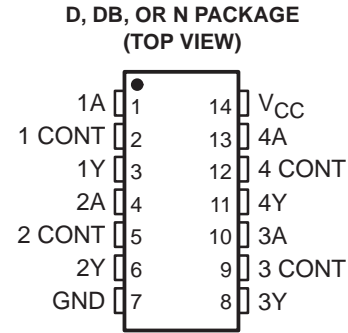


SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

- Meet or Exceed the Requirements of TIA/EIA-232-F and ITU Recommendation V.28
- Low Supply Current . . . 420 μ A Typ
- Preset On-Chip Input Noise Filter
- Built-in Input Hysteresis
- Response and Threshold Control Inputs
- Push-Pull Outputs
- Functionally Interchangeable and Pin-to-Pin Compatible With Texas Instruments SN75189/SN75189A and Motorola MC1489/MC1489A
- Package Options Include Plastic Small-Outline (D) and Shrink Small-Outline (DB) Packages, and Standard Plastic (N) DIP



description

The SN75C189 and SN75C189A are low-power, bipolar, quadruple line receivers that are used to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). These devices have been designed to conform to TIA/EIA-232-F.

The SN75C189 has a 0.33-V typical hysteresis, compared with 0.97 V for the SN75C189A. Each receiver has provision for adjustment of the overall input threshold levels. This is achieved by choosing external series resistors and voltages to provide bias levels for the response-control pins. The output is in the high logic state if the input is open circuit or shorted to ground.

These devices have an on-chip filter that rejects input pulses of less than 1- μ s duration. An external capacitor can be connected from the control pins to ground to provide further input noise filtering for each receiver.

The SN75C189 and SN75C189A have been designed using low-power techniques in a bipolar technology. In most applications, these receivers interface to single inputs of peripheral devices such as UARTs, ACEs, or microprocessors. By using sampling, such peripheral devices usually are insensitive to the transition times of the input signals. If this is not the case, or for other uses, it is recommended that the SN75C189 and SN75C189A outputs be buffered by single Schmitt input gates or single gates of the HCMOS, ALS, or 74F logic families.

The SN75C189 and SN75C189A are characterized for operation from 0°C to 70°C.



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**

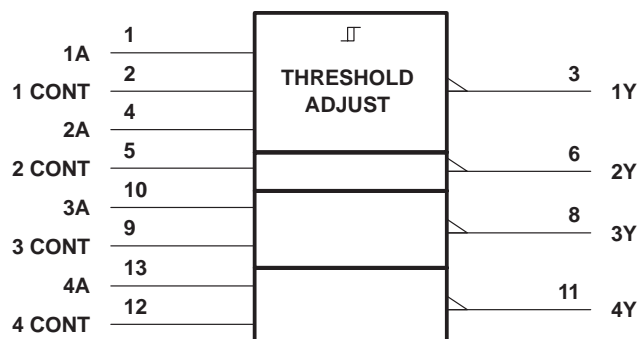
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2000, Texas Instruments Incorporated

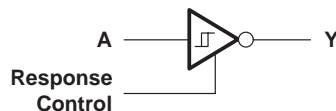
SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

logic symbol†

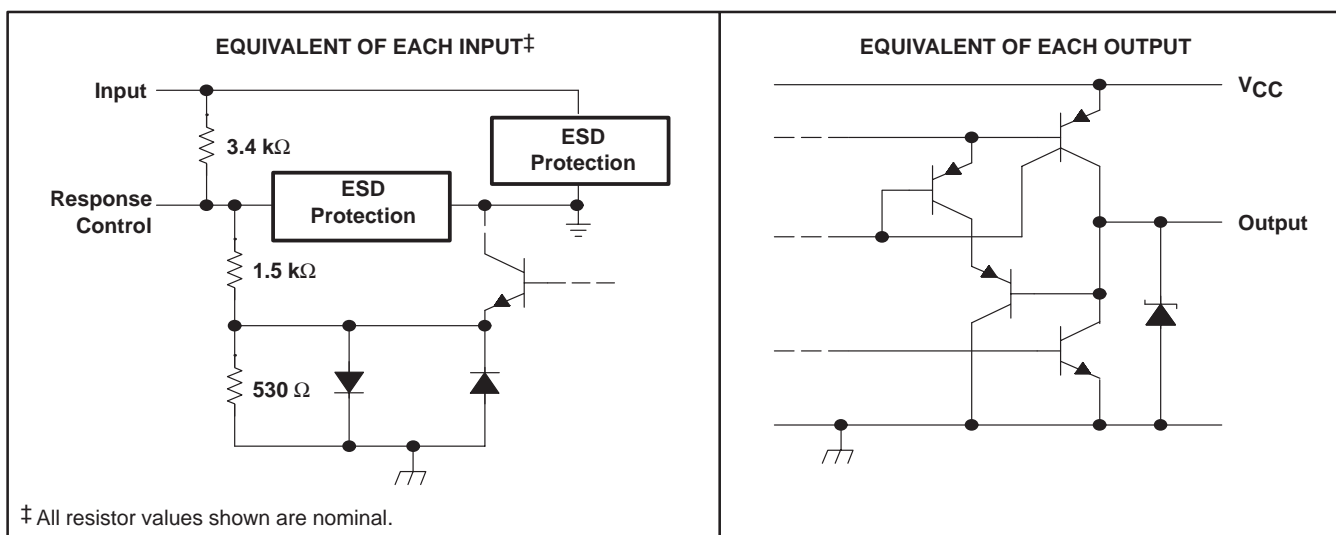


logic diagram (each receiver)



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

schematic 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)	7 V
Input voltage range, V_I	-30 V to 30 V
Output voltage range, V_O	-0.3 V to $V_{CC} + 0.3$ V
Package thermal impedance, θ_{JA} (see Note 2):	
D package	86°C/W
DB package	96°C/W
N package	80°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{stg}	-65°C to 150°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.

NOTES: 1. All voltages are with respect to network GND.

2. The package thermal impedance is calculated in accordance with JESD 51.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

recommended operating conditions

	MIN	NOM	MAX	UNIT
V _{CC} Supply voltage	4.5	5	6	V
V _I Input voltage (see Note 3)	-25		25	V
I _{OH} High-level output current			-3.2	mA
I _{OL} Low-level output current			3.2	mA
Response-control current			±1	mA
T _A Operating free-air temperature	0		70	°C

NOTE 3: The algebraic convention, where the more positive (less negative) limit is designated as maximum, is used in this data sheet for logic levels only, e.g., if -10 V is a maximum, the typical value is a more negative voltage.

electrical characteristics over recommended free-air temperature range, V_{CC} = 5 V ±10% (unless otherwise noted) (see Note 4)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V _{IT+} Positive-going input threshold voltage	'C189	See Figure 1	1		1.5	V
	'C189A		1.6		2.25	
V _{IT-} Negative-going input threshold voltage	'C189	See Figure 1	0.75		1.25	V
	'C189A		0.75	1	1.25	
V _{hys} Input hysteresis voltage (V _{IT+} - V _{IT-})	'C189	See Figure 1	0.15	0.33		V
	'C189A		0.65	0.97		
V _{OH} High-level output voltage	V _{CC} = 4.5 V to 6 V, V _I = 0.75 V, I _{OH} = -20 μA		3.5			V
	V _{CC} = 4.5 V to 6 V, V _I = 0.75 V, I _{OH} = -3.2 mA		2.5			
V _{OL} Low-level output voltage	V _{CC} = 4.5 V to 6 V, V _I = 3 V, I _{OL} = 3.2 mA				0.4	V
I _{IH} High-level input current	See Figure 2	V _I = 25 V	3.6		8.3	mA
		V _I = 3 V	0.43		1	
I _{IL} Low-level input current	See Figure 2	V _I = -25 V	-3.6		-8.3	mA
		V _I = -3 V	-0.43		-1	
I _{OS} Short-circuit output current	See Figure 3				-35	mA
I _{CC} Supply current	V _I = 5 V, See Figure 2	No load,		420	700	μA

† All typical values are at T_A = 25°C.

