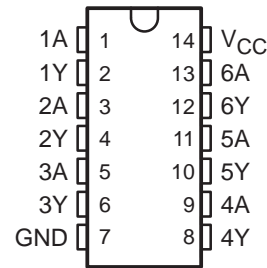


# CD74AC14 HEX SCHMITT-TRIGGER INVERTER

SCHS228B – SEPTEMBER 1998 – REVISED MARCH 2004

- AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage
- Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption
- Greater Noise Immunity Than Standard Inverters
- Operates With Much Slower Than Standard Input Rise and Fall Slew Rates
- Balanced Propagation Delays
- $\pm 24$ -mA Output Drive Current  
– Fanout to 15 F Devices
- SCR Latchup-Resistant CMOS Process and Circuit Design
- Exceeds 2-kV ESD Protection Per MIL-STD-883, Method 3015

E OR M PACKAGE  
(TOP VIEW)



## description/ordering information

The CD74AC14 contains six independent inverters. This device performs the Boolean function  $Y = \bar{A}$ .

Each circuit functions as an independent inverter, but because of the Schmitt action, the inverters have different input threshold levels for positive-going ( $V_{T+}$ ) and negative-going ( $V_{T-}$ ) signals.

## ORDERING INFORMATION

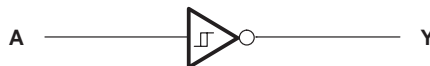
T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	PDIP – E	Tube	CD74AC14E	CD74AC14E
	SOIC – M	Tube	CD74AC14M	AC14M
		Tape and reel	CD74AC14M96	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

FUNCTION TABLE  
(each inverter)

INPUT A	OUTPUT Y
H	L
L	H

## logic diagram, each inverter (positive logic)



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 © 2004, Texas Instruments Incorporated

# CD74AC14

## HEX SCHMITT-TRIGGER INVERTER

SCHS228B – SEPTEMBER 1998 – REVISED MARCH 2004

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

Supply voltage range, $V_{CC}$	-0.5 V to 6 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1)	$\pm 50$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND	$\pm 100$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): E package	80°C/W
M package	86°C/W
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. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The package thermal impedance is calculated in accordance with JESD 51-7.

### recommended operating conditions (see Note 3)

	$T_A = 25^\circ\text{C}$		$-55^\circ\text{C to } 125^\circ\text{C}$		$-40^\circ\text{C to } 85^\circ\text{C}$		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
$V_{CC}$ Supply voltage	1.5	5.5	1.5	5.5	1.5	5.5	V
$V_I$ Input voltage	0	$V_{CC}$	0	$V_{CC}$	0	$V_{CC}$	V
$V_O$ Output voltage	0	$V_{CC}$	0	$V_{CC}$	0	$V_{CC}$	V
$I_{OH}$ High-level output current	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$		-24	-24	-24	-24	mA
$I_{OL}$ Low-level output current	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$		24	24	24	24	mA

NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



# CD74AC14 HEX SCHMITT-TRIGGER INVERTER

SCHS228B – SEPTEMBER 1998 – REVISED MARCH 2004

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C		–55°C to 125°C		–40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
V <sub>T+</sub> Positive-going threshold		5 V	2.6	3.4	2.6	3.4	2.6	3.4	V
V <sub>T–</sub> Negative-going threshold		5 V	1.6	2.4	1.6	2.4	1.6	2.4	V
ΔV <sub>T</sub> Hysteresis (V <sub>T+</sub> – V <sub>T–</sub> )		5 V	0.5		0.5		0.5		V
V <sub>OH</sub>	V <sub>I</sub> = V <sub>T+</sub>	I <sub>OH</sub> = –50 μA	1.5 V	1.4	1.4	1.4			V
			3 V	2.9	2.9	2.9			
			4.5 V	4.4	4.4	4.4			
		I <sub>OH</sub> = –4 mA	3 V	2.58	2.4	2.48			
			4.5 V	3.94	3.7	3.8			
			5.5 V		3.85				
I <sub>OH</sub> = –75 mA <sup>†</sup>	5.5 V			3.85					
V <sub>OL</sub>	V <sub>I</sub> = V <sub>T–</sub>	I <sub>OL</sub> = 50 μA	1.5 V	0.1	0.1	0.1		V	
			3 V	0.1	0.1	0.1			
			4.5 V	0.1	0.1	0.1			
		I <sub>OL</sub> = 12 mA	3 V	0.36	0.5	0.44			
			4.5 V	0.36	0.5	0.44			
			5.5 V		1.65				
I <sub>OL</sub> = 75 mA <sup>†</sup>	5.5 V			1.65					
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V	±0.1		±1		±1		μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V	4		80		40		μA
C <sub>i</sub>			10		10		10		pF

