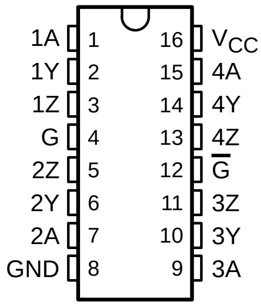
AM26LV31C, AM26LV31I
LOW-VOLTAGE HIGH-SPEED
QUADRUPLE DIFFERENTIAL LINE DRIVERS

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 . . . ±30 mA**
- **Controlled Rise and Fall Times . . . 3 ns Typ**
- **Differential Output Voltage With 100-Ω 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**

D OR NS PACKAGE
(TOP VIEW)



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

LinIMPACT-C60 is a trademark of Texas Instruments.

AVAILABLE OPTIONS

T_A	PACKAGES SMALL OUTLINE (D, NS)
0°C to 70°C	AM26LV31CD
	AM26LV31CNSR
–45°C to 85°C	AM26LV31INSR

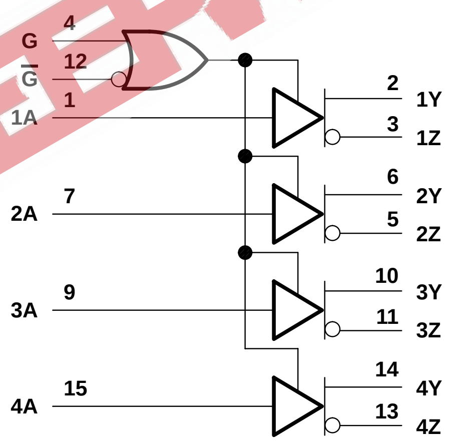
The D package also is available taped and reeled. Add the suffix R to device type (e.g., AM26LV31CDR). The NS package is only available taped and reeled.

FUNCTION TABLE

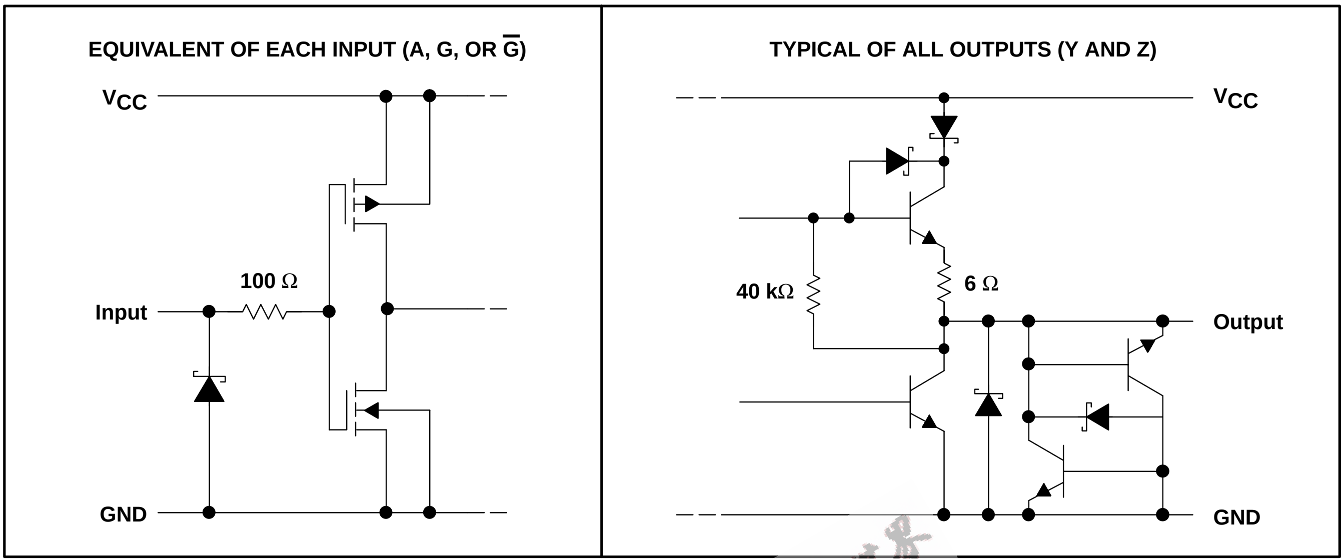
INPUT A	ENABLES G	ENABLES $\overline{G}$	OUTPUTS Y	OUTPUTS Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

