

# SN65C189, SN65C189A, SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

D3144, OCTOBER 1988—REVISED FEBRUARY 1991

- Meets Standard EIA-232-D (Revision of RS-232-C)
- Low Supply Current . . . 420  $\mu$ A Typ
- Preset On-Chip Input Noise Filter
- Built-in Input Hysteresis
- Response and Threshold Control Inputs
- Push-Pull Outputs
- ESD Protection Exceeds 1000 V Per MIL-STD-883C, Method 3015
- Functionally Interchangeable and Pin Compatible With Texas Instruments SN75189/SN75189A, Motorola MC1489/MC1489A, and National Semiconductor DS14C88A

## description

The SN65C189, SN65C189A, 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 with Standard ANSI/EIA-232-D-1986, which supersedes RS-232-C.

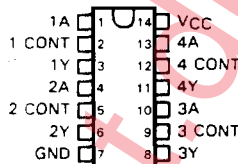
The SN65C189 and SN75C189 have a 0.25 V typical hysteresis compared with 1 V for the SN65C189A and SN75C189A. Each receiver has provision for adjustment of the overall input threshold levels. This is achieved by choosing external series resistors and voltages to provide bias levels for the response control pins. The output is in the high logic state if the input is left open circuited or shorted to ground.

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

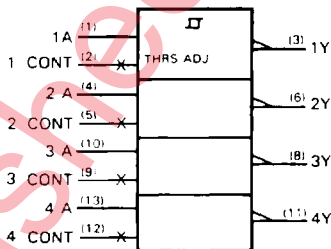
The SN65C189, SN75C189, SN65C189A, and SN75C189A have been designed using low-power techniques in a bipolar technology. In most applications, these receivers will interface to single inputs of peripheral devices such as UARTs, ACEs, or microprocessors. By using sampling, such peripheral devices are usually insensitive to the transition times of the input signals. If this is not the case, or for other uses, it is recommended that the SN65C189, SN75C189, SN65C189A, and SN75C189A outputs be buffered by single Schmitt input gates or single gates of the HCMOS, ALS or 74F logic families.

The SN65C189 and SN65C189A are characterized for operation from -40°C to 85°C. The SN75C189 and SN75C189A are characterized for operation from 0°C to 70°C.

D, DB, OR N PACKAGE  
(TOP VIEW)

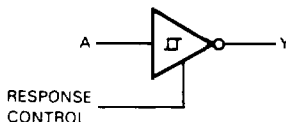


logic symbol†



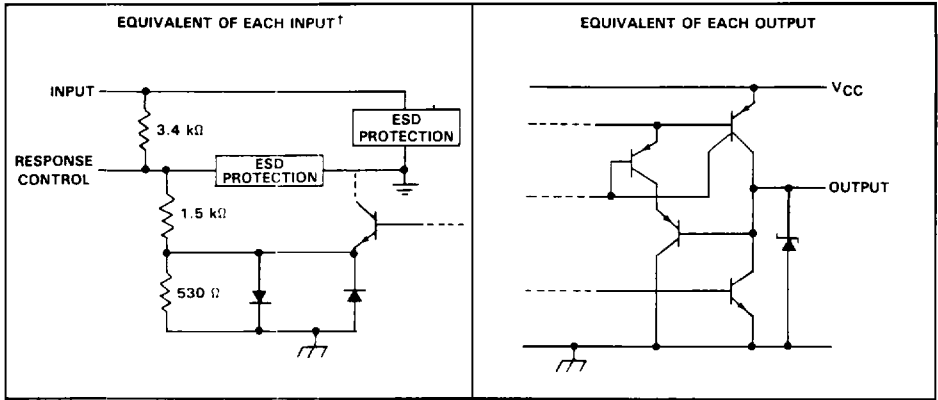
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (each receiver)



# SN65C189, SN65C189A, SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

## 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	-30 V to 30 V
Output voltage range	-0.3 V to $V_{CC} + 0.3$ V
Continuous total dissipation	See Dissipation Rating Table
Operating free-air temperature range: SN65C189, SN65C189A	-40°C to 85°C
SN75C189, SN75C189A	0°C to 70°C
Storage temperature range	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTE 1: All voltages are with respect to the network ground terminal.

