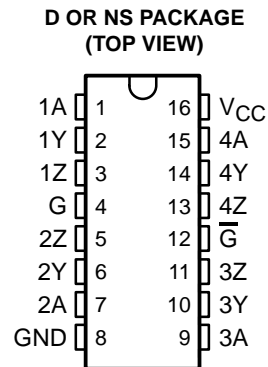


# AM26LV31C, AM26LV31I LOW-VOLTAGE HIGH-SPEED QUADRUPLE DIFFERENTIAL LINE DRIVERS

SLLS201F – MAY 1995 – REVISED APRIL 2002

- Switching Rates up to 32 MHz
- Operate From a Single 3.3-V Supply
- Propagation Delay Time . . . 8 ns Typ
- Pulse Skew Time . . . 500 ps Typ
- High Output-Drive Current . . .  $\pm 30$  mA
- Controlled Rise and Fall Times . . . 3 ns Typ
- Differential Output Voltage With 100- $\Omega$  Load . . . 1.5 V Typ
- Ultra-Low Power Dissipation
  - dc, 0.3 mW Max
  - 32 MHz All Channels (No Load), 385 mW Typ
- Accept 5-V Logic Inputs With a 3.3-V Supply
- Low-Voltage Pin-to-Pin Compatible Replacement for AM26C31, AM26LS31, MB571
- High Output Impedance in Power-Off Condition
- Driver Output Short-Protection Circuit
- Package Options Include Plastic Small-Outline (D, NS) Packages



## description

The AM26LV31C and AM26LV31I are BiCMOS quadruple differential line drivers with 3-state outputs. They are designed to be similar to TIA/EIA-422-B and ITU Recommendation V.11 drivers with reduced supply-voltage range.

The devices are optimized for balanced-bus transmission at switching rates up to 32 MHz. The outputs have very high current capability for driving balanced lines such as twisted-pair transmission lines and provide a high impedance in the power-off condition. The enable function is common to all four drivers and offers the choice of active-high or active-low enable inputs. The AM26LV31C and AM26LV31I are designed using Texas Instruments proprietary LinIMPACT-C60™ technology, facilitating ultra-low power consumption without sacrificing speed. These devices offer optimum performance when used with the AM26LV32 quadruple line receivers.

The AM26LV31C is characterized for operation from 0°C to 70°C. The AM26LV31I is characterized for operation from –45°C to 85°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.

LinIMPACT-C60 is a trademark of Texas Instruments.

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

# AM26LV31C, AM26LV31I LOW-VOLTAGE HIGH-SPEED QUADRUPLE DIFFERENTIAL LINE DRIVERS

SLLS201F – MAY 1995 – REVISED APRIL 2002

## AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGES
	SMALL OUTLINE (D, NS)
0°C to 70°C	AM26LV31CD
	AM26LV31CNSR
-45°C to 85°C	AM26LV31INSR

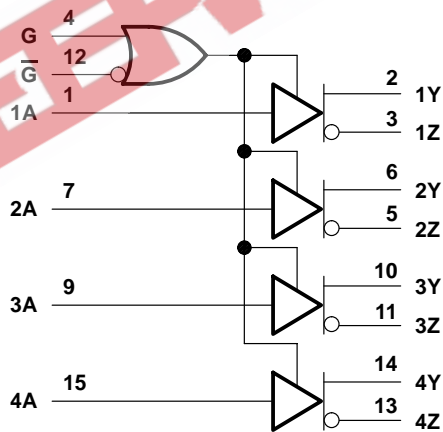
The D package also is available taped and reeled. Add the suffix R to device type (e.g., AM26LV31CDR). The NS package is only available taped and reeled.

