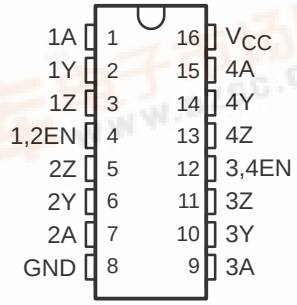
# SN65LBC174, SN75LBC174
# QUADRUPLE LOW-POWER DIFFERENTIAL LINE DRIVERS

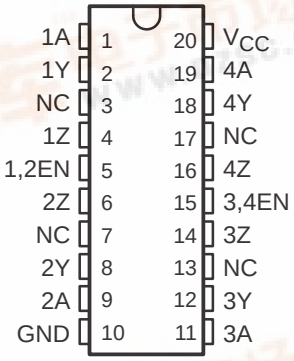
SLLS162A – JULY 1993 – REVISED NOVEMBER 1998

- **Meets or Exceeds the Standard EIA-485**
- **Designed for High-Speed Multipoint Transmission on Long Bus Lines in Noisy Environments**
- **Supports Data Rates up to and Exceeding Ten Million Transfers Per Second**
- **Common-Mode Output Voltage Range of –7 V to 12 V**
- **Positive- and Negative-Current Limiting**
- **Low Power Consumption . . . 1.5 mA Max (Output Disabled)**
- **Functionally Interchangeable With SN75174**

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




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




NC – No internal connection

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

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

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

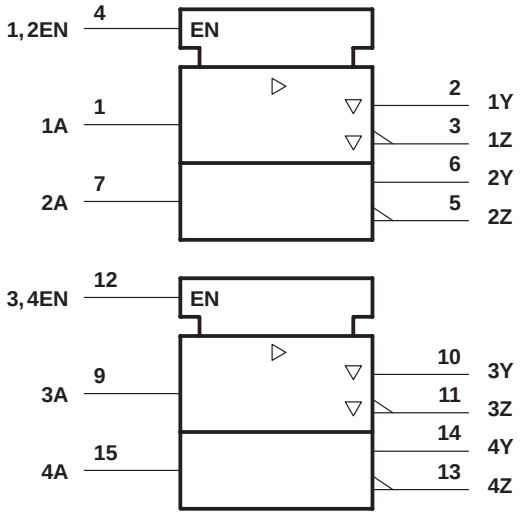
## description

The SN65LBC174 and SN75LBC174 are monolithic, quadruple, differential line drivers with 3-state outputs. Both devices are designed to meet the requirements of the Electronics Industry Association Standard EIA-485. These devices are optimized for balanced multipoint bus transmission at data rates up to and exceeding 10 million bits per second. Each driver features wide positive and negative common-mode output voltage ranges, current limiting, and thermal-shutdown protection, making it suitable for party-line applications in noisy environments. Both devices are designed using LinBiCMOS™, facilitating ultra-low power consumption and inherent robustness.

Both the SN65LBC174 and SN75LBC174 provide positive- and negative-current limiting and thermal shutdown for protection from line fault conditions on the transmission bus line. These devices offer optimum performance when used with the SN75LBC173 or SN75LBC175 quadruple line receivers. The SN65LBC174 and SN75LBC174 are available in the 16-terminal DIP package (N) and the 20-terminal wide-body small outline intergrated circuit (SOIC) package (DW).

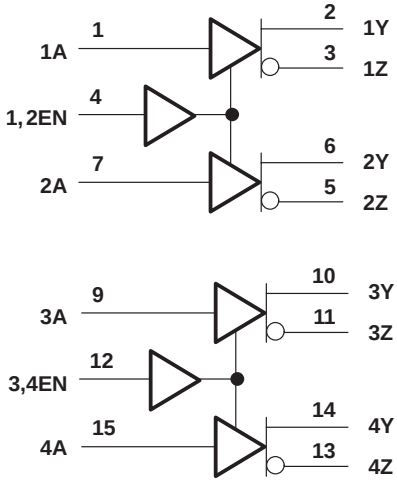
The SN75LBC174 is characterized for operation over the commercial temperature range of 0°C to 70°C. The SN65LBC174 is characterized over the industrial temperature range of –40°C to 85°C.

