

# SN54HC251, SN74HC251 DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUTS

SCLS132A – DECEMBER 1982 – REVISED JANUARY 1996

- 3-State Version of 'HC151
- High-Current 3-State Outputs Interface Directly With System Bus or Can Drive up to 15 LSTTL Loads
- Perform Parallel-to-Serial Conversion
- Complementary Outputs Provide True and Inverted Data
- Package Options Include Plastic Small-Outline (D) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

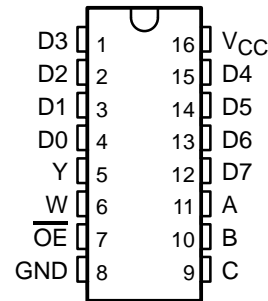
## description

These data selectors/multiplexers contain full binary decoding to select 1-of-8 data sources and feature strobe-controlled complementary 3-state outputs.

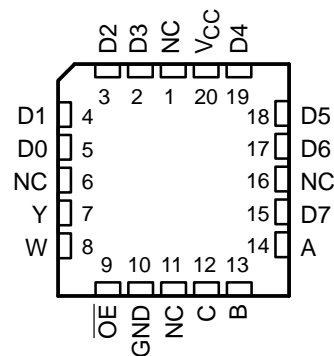
The 3-state outputs can interface with and drive data lines of bus-organized systems. With all but one of the common outputs disabled (at the high-impedance state), the low impedance of the single enabled output drives the bus line to a high or low logic level. Both outputs are controlled by the output-enable ( $\overline{OE}$ ) input. The outputs are disabled when  $\overline{OE}$  is high.

The SN54HC251 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC251 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54HC251 . . . J OR W PACKAGE  
SN74HC251 . . . D OR N PACKAGE  
(TOP VIEW)



SN54HC251 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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**TEXAS  
INSTRUMENTS**

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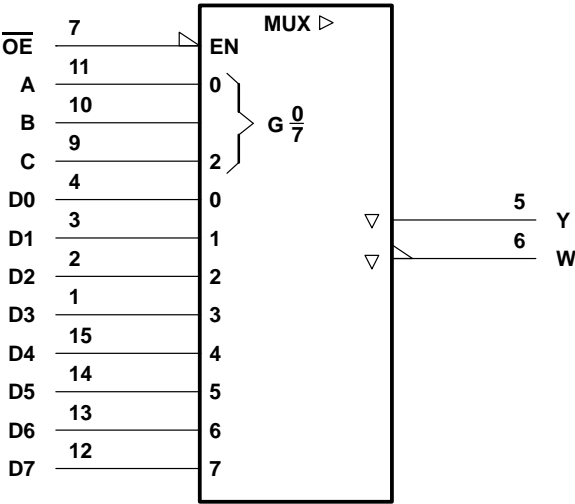
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SCLS132A – DECEMBER 1982 – REVISED JANUARY 1996

| FUNCTION TABLE |   |   |                 |         |                 |
|----------------|---|---|-----------------|---------|-----------------|
| INPUTS         |   |   |                 | OUTPUTS |                 |
| SELECT         |   |   | $\overline{OE}$ | Y       | W               |
| C              | B | A |                 |         |                 |
| X              | X | X | H               | Z       | $\overline{Z}$  |
| L              | L | L | L               | D0      | $\overline{D0}$ |
| L              | L | H | L               | D1      | $\overline{D1}$ |
| L              | H | L | L               | D2      | $\overline{D2}$ |
| L              | H | H | L               | D3      | $\overline{D3}$ |
| H              | L | L | L               | D4      | $\overline{D4}$ |
| H              | L | H | L               | D5      | $\overline{D5}$ |
| H              | H | L | L               | D6      | $\overline{D6}$ |
| H              | H | H | L               | D7      | $\overline{D7}$ |