NOTE 4: All characteristics are measured with response-control terminal open.

switching characteristics, V_{CC} = 5 V ±10%, T_A = 25°C

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{pLH} Propagation delay time, low- to high-level output	R _L = 5 kΩ, C _L = 50 pF, See Figure 4			6	μs
t _{pHL} Propagation delay time, high- to low-level output				6	μs
t _{TLH} Transition time, low- to high-level output‡				500	ns
t _{THL} Transition time, high- to low-level output‡				300	ns
t _{w(N)} Duration of longest pulse rejected as noise§			1		6

‡ Measured between 10% and 90% points of output waveform

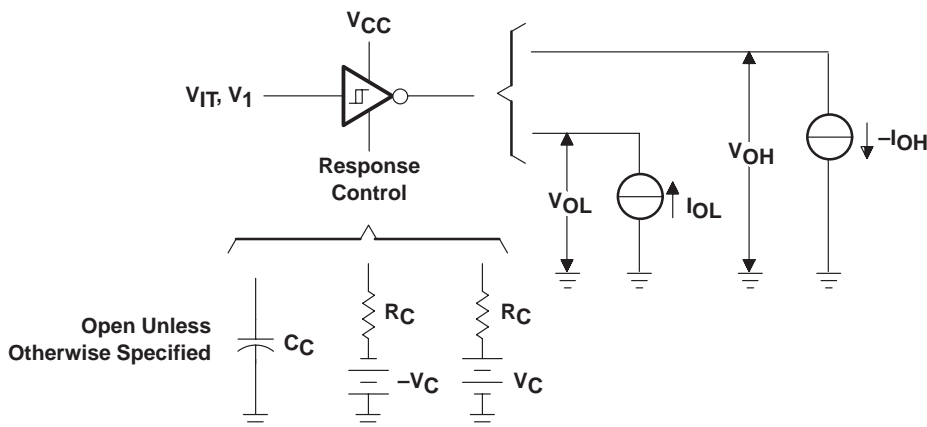
§ The receiver ignores any positive- or negative-going pulse that is less than the minimum value of t_{w(N)} and accepts any positive- or negative-going pulse greater than the maximum of t_{w(N)}.



SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

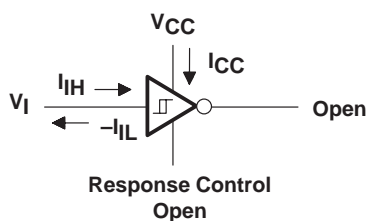
SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

PARAMETER MEASUREMENT INFORMATION



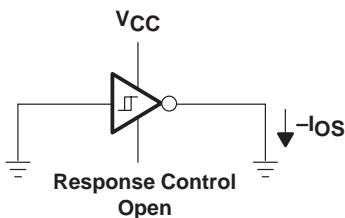
NOTE A: Arrows indicate actual direction of current flow. Current into a terminal is a positive value.

Figure 1. V_{T+} , V_{IT-} , V_{OH} , V_{OL}



NOTE A: Arrows indicate actual direction of current flow. Current into a terminal is a positive value.

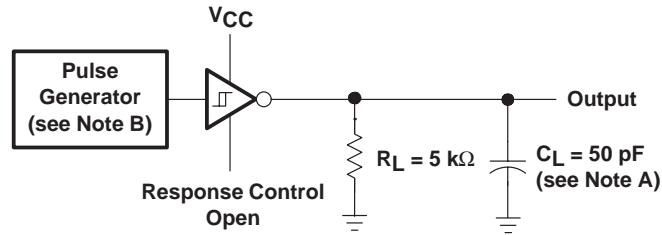
Figure 2. I_{IH} , I_{IL} , I_{CC}



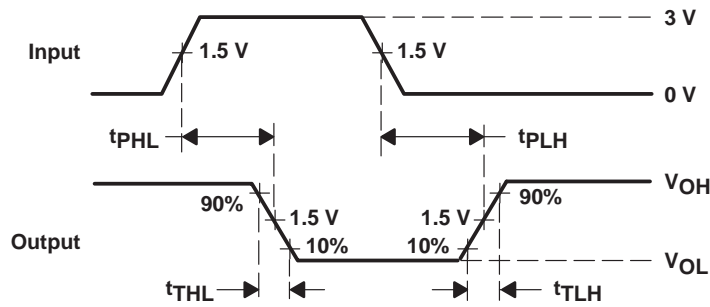
NOTE A: Arrows indicate actual direction of current flow. Current into a terminal is a positive value.

Figure 3. I_{OS}

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A. C_L includes probe and jig capacitances.
 B. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, $t_w = 25\ \mu\text{s}$.