## logic symbol†

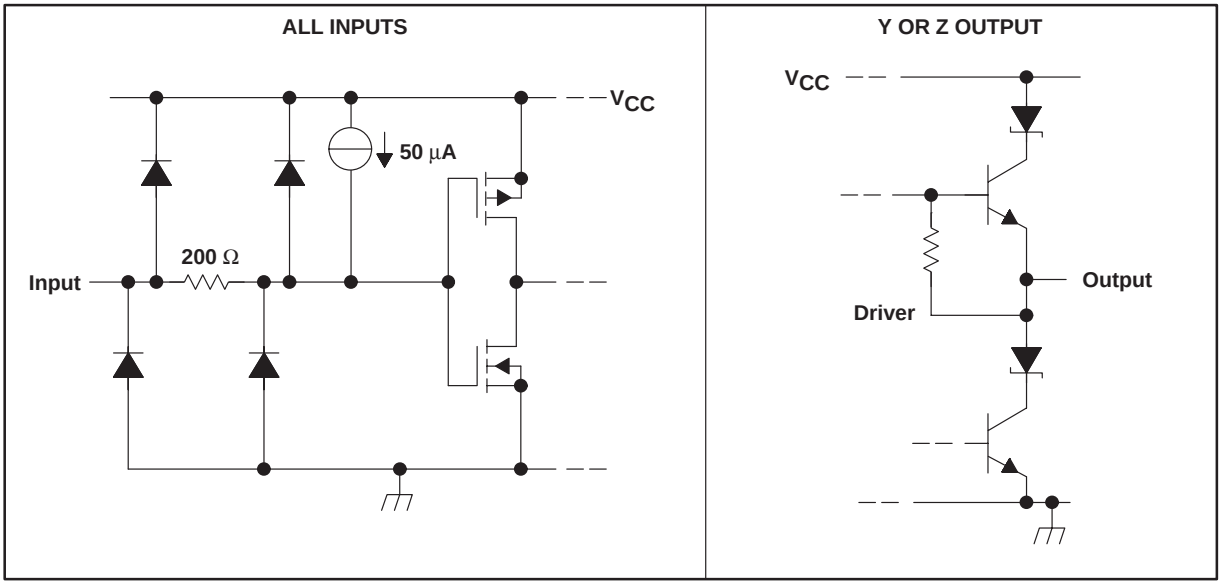



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Terminal numbers shown are for the N package.

## logic diagram (positive logic)




## schematic of inputs and outputs



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

Supply voltage range, $V_{CC}$ (see Note 1) . . . . . –0.3 V to 7 V
Output voltage range, $V_O$ . . . . . –10 V to 15 V
Input voltage range, $V_I$ . . . . . –0.3 V to 7 V
Continuous total power dissipation . . . . . Internally limited‡
Operating free-air temperature range, $T_A$: SN65LBC174 . . . . . –40°C to 85°C
SN75LBC174 . . . . . 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.
‡ The maximum operating junction temperature is internally limited. Use the dissipation rating table to operate below this temperature.
NOTE 1: All voltage values are with respect to GND.

### 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 |
| Voltage at any bus terminal (separately or common-mode), $V_O$ | Y or Z | | | 12 | V |
| | | | | –7 | |
| High-level output current, $I_{OH}$ | Y or Z | | | –60 | mA |
| Low-level output current, $I_{OL}$ | Y or Z | | | 60 | mA |
| Continuous total power dissipation | | See Dissipation Rating Table | | | |
| Operating free-air temperature, $T_A$ | SN65LBC174 | –40 | | 85 | °C |
| | SN75LBC174 | 0 | | 70 | |

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING | $T_A = 85°C$ POWER RATING |
|---|---|---|---|---|
| DW | 1125 mW | 9.0 mW/°C | 720 mW | 585 mW |
| N | 1150 mW | 9.2 mW/°C | 736 mW | 598 mW |

