



# 74HC109; 74HCT109

Dual JK flip-flop with set and reset; positive-edge-trigger

Rev. 6 — 21 February 2024

Product data sheet

## 1. General description

The 74HC109; 74HCT109 is a dual positive edge triggered  $\overline{JK}$  flip-flop featuring individual J and  $\overline{K}$  inputs, clock (CP) inputs, set ( $\overline{SD}$ ) and reset ( $\overline{RD}$ ) inputs and complementary Q and  $\overline{Q}$  outputs. The set and reset are asynchronous active LOW inputs and operate independently of the clock input. The J and  $\overline{K}$  inputs control the state changes of the flip-flops as described in the mode select function table. The J and  $\overline{K}$  inputs must be stable one set-up time prior to the LOW-to-HIGH clock transition for predictable operation. The  $\overline{JK}$  design allows operation as a D-type flip-flop by connecting the J and  $\overline{K}$  inputs together. This device features reduced input threshold levels to allow interfacing to TTL logic levels. Inputs also include clamp diodes, this enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

## 2. Features and benefits

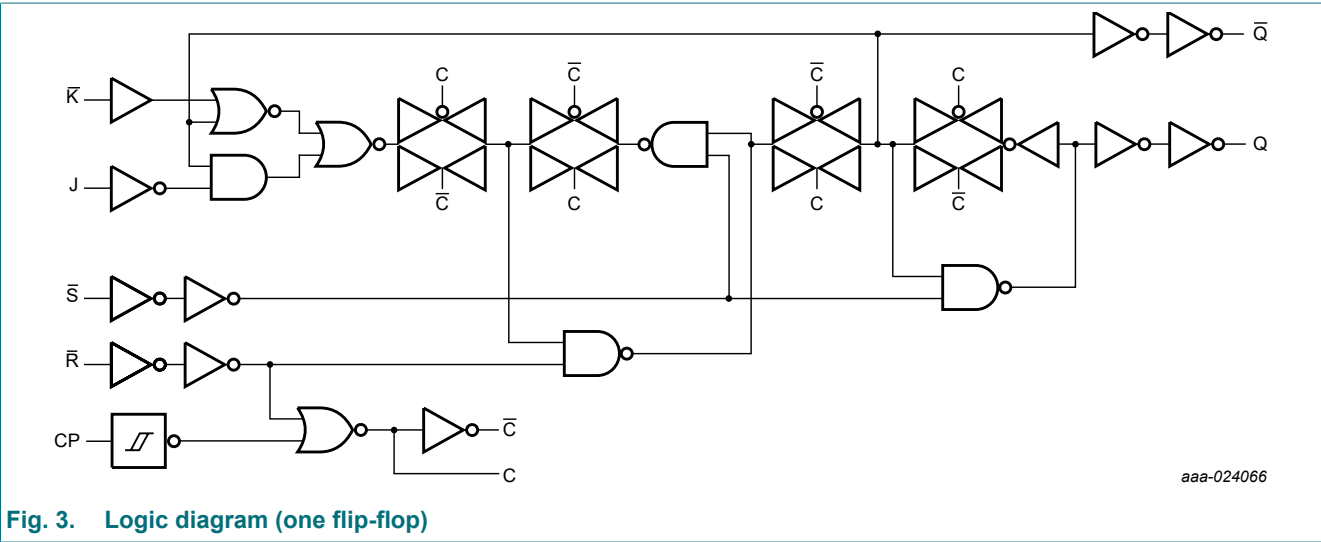
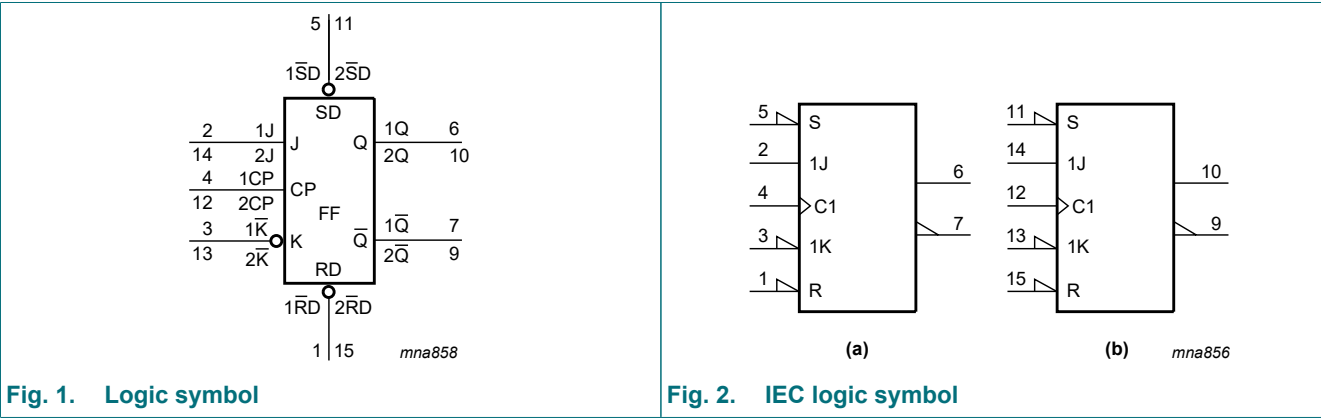
- J and  $\overline{K}$  inputs for easy D-type flip-flop
- Toggle flip-flop or "do nothing" mode
- Wide supply voltage range:
  - For 74HC109: from 2.0 V to 6.0 V
  - For 74HCT109: from 4.5 V to 5.5 V
- CMOS low power dissipation
- High noise immunity
- Input levels:
  - For 74HC109: CMOS level
  - For 74HCT109: TTL level
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- 74HC109 complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- 74HCT109 complies with JEDEC standard 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. Ordering information

