removed.</li><li>• <a href="#">Section 8</a>: Derating values for P<sub>tot</sub> total power dissipation updated.</li></ul> |                       |               |                |
| 74HC_HCT85 v.3 | 20180420                                                                                                                                                                                                                                                                             | Product data sheet    | -             | 74HC_HCT85 v.2 |
| Modifications: | <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li></ul>                                           |                       |               |                |
| 74HC_HCT85 v.2 | 19901201                                                                                                                                                                                                                                                                             | Product specification | -             | 74HC_HCT85 v.1 |
| 74HC_HCT85 v.1 | 19901201                                                                                                                                                                                                                                                                             | Product specification | -             | -              |

## 16. 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".
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