

DATA SHEET

74ALVC74

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

Product specification
Supersedes data of 2003 Jan 24

2003 May 26

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

74ALVC74

FEATURES

- Wide supply voltage range from 1.65 to 3.6 V
- Complies with JEDEC standard:
JESD8-7 (1.65 to 1.95 V)
JESD8-5 (2.3 to 2.7 V)
JESD8B/JESD36 (2.7 to 3.6 V).
- 3.6 V tolerant inputs/outputs
- CMOS low power consumption
- Direct interface with TTL levels (2.7 to 3.6 V)
- Power-down mode
- Latch-up performance exceeds 250 mA
- ESD protection:
HBM EIA/JESD22-A114-A exceeds 2000 V
MM EIA/JESD22-A115-A exceeds 200 V.

DESCRIPTION

The 74ALVC74 is a dual positive-edge triggered, D-type flip-flop with individual data (D), clock (CP), 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. Information on the data input is transferred to the Q output on the LOW-to-HIGH transition of the clock pulse. The D inputs must be stable one set-up time prior to the LOW-to-HIGH clock transition for predictable operation.

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

QUICK REFERENCE DATA

GND = 0 V; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | UNIT |
|-------------------|---|---|---------|------|
| t_{PHL}/t_{PLH} | propagation delay nCP to nQ, n \overline{Q} | $V_{CC} = 1.8\text{ V}; C_L = 30\text{ pF}; R_L = 1\text{ k}\Omega$ | 3.7 | ns |
| | | $V_{CC} = 2.5\text{ V}; C_L = 30\text{ pF}; R_L = 500\ \Omega$ | 2.6 | ns |
| | | $V_{CC} = 2.7\text{ V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$ | 2.8 | ns |
| | | $V_{CC} = 3.3\text{ V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$ | 2.7 | ns |
| t_{PHL}/t_{PLH} | propagation delay n \overline{SD} , n \overline{RD} to nQ, n \overline{Q} | $V_{CC} = 1.8\text{ V}; C_L = 30\text{ pF}; R_L = 1\text{ k}\Omega$ | 3.5 | ns |
| | | $V_{CC} = 2.5\text{ V}; C_L = 30\text{ pF}; R_L = 500\ \Omega$ | 2.5 | ns |
| | | $V_{CC} = 2.7\text{ V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$ | 3.1 | ns |
| | | $V_{CC} = 3.3\text{ V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$ | 2.3 | ns |
| f_{max} | maximum clock frequency | | 425 | MHz |
| C_I | input capacitance | | 3.5 | pF |
| C_{PD} | power dissipation capacitance per buffer | $V_{CC} = 3.3\text{ V}$; notes 1 and 2 | 35 | pF |

Notes

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

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in Volts;

N = total load switching outputs;

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

2. The condition is $V_I = \text{GND to } V_{CC}$.

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

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ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | | | |
|-------------|-------------------|------|----------|----------|----------|
| | TEMPERATURE RANGE | PINS | PACKAGE | MATERIAL | CODE |
| 74ALVC74D | -40 to +85 °C | 14 | SO14 | plastic | SOT108-1 |
| 74ALVC74PW | -40 to +85 °C | 14 | TSSOP14 | plastic | SOT402-1 |
| 74ALVC74BQ | -40 to +85 °C | 14 | DHVQFN14 | plastic | SOT762-1 |

FUNCTION TABLES

Table 1 See note 1

| INPUT | | | | OUTPUT | |
|-------|-----|-----|----|--------|-----|
| nSD | nRD | nCP | nD | nQ | nQ̄ |
| L | H | X | X | H | L |
| H | L | X | X | L | H |
| L | L | X | X | H | H |

Table 2 See note 1

| INPUT | | | | OUTPUT | |
|-------|-----|-----|----|-------------------|--------------------|
| nSD | nRD | nCP | nD | nQ _{n+1} | nQ̄ _{n+1} |
| H | H | ↑ | L | L | H |
| H | H | ↑ | H | H | L |

Note

1. H = HIGH voltage level;
L = LOW voltage level;
X = don't care;
↑ = LOW-to-HIGH CP transition;
Q_{n+1} = state after the next LOW-to-HIGH transition of CP.

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PINNING

| PIN | SYMBOL | DESCRIPTION |
|-----|-----------------|--|
| 1 | 1 $\bar{R}D$ | asynchronous reset-direct input (active LOW) |
| 2 | 1D | data input |
| 3 | 1CP | clock input (LOW-to-HIGH, edge-triggered) |
| 4 | 1 $\bar{S}D$ | asynchronous set-direct input (active LOW) |
| 5 | 1Q | true flip-flop output |
| 6 | 1 \bar{Q} | complement flip-flop output |
| 7 | GND | ground (0 V) |
| 8 | 2 \bar{Q} | complement flip-flop output |
| 9 | 2Q | true flip-flop output |
| 10 | 2 $\bar{S}D$ | asynchronous set-direct input (active LOW) |
| 11 | 2CP | clock input (LOW-to-HIGH, edge-triggered) |
| 12 | 2D | data input |
| 13 | 2 $\bar{R}D$ | asynchronous reset-direct input (active LOW) |
| 14 | V _{CC} | supply voltage |

