SLLS039A – D2601, OCTOBER 1980 – REVISED FEBRUARY 1993

- **Meets EIA Standards RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27**
- **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 Enable**
- **Thermal Shutdown Protection**
- **Positive- and Negative-Current Limiting**
- **Operates From Single 5-V Supply**
- **Low Power Requirements**
- **Functionally Interchangeable With MC3487**

## description

The SN75174 is a monolithic quad differential line driver with 3-state outputs. It is designed to meet the requirements of EIA Standards RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27. The device is optimized for balanced multipoint bus transmission at rates 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 SN75174 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.

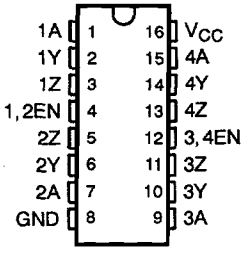
The SN75174 is characterized for operation from 0°C to 70°C.

**FUNCTION TABLE**
**(each driver)**

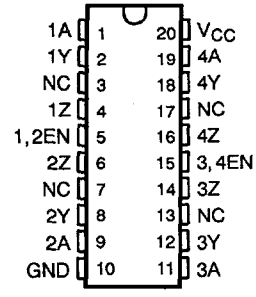
| INPUT | ENABLE | OUTPUTS | |
|---|---|---|---|
| | | Y | Z |
| H | H | H | L |
| L | H | L | H |
| X | L | Z | Z |

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

**N PACKAGE**
**(TOP VIEW)**

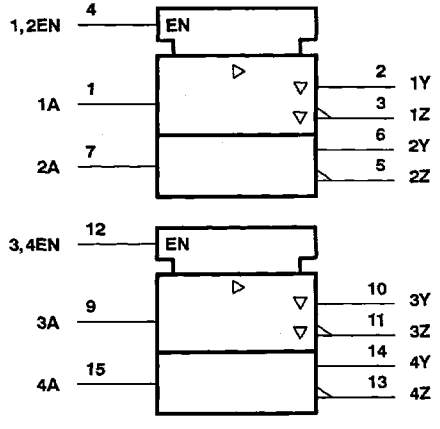



**DW PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## logic symbol†




† This symbol is in accordance with ANSI/IEEE Std 91-984 and IEC Publication 617-12.

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

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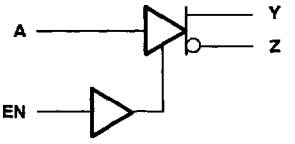
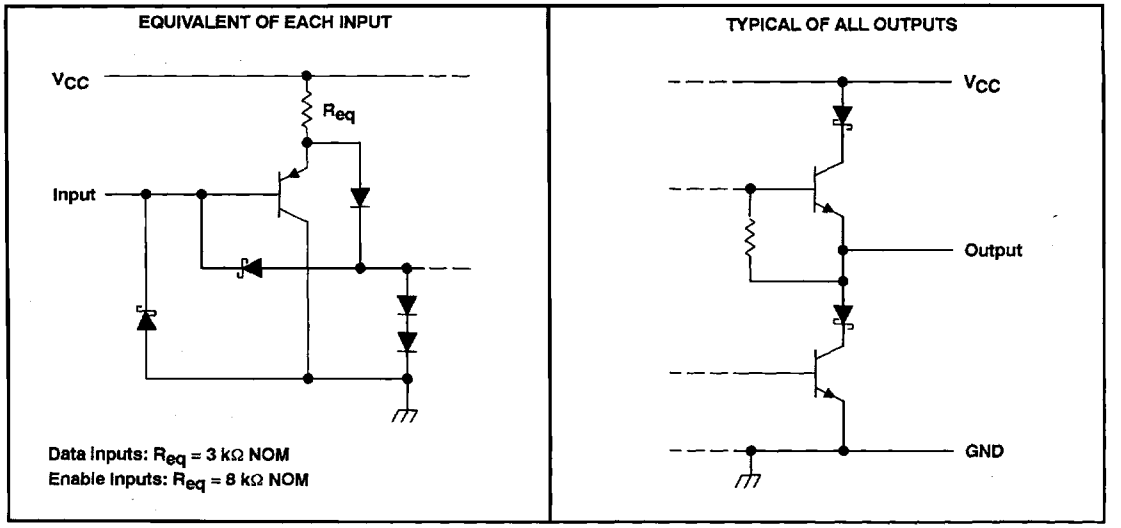
## logic diagram, each driver (positive logic)




