

LOW-VOLTAGE HIGH-SPEED QUADRUPLE DIFFERENTIAL LINE DRIVER WITH ± 15 -kV IEC ESD PROTECTION

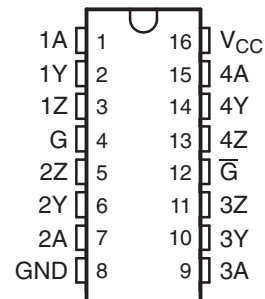
FEATURES

- Meets or Exceeds Standards TIA/EIA-422-B and ITU Recommendation V.11
- Operates From a Single 3.3-V Power Supply
- ESD Protection for RS422 Bus Pins
 - ± 15 -kV Human-Body Model (HBM)
 - ± 8 -kV IEC61000-4-2, Contact Discharge
 - ± 15 -kV IEC61000-4-2, Air-Gap Discharge
- Switching Rates up to 32 MHz
- Propagation Delay Time . . . 8 ns Typ
- Pulse Skew Time . . . 500 ps Typ
- High Output-Drive Current . . . ± 30 mA
- Controlled Rise and Fall Times . . . 5 ns Typ
- Differential Output Voltage With 100- Ω Load . . . 2.6 V Typ
- Accepts 5-V Logic Inputs With 3.3-V Supply
- I_{off} Supports Partial-Power-Down Mode Operation
- Driver Output Short-Protection Circuit
- Glitch-Free Power-Up/Power-Down Protection

SUPPORTS DEFENSE, AEROSPACE, AND MEDICAL APPLICATIONS

- Controlled Baseline
- One Assembly/Test Site
- One Fabrication Site
- Available in Extended ($-55^{\circ}\text{C}/105^{\circ}\text{C}$) Temperature Range⁽¹⁾
- Extended Product Life Cycle
- Extended Product-Change Notification
- Product Traceability

D PACKAGE
(TOP VIEW)



(1) Additional temperature ranges are available – contact factory

DESCRIPTION/ORDERING INFORMATION

The AM26LV31E is a quadruple differential line driver with 3-state outputs. This driver has ± 15 -kV ESD (HBM and IEC61000-4-2, Air-Gap Discharge) and ± 8 -kV ESD (IEC61000-4-2, Contact Discharge) protection. This device is designed to meet TIA/EIA-422-B and ITU Recommendation V.11 drivers with reduced supply voltage.

The device is optimized for balanced-bus transmission at switching rates up to 32 MHz. The outputs have high current capability for driving balanced lines, such as twisted-pair transmission lines, and provide a high impedance in the power-off condition.

The AM26LV31ES is characterized for operation from -55°C to 105°C .

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-55°C to 105°C	SOIC – D	Tape and reel	AM26LV31ESDREP	A26LV31ESP

(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.



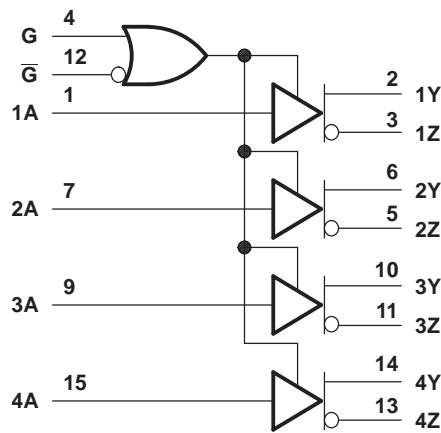
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

