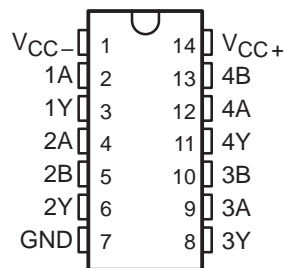


SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

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 μ 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/ μ s max**
- **Flexible Supply Voltage Range**
- **Characterized at $V_{CC\pm}$ of ± 4.5 V and ± 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



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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**

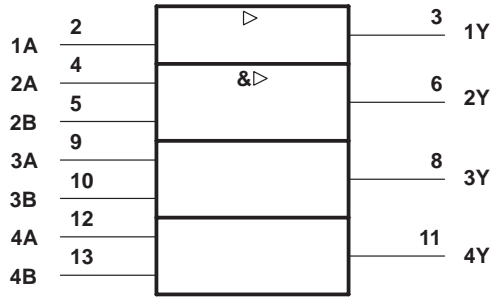
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SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

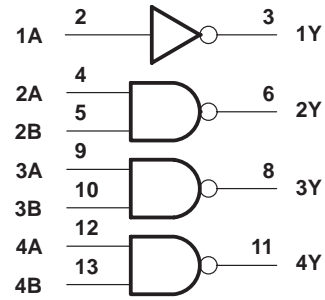
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logic symbol†



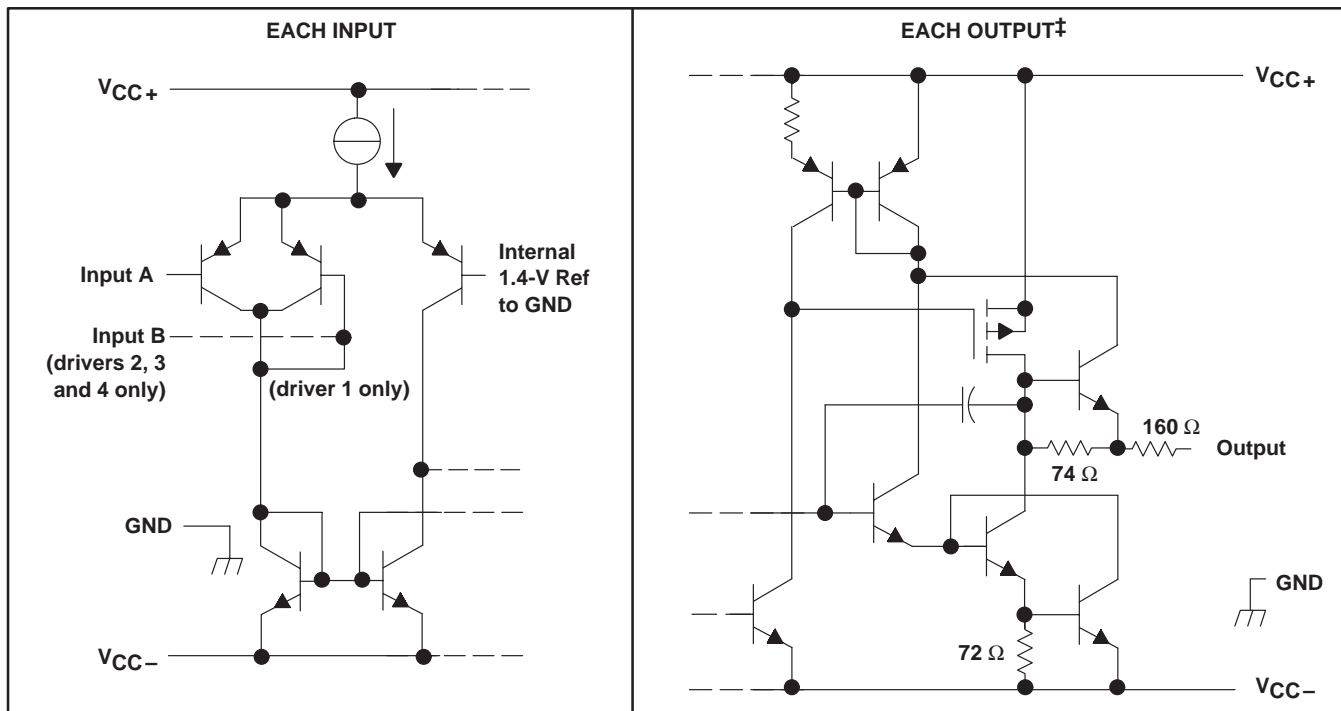
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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 | $V_{CC-} - 6 V$ to $V_{CC+} + 6 V$ |
| 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 | $T_A \leq 25^\circ\text{C}$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$ 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

