

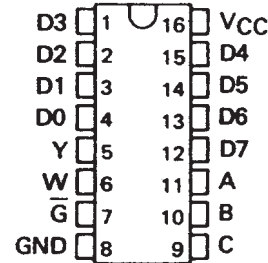
# SN54251, SN54LS251 SN54S251, SN74251, SN74LS251, (TIM9905), SN74S251 DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SDLS085 - DECEMBER 1972 - REVISED MARCH 1988

- Three-State Versions of '151, 'LS151, 'S151
- Three-State Outputs Interface Directly with System Bus
- Perform Parallel-to-Serial Conversion
- Permit Multiplexing from N-lines to One Line
- Complementary Outputs Provide True and Inverted Data
- Fully Compatible with Most TTL Circuits

SN54251, SN54LS251, SN54S251 . . . J OR W PACKAGE  
SN74251 . . . N PACKAGE  
SN74LS251, SN74S251 . . . D OR N PACKAGE

(TOP VIEW)



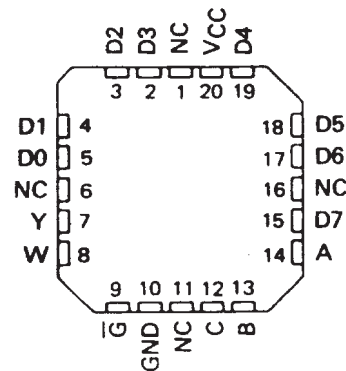
| TYPE      | MAX NO. OF COMMON OUTPUTS | TYPICAL AVG PROP DELAY TIME (D TO Y) | TYPICAL POWER DISSIPATION |
|-----------|---------------------------|--------------------------------------|---------------------------|
| SN54251   | 49                        | 17 ns                                | 250 mW                    |
| SN74251   | 129                       | 17 ns                                | 250 mW                    |
| SN54LS251 | 49                        | 17 ns                                | 35 mW                     |
| SN74LS251 | 129                       | 17 ns                                | 35 mW                     |
| SN54S251  | 39                        | 8 ns                                 | 275 mW                    |
| SN74S251  | 129                       | 8 ns                                 | 275 mW                    |

## description

These monolithic data selectors/multiplexers contain full on-chip binary decoding to select one-of-eight data sources and feature a strobe-controlled three-state output. The strobe must be at a low logic level to enable these devices. The three-state outputs permit a number of outputs to be connected to a common bus. When the strobe input is high, both outputs are in a high-impedance state in which both the upper and lower transistors of each totem-pole output are off, and the output neither drives nor loads the bus significantly. When the strobe is low, the outputs are activated and operate as standard TTL totem-pole outputs.

To minimize the possibility that two outputs will attempt to take a common bus to opposite logic levels, the output control circuitry is designed so that the average output disable time is shorter than the average output enable time. The SN54251 and SN74251 have output clamp diodes to attenuate reflections on the bus line.

SN54LS251, SN54S251 . . . FK PACKAGE  
(TOP VIEW)



