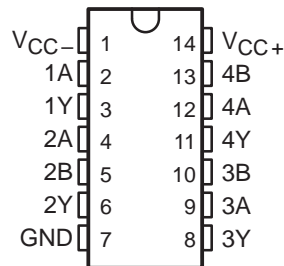


# SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

SLLS033F – JANUARY 1988 – REVISED MARCH 1997

- **Bi-MOS Technology With TTL and CMOS Compatibility**
- **Meets or Exceeds the Requirements of ANSI EIA/TIA-232-E and ITU Recommendation V.28**
- **Very Low Quiescent Current . . . 95  $\mu$ A Typ**  
 **$V_{CC\pm} = \pm 12$  V**
- **Current-Limited Outputs . . . 10 mA Typ**
- **CMOS-and TTL-Compatible Inputs**
- **On-Chip Slew Rate Limited to 30 V/ $\mu$ s max**
- **Flexible Supply Voltage Range**
- **Characterized at  $V_{CC\pm}$  of  $\pm 4.5$  V and  $\pm 15$  V**
- **Functionally Interchangeable With Texas Instruments SN75188, Motorola MC1488, and National Semiconductor DS14C88**

**D, DB†, OR N PACKAGE  
(TOP VIEW)**



† The DB package is only available left-end taped and reeled, i.e., order device SN75C188DBLE.

## description

The SN75C188 is a monolithic, low-power, quadruple line driver that interfaces data terminal equipment with data communications equipment. This device is designed to conform to ANSI Standard EIA/TIA-232-E.

An external diode in series with each supply-voltage terminal is needed to protect the SN75C188 under certain fault conditions to comply with EIA/TIA-232-E.

The SN75C188 is characterized for operation from 0°C to 70°C.

## Function Tables

**DRIVER 1**

| B | Y |
|---|---|
| H | L |
| L | H |

**DRIVERS 2 – 4**

| A | B | Y |
|---|---|---|
| H | H | L |
| L | X | H |
| X | L | H |

H = high level, L = low level,  
X = don't care



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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.

**TEXAS  
INSTRUMENTS**

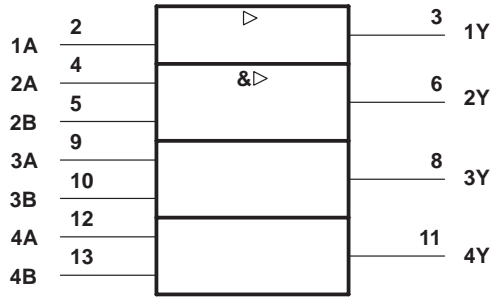
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1997, Texas Instruments Incorporated

# SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

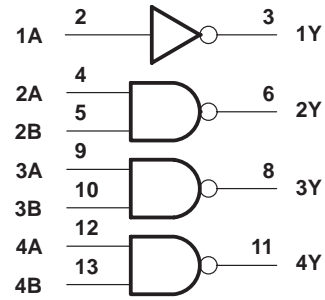
SLLS033F – JANUARY 1988 – REVISED MARCH 1997