Table 1. Ordering information

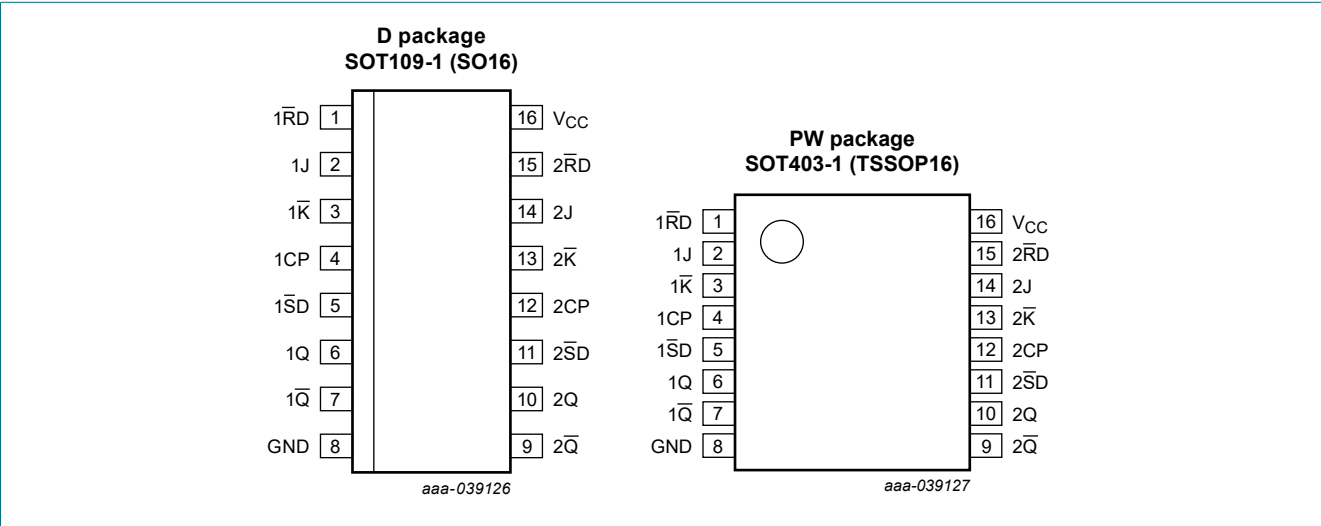
| Type number                                             | Package           |         |                                                                           |                          |
|---------------------------------------------------------|-------------------|---------|---------------------------------------------------------------------------|--------------------------|
|                                                         | Temperature range | Name    | Description                                                               | Version                  |
| <a href="#">74HC109D</a><br><a href="#">74HCT109D</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="#">74HC109PW</a><br><a href="#">74HCT109PW</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> |

4. Functional diagram



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol          | Pin   | Description                               |
|-----------------|-------|-------------------------------------------|
| 1RD, 2RD        | 1, 15 | asynchronous reset input (active LOW)     |
| 1J, 2J          | 2, 14 | synchronous input                         |
| 1K, 2K          | 3, 13 | synchronous input                         |
| 1CP, 2CP        | 4, 12 | clock input (LOW-to-HIGH; edge-triggered) |
| 1SD, 2SD        | 5, 11 | asynchronous set input (active LOW)       |
| 1Q, 2Q          | 6, 10 | true flip-flop output                     |
| 1Q̄, 2Q̄        | 7, 9  | complement flip-flop output               |
| GND             | 8     | ground (0 V)                              |
| V <sub>CC</sub> | 16    | supply voltage                            |

6. Functional description

Table 3. Function selection

*H = HIGH voltage level; h = HIGH voltage level one set-up time before the LOW-to-HIGH CP transition;  
L = LOW voltage level; l = LOW voltage level one set-up time before the LOW-to-HIGH CP transition;  
q = lower case letters indicate the state of the referenced output one set-up time before the LOW-to-HIGH CP transition;  
X = don't care; ↑ = LOW-to-HIGH CP transition*

| Operating modes    | Input |     |     |    |    | Output |     |
|--------------------|-------|-----|-----|----|----|--------|-----|
|                    | nSD   | nRD | nCP | nJ | nK | nQ     | nQ̄ |
| Asynchronous set   | L     | H   | X   | X  | X  | H      | L   |
| Asynchronous reset | H     | L   | X   | X  | X  | L      | H   |
| Undetermined       | L     | L   | X   | X  | X  | H      | H   |
| Toggle             | H     | H   | ↑   | h  | l  | q̄     | q   |
| Load 0 (reset)     | H     | H   | ↑   | l  | l  | L      | H   |
| Load 1 (set)       | H     | H   | ↑   | h  | h  | H      | L   |
| Hold no change     | H     | H   | ↑   | l  | h  | q      | q̄  |

