

# SN75172 QUADRUPLE DIFFERENTIAL LINE DRIVER

SLLS038B – OCTOBER 1980 – REVISED MAY 1995

- Meets or Exceeds the Requirements of ANSI Standards EIA/TIA-422-B and RS-485 and ITU Recommendation V.11
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- 3-State Outputs
- Common-Mode Output Voltage Range of –7 V to 12 V
- Active-High and Active-Low Enables
- Thermal Shutdown Protection
- Positive- and Negative-Current Limiting
- Operates From Single 5-V Supply
- Logically Interchangeable With AM26LS31

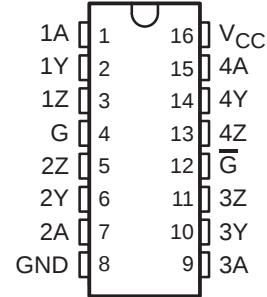
## description

The SN75172 is a monolithic quadruple differential line driver with 3-state outputs. It is designed to meet the requirements of ANSI Standards EIA/TIA-422-B and RS-485 and ITU Recommendation V.11. The device is optimized for balanced multipoint bus transmission at rates of up to 4 megabaud. Each driver features wide positive and negative common-mode output voltage ranges, making it suitable for party-line applications in noisy environments.

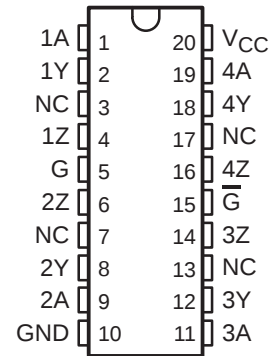
The SN75172 provides positive- and negative-current limiting and thermal shutdown for protection from line fault conditions on the transmission bus line. Shutdown occurs at a junction temperature of approximately 150°C. This device offers optimum performance when used with the SN75173 or SN75175 quadruple differential line receivers.

The SN75172 is characterized for operation from 0°C to 70°C.

**N PACKAGE  
(TOP VIEW)**



**DW PACKAGE  
(TOP VIEW)**



NC – No internal connection

**FUNCTION TABLE  
(each driver)**

| INPUT<br>A | ENABLES |                | OUTPUTS |   |
|------------|---------|----------------|---------|---|
|            | G       | $\overline{G}$ | Y       | Z |
| H          | H       | X              | H       | L |
| L          | H       | X              | L       | H |
| H          | X       | L              | H       | L |
| L          | X       | L              | L       | H |
| X          | L       | H              | Z       | Z |

H = high level, L = low level, X = irrelevant,  
Z = high impedance (off)



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**TEXAS  
INSTRUMENTS**

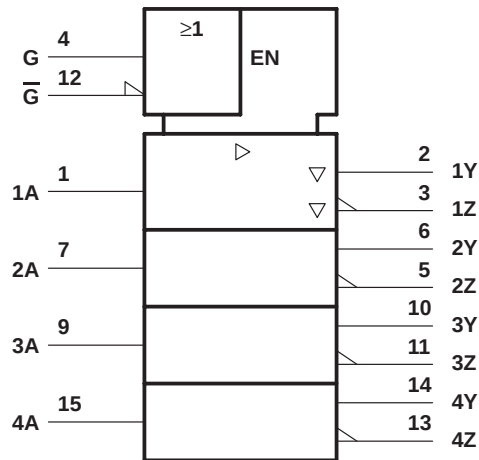
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QUADRUPLE DIFFERENTIAL LINE DRIVER

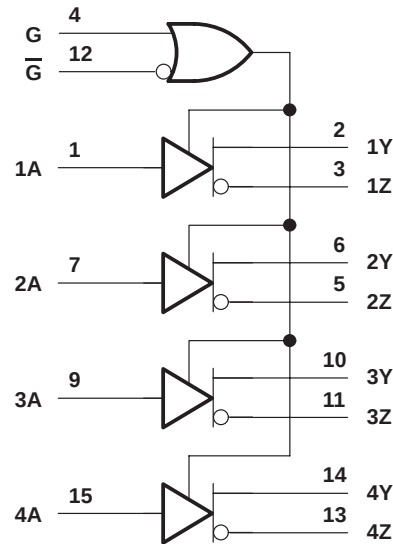
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logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Terminal numbers shown are for the N package.

logic diagram (positive logic)



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

|                                                              |                              |
|--------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)                        | 7 V                          |
| Voltage range at any bus terminal                            | –10 V to 15 V                |
| Input voltage, $V_I$                                         | 5.5 V                        |
| Continuous total dissipation                                 | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$                  | 0°C to 70°C                  |
| Storage temperature range, $T_{stg}$                         | –65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°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.

