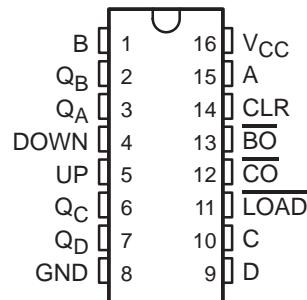


SN74F193A  
SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER  
WITH DUAL CLOCK AND CLEAR

SDFS031A – D3693, JANUARY 1991 – REVISED OCTOBER 1993

- High-Speed  $f_{max}$  of 100 MHz Typical
- Parallel Asynchronous Load for Modulo-N Count Lengths
- Look-Ahead Circuitry Enhances Speed of Cascaded Counters
- Fully Synchronous in Count Modes
- Package Options Include Plastic Small-Outline Packages and Standard Plastic 300-mil DIPs

D OR N PACKAGE  
(TOP VIEW)



### description

The SN74F193A is a synchronous, 4-bit binary up/down counter. Synchronous counting operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple-clock) counters.

The outputs of the four flip-flops are triggered on a low-to-high-level transition of either count/clock (UP or DOWN) input. The direction of the count is determined by which count input is pulsed while the other count input is high.

All four counters are fully programmable; that is, each output may be preset to either level by placing a low on the  $\overline{LOAD}$  input and entering the desired data at the data (D) inputs. The output will change to agree with the data inputs independently of the count pulses. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

A high level applied to the clear (CLR) input forces all outputs to the low level. The clear function is independent of the count and load inputs.

These counters were designed to be cascaded without the need for external circuitry. The borrow ( $\overline{BO}$ ) output produces a low-level pulse while the count is zero (all Q outputs low) and the DOWN input is low. Similarly, the carry ( $\overline{CO}$ ) output produces a low-level pulse while the count is 15 (all Q outputs high) and the UP input is low. The counters can then be easily cascaded by feeding the borrow and carry outputs to the count-down and count-up inputs, respectively, of the succeeding counter.

The SN74F193A is characterized for operation from 0°C to 70°C.

