

SN54BCT534, SN74BCT534 OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCBS033B – AUGUST 1989 – REVISED NOVEMBER 1993

- State-of-the-Art BiCMOS Design Significantly Reduces I_{CCZ}
- Full Parallel Access for Loading
- Buffered Control Inputs
- 3-State Bus-Driving Inverted Outputs
- ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015
- Package Options Include Plastic Small-Outline (DW) Packages, Ceramic Chip Carriers (FK) and Flatpacks (W), and Plastic and Ceramic 300-mil DIPs (J, N)

description

The 'BCT534 is an 8-bit flip-flop with 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.

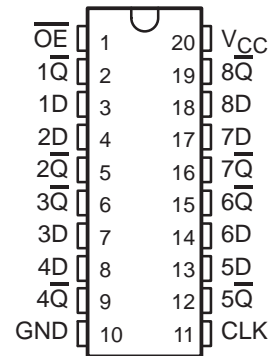
The eight flip-flops of the 'BCT534 are edge-triggered D-type flip-flops. On the positive transition of the clock, the \bar{Q} outputs will be set to the complement of the logic levels that were set up at the data (D) inputs. The 'BCT534 provides inverted data at its outputs.

A buffered 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 state and the increased drive provide the capability to drive bus lines without need for interface or pullup components.

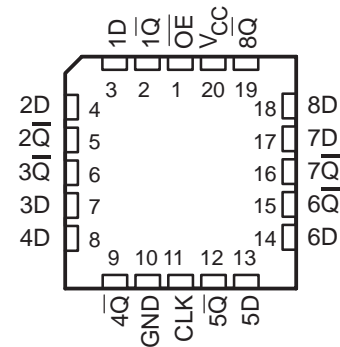
The output-enable (\overline{OE}) input does not affect the internal operations of the flip-flop. Previously stored data can be retained or new data can be entered while the outputs are in the high-impedance state.

The SN54BCT534 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74BCT534 is characterized for operation from 0°C to 70°C .

SN54BCT534 . . . J OR W PACKAGE
SN74BCT534 . . . DW OR N PACKAGE
(TOP VIEW)



SN54BCT534 . . . FK PACKAGE
(TOP VIEW)



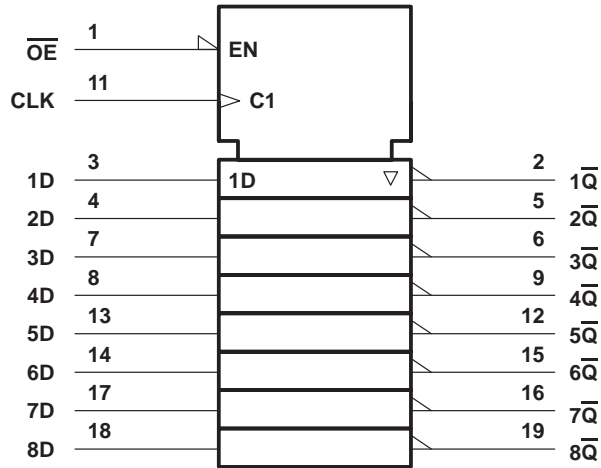
FUNCTION TABLE
(each flip-flop)

| INPUTS | | | OUTPUT |
|-----------------|--------|---|-------------|
| \overline{OE} | CLK | D | \bar{Q} |
| L | ↑ | H | L |
| L | ↑ | L | H |
| L | H or L | X | \bar{Q}_0 |
| H | X | X | Z |

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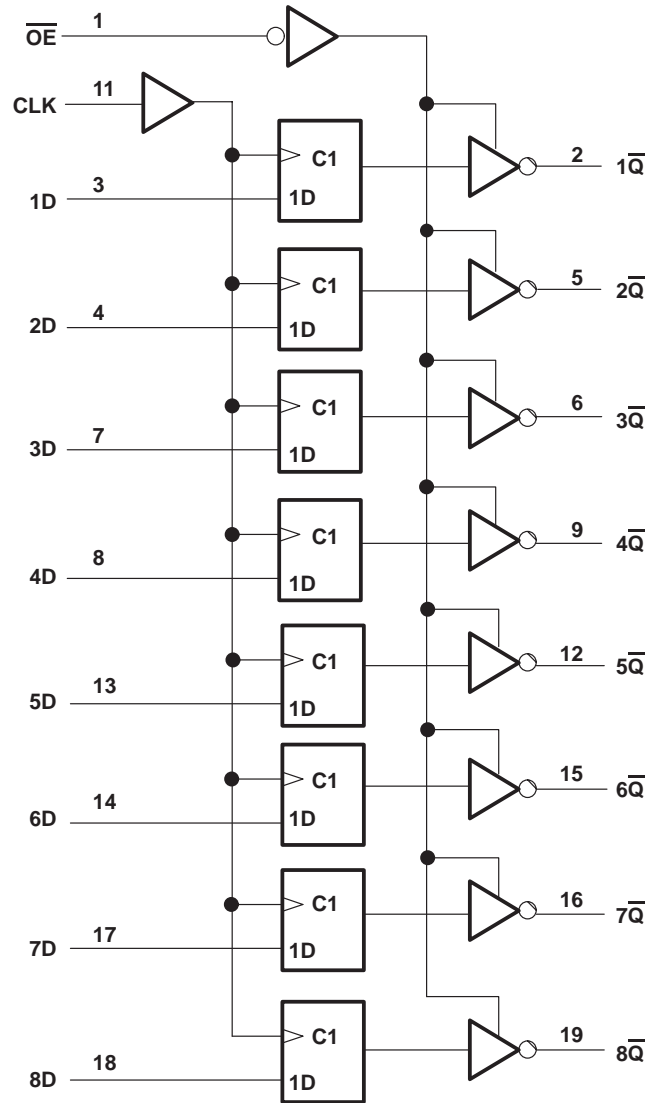
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logic symbol†