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

logic diagram (positive logic)



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, θ_{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	

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

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

† All typical values are at V_{CC} = 3.3 V and T_A = 25°C.
‡ $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are the changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input is changed from a high level to a low level.
§ C_{pd} determines the no-load dynamic current consumption. $I_S = C_{pd} \times V_{CC} \times f + I_{CC}$

switching characteristics, V_{CC} = 3.3 V, T_A = 25°C

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

NOTES: 3. Slew rate is defined by:

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

4. Pulse skew is defined as the $|t_{PLH} - t_{PHL}|$ 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

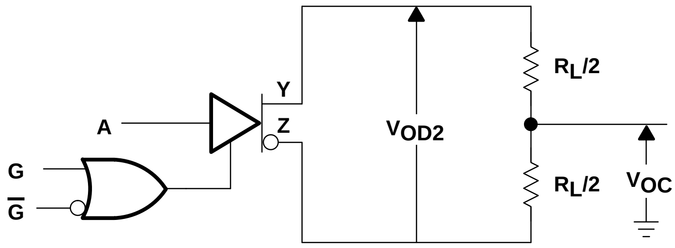
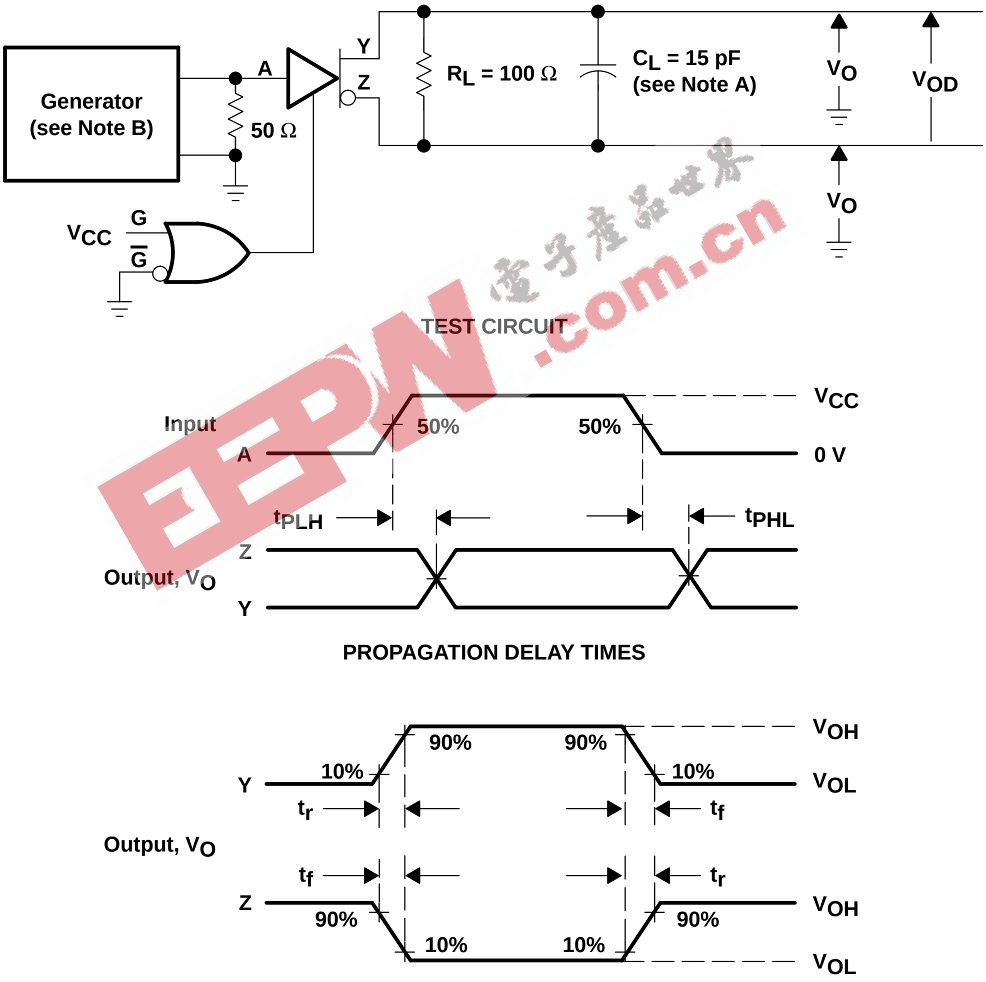