NC - No internal connection

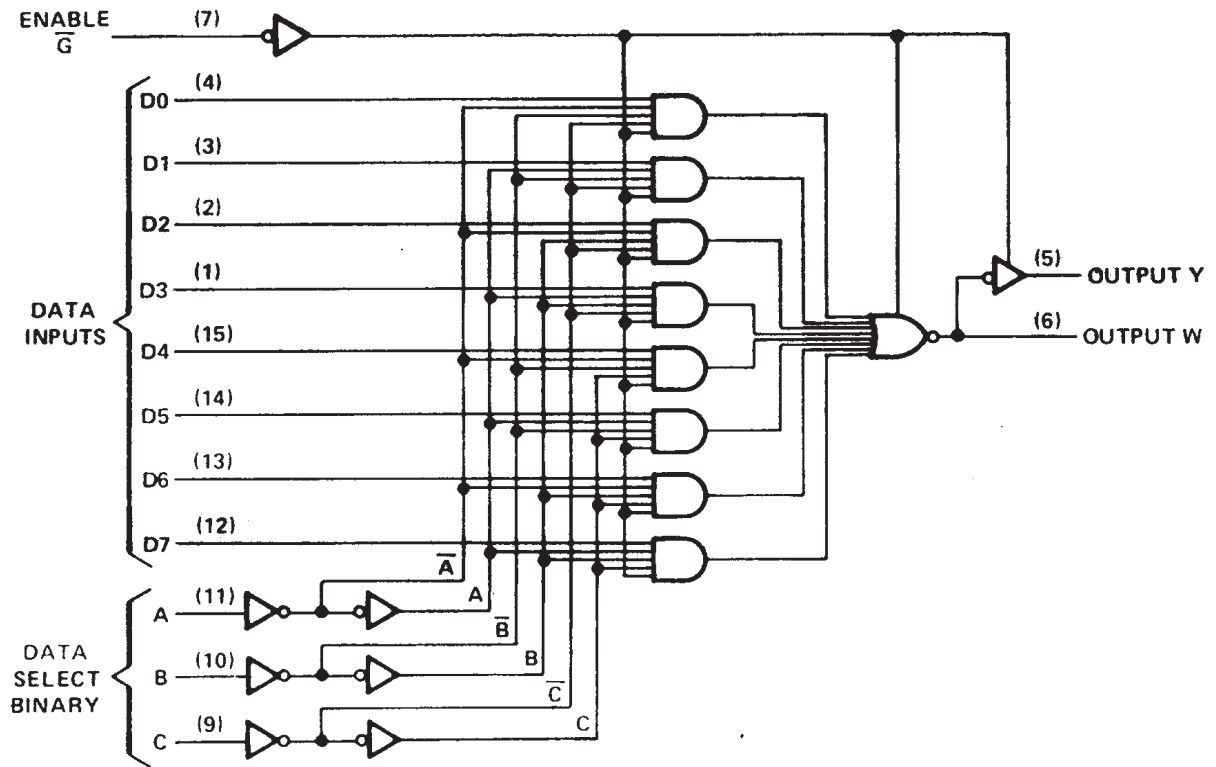
FUNCTION TABLE

| INPUTS |   |   |           | OUTPUTS |            |
|--------|---|---|-----------|---------|------------|
| SELECT |   |   | ENABLE    | Y       | W          |
| C      | B | A | $\bar{G}$ |         |            |
| X      | X | X | H         | Z       | Z          |
| L      | L | L | L         | D0      | $\bar{D0}$ |
| L      | L | H | L         | D1      | $\bar{D1}$ |
| L      | H | L | L         | D2      | $\bar{D2}$ |
| L      | H | H | L         | D3      | $\bar{D3}$ |
| H      | L | L | L         | D4      | $\bar{D4}$ |
| H      | L | H | L         | D5      | $\bar{D5}$ |
| H      | H | L | L         | D6      | $\bar{D6}$ |
| H      | H | H | L         | D7      | $\bar{D7}$ |

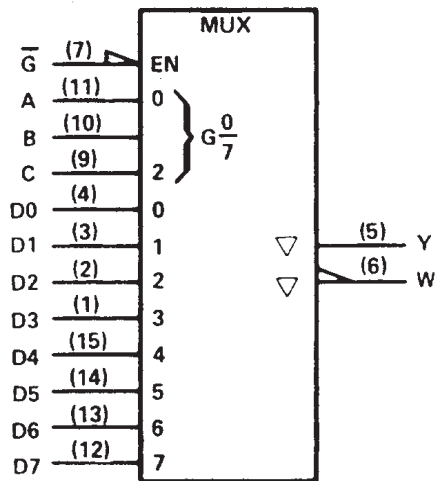
H = high logic level, L = low logic level  
X = irrelevant, Z = high impedance (off)  
D0, D1 . . . D7 = the level of the respective D input

SN54251, SN54LS251 SN54S251,  
 SN74251, SN74LS251, (TIM9905), SN74S251  
**DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS**  
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**logic diagram (positive logic)**



**logic symbol†**



†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

# SN54251 SN74251, DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)**

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)         | 7 V            |
| Input voltage                                 | 5.5 V          |
| Off-state output voltage                      | 5.5 V          |
| Operating free-air temperature range: SN54251 | –55°C to 125°C |
| SN74251                                       | 0°C to 70°C    |
| Storage temperature range                     | –65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