## schematics of inputs and outputs




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

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

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

DISSIPATION RATING TABLE

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ 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† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{IK}$ | Input clamp voltage | $I_I$ = −18 mA | | | | −1.5 | V |
| $V_{OH}$ | High-level output voltage | $V_{IH}$ = 2 V, $I_{OH}$ = −33 mA | $V_{IL}$ = 0.8 V, | | 3.7 | | V |
| $V_{OL}$ | Low-level output voltage | $V_{IH}$ = 2 V, $I_{OL}$ = 33 mA | $V_{IL}$ = 0.8 V, | | 1.1 | | V |
| $V_O$ | Output voltage | $I_O$ = 0 | | 0 | | 6 | V |
| $\lvert V_{OD1}\rvert$ | Differential output voltage | $I_O$ = 0 | | 1.5 | 6 | 6 | V |
| $\lvert V_{OD2}\rvert$ | Differential output voltage | $R_L$ = 100 Ω, | See Figure 1 | 1/2 $V_{OD1}$ or 2§ | | | V |
| | | $R_L$ = 54 Ω, | See Figure 1 | 1.5 | 2.5 | 5 | V |
| $V_{OD3}$ | Differential output voltage | See Note 2 | | 1.5 | | 5 | V |
| $\Delta\lvert V_{OD}\rvert$ | Change in magnitude of differential output voltage‡ | $R_L$ = 54 Ω or 100 Ω, | See Figure 1 | | | ±0.2 | V |
| $V_{OC}$ | Common-mode output voltage§ | | | | | +3 −1 | V |
| $\Delta\lvert V_{OC}\rvert$ | Change in magnitude of common-mode output voltage‡ | | | | | ±0.2 | V |
| $I_O$ | Output current with power off | $V_{CC}$ = 0, | $V_O$ = −7 V to 12 V | | | ±100 | μA |
| $I_{OZ}$ | High-impedance-state output current | $V_O$ = −7 V to 12 V | | | | ±100 | μA |
| $I_{IH}$ | High-level input current | $V_I$ = 2.7 V | | | | 20 | μA |
| $I_{IL}$ | Low-level input current | $V_I$ = 0.5 V | | | | −360 | μA |
| $I_{OS}$ | 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 | Outputs enabled | | 38 | 60 | mA |
| | | | Outputs disabled | | 18 | 40 | |

† All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
‡ $\Delta\lvert V_{OD}\rvert$ and $\Delta\lvert V_{OC}\rvert$ 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.
§ The minimum $V_{OD2}$ with a 100-Ω load is either 1/2 $V_{OD1}$ or 2 V, whichever is greater.
NOTE 2: See Figure 3.5 of EIA Standard RS-485.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{dD}$ | Differential-output delay time | $R_L$ = 54 Ω, | See Figure 2 | | 45 | 65 | ns |
| $t_{tD}$ | Differential-output transition time | | | | 80 | 120 | ns |
| $t_{PZH}$ | Output enable time to high level | $R_L$ = 110 Ω, | See Figure 3 | | 80 | 120 | ns |
| $t_{PZL}$ | Output enable time to low level | $R_L$ = 110 Ω, | See Figure 4 | | 55 | 80 | ns |
| $t_{PHZ}$ | Output disable time from high level | $R_L$ = 110 Ω, | See Figure 3 | | 75 | 115 | ns |
| $t_{PLZ}$ | Output disable time from low level | $R_L$ = 110 Ω, | See Figure 3 | | 18 | 30 | ns |