## FUNCTION TABLE

INPUT A	ENABLES		OUTPUTS	
	G	$\bar{G}$	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

H = high level, L = low level, X = irrelevant,  
Z = high impedance (off)

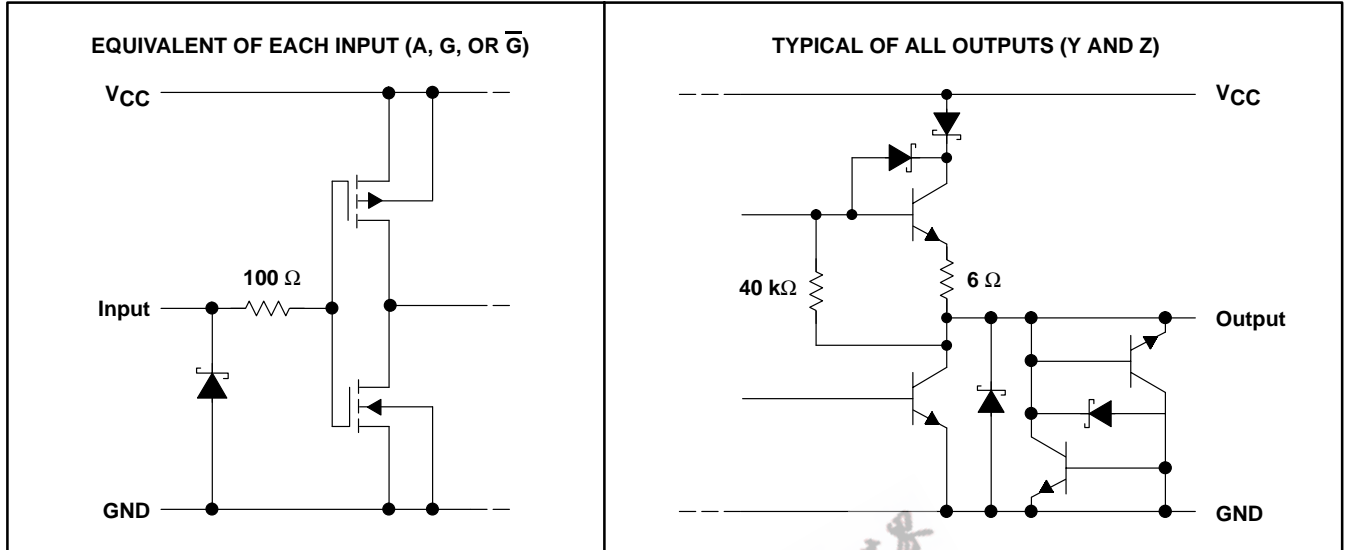
## logic diagram (positive logic)



# AM26LV31C, AM26LV31I LOW-VOLTAGE HIGH-SPEED QUADRUPLE DIFFERENTIAL LINE DRIVERS

SLLS201F – MAY 1995 – REVISED APRIL 2002

## schematic (each driver)



All resistor values are nominal.

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

Supply voltage range, $V_{CC}$ (see Note 1)	–0.3 V to 6 V
Input voltage range, $V_I$	–0.3 V to 6 V
Output voltage range, $V_O$	–0.3 V to 6 V
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package	73°C/W
NS package	64°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 voltage values are with respect to GND.

2. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	3	3.3	3.6	V
$V_{IH}$	High-level input voltage	2			V
$V_{IL}$	Low-level input voltage			0.8	V
$I_{OH}$	High-level output current			–30	mA
$I_{OL}$	Low-level output current			30	mA
$T_A$	Operating free-air temperature	AM26LV31C	0	70	°C
		AM26LV31I	–45	85	

# AM26LV31C, AM26LV31I

## LOW-VOLTAGE HIGH-SPEED

### QUADRUPLE DIFFERENTIAL LINE DRIVERS

SLLS201F – MAY 1995 – REVISED APRIL 2002

electrical characteristics over recommended operating supply-voltage and free-air temperature ranges (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V <sub>IK</sub>	Input clamp voltage	I <sub>I</sub> = -18 mA			-1.5	V
V <sub>OH</sub>	High-level output voltage	V <sub>IH</sub> = 2 V, I <sub>OH</sub> = -12 mA	1.85	2.3		V
V <sub>OL</sub>	Low-level output voltage	V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = 12 mA		0.8	1.05	V
V <sub>OD</sub>	Differential output voltage‡	R <sub>L</sub> = 100 Ω	0.95	1.5		V
V <sub>OC</sub>	Common-mode output voltage		1.3	1.55	1.8	V
Δ V <sub>OC</sub>	Change in magnitude of common-mode output voltage‡				±0.2	V
I <sub>O</sub>	Output current with power off	V <sub>O</sub> = -0.25 V or 6 V, V <sub>CC</sub> = 0			±100	μA
I <sub>OZ</sub>	Off-state (high-impedance state) output current	V <sub>O</sub> = -0.25 V or 6 V, G = 0.8 V or $\bar{G}$ = 2 V			±100	μA
I <sub>IH</sub>	High-level input current	V <sub>CC</sub> = 0 or 3 V, V <sub>I</sub> = 5.5 V			10	μA
I <sub>IL</sub>	Low-level input current	V <sub>CC</sub> = 3.6 V, V <sub>I</sub> = 0			-10	μA
I <sub>OS</sub>	Short-circuit output current	V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 0			-200	mA
I <sub>CC</sub>	Supply current (all drivers)	V <sub>I</sub> = V <sub>CC</sub> or GND, No load			100	μA
C <sub>pd</sub>	Power dissipation capacitance (all drivers)§	No load		160		pF

