

## SDAS066F – DECEMBER 1983 – REVISED OCTOBER 1996

**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652  
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652  
OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS**

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**description (continued)**

The -1 versions of the SN74ALS651A and SN74ALS652A are identical to the standard versions except that the recommended maximum  $I_{OL}$  for the -1 versions is increased to 48 mA. There are no -1 versions of the SN54ALS652, SN54ALS653, SN74ALS653, and SN74ALS654.

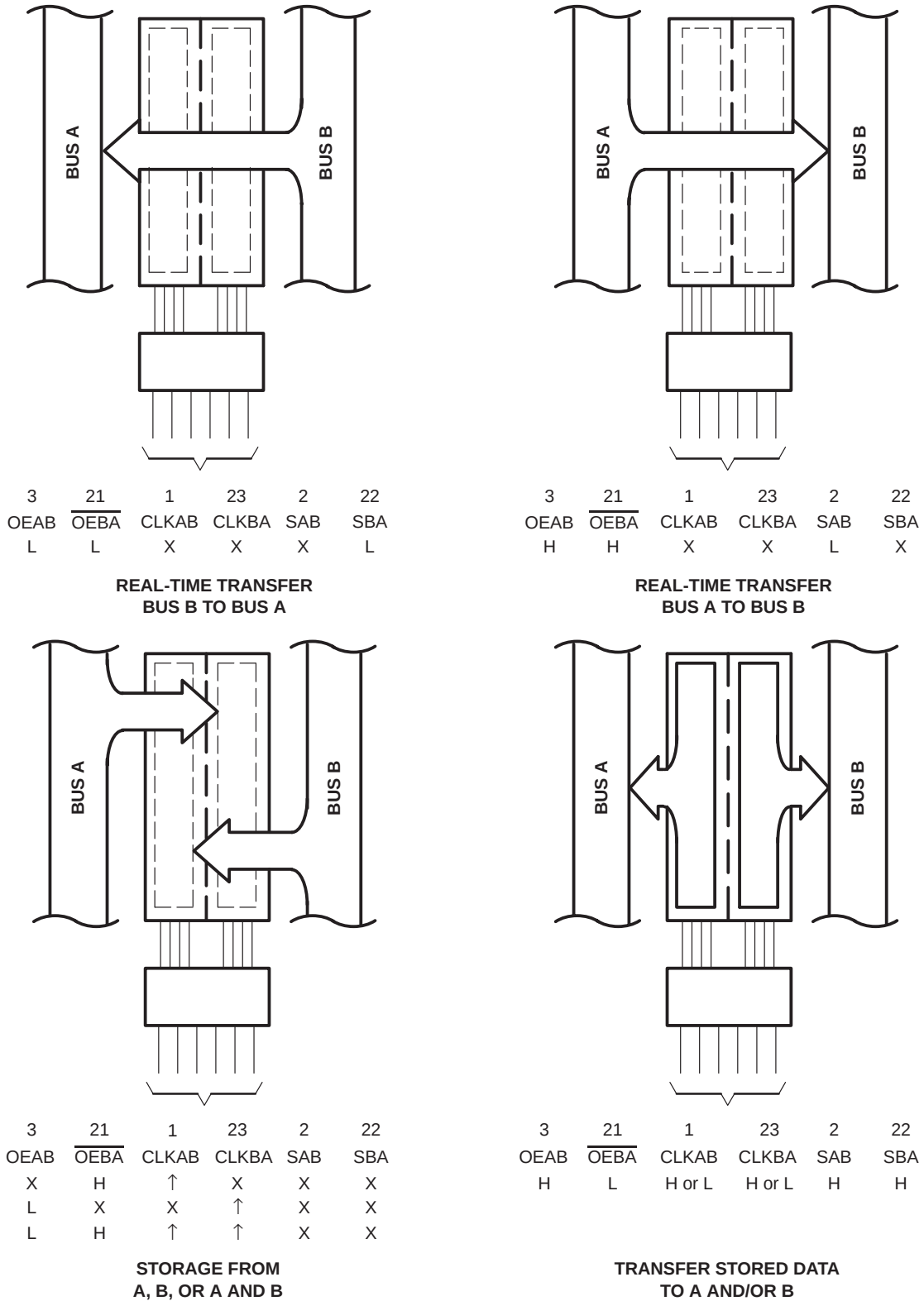
The SN54ALS' and SN54AS' families are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS' and SN74AS' families are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .



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**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652  
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652  
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Pin numbers are for the DW, JT, and NT packages.

**Figure 1. Bus-Management Functions**

# SN54ALS652, SN54ALS653, SN54AS651, SN54AS652 SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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## FUNCTION TABLES

SN54ALS653, SN54AS651,  
SN74ALS651A, SN74ALS653, SN74AS651

| INPUTS |      |        |        |                |                | DATA I/O <sup>†</sup>    |                          | OPERATION OR FUNCTION                                                       |
|--------|------|--------|--------|----------------|----------------|--------------------------|--------------------------|-----------------------------------------------------------------------------|
| OEAB   | OEBA | CLKAB  | CLKBA  | SAB            | SBA            | A1–A8                    | B1–B8                    |                                                                             |
| L      | H    | H or L | H or L | X              | X              | Input                    | Input                    | Isolation                                                                   |
| L      | H    | ↑      | ↑      | X              | X              | Input                    | Input                    | Store A and B data                                                          |
| X      | H    | ↑      | H or L | X              | X              | Input                    | Unspecified <sup>‡</sup> | Store A, hold B                                                             |
| H      | H    | ↑      | ↑      | X <sup>‡</sup> | X              | Input                    | Output                   | Store A in both registers                                                   |
| L      | X    | H or L | ↑      | X              | X              | Unspecified <sup>‡</sup> | Input                    | Hold A, store B                                                             |
| L      | L    | ↑      | ↑      | X              | X <sup>‡</sup> | Output                   | Input                    | Store B in both registers                                                   |
| L      | L    | X      | X      | X              | L              | Output                   | Input                    | Real-time $\overline{B}$ data to A bus                                      |
| L      | L    | X      | H or L | X              | H              | Output                   | Input                    | Stored $\overline{B}$ data to A bus                                         |
| H      | H    | X      | X      | L              | X              | Input                    | Output                   | Real-time $\overline{A}$ data to B bus                                      |
| H      | H    | H or L | X      | H              | X              | Input                    | Output                   | Stored $\overline{A}$ data to B bus                                         |
| H      | L    | H or L | H or L | H              | H              | Output                   | Output                   | Stored $\overline{A}$ data to B bus and stored $\overline{B}$ data to A bus |

<sup>†</sup> The data output functions may be enabled or disabled by a variety of level combinations at OEAB or OEBA. Data input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition on the clock inputs.

<sup>‡</sup> Select control = L; clocks can occur simultaneously.

Select control = H; clocks must be staggered to load both registers.