<sup>†</sup> Test one output at a time, not exceeding 1-second duration. Measurement is made by forcing indicated current and measuring voltage to minimize power dissipation. Test verifies a minimum 50-Ω transmission-line drive capability at 85°C and 75-Ω transmission-line drive capability at 125°C.

switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 5 V ± 0.5 V, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C TO 125°C		–40°C TO 85°C		UNIT
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A	Y	2.6	10.5	2.7	9.5	ns
t <sub>PHL</sub>			2.6	10.5	2.7	9.5	

operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

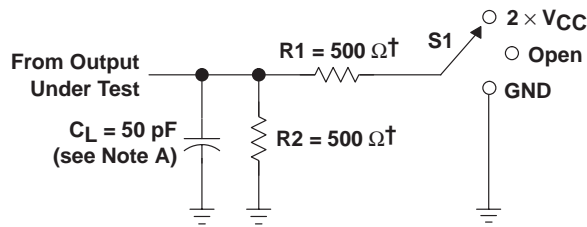
PARAMETER		TYP	UNIT
C <sub>pd</sub>	Power dissipation capacitance	45	pF



# CD74AC14 HEX SCHMITT-TRIGGER INVERTER

SCHS228B – SEPTEMBER 1998 – REVISED MARCH 2004

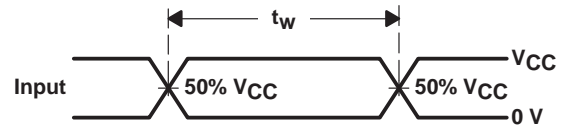
## PARAMETER MEASUREMENT INFORMATION



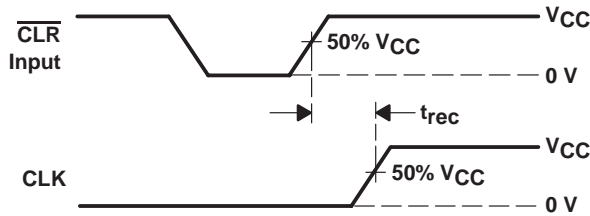
† When  $V_{CC} = 1.5\text{ V}$ ,  $R1 = R2 = 1\text{ k}\Omega$

LOAD CIRCUIT

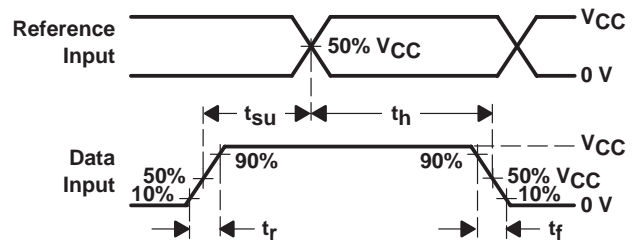
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND



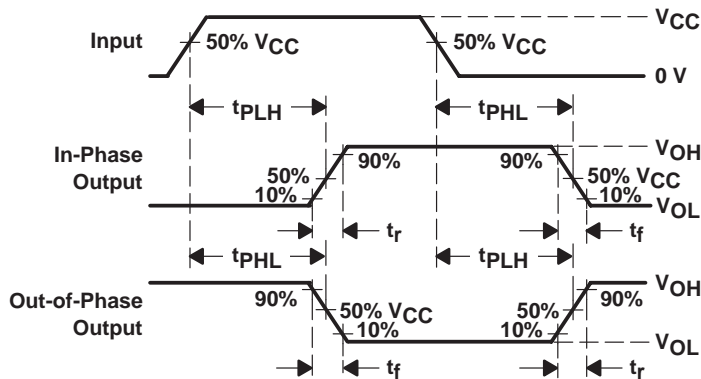
VOLTAGE WAVEFORMS  
PULSE DURATION



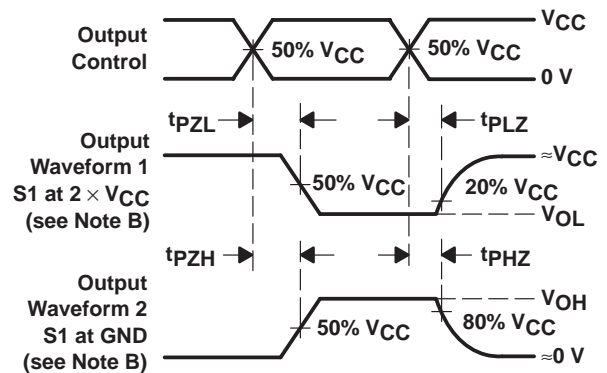
VOLTAGE WAVEFORMS  
RECOVERY TIME



VOLTAGE WAVEFORMS  
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS  
OUTPUT ENABLE AND DISABLE TIMES

- NOTES:
- $C_L$  includes probe and test-fixture capacitance.
  - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 3\text{ ns}$ ,  $t_f = 3\text{ ns}$ . Phase relationships between waveforms are arbitrary.
  - For clock inputs,  $f_{max}$  is measured with the input duty cycle at 50%.
  - The outputs are measured one at a time, with one input transition per measurement.
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
CD74AC14E	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74AC14M	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD74AC14M96	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**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" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