**recommended operating conditions**

|                                       | SN54251 |     |     | SN74251 |     |      | UNIT |
|---------------------------------------|---------|-----|-----|---------|-----|------|------|
|                                       | MIN     | NOM | MAX | MIN     | NOM | MAX  |      |
| Supply voltage, $V_{CC}$              | 4.5     | 5   | 5.5 | 4.75    | 5   | 5.25 | V    |
| High-level output current, $I_{OH}$   |         |     | –2  |         |     | –5.2 | mA   |
| Low-level output current, $I_{OL}$    |         |     | 16  |         |     | 16   | mA   |
| Operating free-air temperature, $T_A$ | –55     |     | 125 | 0       |     | 70   | °C   |

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

| PARAMETER |   | TEST CONDITIONS†  | MIN                    | TYP‡ | MAX            | UNIT          |
|-----------|---|---|------------------------|------|----------------|---------------|
| $V_{IH}$  | High-level input voltage                        |   | 2                      |      |                | V             |
| $V_{IL}$  | Low-level input voltage                         |   |                        |      | 0.8            | V             |
| $V_{IK}$  | Input clamp voltage                             | $V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$   |                        |      | –1.5           | V             |
| $V_{OH}$  | High-level output voltage                       | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = \text{MAX}$    | 2.4                    | 3.2  |                | V             |
| $V_{OL}$  | Low-level output voltage                        | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$ |                        | 0.2  | 0.4            | V             |
| $I_{OZ}$  | Off-state (high-impedance-state) output current | $V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}$   | $V_O = 2.4 \text{ V}$  |      | 40             | $\mu\text{A}$ |
|           |   |   | $V_O = 0.4 \text{ V}$  |      | –40            |               |
| $V_O$     | Output clamp voltage                            | $V_{CC} = \text{MAX}, V_{IH} = 4.5 \text{ V}$   | $I_O = -12 \text{ mA}$ |      | –1.5           | V             |
|           |   |   | $I_O = 12 \text{ mA}$  |      | $V_{CC} + 1.5$ |               |
| $I_I$     | Input current at maximum input voltage          | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$  |                        |      | 1              | mA            |
| $I_{IH}$  | High-level input current                        | $V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$  |                        |      | 40             | $\mu\text{A}$ |
| $I_{IL}$  | Low-level input current                         | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$  |                        |      | –1.6           | mA            |
| $I_{OS}$  | Short-circuit output current §                  | $V_{CC} = \text{MAX}$   | –18                    |      | –55            | mA            |
| $I_{CC}$  | Supply current                                  | $V_{CC} = \text{MAX},$ All inputs at 4.5 V, All outputs open                                |                        | 38   | 62             | mA            |

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

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

§ Not more than one output should be shorted at a time.



# SN54251 SN74251, DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

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switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER† | FROM (INPUT)             | TO (OUTPUT) | TEST CONDITIONS   | MIN | TYP | MAX | UNIT |
|------------|--------------------------|-------------|---|-----|-----|-----|------|
| $t_{PLH}$  | A, B, or C<br>(4 levels) | Y           | $C_L = 50\text{ pF}$ ,<br>$R_L = 400\ \Omega$ ,<br>See Note 2 | 29  | 45  | ns  |      |
| $t_{PHL}$  |                          |             |   | 28  | 45  |     |      |
| $t_{PLH}$  | A, B, or C<br>(3 levels) | W           |   | 20  | 33  | ns  |      |
| $t_{PHL}$  |                          |             |   | 21  | 33  |     |      |
| $t_{PLH}$  | Any D                    | Y           |   | 17  | 28  | ns  |      |
| $t_{PHL}$  |                          |             |   | 18  | 28  |     |      |
| $t_{PLH}$  | Any D                    | W           |   | 10  | 15  | ns  |      |
| $t_{PHL}$  |                          |             |   | 9   | 15  |     |      |
| $t_{PZH}$  | $\bar{G}$                | Y           |   | 17  | 27  | ns  |      |
| $t_{PZL}$  |                          |             |   | 26  | 40  |     |      |
| $t_{PZH}$  | $\bar{G}$                | W           |   | 17  | 27  | ns  |      |
| $t_{PZL}$  |                          |             |   | 24  | 40  |     |      |
| $t_{PHZ}$  | $\bar{G}$                | Y           | $C_L = 5\text{ pF}$ ,<br>$R_L = 400\ \Omega$ ,<br>See Note 2  | 5   | 8   | ns  |      |
| $t_{PLZ}$  |                          |             |   | 15  | 23  |     |      |
| $t_{PHZ}$  | $\bar{G}$                | W           |   | 5   | 8   | ns  |      |
| $t_{PLZ}$  |                          |             |   | 15  | 23  |     |      |