† 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 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: SN54BCT534 | 96 mA |
| SN74BCT534 | 128 mA |
| Operating free-air temperature range: SN54BCT534 | – 55°C to 125°C |
| SN74BCT534 | 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

| | | SN54BCT534 | | | SN74BCT534 | | | 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 | | SN54BCT534 | | | SN74BCT534 | | | UNIT |
|-------------------|---------------------------|--------------------------|------------|------|------|------------|------|------|---------------|
| | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| 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 | 3.4 | | 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 | | | μA |
| 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 | | | μA |
| I_{OZL} | $V_{CC} = 5.5\text{ V}$, | $V_O = 0.5\text{ V}$ | -50 | | | -50 | | | μA |
| I_{CCL} | $V_{CC} = 5.5\text{ V}$, | $V_O = \text{Open}$ | 38 | 55 | | 38 | 55 | | mA |
| I_{CCH} | $V_{CC} = 5.5\text{ V}$, | $V_O = \text{Open}$ | 5 | 8 | | 5 | 8 | | mA |
| I_{CCZ} | $V_{CC} = 5.5\text{ V}$, | $V_O = \text{Open}$ | 4.5 | 7 | | 4.5 | 7 | | mA |
| C_i | $V_{CC} = 5\text{ V}$, | $V_I = V_{CC}$ or GND | 6 | | | 6 | | | pF |
| C_o | $V_{CC} = 5\text{ V}$, | $V_O = V_{CC}$ or GND | 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)

| | | $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ | | SN54BCT534 | | SN74BCT534 | | UNIT |
|--------------------|------------------------|---|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | 0 | 77 | 0 | 70 | 0 | 77 | MHz |
| t_w | Pulse duration | CLK high | 6 | 6 | 6 | 6 | | ns |
| | | CLK low | 7 | 7 | 7 | 7 | | |
| t_{su} | Setup time before CLK↑ | Data high | 6 | 6 | 6 | 6 | | ns |
| | | Data low | 9.5 | 9.5 | 9.5 | 9.5 | | |
| t_h | Hold time after CLK↑ | Data high | 0 | 0 | 0 | 0 | | ns |
| | | Data low | 1 | 1 | 1 | 1 | | |

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switching characteristics (see Note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} = 5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = 25°C | | | V _{CC} = 4.5 V to 5.5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = MIN to MAX† | | | UNIT | |
|------------------|-----------------|----------------|--|-----|------|--|------|------------|------|-----|
| | | | 'BCT534 | | | SN54BCT534 | | SN74BCT534 | | |
| | | | MIN | TYP | MAX | MIN | MAX | MIN | | MAX |
| f _{max} | | | 77 | | | 70 | | 77 | | MHz |
| t _{PLH} | CLK | Q̄ | 3.3 | 6.7 | 9.6 | 3.3 | 12.8 | 3.3 | 11.4 | ns |
| t _{PHL} | | | 3.5 | 6.2 | 8.8 | 3.5 | 11 | 3.5 | 10 | |
| t _{PZH} | OĒ | Q̄ | 3.9 | 7.6 | 10.3 | 3.9 | 13.1 | 3.9 | 12.5 | ns |
| t _{PZL} | | | 4.6 | 8.2 | 11.1 | 4.6 | 13.7 | 4.6 | 13.3 | |
| t _{PHZ} | OĒ | Q̄ | 2.6 | 4.7 | 6.7 | 2.6 | 8 | 2.6 | 7.4 | ns |
| t _{PLZ} | | | 1.8 | 4.1 | 6.1 | 1.8 | 7.8 | 1.8 | 6.9 | |

† 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.

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-9074701MRA | OBSOLETE | CDIP | J | 20 | | TBD | Call TI | Call TI |
| SN74BCT534DW | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI |
| SN74BCT534DWR | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI |
| SN74BCT534N | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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