<sup>(3)</sup> 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\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

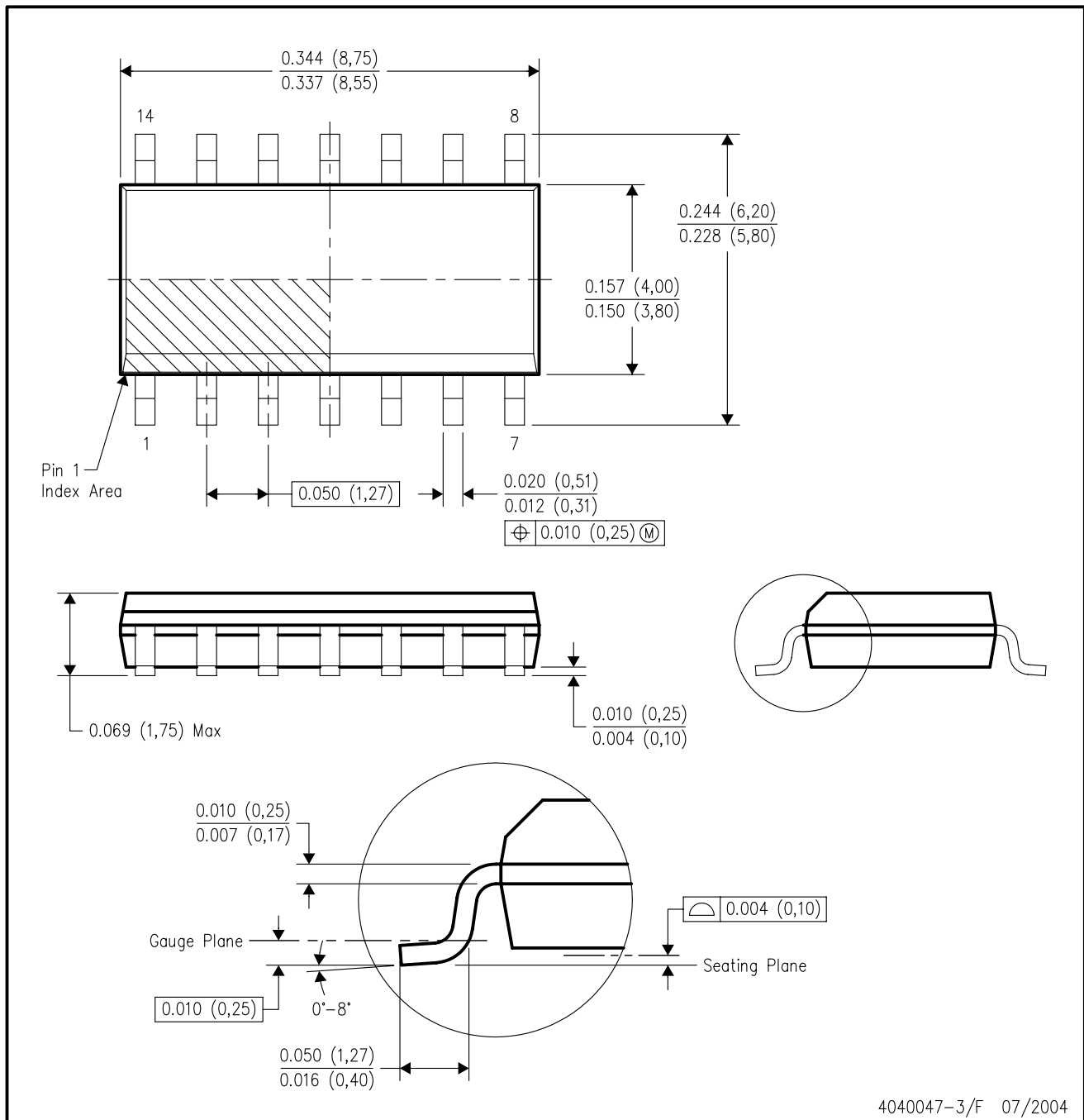
16 PINS SHOWN



- 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



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AB.

## 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:

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

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