† $t_{PLH}$  = Propagation delay time, low-to-high-level output

$t_{PHL}$  = Propagation delay time, high-to-low-level output

$t_{PZH}$  = Output enable time to high level

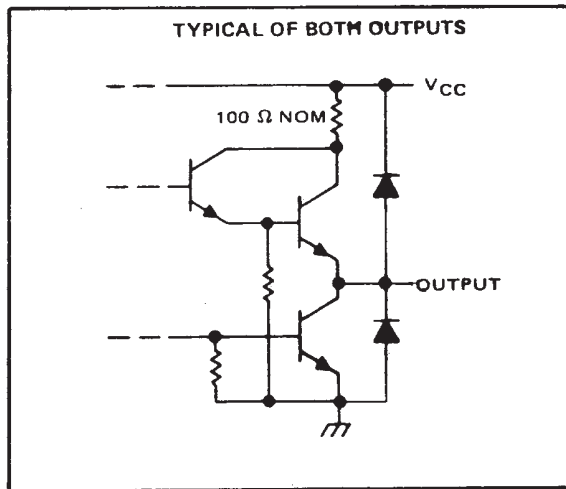
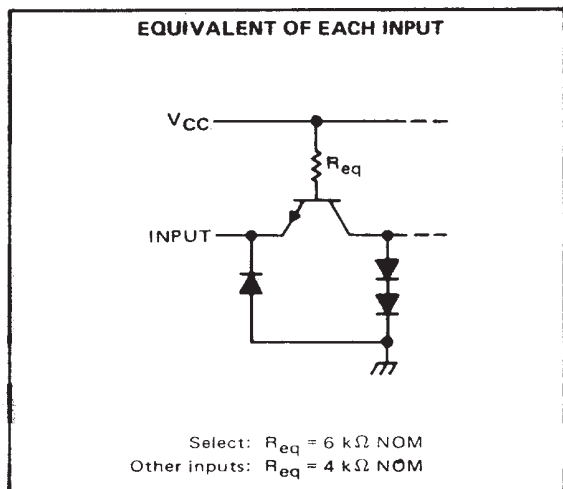
$t_{PZL}$  = Output enable time to low level

$t_{PHZ}$  = Output disable time from high level

$t_{PLZ}$  = Output disable time from low level

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

## schematics of inputs and outputs



# SN54LS251 SN74LS251, DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)           | 7 V            |
| Input voltage                                   | 7 V            |
| Off-state output voltage                        | 5.5 V          |
| Operating free-air temperature range: SN54LS251 | 55°C to 125°C  |
| SN74LS251                                       | 0°C to 70°C    |
| Storage temperature range                       | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

|                                      | SN54LS251 |     |     | SN74LS251 |     |      | UNIT |
|--------------------------------------|-----------|-----|-----|-----------|-----|------|------|
|                                      | MIN       | NOM | MAX | MIN       | NOM | MAX  |      |
| $V_{CC}$ Supply voltage              | 4.5       | 5   | 5.5 | 4.75      | 5   | 5.25 | 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   |           |     | -1  |           |     | -2.6 | mA   |
| $I_{OL}$ Low-level output current    |           |     | 4   |           |     | 8    | mA   |
| $T_A$ Operating free-air temperature | -55       |     | 125 | 0         |     | 70   | °C   |

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

| PARAMETER | TEST CONDITIONS†  | SN54LS251               |       | SN74LS251 |     | UNIT |               |
|-----------|---|-------------------------|-------|-----------|-----|------|---------------|
|           |   | MIN                     | TYP ‡ | MAX       | MIN |      | TYP ‡         |
| $V_{IK}$  | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$   |                         |       | -1.5      |     | -1.5 | V             |
| $V_{OH}$  | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}, I_{OH} = \text{MAX}$ | 2.4                     | 3.4   |           | 2.4 | 3.1  | V             |
| $V_{OL}$  | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}$                      | $I_{OL} = 4 \text{ mA}$ |       | 0.25      | 0.4 | 0.25 | 0.4           |
|           |   | $I_{OL} = 8 \text{ mA}$ |       |           |     | 0.35 | 0.5           |
| $I_{OZ}$  | $V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}$   | $V_O = 2.7 \text{ V}$   |       |           |     | 20   | $\mu\text{A}$ |
|           |   | $V_O = 0.4 \text{ V}$   |       |           |     | -20  |               |
| $I_I$     | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$  |                         |       | 0.1       |     | 0.1  | mA            |
| $I_{IH}$  | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$  |                         |       | 20        |     | 20   | $\mu\text{A}$ |
| $I_{IL}$  | $V_{CC} = \text{MAX}, V_I = 0.4$  | Enable $\bar{C}$        |       |           |     | -0.2 | mA            |
|           |   | All other               |       |           |     | -0.4 |               |
| $I_{OS}§$ | $V_{CC} = \text{MAX}$   |                         |       | -30       |     | -130 | mA            |
| $I_{CC}$  | $V_{CC} = \text{MAX},$ See Note 3   | Condition A             |       | 6.1       | 10  | 6.1  | 10            |
|           |   | Condition B             |       | 7.1       | 12  | 7.1  | 12            |

