# DATA SHEET

# 74AHC123A; 74AHCT123A
## Dual retriggerable monostable multivibrator with reset

Product specification
2000 Mar 15
File under Integrated Circuits, IC06

Philips Semiconductors

PHILIPS

## FEATURES

- ESD protection:
  HBM EIA/JESD22-A114-A exceeds 2000 V
  MM EIA/JESD22-A115-A exceeds 200 V
  CDM EIA/JESD22-C101 exceeds 1000 V
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than $V_{CC}$
- For AHC only: operates with CMOS input levels
- For AHCT only: operates with TTL input levels
- Specified from –40 to +85 °C and –40 to +125 °C
- DC triggered from active HIGH or active LOW inputs
- Retriggerable for very long pulses up to 100% duty factor
- Direct reset terminates output pulse
- Output capability: standard (except for $nR_{EXT}/C_{EXT}$).

## DESCRIPTION

The 74AHC/AHCT123A are high-speed Si-gate CMOS devices and are pin compatible with Low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no.7A.

The 74AHC/AHCT123A are dual retriggerable monostable multivibrators with output pulse width control by three methods. The basic pulse time is programmed by selection of an external resistor ($R_{EXT}$) and capacitor ($C_{EXT}$). The external resistor and capacitor are normally connected as shown in Fig.6.

Once triggered, the basic output pulse width may be extended by retriggering the gated active LOW-going edge input ($n\overline{A}$) or the active HIGH-going edge input (nB). By repeating this process, the output pulse period (nQ = HIGH, $n\overline{Q}$ = LOW) can be made as long as desired. Alternatively an output delay can be terminated at any time by a LOW-going edge on input $n\overline{R}_D$, which also inhibits the triggering.

An internal connection from $n\overline{R}_D$ to the input gate makes it possible to trigger the circuit by a positive-going signal at input $n\overline{R}_D$ as shown in the function table. Figs 8 and 9 illustrate pulse control by retriggering and early reset. The basic output pulse width is essentially determined by the value of the external timing components $R_{EXT}$ and $C_{EXT}$. When $C_{EXT} \geq 10$ nF, the typical output pulse width is defined as: $t_W = R_{EXT} \times C_{EXT}$ where $t_W$ = pulse width in ns; $R_{EXT}$ = external resistor in kΩ; $C_{EXT}$ = external capacitor in pF. Schmitt-trigger action at all inputs makes the circuit highly tolerant to slower input rise and fall times. The ‘123’ is identical to the ‘423’ but can be triggered via the reset input.

## QUICK REFERENCE DATA

GND = 0 V; $T_{amb}$ = 25 °C; $t_r = t_f \leq 3.0$ ns.

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | | UNIT |
|---|---|---|---|---|---|
| | | | AHC | AHCT | |
| $t_{PHL}/t_{PLH}$ | propagation delay | $C_L$ = 15 pF; $V_{CC}$ = 5 V; $R_{EXT}$ = 5 kΩ; $C_{EXT}$ = 0 pF | | | |
| | $n\overline{A}$, nB to nQ, $n\overline{Q}$ | | 5.1 | 5.0 | ns |
| | $n\overline{R}_D$ to nQ, $n\overline{Q}$ | | 5.6 | 5.2 | ns |
| $C_I$ | input capacitance | $V_I = V_{CC}$ or GND | 5 | 3 | pF |
| $C_O$ | output capacitance | | 4 | 4 | pF |
| $C_{PD}$ | power dissipation capacitance | $C_L$ = 50 pF; f = 1 MHz; notes 1 and 2 | 57 | 58 | pF |

### Notes

1. $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in μW).

   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \times C_{EXT} \times V_{CC}^2 \times f_o + D \times 16 \times V_{CC}$ where:

   $f_i$ = input frequency in MHz;

   $f_o$ = output frequency in MHz;

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

   D = duty factor in %;

   $C_L$ = output load capacitance in pF;

   $C_{EXT}$ = timing capacitance in pF;

   $V_{CC}$ = supply voltage in Volts.
2. The condition is $V_I$ = GND to $V_{CC}$.

# Dual retriggerable monostable multivibrator with reset

# 74AHC123A; 74AHCT123A

## FUNCTION TABLE

See note 1.

| INPUTS | | | OUTPUTS | |
|---|---|---|---|---|
| $n\overline{R}_D$ | $n\overline{A}$ | nB | nQ | $n\overline{Q}$ |
| L | X | X | L | H |
| X | H | X | L[2] | H[2] |
| X | X | L | L[2] | H[2] |
| H | L | ↑ | ⎍ [3] | ⊔ [4] |
| H | ↓ | H | ⎍ [3] | ⊔ [4] |
| ↑ | L | H | ⎍ [3] | ⊔ [4] |

### Notes

1. H = HIGH voltage level;
   L = LOW voltage level;
   X = don't care;
   ↑ = LOW-to-HIGH CP transition;
   ↓ = HIGH-to-LOW CP transition.
2. If the monostable multivibrator was triggered before this condition was established, the pulse will be continued as programmed.
3. One HIGH-level output pulse.
4. One LOW-level output pulse.