**SYMBOL EQUIVALENTS**

| DATA SHEET PARAMETER | RS-422-A | RS-485 |
|---|---|---|
| $V_O$ | $V_{Oa}$, $V_{ob}$ | $V_{oa}$, $V_{ob}$ |
| $\|V_{OD1}\|$ | $V_o$ | $V_o$ |
| $\|V_{OD2}\|$ | $V_t$ ($R_L$ = 100 Ω) | $V_t$ ($R_L$ = 54 Ω) |
| $\|V_{OD3}\|$ | | $V_t$ (Test Termination) Measurement 2) |
| $\Delta\|V_{OD}\|$ | $\|\|V_t\| - \|\overline{V}_t\|\|$ | $\|\|V_t\| - \|\overline{V}_t\|\|$ |
| $V_{OC}$ | $\|V_{os}\|$ | $\|V_{os}\|$ |
| $\Delta\|V_{OC}\|$ | $\|V_{os} - \overline{V}_{os}\|$ | $\|V_{os} - \overline{V}_{os}\|$ |
| $I_{OS}$ | $\|I_{sa}\|$,$\|I_{sb}\|$ | |
| $I_O$ | $\|I_{xa}\|$,$\|I_{xb}\|$ | $I_{ia}$,$I_{ib}$ |

## PARAMETER MEASUREMENT INFORMATION

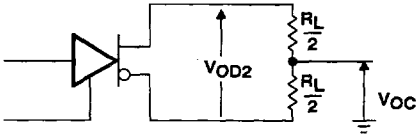
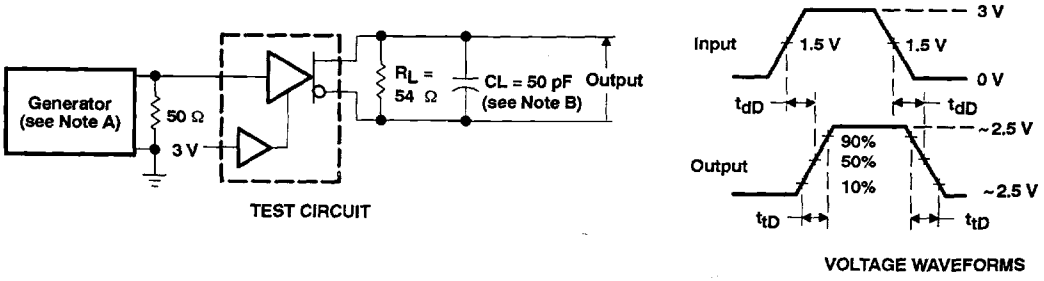