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

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

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTE 3:  $I_{CC}$  is measured with the outputs open and all data and select inputs at 4.5 V under the following conditions:

- A. Enable grounded.
- B. Strobe at 4.5 V.



# SN54LS251 SN74LS251, (TIM9905), DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

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switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER† | FROM (INPUT)             | TO (OUTPUT) | TEST CONDITIONS  | MIN   | TYP | MAX | UNIT |    |
|------------|--------------------------|-------------|--|---|-----|-----|------|----|
| $t_{PLH}$  | A, B, or C<br>(4 levels) | Y           | $C_L = 15\text{ pF}$ ,<br>$R_L = 2\text{ k}\Omega$ ,<br>See Note 2 |   | 29  | 45  | ns   |    |
| $t_{PHL}$  |                          |             |  |   | 28  | 45  |      |    |
| $t_{PLH}$  | A, B, or C<br>(3 levels) | W           |  |   | 20  | 33  | ns   |    |
| $t_{PHL}$  |                          |             |  |   | 21  | 33  |      |    |
| $t_{PLH}$  | Any D                    | Y           |  |   | 17  | 28  | ns   |    |
| $t_{PHL}$  |                          |             |  |   | 18  | 28  |      |    |
| $t_{PLH}$  | Any D                    | W           |  |   | 10  | 15  | ns   |    |
| $t_{PHL}$  |                          |             |  |   | 9   | 15  |      |    |
| $t_{PZH}$  | $\bar{G}$                | Y           |  | $C_L = 5\text{ pF}$ ,<br>$R_L = 2\text{ k}\Omega$ ,<br>See Note 2 |     | 30  | 45   | ns |
| $t_{PZL}$  |                          |             |  |   |     | 26  | 40   |    |
| $t_{PZH}$  | $\bar{G}$                | W           |  |   | 17  | 27  | ns   |    |
| $t_{PZL}$  |                          |             |  |   | 24  | 40  |      |    |
| $t_{PHZ}$  | $\bar{G}$                | Y           |  |   | 30  | 45  | ns   |    |
| $t_{PLZ}$  |                          |             |  |   | 15  | 25  |      |    |
| $t_{PHZ}$  | $\bar{G}$                | W           |  |   | 37  | 55  | ns   |    |
| $t_{PLZ}$  |                          |             |  |   | 15  | 25  |      |    |