## ORDERING INFORMATION

| TYPE NUMBER | PACKAGES | | | | |
|---|---|---|---|---|---|
| | TEMPERATURE RANGE | PINS | PACKAGE | MATERIAL | CODE |
| 74AHC123AD | –40 to +125 °C | 16 | SO | plastic | SOT109-1 |
| 74AHC123APW | | 16 | TSSOP | plastic | SOT403-1 |
| 74AHCT123AD | | 16 | SO | plastic | SOT109-1 |
| 74AHCT123APW | | 16 | TSSOP | plastic | SOT403-1 |

# Dual retriggerable monostable multivibrator with reset

# 74AHC123A; 74AHCT123A

## PINNING

| PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1, 9 | $1\overline{A}$, $2\overline{A}$ | trigger inputs (negative-edge triggered) |
| 2, 10 | 1B, 2B | trigger inputs (positive-edge triggered) |
| 3, 11 | $1\overline{R}_D$, $2\overline{R}_D$ | direct reset LOW and trigger action at positive edge |
| 4, 12 | $1\overline{Q}$, $2\overline{Q}$ | outputs (active LOW) |
| 5, 13 | 2Q, 1Q | outputs (active HIGH) |
| 6, 14 | $2C_{EXT}$, $1C_{EXT}$ | external capacitor connection |
| 7, 15 | $2R_{EXT}/C_{EXT}$, $1R_{EXT}/C_{EXT}$ | external resistor/capacitor connection |
| 8 | GND | ground (0 V) |
| 16 | $V_{CC}$ | DC supply voltage |

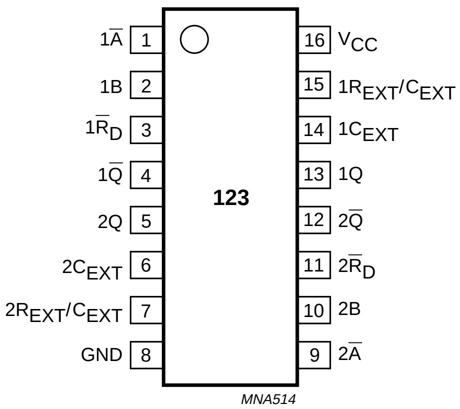



Fig.1 Pin configuration.

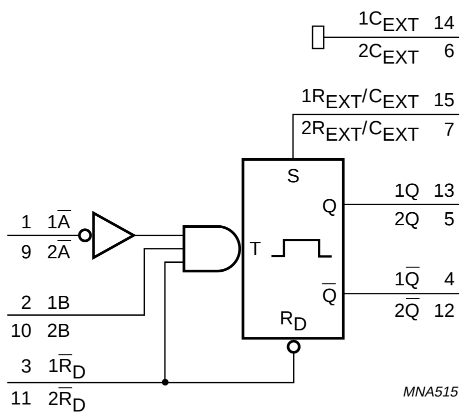



Fig.2 Logic diagram.

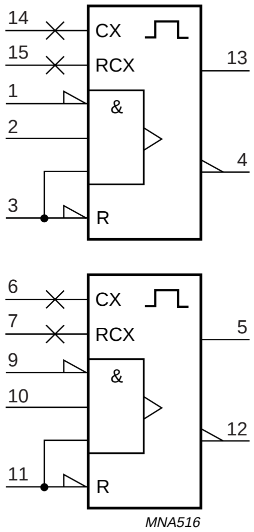



Fig.3 IEC logic symbol.

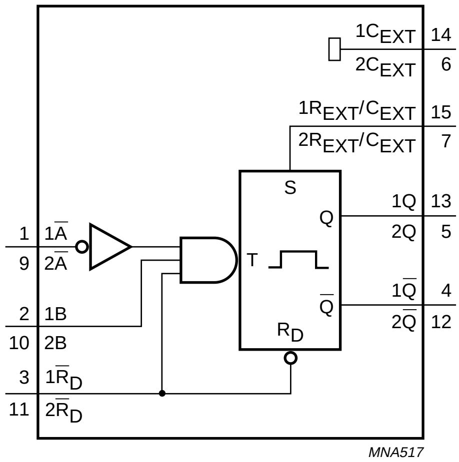
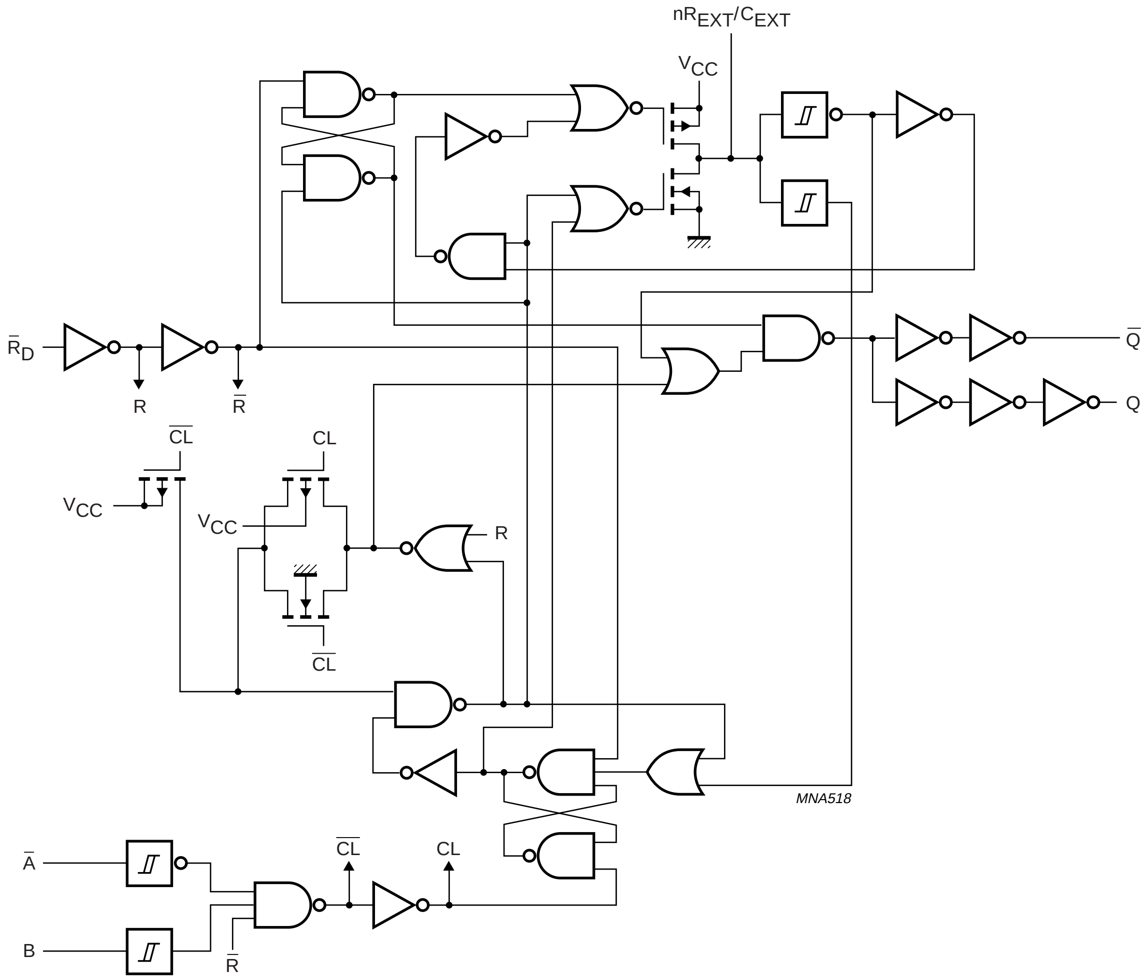