FUNCTION TABLE⁽¹⁾

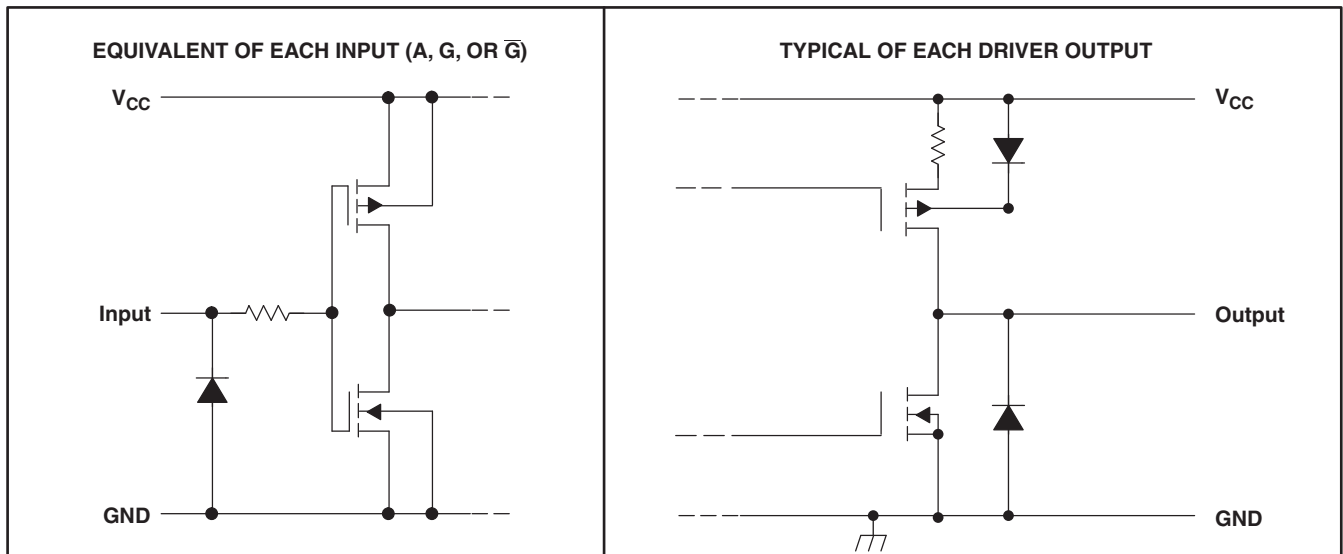
INPUT A	ENABLES		OUTPUTS	
	G	\bar{G}	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

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

LOGIC DIAGRAM



SCHEMATIC



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range ⁽²⁾	–0.5	6	V
V_I	Input voltage range	–0.5	6	V
V_O	Output voltage range	–0.5	6	V
I_{IK}	Input clamp current	$V_I < 0$		–20 mA
I_{OK}	Output clamp current	$V_O < 0$		–20 mA
I_O	Continuous output current		±150	mA
	Continuous current through V_{CC} or GND		±200	mA
T_J	Operating virtual junction temperature		150	°C
θ_{JA}	Package thermal impedance ⁽³⁾⁽⁴⁾		73	°C/W
T_A	Operating free-air temperature range	–55	105	°C
T_{stg}	Storage temperature range	–65	150	°C

- (1) 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.
- (2) All voltage values except differential input voltage are with respect to the network GND.
- (3) Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Selecting the maximum of 150°C can affect reliability.
- (4) 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_I	Input voltage	0		5.5	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	–55		105	°C

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT	
V_{OH}	High-level output voltage	$V_{IH} = 2\text{ V}$, $V_{IL} = 0.8\text{ V}$, $I_{OH} = -20\text{ mA}$	2.4	3	V	
V_{OL}	Low-level output voltage	$V_{IH} = 2\text{ V}$, $V_{IL} = 0.8\text{ V}$, $I_{OL} = 20\text{ mA}$		0.2	0.4	V
$ V_{OD1} $	Differential output voltage	$I_O = 0\text{ mA}$	2		4	V
$ V_{OD2} $	Differential output voltage	$R_L = 100\ \Omega$ (see Figure 1) ⁽²⁾	2	2.6		V
$\Delta V_{OD} $	Change in magnitude of differential output voltage	$R_L = 100\ \Omega$ (see Figure 1) ⁽²⁾			± 0.4	V
V_{OC}	Common-mode output voltage	$R_L = 100\ \Omega$ (see Figure 1) ⁽²⁾		1.5	2	V
$\Delta V_{OC} $	Change in magnitude of common-mode output voltage	$R_L = 100\ \Omega$ (see Figure 1) ⁽²⁾			± 0.4	V
$I_{O(OFF)}$	Output current with power off	$V_{CC} = 0$, $V_O = -0.25\text{ V}$ or 5.5 V			± 127	μA
I_{OZ}	High-impedance state output current	$V_O = -0.25\text{ V}$ or 5.5 V , $G = 0.8\text{ V}$ or $\overline{G} = 2\text{ V}$			± 127	μA
I_I	Input current	$V_{CC} = 0$ or 3.6 V , $V_I = 0$ or 5.5 V			± 10	μA
I_{OS}	Short-circuit output current	$V_O = V_{CC}$ or GND ⁽³⁾		–30	–150	mA
I_{CC}	Supply current (total package)	$V_I = V_{CC}$ or GND, No load, enable			100	μA
C_{pd}	Power dissipation capacitance	No load ⁽⁴⁾		160		pF

(1) All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

(2) Refer to TIA-EIA-422-B for exact conditions.