## 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 |
| $\|V_{OD}\|$ | Differential output voltage‡ | $R_L$ = 54 Ω, See Figure 1 | SN65LBC174 | 1.1 | 1.8 | 5 | V |
| | | | SN75LBC174 | 1.5 | 1.8 | 5 | |
| | | $R_L$ = 60 Ω, See Figure 2 | SN65LBC174 | 1.1 | 1.7 | 5 | |
| | | | SN75LBC174 | 1.5 | 1.7 | 5 | |
| $\Delta\|V_{OD}\|$ | Change in magnitude of common-mode output voltage§ | $R_L$ = 54 Ω, See Figure 1 | | | | ±0.2 | V |
| $V_{OC}$ | Common-mode output voltage | | | | | 3<br>– 1 | V |
| $\Delta\|V_{OC}\|$ | 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 | $V_I$ = 2.4 V | | | | –100 | µA |
| $I_{IL}$ | Low-level input current | $V_I$ = 0.4 V | | | | –100 | µA |
| $I_{OS}$ | Short-circuit output current | $V_O$ = –7 V to 12 V | | | | ±250 | mA |
| $I_{CC}$ | Supply current (all drivers) | No load | Outputs enabled | | | 7 | mA |
| | | | Outputs disabled | | | 1.5 | |

† All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
‡ The minimum $V_{OD}$ specification does not fully comply with EIA-485 at operating temperatures below 0°C. The lower output signal should be used to determine the maximum signal transmission distance.
§ $\Delta|V_{OD}|$ 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.

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

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{d(OD)}$ | Differential output delay time | $R_L$ = 54 Ω, | See Figure 3 | 2 | 11 | 20 | ns |
| $t_{t(OD)}$ | Differential output transition time | | | 10 | 15 | 25 | ns |
| $t_{PZH}$ | Output enable time to high level | $R_L$ = 110 Ω, | See Figure 3 | | | 30 | ns |
| $t_{PZL}$ | Output enable time to low level | $R_L$ = 110 Ω, | See Figure 5 | | | 30 | ns |
| $t_{PHZ}$ | Output disable time from high level | $R_L$ = 110 Ω, | See Figure 4 | | | 50 | ns |
| $t_{PLZ}$ | Output disable time from low level | $R_L$ = 110 Ω, | See Figure 5 | | | 30 | ns |

## PARAMETER MEASUREMENT INFORMATION

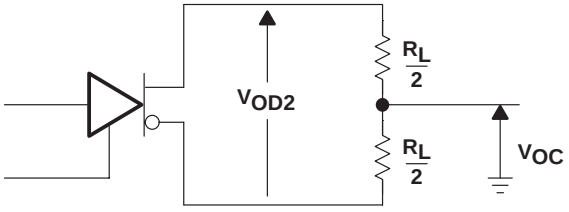



**Figure 1. Differential and Common-Mode Output Voltages**

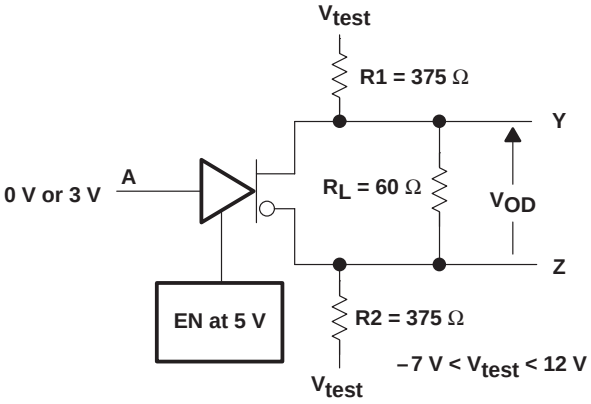
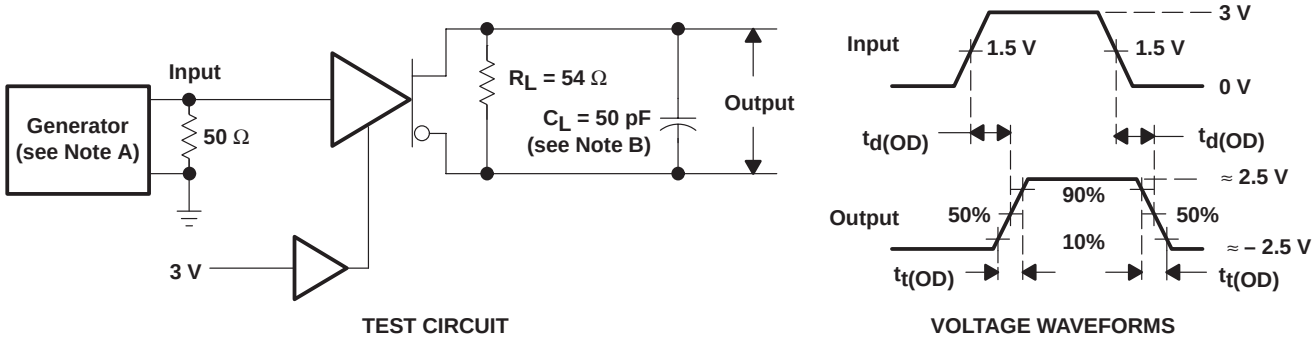



