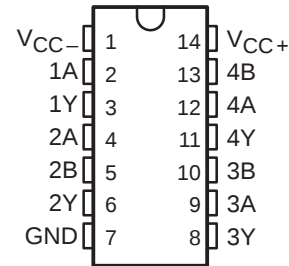


- Bi-MOS Technology With TTL and CMOS Compatibility
- Meets or Exceeds the Requirements of ANSI EIA/TIA-232-E and ITU Recommendation V.28
- Very Low Quiescent Current . . . 95 μ A Typ
 $V_{CC\pm} = \pm 12$ V
- Current-Limited Outputs . . . 10 mA Typ
- CMOS- and TTL-Compatible Inputs
- On-Chip Slew Rate 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



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**

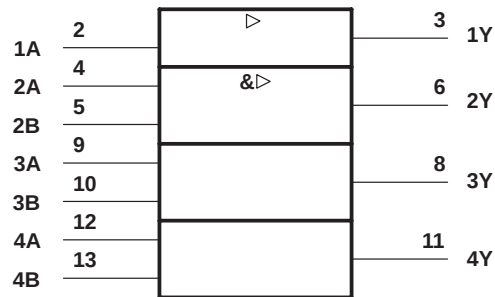
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1997, Texas Instruments Incorporated

SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

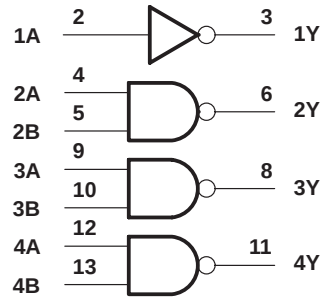
SLLS033F – JANUARY 1988 – REVISED MARCH 1997

logic symbol†



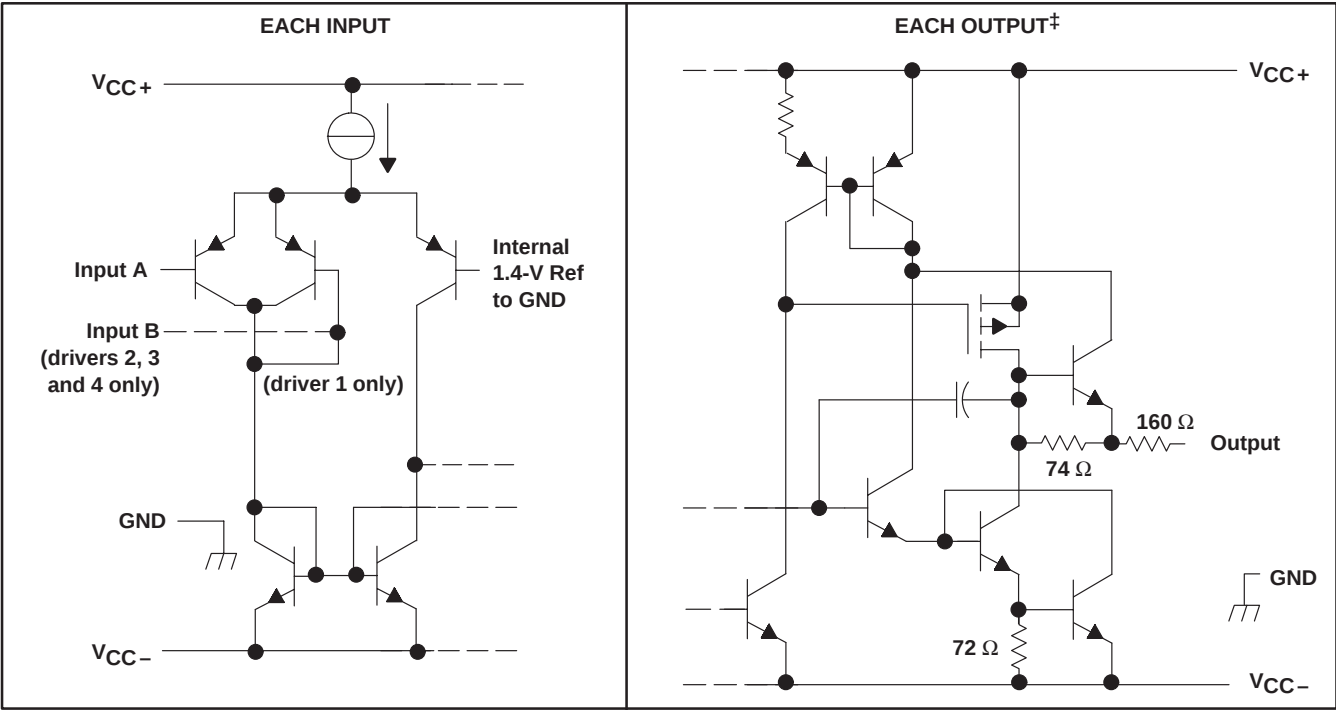
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