## logic symbol†



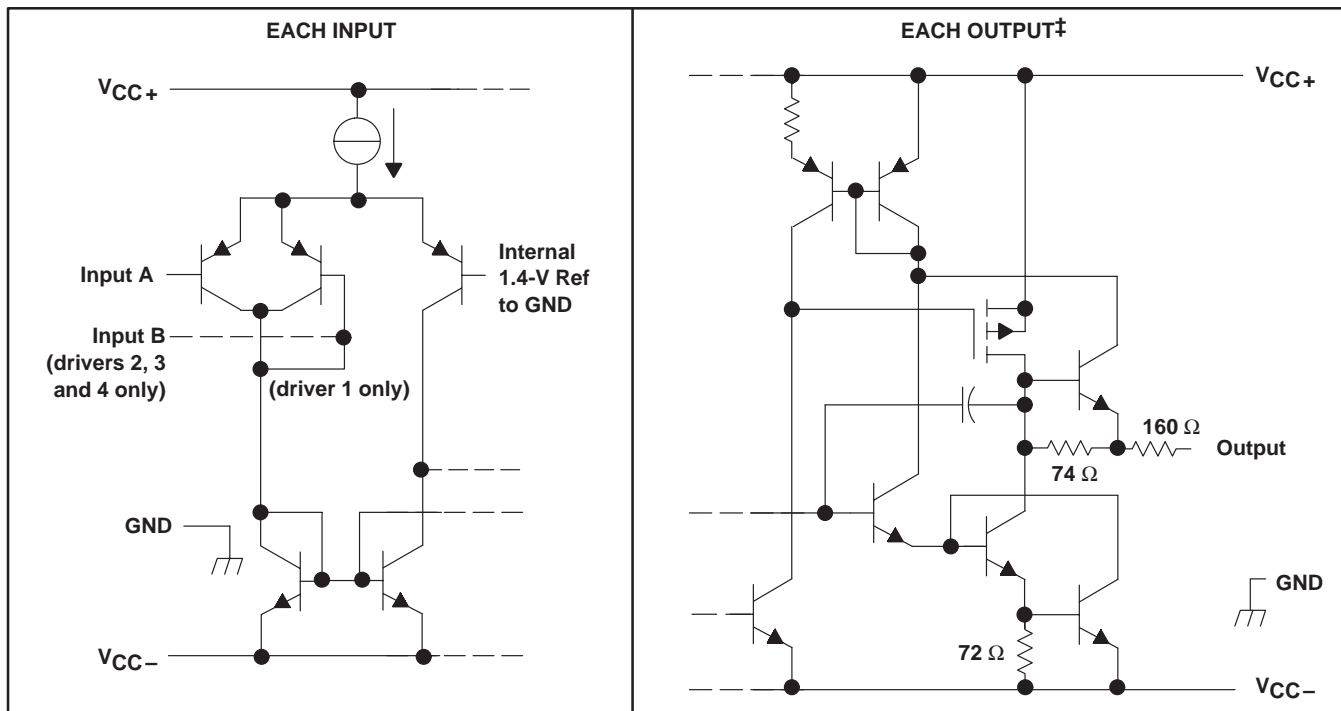
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

## logic diagram (positive logic)



positive logic  
 $Y = \bar{A}$  (driver 1)  
 $Y = \bar{A}\bar{B}$  or  $\bar{A} + \bar{B}$  (drivers 2 through 4)

## schematics of inputs and outputs



‡ All resistor values shown are nominal.

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

|                                                                    |                                                  |
|--------------------------------------------------------------------|--------------------------------------------------|
| Supply voltage, $V_{CC+}$ (see Note 1) .....                       | 15 V                                             |
| Supply voltage, $V_{CC-}$ (see Note 1) .....                       | -15 V                                            |
| Input voltage range, $V_I$ .....                                   | $V_{CC-}$ to $V_{CC+}$                           |
| Output voltage range, $V_O$ .....                                  | $V_{CC-} - 6\text{ V}$ to $V_{CC+} + 6\text{ V}$ |
| Continuous total power 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 |
|---------|---------------------------------------------|---------------------------------------------------|------------------------------------------|
| D       | 950 mW                                      | 7.6 mW/°C                                         | 608 mW                                   |
| DB      | 525 mW                                      | 4.2 mW/°C                                         | 336 mW                                   |
| N       | 1150 mW                                     | 9.2 mW/°C                                         | 736 mW                                   |

**recommended operating conditions**

|                                       | MIN           | NOM | MAX       | UNIT |
|---------------------------------------|---------------|-----|-----------|------|
| Supply voltage, $V_{CC+}$             | 4.5           | 12  | 15        | V    |
| Supply voltage, $V_{CC-}$             | -4.5          | -12 | -15       | V    |
| Input voltage, $V_I$                  | $V_{CC-} + 2$ |     | $V_{CC+}$ | V    |
| High-level Input voltage, $V_{IH}$    | 2             |     |           | V    |
| Low-level Input voltage, $V_{IL}$     |               |     | 0.8       | V    |
| Operating free-air temperature, $T_A$ | 0             |     | 70        | °C   |

