

SN54ABT533 SN74ABT533A OCTAL TRANSPARENT D-TYPE LATCHES WITH 3-STATE OUTPUTS

SCBS186D – JANUARY 1991 – REVISED JANUARY 1997

- **State-of-the-Art *EPIC-II*™ BiCMOS Design Significantly Reduces Power Dissipation**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 1 V at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$**
- **High-Drive Outputs (–32-mA I_{OH} , 64-mA I_{OL})**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)**
- **Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK), Plastic (N) and Ceramic (J) DIPs, and Ceramic Flat (W) Package**

description

These octal transparent D-type latches with 3-state outputs are 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.

When the latch-enable (LE) input is high, the \bar{Q} outputs follow the complements of the data (D) inputs. When LE is taken low, the \bar{Q} outputs are latched at the inverse of the levels at the D inputs.

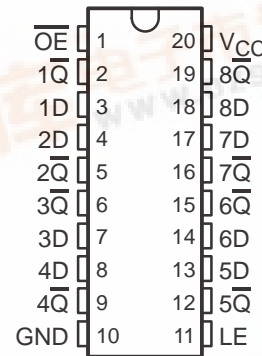
A buffered output-enable (\overline{OE}) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased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

\overline{OE} does not affect the internal operations of the latches. Previously stored data can be retained or new data can be entered while the outputs are in the high-impedance state.

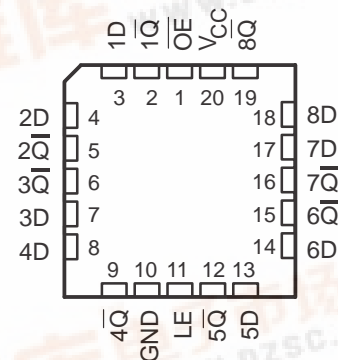
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54ABT533 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ABT533A is characterized for operation from -40°C to 85°C .

SN54ABT533 ... J OR W PACKAGE
SN74ABT533A ... DB, DW, N, OR PW PACKAGE
(TOP VIEW)



SN54ABT533 ... FK PACKAGE
(TOP VIEW)



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TEXAS
INSTRUMENTS

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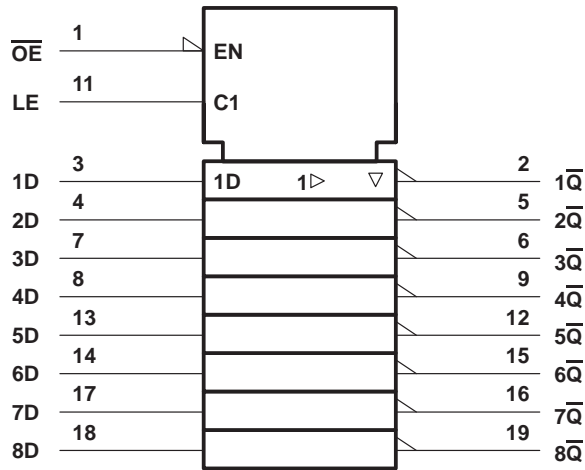
SN54ABT533, SN74ABT533A OCTAL TRANSPARENT D-TYPE LATCHES WITH 3-STATE OUTPUTS

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FUNCTION TABLE
(each latch)

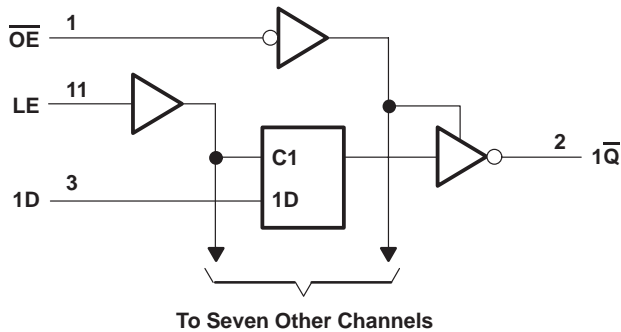
| INPUTS | | | OUTPUT \overline{Q} |
|-----------------|----|---|--------------------------|
| \overline{OE} | LE | D | |
| L | H | H | L |
| L | H | L | H |
| L | L | X | $\overline{Q_0}$ |
| H | X | X | Z |

logic symbol†



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

logic diagram (positive logic)