positive logic
 $Y = \overline{A}$ (driver 1)
 $Y = \overline{AB}$ or $\overline{A} + \overline{B}$ (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	$T_A \leq 25^\circ\text{C}$ 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

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	$V_{IL} = 0.8\text{ V}$, $R_L = 3\text{ k}\Omega$ $V_{CC+} = 5\text{ V}$, $V_{CC-} = -5\text{ V}$	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 [§]	$R_L = 3\text{ k}\Omega$, $C_L = 15\text{ pF}$, See Figure 1			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 $7\text{ k}\Omega$, $C_L = 2500\text{ pF}$, See Figure 1		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	V/ μs

[§] Measured at the 50% level

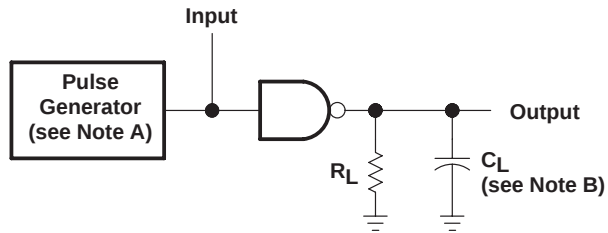
[¶] Measured between the 10% and 90% points on the output waveform

[#] 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

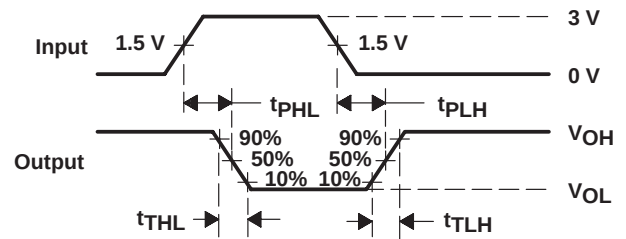


POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

