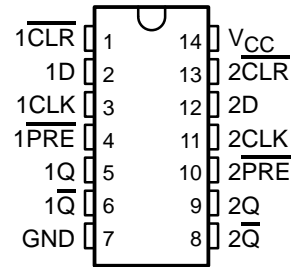


CD54AC74, CD74AC74 DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH CLEAR AND PRESET

SCHS231D – SEPTEMBER 1998 – REVISED DECEMBER 2002

- AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply
- Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption
- Balanced Propagation Delays
- ± 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

CD54AC74 ... F PACKAGE
CD74AC74 ... E OR M PACKAGE
(TOP VIEW)



description/ordering information

The 'AC74 dual positive-edge-triggered devices are D-type flip-flops.

A low level at the preset ($\overline{\text{PRE}}$) or clear ($\overline{\text{CLR}}$) inputs sets or resets the outputs, regardless of the levels of the other inputs. When $\overline{\text{PRE}}$ and $\overline{\text{CLR}}$ are inactive (high), data at the data (D) input meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not related directly to the rise time of the clock pulse. Following the hold-time interval, data at the D input can be changed without affecting the levels at the outputs.

ORDERING INFORMATION

| T _A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------|---------------|-----------------------|------------------|
| –55°C to 125°C | PDIP – E | Tube | CD74AC74E | CD74AC74E |
| | SOIC – M | Tube | CD74AC74M | AC74M |
| | | Tape and reel | CD74AC74M96 | |
| | CDIP – F | Tube | CD54AC74F3A | CD54AC74F3A |

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

FUNCTION TABLE (each flip-flop)

| INPUTS | | | | OUTPUTS | |
|--------|-----|-----|---|----------------|-----------------|
| PRE | CLR | CLK | D | Q | Q̄ |
| L | H | X | X | H | L |
| H | L | X | X | L | H |
| L | L | X | X | H‡ | H‡ |
| H | H | ↑ | H | H | L |
| H | H | ↑ | L | L | H |
| H | H | L | X | Q ₀ | Q̄ ₀ |

‡ This configuration is nonstable; that is, it does not persist when PRE or CLR returns to its inactive (high) level.



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 © 2002, Texas Instruments Incorporated
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

CD54AC74, CD74AC74 DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH CLEAR AND PRESET

SCHS231D – SEPTEMBER 1998 – REVISED DECEMBER 2002

recommended operating conditions (see Note 3)

| | | T _A = 25°C | | –55°C to 125°C | | –40°C to 85°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 _{IH} | High-level input voltage | V _{CC} = 1.5 V | | 1.2 | | 1.2 | | V |
| | | V _{CC} = 3 V | | 2.1 | | 2.1 | | |
| | | V _{CC} = 5.5 V | | 3.85 | | 3.85 | | |
| V _{IL} | Low-level input voltage | V _{CC} = 1.5 V | | 0.3 | | 0.3 | | V |
| | | V _{CC} = 3 V | | 0.9 | | 0.9 | | |
| | | V _{CC} = 5.5 V | | 1.65 | | 1.65 | | |
| 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 V to 5.5 V | | –24 | | –24 | | mA |
| I _{OL} | Low-level output current | V _{CC} = 4.5 V to 5.5 V | | 24 | | 24 | | mA |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 1.5 V to 3 V | | 50 | | 50 | | ns/V |
| | | V _{CC} = 3.6 V to 5.5 V | | 20 | | 20 | | |

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.

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

| PARAMETER | TEST CONDITIONS | V _{CC} | T _A = 25°C | | –55°C to 125°C | | –40°C to 85°C | | UNIT |
|-----------------|---|---------------------------------------|-----------------------|------|----------------|------|---------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = –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 _{OH} = –4 mA | 3 V | 2.58 | 2.4 | 2.48 | | | |
| | | I _{OH} = –24 mA | 4.5 V | 3.94 | 3.7 | 3.8 | | | |
| | | I _{OH} = –50 mA [†] | 5.5 V | | 3.85 | | | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 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 _{OL} = 12 mA | 3 V | 0.36 | 0.5 | 0.44 | | | |
| | | I _{OL} = 24 mA | 4.5 V | 0.36 | 0.5 | 0.44 | | | |
| | | I _{OL} = 50 mA [†] | 5.5 V | | 1.65 | | | | |
| I _I | V _I = V _{CC} or GND | 5.5 V | ±0.1 | ±1 | ±1 | μA | | | |
| I _{CC} | V _I = V _{CC} or GND, I _O = 0 | 5.5 V | 4 | 80 | 40 | μA | | | |
| C _i | | | 10 | 10 | 10 | pF | | | |

[†] 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.