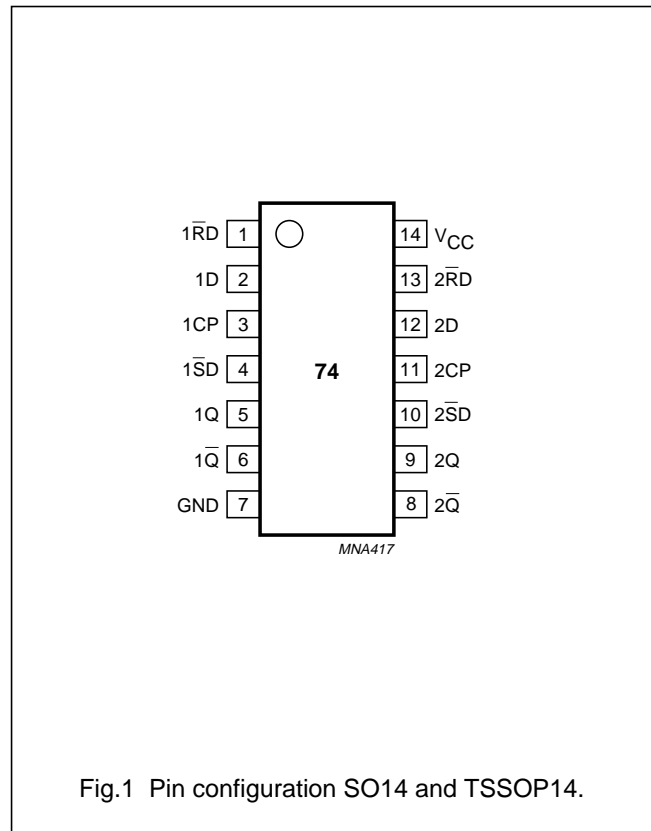


Fig.1 Pin configuration SO14 and TSSOP14.

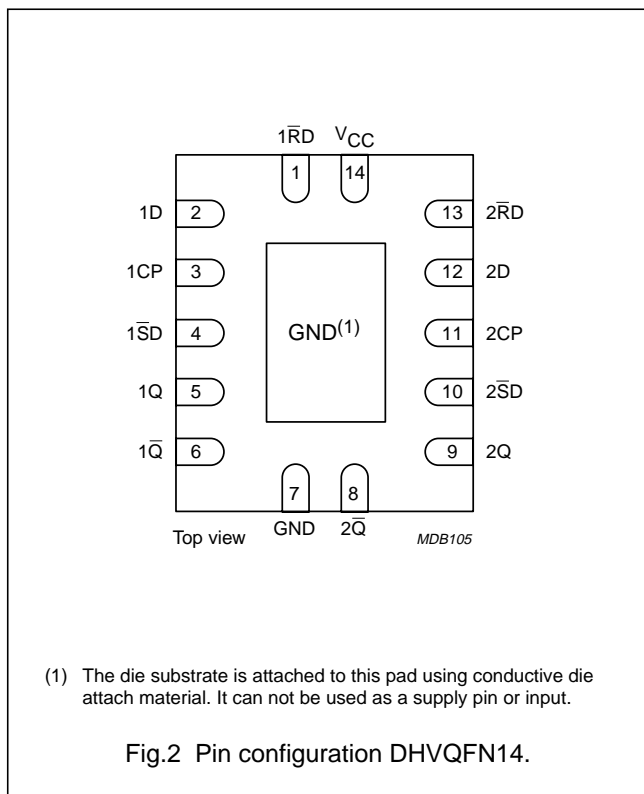


Fig.2 Pin configuration DHVQFN14.