7. Limiting values

Table 4. Limiting values

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

| Symbol           | Parameter               | Conditions                                                          | Min  | Max  | Unit |
|------------------|-------------------------|---------------------------------------------------------------------|------|------|------|
| V <sub>CC</sub>  | supply voltage          |                                                                     | -0.5 | +7   | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V | -    | ±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 | -    | ±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 | [1]                                                                 | -    | 500  | mW   |

[1] 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.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

| Symbol           | Parameter                           | Conditions              | 74HC109 |      |                 | 74HCT109 |      |                 | 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  |      |
| 74HC109         |                           |                                                                                        |       |      |      |                  |      |                   |      |      |
| 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 | -     | -    | 4.0  | -                | 40   | -                 | 80   | μA   |
| C <sub>I</sub>  | input capacitance         |                                                                                        | -     | 3.5  | -    | -                | -    | -                 | -    | pF   |

Dual JK flip-flop with set and reset; positive-edge-trigger

| Symbol           | Parameter                 | Conditions                                                                                                                        | 25 °C |      |      | -40 °C to +85 °C |       | -40 °C to +125 °C |       | Unit |
|------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------------------|-------|-------------------|-------|------|
|                  |                           |                                                                                                                                   | Min   | Typ  | Max  | Min              | Max   | Min               | Max   |      |
| 74HCT109         |                           |                                                                                                                                   |       |      |      |                  |       |                   |       |      |
| 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; V <sub>CC</sub> = 4.5 V                                                                                   | -     | 0    | 0.1  | -                | 0.1   | -                 | 0.1   | V    |
|                  |                           | I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 5.5 V                                                                                  | -     | 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                                            | -     | -    | 4.0  | -                | 40    | -                 | 80    | 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 |       |      |      |                  |       |                   |       |      |
|                  |                           | nJ, nK̄, nSD, nRD and nCP inputs                                                                                                  | -     | 35   | 126  | -                | 157.5 | -                 | 171.5 | 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<sub>L</sub> = 50 pF unless otherwise specified; for test circuit, see Fig. 6.

| Symbol           | Parameter                     | Conditions                                    | 25 °C |        |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|-----------------------------------------------|-------|--------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                               | Min   | Typ[1] | Max | Min              | Max | Min               | Max |      |
| 74HC109          |                               |                                               |       |        |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | nCP to nQ, nQ̄; see Fig. 4 [2]                |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                       | -     | 50     | 175 | -                | 220 | -                 | 265 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                       | -     | 18     | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF | -     | 15     | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                       | -     | 14     | 30  | -                | 37  | -                 | 45  | ns   |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | nSD to nQ, see Fig. 5                         |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                       | -     | 30     | 120 | -                | 150 | -                 | 180 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                       | -     | 11     | 24  | -                | 30  | -                 | 36  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF | -     | 12     | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                       | -     | 9      | 20  | -                | 26  | -                 | 31  | ns   |

Dual JK flip-flop with set and reset; positive-edge-trigger

| Symbol           | Parameter                     | Conditions                                                                  | 25 °C |        |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|-----------------------------------------------------------------------------|-------|--------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                             | Min   | Typ[1] | Max | Min              | Max | Min               | Max |      |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | n $\overline{\text{SD}}$ to n $\overline{\text{Q}}$ ; see Fig. 5            |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                     | -     | 41     | 155 | -                | 195 | -                 | 235 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                     | -     | 15     | 31  | -                | 39  | -                 | 47  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                               | -     | 12     | -   | -                | -   | -                 | -   | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | V <sub>CC</sub> = 6.0 V                                                     | -     | 12     | 26  | -                | 33  | -                 | 40  | ns   |
|                  |                               | n $\overline{\text{RD}}$ to n $\overline{\text{Q}}$ ; see Fig. 5            |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                     | -     | 41     | 185 | -                | 230 | -                 | 280 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                     | -     | 15     | 37  | -                | 46  | -                 | 56  | ns   |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                               | -     | 12     | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                     | -     | 12     | 31  | -                | 39  | -                 | 48  | ns   |
|                  |                               | n $\overline{\text{RD}}$ to n $\overline{\text{Q}}$ ; see Fig. 5            |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                     | -     | 39     | 170 | -                | 215 | -                 | 255 | ns   |
| t <sub>t</sub>   | transition time               | V <sub>CC</sub> = 4.5 V                                                     | -     | 14     | 34  | -                | 43  | -                 | 51  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                               | -     | 12     | -   | -                | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                     | -     | 11     | 29  | -                | 37  | -                 | 43  | ns   |
|                  |                               | nQ, n $\overline{\text{Q}}$ ; see Fig. 4 [3]                                |       |        |     |                  |     |                   |     |      |
| t <sub>w</sub>   | pulse width                   | 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   |
|                  |                               | nCP HIGH or LOW; see Fig. 4                                                 |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                     | 80    | 19     | -   | 100              | -   | 120               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                     | 16    | 7      | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                     | 14    | 6      | -   | 17               | -   | 20                | -   | ns   |
|                  |                               | n $\overline{\text{SD}}$ , n $\overline{\text{RD}}$ HIGH or LOW; see Fig. 5 |       |        |     |                  |     |                   |     |      |
| t <sub>rec</sub> | recovery time                 | V <sub>CC</sub> = 2.0 V                                                     | 80    | 14     | -   | 100              | -   | 120               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                     | 16    | 5      | -   | 20               | -   | 24                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                     | 14    | 4      | -   | 17               | -   | 20                | -   | ns   |
|                  |                               | n $\overline{\text{SD}}$ , n $\overline{\text{RD}}$ to nCP; see Fig. 5      |       |        |     |                  |     |                   |     |      |
| t <sub>rec</sub> | recovery time                 | V <sub>CC</sub> = 2.0 V                                                     | 70    | 19     | -   | 90               | -   | 105               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                     | 14    | 7      | -   | 18               | -   | 21                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                     | 12    | 6      | -   | 15               | -   | 18                | -   | ns   |
|                  |                               |                                                                             |       |        |     |                  |     |                   |     |      |

