

# SN54BCT374, SN74BCT374 OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCBS019B – SEPTEMBER 1988 – REVISED APRIL 1994

- State-of-the-Art BiCMOS Design Significantly Reduces  $I_{CC}$
- Full Parallel Access for Loading
- Buffered Control Inputs
- 3-State True Outputs Drive Bus Lines or Buffer Memory Address Registers
- ESD Protection Exceeds 2000 V Per MIL-Std-883C, Method 3015
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages, Ceramic Chip Carriers (FK) and Flatpacks (W), and Standard Plastic and Ceramic 300-mil DIPs (J, N)

## description

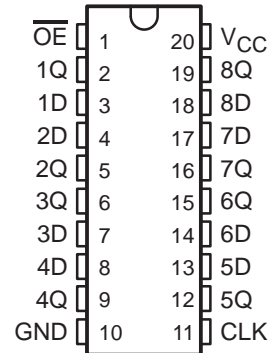
These 8-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight flip-flops of the 'BCT374 are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels that were set up at the data (D) inputs.

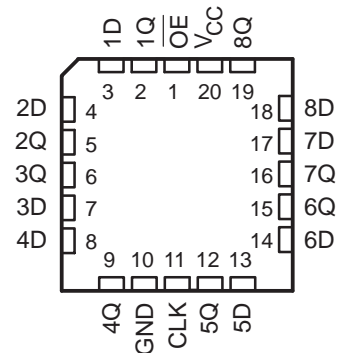
A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either a normal logic state (high or low) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without need for interface or pullup components. The output-enable ( $\overline{OE}$ ) input does not affect internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The SN54BCT374 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74BCT374 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN54BCT374 . . . J OR W PACKAGE  
SN74BCT374 . . . DB OR DW OR N PACKAGE  
(TOP VIEW)



SN54BCT374 . . . FK PACKAGE  
(TOP VIEW)



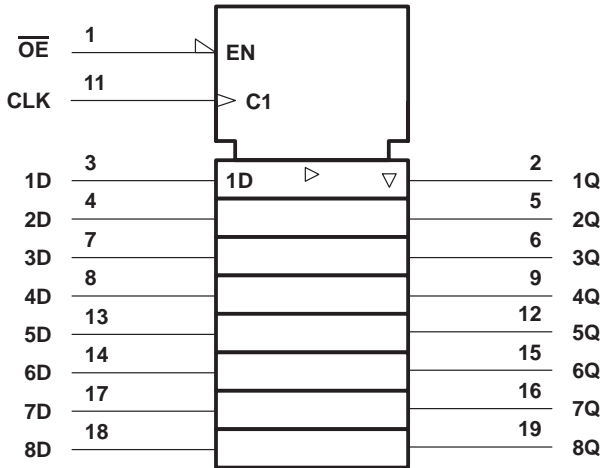
FUNCTION TABLE  
(each flip-flop)

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

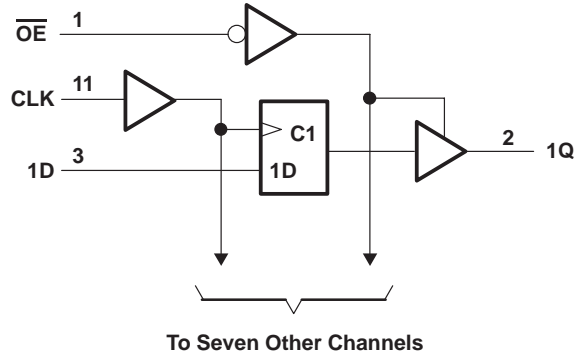
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## logic symbol†



## logic diagram (positive logic)



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

## 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 7 V      |
| Voltage range applied to any output in the disabled or power-off state, $V_O$ ..... | - 0.5 V to 5.5 V    |
| Voltage range applied to any output in the high state, $V_O$ .....                  | - 0.5 V to $V_{CC}$ |
| Input clamp current .....   | - 30 mA             |
| Current into any output in the low state: SN54BCT374 .....                          | 96 mA               |
| SN74BCT374 .....  | 128 mA              |
| Operating free-air temperature range: SN54BCT374 .....                              | - 55°C to 125°C     |
| SN74BCT374 .....  | 0°C to 70°C         |
| Storage temperature range .....   | - 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.

NOTE 1: The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## recommended operating conditions

|                                      | SN54BCT374 |     |     | SN74BCT374 |     |     | UNIT |
|--------------------------------------|------------|-----|-----|------------|-----|-----|------|
|                                      | MIN        | NOM | MAX | MIN        | NOM | MAX |      |
| $V_{CC}$ Supply voltage              | 4.5        | 5   | 5.5 | 4.5        | 5   | 5.5 | V    |
| $V_{IH}$ High-level input voltage    | 2          |     |     | 2          |     |     | V    |
| $V_{IL}$ Low-level input voltage     |            |     | 0.8 |            |     | 0.8 | V    |
| $I_{IK}$ Input clamp current         |            |     | -18 |            |     | -18 | mA   |
| $I_{OH}$ High-level output current   |            |     | -12 |            |     | -15 | mA   |
| $I_{OL}$ Low-level output current    |            |     | 48  |            |     | 64  | mA   |
| $T_A$ Operating free-air temperature | -55        |     | 125 | 0          |     | 70  | °C   |