SN54ALS652, SN54AS652,  
SN74ALS652A, SN74ALS654, SN74AS652

| INPUTS |      |        |        |                |                | DATA I/O <sup>†</sup>    |                          | OPERATION OR FUNCTION                             |
|--------|------|--------|--------|----------------|----------------|--------------------------|--------------------------|---------------------------------------------------|
| OEAB   | OEBA | CLKAB  | CLKBA  | SAB            | SBA            | A1–A8                    | B1–B8                    |                                                   |
| L      | H    | H or L | H or L | X              | X              | Input                    | Input                    | Isolation                                         |
| L      | H    | ↑      | ↑      | X              | X              | Input                    | Input                    | Store A and B data                                |
| X      | H    | ↑      | H or L | X              | X              | Input                    | Unspecified <sup>‡</sup> | Store A, hold B                                   |
| H      | H    | ↑      | ↑      | X <sup>‡</sup> | X              | Input                    | Output                   | Store A in both registers                         |
| L      | X    | H or L | ↑      | X              | X              | Unspecified <sup>‡</sup> | Input                    | Hold A, store B                                   |
| L      | L    | ↑      | ↑      | X              | X <sup>‡</sup> | Output                   | Input                    | Store B in both registers                         |
| L      | L    | X      | X      | X              | L              | Output                   | Input                    | Real-time B data to A bus                         |
| L      | L    | X      | H or L | X              | H              | Output                   | Input                    | Stored B data to A bus                            |
| H      | H    | X      | X      | L              | X              | Input                    | Output                   | Real-time A data to B bus                         |
| H      | H    | H or L | X      | H              | X              | Input                    | Output                   | Stored A data to B bus                            |
| H      | L    | H or L | H or L | H              | H              | Output                   | Output                   | Stored A data to B bus and stored B data to A bus |

<sup>†</sup> The data output functions may be enabled or disabled by a variety of level combinations at OEAB or OEBA. Data input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition on the clock inputs.

<sup>‡</sup> Select control = L; clocks can occur simultaneously.

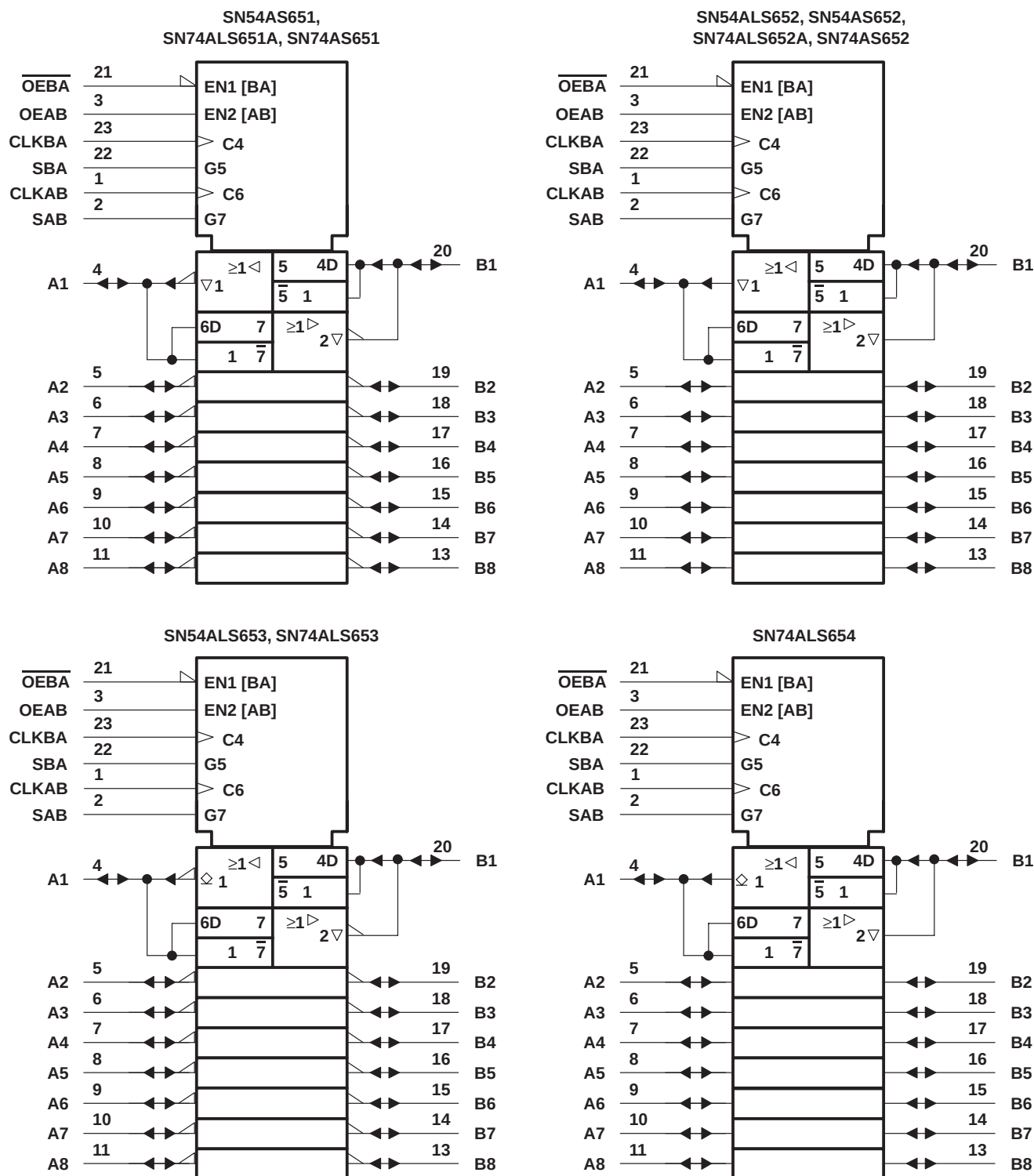
Select control = H; clocks must be staggered to load both registers.



**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652  
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652**  
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logic symbols†

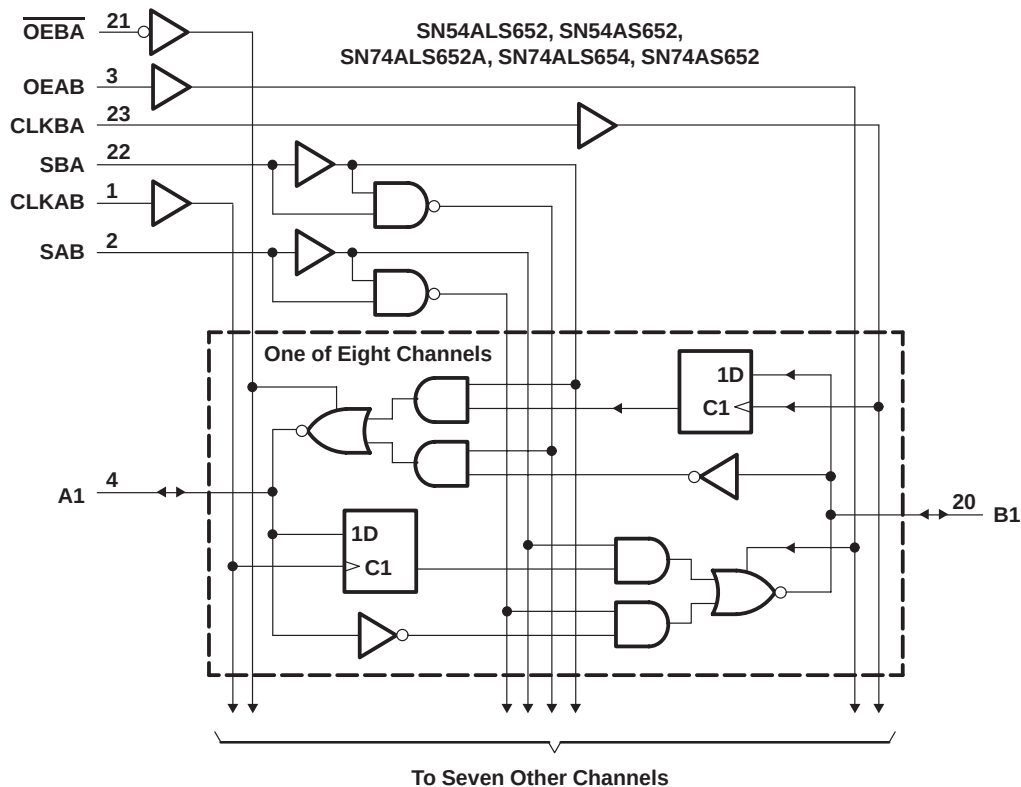
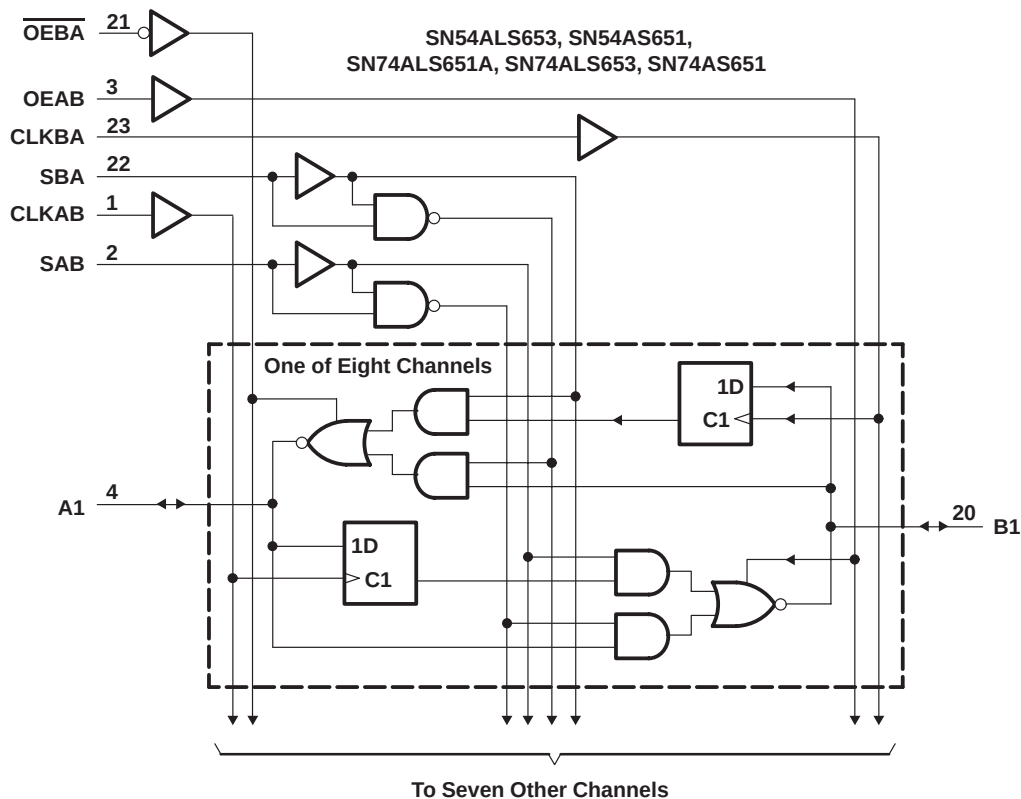