D0, D1 . . . D7 = the level of the respective D input

logic symbol†

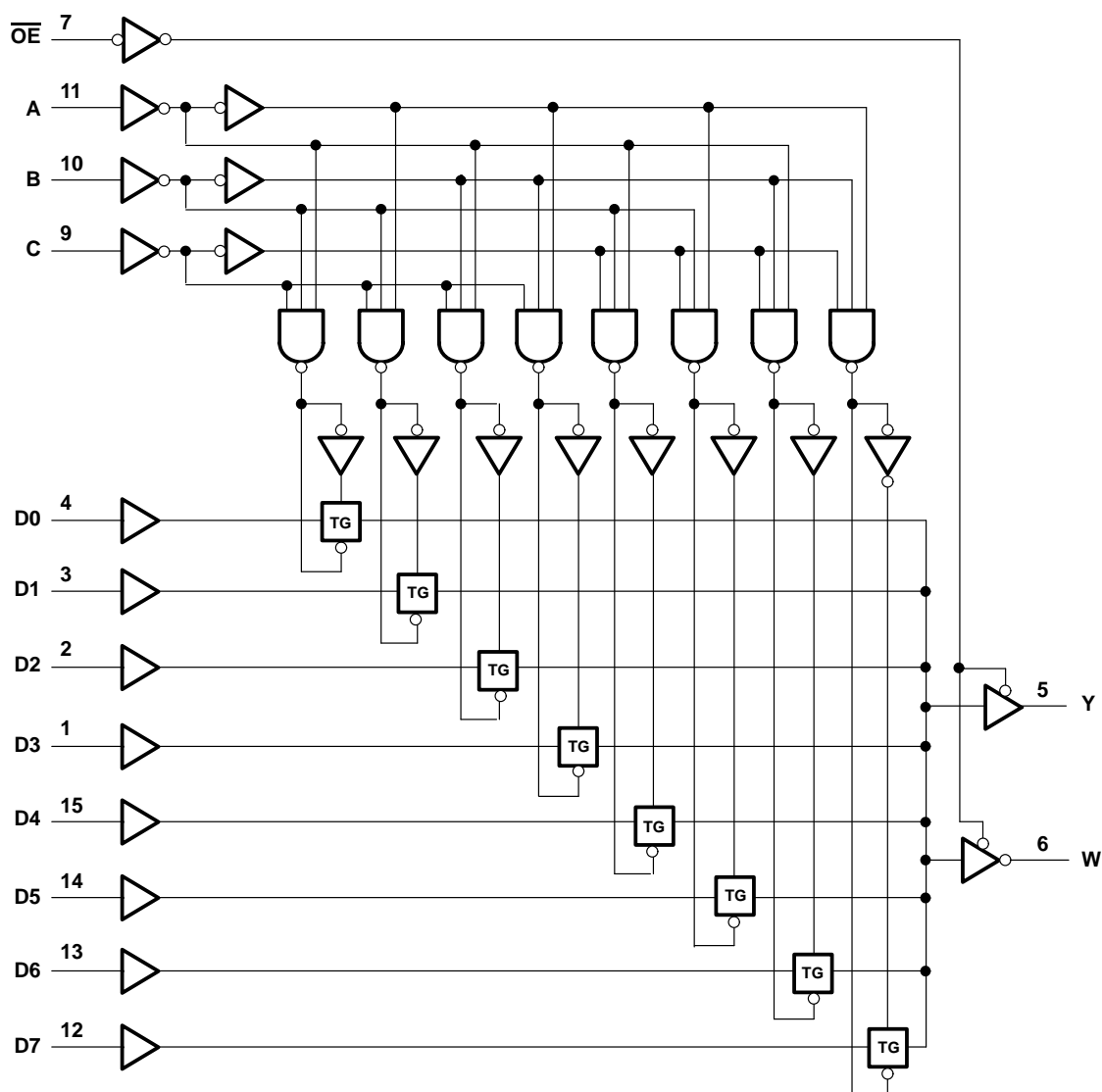


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for the D, J, N, and W packages.

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SCLS132A – DECEMBER 1982 – REVISED JANUARY 1996

logic diagram (positive logic)



Pin numbers shown are for the D, J, N, and W packages.

# SN54HC251, SN74HC251

## DATA SELECTORS/MULTIPLEXERS

### WITH 3-STATE OUTPUTS

SCLS132A – DECEMBER 1982 – REVISED JANUARY 1996

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

|  |                |
|--|----------------|
| Supply voltage range, $V_{CC}$   | –0.5 V to 7 V  |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)                   | ±20 mA         |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1)                  | ±20 mA         |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                                   | ±35 mA         |
| Continuous current through $V_{CC}$ or GND   | ±70 mA         |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): D package | 1.3 W          |
| N package  | 1.1 W          |
| Storage temperature range, $T_{stg}$   | –65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils, except for the N package, which has a trace length of zero.