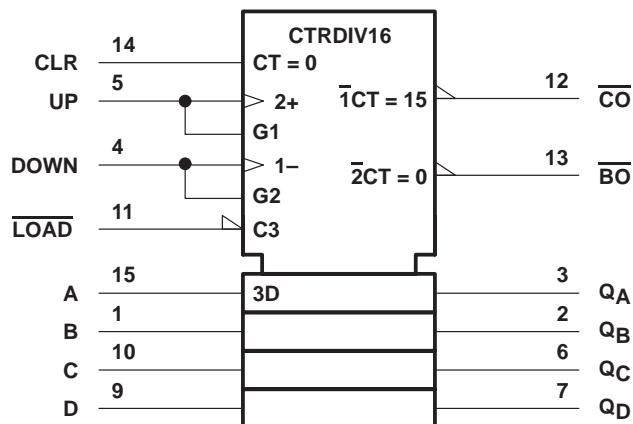
# SN74F193A

## SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER

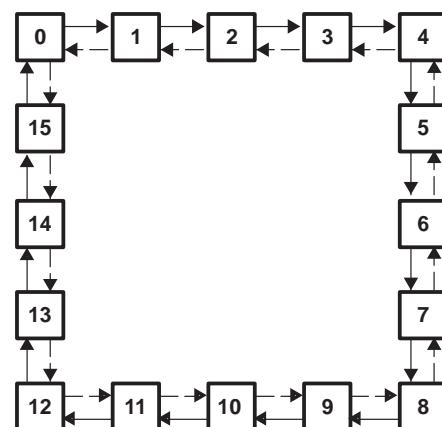
### WITH DUAL CLOCK AND CLEAR

SDF5031A – D3693, JANUARY 1991 – REVISED OCTOBER 1993

#### logic symbol†



#### state diagram



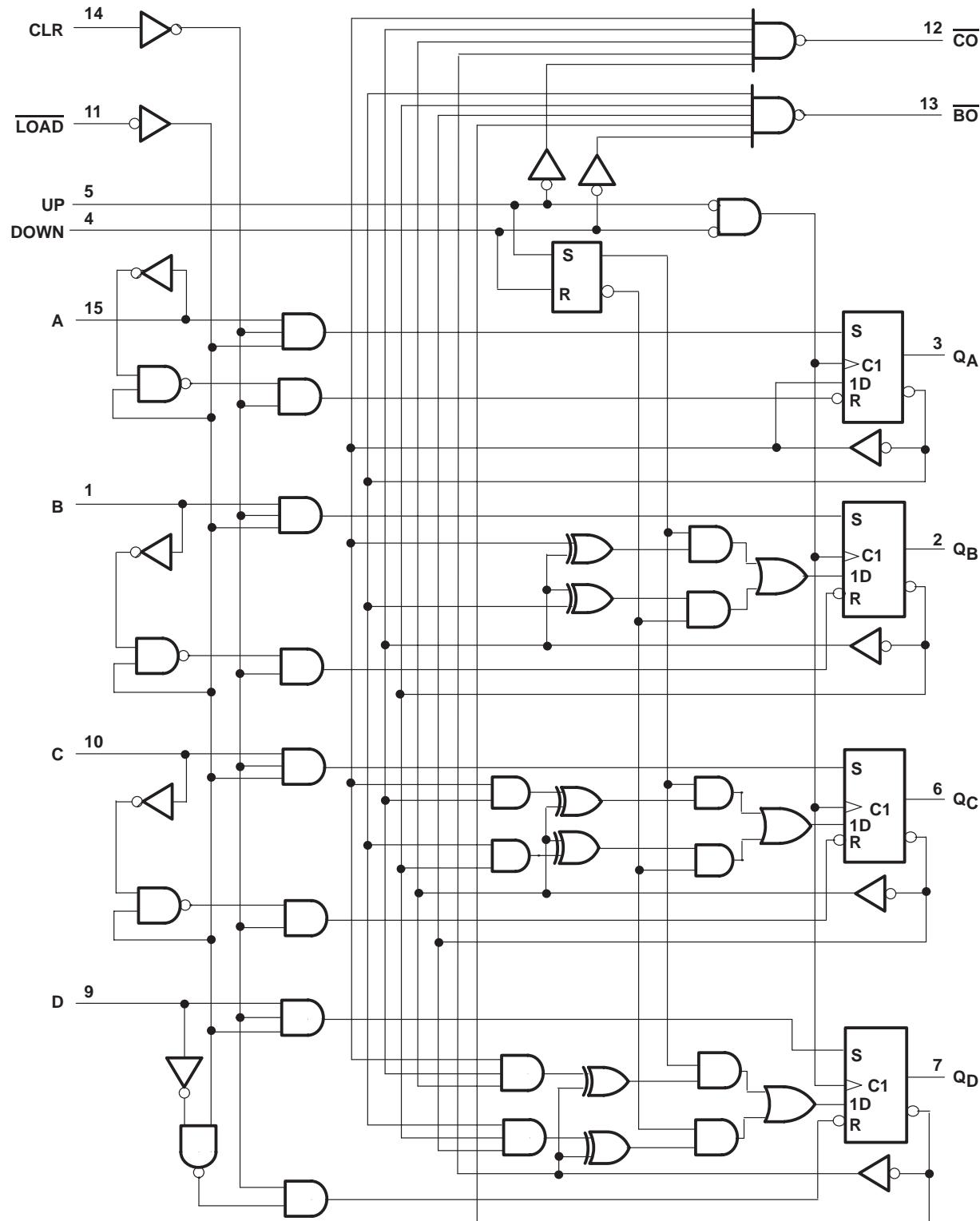
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Count up →  
Count down ←

SN74F193A  
SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER  
WITH DUAL CLOCK AND CLEAR

SDFS031A – D3693, JANUARY 1991 – REVISED OCTOBER 1993

logic diagram (positive logic)