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

SLLS033F – JANUARY 1988 – REVISED MARCH 1997

TYPICAL CHARACTERISTICS

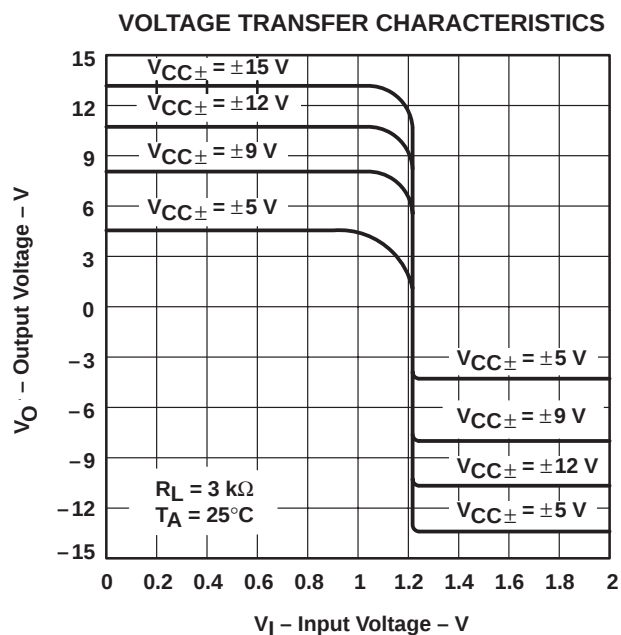


Figure 2

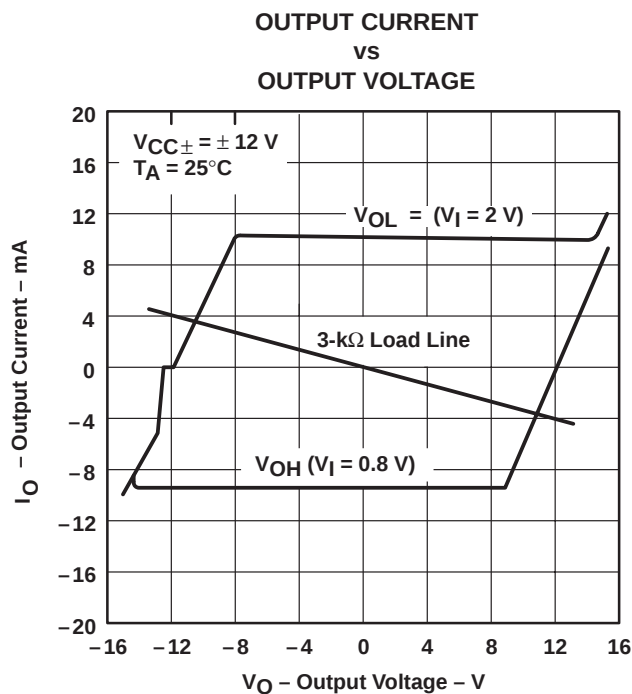


Figure 3

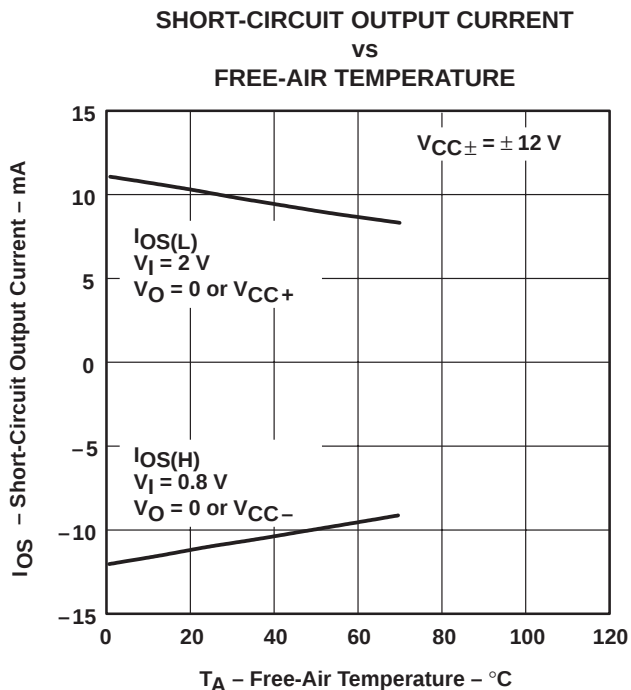


Figure 4

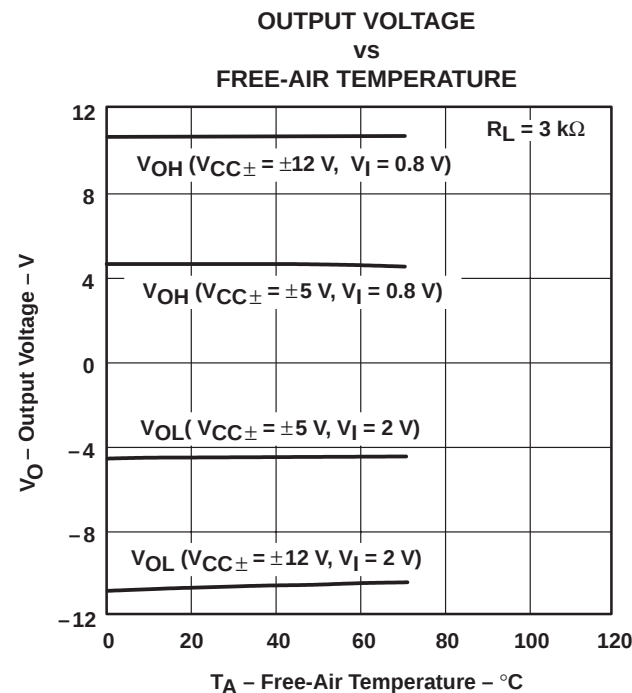
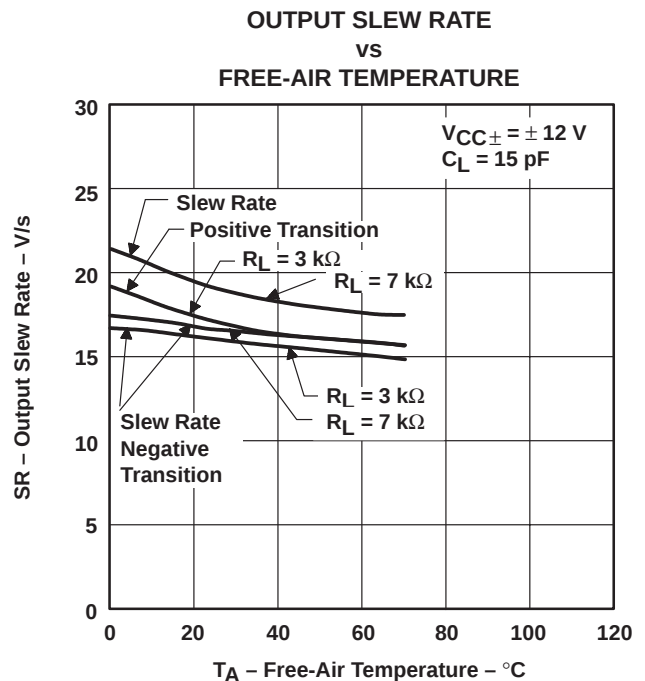
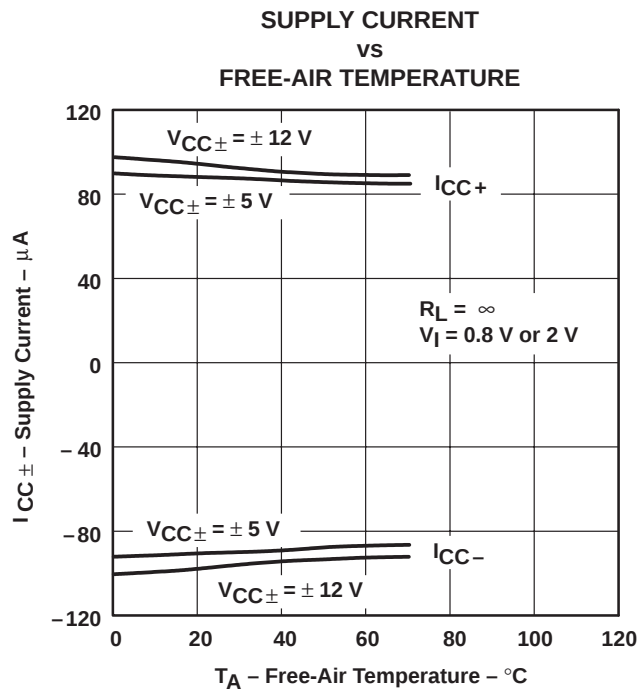
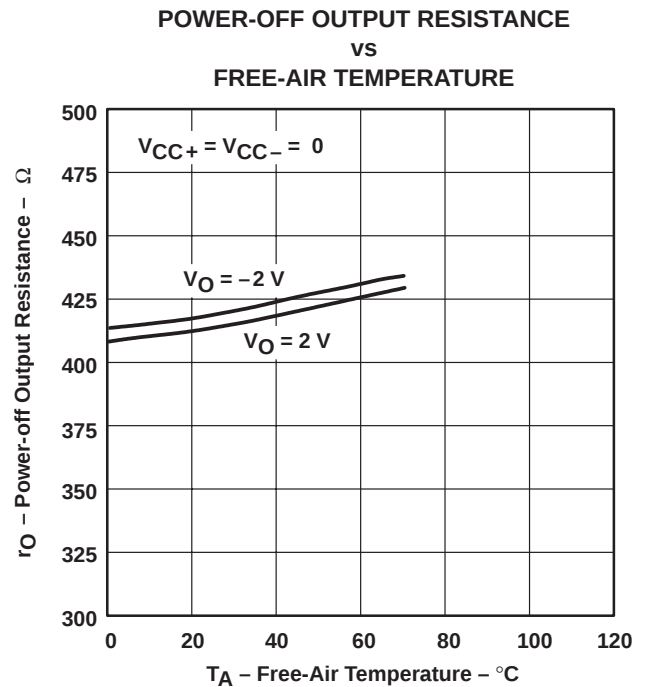
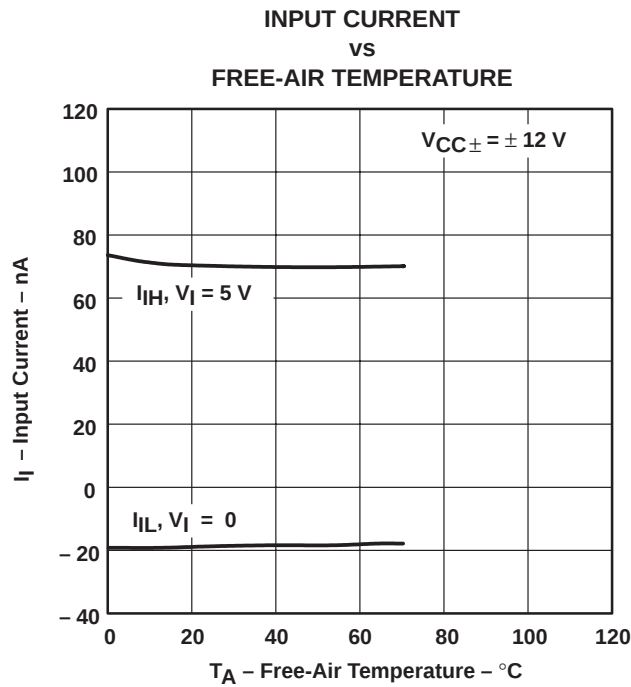