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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 | $V_{IL} = 0.8\text{ V}$, $R_L = 3\text{ k}\Omega$ | $V_{CC+} = 5\text{ V}$, $V_{CC-} = -5\text{ V}$ | 4 | | | V | |
| | | | $V_{CC+} = 12\text{ V}$, $V_{CC-} = -12\text{ V}$ | 10 | | | | |
| V_{OL} | Low-level output voltage (see Note 2) | $V_{IH} = 2\text{ V}$, $R_L = 3\text{ k}\Omega$ | $V_{CC+} = 5\text{ V}$, $V_{CC-} = -5\text{ V}$ | -4 | | | V | |
| | | | $V_{CC+} = 12\text{ V}$, $V_{CC-} = -12\text{ V}$ | -10 | | | | |
| I_{IH} | High-level input current | $V_I = 5\text{ V}$ | | 10 | | | μA | |
| I_{IL} | Low-level input current | $V_I = 0$ | | -10 | | | μA | |
| $I_{OS(H)}$ | 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 V | | | 300 | | | Ω |
| I_{CC+} | Supply current from V_{CC+} | $V_{CC+} = 5\text{ V}$, $V_{CC-} = -5\text{ V}$, No load | All inputs at 2 V or 0.8 V | | 90 | 160 | | μA |
| | | $V_{CC+} = 12\text{ V}$, $V_{CC-} = -12\text{ V}$, No load | All inputs at 2 V or 0.8 V | | 95 | 160 | | |
| I_{CC-} | Supply current from V_{CC-} | $V_{CC+} = 5\text{ V}$, $V_{CC-} = -5\text{ V}$, No load | All inputs at 2 V or 0.8 V | | -90 | -160 | | μA |
| | | $V_{CC+} = 12\text{ V}$, $V_{CC-} = -12\text{ V}$, 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 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§ | $R_L = 3\text{ k}\Omega$, See Figure 1 | $C_L = 15\text{ pF}$ | 3 | | | μs | |
| t_{PHL} | Propagation delay time, high- to low-level output§ | | | 3.5 | | | μs | |
| t_{TLH} | Transition time, low- to high-level output¶ | | | 0.53 | 3.2 | | μs | |
| t_{THL} | Transition time, high- to low-level output¶ | | | 0.53 | 3.2 | | μs | |
| t_{TLH} | Transition time, low- to high-level output# | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, See Figure 1 | $C_L = 2500\text{ pF}$ | 1.5 | | | μs | |
| t_{THL} | Transition time, high- to low-level output# | | | 1.5 | | | μs | |
| SR | Output slew rate§ | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$, $C_L = 15\text{ pF}$ | | | 6 | 15 | 30 | $\text{V}/\mu\text{s}$ |

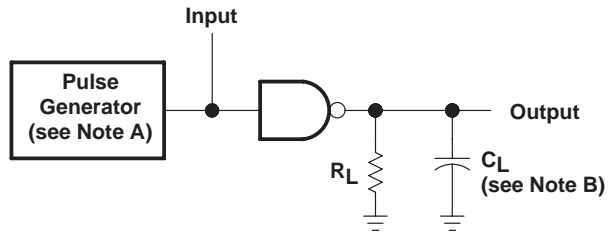
§ Measured at the 50% level

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

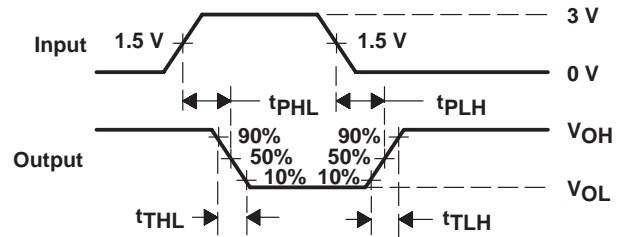
Measured between the 3-V and -3 V points on the output waveform (EIA/TIA-232-E conditions), all unused inputs tied either high or low



PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

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

Figure 1. Test Circuit and Voltage Waveforms

SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

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TYPICAL CHARACTERISTICS

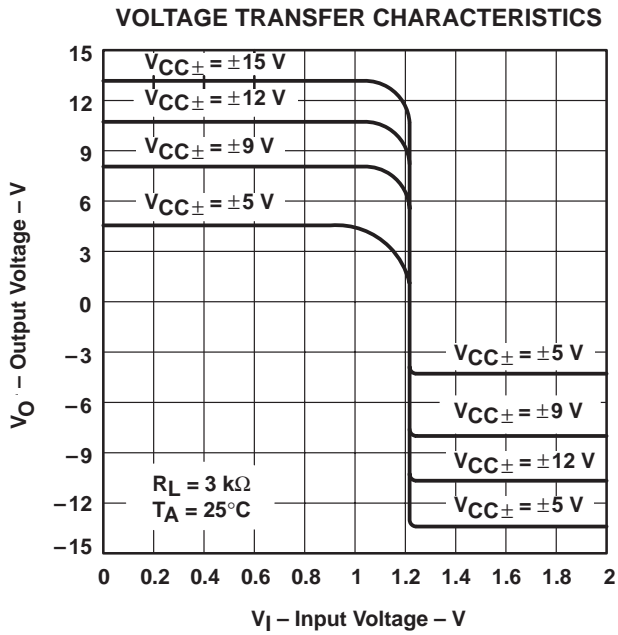


Figure 2

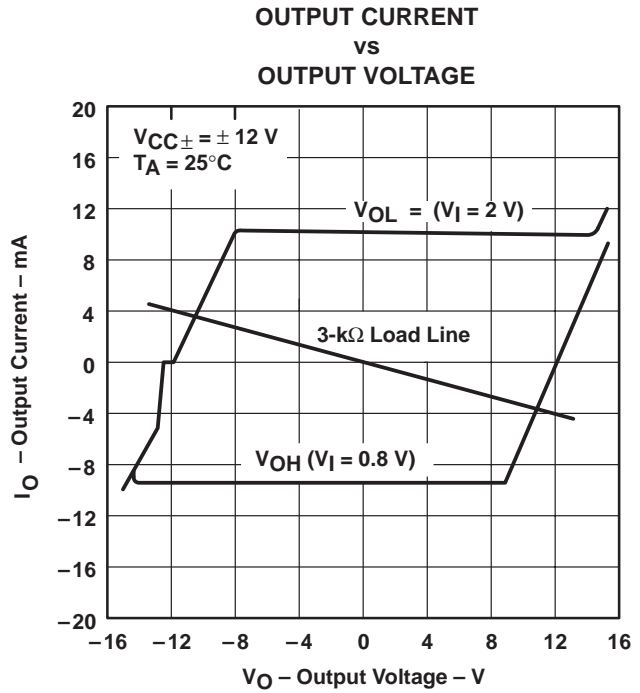


Figure 3

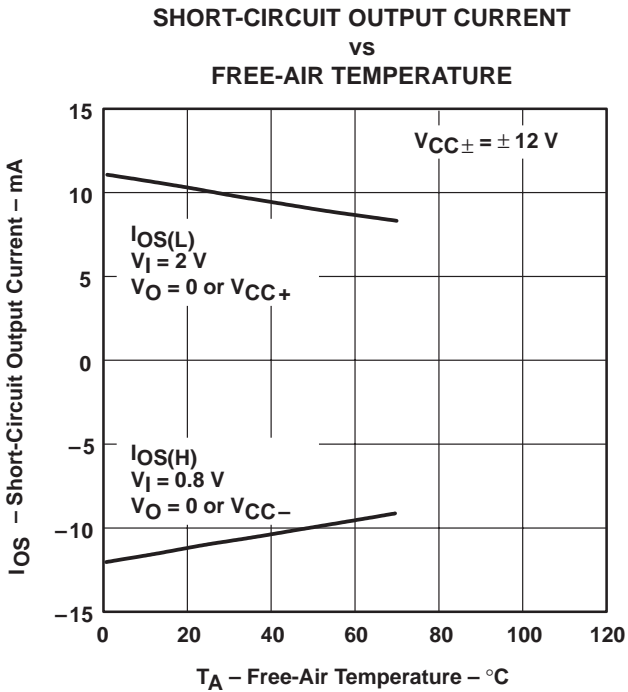