DISSIPATION RATING TABLE

PACKAGE	$T_A = 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
D	950 mW	7.6 mW/°C	608 mW	494 mW
DB	525 mW	4.2 mW/°C	336 mW	273 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

## recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, $V_{CC}$		4.5	5	6	V
Input voltage, $V_I$ (see Note 2)		-25		25	V
High-level output current, $I_{OH}$				-3.2	mA
Low-level output current, $I_{OL}$				3.2	mA
Response control current				±1	mA
Operating free-air temperature, $T_A$	SN65C189, SN65C189A	-40		85	°C
	SN75C189, SN75C189A	0		70	

NOTE 2: 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.

## SN65C189, SN65C189A, SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

**electrical characteristics over recommended free-air temperature range,  $V_{CC} = 5\text{ V} \pm 10\%$  (unless otherwise noted) (See Note 3)**

PARAMETERS		TEST CONDITIONS	MIN	TYP <sup>†</sup>	MAX	UNIT
V <sub>T+</sub>	Positive-going threshold level	SN'C189	See Figure 1	1	1.5	V
		SN'C189A		1.6	2.25	
V <sub>T-</sub>	Negative-going threshold level	SN'C189	See Figure 1	0.75	1.25	V
		SN'C189A		0.75	1	
V <sub>hys</sub>	Input hysteresis	SN'C189	See Figure 1	0.15	0.33	V
		SN'C189A		0.65	0.97	
V <sub>OH</sub>	High-level output voltage	V <sub>CC</sub> = 4.5 V to 6 V, V <sub>I</sub> = 0.75 V, I <sub>OH</sub> = -20 μA	See Figure 1	3.5		V
		V <sub>I</sub> = 0.75 V, I <sub>OH</sub> = -3.2 mA		2.5		
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = 4.5 V to 6 V, V <sub>I</sub> = 3 V, I <sub>OL</sub> = 3.2 mA			0.4	V
I <sub>IH</sub>	High-level input current	See Figure 2	V <sub>I</sub> = 25 V	3.6	8.3	mA
			V <sub>I</sub> = 3 V	0.43	1	
I <sub>IL</sub>	Low-level input current	See Figure 2	V <sub>I</sub> = -25 V	-3.6	-8.3	mA
			V <sub>I</sub> = -3 V	-0.43	-1	
I <sub>OS</sub>	Short-circuit output current	See Figure 3			-35	mA
I <sub>CC</sub>	Supply current	V <sub>I</sub> = 5 V, No load, See Figure 2		420	700	μA

<sup>†</sup>All typical values are at T<sub>A</sub> = 25°C.

NOTE 3: All characteristics are measured with response control terminal open.

### switching characteristics at T<sub>A</sub> = 25°C, V<sub>CC</sub> = 5 V ± 10%

PARAMETERS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Propagation delay time, low-to-high-level output R <sub>L</sub> = 5 kΩ, C <sub>L</sub> = 50 pF, See Figure 4			6	μs
t <sub>PHL</sub>	Propagation delay time, high-to-low-level output R <sub>L</sub> = 5 kΩ, C <sub>L</sub> = 50 pF, See Figure 4			6	μs
t <sub>TLH</sub>	Transition time, low-to-high-level output: <sup>‡</sup> R <sub>L</sub> = 5 kΩ, C <sub>L</sub> = 50 pF, See Figure 4			500	ns
t <sub>THL</sub>	Transition time, high-to-low-level output: <sup>‡</sup> R <sub>L</sub> = 5 kΩ, C <sub>L</sub> = 50 pF, See Figure 4			300	ns
t <sub>w(N)</sub>	Duration of longest pulse rejected as noise: <sup>§</sup> R <sub>L</sub> = 5 kΩ, C <sub>L</sub> = 50 pF, See Figure 4	1		6	μs

<sup>‡</sup>Measured between 10% and 90% points of output waveform.

<sup>§</sup>The intent of this specification is that any input pulse of less than 1 μs will have no effect on the output, and any pulse duration of greater than 6 μs will cause the output to change state twice. Reaction to a pulse duration between 1 μs and 6 μs is uncertain.