(3) Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

(4) C_{pd} determines the no-load dynamic current consumption: $I_S = C_{pd} \times V_{CC} \times f + I_{CC}$

SWITCHING CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
t_{PHL}	Propagation delay time, high- to low-level output	See Figure 2	4	8	12	ns
t_{PLH}	Propagation delay time, low- to high-level output		3.5	8	12	ns
t_t	Transition time (t_r or t_f)	See Figure 2		5	10	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	See Figure 2 ⁽²⁾⁽³⁾		0.5	3	ns
$t_{sk(o)}$	Skew limit (pin to pin)				1.5	ns
$t_{sk(lim)}$	Skew limit (device to device)				3	ns
$f_{(max)}$	Maximum operating frequency	See Figure 2		32		MHz

(1) All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.

(2) Pulse skew is defined as the $|t_{PLH} - t_{PHL}|$ of each channel of the same device.

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

ESD PROTECTION

PARAMETER	TEST CONDITIONS	TYP	UNIT
Driver output	HBM	±15	kV
	IEC61000-4-2, Air-Gap Discharge	±15	
	IEC61000-4-2, Contact Discharge	±8	

PARAMETER MEASUREMENT INFORMATION

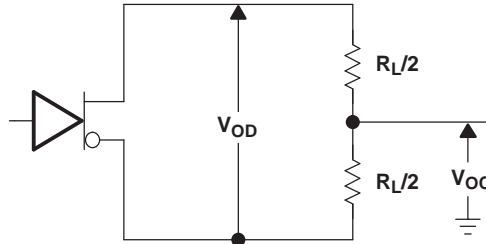
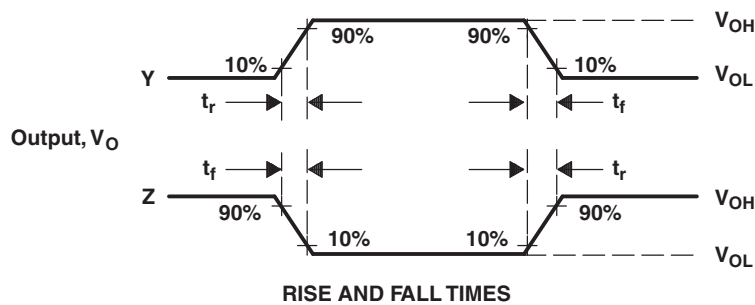
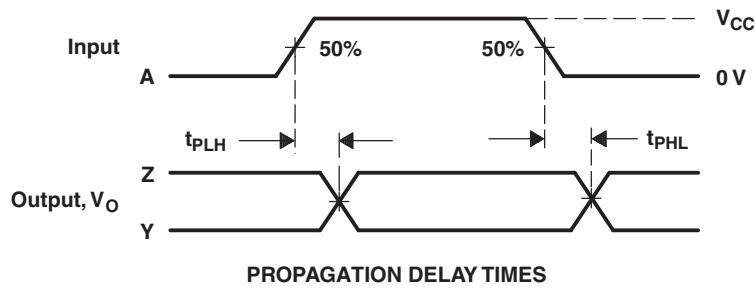
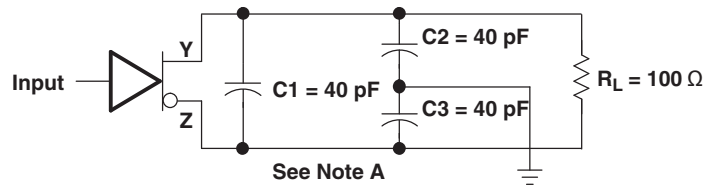