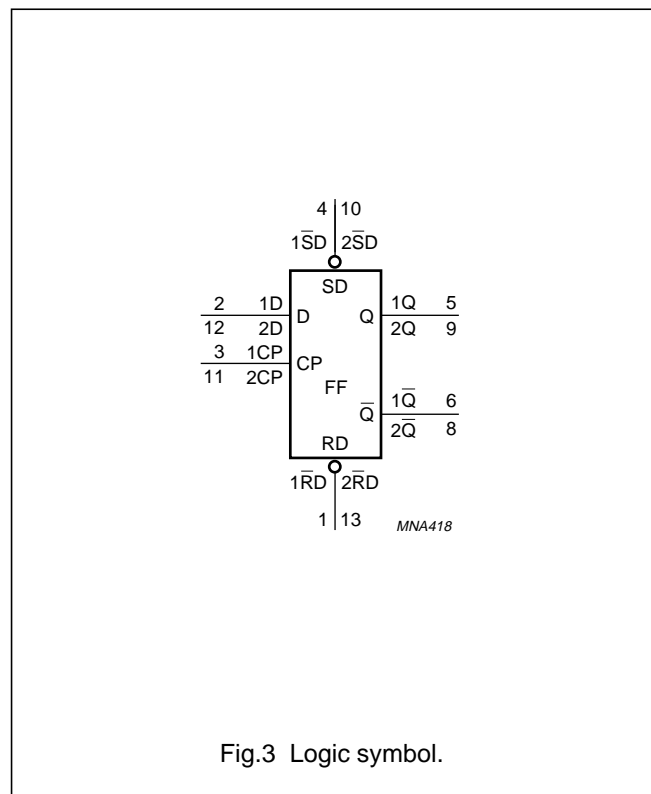
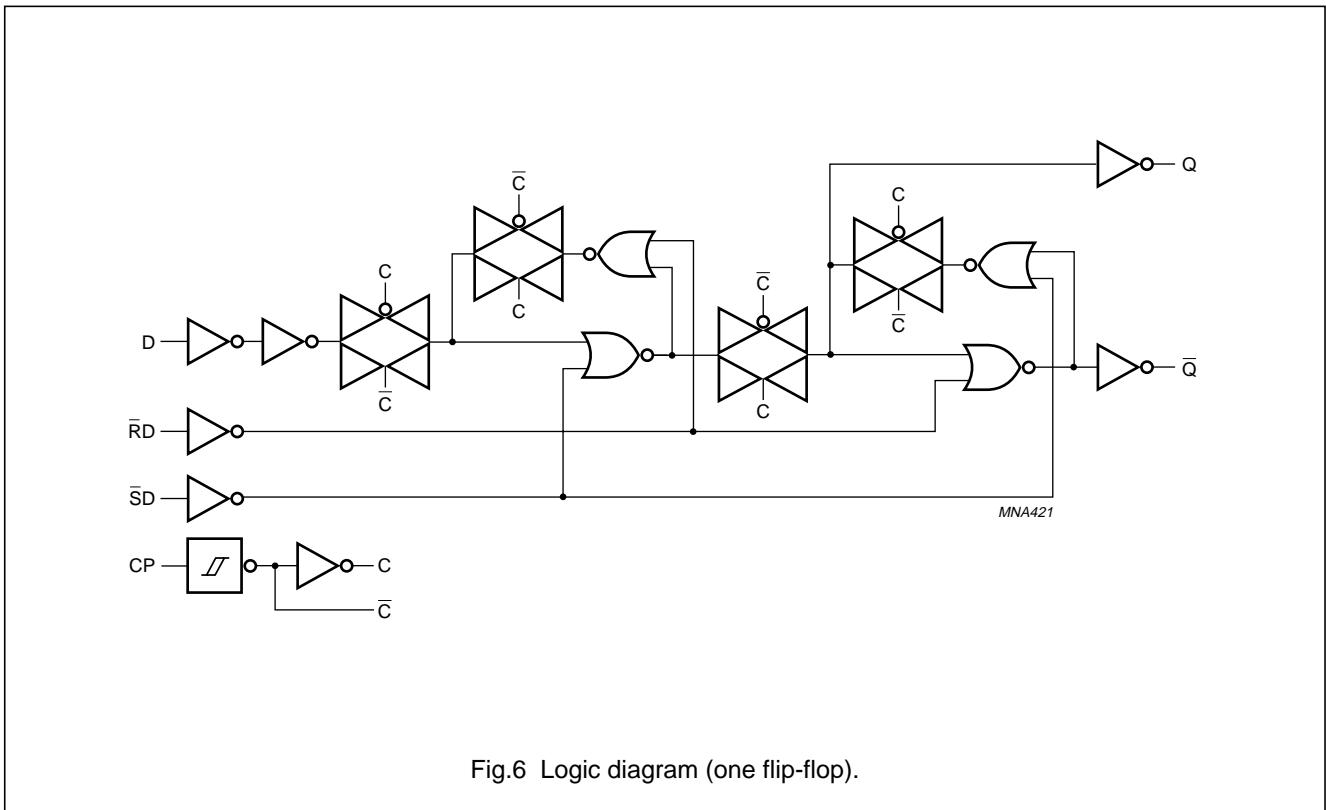
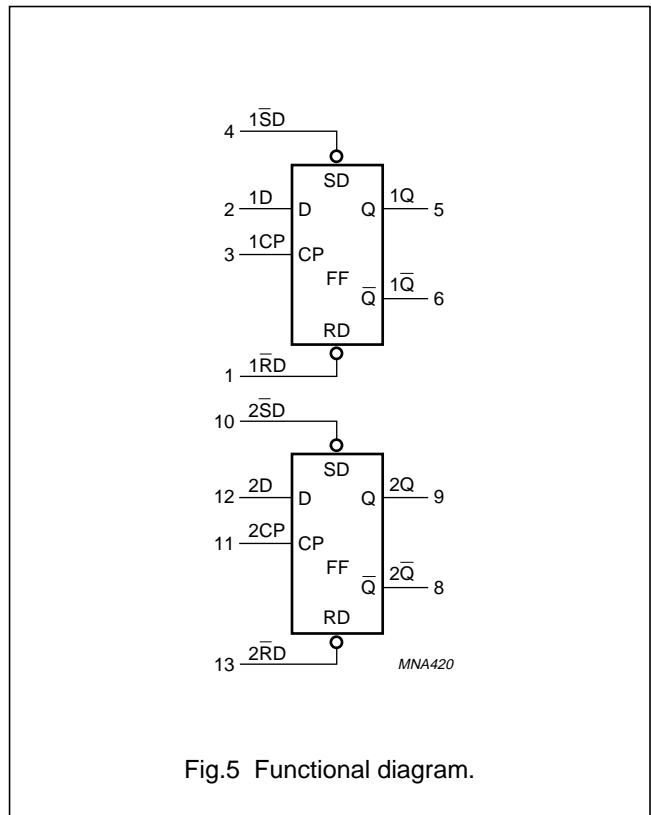
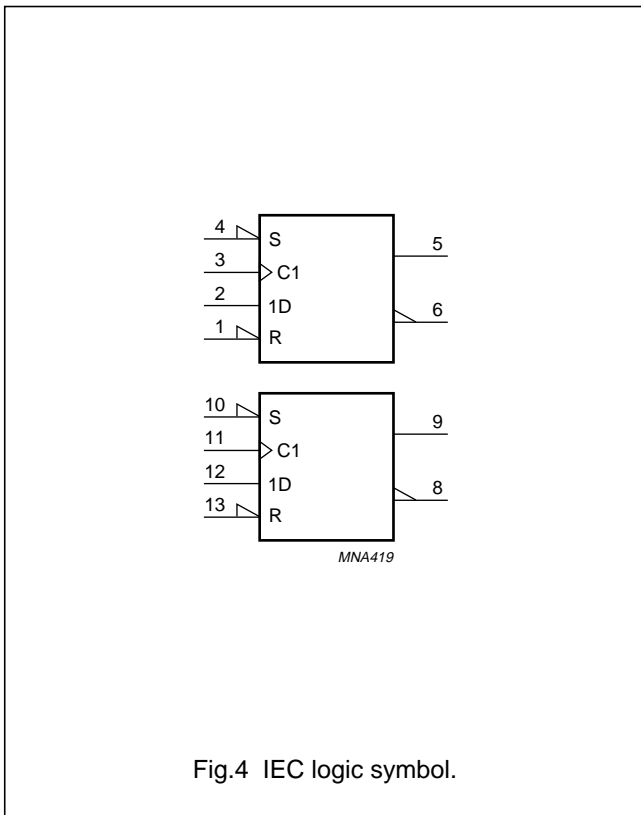


Fig.3 Logic symbol.