# SN75C188

## QUADRUPLE LOW-POWER LINE DRIVERS

SLLS033F – JANUARY 1988 – REVISED MARCH 1997

**electrical characteristics over operating free-air temperature range,  $V_{CC+} = 12\text{ V}$ ,  $V_{CC-} = -12\text{ V}$  (unless otherwise noted)**

| PARAMETER   |                                          | TEST CONDITIONS                                                     |                                                       | MIN | TYP† | MAX  | UNIT          |               |
|-------------|------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------|-----|------|------|---------------|---------------|
| $V_{OH}$    | High-level output voltage                | $V_{IL} = 0.8\text{ V}$ , $R_L = 3\text{ k}\Omega$                  | $V_{CC+} = 5\text{ V}$ ,<br>$V_{CC-} = -5\text{ V}$   | 4   |      |      | V             |               |
|             |                                          |                                                                     | $V_{CC+} = 12\text{ V}$ ,<br>$V_{CC-} = -12\text{ V}$ | 10  |      |      |               |               |
| $V_{OL}$    | Low-level output voltage<br>(see Note 2) | $V_{IH} = 2\text{ V}$ , $R_L = 3\text{ k}\Omega$                    | $V_{CC+} = 5\text{ V}$ ,<br>$V_{CC-} = -5\text{ V}$   | -4  |      |      | V             |               |
|             |                                          |                                                                     | $V_{CC+} = 12\text{ V}$ ,<br>$V_{CC-} = -12\text{ V}$ | -10 |      |      |               |               |
| $I_{IH}$    | High-level input current                 | $V_I = 5\text{ V}$                                                  |                                                       | 10  |      |      | $\mu\text{A}$ |               |
| $I_{IL}$    | Low-level input current                  | $V_I = 0$                                                           |                                                       | -10 |      |      | $\mu\text{A}$ |               |
| $I_{OS(H)}$ | High-level short-circuit output current‡ | $V_I = 0.8\text{ V}$ , $V_O = 0$ or $V_{CC-}$                       |                                                       |     | -5.5 | -10  | -19.5         | mA            |
| $I_{OS(L)}$ | Low-level short-circuit output current‡  | $V_I = 2\text{ V}$ , $V_O = 0$ or $V_{CC+}$                         |                                                       |     | 5.5  | 10   | 19.5          | mA            |
| $r_O$       | Output resistance, power off             | $V_{CC+} = 0$ , $V_{CC-} = 0$ , $V_I = -2\text{ V}$ to $2\text{ V}$ |                                                       |     | 300  |      |               | $\Omega$      |
| $I_{CC+}$   | Supply current from $V_{CC+}$            | $V_{CC+} = 5\text{ V}$ , $V_{CC-} = -5\text{ V}$ ,<br>No load       | All inputs at 2 V or 0.8 V                            |     | 90   | 160  |               | $\mu\text{A}$ |
|             |                                          | $V_{CC+} = 12\text{ V}$ , $V_{CC-} = -12\text{ V}$ ,<br>No load     | All inputs at 2 V or 0.8 V                            |     | 95   | 160  |               |               |
| $I_{CC-}$   | Supply current from $V_{CC-}$            | $V_{CC+} = 5\text{ V}$ , $V_{CC-} = -5\text{ V}$ ,<br>No load       | All inputs at 2 V or 0.8 V                            |     | -90  | -160 |               | $\mu\text{A}$ |
|             |                                          | $V_{CC+} = 12\text{ V}$ , $V_{CC-} = -12\text{ V}$ ,<br>No load     | All inputs at 2 V or 0.8 V                            |     | -95  | -160 |               |               |

† All typical values are at  $T_A = 25^\circ\text{C}$ .

‡ Not more than one output should be shorted at a time.

NOTE 2: The algebraic convention, in which the more positive (less negative) limit is designated as maximum, is used in this data sheet for logic levels only; e.g., if  $-4\text{ V}$  is a maximum, the typical value is a more negative voltage.