Figure 4

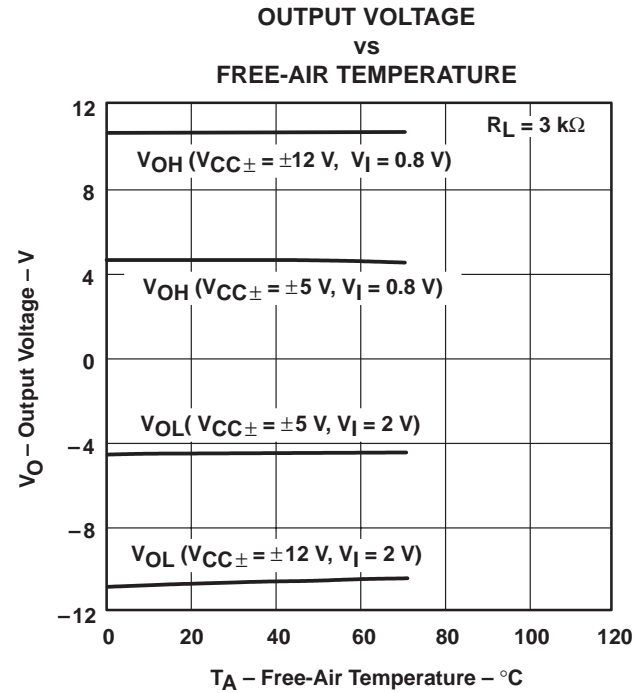
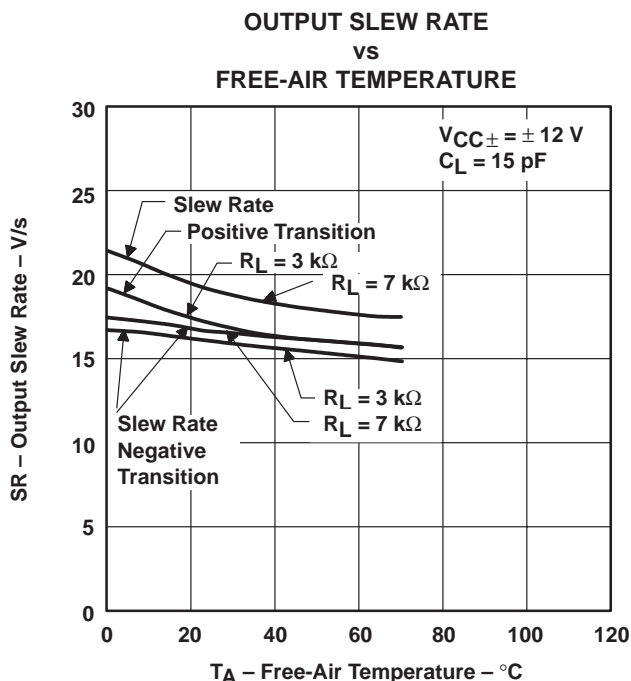
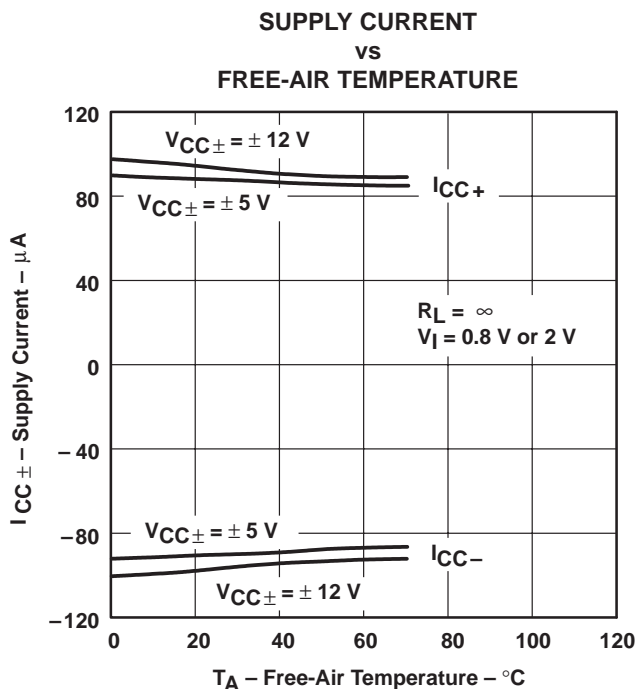
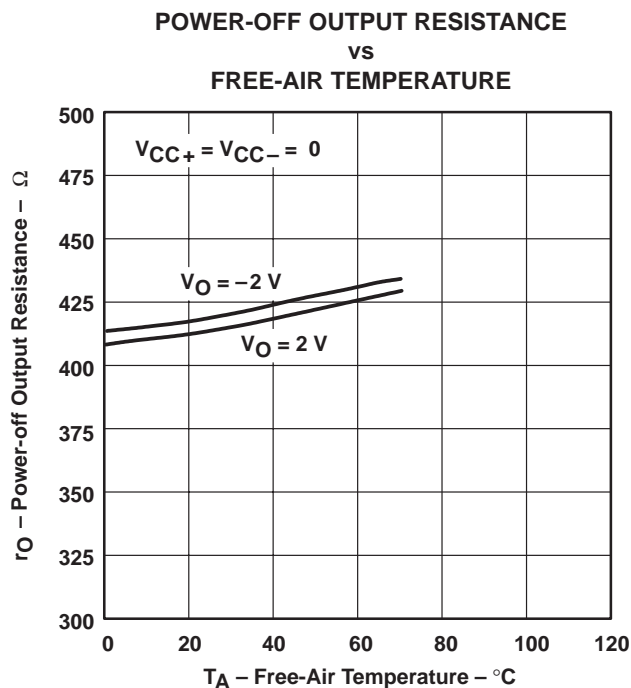
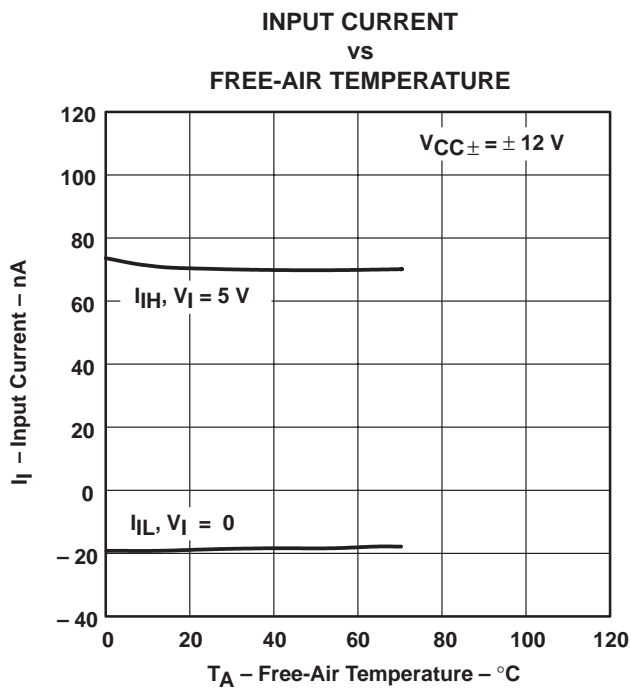