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

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Dual D-type flip-flop with set and reset;
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RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|------------|-------------------------------|---------------------------------|------|----------|------|
| V_{CC} | supply voltage | | 1.65 | 3.6 | V |
| V_I | input voltage | | 0 | 3.6 | V |
| V_O | output voltage | $V_{CC} = 1.65$ to 3.6 V | 0 | V_{CC} | V |
| | | $V_{CC} = 0$ V; Power-down mode | 0 | 3.6 | V |
| T_{amb} | operating ambient temperature | | -40 | +85 | °C |
| t_r, t_f | input rise and fall times | $V_{CC} = 1.65$ to 2.7 V | 0 | 20 | ns/V |
| | | $V_{CC} = 2.7$ to 3.6 V | 0 | 10 | ns/V |

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 | +4.6 | V |
| I_{IK} | input diode current | $V_I < 0$ | - | -50 | mA |
| V_I | input voltage | | -0.5 | +4.6 | V |
| I_{OK} | output diode current | $V_O > V_{CC}$ or $V_O < 0$ | - | ± 50 | mA |
| V_O | output voltage | note 1 | -0.5 | $V_{CC} + 0.5$ | V |
| | | Power-down mode; note 2 | -0.5 | +4.6 | V |
| I_O | output source or sink current | $V_O = 0$ to V_{CC} | - | ± 50 | mA |
| I_{CC}, I_{GND} | V_{CC} or GND current | | - | ± 100 | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | power dissipation | $T_{amb} = -40$ to $+85$ °C; note 3 | - | 500 | mW |

Notes

- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- When $V_{CC} = 0$ V (Power-down mode), the output voltage can be 3.6 V in normal operation.
- For SO14 packages: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
For TSSOP14 packages: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.
For DHVQFN14 packages: above 60 °C the value of P_{tot} derates linearly with 4.5 mW/K.

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DC CHARACTERISTICS

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

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|--|---|--|---------------------|------------------------|---------------------|------------------------|------|
| | | OTHER | V _{CC} (V) | | | | |
| T_{amb} = -40 to +85 °C | | | | | | | |
| V _{IH} | HIGH-level input voltage | | 1.65 to 1.95 | 0.65 × V _{CC} | – | – | V |
| | | | 2.3 to 2.7 | 1.7 | – | – | V |
| | | | 2.7 to 3.6 | 2 | – | – | V |
| V _{IL} | LOW-level input voltage | | 1.65 to 1.95 | – | – | 0.35 × V _{CC} | V |
| | | | 2.3 to 2.7 | – | – | 0.7 | V |
| | | | 2.7 to 3.6 | – | – | 0.8 | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | 1.65 to 3.6 | – | – | 0.2 | V |
| | | I _O = 100 μA | 1.65 | – | 0.11 | 0.3 | V |
| | | I _O = 6 mA | 2.3 | – | 0.17 | 0.4 | V |
| | | I _O = 12 mA | 2.3 | – | 0.25 | 0.6 | V |
| | | I _O = 12 mA | 2.7 | – | 0.16 | 0.4 | V |
| | | I _O = 18 mA | 3.0 | – | 0.23 | 0.4 | V |
| | | I _O = 24 mA | 3.0 | – | 0.30 | 0.55 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | 1.65 to 3.6 | V _{CC} – 0.2 | – | – | V |
| | | I _O = –100 μA | 1.65 | 1.25 | 1.51 | – | V |
| | | I _O = –6 mA | 2.3 | 1.8 | 2.10 | – | V |
| | | I _O = –12 mA | 2.3 | 1.7 | 2.01 | – | V |
| | | I _O = –12 mA | 2.7 | 2.2 | 2.53 | – | V |
| | | I _O = –18 mA | 3.0 | 2.4 | 2.76 | – | V |
| | | I _O = –24 mA | 3.0 | 2.2 | 2.68 | – | V |
| I _{LI} | input leakage current | V _I = 3.6 V or GND | 3.6 | – | ±0.1 | ±5 | μA |
| I _{off} | power OFF leakage current | V _I or V _O = 3.6 V | 0.0 | – | ±0.1 | ±10 | μA |
| I _{CC} | quiescent supply current | V _I = V _{CC} or GND; I _O = 0 | 3.6 | – | 0.2 | 10 | μA |
| ΔI _{CC} | additional quiescent supply current per input pin | V _I = V _{CC} – 0.6 V; I _O = 0 | 3.0 to 3.6 | – | 5 | 750 | μA |