Figure 1. Differential and Common-Mode Output Voltages

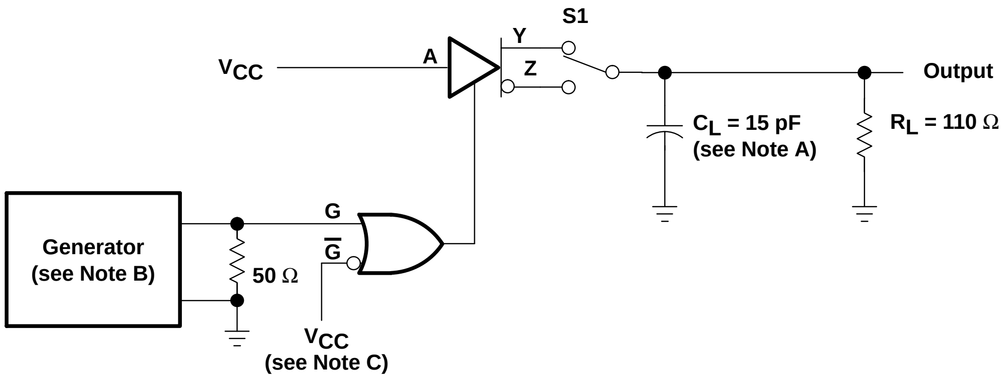


NOTES: A. C_L includes probe and jig capacitance.

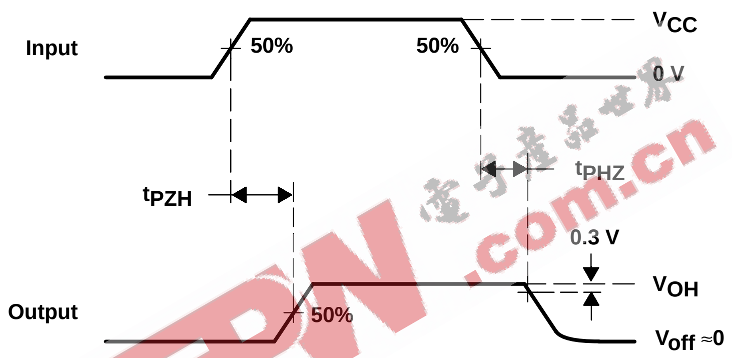
B. The input pulse is supplied by a generator having the following characteristics: PRR = 32 MHz, $Z_O \approx 50\ \Omega$, 50% duty cycle, t_r and $t_f \le 2$ ns.