**SN65C189, SN65C189A, SN75C189, SN75C189A**  
**QUADRUPLE LOW-POWER LINE RECEIVERS**

**PARAMETER MEASUREMENT INFORMATION†**

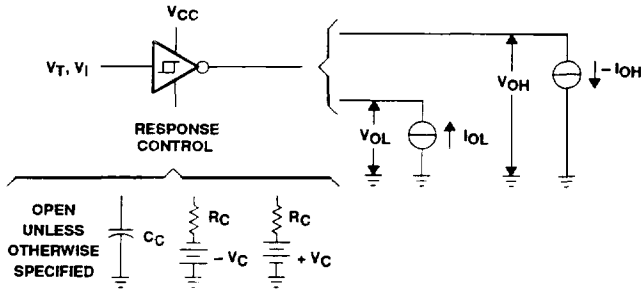
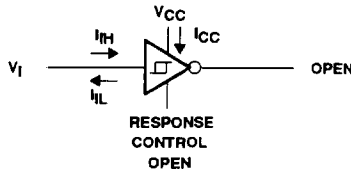


Figure 1.  $V_{T+}$ ,  $V_{T-}$ ,  $V_{OH}$ ,  $V_{OL}$



$I_{CC}$  is tested for all four receivers simultaneously

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

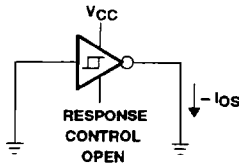
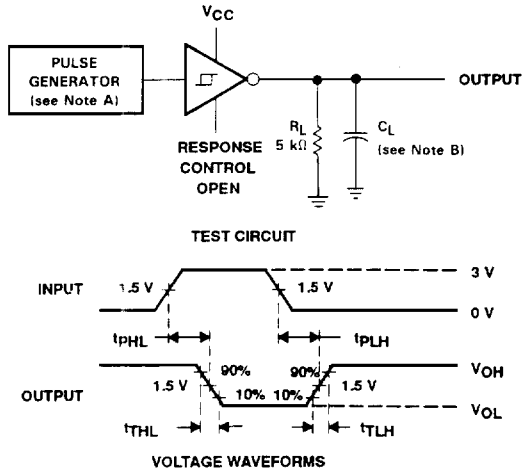


Figure 3.  $I_{OS}$

† Arrows indicate actual direction of current flow. Current into a terminal is a positive value