**switching characteristics,  $V_{CC+} = 12\text{ V}$ ,  $V_{CC-} = -12\text{ V}$ ,  $T_A = 25^\circ\text{C}$**

| PARAMETER |                                                    | TEST CONDITIONS                                                       |                        | MIN  | TYP | MAX | UNIT          |                        |
|-----------|----------------------------------------------------|-----------------------------------------------------------------------|------------------------|------|-----|-----|---------------|------------------------|
| $t_{PLH}$ | Propagation delay time, low- to high-level output§ | $R_L = 3\text{ k}\Omega$ ,<br>See Figure 1                            | $C_L = 15\text{ pF}$   | 3    |     |     | $\mu\text{s}$ |                        |
| $t_{PHL}$ | Propagation delay time, high- to low-level output§ |                                                                       |                        | 3.5  |     |     | $\mu\text{s}$ |                        |
| $t_{TLH}$ | Transition time, low- to high-level output¶        |                                                                       |                        | 0.53 | 3.2 |     | $\mu\text{s}$ |                        |
| $t_{THL}$ | Transition time, high- to low-level output¶        |                                                                       |                        | 0.53 | 3.2 |     | $\mu\text{s}$ |                        |
| $t_{TLH}$ | Transition time, low- to high-level output#        | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$ ,<br>See Figure 1      | $C_L = 2500\text{ pF}$ | 1.5  |     |     | $\mu\text{s}$ |                        |
| $t_{THL}$ | Transition time, high- to low-level output#        |                                                                       |                        | 1.5  |     |     | $\mu\text{s}$ |                        |
| SR        | Output slew rate§                                  | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$ , $C_L = 15\text{ pF}$ |                        |      | 6   | 15  | 30            | $\text{V}/\mu\text{s}$ |

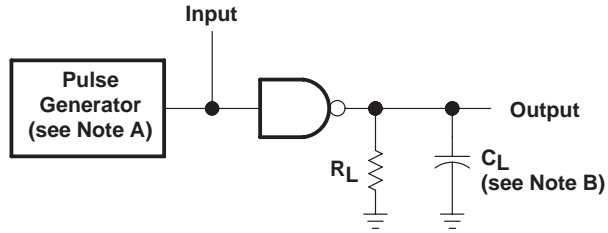
§ Measured at the 50% level

¶ Measured between the 10% and 90% points on the output waveform

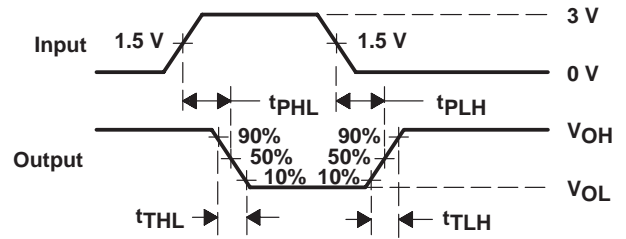
# Measured between the 3-V and  $-3\text{ V}$  points on the output waveform (EIA/TIA-232-E conditions), all unused inputs tied either high or low



PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

NOTES: A. The pulse generator has the following characteristics:  $t_w = 25 \mu s$ , PRR = 20 kHz,  $Z_O = 50 \Omega$ ,  $t_r = t_f \leq 50 \text{ ns}$ .  
 B.  $C_L$  includes probe and jig capacitance.