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

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

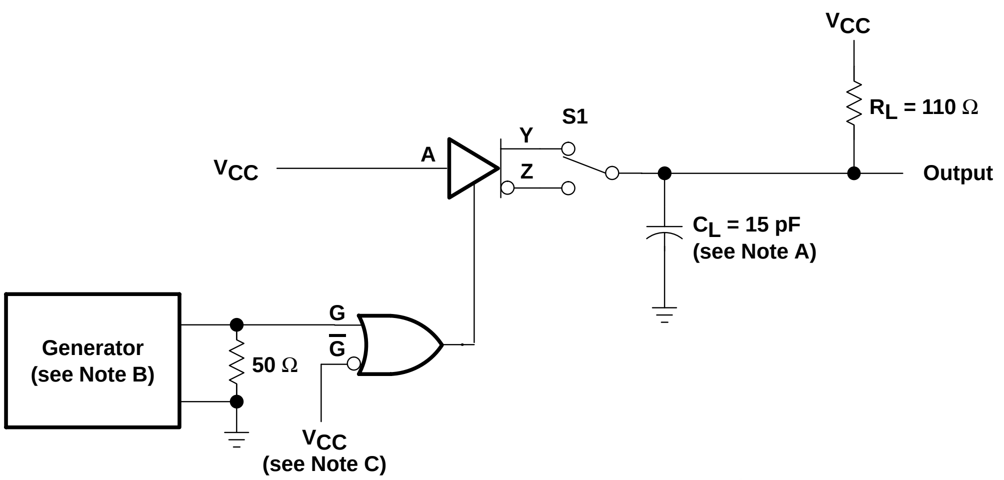


VOLTAGE WAVEFORMS

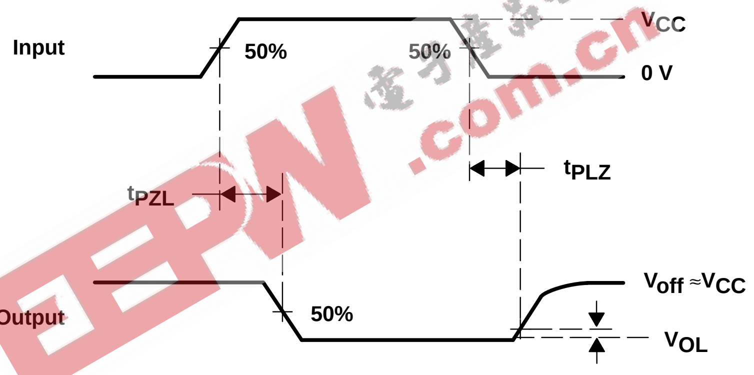
NOTES: A. C_L includes probe and jig capacitance.
B. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, Z_O = 50 Ω, 50% duty cycle, t_r and t_f (10% to 90%) ≤ 2 ns.
C. To test the active-low enable $\overline{G}$, ground G and apply an inverted waveform to $\overline{G}$.

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 Ω, 50% duty cycle, t_r and t_f (10% to 90%) ≤ 2 ns.

C. To test the active-low enable $\overline{G}$, ground G and apply an inverted waveform to $\overline{G}$.

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

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
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

(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.

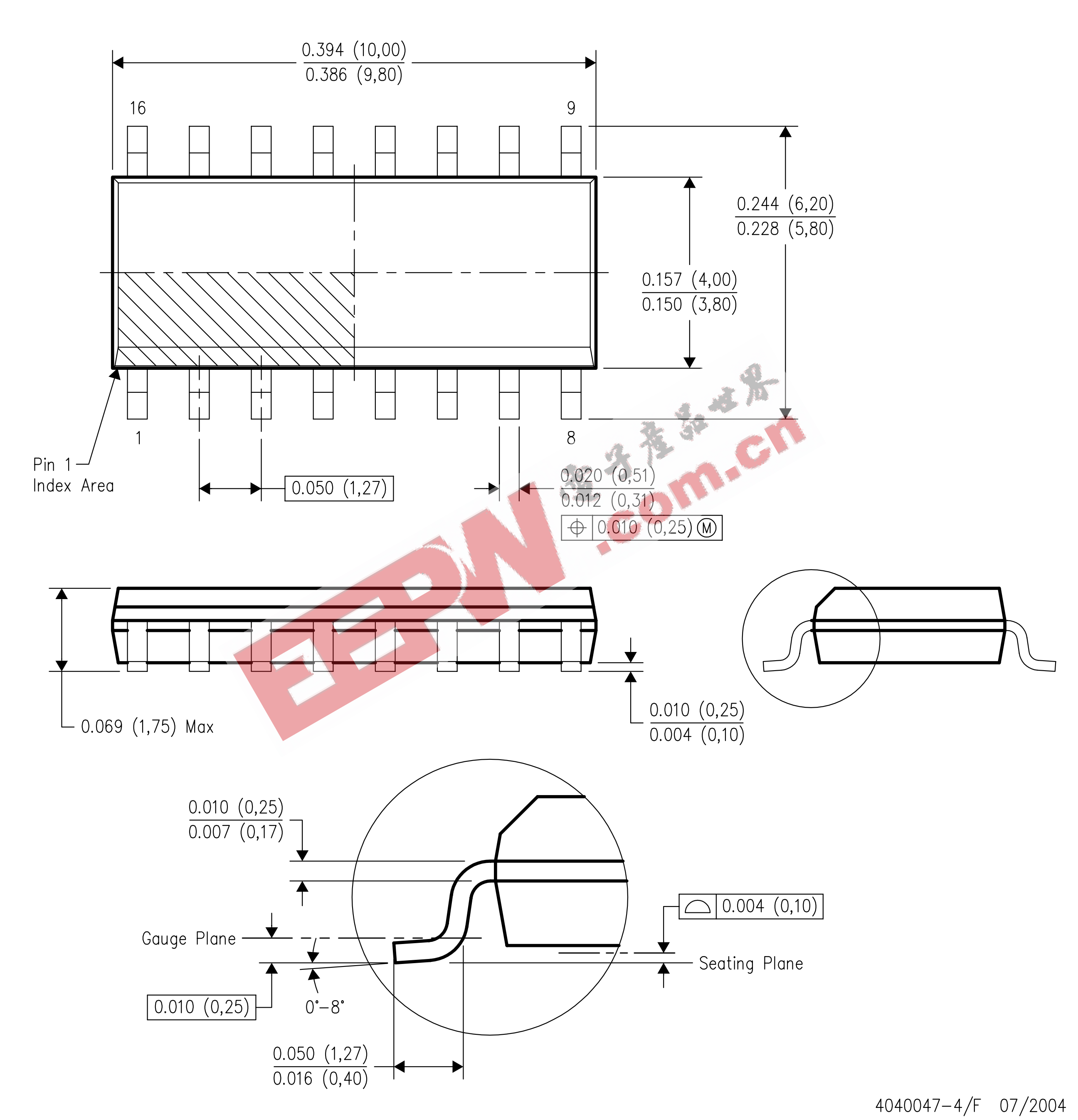
(2) Eco Plan - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
None: Not yet available Lead (Pb-Free).
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are 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 JEDECindustry 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.