Figure 4. Test Circuit and Voltage Waveforms

SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

TYPICAL CHARACTERISTICS

SN75C189
INPUT THRESHOLD VOLTAGE (POSITIVE GOING)
vs
FREE-AIR TEMPERATURE

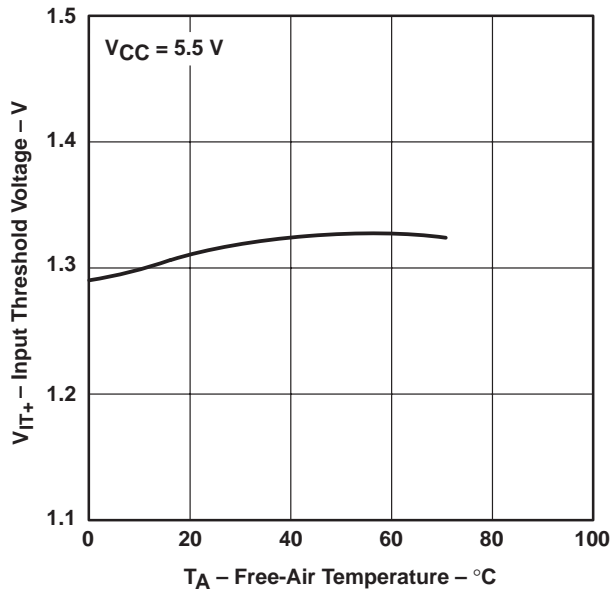


Figure 5

SN75C189A
INPUT THRESHOLD VOLTAGE (POSITIVE GOING)
vs
FREE-AIR TEMPERATURE

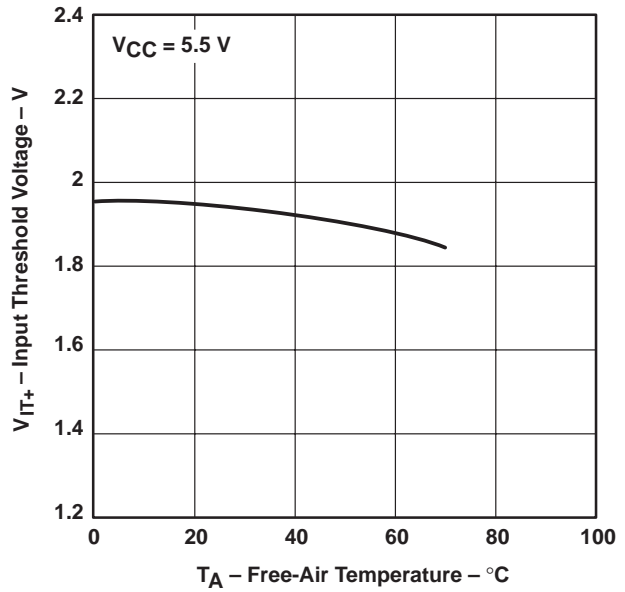


Figure 6

SN75C189