Note

1. All typical values are measured at T_{amb} = 25 °C.

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AC CHARACTERISTICS

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|--|--|------------------|---------------------|------|---------------------|------|------|
| | | OTHER | V _{CC} (V) | | | | |
| T_{amb} = -40 to +85 °C | | | | | | | |
| t _{PHL} /t _{PLH} | propagation delay nCP to nQ, n \bar{Q} | see Figs 6 and 8 | 1.65 to 1.95 | 1.0 | 3.7 | 6.2 | ns |
| | | | 2.3 to 2.7 | 1.0 | 2.6 | 4.2 | ns |
| | | | 2.7 | 1.0 | 2.8 | 4.2 | ns |
| | | | 3.0 to 3.6 | 1.0 | 2.7 | 3.8 | ns |
| t _{PHL} /t _{PLH} | propagation delay n \bar{SD} to nQ, n \bar{Q} | see Figs 7 and 8 | 1.65 to 1.95 | 1.0 | 3.4 | 5.4 | ns |
| | | | 2.3 to 2.7 | 1.0 | 2.4 | 3.8 | ns |
| | | | 2.7 | 1.0 | 3.2 | 4.2 | ns |
| | | | 3.0 to 3.6 | 1.0 | 2.3 | 3.5 | ns |
| t _{PHL} /t _{PLH} | propagation delay n \bar{RD} to nQ, n \bar{Q} | see Figs 7 and 8 | 1.65 to 1.95 | 1.0 | 3.5 | 5.4 | ns |
| | | | 2.3 to 2.7 | 1.0 | 2.5 | 3.8 | ns |
| | | | 2.7 | 1.0 | 3.1 | 4.3 | ns |
| | | | 3.0 to 3.6 | 1.0 | 2.3 | 3.5 | ns |
| t _w | clock pulse width HIGH or LOW | see Figs 6 and 8 | 1.65 to 1.95 | 2.5 | 0.9 | – | ns |
| | | | 2.3 to 2.7 | 2.5 | 0.6 | – | ns |
| | | | 2.7 | 2.5 | 1.3 | – | ns |
| | | | 3.0 to 3.6 | 2.5 | 1.3 | – | ns |
| t _w | set or reset pulse width LOW | see Figs 7 and 8 | 1.65 to 1.95 | 2.5 | 0.9 | – | ns |
| | | | 2.3 to 2.7 | 2.5 | 0.9 | – | ns |
| | | | 2.7 | 2.5 | 1.0 | – | ns |
| | | | 3.0 to 3.6 | 2.5 | 0.7 | – | ns |
| t _{rem} | removal time set or reset | see Figs 7 and 8 | 1.65 to 1.95 | 0.7 | -0.2 | – | ns |
| | | | 2.3 to 2.7 | 0.7 | -0.1 | – | ns |
| | | | 2.7 | 0.7 | -0.1 | – | ns |
| | | | 3.0 to 3.6 | 0.7 | -0.1 | – | ns |
| t _{su} | set-up time nD to nCP | see Figs 6 and 8 | 1.65 to 1.95 | 1.2 | 0.6 | – | ns |
| | | | 2.3 to 2.7 | 1.2 | 0.8 | – | ns |
| | | | 2.7 | 0.9 | 0.5 | – | ns |
| | | | 3.0 to 3.6 | 0.8 | 0.4 | – | ns |
| t _h | hold time nD to nCP | see Figs 6 and 8 | 1.65 to 1.95 | 0.6 | -0.4 | – | ns |
| | | | 2.3 to 2.7 | 0.6 | -0.3 | – | ns |
| | | | 2.7 | 0.7 | -0.4 | – | ns |
| | | | 3.0 to 3.6 | 0.8 | -0.1 | – | ns |

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

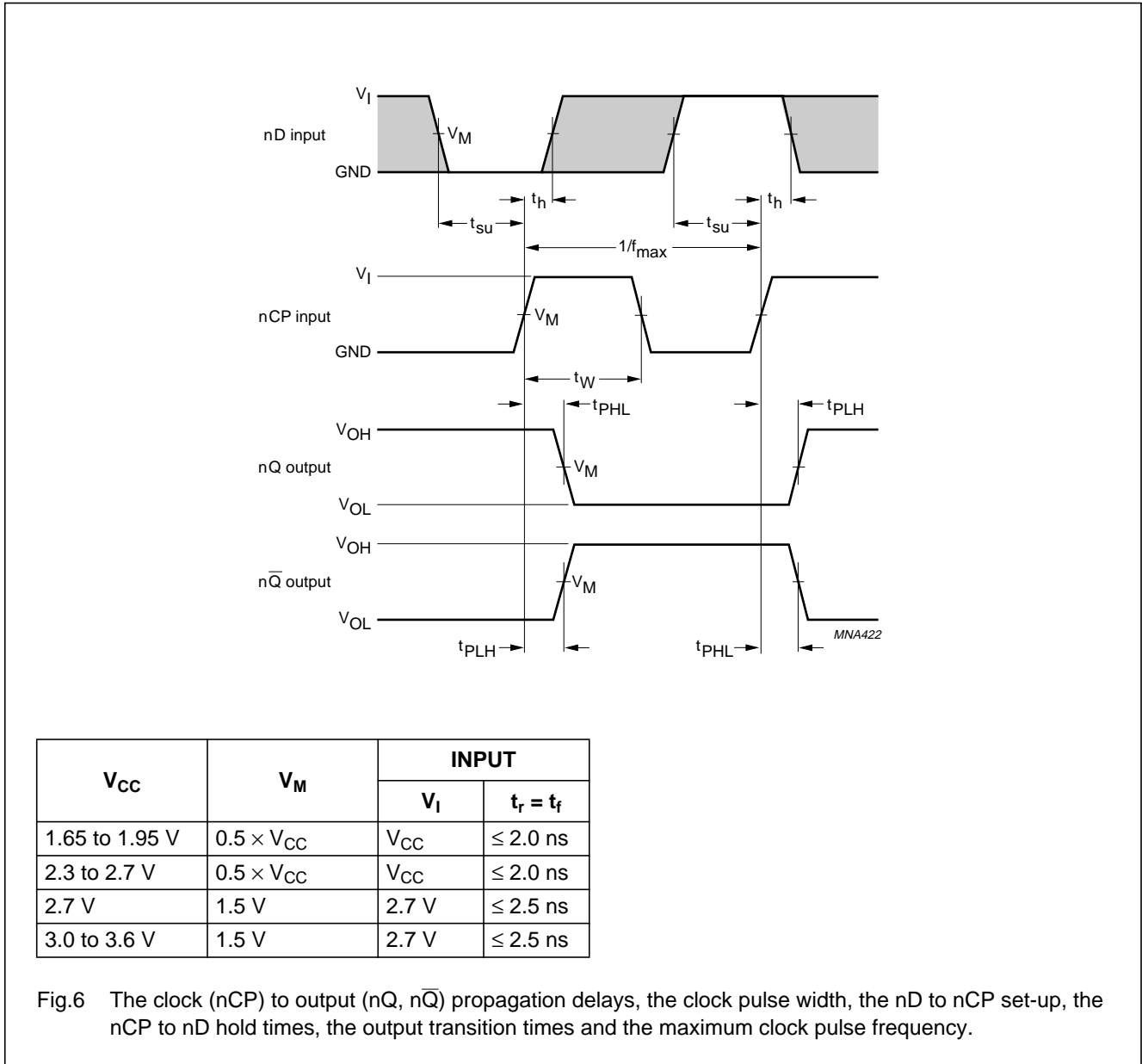
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| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|------------------|-------------------------------|------------------|---------------------|------|---------------------|------|------|
| | | OTHER | V _{CC} (V) | | | | |
| f _{max} | maximum clock pulse frequency | see Figs 6 and 8 | 1.65 to 1.95 | 150 | 275 | – | MHz |
| | | | 2.3 to 2.7 | 200 | 325 | – | MHz |
| | | | 2.7 | 250 | 375 | – | MHz |
| | | | 3.0 to 3.6 | 300 | 425 | – | MHz |