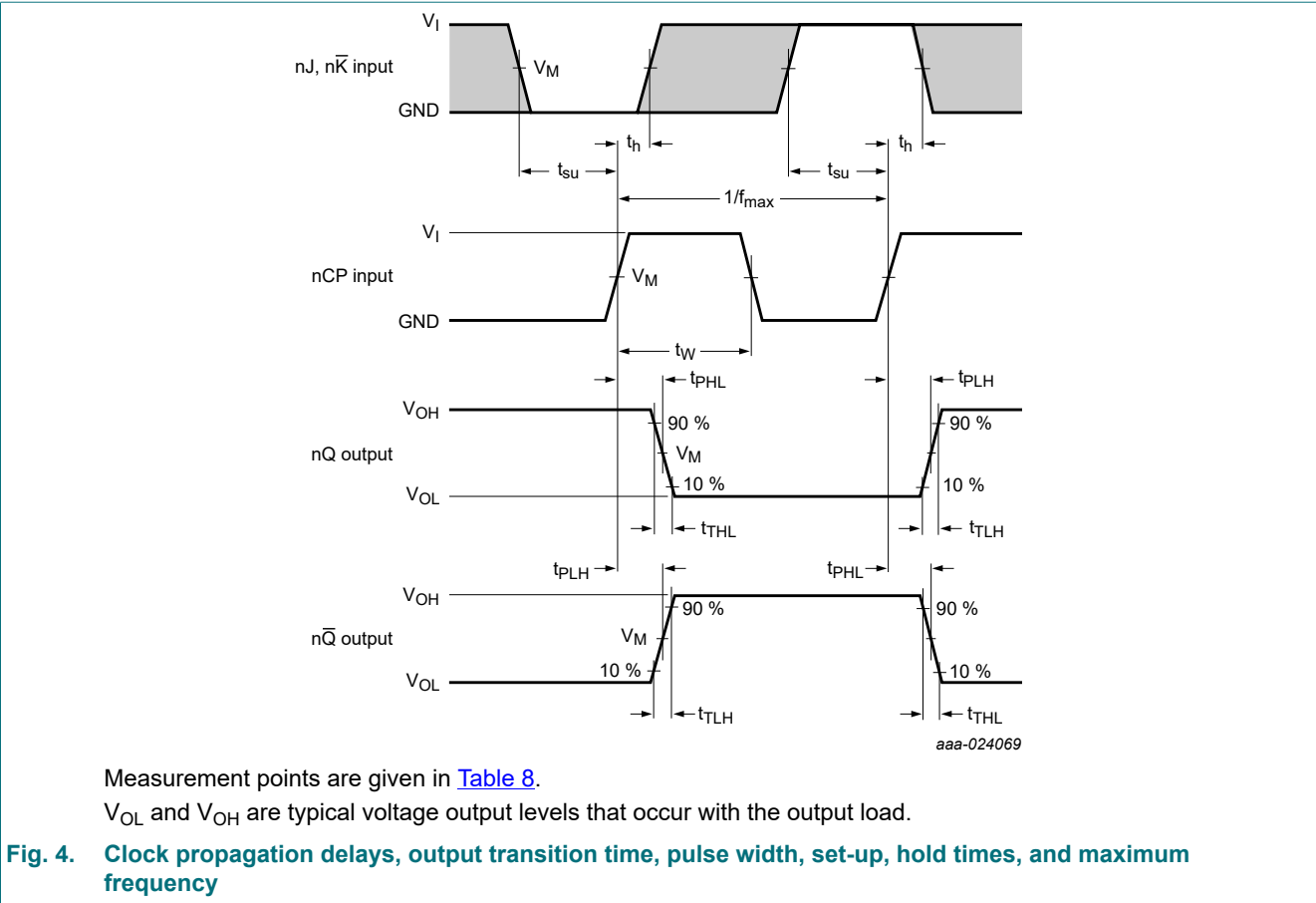
Dual JK flip-flop with set and reset; positive-edge-trigger