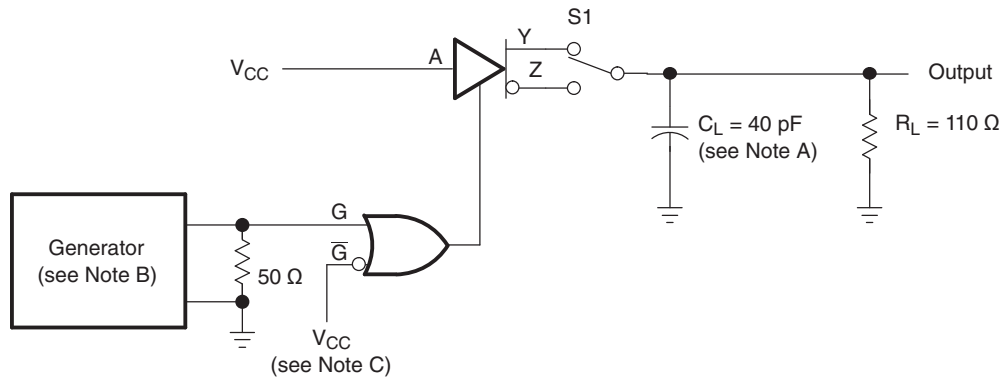
Figure 1. Test Circuit, V_{OD} and V_{OC}



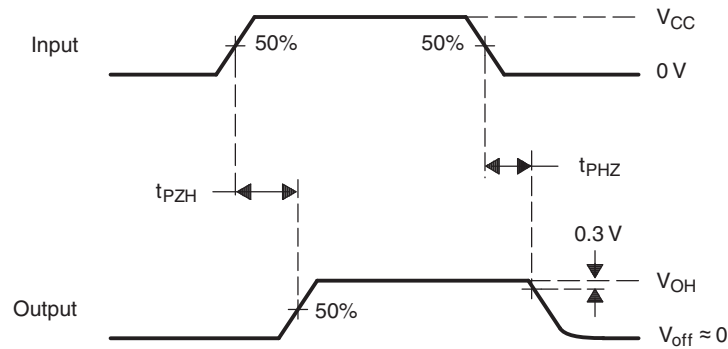
- NOTES: A. C_L includes probe and jig capacitance.
 B. The input pulse is supplied by a generator having the following characteristics: PRR = 32 MHz, 50% duty cycle, t_r and $t_f \leq 2$ ns.

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

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT

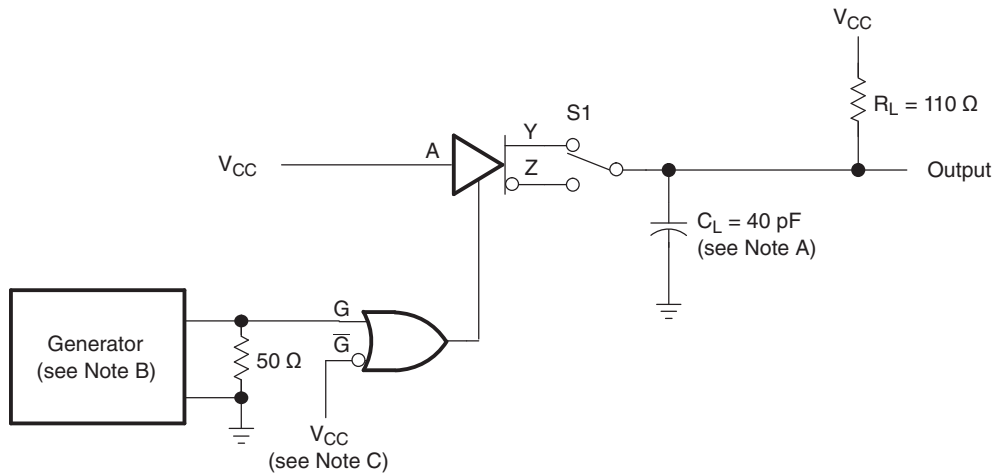


VOLTAGE WAVEFORMS

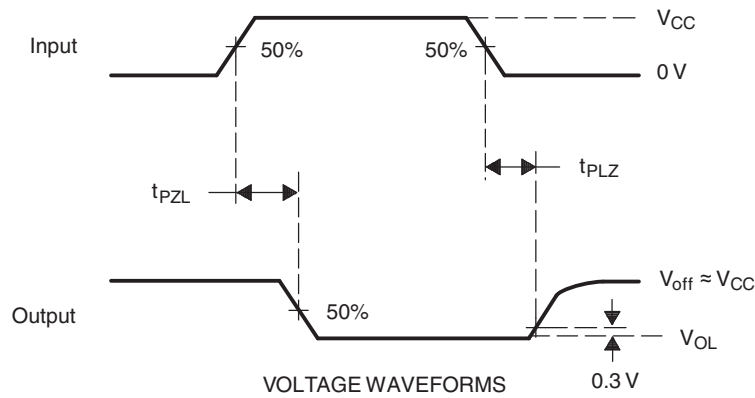
- A. C_L includes probe and jig capacitance.
- B. The input pulse is supplied by a generator having the following characteristics: PRR = 10 MHz, duty cycle = 50%, $t_r = t_f \leq 2\text{ns}$.
- C. To test the active-low enable \overline{G} , ground G and apply an inverted waveform \overline{G} .