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 high or power-off state, V_O | –0.5 V to 5.5 V |
| Current into any output in the low state, I_O : SN54ABT533 | 96 mA |
| SN74ABT533A | 128 mA |
| Input clamp current, I_{IK} ($V_I < 0$) | –18 mA |
| Output clamp current, I_{OK} ($V_O < 0$) | –50 mA |
| Package thermal impedance, θ_{JA} (see Note 2): DB package | 115°C/W |
| DW package | 97°C/W |
| N package | 67°C/W |
| PW package | 128°C/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 negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51, except for through-hole packages, which use a trace length of zero.

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OCTAL TRANSPARENT D-TYPE LATCHES

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recommended operating conditions (see Note 3)

| | | SN54ABT533 | | SN74ABT533A | | UNIT |
|-----------------|------------------------------------|------------|-----------------|-------------|-----------------|------|
| | | MIN | MAX | MIN | MAX | |
| V _{CC} | Supply voltage | 4.5 | 5.5 | 4.5 | 5.5 | V |
| V _{IH} | High-level input voltage | 2 | | 2 | | V |
| V _{IL} | Low-level input voltage | | 0.8 | | 0.8 | V |
| V _I | Input voltage | 0 | V _{CC} | 0 | V _{CC} | V |
| I _{OH} | High-level output current | | –24 | | –32 | mA |
| I _{OL} | Low-level output current | | 48 | | 64 | mA |
| Δt/Δv | Input transition rise or fall rate | | 10 | | 10 | ns/V |
| T _A | Operating free-air temperature | –55 | 125 | –40 | 85 | °C |

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

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

| PARAMETER | TEST CONDITIONS | T _A = 25°C | | | SN54ABT533 | | SN74ABT533A | | UNIT |
|--------------------|--|--------------------------|------|------|------------|-------|-------------|------|------|
| | | | | | MIN | MAX | MIN | MAX | |
| V _{IK} | V _{CC} = 4.5 V, I _I = –18 mA | | | –1.2 | | –1.2 | | –1.2 | V |
| V _{OH} | V _{CC} = 4.5 V, I _{OH} = –3 mA | | | 2.5 | | 2.5 | | 2.5 | V |
| | V _{CC} = 5 V, I _{OH} = –3 mA | | | 3 | | 3 | | 3 | |
| | V _{CC} = 4.5 V | I _{OH} = –24 mA | | 2 | | 2 | | | |
| | | I _{OH} = –32 mA | | 2* | | | | 2 | |
| V _{OL} | V _{CC} = 4.5 V | I _{OL} = 48 mA | | | | 0.55 | | | V |
| | | I _{OL} = 64 mA | | | | 0.55* | | 0.55 | |
| V _{hys} | | | | 100 | | | | | mV |
| I _I | V _{CC} = 5.5 V, V _I = V _{CC} or GND | | | ±1 | | ±1 | | ±1 | μA |
| I _{OZH} | V _{CC} = 5.5 V, V _O = 2.7 V | | | 10 | | 10 | | 10 | μA |
| I _{OZL} | V _{CC} = 5.5 V, V _O = 0.5 V | | | –10 | | –10 | | –10 | μA |
| I _{off} | V _{CC} = 0, V _I or V _O ≤ 4.5 V | | | ±150 | | | | ±150 | μA |
| I _{CEX} | V _{CC} = 5.5 V, V _O = 5.5 V | Outputs high | | | | 50 | | 50 | μA |
| I _{O†} | V _{CC} = 5.5 V, V _O = 2.5 V | –50 | –140 | –180 | –50 | –180 | –50 | –180 | mA |
| I _{CC} | V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND | Outputs high | | 1 | 250 | | | 250 | μA |
| | | Outputs low | | 24 | 30 | | | 30 | mA |
| | | Outputs disabled | | 0.5 | 250 | | | 250 | μA |
| ΔI _{CC} § | V _{CC} = 5.5 V, One input at 3.4 V, Other inputs at V _{CC} or GND | Outputs high | | | | 1.5 | | 1.5 | mA |
| | | Outputs low | | | | 1.5 | | 1.5 | |
| | | Outputs disabled | | | | 1.5 | | 1.5 | |
| C _i | V _I = 2.5 V or 0.5 V | | | 3.5 | | | | | pF |
| C _O | V _O = 2.5 V or 0.5 V | | | 6.5 | | | | | pF |

