

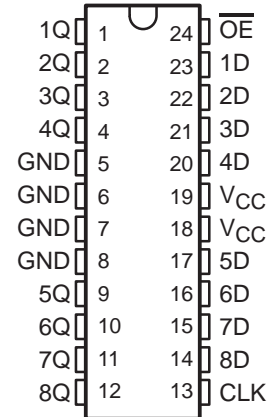
74AC11374

OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOP WITH 3-STATE OUTPUTS

SCAS214A – JULY 1987 – REVISED APRIL 1996

- Eight D-Type Flip-Flops in a Single Package
- 3-State Bus-Driving True Outputs
- Full Parallel Access for Loading
- Flow-Through Architecture Optimizes PCB Layout
- Center-Pin V_{CC} and GND Configurations Minimize High-Speed Switching Noise
- EPIC™ (Enhanced-Performance Implanted CMOS) 1- μ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages, and Standard Plastic 300-mil DIPs (NT)

DB, DW, OR NT PACKAGE
(TOP VIEW)



description

This 8-bit flip-flop features 3-state outputs designed specifically for driving highly-capacitive or relatively low-impedance loads. It is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight flip-flops of the 74AC11374 are edge-triggered D-type flip-flops. On the positive transition of the clock, the Q outputs are set to the logic levels set up at the D inputs.

The output-enable (\overline{OE}) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance third state provides the capability to drive the bus lines in a bus-organized system without need for interface or pullup components.

\overline{OE} does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The 74AC11374 is characterized for operation from -40°C to 85°C .

FUNCTION TABLE
(each flip-flop)

| INPUTS | | | OUTPUT |
|-----------------|--------------|---|--------|
| \overline{OE} | CLK | D | Q |
| L | \uparrow | H | H |
| L | \uparrow | L | L |
| L | L | X | Q_0 |
| L | H | X | Q_0 |
| L | \downarrow | X | Q_0 |
| H | X | X | Z |



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**TEXAS
INSTRUMENTS**

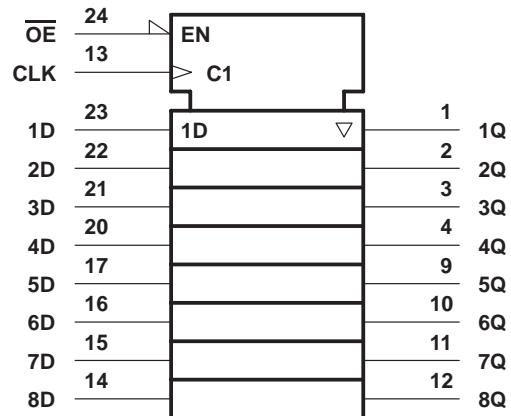
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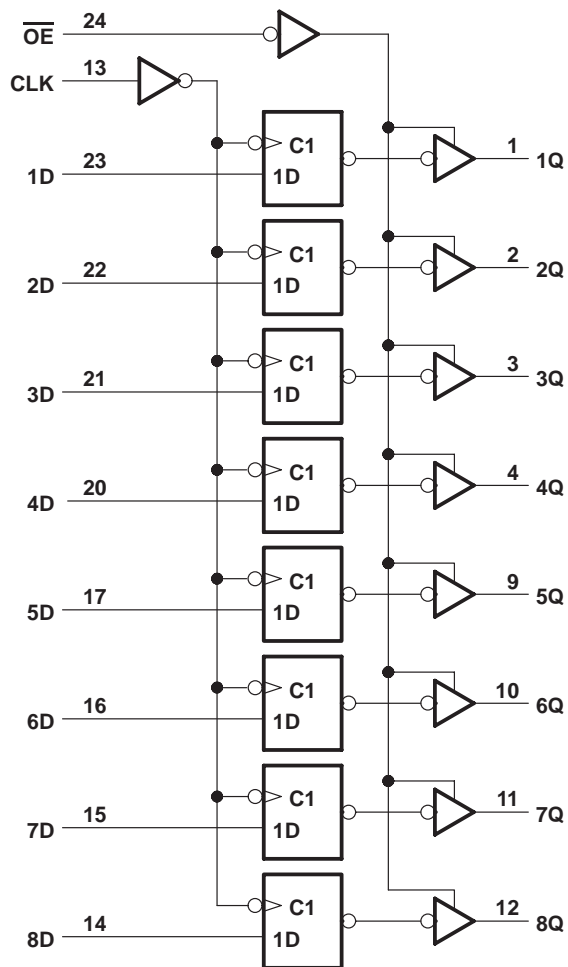
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logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|---|----------------------------|
| Supply voltage range, V_{CC} | –0.5 V to 7 V |
| Input voltage range, V_I (see Note 1) | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, V_O (see Note 1) | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) | ±20 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) | ±50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ±50 mA |
| Continuous current through V_{CC} or GND | ±200 mA |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DB package | 0.65 W |
| DW package | 1.7 W |
| NT package | 1.3 W |
| Storage temperature range, T_{stg} | –65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils, except for the NT package, which has a trace length of zero.