† $t_{PLH}$  = Propagation delay time, low-to-high-level output

$t_{PHL}$  = Propagation delay time, high-to-low-level output

$t_{PZH}$  = Output enable time to high level

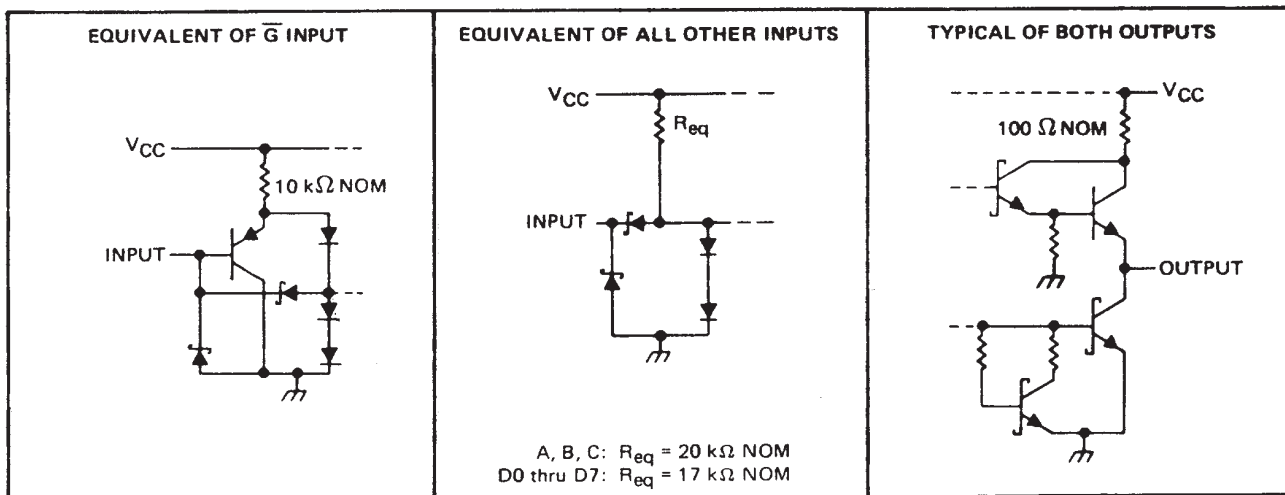
$t_{PZL}$  = Output enable time to low level

$t_{PHZ}$  = Output disable time from high level

$t_{PLZ}$  = Output disable time from low level

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

## schematics of inputs and outputs



# SN54S251 SN74S251, DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|  |                |
|--|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)          | 7 V            |
| Input voltage                                  | 5.5 V          |
| Off-state output voltage                       | 5.5 V          |
| Operating free-air temperature range: SN54S251 | –55°C to 125°C |
| SN74S251                                       | 0°C to 70°C    |
| Storage temperature range                      | –65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

|                                       | SN54S251 |     |     | SN74S251 |     |      | UNIT |
|---------------------------------------|----------|-----|-----|----------|-----|------|------|
|                                       | MIN      | NOM | MAX | MIN      | NOM | MAX  |      |
| Supply voltage, $V_{CC}$              | 4.5      | 5   | 5.5 | 4.75     | 5   | 5.25 | V    |
| High-level output current, $I_{OH}$   |          |     | –2  |          |     | –6.5 | mA   |
| Low-level output current, $I_{OL}$    |          |     | 20  |          |     | 20   | mA   |
| Operating free-air temperature, $T_A$ | –55      |     | 125 | 0        |     | 70   | °C   |

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

| PARAMETER  | TEST CONDITIONS†  | MIN                   | TYP‡ | MAX  | UNIT          |
|--|---|-----------------------|------|------|---------------|
| $V_{IH}$ High-level input voltage                        |   | 2                     |      |      | V             |
| $V_{IL}$ Low-level input voltage                         |   |                       |      | 0.8  | V             |
| $V_{IK}$ Input clamp voltage                             | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$   |                       |      | –1.2 | V             |
| $V_{OH}$ High-level output voltage                       | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = \text{MAX}$    | SN54S'                | 2.4  | 3.4  | V             |
|  |   | SN74S'                | 2.4  | 3.2  |               |
| $V_{OL}$ Low-level output voltage                        | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 20 \text{ mA}$ |                       |      | 0.5  | V             |
| $I_{OZ}$ Off-state (high-impedance-state) output current | $V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}$   | $V_O = 2.4 \text{ V}$ |      | 50   | $\mu\text{A}$ |
|  |   | $V_O = 0.5 \text{ V}$ |      | –50  |               |
| $I_I$ Input current at maximum input voltage             | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$  |                       |      | 1    | mA            |
| $I_{IH}$ High-level input current                        | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$  |                       |      | 50   | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current                         | $V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$  |                       |      | –2   | mA            |
| $I_{OS}$ Short-circuit output current §                  | $V_{CC} = \text{MAX}$   | –40                   |      | –100 | mA            |
| $I_{CC}$ Supply current                                  | $V_{CC} = \text{MAX},$ All inputs at 4.5 V, All outputs open                                |                       | 55   | 85   | mA            |

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

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

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.