| Symbol           | Parameter                     | Conditions                                                                     | 25 °C |        |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|--------------------------------------------------------------------------------|-------|--------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                                | Min   | Typ[1] | Max | Min              | Max | Min               | Max |      |
| t <sub>su</sub>  | set-up time                   | nJ and nK̄ to nCP; see Fig. 4                                                  |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                        | 70    | 17     | -   | 90               | -   | 105               | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | 14    | 6      | -   | 18               | -   | 21                | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                        | 12    | 5      | -   | 15               | -   | 18                | -   | ns   |
| t <sub>h</sub>   | hold time                     | nJ and nK̄ to nCP; see Fig. 4                                                  |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                        | 5     | 0      | -   | 5                | -   | 5                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | 5     | 0      | -   | 5                | -   | 5                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                        | 5     | 0      | -   | 5                | -   | 5                 | -   | ns   |
| f <sub>max</sub> | maximum frequency             | nCP; see Fig. 4                                                                |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                                                        | 6     | 22     | -   | 5                | -   | 4                 | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | 30    | 68     | -   | 24               | -   | 20                | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                  | -     | 75     | -   | -                | -   | -                 | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 6.0 V                                                        | 35    | 81     | -   | 28               | -   | 24                | -   | MHz  |
| C <sub>PD</sub>  | power dissipation capacitance | C <sub>L</sub> = 50 pF; f = 1 MHz; V <sub>I</sub> = GND to V <sub>CC</sub> [4] | -     | 20     | -   | -                | -   | -                 | -   | pF   |
| 74HCT109         |                               |                                                                                |       |        |     |                  |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | nCP to nQ, nQ̄; see Fig. 4 [2]                                                 |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | -     | 20     | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                  | -     | 17     | -   | -                | -   | -                 | -   | ns   |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | nSD to nQ, see Fig. 5                                                          |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | -     | 13     | 26  | -                | 33  | -                 | 39  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                  | -     | 14     | -   | -                | -   | -                 | -   | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | nSD to nQ̄; see Fig. 5                                                         |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | -     | 19     | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                  | -     | 14     | -   | -                | -   | -                 | -   | ns   |
| t <sub>PHL</sub> | HIGH to LOW propagation delay | nRD to nQ; see Fig. 5                                                          |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | -     | 19     | 35  | -                | 44  | -                 | 53  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                  | -     | 15     | -   | -                | -   | -                 | -   | ns   |
| t <sub>PLH</sub> | LOW to HIGH propagation delay | nRD to nQ̄; see Fig. 5                                                         |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                        | -     | 16     | 32  | -                | 40  | -                 | 48  | ns   |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                  | -     | 15     | -   | -                | -   | -                 | -   | ns   |
| t <sub>t</sub>   | transition time               | nQ, nQ̄; V <sub>CC</sub> = 4.5 V; see Fig. 4 [3]                               | -     | 7      | 15  | -                | 19  | -                 | 22  | ns   |
| t <sub>w</sub>   | pulse width                   | nCP HIGH or LOW; V <sub>CC</sub> = 4.5 V; see Fig. 4                           | 18    | 9      | -   | 23               | -   | 27                | -   | ns   |
|                  |                               | nSD, nRD HIGH or LOW; V <sub>CC</sub> = 4.5 V; see Fig. 5                      | 16    | 8      | -   | 20               | -   | 24                | -   | ns   |
| t <sub>rec</sub> | recovery time                 | nSD, nRD to nCP; V <sub>CC</sub> = 4.5 V; see Fig. 5                           | 16    | 8      | -   | 20               | -   | 24                | -   | ns   |

| Symbol           | Parameter                     | Conditions                                                                                | 25 °C |        |     | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|-------------------------------------------------------------------------------------------|-------|--------|-----|------------------|-----|-------------------|-----|------|
|                  |                               |                                                                                           | Min   | Typ[1] | Max | Min              | Max | Min               | Max |      |
| t <sub>su</sub>  | set-up time                   | nJ and nK̄ to nCP;<br>V <sub>CC</sub> = 4.5 V; see Fig. 4                                 | 18    | 8      | -   | 23               | -   | 27                | -   | ns   |
| t <sub>h</sub>   | hold time                     | nJ and nK̄ to nCP;<br>V <sub>CC</sub> = 4.5 V; see Fig. 4                                 | 3     | -3     | -   | 3                | -   | 3                 | -   | ns   |
| f <sub>max</sub> | maximum frequency             | nCP; see Fig. 4                                                                           |       |        |     |                  |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                                                                   | 27    | 55     | -   | 22               | -   | 18                | -   | MHz  |
|                  |                               | V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF                                             | -     | 61     | -   | -                | -   | -                 | -   | MHz  |
| C <sub>PD</sub>  | power dissipation capacitance | C <sub>L</sub> = 50 pF; f = 1 MHz;<br>V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [4] | -     | 22     | -   | -                | -   | -                 | -   | pF   |

- [1] All typical values are measured at T<sub>amb</sub> = 25 °C.
- [2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.
- [3] t<sub>i</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.
- [4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  where:  
f<sub>i</sub> = input frequency in MHz;  
f<sub>o</sub> = output frequency in MHz;  
C<sub>L</sub> = output load capacitance in pF;  
V<sub>CC</sub> = supply voltage in V;  
N = number of inputs switching;  
Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

