D2601, OCTOBER 1980–REVISED MAY 1988

- **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 quadruple differential line driver with three-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.

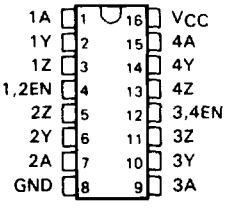
The SN75174 is characterized for operation from 0°C to 70°C.

**FUNCTION TABLE (EACH DRIVER)**

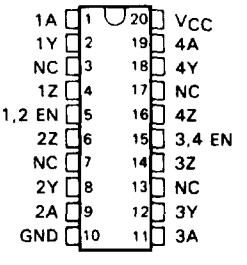
| INPUT | ENABLE | OUTPUTS | |
|---|---|---|---|
| | | Y | Z |
| H | H | H | L |
| L | H | L | H |
| X | L | Z | Z |

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

**J OR N PACKAGE**
**(TOP VIEW)**

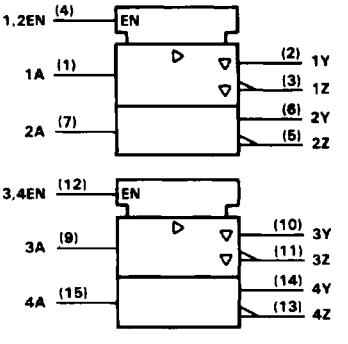



**DW PACKAGE**
**(TOP VIEW)**



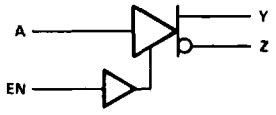

NC – No internal connection

## logic symbol†

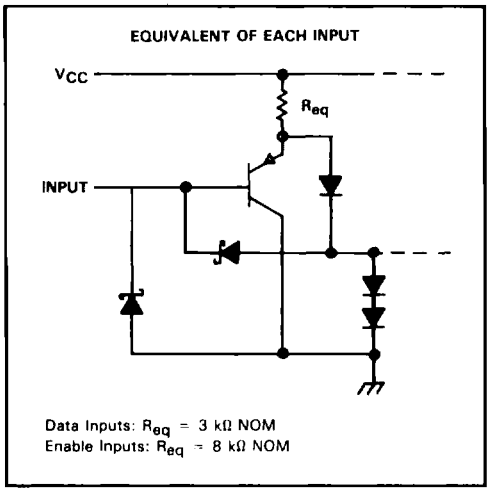


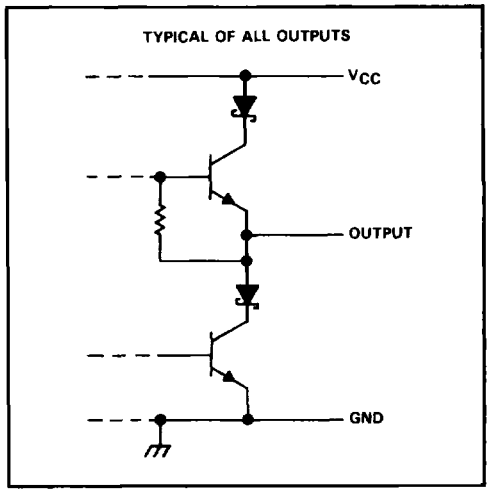

†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**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 . . . . . 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 60 seconds: J package . . . . . 300°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: DW or N package . . . . . 260°C

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

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \leq 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING |
|---|---|---|---|
| DW | 1125 mW | 9.0 mW/°C | 720 mW |
| J | 1025 mW | 8.2 mW/°C | 656 mW |
| N | 1150 mW | 9.2 mW/°C | 736 mW |



TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

## 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 curent, $I_{OH}$ | | | −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, $V_{IL}$ = 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, $I_{OL}$ = 33 mA | | | 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 | V |
| $\lvert V_{OD2}\rvert$ | Differential output voltage | $R_L$ = 100 Ω, See Figure 1 | | ½ $V_{OD1}$ | | | 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<br>−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 | | | | −250 | mA |
| | | $V_O$ = $V_{CC}$ | | | | 180 | |
| | | $V_O$ = 12 V | | | | 500 | |
| $I_{CC}$ | Supply current (all drivers) | No load | Outputs enabled | | 38 | 60 | mA |
| | | | Oututs 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.
NOTE 2: See EIA Standard RS-485 Figure 3.5, Test Termination Measurement 2.