Figure 5



TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

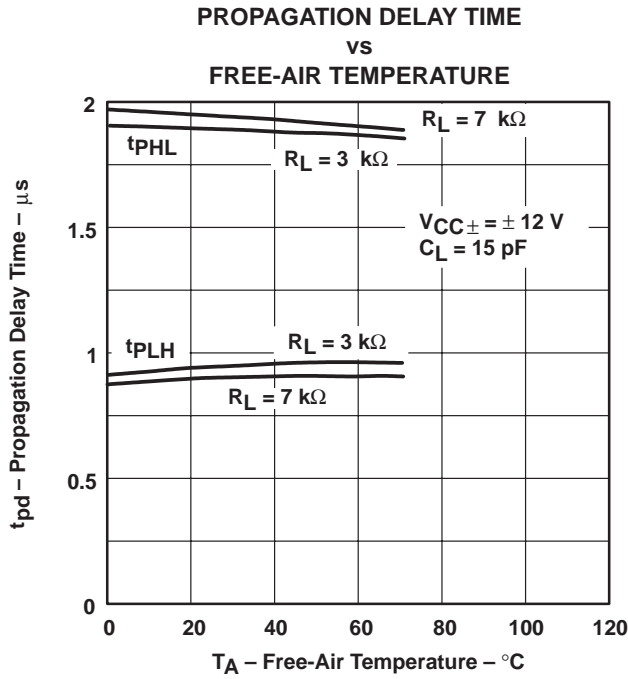


Figure 10

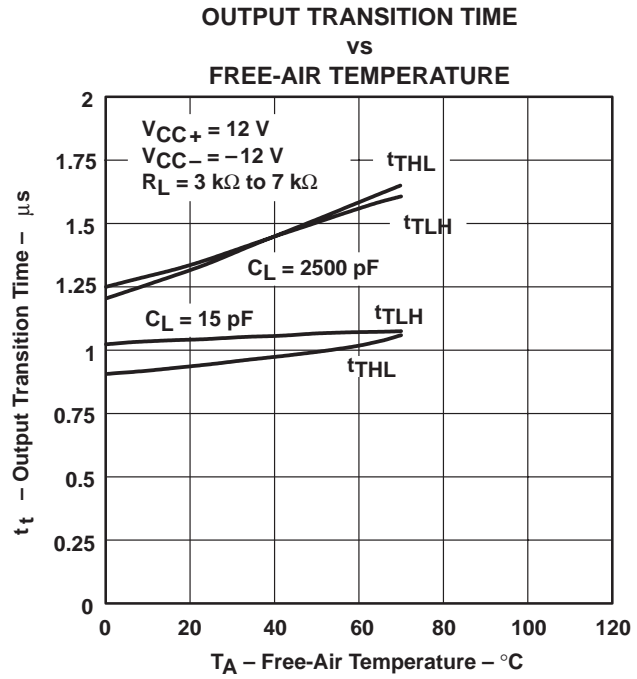


Figure 11

APPLICATION INFORMATION

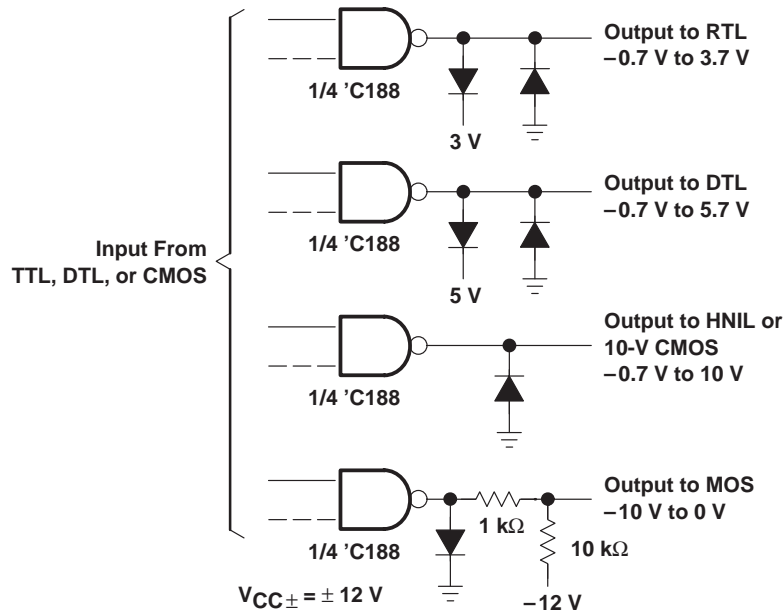
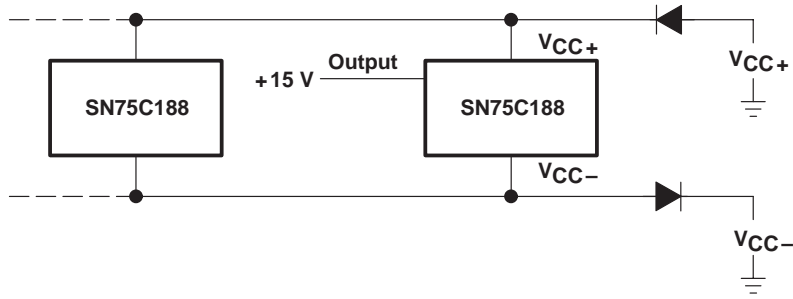


Figure 12. Logic Translator Applications

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 ± 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