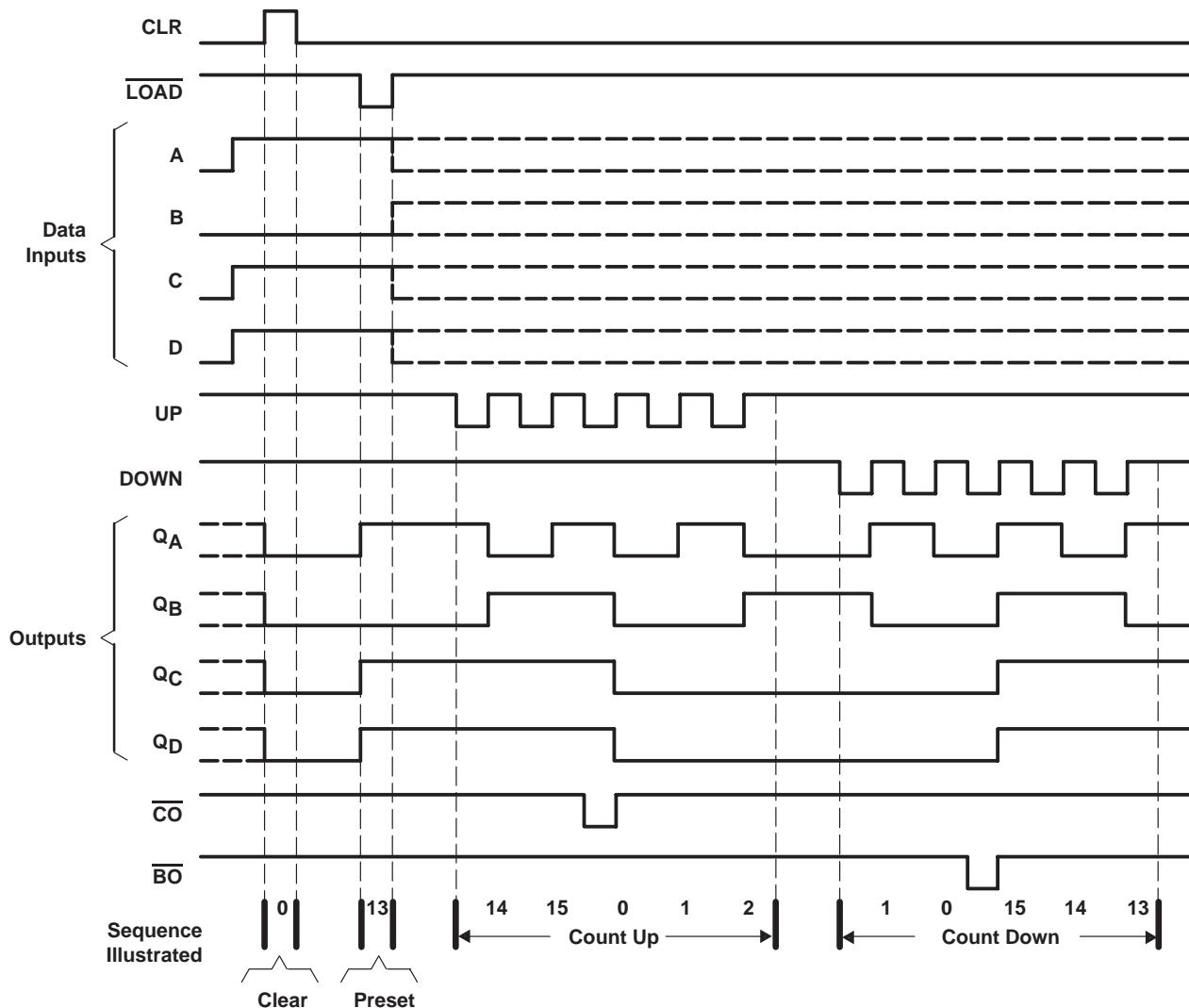
**SN74F193A**  
**SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER**  
**WITH DUAL CLOCK AND CLEAR**

SDF5031A – D3693, JANUARY 1991 – REVISED OCTOBER 1993

**typical clear, load, and count sequence**

Illustrated below is the following sequence:

1. Clear outputs to zero
2. Load (preset) to binary thirteen
3. Count up to fourteen, fifteen (carry), zero, one, and two
4. Count down to one, zero (borrow), fifteen, fourteen, and thirteen



SN74F193A  
SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER  
WITH DUAL CLOCK AND CLEAR

SDFS031A – D3693, JANUARY 1991 – REVISED OCTOBER 1993

**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>**

Supply voltage range, $V_{CC}$ .....	– 0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	– 1.2 V to 7 V
Input current range .....	– 30 mA to 5 mA
Voltage applied to any output in the high state .....	– 0.5 V to $V_{CC}$
Current into any output in the low state .....	40 mA
Operating free-air temperature range .....	0 °C to 70 °C
Storage temperature range .....	– 55°C to 150°C

<sup>†</sup> 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: The input-voltage ratings may be exceeded if the input-current ratings are observed.