Note

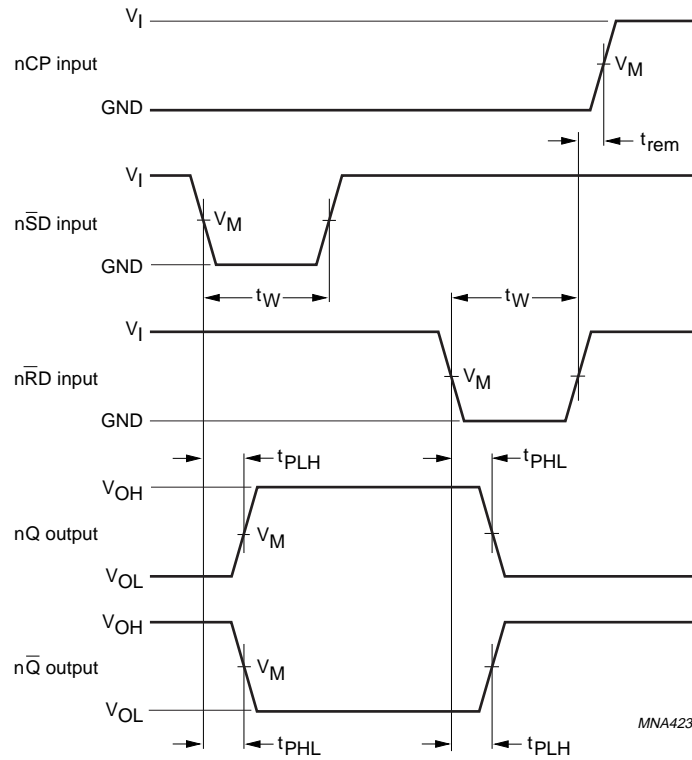
1. All typical values are measured at T_{amb} = 25 °C.

AC WAVEFORMS



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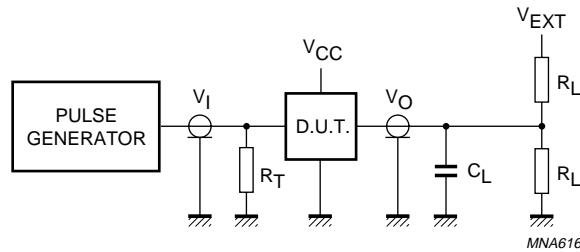


| V_{CC} | V_M | INPUT | |
|----------------|---------------------|----------|---------------|
| | | V_I | $t_r = t_f$ |
| 1.65 to 1.95 V | $0.5 \times V_{CC}$ | V_{CC} | ≤ 2.0 ns |
| 2.3 to 2.7 V | $0.5 \times V_{CC}$ | V_{CC} | ≤ 2.0 ns |
| 2.7 V | 1.5 V | 2.7 V | ≤ 2.5 ns |
| 3.0 to 3.6 V | 1.5 V | 2.7 V | ≤ 2.5 ns |

Fig.7 The set ($n\overline{SD}$) and reset ($n\overline{RD}$) input to output (nQ , $n\overline{Q}$) propagation delays, the set and reset pulse widths and the $n\overline{RD}$ to $n\overline{CP}$ removal time.

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| V _{CC} | V _I | C _L | R _L | V _{EXT} | | |
|-----------------|-----------------|----------------|----------------|------------------------------------|------------------------------------|------------------------------------|
| | | | | t _{PLH} /t _{PHL} | t _{PZH} /t _{PHZ} | t _{PZL} /t _{PLZ} |
| 1.65 to 1.95 V | V _{CC} | 30 pF | 1 kΩ | open | GND | 2 × V _{CC} |
| 2.3 to 2.7 V | V _{CC} | 30 pF | 500 Ω | open | GND | 2 × V _{CC} |
| 2.7 V | 2.7 V | 50 pF | 500 Ω | open | GND | 6 V |
| 3.0 to 3.6 V | 2.7 V | 50 pF | 500 Ω | open | GND | 6 V |

Definitions for test circuits:

R_L = Load resistor.

C_L = Load capacitance including jig and probe capacitance.

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

Fig.8 Load circuitry for switching times.