10.1. Waveforms and test circuit



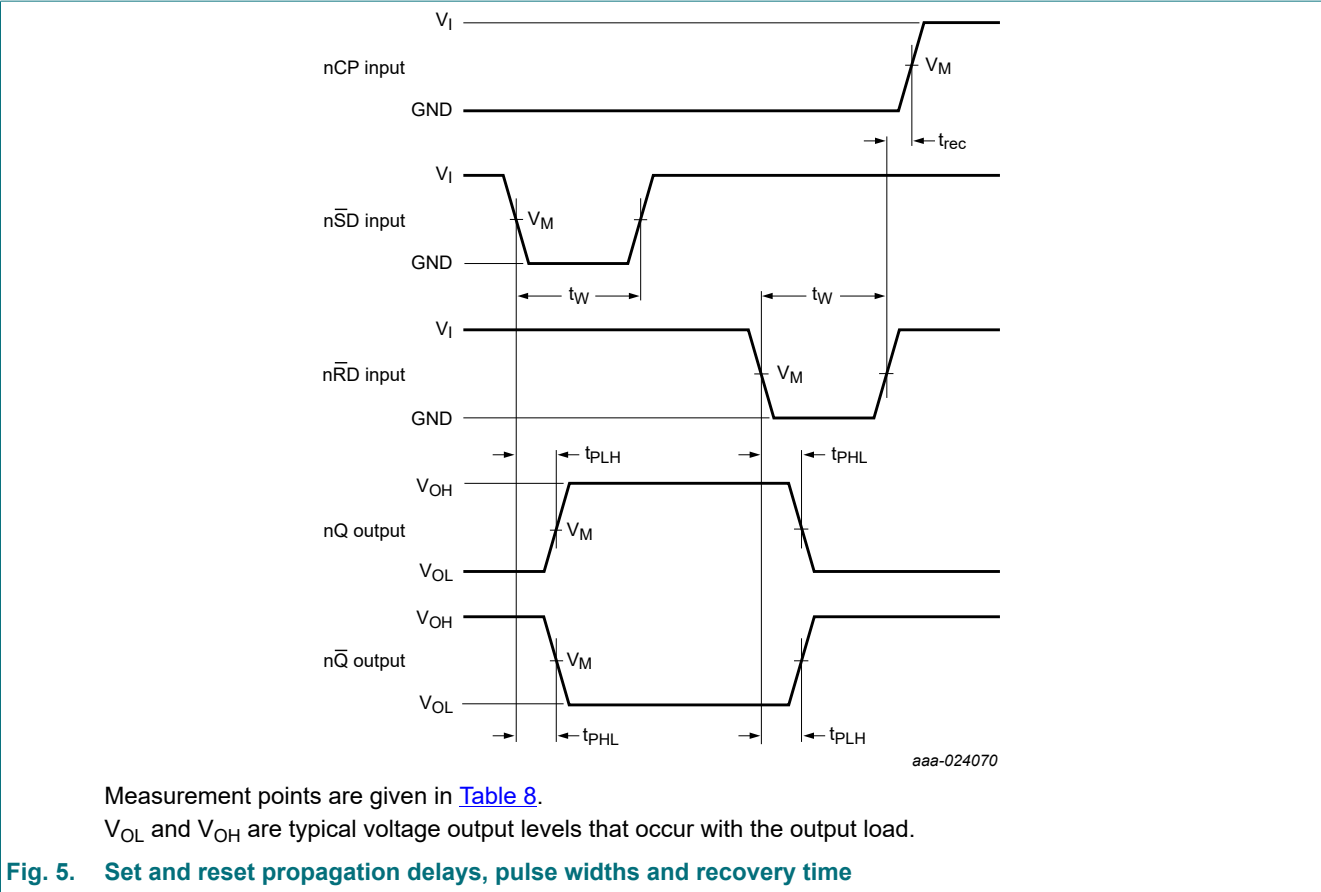
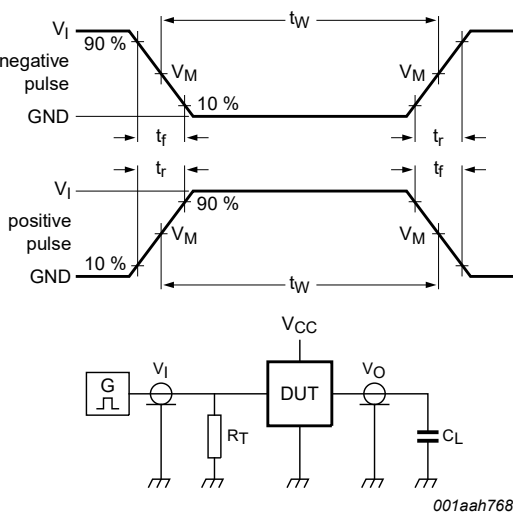


Table 8. Measurement points

| Type     | Input               | Output              |
|----------|---------------------|---------------------|
|          | $V_M$               | $V_M$               |
| 74HC109  | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT109 | 1.3 V               | 1.3 V               |



Test data is given in [Table 9](#).  
Definitions test circuit:  
 $R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator;  
 $C_L$  = Load capacitance including jig and probe capacitance;  
 $R_L$  = Load resistance.