CD54AC74, CD74AC74
DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH CLEAR AND PRESET

SCHS231D – SEPTEMBER 1998 – REVISED DECEMBER 2002

timing requirements over recommended operating free-air temperature range, $V_{CC} = 1.5\text{ V}$ (unless otherwise noted)

| | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|--------------------|--------------------------------------|---|-----|---------------|-----|------|
| | | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | 9 | | 10 | | MHz |
| t_w | Pulse duration | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low | | 50 | 44 | ns |
| | | CLK | | 56 | 49 | |
| t_{su} | Setup time | Data | | 44 | 39 | ns |
| | | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ inactive | | | | ns |
| t_h | Hold time | Data after CLK \uparrow | | 0 | 0 | ns |
| t_{rec} | Recovery time, before CLK \uparrow | CLR \uparrow or PRE \uparrow | | 34 | 30 | ns |

timing requirements over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

| | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|--------------------|--------------------------------------|---|-----|---------------|-----|------|
| | | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | 79 | | 90 | | MHz |
| t_w | Pulse duration | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low | | 5.6 | 4.9 | ns |
| | | CLK | | 6.3 | 5.5 | |
| t_{su} | Setup time | Data | | 4.9 | 4.3 | ns |
| | | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ inactive | | | | ns |
| t_h | Hold time | Data after CLK \uparrow | | 0 | 0 | ns |
| t_{rec} | Recovery time, before CLK \uparrow | CLR \uparrow or PRE \uparrow | | 4.7 | 4.1 | ns |

timing requirements over recommended operating free-air temperature range, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

| | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|--------------------|--------------------------------------|---|-----|---------------|-----|------|
| | | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | 110 | | 125 | | MHz |
| t_w | Pulse duration | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low | | 4 | 3.5 | ns |
| | | CLK | | 4.5 | 3.9 | |
| t_{su} | Setup time | Data | | 3.5 | 3.1 | ns |
| | | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ inactive | | | | ns |
| t_h | Hold time | Data after CLK \uparrow | | 0 | 0 | ns |
| t_{rec} | Recovery time, before CLK \uparrow | CLR \uparrow or PRE \uparrow | | 2.7 | 2.4 | ns |



CD54AC74, CD74AC74
DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH CLEAR AND PRESET

SCHS231D – SEPTEMBER 1998 – REVISED DECEMBER 2002

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 1.5\text{ V}$, $C_L = 50\text{ pF}$ (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 | |
| f_{max} | | | 9 | | 10 | | MHz |
| t_{PLH} | CLK | Q or \bar{Q} | | 125 | | 114 | ns |
| t_{PHL} | | | | 125 | | 114 | |
| t_{PLH} | \overline{PRE} or \overline{CLR} | Q or \bar{Q} | | 132 | | 120 | ns |
| t_{PHL} | | | | 144 | | 131 | |

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (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 | |
| f_{max} | | | 79 | | 90 | | MHz |
| t_{PLH} | CLK | Q or \bar{Q} | 3.5 | 14 | 3.6 | 12.7 | ns |
| t_{PHL} | | | 3.5 | 14 | 3.6 | 12.7 | |
| t_{PLH} | \overline{PRE} or \overline{CLR} | Q or \bar{Q} | 3.7 | 14.7 | 3.8 | 13.4 | ns |
| t_{PHL} | | | 4 | 16.1 | 4.1 | 14.6 | |

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (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 | |
| f_{max} | | | 110 | | 125 | | MHz |
| t_{PLH} | CLK | Q or \bar{Q} | 2.5 | 10 | 2.6 | 9.1 | ns |
| t_{PHL} | | | 2.5 | 10 | 2.6 | 9.1 | |
| t_{PLH} | \overline{PRE} or \overline{CLR} | Q or \bar{Q} | 2.6 | 10.5 | 2.7 | 9.5 | ns |
| t_{PHL} | | | 2.9 | 11.5 | 3 | 10.4 | |

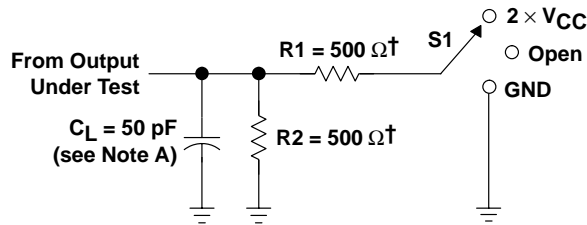
operating characteristics, $T_A = 25^\circ\text{C}$

| PARAMETER | | TYP | UNIT |
|-----------|-------------------------------|-----|------|
| C_{pd} | Power dissipation capacitance | 55 | pF |