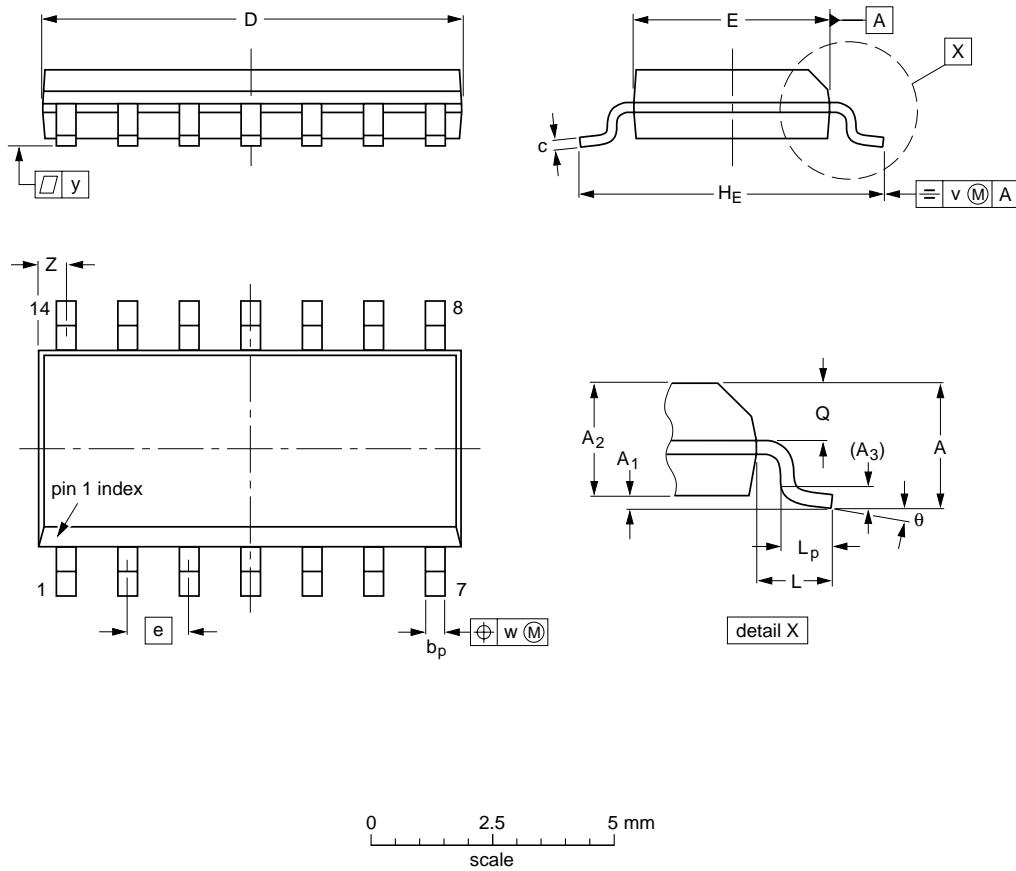
Dual D-type flip-flop with set and reset;
positive-edge trigger

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PACKAGE OUTLINES

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



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 0.10 | 1.45 1.25 | 0.25 | 0.49 0.36 | 0.25 0.19 | 8.75 8.55 | 4.0 3.8 | 1.27 | 6.2 5.8 | 1.05 | 1.0 0.4 | 0.7 0.6 | 0.25 | 0.25 | 0.1 | 0.7 0.3 | 8° 0° |
| inches | 0.069 | 0.010 0.004 | 0.057 0.049 | 0.01 | 0.019 0.014 | 0.0100 0.0075 | 0.35 0.34 | 0.16 0.15 | 0.05 | 0.244 0.228 | 0.041 | 0.039 0.016 | 0.028 0.024 | 0.01 | 0.01 | 0.004 | 0.028 0.012 | |

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

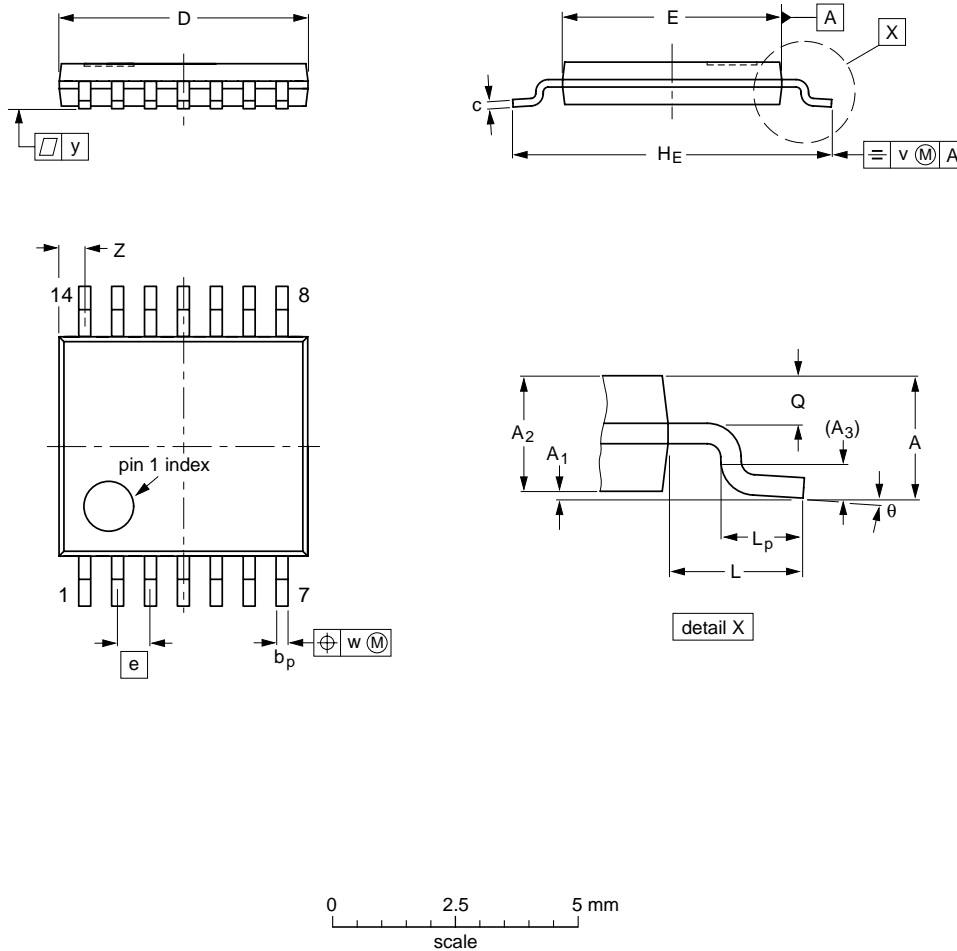
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT108-1 | 076E06 | MS-012 | | | | 99-12-27 03-02-19 |

Dual D-type flip-flop with set and reset;
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TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



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 | 1.1 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.72 0.38 | 8° 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.

