

74HC423

Dual retriggerable monostable multivibrator with reset

Rev. 7 — 11 February 2016

Product data sheet

1. General description

The 74HC423 is a dual retriggerable monostable multivibrator with output pulse width control by two methods. The basic pulse time is programmed by selection of an external resistor (R_{EXT}) and capacitor (C_{EXT}). Once triggered, the basic output pulse width may be extended by retriggering ($n\bar{A}$) or (nB). By repeating this process, the output pulse period ($nQ = HIGH$, $n\bar{Q} = LOW$) can be made as long as desired. When $n\bar{RD}$ is LOW, it forces the nQ output LOW, the $n\bar{Q}$ output HIGH and also inhibits the triggering. Schmitt-trigger action in the $n\bar{A}$ and nB inputs, makes the circuit highly tolerant to slower input rise and fall times. The '423' is identical to the '123' but cannot be triggered via the reset input. 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

- DC triggered from active HIGH or active LOW inputs
- Retriggerable for very long pulses up to 100 % duty factor
- Direct reset terminates output pulse
- Schmitt-trigger action on all inputs except for the reset input
- Complies with JEDEC standard no. 7A
- Input levels:
 - ◆ For 74HC423: CMOS level
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to $+85\text{ °C}$ and from -40 °C to $+125\text{ °C}$

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-------------|-------------------------------------|----------|---|----------|
| | Temperature range | Name | Description | |
| 74HC423D | -40 °C to $+125\text{ °C}$ | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HC423BQ | -40 °C to $+125\text{ °C}$ | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body $2.5 \times 3.5 \times 0.85\text{ mm}$ | SOT763-1 |