INPUT THRESHOLD VOLTAGE (NEGATIVE GOING)
vs
FREE-AIR TEMPERATURE

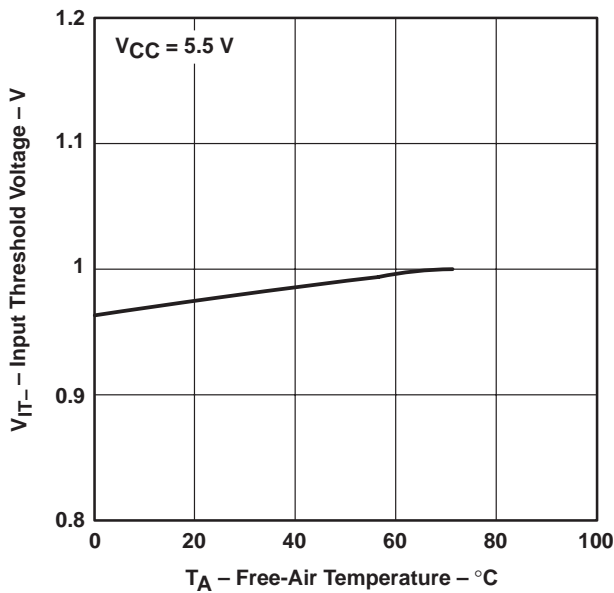


Figure 7

SN75C189A
INPUT THRESHOLD VOLTAGE (NEGATIVE GOING)
vs
FREE-AIR TEMPERATURE

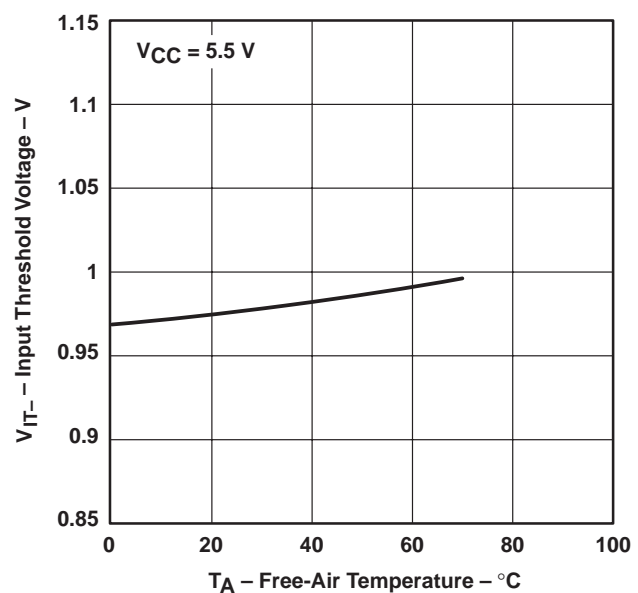
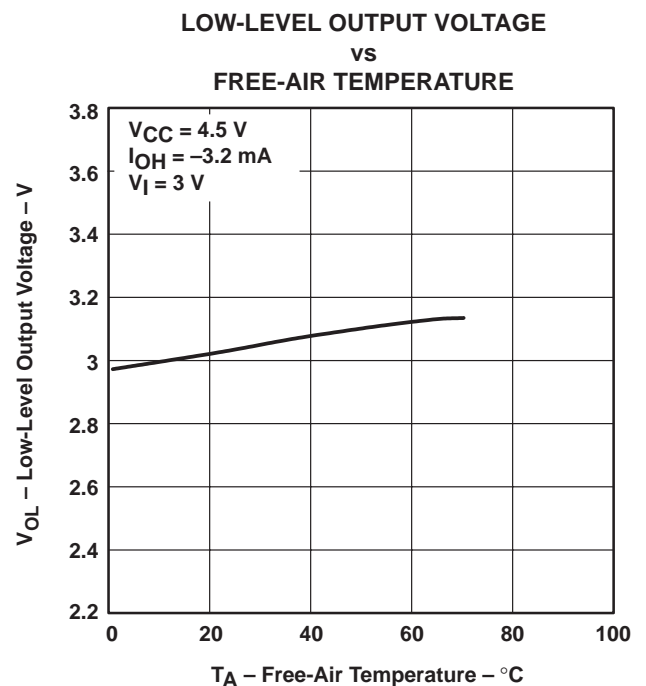
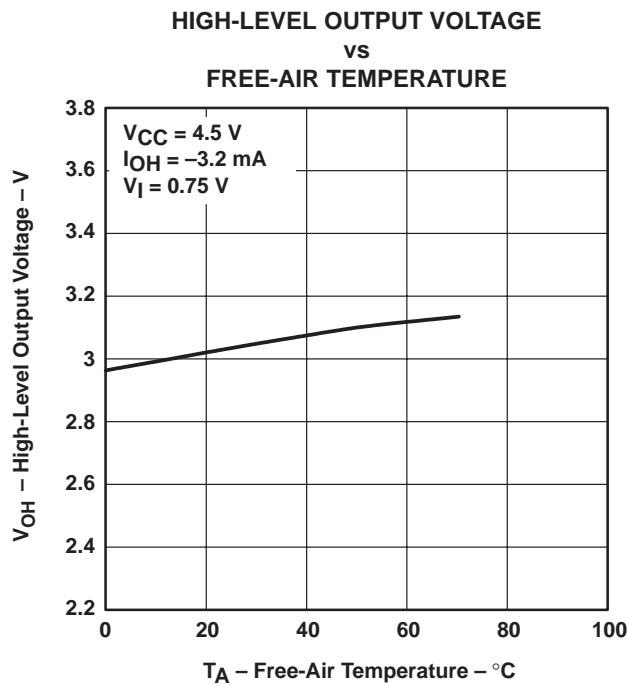
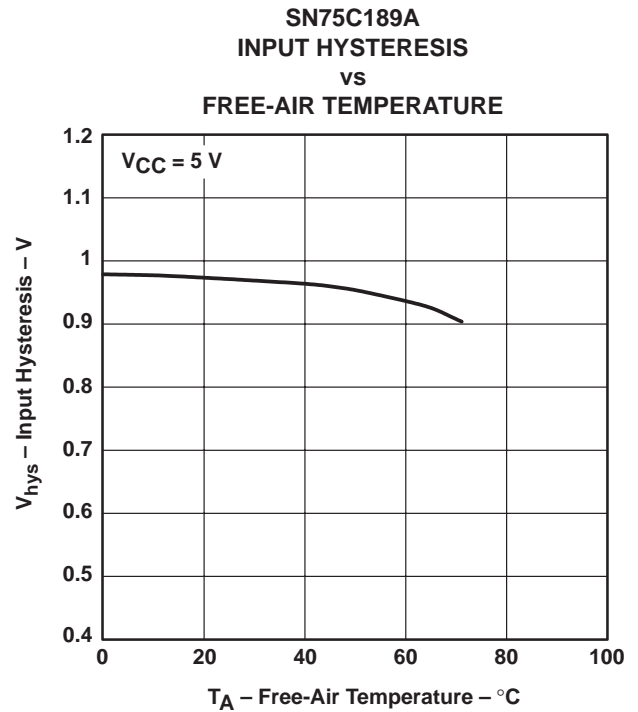
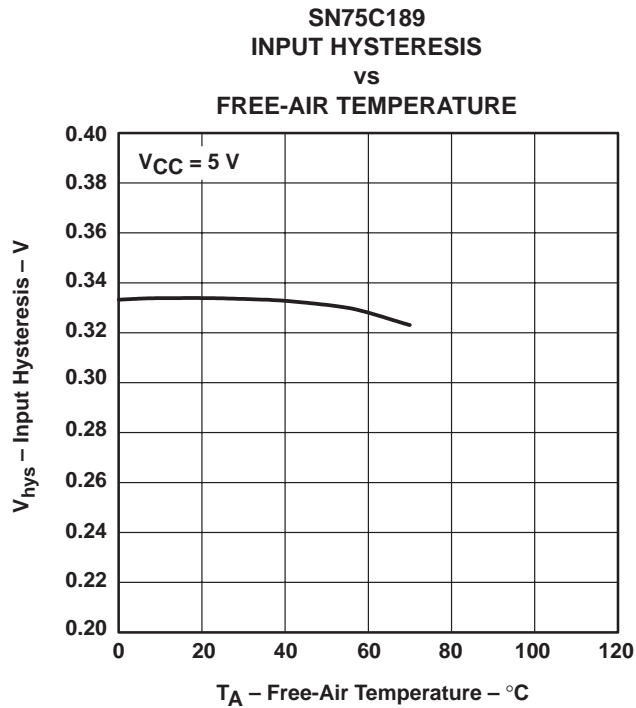