**Figure 2. Driver $V_{OD}$ Test Circuit**




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.

**Figure 3. Time Waveforms for Driver Differential Output Test Circuit Delay and Transition**

## PARAMETER MEASUREMENT INFORMATION

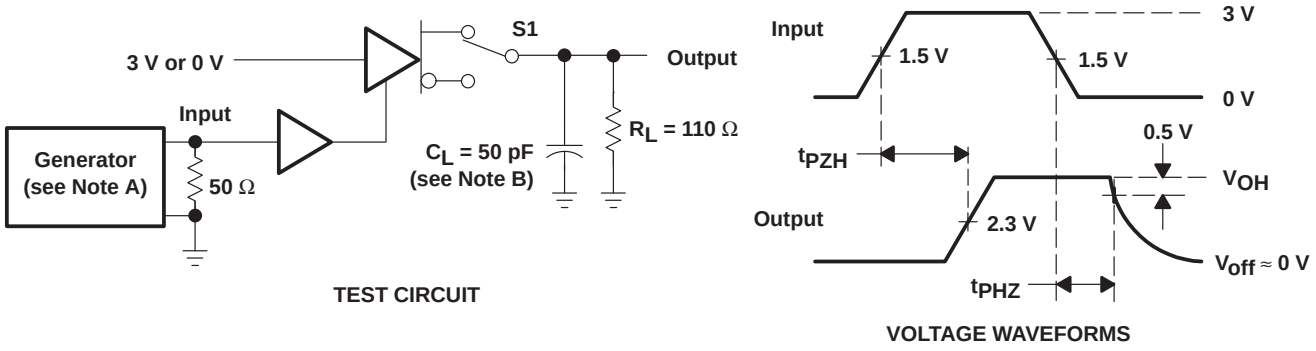
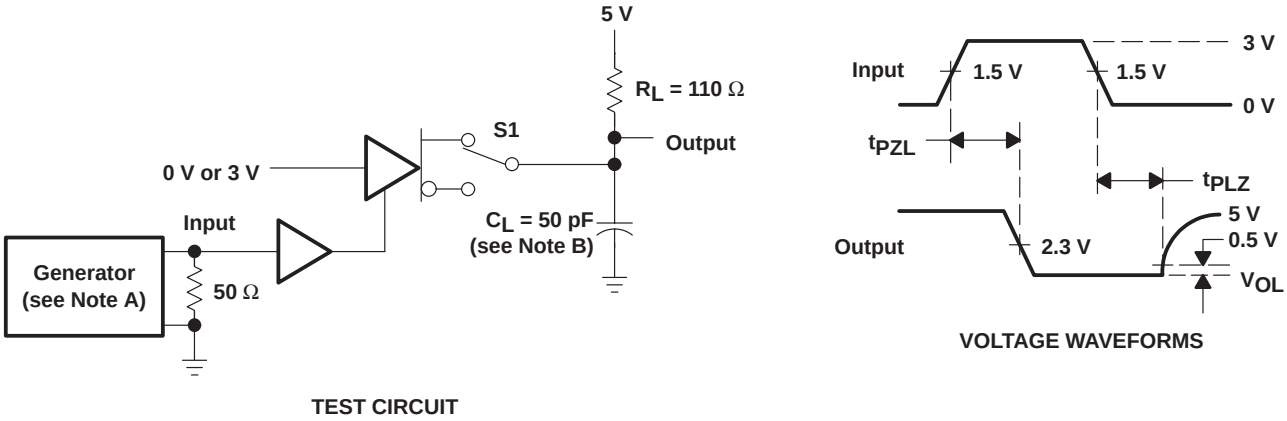



**Figure 4. $t_{PZH}$ and $t_{PHZ}$ Test Circuit and Waveforms**




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.