4. Functional diagram

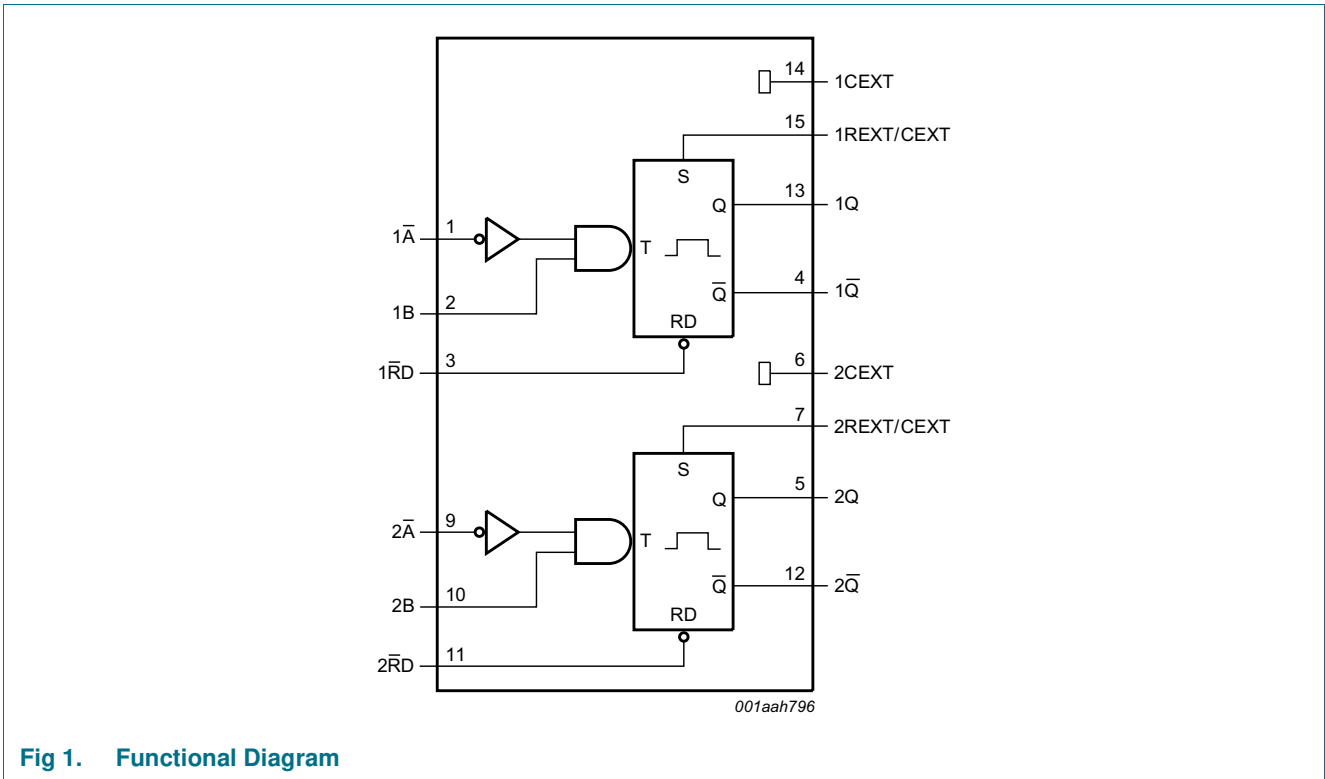


Fig 1. Functional Diagram

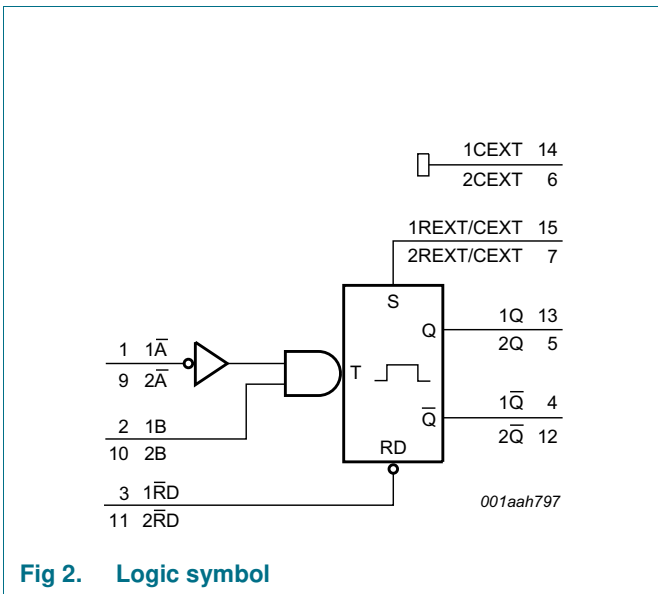


Fig 2. Logic symbol

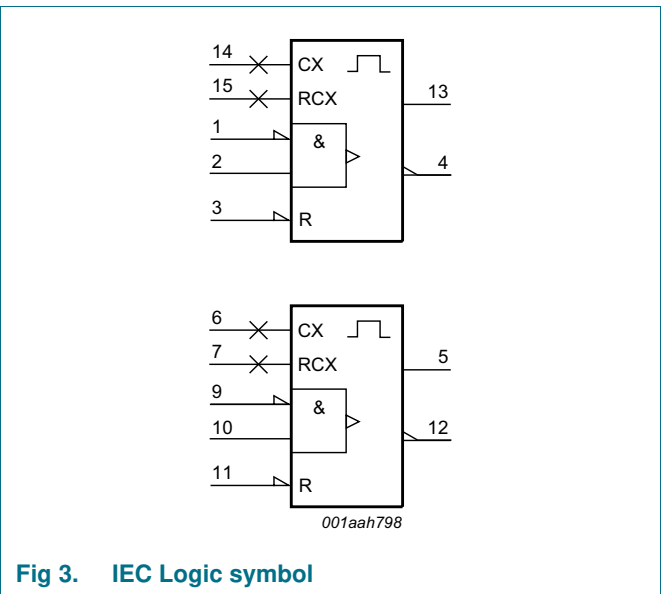


Fig 3. IEC Logic symbol

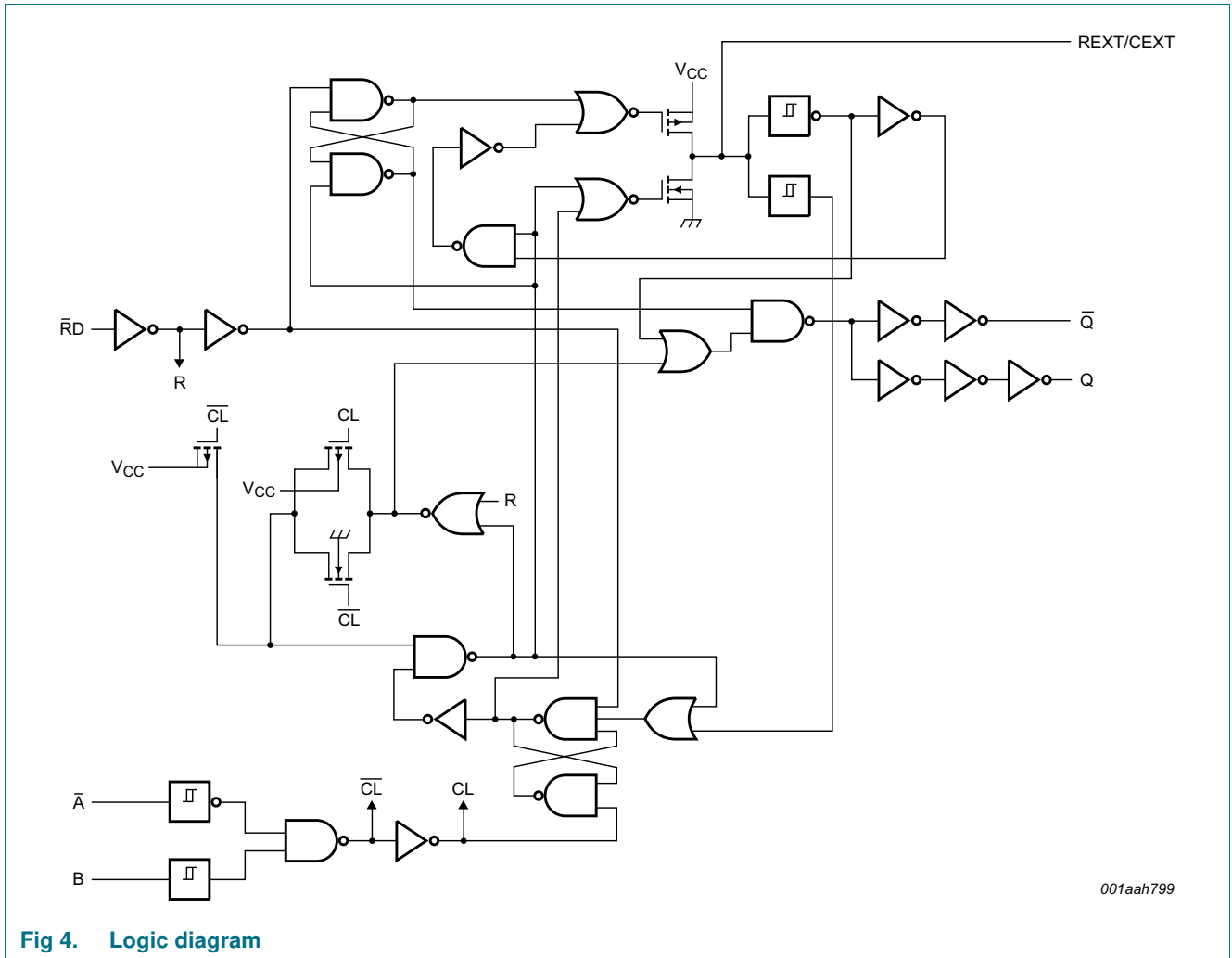
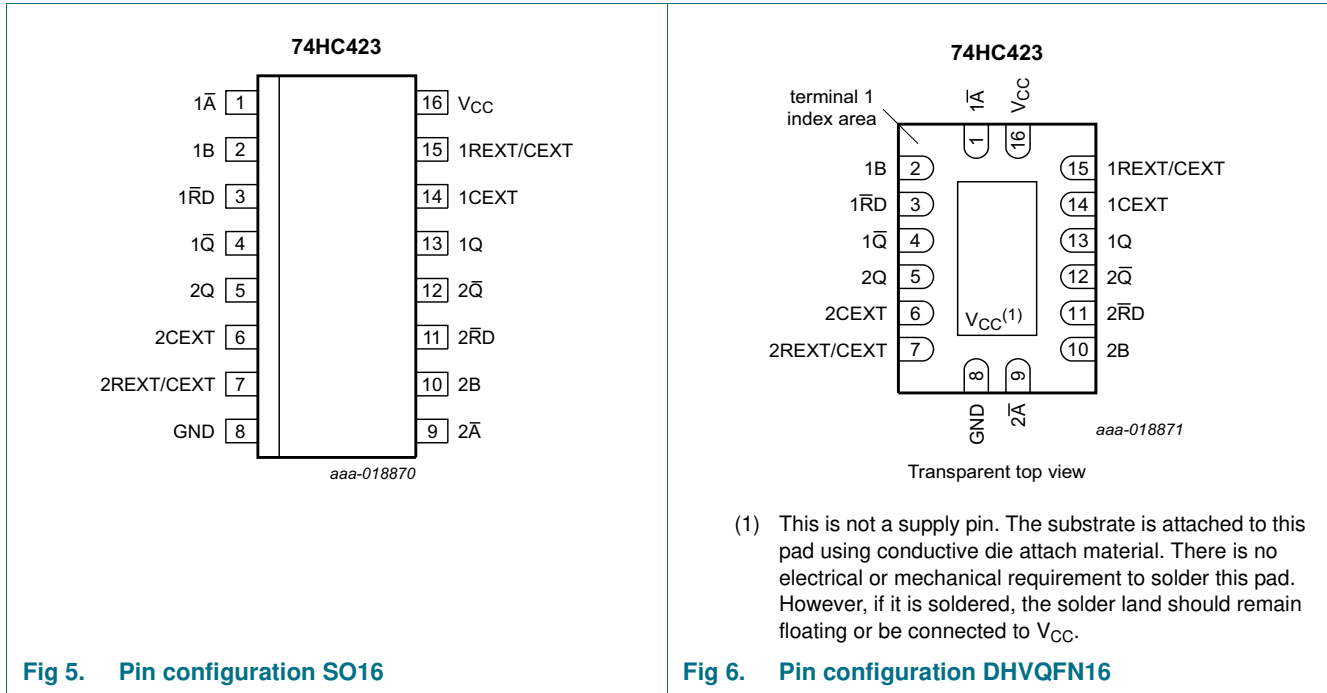