Figure 8



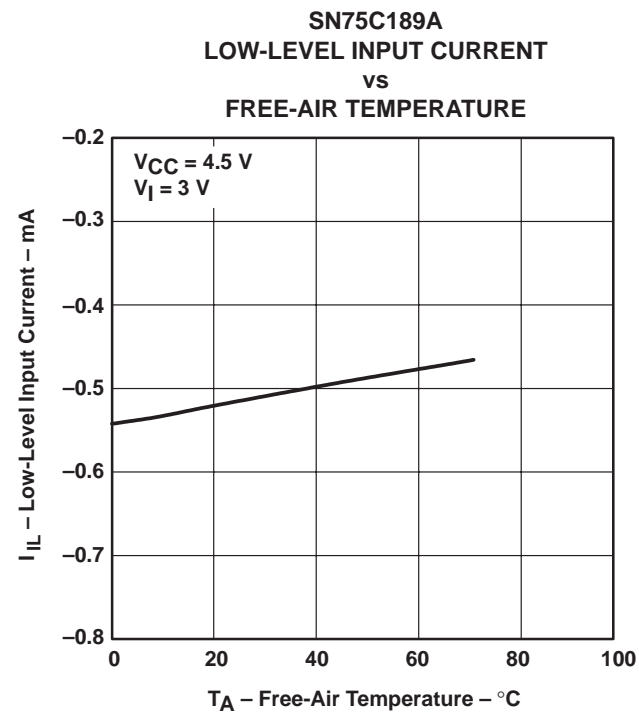
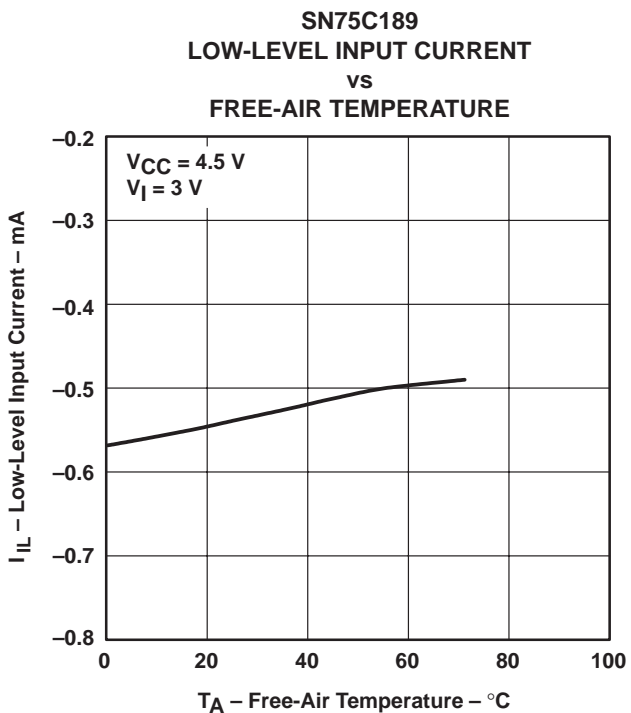
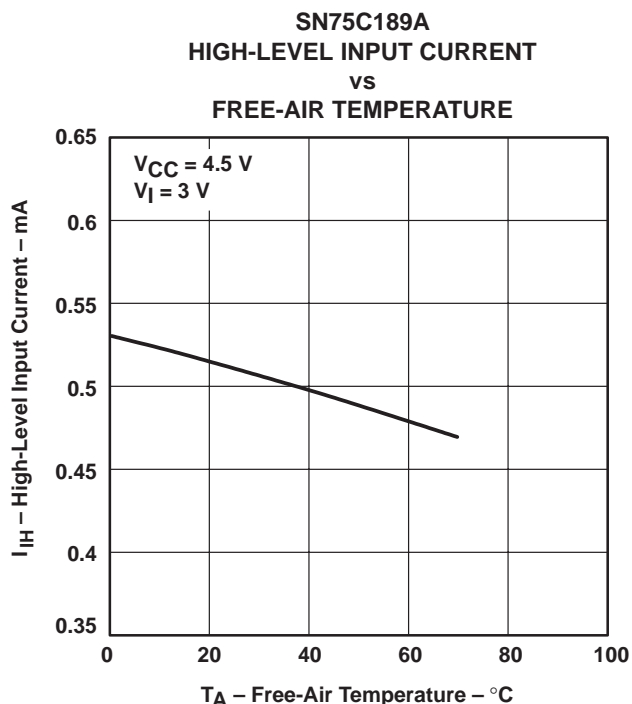
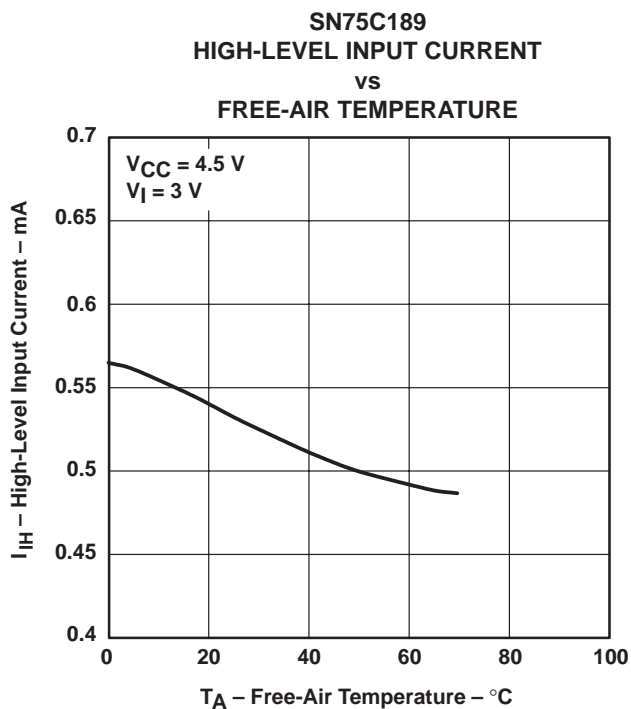
TYPICAL CHARACTERISTICS



SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

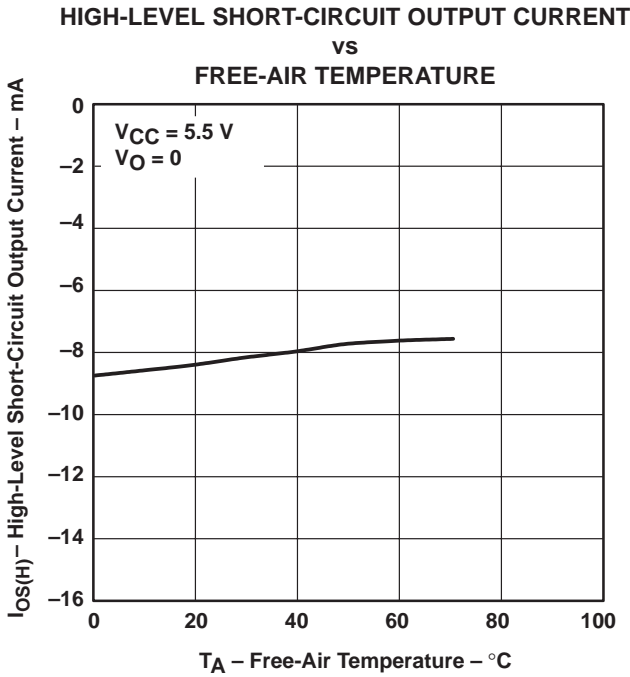


Figure 17

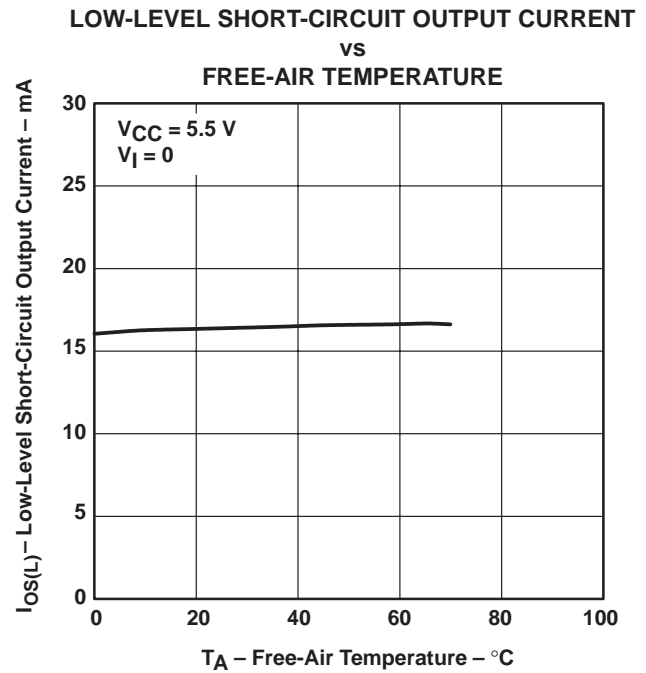


Figure 18

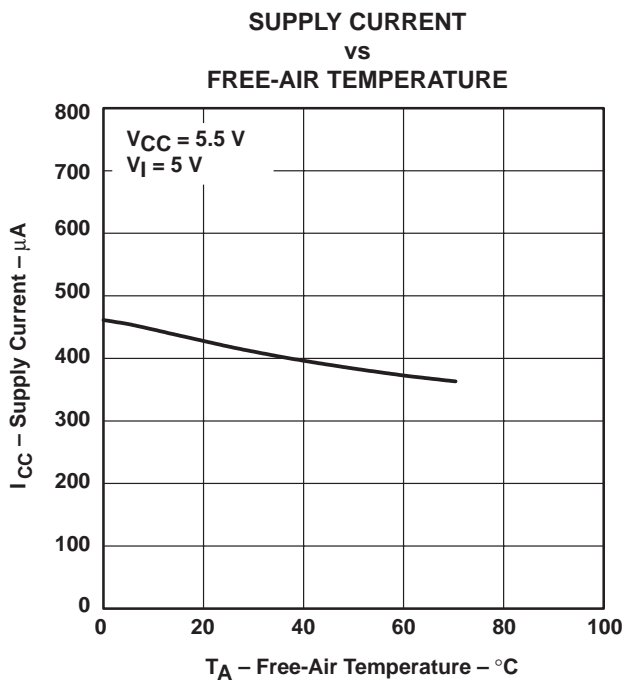


Figure 19

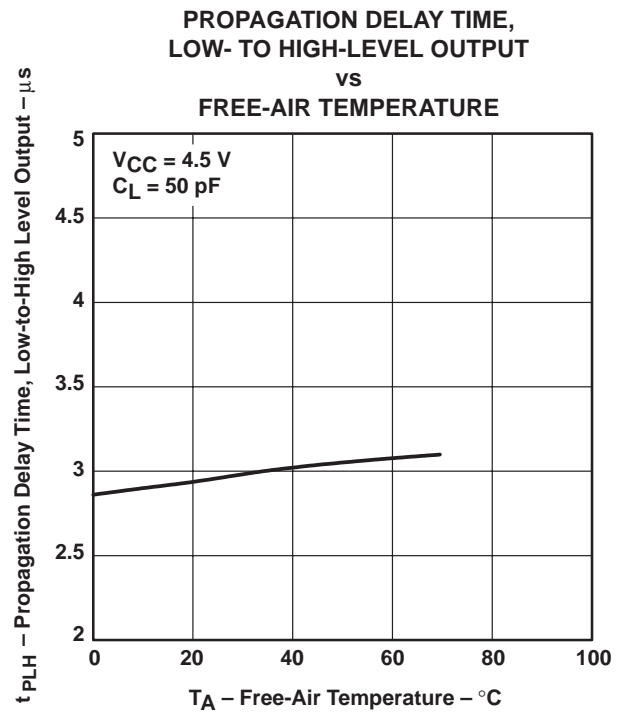


Figure 20

SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

SLLS041G – OCTOBER 1988 – REVISED JANUARY 2000

TYPICAL CHARACTERISTICS

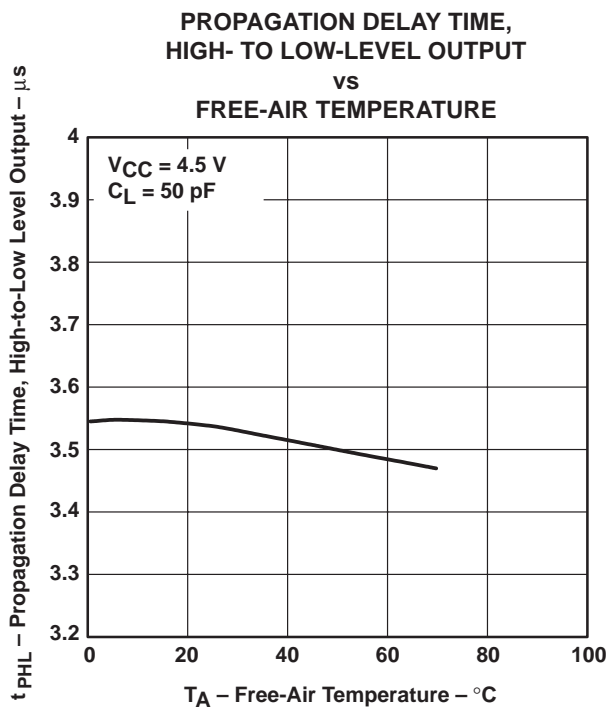


Figure 21

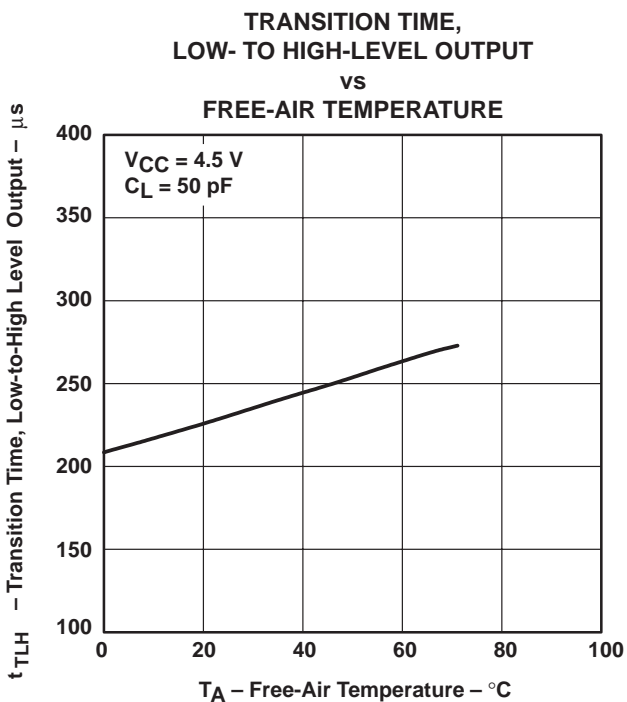


Figure 22

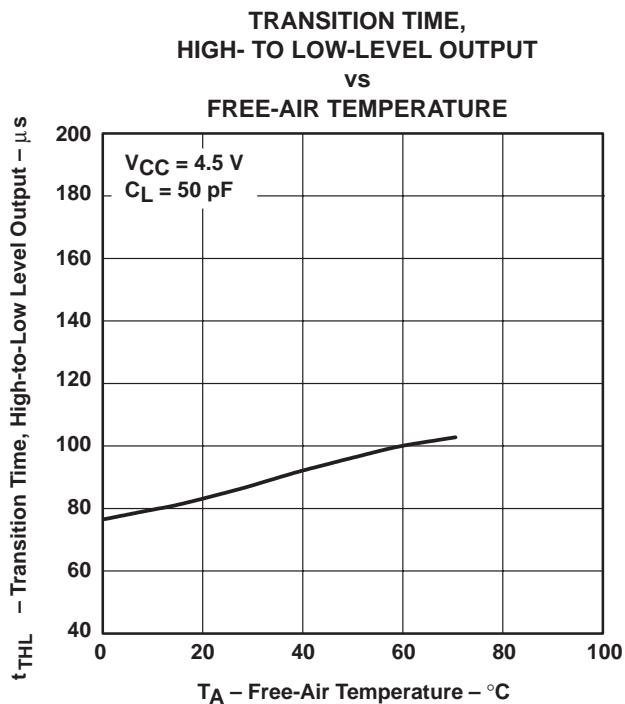


Figure 23



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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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
Low Power Wireless	www.ti.com/lpw	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 © 2007, Texas Instruments Incorporated

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN75C189AD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADBLE	OBSOLETE	SSOP	DB	14		TBD	Call TI	Call TI
SN75C189ADBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADBRG4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ADRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189AN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75C189ANE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75C189ANSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ANSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189ANSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75C189NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75C189NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C189NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN75C189NSRG4	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.

OBSELETE: 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.