**Figure 5. $t_{PZL}$ and $t_{PLZ}$ Test Circuit and Waveforms**

## TYPICAL CHARACTERISTICS

**OUTPUT CURRENT vs OUTPUT VOLTAGE**

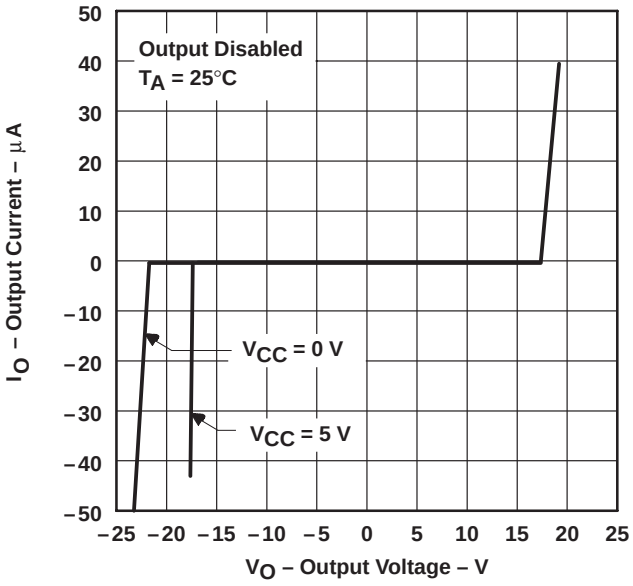



Figure 6

**LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT**

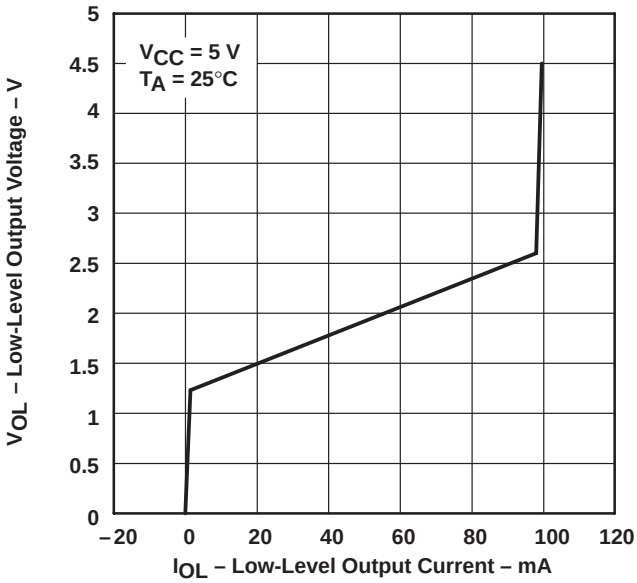



Figure 7

**DIFFERENTIAL OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE**

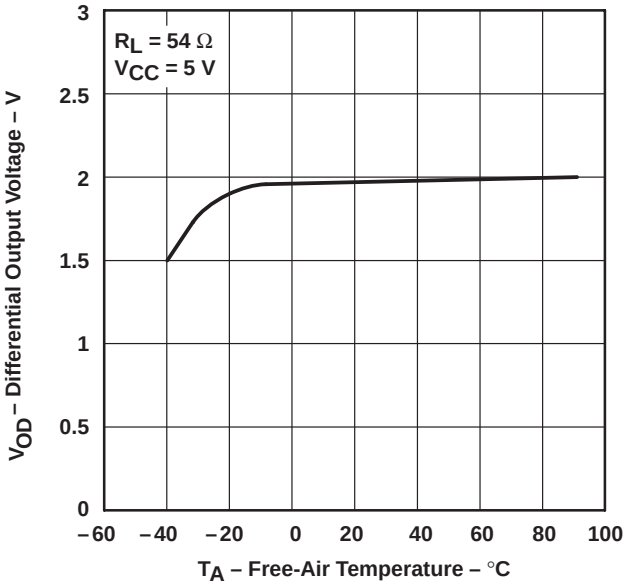