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning







5.2 Pin description

Table 2. Pin description


| Symbol | Pin | Description |
|-----------------------------|-------|---|
| 1 \bar{A} , 2 \bar{A} | 1, 9 | trigger input (negative edge triggered) |
| 1B, 2B | 2, 10 | trigger input (positive edge triggered) |
| 1 $\bar{R}D$, 2 $\bar{R}D$ | 3, 11 | direct reset (active LOW) |
| 1 \bar{Q} , 2 \bar{Q} | 4, 12 | output (active LOW) |
| GND | 8 | ground (0 V) |
| 1Q, 2Q | 13, 5 | output (active HIGH) |
| 1CEXT, 2CEXT | 14, 6 | external capacitor connection |
| 1REXT/CEXT, 2REXT/CEXT | 15, 7 | external resistor/capacitor connection |
| V _{CC} | 16 | supply voltage |


6. Functional description

Table 3. Function table^[1]

| Input | | | Output | |
|-------|----|----|---|---|
| nRD | nA | nB | nQ | nQ |
| L | X | X | L | H |
| X | H | X | L ^[2] | H ^[2] |
| X | X | L | L ^[2] | H ^[2] |
| H | L | ↑ |  |  |
| H | ↓ | H |  |  |

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

 = one HIGH level output pulse;

 = one LOW level output pulse.

- [2] If the monostable multivibrator was triggered before this condition was established, the pulse will continue as programmed.

7. Limiting values

Table 4. Limiting values

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|---|------|------|------|
| V_{CC} | supply voltage | | -0.5 | +7 | V |
| I_{IK} | input clamping current | $V_I < -0.5 \text{ V}$ or $V_I > V_{CC} + 0.5 \text{ V}$ ^[1] | - | ±20 | mA |
| I_{OK} | output clamping current | $V_O < -0.5 \text{ V}$ or $V_O > V_{CC} + 0.5 \text{ V}$ ^[1] | - | ±20 | mA |
| I_O | output current | $-0.5 \text{ V} < V_O < V_{CC} + 0.5 \text{ V}$ | - | ±25 | mA |
| I_{CC} | supply current | | - | 50 | mA |
| I_{GND} | ground current | | -50 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | SO16 and DHVQFN16 packages ^[2] | - | 500 | mW |

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

- [2] For SO16 package: above 70 °C the value of P_{tot} derates linearly at 8 mW/K;
 For DHVQFN16 package: above 60 °C the value of P_{tot} derates linearly at 4.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|-------------------------|-----|------|----------|------|
| V_{CC} | supply voltage | | 2.0 | 5.0 | 6.0 | V |
| V_I | input voltage | | 0 | - | V_{CC} | V |
| V_O | output voltage | | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | - | - | 625 | ns/V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 1.67 | 139 | ns/V |
| | | $V_{CC} = 6.0\text{ V}$ | - | - | 83 | ns/V |