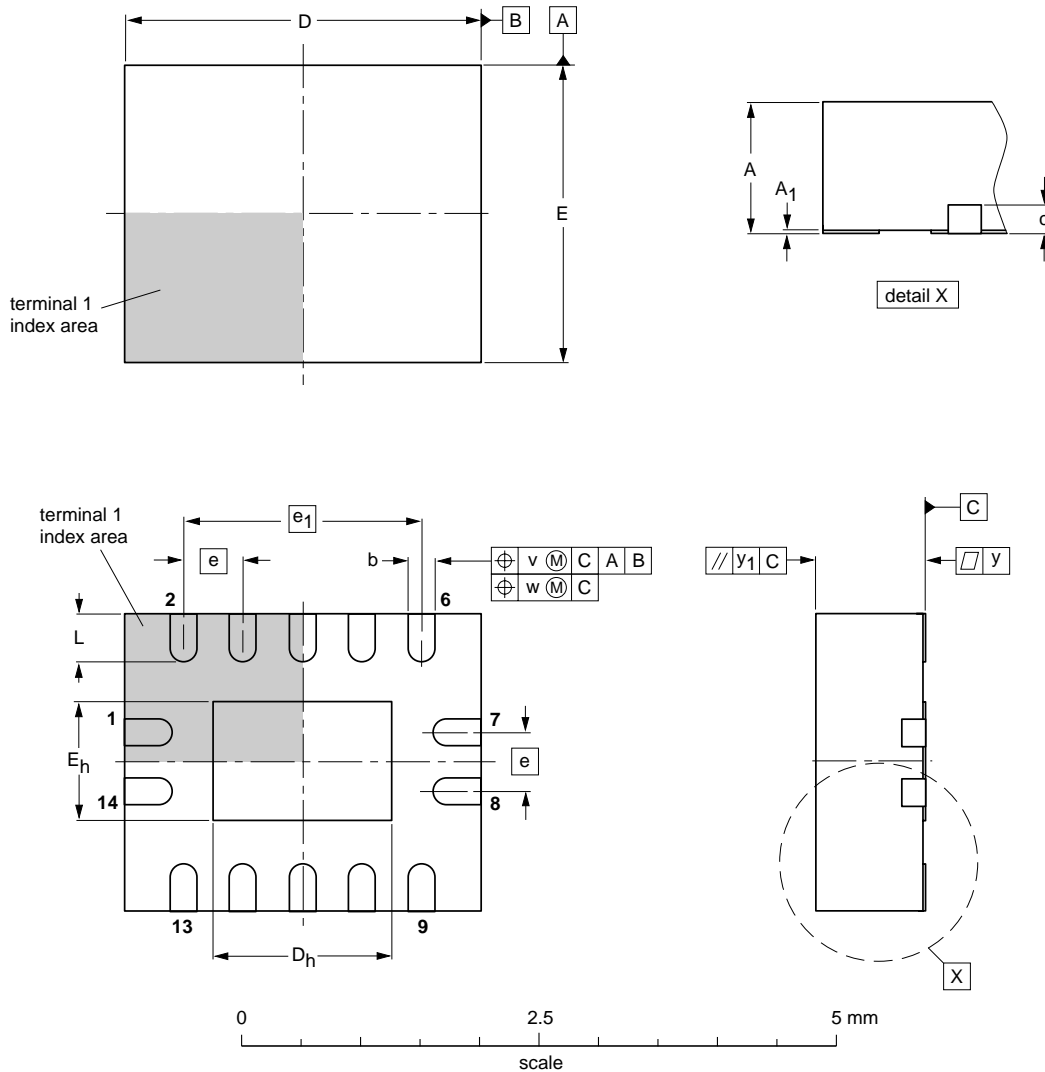
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|--------|-------|--|------------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT402-1 | | MO-153 | | | | 99-12-27 03-02-18 |

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DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads;
14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A ⁽¹⁾ max. | A ₁ | b | c | D ⁽¹⁾ | D _h | E ⁽¹⁾ | E _h | e | e ₁ | L | v | w | y | y ₁ |
|------|--------------------------|----------------|--------------|-----|------------------|----------------|------------------|----------------|-----|----------------|------------|-----|------|------|----------------|
| mm | 1 | 0.05 0.00 | 0.30 0.18 | 0.2 | 3.1 2.9 | 1.65 1.35 | 2.6 2.4 | 1.15 0.85 | 0.5 | 2 | 0.5 0.3 | 0.1 | 0.05 | 0.05 | 0.1 |

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|--------|-------|------------------------|----------------------|
| | IEC | JEDEC | JEITA | | |
| SOT762-1 | --- | MO-241 | --- | | 02-10-17 03-01-27 |

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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 can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

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. Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing.

Several methods exist for reflowing; for example, convection or convection/infrared 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 270 °C depending on solder paste material. The top-surface temperature of the packages should preferably be kept:

- below 220 °C (SnPb process) or below 245 °C (Pb-free process)
 - for all the BGA packages
 - for packages with a thickness ≥ 2.5 mm
 - for packages with a thickness < 2.5 mm and a volume ≥ 350 mm³ so called thick/large packages.
- below 235 °C (SnPb process) or below 260 °C (Pb-free process) for packages with a thickness < 2.5 mm and a volume < 350 mm³ so called small/thin packages.

Moisture sensitivity precautions, as indicated on packing, must be respected at all times.

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 of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

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.

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

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

| PACKAGE ⁽¹⁾ | SOLDERING METHOD | |
|--|-----------------------------------|-----------------------|
| | WAVE | REFLOW ⁽²⁾ |
| BGA, LBGA, LFBGA, SQFP, TFBGA, VFBGA | not suitable | suitable |
| DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, HVSON, SMS | not suitable ⁽³⁾ | suitable |
| PLCC ⁽⁴⁾ , SO, SOJ | suitable | suitable |
| LQFP, QFP, TQFP | not recommended ⁽⁴⁾⁽⁵⁾ | suitable |
| SSOP, TSSOP, VSO, VSSOP | not recommended ⁽⁶⁾ | suitable |

Notes

1. For more detailed information on the BGA packages refer to the “(LF)BGA Application Note” (AN01026); order a copy from your Philips Semiconductors sales office.
2. 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”.
3. These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
4. 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.
5. Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
6. Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP 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.

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|-------|----------------------------------|----------------------------------|--|
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