Figure 8

**HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT**

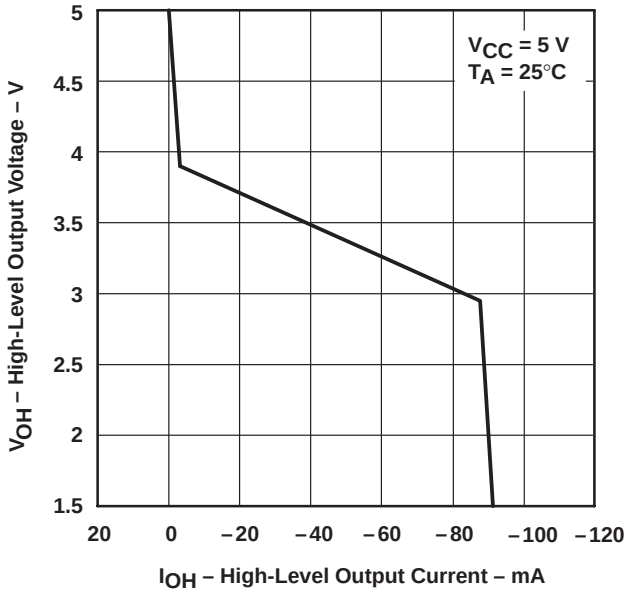



Figure 9

## TYPICAL CHARACTERISTICS

**DIFFERENTIAL OUTPUT VOLTAGE vs OUTPUT CURRENT**

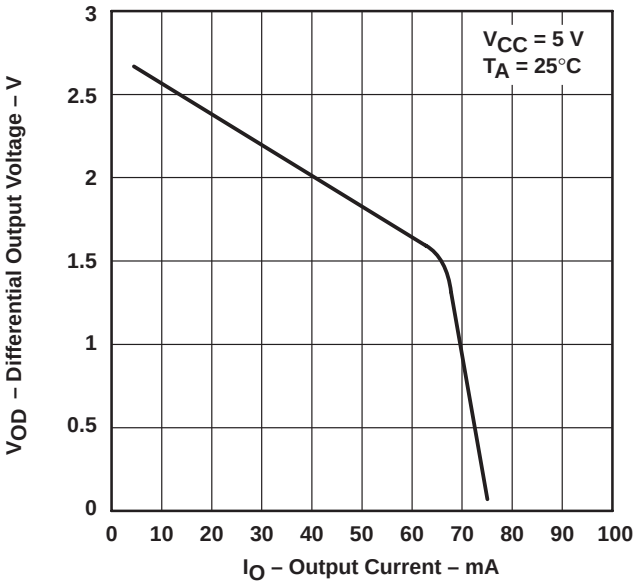



**Figure 10**

**PROPAGATION DELAY TIME, DIFFERENTIAL OUTPUT vs FREE-AIR TEMPERATURE**

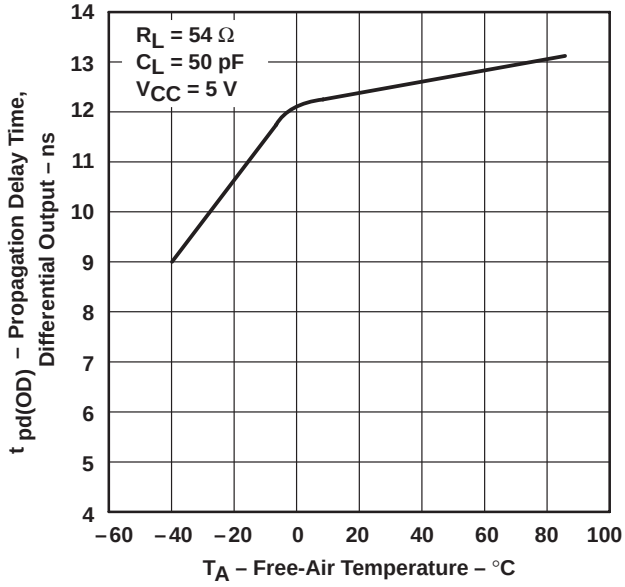