Fig.4 Functional diagram.




For minimum noise generation, it is recommended to ground pins 6 (2CEXT) and 14 (1CEXT) externally to pin 8 (GND).

Fig.5 Logic diagram (one flip-flop).

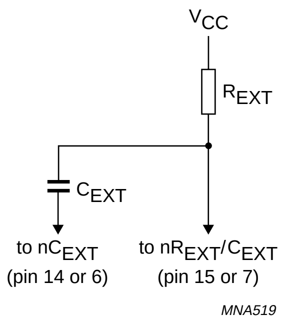



Fig.6 Timing component connections.

**RECOMMENDED OPERATING CONDITIONS**

| SYMBOL | PARAMETER | CONDITIONS | 74AHC | | | 74AHCT | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| $V_{CC}$ | DC supply voltage | | 2.0 | 5.0 | 5.5 | 4.5 | 5.0 | 5.5 | V |
| $V_I$ | input voltage | | 0 | – | 5.5 | 0 | – | 5.5 | V |
| $V_O$ | output voltage | | 0 | – | $V_{CC}$ | 0 | – | $V_{CC}$ | V |
| $T_{amb}$ | operating ambient temperature | see DC and AC characteristics per device | –40 | +25 | +85 | –40 | +25 | +85 | °C |
| | | | –40 | +25 | +125 | –40 | +25 | +125 | °C |
| $t_r$, $t_f$ | input rise and fall time ratios | $V_{CC}$ = 3.3 ±0.3 V | – | – | 100 | – | – | – | ns/V |
| | | $V_{CC}$ = 5 ±0.5 V | – | – | 20 | – | – | 20 | ns/V |
| $R_{EXT}$ | external timing resistor | $V_{CC}$ = 2 V | 5 | – | – | 5 | – | – | kΩ |
| | | $V_{CC}$ > 3 V | 1 | – | – | 1 | – | – | kΩ |
| $C_{EXT}$ | external timing capacitor | | no limits | | | | | | pF |

## 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 |
|---|---|---|---|---|---|
| $V_{CC}$ | DC supply voltage | | –0.5 | +7.0 | V |
| $V_I$ | input voltage | | –0.5 | +7.0 | V |
| $I_{IK}$ | DC input diode current | $V_I$ < –0.5 V; note 1 | – | –20 | mA |
| $I_{OK}$ | DC output clamping diode current | $V_O$ < –0.5 V or $V_O$ > $V_{CC}$ + 0.5 V; note 1 | – | ±20 | mA |
| $I_O$ | DC output sink current | –0.5 V < $V_O$ < $V_{CC}$ + 0.5 V | – | ±25 | mA |
| $I_{CC}$ | DC $V_{CC}$ or GND current | | – | ±75 | mA |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $P_D$ | power dissipation per package | for temperature range: –40 to +125 °C; note 2 | – | 500 | mW |

**Notes**

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. For SO packages: above 70 °C the value of $P_D$ derates linearly with 8 mW/K.
   For TSSOP packages: above 60 °C the value of $P_D$ derates linearly with 5.5 mW/K.

## DC CHARACTERISTICS

**Family 74AHC**

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

| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OTHER | $V_{CC}$ (V) | 25 | | | −40 to +85 | | −40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| $V_{IH}$ | HIGH-level input voltage | | 2.0 | 1.5 | – | – | 1.5 | – | 1.5 | – | V |
| | | | 3.0 | 2.1 | – | – | 2.1 | – | 2.1 | – | V |
| | | | 5.5 | 3.85 | – | – | 3.85 | – | 3.85 | – | V |
| $V_{IL}$ | LOW-level input voltage | | 2.0 | – | – | 0.5 | – | 0.5 | – | 0.5 | V |
| | | | 3.0 | – | – | 0.9 | – | 0.9 | – | 0.9 | V |
| | | | 5.5 | – | – | 1.65 | – | 1.65 | – | 1.65 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$; $I_O = -50\ \mu A$ | 2.0 | 1.9 | 2.0 | – | 1.9 | – | 1.9 | – | V |
| | | | 3.0 | 2.9 | 3.0 | – | 2.9 | – | 2.9 | – | V |
| | | | 4.5 | 4.4 | 4.5 | – | 4.4 | – | 4.4 | – | V |
| | | $V_I = V_{IH}$ or $V_{IL}$; $I_O = -4.0$ mA | 3.0 | 2.58 | – | – | 2.48 | – | 2.40 | – | V |
| | | $V_I = V_{IH}$ or $V_{IL}$; $I_O = -8.0$ mA | 4.5 | 3.94 | – | – | 3.8 | – | 3.70 | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$; $I_O = 50\ \mu A$ | 2.0 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | | | 3.0 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | | | 4.5 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | | $V_I = V_{IH}$ or $V_{IL}$; $I_O = 4.0$ mA | 3.0 | – | – | 0.36 | – | 0.44 | – | 0.55 | V |
| | | $V_I = V_{IH}$ or $V_{IL}$; $I_O = 8.0$ mA | 4.5 | – | – | 0.36 | – | 0.44 | – | 0.55 | V |
| $I_I$ | input leakage current; $R_{EXT}/C_{EXT}$ | $V_I = V_{CC}$ or GND; note 1 | 5.5 | – | – | ±0.25 | – | ±2.5 | – | ±10.0 | μA |
| | input leakage current; $n\overline{A}$, nB, $n\overline{R}_D$ | $V_I = V_{CC}$ or GND | 5.5 | – | – | ±0.1 | – | ±1.0 | – | ±2.0 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | – | – | 4.0 | – | 40 | – | 80 | μA |
| | quiescent supply current active state (per circuit) | $V_I = V_{CC}$ or GND; note 1 | 3 | – | 160 | 250 | – | 280 | – | 280 | μA |
| | | | 4.5 | – | 380 | 500 | – | 650 | – | 650 | μA |
| | | | 5.5 | – | 560 | 750 | – | 975 | – | 975 | μA |
| $C_I$ | input capacitance | | – | – | 5 | 10 | – | 10 | – | 10 | pF |