* On products compliant to MIL-PRF-38535, this parameter does not apply.

† All typical values are at V_{CC} = 5 V.

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

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

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timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

| | | | SN54ABT533 | | UNIT |
|----------|-----------------------------|-------------|---|-----|------|
| | | | $V_{CC} = 5\text{ V}$, $T_A = 25^{\circ}\text{C}$ | | |
| | | | MIN | MAX | |
| t_W | Pulse duration, LE high | | 3.3 | 3.3 | ns |
| t_{SU} | Setup time, data before LE↓ | High or low | 2.1 | 2.1 | ns |
| t_H | Hold time, data after LE↓ | High or low | 1.5 | 1.5 | ns |

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

| | | | SN74ABT533A | | UNIT |
|----------|-----------------------------|-------------|--|-----|------|
| | | | $V_{CC} = 5\text{ V},$ $T_A = 25^{\circ}\text{C}$ | | |
| | | | MIN | MAX | |
| t_W | Pulse duration, LE high | | 3.3 | 3.3 | ns |
| t_{SU} | Setup time, data before LE↓ | High or low | 2.1 | 2.1 | ns |
| t_H | Hold time, data after LE↓ | High or low | 2.1 | 2.1 | ns |

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | SN54ABT533 | | | | | UNIT |
|------------------|-----------------|----------------|---|-----|-----|-----|-----|------|
| | | | V _{CC} = 5 V, T _A = 25°C | | | MIN | MAX | |
| | | | MIN | TYP | MAX | | | |
| t _{PLH} | D | \overline{Q} | 1.9 | 4.2 | 5.4 | 1.9 | 6.7 | ns |
| t _{PHL} | | | 3.1 | 4.9 | 6.3 | 3.1 | 6.9 | |
| t _{PLH} | LE | \overline{Q} | 2.7 | 4.9 | 6.2 | 2.7 | 7.6 | ns |
| t _{PHL} | | | 3.5 | 5.4 | 6.8 | 3.5 | 7.5 | |
| t _{PZH} | \overline{OE} | \overline{Q} | 1.6 | 3.7 | 4.8 | 1.6 | 5.8 | ns |
| t _{PZL} | | | 2.4 | 4.2 | 6.2 | 2.4 | 6.9 | |
| t _{PHZ} | OE | Q | 2.8 | 5.1 | 6.2 | 2.8 | 7.2 | ns |
| t _{PLZ} | | | 2 | 4.1 | 6 | 2 | 6.9 | |