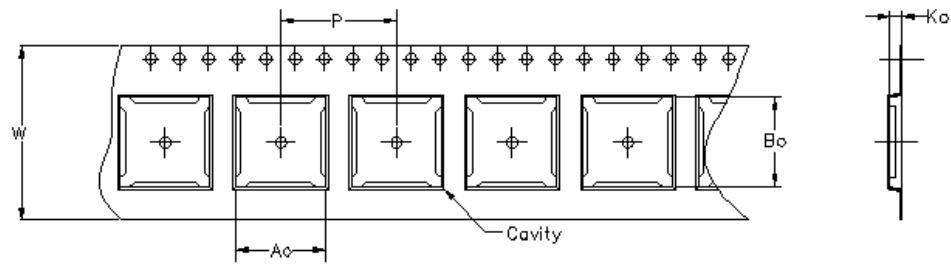
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

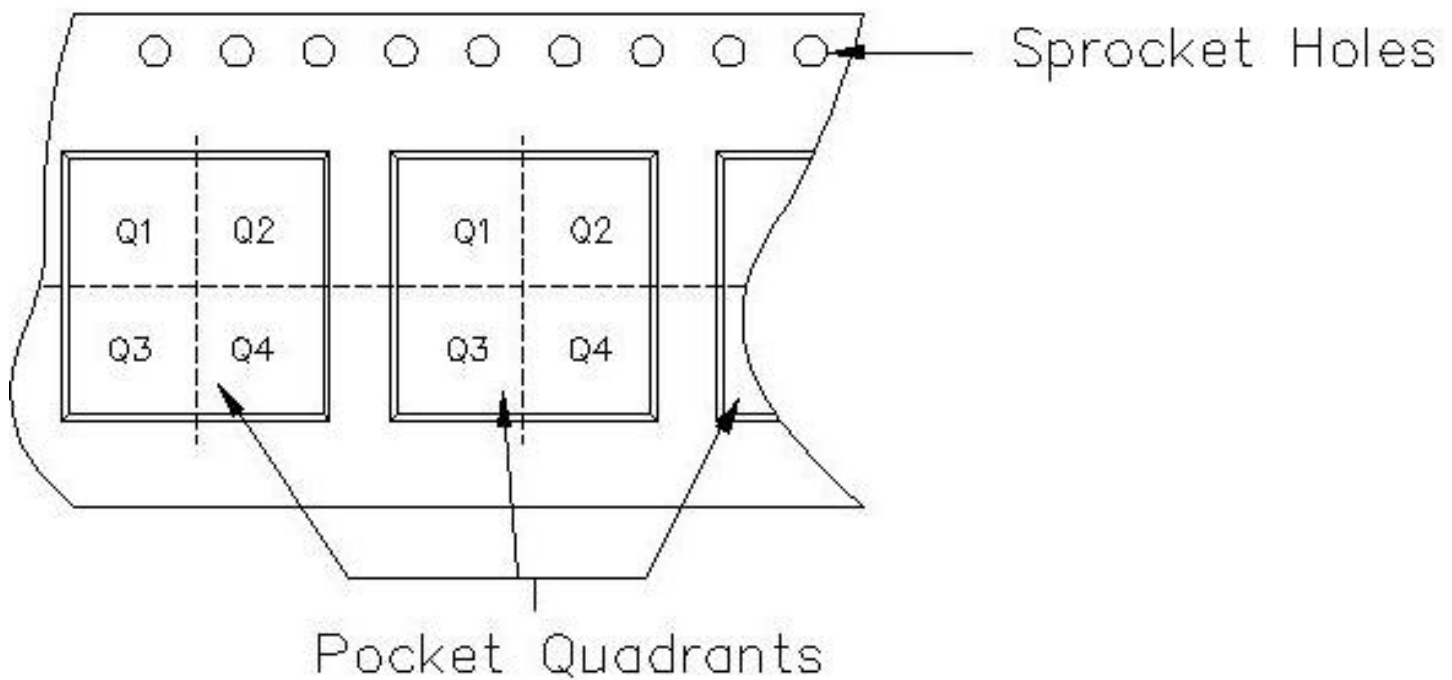
Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.



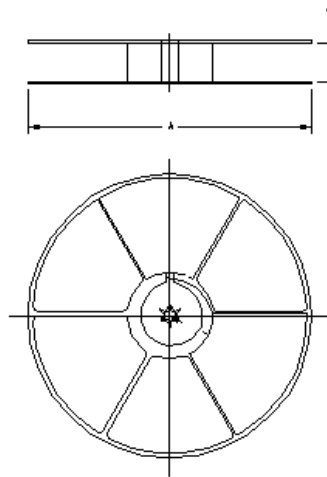
Carrier tape design is defined largely by the component length, width, and thickness.

A_o = Dimension designed to accommodate the component width.
B_o = Dimension designed to accommodate the component length.
K_o = Dimension designed to accommodate the component thickness.
W = Overall width of the carrier tape.
P = Pitch between successive cavity centers.



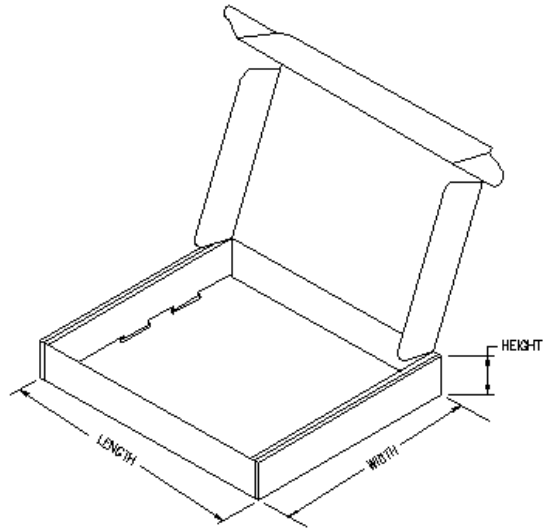
TAPE AND REEL INFORMATION

Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN75C189ADBR	DB	14	MLA	330	16	8.2	6.6	2.5	12	16	Q1
SN75C189ADR	D	14	FMX	330	16	6.5	9.0	2.1	8	16	Q1
SN75C189ADR	D	14	MLA	330	16	6.5	9.0	2.1	8	16	Q1
SN75C189ANSR	NS	14	MLA	330	16	8.2	10.5	2.5	12	16	Q1
SN75C189DR	D	14	MLA	330	16	6.5	9.0	2.1	8	16	Q1
SN75C189NSR	NS	14	MLA	330	16	8.2	10.5	2.5	12	16	Q1



TAPE AND REEL BOX INFORMATION

Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
SN75C189ADBR	DB	14	MLA	346.0	346.0	33.0
SN75C189ADR	D	14	FMX	342.9	336.6	28.58
SN75C189ADR	D	14	MLA	346.0	346.0	33.0
SN75C189ANSR	NS	14	MLA	346.0	346.0	33.0
SN75C189DR	D	14	MLA	346.0	346.0	33.0
SN75C189NSR	NS	14	MLA	346.0	346.0	33.0