#### recommended operating conditions

|          |                                       |                         | SN54HC251 |          |     | SN74HC251 |          |     | UNIT |
|----------|---------------------------------------|-------------------------|-----------|----------|-----|-----------|----------|-----|------|
|          |                                       |                         | MIN       | NOM      | MAX | MIN       | NOM      | MAX |      |
| $V_{CC}$ | Supply voltage                        |                         | 2         | 5        | 6   | 2         | 5        | 6   | V    |
| $V_{IH}$ | High-level input voltage              | $V_{CC} = 2\text{ V}$   | 1.5       |          |     | 1.5       |          |     | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$ | 3.15      |          |     | 3.15      |          |     |      |
|          |                                       | $V_{CC} = 6\text{ V}$   | 4.2       |          |     | 4.2       |          |     |      |
| $V_{IL}$ | Low-level input voltage               | $V_{CC} = 2\text{ V}$   | 0         | 0.5      |     | 0         | 0.5      |     | V    |
|          |                                       | $V_{CC} = 4.5\text{ V}$ | 0         | 1.35     |     | 0         | 1.35     |     |      |
|          |                                       | $V_{CC} = 6\text{ V}$   | 0         | 1.8      |     | 0         | 1.8      |     |      |
| $V_I$    | Input voltage                         |                         | 0         | $V_{CC}$ |     | 0         | $V_{CC}$ |     | V    |
| $V_O$    | Output voltage                        |                         | 0         | $V_{CC}$ |     | 0         | $V_{CC}$ |     | V    |
| $t_t$    | Input transition (rise and fall) time | $V_{CC} = 2\text{ V}$   | 0         | 1000     |     | 0         | 1000     |     | ns   |
|          |                                       | $V_{CC} = 4.5\text{ V}$ | 0         | 500      |     | 0         | 500      |     |      |
|          |                                       | $V_{CC} = 6\text{ V}$   | 0         | 400      |     | 0         | 400      |     |      |
| $T_A$    | Operating free-air temperature        |                         | –55       | 125      |     | –40       | 85       |     | °C   |

**SN54HC251, SN74HC251**  
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**WITH 3-STATE OUTPUTS**

SCLS132A – DECEMBER 1982 – REVISED JANUARY 1996

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

| PARAMETER       | TEST CONDITIONS  |                           | V <sub>CC</sub> | T <sub>A</sub> = 25°C |       |      | SN54HC251 |       | SN74HC251 |       | UNIT |
|-----------------|--|---------------------------|-----------------|-----------------------|-------|------|-----------|-------|-----------|-------|------|
|                 |  |                           |                 | MIN                   | TYP   | MAX  | MIN       | MAX   | MIN       | MAX   |      |
| V <sub>OH</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>  | I <sub>OH</sub> = -20 µA  | 2 V             | 1.9                   | 1.998 |      | 1.9       |       | 1.9       |       | V    |
|                 |  |                           | 4.5 V           | 4.4                   | 4.499 |      | 4.4       |       | 4.4       |       |      |
|                 |  |                           | 6 V             | 5.9                   | 5.999 |      | 5.9       |       | 5.9       |       |      |
|                 |  | I <sub>OH</sub> = -6 mA   | 4.5 V           | 3.98                  | 4.3   |      | 3.7       |       | 3.84      |       |      |
|                 |  | I <sub>OH</sub> = -7.8 mA | 6 V             | 5.48                  | 5.8   |      | 5.2       |       | 5.34      |       |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>  | I <sub>OL</sub> = 20 µA   | 2 V             |                       | 0.002 | 0.1  |           | 0.1   |           | 0.1   | V    |
|                 |  |                           | 4.5 V           |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |  |                           | 6 V             |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |  | I <sub>OL</sub> = 6 mA    | 4.5 V           |                       | 0.17  | 0.26 |           | 0.4   |           | 0.33  |      |
|                 |  | I <sub>OL</sub> = 7.8 mA  | 6 V             |                       | 0.15  | 0.26 |           | 0.4   |           | 0.33  |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or 0  |                           | 6 V             |                       | ±0.1  | ±100 |           | ±1000 |           | ±1000 | nA   |
| I <sub>OZ</sub> | V <sub>O</sub> = V <sub>CC</sub> or 0, V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> |                           | 6 V             |                       | ±0.01 | ±0.5 |           | ±10   |           | ±5    | µA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0                                  |                           | 6 V             |                       |       | 8    |           | 160   |           | 80    | µA   |
| C <sub>i</sub>  |  |                           | 2 V to 6 V      |                       | 3     | 10   |           | 10    |           | 10    | pF   |

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

| PARAMETER        | FROM (INPUT)           | TO (OUTPUT) | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC251 |     | SN74HC251 |     | UNIT |
|------------------|------------------------|-------------|-----------------|-----------------------|-----|-----|-----------|-----|-----------|-----|------|
|                  |                        |             |                 | MIN                   | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| t <sub>pd</sub>  | A, B, or C             | W or Y      | 2 V             |                       | 58  | 205 |           | 300 |           | 256 | ns   |
|                  |                        |             | 4.5 V           |                       | 21  | 41  |           | 60  |           | 51  |      |
|                  |                        |             | 6 V             |                       | 19  | 35  |           | 51  |           | 44  |      |
|                  | Any D                  | W or Y      | 2 V             |                       | 44  | 195 |           | 283 |           | 244 |      |
|                  |                        |             | 4.5 V           |                       | 17  | 39  |           | 57  |           | 49  |      |
|                  |                        |             | 6 V             |                       | 15  | 33  |           | 48  |           | 41  |      |
| t <sub>en</sub>  | $\overline{\text{OE}}$ | W or Y      | 2 V             |                       | 30  | 145 |           | 210 |           | 181 | ns   |
|                  |                        |             | 4.5 V           |                       | 10  | 29  |           | 42  |           | 36  |      |
|                  |                        |             | 6 V             |                       | 9   | 25  |           | 36  |           | 31  |      |
| t <sub>dis</sub> | $\overline{\text{OE}}$ | W or Y      | 2 V             |                       | 25  | 195 |           | 283 |           | 244 | ns   |
|                  |                        |             | 4.5 V           |                       | 15  | 39  |           | 57  |           | 49  |      |
|                  |                        |             | 6 V             |                       | 14  | 33  |           | 48  |           | 41  |      |
| t <sub>t</sub>   |                        | W or Y      | 2 V             |                       | 20  | 75  |           | 110 |           | 95  | ns   |
|                  |                        |             | 4.5 V           |                       | 8   | 15  |           | 22  |           | 19  |      |
|                  |                        |             | 6 V             |                       | 6   | 13  |           | 19  |           | 16  |      |



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## DATA SELECTORS/MULTIPLEXERS

### WITH 3-STATE OUTPUTS

SCLS132A – DECEMBER 1982 – REVISED JANUARY 1996

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

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC251 |     | SN74HC251 |     | UNIT |
|-----------|-----------------|----------------|----------|--------------------------|-----|-----|-----------|-----|-----------|-----|------|
|           |                 |                |          | MIN                      | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| $t_{pd}$  | A, B, or C      | W or Y         | 2 V      |                          | 72  | 300 |           | 450 |           | 375 | ns   |
|           |                 |                | 4.5 V    |                          | 25  | 60  |           | 90  |           | 75  |      |
|           |                 |                | 6 V      |                          | 22  | 52  |           | 77  |           | 65  |      |
|           | Any D           | W or Y         | 2 V      |                          | 59  | 300 |           | 450 |           | 375 |      |
|           |                 |                | 4.5 V    |                          | 21  | 60  |           | 90  |           | 75  |      |
|           |                 |                | 6 V      |                          | 18  | 52  |           | 77  |           | 65  |      |
| $t_{en}$  | $\overline{OE}$ | W or Y         | 2 V      |                          | 50  | 230 |           | 340 |           | 285 | ns   |
|           |                 |                | 4.5 V    |                          | 17  | 46  |           | 68  |           | 57  |      |
|           |                 |                | 6 V      |                          | 15  | 40  |           | 58  |           | 50  |      |
| $t_t$     |                 | W or Y         | 2 V      |                          | 45  | 210 |           | 315 |           | 265 | ns   |
|           |                 |                | 4.5 V    |                          | 17  | 42  |           | 63  |           | 53  |      |
|           |                 |                | 6 V      |                          | 13  | 36  |           | 53  |           | 45  |      |