**SN65C189, SN65C189A, SN75C189, SN75C189A  
QUADRUPLE LOW-POWER LINE RECEIVERS**

**PARAMETER MEASUREMENT INFORMATION**



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

**Figure 4. Switching Times**

**SN65C189, SN65C189A, SN75C189, SN75C189A  
QUADRUPLE LOW-POWER LINE RECEIVERS**

**TYPICAL CHARACTERISTICS**

**SN75C189  
POSITIVE-GOING THRESHOLD VOLTAGE  
vs  
FREE-AIR TEMPERATURE**

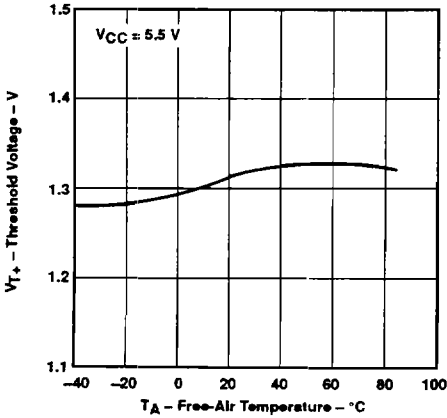


Figure 5

**SN75C189A  
POSITIVE-GOING THRESHOLD VOLTAGE  
vs  
FREE-AIR TEMPERATURE**

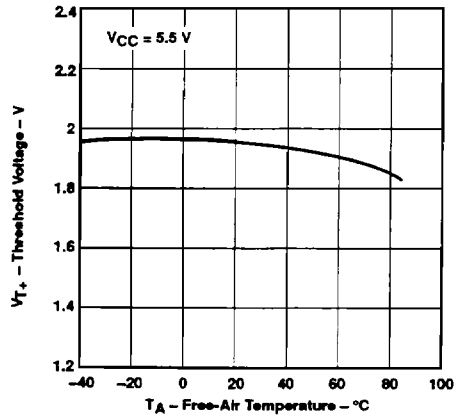


Figure 6

**SN75C189  
NEGATIVE-GOING THRESHOLD VOLTAGE  
vs  
FREE-AIR TEMPERATURE**

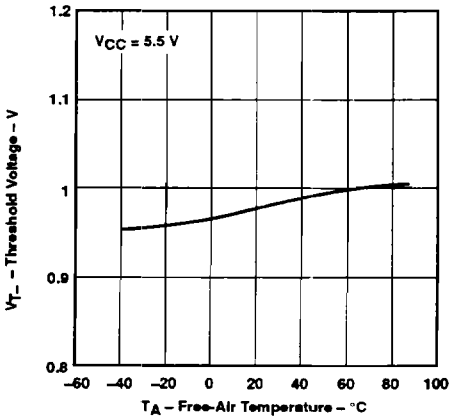


Figure 7

**SN75C189A  
NEGATIVE-GOING THRESHOLD VOLTAGE  
vs  
FREE-AIR TEMPERATURE**

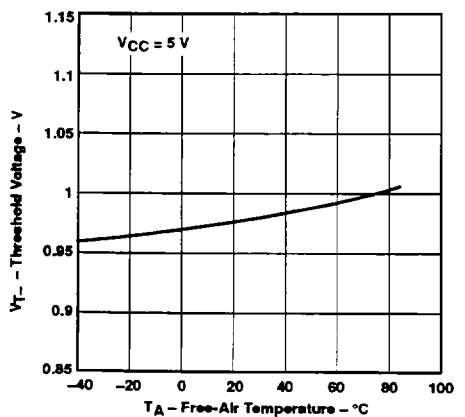


Figure 8

