

# SN54HC645, SN74HC645 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCLS304A – JANUARY 1996 – REVISED MAY 1997

- True Logic
- High-Current 3-State Outputs Can Drive up to 15 LSTTL Loads
- Package Options Include Plastic Small-Outline (DW) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

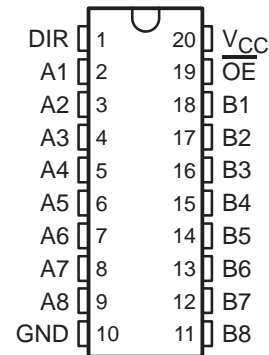
These octal bus transceivers are designed for asynchronous two-way communication between data buses. These devices transmit data from the A bus to the B bus or from the B bus to the A bus, depending upon the level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so the buses are effectively isolated.

The SN54HC645 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC645 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

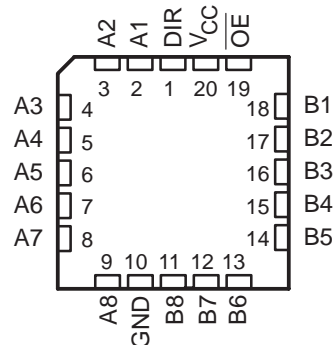
FUNCTION TABLE

| INPUTS          |     | OPERATION       |
|-----------------|-----|-----------------|
| $\overline{OE}$ | DIR |                 |
| L               | L   | B data to A bus |
| L               | H   | A data to B bus |
| H               | X   | Isolation       |

SN54HC645 . . . J OR W PACKAGE  
SN74HC645 . . . DW OR N PACKAGE  
(TOP VIEW)



SN54HC645 . . . FK PACKAGE  
(TOP VIEW)



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

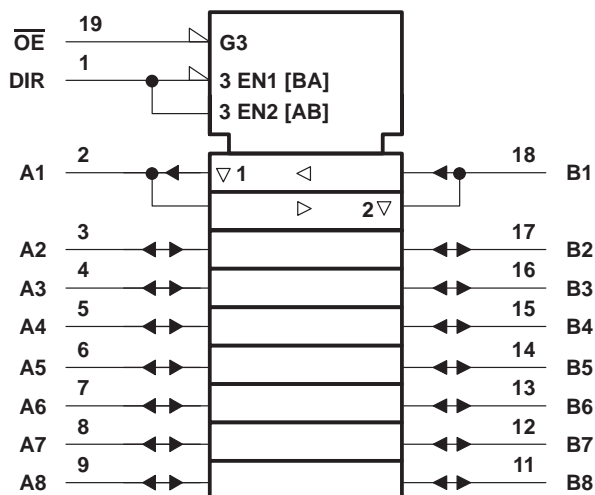
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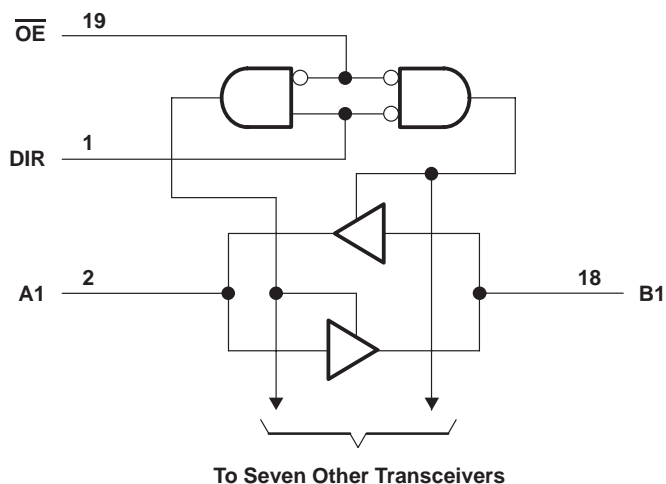
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## logic symbol†