**Note**

1. Voltage on pin $nR_{EXT}/C_{EXT} = 0.5 \times V_{CC}$ and pin $R_{EXT}/C_{EXT}$ in OFF-state during test.

**Family 74AHCT**

Over recommended operating conditions; voltage are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OTHER | $V_{CC}$ (V) | 25 | | | −40 to +85 | | −40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| $V_{IH}$ | HIGH-level input voltage | | 4.5 to 5.5 | 2.0 | – | – | 2.0 | – | 2.0 | – | V |
| $V_{IL}$ | LOW-level input voltage | | 4.5 to 5.5 | – | – | 0.8 | – | 0.8 | – | 0.8 | V |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$; $I_O = -50$ µA | 4.5 | 4.4 | 4.5 | – | 4.4 | – | 4.4 | – | V |
| | | $V_I = V_{IH}$ or $V_{IL}$; $I_O = -8.0$ mA | 4.5 | 3.94 | – | – | 3.8 | – | 3.70 | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$; $I_O = 50$ µA | 4.5 | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | | $V_I = V_{IH}$ or $V_{IL}$; $I_O = 8.0$ mA | 4.5 | – | – | 0.36 | – | 0.44 | – | 0.55 | V |
| $I_I$ | input leakage current; $R_{EXT}/C_{EXT}$ | $V_I = V_{CC}$ or GND; note 1 | 5.5 | – | – | ±0.25 | – | ±2.5 | – | ±10.0 | µA |
| | input leakage current; $n\overline{A}$, nB, $n\overline{R}_D$ | $V_I = V_{CC}$ or GND | 5.5 | – | – | ±0.1 | – | ±1.0 | – | ±2.0 | µA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | – | – | 4.0 | – | 40 | – | 80 | µA |
| | quiescent supply current active state (per circuit) | $V_I = V_{CC}$ or GND; note 1 | 4.5 | – | 380 | 500 | – | 650 | – | 650 | µA |
| | | | 5.5 | – | 560 | 750 | – | 975 | – | 975 | µA |
| $C_I$ | input capacitance | | – | – | 3 | 10 | – | 10 | – | 10 | pF |

**Note**

1. Voltage on pin $nR_{EXT}/C_{EXT} = 0.5 \times V_{CC}$ and pin $R_{EXT}/C_{EXT}$ in OFF-state during test.

## AC CHARACTERISTICS

### Type 74AHC123A

GND = 0 V; $t_r = t_f \leq 3.0$ ns.

| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $C_L$ | 25 | | | –40 to +85 | | –40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| **$V_{CC}$ = 3.0 to 3.6 V;** note 1 | | | | | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay; $n\overline{A}$, nB to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | 15 pF | – | 7.4 | 20.6 | 1.0 | 24.0 | 1.0 | 26.0 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 8.2 | 22.4 | 1.0 | 26.0 | 1.0 | 26.0 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ (reset) | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 6.4 | 15.8 | 1.0 | 18.5 | 1.0 | 20.0 | ns |
| | propagation delay; $n\overline{A}$, nB to nQ , $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | 50 pF | – | 10.5 | 24.1 | 1.0 | 27.5 | 1.0 | 30.0 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 11.7 | 25.9 | 1.0 | 29.5 | 1.0 | 32.0 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ (reset) | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 9.2 | 19.3 | 1.0 | 22.0 | 1.0 | 24.5 | ns |
| $t_W$ | trigger pulse width; $n\overline{A}$ = LOW | see Fig 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | trigger pulse width; nB = HIGH | see Fig 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | reset pulse width; $n\overline{R}_D$ = LOW | see Fig 9 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | output pulse width; nQ = HIGH; $n\overline{Q}$ = LOW | $C_{EXT}$ = 28 pF; $R_{EXT}$ = 2 kΩ; note 3; see Figs 8, 9 and 10 | | – | 115 | 240 | – | 300 | – | 300 | ns |
| | | $C_{EXT}$ = 0.01 µF; $R_{EXT}$ = 10 kΩ; note 3; see Figs 8, 9 and 10 | | 90 | 100 | 110 | 90 | 110 | 85 | 115 | µs |
| | | $C_{EXT}$ = 0.1 µF; $R_{EXT}$ = 10 kΩ; note 3; see Figs 8, 9 and 10 | | 0.9 | 1 | 1.1 | 0.9 | 1.1 | 0.85 | 1.15 | ms |

## Dual retriggerable monostable multivibrator with reset

## 74AHC123A; 74AHCT123A

| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $C_L$ | 25 | | | −40 to +85 | | −40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| **$V_{CC}$ = 3.0 to 3.6 V;** note 1 | | | | | | | | | | | |
| $t_{rt}$ | retrigger time; $n\overline{A}$ to nB | $C_{EXT}$ = 100 pF; $R_{EXT}$ = 1 kΩ; see Figs 8, 9 and 10 | 50 pF | – | 60 | – | – | – | – | – | ns |
| | | $C_{EXT}$ = 0.01 μF; $R_{EXT}$ = 1 kΩ; see Figs 8, 9 and 10 | | – | 1.5 | – | – | – | – | – | μs |
| **$V_{CC}$ = 4.5 to 5.5 V;** note 2 | | | | | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay; $n\overline{A}$, nB to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | 15 pF | – | 5.1 | 12 | 1.0 | 14.0 | 1.0 | 15.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 5.6 | 12.9 | 1.0 | 15.0 | 1.0 | 16.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ (reset) | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 4.4 | 9.4 | 1.0 | 11.0 | 1.0 | 12.0 | ns |
| | propagation delay; $n\overline{A}$, nB to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | 50 pF | – | 7.3 | 14 | 1.0 | 16.0 | 1.0 | 17.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 8.1 | 14.9 | 1.0 | 17.0 | 1.0 | 19.0 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ (reset) | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 6.3 | 11.4 | 1.0 | 13.0 | 1.0 | 14.5 | ns |

| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $C_L$ | 25 | | | −40 to +85 | | −40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| **$V_{CC}$ = 4.5 to 5.5 V;** note 2 | | | | | | | | | | | |
| $t_W$ | trigger pulse width; $n\overline{A}$ = LOW | see Fig 8 | 50 pF | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | trigger pulse width; nB = HIGH | see Fig 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | reset pulse width; $n\overline{R}_D$ = LOW | see Fig 9 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | output pulse width; nQ = HIGH; $n\overline{Q}$ = LOW | $C_{EXT}$ = 28 pF; $R_{EXT}$ = 2 kΩ; note 3; see Figs 8, 9 and 10 | | – | 100 | 200 | – | 240 | – | 240 | ns |
| | | $C_{EXT}$ = 0.01 μF; $R_{EXT}$ = 10 kΩ; note 3; see Figs 8, 9 and 10 | | 90 | 100 | 110 | 90 | 110 | 85 | 115 | μs |
| | | $C_{EXT}$ = 0.1 μF; $R_{EXT}$ = 10 kΩ; note 3; see Figs 8, 9 and 10 | | 0.9 | 1 | 1.1 | 0.9 | 1.1 | 0.85 | 1.15 | ms |
| $t_{rt}$ | retrigger time; $n\overline{A}$ to nB | $C_{EXT}$ = 100 pF; $R_{EXT}$ = 1 kΩ; see Figs 8, 9 and 10 | | – | 39 | – | – | – | – | – | ns |
| | | $C_{EXT}$ = 0.01 μF; $R_{EXT}$ = 1 kΩ; see Figs 8, 9 and 10 | | – | 1.2 | – | – | – | – | – | μs |

**Notes**

1. Typical values are measured at $V_{CC}$ = 3.3 V and $T_{amb}$ = 25 °C.
2. Typical values are measured at $V_{CC}$ = 5.0 V and $T_{amb}$ = 25 °C.
3. For $C_{EXT} \geq 10$ nF the typical value of the pulse width $t_W$ (μs) = $R_{EXT}$ (kΩ) × $C_{EXT}$ (nF).

**Type 74AHCT123A**

GND = 0 V; $t_r = t_f \leq 3.0$ ns.