Fig. 6. Test circuit for measuring switching times

Table 9. Test data

| Type     | Input    |            | Load         | Test               |
|----------|----------|------------|--------------|--------------------|
|          | $V_I$    | $t_r, t_f$ | $C_L$        |                    |
| 74HC109  | $V_{CC}$ | 6 ns       | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74HCT109 | 3 V      | 6 ns       | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

11. Package outline

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

SOT109-1

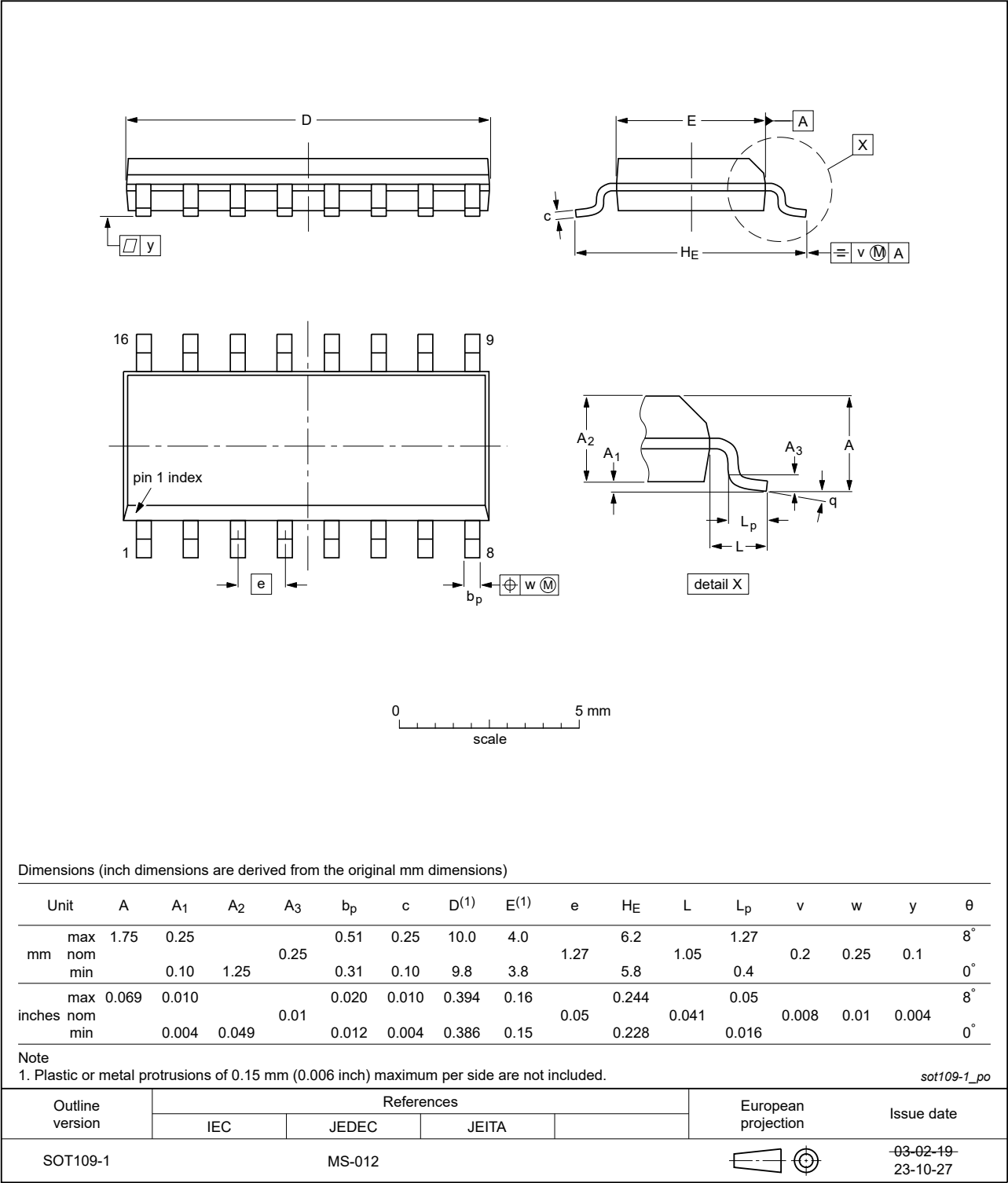


Fig. 7. Package outline SOT109-1 (SO16)