**SN65C189, SN65C189A, SN75C189, SN75C189A  
QUADRUPLE LOW-POWER LINE RECEIVERS**

**TYPICAL CHARACTERISTICS**

**SN75C189  
INPUT HYSTERESIS**

**vs  
FREE-AIR TEMPERATURE**

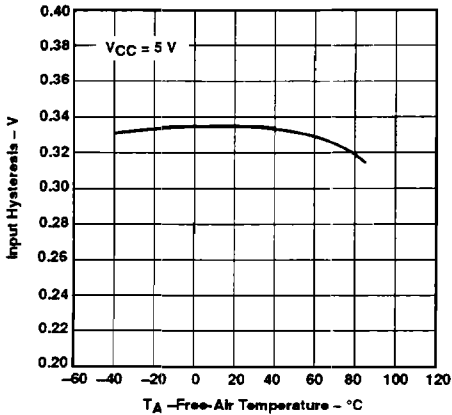


Figure 9

**SN75C189A  
INPUT HYSTERESIS**

**vs  
FREE-AIR TEMPERATURE**

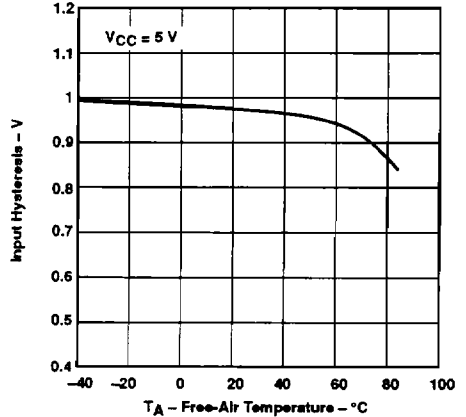


Figure 10

**HIGH-LEVEL OUTPUT VOLTAGE**

**vs  
FREE-AIR TEMPERATURE**

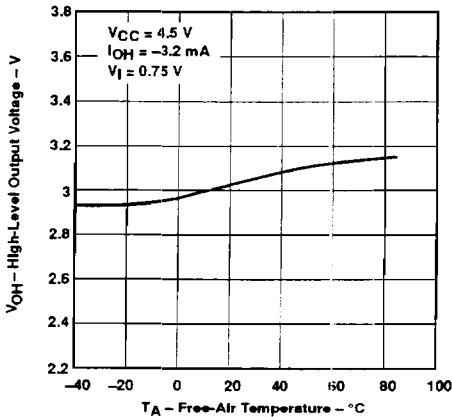


Figure 11

**LOW-LEVEL OUTPUT VOLTAGE**

**vs  
FREE-AIR TEMPERATURE**

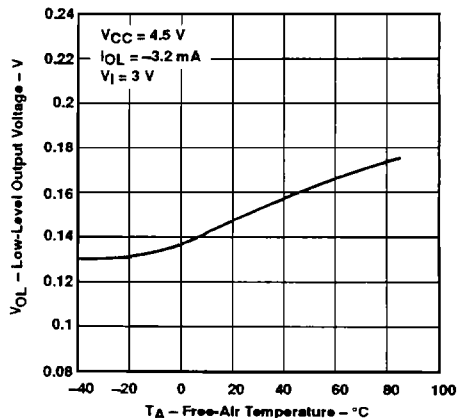


Figure 12

**SN65C189, SN65C189A, SN75C189, SN75C189A**  
**QUADRUPLE LOW-POWER LINE RECEIVERS**

**TYPICAL CHARACTERISTICS**

**SN75C189**  
**HIGH-LEVEL INPUT CURRENT**  
**vs**  
**FREE-AIR TEMPERATURE**

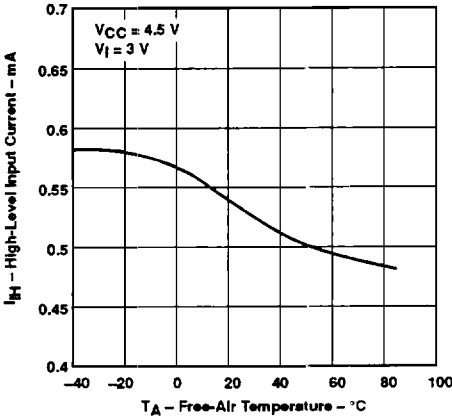


Figure 13

**SN75C189A**  
**HIGH-LEVEL INPUT CURRENT**  
**vs**  
**FREE-AIR TEMPERATURE**

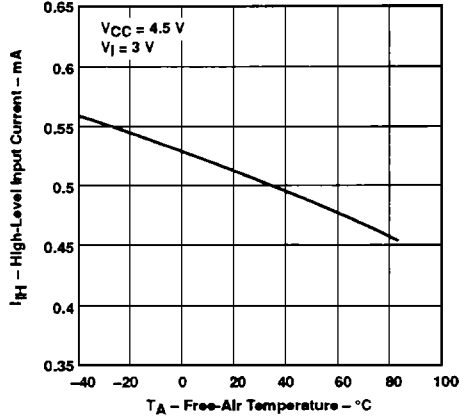