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 | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 2.0\text{ V}$ | 1.5 | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | $V_{CC} = 6.0\text{ V}$ | 4.2 | 3.2 | - | 4.2 | - | 4.2 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 2.0\text{ V}$ | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | $V_{CC} = 6.0\text{ V}$ | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | | | |
| | | $I_O = -20\ \mu\text{A}$; $V_{CC} = 2.0\text{ V}$ | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | $I_O = -20\ \mu\text{A}$; $V_{CC} = 4.5\text{ V}$ | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -20\ \mu\text{A}$; $V_{CC} = 6.0\text{ V}$ | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | $I_O = -4.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$ | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| | | $I_O = -5.2\text{ mA}$; $V_{CC} = 6.0\text{ V}$ | 5.48 | 5.81 | - | 5.34 | - | 5.2 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | | | |
| | | $I_O = 20\ \mu\text{A}$; $V_{CC} = 2.0\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 20\ \mu\text{A}$; $V_{CC} = 4.5\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 20\ \mu\text{A}$; $V_{CC} = 6.0\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 4.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$ | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| | | $I_O = 5.2\text{ mA}$; $V_{CC} = 6.0\text{ V}$ | - | 0.16 | 0.26 | - | 0.33 | - | 0.4 | V |
| I_I | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$ | - | - | ± 0.1 | - | ± 1.0 | - | ± 1.0 | μA |
| I_{CC} | supply current | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$; $V_{CC} = 6.0\text{ V}$ | - | - | 8.0 | - | 80 | - | 160 | μA |
| C_I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$; test circuit see [Figure 12](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-------------------------|-------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|---------------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t_{pd} | propagation delay | $n\bar{A}$ or nB to nQ or $n\bar{Q}$; $R_{EXT} = 5\text{ k}\Omega$; $C_{EXT} = 0\text{ pF}$; see Figure 7 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 80 | 255 | - | 320 | - | 385 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 29 | 51 | - | 64 | - | 77 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 25 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 23 | 43 | - | 54 | - | 65 | ns |
| | | $n\bar{RD}$ to nQ or $n\bar{Q}$; see Figure 7 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 66 | 215 | - | 270 | - | 325 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 24 | 43 | - | 54 | - | 65 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 20 | - | - | - | - | - | ns |
| $V_{CC} = 6.0\text{ V}$ | - | 19 | 37 | - | 46 | - | 55 | ns | | |
| t_t | transition time | see Figure 7 [2] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 19 | 75 | - | 95 | - | 110 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 7 | 15 | - | 19 | - | 22 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 6 | 13 | - | 16 | - | 19 | ns |
| t_{w} | pulse width | $n\bar{A}$ input LOW; see Figure 7 and Figure 8 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 100 | 11 | - | 125 | - | 150 | - | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 20 | 4 | - | 25 | - | 30 | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 17 | 3 | - | 21 | - | 26 | - | ns |
| | | nB input HIGH; see Figure 7 and Figure 8 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 100 | 17 | - | 125 | - | 150 | - | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 20 | 6 | - | 25 | - | 30 | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 17 | 5 | - | 21 | - | 26 | - | ns |
| | | $n\bar{RD}$ input LOW; see Figure 7 and Figure 8 | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | 100 | 14 | - | 125 | - | 150 | - | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 20 | 5 | - | 25 | - | 30 | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | 17 | 4 | - | 21 | - | 26 | - | ns |
| | | nQ HIGH or $n\bar{Q}$ LOW; $V_{CC} = 5.0\text{ V}$; $R_{EXT} = 10\text{ k}\Omega$; $C_{EXT} = 100\text{ nF}$; see Figure 7 and Figure 8 | - | 450 | - | - | - | - | - | μs |
| | | nQ HIGH or $n\bar{Q}$ LOW; $V_{CC} = 5.0\text{ V}$; $R_{EXT} = 5\text{ k}\Omega$; $C_{EXT} = 0\text{ pF}$; $V_I = GND$ to V_{CC} ; see Figure 7 and Figure 8 [3] | - | 75 | - | - | - | - | - | ns |
| t_{trig} | retrigger time | $n\bar{A}$ or nB input; $V_{CC} = 5.0\text{ V}$; $R_{EXT} = 5\text{ k}\Omega$; $C_{EXT} = 0\text{ pF}$; see Figure 10 [4] | - | 110 | - | - | - | - | - | ns |

Table 7. Dynamic characteristics ...continued
GND = 0 V; test circuit see Figure 12.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|------------------|-------------------------------|--|-----------|-----|------|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| R _{EXT} | external timing resistor | V _{CC} = 2.0 V; see Figure 8 | 10 | - | 1000 | - | - | - | - | kΩ |
| | | V _{CC} = 5.0 V | 2 | - | 1000 | - | - | - | - | kΩ |
| C _{EXT} | external timing capacitor | V _{CC} = 5.0 V; see Figure 8 [5] | no limits | | | | | | pF | |
| C _{PD} | power dissipation capacitance | per package; V _I = GND to V _{CC} [6] | - | 54 | - | - | - | - | - | pF |

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

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

[3] For other R_{EXT} and C_{EXT} combinations see Figure 8. If C_{EXT} > 10 pF, the next formula is valid:

$t_W = K \times R_{EXT} \times C_{EXT}$ (typ.), where:

t_W = output pulse width in ns;

R_{EXT} = external resistor in kΩ;

C_{EXT} = external capacitor in pF;

K = 0.55 for V_{CC} = 2.0 V and 0.45 for V_{CC} = 5.0 V; see Figure 9.

Inherent test jig and pin capacitance at pins 15 and 7 (nR_{EXT}/C_{EXT}) is 7 pF.

[4] The time to retrigger the monostable multivibrator depends on the values of R_{EXT} and C_{EXT}. The output pulse width will only be extended when the time between the active-going edges of the trigger input pulses meets the minimum retrigger time.

If C_{EXT} > 10 pF, the next formula (at V_{CC} = 5.0 V) for the set-up time of a retrigger pulse is valid:

$t_{trig} = 30 + 0.19 \times R_{EXT} \times C_{EXT}^{0.9} + 13 \times R_{EXT}^{1.05}$ (typ.); where:

t_{trig} = retrigger time in ns;

C_{EXT} = external capacitor in pF;

R_{EXT} = external resistor in kΩ.