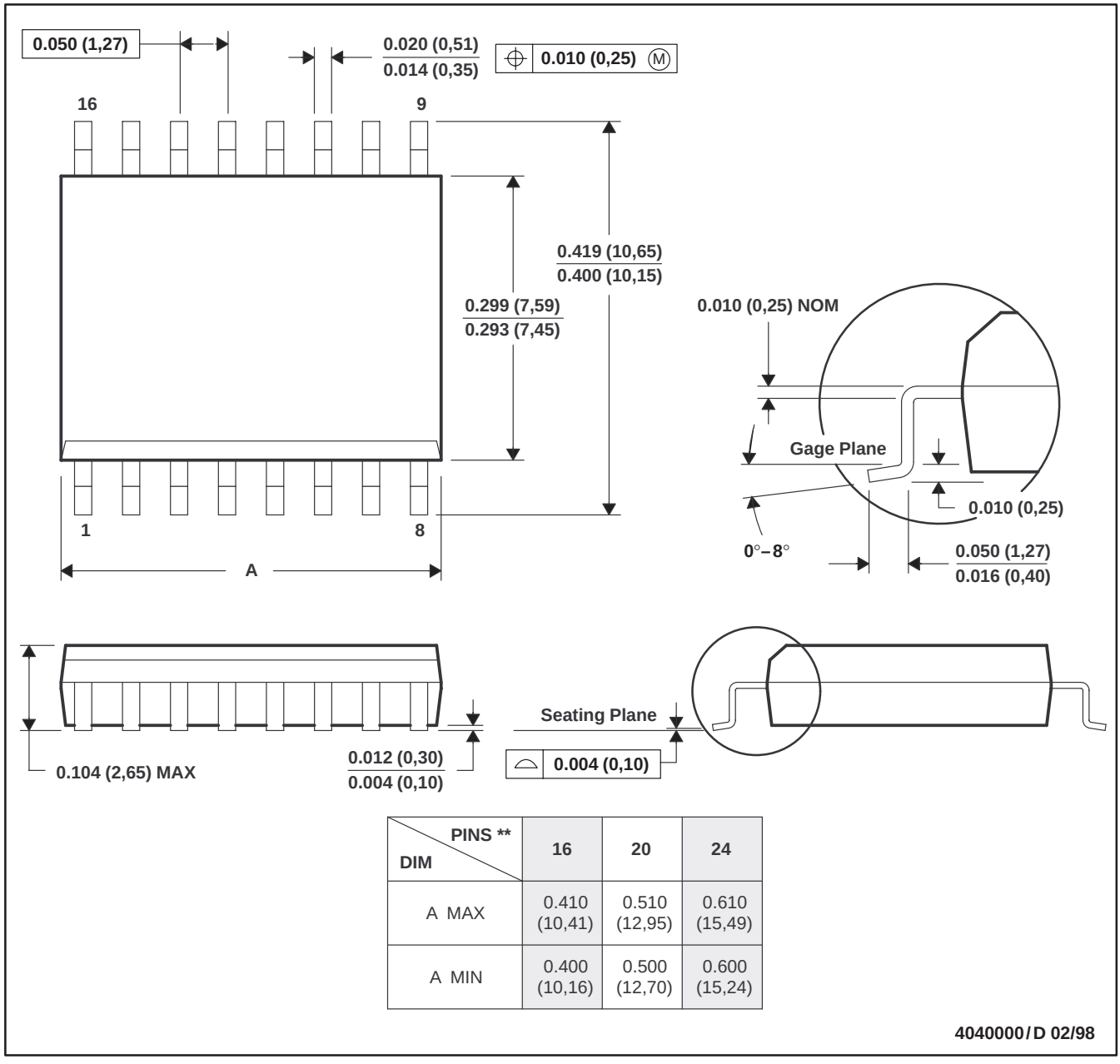



**Figure 11**

## MECHANICAL DATA

**DW (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**16 PIN SHOWN**




| DIM \ PINS ** | 16 | 20 | 24 |
|---|---|---|---|
| A MAX | 0.410 (10,41) | 0.510 (12,95) | 0.610 (15,49) |
| A MIN | 0.400 (10,16) | 0.500 (12,70) | 0.600 (15,24) |