Figure 1. Test Circuit and Voltage Waveforms

# SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

SLLS033F – JANUARY 1988 – REVISED MARCH 1997

## TYPICAL CHARACTERISTICS

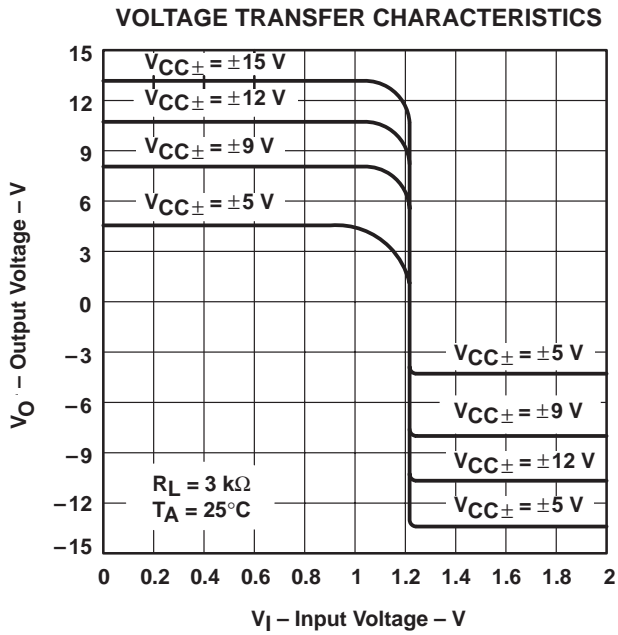


Figure 2

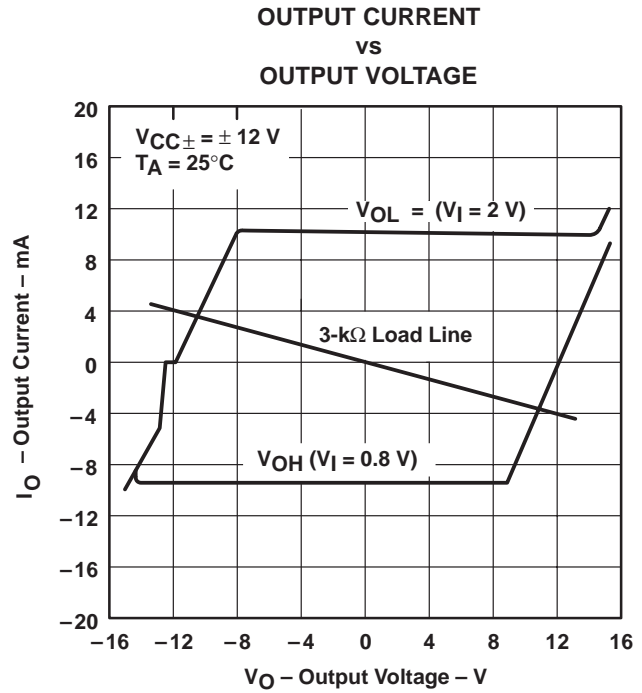


Figure 3

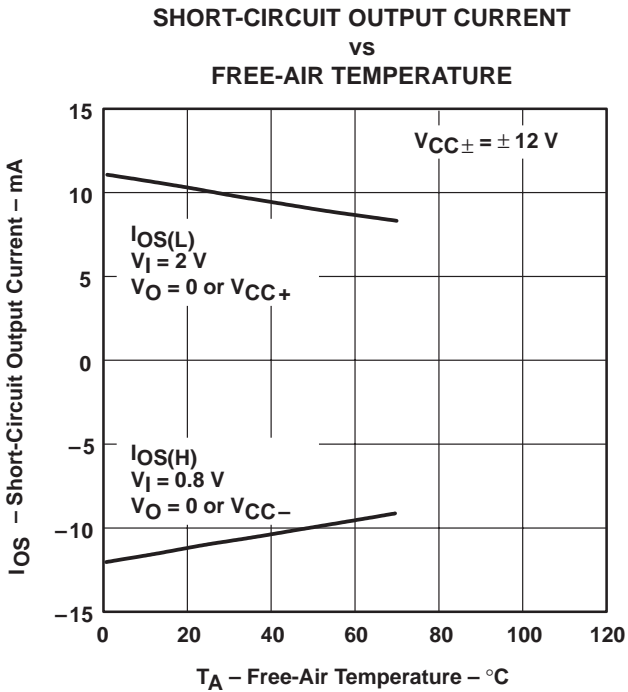


Figure 4

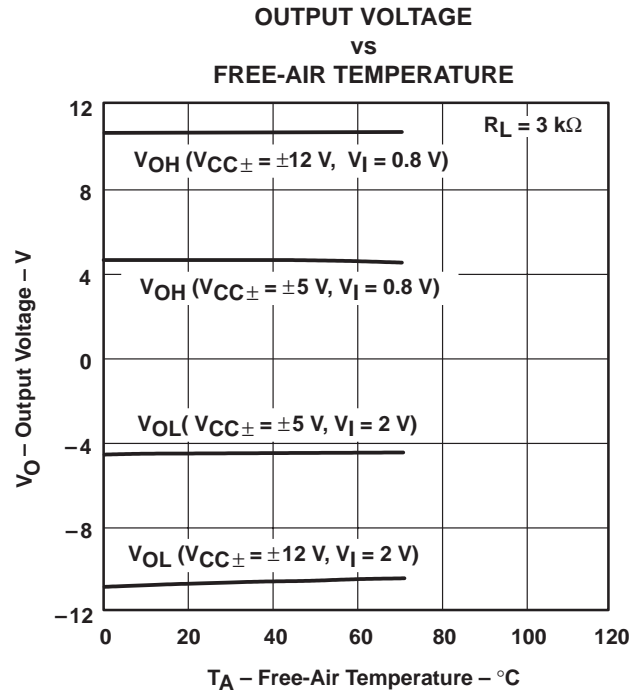