† All typical values are at V<sub>CC</sub> = 3.3 V and T<sub>A</sub> = 25°C.

‡ Δ|V<sub>OD</sub>| and Δ|V<sub>OC</sub>| are the changes in magnitude of V<sub>OD</sub> and V<sub>OC</sub>, respectively, that occur when the input is changed from a high level to a low level.

§ C<sub>pd</sub> determines the no-load dynamic current consumption. I<sub>S</sub> = C<sub>pd</sub> × V<sub>CC</sub> × f + I<sub>CC</sub>

### switching characteristics, V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Propagation delay time, low- to high-level output	See Figure 2	4	8	12	ns
t <sub>PHL</sub>	Propagation delay time, high- to low-level output		4	8	12	ns
t <sub>t</sub>	Transition time (t <sub>r</sub> or t <sub>f</sub> )			3		ns
SR	Slew rate, single-ended output voltage	See Note 3 and Figure 2		0.3	1	V/ns
t <sub>PZH</sub>	Output-enable time to high level	See Figure 3		10	20	ns
t <sub>PZL</sub>	Output-enable time to low level	See Figure 4		10	20	ns
t <sub>PHZ</sub>	Output-disable time from high level	See Figure 3		10	20	ns
t <sub>PLZ</sub>	Output-disable time from low level	See Figure 4		10	20	ns
t <sub>sk(p)</sub>	Pulse skew	f = 32 MHz, See Note 4		0.5	1.5	ns
t <sub>sk(o)</sub>	Skew limit	f = 32 MHz			1.5	ns
t <sub>sk(lim)</sub>	Skew limit (device to device)	f = 32 MHz, See Note 5			3	ns

NOTES: 3. Slew rate is defined by:

$$SR = \frac{90\%(V_{OH} - V_{OL}) - 10\%(V_{OH} - V_{OL})}{t_r}, \text{ the differential slew rate of } V_{OD} \text{ is } 2 \times SR.$$

4. Pulse skew is defined as the |t<sub>PLH</sub> - t<sub>PHL</sub>| of each channel of the same device.

5. Skew limit (device to device) is the maximum difference in propagation delay times between any two channels of any two devices.