**4040000/D 02/98**

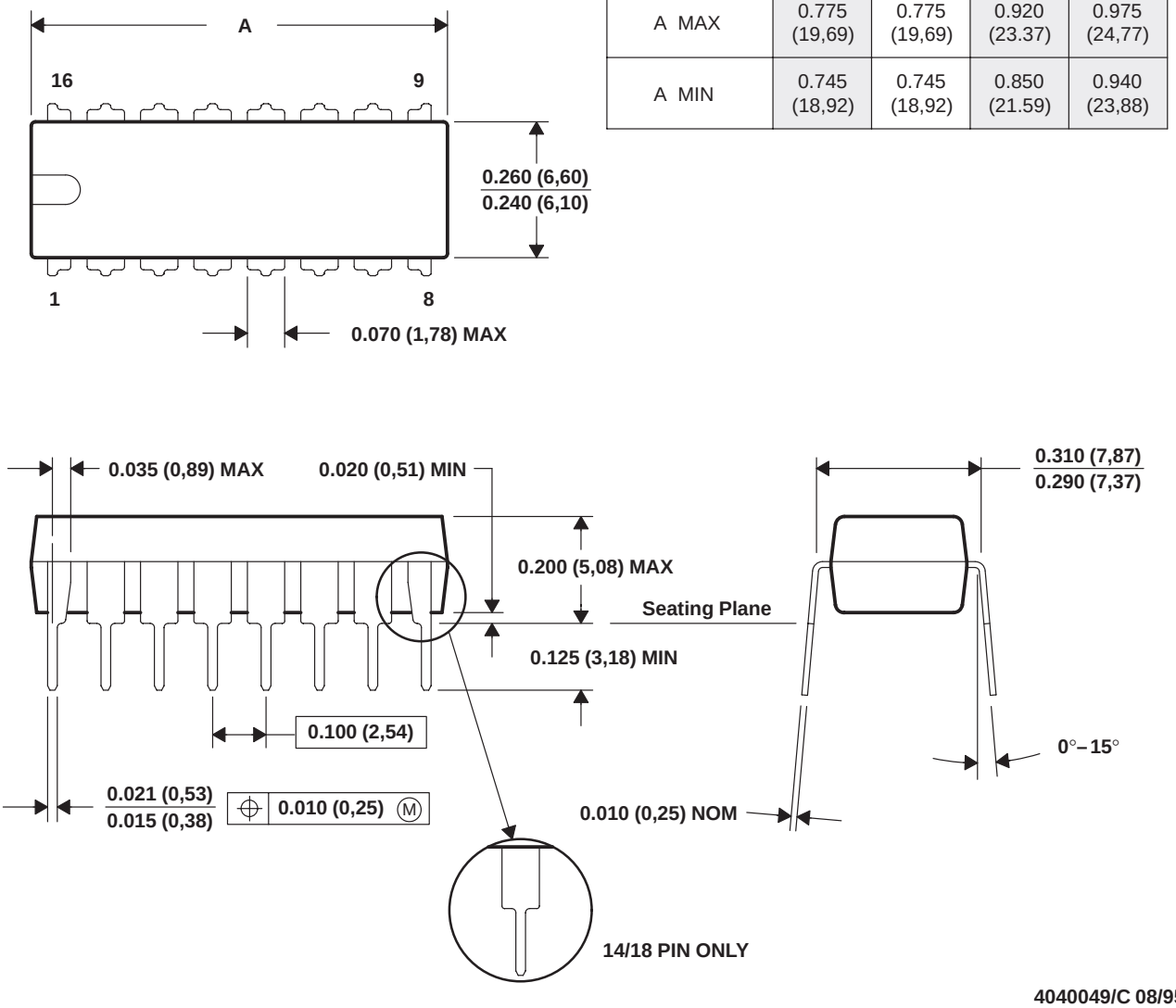
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-013

## MECHANICAL DATA

**N (R-PDIP-T**)** **PLASTIC DUAL-IN-LINE PACKAGE**

**16 PIN SHOWN**

| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23.37) | 0.975 (24,77) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21.59) | 0.940 (23,88) |




NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 (20 pin package is shorter then MS-001.)

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