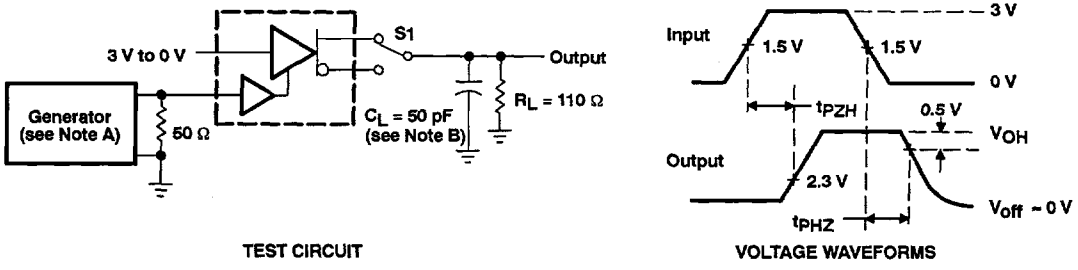

**Figure 1. Differential and Common-Mode Output Voltages**




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

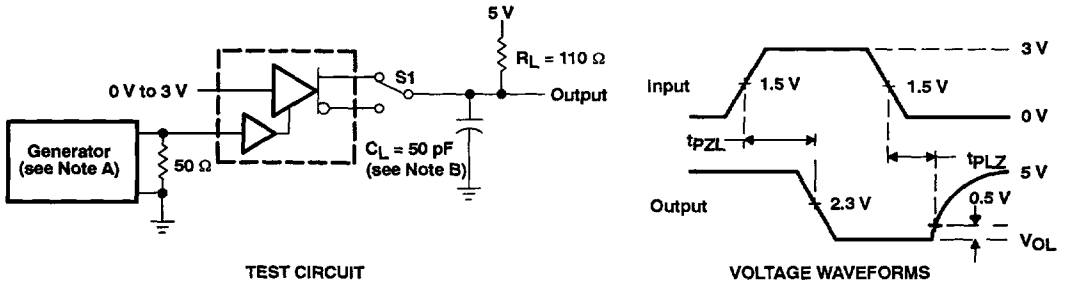
**Figure 2. Differential-Output Test Circuit and Voltage Waveforms**