Inherent test jig and pin capacitance at pins 15 and 7 (nR_{EXT}/C_{EXT}) is 7 pF.

[5] When the device is powered-up, initiate the device via a reset pulse, when C_{EXT} < 50 pF.

[6] C_{PD} is used to determine the dynamic power dissipation (P_D 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_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

11. Waveforms

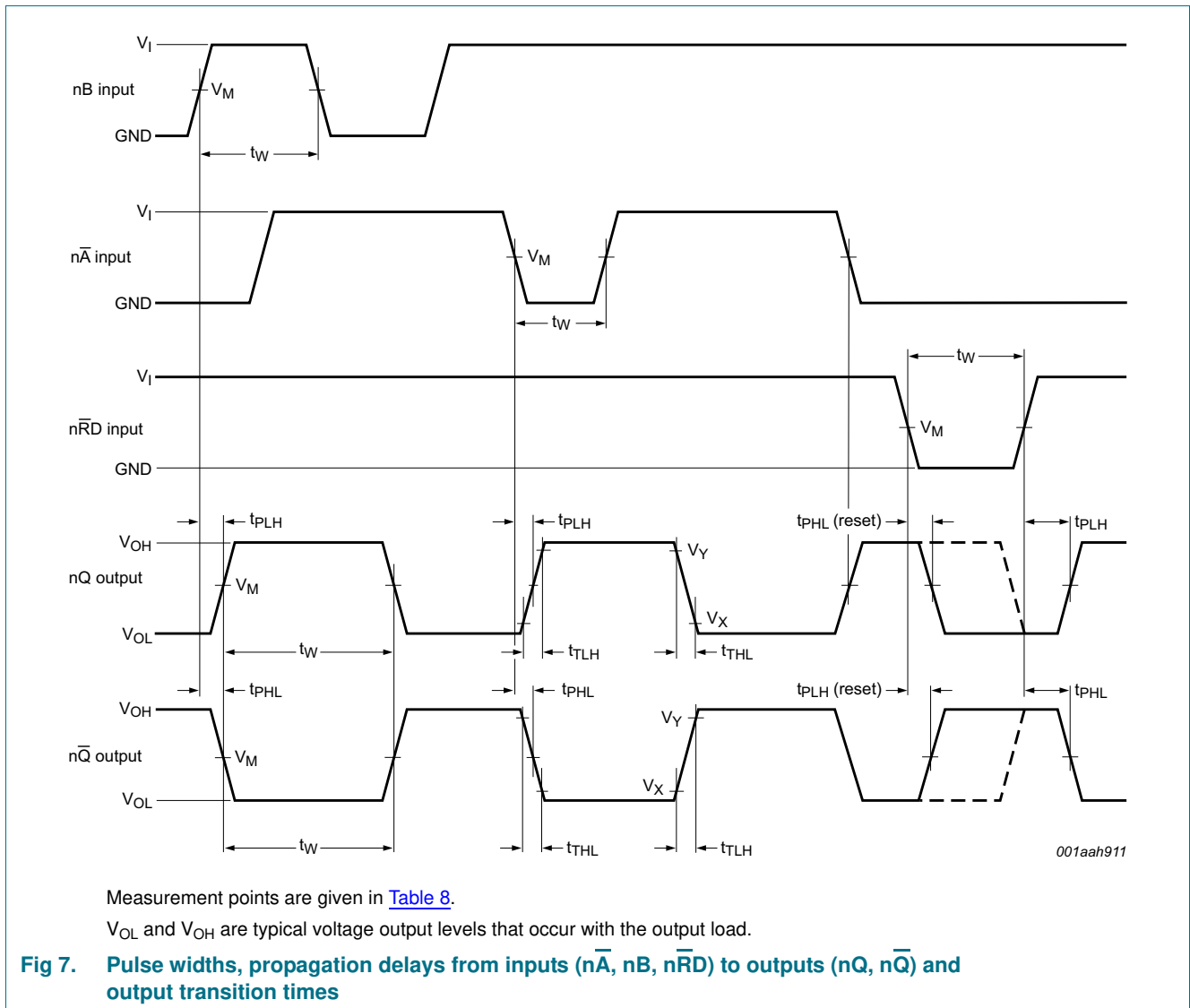
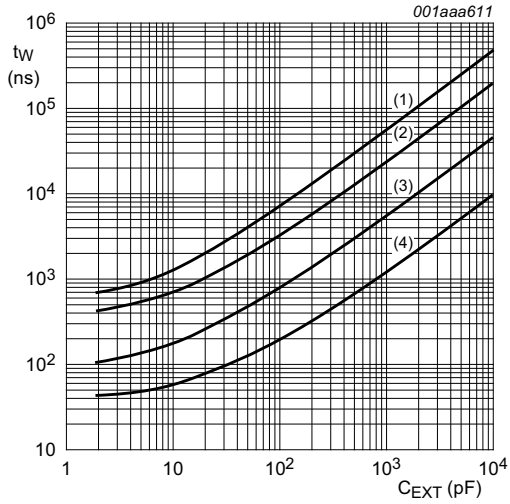


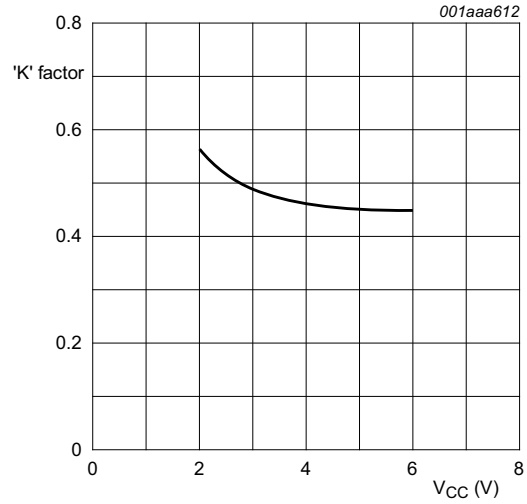
Table 8. Measurement points

| Input | | Output | | |
|----------|-------------|-------------|-------------|-------------|
| V_I | V_M | V_M | V_X | V_Y |
| V_{CC} | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |



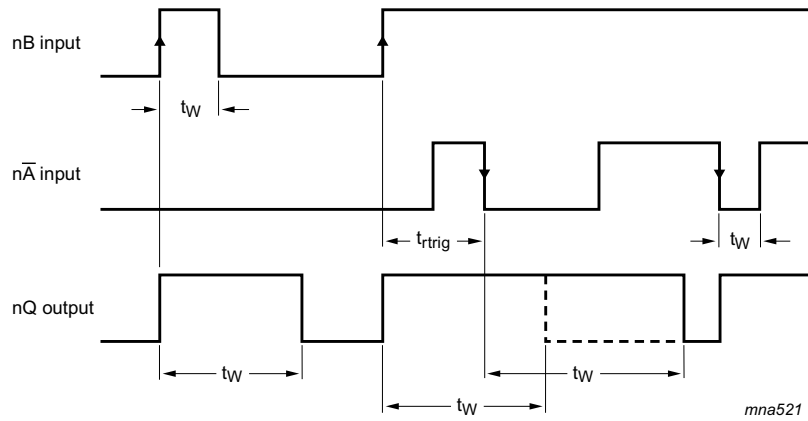
- $V_{CC} = 5.0\text{ V}$ and $T_{amb} = 25\text{ }^{\circ}\text{C}$.
- (1) $R_{EXT} = 100\text{ k}\Omega$.
 - (2) $R_{EXT} = 50\text{ k}\Omega$.
 - (3) $R_{EXT} = 10\text{ k}\Omega$.
 - (4) $R_{EXT} = 2\text{ k}\Omega$.

Fig 8. Typical output pulse width as a function of the external capacitor values



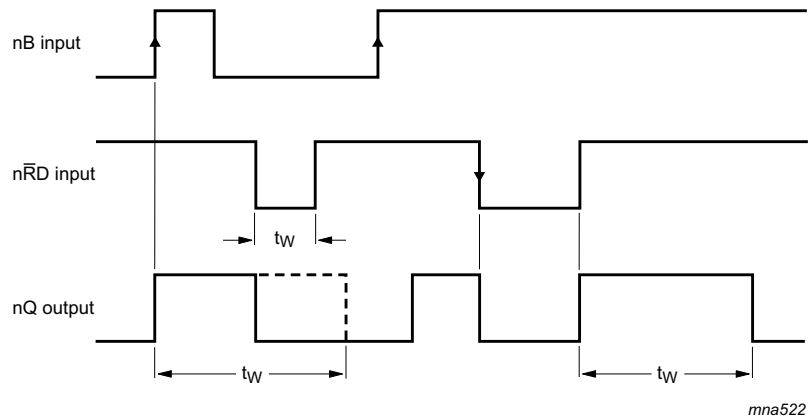
External capacitance = 10 nF,
external resistance = 10 kΩ to 100 kΩ and $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Fig 9. Typical 'K' factor



$n\overline{RD} = \text{HIGH}$.

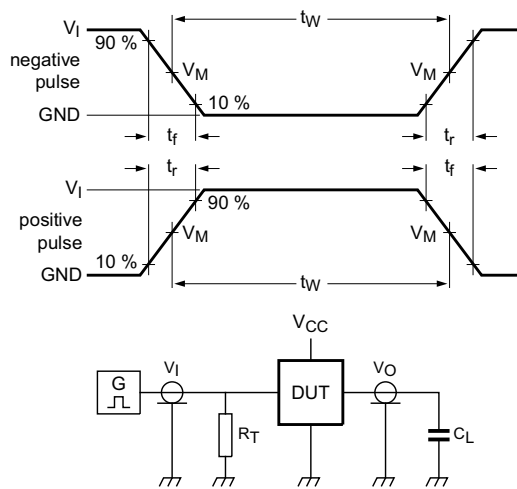
Fig 10. Output pulse control using retrigger pulse (t_{rtrig})



mna522

$n\bar{A}$ = LOW.

Fig 11. Output pulse control using reset input $n\bar{RD}$



001aah768

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

Definitions for 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.

Fig 12. Test circuit for measuring switching times

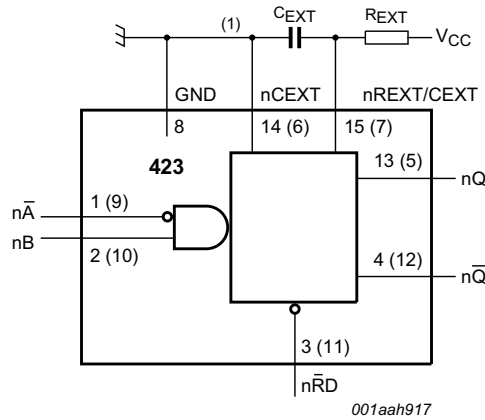
Table 9. Test data

| Supply | Input | Load |
|----------------|----------|--------------|
| V_{CC} | V_I | C_L |
| 2.0 V to 6.0 V | V_{CC} | 15 pF, 50 pF |

12. Application information

12.1 Timing component connections

The basic output pulse width is essentially determined by the values of the external timing components R_{EXT} and C_{EXT} .



- (1) For minimum noise generation it is recommended that the nCEXT pins (6, 14) are connected to ground externally to the GND pin (8).

Fig 13. Timing component connections

12.1.1 Minimum monostable pulse width

To set the minimum pulse width, when $C_{EXT} < 10$ nF, see [Figure 8](#) and when $C_{EXT} > 10$ nF, the output pulse width is defined as:

$$t_W = 0.45 \times R_{EXT} \times C_{EXT} \text{ (typ.)}, \text{ where:}$$

t_W = pulse width in μs ;

R_{EXT} = external resistor in $\text{k}\Omega$;

C_{EXT} = external capacitor in nF.

12.2 Power-up considerations

When the monostable is powered-up it may produce an output pulse, with a pulse width defined by the values of R_{EXT} and C_{EXT} , this output pulse can be eliminated using the circuit shown in [Figure 14](#).

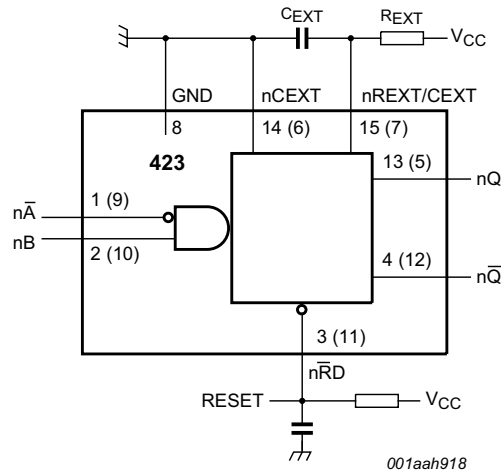


Fig 14. Power-up output pulse elimination circuit

12.3 Power-down considerations

A large capacitor C_{EXT} may cause problems when powering-down the monostable due to the capacitor's stored energy. When a system containing this device is powered-down or a rapid decrease of V_{CC} to zero occurs, the monostable may sustain damage, due to the capacitor discharging through the input protection diodes. To avoid this possibility, use a damping diode D_{EXT} preferably a germanium or Schottky type diode able to withstand large current surges and connect as shown in [Figure 15](#).

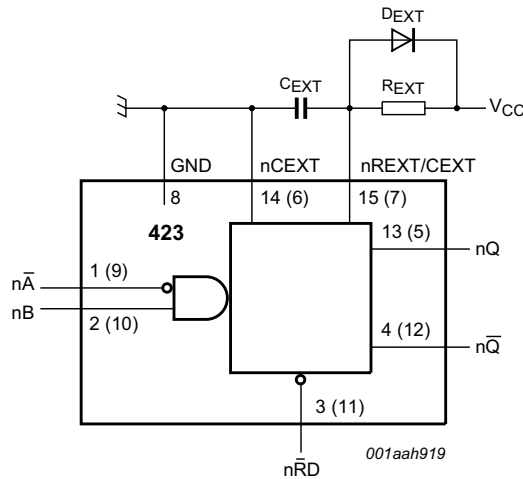


Fig 15. Power-down protection circuit

13. Package outline

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

SOT109-1

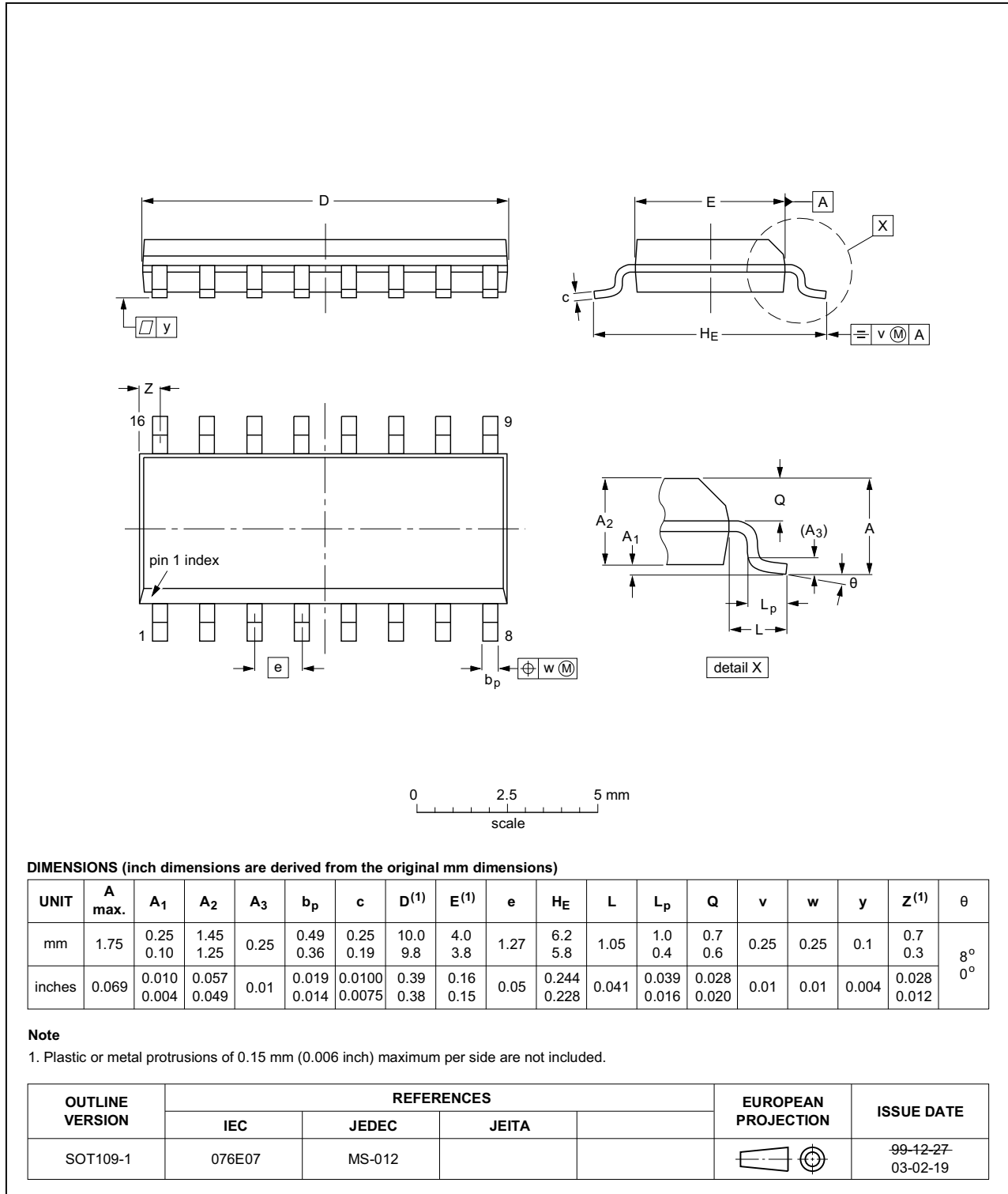


Fig 16. Package outline SOT109-1 (SO16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