Figure 3. Test Circuit and Voltage Waveforms, t_{PZH} and t_{PHZ}

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT



VOLTAGE WAVEFORMS

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

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

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
AM26LV31ESDREP	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/09603-01XE	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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)

⁽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.

OTHER QUALIFIED VERSIONS OF AM26LV31E-EP :

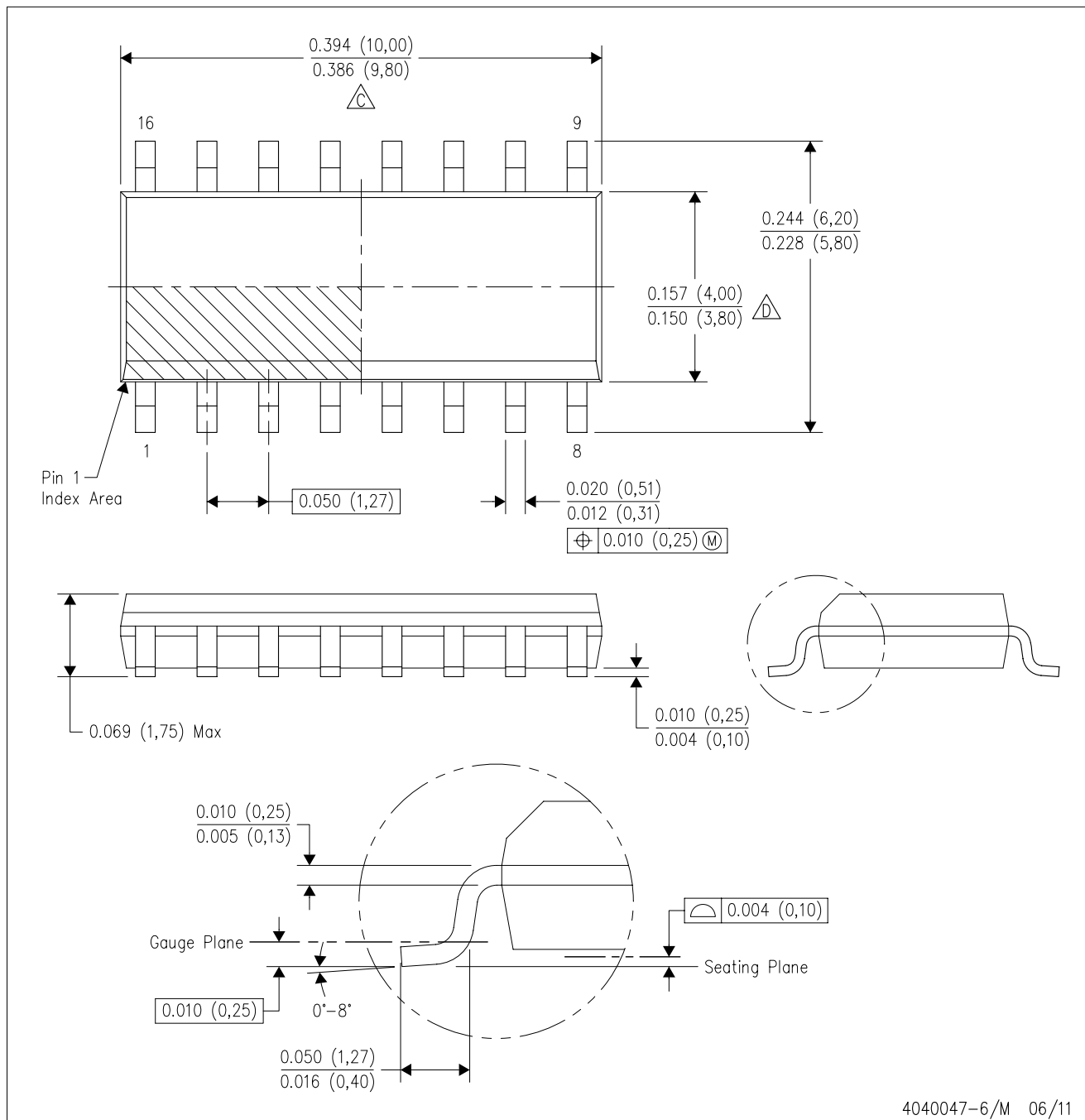
- Catalog: [AM26LV31E](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