## 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 |
| $t_{PHZ}$ | Outut 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 4 | | 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

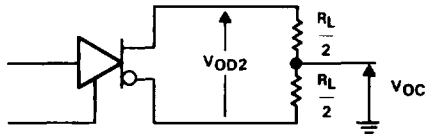
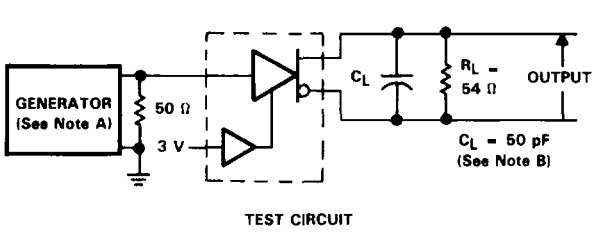
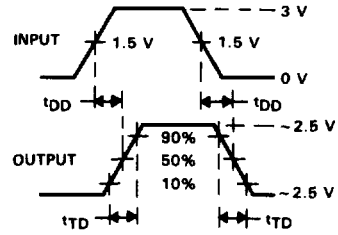



FIGURE 1. DIFFERENTIAL AND COMMON-MODE OUTPUT VOLTAGES




TEST CIRCUIT

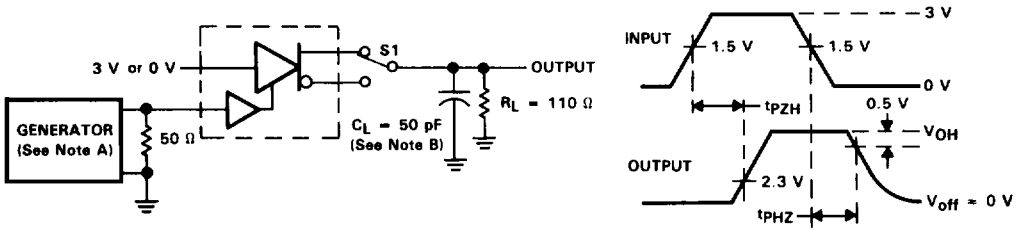



VOLTAGE WAVEFORMS

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

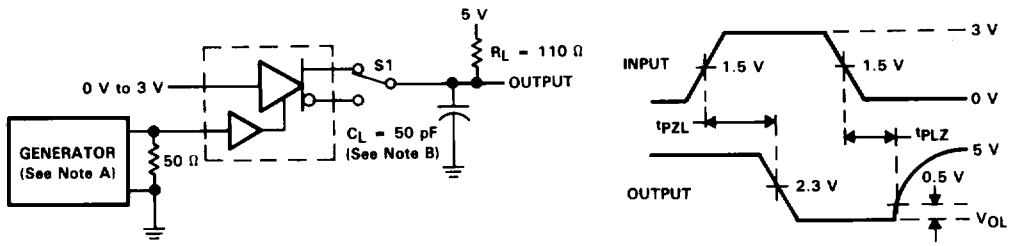
FIGURE 2. DIFFERENTIAL-OUTPUT DELAY AND TRANSITION TIMES