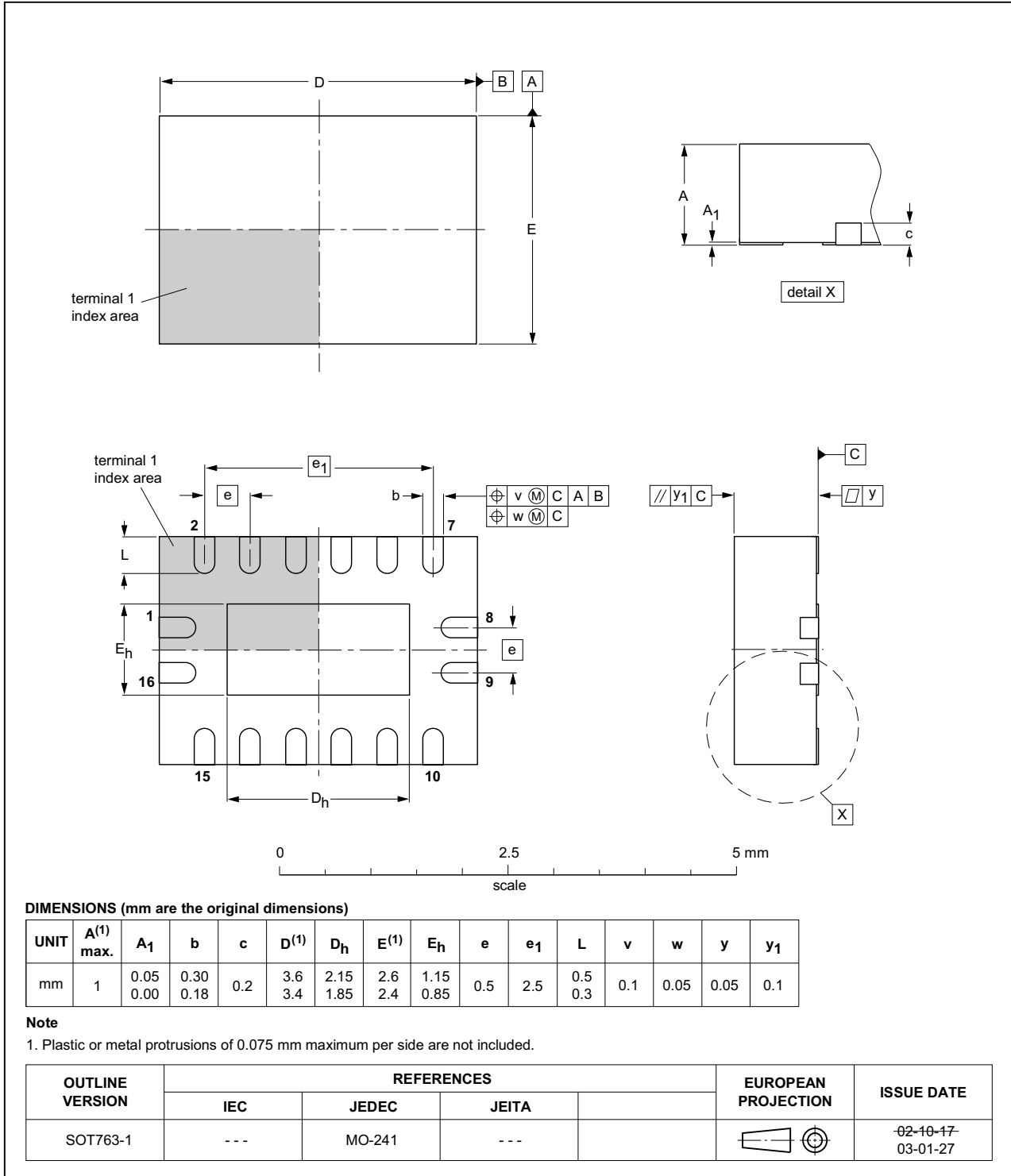


Fig 17. Package outline SOT763-1 (DHVQFN16)

14. Abbreviations

Table 10. Abbreviations

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

15. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------------|---|-----------------------|---------------|---------------------|
| 74HC423 v.7 | 20160211 | Product data sheet | - | 74HC_HCT423 v.6 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74HC423N, 74HCT423N, 74HCT423D, 74HCT423DB, 74HCT423PW and 74HCT423BQ removed. | | | |
| 74HC_HCT423 v.6 | 20111219 | Product data sheet | - | 74HC_HCT423 v.5 |
| Modifications: | <ul style="list-style-type: none"> Legal pages updated. | | | |
| 74HC_HCT423 v.5 | 20110825 | Product data sheet | - | 74HC_HCT423 v.4 |
| 74HC_HCT423 v.4 | 20110318 | Product data sheet | - | 74HC_HCT423 v.3 |
| 74HC_HCT423 v.3 | 20080724 | Product data sheet | - | 74HC_HCT423_CNV v.2 |
| 74HC_HCT423_CNV v.2 | 19980708 | Product specification | - | - |

16. Legal information

16.1 Data sheet status

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

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

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

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

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17. Contact information

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

For sales office addresses, please send an email to: salesaddresses@nexperia.com

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