NOTE 1: All voltage values are with respect to the network ground terminal.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|---------------------------------------------------|------------------------------------------|
| DW      | 1125 mW                                     | 9.0 mW/°C                                         | 720 mW                                   |
| N       | 1150 mW                                     | 9.2 mW/°C                                         | 736 mW                                   |

### recommended operating conditions

|                                       | MIN  | NOM      | MAX  | UNIT |
|---------------------------------------|------|----------|------|------|
| Supply voltage, $V_{CC}$              | 4.75 | 5        | 5.25 | V    |
| High-level input voltage, $V_{IH}$    | 2    |          |      | V    |
| Low-level input voltage, $V_{IL}$     |      |          | 0.8  | V    |
| Common-mode output voltage, $V_{OC}$  |      | –7 to 12 |      | V    |
| High-level output current, $I_{OH}$   |      | –60      |      | mA   |
| Low-level output current, $I_{OL}$    |      | 60       |      | mA   |
| Operating free-air temperature, $T_A$ | 0    |          | 70   | °C   |

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER                                                                        | TEST CONDITIONS                                     | MIN                           | TYP <sup>†</sup> | MAX       | UNIT    |
|----------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------|------------------|-----------|---------|
| $V_{IK}$ Input clamp voltage                                                     | $I_I = -18$ mA                                      |                               |                  | –1.5      | V       |
| $V_O$ Output voltage                                                             | $I_O = 0$                                           | 0                             |                  | 6         | V       |
| $V_{OH}$ High-level output voltage                                               | $V_{IH} = 2$ V, $V_{IL} = 0.8$ V, $I_{OH} = -33$ mA |                               | 3.7              |           | V       |
| $V_{OL}$ Low-level output voltage                                                | $V_{IH} = 2$ V, $V_{IL} = 0.8$ V, $I_{OH} = 33$ mA  |                               | 1.1              |           | V       |
| $ V_{OD1} $ Differential output voltage                                          | $I_O = 0$                                           | 1.5                           |                  | 6         | V       |
| $ V_{OD2} $ Differential output voltage                                          | $R_L = 100\ \Omega$ , See Figure 1                  | $1/2 V_{OD1}$ or $2^\ddagger$ |                  |           | V       |
|                                                                                  | $R_L = 54\ \Omega$ , See Figure 1                   | 1.5                           | 2.5              | 5         | V       |
| $V_{OD3}$ Differential output voltage                                            | See Note 2                                          | 1.5                           |                  | 5         | V       |
| $\Delta V_{OD} $ Change in magnitude of differential output voltage <sup>§</sup> | $R_L = 54\ \Omega$ or $100\ \Omega$ , See Figure 1  |                               |                  | $\pm 0.2$ | V       |
| $V_{OC}$ Common-mode output voltage <sup>¶</sup>                                 |                                                     |                               |                  | +3<br>–1  | V       |
| $\Delta V_{OC} $ Change in magnitude of common-mode output voltage <sup>§</sup>  |                                                     |                               |                  | $\pm 0.2$ | V       |
| $I_O$ Output current with power off                                              | $V_{CC} = 0$ , $V_O = -7$ V to 12 V                 |                               |                  | $\pm 100$ | $\mu$ A |
| $I_{OZ}$ High-impedance-state output current                                     | $V_O = -7$ V to 12 V                                |                               |                  | $\pm 100$ | $\mu$ A |
| $I_{IH}$ High-level input current                                                | $V_I = 2.7$ V                                       |                               |                  | 20        | $\mu$ A |
| $I_{IL}$ Low-level input current                                                 | $V_I = 0.5$ V                                       |                               |                  | –360      | $\mu$ A |
| $I_{OS}$ Short-circuit output current                                            | $V_O = -7$ V                                        |                               |                  | –180      | mA      |
|                                                                                  | $V_O = V_{CC}$                                      |                               |                  | 180       |         |
|                                                                                  | $V_O = 12$ V                                        |                               |                  | 500       |         |
| $I_{CC}$ Supply current (all drivers)                                            | No load                                             |                               |                  |           | mA      |
|                                                                                  | Outputs enabled                                     |                               | 38               | 60        |         |
|                                                                                  | Outputs disabled                                    |                               | 18               | 40        |         |