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT VOLTAGE WAVEFORMS

FIGURE 3. $t_{PZH}$ AND $t_{PHZ}$




TEST CIRCUIT VOLTAGE WAVEFORMS

FIGURE 4. $t_{PZL}$ AND $t_{PLZ}$

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

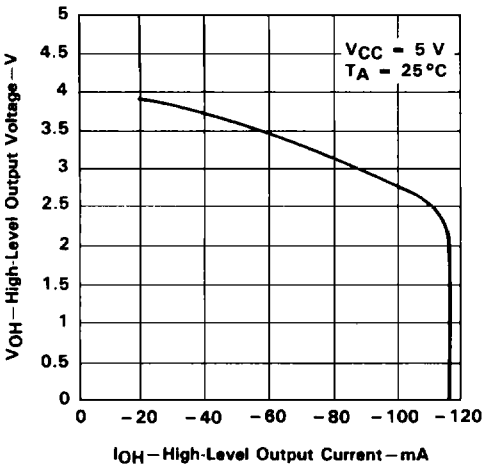



FIGURE 5

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

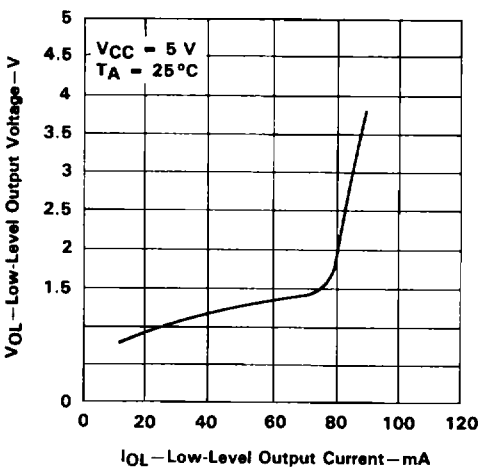



FIGURE 6

DIFFERENTIAL OUTPUT VOLTAGE
vs
OUTPUT CURRENT

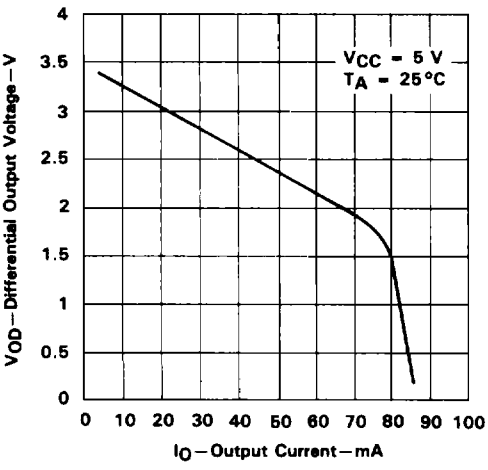



FIGURE 7

OUTPUT CURRENT
vs
OUTPUT VOLTAGE

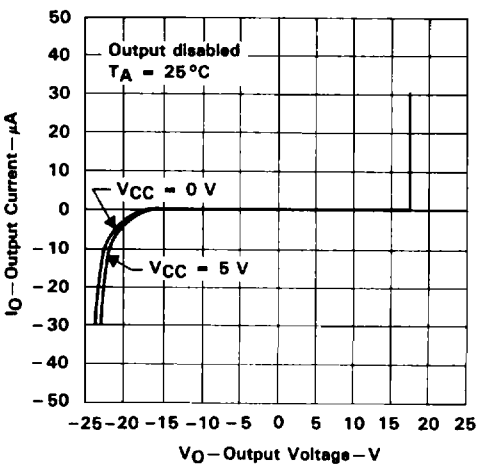



FIGURE 8



TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

## TYPICAL CHARACTERISTICS

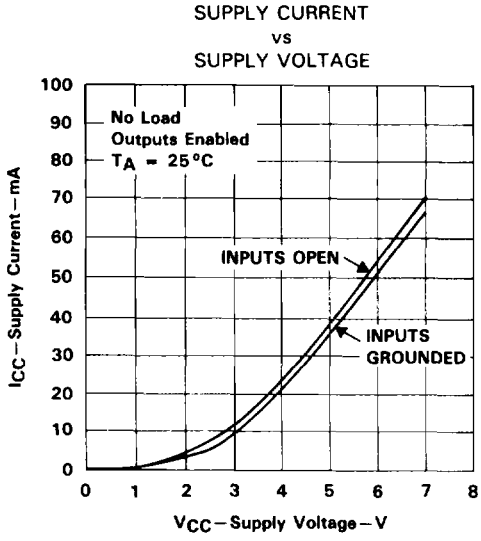



FIGURE 9

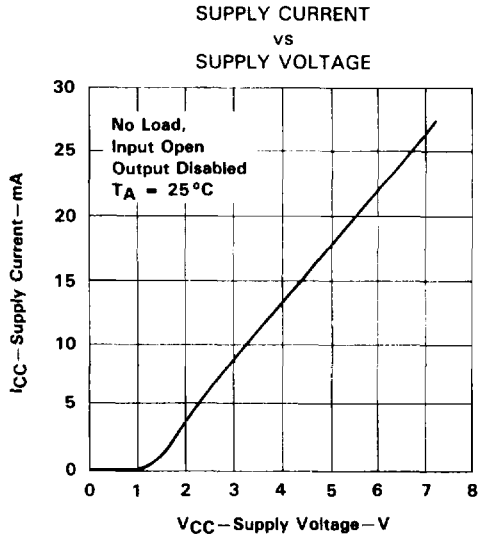
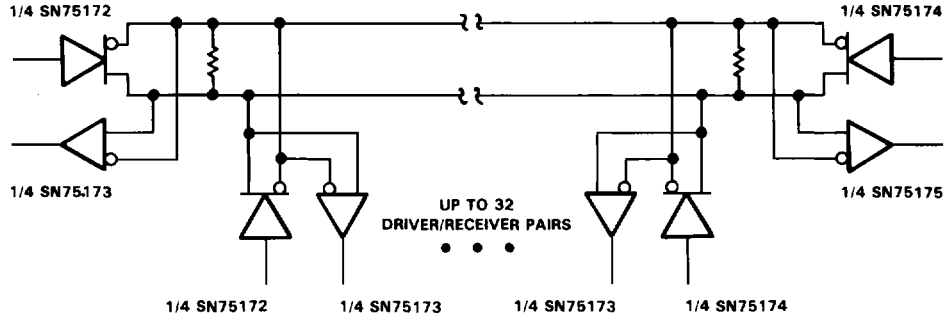



FIGURE 10

## TYPICAL APPLICATION




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