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN75C188D | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188DBLE | OBSOLETE | SSOP | DB | 14 | | TBD | Call TI | Call TI |
| SN75C188DBR | ACTIVE | SSOP | DB | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188DBRE4 | ACTIVE | SSOP | DB | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188DE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188DR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188DRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188N | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN75C188NE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN75C188NSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75C188NSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

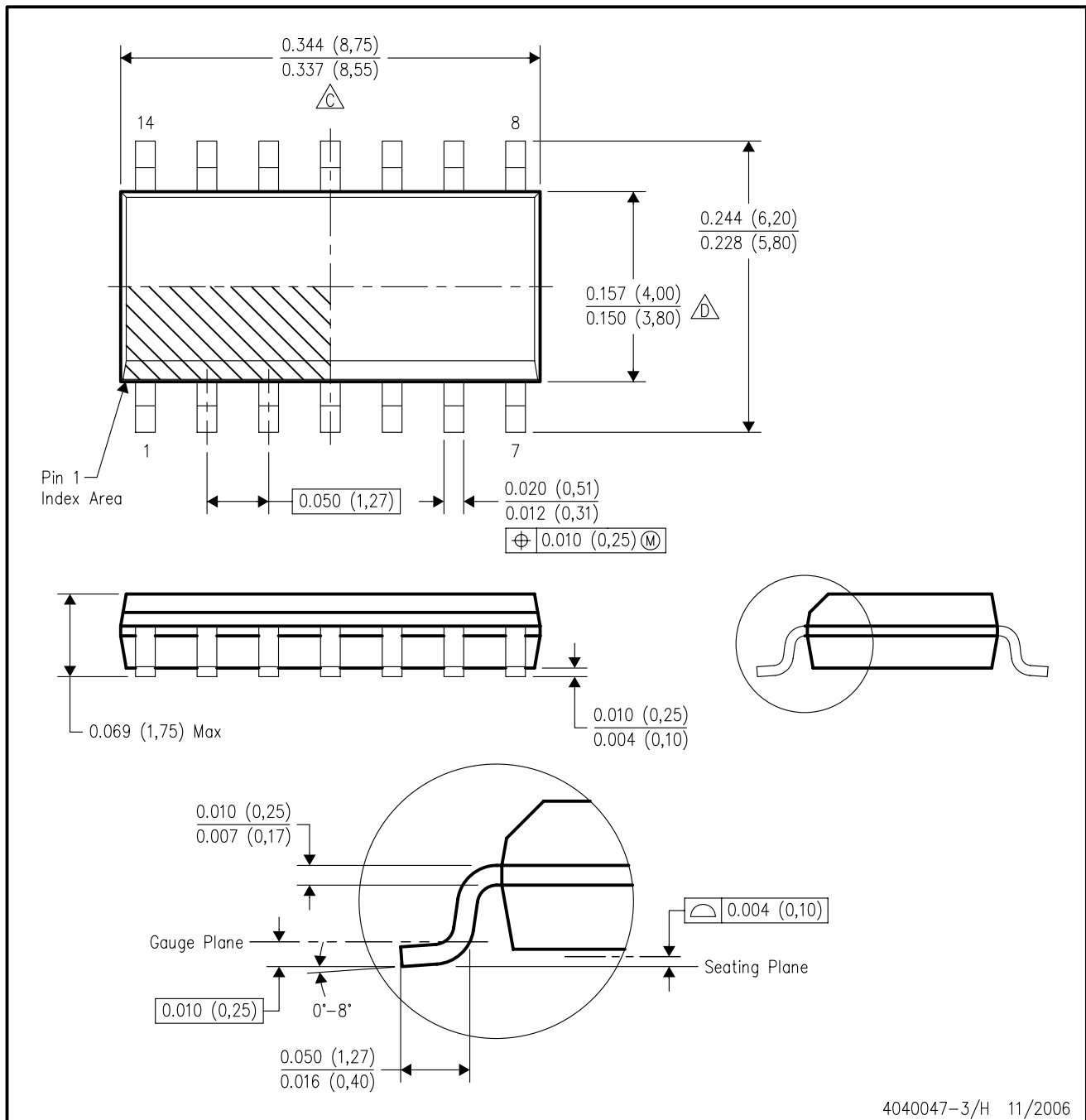


4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AB.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

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