Figure 5

TYPICAL CHARACTERISTICS



SN75C188 QUADRUPLE LOW-POWER LINE DRIVERS

SLLS033F – JANUARY 1988 – REVISED MARCH 1997

TYPICAL CHARACTERISTICS

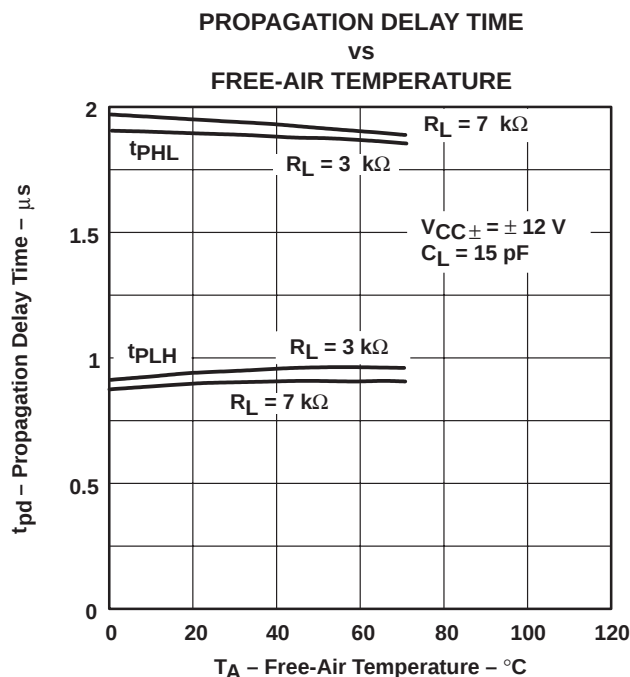


Figure 10

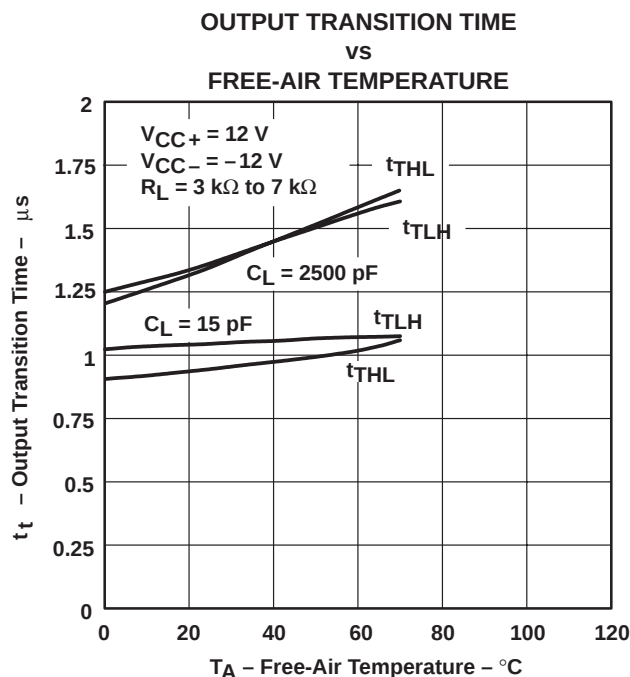


Figure 11

APPLICATION INFORMATION

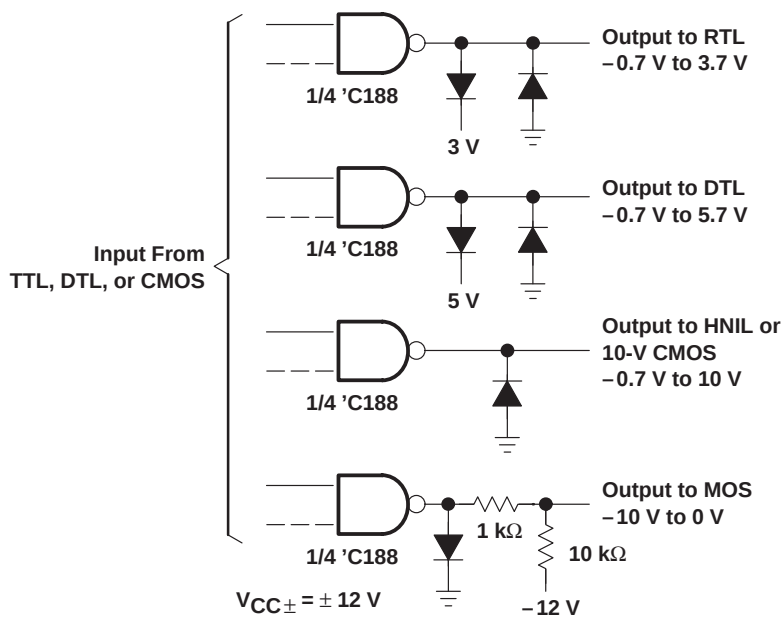
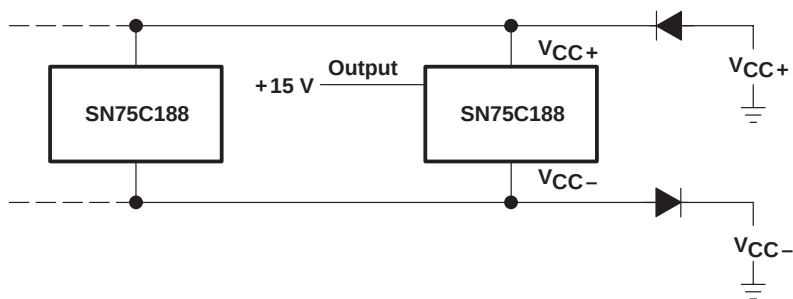


Figure 12. Logic Translator Applications

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	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188DBLE	OBSOLETE	SSOP	DB	14		TBD	Call TI	Call TI
SN75C188DBR	ACTIVE	SSOP	DB	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188DBRE4	ACTIVE	SSOP	DB	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188DE4	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188DRE4	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN75C188NSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C188NSRE4	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-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) 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.

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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

NOTES:

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

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



4040047-3/F 07/2004

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

Copyright © 2005, Texas Instruments Incorporated