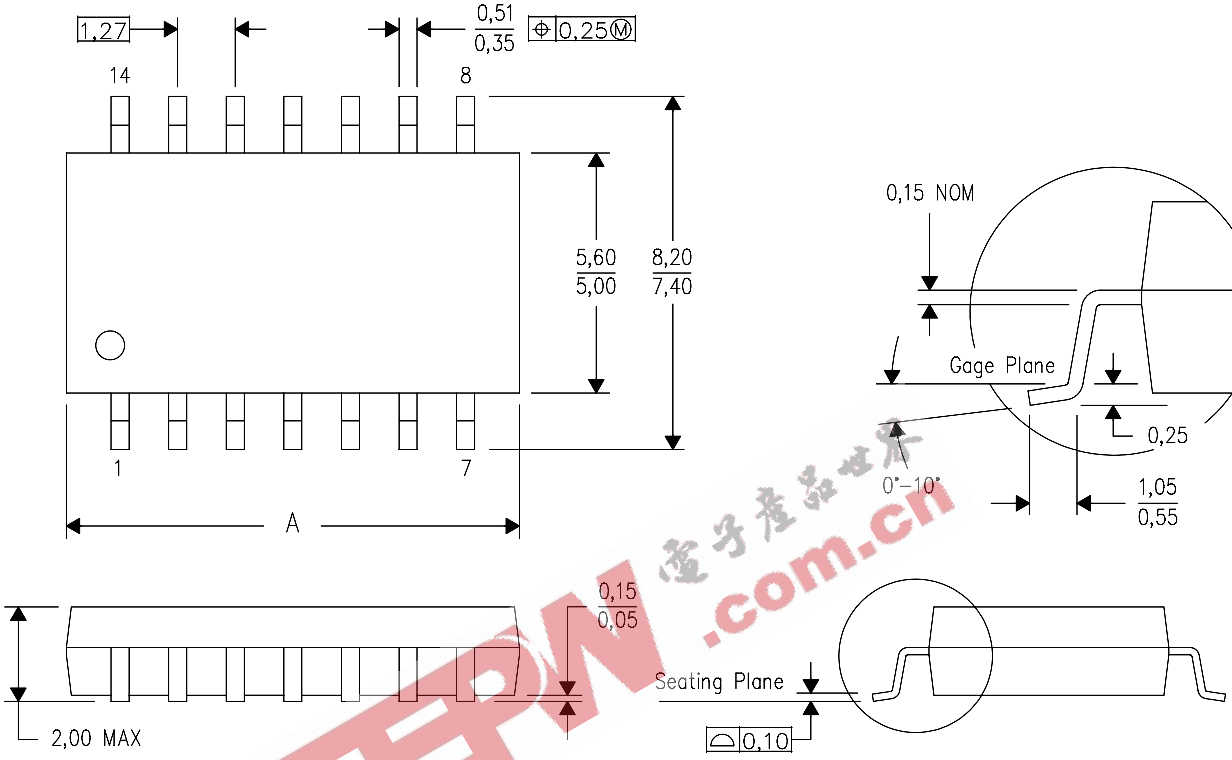
D (R-PDSO-G16) PLASTIC SMALL-OUTLINE PACKAGE



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 AC.

NS (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14-PINS SHOWN



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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:

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