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

<sup>‡</sup> The minimum  $V_{OD2}$  with a 100- $\Omega$  load is either  $1/2 V_{OD1}$  or 2 V, whichever is greater.

<sup>§</sup>  $\Delta|V_{OD}|$  and  $\Delta|V_{OC}|$  are the changes in magnitude of  $V_{OD}$  and  $V_{OC}$ , respectively, that occur when the input is changed from a high level to a low level.

<sup>¶</sup> In ANSI Standard EIA/TIA-422-B,  $V_{OC}$ , which is the average of the two output voltages with respect to ground, is called output offset voltage,  $V_{OS}$ .

NOTE 2: See Figure 3-5 of EIA Standard RS-485.

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| SYMBOL EQUIVALENTS   |                             |                                            |
|----------------------|-----------------------------|--------------------------------------------|
| DATA SHEET PARAMETER | EIA/TIA-422-B               | RS-485                                     |
| $V_O$                | $V_{0a}, V_{0b}$            | $V_{0a}, V_{0b}$                           |
| $ V_{OD1} $          | $V_0$                       | $V_0$                                      |
| $ V_{OD2} $          | $V_t (R_L = 100 \, \Omega)$ | $V_t (R_L = 54 \, \Omega)$                 |
| $ V_{OD2} $          |                             | $V_t$ (Test Termination)<br>Measurement 2) |
| $\Delta V_{OD} $     | $  V_t  -  \bar{V}_t  $     | $  V_t  -  \bar{V}_t  $                    |
| $V_{OC}$             | $ V_{os} $                  | $ V_{os} $                                 |
| $\Delta V_{OC} $     | $ V_{os} - \bar{V}_{os} $   | $ V_{os} - \bar{V}_{os} $                  |
| $I_{OS}$             | $ I_{sa} ,  I_{sb} $        |                                            |
| $I_O$                | $ I_{xa} ,  I_{xb} $        | $I_{ia}, I_{ib}$                           |

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

| PARAMETER                                       | TEST CONDITIONS                         | MIN | TYP | MAX | UNIT |
|-------------------------------------------------|-----------------------------------------|-----|-----|-----|------|
| $t_{d(OD)}$ Differential-output delay time      | $R_L = 54 \, \Omega$ ,    See Figure 2  |     | 45  | 65  | ns   |
| $t_{t(OD)}$ Differential-output transition time |                                         |     | 80  | 120 | ns   |
| $t_{pZH}$ Output enable time to high level      | $R_L = 110 \, \Omega$ ,    See Figure 3 |     | 80  | 120 | ns   |
| $t_{pZL}$ Output enable time to low level       | $R_L = 110 \, \Omega$ ,    See Figure 4 |     | 45  | 80  | ns   |
| $t_{PHZ}$ Output disable time from high level   | $R_L = 110 \, \Omega$ ,    See Figure 3 |     | 78  | 115 | ns   |
| $t_{PLZ}$ Output disable time from low level    | $R_L = 110 \, \Omega$ ,    See Figure 4 |     | 18  | 30  | ns   |