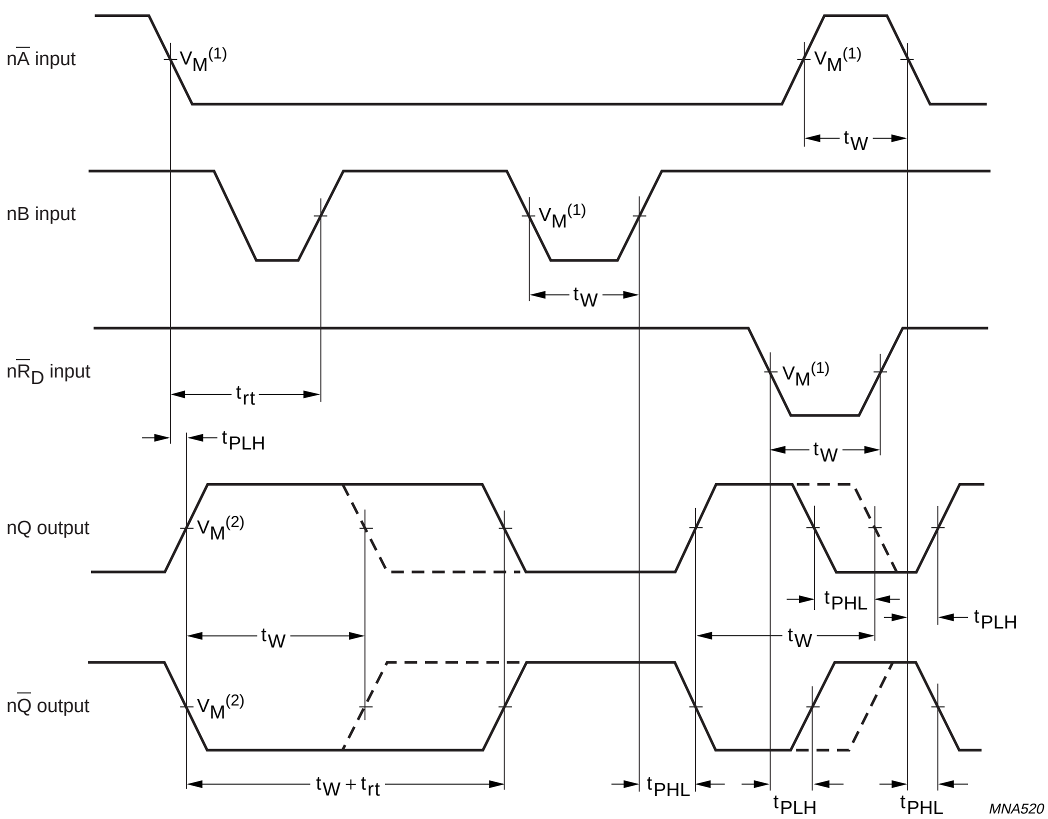
| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $C_L$ | 25 | | | −40 to +85 | | −40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| **$V_{CC}$ = 4.5 to 5.5 V;** note 1 | | | | | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay; $n\overline{A}$, nB to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | 15 pF | – | 5.0 | 12 | 1.0 | 14 | 1.0 | 15.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 5.2 | 12.9 | 1.0 | 15.0 | 1.0 | 16.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ (reset) | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 4.7 | 9.4 | 1.0 | 11 | 1.0 | 12.0 | ns |
| | propagation delay; $n\overline{A}$, nB to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | 50 pF | – | 7.1 | 14 | 1.0 | 16 | 1.0 | 17.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 7.5 | 14.9 | 1.0 | 17.0 | 1.0 | 18.5 | ns |
| | propagation delay; $n\overline{R}_D$ to nQ, $n\overline{Q}$ (reset) | $C_{EXT}$ = 0 pF; $R_{EXT}$ = 5 kΩ; see Figs 7 and 11 | | – | 6.7 | 11.4 | 1.0 | 13 | 1.0 | 14.5 | ns |
| $t_W$ | trigger pulse width; $n\overline{A}$ = LOW | see Fig 8 | 50 pF | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | trigger pulse width; nB = HIGH | see Fig 8 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | reset pulse width; $n\overline{R}_D$ = LOW | see Fig 9 | | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | output pulse width; nQ = HIGH; $n\overline{Q}$ = LOW | $C_{EXT}$ = 28 pF; $R_{EXT}$ = 2 kΩ; note 2; see Figs 8, 9 and 10 | | – | 100 | 200 | – | 240 | – | 240 | ns |
| | | $C_{EXT}$ = 0.01 µF; $R_{EXT}$ = 10 kΩ; note 2; see Figs 8, 9 and 10 | | 90 | 100 | 110 | 90 | 110 | 85 | 115 | µs |
| | | $C_{EXT}$ = 0.1 µF; $R_{EXT}$ = 10 kΩ; note 2; see Figs 8, 9 and 10 | | 0.9 | 1 | 1.1 | 0.9 | 1.1 | 0.85 | 1.15 | ms |

| SYMBOL | PARAMETER | TEST CONDITIONS | | $T_{amb}$ (°C) | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $C_L$ | 25 | | | −40 to +85 | | −40 to +125 | | |
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| **$V_{CC}$ = 4.5 to 5.5 V;** note 1 | | | | | | | | | | | |
| $t_{rt}$ | retrigger time; $n\overline{A}$ to nB | $C_{EXT}$ = 100 pF; $R_{EXT}$ = 1 kΩ; see Figs 8, 9 and 10 | 50 pF | – | 60 | – | – | – | – | – | ns |
| | | $C_{EXT}$ = 0.01 μF; $R_{EXT}$ = 1 kΩ; see Figs 8, 9 and 10 | | – | 1.5 | – | – | – | – | – | μs |

**Notes**

1. Typical values are measured at $V_{CC}$ = 5.0 V and $T_{amb}$ = 25 °C.
2. For $C_{EXT} \geq 10$ nF the typical value of the pulse width $t_W$ (μs) = $R_{EXT}$ (kΩ) × $C_{EXT}$ (nF).

## AC WAVEFORMS




| FAMILY | $V_I$ INPUT REQUIREMENTS | $V_M$ (1) INPUT | $V_M$ (2) OUTPUT |
|---|---|---|---|
| AHC | GND to $V_{CC}$ | 50% $V_{CC}$ | 50% $V_{CC}$ |
| AHCT | GND to 3.0 V | 1.5 V | 50% $V_{CC}$ |

Fig.7 Input ($n\overline{A}$, nB, $n\overline{R}_D$) to output (nQ, $n\overline{Q}$) propagation delays, the input and output pulse widths and the input retrigger time.

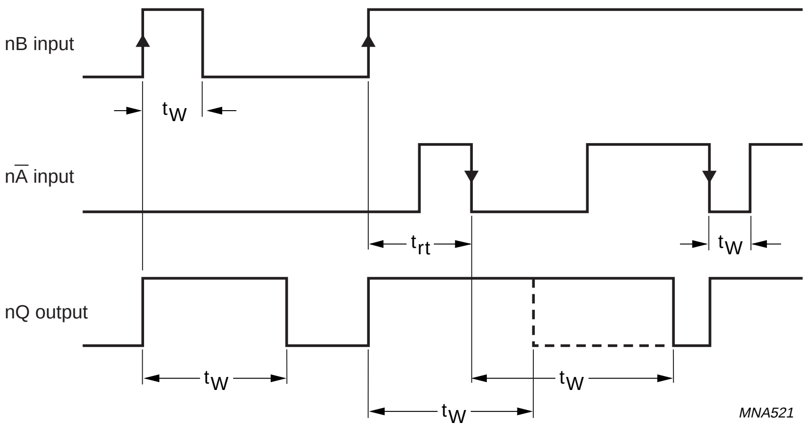



Fig.8 Output pulse control using retrigger pulse; $n\overline{R}_D$ = HIGH.