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for the DW, JT, and NT packages.

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SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652  
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**logic diagrams (positive logic)**



Pin numbers shown are for the DW, JT, and NT packages.



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OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS**

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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>**

|                                                          |                |
|----------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                 | 7 V            |
| Input voltage, $V_I$ : Control inputs                    | 7 V            |
| I/O ports                                                | 5.5 V          |
| Operating free-air temperature range, $T_A$ : SN54ALS652 | –55°C to 125°C |
| SN74ALS651A, SN74ALS652A                                 | 0°C to 70°C    |
| Storage temperature range, $T_{stg}$                     | –65°C to 150°C |

<sup>†</sup> 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.

**recommended operating conditions**

|             |                                                        | SN74ALS651A         |     |                 | UNIT |
|-------------|--------------------------------------------------------|---------------------|-----|-----------------|------|
|             |                                                        | MIN                 | NOM | MAX             |      |
| $V_{CC}$    | Supply voltage                                         | 4.5                 | 5   | 5.5             | V    |
| $V_{IH}$    | High-level input voltage                               | 2                   |     |                 | V    |
| $V_{IL}$    | Low-level input voltage                                |                     |     | 0.8             | V    |
| $I_{OH}$    | High-level output current                              |                     |     | –15             | mA   |
| $I_{OL}$    | Low-level output current                               |                     |     | 24              | mA   |
|             |                                                        |                     |     | 48 <sup>‡</sup> |      |
| $f_{clock}$ | Clock frequency                                        | 0                   |     | 40              | MHz  |
| $t_w$       | Pulse duration                                         | CLKBA or CLKAB high |     | 12.5            | ns   |
|             |                                                        | CLKBA or CLKAB low  |     | 12.5            |      |
| $t_{su}$    | Setup time before CLKAB $\uparrow$ or CLKBA $\uparrow$ | A or B              |     | 10              | ns   |
| $t_h$       | Hold time after CLKAB $\uparrow$ or CLKBA $\uparrow$   | A or B              |     | 0               | ns   |
| $T_A$       | Operating free-air temperature                         | 0                   |     | 70              | °C   |

<sup>‡</sup> Applies only to the SN74ALS651A-1 and only if  $V_{CC}$  is maintained between 4.75 V and 5.25 V

**recommended operating conditions**

|             |                                                        | SN54ALS652          |     |      | SN74ALS652A |     |                 | 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                                |                     |     | 0.7  |             |     | 0.8             | V    |
| $I_{OH}$    | High-level output current                              |                     |     | –12  |             |     | –15             | mA   |
| $I_{OL}$    | Low-level output current                               |                     |     | 12   |             |     | 24              | mA   |
|             |                                                        |                     |     |      |             |     | 48 <sup>‡</sup> |      |
| $f_{clock}$ | Clock frequency                                        | 0                   |     | 35   | 0           |     | 40              | MHz  |
| $t_w$       | Pulse duration                                         | CLKBA or CLKAB high |     | 14.5 | 12.5        |     |                 | ns   |
|             |                                                        | CLKBA or CLKAB low  |     | 14.5 | 12.5        |     |                 |      |
| $t_{su}$    | Setup time before CLKAB $\uparrow$ or CLKBA $\uparrow$ | A or B              |     | 15   | 10          |     |                 | ns   |
| $t_h$       | Hold time after CLKAB $\uparrow$ or CLKBA $\uparrow$   | A or B              |     | 5    | 0           |     |                 | ns   |
| $T_A$       | Operating free-air temperature                         | –55                 |     | 125  | 0           |     | 70              | °C   |

<sup>‡</sup> Applies only to the SN74ALS652A-1 and only if  $V_{CC}$  is maintained between 4.75 V and 5.25 V



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

| PARAMETER        |                | TEST CONDITIONS                                                 |                          | SN74ALS651A         |      |     | UNIT |
|------------------|----------------|-----------------------------------------------------------------|--------------------------|---------------------|------|-----|------|
|                  |                |                                                                 |                          | MIN                 | TYP† | MAX |      |
| V <sub>IK</sub>  |                | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = −18 mA                |                          | −1.2                |      |     | V    |
| V <sub>OH</sub>  |                | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = −0.4 mA     |                          | V <sub>CC</sub> − 2 |      |     | V    |
|                  |                | V <sub>CC</sub> = 4.5 V                                         | I <sub>OH</sub> = −3 mA  | 2.4                 | 3.2  |     |      |
|                  |                |                                                                 | I <sub>OH</sub> = −15 mA | 2                   |      |     |      |
| V <sub>OL</sub>  |                | V <sub>CC</sub> = 4.5 V                                         | I <sub>OL</sub> = 12 mA  | 0.25                | 0.4  | V   |      |
|                  |                |                                                                 | I <sub>OL</sub> = 24 mA  | 0.35                | 0.5  |     |      |
|                  |                | V <sub>CC</sub> = 4.75 V, I <sub>OL</sub> = 48 mA (-1 versions) |                          | 0.35                | 0.5  |     |      |
| I <sub>I</sub>   | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V                   |                          | 0.1                 |      |     | mA   |
|                  | A or B ports   | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V                 |                          | 0.1                 |      |     |      |
| I <sub>IH</sub>  | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V                 |                          | 20                  |      |     | μA   |
|                  | A or B ports‡  |                                                                 |                          | 20                  |      |     |      |
| I <sub>IL</sub>  | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V                 |                          | −0.2                |      |     | mA   |
|                  | A or B ports‡  |                                                                 |                          | −0.2                |      |     |      |
| I <sub>O</sub> § |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V                |                          | −30                 | −112 | mA  |      |
| I <sub>CC</sub>  |                | V <sub>CC</sub> = 5.5 V                                         | Outputs high             | 42                  | 68   | mA  |      |
|                  |                |                                                                 | Outputs low              | 52                  | 82   |     |      |
|                  |                |                                                                 | Outputs disabled         | 52                  | 82   |     |      |

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

‡ For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

§ The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .



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

| PARAMETER                   |                | TEST CONDITIONS                                                 | SN54ALS652               |      |      | SN74ALS652A         |      |     | UNIT |
|-----------------------------|----------------|-----------------------------------------------------------------|--------------------------|------|------|---------------------|------|-----|------|
|                             |                |                                                                 | MIN                      | TYP† | MAX  | MIN                 | TYP† | MAX |      |
| V <sub>IK</sub>             |                | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = −18 mA                | −1.2                     |      |      | −1.2                |      |     | V    |
| V <sub>OH</sub>             |                | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = −0.4 mA     | V <sub>CC</sub> − 2      |      |      | V <sub>CC</sub> − 2 |      |     | V    |
|                             |                | V <sub>CC</sub> = 4.5 V                                         | I <sub>OH</sub> = −3 mA  |      | 2.4  | 3.2                 | 2.4  | 3.2 |      |
|                             |                |                                                                 | I <sub>OH</sub> = −12 mA |      | 2    |                     |      |     |      |
|                             |                |                                                                 | I <sub>OH</sub> = −15 mA |      |      |                     | 2    |     |      |
| V <sub>OL</sub>             |                | V <sub>CC</sub> = 4.5 V                                         | I <sub>OL</sub> = 12 mA  |      | 0.25 | 0.4                 | 0.25 | 0.4 | V    |
|                             |                |                                                                 | I <sub>OL</sub> = 24 mA  |      |      |                     | 0.35 | 0.5 |      |
|                             |                | V <sub>CC</sub> = 4.75 V, I <sub>OL</sub> = 48 mA (-1 versions) |                          |      |      |                     | 0.35 |     |      |
| I <sub>I</sub>              | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V                   | 0.1                      |      |      | 0.1                 |      |     | mA   |
|                             | A or B ports   | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V                 | 0.1                      |      |      | 0.1                 |      |     |      |
| I <sub>IH</sub>             | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V                 | 20                       |      |      | 20                  |      |     | μA   |
|                             | A or B ports‡  |                                                                 | 20                       |      |      | 20                  |      |     |      |
| I <sub>IL</sub>             | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V                 | −0.2                     |      |      | −0.2                |      |     | mA   |
|                             | A or B ports‡  |                                                                 | −0.2                     |      |      | −0.2                |      |     |      |
| I <sub>O</sub> <sup>§</sup> |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V                | −20                      | −112 |      | −30                 | −112 |     | mA   |
| I <sub>CC</sub>             |                | V <sub>CC</sub> = 5.5 V                                         | Outputs high             |      | 47   | 76                  | 47   | 76  | mA   |
|                             |                |                                                                 | Outputs low              |      | 55   | 88                  | 55   | 88  |      |
|                             |                |                                                                 | Outputs disabled         |      | 55   | 88                  | 55   | 88  |      |

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

<sup>‡</sup> For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .

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**switching characteristics (see Figure 2)**

| PARAMETER        | FROM<br>(INPUT)                   | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R1 = 500 Ω,<br>R2 = 500 Ω,<br>T <sub>A</sub> = MIN to MAX† |     | UNIT |
|------------------|-----------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------|-----|------|
|                  |                                   |                | SN74ALS651A                                                                                                                |     |      |
|                  |                                   |                | MIN                                                                                                                        | MAX |      |
| f <sub>max</sub> |                                   |                | 40                                                                                                                         |     | MHz  |
| t <sub>PLH</sub> | CLKBA or CLKAB                    | A or B         | 8                                                                                                                          | 32  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                          | 17  |      |
| t <sub>PLH</sub> | A or B                            | B or A         | 2                                                                                                                          | 18  | ns   |
| t <sub>PHL</sub> |                                   |                | 2                                                                                                                          | 10  |      |
| t <sub>PLH</sub> | SBA or SAB‡<br>(with A or B high) | A or B         | 8                                                                                                                          | 38  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                          | 21  |      |
| t <sub>PLH</sub> | SBA or SAB‡<br>(with A or B low)  | A or B         | 8                                                                                                                          | 25  | ns   |
| t <sub>PHL</sub> |                                   |                | 7                                                                                                                          | 21  |      |
| t <sub>PZH</sub> | $\overline{\text{OEBA}}$          | A              | 3                                                                                                                          | 20  | ns   |
| t <sub>PZL</sub> |                                   |                | 5                                                                                                                          | 18  |      |
| t <sub>PHZ</sub> | $\overline{\text{OEBA}}$          | A              | 2                                                                                                                          | 9   | ns   |
| t <sub>PLZ</sub> |                                   |                | 3                                                                                                                          | 12  |      |
| t <sub>PZH</sub> | OEAB                              | B              | 3                                                                                                                          | 22  | ns   |
| t <sub>PZL</sub> |                                   |                | 6                                                                                                                          | 21  |      |
| t <sub>PHZ</sub> | OEAB                              | B              | 2                                                                                                                          | 12  | ns   |
| t <sub>PLZ</sub> |                                   |                | 2                                                                                                                          | 14  |      |

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

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switching characteristics (see Figure 2)

| PARAMETER        | FROM<br>(INPUT)                               | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R1 = 500 Ω,<br>R2 = 500 Ω,<br>T <sub>A</sub> = MIN to MAX† |     |             |     | UNIT |
|------------------|-----------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------|-----|-------------|-----|------|
|                  |                                               |                | SN54ALS652                                                                                                                 |     | SN74ALS652A |     |      |
|                  |                                               |                | MIN                                                                                                                        | MAX | MIN         | MAX |      |
| f <sub>max</sub> |                                               |                | 35                                                                                                                         |     | 40          |     | MHz  |
| t <sub>PLH</sub> | CLKBA or CLKAB                                | A or B         | 10                                                                                                                         | 35  | 8           | 30  | ns   |
| t <sub>PHL</sub> |                                               |                | 5                                                                                                                          | 20  | 5           | 17  |      |
| t <sub>PLH</sub> | A or B                                        | B or A         | 5                                                                                                                          | 20  | 4           | 18  | ns   |
| t <sub>PHL</sub> |                                               |                | 3                                                                                                                          | 15  | 3           | 12  |      |
| t <sub>PLH</sub> | SBA or SAB <sup>‡</sup><br>(with A or B high) | A or B         | 15                                                                                                                         | 40  | 8           | 35  | ns   |
| t <sub>PHL</sub> |                                               |                | 6                                                                                                                          | 23  | 6           | 20  |      |
| t <sub>PLH</sub> | SBA or SAB <sup>‡</sup><br>(with A or B low)  | A or B         | 8                                                                                                                          | 30  | 8           | 25  | ns   |
| t <sub>PHL</sub> |                                               |                | 5                                                                                                                          | 24  | 5           | 20  |      |
| t <sub>PZH</sub> | $\overline{\text{OEBA}}$                      | A              | 3                                                                                                                          | 20  | 3           | 17  | ns   |
| t <sub>PZL</sub> |                                               |                | 5                                                                                                                          | 22  | 5           | 18  |      |
| t <sub>PHZ</sub> | $\overline{\text{OEBA}}$                      | A              | 1                                                                                                                          | 12  | 1           | 10  | ns   |
| t <sub>PLZ</sub> |                                               |                | 2                                                                                                                          | 20  | 2           | 16  |      |
| t <sub>PZH</sub> | OEAB                                          | B              | 8                                                                                                                          | 25  | 3           | 22  | ns   |
| t <sub>PZL</sub> |                                               |                | 6                                                                                                                          | 21  | 5           | 18  |      |
| t <sub>PHZ</sub> | OEAB                                          | B              | 1                                                                                                                          | 12  | 1           | 10  | ns   |
| t <sub>PLZ</sub> |                                               |                | 2                                                                                                                          | 21  | 2           | 16  |      |