PARAMETER MEASUREMENT INFORMATION

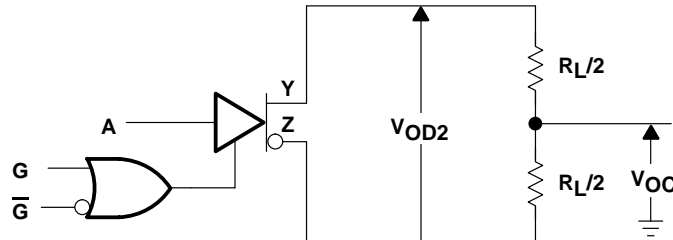
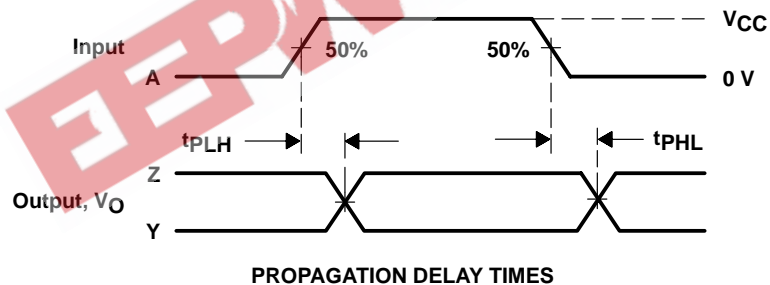
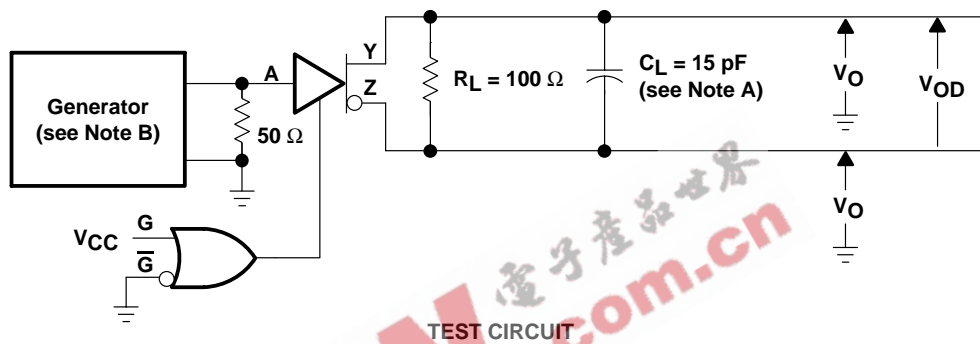
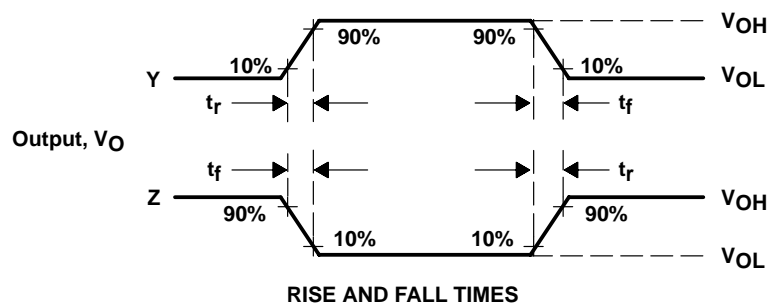


Figure 1. Differential and Common-Mode Output Voltages



PROPAGATION DELAY TIMES



RISE AND FALL TIMES

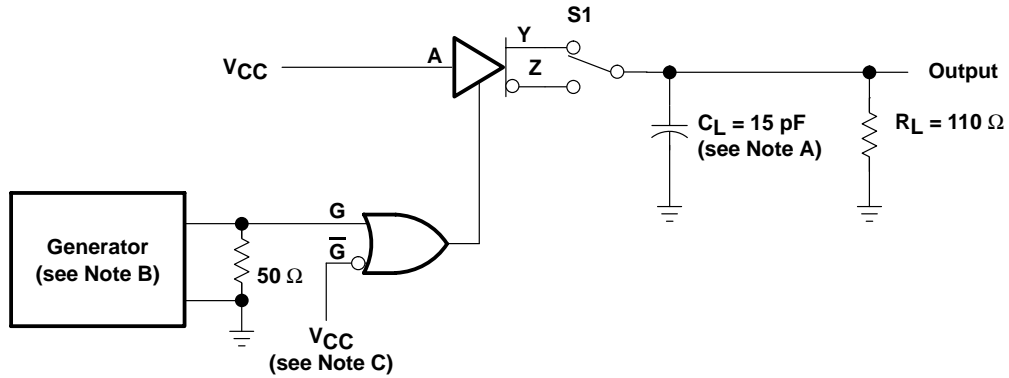
- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. The input pulse is supplied by a generator having the following characteristics: PRR = 32 MHz,  $Z_O \approx 50 \Omega$ , 50% duty cycle,  $t_r$  and  $t_f \leq 2$  ns.