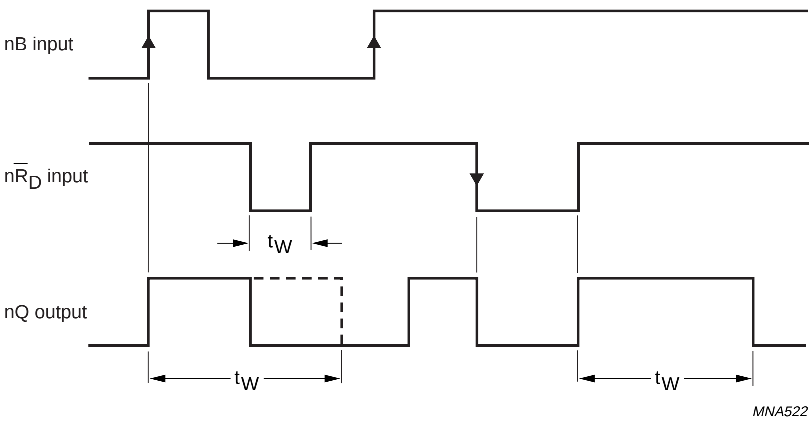



Fig.9 Output pulse control using reset input $n\overline{R}_D$; $n\overline{A}$ = LOW.

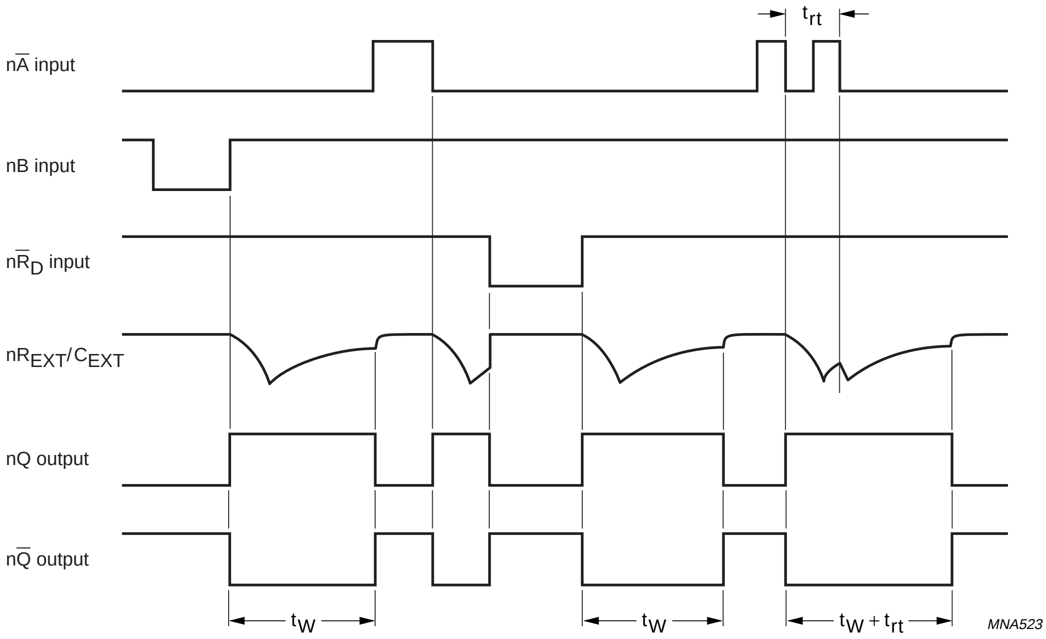
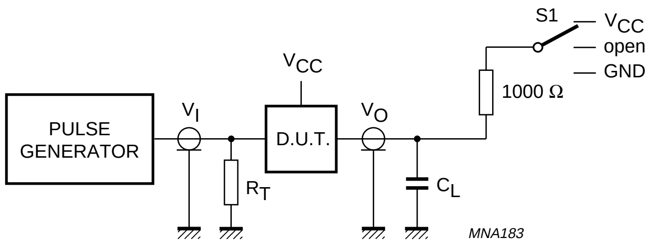



Fig.10 Input and output timing.




| TEST | S1 |
|---|---|
| $t_{PLH}/t_{PHL}$ | open |
| $t_{PLZ}/t_{PZL}$ | $V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND |

Definitions for test circuit.

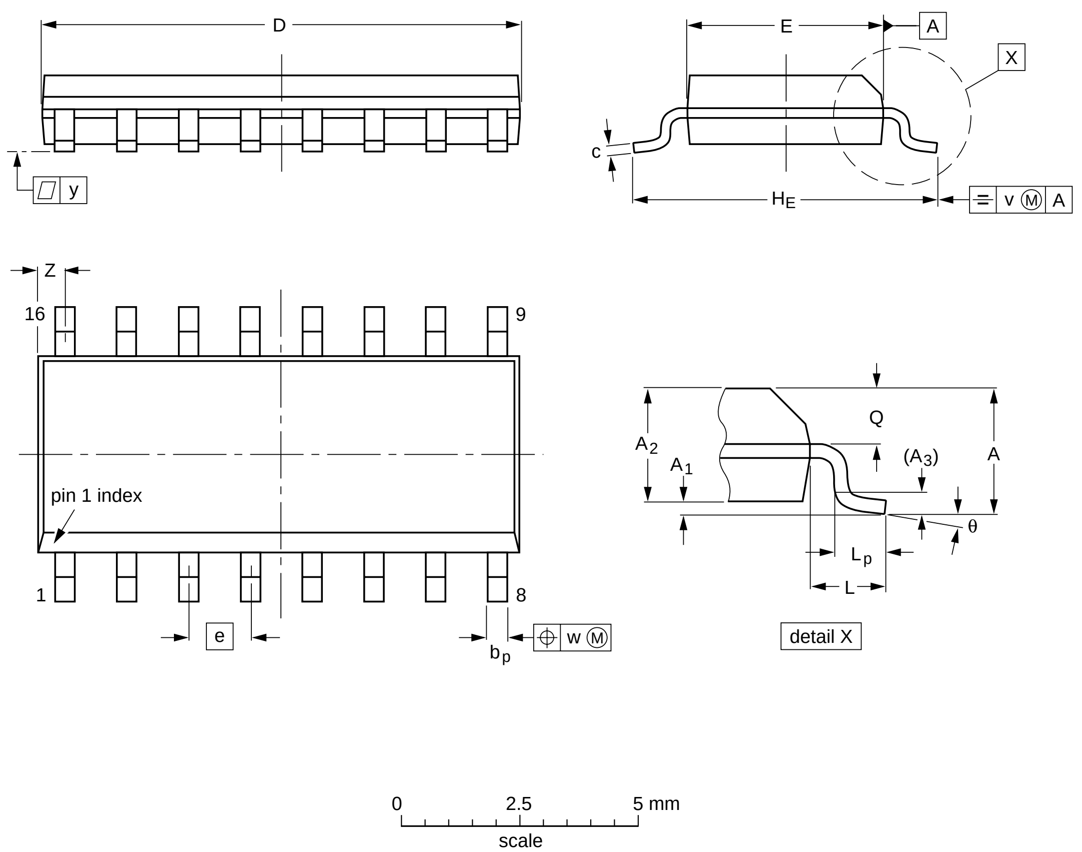
$C_L$ = load capacitance including jig and probe capacitance (See Chapter “AC characteristics”).