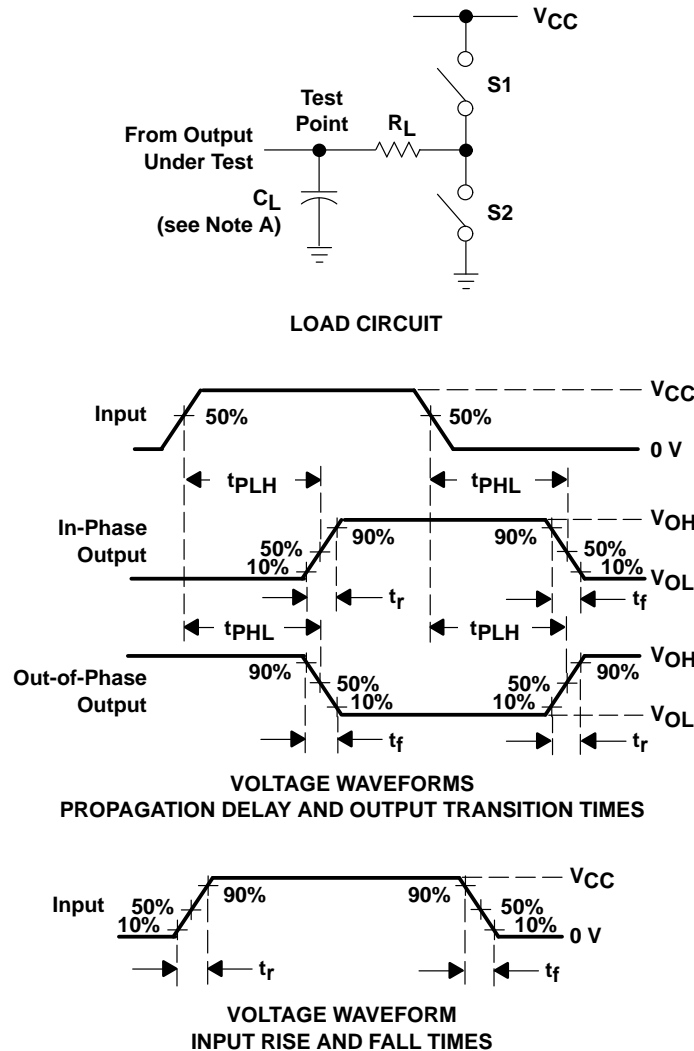
operating characteristics,  $T_A = 25^\circ\text{C}$

| PARAMETER |                               | TEST CONDITIONS | TYP | UNIT |
|-----------|-------------------------------|-----------------|-----|------|
| $C_{pd}$  | Power dissipation capacitance | No load         | 70  | pF   |

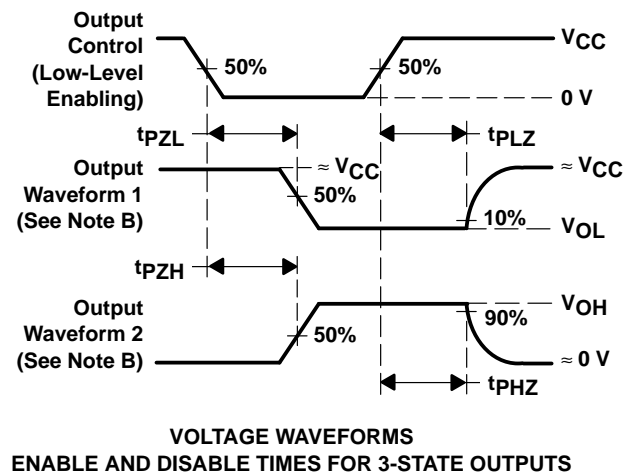


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## PARAMETER MEASUREMENT INFORMATION



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



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
  - C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

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