Figure 2. Test Circuit and Voltage Waveforms,  $t_{PHL}$  and  $t_{PLH}$

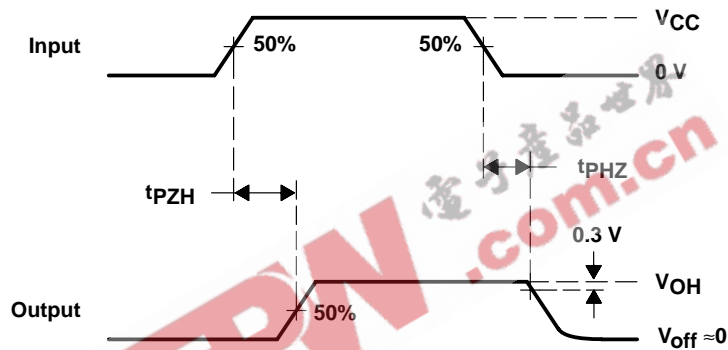
**AM26LV31C, AM26LV31I**  
**LOW-VOLTAGE HIGH-SPEED**  
**QUADRUPLE DIFFERENTIAL LINE DRIVERS**

SLLS201F – MAY 1995 – REVISED APRIL 2002

**PARAMETER MEASUREMENT INFORMATION**



**TEST CIRCUIT**

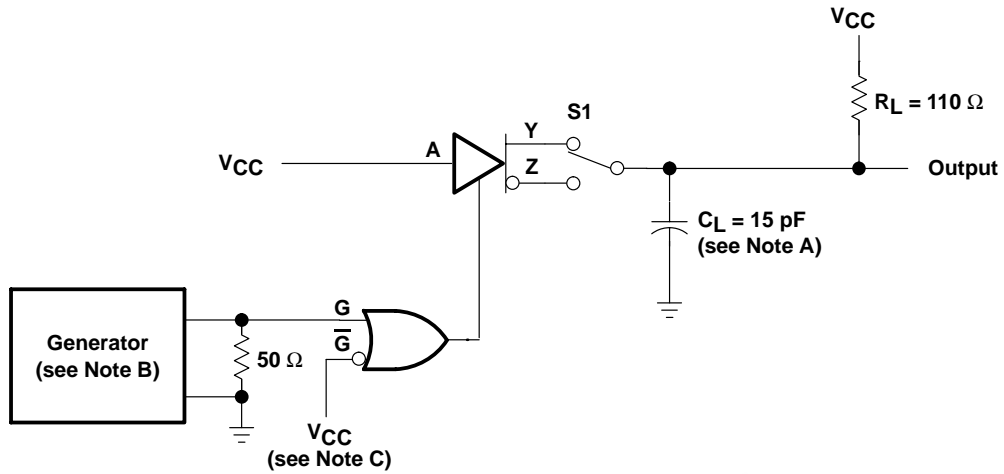


**VOLTAGE WAVEFORMS**

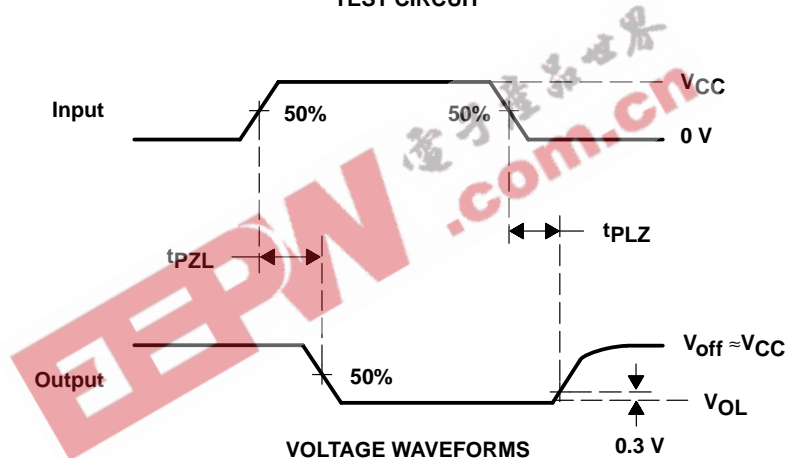
- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r$  and  $t_f$  (10% to 90%)  $\leq 2$  ns.  
 C. To test the active-low enable  $\bar{G}$ , ground G and apply an inverted waveform to  $\bar{G}$ .

**Figure 3. Test Circuit and Voltage Waveforms,  $t_{pZH}$  and  $t_{pHZ}$**

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r$  and  $t_f$  (10% to 90%)  $\leq 2$  ns.  
 C. To test the active-low enable  $\bar{G}$ , ground G and apply an inverted waveform to  $\bar{G}$ .