recommended operating conditions

| | | MIN | NOM | MAX | UNIT |
|---------------------|------------------------------------|------------------|------|----------|------|
| V_{CC} | Supply voltage | 3 | 5 | 5.5 | V |
| V_{IH} | High-level input voltage | $V_{CC} = 3$ V | 2.1 | | V |
| | | $V_{CC} = 4.5$ V | 3.15 | | |
| | | $V_{CC} = 5.5$ V | 3.85 | | |
| V_{IL} | Low-level input voltage | $V_{CC} = 3$ V | | 0.9 | V |
| | | $V_{CC} = 4.5$ V | | 1.35 | |
| | | $V_{CC} = 5.5$ V | | 1.65 | |
| V_I | Input voltage | 0 | | V_{CC} | V |
| V_O | Output voltage | 0 | | V_{CC} | V |
| I_{OH} | High-level output current | $V_{CC} = 3$ V | | –4 | mA |
| | | $V_{CC} = 4.5$ V | | –24 | |
| | | $V_{CC} = 5.5$ V | | –24 | |
| I_{OL} | Low-level output current | $V_{CC} = 3$ V | | 12 | mA |
| | | $V_{CC} = 4.5$ V | | 24 | |
| | | $V_{CC} = 5.5$ V | | 24 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | Data | 0 | 10 | ns/V |
| | | \overline{OE} | 0 | 5 | |
| T_A | Operating free-air temperature | –40 | | 85 | °C |



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | V _{CC} | T _A = 25°C | | | MIN | MAX | UNIT |
|---------------------------------------|---|-----------------|-----------------------|-----|------|------|-----|------|
| | | | MIN | TYP | MAX | | | |
| V _{OH} | I _{OH} = -50 μA | 3 V | 2.9 | | | 2.9 | | V |
| | | 4.5 V | 4.4 | | | 4.4 | | |
| | | 5.5 V | 5.4 | | | 5.4 | | |
| | I _{OH} = -4 mA | 3 V | 2.58 | | | 2.48 | | |
| | | 4.5 V | 3.94 | | | 3.8 | | |
| | | 5.5 V | 4.94 | | | 4.8 | | |
| I _{OH} = -75 mA [†] | 5.5 V | | | | 3.85 | | | |
| V _{OL} | I _{OL} = 50 μA | 3 V | | | | 0.1 | | V |
| | | 4.5 V | | | | 0.1 | | |
| | | 5.5 V | | | | 0.1 | | |
| | I _{OL} = 12 mA | 3 V | | | | 0.36 | | |
| | | 4.5 V | | | | 0.36 | | |
| | | 5.5 V | | | | 0.36 | | |
| I _{OL} = 24 mA | 5.5 V | | | | 0.44 | | | |
| I _{OL} = 75 mA [†] | 5.5 V | | | | 1.65 | | | |
| I _{OZ} | V _O = V _{CC} or GND | 5.5 V | | | | ±0.5 | ±5 | μA |
| I _I | V _I = V _{CC} or GND | 5.5 V | | | | ±0.1 | ±1 | μA |
| I _{CC} | V _I = V _{CC} or GND, I _O = 0 | 5.5 V | | | | 8 | 80 | μA |
| C _i | V _I = V _{CC} or GND | 5 V | | | | 4 | | pF |
| C _o | V _O = V _{CC} or GND | 5 V | | | | 10 | | pF |

[†] Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

timing requirements over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

| | | | T _A = 25°C | | MIN | MAX | UNIT |
|--------------------|------------------------------|-----------------|-----------------------|-----|-----|-----|------|
| | | | MIN | MAX | | | |
| f _{clock} | Clock frequency | | 0 | 75 | 0 | 75 | MHz |
| t _w | Pulse duration | CLK low or high | 6.5 | | 6.5 | | ns |
| t _{su} | Setup time, data before CLK↑ | | 2.5 | | 2.5 | | ns |
| t _h | Hold time, data after CLK↑ | | 4.5 | | 4.5 | | ns |

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

| | | | T _A = 25°C | | MIN | MAX | UNIT |
|--------------------|------------------------------|-----------------|-----------------------|-----|-----|-----|------|
| | | | MIN | MAX | | | |
| f _{clock} | Clock frequency | | 0 | 95 | 0 | 95 | MHz |
| t _w | Pulse duration | CLK low or high | 5 | | 5 | | ns |
| t _{su} | Setup time, data before CLK↑ | | 2.5 | | 2.5 | | ns |
| t _h | Hold time, data after CLK↑ | | 3.5 | | 3.5 | | ns |



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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $T_A = 25^\circ\text{C}$ | | | MIN | MAX | UNIT |
|------------------|------------------------|----------------|--------------------------|-----|------|-----|------|------|
| | | | MIN | TYP | MAX | | | |
| f_{\max} | | | 75 | 90 | | 75 | | MHz |
| t_{PLH} | CLK | Any Q | 1.5 | 9.5 | 12.5 | 1.5 | 14.2 | ns |
| t_{PHL} | | | 1.5 | 9 | 12.6 | 1.5 | 14 | |
| t_{PZH} | $\overline{\text{OE}}$ | Any Q | 1.5 | 8 | 10.9 | 1.5 | 12.3 | ns |
| t_{PZL} | | | 1.5 | 8 | 11.1 | 1.5 | 12.3 | |
| t_{PHZ} | $\overline{\text{OE}}$ | Any Q | 1.5 | 10 | 12.1 | 1.5 | 12.5 | ns |
| t_{PLZ} | | | 1.5 | 8 | 10.7 | 1.5 | 11.6 | |