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

SOT403-1

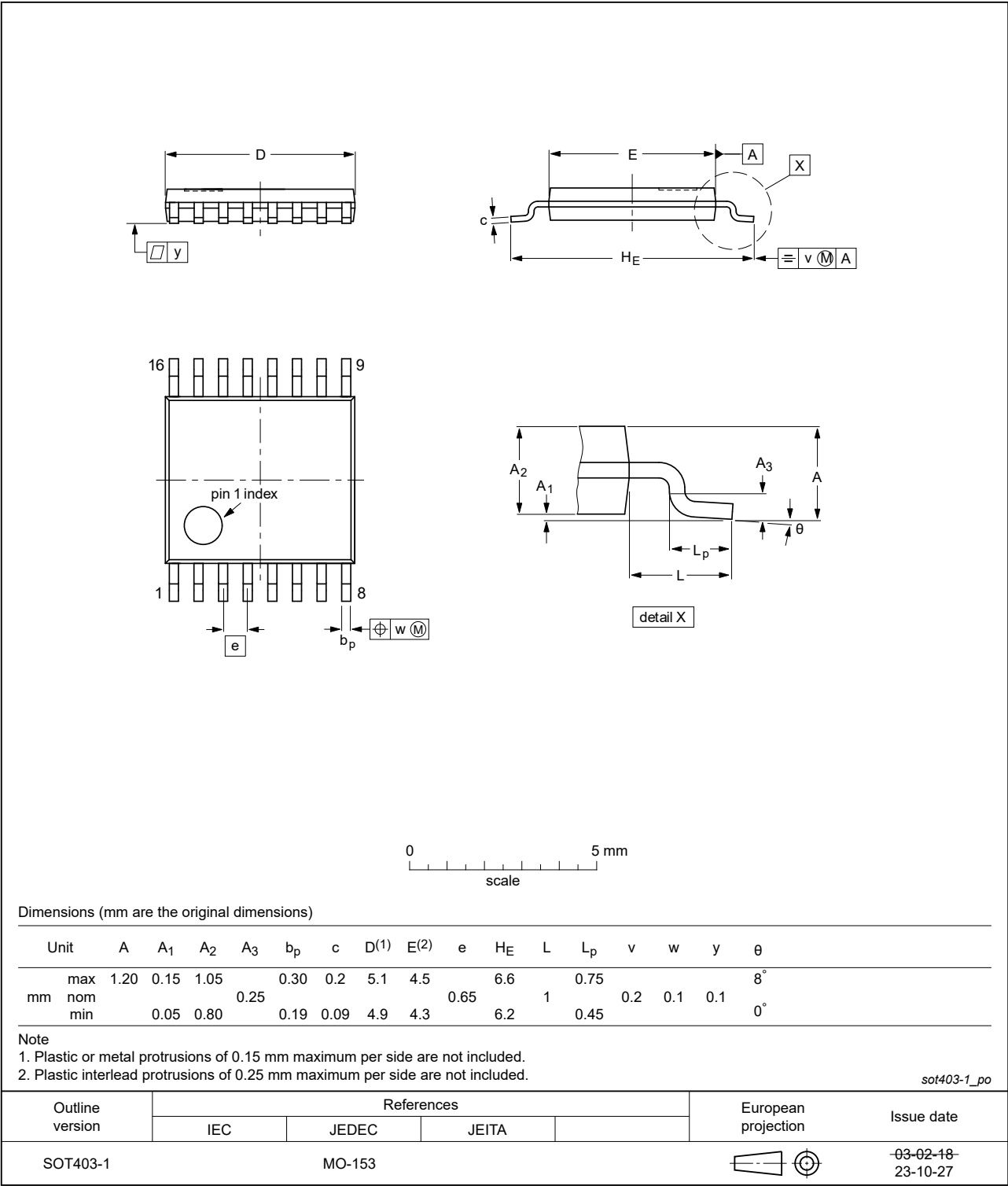


Fig. 8. Package outline SOT403-1 (TSSOP16)

12. 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             |

13. Revision history

Table 11. Revision history

| Document ID         | Release date                                                                                                                                                                                                                                                                                                                 | Data sheet status     | Change notice | Supersedes          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|---------------------|
| 74HC_HCT109 v.6     | 20240221                                                                                                                                                                                                                                                                                                                     | Product data sheet    | -             | 74HC_HCT109 v.5     |
| Modifications:      | <ul style="list-style-type: none"><li>Section 2: ESD specification updated according to the latest JEDEC standard.</li><li>Fig. 7, Fig. 8: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153</li></ul>                                                                                                |                       |               |                     |
| 74HC_HCT109 v.5     | 20210805                                                                                                                                                                                                                                                                                                                     | Product data sheet    | -             | 74HC_HCT109 v.4     |
| Modifications:      | <ul style="list-style-type: none"><li>Type number 74HC109PW (SOT403-1/TSSOP16) added.</li><li>Type numbers 74HC109DB and 74HCT109DB (SOT338-1/SSOP16) removed.</li><li>Section 1 and Section 2 updated.</li></ul>                                                                                                            |                       |               |                     |
| 74HC_HCT109 v.4     | 20200401                                                                                                                                                                                                                                                                                                                     | Product data sheet    | -             | 74HC_HCT109 v.3     |
| 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>Table 4: Derating values for P<sub>tot</sub> total power dissipation updated.</li></ul> |                       |               |                     |
| 74HC_HCT109 v.3     | 20160801                                                                                                                                                                                                                                                                                                                     | Product data sheet    | -             | 74HC_HCT109_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_HCT109_CNV v.2 | 19971125                                                                                                                                                                                                                                                                                                                     | Product specification | -             | -                   |

14. 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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Contents

1. General description..... 1

2. Features and benefits..... 1

3. Ordering information..... 1

4. Functional diagram..... 2

5. Pinning information..... 2

5.1. Pinning..... 2

5.2. Pin description..... 3

6. Functional description..... 3

7. Limiting values..... 3

8. Recommended operating conditions..... 4

9. Static characteristics..... 4

10. Dynamic characteristics..... 5

10.1. Waveforms and test circuit..... 8

11. Package outline..... 11

12. Abbreviations..... 13

13. Revision history..... 13

14. Legal information..... 14

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