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

## logic diagram (positive logic)



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**WITH 3-STATE OUTPUTS**

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**absolute maximum ratings over operating free-air temperature range†**

|   |                  |        |
|---|------------------|--------|
| Supply voltage range, $V_{CC}$ .....  | –0.5 V to 7 V    |        |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1) .....  | ±20 mA           |        |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) ..... | ±20 mA           |        |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....                  | ±35 mA           |        |
| Continuous current through $V_{CC}$ or GND .....                                  | ±70 mA           |        |
| Package thermal impedance, $\theta_{JA}$ (see Note 2):                            | DW package ..... | 97°C/W |
|   | N package .....  | 67°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 voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

**recommended operating conditions**

|          |                                       | SN54HC645               |          |      | SN74HC645               |                         |      | UNIT |
|----------|---------------------------------------|-------------------------|----------|------|-------------------------|-------------------------|------|------|
|          |                                       | MIN                     | NOM      | MAX  | MIN                     | NOM                     | MAX  |      |
| $V_{CC}$ | Supply voltage                        | 2                       | 5        | 6    | 2                       | 5                       | 6    | V    |
| $V_{IH}$ | High-level input voltage              | $V_{CC} = 2\text{ V}$   |          | 1.5  | $V_{CC} = 2\text{ V}$   |                         | 1.5  | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$ |          | 3.15 | $V_{CC} = 4.5\text{ V}$ |                         | 3.15 |      |
|          |                                       | $V_{CC} = 6\text{ V}$   |          | 4.2  | $V_{CC} = 6\text{ V}$   |                         | 4.2  |      |
| $V_{IL}$ | Low-level input voltage               | $V_{CC} = 2\text{ V}$   |          | 0    | 0.5                     | $V_{CC} = 2\text{ V}$   |      | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$ |          | 0    | 1.35                    | $V_{CC} = 4.5\text{ V}$ |      |      |
|          |                                       | $V_{CC} = 6\text{ V}$   |          | 0    | 1.8                     | $V_{CC} = 6\text{ V}$   |      |      |
| $V_I$    | Input voltage                         | 0                       | $V_{CC}$ |      | 0                       | $V_{CC}$                |      | V    |
| $V_O$    | Output voltage                        | 0                       | $V_{CC}$ |      | 0                       | $V_{CC}$                |      | V    |
| $t_t$    | Input transition (rise and fall) time | $V_{CC} = 2\text{ V}$   |          | 0    | 1000                    | $V_{CC} = 2\text{ V}$   |      | ns   |
|          |                                       | $V_{CC} = 4.5\text{ V}$ |          | 0    | 500                     | $V_{CC} = 4.5\text{ V}$ |      |      |
|          |                                       | $V_{CC} = 6\text{ V}$   |          | 0    | 400                     | $V_{CC} = 6\text{ V}$   |      |      |
| $T_A$    | Operating free-air temperature        | –55                     | 125      |      | –40                     | 85                      |      | °C   |



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

| PARAMETER       | TEST CONDITIONS                                     |   | V <sub>CC</sub> | T <sub>A</sub> = 25°C |       |      | SN54HC645 |       | SN74HC645 |       | UNIT |
|-----------------|---|---|-----------------|-----------------------|-------|------|-----------|-------|-----------|-------|------|
|                 |   |   |                 | MIN                   | TYP   | MAX  | MIN       | MAX   | MIN       | MAX   |      |
| V <sub>OH</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -20 μA                                  | 2 V             | 1.9                   | 1.998 |      | 1.9       |       | 1.9       | V     |      |
|                 |   |   | 4.5 V           | 4.4                   | 4.499 |      | 4.4       |       | 4.4       |       |      |
|                 |   |   | 6 V             | 5.9                   | 5.999 |      | 5.9       |       | 5.9       |       |      |
|                 |   | I <sub>OH</sub> = -6 mA                                   | 4.5 V           | 3.98                  | 4.3   |      | 3.7       |       | 3.84      |       |      |
|                 |   |   | 6 V             | 5.48                  | 5.8   |      | 5.2       |       | 5.34      |       |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 20 μA                                   | 2 V             |                       | 0.002 | 0.1  |           | 0.1   |           | 0.1   | V    |
|                 |   |   | 4.5 V           |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |   |   | 6 V             |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |   | I <sub>OL</sub> = 6 mA                                    | 4.5 V           |                       | 0.17  | 0.26 |           | 0.4   |           | 0.33  |      |
|                 |   |   | 6 V             |                       | 0.15  | 0.26 |           | 0.4   |           | 0.33  |      |
| I <sub>I</sub>  | DIR or $\overline{\text{OE}}$                       | V <sub>I</sub> = V <sub>CC</sub> or 0                     | 6 V             |                       | ±0.1  | ±100 |           | ±1000 |           | ±1000 | nA   |
| I <sub>OZ</sub> | A or B  | V <sub>O</sub> = V <sub>CC</sub> or 0                     | 6 V             |                       | ±0.01 | ±0.5 |           | ±10   |           | ±5    | μA   |
| I <sub>CC</sub> |   | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0 | 6 V             |                       |       | 8    |           | 160   |           | 80    | μA   |
| C <sub>i</sub>  | DIR or $\overline{\text{OE}}$                       |   | 2 V to 6 V      |                       | 3     | 10   |           | 10    |           | 10    | pF   |

**switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)**

| PARAMETER        | FROM (INPUT)           | TO (OUTPUT) | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC645 |     | SN74HC645 |     | UNIT |
|------------------|------------------------|-------------|-----------------|-----------------------|-----|-----|-----------|-----|-----------|-----|------|
|                  |                        |             |                 | MIN                   | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| t <sub>pd</sub>  | A or B                 | B or A      | 2 V             |                       | 40  | 105 |           | 160 |           | 130 | ns   |
|                  |                        |             | 4.5 V           |                       | 15  | 21  |           | 32  |           | 26  |      |
|                  |                        |             | 6 V             |                       | 12  | 18  |           | 27  |           | 22  |      |
| t <sub>en</sub>  | $\overline{\text{OE}}$ | A or B      | 2 V             |                       | 125 | 230 |           | 340 |           | 290 | ns   |
|                  |                        |             | 4.5 V           |                       | 23  | 46  |           | 68  |           | 58  |      |
|                  |                        |             | 6 V             |                       | 20  | 39  |           | 58  |           | 49  |      |
| t <sub>dis</sub> | $\overline{\text{OE}}$ | A or B      | 2 V             |                       | 74  | 200 |           | 300 |           | 250 | ns   |
|                  |                        |             | 4.5 V           |                       | 25  | 40  |           | 60  |           | 50  |      |
|                  |                        |             | 6 V             |                       | 21  | 34  |           | 51  |           | 43  |      |
| t <sub>t</sub>   |                        | A or B      | 2 V             |                       | 20  | 60  |           | 90  |           | 75  | ns   |
|                  |                        |             | 4.5 V           |                       | 8   | 12  |           | 18  |           | 15  |      |
|                  |                        |             | 6 V             |                       | 6   | 10  |           | 15  |           | 13  |      |



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switching characteristics over recommended operating free-air temperature range,  $C_L = 150 \text{ pF}$   
(unless otherwise noted) (see Figure 1)

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC645 |     | SN74HC645 |     | UNIT |
|-----------|-----------------|----------------|----------|--------------------------|-----|-----|-----------|-----|-----------|-----|------|
|           |                 |                |          | MIN                      | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| $t_{pd}$  | A or B          | B or A         | 2 V      |                          | 54  | 135 |           | 200 |           | 170 | ns   |
|           |                 |                | 4.5 V    |                          | 18  | 27  |           | 40  |           | 34  |      |
|           |                 |                | 6 V      |                          | 15  | 23  |           | 34  |           | 29  |      |
| $t_{en}$  | $\overline{OE}$ | A or B         | 2 V      |                          | 150 | 270 |           | 405 |           | 335 | ns   |
|           |                 |                | 4.5 V    |                          | 31  | 54  |           | 81  |           | 67  |      |
|           |                 |                | 6 V      |                          | 25  | 46  |           | 69  |           | 56  |      |
| $t_t$     |                 | A or B         | 2 V      |                          | 45  | 210 |           | 315 |           | 265 | ns   |
|           |                 |                | 4.5 V    |                          | 17  | 42  |           | 63  |           | 53  |      |
|           |                 |                | 6 V      |                          | 13  | 36  |           | 53  |           | 45  |      |

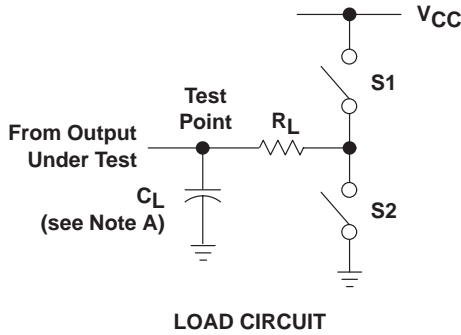
operating characteristics,  $T_A = 25^\circ\text{C}$

| PARAMETER  | TEST CONDITIONS | TYP | UNIT |
|--|-----------------|-----|------|
| $C_{pd}$ Power dissipation capacitance per transceiver | No load         | 40  | pF   |

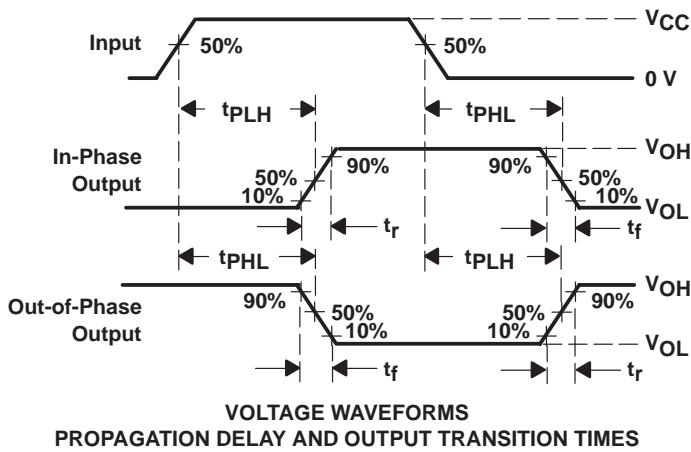
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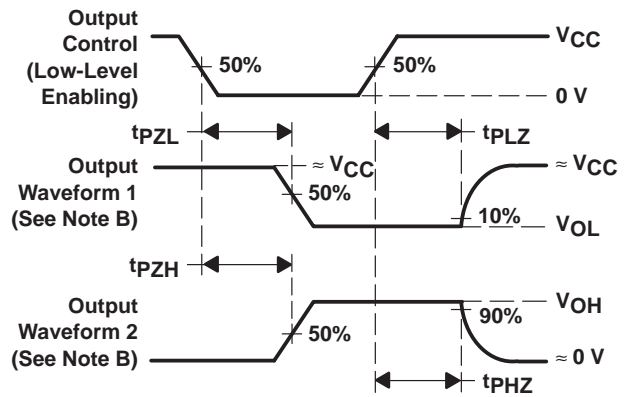
**PARAMETER MEASUREMENT INFORMATION**



| PARAMETER         | $R_L$        | $C_L$           | S1     | S2     |
|-------------------|--------------|-----------------|--------|--------|
| $t_{en}$          | 1 k $\Omega$ | 50 pF or 150 pF | Open   | Closed |
|                   |              |                 | Closed | Open   |
| $t_{dis}$         | 1 k $\Omega$ | 50 pF           | Open   | Closed |
|                   |              |                 | Closed | Open   |
| $t_{pd}$ or $t_t$ | —            | 50 pF or 150 pF | Open   | Open   |



**VOLTAGE WAVEFORM**  
**INPUT RISE AND FALL TIMES**



**VOLTAGE WAVEFORMS**  
**ENABLE AND DISABLE TIMES FOR 3-STATE OUTPUTS**

- NOTES:
- A.  $C_L$  includes probe and test-fixture 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. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

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