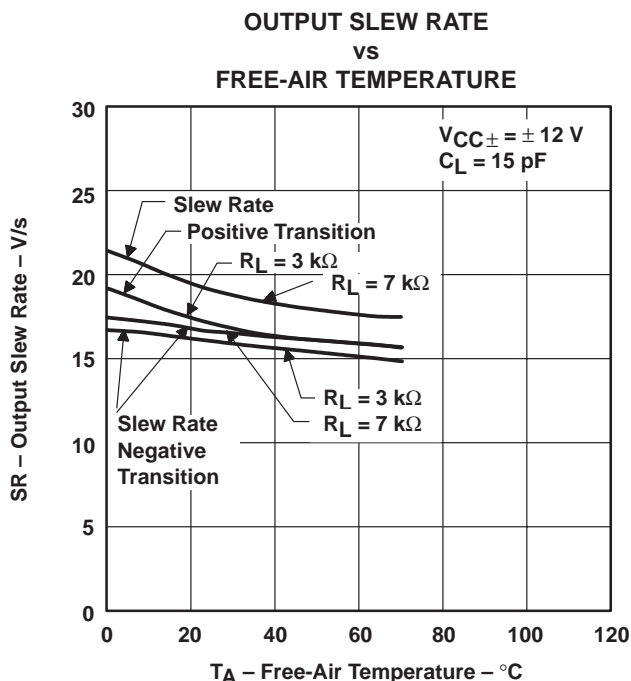
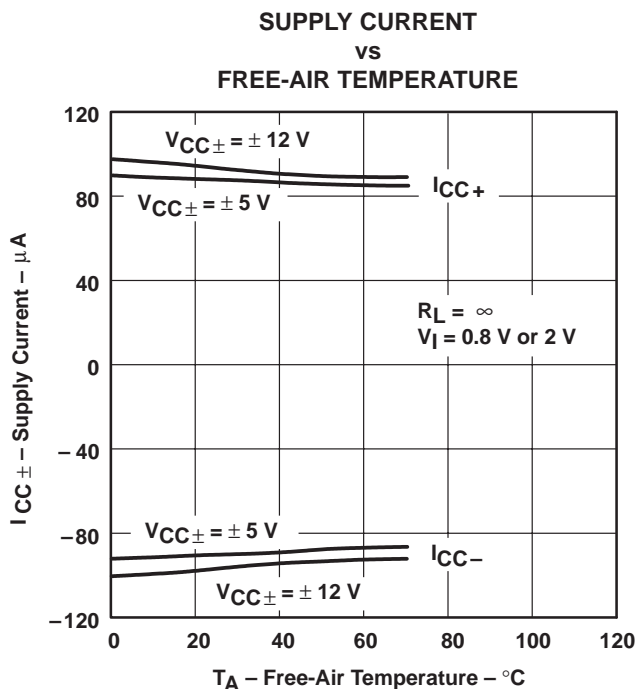
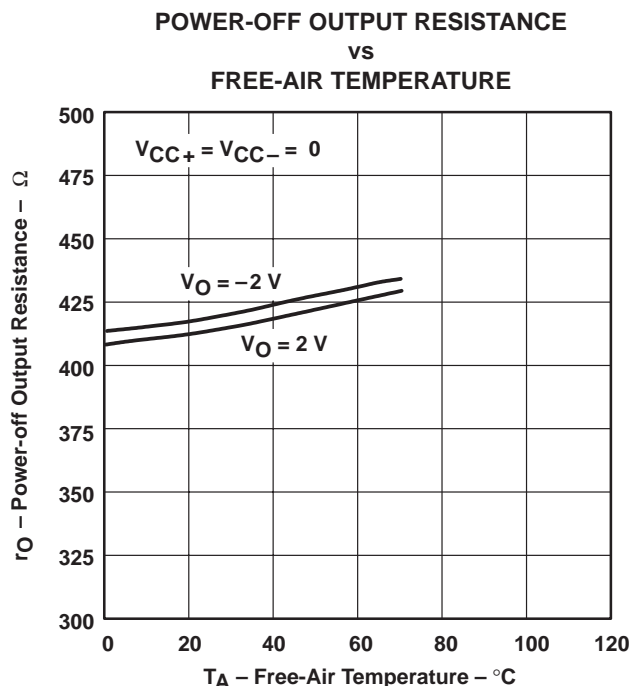
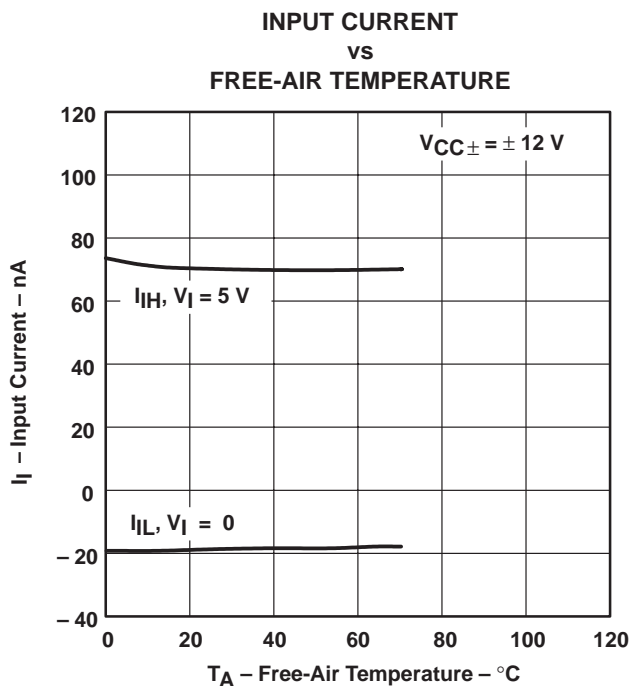