# SN54S251 SN74S251, DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

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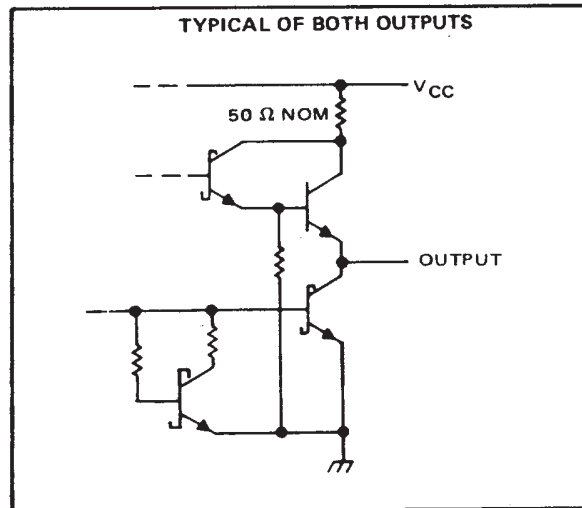
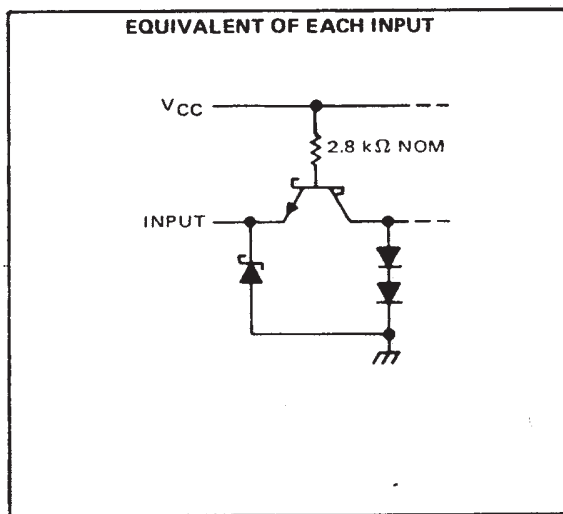
switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER† | FROM (INPUT)             | TO (OUTPUT) | TEST CONDITIONS   | MIN  | TYP  | MAX | UNIT |
|------------|--------------------------|-------------|---|--|------|-----|------|
| $t_{PLH}$  | A, B, or C<br>(4 levels) | Y           | $C_L = 15\text{ pF}$ ,<br>$R_L = 280\ \Omega$ ,<br>See Note 2 | 12   | 18   | ns  |      |
| $t_{PHL}$  |                          |             |   | 13   | 19.5 |     |      |
| $t_{PLH}$  | A, B, or C<br>(3 levels) | W           |   | 10   | 15   | ns  |      |
| $t_{PHL}$  |                          |             |   | 9  | 13.5 |     |      |
| $t_{PLH}$  | Any D                    | Y           |   | 8  | 12   | ns  |      |
| $t_{PHL}$  |                          |             |   | 8  | 12   |     |      |
| $t_{PLH}$  | Any D                    | W           |   | 4.5  | 7    | ns  |      |
| $t_{PHL}$  |                          |             |   | 4.5  | 7    |     |      |
| $t_{PZH}$  | $\bar{G}$                | Y           | $C_L = 50\text{ pF}$ ,<br>$R_L = 280\ \Omega$ ,<br>See Note 2 | 13   | 19.5 | ns  |      |
| $t_{PZL}$  |                          |             |   | 14   | 21   |     |      |
| $t_{PZH}$  | $\bar{G}$                | W           |   | 13   | 19.5 | ns  |      |
| $t_{PZL}$  |                          |             |   | 14   | 21   |     |      |
| $t_{PHZ}$  | $\bar{G}$                | Y           |   | $C_L = 5\text{ pF}$ ,<br>$R_L = 280\ \Omega$ ,<br>See Note 2 | 5.5  | 8.5 | ns   |
| $t_{PLZ}$  |                          |             |   |  | 9    | 14  |      |
| $t_{PHZ}$  | $\bar{G}$                | W           | 5.5   |  | 8.5  | ns  |      |
| $t_{PLZ}$  |                          |             | 9   |  | 14   |     |      |

- † $t_{PLH}$  = Propagation delay time, low-to-high-level output
- $t_{PHL}$  = Propagation delay time, high-to-low-level output
- $t_{PZH}$  = Output enable time to high level
- $t_{PZL}$  = Output enable time to low level
- $t_{PHZ}$  = Output disable time from high level
- $t_{PLZ}$  = Output disable time from low level

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

## schematics of inputs and outputs





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