PARAMETER MEASUREMENT INFORMATION

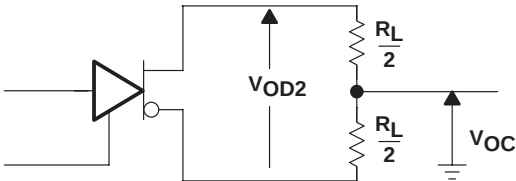
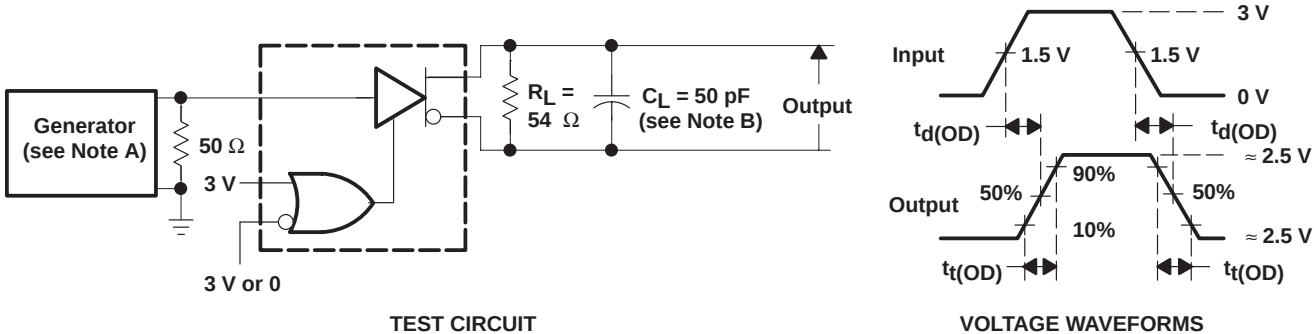


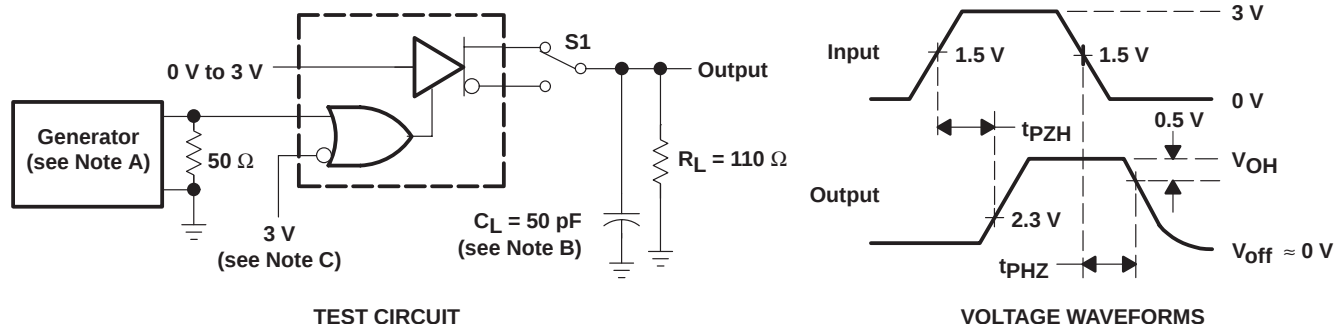
Figure 1. Differential and Common-Mode Output Voltages



- NOTES:
- A. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 5 \text{ ns}$ ,  $t_f \leq 5 \text{ ns}$ ,  $\text{PRR} \leq 1 \text{ MHz}$ , duty cycle = 50%,  $Z_O = 50 \, \Omega$ .
  - B.  $C_L$  includes probe and stray capacitance.

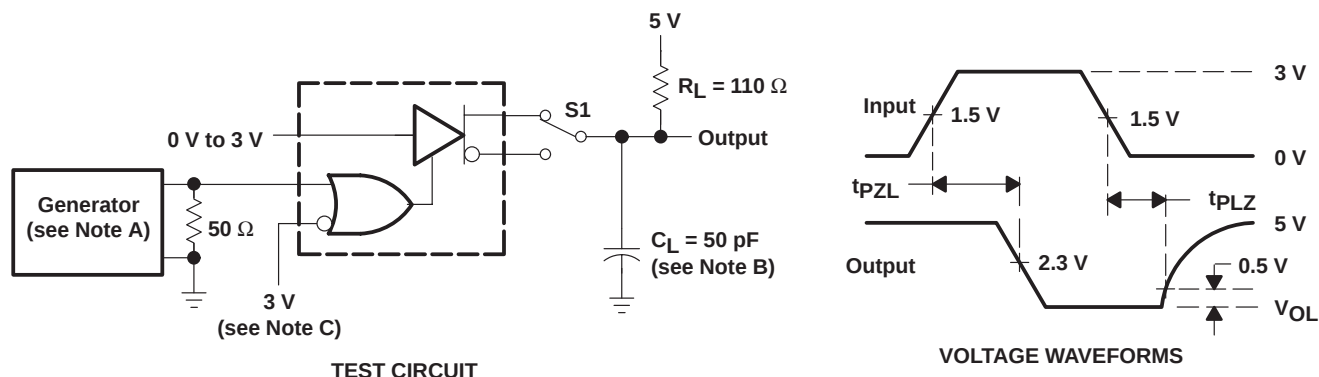
Figure 2. Differential-Output Test Clrcuit and Voltage Waveforms

## PARAMETER MEASUREMENT INFORMATION



- NOTES. A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1\text{ MHz}$ , duty cycle = 50%,  $t_r \leq 5\text{ ns}$ ,  $t_f \leq 5\text{ ns}$ ,  $Z_O = 50\ \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.  
 C. To test the active-low enable  $\overline{G}$ , ground  $\overline{G}$  and apply an inverted waveform to  $\overline{G}$ .

Figure 3. Test Circuit and Voltage Waveforms



- NOTES. A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1\text{ MHz}$ , duty cycle = 50%,  $t_r \leq 5\text{ ns}$ ,  $t_f \leq 5\text{ ns}$ ,  $Z_O = 50\ \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.  
 C. To test the active-low enable  $\overline{G}$ , ground  $\overline{G}$  and apply an inverted waveform to  $\overline{G}$ .

Figure 4. Test Circuit and Voltage Waveforms

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TYPICAL CHARACTERISTICS

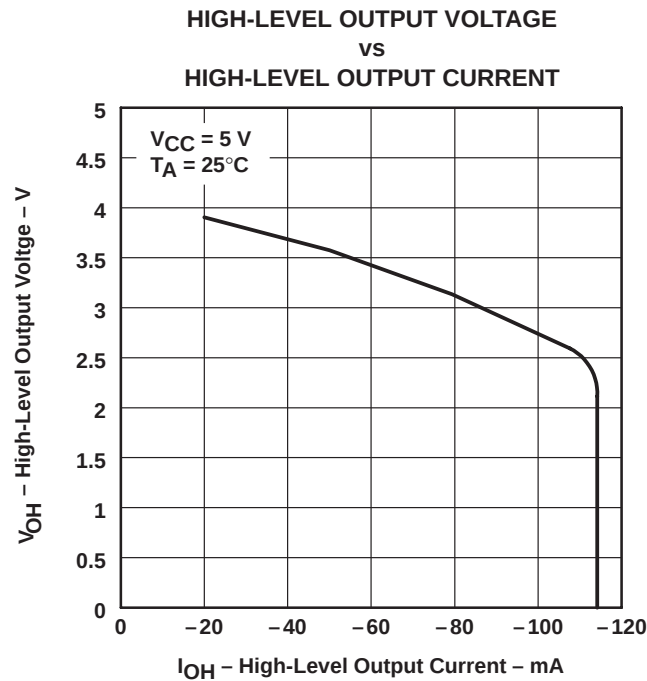


Figure 5

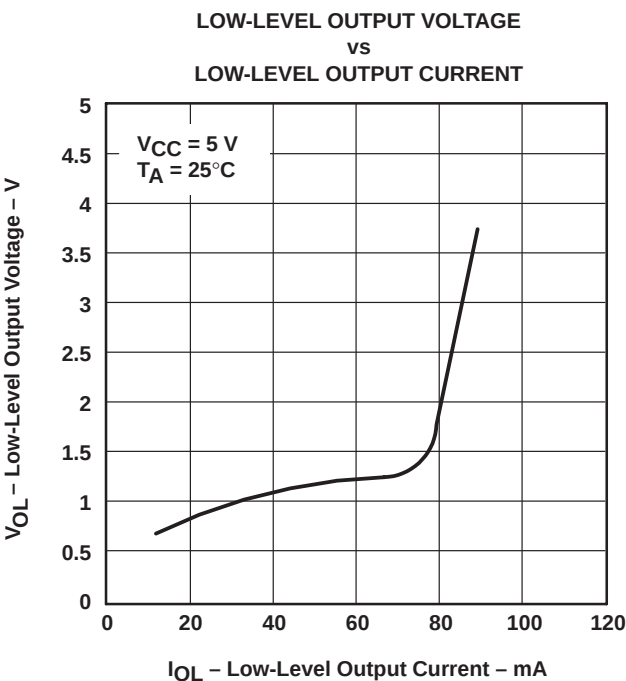


Figure 6

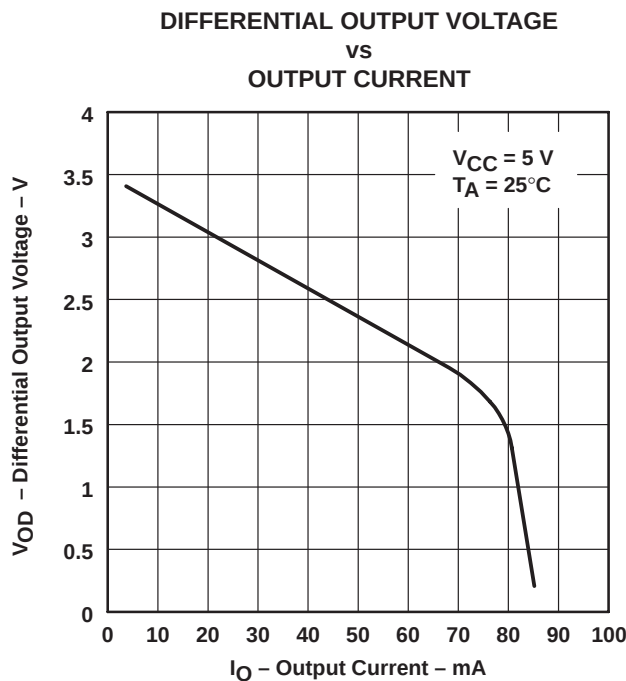


Figure 7

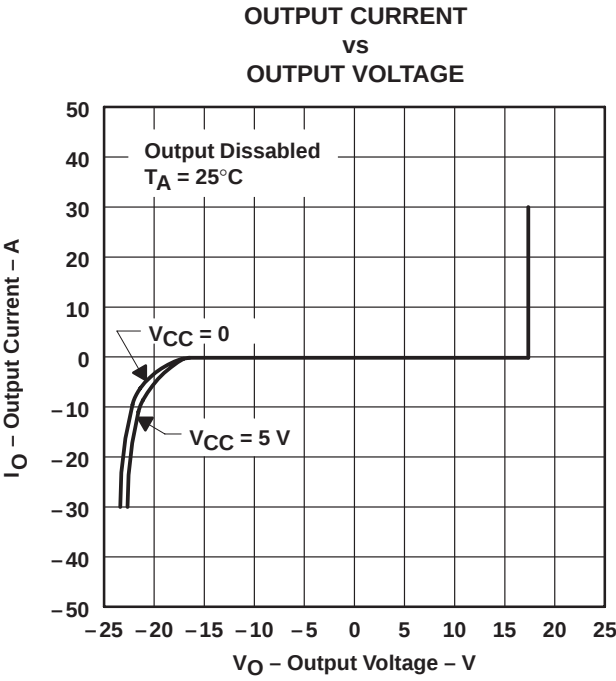
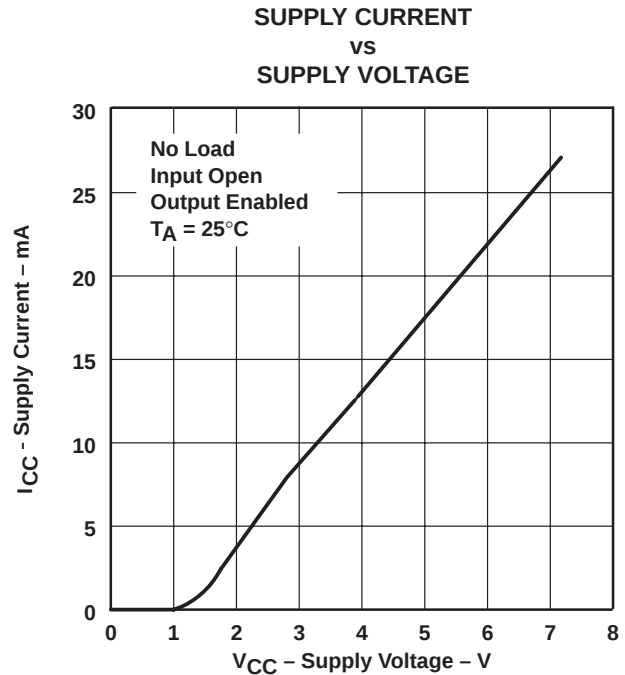
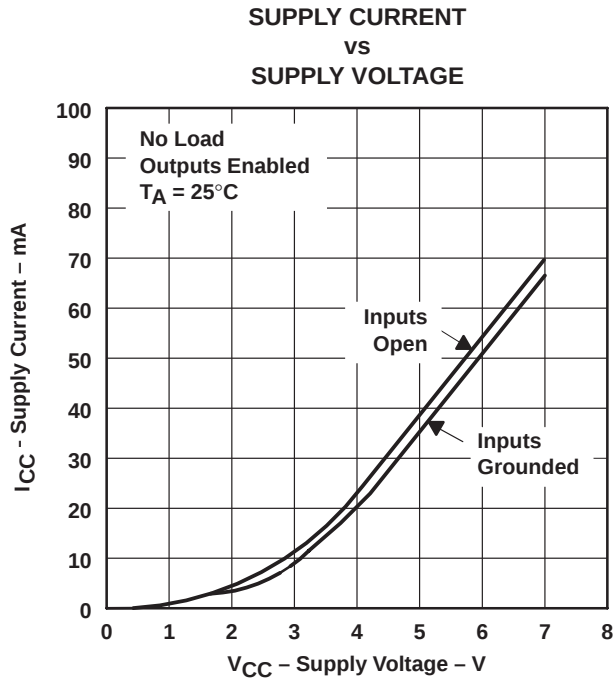
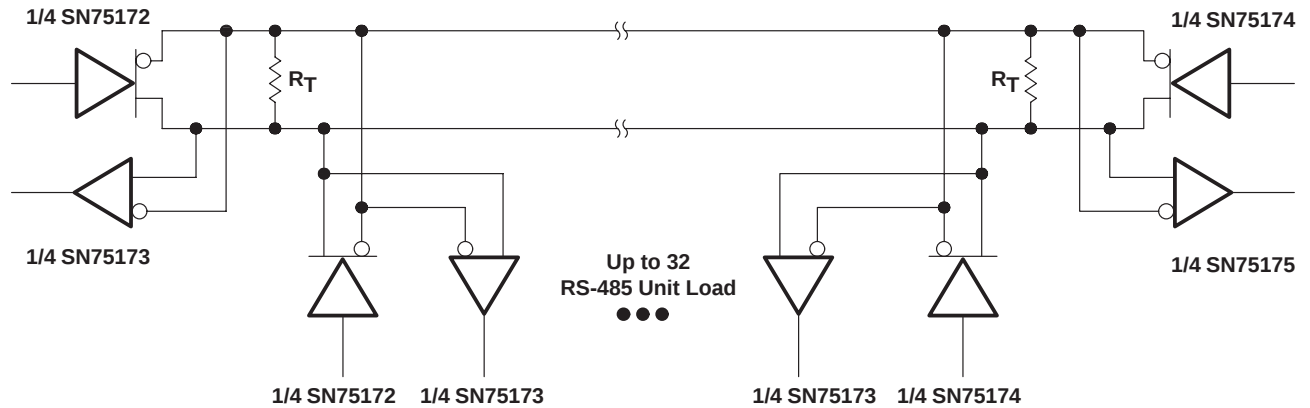


Figure 8

## TYPICAL CHARACTERISTICS



## APPLICATION INFORMATION



NOTE A: The line length should be terminated at both ends in its characteristic impedance ( $R_T = Z_0$ ). Stub lengths off the main line should be kept as short as possible.

Figure 11

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