**recommended operating conditions**

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	4.5	5	5.5	V
$V_{IH}$	High-level input voltage	2			V
$V_{IL}$	Low-level input voltage			0.8	V
$I_{IK}$	Input clamp current			18	mA
$I_{OH}$	High-level output current			– 1	mA
$I_{OL}$	Low-level output current			20	mA
$T_A$	Operating free-air temperature	0		70	°C

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

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>‡</sup>	MAX	UNIT
$V_{IK}$	$V_{CC} = 4.5$ V, $I_I = – 18$ mA			– 1.2	V
$V_{OH}$	$V_{CC} = 4.5$ V, $I_{OH} = – 1$ mA	2.5	3.4		V
	$V_{CC} = 4.75$ V, $I_{OH} = – 1$ mA to 3 mA	2.7			
$V_{OL}$	$V_{CC} = 4.5$ V, $I_{OL} = 20$ mA	0.3	0.5		V
$I_I$	$V_{CC} = 5.5$ V, $V_I = 7$ V			0.1	mA
$I_{IH}$	$V_{CC} = 5.5$ V, $V_I = 2.7$ V			20	μA
$I_{IL}$	$V_{CC} = 5.5$ V, $V_I = 0.5$ V	UP		– 1.8	mA
			Others	– 0.6	
$I_{OS}^§$	$V_{CC} = 5.5$ V, $V_O = 0$	– 60		– 150	mA
$I_{CC}$	$V_{CC} = 5.5$ V, Outputs open		34	54	mA

<sup>†</sup> All typical values are at  $V_{CC} = 5$  V,  $T_A = 25$  °C.

<sup>‡</sup> Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

**SN74F193A****SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTER****WITH DUAL CLOCK AND CLEAR**

SDFSO31A – D3693, JANUARY 1991 – REVISED OCTOBER 1993

**timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)**

		$V_{CC} = 5 \text{ V}$ , $T_A = 25^\circ\text{C}$		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ , $T_A = \text{MIN to MAX}^\dagger$		UNIT
		MIN	MAX	MIN	MAX	
$f_{clock}$	Clock frequency	0	85	0	85	MHz
$t_W$	Pulse duration	CLR high	4	4		ns
		LOAD low	5.5	5.5		
		UP or DOWN high	4	4		
		UP or DOWN low	6	6		
$t_{SU}$	Setup time	Data before LOAD inactive	3.5	3.5		ns
		CLR inactive before UP↑ or DOWN↑	5	5		
		LOAD inactive before UP↑ or DOWN↑	7.5	7.5		
$t_h$	Hold time	Data after LOAD inactive	2.5	2.5		ns

**switching characteristics (see Note 2)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5 \text{ V}$ , $C_L = 50 \text{ pF}$ , $R_L = 500 \Omega$ , $T_A = 25^\circ\text{C}$			UNIT	
			MIN	TYP	MAX		
$f_{max}$			85	100		85	MHz
$t_{PLH}$	UP or DOWN	$\overline{CO}$ or $\overline{BO}$	2.5	8.5	2.5	9	ns
			3	8	3	9	
$t_{PHL}$	UP or DOWN	Any Q	2.5	8.5	2.5	9	ns
			5	12	5	13	
$t_{PLH}$	A, B, C, or D	Any Q	2	7	1.5	8	ns
			6	13.5	5	15	
$t_{PLH}$	LOAD	Any Q	4.5	10	4	11	ns
			5.5	12	5	13	
$t_{PHL}$	CLR	Any Q	5	11	5	12	ns
			6	12	5.5	13	
$t_{PHL}$	CLR	$\overline{BO}$	5	11	5	12	ns
$t_{PLH}$	LOAD	$\overline{CO}$ or $\overline{BO}$	6	13.5	6	15	ns
			6	12.6	6	13.8	
$t_{PLH}$	A, B, C, or D	$\overline{CO}$ or $\overline{BO}$	5.5	13	5	14	ns
			4.5	12.5	4.5	13.5	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

NOTE 2: Load circuits and waveforms are shown in Section 1.