CD54AC74, CD74AC74 DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH CLEAR AND PRESET

SCHS231D – SEPTEMBER 1998 – REVISED DECEMBER 2002

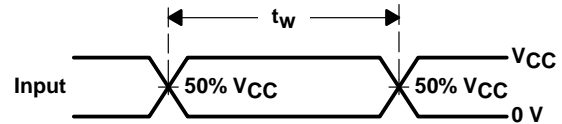
PARAMETER MEASUREMENT INFORMATION



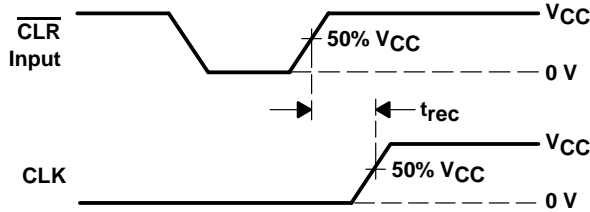
† When $V_{CC} = 1.5\text{ V}$, $R1 = R2 = 1\text{ k}\Omega$

LOAD CIRCUIT

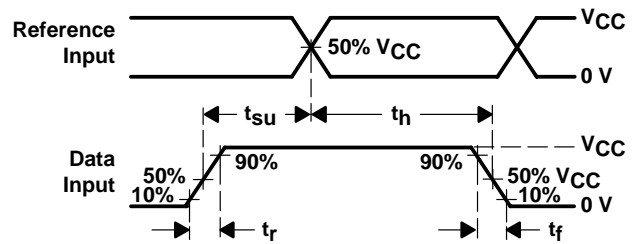
| TEST | S1 |
|-------------------|-------------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



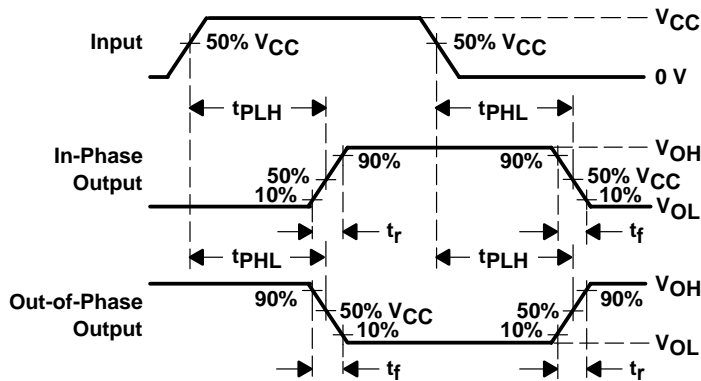
VOLTAGE WAVEFORMS
PULSE DURATION



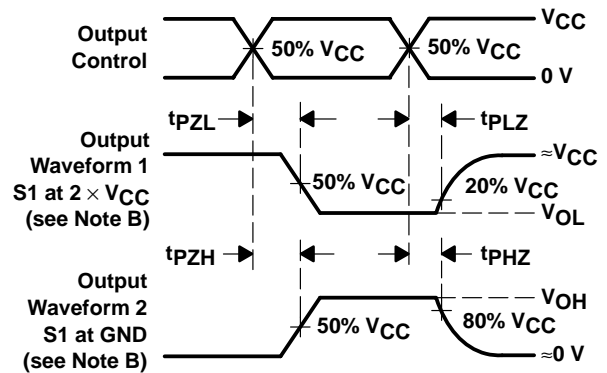
VOLTAGE WAVEFORMS
RECOVERY TIME



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:
- A. C_L includes probe and test-fixture capacitance.
 - B. 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.
 - C. 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.
 - D. For clock inputs, f_{max} is measured with the input duty cycle at 50%.
 - E. The outputs are measured one at a time with one input transition per measurement.
 - F. t_{PLH} and t_{PHL} are the same as t_{pd} .
 - G. t_{PZL} and t_{PZH} are the same as t_{en} .
 - H. t_{PLZ} and t_{PHZ} are the same as t_{dis} .

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| CD54AC74F3A | ACTIVE | CDIP | J | 14 | 1 | None | Call TI | Level-NC-NC-NC |
| CD74AC74E | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| CD74AC74M | ACTIVE | SOIC | D | 14 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| CD74AC74M96 | ACTIVE | SOIC | D | 14 | 2500 | 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 - 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.

⁽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.

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

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.

4040049/E 12/2002

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:

| 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