Figure 4. Test Circuit and Voltage Waveforms,  $t_{PZL}$  and  $t_{PLZ}$

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>
AM26LV31CD	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
AM26LV31CDR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
AM26LV31CNSLE	OBSOLETE	SO	NS	16		None	Call TI	Call TI
AM26LV31CNSR	ACTIVE	SO	NS	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
AM26LV31INSR	ACTIVE	SO	NS	16	2000	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.

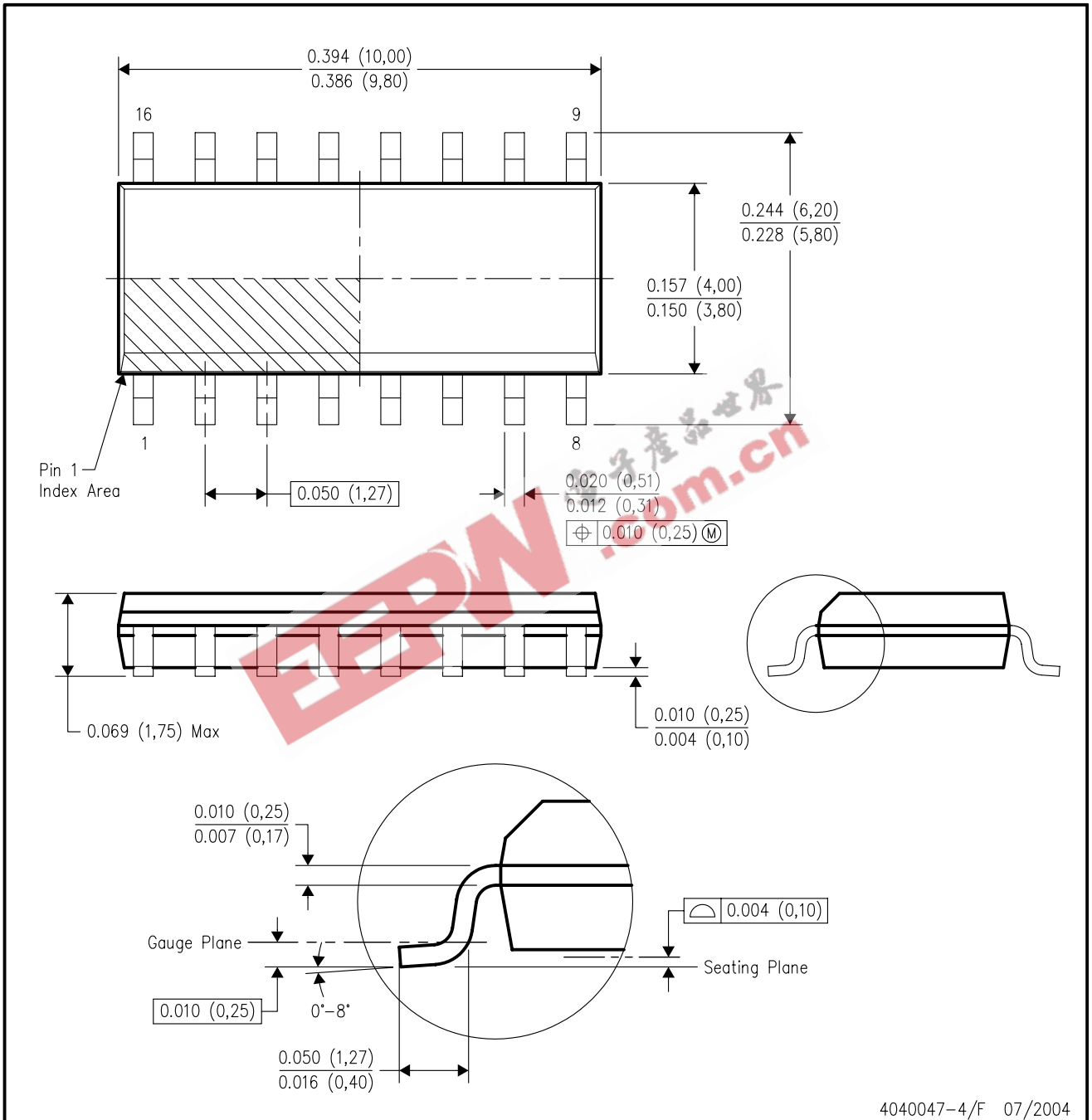
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



# MECHANICAL DATA

## D (R-PDSO-G16)

## PLASTIC SMALL-OUTLINE PACKAGE



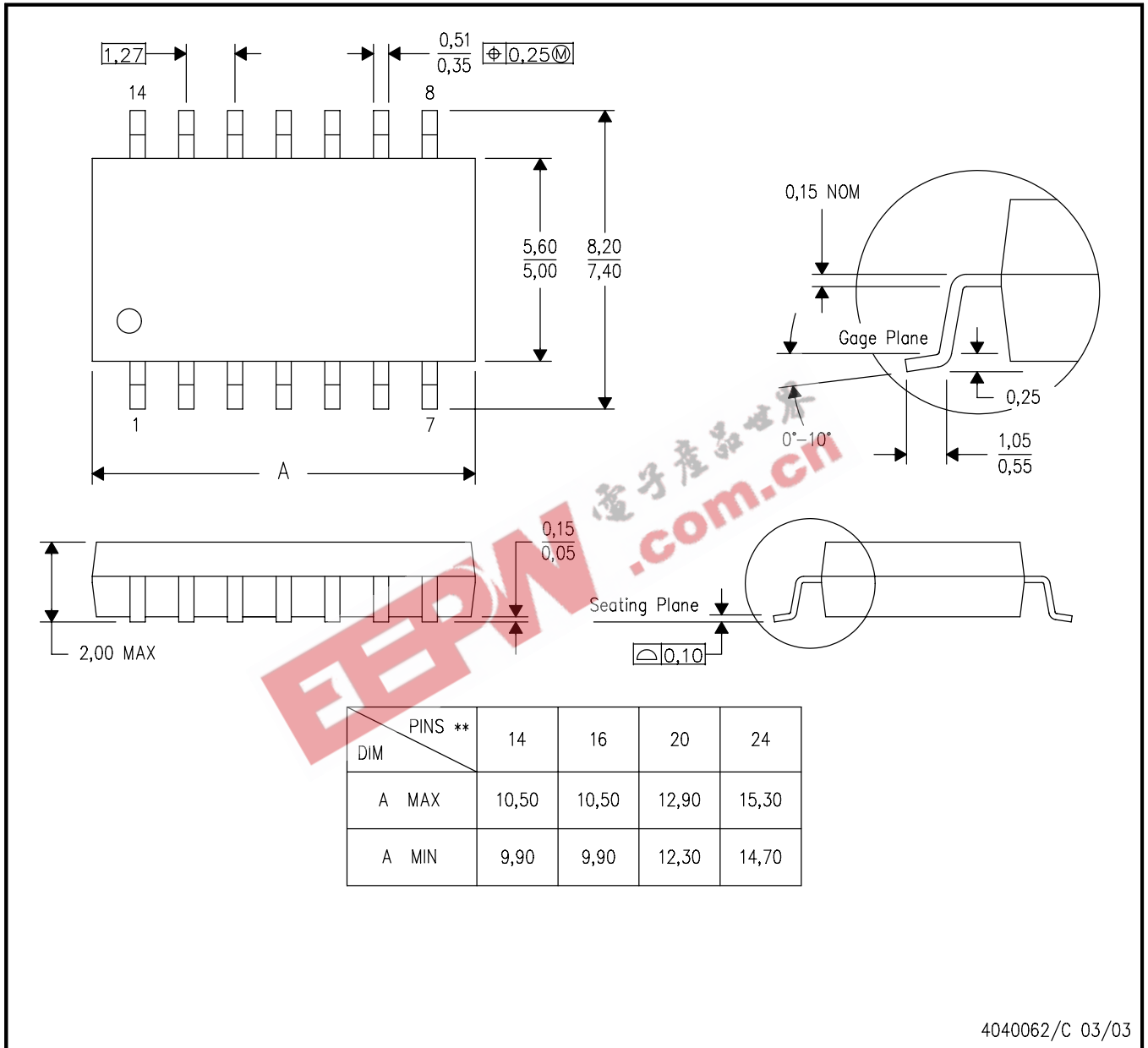
- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-012 variation AC.

## 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.

## 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