**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>
SN74F193AD	OBsolete	SOIC	D	16		TBD	Call TI	Call TI
SN74F193ADR	OBsolete	SOIC	D	16		TBD	Call TI	Call TI
SN74F193AN	OBsolete	PDIP	N	16		TBD	Call TI	Call TI

<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 - 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

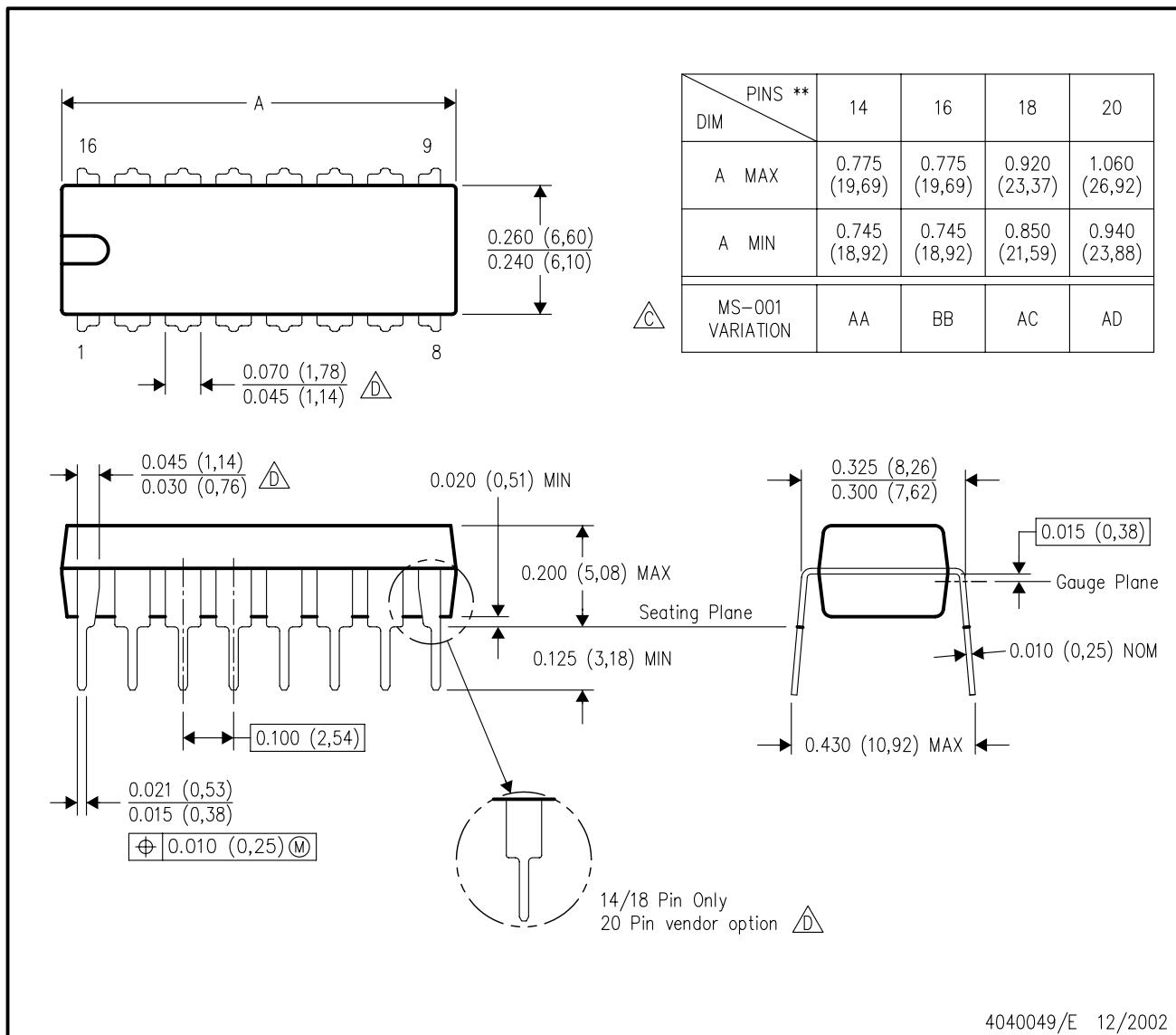
**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information.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

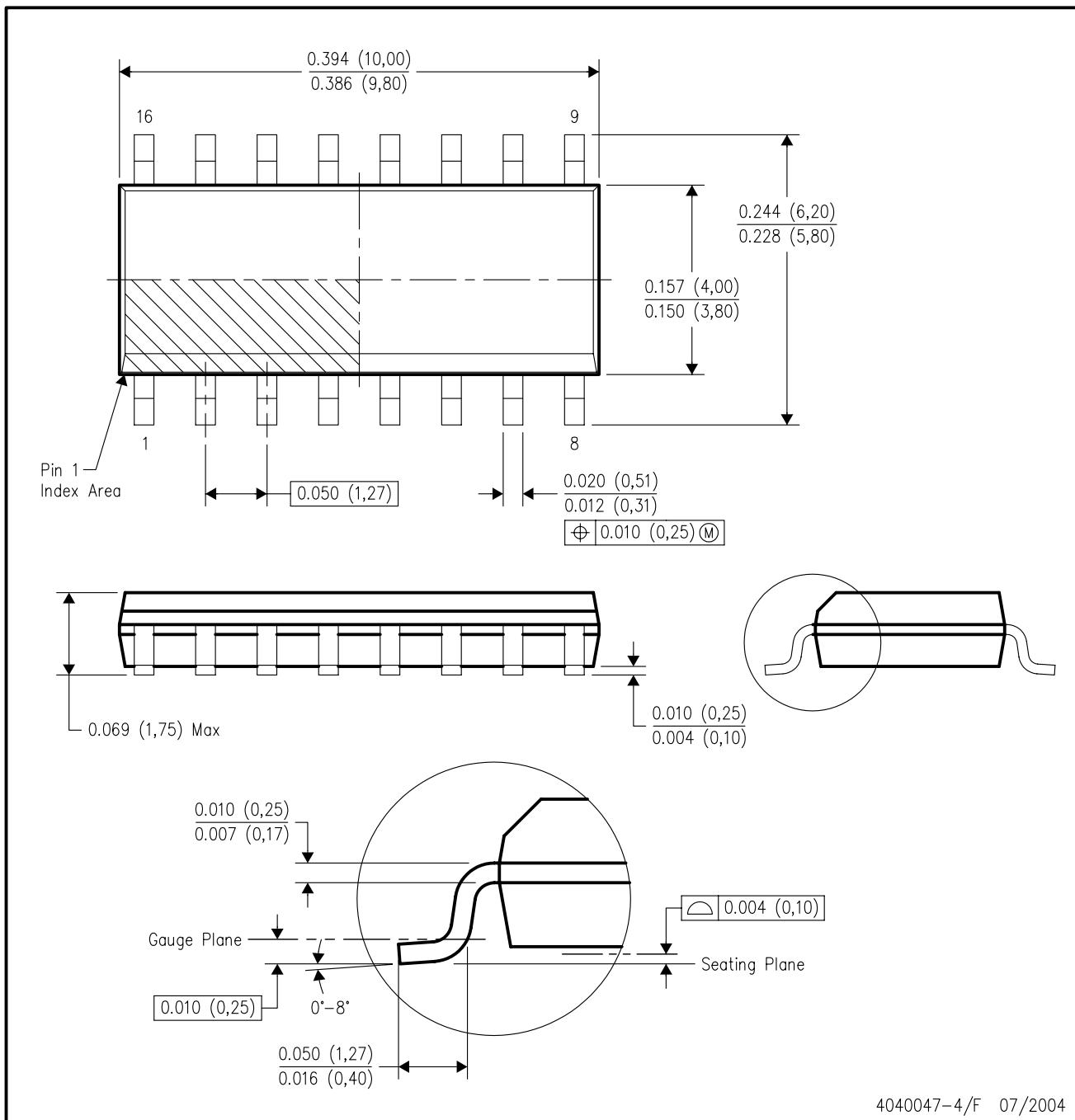
16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



## D (R-PDSO-G16)

## PLASTIC SMALL-OUTLINE PACKAGE



4040047-4/F 07/2004

NOTES:

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

## 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	amplifier.ti.com	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	dataconverter.ti.com	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	dsp.ti.com	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	interface.ti.com	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	logic.ti.com	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	power.ti.com	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	microcontroller.ti.com	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

Copyright © 2005, Texas Instruments Incorporated