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $T_A = 25^\circ\text{C}$ | | | MIN | MAX | UNIT |
|------------------|------------------------|----------------|--------------------------|-----|-----|-----|------|------|
| | | | MIN | TYP | MAX | | | |
| f_{\max} | | | 95 | 110 | | 95 | | MHz |
| t_{PLH} | CLK | Any Q | 1.5 | 6.5 | 9 | 1.5 | 10.2 | ns |
| t_{PHL} | | | 1.5 | 5.5 | 9.1 | 1.5 | 10.1 | |
| t_{PZH} | OE | Any Q | 1.5 | 5.5 | 8 | 1.5 | 9.1 | ns |
| t_{PZL} | | | 1.5 | 5.5 | 8.4 | 1.5 | 9.4 | |
| t_{PHZ} | $\overline{\text{OE}}$ | Any Q | 1.5 | 9 | 11 | 1.5 | 11.2 | ns |
| t_{PLZ} | | | 1.5 | 6 | 8.6 | 1.5 | 9.2 | |

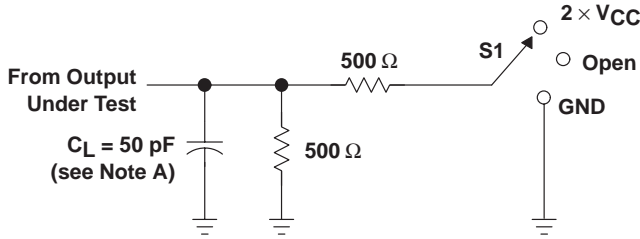
operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | | TYP | UNIT |
|-----------------|---|------------------|---|-----|------|
| C_{pd} | Power dissipation capacitance per flip-flop | Outputs enabled | $C_L = 50\text{ pF}$ $f = 1\text{ MHz}$ | 75 | pF |
| | | Outputs disabled | | 66 | |

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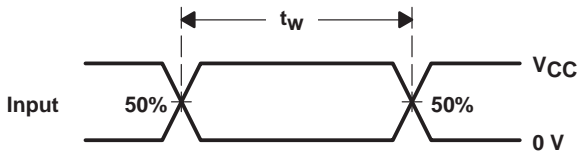
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PARAMETER MEASUREMENT INFORMATION

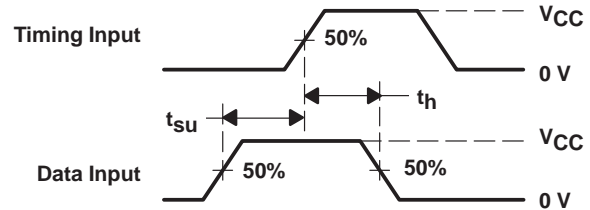


LOAD CIRCUIT

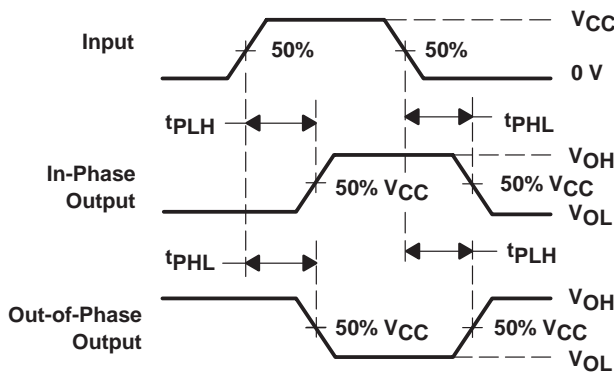
| TEST | S1 |
|-------------------|-------------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



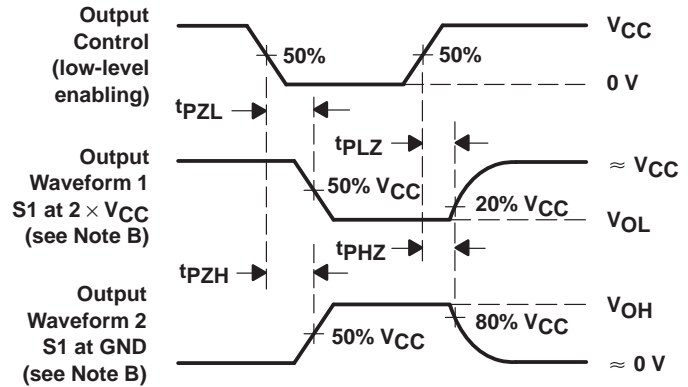
VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

- NOTES: A. C_L includes probe and jig capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 3 \text{ ns}$, $t_f = 3 \text{ ns}$.
 D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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