Figure 5



TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

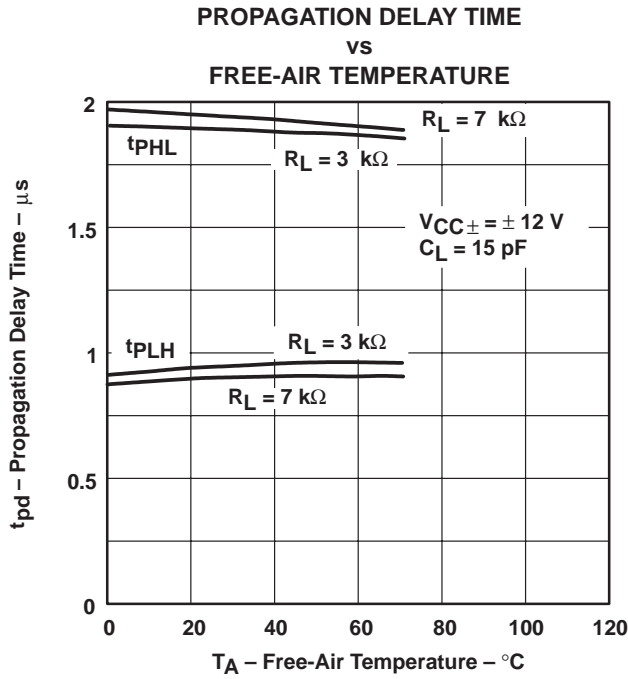


Figure 10

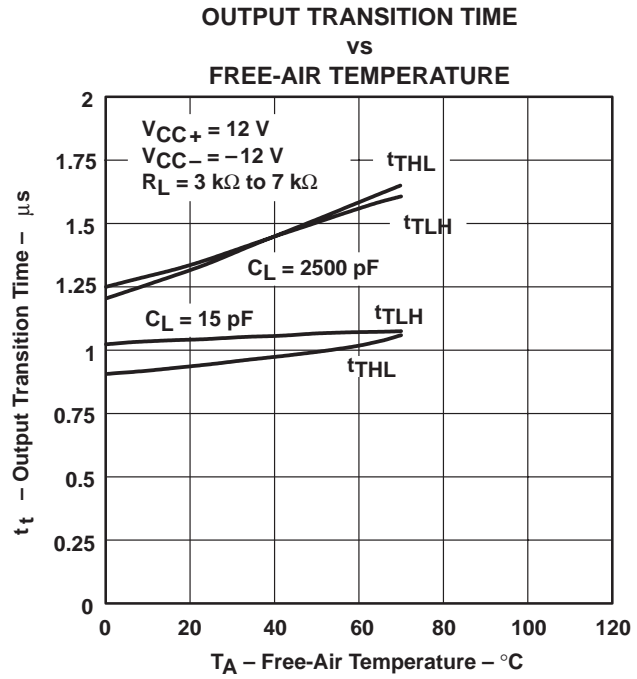


Figure 11

APPLICATION INFORMATION

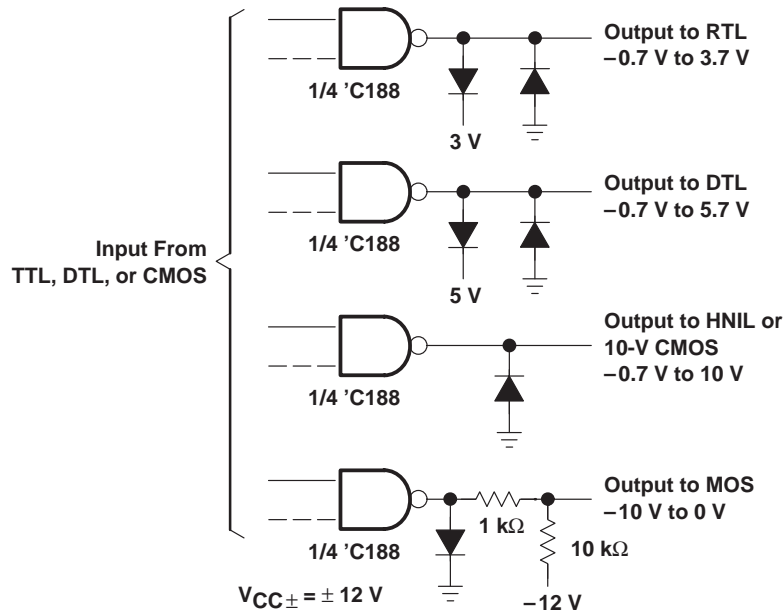
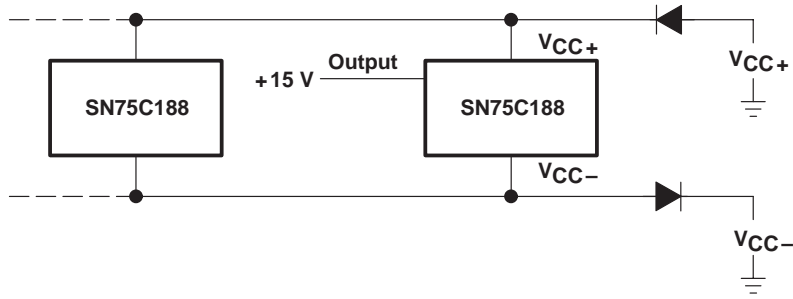


Figure 12. Logic Translator Applications



APPLICATION INFORMATION



NOTE A: External diodes placed in series with the  $V_{CC+}$  and  $V_{CC-}$  leads protect the SN75C188 in the fault condition where the device outputs are shorted to  $\pm 15$  V and the power supplies are at low voltage and provide low-impedance paths to GND.

Figure 13. Power Supply Protection to Meet Power-Off Fault Conditions of Standard EIA/TIA-232-E

## IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.