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT VOLTAGE WAVEFORMS

**Figure 3. Test Circuit and Voltage Waveforms**




TEST CIRCUIT VOLTAGE WAVEFORMS

**Figure 4. Test Circuit and Voltage Waveforms**

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

## TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

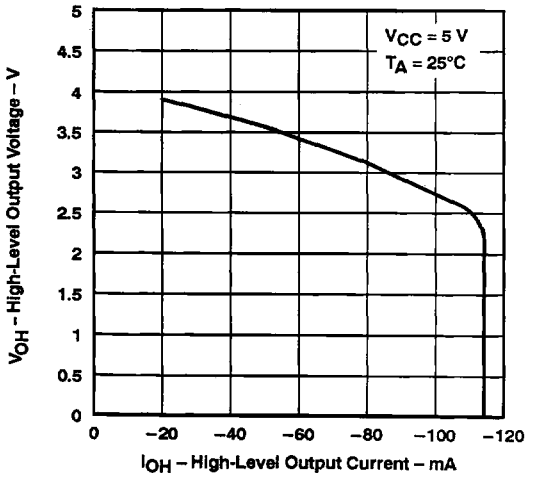



Figure 5

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

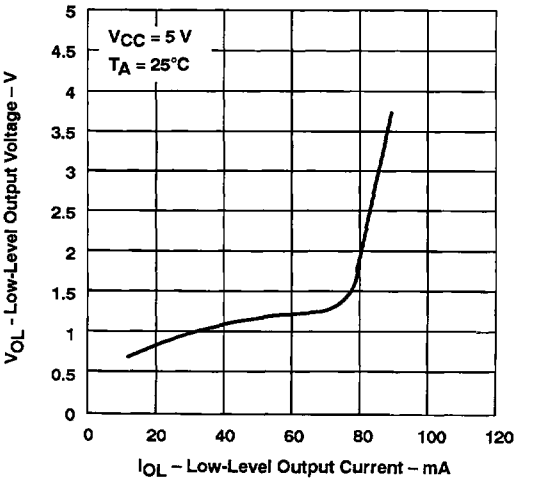



Figure 6

DIFFERENTIAL OUTPUT VOLTAGE
vs
OUTPUT CURRENT

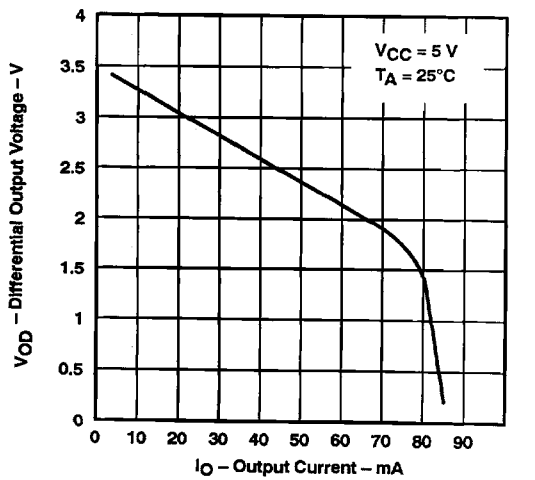



Figure 7

OUTPUT CURRENT
vs
OUTPUT VOLTAGE

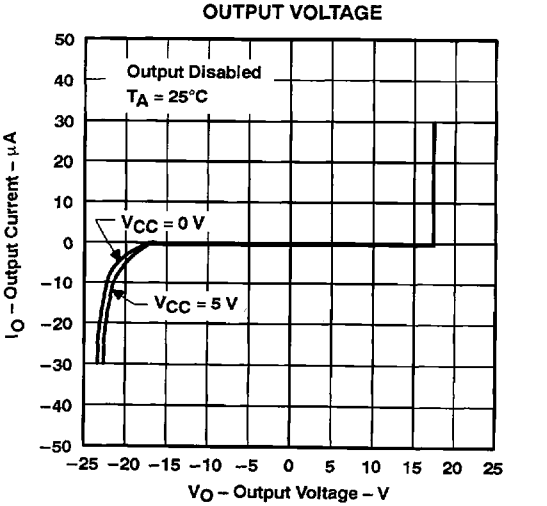



Figure 8

## TYPICAL CHARACTERISTICS

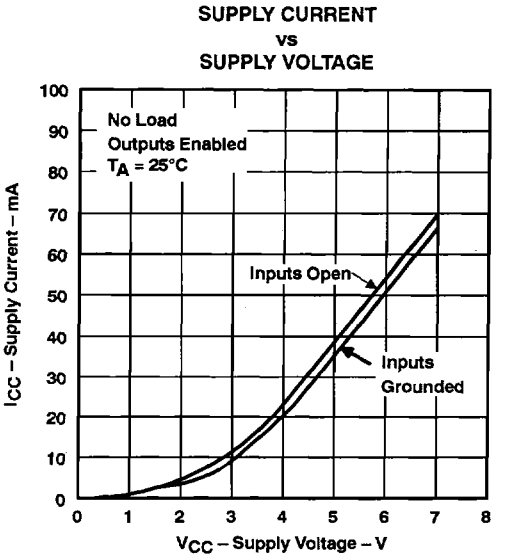



Figure 9

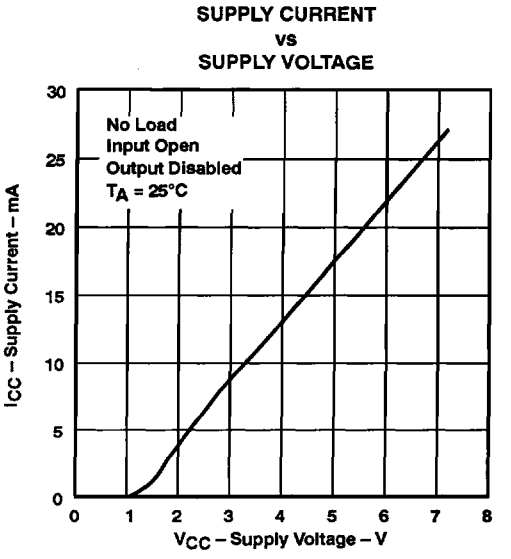
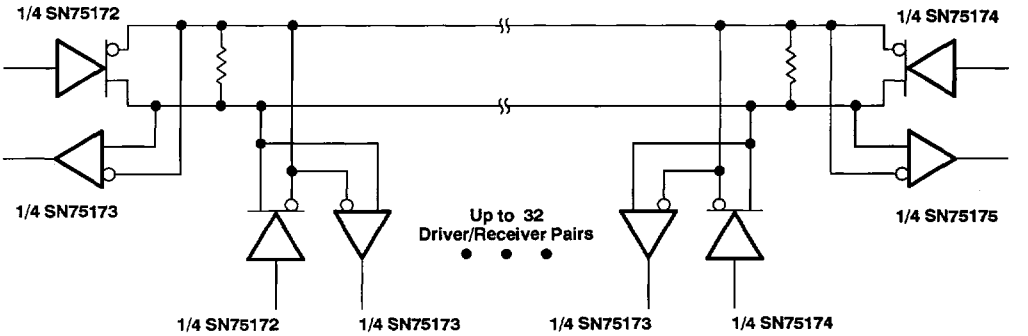



Figure 10

## APPLICATION INFORMATION




NOTE: The line length should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.

**Figure 11. Typical Application Circuit**