D (R-PDSO-G16)

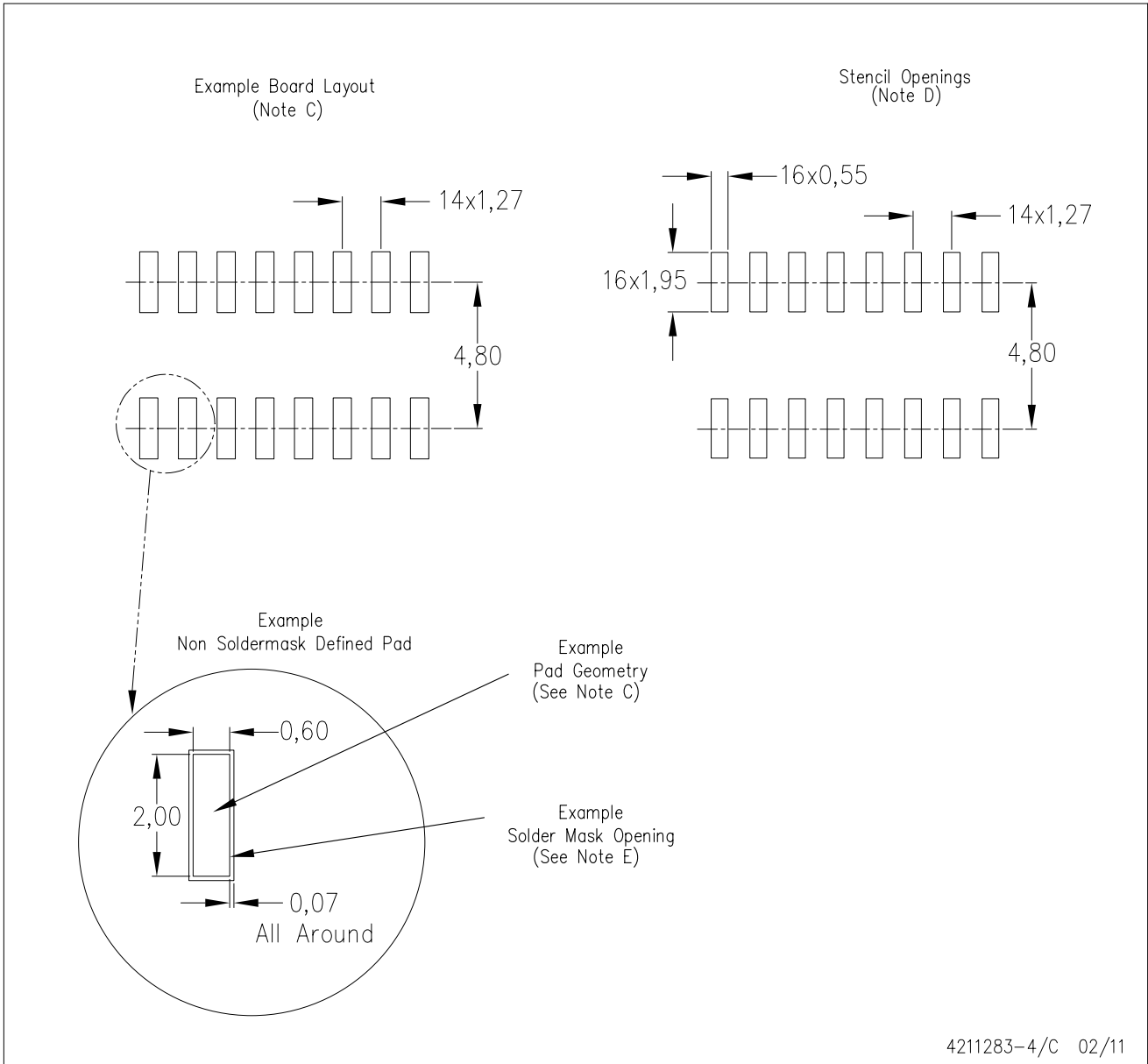
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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 TI 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. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video
Wireless	www.ti.com/wireless-apps

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated

www.BDTIC.com/TI