Figure 14

**SN75C189**  
**LOW-LEVEL INPUT CURRENT**  
**vs**  
**FREE-AIR TEMPERATURE**

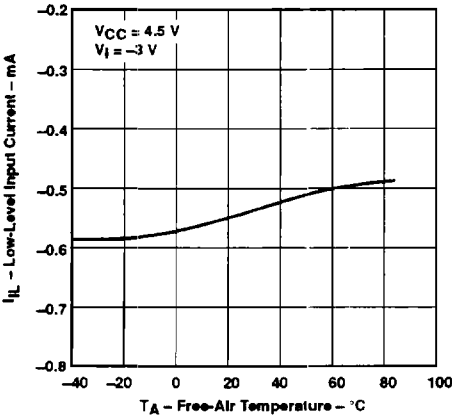


Figure 15

**SN75C189A**  
**LOW-LEVEL INPUT CURRENT**  
**vs**  
**FREE-AIR TEMPERATURE**

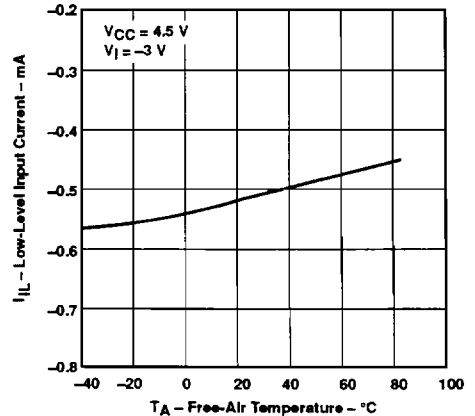


Figure 16





# SN65C189, SN65C189A, SN75C189, SN75C189A QUADRUPLE LOW-POWER LINE RECEIVERS

## TYPICAL CHARACTERISTICS

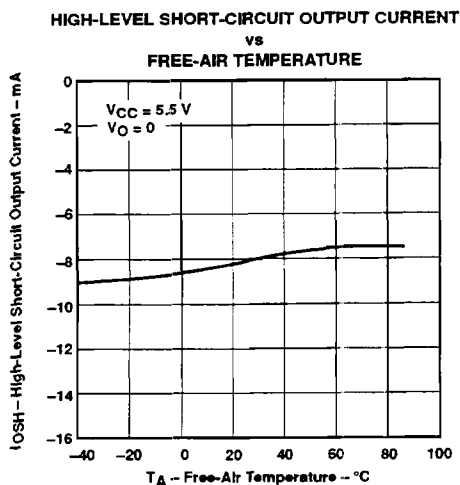


Figure 17

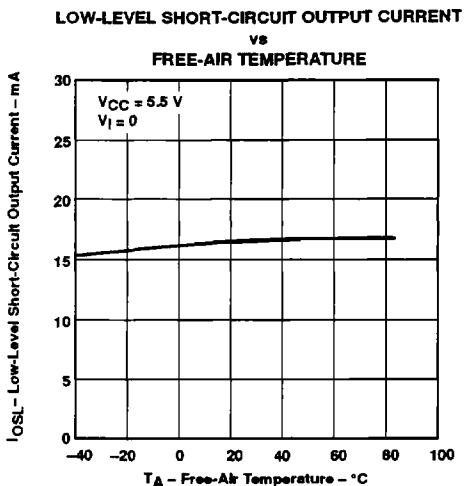


Figure 18

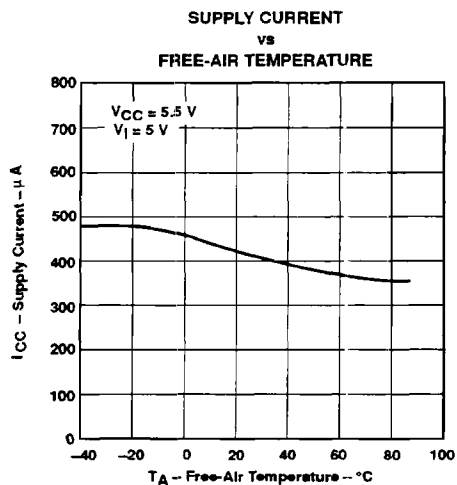


Figure 19

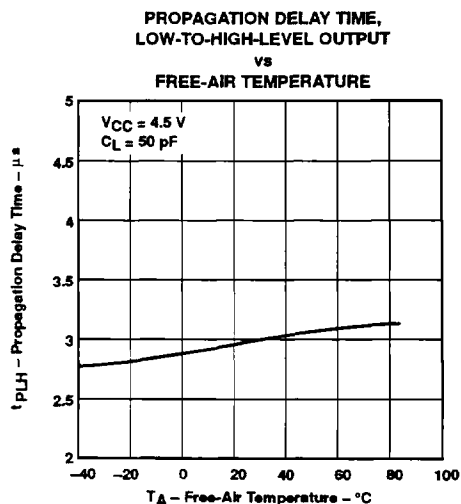


Figure 20

**SN65C189, SN65C189A, SN75C189, SN75C189A**  
**QUADRUPLE LOW-POWER LINE RECEIVERS**

**TYPICAL CHARACTERISTICS**

**PROPAGATION DELAY TIME,  
HIGH-TO-LOW OUTPUT  
vs  
FREE-AIR TEMPERATURE**

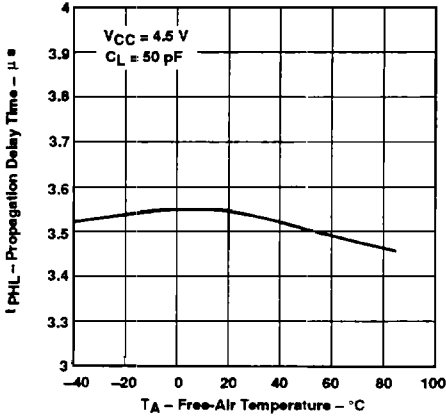


Figure 21