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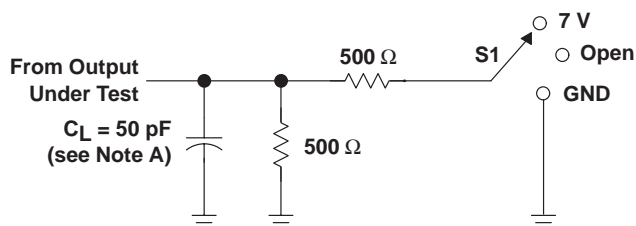
switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | SN74ABT533A | | | | | UNIT |
|------------------|-----------------|----------------|---|-----|-----|-----|-----|------|
| | | | V _{CC} = 5 V, T _A = 25°C | | | MIN | MAX | |
| | | | MIN | TYP | MAX | | | |
| t _{PLH} | D | \overline{Q} | 1.7 | 4.2 | 5.4 | 1.7 | 6.4 | ns |
| t _{PHL} | | | 2.6 | 4.9 | 6.3 | 2.6 | 6.6 | |
| t _{PLH} | LE | \overline{Q} | 2.7 | 4.9 | 6.2 | 2.7 | 7.3 | ns |
| t _{PHL} | | | 3.5 | 5.4 | 6.8 | 3.5 | 7.3 | |
| t _{PZH} | \overline{OE} | \overline{Q} | 1.6 | 3.7 | 4.8 | 1.6 | 5.7 | ns |
| t _{PZL} | | | 2.4 | 4.2 | 6.2 | 2.4 | 6.7 | |
| t _{PHZ} | \overline{OE} | \overline{Q} | 1.6 | 5.1 | 6.2 | 1.6 | 6.9 | ns |
| t _{PLZ} | | | 2 | 4.1 | 6 | 2 | 6.5 | |

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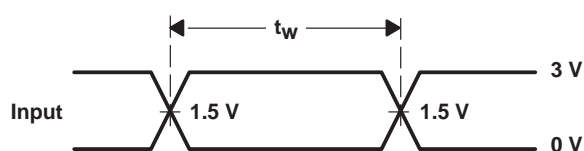
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PARAMETER MEASUREMENT INFORMATION

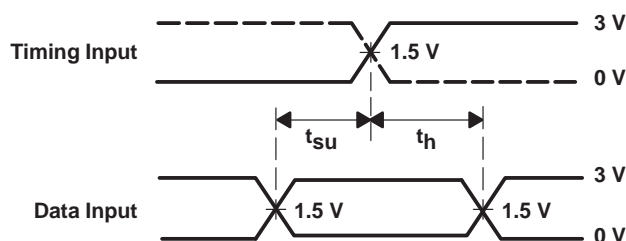


LOAD CIRCUIT

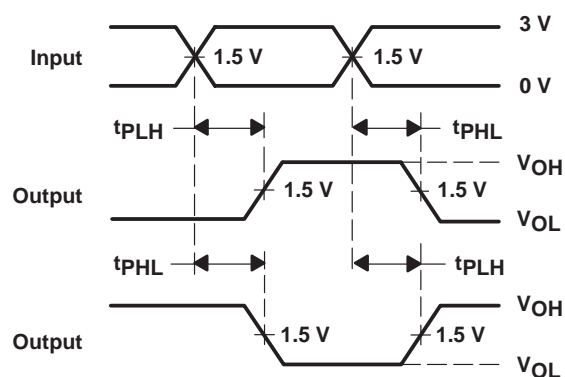
| TEST | S1 |
|-------------------|------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | 7 V |
| t_{PHZ}/t_{PZH} | Open |



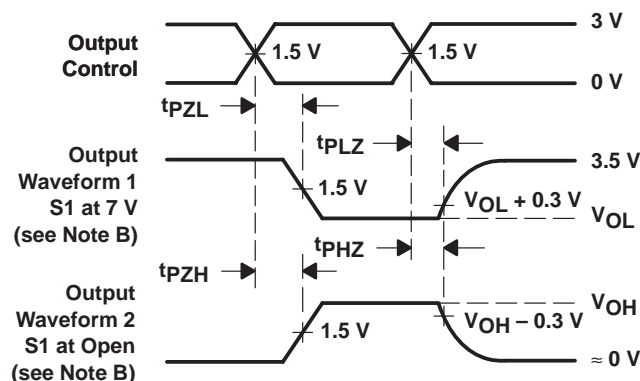
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- C_L includes probe and jig capacitance.
 - 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.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 - The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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