$R_T$ = termination resistance should be equal to the output impedance $Z_o$ of the pulse generator.

Fig.11 Load circuitry for switching times.

## PACKAGE OUTLINES

**SO16: plastic small outline package; 16 leads; body width 3.9 mm** **SOT109-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

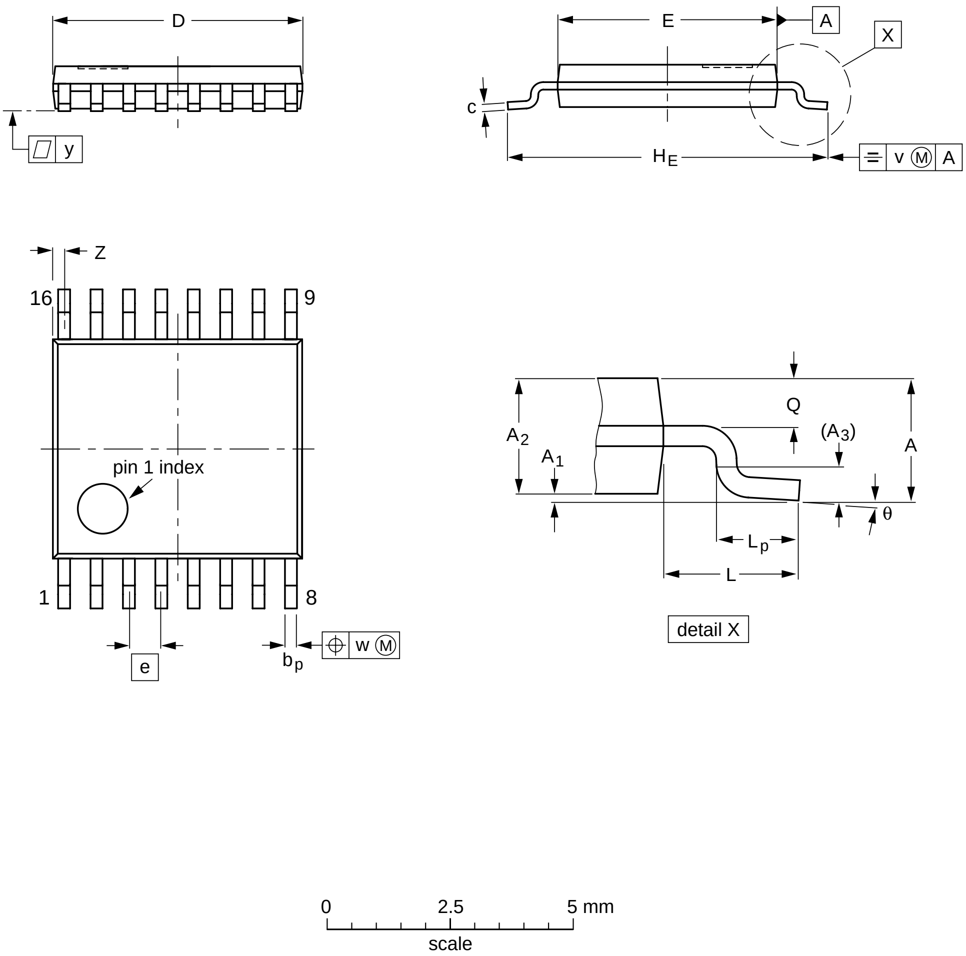
| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (1) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 10.0<br>9.8 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | 8°<br>0° |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38 | 0.16<br>0.15 | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT109-1 | 076E07 | MS-012 | | | | ~~97-05-22~~<br>99-12-27 |

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




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

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.10 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 5.1<br>4.9 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1.0 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.40<br>0.06 | 8°<br>0° |

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT403-1 | | MO-153 | | | | ~~95-04-04~~<br>99-12-27 |

## SOLDERING

### Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

### Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferable be kept below 230 °C.

### Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

  The footprint must incorporate solder thieves at the downstream end.
- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.
A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

### Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

**Suitability of surface mount IC packages for wave and reflow soldering methods**

| PACKAGE | SOLDERING METHOD | |
|---|---|---|
| | WAVE | REFLOW[1] |
| BGA, LFBGA, SQFP, TFBGA | not suitable | suitable |
| HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, SMS | not suitable[2] | suitable |
| PLCC[3], SO, SOJ | suitable | suitable |
| LQFP, QFP, TQFP | not recommended[3][4] | suitable |
| SSOP, TSSOP, VSO | not recommended[5] | suitable |

**Notes**

1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
3. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
5. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

## DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
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