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

| PARAMETER         | TEST CONDITIONS           |  | SN54BCT374 |      | SN74BCT374 |      | UNIT  |               |
|-------------------|---------------------------|--|------------|------|------------|------|-------|---------------|
|                   |                           |  | MIN        | TYP† | MAX        | MIN  |       | TYP†          |
| $V_{IK}$          | $V_{CC} = 4.5\text{ V}$ , | $I_I = -18\text{ mA}$                  |            |      | -1.2       |      | -1.2  | V             |
| $V_{OH}$          | $V_{CC} = 4.5\text{ V}$   | $I_{OH} = -3\text{ mA}$                | 2.4        | 3.3  |            | 2.4  | 3.3   | V             |
|                   |                           | $I_{OH} = -12\text{ mA}$               | 2          | 3.2  |            |      |       |               |
|                   |                           | $I_{OH} = -15\text{ mA}$               |            |      |            | 2    | 3.1   |               |
| $V_{OL}$          | $V_{CC} = 4.5\text{ V}$   | $I_{OL} = 48\text{ mA}$                |            | 0.38 | 0.55       |      |       | V             |
|                   |                           | $I_{OL} = 64\text{ mA}$                |            |      |            | 0.42 | 0.55  |               |
| $I_I$             | $V_{CC} = 5.5\text{ V}$ , | $V_I = 5.5\text{ V}$                   |            |      | 0.4        |      | 0.4   | mA            |
| $I_{IH}$          | $V_{CC} = 5.5\text{ V}$ , | $V_I = 2.7\text{ V}$                   |            |      | 20         |      | 20    | $\mu\text{A}$ |
| $I_{IL}$          | $V_{CC} = 5.5\text{ V}$ , | $V_I = 0.5\text{ V}$                   |            |      | -0.6       |      | -0.6  | mA            |
| $I_{OS}^\ddagger$ | $V_{CC} = 5.5\text{ V}$ , | $V_O = 0$                              | -100       |      | -225       | -100 | -225  | mA            |
| $I_{OZH}$         | $V_{CC} = 5.5\text{ V}$ , | $V_O = 2.7\text{ V}$                   |            |      | 50         |      | 50    | $\mu\text{A}$ |
| $I_{OZL}$         | $V_{CC} = 5.5\text{ V}$ , | $V_O = 0.5\text{ V}$                   |            |      | -50        |      | -50   | $\mu\text{A}$ |
| $I_{CCL}$         | $V_{CC} = 5.5\text{ V}$   |  |            | 37   | 60         |      | 37 60 | mA            |
| $I_{CCH}$         | $V_{CC} = 5.5\text{ V}$   |  |            | 2    | 5          |      | 2 5   | mA            |
| $I_{CCZ}$         | $V_{CC} = 5.5\text{ V}$   |  |            | 5    | 8          |      | 5 8   | mA            |
| $C_i$             | $V_{CC} = 5\text{ V}$ ,   | $V_I = 2.5\text{ V}$ or $0.5\text{ V}$ |            |      | 6          |      | 6     | pF            |
| $C_o$             | $V_{CC} = 5\text{ V}$ ,   | $V_O = 2.5\text{ V}$ or $0.5\text{ V}$ |            |      | 10         |      | 10    | pF            |

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

**timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)**

|                    |  |                  | $V_{CC} = 5\text{ V}$ ,<br>$T_A = 25^\circ\text{C}$ |     | SN54BCT374 |     | SN74BCT374 |     | UNIT |
|--------------------|--|------------------|---|-----|------------|-----|------------|-----|------|
|                    |  |                  | MIN   | MAX | MIN        | MAX | MIN        | MAX |      |
| $f_{\text{clock}}$ | Clock frequency                        |                  |   | 70  |            | 70  |            | 70  | MHz  |
| $t_w$              | Pulse duration                         | CLK high         | 7   |     | 8          |     | 7          |     | ns   |
| $t_{su}$           | Setup time before $\text{CLK}\uparrow$ | Data high or low | 6.5   |     | 6.5        |     | 6.5        |     | ns   |
| $t_h$              | Hold time after $\text{CLK}\uparrow$   | Data high or low | 0   |     | 0          |     | 0          |     | ns   |



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**switching characteristics (see Note 2)**

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | V <sub>CC</sub> = 5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>1</sub> = 500 Ω,<br>R <sub>2</sub> = 500 Ω,<br>T <sub>A</sub> = 25°C |     |      | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>1</sub> = 500 Ω,<br>R <sub>2</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX† |      |            |      | UNIT |
|------------------|-----------------|----------------|--|-----|------|--|------|------------|------|------|
|                  |                 |                | 'BCT374  |     |      | SN54BCT374   |      | SN74BCT374 |      |      |
|                  |                 |                | MIN  | TYP | MAX  | MIN  | MAX  | MIN        | MAX  |      |
| f <sub>max</sub> |                 |                | 70   |     |      | 70   |      | 70         |      | MHz  |
| t <sub>PLH</sub> | CLK             | Q              | 2  | 7.2 | 9.1  | 2  | 11.6 | 2          | 10.6 | ns   |
| t <sub>PHL</sub> |                 |                | 2  | 7.1 | 8.8  | 2  | 10.6 | 2          | 10   |      |
| t <sub>PZH</sub> | $\overline{OE}$ | Q              | 1  | 8.3 | 10.1 | 1  | 12.7 | 1          | 12.3 | ns   |
| t <sub>PZL</sub> |                 |                | 1  | 8.6 | 10.6 | 1  | 13   | 1          | 12.7 |      |
| t <sub>PHZ</sub> | OE              | Q              | 1  | 4.7 | 6.3  | 1  | 7.1  | 1          | 6.8  | ns   |
| t <sub>PLZ</sub> |                 |                | 1  | 4.8 | 6.3  | 1  | 7.5  | 1          | 6.8  |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

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