**TRANSITION TIME,  
LOW-TO-HIGH-LEVEL  
vs  
FREE-AIR TEMPERATURE**

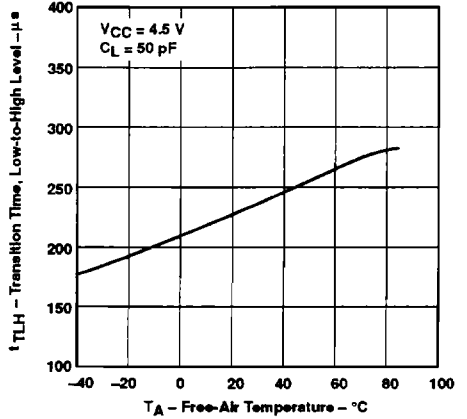


Figure 22

**TRANSITION TIME,  
HIGH-TO-LOW-LEVEL  
vs  
FREE-AIR TEMPERATURE**

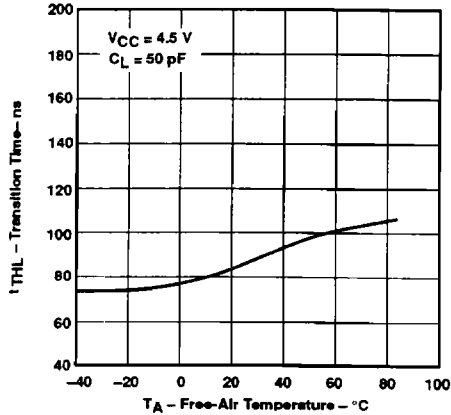


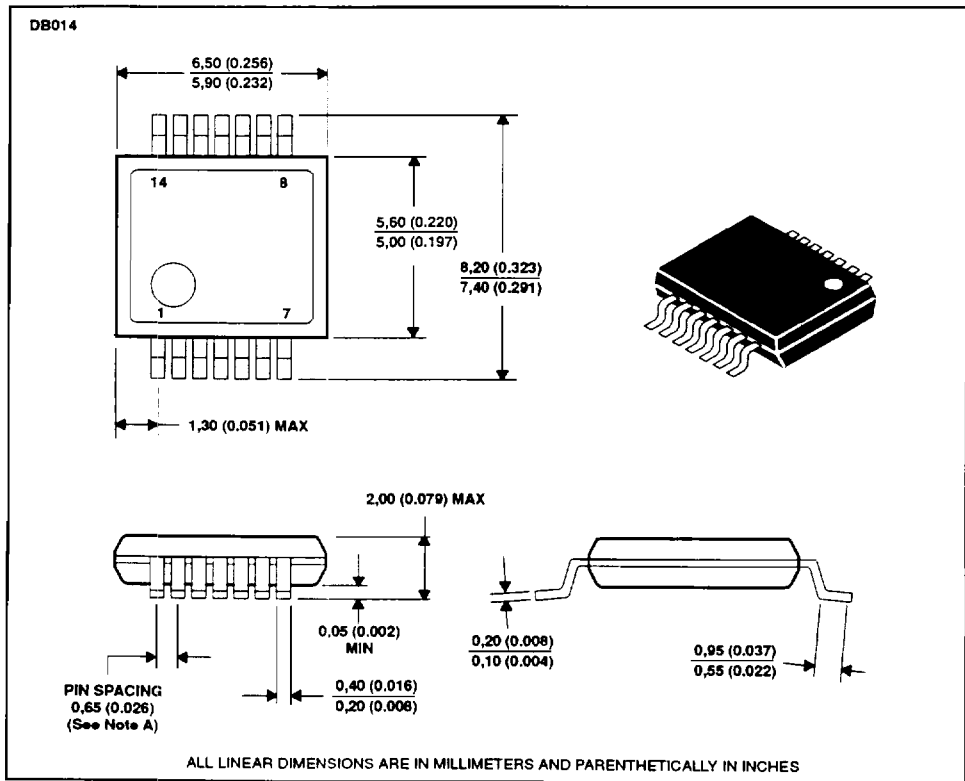
Figure 23

**SN65C189, SN65C189A, SN75C189, SN75C189A  
QUADRUPLE LOW-POWER LINE RECEIVERS**

**MECHANICAL DATA**

**DB014 "shrunk small outline" package**

This "shrunk small outline" package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high-humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



- NOTES:
- A. Leads are within 0,25 (0.010) radius of true position at maximum material condition.
  - B. Body dimensions do not include mold flash or protrusion.
  - C. Mold flash or protrusion shall not exceed 0,15 (0.006).
  - D. Lead tips to be planar within ±0,051 (0.002) exclusive of solder.