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

# SN54ALS652, SN54ALS653, SN54AS651, SN54AS652 SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                          |                |
|----------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                 | 7 V            |
| Input voltage, $V_I$ : All inputs and A I/O ports        | 7 V            |
| B I/O ports                                              | 5.5 V          |
| Operating free-air temperature range, $T_A$ : SN54ALS653 | –55°C to 125°C |
| SN74ALS653, SN74ALS654                                   | 0°C to 70°C    |
| Storage temperature range, $T_{stg}$                     | –65°C to 150°C |

<sup>†</sup> 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.

## recommended operating conditions

|                    |                                    |                     | SN54ALS653 |     |     | SN74ALS653 |     |     | UNIT |    |    |
|--------------------|------------------------------------|---------------------|------------|-----|-----|------------|-----|-----|------|----|----|
|                    |                                    |                     | MIN        | NOM | MAX | MIN        | NOM | MAX |      |    |    |
| V <sub>CC</sub>    | Supply voltage                     |                     | 4.5        | 5   | 5.5 | 4.5        | 5   | 5.5 | V    |    |    |
| V <sub>IH</sub>    | High-level input voltage           |                     | 2          |     |     | 2          |     |     | V    |    |    |
| V <sub>IL</sub>    | Low-level input voltage            |                     | 0.7        |     |     | 0.8        |     |     | V    |    |    |
| V <sub>OH</sub>    | High-level output voltage          | A ports             | 5.5        |     |     | 5.5        |     |     | V    |    |    |
| I <sub>OH</sub>    | High-level output current          | B ports             | −12        |     |     | −15        |     |     | mA   |    |    |
| I <sub>OL</sub>    | Low-level output current           |                     | 12         |     |     | 24         |     |     | mA   |    |    |
| f <sub>clock</sub> | Clock frequency                    |                     | 0          | 25  |     | 0          | 35  |     | MHz  |    |    |
| t <sub>w</sub>     | Pulse duration                     | CLKBA or CLKAB high | 20         |     |     | 14.5       |     |     | ns   |    |    |
|                    |                                    | CLKBA or CLKAB low  | 20         |     |     | 14.5       |     |     |      |    |    |
| t <sub>su</sub>    | Setup time before CLKAB↑ or CLKBA↑ | A or B              | 15         |     |     | 10         |     |     | ns   |    |    |
| t <sub>h</sub>     | Hold time after CLKAB↑ or CLKBA↑   | A or B              | 5          |     |     | 0          |     |     | ns   |    |    |
| T <sub>A</sub>     | Operating free-air temperature     |                     | −55        |     |     | 125        |     |     | 0    | 70 | °C |

## recommended operating conditions

|             |                                                        | SN74ALS654          |     |     | UNIT |
|-------------|--------------------------------------------------------|---------------------|-----|-----|------|
|             |                                                        | MIN                 | NOM | MAX |      |
| $V_{CC}$    | Supply voltage                                         | 4.5                 | 5   | 5.5 | V    |
| $V_{IH}$    | High-level input voltage                               | 2                   |     |     | V    |
| $V_{IL}$    | Low-level input voltage                                |                     |     | 0.8 | V    |
| $V_{OH}$    | High-level output voltage                              | A ports             |     |     | 5.5  |
| $I_{OH}$    | High-level output current                              | B ports             |     |     | –15  |
| $I_{OL}$    | Low-level output current                               | 24                  |     |     | mA   |
| $f_{clock}$ | Clock frequency                                        | 0                   |     | 35  | MHz  |
| $t_w$       | Pulse duration                                         | CLKBA or CLKAB high |     |     | 14.5 |
|             |                                                        | CLKBA or CLKAB low  |     |     | 14.5 |
| $t_{su}$    | Setup time before CLKAB $\uparrow$ or CLKBA $\uparrow$ | A or B              |     |     | 10   |
| $t_h$       | Hold time after CLKAB $\uparrow$ or CLKBA $\uparrow$   | A or B              |     |     | 0    |
| $T_A$       | Operating free-air temperature                         | 0                   |     |     | 70   |



**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652  
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652  
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**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER                   |                | TEST CONDITIONS                                             |                          | SN54ALS653         |      |      | SN74ALS653         |      |     | UNIT |
|-----------------------------|----------------|-------------------------------------------------------------|--------------------------|--------------------|------|------|--------------------|------|-----|------|
|                             |                |                                                             |                          | MIN                | TYP† | MAX  | MIN                | TYP† | MAX |      |
| V <sub>IK</sub>             |                | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = −18 mA            |                          | −1.2               |      |      | −1.2               |      |     | V    |
| V <sub>OH</sub>             | B ports        | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = −0.4 mA |                          | V <sub>CC</sub> −2 |      |      | V <sub>CC</sub> −2 |      |     | V    |
|                             |                | V <sub>CC</sub> = 4.5 V                                     | I <sub>OH</sub> = −3 mA  | 2.4                | 3.2  | 2.4  | 3.2                |      |     |      |
|                             |                |                                                             | I <sub>OH</sub> = −12 mA | 2                  |      |      |                    |      |     |      |
|                             |                |                                                             | I <sub>OH</sub> = −15 mA |                    |      | 2    |                    |      |     |      |
| V <sub>OL</sub>             |                | V <sub>CC</sub> = 4.5 V                                     | I <sub>OL</sub> = 12 mA  | 0.25               | 0.4  | 0.25 | 0.4                | V    |     |      |
|                             |                |                                                             | I <sub>OL</sub> = 24 mA  |                    |      | 0.35 | 0.5                |      |     |      |
| I <sub>I</sub>              | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V               |                          | 0.1                |      |      | 0.1                |      |     | mA   |
|                             | A or B ports   | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V             |                          | 0.1                |      |      | 0.1                |      |     |      |
| I <sub>IH</sub>             | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V             |                          | 20                 |      |      | 20                 |      |     | μA   |
|                             | A or B ports‡  |                                                             |                          | 20                 |      |      | 20                 |      |     |      |
| I <sub>IL</sub>             | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V             |                          | −0.2               |      |      | −0.2               |      |     | mA   |
|                             | A or B ports‡  |                                                             |                          | −0.2               |      |      | −0.2               |      |     |      |
| I <sub>OH</sub>             | A ports        | V <sub>CC</sub> = 4.5 V, V <sub>OH</sub> = 5.5 V            |                          | 0.1                |      |      | 0.1                |      |     | mA   |
| I <sub>O</sub> <sup>§</sup> | B ports        | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V            |                          | −20 −112           |      |      | −30 −112           |      |     | mA   |
| I <sub>CC</sub>             |                | V <sub>CC</sub> = 5.5 V                                     | Outputs high             | 47 76              |      |      | 47 76              |      |     | mA   |
|                             |                |                                                             | Outputs low              | 55 88              |      |      | 55 88              |      |     |      |
|                             |                |                                                             | Outputs disabled         | 55 88              |      |      | 55 88              |      |     |      |

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

‡ For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

§ The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .

**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652**  
**SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652**  
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**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER                   |                | TEST CONDITIONS                                             |                          | SN74ALS654          |      |     | UNIT |
|-----------------------------|----------------|-------------------------------------------------------------|--------------------------|---------------------|------|-----|------|
|                             |                |                                                             |                          | MIN                 | TYP† | MAX |      |
| V <sub>IK</sub>             |                | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = −18 mA            |                          | −1.2                |      |     | V    |
| V <sub>OH</sub>             | B ports        | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = −0.4 mA |                          | V <sub>CC</sub> − 2 |      |     | V    |
|                             |                | V <sub>CC</sub> = 4.5 V                                     | I <sub>OH</sub> = −3 mA  | 2.4                 | 3.2  |     |      |
|                             |                |                                                             | I <sub>OH</sub> = −15 mA | 2                   |      |     |      |
| V <sub>OL</sub>             |                | V <sub>CC</sub> = 4.5 V                                     | I <sub>OL</sub> = 12 mA  | 0.25                | 0.4  | V   |      |
|                             |                |                                                             | I <sub>OL</sub> = 24 mA  | 0.35                | 0.5  |     |      |
| I <sub>I</sub>              | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V               | 0.1                      |                     |      | mA  |      |
|                             | A or B ports   | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V             | 0.1                      |                     |      |     |      |
| I <sub>IH</sub>             | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V             | 20                       |                     |      | μA  |      |
|                             | A or B ports‡  |                                                             | 20                       |                     |      |     |      |
| I <sub>IL</sub>             | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V             | −0.2                     |                     |      | mA  |      |
|                             | A or B ports‡  |                                                             | −0.2                     |                     |      |     |      |
| I <sub>OH</sub>             | A ports        | V <sub>CC</sub> = 4.5 V, V <sub>OH</sub> = 5.5 V            | 0.1                      |                     |      | mA  |      |
| I <sub>O</sub> <sup>§</sup> | B ports        | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V            | −30                      | −112                |      | mA  |      |
| I <sub>CC</sub>             |                | V <sub>CC</sub> = 5.5 V                                     | Outputs high             | 47                  | 76   | mA  |      |
|                             |                |                                                             | Outputs low              | 55                  | 88   |     |      |
|                             |                |                                                             | Outputs disabled         | 55                  | 88   |     |      |

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

‡ For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

§ The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .

**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652  
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652  
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switching characteristics (see Figure 2)

| PARAMETER        | FROM<br>(INPUT)                   | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 680 Ω (A outputs),<br>R1 = R2 = 500 Ω (B outputs),<br>T <sub>A</sub> = MIN to MAX <sup>†</sup> |     |            |     | UNIT |
|------------------|-----------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------|-----|------|
|                  |                                   |                | SN54ALS653                                                                                                                                                                      |     | SN74ALS653 |     |      |
|                  |                                   |                | MIN                                                                                                                                                                             | MAX | MIN        | MAX |      |
| f <sub>max</sub> |                                   |                | 25                                                                                                                                                                              |     | 35         |     | MHz  |
| t <sub>PLH</sub> | CLKBA                             | A              | 16                                                                                                                                                                              | 71  | 16         | 64  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 24  | 6          | 22  |      |
| t <sub>PLH</sub> | CLKAB                             | B              | 10                                                                                                                                                                              | 35  | 10         | 30  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                                                                               | 20  | 5          | 17  |      |
| t <sub>PLH</sub> | A                                 | B              | 5                                                                                                                                                                               | 20  | 5          | 18  | ns   |
| t <sub>PHL</sub> |                                   |                | 1.5                                                                                                                                                                             | 18  | 2          | 15  |      |
| t <sub>PLH</sub> | B                                 | A              | 8                                                                                                                                                                               | 63  | 12         | 56  | ns   |
| t <sub>PHL</sub> |                                   |                | 2                                                                                                                                                                               | 18  | 2          | 15  |      |
| t <sub>PLH</sub> | SBA <sup>‡</sup><br>(with B high) | A              | 12                                                                                                                                                                              | 68  | 19         | 62  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                                                                               | 27  | 5          | 25  |      |
| t <sub>PLH</sub> | SBA <sup>‡</sup><br>(with B low)  | A              | 12                                                                                                                                                                              | 68  | 19         | 62  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                                                                               | 27  | 5          | 25  |      |
| t <sub>PLH</sub> | SAB <sup>‡</sup><br>(with A high) | B              | 8                                                                                                                                                                               | 30  | 15         | 35  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 25  | 6          | 22  |      |
| t <sub>PLH</sub> | SAB <sup>‡</sup><br>(with A low)  | B              | 12                                                                                                                                                                              | 40  | 8          | 25  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 25  | 6          | 22  |      |
| t <sub>PLH</sub> | $\overline{\text{OEBA}}$          | A              | 6                                                                                                                                                                               | 35  | 6          | 30  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 27  | 6          | 24  |      |
| t <sub>PZH</sub> | OEAB                              | B              | 7                                                                                                                                                                               | 25  | 8          | 22  | ns   |
| t <sub>PZL</sub> |                                   |                | 6                                                                                                                                                                               | 25  | 6          | 22  |      |
| t <sub>PHZ</sub> | OEAB                              | B              | 1                                                                                                                                                                               | 16  | 1          | 14  | ns   |
| t <sub>PLZ</sub> |                                   |                | 2                                                                                                                                                                               | 21  | 2          | 16  |      |

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

<sup>‡</sup> These parameters are measured with the internal output state of the storage register opposite that of the bus input.

**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652**  
**SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652**  
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**switching characteristics (see Figure 2)**

| PARAMETER        | FROM<br>(INPUT)                   | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 680 Ω (A outputs),<br>R1 = R2 = 500 Ω (B outputs),<br>T <sub>A</sub> = MIN to MAX <sup>†</sup> |     | UNIT |
|------------------|-----------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|
|                  |                                   |                | SN74ALS654                                                                                                                                                                      |     |      |
|                  |                                   |                | MIN                                                                                                                                                                             | MAX |      |
| f <sub>max</sub> |                                   |                | 35                                                                                                                                                                              |     | MHz  |
| t <sub>PLH</sub> | CLKBA                             | A              | 16                                                                                                                                                                              | 64  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 22  |      |
| t <sub>PLH</sub> | CLKAB                             | B              | 10                                                                                                                                                                              | 30  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                                                                               | 17  |      |
| t <sub>PLH</sub> | A                                 | B              | 5                                                                                                                                                                               | 18  | ns   |
| t <sub>PHL</sub> |                                   |                | 2                                                                                                                                                                               | 15  |      |
| t <sub>PLH</sub> | B                                 | A              | 12                                                                                                                                                                              | 56  | ns   |
| t <sub>PHL</sub> |                                   |                | 2                                                                                                                                                                               | 21  |      |
| t <sub>PLH</sub> | SBA <sup>‡</sup><br>(with B low)  | A              | 19                                                                                                                                                                              | 62  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                                                                               | 25  |      |
| t <sub>PLH</sub> | SBA <sup>‡</sup><br>(with B high) | A              | 19                                                                                                                                                                              | 62  | ns   |
| t <sub>PHL</sub> |                                   |                | 5                                                                                                                                                                               | 25  |      |
| t <sub>PLH</sub> | SAB <sup>‡</sup><br>(with A low)  | B              | 15                                                                                                                                                                              | 35  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 22  |      |
| t <sub>PLH</sub> | SAB <sup>‡</sup><br>(with A high) | B              | 8                                                                                                                                                                               | 25  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 22  |      |
| t <sub>PLH</sub> | $\overline{\text{OEBA}}$          | A              | 6                                                                                                                                                                               | 30  | ns   |
| t <sub>PHL</sub> |                                   |                | 6                                                                                                                                                                               | 24  |      |
| t <sub>PZH</sub> | OEAB                              | B              | 6                                                                                                                                                                               | 22  | ns   |
| t <sub>PZL</sub> |                                   |                | 6                                                                                                                                                                               | 22  |      |
| t <sub>PHZ</sub> | OEAB                              | B              | 1                                                                                                                                                                               | 14  | ns   |
| t <sub>PLZ</sub> |                                   |                | 2                                                                                                                                                                               | 16  |      |

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

<sup>‡</sup> These parameters are measured with the internal output state of the storage register opposite that of the bus input.



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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>**

|                                                                    |                |
|--------------------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                           | 7 V            |
| Input voltage, $V_I$ : Control inputs                              | 7 V            |
| I/O ports                                                          | 5.5 V          |
| Operating free-air temperature range, $T_A$ : SN54AS651, SN54AS652 | –55°C to 125°C |
| SN74AS651, SN74AS652                                               | 0°C to 70°C    |
| Storage temperature range, $T_{stg}$                               | –65°C to 150°C |

<sup>†</sup> 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.

**recommended operating conditions**

|                      |                                    |                     | SN54AS651<br>SN54AS652 |     |     | SN74AS651<br>SN74AS652 |     |     | UNIT |    |
|----------------------|------------------------------------|---------------------|------------------------|-----|-----|------------------------|-----|-----|------|----|
|                      |                                    |                     | MIN                    | NOM | MAX | MIN                    | NOM | MAX |      |    |
| V <sub>CC</sub>      | Supply voltage                     |                     | 4.5                    | 5   | 5.5 | 4.5                    | 5   | 5.5 | V    |    |
| V <sub>IH</sub>      | High-level input voltage           |                     | 2                      |     |     | 2                      |     |     | V    |    |
| V <sub>IL</sub>      | Low-level input voltage            |                     | 0.8                    |     |     | 0.8                    |     |     | V    |    |
| I <sub>OH</sub>      | High-level output current          |                     | −12                    |     |     | −15                    |     |     | mA   |    |
| I <sub>OL</sub>      | Low-level output current           |                     | 32                     |     |     | 48                     |     |     | mA   |    |
| f <sub>clock</sub> * | Clock frequency                    |                     | 0                      | 75  |     | 0                      | 90  |     | MHz  |    |
| t <sub>w</sub> *     | Pulse duration                     | CLKBA or CLKAB high | 6                      |     |     | 5                      |     |     | ns   |    |
|                      |                                    | CLKBA or CLKAB low  | 7                      |     |     | 6                      |     |     |      |    |
| t <sub>su</sub> *    | Setup time before CLKAB↑ or CLKBA↑ | A or B              | 7                      |     |     | 6                      |     |     | ns   |    |
| t <sub>h</sub> *     | Hold time after CLKAB↑ or CLKBA    | A or B              | 0                      |     |     | 0                      |     |     | ns   |    |
| T <sub>A</sub>       | Operating free-air temperature     |                     | −55                    |     |     | 125                    |     | 0   | 70   | °C |

\* On products compliant to MIL-PRF-38535, this parameter is based on characterized data but is not production tested.



**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652**  
**SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652**  
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**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER        |                | TEST CONDITIONS                                           |                          | SN54AS651<br>SN54AS652 |       | SN74AS651<br>SN74AS652 |     | UNIT |
|------------------|----------------|-----------------------------------------------------------|--------------------------|------------------------|-------|------------------------|-----|------|
|                  |                |                                                           |                          | MIN                    | TYP†  | MAX                    | MIN |      |
| V <sub>IK</sub>  |                | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = −18 mA          |                          | −1.2                   |       | −1.2                   |     | V    |
| V <sub>OH</sub>  |                | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = −2 mA |                          | V <sub>CC</sub> − 2    |       | V <sub>CC</sub> − 2    |     | V    |
|                  |                | V <sub>CC</sub> = 4.5 V                                   | I <sub>OH</sub> = −3 mA  | 2.4                    | 3.2   | 2.4                    | 3.2 |      |
|                  |                |                                                           | I <sub>OH</sub> = −12 mA | 2                      |       |                        |     |      |
|                  |                |                                                           | I <sub>OH</sub> = −15 mA |                        |       | 2                      |     |      |
| V <sub>OL</sub>  |                | V <sub>CC</sub> = 4.5 V                                   | I <sub>OL</sub> = 32 mA  | 0.25                   | 0.5   |                        |     | V    |
|                  |                |                                                           | I <sub>OL</sub> = 48 mA  |                        |       | 0.35                   | 0.5 |      |
| I <sub>I</sub>   | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V             | 0.1                      |                        | 0.1   |                        | mA  |      |
|                  | A or B ports   | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V           | 0.1                      |                        | 0.1   |                        |     |      |
| I <sub>IH</sub>  | Control inputs | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V           | 20                       |                        | 20    |                        | μA  |      |
|                  | A or B ports‡  |                                                           | 70                       |                        | 70    |                        |     |      |
| I <sub>IL</sub>  | Control input  | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V           | −0.5                     |                        | −0.5  |                        | mA  |      |
|                  | A or B ports‡  |                                                           | −0.75                    |                        | −0.75 |                        |     |      |
| I <sub>O</sub> § |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V          | −30                      | −112                   | −30   | −112                   | mA  |      |
| I <sub>CC</sub>  | ‘AS651         | V <sub>CC</sub> = 5.5 V                                   | Outputs high             | 110                    | 185   | 110                    | 185 | mA   |
|                  |                |                                                           | Outputs low              | 120                    | 195   | 120                    | 195 |      |
|                  |                |                                                           | Outputs disabled         | 130                    | 195   | 130                    | 195 |      |
|                  | ‘AS652         | V <sub>CC</sub> = 5.5 V                                   | Outputs high             | 120                    | 195   | 120                    | 195 |      |
|                  |                |                                                           | Outputs low              | 130                    | 211   | 130                    | 211 |      |
|                  |                |                                                           | Outputs disabled         | 130                    | 211   | 130                    | 211 |      |

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

<sup>‡</sup> For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .

**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652  
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652  
OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS**

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switching characteristics (see Figure 2)

| PARAMETER          | FROM<br>(INPUT)          | TO<br>(OUTPUT) | 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 |
|--------------------|--------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------|-----|------|
|                    |                          |                | SN54AS651                                                                                                                                          |     | SN74AS651 |     |      |
|                    |                          |                | MIN                                                                                                                                                | MAX | MIN       | MAX |      |
| f <sub>max</sub> * |                          |                | 75                                                                                                                                                 |     | 90        |     | MHz  |
| t <sub>PLH</sub>   | CLKBA or CLKAB           | A or B         | 2                                                                                                                                                  | 11  | 2         | 8.5 | ns   |
| t <sub>PHL</sub>   |                          |                | 2                                                                                                                                                  | 10  | 2         | 9   |      |
| t <sub>PLH</sub>   | A or B                   | B or A         | 2                                                                                                                                                  | 12  | 2         | 8   | ns   |
| t <sub>PHL</sub>   |                          |                | 1                                                                                                                                                  | 8   | 1         | 7   |      |
| t <sub>PLH</sub>   | SBA or SAB‡              | A or B         | 2                                                                                                                                                  | 15  | 2         | 11  | ns   |
| t <sub>PHL</sub>   |                          |                | 2                                                                                                                                                  | 11  | 2         | 9   |      |
| t <sub>PZH</sub>   | $\overline{\text{OEBA}}$ | A              | 2                                                                                                                                                  | 11  | 2         | 10  | ns   |
| t <sub>PZL</sub>   |                          |                | 3                                                                                                                                                  | 18  | 3         | 16  |      |
| t <sub>PHZ</sub>   | $\overline{\text{OEBA}}$ | A              | 2                                                                                                                                                  | 10  | 2         | 9   | ns   |
| t <sub>PLZ</sub>   |                          |                | 2                                                                                                                                                  | 10  | 2         | 9   |      |
| t <sub>PZH</sub>   | OEAB                     | B              | 3                                                                                                                                                  | 12  | 3         | 11  | ns   |
| t <sub>PZL</sub>   |                          |                | 3                                                                                                                                                  | 20  | 3         | 16  |      |
| t <sub>PHZ</sub>   | OEAB                     | B              | 2                                                                                                                                                  | 11  | 2         | 10  | ns   |
| t <sub>PLZ</sub>   |                          |                | 2                                                                                                                                                  | 12  | 2         | 11  |      |

\* On products compliant to MIL-PRF-38535, this parameter is based on characterized data but is not production tested.

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

**SN54ALS652, SN54ALS653, SN54AS651, SN54AS652**  
**SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS**

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**switching characteristics (see Figure 2)**

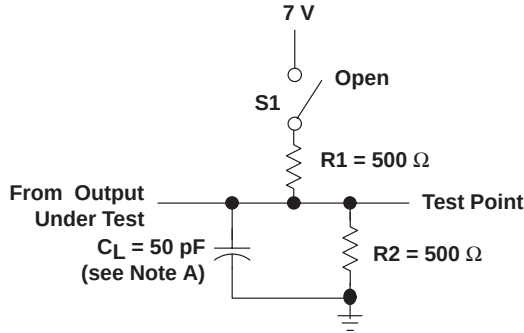
| PARAMETER          | FROM<br>(INPUT)          | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V TO 5.5 V,<br>C <sub>L</sub> = 50 PF,<br>R1 = 500 Ω,<br>R2 = 500 Ω,<br>T <sub>A</sub> = MIN TO MAX <sup>†</sup> |     |           |     | UNIT |
|--------------------|--------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------|-----|-----------|-----|------|
|                    |                          |                | SN54AS652                                                                                                                              |     | SN74AS652 |     |      |
|                    |                          |                | MIN                                                                                                                                    | MAX | TYP       | MAX |      |
| f <sub>max</sub> * |                          |                | 75                                                                                                                                     |     | 90        |     | MHz  |
| t <sub>PLH</sub>   | CLKBA or CLKAB           | A or B         | 2                                                                                                                                      | 11  | 2         | 8.5 | ns   |
| t <sub>PHL</sub>   |                          |                | 2                                                                                                                                      | 10  | 2         | 9   |      |
| t <sub>PLH</sub>   | A or B                   | B or A         | 2                                                                                                                                      | 12  | 2         | 9   | ns   |
| t <sub>PHL</sub>   |                          |                | 1                                                                                                                                      | 8   | 1         | 7   |      |
| t <sub>PLH</sub>   | SBA or SAB <sup>‡</sup>  | A or B         | 2                                                                                                                                      | 15  | 2         | 11  | ns   |
| t <sub>PHL</sub>   |                          |                | 2                                                                                                                                      | 11  | 2         | 9   |      |
| t <sub>PZH</sub>   | $\overline{\text{OEBA}}$ | A              | 2                                                                                                                                      | 11  | 2         | 10  | ns   |
| t <sub>PZL</sub>   |                          |                | 3                                                                                                                                      | 18  | 3         | 16  |      |
| t <sub>PHZ</sub>   | $\overline{\text{OEBA}}$ | A              | 2                                                                                                                                      | 10  | 2         | 9   | ns   |
| t <sub>PLZ</sub>   |                          |                | 2                                                                                                                                      | 10  | 2         | 9   |      |
| t <sub>PZH</sub>   | OEAB                     | B              | 3                                                                                                                                      | 12  | 3         | 11  | ns   |
| t <sub>PZL</sub>   |                          |                | 3                                                                                                                                      | 20  | 3         | 16  |      |
| t <sub>PHZ</sub>   | OEAB                     | B              | 2                                                                                                                                      | 11  | 2         | 10  | ns   |
| t <sub>PLZ</sub>   |                          |                | 2                                                                                                                                      | 12  | 2         | 11  |      |

\* On products compliant to MIL-PRF-38535, this parameter is based on characterized data but is not production tested.

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

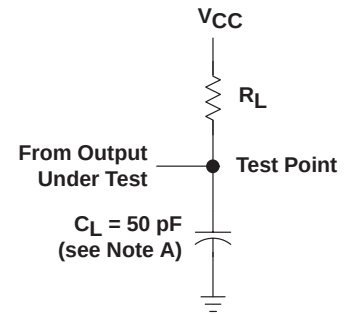
## PARAMETER MEASUREMENT INFORMATION



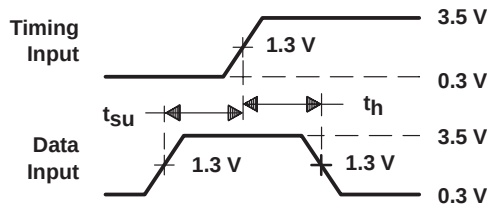
LOAD CIRCUIT  
FOR 3-STATE OUTPUTS

SWITCH POSITION TABLE

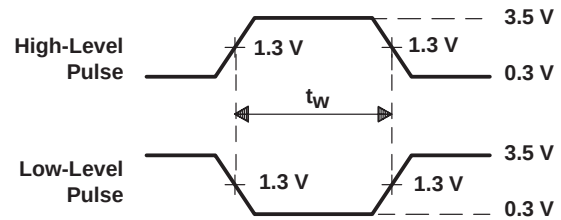
| TEST      | S1     |
|-----------|--------|
| $t_{PLH}$ | Open   |
| $t_{PHL}$ | Open   |
| $t_{PZH}$ | Open   |
| $t_{PZL}$ | Closed |
| $t_{PHZ}$ | Open   |
| $t_{PLZ}$ | Closed |



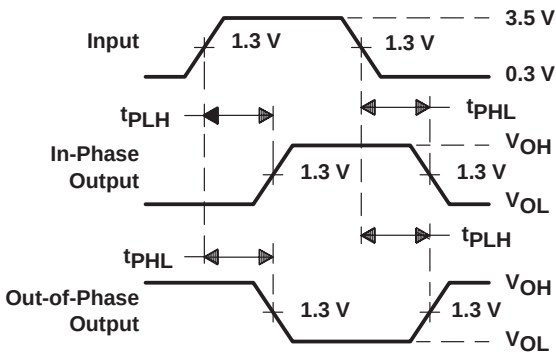
LOAD CIRCUIT  
FOR OPEN-COLLECTOR OUTPUTS



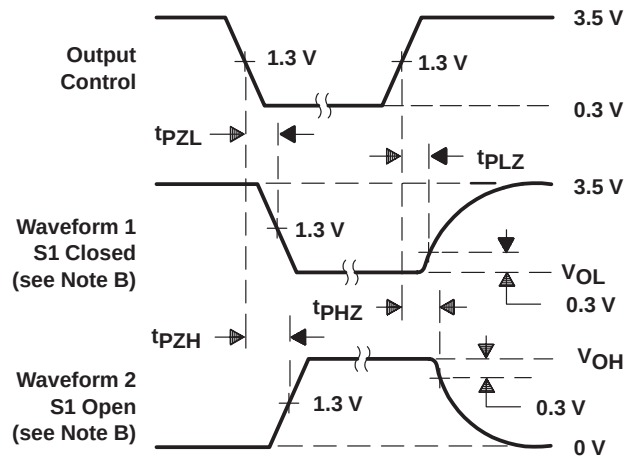
VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

- 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:  $PRR \leq 1$  MHz,  $Z_0 = 50 \Omega$ ,  $t_r \leq 2$  ns,  $t_f \leq 2$  ns.  
 D. The outputs are measured one at a time with one transition per measurement.

Figure 2. Load Circuits and Voltage Waveforms

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