N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

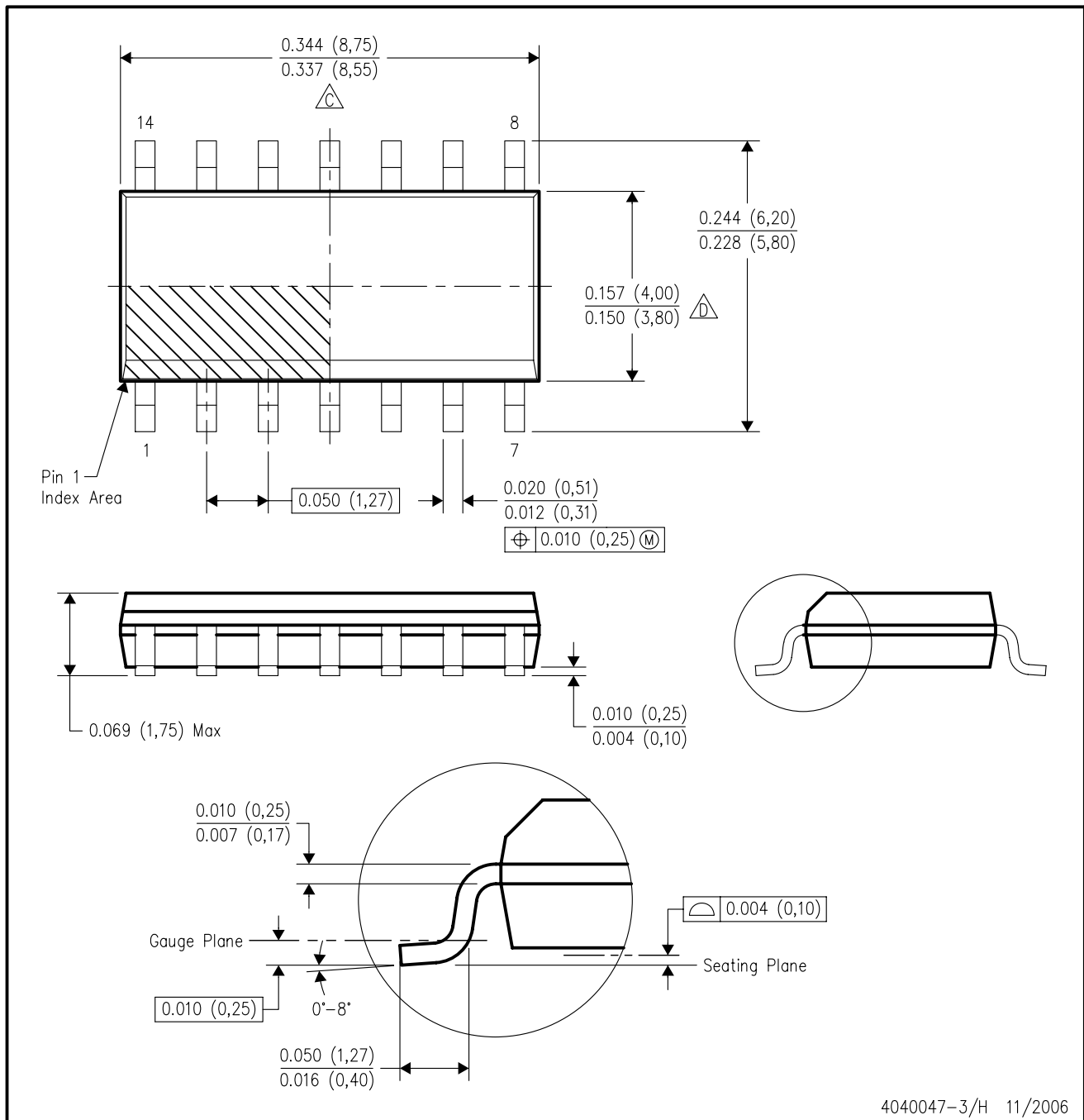
16 PINS SHOWN



- 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/H 11/2006

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ 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.
 - $\triangle D$ 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

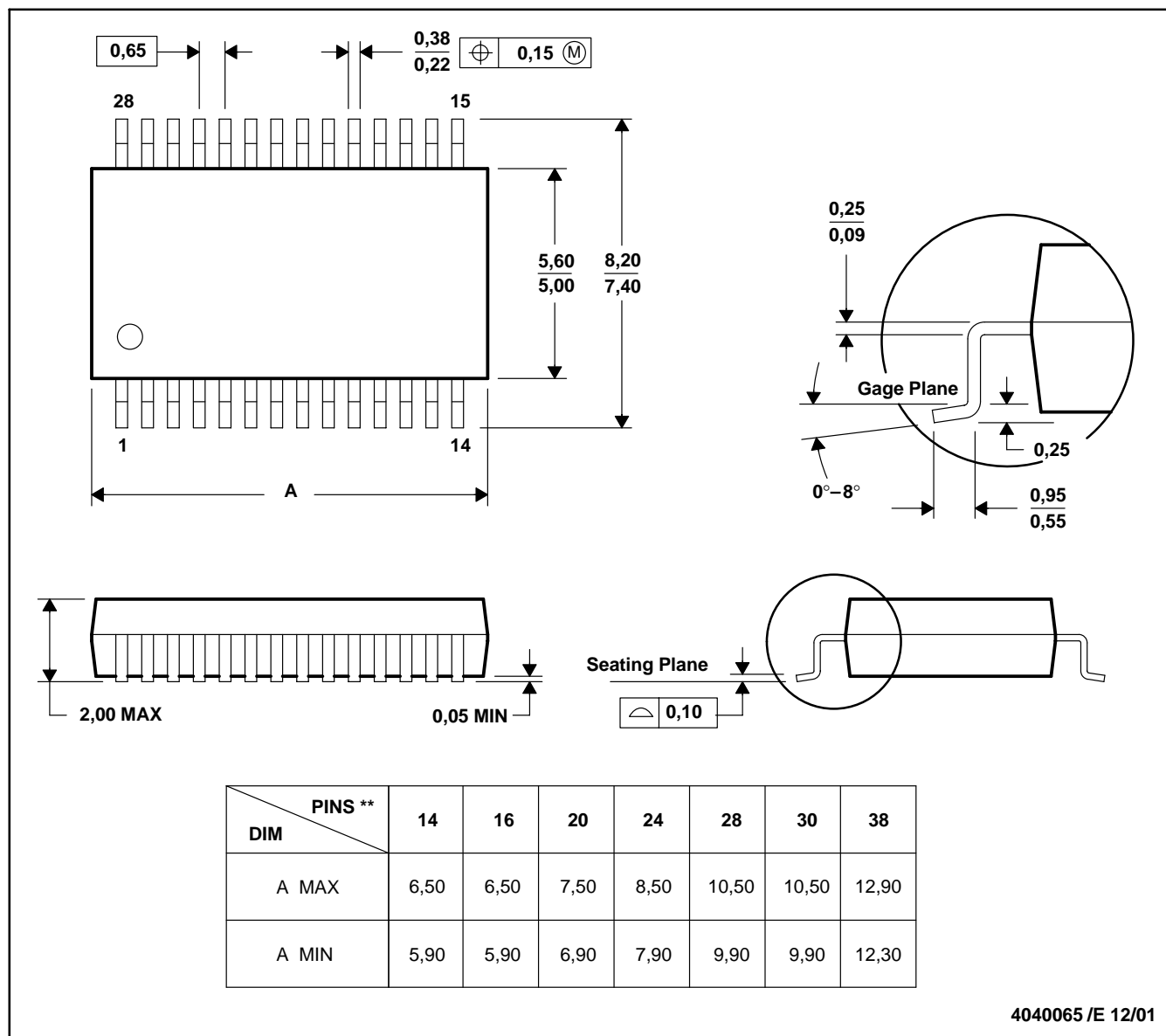


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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

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 TI 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. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated